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## Keyboard and Embedded Controller for Notebook PC

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### Product Features

- ARM® Cortex®-M4 Processor Core
  - 32-Bit ARM v7-M Instruction Set Architecture
  - Hardware Floating Point Unit (FPU)
  - Single 4GByte Addressing Space (Von Neumann Model)
  - Little-Endian Byte Ordering
  - Bit-Banding Feature Included
  - NVIC Nested Vectored Interrupt Controller
    - Up to 240 Individually-Vectored Interrupt Sources Supported
    - 8 Levels of Priority, Individually Assignable By Vector
    - Chip-Level Interrupt Aggregator supported, to expand number of interrupt sources or reduce number of vectors
  - System Tick Timer
  - Complete ARM-Standard Debug Support
    - JTAG-Based DAP Port, Comprised of SWJ-DP and AHB-AP Debugger Access Functions
    - Full DWT Hardware Functionality: 4 Data Watchpoints and Execution Monitoring
    - Full FPB Hardware Breakpoint Functionality: 6 Execution Breakpoints and 2 Literal (Data) Breakpoints
  - Comprehensive ARM-Standard Trace Support
    - Full DWT Hardware Trace Functionality for Watchpoint and Performance Monitoring
    - Full ITM Hardware Trace Functionality for Instrumented Firmware Support and Profiling
    - Full ETM Hardware Trace Functionality for Instruction Trace
    - Full TPIU Functionality for Trace Output Communication
- 128K SRAM (Code or Data)
  - 96K Optimized for Code
  - 32K Optimized for Data
- LPC Interface
  - Supports LPC Bus frequencies of 19MHz to 33MHz
  - LPC I/O Cycles Decoded
  - LPC Memory Cycles Decoded
  - Clock Run Support
  - Serial IRQ
  - ACPI SCI interface
  - SMI# output
- Two SPI Memory Interfaces
  - 3-pin Full Duplex serial communication interface
  - Two Private and Two Shared Chip Selects
  - DMA Support
- 8042 Style Host Interface
  - Mailbox Registers Interface
    - Forty-three 8-Bit scratch registers
    - Two Register Mailbox Command Interface
    - Two Register SMI Source Interface
- Two ACPI Embedded Controller Interface
  - 1 or 4 Byte Data transfer capable
- ACPI Power Management Interface
  - SCI Event-Generating Functions
- Embedded Memory Interface
  - Host Serial IRQ Source
  - Provides Two Windows to On-Chip SRAM for Host Access
- Two Register Mailbox Command Interface
- Battery Backed (VCC0/VBAT) Resources
  - Power Fail Register
  - Power-Fail Status Register
  - Battery backed 64 byte memory
- Real Time Clock (RTC)
  - VCC0 (VBAT) Powered
  - 32KHz Crystal Oscillator
  - 32KHz Clock output available under VCC1 power
  - Time-of-Day and Calendar Registers
  - Programmable Alarms
  - Supports Leap Year and Daylight Savings Time
- Hibernation Timers
- General Purpose Analog to Digital Converter
  - 10-bit conversion precision
  - 10-bit conversion per channel is completed in less than 12us
  - 5 ADC channels
    - 10-bit Conversion with 2.9mV resolution
    - 0 to 3.3 VDC Conversion Range
  - Optional continuous sampling at a programmable rate
  - Internal Analog Voltage Reference (3.0V +/- 1%)
- Watch Dog Timer
- Four Programmable 16-bit and Two 32-bit Timers
  - Wake-capable Auto-reloading Timers
- Four Independent Hardware Driven PS/2 Ports
  - Fully functional on Main and/or Suspend Power
  - PS/2 Edge Wake Capable
- Four Programmable Pulse-Width Modulator Outputs
  - Independent Clock Rates
  - 16-Bit Duty Cycle Granularity
  - Operational in both Full on and Standby modes

# MEC1322

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- Four EC-based SMBus 2.0 Host Controllers
  - Allows Master or Dual Slave Operation
  - Controllers are Fully Operational on Standby Power
  - DMA-driven I<sup>2</sup>C Network Layer Hardware
  - I<sup>2</sup>C Datalink Compatibility Mode
  - Multi-Master Capable
  - Supports Clock Stretching
  - Programmable Bus Speeds
    - 400 KHz Fast-mode Capable
    - 1 Mbps Fast-mode Plus Capable
  - Hardware Bus Access "Fairness" Interface
  - SMBus Time-outs Interface
  - 5 Ports
  - 2 Port Flexible Multiplexing
- PECl 3.0 Interface
- Keyboard Matrix Scan Interface
  - 18 x 8 Interrupt/Wake Capable Multiplexed Keyboard Scan Matrix
  - Row Predrive Option
- Four Breathing/Blinking LED Interfaces
  - Programmable Blink Rates
  - Piecewise Linear Breathing LED Output Controller
  - Operational in EC Sleep States
- Dual Fan Tachometer Inputs
- RPM-Based Fan Speed Control Algorithm
  - Utilizes one TACH input and one PWM output
  - 3% accurate from 500 RPM to 16k RPM
  - Automatic Tachometer feedback
  - Aging Fan or Invalid Drive Detection
  - Spin Up Routine
  - Ramp Rate Control
  - RPM-based Fan Speed Control Algorithm
- Fast GATEA20 & Fast CPU\_RESET
- RSMRST# Functionality Supporting System Deep Sleep
  - Compatible with south bridge SUS-CLK/RSMRST# gating rules
  - Replacement 32K distribution available when RSMRST# is asserted
- Integrated Power-on Reset Generator
  - VCC1\_RST# open drain output
  - Accepts External driven Reset
- Anti-Glitch Protection on Power-on
- All Blocks Support Low Power Sleep Modes
- General Purpose Input/Output Pins
  - Low Power
  - High Configurability
- Two pin Debug Port with standard 16C550A register interface
  - Accessible from both Host and EC
- BC-Link Interconnection Bus
  - One High Speed Bus Master Controller
- Package Options
  - 128-pin VTQFP
  - 132-pin DQFN
  - 144-pin WFBGA

## Description

The MEC1322 incorporates a high-performance 32-bit ARM® Cortex®-M4 embedded microcontroller with 128 Kilobytes of SRAM and 32 Kilobytes of Boot ROM. It communicates with the system host using the Intel® Low Pin Count (LPC) bus.

The MEC1322 has two SPI memory interfaces that allow the EC to read its code from external SPI flash memory: private SPI and/or shared SPI. The Shared SPI interface allows for EC code to be stored in a shared SPI chip along with the system BIOS. The private SPI memory interface provides for a dedicated SPI flash that is only accessible by the EC.

The MEC1322 provides support for loading EC code from the private or shared SPI flash device on a VCC1 power-on. Before executing the EC code loaded from a SPI Flash Device, the MEC1322 validates the EC code using a digital signature encoded according to PKCS #1. The signature uses RSA-2048 encryption and SHA-256 hashing. This provides automated detection of invalid EC code that may be a result of malicious or accidental corruption. It occurs before each boot of the host processor, thereby ensuring a HW based root of trust not easily thwarted via physical replacement attack.

The MEC1322 is directly powered by two separate suspend supply planes (VBAT and VCC1) and senses the runtime power plane (VCC) to provide "Instant On" and system power management functions. It also contains an integrated VCC1 Reset Interface and a system Power Management Interface that supports low-power states and can drive state changes as a result of hardware wake events.

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## 1.0 PIN CONFIGURATION

### 1.1 Description

The [Pin Configuration](#) chapter includes a [Pin List](#), [Pin Description](#), [Pin Multiplexing](#) and [Package Outline](#).

### 1.2 Terminology and Symbols for Pins/Buffers

| Term            | Definition   |
|-----------------|--|
| Pin Ref. Number | There is a unique reference number for each pin name.  |
| #               | The '#' sign at the end of a signal name indicates an active-low signal  |
| n               | The lowercase 'n' preceding a signal name indicates an active-low signal   |
| PWR             | Power  |
| I               | Digital Input  |
| IS              | Input with Schmitt Trigger   |
| I_AN            | Analog Input   |
| O               | Push-Pull Output   |
| OD              | Open Drain Output  |
| IO              | Bi-directional pin   |
| IOD             | Bi-directional pin with Open Drain Output  |
| PIO             | Programmable as Input, Output, Open Drain Output, Bi-directional or Bi-directional with Open Drain Output.   |
| PCI_I           | Input. These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 1-1</a> )  |
| PCI_O           | Output. These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 1-1</a> )   |
| PCI_OD          | Open Drain Output. These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 1-1</a> )  |
| PCI_IO          | Input/Output These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 1-1</a> )  |
| PCI_ICLK        | Clock Input. These pins meet the PCI 3.3V AC and DC Characteristics and timing. ( <a href="#">Note 1-2</a> )   |
| PCI_PIO         | Programmable as Input, Output, Open Drain Output, Bi-directional or Bi-directional with Open Drain Output. These pins meet the PCI 3.3V AC and DC Characteristics. ( <a href="#">Note 1-1</a> ). |
| IO_PECI         | PECI Input/Output. These pins are at the Peci $V_{REF}$ level. See <a href="#">Chapter 37.0, "Electrical Specifications"</a> .   |

**Note 1-1** See the "PCI Local Bus Specification," Revision 2.1, Section 4.2.2.

**Note 1-2** See the "PCI Local Bus Specification," Revision 2.1, Section 4.2.2 and 4.2.3.

### 1.3 Pin List

The [Pin List](#) for the three package options is shown in [Table 1-1](#), [Table 1-2](#) and [Table 1-3](#).

**Note:** The Pin Ref. Numbers are the same as the pin numbers in the "128 VTQFP Number" column in [Table 1-1](#), "[MEC1322 128 VTQFP Pin Configuration](#)".

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**TABLE 1-1: MEC1322 128 VTQFP PIN CONFIGURATION**

| 128 VTQFP Number | Pin Name                     | Pin Ref. Number | 128 VTQFP Number | Pin Name            | 128 VTQFP Number | Pin Name                  |
|------------------|------------------------------|-----------------|------------------|---------------------|------------------|---------------------------|
| 1                | GPIO036                      | 44              | 44               | ADC0/GPIO056        | 87               | GPIO165/TXD/SHD_CS1#      |
| 2                | GPIO153/PVT_SCLK             | 45              | 45               | AVSS                | 88               | GPIO023/I2C1_DAT0         |
| 3                | GPIO122/SHD_SCLK             | 46              | 46               | LAD0/GPIO112        | 89               | GPIO022/I2C1_CLK0         |
| 4                | GPIO011/KSO16                | 47              | 47               | VSS                 | 90               | GPIO021/I2C2_DAT0         |
| 5                | KSO13/GPIO006                | 48              | 48               | LAD1/GPIO114        | 91               | GPIO020/I2C2_CLK0         |
| 6                | KSO12/GPIO005                | 49              | 49               | JTAG_RST#           | 92               | GPIO105/TACH1             |
| 7                | KSO11/GPIO107                | 50              | 50               | LAD2/GPIO113        | 93               | GPIO145                   |
| 8                | KSO10/GPIO004                | 51              | 51               | LAD3/GPIO111        | 94               | GPIO164/PVT_MISO          |
| 9                | KSO09/GPIO106                | 52              | 52               | LFRAME#/GPIO120     | 95               | GPIO124/SHD_MISO          |
| 10               | KSO08/GPIO003                | 53              | 53               | LRESET#/GPIO116     | 96               | GPIO146/PVT_CS0#          |
| 11               | VSS                          | 54              | 54               | PCI_CLK/GPIO117     | 97               | GPIO150/SHD_CS0#          |
| 12               | KSO07/GPIO002                | 55              | 55               | CLKRUN#/GPIO014     | 98               | GPIO157/BC_CLK            |
| 13               | KSO06/GPIO001                | 56              | 56               | VSS                 | 99               | GPIO160/BC_DAT            |
| 14               | VCC1                         | 57              | 57               | SER_IRQ/GPIO115     | 100              | GPIO161/BC_INT#           |
| 15               | CAP                          | 58              | 58               | VCC1                | 101              | GPIO140/TACH2/TACH2PWM_IN |
| 16               | KSO05/GPIO104/TFDP_CLK       | 59              | 59               | GPIO041             | 102              | GPIO045/A20MP/PVT_CS1#    |
| 17               | KSO04/GPIO103/TFDP_DATA/XNOR | 60              | 60               | nRESET_OUT#/GPIO121 | 103              | GPIO053/PS2_CLK3          |
| 18               | KSO03/GPIO102/JTAG_TDO       | 61              | 61               | PS2_CLK1/GPIO050    | 104              | VSS                       |
| 19               | KSO02/GPIO101/JTAG_TDI       | 62              | 62               | PS2_DAT1/GPIO065    | 105              | GPIO152/PS2_DAT3          |
| 20               | KSO01/GPIO100/JTAG_TMS       | 63              | 63               | GPIO035             | 106              | VCC1                      |
| 21               | KSO00/GPIO000/JTAG_TCK       | 64              | 64               | GPIO027             | 107              | GPIO030                   |
| 22               | KS17/GPIO043                 | 65              | 65               | GPIO033             | 108              | GPIO012/KSO17             |
| 23               | KS16/GPIO042                 | 66              | 66               | PS2_CLK0/GPIO046    | 109              | I2C0_DAT1/GPIO017         |
| 24               | KS15/GPIO040                 | 67              | 67               | PS2_DAT0/GPIO047    | 110              | I2C0_CLK1/GPIO134         |
| 25               | KS14/GPIO142/TRACECLK        | 68              | 68               | VBAT                | 111              | I2C0_DAT0/GPIO016         |
| 26               | KS13/GPIO032/TRACEDATA0      | 69              | 69               | XTAL2               | 112              | I2C0_CLK0/GPIO015         |
| 27               | KS12/GPIO144/TRACEDATA1      | 70              | 70               | VSS_VBAT            | 113              | LED0/GPIO154              |
| 28               | KS11/GPIO126/TRACEDATA2      | 71              | 71               | XTAL1               | 114              | LED1/GPIO155              |
| 29               | KS10/GPIO125/TRACEDATA3      | 72              | 72               | VCC_FWRGD/GPIO063   | 115              | LED2/GPIO156              |
| 30               | GPIO031                      | 73              | 73               | GPIO110             | 116              | GPIO163                   |
| 31               | GPIO127/PECL_RDY             | 74              | 74               | GPIO130             | 117              | VSS                       |
| 32               | PS2_DAT2/GPIO052             | 75              | 75               | 32KHZ_OUT#/GPIO013  | 118              | GPIO136/PWM1              |
| 33               | GPIO147                      | 76              | 76               | nEC_SCI/GPIO026     | 119              | VCC1                      |
| 34               | GPIO151                      | 77              | 77               | VCC1_RST#/GPIO131   | 120              | GPIO133/PWM0              |
| 35               | PS2_CLK2/GPIO051             | 78              | 78               | GPIO141/PWM3/LED3   | 121              | GPIO034/PWM2/TACH2PWM_OUT |
| 36               | VSS                          | 79              | 79               | VREF_PECI           | 122              | GPIO135/KBRST             |
| 37               | VCC1                         | 80              | 80               | GPIO132/PECL_DAT    | 123              | GPIO044/nSMI              |
| 38               | ADC4/GPIO062                 | 81              | 81               | GPIO007/KSO14       | 124              | GPIO066                   |
| 39               | ADC3/GPIO061                 | 82              | 82               | VSS                 | 125              | GPIO025/I2C3_DAT0         |
| 40               | AVCC                         | 83              | 83               | GPIO010/KSO15       | 126              | GPIO024/I2C3_CLK0         |
| 41               | GPIO206                      | 84              | 84               | VCC1                | 127              | GPIO054/PVT_MOSI          |
| 42               | ADC2/GPIO060                 | 85              | 85               | GPIO143/RSMRST#     | 128              | GPIO064/SHD_MOSI          |
| 43               | ADC1/GPIO057                 | 86              | 86               | GPIO162/RXD         |                  |                           |

**Note 1:** The XTAL2 pin can be used as a single ended clock input. See Note 9 in [Section 1.6, "Notes for Tables in this Chapter," on page 39.](#)

**2:** See Note 10 in [Section 1.6, "Notes for Tables in this Chapter," on page 39](#) for information about the SPI pins.

**3:** The VCC1\_RST#/GPIO131 pin cannot be used as a GPIO pin. The input path to the VCC1\_RST# logic is always active and will cause a reset if this pin is set low in GPIO mode.

**4:** The GPIO041 pin defaults to output low. This pin must be reprogrammed to the GPIO function upon power-up.

**Note:** Table 1-2, "MEC1322 132 DQFN Pin Configuration" shows the mapping between Pin Ref. Number and 132 DQFN Number for the 132 DQFN package.

**TABLE 1-2: MEC1322 132 DQFN PIN CONFIGURATION**

| Pin Ref. Number | 132 DQFN Number | Pin Name                     | Pin Ref. Number | 132 DQFN Number | Pin Name           |
|-----------------|-----------------|------------------------------|-----------------|-----------------|--------------------|
| 2               | B1              | GPIO153/PVT_SCLK             | 32              | B18             | PS2_DAT2/GPIO052   |
| 3               | A1              | GPIO122/SHD_SCLK             | 33              | A17             | GPIO147            |
| 4               | B2              | GPIO011/KSO16                | 34              | B19             | GPIO151            |
| 5               | A2              | KSO13/GPIO006                | 132             | A18             | GPIO211            |
| 6               | B3              | KSO12/GPIO005                | 35              | B20             | PS2_CLK2/GPIO051   |
| 7               | A3              | KSO11/GPIO107                | 37              | A19             | VCC1               |
| 8               | B4              | KSO10/GPIO004                | 38              | B21             | ADC4/GPIO062       |
| 10              | A4              | KSO08/GPIO003                | 39              | A20             | ADC3/GPIO061       |
| 9               | B5              | KSO09/GPIO106                | 40              | B22             | AVCC               |
| 11              | A5              | VSS                          | 41              | A21             | GPIO206            |
| 12              | B6              | KSO07/GPIO002                | 42              | B23             | ADC2/GPIO060       |
| 13              | A6              | KSO06/GPIO001                | 43              | A22             | ADC1/GPIO057       |
| 14              | B7              | VCC1                         | 44              | B24             | ADC0/GPIO056       |
| 15              | A7              | CAP                          | 45              | A23             | AVSS               |
| 129             | B8              | GPIO067                      | 46              | B25             | LAD0/GPIO112       |
| 130             | A8              | GPIO055                      | 133             | A24             | GPIO200            |
| 131             | B9              | GPIO210                      | 48              | B26             | LAD1/GPIO114       |
| 16              | A9              | KSO05/GPIO104/TFDP_CLK       | 49              | A25             | JTAG_RST#          |
| 17              | B10             | KSO04/GPIO103/TFDP_DATA/XNOR | 50              | B27             | LAD2/GPIO113       |
| 18              | A10             | KSO03/GPIO102/JTAG_TDO       | 51              | A26             | LAD3/GPIO111       |
| 19              | B11             | KSO02/GPIO101/JTAG_TDI       | 52              | B28             | LFRAME#/GPIO120    |
| 20              | A11             | KSO01/GPIO100/JTAG_TMS       | 53              | A27             | LRESET#/GPIO116    |
| 21              | B12             | KSO00/GPIO000/JTAG_TCK       | 54              | B29             | PCI_CLK/GPIO117    |
| 22              | A12             | KSI7/GPIO043                 | 55              | A28             | CLKRUN#/GPIO014    |
| 24              | B13             | KSI5/GPIO040                 | 134             | B30             | GPIO123            |
| 23              | A13             | KSI6/GPIO042                 | 57              | A29             | SER_IRQ/GPIO115    |
| 25              | B14             | KSI4/GPIO142/TRACECLK        | 58              | B31             | VCC1               |
| 26              | A14             | KSI3/GPIO032/TRACEDATA0      | 59              | A30             | GPIO041            |
| 27              | B15             | KSI2/GPIO144/TRACEDATA1      | 60              | B32             | nRESET_OUT/GPIO121 |
| 28              | A15             | KSI1/GPIO126/TRACEDATA2      | 61              | A31             | PS2_CLK1/GPIO050   |
| 29              | B16             | KSI0/GPIO125/TRACEDATA3      | 62              | B33             | PS2_DAT1/GPIO065   |
| 30              | A16             | GPIO031                      | 63              | A32             | GPIO035            |
| 31              | B17             | GPIO127/PECL_RDY             | 64              | B34             | GPIO027            |

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| Pin Ref. Number | 132 DQFN Number | Pin Name             | Pin Ref. Number | 132 DQFN Number | Pin Name                  |
|-----------------|-----------------|----------------------|-----------------|-----------------|---------------------------|
| 65              | B35             | GPIO033              | 97              | B52             | GPIO150/SHD_CS0#          |
| 66              | A33             | PS2_CLK0/GPIO046     | 98              | A49             | GPIO157/BC_CLK            |
| 67              | B36             | PS2_DAT0/GPIO047     | 99              | B53             | GPIO160/BC_DAT            |
| 68              | A34             | VBAT                 | 100             | A50             | GPIO161/BC_INT#           |
| 69              | B37             | XTAL2                | 101             | B54             | GPIO140/TACH2/TACH2PWM_IN |
| 70              | A35             | VSS_VBAT             | 102             | A51             | GPIO045/A20M/PVT_CS1#     |
| 71              | B38             | XTAL1                | 103             | B55             | GPIO053/PS2_CLK3          |
| 72              | A36             | VCC_PWRGD/GPIO063    | 139             | A52             | GPIO203                   |
| 73              | B39             | GPIO110              | 105             | B56             | GPIO152/PS2_DAT3          |
| 74              | A37             | GPIO130              | 106             | A53             | VCC1                      |
| 75              | B40             | 32KHZ_OUT/GPIO013    | 107             | B57             | GPIO030                   |
| 76              | A38             | nEC_SCI/GPIO026      | 108             | A54             | GPIO012/KSO17             |
| 77              | B41             | VCC1_RST#/GPIO131    | 109             | B58             | I2C0_DAT1/GPIO017         |
| 78              | A39             | GPIO141/PWM3/LED3    | 110             | A55             | I2C0_CLK1/GPIO134         |
| 79              | B42             | VREF_PECI            | 111             | B59             | I2C0_DAT0/GPIO016         |
| 80              | A40             | GPIO132/PECI_DAT     | 112             | A56             | I2C0_CLK0/GPIO015         |
| 81              | B43             | GPIO007/KSO14        | 113             | B60             | LED0/GPIO154              |
| 136             | A41             | GPIO202              | 114             | A57             | LED1/GPIO155              |
| 83              | B44             | GPIO010/KSO15        | 115             | B61             | LED2/GPIO156              |
| 84              | A42             | VCC1                 | 116             | A58             | GPIO163                   |
| 85              | B45             | GPIO143/RSMRST#      | 141             | B62             | GPIO204                   |
| 86              | A43             | GPIO162/RXD          | 118             | A59             | GPIO136/PWM1              |
| 87              | B46             | GPIO165/TXD/SHD_CS1# | 119             | B63             | VCC1                      |
| 88              | A44             | GPIO023/I2C1_DAT0    | 120             | A60             | GPIO133/PWM0              |
| 89              | B47             | GPIO022/I2C1_CLK0    | 121             | B64             | GPIO034/PWM2/TACH2PWM_OUT |
| 90              | A45             | GPIO021/I2C2_DAT0    | 122             | A61             | GPIO135/KBRST             |
| 91              | B48             | GPIO020/I2C2_CLK0    | 123             | B65             | GPIO044/nSMI              |
| 92              | A46             | GPIO105/TACH1        | 124             | A62             | GPIO066                   |
| 93              | B49             | GPIO145              | 125             | B66             | GPIO025/I2C3_DAT0         |
| 94              | A47             | GPIO164/PVT_MISO     | 126             | A63             | GPIO024/I2C3_CLK0         |
| 95              | B50             | GPIO124/SHD_MISO     | 127             | B67             | GPIO054/PVT_MOSI          |
| 96              | A48             | GPIO146/PVT_CS0#     | 128             | A64             | GPIO064/SHD_MOSI          |
| 137             | B51             | GPIO201              | 1               | B68             | GPIO036                   |

**Note:** [Table 1-3, "MEC1322 144 WFBGA Pin Configuration"](#) shows the mapping between Pin Ref. Number and 144 WFBGA ball number.



**TABLE 1-3: MEC1322 144 WFBGA PIN CONFIGURATION**

| Pin Ref. Number | 144 WFBGA Number | Pin Name                     | Pin Ref. Number | 144 WFBGA Number | Pin Name           |
|-----------------|------------------|------------------------------|-----------------|------------------|--------------------|
| 1               | C3               | GPIO036                      | 37              | H5               | VCC1               |
| 2               | F5               | GPIO153/PVT_SCLK             | 38              | N5               | ADC4/GPIO062       |
| 3               | F6               | GPIO122/SHD_SCLK             | 39              | M5               | ADC3/GPIO061       |
| 4               | A2               | GPIO011/KSO16                | 40              | L5               | AVCC               |
| 5               | A1               | KSO13/GPIO006                | 41              | N6               | GPIO206            |
| 6               | B1               | KSO12/GPIO005                | 42              | M6               | ADC2/GPIO060       |
| 7               | B2               | KSO11/GPIO107                | 43              | L6               | ADC1/GPIO057       |
| 8               | C2               | KSO10/GPIO004                | 44              | N7               | ADC0/GPIO056       |
| 9               | C1               | KSO09/GPIO106                | 45              | M7               | AVSS               |
| 10              | D2               | KSO08/GPIO003                | 46              | N8               | LAD0/GPIO112       |
| 11              | D1               | VSS                          | 47              | A5               | VSS                |
| 12              | E2               | KSO07/GPIO002                | 48              | M8               | LAD1/GPIO114       |
| 13              | E1               | KSO06/GPIO001                | 49              | J3               | JTAG_RST#          |
| 14              | G5               | VCC1                         | 50              | L8               | LAD2/GPIO113       |
| 15              | F1               | CAP                          | 51              | L9               | LAD3/GPIO111       |
| 16              | G2               | KSO05/GPIO104/TFDP_CLK       | 52              | N9               | LFAME#/GPIO120     |
| 17              | H3               | KSO04/GPIO103/TFDP_DATA/XNOR | 53              | N10              | LRESET#/GPIO116    |
| 18              | H1               | KSO03/GPIO102/JTAG_TDO       | 54              | M9               | PCI_CLK/GPIO117    |
| 19              | J1               | KSO02/GPIO101/JTAG_TDI       | 55              | M10              | CLKRUN#/GPIO014    |
| 20              | H2               | KSO01/GPIO100/JTAG_TMS       | 56              | F3               | VSS                |
| 21              | J2               | KSO00/GPIO000/JTAG_TCK       | 57              | L10              | SER_IRQ/GPIO115    |
| 22              | K1               | KS17/GPIO043                 | 58              | J5               | VCC1               |
| 23              | K3               | KS16/GPIO042                 | 59              | N11              | GPIO041            |
| 24              | K2               | KS15/GPIO040                 | 60              | N12              | nRESET_OUT/GPIO121 |
| 25              | L1               | KS14/GPIO142/TRACECLK        | 61              | N13              | PS2_CLK1/GPIO050   |
| 26              | L2               | KS13/GPIO032/TRACEDATA0      | 62              | L11              | PS2_DAT1/GPIO065   |
| 27              | L3               | KS12/GPIO144/TRACEDATA1      | 63              | M12              | GPIO035            |
| 28              | M2               | KS11/GPIO126/TRACEDATA2      | 64              | M13              | GPIO027            |
| 29              | M1               | KS10/GPIO125/TRACEDATA3      | 65              | L12              | GPIO033            |
| 30              | N2               | GPIO031                      | 66              | K11              | PS2_CLK0/GPIO046   |
| 31              | N1               | GPIO127/PECI_RDY             | 67              | J12              | PS2_DAT0/GPIO047   |
| 32              | M3               | PS2_DAT2/GPIO052             | 68              | K12              | VBAT               |
| 33              | N3               | GPIO147                      | 69              | L13              | XTAL2              |
| 34              | M4               | GPIO151                      | 70              | K13              | VSS_VBAT           |
| 35              | L4               | PS2_CLK2/GPIO051             | 71              | J13              | XTAL1              |
| 36              | E3               | VSS                          | 72              | J11              | VCC_PWRGD/GPIO063  |

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| Pin Ref. Number | 144 WFBGA Number | Pin Name                  | Pin Ref. Number | 144 WFBGA Number | Pin Name                  |
|-----------------|------------------|---------------------------|-----------------|------------------|---------------------------|
| 73              | H13              | GPIO110                   | 109             | B9               | I2C0_DAT1/GPIO017         |
| 74              | H11              | GPIO130                   | 110             | A9               | I2C0_CLK1/GPIO134         |
| 75              | H12              | 32KHZ_OUT/GPIO013         | 111             | A8               | I2C0_DAT0/GPIO016         |
| 76              | G13              | nEC_SCI/GPIO026           | 112             | C8               | I2C0_CLK0/GPIO015         |
| 77              | H8               | VCC1_RST#/GPIO131         | 113             | A7               | LED0/GPIO154              |
| 78              | G8               | GPIO141/PWM3/LED3         | 114             | B8               | LED1/GPIO155              |
| 79              | G12              | VREF_PECI                 | 115             | C7               | LED2/GPIO156              |
| 80              | G9               | GPIO132/PECI_DAT          | 116             | B7               | GPIO163                   |
| 81              | G11              | GPIO007/KSO14             | 117             | C10              | VSS                       |
| 82              | J9               | VSS                       | 118             | A6               | GPIO136/PWM1              |
| 83              | F13              | GPIO010/KSO15             | 119             | G6               | VCC1                      |
| 84              | J6               | VCC1                      | 120             | B6               | GPIO133/PWM0              |
| 85              | F11              | GPIO143/RSMRST#           | 121             | C5               | GPIO034/PWM2/TACH2PWM_OUT |
| 86              | D13              | GPIO162/RXD               | 122             | A4               | GPIO135/KBRST             |
| 87              | F7               | GPIO165/TXD/SHD_CS1#      | 123             | B4               | GPIO044/nSMI              |
| 88              | E13              | GPIO023/I2C1_DAT0         | 124             | C4               | GPIO066                   |
| 89              | E12              | GPIO022/I2C1_CLK0         | 125             | B3               | GPIO025/I2C3_DAT0         |
| 90              | E11              | GPIO021/I2C2_DAT0         | 126             | A3               | GPIO024/I2C3_CLK0         |
| 91              | D11              | GPIO020/I2C2_CLK0         | 127             | E6               | GPIO054/PVT_MOSI          |
| 92              | D12              | GPIO105/TACH1             | 128             | E5               | GPIO064/SHD_MOSI          |
| 93              | C13              | GPIO145                   | 129             | G3               | GPIO067                   |
| 94              | F9               | GPIO164/PVT_MISO          | 130             | F2               | GPIO055                   |
| 95              | E9               | GPIO124/SHD_MISO          | 131             | G1               | GPIO210                   |
| 96              | F8               | GPIO146/PVT_CS0#          | 132             | N4               | GPIO211                   |
| 97              | E8               | GPIO150/SHD_CS0#          | 133             | L7               | GPIO200                   |
| 98              | B12              | GPIO157/BC_CLK            | 134             | J7               | GPIO123                   |
| 99              | B13              | GPIO160/BC_DAT            | 135             | H7               | VCC1                      |
| 100             | A12              | GPIO161/BC_INT#           | 136             | F12              | GPIO202                   |
| 101             | A13              | GPIO140/TACH2/TACH2PWM_IN | 137             | C12              | GPIO201                   |
| 102             | E7               | GPIO045/A20MPVT_CS1#      | 138             | H9               | VSS                       |
| 103             | C11              | GPIO053/PS2_CLK3          | 139             | B11              | GPIO203                   |
| 104             | J8               | VSS                       | 140             | C9               | VSS                       |
| 105             | A11              | GPIO152/PS2_DAT3          | 141             | C6               | GPIO204                   |
| 106             | H6               | VCC1                      | 142             | M11              | NC                        |
| 107             | A10              | GPIO030                   | 143             | D3               | VSS                       |
| 108             | B10              | GPIO012/KSO17             | 144             | B5               | VSS                       |

**Note:** The NC pin in the 144 WFBGA package should be left unconnected on the board.

The pin name to package ball mapping of the 144 pin WFBGA package is shown in [FIGURE 1-1](#):

**FIGURE 1-1: MEC1322 PIN NAME TO 144-PIN WFBGA BALL MAPPING (TOP)**

|          | 1                       | 2                       | 3                            | 4                | 5                         | 6                | 7                     |
|----------|-------------------------|-------------------------|------------------------------|------------------|---------------------------|------------------|-----------------------|
| <b>A</b> | KSO13/GPIO006           | GPIO011/KSO16           | GPIO024/I2C3_CLK0            | GPIO135/KBRST    | VSS                       | GPIO136/PWM1     | LED0/GPIO154          |
| <b>B</b> | KSO12/GPIO005           | KSO11/GPIO107           | GPIO025/I2C3_DATA0           | GPIO044/nSMI     | VSS                       | GPIO133/PWM0     | GPIO163               |
| <b>C</b> | KSO09/GPIO106           | KSO10/GPIO004           | GPIO036                      | GPIO066          | GPIO034/PWM2/TACH2PWM_OUT | GPIO204          | LED2/GPIO156          |
| <b>D</b> | VSS                     | KSO08/GPIO003           | VSS                          | No Ball          | No Ball                   | No Ball          | No Ball               |
| <b>E</b> | KSO06/GPIO001           | KSO07/GPIO002           | VSS                          | No Ball          | GPIO064/SHD_MOSI          | GPIO054/PVT_MOSI | GPIO045/A20M/PVT_CS1# |
| <b>F</b> | CAP                     | GPIO055                 | VSS                          | No Ball          | GPIO153/PVT_SCLK          | GPIO122/SHD_SCLK | GPIO165/TXD/SHD_CS1#  |
| <b>G</b> | GPIO210                 | KSO05/GPIO104/TFDP_CLK  | GPIO067                      | No Ball          | VCC1                      | VCC1             | No Ball               |
| <b>H</b> | KSO03/GPIO102/JTAG_TDO  | KSO01/GPIO100/JTAG_TMS  | KSO04/GPIO103/TFDP_DATA/XNOR | No Ball          | VCC1                      | VCC1             | VCC1                  |
| <b>J</b> | KSO02/GPIO101/JTAG_TDI  | KSO00/GPIO000/JTAG_TCK  | JTAG_RST#                    | No Ball          | VCC1                      | VCC1             | GPIO123               |
| <b>K</b> | KSI7/GPIO043            | KSI5/GPIO040            | KSI6/GPIO042                 | No Ball          | No Ball                   | No Ball          | No Ball               |
| <b>L</b> | KSI4/GPIO142/TRACECLK   | KSI3/GPIO032/TRACEDATA0 | KSI2/GPIO144/TRACEDATA1      | PS2_CLK2/GPIO051 | AVCC                      | ADC1/GPIO057     | GPIO200               |
| <b>M</b> | KSI0/GPIO125/TRACEDATA3 | KSI1/GPIO126/TRACEDATA2 | PS2_DAT2/GPIO052             | GPIO151          | ADC3/GPIO061              | ADC2/GPIO060     | AVSS                  |
| <b>N</b> | GPIO127/PECL_RDY        | GPIO031                 | GPIO147                      | GPIO211          | ADC4/GPIO062              | GPIO206          | ADC0/GPIO056          |

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| 8                 | 9                 | 10              | 11                 | 12                 | 13                        |   |
|-------------------|-------------------|-----------------|--------------------|--------------------|---------------------------|---|
| I2C0_DAT0/GPIO016 | I2C0_CLK1/GPIO134 | GPIO030         | GPIO152/PS2_DAT3   | GPIO161/BC_INT#    | GPIO140/TACH2/TACH2PWM_IN | A |
| LED1/GPIO155      | I2C0_DAT1/GPIO017 | GPIO012/KSO17   | GPIO203            | GPIO157/BC_CLK     | GPIO160/BC_DATA           | B |
| I2C0_CLK0/GPIO015 | VSS               | VSS             | GPIO053/PS2_CLK3   | GPIO201            | GPIO145                   | C |
| No Ball           | No Ball           | No Ball         | GPIO020/I2C2_CLK0  | GPIO105/TACH1      | GPIO162/RXD               | D |
| GPIO150/SHD_CS0#  | GPIO124/SHD_MISO  | No Ball         | GPIO021/I2C2_DATA0 | GPIO022/I2C1_CLK0  | GPIO023/I2C1_DATA0        | E |
| GPIO146/PVT_CS0#  | GPIO164/PVT_MISO  | No Ball         | GPIO143/RSMRST#    | GPIO202            | GPIO010/KSO15             | F |
| GPIO141/PWM3/LED3 | GPIO132/PECLDAT   | No Ball         | GPIO007/KSO14      | VREF_PECI          | nEC_SCI/GPIO026           | G |
| VCC1_RST#/GPIO131 | VSS               | No Ball         | GPIO130            | 32KHZ_OUT/GPIO013  | GPIO110                   | H |
| VSS               | VSS               | No Ball         | VCC_PWRGD/GPIO063  | PS2_DAT0/GPIO047   | XTAL1                     | J |
| No Ball           | No Ball           | No Ball         | PS2_CLK0/GPIO046   | VBAT               | VSS_VBAT                  | K |
| LAD2/GPIO113      | LAD3/GPIO111      | SER_IRQ/GPIO115 | PS2_DAT1/GPIO065   | GPIO033            | XTAL2                     | L |
| LAD1/GPIO114      | PCI_CLK/GPIO117   | CLKRUN#/GPIO014 | NC                 | GPIO035            | GPIO027                   | M |
| LAD0/GPIO112      | LFRAME#/GPIO120   | LRESET#/GPIO116 | GPIO041            | nRESET_OUT/GPIO121 | PS2_CLK1/GPIO050          | N |

## 1.3.1 NON 5 VOLT TOLERANT PINS

There are no 5 Volt tolerant pins in the MEC1322.

## 1.3.2 POR GLITCH PROTECTED PINS

All pins in the MEC1322 have POR output glitch protection. POR output glitch protection ensures that pins will have a steady-state output during VCC1 POR.

In addition, signals in [Table 1-4](#) have additional drive low POR circuitry. Signals in [Table 1-4](#) refer to Pin Reference Numbers as defined in [Table 1-1](#).

These pins are anti-glitch, driven low on VCC1 POR.

**TABLE 1-4: GLITCH PROTECTED POR DRIVE LOW PINS**

| Pin Reference Number | Pin Name           |
|----------------------|--------------------|
| 60                   | nRESET_OUT/GPIO121 |
| 77                   | VCC1_RST#/GPIO131  |
| 85                   | GPIO143/RSMRST#    |
| 125                  | GPIO025/I2C3_DAT0  |

**Note:** The GPIO025/I2C3\_DAT0 pin is driven low, glitch free, while VCC1 is coming up. However, after VCC1 is up and stable, the pin becomes an input (i.e., tri-stated Open Drain type), as shown in [Table 1-37, "Multiplexing Table \(16 of 18\)," on page 36](#).

The following signals require a pull-down on the board:

- nRESET\_OUT/GPIO121
- GPIO143/RSMRST#

**Note:** These glitch protected pins have no backdrive protection. See [Section 1.3.3, "Non Backdrive Protected Pins"](#).

## 1.3.3 NON BACKDRIVE PROTECTED PINS

[Table 1-5](#) lists pins which do not have backdrive protection. Signals in [Table 1-5](#) refer to Pin Reference Numbers as defined in [Table 1-1](#).

These pins have no backdrive protection. If VCC1 is off must insure that none of these pins is above 0V to prevent backdrive onto the VCC1 supply.

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**TABLE 1-5: NON BACKDRIVE PROTECTED PINS**

| Pin Reference Number | Pin Name           |
|----------------------|--------------------|
| 38                   | ADC4/GPIO062       |
| 39                   | ADC3/GPIO061       |
| 42                   | ADC2/GPIO060       |
| 43                   | ADC1/GPIO057       |
| 44                   | ADC0/GPIO056       |
| 46                   | LAD0/GPIO112       |
| 48                   | LAD1/GPIO114       |
| 50                   | LAD2/GPIO113       |
| 51                   | LAD3/GPIO111       |
| 52                   | LFRAME#/GPIO120    |
| 53                   | LRESET#/GPIO116    |
| 54                   | PCI_CLK/GPIO117    |
| 55                   | CLKRUN#/GPIO014    |
| 57                   | SER_IRQ/GPIO115    |
| 60                   | nRESET_OUT/GPIO121 |
| 69                   | XTAL2              |
| 71                   | XTAL1              |
| 77                   | VCC1_RST#/GPIO131  |
| 79                   | VREF_PECI          |
| 80                   | GPIO132/PECI_DAT   |
| 85                   | GPIO143/RSMRST#    |
| 125                  | GPIO025/I2C3_DAT0  |

## 1.4 Pin Description

### 1.4.1 OVERVIEW

The following tables describe the signal functions in the MEC1322 pin configuration. See [Section 1.6, "Notes for Tables in this Chapter," on page 39](#) for notes that are referenced in the [Pin Description](#) tables.

### 1.4.2 HOST INTERFACE

**TABLE 1-6: HOST INTERFACE**

| HOST INTERFACE Pin Ref. Number | Signal Name | Description  | (11 Pins) Notes |
|--------------------------------|-------------|--|-----------------|
| 57                             | SER_IRQ     | Serial IRQ   | Note 1          |
| 53                             | LRESET#     | LPC Reset. LRESET# is the same as the system PCI reset, PCIRST#            |                 |
| 54                             | PCI_CLK     | PCI Clock  |                 |
| 52                             | LFRAME#     | Frame signal. Indicates start of new cycle and termination of broken cycle |                 |
| 46                             | LAD0        | LPC Multiplexed command, address and data bus Bit 0.                       | Note 1          |
| 48                             | LAD1        | LPC Multiplexed command, address and data bus Bit 1.                       | Note 1          |
| 50                             | LAD2        | LPC Multiplexed command, address and data bus Bit 2.                       | Note 1          |
| 51                             | LAD3        | LPC Multiplexed command, address and data bus Bit 3.                       | Note 1          |
| 55                             | CLKRUN#     | PCI Clock Control  |                 |
| 76                             | nEC_SCI     | Power Management Event   |                 |
| 123                            | nSMI        | SMI Output   |                 |

## 1.4.3 BC-LINK INTERFACE

**TABLE 1-7: BC-LINK INTERFACE**

| BC-Link Interface |             |                          | (3 Pins) |
|-------------------|-------------|--------------------------|----------|
| Pin Ref. Number   | Signal Name | Description              | Notes    |
| 98                | BC_CLK      | BC-Link Master clock     |          |
| 99                | BC_DAT      | BC-Link Master data I/O  | Note 7   |
| 100               | BC_INT#     | BC-Link Master interrupt |          |

## 1.4.4 JTAG INTERFACE

**TABLE 1-8: JTAG INTERFACE**

| JTAG Interface  |             |                              | (5 Pins) |
|-----------------|-------------|------------------------------|----------|
| Pin Ref. Number | Signal Name | Description                  | Notes    |
| 21              | JTAG_TCK    | JTAG Test Clock              |          |
| 19              | JTAG_TDI    | JTAG Test Data In            |          |
| 18              | JTAG_TDO    | JTAG Test Data Out           |          |
| 20              | JTAG_TMS    | JTAG Test Mode Select        |          |
| 49              | JTAG_RST#   | JTAG Test Reset (active low) | Note 2   |

**Note:** JTAG\_TDO is a push-pull output. This function is not configured through the associated GPIO [Pin Control Register](#); however the drive strength is configured through the associated GPIO [Pin Control Register 2](#).

## 1.4.5 MASTER CLOCK INTERFACE

**TABLE 1-9: MASTER CLOCK INTERFACE**

| Master Clock Interface |             |  | (3 Pins) |
|------------------------|-------------|--|----------|
| Pin Ref. Number        | Signal Name | Description  | Notes    |
| 71                     | XTAL1       | 32.768 KHz Crystal Output                                      | Note 9   |
| 69                     | XTAL2       | 32.768 KHz Crystal Input (single-ended 32.768 KHz clock input) | Note 9   |
| 75                     | 32KHZ_OUT   | 32.768 KHz Digital Output                                      |          |

## 1.4.6 ANALOG DATA ACQUISITION INTERFACE

**TABLE 1-10: ANALOG DATA ACQUISITION**

| Analog Data Acquisition Interface |             |               | (5 Pins) |
|-----------------------------------|-------------|---------------|----------|
| Pin Ref. Number                   | Signal Name | Description   | Notes    |
| 44                                | ADC0        | ADC channel 0 | Note 8   |
| 43                                | ADC1        | ADC channel 1 | Note 8   |
| 42                                | ADC2        | ADC channel 2 | Note 8   |
| 39                                | ADC3        | ADC channel 3 | Note 8   |
| 38                                | ADC4        | ADC channel 4 | Note 8   |

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## 1.4.7 FAN TACHOMETER AND PWM INTERFACE

**TABLE 1-11: FAN TACHOMETER AND PWM INTERFACE**

| PWM & TACHOMETER |              |   | (6 Pins) |
|------------------|--------------|---|----------|
| Pin Ref. Number  | Signal Name  | Description   | Notes    |
| 92               | TACH1        | Fan Tachometer Input 2  |          |
| 101              | TACH2PWM_IN  | Tach input to RPM-Based Fan Speed Control Algorithm                     |          |
| 120              | PWM0         | Pulse Width Modulator Output 0  |          |
| 118              | PWM1         | Pulse Width Modulator Output 1  |          |
| 78               | PWM3         | Pulse Width Modulator Output 3  |          |
| 121              | TACH2PWM_OUT | Pulse Width Modulator Output from RPM Based Fan Speed Control Algorithm |          |

## 1.4.8 GENERAL PURPOSE I/O INTERFACE

**TABLE 1-12: GPIO INTERFACE**

| GPIO Interface              |             |                                   |         |
|-----------------------------|-------------|-----------------------------------|---------|
| Pin Ref. Number             | Signal Name | Description                       | Notes   |
| See Pin Configuration Table | GPIO        | General Purpose Input Output Pins | Note 12 |

**Note:** No GPIO pin should be left floating in a system. If a GPIO pin is not in use, it should be either tied high, tied low, or pulled to either power or ground through a resistor.

## 1.4.9 MISCELLANEOUS FUNCTIONS

**TABLE 1-13: MISCELLANEOUS FUNCTIONS**

| MISC Functions  |             |                                       | (13 Pins) |
|-----------------|-------------|---------------------------------------|-----------|
| Pin Ref. Number | Signal Name | Description                           | Notes     |
| 102             | A20M        | KBD GATEA20 Output                    |           |
| 122             | KBRST       | CPU_RESET                             |           |
| 113             | LED0        | LED (Blinking/Breathing PWM) Output 0 |           |
| 114             | LED1        | LED (Blinking/Breathing PWM) Output 1 |           |
| 115             | LED2        | LED (Blinking/Breathing PWM) Output 2 |           |
| 78              | LED3        | LED (Blinking/Breathing PWM) Output 3 |           |
| 16              | TFDP_CLK    | Trace FIFO debug port - clock         |           |
| 17              | TFDP_DATA   | Trace FIFO debug port - data          |           |
| 60              | nRESET_OUT  | EC-driven External System Reset       | Note 6    |
| 72              | VCC_PWRGD   | System Main Power Indication          |           |
| 77              | VCC1_RST#   | Reset Generator Output                |           |
| 85              | RSMRST#     | Resume Reset Output                   | Note 6    |
| 17              | XNOR        | Test Output                           |           |

**Note 1:** The KBRST pin function is the output of CPU\_RESET described in [Section 11.11.2, "CPU\\_RESET Hardware Speed-Up,"](#) on page 151.

**2:** The nRESET\_OUT pin function is an external output signal version of the internal signal nSIO\_RESET. See the iRESET\_OUT bit in the [Power Reset Control \(PWR\\_RST\\_CTRL\) Register](#) on page 71 and nSIO\_RESET in [Table 3-7, "Definition of Reset Signals,"](#) on page 52.

**3:** XNOR is a push-pull output. This function is not configured through the associated [GPIO Pin Control Register](#); however the drive strength is configured through the associated [GPIO Pin Control Register 2](#).



## 1.4.10 PS/2 INTERFACE

**TABLE 1-14: PS/2 INTERFACE**

| PS/2 Interface  |             |              | (8 Pins) |
|-----------------|-------------|--------------|----------|
| Pin Ref. Number | Signal Name | Description  | Notes    |
| 35              | PS2_CLK2    | PS/2 clock 2 |          |
| 32              | PS2_DAT2    | PS/2 data 2  |          |
| 61              | PS2_CLK1    | PS/2 clock 1 |          |
| 62              | PS2_DAT1    | PS/2 data 1  |          |
| 66              | PS2_CLK0    | PS/2 clock 0 |          |
| 67              | PS2_DAT0    | PS/2 data 0  |          |
| 103             | PS2_CLK3    | PS/2 clock 3 |          |
| 105             | PS2_DAT3    | PS/2 data 3  |          |

## 1.4.11 POWER INTERFACE

**TABLE 1-15: POWER INTERFACE**

| Power Interface                 |             |                                      | (18 Pins) |
|---------------------------------|-------------|--------------------------------------|-----------|
| Pin Ref. Number                 | Signal Name | Description                          | Notes     |
| 70                              | VSS_VBAT    | VBAT associated ground               |           |
| 68                              | VBAT        | VBAT supply                          |           |
| 15                              | CAP         | Internal Voltage Regulator Capacitor | Note 3    |
| 11, 36, 47, 56, 82,<br>104, 117 | VSS         | VCC1 associated ground               |           |
| 14, 37, 58, 84, 106,<br>119     | VCC1        | VCC1 supply                          |           |
| 45                              | AVSS        | Analog ADC supply associated ground  |           |
| 40                              | AVCC        | Analog ADC VCC1 associated Supply    |           |

**APPLICATION NOTE:** See [FIGURE 3-1: Recommended Battery Circuit on page 49](#).

## 1.4.12 SMBUS INTERFACE

**TABLE 1-16: SMBUS INTERFACE**

| SMBus Interface |             |                                 | (10 Pins) |
|-----------------|-------------|---------------------------------|-----------|
| Pin Ref. Number | Signal Name | Description                     | Notes     |
| 112             | I2C0_CLK0   | SMBus Controller 0 Port 0 Clock |           |
| 111             | I2C0_DAT0   | SMBus Controller 0 Port 0 Data  |           |
| 110             | I2C0_CLK1   | SMBus Controller 0 Port 1 Clock |           |
| 109             | I2C0_DAT1   | SMBus Controller 0 Port 1 Data  |           |
| 89              | I2C1_CLK0   | SMBus Controller 1 Clock        |           |
| 88              | I2C1_DAT0   | SMBus Controller 1 Data         |           |
| 91              | I2C2_CLK0   | SMBus Controller 2 Clock        |           |
| 90              | I2C2_DAT0   | SMBus Controller 2 Data         |           |
| 126             | I2C3_CLK0   | SMBus Controller 3 Clock        |           |
| 125             | I2C3_DAT0   | SMBus Controller 3 Data         |           |

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## 1.4.13 PECE INTERFACE

**TABLE 1-17: PECE INTERFACE**

| PECE Interface  |             |                        | (3 Pins) |
|-----------------|-------------|------------------------|----------|
| Pin Ref. Number | Signal Name | Description            | Notes    |
| 80              | PECE_DAT    | PECE Bus               |          |
| 31              | PECE_RDY    | PECE Ready             |          |
| 79              | VREF_PECE   | PECE Voltage Reference |          |

## 1.4.14 KEYBOARD SCAN INTERFACE

**TABLE 1-18: KEYBOARD SCAN INTERFACE**

| Keyboard Scan Interface |             |                                | (26 Pins) |
|-------------------------|-------------|--------------------------------|-----------|
| Pin Ref. Number         | Signal Name | Description                    | Notes     |
| 29                      | KSI0        | Keyboard Scan Matrix Input 0   | Note 11   |
| 28                      | KSI1        | Keyboard Scan Matrix Input 1   | Note 11   |
| 27                      | KSI2        | Keyboard Scan Matrix Input 2   | Note 11   |
| 26                      | KSI3        | Keyboard Scan Matrix Input 3   | Note 11   |
| 25                      | KSI4        | Keyboard Scan Matrix Input 4   | Note 11   |
| 24                      | KSI5        | Keyboard Scan Matrix Input 5   | Note 11   |
| 23                      | KSI6        | Keyboard Scan Matrix Input 6   | Note 11   |
| 22                      | KSI7        | Keyboard Scan Matrix Input 7   | Note 11   |
| 21                      | KSO00       | Keyboard Scan Matrix Output 0  |           |
| 20                      | KSO01       | Keyboard Scan Matrix Output 1  |           |
| 19                      | KSO02       | Keyboard Scan Matrix Output 2  |           |
| 18                      | KSO03       | Keyboard Scan Matrix Output 3  |           |
| 17                      | KSO04       | Keyboard Scan Matrix Output 4  |           |
| 16                      | KSO05       | Keyboard Scan Matrix Output 5  |           |
| 13                      | KSO06       | Keyboard Scan Matrix Output 6  |           |
| 12                      | KSO07       | Keyboard Scan Matrix Output 7  |           |
| 10                      | KSO08       | Keyboard Scan Matrix Output 8  |           |
| 9                       | KSO09       | Keyboard Scan Matrix Output 9  |           |
| 8                       | KSO10       | Keyboard Scan Matrix Output 10 |           |
| 7                       | KSO11       | Keyboard Scan Matrix Output 11 |           |
| 6                       | KSO12       | Keyboard Scan Matrix Output 12 |           |
| 5                       | KSO13       | Keyboard Scan Matrix Output 13 |           |
| 81                      | KSO14       | Keyboard Scan Matrix Output 14 |           |
| 83                      | KSO15       | Keyboard Scan Matrix Output 15 |           |
| 4                       | KSO16       | Keyboard Scan Matrix Output 16 |           |
| 108                     | KSO17       | Keyboard Scan Matrix Output 17 |           |

## 1.4.15 SPI CONTROLLER INTERFACE

**TABLE 1-19: SPI CONTROLLER INTERFACE**

| SPI Controllers Interface |             |                           | (10 Pins) |
|---------------------------|-------------|---------------------------|-----------|
| Pin Ref. Number           | Signal Name | Description               | Notes     |
| 3                         | SHD_SCLK    | Shared SPI Clock          | Note 10   |
| 128                       | SHD_MOSI    | Shared SPI Output         | Note 10   |
| 95                        | SHD_MISO    | Shared SPI Input          | Note 10   |
| 97                        | SHD_CS0#    | Shared SPI Chip Select 0  | Note 10   |
| 87                        | SHD_CS1#    | Shared SPI Chip Select 1  |           |
| 2                         | PVT_SCLK    | Private SPI Clock         | Note 10   |
| 127                       | PVT_MOSI    | Private SPI Output        | Note 10   |
| 94                        | PVT_MISO    | Private SPI Input         | Note 10   |
| 96                        | PVT_CS0#    | Private SPI Chip Select 0 | Note 10   |
| 102                       | PVT_CS1#    | Private SPI Chip Select 1 |           |

## 1.4.16 TRACE DEBUG INTERFACE

**TABLE 1-20: TRACE DEBUG INTERFACE**

| Trace Debug Interface |             |              | (5 Pins) |
|-----------------------|-------------|--------------|----------|
| Pin Ref. Number       | Signal Name | Description  | Notes    |
| 25                    | TRACECLK    | Trace Clock  |          |
| 26                    | TRACEDATA0  | Trace Data 0 |          |
| 27                    | TRACEDATA1  | Trace Data 1 |          |
| 28                    | TRACEDATA2  | Trace Data 2 |          |
| 29                    | TRACEDATA3  | Trace Data 3 |          |

The [Trace Debug Interface](#) is enabled using the [TRACE\\_EN](#) bit in the [ETM TRACE Enable](#) register defined in [Chapter 35.0, "EC Subsystem Registers"](#).

**Note:** These pins are push-pull outputs when enabled as the [Trace Debug Interface](#) pin functions. This functionality is not configured through the associated [GPIO Pin Control Register](#); however the drive strength of these pins is configured through the associated [GPIO Pin Control Register 2](#).

## 1.4.17 UART PORT

**TABLE 1-21: UART PORT**

| UART Port       |             |                    | (2 Pins) |
|-----------------|-------------|--------------------|----------|
| Pin Ref. Number | Signal Name | Description        | Notes    |
| 86              | RXD         | UART Receive Data  |          |
| 87              | TXD         | UART Transmit Data |          |

## 1.5 Pin Multiplexing

Multifunction [Pin Multiplexing](#) in the MEC1322 is controlled by the GPIO Interface and illustrated in the [Multiplexing Tables](#) that follow. See [Section 1.6, "Notes for Tables in this Chapter," on page 39](#) for notes that are referenced in the [Pin Multiplexing](#) tables. See [Section 20.8.1, "Pin Control Register," on page 250](#) for [Pin Multiplexing](#) programming details. See also [Section 20.7, "Pin Multiplexing Control," on page 248](#).

Pin signal functions that exhibit power domain emulation (see [Multiplexing Tables](#) below) have a different power supply designation in the "Emulated Power Well" column and "Signal Power Well" columns of the [Multiplexing Tables](#) in [Section 1.5.2](#).

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## 1.5.1 VCC2 POWER DOMAIN EMULATION

The System Runtime Supply power VCC2 is not connected to the MEC1322. The VCC\_PWRGD signal is used to indicate when power is applied to the System Runtime Supply.

Pin signal functions with VCC2 power domain emulation are documented in the [Multiplexing Tables](#) as “Signal Power Well”= VCC1 and “Emulated Power Well” = VCC2. These pins are powered by VCC1 and controlled by the VCC\_PWRGD signal input. Outputs on VCC2 power domain emulation pin signal functions are tri-stated when VCC\_PWRGD is not asserted and are functional when VCC\_PWRGD is active. Inputs on VCC2 power domain emulation pin signal functions are gated according as defined by the [Gated State](#) column in the following tables.

Power well emulation for GPIOs and for signals that are multiplexed with GPIO signals is controlled by the [Power Gating Signals](#) field in the GPIO Pin Control Register.

## 1.5.2 MULTIPLEXING TABLES

In the following tables, the columns have the following meanings:

### MUX

If the pin has an associated GPIO, then the MUX column refers to the [Mux Control](#) field in the GPIO [Pin Control Register](#). Setting the Mux Control field to value listed in the row will configure the pin for the signal listed in the Signal column on the same row. The row marked “Default” is the setting that is assigned on system reset.

If there is no GPIO associated with a pin, then the pin has a single function.

### Signal

This column lists the signals that can appear on each pin, as configured by the MUX control.

### Buffer Type

Pin buffer types are defined in [Table 37-4, “DC Electrical Characteristics,” on page 391](#).

Note that all GPIO pins are of buffer type PIO, which may be configured as input/output, push-pull/OD etc. via the GPIO [Pin Control Register](#) and [Pin Control Register 2](#). There are some pins where the buffer type is configured by the alternate function selection, in which case that buffer type is shown in this column.

### Default Operation

This column gives the pin behavior following the power-up of VCC1. All GPIO pins are programmable after this event. This default pin behavior corresponds to the row marked “Default” in the MUX column.

**Note:** An internal pull-up resistor is indicated by (PU) and an internal pull-down is indicated by (PD). These are configured via the GPIO [Pin Control Register](#).

### Signal Power Well

This column defines the power well that powers the pin.

### Emulated Power Well

[Power well emulation for GPIOs and for signals that are multiplexed with GPIO signals is controlled by the Power Gating Signals field in the GPIO Pin Control Register.](#)

Power well emulation for signals that are not multiplexed with GPIO signals is defined by the entries in this column.

See [Section 1.5.1, “VCC2 Power Domain Emulation”](#).

**Note:** The [Glitch Protected POR Drive Low Pins](#) are configured as “always on”, as indicated by “ON” in this column.

### Gated State

This column defines the internal value of an input signal when either its emulated power well is inactive or it is not selected by the GPIO alternate function MUX. A value of “No Gate” means that the internal signal always follows the pin even when the emulated power well is inactive.

**Note:** Gated state is only meaningful to the operation of input signals. A gated state on an output pin defines the internal behavior of the GPIO MUX and does not imply pin behavior.

**TABLE 1-22: MULTIPLEXING TABLE (1 OF 18)**

| Pin Ref. Number | MUX        | Signal   | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes   |
|-----------------|------------|----------|-------------|-------------------|-------------------|---------------------|-------------|---------|
| 1               | Default: 0 | GPIO036  | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 1               | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 1               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 1               | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 2               | Default: 0 | GPIO153  | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 10 |
| 2               | 1          | PVT_SCLK | PIO         |                   | VCC1              | VCC1                |             | Note 10 |
| 2               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 2               | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 3               | Default: 0 | GPIO122  | PIO         | I (PD)            | VCC1              | VCC1                | No Gate     | Note 10 |
| 3               | 1          | SHD_SCLK | PIO         |                   | VCC1              | VCC1                |             | Note 10 |
| 3               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 3               | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 4               | Default: 0 | GPIO011  | PIO         | IOD (PD)          | VCC1              | VCC1                | No Gate     |         |
| 4               | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 4               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 4               | 3          | KSO16    | PIO         |                   | VCC1              | VCC1                |             |         |
| 5               | 0          | GPIO006  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 5               | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 5               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 5               | Default: 3 | KSO13    | PIO         | 0-4mA             | VCC1              | VCC1                |             |         |
| 6               | 0          | GPIO005  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 6               | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 6               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 6               | Default: 3 | KSO12    | PIO         | 0-4mA (PD)        | VCC1              | VCC1                |             |         |
| 7               | 0          | GPIO107  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 7               | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 7               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 7               | Default: 3 | KSO11    | PIO         | 0-4mA             | VCC1              | VCC1                |             |         |
| 8               | 0          | GPIO004  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 8               | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 8               | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 8               | Default: 3 | KSO10    | PIO         | 0-4mA             | VCC1              | VCC1                |             |         |

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TABLE 1-23: MULTIPLEXING TABLE (2 OF 18)

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes  |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|--------|
| 9               | 0          | GPIO106   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 9               | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 9               | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 9               | Default: 3 | KSO09     | PIO         | 0-4mA             | VCC1              | VCC1                |             |        |
| 10              | 0          | GPIO003   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 10              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 10              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 10              | Default: 3 | KSO08     | PIO         | 0-4mA             | VCC1              | VCC1                |             |        |
| 11              |            | VSS       | PWR         |                   | PWR               | PWR                 |             |        |
| 11              |            |           |             |                   |                   |                     |             |        |
| 11              |            |           |             |                   |                   |                     |             |        |
| 11              |            |           |             |                   |                   |                     |             |        |
| 12              | 0          | GPIO002   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 12              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 12              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 12              | Default: 3 | KSO07     | PIO         | 0-4mA             | VCC1              | VCC1                |             |        |
| 13              | 0          | GPIO001   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 13              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 13              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 13              | Default: 3 | KSO06     | PIO         | 0-4mA             | VCC1              | VCC1                |             |        |
| 14              |            | VCC1      | PWR         |                   | PWR               | PWR                 |             |        |
| 14              |            |           |             |                   |                   |                     |             |        |
| 14              |            |           |             |                   |                   |                     |             |        |
| 14              |            |           |             |                   |                   |                     |             |        |
| 15              |            | CAP       | PWR         |                   | PWR               | PWR                 |             | Note 3 |
| 15              |            |           |             |                   |                   |                     |             |        |
| 15              |            |           |             |                   |                   |                     |             |        |
| 15              |            |           |             |                   |                   |                     |             |        |
| 16              | 0          | GPIO104   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 16              | 1          | T_FDP_CLK | PIO         |                   | VCC1              | VCC1                |             |        |
| 16              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 16              | Default: 3 | KSO05     | PIO         | 0-4mA             | VCC1              | VCC1                |             |        |

**TABLE 1-24: MULTIPLEXING TABLE (3 OF 18)**

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes   |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|---------|
| 17              | 0          | GPIO103   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 17              | 1          | TFDP_DATA | PIO         |                   | VCC1              | VCC1                |             |         |
| 17              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 17              | Default: 3 | KSO04     | PIO         | O-4mA             | VCC1              | VCC1                |             |         |
| 18              | 0          | GPIO102   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 18              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 18              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 18              | Default: 3 | KSO03     | PIO         | O-4mA             | VCC1              | VCC1                |             |         |
| 19              | 0          | GPIO101   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 19              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 19              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 19              | Default: 3 | KSO02     | PIO         | O-4mA             | VCC1              | VCC1                |             |         |
| 20              | 0          | GPIO100   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 20              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 20              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 20              | Default: 3 | KSO01     | PIO         | O-4mA             | VCC1              | VCC1                |             |         |
| 21              | 0          | GPIO000   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 21              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 21              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 21              | Default: 3 | KSO00     | PIO         | O-4mA             | VCC1              | VCC1                |             |         |
| 22              | 0          | GPIO043   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 22              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 22              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 22              | Default: 3 | KSI7      | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 23              | 0          | GPIO042   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 23              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 23              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 23              | Default: 3 | KSI6      | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 24              | 0          | GPIO040   | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 24              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 24              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |         |
| 24              | Default: 3 | KSI5      | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |

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TABLE 1-25: MULTIPLEXING TABLE (4 OF 18)

| Pin Ref. Number | MUX        | Signal   | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes   |
|-----------------|------------|----------|-------------|-------------------|-------------------|---------------------|-------------|---------|
| 25              | 0          | GPIO142  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 25              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 25              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 25              | Default: 3 | KSI4     | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 26              | 0          | GPIO032  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 26              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 26              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 26              | Default: 3 | KSI3     | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 27              | 0          | GPIO144  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 27              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 27              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 27              | Default: 3 | KSI2     | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 28              | 0          | GPIO126  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 28              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 28              | Default: 2 | KSI1     | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 28              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 29              | 0          | GPIO125  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 29              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 29              | Default: 2 | KSI0     | PIO         | I                 | VCC1              | VCC1                | Low         | Note 11 |
| 29              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 30              | Default: 0 | GPIO031  | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 30              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 30              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 30              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 31              | Default: 0 | GPIO127  | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 31              | 1          | PECL_RDY | PIO         |                   | VCC1              | VCC1                | High        |         |
| 31              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 31              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 32              | 0          | GPIO052  | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 32              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |
| 32              | Default: 2 | PS2_DAT2 | PIO         | IOD-12mA          | VCC1              | VCC1                | Low         |         |
| 32              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |         |



**TABLE 1-26: MULTIPLEXING TABLE (5 OF 18)**

| Pin Ref. Number | MUX        | Signal   | Buffer Type     | Default Operation     | Signal Power Well | Emulated Power Well | Gated State | Notes  |
|-----------------|------------|----------|-----------------|-----------------------|-------------------|---------------------|-------------|--------|
| 33              | Default: 0 | GPIO147  | PIO             | I (PU)                | VCC1              | VCC1                | No Gate     |        |
| 33              | 1          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 33              | 2          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 33              | 3          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 34              | Default: 0 | GPIO151  | PIO             | I (PU)                | VCC1              | VCC1                | No Gate     |        |
| 34              | 1          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 34              | 2          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 34              | 3          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 35              | 0          | GPIO051  | PIO             |                       | VCC1              | VCC1                | No Gate     |        |
| 35              | 1          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 35              | Default: 2 | PS2_CLK2 | PIO             | I <sub>OD</sub> -12mA | VCC1              | VCC1                | Low         |        |
| 35              | 3          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 36              |            | VSS      | PWR             |                       | PWR               | PWR                 |             |        |
| 36              |            |          |                 |                       |                   |                     |             |        |
| 36              |            |          |                 |                       |                   |                     |             |        |
| 36              |            |          |                 |                       |                   |                     |             |        |
| 37              |            | VCC1     | PWR             |                       | PWR               | PWR                 |             |        |
| 37              |            |          |                 |                       |                   |                     |             |        |
| 37              |            |          |                 |                       |                   |                     |             |        |
| 37              |            |          |                 |                       |                   |                     |             |        |
| 38              | 0          | GPIO062  | PIO             |                       | VCC1              | VCC1                | No Gate     |        |
| 38              | Default: 1 | ADC4     | I <sub>AN</sub> | I <sub>AN</sub>       | AVCC1_ADC         | AVCC1_ADC           | Low         | Note 8 |
| 38              | 2          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 38              | 3          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 39              | 0          | GPIO061  | PIO             |                       | VCC1              | VCC1                | No Gate     |        |
| 39              | Default: 1 | ADC3     | I <sub>AN</sub> | I <sub>AN</sub>       | AVCC1_ADC         | AVCC1_ADC           | Low         | Note 8 |
| 39              | 2          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 39              | 3          | Reserved | Reserved        |                       | Reserved          | Reserved            |             |        |
| 40              |            | AVCC     | PWR             |                       | PWR               | PWR                 |             |        |
| 40              |            |          |                 |                       |                   |                     |             |        |
| 40              |            |          |                 |                       |                   |                     |             |        |
| 40              |            |          |                 |                       |                   |                     |             |        |

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TABLE 1-27: MULTIPLEXING TABLE (6 OF 18)

| Pin Ref. Number | MUX        | Signal   | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes  |
|-----------------|------------|----------|-------------|-------------------|-------------------|---------------------|-------------|--------|
| 41              | Default: 0 | GPIO206  | PIO         | I                 | VCC1              | VCC1                | No Gate     |        |
| 41              | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 41              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 41              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 42              | 0          | GPIO060  | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 42              | Default: 1 | ADC2     | I_AN        | I_AN (PU)         | AVCC1_ADC         | AVCC1_ADC           | Low         | Note 8 |
| 42              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 42              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 43              | 0          | GPIO057  | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 43              | Default: 1 | ADC1     | I_AN        | I_AN              | AVCC1_ADC         | AVCC1_ADC           | Low         | Note 8 |
| 43              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 43              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 44              | 0          | GPIO056  | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 44              | 1          | ADC0     | I_AN        |                   | AVCC1_ADC         | AVCC1_ADC           | Low         | Note 8 |
| 44              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 44              | Default: 3 | ADC0     | I_AN        | I_AN              | AVCC1_ADC         | AVCC1_ADC           | Low         | Note 8 |
| 45              |            | AVSS     | PWR         |                   | PWR               | PWR                 |             |        |
| 45              |            |          |             |                   |                   |                     |             |        |
| 45              |            |          |             |                   |                   |                     |             |        |
| 45              |            |          |             |                   |                   |                     |             |        |
| 46              | 0          | GPIO112  | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 46              | Default: 1 | LAD0     | PCI_IO      | PCI_IO            | VCC1              | VCC1                | High        | Note 1 |
| 46              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 46              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 47              |            | VSS      | PWR         |                   | PWR               | PWR                 |             |        |
| 47              |            |          |             |                   |                   |                     |             |        |
| 47              |            |          |             |                   |                   |                     |             |        |
| 47              |            |          |             |                   |                   |                     |             |        |
| 48              | 0          | GPIO114  | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 48              | Default: 1 | LAD1     | PCI_IO      | PCI_IO            | VCC1              | VCC1                | High        | Note 1 |
| 48              | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |
| 48              | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |        |

**TABLE 1-28: MULTIPLEXING TABLE (7 OF 18)**

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes  |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|--------|
| 49              | Default: 0 | JTAG_RST# | I           | I                 | VCC1              | VCC1                | No Gate     | Note 2 |
| 49              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 49              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 49              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 50              | 0          | GPIO113   | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 50              | Default: 1 | LAD2      | PCI_IO      | PCI_IO            | VCC1              | VCC1                | High        | Note 1 |
| 50              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 50              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 51              | 0          | GPIO111   | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 51              | Default: 1 | LAD3      | PCI_IO      | PCI_IO            | VCC1              | VCC1                | High        | Note 1 |
| 51              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 51              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 52              | 0          | GPIO120   | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 52              | Default: 1 | LFRAME#   | PCI_I       | PCI_I             | VCC1              | VCC1                | High        |        |
| 52              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 52              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 53              | 0          | GPIO116   | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 53              | Default: 1 | LRESET#   | PCI_I       | PCI_I             | VCC1              | VCC1                | Low         |        |
| 53              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 53              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 54              | 0          | GPIO117   | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 54              | Default: 1 | PCI_CLK   | PCI_CLK     | PCI_CLK           | VCC1              | VCC1                | Low         |        |
| 54              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 54              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 55              | 0          | GPIO014   | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |        |
| 55              | Default: 1 | CLKRUN#   | PCI_I       | PCI_I             | VCC1              | VCC1                | Low         |        |
| 55              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 55              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 56              |            | VSS       | PWR         |                   | PWR               | PWR                 |             |        |
| 56              |            |           |             |                   |                   |                     |             |        |
| 56              |            |           |             |                   |                   |                     |             |        |
| 56              |            |           |             |                   |                   |                     |             |        |

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TABLE 1-29: MULTIPLEXING TABLE (8 OF 18)

| Pin Ref. Number | MUX        | Signal     | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes   |
|-----------------|------------|------------|-------------|-------------------|-------------------|---------------------|-------------|---------|
| 57              | 0          | GPIO115    | PCI_PIO     |                   | VCC1              | VCC1                | No Gate     |         |
| 57              | Default: 1 | SER_IRQ    | PCI_I       | PCI_I             | VCC1              | VCC1                | High        | Note 1  |
| 57              | 2          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 57              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 58              |            | VCC1       | PWR         |                   | PWR               | PWR                 |             |         |
| 58              |            |            |             |                   |                   |                     |             |         |
| 58              |            |            |             |                   |                   |                     |             |         |
| 58              |            |            |             |                   |                   |                     |             |         |
| 59              | 0          | GPIO041    | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 59              | Default: 1 | Reserved   | PIO         | 0-8mA (PD) LOW    | VCC1              | ON                  |             | Note 12 |
| 59              | 2          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 59              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 60              | 0          | GPIO121    | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 60              | Default: 1 | nRESET_OUT | PIO         | 0-8mA             | VCC1              | ON                  |             | Note 6  |
| 60              | 2          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 60              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 61              | 0          | GPIO050    | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 61              | 1          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 61              | Default: 2 | PS2_CLK1   | PIO         | IOD-12mA          | VCC1              | VCC1                | Low         |         |
| 61              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 62              | 0          | GPIO065    | PIO         |                   | VCC1              | VCC1                | No Gate     |         |
| 62              | 1          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 62              | Default: 2 | PS2_DAT1   | PIO         | IOD-12mA          | VCC1              | VCC1                | Low         |         |
| 62              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 63              | Default: 0 | GPIO035    | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 63              | 1          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 63              | 2          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 63              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 64              | Default: 0 | GPIO027    | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 64              | 1          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 64              | 2          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |
| 64              | 3          | Reserved   | Reserved    |                   | Reserved          | Reserved            |             |         |

**TABLE 1-30: MULTIPLEXING TABLE (9 OF 18)**

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes  |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|--------|
| 65              | Default: 0 | GPIO033   | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |        |
| 65              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 65              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 65              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 66              | 0          | GPIO046   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 66              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 66              | Default: 2 | PS2_CLK0  | PIO         | IOD-12mA          | VCC1              | VCC1                | Low         |        |
| 66              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 67              | 0          | GPIO047   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 67              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 67              | Default: 2 | PS2_DAT0  | PIO         | IOD-12mA          | VCC1              | VCC1                | Low         |        |
| 67              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 68              |            | VBAT      | PWR         |                   | PWR               | PWR                 |             |        |
| 68              |            |           |             |                   |                   |                     |             |        |
| 68              |            |           |             |                   |                   |                     |             |        |
| 68              |            |           |             |                   |                   |                     |             |        |
| 69              | Default: 0 | XTAL2     | ICLK        |                   | VBAT              | VBAT                |             | Note 9 |
| 69              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 69              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 69              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 70              |            | VSS_VBAT  | PWR         |                   | PWR               | PWR                 |             |        |
| 70              |            |           |             |                   |                   |                     |             |        |
| 70              |            |           |             |                   |                   |                     |             |        |
| 70              |            |           |             |                   |                   |                     |             |        |
| 71              | Default: 0 | XTAL1     | OCLK        |                   | VBAT              | VBAT                |             | Note 9 |
| 71              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 71              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 71              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 72              | 0          | GPIO063   | PIO         |                   | VCC1              | VCC1                | No Gate     |        |
| 72              | Default: 1 | VCC_PWRGD | PIO         | I                 | VCC1              | VCC1                | High        |        |
| 72              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 72              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |

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TABLE 1-31: MULTIPLEXING TABLE (10 OF 18)

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|-------|
| 73              | Default: 0 | GPIO110   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 73              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 73              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 73              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 74              | Default: 0 | GPIO130   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 74              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 74              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 74              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 75              | 0          | GPIO013   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 75              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 75              | Default: 2 | 32KHZ_OUT | PIO         | O-4mA             | VCC1              | VCC1                |             |       |
| 75              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 76              | 0          | GPIO026   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 76              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 76              | Default: 2 | nEC_SCI   | PIO         | OD-12mA           | VCC1              | VCC1                |             |       |
| 76              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 77              | 0          | GPIO131   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 77              | Default: 1 | VCC1_RST# | PIO         | OD-4mA            | VCC1              | ON                  | High        |       |
| 77              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 77              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 78              | Default: 0 | GPIO141   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 78              | 1          | PWM3      | PIO         |                   | VCC1              | VCC1                |             |       |
| 78              | 2          | LED3      | PIO         |                   | VCC1              | VCC1                |             |       |
| 78              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 79              |            | VREF_PECI | VREF_PECI   |                   | VREF_PECI         | VREF_PECI           |             |       |
| 79              |            |           |             |                   |                   |                     |             |       |
| 79              |            |           |             |                   |                   |                     |             |       |
| 79              |            |           |             |                   |                   |                     |             |       |
| 80              | Default: 0 | GPIO132   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 80              | 1          | PECI_DAT  | PECI_IO     |                   | VREF_PECI         | VREF_PECI           | Low         |       |
| 80              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 80              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |

**TABLE 1-32: MULTIPLEXING TABLE (11 OF 18)**

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes  |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|--------|
| 81              | Default: 0 | GPIO007   | PIO         | I                 | VCC1              | VCC1                | No Gate     |        |
| 81              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 81              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 81              | 3          | KSO14     | PIO         |                   | VCC1              | VCC1                |             |        |
| 82              |            | VSS       | PWR         |                   | PWR               | PWR                 |             |        |
| 82              |            |           |             |                   |                   |                     |             |        |
| 82              |            |           |             |                   |                   |                     |             |        |
| 82              |            |           |             |                   |                   |                     |             |        |
| 83              | Default: 0 | GPIO010   | PIO         | I                 | VCC1              | VCC1                | No Gate     |        |
| 83              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 83              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 83              | 3          | KSO15     | PIO         |                   | VCC1              | VCC1                |             |        |
| 84              |            | VCC1      | PWR         |                   | PWR               | PWR                 |             |        |
| 84              |            |           |             |                   |                   |                     |             |        |
| 84              |            |           |             |                   |                   |                     |             |        |
| 84              |            |           |             |                   |                   |                     |             |        |
| 85              | Default: 0 | GPIO143   | PIO         | I                 | VCC1              | ON                  | No Gate     |        |
| 85              | 1          | RSMRST#   | PIO         |                   | VCC1              | VCC1                |             | Note 6 |
| 85              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 85              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 86              | Default: 0 | GPIO162   | PIO         | I                 | VCC1              | VCC1                | No Gate     |        |
| 86              | 1          | RXD       | PIO         |                   | VCC1              | VCC1                | High        |        |
| 86              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 86              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 87              | Default: 0 | GPIO165   | PIO         | I                 | VCC1              | VCC1                | No Gate     |        |
| 87              | 1          | TXD       | PIO         |                   | VCC1              | VCC1                | High        |        |
| 87              | 2          | SHD_CS1#  | PIO         |                   | VCC1              | VCC1                | High        |        |
| 87              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 88              | Default: 0 | GPIO023   | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 5 |
| 88              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |
| 88              | 2          | I2C1_DAT0 | PIO         |                   | VCC1              | VCC1                | High        |        |
| 88              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |        |

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TABLE 1-33: MULTIPLEXING TABLE (12 OF 18)

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes              |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|--------------------|
| 89              | Default: 0 | GPIO022   | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 5             |
| 89              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 89              | 2          | I2C1_CLK0 | PIO         |                   | VCC1              | VCC1                | High        |                    |
| 89              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 90              | Default: 0 | GPIO021   | PIO         | I                 | VCC1              | VCC1                | No Gate     |                    |
| 90              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 90              | 2          | I2C2_DAT0 | PIO         |                   | VCC1              | VCC1                | High        |                    |
| 90              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 91              | Default: 0 | GPIO020   | PIO         | I                 | VCC1              | VCC1                | No Gate     |                    |
| 91              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 91              | 2          | I2C2_CLK0 | PIO         |                   | VCC1              | VCC1                | High        |                    |
| 91              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 92              | Default: 0 | GPIO105   | PIO         | I                 | VCC1              | VCC1                | No Gate     |                    |
| 92              | 1          | TACH1     | PIO         |                   | VCC1              | VCC1                | Low         |                    |
| 92              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 92              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 93              | Default: 0 | GPIO145   | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |                    |
| 93              | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 93              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 93              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 94              | Default: 0 | GPIO164   | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 10            |
| 94              | 1          | PVT_MISO  | PIO         |                   | VCC1              | VCC1                | Low         | Note 10            |
| 94              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 94              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 95              | Default: 0 | GPIO124   | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 10            |
| 95              | 1          | SHD_MISO  | PIO         |                   | VCC1              | VCC1                | Low         | Note 10            |
| 95              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 95              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 96              | Default: 0 | GPIO146   | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 4,<br>Note 10 |
| 96              | 1          | PVT_CS0#  | PIO         |                   | VCC1              | VCC1                | High        | Note 10            |
| 96              | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |
| 96              | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |                    |



**TABLE 1-34: MULTIPLEXING TABLE (13 OF 18)**

| Pin Ref. Number | MUX        | Signal      | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes   |
|-----------------|------------|-------------|-------------|-------------------|-------------------|---------------------|-------------|---------|
| 97              | Default: 0 | GPIO150     | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 10 |
| 97              | 1          | SHD_CS0#    | PIO         |                   | VCC1              | VCC1                | High        | Note 10 |
| 97              | 2          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 97              | 3          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 98              | Default: 0 | GPIO157     | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 98              | 1          | BC_CLK      | PIO         |                   | VCC1              | VCC1                |             |         |
| 98              | 2          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 98              | 3          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 99              | Default: 0 | GPIO160     | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 99              | 1          | BC_DAT      | PIO         |                   | VCC1              | VCC1                | Low         | Note 7  |
| 99              | 2          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 99              | 3          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 100             | Default: 0 | GPIO161     | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 100             | 1          | BC_INT#     | PIO         |                   | VCC1              | VCC1                | High        |         |
| 100             | 2          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 100             | 3          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 101             | Default: 0 | GPIO140     | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 101             | 1          | TACH2       | PIO         |                   | VCC1              | VCC1                | Low         |         |
| 101             | 2          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 101             | 3          | TACH2PWM_IN | PIO         |                   | VCC1              | VCC1                | Low         |         |
| 102             | Default: 0 | GPIO045     | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 102             | 1          | A20M        | PIO         |                   | VCC1              | VCC1                |             |         |
| 102             | 2          | PVT_CS1#    | PIO         |                   | VCC1              | VCC1                | High        |         |
| 102             | 3          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 103             | Default: 0 | GPIO053     | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 103             | 1          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 103             | 2          | PS2_CLK3    | PIO         |                   | VCC1              | VCC1                | Low         |         |
| 103             | 3          | Reserved    | Reserved    |                   | Reserved          | Reserved            |             |         |
| 104             |            | VSS         | PWR         |                   | PWR               | PWR                 |             |         |
| 104             |            |             |             |                   |                   |                     |             |         |
| 104             |            |             |             |                   |                   |                     |             |         |
| 104             |            |             |             |                   |                   |                     |             |         |

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TABLE 1-35: MULTIPLEXING TABLE (14 OF 18)

| Pin Ref. Number | MUX        | Signal    | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes |
|-----------------|------------|-----------|-------------|-------------------|-------------------|---------------------|-------------|-------|
| 105             | Default: 0 | GPIO152   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 105             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 105             | 2          | PS2_DAT3  | PIO         |                   | VCC1              | VCC1                | Low         |       |
| 105             | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 106             |            | VCC1      | PWR         |                   | PWR               | PWR                 |             |       |
| 106             |            |           |             |                   |                   |                     |             |       |
| 106             |            |           |             |                   |                   |                     |             |       |
| 106             |            |           |             |                   |                   |                     |             |       |
| 107             | Default: 0 | GPIO030   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 107             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 107             | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 107             | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 108             | Default: 0 | GPIO012   | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 108             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 108             | 2          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 108             | 3          | KSO17     | PIO         |                   | VCC1              | VCC1                |             |       |
| 109             | 0          | GPIO017   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 109             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 109             | Default: 2 | I2C0_DAT1 | PIO         | IOD-4mA           | VCC1              | VCC1                | High        |       |
| 109             | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 110             | 0          | GPIO134   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 110             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 110             | Default: 2 | I2C0_CLK1 | PIO         | IOD-4mA           | VCC1              | VCC1                | High        |       |
| 110             | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 111             | 0          | GPIO016   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 111             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 111             | Default: 2 | I2C0_DAT0 | PIO         | IOD-4mA           | VCC1              | VCC1                | High        |       |
| 111             | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 112             | 0          | GPIO015   | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 112             | 1          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |
| 112             | Default: 2 | I2C0_CLK0 | PIO         | IOD-4mA           | VCC1              | VCC1                | High        |       |
| 112             | 3          | Reserved  | Reserved    |                   | Reserved          | Reserved            |             |       |

**TABLE 1-36: MULTIPLEXING TABLE (15 OF 18)**

| Pin Ref. Number | MUX        | Signal   | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes |
|-----------------|------------|----------|-------------|-------------------|-------------------|---------------------|-------------|-------|
| 113             | 0          | GPIO154  | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 113             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 113             | Default: 2 | LED0     | PIO         | OD-12mA           | VCC1              | VCC1                |             |       |
| 113             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 114             | 0          | GPIO155  | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 114             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 114             | Default: 2 | LED1     | PIO         | OD-12mA           | VCC1              | VCC1                |             |       |
| 114             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 115             | 0          | GPIO156  | PIO         |                   | VCC1              | VCC1                | No Gate     |       |
| 115             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 115             | Default: 2 | LED2     | PIO         | OD-12mA           | VCC1              | VCC1                |             |       |
| 115             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 116             | Default: 0 | GPIO163  | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 116             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 116             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 116             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 117             |            | VSS      | PWR         |                   | PWR               | PWR                 |             |       |
| 117             |            |          |             |                   |                   |                     |             |       |
| 117             |            |          |             |                   |                   |                     |             |       |
| 117             |            |          |             |                   |                   |                     |             |       |
| 118             | Default: 0 | GPIO136  | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 118             | 1          | PWM1     | PIO         |                   | VCC1              | VCC1                |             |       |
| 118             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 118             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 119             |            | VCC1     | PWR         |                   | PWR               | PWR                 |             |       |
| 119             |            |          |             |                   |                   |                     |             |       |
| 119             |            |          |             |                   |                   |                     |             |       |
| 119             |            |          |             |                   |                   |                     |             |       |
| 120             | Default: 0 | GPIO133  | PIO         | I                 | VCC1              | VCC1                | No Gate     |       |
| 120             | 1          | PWM0     | PIO         |                   | VCC1              | VCC1                |             |       |
| 120             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 120             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |

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TABLE 1-37: MULTIPLEXING TABLE (16 OF 18)

| Pin Ref. Number | MUX        | Signal       | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes   |
|-----------------|------------|--------------|-------------|-------------------|-------------------|---------------------|-------------|---------|
| 121             | Default: 0 | GPIO034      | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 121             | 1          | PWM2         | PIO         |                   | VCC1              | VCC1                |             |         |
| 121             | 2          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 121             | 3          | TACH2PWM_OUT | PIO         |                   | VCC1              | VCC1                |             |         |
| 122             | Default: 0 | GPIO135      | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 122             | 1          | KBRST        | PIO         |                   | VCC1              | VCC1                |             |         |
| 122             | 2          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 122             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 123             | Default: 0 | GPIO044      | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 123             | 1          | nSMI         | PIO         |                   | VCC1              | VCC1                |             |         |
| 123             | 2          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 123             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 124             | Default: 0 | GPIO066      | PIO         | I                 | VCC1              | VCC1                | No Gate     |         |
| 124             | 1          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 124             | 2          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 124             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 125             | Default: 0 | GPIO025      | PIO         | I                 | VCC1              | ON                  | No Gate     |         |
| 125             | 1          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 125             | 2          | I2C3_DAT0    | PIO         |                   | VCC1              | VCC1                | High        |         |
| 125             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 126             | Default: 0 | GPIO024      | PIO         | I (PU)            | VCC1              | VCC1                | No Gate     |         |
| 126             | 1          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 126             | 2          | I2C3_CLK0    | PIO         |                   | VCC1              | VCC1                | High        |         |
| 126             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 127             | Default: 0 | GPIO054      | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 10 |
| 127             | 1          | PVT_MOSI     | PIO         |                   | VCC1              | VCC1                |             | Note 10 |
| 127             | 2          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 127             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 128             | Default: 0 | GPIO064      | PIO         | I                 | VCC1              | VCC1                | No Gate     | Note 10 |
| 128             | 1          | SHD_MOSI     | PIO         |                   | VCC1              | VCC1                |             | Note 10 |
| 128             | 2          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |
| 128             | 3          | Reserved     | Reserved    |                   | Reserved          | Reserved            |             |         |

**TABLE 1-38: MULTIPLEXING TABLE (17 OF 18)**

| Pin Ref. Number | MUX        | Signal   | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes |
|-----------------|------------|----------|-------------|-------------------|-------------------|---------------------|-------------|-------|
| 129             | Default: 0 | GPIO067  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 129             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 129             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 129             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 130             | Default: 0 | GPIO055  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 130             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 130             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 130             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 131             | Default: 0 | GPIO210  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 131             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 131             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 131             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 132             | Default: 0 | GPIO211  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 132             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 132             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 132             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 133             | Default: 0 | GPIO200  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 133             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 133             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 133             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 134             | Default: 0 | GPIO123  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 134             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 134             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 134             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 135             |            | VCC1     | PWR         |                   | PWR               | PWR                 |             |       |
| 135             |            |          |             |                   |                   |                     |             |       |
| 135             |            |          |             |                   |                   |                     |             |       |
| 135             |            |          |             |                   |                   |                     |             |       |
| 136             | Default: 0 | GPIO202  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 136             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 136             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 136             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |

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TABLE 1-39: MULTIPLEXING TABLE (18 OF 18)

| Pin Ref. Number | MUX        | Signal   | Buffer Type | Default Operation | Signal Power Well | Emulated Power Well | Gated State | Notes |
|-----------------|------------|----------|-------------|-------------------|-------------------|---------------------|-------------|-------|
| 137             | Default: 0 | GPIO201  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 137             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 137             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 137             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 138             |            | VSS      | PWR         |                   | PWR               | PWR                 |             |       |
| 138             |            |          |             |                   |                   |                     |             |       |
| 138             |            |          |             |                   |                   |                     |             |       |
| 138             |            |          |             |                   |                   |                     |             |       |
| 139             | Default: 0 | GPIO203  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 139             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 139             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 139             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 140             |            | VSS      | PWR         |                   | PWR               | PWR                 |             |       |
| 140             |            |          |             |                   |                   |                     |             |       |
| 140             |            |          |             |                   |                   |                     |             |       |
| 140             |            |          |             |                   |                   |                     |             |       |
| 141             | Default: 0 | GPIO204  | PIO         | I (PD)            | VCC1              | ON                  | No Gate     |       |
| 141             | 1          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 141             | 2          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 141             | 3          | Reserved | Reserved    |                   | Reserved          | Reserved            |             |       |
| 142             |            | NC       |             |                   |                   |                     |             |       |
| 142             |            |          |             |                   |                   |                     |             |       |
| 142             |            |          |             |                   |                   |                     |             |       |
| 142             |            |          |             |                   |                   |                     |             |       |
| 143             |            | VSS      | PWR         |                   | PWR               | PWR                 |             |       |
| 143             |            |          |             |                   |                   |                     |             |       |
| 143             |            |          |             |                   |                   |                     |             |       |
| 143             |            |          |             |                   |                   |                     |             |       |
| 144             |            | VSS      | PWR         |                   | PWR               | PWR                 |             |       |
| 144             |            |          |             |                   |                   |                     |             |       |
| 144             |            |          |             |                   |                   |                     |             |       |
| 144             |            |          |             |                   |                   |                     |             |       |

## 1.6 Notes for Tables in this Chapter

|                |   |
|----------------|---|
| <b>Note 1</b>  | The LAD and SER_IRQ pins require an external weak pull-up resistor of 10k-100k ohms.  |
| <b>Note 2</b>  | When the JTAG_RST# pin is not asserted (logic '1'), the JTAG_TDI, JTAG_TDO, JTAG_TCK, JTAG_TMS signal functions in the JTAG interface are unconditionally routed to the interface; the Pin Control register for these pins has no effect. When the JTAG_RST# pin is asserted (logic '0'), the JTAG_TDI, JTAG_TDO, JTAG_TCK, JTAG_TMS signal functions in the JTAG interface are not routed to the interface and the Pin Control Register for these pins controls the muxing. The pin control registers can not be used to route the JTAG interface to the pins. The System Board Designer should terminate this pin in all functional states using jumpers and pull-up or pull down resistors, etc. |
| <b>Note 3</b>  | An external cap must be connected as close to the CAP pin/ball as possible with a routing resistance and CAP ESR of less than 100mohms. The capacitor value is 1uF and must be ceramic with X5R or X7R dielectric. The cap pin/ball should remain on the top layer of the PCB and traced to the CAP. Avoid adding vias to other layers to minimize inductance.  |
| <b>Note 4</b>  | A pull-down is required on the GPIO146/PVT_CS0# pin if there is no private SPI flash device on the board.   |
| <b>Note 5</b>  | This I2C port supports 1Mbps (pin 88, GPIO023/I2C1_DAT0 and pin 89, GPIO022/I2C1_CLK0). For 1Mbps I2C recommended capacitance/pull-up relationships from Intel, refer to the Shark Bay platform guide, Intel ref number 486714. Refer to the PCH - SMBus 2.0/SMLink Interface Design Guidelines, Table 20-5 Bus Capacitance/Pull-Up Resistor Relationship.  |
| <b>Note 6</b>  | The following glitch protected pins require a pull-down on the board: pin 60, nRESET_OUT/GPIO121 and pin 85, GPIO143/RSMRST#. The nRESET_OUT pin will drive low when VCC1 comes on and stays low until the iRESET_OUT bit is cleared after VCC PWRGD asserts. The RSMRST# pin also drives low (as a GPIO push-pull output) following a VCC1 power-on until firmware deasserts it by writing the GPIO data bit to '1'. The GPIO143/RSMRST# pin operates in this manner as a GPIO; the RSMRST# function is not a true alternate function and the GPIO143 control register must not be changed from the GPIO default function.   |
| <b>Note 7</b>  | The BC DAT pin requires a weak pull up resistor (100 K Ohms).   |
| <b>Note 8</b>  | The voltage on the ADC pins must not exceed 3.6 V or damage to the device will occur.   |
| <b>Note 9</b>  | The XTAL1 pin should be left floating when using the XTAL2 pin for the single ended clock input.  |
| <b>Note 10</b> | MEC1322: The SPI pins are configured to their SPI function by ROM boot code as follows. Shared SPI pins are configured to the following SPI functions: SHD_CLK, SHD_MOSI, SHD_MISO and SHD_CS0#. If the PVT_CS0# pin (pin 96) is sampled high, then the private SPI pins are configured to the following SPI functions after a successful load from flash: PVT_CLK, PVT_MOSI, PVT_MISO and PVT_CS0#; otherwise these pins are left as the GPIO function. It is recommended that user code reconfigures the shared SPI pins to the GPIO input function before releasing RSMRST#.   |
| <b>Note 11</b> | The KSI[7:0] pins have the internal pull-up enabled by ROM boot code. Therefore the Buffer Type on these pins is I (PU) after the ROM boot code runs.   |
| <b>Note 12</b> | The GPIO041 pin defaults to output low. This pin must be reprogrammed to the GPIO function upon power-up.   |

## 1.7 Pin States After VCC1 Power-On

Pins that default to IOD or OD in the [Multiplexing Tables](#) are open drain and come up tri-stated after VCC1 power-on. Pins that default to I are inputs and also come up tri-stated (high-z).

[Table 1-40](#) shows pins that have specific states after VCC1 power-on.

**TABLE 1-40: PIN STATES AFTER VCC1 POWER-ON**

| Pin Reference Number | Pin Name                     | Pin State after VCC1 Power-on   |
|----------------------|------------------------------|---|
| 21                   | KSO00/GPIO000/JTAG_TCK       | Push-pull - High  |
| 20                   | KSO01/GPIO100/JTAG_TMS       | Push-pull - High  |
| 19                   | KSO02/GPIO101/JTAG_TDI       | Push-pull - High  |
| 18                   | KSO03/GPIO102/JTAG_TDO       | Push-pull - High  |
| 17                   | KSO04/GPIO103/TFDP_DATA/XNOR | Push-pull - High  |
| 16                   | KSO05/GPIO104/TFDP_CLK       | Push-pull - High  |
| 13                   | KSO06/GPIO001                | Push-pull - High  |
| 12                   | KSO07/GPIO002                | Push-pull - High  |
| 10                   | KSO08/GPIO003                | Push-pull - High  |
| 9                    | KSO09/GPIO106                | Push-pull - High  |
| 8                    | KSO10/GPIO004                | Push-pull - High  |
| 7                    | KSO11/GPIO107                | Push-pull - High  |
| 6                    | KSO12/GPIO005                | Push-pull - High  |
| 5                    | KSO13/GPIO006                | Push-pull - High  |
| 113                  | LED0/GPIO154                 | OD - low  |
| 114                  | LED1/GPIO155                 | OD - low  |
| 115                  | LED2/GPIO156                 | OD - low  |
| 66                   | PS2_CLK0/GPIO046             | IOD - low   |
| 61                   | PS2_CLK1/GPIO050             | IOD - low   |
| 35                   | PS2_CLK2/GPIO051             | IOD - low   |
| 60                   | nRESET_OUT/GPIO121           | Glitch Protected - driven low while VCC 1 is rising.<br>The pin becomes a push-pull output after VCC 1 is up and stable (requires a pull-down on the board) |
| 77                   | VCC1_RST#/GPIO131            | Glitch Protected - driven low while VCC 1 is rising.<br>The pin becomes OD after VCC 1 is up and stable (requires a pull-up on the board)                   |
| 85                   | GPIO143/RSMRST#              | Glitch Protected - driven low while VCC 1 is rising.<br>The pin becomes a push-pull output after VCC 1 is up and stable (requires a pull-down on the board) |
| 125                  | GPIO025/I2C3_DAT0            | Glitch Protected - driven low while VCC 1 is rising.<br>The pin becomes an input (i.e., tri-stated OD type) after VCC 1 is up and stable.                   |



## 1.8 Package Outline

FIGURE 1-2: 128-PIN VTQFP PACKAGE OUTLINE

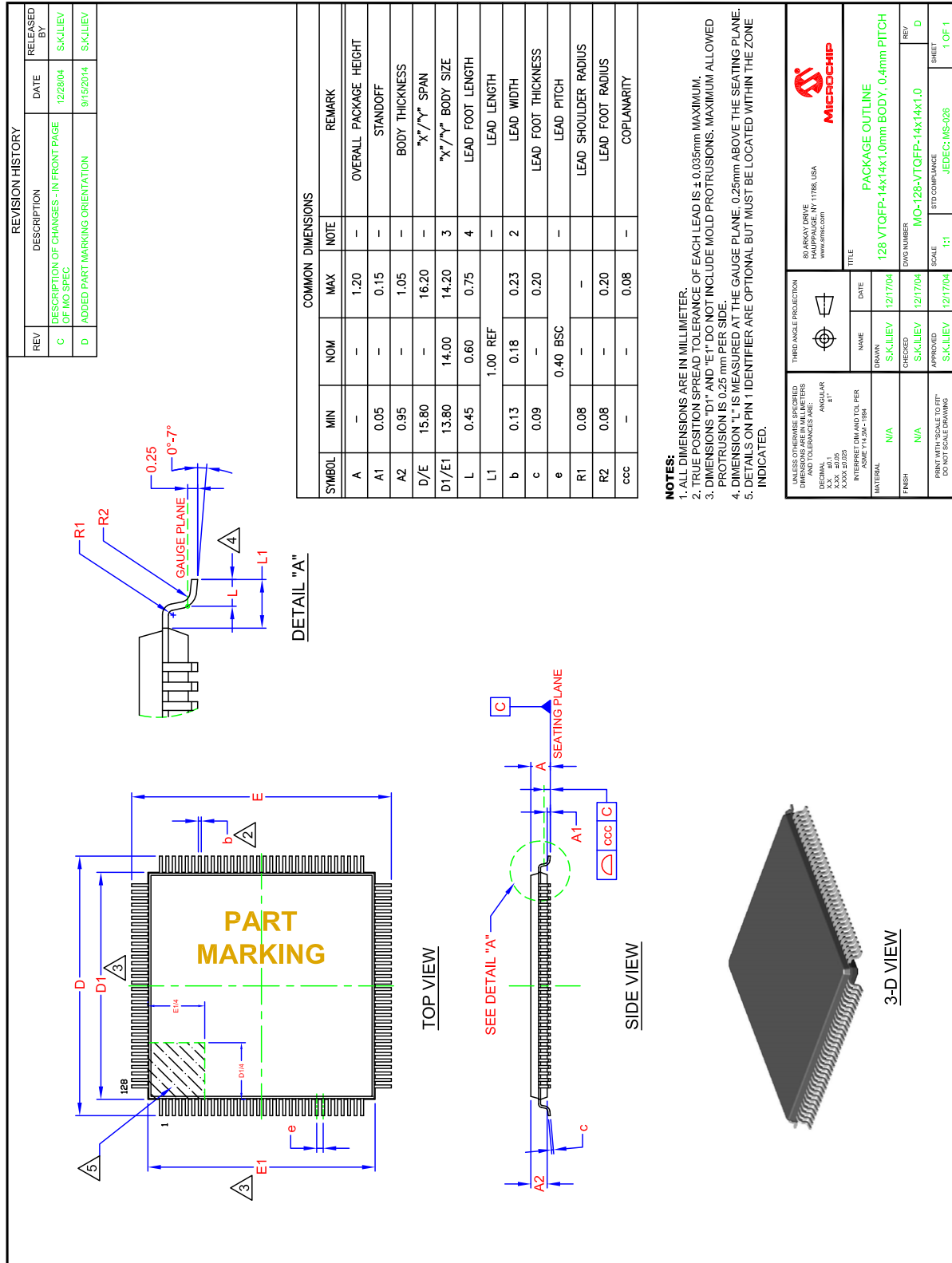
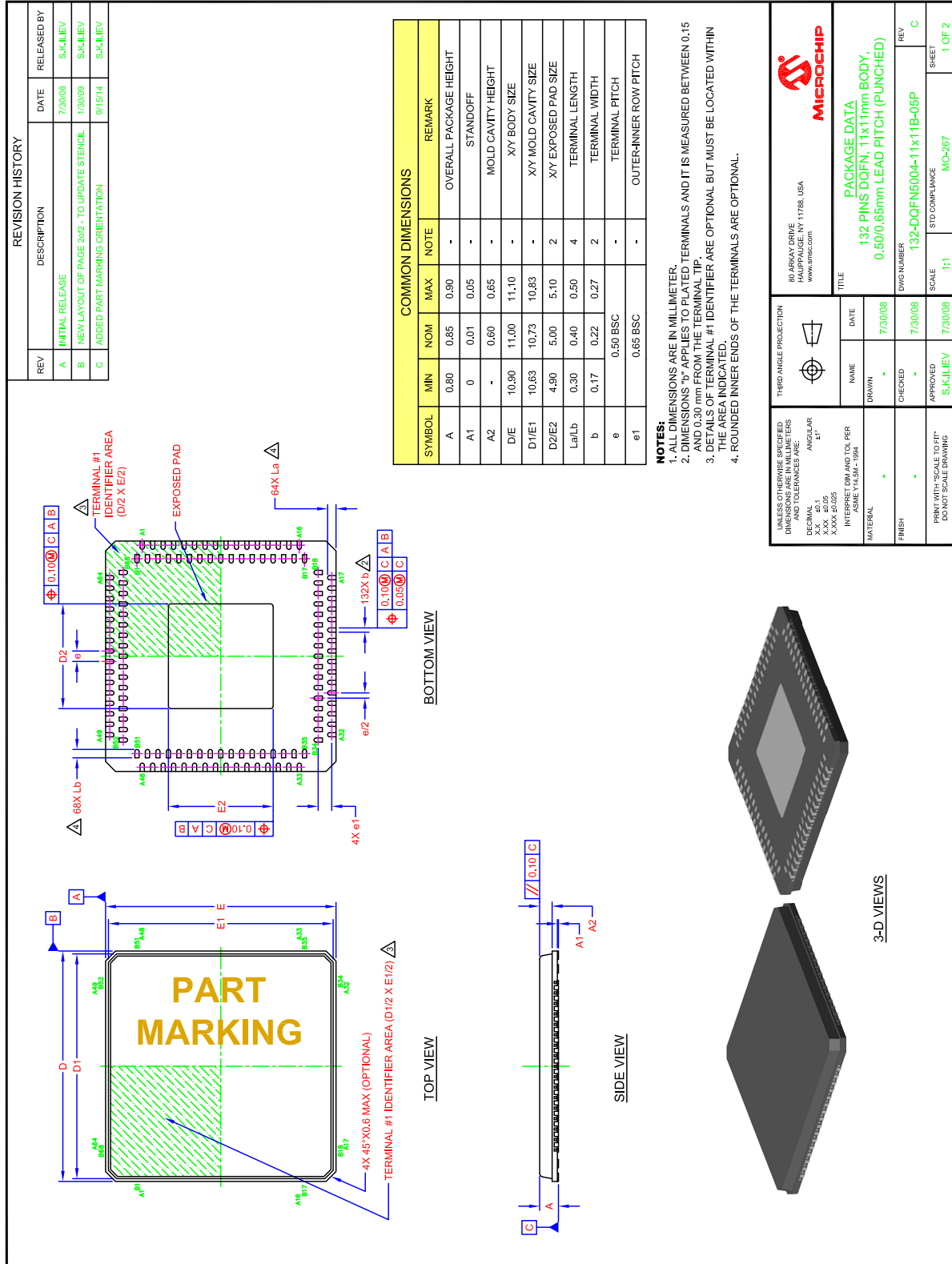
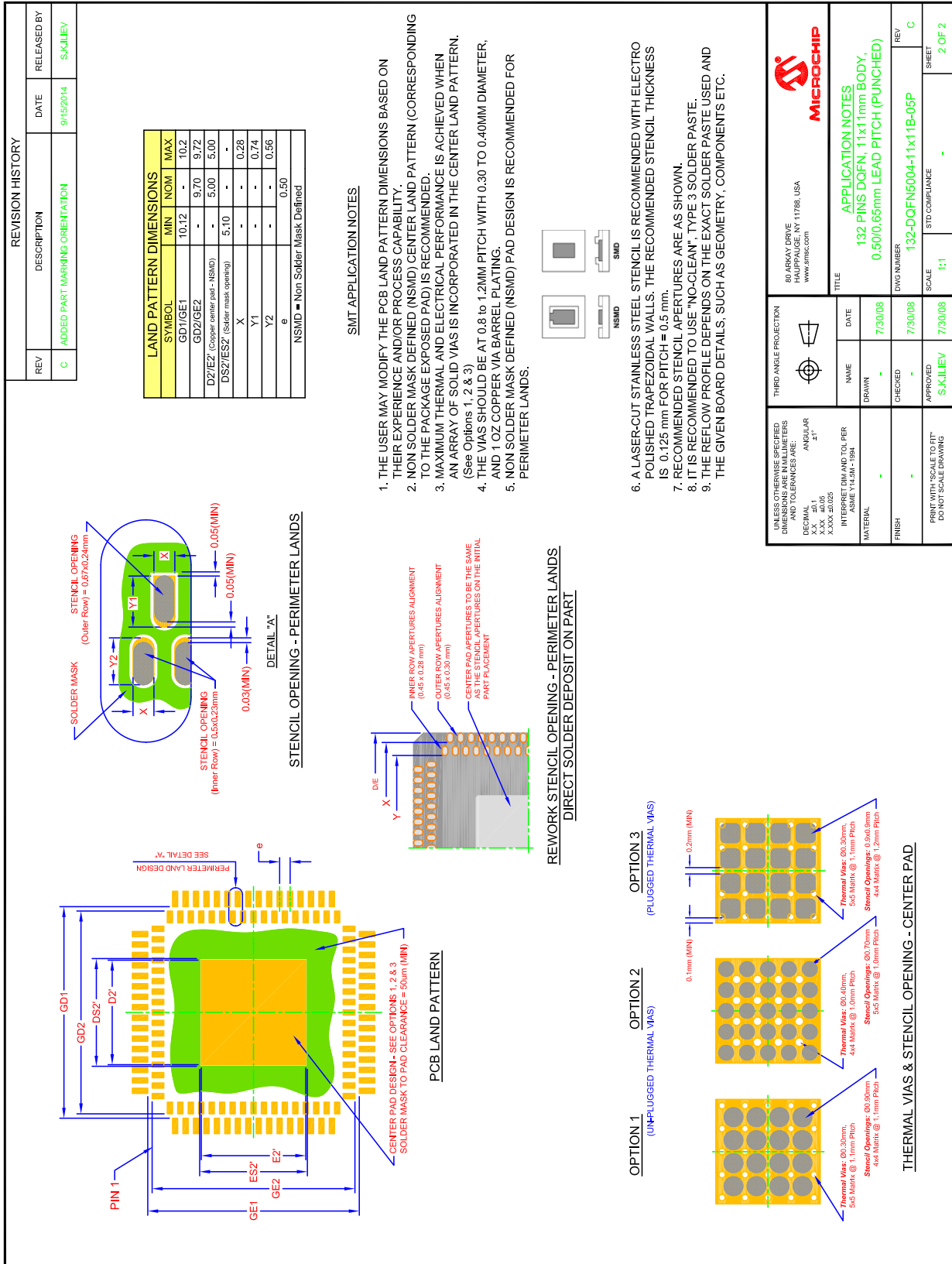


FIGURE 1-3: 132-PIN DQFN PACKAGE OUTLINE (1 OF 2)

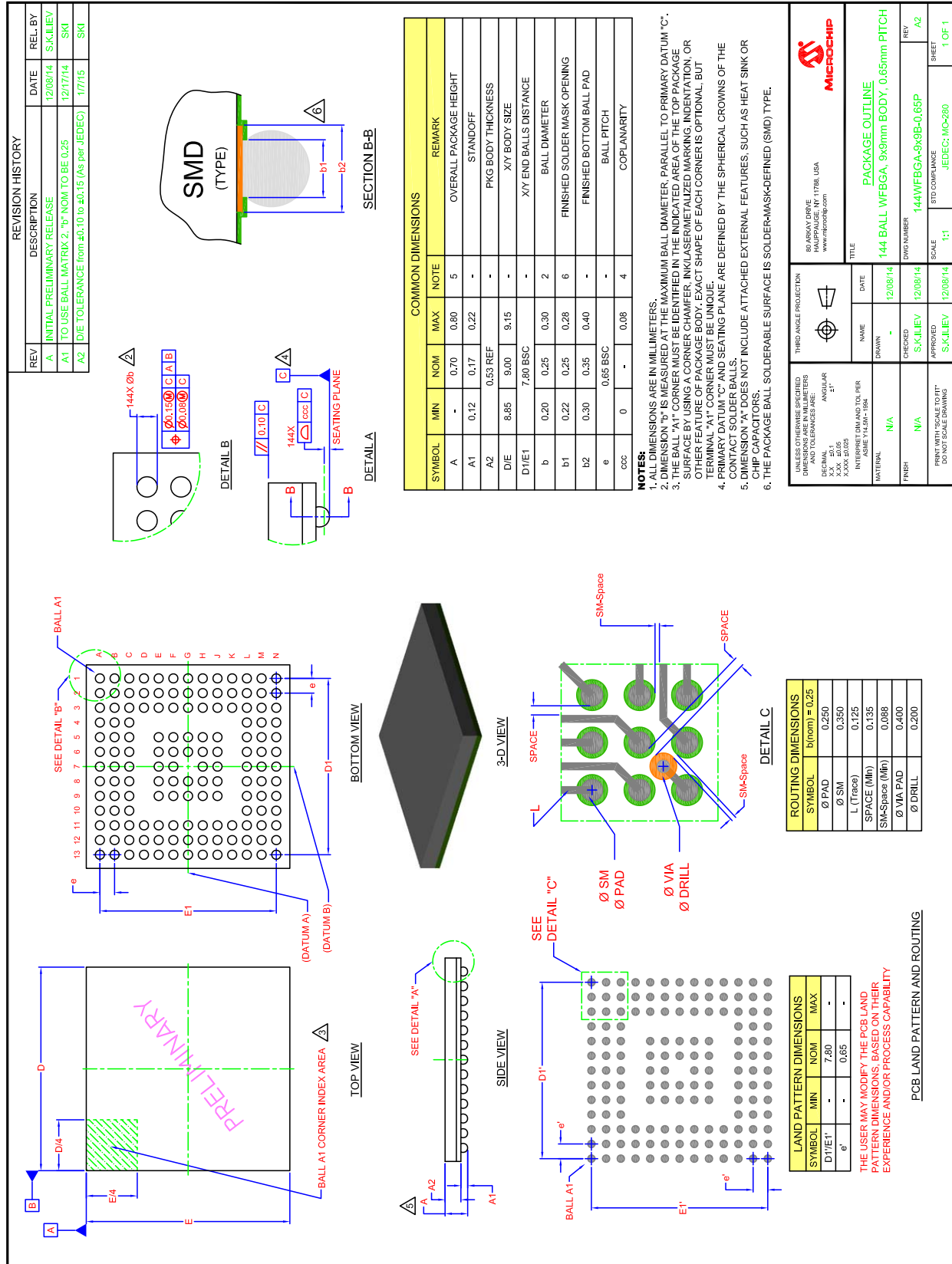


**FIGURE 1-4: 132-PIN DQFN PACKAGE OUTLINE (2 OF 2)**



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FIGURE 1-5: 144-PIN WFBGA PACKAGE OUTLINE

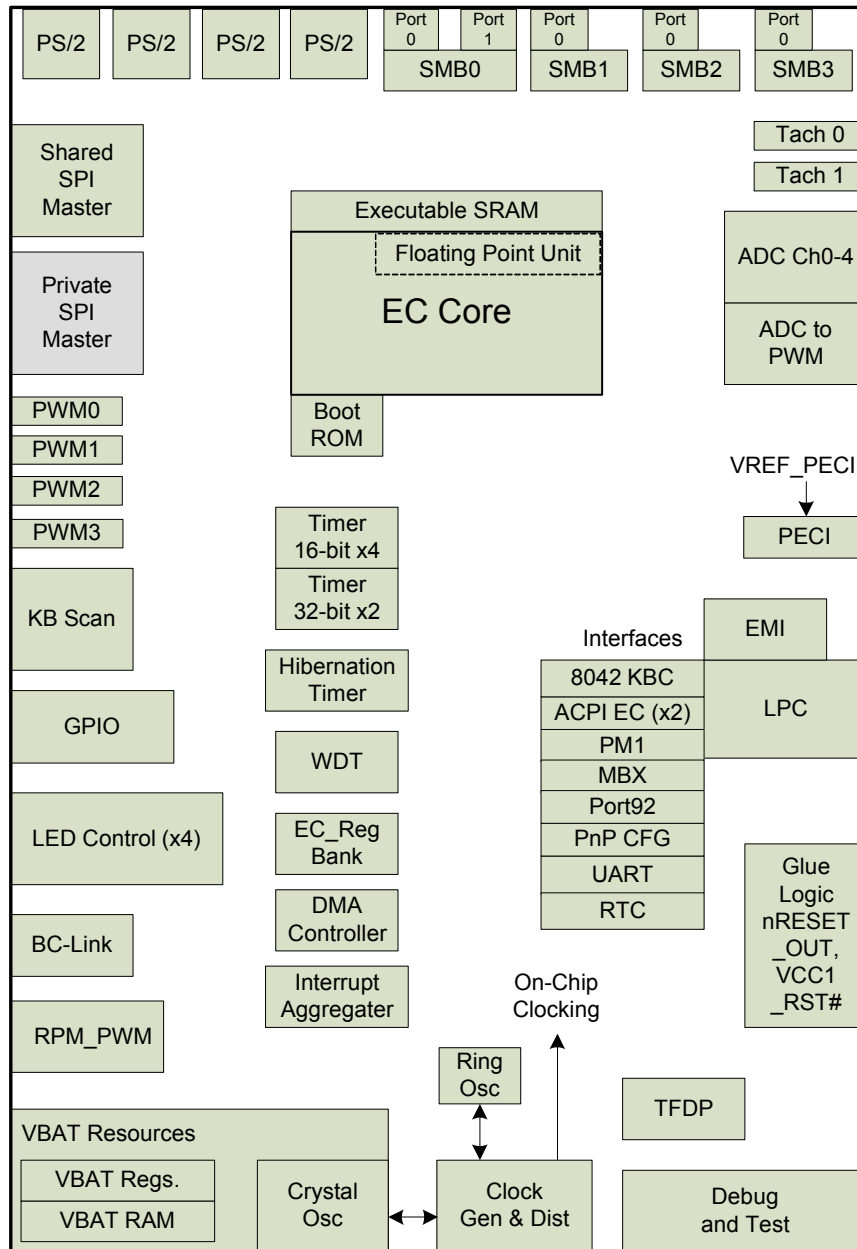


## 2.0 BLOCK OVERVIEW

This Chapter provides an overview of the blocks in the MEC1322.

The block diagram of the MEC1322 is shown in [Figure 2-1](#).

**FIGURE 2-1: BLOCK DIAGRAM**



[Table 2-1 on page 46](#) lists Address Ranges for each of the blocks.

**TABLE 2-1: BLOCK ADDRESS RANGES**

| Feature              | Logical Device No. (LDN) | Base Address (Hex) | End of Range (Hex) | Instance |
|----------------------|--------------------------|--------------------|--------------------|----------|
| EMI/IMAP             | 0                        | 400F0000           | 400F03FF           | 0        |
| 8042 Emulation       | 6                        | 400F0400           | 400F07FF           |          |
| ACPI full duplex     | 3                        | 400F0C00           | 400F0FFF           | 0        |
| ACPI full duplex     | 4                        | 400F1000           | 400F13FF           | 1        |
| ACPIPM1              | 5                        | 400F1400           | 400F17FF           |          |
| UART                 | 7                        | 400F1C00           | 400F1FFF           |          |
| Legacy (Fast KB)     | 1                        | 400F1800           | 400F1BFF           |          |
| Mailbox              | 9                        | 400F2400           | 400F27FF           |          |
| RTC                  | B                        | 400F2C00           | 400F2DFF           |          |
| Global Configuration | 3F                       | 400FFC00           | 400FFFFFF          |          |
| LPC                  | C                        | 400F3000           | 400F33FF           |          |
| GPIO                 |                          | 40081000           | 400817FF           |          |
| JTAG                 |                          | 40080000           | 400800FF           |          |
| PCR                  |                          | 40080100           | 40080FFF           |          |
| Interrupts           |                          | 4000C000           | 4000C3FF           |          |
| DMA                  |                          | 40002400           | 400027FF           |          |
| 16 bit timer         |                          | 40000C00           | 40000C1F           | 0        |
| 16 bit timer         |                          | 40000C20           | 40000C3F           | 1        |
| 16 bit timer         |                          | 40000C40           | 40000C5F           | 2        |
| 16 bit timer         |                          | 40000C60           | 40000C7F           | 3        |
| 32 bit timer         |                          | 40000C80           | 40000C9F           | 4        |
| 32 bit timer         |                          | 40000CA0           | 40000CBF           | 5        |
| SMB                  |                          | 4000AC00           | 4000AFFF           | 1        |
| SMB                  |                          | 4000B000           | 4000B3FF           | 2        |
| SMB                  |                          | 4000B400           | 4000B7FF           | 3        |
| SMB                  |                          | 40001800           | 40001BFF           | 0        |

TABLE 2-1: BLOCK ADDRESS RANGES (CONTINUED)

| Feature           | Logical Device No. (LDN) | Base Address (Hex) | End of Range (Hex) | Instance |
|-------------------|--------------------------|--------------------|--------------------|----------|
| 64 Byte VBAT RAM  |                          | 4000A800           | 4000ABFF           |          |
| VBAT Registers    |                          | 4000A400           | 4000A7FF           |          |
| RPM FAN           |                          | 4000A000           | 4000A3FF           |          |
| KeyScan           |                          | 40009C00           | 40009FFF           |          |
| Hibernation Timer |                          | 40009800           | 40009BFF           |          |
| GP-SPI            |                          | 40009400           | 4000947F           | 0        |
| GP-SPI            |                          | 40009480           | 400094FF           | 1        |
| PS/2              |                          | 40009000           | 4000903F           | 0        |
| PS/2              |                          | 40009040           | 4000907F           | 1        |
| PS/2              |                          | 40009080           | 400090BF           | 2        |
| PS/2              |                          | 400090C0           | 400090FF           | 3        |
| ADC               |                          | 40007C00           | 40007C7F           |          |
| PWM               |                          | 40005800           | 4000580F           | 0        |
| PWM               |                          | 40005810           | 4000581F           | 1        |
| PWM               |                          | 40005820           | 4000582F           | 2        |
| PWM               |                          | 40005830           | 4000583F           | 3        |
| TACH              |                          | 40006000           | 4000600F           | 0        |
| TACH              |                          | 40006010           | 4000601F           | 1        |
| WDT               |                          | 40000400           | 400007FF           |          |
| TFDP              |                          | 40008C00           | 40008FFF           |          |
| BC-Link           |                          | 4000BC00           | 4000BFFF           |          |
| PECI              |                          | 40006400           | 400067FF           |          |
| B/B LED           |                          | 4000B800           | 4000B8FF           | 0        |
| B/B LED           |                          | 4000B900           | 4000B9FF           | 1        |
| B/B LED           |                          | 4000BA00           | 4000BAFF           | 2        |
| B/B LED           |                          | 4000BB00           | 4000BBFF           | 3        |
| EC_REG_BANK       |                          | 4000FC00           | 4000FC1B           |          |
| Data Space SRAM   |                          | 00118000           | 0011FFFF           |          |
| Code Space SRAM   |                          | 00100000           | 00117FFF           |          |
| ROM               |                          | 00000000           | 00007FFF           |          |

# MEC1322

## 3.0 POWER, CLOCKS, AND RESETS

### 3.1 Introduction

The [Power, Clocks, and Resets](#) (PCR) chapter identifies all the power supplies, clock sources, and reset inputs to the chip and defines all the derived power, clock, and reset signals. In addition, this section identifies Power, Clock, and Reset events that may be used to generate an interrupt event, as well as, the [Chip Power Management Features](#).

### 3.2 References

No references have been cited for this chapter.

### 3.3 Interrupts

The [Power, Clocks, and Resets](#) logic generates no events

### 3.4 Power

#### 3.4.1 POWER SOURCES

[Table 3-1](#) lists the power supplies from which the MEC1322 draws current. These current values are defined in [Section 37.4, "Power Consumption,"](#) on page 395.

**TABLE 3-1: POWER SOURCE DEFINITIONS**

| Power Well             | Nominal Voltage | Description  | Source        |
|------------------------|-----------------|--|---------------|
| VCC1                   | 3.3V            | Main Battery Pack Supply Power Well. This is the "Always-on" supply. | Pin Interface |
| VBAT (VCC0) (Note 3-1) | 3.0V            | System Battery Back-up Power Well. This is the "coin-cell" battery.  | Pin Interface |

**Note:** The Minimum rise/fall time requirement on VCC1 is 200us.

**Note:** The Minimum rise time requirement on VBAT is 100us.

**Note 3-1** Note on Battery Replacement: Microchip recommends removing all power sources to the device defined in [Table 3-1, "Power Source Definitions"](#) and all external voltage references defined in [Table 3-2, "Voltage Reference Definitions"](#) before removing and replacing the battery. In addition, upon removing the battery, ground the battery pin before replacing the battery.

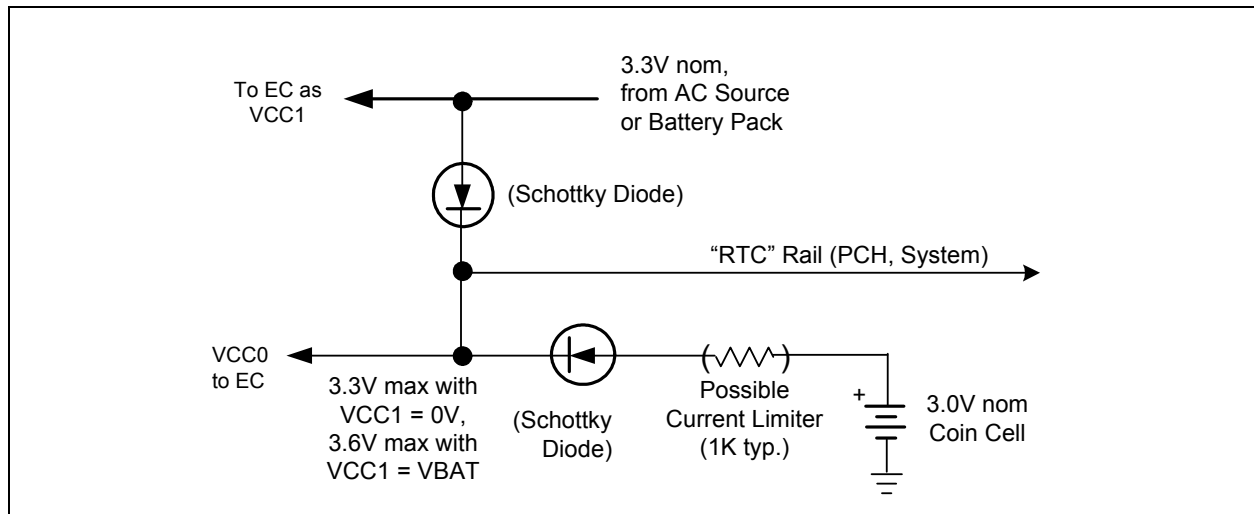
**APPLICATION NOTE:** Battery Circuit Requirement:

- VCC0 must always be present if VCC1 is present.



The following circuit is recommended to fulfill this requirement:

**FIGURE 3-1: RECOMMENDED BATTERY CIRCUIT**



### 3.4.2 VOLTAGE REFERENCES

Table 3-2 lists the External Voltage References to which the MEC1322 provides high impedance interfaces.

**TABLE 3-2: VOLTAGE REFERENCE DEFINITIONS**

| Power Well              | Nominal Input Voltage | Scaling Ratio | Nominal Monitored Voltage | Description  | Source        |
|-------------------------|-----------------------|---------------|---------------------------|--|---------------|
| VREF_PECI<br>(Note 3-2) | Variable              | n/a           | Variable                  | Processor Voltage External Voltage Reference Used to scale Processor Interface signals | Pin Interface |

**Note 3-2** The VREF\_PECI does not have a power good signal associated with it. See VREF Buffer type definition in Table 37-4, "DC Electrical Characteristics," on page 391.

### 3.4.3 POWER GOOD SIGNALS

The power good timing and thresholds are defined in the Section 38.1, "Voltage Thresholds and Power Good Timing," on page 397.

**TABLE 3-3: POWER GOOD SIGNAL DEFINITIONS**

| Power Good Signal | Description   | Source   |
|-------------------|---|--|
| VCC1GD            | VCC1GD is an internal power good signal used to indicate when the VCC1 rail is on and stable. | VCC1GD is asserted following a delay after the VCC1 power well exceeds its preset voltage threshold. VCC1GD is de-asserted as soon as this voltage drops below this threshold. |
| PWRGD             | PWRGD is used to indicate when the main power rail voltage is on and stable.                  | VCC_PWRGD Input pin  |

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## 3.4.4 SYSTEM POWER SEQUENCING

The following table defines the behavior of the [Power Sources](#) in each of the defined ACPI power states.

**TABLE 3-4: TYPICAL POWER SUPPLIES VS. ACPI POWER STATES**

| Supply Name | ACPI Power State |             |             |                                    |                                    |                                    | Description  |
|-------------|------------------|-------------|-------------|------------------------------------|------------------------------------|------------------------------------|--|
|             | S0<br>(FULL ON)  | S1<br>(POS) | S3<br>(STR) | S4<br>(STD)                        | S5<br>(Soft Off)                   | G3<br>(MECH Off)                   |  |
| VCC1        | ON               | ON          | ON          | ON                                 | ON                                 | OFF                                | MEC1322 "Always-on" Supply. ( <a href="#">Note 3-3</a> ) |
| VBAT (VCC0) | ON               | ON          | ON          | ON<br>( <a href="#">Note 3-4</a> ) | ON<br>( <a href="#">Note 3-4</a> ) | ON<br>( <a href="#">Note 3-4</a> ) | MEC1322 Battery Back-up Supply                           |

**Note 3-3** VCC1 power supply is always on while the battery pack or ac power is applied to the system.

**Note 3-4** This device requires that the VBAT power is on when the VCC1 power supply is on. External circuitry, a diode isolation circuit, is implemented on the motherboard to extend the battery life. This external circuitry ensures the VBAT pin will derive power from the VCC1 power well when it is on. Therefore, the VBAT supply will never appear to be off when the VCC1 rail is on. See [APPLICATION NOTE: on page 48](#).

## 3.5 Clocks

The following section defines the MEC1322 clocks that are generated or referenced.

**TABLE 3-5: CLOCK DEFINITIONS**

| Clock Name                    | Frequency  | Description  | Source   |
|-------------------------------|------------|--|--|
| SUSCLK                        | 32.768 KHz | 32.768 kHz Suspend Well Clock Source is a single-ended input that is an accurate 32.768KHz clock. ( <a href="#">Note 3-5</a> ) | Pin Interface (XTAL2)  |
| 32.768 kHz Crystal Oscillator | 32.768 KHz | A 32.768 KHz parallel resonant crystal connected between the XTAL1 and XTAL2 pins.   | Pin Interface (XTAL1 and XTAL2)  |
| 48 MHz Ring Oscillator        | 48MHz      | The 48 MHz Ring Oscillator is a high-accuracy, low power, low start-up latency 48 MHz Ring Oscillator.                         | Enabled by VCC1 Power ( <a href="#">Note 3-6</a> ). May be stopped by <a href="#">Chip Power Management Features</a> .   |
| 24MHz_Clk                     | 24 MHz     | Derived clock for UART   | <a href="#">48 MHz Ring Oscillator</a>   |
| 16MHz_Clk                     | 16MHz      | Derived clock for SMBus Controller   | <a href="#">48 MHz Ring Oscillator</a>   |
| 1.8432MHz_Clk                 | 1.843 MHz  | Derived clock for UART   | <a href="#">48 MHz Ring Oscillator</a>   |
| 100kHz_Clk                    | 100 kHz    | Derived for several blocks in the EC Subsystem, including, but not limited to, PWM, TACH.                                      | <a href="#">48 MHz Ring Oscillator</a>   |
| 32KHz_Clk                     | 32.768 KHz | Internal 32kHz clock domain  | Pin Interface:<br>XTAL2: 32KHz Crystal input/ single-ended clock source input pin.<br>XTAL1: 32KHz Crystal output<br><br>The XOSEL bit configures the source of this clock domain as either a single-ended 32.768 KHz clock input ( <a href="#">SUSCLK</a> ) or the <a href="#">32.768 kHz Crystal Oscillator</a> ( <a href="#">Note 3-7</a> ). If neither of these is available, this clock domain is derived from the <a href="#">48 MHz Ring Oscillator</a> . |

- Note 3-5** The chipset will not produce a valid 32KHz clock until about 5 ms (PCH) or 110 ms (ICH) after the deassertion of RSMRST#. See chipset specification for the actual timing.
- Note 3-6** The [48 MHz Ring Oscillator](#) is reset by VCC1GD.
- Note 3-7** The [Clock Enable Register](#) contains the XOSEL bit and the 32K\_EN bit (see [Section 4.7.2, "Clock Enable Register," on page 73](#)). The 32.768 KHz Oscillator provides a stable timebase for the [48 MHz Ring Oscillator](#) as well as the clock source for the 32KHz Clock Domain. After VBAT POR there is a 500ms max time for the [48 MHz Ring Oscillator](#) to become accurate.

### 3.5.1 32KHZ CLOCK SWITCHING

The 32kHz clock switching logic switches the clock source of the 32kHz clock domain to be either the single-ended 32.768 KHz clock input or the [32.768 kHz Crystal Oscillator](#). If neither of these is available, this clock domain is derived from the [48 MHz Ring Oscillator](#).

Following a [VBAT\\_POR](#), the XOSEL bit and the 32K\_EN bit in the [Clock Enable Register](#) are programmed to configure the source of this clock domain.

If the single-ended 32.768 KHz clock input is configured as the source of the 32kHz clock domain, then following a [VCC1\\_RESET](#), the time for this clock domain to become accurate at 32.768kHz after the [SUSCLK](#) input goes active is 100us (max).

If the [32.768 kHz Crystal Oscillator](#) is configured as the source of the 32kHz clock domain, then following a [VCC1\\_RESET](#), there is 100us (max) delay time for this clock domain to become accurate at 32.768kHz.

### 3.5.2 CLOCK DOMAINS VS. ACPI POWER STATES

[Table 3-6, "Typical MEC1322 Clocks vs. ACPI Power States"](#) shows the relationship between ACPI power states and MEC1322 clock domains:

**TABLE 3-6: TYPICAL MEC1322 CLOCKS VS. ACPI POWER STATES**

| Clock Name                                    | ACPI Power State |          |          |          |               |               | Description  |
|---|------------------|----------|----------|----------|---------------|---------------|--|
|   | S0 (FULL ON)     | S1 (POS) | S3 (STR) | S4 (STD) | S5 (Soft Off) | G3 (MECH Off) |  |
| <a href="#">SUSCLK</a>                        | ON               | ON       | ON       | ON       | ON            | OFF           | This clock is the system suspend clock source. ( <a href="#">Note 3-5</a> ).   |
| <a href="#">32.768 kHz Crystal Oscillator</a> | ON               | ON       | ON       | ON       | ON            | ON            | This clock is generated from a 32.768 KHz parallel resonant crystal connected between the XTAL1 and XTAL2 pins.  |
| <a href="#">32KHz_Clk</a>                     | ON               | ON       | ON       | ON       | ON            | ON/ OFF       | This clock domain is generated from the 32KHz clock input (SUSCLK) when available or the crystal oscillator pins. Otherwise it is generated internally from the <a href="#">48 MHz Ring Oscillator</a> . |

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**TABLE 3-6: TYPICAL MEC1322 CLOCKS VS. ACPI POWER STATES (CONTINUED)**

| Clock Name             | ACPI Power State |          |          |          |               |               | Description   |
|------------------------|------------------|----------|----------|----------|---------------|---------------|---|
|                        | S0 (FULL ON)     | S1 (POS) | S3 (STR) | S4 (STD) | S5 (Soft Off) | G3 (MECH Off) |   |
| 48 MHz Ring Oscillator | ON               | ON       | ON       | ON       | ON            | OFF           | This clock is powered by the MEC1322 suspend supply (VCC1) but may start and stop as described in <a href="#">Section 3.7, "Chip Power Management Features,"</a> on <a href="#">page 54</a> (see also <a href="#">Note 3-3</a> ). |

## 3.6 Resets

**TABLE 3-7: DEFINITION OF RESET SIGNALS**

| Reset      | Description   | Source  |
|------------|---|---|
| VBAT_POR   | Internal VBAT Reset signal. This signal is used to reset VBAT powered registers.          | <a href="#">VBAT_POR</a> is a pulse that is asserted at the rising edge of <a href="#">VCC1GD</a> if the VBAT voltage is below a nominal 1.25V. <a href="#">VBAT_POR</a> is also asserted as a level if, while <a href="#">VCC1GD</a> is not asserted ('0'), the coin cell is replaced with a new cell that delivers at least a nominal 1.25V. In this latter case <a href="#">VBAT_POR</a> is de-asserted when <a href="#">VCC1GD</a> is asserted. No action is taken if the coin cell is replaced, or if the VBAT voltage falls below 1.25 V nominal, while <a href="#">VCC1GD</a> is asserted. |
| VCC1_RESET | Internal VCC1 Reset signal. This signal is used to reset VCC1 powered registers.          | <a href="#">VCC1_RESET</a> is asserted when <a href="#">VCC1GD</a> is low and is deasserted when <a href="#">VCC1GD</a> is high. The <a href="#">VCC1_RST#</a> pin asserted as input will also cause a <a href="#">VCC1_RESET</a> . A <a href="#">WDT_RESET</a> event will also cause a <a href="#">VCC1_RESET</a> assertion.   |
| PCI RESET# | System reset signal connected to the LPC <a href="#">LRESET#</a> pin.                     | Pin Interface, <a href="#">LRESET#</a> pin. See <a href="#">Note 3-8</a> .  |
| nSIO_RESET | Performs a reset when VCC is turned off or when the system host resets the LPC Interface. | <a href="#">nSIO_RESET</a> is a signal that is asserted if <a href="#">VCC1GD</a> is low, <a href="#">PWRGD</a> is low, or <a href="#">PCI RESET#</a> is asserted low and may be deasserted when these three signals are all high. The <a href="#">iRESET_OUT</a> bit controls the deassertion of <a href="#">nSIO_RESET</a> . See <a href="#">Note 3-8</a> . A <a href="#">WDT_RESET</a> event will also cause an <a href="#">nSIO_RESET</a> assertion.  |

**TABLE 3-7: DEFINITION OF RESET SIGNALS (CONTINUED)**

| Reset         | Description  | Source   |
|---------------|--|--|
| WDT_RESET     | Internal WDT Reset signal. This signal resets VCC1 powered registers with the exception of the <a href="#">WDT Event Count</a> register. Note that the glitch protect circuits do not activate on a WDT reset. <a href="#">WDT_RESET</a> does not reset VBAT registers or logic. | A <a href="#">WDT_RESET</a> is asserted by a <a href="#">WDT Event</a> .<br><b>Note:</b> This event is indicated by the <a href="#">WDT</a> bit in the <a href="#">Power-Fail and Reset Status Register</a>  |
| EC_PROC_RESET | Internal reset signal to reset the processor in the EC Subsystem.  | An <a href="#">EC_PROC_RESET</a> is a stretched version of the <a href="#">VCC1_RESET</a> . This reset asserts at the same time that <a href="#">VCC1_RESET</a> asserts and is held asserted for 1ms after the <a href="#">VCC1_RESET</a> deasserts. |

**Note 3-8** If the LRESET# pin is assigned to the GPIO function rather than LRESET#, the internal LRESET# signal is gated low, and therefore the nRESET\_OUT function will not operate properly.

### 3.6.1 INTEGRATED VCC1 POWER ON RESET (VCC1\_RST#)

The VCC1\_RST# pin is used to control the power up sequence for external devices. The VCC1\_RST# timing is shown in [Section 38.1.1, "VCC1\\_RST# Timing," on page 397](#).

The following summarizes the operation of the VCC1\_RST# signal.

- The VCC1\_RST# pin is both a reset input and an output to the system.
- The VCC1\_RST# output provides a POR reset during power up transition
- The VCC1\_RST# output has Output Pin Glitch Protection
- The VCC1\_RST# output stretches an external driven reset by 1ms (typ).
- The VCC1\_RST# input detects an externally driven reset and places the MEC1322 into a VCC1 POR state.

The VCC1\_RST# is an open drain pin. An external pull-up is required for the VCC1\_RST# signal to be high.

**Note:** The external pull-up on the VCC1\_RST# pin must be chosen to meet the timing in [Table 38-2, "VCC1\\_RST# Rise Time," on page 397](#).

The following sequence illustrates the interaction between the internally and externally driven assertion of VCC1\_RST#:

1. The Integrated VCC1 Power On Reset Generator insures VCC1\_RST# is driven low during a VCC1 POR from VCC1 = 1V to 2.4V (typ) without glitches.
2. The VCC1\_RST# pin is driven low during the POR transition until VCC1 > 2.4V (typ) and then the VCC1\_RST# pin remains low afterwards for 1ms (typ) delay window. The VCC1\_RST# input is not examined during the 1ms (typ) delay window; therefore, the system input and/or the external pin termination may be modified (i.e. drive it low, let it float, etc.)
  - The VCC1\_RST# input is not examined during the POR transition while VCC1 < 2.4V (typ); therefore, the system input to the VCC1\_RST# pin may modify the output termination (i.e. drive it low, let it float, etc.)
3. The VCC1\_RST# pin is driven low during the 1ms (typ) delay window. The MEC1322 is in the VCC1\_POR state during this time.
4. After the 1ms (typ) window, the VCC1\_RST# pin open drain output from the MEC1322 is not driven/released. The strap option pins are sampled at this time.
5. The MEC1322 will remain in the VCC1 POR for 2.65us (min) after the VCC1\_RST# pin is released. The VCC1\_RST# input pin is ignored during this time.
6. The VCC1\_RST# pin input is sampled at 2.65us (min) after the VCC1\_RST# pin is released.
  - If the VCC1\_RST# pin is high when sampled, then the EC starts executing.
  - If the VCC1\_RST# pin is low when sampled, the pin is being driven externally (i.e., the system is forcing a reset):
    - The VCC1\_RST# pin is driven low for 1ms (typ), then sampled at 2.65us (min) after the VCC1\_RST# pin is released (see step 3).

**Note 1:** The minimum low pulse provided to initiate reset = 20ns.

**2:** There is no glitch protection or noise filtering (i.e. a vary narrow noise pulse cause a reset).

## 3.7 Chip Power Management Features

This device is designed to always operate in its lowest power state during normal operation. In addition, this device offers additional programmable options to put individual logical blocks to sleep as defined in [Section 3.7.1, "Block Low Power Modes,"](#) on page 54.

### 3.7.1 BLOCK LOW POWER MODES

All power related control signals are generated and monitored centrally in the chip's Power, Clocks, and Resets (PCR) block. The power manager of the PCR block uses a sleep interface to communicate with all the blocks. The sleep interface consists of three signals:

- **sleep\_en (request to sleep the block)** is generated by the PCR block. A group of sleep\_en signals are generated for every clock segment. Each group consists of a sleep\_en signal for every block in that clock segment.
- **clk\_req (request clock on)** is generated by every block. They are grouped by blocks on the same clock segment. The PCR monitors these signals to see when it can gate off clocks.
- **reset\_en (reset on sleep)** bits determine if the block (including registers) will be reset when it enters sleep mode.

A block can always drive clk\_req low synchronously, but it MUST drive it high asynchronously since its internal clocks are gated and it has to assume that the clock input itself is gated. Therefore the block can only drive clk\_req high as a result of a register access or some other input signal.

The following table defines a block's power management protocol:

| Power State      | sleep_en    | clk_req       | Description  |
|------------------|-------------|---------------|--|
| Normal operation | Low         | Low           | Block is idle and NOT requesting clocks. The block gates its own internal clock.   |
| Normal operation | Low         | High          | Block is NOT idle and requests clocks.   |
| Request sleep    | Rising Edge | Low           | Block is IDLE and enters sleep mode immediately. The block gates its own internal clock. The block cannot request clocks again until sleep_en goes low.  |
| Request sleep    | Rising Edge | High then Low | Block is not IDLE and will stop requesting clocks and enter sleep when it finishes what it is doing. This delay is block specific, but should be less than 1 ms. The block gates its own internal clock. After driving clk_req low, the block cannot request clocks again until sleep_en goes low. |
| Register Access  | X           | High          | Register access to a block is always available regardless of sleep_en. Therefore the block ungates its internal clock and drives clk_req high during the access. The block will regate its internal clock and drive clk_req low when the access is done.   |

A wake event clears all sleep enable bits momentarily, and then returns the sleep enable bits back to their original state. The block that needs to respond to the wake event will do so. See [Section 15.8.1, "WAKE Generation,"](#) on page 194.

The Sleep Enable, Clock Required and Reset Enable registers are defined in [Section 3.8, "EC-Only Registers,"](#) on page 55.

## 3.8 EC-Only Registers

**TABLE 3-8: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address (Note 3-9) |
|----------------|-----------------|------|-------------------------------|-------------------------|
| PCR            | 0               | EC   | 32-bit internal address space | 4008_0100h              |

**Note 3-9** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 3-9: POWER, CLOCKS AND RESET VCC1-POWERED REGISTERS SUMMARY**

| Offset | Register Name   |
|--------|---|
| 00h    | Chip Sleep Enable Register (CHIP_SLP_EN)                  |
| 04h    | Chip Clock Required Status Registers (CHIP_CLK_REQ_STS)   |
| 08h    | EC Sleep Enable Register (EC_SLP_EN)                      |
| 0Ch    | EC Clock Required Status Registers (EC_CLK_REQ_STS)       |
| 10h    | Host Sleep Enable Register (HOST_SLP_EN)                  |
| 14h    | Host Clock Required Status Registers (HOST_CLK_REQ)       |
| 18h    | System Sleep Control Register (SYS_SLP_CNTRL)             |
| 20h    | Processor Clock Control Register (PROC_CLK_CNTRL)         |
| 24h    | EC Sleep Enable 2 Register (EC_SLP_EN2)                   |
| 28h    | EC Clock Required 2 Status Register (EC_CLK_REQ2_STS)     |
| 2Ch    | Slow Clock Control Register (SLOW_CLK_CNTRL)              |
| 30h    | Oscillator ID Register (CHIP_OSC_ID)                      |
| 34h    | PCR chip sub-system power reset status (CHIP_PWR_RST_STS) |
| 38h    | Chip Reset Enable Register (CHIP_RST_EN)                  |
| 3Ch    | Host Reset Enable Register (HOST_RST_EN)                  |
| 40h    | EC Reset Enable Register (EC_RST_EN)                      |
| 44h    | EC Reset Enable 2 Register (EC_RST_EN2)                   |
| 48h    | Power Reset Control (PWR_RST_CTRL) Register               |

**Note:** All register addresses are naturally aligned on 32-bit boundaries. Offsets for registers that are smaller than 32 bits are reserved and must not be used for any other purpose.

## 3.9 Sleep Enable and Clock Required Registers

The following are the Sleep Enable and Clock Required registers for the MEC1322.

### 3.9.1 CHIP SLEEP ENABLE REGISTER (CHIP\_SLP\_EN)

| Offset | 00h                       |      |         |             |
|--------|---------------------------|------|---------|-------------|
| Bits   | Description               | Type | Default | Reset Event |
| 31:2   | RESERVED                  | RES  |         |             |
| 1      | MCHP Reserved (Note 3-10) | R/W  | 0h      | VCC1_RESET  |
| 0      | MCHP Reserved (Note 3-10) | R/W  | 0h      | VCC1_RESET  |

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**Note 3-10** MCHP Reserved bits in the sleep\_en registers must be written to 1 in order for the chip to be put into sleep mode.

## 3.9.2 CHIP CLOCK REQUIRED STATUS REGISTERS (CHIP\_CLK\_REQ\_STS)

| Offset | 04h           |      |         |                |
|--------|---------------|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:2   | RESERVED      | RES  |         |                |
| 1      | MCHP Reserved | R    | 0h      | VCC1_R<br>ESET |
| 0      | MCHP Reserved | R    | -       | VCC1_R<br>ESET |

## 3.9.3 EC SLEEP ENABLE REGISTER (EC\_SLP\_EN)

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31     | TIMER16_1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-11 on page 57</a> . | R/W  | 0h      | VCC1_R<br>ESET |
| 30     | TIMER16_0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-11 on page 57</a> . | R/W  | 0h      | VCC1_R<br>ESET |
| 29     | EC_REG_BANK Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.   | R/W  | 0h      | VCC1_R<br>ESET |
| 28:23  | RESERVED   | RES  |         |                |
| 22     | PWM3 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
| 21     | PWM2 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
| 20     | PWM1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
| 19:12  | RESERVED   | RES  |         |                |
| 11     | TACH1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.   | R/W  | 0h      | VCC1_R<br>ESET |
| 10     | SMB0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
| 9      | WDT Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.   | R/W  | 0h      | VCC1_R<br>ESET |



| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 8      | PROCESSOR Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment. | R/W  | 0h      | VCC1_R<br>ESET |
| 7      | TFDP Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.      | R/W  | 0h      | VCC1_R<br>ESET |
| 6      | DMA Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.       | R/W  | 0h      | VCC1_R<br>ESET |
| 5      | PMC Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.       | R/W  | 0h      | VCC1_R<br>ESET |
| 4      | PWM0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.      | R/W  | 0h      | VCC1_R<br>ESET |
| 3      | RESERVED   | RES  |         |                |
| 2      | TACH0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.     | R/W  | 0h      | VCC1_R<br>ESET |
| 1      | PECI Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.      | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | INT Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.       | R/W  | 0h      | VCC1_R<br>ESET |

**Note 3-11** The basic timers in this device have an auto-reload mode. When this mode is selected, the block's clk\_req equation is always asserted, which will prevent the device from gating its clock tree and going to sleep. When the firmware intends to put the device to sleep, none of the timers should be in auto-reload mode. Alternatively, use the timer's HALT function inside the control register to stop the timer in auto-reload mode so it can go to sleep.

### 3.9.4 EC CLOCK REQUIRED STATUS REGISTERS (EC\_CLK\_REQ\_STS)

| Offset | 0Ch   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31     | TIMER16_1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.   | R    | 0h      | VCC1_R<br>ESET |
| 30     | TIMER16_0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.   | R    | 0h      | VCC1_R<br>ESET |
| 29     | EC_REG_BANK Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 28:23  | RESERVED  | RES  |         |                |

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| Offset | 0Ch   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 22     | PWM3 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 21     | PWM2 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 20     | PWM1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 19:12  | RESERVED  | RES  |         |                |
| 11     | TACH1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.     | R    | 0h      | VCC1_R<br>ESET |
| 10     | SMB0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 9      | WDT Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.       | R    | 0h      | VCC1_R<br>ESET |
| 8      | PROCESSOR Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 1h      | VCC1_R<br>ESET |
| 7      | TFDP Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 6      | DMA Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.       | R    | 0h      | VCC1_R<br>ESET |
| 5      | PMC Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.       | R    | 0h      | VCC1_R<br>ESET |
| 4      | PWM0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 3      | RESERVED  | RES  |         |                |
| 2      | TACH0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.     | R    | 0h      | VCC1_R<br>ESET |
| 1      | PECI Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 0      | INT Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.       | R    | 0h      | VCC1_R<br>ESET |

## 3.9.5 HOST SLEEP ENABLE REGISTER (HOST\_SLP\_EN)

| Offset | 10h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:19  | RESERVED   | RES  |         |                |
| 18     | RTC Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.       | R/W  | 0h      | VCC1_R<br>ESET |
| 17     | RESERVED   | RES  |         |                |
| 16     | 8042EM Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.    | R/W  | 0h      | VCC1_R<br>ESET |
| 15     | ACPI PM1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
| 14     | ACPI EC 1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment. | R/W  | 0h      | VCC1_R<br>ESET |
| 13     | ACPI EC 0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment. | R/W  | 0h      | VCC1_R<br>ESET |
| 12     | GLBL_CFG<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.               | R/W  | 0h      | VCC1_R<br>ESET |
| 11:2   | RESERVED   | RES  |         |                |
| 1      | UART 0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.    | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | LPC Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.       | R/W  | 0h      | VCC1_R<br>ESET |

## 3.9.6 HOST CLOCK REQUIRED STATUS REGISTERS (HOST\_CLK\_REQ)

| Offset | 14h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:19  | RESERVED   | RES  |         |                |
| 18     | RTC Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 17     | RESERVED   | RES  |         |                |
| 16     | 8042EM Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.   | R    | 0h      | VCC1_R<br>ESET |
| 15     | ACPI PM1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |

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| Offset | 14h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 14     | ACPI EC 1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 13     | ACPI EC 0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 12     | GLBL_CFG Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.  | R    | -       | VCC1_R<br>ESET |
| 11:2   | RESERVED  | RES  |         |                |
| 1      | UART 0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.    | R    | -       | VCC1_R<br>ESET |
| 0      | LPC Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.       | R    | -       | VCC1_R<br>ESET |

## 3.9.7 SYSTEM SLEEP CONTROL REGISTER (SYS\_SLP\_CNTRL)

| Offset | 18h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:3   | RESERVED  | RES  |         |                |
| 2      | Core regulator standby<br>0: keep regulator fully operational when sleeping.<br>1: standby the regulator when sleeping. Allows enough power for chip static operation for memory retention. | R/W  | 0h      | VCC1_R<br>ESET |
| 1      | Ring oscillator output gate<br>0: keep ROSC ungated when sleeping.<br>1: gate the ROSC output when sleeping.  | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | Ring oscillator power down<br>0: keep ROSC operating when sleeping.<br>1: disable ROSC when sleeping. Clocks will start on wakeup, but there is a clock lock latency penalty.               | R/W  | 0h      | VCC1_R<br>ESET |

The System Sleep States shown in [Table 3-10](#) and determined by the bits in this register, are only entered if all blocks are sleeping; that is, if the sleep enable bits are set for all blocks and no clocks are required.

**TABLE 3-10: SYSTEM SLEEP CONTROL BIT ENCODING**

| D2 | D1 | D0 | Wake Latency (TYP)                     | Description  |
|----|----|----|--|--|
| 0  | 0  | 0  | 0                                      | The Core regulator and the Ring Oscillator remain powered and running during sleep cycles (SYSTEM HEAVY SLEEP 1) (DEFAULT) |
| 0  | 1  | 0  | 0                                      | The Core regulator remains powered and the Ring oscillator is running but gated during sleep cycles (SYSTEM HEAVY SLEEP 2) |
| 0  | X  | 1  | 200us<br>( <a href="#">Note 3-12</a> ) | The Core regulator remains powered and the Ring oscillator is powered down during sleep cycles (SYSTEM HEAVY SLEEP 3)      |
| 1  | X  | 1  | 1ms                                    | The Core regulator is suspended and the Ring oscillator is powered down during sleep cycles. (SYSTEM DEEPEST SLEEP)        |

**Note 3-12** This is the latency following a wake event until the [48 MHz Ring Oscillator](#) is locked and clocking the system.

### 3.9.8 PROCESSOR CLOCK CONTROL REGISTER (PROC\_CLK\_CNTRL)

| Offset | 20h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:8   | RESERVED   | RES  |         |             |
| 7:0    | Processor Clock Divide Value<br>1: divide <a href="#">48 MHz Ring Oscillator</a> by 1.<br>4: divide <a href="#">48 MHz Ring Oscillator</a> by 4.<br>16: divide <a href="#">48 MHz Ring Oscillator</a> by 16.<br>48: divide <a href="#">48 MHz Ring Oscillator</a> by 48.<br>No other values are supported. | R/W  | 4h      | VCC1_R ESET |

### 3.9.9 EC SLEEP ENABLE 2 REGISTER (EC\_SLP\_EN2)

| Offset | 24h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:29  | RESERVED   | RES  |         |             |
| 28     | MCHP Reserved ( <a href="#">Note 3-10</a> )  | R/W  | 0h      | VCC1_R ESET |
| 27     | MCHP Reserved ( <a href="#">Note 3-10</a> )  | R/W  | 0h      | VCC1_R ESET |
| 26     | MCHP Reserved ( <a href="#">Note 3-10</a> )  | R/W  | 0h      | VCC1_R ESET |
| 25     | LED3 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R ESET |
| 24     | TIMER32_1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-11 on page 57</a> . | R/W  | 0h      | VCC1_R ESET |
| 23     | TIMER32_0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-11 on page 57</a> . | R/W  | 0h      | VCC1_R ESET |

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| Offset | 24h | Bits | Description  | Type | Default | Reset Event    |
|--------|-----|------|--|------|---------|----------------|
|        |     | 22   | TIMER16_3 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-11 on page 57</a> . | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 21   | TIMER16_2_Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-11 on page 57</a> . | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 20   | SPI1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 19   | BCM Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.   | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 18   | LED2 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 17   | LED1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 16   | LED0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 15   | SMB3 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 14   | SMB2 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 13   | SMB1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 12   | RPM-PWM Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.   | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 11   | KEYSCAN Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.   | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 10   | HTIMER Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 9    | SPI0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.  | R/W  | 0h      | VCC1_R<br>ESET |
|        |     | 8    | PS2_3 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-14</a> .                | R/W  | 0h      | VCC1_R<br>ESET |

| Offset | 24h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7      | PS2_2 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-14</a> . | R/W  | 0h      | VCC1_R<br>ESET |
| 6      | PS2_1 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-14</a> . | R/W  | 0h      | VCC1_R<br>ESET |
| 5      | PS2_0 Sleep Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.<br>See <a href="#">Note 3-14</a> . | R/W  | 0h      | VCC1_R<br>ESET |
| 4      | MCHP Reserved ( <a href="#">Note 3-10</a> )   | R/W  | 0h      | VCC1_R<br>ESET |
| 3      | ADC Sleep Enable ( <a href="#">Note 3-13</a> )<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment.        | R/W  | 0h      | VCC1_R<br>ESET |
| 2:0    | Reserved  | R    |         |                |

**Note 3-13** The ADC VREF must be powered down in order to get the lowest deep sleep current. The ADC VREF Power down bit, ADC\_VREF\_PD\_REF is in the EC Subsystem Registers ADC VREF PD on page 381.

**Note 3-14** The PS2 block will only sleep while the PS2 is disabled or in Rx mode with no traffic on the bus.

### 3.9.10 EC CLOCK REQUIRED 2 STATUS REGISTER (EC\_CLK\_REQ2\_STS)

| Offset | 28h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:29  | RESERVED  | RES  |         |                |
| 28     | MCHP Reserved   | R    | 0h      | VCC1_R<br>ESET |
| 27     | MCHP Reserved   | R    | 0h      | VCC1_R<br>ESET |
| 26     | MCHP Reserved   | R    | 0h      | VCC1_R<br>ESET |
| 25     | LED3 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 24     | TIMER32_1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 23     | TIMER32_0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |

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| Offset | 28h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 22     | TIMER16_3 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 21     | TIMER16_2_Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 20     | SPI1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 19     | BCM Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.       | R    | 0h      | VCC1_R<br>ESET |
| 18     | LED2 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 17     | LED1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 16     | LED0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 15     | SMB3 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 14     | SMB2 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 13     | SMB1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 12     | RPM-PWM Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.   | R    | 0h      | VCC1_R<br>ESET |
| 11     | KEYSCAN Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.   | R    | 0h      | VCC1_R<br>ESET |
| 10     | HTIMER Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.    | R    | 0h      | VCC1_R<br>ESET |
| 9      | SPI0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.      | R    | 0h      | VCC1_R<br>ESET |
| 8      | PS2_3 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.     | R    | 0h      | VCC1_R<br>ESET |
| 7      | PS2_2 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.     | R    | 0h      | VCC1_R<br>ESET |



| Offset | 28h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 6      | PS2_1 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 5      | PS2_0 Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks. | R    | 0h      | VCC1_R<br>ESET |
| 4      | MCHP Reserved   | R    | 0h      | VCC1_R<br>ESET |
| 3      | ADC Clock Required<br>0: block does NOT need clocks.<br>1: block requires clocks.   | R    | 0h      | VCC1_R<br>ESET |
| 2:0    | RESERVED  | RES  |         |                |

### 3.9.11 SLOW CLOCK CONTROL REGISTER (SLOW\_CLK\_CNTRL)

| Offset | 2Ch   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:10  | RESERVED  | RES  |         |                |
| 9:0    | Slow Clock (100 kHz) Divide Value<br>Configures the <a href="#">100kHz_Clk</a> .<br>0: Clock off<br>n: divide by n.<br><b>Note:</b> The default setting is for 100 kHz. | R/W  | 1E0h    | VCC1_R<br>ESET |

### 3.9.12 OSCILLATOR ID REGISTER (CHIP\_OSC\_ID)

| Offset | 30h                                |      |         |                |
|--------|------------------------------------|------|---------|----------------|
| Bits   | Description                        | Type | Default | Reset Event    |
| 31:9   | RESERVED                           | RES  |         |                |
| 8      | OSC_LOCK<br>Oscillator Lock Status | R    | 0h      | VCC1_R<br>ESET |
| 7:0    | MCHP Reserved                      | R    | N/A     | VCC1_R<br>ESET |

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## 3.9.13 PCR CHIP SUB-SYSTEM POWER RESET STATUS (CHIP\_PWR\_RST\_STS)

| Offset | 34h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:12  | RESERVED  | RES  |         |             |
| 11     | <b>PCICLK_ACTIVE</b><br>This bit monitors the state of the PCI clock input. This status bit detects edges on the clock input but does not validate the frequency.<br>0: The 33MHz PCI clock input is not present.<br>1: The 33MHz PCI clock is present.   | R    | -       | VCC1_RESET  |
| 10     | <b>32K_ACTIVE</b><br>This bit monitors the state of the 32K clock input. This status bit detects edges on the clock input but does not validate the frequency.<br>0: The 32K clock input is not present. The internal 32K clock is derived from the ring oscillator<br>1: The 32K clock input is present. The internal 32K clock is derived from the pin and the ring oscillator is synchronized to the external 32K clock. | R    | -       | VCC1_RESET  |
| 9:7    | RESERVED  | RES  |         |             |
| 6      | <b>VCC1 reset status</b><br>Indicates the status of <b>VCC1_RESET</b> .<br>0 = No reset occurred since the last time this bit was cleared.<br>1 = A reset occurred.<br><b>Note:</b> The bit will not clear if a write 1 is attempted at the same time that a VCC1_RST_N occurs, this way a reset event is never missed.   | R/WC | 1h      | VCC1_RESET  |
| 5      | <b>VBAT reset status</b><br>Indicates the status of <b>VBAT_POR</b> .<br>0 = No reset occurred while <b>VCC1</b> was off or since the last time this bit was cleared.<br>1 = A reset occurred.<br><b>Note:</b> The bit will not clear if a write 1 is attempted at the same time that a VBAT_RST_N occurs, this way a reset event is never missed.  | R/WC | -       | VCC1_RESET  |
| 4      | RESERVED  | RES  |         |             |
| 3      | <b>SIO_Reset Status</b><br>Indicates the status of <b>nSIO_RESET</b> .<br>0 = reset active.<br>1 = reset not active.  | R    | xh      | Note 3-15   |
| 2      | <b>VCC Reset Status</b><br>Indicates the status of <b>PWRGD</b> .<br>0 = reset active ( <b>PWRGD</b> not asserted).<br>1 = reset not active ( <b>PWRGD</b> asserted).   | R    | xh      | Note 3-15   |
| 1:0    | RESERVED  | RES  |         |             |

**Note 3-15** This read-only status bit always reflects the current status of the event and is not affected by any Reset events.

## 3.9.14 CHIP RESET ENABLE REGISTER (CHIP\_RST\_EN)

| Offset | 38h           |      |         |             |
|--------|---------------|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:2   | RESERVED      | RES  |         |             |
| 1      | MCHP Reserved | R    | 0h      | VCC1_R ESET |
| 0      | MCHP Reserved | R/W  | 0h      | VCC1_R ESET |

**Note:** If a block is configured such that it is to be reset when it goes to sleep, then registers within the block may not be writable when the block is asleep.

## 3.9.15 HOST RESET ENABLE REGISTER (HOST\_RST\_EN)

| Offset | 3Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:19  | RESERVED   | RES  |         |             |
| 18     | RTC Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.       | R/W  | 0h      | VCC1_R ESET |
| 17     | RESERVED   | RES  |         |             |
| 16     | 8042EM Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.    | R/W  | 0h      | VCC1_R ESET |
| 15     | ACPI PM1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.  | R/W  | 0h      | VCC1_R ESET |
| 14     | ACPI EC 1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R ESET |
| 13     | ACPI EC 0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R ESET |
| 12     | GLBL_CFG Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.  | R/W  | 0h      | VCC1_R ESET |
| 11:2   | RESERVED   | RES  |         |             |
| 1      | UART 0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.    | R/W  | 0h      | VCC1_R ESET |
| 0      | LPC Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.       | R/W  | 0h      | VCC1_R ESET |

**Note:** If a block is configured such that it is to be reset when it goes to sleep, then registers within the block may not be writable when the block is asleep.

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## 3.9.16 EC RESET ENABLE REGISTER (EC\_RST\_EN)

| Offset | 40h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31     | TIMER16_1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.   | R/W  | 0h      | VCC1_R<br>ESET |
| 30     | TIMER16_0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.   | R/W  | 0h      | VCC1_R<br>ESET |
| 29     | EC_REG_BANK Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R<br>ESET |
| 28:23  | RESERVED   | RES  |         |                |
| 22     | PWM3 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.        | R/W  | 0h      | VCC1_R<br>ESET |
| 21     | PWM2 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.        | R/W  | 0h      | VCC1_R<br>ESET |
| 20     | PWM1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.        | R/W  | 0h      | VCC1_R<br>ESET |
| 19:12  | RESERVED   | RES  |         |                |
| 11     | TACH1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.       | R/W  | 0h      | VCC1_R<br>ESET |
| 10     | SMB0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.        | R/W  | 0h      | VCC1_R<br>ESET |
| 9      | WDT Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.         | R/W  | 0h      | VCC1_R<br>ESET |
| 8      | PROCESSOR Sleep Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.   | R/W  | 0h      | VCC1_R<br>ESET |
| 7      | TFDP Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.        | R/W  | 0h      | VCC1_R<br>ESET |
| 6      | DMA Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.         | R/W  | 0h      | VCC1_R<br>ESET |
| 5      | PMC Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.         | R/W  | 0h      | VCC1_R<br>ESET |
| 4      | PWM0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.        | R/W  | 0h      | VCC1_R<br>ESET |

| Offset | 40h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 3      | RESERVED   | RES  |         |                |
| 2      | TACH0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R<br>ESET |
| 1      | PECI Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.  | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | INT Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.   | R/W  | 0h      | VCC1_R<br>ESET |

**Note:** If a block is configured such that it is to be reset when it goes to sleep, then registers within the block may not be writable when the block is asleep.

### 3.9.17 EC RESET ENABLE 2 REGISTER (EC\_RST\_EN2)

| Offset | 44h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:29  | RESERVED   | RES  |         |                |
| 28     | MCHP Reserved  | R/W  | 0h      | VCC1_R<br>ESET |
| 27     | MCHP Reserved  | R/W  | 0h      | VCC1_R<br>ESET |
| 26     | MCHP Reserved  | R/W  | 0h      | VCC1_R<br>ESET |
| 25     | LED3 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.      | R/W  | 0h      | VCC1_R<br>ESET |
| 24     | TIMER32_1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R<br>ESET |
| 23     | TIMER32_0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R<br>ESET |
| 22     | TIMER16_3 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R<br>ESET |
| 21     | TIMER16_2_Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W  | 0h      | VCC1_R<br>ESET |
| 20     | SPI1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.      | R/W  | 0h      | VCC1_R<br>ESET |

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| Offset | 44h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 19     | BCM Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                  | R/W  | 0h      | VCC1_R<br>ESET |
| 18     | LED2 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                 | R/W  | 0h      | VCC1_R<br>ESET |
| 17     | LED1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                 | R/W  | 0h      | VCC1_R<br>ESET |
| 16     | LED0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                 | R/W  | 0h      | VCC1_R<br>ESET |
| 15     | SMB3 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                 | R/W  | 0h      | VCC1_R<br>ESET |
| 14     | SMB2 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                 | R/W  | 0h      | VCC1_R<br>ESET |
| 13     | SMB1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                 | R/W  | 0h      | VCC1_R<br>ESET |
| 12     | RPM-PWM Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                              | R/W  | 0h      | VCC1_R<br>ESET |
| 11     | KEYSCAN Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                              | R/W  | 0h      | VCC1_R<br>ESET |
| 10     | HTIMER Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                               | R/W  | 0h      | VCC1_R<br>ESET |
| 9      | SPI0 Reset Enable<br>0: block is free to use clocks as necessary.<br>1: block is commanded to sleep at next available moment. | R/W  | 0h      | VCC1_R<br>ESET |
| 8      | PS2_3 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                | R/W  | 0h      | VCC1_R<br>ESET |
| 7      | PS2_2 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                | R/W  | 0h      | VCC1_R<br>ESET |
| 6      | PS2_1 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                | R/W  | 0h      | VCC1_R<br>ESET |
| 5      | PS2_0 Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep.                                | R/W  | 0h      | VCC1_R<br>ESET |
| 4      | MCHP Reserved   | R/W  | 0h      | VCC1_R<br>ESET |

|               |  |             |                |                    |
|---------------|--|-------------|----------------|--------------------|
| <b>Offset</b> | 44h  |             |                |                    |
| <b>Bits</b>   | <b>Description</b>   | <b>Type</b> | <b>Default</b> | <b>Reset Event</b> |
| 3             | ADC Reset Enable<br>0: block will not be reset on sleep.<br>1: block will be reset on sleep. | R/W         | 0h             | VCC1_RESET         |
| 2:0           | RESERVED   | RES         |                |                    |

**Note:** If a block is configured such that it is to be reset when it goes to sleep, then registers within the block may not be writable when the block is asleep.

### 3.9.18 POWER RESET CONTROL (PWR\_RST\_CTRL) REGISTER

|               |   |             |                |                    |
|---------------|---|-------------|----------------|--------------------|
| <b>Offset</b> | 48h   |             |                |                    |
| <b>Bits</b>   | <b>Description</b>  | <b>Type</b> | <b>Default</b> | <b>Reset Event</b> |
| 31:1          | RESERVED  | RES         |                |                    |
| 0             | iRESET_OUT<br>The iRESET_OUT bit is used by firmware to control the internal nSIO_RESET signal function and the external nRESET_OUT pin. The external pin nRESET_OUT is always driven by nSIO_RESET. Firmware can program the state of iRESET_OUT except when the VCC PWRGD bit is not asserted ('0'), in which case iRESET_OUT is 'don't care' and nSIO_RESET is asserted ('0') (TABLE 3-11:).<br><br>The internal nSIO_RESET signal is asserted when iRESET_OUT is asserted even if the nRESET_OUT pin is configured as an alternate function.<br><br>The iRESET_OUT bit must be cleared to take the Host out of reset. | R/W         | 1h             | VCC1_RESET         |

**TABLE 3-11: iRESET\_OUT BIT BEHAVIOR**

| VCC PWRGD | iRESET_OUT | nSIO_RESET & nRESET_OUT | Description  |
|-----------|------------|-------------------------|--|
| 0         | X          | 0 (ASSERTED)            | The iRESET_OUT bit does not affect the state of nSIO_RESET when VCC PWRGD is not asserted. |
| 1         | 1          | 0 (ASSERTED)            | The iRESET_OUT bit can only be written by firmware when VCC PWRGD is asserted.             |
|           | 0          | 1 (NOT ASSERTED)        |  |

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## 4.0 VBAT REGISTER BANK

### 4.1 Introduction

This chapter defines a bank of registers powered by [VBAT](#).

### 4.2 Interface

This block is designed to be accessed internally by the EC via the register interface.

### 4.3 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

#### 4.3.1 POWER DOMAINS

**TABLE 4-1: POWER SOURCES**

| Name                 | Description   |
|----------------------|---|
| <a href="#">VBAT</a> | The <a href="#">VBAT Register Bank</a> are all implemented on this single power domain. |

#### 4.3.2 CLOCK INPUTS

This block does not require any special clock inputs. All register accesses are synchronized to the host clock.

#### 4.3.3 RESETS

**TABLE 4-2: RESET SIGNALS**

| Name                     | Description  |
|--------------------------|--|
| <a href="#">VBAT_POR</a> | This reset signal, which is an input to this block, resets all the logic and registers to their initial default state. |

## 4.4 Interrupts

**TABLE 4-3: INTERRUPT SIGNALS**

| Name       | Description  |
|------------|--|
| PFR_Status | This interrupt signal from the Power-Fail and Reset Status Register indicates VBAT RST and WDT events. |

## 4.5 Low Power Modes

The [VBAT Register Bank](#) is designed to always operate in the lowest power consumption state.

## 4.6 Description

The VBAT Register Bank block is a block implemented for aggregating miscellaneous battery-backed registers required the host and by the Embedded Controller (EC) Subsystem that are not unique to a block implemented in the EC subsystem.

## 4.7 EC-Only Registers

**TABLE 4-4: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address ( <a href="#">Note 4-1</a> ) |
|----------------|-----------------|------|-------------------------------|---|
| VBAT_REG_BANK  | 0               | EC   | 32-bit internal address space | 4000A400h                                 |

**Note 4-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.



**TABLE 4-5: RUNTIME REGISTER SUMMARY**

| Offset | Register Name                        |
|--------|--------------------------------------|
| 00h    | Power-Fail and Reset Status Register |
| 04h    | MCHP Reserved                        |
| 08h    | Clock Enable Register                |

## 4.7.1 POWER-FAIL AND RESET STATUS REGISTER

The Power-Fail and Reset Status Register collects and retains the VBAT RST and WDT event status when VCC1 is unpowered.

| Address | 00h   |      |         |              |
|---------|---|------|---------|--------------|
| Bits    | Description   | Type | Default | Reset Event  |
| 7       | <b>VBAT_RST</b><br>The VBAT RST bit is set to '1' by hardware when a <a href="#">VBAT_POR</a> is detected. This is the register default value. To clear VBAT RST EC firmware must write a '1' to this bit; writing a '0' to VBAT RST has no affect. | R/WC | 1       | VBAT_P<br>OR |
| 6       | Reserved  | RES  | -       | -            |
| 5       | <b>WDT</b><br>The WDT bit is asserted ('1') following a Watch-Dog Timer Forced Reset ( <a href="#">WDT Event</a> ). To clear the WDT bit EC firmware must write a '1' to this bit; writing a '0' to the WDT bit has no affect.                      | R/WC | 0       | VBAT_P<br>OR |
| 4:1     | Reserved  | RES  | -       | -            |
| 0       | <b>DET32K_IN</b><br>0 = No clock detected on the XTAL[1:2] pins.<br>1 = Clock detected on the XTAL[1:2] pins.   | R    | X       | VBAT_P<br>OR |

## 4.7.2 CLOCK ENABLE REGISTER

| Address | 08h   |      |         |              |
|---------|---|------|---------|--------------|
| Bits    | Description   | Type | Default | Reset Event  |
| 31:2    | RESERVED  | RES  | -       | -            |
| 1       | <b>32K_EN</b><br>This bit controls the 32.768 KHz Crystal Oscillator as defined in <a href="#">TABLE 4-6</a> .  | R/W  | 0b      | VBAT_P<br>OR |
| 0       | <b>XOSEL</b><br>This bit controls whether a crystal or single ended clock source is used.<br>1= the 32.768 KHz Crystal Oscillator is driven by a single-ended 32.768 KHz clock source connected to the XTAL2 pin.<br>0= the 32.768 KHz Crystal Oscillator requires a 32.768 KHz parallel resonant crystal connected between the XTAL1 and XTAL2 pins (default). | R/W  | 0b      | VBAT_P<br>OR |

**APPLICATION NOTE:** The XOSEL bit should be correctly configured by firmware before the 32K\_EN bit is asserted.

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TABLE 4-6: 32K\_EN BIT

| 32K_EN | 32.768 KHz Crystal Oscillator | Description   |
|--------|-------------------------------|---|
| 0      | OFF                           | VBAT_POR default.   |
| 1      | ON                            | The 32.768 KHz Crystal Oscillator can only be enabled by firmware ( <a href="#">Note 4-2</a> ). |

**Note 4-2** the 48MHz Ring Oscillator must not stop before 40  $\mu$ s min after the 32K\_EN bit is asserted.

## 5.0 LPC INTERFACE

### 5.1 Introduction

The Intel® Low Pin Count (LPC) Interface is the LPC Interface used by the system host to configure the chip and communicate with the logical devices implemented in the design through a series of read/write registers. Register access is accomplished through the LPC transfer cycles defined in [Table 5-8, "LPC Cycle Types Supported"](#).

The Logical Devices implemented in the design are identified in [Table 5-16, "I/O Base Address Registers," on page 92](#). The Base Address Registers allow any logical device's runtime registers to be relocated in LPC I/O space. All chip configuration registers for the device are accessed indirectly through the LPC I/O Configuration Port (see [Section 5.8.3, "Configuration Port," on page 83](#)).

LPC memory cycles may also be used to access the Base Address Registers of certain devices.

### 5.2 References

- Intel® Low Pin Count (LPC) Interface Specification, v1.1
- PCI Local Bus Specification, Rev. 2.2
- Serial IRQ Specification for PCI Systems Version 6.0.
- PCI Mobile Design Guide Rev 1.0

### 5.3 Terminology

This table defines specialized terms localized to this feature.

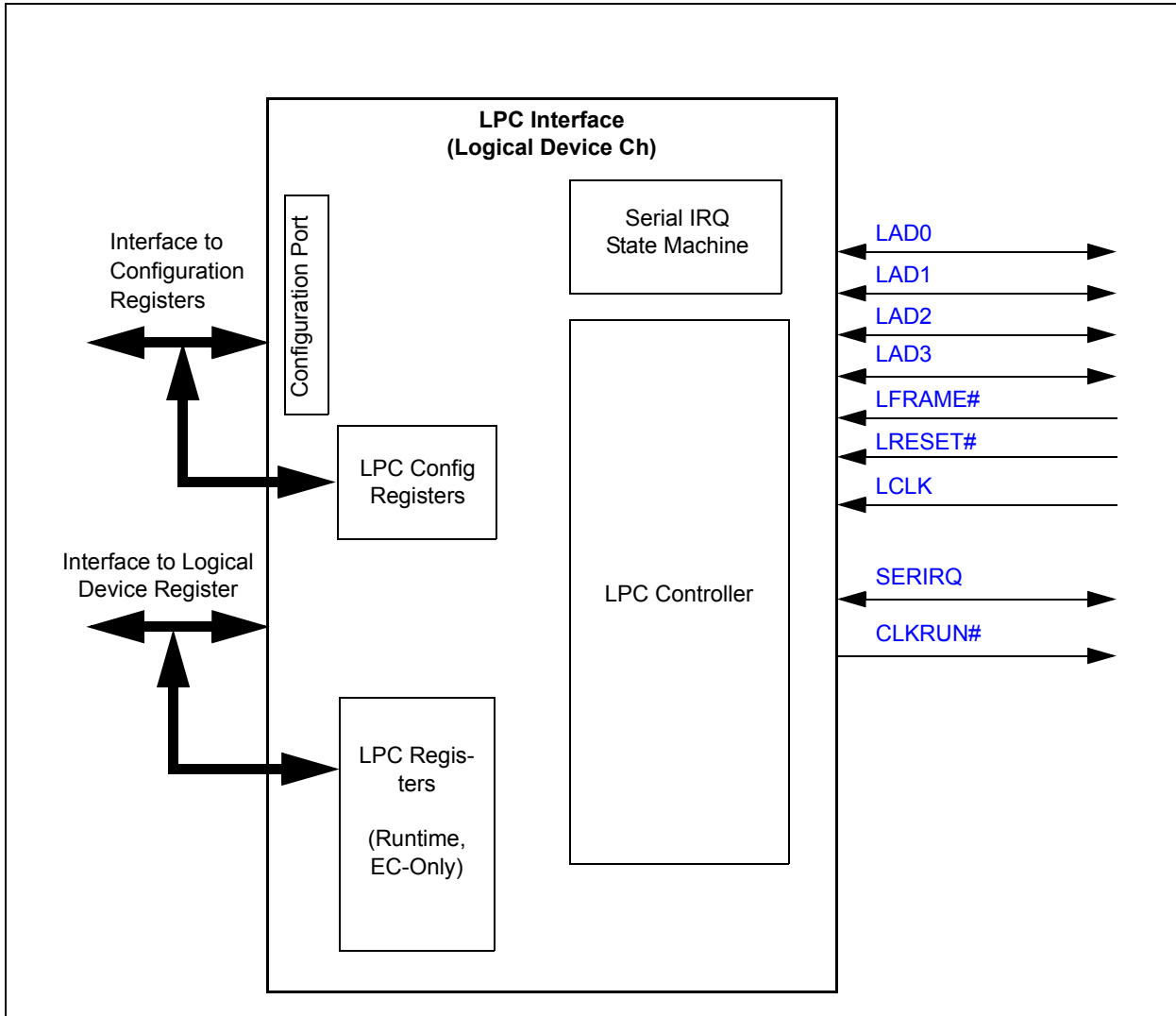
**TABLE 5-1: TERMINOLOGY**

| Term                    | Definition  |
|-------------------------|---|
| System Host             | Refers to the external CPU that communicates with this device via the LPC Interface.  |
| Logical Devices         | Logical Devices are LPC accessible features that are allocated a Base Address and range in LPC I/O address space  |
| Runtime Register        | Runtime Registers are register that are directly I/O accessible by the System Host via the LPC interface. These registers are defined in <a href="#">Section 5.10, "Runtime Registers," on page 93</a> .          |
| Configuration Registers | Registers that are only accessible in CONFIG_MODE. These registers are defined in <a href="#">Section 5.9, "LPC Configuration Registers," on page 88</a> .  |
| EC_Only Registers       | Registers that are not accessible by the System Host. They are only accessible by an internal embedded controller. These registers are defined in <a href="#">Section 5.11, "EC-Only Registers," on page 94</a> . |

## 5.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 5-1: BLOCK DIAGRAM OF LPC INTERFACE CONTROLLER WITH CLKRUN# SUPPORT**



### 5.4.1 SIGNAL DESCRIPTION

**TABLE 5-2: SIGNAL DESCRIPTION TABLE**

| Name | Direction    | Description   |
|------|--------------|---|
| LAD0 | Input/Output | Bit[0] of the LPC multiplexed command, address, and data bus. |
| LAD1 | Input/Output | Bit[1] of the LPC multiplexed command, address, and data bus. |
| LAD2 | Input/Output | Bit[2] of the LPC multiplexed command, address, and data bus. |
| LAD3 | Input/Output | Bit[3] of the LPC multiplexed command, address, and data bus. |

TABLE 5-2: SIGNAL DESCRIPTION TABLE (CONTINUED)

| Name    | Direction         | Description  |
|---------|-------------------|--|
| LFRAME# | Input             | Active low signal indicates start of new cycle and termination of broken cycle.  |
| LRESET# | Input             | Active low signal used as LPC Interface Reset. Same as PCI Reset on host.<br><b>Note:</b> LRESET# is typically connected to the host PCI RESET (PCIRST#) signal. |
| LCLK    | Input             | PCI clock input (PCI_CLK)  |
| SERIRQ  | Input/Output      | Serial IRQ pin used with the LCLK signal to transfer interrupts to the host.   |
| CLKRUN# | Open-Drain Output | Clock Control for LCLK   |

#### 5.4.2 REGISTER INTERFACES

The registers defined for the [LPC Interface](#) block are accessible by the various hosts as indicated in [Section 5.9, "LPC Configuration Registers"](#), [Section 5.11, "EC-Only Registers"](#) and [Section 5.10, "Runtime Registers"](#).

### 5.5 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

#### 5.5.1 POWER DOMAINS

TABLE 5-3: POWER SOURCES

| Name | Description  |
|------|--|
| VCC1 | The <a href="#">LPC Interface</a> block and registers are powered by VCC1. |

#### 5.5.2 CLOCK INPUTS

TABLE 5-4: CLOCK INPUTS

| Name | Description   |
|------|---|
| LCLK | This <a href="#">LPC Interface</a> has a single clock input, called LCLK. |

**Note:** The PCI\_CLK input to LCLK can run at 19.2MHz to 33MHz. When the PCI\_CLK input frequency is from 19.2MHz (including 24MHz) to 33MHz the [Handshake](#) bit in the [EC Clock Control Register](#) must be set to a '1' to capture LPC transactions properly. See [Section 5.11.4, "EC Clock Control Register," on page 96](#).

#### 5.5.3 RESETS

TABLE 5-5: RESET SIGNALS

| Name       | Description   |
|------------|---|
| VCC1_RESET | Power on Reset to the block. This signal resets all the register and logic in this block to its default state.  |
| nSIO_RESET | This signal is used to indicate when the main power rail in the system is reset. The LPC interface is operational when main power is present. This signal is used to reset selected registers as defined in the <a href="#">Register Interfaces</a> descriptions. |
| LRESET#    | The LRESET# signal comes from the LPC pin interface. This signal is defined in the <a href="#">Intel® Low Pin Count (LPC) Interface Specification, v1.1</a> .   |

The following table defines the effective reset state that result from the combination of these three reset signals.

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**TABLE 5-6: LPC Interface BLOCK RESET STATES**

| VCC1_RESET<br>(Note 5-2) | LRESET#<br>(Note 5-1, Note 5-4) | nSIO_RESET<br>(Note 5-3) | Reset State                         |
|--------------------------|---------------------------------|--------------------------|-------------------------------------|
| Asserted                 | X                               | X                        | Resets all registers and logic      |
| Deasserted               | Asserted                        | X                        | Resets selected registers and logic |
|                          | Deasserted                      | Asserted                 | Resets selected registers           |
|                          |                                 | Deasserted               | Nothing is in Reset                 |

**Note 5-1** The EC can determine the state of the LRESET# input using registers in LPC Bus Monitor Register on page 95.

**Note 5-2** VCC1\_RESET is asserted when VCC1 is turned off and is released after VCC1 is turned on. The VCC1\_RESET will be released before the System Host is expected to attempt communication over the LPC Interface.

**Note 5-3** See the individual register descriptions to determine which registers are effected by nSIO\_RESET.

**Note 5-4** The LPC Interface will be ready to receive a new transaction when LRESET# is deasserted. See the individual register descriptions to determine which registers are effected by this reset.

In system, the LPC Interface is required to be operational in ACPI Sleep States S0 - S2. When the system enters Sleep States S3 - S5 the LPC interface must tristate its outputs. The following table shows the behavior of LPC output and input/output signals under reset conditions.

**Note:** See Section 5.8.1.3, "LPC Clock Run," on page 80 page 157 for LPC protocol dependent pin state transitions requirements.

**TABLE 5-7: LPC INTERFACE SIGNALS BEHAVIOR ON RESET**

| Pins     | VCC1_RESET | nSIO_RESET | LRESET#<br>Asserted |
|----------|------------|------------|---------------------|
| LAD[3:0] | Tri-state  | Tri-state  | Tri-State           |
| SERIRQ   | Tri-state  | Tri-state  | Tri-State           |
| CLKRUN#  | Tri-state  | Tri-state  | Tri-State           |

## 5.6 Interrupts

This section defines the Interrupt Sources generated from this block.

| Source           | Description   |
|------------------|---|
| LPC_INTERNAL_ERR | The LPC_INTERNAL_ERR event is sourced by bit D0 of the Host Bus Error Register. |

## 5.7 Low Power Modes

The LPC Controller may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

The LPC Block has implemented an EC Clock Control Register to determine how the internal clocks are effected by the supported low power modes. See Section 5.11.4, "EC Clock Control Register," on page 96 for a description of these options.

## 5.8 Description

This LPC Controller is compliant with the Intel® Low Pin Count (LPC) Interface Specification, v1.1. Section 5.8.1, "LPC Controller Description" further clarifies which LPC Interface features have been implemented and qualifies any system specific requirements.

The LPC Controller claims only LPC transactions targeted for one of its peripherals. [Section 5.8.2, on page 81](#), describes the mechanism for [Claiming and Forwarding Transactions for Supported LPC Cycles](#). LPC transactions may be used to configure the chip and to access registers during operation. The mechanism to configure the chip is described in [Section 5.8.3, "Configuration Port," on page 83](#).

LPC memory cycles may also be used to access the Base Address Registers of certain devices.

Once configured, the LPC peripherals implemented as logical devices on chip may use the [SERIRQ](#) to notify the host of an event. See [Section 5.8.4, "Serial IRQs," on page 84](#).

## 5.8.1 LPC CONTROLLER DESCRIPTION

The following sections qualify the LPC features implemented according to the LPC Specification.

### 5.8.1.1 Cycle Types Supported

The following cycle types are supported by the LPC Interface Controller. All other cycles that it does not support are ignored.

**TABLE 5-8: LPC CYCLE TYPES SUPPORTED**

| Cycle Type   | Transfer Size |
|--------------|---------------|
| I/O Read     | 1 byte        |
| I/O Write    | 1 byte        |
| Memory Read  | 1 byte        |
| Memory Write | 1 byte        |

When the LPC Controller detects a transaction targeted for this device it claims and forwards that transaction as defined in [Section 5.8.2, "Claiming and Forwarding Transactions for Supported LPC Cycles," on page 81](#).

### LPC I/O CYCLES

The system host may use LPC I/O cycles to read/write the I/O mapped configuration and runtime registers implemented in this device. See the [Intel® Low Pin Count \(LPC\) Interface Specification, v1.1](#), Section 5.2 for definition of LPC I/O Cycles.

### LPC MEMORY CYCLES

The system host may use LPC memory cycles to access memory mapped registers implemented in this device. See the [Intel® Low Pin Count \(LPC\) Interface Specification, v1.1](#), Section 5.1 for definition of LPC Memory Cycles.

### 5.8.1.2 LAD[3:0] Fields

The LAD[3:0] signals support multiple fields for each protocol as defined in section 4.2.1 LAD[3:0] of the [Intel® Low Pin Count \(LPC\) Interface Specification, v1.1](#). The following sections further qualify the fields supported.

### WAIT SYNCs ON LPC

LPC transactions that access registers located on the device require a minimum of two wait SYNCs on the LPC bus. The number of SYNCs may be larger if the internal bus is in use by the embedded controller, or if the data referenced by the host is not present in a register. The device always uses Long Wait SYNCs, rather than Short Wait SYNCs, when responding to an LPC bus request.

**Note:** All LPC transactions are synchronized to the [LCLK](#) and will complete with a maximum of 8 wait states, unless otherwise noted.

### ERROR SYNCs ON LPC

The device does not issue ERROR SYNC cycles.

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## 5.8.1.3 LPC Clock Run

### USING CLKRUN#

CLKRUN# is used to indicate the status of LCLK as well as to request that a stopped clock be started. See [FIGURE 5-2: CLKRUN# System Implementation Example on page 81](#), an example of a typical system implementation using CLKRUN#.

LCLK Run Support can be enabled and disabled via SIRQ\_MODE as shown in [Table 5-9, "LPC Controller CLKRUN# Function"](#). When the SIRQ\_MODE is '0,' Serial IRQs are disabled, the CLKRUN# pin is disabled, and the affects of Interrupt requests on CLKRUN# are ignored. When the SIRQ\_MODE is '1,' Serial IRQs are enabled, the CLKRUN# pin is enabled, and the CLKRUN# support related to Interrupts requests as described in the section below is enabled.

The CLKRUN# pin is an open drain output and input. Refer to the PCI Mobile Design Guide Rev 1.0 for a description of the CLKRUN# function. If CLKRUN# is sampled "high", LCLK is stopped or stopping. If CLKRUN# is sampled "low", LCLK is starting or started (running).

### CLKRUN# Support for Serial IRQ Cycle

If a logical device asserts or de-asserts an interrupt and CLKRUN# is sampled "high", the LPC Controller can request the restoration of the clock by asserting the CLKRUN# signal asynchronously ([Table 5-9](#)). The LPC Controller holds CLKRUN# low until it detects two rising edges of the clock. After the second clock edge, the controller must disable the open drain driver ([Figure 5-3](#)).

The LPC Controller must not assert CLKRUN# if it is already driven low by the central resource; i.e., the PCI CLOCK GENERATOR in [Figure 5-2](#). The controller does not assert CLKRUN# under any conditions if the Serial IRQs are disabled.

The LPC Controller must not assert CLKRUN# unless the line has been de-asserted for two successive clocks; i.e., before the clock was stopped ([Figure 5-3](#)).

The LPC Controller does not assert CLKRUN# if it is already driven low by the central resource; i.e., the PCI CLOCK GENERATOR. The LPC Controller also does not assert CLKRUN# unless the signal has been de-asserted for two successive clocks; i.e., before the clock was stopped.

**TABLE 5-9: LPC CONTROLLER CLKRUN# FUNCTION**

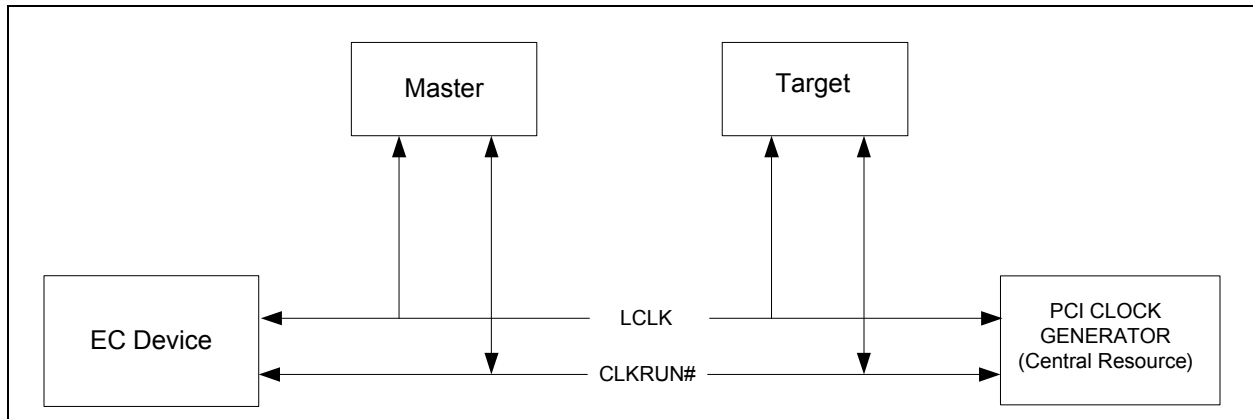
| SIRQ_MODE<br>( <a href="#">Note 5-5</a> ) | Internal Interrupt<br>Or DMA Request | CLKRUN#        | Action |
|---|--------------------------------------|----------------|--------|
| 0   | X                                    | X              | None   |
| 1   | NO CHANGE                            | X              | None   |
|   | CHANGE ( <a href="#">Note 5-6</a> )  | 0              | None   |
| 1   |                                      | Assert CLKRUN# |        |

**Note 5-5** SIRQ\_MODE is defined in [Section 5.8.4.1, "Enabling SERIRQ Function," on page 84](#).

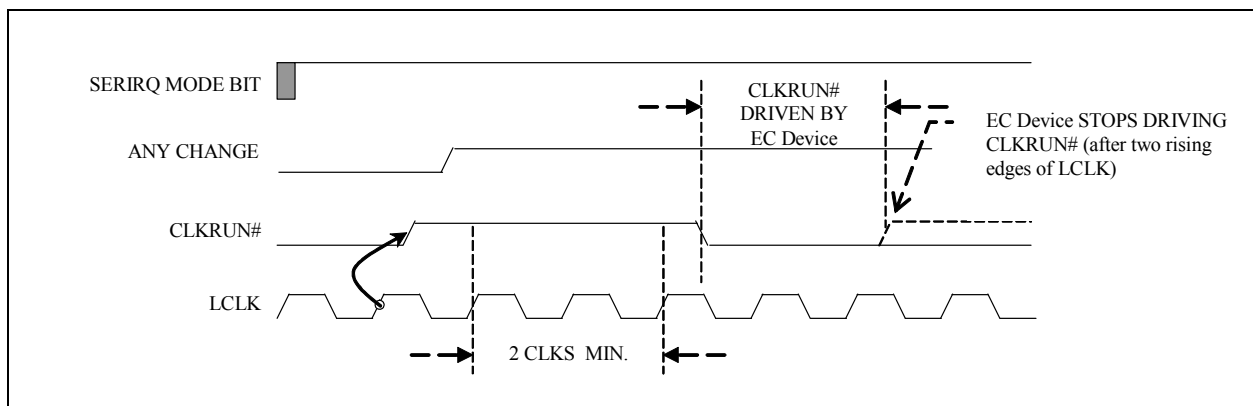
**Note 5-6** "Change" means either-edge change on any or all parallel IRQs routed to the Serial IRQ block. The "change" detection logic must run asynchronously to LCLK and regardless of the Serial IRQ mode; i.e., "continuous" or "quiet".



**FIGURE 5-2: CLKRUN# SYSTEM IMPLEMENTATION EXAMPLE**



**FIGURE 5-3: CLOCK START ILLUSTRATION**



**Note 1:** The signal “ANY CHANGE” is the same as “CHANGE/ASSERTION” in [Table 5-9](#).

**2:** The LPC Controller must continually monitor the state of CLKRUN# to maintain LCLK until an active “any IRQ change” condition has been transferred to the host in a Serial IRQ cycle or “any DRQ assertion” condition has been transferred to the host in a DMA cycle. For example, if “any IRQ change or DRQ assertion” is asserted before CLKRUN# is de-asserted (not shown in [Figure 5-3](#)), the controller must assert CLKRUN# as needed until the Serial IRQ cycle or DMA cycle has completed.

## 5.8.2 CLAIMING AND FORWARDING TRANSACTIONS FOR SUPPORTED LPC CYCLES

The following sections define how the LPC Controller determines if a cycle is targeted for one of the chip’s logical devices and how that transaction is then forwarded to that logical device. The following sections include:

- [Section 5.8.2.1, “I/O Transactions,” on page 81](#)
- [Section 5.8.2.2, “Device Memory Transactions,” on page 82](#)

### 5.8.2.1 I/O Transactions

The system host will generate I/O commands to communicate with I/O peripherals, such as Keyboard Controller, UART, etc. The LPC Controller claims only I/O transactions targeted to it and it ignores all others. The following sections describe how I/O transactions are claimed and forwarded to access the Runtime and Configuration registers.

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## CLAIMING LPC I/O TRANSACTIONS

The LPC Controller claims an I/O transaction that is targeted for one of its peripherals (also referred to as logical devices). A Base Address Register has been implemented for each logical device. See [Section 5.9.3, "I/O Base Address Registers \(BARs\)," on page 91](#). If one of the addresses programmed in the Logical Device Base Address Registers matches an LPC I/O address using the following relationship, the LPC Controller will claim the LPC bus cycle:

$(\text{LPC Address} \& \sim\text{BAR.MASK}) == (\text{BAR.LPC\_Address} \& \sim\text{BAR.MASK}) \&\& (\text{BAR.Valid} == 1)$

|  |
|--|
| <b>Note:</b> The LPC Controller's Base Address register is used to define the Base I/O Address of the <a href="#">Configuration Port</a> . |
|--|

## FORWARDING I/O TRANSACTIONS

The system host will use I/O transactions to access the Configuration and Runtime registers.

To access the Runtime registers, the host must configure the [I/O Base Address Registers \(BARs\)](#), which are accessible via the [Configuration Port](#). The Configuration Port, Logical Device Ch, is located at the Base I/O Address programmed in the BAR Configuration register located at offset 60h.

If the I/O transaction matches the BAR of Logical Device Ch, the transaction will be forwarded to the Configuration Port, otherwise the transaction will be forwarded to the Runtime Registers of the targeted logical device.

Each Logical Device may have up to 128 Contiguous Runtime Registers. The Runtime Registers are located at a defined offset from the Logical Device's base address. The host can directly access these registers with a standard LPC I/O command.

The Logical Device number for the matching device is located in the Frame field of the BAR. When matching LPC I/O addresses, the LPC Controller ignores address bits that correspond to '1b' bits in the MASK field.

For illustration purposes only, lets examine two types of logical devices (these may or may not reside in this design).

Example 1:

The Keyboard Controller (8042 Interface) Base Address Register has 60h in the LPC Address field, the Frame field is 01h, and the MASK field is 04h. Because of the single '1b' bit in MASK, the BAR will match LPC I/O patterns in the form '0000\_0000\_0110\_0x00b', so both 60h and 64h will be matched and claimed by the LPC Controller.

Example 2:

If a standard 16550 UART was located at LPC I/O address 238h, then the UART Receive buffer would appear at address 238h and the Line Status register at 23Dh. If the BAR for the UART was set to 0238\_8047h, then the UART will be matched at I/O address 238h.

### 5.8.2.2 Device Memory Transactions

Alternatively, LPC memory transactions can be used to access certain logical devices. The LPC Controller claims a memory transaction that is targeted for one of these logical devices. A Device Memory Base Address Register has been implemented for the logical devices listed in [Table 5-17, "Device Memory Base Address Register Default Values," on page 93](#).

On every LPC bus Memory access all Base Address Registers are checked in parallel and if any matches the LPC memory address the MEC1322 claims the bus cycle. The memory address is claimed as described in [I/O Transactions](#) except that the LPC memory cycle address is 32 bits instead of the 16 bit I/O cycle address.

Software should insure that no two BARs map the same LPC memory address. If two BARs do map to the same address, the BAR\_Conflict bit in the Host Bus Error Register is set when an LPC access targeting the BAR Conflict address. An EC interrupt can be generated.

Each Device Memory BAR is 48 bits wide. The format of each Device Memory BAR is summarized in [Device Memory Base Address Register Format](#). An LPC memory request is translated by the Device Memory BAR into an 8-bit read or write transaction on the AHB bus. The 32-bit LPC memory address is translated into a 24-bit AHB address

The Base Address Register Table is itself part of the AHB address space. It resides in the Configuration quadrant of Logical Device Ch, the LPC Interface.

## 5.8.3 CONFIGURATION PORT

The LPC Host can access the Chip's Configuration Registers through the Configuration Port when CONFIG MODE is enabled. The device defaults to CONFIG MODE being disabled.

**Note:** The data read from the Configuration Port Data register is undefined when CONFIG MODE is not enabled.

The Configuration Port is composed of an INDEX and DATA Register. The INDEX register is used as an address pointer to an 8-bit configuration register and the DATA register is used to read or write the data value from the indexed configuration register. Once CONFIG MODE is enabled, reading the Configuration Port Data register will return the data value that is in the indexed Configuration Register.

If no value was written to the INDEX register, reading the Data Register in the Configuration Port will return the value in Configuration Address location 00h (default).

**TABLE 5-10: CONFIGURATION PORT**

| Default I/O Address<br>(Note 5-7) | Type         | Register Name | Relative Address                      | Default Value | Notes    |
|-----------------------------------|--------------|---------------|---------------------------------------|---------------|----------|
| 002Eh                             | Read / Write | INDEX         | Configuration Port's Base Address + 0 | 00h           | Note 5-7 |
| 002Fh                             | Read / Write | DATA          | Configuration Port's Base Address + 1 | 00h           |          |

**Note 5-7** The default Base I/O Address of the Configuration Port can be relocated by programming the BAR register for Logical Device Ch (LPC/Configuration Port) at offset 60h. The Relative Address shows the general case for determining the I/O address for each register.

### 5.8.3.1 Enable CONFIG MODE

The INDEX and DATA registers are effective only when the chip is in CONFIG MODE. CONFIG MODE is enabled when the Config Entry Key is successfully written to the I/O address of the INDEX register of the CONFIG PORT while the CONFIG MODE is disabled (see [Section 5.8.3.2, "Disable CONFIG MODE"](#)).

Config Entry Key = < 55h>

### 5.8.3.2 Disable CONFIG MODE

CONFIG MODE defaults to disabled on a [VCC1\\_RESET](#), [nSIO\\_RESET](#), and when [LRESET#](#) is asserted. CONFIG MODE is also disabled when the following Config Exit Key is successfully written to the I/O address of the INDEX PORT of the CONFIG PORT while CONFIG MODE is enabled.

Config Exit Key = < AAh>

### 5.8.3.3 Configuration Sequence Example

To program the configuration registers, the following sequence must be followed:

1. Enable Configuration State
2. Program the Configuration Registers
3. Disable Configuration State.

The following is an example of a configuration program in Intel 8086 assembly language.

```

;-----
; ENABLE CONFIGURATION STATE
;-----
MOV     DX,CONFIG_PORT_BASE_ADDRESS
MOV     AX,055H; Config Entry Key
OUT     DX,AL
;-----
; CONFIGURE BASE ADDRESS,   |
; LOGICAL DEVICE 8         |
;-----
MOV     DX,CONFIG_PORT_BASE_ADDRESS
MOV     AL,07H
OUT     DX,AL; Point to LD# Config Reg
MOV     DX,CONFIG_PORT_BASE_ADDRESS+1

```

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```

MOV     AL, 08H
OUT DX,AL; Point to Logical Device 8
;
MOV     DX,CONFIG_PORT_BASE_ADDRESS
MOV     AL,60H
OUT     DX,AL ; Point to BASE ADDRESS REGISTER
MOV     DX,CONFIG_PORT_BASE_ADDRESS+1
MOV     AL,02H
OUT     DX,AL ; Update BASE ADDRESS REGISTER
;-----
; DISABLE CONFIGURATION STATE
;-----
MOV     DX,CONFIG_PORT_BASE_ADDRESS
MOV     AX,0AAH; Config Exit Key
OUT     DX,AL.

```

## 5.8.4 SERIAL IRQS

The device supports the serial interrupt scheme, which is adopted by several companies, to transmit interrupt information to the system. The serial interrupt scheme adheres to the [Serial IRQ Specification for PCI Systems Version 6.0.](#)

### 5.8.4.1 Enabling SERIRQ Function

Each Serial IRQ channel defaults to disabled. To enable a Serial IRQ channel the host must program the [Serial IRQ Configuration Registers on page 89.](#)

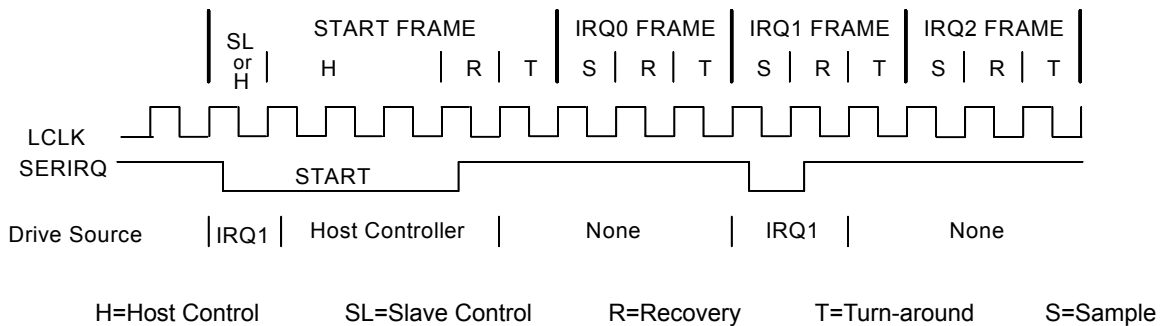
### 5.8.4.2 TIMING DIAGRAMS for SERIRQ CYCLE

LCLK = LCLK pin

SERIRQ = Serial IRQ pin

Start Frame timing with source sampled a low pulse on IRQ1

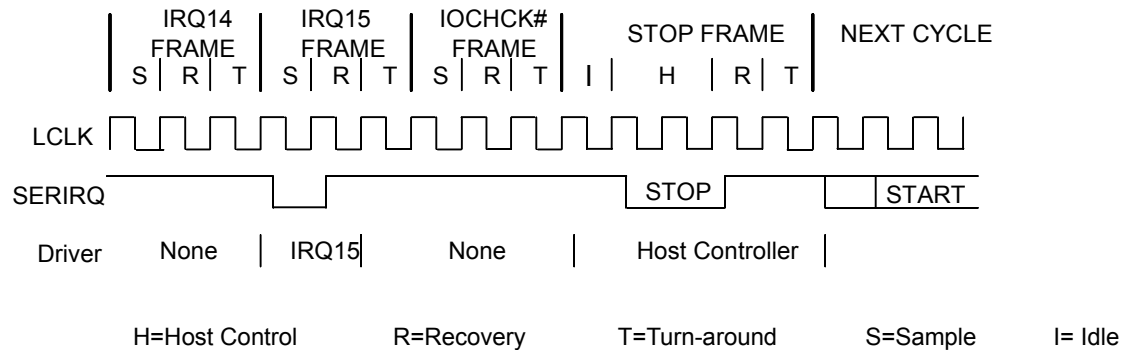
**FIGURE 5-4: SERIAL INTERRUPTS WAVEFORM “START FRAME”**



Start Frame pulse can be 4-8 clocks wide.

Stop Frame Timing with Host using 17 SERIRQ sampling period

**FIGURE 5-5: SERIAL INTERRUPT WAVEFORM “STOP FRAME”**



Stop pulse is two clocks wide for Quiet mode, three clocks wide for Continuous mode.

There may be none, one, or more Idle states during the Stop Frame.

The next SERIRQ cycle's Start Frame pulse may or may not start immediately after the turn-around clock of the Stop Frame.

### 5.8.4.3 SERIRQ Cycle Control

#### SERIRQ START FRAME

There are two modes of operation for the SERIRQ Start Frame.

##### Quiet (Active) Mode

Any device may initiate a Start Frame by driving the SERIRQ low for one clock, while the SERIRQ is Idle. After driving low for one clock, the SERIRQ must immediately be tri-stated without at any time driving high. A Start Frame may not be initiated while the SERIRQ is active. The SERIRQ is Idle between Stop and Start Frames. The SERIRQ is active between Start and Stop Frames. This mode of operation allows the SERIRQ to be Idle when there are no IRQ/Data transitions which should be most of the time.

Once a Start Frame has been initiated, the host controller will take over driving the SERIRQ low in the next clock and will continue driving the SERIRQ low for a programmable period of three to seven clocks. This makes a total low pulse width of four to eight clocks. Finally, the host controller will drive the SERIRQ back high for one clock then tri-state.

Any SERIRQ Device which detects any transition on an IRQ/Data line for which it is responsible must initiate a Start Frame in order to update the host controller unless the SERIRQ is already in an SERIRQ Cycle and the IRQ/Data transition can be delivered in that SERIRQ Cycle.

##### Continuous (Idle) Mode

Only the Host controller can initiate a Start Frame to update IRQ/Data line information. All other SERIRQ agents become passive and may not initiate a Start Frame. SERIRQ will be driven low for four to eight clocks by host controller. This mode has two functions. It can be used to stop or idle the SERIRQ or the host controller can operate SERIRQ in a continuous mode by initiating a Start Frame at the end of every Stop Frame.

An SERIRQ mode transition can only occur during the Stop Frame. Upon reset, SERIRQ bus is defaulted to continuous mode, therefore only the host controller can initiate the first Start Frame. Slaves must continuously sample the Stop Frames pulse width to determine the next SERIRQ Cycle's mode.

#### SERIRQ DATA FRAME

Once a Start Frame has been initiated, the LPC Controller will watch for the rising edge of the Start Pulse and start counting IRQ/Data Frames from there. Each IRQ/Data Frame is three clocks: Sample phase, Recovery phase, and Turn-around phase. During the sample phase, the LPC Controller must drive the SERIRQ (SIRQ pin) low, if and only if, its last detected IRQ/Data value was low. If its detected IRQ/Data value is high, SERIRQ must be left tri-stated. During the recovery phase, the LPC Controller must drive the SERIRQ high, if and only if, it had driven the SERIRQ low during the previous sample phase. During the turn-around phase, the controller must tri-state the SERIRQ. The device drives the SERIRQ line low at the appropriate sample point if its associated IRQ/Data line is low, regardless of which device initiated the start frame.

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The Sample phase for each IRQ/Data follows the low to high transition of the Start Frame pulse by a number of clocks equal to the IRQ/Data Frame times three, minus one e.g. The IRQ5 Sample clock is the sixth IRQ/Data Frame, then the sample phase is  $\{(6 \times 3) - 1 = 17\}$  the seventeenth clock after the rising edge of the Start Pulse.

**TABLE 5-11: SERIRQ SAMPLING PERIODS**

| SERIRQ Period | Signal Sampled | # of Clocks Past Start |
|---------------|----------------|------------------------|
| 1             | Not Used       | 2                      |
| 2             | IRQ1           | 5                      |
| 3             | IRQ2           | 8                      |
| 4             | IRQ3           | 11                     |
| 5             | IRQ4           | 14                     |
| 6             | IRQ5           | 17                     |
| 7             | IRQ6           | 20                     |
| 8             | IRQ7           | 23                     |
| 9             | IRQ8           | 26                     |
| 10            | IRQ9           | 29                     |
| 11            | IRQ10          | 32                     |
| 12            | IRQ11          | 35                     |
| 13            | IRQ12          | 38                     |
| 14            | IRQ13          | 41                     |
| 15            | IRQ14          | 44                     |
| 16            | IRQ15          | 47                     |

The SIRQ data frame will now support IRQ2 from a logical device; previously SERIRQ Period 3 was reserved for use by the System Management Interrupt (LSMI#). When using Period 3 for IRQ2, the user should mask off the SMI via the ESMI Mask Register. Likewise, when using Period 3 for LSMI#, the user should not configure any logical devices as using IRQ2.

SERIRQ Period 14 is used to transfer IRQ13. Each Logical devices will have IRQ13 as a choice for their primary interrupt.

## STOP CYCLE CONTROL

Once all IRQ/Data Frames have completed, the host controller will terminate SERIRQ activity by initiating a Stop Frame. Only the host controller can initiate the Stop Frame. A Stop Frame is indicated when the SERIRQ is low for two or three clocks. If the Stop Frame's low time is two clocks, then the next SERIRQ cycle's sampled mode is the Quiet mode; and any SERIRQ device may initiate a Start Frame in the second clock or more after the rising edge of the Stop Frame's pulse. If the Stop Frame's low time is three clocks, then the next SERIRQ cycle's sampled mode is the continuous mode, and only the host controller may initiate a Start Frame in the second clock or more after the rising edge of the Stop Frame's pulse.

### 5.8.4.4 Latency

Latency for IRQ/Data updates over the SERIRQ bus in bridge-less systems with the minimum IRQ/Data Frames of 17 will range up to 96 clocks (3.84 $\mu$ S with a 25 MHz LCLK or 2.88 $\mu$ s with a 33 MHz LCLK).

**Note:** If one or more PCI to PCI Bridge is added to a system, the latency for IRQ/Data updates from the secondary or tertiary buses will be a few clocks longer for synchronous buses, and approximately double for asynchronous buses.

### 5.8.4.5 EOI/ISR Read Latency

Any serialized IRQ scheme has a potential implementation issue related to IRQ latency. IRQ latency could cause an EOI or ISR Read to precede an IRQ transition that it should have followed. This could cause a system fault. The host interrupt controller is responsible for ensuring that these latency issues are mitigated. The recommended solution is to delay EOIs and ISR Reads to the interrupt controller by the same amount as the SERIRQ Cycle latency in order to ensure that these events do not occur out of order.

## 5.8.4.6 AC/DC Specification Issue

All Serial IRQ agents must drive/sample SERIRQ synchronously related to the rising edge of LCLK. The SERIRQ pin uses the electrical specification of the PCI bus. Electrical parameters will follow the PCI Local Bus Specification, Rev. 2.2 definition of “sustained tri-state.”

## 5.8.4.7 Reset and Initialization

The SERIRQ bus uses LRESET# as its reset signal and follows the PCI bus reset mechanism. The SERIRQ pin is tri-stated by all agents while LRESET# is active. With reset, SERIRQ slaves and bridges are put into the (continuous) Idle mode. The host controller is responsible for starting the initial SERIRQ cycle to collect system’s IRQ/Data default values. The system then follows with the Continuous/Quiet mode protocol (Stop Frame pulse width) for subsequent SERIRQ cycles. It is the host controller’s responsibility to provide the default values to the 8259’s and other system logic before the first SERIRQ cycle is performed. For SERIRQ system suspend, insertion, or removal application, the host controller should be programmed into Continuous (IDLE) mode first. This is to ensure the SERIRQ bus is in Idle state before the system configuration changes.

## 5.8.4.8 SERIRQ Interrupts

The LPC Controller routes Logical Device interrupts onto SIRQ stream frames IRQ[0:15]. Routing is controlled by the SIRQ Interrupt Configuration Registers. There is one SIRQ Interrupt Configuration Register for each accessible SIRQ Frame (IRQ); all 16 registers are listed in [Table 5-15, "SIRQ Interrupt Configuration Register Map"](#).

The format for each SIRQ Interrupt Configuration Register is described in [Section 5.9.2.1, "SIRQ Configuration Register Format," on page 90](#). Each Logical Device can have up to two LPC SERIRQ interrupts. When the device is polled by the host, each SIRQ frame routes the level of the Logical Device interrupt (selected by the corresponding SIRQ Interrupt Configuration Register) to the SIRQ stream.

## 5.8.4.9 SERIRQ Routing

Each SIRQ Interrupt Configuration Register controls a series of multiplexers which route to a single Logical Device interrupt as illustrated in [FIGURE 5-6: SIRQ Routing Internal Logical Devices on page 88](#). The following table defines the Serial IRQ routing for each logical device implemented in the chip.

**TABLE 5-12: LOGICAL DEVICE SIRQ ROUTING**

| SIRQ Interrupt Configuration Register |        |       | Logical Device Interrupt Source           |                  |
|---------------------------------------|--------|-------|---|------------------|
| SELECT                                | DEVICE | FRAME | Logical Device (Block Instance - Note 1:) | Interrupt Source |
| 0                                     | 0      | 0h    | EMI                                       | EC-to-Host       |
| 1                                     | 0      | 0h    | EMI                                       | Host Event       |
| 0                                     | 0      | 1h    | 8042 Keyboard Controller                  | KIRQ             |
| 1                                     | 0      | 1h    | 8042 Keyboard Controller                  | MIRQ             |
| 0                                     | 0      | 3h    | ACPI EC0                                  | EC_OBF           |
| 0                                     | 0      | 4h    | ACPI EC1                                  | EC_OBF           |
| 0                                     | 0      | 5h    | ACPI PM1                                  | N/A              |
| 0                                     | 0      | 6h    | Legacy Port92/GateA20                     | N/A              |
| 0                                     | 0      | 7h    | UART 0                                    | UART             |
| 0                                     | 0      | 9h    | Mailbox                                   | MBX_Host SIRQ    |
| 1                                     | 0      | 9h    | Mailbox                                   | MBX_Host_SMI     |

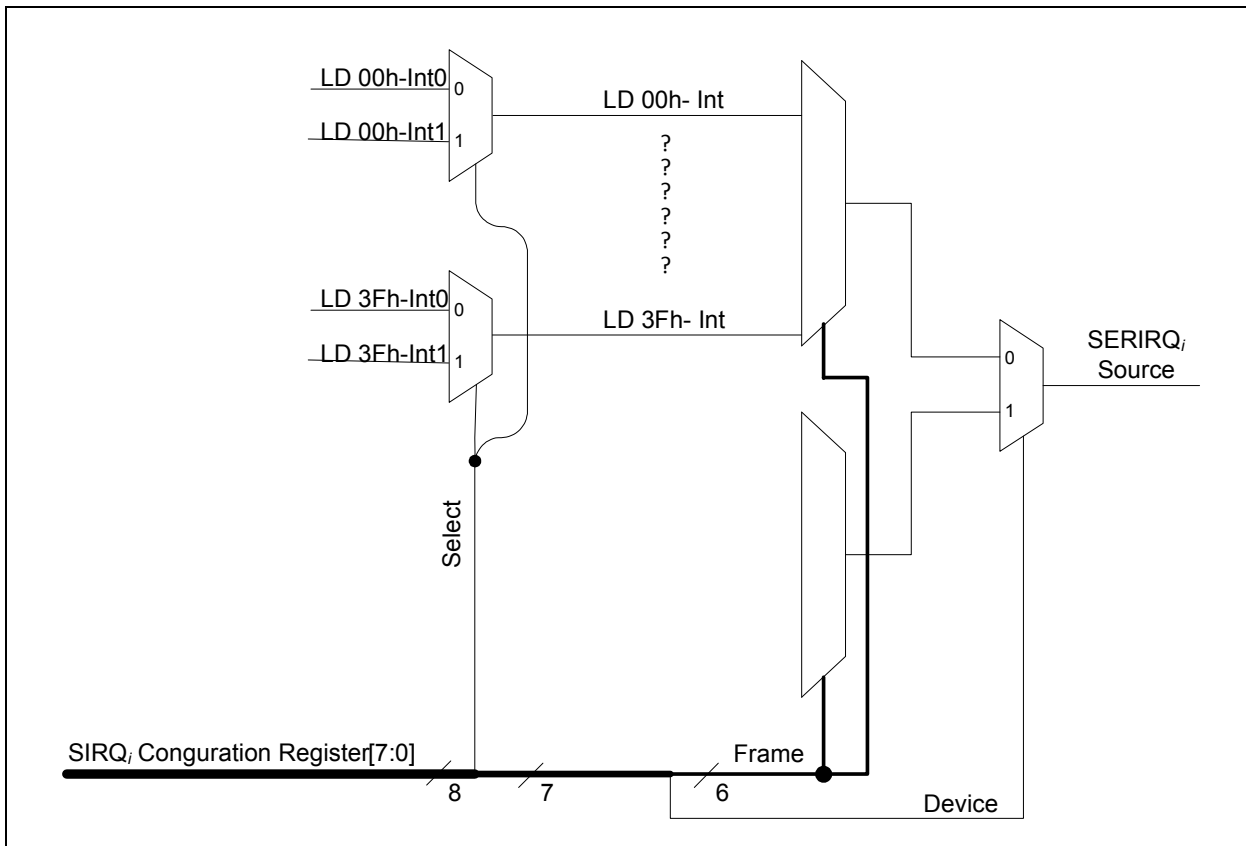
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TABLE 5-12: LOGICAL DEVICE SIRQ ROUTING (CONTINUED)

| SIRQ Interrupt Configuration Register |        |       | Logical Device Interrupt Source              |                  |
|---------------------------------------|--------|-------|--|------------------|
| SELECT                                | DEVICE | FRAME | Logical Device<br>(Block Instance - Note 1:) | Interrupt Source |
| 0                                     | 0      | Bh    | RTC  | RTC              |
| 0                                     | 0      | Ch    | LPC interface                                | EC_IRQ           |

**Note 1:** The Block Instance number is only included if there are multiple instantiations of a block. Otherwise, single block instances do not require this differentiation.

FIGURE 5-6: SIRQ ROUTING INTERNAL LOGICAL DEVICES



**Note:** Two Logical Devices cannot share a Serial IRQ.

## 5.9 LPC Configuration Registers

The configuration registers listed in [Table 5-14, "Configuration Register Summary"](#) are for a single instance of the [LPC Interface](#). The addresses of each register listed in [Table 5-14](#) are defined as a relative offset to the host "Begin Address" defined in [Table 5-13](#).



**TABLE 5-13: CONFIGURATION REGISTER ADDRESS RANGE TABLE**

| Instance NAME | Instance Number | Host | Address Space                 | Begin Address (Note 5-8) |
|---------------|-----------------|------|-------------------------------|--------------------------|
| LPC Interface | 0               | LPC  | Configuration Port            | INDEX = 00h              |
|               | 0               | EC   | 32-bit internal address space | 400F_3300h               |

**Note 5-8** The Begin Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 5-14: CONFIGURATION REGISTER SUMMARY**

| Register Name  | Offset                         | Size | Notes |
|--|--------------------------------|------|-------|
| <a href="#">LPC Activate Register</a>                | 30h                            | 8    |       |
| <a href="#">SIRQ Configuration Register Format</a>   | 40h - 4Fh                      | 8    |       |
| <a href="#">I/O Base Address Registers (BARs)</a>    | See <a href="#">Table 5-16</a> | 32   |       |
| <a href="#">Device Memory Base Address Registers</a> | See <a href="#">Table 5-17</a> | 48   |       |

## 5.9.1 LPC ACTIVATE REGISTER

The [LPC Activate Register](#) controls the LPC device itself. The Host can shut down the LPC Logical Device by clearing the Activate bit, but it cannot restart the LPC interface, since once the LPC interface is inactive the Host has no access to any registers on the device. The Embedded Controller can set or clear the Activate bit at any time.

| Offset | 30h  |      |         |                            |
|--------|--|------|---------|----------------------------|
| Bits   | Description  | Type | Default | Reset Event                |
| 7:1    | RESERVED   | RES  | -       | -                          |
| 0      | ACTIVATE<br>1= Activate<br>When this bit is 1, the LPC Logical Device is powered and functional.<br>0= Deactivate<br>When this bit is 0, the logical device is powered down and inactive.<br>Except for the <a href="#">LPC Activate Register</a> itself, clocks to the block are gated and the LPC Logical Device will permit the ring oscillator to be shut down (see <a href="#">Section 5.11.4, "EC Clock Control Register," on page 96</a> ). LPC bus output pads will be tri-stated. | R/W  | 0b      | <a href="#">VCC1_RESET</a> |

**APPLICATION NOTE:** The bit in the [LPC Activate Register](#) should not be written '0' to by the Host over LPC.

## 5.9.2 SERIAL IRQ CONFIGURATION REGISTERS

The LPC Controller implements 16 IRQ channels that may be configured to be asserted by any logical device.

- For a description of the SIRQ Configuration Register format see [Table 5-15, "SIRQ Interrupt Configuration Register Map," on page 90](#).
- For a summary of the SIRQ IRQ Configuration registers implemented see [Table 5-16, "I/O Base Address Registers," on page 92](#).
- For a list of the SIRQ sources see [Table 5-12, "Logical Device Sirq Routing," on page 87](#).

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## 5.9.2.1 SIRQ Configuration Register Format

| Offset | See <a href="#">Table 5-15, "SIRQ Interrupt Configuration Register Map,"</a> on page 90.  |      |                          |             |
|--------|---|------|--------------------------|-------------|
| Bits   | Description   | Type | Default                  | Reset Event |
| 7      | <b>SELECT</b><br>If this bit is 1, the first interrupt signal from the Logical Device is selected for the SERIRQ vector. If this bit is 0, the second interrupt signal from the Logical Device is selected.<br><b>Note:</b> The Keyboard Controller is an example of a Logical Devices that requires a second interrupt signal. Most Logical Devices require only a single interrupt and ignore this field as result. | R/W  | <a href="#">Note 5-9</a> | nSIO_R ESET |
| 6      | <b>DEVICE</b><br>This field should always be set to 0 in order to enable a SERIRQ.  | R/W  | <a href="#">Note 5-9</a> | nSIO_R ESET |
| 5:0    | <b>FRAME</b><br>These six bits select the Logical Device for on-chip devices as the source for the interrupt.<br><b>Note:</b> The LPC Logical Device (Logical Device Number 0Ch) can be used by the Embedded Controller to generate a Serial Interrupt Request to the Host under software control.  | R/W  | <a href="#">Note 5-9</a> | nSIO_R ESET |

**Note 5-9** See [Table 5-15, "SIRQ Interrupt Configuration Register Map,"](#) on page 90.

## 5.9.2.2 SIRQ Configuration Registers

**TABLE 5-15: SIRQ INTERRUPT CONFIGURATION REGISTER MAP**

| Offset | Type | Reset | Configuration Register Name |
|--------|------|-------|-----------------------------|
| 40h    | R/W  | FFh   | IRQ0                        |
| 41h    | R/W  | FFh   | IRQ1                        |
| 42h    | R/W  | FFh   | IRQ2                        |
| 43h    | R/W  | FFh   | IRQ3                        |
| 44h    | R/W  | FFh   | IRQ4                        |
| 45h    | R/W  | FFh   | IRQ5                        |
| 46h    | R/W  | FFh   | IRQ6                        |
| 47h    | R/W  | FFh   | IRQ7                        |
| 48h    | R/W  | FFh   | IRQ8                        |
| 49h    | R/W  | FFh   | IRQ9                        |
| 4Ah    | R/W  | FFh   | IRQ10                       |
| 4Bh    | R/W  | FFh   | IRQ11                       |
| 4Ch    | R/W  | FFh   | IRQ12                       |
| 4Dh    | R/W  | FFh   | IRQ13                       |
| 4Eh    | R/W  | FFh   | IRQ14                       |
| 4Fh    | R/W  | FFh   | IRQ15                       |

**Note:** A SERIRQ interrupt is deactivated by setting an entry in the [SIRQ Interrupt Configuration Register Map](#) to FFh, which is the default reset value.

## 5.9.3 I/O BASE ADDRESS REGISTERS (BARS)

The LPC Controller has implemented a Base Address Register (BAR) for each Logical Device in the LPC Configuration space.

- For a description of the Base Address Register format see [Section 5.9.3.1, "I/O Base Address Register Format," on page 91](#).
- For a description of the BARs per Logical Device see [Table 5-16, "I/O Base Address Registers," on page 92](#).

On every LPC bus I/O access the unmasked portion of the programmed LPC Host Address in each of the Base Address Registers are checked in parallel and if any matches the LPC I/O address the LPC Controller claims the bus cycle.

**Note:** Software should ensure that no two BARs map the same LPC I/O address. If two BARs do map to the same address, the `LPC_INTERNAL_ERR` and `BAR_CONFLICT` status bits are set when an LPC access is targeting the address with the BAR conflict.

The format of each BAR is summarized in [Section 5.9.3.1, "I/O Base Address Register Format," on page 91](#).

### 5.9.3.1 I/O Base Address Register Format

Each LPC accessible logical device has a programmable Base Address Register. The following table defines the generic format used for all of these registers. See [Table 5-16, "I/O Base Address Registers"](#) for a list of all the Logical Device Base Address registers implemented.

| Offset | See <a href="#">Table 5-16, "I/O Base Address Registers," on page 92</a>  |                                      |                                |                           |
|--------|---|--------------------------------------|--------------------------------|---------------------------|
| Bits   | Description   | Type                                 | Default                        | Reset Event               |
| 31:16  | LPC Host Address<br>These 16 bits are used to match LPC I/O addresses   | R/W<br>( <a href="#">Note 5-11</a> ) | See <a href="#">Table 5-16</a> | <a href="#">Note 5-10</a> |
| 15     | VALID<br>If this bit is 1, the BAR is valid and will participate in LPC matches. If it is 0 this BAR is ignored   | R/W                                  | See <a href="#">Table 5-16</a> | <a href="#">Note 5-10</a> |
| 14     | DEVICE (device)<br>This bit combined with <code>FRAME</code> constitute the Logical Device Number. <code>DEVICE</code> identifies the physical location of the logical device. This bit should always be set to 0.  | R                                    | See <a href="#">Table 5-16</a> | <a href="#">Note 5-10</a> |
| 13:8   | FRAME<br>These 6 bits are used to specify a logical device frame number within a bus. This field is multiplied by 400h to provide the frame address within the peripheral bus address. Frame values for frames corresponding to logical devices that are not present on the device are invalid. | R                                    | See <a href="#">Table 5-16</a> | <a href="#">Note 5-10</a> |
| 7:0    | MASK<br>These 8 bits are used to mask off address bits in the address match between an LPC I/O address and the Host Address field of the BARs, as described in <a href="#">Section 5.8.2.1, "I/O Transactions"</a> . A block of up to 256 8-bit registers can be assigned to one base address.  | R                                    | See <a href="#">Table 5-16</a> | <a href="#">Note 5-10</a> |

**Note 5-10** Offset 60h is the LPC Base Address register. The LPC Base Address register is only reset on `VCC1_RESET`. However, bits[31:16] are reloaded on `nSIO_RESET` with the value in the `LPC BAR Init Register`.

**Note 5-11** Bits[31:16] LPC Host Address bit field in the LPC Base Address register at offset 60h must be written LSB then MSB. This particular register has a shadow that lets the Host come in and write to the lower byte of the 16-bit address, and the resulting 16-bit LPC Host address field does not update. Writing to the upper byte triggers a full 16-bit field update.

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## 5.9.3.2 Logical Device I/O BAR Description

The following table defines the LPC I/O BAR of each logical device implemented in the design.

**TABLE 5-16: I/O BASE ADDRESS REGISTERS**

| Offset | Logical Device Number | Logical Devices                    | Reset Default      | Base Address Register Bit Field Descriptions |           |           |               |              |
|--------|-----------------------|------------------------------------|--------------------|--|-----------|-----------|---------------|--------------|
|        |                       |                                    |                    | Bits [D31:D16]                               | Bit [D15] | Bit [D14] | Bits [D13:D8] | Bits [D6:D0] |
|        |                       |                                    |                    | Default LPC I/O Host Address                 | VALID     | DEVICE    | FRAME         | MASK         |
| 60h    | C                     | LPC Interface (Configuration Port) | 002E_0C01 (Note 1) | 002E   | 0         | 0         | C             | 1            |
| 64h    | 0                     | EMI 0                              | 0000_000F          | 0000   | 0         | 0         | 0             | F            |
| 68h    | 7                     | UART 0                             | 0000_0707          | 0000   | 0         | 0         | 7             | 7            |
| 78h    | 1                     | 8042EM                             | 0060_0104          | 0060   | 0         | 0         | 1             | 4            |
| 88h    | 3                     | ACPI EC0                           | 0062_0304          | 0062   | 0         | 0         | 3             | 4            |
| 8Ch    | 4                     | ACPI EC1                           | 0066_0407          | 0066   | 0         | 0         | 4             | 7            |
| 90h    | 5                     | ACPI PM1                           | 0000_0507          | 0000   | 0         | 0         | 5             | 7            |
| 94h    | 6                     | Legacy Port92/GateA20              | 0092_0600          | 0092   | 0         | 0         | 6             | 0            |
| 98h    | 9                     | Mailbox                            | 0000_0901          | 0000   | 0         | 0         | 9             | 1            |
| 9Ch    | B                     | RTC                                | 0000_0B3F          | 0000   | 0         | 0         | B             | 3F           |

Note 1: The default Base I/O Address of the Configuration Port can be relocated by programming the BAR register for Logical Device Ch (LPC/Configuration Port) at offset 60h.

Note 2: The FRAME and MASK fields for these Legacy devices are not used to determine which LPC I/O addresses to claim. The address range match is maintained within the blocks themselves.

## 5.9.4 DEVICE MEMORY BASE ADDRESS REGISTERS

Some Logical Devices have a Memory Base Address Register. These Device Memory BARs are located in blocks of Configuration Registers in Logical Device 0Ch, in the AHB address range 400F\_33C0h through 400F\_33FFh. The following table defines the generic format used for all of these registers.

Each Device Memory BAR is 48 bits wide. The format of each Device Memory BAR is summarized in [Device Memory Base Address Register Format](#). An LPC memory request is translated by the Device Memory BAR into an 8-bit read or write transaction on the AHB bus. The 32-bit LPC memory address is translated into a 24-bit AHB address

### 5.9.4.1 Device Memory Base Address Register Format

| Offset | See <a href="#">Table 5-17, "Device Memory Base Address Register Default Values"</a>                             |      |                                |             |
|--------|--|------|--------------------------------|-------------|
| Bits   | Description  | Type | Default                        | Reset Event |
| 47:16  | HOST_ADDRESS[31:0]<br>These 32 bits are used to match LPC memory addresses.                                      | R/W  | See <a href="#">Table 5-17</a> | nSIO_R ESET |
| 15     | VALID<br>If this bit is 1, the BAR is valid and will participate in LPC matches. If it is 0 this BAR is ignored. | R/W  | See <a href="#">Table 5-17</a> | nSIO_R ESET |
| 14     | RESERVED   | RES  | -                              | -           |

|               |   |                           |                                |                    |
|---------------|---|---------------------------|--------------------------------|--------------------|
| <b>Offset</b> | See <a href="#">Table 5-17, "Device Memory Base Address Register Default Values"</a>  |                           |                                |                    |
| <b>Bits</b>   | <b>Description</b>  | <b>Type</b>               | <b>Default</b>                 | <b>Reset Event</b> |
| 13:8          | FRAME<br>These 6 bits are used to specify a logical device frame number within a bus. This field is multiplied by 400h to provide the frame address within the peripheral bus address. In the MEC1322 Frame values for frames corresponding to logical devices that are not present on the MEC1322 are invalid. | <a href="#">Note 5-12</a> | See <a href="#">Table 5-17</a> | nSIO_R ESET        |
| 7:0           | MASK<br>These bits are used to mask off address bits in the address match between an LPC memory address and the Host Address field of the BARs, as described in the following section.  | <a href="#">Note 5-12</a> | See <a href="#">Table 5-17</a> | nSIO_R ESET        |

**Note 5-12** The Mask and Frame fields of all logical devices are read-only except for 3h (ACPI EC Channel 0).

## 5.9.4.2 Device Memory Base Address Register Table

[Table 5-17](#) lists the Base Address Registers for logical devices which have LPC memory access in the MEC1322.

LPC Memory cycle access is controlled by LPC Memory Base Address Registers. LPC Memory BAR registers are located in LDN Ch (LPC Interface) at AHB base address 400F\_3300h starting at the offset shown in [Table 5-17](#).

**TABLE 5-17: DEVICE MEMORY BASE ADDRESS REGISTER DEFAULT VALUES**

| LPC offset in CR space | Logical Device Number | Logical Device | Memory BAR Default Value | LPC Memory Address |
|------------------------|-----------------------|----------------|--------------------------|--------------------|
| C0h                    | 9h                    | Mailbox        | 0000_0000_0901h          | 0000_0000h         |
| C6h                    | 3h                    | ACPIEC0        | 0000_0062_0304h          | 0000_0062h         |
| CCh                    | 4h                    | ACPIEC1        | 0000_0066_0407h          | 0000_0066h         |
| D2h                    | 0h                    | EMI            | 0000_0000_000Fh          | 0000_0000h         |

**Note 1:** The VALID, DEVICE, FRAME and MASK fields are as shown in [Table 5-16, "I/O Base Address Registers"](#).

## 5.10 Runtime Registers

The runtime registers listed in [Table 5-19, "Runtime Register Summary"](#) are for a single instance of the [LPC Interface](#). The addresses of each register listed in [Table 5-19](#) are defined as a relative offset to the host "Begin Address" define in [Table 5-2](#).

**TABLE 5-18: RUNTIME REGISTER ADDRESS RANGE TABLE**

| INSTANCE NAME | INSTANCE NUMBER | HOST | ADDRESS SPACE | BEGIN ADDRESS                              |
|---------------|-----------------|------|---------------|--|
| LPC Interface | 0               | LPC  | LPC I/O       | Base I/O Address of Logical Device Ch +00h |

**Note 1:** The Begin Address indicates where the first register can be accessed in a particular address space for a block instance.

**2:** The LPC Runtime registers are only accessible from the LPC interface and are used to implement the LPC Configuration Port. They are not accessible by any other Host.

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**TABLE 5-19: RUNTIME REGISTER SUMMARY**

| Offset | Register Name                  |
|--------|--------------------------------|
| 00h    | <a href="#">INDEX Register</a> |
| 01h    | <a href="#">DATA Register</a>  |

**Note:** The LPC Runtime Register space has been used to implement the INDEX and DATA registers in the Configuration Port. In CONFIG\_MODE, the Configuration Port is used to access the Configuration Registers.

## 5.10.1 INDEX REGISTER

| Offset | 00h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 7:0    | INDEX<br>The INDEX register, which is part of the Configuration Port, is used as a pointer to a Configuration Register Address.<br><b>Note:</b> For a description of accessing the Configuration Port see <a href="#">Section 5.8.3, "Configuration Port," on page 83.</a> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

## 5.10.2 DATA REGISTER

| Offset | 01h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | DATA<br>The DATA register, which is part of the Configuration Port, is used to read or write data to the register currently being selected by the INDEX Register.<br><b>Note:</b> For a description of accessing the Configuration Port see <a href="#">Section 5.8.3, "Configuration Port," on page 83</a> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

## 5.11 EC-Only Registers

**Note:** EC-Only registers are not accessible by the LPC interface.

The registers listed in [Table 5-21, "EC-Only Register Summary"](#) are for a single instance of the [LPC Interface](#). Their addresses are defined as a relative offset to the host base address defined in [Table 5-20](#).

The following table defines the fixed host base address for each [LPC Interface](#) instance.

**TABLE 5-20: EC-ONLY REGISTER ADDRESS RANGE TABLE**

| INSTANCE NAME | INSTANCE NUMBER | HOST | ADDRESS SPACE                 | BEGIN ADDRESS |
|---------------|-----------------|------|-------------------------------|---------------|
| LPC Interface | 0               | EC   | 32-bit internal address space | 400F_3100h    |

The Begin Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 5-21: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name                             |
|--------|---|
| 04h    | <a href="#">LPC Bus Monitor Register</a>  |
| 08h    | <a href="#">Host Bus Error Register</a>   |
| 0Ch    | <a href="#">EC SERIRQ Register</a>        |
| 10h    | <a href="#">EC Clock Control Register</a> |
| 14h    | <a href="#">MCHP Test Register</a>        |
| 18h    | <a href="#">MCHP Test Register</a>        |
| 20h    | <a href="#">BAR Inhibit Register</a>      |
| 24h    | MCHP Reserved                             |
| 28h    | MCHP Reserved                             |
| 2Ch    | MCHP Reserved                             |
| 30h    | <a href="#">LPC BAR Init Register</a>     |

**Note:** MCHP Reserved registers are read/write registers. Modifying these registers may have unwanted results.

## 5.11.1 LPC BUS MONITOR REGISTER

| Offset | 04h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:2   | RESERVED   | RES  | -       | -                           |
| 1      | <p>LRESET_STATUS</p> <p>This bit reflects the state of the LRESET# input pin. The LRESET_Status is the inverse of the LRESET# pin.</p> <p>When the LRESET_Status bit is '0b', the LRESET# input pin is de-asserted (that is, the pin has the value '1b'). When the LRESET_Status bit is '1b', the LRESET# input pin is asserted (that is, the pin has the value '0b').</p> | R    | 0h      | <a href="#">VCC1_R ESET</a> |
| 0      | MCHP Reserved  | R    | 0h      | <a href="#">VCC1_R ESET</a> |

## 5.11.2 HOST BUS ERROR REGISTER

| Offset | 08h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:8   | <p>ErrorAddress[23:16]</p> <p>This 24-bit field captures the 24-bit internal address of every LPC transaction whenever the bit <a href="#">LPC_INTERNAL_ERR</a> in this register is 0. When <a href="#">LPC_INTERNAL_ERR</a> is 1 this register is not updated but retains its previous value. When bus errors occur this field saves the address of the first address that caused an error.</p> | R    | 0h      | <a href="#">VCC1_R ESET</a> |
| 5      | <p>DMA_ERR</p> <p>This bit is set to 1 whenever <a href="#">EN_INTERNAL_ERR</a> is 1 and an LPC DMA access causes an internal bus error. Once set, it remains set until cleared by being written with a 1.</p>   | R/WC | 0h      | <a href="#">VCC1_R ESET</a> |

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| Offset | 08h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 4      | <b>CONFIG_ERR</b><br>This bit is set to 1 whenever <a href="#">EN_INTERNAL_ERR</a> is 1 and an LPC Configuration access causes an internal bus error. Once set, it remains set until cleared by being written with a 1.  | R/WC | 0h      | VCC1_R ESET |
| 3      | <b>RUNTIME_ERR</b><br>This bit is set to 1 whenever <a href="#">EN_INTERNAL_ERR</a> is 1 and an LPC I/O access causes an internal bus error. This error will only occur if a BAR is misconfigured. Once set, it remains set until cleared by being written with a 1.   | R/WC | 0h      | VCC1_R ESET |
| 2      | <b>BAR_CONFLICT</b><br>This bit is set to 1 whenever a BAR conflict occurs on an LPC address. A Bar conflict occurs when more than one BAR matches the address during of an LPC cycle access. Once this bit is set, it remains set until cleared by being written with a 1.                                    | R/WC | 0h      | VCC1_R ESET |
| 1      | <b>EN_INTERNAL_ERR</b><br>When this bit is 0, only a BAR conflict, which occurs when two BARs match the same LPC I/O address, will cause <a href="#">LPC_INTERNAL_ERR</a> to be set. When this bit is 1, internal bus errors will also cause <a href="#">LPC_INTERNAL_ERR</a> to be set.                       | R/WC | 0h      | VCC1_R ESET |
| 0      | <b>LPC_INTERNAL_ERR</b><br>This bit is set whenever a BAR conflict or an internal bus error occurs as a result of an LPC access. Once set, it remains set until cleared by being written with a 1. This signal may be used to generate interrupts. See <a href="#">Section 5.6, "Interrupts," on page 78</a> . | R/WC | 0h      | VCC1_R ESET |

## 5.11.3 EC SERIRQ REGISTER

| Offset | 0Ch   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:1   | RESERVED  | RES  | -       | -           |
| 0      | <b>EC_IRQ</b><br>If the LPC Logical Device is selected as the source for a Serial Interrupt Request by an Interrupt Configuration register (see <a href="#">Section 5.8.4.8, "SERIRQ Interrupts," on page 87</a> ), this bit is used as the interrupt source. | R/W  | 0h      | VCC1_R ESET |

## 5.11.4 EC CLOCK CONTROL REGISTER

| Offset | 10h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:3   | RESERVED   | RES  | -       | -           |
| 2      | <b>Handshake</b><br>This bit controls throughput of LPC transactions. When this bit is a '0' the part supports a 33MHz PCI Clock. When this bit is a '1', the part supports a PCI Clock from 19.2MHz (including 24MHz) to 33MHz. | RES  | 1h      | VCC1_RESET  |



| Offset | 10h   |      |         |                            |
|--------|---|------|---------|----------------------------|
| Bits   | Description   | Type | Default | Reset Event                |
| 1:0    | <p>Clock_Control</p> <p>This field controls when the host interface will permit the internal ring oscillator to be shut down. The choices are as follows:</p> <p><b>0h:</b> Reserved</p> <p><b>1h:</b> The host interface will permit the internal clocks to be shut down if the CLKRUN# signals "CLOCK STOP" and there are no pending serial interrupt request or DMA requests from devices associated with the device. The CLKRUN# signals "CLOCK STOP" by CLKRUN# being high for 5 LPCCLK's after the raising edge of CLKRUN#</p> <p><b>2h:</b> The host interface will permit the ring oscillator to be shut down after the completion of every LPC transaction. This mode may cause an increase in the time to respond to LPC transactions if the ring oscillator is off when the LPC transaction is detected.</p> <p><b>3h:</b> The ring oscillator is not permitted to shut down as long as the host interface is active. When the <a href="#">ACTIVATE</a> bit in the <a href="#">LPC Activate Register</a> is 0, the Host Interface will permit the ring oscillator to be shut down and the <a href="#">Clock_Control</a> Field is ignored. The <a href="#">Clock_Control</a> Field only effects the Host Interface when the <a href="#">ACTIVATE</a> bit in the <a href="#">LPC Activate Register</a> is 1.</p> <p>Although the Host Interface can permit the internal oscillator to shut down, it cannot turn the oscillator on in response to an LPC transaction that occurs while the oscillator is off. In order to restart the oscillator in order to complete an LPC transaction, EC firmware must enable a wake interrupt on the LPC LFRAME# input. See the Application Note in <a href="#">Section 15.8.1, "WAKE Generation"</a> for details.</p> | R/W  | 0h      | <a href="#">VCC1_RESET</a> |

## 5.11.5 MCHP TEST REGISTER

| Offset | 14h           |      |         |                            |
|--------|---------------|------|---------|----------------------------|
| Bits   | Description   | Type | Default | Reset Event                |
| 31:8   | RESERVED      | RES  | -       | -                          |
| 7:0    | MCHP Reserved | R    | 0h      | <a href="#">VCC1_RESET</a> |

## 5.11.6 MCHP TEST REGISTER

| Offset | 18h           |      |         |                            |
|--------|---------------|------|---------|----------------------------|
| Bits   | Description   | Type | Default | Reset Event                |
| 31:2   | RESERVED      | RES  | -       | -                          |
| 1      | MCHP Reserved | R/W  | 0h      | <a href="#">VCC1_RESET</a> |
| 0      | MCHP Reserved | R/W  | 0h      | <a href="#">VCC1_RESET</a> |

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## 5.11.7 BAR INHIBIT REGISTER

| Offset | 20h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:0   | BAR_Inhibit[31:0]<br>When bit $D_i$ of BAR_Inhibit is 1, the BAR for Logical Device $i$ is disabled and its addresses will not be claimed on the LPC bus, independent of the value of the Valid bit in the BAR. The association between bits in BAR_Inhibit and Logical Devices is illustrated in <a href="#">Table 5-22, "BAR Inhibit Device Map"</a> . | R/W  | 0h      | VCC1_RESET  |

**TABLE 5-22: BAR INHIBIT DEVICE MAP**

| Bar Inhibit Bit | Logical Device Number |
|-----------------|-----------------------|
| 0               | 0h                    |
| 1               | 1h                    |
| .               | .                     |
| .               | .                     |
| .               | .                     |
| 31              | 31h                   |

## 5.11.8 LPC BAR INIT REGISTER

| Offset | 30h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 15:0   | BAR_Init<br>This field is loaded into the LPC BAR at offset 60h on <a href="#">nSIO_RESET</a> . | R/W  | 002Eh   | nSIO_RESET  |

## 6.0 CHIP CONFIGURATION

### 6.1 Introduction

This chapter defines the mechanism to configure the device.

### 6.2 Terminology

This section documents terms used locally in this chapter. Common terminology that is used in the chip specification is captured in the Chip-Level Terminology section.

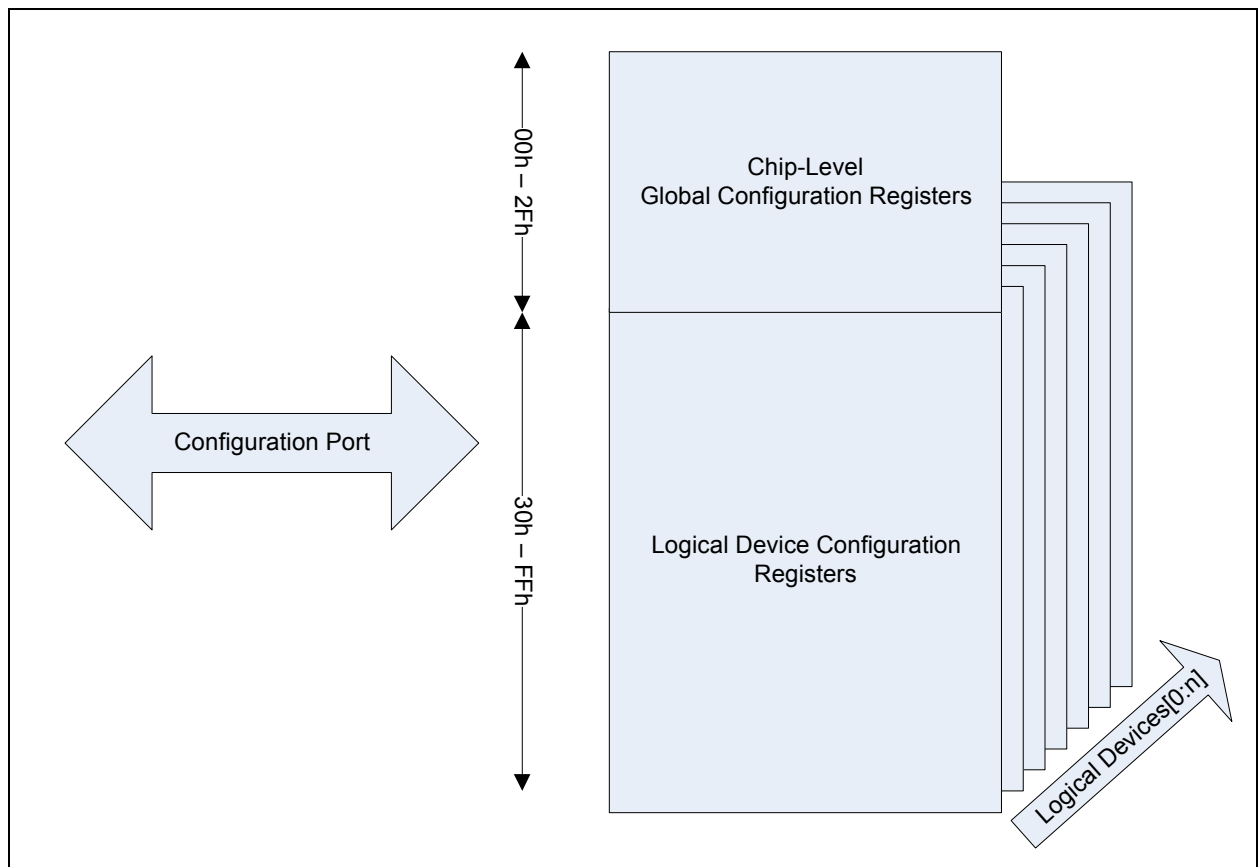
**TABLE 6-1: TERMINOLOGY**

| Term                                   | Definition  |
|--|---|
| Global Configuration Registers         | Registers used to configure the chip that are always accessible via the Configuration Port  |
| Logical Device Configuration Registers | Registers used to configure a logical device in the chip. These registers are only accessible via the Configuration Port when enabled via the Global Configuration registers. |

### 6.3 Interface

This block is designed to be accessed via the Host accessible Configuration Port.

**FIGURE 6-1: BLOCK DIAGRAM OF CONFIGURATION PORT**



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**Note:** Each logical device has a bank of Configuration registers that are accessible at offsets 30h to FFh via the Configuration Port. The Logical Device number programmed in offset 07h determines which bank of configuration registers is currently accessible.

## 6.3.1 HOST INTERFACE

The registers defined for the [Chip Configuration](#) are accessible by the Configuration Port when the device is in CONFIG MODE. For a description of the Configuration Port and CONFIG MODE see the description of the LPC Interface.

## 6.4 Power, Clocks and Reset

This section defines the Power, Clock, and Reset input parameters to this block.

### 6.4.1 POWER DOMAINS

**TABLE 6-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block reside on this single power well. |

### 6.4.2 CLOCK INPUTS

This block does not require any special clock inputs.

### 6.4.3 RESETS

**TABLE 6-3: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | Power on Reset to the block. This signal resets all the register and logic in this block to its default state. |

## 6.5 Interrupts

This block does not generate any interrupts.

## 6.6 Low Power Modes

This block always automatically adjusts to operate in the lowest power mode.

## 6.7 Description

The Chip Configuration Registers are divided into two groups: Global Configuration Registers and Logical Device Configuration registers. The following descriptions assume that the LPC interface has already been configured to operate in CONFIG MODE.

- Global Configuration Registers are always accessible via the LPC Configuration Port.
- The Logical Device Configuration registers are only accessible via the LPC Configuration Port when the corresponding Logical Device Number is loaded in the Logical Device Number register. The Logical Device Number register is a Global Configuration Register.

There are 48 8-bit Global Configuration Registers (at offsets 00h through 2Fh), plus up to 208 8-bit registers associated with each Logical Device. The Logical Device is selected with the [Logical Device Number Register](#) (Global Configuration Register 07h).

Sequence to Access Logical Device Configuration Register:

- a) Write the number of the Logical Device being accessed in the [Logical Device Number](#) Configuration Register by writing 07h into the INDEX PORT and the [Logical Device Number](#) into the DATA PORT.
- b) Write the address of the desired logical device configuration register to the INDEX PORT and then write or read the value of the configuration register through the DATA PORT.

**Note 1:** If accessing the Global Configuration Registers, step (a) is not required.

- 2:** Any write to an undefined or reserved Configuration register is terminated normally on the LPC bus without any modification of state in the MEC1322. Any read to an undefined or reserved Configuration register returns FFh.

The following sections define the Global Configuration registers and the Logical Configuration registers.

## 6.7.1 GLOBAL CONTROL/CONFIGURATION REGISTERS

As with all Configuration Registers, the INDEX PORT is used to select a Global Configuration Register in the chip. The DATA PORT is then used to access the selected register. The INDEX and DATA PORTS are defined in the LPC Interface description.

The Host can access all the Global Configuration registers at the offsets listed in [Table 6-4, "Chip-Level \(Global\) Control/Configuration Registers"](#) through the INDEX PORT and the DATA PORT.

The EC can access all the Global Configuration registers at the offsets listed in [Table 6-4, "Chip-Level \(Global\) Control/Configuration Registers"](#) from the base address shown in [Table 6-6, "EC-Only Register Address Table,"](#) on page 102.

**TABLE 6-4: CHIP-LEVEL (GLOBAL) CONTROL/CONFIGURATION REGISTERS**

| Register                               | Offset    | Description  |
|--|-----------|--|
| <b>Chip (Global) Control Registers</b> |           |  |
| Reserved                               | 00h - 06h | Reserved - Writes are ignored, reads return 0.   |
| Logical Device Number                  | 07h       | A write to this register selects the current logical device. This allows access to the control and configuration registers for each logical device.<br><br><b>Note:</b> The Activate command operates only on the selected logical device. |
| Reserved                               | 08h - 1Fh | Reserved - Writes are ignored, reads return 0.   |
| Device ID                              | 20h       | A read-only register which provides device identification:<br>Bits[7:0] = 15h  |
| Device Revision<br>Hard Wired          | 21h       | A read-only register which provides device revision information.<br><br>Bits[7:0] = current revision when read   |
| Reserved                               | 24h       | Reserved – writes are ignored, reads return "0".   |
| MCHP Reserved                          | 25h - 2Fh | MCHP Reserved.<br>This register locations are reserved for Microchip use. Modifying these locations may cause unwanted results.  |

## 6.7.2 LOGICAL DEVICE CONFIGURATION REGISTERS

The Logical Device Configuration registers support motherboard designs in which the resources required by their components are known and assigned by the BIOS at POST.

Each logical device may have a set of directly I/O addressable Runtime Registers, Configuration Registers accessible via the Configuration Port, or DMA registers. The following table lists the register types for each LPC Host-accessible Logical Device implemented in the design. The Embedded Controller (EC) can access all Configuration Registers and all Runtime Registers directly.

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TABLE 6-5: HOST LOGICAL DEVICES ON MEC1322

| Logical Device Number | Logical Devices       | LPC I/O Runtime Access | LPC I/O Configuration Access |
|-----------------------|-----------------------|------------------------|------------------------------|
| 0                     | EMI 0                 | yes                    | no                           |
| 1                     | 8042EM                | no                     | yes                          |
| 3                     | ACPI EC0              | yes                    | no                           |
| 4                     | ACPI EC1              | yes                    | no                           |
| 5                     | ACPI PM1              | yes                    | no                           |
| 6                     | Legacy Port92/GateA20 | yes                    | yes                          |
| 7                     | UART 0                | yes                    | yes                          |
| 9                     | Mailbox               | yes                    | no                           |
| B                     | RTC                   | yes                    | no                           |

## 6.8 EC-Only Registers

TABLE 6-6: EC-ONLY REGISTER ADDRESS TABLE

| Block Instance | Instance Number | Host | Address Space                 | Base Address (Note 6-1) |
|----------------|-----------------|------|-------------------------------|-------------------------|
| HOST_REGS      | 0               | EC   | 32-bit internal address space | 400F_FF00h              |

**Note 6-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

The chip-level (global) registers reside in Logical Device 3Fh at EC addresses 400F\_FF00h through 400F\_FF2Fh.

The EC can access all these registers at the addresses listed in [Table 6-4, “Chip-Level \(Global\) Control/Configuration Registers,” on page 101.](#)

## 7.0 ARM M4F BASED EMBEDDED CONTROLLER

### 7.1 Introduction

This chapter contains a description of the ARM M4F Embedded Controller (EC).

The EC is built around an ARM® Cortex®-M4F Processor provided by Arm Ltd. (the “ARM M4F IP”). The ARM Cortex® M4F is a full-featured 32-bit embedded processor, implementing the ARMv7-M THUMB instruction set and FPU instruction set in hardware.

The ARM M4F IP is configured as a Von Neumann, Byte-Addressable, Little-Endian architecture. It provides a single unified 32-bit byte-level address, for a total direct addressing space of 4GByte. It has multiple bus interfaces, but these express priorities of access to the chip-level resources (Instruction Fetch vs. Data RAM vs. others), and they do not represent separate addressing spaces.

The ARM M4F IP has configurable options, which are selected as follows.

- **Little-Endian** byte ordering is selected at all times (hard-wired)
- **Bit Banding** feature is included for efficient bit-level access.
- **Floating-Point Unit (FPU)** is included, to implement the Floating-Point instruction set in hardware
- **Debug** features are included at “Ex+” level, defined as follows:
- **DWT** Unit provides 4 Data Watchpoint comparators and Execution Monitoring
- **FPB** Unit provides HW Breakpointing with 6 Instruction and 2 Literal (Read-Only Data) address comparators. The FPB comparators are also available for Patching: remapping Instruction and Literal Data addresses.
- **Trace** features are included at “Full” level, defined as follows:
- **DWT** for reporting breakpoints and watchpoints
- **ITM** for profiling and to timestamp and output messages from instrumented firmware builds
- **ETM** for instruction tracing, and for enhanced reporting of Core and DWT events
- The ARM-defined **HTM** trace feature is **not currently included**.
- **NVIC** Interrupt controller with 8 priority levels and up to 240 individually-vectorized interrupt inputs.
- A Microchip-defined Interrupt Aggregator function (at chip level) may be used to group multiple interrupts onto single NVIC inputs.
- The ARM-defined **WIC** feature is **not currently included**.
- Microchip Interrupt Aggregator function (at chip level) is expected to provide Wake control instead.
- The ARM-defined **MPU** feature is **not currently included**.
- Memory Protection functionality is not expected to be necessary.

### 7.2 References

- ARM Limited: Cortex®-M4 Technical Reference Manual, DDI0439C, 29 June 2010
- ARM Limited: ARM®v7-M Architecture Reference Manual, DDI0403D, November 2010
- NOTE: Filename DDI0403D\_arm\_architecture\_v7m\_reference\_manual\_errata\_markup\_1\_0.pdf
- ARM® Generic Interrupt Controller Architecture version 1.0 Architecture Specification, IHI0048A, September 2008
- ARM Limited: AMBA® Specification (Rev 2.0), IHI0011A, 13 May 1999
- ARM Limited: AMBA® 3 AHB-Lite Protocol Specification, IHI0033A, 6 June 2006
- ARM Limited: AMBA® 3 ATB Protocol Specification, IHI0032A, 19 June 2006
- ARM Limited: Cortex-M™ System Design Kit Technical Reference Manual, DDI0479B, 16 June 2011
- ARM Limited: CoreSight™ v1.0 Architecture Specification, IHI0029B, 24 March 2005
- ARM Limited: CoreSight™ Components Technical Reference Manual, DDI0314H, 10 July 2009
- ARM Limited: ARM® Debug Interface v5 Architecture Specification, IHI0031A, 8 February 2006
- ARM Limited: ARM® Debug Interface v5 Architecture Specification ADIv5.1 Supplement, DSA09-PRDC-008772, 17 August 2009
- ARM Limited: Embedded Trace Macrocell™ (ETMv1.0 to ETMv3.5) Architecture Specification, IHI0014Q, 23 September 2011
- ARM Limited: CoreSight™ ETM™-M4 Technical Reference Manual, DDI0440C, 29 June 2010

## 7.3 Terminology

### 7.3.1 ARM IP TERMS AND ACRONYMS

- Cortex-M4F
- The ARM designation for the specific IP selected for this product: a Cortex M4 processor core containing a hardware Floating Point Unit (FPU).
- ARMv7
- The identifying name for the general architecture implemented by the **Cortex-M** family of IP products.
- Note that **ARMv7** has no relationship to the older “ARM 7” product line, which is classified as an “ARMv3” architecture, and is very different.
- FPU
- Floating-Point Unit: a subblock included in the Core for implementing the Floating Point instruction set in hardware.
- NVIC
- Nested Vectored Interrupt Controller subblock. Accepts external interrupt inputs. See documents [ARM Limited: ARM@v7-M Architecture Reference Manual, DDI0403D, November 2010](#) and [ARM@ Generic Interrupt Controller Architecture version 1.0 Architecture Specification, IHI0048A, September 2008](#).
- FPB
- FLASH Patch Breakpoint subblock. Provides either Remapping (Address substitution) or Breakpointing (Exception or Halt) for a set of Instruction addresses and Data addresses. See Section 8.3 of [ARM Limited: Cortex@-M4 Technical Reference Manual, DDI0439C, 29 June 2010](#).
- DAP
- Debug Access Port, a subblock consisting of **DP** and **AP** subblocks
- DP
- Any of the ports in the **DAP** subblock for connection to an off-chip Debugger. A single **SWJ-DP** option is currently selected for this function, providing **JTAG** connectivity.
- SWJ-DP
- Serial Wire / **JTAG** Debug Port, the **DP** option selected by Microchip for the **DAP**.
- AP
- Any of the ports on the **DAP** subblock for accessing on-chip resources on behalf of the Debugger, independent of processor operations. A single **AHB-AP** option is currently selected for this function.
- AHB-AP
- AHB Access Port, the **AP** option selected by Microchip for the **DAP**.
- MEM-AP
- A generic term for an **AP** that connects to a memory-mapped bus on-chip. For this product, this term is synonymous with the AHB Access Port, **AHB-AP**.
- ROM Table
- A ROM-based data structure in the Debug section that allows an external Debugger and/or a FW monitor to determine which of the Debug features are present.
- DWT
- Data Watchdog and Trace subblock. This contains comparators and counters used for data watchpoints and Core activity tracing.
- ETM
- Embedded Trace Macrocell subblock. Provides enhancements for Trace output reporting, mostly from the **DWT** subblock. It adds enhanced instruction tracing, filtering, triggering and timestamping.
- ITM
- Instrumentation Trace Macrocell subblock. Provides a HW Trace interface for “print”-style reports from instrumented firmware builds, with timestamping also provided.
- TPIU
- Trace Port Interface Unit subblock. Multiplexes and buffers Trace reports from the ETM and ITM subblocks.
- TPA
- Trace Port Analyzer: any off-chip device that uses the **TPIU** output.
- ATB



- Interface standard for Trace data to the **TPIU** from **ETM** and/or **ITM** blocks, Defined in **AMBA 3**. See [ARM Limited: AMBA® 3 ATB Protocol Specification, IHI0032A, 19 June 2006](#).
- **AMBA**
- The collective term for bus standards originated by ARM Limited.
- **AMBA 3** defines the IP's **AHB-Lite** and **ATB** bus interfaces.
- **AMBA 2** (AMBA Rev. 2.0) defines the EC's **AHB** bus interface.
- **AHB**
- Advanced High-Performance Bus, a system-level on-chip **AMBA 2** bus standard. See [ARM Limited: AMBA® Specification \(Rev 2.0\), IHI0011A, 13 May 1999](#).
- **AHB-Lite**
- A Single-Master subset of the **AHB** bus standard: defined in the **AMBA 3** bus standard. See [ARM Limited: AMBA® 3 AHB-Lite Protocol Specification, IHI0033A, 6 June 2006](#).
- **PPB**
- Private Peripheral Bus: A specific **APB** bus with local connectivity within the EC.
- **APB**
- Advanced Peripheral Bus, a limited 32-bit-only bus defined in **AMBA 2** for I/O register accesses. This term is relevant only to describe the **PPB** bus internal to the EC core. See [ARM Limited: AMBA® Specification \(Rev 2.0\), IHI0011A, 13 May 1999](#).
- **MPU**
- Memory Protection Unit. This is an optional subblock that is **not currently included**.
- **HTM**
- AHB Trace Macrocell. This is an optional subblock that is **not currently included**.
- **WIC**
- Wake-Up Interrupt Controller. This is an optional subblock that is **not currently included**.

## 7.3.2 MICROCHIP TERMS AND ACRONYMS

- **PMU**
- This Processor Memory Unit is a module that may be present at the chip level containing any memory resources that are closely-coupled to the MEC1322 EC. It manages accesses from both the EC processor and chip-level bus masters.
- Interrupt Aggregator
- This is a module that may be present at the chip level, which can combine multiple interrupt sources onto single interrupt inputs at the EC, causing them to share a vector.

## 7.4 ARM M4F IP Interfaces

This section defines only the interfaces to the ARM IP itself. For the interfaces of the entire block, see [Section 7.5, "Block External Interfaces," on page 107](#).

The MEC1322 IP has the following major external interfaces, as shown in [FIGURE 7-1: ARM M4F Based Embedded Controller I/O Block Diagram on page 107](#):

- ICode AHB-Lite Interface
- DCode AHB-Lite Interface
- System AHB-Lite Interface
- Debug (JTAG) Interface
- Trace Port Interface
- Interrupt Interface

The EC operates on the model of a single 32-bit addressing space of byte addresses (4Gbytes, Von Neumann architecture) with Little-Endian byte ordering. On the basis of an internal decoder (part of the Bus Matrix shown in [Figure 7-1](#)), it routes Read/Write/Fetch accesses to one of three external interfaces, or in some cases internally (shown as the PPB interface).

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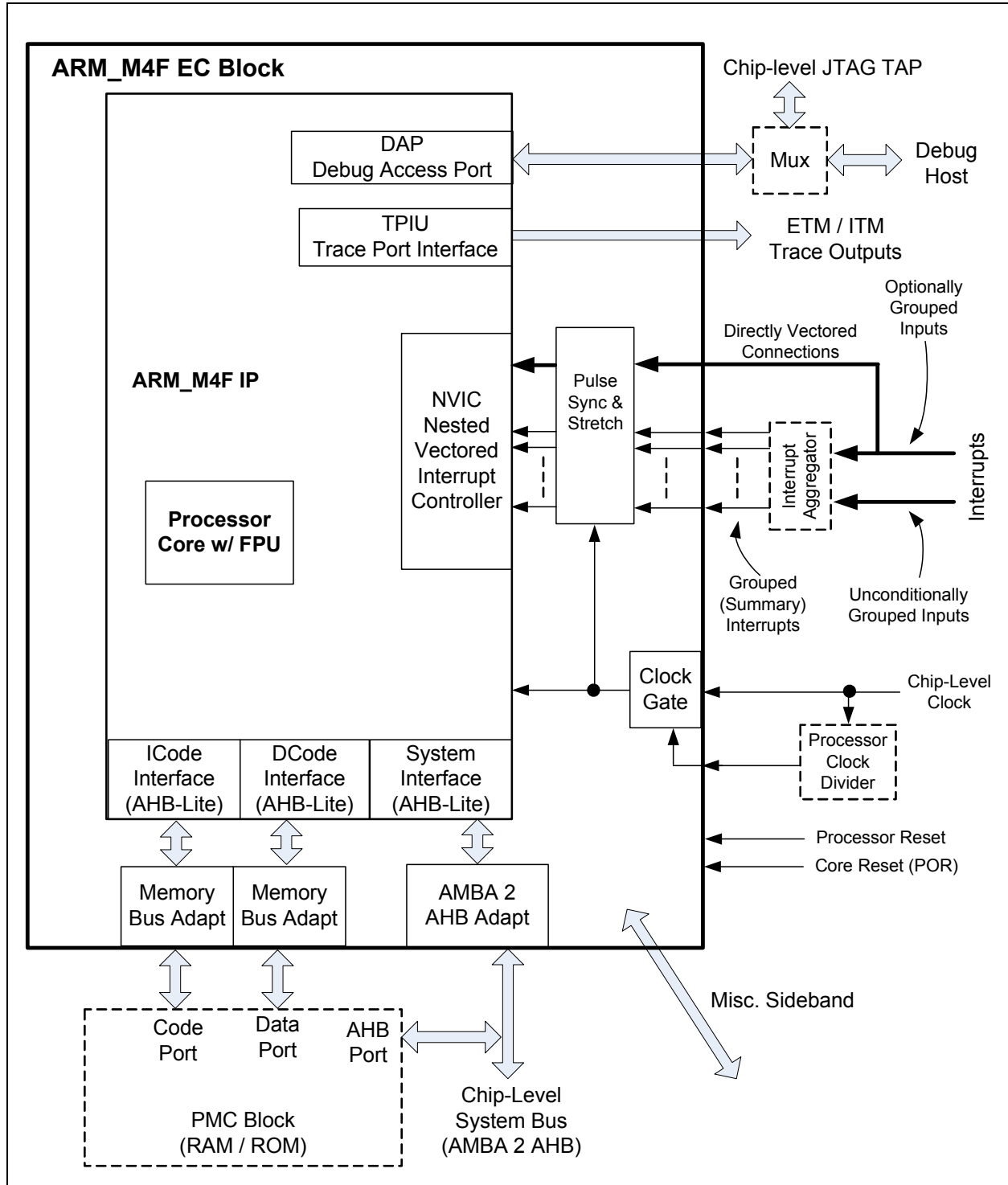
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The EC executes instructions out of closely-coupled memory via the ICode Interface. Data accesses to closely-coupled memory are handled via the DCode Interface. The EC accesses the rest of the on-chip address space via the System AHB-Lite interface. The Debugger program in the host can probe the EC and all EC addressable memory via the JTAG debug interface.

Aliased addressing spaces are provided at the chip level so that specific bus interfaces can be selected explicitly where needed. For example, the EC's Bit Banding feature uses the System AHB-Lite bus to access resources normally accessed via the DCode or ICode interface.

## 7.5 Block External Interfaces

FIGURE 7-1: ARM M4F BASED EMBEDDED CONTROLLER I/O BLOCK DIAGRAM



# MEC1322

## 7.6 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 7.6.1 POWER DOMAINS

**TABLE 7-1: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The <a href="#">ARM M4F Based Embedded Controller</a> is powered by VCC1. |

### 7.6.2 CLOCK INPUTS

#### 7.6.2.1 Basic Clocking

The basic clocking comes from a free-running Clock signal provided from the chip level.

**TABLE 7-2: CLOCK INPUTS**

| Name                   | Description  |
|------------------------|--|
| 48 MHz Ring Oscillator | The EC clock derived from the <a href="#">48 MHz Ring Oscillator</a> is the clock source to the <a href="#">ARM M4F Based Embedded Controller</a> . Division of the clock rate is allowed, according to the Processor Clock Enable.<br><b>Note:</b> The EC clock is controlled from the chip-level Power, Clocks, and Reset (PCR) circuitry. See <a href="#">Section 3.9.8, "Processor Clock Control Register (PROC_CLK_CNTRL)," on page 61.</a> |

#### 7.6.2.2 System Tick Clocking

The System Tick clocking is controlled by a signal from chip-level logic. It is the [48 MHz Ring Oscillator](#) divided by the following:

- (([Processor Clock Divide Value](#))x2)+1.

#### 7.6.2.3 Debug JTAG Clocking

The Debug JTAG clocking comes from chip-level logic, which may multiplex or gate this clock. See [Section 7.9.3, "Debugger Access Support," on page 111.](#)

#### 7.6.2.4 Trace Clocking

The Clock for the Trace interface is identical to the [48 MHz Ring Oscillator](#) input.

### 7.6.3 RESETS

The reset interface from the chip level is given below.

**TABLE 7-3: RESET SIGNALS**

| Name          | Description  |
|---------------|--|
| EC_PROC_RESET | The <a href="#">ARM M4F Based Embedded Controller</a> is reset by EC_PROC_RESET. |

## 7.7 Interrupts

The [ARM M4F Based Embedded Controller](#) is equipped with an Interrupt Interface to respond to interrupts. These inputs go to the IP's NVIC block after a small amount of hardware processing to ensure their detection at varying clock rates. See [FIGURE 7-1: ARM M4F Based Embedded Controller I/O Block Diagram on page 107.](#)

As shown in [Figure 7-1](#), an Interrupt Aggregator block may exist at the chip level, to allow multiple related interrupts to be grouped onto the same NVIC input, and so allowing them to be serviced using the same vector. This may allow the same interrupt handler to be invoked for a group of related interrupt inputs. It may also be used to expand the total number of interrupt inputs that can be serviced.

Connections to the chip-level system are given in [Table 15-3, "Interrupt Event Aggregator Routing Summary," on page 195.](#)

The NMI (Non-Maskable Interrupt) connection is tied off and not used.

## 7.7.1 NVIC INTERRUPT INTERFACE

The NVIC interrupt unit can be wired to up to 240 interrupt inputs from the chip level. The interrupts that are actually connected from the chip level are defined in [Table 15-3, “Interrupt Event Aggregator Routing Summary,” on page 195.](#)

All NVIC interrupt inputs can be programmed as either pulse or level triggered. They can also be individually masked, and individually assigned to their own hardware-managed priority level.

## 7.7.2 NVIC RELATIONSHIP TO EXCEPTION VECTOR TABLE ENTRIES

The Vector Table consists of 4-byte entries, one per vector. Entry 0 is not a vector, but provides an initial Reset value for the Main Stack Pointer. Vectors start with the Reset vector, at Entry #1. Entries up through #15 are dedicated for internal exceptions, and do not involve the NVIC.

NVIC entries in the Vector Table start with Entry #16, so that NVIC Interrupt #0 is at Entry #16, and all NVIC interrupt numbers are incremented by 16 before accessing the Vector Table.

The number of connections to the NVIC determines the necessary minimum size of the Vector Table, as shown below. It can extend as far as 256 entries (255 vectors, plus the non-vector entry #0).

A Vector entry is used to load the Program Counter (PC) and the EPSR.T bit. Since the Program Counter only expresses code addresses in units of two-byte Halfwords, bit[0] of the vector location is used to load the EPSR.T bit instead, selecting THUMB mode for exception handling. Bit[0] must be ‘1’ in all vectors, otherwise a UsageFault exception will be posted (INVSTATE, unimplemented instruction set). If the Reset vector is at fault, the exception posted will be HardFault instead.

**TABLE 7-4: EXCEPTION AND INTERRUPT VECTOR TABLE LAYOUT**

| Table Entry                                | Exception Number | Exception   |
|--|------------------|---|
| Special Entry for Reset Stack Pointer      |                  |   |
| 0  | (none)           | Holds Reset Value for the Main Stack Pointer. Not a Vector. |
| Core Internal Exception Vectors start here |                  |   |
| 1  | 1                | Reset Vector (PC + EPSR.T bit)                              |
| 2  | 2                | NMI (Non-Maskable Interrupt) Vector                         |
| 3  | 3                | HardFault Vector  |
| 4  | 4                | MemManage Vector  |
| 5  | 5                | BusFault Vector   |
| 6  | 6                | UsageFault Vector   |
| 7  | (none)           | (Reserved by ARM Ltd.)                                      |
| 8  | (none)           | (Reserved by ARM Ltd.)                                      |
| 9  | (none)           | (Reserved by ARM Ltd.)                                      |
| 10   | (none)           | (Reserved by ARM Ltd.)                                      |
| 11   | 11               | SVCall Vector   |
| 12   | 12               | Debug Monitor Vector  |
| 13   | (none)           | (Reserved by ARM Ltd.)                                      |
| 14   | 14               | PendSV Vector   |
| 15   | 15               | SysTick Vector  |
| NVIC Interrupt Vectors start here          |                  |   |
| 16   | 16               | NVIC Interrupt #0 Vector                                    |
| .  | .                | .   |
| .  | .                | .   |
| .  | .                | .   |
| n + 16                                     | n + 16           | NVIC Interrupt #n Vector                                    |
| .  | .                | .   |
| .  | .                | .   |
| .  | .                | .   |

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**TABLE 7-4: EXCEPTION AND INTERRUPT VECTOR TABLE LAYOUT (CONTINUED)**

| Table Entry | Exception Number | Exception  |
|-------------|------------------|--|
| max + 16    | max + 16         | NVIC Interrupt #max Vector (Highest-numbered NVIC connection.) |
| .           | .                | Table size may (but need not) extend further.                  |
| .           | .                | .  |
| .           | .                | .  |
| 255         | 255              | NVIC Interrupt #239 (Architectural Limit of Exception Table)   |

## 7.8 Low Power Modes

The ARM processor low power modes are handled through the [Power, Clocks, and Resets](#) registers, not directly through the ARM core registers. See [Section 3.7, "Chip Power Management Features," on page 54](#).

The ARM processor can enter Sleep or Deep Sleep mode internally. This action will cause an output signal Clock Required to be turned off, allowing clocks to be stopped from the chip level. However, Clock Required will still be held active, or set to active, unless all of the following conditions exist:

- No interrupt is pending.
- An input signal Sleep Enable from the chip level is active.
- The Debug JTAG port is inactive (reset or configured not present).

In addition, regardless of the above conditions, a chip-level input signal [Force Halt](#) may halt the processor and remove Clock Required.

## 7.9 Description

### 7.9.1 BUS CONNECTIONS

There are three bus connections used from MEC1322 EC block, which are directly related to the IP bus ports. See [FIGURE 7-1: ARM M4F Based Embedded Controller I/O Block Diagram on page 107](#).

For the mapping of addresses at the chip level, see [Chapter 2.0, "Block Overview," on page 45](#).

#### 7.9.1.1 Closely Coupled Instruction Fetch Bus

As shown in [Figure 7-1](#), the AHB-Lite ICode port from the IP is converted to a more conventional SRAM memory-style bus and connected to the on-chip memory resources with routing priority appropriate to Instruction Fetches.

#### 7.9.1.2 Closely Coupled Data Bus

As shown in [Figure 7-1](#), the AHB-Lite DCode port from the IP is converted to a more conventional SRAM memory-style bus and connected to the on-chip memory resources with routing priority appropriate to fast Data Read/Write accesses.

#### 7.9.1.3 Chip-Level System Bus

As shown in [Figure 7-1](#), the AHB-Lite System port from the IP is converted from AHB-Lite to fully arbitrated multi-master capability (the AMBA 2 defined AHB bus: see [ARM Limited: AMBA® Specification \(Rev 2.0\), IHI0011A, 13 May 1999](#)). Using this bus, all addressable on-chip resources are available. The multi-mastering capability supports the Microchip DMA and EMI features if present, as well as the Bit-Banding feature of the IP itself.

As also shown in [Figure 7-1](#), the Closely-Coupled memory resources are also available through this bus connection using aliased addresses. This is required in order to allow Bit Banding to be used in these regions, but it also allows them to be accessed by DMA and other bus masters at the chip level.

**APPLICATION NOTE:** Registers with properties such as Write-1-to-Clear (W1C), Read-to-Clear and FIFOs need to be handled with appropriate care when being used with the bit band alias addressing scheme. Accessing such a register through a bit band alias address will cause the hardware to perform a read-modify-write, and if a W1C-type bit is set, it will get cleared with such an access. For example, using a bit band access to the Interrupt Aggregator, including the Interrupt Enables and Block Interrupt Status to clear an IRQ will clear all active IRQs.

## 7.9.2 INSTRUCTION PIPELINING

There are no special considerations except as defined by ARM documentation.

## 7.9.3 DEBUGGER ACCESS SUPPORT

An external Debugger accesses the chip through a JTAG standard interface. The debugger itself, however, is not an ARM product, and its capabilities will depend on the third-party product selected for code development and debug.

As shown in [FIGURE 7-1: ARM M4F Based Embedded Controller I/O Block Diagram on page 107](#), there may be other resources at the chip level that share the JTAG port pins; for example chip-level Boundary Scan. See [Section 1.4.4, "JTAG Interface," on page 15](#) for configuring the JTAG pins at the chip level for Debug purposes.

### 7.9.3.1 Debug and Access Ports (SWJ-DP and AHB-AP Subblocks)

These two subblocks work together to provide access to the chip for the Debugger using the Debug JTAG connection, as described in Chapter 4 of the [ARM Limited: ARM® Debug Interface v5 Architecture Specification, IHI0031A, 8 February 2006](#).

## 7.9.4 BREAKPOINT, WATCHPOINT AND TRACE SUPPORT

See [ARM Limited: ARM® Debug Interface v5 Architecture Specification, IHI0031A, 8 February 2006](#) and also [ARM Limited: ARM® Debug Interface v5 Architecture Specification ADiv5.1 Supplement, DSA09-PRDC-008772, 17 August 2009](#). A summary of functionality follows.

Breakpoint and Watchpoint facilities can be programmed to do one of the following:

- Halt the processor. This means that the external Debugger will detect the event by periodically polling the state of the EC.
- Transfer control to an internal Debug Monitor firmware routine, by triggering the Debug Monitor exception (see [Table 7-4, "Exception and Interrupt Vector Table Layout," on page 109](#)).

### 7.9.4.1 Instrumentation Support (ITM Subblock)

The Instrumentation Trace Macrocell (ITM) is for profiling software. This uses non-blocking register accesses, with a fixed low-intrusion overhead, and can be added to a Real-Time Operating System (RTOS), application, or exception handler. If necessary, product code can retain the register access instructions, avoiding probe effects.

### 7.9.4.2 HW Breakpoints and ROM Patching (FPB Subblock)

The Flash Patch and Breakpoint (FPB) block. This block can remap sections of ROM, typically Flash memory, to regions of RAM, and can set breakpoints on code in ROM. This block can be used for debug, and to provide a code or data patch to an application that requires field updates to a product in ROM.

### 7.9.4.3 Data Watchpoints and Trace (DWT Subblock)

The Debug Watchpoint and Trace (DWT) block provides watchpoint support, program counter sampling for performance monitoring, and embedded trace trigger control.

### 7.9.4.4 Trace Interface (ETM and TPIU)

The Embedded Trace Macrocell (ETM) provides instruction tracing capability. For details of functionality and usage, see also [ARM Limited: Embedded Trace Macrocell™ \(ETMv1.0 to ETMv3.5\) Architecture Specification, IHI0014Q, 23 September 2011](#) and [ARM Limited: CoreSight™ ETM™-M4 Technical Reference Manual, DDI0440C, 29 June 2010](#).

The Trace Port Interface Unit (TPIU) provides the external interface for the ITM, DWT and ETM.

See [Section 1.4.16, "Trace Debug Interface," on page 19](#) for configuring the Trace pins at the chip level for Trace output.

## 7.10 ARM Configuration

In order to function correctly, it is necessary to set the ARM Auxiliary Control Register (ACTLR), located at address 0xE-000E008, to 0x02. This sets bit[1], DISDEFWBUF, to 1. This must be done as soon as possible after Power On Reset, or register corruption may occur.

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## 8.0 RAM AND ROM

### SRAM

The 128KBytes SRAM (Code or Data) is allocated as follows:

- 96K Optimized for Code
- 32K Optimized for Data.

**Note:** 120KBytes are available for application code as follows: 96K Optimized for Code, 24K Optimized for Data.

The distinction between “96KB optimized for instructions” and “32KB optimized for data” SRAMs: is as follows: The MEC1322 has two blocks of SRAM, one of 96KB and one of 32KB. Both can be used for either instructions or data. As long as the ARM fetches instructions from one SRAM and does loads and stores to the other, code and data accesses operate in parallel and there are no wait states. If on the same cycle the ARM fetches an instruction and does a load or a store to the same SRAM, either the code fetch will be delayed by one cycle or the data access will be delayed by one cycle. The 96KB SRAM is optimized for instructions, in that if the ARM accesses this SRAM for both instructions and data on the same cycle, the instruction fetch will complete in one cycle and the load/store will be delayed for one cycle. The 32KB SRAM is optimized for data, in that if the ARM accesses this SRAM for both instructions and data on the same cycle, the load/store will complete in once cycle and the instruction fetch will be delayed for one cycle. In both cases, the SRAM arbiter ensures that the arbitration loser will win on subsequent cycles and thus will not be locked out of the SRAM indefinitely. User applications, therefore, are free to allocate code and data anywhere in the 128KB SRAM address space, except that there will be an occasional small performance hit if both code and data are allocated in the same SRAM.

The application loader in the MEC1322 ROM requires the top 8KB of the 32KB SRAM in order to perform its functions. The user can therefore load a maximum of 120KB into SRAM using the ROM loader. Once the ROM application loader has completed its operation, the entire 128KB address space can be allocated to whatever functions, code or data, the user wishes.

The SRAM is located at EC Base address 00100000h in 32-bit internal address space.

**Note:** 120KB is available for application code in the address range 00100000h to 0011DFFFh

### ROM

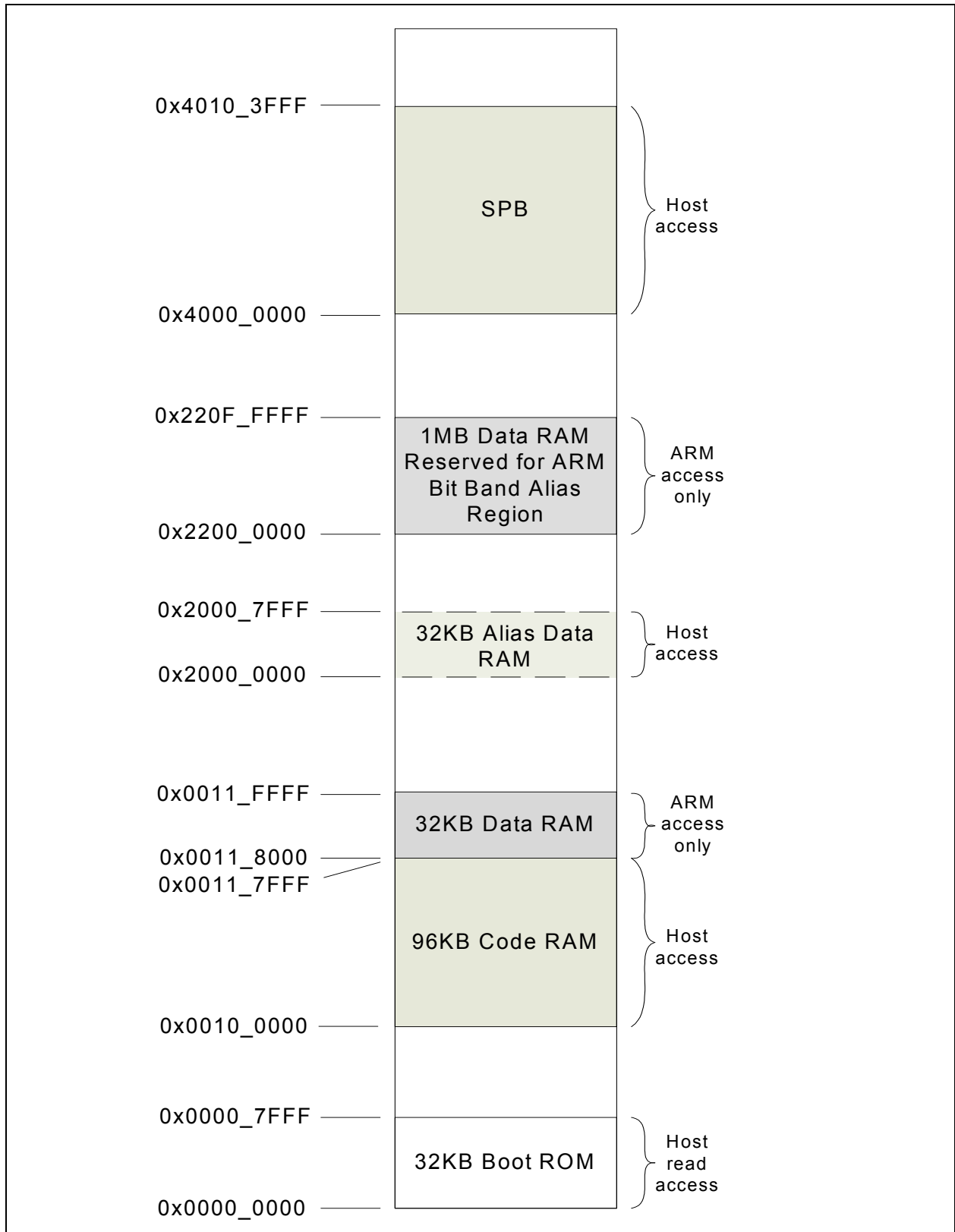
The 32KByte Boot ROM is located at EC Base address 00000000h in 32-bit internal address space.

**Note:** 30KB is available for application code in the address range 00000000h to 000077FFh

The memory map of the RAM and ROM is represented as follows:



**FIGURE 8-1: MEMORY LAYOUT**



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## 9.0 EMBEDDED MEMORY INTERFACE (EMI)

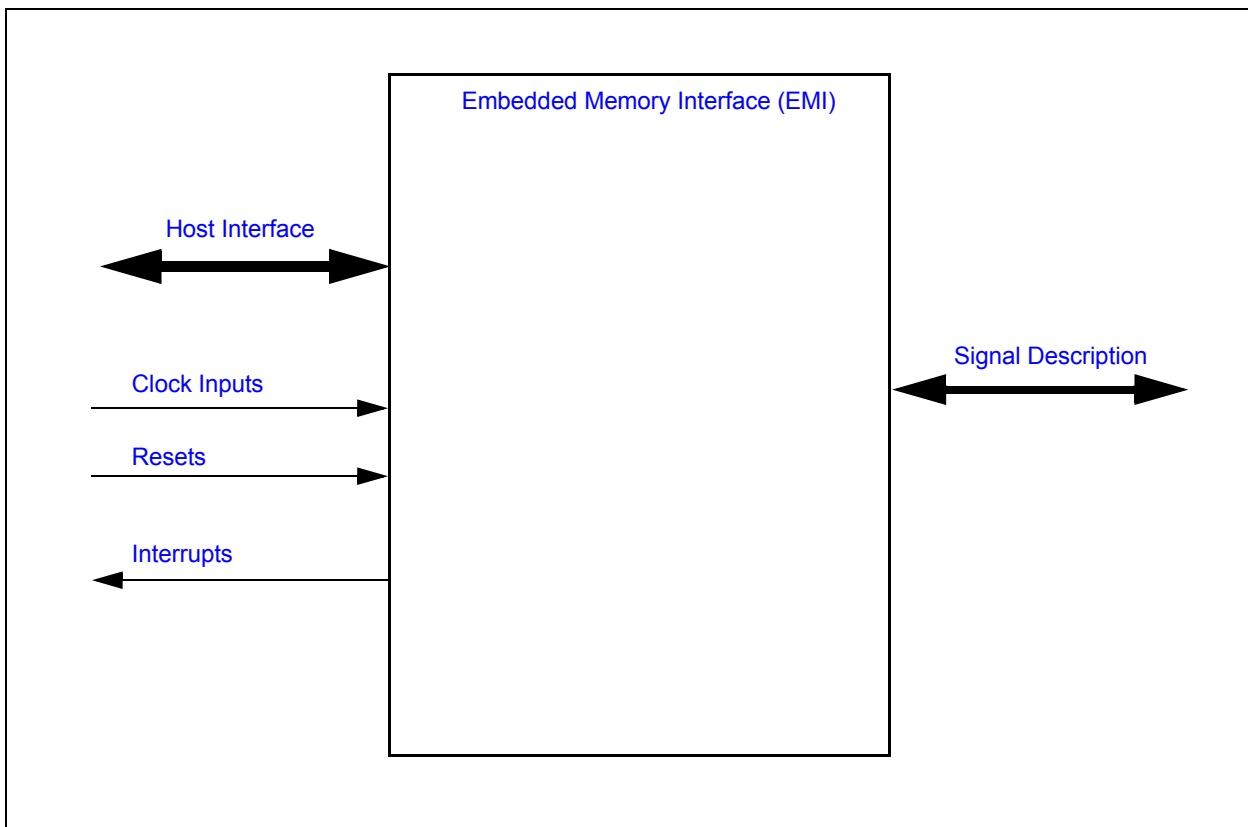
### 9.1 Introduction

The [Embedded Memory Interface \(EMI\)](#) provides a standard run-time mechanism for the system host to communicate with the Embedded Controller (EC) and other logical components. The Embedded Memory Interface includes 13 byte-addressable registers in the Host's address space, as well as 22 bytes of registers that are accessible only by the EC. The Embedded Memory Interface can be used by the Host to access bytes of memory designated by the EC without requiring any assistance from the EC. The EC may configure these regions of memory as read-only, write-only, or read/write capable.

### 9.2 Interface

This block is designed to be accessed externally and internally via a register interface.

**FIGURE 9-1: I/O DIAGRAM OF BLOCK**



### 9.3 Signal Description

There are no external signals associated with this block.

### 9.4 Host Interface

The registers defined for the [Embedded Memory Interface \(EMI\)](#) are accessible by the System Host and the Embedded Controller as indicated in [Section 9.10, "EC-Only Registers"](#) and [Section 9.9, "Runtime Registers"](#).

## 9.5 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 9.5.1 POWER DOMAINS

**TABLE 9-1: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block reside on this single power well. |

### 9.5.2 CLOCK INPUTS

This block has no special clocking requirements. Host register accesses are synchronized to the host bus clock and EC register accesses are synchronized to the EC bus clock, thereby allowing the transactions to complete in one bus clock.

### 9.5.3 RESETS

**TABLE 9-2: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal resets all the logic and register in this block. |

## 9.6 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 9-3: SYSTEM INTERRUPTS**

| Source     | Description  |
|------------|--|
| Host Event | This interrupt source for the SIRQ logic is generated when any of the EC_SWI bits are asserted and the corresponding EC_SWI_EN bits are asserted as well. This event is also asserted if the host writes the <a href="#">EC-to-HOST Mailbox Register</a> . |
| EC-to-Host | This interrupt source for the SIRQ logic is generated by the host writing the <a href="#">EC-to-HOST Mailbox Register</a> .  |

**TABLE 9-4: EC INTERRUPTS**

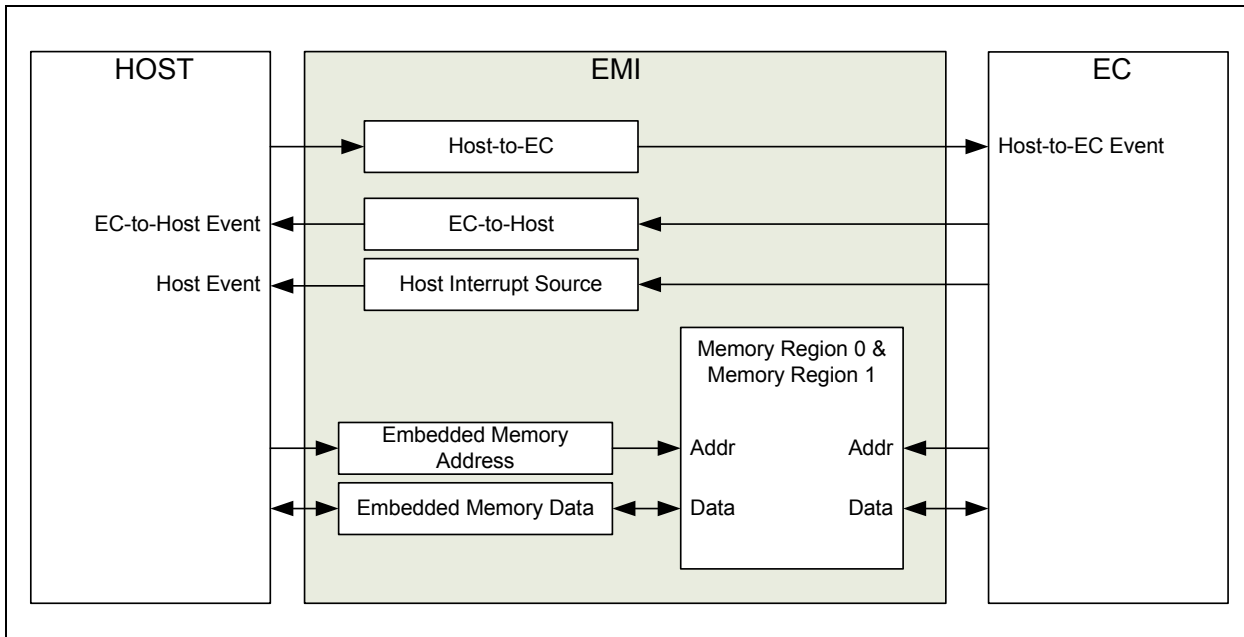
| Source     | Description  |
|------------|--|
| Host-to-EC | Interrupt source for the Interrupt Aggregator, generated by the host writing the <a href="#">HOST-to-EC Mailbox Register</a> . |

## 9.7 Low Power Modes

The [Embedded Memory Interface \(EMI\)](#) automatically enters low power mode when no transaction target it.

## 9.8 Description

FIGURE 9-2: EMBEDDED MEMORY INTERFACE BLOCK DIAGRAM



The Embedded Memory Interface (EMI) is composed of a mailbox, a direct memory interface, and an Application ID register.

The mailbox contains two registers, the [HOST-to-EC Mailbox Register](#) and the [EC-to-HOST Mailbox Register](#), that act as a communication portal between the system host and the embedded controller. When the [HOST-to-EC Mailbox Register](#) is written an interrupt is generated to the embedded controller. Similarly, when the [EC-to-HOST Mailbox Register](#) is written an interrupt is generated to the system host. The source of the system host interrupt may be read in the Interrupt Source Register. These interrupt events may be individually prevented from generating a Host Event via the Interrupt Mask Register.

The direct memory interface, which is composed of a byte addressable 16-bit EC Address Register and a 32-bit EC Data Register, permits the Host to read or write a portion of the EC's internal address space. The embedded controller may enable up to two regions of the EC's internal address space to be exposed to the system host. The system host may access these memory locations without intervention or assistance from the EC.

The Embedded Memory Interface can be configured so that data transfers between the Embedded Memory Interface data bytes and the 32-bit internal address space may be multiple bytes, while Host I/O is always executed a byte at a time.

When the Host reads one of the four bytes in the Embedded Memory Interface data register, data from the internal 32-bit address space, at the address defined by the Embedded Memory Interface address register, is returned to the Host. This read access will load 1, 2, or 4 bytes into the Data register depending on the configuration of the [ACCESS\\_TYPE](#) bits. Similarly, writing one of the four bytes in the data register will write the corresponding byte(s) from the data register into the internal 32-bit address space as indicated by the [ACCESS\\_TYPE](#) bits. This configuration option is done to ensure that data the EC treats as 16-bit or 32-bit will be consistent in the Host, even though one byte of the data may change between two or more 8-bit accesses by the Host.

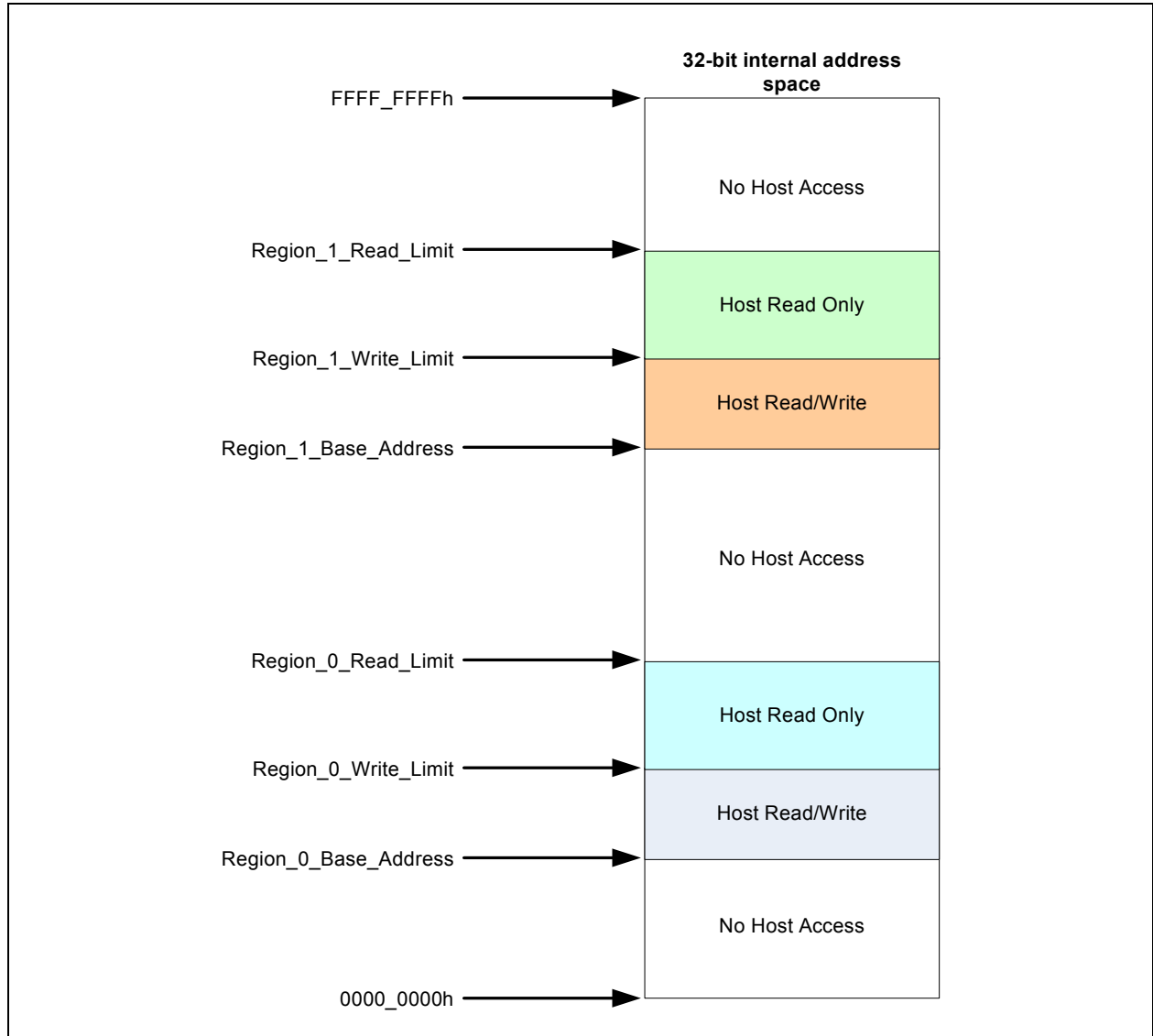
In addition, there is an auto-increment function for the Embedded Memory Interface address register. When enabled, the Host can read or write blocks of memory in the 32-bit internal address space by repeatedly accessing the Embedded Memory Interface data register, without requiring Host updates to the Embedded Memory Interface address register.

Finally, the [Application ID Register](#) may be used by the host to provide an arbitration mechanism if more than one software thread requires access through the EMI interface. See [Section 9.8.4, "Embedded Memory Interface Usage," on page 118](#) for more details.

## 9.8.1 EMBEDDED MEMORY MAP

Each Embedded Memory interface provides direct access for the Host into two windows in the EC 32-bit internal address space. This mapping is shown in Figure 9-3, "Embedded Memory Addressing":

**FIGURE 9-3: EMBEDDED MEMORY ADDRESSING**



The Base addresses, the Read limits and the Write limits are defined by registers that are in the EC address space and cannot be accessed by the Host. In each region, the Read limit need not be greater than the Write limit. The regions can be contiguous or overlapping. For example, if the Region 0 Read limit is set to 0 and the Write limit is set to a positive number, then the Embedded Memory interface defines a region in the EC memory that the EC can read and write but is write-only for the host. This might be useful for storage of security data, which the Host might wish to send to the EC but should not be readable in the event a virus invades the Host.

Each window into the EC memory can be as large as 32k bytes in the 32-bit internal address space. See [FIGURE 8-1: Memory Layout on page 113](#) for host accessible regions.

## 9.8.2 EC DATA REGISTER

The 4 1-byte EC Data Byte registers function as a 32-bit register, which creates a 4 byte window into the Memory REGION being accessed. The 4-byte window is always aligned on a 4-byte boundary. Depending on the read/write configuration of the memory region being accessed, the bytes may be extracted from or loaded into memory as a byte, word, or a DWord. The ACCESS\_TYPE determines the size of the memory access. The address accessed is determined by the two EC\_Address byte registers, which together function as a 15-bit EC Address Register.

- A write to the EC Data Register when the EC Address is in a read-only or a no-access region, as defined by the Memory Base and Limit registers, will update the EC Data Register but memory will not be modified.
- A read to the EC Data Register when the EC Address is in a no-access region, as defined by the Memory Base and Limit registers, will not trigger a memory read and will not modify the EC Data Register. In auto-increment mode (ACCESS\_TYPE=11b), reads of Byte 3 of the EC Data Register will still trigger increments of the EC Address Register when the address is out of bounds, while writes of Byte 3 will not.

## 9.8.3 ACCESS TYPES

The access type field (ACCESS\_TYPE in the EC Address LSB Register) defines the type of host access that occurs when the EC Data Register is read or written.

- 11: Auto-increment 32-bit access. This defines a 32-bit access, as in the 10 case. In addition, any read or write of Byte 3 in the EC Data Register causes the EC Data Register to be incremented by 1. That is, the EC\_Address field will point to the next 32-bit double word in the 32-bit internal address space.
- 10: 32-bit access. A read of Byte 0 in the EC Data Register causes the 32 bits in the 32-bit internal address space at an offset of EC\_Address to be loaded into the entire EC Data Register. The read then returns the contents of Byte 0. A read of Byte 1, Byte 2 or Byte 3 in the EC Data Register returns the contents of the register, without any update from the 32-bit internal address space.

A write of Byte 3 in the EC Data Register causes the EC Data Register to be written into the 32 bits in the 32-bit internal address space at an offset of EC\_Address. A write of Byte 0, Byte 1 or Byte 2 in the EC Data Register updates the contents of the register, without any change to the 32-bit internal address space.

- 01: 16-bit access. A read of Byte 0 in the EC Data Register causes the 16 bits in the 32-bit internal address space at an offset of EC\_Address to be loaded into Byte 0 and Byte 1 of the EC Data Register. The read then returns the contents of Byte 0. A read of Byte 2 in the EC Data Register causes the 16 bits in the 32-bit internal address space at an offset of EC\_Address+2 to be loaded into Byte 2 and Byte 3 of the EC Data Register. The read then returns the contents of Byte 2. A read of Byte 1 or Byte 3 in the EC Data Register return the contents of the register, without any update from the 32-bit internal address space.

A write of Byte 1 in the EC Data Register causes Bytes 1 and 0 of the EC Data Register to be written into the 16 bits in the 32-bit internal address space at an offset of EC\_Address. A write of Byte 3 in the EC Data Register causes Bytes 3 and 2 of the EC Data Register to be written into the 16 bits in the 32-bit internal address space at an offset of EC\_Address+2. A write of Byte 0 or Byte 2 in the EC Data Register updates the contents of the register, without any change to the 32-bit internal address space.

- 00: 8-bit access. Any byte read of Byte 0 through Byte 3 in the EC Data Register causes the corresponding byte within the 32-bit double word addressed by EC\_Address to be loaded into the byte of EC Data Register and returned by the read. Any byte write to Byte 0 through Byte 3 in the EC Data Register writes the corresponding byte within the 32-bit double word addressed by EC\_Address, as well as the byte of the EC Data Register.

## 9.8.4 EMBEDDED MEMORY INTERFACE USAGE

The Embedded Memory Interface provides a generic facility for communication between the Host and the EC and can be used for many functions. Some examples are:

- Virtual registers. A block of memory in the 32-bit internal address space can be used to implement a set of virtual registers. The Host is given direct read-only access to this address space, referred to as peek mode. The EC may read or write this memory as needed.
- Program downloading. Because the Instruction Closely Coupled Memory is implemented in the same 32-bit internal address space, the Embedded Memory Interface can be used by the Host to download new program segments for the EC in the upper 32KB SRAM. The Read/Write window would be configured by the Host to point to the beginning of the loadable program region, which could then be loaded by the Host.
- Data exchange. The Read/Write portion of the memory window can be used to contain a communication packet. The Host, by default, "owns" the packet, and can write it at any time. When the Host wishes to communicate with the EC, it sends the EC a command, through the Host-to-EC message facility, to read the packet and perform

some operations as a result. When it is completed processing the packet, the EC can inform the Host, either through a message in the EC-to-Host channel or by triggering an event such as an SMI directly. If return results are required, the EC can write the results into the Read/Write region, which the Host can read directly when it is informed that the EC has completed processing. Depending on the command, the operations could entail update of virtual registers in the 32-bit internal address space, reads of any register in the EC address space, or writes of any register in the EC address space. Because there are two regions that are defined by the base registers, the memory used for the communication packet does not have to be contiguous with a set of virtual registers.

Because there are two Embedded Memory Interface memory regions, the Embedded Memory Interface cannot be used for more than two of these functions at a time. The Host can request that the EC switch from one function to another through the use of the Host-to-EC mailbox register.

The [Application ID Register](#) is provided to help software applications track ownership of an Embedded Memory Interface. An application can write the register with its Application ID, then immediately read it back. If the read value is not the same as the value written, then another application has ownership of the interface.

**Note:** The protocol used to pass commands back and forth through the Embedded Memory Interface Registers Interface is left to the System designer. Microchip can provide an application example of working code in which the host uses the Embedded Memory Interface registers to gain access to all of the EC registers.

## 9.9 Runtime Registers

The registers listed in the Runtime Register Summary table are for a single instance of the EMI. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Runtime Register Base Address Table.

**TABLE 9-5: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address (Note 9-1) |
|----------------|-----------------|------|-------------------------------|-------------------------|
| EMI            | 0               | EC   | 32-bit internal address space | 400F_0000h              |
| EMI            | 0               | LPC  | I/O                           | Programmed BAR          |

**Note 9-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 9-6: RUNTIME REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                      |
|--------|---|
| 00h    | <a href="#">HOST-to-EC Mailbox Register</a>   |
| 01h    | <a href="#">EC-to-HOST Mailbox Register</a>   |
| 02h    | <a href="#">EC Address LSB Register</a>       |
| 03h    | <a href="#">EC Address MSB Register</a>       |
| 04h    | <a href="#">EC Data Byte 0 Register</a>       |
| 05h    | <a href="#">EC Data Byte 1 Register</a>       |
| 06h    | <a href="#">EC Data Byte 2 Register</a>       |
| 07h    | <a href="#">EC Data Byte 3 Register</a>       |
| 08h    | <a href="#">Interrupt Source LSB Register</a> |
| 09h    | <a href="#">Interrupt Source MSB Register</a> |
| 0Ah    | <a href="#">Interrupt Mask LSB Register</a>   |
| 0Bh    | <a href="#">Interrupt Mask MSB Register</a>   |
| 0Ch    | <a href="#">Application ID Register</a>       |

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## 9.9.1 HOST-TO-EC MAILBOX REGISTER

| Offset | 00h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 7:0    | <p><b>HOST_EC_MBOX</b></p> <p>8-bit mailbox used communicate information from the system host to the embedded controller. Writing this register generates an event to notify the embedded controller.</p> <p>The embedded controller has the option of clearing some or all of the bits in this register. This is dependent on the protocol layer implemented using the EMI Mailbox. The host must know this protocol to determine the meaning of the value that will be reported on a read.</p> <p>This bit field is aliased to the <a href="#">HOST_EC_MBOX</a> bit field in the <a href="#">HOST-to-EC Mailbox Register</a></p> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

## 9.9.2 EC-TO-HOST MAILBOX REGISTER

| Offset | 01h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | <p><b>EC_HOST_MBOX</b></p> <p>8-bit mailbox used communicate information from the embedded controller to the system host. Writing this register generates an event to notify the system host.</p> <p>The system host has the option of clearing some or all of the bits in this register. This is dependent on the protocol layer implemented using the EMI Mailbox. The embedded controller must know this protocol to determine the meaning of the value that will be reported on a read.</p> <p>This bit field is aliased to the <a href="#">EC_HOST_MBOX</a> bit field in the <a href="#">EC-to-HOST Mailbox Register</a></p> | R/WC | 0h      | <a href="#">VCC1_R ESET</a> |

## 9.9.3 EC ADDRESS LSB REGISTER

| Offset | 02h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:2    | <p><b>EC_ADDRESS_LSB</b></p> <p>This field defines bits[7:2] of EC_Address [15:0]. Bits[1:0] of the EC_Address are always forced to 00b.</p> <p>The EC_Address is aligned on a DWord boundary. It is the address of the memory being accessed by <a href="#">EC Data Byte 0 Register</a>, which is an offset from the programmed base address of the selected <a href="#">REGION</a>.</p> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |



| Offset | 02h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 1:0    | <p>ACCESS_TYPE</p> <p>This field defines the type of access that occurs when the EC Data Register is read or written.</p> <p>11b=Auto-increment 32-bit access.<br/>10b=32-bit access.<br/>01b=16-bit access.<br/>00b=8-bit access.</p> <p>Each of these access types are defined in detail in <a href="#">Section 9.8.3, "Access Types"</a>.</p> | R/W  | 0h      | VCC1_R<br>ESET |

## 9.9.4 EC ADDRESS MSB REGISTER

| Offset | 03h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7      | <p>REGION</p> <p>The field specifies which of two segments in the 32-bit internal address space is to be accessed by the EC_Address[14:2] to generate accesses to the memory.</p> <p>1= The address defined by EC_Address[14:2] is relative to the base address specified by the Memory Base Address 1 Register.<br/>0= The address defined by EC_Address[14:2] is relative to the base address specified by the Memory Base Address 0 Register.</p> | R/W  | 0h      | VCC1_R<br>ESET |
| 6:0    | <p>EC_ADDRESS_MSB</p> <p>This field defines bits[14:8] of EC_Address. Bits[1:0] of the EC_Address are always forced to 00b.</p> <p>The EC_Address is aligned on a DWord boundary. It is the address of the memory being accessed by <a href="#">EC Data Byte 0 Register</a>, which is an offset from the programmed base address of the selected <a href="#">REGION</a>.</p>   | R/W  | 0h      | VCC1_R<br>ESET |

## 9.9.5 EC DATA BYTE 0 REGISTER

| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | <p>EC_DATA_BYTE_0</p> <p>This is byte 0 (Least Significant Byte) of the 32-bit <a href="#">EC Data Register</a>.</p> <p>Use of the Data Byte registers to access EC memory is defined in detail in <a href="#">Section 9.8.2, "EC Data Register"</a>.</p> | R/W  | 0h      | VCC1_R<br>ESET |

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## 9.9.6 EC DATA BYTE 1 REGISTER

| Offset | 05h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC_DATA_BYTE_1<br>This is byte 1 of the 32-bit <a href="#">EC Data Register</a> .<br><br>Use of the Data Byte registers to access EC memory is defined in detail in <a href="#">Section 9.8.2, "EC Data Register"</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 9.9.7 EC DATA BYTE 2 REGISTER

| Offset | 06h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC_DATA_BYTE_2<br>This is byte 2 of the 32-bit <a href="#">EC Data Register</a> .<br><br>Use of the Data Byte registers to access EC memory is defined in detail in <a href="#">Section 9.8.2, "EC Data Register"</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 9.9.8 EC DATA BYTE 3 REGISTER

| Offset | 07h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC_DATA_BYTE_3<br>This is byte 3 (Most Significant Byte) of the 32-bit <a href="#">EC Data Register</a> .<br><br>Use of the Data Byte registers to access EC memory is defined in detail in <a href="#">Section 9.8.2, "EC Data Register"</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 9.9.9 INTERRUPT SOURCE LSB REGISTER

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:1    | EC_SWI_LSB<br>EC Software Interrupt Least Significant Bits. These bits are software interrupt bits that may be set by the EC to notify the host of an event. The meaning of these bits is dependent on the firmware implementation.<br><br>Each bit in this field is cleared when written with a '1b'. The ability to clear the bit can be disabled by the EC if the corresponding bit in the <a href="#">Host Clear Enable Register</a> is set to '0b'. This may be used by firmware for events that cannot be cleared while the event is still active. | R/WC | 0h      | VCC1_R<br>ESET |

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 0      | <p>EC_WR</p> <p>EC Mailbox Write. This bit is set when the <a href="#">EC-to-HOST Mailbox Register</a> has been written by the EC at offset 01h of the EC-Only registers.</p> <p>Note: there is no corresponding mask bit in the <a href="#">Interrupt Mask LSB Register</a></p> | R    | 0h      | VCC1_R<br>ESET |

## 9.9.10 INTERRUPT SOURCE MSB REGISTER

| Offset | 09h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | <p>EC_SWI_MSB</p> <p>EC Software Interrupt Most Significant Bits. These bits are software interrupt bits that may be set by the EC to notify the host of an event. The meaning of these bits is dependent on the firmware implementation.</p> <p>Each bit in this field is cleared when written with a '1b'. The ability to clear the bit can be disabled by the EC. if the corresponding bit in the <a href="#">Host Clear Enable Register</a> is set to '0b'. This may be used by firmware for events that cannot be cleared while the event is still active.</p> | R/WC | 0h      | VCC1_R<br>ESET |

## 9.9.11 INTERRUPT MASK LSB REGISTER

| Offset | 0Ah   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:1    | <p>EC_SWI_EN_LSB</p> <p>EC Software Interrupt Enable Least Significant Bits. Each bit that is set to '1b' in this field enables the generation of a Host Event interrupt by the corresponding bit in the EC_SWI field in the <a href="#">Interrupt Source LSB Register</a>.</p> | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | MCHP Reserved   | R/W  | 0h      | VCC1_R<br>ESET |

## 9.9.12 INTERRUPT MASK MSB REGISTER

| Offset | 0Bh  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | <p>EC_SWI_EN_MSB</p> <p>EC Software Interrupt Enable Most Significant Bits. Each bit that is set to '1b' in this field enables the generation of a Host Event interrupt by the corresponding bit in the EC_SWI field in the <a href="#">Interrupt Source MSB Register</a>.</p> | R/W  | 0h      | VCC1_R<br>ESET |

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## 9.9.13 APPLICATION ID REGISTER

| Offset | 0Ch  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | APPLICATION_ID<br>When this field is 00h it can be written with any value. When set to a non-zero value, writing that value will clear this register to 00h.<br>When set to a non-zero value, writing any value other than the current contents will have no effect. | R/W  | 0h      | VCC1_R<br>ESET |

## 9.10 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [Embedded Memory Interface \(EMI\)](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the EC-Only Register Base Address Table.

| Block Instance | Instance Number | Host | Address Space                 | Base Address |
|----------------|-----------------|------|-------------------------------|--------------|
| EMI            | 0               | EC   | 32-bit internal address space | 400F_0100h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

| Offset | Register Name (Mnemonic)                       |
|--------|--|
| 00h    | <a href="#">HOST-to-EC Mailbox Register</a>    |
| 01h    | <a href="#">EC-to-HOST Mailbox Register</a>    |
| 04h    | <a href="#">Memory Base Address 0 Register</a> |
| 08h    | <a href="#">Memory Read Limit 0 Register</a>   |
| 0Ah    | <a href="#">Memory Write Limit 0 Register</a>  |
| 0Ch    | <a href="#">Memory Base Address 1 Register</a> |
| 10h    | <a href="#">Memory Read Limit 1 Register</a>   |
| 12h    | <a href="#">Memory Write Limit 1 Register</a>  |
| 14h    | <a href="#">Interrupt Set Register</a>         |
| 16h    | <a href="#">Host Clear Enable Register</a>     |

### 9.10.1 HOST-TO-EC MAILBOX REGISTER

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | HOST_EC_MBOX<br>8-bit mailbox used communicate information from the system host to the embedded controller. Writing this register generates an event to notify the embedded controller.<br><br>The embedded controller has the option of clearing some or all of the bits in this register. This is dependent on the protocol layer implemented using the EMI Mailbox. The host must know this protocol to determine the meaning of the value that will be reported on a read.<br><br>This bit field is aliased to the <a href="#">HOST_EC_MBOX</a> bit field in the <a href="#">HOST-to-EC Mailbox Register</a> . | R/WC | 0h      | VCC1_R<br>ESET |

## 9.10.2 EC-TO-HOST MAILBOX REGISTER

| Offset | 01h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | <p><b>EC_HOST_MBOX</b><br/>8-bit mailbox used communicate information from the embedded controller to the system host. Writing this register generates an event to notify the system host.</p> <p>The system host has the option of clearing some or all of the bits in this register. This is dependent on the protocol layer implemented using the EMI Mailbox. The embedded controller must know this protocol to determine the meaning of the value that will be reported on a read.</p> <p>This bit field is aliased to <a href="#">EC_HOST_MBOX</a> bit field in the <a href="#">EC-to-HOST Mailbox Register</a>.</p> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

## 9.10.3 MEMORY BASE ADDRESS 0 REGISTER

| Offset | 04h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:2   | <p><b>MEMORY_BASE_ADDRESS_0</b><br/>This memory base address defines the beginning of region 0 in the Embedded Controller's 32-bit internal address space. Memory allocated to region 0 is intended to be shared between the Host and the EC. The region defined by this base register is used when bit 15 of the EC Address Register is 0. The access will be to a memory location at an offset defined by the EC_Address relative to the beginning of the region defined by this register. Therefore, a read or write to the memory that is triggered by the EC Data Register will occur at <code>Memory_Base_Address_0 + EC_Address</code>.</p> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |
| 1:0    | Reserved   | R    | -       | -                           |

## 9.10.4 MEMORY READ LIMIT 0 REGISTER

| Offset | 08h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 15     | Reserved  | R    | -       | -                           |
| 14:2   | <p><b>MEMORY_READ_LIMIT_0</b><br/>Whenever a read of any byte in the EC Data Register is attempted, and bit 15 of EC_Address is 0, the field <code>EC_Address[14:2]</code> in the <code>EC_Address_Register</code> is compared to this field. As long as <code>EC_Address[14:2]</code> is less than this field the <code>EC_Data_Register</code> will be loaded from the 24-bit internal address space.</p> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |
| 1:0    | Reserved  | R    | -       | -                           |

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## 9.10.5 MEMORY WRITE LIMIT 0 REGISTER

| Offset | 0Ah   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 15     | Reserved  | R    | -       | -              |
| 14:2   | MEMORY_WRITE_LIMIT_0<br>Whenever a write of any byte in EC DATA Register is attempted and bit 15 of EC_Address is 0, the field EC_ADDRESS_MSB in the EC_Address Register is compared to this field. As long as EC_Address[14:2] is less than Memory_Write_Limit_0[14:2] the addressed bytes in the EC DATA Register will be written into the internal 24-bit address space. If EC_Address[14:2] is greater than or equal to the Memory_Write_Limit_0[14:2] no writes will take place. | R/W  | 0h      | VCC1_R<br>ESET |
| 1:0    | Reserved  | R    | -       | -              |

## 9.10.6 MEMORY BASE ADDRESS 1 REGISTER

| Offset | 0Ch  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:2   | MEMORY_BASE_ADDRESS_1<br>This memory base address defines the beginning of region 1 in the Embedded Controller's 32-bit internal address space. Memory allocated to region 1 is intended to be shared between the Host and the EC. The region defined by this base register is used when bit 15 of the EC Address Register is 1. The access will be to a memory location at an offset defined by the EC_Address relative to the beginning of the region defined by this register. Therefore, a read or write to the memory that is triggered by the EC Data Register will occur at Memory_Base_Address_1 + EC_Address. | R/W  | 0h      | VCC1_R<br>ESET |
| 1:0    | Reserved   | R    | -       | -              |

## 9.10.7 MEMORY READ LIMIT 1 REGISTER

| Offset | 10h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 15     | Reserved  | R    | -       | -              |
| 14:2   | MEMORY_READ_LIMIT_1<br>Whenever a read of any byte in the EC Data Register is attempted, and bit 15 of EC_ADDRESS is 1, the field EC_ADDRESS in the EC_Address_Register is compared to this field. As long as EC_ADDRESS is less than this value, the EC_Data_Register will be loaded from the 24-bit internal address space. | R/W  | 0h      | VCC1_R<br>ESET |
| 1:0    | Reserved  | R    | -       | -              |

## 9.10.8 MEMORY WRITE LIMIT 1 REGISTER

| Offset | 12h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 15     | Reserved   | R    | -       | -              |
| 14:2   | <b>MEMORY_WRITE_LIMIT_1</b><br>Whenever a write of any byte in EC DATA Register is attempted and bit 15 of EC_Address is 1, the field EC_Address[14:2] in the EC_Address Register is compared to this field. As long as EC_Address[14:2] is less than Memory_Write_Limit_1[14:2] the addressed bytes in the EC DATA Register will be written into the internal 24-bit address space. If EC_Address[14:2] is greater than or equal to the Memory_Write_Limit_1[14:2] no writes will take place. | R/W  | 0h      | VCC1_R<br>ESET |
| 1:0    | Reserved   | R    | -       | -              |

## 9.10.9 INTERRUPT SET REGISTER

| Offset | 14h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 15:1   | <b>EC_SWI_SET</b><br>EC Software Interrupt Set. This register provides the EC with a means of updating the Interrupt Source Registers. Writing a bit in this field with a '1b' sets the corresponding bit in the Interrupt Source Register to '1b'. Writing a bit in this field with a '0b' has no effect. Reading this field returns the current contents of the Interrupt Source Register. | R/WS | 0h      | VCC1_R<br>ESET |
| 0      | Reserved   | R    | -       | -              |

## 9.10.10 HOST CLEAR ENABLE REGISTER

| Offset | 16h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 15:1   | <b>HOST_CLEAR_ENABLE</b><br>When a bit in this field is '0b', the corresponding bit in the Interrupt Source Register cannot be cleared by writes to the Interrupt Source Register. When a bit in this field is '1b', the corresponding bit in the Interrupt Source Register can be cleared when that register bit is written with a '1b'.<br><br>These bits allow the EC to control whether the status bits in the Interrupt Source Register are based on an edge or level event. | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | Reserved  | R    | -       | -              |

## 10.0 ACPI EMBEDDED CONTROLLER INTERFACE (ACPI-ECI)

### 10.1 Introduction

The [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) is a Host/EC Message Interface. The ACPI specification defines the standard hardware and software communications interface between the OS and an embedded controller. This interface allows the OS to support a standard driver that can directly communicate with the embedded controller, allowing other drivers within the system to communicate with and use the EC resources; for example, Smart Battery and AML code.

The [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) provides a four byte full duplex data interface which is a superset of the standard [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) one byte data interface. The [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) defaults to the standard one byte interface.

The MEC1322 has two instances of the ACPI Embedded Controller Interface.

1. The EC host in [Table 10-8](#) and [Table 10-10](#) corresponds to the EC in the ACPI specification. This interface is referred to elsewhere in this chapter as [ACPI\\_EC](#).
2. The LPC host in [Table 10-8](#) and [Table 10-10](#) corresponds to the “System Host Interface to OS” in the ACPI specification. This interface is referred to elsewhere in this chapter as [ACPI\\_OS](#).

### 10.2 References

- Advanced Configuration and Power Interface Specification, Revision 4.0 June 16, 2009, Hewlett-Packard Corporation Intel Corporation Microsoft Corporation Phoenix Technologies Ltd. Toshiba Corporation

### 10.3 Terminology

**TABLE 10-1: TERMINOLOGY**

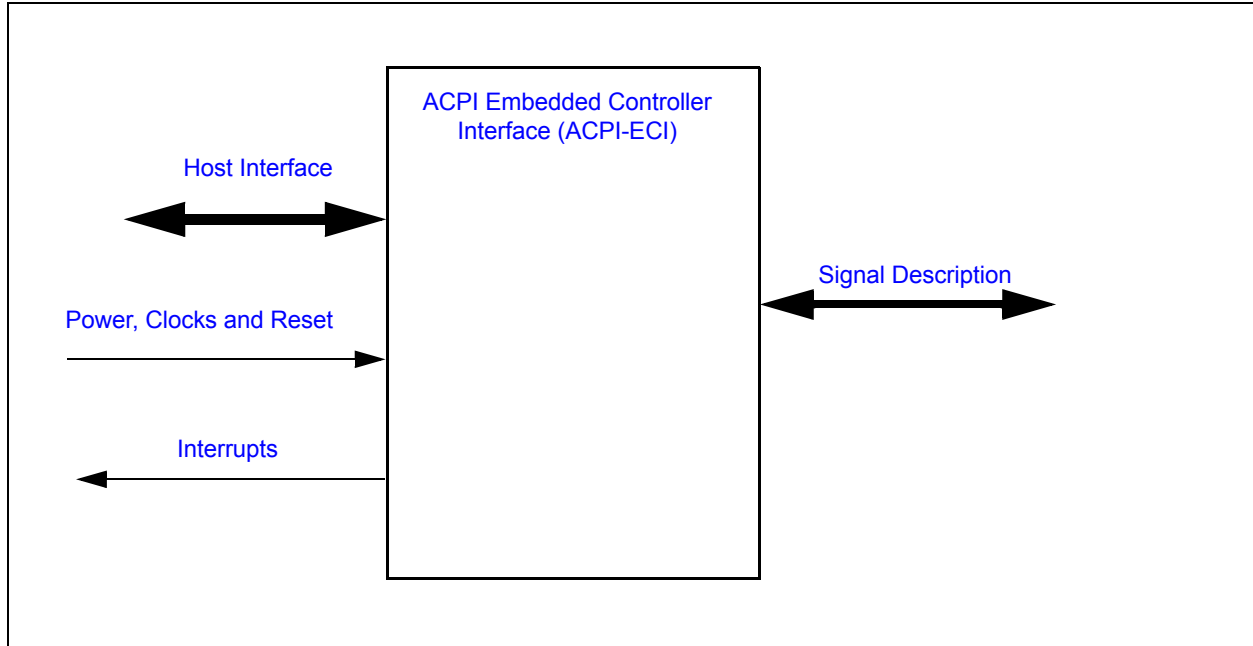
| Term                    | Definition  |
|-------------------------|---|
| <a href="#">ACPI_EC</a> | The EC host corresponding to the ACPI specification interface to the EC.  |
| <a href="#">ACPI_OS</a> | The LPC host corresponding to the ACPI specification interface to the “System Host Interface to OS”.<br><a href="#">ACPI_OS</a> terminology is not meant to distinguish the ACPI System Management from Operating System but merely the hardware path upstream towards the CPU. |



## 10.4 Interface

This block is designed to be accessed externally and internally via a register interface.

**FIGURE 10-1: I/O DIAGRAM OF BLOCK**



## 10.5 Signal Description

There are no external signals.

## 10.6 Host Interface

The registers defined for the [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) are accessible by the System Host and the Embedded Controller as indicated in [Section 10.12, "Runtime Registers"](#) and [Section 10.13, "EC-Only Registers"](#).

## 10.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 10.7.1 POWER DOMAINS

**TABLE 10-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block reside on this single power well. |

### 10.7.2 CLOCK INPUTS

This block only requires the Host interface clocks to synchronize registers access.

### 10.7.3 RESETS

**TABLE 10-3: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | VCC1_RESET resets all the logic and registers in <a href="#">ACPI Embedded Controller Interface (ACPI-ECI)</a> . |

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## 10.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 10-4: SYSTEM INTERRUPTS**

| Source | Description  |
|--------|--|
| EC_OBF | EC_OBF interrupt is asserted when the OBF in the EC STATUS Register is cleared to '0'. |

**TABLE 10-5: EC INTERRUPTS**

| Source | Description  |
|--------|--|
| EC_OBF | EC_OBF interrupt is asserted when the OBF in the EC STATUS Register is cleared to '0'. |
| EC_IBF | EC_IBF interrupt is asserted when the IBF in the EC STATUS Register is set to '1'.     |

**Note:** The usage model from the ACPI specification requires both SMI's and SCI's. The ACPI\_OS SMI & SCI interrupts are not implemented in the ACPI Embedded Controller Interface (ACPI-ECI). The SMI\_EVT and SCI\_EVT bits in the OS STATUS OS Register are software flags and this block do not initiate SMI or SCI events.

## 10.9 Low Power Modes

The ACPI Embedded Controller Interface (ACPI-ECI) automatically enters low power mode when no transaction targets it.

## 10.10 Description

The [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) provides an APCI-EC interface that adheres to the ACPI specification. The ACPI Embedded Controller Interface (ACPI-ECI) includes two modes of operation: [Legacy Mode](#) and [Four-byte Mode](#).

The ACPI Embedded Controller Interface (ACPI-ECI) defaults to [Legacy Mode](#) which provides single byte Full Duplex operation. [Legacy Mode](#) corresponds to the ACPI specification functionality as illustrated in [FIGURE 10-2: on page 131](#). The EC interrupts in [FIGURE 10-2: on page 131](#) are implemented as [EC\\_OBF](#) & [EC\\_IBF](#). See [Section 10.8, "Interrupts," on page 130](#).

In [Four-byte Mode](#), the ACPI Embedded Controller Interface (ACPI-ECI) provides four byte Full Duplex operation. [Four-byte Mode](#) is a superset of the ACPI specification functionality as illustrated in [FIGURE 10-2: on page 131](#).

Both [Legacy Mode](#) & [Four-byte Mode](#) provide Full Duplex Communications which allows data/command transfers in one direction while maintaining data from the other direction; communications can flow both ways simultaneously.

In [Legacy Mode](#), [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) contains three registers: [ACPI OS COMMAND Register](#), [OS STATUS OS Register](#), and [OS2EC Data EC Byte 0 Register](#). The standard [ACPI Embedded Controller Interface \(ACPI-ECI\)](#) registers occupy two addresses in the [ACPI\\_OS](#) space ([Table 10-9](#)).

The [OS2EC Data EC Byte 0 Register](#) and [ACPI OS COMMAND Register](#) registers appear as a single 8-bit data register in the [ACPI\\_EC](#). The [CMD](#) bit in the [OS STATUS OS Register](#) is used by the [ACPI\\_EC](#) to discriminate commands from data written by the [ACPI\\_OS](#) to the [ACPI\\_EC](#). [CMD](#) bit is controlled by hardware: [ACPI\\_OS](#) writes to the [OS2EC Data EC Byte 0 Register](#) register clear the [CMD](#) bit; [ACPI\\_OS](#) writes to the [ACPI OS COMMAND Register](#) set the [CMD](#) bit.

FIGURE 10-2: BLOCK DIAGRAM CORRESPONDING TO THE ACPI SPECIFICATION

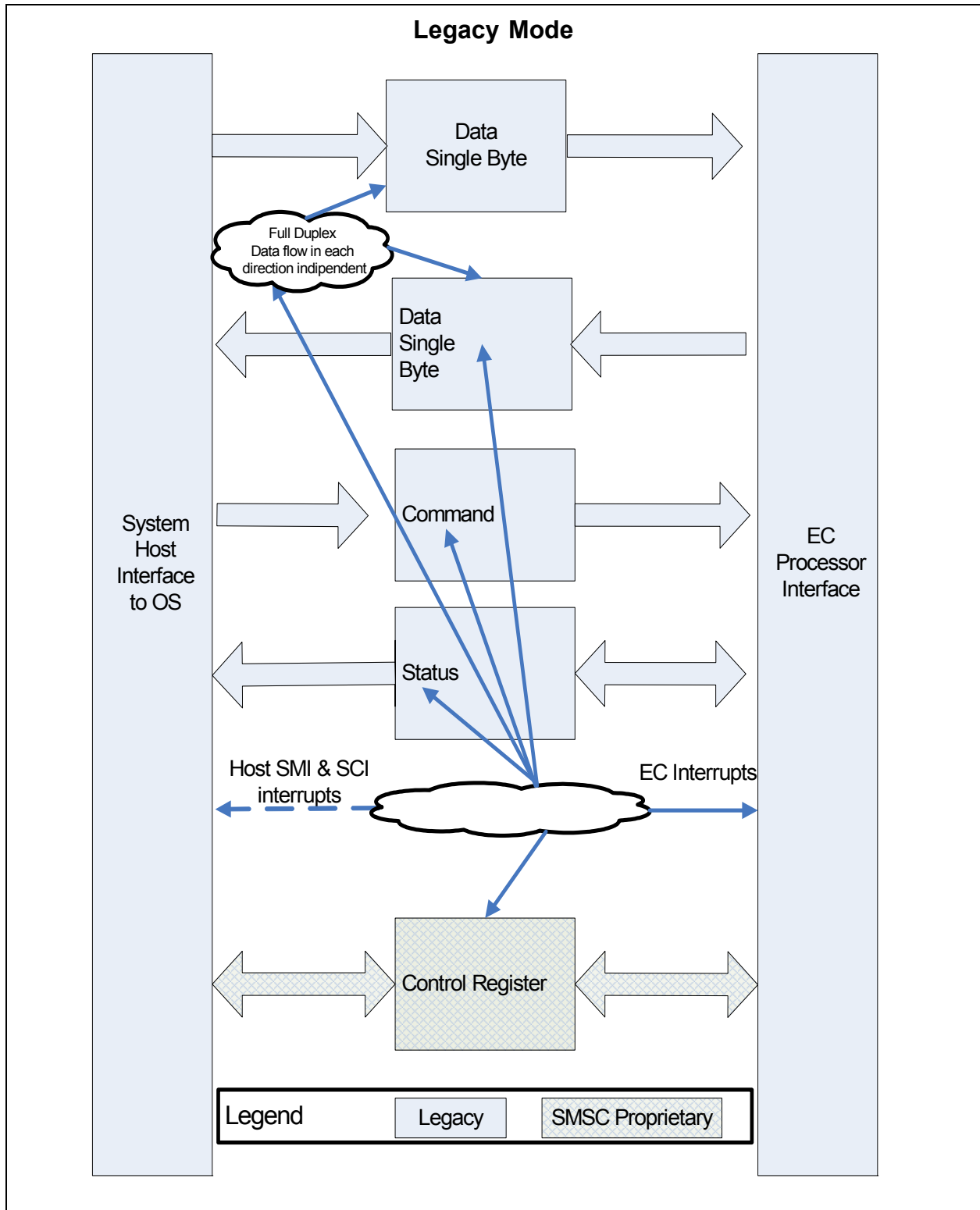
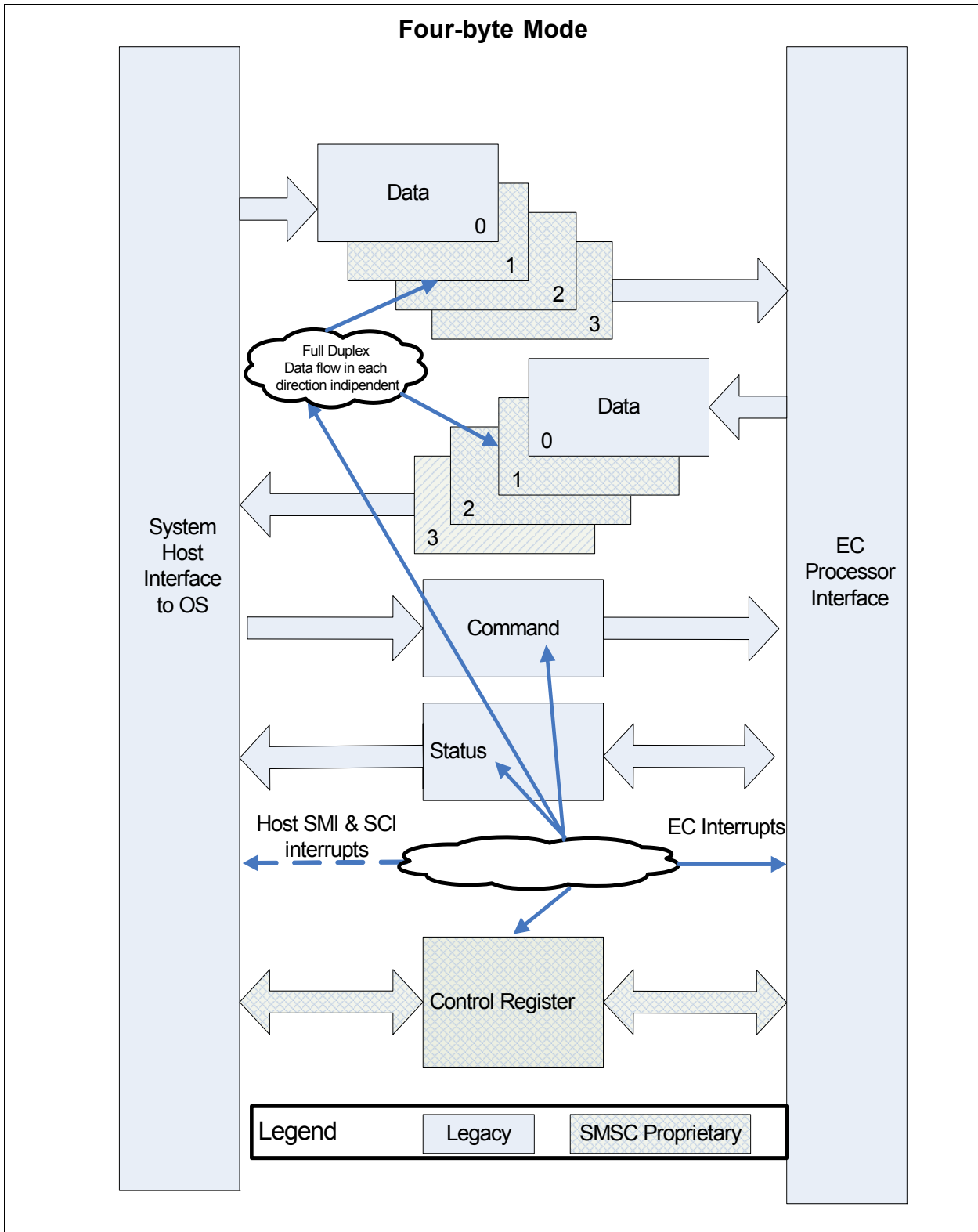


FIGURE 10-2: BLOCK DIAGRAM CORRESPONDING TO THE ACPI SPECIFICATION



## 10.11 Register Aliasing between Runtime and EC-Only Registers

Table 10-6, "Runtime Register Aliasing into EC-Only Registers" indicates the aliasing from Runtime registers to EC-Only registers. The "Host/EC Access" column distinguishes the aliasing based on access type. See individual register descriptions for more details.

**TABLE 10-6: RUNTIME REGISTER ALIASING INTO EC-ONLY REGISTERS**

| Host Offset | Runtime Register Register Name (Mnemonic) | Host Access | EC Offset | Aliased EC-Only Register Register Name (Mnemonic) | EC Access |
|-------------|---|-------------|-----------|---|-----------|
| 00h         | ACPI OS Data Register Byte 0 Register     | W           | 108h      | OS2EC Data EC Byte 0 Register                     | R         |
| 00h         | ACPI OS Data Register Byte 0 Register     | R           | 100h      | EC2OS Data EC Byte 0 Register                     | W         |
| 01h         | ACPI OS Data Register Byte 1 Register     | W           | 109h      | OS2EC Data EC Byte 1 Register                     | R         |
| 01h         | ACPI OS Data Register Byte 1 Register     | R           | 101h      | EC2OS Data EC Byte 1 Register                     | W         |
| 02h         | ACPI OS Data Register Byte 2 Register     | W           | 10Ah      | OS2EC Data EC Byte 2 Register                     | R         |
| 02h         | ACPI OS Data Register Byte 2 Register     | R           | 102h      | EC2OS Data EC Byte 2 Register                     | W         |
| 03h         | ACPI OS Data Register Byte 3 Register     | W           | 10Bh      | OS2EC Data EC Byte 3 Register                     | R         |
| 03h         | ACPI OS Data Register Byte 3 Register     | R           | 103h      | EC2OS Data EC Byte 3 Register                     | W         |
| 04h         | ACPI OS COMMAND Register                  | W           | 108h      | OS2EC Data EC Byte 0 Register                     | R         |
| 04h         | OS STATUS OS Register                     | R           | 104h      | EC STATUS Register                                | W         |
| 05h         | OS Byte Control Register                  | R           | 105h      | EC Byte Control Register                          | R/W       |
| 06h         | Reserved                                  |             | 106h      | Reserved  |           |
| 07h         | Reserved                                  |             | 107h      | Reserved  |           |

Table 10-7, "EC-Only Registers Summary" indicates the aliasing from EC-Only to Runtime registers. The "Host/EC Access" column distinguishes the aliasing based on access type. See individual register descriptions for more details.

**TABLE 10-7: EC-ONLY REGISTERS SUMMARY**

| EC Offset | EC-Only Registers Register Name (Mnemonic) | EC Access | Host Offset | Aliased Runtime Register Register Name (Mnemonic) | Host Access |
|-----------|--|-----------|-------------|---|-------------|
| 108h      | OS2EC Data EC Byte 0 Register              | R         | 00h         | ACPI OS Data Register Byte 0 Register             | W           |
| 108h      | OS2EC Data EC Byte 0 Register              | R         | 04h         | ACPI OS COMMAND Register                          | W           |
| 109h      | OS2EC Data EC Byte 1 Register              | R         | 01h         | ACPI OS Data Register Byte 1 Register             | W           |
| 10Ah      | OS2EC Data EC Byte 2 Register              | R         | 02h         | ACPI OS Data Register Byte 2 Register             | W           |
| 10Bh      | OS2EC Data EC Byte 3 Register              | R         | 03h         | ACPI OS Data Register Byte 3 Register             | W           |
| 104h      | EC STATUS Register                         | W         | 04h         | OS STATUS OS Register                             | W           |
| 105h      | EC Byte Control Register                   | R/W       | 05h         | OS Byte Control Register                          | R           |
| 106h      | Reserved                                   | R         |             | Reserved  | R           |
| 107h      | Reserved                                   | R         |             | Reserved  | R           |
| 100h      | EC2OS Data EC Byte 0 Register              | W         | 00h         | ACPI OS Data Register Byte 0 Register             | R           |

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**TABLE 10-7: EC-ONLY REGISTERS SUMMARY (CONTINUED)**

| EC Offset | EC-Only Registers Register Name (Mnemonic)    | EC Access | Host Offset | Aliased Runtime Register Register Name (Mnemonic)     | Host Access |
|-----------|---|-----------|-------------|---|-------------|
| 101h      | <a href="#">EC2OS Data EC Byte 1 Register</a> | W         | 01h         | <a href="#">ACPI OS Data Register Byte 1 Register</a> | R           |
| 102h      | <a href="#">EC2OS Data EC Byte 2 Register</a> | W         | 02h         | <a href="#">ACPI OS Data Register Byte 2 Register</a> | R           |
| 103h      | <a href="#">EC2OS Data EC Byte 3 Register</a> | W         | 03h         | <a href="#">ACPI OS Data Register Byte 3 Register</a> | R           |

## 10.12 Runtime Registers

The registers listed in the Runtime Register Summary table are for two instances of the [ACPI Embedded Controller Interface \(ACPI-EC\)](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Runtime Register Base Address Table.

**Note:** The Runtime registers may be accessed by the EC but typically the Host will access the Runtime Registers and the EC will access just the EC-Only registers.

**TABLE 10-8: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address   |
|----------------|-----------------|------|-------------------------------|----------------|
| ACPI-EC        | 0               | LPC  | I/O                           | Programmed BAR |
|                |                 | EC   | 32-bit internal address space | 400F_0C00h     |
| ACPI-EC        | 1               | LPC  | I/O                           | Programmed BAR |
|                |                 | EC   | 32-bit internal address space | 400F_1000h     |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance

**TABLE 10-9: RUNTIME REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                              |
|--------|---|
| 00h    | <a href="#">ACPI OS Data Register Byte 0 Register</a> |
| 01h    | <a href="#">ACPI OS Data Register Byte 1 Register</a> |
| 02h    | <a href="#">ACPI OS Data Register Byte 2 Register</a> |
| 03h    | <a href="#">ACPI OS Data Register Byte 3 Register</a> |
| 04h    | <a href="#">ACPI OS COMMAND Register</a>              |
| 04h    | <a href="#">OS STATUS OS Register</a>                 |
| 05h    | <a href="#">OS Byte Control Register</a>              |
| 06h    | Reserved  |
| 07h    | Reserved  |

### 10.12.1 ACPI OS DATA REGISTER BYTE 0 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 00h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | ACPI_OS_DATA_BYTE_0<br>This is byte 0 of the 32-bit <a href="#">ACPI-OS DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R ESET |

## ACPI-OS DATA BYTES[3:0]

Writes by the [ACPI\\_OS](#) to the [ACPI-OS DATA BYTES\[3:0\]](#) are aliased to the [OS2EC DATA BYTES\[3:0\]](#). Reads by the [ACPI\\_OS](#) from the [ACPI-OS DATA BYTES\[3:0\]](#) are aliased to the [EC2OS DATA BYTES\[3:0\]](#).

All access to the [ACPI-OS DATA BYTES\[3:0\]](#) registers should be orderly: Least Significant Byte to Most Significant Byte when byte access is used.

Writes to any of the four [ACPI-OS DATA BYTES\[3:0\]](#) registers clears the [CMD](#) bit in the [OS STATUS OS Register](#) (the state of the [FOUR\\_BYTE\\_ACCESS](#) bit in the [OS Byte Control Register](#) has no impact.)

When the [FOUR\\_BYTE\\_ACCESS](#) bit in the [OS Byte Control Register](#) is cleared to '0', the following access rules apply:

1. Writes to the [ACPI OS Data Register Byte 0 Register](#) sets the [IBF](#) bit in the [OS STATUS OS Register](#).
2. Reads from the [ACPI OS Data Register Byte 0 Register](#) clears the [OBF](#) bit in the [OS STATUS OS Register](#).
3. All writes to [ACPI-OS DATA BYTES\[3:1\]](#) complete without error but the data are not registered.
4. All reads from [ACPI-OS DATA BYTES\[3:1\]](#) return 00h without error.
5. Access to [ACPI-OS DATA BYTES\[3:1\]](#) has no effect on the [IBF](#) & [OBF](#) bits in the [OS STATUS OS Register](#).

When the Four Byte Access bit in the [OS Byte Control Register](#) is set to '1', the following access rules apply:

1. Writes to the [ACPI OS Data Register Byte 3 Register](#) sets the [IBF](#) bit in the [OS STATUS OS Register](#).
2. Reads from the [ACPI OS Data Register Byte 3 Register](#) clears the [OBF](#) bit in the [OS STATUS OS Register](#).

### 10.12.2 ACPI OS DATA REGISTER BYTE 1 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 01h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | ACPI_OS_DATA_BYTE_1<br>This is byte 1 of the 32-bit <a href="#">ACPI-OS DATA BYTES[3:0]</a> . | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

### 10.12.3 ACPI OS DATA REGISTER BYTE 2 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 02h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | ACPI_OS_DATA_BYTE_2<br>This is byte 2 of the 32-bit <a href="#">ACPI-OS DATA BYTES[3:0]</a> . | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

### 10.12.4 ACPI OS DATA REGISTER BYTE 3 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 03h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | ACPI_OS_DATA_BYTE_3<br>This is byte 3 of the 32-bit <a href="#">ACPI-OS DATA BYTES[3:0]</a> . | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

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## 10.12.5 ACPI OS COMMAND REGISTER

| Offset | 04h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | <p>ACPI_OSS_COMMAND</p> <p>Writes to the this register are aliased in the <a href="#">OS2EC Data EC Byte 0 Register</a>.</p> <p>Writes to the this register also set the <a href="#">CMD</a> and <a href="#">IBF</a> bits in the <a href="#">OS STATUS OS Register</a></p> | W    | 0h      | VCC1_R<br>ESET |

## 10.12.6 OS STATUS OS REGISTER

This read-only register is aliased to the [EC STATUS Register on page 143](#). the [EC STATUS Register on page 143](#) has read write access.

| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7      | <p>UD0B</p> <p>User Defined</p>   | R    | 0b      | VCC1_R<br>ESET |
| 6      | <p>SMI_EVT</p> <p>This bit is set when an SMI event is pending; i.e., the <a href="#">ACPI_EC</a> is requesting an SMI query; This bit is cleared when no SMI events are pending.</p> <p>This bit is an <a href="#">ACPI_EC</a>-maintained software flag that is set when the <a href="#">ACPI_EC</a> has detected an internal event that requires system management interrupt handler attention. The <a href="#">ACPI_EC</a> sets this bit before generating an SMI.</p> <p><b>Note:</b> The usage model from the ACPI specification requires both SMI's and SCI's. The ACPI_OS SMI &amp; SCI interrupts are not implemented in the ACPI Embedded Controller Interface (ACPI-ECI). The SMI_EVT and SCI_EVT bits in the <a href="#">OS STATUS OS Register</a> are software flags and this block do not initiate SMI or SCI events.</p>    | R    | 0b      | VCC1_R<br>ESET |
| 5      | <p>SCI_EVT</p> <p>This bit is set by software when an SCI event is pending; i.e., the <a href="#">ACPI_EC</a> is requesting an SCI query; SCI Event flag is clear when no SCI events are pending.</p> <p>This bit is an <a href="#">ACPI_EC</a>-maintained software flag that is set when the embedded controller has detected an internal event that requires operating system attention. The <a href="#">ACPI_EC</a> sets this bit before generating an SCI to the OS.</p> <p><b>Note:</b> The usage model from the ACPI specification requires both SMI's and SCI's. The ACPI_OS SMI &amp; SCI interrupts are not implemented in the ACPI Embedded Controller Interface (ACPI-ECI). The SMI_EVT and SCI_EVT bits in the <a href="#">OS STATUS OS Register</a> are software flags and this block do not initiate SMI or SCI events.</p> | R    | 0b      | VCC1_R<br>ESET |



| Offset | 04h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 4      | <p><b>BURST</b></p> <p>The BURST bit is set when the <a href="#">ACPI_EC</a> is in Burst Mode for polled command processing; the BURST bit is cleared when the <a href="#">ACPI_EC</a> is in Normal mode for interrupt-driven command processing.</p> <p>The BURST bit is an <a href="#">ACPI_EC</a>-maintained software flag that indicates the embedded controller has received the Burst Enable command from the host, has halted normal processing, and is waiting for a series of commands to be sent from the host. Burst Mode allows the OS or system management handler to quickly read and write several bytes of data at a time without the overhead of SCIs between commands.</p> <p>The BURST bit is maintained by <a href="#">ACPI_EC</a> software, only.</p>                           | R    | 0b      | VCC1_R<br>ESET |
| 3      | <p><b>CMD</b></p> <p>This bit is set when the <a href="#">OS2EC Data EC Byte 0 Register</a> contains a command byte written into <a href="#">ACPI OS COMMAND Register</a>; this bit is cleared when the <a href="#">OS2EC DATA BYTES[3:0]</a> contains a data byte written into the <a href="#">ACPI-OS DATA BYTES[3:0]</a>.</p> <p>This bit is hardware controlled:</p> <ul style="list-style-type: none"> <li>• <a href="#">ACPI_OS</a> writes to any of the four <a href="#">ACPI-OS DATA BYTES[3:0]</a> bytes clears this bit</li> <li>• <a href="#">ACPI_OS</a> writes to the <a href="#">ACPI OS COMMAND Register</a> sets this bit.</li> </ul> <p><b>Note:</b> This bit allows the embedded controller to differentiate the start of a command sequence from a data byte write operation.</p> | R    | 0b      | VCC1_R<br>ESET |
| 2      | <p><b>UD1B</b></p> <p>User Defined</p>   | R    | 0b      | VCC1_R<br>ESET |

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| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 1      | <p><b>IBF</b></p> <p>The Input Buffer Full bit is set to indicate that a the <a href="#">ACPI_OS</a> has written a command or data to the <a href="#">ACPI_EC</a> and that data is ready. This bit is automatically cleared when data has been read by the <a href="#">ACPI_EC</a>.</p> <p><b>Note:</b> The setting and clearing of this <a href="#">IBF</a> varies depending on the setting of the following bits: <a href="#">CMD</a> bit in this register and <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a>. Three scenarios follow:</p> <ol style="list-style-type: none"> <li>1. The <a href="#">IBF</a> is set when the <a href="#">ACPI_OS</a> writes to the <a href="#">ACPI OS COMMAND Register</a>. This same write autonomously sets the <a href="#">CMD</a> bit in this register.</li> </ol> <p>The <a href="#">IBF</a> is cleared if the <a href="#">CMD</a> bit in this register is set and the <a href="#">ACPI_EC</a> reads from the <a href="#">OS2EC Data EC Byte 0 Register</a>.</p> <p><b>Note:</b> When <a href="#">CMD</a> bit in this register is set the <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a> has no impact on the <a href="#">IBF</a> bit behavior.</p> <ol style="list-style-type: none"> <li>2. A write by the to the <a href="#">ACPI_OS</a> to the <a href="#">ACPI OS Data Register Byte 0 Register</a> sets the <a href="#">IBF</a> bit if the <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a> is in the cleared to '0' state prior to this write. This same write autonomously clears the <a href="#">CMD</a> bit in this register.</li> </ol> <p>A read of the <a href="#">OS2EC Data EC Byte 0 Register</a> clears the <a href="#">IBF</a> bit if the <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a> is in the cleared to '0' state prior to this read.</p> <ol style="list-style-type: none"> <li>3. A write by the to the <a href="#">ACPI_OS</a> to the <a href="#">ACPI OS Data Register Byte 3 Register</a> sets the <a href="#">IBF</a> bit if the <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a> is in the set to '1' state prior to this write. This same write autonomously clears the <a href="#">CMD</a> bit in this register.</li> </ol> <p>A read of the <a href="#">OS2EC Data EC Byte 3 Register</a> clears the <a href="#">IBF</a> bit if the <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a> is in the set to '1' state prior to this read.</p> <p>An <a href="#">EC_IBF</a> interrupt signals the <a href="#">ACPI_EC</a> that there is data available. The ACPI Specification usage model is as follows:</p> <ol style="list-style-type: none"> <li>1. The <a href="#">ACPI_EC</a> reads the <a href="#">EC STATUS Register</a> and sees the <a href="#">IBF</a> flag set,</li> <li>2. The <a href="#">ACPI_EC</a> reads all the data available in the <a href="#">OS2EC DATA BYTES[3:0]</a>. This causes the <a href="#">IBF</a> bit to be automatically cleared by hardware.</li> <li>3. The <a href="#">ACPI_EC</a> must then generate a software interrupt (See <a href="#">Note: on page 130</a>) to alert the <a href="#">ACPI_OS</a> that the data has been read and that the host is free to write more data to the <a href="#">ACPI_EC</a> as needed.</li> </ol> | R    | 0h      | VCC1_R<br>ESET |

| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 0      | <p>OBF</p> <p>The Output Buffer Full bit is set to indicate that a the <a href="#">ACPI_EC</a> has written a data to the <a href="#">ACPI_OS</a> and that data is ready. This bit is automatically cleared when all the data has been read by the <a href="#">ACPI_OS</a>.</p> <p><b>Note:</b> The setting and clearing of this <a href="#">OBF</a> varies depending on the setting <a href="#">FOUR_BYTE_ACCESS</a> bit in the <a href="#">OS Byte Control Register</a>. Two scenarios follow:</p> <ol style="list-style-type: none"> <li>1. The <a href="#">OBF</a> bit is set if the Four Byte Access bit in the <a href="#">OS Byte Control Register</a> is '0' when the <a href="#">ACPI_EC</a> writes to the <a href="#">EC2OS Data EC Byte 0 Register</a>.</li> </ol> <p>The <a href="#">OBF</a> is cleared if the Four Byte Access bit in the <a href="#">OS Byte Control Register</a> is cleared to '0' when the <a href="#">ACPI_OS</a> reads from the <a href="#">ACPI OS Data Register Byte 0 Register</a>.</p> <ol style="list-style-type: none"> <li>2. The <a href="#">OBF</a> is set if the Four Byte Access bit in the <a href="#">OS Byte Control Register</a> is set to '1' when the <a href="#">ACPI_EC</a> writes to the <a href="#">EC2OS Data EC Byte 3 Register</a>.</li> </ol> <p>The <a href="#">OBF</a> is cleared if the Four Byte Access bit in the <a href="#">OS Byte Control Register</a> is set to '1' when the <a href="#">ACPI_OS</a> reads from the <a href="#">ACPI OS Data Register Byte 3 Register</a>.</p> <p>The ACPI Specification usage model is as follows:</p> <ol style="list-style-type: none"> <li>1. The <a href="#">ACPI_EC</a> must generate a software interrupt (See <a href="#">Note: on page 130</a>) to alert the <a href="#">ACPI_OS</a> that the data is available.</li> <li>2. The <a href="#">ACPI_OS</a> reads the <a href="#">OS STATUS OS Register</a> and sees the <a href="#">OBF</a> flag set, the <a href="#">ACPI_OS</a> reads all the data available in the <a href="#">ACPI-OS DATA BYTES[3:0]</a>.</li> <li>3. The <a href="#">ACPI_OS</a> reads all the data available in the <a href="#">ACPI-OS DATA BYTES[3:0]</a>. This causes the <a href="#">OBF</a> bit to be automatically cleared by hardware and the associated <a href="#">EC_OBF</a> interrupt to be asserted.</li> </ol> | R    | 0h      | VCC1_R<br>ESET |

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## 10.12.7 OS BYTE CONTROL REGISTER

This register is aliased to the [EC Byte Control Register on page 144](#). No behavioral differences occur due to address aliasing.

| Offset | 05   |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:1    | Reserved   | R    | -       | -           |
| 0      | <p><b>FOUR_BYTE_ACCESS</b></p> <p>When this bit is set to '1', the ACPI Embedded Controller Interface (ACPI-ECI) accesses four bytes through the <a href="#">ACPI-OS DATA BYTES[3:0]</a>.</p> <p>When this bit is cleared to '0', the ACPI Embedded Controller Interface (ACPI-ECI) accesses one byte through the <a href="#">ACPI OS Data Register Byte 0 Register</a>. The corresponds to <a href="#">Legacy Mode</a> described in <a href="#">Section 10.10, "Description," on page 130</a>.</p> <p><b>Note 1:</b> This bit effects the behavior of the <a href="#">IBF &amp; OBF</a> bits in the <a href="#">OS STATUS OS Register</a>.</p> <p><b>2:</b> See <a href="#">ACPI-OS DATA BYTES[3:0] on page 135</a>, <a href="#">OS2EC DATA BYTES[3:0] on page 141</a>, and <a href="#">EC2OS DATA BYTES[3:0] on page 142</a> for detailed description of access rules.</p> | R    | 0b      | VCC1_R ESET |

**Note:** The ACPI\_OS access Base Address Register (BAR) should be configured to match the access width selected by the Four Byte Access bit in the OS Byte Control Register. This BAR is not described in this chapter.

## 10.13 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for two instances of the [ACPI Embedded Controller Interface \(ACPI-ECI\)](#). The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 10-10: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address |
|----------------|-----------------|------|-------------------------------|--------------|
| ACPI-EC        | 0               | EC   | 32-bit internal address space | 400F_0C00h   |
| ACPI-EC        | 1               | EC   | 32-bit internal address space | 400F_1000h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 10-11: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                      |
|--------|---|
| 100h   | <a href="#">EC2OS Data EC Byte 0 Register</a> |
| 101h   | <a href="#">EC2OS Data EC Byte 1 Register</a> |
| 102h   | <a href="#">EC2OS Data EC Byte 2 Register</a> |
| 103h   | <a href="#">EC2OS Data EC Byte 3 Register</a> |
| 104h   | <a href="#">EC STATUS Register</a>            |
| 105h   | <a href="#">EC Byte Control Register</a>      |
| 106h   | Reserved                                      |

**TABLE 10-11: EC-ONLY REGISTER SUMMARY (CONTINUED)**

| Offset | Register Name (Mnemonic)                      |
|--------|---|
| 107h   | Reserved                                      |
| 108h   | <a href="#">OS2EC Data EC Byte 0 Register</a> |
| 109h   | <a href="#">OS2EC Data EC Byte 1 Register</a> |
| 10Ah   | <a href="#">OS2EC Data EC Byte 2 Register</a> |
| 10Bh   | <a href="#">OS2EC Data EC Byte 3 Register</a> |

### 10.13.1 OS2EC DATA EC BYTE 0 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 108h   |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | OS_TO_EC_DATA_BYTE_0<br>This is byte 0 of the 32-bit <a href="#">OS2EC DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

#### **OS2EC DATA BYTES[3:0]**

When the [CMD](#) bit in the [OS STATUS OS Register](#) is cleared to '0', reads by the [ACPI\\_EC](#) from the [OS2EC DATA BYTES\[3:0\]](#) are aliased to the [ACPI-OS DATA BYTES\[3:0\]](#).

All access to the [OS2EC DATA BYTES\[3:0\]](#) registers should be orderly: Least Significant Byte to Most Significant Byte when byte access is used.

When the [FOUR\\_BYTE\\_ACCESS](#) bit in the [OS Byte Control Register](#) is cleared to '0', the following access rules apply:

- Writes to the [OS2EC DATA BYTES\[3:0\]](#) have no effect on the [OBF](#) bit in the [OS STATUS OS Register](#).
- Reads from the [OS2EC Data EC Byte 0 Register](#) clears the [IBF](#) bit in the [OS STATUS OS Register](#).
- All reads from [OS2EC DATA BYTES\[3:1\]](#) return 00h without error.
- Access to [OS2EC DATA BYTES\[3:1\]](#) has no effect on the [IBF](#) & [OBF](#) bits in the [OS STATUS OS Register](#).

When the [FOUR\\_BYTE\\_ACCESS](#) bit in the [OS Byte Control Register](#) is set to '1', the following access rules apply:

- Writes to the [OS2EC DATA BYTES\[3:0\]](#) have no effect on the [OBF](#) bit in the [OS STATUS OS Register](#).
- Reads from the [OS2EC Data EC Byte 3 Register](#) clears the [IBF](#) bit in the [OS STATUS OS Register](#).

### 10.13.2 OS2EC DATA EC BYTE 1 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 109h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | OS2EC_DATA_BYTE_1<br>This is byte 1 of the 32-bit <a href="#">OS2EC DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

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## 10.13.3 OS2EC DATA EC BYTE 2 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 10Ah  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | OS2EC_DATA_BYTE_2<br>This is byte 2 of the 32-bit <a href="#">OS2EC DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 10.13.4 OS2EC DATA EC BYTE 3 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 10Bh  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | OS2EC_DATA_BYTE_3<br>This is byte 3 of the 32-bit <a href="#">OS2EC DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 10.13.5 EC2OS DATA EC BYTE 0 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\]](#) on page 135, [OS2EC DATA BYTES\[3:0\]](#) on page 141, and [EC2OS DATA BYTES\[3:0\]](#) on page 142 for detailed description of access rules.

| Offset | 100h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC2OS_DATA_BYTE_0<br>This is byte 0 of the 32-bit <a href="#">EC2OS DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

### EC2OS DATA BYTES[3:0]

Writes by the [ACPI\\_EC](#) to the [EC2OS DATA BYTES\[3:0\]](#) are aliased to the [ACPI-OS DATA BYTES\[3:0\]](#)

All access to the [EC2OS DATA BYTES\[3:0\]](#) registers should be orderly: Least Significant Byte to Most Significant Byte when byte access is used.

When the [FOUR\\_BYTE\\_ACCESS](#) bit in the [OS Byte Control Register](#) is cleared to '0', the following access rules apply:

1. Writes to the [EC2OS Data EC Byte 0 Register](#) set the [OBF](#) bit in the [OS STATUS OS Register](#).
2. Reads from the [EC2OS DATA BYTES\[3:0\]](#) have no effect on the [IBF](#) bit in the [OS STATUS OS Register](#).
3. All reads from [EC2OS DATA BYTES\[3:1\]](#) return 00h without error.
4. All writes to [EC2OS DATA BYTES\[3:1\]](#) complete without error but the data are not registered.
5. Access to [EC2OS DATA BYTES\[3:1\]](#) have no effect on the [IBF](#) & [OBF](#) bits in the [OS STATUS OS Register](#).

When the [FOUR\\_BYTE\\_ACCESS](#) bit in the [OS Byte Control Register](#) is set to '1', the following access rules apply:

1. Writes to the [EC2OS Data EC Byte 3 Register](#) set the [OBF](#) bit in the [OS STATUS OS Register](#).
2. Reads from the [EC2OS DATA BYTES\[3:0\]](#) have no effect on the [IBF](#) bit in the [OS STATUS OS Register](#).

## 10.13.6 EC2OS DATA EC BYTE 1 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\] on page 135](#), [OS2EC DATA BYTES\[3:0\] on page 141](#), and [EC2OS DATA BYTES\[3:0\] on page 142](#) for detailed description of access rules.

| Offset | 101h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC2OS_DATA_BYTE_1<br>This is byte 1 of the 32-bit <a href="#">EC2OS DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 10.13.7 EC2OS DATA EC BYTE 2 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\] on page 135](#), [OS2EC DATA BYTES\[3:0\] on page 141](#), and [EC2OS DATA BYTES\[3:0\] on page 142](#) for detailed description of access rules.

| Offset | 102h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC2OS_DATA_BYTE_2<br>This is byte 2 of the 32-bit <a href="#">EC2OS DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 10.13.8 EC2OS DATA EC BYTE 3 REGISTER

This register is aliased; see [ACPI-OS DATA BYTES\[3:0\] on page 135](#), [OS2EC DATA BYTES\[3:0\] on page 141](#), and [EC2OS DATA BYTES\[3:0\] on page 142](#) for detailed description of access rules.

| Offset | 103h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | EC2OS_DATA_BYTE_3<br>This is byte 3 of the 32-bit <a href="#">EC2OS DATA BYTES[3:0]</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 10.13.9 EC STATUS REGISTER

This register is aliased to the [OS STATUS OS Register on page 136](#). The [OS STATUS OS Register](#) is a read only version of this register.

| Offset | 104h   |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7      | UD0A<br>User Defined   | R/W  | 0b      | VCC1_R<br>ESET |
| 6      | SMI_EVT<br>See <a href="#">SMI_EVT</a> bit in <a href="#">OS STATUS OS Register on page 136</a> for bit description. | R/W  | 0b      | VCC1_R<br>ESET |
| 5      | SCI_EVT<br>See <a href="#">SMI_EVT</a> bit in <a href="#">OS STATUS OS Register on page 136</a> for bit description. | R/W  | 0b      | VCC1_R<br>ESET |
| 4      | BURST<br>See <a href="#">BURST</a> bit in <a href="#">OS STATUS OS Register on page 136</a> for bit description.     | R/W  | 0b      | VCC1_R<br>ESET |

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| Offset | 104h   |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 3      | CMD<br>See <a href="#">CMD</a> bit in <a href="#">OS STATUS OS Register on page 136</a> for bit description. | R    | 0b      | VCC1_R<br>ESET |
| 2      | UD1A<br>User Defined   | R/W  | 0b      | VCC1_R<br>ESET |
| 1      | IBF<br>See <a href="#">IBF</a> bit in <a href="#">OS STATUS OS Register on page 136</a> for bit description. | R    | 0h      | VCC1_R<br>ESET |
| 0      | OBF<br>See <a href="#">OBF</a> bit in <a href="#">OS STATUS OS Register on page 136</a> for bit description. | R    | 0h      | VCC1_R<br>ESET |

**Note:** The [IBF](#) and [OBF](#) bits are not de-asserted by hardware when the host is powered off, or the LPC interface powers down; for example, following system state changes S3->S0, S5->S0, G3-> S0. For further information on how these bits are cleared, refer to [IBF](#) and [OBF](#) bit descriptions in the STATUS OS-Register definition.

## 10.13.10 EC BYTE CONTROL REGISTER

This register is aliased to the [OS Byte Control Register on page 140](#). The [OS Byte Control Register](#) is a read only version of this register.

| Offset | 105h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:1    | Reserved  | R    | -       | -              |
| 0      | FOUR_BYTE_ACCESS<br>See <a href="#">FOUR_BYTE_ACCESS</a> bit in <a href="#">OS Byte Control Register on page 140</a> for bit description. | R/W  | 0b      | VCC1_R<br>ESET |



## 11.0 8042 EMULATED KEYBOARD CONTROLLER

### 11.1 Introduction

The MEC1322 keyboard controller uses the EC to produce a superset of the features provided by the industry-standard 8042 keyboard controller. The [8042 Emulated Keyboard Controller](#) is a Host/EC Message Interface with hardware assists to emulate 8042 behavior and provide Legacy GATEA20 support.

**Note:** There is no VCC emulation in hardware for this interface.

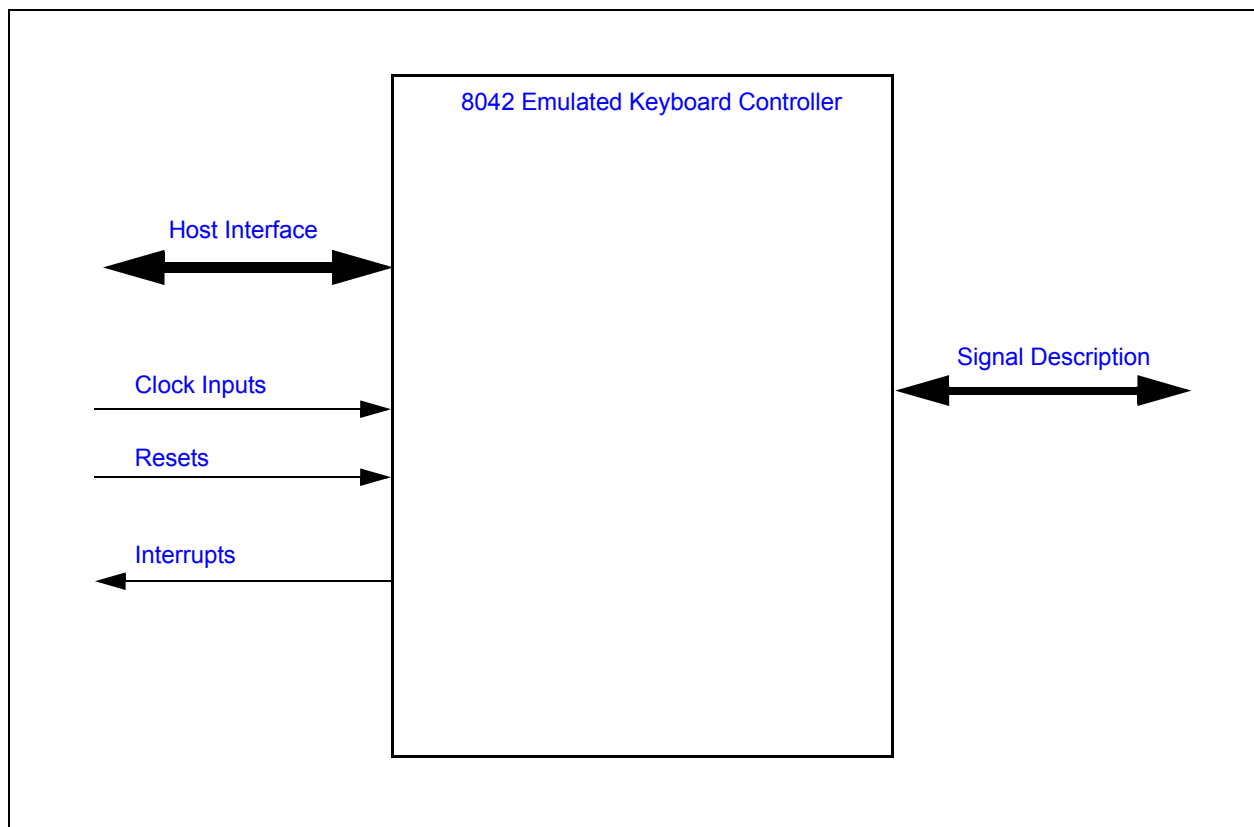
### 11.2 References

There are no references for this block.

### 11.3 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 11-1: I/O DIAGRAM OF BLOCK**



### 11.4 Signal Description

**TABLE 11-1: SIGNAL DESCRIPTION TABLE**

| Name  | Direction | Description                   |
|-------|-----------|-------------------------------|
| KBRST | Output    | Keyboard Reset, routed to pin |

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## 11.5 Host Interface

The 8042 interface is accessed by host software via a registered interface, as defined in [Section 11.13, "Configuration Registers"](#) and [Section 11.14, "Runtime Registers"](#).

## 11.6 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 11.6.1 POWER DOMAINS

**TABLE 11-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | This Power Well is used to power the registers and logic in this block. |

### 11.6.2 CLOCK INPUTS

**TABLE 11-3: CLOCK INPUTS**

| Name | Description  |
|------|--|
| 1MHz | Clock used for the counter in the CPU_RESET circuitry. |

### 11.6.3 RESETS

**TABLE 11-4: RESET SIGNALS**

| Name       | Description   |
|------------|---|
| VCC1_RESET | This reset is asserted when VCC1 is applied.                                    |
| PWRGD      | This signal is asserted when the main power rail is asserted.                   |
| PCI RESET# | This signal is asserted when LRESET# is asserted.                               |
| nSIO_RESET | This signal is asserted when VCC1 is low, PWRGD is low, or LRESET# is asserted. |

## 11.7 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 11-5: SYSTEM INTERRUPTS**

| Source | Description   |
|--------|---|
| KIRQ   | This interrupt source for the SIRQ logic, representing a Keyboard interrupt, is generated when the PCOBF status bit is '1'. |
| MIRQ   | This interrupt source for the SIRQ logic, representing a Mouse interrupt, is generated when the AUXOBF status bit is '1'.   |

**TABLE 11-6: EC INTERRUPTS**

| Source     | Description  |
|------------|--|
| 8042EM_IBF | Interrupt generated by the host writing either data or command to the data register    |
| 8042EM_OBF | Interrupt generated by the host reading either data or aux data from the data register |

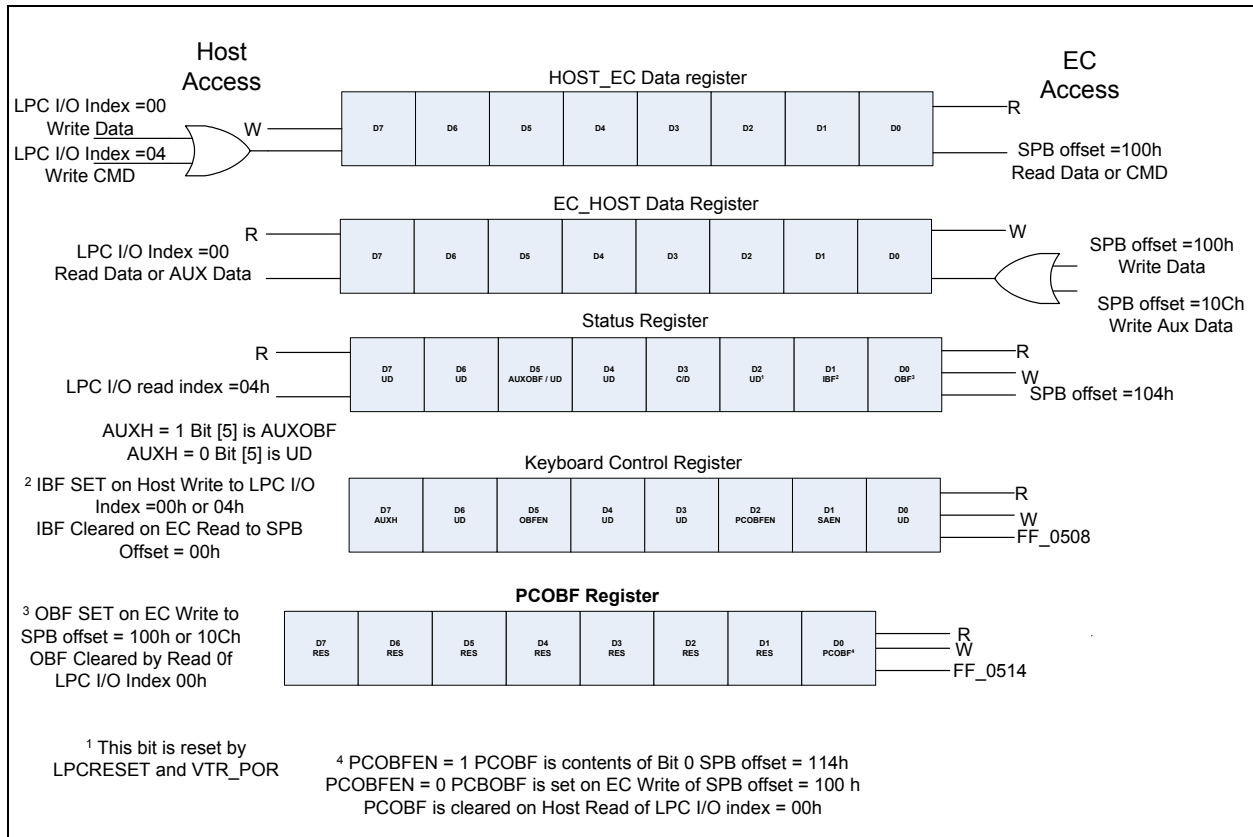
## 11.8 Low Power Modes

The 8042 Interface may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 11.9 Description

### 11.9.1 BLOCK DIAGRAM

**FIGURE 11-2: BLOCK DIAGRAM OF 8042 Emulated Keyboard Controller**



## 11.10 EC-to-Host Keyboard Communication

The EC can write to the [EC\\_HOST Data / AUX Data Register](#) by writing to the [HOST2EC Data Register](#) at EC-Only offset 0h or the [EC AUX Data Register](#) at EC-Only offset Ch. A write to either of these addresses automatically sets bit 0 (OBF) in the Status register. A write to the [HOST2EC Data Register](#) may also set PCOBF. A write to the [EC AUX Data Register](#) may also set AUXOBF.

### 11.10.1 PCOBF DESCRIPTION

If enabled by the bit OBFEN, the bit PCOBF is gated onto KIRQ. The KIRQ signal is a system interrupt which signifies that the EC has written to the [HOST2EC Data Register](#) (EC-Only offset 0h). On power-up, PCOBF is reset to 0. PCOBF will normally reflect the status of writes to HOST2EC register, if PCOBFEN is "0". PCOBF is cleared by hardware on a HOST read of the [EC\\_HOST Data / AUX Data Register](#).

KIRQ is normally selected as IRQ1 for keyboard support.

Additional flexibility has been added which allows firmware to directly control the PCOBF output signal, independent of data transfers to the host-interface data output register. This feature allows the MEC1322 to be operated via the host "polled" mode. Firmware control is active when PCOBFEN is '1'. Firmware sets PCOBF high by writing a "1" to the [PCOBF](#) field of the [PCOBF Register](#). Firmware must also clear PCOBF by writing a "0" to the [PCOBF](#) field.

The PCOBF register is also readable; the value read back on bit 0 of the register always reflects the present value of the PCOBF output. If PCOBFEN = 1, then this value reflects the output of the firmware latch in the [PCOBF Register](#). If PCOBFEN = 0, then the value read back reflects the in-process status of write cycles to the [HOST2EC Data Register](#) (i.e., if the value read back is high, the host interface output data register has just been written to). If OBFEN=0, then KIRQ is driven inactive (low).

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## 11.10.2 AUXOBF DESCRIPTION

If enabled by the bit OBFEN, the bit AUXOBF is multiplexed onto MIRQ. The AUXOBF/MIRQ signal is a system interrupt which signifies that the EC has written to the [EC\\_HOST Data / AUX Data Register](#). On power-up, after [VCC1\\_RESET](#), AUXOBF is reset to 0. AUXOBF will normally reflect the status of writes to EC [EC AUX Data Register](#) (EC-Only offset Ch). AUXOBF is cleared by hardware on a read of the Host Data Register. If OBFEN=0, then MIRQ is driven inactive (low).

MIRQ is normally selected as IRQ12 for mouse support.

Firmware can also directly control the AUXOBF output signal, similar to the mechanism it can use to control PCOBF. Firmware control is active when [AUXH](#) is '0'. Firmware sets AUXOBF high by writing a "1" to the [AUXOBF](#) field of the [EC Keyboard Status Register](#). Firmware must also clear AUXOBF by writing a "0" to the [AUXOBF](#) field.

**TABLE 11-7: OBFEN AND PCOBFEN EFFECTS ON KIRQ**

| OBFEN | PCOBFEN |   |
|-------|---------|---|
| 0     | X       | KIRQ is inactive and driven low   |
| 1     | 0       | KIRQ = PCOBF (status of writes to <a href="#">HOST2EC Data Register</a> ) |
| 1     | 1       | KIRQ = PCOBF (status of writes to <a href="#">PCOBF Register</a> )        |

**TABLE 11-8: OBFEN AND AUXH EFFECTS ON MIRQ**

| OBFEN | AUXH |  |
|-------|------|--|
| 0     | X    | MIRQ is inactive and driven low  |
| 1     | 0    | MIRQ = AUXOBF (status of writes to <a href="#">EC AUX Data Register</a> )                  |
| 1     | 1    | MIRQ = AUXOBF (status of writes to AUXOBF in <a href="#">EC Keyboard Status Register</a> ) |

## 11.11 Legacy Port92/GATEA20 Support

The MEC1322 supports LPC I/O writes to port HOST I/O address 92h as a quick alternate mechanism for generating a CPU\_RESET pulse or controlling the state of GATEA20. The Port92/GateA20 logic has a separate Logical Device Number and Base Address register (see [Section 11.16, "Legacy Port92/GATEA20 Configuration Registers"](#) and [Section 11.17, "Legacy Port92/GATEA20 Runtime Registers"](#)). The Base Address Register for the Port92/GateA20 Logical Device has only one writable bit, the Valid Bit, since the only I/O accessible Register has a fixed address.

The [Port 92 Register](#) resides at HOST I/O address 92h and is used to support the alternate reset (ALT\_RST#) and alternate GATEA20 (ALT\_A20) functions. This register defaults to 00h on assertion of [nSIO\\_RESET](#).

Setting the Port92 Enable bit ([Port 92 Enable Register](#)) enables the Port92h Register. When Port92 is disabled, by clearing the Port92 Enable bit, then access to this register is completely disabled (I/O writes to host 92h are ignored and I/O reads float the system data bus SD[7:0]).

### 11.11.1 GATE A20 SPEEDUP

The MEC1322 contains on-chip logic support for the GATEA20 hardware speed-up feature. GATEA20 is part of the control required to mask address line A20 to emulate 8086 addressing.

In addition to the ability for the host to control the GATEA20 output signal directly, a configuration bit called [SAEN](#) in the [Keyboard Control Register](#) is provided; when set, SAEN allows firmware to control the GATEA20 output. When SAEN is set, a 1 bit register ([GATEA20 Control Register](#)) controls the GATEA20 output.

Host control and firmware control of GATEA20 affect two separate register elements. Read back of GATEA20 through the use of EC OFFSET 100h reflects the present state of the GATEA20 output signal: if SAEN is set, the value read back corresponds to the last firmware-initiated control of GATEA20; if SAEN is reset, the value read back corresponds to the last host-initiated control of GATEA20.

Host control of the GATEA20 output is provided by the hardware interpretation of the "GATEA20 sequence" (see [Table 11-9, "GATEA20 Command/Data Sequence Examples"](#)). The foregoing description assumes that the SAEN configuration bit is reset.

When the MEC1322 receives a “D1” command followed by data (via the host interface), the on-chip hardware copies the value of data bit 1 in the received data field to the GATEA20 host latch. At no time during this host-interface transaction will PCOBF or the IBF flag (bit 1) in the EC Keyboard Status Register be activated; for example, this host control of GATEA20 is transparent to firmware, with no consequent degradation of overall system performance. Table 11-9 details the possible GATEA20 sequences and the MEC1322 responses.

An additional level of control flexibility is offered via a memory-mapped synchronous set and reset capability. Any data written to the SETGA20L Register causes the GATEA20 host latch to be set; any data written to the RSTGA20L Register causes it to be reset. This control mechanism should be used with caution. It was added to augment the “normal” control flow as described above, not to replace it. Since the host and the firmware have asynchronous control capability of the host latch via this mechanism, a potential conflict could arise. Therefore, after using the SETGA20L and RSTGA20L registers, firmware should read back the GATEA20 status via the GATEA20 Control Register (with SAEN = 0) to confirm the actual GATEA20 response.

**TABLE 11-9: GATEA20 COMMAND/DATA SEQUENCE EXAMPLES**

| Data Byte        | R/W              | D[0:7]               | IBF Flag         | GATEA20          | Comments                     |
|------------------|------------------|----------------------|------------------|------------------|------------------------------|
| 1<br>0<br>1      | W<br>W<br>W      | D1<br>DF<br>FF       | 0<br>0<br>0      | Q<br>1<br>1      | GATEA20 Turn-on Sequence     |
| 1<br>0<br>1      | W<br>W<br>W      | D1<br>DD<br>FF       | 0<br>0<br>0      | Q<br>0<br>0      | GATEA20 Turn-off Sequence    |
| 1<br>1<br>0<br>1 | W<br>W<br>W<br>W | D1<br>D1<br>DF<br>FF | 0<br>0<br>0<br>0 | Q<br>Q<br>1<br>1 | GATEA20 Turn-on Sequence(*)  |
| 1<br>1<br>0<br>1 | W<br>W<br>W<br>W | D1<br>D1<br>DD<br>FF | 0<br>0<br>0<br>0 | Q<br>Q<br>0<br>0 | GATEA20 Turn-off Sequence(*) |
| 1<br>1<br>1      | W<br>W<br>W      | D1<br>XX**<br>FF     | 0<br>1<br>1      | Q<br>Q<br>Q      | Invalid Sequence             |

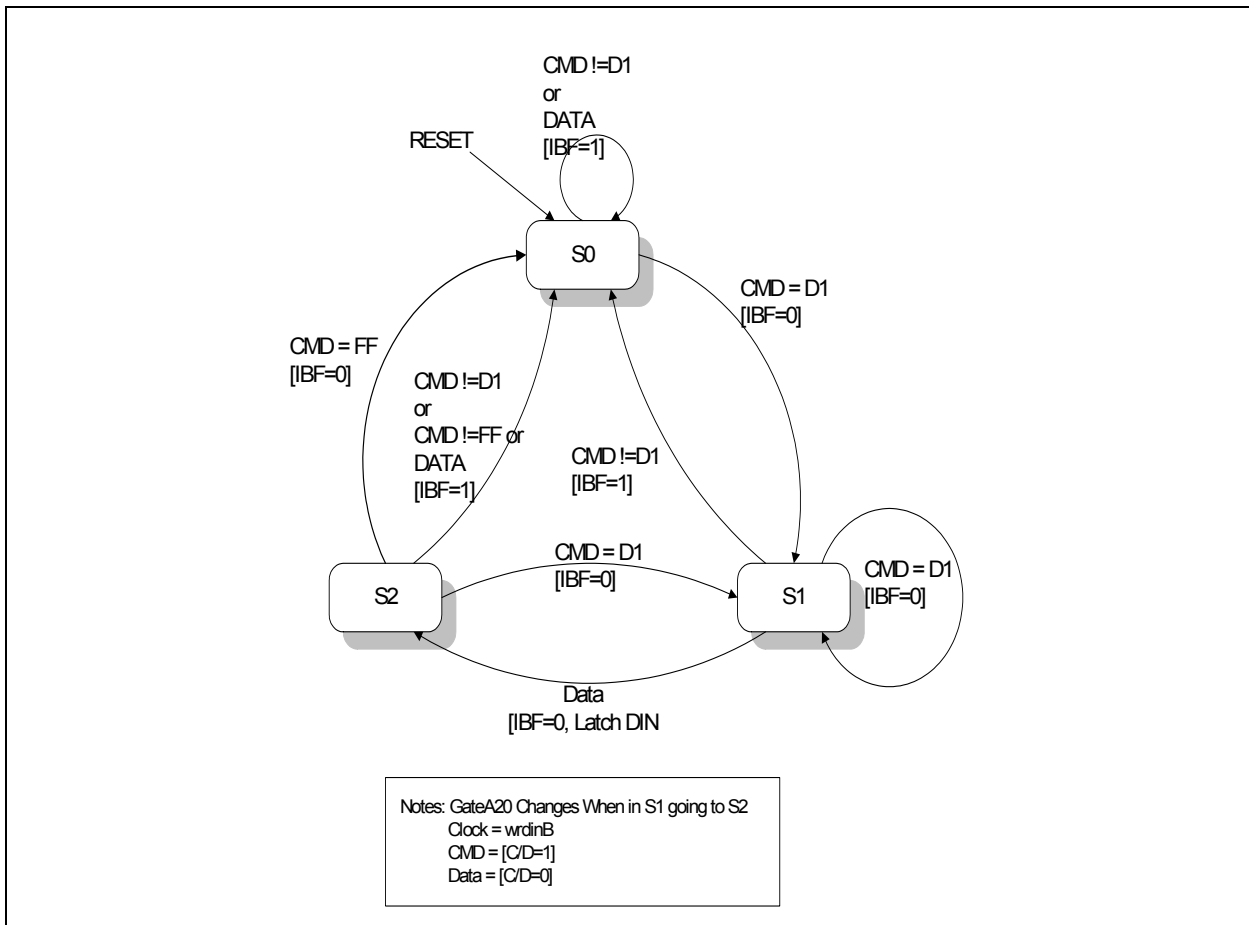
**Note:** The following notes apply:

- All examples assume that the SAEN configuration bit is 0.
- “Q” indicates the bit remains set at the previous state.
- \*Not a standard sequence.
- \*\*XX = Anything except D1.
- If multiple data bytes, set IBF and wait at state 0. Let the software know something unusual happened.
- For data bytes, only D[1] is used; all other bits are don't care.
- Host Commands (FF, FE, & D1) do not cause IBF. The method of blocking IBF in Figure 11-4 is the nLOW not being asserted when FF, FE, & D1 Host commands are written”.

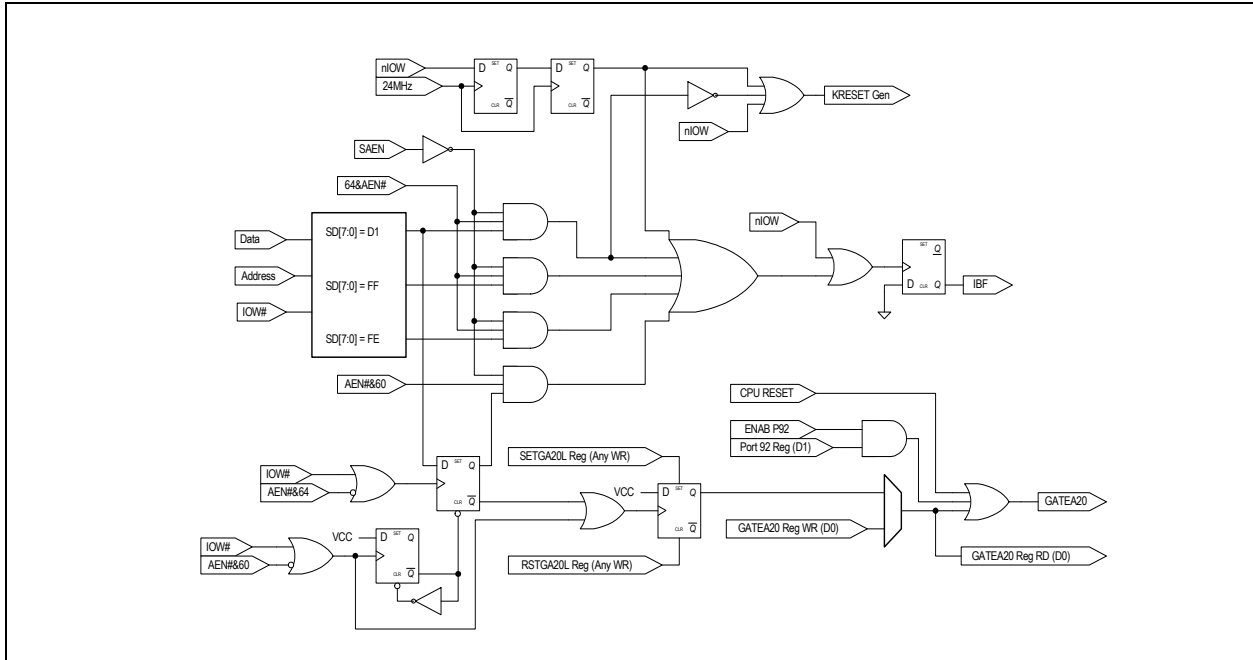
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The hardware GATEA20 state machine returns to state S1 from state S2 when CMD = D1, as shown in the following figures:.

**FIGURE 11-3: GATEA20 STATE MACHINE**



**FIGURE 11-4: GATEA20 IMPLEMENTATION DIAGRAM**



## 11.11.2 CPU\_RESET HARDWARE SPEED-UP

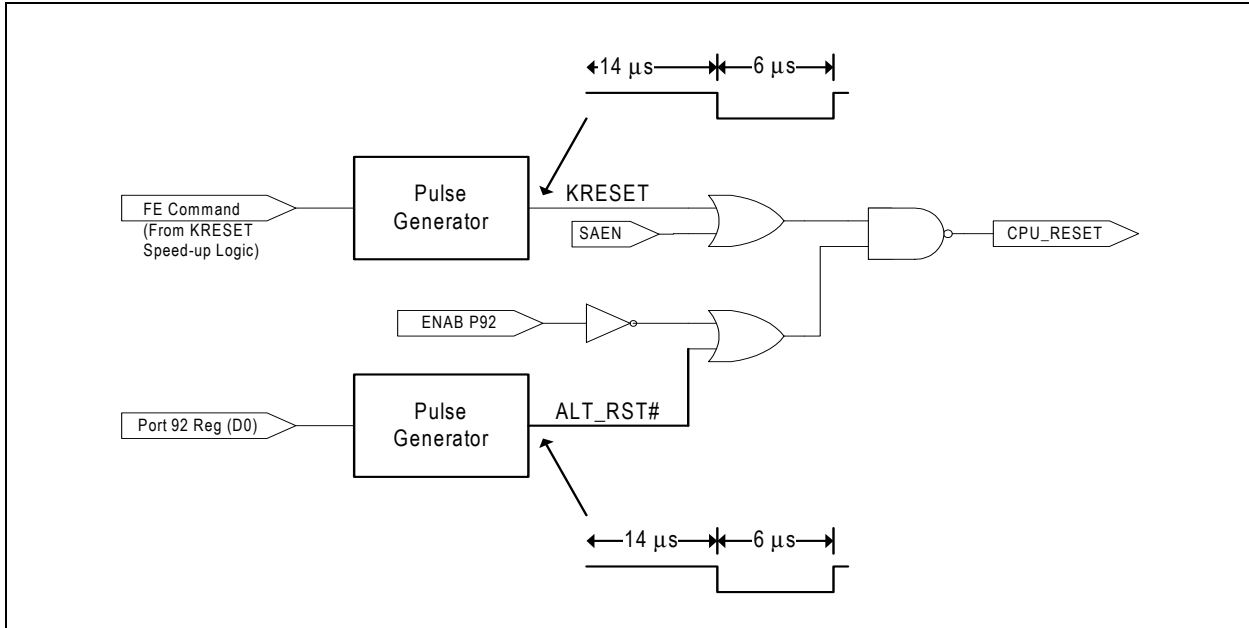
The [ALT\\_CPU\\_RESET](#) bit generates, under program control, the [ALT\\_RST#](#) signal, which provides an alternate, means to drive the MEC1322 [CPU\\_RESET](#) pin which in turn is used to reset the Host CPU. The [ALT\\_RST#](#) signal is internally Nanded together with the [KBDRESET#](#) pulse from the [KRESET](#) Speed up logic to provide an alternate software means of resetting the host CPU.

Before another [ALT\\_RST#](#) pulse can be generated, [ALT\\_CPU\\_RESET](#) must be cleared to '0' either by an [nSIO\\_RESET](#) or by a write to the [Port 92 Register](#) with bit 0 = '0'. An [ALT\\_RST#](#) pulse is not generated in the event that the [ALT\\_CPU\\_RESET](#) bit is cleared and set before the prior [ALT\\_RST#](#) pulse has completed.

If the 8042EM Sleep Enable is asserted, or the 8042 EM [ACTIVATE](#) bit is de-asserted, the 1MHz clocks source is disabled.

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FIGURE 11-5: CPU\_RESET IMPLEMENTATION DIAGRAM



## 11.12 Instance Description

There are two blocks defined in this chapter: [Emulated 8042 Interface](#) and the [Legacy Port92/GATEA20 Support](#). The MEC1322 has one instance of each block.

## 11.13 Configuration Registers

The registers listed in the Configuration Register Summary table are for a single instance of the [Emulated 8042 Interface](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Configuration Register Base Address Table.

TABLE 11-10: CONFIGURATION REGISTER BASE ADDRESS TABLE

| Block Instance          | Instance Number | Logical Device Number | Host | Address Space                 | Base Address |
|-------------------------|-----------------|-----------------------|------|-------------------------------|--------------|
| Emulated 8042 Interface | 0               | 1                     | LPC  | Configuration Port            | INDEX = 00h  |
|                         |                 |                       | EC   | 32-bit internal address space | 400F_0400h   |

Each Configuration register access through the Host Access Port is via its LDN and its Host Access Port Index. EC access is a relative offset to the EC Base Address.

TABLE 11-11: CONFIGURATION REGISTER SUMMARY

| Offset | Register Name (Mnemonic)          |
|--------|-----------------------------------|
| 30h    | <a href="#">Activate Register</a> |



## 11.13.1 ACTIVATE REGISTER

| Offset | 30h  |      |         |                       |
|--------|--|------|---------|-----------------------|
| Bits   | Description  | Type | Default | Reset Event           |
| 7:1    | Reserved   | R    | -       | -                     |
| 0      | <b>ACTIVATE</b><br>1=The 8042 Interface is powered and functional.<br>0=The 8042 Interface is powered down and inactive. | R/W  | 0b      | PWRGD and VCC1_R ESET |

## 11.14 Runtime Registers

The registers listed in the Runtime Register Summary table are for a single instance of the [Emulated 8042 Interface](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Runtime Register Base Address Table.

| Block Instance                 | Instance Number | Host | Address Space        | Base Address   |
|--------------------------------|-----------------|------|----------------------|----------------|
| <b>Emulated 8042 Interface</b> | 0               | LPC  | I/O                  | Programmed BAR |
|                                |                 | EC   | 32-bit address space | 400F_0400h     |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 11-12: RUNTIME REGISTER SUMMARY**

| Offset  | Register Name (Mnemonic)                         |
|---------|--|
| 00h/04h | <a href="#">HOST_EC Data / CMD Register</a>      |
| 00h     | <a href="#">EC_HOST Data / AUX Data Register</a> |
| 04h     | <a href="#">Keyboard Status Read Register</a>    |

### 11.14.1 HOST\_EC DATA / CMD REGISTER

| Offset | 00h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | <b>WRITE_DATA</b><br>This 8-bit register is write-only. When written, the <a href="#">C/D</a> bit in the <a href="#">Keyboard Status Read Register</a> is cleared to ‘0’, signifying data, and the <a href="#">IBF</a> in the same register is set to ‘1’.<br><br>When the Runtime Register at offset 0h is read by the Host, it functions as the <a href="#">EC_HOST Data / AUX Data Register</a> . | W    | 0h      | VCC1_R ESET |

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| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | <p>WRITE_CMD</p> <p>This 8-bit register is write-only and is an alias of the register at offset 0h. When written, the <b>C/D</b> bit in the <a href="#">Keyboard Status Read Register</a> is set to '1', signifying a command, and the <b>IBF</b> in the same register is set to '1'.</p> <p>When the Runtime Register at offset 4h is read by the Host, it functions as the <a href="#">Keyboard Status Read Register</a>.</p> | W    | 0h      | VCC1_R<br>ESET |

## 11.14.2 EC\_HOST DATA / AUX DATA REGISTER

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | <p>READ_DATA</p> <p>This 8-bit register is read-only. When read by the Host, the <b>PCOBF</b> and/or <b>AUXOBF</b> interrupts are cleared and the <b>OBF</b> flag in the status register is cleared.</p> | R    | 0h      | VCC1_R<br>ESET |

## 11.14.3 KEYBOARD STATUS READ REGISTER

This register is a read-only alias of the [EC Keyboard Status Register](#).

| Offset | 04h  |      |         |                                     |
|--------|--|------|---------|-------------------------------------|
| Bits   | Description  | Type | Default | Reset Event                         |
| 7:6    | <p>UD2</p> <p>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.</p>  | R    | 0h      | VCC1_R<br>ESET                      |
| 5      | <p>AUXOBF</p> <p>Auxiliary Output Buffer Full. This bit is set to "1" whenever the EC writes the <a href="#">EC AUX Data Register</a>. This flag is reset to "0" whenever the EC writes the <a href="#">EC Data Register</a>.</p>  | R    | 0h      | VCC1_R<br>ESET                      |
| 4      | <p>UD1</p> <p>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.</p>  | R    | 0h      | VCC1_R<br>ESET                      |
| 3      | <p>C/D</p> <p>Command Data. This bit specifies whether the input data register contains data or a command ("0" = data, "1" = command). During a Host command write operation (when the Host writes the <a href="#">HOST_EC Data / CMD Register</a> at offset 04h), this bit is set to "1". During a Host data write operation (when the Host writes the <a href="#">HOST_EC Data / CMD Register</a> at offset 0h), this bit is set to "0".</p> | R    | 0h      | VCC1_R<br>ESET                      |
| 2      | <p>UD0</p> <p>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.</p> <p><b>Note:</b> This bit is reset to '0' when the LRESET# pin signal is asserted.</p>  | R    | 0h      | VCC1_R<br>ESET and<br>PCI<br>RESET# |

|               |   |             |                |                             |
|---------------|---|-------------|----------------|-----------------------------|
| <b>Offset</b> | 04h   |             |                |                             |
| <b>Bits</b>   | <b>Description</b>  | <b>Type</b> | <b>Default</b> | <b>Reset Event</b>          |
| 1             | <b>IBF</b><br>Input Buffer Full. This bit is set to “1” whenever the Host writes data or a command into the <a href="#">HOST_EC Data / CMD Register</a> . When this bit is set, the EC's <a href="#">8042EM_IBF</a> interrupt is asserted, if enabled. When the EC reads the <a href="#">HOST_EC Data/CMD Register</a> , this bit is automatically reset and the interrupt is cleared.<br><b>Note:</b> This bit is not reset when <a href="#">PWRGD</a> is asserted or when the LPC interface powers down. To clear this bit, firmware must read the <a href="#">EC Data Register</a> in the EC-Only address space. | R           | 0h             | <a href="#">VCC1_R ESET</a> |
| 0             | <b>OBF</b><br>Output Buffer Full. This bit is set when the EC writes a byte of Data or AUX Data into the <a href="#">EC_HOST Data / AUX Data Register</a> . When the Host reads the <a href="#">HOST_EC Data / CMD Register</a> , this bit is automatically cleared by hardware and a <a href="#">8042EM_OBF</a> interrupt is generated.<br><b>Note:</b> This bit is not reset when <a href="#">PWRGD</a> is asserted or when the LPC interface powers down. To clear this bit, firmware must read the <a href="#">HOST_EC Data / CMD Register</a> in the Runtime address space.                                    | R           | 0h             | <a href="#">VCC1_R ESET</a> |

## 11.15 Emulated 8042 Interface EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [Emulated 8042 Interface](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the EC-Only Register Base Address Table.

**TABLE 11-13: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance                 | Instance Number | Host | Address Space        | Base Address |
|--------------------------------|-----------------|------|----------------------|--------------|
| <b>Emulated 8042 Interface</b> | 0               | EC   | 32-bit address space | 400F_0410h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 11-14: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                    |
|--------|---|
| 0h     | <a href="#">HOST2EC Data Register</a>       |
| 0h     | <a href="#">EC Data Register</a>            |
| 4h     | <a href="#">EC Keyboard Status Register</a> |
| 8h     | <a href="#">Keyboard Control Register</a>   |
| Ch     | <a href="#">EC AUX Data Register</a>        |
| 14h    | <a href="#">PCOBF Register</a>              |

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## 11.15.1 HOST2EC DATA REGISTER

| Offset | 0h  |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | HOST2EC_DATA<br>This register is an alias of the <a href="#">HOST_EC Data / CMD Register</a> .<br>When read at the EC-Only offset of 0h, it returns the data written by the Host to either Runtime Register offset 0h or Runtime Register offset 04h. | R    | 0h      | VCC1_R<br>ESET |

## 11.15.2 EC DATA REGISTER

| Offset | 0h          |      |         |                |
|--------|-------------|------|---------|----------------|
| Bits   | Description | Type | Default | Reset Event    |
| 7:0    | EC_DATA     | W    | 0h      | VCC1_R<br>ESET |

## 11.15.3 EC KEYBOARD STATUS REGISTER

This register is an alias of the [Keyboard Status Read Register](#). The fields [C/D](#), [IBF](#), and [OBF](#) remain read-only.

| Offset | 04h  |      |         |                                     |
|--------|--|------|---------|-------------------------------------|
| Bits   | Description  | Type | Default | Reset Event                         |
| 7:6    | UD2<br>User-defined data. Readable and writable by the EC.   | R/W  | 0h      | VCC1_R<br>ESET                      |
| 5      | AUXOBF<br>Auxiliary Output Buffer Full. This bit is set to '1' whenever the EC writes the <a href="#">EC AUX Data Register</a> . This flag is reset to '0' whenever the EC writes the <a href="#">EC Data Register</a> .   | R/W  | 0h      | VCC1_R<br>ESET                      |
| 4      | UD1<br>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.   | R/W  | 0h      | VCC1_R<br>ESET                      |
| 3      | C/D<br>Command Data. This bit specifies whether the input data register contains data or a command. During a Host command write operation (when the Host writes the <a href="#">HOST_EC Data / CMD Register</a> at offset 04h), this bit is set to '1'. During a Host data write operation (when the Host writes the <a href="#">HOST_EC Data / CMD Register</a> at offset 0h), this bit is set to '0'.<br><br>1=Command<br>0=Data | R    | 0h      | VCC1_R<br>ESET                      |
| 2      | UD0<br>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.<br><br>This bit is reset to '0' when the LRESET# pin signal is asserted.  | R/W  | 0h      | VCC1_R<br>ESET and<br>PCI<br>RESET# |

| Offset | 04h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 1      | <p>IBF</p> <p>Input Buffer Full. This bit is set to “1” whenever the Host writes data or a command into the <a href="#">HOST_EC Data / CMD Register</a>. When this bit is set, the EC's <a href="#">8042EM_IBF</a> interrupt is asserted, if enabled. When the EC reads the Data/CMD Register, this bit is automatically reset and the interrupt is cleared.</p> <p>This bit is not reset when <a href="#">PWRGD</a> is asserted or when the LPC interface powers down. To clear this bit, firmware must read the <a href="#">EC Data Register</a> in the EC-Only address space.</p> | R    | 0h      | <a href="#">VCC1_R ESET</a> |
| 0      | <p>OBF</p> <p>Output Buffer Full. This bit is set when the EC writes a byte of Data or AUX Data into the <a href="#">EC_HOST Data / AUX Data Register</a>. When the Host reads the <a href="#">HOST_EC Data / CMD Register</a>, this bit is automatically cleared by hardware and a <a href="#">8042EM_OBF</a> interrupt is generated.</p> <p>This bit is not reset when <a href="#">PWRGD</a> is asserted or when the LPC interface powers down. To clear this bit, firmware must read the Data/CMD Register in the Runtime address space.</p>                                      | R    | 0h      | <a href="#">VCC1_R ESET</a> |

#### 11.15.4 KEYBOARD CONTROL REGISTER

| Offset | 08h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 7      | <p>AUXH</p> <p>AUX in Hardware.</p> <p>1=<a href="#">AUXOBF</a> of the <a href="#">Keyboard Status Read Register</a> is set in hardware by a write to the <a href="#">EC AUX Data Register</a></p> <p>0=<a href="#">AUXOBF</a> is not modified in hardware, but can be read and written by the EC using the EC-Only alias of the <a href="#">EC Keyboard Status Register</a></p> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |
| 6      | <p>UD5</p> <p>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.</p>  | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |
| 5      | <p>OBFEN</p> <p>When this bit is ‘1’, the system interrupt signal KIRQ is driven by the bit <a href="#">PCOBF</a> and MIRQ is driven by <a href="#">AUXOBF</a>. When this bit is ‘0’, KIRQ and MIRQ are driven low.</p> <p>This bit must not be changed when <a href="#">OBF</a> of the status register is equal to ‘1’.</p>   | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |
| 4:3    | <p>UD4</p> <p>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.</p>  | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |
| 2      | <p>PCOBFEN</p> <p>1= reflects the value written to the <a href="#">PCOBF Register</a></p> <p>0=<a href="#">PCOBF</a> reflects the status of writes to the <a href="#">EC Data Register</a></p>   | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

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| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 1      | SAEN<br>Software-assist enable.<br><br>1=This bit allows control of the GATEA20 signal via firmware<br>0=GATEA20 corresponds to either the last Host-initiated control of GATEA20 or the firmware write to the <a href="#">Keyboard Control Register</a> or the <a href="#">EC AUX Data Register</a> . | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | UD3<br>User-defined data. Readable and writable by the EC when written by the EC at its EC-only alias.   | R/W  | 0h      | VCC1_R<br>ESET |

## 11.15.5 EC AUX DATA REGISTER

| Offset | 0Ch  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | EC_AUX_DATA<br>This 8-bit register is write-only. When written, the C/D in the <a href="#">Keyboard Status Read Register</a> is cleared to '0', signifying data, and the IBF in the same register is set to '1'.<br><br>When the Runtime Register at offset 0h is read by the Host, it functions as the <a href="#">EC_HOST Data / AUX Data Register</a> . | W    | 0h      | VCC1_R<br>ESET |

## 11.15.6 PCOBF REGISTER

| Offset | 14h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:1    | Reserved   | R    | -       | -              |
| 0      | PCOBF<br>For a description of this bit, see <a href="#">Section 11.10.1, "PCOBF Description"</a> . | R/W  | 0h      | VCC1_R<br>ESET |

## 11.16 Legacy Port92/GATEA20 Configuration Registers

The registers listed in the Configuration Register Summary table are for a single instance of the Legacy Port92/GATEA20 logic. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the Configuration Register Base Address Table.

**TABLE 11-15: CONFIGURATION BASE ADDRESS TABLE**

| Block Instance | Instance Number | Logical Device Number | Host | Address Space                 | Base Address |
|----------------|-----------------|-----------------------|------|-------------------------------|--------------|
| Port92-Legacy  | 0               | 1                     | LPC  | Configuration Port            | INDEX = 00h  |
|                |                 |                       | EC   | 32-bit internal address space | 400F_1800h   |

Each Configuration register access through the Host Access Port is via its LDN and its Host Access Port Index. EC access is a relative offset to the EC Base Address.

**TABLE 11-16: CONFIGURATION REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                |
|--------|---|
| 30h    | <a href="#">Port 92 Enable Register</a> |

### 11.16.1 PORT 92 ENABLE REGISTER

| Offset | 30h  |      |         |  |
|--------|--|------|---------|--|
| Bits   | Description  | Type | Default | Reset Event  |
| 7:1    | Reserved   | R    | -       | -  |
| 0      | P92_EN<br>When this bit is '1', the Port92h Register is enabled. When this bit is '0', the Port92h Register is disabled, and Host writes to LPC address 92h are ignored. | R/W  | 0h      | <a href="#">PWRGD</a><br>and<br><a href="#">VCC1_R</a><br><a href="#">ESET</a> |

## 11.17 Legacy Port92/GATEA20 Runtime Registers

The registers listed in the Runtime Register Summary table are for a single instance of the Legacy Port92/GATEA20 logic. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the Runtime Register Base Address Table.

**TABLE 11-17: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space        | Base Address |
|----------------|-----------------|------|----------------------|--------------|
| Port92-Legacy  | 0               | LPC  | I/O                  | 0092h        |
|                |                 | EC   | 32-bit address space | 400F_1800h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 11-18: RUNTIME REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)         |
|--------|----------------------------------|
| 0h     | <a href="#">Port 92 Register</a> |

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## 11.17.1 PORT 92 REGISTER

| Offset | 0h   |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:2    | Reserved   | R    | -       | -           |
| 1      | <b>ALT_GATE_A20</b><br>This bit provides an alternate means for system control of the GATEA20 pin. ALT_A20 low drives GATEA20 low, if A20 from the keyboard controller is also low. When Port 92 is enabled, writing a 1 to this bit forces ALT_A20 high. ALT_A20 high drives GATEA20 high regardless of the state of A20 from the keyboard controller.<br>0=ALT_A20 is driven low<br>1=ALT_A20 is driven high   | R/W  | 0h      | nSIO_R ESET |
| 0      | <b>ALT_CPU_RESET</b><br>This bit provides an alternate means to generate a CPU_RESET pulse. The CPU_RESET output provides a means to reset the system CPU to effect a mode switch from Protected Virtual Address Mode to the Real Address Mode. This provides a faster means of reset than is provided through the EC keyboard controller. Writing a "1" to this bit will cause the ALT_RST# internal signal to pulse (active low) for a minimum of 6µs after a delay of 14µs. Before another ALT_RST# pulse can be generated, this bit must be written back to "0". | R/W  | 0h      | nSIO_R ESET |

## 11.18 Emulated 8042 Interface EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the Legacy Port92/GATEA20 logic. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 11-19: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space        | Base Address |
|----------------|-----------------|------|----------------------|--------------|
| Port92-Legacy  | 0               | EC   | 32-bit address space | 400F_1900h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 11-20: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic) |
|--------|--------------------------|
| 0h     | GATEA20 Control Register |
| 8h     | SETGA20L Register        |
| Ch     | RSTGA20L Register        |



## 11.18.1 GATEA20 CONTROL REGISTER

| Offset | 0h   |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:1    | Reserved   | R    | -       | -              |
| 0      | GATEA20<br>0=The GATEA20 output is driven low<br>1=The GATEA20 output is driven high | R/W  | 1h      | VCC1_R<br>ESET |

## 11.18.2 SETGA20L REGISTER

| Offset | 08h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | SETGA20L<br>See <a href="#">Section 11.11.1, "GATE A20 Speedup"</a> for information on this register. A write to this register sets GATEA20 in the GATEA20 Control Register. | W    | -       | -           |

## 11.18.3 RSTGA20L REGISTER

| Offset | 0Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | RSTGA20L<br>See <a href="#">Section 11.11.1, "GATE A20 Speedup"</a> for information on this register. A write to this register sets GATEA20 in the GATEA20 Control Register. | W    | -       | -           |

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## 12.0 MAILBOX INTERFACE

### 12.1 Overview

The Mailbox provides a standard run-time mechanism for the host to communicate with the Embedded Controller (EC)

### 12.2 References

No references have been cited for this feature.

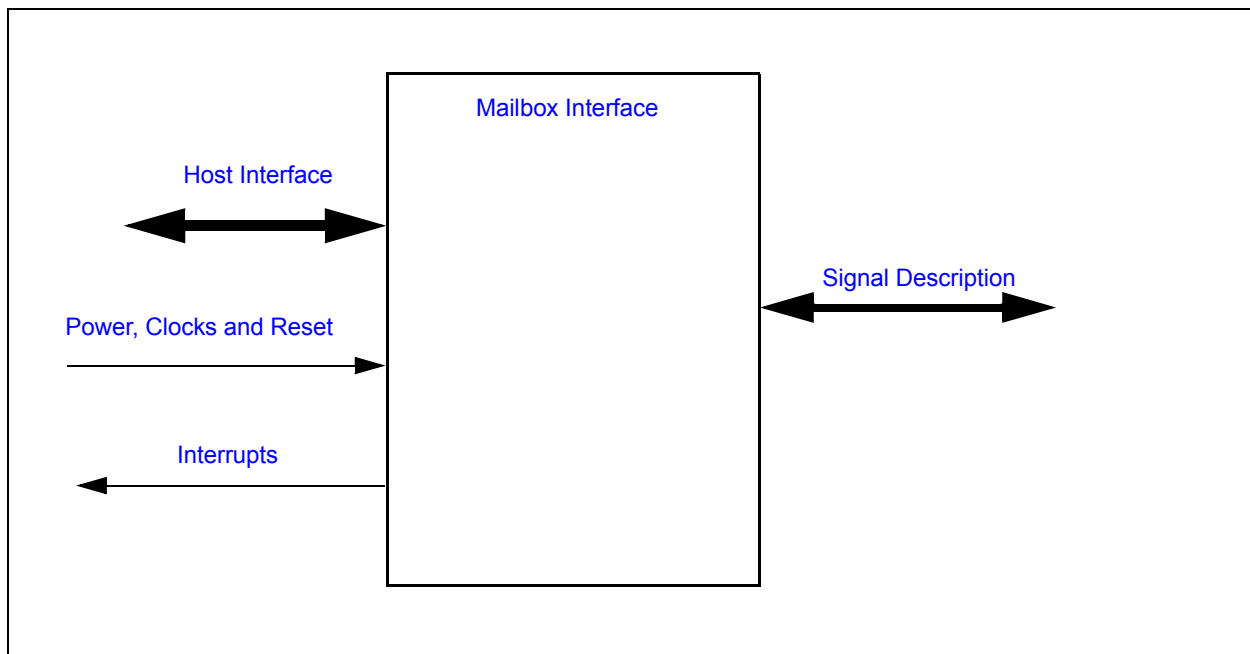
### 12.3 Terminology

There is no terminology defined for this section.

### 12.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 12-1: I/O DIAGRAM OF BLOCK**



### 12.5 Signal Description

**TABLE 12-1: SIGNAL DESCRIPTION TABLE**

| Name | Direction | Description                   |
|------|-----------|-------------------------------|
| nSMI | OUTPUT    | SMI alert signal to the Host. |

### 12.6 Host Interface

The Mailbox interface is accessed by host software via a registered interface, as defined in [Section 12.11, "Runtime Registers"](#) and [Section 12.12, "EC-Only Registers"](#).

### 12.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

## 12.7.1 POWER DOMAINS

**TABLE 12-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block are powered by this power well. |

## 12.7.2 CLOCK INPUTS

**TABLE 12-3: CLOCK INPUTS**

| Name                   | Description                                 |
|------------------------|---|
| 48 MHz Ring Oscillator | This is the clock source for Mailbox logic. |

## 12.7.3 RESETS

**TABLE 12-4: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This signal resets all the registers and logic in this block to their default state.   |
| PWRGD      | This signal is asserted when the main power rail is asserted. The Host Access Port is reset when this signal is de-asserted. |

## 12.8 Interrupts

**TABLE 12-5: SYSTEM INTERRUPTS**

| Source        | Description  |
|---------------|--|
| MBX_Host_SIRQ | This interrupt source for the SIRQ logic is generated when the EC_WR bit is '1' and enabled by the EC_WR_EN bit.   |
| MBX_Host_SMI  | This interrupt source for the SIRQ logic is generated when any of the EC_SWI bits are asserted and the corresponding EC_SWI_EN bit are asserted as well. This event is also asserted if the EC_WR/EC_WR_EN event occurs as well.<br><br>This bit is also routed to the nSMI pin. |

**TABLE 12-6: EC INTERRUPTS**

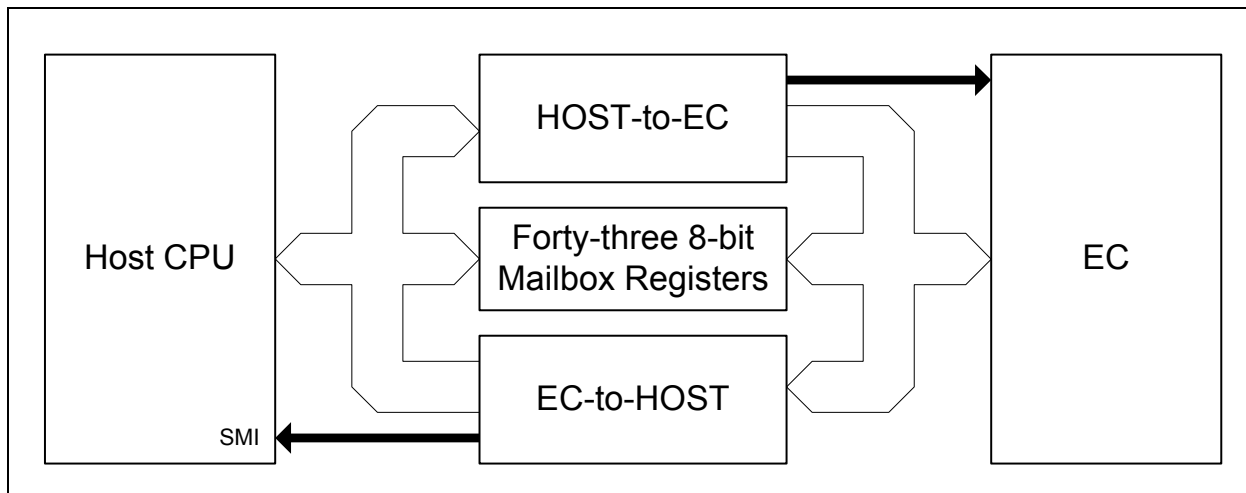
| Source   | Description  |
|----------|--|
| MBX      | Interrupt generated by the host writing the HOST-to-EC Mailbox register. |
| MBX_DATA | Interrupt generated by the host writing the MBX_DATA register.           |

## 12.9 Low Power Modes

The Mailbox automatically enters a low power mode whenever it is not actively.

## 12.10 Description

FIGURE 12-2: MAILBOX BLOCK DIAGRAM



### 12.10.1 HOST ACCESS PORT

The Mailbox includes a total of 47 index-addressable 8-bit Mailbox registers and a two byte Mailbox Registers Host Access Port. Forty-three of the 47 index-addressable 8-bit registers are EC Mailbox registers, which can be read and written by both the EC and the Host. The remaining four registers are used for signaling between the Host and the EC. The Host Access Port consists of two 8-bit run-time registers that occupy two addresses in the HOST I/O space, [MBX\\_INDEX Register](#) and [MBX\\_DATA Register](#). The Host Access Port is used by the host to access the 47 index-addressable 8-bit registers.

To access a Mailbox register once the Mailbox Registers Interface Base Address has been initialized, the Mailbox register index address is first written to the MBX Index port. After the Index port has been written, the Mailbox data byte can be read or written via the MBX data port.

The Host Access Port is intended to be accessed by the Host only, however it may be accessed by the EC at the Offset shown from its EC base address in [Table 12-7, "Runtime Register Base Address Table"](#).

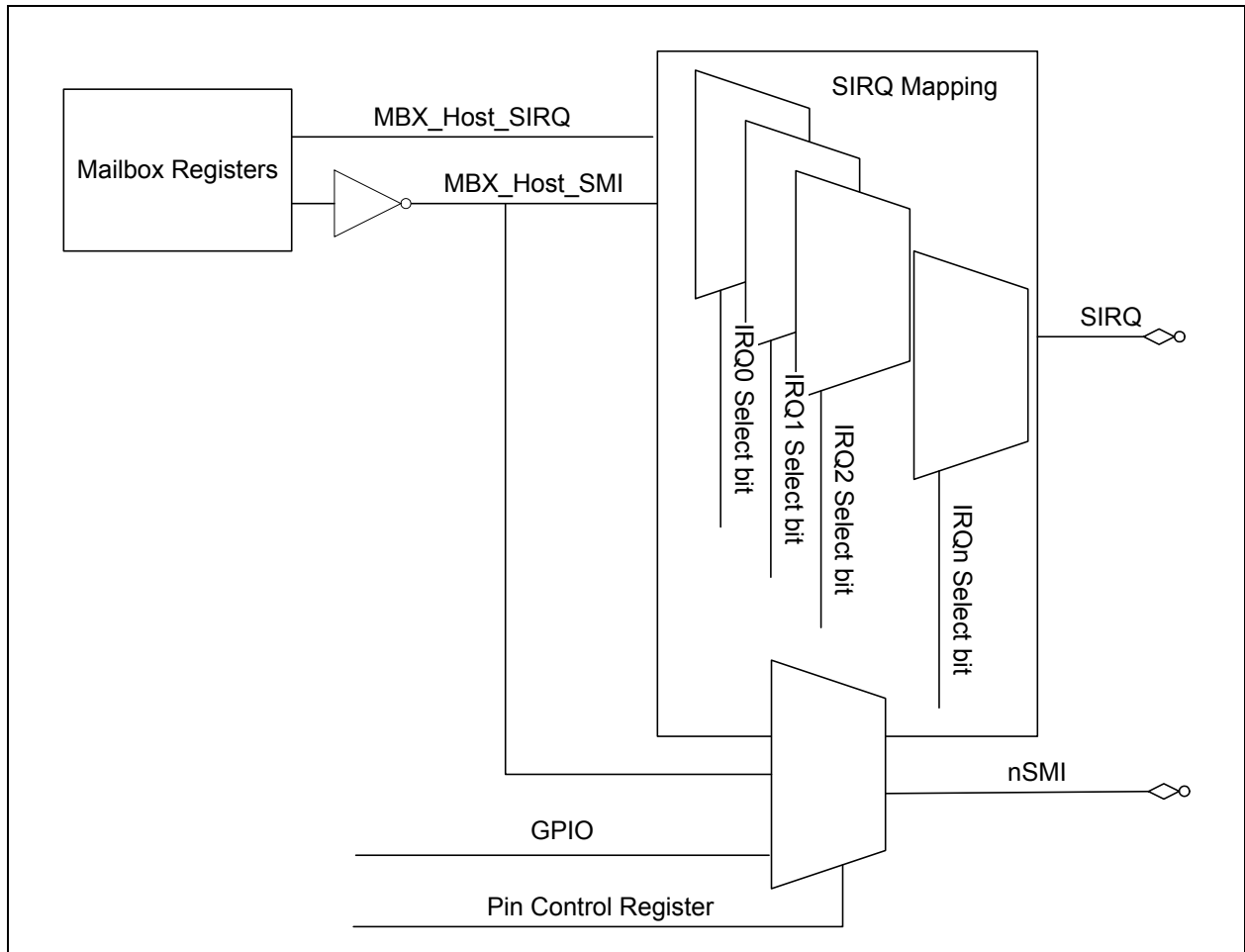
### 12.10.2 HOST INTERRUPT GENERATION

The Mailbox can generate a SIRQ event for EC-to-HOST EC events, using the [EC-to-Host Mailbox Register](#). This interrupt is routed to the SIRQ block.

The Mailbox can also generate an SMI event, using [SMI Interrupt Source Register](#). The SMI event can be routed to any frame in the SIRQ stream as well as to the nSMI pin. The SMI event can be routed to nSMI pin by selecting the nSMI signal function in the associated GPIO [Pin Control Register](#). The SMI event produces a standard active low frame on the serial IRQ stream and active low level on the open drain nSMI pin.

Routing for both the SIRQ logic and the nSMI pin is shown in [Figure 12-3](#).

FIGURE 12-3: MAILBOX SIRQ AND SMI ROUTING



### 12.10.3 EC MAILBOX CONTROL

The [HOST-to-EC Mailbox Register](#) and [EC-to-Host Mailbox Register](#) are designed to pass commands between the host and the EC. If enabled, these registers can generate interrupts to both the Host and the EC.

The two registers are not dual-ported, so the HOST BIOS and Keyboard BIOS must be designed to properly share these registers. When the host performs a write of the [HOST-to-EC Mailbox Register](#), an interrupt will be generated and seen by the EC if unmasked. When the EC writes FFh to the Mailbox Register, the register resets to 00h, providing a simple means for the EC to inform the host that an operation has been completed.

When the EC writes the [EC-to-Host Mailbox Register](#), an SMI may be generated and seen by the host if unmasked. When the Host CPU writes FFh to the register, the register resets to 00h, providing a simple means for the host to inform that EC that an operation has been completed.

**Note:** The protocol used to pass commands back and forth through the Mailbox Registers Interface is left to the System designer. Microchip can provide an application example of working code in which the host uses the Mailbox registers to gain access to all of the EC registers.

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## 12.11 Runtime Registers

The registers listed in the Runtime Register Summary table are for a single instance of the Mailbox. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Runtime Register Base Address Table.

**TABLE 12-7: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance    | Instance Number | Host | Address Space        | Base Address   |
|-------------------|-----------------|------|----------------------|----------------|
| Mailbox Interface | 0               | LPC  | I/O                  | Programmed BAR |
|                   |                 | EC   | 32-bit address space | 400F_2400h     |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 12-8: RUNTIME REGISTER SUMMARY**

| Offset | Register Name (Mnemonic) |
|--------|--------------------------|
| 0h     | MBX_INDEX Register       |
| 1h     | MBX_DATA Register        |

### 12.11.1 MBX\_INDEX REGISTER

| Offset | 0h  |      |         |                         |
|--------|---|------|---------|-------------------------|
| Bits   | Description   | Type | Default | Reset Event             |
| 7:0    | INDEX<br>The index into the mailbox registers listed in <a href="#">Table 12-10, "EC-Only Register Summary"</a> . | R/W  | 0h      | VCC1_R ESET and PWRGD=0 |

### 12.11.2 MBX\_DATA REGISTER

| Offset | 01h  |      |         |                         |
|--------|--|------|---------|-------------------------|
| Bits   | Description  | Type | Default | Reset Event             |
| 7:0    | DATA<br>Data port used to access the registers listed in <a href="#">Table 12-10, "EC-Only Register Summary"</a> . | R/W  | 0h      | VCC1_R ESET and PWRGD=0 |

## 12.12 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the Mailbox. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the EC-Only Register Base Address Table.

**TABLE 12-9: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance    | Instance Number | Host | Address Space        | Base Address |
|-------------------|-----------------|------|----------------------|--------------|
| Mailbox Interface | 0               | EC   | 32-bit address space | 400F_2500h   |

The EC-Only registers can be accessed by the EC at the EC Offset from the Base Address. In addition, the registers can be accessed through the Host Access Port, at the indexes listed in the following tables as “MBX\_INDEX”.

TABLE 12-10: EC-ONLY REGISTER SUMMARY

| EC Offset | Host I/O Index (MBX_INDEX) | Register Name (Mnemonic)                      |
|-----------|----------------------------|---|
| 00h       | 82h                        | <a href="#">HOST-to-EC Mailbox Register</a>   |
| 04h       | 83h                        | <a href="#">EC-to-Host Mailbox Register</a>   |
| 08h       | 96h                        | <a href="#">SMI Interrupt Source Register</a> |
| 0Ch       | 97h                        | <a href="#">SMI Interrupt Mask Register</a>   |
| 10h       | 84h                        | Mailbox register [0]                          |
|           | 85h                        | Mailbox register [1]                          |
|           | 86h                        | Mailbox register [2]                          |
|           | 87h                        | Mailbox register [3]                          |
| 14h       | 88h                        | Mailbox register [4]                          |
|           | 89h                        | Mailbox register [5]                          |
|           | 8Ah                        | Mailbox register [6]                          |
|           | 8Bh                        | Mailbox register [7]                          |
| 18h       | 8Ch                        | Mailbox register [8]                          |
|           | 8Dh                        | Mailbox register [9]                          |
|           | 8Eh                        | Mailbox register [A]                          |
|           | 8Fh                        | Mailbox register [B]                          |
| 1Ch       | 90h                        | Mailbox register [C]                          |
|           | 91h                        | Mailbox register [D]                          |
|           | 92h                        | Mailbox register [E]                          |
|           | 93h                        | Mailbox register [F]                          |
| 20h       | 94h                        | Mailbox register [10]                         |
|           | 95h                        | Mailbox register [11]                         |
|           | 98h                        | Mailbox register [12]                         |
|           | 99h                        | Mailbox register [13]                         |
| 24h       | 9Bh                        | Mailbox register [14]                         |
|           | 9Dh                        | Mailbox register [15]                         |
|           | 9Fh                        | Mailbox register [16]                         |
|           | A0h                        | Mailbox register [17]                         |
| 28h       | A1h                        | Mailbox register [18]                         |
|           | A2h                        | Mailbox register [19]                         |
|           | A3h                        | Mailbox register [1A]                         |
|           | A4h                        | Mailbox register [1B]                         |
| 2Ch       | A5h                        | Mailbox register [1C]                         |
|           | A6h                        | Mailbox register [1D]                         |
|           | A7h                        | Mailbox register [1E]                         |
|           | A8h                        | Mailbox register [1F]                         |
| 30h       | A9h                        | Mailbox register [20]                         |
|           | AAh                        | Mailbox register [21]                         |
|           | ABh                        | Mailbox register [22]                         |
|           | ACh                        | Mailbox register [23]                         |

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**TABLE 12-10: EC-ONLY REGISTER SUMMARY (CONTINUED)**

| EC Offset | Host I/O Index (MBX_INDEX) | Register Name (Mnemonic) |
|-----------|----------------------------|--------------------------|
| 34h       | ADh                        | Mailbox register [24]    |
|           | AEh                        | Mailbox register [25]    |
|           | AFh                        | Mailbox register [26]    |
|           | B0h                        | Mailbox register [27]    |
| 38h       | B1h                        | Mailbox register [28]    |
|           | B2h                        | Mailbox register [29]    |
|           | B3h                        | Mailbox register [2A]    |

**Note:** The Mailbox Index Addresses 9Ah, 9Ch and 9Eh are not used in [Table 12-10](#). These addresses are Reserved.

## 12.12.1 HOST-TO-EC MAILBOX REGISTER

|                  |   |   |                |                             |
|------------------|---|---|----------------|-----------------------------|
| <b>Offset</b>    | 0h  |   |                |                             |
| <b>MBX_INDEX</b> | 82h   |   |                |                             |
| <b>Bits</b>      | <b>Description</b>  | <b>Type</b>   | <b>Default</b> | <b>Reset Event</b>          |
| 7:0              | <p>HOST_EC_MBOX</p> <p>If enabled, an interrupt to the EC marked by the <a href="#">MBX_DATA</a> bit in the Interrupt Aggregator will be generated whenever the Host writes this register.</p> <p>This register is cleared when written with FFh.</p> | <p>Host Access Port:</p> <p>R/W</p> <p>EC: R/WC</p> | 0h             | <a href="#">VCC1_R ESET</a> |

## 12.12.2 EC-TO-HOST MAILBOX REGISTER

|                  |  |   |                |                             |
|------------------|--|---|----------------|-----------------------------|
| <b>Offset</b>    | 4h   |   |                |                             |
| <b>MBX_INDEX</b> | 83h  |   |                |                             |
| <b>Bits</b>      | <b>Description</b>   | <b>Type</b>   | <b>Default</b> | <b>Reset Event</b>          |
| 7:0              | <p>EC_HOST_MBOX</p> <p>An EC write to this register will set bit <a href="#">EC_WR</a> in the <a href="#">SMI Interrupt Source Register</a> to '1b'. If enabled, this will generate a Host SMI.</p> <p>This register is cleared when written with FFh.</p> | <p>Host Access Port:</p> <p>R/WC</p> <p>EC: R/W</p> | 0h             | <a href="#">VCC1_R ESET</a> |



## 12.12.3 SMI INTERRUPT SOURCE REGISTER

|                  |   |   |                |                    |
|------------------|---|---|----------------|--------------------|
| <b>Offset</b>    | 8h  |   |                |                    |
| <b>MBX_INDEX</b> | 96h   |   |                |                    |
| <b>Bits</b>      | <b>Description</b>  | <b>Type</b>                             | <b>Default</b> | <b>Reset Event</b> |
| 7:1              | <p>EC_SWI<br/>EC Software Interrupt. An SIRQ to the Host is generated when any bit in this register when this bit is set to '1b' and the corresponding bit in the <a href="#">SMI Interrupt Mask Register</a> register is '1b'.</p> <p>This field is Read/Write when accessed by the EC at the EC offset. When written through the Host Access Port, each bit in this field is cleared when written with a '1b'. Writes of '0b' have no effect.</p>   | Host Access Port:<br>R/WC<br>EC:<br>R/W | 0h             | VCC1_R<br>ESET     |
| 0                | <p>EC_WR<br/>EC Mailbox Write. This bit is set automatically when the <a href="#">EC-to-Host Mailbox Register</a> has been written. An SMI or SIRQ to the Host is generated when n this bit is '1b' and the corresponding bit in the <a href="#">SMI Interrupt Mask Register</a> register is '1b'. This bit is automatically cleared by a read of the <a href="#">EC-to-Host Mailbox Register</a> through the Host Access Port.</p> <p>This bit is read-only when read through the Host Access Port. It is neither readable nor writable directly by the EC when accessed at the EC offset.</p> | Host Access Port:<br>R<br>EC:<br>-      | 0h             | VCC1_R<br>ESET     |

## 12.12.4 SMI INTERRUPT MASK REGISTER

|                  |  |  |                |                    |
|------------------|--|--|----------------|--------------------|
| <b>Offset</b>    | Ch   |  |                |                    |
| <b>MBX_INDEX</b> | 97h  |  |                |                    |
| <b>Bits</b>      | <b>Description</b>   | <b>Type</b>                            | <b>Default</b> | <b>Reset Event</b> |
| 7:1              | <p>EC_SWI_EN<br/>EC Software Interrupt Enable. If this bit is '1b', the bit EC_WR in the SMI Interrupt Source Register is enabled for the generation of SIRQ or nSMI events.</p>   | Host Access Port:<br>R/W<br>EC:<br>R/W | 0h             | VCC1_R<br>ESET     |
| 0                | <p>EC_WR_EN<br/>EC Mailbox Write. Interrupt Enable. Each bit in this field that is '1b' enables the generation of SIRQ interrupts when the corresponding bit in the EC_SWI field in the SMI Interrupt Source Register is '1b'.</p> | Host Access Port:<br>R/W<br>EC:<br>R/W | 0h             | VCC1_R<br>ESET     |

## 13.0 ACPI PM1 BLOCK INTERFACE

### 13.1 Introduction

The MEC1322 supports ACPI as described in this section. These features comply with the ACPI Specification through a combination of hardware and EC software.

### 13.2 References

ACPI Specification, Revision 1.0

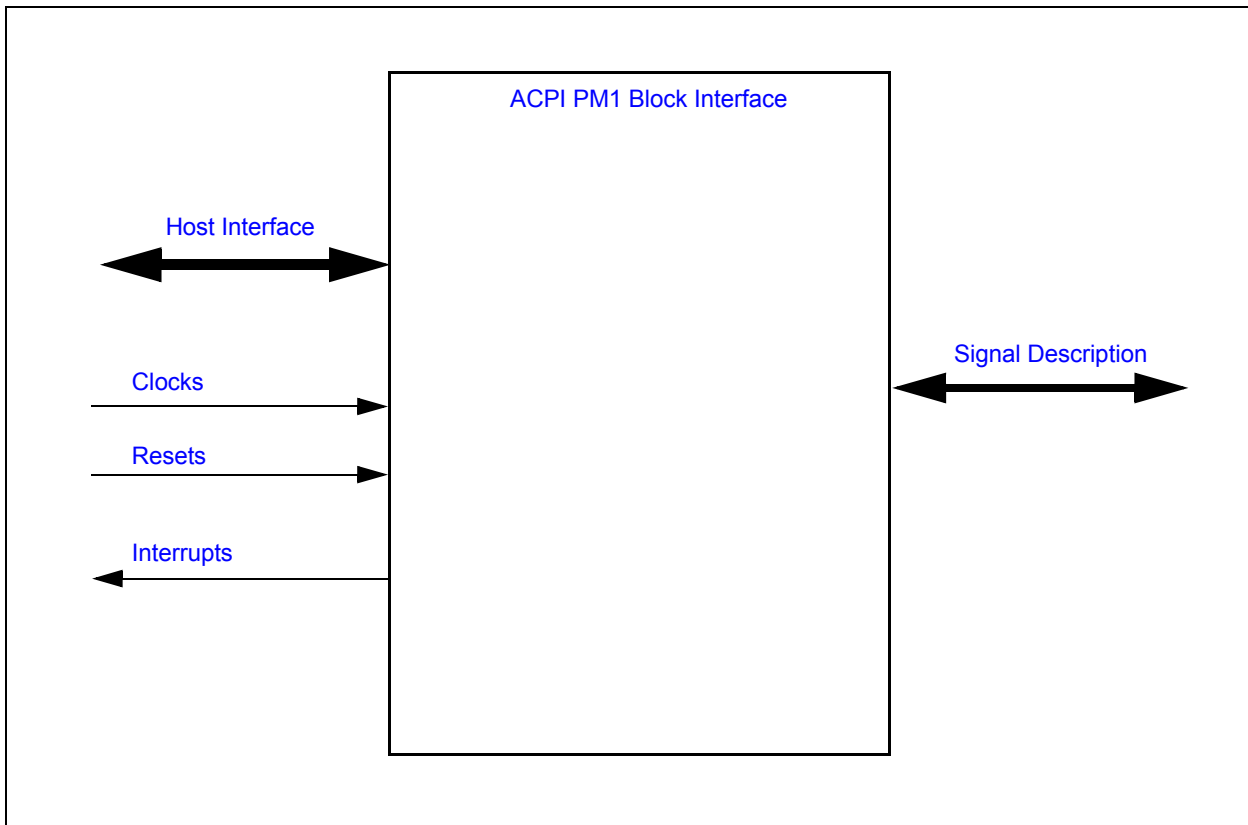
### 13.3 Terminology

None

### 13.4 Interface

This block is an IP block designed to be incorporated into a chip. It is designed to be accessed externally via the pin interface and internally via a registered host interface. The following diagram illustrates the various interfaces to the block.

**FIGURE 13-1: I/O DIAGRAM OF BLOCK**



### 13.5 Signal Description

Table 13-1, "ACPI PM1 Signal Description Table" lists the signals that are typically routed to the pin interface.

**TABLE 13-1: ACPI PM1 SIGNAL DESCRIPTION TABLE**

| Name    | Direction | Description  |
|---------|-----------|--|
| EC_SCI# | Output    | Any or all of the <a href="#">PWRBTN_STS</a> , <a href="#">SLPBTN_STS</a> , and <a href="#">RTC_STS</a> bits in the <a href="#">Power Management 1 Status 2 Register</a> can assert the <a href="#">EC_SCI#</a> pin if enabled by the associated bits in the <a href="#">Power Management 1 Enable 2 Register</a> register. The <a href="#">EC_SCI_STS</a> bit in the <a href="#">EC-Only Registers</a> register can also be used to generate an SCI on the <a href="#">EC_SCI#</a> pin. |

### 13.6 Host Interface

The registers defined for the [ACPI PM1 Block Interface](#) are accessible by the various hosts as indicated in [Section 13.11, "Runtime Registers"](#).

### 13.7 Power, Clocks and Resets

This section defines the Power, Clock, and Reset parameters of the block.

#### 13.7.1 POWER DOMAINS

**TABLE 13-2: POWER SOURCES**

| Name                 | Description  |
|----------------------|--|
| <a href="#">VCC1</a> | This power well sources the registers and logic in this block. |

#### 13.7.2 CLOCKS

This section describes all the clocks in the block, including those that are derived from the I/O Interface as well as the ones that are derived or generated internally.

**TABLE 13-3: CLOCKS**

| Name                                   | Description   |
|--|---|
| <a href="#">48 MHz Ring Oscillator</a> | This clock signal drives selected logic (e.g., counters). |

#### 13.7.3 RESETS

**TABLE 13-4: RESET SIGNALS**

| Name                       | Description  |
|----------------------------|--|
| <a href="#">VCC1_RESET</a> | This reset signal resets all of the registers and logic in this block. |

### 13.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 13-5: EC INTERRUPTS**

| Source      | Description   |
|-------------|---|
| ACPIPM1_CTL | This Interrupt is generated to the EC by the Host writing to the <a href="#">Power Management 1 Control 2 Register</a> register |
| ACPIPM1_EN  | This Interrupt is generated to the EC by the Host writing to the <a href="#">Power Management 1 Enable 2 Register</a> register  |
| ACPIPM1_STS | This Interrupt is generated to the EC by the Host writing to the <a href="#">Power Management 1 Status 2 Register</a> register  |

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## 13.9 Low Power Modes

The [ACPI PM1 Block Interface](#) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

### 13.10 Description

This section describes the functions of the [ACPI PM1 Block Interface](#) in more detail.

The MEC1322 implements the ACPI fixed registers but includes only those bits that apply to the power button sleep button and RTC alarm events. The ACPI [WAK\\_STS](#), [SLP\\_TYP](#), and [SLP\\_EN](#) bits are also supported.

The MEC1322 can generate SCI Interrupts to the Host. The functions described in the following sub-sections can generate a SCI event on the [EC\\_SCI#](#) pin. In the MEC1322, an SCI event is considered the same as an ACPI wakeup or runtime event.

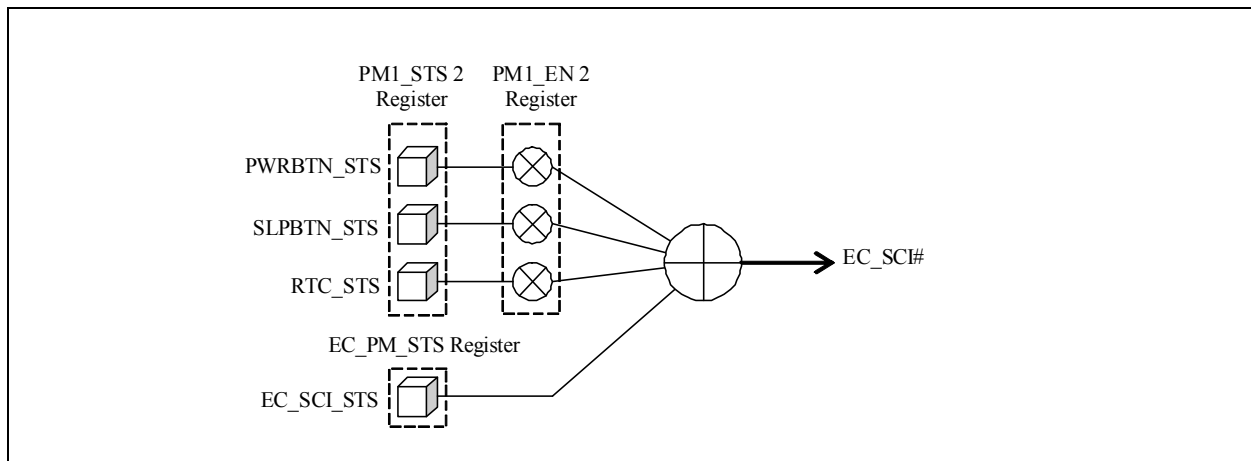
#### 13.10.1 SCI EVENT-GENERATING FUNCTIONS

| Event                      | Event Bit                    | Definition   |
|----------------------------|------------------------------|--|
| Power Button with Override | <a href="#">PWRBTN_STS</a>   | <p>The power button has a status and an enable bit in the PM1_BLK of registers to provide an SCI upon the button press. The status bit is software Read/Writable by the EC; the enable bit is Read-only by the EC. It also has a status and enable bit in the PM1_BLK of registers to indicate and control the power button override (fail-safe) event. These bits are not required by ACPI.</p> <p>The <a href="#">PWRBTN_STS</a> bit is set by the Host to enable the generation of an SCI due to the power button event. The status bit is set by the EC when it generates a power button event and is cleared by the Host writing a '1' to this bit (writing a '0' has no effect); it can also be cleared by the EC. If the enable bit is set, the EC generates an SCI power management event.</p>   |
|                            | <a href="#">PWRBTNOR_STS</a> | <p>The power button has a status and an enable bit in the PM1_BLK of registers to provide an SCI upon the power button override. The power button override event status bit is software Read/Writable by the EC; the enable bit is software read-only by the EC. The enable bit for the override event is located at bit 1 in the Power Management 1 Control Register 2 (PM1_CNTRL 2). The power button bit has a status and enable bit in the <a href="#">Runtime Registers</a> to provide an SCI power management event on a button press</p> <p>The <a href="#">PWRBTNOR_STS</a> bit is set by the Host to enable the generation of an SCI due to the power button override event. The status bit is set by the EC when it generates a power button event and is cleared by the Host writing a '1' to this bit (writing a '0' has no effect); it can also be cleared by the EC. If the enable bit is set, the EC generates an SCI power management event.</p> |
| Sleep Button               | <a href="#">SLPBTN_STS</a>   | <p>The sleep button that has a status and an enable bit in the <a href="#">Runtime Registers</a> to provide an SCI power management event on a button press. The status bit is software Read/Writable by the EC; the enable bit is Read-only by the EC.</p> <p>The <a href="#">SLPBTN_STS</a> bit is set by the Host to enable the generation of an SCI due to the sleep button event. The status bit is set by the EC when it generates a sleep button event and is cleared by the Host writing a '1' to this bit (writing a '0' has no effect); it can also be cleared by the EC. If the enable bit is set, the EC will generate an SCI power management event.</p>  |

| Event     | Event Bit               | Definition  |
|-----------|-------------------------|---|
| RTC Alarm | <a href="#">RTC_STS</a> | <p>The ACPI specification requires that the RTC alarm generate a hardware wake-up event from the sleeping state. The RTC alarm can be enabled as an SCI event and its status can be determined through bits in the <a href="#">Runtime Registers</a>. The status bit is software Read/Writable by the EC; the enable bit is Read-only by the EC.</p> <p>The <a href="#">RTC_STS</a> bit is set by the Host to enable the generation of an SCI due to the RTC alarm event. The status bit is set by the EC when the RTC generates an alarm event and is cleared by the Host writing a '1' to this bit (writing a '0' has no effect); it can also be cleared by the EC. If the enable bit is set, the EC will generate an SCI power management event.</p> |

Figure 13-2 describes the relationship of PM1 Status and Enable bits to the [EC\\_SCI#](#) pin.

**FIGURE 13-2: EC\_SCI# INTERFACE**



## 13.11 Runtime Registers

The registers listed in the Runtime Register Summary table are for a single instance of the ACPI PM1 interface. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the Runtime Register Base Address Table.

**TABLE 13-6: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance                           | Instance Number | Host | Address Space                 | Base Address   |
|--|-----------------|------|-------------------------------|----------------|
| <a href="#">ACPI PM1 Block Interface</a> | 0               | LPC  | I/O                           | Programmed BAR |
|  | 0               | EC   | 32-bit internal address space | 400F_1400h     |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 13-7: RUNTIME REGISTERS SUMMARY**

| Offset | Register Name   |
|--------|---|
| 00h    | <a href="#">Power Management 1 Status 1 Register</a>  |
| 01h    | <a href="#">Power Management 1 Status 2 Register</a>  |
| 02h    | <a href="#">Power Management 1 Enable 1 Register</a>  |
| 03h    | <a href="#">Power Management 1 Enable 2 Register</a>  |
| 04h    | <a href="#">Power Management 1 Control 1 Register</a> |
| 05h    | <a href="#">Power Management 1 Control 2 Register</a> |

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**TABLE 13-7: RUNTIME REGISTERS SUMMARY (CONTINUED)**

| Offset | Register Name   |
|--------|---|
| 06h    | <a href="#">Power Management 2 Control 1 Register</a> |
| 07h    | <a href="#">Power Management 2 Control 2 Register</a> |

## 13.11.1 POWER MANAGEMENT 1 STATUS 1 REGISTER

| Offset | 00h         |      |         |             |
|--------|-------------|------|---------|-------------|
| Bits   | Description | Type | Default | Reset Event |
| 7:0    | Reserved    | R    | -       | -           |

## 13.11.2 POWER MANAGEMENT 1 STATUS 2 REGISTER

| Offset | 01h  |                                       |         |                |
|--------|--|---------------------------------------|---------|----------------|
| Bits   | Description  | Type                                  | Default | Reset Event    |
| 7      | WAK_STS<br>This bit can be set or cleared by the EC. The Host writing a one to this bit can also clear this bit.   | R/WC<br>( <a href="#">Note 13-1</a> ) | 00h     | VCC1_R<br>ESET |
| 6:4    | Reserved   | R                                     | -       | -              |
| 3      | PWRBTNOR_STS<br>This bit can be set or cleared by the EC to simulate a Power button override event status if the power is controlled by the EC. The Host writing a one to this bit can also clear this bit. The EC must generate the associated hardware event under software control. | R/WC<br>( <a href="#">Note 13-1</a> ) | 00h     | VCC1_R<br>ESET |
| 2      | RTC_STS<br>This bit can be set or cleared by the EC to simulate a RTC status. The Host writing a one to this bit can also clear this bit. The EC must generate the associated SCI interrupt under software control.  | R/WC<br>( <a href="#">Note 13-1</a> ) | 00h     | VCC1_R<br>ESET |
| 1      | SLPBTN_STS<br>This bit can be set or cleared by the EC to simulate a Sleep button status if the sleep state is controlled by the EC. The Host writing a one to this bit can also clear this bit. The EC must generate the associated SCI interrupt under software control.             | R/WC<br>( <a href="#">Note 13-1</a> ) | 00h     | VCC1_R<br>ESET |
| 0      | PWRBTN_STS<br>This bit can be set or cleared by the EC to simulate a Power button status if the power is controlled by the EC. The Host writing a one to this bit can also clear this bit. The EC must generate the associated SCI interrupt under software control.                   | R/WC<br>( <a href="#">Note 13-1</a> ) | 00h     | VCC1_R<br>ESET |

**Note 13-1** These bits are set/cleared by the EC directly i.e., writing '1' sets the bit and writing '0' clears it. These bits can also be cleared by the Host software writing a one to this bit position and by [VCC1\\_RESET](#). Writing a 0 by the Host has no effect.

## 13.11.3 POWER MANAGEMENT 1 ENABLE 1 REGISTER

| Offset | 02h         |      |         |             |
|--------|-------------|------|---------|-------------|
| Bits   | Description | Type | Default | Reset Event |
| 7:0    | Reserved    | R    | -       | -           |

## 13.11.4 POWER MANAGEMENT 1 ENABLE 2 REGISTER

| Offset | 03h   |                    |         |             |
|--------|---|--------------------|---------|-------------|
| Bits   | Description   | Type               | Default | Reset Event |
| 7:3    | Reserved  | R                  | -       | -           |
| 2      | RTC_EN<br>This bit can be read or written by the Host. It can be read by the EC.    | R/W<br>(Note 13-2) | 00h     | VCC1_R ESET |
| 1      | SLPBTN_EN<br>This bit can be read or written by the Host. It can be read by the EC. | R/W<br>(Note 13-2) | 00h     | VCC1_R ESET |
| 0      | PWRBTN_EN<br>This bit can be read or written by the Host. It can be read by the EC. | R/W<br>(Note 13-2) | 00h     | VCC1_R ESET |

**Note 13-2** These bits are read-only by the EC.

## 13.11.5 POWER MANAGEMENT 1 CONTROL 1 REGISTER

| Offset | 04h         |      |         |             |
|--------|-------------|------|---------|-------------|
| Bits   | Description | Type | Default | Reset Event |
| 7:0    | Reserved    | R    | 0h      | VCC1_R ESET |

## 13.11.6 POWER MANAGEMENT 1 CONTROL 2 REGISTER

| Offset | 05h  |                    |         |             |
|--------|--|--------------------|---------|-------------|
| Bits   | Description  | Type               | Default | Reset Event |
| 7:6    | Reserved   | R                  | -       | -           |
| 5      | SLP_EN<br>See Table 13-8.  | See Table 13-8.    | 00h     | VCC1_R ESET |
| 4:2    | SLP_TYP<br>These bits can be set or cleared by the Host, read by the EC.   | R/W<br>(Note 13-3) | 00h     | VCC1_R ESET |
| 1      | PWRBTNOR_EN<br>This bit can be set or cleared by the Host, read by the EC. | R/W<br>(Note 13-3) | 00h     | VCC1_R ESET |
| 0      | Reserved   | R                  | -       | -           |

**Note 13-3** These bits are read-only by the EC.

**TABLE 13-8: SLP\_EN DEFINITION**

| Host / EC | R/W   | Description  |
|-----------|-------|--|
| Host      | Read  | Always reads 0   |
|           | Write | Writing a 0 has no effect, Writing a 1 sets this bit   |
| EC        | Read  | Reads the value of the bit                             |
|           | Write | Writing a 0 has no effect, Writing a 1 clears this bit |

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## 13.11.7 POWER MANAGEMENT 2 CONTROL 1 REGISTER

| Offset | 06h         |      |         |             |
|--------|-------------|------|---------|-------------|
| Bits   | Description | Type | Default | Reset Event |
| 7:0    | Reserved    | R    | -       | -           |

## 13.11.8 POWER MANAGEMENT 2 CONTROL 2 REGISTER

| Offset | 07h         |      |         |             |
|--------|-------------|------|---------|-------------|
| Bits   | Description | Type | Default | Reset Event |
| 7:0    | Reserved    | R    | -       | -           |

## 13.12 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the ACPI PM1 interface. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 13-9: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance           | Instance Number | Host | Address Space        | Base Address |
|--------------------------|-----------------|------|----------------------|--------------|
| ACPI PM1 Block Interface | 0               | EC   | 32-bit address space | 400F_1500h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 13-10: EC-ONLY REGISTERS SUMMARY**

| Offset | Register Name   |
|--------|---|
| 00h    | <a href="#">Power Management 1 Status 1 Register</a>  |
| 01h    | <a href="#">Power Management 1 Status 2 Register</a>  |
| 02h    | <a href="#">Power Management 1 Enable 1 Register</a>  |
| 03h    | <a href="#">Power Management 1 Enable 2 Register</a>  |
| 04h    | <a href="#">Power Management 1 Control 1 Register</a> |
| 05h    | <a href="#">Power Management 1 Control 2 Register</a> |
| 06h    | <a href="#">Power Management 2 Control 1 Register</a> |
| 07h    | <a href="#">Power Management 2 Control 2 Register</a> |
| 10h    | <a href="#">EC_PM_STS Register</a>                    |

**Note:** The Power Management Status, Enable and Control registers in [Table 13-10, "EC-Only Registers Summary"](#) are described in [Section 13.11, "Runtime Registers,"](#) on page 173.



## 13.12.1 EC\_PM\_STS REGISTER

| Offset | 10h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:1    | UD  | R/W  | 00h     | VCC1_R<br>ESET |
| 0      | EC_SCI_STS<br>If the EC_SCI_STS bit is "1", an interrupt is generated on the EC_SCI# pin. | R/W  | 00h     | VCC1_R<br>ESET |

**Note:** This register is only accessed by the EC. There is no host access to this register.

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## 14.0 UART

### 14.1 Introduction

The 16550 UART (Universal Asynchronous Receiver/Transmitter) is a full-function Two Pin Serial Port that supports the standard RS-232 Interface.

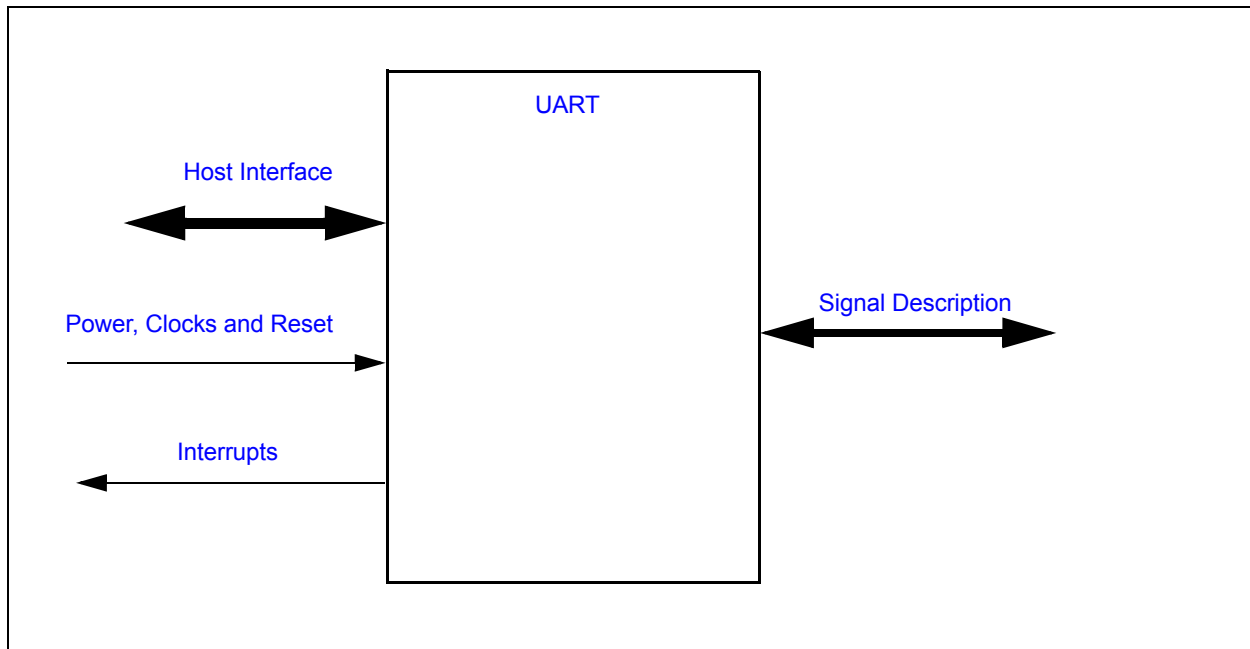
### 14.2 References

1. EIA Standard RS-232-C specification

### 14.3 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

FIGURE 14-1: I/O DIAGRAM OF BLOCK



### 14.4 Signal Description

TABLE 14-1: SIGNAL DESCRIPTION TABLE

| Name | Direction | Description                  |
|------|-----------|------------------------------|
| TXD  | Output    | Transmit serial data output. |
| RXD  | Input     | Receiver serial data input.  |

### 14.5 Host Interface

The UART is accessed by host software via a registered interface, as defined in [Section 14.10, "Configuration Registers"](#) and [Section 14.11, "Runtime Registers"](#).

## 14.6 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 14.6.1 POWER DOMAINS

**TABLE 14-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | This Power Well is used to power the registers and logic in this block. |

### 14.6.2 CLOCK INPUTS

**TABLE 14-3: CLOCK INPUTS**

| Name          | Description   |
|---------------|---|
| 1.8432MHz_Clk | The UART requires a 1.8432 MHz $\pm$ 2% clock input for baud rate generation.   |
| 24MHz_Clk     | 24 MHz $\pm$ 2% clock input. This clock may be enabled to generate the baud rate, which requires a 1.8432 MHz $\pm$ 2% clock input. |

### 14.6.3 RESETS

**TABLE 14-4: RESET SIGNALS**

| Name       | Description   |
|------------|---|
| VCC1_RESET | This reset is asserted when VCC1 is applied.  |
| nSIO_RESET | This is an alternate reset condition, typically asserted when the main power rail is asserted.  |
| RESET      | This reset is determined by the POWER bit signal. When the power bit signal is 1, this signal is equal to nSIO_RESET. When the power bit signal is 0, this signal is equal to VCC1_RESET. |

## 14.7 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 14-5: SYSTEM INTERRUPTS**

| Source | Description  |
|--------|--|
| UART   | The UART interrupt event output indicates if an interrupt is pending. See <a href="#">Table 14-13, "Interrupt Control Table," on page 186.</a> |

**TABLE 14-6: EC INTERRUPTS**

| Source | Description  |
|--------|--|
| UART   | The UART interrupt event output indicates if an interrupt is pending. See <a href="#">Table 14-13, "Interrupt Control Table," on page 186.</a> |

## 14.8 Low Power Modes

The UART may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 14.9 Description

The UART is compatible with the 16450, the 16450 ACE registers and the 16C550A. The UART performs serial-to-parallel conversions on received characters and parallel-to-serial conversions on transmit characters. Two sets of baud rates are provided. When the 1.8432 MHz source clock is selected, standard baud rates from 50 to 115.2K are available. When the source clock is 32.26 MHz, baud rates from 126K to 2,016K are available. The character options are programmable for 1 start; 1, 1.5 or 2 stop bits; even, odd, sticky or no parity; and prioritized interrupts. The UART contains a programmable baud rate generator that is capable of dividing the input clock signal by 1 to 65535. The UART is also

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capable of supporting the MIDI data rate. Refer to the Configuration Registers for information on disabling, powering down and changing the base address of the UART. The UART interrupt is enabled by programming OUT2 of the UART to logic "1." Because OUT2 is logic "0," it disables the UART's interrupt. The UART is accessible by both the Host and the EC.

## 14.9.1 PROGRAMMABLE BAUD RATE

The Serial Port contains a programmable Baud Rate Generator that is capable of dividing the internal clock source by any divisor from 1 to 65535. The clock source is either the [1.8432MHz\\_Clk](#) clock source or the [24MHz\\_Clk](#) clock source. The output frequency of the Baud Rate Generator is 16x the Baud rate. Two eight bit latches store the divisor in 16 bit binary format. These Divisor Latches must be loaded during initialization in order to ensure desired operation of the Baud Rate Generator. Upon loading either of the Divisor Latches, a 16 bit Baud counter is immediately loaded. This prevents long counts on initial load. If a 0 is loaded into the BRG registers, the output divides the clock by the number 3. If a 1 is loaded, the output is the inverse of the input oscillator. If a two is loaded, the output is a divide by 2 signal with a 50% duty cycle. If a 3 or greater is loaded, the output is low for 2 bits and high for the remainder of the count.

The following tables show possible baud rates.

**TABLE 14-7: UART BAUD RATES USING CLOCK SOURCE [1.8432MHz\\_Clk](#)**

| Desired Baud Rate | BAUD_CLOCK_SEL | Divisor Used to Generate 16X Clock |
|-------------------|----------------|------------------------------------|
| 50                | 0              | 2304                               |
| 75                | 0              | 1536                               |
| 110               | 0              | 1047                               |
| 134.5             | 0              | 857                                |
| 150               | 0              | 768                                |
| 300               | 0              | 384                                |
| 600               | 0              | 192                                |
| 1200              | 0              | 96                                 |
| 1800              | 0              | 64                                 |
| 2000              | 0              | 58                                 |
| 2400              | 0              | 48                                 |
| 3600              | 0              | 32                                 |
| 4800              | 0              | 24                                 |
| 7200              | 0              | 16                                 |
| 9600              | 0              | 12                                 |
| 19200             | 0              | 6                                  |
| 38400             | 0              | 3                                  |
| 57600             | 0              | 2                                  |
| 115200            | 0              | 1                                  |

**TABLE 14-8: UART BAUD RATES USING CLOCK SOURCE [24MHz\\_Clk](#)**

| Desired Baud Rate | BAUD_CLOCK_SEL | Divisor Used to Generate 16X Clock |
|-------------------|----------------|------------------------------------|
| 125000            | 1              | 12                                 |
| 136400            | 1              | 11                                 |
| 150000            | 1              | 10                                 |
| 166700            | 1              | 9                                  |
| 187500            | 1              | 8                                  |
| 214300            | 1              | 7                                  |
| 250000            | 1              | 6                                  |

**TABLE 14-8: UART BAUD RATES USING CLOCK SOURCE 24MHz\_Clk (CONTINUED)**

| Desired Baud Rate | BAUD_CLOCK_SEL | Divisor Used to Generate 16X Clock |
|-------------------|----------------|------------------------------------|
| 300000            | 1              | 5                                  |
| 375000            | 1              | 4                                  |
| 500000            | 1              | 3                                  |
| 750000            | 1              | 2                                  |
| 1500000           | 1              | 1                                  |

## 14.10 Configuration Registers

The registers listed in the Configuration Register Summary table are for a single instance of the [UART](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Configuration Register Base Address Table.

**FIGURE 14-2: CONFIGURATION REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Logical Device Number | Host | Address Space                 | Base Address |
|----------------|-----------------|-----------------------|------|-------------------------------|--------------|
| UART           | 0               | 7                     | LPC  | Configuration Port            | INDEX = 00h  |
| UART           | 0               |                       | EC   | 32-bit internal address space | 400F_1F00h   |

Each Configuration register access through the Host Access Port is via its LDN and its Host Access Port Index. EC access is a relative offset to the EC Base Address.

**TABLE 14-9: CONFIGURATION REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                      |
|--------|---|
| 30h    | <a href="#">Activate Register</a>             |
| F0h    | <a href="#">Configuration Select Register</a> |

### 14.10.1 ACTIVATE REGISTER

| Offset | 30h   |      |         |              |
|--------|---|------|---------|--------------|
| Bits   | Description   | Type | Default | Reset Event  |
| 7:1    | Reserved  | R    | -       | -            |
| 0      | <b>ACTIVATE</b><br>When this bit is 1, the UART logical device is powered and functional. When this bit is 0, the UART logical device is powered down and inactive. | R/W  | 0b      | <b>RESET</b> |

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## 14.10.2 CONFIGURATION SELECT REGISTER

| Offset | F0h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:3    | Reserved   | R    | -       | -           |
| 2      | POLARITY<br>1=The UART_TX and UART_RX pins functions are inverted<br>0=The UART_TX and UART_RX pins functions are not inverted                           | R/W  | 0b      | RESET       |
| 1      | POWER<br>1=The RESET reset signal is derived from nSIO_RESET<br>0=The RESET reset signal is derived from VCC1_RESET                                      | R/W  | 1b      | RESET       |
| 0      | CLK_SRC<br>1=The UART Baud Clock is derived from an external clock source<br>0=The UART Baud Clock is derived from one of the two internal clock sources | R/W  | 0b      | RESET       |

## 14.11 Runtime Registers

The registers listed in the Runtime Register Summary table are for a single instance of the **UART**. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in Runtime Register Base Address Table.

**TABLE 14-10: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address (Note 14-1) |
|----------------|-----------------|------|-------------------------------|--------------------------|
| UART           | 0               | LPC  | I/O                           | Programmed BAR           |
|                |                 | EC   | 32-bit internal address space | 400F_1C00h               |

**Note 14-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 14-11: RUNTIME REGISTER SUMMARY**

| DLAB (Note 14-2) | Offset | Register Name (Mnemonic)                      |
|------------------|--------|---|
| 0                | 0h     | Receive Buffer Register                       |
| 0                | 0h     | Transmit Buffer Register                      |
| 1                | 0h     | Programmable Baud Rate Generator LSB Register |
| 1                | 1h     | Programmable Baud Rate Generator MSB Register |
| 0                | 1h     | Interrupt Enable Register                     |
| x                | 02h    | FIFO Control Register                         |
| x                | 02h    | Interrupt Identification Register             |
| x                | 03h    | Line Control Register                         |
| x                | 04h    | Modem Control Register                        |
| x                | 05h    | Line Status Register                          |
| x                | 06h    | Modem Status Register                         |
| x                | 07h    | Scratchpad Register                           |

**Note 14-2** DLAB is bit 7 of the Line Control Register.

## 14.11.1 RECEIVE BUFFER REGISTER

| Offset | 0h (DLAB=0)   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>RECEIVED_DATA</b><br>This register holds the received incoming data byte. Bit 0 is the least significant bit, which is transmitted and received first. Received data is double buffered; this uses an additional shift register to receive the serial data stream and convert it to a parallel 8 bit word which is transferred to the Receive Buffer register. The shift register is not accessible. | R    | 0h      | RESET       |

## 14.11.2 TRANSMIT BUFFER REGISTER

| Offset | 0h (DLAB=0)   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>TRANSMIT_DATA</b><br>This register contains the data byte to be transmitted. The transmit buffer is double buffered, utilizing an additional shift register (not accessible) to convert the 8 bit data word to a serial format. This shift register is loaded from the Transmit Buffer when the transmission of the previous byte is complete. | W    | 0h      | RESET       |

## 14.11.3 PROGRAMMABLE BAUD RATE GENERATOR LSB REGISTER

| Offset | 00h (DLAB=1)   |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | <b>BAUD_RATE_DIVISOR_LSB</b><br>See <a href="#">Section 14.9.1, "Programmable Baud Rate"</a> . | R/W  | 0h      | RESET       |

## 14.11.4 PROGRAMMABLE BAUD RATE GENERATOR MSB REGISTER

| Offset | 01h (DLAB=1)  |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7      | <b>BAUD_CLK_SEL</b><br><br>1=If <a href="#">CLK_SRC</a> is '0', the baud clock is derived from the <a href="#">1.8432MHz_Clk</a> . If <a href="#">CLK_SRC</a> is '1', this bit has no effect<br>1=If <a href="#">CLK_SRC</a> is '0', the baud clock is derived from the <a href="#">24MHz_Clk</a> . If <a href="#">CLK_SRC</a> is '1', this bit has no effect | R/W  | 0h      | RESET       |
| 6:0    | <b>BAUD_RATE_DIVISOR_MSB</b><br>See <a href="#">Section 14.9.1, "Programmable Baud Rate"</a> .  | R/W  | 0h      | RESET       |

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## 14.11.5 INTERRUPT ENABLE REGISTER

The lower four bits of this register control the enables of the five interrupt sources of the Serial Port interrupt. It is possible to totally disable the interrupt system by resetting bits 0 through 3 of this register. Similarly, setting the appropriate bits of this register to a high, selected interrupts can be enabled. Disabling the interrupt system inhibits the Interrupt Identification Register and disables any Serial Port interrupt out of the MEC1322. All other system functions operate in their normal manner, including the Line Status and MODEM Status Registers. The contents of the Interrupt Enable Register are described below.

| Offset | 01h (DLAB=0)  |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:4    | Reserved  | R    | -       | -           |
| 3      | EMSI<br>This bit enables the MODEM Status Interrupt when set to logic "1". This is caused when one of the Modem Status Register bits changes state.   | R/W  | 0h      | RESET       |
| 2      | ELSI<br>This bit enables the Received Line Status Interrupt when set to logic "1". The error sources causing the interrupt are Overrun, Parity, Framing and Break. The Line Status Register must be read to determine the source. | R/W  | 0h      | RESET       |
| 1      | ETHREI<br>This bit enables the Transmitter Holding Register Empty Interrupt when set to logic "1".  | R/W  | 0h      | RESET       |
| 0      | ERDAI<br>This bit enables the Received Data Available Interrupt (and timeout interrupts in the FIFO mode) when set to logic "1".  | R/W  | 0h      | RESET       |

## 14.11.6 FIFO CONTROL REGISTER

This is a write only register at the same location as the [Interrupt Identification Register](#).

**Note:** DMA is not supported.

| Offset | 02h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:6    | RECV_FIFO_TRIGGER_LEVEL<br>These bits are used to set the trigger level for the RCVR FIFO interrupt.  | W    | 0h      | RESET       |
| 5:4    | Reserved  | R    | -       | -           |
| 3      | DMA_MODE_SELECT<br>Writing to this bit has no effect on the operation of the UART. The RXRDY and TXRDY pins are not available on this chip.   | W    | 0h      | RESET       |
| 2      | CLEAR_XMIT_FIFO<br>Setting this bit to a logic "1" clears all bytes in the XMIT FIFO and resets its counter logic to "0". The shift register is not cleared. This bit is self-clearing. | W    | 0h      | RESET       |
| 1      | CLEAR_RECV_FIFO<br>Setting this bit to a logic "1" clears all bytes in the RCVR FIFO and resets its counter logic to "0". The shift register is not cleared. This bit is self-clearing. | W    | 0h      | RESET       |



|               |  |             |                |                    |
|---------------|--|-------------|----------------|--------------------|
| <b>Offset</b> | 02h  |             |                |                    |
| <b>Bits</b>   | <b>Description</b>   | <b>Type</b> | <b>Default</b> | <b>Reset Event</b> |
| 0             | EXRF<br>Enable XMIT and RECV FIFO. Setting this bit to a logic “1” enables both the XMIT and RCVR FIFOs. Clearing this bit to a logic “0” disables both the XMIT and RCVR FIFOs and clears all bytes from both FIFOs. When changing from FIFO Mode to non-FIFO (16450) mode, data is automatically cleared from the FIFOs. This bit must be a 1 when other bits in this register are written to or they will not be properly programmed. | W           | 0h             | RESET              |

**TABLE 14-12: RECV FIFO TRIGGER LEVELS**

| Bit 7 | Bit 6 | RECV FIFO Trigger Level (BYTES) |
|-------|-------|---------------------------------|
| 0     | 0     | 1                               |
|       | 1     | 4                               |
| 1     | 0     | 8                               |
|       | 1     | 14                              |

## 14.11.7 INTERRUPT IDENTIFICATION REGISTER

By accessing this register, the host CPU can determine the highest priority interrupt and its source. Four levels of priority interrupt exist. They are in descending order of priority:

1. Receiver Line Status (highest priority)
2. Received Data Ready
3. Transmitter Holding Register Empty
4. MODEM Status (lowest priority)

Information indicating that a prioritized interrupt is pending and the source of that interrupt is stored in the Interrupt Identification Register (refer to [Table 14-13](#)). When the CPU accesses the IIR, the Serial Port freezes all interrupts and indicates the highest priority pending interrupt to the CPU. During this CPU access, even if the Serial Port records new interrupts, the current indication does not change until access is completed. The contents of the IIR are described below.

|               |  |             |                |                    |
|---------------|--|-------------|----------------|--------------------|
| <b>Offset</b> | 02h  |             |                |                    |
| <b>Bits</b>   | <b>Description</b>   | <b>Type</b> | <b>Default</b> | <b>Reset Event</b> |
| 7:6           | FIFO_EN<br>These two bits are set when the FIFO CONTROL Register bit 0 equals 1.   | R           | 0h             | RESET              |
| 5:4           | Reserved   | R           | -              | -                  |
| 3:1           | INTID<br>These bits identify the highest priority interrupt pending as indicated by <a href="#">Table 14-13</a> , "Interrupt Control Table". In non-FIFO mode, Bit[3] is a logic “0”. In FIFO mode Bit[3] is set along with Bit[2] when a time-out interrupt is pending. | R           | 0h             | RESET              |

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|               |  |             |                |                    |
|---------------|--|-------------|----------------|--------------------|
| <b>Offset</b> | 02h  |             |                |                    |
| <b>Bits</b>   | <b>Description</b>   | <b>Type</b> | <b>Default</b> | <b>Reset Event</b> |
| 0             | <b>IPEND</b><br>This bit can be used in either a hardwired prioritized or polled environment to indicate whether an interrupt is pending. When bit 0 is a logic '0' an interrupt is pending and the contents of the IIR may be used as a pointer to the appropriate internal service routine. When bit 0 is a logic '1' no interrupt is pending. | R           | 1h             | RESET              |

**TABLE 14-13: INTERRUPT CONTROL TABLE**

| FIFO Mode Only | Interrupt Identification Register |       |       | Interrupt SET and RESET Functions |                |                                    |   |   |
|----------------|-----------------------------------|-------|-------|-----------------------------------|----------------|------------------------------------|---|---|
|                | Bit 3                             | Bit 2 | Bit 1 | Bit 0                             | Priority Level | Interrupt Type                     | Interrupt Source  | Interrupt Reset Control   |
| 0              | 0                                 | 0     | 0     | 1                                 | -              | None                               | None  | -   |
|                |                                   |       |       | 0                                 | Highest        | Receiver Line Status               | Overrun Error, Parity Error, Framing Error or Break Interrupt   | Reading the Line Status Register  |
| 1              | 0                                 | 0     | 0     | 0                                 | Second         | Received Data Available            | Receiver Data Available   | Read Receiver Buffer or the FIFO drops below the trigger level.                               |
|                |                                   |       |       | 1                                 |                | Character Timeout Indication       | No Characters Have Been Removed From or Input to the RCVR FIFO during the last 4 Char times and there is at least 1 char in it during this time | Reading the Receiver Buffer Register  |
| 0              | 0                                 | 0     | 1     | 0                                 | Third          | Transmitter Holding Register Empty | Transmitter Holding Register Empty  | Reading the IIR Register (if Source of Interrupt) or Writing the Transmitter Holding Register |
|                |                                   |       |       | 1                                 | Fourth         | MODEM Status                       | Clear to Send or Data Set Ready or Ring Indicator or Data Carrier Detect  | Reading the MODEM Status Register   |

## 14.11.8 LINE CONTROL REGISTER

| Offset | 03h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7      | <b>DLAB</b><br>Divisor Latch Access Bit (DLAB). It must be set high (logic "1") to access the Divisor Latches of the Baud Rate Generator during read or write operations. It must be set low (logic "0") to access the Receiver Buffer Register, the Transmitter Holding Register, or the Interrupt Enable Register.   | R/W  | 0h      | RESET       |
| 6      | <b>BREAK_CONTROL</b><br>Set Break Control bit. When bit 6 is a logic "1", the transmit data output (TXD) is forced to the Spacing or logic "0" state and remains there (until reset by a low level bit 6) regardless of other transmitter activity. This feature enables the Serial Port to alert a terminal in a communications system.   | R/W  | 0h      | RESET       |
| 5      | <b>STICK_PARITY</b><br>Stick Parity bit. When parity is enabled it is used in conjunction with bit 4 to select Mark or Space Parity. When LCR bits 3, 4 and 5 are 1 the Parity bit is transmitted and checked as a 0 (Space Parity). If bits 3 and 5 are 1 and bit 4 is a 0, then the Parity bit is transmitted and checked as 1 (Mark Parity). If bit 5 is 0 Stick Parity is disabled. Bit 3 is a logic "1" and bit 5 is a logic "1", the parity bit is transmitted and then detected by the receiver in the opposite state indicated by bit 4. | R/W  | 0h      | RESET       |
| 4      | <b>PARITY_SELECT</b><br>Even Parity Select bit. When bit 3 is a logic "1" and bit 4 is a logic "0", an odd number of logic "1"s is transmitted or checked in the data word bits and the parity bit. When bit 3 is a logic "1" and bit 4 is a logic "1" an even number of bits is transmitted and checked.  | R/W  | 0h      | RESET       |
| 3      | <b>ENABLE_PARITY</b><br>Parity Enable bit. When bit 3 is a logic "1", a parity bit is generated (transmit data) or checked (receive data) between the last data word bit and the first stop bit of the serial data. (The parity bit is used to generate an even or odd number of 1s when the data word bits and the parity bit are summed).  | R/W  | 0h      | RESET       |
| 2      | <b>STOP_BITS</b><br>This bit specifies the number of stop bits in each transmitted or received serial character. <a href="#">Table 14-14</a> summarizes the information.   | R/W  | 0h      | RESET       |
| 1:0    | <b>WORD_LENGTH</b><br>These two bits specify the number of bits in each transmitted or received serial character. The encoding of bits 0 and 1 is as follows:  | R/W  | 0h      | RESET       |

**TABLE 14-14: STOP BITS**

| Bit 2 | Word Length | Number of Stop Bits |
|-------|-------------|---------------------|
| 0     | --          | 1                   |
| 1     | 5 bits      | 1.5                 |
|       | 6 bits      |                     |
|       | 7 bits      |                     |
|       | 8 bits      |                     |

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**Note:** The receiver will ignore all stop bits beyond the first, regardless of the number used in transmitting.

**TABLE 14-15: SERIAL CHARACTER**

| Bit 1 | Bit 0 | Word Length |
|-------|-------|-------------|
| 0     | 0     | 5 Bits      |
| 0     | 1     | 6 Bits      |
| 1     | 0     | 7 Bits      |
| 1     | 1     | 8 Bits      |

The Start, Stop and Parity bits are not included in the word length.

## 14.11.9 MODEM CONTROL REGISTER

| Offset | 04h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:5    | Reserved  | R    | -       | -           |
| 4      | <p><b>LOOPBACK</b></p> <p>This bit provides the loopback feature for diagnostic testing of the Serial Port. When bit 4 is set to logic "1", the following occur:</p> <ol style="list-style-type: none"> <li>The TXD is set to the Marking State (logic "1").</li> <li>The receiver Serial Input (RXD) is disconnected.</li> <li>The output of the Transmitter Shift Register is "looped back" into the Receiver Shift Register input.</li> <li>All MODEM Control inputs (nCTS, nDSR, nRI and nDCD) are disconnected.</li> <li>The four MODEM Control outputs (nDTR, nRTS, OUT1 and OUT2) are internally connected to the four MODEM Control inputs (nDSR, nCTS, RI, DCD).</li> <li>The Modem Control output pins are forced inactive high.</li> <li>Data that is transmitted is immediately received.</li> </ol> <p>This feature allows the processor to verify the transmit and receive data paths of the Serial Port. In the diagnostic mode, the receiver and the transmitter interrupts are fully operational. The MODEM Control Interrupts are also operational but the interrupts' sources are now the lower four bits of the MODEM Control Register instead of the MODEM Control inputs. The interrupts are still controlled by the Interrupt Enable Register.</p> | R/W  | 0h      | RESET       |
| 3      | <p><b>OUT2</b></p> <p>Output 2 (OUT2). This bit is used to enable an UART interrupt. When OUT2 is a logic "0", the serial port interrupt output is forced to a high impedance state - disabled. When OUT2 is a logic "1", the serial port interrupt outputs are enabled.</p>  | R/W  | 0h      | RESET       |
| 2      | <p><b>OUT1</b></p> <p>This bit controls the Output 1 (OUT1) bit. This bit does not have an output pin and can only be read or written by the CPU.</p>   | R/W  | 0h      | RESET       |
| 1      | <p><b>RTS</b></p> <p>This bit controls the Request To Send (nRTS) output. Bit 1 affects the nRTS output in a manner identical to that described above for bit 0.</p>  | R/W  | 0h      | RESET       |

| Offset | 04h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 0      | <p>DTR</p> <p>This bit controls the Data Terminal Ready (nDTR) output. When bit 0 is set to a logic "1", the nDTR output is forced to a logic "0". When bit 0 is a logic "0", the nDTR output is forced to a logic "1".</p> | R/W  | 0h      | RESET       |

## 14.11.10 LINE STATUS REGISTER

| Offset | 05h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7      | <p>FIFO_ERROR</p> <p>This bit is permanently set to logic "0" in the 450 mode. In the FIFO mode, this bit is set to a logic "1" when there is at least one parity error, framing error or break indication in the FIFO. This bit is cleared when the LSR is read if there are no subsequent errors in the FIFO.</p>   | R    | 0h      | RESET       |
| 6      | <p>TRANSMIT_ERROR</p> <p>Transmitter Empty. Bit 6 is set to a logic "1" whenever the Transmitter Holding Register (THR) and Transmitter Shift Register (TSR) are both empty. It is reset to logic "0" whenever either the THR or TSR contains a data character. Bit 6 is a read only bit. In the FIFO mode this bit is set whenever the THR and TSR are both empty,</p>   | R    | 0h      | RESET       |
| 5      | <p>TRANSMIT_EMPTY</p> <p>Transmitter Holding Register Empty Bit 5 indicates that the Serial Port is ready to accept a new character for transmission. In addition, this bit causes the Serial Port to issue an interrupt when the Transmitter Holding Register interrupt enable is set high. The THRE bit is set to a logic "1" when a character is transferred from the Transmitter Holding Register into the Transmitter Shift Register. The bit is reset to logic "0" whenever the CPU loads the Transmitter Holding Register. In the FIFO mode this bit is set when the XMIT FIFO is empty, it is cleared when at least 1 byte is written to the XMIT FIFO. Bit 5 is a read only bit.</p>   | R    | 0h      | RESET       |
| 4      | <p>BREAK_INTERRUPT</p> <p>Break Interrupt. Bit 4 is set to a logic "1" whenever the received data input is held in the Spacing state (logic "0") for longer than a full word transmission time (that is, the total time of the start bit + data bits + parity bits + stop bits). The BI is reset after the CPU reads the contents of the Line Status Register. In the FIFO mode this error is associated with the particular character in the FIFO it applies to. This error is indicated when the associated character is at the top of the FIFO. When break occurs only one zero character is loaded into the FIFO. Restarting after a break is received, requires the serial data (RXD) to be logic "1" for at least 1/2 bit time.</p> <p>Bits 1 through 4 are the error conditions that produce a Receiver Line Status Interrupt BIT 3 whenever any of the corresponding conditions are detected and the interrupt is enabled</p> | R    | 0h      | RESET       |

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| Offset | 05h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 3      | <b>FRAME_ERROR</b><br>Framing Error. Bit 3 indicates that the received character did not have a valid stop bit. Bit 3 is set to a logic "1" whenever the stop bit following the last data bit or parity bit is detected as a zero bit (Spacing level). This bit is reset to a logic "0" whenever the Line Status Register is read. In the FIFO mode this error is associated with the particular character in the FIFO it applies to. This error is indicated when the associated character is at the top of the FIFO. The Serial Port will try to resynchronize after a framing error. To do this, it assumes that the framing error was due to the next start bit, so it samples this 'start' bit twice and then takes in the 'data'. | R    | 0h      | RESET       |
| 2      | <b>PARITY ERROR</b><br>Parity Error. Bit 2 indicates that the received data character does not have the correct even or odd parity, as selected by the even parity select bit. This bit is set to a logic "1" upon detection of a parity error and is reset to a logic "0" whenever the Line Status Register is read. In the FIFO mode this error is associated with the particular character in the FIFO it applies to. This error is indicated when the associated character is at the top of the FIFO.   | R    | 0h      | RESET       |
| 1      | <b>OVERRUN_ERROR</b><br>Overrun Error. Bit 1 indicates that data in the Receiver Buffer Register was not read before the next character was transferred into the register, thereby destroying the previous character. In FIFO mode, an overrun error will occur only when the FIFO is full and the next character has been completely received in the shift register, the character in the shift register is overwritten but not transferred to the FIFO. This bit is set to a logic "1" immediately upon detection of an overrun condition, and reset whenever the Line Status Register is read.   | R    | 0h      | RESET       |
| 0      | <b>DATA_READY</b><br>Data Ready. It is set to a logic '1' whenever a complete incoming character has been received and transferred into the Receiver Buffer Register or the FIFO. Bit 0 is reset to a logic '0' by reading all of the data in the Receive Buffer Register or the FIFO.  | R    | 0h      | RESET       |

## 14.11.11 MODEM STATUS REGISTER

| Offset | 06h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7      | <b>DCD</b><br>This bit is the complement of the Data Carrier Detect (nDCD) input. If bit 4 of the MCR is set to logic '1', this bit is equivalent to OUT2 in the MCR. | R    | 0h      | RESET       |
| 6      | <b>RI#</b><br>This bit is the complement of the Ring Indicator (nRI) input. If bit 4 of the MCR is set to logic '1', this bit is equivalent to OUT1 in the MCR.       | R    | 0h      | RESET       |

| Offset | 06h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 5      | DSR<br>This bit is the complement of the Data Set Ready (nDSR) input. If bit 4 of the MCR is set to logic '1', this bit is equivalent to DTR in the MCR.  | R    | 0h      | RESET       |
| 4      | CTS<br>This bit is the complement of the Clear To Send (nCTS) input. If bit 4 of the MCR is set to logic '1', this bit is equivalent to nRTS in the MCR.  | R    | 0h      | RESET       |
| 3      | DCD<br>Delta Data Carrier Detect (DDCD). Bit 3 indicates that the nDCD input to the chip has changed state.<br>NOTE: Whenever bit 0, 1, 2, or 3 is set to a logic '1', a MODEM Status Interrupt is generated. | R    | 0h      | RESET       |
| 2      | RI<br>Trailing Edge of Ring Indicator (TERI). Bit 2 indicates that the nRI input has changed from logic '0' to logic '1'.   | R    | 0h      | RESET       |
| 1      | DSR<br>Delta Data Set Ready (DDSR). Bit 1 indicates that the nDSR input has changed state since the last time the MSR was read.   | R    | 0h      | RESET       |
| 0      | CTS<br>Delta Clear To Send (DCTS). Bit 0 indicates that the nCTS input to the chip has changed state since the last time the MSR was read.  | R    | 0h      | RESET       |

**Note:** The Modem Status Register (MSR) only provides the current state of the UART MODEM control lines in Loopback Mode. The MEC1322 does not support external connections for the MODEM Control inputs (nCTS, nDSR, nRI and nDCD) or for the four MODEM Control outputs (nDTR, nRTS, OUT1 and OUT2).

## 14.11.12 SCRATCHPAD REGISTER

| Offset | 07h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | SCRATCH<br>This 8 bit read/write register has no effect on the operation of the Serial Port. It is intended as a scratchpad register to be used by the programmer to hold data temporarily. | R/W  | 0h      | RESET       |

## 15.0 EC INTERRUPT AGGREGATOR

### 15.1 Introduction

The [EC Interrupt Aggregator](#) works in conjunction with the processor's interrupt interface to handle hardware interrupts and exceptions.

Exceptions are synchronous to instructions, are not maskable, and have higher priority than interrupts. All three exceptions - reset, memory error, and instruction error - are hardwired directly to the processor. Interrupts are typically asynchronous and are maskable.

Interrupts classified as wake events can be recognized without a running clock, e.g., while the MEC1322 is in sleep state.

This chapter focuses on the [EC Interrupt Aggregator](#). Please refer to embedded controller's documentation for more information on interrupt and exception handling.

### 15.2 References

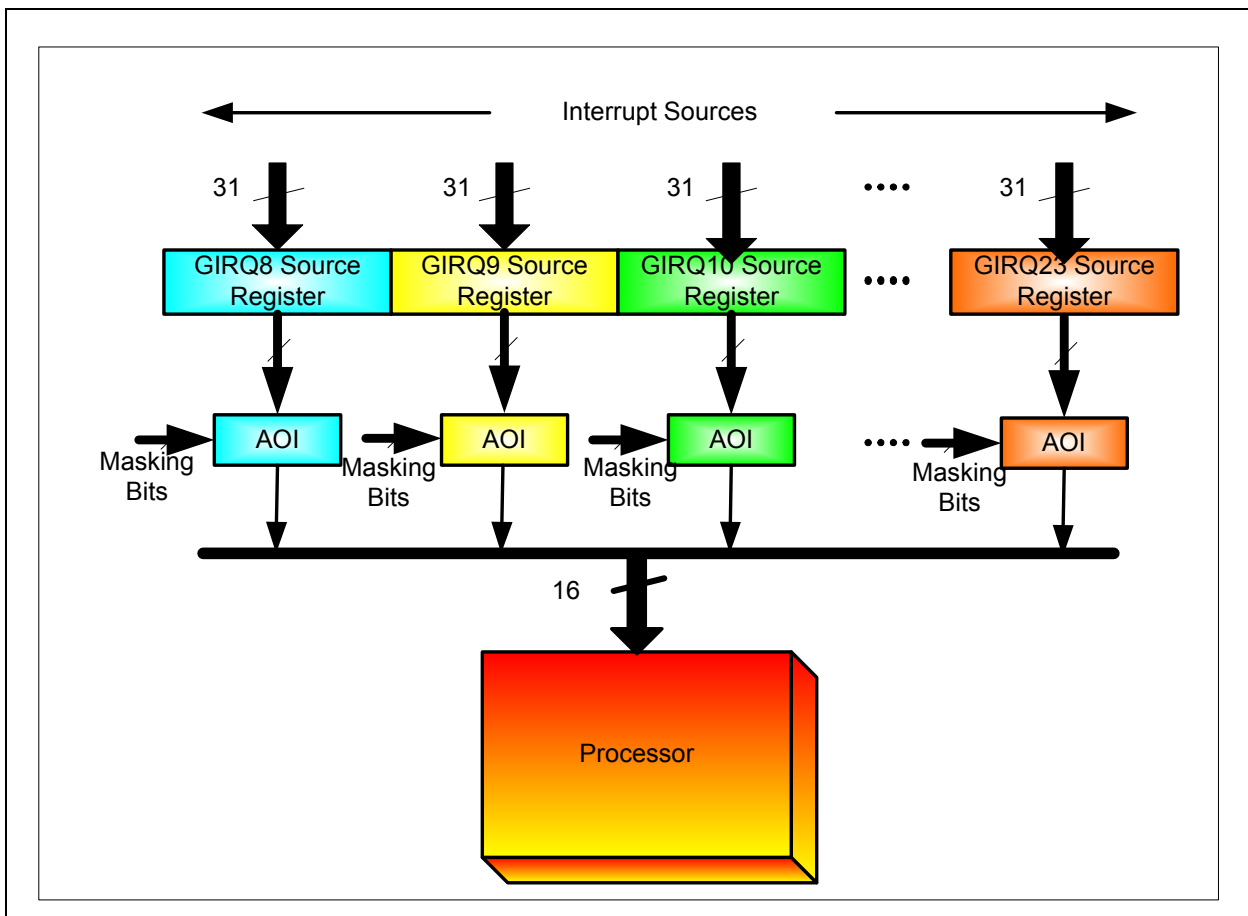
None

### 15.3 Terminology

None

### 15.4 Interface

FIGURE 15-1: BLOCK DIAGRAM OF [EC Interrupt Aggregator](#)





### 15.4.1 SIGNAL INTERFACE

This block is not accessible from the pin interface.

### 15.4.2 HOST INTERFACE

The registers defined for the [EC Interrupt Aggregator](#) are only accessible by the embedded controller via the [EC-Only Registers](#).

## 15.5 Power, Clocks and Reset

### 15.5.1 BLOCK POWER DOMAIN

**TABLE 15-1: BLOCK POWER**

| Power Well Source | Effect on Block  |
|-------------------|--|
| VCC1              | The EC Interrupt Aggregator block and registers operate on this single power well. |

### 15.5.2 BLOCK CLOCKS

None

### 15.5.3 BLOCK RESET

**TABLE 15-2: BLOCK RESETS**

| Reset Name | Reset Description  |
|------------|--|
| VCC1_RESET | This signal is used to indicate when the VCC1 logic and registers in this block are reset. |

## 15.6 Interrupts

This block aggregates all the interrupts targeted for the embedded controller into the Source Registers defined in [Section 15.9, "EC-Only Registers," on page 202](#). The unmasked bits of each source register are then OR'd together and routed to the embedded controller's interrupt interface. The name of each Source Register identifies the IRQ number of the interrupt port on the embedded controller.

## 15.7 Low Power Modes

This block always automatically adjusts to operate in the lowest power mode.

## 15.8 Description

The interrupt generation logic is made of 16 groups of signals, each of which consist of a Status register, a Enable register and a Result register.

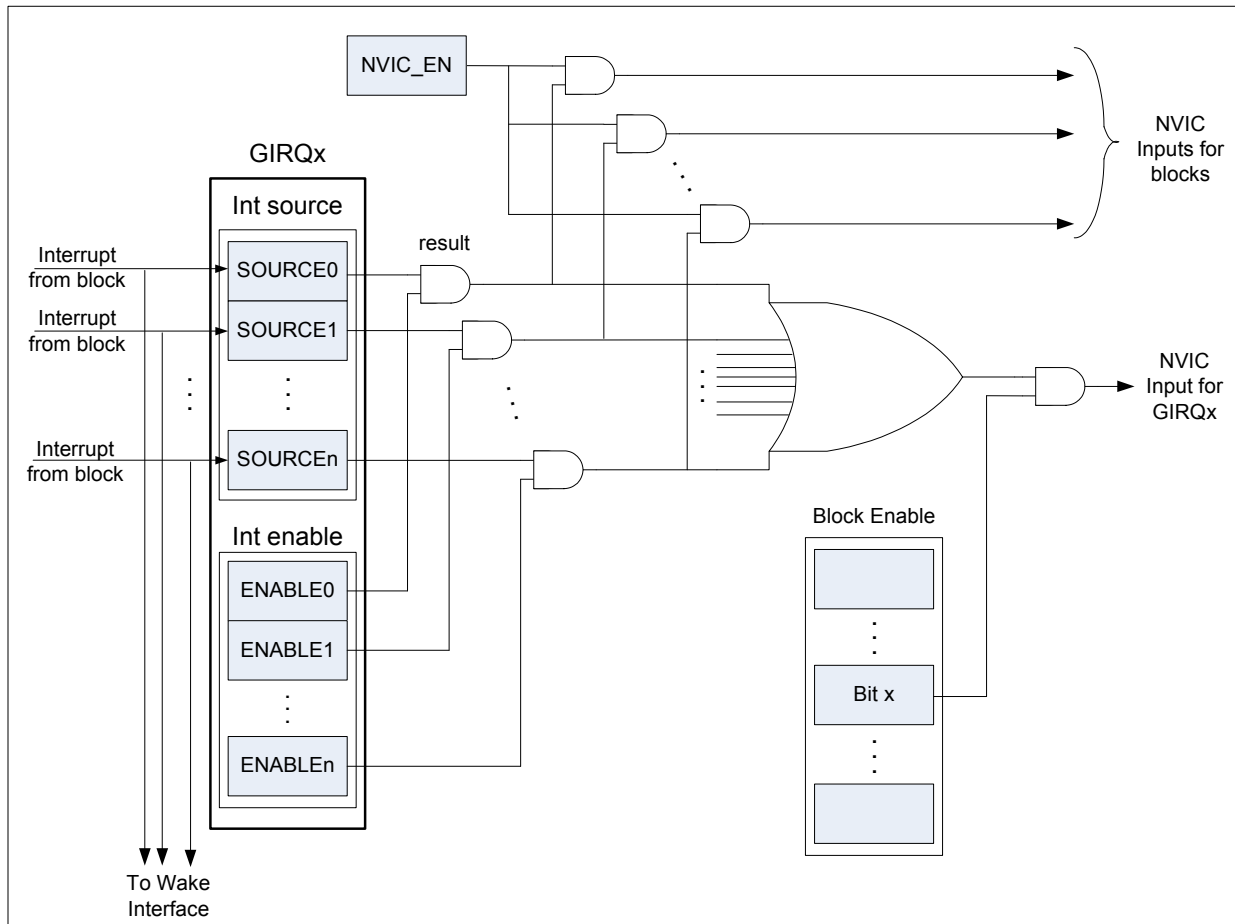
The Status and Enable are latched registers. The Result register is a bit by bit AND function of the Source and Enable registers. All the bits of the Result register are OR'ed together and AND'ed with the corresponding bit in the Block Select register to form the interrupt signal that is routed to the ARM interrupt controller.

The Result register bits may also be enabled to the NVIC block via the `NVIC_EN` bit in the [Interrupt Control](#) register. See [Chapter 35.0, "EC Subsystem Registers"](#)

[Section 15.8.1](#) shows a representation of the interrupt structure.

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**FIGURE 15-2: INTERRUPT STRUCTURE**



## 15.8.1 WAKE GENERATION

The EC Interrupt Aggregator notifies the Chip Power Management Features to wake the system when it detects a wake capable event has occurred. This logic requires no clocks.

The interrupt sources AND'ed with the corresponding Enable bit will be OR'ed to produce a wake event

The wake up sources are identified with a "Y" in the "WAKE" column of the Bit definitions table for each IRQ's Source Register.

### 15.8.1.1 Configuring Wake Interrupts

All GPIO inputs are wake-capable. In order for a GPIO input to wake the MEC1322 from a sleep state, the Interrupt Detection field of the GPIO Pin Control Register must be set to Rising Edge Triggered, Falling Edge Triggered, or Either Edge Triggered. If the Interrupt Detection field is set to any other value, a GPIO input will not trigger a wake interrupt.

Some of the Wake Capable Interrupts are triggered by activity on pins that are shared with a GPIO. These interrupts will only trigger a wake if the Interrupt Detection field of the corresponding GPIO Pin Control Register is set to Rising Edge Triggered, Falling Edge Triggered, or Either Edge Triggered.

**APPLICATION NOTE:** Neither LPC accesses nor JTAG debug accesses are wake capable. In order to enable LPC transactions to MEC1322 Logical Devices while the MEC1322 is in a Sleep mode in which the main oscillator is shut off, just before entering sleep EC firmware must enable an interrupt on the falling edge of the GPIO associated with the LFRAME# input. When responding to this LFRAME#/GPIO interrupt EC firmware should disable the LFRAME#/GPIO interrupt until firmware determines that it is again appropriate to enter a Deep Sleep mode. Similarly, EC

firmware must enable an interrupt on the falling edge of the GPIO associated with JTAG\_CLK if JTAG debug accesses are required while the MEC1322 is in a sleep mode in which the main clock is turned off.

## 15.8.2 INTERRUPT SUMMARY

Table 15-3, "Interrupt Event Aggregator Routing Summary" summarizes the interrupts, wake capabilities and NVIC vector locations.

Table 15-4, "EC Interrupt Structure" summarizes the interrupts, priorities and vector locations.

**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY**

| Interrupt | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |
|-----------|----------------|----------------|------------|-----------------|-----------------------|
| GPIO140   | GIRQ8          | 0              | Yes        | 57              | N/A                   |
| GPIO141   | GIRQ8          | 1              |            |                 |                       |
| GPIO142   | GIRQ8          | 2              |            |                 |                       |
| GPIO143   | GIRQ8          | 3              |            |                 |                       |
| GPIO144   | GIRQ8          | 4              |            |                 |                       |
| GPIO145   | GIRQ8          | 5              |            |                 |                       |
| GPIO146   | GIRQ8          | 6              |            |                 |                       |
| GPIO147   | GIRQ8          | 7              |            |                 |                       |
| GPIO150   | GIRQ8          | 8              |            |                 |                       |
| GPIO151   | GIRQ8          | 9              |            |                 |                       |
| GPIO152   | GIRQ8          | 10             |            |                 |                       |
| GPIO153   | GIRQ8          | 11             |            |                 |                       |
| GPIO154   | GIRQ8          | 12             |            |                 |                       |
| GPIO155   | GIRQ8          | 13             |            |                 |                       |
| GPIO156   | GIRQ8          | 14             |            |                 |                       |
| GPIO157   | GIRQ8          | 15             |            |                 |                       |
| GPIO160   | GIRQ8          | 16             |            |                 |                       |
| GPIO161   | GIRQ8          | 17             |            |                 |                       |
| GPIO162   | GIRQ8          | 18             |            |                 |                       |
| GPIO163   | GIRQ8          | 19             |            |                 |                       |
| GPIO164   | GIRQ8          | 20             |            |                 |                       |
| GPIO165   | GIRQ8          | 21             |            |                 |                       |

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**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY (CONTINUED)**

| Interrupt | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |
|-----------|----------------|----------------|------------|-----------------|-----------------------|
| GPIO100   | GIRQ9          | 0              | Yes        | 58              | N/A                   |
| GPIO101   | GIRQ9          | 1              |            |                 |                       |
| GPIO102   | GIRQ9          | 2              |            |                 |                       |
| GPIO103   | GIRQ9          | 3              |            |                 |                       |
| GPIO104   | GIRQ9          | 4              |            |                 |                       |
| GPIO105   | GIRQ9          | 5              |            |                 |                       |
| GPIO106   | GIRQ9          | 6              |            |                 |                       |
| GPIO107   | GIRQ9          | 7              |            |                 |                       |
| GPIO110   | GIRQ9          | 8              |            |                 |                       |
| GPIO111   | GIRQ9          | 9              |            |                 |                       |
| GPIO112   | GIRQ9          | 10             |            |                 |                       |
| GPIO113   | GIRQ9          | 11             |            |                 |                       |
| GPIO114   | GIRQ9          | 12             |            |                 |                       |
| GPIO115   | GIRQ9          | 13             |            |                 |                       |
| GPIO116   | GIRQ9          | 14             |            |                 |                       |
| GPIO117   | GIRQ9          | 15             |            |                 |                       |
| GPIO120   | GIRQ9          | 16             |            |                 |                       |
| GPIO121   | GIRQ9          | 17             |            |                 |                       |
| GPIO122   | GIRQ9          | 18             |            |                 |                       |
| GPIO123   | GIRQ9          | 19             |            |                 |                       |
| GPIO124   | GIRQ9          | 20             |            |                 |                       |
| GPIO125   | GIRQ9          | 21             |            |                 |                       |
| GPIO126   | GIRQ9          | 22             |            |                 |                       |
| GPIO127   | GIRQ9          | 23             |            |                 |                       |
| GPIO130   | GIRQ9          | 24             |            |                 |                       |
| GPIO131   | GIRQ9          | 25             |            |                 |                       |
| GPIO132   | GIRQ9          | 26             |            |                 |                       |
| GPIO133   | GIRQ9          | 27             |            |                 |                       |
| GPIO134   | GIRQ9          | 28             |            |                 |                       |
| GPIO135   | GIRQ9          | 29             |            |                 |                       |
| GPIO136   | GIRQ9          | 30             |            |                 |                       |

**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY (CONTINUED)**

| Interrupt | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |
|-----------|----------------|----------------|------------|-----------------|-----------------------|
| GPIO040   | GIRQ10         | 0              | Yes        | 59              | N/A                   |
| GPIO041   | GIRQ10         | 1              |            |                 |                       |
| GPIO042   | GIRQ10         | 2              |            |                 |                       |
| GPIO043   | GIRQ10         | 3              |            |                 |                       |
| GPIO044   | GIRQ10         | 4              |            |                 |                       |
| GPIO045   | GIRQ10         | 5              |            |                 |                       |
| GPIO046   | GIRQ10         | 6              |            |                 |                       |
| GPIO047   | GIRQ10         | 7              |            |                 |                       |
| GPIO050   | GIRQ10         | 8              |            |                 |                       |
| GPIO051   | GIRQ10         | 9              |            |                 |                       |
| GPIO052   | GIRQ10         | 10             |            |                 |                       |
| GPIO053   | GIRQ10         | 11             |            |                 |                       |
| GPIO054   | GIRQ10         | 12             |            |                 |                       |
| GPIO055   | GIRQ10         | 13             |            |                 |                       |
| GPIO056   | GIRQ10         | 14             |            |                 |                       |
| GPIO057   | GIRQ10         | 15             |            |                 |                       |
| GPIO060   | GIRQ10         | 16             |            |                 |                       |
| GPIO061   | GIRQ10         | 17             |            |                 |                       |
| GPIO062   | GIRQ10         | 18             |            |                 |                       |
| GPIO063   | GIRQ10         | 19             |            |                 |                       |
| GPIO064   | GIRQ10         | 20             |            |                 |                       |
| GPIO065   | GIRQ10         | 21             |            |                 |                       |
| GPIO066   | GIRQ10         | 22             |            |                 |                       |
| GPIO067   | GIRQ10         | 23             |            |                 |                       |

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**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY (CONTINUED)**

| Interrupt   | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |    |
|-------------|----------------|----------------|------------|-----------------|-----------------------|----|
| GPIO000     | GIRQ11         | 0              | Yes        | 60              | N/A                   |    |
| GPIO001     | GIRQ11         | 1              |            |                 |                       |    |
| GPIO002     | GIRQ11         | 2              |            |                 |                       |    |
| GPIO003     | GIRQ11         | 3              |            |                 |                       |    |
| GPIO004     | GIRQ11         | 4              |            |                 |                       |    |
| GPIO005     | GIRQ11         | 5              |            |                 |                       |    |
| GPIO006     | GIRQ11         | 6              |            |                 |                       |    |
| GPIO007     | GIRQ11         | 7              |            |                 |                       |    |
| GPIO010     | GIRQ11         | 8              |            |                 |                       |    |
| GPIO011     | GIRQ11         | 9              |            |                 |                       |    |
| GPIO012     | GIRQ11         | 10             |            |                 |                       |    |
| GPIO013     | GIRQ11         | 11             |            |                 |                       |    |
| GPIO014     | GIRQ11         | 12             |            |                 |                       |    |
| GPIO015     | GIRQ11         | 13             |            |                 |                       |    |
| GPIO016     | GIRQ11         | 14             |            |                 |                       |    |
| GPIO017     | GIRQ11         | 15             |            |                 |                       |    |
| GPIO020     | GIRQ11         | 16             |            |                 |                       |    |
| GPIO021     | GIRQ11         | 17             |            |                 |                       |    |
| GPIO022     | GIRQ11         | 18             |            |                 |                       |    |
| GPIO023     | GIRQ11         | 19             |            |                 |                       |    |
| GPIO024     | GIRQ11         | 20             |            |                 |                       |    |
| GPIO025     | GIRQ11         | 21             |            |                 |                       |    |
| GPIO026     | GIRQ11         | 22             |            |                 |                       |    |
| GPIO027     | GIRQ11         | 23             |            |                 |                       |    |
| GPIO030     | GIRQ11         | 24             |            |                 |                       |    |
| GPIO031     | GIRQ11         | 25             |            |                 |                       |    |
| GPIO032     | GIRQ11         | 26             |            |                 |                       |    |
| GPIO033     | GIRQ11         | 27             |            |                 |                       |    |
| GPIO034     | GIRQ11         | 28             |            |                 |                       |    |
| GPIO035     | GIRQ11         | 29             |            |                 |                       |    |
| GPIO036     | GIRQ11         | 30             |            |                 |                       |    |
| I2C0 / SMB0 | GIRQ12         | 0              |            |                 |                       | No |
| I2C1 / SMB1 | GIRQ12         | 1              | 1          |                 |                       |    |
| I2C2 / SMB2 | GIRQ12         | 2              | 2          |                 |                       |    |
| I2C3 / SMB3 | GIRQ12         | 3              | 3          |                 |                       |    |
| I2C0_0_WK   | GIRQ12         | 4              | Yes        | 61              | N/A                   |    |
| I2C0_1_WK   | GIRQ12         | 5              |            |                 |                       |    |
| I2C2_0_WK   | GIRQ12         | 6              |            |                 |                       |    |
| I2C1_0_WK   | GIRQ12         | 7              |            |                 |                       |    |
| I2C3_0_WK   | GIRQ12         | 8              |            |                 |                       |    |

**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY (CONTINUED)**

| Interrupt     | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |
|---------------|----------------|----------------|------------|-----------------|-----------------------|
| DMA0          | GIRQ13         | 16             | No         | 62              | 4                     |
| DMA1          | GIRQ13         | 17             |            |                 | 5                     |
| DMA2          | GIRQ13         | 18             |            |                 | 6                     |
| DMA3          | GIRQ13         | 19             |            |                 | 7                     |
| DMA4          | GIRQ13         | 20             |            |                 | 8                     |
| DMA5          | GIRQ13         | 21             |            |                 | 9                     |
| DMA6          | GIRQ13         | 22             |            |                 | 10                    |
| DMA7          | GIRQ13         | 23             |            |                 | 11                    |
| DMA8          | GIRQ13         | 24             |            |                 | 81                    |
| DMA9          | GIRQ13         | 25             |            |                 | 82                    |
| DMA10         | GIRQ13         | 26             |            |                 | 83                    |
| DMA11         | GIRQ13         | 27             |            |                 | 84                    |
| LPC           | GIRQ14         | 2              | No         | 63              | 12                    |
| UART_0        | GIRQ15         | 0              | No         | 64              | 13                    |
| Reserved      | GIRQ15         | 1              |            |                 | N/A                   |
| EMI_0 (IMAP)  | GIRQ15         | 2              |            |                 | 14                    |
| Reserved      | GIRQ15         | 3              |            |                 | N/A                   |
| Reserved      | GIRQ15         | 4              |            |                 | N/A                   |
| Reserved      | GIRQ15         | 5              |            |                 | N/A                   |
| ACPIEC[0] IBF | GIRQ15         | 6              |            |                 | 15                    |
| ACPIEC[0] OBF | GIRQ15         | 7              |            |                 | 16                    |
| ACPIEC[1] IBF | GIRQ15         | 8              |            |                 | 17                    |
| ACPIEC[1] OBF | GIRQ15         | 9              |            |                 | 18                    |
| ACPIPM1 CTL   | GIRQ15         | 10             |            |                 | 19                    |
| ACPIPM1 EN    | GIRQ15         | 11             |            |                 | 20                    |
| ACPIPM1 STS   | GIRQ15         | 12             |            |                 | 21                    |
| 8042EM OBF    | GIRQ15         | 13             |            |                 | 22                    |
| 8042EM IBF    | GIRQ15         | 14             |            |                 | 23                    |
| MAILBOX       | GIRQ15         | 15             |            |                 | 24                    |
| MAILBOX DATA  | GIRQ15         | 16             |            |                 | 40                    |
| PECIHOST      | GIRQ16         | 3              |            |                 | No                    |

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**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY (CONTINUED)**

| Interrupt     | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |     |
|---------------|----------------|----------------|------------|-----------------|-----------------------|-----|
| TACH_0        | GIRQ17         | 0              | No         | 66              | 26                    |     |
| TACH_1        | GIRQ17         | 1              | No         |                 | 27                    |     |
| PS2_0_WK      | GIRQ17         | 2              | Yes        |                 | N/A                   |     |
| PS2_1_WK      | GIRQ17         | 3              | Yes        |                 |                       |     |
| PS2_2_WK      | GIRQ17         | 4              | Yes        |                 |                       |     |
| PS2_3_WK      | GIRQ17         | 5              | Yes        |                 |                       |     |
| BC_INT_N_WK   | GIRQ17         | 6              | Yes        |                 | 28                    |     |
| ADC_SNGL      | GIRQ17         | 10             | No         |                 |                       | 29  |
| ADC_RPT       | GIRQ17         | 11             | No         |                 |                       | 30  |
| MCHP Reserved | GIRQ17         | 12             | No         |                 |                       | 31  |
| MCHP Reserved | GIRQ17         | 13             | No         |                 |                       | 32  |
| PS2_0         | GIRQ17         | 14             | No         |                 |                       | 33  |
| PS2_1         | GIRQ17         | 15             | No         |                 |                       | 34  |
| PS2_2         | GIRQ17         | 16             | No         |                 |                       | 35  |
| PS2_3         | GIRQ17         | 17             | No         |                 |                       | 91  |
| RTC           | GIRQ17         | 18             | Yes        |                 |                       | 92  |
| RTC ALARM     | GIRQ17         | 19             | Yes        |                 |                       | 38  |
| HTIMER        | GIRQ17         | 20             | Yes        |                 |                       | 39  |
| KSC_INT       | GIRQ17         | 21             | No         |                 |                       | N/A |
| KSC_INT wake  | GIRQ17         | 22             | Yes        |                 |                       | 41  |
| RPM_INT Stall | GIRQ17         | 23             | No         | 42              |                       |     |
| RPM_INT Spin  | GIRQ17         | 24             | No         | 43              |                       |     |
| PFR_STS       | GIRQ17         | 25             | No         | 44              |                       |     |
| PWM_WDT0      | GIRQ17         | 26             | No         | 45              |                       |     |
| PWM_WDT1      | GIRQ17         | 27             | No         | 46              |                       |     |
| PWM_WDT2      | GIRQ17         | 28             | No         | 47              |                       |     |
| BCM_INT Err   | GIRQ17         | 29             | No         | 48              |                       |     |
| BCM_INT Busy  | GIRQ17         | 30             | No         | 67              | 36                    |     |
| SPI0 TX       | GIRQ18         | 0              | No         |                 | 37                    |     |
| SPI0 RX       | GIRQ18         | 1              |            |                 | 55                    |     |
| SPI1 TX       | GIRQ18         | 2              |            |                 | 56                    |     |
| SPI1 RX       | GIRQ18         | 3              |            |                 | 85                    |     |
| PWM_WDT3      | GIRQ18         | 4              |            |                 | 86                    |     |
| MCHP Reserved | GIRQ18         | 5              |            |                 | 87                    |     |
| MCHP Reserved | GIRQ18         | 6              |            |                 | 88                    |     |
| MCHP Reserved | GIRQ18         | 7              |            |                 | 89                    |     |
| MCHP Reserved | GIRQ18         | 8              |            |                 | 90                    |     |
| MCHP Reserved | GIRQ18         | 9              |            | 68              | N/A                   |     |
| VCC_PWRGD     | GIRQ19         | 0              | Yes        |                 |                       |     |
| LRESET#       | GIRQ19         | 1              | Yes        | 69              | N/A                   |     |
| GPIO200       | GIRQ20         | 0              |            |                 |                       |     |
| GPIO201       | GIRQ20         | 1              |            |                 |                       |     |
| GPIO202       | GIRQ20         | 2              |            |                 |                       |     |
| GPIO203       | GIRQ20         | 3              |            |                 |                       |     |



**TABLE 15-3: INTERRUPT EVENT AGGREGATOR ROUTING SUMMARY (CONTINUED)**

| Interrupt  | Aggregator IRQ | Aggregator Bit | Wake Event | Aggregated NVIC | Direct NVIC Interrupt |    |    |    |
|------------|----------------|----------------|------------|-----------------|-----------------------|----|----|----|
| GPIO204    | GIRQ20         | 4              |            |                 |                       |    |    |    |
| N/A        | GIRQ20         | 5              |            |                 |                       |    |    |    |
| GPIO206    | GIRQ20         | 6              |            |                 |                       |    |    |    |
| N/A        | GIRQ20         | 7              |            |                 |                       |    |    |    |
| GPIO210    | GIRQ20         | 8              |            |                 |                       |    |    |    |
| GPIO211    | GIRQ20         | 9              |            |                 |                       |    |    |    |
| TIMER_16_0 | GIRQ23         | 0              |            |                 |                       | No | 72 | 49 |
| TIMER_16_1 | GIRQ23         | 1              |            |                 |                       |    |    | 50 |
| TIMER_16_2 | GIRQ23         | 2              |            |                 |                       |    |    | 51 |
| TIMER_16_3 | GIRQ23         | 3              |            |                 | 52                    |    |    |    |
| TIMER_32_0 | GIRQ23         | 4              |            |                 | 53                    |    |    |    |
| TIMER_32_1 | GIRQ23         | 5              |            |                 | 54                    |    |    |    |

**TABLE 15-4: EC INTERRUPT STRUCTURE**

| Vector | Name              | Link Register | Priority (Default) | Relative Priority | Byte Offset |
|--------|-------------------|---------------|--------------------|-------------------|-------------|
| 0      | Reset             | -             | High               | H1                | 00h         |
| 1      | Memory Error      | ILINK2        | High               | H2                | 08h         |
| 2      | Instruction Error | ILINK2        | High               | H3                | 10h         |
| 3      | IRQ3-Reserved     | ILINK1        | level 1 (low)      | L27               | 18h         |
| 4      | IRQ4-Reserved     | ILINK1        | level 1 (low)      | L26               | 20h         |
| 5      | IRQ5-Reserved     | ILINK1        | level 1 (low)      | L25               | 28h         |
| 6      | IRQ6-Reserved     | ILINK2        | level 2 (mid)      | M2                | 30h         |
| 7      | IRQ7-Reserved     | ILINK2        | level 2 (mid)      | M1                | 38h         |
| 8      | IRQ8              | ILINK1        | level 1 (low)      | L24               | 40h         |
| 9      | IRQ9              | ILINK1        | level 1 (low)      | L23               | 48h         |
| 10     | IRQ10             | ILINK1        | level 1 (low)      | L22               | 50h         |
| 11     | IRQ11             | ILINK1        | level 1 (low)      | L21               | 58h         |
| 12     | IRQ12             | ILINK1        | level 1 (low)      | L20               | 60h         |
| 13     | IRQ13             | ILINK1        | level 1 (low)      | L19               | 68h         |
| 14     | IRQ14             | ILINK1        | level 1 (low)      | L18               | 70h         |
| 15     | IRQ15             | ILINK1        | level 1 (low)      | L17               | 78h         |
| 16     | IRQ16             | ILINK1        | level 1 (low)      | L16               | 80h         |
| 17     | IRQ17             | ILINK1        | level 1 (low)      | L15               | 88h         |
| 18     | IRQ18             | ILINK1        | level 1 (low)      | L14               | 90h         |
| 19     | IRQ19             | ILINK1        | level 1 (low)      | L13               | 98h         |
| 20     | IRQ20             | ILINK1        | level 1 (low)      | L12               | A0h         |
| 21     | IRQ21             | ILINK1        | level 1 (low)      | L11               | A8h         |
| 22     | IRQ22             | ILINK1        | level 1 (low)      | L10               | B0h         |
| 23     | IRQ23             | ILINK1        | level 1 (low)      | L9                | B8h         |
| 24     | IRQ24             | ILINK1        | level 1 (low)      | L8                | C0h         |
| 25     | IRQ25             | ILINK1        | level 1 (low)      | L7                | C8h         |
| 26     | IRQ26             | ILINK1        | level 1 (low)      | L6                | D0h         |

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**TABLE 15-4: EC INTERRUPT STRUCTURE (CONTINUED)**

| Vector | Name  | Link Register | Priority (Default) | Relative Priority | Byte Offset |
|--------|-------|---------------|--------------------|-------------------|-------------|
| 27     | IRQ27 | ILINK1        | level 1 (low)      | L5                | D8h         |
| 28     | IRQ28 | ILINK1        | level 1 (low)      | L4                | E0h         |
| 29     | IRQ29 | ILINK1        | level 1 (low)      | L3                | E8h         |
| 30     | IRQ30 | ILINK1        | level 1 (low)      | L2                | F0h         |
| 31     | IRQ31 | ILINK1        | level 1 (low)      | L1                | F8h         |

**Note:** IRQ Vector 31 is the highest L1 Priority

## 15.8.3 DISABLING INTERRUPTS

The [Block Enable Clear Register](#) and [Block Enable Set Register](#) should not be used for disabling and enabling interrupts for software operations i.e., critical sections. The ARM enable/disable mechanisms should be used.

## 15.9 EC-Only Registers

The configuration registers listed in EC-Only Register Summary table are for a single instance of the EC Interrupt Aggregator. The addresses of each register listed in the summary table are defined as a relative offset to the host "Begin Address" defined in the EC-Only Register Base Address Table.

**TABLE 15-5: EC-ONLY REGISTER ADDRESS RANGE TABLE**

| Instance Name        | Instance Number | Host | Address Space                 | Begin Address (Note 15-1) |
|----------------------|-----------------|------|-------------------------------|---------------------------|
| Interrupt Aggregator | 0               | EC   | 32-bit internal address space | 4000_C000h                |

**Note 15-1** The Begin Address indicates the location of the first register accessible at offset 00h in the Interrupt Aggregator EC-Only address space.

**TABLE 15-6: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name                                |
|--------|--|
| 00h    | <a href="#">GIRQ8</a> Source Register        |
| 04h    | <a href="#">GIRQ8</a> Enable Set Register    |
| 08h    | <a href="#">GIRQ8</a> Result Register        |
| 0Ch    | <a href="#">GIRQ8</a> Enable Clear Register  |
| 14h    | <a href="#">GIRQ9</a> Source Register        |
| 18h    | <a href="#">GIRQ9</a> Enable Set Register    |
| 1Ch    | <a href="#">GIRQ9</a> Result Register        |
| 20h    | <a href="#">GIRQ9</a> Enable Clear Register  |
| 28h    | <a href="#">GIRQ10</a> Source Register       |
| 2Ch    | <a href="#">GIRQ10</a> Enable Set Register   |
| 30h    | <a href="#">GIRQ10</a> Result Register       |
| 34h    | <a href="#">GIRQ10</a> Enable Clear Register |
| 3Ch    | <a href="#">GIRQ11</a> Source Register       |
| 40h    | <a href="#">GIRQ11</a> Enable Set Register   |
| 44h    | <a href="#">GIRQ11</a> Result Register       |
| 48h    | <a href="#">GIRQ11</a> Enable Clear Register |

TABLE 15-6: EC-ONLY REGISTER SUMMARY (CONTINUED)

| Offset | Register Name                |
|--------|------------------------------|
| 50h    | GIRQ12 Source Register       |
| 54h    | GIRQ12 Enable Set Register   |
| 58h    | GIRQ12 Result Register       |
| 5Ch    | GIRQ12 Enable Clear Register |
| 64h    | GIRQ13 Source Register       |
| 68h    | GIRQ13 Enable Set Register   |
| 6Ch    | GIRQ13 Result Register       |
| 70h    | GIRQ13 Enable Clear Register |
| 78h    | GIRQ14 Source Register       |
| 7Ch    | GIRQ14 Enable Set Register   |
| 80h    | GIRQ14 Result Register       |
| 84h    | GIRQ14 Enable Clear Register |
| 8Ch    | GIRQ15 Source Register       |
| 90h    | GIRQ15 Enable Set Register   |
| 94h    | GIRQ15 Result Register       |
| 98h    | GIRQ15 Enable Clear Register |
| A0h    | GIRQ16 Source Register       |
| A4h    | GIRQ16 Enable Set Register   |
| A8h    | GIRQ16 Result Register       |
| ACh    | GIRQ16 Enable Clear Register |
| B4h    | GIRQ17 Source Register       |
| B8h    | GIRQ17 Enable Set Register   |
| BCh    | GIRQ17 Result Register       |
| C0h    | GIRQ17 Enable Clear Register |
| C8h    | GIRQ18 Source Register       |
| CCh    | GIRQ18 Enable Set Register   |
| D0h    | GIRQ18 Result Register       |
| D4h    | GIRQ18 Enable Clear Register |
| DCh    | GIRQ19 Source Register       |
| E0h    | GIRQ19 Enable Set Register   |
| E4h    | GIRQ19 Result Register       |
| E8h    | GIRQ19 Enable Clear Register |
| F0h    | GIRQ20 Source Register       |
| F4h    | GIRQ20 Enable Set Register   |
| F8h    | GIRQ20 Result Register       |
| FCh    | GIRQ20 Enable Clear Register |
| 104h   | GIRQ21 Source Register       |
| 108h   | GIRQ21 Enable Set Register   |
| 10Ch   | GIRQ21 Result Register       |
| 110h   | GIRQ21 Enable Clear Register |
| 118h   | GIRQ22 Source Register       |
| 11Ch   | GIRQ22 Enable Set Register   |
| 120h   | GIRQ22 Result Register       |
| 124h   | GIRQ22 Enable Clear Register |

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**TABLE 15-6: EC-ONLY REGISTER SUMMARY (CONTINUED)**

| Offset | Register Name                                |
|--------|--|
| 12Ch   | <a href="#">GIRQ23 Source Register</a>       |
| 130h   | <a href="#">GIRQ23 Enable Set Register</a>   |
| 134h   | <a href="#">GIRQ23 Result Register</a>       |
| 138h   | <a href="#">GIRQ23 Enable Clear Register</a> |
| 200h   | <a href="#">Block Enable Set Register</a>    |
| 204h   | <a href="#">Block Enable Clear Register</a>  |
| 208h   | <a href="#">Block IRQ Vector Register</a>    |

All of the GIRQx Source, Enable, and Result registers have the same format. The following tables define the generic format for each of these registers. The bit definitions are defined in the sections that follow.

**Note:** The behavior of the enable bit controlled by the GIRQx Enable Set and GIRQx Enable Clear Registers, the GIRQx Source bit, and the GIRQx Result bit are illustrated in [Section 15.8.1, "WAKE Generation,"](#) on [page 194](#).

**TABLE 15-7: GIRQX SOURCE REGISTER**

| Offset   | -                    |  |     |       | 32-bit                                  |    | Size                                  |  |
|----------|----------------------|--|-----|-------|---|----|---------------------------------------|--|
| Power    | <a href="#">VCC1</a> |  |     |       | 0000_0000h                              |    | <a href="#">VCC1_RESET</a><br>Default |  |
| Bit      | D31                  | D30  | D29 | • • • | D2                                      | D1 | D0                                    |  |
| Type     | R                    | R/WC except for reserved bits, which are R |     |       |   |    |                                       |  |
| Bit Name | Reserved             |  |     |       | See Tables in the following subsections |    |                                       |  |

The R/WC bits are sticky status bits indicating the state of interrupt source before the interrupt enable bit.

**TABLE 15-8: GIRQX ENABLE SET REGISTER**

| Offset   | -                    |  |     |       | 32-bit                                  |    | Size                                  |  |
|----------|----------------------|--|-----|-------|---|----|---------------------------------------|--|
| POWER    | <a href="#">VCC1</a> |  |     |       | 0000_0000h                              |    | <a href="#">VCC1_RESET</a><br>Default |  |
| BIT      | D31                  | D30  | D29 | • • • | D2                                      | D1 | D0                                    |  |
| TYPE     | R                    | R/WS except for reserved bits, which are R |     |       |   |    |                                       |  |
| BIT NAME | Reserved             |  |     |       | See Tables in the following subsections |    |                                       |  |

GIRQ Enable Set [31:0]

Each GIRQx bit can be individually enabled to assert an interrupt event.

0= Writing a zero has no effect.

1= Writing a one will enable respective GIRQx.

Reading always returns the current value of the GIRQx ENABLE bit. The state of the GIRQx ENABLE bit is determined by the corresponding GIRQx Enable Set bit and the GIRQx Enable Clear bit. (0=disabled, 1=enabled)

**TABLE 15-9: GIRQX RESULT REGISTER**

|                 |            |   |            |     |            |           |                       |  |
|-----------------|------------|---|------------|-----|------------|-----------|-----------------------|--|
| <b>Offset</b>   | -          |   |            |     | 32-bit     |           | <b>EC Size</b>        |  |
| <b>POWER</b>    | VCC1       |   |            |     | 8000_0000h |           | VCC1_RESET<br>Default |  |
| <b>BIT</b>      | <b>D31</b> | <b>D30</b>                              | <b>D29</b> | ••• | <b>D2</b>  | <b>D1</b> | <b>D0</b>             |  |
| <b>TYPE</b>     | R          | R                                       |            |     |            |           |                       |  |
| <b>BIT NAME</b> | '1'        | See Tables in the following subsections |            |     |            |           |                       |  |

GIRQx Interrupt Result

Bits D30 down to D0 are defined in the following subsections reflect the state of the GIRQx interrupt source after the enable bit. The GIRQx result bits are OR'd together to generate the IRQx vector.

Bit D31

Bit D31 is hard-coded to '1'.

**TABLE 15-10: GIRQX ENABLE CLEAR REGISTER**

|                 |            |  |            |     |            |           |                       |  |
|-----------------|------------|--|------------|-----|------------|-----------|-----------------------|--|
| <b>Offset</b>   | -          |  |            |     | 32-bit     |           | <b>Size</b>           |  |
| <b>POWER</b>    | VCC1       |  |            |     | 0000_0000h |           | VCC1_RESET<br>Default |  |
| <b>BIT</b>      | <b>D31</b> | <b>D30</b>                                 | <b>D29</b> | ••• | <b>D2</b>  | <b>D1</b> | <b>D0</b>             |  |
| <b>TYPE</b>     | R          | R/WC except for reserved bits, which are R |            |     |            |           |                       |  |
| <b>BIT NAME</b> | Reserved   | See Tables in the following subsections    |            |     |            |           |                       |  |

GIRQx Enable Clear[31:0]

Each GIRQx bit can be individually disabled to assert an interrupt event.

0= Writing a zero has no effect.

1= Writing a one will disable respective GIRQx.

Reading always returns the current value of the GIRQx ENABLE bit. The state of the GIRQx ENABLE bit is determined by the corresponding GIRQx Enable Set bit and the GIRQx Enable Clear bit. (0=disabled, 1-enabled)

## 15.9.1 GIRQ8

**TABLE 15-11: BIT DEFINITIONS FOR GIRQ8 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit   | Block Instance Name | Source Name | Wake | Source Description  |
|-------|---------------------|-------------|------|---|
| [7:0] | GPIO[147:140]       | GPIO_Event  | Y    | <p>Bits[0:7] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO140 through GPIO147, respectively.</p> <p>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function.</p> |

**TABLE 15-11: BIT DEFINITIONS FOR GIRQ8 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name | Wake | Source Description  |
|---------|---------------------|-------------|------|---|
| [15:8]  | GPIO[157:150]       | GPIO_Event  | Y    | <p>Bits[8:15] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO150 through GPIO157, respectively.</p> <p>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (<a href="#">int_det</a>) bits in the Pin Control Register associated with the GPIO signal function.</p>  |
| [21:16] | GPIO[165:160]       | GPIO_Event  | Y    | <p>Bits[16:21] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO160 through GPIO165, respectively.</p> <p>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (<a href="#">int_det</a>) bits in the Pin Control Register associated with the GPIO signal function.</p> |
| [30:22] | Reserved            | Reserved    | N    | Reserved  |
| 31      | n/a                 | n/a         | N    | See <a href="#">Table 15-7</a> , " <a href="#">GIRQx Source Register</a> ", <a href="#">Table 15-8</a> , " <a href="#">GIRQx Enable Set Register</a> ", <a href="#">Table 15-10</a> , " <a href="#">GIRQx Enable Clear Register</a> ", and <a href="#">Table 15-9</a> , " <a href="#">GIRQx Result Register</a> " for a definition of this bit for the Source, Enable, and Result registers.      |

## 15.9.2 GIRQ9

**TABLE 15-12: BIT DEFINITIONS FOR GIRQ9 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name | Wake | Source Description  |
|---------|---------------------|-------------|------|---|
| [7:0]   | GPIO[107:100]       | GPIO_Event  | Y    | <p>Bits[0:7] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO100 through GPIO107, respectively.</p> <p>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (<a href="#">int_det</a>) bits in the Pin Control Register associated with the GPIO signal function.</p>   |
| [15:8]  | GPIO[117:110]       | GPIO_Event  | Y    | <p>Bits[8:15] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO110 through GPIO117, respectively.</p> <p>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (<a href="#">int_det</a>) bits in the Pin Control Register associated with the GPIO signal function.</p>  |
| [23:16] | GPIO[127:120]       | GPIO_Event  | Y    | <p>Bits[16:23] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO120 through GPIO127, respectively.</p> <p>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (<a href="#">int_det</a>) bits in the Pin Control Register associated with the GPIO signal function.</p> |

**TABLE 15-12: BIT DEFINITIONS FOR GIRQ9 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name | Wake | Source Description   |
|---------|---------------------|-------------|------|--|
| [30:24] | GPIO[136:130]       | GPIO_Event  | Y    | Bits[24:30] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO130 through GPIO136, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function. |
| 31      | n/a                 | n/a         | N    | See <a href="#">Table 15-7</a> , "GIRQx Source Register", <a href="#">Table 15-8</a> , "GIRQx Enable Set Register", <a href="#">Table 15-10</a> , "GIRQx Enable Clear Register", and <a href="#">Table 15-9</a> , "GIRQx Result Register" for a definition of this bit for the Source, Enable, and Result registers.   |

## 15.9.3 GIRQ10

**TABLE 15-13: BIT DEFINITIONS FOR GIRQ10 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name | Wake | Source Description   |
|---------|---------------------|-------------|------|--|
| [7:0]   | GPIO[047:040]       | GPIO_Event  | Y    | Bits[0:7] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO040 through GPIO047, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function.   |
| [15:8]  | GPIO[057:050]       | GPIO_Event  | Y    | Bits[8:15] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO050 through GPIO057, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function.  |
| [23:16] | GPIO[067:060]       | GPIO_Event  | Y    | Bits[16:23] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO060 through GPIO067, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function. |
| [30:24] | Reserved            | Reserved    | N    | Reserved   |
| 31      | n/a                 | n/a         | N    | See <a href="#">Table 15-7</a> , "GIRQx Source Register", <a href="#">Table 15-8</a> , "GIRQx Enable Set Register", <a href="#">Table 15-10</a> , "GIRQx Enable Clear Register", and <a href="#">Table 15-9</a> , "GIRQx Result Register" for a definition of this bit for the Source, Enable, and Result registers.   |

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## 15.9.4 GIRQ11

**TABLE 15-14: BIT DEFINITIONS FOR GIRQ11 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name                | Wake | Source Description   |
|---------|---------------------|----------------------------|------|--|
| [7:0]   | GPIO[007:000]       | <a href="#">GPIO_Event</a> | Y    | Bits[0:7] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO000 through GPIO007, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection ( <a href="#">int_det</a> ) bits in the Pin Control Register associated with the GPIO signal function.   |
| [15:8]  | GPIO[017:010]       | <a href="#">GPIO_Event</a> | Y    | Bits[8:15] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO010 through GPIO017, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection ( <a href="#">int_det</a> ) bits in the Pin Control Register associated with the GPIO signal function.  |
| [23:16] | GPIO[027:020]       | <a href="#">GPIO_Event</a> | Y    | Bits[16:23] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO020 through GPIO027, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection ( <a href="#">int_det</a> ) bits in the Pin Control Register associated with the GPIO signal function. |
| [30:24] | GPIO[036:030]       | <a href="#">GPIO_Event</a> | Y    | Bits[24:30] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO030 through GPIO036, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection ( <a href="#">int_det</a> ) bits in the Pin Control Register associated with the GPIO signal function. |
| 31      | n/a                 | n/a                        | N    | See Table 15-7, "GIRQx Source Register", Table 15-8, "GIRQx Enable Set Register", Table 15-10, "GIRQx Enable Clear Register", and Table 15-9, "GIRQx Result Register" for a definition of this bit for the Source, Enable, and Result registers.   |

## 15.9.5 GIRQ12

**TABLE 15-15: BIT DEFINITIONS FOR GIRQ12 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit | Block Instance Name | Source Name         | Wake | Source Description  |
|-----|---------------------|---------------------|------|---|
| 0   | I2C0 / SMB0         | <a href="#">SMB</a> | N    | I2C/SMBus controller 0 interrupt. This interrupt is signaled when the I2C/SMBus controller 0 asserts its interrupt request. |
| 1   | I2C1 / SMB1         | <a href="#">SMB</a> | N    | I2C/SMBus controller 1 interrupt. This interrupt is signaled when the I2C/SMBus controller 1 asserts its interrupt request. |
| 2   | I2C2 / SMB2         | <a href="#">SMB</a> | N    | I2C/SMBus controller 2 interrupt. This interrupt is signaled when the I2C/SMBus controller 2 asserts its interrupt request. |



**TABLE 15-15: BIT DEFINITIONS FOR GIRQ12 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name | Wake | Source Description  |
|--------|---------------------|-------------|------|---|
| 3      | I2C3 / SMB3         | SMB         | N    | I2C/SMBus controller 3 interrupt. This interrupt is signaled when the I2C/SMBus controller 3 asserts its interrupt request.   |
| 4      | I2C0_0_WK           | SMB         | Y    | I2C/SMBus controller 0 (port 0) Wake interrupt. This interrupt is signaled when there is activity on the I2C/SMBus controller 0 port 0 data pin, I2C0_DAT0 (see <a href="#">Note 15-2 on page 215</a> ).  |
| 5      | I2C0_1_WK           | SMB         | Y    | I2C/SMBus controller 0 (port 1) Wake interrupt. This interrupt is signaled when there is activity on the I2C/SMBus controller 0 port 1 data pin, I2C0_DAT1 (see <a href="#">Note 15-2 on page 215</a> ).  |
| 6      | I2C2_0_WK           | SMB         | Y    | I2C/SMBus controller 2 (port 0) Wake interrupt. This interrupt is signaled when there is activity on the I2C/SMBus controller 2 (port 0) data pin, I2C2_DAT0 (see <a href="#">Note 15-2 on page 215</a> ).  |
| 7      | I2C1_0_WK           | SMB         | Y    | I2C/SMBus controller 1 (port 0) Wake interrupt. This interrupt is signaled when there is activity on the I2C/SMBus controller 1 port 0 data pin, I2C1_DAT0 (see <a href="#">Note 15-2 on page 215</a> ).  |
| 8      | I2C3_0_WK           | SMB         | Y    | I2C/SMBus controller 3 (port 0) Wake interrupt. This interrupt is signaled when there is activity on the I2C/SMBus controller 3 port 0 data pin, I2C3_DAT0 (see <a href="#">Note 15-2 on page 215</a> ).  |
| [30:9] | Reserved            | Reserved    | N    | Reserved  |
| 31     | n/a                 | n/a         | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.6 GIRQ13

**TABLE 15-16: BIT DEFINITIONS FOR GIRQ13 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name | Wake | Source Description              |
|---------|---------------------|-------------|------|---------------------------------|
| [15:0]  | Reserved            | Reserved    | N    | Reserved                        |
| 16      | IRQ_DMA0            | DMA0        | N    | Direct Memory Access Channel 0  |
| 17      | IRQ_DMA1            | DMA1        | N    | Direct Memory Access Channel 1  |
| 18      | IRQ_DMA2            | DMA2        | N    | Direct Memory Access Channel 2  |
| 19      | IRQ_DMA3            | DMA3        | N    | Direct Memory Access Channel 3  |
| 20      | IRQ_DMA4            | DMA4        | N    | Direct Memory Access Channel 4  |
| 21      | IRQ_DMA5            | DMA5        | N    | Direct Memory Access Channel 5  |
| 22      | IRQ_DMA6            | DMA6        | N    | Direct Memory Access Channel 6  |
| 23      | IRQ_DMA7            | DMA7        | N    | Direct Memory Access Channel 7  |
| 24      | IRQ_DMA8            | DMA8        | N    | Direct Memory Access Channel 8  |
| 25      | IRQ_DMA9            | DMA9        | N    | Direct Memory Access Channel 9  |
| 26      | IRQ_DMA10           | DMA10       | N    | Direct Memory Access Channel 10 |
| 27      | IRQ_DMA11           | DMA11       | N    | Direct Memory Access Channel 11 |
| [30:28] | Reserved            | Reserved    | N    | Reserved                        |

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**TABLE 15-16: BIT DEFINITIONS FOR GIRQ13 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit | Block Instance Name | Source Name | Wake | Source Description  |
|-----|---------------------|-------------|------|---|
| 31  | n/a                 | n/a         | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.7 GIRQ14

**TABLE 15-17: BIT DEFINITIONS FOR GIRQ14 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name      | Wake | Source Description  |
|--------|---------------------|------------------|------|---|
| [1:0]  | Reserved            | Reserved         | N    | Reserved  |
| 2      | IRQ_LPC             | LPC_INTERNAL_ERR | N    | The LPC_INTERNAL_ERR event is sourced by bit D0 of the Host Bus Error Register.   |
| [30:3] | Reserved            | Reserved         | N    | Reserved  |
| 31     | n/a                 | n/a              | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.8 GIRQ15

**TABLE 15-18: BIT DEFINITIONS FOR GIRQ15 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit | Block Instance Name | Source Name    | Wake | Source Description   |
|-----|---------------------|----------------|------|--|
| 0   | UART_0              | UART           | N    | The UART interrupt event output indicates if an interrupt is pending. See <a href="#">Table 14-13, "Interrupt Control Table,"</a> on page 186. |
| 1   | Reserved            | Reserved       | N    | Reserved   |
| 2   | EMI_0               | Host-to-EC     | N    | Communication event notifying the embedded controller that the host has written to the Host-to-EC register.                                    |
| 5:3 | Reserved            | Reserved       | N    | Reserved   |
| 6   | ACPI_EC[0] IBF      | EC_IBF         | N    | EC_IBF interrupt is asserted when the IBF in the STATUS EC-Register is set to '1'.   |
| 7   | ACPI_EC[0] OBF      | EC_OBF         | N    | EC_OBF interrupt is asserted when the OBF in the STATUS EC-Register is cleared to '0'.   |
| 8   | ACPI_EC[1] IBF      | EC_IBF         | N    | EC_IBF interrupt is asserted when the IBF in the STATUS EC-Register is set to '1'.   |
| 9   | ACPI_EC[1] OBF      | EC_OBF         | N    | EC_OBF interrupt is asserted when the OBF in the STATUS EC-Register is cleared to '0'.   |
| 10  | ACPI_PM1_CTL        | ACPIPM1_CTL    | N    | PM1_CTL2 written by Host   |
| 11  | ACPIPM1 EN          | ACPIPM1_EN     | N    | PM1_EN2 written by Host  |
| 12  | ACPIPM1 STS         | ACPIPM1_STS    | N    | PM1_STS2 written by Host   |
| 13  | 8042EM OBF          | 8042EM_OBF     | N    | Interrupt generated by the host reading either data or aux data from the data register   |
| 14  | 8042EM IBF          | 8042EM_IBF     | N    | Interrupt generated by the host writing either data or command to the data register  |
| 15  | MBX                 | MBX Host-to-EC | N    | Interrupt generated for HOST-to-EC events for writes to the HOST-to-EC Mailbox Register  |

**TABLE 15-18: BIT DEFINITIONS FOR GIRQ15 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name | Wake | Source Description   |
|---------|---------------------|-------------|------|--|
| 16      | MBX_DATA            | MBX_DATA    | N    | Interrupt generated for Host writes to Mailbox Data Register   |
| [30:17] | Reserved            | Reserved    | N    | Reserved   |
| 31      | n/a                 | n/a         | N    | See <a href="#">Table 15-7</a> , "GIRQx Source Register", <a href="#">Table 15-8</a> , "GIRQx Enable Set Register", <a href="#">Table 15-10</a> , "GIRQx Enable Clear Register", and <a href="#">Table 15-9</a> , "GIRQx Result Register" for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.9 GIRQ16

**TABLE 15-19: BIT DEFINITIONS FOR GIRQ16 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name              | Wake | Source Description   |
|--------|---------------------|--------------------------|------|--|
| [2:0]  | Reserved            | Reserved                 | N    | Reserved   |
| 3      | PECIHOST            | <a href="#">PECIHOST</a> | N    | PECI Host  |
| [30:4] | Reserved            | Reserved                 | N    | Reserved   |
| 31     | n/a                 | n/a                      | N    | See <a href="#">Table 15-7</a> , "GIRQx Source Register", <a href="#">Table 15-8</a> , "GIRQx Enable Set Register", <a href="#">Table 15-10</a> , "GIRQx Enable Clear Register", and <a href="#">Table 15-9</a> , "GIRQx Result Register" for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.10 GIRQ17

**TABLE 15-20: BIT DEFINITIONS FOR GIRQ17 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit   | Block Instance Name | Source Name                    | Wake | Source Description   |
|-------|---------------------|--------------------------------|------|--|
| 0     | IRQ_TACH0           | <a href="#">TACH</a>           | N    | This internal signal is generated from the OR'd result of the status events, as defined in the TACHx Status Register.. |
| 1     | IRQ_TACH1           | <a href="#">TACH</a>           | N    | This internal signal is generated from the OR'd result of the status events, as defined in the TACHx Status Register.  |
| 2     | PS2_0_WK            | PS2_DAT0 pin                   | Y    | PS2_0 Start Detect from pin signal PS2_DAT0 (see <a href="#">Note 15-2 on page 215</a> ).                              |
| 3     | PS2_1_WK            | PS2_DAT1 pin                   | Y    | PS2_1 Start Detect from pin signal PS2_DAT1 (see <a href="#">Note 15-2 on page 215</a> ).                              |
| 4     | PS2_2_WK            | PS2_DAT2 pin                   | Y    | PS2_2 Start Detect from pin signal PS2_DAT2 (see <a href="#">Note 15-2 on page 215</a> ).                              |
| 5     | PS2_3_WK            | PS2_DAT3 pin                   | Y    | PS2_3 Start Detect from pin signal PS2_DAT3 (see <a href="#">Note 15-2 on page 215</a> ).                              |
| 6     | BC_INT_N_WK         | BC_LINK                        | Y    | Interrupt from the BC_LINK Companion BC_INT# pin (see <a href="#">Note 15-2 on page 215</a> ).                         |
| [9:7] | Reserved            | Reserved                       | N    | Reserved   |
| 10    | ADC_SNGL            | <a href="#">ADC_Single_Int</a> | N    | Interrupt signal from ADC controller to EC for Single-Sample ADC conversion  |
| 11    | ADC_RPT             | <a href="#">ADC_Repeat_Int</a> | N    | Interrupt signal from ADC controller to EC for Repeated ADC conversion   |
| 12    | MCHP Reserved       | MCHP Reserved                  | N    | MCHP Reserved  |

**TABLE 15-20: BIT DEFINITIONS FOR GIRQ17 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit | Block Instance Name | Source Name                                    | Wake | Source Description  |
|-----|---------------------|--|------|---|
| 13  | MCHP Reserved       | MCHP Reserved                                  | N    | MCHP Reserved   |
| 14  | PS2_0               | <a href="#">PS2_ACT</a>                        | N    | PS2_0 Activity Interrupt from PS/2 Block  |
| 15  | PS2_1               | <a href="#">PS2_ACT</a>                        | N    | PS2_1 Activity Interrupt from PS/2 Block  |
| 16  | PS2_2               | <a href="#">PS2_ACT</a>                        | N    | PS2_2 Activity Interrupt from PS/2 Block  |
| 17  | PS2_3               | <a href="#">PS2_ACT</a>                        | N    | PS2_3 Activity Interrupt from PS/2 Block  |
| 18  | RTC                 | <a href="#">RTC</a>                            | Y    | RTC Interrupt   |
| 19  | RTC ALARM           | <a href="#">RTC ALARM</a>                      | Y    | RTC Alarm Interrupt   |
| 20  | HTIMER              | <a href="#">HTIMER</a>                         | Y    | Signal indicating that the hibernation timer is enabled and has expired.  |
| 21  | KEYSCAN             | <a href="#">KSC_INT</a>                        | N    | Keyboard Scan Interface runtime interrupt   |
| 22  | KEYSCAN wake        | <a href="#">KSC_INT_WAKE</a>                   | Y    | Keyboard Scan Interface wake interrupt  |
| 23  | RPM_INT Stall       | <a href="#">Fan Stall Status Interrupt</a>     | N    | RPM-PWM Interface DRIVE_FAIL & FAN_SPIN indication  |
| 24  | RPM_INT Spin        | <a href="#">Fan Fail/Spin Status Interrupt</a> | N    | RPM-PWM Interface SPIN indication   |
| 25  | PFR_Status          | <a href="#">PFR_Status</a>                     | N    | Power-Fail and Reset Status Register events (VBAT POR and WDT).   |
| 26  | PWM_WDT[0]          | <a href="#">PWM_WDT</a>                        | N    | PWM watchdog time out interrupt from Blinking/Breathing PWM block   |
| 27  | PWM_WDT[1]          | <a href="#">PWM_WDT</a>                        | N    | PWM watchdog time out interrupt from Blinking/Breathing PWM block   |
| 28  | PWM_WDT[2]          | <a href="#">PWM_WDT</a>                        | N    | PWM watchdog time out interrupt from Blinking/Breathing PWM block   |
| 29  | BCM_ERR             | <a href="#">BCM_INT Err</a>                    | N    | BC_LINK Master Error Flag Interrupt   |
| 30  | BCM_BUSY_-CLR       | <a href="#">BCM_INT Busy</a>                   | N    | BC_LINK Master Busy Clear Flag Interrupt  |
| 31  | n/a                 | n/a  | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.11 GIRQ18

**TABLE 15-21: BIT DEFINITIONS FOR GIRQ18 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit | Block Instance Name | Source Name              | Wake | Source Description  |
|-----|---------------------|--------------------------|------|---|
| 0   | SPI0 TX             | <a href="#">TXBE_STS</a> | N    | SPI controller 0 Interrupt output to EC driven by TXBE status bit |
| 1   | SPI0 RX             | <a href="#">RXBF_STS</a> | N    | SPI controller 0 Interrupt output to EC driven by RXBE status bit |
| 2   | SPI1 TX             | <a href="#">TXBE_STS</a> | N    | SPI controller 1 Interrupt output to EC driven by TXBE status bit |
| 3   | SPI1 RX             | <a href="#">RXBF_STS</a> | N    | SPI controller 1 Interrupt output to EC driven by RXBE status bit |
| 4   | PWM_WDT[3]          | <a href="#">PWM_WDT</a>  | N    | PWM watchdog time out interrupt from Blinking/Breathing PWM block |
| 5   | MCHP Reserved       | MCHP Reserved            | N    | MCHP Reserved   |

**TABLE 15-21: BIT DEFINITIONS FOR GIRQ18 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name   | Wake | Source Description  |
|---------|---------------------|---------------|------|---|
| 6       | MCHP Reserved       | MCHP Reserved | N    | MCHP Reserved   |
| 7       | MCHP Reserved       | MCHP Reserved | N    | MCHP Reserved   |
| 8       | MCHP Reserved       | MCHP Reserved | N    | MCHP Reserved   |
| 9       | MCHP Reserved       | MCHP Reserved | N    | MCHP Reserved   |
| [30:10] | Reserved            | Reserved      | N    | Reserved  |
| 31      | n/a                 | n/a           | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.12 GIRQ19

**TABLE 15-22: BIT DEFINITIONS FOR GIRQ19 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name | Wake | Source Description  |
|--------|---------------------|-------------|------|---|
| 0      | VCC_PWRGD           | VCC_PWRGD   | Y    | VCC_PWRGD interrupt from pin (see <a href="#">Note 15-2 on page 215</a> ).  |
| 1      | LRESET#             | LRESET#     | Y    | LRESET# interrupt from pin (see <a href="#">Note 15-2 on page 215</a> ).  |
| [30:2] | Reserved            | Reserved    | N    | Reserved  |
| 31     | n/a                 | n/a         | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.13 GIRQ20

**TABLE 15-23: BIT DEFINITIONS FOR GIRQ20 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit   | Block Instance Name | Source Name                | Wake | Source Description   |
|-------|---------------------|----------------------------|------|--|
| [4:0] | GPIO[204:200]       | <a href="#">GPIO_Event</a> | Y    | Bits[0:4] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO200 through GPIO204, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function. |
| 5     | Reserved            | Reserved                   | N    | Reserved   |
| 6     | GPIO206             | <a href="#">GPIO_Event</a> | Y    | Bit 6 is controlled by the <a href="#">GPIO_Events</a> generated by GPIO206.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function.                                    |
| 7     | Reserved            | Reserved                   | N    | Reserved   |

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**TABLE 15-23: BIT DEFINITIONS FOR GIRQ20 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit     | Block Instance Name | Source Name                | Wake | Source Description   |
|---------|---------------------|----------------------------|------|--|
| [9:8]   | GPIO[211:210]       | <a href="#">GPIO_Event</a> | Y    | Bits[8:9] are controlled by the <a href="#">GPIO_Events</a> generated by GPIO210 through GPIO211, respectively.<br><br>The GPIO Interface can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the Interrupt Detection (int_det) bits in the Pin Control Register associated with the GPIO signal function. |
| [11:10] | MCHP Reserved       | MCHP Reserved              | N/A  | MCHP Reserved  |
| [30:12] | Reserved            | Reserved                   | N    | Reserved   |
| 31      | n/a                 | n/a                        | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers.  |

## 15.9.14 GIRQ21

**TABLE 15-24: BIT DEFINITIONS FOR GIRQ21 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name | Wake | Source Description  |
|--------|---------------------|-------------|------|---|
| [1:0]  | MCHP Reserved       | n/a         | n/a  | n/a   |
| [30:2] | Reserved            | Reserved    | N    | Reserved  |
| 31     | n/a                 | n/a         | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.15 GIRQ22

**TABLE 15-25: BIT DEFINITIONS FOR GIRQ22 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name | Wake | Source Description  |
|--------|---------------------|-------------|------|---|
| [30:0] | Reserved            | Reserved    | N    | Reserved  |
| 31     | n/a                 | n/a         | N    | See <a href="#">Table 15-7, "GIRQx Source Register"</a> , <a href="#">Table 15-8, "GIRQx Enable Set Register"</a> , <a href="#">Table 15-10, "GIRQx Enable Clear Register"</a> , and <a href="#">Table 15-9, "GIRQx Result Register"</a> for a definition of this bit for the Source, Enable, and Result registers. |

## 15.9.16 GIRQ23

**TABLE 15-26: BIT DEFINITIONS FOR GIRQ23 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit | Block Instance Name | Source Name                | Wake | Source Description   |
|-----|---------------------|----------------------------|------|--|
| 0   | 16-bit Timer_0      | <a href="#">TIMER_32_x</a> | N    | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the tEVENT_INTERRUPT status bit if enabled. |

**TABLE 15-26: BIT DEFINITIONS FOR GIRQ23 SOURCE, ENABLE, AND RESULT REGISTERS**

| Bit    | Block Instance Name | Source Name | Wake | Source Description   |
|--------|---------------------|-------------|------|--|
| 1      | 16-bit Timer_1      | TIMER_32_x  | N    | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the tEVENT_INTERRUPT status bit if enabled.   |
| 2      | 16-bit Timer_2      | TIMER_32_x  | N    | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the tEVENT_INTERRUPT status bit if enabled.   |
| 3      | 16-bit Timer_3      | TIMER_32_x  | N    | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the tEVENT_INTERRUPT status bit if enabled.   |
| 4      | 32-bit Timer_0      | TIMER_32_x  | N    | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the tEVENT_INTERRUPT status bit if enabled.   |
| 5      | 32-bit Timer_1      | TIMER_32_x  | N    | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the tEVENT_INTERRUPT status bit if enabled.   |
| [30:6] | Reserved            | Reserved    | N    | Reserved   |
| 31     | n/a                 | n/a         | N    | See Table 15-7, "GIRQx Source Register", Table 15-8, "GIRQx Enable Set Register", Table 15-10, "GIRQx Enable Clear Register", and Table 15-9, "GIRQx Result Register" for a definition of this bit for the Source, Enable, and Result registers. |

**Note 15-2** All wakeup interrupts associated with pins must be configured as falling edge interrupts through the associated GPIO control register.

## 15.9.17 BLOCK ENABLE SET REGISTER

| Offset          | 200h                          |      |      |      |      |      | 32-bit     |      | Size                  |
|-----------------|-------------------------------|------|------|------|------|------|------------|------|-----------------------|
| <b>POWER</b>    | VCC1                          |      |      |      |      |      | 0000_0000h |      | VCC1_RESET<br>Default |
| <b>BIT</b>      | D31                           | D30  | D29  | D28  | D27  | D26  | D25        | D24  |                       |
| <b>TYPE</b>     | R                             | R    | R    | R    | R    | R    | R          | R    |                       |
| <b>BIT NAME</b> | Reserved                      |      |      |      |      |      |            |      |                       |
| <b>BIT</b>      | D23                           | D22  | D21  | D20  | D19  | D18  | D17        | D16  |                       |
| <b>TYPE</b>     | R/WS                          | R/WS | R/WS | R/WS | R/WS | R/WS | R/WS       | R/WS |                       |
| <b>BIT NAME</b> | IRQ Vector Enable Set [23:16] |      |      |      |      |      |            |      |                       |
| <b>BIT</b>      | D15                           | D14  | D13  | D12  | D11  | D10  | D9         | D8   |                       |
| <b>TYPE</b>     | R/WS                          | R/WS | R/WS | R/WS | R/WS | R/WS | R/WS       | R/WS |                       |
| <b>BIT NAME</b> | IRQ Vector Enable Set [15:8]  |      |      |      |      |      |            |      |                       |
| <b>BIT</b>      | D7                            | D6   | D5   | D4   | D3   | D2   | D1         | D0   |                       |
| <b>TYPE</b>     | R                             | R    | R    | R    | R    | R    | R          | R    |                       |
| <b>BIT NAME</b> | Reserved                      |      |      |      |      |      |            |      |                       |

IRQ Vector Enable Set [31:0]

Each IRQ Vector can be individually enabled to assert an interrupt event to the EC.

0= Writing a zero has no effect.

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1= Writing a one will enable respective IRQ<sub>i</sub>.

Reading always returns the current value of the IRQ<sub>i</sub> VECTOR ENABLE bit. The state of the IRQ<sub>i</sub> VECTOR ENABLE bit is determined by the corresponding IRQ<sub>i</sub> Vector Enable Set bit and the IRQ<sub>i</sub> Vector Enable Clear bit. (0=disabled, 1-enabled)

## 15.9.18 BLOCK ENABLE CLEAR REGISTER

| Offset   | 204h                            |      |      |      |      |      | 32-bit     |      | Size                  |
|----------|---------------------------------|------|------|------|------|------|------------|------|-----------------------|
| POWER    | VCC1                            |      |      |      |      |      | 0000_0000h |      | VCC1_RESET<br>Default |
| BIT      | D31                             | D30  | D29  | D28  | D27  | D26  | D25        | D24  |                       |
| TYPE     | R                               | R    | R    | R    | R    | R    | R          | R    |                       |
| BIT NAME | Reserved                        |      |      |      |      |      |            |      |                       |
| BIT      | D23                             | D22  | D21  | D20  | D19  | D18  | D17        | D16  |                       |
| TYPE     | R/WC                            | R/WC | R/WC | R/WC | R/WC | R/WC | R/WC       | R/WC |                       |
| BIT NAME | IRQ Vector Enable Clear [23:16] |      |      |      |      |      |            |      |                       |
| BIT      | D15                             | D14  | D13  | D12  | D11  | D10  | D9         | D8   |                       |
| TYPE     | R/WC                            | R/WC | R/WC | R/WC | R/WC | R/WC | R/WC       | R/WC |                       |
| BIT NAME | IRQ Vector Enable Clear [15:8]  |      |      |      |      |      |            |      |                       |
| BIT      | D7                              | D6   | D5   | D4   | D3   | D2   | D1         | D0   |                       |
| TYPE     | R                               | R    | R    | R    | R    | R    | R          | R    |                       |
| BIT NAME | Reserved                        |      |      |      |      |      |            |      |                       |

IRQ Vector Enable Clear[31:0]

Each IRQ Vector can be individually disabled to assert an interrupt event to the EC.

0= Writing a zero has no effect.

1= Writing a one will disable respective IRQ<sub>i</sub> vector.

Reading always returns the current value of the IRQ<sub>i</sub> VECTOR ENABLE bit. The state of the IRQ<sub>i</sub> VECTOR ENABLE bit is determined by the corresponding IRQ<sub>i</sub> Vector Enable Set bit and the IRQ<sub>i</sub> Vector Enable Clear bit. (0=disabled, 1-enabled)

## 15.9.19 BLOCK IRQ VECTOR REGISTER

| Offset   | 208h     |     |     |     |     |     | 32-bit     |     | Size                  |
|----------|----------|-----|-----|-----|-----|-----|------------|-----|-----------------------|
| POWER    | VCC1     |     |     |     |     |     | 0000_0000h |     | VCC1_RESET<br>Default |
| BIT      | D31      | D30 | D29 | D28 | D27 | D26 | D25        | D24 |                       |
| TYPE     | R        | R   | R   | R   | R   | R   | R          | R   |                       |
| BIT NAME | Reserved |     |     |     |     |     |            |     |                       |
| BIT      | D23      | D22 | D21 | D20 | D19 | D18 | D17        | D16 |                       |
| TYPE     | R        | R   | R   | R   | R   | R   | R          | R   |                       |



| BIT NAME | IRQ Vector [23:16] |     |     |     |     |     |    |    |
|----------|--------------------|-----|-----|-----|-----|-----|----|----|
| BIT      | D15                | D14 | D13 | D12 | D11 | D10 | D9 | D8 |
| TYPE     | R                  | R   | R   | R   | R   | R   | R  | R  |
| BIT NAME | IRQ Vector [15:8]  |     |     |     |     |     |    |    |
| BIT      | D7                 | D6  | D5  | D4  | D3  | D2  | D1 | D0 |
| TYPE     | R                  | R   | R   | R   | R   | R   | R  | R  |
| BIT NAME | Reserved           |     |     |     |     |     |    |    |

IRQ Vector [31:0]

Each read only bit reflects the current state of the IRQ *i* vector to the EC.

**Note:** If the IRQ *i* vector is disabled via the [Block Enable Clear Register](#) the corresponding IRQ *i* vector to the EC is forced to 0. If the IRQ *i* vector is enabled, the corresponding IRQ *i* vector to the EC represents the current status of the IRQ event.

## 16.0 WATCHDOG TIMER (WDT)

### 16.1 Introduction

The function of the Watchdog Timer is to provide a mechanism to detect if the internal embedded controller has failed. When enabled, the Watchdog Timer (WDT) circuit will generate a [WDT Event](#) if the user program fails to reload the WDT within a specified length of time known as the WDT Interval.

### 16.2 References

No references have been cited for this chapter.

### 16.3 Terminology

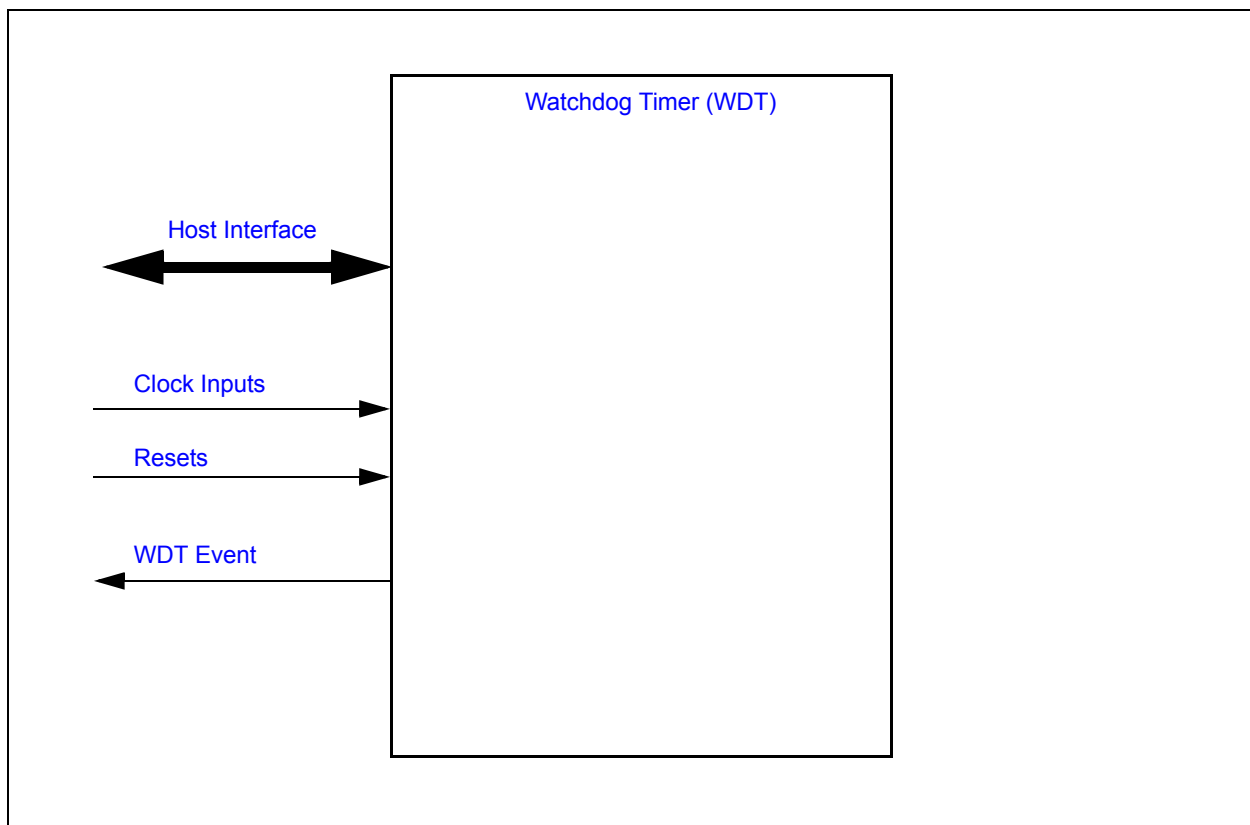
There is no terminology defined for this chapter.

### 16.4 Interface

This block is designed to be accessed internally via a registered host interface or externally via the signal interface.

### 16.5 Host Interface

**FIGURE 16-1: I/O DIAGRAM OF BLOCK**



The registers defined for the [Watchdog Timer \(WDT\)](#) are accessible by the embedded controller as indicated in [Section 16.8, "EC-Only Registers"](#). All registers accesses are synchronized to the host clock and complete immediately. Register reads/writes are not delayed by the [32KHz\\_Clk](#).

## 16.6 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 16.6.1 POWER DOMAINS

**TABLE 16-1: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block reside on this single power well. |

### 16.6.2 CLOCK INPUTS

**TABLE 16-2: CLOCK INPUTS**

| Name      | Description  |
|-----------|--|
| 32KHz_Clk | The 32KHz_Clk clock input is the clock source to the Watchdog Timer functional logic, including the counter. |

### 16.6.3 RESETS

**TABLE 16-3: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | Power on Reset to the block. This signal resets all the register and logic in this block to its default state. |

**TABLE 16-4: RESET OUTPUT EVENT**

| Source    | Description  |
|-----------|--|
| WDT Event | Pulse generated when WDT expires. This signal is used to reset the embedded controller and its subsystem.<br><br>The event is cleared after an VCC1_RESET. |

## 16.7 Description

### 16.7.1 WDT OPERATION

#### 16.7.1.1 WDT Activation Mechanism

The WDT is activated by the following sequence of operations during normal operation:

1. Load the [WDT Load Register](#) with the count value.
2. Set the [WDT Enable](#) bit in the [WDT Control Register](#).

The [WDT Activation Mechanism](#) starts the WDT decrementing counter.

#### 16.7.1.2 WDT Deactivation Mechanism

The WDT is deactivated by the clearing the [WDT Enable](#) bit in the [WDT Control Register](#). The [WDT Deactivation Mechanism](#) places the WDT in a low power state in which clock are gated and the counter stops decrementing.

#### 16.7.1.3 WDT Reload Mechanism

The WDT must be reloaded within periods that are shorter than the programmed watchdog interval; otherwise, the WDT will underflow and a [WDT Event](#) will be generated and the [WDT Status](#) bit will be set in the [WDT Control Register](#). It is the responsibility of the user program to continually execute code which reloads the watchdog timer, causing the counter to be reloaded

There are three methods of reloading the WDT: a write to the [WDT Load Register](#), a write to the [WDT Kick Register](#), or WDT event.

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## 16.7.1.4 WDT Interval

The [WDT Interval](#) is the time it takes for the WDT to decrements from the [WDT Load Register](#) value to 0000h. The [WDT Count Register](#) value takes  $33/32\text{KHz\_Clk}$  seconds (ex.  $33/32.768\text{ KHz} = 1.007\text{ms}$ ) to decrement by 1 count.

## 16.8 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [Watchdog Timer \(WDT\)](#). The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 16-5: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address |
|----------------|-----------------|------|-------------------------------|--------------|
| WDT            | 0               | EC   | 32-bit internal address space | 4000_0400h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 16-6: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)             |
|--------|--------------------------------------|
| 00h    | <a href="#">WDT Load Register</a>    |
| 04h    | <a href="#">WDT Control Register</a> |
| 08h    | <a href="#">WDT Kick Register</a>    |
| 0Ch    | <a href="#">WDT Count Register</a>   |

### 16.8.1 WDT LOAD REGISTER

| Offset | 00h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 15:0   | WDT Load<br>Writing this field reloads the Watch Dog Timer counter. | R/W  | Fh      | <a href="#">VCC1_R ESET</a> |

### 16.8.2 WDT CONTROL REGISTER

| Offset | 04h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:2    | RESERVED  | R    | -       | -                           |
| 1      | WDT Status<br>WDT_RST is set by hardware if the last reset of MEC1322 was caused by an underflow of the WDT. See <a href="#">Section 16.7.1.3, "WDT Reload Mechanism," on page 219</a> for more information.<br><br>This bit must be cleared by the EC firmware writing a '1' to this bit. Writing a '0' to this bit has no effect. | R/WC | 0b      | <a href="#">VCC1_R ESET</a> |

| Offset | 04h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 0      | <p>WDT Enable</p> <p>In <a href="#">WDT Operation</a>, the WDT is activated by the sequence of operations defined in <a href="#">Section 16.7.1.1, "WDT Activation Mechanism"</a> and deactivated by the sequence of operations defined in <a href="#">Section 16.7.1.2, "WDT Deactivation Mechanism"</a>.</p> <p>0 = block disabled<br/>1 = block enabled</p> <p><b>Note:</b> The default of the WDT is inactive.</p> | R/W  | 0b      | VCC1_R<br>ESET |

### 16.8.3 WDT KICK REGISTER

| Offset | 08h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | <p>Kick</p> <p>The <a href="#">WDT Kick Register</a> is a strobe. Reads of the <a href="#">WDT Kick Register</a> return 0. Writes to the <a href="#">WDT Kick Register</a> cause the WDT to reload the <a href="#">WDT Load Register</a> value and start decrementing when the <a href="#">WDT Enable</a> bit in the <a href="#">WDT Control Register</a> is set to '1'. When the <a href="#">WDT Enable</a> bit in the <a href="#">WDT Control Register</a> is cleared to '0', writes to the <a href="#">WDT Kick Register</a> have no effect.</p> | W    | n/a     | VCC1_R<br>ESET |

### 16.8.4 WDT COUNT REGISTER

| Offset | 0Ch  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 15:0   | <p>WDT Count</p> <p>This read-only register provide the current WDT count.</p> | R    | Fh      | VCC1_R<br>ESET |

## 17.0 BASIC TIMER

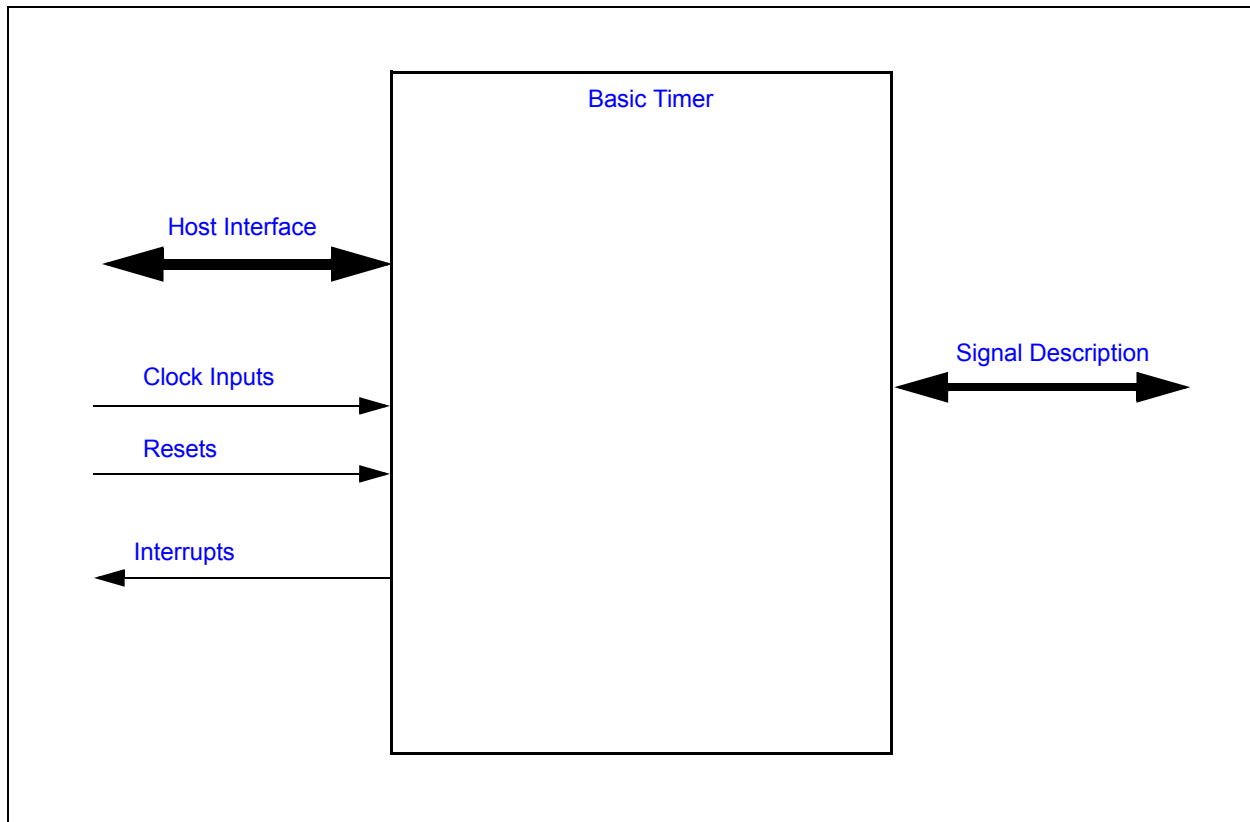
### 17.1 Introduction

This timer block offers a simple mechanism for firmware to maintain a time base. This timer may be instantiated as 16 bits or 32 bits. The name of the timer instance indicates the size of the timer.

### 17.2 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 17-1: I/O DIAGRAM OF BLOCK**



### 17.3 Signal Description

There are no external signals for this block.

### 17.4 Host Interface

The embedded controller may access this block via the registers defined in [Section 17.9, "EC-Only Registers,"](#) on [page 224](#).

### 17.5 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

## 17.5.1 POWER DOMAINS

**TABLE 17-1: POWER SOURCES**

| Name | Description  |
|------|--|
| VCC1 | The timer control logic and registers are all implemented on this single power domain. |

## 17.5.2 CLOCK INPUTS

**TABLE 17-2: CLOCK INPUTS**

| Name                   | Description  |
|------------------------|--|
| 48 MHz Ring Oscillator | This is the clock source to the timer logic. The Pre-scaler may be used to adjust the minimum resolution per bit of the counter. |

## 17.5.3 RESETS

**TABLE 17-3: RESET SIGNALS**

| Name        | Description  |
|-------------|--|
| VCC1_RESET  | This reset signal, which is an input to this block, resets all the logic and registers to their initial default state.   |
| Soft Reset  | This reset signal, which is created by this block, resets all the logic and registers to their initial default state. This reset is generated by the block when the <b>SOFT_RESET</b> bit is set in the Timer Control Register register. |
| Timer_Reset | This reset signal, which is created by this block, is asserted when either the VCC1_RESET or the Soft Reset signal is asserted. The VCC1_RESET and Soft Reset signals are OR'd together to create this signal.                           |

## 17.6 Interrupts

**TABLE 17-4: EC INTERRUPTS**

| Source     | Description   |
|------------|---|
| TIMER_16_x | This interrupt event fires when a 16-bit timer x reaches its limit. This event is sourced by the <b>EVENT_INTERRUPT</b> status bit if enabled.  |
| TIMER_32_x | This interrupt event fires when a 32-bit timer x reaches its limit. This event is sourced by the <b>tEVENT_INTERRUPT</b> status bit if enabled. |

## 17.7 Low Power Modes

The Basic Timer may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry. This block is only be permitted to enter low power modes when the block is not active.

The sleep state of this timer is as follows:

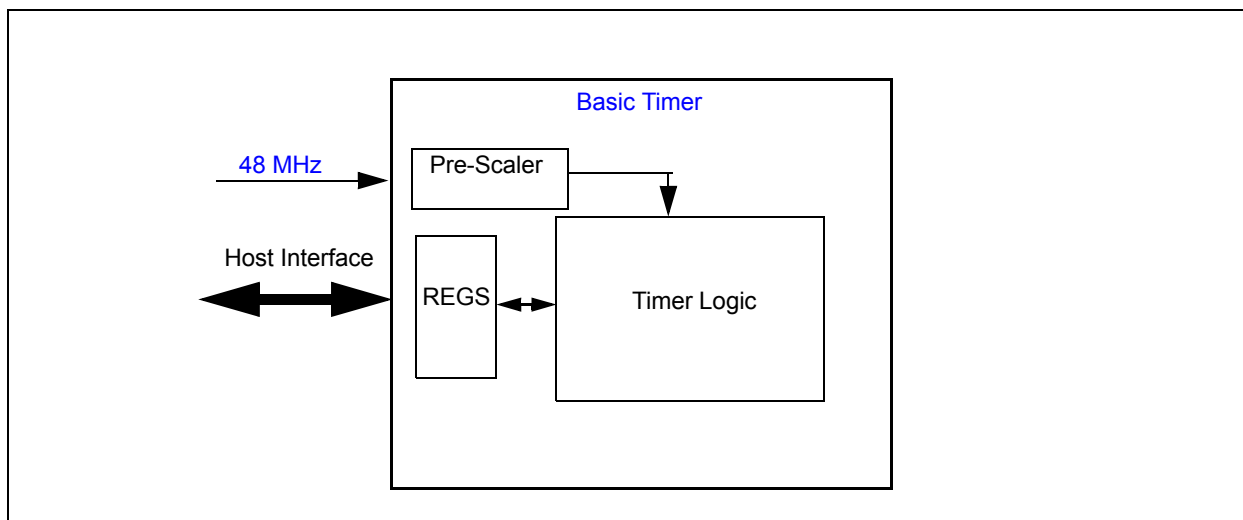
- Asleep while the block is not Enabled
- Asleep while the block is not running (start inactive).
- Asleep while the block is halted (even if running).

The block is active while start is active.

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## 17.8 Description

FIGURE 17-2: BLOCK DIAGRAM



This timer block offers a simple mechanism for firmware to maintain a time base in the design. The timer may be enabled to execute the following features:

- Programmable resolution per LSB of the counter via the Pre-scale bits in the Timer Control Register
- Programmable as either an up or down counter
- One-shot or Continuous Modes
- In one-shot mode the Auto Restart feature stops the counter when it reaches its limit and generates a level event.
- In Continuous Mode the Auto Restart feature restarts that counter from the programmed preload value and generates a pulse event.
- Counter may be reloaded, halted, or started via the Timer Control register
- Block may be reset by either a Power On Reset (POR) or via a Soft Reset.

## 17.9 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the Basic Timer. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the EC-Only Register Base Address Table.

TABLE 17-5: EC-ONLY REGISTER BASE ADDRESS TABLE

| Block Instance         | Instance Number | Host | Address Space                 | Base Address |
|------------------------|-----------------|------|-------------------------------|--------------|
| TIMER16 (16-bit Timer) | 0               | EC   | 32-bit internal address space | 4000_0C00h   |
| TIMER16 (16-bit Timer) | 1               | EC   | 32-bit internal address space | 4000_0C20h   |
| TIMER16 (16-bit Timer) | 2               | EC   | 32-bit internal address space | 4000_0C40h   |
| TIMER16 (16-bit Timer) | 3               | EC   | 32-bit internal address space | 4000_0C60h   |
| TIMER32 (32-bit Timer) | 0               | EC   | 32-bit internal address space | 4000_0C80h   |
| TIMER32 (32-bit Timer) | 1               | EC   | 32-bit internal address space | 4000_0CA0h   |



The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 17-6: RUNTIME REGISTER SUMMARY**

| Offset | Register Name                             |
|--------|---|
| 00h    | <a href="#">Timer Count Register</a>      |
| 04h    | <a href="#">Timer Preload Register</a>    |
| 08h    | <a href="#">Timer Status Register</a>     |
| 0Ch    | <a href="#">Timer Int Enable Register</a> |
| 10h    | <a href="#">Timer Control Register</a>    |

## 17.9.1 TIMER COUNT REGISTER

| Offset | 00h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:0   | <p><b>COUNTER</b></p> <p>This is the value of the Timer counter. This is updated by Hardware but may be set by Firmware. If it is set while the Hardware Timer is operating, functionality can not be maintained. When read, it is buffered so single byte reads will be able to catch the full 4 byte register without it changing.</p> <p>The size of the Counter is indicated by the instance name. Bits 0 to (size-1) are r/w counter bits. Bits 31 down to size are reserved. Reads return 0 and writes have no effect.</p> | R/W  | 0h      | <a href="#">Timer_Reset</a> |

## 17.9.2 TIMER PRELOAD REGISTER

| Offset | 04h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 31:0   | <p><b>PRE_LOAD</b></p> <p>This is the value of the Timer pre-load for the counter. This is used by H/W when the counter is to be restarted automatically; this will become the new value of the counter upon restart.</p> <p>The size of the Pre-Load value is the same as the size of the counter. The size of the Counter is indicated by the instance name. Bits 0 to (size-1) are r/w pre-load bits. Bits 31 down to size are reserved. Reads return 0 and writes have no effect.</p> | R/W  | 0h      | <a href="#">Timer_Reset</a> |

## 17.9.3 TIMER STATUS REGISTER

| Offset | 08h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:0   | Reserved   | R    | -       | -                           |
| 0      | <p><b>EVENT_INTERRUPT</b></p> <p>This is the interrupt status that fires when the timer reaches its limit. This may be level or a self clearing signal cycle pulse, based on the <a href="#">AUTO_RESTART</a> bit in the <a href="#">Timer Control Register</a>. If the timer is set to automatically restart, it will provide a pulse, otherwise a level is provided.</p> | R/WC | 0h      | <a href="#">Timer_Reset</a> |

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## 17.9.4 TIMER INT ENABLE REGISTER

| Offset | 0Ch  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:0   | Reserved   | R    | -       | -                           |
| 0      | EVENT_INTERRUPT_ENABLE<br>This is the interrupt enable for the status <a href="#">EVENT_INTERRUPT</a> bit in the <a href="#">Timer Status Register</a> | R/W  | 0h      | <a href="#">Timer_Reset</a> |

## 17.9.5 TIMER CONTROL REGISTER

| Offset | 10h  |      |         |                             |
|--------|--|------|---------|-----------------------------|
| Bits   | Description  | Type | Default | Reset Event                 |
| 31:16  | PRE_SCALE<br>This is used to divide down the system clock through clock enables to lower the power consumption of the block and allow slow timers. Updating this value during operation may result in erroneous clock enable pulses until the clock divider restarts.<br>The number of clocks per clock enable pulse is (Value + 1); a setting of 0 runs at the full clock speed, while a setting of 1 runs at half speed. | R/W  | 0h      | <a href="#">Timer_Reset</a> |
| 15:8   | Reserved   | R    | -       | -                           |
| 7      | HALT<br>This is a halt bit. This will halt the timer as long as it is active. Once the halt is inactive, the timer will start from where it left off.<br><br>1=Timer is halted. It stops counting. The clock divider will also be reset.<br>0=Timer runs normally  | R/W  | 0h      | <a href="#">Timer_Reset</a> |
| 6      | RELOAD<br>This bit reloads the counter without interrupting its operation. This will not function if the timer has already completed (when the START bit in this register is '0'). This is used to periodically prevent the timer from firing when an event occurs. Usage while the timer is off may result in erroneous behavior.   | R/W  | 0h      | <a href="#">Timer_Reset</a> |

| Offset | 10h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 5      | <p><b>START</b></p> <p>This bit triggers the timer counter. The counter will operate until it hits its terminating condition. This will clear this bit. It should be noted that when operating in restart mode, there is no terminating condition for the counter, so this bit will never clear. Clearing this bit will halt the timer counter.</p> <p>Setting this bit will:</p> <ul style="list-style-type: none"> <li>• Reset the clock divider counter.</li> <li>• Enable the clock divider counter.</li> <li>• Start the timer counter.</li> <li>• Clear all interrupts.</li> </ul> <p>Clearing this bit will:</p> <ul style="list-style-type: none"> <li>• Disable the clock divider counter.</li> <li>• Stop the timer counter.</li> </ul> | R/W  | 0h      | Timer_Reset |
| 4      | <p><b>SOFT_RESET</b></p> <p>This is a soft reset.<br/>This is self clearing 1 cycle after it is written.</p>  | WO   | 0h      | Timer_Reset |
| 3      | <p><b>AUTO_RESTART</b></p> <p>This will select the action taken upon completing a count.</p> <p>1=The counter will automatically restart the count, using the contents of the <a href="#">Timer Preload Register</a> to load the <a href="#">Timer Count Register</a><br/>The interrupt will be set in edge mode<br/>0=The counter will simply enter a done state and wait for further control inputs. The interrupt will be set in level mode.</p>   | R/W  | 0h      | Timer_Reset |
| 2      | <p><b>COUNT_UP</b></p> <p>This selects the counter direction.</p> <p>When the counter is incrementing the counter will saturate and trigger the event when it reaches all F's. When the counter is decrementing the counter will saturate when it reaches 0h.</p> <p>1=The counter will increment<br/>0=The counter will decrement</p>  | R/W  | 0h      | Timer_Reset |
| 1      | Reserved  | R    | -       | -           |
| 0      | <p><b>ENABLE</b></p> <p>This enables the block for operation.</p> <p>1=This block will function normally<br/>0=This block will gate its clock and go into its lowest power state</p>  | R/W  | 0h      | Timer_Reset |

## 18.0 HIBERNATION TIMER

### 18.1 Introduction

The Hibernation Timer can generate a wake event to the Embedded Controller (EC) when it is in a hibernation mode. This block supports wake events up to 2 hours in duration. The timer is a 16-bit binary count-down timer that can be programmed in 30.5 $\mu$ s and 0.125 second increments for period ranges of 30.5 $\mu$ s to 2s or 0.125s to 136.5 minutes, respectively. Writing a non-zero value to this register starts the counter from that value. A wake-up interrupt is generated when the count reaches zero.

### 18.2 References

No references have been cited for this chapter

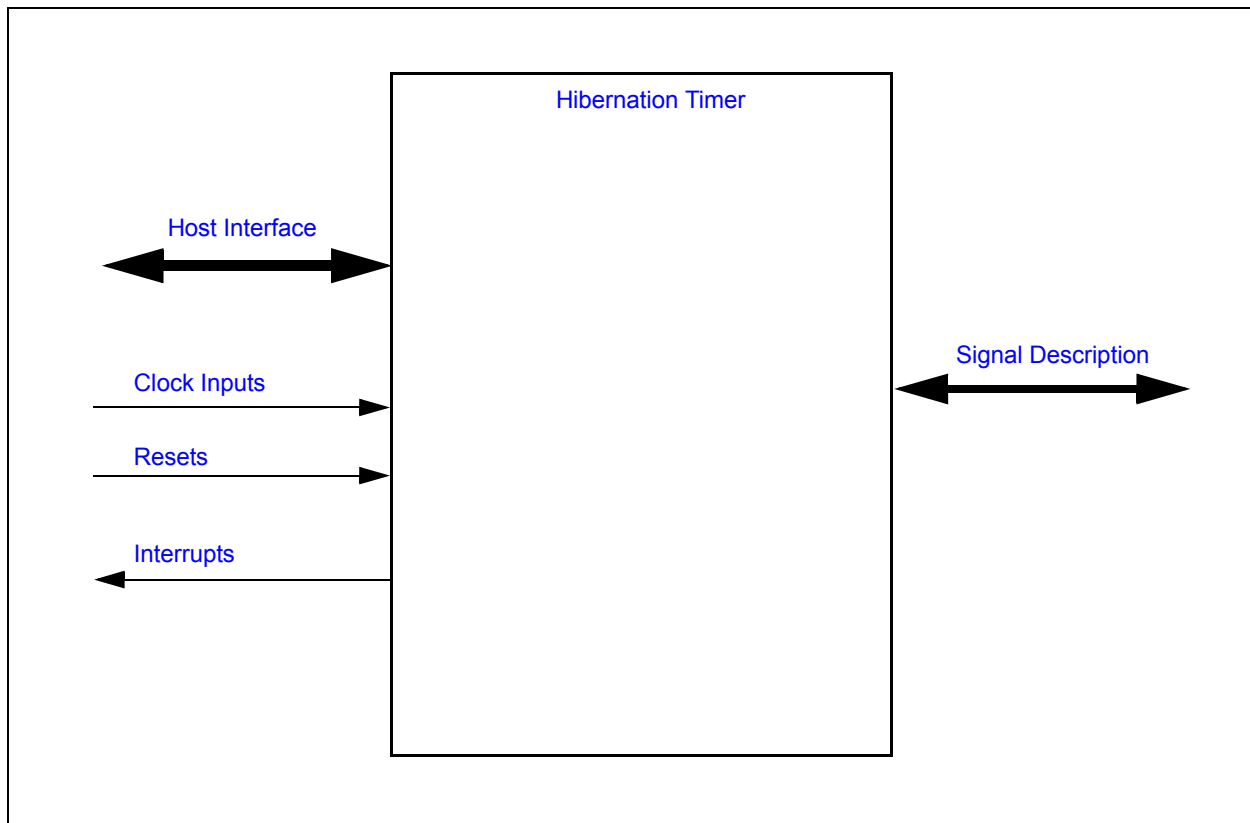
### 18.3 Terminology

No terms have been cited for this chapter.

### 18.4 Interface

This block is an IP block designed to be incorporated into a chip. It is designed to be accessed externally via the pin interface and internally via a registered host interface. The following diagram illustrates the various interfaces to the block.

**FIGURE 18-1: HIBERNATION TIMER INTERFACE DIAGRAM**



### 18.5 Signal Description

There are no external signals for this block.

## 18.6 Host Interface

The registers defined for the [Hibernation Timer](#) are accessible by the various hosts as indicated in [Section 18.10, "EC-Only Registers"](#).

## 18.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 18.7.1 POWER DOMAINS

**TABLE 18-1: POWER SOURCES**

| Name | Description  |
|------|--|
| VCC1 | The timer control logic and registers are all implemented on this single power domain. |

### 18.7.2 CLOCK INPUTS

**TABLE 18-2: CLOCK INPUTS**

| Name      | Description  |
|-----------|--|
| 32KHz_Clk | This is the clock source to the timer logic. The Pre-scaler may be used to adjust the minimum resolution per bit of the counter.<br><br>if the main oscillator is stopped then an external 32.768kHz clock source must be active for the Hibernation Timer to continue to operate. |

### 18.7.3 RESETS

**TABLE 18-3: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal, which is an input to this block, resets all the logic and registers to their initial default state. |

## 18.8 Interrupts

This section defines the interrupt Interface signals routed to the chip interrupt aggregator.

Each instance of the [Hibernation Timer](#) in the MEC1322 can be used to generate interrupts and wake-up events when the timer decrements to zero. The [Hibernation Timer](#) interrupt is are routed to the [HTIMER](#) bit in the [GIRQ17 Source Register](#).

**TABLE 18-4: INTERRUPT INTERFACE SIGNAL DESCRIPTION TABLE**

| Name   | Direction | Description  |
|--------|-----------|--|
| HTIMER | Output    | Signal indicating that the timer is enabled and decrements to 0. This signal is used to generate an Hibernation Timer interrupt event. |

## 18.9 Low Power Modes

The Hibernation Timer may be put into a low power state by the chip Power, Clocks, and Reset (PCR) circuitry.

The timer operates off of the [32KHz\\_Clk](#), and therefore will operate normally when [48 MHz Ring Oscillator](#) is stopped.

The sleep enable inputs have no effect on the Hibernation Timer and the clock required outputs are only asserted during register read/write cycles for as long as necessary to propagate updates to the block core.

## 18.10 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the Hibernation Timer. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

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**TABLE 18-5: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance    | Instance Number | Host | Address Space                 | Base Address |
|-------------------|-----------------|------|-------------------------------|--------------|
| Hibernation Timer | 0               | EC   | 32-bit internal address space | 4000_9800h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 18-6: HIBERNATION TIMER SUMMARY**

| Offset | Register Name                           |
|--------|---|
| 00h    | <a href="#">HTimer Preload Register</a> |
| 04h    | <a href="#">HTimer Control Register</a> |
| 08h    | <a href="#">HTimer Count Register</a>   |

## 18.10.1 HTIMER PRELOAD REGISTER

| Offset | 00h  |      |         |                            |
|--------|--|------|---------|----------------------------|
| Bits   | Description  | Type | Default | Reset Event                |
| 15:0   | <b>HT_PRELOAD</b><br>This register is used to set the Hibernation Timer Preload value. Writing this register to a non-zero value resets the down counter to start counting down from this programmed value. Writing this register to 0000h disables the hibernation counter. The resolution of this timer is determined by the CTRL bit in the <a href="#">HTimer Control Register</a> . Writes to the <a href="#">HTimer Control Register</a> are completed with an EC bus cycle. | R/W  | 000h    | <a href="#">VCC1_RESET</a> |

## 18.10.2 HTIMER CONTROL REGISTER

| Offset | 04h   |      |         |                            |
|--------|---|------|---------|----------------------------|
| Bits   | Description   | Type | Default | Reset Event                |
| 15:1   | Reserved  | R    | -       | -                          |
| 0      | <b>CTRL</b><br>1= The Hibernation Timer has a resolution of 0.125s per LSB, which yields a maximum time in excess of 2 hours.<br>0= The Hibernation Timer has a resolution of 30.5µs per LSB, which yields a maximum time of ~2seconds. | R    | 0000h   | <a href="#">VCC1_RESET</a> |

## 18.10.3 HTIMER COUNT REGISTER

| Offset | 08h   |      |         |                            |
|--------|---|------|---------|----------------------------|
| Bits   | Description   | Type | Default | Reset Event                |
| 15:0   | <b>COUNT</b><br>The current state of the Hibernation Timer. | R    | 0000h   | <a href="#">VCC1_RESET</a> |

## 19.0 RTC WITH DATE AND DST ADJUSTMENT

### 19.1 Introduction

This block provides the capabilities of an industry-standard 146818B Real-Time Clock module, without CMOS RAM. Enhancements to this architecture include:

- Industry standard Day of Month Alarm field, allowing for monthly alarms
- Configurable, automatic Daylight Savings adjustment
- Week Alarm for periodic interrupts and wakes based on Day of Week
- System Wake capability on interrupts.

### 19.2 References

1. Motorola 146818B Data Sheet, available on-line
2. Intel Lynx Point PCH EDS specification

### 19.3 Terminology

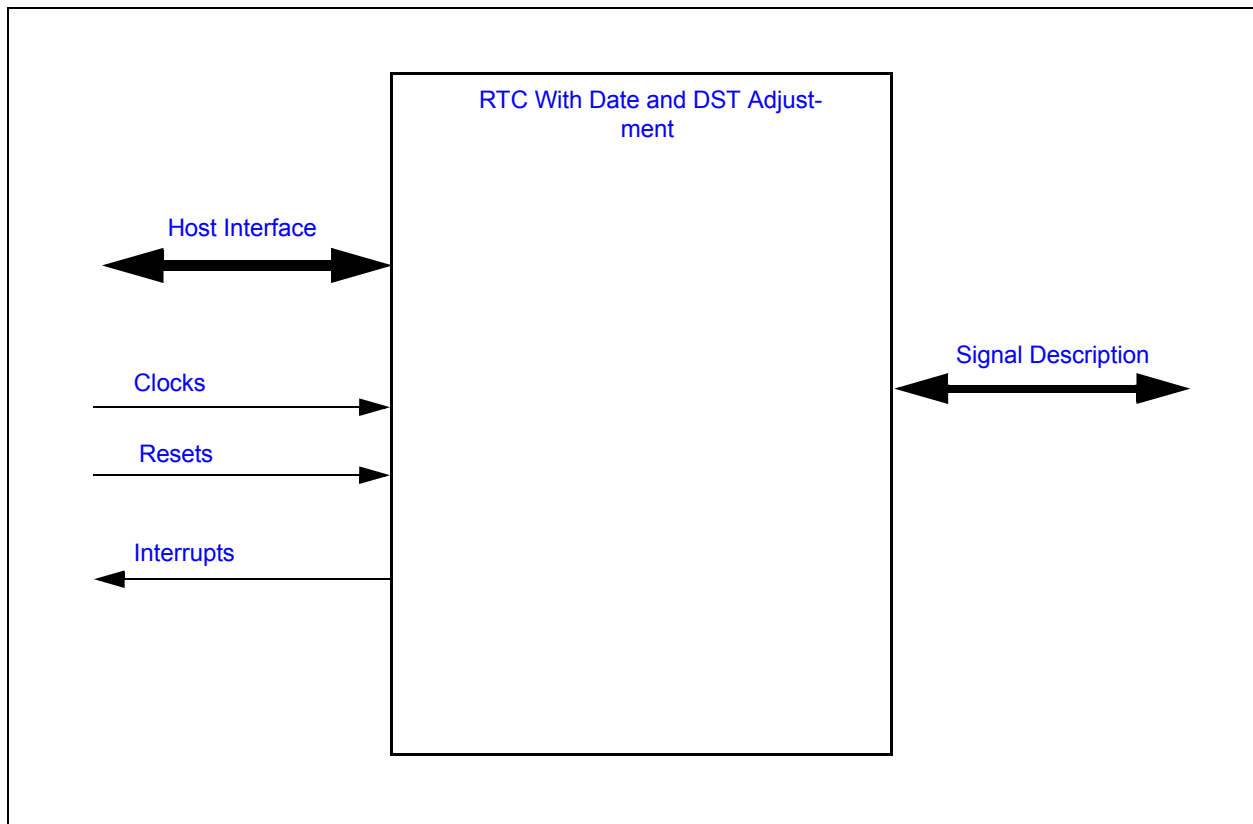
Time and Date Registers:

This is the set of registers that are automatically counted by hardware every 1 second while the block is enabled to run and to update. These registers are: **Seconds, Minutes, Hours, Day of Week, Day of Month, Month, and Year.**

### 19.4 Interface

This block's connections are entirely internal to the chip.

**FIGURE 19-1: I/O DIAGRAM OF BLOCK**



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## 19.5 Signal Description

There are no external signals.

## 19.6 Host Interface

The registers defined for the [RTC With Date and DST Adjustment](#) are accessible by the host and EC.

## 19.7 Power, Clocks and Resets

This section defines the Power, Clock, and Reset parameters of the block.

### 19.7.1 POWER DOMAINS

**TABLE 19-1: POWER SOURCES**

| Name                 | Description  |
|----------------------|--|
| <a href="#">VBAT</a> | This power well sources all of the internal registers and logic in this block.                                     |
| <a href="#">VCC1</a> | This power well sources only bus communication. The block continues to operate internally while this rail is down. |

### 19.7.2 CLOCKS

**TABLE 19-2: CLOCKS**

| Name                      | Description   |
|---------------------------|---|
| <a href="#">32KHz_Clk</a> | This 32KHz clock input drives all internal logic, and will be present at all times that the <a href="#">VBAT</a> well is powered. |

### 19.7.3 RESETS

**TABLE 19-3: RESET SIGNALS**

| Name                       | Description  |
|----------------------------|--|
| <a href="#">VBAT_POR</a>   | This reset signal is used in the <a href="#">RTC_RST</a> signal to reset all of the registers and logic in this block. It directly resets the Soft Reset bit in the RTC Control Register.  |
| <a href="#">RTC_RST</a>    | This reset signal resets all of the registers and logic in this block, except for the Soft Reset bit in the RTC Control Register. It is triggered by <a href="#">VBAT_POR</a> , but can also be triggered by a Soft Reset from the RTC Control Register. |
| <a href="#">VCC1_RESET</a> | This reset signal is used to inhibit the bus communication logic, and isolates this block from <a href="#">VCC1</a> powered circuitry on-chip. Otherwise it has no effect on the internal state.   |

## 19.8 Interrupts

**TABLE 19-4: SYSTEM INTERRUPTS**

| Source              | Description   |
|---------------------|---|
| <a href="#">RTC</a> | This interrupt source for the SIRQ logic is generated when any of the following events occur: <ul style="list-style-type: none"><li>• Update complete. This is triggered, at 1-second intervals, when the Time register updates have completed</li><li>• Alarm. This is triggered when the alarm value matches the current time (and date, if used)</li><li>• Periodic. This is triggered at the chosen programmable rate</li></ul> |



**TABLE 19-5: EC INTERRUPTS**

| Source    | Description  |
|-----------|--|
| RTC       | This interrupt is signaled to the Interrupt Aggregator when any of the following events occur: <ul style="list-style-type: none"> <li>Update complete. This is triggered, at 1-second intervals, when the Time register updates have completed</li> <li>Alarm. This is triggered when the alarm value matches the current time (and date, if used)</li> <li>Periodic. This is triggered at the chosen programmable rate</li> </ul> |
| RTC ALARM | This wake interrupt is signaled to the Interrupt Aggregator when an Alarm event occurs.  |

## 19.9 Low Power Modes

The RTC has no low-power modes. It runs continuously while the **VBAT** well is powered.

## 19.10 Description

This block provides the capabilities of an industry-standard 146818B Real-Time Clock module, excluding the CMOS RAM and the SQW output. See the following registers, which represent enhancements to this architecture. These enhancements are listed below.

See the Date Alarm field of [Register D](#) for a Day of Month qualifier for alarms.

See the [Week Alarm Register](#) for a Day of Week qualifier for alarms.

See the registers [Daylight Savings Forward Register](#) and [Daylight Savings Backward Register](#) for setting up hands-off Daylight Savings adjustments.

See the [RTC Control Register](#) for enhanced control over the block's operations.

## 19.11 Runtime Registers

The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in Runtime Register Base Address Table.

**TABLE 19-6: RUNTIME REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address   |
|----------------|-----------------|------|-------------------------------|----------------|
| RTC            | 0               | LPC  | I/O                           | Programmed BAR |
|                | 0               | EC   | 32-bit internal Address Space | 400F_2C00h     |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance. Add the register's Offset to this value to obtain the direct address of the register.

**TABLE 19-7: RUNTIME REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)               |
|--------|--|
| 00h    | <a href="#">Seconds Register</a>       |
| 01h    | <a href="#">Seconds Alarm Register</a> |
| 02h    | <a href="#">Minutes Register</a>       |
| 03h    | <a href="#">Minutes Alarm Register</a> |
| 04h    | <a href="#">Hours Register</a>         |
| 05h    | <a href="#">Hours Alarm Register</a>   |
| 06h    | <a href="#">Day of Week Register</a>   |
| 07h    | <a href="#">Day of Month Register</a>  |
| 08h    | <a href="#">Month Register</a>         |

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**TABLE 19-7: RUNTIME REGISTER SUMMARY (CONTINUED)**

| Offset | Register Name (Mnemonic)           |
|--------|------------------------------------|
| 09h    | Year Register                      |
| 0Ah    | Register A                         |
| 0Bh    | Register B                         |
| 0Ch    | Register C                         |
| 0Dh    | Register D                         |
| 0Eh    | (reserved)                         |
| 0Fh    | (reserved)                         |
| 10h    | RTC Control Register               |
| 14h    | Week Alarm Register                |
| 18h    | Daylight Savings Forward Register  |
| 1Ch    | Daylight Savings Backward Register |
| 20h    | MCHP Reserved                      |

**Note:** This extended register set occupies offsets that have historically been used as CMOS RAM. Code ported to use this block should be examined to ensure that it does not assume that RAM exists in this block.

## 19.11.1 SECONDS REGISTER

| Offset | 00h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | SECONDS<br>Displays the number of seconds past the current minute, in the range 0--59. Presentation may be selected as binary or BCD, depending on the DM bit in Register B. Values written must also use the format defined by the current setting of the DM bit. | R/W  | 00h     | RTC_RST     |

## 19.11.2 SECONDS ALARM REGISTER

| Offset | 01h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | SECONDS_ALARM<br>Holds a match value, compared against the Seconds Register to trigger the Alarm event. Values written to this register must use the format defined by the current setting of the DM bit in Register B. A value of 11xxxxxb written to this register makes it don't-care (always matching). | R/W  | 00h     | RTC_RST     |

## 19.11.3 MINUTES REGISTER

| Offset | 02h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | <b>MINUTES</b><br>Displays the number of minutes past the current hour, in the range 0-59. Presentation may be selected as binary or BCD, depending on the DM bit in Register B. Values written must also use the format defined by the current setting of the DM bit. | R/W  | 00h     | RTC_RST     |

## 19.11.4 MINUTES ALARM REGISTER

| Offset | 03h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:0    | <b>MINUTES_ALARM</b><br>Holds a match value, compared against the Minutes Register to trigger the Alarm event. Values written to this register must use the format defined by the current setting of the DM bit in Register B. A value of 11xxxxxb written to this register makes it don't-care (always matching). | R/W  | 00h     | RTC_RST     |

## 19.11.5 HOURS REGISTER

| Offset | 04h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7      | <b>HOURS_AM_PM</b><br>In 12-hour mode (see bit "24/12" in register B), this bit indicates AM or PM.<br><br>1=PM<br>0=AM   | R/W  | 0b      | RTC_RST     |
| 6:0    | <b>HOURS</b><br>Displays the number of the hour, in the range 1--12 for 12-hour mode (see bit "24/12" in register B), or in the range 0--23 for 24-hour mode. Presentation may be selected as binary or BCD, depending on the DM bit in Register B. Values written must also use the format defined by the current setting of the DM bit. | R/W  | 00h     | RTC_RST     |

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## 19.11.6 HOURS ALARM REGISTER

| Offset | 05h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>HOURS_ALARM</b><br>Holds a match value, compared against the Hours Register to trigger the Alarm event. Values written to this register must use the format defined by the current settings of the DM bit and the 24/12 bit in Register B. A value of 11xxxxxb written to this register makes it don't-care (always matching). | R/W  | 00h     | RTC_RST     |

## 19.11.7 DAY OF WEEK REGISTER

| Offset | 06h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>DAY_OF_WEEK</b><br>Displays the day of the week, in the range 1 (Sunday) through 7 (Saturday). Numbers in this range are identical in both binary and BCD notation, so this register's format is unaffected by the DM bit. | R/W  | 00h     | RTC_RST     |

## 19.11.8 DAY OF MONTH REGISTER

| Offset | 07h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>DAY_OF_MONTH</b><br>Displays the day of the current month, in the range 1--31. Presentation may be selected as binary or BCD, depending on the DM bit in Register B. Values written must also use the format defined by the current setting of the DM bit. | R/W  | 00h     | RTC_RST     |

## 19.11.9 MONTH REGISTER

| Offset | 08h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>MONTH</b><br>Displays the month, in the range 1--12. Presentation may be selected as binary or BCD, depending on the DM bit in Register B. Values written must also use the format defined by the current setting of the DM bit. | R/W  | 00h     | RTC_RST     |

## 19.11.10 YEAR REGISTER

| Offset | 09h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>YEAR</b><br>Displays the number of the year in the current century, in the range 0 (year 2000) through 99 (year 2099). Presentation may be selected as binary or BCD, depending on the DM bit in Register B. Values written must also use the format defined by the current setting of the DM bit. | R/W  | 00h     | RTC_RST     |

## 19.11.11 REGISTER A

| Offset | 0Ah   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7      | <b>UPDATE_IN_PROGRESS</b><br>'0' indicates that the Time and Date registers are stable and will not be altered by hardware soon. '1' indicates that a hardware update of the Time and Date registers may be in progress, and those registers should not be accessed by the host program. This bit is set to '1' at a point 488us (16 cycles of the 32K clock) before the update occurs, and is cleared immediately after the update. See also the Update-Ended Interrupt, which provides more useful status.  | R    | 0b      | RTC_RST     |
| 6:4    | <b>DIVISION_CHAIN_SELECT</b><br>This field provides general control for the Time and Date register updating logic.<br><br>11xb=Halt counting. The next time that 010b is written, updates will begin 500ms later.<br>010b=Required setting for normal operation. It is also necessary to set the Block Enable bit in the <a href="#">RTC Control Register</a> to '1' for counting to begin<br>000b=Reserved. This field should be initialized to another value before Enabling the block in the <a href="#">RTC Control Register</a><br>Other values Reserved | R/W  | 000b    | RTC_RST     |
| 3:0    | <b>RATE_SELECT</b><br>This field selects the rate of the Periodic Interrupt source. See <a href="#">Table 19-8</a>  | R/W  | 0h      | RTC_RST     |

**TABLE 19-8: REGISTER A FIELD RS: PERIODIC INTERRUPT SETTINGS**

| RS (hex) | Interrupt Period |
|----------|------------------|
| 0        | Never Triggered  |
| 1        | 3.90625 ms       |
| 2        | 7.8125 ms        |
| 3        | 122.070 us       |
| 4        | 244.141 us       |
| 5        | 488.281 us       |
| 6        | 976.5625 us      |

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**TABLE 19-8: REGISTER A FIELD RS: PERIODIC INTERRUPT SETTINGS (CONTINUED)**

| RS (hex) | Interrupt Period |
|----------|------------------|
| 7        | 1.953125 ms      |
| 8        | 3.90625 ms       |
| 9        | 7.8125 ms        |
| A        | 15.625 ms        |
| B        | 31.25 ms         |
| C        | 62.5 ms          |
| D        | 125 ms           |
| E        | 250 ms           |
| F        | 500 ms           |

## 19.11.12 REGISTER B

| Offset | 0Bh  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7      | <p>UPDATE_CYCLE_INHIBIT</p> <p>In its default state '0', this bit allows hardware updates to the Time and Date registers, which occur at 1-second intervals. A '1' written to this field inhibits updates, allowing these registers to be cleanly written to different values. Writing '0' to this bit allows updates to continue.</p> | R/W  | 0b      | RTC_RST     |
| 6      | <p>PERIODIC_INTERRUPT_ENABLE</p> <p>1=Allows the Periodic Interrupt events to be propagated as interrupts<br/>0=Periodic events are not propagated as interrupts</p>   | R/W  | 0b      | RTC_RST     |
| 5      | <p>ALARM_INTERRUPT_ENABLE</p> <p>1=Allows the Alarm Interrupt events to be propagated as interrupts<br/>0=Alarm events are not propagated as interrupts</p>  | R/W  | 0b      | RTC_RST     |
| 4      | <p>UPDATE_ENDED_INTERRUPT_ENABLE</p> <p>1=Allows the Update Ended Interrupt events to be propagated as interrupts<br/>0=Update Ended events are not propagated as interrupts</p>   | R/W  | 0b      | RTC_RST     |
| 3      | Reserved   | R    | -       | -           |
| 2      | <p>DATA_MODE</p> <p>1=Binary Mode for Dates and Times<br/>0=BCD Mode for Dates and Times</p>   | R/W  | 0b      | RTC_RST     |
| 1      | <p>HOUR_FORMAT_24_12</p> <p>1=24-Hour Format for Hours and Hours Alarm registers. 24-Hour format keeps the AM/PM bit off, with value range 0--23<br/>0=12-Hour Format for Hours and Hours Alarm registers. 12-Hour format has an AM/PM bit, and value range 1--12</p>  | R/W  | 0b      | RTC_RST     |

| Offset | 0Bh  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 0      | <p>DAYLIGHT_SAVINGS_ENABLE</p> <p>1=Enables automatic hardware updating of the hour, using the registers Daylight Savings Forward and Daylight Savings Backward to select the yearly date and hour for each update<br/>0=Automatic Daylight Savings updates disabled</p> | R/W  | 0b      | RTC_RST     |

**Note:** The DATA\_MODE and HOUR\_FORMAT\_24\_12 bits affect only how values are presented as they are being read and how they are interpreted as they are being written. They do not affect the internal contents or interpretations of registers that have already been written, nor do they affect how those registers are represented or counted internally. This mode bits may be set and cleared dynamically, for whatever I/O data representation is desired by the host program.

### 19.11.13 REGISTER C

| Offset | 0Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7      | <p>INTERRUPT_REQUEST_FLAG</p> <p>1=Any of bits[6:4] below is active after masking by their respective Enable bits in Register B.<br/>0=No bits in this register are active</p> <p>This bit is automatically cleared by every Read access to this register.</p>   | RC   | 0b      | RTC_RST     |
| 6      | <p>PERIODIC_INTERRUPT_FLAG</p> <p>1=A Periodic Interrupt event has occurred since the last time this register was read. This bit displays status regardless of the Periodic Interrupt Enable bit in Register B<br/>0=A Periodic Interrupt event has not occurred</p> <p>This bit is automatically cleared by every Read access to this register.</p> | RC   | 0b      | RTC_RST     |
| 5      | <p>ALARM_FLAG</p> <p>1=An Alarm event has occurred since the last time this register was read. This bit displays status regardless of the Alarm Interrupt Enable bit in Register B.<br/>0=An Alarm event has not occurred</p> <p>This bit is automatically cleared by every Read access to this register.</p>  | RC   | 0b      | RTC_RST     |

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| Offset | 0Ch | Bits | Description   | Type | Default | Reset Event |
|--------|-----|------|---|------|---------|-------------|
|        |     | 4    | UPDATE_ENDED_INTERRUPT_FLAG<br><br>1=A Time and Date update has completed since the last time this register was read. This bit displays status regardless of the Update-Ended Interrupt Enable bit in Register B. Presentation of this status indicates that the Time and Date registers will be valid and stable for over 999ms<br>0=A Time and Data update has not completed since the last time this register was read<br><br>This bit is automatically cleared by every Read access to this register. | RC   | 0b      | RTC_RST     |
|        |     | 3:0  | Reserved  | R    | -       | -           |

## 19.11.14 REGISTER D

| Offset | 0Dh | Bits | Description  | Type | Default | Reset Event |
|--------|-----|------|--|------|---------|-------------|
|        |     | 7:6  | Reserved   | R    | -       | -           |
|        |     | 5:0  | DATE_ALARM<br>This field, if set to a non-zero value, will inhibit the Alarm interrupt unless this field matches the contents of the Month register also. If this field contains 00h (default), it represents a don't-care, allowing more frequent alarms. | R/W  | 00h     | RTC_RST     |

## 19.11.15 RTC CONTROL REGISTER

| Offset | 10h | Bits | Description  | Type | Default | Reset Event |
|--------|-----|------|--|------|---------|-------------|
|        |     | 7:4  | Reserved   | R    | -       | -           |
|        |     | 3    | ALARM_ENABLE<br><br>1=Enables the Alarm features<br>0=Disables the Alarm features  | R/W  | 0b      | RTC_RST     |
|        |     | 2    | Microchip Reserved   | R/W  | 0b      | RTC_RST     |
|        |     | 1    | SOFT_RESET<br>A '1' written to this bit position will trigger the <a href="#">RTC_RST</a> reset, resetting the block and all registers except this one and the Test Register. This bit is self-clearing at the end of the reset, one cycle of LPC Bus Clock later, and so requires no waiting. | R/W  | 0b      | VBAT_POR    |
|        |     | 0    | BLOCK_ENABLE<br>This bit must be '1' in order for the block to function internally. Registers may be initialized first, before setting this bit to '1' to start operation.   | R/W  | 0b      | RTC_RST     |



## 19.11.16 WEEK ALARM REGISTER

| Offset | 14h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:0    | <b>ALARM_DAY_OF_WEEK</b><br>This register, if written to a value in the range 1--7, will inhibit the Alarm interrupt unless this field matches the contents of the Day of Week Register also. If this field is written to any value 11xxxxxb (like the default FFh), it represents a don't-care, allowing more frequent alarms, and will read back as FFh until another value is written. | R/W  | FFh     | RTC_RST     |

## 19.11.17 DAYLIGHT SAVINGS FORWARD REGISTER

| Offset | 18h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31     | <b>DST_FORWARD_AM_PM</b><br>This bit selects AM vs. PM, to match bit[7] of the Hours Register if 12-Hour mode is selected in Register B at the time of writing.  | R/W  | 0b      | RTC_RST     |
| 30:24  | <b>DST_FORWARD_HOUR</b><br>This field holds the matching value for bits[6:0] of the Hours register. The written value will be interpreted according to the 24/12 Hour mode and DM mode settings at the time of writing.  | R/W  | 00h     | RTC_RST     |
| 23:19  | Reserved   | R    | -       | -           |
| 18:16  | <b>DST_FORWARD_WEEK</b><br>This value matches an internally-maintained week number within the current month. Valid values for this field are:<br><br>5=Last week of month<br>4 =Fourth week of month<br>3=Third week of month<br>2=Second week of month<br>1=First week of month | R/W  | 0h      | RTC_RST     |
| 15:11  | Reserved   | R    | -       | -           |
| 10:8   | <b>DST_FORWARD_DAY_OF_WEEK</b><br>This field matches the Day of Week Register bits[2:0].   | R/W  | 0h      | RTC_RST     |
| 7:0    | <b>DST_FORWARD_MONTH</b><br>This field matches the Month Register.   | R/W  | 00h     | RTC_RST     |

This is a 32-bit register, accessible also as individual bytes. When writing as individual bytes, ensure that the DSE bit (in Register B) is off first, or that the block is disabled or stopped (SET bit), to prevent a time update while this register may have incompletely-updated contents.

When enabled by the DSE bit in Register B, this register defines an hour and day of the year at which the Hours register will be automatically incremented by 1 additional hour.

There are no don't-care fields recognized. All fields must be already initialized to valid settings whenever the DSE bit is '1'.

Fields other than Week and Day of Week use the current setting of the DM bit (binary vs. BCD) to interpret the information as it is written to them. Their values, as held internally, are not changed by later changes to the DM bit, without subsequently writing to this register as well.

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**Note:** An Alarm that is set inside the hour after the time specified in this register will not be triggered, because that one-hour period is skipped. This period includes the exact time (0 minutes: 0 seconds) given by this register, through the 59 minutes: 59 seconds point afterward.

## 19.11.18 DAYLIGHT SAVINGS BACKWARD REGISTER

| Offset | 1Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31     | DST_BACKWARD_AM_PM<br>This bit selects AM vs. PM, to match bit[7] of the Hours register if 12-Hour mode is selected in Register B at the time of writing.  | R/W  | 0b      | RTC_RST     |
| 30:24  | DST_BACKWARD_HOUR<br>This field holds the matching value for bits[6:0] of the Hours register. The written value will be interpreted according to the 24/12 Hour mode and DM mode settings at the time of writing.  | R/W  | 00h     | RTC_RST     |
| 23:19  | Reserved   | R    | -       | -           |
| 18:16  | DST_BACKWARD_WEEK<br>This value matches an internally-maintained week number within the current month. Valid values for this field are:<br><br>5=Last week of month<br>4 =Fourth week of month<br>3=Third week of month<br>2=Second week of month<br>1=First week of month | R/W  | 0h      | RTC_RST     |
| 15:11  | Reserved   | R    | -       | -           |
| 10:8   | DST_BACKWARD_DAY_OF_WEEK<br>This field matches the Day of Week Register bits[2:0].   | R/W  | 0h      | RTC_RST     |
| 7:0    | DST_BACKWARD_MONTH<br>This field matches the Month Register.   | R/W  | 00h     | RTC_RST     |

This is a 32-bit register, accessible also as individual bytes. When writing as individual bytes, ensure that the DSE bit (in Register B) is off first, or that the block is disabled or stopped (SET bit), to prevent a time update while this register may have incompletely-updated contents.

When enabled by the DSE bit in Register B, this register defines an hour and day of the year at which the Hours register increment will be inhibited from occurring. After triggering, this feature is automatically disabled for long enough to ensure that it will not retrigger the second time this Hours value appears, and then this feature is re-enabled automatically.

There are no don't-care fields recognized. All fields must be already initialized to valid settings whenever the DSE bit is '1'.

Fields other than Week and Day of Week use the current setting of the DM bit (binary vs. BCD) to interpret the information as it is written to them. Their values, as held internally, are not changed by later changes to the DM bit, without subsequently writing to this register as well.

**Note:** An Alarm that is set inside the hour before the time specified in this register will be triggered twice, because that one-hour period is repeated. This period will include the exact time (0 minutes: 0 seconds) given by this register, through the 59 minutes: 59 seconds point afterward.

## 20.0 GPIO INTERFACE

### 20.1 General Description

The MEC1322 [GPIO Interface](#) provides general purpose input monitoring and output control, as well as managing many aspects of pin functionality; including, multi-function Pin Multiplexing Control, [GPIO Direction](#) control, [PU/PD \(PU\\_PD\)](#) resistors, asynchronous wakeup and synchronous [Interrupt Detection \(int\\_det\)](#), [GPIO Direction](#), and [Polarity](#) control, as well as control of pin drive strength and slew rate.

Features of the [GPIO Interface](#) include:

- Inputs:
  - Asynchronous rising and falling edge wakeup detection
  - Interrupt High or Low Level
- On Output:
  - Push Pull or Open Drain output
- Pull up or pull down resistor control
- Interrupt and wake capability available for all GPIOs
- Programmable pin drive strength and slew rate limiting
- Group- or individual control of GPIO data.
- Multiplexing of all multi-function pins are controlled by the GPIO interface

### 20.2 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

#### 20.2.1 POWER DOMAINS

**TABLE 20-1: POWER SOURCES**

| Name                 | Description   |
|----------------------|---|
| <a href="#">VCC1</a> | The registers and logic in this block are powered by <a href="#">VCC1</a> . |

#### 20.2.2 CLOCK INPUTS

**TABLE 20-2: CLOCK INPUTS**

| Name                                   | Description   |
|--|---|
| <a href="#">48 MHz Ring Oscillator</a> | The <a href="#">48 MHz Ring Oscillator</a> is used for synchronizing the GPIO inputs. |

#### 20.2.3 RESETS

**TABLE 20-3: RESET SIGNALS**

| Name                       | Description   |
|----------------------------|---|
| <a href="#">VCC1_RESET</a> | This reset is asserted when <a href="#">VCC1</a> is applied.  |
| <a href="#">nSIO_RESET</a> | This is an alternate reset condition, typically asserted when the main power rail is asserted. This reset is used for VCC Power Well Emulation. |

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## 20.3 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 20-4: INTERRUPTS**

| Source     | Description  |
|------------|--|
| GPIO_Event | <p>Each pin in the <a href="#">GPIO Interface</a> has the ability to generate an interrupt event. This event may be used as a wake event.</p> <p>The <a href="#">GPIO Interface</a> can generate an interrupt source event on a high level, low level, rising edge and falling edge, as configured by the <a href="#">Interrupt Detection (int_det)</a> bits in the <a href="#">Pin Control Register</a> associated with the GPIO signal function.</p> <p><b>Note:</b> The minimum pulse width ensured to generate an interrupt/wakeup event is 5ns.</p> |

## 20.4 Accessing GPIOs

There are two ways to access GPIO output data. Bit [10] is used to determine which GPIO output data bit affects the GPIO output pin.

- Output GPIO Data
  - Outputs to individual GPIO ports are grouped into 32-bit [GPIO Output Registers](#).
- [Alternative GPIO data](#)
  - Alternatively, each GPIO output port is individually accessible via Bit [16] in the port's [Pin Control Register](#). On reads, Bit [16] returns the programmed value, not the value on the pin.

There are two ways to access GPIO input data.

- Input GPIO Data
  - Inputs from individual GPIO ports are grouped into 32-bit [GPIO Input Registers](#) and always reflect the current state of the GPIO input from the pad.
- [GPIO input from pad](#)
  - Alternatively, each GPIO input port is individually accessible via Bit [24] in the port's [Pin Control Register](#). Bit [24] always reflects the current state of GPIO input from the pad.

## 20.5 GPIO Indexing

Each GPIO signal function name consists of a 4-character prefix ("GPIO") followed by a 3-digit octal-encoded index number. In the MEC1322 GPIO indexing is done sequentially starting from 'GPIO000.'

## 20.6 GPIO Multiplexing Control

Pin multiplexing depends upon the Mux Control bits in the Pin Control Register. There are two Pin Control Registers for each GPIO signal function.

The MEC1322 Pin Control Register address offsets shown in the following tables depends on the GPIO Index number. Pin Control Register defaults are also shown in these tables.

**Note 1:** Pin Control Register 2 default values are not shown in these tables.

- 2: The GPIO143/RSMRST# pin operates as described in [Section 1.6, "Notes for Tables in this Chapter," on page 39](#) when it is configured as a GPIO; the RSMRST# function is not a true alternate function. For proper RSMRST# operation on the pin, the GPIO143 control register must not be changed from the GPIO default function.
- 3: [The VCC1\\_RST#/GPIO131 pin cannot be used as a GPIO pin. The input path to the VCC1\\_RST# logic is always active and will cause a reset if this pin is set low in GPIO mode.](#)
- 4: The KSI[7:0] pins have the internal pullups enabled by ROM boot code. Therefore the Pin Control Reg. POR Value is as follows after the ROM boot code runs:

GPIO043 = 00003001h  
GPIO042 = 00003001h

GPIO040 = 00003001h  
 GPIO142 = 00003001h  
 GPIO032 = 00003001h  
 GPIO144 = 00003001h  
 GPIO126 = 00002001h  
 GPIO125 = 00002001h

**TABLE 20-5: PIN CONTROL REGISTERS**

| GPIO Name (Octal) | Pin Control Reg. Offset (Hex) | Pin Control Reg. POR Value (Hex) | POR Default Signal Function | Mux Control = 00 | Mux Control = 01 | Mux Control = 10 | Mux Control = 11 |
|-------------------|-------------------------------|----------------------------------|-----------------------------|------------------|------------------|------------------|------------------|
| GPIO000           | 0000                          | 00003000                         | KSO00                       | GPIO000          | Reserved         | Reserved         | KSO00            |
| GPIO001           | 0004                          | 00003000                         | KSO06                       | GPIO001          | Reserved         | Reserved         | KSO06            |
| GPIO002           | 0008                          | 00003000                         | KSO07                       | GPIO002          | Reserved         | Reserved         | KSO07            |
| GPIO003           | 000C                          | 00003000                         | KSO08                       | GPIO003          | Reserved         | Reserved         | KSO08            |
| GPIO004           | 0010                          | 00003000                         | KSO10                       | GPIO004          | Reserved         | Reserved         | KSO10            |
| GPIO005           | 0014                          | 00003002                         | KSO12                       | GPIO005          | Reserved         | Reserved         | KSO12            |
| GPIO006           | 0018                          | 00003000                         | KSO13                       | GPIO006          | Reserved         | Reserved         | KSO13            |
| GPIO007           | 001C                          | 00000000                         | GPIO007                     | GPIO007          | Reserved         | Reserved         | KSO14            |
| GPIO010           | 0020                          | 00000000                         | GPIO010                     | GPIO010          | Reserved         | Reserved         | KSO15            |
| GPIO011           | 0024                          | 00000002                         | GPIO011                     | GPIO011          | Reserved         | Reserved         | KSO16            |
| GPIO012           | 0028                          | 00000000                         | GPIO012                     | GPIO012          | Reserved         | Reserved         | KSO17            |
| GPIO013           | 002C                          | 00002000                         | 32KHZ_OUT                   | GPIO013          | Reserved         | 32KHZ_OUT        | Reserved         |
| GPIO014           | 0030                          | 00001000                         | CLKRUN#                     | GPIO014          | CLKRUN#          | Reserved         | Reserved         |
| GPIO015           | 0034                          | 00002100                         | I2C0_CLK0                   | GPIO015          | Reserved         | I2C0_CLK0        | Reserved         |
| GPIO016           | 0038                          | 00002100                         | I2C0_DAT0                   | GPIO016          | Reserved         | I2C0_DAT0        | Reserved         |
| GPIO017           | 003C                          | 00002100                         | I2C0_DAT1                   | GPIO017          | Reserved         | I2C0_DAT1        | Reserved         |
| GPIO020           | 0040                          | 00000000                         | GPIO020                     | GPIO020          | Reserved         | I2C2_CLK0        | Reserved         |
| GPIO021           | 0044                          | 00000000                         | GPIO021                     | GPIO021          | Reserved         | I2C2_DAT0        | Reserved         |
| GPIO022           | 0048                          | 00000000                         | GPIO022                     | GPIO022          | Reserved         | I2C1_CLK0        | Reserved         |
| GPIO023           | 004C                          | 00000000                         | GPIO023                     | GPIO023          | Reserved         | I2C1_DAT0        | Reserved         |
| GPIO024           | 0050                          | 00000001                         | GPIO024                     | GPIO024          | Reserved         | I2C3_CLK0        | Reserved         |
| GPIO025           | 0054                          | 00000000                         | GPIO025                     | GPIO025          | Reserved         | I2C3_DAT0        | Reserved         |
| GPIO026           | 0058                          | 00002100                         | nEC_SCI                     | GPIO026          | Reserved         | nEC_SCI          | Reserved         |
| GPIO027           | 005C                          | 00000001                         | GPIO027                     | GPIO027          | Reserved         | Reserved         | Reserved         |
| GPIO030           | 0060                          | 00000000                         | GPIO030                     | GPIO030          | Reserved         | Reserved         | Reserved         |
| GPIO031           | 0064                          | 00000001                         | GPIO031                     | GPIO031          | Reserved         | Reserved         | Reserved         |
| GPIO032           | 0068                          | 00003000                         | KSI3                        | GPIO032          | Reserved         | Reserved         | KSI3             |
| GPIO033           | 006C                          | 00000001                         | GPIO033                     | GPIO033          | Reserved         | Reserved         | Reserved         |
| GPIO034           | 0070                          | 00000000                         | GPIO034                     | GPIO034          | PWM2             | Reserved         | TACH2PWM_OUT     |
| GPIO035           | 0074                          | 00000001                         | GPIO035                     | GPIO035          | Reserved         | Reserved         | Reserved         |
| GPIO036           | 0078                          | 00000001                         | GPIO036                     | GPIO036          | Reserved         | Reserved         | Reserved         |
| GPIO040           | 0080                          | 00003000                         | KSI5                        | GPIO040          | Reserved         | Reserved         | KSI5             |

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| GPIO Name (Octal) | Pin Control Reg. Offset (Hex) | Pin Control Reg. POR Value (Hex) | POR Default Signal Function | Mux Control = 00 | Mux Control = 01 | Mux Control = 10 | Mux Control = 11 |
|-------------------|-------------------------------|----------------------------------|-----------------------------|------------------|------------------|------------------|------------------|
| GPIO041           | 0084                          | 00001002                         | Reserved                    | GPIO041          | Reserved         | Reserved         | Reserved         |
| GPIO042           | 0088                          | 00003000                         | KSI6                        | GPIO042          | Reserved         | Reserved         | KSI6             |
| GPIO043           | 008C                          | 00003000                         | KSI7                        | GPIO043          | Reserved         | Reserved         | KSI7             |
| GPIO044           | 0090                          | 00000000                         | GPIO044                     | GPIO044          | nSMI             | Reserved         | Reserved         |
| GPIO045           | 0094                          | 00000000                         | GPIO045                     | GPIO045          | A20M             | PVT_CS1#         | Reserved         |
| GPIO046           | 0098                          | 00002100                         | PS2_CLK0                    | GPIO046          | Reserved         | PS2_CLK0         | Reserved         |
| GPIO047           | 009C                          | 00002100                         | PS2_DAT0                    | GPIO047          | Reserved         | PS2_DAT0         | Reserved         |
| GPIO050           | 00A0                          | 00002100                         | PS2_CLK1                    | GPIO050          | Reserved         | PS2_CLK1         | Reserved         |
| GPIO051           | 00A4                          | 00002100                         | PS2_CLK2                    | GPIO051          | Reserved         | PS2_CLK2         | Reserved         |
| GPIO052           | 00A8                          | 00002100                         | PS2_DAT2                    | GPIO052          | Reserved         | PS2_DAT2         | Reserved         |
| GPIO053           | 00AC                          | 00000000                         | GPIO053                     | GPIO053          | Reserved         | PS2_CLK3         | Reserved         |
| GPIO054           | 00B0                          | 00000000                         | GPIO054                     | GPIO054          | PVT_MOSI         | Reserved         | Reserved         |
| GPIO055           | 00B4                          | 00000000                         | GPIO055                     | GPIO055          | Reserved         | Reserved         | Reserved         |
| GPIO056           | 00B8                          | 00003000                         | ADC0                        | GPIO056          | ADC0             | Reserved         | Reserved         |
| GPIO057           | 00BC                          | 00001000                         | ADC1                        | GPIO057          | ADC1             | Reserved         | Reserved         |
| GPIO060           | 00C0                          | 00001001                         | ADC2                        | GPIO060          | ADC2             | Reserved         | Reserved         |
| GPIO061           | 00C4                          | 00001000                         | ADC3                        | GPIO061          | ADC3             | Reserved         | Reserved         |
| GPIO062           | 00C8                          | 00001000                         | ADC4                        | GPIO062          | ADC4             | Reserved         | Reserved         |
| GPIO063           | 00CC                          | 00001000                         | VCC_PWRGD                   | GPIO063          | VCC_PWRGD        | Reserved         | Reserved         |
| GPIO064           | 00D0                          | 00000000                         | GPIO064                     | GPIO064          | SHD_MOSI         | Reserved         | Reserved         |
| GPIO065           | 00D4                          | 00002100                         | PS2_DAT1                    | GPIO065          | Reserved         | PS2_DAT1         | Reserved         |
| GPIO066           | 00D8                          | 00000000                         | GPIO066                     | GPIO066          | Reserved         | Reserved         | Reserved         |
| GPIO067           | 00DC                          | 00000000                         | GPIO067                     | GPIO067          | Reserved         | Reserved         | Reserved         |
| GPIO100           | 0100                          | 00003000                         | KSO01                       | GPIO100          | Reserved         | Reserved         | KSO01            |
| GPIO101           | 0104                          | 00003000                         | KSO02                       | GPIO101          | Reserved         | Reserved         | KSO02            |
| GPIO102           | 0108                          | 00003000                         | KSO03                       | GPIO102          | Reserved         | Reserved         | KSO03            |
| GPIO103           | 010C                          | 00003000                         | KSO04                       | GPIO103          | TFDP_DATA        | Reserved         | KSO04            |
| GPIO104           | 0110                          | 00003000                         | KSO05                       | GPIO104          | TFDP_CLK         | Reserved         | KSO05            |
| GPIO105           | 0114                          | 00000000                         | GPIO105                     | GPIO105          | TACH1            | Reserved         | Reserved         |
| GPIO106           | 0118                          | 00003000                         | KSO09                       | GPIO106          | Reserved         | Reserved         | KSO09            |
| GPIO107           | 011C                          | 00003000                         | KSO11                       | GPIO107          | Reserved         | Reserved         | KSO11            |
| GPIO110           | 0120                          | 00000000                         | GPIO110                     | GPIO110          | Reserved         | Reserved         | Reserved         |

| GPIO Name (Octal) | Pin Control Reg. Offset (Hex) | Pin Control Reg. POR Value (Hex) | POR Default Signal Function | Mux Control = 00 | Mux Control = 01 | Mux Control = 10 | Mux Control = 11 |
|-------------------|-------------------------------|----------------------------------|-----------------------------|------------------|------------------|------------------|------------------|
| GPIO111           | 0124                          | 00001000                         | LAD3                        | GPIO111          | LAD3             | Reserved         | Reserved         |
| GPIO112           | 0128                          | 00001000                         | LAD0                        | GPIO112          | LAD0             | Reserved         | Reserved         |
| GPIO113           | 012C                          | 00001000                         | LAD2                        | GPIO113          | LAD2             | Reserved         | Reserved         |
| GPIO114           | 0130                          | 00001000                         | LAD1                        | GPIO114          | LAD1             | Reserved         | Reserved         |
| GPIO115           | 0134                          | 00001000                         | SER_IRQ                     | GPIO115          | SER_IRQ          | Reserved         | Reserved         |
| GPIO116           | 0138                          | 00001000                         | LRESET#                     | GPIO116          | LRESET#          | Reserved         | Reserved         |
| GPIO117           | 013C                          | 00001000                         | PCI_CLK                     | GPIO117          | PCI_CLK          | Reserved         | Reserved         |
| GPIO120           | 0140                          | 00001000                         | LFRAME#                     | GPIO120          | LFRAME#          | Reserved         | Reserved         |
| GPIO121           | 0144                          | 00001000                         | nRESET_OUT                  | GPIO121          | nRESET_OUT       | Reserved         | Reserved         |
| GPIO122           | 0148                          | 00000000                         | GPIO122                     | GPIO122          | SHD_SCLK         | Reserved         | Reserved         |
| GPIO123           | 014C                          | 00000000                         | GPIO123                     | GPIO123          | Reserved         | Reserved         | Reserved         |
| GPIO124           | 0150                          | 00000000                         | GPIO124                     | GPIO124          | SHD_MISO         | Reserved         | Reserved         |
| GPIO125           | 0154                          | 00002000                         | KS10                        | GPIO125          | Reserved         | KS10             | Reserved         |
| GPIO126           | 0158                          | 00002000                         | KS11                        | GPIO126          | Reserved         | KS11             | Reserved         |
| GPIO127           | 015C                          | 00000000                         | GPIO127                     | GPIO127          | PECI_RDY         | Reserved         | Reserved         |
| GPIO130           | 0160                          | 00000000                         | GPIO130                     | GPIO130          | Reserved         | Reserved         | Reserved         |
| GPIO131           | 0164                          | 00001100                         | VCC1_RST#                   | GPIO131          | VCC1_RST#        | Reserved         | Reserved         |
| GPIO132           | 0168                          | 00000000                         | GPIO132                     | GPIO132          | PECI_DAT         | Reserved         | Reserved         |
| GPIO133           | 016C                          | 00000000                         | GPIO133                     | GPIO133          | PWM0             | Reserved         | Reserved         |
| GPIO134           | 0170                          | 00002100                         | I2C0_CLK1                   | GPIO134          | Reserved         | I2C0_CLK1        | Reserved         |
| GPIO135           | 0174                          | 00000000                         | GPIO135                     | GPIO135          | KBRST            | Reserved         | Reserved         |
| GPIO136           | 0178                          | 00000000                         | GPIO136                     | GPIO136          | PWM1             | Reserved         | Reserved         |
| GPIO140           | 0180                          | 00000000                         | GPIO140                     | GPIO140          | TACH2            | Reserved         | TACH2PWM_IN      |
| GPIO141           | 0184                          | 00000000                         | GPIO141                     | GPIO141          | PWM3             | LED3             | Reserved         |
| GPIO142           | 0188                          | 00003000                         | KS14                        | GPIO142          | Reserved         | Reserved         | KS14             |
| GPIO143           | 018C                          | 00000200                         | GPIO143                     | GPIO143          | RSMRST#          | Reserved         | Reserved         |
| GPIO144           | 0190                          | 00003000                         | KS12                        | GPIO144          | Reserved         | Reserved         | KS12             |
| GPIO145           | 0194                          | 00000001                         | GPIO145                     | GPIO145          | Reserved         | Reserved         | Reserved         |
| GPIO146           | 0198                          | 00000000                         | GPIO146                     | GPIO146          | PVT_CS0#         | Reserved         | Reserved         |
| GPIO147           | 019C                          | 00000001                         | GPIO147                     | GPIO147          | Reserved         | Reserved         | Reserved         |
| GPIO150           | 01A0                          | 00000000                         | GPIO150                     | GPIO150          | SHD_CS0#         | Reserved         | Reserved         |
| GPIO151           | 01A4                          | 00000001                         | GPIO151                     | GPIO151          | Reserved         | Reserved         | Reserved         |

| GPIO Name (Octal) | Pin Control Reg. Offset (Hex) | Pin Control Reg. POR Value (Hex) | POR Default Signal Function | Mux Control = 00 | Mux Control = 01 | Mux Control = 10 | Mux Control = 11 |
|-------------------|-------------------------------|----------------------------------|-----------------------------|------------------|------------------|------------------|------------------|
| GPIO152           | 01A8                          | 00000000                         | GPIO152                     | GPIO152          | Reserved         | PS2_DAT3         | Reserved         |
| GPIO153           | 01AC                          | 00000000                         | GPIO153                     | GPIO153          | PVT_SCLK         | Reserved         | Reserved         |
| GPIO154           | 01B0                          | 00002000                         | LED0                        | GPIO154          | Reserved         | LED0             | Reserved         |
| GPIO155           | 01B4                          | 00002000                         | LED1                        | GPIO155          | Reserved         | LED1             | Reserved         |
| GPIO156           | 01B8                          | 00002000                         | LED2                        | GPIO156          | Reserved         | LED2             | Reserved         |
| GPIO157           | 01BC                          | 00000001                         | GPIO157                     | GPIO157          | BC_CLK           | Reserved         | Reserved         |
| GPIO160           | 01C0                          | 00000001                         | GPIO160                     | GPIO160          | BC_DAT           | Reserved         | Reserved         |
| GPIO161           | 01C4                          | 00000001                         | GPIO161                     | GPIO161          | BC_INT#          | Reserved         | Reserved         |
| GPIO162           | 01C8                          | 00000000                         | GPIO162                     | GPIO162          | RXD              | Reserved         | Reserved         |
| GPIO163           | 01CC                          | 00000000                         | GPIO163                     | GPIO163          | Reserved         | Reserved         | Reserved         |
| GPIO164           | 01D0                          | 00000000                         | GPIO164                     | GPIO164          | PVT_MISO         | Reserved         | Reserved         |
| GPIO165           | 01D4                          | 00000000                         | GPIO165                     | GPIO165          | TXD              | SHD_CS1#         | Reserved         |
| GPIO200           | 0200                          | 00000000                         | GPIO200                     | GPIO200          | Reserved         | Reserved         | Reserved         |
| GPIO201           | 0204                          | 00000000                         | GPIO201                     | GPIO201          | Reserved         | Reserved         | Reserved         |
| GPIO202           | 0208                          | 00000000                         | GPIO202                     | GPIO202          | Reserved         | Reserved         | Reserved         |
| GPIO203           | 020C                          | 00000000                         | GPIO203                     | GPIO203          | Reserved         | Reserved         | Reserved         |
| GPIO204           | 0210                          | 00000000                         | GPIO204                     | GPIO204          | Reserved         | Reserved         | Reserved         |
| GPIO206           | 0218                          | 00000000                         | GPIO206                     | GPIO206          | Reserved         | Reserved         | Reserved         |
| GPIO210           | 0220                          | 00000000                         | GPIO210                     | GPIO210          | Reserved         | Reserved         | Reserved         |
| GPIO211           | 0224                          | 00000000                         | GPIO211                     | GPIO211          | Reserved         | Reserved         | Reserved         |

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**Note 1:** The value of the [Pin Control Register 2](#) for each pin is not shown in the tables above. The default value can be determined by the current value shown in the “Default Operation” column of the [Multiplexing Tables](#) in [Section 1.5.2, "Multiplexing Tables," on page 20](#) as follows:

2mA: 00000000h  
 4mA: 00000010h  
 8mA: 00000020h  
 12mA: 00000030h

**2:** The default slew rate is slow.

**3:** [The GPIO041 pin defaults to output low. This pin must be reprogrammed to the GPIO function upon power-up.](#)

## 20.7 Pin Multiplexing Control

Pin multiplexing depends upon the [Mux Control](#) bits in the [Pin Control Register](#). There is a [Pin Control Register](#) for each GPIO signal function. [TABLE 20-5](#): shows default of the register for each GPIO pin.

The registers listed in the Register Summary table are for a single instance of the MEC1322. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the Register Base Address Table.

**TABLE 20-6: REGISTER BASE ADDRESS TABLE**

| Instance Name | Instance Number | Host | Address Space                 | Base Address (Note 20-1)  |
|---------------|-----------------|------|-------------------------------|---------------------------|
| GPIO          | 0               | LPC  | I/O                           | <a href="#">Note 20-2</a> |
|               | 0               | EC   | 32-bit internal address space | 4008_1000h                |

**Note 20-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**Note 20-2** The GPIO registers may be accessed by the LPC Host via the EMI block via GPIO commands or by direct access if enabled by firmware. See the firmware documentation for a description of this access method.

**TABLE 20-7: REGISTER SUMMARY**

| Offset                                | Register Name  |
|---------------------------------------|--|
| 000h - 01Ch                           | GPIO000-GPIO007 <a href="#">Pin Control Register</a> |
| 020h - 03Ch                           | GPIO010-GPIO017 <a href="#">Pin Control Register</a> |
| 040h - 05Ch                           | GPIO020-GPIO027 <a href="#">Pin Control Register</a> |
| 060h - 078h                           | GPIO030-GPIO036 <a href="#">Pin Control Register</a> |
| 080h - 09Ch                           | GPIO040-GPIO047 <a href="#">Pin Control Register</a> |
| 0A0h - 0BCh                           | GPIO050-GPIO057 <a href="#">Pin Control Register</a> |
| 0C0h - 0DCh                           | GPIO060-GPIO067 <a href="#">Pin Control Register</a> |
| 100h - 11Ch                           | GPIO100-GPIO107 <a href="#">Pin Control Register</a> |
| 120h - 13Ch                           | GPIO110-GPIO117 <a href="#">Pin Control Register</a> |
| 140h - 15Ch                           | GPIO120-GPIO127 <a href="#">Pin Control Register</a> |
| 160h - 178h                           | GPIO130-GPIO136 <a href="#">Pin Control Register</a> |
| 180h - 19Ch                           | GPIO140-GPIO147 <a href="#">Pin Control Register</a> |
| 1A0h - 1BCh                           | GPIO150-GPIO157 <a href="#">Pin Control Register</a> |
| 1C0h - 1D4h                           | GPIO160-GPIO165 <a href="#">Pin Control Register</a> |
| 200h - 210h                           | GPIO200-GPIO204 <a href="#">Pin Control Register</a> |
| 218h                                  | GPIO206 <a href="#">Pin Control Register</a>         |
| 220h - 224h                           | GPIO210-GPIO211 <a href="#">Pin Control Register</a> |
| 280h<br>( <a href="#">Note 20-3</a> ) | <a href="#">Output GPIO[000:036]</a>                 |



TABLE 20-7: REGISTER SUMMARY (CONTINUED)

| Offset              | Register Name                          |
|---------------------|--|
| 284h<br>(Note 20-3) | Output GPIO[040:076]                   |
| 288h<br>(Note 20-3) | Output GPIO[100:127]                   |
| 28Ch<br>(Note 20-3) | Output GPIO[140:176]                   |
| 290h<br>(Note 20-3) | Output GPIO[200:236]                   |
| 300h<br>(Note 20-3) | Input GPIO[000:036]                    |
| 304h<br>(Note 20-3) | Input GPIO[040:076]                    |
| 308h<br>(Note 20-3) | Input GPIO[100:127]                    |
| 30Ch<br>(Note 20-3) | Input GPIO[140:176]                    |
| 310h<br>(Note 20-3) | Input GPIO[200:236]                    |
| 500h - 51Ch         | GPIO000-GPIO007 Pin Control Register 2 |
| 520h - 53Ch         | GPIO010-GPIO017 Pin Control Register 2 |
| 540h - 55Ch         | GPIO020-GPIO027 Pin Control Register 2 |
| 560h - 578h         | GPIO030-GPIO036 Pin Control Register 2 |
| 580h - 59Ch         | GPIO040-GPIO047 Pin Control Register 2 |
| 5A0h - 5BCh         | GPIO050-GPIO057 Pin Control Register 2 |
| 5C0h - 5DCh         | GPIO060-GPIO067 Pin Control Register 2 |
| 5E0h - 5FCh         | GPIO100-GPIO107 Pin Control Register 2 |
| 600h                | GPIO110 Pin Control Register 2         |
| 604h - 623h         | MCHP Reserved (Note 20-4)              |
| 624h - 63Ch         | GPIO121-GPIO127 Pin Control Register 2 |
| 640h - 658h         | GPIO130-GPIO136 Pin Control Register 2 |
| 660h - 67Ch         | GPIO140-GPIO147 Pin Control Register 2 |
| 680h - 69Ch         | GPIO150-GPIO157 Pin Control Register 2 |
| 6A0h - 6B4h         | GPIO160-GPIO165 Pin Control Register 2 |
| 720h - 730h         | GPIO200-GPIO204 Pin Control Register 2 |
| 738h                | GPIO206 Pin Control Register 2         |
| 740h - 744h         | GPIO210-GPIO211 Pin Control Register 2 |

**Note 20-3** The GPIO input and output registers are LPC I/O accessible via Region 0 of the EMI block. This access is defined in the EMI Protocols chapter of the firmware specification.

**Note 20-4** There is no Pin Control Register 2 for GPIO111-GPIO117 and GPIO120, which are PCI\_PIO buffer type pins. The drive strength and slew rate are not configurable on these pins.

**Note:** The following GPIOs that do not exist in the 128-pin package are configured as inputs and grounded in the package. Firmware should not attempt to turn those GPIOs into outputs and drive them high, or excessive current will be consumed.

- GPIO067
- GPIO055
- GPIO210
- GPIO200
- GPIO202
- GPIO201
- GPIO203
- GPIO204

The following GPIOs that do not exist in the 128-pin package are not connected (NC) in the package. These GPIOs should be configured as inputs and the internal pull-down should be enabled.

- GPIO211
- GPIO123

## 20.8 Pin Control Registers

Two [Pin Control Registers](#) are implemented for each GPIO. The [Pin Control Register](#) format is described in [Section 20.8.1, "Pin Control Register," on page 250](#). The [Pin Control Register 2](#) format is described in [Section 20.8.2, "Pin Control Register 2," on page 253](#). [Pin Control Register](#) address offsets and defaults are defined in [Table 20-5, "Pin Control Registers," on page 245](#).

### 20.8.1 PIN CONTROL REGISTER

| Offset | See <a href="#">Note 20-5</a>  |      |                           |                |
|--------|--|------|---------------------------|----------------|
| Bits   | Description  | Type | Default                   | Reset Event    |
| 31:25  | RESERVED   | RES  | -                         | -              |
| 24     | GPIO input from pad<br><br>On reads, Bit [24] reflects the state of GPIO input from the pad regardless of setting of Bit [10].<br><br><b>Note:</b> This bit is forced high when the selected power well is off as selected by the Power Gating Signal bits. See bits[3:2].   | R    | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 23:17  | RESERVED   | RES  | -                         | -              |
| 16     | Alternative GPIO data<br>If enabled by the Output GPIO Write Enable bit, the <a href="#">Alternative GPIO data</a> bit determines the level on the GPIO pin when the pin is configured for the GPIO output function.<br><br>On writes:<br>If enabled via the <a href="#">Output GPIO Write Enable</a><br>0: GPIO[x] out = '0'<br>1: GPIO[x] out = '1'<br><br><b>Note:</b> If disabled via the <a href="#">Output GPIO Write Enable</a> then the GPIO[x] out pin is unaffected by writing this bit.<br><br>On reads:<br>Bit [16] returns the last programmed value, not the value on the pin. | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 15:14  | RESERVED   | RES  | -                         | -              |

| Offset | See <a href="#">Note 20-5</a>  |      |                           |                |
|--------|--|------|---------------------------|----------------|
| Bits   | Description  | Type | Default                   | Reset Event    |
| 13:12  | <p>Mux Control</p> <p>The Mux Control field determines the active signal function for a pin.</p> <p>00 = GPIO Function Selected<br/>           01 = Signal Function 1 Selected<br/>           10 = Signal Function 2 Selected<br/>           11 = Signal Function 3 Selected</p>   | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 11     | <p>Polarity</p> <p>0 = Non-inverted<br/>           1 = Inverted</p> <p>When the Polarity bit is set to '1' and the <a href="#">Mux Control</a> bits are greater than '00,' the selected signal function outputs are inverted and <a href="#">Interrupt Detection (int_det)</a> sense defined in <a href="#">Table 20-8, "Edge Enable and Interrupt Detection Bits Definition"</a> is inverted. When the <a href="#">Mux Control</a> field selects the GPIO signal function (Mux = '00'), the Polarity bit does not effect the output. Regardless of the state of the <a href="#">Mux Control</a> field and the Polarity bit, the state of the pin is always reported without inversion in the GPIO input register.</p>   | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 10     | <p>Output GPIO Write Enable</p> <p>Every GPIO has two mechanisms to set a GPIO data output: Output GPIO Bit located in the <a href="#">GPIO Output Registers</a> and the <a href="#">Alternative GPIO data</a> bit located in bit 16 of this register.</p> <p>This control bit determines the source of the GPIO output.<br/>           0 = <a href="#">Alternative GPIO data</a> write enabled<br/>           When this bit is zero the <a href="#">Alternative GPIO data</a> write is enabled and the Output GPIO is disabled.</p> <p>1 = Output GPIO enable<br/>           When this bit is one the <a href="#">Alternative GPIO data</a> write is disabled and the Output GPIO is enabled.</p> <p><b>Note:</b> See description in <a href="#">Section 20.4, "Accessing GPIOs"</a>.</p> | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 9      | <p>GPIO Direction</p> <p>0 = Input<br/>           1 = Output</p> <p>The <a href="#">GPIO Direction</a> bit controls the buffer direction only when the <a href="#">Mux Control</a> field is '00' selecting the pin signal function to be GPIO. When the <a href="#">Mux Control</a> field is greater than '00' (i.e., a non-GPIO signal function is selected) the <a href="#">GPIO Direction</a> bit has no affect and the selected signal function logic directly controls the pin direction.</p>   | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |

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| Offset | See <a href="#">Note 20-5</a>   |      |                           |                |
|--------|---|------|---------------------------|----------------|
| Bits   | Description   | Type | Default                   | Reset Event    |
| 8      | <p>Output Buffer Type</p> <p>0 = Push-Pull</p> <p>1 = Open Drain</p> <p><b>Note:</b> Unless explicitly stated otherwise, pins with (I/O/OD) or (O/OD) in their buffer type column in the tables in are compliant with the following Programmable OD/PP Multiplexing Design Rule: Each compliant pin has a programmable open drain/push-pull buffer controlled by the Output Buffer Type bit in the associated <a href="#">Pin Control Register</a>. The state of this bit controls the mode of the interface buffer for all selected functions, including the GPIO function.</p>  | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 7      | <p>Edge Enable (edge_en)</p> <p>0 = Edge detection disabled</p> <p>1 = Edge detection enabled</p> <p><b>Note:</b> See <a href="#">Table 20-8, "Edge Enable and Interrupt Detection Bits Definition"</a>.</p>  | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 6:4    | <p>Interrupt Detection (int_det)</p> <p>The interrupt detection bits determine the event that generates a <a href="#">GPIO_Event</a>.</p> <p><b>Note:</b> See <a href="#">Table 20-8, "Edge Enable and Interrupt Detection Bits Definition"</a>.</p>  | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 3:2    | <p>Power Gating Signals</p> <p>The Power Gating Signals provide the GPIO pin Power Emulation options. The pin will be tristated when the selected power well is off (i.e., gated) as indicated.</p> <p>The Emulated Power Well column defined in the <a href="#">Multiplexing Tables</a> in <a href="#">Section 1.5, "Pin Multiplexing,"</a> on page 19 indicates the emulation options supported for each signal. The Signal Power Well column defines the actual buffer power supply per function.</p> <p>00 = VCC1 Power Rail<br/>The output buffer is tristated when <a href="#">VCC1GD</a> = 0.</p> <p>01 = VCC2 Power Rail<br/>The output buffer is tristated when <a href="#">PWRGD</a> = 0.</p> <p>10 = Reserved</p> <p>11 = Reserved</p> | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |
| 1:0    | <p>PU/PD (PU_PD)</p> <p>These bits are used to enable an internal pull-up.</p> <p>00 = None</p> <p>01 = Pull Up Enabled</p> <p>10 = Pull Down Enabled (<a href="#">Note 20-6</a>)</p> <p>11 = None</p>  | R/W  | <a href="#">Note 20-5</a> | VCC1_R<br>ESET |

**Note 20-5** See [Section 20.7, "Pin Multiplexing Control,"](#) on page 248 for the offset and default values for each GPIO Pin Control Register.

**Note 20-6** The [Pin Control Registers](#) for GPIO111-GPIO117 and GPIO120, which are PCI\_PIO buffer type pins, do not have an internal pull-down. This configuration option has no effect on the pin.

TABLE 20-8: EDGE ENABLE AND INTERRUPT DETECTION BITS DEFINITION

| Edge Enable | Interrupt Detection Bits |    |    | Selected Function             |
|-------------|--------------------------|----|----|-------------------------------|
|             | D7                       | D6 | D5 |                               |
| 0           | 0                        | 0  | 0  | Low Level Sensitive           |
| 0           | 0                        | 0  | 1  | High Level Sensitive          |
| 0           | 0                        | 1  | 0  | Reserved                      |
| 0           | 0                        | 1  | 1  | Reserved                      |
| 0           | 1                        | 0  | 0  | Interrupt events are disabled |
| 0           | 1                        | 0  | 1  | Reserved                      |
| 0           | 1                        | 1  | 0  | Reserved                      |
| 0           | 1                        | 1  | 1  | Reserved                      |
| 1           | 1                        | 0  | 1  | Rising Edge Triggered         |
| 1           | 1                        | 1  | 0  | Falling Edge Triggered        |
| 1           | 1                        | 1  | 1  | Either edge triggered         |

**Note:** Only edge triggered interrupts can wake up the main ring oscillator. The GPIO must be enabled for edge-triggered interrupts and the GPIO interrupt must be enabled in the interrupt aggregator in order to wake up the ring when the ring is shut down.

**APPLICATION NOTE:** All GPIO interrupt detection configurations default to '0000', which is low level interrupt. Having interrupt detection enabled will un-gated the clock to the GPIO module whenever the interrupt is active, which increases power consumption. Interrupt detection should be disabled when not required to save power; this is especially true for pin interfaces (i.e., LPC).

### 20.8.2 PIN CONTROL REGISTER 2

| Offset | See <a href="#">Note 20-5</a>   |      |                                     |                |
|--------|---|------|-------------------------------------|----------------|
| Bits   | Description   | Type | Default                             | Reset Event    |
| 31:6   | RESERVED  | RES  | -                                   | -              |
| 5:4    | Drive Strength<br>These bits are used to select the drive strength on the pin.<br>00 = 2mA<br>01 = 4mA<br>10 = 8mA<br>11 = 12mA | R/W  | <a href="#">Note 1: on page 248</a> | VCC1_R<br>ESET |
| 3:1    | RESERVED  | RES  | -                                   | -              |
| 0      | Slew Rate<br>This bit is used to select the slew rate on the pin.<br>0 = slow (half frequency)<br>1 = fast                      | R/W  | 0                                   | VCC1_R<br>ESET |

### 20.8.3 GPIO OUTPUT REGISTERS

If enabled by the [Output GPIO Write Enable](#) bit, the GPIO Output bits determine the level on the GPIO pin when the pin is configured for the GPIO output function.

On writes:

If enabled via the [Output GPIO Write Enable](#)

0: GPIO[x] out = '0'

1: GPIO[x] out = '1'

If disabled via the [Output GPIO Write Enable](#) then the GPIO[x] out pin is unaffected by writing this bit.

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On reads:

Bit [16] returns the last programmed value, not the value on the pin.

**Note:** Bits associated with GPIOs that are not implemented are shown as Reserved.

## 20.8.3.1 Output GPIO[000:036]

| Offset | 280h (Note 20-3)     |      |         |                |
|--------|----------------------|------|---------|----------------|
| Bits   | Description          | Type | Default | Reset Event    |
| 31     | RESERVED             | RES  | -       | -              |
| 30:24  | GPIO[036:030] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 23:16  | GPIO[027:020] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[017:010] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[007:000] Output | R/W  | 00h     | VCC1_R<br>ESET |

## 20.8.3.2 Output GPIO[040:076]

| Offset | 284h (Note 20-3)     |      |         |                |
|--------|----------------------|------|---------|----------------|
| Bits   | Description          | Type | Default | Reset Event    |
| 31:24  | RESERVED             | RES  | -       | -              |
| 23:16  | GPIO[067:060] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[057:050] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[047:040] Output | R/W  | 00h     | VCC1_R<br>ESET |

## 20.8.3.3 Output GPIO[100:127]

| Offset | 288h (Note 20-3)     |      |         |                |
|--------|----------------------|------|---------|----------------|
| Bits   | Description          | Type | Default | Reset Event    |
| 31     | RESERVED             | RES  | -       | -              |
| 30:24  | GPIO[136:130] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 23:16  | GPIO[127:120] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[117:110] Output | R/W  | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[107:100] Output | R/W  | 00h     | VCC1_R<br>ESET |

## 20.8.3.4 Output GPIO[140:176]

| Offset | 28Ch (Note 20-3)     |      |         |             |
|--------|----------------------|------|---------|-------------|
| Bits   | Description          | Type | Default | Reset Event |
| 31:22  | RESERVED             | RES  | -       | -           |
| 21:16  | GPIO[165:160] Output | R/W  | 00h     | VCC1_R ESET |
| 15:8   | GPIO[157:150] Output | R/W  | 00h     | VCC1_R ESET |
| 7:0    | GPIO[147:140] Output | R/W  | 00h     | VCC1_R ESET |

## 20.8.3.5 Output GPIO[200:236]

| Offset | 290h (Note 20-3)     |      |         |             |
|--------|----------------------|------|---------|-------------|
| Bits   | Description          | Type | Default | Reset Event |
| 31     | RESERVED             | RES  | -       | -           |
| 30:24  | RESERVED             | RES  | -       | -           |
| 23:12  | RESERVED             | RES  | -       | -           |
| 11:10  | MCHP Reserved        | R/W  | 00h     | VCC1_R ESET |
| 9:8    | GPIO[211:210] Output | R/W  | 00h     | VCC1_R ESET |
| 7      | RESERVED             | RES  | -       | -           |
| 6      | GPIO206 Output       | R/W  | 00h     | VCC1_R ESET |
| 5      | RESERVED             | RES  | -       | -           |
| 4:0    | GPIO[204:200] Output | R/W  | 00h     | VCC1_R ESET |

## 20.8.4 GPIO INPUT REGISTERS

The [GPIO Input Registers](#) can always be used to read the state of a pin, even when the pin is in an output mode and/or when a signal function other than the GPIO signal function is selected; i.e., the [Pin Control Register Mux Control](#) bits are not equal to '00.'

The MSbit of the Input GPIO registers have been implemented as a read/write scratch pad bit to support processor specific instructions.

**Note:** Bits associated with GPIOs that are not implemented are shown as Reserved.

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## 20.8.4.1 Input GPIO[000:036]

| Offset | 300h (Note 20-3)    |      |         |                |
|--------|---------------------|------|---------|----------------|
| Bits   | Description         | Type | Default | Reset Event    |
| 31     | Scratchpad Bit      | R/W  | 0b      | VCC1_R<br>ESET |
| 30:24  | GPIO[036:030] Input | R    | 00h     | VCC1_R<br>ESET |
| 23:16  | GPIO[027:020] Input | R    | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[017:010] Input | R    | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[007:000] Input | R    | 00h     | VCC1_R<br>ESET |

## 20.8.4.2 Input GPIO[040:076]

| Offset | 304h (Note 20-3)    |      |         |                |
|--------|---------------------|------|---------|----------------|
| Bits   | Description         | Type | Default | Reset Event    |
| 31     | Scratchpad Bit      | R/W  | 0b      | VCC1_R<br>ESET |
| 30:24  | RESERVED            | R    | -       | -              |
| 23:16  | GPIO[067:060] Input | R    | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[057:050] Input | R    | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[047:040] Input | R    | 00h     | VCC1_R<br>ESET |

## 20.8.4.3 Input GPIO[100:127]

| Offset | 308h (Note 20-3)    |      |         |                |
|--------|---------------------|------|---------|----------------|
| Bits   | Description         | Type | Default | Reset Event    |
| 31     | Scratchpad Bit      | R/W  | 0b      | VCC1_R<br>ESET |
| 30:24  | GPIO[136:130] Input | R    | 00h     | VCC1_R<br>ESET |
| 23:16  | GPIO[127:120] Input | R    | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[117:110] Input | R    | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[107:100] Input | R    | 00h     | VCC1_R<br>ESET |



## 20.8.4.4 Input GPIO[140:176]

| Offset | 30Ch(Notes 20-3)    |      |         |                |
|--------|---------------------|------|---------|----------------|
| Bits   | Description         | Type | Default | Reset Event    |
| 31     | Scratchpad Bit      | R/W  | 0b      | VCC1_R<br>ESET |
| 30:22  | Reserved            | R    | 00h     | VCC1_R<br>ESET |
| 21:16  | GPIO[165:160] Input | R    | 00h     | VCC1_R<br>ESET |
| 15:8   | GPIO[157:150] Input | R    | 00h     | VCC1_R<br>ESET |
| 7:0    | GPIO[147:140] Input | R    | 00h     | VCC1_R<br>ESET |

## 20.8.4.5 Input GPIO[200:236]

| Offset | 310h(Notes 20-3)    |      |         |                |
|--------|---------------------|------|---------|----------------|
| Bits   | Description         | Type | Default | Reset Event    |
| 31     | Scratchpad Bit      | R/W  | 0b      | VCC1_R<br>ESET |
| 30:24  | Scratchpad Bits     | R/W  | 00h     | VCC1_R<br>ESET |
| 23:16  | Scratchpad Bits     | R/W  | 00h     | VCC1_R<br>ESET |
| 15:12  | RESERVED            | RES  | -       | -              |
| 11:10  | MCHP Reserved       | R/W  | 00h     | VCC1_R<br>ESET |
| 9:8    | GPIO[211:210] Input | R/W  | 00h     | VCC1_R<br>ESET |
| 7      | RESERVED            | RES  | -       | -              |
| 6      | GPIO206 Input       | R/W  | 00h     | VCC1_R<br>ESET |
| 5      | RESERVED            | RES  | -       | -              |
| 4:0    | GPIO[204:200] Input | R/W  | 00h     | VCC1_R<br>ESET |

## 21.0 INTERNAL DMA CONTROLLER

### 21.1 Introduction

The [Internal DMA Controller](#) transfers data to/from the source from/to the destination. The firmware is responsible for setting up each channel. Afterwards either the firmware or the hardware may perform the flow control. The hardware flow control exists entirely inside the source device. Each transfer may be 1, 2, or 4 bytes in size, so long as the device supports a transfer of that size. Every device must be on the internal 32-bit address space.

### 21.2 References

No references have been cited for this chapter

### 21.3 Terminology

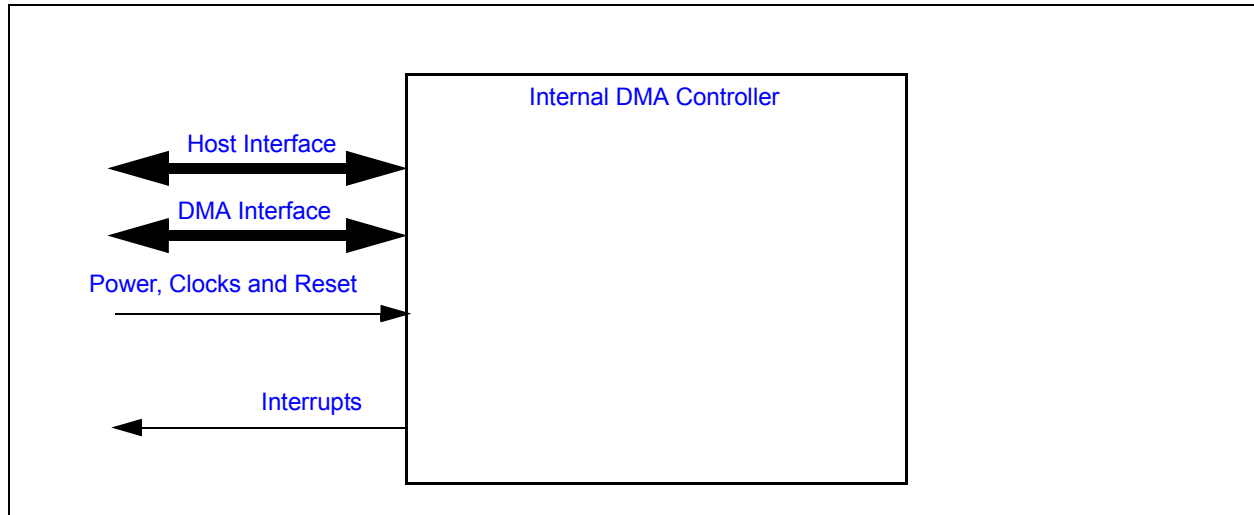
**TABLE 21-1: TERMINOLOGY**

| Term          | Definition  |
|---------------|---|
| DMA Transfer  | This is a complete <b>DMA Transfer</b> which is done after the <b>Master Device</b> terminates the transfer, the Firmware Aborts the transfer or the DMA reaches its transfer limit.<br>A DMA Transfer may consist of one or more data packets.   |
| Data Packet   | Each data packet may be composed of 1, 2, or 4 bytes. The size of the data packet is limited by the max size supported by both the source and the destination. Both source and destination will transfer the same number of bytes per packet.   |
| Channel       | The Channel is responsible for end-to-end (source-to-destination) Data Packet delivery.   |
| Device        | A Device may refer to a Master or Slave connected to the DMA Channel. Each DMA Channel may be assigned one or more devices.   |
| Master Device | This is the master of the DMA, which determines when it is active.<br>The Firmware is the master while operating in Firmware Flow Control.<br>The Hardware is the master while operating in Hardware Flow Control.<br><br>The Master Device in Hardware Mode is selected by <b>DMA Channel Control:Hardware Flow Control Device</b> . It is the index of the <b>Flow Control Port</b> . |
| Slave Device  | The Slave Device is defined as the device associated with the targeted Memory Address.  |
| Source        | The DMA Controller moves data from the Source to the Destination. The Source provides the data. The Source may be either the Master or Slave Controller.  |
| Destination   | The DMA Controller moves data from the Source to the Destination. The Destination receives the data. The Destination may be either the Master or Slave Controller.  |

## 21.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 21-1: INTERNAL DMA CONTROLLER I/O DIAGRAM**



### 21.4.1 SIGNAL DESCRIPTION

This block doesn't have any external signals that may be routed to the pin interface. This DMA Controller is intended to be used internally to transfer large amounts of data without the embedded controller being actively involved in the transfer.

### 21.4.2 HOST INTERFACE

The registers defined for the [Internal DMA Controller](#) are accessible by the various hosts as indicated in [Section 21.9, "EC-Only Registers"](#).

### 21.4.3 DMA INTERFACE

Each DMA Master Device that may engage in a DMA transfer must have a compliant DMA interface. The following table lists the DMA Devices in the MEC1322.

**TABLE 21-2: DMA CONTROLLER DEVICE SELECTION**

| Device Name        | Device Number<br>(Note 21-1) | Controller Source |
|--------------------|------------------------------|-------------------|
| SMBus 0 Controller | 0                            | Slave             |
|                    | 1                            | Master            |
| SMBus 1 Controller | 2                            | Slave             |
|                    | 3                            | Master            |
| SMBus 2 Controller | 4                            | Slave             |
|                    | 5                            | Master            |
| SMBus 3 Controller | 6                            | Slave             |
|                    | 7                            | Master            |
| SPI 0 Controller   | 8                            | Transmit          |
|                    | 9                            | Receive           |
| SPI 1 Controller   | 10                           | Transmit          |
|                    | 11                           | Receive           |

**Note 21-1** The Device Number is programmed into field [HARDWARE\\_FLOW\\_CONTROL\\_DEVICE](#) of the [DMA Channel N Control](#) register.

**TABLE 21-3: DMA CONTROLLER MASTER DEVICES SIGNAL LIST**

| Device Name        | Dev Num (21.5) | Device Signal Name | Direction | Description  |
|--------------------|----------------|--------------------|-----------|--|
| SMBus 0 Controller | 0              | SMB_SDMA_Req       | INPUT     | DMA request control from SMBus Slave channel.                  |
|                    |                | SMB_SDMA_Term      | INPUT     | DMA termination control from SMBus Slave channel.              |
|                    |                | SMB_SDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Slave channel.  |
|                    | 1              | SMB_MDMA_Req       | INPUT     | DMA request control from SMBus Master channel.                 |
|                    |                | SMB_MDMA_Term      | INPUT     | DMA termination control from SMBus Master channel.             |
|                    |                | SMB_MDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Master channel. |
| SMBus 1 Controller | 2              | SMB_SDMA_Req       | INPUT     | DMA request control from SMBus Slave channel.                  |
|                    |                | SMB_SDMA_Term      | INPUT     | DMA termination control from SMBus Slave channel.              |
|                    |                | SMB_SDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Slave channel.  |
|                    | 3              | SMB_MDMA_Req       | INPUT     | DMA request control from SMBus Master channel.                 |
|                    |                | SMB_MDMA_Term      | INPUT     | DMA termination control from SMBus Master channel.             |
|                    |                | SMB_MDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Master channel. |
| SMBus 2 Controller | 4              | SMB_SDMA_Req       | INPUT     | DMA request control from SMBus Slave channel.                  |
|                    |                | SMB_SDMA_Term      | INPUT     | DMA termination control from SMBus Slave channel.              |
|                    |                | SMB_SDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Slave channel.  |
|                    | 5              | SMB_MDMA_Req       | INPUT     | DMA request control from SMBus Master channel.                 |
|                    |                | SMB_MDMA_Term      | INPUT     | DMA termination control from SMBus Master channel.             |
|                    |                | SMB_MDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Master channel. |

**TABLE 21-3: DMA CONTROLLER MASTER DEVICES SIGNAL LIST (CONTINUED)**

| Device Name        | Dev Num (21.5) | Device Signal Name | Direction | Description   |
|--------------------|----------------|--------------------|-----------|---|
| SMBus 3 Controller | 6              | SMB_SDMA_Req       | INPUT     | DMA request control from SMBus Slave channel.                             |
|                    |                | SMB_SDMA_Term      | INPUT     | DMA termination control from SMBus Slave channel.                         |
|                    |                | SMB_SDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Slave channel.             |
|                    | 7              | SMB_MDMA_Req       | INPUT     | DMA request control from SMBus Master channel.                            |
|                    |                | SMB_MDMA_Term      | INPUT     | DMA termination control from SMBus Master channel.                        |
|                    |                | SMB_MDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to Master channel.            |
| SPI 0 Controller   | 8              | SPI_SDMA_Req       | INPUT     | DMA request control from SPI TX channel.                                  |
|                    |                | SPI_SDMA_Term      | INPUT     | DMA termination control from SPI TX channel. Not supported.               |
|                    |                | SPI_SDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to TX Channel. Not supported. |
|                    | 9              | SPI_MDMA_Req       | INPUT     | DMA request control from SPI RX channel.                                  |
|                    |                | SPI_MDMA_Term      | INPUT     | DMA termination control from SPI RX channel. Not supported.               |
|                    |                | SPI_MDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to RX channel. Not supported. |
| SPI 1 Controller   | 10             | SPI_SDMA_Req       | INPUT     | DMA request control from SPI TX channel.                                  |
|                    |                | SPI_SDMA_Term      | INPUT     | DMA termination control from SPI TX channel. Not supported.               |
|                    |                | SPI_SDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to TX Channel. Not supported. |
|                    | 11             | SPI_MDMA_Req       | INPUT     | DMA request control from SPI RX channel.                                  |
|                    |                | SPI_MDMA_Term      | INPUT     | DMA termination control from SPI RX channel. Not supported.               |
|                    |                | SPI_MDMA_Done      | OUTPUT    | DMA termination control from DMA Controller to RX channel. Not supported. |

## 21.5 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 21.5.1 POWER DOMAINS

**TABLE 21-4: POWER SOURCES**

| Name | Description  |
|------|--|
| VCC1 | This power well sources the registers and logic in this block. |

### 21.5.2 CLOCK INPUTS

**TABLE 21-5: CLOCK INPUTS**

| Name                   | Description   |
|------------------------|---|
| 48 MHz Ring Oscillator | This clock signal drives selected logic (e.g., counters). |

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## 21.5.3 RESETS

**TABLE 21-6: RESET SIGNALS**

| Name       | Description   |
|------------|---|
| VCC1_RESET | This reset signal resets all of the registers and logic in this block.                      |
| RESET      | This reset is generated if either the VCC1_RESET is asserted or the SOFT_RESET is asserted. |

## 21.6 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 21-7: INTERRUPTS**

| Source | Description   |
|--------|---|
| DMA0   | Direct Memory Access Channel 0<br>This signal is generated by the STATUS_DONE bit.  |
| DMA1   | Direct Memory Access Channel 1<br>This signal is generated by the STATUS_DONE bit.  |
| DMA2   | Direct Memory Access Channel 2<br>This signal is generated by the STATUS_DONE bit.  |
| DMA3   | Direct Memory Access Channel 3<br>This signal is generated by the STATUS_DONE bit.  |
| DMA4   | Direct Memory Access Channel 4<br>This signal is generated by the STATUS_DONE bit.  |
| DMA5   | Direct Memory Access Channel 5<br>This signal is generated by the STATUS_DONE bit.  |
| DMA6   | Direct Memory Access Channel 6<br>This signal is generated by the STATUS_DONE bit.  |
| DMA7   | Direct Memory Access Channel 7<br>This signal is generated by the STATUS_DONE bit.  |
| DMA8   | Direct Memory Access Channel 8<br>This signal is generated by the STATUS_DONE bit.  |
| DMA9   | Direct Memory Access Channel 9<br>This signal is generated by the STATUS_DONE bit.  |
| DMA10  | Direct Memory Access Channel 10<br>This signal is generated by the STATUS_DONE bit. |
| DMA11  | Direct Memory Access Channel 11<br>This signal is generated by the STATUS_DONE bit. |

## 21.7 Low Power Modes

The [Internal DMA Controller](#) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

When the block is commanded to go to sleep it will place the DMA block into sleep mode only after all transactions on the DMA have been completed. For Firmware Flow Controlled transactions, the DMA will wait until it hits its terminal count and clears the Go control bit. For Hardware Flow Control, the DMA will go to sleep after either the terminal count is hit, or the Master device flags the terminate signal.

## 21.8 Description

The MEC1322 features a 12 channel DMA controller. The DMA controller can autonomously move data from/to any DMA capable master device to/from any populated memory location. This mechanism allows hardware IP blocks to transfer large amounts of data into or out of memory without EC intervention.

The DMA has the following characteristics:

- Data is only moved 1 [Data Packet](#) at a time
- Data only moves between devices on the accessible via the internal 32-bit address space

- The DMA Controller has 12 DMA Channels
- Each DMA Channel may be configured to communicate with any DMA capable device on the 32-bit internal address space. Each device has been assigned a device number. See [Section 21.4.3, "DMA Interface," on page 259](#).

The controller will access SRAM buffers only with incrementing addresses (that is, it cannot start at the top of a buffer, nor does it handle circular buffers automatically). The controller does not handle chaining (that is, automatically starting a new DMA transfer when one finishes).

## 21.8.1 CONFIGURATION

The DMA Controller is enabled via the [ACTIVATE](#) bit in [DMA Main Control](#) register.

Each DMA Channel must also be individually enabled via the [CHANNEL\\_ACTIVATE](#) bit in the [DMA Channel N Activate](#) to be operational.

Before starting a DMA transaction on a DMA Channel the host must assign a DMA Master to the channel via [HARDWARE\\_FLOW\\_CONTROL\\_DEVICE](#). The host must not configure two different channels to the same DMA Master at the same time.

Data will be transferred between the DMA Master, starting at the programmed [DEVICE\\_ADDRESS](#), and the targeted memory location, starting at the [MEMORY\\_START\\_ADDRESS](#). The address for either the DMA Master or the targeted memory location may remain static or it may increment. To enable the DMA Master to increment its address set the [INCREMENT\\_DEVICE\\_ADDRESS](#) bit. To enable the targeted memory location to increment its addresses set the [INCREMENT\\_MEMORY\\_ADDRESS](#). The DMA transfer will continue as long as the target memory address being accessed is less than the [MEMORY\\_END\\_ADDRESS](#). If the DMA Controller detects that the memory location it is attempting to access on the Target is equal to the [MEMORY\\_END\\_ADDRESS](#) it will notify the DMA Master that the transaction is done. Otherwise the Data will be transferred in packets. The size of the packet is determined by the [TRANSFER\\_SIZE](#).

## 21.8.2 OPERATION

The DMA Controller is designed to move data from one memory location to another.

### 21.8.2.1 Establishing a Connection

A DMA Master will initiate a DMA Transaction by requesting access to a channel. The DMA arbiter, which evaluates each channel request using a basic round robin algorithm, will grant access to the DMA master. Once granted, the channel will hold the grant until it decides to release it, by notifying the DMA Controller that it is done.

**Note:** If Firmware wants to prevent any other channels from being granted while it is active it can set the [LOCK\\_CHANNEL](#) bit.

### 21.8.2.2 Initiating a Transfer

Once a connection is established the DMA Master will issue a DMA request to start a DMA transfer. If Firmware wants to have a transfer request serviced it must set the [RUN](#) bit to have its transfer requests serviced.

Firmware can initiate a transaction by setting the [TRANSFER\\_GO](#) bit. The DMA transfer will remain active until either the Master issues a Terminate or the DMA Controller signals that the transfer is [DONE](#). Firmware may terminate a transaction by setting the [TRANSFER\\_ABORT](#) bit.

**Note:** Before initiating a DMA transaction via firmware the hardware flow control must be disabled via the [DISABLE\\_HARDWARE\\_FLOW\\_CONTROL](#) bit.

Data may be moved from the DMA Master to the targeted Memory address or from the targeted Memory Address to the DMA Master. The direction of the transfer is determined by the [TRANSFER\\_DIRECTION](#) bit.

Once a transaction has been initiated firmware can use the [STATUS\\_DONE](#) bit to determine when the transaction is completed. This status bit is routed to the interrupt interface. In the same register there are additional status bits that indicate if the transaction completed successfully or with errors. This bits are OR'd together with the [STATUS\\_DONE](#) bit to generate the interrupt event. Each status bit may be individually enabled/disabled from generating this event.

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## 21.9 EC-Only Registers

The DMA Controller consists of a Main Block and a number of Channels. [Table 21-9, "Main EC-Only Register Summary"](#) lists the registers in the Main Block and [Table 21-10, "Channel EC-Only Register Summary"](#) lists the registers in each channel. The addresses of each register listed in these tables are defined as a relative offset to the "Base Address" defined in the EC-Only Register Base Address Table. The Base Address for the Main Block and each Channel is defined in the table:

**TABLE 21-8: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Instance Name  | Channel Number | Host | Address Space                 | Base Address |
|----------------|----------------|------|-------------------------------|--------------|
| DMA Controller | Main Block     | EC   | 32-bit internal address space | 4000_2400h   |
| DMA Controller | 0              | EC   | 32-bit internal address space | 4000_2410h   |
| DMA Controller | 1              | EC   | 32-bit internal address space | 4000_2430h   |
| DMA Controller | 2              | EC   | 32-bit internal address space | 4000_2450h   |
| DMA Controller | 3              | EC   | 32-bit internal address space | 4000_2470h   |
| DMA Controller | 4              | EC   | 32-bit internal address space | 4000_2490h   |
| DMA Controller | 5              | EC   | 32-bit internal address space | 4000_24B0h   |
| DMA Controller | 6              | EC   | 32-bit internal address space | 4000_24D0h   |
| DMA Controller | 7              | EC   | 32-bit internal address space | 4000_24F0h   |
| DMA Controller | 8              | EC   | 32-bit internal address space | 4000_2510h   |
| DMA Controller | 9              | EC   | 32-bit internal address space | 4000_2530h   |
| DMA Controller | 10             | EC   | 32-bit internal address space | 4000_2550h   |
| DMA Controller | 11             | EC   | 32-bit internal address space | 4000_2570h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 21-9: MAIN EC-ONLY REGISTER SUMMARY**

| Offset | REGISTER NAME (Mnemonic)         |
|--------|----------------------------------|
| 00h    | <a href="#">DMA Main Control</a> |
| 04h    | <a href="#">DMA Data Packet</a>  |



## 21.9.1 DMA MAIN CONTROL

| Offset | 00h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:2    | Reserved   | R    | -       | -           |
| 1      | SOFT_RESET<br>Soft reset the entire module.<br><br>This bit is self-clearing.  | W    | 0b      | -           |
| 0      | ACTIVATE<br>Enable the blocks operation.<br><br>1=Enable block. Each individual channel must be enabled separately.<br>0=Disable all channels. | R/WS | 0b      | RESET       |

## 21.9.2 DMA DATA PACKET

| Offset | 04h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:0   | DATA_PACKET<br>Debug register that has the data that is stored in the Data Packet.<br>This data is read data from the currently active transfer source. | R    | 0000h   | -           |

**TABLE 21-10: CHANNEL EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)<br>(Note 21-2)            |
|--------|--|
| 00h    | <a href="#">DMA Channel N Activate</a>             |
| 04h    | <a href="#">DMA Channel N Memory Start Address</a> |
| 08h    | <a href="#">DMA Channel N Memory End Address</a>   |
| 0Ch    | <a href="#">DMA Channel N Device Address</a>       |
| 10h    | <a href="#">DMA Channel N Control</a>              |
| 14h    | <a href="#">DMA Channel N Interrupt Status</a>     |
| 18h    | <a href="#">DMA Channel N Interrupt Enable</a>     |

**Note 21-2** The letter 'N' following DMA Channel indicates the Channel Number. Each Channel implemented will have these registers to determine that channel's operation.

## 21.9.3 DMA CHANNEL N ACTIVATE

| Offset | 00h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:1    | Reserved   | R    | -       | -           |
| 0      | CHANNEL_ACTIVATE<br>Enable this channel for operation.<br>The DMA Main Control:Activate must also be enabled for this channel to be operational. | R/W  | 0h      | RESET       |

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## 21.9.4 DMA CHANNEL N MEMORY START ADDRESS

| Offset | 04h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:0   | <p>MEMORY_START_ADDRESS</p> <p>This is the starting address for the Memory device.</p> <p>This field is updated by Hardware after every packet transfer by the size of the transfer, as defined by DMA Channel Control:Channel Transfer Size while the DMA Channel Control:Increment Memory Address is Enabled.</p> <p>The Memory device is defined as the device that is the slave device in the transfer.</p> <p>ex. With Hardware Flow Control, the Memory device is the device that is not connected to the Hardware Flow Controlling device.</p> <p><b>Note:</b> This field is only as large as the maximum allowed AHB Address Size in the system. If the HADDR size is 24 Bits, then Bits [31:24] will be RESERVED.</p> | R/W  | 0000h   | RESET       |

## 21.9.5 DMA CHANNEL N MEMORY END ADDRESS

| Offset | 08h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:0   | <p>MEMORY_END_ADDRESS</p> <p>This is the ending address for the Memory device.</p> <p>This will define the limit of the transfer, so long as DMA Channel Control:Increment Memory Address is Enabled. When the Memory Start Address is equal to this value, the DMA will terminate the transfer and flag the status DMA Channel Interrupt:Status Done.</p> <p><b>Note:</b> This field is only as large as the maximum allowed AHB Address Size in the system. If the HADDR size is 24 Bits, then Bits [31:24] will be RESERVED.</p> | R/W  | 0000h   | RESET       |

## 21.9.6 DMA CHANNEL N DEVICE ADDRESS

| Offset | 0Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:0   | <p>DEVICE_ADDRESS</p> <p>This is the Master Device address.</p> <p>This is used as the address that will access the Device on the DMA. The Device is defined as the Master of the DMA transfer; as in the device that is controlling the Hardware Flow Control.</p> <p>This field is updated by Hardware after every Data Packet transfer by the size of the transfer, as defined by DMA Channel Control:Transfer Size while the DMA Channel Control:Increment Device Address is Enabled.</p> <p><b>Note:</b> This field is only as large as the maximum allowed AHB Address Size in the system. If the HADDR size is 24 Bits, then Bits [31:24] will be RESERVED.</p> | R/W  | 0000h   | RESET       |

## 21.9.7 DMA CHANNEL N CONTROL

| Offset | 10h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:26  | Reserved  | R    | -       | -           |
| 25     | <p>TRANSFER_ABORT</p> <p>This is used to abort the current transfer on this DMA Channel. The aborted transfer will be forced to terminate immediately.</p>  | R/W  | 0h      | RESET       |
| 24     | <p>TRANSFER_GO</p> <p>This is used for the <b>Firmware Flow Control</b> DMA transfer.</p> <p>This is used to start a transfer under the <b>Firmware Flow Control</b>. Do not use this in conjunction with the <b>Hardware Flow Control</b>; <b>DMA Channel Control:Disable Hardware Flow Control</b> must be set in order for this field to function correctly.</p>         | R/W  | 0h      | RESET       |
| 23     | Reserved  | R    | -       | -           |
| 22:20  | <p>TRANSFER_SIZE</p> <p>This is the transfer size in Bytes of each Data Packet transfer.</p> <p><b>Note:</b> The transfer size must be a legal transfer size. Valid sizes are 1, 2 and 4 Bytes.</p>   | R/W  | 0h      | RESET       |
| 19     | <p>DISABLE_HARDWARE_FLOW_CONTROL</p> <p>This will Disable the <b>Hardware Flow Control</b>. When disabled, any DMA Master device attempting to communicate to the DMA over the <b>DMA Flow Control Interface (Ports: dma_req, dma_term, and dma_done)</b> will be ignored.</p> <p>This should be set before using the DMA channel in <b>Firmware Flow Control</b> mode.</p> | RW   | 0h      | RESET       |

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| Offset | 10h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 18     | <p>LOCK_CHANNEL</p> <p>This is used to lock the arbitration of the Channel Arbiter on this channel once this channel is granted. Once this is locked, it will remain on the arbiter until it has completed its transfer (either the Transfer Aborted, Transfer Done or Transfer Terminated conditions).</p> <p><b>Note:</b> This setting may starve other channels if the locked channel takes an excessive period of time to complete.</p>   | RW   | 0h      | RESET       |
| 17     | <p>INCREMENT_DEVICE_ADDRESS</p> <p>This will enable an auto-increment to the <b>DMA Channel Device Address</b>.</p> <p><b>1:</b> Increment the <b>DMA Channel Device Address</b> by <b>DMA Channel Control:Transfer Size</b> after every <b>Data Packet transfer</b><br/> <b>0:</b> Do nothing</p>  | RW   | 0h      | RESET       |
| 16     | <p>INCREMENT_MEMORY_ADDRESS</p> <p>This will enable an auto-increment to the <b>DMA Channel Memory Address</b>.</p> <p><b>1=</b>Increment the DMA Channel Memory Address by DMA Channel Control:Transfer Size after every Data Packet transfer<br/> <b>0=</b>Do nothing</p> <p><b>Note:</b> <i>If this is not set, the DMA will never terminate the transfer on its own. It will have to be terminated through the Hardware Flow Control or through a DMA Channel Control:Transfer Abort.</i></p> | RW   | 0h      | RESET       |
| 15:9   | <p>HARDWARE_FLOW_CONTROL_DEVICE</p> <p>This is the device that is connected to this channel as its <b>Hardware Flow Control</b> master. The <b>Flow Control Interface</b> is a bus with each master concatenated onto it. This selects which bus index of the concatenated <b>Flow Control Interface</b> bus is targeted towards this channel. The <b>Flow Control Interface</b> Port list is <b>dma_req</b>, <b>dma_term</b>, and <b>dma_done</b>.</p>   | RW   | 0h      | RESET       |
| 8      | <p>TRANSFER_DIRECTION</p> <p>This determines the direction of the DMA Transfer.</p> <p><b>1=</b>Data Packet Read from <b>Memory Start Address</b> followed by Data Packet Write to <b>Device Address</b><br/> <b>0=</b>Data Packet Read from <b>Device Address</b> followed by Data Packet Write to <b>Memory Start Address</b></p>   | RW   | 0h      | RESET       |
| 7:6    | Reserved  | R    | -       | -           |
| 5      | <p>BUSY</p> <p>This is a status signal.</p> <p><b>1=</b>The DMA Channel is busy (FSM is not IDLE)<br/> <b>0=</b>The DMA Channel is not busy (FSM is IDLE)</p>   | RO   | 0h      | RESET       |

| Offset | 10h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 4:3    | <p><b>STATUS</b></p> <p>This is a status signal. The status decode is listed in priority order with the highest priority first.</p> <p>3: Error detected by the DMA<br/>           2: The DMA Channel is externally done, in that the Device has terminated the transfer over the <b>Hardware Flow Control</b> through the Port <b>dma_term</b><br/>           1: The DMA Channel is locally done, in that <b>Memory Start Address</b> equals <b>Memory End Address</b><br/>           0: DMA Channel Control:Run is Disabled (0x0)</p> <p><b>Note:</b> This functionality has been replaced by the Interrupt field, and as such should never be used.</p> <p>The field will not flag back appropriately timed status, and if used may cause the firmware to become out-of-sync with the hardware.</p> <p>This field has multiple non-exclusive statuses, but may only display a single status. As such, multiple statuses may be TRUE, but this will appear as though only a single status has been triggered.</p> | R    | 0h      | RESET       |
| 2      | <p><b>DONE</b></p> <p>This is a status signal. It is only valid while <b>DMA Channel Control:Run</b> is Enabled. This is the inverse of the <b>DMA Channel Control:Busy</b> field, except this is qualified with the <b>DMA Channel Control:Run</b> field.</p> <p>1=Channel is done<br/>           0=Channel is not done or it is OFF</p>   | RO   | 0h      | RESET       |
| 1      | <p><b>REQUEST</b></p> <p>This is a status field.</p> <p>1= There is a transfer request from the Master Device<br/>           0= There is no transfer request from the Master Device</p>   | RO   | 0h      | RESET       |
| 0      | <p><b>RUN</b></p> <p>This is a control field.</p> <p><b>Note:</b> This bit only applies to <b>Hardware Flow Control</b> mode.</p> <p>1= This channel is enabled and will service transfer requests<br/>           0=This channel is disabled. All transfer requests are ignored</p>   | RW   | 0h      | RESET       |

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## 21.9.8 DMA CHANNEL N INTERRUPT STATUS

| Offset | 14h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 7:3    | Reserved   | R    | -       | -           |
| 2      | <p>STATUS_DONE</p> <p>This is an interrupt source register. This flags when the DMA Channel has completed a transfer successfully on its side. A completed transfer is defined as when the DMA Channel reaches its limit; <b>Memory Start Address</b> equals <b>Memory End Address</b>. A completion due to a <b>Hardware Flow Control Terminate</b> will not flag this interrupt.</p> <p>1=<b>Memory Start Address</b> equals <b>Memory End Address</b><br/>           0=<b>Memory Start Address</b> does not equal <b>Memory End Address</b></p> | R/WC | 0h      | RESET       |
| 1      | <p>STATUS_FLOW_CONTROL</p> <p>This is an interrupt source register. This flags when the DMA Channel has encountered a <b>Hardware Flow Control Request</b> after the DMA Channel has completed the transfer. This means the Master Device is attempting to overflow the DMA.</p> <p>1=Hardware Flow Control is requesting after the transfer has completed<br/>           0=No Hardware Flow Control event</p>   |      | 0h      | RESET       |
| 0      | <p>STATUS_BUS_ERROR</p> <p>This is an interrupt source register. This flags when there is an Error detected over the internal 32-bit Bus.</p> <p>1: Error detected.</p>  | R/WC | 0h      | RESET       |

## 21.9.9 DMA CHANNEL N INTERRUPT ENABLE

| Offset | 18h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:3    | Reserved  | R    | -       | -           |
| 2      | <p>STATUS_ENABLE_DONE</p> <p>This is an interrupt enable for <b>DMA Channel Interrupt:Status Done</b>.</p> <p>1=Enable Interrupt<br/>           0=Disable Interrupt</p>                             | R/W  | 0h      | RESET       |
| 1      | <p>STATUS_ENABLE_FLOW_CONTROL_ERROR</p> <p>This is an interrupt enable for <b>DMA Channel Interrupt:Status Flow Control Error</b>.</p> <p>1=Enable Interrupt<br/>           0=Disable Interrupt</p> | R/W  | 0h      | RESET       |

| Offset | 18h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 0      | <b>STATUS_ENABLE_BUS_ERROR</b><br>This is an interrupt enable for <b>DMA Channel Interrupt:Status Bus Error</b> .<br><br>1=Enable Interrupt<br>0=Disable Interrupt | R/W  | 0h      | RESET       |

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## 22.0 SMBUS INTERFACE

### 22.1 Introduction

The MEC1322 [SMBus Interface](#) includes one instance of the SMBus controller core. This chapter describes aspects of the [SMBus Interface](#) that are unique to the MEC1322 instantiations of this core; including, Power Domain, Resets, Clocks, Interrupts, Registers and the Physical Interface. For a *General Description, Features, Block Diagram, Functional Description, Registers Interface and other core-specific details*, see Ref [1] (note: in this chapter, *italicized text* typically refers to SMBus controller core interface elements as described in Ref [1]).

### 22.2 References

1. SMBus Controller Core Interface, Revision 3.4, Core-Level Architecture Specification, SMSC, 7/16/12

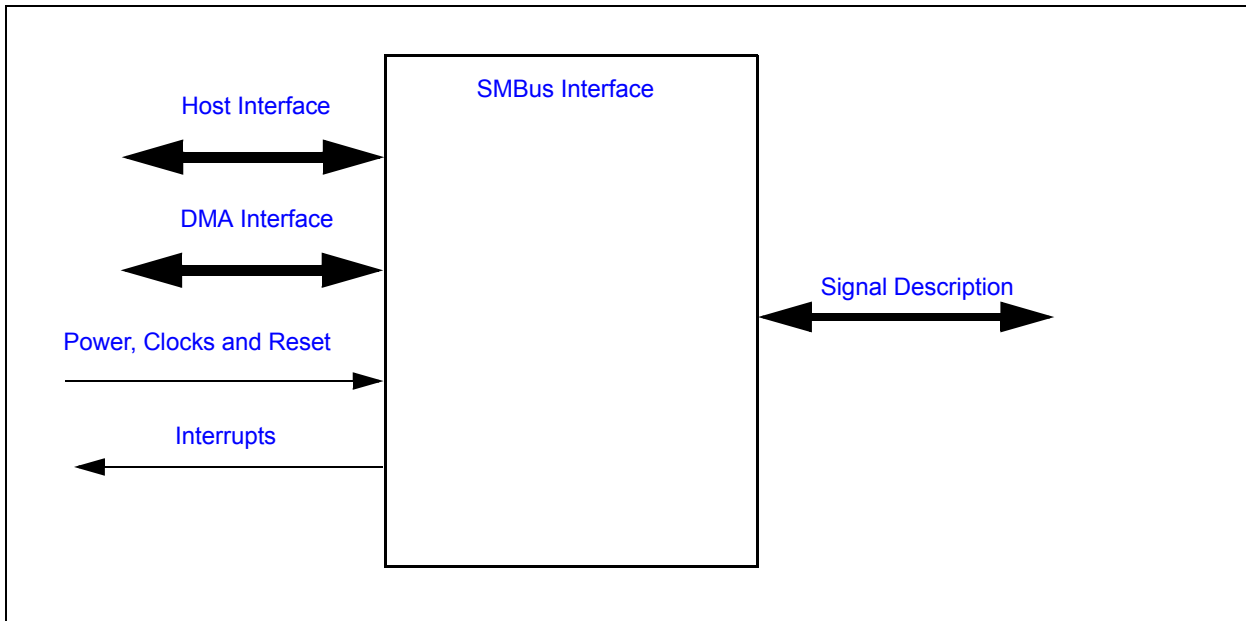
### 22.3 Terminology

There is no terminology defined for this chapter.

### 22.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface. In addition, this block is equipped with

**FIGURE 22-1: I/O DIAGRAM OF BLOCK**



### 22.5 Signal Description

The Signal Description Table lists the signals that are typically routed to the pin interface.

**TABLE 22-1: SIGNAL DESCRIPTION TABLE**

| Name     | Direction    | Description        |
|----------|--------------|--------------------|
| SMB_DAT0 | Input/Output | SMBus Data Port 0  |
| SMB_CLK0 | Input/Output | SMBus Clock Port 0 |
| SMB_DAT1 | Input/Output | SMBus Data Port 1  |
| SMB_CLK1 | Input/Output | SMBus Clock Port 1 |

**Note:** The SMB block signals that are shown in [Table 22-1](#) are routed to the SMB pins as listed in [Table 22-2](#).



**TABLE 22-2: SIGNAL TO PIN NAME LOOKUP TABLE**

| Block Name | Pin Name  | Description                     |
|------------|-----------|---------------------------------|
| SMBx_DATn  | I2Cx_DATn | SMBus Controller x Port n Data  |
| SMBx_CLKn  | I2Cx_CLKn | SMBus Controller x Port n Clock |

## 22.6 Host Interface

The registers defined for the [SMBus Interface](#) are accessible as indicated in [Section 22.12, "SMBus Registers"](#).

## 22.7 DMA Interface

This block is designed to communicate with the Internal DMA Controller. This feature is defined in the SMBus Controller Core Interface specification (See Ref [1]).

**Note:** For a description of the Internal DMA Controller implemented in this design see [Chapter 21.0, "Internal DMA Controller"](#).

## 22.8 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 22.8.1 POWER DOMAINS

**TABLE 22-3: POWER SOURCES**

| Name                 | Description  |
|----------------------|--|
| <a href="#">VCC1</a> | This power well sources the registers and logic in this block. |

### 22.8.2 CLOCK INPUTS

**TABLE 22-4: CLOCK INPUTS**

| Name                                   | Description  |
|--|--|
| <a href="#">48 MHz Ring Oscillator</a> | This is the clock signal drives the SMBus controller core. The core also uses this clock to generate the SMB_CLK on the pin interface. |
| <a href="#">16MHz_Clk</a>              | This is the clock signal is used for baud rate generation.   |

### 22.8.3 RESETS

**TABLE 22-5: RESET SIGNALS**

| Name                       | Description   |
|----------------------------|---|
| <a href="#">VCC1_RESET</a> | This reset signal resets all of the registers and logic in the SMBus controller core. |

## 22.9 Interrupts

**TABLE 22-6: EC INTERRUPTS**

| Source | Description                    |
|--------|--------------------------------|
| SMB    | SMBus Activity Interrupt Event |

## 22.10 Low Power Modes

The [SMBus Interface](#) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 22.11 Description

### 22.11.1 SMBUS CONTROLLER CORE

The MEC1322 [SMBus Interface](#) behavior is defined in the SMBus Controller Core Interface specification (See Ref [1]).

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## 22.11.2 PHYSICAL INTERFACE

The [SMBus Interface](#) has two physical ports, selected by the *PORT SEL [3:0]* bits in the *Configuration Register* as described in Ref [1].

**Note 1:** SMBus controller 0 uses port 0 and port 1. SMBus controllers 1-3 use port 0.

**2:** The buffer type for these pins must be configured as open-drain outputs in the GPIO Configuration registers associated with the GPIO signals that share the ports.

## 22.12 SMBus Registers

The registers listed in the *SMBus Core Register Summary* table in the SMBus Controller Core Interface specification (Ref [1]) are for a single instance of the SMBus Controller Core. The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the following table:

**TABLE 22-7: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance   | Instance Number | Host | Address Space                 | Base Address (Note 22-1) |
|------------------|-----------------|------|-------------------------------|--------------------------|
| SMBus Controller | 0               | EC   | 32-bit internal address space | 4000_1800h               |
| SMBus Controller | 1               | EC   | 32-bit internal address space | 4000_AC00h               |
| SMBus Controller | 2               | EC   | 32-bit internal address space | 4000_B000h               |
| SMBus Controller | 3               | EC   | 32-bit internal address space | 4000_B400h               |

**Note 22-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

## 23.0 PECI INTERFACE

### 23.1 Overview

The MEC1322 includes a [PECI Interface](#) to allow the EC to retrieve temperature readings from PECI-compliant devices. The [PECI Interface](#) implements the PHY and Link Layer of a PECI host controller as defined in [References](#)[1] and includes hardware support for the PECI 2.0 command set.

This chapter focuses on MEC1322 specific [PECI Interface](#) configuration information such as [Power Domains](#), [Clock Inputs](#), [Resets](#), [Interrupts](#), and other chip specific information. For a functional description of the MEC1322 [PECI Interface](#) refer to [References](#) [1].

### 23.2 References

1. PECI Interface Core, Rev. 1.31, Core-Level Architecture Specification, SMSC Confidential, 4/15/11

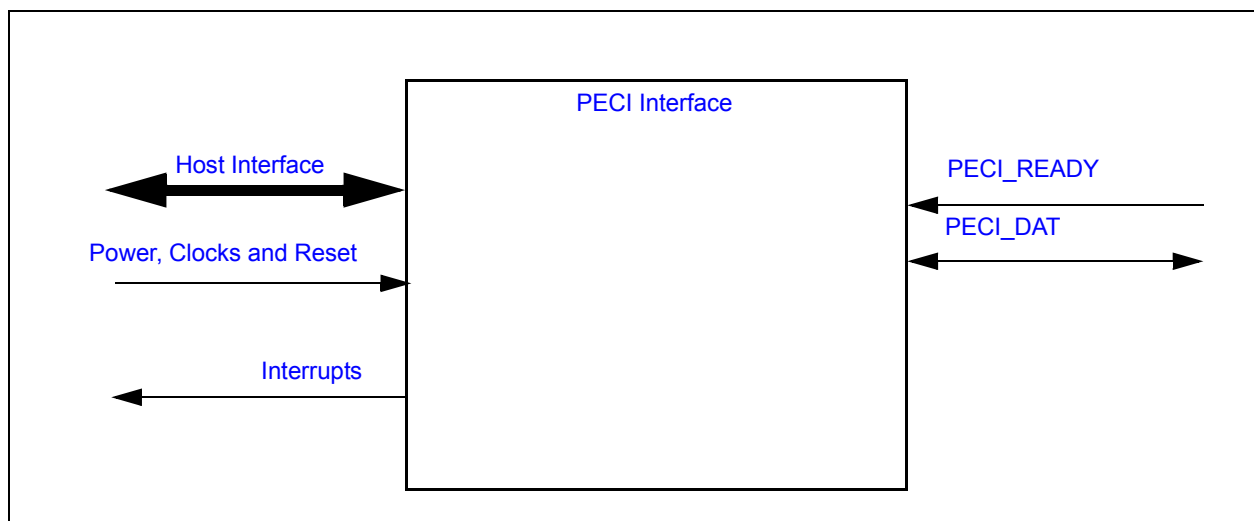
### 23.3 Terminology

No terminology has been defined for this chapter.

### 23.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 23-1: PECI INTERFACE I/O DIAGRAM**



### 23.5 Signal Description

The Signal Description Table lists the signals that are typically routed to the pin interface.

**TABLE 23-1: SIGNAL DESCRIPTION TABLE**

| Name       | Direction    | Description  |
|------------|--------------|--|
| PECI_READY | Input        | PECI Ready input pin<br><b>Note:</b> This signal is optional. If this signal is not on the pin interface it is pulled high internally. |
| PECI_DAT   | Input/Output | PECI Data signal pin   |

**Note:** Routing guidelines for the PECI\_DAT pin is provided in Intel Platform design guides. Refer to the appropriate Intel document for current information. See [Table 23-2](#).

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**TABLE 23-2: PECE ROUTING GUIDELINES**

|                 |                              |
|-----------------|------------------------------|
| Trace Impedance | 50 Ohms +/- 15%              |
| Spacing         | 10 mils                      |
| Routing Layer   | Microstrip                   |
| Trace Width     | Calculate to match impedance |
| Length          | 1" - 15"                     |

## 23.6 Host Interface

The registers defined for the [PECE Interface](#) are accessible by the various hosts as indicated in [Section 23.11, "PECE Interface Registers"](#).

## 23.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 23.7.1 POWER DOMAINS

**TABLE 23-3: POWER SOURCES**

| Name                 | Description  |
|----------------------|--|
| <a href="#">VCC1</a> | The <a href="#">PECE Interface</a> logic and registers are powered by <a href="#">VCC1</a> . |

### 23.7.2 CLOCK INPUTS

**TABLE 23-4: CLOCK INPUTS**

| Name                                   | Description             |
|--|-------------------------|
| <a href="#">48 MHz Ring Oscillator</a> | PECE Module Input Clock |

### 23.7.3 RESETS

**TABLE 23-5: RESET SIGNALS**

| Name                       | Description           |
|----------------------------|-----------------------|
| <a href="#">VCC1_RESET</a> | PECE Core Reset Input |

## 23.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 23-6: EC INTERRUPTS**

| Source   | Description |
|----------|-------------|
| PECEHOST | PECE Host   |

## 23.9 Low Power Modes

The [PECE Interface](#) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 23.10 Instance Description

There is one instance of the PECE Core implemented in the [PECE Interface](#) in the MEC1322. See [PECE Interface Core, Rev. 1.31, Core-Level Architecture Specification, SMSC Confidential, 4/15/11](#) for a description of the PECE Core.

## 23.11 PECE Interface Registers

The registers listed in the PECE Interface Register Summary table are for a single instance of the [PECE Interface](#). The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the PECE Interface Register Base Address Table.

**TABLE 23-7: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address (Note 23-1) |
|----------------|-----------------|------|-------------------------------|--------------------------|
| PECI Interface | 0               | EC   | 32-bit Internal Address Space | 4000_6400h               |

**Note 23-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 23-8: PECT INTERFACE REGISTER SUMMARY**

| Offset    | Register Name (Mnemonic)              |
|-----------|---------------------------------------|
| 00h       | Write Data Register                   |
| 04h       | Read Data Register                    |
| 08h       | Control Register                      |
| 0Ch       | Status Register 1                     |
| 10h       | Status Register 2                     |
| 14h       | Error Register                        |
| 18h       | Interrupt Enable 1 Register           |
| 1Ch       | Interrupt Enable 2 Register           |
| 20h       | Optimal Bit Time Register (Low Byte)  |
| 24h       | Optimal Bit Time Register (High Byte) |
| 28h       | MCHP Reserved                         |
| 2Ch       | MCHP Reserved                         |
| 30h-3Ch   | Reserved                              |
| 40h       | Block ID Register                     |
| 44h       | Revision Register                     |
| 48h - 7Ch | MCHP Reserved                         |

**Note:** MCHP Reserved registers are reserved for Microchip use only. Reading and writing MCHP Reserved registers may cause undesirable results

For register details see [References \[1\]](#).

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## 24.0 TACH

### 24.1 Introduction

This block monitors TACH output signals (or locked rotor signals) from various types of fans, and determines their speed.

### 24.2 References

No references have been cited for this feature.

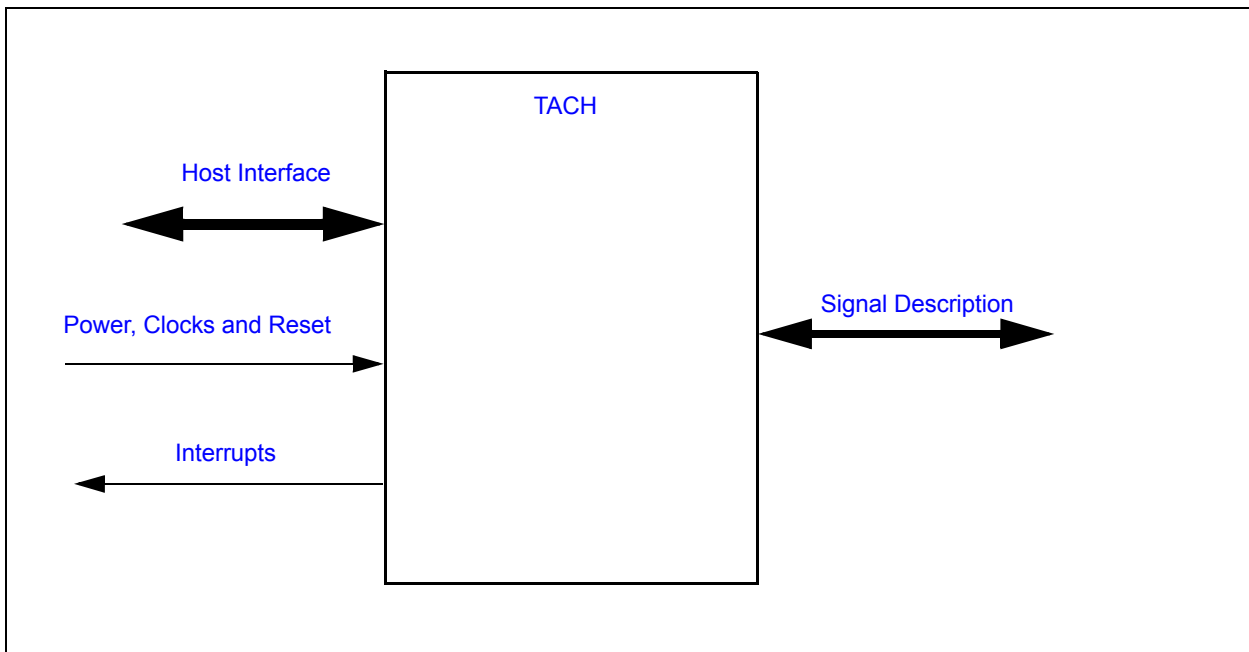
### 24.3 Terminology

There is no terminology defined for this section.

### 24.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 24-1: I/O DIAGRAM OF BLOCK**



### 24.5 Signal Description

**TABLE 24-1: SIGNAL DESCRIPTION TABLE**

| Name       | Direction | Description                       |
|------------|-----------|-----------------------------------|
| TACH INPUT | Input     | Tachometer signal from TACHx Pin. |

### 24.6 Host Interface

The registers defined for the **TACH** are accessible by the various hosts as indicated in [Section 24.11, "EC-Only Registers"](#).

## 24.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 24.7.1 POWER DOMAINS

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block are powered by this power well. |

### 24.7.2 CLOCK INPUTS

| Name       | Description   |
|------------|---|
| 100kHz_Clk | This is the clock input to the tachometer monitor logic. In Mode 1, the TACH is measured in the number of these clocks. |

### 24.7.3 RESETS

| Name       | Description  |
|------------|--|
| VCC1_RESET | This signal resets all the registers and logic in this block to their default state. |

## 24.8 Interrupts

This section defines the Interrupt Sources generated from this block.

| Source | Description  |
|--------|--|
| TACH   | This internal signal is generated from the OR'd result of the status events, as defined in the <a href="#">TACHx Status Register</a> . |

## 24.9 Low Power Modes

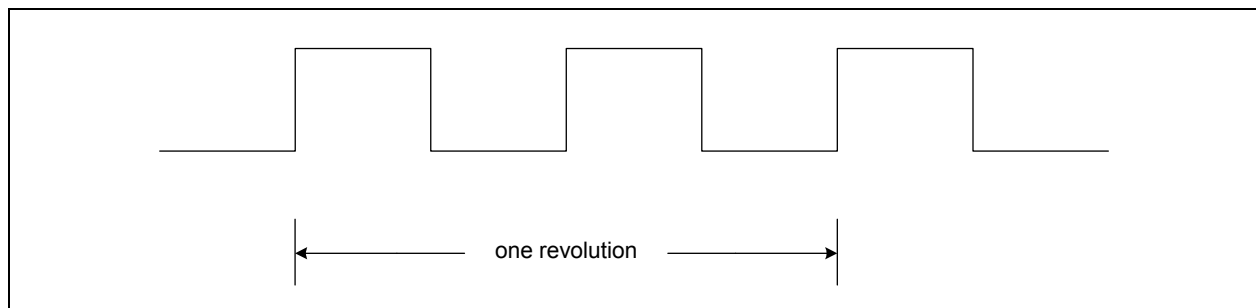
The TACH may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 24.10 Description

The TACH block monitors Tach output signals or locked rotor signals generated by various types of fans. These signals can be used to determine the speed of the attached fan. This block is designed to monitor fans at fan speeds from 100 RPMs to 30,000 RPMs.

Typically, these are DC brushless fans that generate (with each revolution) a 50% duty cycle, two-period square wave, as shown in [Figure 24-2](#) below.

**FIGURE 24-2: FAN GENERATED 50%DUTY CYCLE WAVEFORM**



In typical systems, the fans are powered by the main power supply. Firmware may disable this block when it detects that the main power rail has been turned off by either clearing the <enable> [TACH\\_ENABLE](#) bit or putting the block to sleep via the supported Low Power Mode interface (see [Low Power Modes](#)).

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## 24.10.1 MODES OF OPERATION

The Tachometer block supports two modes of operation. The mode of operation is selected via the [TACH\\_READING\\_MODE\\_SELECT](#) bit.

### 24.10.1.1 Free Running Counter

In Mode 0, the Tachometer block uses the TACH input as the clock source for the internal TACH pulse counter (see [TACHX\\_COUNTER](#)). The counter is incremented when it detects a rising edge on the TACH input. In this mode, the firmware may periodically poll the [TACHX\\_COUNTER](#) field to determine the average speed over a period of time. The firmware must store the previous reading and the current reading to compute the number of pulses detected over a period of time. In this mode, the counter continuously increments until it reaches FFFFh. It then wraps back to 0000h and continues counting. The firmware must ensure that the sample rate is greater than the time it takes for the counter to wrap back to the starting point.

**Note:** Tach interrupts should be disabled in Mode 0.

### 24.10.1.2 Mode 1 -- Number of Clock Pulses per Revolution

In Mode 1, the Tachometer block uses its [100kHz\\_Clk](#) clock input to measure the programmable number of TACH pulses. In this mode, the internal TACH pulse counter ([TACHX\\_COUNTER](#)) returns the value in number of [100kHz\\_Clk](#) pulses per programmed number of [TACH\\_EDGES](#). For fans that generate two square waves per revolution, these bits should be configured to five edges.

When the number of edges is detected, the counter is latched and the [COUNT\\_READY\\_STATUS](#) bit is asserted. If the [COUNT\\_READY\\_INT\\_EN](#) bit is set a TACH interrupt event will be generated.

## 24.10.2 OUT-OF-LIMIT EVENTS

The TACH Block has a pair of limit registers that may be configured to generate an event if the Tach indicates that the fan is operating too slow or too fast. If the <TACH reading> exceeds one of the programmed limits, the [TACHx High Limit Register](#) and the [TACHx Low Limit Register](#), the bit [TACH\\_OUT\\_OF\\_LIMIT\\_STATUS](#) will be set. If the [TACH\\_OUT\\_OF\\_LIMIT\\_STATUS](#) bit is set, the Tachometer block will generate an interrupt event.

## 24.11 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [TACH](#). The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 24-2: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address |
|----------------|-----------------|------|-------------------------------|--------------|
| TACH           | 0               | EC   | 32-bit internal address space | 4000_6000h   |
| TACH           | 1               | EC   | 32-bit internal address space | 4000_6010h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 24-3: TACH REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                  |
|--------|---|
| 00h    | <a href="#">TACHx Control Register</a>    |
| 04h    | <a href="#">TACHx Status Register</a>     |
| 08h    | <a href="#">TACHx High Limit Register</a> |
| 0Ch    | <a href="#">TACHx Low Limit Register</a>  |



## 24.11.1 TACHX CONTROL REGISTER

| Offset | 00h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:16  | <p>TACHX_COUNTER</p> <p>This 16-bit field contains the latched value of the internal Tach pulse counter, which may be configured by the Tach Reading Mode Select field to operate as a free-running counter or to be gated by the Tach input signal.</p> <p>If the counter is free-running (Mode 0), the internal Tach counter increments (if enabled) on transitions of the raw Tach input signal and is latched into this field every time it is incremented. The act of reading this field will not reset the counter, which rolls over to 0000h after FFFFh. The firmware will compute the delta between the current count reading and the previous count reading, to determine the number of pulses detected over a programmed period.</p> <p>If the counter is gated by the Tach input and clocked by <a href="#">100kHz_Clk</a> (Mode 1), the internal counter will be latched into the reading register when the programmed number of edges is detected or when the counter reaches FFFFh. The internal counter is reset to zero after it is copied into this register.</p> <p><b>Note:</b> In Mode 1, a counter value of FFFFh means that the Tach did not detect the programmed number of edges in 655ms. A stuck fan can be detected by setting the <a href="#">TACHx High Limit Register</a> to a number less than FFFFh. If the internal counter then reaches FFFFh, the reading register will be set to FFFFh and an out-of-limit interrupt can be sent to the EC.</p> | R    | 00h     | VCC1_RESET  |
| 15     | <p>TACH_INPUT_INT_EN</p> <p>1=Enable Tach Input toggle interrupt from Tach block<br/>0=Disable Tach Input toggle interrupt from Tach block</p>   | R/W  | 0b      | VCC1_RESET  |
| 14     | <p>COUNT_READY_INT_EN</p> <p>1=Enable Count Ready interrupt from Tach block<br/>0=Disable Count Ready interrupt from Tach block</p>  | R/W  | 0b      | VCC1_RESET  |
| 13     | Reserved   | R    | -       | -           |
| 12:11  | <p>TACH_EDGES</p> <p>A Tach signal is a square wave with a 50% duty cycle. Typically, two Tach periods represents one revolution of the fan. A Tach period consists of three Tach edges.</p> <p>This programmed value represents the number of Tach edges that will be used to determine the interval for which the number of <a href="#">100kHz_Clk</a> pulses will be counted</p> <p>11b=9 Tach edges (4 Tach periods)<br/>10b=5 Tach edges (2 Tach periods)<br/>01b=3 Tach edges (1 Tach period)<br/>00b=2 Tach edges (1/2 Tach period)</p>   | R/W  | 00b     | VCC1_RESET  |

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| Offset | 00h  |      |         |                            |
|--------|--|------|---------|----------------------------|
| Bits   | Description  | Type | Default | Reset Event                |
| 10     | <p>TACH_READING_MODE_SELECT</p> <p>1=Counter is incremented on the rising edge of the <a href="#">100kHz_Clk</a> input. The counter is latched into the <a href="#">TACHX_COUNTER</a> field and reset when the programmed number of edges is detected.</p> <p>0=Counter is incremented when Tach Input transitions from low-to-high state (default)</p>  | R/W  | 0b      | <a href="#">VCC1_RESET</a> |
| 9      | Reserved   | R    | -       | -                          |
| 8      | <p>FILTER_ENABLE</p> <p>This filter is used to remove high frequency glitches from Tach Input. When this filter is enabled, Tach input pulses less than two <a href="#">100kHz_Clk</a> periods wide get filtered.</p> <p>1= Filter enabled<br/>0= Filter disabled (default)</p> <p>It is recommended that the Tach input filter always be enabled.</p>   | R/W  | 0b      | <a href="#">VCC1_RESET</a> |
| 7:2    | Reserved   | R    | -       | -                          |
| 1      | <p>TACH_ENABLE</p> <p>This bit gates the clocks into the block. When clocks are gated, the TACHx pin is tristated. When re-enabled, the internal counters will continue from the last known state and stale status events may still be pending. Firmware should discard any status or reading values until the reading value has been updated at least one time after the enable bit is set.</p> <p>1= TACH Monitoring enabled, clocks enabled.<br/>0= TACH Idle, clocks gated</p> | R/W  | 0b      | <a href="#">VCC1_RESET</a> |
| 0      | <p>TACH_OUT_OF_LIMIT_ENABLE</p> <p>This bit is used to enable the <a href="#">TACH_OUT_OF_LIMIT_STATUS</a> bit in the <a href="#">TACHx Status Register</a> to generate an interrupt event.</p> <p>1=Enable interrupt output from Tach block<br/>0=Disable interrupt output from Tach block (default)</p>  | R/W  | 0b      | <a href="#">VCC1_RESET</a> |

## 24.11.2 TACHX STATUS REGISTER

| Offset | 04h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:4   | Reserved   | R    | -       | -              |
| 3      | <p>COUNT_READY_STATUS</p> <p>This status bit is asserted when the Tach input changes state and when the counter value is latched. This bit remains cleared to '0' when the <a href="#">TACH_READING_MODE_SELECT</a> bit in the <a href="#">TACHx Control Register</a> is '0'. When the <a href="#">TACH_READING_MODE_SELECT</a> bit in the <a href="#">TACHx Control Register</a> is set to '1', this bit is set to '1' when the counter value is latched by the hardware. It is cleared when written with a '1'. If <a href="#">COUNT_READY_INT_EN</a> in the <a href="#">TACHx Control Register</a> is set to 1, this status bit will assert the Tach Interrupt signal.</p> <p>1=Reading ready<br/>0=Reading not ready</p> | R/WC | 0b      | VCC1_R<br>ESET |
| 2      | <p>TOGGLE_STATUS</p> <p>This bit is set when Tach Input changes state. It is cleared when written with a '1'. If <a href="#">TACH_INPUT_INT_EN</a> in the <a href="#">TACHx Control Register</a> is set to '1', this status bit will assert the Tach Interrupt signal.</p> <p>1=Tach Input changed state (this bit is set on a low-to-high or high-to-low transition)<br/>0=Tach stable</p>  | R/WC | 0b      | VCC1_R<br>ESET |
| 1      | <p>TACH_PIN_STATUS</p> <p>This bit reflects the state of Tach Input. This bit is a read only bit that may be polled by the embedded controller.</p> <p>1= Tach Input is high<br/>0= Tach Input is low</p>  | R    | 0b      | VCC1_R<br>ESET |
| 0      | <p>TACH_OUT_OF_LIMIT_STATUS</p> <p>This bit is set when the Tach Count value is greater than the high limit or less than the low limit. It is cleared when written with a '1'. To disable this status event set the limits to their extreme values. If <a href="#">TACH_OUT_OF_LIMIT_ENABLE</a> in the <a href="#">TACHx Control Register</a> is set to '1', this status bit will assert the Tach Interrupt signal.</p> <p>1=Tach is outside of limits<br/>0=Tach is within limits</p>   | R/WC | 0b      | VCC1_R<br>ESET |

**Note 1:** Some fans offer a Locked Rotor output pin that generates a level event if a locked rotor is detected. This bit may be used in combination with the Tach pin status bit to detect a locked rotor signal event from a fan.

**2:** Tach Input may come up as active for Locked Rotor events. This would not cause an interrupt event because the pin would not toggle. Firmware must read the status events as part of the initialization process, if polling is not implemented.

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## 24.11.3 TACHX HIGH LIMIT REGISTER

| Offset | 08h  |      |         |                            |
|--------|--|------|---------|----------------------------|
| Bits   | Description  | Type | Default | Reset Event                |
| 31:16  | Reserved   | -    | -       | -                          |
| 15:0   | <b>TACH_HIGH_LIMIT</b><br>This value is compared with the value in the <a href="#">TACHX_COUNTER</a> field. If the value in the counter is greater than the value programmed in this register, the TACH_OUT_OF_LIMIT_STATUS bit will be set. The TACH_OUT_OF_LIMIT_STATUS status event may be enabled to generate an interrupt to the embedded controller via the TACH_OUT_OF_LIMIT_ENABLE bit in the <a href="#">TACHx Control Register</a> . | R/W  | FFFFh   | <a href="#">VCC1_RESET</a> |

## 24.11.4 TACHX LOW LIMIT REGISTER

| Offset | 0Ch  |      |         |                            |
|--------|--|------|---------|----------------------------|
| Bits   | Description  | Type | Default | Reset Event                |
| 31:16  | Reserved   | R    | -       | -                          |
| 15:0   | <b>TACHX_LOW_LIMIT</b><br>This value is compared with the value in the <a href="#">TACHX_COUNTER</a> field of the <a href="#">TACHx Control Register</a> . If the value in the counter is less than the value programmed in this register, the TACH_OUT_OF_LIMIT_STATUS bit will be set. The TACH_OUT_OF_LIMIT_STATUS status event may be enabled to generate an interrupt to the embedded controller via the TACH_OUT_OF_LIMIT_ENABLE bit in the <a href="#">TACHx Control Register</a><br><br>To disable the TACH_OUT_OF_LIMIT_STATUS low event, program 0000h into this register. | R/W  | 0000h   | <a href="#">VCC1_RESET</a> |

## 25.0 PWM

### 25.1 Introduction

This block generates a PWM output that can be used to control 4-wire fans, blinking LEDs, and other similar devices. Each PWM can generate an arbitrary duty cycle output at frequencies from less than 0.1 Hz to 24 MHz. The PWM controller can also be used to generate the PROCHOT output and Speaker output.

The PWMx Counter ON Time registers and PWMx Counter OFF Time registers determine the operation of the PWM\_OUTPUT signals. See [Section 25.11.1, "PWMx Counter ON Time Register," on page 288](#) and [Section 25.11.2, "PWMx Counter OFF Time Register," on page 289](#) for a description of the PWM\_OUTPUT signals.

### 25.2 References

There are no standards referenced in this chapter.

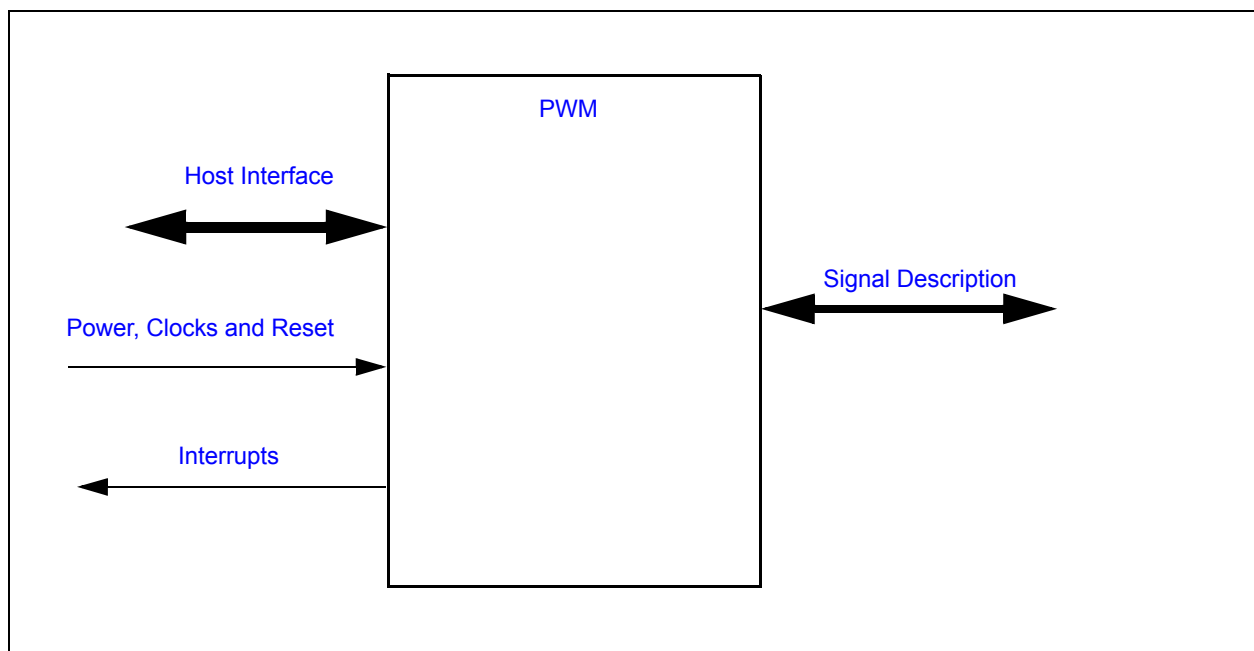
### 25.3 Terminology

There is no terminology defined for this section.

### 25.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 25-1: I/O DIAGRAM OF BLOCK**



There are no external signals for this block.

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## 25.5 Signal Description

TABLE 25-1: SIGNAL DESCRIPTION TABLE

| Name       | Direction | Description                               |
|------------|-----------|---|
| PWM_OUTPUT | OUTPUT    | Pulse Width Modulated signal to PWMx pin. |

## 25.6 Host Interface

The registers defined for the PWM Interface are accessible by the various hosts as indicated in [Section 25.11, "EC-Only Registers"](#).

## 25.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 25.7.1 POWER DOMAINS

TABLE 25-2: POWER SOURCES

| Name | Description  |
|------|--|
| VCC1 | The PWM logic and registers are powered by this single power source. |

### 25.7.2 CLOCK INPUTS

TABLE 25-3: CLOCK INPUTS

| Name                   | Description   |
|------------------------|---|
| 100kHz_Clk             | 100kHz_Clk clock input for generating low PWM frequencies, such as 10 Hz to 100 Hz.               |
| 48 MHz Ring Oscillator | 48 MHz Ring Oscillator clock input for generating high PWM frequencies, such as 15 kHz to 30 kHz. |

### 25.7.3 RESETS

TABLE 25-4: RESET SIGNALS

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal resets all the logic in this block to its initial state including the registers, which are set to their defined default state. |

## 25.8 Interrupts

The PWM block does not generate any interrupt events.

## 25.9 Low Power Modes

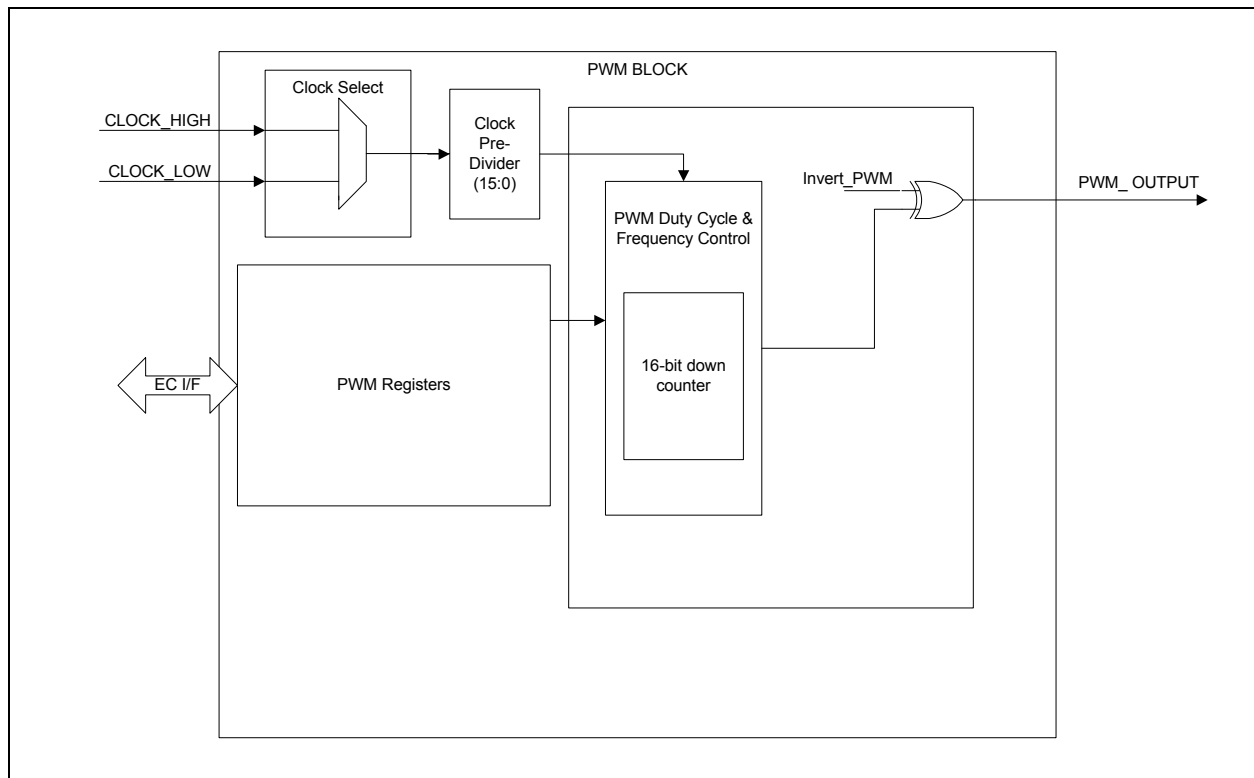
The PWM may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry. When the PWM is in the sleep state, the internal counters reset to 0 and the internal state of the PWM and the PWM\_OUTPUT signal set to the OFF state.

## 25.10 Description

The PWM\_OUTPUT signal is used to generate a duty cycle of specified frequency. This block can be programmed so that the PWM signal toggles the PWM\_OUTPUT, holds it high, or holds it low. When the PWM is configured to toggle, the PWM\_OUTPUT alternates from high to low at the rate specified in the PWMx Counter ON Time Register and PWMx Counter OFF Time Register.

The following diagram illustrates how the clock inputs and registers are routed to the PWM Duty Cycle & Frequency Control logic to generate the PWM output.

**FIGURE 25-2: BLOCK DIAGRAM OF PWM CONTROLLER**



**Note:** In Figure 25-2, the 48 MHz Ring Oscillator is represented as CLOCK\_HIGH and 100kHz\_Clk is represented as CLOCK\_LOW.

The PWM clock source to the PWM Down Counter, used to generate a duty cycle and frequency on the PWM, is determined through the Clock select[1] and Clock Pre-Divider[6:3] bits in the [PWMx Configuration Register](#) register.

The PWMx Counter ON/OFF Time registers determine both the frequency and duty cycle of the signal generated on PWM\_OUTPUT as described below.

The PWM frequency is determined by the selected clock source and the total on and off time programmed in the [PWMx Counter ON Time Register](#) and [PWMx Counter OFF Time Register](#) registers. The frequency is the time it takes (at that clock rate) to count down to 0 from the total on and off time.

The PWM duty cycle is determined by the relative values programmed in the [PWMx Counter ON Time Register](#) and [PWMx Counter OFF Time Register](#) registers.

The [PWM Frequency Equation](#) and [PWM Duty Cycle Equation](#) are shown below.

**FIGURE 25-3: PWM FREQUENCY EQUATION**

$$\text{PWM Frequency} = \frac{1}{(\text{PreDivisor} + 1)} \times \frac{(\text{ClockSourceFrequency})}{(\text{PWMCounterOnTime} + \text{PWMCounterOffTime})}$$

In Figure 25-3, the ClockSourceFrequency variable is the frequency of the clock source selected by the Clock Select bit in the [PWMx Configuration Register](#), and PreDivisor is a field in the [PWMx Configuration Register](#). The PWMCounterOnTime, PWMCounterOffTime are registers that are defined in [Section 25.11, "EC-Only Registers"](#).

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**FIGURE 25-4: PWM DUTY CYCLE EQUATION**

$$\text{PWM Duty Cycle} = \frac{\text{PWMCounterOnTime}}{(\text{PWMCounterOnTime} + \text{PWMCounterOffTime})}$$

The [PWMx Counter ON Time Register](#) and [PWMx Counter OFF Time Register](#) registers should be accessed as 16-bit values.

## 25.11 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [PWM](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the EC-Only Register Base Address Table.

**TABLE 25-5: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address |
|----------------|-----------------|------|-------------------------------|--------------|
| PWM            | 0               | EC   | 32-bit internal address space | 4000_5800h   |
| PWM            | 1               | EC   | 32-bit internal address space | 4000_5810h   |
| PWM            | 2               | EC   | 32-bit internal address space | 4000_5820h   |
| PWM            | 3               | EC   | 32-bit internal address space | 4000_5830h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 25-6: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                       |
|--------|--|
| 00h    | <a href="#">PWMx Counter ON Time Register</a>  |
| 04h    | <a href="#">PWMx Counter OFF Time Register</a> |
| 08h    | <a href="#">PWMx Configuration Register</a>    |

### 25.11.1 PWMX COUNTER ON TIME REGISTER

| Offset | 00h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:16  | Reserved  | R    | -       | -           |
| 15:0   | <p>PWMX_COUNTER_ON_TIME</p> <p>This field determine both the frequency and duty cycle of the PWM signal.</p> <p>When this field is set to zero and the PWMX_COUNTER_OFF_TIME is not set to zero, the PWM_OUTPUT is held low (Full Off).</p> | R/W  | 0000h   | VCC1_RESET  |



## 25.11.2 PWMX COUNTER OFF TIME REGISTER

| Offset | 04h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:16  | Reserved   | R    | -       | -              |
| 15:0   | <p>PWMX_COUNTER_OFF_TIME</p> <p>This field determine both the frequency and duty cycle of the PWM signal. When this field is set to zero, the PWM_OUTPUT is held high (Full On).</p> | R/W  | FFFFh   | VCC1_R<br>ESET |

## 25.11.3 PWMX CONFIGURATION REGISTER

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:7   | Reserved   | R    | -       | -              |
| 6:3    | <p>CLOCK_PRE_DIVIDER</p> <p>The Clock source for the 16-bit down counter (see <a href="#">PWMx Counter ON Time Register</a> and <a href="#">PWMx Counter OFF Time Register</a>) is determined by bit D1 of this register. The Clock source is then divided by the value of Pre-Divider+1 and the resulting signal determines the rate at which the down counter will be decremented. For example, a Pre-Divider value of 1 divides the input clock by 2 and a value of 2 divides the input clock by 3. A Pre-Divider of 0 will disable the Pre-Divider option.</p> | R/W  | 0000b   | VCC1_R<br>ESET |
| 2      | <p>INVERT</p> <p>1= PWM_OUTPUT ON State is active low<br/>0=PWM_OUTPUT ON State is active high</p>   | R/W  | 0b      | VCC1_R<br>ESET |
| 1      | <p>CLOCK_SELECT</p> <p>This bit determines the clock source used by the PWM duty cycle and frequency control logic.</p> <p>1=CLOCK_LOW<br/>0=CLOCK_HIGH</p>  | R/W  | 0b      | VCC1_R<br>ESET |
| 0      | <p>PWM_ENABLE</p> <p>1=Enabled (default)<br/>0=Disabled (gates clocks to save power)</p> <p><b>Note:</b> When the PWM enable bit is set to 0 the internal counters are reset and the internal state machine is set to the OFF state. In addition, the PWM_OUTPUT signal is set to the inactive state as determined by the Invert bit. The <a href="#">PWMx Counter ON Time Register</a> and <a href="#">PWMx Counter OFF Time Register</a> are not affected by the PWM enable bit and may be read and written while the PWM enable bit is 0.</p>                   | R/W  | 0b      | VCC1_R<br>ESET |

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## 26.0 RPM-PWM INTERFACE

### 26.1 Introduction

The [RPM-PWM Interface](#) is closed-loop RPM based Fan Control Algorithm that monitors the fan's speed and automatically adjusts the drive to maintain the desired fan speed.

The [RPM-PWM Interface](#) functionality consists of a closed-loop "set-and-forget" RPM based fan controller.

### 26.2 References

No references have been cited for this chapter

### 26.3 Terminology

There is no terminology defined for this chapter.

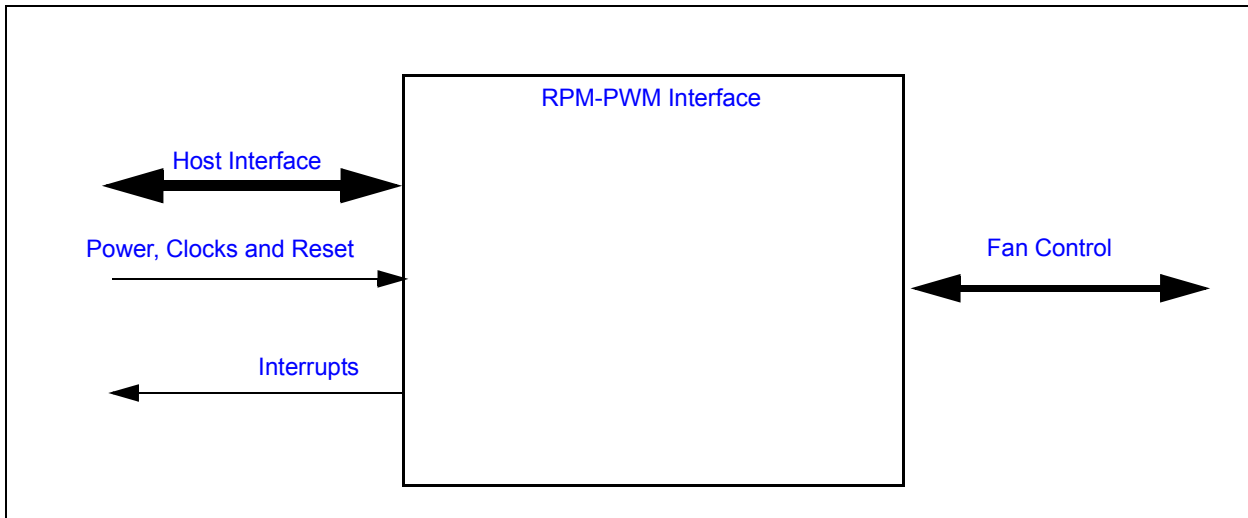
### 26.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

The registers in the block are accessed by embedded controller code at the addresses shown in [Section 26.9, "Fan Control Register Bank"](#).

[Figure 26-1](#) illustrates and categorizes the [RPM-PWM Interface](#) block signals. These signals are described in [Table 26-1](#).

**FIGURE 26-1: RPM-PWM INTERFACE I/O DIAGRAM**



#### 26.4.1 FAN CONTROL

The Fan Control Signal Description Table lists the signals that are routed to/from the block.

**TABLE 26-1: FAN CONTROL SIGNAL DESCRIPTION TABLE**

| Name | Direction | Description               |
|------|-----------|---------------------------|
| TACH | Input     | Tachometer input from fan |
| PWM  | Output    | PWM fan drive output      |

#### 26.4.2 HOST INTERFACE

The registers defined for the [RPM-PWM Interface](#) are accessible by the various hosts as indicated in [Section 26.9, "Fan Control Register Bank"](#).

## 26.5 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 26.5.1 POWER DOMAINS

**TABLE 26-2: POWER SOURCES**

| Name | Description  |
|------|--|
| VCC1 | This power well sources the registers and logic in this block. |

### 26.5.2 CLOCK INPUTS

**TABLE 26-3: CLOCK INPUTS**

| Name                   | Description   |
|------------------------|---|
| 48 MHz Ring Oscillator | This clock signal drives selected logic (e.g., counters). |

### 26.5.3 RESETS

**TABLE 26-4: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal resets all of the registers and logic in this block. |

## 26.6 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 26-5: INTERRUPTS**

| Source                         | Description  |
|--------------------------------|--|
| Fan Fail/Spin Status Interrupt | The DRIVE_FAIL & FAN_SPIN bits in the Fan Status Register are logically ORed and routed to the FAIL_SPIN Interrupt |
| Fan Stall Status Interrupt     | The FAN_STALL bit in the Fan Status Register is routed to the FAN_STALL Interrupt                                  |

## 26.7 Low Power Modes

The [RPM-PWM Interface](#) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 26.8 Description

This section defines the functionality of the block.

### 26.8.1 GENERAL OPERATION

The [RPM-PWM Interface](#) is an RPM based Fan Control Algorithm that monitors the fan's speed and automatically adjusts the drive to maintain the desired fan speed. This RPM based Fan Control Algorithm controls a PWM output based on a tachometer input.

### 26.8.2 FAN CONTROL MODES OF OPERATION

The [RPM-PWM Interface](#) has two modes of operation for the PWM Fan Driver. They are:

- Manual Mode - in this mode of operation, the user directly controls the fan drive setting. Updating the Fan Driver Setting Register (see [Section 26.9.1, "Fan Setting Register"](#)) will update the fan drive based on the programmed ramp rate (default disabled).
- The Manual Mode is enabled by clearing the EN\_ALGO bit in the Fan Configuration Register (see [Section 26.9.3, "Fan Configuration 1 Register"](#)).
- Whenever the Manual Mode is enabled the current drive settings will be changed to what was last used by the RPM control algorithm.
- Setting the drive value to 00h will disable the PWM Fan Driver.
- Changing the drive value from 00h will invoke the Spin Up Routine.

- Using RPM based Fan Control Algorithm - in this mode of operation, the user determines a target tachometer reading and the drive setting is automatically updated to achieve this target speed.

**TABLE 26-6: FAN CONTROLS ACTIVE FOR OPERATING MODE**

| Manual Mode                              | Algorithm  |
|--|--|
| Fan Driver Setting (read / write)        | Fan Driver Setting (read only)                           |
| EDGES[1:0] (Fan Configuration)           | EDGES[1:0] (Fan Configuration)                           |
| UPDATE[2:0] (Fan configuration)          | UPDATE[2:0] (Fan configuration)                          |
| LEVEL (Spin Up Configuration)            | LEVEL (Spin Up Configuration)                            |
| SPINUP_TIME[1:0] (Spin Up Configuration) | SPINUP_TIME[1:0] (Spin Up Configuration)                 |
| Fan Step                                 | Fan Step   |
| -  | Fan Minimum Drive  |
| Valid TACH Count                         | Valid TACH Count   |
| -  | TACH Target  |
| TACH Reading                             | TACH Reading   |
| RANGE[2:0] (Fan Configuration 2)         | RANGE[2:0] (Fan Configuration 2)                         |
| -  | DRIVE_FAIL_CNT[2:0] (Spin Up Config) and Drive Fail Band |

### 26.8.3 RPM BASED FAN CONTROL ALGORITHM

The [RPM-PWM Interface](#) includes an RPM based Fan Control Algorithm.

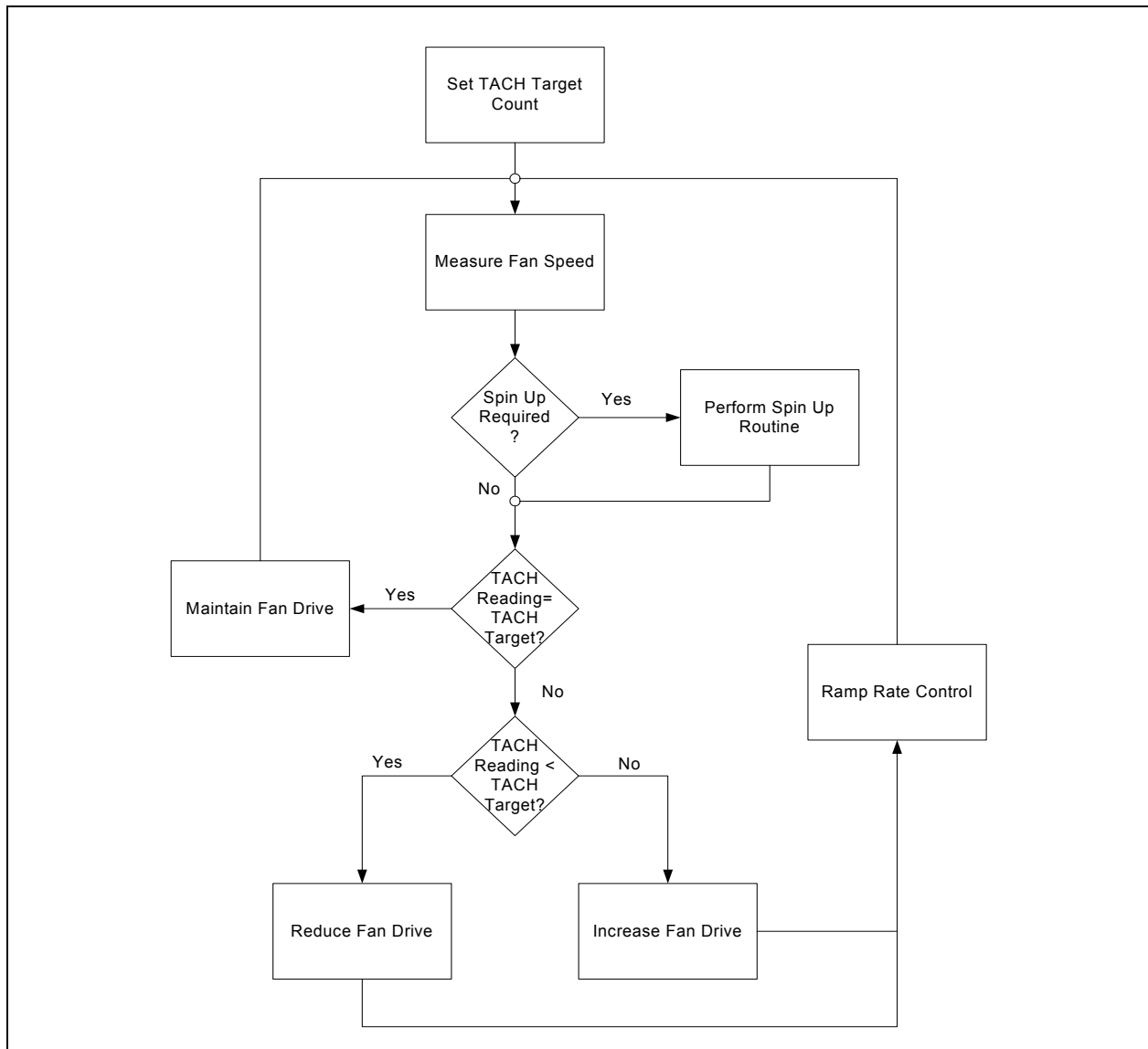
The fan control algorithm uses Proportional, Integral, and Derivative terms to automatically approach and maintain the system's desired fan speed to an accuracy directly proportional to the accuracy of the clock source. Figure 26-2, "RPM based Fan Control Algorithm" shows a simple flow diagram of the RPM based Fan Control Algorithm operation.

The desired tachometer count is set by the user inputting the desired number of 32.768KHz cycles that occur per fan revolution. The user may change the target count at any time. The user may also set the target count to FFh in order to disable the fan driver.

For example, if a desired RPM rate for a 2-pole fan is 3000 RPMs, the user would input the hexadecimal equivalent of 1312d (52\_00h in the TACH Target Registers). This number represents the number of 32.768KHz cycles that would occur during the time it takes the fan to complete a single revolution when it is spinning at 3000RPMs (see [Section 26.9.11, "TACH Target Register"](#) and [Section 26.9.12, "TACH Reading Register"](#)).

The [RPM-PWM Interface's](#) RPM based Fan Control Algorithm has programmable configuration settings for parameters such as ramp-rate control and spin up conditions. The fan driver automatically detects and attempts to alleviate a stalled/stuck fan condition while also asserting the interrupt signal. The [RPM-PWM Interface](#) works with fans that operate up to 16,000 RPMs and provide a valid tachometer signal. The fan controller will function either with an externally supplied 32.768KHz clock source or with its own internal 32KHz oscillator depending on the required accuracy.

FIGURE 26-2: RPM BASED FAN CONTROL ALGORITHM



### 26.8.3.1 Programming the RPM Based Fan Control Algorithm

The RPM based Fan Control Algorithm powers-up disabled. The following registers control the algorithm. The [RPM-PWM Interface](#) fan control registers are pre-loaded with defaults that will work for a wide variety of fans so only the TACH Target Register is required to set a fan speed. The other fan control registers can be used to fine-tune the algorithm behavior based on application requirements.

1. Set the Valid TACH Count Register to the minimum tachometer count that indicates the fan is spinning.
2. Set the Spin Up Configuration Register to the spin up level and Spin Time desired.
3. Set the Fan Step Register to the desired step size.
4. Set the Fan Minimum Drive Register to the minimum drive value that will maintain fan operation.
5. Set the Update Time, and Edges options in the Fan Configuration Register.
6. Set the TACH Target Register to the desired tachometer count.
7. Enable the RPM based Fan Control Algorithm by setting the EN\_ALGO bit.

## 26.8.3.2 Tachometer Measurement

In both modes of operation, the tachometer measurement operates independently of the mode of operation of the fan driver and RPM based Fan Speed Control algorithm. Any tachometer reading that is higher than the Valid TACH Count (see [Section 26.9.9, "Valid TACH Count Register"](#)) will flag a stalled fan and trigger an interrupt.

When measuring the tachometer, the fan must provide a valid tachometer signal at all times to ensure proper operation. The tachometer measurement circuitry is programmable to detect the fan speed of a variety of fan configurations and architectures including 1-pole, 2-pole (default), 3-pole, and 4-pole fans.

**APPLICATION NOTE:** The tachometer measurement works independently of the drive settings. If the device is put into manual mode and the fan drive is set at a level that is lower than the fan can operate (including zero drive), the tachometer measurement may signal a Stalled Fan condition and assert an interrupt.

### STALLED FAN

If the TACH Reading Register exceeds the user-programmable Valid TACH Count setting, it will flag the fan as stalled and trigger an interrupt. If the RPM based Fan Control Algorithm is enabled, the algorithm will automatically attempt to restart the fan until it detects a valid tachometer level or is disabled.

The FAN\_STALL Status bit indicates that a stalled fan was detected. This bit is checked conditionally depending on the mode of operation.

- Whenever the Manual Mode is enabled or whenever the drive value is changed from 00h, the FAN\_STALL interrupt will be masked for the duration of the programmed Spin Up Time (see [Table 26-17, "Spin time," on page 303](#)) to allow the fan an opportunity to reach a valid speed without generating unnecessary interrupts.
- In Manual Mode, whenever the TACH Reading Register exceeds the Valid TACH Count Register setting, the FAN\_STALL status bit will be set.
- When the RPM based Fan Control Algorithm, the stalled fan condition is checked whenever the Update Time is met and the fan drive setting is updated. It is not a continuous check.

## 26.8.3.3 Spin Up Routine

The [RPM-PWM Interface](#) also contains programmable circuitry to control the spin up behavior of the fan driver to ensure proper fan operation. The Spin Up Routine is initiated under the following conditions:

- The TACH Target High Byte Register value changes from a value of FFh to a value that is less than the Valid TACH Count (see [Section 26.9.9, "Valid TACH Count Register"](#)).
- The RPM based Fan Control Algorithm's measured tachometer reading is greater than the Valid TACH Count.
- When in Manual Mode, the Drive Setting changes from a value of 00h.

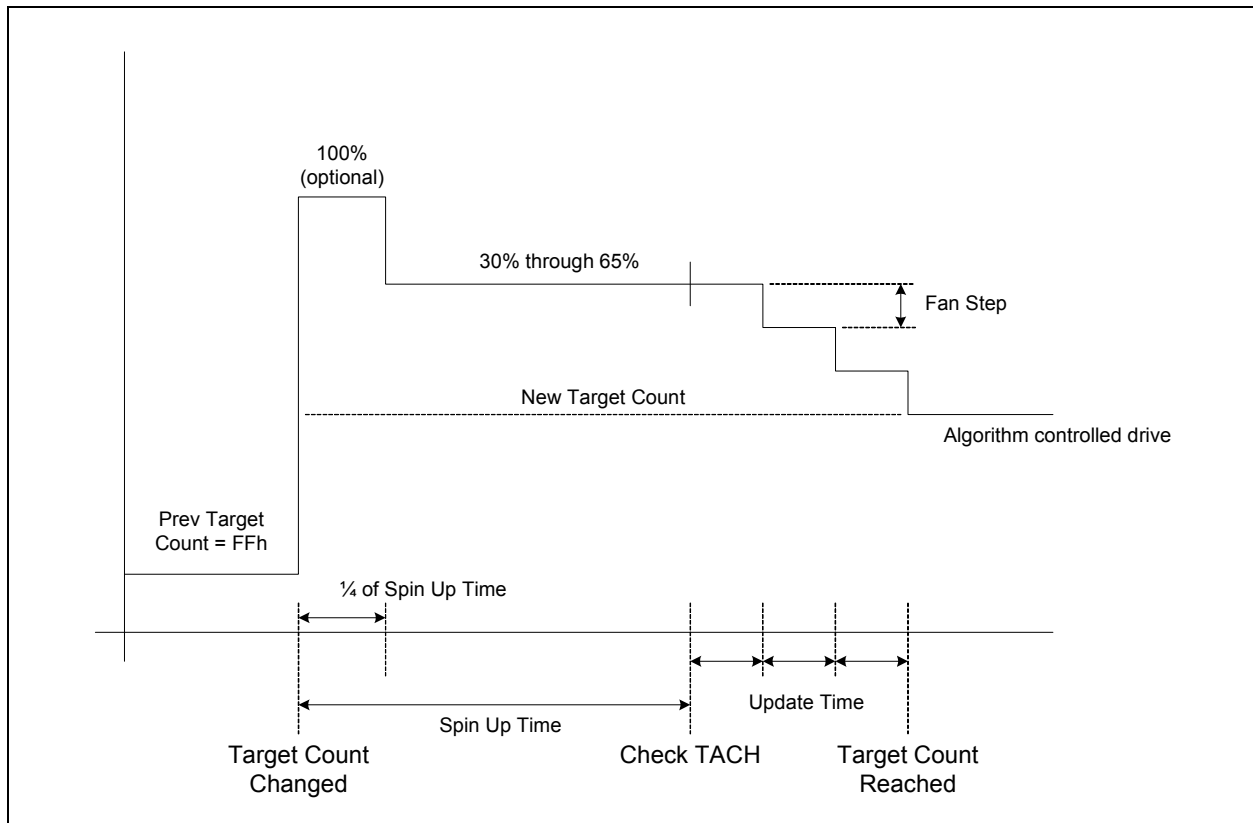
When the Spin Up Routine is operating, the fan driver is set to full scale for one quarter of the total user defined spin up time. For the remaining spin up time, the fan driver output is set a a user defined level (30% to 65% drive).

After the Spin Up Routine has finished, the [RPM-PWM Interface](#) measures the tachometer. If the measured tachometer reading is higher than the Valid TACH Count Register setting, the FAN\_SPIN status bit is set and the Spin Up Routine will automatically attempt to restart the fan.

**APPLICATION NOTE:** When the device is operating in manual mode, the FAN\_SPIN status bit may be set if the fan drive is set at a level that is lower than the fan can operate (excluding zero drive which disables the fan driver). If the FAN\_SPIN interrupt is unmasked, this condition will trigger an errant interrupt.

Figure 26-3, "Spin Up Routine" shows an example of the Spin Up Routine in response to a programmed fan speed change based on the first condition above.

FIGURE 26-3: SPIN UP ROUTINE



#### 26.8.4 PWM DRIVER

The [RPM-PWM Interface](#) contains an optional, programmable 8-bit PWM driver which can serve as part of the RPM based Fan Speed Control Algorithm or in Manual Mode.

When enabled, the PWM driver can operate in four programmable frequency bands. The lower frequency bands offer frequencies in the range of 9.5Hz to 4.8kHz while the higher frequency options offer frequencies of 21Hz or 25.2kHz.

#### 26.8.5 ALERTS AND LIMITS

Figure 26-4, "Interrupt Flow" shows the interactions of the interrupts for fan events.

If the Fan Driver detects a drive fail, spin-up or stall event, the interrupt signal will be asserted (if enabled).

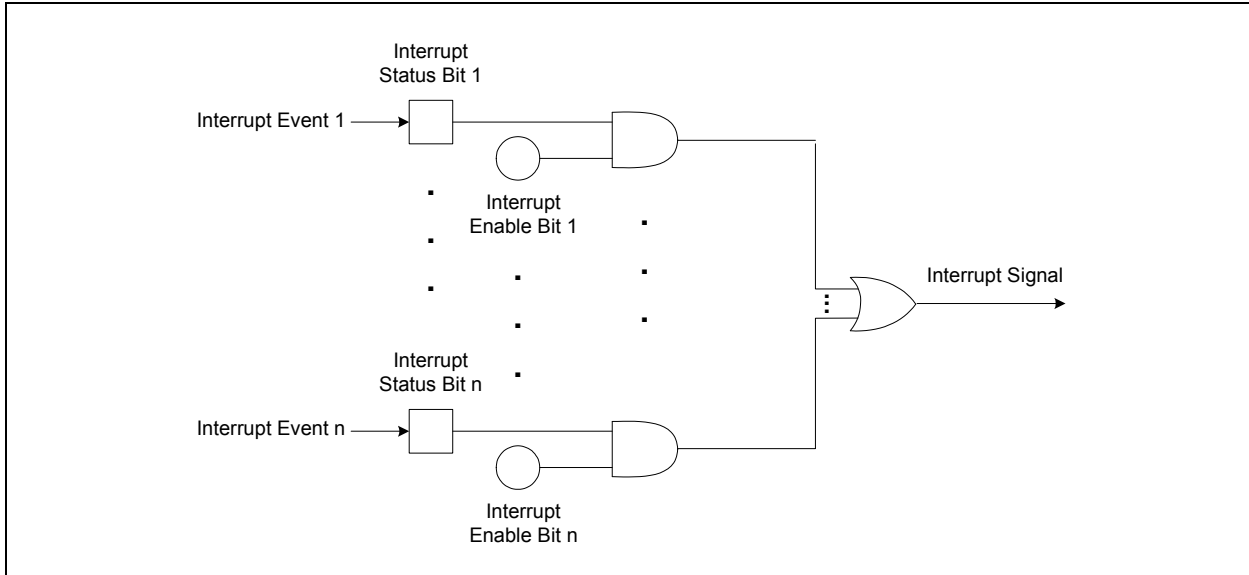
All of these interrupts can be masked from asserting the interrupt signal individually. If any bit of either Status register is set, the interrupt signal will be asserted provided that the corresponding interrupt enable bit is set accordingly.

The Status register will be updated due to an active event, regardless of the setting of the individual enable bits. Once a status bit has been set, it will remain set until the Status register bit is written to 1 (and the error condition has been removed).

If the interrupt signal is asserted, it will be cleared immediately if either the status or enable bit is cleared.

See [Section 26.6, "Interrupts," on page 291](#).

**FIGURE 26-4: INTERRUPT FLOW**



## 26.9 Fan Control Register Bank

The registers listed in the [Table 26-8, "Fan Control Register Summary"](#) are for a single instance of the [RPM-PWM Interface](#) block. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in [Table 26-7, "Fan Control Register Bank Base Address Table"](#).

**TABLE 26-7: FAN CONTROL REGISTER BANK BASE ADDRESS TABLE**

| Instance Name                     | Instance Number | Host | Address Space                 | Base Address (Note 26-1) |
|-----------------------------------|-----------------|------|-------------------------------|--------------------------|
| <a href="#">RPM-PWM Interface</a> | 0               | EC   | 32-bit internal address space | 4000_A000h               |

**Note 26-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 26-8: FAN CONTROL REGISTER SUMMARY**

| Register Name                 | Offset |
|-------------------------------|--------|
| Fan Setting                   | 00h    |
| PWM Divide                    | 01h    |
| Fan Configuration 1           | 02h    |
| Fan Configuration 2           | 03h    |
| MCHP Reserved                 | 04h    |
| Gain                          | 05h    |
| Fan Spin Up Configuration     | 06h    |
| Fan Step                      | 07h    |
| Fan Minimum Drive             | 08h    |
| Valid Tach Count              | 09h    |
| Fan Drive Fail Band Low Byte  | 0Ah    |
| Fan Drive Fail Band High Byte | 0Bh    |
| Tach Target Low Byte          | 0Ch    |
| Tach Target High Byte         | 0Dh    |
| Tach Reading Low Byte         | 0Eh    |



**TABLE 26-8: FAN CONTROL REGISTER SUMMARY (CONTINUED)**

| Register Name             | Offset |
|---------------------------|--------|
| Tach Reading High Byte    | 0Fh    |
| PWM Driver Base Frequency | 10h    |
| Fan Status                | 11h    |

## 26.9.1 FAN SETTING REGISTER

The Fan Setting Registers are used to control the output of the Fan Driver. The driver setting operates independently of the Polarity bit for the PWM output. That is, a setting of 00h will mean that the fan drive is at minimum drive while a value of FFh will mean that the fan drive is at maximum drive.

If the Spin Up Routine is invoked, reading from the registers will return the current fan drive setting that is being used by the Spin Up Routine instead of what was previously written into these registers.

The Fan Driver Setting Registers, when the RPM based Fan Control Algorithm is enabled, are read only. Writing to the register will have no effect and the data will not be stored. Reading from the register will always return the current fan drive setting.

If the INT\_PWRGD pin is de-asserted, the Fan Driver Setting Register will be made read only. Writing to the register will have no effect and reading from the register will return 000h.

When the RPM based Fan Control Algorithm is disabled, the current fan drive setting that was last used by the algorithm is retained and will be used.

If the Fan Driver Setting Register is set to a value of 00h, all tachometer related status bits will be masked until the setting is changed. Likewise, the FAN\_SHORT bit will be cleared and masked until the setting is changed.

The contents of the register represent the weighting of each bit in determining the final duty cycle. The output drive for a PWM output is given by the following equation:

$$\text{Drive} = (\text{FAN\_SETTING VALUE}/255) \times 100\%.$$

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | FAN_SETTING[7:0]<br>The Fan Driver Setting used to control the output of the Fan Driver. | R/W  | 00h     | VCC1_R<br>ESET |

## 26.9.2 PWM DIVIDE REGISTER

The PWM Divide Register determines the final PWM frequency. The base frequency set by the PWM\_BASE[1:0] bits is divided by the decimal equivalent of the register settings.

The final PWM frequency is derived as the base frequency divided by the value of this register as shown in the equation below:

$$\text{PWM\_Frequency} = \text{base\_clk} / \text{PWM\_D}$$

Where:

- base\_clk = The base frequency set by the PWMx\_CFG[1:0] bits
- PWM\_D = the divide setting set by the PWM Divide Register.

| Offset | 01h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:0    | PWM_DIVIDE[7:0]<br>The PWM Divide value determines the final frequency of the PWM driver. The driver base frequency is divided by the PWM Divide value to determine the final frequency. | R/W  | 01h     | VCC1_R<br>ESET |

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## 26.9.3 FAN CONFIGURATION 1 REGISTER

The Fan Configuration Register 1 controls the general operation of the RPM based Fan Control Algorithm used by the fan driver.

| Offset | 02h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7      | <p>EN_ALGO</p> <p>Enables the RPM based Fan Control Algorithm.</p> <ul style="list-style-type: none"> <li>• '0' - (default) the control circuitry is disabled and the fan driver output is determined by the Fan Driver Setting Register.</li> <li>• '1' - the control circuitry is enabled and the Fan Driver output will be automatically updated to maintain the programmed fan speed as indicated by the TACH Target Register.</li> </ul>  | R/W  | 0b      | VCC1_R<br>ESET |
| 6:5    | <p>RANGE[1:0]</p> <p>Adjusts the range of reported and programmed tachometer reading values. The RANGE bits determine the weighting of all TACH values (including the Valid TACH Count, TACH Target, and TACH reading) as shown in <a href="#">Table 26-9, "Range Decode"</a>.</p>   | R/W  | 01b     | VCC1_R<br>ESET |
| 4:3    | <p>EDGES[1:0]</p> <p>Determines the minimum number of edges that must be detected on the TACH signal to determine a single rotation. A typical fan measured 5 edges (for a 2-pole fan). Increasing the number of edges measured with respect to the number of poles of the fan will cause the TACH Reading registers to indicate a fan speed that is higher or lower than the actual speed. In order for the FSC Algorithm to operate correctly, the TACH Target must be updated by the user to accommodate this shift. The Effective Tach Multiplier shown in <a href="#">Table 26-10, "Minimum Edges for Fan Rotation"</a> is used as a direct multiplier term that is applied to the Actual RPM to achieve the Reported RPM. It should only be applied if the number of edges measured does not match the number of edges expected based on the number of poles of the fan (which is fixed for any given fan). Contact Microchip for recommended settings when using fans with more or less than 2 poles.</p> | R/W  | 01b     | VCC1_R<br>ESET |
| 2:0    | <p>UPDATE[2:0]</p> <p>Determines the base time between fan driver updates. The Update Time, along with the Fan Step Register, is used to control the ramp rate of the drive response to provide a cleaner transition of the actual fan operation as the desired fan speed changes. The Update Time is set as shown in <a href="#">Table 26-11, "Update Time"</a>.</p> <p><b>APPLICATION NOTE:</b> This ramp rate control applies for all changes to the active PWM output including when the RPM based Fan Speed Control Algorithm is disabled.</p>  | R/W  | 011b    | VCC1_R<br>ESET |

**TABLE 26-9: RANGE DECODE**

| Range [1:0] |   | Reported Minimum RPHM | TACH Count Multiplier |
|-------------|---|-----------------------|-----------------------|
| 1           | 0 |                       |                       |
| 0           | 0 | 500                   | 1                     |
| 0           | 1 | 1000 (default)        | 2                     |
| 1           | 0 | 2000                  | 4                     |
| 1           | 1 | 4000                  | 8                     |

**TABLE 26-10: MINIMUM EDGES FOR FAN ROTATION**

| Edges 1:0] |   | Minimum TACH Edges | Number of Fan Poles | Effective TACH Multiplier (Based on 2 Pole Fans) If Edges Changed |
|------------|---|--------------------|---------------------|---|
| 1          | 0 |                    |                     |   |
| 0          | 0 | 3                  | 1                   | 0.5   |
| 0          | 1 | 5                  | 2 (default)         | 1   |
| 1          | 0 | 7                  | 3                   | 1.5   |
| 1          | 1 | 9                  | 4                   | 2   |

**TABLE 26-11: UPDATE TIME**

| Update [2:0] |   |   | TACH Count Multiplier (ms) |
|--------------|---|---|----------------------------|
| 2            | 1 | 0 |                            |
| 0            | 0 | 0 | 100                        |
| 0            | 0 | 1 | 200                        |
| 0            | 1 | 0 | 300                        |
| 0            | 1 | 1 | 400 (default)              |
| 1            | 0 | 0 | 500                        |
| 1            | 0 | 1 | 800                        |
| 1            | 1 | 0 | 1200                       |
| 1            | 1 | 1 | 1600                       |

## 26.9.4 FAN CONFIGURATION 2 REGISTER

The Fan Configuration 2 Register controls the tachometer measurement and advanced features of the RPM based Fan Control Algorithm.

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| Offset | 03h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7      | MCHP Reserved   | R/W  | 0b      | VCC1_R<br>ESET |
| 6      | EN_RRC<br>Enables the ramp rate control circuitry during the Manual Mode of operation.<br><ul style="list-style-type: none"> <li>'0' (default) - The ramp rate control circuitry for the Manual Mode of operation is disabled. When the Fan Drive Setting values are changed and the RPM based Fan Control Algorithm is disabled, the fan driver will be set to the new setting immediately.</li> <li>'1' - The ramp rate control circuitry for the Manual Mode of operation is enabled. The PWM setting will follow the ramp rate controls as determined by the Fan Step and Update Time settings. The maximum PWM step is capped at the Fan Step setting and is updated based on the Update Time as given by <a href="#">Table 26-11</a>, "Update Time".</li> </ul> | R/W  | 0b      | VCC1_R<br>ESET |
| 5      | DIS_GLITCH<br>Disables the low pass glitch filter that removes high frequency noise injected on the TACH pin.<br><ul style="list-style-type: none"> <li>'0' (default) - The glitch filter is enabled.</li> <li>'1' - The glitch filter is disabled.</li> </ul>  | R/W  | 0b      | VCC1_R<br>ESET |
| 4:3    | DER_OPT[1:0]<br>Control some of the advanced options that affect the derivative portion of the RPM based fan control algorithm as shown in <a href="#">Table 26-12</a> , "Derivative Options". These bits only apply if the Fan Speed Control Algorithm is used.  | R/W  | 11b     | VCC1_R<br>ESET |
| 2:1    | ERR_RNG[1:0]<br>Control some of the advanced options that affect the error window. When the measured fan speed is within the programmed error window around the target speed, the fan drive setting is not updated. These bits only apply if the Fan Speed Control Algorithm is used. See <a href="#">Table 26-13</a> , "Error Range Options".  | R/W  | 01b     | VCC1_R<br>ESET |
| 0      | POLARITY<br>Determines the polarity of the PWM driver. This does NOT affect the drive setting registers. A setting of 0% drive will still correspond to 0% drive independent of the polarity.<br><ul style="list-style-type: none"> <li>'0' (default) - the Polarity of the PWM driver is normal. A drive setting of 00h will cause the output to be set at 0% duty cycle and a drive setting of FFh will cause the output to be set at 100% duty cycle.</li> <li>'1' - The Polarity of the PWM driver is inverted. A drive setting of 00h will cause the output to be set at 100% duty cycle and a drive setting of FFh will cause the output to be set at 0% duty cycle.</li> </ul>   | R/W  | 0b      | VCC1_R<br>ESET |

**TABLE 26-12: DERIVATIVE OPTIONS**

| DER_OPT[1:0] |   | Operation  | NOTE<br>(see Section 26.9.7, "Fan Step Register")  |
|--------------|---|--|--|
| 1            | 0 |  |  |
| 0            | 0 | No derivative options used   | PWM steps are limited to the maximum PWM drive step value in Fan Step Register   |
| 0            | 1 | Basic derivative. The derivative of the error from the current drive setting and the target is added to the iterative PWM drive setting (in addition to proportional and integral terms)   | PWM steps are limited to the maximum PWM drive step value in Fan Step Register   |
| 1            | 0 | Step derivative. The derivative of the error from the current drive setting and the target is added to the iterative PWM drive setting and is not capped by the maximum PWM drive step. This allows for very fast response times | PWM steps are not limited to the maximum PWM drive step value in Fan Step Register (i.e., maximum fan step setting is ignored) |
| 1            | 1 | Both the basic derivative and the step derivative are used effectively causing the derivative term to have double the effect of the derivative term (default).   | PWM steps are not limited to the maximum PWM drive step value in Fan Step Register (i.e., maximum fan step setting is ignored) |

**TABLE 26-13: ERROR RANGE OPTIONS**

| ERR_RNGX[1:0] |   | Operation        |
|---------------|---|------------------|
| 1             | 0 |                  |
| 0             | 0 | 0 RPM            |
| 0             | 1 | 50 RPM (default) |
| 1             | 0 | 100 RPM          |
| 1             | 1 | 200 RPM          |

### 26.9.5 GAIN REGISTER

The Gain Register The Gain Register stores the gain terms used by the proportional and integral portions of the RPM based Fan Control Algorithm. These terms will affect the FSC closed loop acquisition, overshoot, and settling as would be expected in a classic PID system.

This register only applies if the Fan Speed Control Algorithm is used.

| Offset | 05h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:6    | RESERVED  | R/W  | 00h     | -           |
| 5:4    | GAIND[1:0]<br>The derivative gain term. See Table 26-14, "Gain Decode".   | R/W  | 10h     | VCC1_R ESET |
| 3:2    | GAINI[1:0]<br>The integral gain term. See Table 26-14, "Gain Decode".     | R/W  | 10h     | VCC1_R ESET |
| 1:0    | GAINP[1:0]<br>The proportional gain term. See Table 26-14, "Gain Decode". | R/W  | 10h     | VCC1_R ESET |

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**TABLE 26-14: GAIN DECODE**

| GAIN <sub>D</sub> or GAIN <sub>P</sub> or GAIN <sub>I</sub> [1:0] |   | Respective Gain Factor |
|---|---|------------------------|
| 1   | 0 |                        |
| 0   | 0 | 1x                     |
| 0   | 1 | 2x                     |
| 1   | 0 | 4x (default)           |
| 1   | 1 | 8x                     |

## 26.9.6 FAN SPIN UP CONFIGURATION REGISTER

The Fan Spin Up Configuration Register controls the settings of Spin Up Routine.

| Offset | 06h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 7:6    | <b>DRIVE_FAIL_CNT[1:0]</b><br>Determines how many update cycles are used for the Drive Fail detection function as shown in <a href="#">Table 26-15, "DRIVE_FAIL_CNT[1:0] Bit Decode"</a> . This circuitry determines whether the fan can be driven to the desired Tach target. These settings only apply if the Fan Speed Control Algorithm is enabled.   | R/W  | 00b     | VCC1_R ESET |
| 5      | <b>NOKICK</b><br>Determines if the Spin Up Routine will drive the fan to 100% duty cycle for 1/4 of the programmed spin up time before driving it at the programmed level. <ul style="list-style-type: none"> <li>'0' (default) - The Spin Up Routine will drive the PWM to 100% for 1/4 of the programmed spin up time before reverting to the programmed spin level.</li> <li>'1' - The Spin Up Routine will not drive the PWM to 100%. It will set the drive at the programmed spin level for the entire duration of the programmed spin up time.</li> </ul> | R/W  | 0b      | VCC1_R ESET |
| 4:2    | <b>SPIN_LVL[2:0]</b><br><b>SPIN_LVL[2:0]</b> - Determines the final drive level that is used by the Spin Up Routine as shown in <a href="#">Table 26-16, "Spin Level"</a> .   | R/W  | 110b    | VCC1_R ESET |
| 1:0    | <b>SPINUP_TIME[1:0]</b><br>Determines the maximum Spin Time that the Spin Up Routine will run for. If a valid tachometer measurement is not detected before the Spin Time has elapsed, an interrupt will be generated. When the RPM based Fan Control Algorithm is active, the fan driver will attempt to re-start the fan immediately after the end of the last spin up attempt.<br>The Spin Time is set as shown in <a href="#">Table 26-17, "Spin time"</a> .  | R/W  | 01b     | VCC1_R ESET |

**TABLE 26-15: DRIVE\_FAIL\_CNT[1:0] BIT DECODE**

| DRIVE_FAIL_CNT[1:0] |   | Number of Update Periods   |
|---------------------|---|--|
| 1                   | 0 |  |
| 0                   | 0 | Disabled - the Drive Fail detection circuitry is disabled                |
| 0                   | 1 | 16 - the Drive Fail detection circuitry will count for 16 update periods |

**TABLE 26-15: DRIVE\_FAIL\_CNT[1:0] BIT DECODE (CONTINUED)**

| DRIVE_FAIL_CNT[1:0] |   | Number of Update Periods   |
|---------------------|---|--|
| 1                   | 0 |  |
| 1                   | 0 | 32 - the Drive Fail detection circuitry will count for 32 update periods |
| 1                   | 1 | 64 - the Drive Fail detection circuitry will count for 64 update periods |

**TABLE 26-16: SPIN LEVEL**

| SPIN_LVL[2:0] |   |   | Spin Up Drive Level |
|---------------|---|---|---------------------|
| 2             | 1 | 0 |                     |
| 0             | 0 | 0 | 30%                 |
| 0             | 0 | 1 | 35%                 |
| 0             | 1 | 0 | 40%                 |
| 0             | 1 | 1 | 45%                 |
| 1             | 0 | 0 | 50%                 |
| 1             | 0 | 1 | 55%                 |
| 1             | 1 | 0 | 60% (default)       |
| 1             | 1 | 1 | 65%                 |

**TABLE 26-17: SPIN TIME**

| SPINUP_TIME[1:0] |   | Total Spin Up Time |
|------------------|---|--------------------|
| 1                | 0 |                    |
| 0                | 0 | 250 ms             |
| 0                | 1 | 500 ms (default)   |
| 1                | 0 | 1 sec              |
| 1                | 1 | 2 sec              |

## 26.9.7 FAN STEP REGISTER

The Fan Step Register, along with the Update Time, controls the ramp rate of the fan driver response calculated by the RPM based Fan Control Algorithm for the Derivative Options field values of “00” and “01” in the Fan Configuration 2 Register (see [Table 26-12, “Derivative Options,” on page 301](#)).

The value of the register represents the maximum step size the fan driver will take for each update (see [Section 26.9.3, “Fan Configuration 1 Register,” on page 298](#)).

When the maximum step size limitation is applied, if the necessary fan driver delta is larger than the Fan Step, it will be capped at the Fan Step setting and updated every Update Time ms.

The maximum step size is ignored for the Derivative Options field values of “10” and “11”.

| Offset | 07h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:6    | RESERVED   | R/W  | 00h     | -              |
| 5:0    | FAN_STEP[5:0]<br>The Fan Step value represents the maximum step size the fan driver will take between update times | R/W  | 10h     | VCC1_R<br>ESET |

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## 26.9.8 FAN MINIMUM DRIVE REGISTER

the Fan Minimum Drive Register stores the minimum drive setting for the RPM based Fan Control Algorithm. The RPM based Fan Control Algorithm will not drive the fan at a level lower than the minimum drive unless the target Fan Speed is set at FFh (see "[TACH Target Registers](#)").

During normal operation, if the fan stops for any reason (including low drive), the RPM based Fan Control Algorithm will attempt to restart the fan. Setting the Fan Minimum Drive Registers to a setting that will maintain fan operation is a useful way to avoid potential fan oscillations as the control circuitry attempts to drive it at a level that cannot support fan operation.

These registers only apply if the Fan Speed Control Algorithm is used.

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description                                  | Type | Default | Reset Event    |
| 7:0    | MIN_DRIVE[7:0]<br>The minimum drive setting. | R/W  | 66h     | VCC1_R<br>ESET |

**APPLICATION NOTE:** To ensure proper operation, the Fan Minimum Drive register must be set prior to setting the Tach Target High and Low Byte registers, and then the Tach Target registers can be subsequently updated. At a later time, if the Fan Minimum Drive register is changed to a value higher than current Fan value, the Tach Target registers must also be updated.

## 26.9.9 VALID TACH COUNT REGISTER

The Valid TACH Count Register stores the maximum TACH Reading Register value to indicate that the fan is spinning properly. The value is referenced at the end of the Spin Up Routine to determine if the fan has started operating and decide if the device needs to retry. See the equation in the TACH Reading Registers section for translating the RPM to a count.

If the TACH Reading Register value exceeds the Valid TACH Count Register (indicating that the Fan RPM is below the threshold set by this count), a stalled fan is detected. In this condition, the algorithm will automatically begin its Spin Up Routine.

**APPLICATION NOTE:** The automatic invoking of the Spin Up Routine only applies if the Fan Speed Control Algorithm is used. If the FSC is disabled, then the device will only invoke the Spin Up Routine when the PWM setting changes from 00h.

If a TACH Target setting is set above the Valid TACH Count setting, that setting will be ignored and the algorithm will use the current fan drive setting.

These registers only apply if the Fan Speed Control Algorithm is used.

| Offset | 09h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:0    | VALID_TACH_CNT[7:0]<br>The maximum TACH Reading Register value to indicate that the fan is spinning properly. | R/W  | F5h     | VCC1_R<br>ESET |

## 26.9.10 FAN DRIVE FAIL BAND REGISTER

The Fan Drive Fail Band Registers store the number of Tach counts used by the Fan Drive Fail detection circuitry. This circuitry is activated when the fan drive setting high byte is at FFh. When it is enabled, the actual measured fan speed is compared against the target fan speed.

This circuitry is used to indicate that the target fan speed at full drive is higher than the fan is actually capable of reaching. If the measured fan speed does not exceed the target fan speed minus the Fan Drive Fail Band Register settings for a period of time longer than set by the DRIVE\_FAIL\_CNTx[1:0] bits in the [Fan Spin Up Configuration Register on page 302](#), the DRIVE\_FAIL status bit will be set and an interrupt generated.

These registers only apply if the Fan Speed Control Algorithm is used.



| Offset | 0Ah   |      |                    |                |
|--------|---|------|--------------------|----------------|
| Bits   | Description   | Type | Default            | Reset Event    |
| 15:3   | FAN_DRIVE_FAIL_BAND[12:0]<br>The number of Tach counts used by the Fan Drive Fail detection circuitry | RES  | 000000000<br>0000b | VCC1_R<br>ESET |
| 2:0    | RESERVED  | R/W  | 000b               | -              |

## 26.9.11 TACH TARGET REGISTER

The TACH Target Registers hold the target tachometer value that is maintained for the RPM based Fan Control Algorithm.

If the algorithm is enabled, setting the TACH Target Register High Byte to FFh will disable the fan driver (or set the PWM duty cycle to 0%). Setting the TACH Target to any other value (from a setting of FFh) will cause the algorithm to invoke the Spin Up Routine after which it will function normally.

These registers only apply if the Fan Speed Control Algorithm is used.

| Offset | 0Ch   |      |                   |                |
|--------|---|------|-------------------|----------------|
| Bits   | Description                                       | Type | Default           | Reset Event    |
| 15:3   | TACH_TARGET[12:0]<br>The target tachometer value. | RES  | 111111111<br>111b | VCC1_R<br>ESET |
| 2:0    | RESERVED  | R/W  | 000b              | -              |

## 26.9.12 TACH READING REGISTER

The TACH Reading Registers' contents describe the current tachometer reading for the fan. By default, the data represents the fan speed as the number of 32.768kHz clock periods that occur for a single revolution of the fan.

The Equation below shows the detailed conversion from tachometer measurement (COUNT) to RPM.

$$RPM = \frac{1}{Poles} \times \frac{(n-1)}{COUNT \times \frac{1}{m}} \times fTACH \times 60$$

where:

- Poles = number of poles of the fan (typically 2)
- fTACH = the frequency of the tachometer measurement clock
- n = number of edges measured (typically 5 for a 2 pole fan)
- m = the multiplier defined by the RANGE bits
- COUNT = TACH Reading Register value (in decimal)

The following equation shows the simplified translation of the TACH Reading Register count to RPM assuming a 2-pole fan, measuring 5 edges, with a frequency of 32.768kHz.

$$RPM = \frac{3932160 \times m}{COUNT}$$

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| Offset | 0Eh   |      |                   |                |
|--------|---|------|-------------------|----------------|
| Bits   | Description   | Type | Default           | Reset Event    |
| 15:3   | TACH_READING[12:0]<br>The current tachometer reading value. | RES  | 111111111<br>111b | VCC1_R<br>ESET |
| 2:0    | RESERVED  | R/W  | 000b              | -              |

## 26.9.13 PWM DRIVER BASE FREQUENCY REGISTER

- The PWM Driver Base Register controls the base PWM frequency range.

| Offset | 10h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:2    | RESERVED   | RES  | 000000b | -              |
| 1:0    | PWM_BASE[1:0]<br>Determines the frequency range of the PWM fan driver (when enabled) as shown in <a href="#">Table 26-18</a> . | R/W  | 00b     | VCC1_R<br>ESET |

**TABLE 26-18: PWM\_BASE[1:0] DECODE**

| PWM_BASE[1:0] |   | PWM Frequency |
|---------------|---|---------------|
| 1             | 0 |               |
| 0             | 0 | 26.83KHz      |
| 0             | 1 | 20.87kHz      |
| 1             | 0 | 4.82kHz       |
| 1             | 1 | 2.41KHz       |

## 26.9.14 FAN STATUS REGISTER

The bits in this register are routed to interrupts.

| Offset | 11h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 7:6    | RESERVED   | RES  | 00b     | -              |
| 5      | DRIVE_FAIL<br>The bit Indicates that the RPM-based Fan Speed Control Algorithm cannot drive the Fan to the desired target setting at maximum drive. <ul style="list-style-type: none"> <li>'0' - The RPM-based Fan Speed Control Algorithm can drive Fan to the desired target setting.</li> <li>'1' - The RPM-based Fan Speed Control Algorithm cannot drive Fan to the desired target setting at maximum drive.</li> </ul> | R/WC | 0b      | VCC1_R<br>ESET |
| 4:2    | RESERVED   | RES  | 000b    | -              |

| Offset | 11h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 1      | <b>FAN_SPIN</b><br>The bit Indicates that the Spin up Routine for the Fan could not detect a valid tachometer reading within its maximum time window. <ul style="list-style-type: none"> <li>• '0' - The Spin up Routine for the Fan detected a valid tachometer reading within its maximum time window.</li> <li>• '1' - The Spin up Routine for the Fan could not detect a valid tachometer reading within its maximum time window.</li> </ul> | R/WC | 0b      | VCC1_R<br>ESET |
| 0      | <b>FAN_STALL</b><br>The bit Indicates that the tachometer measurement on the Fan detects a stalled fan. <ul style="list-style-type: none"> <li>• '0' - Stalled fan not detected.</li> <li>• '1' - Stalled fan not detected.</li> </ul>   | R/WC | 0b      | VCC1_R<br>ESET |

## 27.0 GENERAL PURPOSE SERIAL PERIPHERAL INTERFACE

### 27.1 Overview

The General Purpose Serial Peripheral Interface (GP-SPI) may be used to communicate with various peripheral devices, e.g., EEPROMS, DACs, ADCs, that use a standard Serial Peripheral Interface.

Characteristics of the GP-SPI Controller include:

- 8-bit serial data transmitted and received simultaneously over two data pins in Full Duplex mode with options to transmit and receive data serially on one data pin in Half Duplex (Bidirectional) mode.
- An internal programmable clock generator and clock polarity and phase controls allowing communication with various SPI peripherals with specific clocking requirements.
- SPI cycle completion that can be determined by status polling or interrupts.
- The ability to read data in on both SPDIN and SPDOUT in parallel. This allows this SPI Interface to support dual data rate read accesses for emerging double rate SPI flashes
- Support of back-to-back reads and writes without clock stretching, provided the host can read and write the data registers within one byte transaction time.

### 27.2 References

No references have been cited for this feature.

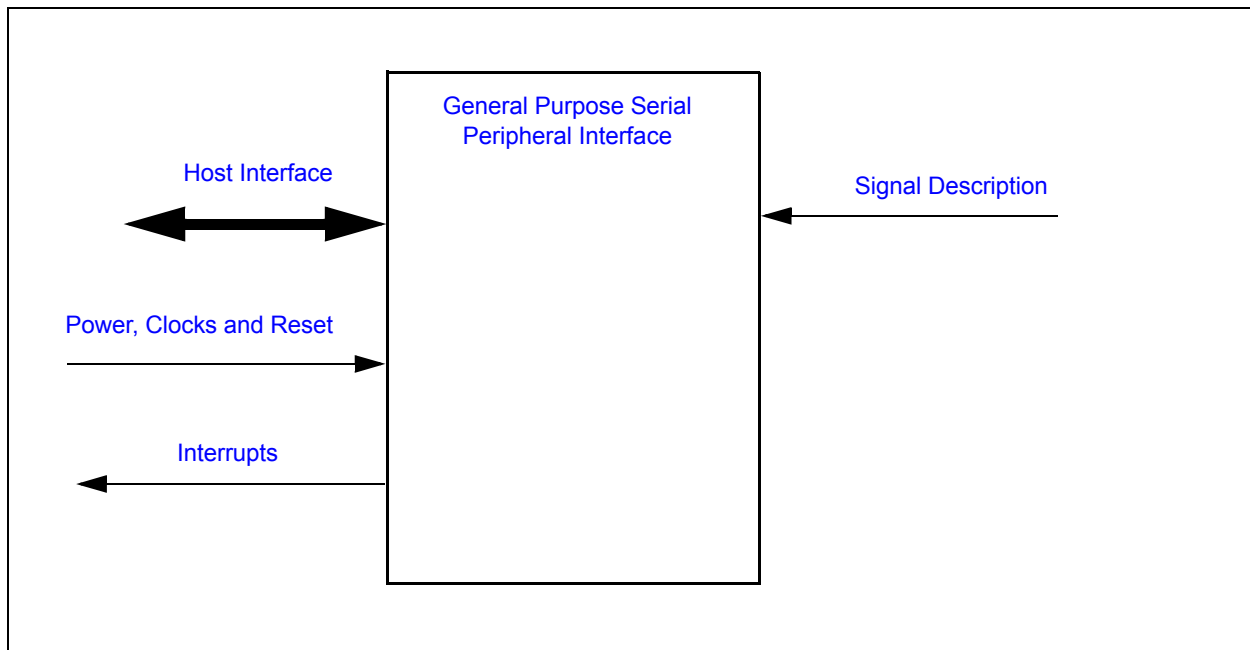
### 27.3 Terminology

No terminology for this block.

### 27.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 27-1: I/O DIAGRAM OF BLOCK**



## 27.5 Signal Description

**TABLE 27-1: SIGNAL DESCRIPTION TABLE**

| Name    | Direction    | Description  |
|---------|--------------|--|
| SPDIN   | Input        | Serial Data In pin   |
| SPDOUT  | Input/Output | Serial Data Output pin. Switches to input when used in double-data-rate mode |
| SPI_CLK | Output       | SPI Clock output used to drive the SPCLK pin.                                |
| SPI_CS# | Output       | SPI chip select  |

**Note:** The SPI block signals that are shown in [Table 27-1](#) are routed to the SPI pins as listed in [Table 27-2](#).

**TABLE 27-2: SIGNAL TO PIN NAME LOOKUP TABLE**

| Block Name | Pin Name           |
|------------|--------------------|
| SPDIN      | SHD_MISO, PVT_MISO |
| SPDOUT     | SHD_MOSI, PVT_MOSI |
| SPI_CLK    | SHD_SCLK, PVT_SCLK |
| SPI_CS#    | SHD_CS0#, PVT_CS0# |

## 27.6 Host Interface

The registers defined for the General Purpose Serial Peripheral Interface are accessible by the various hosts as indicated in [Section 27.12, "EC-Only Registers"](#).

## 27.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 27.7.1 POWER DOMAINS

**TABLE 27-3: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block are powered by this power well. |

### 27.7.2 CLOCK INPUTS

**TABLE 27-4: CLOCK INPUTS**

| Name                   | Description   |
|------------------------|---|
| 48 MHz Ring Oscillator | This is a clock source for the SPI clock generator. |
| 2MHz                   | This is a clock source for the SPI clock generator. |

### 27.7.3 RESETS

**TABLE 27-5: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This signal resets all the registers and logic in this block to their default state. |

## 27.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 27-6: EC INTERRUPTS**

| Source   | Description   |
|----------|---|
| TXBE_STS | Transmit buffer empty status (TXBE), in the <a href="#">SPI Status Register</a> , sent as an interrupt request to the Interrupt Aggregator. |
| RXBF_STS | Receive buffer full status (RXBF), in the <a href="#">SPI Status Register</a> , sent as an interrupt request to the Interrupt Aggregator.   |

These status bits are also connected respectively to the DMA Controller's SPI Controller TX and RX requests signals.

## 27.9 Low Power Modes

The GP-SPI Interface may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 27.10 Description

The Serial Peripheral Interface (SPI) block is a master SPI block used to communicate with external SPI devices. The SPI master is responsible for generating the SPI clock and is designed to operate in Full Duplex, Half Duplex, and Dual modes of operation. The clock source may be programmed to operate at various clock speeds. The data is transmitted serially via 8-bit transmit and receive shift registers. Communication with SPI peripherals that require transactions of varying lengths can be achieved with multiple 8-bit cycles.

This block has many configuration options: The data may be transmitted and received either MSbit or LSbit first; The SPI Clock Polarity may be either active high or active low; Data may be sampled or presented on either the rising or falling edge of the clock (referred to as the transmit clock phase); and the SPI\_CLK SPDOUT frequency may be programmed to a range of values as illustrated in [Table 27-7, "SPI\\_CLK Frequencies"](#). In addition to these many programmable options, this feature has several status bits that may be enabled to notify the host that data is being transmitted or received.

### 27.10.1 INITIATING AN SPI TRANSACTION

All SPI transactions are initiated by a write to the TX\_DATA register. No read or write operations can be initiated until the Transmit Buffer is Empty, which is indicated by a one in the TXBE status bit.

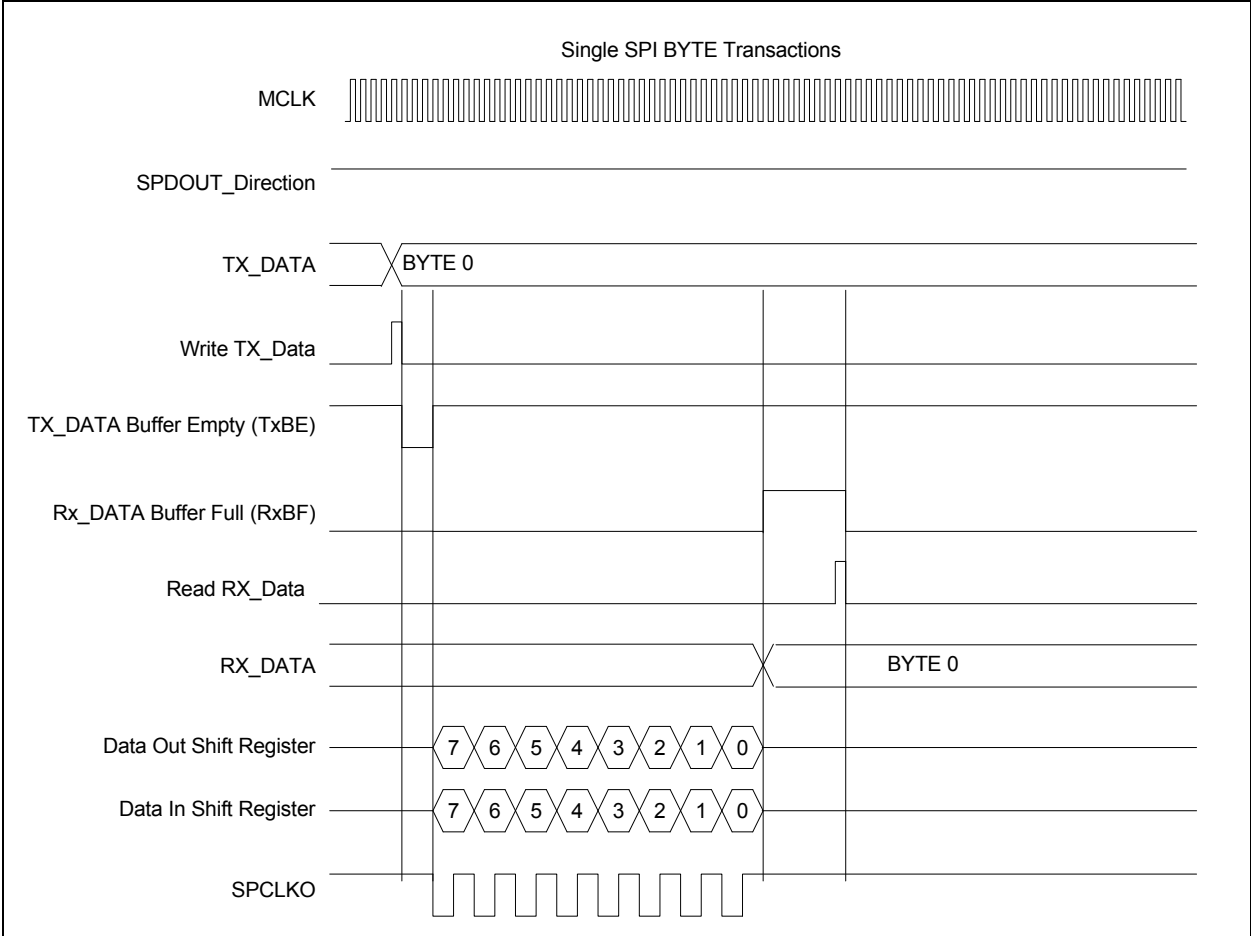
If the transaction is a write operation, the host writes the TX\_DATA register with the value to be transmitted. Writing the TX\_DATA register causes the TXBE status bit to be cleared, indicating that the value has been registered. If empty, the SPI Core loads this TX\_DATA value into an 8-bit transmit shift register and begins shifting the data out. Loading the value into the shift register causes the TXBE status bit to be asserted, indicating to software that the next byte can be written to the TX\_DATA register.

If the transaction is a read operation, the host initiates a write to the TX\_DATA register in the same manner as the write operation. Unlike the transmit command, the host must clear the RXBF status bit by reading the RX\_DATA register before writing the TX\_DATA register. This time, the host will be required to poll the RXBF status bit to determine when the value in the RX\_DATA register is valid.

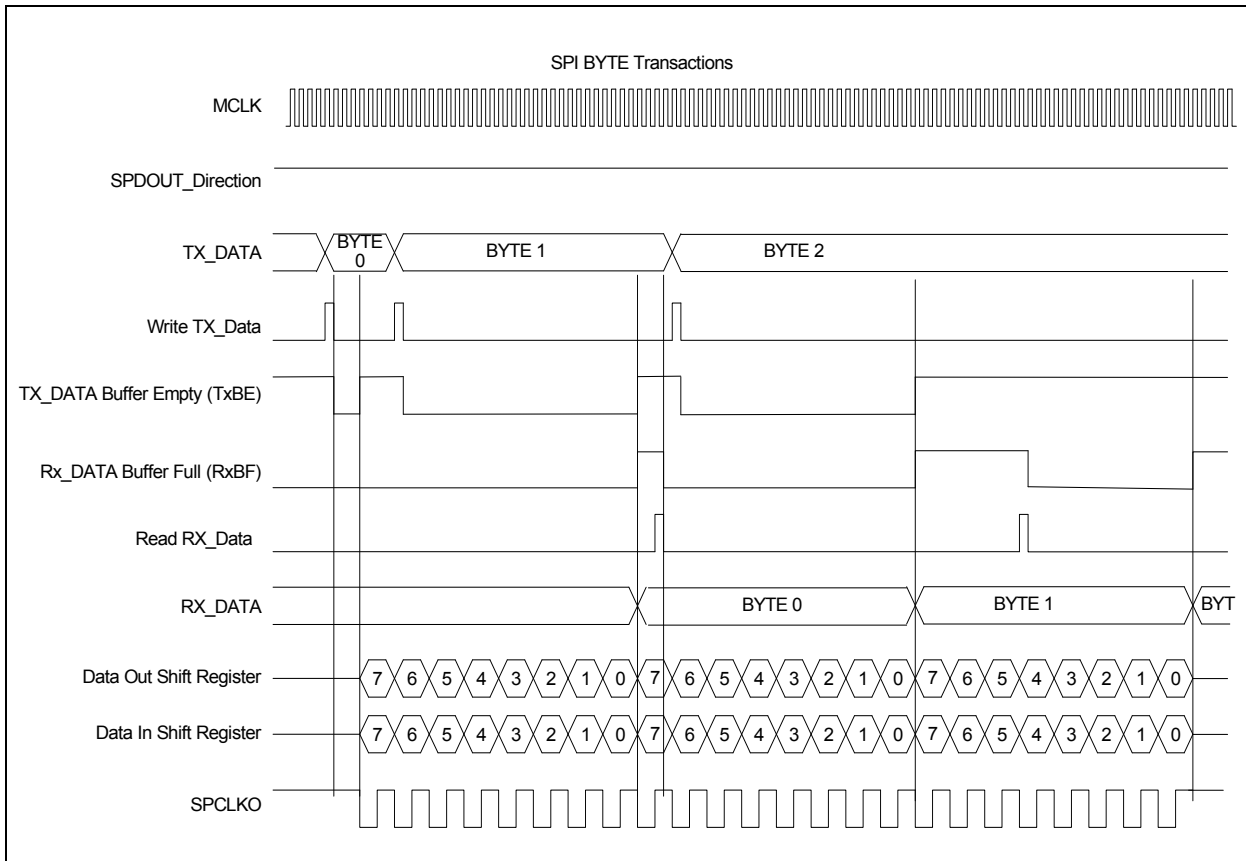
- Note 1:** If the SPI interface is configured for Half Duplex mode, the host must still write a dummy byte to receive data.
- 2:** Since RX and TX transactions are executed by the same sequence of transactions, data is always shifted into the RX\_DATA register. Therefore, every write operation causes data to be latched into the RX\_DATA register and the RXBF bit is set. This status bit should be cleared before initiating subsequent transactions. The host utilizing this SPI core to transmit SPI Data must discard the unwanted receive bytes.
  - 3:** The length and order of data sent to and received from a SPI peripheral varies between peripheral devices. The SPI must be properly configured and software-controlled to communicate with each device and determine whether SPIRD data is valid slave data.

The following diagrams show sample single byte and multi-byte SPI Transactions.

FIGURE 27-2: SINGLE BYTE SPI TX/RX TRANSACTIONS (FULL DUPLEX MODE)



**FIGURE 27-3: MULTI-BYTE SPI TX/RX TRANSACTIONS (FULL DUPLEX MODE)**



The data may be configured to be transmitted MSB or LSB first. This is configured by the [LSBF](#) bit in the [SPI Control Register](#). The transmit data is shifted out on the edge as selected by the [TCLKPH](#) bit in the [SPI Clock Control Register](#). All received data can be sampled on a rising or falling SPI\_CLK edge using the [RCLKPH](#) bit in the [SPI Clock Control Register](#). This clock setting must be identical to the clocking requirements of the current SPI slave.

**Note:** Common peripheral devices require a chip select signal to be asserted during a transaction. Chip selects for SPI devices may be controlled by MEC1322 GPIO pins.

There are three types of transactions that can be implemented for transmitting and receiving the SPI data. They are Full Duplex, Half Duplex, and Dual Mode. These modes are defined in [Section 27.10.3, "Types of SPI Transactions"](#).

## 27.10.2 DMA MODE

Transmit and receive operations can use a DMA channel. Note that only one DMA channel may be enabled at a time. Setting up the DMA Controller involves specifying the device (Flash GP-SPI), direction (transmit/receive), and the start and end addresses of the DMA buffers in the closely couple memory. Please refer to the DMA Controller chapter for register programming information.

**SPI transmit / DMA write:** the GP-SPI block's transmit empty (TxBE) status signal is used as a write request to the DMA controller, which then fetches a byte from the DMA transmit buffer and writes it to the GP-SPI's SPI TX Data Register (SPITD). As content of the latter is transferred to the internal Tx shift register from which data is shifted out onto the SPI bus bit by bit, the Tx Empty signal is again asserted, triggering the DMA fetch-and-write cycle. The process continues until the end of the DMA buffer is reached - the DMA controller stops responding to an active Tx Empty until the buffer's address registers are reprogrammed.

**SPI receive / DMA read:** the [AUTO\\_READ](#) bit in the SPI Control Register must be set. The driver first writes (dummy data) to the SPI TX Data Register (SPITD) to initiate the toggling of the SPI clock, enabling data to be shifted in. After one byte is received, the Rx Full (RxBF) status signal, used as a read request to the DMA controller, is asserted. The



DMA controller then reads the received byte from the GP-SPI's SPI RX Data Register (SPIRD) and stores it in the DMA receive buffer. With AUTO\_READ set, this read clears both the RxBF and TxBE. Clearing TxBE causes (dummy) data from the SPI TX Data Register (SPITD) to be transferred to the internal shift register, mimicking the effect of the aforementioned write to the SPI TX Data Register (SPITD) by the driver. SPI clock is toggled again to shift in the second read byte. This process continues until the end of the DMA buffer is reached - the DMA controller stops responding to an active Tx Empty until the buffer's address registers are reprogrammed.

## 27.10.3 TYPES OF SPI TRANSACTIONS

The GP-SPI controller can be configured to operate in three modes: Full Duplex, Half Duplex, and Dual Mode.

### 27.10.3.1 Full Duplex

In Full Duplex Mode, serial data is transmitted and received simultaneously by the SPI master over the SPDOOUT and SPDIN pins. To enable Full Duplex Mode clear SPDIN Select.

When a transaction is completed in the full-duplex mode, the RX\_DATA shift register always contains received data (valid or not) from the last transaction.

### 27.10.3.2 Half Duplex

In Half Duplex Mode, serial data is transmitted and received sequentially over a single data line (referred to as the SPDOOUT pin). To enable Half Duplex Mode set SPDIN Select to 01b. The direction of the SPDOOUT signal is determined by the BIOEN bit.

- To transmit data in half duplex mode set the BIOEN bit before writing the TX\_DATA register.
- To receive data in half duplex mode clear the BIOEN bit before writing the TX\_DATA register with a dummy byte.

|  |
|--|
| <b>Note:</b> The Software driver must properly drive the BIOEN bit and store received data depending on the transaction format of the specific slave device. |
|--|

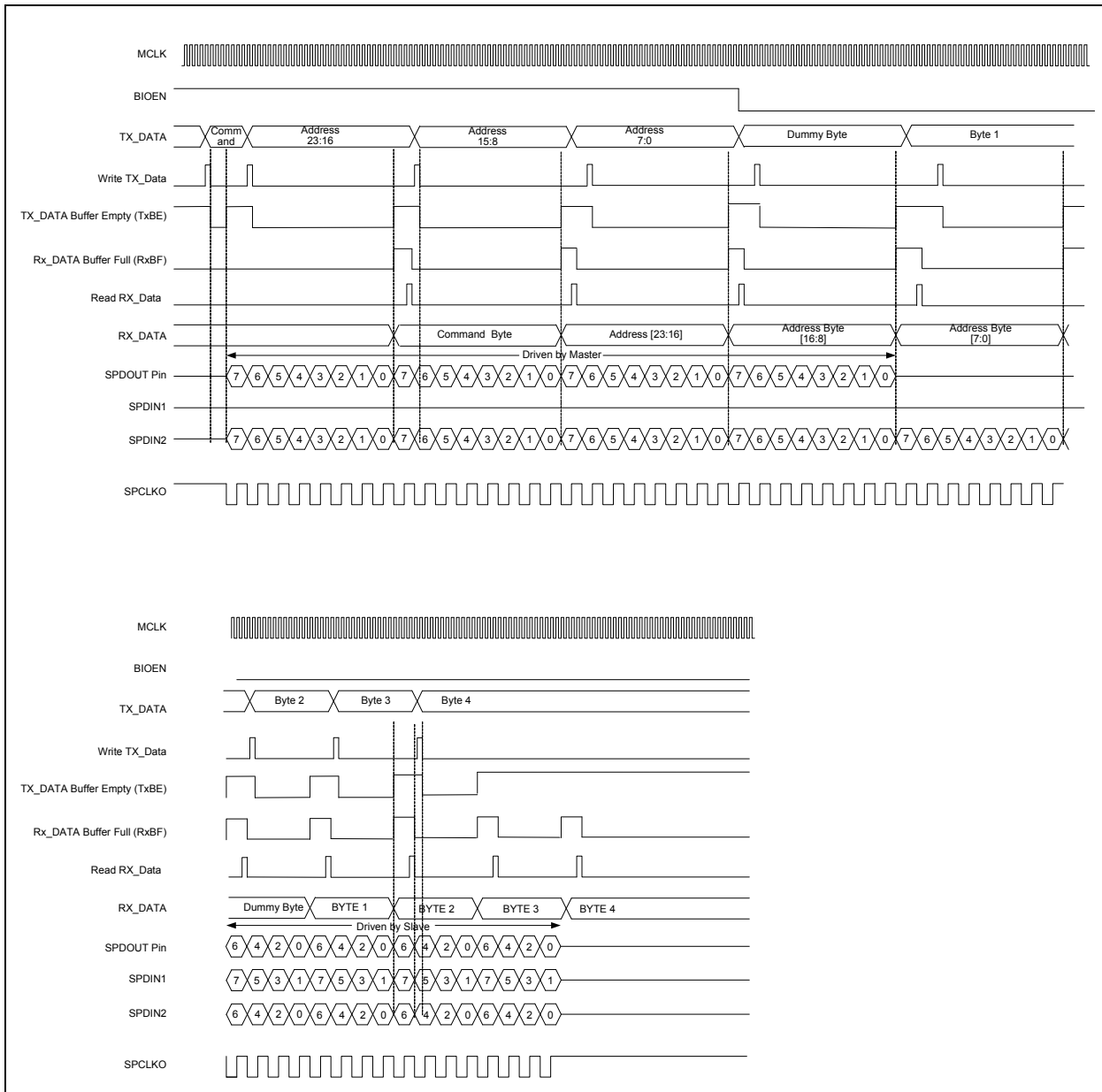
### 27.10.3.3 Dual Mode of Operation

In Dual Mode, serial data is transmitted sequentially from the SPDOOUT pin and received in by the SPI master from the SPDOOUT and SPDIN pins. This essentially doubles the received data rate and is often available in SPI Flash devices. To enable Dual Mode of operation the SPI core must be configured to receive data in path on the SPDIN1 and SPDIN2 inputs via SPDIN Select. The BIOEN bit determines if the SPI core is transmitting or receiving. The setting of this bit determines the direction of the SPDOOUT signal. The SPDIN Select bits are configuration bits that remain static for the duration of a dual read command. The BIOEN bit must be toggled to indicate when the SPI core is transmitting and receiving.

- To transmit data in dual mode set the BIOEN bit before writing the TX\_DATA register.
- To receive data in dual mode clear the BIOEN bit before writing the TX\_DATA register with a dummy byte. The even bits (0,2,4,and 6) are received on the SPDOOUT pin and the odd bits (1,3,5,and 7) are received on the SPDIN pin. The hardware assembles these received bits into a single byte and loads them into the RX\_DATA register accordingly.

The following diagram illustrates a Dual Fast Read Command that is supported by some SPI Flash devices.

**FIGURE 27-4: DUAL FAST READ FLASH COMMAND**



**Note:** When the SPI core is used for flash commands, like the Dual Read command, the host discards the bytes received during the command, address, and dummy byte portions of the transaction.

## 27.10.4 HOW BIOEN BIT CONTROLS DIRECTION OF SPDOUT BUFFER

When the SPI is configured for Half Duplex mode or Dual Mode the SPDO pin operates as a bi-directional signal. The BIOEN bit is used to determine the direction of the SPDO buffer when a byte is transmitted. Internally, the BIOEN bit is sampled to control the direction of the SPDO buffer when the TX\_DATA value is loaded into the transmit shift register. The direction of the buffer is never changed while a byte is being transmitted.

Since the TX\_DATA register may be written while a byte is being shifted out on the SPDO pin, the BIOEN bit does not directly control the direction of the SPDO buffer. An internal DIRECTION bit, which is a latched version of the BIOEN bit determines the direction of the SPDO buffer. The following list summarizes when the BIOEN bit is sampled.

- The DIRECTION bit is equal to the BIOEN bit when data is not being shifted out (i.e., SPI interface is idle).
- The hardware samples the BIOEN bit when it is shifting out the last bit of a byte to determine if the buffer needs to be turned around for the next byte.
- The BIOEN bit is also sampled any time the value in the TX\_DATA register is loaded into the shift register to be transmitted.

If a TAR (Turn-around time) is required between transmitting and receiving bytes on the SPDOOUT signal, software should allow all the bytes to be transmitted before changing the buffer to an input and then load the TX\_DATA register to begin receiving bytes. If TAR greater than zero is required, software must wait for the transmission in one direction to complete before writing the TX\_DATA register to start sending/receiving in the opposite direction. This allows the SPI block to operate the same as legacy Microchip SPI devices.

## 27.10.5 CONFIGURING THE SPI CLOCK GENERATOR

The SPI controller generates the SPI\_CLK signal to the external SPI device. The frequency of the SPI\_CLK signal is determined by one of two clock sources and the Preload value of the clock generator down counter. The clock generator toggles the SPI\_CLK output every time the counter underflows, while data is being transmitted.

**Note:** When the SPI interface is in the idle state and data is not being transmitted, the SPI\_CLK signal stops in the inactive state as determined by the configuration bits.

The clock source to the down counter is determined by Bit CLKSRC. Either the main system clock or the 2MHz clock can be used to decrement the down counter in the clock generator logic.

The SPI\_CLK frequency is determined by the following formula:

$$\text{SPI\_CLK\_FREQ} = \left( \left( \frac{1}{2} \times \text{REFERENCE\_CLOCK} \right) / \text{PRELOAD} \right)$$

The REFERENCE\_CLOCK frequency is selected by CLKSRC in the [SPI Clock Control Register](#) and PRELOAD is the PRELOAD field of the [SPI Clock Generator Register](#). The frequency can be either the 48 MHz Ring Oscillator clock or a 2MHz clock. When the PRELOAD value is 0, the REFERENCE\_CLOCK is always the 48 MHz Ring Oscillator clock and the CLKSRC bit is ignored.

Sample SPI Clock frequencies are shown in the following table:

**TABLE 27-7: SPI\_CLK FREQUENCIES**

| Clock Source | PRELOAD | SPI_CLK Frequency  |
|--------------|---------|--------------------|
| Don't Care   | 0       | 48MHz              |
| 48MHz        | 1       | 24MHz              |
| 48MHz        | 2       | 12MHz<br>(default) |
| 48MHz        | 3       | 6MHz               |
| 48MHz        | 63      | 381KHz             |
| 2MHz         | 1       | 1MHz               |
| 2MHz         | 2       | 500KHz             |
| 2MHz         | 3       | 333KHz             |
| 2MHz         | 63      | 15.9KHz            |

## 27.10.6 CONFIGURING SPI MODE

In practice, there are four modes of operation that define when data should be latched. These four modes are the combinations of the SPI\_CLK polarity and phase.

The output of the clock generator may be inverted to create an active high or active low clock pulse. This is used to determine the inactive state of the SPI\_CLK signal and is used for determining the first edge for shifting the data. The polarity is selected by CLKPOL in the [SPI Clock Control Register](#).

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The phase of the clock is selected independently for receiving data and transmitting data. The receive phase is determined by **RCLKPH** and the transmit phase is determined by **TCLKPH** in the SPI Clock Control Register.

The following table summarizes the effect of **CLKPOL**, **RCLKPH** and **TCLKPH**.

**TABLE 27-8: SPI DATA AND CLOCK BEHAVIOR**

| CLKPOL | RCLKPH | TCLKPH | Behavior   |
|--------|--------|--------|--|
| 0      | 0      | 0      | Inactive state is low. First edge is rising edge.<br>Data is sampled on the rising edge.<br>Data is transmitted on the falling edge.<br>Data is valid before the first rising edge.    |
| 0      | 0      | 1      | Inactive state is low. First edge is rising edge.<br>Data is sampled on the rising edge.<br>Data is transmitted on the rising edge.  |
| 0      | 1      | 0      | Inactive state is low. First edge is rising edge.<br>Data is sampled on the falling edge.<br>Data is transmitted on the falling edge.<br>Data is valid before the first rising edge.   |
| 0      | 1      | 1      | Inactive state is low. First edge is rising edge.<br>Data is sampled on the falling edge.<br>Data is transmitted on the rising edge.   |
| 1      | 0      | 0      | Inactive state is high. First edge is falling edge.<br>Data is sampled on the falling edge.<br>Data is transmitted on the rising edge.<br>Data is valid before the first falling edge. |
| 1      | 0      | 1      | Inactive state is high. First edge is falling edge.<br>Data is sampled on the falling edge.<br>Data is transmitted on the falling edge.  |
| 1      | 1      | 0      | Inactive state is high. First edge is falling edge.<br>Data is sampled on the rising edge.<br>Data is transmitted on the rising edge.<br>Data is valid before the first falling edge.  |
| 1      | 1      | 1      | Inactive state is high. First edge is falling edge.<br>Data is sampled on the rising edge.<br>Data is transmitted on the falling edge.   |

## 27.11 SPI Examples

### 27.11.1 FULL DUPLEX MODE TRANSFER EXAMPLES

#### 27.11.1.1 Read Only

The slave device used in this example is a MAXIM MAX1080 10 bit, 8 channel ADC:

- The SPI block is activated by setting the enable bit in SPIAR - SPI Enable Register
- The SPI MODE bit is de-asserted '0' to enable the SPI interface in Full Duplex mode.
- The CLKPOL and TCLKPH bits are de-asserted '0', and RCLKPH is asserted '1' to match the clocking requirements of the slave device.
- The LSBF bit is de-asserted '0' to indicate that the slave expects data in MSB-first order.
- Assert CS# using a GPIO pin.
- Write a valid command word (as specified by the slave device) to the SPITD - SPI TX\_Data Register with TXFE asserted '1'. The SPI master automatically clears the TXFE bit indicating the byte has been put in the TX buffer. If the shift register is empty the TX\_DATA byte is loaded into the shift register and the SPI master reasserts the TXFE bit. Once the data is in the shift register the SPI master begins shifting the data value onto the SPDOUT pin and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.

- A dummy 8 bit data value (any value) is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting the dummy data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses from the first transmit bytes:
  - The first SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit command data to the slave. This particular slave device drives '0' on the SPDIN pin to the master while it is accepting command data. This SPIRD data is ignored.
  - Once the first SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- The final SPI cycle is initiated when another dummy 8 bit data value (any value) is written to the TX\_DATA register. Note that this value may be another dummy value or it can be a new 8 bit command to be sent to the ADC. The new command will be transmitted while the final data from the last command is received simultaneously. This overlap allows ADC data to be read every 16 SPCLK cycles after the initial 24 clock cycle. The SPI master automatically clears the TXFE bit, but does not begin shifting the dummy data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses, the second SPI cycle is complete:
  - The first SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is the first half of a valid 16 bit ADC value. SPIRD is read and stored.
  - Once the second SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the data value onto the SPDOUT pin, and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- After 8 SPI\_CLK pulses, the final SPI cycle is complete, TXBF is asserted '1', and the SPINT interrupt is asserted (if enabled). The data now contained in SPIRD - SPI RX\_Data Register is the second half of a valid 16 bit ADC value. SPIRD is read and stored.
- If a command was overlapped with the received data in the final cycle, #CS should remain asserted and the SPI master will initiate another SPI cycle. If no new command was sent, #CS is released and the SPI is idle.

## 27.11.1.2 Read/Write

The slave device used in this example is a Fairchild NS25C640 FM25C640 64K Bit Serial EEPROM. The following subsections describe the read and write sequences.

### Read

- The SPI block is activated by setting the enable bit in SPIAR - SPI Enable Register
- The SPIMODE bit is de-asserted '0' to enable the SPI interface in Full Duplex mode.
- The CLKPOL, TCLKPH and RCLKPH bits are de-asserted '0' to match the clocking requirements of the slave device.
- The LSBF bit is de-asserted '0' to indicate that the slave expects data in MSB-first order.
- Assert CS# low using a GPIO pin.
- Write a valid command word (as specified by the slave device) to the SPITD - SPI TX\_Data Register with TXFE asserted '1'. The SPI master automatically clears the TXFE bit indicating the byte has been put in the TX buffer. If the shift register is empty the TX\_DATA byte is loaded into the shift register and the SPI master reasserts the TXFE bit. Once the data is in the shift register the SPI master begins shifting the data value onto the SPDOUT pin and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, EEPROM address A15-A8 is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting the dummy data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.

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- After 8 SPI\_CLK pulses from the first transmit byte (Command Byte transmitted):
  - The first SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit command data to the slave. This particular slave device tri-states the SPDIN pin to the master while it is accepting command data. This SPIRD data is ignored.

**Note:** External pull-up or pull-down is required on the SPDIN pin if it is tri-stated by the slave device.

- Once the first SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (EEPROM address A15-A8) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock. Note: The particular slave device ignores address A15-A13.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, EEPROM address A7-A0 is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting this data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses from the second transmit byte (Address Byte (MSB) transmitted):
  - EEPROM address A15-A8 has been transmitted to the slave completing the second SPI cycle. Once again, the RXBF bit is asserted '1' and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit address data to the slave.
  - Once the second SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (EEPROM address A7-A0) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, a dummy byte is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting this data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses, the third SPI cycle is complete (Address Byte (LSB) transmitted):
  - EEPROM address A7-A0 has been transmitted to the slave completing the third SPI cycle. Once again, the RXBF bit is asserted '1' and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit address data to the slave.
  - Once the third SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (dummy byte) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- If only one receive byte is required, the host would not write any more value to the TX\_DATA register until this transaction completes. If more than one byte of data is to be received, another dummy byte would be written to the TX\_DATA register (one dummy byte per receive byte is required). The SPI master automatically clears the TXFE bit when the TX\_DATA register is written, but does not begin shifting this data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses, the fourth SPI cycle is complete (First Data Byte received):
  - The dummy byte has been transmitted to the slave completing the fourth SPI cycle. Once again, the RXBF bit is asserted '1' and the SPINT interrupt is asserted, if enabled. Unlike the command and address phases, the data now contained in SPIRD - SPI RX\_Data Register is the 8-bit EEPROM data since the last cycle was initiated to receive data from the slave.
  - Once the fourth SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (if any) and loads it into the TX shift register. This process will be repeated until all the desired data is received.
- The host software will read and store the EEPROM data value in SPIRD - SPI RX\_Data Register.

- If no more data needs to be received by the master, CS# is released and the SPI is idle. Otherwise, master continues reading the data by writing a dummy value to the TX\_DATA register after every 8 SPI\_CLK cycles.

## Write

- The SPI block is activated by setting the enable bit in SPIAR - SPI Enable Register
- The SPI MODE bit is de-asserted '0' to enable the SPI interface in Full Duplex mode.
- The CLKPOL, TCLKPH and RCLKPH bits are de-asserted '0' to match the clocking requirements of the slave device.
- The LSBF bit is de-asserted '0' to indicate that the slave expects data in MSB-first order.
- Assert WR# high using a GPIO pin.
- Assert CS# low using a GPIO pin.
- Write a valid command word (as specified by the slave device) to the SPITD - SPI TX\_Data Register with TXFE asserted '1'. The SPI master automatically clears the TXFE bit indicating the byte has been put in the TX buffer. If the shift register is empty the TX\_DATA byte is loaded into the shift register and the SPI master reasserts the TXFE bit. Once the data is in the shift register the SPI master begins shifting the data value onto the SPDOUT pin and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, EEPROM address A15-A8 is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting the dummy data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses from the first transmit byte (Command Byte transmitted):
  - The first SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit command data to the slave. This particular slave device tri-states the SPDIN pin to the master while it is accepting command data. This SPIRD data is ignored.

**USER'S NOTE:** External pull-up or pull-down is required on the SPDIN pin if it is tri-stated by the slave device.

- Once the first SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (EEPROM address A15-A8) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock. Note: The particular slave device ignores address A15-A13.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, EEPROM address A7-A0 is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting this data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses from the second transmit byte (Address Byte (MSB) transmitted):
  - EEPROM address A15-A8 has been transmitted to the slave completing the second SPI cycle. Once again, the RXBF bit is asserted '1' and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit address data to the slave.
  - Once the second SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (EEPROM address A7-A0) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, a data byte (D7:D0) is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting this data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses, the third SPI cycle is complete (Address Byte (LSB) transmitted):
  - EEPROM address A7-A0 has been transmitted to the slave completing the third SPI cycle. Once again, the RXBF bit is asserted '1' and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD -

SPI RX\_Data Register is invalid since the last cycle was initiated solely to transmit address data to the slave.

- Once the third SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (data byte D7:D0) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPCLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- If only one data byte is to be written, the host would not write any more values to the TX\_DATA register until this transaction completes. If more than one byte of data is to be written, another data byte would be written to the TX\_DATA register. The SPI master automatically clears the TXFE bit when the TX\_DATA register is written, but does not begin shifting this data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses, the fourth SPI cycle is complete (First Data Byte transmitted):
  - The data byte has been transmitted to the slave completing the fourth SPI cycle. Once again, the RXBF bit is asserted '1' and the SPINT interrupt is asserted, if enabled. Like the command and address phases, the data now contained in SPIRD - SPI RX\_Data Register is invalid since the last cycle was initiated to transmit data to the slave.
  - Once the fourth SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (if any) and loads it into the TX shift register. This process will be repeated until all the desired data is transmitted.
- If no more data needs to be transmitted by the master, CS# and WR# are released and the SPI is idle.

## 27.11.2 HALF DUPLEX (BIDIRECTIONAL MODE) TRANSFER EXAMPLE

The slave device used in this example is a National LM74 12 bit (plus sign) temperature sensor.

- The SPI block is activated by setting the enable bit in SPIAR - SPI Enable Register
- The SPIMODE bit is asserted '1' to enable the SPI interface in Half Duplex mode.
- The CLKPOL, TCLKPH and RCLKPH bits are de-asserted '0' to match the clocking requirements of the slave device.
- The LSBF bit is de-asserted '0' to indicate that the slave expects data in MSB-first order.
- BIOEN is asserted '0' to indicate that the first data in the transaction is to be received from the slave.
- Assert CS# using a GPIO pin.

//Receive 16-bit Temperature Reading

- Write a dummy command byte (as specified by the slave device) to the SPITD - SPI TX\_Data Register with TXFE asserted '1'. The SPI master automatically clears the TXFE bit indicating the byte has been put in the TX buffer. If the shift register is empty the TX\_DATA byte is loaded into the shift register and the SPI master reasserts the TXFE bit. Once the data is in the shift register the SPI master begins shifting the data value onto the SPDOUT pin and drives the SPI\_CLK pin. This data is lost because the output buffer is disabled. Data on the SPDIN pin is sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, another dummy byte is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting the dummy data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses from the first receive byte
  - The first SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is the first half of the 16 bit word containing the temperature data.
  - Once the first SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (dummy byte 2) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.

//Transmit next reading command



- BIOEN is asserted '1' to indicate that data will now be driven by the master.
- Next, a command byte is written to the TX\_DATA register. This value is the first half of a 16 bit command to be sent to temperature sensor peripheral. The SPI master automatically clears the TXFE bit, but does not begin shifting the command data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty. This data will be transmitted because the output buffer is enabled. Data on the SPDIN pin is sampled on each clock.
- After 8 SPI\_CLK pulses from the second receive byte:
  - The second SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is the second half of the 16 bit word containing the temperature data.
  - Once the first SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (command byte 1) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Next, the second command byte is written to the TX\_DATA register. The SPI master automatically clears the TXFE bit, but does not begin shifting the command data value onto the SPDOUT pin. This byte will remain in the TX\_DATA register until the TX shift register is empty.
- After 8 SPI\_CLK pulses from the first transmit byte:
  - The third SPI cycle is complete, RXBF bit is asserted '1', and the SPINT interrupt is asserted, if enabled. The data now contained in SPIRD - SPI RX\_Data Register is invalid, since this command was used to transmit the first command byte to the SPI slave.
  - Once the first SPI cycle is completed, the SPI master takes the pending data in the TX\_DATA register (command byte 2) and loads it into the TX shift register. Loading the shift register automatically asserts the TXFE bit, begins shifting the dummy data value onto the SPDOUT pin, and drives the SPI\_CLK pin. Data on the SPDIN pin is also sampled on each clock.
- Once the TXFE bit is asserted the SPI Master is ready to transmit or receive its next byte. Before writing the next TX\_DATA value, software must clear the RXBF status bit by reading the SPIRD - SPI RX\_Data Register.
- Since no more data needs to be transmitted, the host software will wait for the RXBF status bit to be asserted indicating the second command byte was transmitted successfully.
- CS# is de-asserted.

## 27.12 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the General Purpose Serial Peripheral Interface. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 27-9: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance                                       | Instance Number | Host | Address Space                 | Base Address |
|--|-----------------|------|-------------------------------|--------------|
| General Purpose Serial Peripheral Interface (GP-SPI) | 0               | EC   | 32-bit internal address space | 4000_9400h   |
|  | 1               | EC   | 32-bit internal address space | 4000_9480h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**Note:** The Shared SPI controller is instance 0 and the Private SPI is instance 1 of the General Purpose Serial Peripheral Interface (GP-SPI) block.

**TABLE 27-10: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name                                |
|--------|--|
| 0h     | <a href="#">SPI Enable Register</a>          |
| 4h     | <a href="#">SPI Control Register</a>         |
| 8h     | <a href="#">SPI Status Register</a>          |
| Ch     | <a href="#">SPI TX_Data Register</a>         |
| 10h    | <a href="#">SPI RX_Data Register</a>         |
| 14h    | <a href="#">SPI Clock Control Register</a>   |
| 18h    | <a href="#">SPI Clock Generator Register</a> |

## 27.12.1 SPI ENABLE REGISTER

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:1   | Reserved  | R    | -       | -              |
| 0      | <p>ENABLE</p> <p>1=Enabled. The device is fully operational<br/>0=Disabled. Clocks are gated to conserve power and the SPDOUT and SPI_CLK signals are set to their inactive state</p> | R/W  | 0h      | VCC1_R<br>ESET |

## 27.12.2 SPI CONTROL REGISTER

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:7   | Reserved   | R    | -       | -              |
| 6      | <p>CE</p> <p>SPI Chip Select Enable.</p> <p>1= SPI_CS# output signal is asserted, i.e., driven to logic '0'<br/>0= SPI_CS# output signal is deasserted, i.e., driven to logic '1'</p>  | R/W  | 0h      | VCC1_R<br>ESET |
| 5      | <p>AUTO_READ</p> <p>Auto Read Enable.</p> <p>1=A read of the SPI RX_DATA Register will clear both the RXBF status bit and the TXBE status bit<br/>0=A read of the SPI RX_DATA Register will clear the RXBF status bit. The TXBE status bit will not be modified</p>  | R/W  | 0h      | VCC1_R<br>ESET |
| 4      | <p>SOFT_RESET</p> <p>Soft Reset is a self-clearing bit. Writing zero to this bit has no effect. Writing a one to this bit resets the entire SPI Interface, including all counters and registers back to their initial state.</p>   | R/W  | 0h      | VCC1_R<br>ESET |
| 3:2    | <p>SPDIN_SELECT</p> <p>The SPDIN Select which SPI input signals are enabled when the BIOEN bit is configured as an input.</p> <p>1xb=SPDIN1 and SPDIN2. Select this option for Dual Mode<br/>01b=SPDIN2 only. Select this option for Half Duplex<br/>00b=SPDIN1 only. Select this option for Full Duplex</p> | R/W  | 0h      | VCC1_R<br>ESET |

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 1      | <p><b>BIOEN</b><br/>Bidirectional Output Enable control. When the SPI is configured for Half Duplex mode or Dual Mode the SPDOOUT pin operates as a bi-directional signal. The BIOEN bit is used by the internal DIRECTION bit to control the direction of the SPDOOUT buffers. The direction of the buffer is never changed while a byte is being transmitted.</p> <p>1=The SPDOOUT_Direction signal configures the SPDOOUT signal as an output.<br/>0=The SPDOOUT_Direction signal configures the SPDOOUT signal as an input.</p> <p>See <a href="#">Section 27.10.4, "How BIOEN Bit Controls Direction of SPDOOUT Buffer"</a> for details on the use of BIOEN.</p> | R/W  | 1h      | VCC1_R<br>ESET |
| 0      | <p><b>LSBF</b><br/>Least Significant Bit First</p> <p>1= The data is transferred in LSB-first order.<br/>0= The data is transferred in MSB-first order. (default)</p>   | R/W  | 0h      | VCC1_R<br>ESET |

### 27.12.3 SPI STATUS REGISTER

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:3   | Reserved   | R    | -       | -              |
| 2      | ACTIVE   | R    | 0h      | VCC1_R<br>ESET |
| 1      | <p><b>RXBF</b><br/>Receive Data Buffer Full status. When this bit is '1' the Rx_Data buffer is full. Reading the SPI RX_Data Register clears this bit. This signal may be used to generate a SPI_RX interrupt to the EC.</p> <p>1=RX_Data buffer is full<br/>0=RX_Data buffer is not full</p>      | R    | 0h      | VCC1_R<br>ESET |
| 0      | <p><b>TXBE</b><br/>Transmit Data Buffer Empty status. When this bit is '1' the Tx_Data buffer is empty. Writing the SPI TX_Data Register clears this bit. This signal may be used to generate a SPI_TX interrupt to the EC.</p> <p>1=TX_Data buffer is empty<br/>0=TX_Data buffer is not empty</p> | R    | 1h      | VCC1_R<br>ESET |

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## 27.12.4 SPI TX\_DATA REGISTER

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:8   | Reserved  | R    | -       | -              |
| 7:0    | <p><b>TX_DATA</b></p> <p>A write to this register when the Tx_Data buffer is empty (TXBE in the SPI Status Register is '1') initiates a SPI transaction. The byte written to this register will be loaded into the shift register and the TXBE flag will be asserted. This indicates that the next byte can be written into the TX_DATA register. This byte will remain in the TX_DATA register until the SPI core has finished shifting out the previous byte. Once the shift register is empty, the hardware will load the pending byte into the shift register and once again assert the TxBE bit.</p> <p>The TX_DATA register must not be written when the TXBE bit is zero. Writing this register may overwrite the transmit data before it is loaded into the shift register.</p> | R/W  | 0h      | VCC1_R<br>ESET |

## 27.12.5 SPI RX\_DATA REGISTER

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:8   | Reserved  | R    | -       | -              |
| 7:0    | <p><b>RX_DATA</b></p> <p>This register is used to read the value returned by the external SPI device. At the end of a byte transfer the RX_DATA register contains serial input data (valid or not) from the last transaction and the RXBF bit is set to one. This status bit indicates that the RX_DATA register has been loaded with a the serial input data. The RX_DATA register should not be read before the RXBF bit is set.</p> <p>The RX_DATA register must be read, clearing the RXBF status bit before writing the TX_DATA register. The data in the receive shift register is only loaded into the RX_DATA register when this bit is cleared. If a data byte is pending in the receive shift register the value will be loaded immediately into the RX_DATA register and the RXBF status flag will be asserted. Software should read the RX_DATA register twice before starting a new transaction to make sure the RX_DATA buffer and shift register are both empty.</p> | R/W  | 0h      | VCC1_R<br>ESET |

## 27.12.6 SPI CLOCK CONTROL REGISTER

This register should not be changed during an active SPI transaction.

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:5   | Reserved   | R    | -       | -              |
| 4      | <p>CLKSRC</p> <p>Clock Source for the SPI Clock Generator. This bit should not be changed during a SPI transaction. When the field <a href="#">PRELOAD</a> in the <a href="#">SPI Clock Generator Register</a> is 0, this bit is ignored and the Clock Source is always the main system clock (the equivalent of setting this bit to '0').</p> <p>1=2MHz<br/>0=48 MHz Ring Oscillator</p>  | R/W  | 0h      | VCC1_R<br>ESET |
| 3      | Reserved   | R    | -       | -              |
| 2      | <p>CLKPOL</p> <p>SPI Clock Polarity.</p> <p>1=The SPI_CLK signal is high when the interface is idle and the first clock edge is a falling edge<br/>0=The SPI_CLK is low when the interface is idle and the first clock edge is a rising edge</p>   | R/W  | 0h      | VCC1_R<br>ESET |
| 1      | <p>RCLKPH</p> <p>Receive Clock Phase, the SPI_CLK edge on which the master will sample data. The receive clock phase is not affected by the SPI Clock Polarity.</p> <p>1=Valid data on SPDIN signal is expected after the first SPI_CLK edge. This data is sampled on the second and following even SPI_CLK edges (i.e., sample data on falling edge)<br/>0=Valid data is expected on the SPDIN signal on the first SPI_CLK edge. This data is sampled on the first and following odd SPI_CLK edges (i.e., sample data on rising edge)</p>   | R/W  | 1h      | VCC1_R<br>ESET |
| 0      | <p>TCLKPH</p> <p>Transmit Clock Phase, the SPCLK edge on which the master will clock data out. The transmit clock phase is not affected by the SPI Clock Polarity.</p> <p>1=Valid data is clocked out on the first SPI_CLK edge on SPDOOUT signal. The slave device should sample this data on the second and following even SPI_CLK edges (i.e., sample data on falling edge)<br/>0=Valid data is clocked out on the SPDOOUT signal prior to the first SPI_CLK edge. The slave device should sample this data on the first and following odd SPI_CLK edges (i.e., sample data on rising edge)</p> | R/W  | 0h      | VCC1_R<br>ESET |

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## 27.12.7 SPI CLOCK GENERATOR REGISTER

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description                                   | Type | Default | Reset Event    |
| 31:16  | Reserved                                      | R    | -       | -              |
| 5:0    | PRELOAD<br>SPI Clock Generator Preload value. | R/W  | 2h      | VCC1_R<br>ESET |

## 28.0 BLINKING/BREATHING PWM

### 28.1 Introduction

LEDs are used in computer applications to communicate internal state information to a user through a minimal interface. Typical applications will cause an LED to blink at different rates to convey different state information. For example, an LED could be full on, full off, blinking at a rate of once a second, or blinking at a rate of once every four seconds, in order to communicate four different states.

As an alternative to blinking, an LED can “breathe”, that is, oscillate between a bright state and a dim state in a continuous, or apparently continuous manner. The rate of breathing, or the level of brightness at the extremes of the oscillation period, can be used to convey state information to the user that may be more informative, or at least more novel, than traditional blinking.

The blinking/breathing hardware is implemented using a PWM. The PWM can be driven either by the 48 MHz clock or by a 32.768 KHz clock input. When driven by the 48 MHz clock, the PWM can be used as a standard 8-bit PWM in order to control a fan. When used to drive blinking or breathing LEDs, the 32.768 KHz clock source is used.

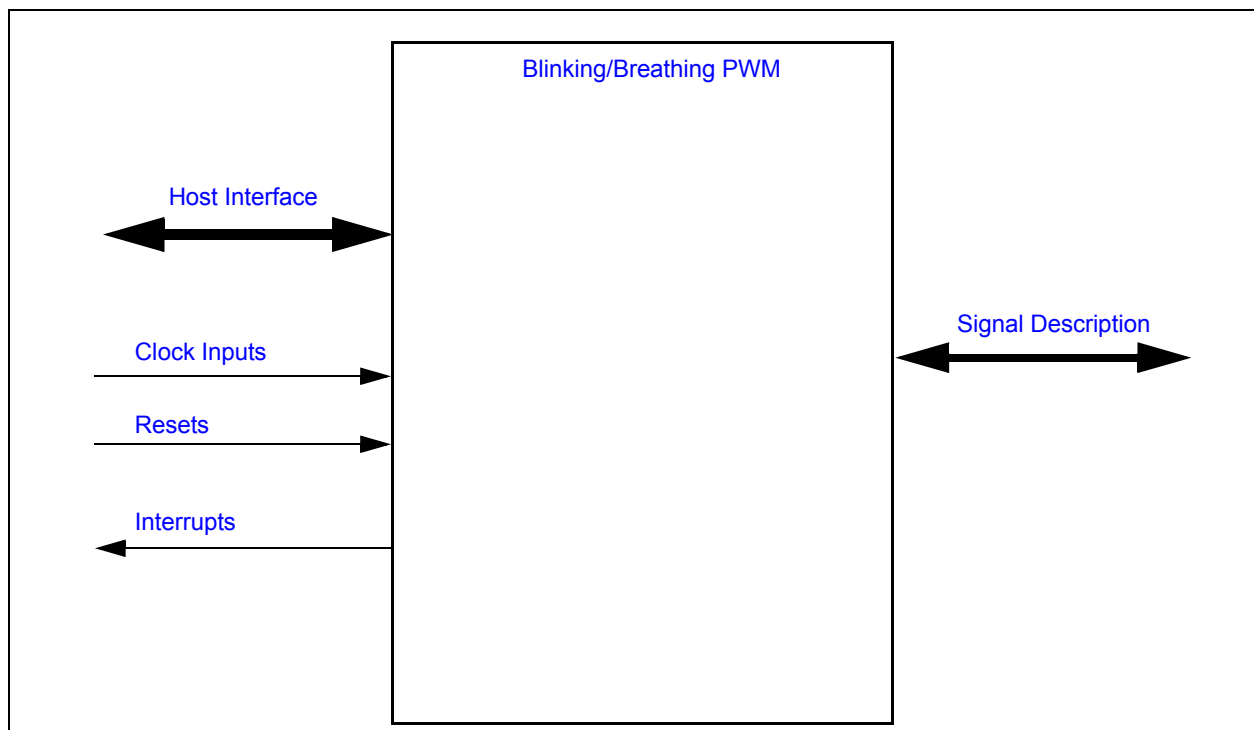
Features:

- Each PWM independently configurable
- Each PWM configurable for LED blinking and breathing output
- Highly configurable breathing rate from 60ms to 1min
- Non-linear brightness curves approximated with 8 piece wise-linear segments
- All LED PWMs can be synchronized
- Each PWM configurable for 8-bit PWM support
- Multiple clock rates
- Configurable Watchdog Timer

### 28.2 Interface

This block is designed to drive a pin on the pin interface and to be accessed internally via a registered host interface.

**FIGURE 28-1: I/O DIAGRAM OF BLOCK**



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## 28.3 Signal Description

TABLE 28-1: SIGNAL DESCRIPTION

| Name       | Direction | Description   |
|------------|-----------|---|
| PWM Output | Output    | Output of PWM<br><br>By default, the PWM pin is configured to be active high: when the PWM is configured to be fully on, the pin is driving high. When the PWM is configured to be fully off, the pin is low. If firmware requires the Blinking/Breathing PWM to be active low, the Polarity bit in the GPIO Pin Control Register associated with the PWM can be set to 1, which inverts the output polarity. |

## 28.4 Host Interface

The blinking/breathing PWM block is accessed by a controller over the standard register interface.

## 28.5 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 28.5.1 POWER DOMAINS

TABLE 28-2: POWER SOURCES

| Name | Description  |
|------|--|
| VCC1 | Main power. The source of main power for the device is system dependent. |

### 28.5.2 CLOCK INPUTS

TABLE 28-3: CLOCK INPUTS

| Name                   | Description      |
|------------------------|------------------|
| 32KHz_Clk              | 32.768 KHz clock |
| 48 MHz Ring Oscillator | 48 MHz clock     |

### 28.5.3 RESETS

TABLE 28-4: RESET SIGNALS

| Name       | Description |
|------------|-------------|
| VCC1_RESET | Block reset |

## 28.6 Interrupts

Each PWM can generate an interrupt. The interrupt is asserted for one 48 MHz clock period whenever the PWM WDT times out. The PWM WDT is described in [Section 28.8.3.1, "PWM WDT," on page 332](#).

**Note:** PWM\_WDT[0], PWM\_WDT[1], PWM\_WDT[2], PWM\_WDT[3] bits in the GIRQ17 and GIRQ18 registers are the interrupt source bits for the three instances of the Blinking/Breathing PWM in the MEC1322.

TABLE 28-5: EC INTERRUPTS

| Source  | Description           |
|---------|-----------------------|
| PWM_WDT | PWM watchdog time out |



## 28.7 Low Power Mode

The Blinking/Breathing PWM may be put into a low power mode by the chip-level power, clocks, and reset (PCR) circuitry. The low power mode is only applicable when the Blinking/Breathing PWM is operating in the [General Purpose PWM](#) mode. When the low speed clock mode is selected, the blinking/breathing function continues to operate, even when the [48 MHz clock](#) is stopped. Low power mode behavior is summarized in the following table:

**TABLE 28-6: LOW POWER MODE BEHAVIOR**

| CLOCK_S<br>OURCE | CONTROL | Mode                | Low Power<br>Mode | Description   |
|------------------|---------|---------------------|-------------------|---|
| X                | '00'b   | PWM 'OFF'           | Yes               | 32.768 KHz clock is required.   |
| X                | '01'b   | Breathing           | Yes               |   |
| 1                | '10'b   | General Purpose PWM | No                | 48 MHz clock is required, even when a sleep command to the block is asserted. |
| 0                | '10'b   | Blinking            | Yes               | 32.768 KHz clock is required.   |
| X                | '11'b   | PWM 'ON'            | Yes               |   |

**Note:** In order for the MEC1322 to enter its heavy and deep sleep states, the SLEEP\_ENABLE input for all Blinking/Breathing PWM instances must be asserted, even if the PWMs are configured to use the low speed clock.

## 28.8 Description

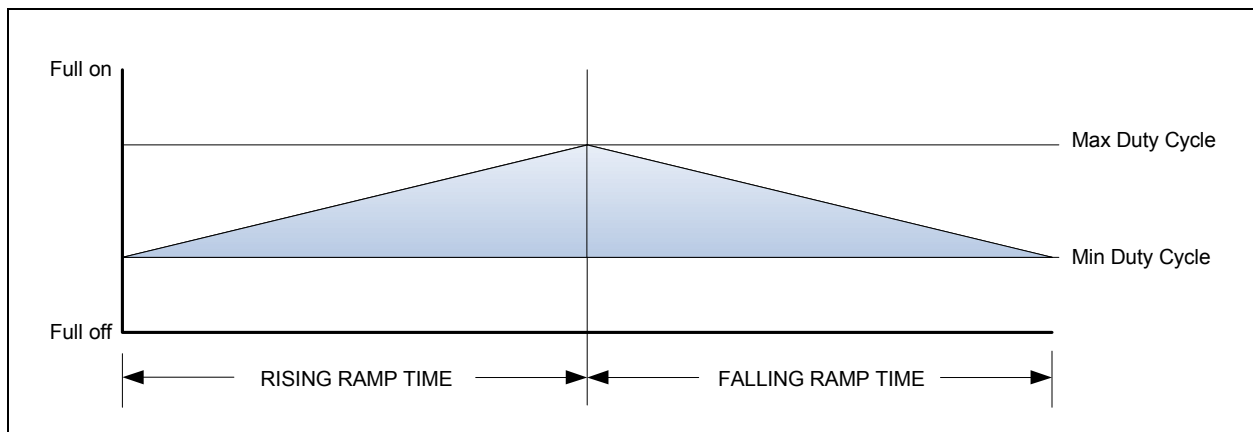
### 28.8.1 BREATHING

If an LED blinks rapidly enough, the eye will interpret the light as reduced brightness, rather than a blinking pattern. Therefore, if the blinking period is short enough, modifying the duty cycle will set the apparent brightness, rather than a blinking rate. At a blinking rate of 128Hz or greater, almost all people will perceive a continuous light source rather than an intermittent pattern.

Because making an LED appear to breathe is an aesthetic effect, the breathing mechanism must be adjustable or customers may find the breathing effect unattractive. There are several variables that can affect breathing appearance, as described below.

The following figure illustrates some of the variables in breathing:

**FIGURE 28-2: BREATHING LED EXAMPLE**

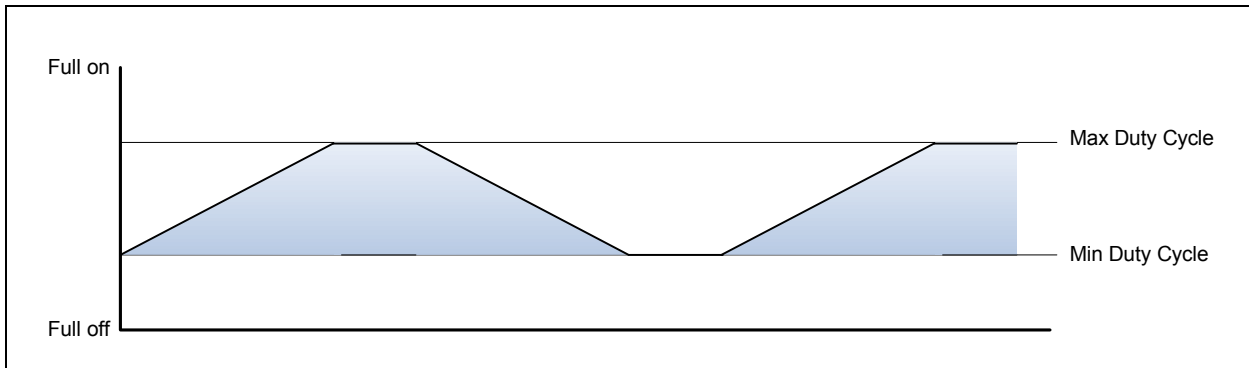


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The breathing range of and LED can range between full on and full off, or in a range that falls within the full-on/full-off range, as shown in this figure. The ramp time can be different in different applications. For example, if the ramp time was 1 second, the LED would appear to breathe quickly. A time of 2 seconds would make the LED appear to breathe more leisurely.

The breathing pattern can be clipped, as shown in the following figure, so that the breathing effect appears to pause at its maximum and minimum brightnesses:

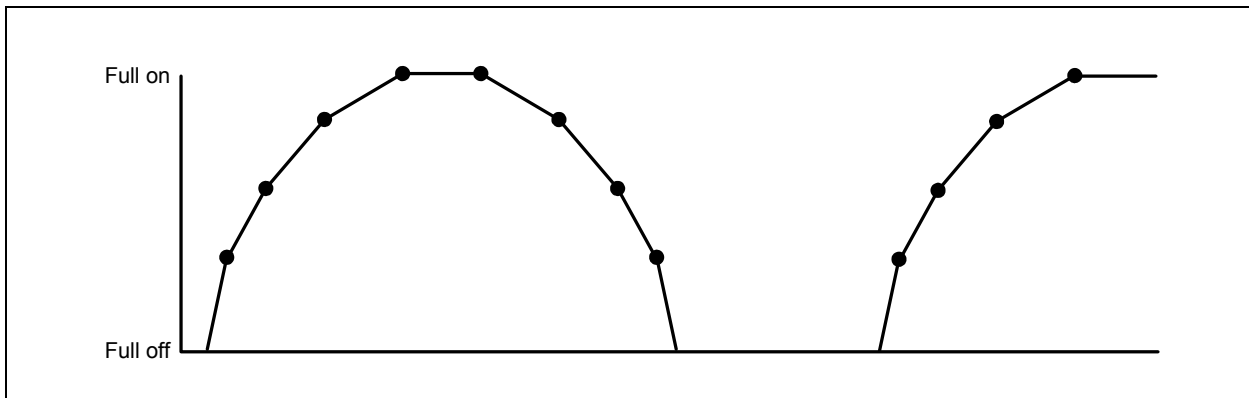
**FIGURE 28-3: CLIPPING EXAMPLE**



The clipping periods at the two extremes can be adjusted independently, so that for example an LED can appear to breathe (with a short delay at maximum brightness) followed by a longer “resting” period (with a long delay at minimum brightness).

The brightness can also be changed in a non-linear fashion, as shown in the following figure:

**FIGURE 28-4: EXAMPLE OF A SEGMENTED CURVE**



In this figure, the rise and fall curves are implemented in 4 linear segments and the rise and fall periods are symmetric.

The breathing mode uses the [32.768 KHz clock](#) for its time base.

## 28.8.2 BLINKING

When configured for blinking, a subset of the hardware used in breathing is used to implement the blinking function. The PWM (an 8-bit accumulator plus an 8-bit duty cycle register) drives the LED directly. The Duty Cycle register is programmed directly by the user, and not modified further. The PWM accumulator is configured as a simple 8-bit up counter. The counter uses the [32.768 KHz clock](#), and is pre-scaled by the Delay counter, to slow the PWM down from the 128Hz provided by directly running the PWM on the [32.768 KHz clock](#).

With the pre-scaler, the blink rate of the LED could be as fast as 128Hz (which, because it is blinking faster than the eye can distinguish, would appear as a continuous level) to 0.03125Hz (that is, with a period of 7.8ms to 32 seconds). Any duty cycle from 0% (0h) to 100% (FFh) can be configured, with an 8-bit precision. An LED with a duty cycle value of 0h will be fully off, while an LED with a duty cycle value of FFh will be fully on.

In Blinking mode the PWM counter is always in 8-bit mode.

[Table 28-7, "LED Blink Configuration Examples"](#) shows some example blinking configurations:

**TABLE 28-7: LED BLINK CONFIGURATION EXAMPLES**

| Prescale | Duty Cycle | Blink Frequency | Blink                 |
|----------|------------|-----------------|-----------------------|
| 000h     | 00h        | 128Hz           | full off              |
| 000h     | FFh        | 128Hz           | full on               |
| 001h     | 40h        | 64Hz            | 3.9ms on, 11.6ms off  |
| 003h     | 80h        | 32Hz            | 15.5ms on, 15.5ms off |
| 07Fh     | 20h        | 1Hz             | 125ms on, 0.875s off  |
| 0BFh     | 16h        | 0.66Hz          | 125ms on, 1.375s off  |
| 0FFh     | 10h        | 0.5Hz           | 125ms on, 1.875s off  |
| 180h     | 0Bh        | 0.33Hz          | 125ms on, 2.875s off  |
| 1FFh     | 40h        | 0.25Hz          | 1s on, 3s off         |

The Blinking and General Purpose PWM modes share the hardware used in the breathing mode. The Prescale value is derived from the LD field of the LED\_DELAY register and the Duty Cycle is derived from the MIN field of the LED\_LIMITS register.

**TABLE 28-8: BLINKING MODE CALCULATIONS**

| Parameter | Unit    | Equation  |
|-----------|---------|---|
| Frequency | Hz      | $(32\text{KHz\_Cik frequency}) / (\text{PRESCALE} + 1) / 255$ |
| 'H' Width | Seconds | $(1/\text{PERIOD}) \times (\text{DutyCycle}/255)$             |
| 'L' Width | Seconds | $(1/\text{PERIOD}) \times (255 - \text{DutyCycle})$           |

## 28.8.3 GENERAL PURPOSE PWM

When used in the Blinking configuration with the [48 MHz Ring Oscillator](#), the LED module can be used as a general-purpose programmable Pulse-Width Modulator with an 8-bit programmable pulse width. It can be used for fan speed control, sound volume, etc. With the [48 MHz Ring Oscillator](#) source, the PWM frequency can be configured in the range shown in [Table 28-9](#).

**TABLE 28-9: PWM CONFIGURATION EXAMPLES**

| Prescale | PWM Frequency |
|----------|---------------|
| 000h     | 187.5 KHz     |
| 001h     | 93.75 KHz     |
| 003h     | 46.875 KHz    |
| 006h     | 26.8 KHz      |
| 00Bh     | 15.625 KHz    |
| 07Fh     | 1.46 KHz      |
| 1FFh     | 366 Hz        |
| FFFh     | 46 Hz         |

**TABLE 28-10: GENERAL PURPOSE PWM MODE CALCULATIONS**

| Parameter | Unit    | Equation   |
|-----------|---------|--|
| Frequency | Hz      | $(48 \text{ MHz Ring Oscillator frequency}) / (\text{PRESCALE} + 1) / 255$ |
| 'H' Width | Seconds | $(1/\text{PERIOD}) \times (\text{DutyCycle}/255)$                          |
| 'L' Width | Seconds | $(1/\text{PERIOD}) \times (255 - \text{DutyCycle})$                        |

### 28.8.3.1 PWM WDT

When the PWM is configured as a general-purpose PWM (in the Blinking configuration with the [48 MHz clock](#)), the PWM includes a Watch Dog Timer (WDT). The WDT consists of an internal 8-bit counter and an 8-bit reload value (the field WDTLD in [LED Configuration Register](#) register). The internal counter is loaded with the reset value of WDTLD (14h, or 4 seconds) on system [VCC1\\_RESET](#) and loaded with the contents of WDTLD whenever either the [LED Configuration Register](#) register is written or the MIN byte in the [LED Limits Register](#) register is written (the MIN byte controls the duty cycle of the PWM).

Whenever the internal counter is non-zero, it is decremented by 1 for every tick of the 5 Hz clock. If the counter decrements from 1 to 0, a WDT Terminal Count causes an interrupt to be generated and reset sets the [CONTROL](#) bit in the [LED Configuration Register](#) to 3h, which forces the PWM to be full on. No other PWM registers or fields are affected.

If the 5 Hz clock halts, the watchdog timer stops decrementing but retains its value, provided the device continues to be powered. When the 5 Hz clock restarts, the watchdog counter will continue decrementing where it left off.

Setting the WDTLD bits to 0 disables the PWM WDT. Other sample values for WDTLD are:

01h = 200 ms

02h = 400 ms

03h = 600 ms

04h = 800 ms

...

14h = 4seconds

FFh = 51 seconds

## 28.9 Implementation

In addition to the registers described in [Section 28.10, "EC-Only Registers"](#), the PWM is implemented using a number of components that are interconnected differently when configured for breathing operation and when configured for blinking/PWM operation.

### 28.9.1 BREATHING CONFIGURATION

The **PSIZE** parameter can configure the PWM to one of three modes: 8-bit, 7-bit and 6-bit. The **PERIOD CTR** counts ticks of its input clock. In 8-bit mode, it counts from 0 to 255 (that is, 256 steps), then repeats continuously. In this mode, a full cycle takes 7.8ms (128Hz). In 7-bit mode it counts from 0 to 127 (128 steps), and a full cycle takes 3.9ms (256Hz). In 6-bit mode it counts from 0 to 63 (64 steps) and a full cycle takes 1.95ms (512Hz).

The output of the LED circuit is asserted whenever the **PERIOD CTR** is less than the contents of the **DUTY CYCLE** register. The appearance of breathing is created by modifying the contents of the **DUTY CYCLE** register in a continuous manner. When the LED control is off the internal counters and registers are all reset to 0 (i.e. after a write setting the [RESET](#) bit in the [LED Configuration Register](#) Register.) Once enabled, the **DUTY CYCLE** register is increased by an amount determined by the LED\_STEP register and at a rate determined by the **DELAY** counter. Once the duty cycle reaches its maximum value (determined by the field MAX), the duty cycle is held constant for a period determined by the field HD. Once the hold time is complete, the **DUTY CYCLE** register is decreased, again by an amount determined by the LED\_STEP register and at a rate determined by the **DELAY** counter. When the duty cycle then falls at or below the minimum value (determined by the field MIN), the duty cycle is held constant for a period determined by the field HD. Once the hold time is complete, the cycle repeats, with the duty cycle oscillating between MIN and MAX.

The rising and falling ramp times as shown in [FIGURE 28-3: Clipping Example on page 330](#) can be either symmetric or asymmetric depending on the setting of the [SYMMETRY](#) bit in the [LED Configuration Register](#) Register. In Symmetric mode the rising and falling ramp rates have mirror symmetry; both rising and falling ramp rates use the same (all) 8

segments fields in each of the following registers (see Table 28-11): the LED Update Stepsize Register register and the LED Update Interval Register register. In Asymmetric mode the rising ramp rate uses 4 of the 8 segments fields and the falling ramp rate uses the remaining 4 of the 8 segments fields (see Table 28-11).

The parameters MIN, MAX, HD, LD and the 8 fields in LED\_STEP and LED\_INT determine the brightness range of the LED and the rate at which its brightness changes. See the descriptions of the fields in Section 28.10, "EC-Only Registers", as well as the examples in Section 28.9.3, "Breathing Examples" for information on how to set these fields.

**TABLE 28-11: SYMMETRIC BREATHING MODE REGISTER USAGE**

| Rising/ Falling Ramp Times in Figure 28-3, "Clipping Example" | Duty Cycle | Segment Index | Symmetric Mode Register Fields Utilized |             |
|---|------------|---------------|---|-------------|
| X   | 000xxxxb   | 000b          | STEP[0]/INT[0]                          | Bits[3:0]   |
| X   | 001xxxxb   | 001b          | STEP[1]/INT[1]                          | Bits[7:4]   |
| X   | 010xxxxb   | 010b          | STEP[2]/INT[2]                          | Bits[11:8]  |
| X   | 011xxxxb   | 011b          | STEP[3]/INT[3]                          | Bits[15:12] |
| X   | 100xxxxb   | 100b          | STEP[4]/INT[4]                          | Bits[19:16] |
| X   | 101xxxxb   | 101b          | STEP[5]/INT[5]                          | Bits[23:20] |
| X   | 110xxxxb   | 110b          | STEP[6]/INT[6]                          | Bits[27:24] |
| X   | 111xxxxb   | 111b          | STEP[7]/INT[7]                          | Bits[31:28] |

**Note:** In Symmetric Mode the Segment\_Index[2:0] = Duty Cycle Bits[7:5]

**TABLE 28-12: ASYMMETRIC BREATHING MODE REGISTER USAGE**

| Rising/ Falling Ramp Times in Figure 28-3, "Clipping Example" | Duty Cycle | Segment Index | Asymmetric Mode Register Fields Utilized |             |
|---|------------|---------------|--|-------------|
| Rising  | 00xxxxxb   | 000b          | STEP[0]/INT[0]                           | Bits[3:0]   |
| Rising  | 01xxxxxb   | 001b          | STEP[1]/INT[1]                           | Bits[7:4]   |
| Rising  | 10xxxxxb   | 010b          | STEP[2]/INT[2]                           | Bits[11:8]  |
| Rising  | 11xxxxxb   | 011b          | STEP[3]/INT[3]                           | Bits[15:12] |
| falling   | 00xxxxxb   | 100b          | STEP[4]/INT[4]                           | Bits[19:16] |
| falling   | 01xxxxxb   | 101b          | STEP[5]/INT[5]                           | Bits[23:20] |
| falling   | 10xxxxxb   | 110b          | STEP[6]/INT[6]                           | Bits[27:24] |
| falling   | 11xxxxxb   | 111b          | STEP[7]/INT[7]                           | Bits[31:28] |

**Note:** In Asymmetric Mode the Segment\_Index[2:0] is the bit concatenation of following: Segment\_Index[2] = (FALLING RAMP TIME in Figure 28-3, "Clipping Example") and Segment\_Index[1:0] = Duty Cycle Bits[7:6].

## 28.9.2 BLINKING CONFIGURATION

The Delay counter and the PWM counter are the same as in the breathing configuration, except in this configuration they are connected differently. The Delay counter is clocked on either the 32.768 KHz clock or the 48 MHz clock, rather than the output of the PWM. The PWM counter is clocked by the zero output of the Delay counter, which functions as a prescaler for the input clocks to the PWM. The Delay counter is reloaded from the LD field of the LED\_DELAY register. When the LD field is 0 the input clock is passed directly to the PWM counter without prescaling. In Blinking/PWM mode the PWM counter is always 8-bit, and the PSIZE parameter has no effect.

The frequency of the PWM pulse waveform is determined by the formula:

$$f_{PWM} = \frac{f_{clock}}{(256 \times (LD + 1))}$$

where  $f_{PWM}$  is the frequency of the PWM,  $f_{clock}$  is the frequency of the input clock (32.768 KHz clock or 48 MHz clock) and LD is the contents of the LD field.

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**Note:** At a duty cycle value of 00h (in the MIN register), the LED output is fully off. At a duty cycle value of 255h, the LED output is fully on. Alternatively, In order to force the LED to be fully on, firmware can set the CONTROL field of the Configuration register to 3 (always on).

The other registers in the block do not affect the PWM or the LED output in Blinking/PWM mode.

## 28.9.3 BREATHING EXAMPLES

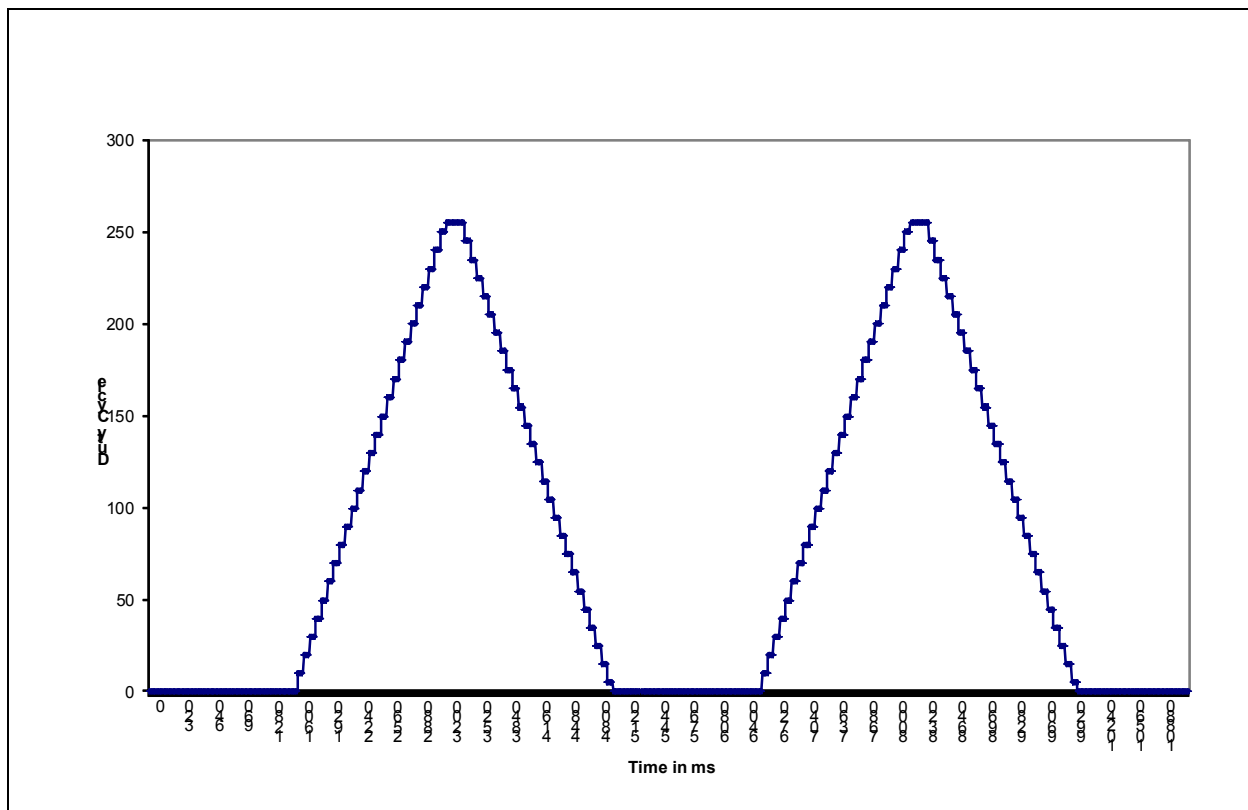
### 28.9.3.1 Linear LED brightness change

In this example, the brightness of the LED increases and diminishes in a linear fashion. The entire cycle takes 5 seconds. The rise time and fall time are 1.6 seconds, with a hold time at maximum brightness of 200ms and a hold time at minimum brightness of 1.6 seconds. The LED brightness varies between full off and full on. The PWM size is set to 8-bit, so the time unit for adjusting the PWM is approximately 8ms. The registers are configured as follows:

**TABLE 28-13: LINEAR EXAMPLE CONFIGURATION**

| Field                            | Value            |      |      |      |      |      |      |      |
|----------------------------------|------------------|------|------|------|------|------|------|------|
| PSIZE                            | 8-bit            |      |      |      |      |      |      |      |
| MAX                              | 255              |      |      |      |      |      |      |      |
| MIN                              | 0                |      |      |      |      |      |      |      |
| HD                               | 25 ticks (200ms) |      |      |      |      |      |      |      |
| LD                               | 200 ticks (1.6s) |      |      |      |      |      |      |      |
| Duty cycle most significant bits | 000b             | 001b | 010b | 011b | 100b | 101b | 110b | 111b |
| LED_INT                          | 8                | 8    | 8    | 8    | 8    | 8    | 8    | 8    |
| LED_STEP                         | 10               | 10   | 10   | 10   | 10   | 10   | 10   | 10   |

**FIGURE 28-5: LINEAR BRIGHTNESS CURVE EXAMPLE**



### 28.9.3.2 Non-linear LED brightness change

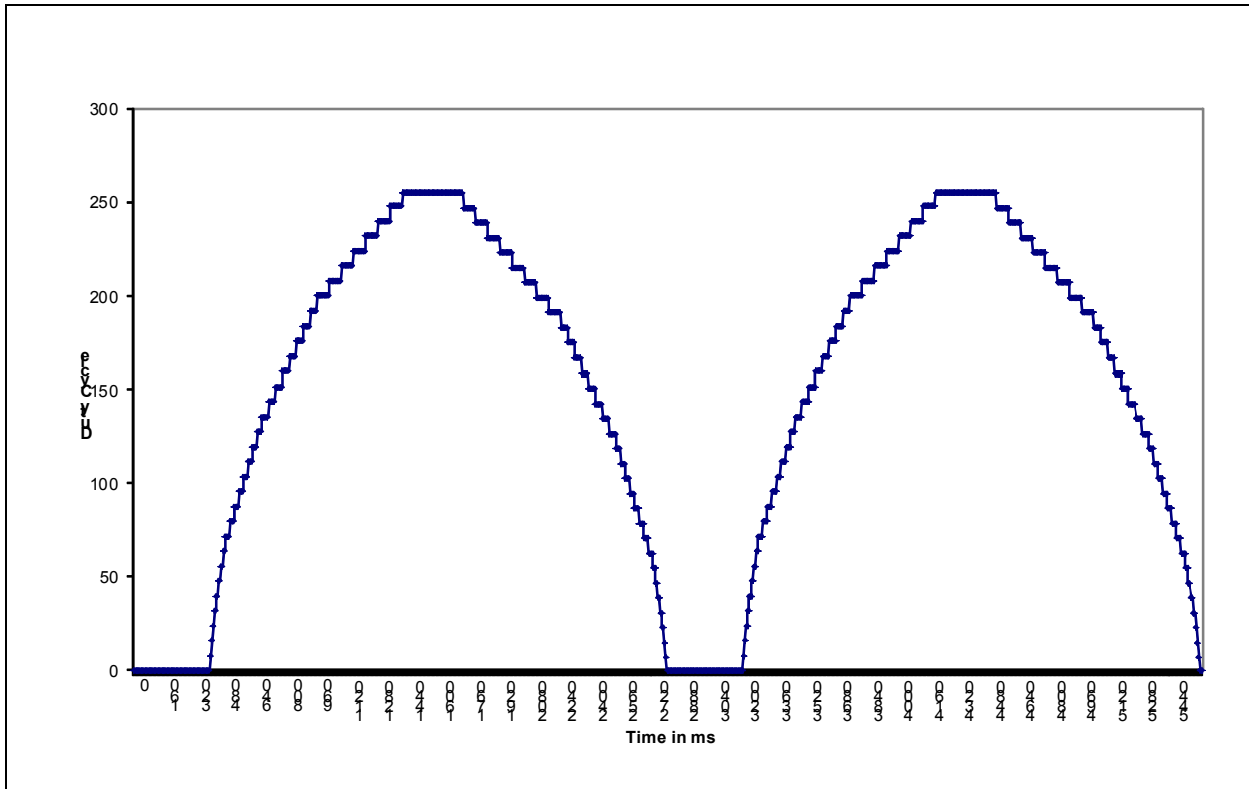
In this example, the brightness of the LED increases and diminishes in a non-linear fashion. The brightness forms a curve that is approximated by four piece wise-linear line segments. The entire cycle takes about 2.8 seconds. The rise time and fall time are about 1 second, with a hold time at maximum brightness of 320ms and a hold time at minimum brightness of 400ms. The LED brightness varies between full off and full on. The PWM size is set to 7-bit, so the time unit for adjusting the PWM is approximately 4ms. The registers are configured as follows:

**TABLE 28-14: NON-LINEAR EXAMPLE CONFIGURATION**

| Field                            | Value                 |      |      |      |      |      |      |      |
|----------------------------------|-----------------------|------|------|------|------|------|------|------|
| PSIZE                            | 7-bit                 |      |      |      |      |      |      |      |
| MAX                              | 255 (effectively 127) |      |      |      |      |      |      |      |
| MIN                              | 0                     |      |      |      |      |      |      |      |
| HD                               | 80 ticks (320ms)      |      |      |      |      |      |      |      |
| LD                               | 100 ticks (400ms)     |      |      |      |      |      |      |      |
| Duty cycle most significant bits | 000b                  | 001b | 010b | 011b | 100b | 101b | 110b | 111b |
| LED_INT                          | 2                     | 3    | 6    | 6    | 9    | 9    | 16   | 16   |
| LED_STEP                         | 4                     | 4    | 4    | 4    | 4    | 4    | 4    | 4    |

The resulting curve is shown in the following figure:

**FIGURE 28-6: NON-LINEAR BRIGHTNESS CURVE EXAMPLE**



## 28.10 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [Blinking/Breathing PWM](#). The addresses of each register listed in this table are defined as a relative offset to the host “Base Address” defined in the EC-Only Register Base Address Table.

**TABLE 28-15: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance                         | Instance Number | Host | Address Space                 | Base Address |
|--|-----------------|------|-------------------------------|--------------|
| <a href="#">Blinking/Breathing PWM</a> | 0               | EC   | 32-bit internal address space | 4000_B800h   |
| <a href="#">Blinking/Breathing PWM</a> | 1               | EC   | 32-bit internal address space | 4000_B900h   |
| <a href="#">Blinking/Breathing PWM</a> | 2               | EC   | 32-bit internal address space | 4000_BA00h   |
| <a href="#">Blinking/Breathing PWM</a> | 3               | EC   | 32-bit internal address space | 4000_BB00h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.



TABLE 28-16: EC-ONLY REGISTER SUMMARY

| Offset | Register Name (Mnemonic)                     |
|--------|--|
| 00h    | <a href="#">LED Configuration Register</a>   |
| 04h    | <a href="#">LED Limits Register</a>          |
| 08h    | <a href="#">LED Delay Register</a>           |
| 0Ch    | <a href="#">LED Update Stepsize Register</a> |
| 10h    | <a href="#">LED Update Interval Register</a> |

In the following register definitions, a “PWM period” is defined by time the PWM counter goes from 000h to its maximum value (FFh in 8-bit mode, FEh in 7-bit mode and FCh in 6-bit mode, as defined by the PSCALE field in register LED\_CFG). The end of a PWM period occurs when the PWM counter wraps from its maximum value to 0.

The registers in this block can be written 32-bits, 16-bits or 8-bits at a time. Writes to [LED Configuration Register](#) take effect immediately. Writes to [LED Limits Register](#) are held in a holding register and only take effect only at the end of a PWM period. The update takes place at the end of every period, even if only one byte of the register was updated. This means that in blink/PWM mode, software can change the duty cycle with a single 8-bit write to the MIN field in the LED\_LIMIT register. Writes to [LED Delay Register](#), [LED Update Stepsize Register](#) and [LED Update Interval Register](#) also go initially into a holding register. The holding registers are copied to the operating registers at the end of a PWM period only if the Enable Update bit in the [LED Configuration Register](#) is set to 1. If LED\_CFG is 0, data in the holding registers is retained but not copied to the operating registers when the PWM period expires. To change an LED breathing configuration, software should write these three registers with the desired values and then set LED\_CFG to 1. This mechanism ensures that all parameters affecting LED breathing will be updated consistently, even if the registers are only written 8 bits at a time.

### 28.10.1 LED CONFIGURATION REGISTER

| Offset | 00h   |      |         |                            |
|--------|---|------|---------|----------------------------|
| Bits   | Description   | Type | Default | Reset Event                |
| 31:16  | Reserved  | R    | -       | -                          |
| 16     | <p>SYMMETRY</p> <p>1=The rising and falling ramp times are in Asymmetric mode. <a href="#">Table 28-12, "Asymmetric Breathing Mode Register Usage"</a> shows the application of the Stepsize and Interval registers to the four segments of rising duty cycles and the four segments of falling duty cycles.</p> <p>0=The rising and falling ramp times (as shown in Figure 28-2, "Breathing LED Example") are in Symmetric mode. <a href="#">Table 28-11, "Symmetric Breathing Mode Register Usage"</a> shows the application of the Stepsize and Interval registers to the 8 segments of both rising and falling duty cycles.</p> | R/W  | 0b      | <a href="#">VCC1_RESET</a> |
| 15:8   | <p>WDT_RELOAD</p> <p>The PWM Watchdog Timer counter reload value. On system reset, it defaults to 14h, which corresponds to a 4 second Watchdog timeout value.</p>  | R/W  | 14h     | <a href="#">VCC1_RESET</a> |
| 7      | <p>RESET</p> <p>Writes of '1' to this bit resets the PWM registers to their default values. This bit is self clearing.</p> <p>Writes of '0' to this bit have no effect.</p>   | W    | 0b      | <a href="#">VCC1_RESET</a> |

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| Offset | 00h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 6      | <p>ENABLE_UPDATE</p> <p>This bit is set to 1 when written with a '1'. Writes of '0' have no effect. Hardware clears this bit to 0 when the breathing configuration registers are updated at the end of a PWM period. The current state of the bit is readable any time.</p> <p>This bit is used to enable consistent configuration of LED_DELAY, LED_STEP and LED_INT. As long as this bit is 0, data written to those three registers is retained in a holding register. When this bit is 1, data in the holding register are copied to the operating registers at the end of a PWM period. When the copy completes, hardware clears this bit to 0.</p> | R/WS | 0b      | VCC1_RESET  |
| 5:4    | <p>PWM_SIZE</p> <p>This bit controls the behavior of PWM:</p> <p>3=Reserved<br/>           2=PWM is configured as a 6-bit PWM<br/>           1=PWM is configured as a 7-bit PWM<br/>           0=PWM is configured as an 8-bit PWM</p>   | R/W  | 0b      | VCC1_RESET  |
| 3      | <p>SYNCHRONIZE</p> <p>When this bit is '1', all counters for all LEDs are reset to their initial values. When this bit is '0' in the <a href="#">LED Configuration Register</a> for all LEDs, then all counters for LEDs that are configured to blink or breathe will increment or decrement, as required.</p> <p>To synchronize blinking or breathing, the <a href="#">SYNCHRONIZE</a> bit should be set for at least one LED, the control registers for each LED should be set to their required values, then the SYNCHRONIZE bits should all be cleared. If the all LEDs are set for the same blink period, they will all be synchronized.</p>        | R/W  | 0b      | VCC1_RESET  |
| 2      | <p>CLOCK_SOURCE</p> <p>This bit controls the base clock for the PWM. It is only valid when CNTRL is set to blink (2).</p> <p>1=Clock source is the <a href="#">48 MHz clock</a><br/>           0=Clock source is the <a href="#">32.768 KHz clock</a></p>  | R/W  | 0b      | VCC1_RESET  |
| 1:0    | <p>CONTROL</p> <p>This bit controls the behavior of PWM:</p> <p>3=PWM is always on<br/>           2=LED blinking (standard PWM)<br/>           1=LED breathing configuration<br/>           0=PWM is always off. All internal registers and counters are reset to 0. Clocks are gated</p>  | R/W  | 00b     | VCC1_RESET  |
|        |  |      | 11b     | WDT TC      |

## 28.10.2 LED LIMITS REGISTER

This register may be written at any time. Values written into the register are held in an holding register, which is transferred into the actual register at the end of a PWM period. The two byte fields may be written independently. Reads of this register return the current contents and not the value of the holding register.

| Offset | 04h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:16  | Reserved  | R    | -       | -           |
| 15:8   | <b>MAXIMUM</b><br>In breathing mode, when the current duty cycle is greater than or equal to this value the breathing apparatus holds the current duty cycle for the period specified by the field HD in register LED_DELAY, then starts decrementing the current duty cycle  | R/W  | 0h      | VCC1_RESET  |
| 7:0    | <b>MINIMUM</b><br>In breathing mode, when the current duty cycle is less than or equal to this value the breathing apparatus holds the current duty cycle for the period specified by the field LD in register LED_DELAY, then starts incrementing the current duty cycle<br><br>In blinking mode, this field defines the duty cycle of the blink function. | R/W  | 0h      | VCC1_RESET  |

### 28.10.3 LED DELAY REGISTER

This register may be written at any time. Values written into the register are held in an holding register, which is transferred into the actual register at the end of a PWM period if the Enable Update bit in the LED Configuration register is set to 1. Reads of this register return the current contents and not the value of the holding register.

| Offset | 08h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:24  | Reserved  | R    | -       | -           |
| 23:12  | <b>HIGH_DELAY</b><br>In breathing mode, the number of PWM periods to wait before updating the current duty cycle when the current duty cycle is greater than or equal to the value MAX in register LED_LIMIT.<br><br>4095=The current duty cycle is decremented after 4096 PWM periods<br>...<br>1=The delay counter is bypassed and the current duty cycle is decremented after two PWM period<br>0=The delay counter is bypassed and the current duty cycle is decremented after one PWM period | R/W  | 000h    | VCC1_RESET  |
| 11:0   | <b>LOW_DELAY</b><br>The number of PWM periods to wait before updating the current duty cycle when the current duty cycle is greater than or equal to the value MIN in register LED_LIMIT.<br><br>4095=The current duty cycle is incremented after 4096 PWM periods<br>...<br>0=The delay counter is bypassed and the current duty cycle is incremented after one PWM period<br><br>In blinking mode, this field defines the prescaler for the PWM clock   | R/W  | 000h    | VCC1_RESET  |

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## 28.10.4 LED UPDATE STEPSIZE REGISTER

This register has eight segment fields which provide the amount the current duty cycle is adjusted at the end of every PWM period. Segment field selection is decoded based on the segment index. The segment index equation utilized depends on the [SYMMETRY](#) bit in the [LED Configuration Register](#) Register)

- In Symmetric Mode the `Segment_Index[2:0] = Duty Cycle Bits[7:5]`.
- In Asymmetric Mode the `Segment_Index[2:0]` is the bit concatenation of following: `Segment_Index[2] = (FALLING RAMP TIME` in Figure 28-3, "Clipping Example") and `Segment_Index[1:0] = Duty Cycle Bits[7:6]`.

This register may be written at any time. Values written into the register are held in an holding register, which is transferred into the actual register at the end of a PWM period if the Enable Update bit in the LED Configuration register is set to 1. Reads of this register return the current contents and not the value of the holding register.

In 8-bit mode, each 4-bit STEPSIZE field represents 16 possible duty cycle modifications, from 1 to 16 as the duty cycle is modified between 0 and 255:

15: Modify the duty cycle by 16

...

1: Modify the duty cycle by 2

0: Modify the duty cycle by 1

In 7-bit mode, the least significant bit of the 4-bit field is ignored, so each field represents 8 possible duty cycle modifications, from 1 to 8, as the duty cycle is modified between 0 and 127:

14, 15: Modify the duty cycle by 8

...

2, 3: Modify the duty cycle by 2

0, 1: Modify the duty cycle by 1

In 6-bit mode, the two least significant bits of the 4-bit field is ignored, so each field represents 4 possible duty cycle modifications, from 1 to 4 as the duty cycle is modified between 0 and 63:

12, 13, 14, 15: Modify the duty cycle by 4

8, 9, 10, 11: Modify the duty cycle by 3

4, 5, 6, 7: Modify the duty cycle by 2

0, 1, 2, 3: Modify the duty cycle by 1

| Offset | 0Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:28  | UPDATE_STEP7<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 111. | R/W  | 0h      | VCC1_RESET  |
| 27:24  | UPDATE_STEP6<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 110. | R/W  | 0h      | VCC1_RESET  |
| 23:20  | UPDATE_STEP5<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 101  | R/W  | 0h      | VCC1_RESET  |
| 19:16  | UPDATE_STEP4<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 100. | R/W  | 0h      | VCC1_RESET  |
| 15:12  | UPDATE_STEP3<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 011. | R/W  | 0h      | VCC1_RESET  |

| Offset | 0Ch  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 11:8   | UPDATE_STEP2<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 010. | R/W  | 0h      | VCC1_RESET  |
| 7:4    | UPDATE_STEP1<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 001. | R/W  | 0h      | VCC1_RESET  |
| 3:0    | UPDATE_STEP0<br>Amount the current duty cycle is adjusted at the end of every PWM period when the segment index is equal to 000. | R/W  | 0h      | VCC1_RESET  |

## 28.10.5 LED UPDATE INTERVAL REGISTER

This register has eight segment fields which provide the number of PWM periods between updates to current duty cycle. Segment field selection is decoded based on the segment index. The segment index equation utilized depends on the [SYMMETRY](#) bit in the [LED Configuration Register](#) Register)

- In Symmetric Mode the [Segment\\_Index\[2:0\] = Duty Cycle Bits\[7:5\]](#)
- In Asymmetric Mode the [Segment\\_Index\[2:0\]](#) is the bit concatenation of following: [Segment\\_Index\[2\] = \(FALLING RAMP TIME in Figure 28-3, "Clipping Example"\)](#) and [Segment\\_Index\[1:0\] = Duty Cycle Bits\[7:6\]](#).

This register may be written at any time. Values written into the register are held in an holding register, which is transferred into the actual register at the end of a PWM period if the Enable Update bit in the LED Configuration register is set to 1. Reads of this register return the current contents and not the value of the holding register.

| Offset | 10h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:28  | UPDATE_INTERVAL7<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 111b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h      | VCC1_RESET  |
| 27:24  | UPDATE_INTERVAL6<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 110b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h      | VCC1_RESET  |
| 23:20  | UPDATE_INTERVAL5<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 101b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h      | VCC1_RESET  |

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| Offset | 10h  | Bits | Description | Type       | Default | Reset Event |
|--------|--|------|-------------|------------|---------|-------------|
| 19:16  | UPDATE_INTERVAL4<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 100b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h          | VCC1_RESET |         |             |
| 15:12  | UPDATE_INTERVAL3<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 011b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h          | VCC1_RESET |         |             |
| 11:8   | UPDATE_INTERVAL2<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 010b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h          | VCC1_RESET |         |             |
| 7:4    | UPDATE_INTERVAL1<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 001b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h          | VCC1_RESET |         |             |
| 3:0    | UPDATE_INTERVAL0<br>The number of PWM periods between updates to current duty cycle when the segment index is equal to 000b.<br><br>15=Wait 16 PWM periods<br>...<br>0=Wait 1 PWM period | R/W  | 0h          | VCC1_RESET |         |             |

## 29.0 PS/2 INTERFACE

### 29.1 Introduction

There are four PS/2 Ports in the MEC1322 which are directly controlled by the EC. The hardware implementation eliminates the need to bit bang I/O ports to generate PS/2 traffic, however bit banging is available via the associated GPIO pins.

### 29.2 References

No references have been cited for this feature.

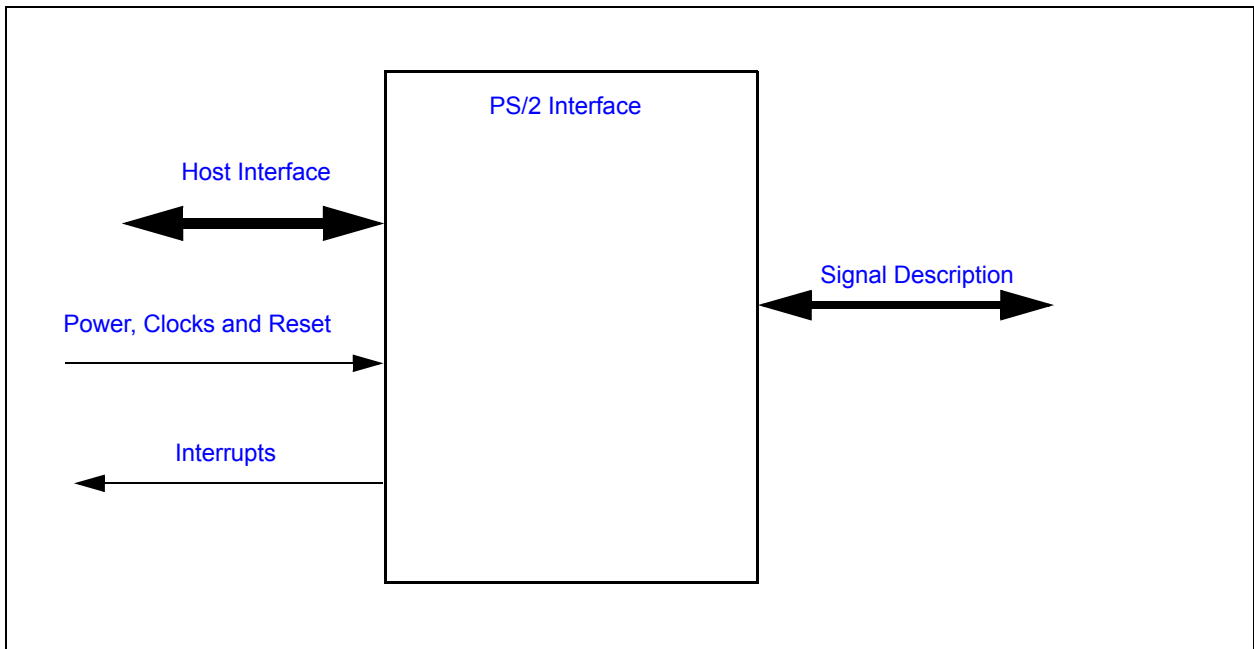
### 29.3 Terminology

There is no terminology defined for this section.

### 29.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 29-1: I/O DIAGRAM OF BLOCK**



### 29.5 Signal Description

**TABLE 29-1: SIGNAL DESCRIPTION TABLE**

| Name   | Direction        | Description                |
|--------|------------------|----------------------------|
| PS2DAT | INPUT/<br>OUTPUT | Data from the PS/2 device  |
| PS2CLK | INPUT/<br>OUTPUT | Clock from the PS/2 device |

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## 29.6 Host Interface

The registers defined for the Keyboard Scan Interface are accessible by the various hosts as indicated in [Section 29.15, "EC-Only Registers"](#).

## 29.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 29.7.1 POWER DOMAINS

**TABLE 29-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block are powered by this power well. |

### 29.7.2 CLOCK INPUTS

**TABLE 29-3: CLOCK INPUTS**

| Name                   | Description  |
|------------------------|--|
| 48 MHz Ring Oscillator | This is the clock source for PS/2 Interface logic.       |
| 2 MHz Clock            | The PS/2 state machine is clocked using the 2 MHz clock. |

### 29.7.3 RESETS

**TABLE 29-4: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This signal resets all the registers and logic in this block to their default state. |

## 29.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 29-5: EC INTERRUPTS**

| Source   | Description   |
|----------|---|
| PW2_x    | Interrupt request to the Interrupt Aggregator for PS2 controller instance x, based on PS2 controller activity. <a href="#">Section 29.15.4, "PS2 Status Register"</a> defines the sources for the interrupt request.  |
| PS2_x_WK | Wake-up request to the Interrupt Aggregator's wake-up interface for PS2 port x.<br><br>In order to enable PS2 wakeup interrupts, the pin control registers for the PS2DAT pin must be programmed to Input, Falling Edge Triggered, non-inverted polarity detection. |

## 29.9 Low Power Modes

The PS/2 Interface may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

The PS2 interface will only sleep while the PS2 is disabled or in Rx mode with no traffic on the bus.

### 29.10 Description

Each EC PS/2 serial channels use a synchronous serial protocol to communicate with the auxiliary device. Each PS/2 channel has Clock and Data signal lines. The signal lines are bi-directional and employ open drain outputs capable of sinking 12mA, as required by the PS/2 specification. A pull-up resistor, typically 10K, is connected to both lines. This allows either the EC PS/2 logic or the auxiliary device to drive the lines. Regardless of the drive source, the auxiliary



device always provides the clock for transmit and receive operations. The serial packet is made up of eleven bits, listed in the order they appear on the data line: start bit, eight data bits (least significant bit first), odd parity, and stop bit. Each bit cell is from 60µS to 100µS long.

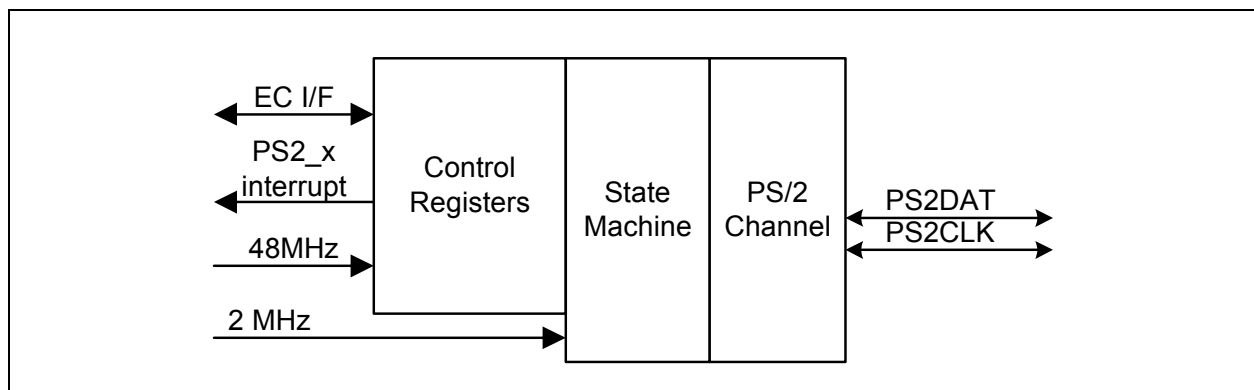
All PS/2 Serial Channel signals (PS2CLK and PS2DAT) are driven by open drain drivers which can be pulled to **VCC1** or the main power rail (+3.3V nominal) through 10K-ohm resistors.

The PS/2 controller supports a PS/2 Wake Interface that can wake the EC from the IDLE or SLEEP states. The Wake Interface can generate wake interrupts without a clock. The PS/2 Wake Interface is only active when the peripheral device and external pull-up resistors are powered by the **VCC1** supply.

There are no special precautions to be taken to prevent back drive of a PS/2 peripheral powered by the main power well when the power well is off, as long as the external 10K pull-up resistor is tied to the same power source as the peripheral.

## 29.11 Block Diagram

**FIGURE 29-2: PORT PS/2 BLOCK DIAGRAM**



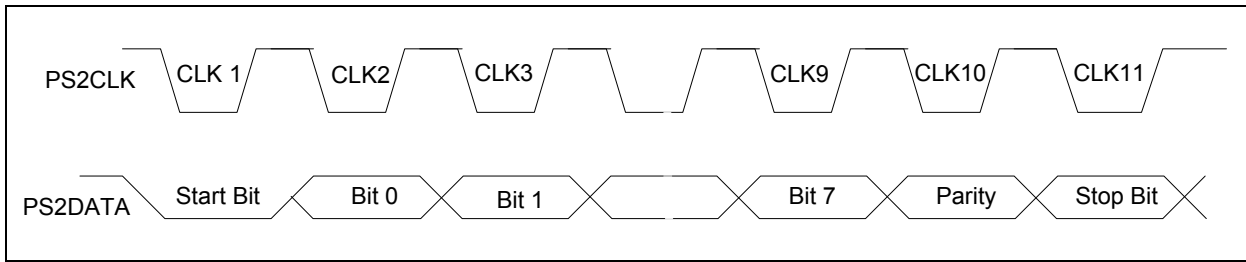
## 29.12 PS/2 Port Physical Layer Byte Transmission Protocol

The PS/2 physical layer transfers a byte of data via an eleven bit serial stream as shown in Table 29-6. A logic 1 is sent at an active high level. Data sent from a Keyboard or mouse device to the host is read on the falling edge of the clock signal. The Keyboard or mouse device always generates the clock signal. The Host may inhibit communication by pulling the Clock line low. The Clock line must be continuously high for at least 50 microseconds before the Keyboard or mouse device can begin to transmit its data. See Table 29-7, "PS/2 Port Physical Layer Bus States".

**TABLE 29-6: PS/2 PORT PHYSICAL LAYER BYTE TRANSMISSION PROTOCOL**

| Bit | Function                           |
|-----|------------------------------------|
| 1   | Start bit (always 0)               |
| 2   | Data bit 0 (least significant bit) |
| 3   | Data bit 1                         |
| 4   | Data bit 2                         |
| 5   | Data bit 3                         |
| 6   | Data bit 4                         |
| 7   | Data bit 5                         |
| 8   | Data bit 6                         |
| 9   | Data bit 7 (most significant bit)  |
| 10  | Parity bit (odd parity)            |
| 11  | Stop Bit (always 1)                |

**FIGURE 29-3: PS/2 PORT PHYSICAL LAYER BYTE TRANSMISSION PROTOCOL**



**TABLE 29-7: PS/2 PORT PHYSICAL LAYER BUS STATES**

| Data | Clock | State                   |
|------|-------|-------------------------|
| high | high  | Idle                    |
| high | low   | Communication Inhibited |
| low  | low   | Request to Send         |

## 29.13 Controlling PS/2 Transactions

PS/2 transfers are controlled by fields in the [PS2 Control Register](#).

The interface is enabled by the [PS2\\_EN](#) bit. Transfers are enabled when PS2\_EN is '1' and disabled when PS2\_EN is '0'. If the PS2\_EN bit is cleared to '0' while a transfer is in progress but prior to the leading edge (falling edge) of the 10th (parity bit) clock edge, the receive data is discarded (RDATA\_RDY remains low). If the PS2\_EN bit is cleared following the leading edge of the 10th clock signal, then the receive data is saved in the Receive Register (RDATA\_RDY goes high) assuming no parity error.

The direction of a PS/2 transfer is controlled by the [PS2\\_T/R](#) bit.

### 29.13.1 RECEIVE

If PS2\_T/R is '0' while the PS2 Interface is enabled, the interface is configured to receive data. If while PS2\_T/R is '0' RDATA\_RDY is '0', the channel's PS2CLK and PS2DAT will float waiting for the external PS/2 device to signal the start of a transmission. If RDATA\_RDY is '1', the channel's PS2DAT line will float but its PS2CLK line will be held low, holding off the peripheral, until the Receive Register is read.

The peripheral initiates a reception by sending a start bit followed by the data bits). After a successful reception, data are placed in the [PS2 Receive Buffer Register](#), the RDATA\_RDY bit in the [PS2 Status Register](#) is set and the PS2CLK line is forced low. Further receive transfers are inhibited until the EC reads the data in the PS2 Receive Buffer Register. RDATA\_RDY is cleared and the PS2CLK line is tri-stated following a read of the PS2 Receive Buffer Register.

The Receive Buffer Register is initialized to FFh after a read or after a Time-out has occurred.

### 29.13.2 TRANSMIT

If PS2\_T/R is '1' while the PS2 Interface is enabled, the interface is configured to transmit data. When the PS2\_T/R bit is written to '1' while the state machine is idle, the channel prepares for a transmission: the interface will drive the PS2-CLK line low and then float the PS2DAT line, holding this state until a write occurs to the Transmit Register or until the PS2\_T/R bit is cleared. A transmission is started by writing the [PS2 Transmit Buffer Register](#). Writes to the Transmit Buffer Register are blocked when PS2\_EN is '0', PS2\_T/R is '0' or when the transmit state machine is active (the XMIT\_IDLE bit in the PS/2 Status Register is '0'). The transmission of data will not start if there is valid data in the Receive Data Register (when the status bit RDATA\_RDY is '1'). When a transmission is started, the transmission state machine becomes active (the XMIT\_IDLE bit is set to '1' by hardware), the PS2DAT line is driven low and within 80ns the PS2CLK line floats (externally pulled high by the pull-up resistor).

The transmission terminates either on the 11th clock edge of the transmission or if a Transmit Time-Out error condition occurs. When the transmission terminates, the PS2\_T/R bit is cleared to '0' and the state machine becomes idle, setting XMIT\_IDLE to '1'.

The PS2\_T/R bit must be written to a '1' before initiating another transmission to the remote device. If the PS2\_T/R bit is set to '1' while the channel is actively receiving data (that is, while the status bit RDATA\_RDY is '1') prior to the leading edge of the 10th (parity bit) clock edge, the receive data is discarded. If the bit is set after the 10th edge, the receive data is saved in the Receive Register.

## 29.14 Instance Description

## 29.15 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the PS/2 Interface. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 29-8: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address |
|----------------|-----------------|------|-------------------------------|--------------|
| PS/2 Interface | 0               | EC   | 32-bit internal address space | 4000_9000h   |
|                | 1               | EC   | 32-bit internal address space | 4000_9040h   |
|                | 2               | EC   | 32-bit internal address space | 4000_9080h   |
|                | 3               | EC   | 32-bit internal address space | 4000_90C0h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 29-9: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name                |
|--------|------------------------------|
| 0h     | PS2 Transmit Buffer Register |
| 0h     | PS2 Receive Buffer Register  |
| 4h     | PS2 Control Register         |
| 8h     | PS2 Status Register          |

### 29.15.1 PS2 TRANSMIT BUFFER REGISTER

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:8   | Reserved  | R    | -       | -              |
| 7:0    | TRANSMIT_DATA<br>Writes to this register start a transmission of the data in this register to the peripheral. | W    | 0h      | VCC1_R<br>ESET |

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## 29.15.2 PS2 RECEIVE BUFFER REGISTER

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:8   | Reserved   | R    | -       | -              |
| 7:0    | <p>RECEIVE_DATA<br/>Data received from a peripheral are recorded in this register.</p> <p>A transmission initiated by writing the <a href="#">PS2 Transmit Buffer Register</a> will not start until valid data in this register have been read and RDATA_RDY has been cleared by hardware.</p> <p>The Receive Buffer Register is initialized to FFh after a read or after a Time-out has occurred.</p> | R    | FFh     | VCC1_R<br>ESET |

## 29.15.3 PS2 CONTROL REGISTER

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:6   | Reserved   | R    | -       | -              |
| 5:4    | <p>STOP<br/>These bits are used to set the level of the stop bit expected by the PS/2 channel state machine. These bits are therefore only valid when PS2_EN is set.</p> <p>00b=Receiver expects an active high stop bit.<br/>01b=Receiver expects an active low stop bit.<br/>10b=Receiver ignores the level of the Stop bit (11th bit is not interpreted as a stop bit).<br/>11b=Reserved.</p> | R/W  | 0h      | VCC1_R<br>ESET |
| 3:2    | <p>PARITY<br/>These bits are used to set the parity expected by the PS/2 channel state machine. These bits are therefore only valid when PS2_EN is set.</p> <p>00b=Receiver expects Odd Parity (default).<br/>01b=Receiver expects Even Parity.<br/>10b=Receiver ignores level of the parity bit (10th bit is not interpreted as a parity bit).<br/>11b=Reserved</p>                             | R/W  | 0h      | VCC1_R<br>ESET |
| 1      | <p>PS2_EN<br/>PS/2 Enable.</p> <p>0=The PS/2 state machine is disabled. The CLK pin is driven low and the DATA pin is tri-stated.<br/>1=The PS/2 state machine is enabled, allowing the channel to perform automatic reception or transmission, depending on the state of PS2_T/R.</p>   | R/W  | 0h      | VCC1_R<br>ESET |
| 0      | <p>PS2_T/R<br/>PS/2 Transmit/Receive</p> <p>0=The P2/2 channel is enabled to receive data.<br/>1=The PS2 channel is enabled to transmit data.</p>  | R/W  | 0h      | VCC1_R<br>ESET |

Changing values in the PS2 CONTROL REGISTER at a rate faster than 2 MHz, may result in unpredictable behavior.

## 29.15.4 PS2 STATUS REGISTER

| Offset | 08h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:8   | Reserved   | R    | -       | -           |
| 7      | <p>XMIT_START_TIMEOUT<br/>Transmit Start Timeout.</p> <p>0=No transmit start timeout detected<br/>1=A start bit was not received within 25 ms following the transmit start event. The transmit start bit time-out condition is also indicated by the XMIT_TIMEOUT bit.</p>   | R/WC | 0h      | VCC1_RESET  |
| 6      | <p>RX_BUSY<br/>Receive Channel Busy.</p> <p>0=The channel is actively receiving PS/2 data<br/>1=The channel is idle</p>  | R    | 0h      | VCC1_RESET  |
| 5      | <p>XMIT_TIME_OUT<br/>Transmitter Idle.</p> <p>When the XMIT_TIMEOUT bit is set, the PS2_T/R bit is held clear, the PS/2 channel's CLK line is pulled low for a minimum of 300µs until the PS/2 Status register is read. The XMIT_TIMEOUT bit is set on one of three transmit conditions: when the transmitter bit time (the time between falling edges) exceeds 300µs, when the transmitter start bit is not received within 25ms from signaling a transmit start event or if the time from the first bit (start) to the 10th bit (parity) exceeds 2ms</p> | R/WC | 0h      | VCC1_RESET  |
| 4      | <p>XMIT_IDLE<br/>Transmitter Idle.</p> <p>0=The channel is actively transmitting PS/2 data. Writing the <a href="#">PS2 Transmit Buffer Register</a> will cause the XMIT_IDLE bit to clear<br/>1=The channel is not transmitting. This bit transitions from '0' to '1' in the following cases:<br/>The falling edge of the 11th CLK<br/>XMIT_TIMEOUT is set<br/>The PS2_T/R bit is cleared<br/>The PS2_EN bit is cleared.</p> <p>A low to high transition on this bit generates a PS2 Activity interrupt.</p>  | R    | 0h      | VCC1_RESET  |
| 3      | <p>FE<br/>Framing Error</p> <p>When receiving data, the stop bit is clocked in on the falling edge of the 11th CLK edge. If the channel is configured to expect either a high or low stop bit and the 11th bit is contrary to the expected stop polarity, then the FE and REC_TIMEOUT bits are set following the falling edge of the 11th CLK edge and an interrupt is generated.</p>  | R/WC | 0h      | VCC1_RESET  |

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| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 2      | <p>PE<br/>Parity Error</p> <p>When receiving data, the parity bit is clocked in on the falling edge of the 10th CLK edge. If the channel is configured to expect either even or odd parity and the 10th bit is contrary to the expected parity, then the PE and REC_TIMEOUT bits are set following the falling edge of the 10th CLK edge and an interrupt is generated.</p>  | R/WC | 0h      | VCC1_R<br>ESET |
| 1      | <p>REC_TIMEOUT<br/>Receive Timeout</p> <p>Following assertion of the REC_TIMEOUT bit, the channel's CLK line is automatically pulled low for a minimum of 300us until the PS/2 status register is read. Under PS2 automatic operation, PS2_EN is set, this bit is set on one of three receive error conditions:<br/>           When the receiver bit time (the time between falling edges) exceeds 300µs.<br/>           If the time from the first bit (start) to the 10th bit (parity) exceeds 2ms.<br/>           On a receive parity error along with the Parity Error (PE) bit.<br/>           On a receive framing error due to an incorrect STOP bit along with the framing error (FE) bit.</p> <p>A low to high transition on this bit generates a PS2 Activity interrupt.</p> | R/WC | 0h      | VCC1_R<br>ESET |
| 0      | <p>RDATA_RDY<br/>Receive Data Ready</p> <p>Under normal operating conditions, this bit is set following the falling edge of the 11th clock given successful reception of a data byte from the PS/2 peripheral (i.e., no parity, framing, or receive time-out errors) and indicates that the received data byte is available to be read from the Receive Register. This bit may also be set in the event that the PS2_EN bit is cleared following the 10th CLK edge.</p> <p>Reading the Receive Register clears this bit.</p> <p>A low to high transition on this bit generates a PS2 Activity interrupt.</p>   | R    | 0h      | VCC1_R<br>ESET |

## 30.0 KEYBOARD SCAN INTERFACE

### 30.1 Overview

The Keyboard Scan Interface block provides a register interface to the EC to directly scan an external keyboard matrix of size up to 18x8.

The maximum configuration of the Keyboard Scan Interface is 18 outputs by 8 inputs. For a smaller matrix size, firmware should configure unused KSO pins as GPIOs or another alternate function, and it should mask out unused KSIs and associated interrupts.

### 30.2 References

No references have been cited for this feature.

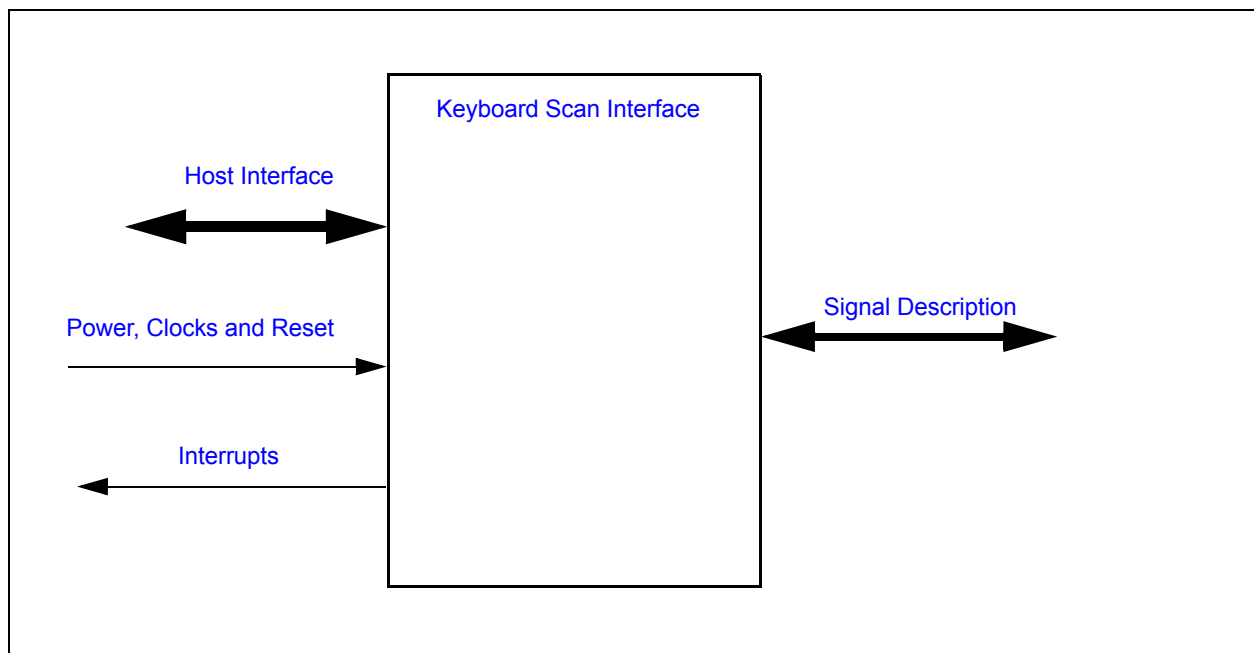
### 30.3 Terminology

There is no terminology defined for this section.

### 30.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 30-1: I/O DIAGRAM OF BLOCK**



### 30.5 Signal Description

**TABLE 30-1: SIGNAL DESCRIPTION TABLE**

| Name      | Direction | Description                                  |
|-----------|-----------|--|
| KSI[7:0]  | Input     | Column inputs from external keyboard matrix. |
| KSO[17:0] | Output    | Row outputs to external keyboard matrix.     |

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## 30.6 Host Interface

The registers defined for the Keyboard Scan Interface are accessible by the various hosts as indicated in [Section 30.11](#), "EC-Only Registers".

## 30.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 30.7.1 POWER DOMAINS

**TABLE 30-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The logic and registers implemented in this block are powered by this power well. |

### 30.7.2 CLOCK INPUTS

**TABLE 30-3: CLOCK INPUTS**

| Name                   | Description   |
|------------------------|---|
| 48 MHz Ring Oscillator | This is the clock source for Keyboard Scan Interface logic. |

### 30.7.3 RESETS

**TABLE 30-4: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This signal resets all the registers and logic in this block to their default state. |

## 30.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 30-5: EC INTERRUPTS**

| Source       | Description  |
|--------------|--|
| KSC_INT      | Interrupt request to the Interrupt Aggregator.                   |
| KSC_INT_WAKE | Wake-up request to the Interrupt Aggregator's wake-up interface. |

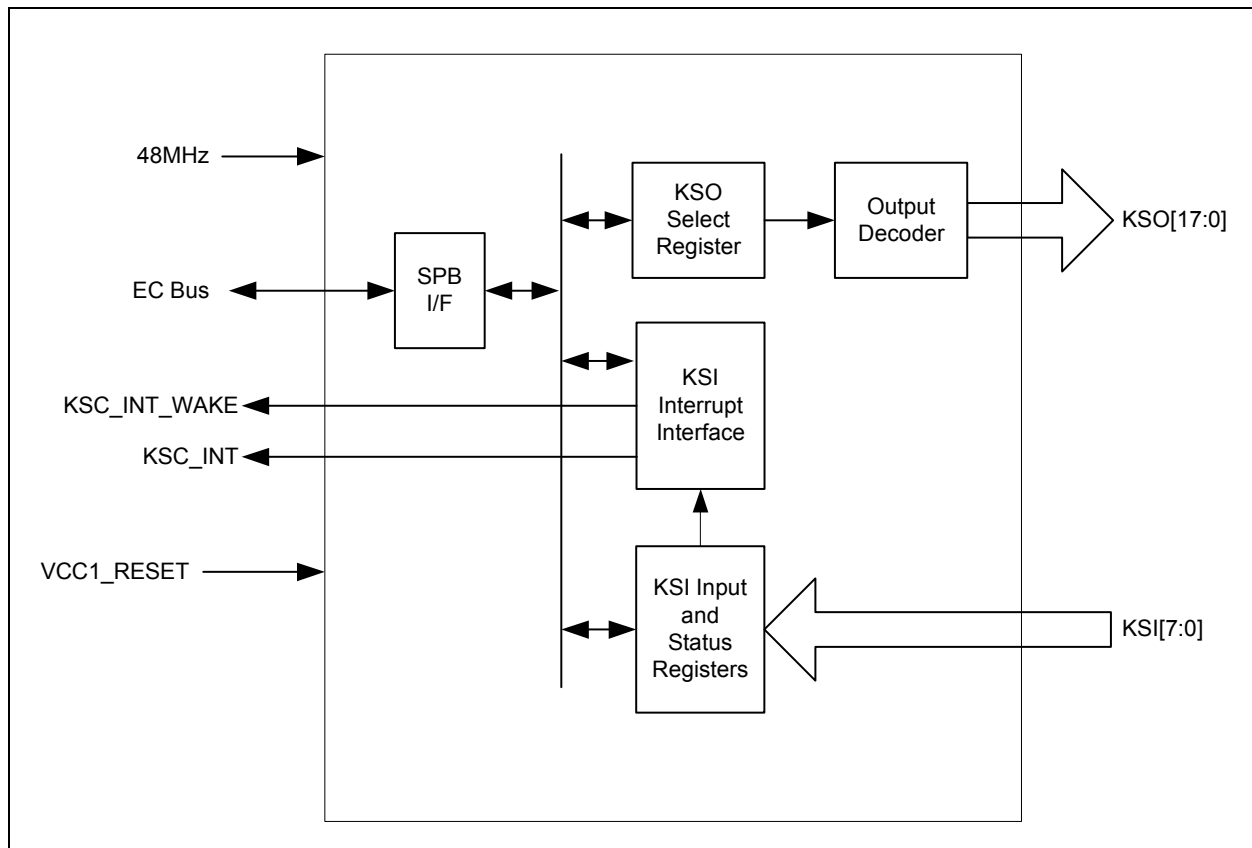
## 30.9 Low Power Modes

The Keyboard Scan Interface automatically enters a low power mode whenever it is not actively scanning the keyboard matrix. The block is also placed in a low-power state when it is disabled by the [KSEN](#) bit. When the interface is in a low-power mode it will not prevent the chip from entering a sleep state. When the interface is active it will inhibit the chip sleep state until the interface has re-entered its low power mode.



## 30.10 Description

FIGURE 30-2: Keyboard Scan Interface Block Diagram



During scanning the firmware sequentially drives low one of the rows (KSO[17:0]) and then reads the column data line (KSI[7:0]). A key press is detected as a zero in the corresponding position in the matrix. Keys that are pressed are debounced by firmware. Once confirmed, the corresponding keycode is loaded into host data read buffer in the 8042 Host Interface module. Firmware may need to buffer keycodes in memory in case this interface is stalled or the host requests a Resend.

### 30.10.1 INITIALIZATION OF KSO PINS

If the Keyboard Scan Interface is not configured for PREDRIVE Mode, KSO pins should be configured as open-drain outputs. Internal or external pull-ups should be used so that the GPIO functions that share the pins do not have a floating input when the KSO pins are tri-stated.

If the Keyboard Scan Interface is configured for PREDRIVE Mode, KSO pins must be configured as push-pull outputs. Internal or external pull-ups should be used to protect the GPIO inputs associated with the KSO pins from floating inputs.

### 30.10.2 PREDRIVE MODE

There is an optional Predrive Mode that can be enabled to actively drive the KSO pins high before switching to open-drain operation. The PREDRIVE ENABLE bit in the [Keyscan Extended Control Register](#) is used to enable the PREDRIVE option. Timing for the Predrive mode is shown in [Section 38.9, Keyboard Scan Matrix Timing](#).

#### 30.10.2.1 Predrive Mode Programming

The following precautions should be taken to prevent output pad damage during [Predrive Mode Programming](#).

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## 30.10.2.2 Asserting PREDRIVE\_ENABLE

1. Disable Key Scan Interface (KSEN = '1')
2. Enable Predrive function (PREDRIVE\_ENABLE = '1')
3. Program buffer type for all KSO pins to "push-pull"
4. Enable Keyscan Interface (KSEN = '0')

## 30.10.2.3 De-asserting PREDRIVE\_ENABLE

1. Disable Key Scan Interface (KSEN = '1')
2. Program buffer type for all KSO pins to "open-drain"
3. Disable Predrive function (PREDRIVE\_ENABLE = '0')
4. Enable Keyscan Interface (KSEN = '0')

## 30.10.3 INTERRUPT GENERATION

To support interrupt-based processing, an interrupt can optionally be generated on the high-to-low transition on any of the KSI inputs. A running clock is not required to generate interrupts.

### 30.10.3.1 Runtime interrupt

[KSC\\_INT](#) is the block's runtime active-high level interrupt. It is connected to the interrupt interface of the Interrupt Aggregator, which then relays interrupts to the EC.

Associated with each KSI input is a status register bit and an interrupt enable register bit. A status bit is set when the associated KSI input goes from high to low. If the interrupt enable bit for that input is set, an interrupt is generated. An interrupt is de-asserted when the status bit and/or interrupt enable bit is clear. A status bit cleared when written to a '1'.

Interrupts from individual KSIs are logically ORed together to drive the [KSC\\_INT](#) output port. Once asserted, an interrupt is not asserted again until either all [KSI\[7:0\]](#) inputs have returned high or the [KSI](#) has changed.

### 30.10.3.2 Wake-up Interrupt

[KSC\\_INT\\_WAKE](#) is the block's wakeup interrupt. It is routed to the Interrupt Aggregator.

During sleep mode, i.e., when the bus clock is stopped, a high-to-low transition on any KSI whose interrupt enable bit is set causes the [KSC\\_INT\\_WAKE](#) to be asserted. Also set is the associated status bit in the [EC Clock Required 2 Status Register \(EC\\_CLK\\_REQ2\\_STS\)](#). [KSC\\_WAKEUP\\_INT](#) remains active until the bus clock is started.

The aforementioned transition on KSI also sets the corresponding status bit in the [KSI STATUS Register](#). If enabled, a runtime interrupt is also asserted on [KSC\\_INT](#) when the bus clock resumes running.

## 30.10.4 WAKE PROGRAMMING

Using the Keyboard Scan Interface to 'wake' the MEC1322 can be accomplished using either the Keyboard Scan Interface wake interrupt, or using the wake capabilities of the GPIO Interface pins that are multiplexed with the Keyboard Scan Interface pins. Enabling the Keyboard Scan Interface wake interrupt requires only a single interrupt enable access and is recommended over using the GPIO Interface for this purpose.

## 30.11 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the Keyboard Scan Interface. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 30-6: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance          | Instance Number | Host | Address Space                 | Base Address |
|-------------------------|-----------------|------|-------------------------------|--------------|
| Keyboard Scan Interface | 0               | EC   | 32-bit internal address space | 4000_9C00h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 30-7: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name                                     |
|--------|---|
| 0h     | Reserved  |
| 4h     | <a href="#">KSO Select Register</a>               |
| 8h     | <a href="#">KSI INPUT Register</a>                |
| Ch     | <a href="#">KSI STATUS Register</a>               |
| 10h    | <a href="#">KSI INTERRUPT ENABLE Register</a>     |
| 14h    | <a href="#">Keyscan Extended Control Register</a> |

## 30.11.1 KSO SELECT REGISTER

| Offset | 04h | Bits | Description  | Type | Default | Reset Event                 |
|--------|-----|------|--|------|---------|-----------------------------|
|        |     | 31:4 | Reserved   | R    | -       | -                           |
|        |     | 7    | <b>KSO_INVERT</b><br>This bit controls the output level of KSO pins when selected.<br><br>0= KSO[x] driven low when selected<br>1= KSO[x] driven high when selected.                             | R/W  | 0b      | <a href="#">VCC1_R ESET</a> |
|        |     | 6    | <b>KSEN</b><br>This field enables and disables keyboard scan<br><br>0= Keyboard scan enabled<br>1= Keyboard scan disabled. All KSO output buffers disabled.                                      | R/W  | 1h      | <a href="#">VCC1_R ESET</a> |
|        |     | 5    | <b>KSO_ALL</b><br><br>0=When key scan is enabled, KSO output controlled by the KSO_SELECT field.<br>1=KSO[x] driven high when selected.  | R/W  | 0b      | <a href="#">VCC1_R ESET</a> |
|        |     | 4:0  | <b>KSO_SELECT</b><br>This field selects a KSO line (00000b = KSO[0] etc.) for output according to the value off KSO_INVERT in this register. See <a href="#">Table 30-8, "KSO Select Decode"</a> | R/W  | 0h      | <a href="#">VCC1_R ESET</a> |

**TABLE 30-8: KSO SELECT DECODE**

| KSO Select [4:0] | KSO Selected |
|------------------|--------------|
| 00h              | KSO00        |
| 01h              | KSO01        |
| 02h              | KSO02        |
| 03h              | KSO03        |
| 04h              | KSO04        |
| 05h              | KSO05        |
| 06h              | KSO06        |
| 07h              | KSO07        |
| 08h              | KSO08        |
| 09h              | KSO09        |
| 0Ah              | KSO10        |

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**TABLE 30-8: KSO SELECT DECODE (CONTINUED)**

| KSO Select [4:0] | KSO Selected |
|------------------|--------------|
| 0Bh              | KSO11        |
| 0Ch              | KSO12        |
| 0Dh              | KSO13        |
| 0Eh              | KSO14        |
| 0Fh              | KSO15        |
| 10h              | KSO16        |
| 11h              | KSO17        |

**TABLE 30-9: KEYBOARD SCAN OUT CONTROL SUMMARY**

| KSO_INVERTt | KSEN | KSO_ALL | KSO_SELECT    | Description  |
|-------------|------|---------|---------------|--|
| X           | 1    | x       | x             | Keyboard Scan disabled. KSO[17:0] output buffers disabled. |
| 0           | 0    | 0       | 10001b-00000b | KSO[Drive Selected] driven low. All others driven high     |
| 1           | 0    | 0       | 10001b-00000b | KSO[Drive Selected] driven high. All others driven low     |
| 0           | 0    | 0       | 11111b-10010b | All KSO's driven high                                      |
| 1           | 0    | 0       | 11111b-10010b | All KSO's driven low                                       |
| 0           | 0    | 1       | x             | All KSO's driven high                                      |
| 1           | 0    | 1       | x             | All KSO's driven low                                       |

## 30.11.2 KSI INPUT REGISTER

| Offset | 08h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:8   | Reserved   | R    | -       | -              |
| 7:0    | KSI<br>This field returns the current state of the KSI pins. | R    | 0h      | VCC1_R<br>ESET |

## 30.11.3 KSI STATUS REGISTER

| Offset | 0Ch  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:8   | Reserved   | R    | -       | -              |
| 7:0    | KSI_STATUS<br>Each bit in this field is set on the falling edge of the corresponding KSI input pin.<br><br>A KSI interrupt is generated when its corresponding status bit and interrupt enable bit are both set. KSI interrupts are logically ORed together to produce <b>KSC_INT</b> and <b>KSC_INT_WAKE</b> .<br><br>Writing a '1' to a bit will clear it. Writing a '0' to a bit has no effect. | R/WC | 0h      | VCC1_R<br>ESET |

## 30.11.4 KSI INTERRUPT ENABLE REGISTER

| Offset | 10h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:8   | Reserved  | R    | -       | -           |
| 7:0    | <b>KSI_INT_EN</b><br>Each bit in KSI_INT_EN enables interrupt generation due to high-to-low transition on a KSI input. An interrupt is generated when the corresponding bits in KSI_STATUS and KSI_INT_EN are both set. | R/W  | 0h      | VCC1_RESET  |

## 30.11.5 KEYSKAN EXTENDED CONTROL REGISTER

| Offset | 14h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 32:1   | Reserved   | R    | -       | -           |
| 0      | <b>PREDRIVE_ENABLE</b><br>PREDRIVE_ENABLE enables the PREDRIVE mode to actively drive the KSO pins high for approximately 100 ns before switching to open-drain operation.<br><br>0=Disable predrive on KSO pins<br>1=Enable predrive on KSO pins. | RW   | 0       | VCC1_RESET  |

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## 31.0 BC-LINK MASTER

### 31.1 Overview

This block provides BC-Link™ connectivity to a slave device. The BC-Link™ protocol includes a start bit to signal the beginning of a message and a turnaround (TAR) period for bus transfer between the Master and Companion devices.

### 31.2 References

No references have been cited for this feature.

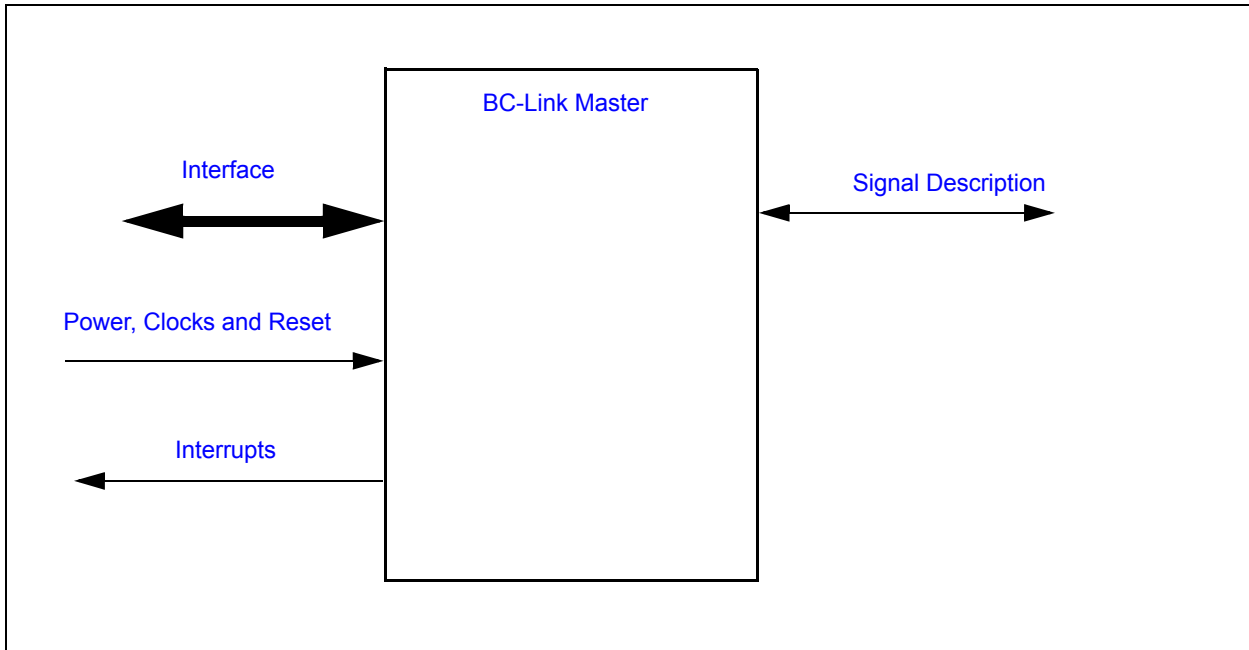
### 31.3 Terminology

There is no terminology defined for this section.

### 31.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

FIGURE 31-1: I/O DIAGRAM OF BLOCK



### 31.5 Signal Description

TABLE 31-1: SIGNAL DESCRIPTION TABLE

| Name     | Direction    | Description                     |
|----------|--------------|---------------------------------|
| BCM_CLK  | Output       | BC-Link output clock            |
| BCM_DAT  | Input/Output | Bidirectional data line         |
| BCM_INT# | Input        | Input from the companion device |

**Note:** A weak pull-up resistor is recommended on the data line (100KΩ).

The maximum speed at which the BC-Link Master Interface can operate reliably depends on the drive strength of the BC-Link BCM\_CLK and BCM\_DAT pins, as well as the nature of the connection to the Companion device (over ribbon cable or on a PC board). The following table shows the recommended maximum speeds over a PC board as well as a 12 inch ribbon cable for selected drive strengths. The frequency is set with the [BC-Link Clock Select Register](#).

**TABLE 31-2: BC-LINK MASTER PIN DRIVE STRENGTH VS. FREQUENCY**

| Pin Drive Strength | Max Freq on PC Board | Min Value in BC-Link Clock Select Register | Max Freq over Ribbon cable | Min Value in BC-Link Clock Select Register |
|--------------------|----------------------|--|----------------------------|--|
| 16mA               | 24Mhz                | 1  | 16Mhz                      | 2  |

## 31.6 Host Interface

The registers defined for the BC-Link Master Interface are accessible by the various hosts as indicated in [Section 31.11, "EC-Only Registers"](#).

## 31.7 Power, Clocks and Reset

### 31.7.1 POWER DOMAINS

**TABLE 31-3: POWER SOURCES**

| Name                 | Description   |
|----------------------|---|
| <a href="#">VCC1</a> | The logic and registers implemented in this block are powered by this power well. |

### 31.7.2 CLOCK INPUTS

**TABLE 31-4: CLOCK INPUTS**

| Name                                   | Description   |
|--|---|
| <a href="#">48 MHz Ring Oscillator</a> | This is the clock source for Keyboard Scan Interface logic. |

### 31.7.3 RESETS

**TABLE 31-5: RESET SIGNALS**

| Name                       | Description  |
|----------------------------|--|
| <a href="#">VCC1_RESET</a> | This signal resets all the registers and logic in this block to their default state. |

## 31.8 Interrupts

This section defines the Interrupt Sources generated from this block.

**TABLE 31-6: EC INTERRUPTS**

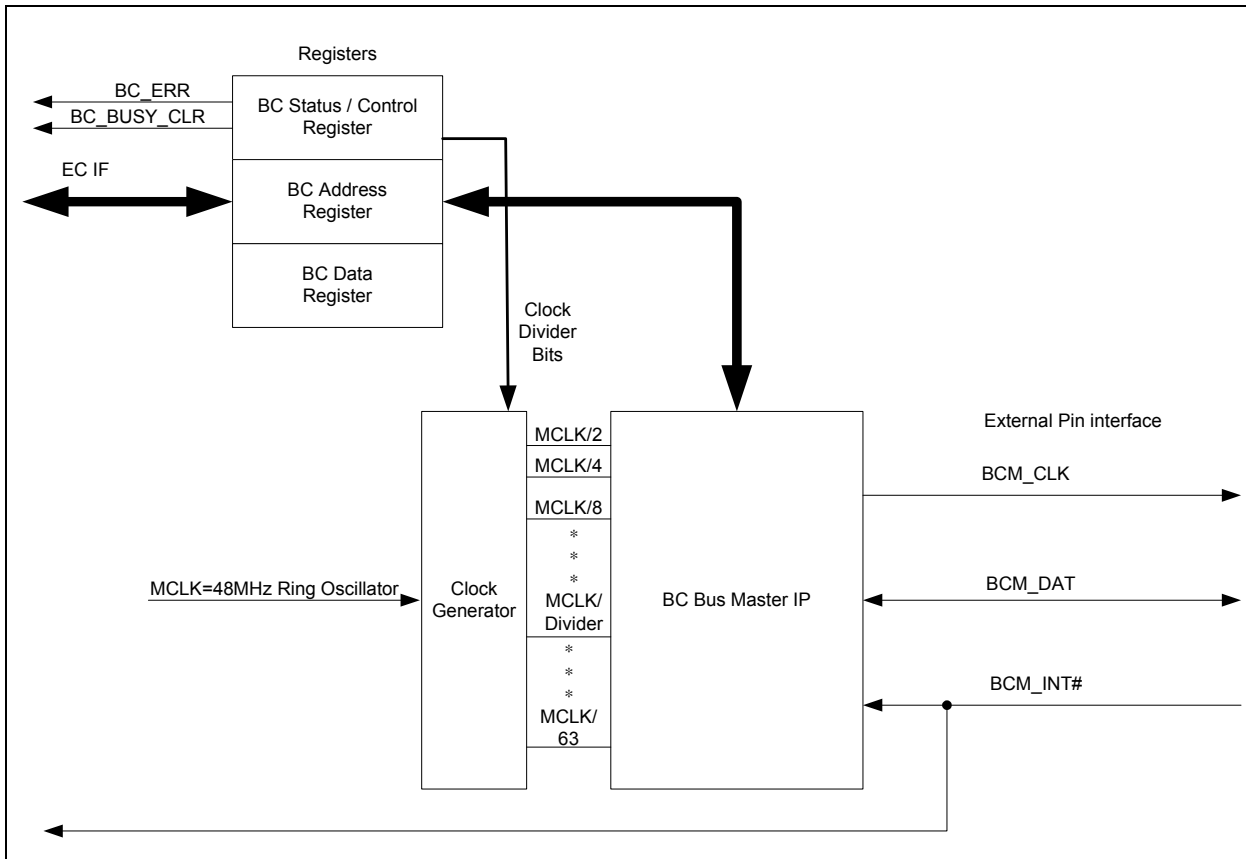
| Source                       | Description   |
|------------------------------|---|
| <a href="#">BCM_INT Busy</a> | Interrupt request to the Interrupt Aggregator, generated from the status event <a href="#">BUSY</a> defined in the <a href="#">BC-Link Status Register</a> .  |
| <a href="#">BCM_INT Err</a>  | Interrupt request to the Interrupt Aggregator, generated from the status event defined in the <a href="#">BC-Link Status Register</a> .   |
| <a href="#">BC_INT_N_WK</a>  | Wake-up request to the Interrupt Aggregator's wake-up interface for BC-Link Master port.<br><br>In order to enable BC-Link wakeup interrupts, the pin control registers for the <a href="#">BC_INT#</a> pin must be programmed to Input, Falling Edge Triggered, non-inverted polarity detection. |

## 31.9 Low Power Modes

The BC-Link Master Interface automatically enters a low power mode whenever it is not active (that is, whenever the **BUSY** bit in the **BC-Link Status Register** is '0'). When the interface is in a low-power mode it will not prevent the chip from entering a sleep state. When the interface is active it will inhibit the chip sleep state until the interface has reentered its low power mode.

## 31.10 Description

**FIGURE 31-2: BC-LINK MASTER BLOCK DIAGRAM**



### 31.10.1 BC-LINK MASTER READ OPERATION

The BC-Link Read protocol requires two reads of the **BC-Link Data Register**. The two reads drive a two state-state machine: the two states are Read#1 and Read#2. The Read#1 of the Data Register starts the read protocol on the BC-Link pins and sets the **BUSY** bit in the **BC-Link Status Register**. The contents of the data read during Read#1 by the EC is stale and is not to be used. After the **BUSY** bit in the BC-Link Status Register autonomously clears to '0', the Read#2 of the Data Register transfers the data read from the peripheral/BC-Link companion chip to the EC.

1. Software starts by checking the status of the **BUSY** bit in the Status Register. If the **BUSY** bit is '0', proceed. If **BUSY** is '1', firmware must wait until it is '0'.
2. Software writes the address of the register to be read into the **BC-Link Address Register**.
3. Software then reads the Data Register. This read returns random data. The read activates the BC-Link Master state machine to transmit the read request packet to the BC-Link companion. When the transfer initiates, the hardware sets the **BUSY** bit to a '1'.
4. The BC-Link Companion reads the selected register and transmits the read response packet to the BC-Link Master. The Companion will ignore the read request if there is a CRC error; this will cause the Master state machine to time-out and issue a **BC\_ERR** Interrupt.



5. The Master state machine loads the Data Register, issues a BUSY Bit Clear interrupt and clears the BUSY bit to '0'.
6. Software, after either receiving the Bit Clear interrupt, or polling the BUSY bit until it is '0', checks the **BC\_ERR** bit in the Status Register.
7. Software can now read the Data Register which contains the valid data if there was no BC Bus error.
8. If a Bus Error occurs, firmware must issue a soft reset by setting the **RESET** bit in the Status Register to '1'.
9. The read can re-tried once BUSY is cleared.

**Note:** Steps 3 through 7 should be completed as a contiguous sequence. If not the interface could be presenting incorrect data when software thinks it is accessing a valid register read.

## 31.10.2 BC-LINK MASTER WRITE OPERATION

1. Software starts by checking the status of the **BUSY** bit in the **BC-Link Status Register**. If the BUSY bit is '0', proceed. If BUSY is '1', firmware must wait until it is '0'.
2. Software writes the address of the register to be written into the **BC-Link Address Register**.
3. Software writes the data to be written into the addressed register in to the **BC-Link Data Register**.
4. The write to the Data Register starts the BC\_Link write operation. The Master state machine sets the BUSY bit.
5. The **BC-Link Master** Interface transmits the write request packet.
6. When the write request packet is received by the BC-Link companion, the CRC is checked and data is written to the addressed companion register.
7. The companion sends an ACK if the write is completed. A time-out will occur approximately 16 BC-Link clocks after the packet is sent by the Master state machine. If a time-out occurs, the state machine will set the **BC\_ERR** bit in the Status Register to '1' approximately 48 clocks later and then clear the BUSY bit.
8. The Master state machine issues the Bit Clear interrupt and clears the BUSY bit after receiving the ACK from the Companion
9. If a Bus Error occurs, firmware must issue a soft reset by setting the **RESET** bit in the Status Register to '1'.
10. The write can re-tried once BUSY is cleared.

## 31.11 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the BC-Link Master interface. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 31-7: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address (Note 31-1) |
|----------------|-----------------|------|-------------------------------|--------------------------|
| BC-LINK        | 0               | EC   | 32-bit internal address space | 4000_BC00h               |

**Note 31-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 31-8: EC-ONLY REGISTER SUMMARY**

| Register Name                                 | EC Offset |
|---|-----------|
| <a href="#">BC-Link Status Register</a>       | 00h       |
| <a href="#">BC-Link Address Register</a>      | 04h       |
| <a href="#">BC-Link Data Register</a>         | 08h       |
| <a href="#">BC-Link Clock Select Register</a> | 0Ch       |

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## 31.11.1 BC-LINK STATUS REGISTER

| Offset | 00h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:4   | Reserved  | R    | -       | -           |
| 7      | <p>RESET</p> <p>When this bit is '1' the BC_Link Master Interface will be placed in reset and be held in reset until this bit is cleared to '0'. Setting RESET to '1' causes the BUSY bit to be set to '1'. The BUSY remains set to '1' until the reset operation of the BC Interface is completed, which takes approximately 48 BC clocks.</p> <p>The de-assertion of the BUSY bit on reset will not generate an interrupt, even if the BC_BUSY_CLR_INT_EN bit is '1'. The BUSY bit must be polled in order to determine when the reset operation has completed.</p>           | R/W  | 1h      | VCC1_R ESET |
| 6      | <p>BC_ERR</p> <p>This bit indicates that a BC Bus Error has occurred. If an error occurs this bit is set by hardware when the BUSY bit is cleared. This bit is cleared when written with a '1'. An interrupt is generated if this bit is '1' and BC_ERR_INT_EN bit is '1'. Errors that cause this interrupt are:</p> <ul style="list-style-type: none"> <li>• Bad Data received by the BASE (CRC Error)</li> <li>• Time-out caused by the COMPANION not responding.</li> </ul> <p>All COMPANION errors cause the COMPANION to abort the operation and the BASE to time-out.</p> | R/WC | 0h      | VCC1_R ESET |
| 5      | <p>BC_ERR_INT_EN</p> <p>This bit is an enable for generating an interrupt when the BC_ERR bit is set by hardware. When this bit is '1', the interrupt signal is enabled. When this bit is '0', the interrupt is disabled.</p>   | R/W  | 0b      | VCC1_R ESET |
| 4      | <p>BC_BUSY_CLR_INT_EN</p> <p>This bit is an enable for generating an interrupt when the BUSY bit in this register is cleared by hardware. When this bit is set to '1', the interrupt signal is enabled. When the this bit is cleared to '0', the interrupt is disabled. When enabled, the interrupt occurs after a BC Bus read or write.</p>  | R/W  | 0h      | VCC1_R ESET |
| 3:1    | Reserved  | R    | -       | -           |
| 0      | <p>BUSY</p> <p>This bit is asserted to '1' when the BC interface is transferring data and on reset. Otherwise it is cleared to '0'. When this bit is cleared by hardware, an interrupt is generated if the BC_BUSY_CLR_INT_EN bit is set to '1'.</p>  | R    | 1h      | VCC1_R ESET |

## 31.11.2 BC-LINK ADDRESS REGISTER

| Offset | 04h   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:8   | Reserved  | R    | -       | -           |
| 7:0    | <p>ADDRESS</p> <p>Address in the Companion for the BC-Link transaction.</p> | R/W  | 0h      | VCC1_R ESET |

## 31.11.3 BC-LINK DATA REGISTER

| Offset | 08h  |      |         |             |
|--------|--|------|---------|-------------|
| Bits   | Description  | Type | Default | Reset Event |
| 31:8   | Reserved   | R    | -       | -           |
| 7:0    | <b>DATA</b><br>As described in <a href="#">Section 31.10.1, "BC-Link Master READ Operation"</a> and <a href="#">Section 31.10.2, "BC-Link Master WRITE Operation"</a> , this register hold data used in a BC-Link transaction. | R/W  | 0h      | VCC1_RESET  |

## 31.11.4 BC-LINK CLOCK SELECT REGISTER

| Offset | 0Ch   |      |         |             |
|--------|---|------|---------|-------------|
| Bits   | Description   | Type | Default | Reset Event |
| 31:8   | Reserved  | R    | -       | -           |
| 7:0    | <b>DIVIDER</b><br>The BC Clock is set to the Master Clock divided by this field, or 48MHz/ (Divider +1). The clock divider bits can only be changed when the BC Bus is in soft RESET (when either the Reset bit is set by software or when the BUSY bit is set by the interface).<br><br>Example settings for DIVIDER are shown in <a href="#">Table 31-9, "Example Frequency Settings"</a> . | R/W  | 4h      | VCC1_RESET  |

**TABLE 31-9: EXAMPLE FREQUENCY SETTINGS**

| Divider | Frequency |
|---------|-----------|
| 0       | 48MHz     |
| 1       | 24MHz     |
| 2       | 16MHz     |
| 3       | 12MHz     |
| 4       | 9.6MHz    |
| 15      | 2.18MHz   |
| 2A      | 1.12MHz   |

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## 32.0 TRACE FIFO DEBUG PORT (TFDP)

### 32.1 Introduction

The TFDP serially transmits Embedded Controller (EC)-originated diagnostic vectors to an external debug trace system.

### 32.2 References

No references have been cited for this chapter.

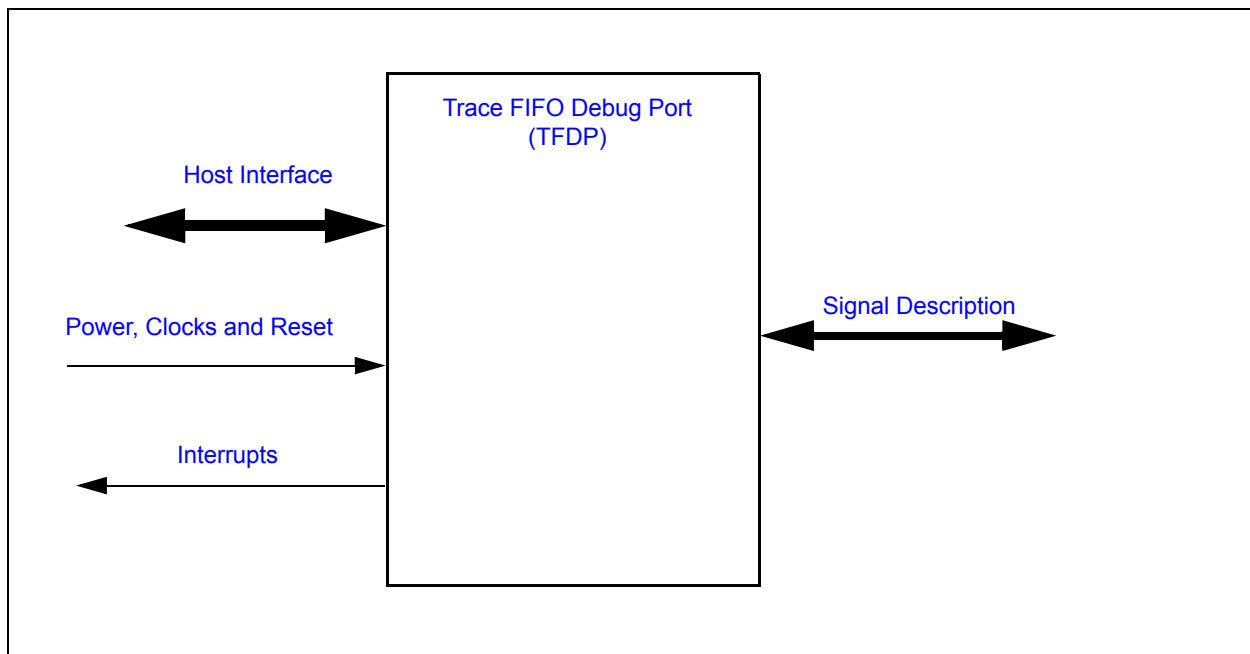
### 32.3 Terminology

There is no terminology defined for this chapter.

### 32.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 32-1: I/O DIAGRAM OF BLOCK**



### 32.5 Signal Description

The Signal Description Table lists the signals that are typically routed to the pin interface.

**TABLE 32-1: SIGNAL DESCRIPTION TABLE**

| Name      | Direction | Description   |
|-----------|-----------|---|
| TFDP Clk  | Output    | Derived from EC Bus Clock.                                |
| TFDP Data | Output    | Serialized data shifted out by <a href="#">TFDP Clk</a> . |

### 32.6 Host Interface

The registers defined for the [Trace FIFO Debug Port \(TFDP\)](#) are accessible by the various hosts as indicated in [Section 32.11, "EC-Only Registers"](#).

## 32.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

### 32.7.1 POWER DOMAINS

**TABLE 32-2: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | This power well sources all of the registers and logic in this block. |

### 32.7.2 CLOCK INPUTS

**TABLE 32-3: CLOCK INPUTS**

| Name                   | Description                                      |
|------------------------|--|
| 48 MHz Ring Oscillator | This clock input is used to derive the TFDP Clk. |

### 32.7.3 RESETS

**TABLE 32-4: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal resets all of the registers and logic in this block. |

## 32.8 Interrupts

There are no interrupts generated from this block.

## 32.9 Low Power Modes

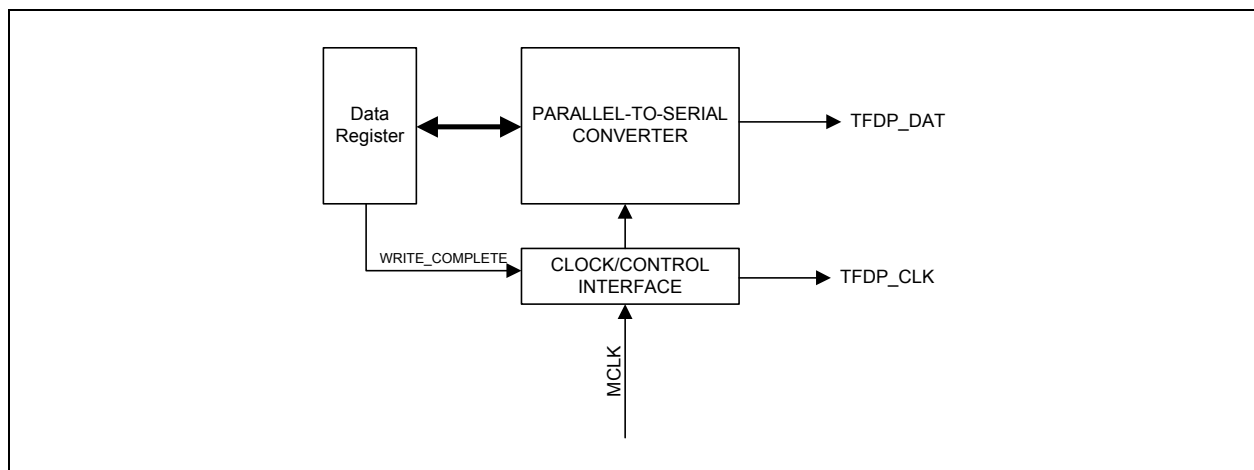
The Trace FIFO Debug Port (TFDP) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

## 32.10 Description

The TFDP is a unidirectional (from processor to external world) two-wire serial, byte-oriented debug interface for use by processor firmware to transmit diagnostic information.

The TFDP consists of the Debug Data Register, Debug Control Register, a Parallel-to-Serial Converter, a Clock/Control Interface and a two-pin external interface (TFDP Clk, TFDP Data).

**FIGURE 32-2: BLOCK DIAGRAM OF TFDP DEBUG PORT**



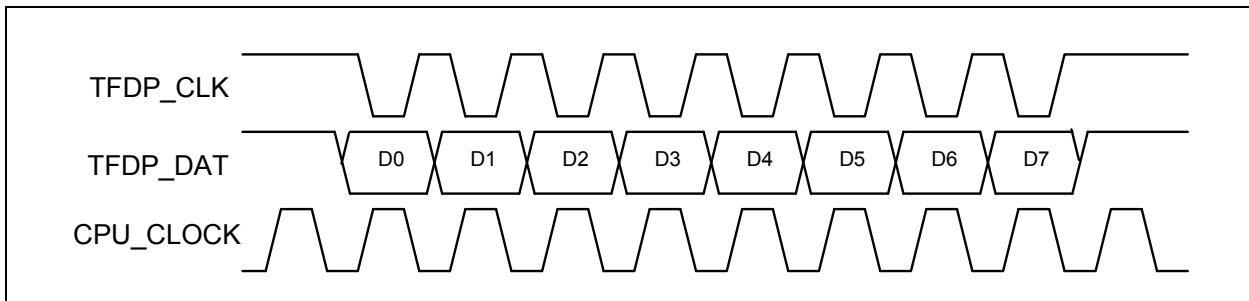
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The firmware executing on the embedded controller writes to the [Debug Data Register](#) to initiate a transfer cycle. At first, data from the [Debug Data Register](#) is shifted into the LSB. Afterwards, it is transmitted at the rate of one byte per transfer cycle.

Data is transferred in one direction only from the [Debug Data Register](#) to the external interface. The data is shifted out at the clock edge. The clock edge is selected by the [EDGE\\_SEL](#) bit in the [Debug Control Register](#). After being shifted out, valid data is provided at the opposite edge of the TFDP\_CLK. For example, when the [EDGE\\_SEL](#) bit is '0' (default), valid data is maintained at the falling edge of TFDP\_CLK. The Setup Time (to the falling edge of TFDP\_CLK) is 10 ns, minimum. The Hold Time is 1 ns, minimum.

When the Serial Debug Port is inactive, the TFDP\_CLK and TFDP\_DAT outputs are '1.' The EC Bus Clock clock input is the transfer clock.

**FIGURE 32-3: DATA TRANSFER**



## 32.11 EC-Only Registers

The registers listed in the EC-Only Register Summary table are for a single instance of the [Trace FIFO Debug Port \(TFDP\)](#). The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in the EC-Only Register Base Address Table.

**TABLE 32-5: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance  | Instance Number | Host | Address Space                 | Base Address |
|-----------------|-----------------|------|-------------------------------|--------------|
| TFDP Debug Port | 0               | EC   | 32-bit internal address space | 4000_8C00h   |

The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 32-6: EC-ONLY REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)               |
|--------|--|
| 00h    | <a href="#">Debug Data Register</a>    |
| 04h    | <a href="#">Debug Control Register</a> |

### 32.11.1 DEBUG DATA REGISTER

The Debug Data Register is Read/Write. It always returns the last data written by the TFDP or the power-on default '00h'.

| Offset | 00h   |      |         |                             |
|--------|---|------|---------|-----------------------------|
| Bits   | Description   | Type | Default | Reset Event                 |
| 7:0    | DATA<br>Debug data to be shifted out on the TFDP Debug port. While data is being shifted out, the Host Interface will 'hold-off' additional writes to the data register until the transfer is complete. | R/W  | 00h     | <a href="#">VCC1_R ESET</a> |

## 32.11.2 DEBUG CONTROL REGISTER

| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7      | Reserved  | R    | -       | -              |
| 6:4    | IP_DELAY<br>Inter-packet Delay. The delay is in terms of TFDP Debug output clocks. A value of 0 provides a 1 clock inter-packet period, while a value of 7 provides 8 clocks between packets: | R/W  | 000b    | VCC1_R<br>ESET |
| 3:2    | DIVSEL<br>Clock Divider Select. The TFDP Debug output clock is determined by this field, according to <a href="#">Table 32-7, "TFDP Debug Clocking"</a> :                                     | R/W  | 00b     | VCC1_R<br>ESET |
| 1      | EDGE_SEL<br><br>1= Data is shifted out on the falling edge of the debug clock<br>0= Data is shifted out on the rising edge of the debug clock (Default)                                       | R/W  | 0b      | VCC1_R<br>ESET |
| 0      | EN<br>Enable.<br><br>1=Clock enabled<br>0=Clock is disabled (Default)   | R/W  | 0b      | VCC1_R<br>ESET |

**TABLE 32-7: TFDP DEBUG CLOCKING**

| divsel | TFDP Debug Clock |
|--------|------------------|
| 00     | 24 MHz           |
| 01     | 12 MHz           |
| 10     | 6 MHz            |
| 11     | Reserved         |

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## 33.0 ANALOG TO DIGITAL CONVERTER

### 33.1 Introduction

This block is designed to convert external analog voltage readings into digital values. It consists of a single successive-approximation Analog-Digital Converter that can be shared among five inputs.

**Note:** Transitions on ADC GPIOs are not permitted when [Analog to Digital Converter](#) readings are being taken.

### 33.2 References

No references have been cited for this chapter

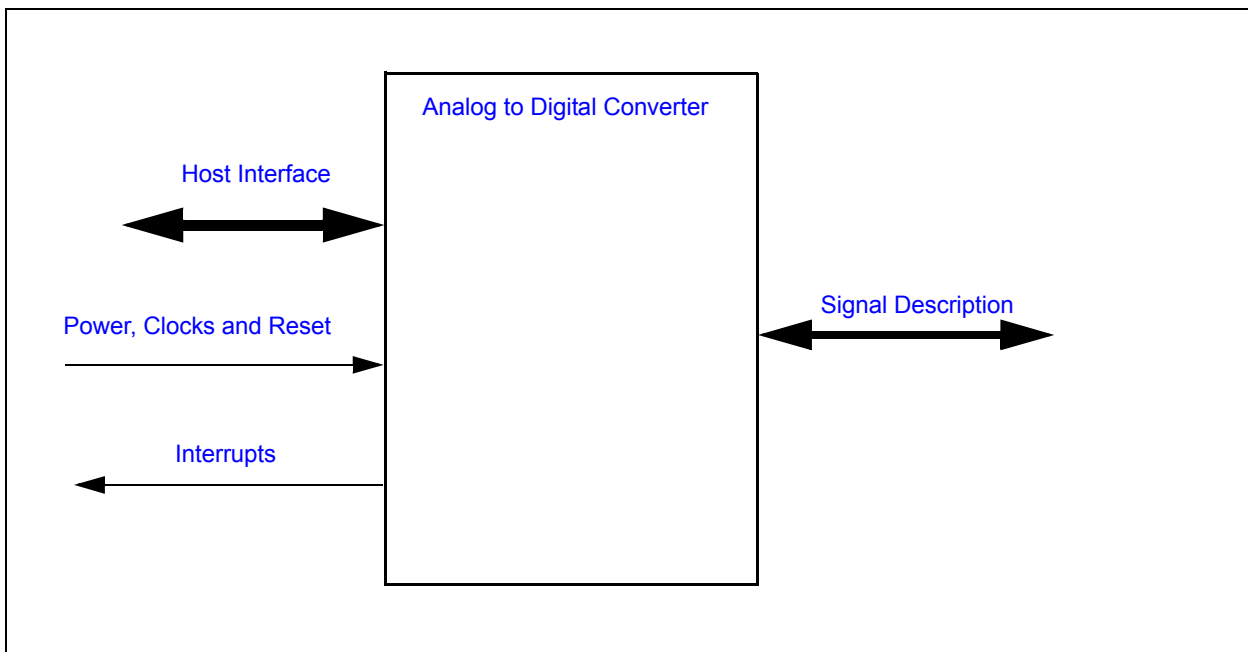
### 33.3 Terminology

No terminology is defined for this chapter

### 33.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 33-1: I/O DIAGRAM OF BLOCK**



### 33.5 Signal Description

The Signal Description Table lists the signals that are typically routed to the pin interface.

**TABLE 33-1: SIGNAL DESCRIPTION TABLE**

| Name    | Direction | Description                            |
|---------|-----------|--|
| ADC 4:0 | Input     | ADC Analog Voltage Input 4:0 from pins |

**Note:** VREF\_ADC, the Analog Voltage Reference of 3.0V, is internally generated in the IP block.



### 33.6 Host Interface

The registers defined for the Trace FIFO Debug Port are accessible by the various hosts as indicated in [Section 33.11, "EC-Only Registers"](#).

### 33.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

#### 33.7.1 POWER DOMAINS

**TABLE 33-2: POWER SOURCES**

| Name | Description  |
|------|--|
| VCC1 | This power well sources the registers in this block.                 |
| AVCC | This power well sources the logic in this block, except where noted. |
| AVSS | This is the ground signal for the block.                             |

#### 33.7.2 CLOCK INPUTS

**TABLE 33-3: CLOCK INPUTS**

| Name   | Description  |
|--------|--|
| 1.2MHz | This derived clock signal drives selected logic (1.2 MHz clock with a 50% duty cycle). |

#### 33.7.3 RESETS

**TABLE 33-4: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal resets all of the registers and logic in this block. |

### 33.8 Interrupts

**TABLE 33-5: EC INTERRUPTS**

| Source         | Description  |
|----------------|--|
| ADC_Single_Int | Interrupt signal from ADC controller to EC for Single-Sample ADC conversion. |
| ADC_Repeat_Int | Interrupt signal from ADC controller to EC for Repeated ADC conversion.      |

### 33.9 Low Power Modes

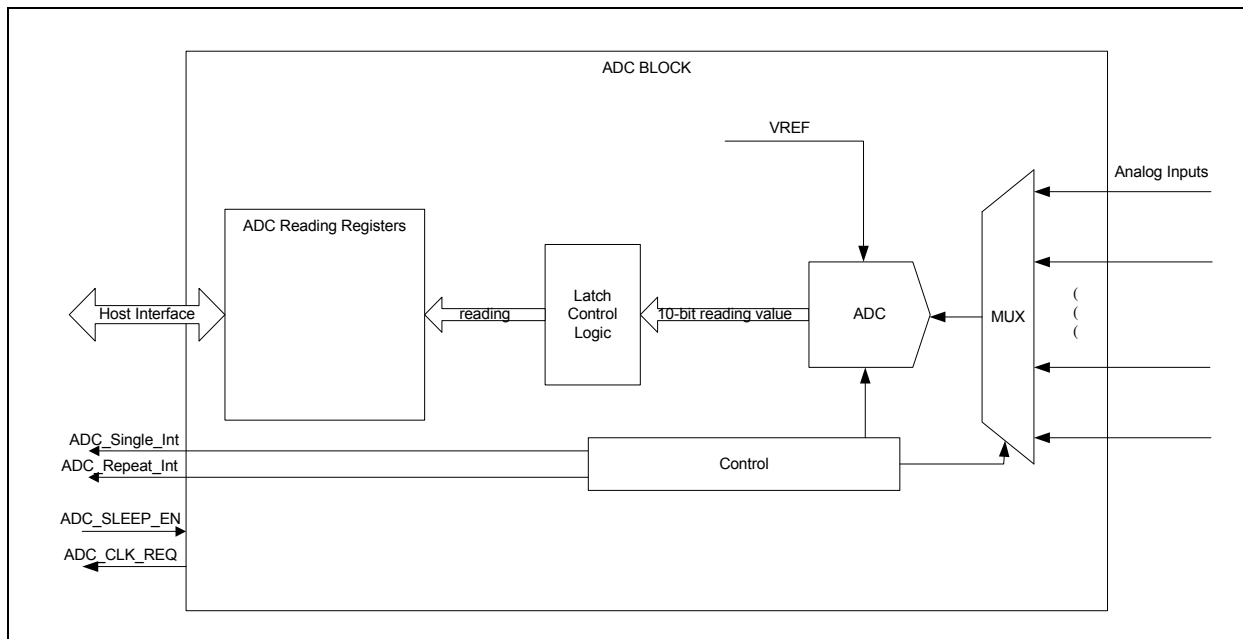
The ADC may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry.

The ADC is designed to conserve power when it is either sleeping or disabled. It is disabled via the [Activate](#) Bit and sleeps when the ADC\_SLEEP\_EN signal is asserted. The sleeping state only controls clocking in the ADC and does not power down the analog circuitry. For lowest power consumption, the ADC [Activate](#) bit must be set to '0.'

**Note:** The ADC VREF must be powered down in order to get the lowest deep sleep current. The ADC VREF Power down bit, [ADC\\_VREF\\_PD\\_REF](#) is in the [EC Subsystem Registers ADC VREF PD on page 381](#).

## 33.10 Description

**FIGURE 33-2: ADC BLOCK DIAGRAM**



The MEC1322 features a five channel successive approximation Analog to Digital Converter. The ADC architecture features excellent linearity and converts analog signals to 10 bit words. Conversion takes less than 12 microseconds per 10-bit word. The five channels are implemented with a single high speed ADC fed by a five input analog multiplexer. The multiplexer cycles through the five voltage channels, starting with the lowest-numbered channel and proceeding to the highest-number channel, selecting only those channels that are programmed to be active.

The input range on the voltage channels spans from 0V to the internal voltage reference. With an internal voltage reference of 3.0V, this provides resolutions of 2.9mV. The range can easily be extended with the aid of resistor dividers. The accuracy of any voltage reading depends on the accuracy and stability of the voltage reference input.

**Note:** The ADC pins are 3.3V tolerant.

The ADC conversion cycle starts either when the [Start\\_Single](#) bit in the ADC to set to 1 or when the ADC Repeat Timer counts down to 0. When the [Start\\_Single](#) is set to 1 the conversion cycle converts channels enabled by configuration bits in the [ADC Single Register](#). When the Repeat Timer counts down to 0 the conversion cycle converts channels enabled by configuration bits in the [ADC Repeat Register](#). When both the [Start\\_Single](#) bit and the Repeat Timer request conversions the [Start\\_Single](#) conversion is completed first.

Conversions always start with the lowest-numbered enabled channel and proceed to the highest-numbered enabled channel.

**Note:** If software repeatedly sets [Start\\_Single](#) to 1 at a rate faster than the Repeat Timer count down interval, the conversion cycle defined by the [ADC Repeat Register](#) will not be executed.

### 33.10.1 REPEAT MODE

- Repeat Mode will start a conversion cycle of all ADC channels enabled by bits [Rpt\\_En\[4:0\]](#) in the [ADC Repeat Register](#). The conversion cycle will begin after a delay determined by [Start\\_Delay\[15:0\]](#) in the [ADC Delay Register](#).

- After all channels enabled by [Rpt\\_En\[4:0\]](#) are complete, [Repeat\\_Done\\_Status](#) will be set to 1. This status bit is cleared when the next repeating conversion cycle begins to give a reflection of when the conversion is in progress.
- As long as [Start\\_Repeat](#) is 1 the ADC will repeatedly begin conversion cycles with a period defined by [Repeat\\_Delay\[15:0\]](#).
- If the delay period expires and a conversion cycle is already in progress because [Start\\_Single](#) was written with a 1, the cycle in progress will complete, followed immediately by a conversion cycle using [Rpt\\_En\[4:0\]](#) to control the channel conversions.

### 33.10.2 SINGLE MODE

- The Single Mode conversion cycle will begin without a delay. After all channels enabled by [Single\\_En\[4:0\]](#) are complete, [Single\\_Done\\_Status](#) will be set to 1. When the next conversion cycle begins the bit is cleared.
- If [Start\\_Single](#) is written with a 1 while a conversion cycle is in progress because [Start\\_Repeat](#) is set, the conversion cycle will complete, followed immediately by a conversion cycle using [Single\\_En\[4:0\]](#) to control the channel conversions.

## 33.11 EC-Only Registers

The registers listed in the [Table 33-7, "Analog to Digital Converter Register Summary"](#) are for a single instance of the [Analog to Digital Converter](#) block. The addresses of each register listed in this table are defined as a relative offset to the host "Base Address" defined in [Table 33-6, "Analog to Digital Converter Base Address Table"](#).

**TABLE 33-6: ANALOG TO DIGITAL CONVERTER BASE ADDRESS TABLE**

| Instance Name | Instance Number | Host | Address Space                 | Base Address (Note 33-1) |
|---------------|-----------------|------|-------------------------------|--------------------------|
| ADC           | 0               | EC   | 32-bit internal address space | 4000_7C00h               |

**Note 33-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 33-7: ANALOG TO DIGITAL CONVERTER REGISTER SUMMARY**

| Offset | Register Name (Mnemonic)                       |
|--------|--|
| 00h    | <a href="#">ADC Control Register</a>           |
| 04h    | <a href="#">ADC Delay Register</a>             |
| 08h    | <a href="#">ADC Status Register</a>            |
| 0Ch    | <a href="#">ADC Single Register</a>            |
| 10h    | <a href="#">ADC Repeat Register</a>            |
| 14h    | <a href="#">ADC Channel 0 Reading Register</a> |
| 18h    | <a href="#">ADC Channel 1 Reading Register</a> |
| 1Ch    | <a href="#">ADC Channel 2 Reading Register</a> |
| 20h    | <a href="#">ADC Channel 3 Reading Register</a> |
| 24h    | <a href="#">ADC Channel 4 Reading Register</a> |

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## 33.11.1 ADC CONTROL REGISTER

The [ADC Control Register](#) is used to control the behavior of the Analog to Digital Converter.

| Offset | 00h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:8   | RESERVED   | RES  |         |                |
| 7      | <p><b>Single_Done_Status</b></p> <p>This bit is cleared when it is written with a 1. Writing a 0 to this bit has no effect.<br/>This bit can be used to generate an EC interrupt.</p> <p>0: ADC single-sample conversion is not complete. This bit is cleared whenever an ADC conversion cycle begins for a single conversion cycle.<br/>1: ADC single-sample conversion is completed. This bit is set to 1 when all enabled channels in the single conversion cycle.</p>              | R/WC | 0h      | VCC1_R<br>ESET |
| 6      | <p><b>Repeat_Done_Status</b></p> <p>This bit is cleared when it is written with a 1. Writing a 0 to this bit has no effect.<br/>This bit can be used to generate an EC interrupt.</p> <p>0: ADC repeat-sample conversion is not complete. This bit is cleared whenever an ADC conversion cycle begins for a repeating conversion cycle.<br/>1: ADC repeat-sample conversion is completed. This bit is set to 1 when all enabled channels in a repeating conversion cycle complete.</p> | R/WC | 0h      | VCC1_R<br>ESET |
| 5      | RESERVED   | RES  |         |                |
| 4      | <p><b>Soft Reset</b></p> <p>1: writing one causes a reset of the ADC block hardware (not the registers)<br/>0: writing zero takes the ADC block out of reset</p>   | R/W  | 0h      | VCC1_R<br>ESET |
| 3      | <p><b>Power_Saver_Dis</b></p> <p>0: Power saving feature is enabled. The <a href="#">Analog to Digital Converter</a> controller powers down the ADC between conversion sequences.<br/>1: Power saving feature is disabled.</p>   | R/W  | 0h      | VCC1_R<br>ESET |
| 2      | <p><b>Start_Repeat</b></p> <p>0: The ADC Repeat Mode is disabled. Note: This setting will not terminate any conversion cycle in process, but will inhibit any further periodic conversions.<br/>1: The ADC Repeat Mode is enabled. This setting will start a conversion cycle of all ADC channels enabled by bits <a href="#">Rpt_En[4:0]</a> in the <a href="#">ADC Repeat Register</a>.</p>  | R/W  | 0h      | VCC1_R<br>ESET |
| 1      | <p><b>Start_Single</b></p> <p>0: The ADC Single Mode is disabled.<br/>1: The ADC Single Mode is enabled. This setting starts a single conversion cycle of all ADC channels enabled by bits <a href="#">Single_En[4:0]</a> in the <a href="#">ADC Single Register</a>.</p> <p><b>Note:</b> This bit is self-clearing</p>  | R/W  | 0h      | VCC1_R<br>ESET |

| Offset | 00h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 0      | <p><b>Activate</b></p> <p>0: The ADC is disabled and placed in its lowest power state. Note: Any conversion cycle in process will complete before the block is shut down, so that the reading registers will contain valid data but no new conversion cycles will begin.</p> <p>1: ADC block is enabled for operation. <a href="#">Start_Single</a> or <a href="#">Start_Repeat</a> can begin data conversions by the ADC. Note: A reset pulse is sent to the ADC core when this bit changes from 0 to 1.</p> | R/W  | 0h      | VCC1_R<br>ESET |

### 33.11.2 ADC DELAY REGISTER

The ADC Delay register determines the delay from setting [Start\\_Repeat](#) in the [ADC Control Register](#) and the start of a conversion cycle. This register also controls the interval between conversion cycles in repeat mode.

| Offset | 04h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:16  | <p><b>Repeat_Delay[15:0]</b></p> <p>This field determines the interval between conversion cycles when <a href="#">Start_Repeat</a> is 1. The delay is in units of 40µs. A value of 0 means no delay between conversion cycles, and a value of 0xFFFF means a delay of 2.6 seconds.</p> <p>This field has no effect when <a href="#">Start_Single</a> is written with a 1.</p>   | R/W  | 0000h   | VCC1_R<br>ESET |
| 15:0   | <p><b>Start_Delay[15:0]</b></p> <p>This field determines the starting delay before a conversion cycle is begun when <a href="#">Start_Repeat</a> is written with a 1. The delay is in units of 40µs. A value of 0 means no delay before the start of a conversion cycle, and a value of 0xFFFF means a delay of 2.6 seconds.</p> <p>This field has no effect when <a href="#">Start_Single</a> is written with a 1.</p> | R/W  | 0000h   | VCC1_R<br>ESET |

### 33.11.3 ADC STATUS REGISTER

The [ADC Status Register](#) indicates whether the ADC has completed a conversion cycle.

| Offset | 08h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:5   | RESERVED  | RES  |         |                |
| 4:0    | <p><b>ADC_Ch_Status[4:0]</b></p> <p><b>All bits are cleared by being written with a '1'.</b></p> <p>0: conversion of the corresponding ADC channel is not complete</p> <p>1: conversion of the corresponding ADC channel is complete</p> <p>Note: for enabled single cycles, the <a href="#">Single_Done_Status</a> bit in the <a href="#">ADC Control Register</a> is also set after all enabled channel conversion are done; for enabled repeat cycles, the <a href="#">Repeat_Done_Status</a> in the <a href="#">ADC Control Register</a> is also set after all enabled channel conversion are done.</p> | R/WC | 00h     | VCC1_R<br>ESET |

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## 33.11.4 ADC SINGLE REGISTER

The [ADC Single Register](#) is used to control which ADC channel is captured during a Single-Sample conversion cycle initiated by the [Start\\_Single](#) bit in the [ADC Control Register](#).

**APPLICATION NOTE:** Do not change the bits in this register in the middle of a conversion cycle to insure proper operation.

| Offset | 0Ch   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:5   | RESERVED  | RES  |         |                |
| 4:0    | <b>Single_En[4:0]</b><br>0: single cycle conversions for this channel are disabled<br>1: single cycle conversions for this channel are enabled<br>Each bit in this field enables the corresponding ADC channel when a single cycle of conversions is started when the <a href="#">Start_Single</a> bit in the <a href="#">ADC Control Register</a> is written with a 1. | R/W  | 00h     | VCC1_R<br>ESET |

## 33.11.5 ADC REPEAT REGISTER

The [ADC Repeat Register](#) is used to control which ADC channels are captured during a repeat conversion cycle initiated by the [Start\\_Repeat](#) bit in the [ADC Control Register](#).

| Offset | 10h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:5   | RESERVED  | RES  |         |                |
| 4:0    | <b>Rpt_En[4:0]</b><br>0: repeat conversions for this channel are disabled<br>1: repeat conversions for this channel are enabled<br>Each bit in this field enables the corresponding ADC channel for each pass of the Repeated ADC Conversion that is controlled by bit <a href="#">Start_Repeat</a> in the <a href="#">ADC Control Register</a> . | R/W  | 00h     | VCC1_R<br>ESET |

## 33.11.6 ADC CHANNEL READING REGISTERS

All 5 ADC channels return their results into a 32-bit reading register. In each case the low 10 bits of the reading register return the result of the Analog to Digital conversion and the upper 22 bits return 0. [Table 33-7, "Analog to Digital Converter Register Summary," on page 371](#) shows the addresses of all the reading registers.

**Note:** The [ADC Channel Reading Registers](#) access require single 16, or 32 bit reads; i.e., two 8 bit reads cannot ensure data coherency.

| Offset | See <a href="#">Table 33-7, "Analog to Digital Converter Register Summary"</a>                 |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:10  | RESERVED   | RES  |         |                |
| 9:0    | <b>ADCx_[9:0]</b><br>This read-only field reports the 10-bit output reading of the Input ADCx. | R/W  | 000h    | VCC1_R<br>ESET |

## 34.0 VBAT-POWERED RAM

### 34.1 Overview

The VBAT Powered RAM provides a 64 Byte Random Accessed Memory that is operational while the main power rail is operational, and will retain its values powered by battery power while the main rail is unpowered.

### 34.2 References

No references have been cited for this feature.

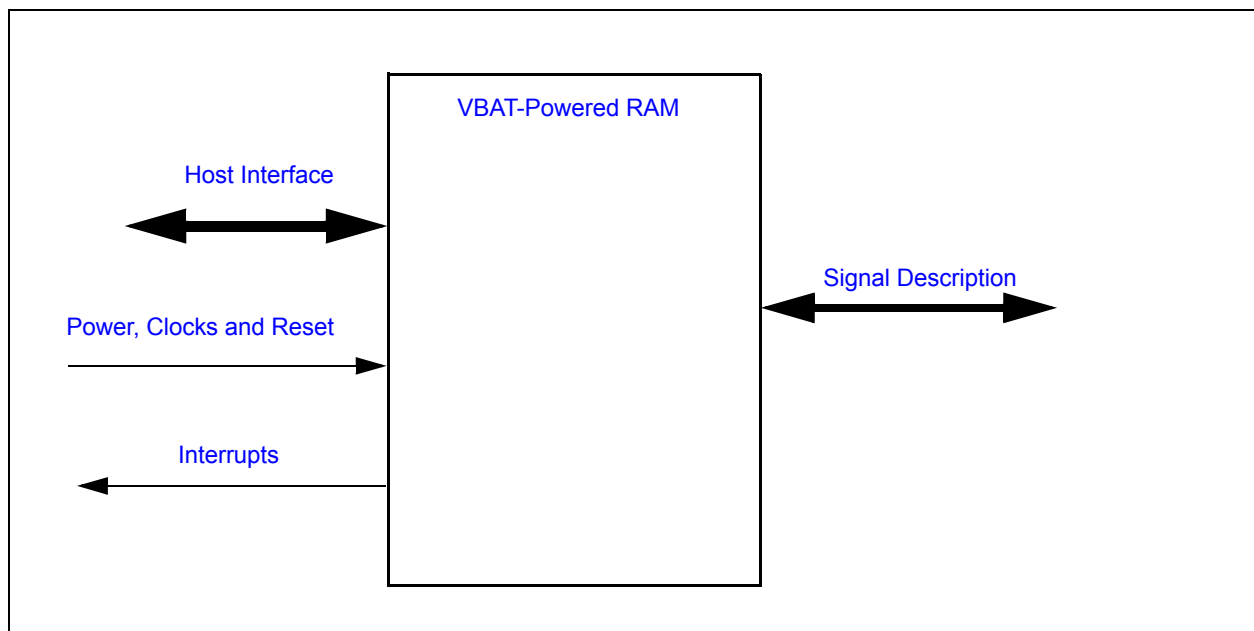
### 34.3 Terminology

There is no terminology defined for this section.

### 34.4 Interface

This block is designed to be accessed externally via the pin interface and internally via a registered host interface.

**FIGURE 34-1: I/O DIAGRAM OF BLOCK**



### 34.5 Signal Description

There are no external signals for this block.

### 34.6 Host Interface

The registers defined for the Keyboard Scan Interface are accessible by the various hosts as indicated in [Section 34.11, "Registers"](#).

### 34.7 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

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## 34.7.1 POWER DOMAINS

**TABLE 34-1: POWER SOURCES**

| Name | Description  |
|------|--|
| VCC1 | The main power well used when the VBAT RAM is accessed by the EC.                  |
| VBAT | The power well used to retain memory state while the main power rail is unpowered. |

## 34.7.2 CLOCK INPUTS

No special clocks are required for this block.

## 34.7.3 RESETS

**TABLE 34-2: RESET SIGNALS**

| Name     | Description  |
|----------|--|
| VBAT_POR | This signal resets all the registers and logic in this block to their default state. |

## 34.8 Interrupts

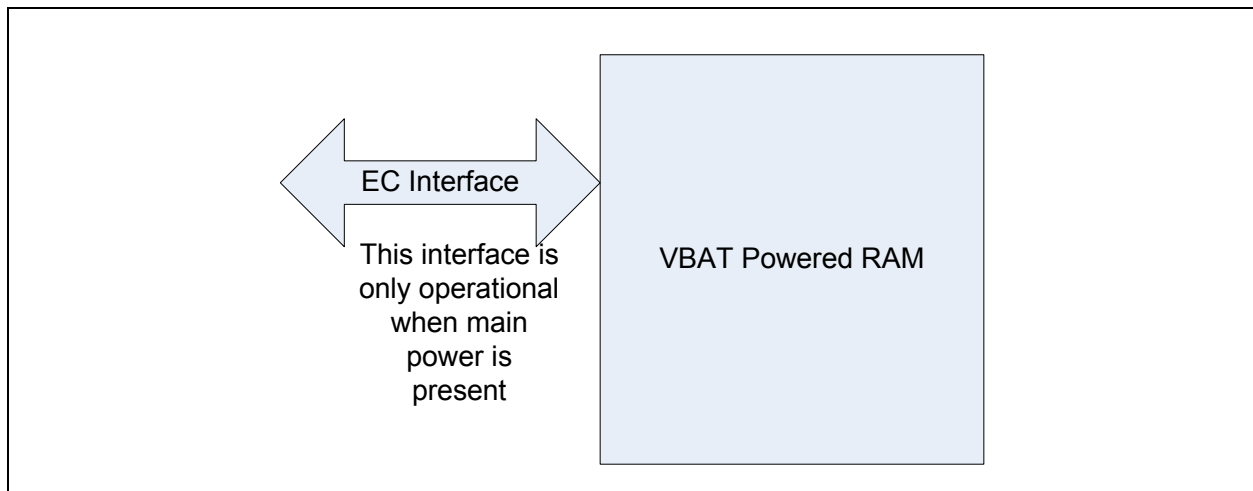
This block does not generate any interrupts.

## 34.9 Low Power Modes

The VBAT-Powered RAM automatically enters a low power mode whenever it is not being accessed by the EC. There is no chip-level Sleep Enable input.

## 34.10 Description

**FIGURE 34-2: VBAT RAM BLOCK DIAGRAM**



The VBAT Powered RAM provides a 64 Byte Random Accessed Memory that is operational while VCC1 is powered, and will retain its values powered by VBAT while VCC1 is unpowered. The RAM is organized as a 16 words x 32-bit wide for a total of 64 bytes.



## 34.11 Registers

### 34.11.1 REGISTERS SUMMARY

The registers listed in the [Table 34-3, "EC-Only Register Base Address Table"](#) are for a single instance of the Keyboard Scan Interface block. Each 32-bit RAM location is an offset from the EC base address.

**TABLE 34-3: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance   | Instance Number | Host | Address Space                 | Base Address (Note 34-1) |
|------------------|-----------------|------|-------------------------------|--------------------------|
| VBAT-Powered RAM | 0               | EC   | 32-bit internal address space | 4000_A800h               |

**Note 34-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

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## 35.0 EC SUBSYSTEM REGISTERS

### 35.1 Introduction

This chapter defines a bank of registers associated with the EC Subsystem.

### 35.2 References

None

### 35.3 Interface

This block is designed to be accessed internally by the EC via the register interface.

### 35.4 Power, Clocks and Reset

This section defines the Power, Clock, and Reset parameters of the block.

#### 35.4.1 POWER DOMAINS

**TABLE 35-1: POWER SOURCES**

| Name | Description   |
|------|---|
| VCC1 | The <a href="#">EC Subsystem Registers</a> are all implemented on this single power domain. |

#### 35.4.2 CLOCK INPUTS

This block does not require any special clock inputs. All register accesses are synchronized to the host clock.

#### 35.4.3 RESETS

**TABLE 35-2: RESET SIGNALS**

| Name       | Description  |
|------------|--|
| VCC1_RESET | This reset signal, which is an input to this block, resets all the logic and registers to their initial default state. |

### 35.5 Interrupts

This block does not generate any interrupt events.

### 35.6 Low Power Modes

The [EC Subsystem Registers](#) may be put into a low power state by the chip's Power, Clocks, and Reset (PCR) circuitry. When this block is commanded to sleep it will still allow read/write access to the registers.

### 35.7 Description

The EC Subsystem Registers block is a block implemented for aggregating miscellaneous registers required by the Embedded Controller (EC) Subsystem that are not unique to a block implemented in the EC subsystem.

### 35.8 EC-Only Registers

**TABLE 35-3: EC-ONLY REGISTER BASE ADDRESS TABLE**

| Block Instance | Instance Number | Host | Address Space                 | Base Address ( <a href="#">Note 35-1</a> ) |
|----------------|-----------------|------|-------------------------------|--|
| EC_REG_BANK    | 0               | EC   | 32-bit internal address space | 4000_FC00h                                 |

**Note 35-1** The Base Address indicates where the first register can be accessed in a particular address space for a block instance.

**TABLE 35-4: RUNTIME REGISTER SUMMARY**

| Offset | Register Name     |
|--------|-------------------|
| 04h    | MCHP Reserved     |
| 08h    | MCHP Reserved     |
| 0Ch    | MCHP Reserved     |
| 10h    | MCHP Reserved     |
| 14h    | AHB Error Control |
| 18h    | Interrupt Control |
| 1Ch    | ETM TRACE Enable  |
| 20h    | JTAG Enable       |
| 24h    | MCHP Reserved     |
| 28h    | WDT Event Count   |
| 2Ch    | MCHP Reserved     |
| 30h    | MCHP Reserved     |
| 34h    | MCHP Reserved     |
| 38h    | ADC VREF PD       |
| 3Ch    | MCHP Reserved     |
| 40h    | MCHP Reserved     |

### 35.8.1 AHB ERROR CONTROL

| Offset | 14h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 7:1    | Reserved  | R    | -       | -              |
| 0      | <b>AHB_ERROR_DISABLE</b><br>0: EC memory exceptions are enabled.<br>1: EC memory exceptions are disabled. | RW   | 0h      | VCC1_R<br>ESET |

### 35.8.2 INTERRUPT CONTROL

| Offset | 18h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:1   | Reserved  | R    | -       | -              |
| 0      | <b>NVIC_EN</b><br><br>This bit enables Alternate NVIC IRQ's Vectors. The Alternate NVIC Vectors provides each interrupt event with a dedicated (direct) NVIC vector.<br>0 = Alternate NVIC vectors disabled<br>1 = Alternate NVIC vectors enabled | R/W  | 1b      | VCC1_R<br>ESET |

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## 35.8.3 ETM TRACE ENABLE

| Offset | 1Ch   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:1   | Reserved  | R    | -       | -              |
| 0      | TRACE_EN<br><br>This bit enables the ARM TRACE debug port (ETM/ITM). The <a href="#">Trace Debug Interface</a> pins are forced to the TRACE functions.<br>0 = ARM TRACE port disabled<br>1 = ARM TRACE port enabled | R/W  | 0b      | VCC1_R<br>ESET |

## 35.8.4 JTAG ENABLE

| Offset | 20h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:1   | Reserved  | R    | -       | -              |
| 0      | JTAG_EN<br><br>This bit enables the JTAG debug port.<br>0 = JTAG port disabled. JTAG cannot be enabled (i.e., the TRST# pin is ignored and the JTAG signals remain in their non-JTAG state).<br>1 = JTAG port enabled. A high on TRST# enables JTAG | R/W  | 0b      | VCC1_R<br>ESET |

## 35.8.5 WDT EVENT COUNT

| Offset | 28h   |      |         |                |
|--------|---|------|---------|----------------|
| Bits   | Description   | Type | Default | Reset Event    |
| 31:4   | Reserved  | R    | -       | -              |
| 3:0    | WDT_COUNT<br><br>These EC R/W bits are cleared to 0 on VCC1 POR, but <u>not</u> on a WDT.<br><br><b>Note:</b> This field is written by Boot ROM firmware to indicate the number of times a WDT fired before loading a good EC code image. | R/W  | 0b      | VCC1_R<br>ESET |

## 35.8.6 ADC VREF PD

| Offset | 38h  |      |         |                |
|--------|--|------|---------|----------------|
| Bits   | Description  | Type | Default | Reset Event    |
| 31:1   | Reserved   | R    | -       | -              |
| 0      | <b>ADC_VREF_PD_REF</b><br>ADC VREF Power down<br>0=on<br>1=off | R/W  | 0b      | VCC1_R<br>ESET |

## 36.0 TEST MECHANISMS

### 36.1 Introduction

This section defines the [XNOR Chain](#) for board test.

Other test mechanisms for the ARM are described in [Chapter 7.0, "ARM M4F Based Embedded Controller"](#).

### 36.2 XNOR Chain

#### 36.2.1 OVERVIEW

The XNOR Chain test mode provides a means to confirm that all MEC1322 pins are in contact with the motherboard during assembly and test operations.

An example of an XNOR Chain test structure is illustrated below in [36.2.3 Figure 36-1](#). When the XNOR Chain test mode is enabled all pins, except for the [Excluded Pins](#) shown in [Section 36.2.2](#), are disconnected from their internal functions and forced as inputs to the XNOR Chain. This allows a single input pin to toggle the XNOR Chain output if all other input pins are held high or low. The XNOR Chain output is the [Test Output Pin, pin 17: KSO04/GPIO103/TFDP\\_DATA/XNOR](#).

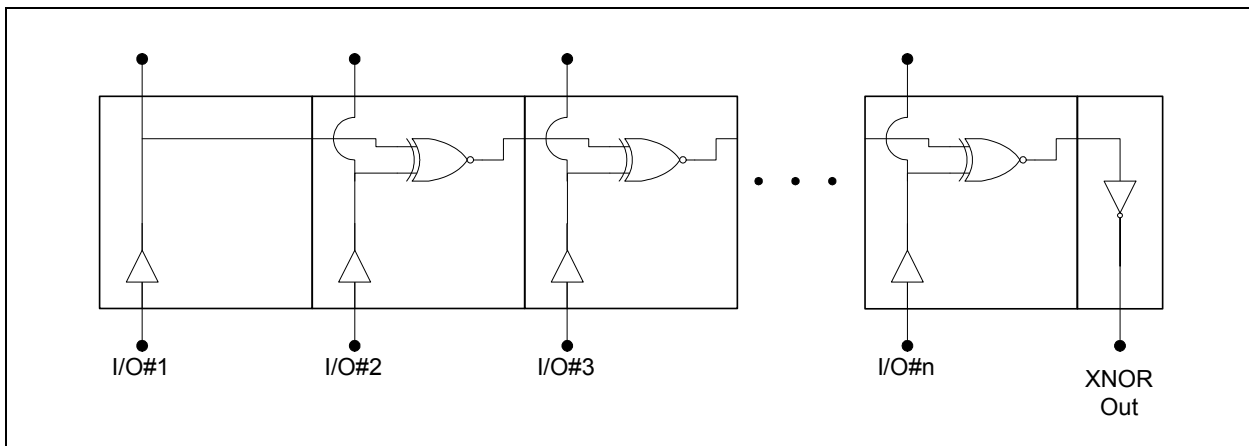
The tests that are performed when the XNOR Chain test mode is enabled require the board-level test hardware to control the device pins and observe the results at the XNOR Chain output pin; e.g., as described in [Section 36.2.3, "Test Procedure," on page 383](#).

#### 36.2.2 EXCLUDED PINS

All pins in the pinout are included in the XNOR chain, except the following:

- Power Pins (VCC1, AVCC, VBAT, VREF\_PEC1)
- Ground Pins (VSS, AVSS, VSS\_VBAT)
- CAP
- Crystal pins (XTAL1, XTAL2)
- Test Output Pin, pin 17: KSO04/GPIO103/TFDP\_DATA/XNOR
- Test Port (JTAG\_RST#, KSO02/GPIO101/JTAG\_TDI, KSO03/GPIO102/JTAG\_TDO, KSO01/GPIO100/JTAG\_TMS, and KSO00/GPIO000/JTAG\_TCK)

**FIGURE 36-1: XNOR CHAIN TEST STRUCTURE**



## 36.2.3 TEST PROCEDURE

### 36.2.3.1 Setup

**Warning: Ensure power supply is off during Setup.**

1. Connect JTAG\_RST# to ground.
2. Connect the VSS, AVSS, VSS\_VBAT pins to ground.
3. Connect the VCC1, AVCC, VBAT pins to an unpowered 3.3V power source.
4. Connect the VREF\_PECI pin to an unpowered 1.8V power source.
5. Connect an oscilloscope or voltmeter to the Test Output pin.
6. All other pins should be tied to ground.

**Note:** There are 101 pins in the XNOR Chain.

### 36.2.3.2 Testing

1. Turn on the 3.3V power source.
2. Enable the XNOR Chain as defined in [Section 36.2.3.3, "Procedure to Enable the XNOR Chain"](#).

**Note:** At this point all inputs to the XNOR Chain are low, except for the JTAG\_RST# pin, and the output on the Test Output pin is non-inverted from its initial state, which is dependent on the number of pins in the chain. If the number of input pins in the chain is an even number, the initial state of the [Test Output Pin, pin 17: KSO04/GPIO103/TFDP\\_DATA/XNOR](#) is low. If the number of input pins in the chain is an odd number, the initial state of the [Test Output Pin, pin 17: KSO04/GPIO103/TFDP\\_DATA/XNOR](#) is high.

3. Bring one pin in the chain high. The output on the [Test Output Pin, pin 17: KSO04/GPIO103/TFDP\\_DATA/XNOR](#) pin should toggle. Then individually toggle each of the remaining pins in the chain. Each time an input pin is toggled either high or low the [Test Output Pin, pin 17: KSO04/GPIO103/TFDP\\_DATA/XNOR](#) pin should toggle.
4. Once the XNOR test is completed, exit the XNOR Chain Test Mode by cycling VCC1 power.

### 36.2.3.3 Procedure to Enable the XNOR Chain

//BEGIN PROCEDURE TO ENTER XNOR CHAIN

////////////////////////////////////

//Reset Test Interface

////////////////////////////////////

force JTAG\_RST# = 0

force KSO00/GPIO000/JTAG\_TCK = 0

force KSO02/GPIO101/JTAG\_TDI = 0

force KSO01/GPIO100/JTAG\_TMS = 1

Wait 100 ns

////////////////////////////////////

//Come out of reset

////////////////////////////////////

force TRST#/JTAG\_RST# = 1

Wait 100 ns

force KSO00/GPIO000/JTAG\_TCK = 1

force KSO00/GPIO000/JTAG\_TCK = 0

force KSO00/GPIO000/JTAG\_TCK = 1

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---

```
force KSO00/GPIO000/JTAG_TCK = 0
force KSO00/GPIO000/JTAG_TCK = 1
force KSO00/GPIO000/JTAG_TCK = 0
force KSO00/GPIO000/JTAG_TCK = 1
force KSO00/GPIO000/JTAG_TCK = 0
```

```
////////////////////////////////////
```

```
//Sequence 1
```

```
// Write IR with 7h
```

```
////////////////////////////////////
```

```
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //1N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //2N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 1
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //3N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 1
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //4N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //5N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
```

```
////////////////////////////////////
```

```
//SHIFT IR 0x7h
```

```
////////////////////////////////////
```

```
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //6N
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //7N
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //8N
```



---

```
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //9N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 1; //Next will be EXIT1_IR
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //10N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 1; //Next will be UPDATE_IR
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //11N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0; //Next will be IDLE
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //12N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0; //Next will be IDLE
Wait 0 ns
```

```
////////////////////////////////////
// Sequence 2
```

```
// DIR=0, CMD[2:0]=1, DATA[7:0]=01\h, ADDR[7:0]=88\h
```

```
////////////////////////////////////
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //1N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 1
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //2N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //3N
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
```

```
////////////////////////////////////
//DIR 0 - Write
////////////////////////////////////
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR1)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
```

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---

```
////////////////////////////////////
//CMD 1 - Test
////////////////////////////////////
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^ TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR2)
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^ TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR3)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^ TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR4)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
```

```
////////////////////////////////////
//DATA 0x01 - XNOR_EN
////////////////////////////////////
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^ TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR5)
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^ TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR6)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^ TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR7)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^ TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR8)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
```

```
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR9)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR10)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR11)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR12)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
```

```
////////////////////////////////////
```

```
//ADDRESS 0x88 - Customer Control
```

```
////////////////////////////////////
```

```
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR13)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR14)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR15)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR16)
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
```

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---

```
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR17)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 1/^TP_GPIO102.Check(1);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR18)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR19)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (DR20)
force KSO02/GPIO101/JTAG_TDI = 1
force KSO01/GPIO100/JTAG_TMS = 1
force KSO00/GPIO000/JTAG_TCK = 1; //P
**Verify KSO03/GPIO102/JTAG_TDO = 0/^TP_GPIO102.Check(0);
force KSO00/GPIO000/JTAG_TCK = 0; //N (E1_DR)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 1
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //N (UP_DR)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //N (EXTRA CLK)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
force KSO00/GPIO000/JTAG_TCK = 1; //P
force KSO00/GPIO000/JTAG_TCK = 0; //N (EXTRA CLK)
force KSO02/GPIO101/JTAG_TDI = 0
force KSO01/GPIO100/JTAG_TMS = 0
Wait 100 ns
```

```
////////////////////////////////////
//FINISHED PROCEDURE TO ENTER XNOR
////////////////////////////////////
```

## 37.0 ELECTRICAL SPECIFICATIONS

### 37.1 Maximum Ratings\*

\*Stresses exceeding those listed could cause permanent damage to the device. This is a stress rating only and functional operation of the device at any other condition above those indicated in the operation sections of this specification is not implied.

**Note:** When powering this device from laboratory or system power supplies, it is important that the Absolute Maximum Ratings not be exceeded or device failure can result. Some power supplies exhibit voltage spikes on their outputs when the AC power is switched on or off. In addition, voltage transients on the AC power line may appear on the DC output. If this possibility exists, it is suggested that a clamp circuit be used.

#### 37.1.1 ABSOLUTE MAXIMUM THERMAL RATINGS

**TABLE 37-1: ABSOLUTE MAXIMUM THERMAL RATINGS**

| Parameter                   | Maximum Limits                                       |
|-----------------------------|--|
| Operating Temperature Range | 0°C to +70°C Commercial<br>-40°C to +85°C Industrial |
| Storage Temperature Range   | -55° to +150°C                                       |
| Lead Temperature Range      | Refer to JEDEC Spec J-STD-020B                       |

#### 37.1.2 ABSOLUTE MAXIMUM SUPPLY VOLTAGE RATINGS

**TABLE 37-2: ABSOLUTE POWER SUPPLY RATINGS**

| Symbol | Parameter   | Maximum Limits  |
|--------|---|-----------------|
| VBAT   | 3.0V Battery Backup Power Supply with respect to ground | -0.3V to +3.63V |
| VCC1   | 3.3V Suspend Power Supply with respect to ground        | -0.3V to +3.63V |
| VCC2   | 3.3V Main Power Supply with respect to ground           | -0.3V to +3.63V |

#### 37.1.3 ABSOLUTE MAXIMUM I/O VOLTAGE RATINGS

| Parameter   | Maximum Limits   |
|---|--|
| Voltage with respect to ground on any pin without back-drive protection | -0.3V to (Power Supply used to power the buffer) + 0.3V<br>( <a href="#">Note 37-1</a> ) |

**Note 37-1** The Power Supply used to power the buffer is shown in the Signal Power Well column of the [Pin Multiplexing](#) Tables in **Section 1.0 “Pin Configuration”**.

## 37.2 Operational Specifications

### 37.2.1 POWER SUPPLY OPERATIONAL CHARACTERISTICS

**TABLE 37-3: POWER SUPPLY OPERATING CONDITIONS**

| Symbol | Parameter                   | MIN   | TYP | MAX   | Units |
|--------|-----------------------------|-------|-----|-------|-------|
| VBAT   | Battery Backup Power Supply | 2.0   | 3.0 | 3.6   | V     |
| VCC1   | Suspend Power Supply        | 3.135 | 3.3 | 3.465 | V     |

**Note:** The specification for the VCC1 supply is +/- 5%.

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## 37.2.2 AC ELECTRICAL SPECIFICATIONS

The clock rise and fall times use the standard input thresholds of 0.8V and 2.0V unless otherwise specified and the capacitive values listed in [Section 37.2.2, "AC Electrical Specifications," on page 390](#).

## 37.2.3 CAPACITIVE LOADING SPECIFICATIONS

The following table defines the maximum capacitive load validated for the buffer characteristics listed in [Table 37-4, "DC Electrical Characteristics," on page 391](#).

CAPACITANCE  $T_A = 25^\circ\text{C}$ ;  $f_c = 1\text{MHz}$ ;  $V_{CC} = 3.3\text{VDC}$

**Note:** All output pins, except pin under test, tied to AC ground.

| Parameter  | Symbol    | Limits |     |                           | Unit | Notes                     |
|--|-----------|--------|-----|---------------------------|------|---------------------------|
|  |           | MIN    | TYP | MAX                       |      |                           |
| Input Capacitance of PCI_I and PCI_IO pins                     | $C_{IN}$  |        |     | <a href="#">Note 37-2</a> | pF   |                           |
| Input Capacitance of PCI_CLK pin                               | $C_{IN}$  |        |     | <a href="#">Note 37-2</a> | pF   |                           |
| Output Load Capacitance supported by PCI_IO, PCI_O, and PCI_OD | $C_{OUT}$ |        |     | <a href="#">Note 37-2</a> | pF   |                           |
| SUSCLK Input Capacitance                                       | $C_{IN}$  |        |     | 10                        | pF   |                           |
| Input Capacitance of PECL_I and PECL_IO                        | $C_{IN}$  |        |     | 10                        | pF   |                           |
| Output Load Capacitance supported by PECL_IO and OD_PH         | $C_{OUT}$ |        |     | 10                        | pF   |                           |
| Input Capacitance (all other input pins)                       | $C_{IN}$  |        |     | 10                        | pF   | <a href="#">Note 37-3</a> |
| Output Capacitance (all other output pins)                     | $C_{OUT}$ |        |     | 20                        | pF   | <a href="#">Note 37-4</a> |

**Note 37-2** The PCI buffers are designed to meet the defined PCI Local Bus Specification, Rev. 2.1, electrical requirements.

**Note 37-3** All input buffers can be characterized by this capacitance unless otherwise specified.

**Note 37-4** All output buffers can be characterized by this capacitance unless otherwise specified.

## 37.2.4 DC ELECTRICAL CHARACTERISTICS FOR I/O BUFFERS

**TABLE 37-4: DC ELECTRICAL CHARACTERISTICS**

| Parameter                  | Symbol    | MIN               | TYP | MAX               | Units   | Comments   |
|----------------------------|-----------|-------------------|-----|-------------------|---------|--|
| <b>PIO Type Buffer</b>     |           |                   |     |                   |         |  |
| All PIO Buffers            |           |                   |     |                   |         | Internal PU/PD selected via the GPIO Pin Control Register. |
| Pull-up current            | $I_{PU}$  | 39                | 84  | 162               | $\mu A$ |  |
| Pull-down current          | $I_{PD}$  | 39                | 65  | 105               | $\mu A$ |  |
| I Type Input Buffer        |           |                   |     |                   |         | TTL Compatible Schmitt Trigger Input                       |
| Low Input Level            | $V_{ILI}$ |                   |     | 0.3x<br>$V_{CC1}$ | V       |  |
| High Input Level           | $V_{IHI}$ | 0.7x<br>$V_{CC1}$ |     |                   | V       |  |
| Tolerance                  |           |                   |     | 3.63              | V       | This buffer is not 5V tolerant.                            |
| Schmitt Trigger Hysteresis | $V_{HYS}$ |                   | 400 |                   | mV      |  |
| O-2 mA Type Buffer         |           |                   |     |                   |         |  |
| Low Output Level           | $V_{OL}$  |                   |     | 0.4               | V       | $I_{OL} = 2\text{ mA}$                                     |
| High Output Level          | $V_{OH}$  | $V_{CC1} - 0.4$   |     |                   | V       | $I_{OH} = -2\text{ mA}$                                    |
| Tolerance                  |           |                   |     |                   |         | This buffer is not 5V tolerant.                            |
| IO-2 mA Type Buffer        | –         | –                 | –   | –                 | –       | Same characteristics as an I and an O-2mA.                 |
| OD-2 mA Type Buffer        |           |                   |     |                   |         |  |
| Low Output Level           | $V_{OL}$  |                   |     | 0.4               | V       | $V_{OL} = 2\text{ mA}$                                     |
| Tolerance                  |           |                   |     |                   |         | This buffer is not 5V tolerant.                            |
| IOD-2 mA Type Buffer       | –         | –                 | –   | –                 | –       | Same characteristics as an I and an OD-2mA.                |
| O-4 mA Type Buffer         |           |                   |     |                   |         |  |
| Low Output Level           | $V_{OL}$  |                   |     | 0.4               | V       | $I_{OL} = 4\text{ mA}$                                     |
| High Output Level          | $V_{OH}$  | $V_{CC1} - 0.4$   |     |                   | V       | $I_{OH} = -4\text{ mA}$                                    |
| Tolerance                  |           |                   |     |                   |         | This buffer is not 5V tolerant.                            |
| IO-4 mA Type Buffer        | –         | –                 | –   | –                 | –       | Same characteristics as an I and an O-4mA.                 |
| OD-4 mA Type Buffer        |           |                   |     |                   |         |  |
| Low Output Level           | $V_{OL}$  |                   |     | 0.4               | V       | $V_{OL} = 4\text{ mA}$                                     |
| Tolerance                  |           |                   |     |                   |         | This buffer is not 5V tolerant.                            |
| IOD-4 mA Type Buffer       | –         | –                 | –   | –                 | –       | Same characteristics as an I and an OD-4mA.                |

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**TABLE 37-4: DC ELECTRICAL CHARACTERISTICS (CONTINUED)**

| Parameter                                 | Symbol   | MIN      | TYP | MAX | Units | Comments  |
|---|----------|----------|-----|-----|-------|---|
| O-8 mA Type Buffer                        |          |          |     |     |       |   |
| Low Output Level                          | $V_{OL}$ |          |     | 0.4 | V     | $I_{OL} = 8 \text{ mA}$   |
| High Output Level                         | $V_{OH}$ | VCC1-0.4 |     |     | V     | $I_{OH} = -8 \text{ mA}$  |
| Tolerance                                 |          |          |     |     |       | This buffer is not 5V tolerant.   |
| IO-8 mA Type Buffer                       | –        | –        | –   | –   | –     | Same characteristics as an I and an O-8mA.  |
| OD-8 mA Type Buffer                       |          |          |     |     |       |   |
| Low Output Level                          | $V_{OL}$ |          |     | 0.4 | V     | $V_{OL} = 8 \text{ mA}$   |
| Tolerance                                 |          |          |     |     |       | This buffer is not 5V tolerant.   |
| IOD-8 mA Type Buffer                      | –        | –        | –   | –   | –     | Same characteristics as an I and an OD-8mA.   |
| O-12 mA Type Buffer                       |          |          |     |     |       |   |
| Low Output Level                          | $V_{OL}$ |          |     | 0.4 | V     | $I_{OL} = 12 \text{ mA}$  |
| High Output Level                         | $V_{OH}$ | VCC1-0.4 |     |     | V     | $I_{OH} = -12 \text{ mA}$   |
| Tolerance                                 |          |          |     |     |       | This buffer is not 5V tolerant.   |
| IO-12 mA Type Buffer                      | –        | –        | –   | –   | –     | Same characteristics as an I and an O-12mA.   |
| OD-12 mA Type Buffer                      |          |          |     |     |       |   |
| Low Output Level                          | $V_{OL}$ |          |     | 0.4 | V     | $I_{OL} = 12 \text{ mA}$  |
| Tolerance                                 |          |          |     |     |       | This buffer is not 5V tolerant.   |
| IOD-12 mA Type Buffer                     | –        | –        | –   | –   | –     | Same characteristics as an I and an OD-12mA.  |
| <b>I_AN Type Buffer</b>                   |          |          |     |     |       |   |
| I_AN Type Buffer<br>(Analog Input Buffer) | I_AN     |          |     |     |       | Voltage range on pins:<br>-0.3V to +3.63V<br><br>These buffers are not 5V tolerant buffers and they are not backdrive protected |



**TABLE 37-4: DC ELECTRICAL CHARACTERISTICS (CONTINUED)**

| Parameter                  | Symbol                   | MIN                     | TYP                   | MAX                     | Units | Comments   |
|----------------------------|--------------------------|-------------------------|-----------------------|-------------------------|-------|--|
| <b>PCI_PIO Type Buffer</b> |                          |                         |                       |                         |       |  |
| All PCI_PIO Buffers        |                          |                         |                       |                         |       | Internal PU is selected via the GPIO Pin Control Register.   |
| Pull-up current            | I <sub>PU</sub>          | 0.6                     | 1                     | 1.5                     | mA    |  |
| PCI_CLK Type Buffer        | PCI_ICLK                 |                         |                       |                         |       | See <i>PCI Local Bus Specification Rev. 2.1</i><br><br>These buffers are not 5V tolerant buffers and they are not backdrive protected. |
| PCI_IO Type Buffers        | PCI_IO<br>PCI_O<br>PCI_I |                         |                       |                         |       |  |
| PCI_OD Type Buffer         | PCI_OD                   |                         |                       |                         |       |  |
| <b>PECI Type Buffer</b>    |                          |                         |                       |                         |       |  |
| V <sub>REF</sub> Buffer    |                          |                         |                       |                         |       | Connects to CPU Voltage pin (Processor dependent)  |
| PECI Bus Voltage           | V <sub>BUS</sub>         | 0.95                    |                       | 1.26                    | V     |  |
| Input current              | IDC                      |                         |                       | 100                     | μA    |  |
| Input Low Current          | ILEAK                    | -10                     |                       | +10                     | μA    | This buffer is not 5V tolerant<br>This buffer is not backdrive protected.  |
| PECI_I Buffer              |                          |                         |                       |                         |       | All input and output voltages are a function of VREF buffer input.   |
| Input voltage range        | V <sub>In</sub>          | -0.3                    |                       | V <sub>REF</sub> + 0.3  | V     |  |
| Low Input Level            | V <sub>IL</sub>          |                         |                       | 0.275× V <sub>REF</sub> | V     |  |
| High Input Level           | V <sub>IH</sub>          | 0.725× V <sub>REF</sub> |                       |                         | V     | This buffer is not 5V tolerant<br>This buffer is not backdrive protected.  |
| PECI_IO                    |                          |                         |                       |                         |       | All input and output voltages are a function of VREF buffer input.<br>See Peci Specification.  |
| Input voltage range        | V <sub>In</sub>          | -0.3                    |                       | V <sub>REF</sub> + 0.3  | V     |  |
| Hysteresis                 | V <sub>HYS</sub>         | 0.1 × V <sub>REF</sub>  | 0.2× V <sub>REF</sub> |                         | V     |  |
| Low Input Level            | V <sub>IL</sub>          |                         |                       | 0.275× V <sub>REF</sub> | V     |  |
| High Input Level           | V <sub>IH</sub>          | 0.725× V <sub>REF</sub> |                       |                         | V     |  |
| Low Output Level           | V <sub>OL</sub>          |                         |                       | 0.25× V <sub>REF</sub>  | V     | 0.5mA < IOL < 1mA  |
| High Output Level          | V <sub>OH</sub>          | 0.75 × V <sub>REF</sub> |                       |                         | V     | IOH = -6mA   |
| Tolerance                  |                          |                         |                       | 3.63                    | V     | This buffer is not 5V tolerant<br>This buffer is not backdrive protected.  |

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**TABLE 37-4: DC ELECTRICAL CHARACTERISTICS (CONTINUED)**

| Parameter                 | Symbol   | MIN | TYP | MAX | Units | Comments        |
|---------------------------|--|-----|-----|-----|-------|-----------------|
| <b>Crystal oscillator</b> |  |     |     |     |       |                 |
| XTAL1 (OCLK)              | The MEC1322 crystal oscillator design requires a 32.768 KHz parallel resonant crystal with load caps in the range 4-18pF. Refer to "Application Note PCB Layout Guide for MEC1322" for more information. |     |     |     |       |                 |
| XTAL2 (ICLK)              |  |     |     |     |       |                 |
| Low Input Level           | $V_{IL}$   |     |     | 0.4 | V     |                 |
| High Input Level          | $V_{IH}$   | 2.0 |     |     | V     | VIN = 0 to VCC1 |

## 37.2.4.1 Pin Leakage

Leakage characteristics for all pins is shown in the following table:

**TABLE 37-5: PIN LEAKAGE**

(TA = 0°C to +85°C)

| Parameter       | Symbol   | MIN | TYP | MAX  | Units | Comments       |
|-----------------|----------|-----|-----|------|-------|----------------|
| Leakage Current | $I_{IL}$ |     |     | +/-2 | μA    | VIN=0V to VCC1 |

## 37.2.4.2 Backdrive Protection

All signal pins are Backdrive Protected except those listed in the Pin Configuration chapter as non-backdrive protected.

**TABLE 37-6: BACKDRIVE PROTECTION**

(TA = 0°C to +85°C)

| Parameter     | Symbol   | MIN | TYP | MAX | Units | Comments          |
|---------------|----------|-----|-----|-----|-------|-------------------|
| Input Leakage | $I_{IL}$ | -2  |     | +2  | μA    | VIN=3.47V@VCC1=0V |

## 37.2.5 ADC ELECTRICAL CHARACTERISTICS

**TABLE 37-7: ADC CHARACTERISTICS**

| Parameter                       | MIN   | TYP | MAX   | Units      |
|---------------------------------|-------|-----|-------|------------|
| Analog Supply Voltage, AVCC     | 3.135 | 3.3 | 3.465 | V          |
| Resolution                      | -     | -   | 10    | Bits       |
| Accuracy                        | -     | 1   | -     | LSB        |
| Differential Non Linearity, DNL | -1    | -   | +1    | LSB        |
| Integral Non Linearity, INL     | -1.5  | -   | +1.5  | LSB        |
| Gain Error, EGAIN               | -2    | -   | 2     | LSB        |
| Offset Error, EOFFSET           | -2    | -   | 2     | LSB        |
| Conversion Time                 | -     | -   | 12    | μs/channel |
| Input Impedance                 | 3     | -   | -     | MΩ         |

**Note:** The AVCC power supply accuracy is shown as 3.3V +/- 5%.

## 37.3 Thermal Characteristics

**TABLE 37-8: THERMAL OPERATING CONDITIONS**

| Rating  | Symbol            | Min.                                | Typical | Max. | Unit |
|---|-------------------|-------------------------------------|---------|------|------|
| <b>Consumer Temperature Devices</b>   |                   |                                     |         |      |      |
| Operating Junction Temperature Range  | TJ                | —                                   | —       | +125 | °C   |
| Operating Ambient Temperature Range - Commercial  | TA                | 0                                   | —       | +70  | °C   |
| Operating Ambient Temperature Range - Industrial  | TA                | -40                                 | —       | +85  | °C   |
| Power Dissipation:<br>Internal Chip Power Dissipation:<br>$P_{INT} = V_{CC1} \times I_{VCC1}$ from <a href="#">Table 37-10</a><br>(e.g., 3.45V x 9.75mA = 33.64mW)<br>I/O Pin Power Dissipation:<br>$I/O = S ((V_{CC1} - V_{OH}) \times I_{OH}) + S (V_{OL} \times I_{OL})$ | PD                | P <sub>INT</sub> + P <sub>I/O</sub> |         |      | W    |
| Maximum Allowed Power Dissipation   | PD <sub>MAX</sub> | $(T_J - T_A)/\theta_{JA}$           |         |      | W    |

**TABLE 37-9: THERMAL PACKAGING CHARACTERISTICS**

| Characteristics                           | Symbol        | Typical | Max. | Unit | Notes |
|---|---------------|---------|------|------|-------|
| Package Thermal Resistance, 128-pin VTQFP | $\theta_{JA}$ | 51.0    | —    | °C/W | 1     |
|   | $\theta_{JC}$ | 25.0    | —    | °C/W | 1     |
| Package Thermal Resistance, 132-pin DQFN  | $\theta_{JA}$ | 28.0    | —    | °C/W | 1     |
|   | $\theta_{JC}$ | 5.0     | —    | °C/W | 1     |
| Package Thermal Resistance, 144-pin WFBGA | $\theta_{JA}$ | 50.0    | —    | °C/W | 1     |
|   | $\theta_{JC}$ | 17.0    | —    | °C/W | 1     |

**Note 1:** Junction to ambient thermal resistance, Theta-JA ( $\theta_{JA}$ ) and Junction to case thermal resistance, Theta-JC ( $\theta_{JC}$ ) numbers are achieved by package simulations.

## 37.4 Power Consumption

**TABLE 37-10: VCC1 SUPPLY CURRENT, I<sub>VCC1</sub>**

| VCC2 | VCC1 | System State | 48 MHz Ring Oscillator Frequency | Typical (3.3V, 25° C) | Max (3.465V, 70° C) | Max (3.465V, 85° C) | Units | Comments                       |
|------|------|--------------|----------------------------------|-----------------------|---------------------|---------------------|-------|--------------------------------|
| On   | On   | S0           | 48MHz                            | 8.50                  | 9.75                | 10.25               | mA    | FULL ON, 48MHz, LPC Clock ON   |
| On   | On   | S0           | 12MHz                            | 6.00                  | 8.00                | 8.50                | mA    | FULL ON, 12MHz, LPC Clock ON   |
| On   | On   | S0           | 3MHz                             | 5.50                  | 7.00                | 7.50                | mA    | FULL ON, 3MHz, LPC Clock ON    |
| On   | On   | S0           | 1MHz                             | 5.00                  | 6.50                | 7.00                | mA    | FULL ON, 1MHz, LPC Clock ON    |
| On   | On   | S0           | 12MHz                            | 3.00                  | 3.70                | 4.25                | mA    | Heavy Sleep 1, LPC Clock ON    |
| On   | On   | S0           | Off                              | 0.80                  | 1.50                | 2.10                | mA    | Heavy Sleep 2, LPC Clock ON    |
| On   | On   | S0           | Off                              | 0.50                  | 1.25                | 1.85                | mA    | Heavy Sleep 3, LPC Clock ON    |
| Off  | On   | S5           | 48MHz                            | 7.75                  | 9.25                | 9.75                | mA    | FULL ON (48MHz), LPC Clock Off |

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**TABLE 37-10: VCC1 SUPPLY CURRENT, I\_VCC1 (CONTINUED)**

| VCC2 | VCC1 | System State | 48 MHz Ring Oscillator Frequency | Typical (3.3V, 25 <sup>0</sup> C) | Max (3.465V, 70 <sup>0</sup> C) | Max (3.465V, 85 <sup>0</sup> C) | Units | Comments                                 |
|------|------|--------------|----------------------------------|-----------------------------------|---------------------------------|---------------------------------|-------|--|
| Off  | On   | S5           | 12MHz                            | 5.25                              | 7.00                            | 7.50                            | mA    | FULL ON (12MHz), LPC Clock Off           |
| Off  | On   | S5           | 3MHz                             | 4.75                              | 6.25                            | 6.75                            | mA    | FULL ON (3MHz), LPC Clock Off            |
| Off  | On   | S5           | 1MHz                             | 4.50                              | 6.00                            | 6.50                            | mA    | FULL ON (1MHz), LPC Clock Off            |
| Off  | On   | S5           | 12MHz                            | 2.00                              | 2.75                            | 3.25                            | mA    | Heavy Sleep 1, LPC Clock Off (Note 37-1) |
| Off  | On   | S5           | Off                              | 0.65                              | 1.25                            | 1.65                            | mA    | Heavy Sleep 2, LPC Clock Off (Note 37-1) |
| Off  | On   | S5           | Off                              | 0.33                              | 0.95                            | 1.55                            | mA    | Heavy Sleep 3, LPC Clock Off (Note 37-1) |
| Off  | On   | S5           | Off                              | 0.30                              | 0.90                            | 1.50                            | mA    | Deepest Sleep, LPC Clock Off (Note 37-1) |

**Note:** FULL ON is defined as follows: The processor is not sleeping, the Core regulator and the Ring Oscillator remain powered, and at least one block is not sleeping.

**Note 37-1** The sleep states are defined in the System Sleep Control Register in the Power, Clocks and Resets Chapter. See [Table 3-10, "System Sleep Control Bit Encoding,"](#) on page 61.

**TABLE 37-11: VBAT SUPPLY CURRENT, I\_VBAT (VBAT=3.0V)**

| VCC2 | VCC1 | System State | 48 MHz Ring Oscillator Frequency | Typical (3.0V, 25 <sup>0</sup> C) | Max (3.0V, 70 <sup>0</sup> C) | Max (3.0V, 85 <sup>0</sup> C) | Units | Comments                          |
|------|------|--------------|----------------------------------|-----------------------------------|-------------------------------|-------------------------------|-------|-----------------------------------|
| Off  | Off  | S5           | Off                              | 2.50                              | 6.50                          | 9.00                          | uA    | 32kHz crystal oscillator          |
| Off  | Off  | S5           | Off                              | 2.00                              | 6.00                          | 8.50                          | uA    | External 32kHz clock on XTAL2 pin |

**TABLE 37-12: VBAT SUPPLY CURRENT, I\_VBAT (VBAT=3.3V)**

| VCC2 | VCC1 | System State | 48 MHz Ring Oscillator Frequency | Typical (3.3V, 25 <sup>0</sup> C) | Max (3.3V, 70 <sup>0</sup> C) | Max (3.3V, 85 <sup>0</sup> C) | Units | Comments                          |
|------|------|--------------|----------------------------------|-----------------------------------|-------------------------------|-------------------------------|-------|-----------------------------------|
| Off  | Off  | S5           | Off                              | 2.75                              | 6.75                          | 9.25                          | uA    | 32kHz crystal oscillator          |
| Off  | Off  | S5           | Off                              | 2.50                              | 6.25                          | 8.75                          | uA    | External 32kHz clock on XTAL2 pin |

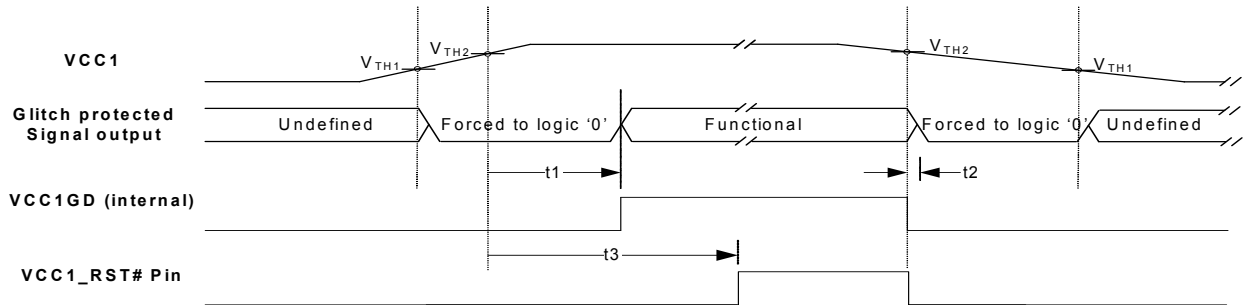
## 38.0 TIMING DIAGRAMS

**Note:** Timing values are preliminary and may change after characterization.

### 38.1 Voltage Thresholds and Power Good Timing

#### 38.1.1 VCC1\_RST# TIMING

**FIGURE 38-1: VCC1\_RST# TIMING**



**TABLE 38-1: VCC1\_RST# TIMING**

| Parameters   | Symbol            | MIN  | TYP | MAX  | Unit | Notes     |
|--|-------------------|------|-----|------|------|-----------|
| VCC1 Threshold for Pin Glitch Protection active                                    | V <sub>TH1</sub>  | 0.9  | 1   | 1.1  | V    |           |
| VCC1 Power Good Threshold  | V <sub>TH2</sub>  | 2.16 | 2.4 | 2.64 | V    |           |
| VCC1 Rise Time (Off to VCC1 =V <sub>Threshold</sub> )                              | V <sub>Rise</sub> | 200  |     |      | μs   |           |
| VCC1 Fall Time (VCC1 =V <sub>Threshold</sub> ) to Off                              | V <sub>Fall</sub> | 200  |     |      | μs   |           |
| VCC1 > V <sub>TH2</sub> to VCC1GD (internal) asserted                              | t1                |      | 600 |      | μs   |           |
| VCC1 < V <sub>TH2</sub> to VCC1GD (internal) deasserted and VCC1_RST# pin asserted | t2                |      | 100 |      | ns   |           |
| VCC1 > V <sub>TH2</sub> to VCC1_RST# pin deasserted                                | t3                |      | 1   |      | ms   | Note 38-1 |

**Note 38-1** The ARM starts executing instructions when EC\_PROC\_RESET deasserts, which has the same timing as t3.

**FIGURE 38-2: VCC1\_RST# RISE TIME**



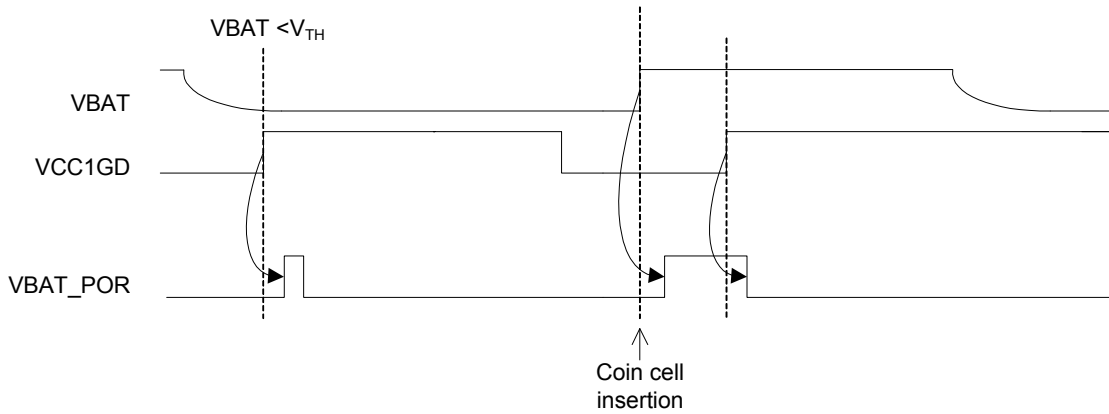
**TABLE 38-2: VCC1\_RST# RISE TIME**

| Parameters          | Symbol | MIN | TYP | MAX  | Units | Notes     |
|---------------------|--------|-----|-----|------|-------|-----------|
| VCC1_RST# Rise Time | t1     |     |     | 2.65 | μs    | Note 38-2 |

**Note 38-2** This corresponds to the time 2.65us (min) after the VCC1\_RST# pin is released, the VCC1\_RST# pin input is sampled. See Section 3.6.1, "Integrated Vcc1 Power On Reset (VCC1\_RST#)," on page 53.

## 38.1.2 VBAT THRESHOLDS AND VBAT\_POR

**FIGURE 38-3: VBAT THRESHOLDS AND VBAT\_POR**



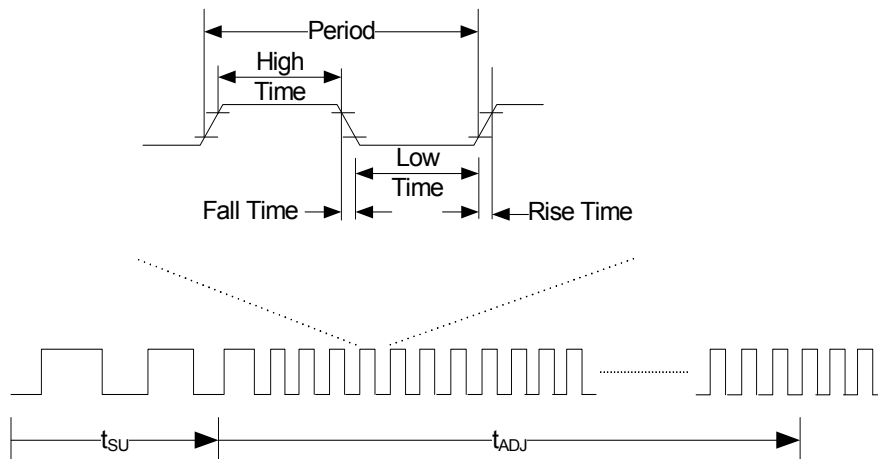
**TABLE 38-3: VBAT THRESHOLDS AND VBAT\_POR**

| Parameters                                      | Symbol     | MIN   | TYP  | MAX   | Units   | Notes     |
|---|------------|-------|------|-------|---------|-----------|
| VBAT Power On Reset Threshold                   | $V_{TH}$   | 1.125 | 1.25 | 1.375 | V       | Note 38-3 |
| VBAT Rise Time (Off to VBAT = $V_{Threshold}$ ) | $V_{Rise}$ | 100   |      |       | $\mu s$ |           |

**Note 38-3** VBAT is monitored on two events: coin cell insertion and VCC1GD assertion. If VBAT is below  $V_{TH}$  when VCC1GD is asserted a VBAT\_POR is generated.

## 38.2 Clocking AC Timing Characteristics

**FIGURE 38-4: CLOCK TIMING DIAGRAM**



**TABLE 38-4: CLOCK TIMING PARAMETERS**

| Clock                  | Parameters  | Symbol    | MIN                 | TYP    | MAX                 | Units   |
|------------------------|---|-----------|---------------------|--------|---------------------|---------|
| 48 MHz Ring Oscillator | Start-up accuracy (without 32 kHz present)  | $f_{SU}$  | 22                  | -      | 53                  | MHz     |
|                        | Start-up delay from 0 MHz to Start-up accuracy  | $t_{SU}$  | -                   | -      | 6                   | $\mu$ s |
|                        | Operating Frequency (with 32 kHz present after frequency lock to 48 MHz)  | $f_{OP}$  | 47.04               | 48     | 48.95               | MHz     |
|                        | Adjustment Delay from Start-up accuracy to Operating accuracy (time to attain frequency lock - with 32 kHz present) | $t_{ADJ}$ | 0.03                | -      | 4<br>(Note 38-4)    | ms      |
|                        | Operating Frequency (with 32 kHz removed after frequency locked to 48 MHz)  | $f_{OP}$  | 43.2<br>(Note 38-6) | -      | 52.8<br>(Note 38-6) | MHz     |
| SUSCLK                 | Operating Frequency   | -         | -                   | 32.768 | -                   | kHz     |
|                        | Period  | -         | (Note 38-5)         | 30.52  | (Note 38-5)         | $\mu$ s |
|                        | High Time   | -         | 10                  |        |                     | us      |
|                        | Low Time  | -         | 10                  |        |                     | us      |
|                        | Fall Time   | -         | -                   | -      | 1                   | us      |
|                        | Rise Time   | -         | -                   | -      | 1                   | us      |

**Note 38-4** This time only applies if the external 32KHz clock input is available.

**Note 38-5** SUSCLK is required to have an accuracy of +/- 100 ppm.

**Note 38-6** The drift in frequency after frequency lock if the 32kHz clock is removed is determined by varying temperature while voltage is held constant.

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## 38.3 GPIO Timings

FIGURE 38-5: GPIO TIMING

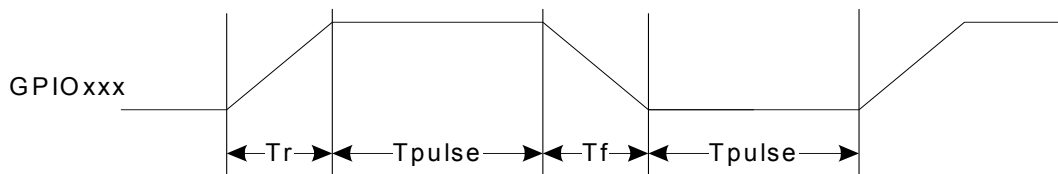


TABLE 38-5: GPIO TIMING PARAMETERS

| Symbol             | Parameter                  | MIN  | TYP | MAX  | Unit | Notes                                |
|--------------------|----------------------------|------|-----|------|------|--------------------------------------|
| $t_R$              | GPIO Rise Time (push-pull) | 0.54 |     | 1.31 | ns   | Pad type = IO2<br>$C_L=2\text{pF}$   |
| $t_F$              | GPIO Fall Time             | 0.52 |     | 1.27 | ns   |                                      |
| $t_R$              | GPIO Rise Time (push-pull) | 0.58 |     | 1.46 | ns   | Pad type = IO4<br>$C_L=5\text{pF}$   |
| $t_F$              | GPIO Fall Time             | 0.62 |     | 1.48 | ns   |                                      |
| $t_R$              | GPIO Rise Time (push-pull) | 0.80 |     | 2.00 | ns   | Pad type = IO8<br>$C_L=10\text{pF}$  |
| $t_F$              | GPIO Fall Time             | 0.80 |     | 1.96 | ns   |                                      |
| $t_R$              | GPIO Rise Time (push-pull) | 1.02 |     | 2.46 | ns   | Pad type = IO12<br>$C_L=20\text{pF}$ |
| $t_F$              | GPIO Fall Time             | 1.07 |     | 2.51 | ns   |                                      |
| $t_{\text{pulse}}$ | GPIO Pulse Width           | 60   |     |      | ns   |                                      |



## 38.4 LPC LCLK Timing

FIGURE 38-6: LPC CLOCK TIMING

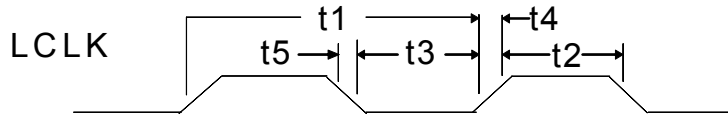


TABLE 38-6: LPC CLOCK TIMING PARAMETERS

| Name | Description | MIN | TYP | MAX               | Units |
|------|-------------|-----|-----|-------------------|-------|
| t1   | Period      | 30  |     | 57<br>(Note 38-7) | nsec  |
| t2   | High Time   | 11  |     |                   |       |
| t3   | Low Time    |     |     |                   |       |
| t4   | Rise Time   |     |     | 3                 |       |
| t5   | Fall Time   |     |     |                   |       |

**Note 38-7** The standard clock frequency supported is 33MHz (max 33.3ns period). Setting the Handshake bit in the Host Interface allows the LPC interface to support a PCI clock rate from 19.2MHz to 33MHz.

## 38.5 LPC RESET# Timing

FIGURE 38-7: RESET TIMING

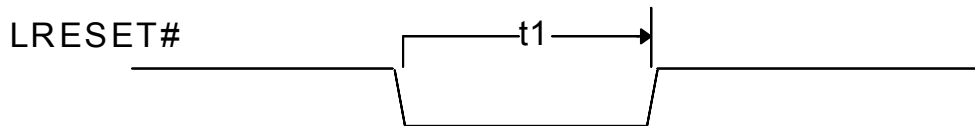
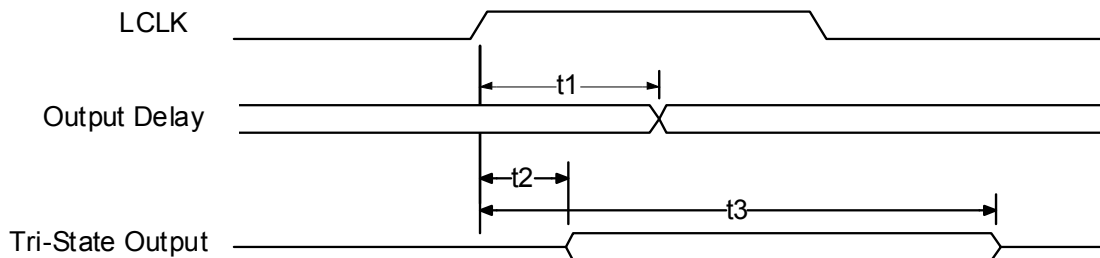


TABLE 38-7: RESET TIMING PARAMETERS

| Name | Description   | MIN | TYP | MAX | Units |
|------|---------------|-----|-----|-----|-------|
| t1   | LRESET# width | 1   |     |     | ms    |

### 38.5.1 LPC BUS TIMING

FIGURE 38-8: OUTPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS



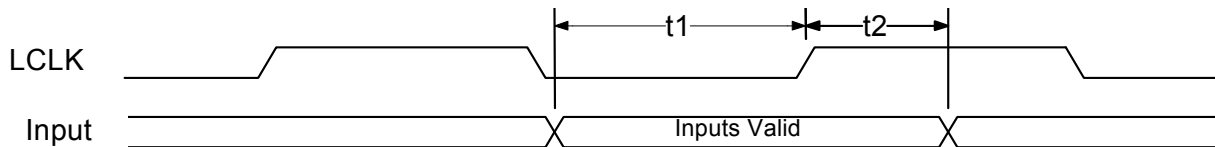
# MEC1322

**TABLE 38-8: OUTPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS PARAMETERS**

| Name | Description                                | MIN | TYP | MAX | Units |
|------|--|-----|-----|-----|-------|
| t1   | LCLK to Signal Valid Delay – Bused Signals | 2   |     | 11  | ns    |
| t2   | Float to Active Delay                      |     |     |     |       |
| t3   | Active to Float Delay                      |     |     | 28  |       |

## 38.5.2 LPC INPUT TIMING

**FIGURE 38-9: INPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS**

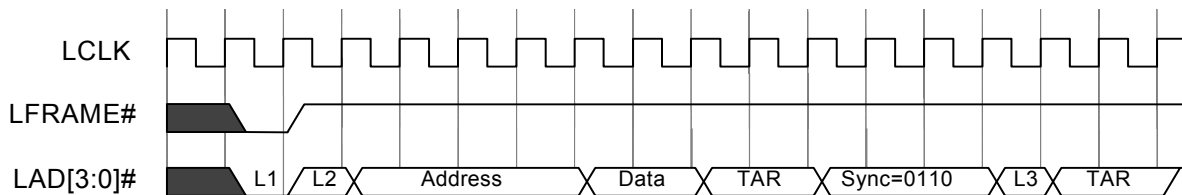


**TABLE 38-9: INPUT TIMING MEASUREMENT CONDITIONS, LPC SIGNALS PARAMETERS**

| Name | Description                               | MIN | TYP | MAX | Units |
|------|---|-----|-----|-----|-------|
| t1   | Input Set Up Time to LCLK – Bused Signals | 7   |     |     | ns    |
| t2   | Input Hold Time from LCLK                 | 0   |     |     |       |

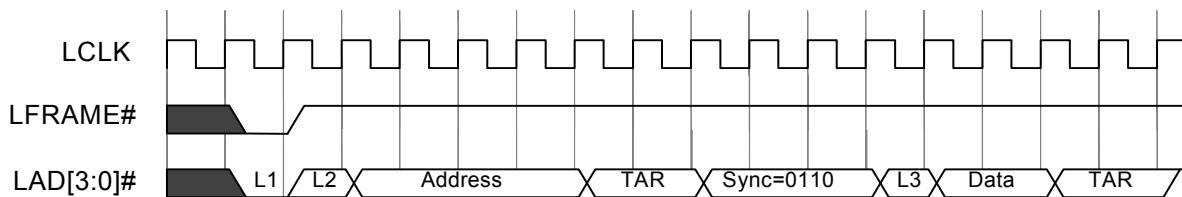
## 38.5.3 LPC I/O TIMING

**FIGURE 38-10: I/O WRITE**



**Note:** L1=Start; L2=CYCTYP+DIR; L3=Sync of 0000

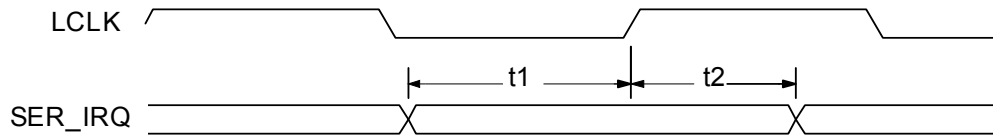
**FIGURE 38-11: I/O READ**



**Note:** L1=Start; L2=CYCTYP+DIR; L3=Sync of 0000

## 38.5.4 SERIAL IRQ TIMING

**FIGURE 38-12: SETUP AND HOLD TIME**



**TABLE 38-10: SETUP AND HOLD TIME**

| Name | Description                       | MIN | TYP | MAX | Units |
|------|-----------------------------------|-----|-----|-----|-------|
| t1   | SER_IRQ Setup Time to LCLK Rising | 7   |     |     | nsec  |
| t2   | SER_IRQ Hold Time to LCLK Rising  | 0   |     |     |       |

## 38.6 Serial Port (UART) Data Timing

FIGURE 38-13: SERIAL PORT DATA

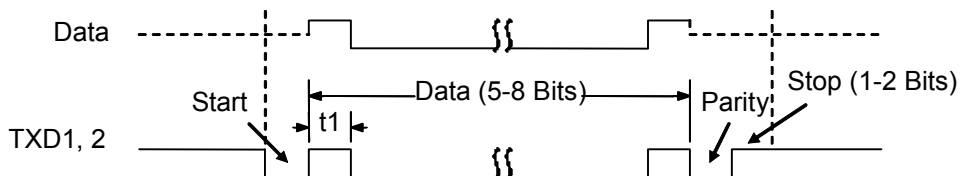


TABLE 38-11: SERIAL PORT DATA PARAMETERS

| Name  | Description               | MIN | TYP                         | MAX | Units |
|-------|---------------------------|-----|-----------------------------|-----|-------|
| $t_1$ | Serial Port Data Bit Time |     | $t_{BR}$<br>(Note 3<br>8-8) |     | nsec  |

**Note 38-8**  $t_{BR}$  is 1/Baud Rate. The Baud Rate is programmed through the Baud\_Rate\_Divisor bits located in the Programmable Baud Rate Generator registers. The selectable baud rates are listed in [Table 14-7, "UART Baud Rates using Clock Source 1.8432MHz\\_Clk"](#) and [Table 14-8, "UART Baud Rates using Clock Source 24MHz\\_Clk"](#). Some of the baud rates have some percentage of error because the clock does not divide evenly. This error can be determined from the values in these baud rate tables.

## 38.7 PECl Interface

Table 1.1

| Name             | Description  | MIN            | MAX                  | Units                  | Notes                      |
|------------------|--|----------------|----------------------|------------------------|----------------------------|
| $t_{BIT}$        | Bit time (overall time evident on PECl pin)<br>Bit time driven by an originator  | 0.495<br>0.495 | 500<br>250           | $\mu$ sec<br>$\mu$ sec | <a href="#">Note 38-9</a>  |
| $t_{BIT,jitter}$ | Bit time jitter between adjacent bits in a PECl message header or data bytes after timing has been negotiated  | -              | -                    | %                      |                            |
| $t_{BIT,drift}$  | Change in bit time across a PECl address or PECl message bits as driven by the originator. This limit only applies across $t_{BIT-A}$ bit drift and $t_{BIT-M}$ drift. | -              | -                    | %                      |                            |
| $t_{H1}$         | High level time for logic 1  | 0.6            | 0.8                  | $t_{BIT}$              | <a href="#">Note 38-10</a> |
| $t_{H0}$         | High level time for logic 0  | 0.2            | 0.4                  | $t_{BIT}$              |                            |
| $t_{PEClR}$      | Rise time<br>(measured from $V_{OL}$ to $V_{IH,min}$ , $V_{t(nom)}-5\%$ )  | -              | 30 +<br>(5 x #nodes) | ns                     | <a href="#">Note 38-11</a> |
| $t_{PEClF}$      | Fall time<br>(measured from $V_{OH}$ to $V_{IL,max}$ , $V_{t(nom)}+5\%$ )  | -              | (30 x #nodes)        | ns                     | <a href="#">Note 38-11</a> |

**Note 38-9** The originator must drive a more restrictive time to allow for quantized sampling errors by a client yet still attain the minimum time less than 500  $\mu$ sec.  $t_{BIT}$  limits apply equally to  $t_{BIT-A}$  and  $t_{BIT-M}$ . The MEC1322 is designed to support 2 MHz, or a 500ns bit time. See the PECl 3.0 specification from Intel Corp. for further details.

**Note 38-10** The minimum and maximum bit times are relative to  $t_{BIT}$  defined in the Timing Negotiation pulse. See the PECl 3.0 specification from Intel Corp. for further details.

**Note 38-11** "#nodes" is the number of nodes on the PECl bus; host and client nodes are counted as one each. Extended trace lengths may appear as extra nodes. Refer also to [Table 23-2, "PECl Routing Guidelines"](#). See the PECl 3.0 specification from Intel Corp. for further details.

## 38.8 8042 Emulation CPU\_Reset Timing

FIGURE 38-14: CPU\_RESET TIMING

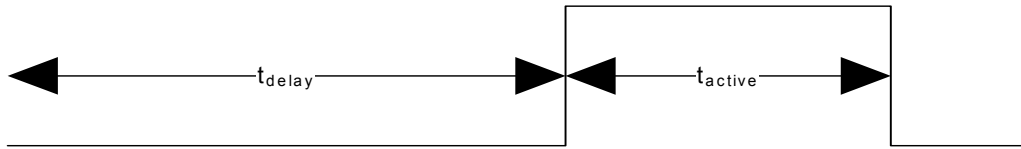


TABLE 38-12: CPU\_RESET TIMING PARAMETERS

| NAME                | DESCRIPTION                 | MIN | TYP | MAX  | UNITS         |
|---------------------|-----------------------------|-----|-----|------|---------------|
| $t_{\text{delay}}$  | Delay prior to active pulse | 14  | 15  | 15.5 | $\mu\text{s}$ |
| $t_{\text{active}}$ | Active pulse width          | 6   | 8   | 8.5  | $\mu\text{s}$ |

**Note 38-12** [Figure 38-14](#) and [Table 38-12](#) refer to [FIGURE 11-5: CPU\\_RESET Implementation Diagram on page 152](#) in which CPU\_RESET is the inverse of ALT\_RST# & KRESET.

**Note 38-13** The KBRST pin function is the output of CPU\_RESET described in [Section 11.11.2, "CPU\\_RESET Hardware Speed-Up," on page 151](#).

## 38.9 Keyboard Scan Matrix Timing

TABLE 38-13: ACTIVE PRE DRIVE MODE TIMING

| Parameter            | Symbol                | Value |      |      | Units |
|----------------------|-----------------------|-------|------|------|-------|
|                      |                       | MIN   | TYP  | MAX  |       |
| Active Predrive Mode | $t_{\text{PREDRIVE}}$ | 40.87 | 41.7 | 42.5 | ns    |

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## 38.10 PS/2 Timing

FIGURE 38-15: PS/2 TRANSMIT TIMING

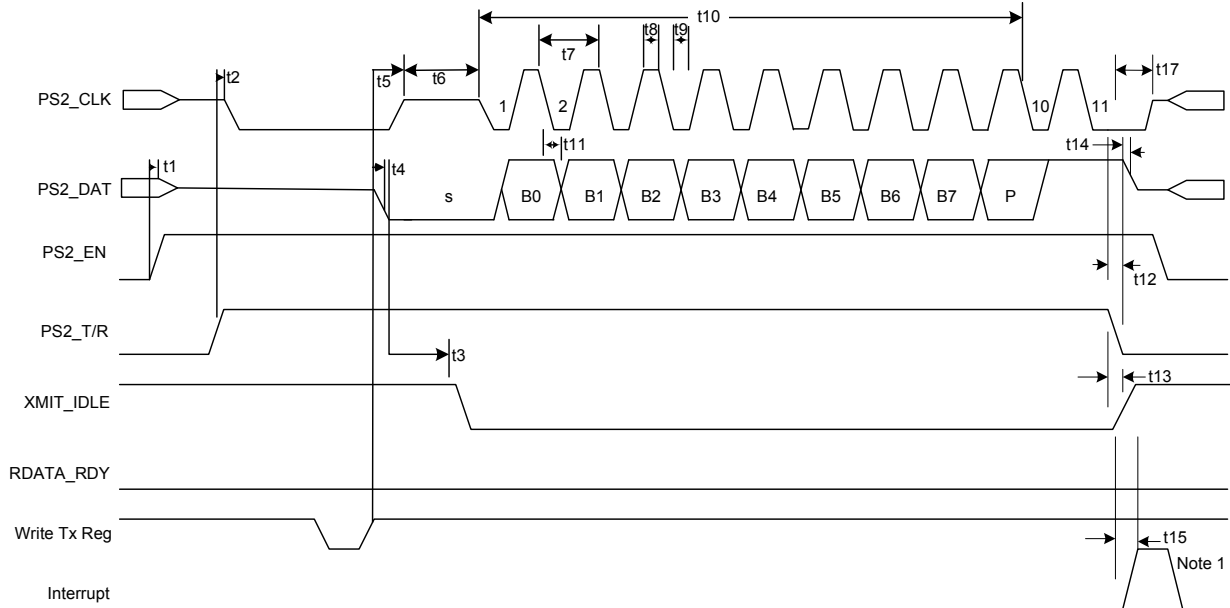


TABLE 38-14: PS/2 CHANNEL TRANSMISSION TIMING PARAMETERS

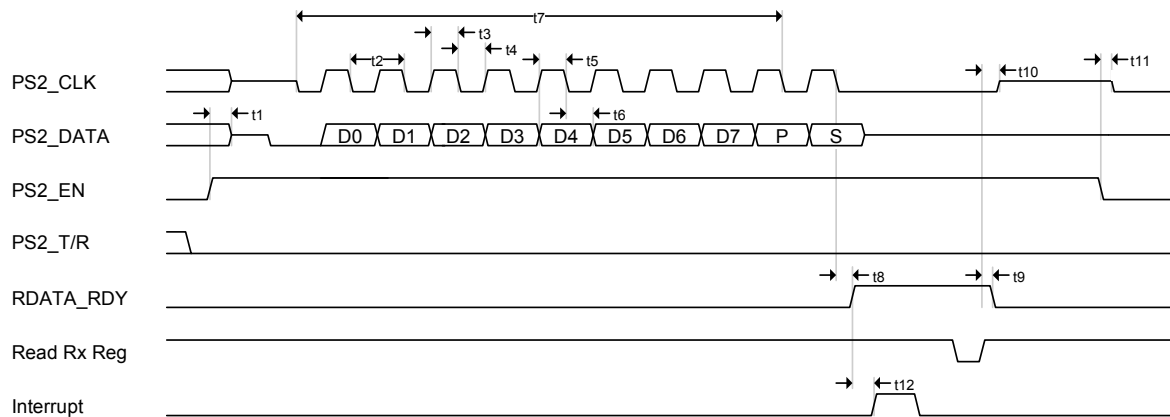
| Name | Description   | MIN   | TYP | MAX    | Units |
|------|---|-------|-----|--------|-------|
| t1   | The PS/2 Channel's CLK and DATA lines are floated following PS2_EN=1 and PS2_T/R=0.   |       |     | 1000   | ns    |
| t2   | PS2_T/R bit set to CLK driven low preparing the PS/2 Channel for data transmission.   |       |     |        |       |
| t3   | CLK line floated to XMIT_IDLE bit deasserted.   |       |     | 1.7    |       |
| t4   | Trailing edge of WR to Transmit Register to DATA line driven low.   | 45    |     | 90     |       |
| t5   | Trailing edge of EC WR of Transmit Register to CLK line floated.  | 90    |     | 130    | ns    |
| t6   | Initiation of Start of Transmit cycle by the PS/2 channel controller to the auxiliary peripheral's responding by latching the Start bit and driving the CLK line low. | 0.002 |     | 25.003 | ms    |
| t7   | Period of CLK   | 60    |     | 302    | μs    |
| t8   | Duration of CLK high (active)   | 30    |     | 151    |       |
| t9   | Duration of CLK low (inactive)  |       |     |        |       |
| t10  | Duration of Data Frame. Falling edge of Start bit CLK (1st clk) to falling edge of Parity bit CLK (10th clk).   |       |     | 2.002  | ms    |



**TABLE 38-14: PS/2 CHANNEL TRANSMISSION TIMING PARAMETERS (CONTINUED)**

| Name | Description  | MIN | TYP | MAX | Units |
|------|--|-----|-----|-----|-------|
| t11  | DATA output by MEC1322 following the falling edge of CLK. The auxiliary peripheral device samples DATA following the rising edge of CLK.         |     |     | 1.0 | μs    |
| t12  | Rising edge following the 11th falling clock edge to PS_T/R bit driven low.  | 3.5 |     | 7.1 | μs    |
| t13  | Trailing edge of PS_T/R to XMIT_IDLE bit asserted.   |     |     | 500 | ns    |
| t14  | DATA released to high-Z following the PS2_T/R bit going low.   |     |     |     |       |
| t15  | XMIT_IDLE bit driven high to interrupt generated.<br>Note1- Interrupt is cleared by writing a 1 to the status bit in the GIRQ17 source register. |     |     |     |       |
| t17  | Trailing edge of CLK is held low prior to going high-Z   |     |     |     |       |

**FIGURE 38-16: PS/2 RECEIVE TIMING**



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**TABLE 38-15: PS/2 CHANNEL RECEIVE TIMING DIAGRAM PARAMETERS**

| Name | Description   | MIN | TYP | MAX   | Units |
|------|---|-----|-----|-------|-------|
| t1   | The PS/2 Channel's CLK and DATA lines are floated following PS2_EN=1 and PS2_T/R=0.                           |     |     | 1000  | ns    |
| t2   | Period of CLK   | 60  |     | 302   | μs    |
| t3   | Duration of CLK high (active)   | 30  |     | 151   |       |
| t4   | Duration of CLK low (inactive)  |     |     |       |       |
| t5   | DATA setup time to falling edge of CLK. MEC1322 samples the data line on the falling CLK edge.                | 1   |     |       |       |
| t6   | DATA hold time from falling edge of CLK. MEC1322 samples the data line on the falling CLK edge.               | 2   |     |       |       |
| t7   | Duration of Data Frame. Falling edge of Start bit CLK (1st clk) to falling edge of Parity bit CLK (10th clk). |     |     | 2.002 | ms    |
| t8   | Falling edge of 11th CLK to RDATA_RDY asserted.   |     |     | 1.6   | μs    |
| t9   | Trailing edge of the EC's RD signal of the Receive Register to RDATA_RDY bit de-asserted.                     |     |     | 500   | ns    |
| t10  | Trailing edge of the EC's RD signal of the Receive Register to the CLK line released to high-Z.               |     |     |       |       |
| t11  | PS2_CLK is "Low" and PS2_DATA is "Hi-Z" when PS2_EN is de-asserted.   |     |     |       |       |
| t12  | RDATA_RDY asserted an interrupt is generated.   |     |     |       |       |

## 38.11 PWM Timing

FIGURE 38-17: PWM OUTPUT TIMING

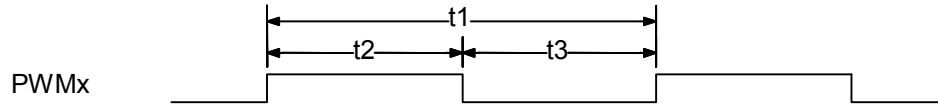


TABLE 38-16: PWM TIMING PARAMETERS

| Name  | Description | MIN    | TYP | MAX     | Units |
|-------|-------------|--------|-----|---------|-------|
| $t_1$ | Period      | 42ns   |     | 23.3sec |       |
| $f_f$ | Frequency   | 0.04Hz |     | 24MHz   |       |
| $t_2$ | High Time   | 0      |     | 11.65   | sec   |
| $t_3$ | Low Time    | 0      |     | 11.65   | sec   |
| $t_d$ | Duty cycle  | 0      |     | 100     | %     |

## 38.12 Fan Tachometer Timing

FIGURE 38-18: FAN TACHOMETER INPUT TIMING

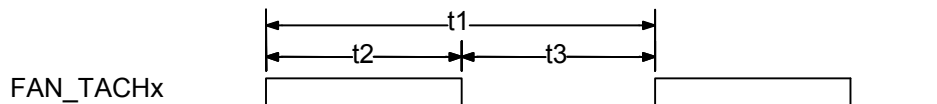


TABLE 38-17: FAN TACHOMETER INPUT TIMING PARAMETERS

| Name | Description     | MIN | TYP | MAX | Units |
|------|-----------------|-----|-----|-----|-------|
| t1   | Pulse Time      | 100 |     |     | μsec  |
| t2   | Pulse High Time | 20  |     |     |       |
| t3   | Pulse Low Time  | 20  |     |     |       |

**Note:**  $t_{TACH}$  is the clock used for the tachometer counter. It is  $30.52 * \text{prescaler}$ , where the prescaler is programmed in the Fan Tachometer Timebase Prescaler register.

## 38.13 Blinking/Breathing PWM Timing

FIGURE 38-19: BLINKING/BREATHING PWM OUTPUT TIMING

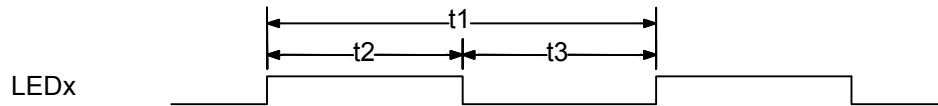


TABLE 38-18: BLINKING/BREATHING PWM TIMING PARAMETERS, BLINKING MODE

| Name           | Description | MIN     | TYP | MAX   | Units |
|----------------|-------------|---------|-----|-------|-------|
| t1             | Period      | 7.8ms   |     | 32sec |       |
| t <sub>f</sub> | Frequency   | 0.03125 |     | 128   | Hz    |
| t2             | High Time   | 0       |     | 16    | sec   |
| t3             | Low Time    | 0       |     | 16    | sec   |
| t <sub>d</sub> | Duty cycle  | 0       |     | 100   | %     |

TABLE 38-19: BLINKING/BREATHING PWM TIMING PARAMETERS, GENERAL PURPOSE

| Name           | Description | MIN    | TYP | MAX      | Units |
|----------------|-------------|--------|-----|----------|-------|
| t1             | Period      | 5.3us  |     | 21.8ms   |       |
| t <sub>f</sub> | Frequency   | 45.8Hz |     | 187.5kHz |       |
| t2             | High Time   | 0      |     | 10.9     | ms    |
| t3             | Low Time    | 0      |     | 10.9     | ms    |
| t <sub>d</sub> | Duty cycle  | 0      |     | 100      | %     |

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## 38.14 I<sup>2</sup>C/SMBus Timing

FIGURE 38-20: I<sup>2</sup>C/SMBUS TIMING

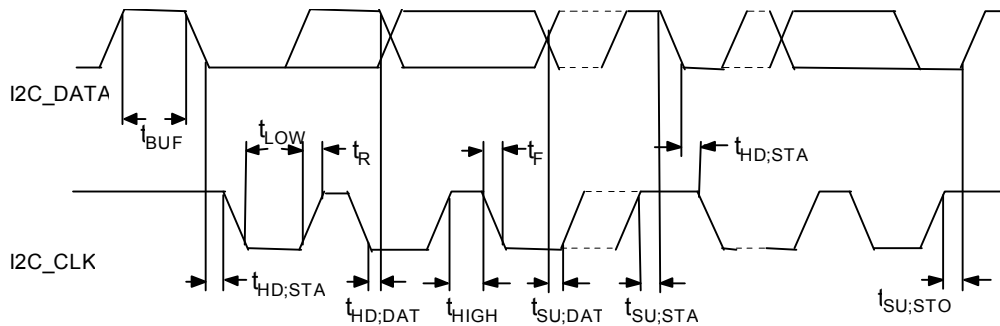
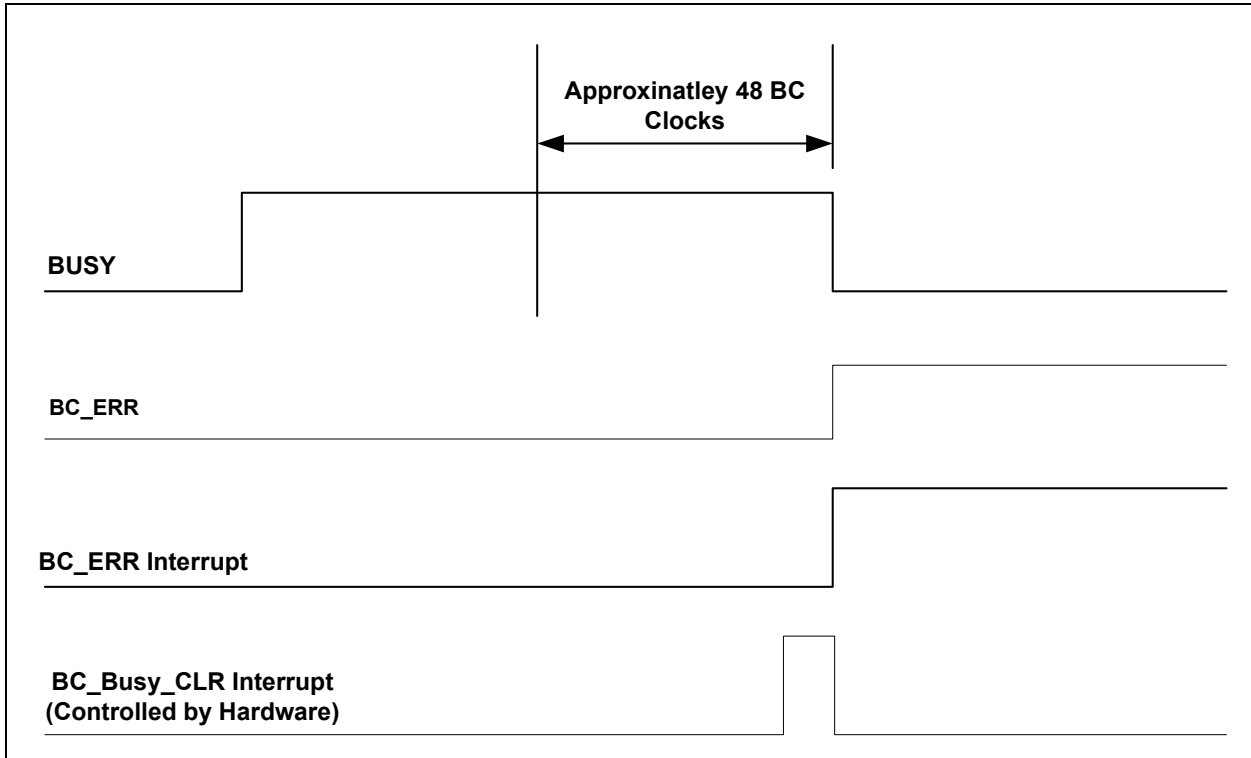


TABLE 38-20: I<sup>2</sup>C/SMBUS TIMING PARAMETERS

| Symbol       | Parameter                   | Standard-Mode |      | Fast-Mode |      | Fast-Mode Plus |      | Units   |
|--------------|-----------------------------|---------------|------|-----------|------|----------------|------|---------|
|              |                             | MIN.          | MAX. | MIN.      | MAX. | MIN.           | MAX. |         |
| $f_{SCL}$    | SCL Clock Frequency         |               | 100  |           | 400  |                | 1000 | kHz     |
| $t_{BUF}$    | Bus Free Time               | 4.7           |      | 1.3       |      | 0.5            |      | $\mu$ s |
| $t_{SU;STA}$ | START Condition Set-Up Time | 4.7           |      | 0.6       |      | 0.26           |      | $\mu$ s |
| $t_{HD;STA}$ | START Condition Hold Time   | 4.0           |      | 0.6       |      | 0.26           |      | $\mu$ s |
| $t_{LOW}$    | SCL LOW Time                | 4.7           |      | 1.3       |      | 0.5            |      | $\mu$ s |
| $t_{HIGH}$   | SCL HIGH Time               | 4.0           |      | 0.6       |      | 0.26           |      | $\mu$ s |
| $t_R$        | SCL and SDA Rise Time       |               | 1.0  |           | 0.3  |                | 0.12 | $\mu$ s |
| $t_F$        | SCL and SDA Fall Time       |               | 0.3  |           | 0.3  |                | 0.12 | $\mu$ s |
| $t_{SU;DAT}$ | Data Set-Up Time            | 0.25          |      | 0.1       |      | 0.05           |      | $\mu$ s |
| $t_{HD;DAT}$ | Data Hold Time              | 0             |      | 0         |      | 0              |      | $\mu$ s |
| $t_{SU;STO}$ | STOP Condition Set-Up Time  | 4.0           |      | 0.6       |      | 0.26           |      | $\mu$ s |

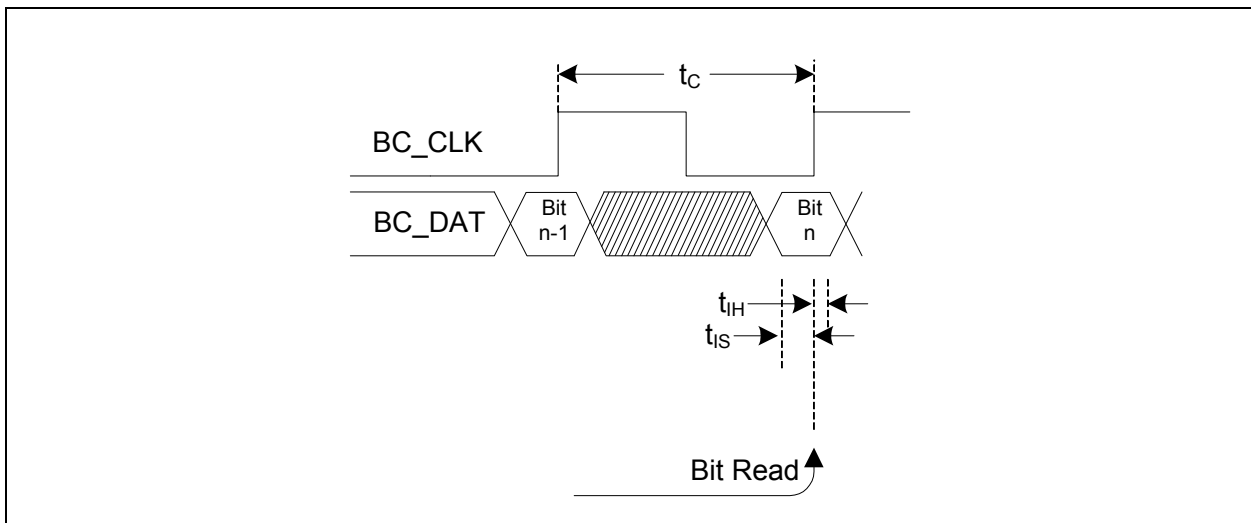
## 38.15 BC-Link Master Interrupt Timing

FIGURE 38-21: BC-LINK ERR INTERRUPT TIMING

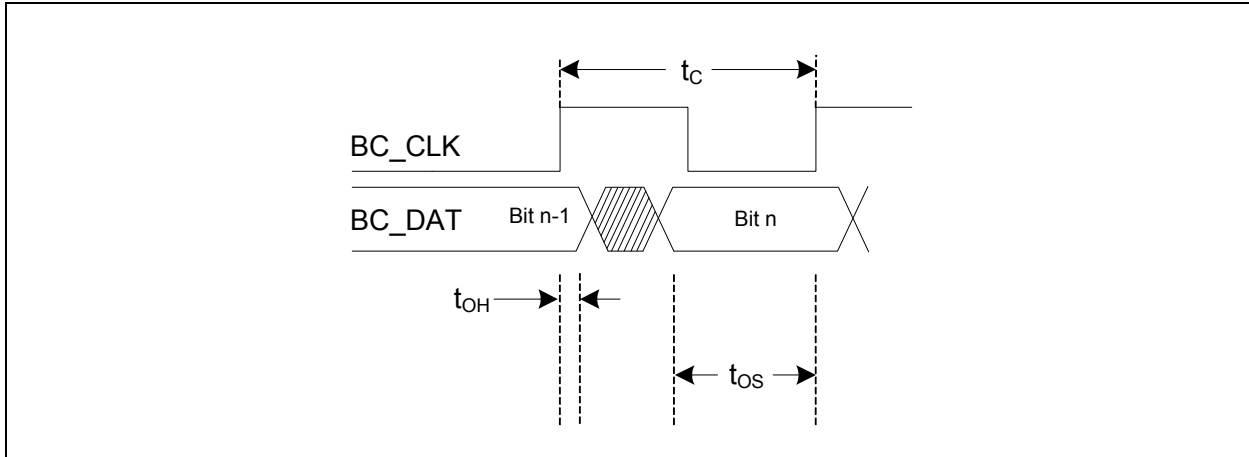


## 38.16 BC-Link Master Timing

FIGURE 38-22: BC-LINK READ TIMING



**FIGURE 38-23: BC-LINK WRITE TIMING**



**TABLE 38-21: BC-LINK MASTER TIMING DIAGRAM PARAMETERS**

| Name                     | Description  | MIN  | TYP   | MAX                | Units |
|--------------------------|--|------|-------|--------------------|-------|
| $t_c(\text{High Speed})$ | High Spec BC Clock Frequency                                     | 23.5 | 24    | 24.5               | MHz   |
|                          | High Spec BC Clock Period  | 40.8 | 41.67 | 42.5               | ns    |
| $t_{OS}$                 | BC-Link Master DATA output setup time before rising edge of CLK. |      |       | $t_c - t_{OH-MAX}$ | nsec  |
| $t_{OH}$                 | BC-Link Master Data hold time after falling edge of CLK          |      |       | 10                 | nsec  |
| $t_{IS}$                 | BC-Link Master DATA input setup time before rising edge of CLK.  | 15   |       |                    | nsec  |
| $t_{IH}$                 | BC-Link Master DATA input hold time after rising edge of CLK.    | 0    |       |                    | nsec  |

- Note 1:** The BC-Link Master DATA input ( $t_{IH}$  in [Table 38-21](#)) must be stable before next rising edge of CLK.
- 2:** The BC-Link Clock frequency is limited by the application usage model (see BC-Link Master [Section 31.5, Signal Description](#)). The BC-Link Clock frequency is controlled by the BC-Link Clock Select Register. The  $t_c(\text{High Speed})$  parameter implies both BC-link master and companion devices are located on the same circuit board and a high speed clock setting is possible.

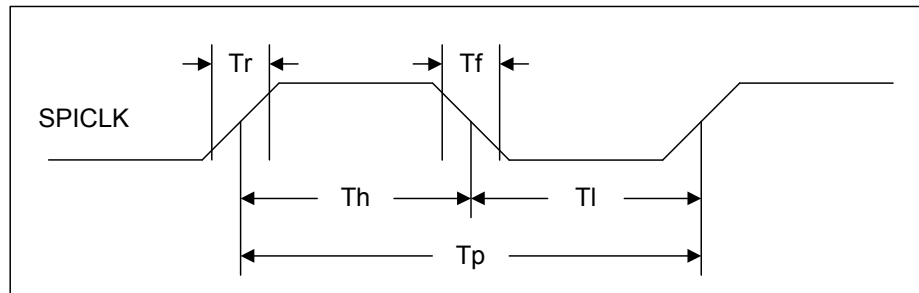
**Note:** The timing budget equation is as follows for data from BC-Link slave to master:  

$$T_c > T_{OD}(\text{master-clk}) + T_{prop}(\text{clk}) + T_{OD}(\text{slave}) + T_{prop}(\text{slave data}) + T_{IS}(\text{master}).$$



## 38.17 Serial Peripheral Interface (SPI) Timings

**FIGURE 38-24: SPI CLOCK TIMING**



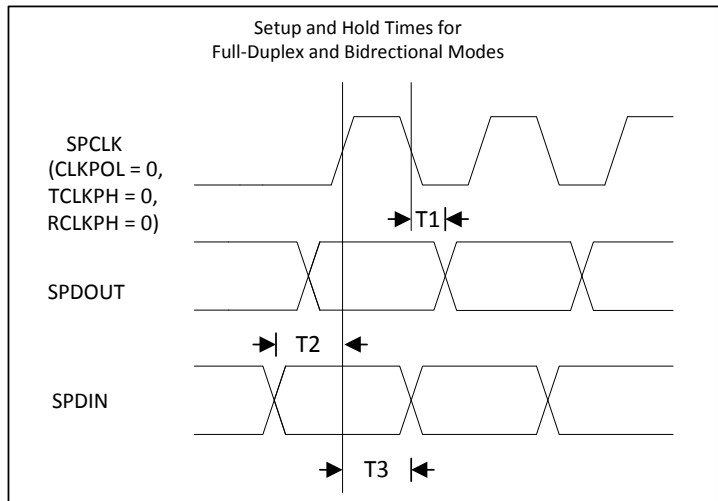
**TABLE 38-22: SPI CLOCK TIMING PARAMETERS**

| NAME      | DESCRIPTION  | MIN                 | TYP                 | MAX                 | UNITS |
|-----------|--|---------------------|---------------------|---------------------|-------|
| $T_r$     | SPI Clock Rise Time. Measured from 10% to 90%.                 |                     |                     | 10% of SPCLK Period | ns    |
| $T_f$     | SPI Clock Fall Time. Measured from 90% to 10%.                 |                     |                     | 10% of SPCLK Period | ns    |
| $T_h/T_l$ | SPI Clock High Time/SPI Clock Low Time                         | 40% of SPCLK Period | 50% of SPCLK Period | 60% of SPCLK Period | ns    |
| $T_p$     | SPI Clock Period – As selected by SPI Clock Generator Register | 20.8 (Note 38-14)   |                     | 62492.25            | ns    |

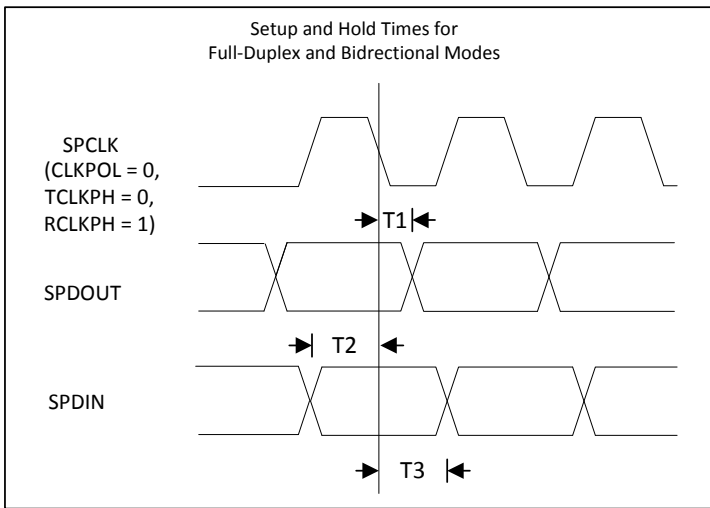
**Note 38-14** This timing value applies when the 48MHz ring oscillator is at its 48MHz operating frequency (with 32 kHz present after frequency lock to 48MHz).

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**FIGURE 38-25: SPI SETUP AND HOLD TIMES, CLKPOL=0, TCLKPH=0, RCLKPH=0**



**FIGURE 38-26: SPI SETUP AND HOLD TIMES, CLKPOL=0, TCLKPH=0, RCLKPH=1**



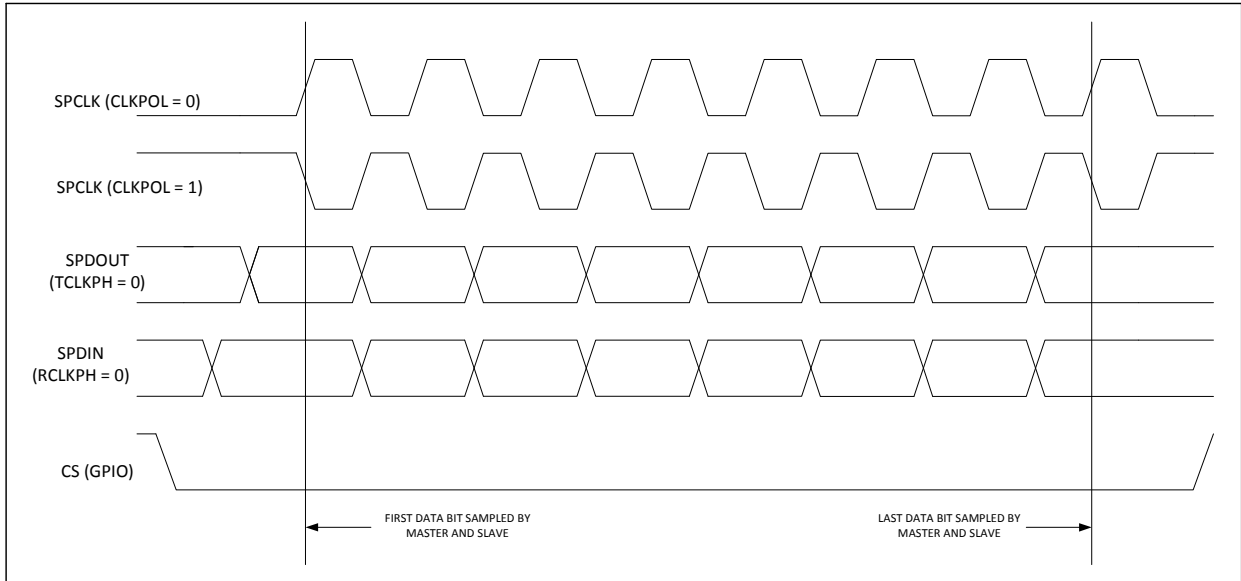
**TABLE 38-23: SPI SETUP AND HOLD TIMES PARAMETERS**

| NAME | DESCRIPTION        | MIN | TYP | MAX | UNITS |
|------|--------------------|-----|-----|-----|-------|
| T1   | Data Output Delay  |     |     | 5   | ns    |
| T2   | Data IN Setup Time | 10  |     |     | ns    |
| T3   | Data IN Hold Time  | 0   |     |     | ns    |

## 38.17.1 SPI INTERFACE TIMINGS

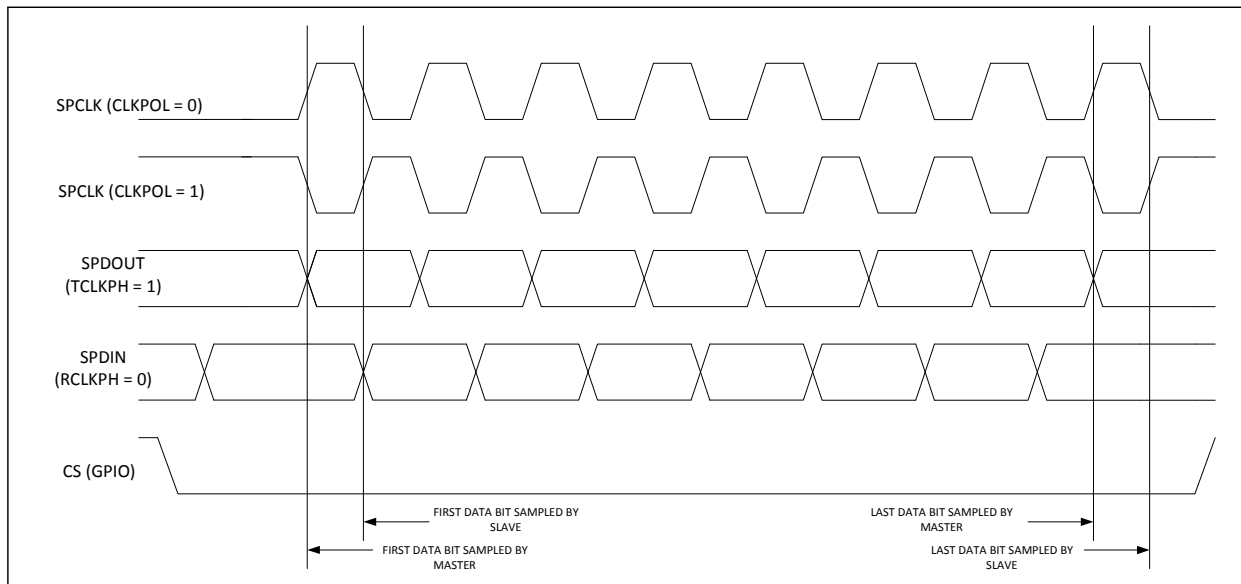
The following timing diagrams represent a single-byte transfer over the SPI interface using different SPCLK phase settings. Data bits are transmitted in bit order starting with the MSB (LSBF='0') or the LSB (LSBF='1'). See the [SPI Control Register](#) for information on the LSBF bit. The CS signal in each diagram is a generic bit-controlled chip select signal required by most peripheral devices. This signal and additional chip selects can be GPIO controlled. Note that these timings for Full Duplex Mode are also applicable to Half Duplex (or Bi-directional) mode.

**FIGURE 38-27: INTERFACE TIMING, FULL DUPLEX MODE (TCLKPH = 0, RCLKPH = 0)**



In this mode, data is available immediately when a device is selected and is sampled on the first and following odd SPCLK edges by the master and slave.

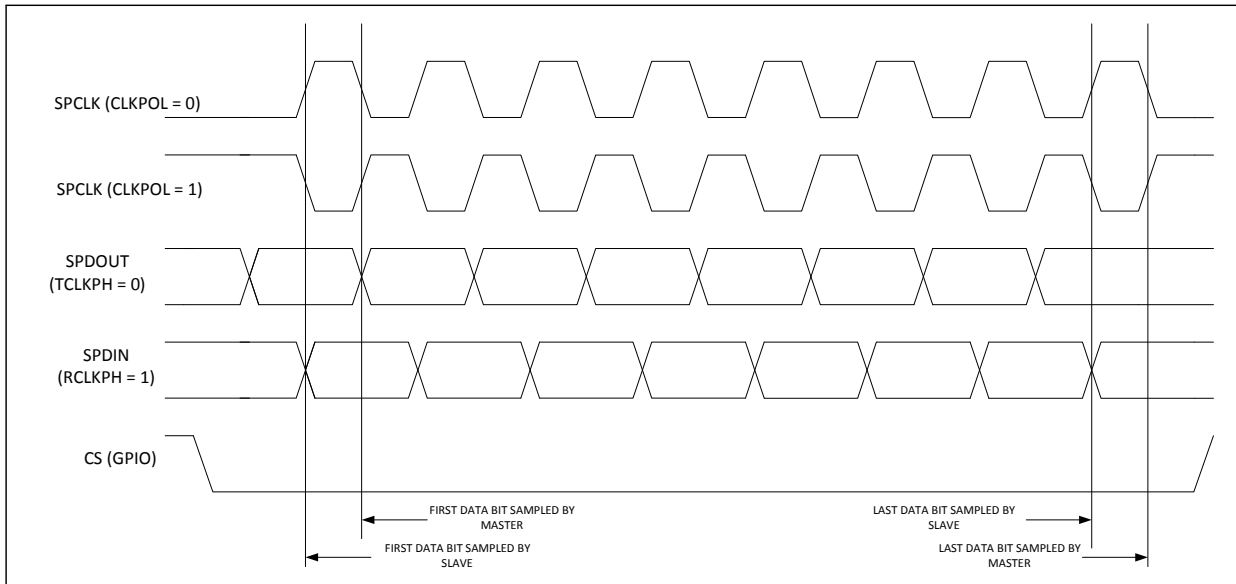
**FIGURE 38-28: SPI INTERFACE TIMING, FULL DUPLEX MODE (TCLKPH = 1, RCLKPH = 0)**



In this mode, the master requires an initial SPCLK edge before data is available. The data from slave is available immediately when the slave device is selected. The data is sampled on the first and following odd edges by the master. The data is sampled on the second and following even SPCLK edges by the slave.

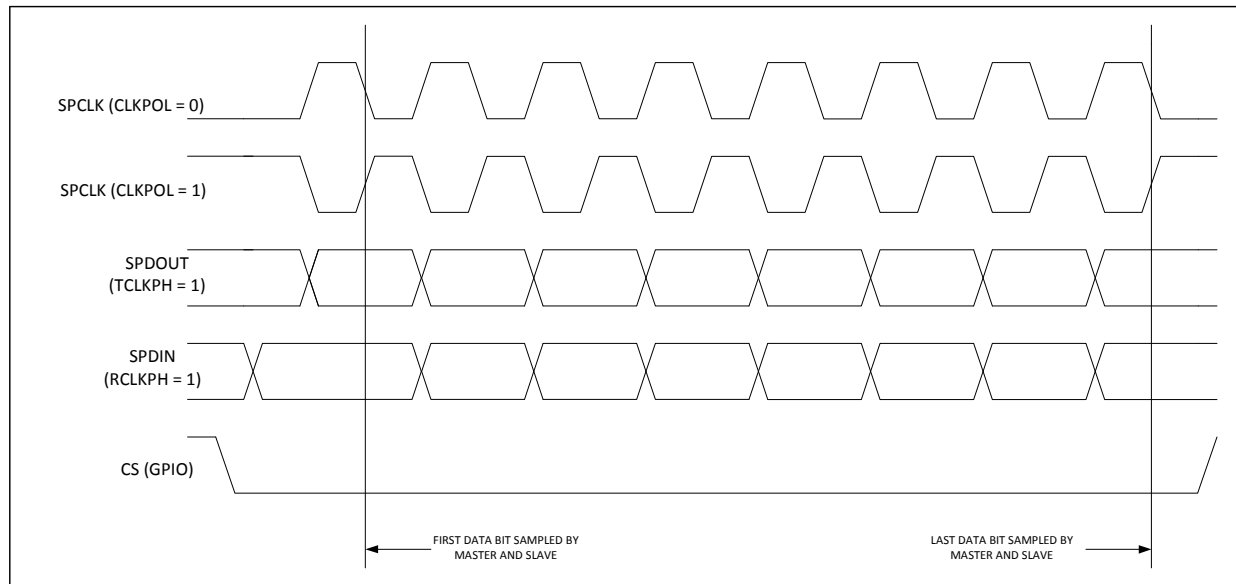
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**FIGURE 38-29: SPI INTERFACE TIMING, FULL DUPLEX MODE (TCLKPH = 0, RCLKPH = 1)**



In this mode, the data from slave is available immediately when the slave device is selected. The slave device requires an initial  $SPCLK$  edge before data is available. The data is sampled on the second and following even  $SPCLK$  edges by the master. The data is sampled on the first and following odd edges by the slave.

**FIGURE 38-30: SPI INTERFACE TIMING - FULL DUPLEX MODE (TCLKPH = 1, RCLKPH = 1)**



In this mode, the master and slave require an initial  $SPCLK$  edge before data is available. Data is sampled on the second and following even  $SPCLK$  edges by the master and slave.

## 38.18 Serial Debug Port Timing

FIGURE 38-31: SERIAL DEBUG PORT TIMING PARAMETERS

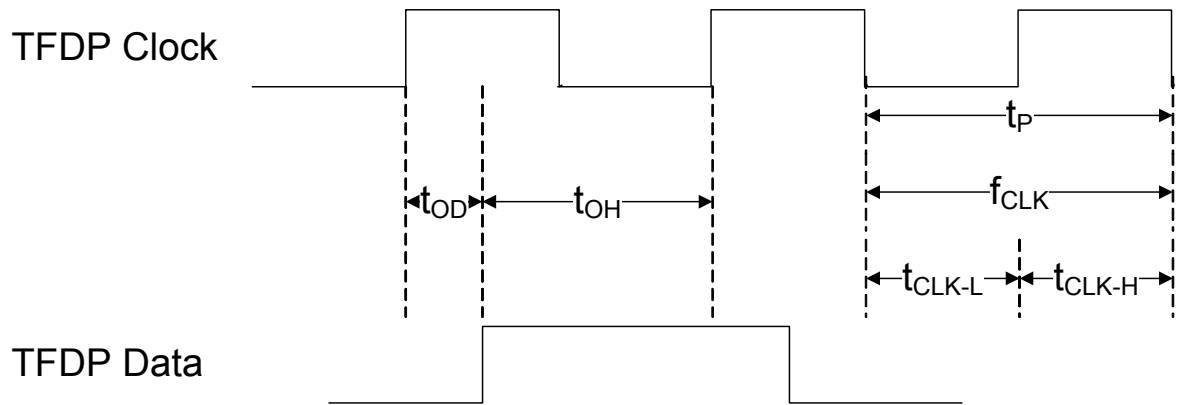


TABLE 38-24: SERIAL DEBUG PORT INTERFACE TIMING PARAMETERS

| Name        | Description  | MIN            | TYP | MAX         | Units   |
|-------------|--|----------------|-----|-------------|---------|
| $f_{clk}$   | TFDP Clock frequency (Note 38-15)                    | 6              | -   | 24          | MHz     |
| $t_p$       | TFDP Clock Period.                                   | 1/fclk         |     |             | $\mu$ s |
| $t_{OD}$    | TFDP Data output delay after falling edge of MSCLK.  |                |     | 5           | nsec    |
| $t_{OH}$    | TFDP Data hold time after falling edge of TFDP Clock | $t_p - t_{OD}$ |     |             | nsec    |
| $t_{CLK-L}$ | TFDP Clock Low Time                                  | $t_p/2 - 3$    |     | $t_p/2 + 3$ | nsec    |
| $t_{CLK-H}$ | TFDP Clock high Time (see Note 38-15)                | $t_p/2 - 3$    |     | $t_p/2 + 3$ | nsec    |

**Note 38-15** When the clock divider for the embedded controller is an odd number value greater than 2h, then  $t_{CLK-L} = t_{CLK-H} + 15$  ns. When the clock divider for the embedded controller is 0h, 1h, or an even number value greater than 2h, then  $t_{CLK-L} = t_{CLK-H}$ .

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## 38.19 JTAG Interface Timing

FIGURE 38-32: JTAG POWER-UP & ASYNCHRONOUS RESET TIMING

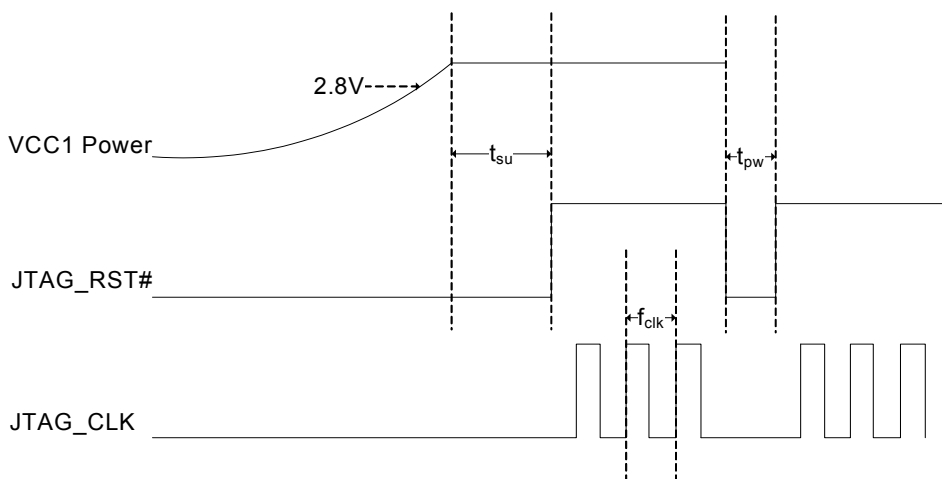


FIGURE 38-33: JTAG SETUP & HOLD PARAMETERS

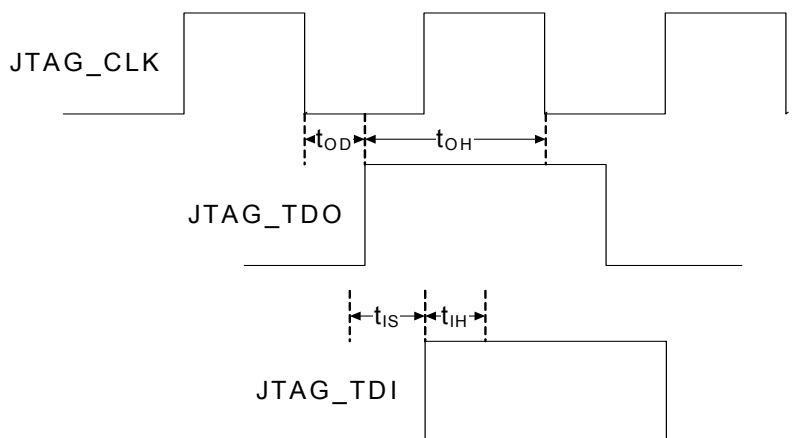


TABLE 38-25: JTAG INTERFACE TIMING PARAMETERS

| Name      | Description  | MIN                       | TYP | MAX | Units |
|-----------|--|---------------------------|-----|-----|-------|
| $t_{su}$  | JTAG_RST# de-assertion after VCC1 power is applied | 5                         |     |     | ms    |
| $t_{pw}$  | JTAG_RST# assertion pulse width                    | 500                       |     |     | nsec  |
| $f_{clk}$ | JTAG_CLK frequency (see note)                      |                           |     | 48  | MHz   |
| $t_{OD}$  | TDO output delay after falling edge of TCLK.       | 5                         |     | 10  | nsec  |
| $t_{OH}$  | TDO hold time after falling edge of TCLK           | $1 \text{ TCLK} - t_{OD}$ |     |     | nsec  |
| $t_{IS}$  | TDI setup time before rising edge of TCLK.         | 5                         |     |     | nsec  |
| $t_{IH}$  | TDI hold time after rising edge of TCLK.           | 5                         |     |     | nsec  |

**Note:**  $f_{clk}$  is the maximum frequency to access a JTAG Register.

## 39.0 MEMORY MAP

| Address (Hex) | HW Block Instance Name   | HW Block Instance No. | Reg. Bank Name      | Reg. Instance Name     |
|---------------|--------------------------|-----------------------|---------------------|------------------------|
| 0             | 32K ROM                  | 0                     | 32K ROM             | 32K ROM                |
| 100000        | 128K SRAM                | 0                     | 128K SRAM           | 128K SRAM              |
| 40000400      | Watchdog Timer Interface | 0                     | WDT Registers       | WDT Load Register      |
| 40000404      | Watchdog Timer Interface | 0                     | WDT Registers       | WDT Control Register   |
| 40000408      | Watchdog Timer Interface | 0                     | WDT Registers       | WDT Kick Register      |
| 4000040C      | Watchdog Timer Interface | 0                     | WDT Registers       | WDT Count Register     |
| 40000C00      | Basic Timer              | 0                     | Basic_Timer_EC_Only | Timer Count            |
| 40000C04      | Basic Timer              | 0                     | Basic_Timer_EC_Only | Timer Preload          |
| 40000C08      | Basic Timer              | 0                     | Basic_Timer_EC_Only | Timer Status           |
| 40000C0C      | Basic Timer              | 0                     | Basic_Timer_EC_Only | Timer Interrupt Enable |
| 40000C10      | Basic Timer              | 0                     | Basic_Timer_EC_Only | Timer Control          |
| 40000C20      | Basic Timer              | 1                     | Basic_Timer_EC_Only | Timer Count            |
| 40000C24      | Basic Timer              | 1                     | Basic_Timer_EC_Only | Timer Preload          |
| 40000C28      | Basic Timer              | 1                     | Basic_Timer_EC_Only | Timer Status           |
| 40000C2C      | Basic Timer              | 1                     | Basic_Timer_EC_Only | Timer Interrupt Enable |
| 40000C30      | Basic Timer              | 1                     | Basic_Timer_EC_Only | Timer Control          |
| 40000C40      | Basic Timer              | 2                     | Basic_Timer_EC_Only | Timer Count            |
| 40000C44      | Basic Timer              | 2                     | Basic_Timer_EC_Only | Timer Preload          |
| 40000C48      | Basic Timer              | 2                     | Basic_Timer_EC_Only | Timer Status           |
| 40000C4C      | Basic Timer              | 2                     | Basic_Timer_EC_Only | Timer Interrupt Enable |
| 40000C50      | Basic Timer              | 2                     | Basic_Timer_EC_Only | Timer Control          |
| 40000C60      | Basic Timer              | 3                     | Basic_Timer_EC_Only | Timer Count            |
| 40000C64      | Basic Timer              | 3                     | Basic_Timer_EC_Only | Timer Preload          |
| 40000C68      | Basic Timer              | 3                     | Basic_Timer_EC_Only | Timer Status           |
| 40000C6C      | Basic Timer              | 3                     | Basic_Timer_EC_Only | Timer Interrupt Enable |
| 40000C70      | Basic Timer              | 3                     | Basic_Timer_EC_Only | Timer Control          |
| 40000C80      | Basic Timer              | 4                     | Basic_Timer_EC_Only | Timer Count            |
| 40000C84      | Basic Timer              | 4                     | Basic_Timer_EC_Only | Timer Preload          |
| 40000C88      | Basic Timer              | 4                     | Basic_Timer_EC_Only | Timer Status           |
| 40000C8C      | Basic Timer              | 4                     | Basic_Timer_EC_Only | Timer Interrupt Enable |
| 40000C90      | Basic Timer              | 4                     | Basic_Timer_EC_Only | Timer Control          |
| 40000CA0      | Basic Timer              | 5                     | Basic_Timer_EC_Only | Timer Count            |
| 40000CA4      | Basic Timer              | 5                     | Basic_Timer_EC_Only | Timer Preload          |
| 40000CA8      | Basic Timer              | 5                     | Basic_Timer_EC_Only | Timer Status           |
| 40000CAC      | Basic Timer              | 5                     | Basic_Timer_EC_Only | Timer Interrupt Enable |
| 40000CB0      | Basic Timer              | 5                     | Basic_Timer_EC_Only | Timer Control          |
| 40001800      | SMB Device Interface     | 0                     | SMB_EC_Only         | Status Register        |
| 40001800      | SMB Device Interface     | 0                     | SMB_EC_Only         | Control Register       |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                    |
|---------------|------------------------|-----------------------|----------------|---------------------------------------|
| 40001801      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001804      | SMB Device Interface   | 0                     | SMB_EC_Only    | Own Address Register                  |
| 40001806      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001808      | SMB Device Interface   | 0                     | SMB_EC_Only    | Data                                  |
| 40001809      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 4000180C      | SMB Device Interface   | 0                     | SMB_EC_Only    | SMBus Master Command Register         |
| 40001810      | SMB Device Interface   | 0                     | SMB_EC_Only    | SMBus Slave Command Register          |
| 40001814      | SMB Device Interface   | 0                     | SMB_EC_Only    | PEC Register                          |
| 40001815      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001818      | SMB Device Interface   | 0                     | SMB_EC_Only    | DATA_TIMING2                          |
| 40001819      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001820      | SMB Device Interface   | 0                     | SMB_EC_Only    | Completion Register                   |
| 40001824      | SMB Device Interface   | 0                     | SMB_EC_Only    | Idle Scaling Register                 |
| 40001828      | SMB Device Interface   | 0                     | SMB_EC_Only    | Configuration Register                |
| 4000182C      | SMB Device Interface   | 0                     | SMB_EC_Only    | Bus Clock Register                    |
| 4000182E      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001830      | SMB Device Interface   | 0                     | SMB_EC_Only    | Block ID Register                     |
| 40001831      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001834      | SMB Device Interface   | 0                     | SMB_EC_Only    | Revision Register                     |
| 40001835      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001838      | SMB Device Interface   | 0                     | SMB_EC_Only    | Bit-Bang Control Register             |
| 40001839      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 4000183C      | SMB Device Interface   | 0                     | SMB_EC_Only    | Clock Sync                            |
| 40001840      | SMB Device Interface   | 0                     | SMB_EC_Only    | Data Timing Register                  |
| 40001844      | SMB Device Interface   | 0                     | SMB_EC_Only    | Time-Out Scaling Register             |
| 40001848      | SMB Device Interface   | 0                     | SMB_EC_Only    | SMBus Slave Transmit Buffer Register  |
| 40001849      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 4000184C      | SMB Device Interface   | 0                     | SMB_EC_Only    | SMBus Slave Receive Buffer Register   |
| 4000184D      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001850      | SMB Device Interface   | 0                     | SMB_EC_Only    | SMBus Master Transmit Buffer Register |
| 40001851      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40001854      | SMB Device Interface   | 0                     | SMB_EC_Only    | SMBus Master Receive Buffer Register  |
| 40001855      | SMB Device Interface   | 0                     | SMB_EC_Only    | Reserved                              |
| 40002400      | DMA                    | 0                     | DMA Main       | DMA Main Control Register             |
| 40002401      | DMA                    | 0                     | DMA Main       | DMA Reserved                          |
| 40002404      | DMA                    | 0                     | DMA Main       | DMA Data Register                     |
| 40002410      | DMA                    | 0                     | DMA_CH0        | DMA Activate Register                 |
| 40002414      | DMA                    | 0                     | DMA_CH0        | DMA Memory Start Address Register     |



| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                |
|---------------|------------------------|-----------------------|----------------|-----------------------------------|
| 40002418      | DMA                    | 0                     | DMA_CH0        | DMA Memory End Address Register   |
| 4000241C      | DMA                    | 0                     | DMA_CH0        | AHB Address Register              |
| 40002420      | DMA                    | 0                     | DMA_CH0        | DMA Control Register              |
| 40002424      | DMA                    | 0                     | DMA_CH0        | DMA Channel Interrupt Status      |
| 40002428      | DMA                    | 0                     | DMA_CH0        | DMA Channel Interrupt Enable      |
| 4000242C      | DMA                    | 0                     | DMA_CH0        | DMA Test Register                 |
| 40002430      | DMA                    | 0                     | DMA_CH1        | DMA Activate Register             |
| 40002434      | DMA                    | 0                     | DMA_CH1        | DMA Memory Start Address Register |
| 40002438      | DMA                    | 0                     | DMA_CH1        | DMA Memory End Address Register   |
| 4000243C      | DMA                    | 0                     | DMA_CH1        | AHB Address Register              |
| 40002440      | DMA                    | 0                     | DMA_CH1        | DMA Control Register              |
| 40002444      | DMA                    | 0                     | DMA_CH1        | DMA Channel Interrupt Status      |
| 40002448      | DMA                    | 0                     | DMA_CH1        | DMA Channel Interrupt Enable      |
| 4000244C      | DMA                    | 0                     | DMA_CH1        | DMA Test Register                 |
| 40002450      | DMA                    | 0                     | DMA_CH2        | DMA Activate Register             |
| 40002454      | DMA                    | 0                     | DMA_CH2        | DMA Memory Start Address Register |
| 40002458      | DMA                    | 0                     | DMA_CH2        | DMA Memory End Address Register   |
| 4000245C      | DMA                    | 0                     | DMA_CH2        | AHB Address Register              |
| 40002460      | DMA                    | 0                     | DMA_CH2        | DMA Control Register              |
| 40002464      | DMA                    | 0                     | DMA_CH2        | DMA Channel Interrupt Status      |
| 40002468      | DMA                    | 0                     | DMA_CH2        | DMA Channel Interrupt Enable      |
| 4000246C      | DMA                    | 0                     | DMA_CH2        | DMA Test Register                 |
| 40002470      | DMA                    | 0                     | DMA_CH3        | DMA Activate Register             |
| 40002474      | DMA                    | 0                     | DMA_CH3        | DMA Memory Start Address Register |
| 40002478      | DMA                    | 0                     | DMA_CH3        | DMA Memory End Address Register   |
| 4000247C      | DMA                    | 0                     | DMA_CH3        | AHB Address Register              |
| 40002480      | DMA                    | 0                     | DMA_CH3        | DMA Control Register              |
| 40002484      | DMA                    | 0                     | DMA_CH3        | DMA Channel Interrupt Status      |
| 40002488      | DMA                    | 0                     | DMA_CH3        | DMA Channel Interrupt Enable      |
| 4000248C      | DMA                    | 0                     | DMA_CH3        | DMA Test Register                 |
| 40002490      | DMA                    | 0                     | DMA_CH4        | DMA Activate Register             |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                |
|---------------|------------------------|-----------------------|----------------|-----------------------------------|
| 40002494      | DMA                    | 0                     | DMA_CH4        | DMA Memory Start Address Register |
| 40002498      | DMA                    | 0                     | DMA_CH4        | DMA Memory End Address Register   |
| 4000249C      | DMA                    | 0                     | DMA_CH4        | AHB Address Register              |
| 400024A0      | DMA                    | 0                     | DMA_CH4        | DMA Control Register              |
| 400024A4      | DMA                    | 0                     | DMA_CH4        | DMA Channel Interrupt Status      |
| 400024A8      | DMA                    | 0                     | DMA_CH4        | DMA Channel Interrupt Enable      |
| 400024AC      | DMA                    | 0                     | DMA_CH4        | DMA Test Register                 |
| 400024B0      | DMA                    | 0                     | DMA_CH5        | DMA Activate Register             |
| 400024B4      | DMA                    | 0                     | DMA_CH5        | DMA Memory Start Address Register |
| 400024B8      | DMA                    | 0                     | DMA_CH5        | DMA Memory End Address Register   |
| 400024BC      | DMA                    | 0                     | DMA_CH5        | AHB Address Register              |
| 400024C0      | DMA                    | 0                     | DMA_CH5        | DMA Control Register              |
| 400024C4      | DMA                    | 0                     | DMA_CH5        | DMA Channel Interrupt Status      |
| 400024C8      | DMA                    | 0                     | DMA_CH5        | DMA Channel Interrupt Enable      |
| 400024CC      | DMA                    | 0                     | DMA_CH5        | DMA Test Register                 |
| 400024D0      | DMA                    | 0                     | DMA_CH6        | DMA Activate Register             |
| 400024D4      | DMA                    | 0                     | DMA_CH6        | DMA Memory Start Address Register |
| 400024D8      | DMA                    | 0                     | DMA_CH6        | DMA Memory End Address Register   |
| 400024DC      | DMA                    | 0                     | DMA_CH6        | AHB Address Register              |
| 400024E0      | DMA                    | 0                     | DMA_CH6        | DMA Control Register              |
| 400024E4      | DMA                    | 0                     | DMA_CH6        | DMA Channel Interrupt Status      |
| 400024E8      | DMA                    | 0                     | DMA_CH6        | DMA Channel Interrupt Enable      |
| 400024EC      | DMA                    | 0                     | DMA_CH6        | DMA Test Register                 |
| 400024F0      | DMA                    | 0                     | DMA_CH7        | DMA Activate Register             |
| 400024F4      | DMA                    | 0                     | DMA_CH7        | DMA Memory Start Address Register |
| 400024F8      | DMA                    | 0                     | DMA_CH7        | DMA Memory End Address Register   |
| 400024FC      | DMA                    | 0                     | DMA_CH7        | AHB Address Register              |
| 40002500      | DMA                    | 0                     | DMA_CH7        | DMA Control Register              |
| 40002504      | DMA                    | 0                     | DMA_CH7        | DMA Channel Interrupt Status      |
| 40002508      | DMA                    | 0                     | DMA_CH7        | DMA Channel Interrupt Enable      |
| 4000250C      | DMA                    | 0                     | DMA_CH7        | DMA Test Register                 |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                |
|---------------|------------------------|-----------------------|----------------|-----------------------------------|
| 40002510      | DMA                    | 0                     | DMA_CH8        | DMA Activate Register             |
| 40002514      | DMA                    | 0                     | DMA_CH8        | DMA Memory Start Address Register |
| 40002518      | DMA                    | 0                     | DMA_CH8        | DMA Memory End Address Register   |
| 4000251C      | DMA                    | 0                     | DMA_CH8        | AHB Address Register              |
| 40002520      | DMA                    | 0                     | DMA_CH8        | DMA Control Register              |
| 40002524      | DMA                    | 0                     | DMA_CH8        | DMA Channel Interrupt Status      |
| 40002528      | DMA                    | 0                     | DMA_CH8        | DMA Channel Interrupt Enable      |
| 4000252C      | DMA                    | 0                     | DMA_CH8        | DMA Test Register                 |
| 40002530      | DMA                    | 0                     | DMA_CH9        | DMA Activate Register             |
| 40002534      | DMA                    | 0                     | DMA_CH9        | DMA Memory Start Address Register |
| 40002538      | DMA                    | 0                     | DMA_CH9        | DMA Memory End Address Register   |
| 4000253C      | DMA                    | 0                     | DMA_CH9        | AHB Address Register              |
| 40002540      | DMA                    | 0                     | DMA_CH9        | DMA Control Register              |
| 40002544      | DMA                    | 0                     | DMA_CH9        | DMA Channel Interrupt Status      |
| 40002548      | DMA                    | 0                     | DMA_CH9        | DMA Channel Interrupt Enable      |
| 4000254C      | DMA                    | 0                     | DMA_CH9        | DMA Test Register                 |
| 40002550      | DMA                    | 0                     | DMA_CH10       | DMA Activate Register             |
| 40002554      | DMA                    | 0                     | DMA_CH10       | DMA Memory Start Address Register |
| 40002558      | DMA                    | 0                     | DMA_CH10       | DMA Memory End Address Register   |
| 4000255C      | DMA                    | 0                     | DMA_CH10       | AHB Address Register              |
| 40002560      | DMA                    | 0                     | DMA_CH10       | DMA Control Register              |
| 40002564      | DMA                    | 0                     | DMA_CH10       | DMA Channel Interrupt Status      |
| 40002568      | DMA                    | 0                     | DMA_CH10       | DMA Channel Interrupt Enable      |
| 4000256C      | DMA                    | 0                     | DMA_CH10       | DMA Test Register                 |
| 40002570      | DMA                    | 0                     | DMA_CH11       | DMA Activate Register             |
| 40002574      | DMA                    | 0                     | DMA_CH11       | DMA Memory Start Address Register |
| 40002578      | DMA                    | 0                     | DMA_CH11       | DMA Memory End Address Register   |
| 4000257C      | DMA                    | 0                     | DMA_CH11       | AHB Address Register              |
| 40002580      | DMA                    | 0                     | DMA_CH11       | DMA Control Register              |
| 40002584      | DMA                    | 0                     | DMA_CH11       | DMA Channel Interrupt Status      |
| 40002588      | DMA                    | 0                     | DMA_CH11       | DMA Channel Interrupt Enable      |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name               |
|---------------|------------------------|-----------------------|----------------|----------------------------------|
| 4000258C      | DMA                    | 0                     | DMA_CH11       | DMA Test Register                |
| 40005800      | PWM                    | 0                     | PWM_EC_Only    | PWM Counter ON Time Register     |
| 40005804      | PWM                    | 0                     | PWM_EC_Only    | PWM Counter OFF Time Register    |
| 40005808      | PWM                    | 0                     | PWM_EC_Only    | PWM Configuration Register       |
| 4000580C      | PWM                    | 0                     | PWM_EC_Only    | Reserved                         |
| 40005810      | PWM                    | 1                     | PWM_EC_Only    | PWM Counter ON Time Register     |
| 40005814      | PWM                    | 1                     | PWM_EC_Only    | PWM Counter OFF Time Register    |
| 40005818      | PWM                    | 1                     | PWM_EC_Only    | PWM Configuration Register       |
| 4000581C      | PWM                    | 1                     | PWM_EC_Only    | Reserved                         |
| 40005820      | PWM                    | 2                     | PWM_EC_Only    | PWM Counter ON Time Register     |
| 40005824      | PWM                    | 2                     | PWM_EC_Only    | PWM Counter OFF Time Register    |
| 40005828      | PWM                    | 2                     | PWM_EC_Only    | PWM Configuration Register       |
| 4000582C      | PWM                    | 2                     | PWM_EC_Only    | Reserved                         |
| 40005830      | PWM                    | 3                     | PWM_EC_Only    | PWM Counter ON Time Register     |
| 40005834      | PWM                    | 3                     | PWM_EC_Only    | PWM Counter OFF Time Register    |
| 40005838      | PWM                    | 3                     | PWM_EC_Only    | PWM Configuration Register       |
| 4000583C      | PWM                    | 3                     | PWM_EC_Only    | Reserved                         |
| 40006000      | TACH                   | 0                     | TACH_EC_ONLY   | TACH Control Register            |
| 40006004      | TACH                   | 0                     | TACH_EC_ONLY   | TACH Status Register             |
| 40006008      | TACH                   | 0                     | TACH_EC_ONLY   | TACH High Limit Register         |
| 4000600C      | TACH                   | 0                     | TACH_EC_ONLY   | TACH Low Limit Register          |
| 40006010      | TACH                   | 1                     | TACH_EC_ONLY   | TACH Control Register            |
| 40006014      | TACH                   | 1                     | TACH_EC_ONLY   | TACH Status Register             |
| 40006018      | TACH                   | 1                     | TACH_EC_ONLY   | TACH High Limit Register         |
| 4000601C      | TACH                   | 1                     | TACH_EC_ONLY   | TACH Low Limit Register          |
| 40006400      | PECI                   | 0                     | PECI_EC_Only   | PECI Write Data Register         |
| 40006404      | PECI                   | 0                     | PECI_EC_Only   | PECI Read Data Register          |
| 40006408      | PECI                   | 0                     | PECI_EC_Only   | PECI Control Register            |
| 4000640C      | PECI                   | 0                     | PECI_EC_Only   | PECI Status 1 Register           |
| 40006410      | PECI                   | 0                     | PECI_EC_Only   | PECI Status 2 Register           |
| 40006414      | PECI                   | 0                     | PECI_EC_Only   | PECI Error Register              |
| 40006418      | PECI                   | 0                     | PECI_EC_Only   | PECI Interrupt Enable 1 Register |
| 4000641C      | PECI                   | 0                     | PECI_EC_Only   | PECI Interrupt Enable 2 Register |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                         |
|---------------|------------------------|-----------------------|----------------|--|
| 40006420      | PECI                   | 0                     | PECI_EC_Only   | PECI Optimal Bit Time (Low Byte) Register  |
| 40006424      | PECI                   | 0                     | PECI_EC_Only   | PECI Optimal Bit Time (High Byte) Register |
| 40006428      | PECI                   | 0                     | PECI_EC_Only   | PECI Request Timer (Low Byte) Register     |
| 4000642C      | PECI                   | 0                     | PECI_EC_Only   | PECI Request Timer (High Byte) Register    |
| 40006430      | PECI                   | 0                     | PECI_EC_Only   | PECI Reserved                              |
| 40006440      | PECI                   | 0                     | PECI_EC_Only   | PECI Block ID Register                     |
| 40006444      | PECI                   | 0                     | PECI_EC_Only   | Block Revision                             |
| 40007C00      | ADC                    | 0                     | ADC Registers  | ADC Control Register                       |
| 40007C04      | ADC                    | 0                     | ADC Registers  | ADC Delay Register                         |
| 40007C08      | ADC                    | 0                     | ADC Registers  | ADC Status Register                        |
| 40007C0C      | ADC                    | 0                     | ADC Registers  | ADC Single Register                        |
| 40007C10      | ADC                    | 0                     | ADC Registers  | ADC Repeat Register                        |
| 40007C14      | ADC                    | 0                     | ADC Registers  | ADC Channel 0 Reading Registers            |
| 40007C18      | ADC                    | 0                     | ADC Registers  | ADC Channel 1 Reading Registers            |
| 40007C1C      | ADC                    | 0                     | ADC Registers  | ADC Channel 2 Reading Registers            |
| 40007C20      | ADC                    | 0                     | ADC Registers  | ADC Channel 3 Reading Registers            |
| 40007C24      | ADC                    | 0                     | ADC Registers  | ADC Channel 4 Reading Registers            |
| 40007C54      | ADC                    | 0                     | ADC Registers  | ADC Test Register                          |
| 40007C58      | ADC                    | 0                     | ADC Registers  | ADC Test Register                          |
| 40007C78      | ADC                    | 0                     | ADC Registers  | ADC Test Register                          |
| 40007C7C      | ADC                    | 0                     | ADC Registers  | ADC Configuration Register                 |
| 40008C00      | Trace FIFO Debug Port  | 0                     | TFDP           | Data                                       |
| 40008C04      | Trace FIFO Debug Port  | 0                     | TFDP           | Control                                    |
| 40009000      | PS/2                   | 0                     | Registers      | PS/2 Transmit Buffer Register              |
| 40009000      | PS/2                   | 0                     | Registers      | PS/2 Receive Buffer Register               |
| 40009004      | PS/2                   | 0                     | Registers      | PS/2 Control Register                      |
| 40009008      | PS/2                   | 0                     | Registers      | PS/2 Status Register                       |
| 40009040      | PS/2                   | 1                     | Registers      | PS/2 Transmit Buffer Register              |
| 40009040      | PS/2                   | 1                     | Registers      | PS/2 Receive Buffer Register               |
| 40009044      | PS/2                   | 1                     | Registers      | PS/2 Control Register                      |
| 40009048      | PS/2                   | 1                     | Registers      | PS/2 Status Register                       |
| 40009080      | PS/2                   | 2                     | Registers      | PS/2 Receive Buffer Register               |

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| Address (Hex) | HW Block Instance Name       | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                   |
|---------------|------------------------------|-----------------------|----------------|--------------------------------------|
| 40009080      | PS/2                         | 2                     | Registers      | PS/2 Transmit Buffer Register        |
| 40009084      | PS/2                         | 2                     | Registers      | PS/2 Control Register                |
| 40009088      | PS/2                         | 2                     | Registers      | PS/2 Status Register                 |
| 400090C0      | PS/2                         | 3                     | Registers      | PS/2 Transmit Buffer Register        |
| 400090C0      | PS/2                         | 3                     | Registers      | PS/2 Receive Buffer Register         |
| 400090C4      | PS/2                         | 3                     | Registers      | PS/2 Control Register                |
| 400090C8      | PS/2                         | 3                     | Registers      | PS/2 Status Register                 |
| 40009400      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI Enable Register                  |
| 40009404      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI Control Register                 |
| 40009408      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI Status Register                  |
| 4000940C      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI TX_Data Register                 |
| 40009410      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI RX_Data Register                 |
| 40009414      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI Clock Control Register           |
| 40009418      | EC GP-SPI                    | 0                     | GP-SPI_EC_Only | SPI Clock Generator Register         |
| 40009480      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI Enable Register                  |
| 40009484      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI Control Register                 |
| 40009488      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI Status Register                  |
| 4000948C      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI TX_Data Register                 |
| 40009490      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI RX_Data Register                 |
| 40009494      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI Clock Control Register           |
| 40009498      | EC GP-SPI                    | 1                     | GP-SPI_EC_Only | SPI Clock Generator Register         |
| 40009800      | Hibernation Timer            | 0                     | Registers      | HTimer x Preload Register            |
| 40009804      | Hibernation Timer            | 0                     | Registers      | Hibernation Timer x Control Register |
| 40009808      | Hibernation Timer            | 0                     | Registers      | Hibernation Timer x Count Register   |
| 40009C00      | Keyboard Matrix Scan Support | 0                     | Registers      | Reserved                             |
| 40009C04      | Keyboard Matrix Scan Support | 0                     | Registers      | KSO Select Register                  |
| 40009C08      | Keyboard Matrix Scan Support | 0                     | Registers      | KSI Input Register                   |
| 40009C0C      | Keyboard Matrix Scan Support | 0                     | Registers      | KSI Status Register                  |
| 40009C10      | Keyboard Matrix Scan Support | 0                     | Registers      | KSI Interrupt Enable Register        |
| 40009C14      | Keyboard Matrix Scan Support | 0                     | Registers      | Keyscan Extended Control Register    |
| 4000A000      | RPM Fan Control              | 0                     | RPM_FAN        | Fan Setting                          |
| 4000A001      | RPM Fan Control              | 0                     | RPM_FAN        | PWM Divide                           |
| 4000A002      | RPM Fan Control              | 0                     | RPM_FAN        | Fan Configuration 1                  |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name   | Reg. Instance Name                   |
|---------------|------------------------|-----------------------|------------------|--------------------------------------|
| 4000A003      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Configuration 2                  |
| 4000A004      | RPM Fan Control        | 0                     | RPM_FAN          | MCHP Reserved                        |
| 4000A005      | RPM Fan Control        | 0                     | RPM_FAN          | Gain                                 |
| 4000A006      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Spin Up Configuration            |
| 4000A007      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Step                             |
| 4000A008      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Minimum Drive                    |
| 4000A009      | RPM Fan Control        | 0                     | RPM_FAN          | Valid Tach Count                     |
| 4000A00A      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Drive Fail Band Low Byte         |
| 4000A00B      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Drive Fail Band High Byte        |
| 4000A00C      | RPM Fan Control        | 0                     | RPM_FAN          | Tach Target Low Byte                 |
| 4000A00D      | RPM Fan Control        | 0                     | RPM_FAN          | Tach Target High Byte                |
| 4000A00E      | RPM Fan Control        | 0                     | RPM_FAN          | Tach Reading Low Byte                |
| 4000A00F      | RPM Fan Control        | 0                     | RPM_FAN          | Tach Reading High Byte               |
| 4000A010      | RPM Fan Control        | 0                     | RPM_FAN          | PWM Driver Base Frequency            |
| 4000A011      | RPM Fan Control        | 0                     | RPM_FAN          | Fan Status                           |
| 4000A012      | RPM Fan Control        | 0                     | RPM_FAN          | Reserved                             |
| 4000A014      | RPM Fan Control        | 0                     | RPM_FAN          | RPM Fan Test                         |
| 4000A015      | RPM Fan Control        | 0                     | RPM_FAN          | RPM Fan Test1                        |
| 4000A016      | RPM Fan Control        | 0                     | RPM_FAN          | RPM Fan Test2                        |
| 4000A017      | RPM Fan Control        | 0                     | RPM_FAN          | RPM Fan Test3                        |
| 4000A400      | VBAT Registers         | 0                     | VBAT_EC_REG_BANK | Power-Fail and Reset Status Register |
| 4000A404      | VBAT Registers         | 0                     | VBAT_EC_REG_BANK | Control                              |
| 4000A800      | VBAT Powered RAM       | 0                     | Registers        | VBAT Backed Memory                   |
| 4000AC00      | SMB Device Interface   | 1                     | SMB_EC_Only      | Control Register                     |
| 4000AC00      | SMB Device Interface   | 1                     | SMB_EC_Only      | Status Register                      |
| 4000AC01      | SMB Device Interface   | 1                     | SMB_EC_Only      | Reserved                             |
| 4000AC04      | SMB Device Interface   | 1                     | SMB_EC_Only      | Own Address Register                 |
| 4000AC06      | SMB Device Interface   | 1                     | SMB_EC_Only      | Reserved                             |
| 4000AC08      | SMB Device Interface   | 1                     | SMB_EC_Only      | Data                                 |
| 4000AC09      | SMB Device Interface   | 1                     | SMB_EC_Only      | Reserved                             |
| 4000AC0C      | SMB Device Interface   | 1                     | SMB_EC_Only      | SMBus Master Command Register        |
| 4000AC10      | SMB Device Interface   | 1                     | SMB_EC_Only      | SMBus Slave Command Register         |
| 4000AC14      | SMB Device Interface   | 1                     | SMB_EC_Only      | PEC Register                         |
| 4000AC15      | SMB Device Interface   | 1                     | SMB_EC_Only      | Reserved                             |
| 4000AC18      | SMB Device Interface   | 1                     | SMB_EC_Only      | DATA_TIMING2                         |
| 4000AC19      | SMB Device Interface   | 1                     | SMB_EC_Only      | Reserved                             |
| 4000AC20      | SMB Device Interface   | 1                     | SMB_EC_Only      | Completion Register                  |
| 4000AC24      | SMB Device Interface   | 1                     | SMB_EC_Only      | Idle Scaling Register                |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                    |
|---------------|------------------------|-----------------------|----------------|---------------------------------------|
| 4000AC28      | SMB Device Interface   | 1                     | SMB_EC_Only    | Configuration Register                |
| 4000AC2C      | SMB Device Interface   | 1                     | SMB_EC_Only    | Bus Clock Register                    |
| 4000AC2E      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC30      | SMB Device Interface   | 1                     | SMB_EC_Only    | Block ID Register                     |
| 4000AC31      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC34      | SMB Device Interface   | 1                     | SMB_EC_Only    | Revision Register                     |
| 4000AC35      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC38      | SMB Device Interface   | 1                     | SMB_EC_Only    | Bit-Bang Control Register             |
| 4000AC39      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC3C      | SMB Device Interface   | 1                     | SMB_EC_Only    | Clock Sync                            |
| 4000AC40      | SMB Device Interface   | 1                     | SMB_EC_Only    | Data Timing Register                  |
| 4000AC44      | SMB Device Interface   | 1                     | SMB_EC_Only    | Time-Out Scaling Register             |
| 4000AC48      | SMB Device Interface   | 1                     | SMB_EC_Only    | SMBus Slave Transmit Buffer Register  |
| 4000AC49      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC4C      | SMB Device Interface   | 1                     | SMB_EC_Only    | SMBus Slave Receive Buffer Register   |
| 4000AC4D      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC50      | SMB Device Interface   | 1                     | SMB_EC_Only    | SMBus Master Transmit Buffer Register |
| 4000AC51      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000AC54      | SMB Device Interface   | 1                     | SMB_EC_Only    | SMBus Master Receive Buffer Register  |
| 4000AC55      | SMB Device Interface   | 1                     | SMB_EC_Only    | Reserved                              |
| 4000B000      | SMB Device Interface   | 2                     | SMB_EC_Only    | Control Register                      |
| 4000B000      | SMB Device Interface   | 2                     | SMB_EC_Only    | Status Register                       |
| 4000B001      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B004      | SMB Device Interface   | 2                     | SMB_EC_Only    | Own Address Register                  |
| 4000B006      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B008      | SMB Device Interface   | 2                     | SMB_EC_Only    | Data                                  |
| 4000B009      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B00C      | SMB Device Interface   | 2                     | SMB_EC_Only    | SMBus Master Command Register         |
| 4000B010      | SMB Device Interface   | 2                     | SMB_EC_Only    | SMBus Slave Command Register          |
| 4000B014      | SMB Device Interface   | 2                     | SMB_EC_Only    | PEC Register                          |
| 4000B015      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B018      | SMB Device Interface   | 2                     | SMB_EC_Only    | DATA_TIMING2                          |
| 4000B019      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B020      | SMB Device Interface   | 2                     | SMB_EC_Only    | Completion Register                   |
| 4000B024      | SMB Device Interface   | 2                     | SMB_EC_Only    | Idle Scaling Register                 |
| 4000B028      | SMB Device Interface   | 2                     | SMB_EC_Only    | Configuration Register                |
| 4000B02C      | SMB Device Interface   | 2                     | SMB_EC_Only    | Bus Clock Register                    |
| 4000B02E      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |



| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                    |
|---------------|------------------------|-----------------------|----------------|---------------------------------------|
| 4000B030      | SMB Device Interface   | 2                     | SMB_EC_Only    | Block ID Register                     |
| 4000B031      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B034      | SMB Device Interface   | 2                     | SMB_EC_Only    | Revision Register                     |
| 4000B035      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B038      | SMB Device Interface   | 2                     | SMB_EC_Only    | Bit-Bang Control Register             |
| 4000B039      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B03C      | SMB Device Interface   | 2                     | SMB_EC_Only    | Clock Sync                            |
| 4000B040      | SMB Device Interface   | 2                     | SMB_EC_Only    | Data Timing Register                  |
| 4000B044      | SMB Device Interface   | 2                     | SMB_EC_Only    | Time-Out Scaling Register             |
| 4000B048      | SMB Device Interface   | 2                     | SMB_EC_Only    | SMBus Slave Transmit Buffer Register  |
| 4000B049      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B04C      | SMB Device Interface   | 2                     | SMB_EC_Only    | SMBus Slave Receive Buffer Register   |
| 4000B04D      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B050      | SMB Device Interface   | 2                     | SMB_EC_Only    | SMBus Master Transmit Buffer Register |
| 4000B051      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B054      | SMB Device Interface   | 2                     | SMB_EC_Only    | SMBus Master Receive Buffer Register  |
| 4000B055      | SMB Device Interface   | 2                     | SMB_EC_Only    | Reserved                              |
| 4000B400      | SMB Device Interface   | 3                     | SMB_EC_Only    | Control Register                      |
| 4000B400      | SMB Device Interface   | 3                     | SMB_EC_Only    | Status Register                       |
| 4000B401      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B404      | SMB Device Interface   | 3                     | SMB_EC_Only    | Own Address Register                  |
| 4000B406      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B408      | SMB Device Interface   | 3                     | SMB_EC_Only    | Data                                  |
| 4000B409      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B40C      | SMB Device Interface   | 3                     | SMB_EC_Only    | SMBus Master Command Register         |
| 4000B410      | SMB Device Interface   | 3                     | SMB_EC_Only    | SMBus Slave Command Register          |
| 4000B414      | SMB Device Interface   | 3                     | SMB_EC_Only    | PEC Register                          |
| 4000B415      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B418      | SMB Device Interface   | 3                     | SMB_EC_Only    | DATA_TIMING2                          |
| 4000B419      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B420      | SMB Device Interface   | 3                     | SMB_EC_Only    | Completion Register                   |
| 4000B424      | SMB Device Interface   | 3                     | SMB_EC_Only    | Idle Scaling Register                 |
| 4000B428      | SMB Device Interface   | 3                     | SMB_EC_Only    | Configuration Register                |
| 4000B42C      | SMB Device Interface   | 3                     | SMB_EC_Only    | Bus Clock Register                    |
| 4000B42E      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B430      | SMB Device Interface   | 3                     | SMB_EC_Only    | Block ID Register                     |
| 4000B431      | SMB Device Interface   | 3                     | SMB_EC_Only    | Reserved                              |
| 4000B434      | SMB Device Interface   | 3                     | SMB_EC_Only    | Revision Register                     |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name    | Reg. Instance Name                    |
|---------------|------------------------|-----------------------|-------------------|---------------------------------------|
| 4000B435      | SMB Device Interface   | 3                     | SMB_EC_Only       | Reserved                              |
| 4000B438      | SMB Device Interface   | 3                     | SMB_EC_Only       | Bit-Bang Control Register             |
| 4000B439      | SMB Device Interface   | 3                     | SMB_EC_Only       | Reserved                              |
| 4000B43C      | SMB Device Interface   | 3                     | SMB_EC_Only       | Clock Sync                            |
| 4000B440      | SMB Device Interface   | 3                     | SMB_EC_Only       | Data Timing Register                  |
| 4000B444      | SMB Device Interface   | 3                     | SMB_EC_Only       | Time-Out Scaling Register             |
| 4000B448      | SMB Device Interface   | 3                     | SMB_EC_Only       | SMBus Slave Transmit Buffer Register  |
| 4000B449      | SMB Device Interface   | 3                     | SMB_EC_Only       | Reserved                              |
| 4000B44C      | SMB Device Interface   | 3                     | SMB_EC_Only       | SMBus Slave Receive Buffer Register   |
| 4000B44D      | SMB Device Interface   | 3                     | SMB_EC_Only       | Reserved                              |
| 4000B450      | SMB Device Interface   | 3                     | SMB_EC_Only       | SMBus Master Transmit Buffer Register |
| 4000B451      | SMB Device Interface   | 3                     | SMB_EC_Only       | Reserved                              |
| 4000B454      | SMB Device Interface   | 3                     | SMB_EC_Only       | SMBus Master Receive Buffer Register  |
| 4000B455      | SMB Device Interface   | 3                     | SMB_EC_Only       | Reserved                              |
| 4000B800      | LED                    | 0                     | EC-Only Registers | LED Configuration                     |
| 4000B804      | LED                    | 0                     | EC-Only Registers | LED Limits                            |
| 4000B808      | LED                    | 0                     | EC-Only Registers | LED Delay                             |
| 4000B80C      | LED                    | 0                     | EC-Only Registers | LED Update Stepsize                   |
| 4000B810      | LED                    | 0                     | EC-Only Registers | LED Update Interval                   |
| 4000B900      | LED                    | 1                     | EC-Only Registers | LED Configuration                     |
| 4000B904      | LED                    | 1                     | EC-Only Registers | LED Limits                            |
| 4000B908      | LED                    | 1                     | EC-Only Registers | LED Delay                             |
| 4000B90C      | LED                    | 1                     | EC-Only Registers | LED Update Stepsize                   |
| 4000B910      | LED                    | 1                     | EC-Only Registers | LED Update Interval                   |
| 4000BA00      | LED                    | 2                     | EC-Only Registers | LED Configuration                     |
| 4000BA04      | LED                    | 2                     | EC-Only Registers | LED Limits                            |
| 4000BA08      | LED                    | 2                     | EC-Only Registers | LED Delay                             |
| 4000BA0C      | LED                    | 2                     | EC-Only Registers | LED Update Stepsize                   |
| 4000BA10      | LED                    | 2                     | EC-Only Registers | LED Update Interval                   |
| 4000BB00      | LED                    | 3                     | EC-Only Registers | LED Configuration                     |
| 4000BB04      | LED                    | 3                     | EC-Only Registers | LED Limits                            |
| 4000BB08      | LED                    | 3                     | EC-Only Registers | LED Delay                             |
| 4000BB0C      | LED                    | 3                     | EC-Only Registers | LED Update Stepsize                   |
| 4000BB10      | LED                    | 3                     | EC-Only Registers | LED Update Interval                   |
| 4000BC00      | BC-Link Master         | 0                     | Registers         | BC-Link Status Register               |
| 4000BC04      | BC-Link Master         | 0                     | Registers         | BC-Link Address Register              |
| 4000BC08      | BC-Link Master         | 0                     | Registers         | BC-Link Data Register                 |
| 4000BC0C      | BC-Link Master         | 0                     | Registers         | BC-Link Clock Select Register         |

| Address (Hex) | HW Block Instance Name         | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name           |
|---------------|--------------------------------|-----------------------|----------------|------------------------------|
| 4000C000      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ8 Source Register        |
| 4000C004      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ8 Enable Set Register    |
| 4000C008      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ8 Result Register        |
| 4000C00C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ8 Enable Clear Register  |
| 4000C014      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ9 Source Register        |
| 4000C018      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ9 Enable Set Register    |
| 4000C01C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ9 Result Register        |
| 4000C020      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ9 Enable Clear Register  |
| 4000C028      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ10 Source Register       |
| 4000C02C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ10 Enable Set Register   |
| 4000C030      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ10 Result Register       |
| 4000C034      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ10 Enable Clear Register |
| 4000C03C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ11 Source Register       |
| 4000C040      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ11 Enable Set Register   |
| 4000C044      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ11 Result Register       |
| 4000C048      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ11 Enable Clear Register |
| 4000C050      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ12 Source Register       |
| 4000C054      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ12 Enable Set Register   |
| 4000C058      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ12 Result Register       |
| 4000C05C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ12 Enable Clear Register |
| 4000C064      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ13 Source Register       |
| 4000C068      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ13 Enable Set Register   |
| 4000C06C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ13 Result Register       |
| 4000C070      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ13 Enable Clear Register |
| 4000C078      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ14 Source Register       |

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| Address (Hex) | HW Block Instance Name         | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name           |
|---------------|--------------------------------|-----------------------|----------------|------------------------------|
| 4000C07C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ14 Enable Set Register   |
| 4000C080      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ14 Result Register       |
| 4000C084      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ14 Enable Clear Register |
| 4000C08C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ15 Source Register       |
| 4000C090      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ15 Enable Set Register   |
| 4000C094      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ15 Result Register       |
| 4000C098      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ15 Enable Clear Register |
| 4000C0A0      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ16 Source Register       |
| 4000C0A4      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ16 Enable Set Register   |
| 4000C0A8      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ16 Result Register       |
| 4000C0AC      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ16 Enable Clear Register |
| 4000C0B4      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ17 Source Register       |
| 4000C0B8      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ17 Enable Set Register   |
| 4000C0BC      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ17 Result Register       |
| 4000C0C0      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ17 Enable Clear Register |
| 4000C0C8      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ18 Source Register       |
| 4000C0CC      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ18 Enable Set Register   |
| 4000C0D0      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ18 Result Register       |
| 4000C0D4      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ18 Enable Clear Register |
| 4000C0DC      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ19 Source Register       |
| 4000C0E0      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ19 Enable Set Register   |
| 4000C0E4      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ19 Result Register       |
| 4000C0E8      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ19 Enable Clear Register |
| 4000C0F0      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ20 Source Register       |
| 4000C0F4      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ20 Enable Set Register   |

| Address (Hex) | HW Block Instance Name         | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name           |
|---------------|--------------------------------|-----------------------|----------------|------------------------------|
| 4000C0F8      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ20 Result Register       |
| 4000C0FC      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ20 Enable Clear Register |
| 4000C104      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ21 Source Register       |
| 4000C108      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ21 Enable Set Register   |
| 4000C10C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ21 Result Register       |
| 4000C110      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ21 Enable Clear Register |
| 4000C118      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ22 Source Register       |
| 4000C11C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ22 Enable Set Register   |
| 4000C120      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ22 Result Register       |
| 4000C124      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ22 Enable Clear Register |
| 4000C12C      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ23 Source Register       |
| 4000C130      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ23 Enable Set Register   |
| 4000C134      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ23 Result Register       |
| 4000C138      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | GIRQ23 Enable Clear Register |
| 4000C200      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | Block Enable Set Register    |
| 4000C204      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | Block Enable Clear Register  |
| 4000C208      | EC Interrupt Aggregator (INTS) | 0                     | INTS_EC_ONLY   | Block IRQ Vector Register    |
| 4000FC00      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | Reserved                     |
| 4000FC04      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | MCHP Reserved                |
| 4000FC08      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | MCHP Reserved                |
| 4000FC0C      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | MCHP Reserved                |
| 4000FC10      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | MCHP Reserved                |
| 4000FC11      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | Reserved                     |
| 4000FC14      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | AHB Error Control            |
| 4000FC15      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | Reserved                     |
| 4000FC18      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | Interrupt Control            |
| 4000FC1C      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | ETM Trace Enable             |
| 4000FC20      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | JTAG Enable                  |
| 4000FC24      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | MCHP Reserved                |
| 4000FC28      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | WDT Event Count              |
| 4000FC2C      | EC_REG_BANK                    | 0                     | EC_REG_BANK    | MCHP Reserved                |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                  |
|---------------|------------------------|-----------------------|----------------|-------------------------------------|
| 4000FC30      | EC_REG_BANK            | 0                     | EC_REG_BANK    | MCHP Reserved                       |
| 4000FC34      | EC_REG_BANK            | 0                     | EC_REG_BANK    | MCHP Reserved                       |
| 4000FC38      | EC_REG_BANK            | 0                     | EC_REG_BANK    | ADC VREF PD                         |
| 4000FC3C      | EC_REG_BANK            | 0                     | EC_REG_BANK    | MCHP Reserved                       |
| 4000FC40      | EC_REG_BANK            | 0                     | EC_REG_BANK    | MCHP Reserved                       |
| 40080000      | JTAG                   | 0                     | JTAG_EC_Only   | JTAG Message OBF                    |
| 40080004      | JTAG                   | 0                     | JTAG_EC_Only   | JTAG Message IBF                    |
| 40080008      | JTAG                   | 0                     | JTAG_EC_Only   | JTAG OBF Status                     |
| 40080009      | JTAG                   | 0                     | JTAG_EC_Only   | JTAG IBF Status                     |
| 4008000C      | JTAG                   | 0                     | JTAG_EC_Only   | JTAG DBG Ctrl                       |
| 40080100      | PCR                    | 0                     | PCR            | Chip Sleep Enable Register          |
| 40080104      | PCR                    | 0                     | PCR            | Chip Clock Required Register        |
| 40080108      | PCR                    | 0                     | PCR            | EC Sleep Enables Register           |
| 4008010C      | PCR                    | 0                     | PCR            | EC Clock Required Status Register   |
| 40080110      | PCR                    | 0                     | PCR            | Host Sleep Enables Register         |
| 40080114      | PCR                    | 0                     | PCR            | Host Clock Required Status Register |
| 40080118      | PCR                    | 0                     | PCR            | CHIP_PCR_ADDR_SYS_SLEEP_CTRL_0      |
| 40080120      | PCR                    | 0                     | PCR            | Processor Clock Control             |
| 40080124      | PCR                    | 0                     | PCR            | EC Sleep Enable 2 Register          |
| 40080128      | PCR                    | 0                     | PCR            | EC Clock Required 2 Status Register |
| 4008012C      | PCR                    | 0                     | PCR            | Slow Clock Control                  |
| 40080130      | PCR                    | 0                     | PCR            | Oscillator ID Register              |
| 40080134      | PCR                    | 0                     | PCR            | Reserved                            |
| 40080138      | PCR                    | 0                     | PCR            | Chip Reset Enable                   |
| 4008013C      | PCR                    | 0                     | PCR            | Host Reset Enable                   |
| 40080140      | PCR                    | 0                     | PCR            | EC Reset Enable                     |
| 40080144      | PCR                    | 0                     | PCR            | EC Reset Enable 2                   |
| 40080148      | PCR                    | 0                     | PCR            | PCR Clock Reset Control             |
| 40081000      | GPIO                   | 0                     | GPIO Registers | GPIO000 Pin Control                 |
| 40081004      | GPIO                   | 0                     | GPIO Registers | GPIO001 Pin Control                 |
| 40081008      | GPIO                   | 0                     | GPIO Registers | GPIO002 Pin Control                 |
| 4008100C      | GPIO                   | 0                     | GPIO Registers | GPIO003 Pin Control                 |
| 40081010      | GPIO                   | 0                     | GPIO Registers | GPIO004 Pin Control                 |
| 40081014      | GPIO                   | 0                     | GPIO Registers | GPIO005 Pin Control                 |
| 40081018      | GPIO                   | 0                     | GPIO Registers | GPIO006 Pin Control                 |
| 4008101C      | GPIO                   | 0                     | GPIO Registers | GPIO007 Pin Control                 |
| 40081020      | GPIO                   | 0                     | GPIO Registers | GPIO010 Pin Control                 |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name  |
|---------------|------------------------|-----------------------|----------------|---------------------|
| 40081024      | GPIO                   | 0                     | GPIO Registers | GPIO011 Pin Control |
| 40081028      | GPIO                   | 0                     | GPIO Registers | GPIO012 Pin Control |
| 4008102C      | GPIO                   | 0                     | GPIO Registers | GPIO013 Pin Control |
| 40081030      | GPIO                   | 0                     | GPIO Registers | GPIO014 Pin Control |
| 40081034      | GPIO                   | 0                     | GPIO Registers | GPIO015 Pin Control |
| 40081038      | GPIO                   | 0                     | GPIO Registers | GPIO016 Pin Control |
| 4008103C      | GPIO                   | 0                     | GPIO Registers | GPIO017 Pin Control |
| 40081040      | GPIO                   | 0                     | GPIO Registers | GPIO020 Pin Control |
| 40081044      | GPIO                   | 0                     | GPIO Registers | GPIO021 Pin Control |
| 40081048      | GPIO                   | 0                     | GPIO Registers | GPIO022 Pin Control |
| 4008104C      | GPIO                   | 0                     | GPIO Registers | GPIO023 Pin Control |
| 40081050      | GPIO                   | 0                     | GPIO Registers | GPIO024 Pin Control |
| 40081054      | GPIO                   | 0                     | GPIO Registers | GPIO025 Pin Control |
| 40081058      | GPIO                   | 0                     | GPIO Registers | GPIO026 Pin Control |
| 4008105C      | GPIO                   | 0                     | GPIO Registers | GPIO027 Pin Control |
| 40081060      | GPIO                   | 0                     | GPIO Registers | GPIO030 Pin Control |
| 40081064      | GPIO                   | 0                     | GPIO Registers | GPIO031 Pin Control |
| 40081068      | GPIO                   | 0                     | GPIO Registers | GPIO032 Pin Control |
| 4008106C      | GPIO                   | 0                     | GPIO Registers | GPIO033 Pin Control |
| 40081070      | GPIO                   | 0                     | GPIO Registers | GPIO034 Pin Control |
| 40081074      | GPIO                   | 0                     | GPIO Registers | GPIO035 Pin Control |
| 40081078      | GPIO                   | 0                     | GPIO Registers | GPIO036 Pin Control |
| 40081080      | GPIO                   | 0                     | GPIO Registers | GPIO040 Pin Control |
| 40081084      | GPIO                   | 0                     | GPIO Registers | GPIO041 Pin Control |
| 40081088      | GPIO                   | 0                     | GPIO Registers | GPIO042 Pin Control |
| 4008108C      | GPIO                   | 0                     | GPIO Registers | GPIO043 Pin Control |
| 40081090      | GPIO                   | 0                     | GPIO Registers | GPIO044 Pin Control |
| 40081094      | GPIO                   | 0                     | GPIO Registers | GPIO045 Pin Control |
| 40081098      | GPIO                   | 0                     | GPIO Registers | GPIO046 Pin Control |
| 4008109C      | GPIO                   | 0                     | GPIO Registers | GPIO047 Pin Control |
| 400810A0      | GPIO                   | 0                     | GPIO Registers | GPIO050 Pin Control |
| 400810A4      | GPIO                   | 0                     | GPIO Registers | GPIO051 Pin Control |
| 400810A8      | GPIO                   | 0                     | GPIO Registers | GPIO052 Pin Control |
| 400810AC      | GPIO                   | 0                     | GPIO Registers | GPIO053 Pin Control |
| 400810B0      | GPIO                   | 0                     | GPIO Registers | GPIO054 Pin Control |
| 400810B4      | GPIO                   | 0                     | GPIO Registers | GPIO055 Pin Control |
| 400810B8      | GPIO                   | 0                     | GPIO Registers | GPIO056 Pin Control |
| 400810BC      | GPIO                   | 0                     | GPIO Registers | GPIO057 Pin Control |
| 400810C0      | GPIO                   | 0                     | GPIO Registers | GPIO060 Pin Control |
| 400810C4      | GPIO                   | 0                     | GPIO Registers | GPIO061 Pin Control |
| 400810C8      | GPIO                   | 0                     | GPIO Registers | GPIO062 Pin Control |
| 400810CC      | GPIO                   | 0                     | GPIO Registers | GPIO063 Pin Control |
| 400810D0      | GPIO                   | 0                     | GPIO Registers | GPIO064 Pin Control |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name  |
|---------------|------------------------|-----------------------|----------------|---------------------|
| 400810D4      | GPIO                   | 0                     | GPIO Registers | GPIO065 Pin Control |
| 400810D8      | GPIO                   | 0                     | GPIO Registers | GPIO066 Pin Control |
| 400810DC      | GPIO                   | 0                     | GPIO Registers | GPIO067 Pin Control |
| 40081100      | GPIO                   | 0                     | GPIO Registers | GPIO100 Pin Control |
| 40081104      | GPIO                   | 0                     | GPIO Registers | GPIO101 Pin Control |
| 40081108      | GPIO                   | 0                     | GPIO Registers | GPIO102 Pin Control |
| 4008110C      | GPIO                   | 0                     | GPIO Registers | GPIO103 Pin Control |
| 40081110      | GPIO                   | 0                     | GPIO Registers | GPIO104 Pin Control |
| 40081114      | GPIO                   | 0                     | GPIO Registers | GPIO105 Pin Control |
| 40081118      | GPIO                   | 0                     | GPIO Registers | GPIO106 Pin Control |
| 4008111C      | GPIO                   | 0                     | GPIO Registers | GPIO107 Pin Control |
| 40081120      | GPIO                   | 0                     | GPIO Registers | GPIO110 Pin Control |
| 40081124      | GPIO                   | 0                     | GPIO Registers | GPIO111 Pin Control |
| 40081128      | GPIO                   | 0                     | GPIO Registers | GPIO112 Pin Control |
| 4008112C      | GPIO                   | 0                     | GPIO Registers | GPIO113 Pin Control |
| 40081130      | GPIO                   | 0                     | GPIO Registers | GPIO114 Pin Control |
| 40081134      | GPIO                   | 0                     | GPIO Registers | GPIO115 Pin Control |
| 40081138      | GPIO                   | 0                     | GPIO Registers | GPIO116 Pin Control |
| 4008113C      | GPIO                   | 0                     | GPIO Registers | GPIO117 Pin Control |
| 40081140      | GPIO                   | 0                     | GPIO Registers | GPIO120 Pin Control |
| 40081144      | GPIO                   | 0                     | GPIO Registers | GPIO121 Pin Control |
| 40081148      | GPIO                   | 0                     | GPIO Registers | GPIO122 Pin Control |
| 4008114C      | GPIO                   | 0                     | GPIO Registers | GPIO123 Pin Control |
| 40081150      | GPIO                   | 0                     | GPIO Registers | GPIO124 Pin Control |
| 40081154      | GPIO                   | 0                     | GPIO Registers | GPIO125 Pin Control |
| 40081158      | GPIO                   | 0                     | GPIO Registers | GPIO126 Pin Control |
| 4008115C      | GPIO                   | 0                     | GPIO Registers | GPIO127 Pin Control |
| 40081160      | GPIO                   | 0                     | GPIO Registers | GPIO130 Pin Control |
| 40081164      | GPIO                   | 0                     | GPIO Registers | GPIO131 Pin Control |
| 40081168      | GPIO                   | 0                     | GPIO Registers | GPIO132 Pin Control |
| 4008116C      | GPIO                   | 0                     | GPIO Registers | GPIO133 Pin Control |
| 40081170      | GPIO                   | 0                     | GPIO Registers | GPIO134 Pin Control |
| 40081174      | GPIO                   | 0                     | GPIO Registers | GPIO135 Pin Control |
| 40081178      | GPIO                   | 0                     | GPIO Registers | GPIO136 Pin Control |
| 40081180      | GPIO                   | 0                     | GPIO Registers | GPIO140 Pin Control |
| 40081184      | GPIO                   | 0                     | GPIO Registers | GPIO141 Pin Control |
| 40081188      | GPIO                   | 0                     | GPIO Registers | GPIO142 Pin Control |
| 4008118C      | GPIO                   | 0                     | GPIO Registers | GPIO143 Pin Control |
| 40081190      | GPIO                   | 0                     | GPIO Registers | GPIO144 Pin Control |
| 40081194      | GPIO                   | 0                     | GPIO Registers | GPIO145 Pin Control |
| 40081198      | GPIO                   | 0                     | GPIO Registers | GPIO146 Pin Control |
| 4008119C      | GPIO                   | 0                     | GPIO Registers | GPIO147 Pin Control |
| 400811A0      | GPIO                   | 0                     | GPIO Registers | GPIO150 Pin Control |



| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name    |
|---------------|------------------------|-----------------------|----------------|-----------------------|
| 400811A4      | GPIO                   | 0                     | GPIO Registers | GPIO151 Pin Control   |
| 400811A8      | GPIO                   | 0                     | GPIO Registers | GPIO152 Pin Control   |
| 400811AC      | GPIO                   | 0                     | GPIO Registers | GPIO153 Pin Control   |
| 400811B0      | GPIO                   | 0                     | GPIO Registers | GPIO154 Pin Control   |
| 400811B4      | GPIO                   | 0                     | GPIO Registers | GPIO155 Pin Control   |
| 400811B8      | GPIO                   | 0                     | GPIO Registers | GPIO156 Pin Control   |
| 400811BC      | GPIO                   | 0                     | GPIO Registers | GPIO157 Pin Control   |
| 400811C0      | GPIO                   | 0                     | GPIO Registers | GPIO160 Pin Control   |
| 400811C4      | GPIO                   | 0                     | GPIO Registers | GPIO161 Pin Control   |
| 400811C8      | GPIO                   | 0                     | GPIO Registers | GPIO162 Pin Control   |
| 400811CC      | GPIO                   | 0                     | GPIO Registers | GPIO163 Pin Control   |
| 400811D0      | GPIO                   | 0                     | GPIO Registers | GPIO164 Pin Control   |
| 400811D4      | GPIO                   | 0                     | GPIO Registers | GPIO165 Pin Control   |
| 40081200      | GPIO                   | 0                     | GPIO Registers | GPIO200 Pin Control   |
| 40081204      | GPIO                   | 0                     | GPIO Registers | GPIO201 Pin Control   |
| 40081208      | GPIO                   | 0                     | GPIO Registers | GPIO202 Pin Control   |
| 4008120C      | GPIO                   | 0                     | GPIO Registers | GPIO203 Pin Control   |
| 40081210      | GPIO                   | 0                     | GPIO Registers | GPIO204 Pin Control   |
| 40081214      | GPIO                   | 0                     | GPIO Registers | Reserved              |
| 40081218      | GPIO                   | 0                     | GPIO Registers | GPIO206 Pin Control   |
| 4008121C      | GPIO                   | 0                     | GPIO Registers | Reserved              |
| 40081220      | GPIO                   | 0                     | GPIO Registers | GPIO210 Pin Control   |
| 40081224      | GPIO                   | 0                     | GPIO Registers | GPIO211 Pin Control   |
| 40081280      | GPIO                   | 0                     | GPIO Registers | Output GPIO[000:036]  |
| 40081284      | GPIO                   | 0                     | GPIO Registers | Output GPIO[040:076]  |
| 40081288      | GPIO                   | 0                     | GPIO Registers | Output GPIO[100:136]  |
| 4008128C      | GPIO                   | 0                     | GPIO Registers | Output GPIO[140:176]  |
| 40081290      | GPIO                   | 0                     | GPIO Registers | Output GPIO[200:236]  |
| 40081300      | GPIO                   | 0                     | GPIO Registers | Input GPIO[000:036]   |
| 40081304      | GPIO                   | 0                     | GPIO Registers | Input GPIO[040:076]   |
| 40081308      | GPIO                   | 0                     | GPIO Registers | Input GPIO[100:136]   |
| 4008130C      | GPIO                   | 0                     | GPIO Registers | Input GPIO[140:176]   |
| 40081310      | GPIO                   | 0                     | GPIO Registers | Input GPIO[200:236]   |
| 40081314      | GPIO                   | 0                     | GPIO Registers | Reserved              |
| 40081500      | GPIO                   | 0                     | GPIO Registers | GPIO000 Pin Control 2 |
| 40081504      | GPIO                   | 0                     | GPIO Registers | GPIO001 Pin Control 2 |
| 40081508      | GPIO                   | 0                     | GPIO Registers | GPIO002 Pin Control 2 |
| 4008150C      | GPIO                   | 0                     | GPIO Registers | GPIO003 Pin Control 2 |
| 40081510      | GPIO                   | 0                     | GPIO Registers | GPIO004 Pin Control 2 |
| 40081514      | GPIO                   | 0                     | GPIO Registers | GPIO005 Pin Control 2 |
| 40081518      | GPIO                   | 0                     | GPIO Registers | GPIO006 Pin Control 2 |
| 4008151C      | GPIO                   | 0                     | GPIO Registers | GPIO007 Pin Control 2 |
| 40081520      | GPIO                   | 0                     | GPIO Registers | GPIO010 Pin Control 2 |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name    |
|---------------|------------------------|-----------------------|----------------|-----------------------|
| 40081524      | GPIO                   | 0                     | GPIO Registers | GPIO011 Pin Control 2 |
| 40081528      | GPIO                   | 0                     | GPIO Registers | GPIO012 Pin Control 2 |
| 4008152C      | GPIO                   | 0                     | GPIO Registers | GPIO013 Pin Control 2 |
| 40081530      | GPIO                   | 0                     | GPIO Registers | GPIO014 Pin Control 2 |
| 40081534      | GPIO                   | 0                     | GPIO Registers | GPIO015 Pin Control 2 |
| 40081538      | GPIO                   | 0                     | GPIO Registers | GPIO016 Pin Control 2 |
| 4008153C      | GPIO                   | 0                     | GPIO Registers | GPIO017 Pin Control 2 |
| 40081540      | GPIO                   | 0                     | GPIO Registers | GPIO020 Pin Control 2 |
| 40081544      | GPIO                   | 0                     | GPIO Registers | GPIO021 Pin Control 2 |
| 40081548      | GPIO                   | 0                     | GPIO Registers | GPIO022 Pin Control 2 |
| 4008154C      | GPIO                   | 0                     | GPIO Registers | GPIO023 Pin Control 2 |
| 40081550      | GPIO                   | 0                     | GPIO Registers | GPIO024 Pin Control 2 |
| 40081554      | GPIO                   | 0                     | GPIO Registers | GPIO025 Pin Control 2 |
| 40081558      | GPIO                   | 0                     | GPIO Registers | GPIO026 Pin Control 2 |
| 4008155C      | GPIO                   | 0                     | GPIO Registers | GPIO027 Pin Control 2 |
| 40081560      | GPIO                   | 0                     | GPIO Registers | GPIO030 Pin Control 2 |
| 40081564      | GPIO                   | 0                     | GPIO Registers | GPIO031 Pin Control 2 |
| 40081568      | GPIO                   | 0                     | GPIO Registers | GPIO032 Pin Control 2 |
| 4008156C      | GPIO                   | 0                     | GPIO Registers | GPIO033 Pin Control 2 |
| 40081570      | GPIO                   | 0                     | GPIO Registers | GPIO034 Pin Control 2 |
| 40081574      | GPIO                   | 0                     | GPIO Registers | GPIO035 Pin Control 2 |
| 40081578      | GPIO                   | 0                     | GPIO Registers | GPIO036 Pin Control 2 |
| 40081580      | GPIO                   | 0                     | GPIO Registers | GPIO040 Pin Control 2 |
| 40081584      | GPIO                   | 0                     | GPIO Registers | GPIO041 Pin Control 2 |
| 40081588      | GPIO                   | 0                     | GPIO Registers | GPIO042 Pin Control 2 |
| 4008158C      | GPIO                   | 0                     | GPIO Registers | GPIO043 Pin Control 2 |
| 40081590      | GPIO                   | 0                     | GPIO Registers | GPIO044 Pin Control 2 |
| 40081594      | GPIO                   | 0                     | GPIO Registers | GPIO045 Pin Control 2 |
| 40081598      | GPIO                   | 0                     | GPIO Registers | GPIO046 Pin Control 2 |
| 4008159C      | GPIO                   | 0                     | GPIO Registers | GPIO047 Pin Control 2 |
| 400815A0      | GPIO                   | 0                     | GPIO Registers | GPIO050 Pin Control 2 |
| 400815A4      | GPIO                   | 0                     | GPIO Registers | GPIO051 Pin Control 2 |
| 400815A8      | GPIO                   | 0                     | GPIO Registers | GPIO052 Pin Control 2 |
| 400815AC      | GPIO                   | 0                     | GPIO Registers | GPIO053 Pin Control 2 |
| 400815B0      | GPIO                   | 0                     | GPIO Registers | GPIO054 Pin Control 2 |
| 400815B4      | GPIO                   | 0                     | GPIO Registers | GPIO055 Pin Control 2 |
| 400815B8      | GPIO                   | 0                     | GPIO Registers | GPIO056 Pin Control 2 |
| 400815BC      | GPIO                   | 0                     | GPIO Registers | GPIO057 Pin Control 2 |
| 400815C0      | GPIO                   | 0                     | GPIO Registers | GPIO060 Pin Control 2 |
| 400815C4      | GPIO                   | 0                     | GPIO Registers | GPIO061 Pin Control 2 |
| 400815C8      | GPIO                   | 0                     | GPIO Registers | GPIO062 Pin Control 2 |
| 400815CC      | GPIO                   | 0                     | GPIO Registers | GPIO063 Pin Control 2 |
| 400815D0      | GPIO                   | 0                     | GPIO Registers | GPIO064 Pin Control 2 |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name    |
|---------------|------------------------|-----------------------|----------------|-----------------------|
| 400815D4      | GPIO                   | 0                     | GPIO Registers | GPIO065 Pin Control 2 |
| 400815D8      | GPIO                   | 0                     | GPIO Registers | GPIO066 Pin Control 2 |
| 400815DC      | GPIO                   | 0                     | GPIO Registers | GPIO067 Pin Control 2 |
| 400815E0      | GPIO                   | 0                     | GPIO Registers | GPIO100 Pin Control 2 |
| 400815E4      | GPIO                   | 0                     | GPIO Registers | GPIO101 Pin Control 2 |
| 400815E8      | GPIO                   | 0                     | GPIO Registers | GPIO102 Pin Control 2 |
| 400815EC      | GPIO                   | 0                     | GPIO Registers | GPIO103 Pin Control 2 |
| 400815F0      | GPIO                   | 0                     | GPIO Registers | GPIO104 Pin Control 2 |
| 400815F4      | GPIO                   | 0                     | GPIO Registers | GPIO105 Pin Control 2 |
| 400815F8      | GPIO                   | 0                     | GPIO Registers | GPIO106 Pin Control 2 |
| 400815FC      | GPIO                   | 0                     | GPIO Registers | GPIO107 Pin Control 2 |
| 40081600      | GPIO                   | 0                     | GPIO Registers | GPIO110 Pin Control 2 |
| 40081604      | GPIO                   | 0                     | GPIO Registers | GPIO111 Pin Control 2 |
| 40081608      | GPIO                   | 0                     | GPIO Registers | GPIO112 Pin Control 2 |
| 4008160C      | GPIO                   | 0                     | GPIO Registers | GPIO113 Pin Control 2 |
| 40081610      | GPIO                   | 0                     | GPIO Registers | GPIO114 Pin Control 2 |
| 40081614      | GPIO                   | 0                     | GPIO Registers | GPIO115 Pin Control 2 |
| 40081618      | GPIO                   | 0                     | GPIO Registers | GPIO116 Pin Control 2 |
| 4008161C      | GPIO                   | 0                     | GPIO Registers | GPIO117 Pin Control 2 |
| 40081620      | GPIO                   | 0                     | GPIO Registers | GPIO120 Pin Control 2 |
| 40081624      | GPIO                   | 0                     | GPIO Registers | GPIO121 Pin Control 2 |
| 40081628      | GPIO                   | 0                     | GPIO Registers | GPIO122 Pin Control 2 |
| 4008162C      | GPIO                   | 0                     | GPIO Registers | GPIO123 Pin Control 2 |
| 40081630      | GPIO                   | 0                     | GPIO Registers | GPIO124 Pin Control 2 |
| 40081634      | GPIO                   | 0                     | GPIO Registers | GPIO125 Pin Control 2 |
| 40081638      | GPIO                   | 0                     | GPIO Registers | GPIO126 Pin Control 2 |
| 4008163C      | GPIO                   | 0                     | GPIO Registers | GPIO127 Pin Control 2 |
| 40081640      | GPIO                   | 0                     | GPIO Registers | GPIO130 Pin Control 2 |
| 40081644      | GPIO                   | 0                     | GPIO Registers | GPIO131 Pin Control 2 |
| 40081648      | GPIO                   | 0                     | GPIO Registers | GPIO132 Pin Control 2 |
| 4008164C      | GPIO                   | 0                     | GPIO Registers | GPIO133 Pin Control 2 |
| 40081650      | GPIO                   | 0                     | GPIO Registers | GPIO134 Pin Control 2 |
| 40081654      | GPIO                   | 0                     | GPIO Registers | GPIO135 Pin Control 2 |
| 40081658      | GPIO                   | 0                     | GPIO Registers | GPIO136 Pin Control 2 |
| 40081660      | GPIO                   | 0                     | GPIO Registers | GPIO140 Pin Control 2 |
| 40081664      | GPIO                   | 0                     | GPIO Registers | GPIO141 Pin Control 2 |
| 40081668      | GPIO                   | 0                     | GPIO Registers | GPIO142 Pin Control 2 |
| 4008166C      | GPIO                   | 0                     | GPIO Registers | GPIO143 Pin Control 2 |
| 40081670      | GPIO                   | 0                     | GPIO Registers | GPIO144 Pin Control 2 |
| 40081674      | GPIO                   | 0                     | GPIO Registers | GPIO145 Pin Control 2 |
| 40081678      | GPIO                   | 0                     | GPIO Registers | GPIO146 Pin Control 2 |
| 4008167C      | GPIO                   | 0                     | GPIO Registers | GPIO147 Pin Control 2 |
| 40081680      | GPIO                   | 0                     | GPIO Registers | GPIO150 Pin Control 2 |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name              |
|---------------|------------------------|-----------------------|----------------|---------------------------------|
| 40081684      | GPIO                   | 0                     | GPIO Registers | GPIO151 Pin Control 2           |
| 40081688      | GPIO                   | 0                     | GPIO Registers | GPIO152 Pin Control 2           |
| 4008168C      | GPIO                   | 0                     | GPIO Registers | GPIO153 Pin Control 2           |
| 40081690      | GPIO                   | 0                     | GPIO Registers | GPIO154 Pin Control 2           |
| 40081694      | GPIO                   | 0                     | GPIO Registers | GPIO155 Pin Control 2           |
| 40081698      | GPIO                   | 0                     | GPIO Registers | GPIO156 Pin Control 2           |
| 4008169C      | GPIO                   | 0                     | GPIO Registers | GPIO157 Pin Control 2           |
| 400816A0      | GPIO                   | 0                     | GPIO Registers | GPIO160 Pin Control 2           |
| 400816A4      | GPIO                   | 0                     | GPIO Registers | GPIO161 Pin Control 2           |
| 400816A8      | GPIO                   | 0                     | GPIO Registers | GPIO162 Pin Control 2           |
| 400816AC      | GPIO                   | 0                     | GPIO Registers | GPIO163 Pin Control 2           |
| 400816B0      | GPIO                   | 0                     | GPIO Registers | GPIO164 Pin Control 2           |
| 400816B4      | GPIO                   | 0                     | GPIO Registers | GPIO165 Pin Control 2           |
| 40081720      | GPIO                   | 0                     | GPIO Registers | GPIO200 Pin Control 2           |
| 40081724      | GPIO                   | 0                     | GPIO Registers | GPIO201 Pin Control 2           |
| 40081728      | GPIO                   | 0                     | GPIO Registers | GPIO202 Pin Control 2           |
| 4008172C      | GPIO                   | 0                     | GPIO Registers | GPIO203 Pin Control 2           |
| 40081730      | GPIO                   | 0                     | GPIO Registers | GPIO204 Pin Control 2           |
| 40081738      | GPIO                   | 0                     | GPIO Registers | GPIO206 Pin Control 2           |
| 40081740      | GPIO                   | 0                     | GPIO Registers | GPIO210 Pin Control 2           |
| 40081744      | GPIO                   | 0                     | GPIO Registers | GPIO211 Pin Control 2           |
| 400F0000      | IMAP                   | 0                     | EMI_RUNTIME    | EMI Host-to-EC Mailbox Register |
| 400F0001      | IMAP                   | 0                     | EMI_RUNTIME    | EC-to-Host Mailbox Register     |
| 400F0002      | IMAP                   | 0                     | EMI_RUNTIME    | EC Address Register             |
| 400F0004      | IMAP                   | 0                     | EMI_RUNTIME    | EC Data Register                |
| 400F0008      | IMAP                   | 0                     | EMI_RUNTIME    | Interrupt Source Register       |
| 400F000A      | IMAP                   | 0                     | EMI_RUNTIME    | Interrupt Mask Register         |
| 400F000C      | IMAP                   | 0                     | EMI_RUNTIME    | Application ID Register         |
| 400F0100      | IMAP                   | 0                     | EMI_EC_ONLY    | EMI Host-to-EC Mailbox Register |
| 400F0101      | IMAP                   | 0                     | EMI_EC_ONLY    | EC-to-Host Mailbox Register     |
| 400F0104      | IMAP                   | 0                     | EMI_EC_ONLY    | Memory Base Address 0 Register  |
| 400F0108      | IMAP                   | 0                     | EMI_EC_ONLY    | Memory Read Limit 0 Register    |
| 400F010A      | IMAP                   | 0                     | EMI_EC_ONLY    | Memory Write Limit 0 Register   |
| 400F010C      | IMAP                   | 0                     | EMI_EC_ONLY    | Memory Base Address 1 Register  |
| 400F0110      | IMAP                   | 0                     | EMI_EC_ONLY    | Memory Read Limit 1 Register    |
| 400F0112      | IMAP                   | 0                     | EMI_EC_ONLY    | Memory Write Limit 1 Register   |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name    | Reg. Instance Name               |
|---------------|------------------------|-----------------------|-------------------|----------------------------------|
| 400F0114      | IMAP                   | 0                     | EMI_EC_ONLY       | Interrupt Set Register           |
| 400F0116      | IMAP                   | 0                     | EMI_EC_ONLY       | Host Clear Enable Register       |
| 400F0400      | 8042 Host Interface    | 0                     | KBC_Runtime       | EC_Host Data/Aux Register (Read) |
| 400F0400      | 8042 Host Interface    | 0                     | KBC_Runtime       | Host_EC Data Register (Write)    |
| 400F0404      | 8042 Host Interface    | 0                     | KBC_Runtime       | Host_EC Command Register (Write) |
| 400F0404      | 8042 Host Interface    | 0                     | KBC_Runtime       | Keyboard Status Read Register    |
| 400F0500      | 8042 Host Interface    | 0                     | KBC_EC_Only       | Host_EC Data/Cmd Register        |
| 400F0500      | 8042 Host Interface    | 0                     | KBC_EC_Only       | EC_Host Data Register            |
| 400F0504      | 8042 Host Interface    | 0                     | KBC_EC_Only       | Keyboard Status Read Register    |
| 400F0508      | 8042 Host Interface    | 0                     | KBC_EC_Only       | Keyboard Control Register        |
| 400F050C      | 8042 Host Interface    | 0                     | KBC_EC_Only       | EC_Host Aux Register             |
| 400F0514      | 8042 Host Interface    | 0                     | KBC_EC_Only       | PCOBF Register                   |
| 400F0730      | 8042 Host Interface    | 0                     | KBC_Configuration | Activate Register                |
| 400F0C00      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 0     |
| 400F0C00      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 0     |
| 400F0C01      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 1     |
| 400F0C01      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 1     |
| 400F0C02      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 2     |
| 400F0C02      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 2     |
| 400F0C03      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 3     |
| 400F0C03      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Data Register Byte 3     |
| 400F0C04      | ACPI EC Interface      | 0                     | ACPI_Runtime      | ACPI OS Command Register         |
| 400F0C04      | ACPI EC Interface      | 0                     | ACPI_Runtime      | STATUS OS-Register               |
| 400F0C05      | ACPI EC Interface      | 0                     | ACPI_Runtime      | Byte Control OS-Register         |
| 400F0D00      | ACPI EC Interface      | 0                     | ACPI_EC_Only      | EC2OS Data EC-Register Byte 0    |
| 400F0D01      | ACPI EC Interface      | 0                     | ACPI_EC_Only      | EC2OS Data EC-Register Byte 1    |
| 400F0D02      | ACPI EC Interface      | 0                     | ACPI_EC_Only      | EC2OS Data EC-Register Byte 2    |
| 400F0D03      | ACPI EC Interface      | 0                     | ACPI_EC_Only      | EC2OS Data EC-Register Byte 3    |
| 400F0D04      | ACPI EC Interface      | 0                     | ACPI_EC_Only      | STATUS EC-Register               |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name            |
|---------------|------------------------|-----------------------|----------------|-------------------------------|
| 400F0D05      | ACPI EC Interface      | 0                     | ACPI_EC_Only   | Byte Control EC-Register      |
| 400F0D08      | ACPI EC Interface      | 0                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 0 |
| 400F0D08      | ACPI EC Interface      | 0                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 0 |
| 400F0D09      | ACPI EC Interface      | 0                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 1 |
| 400F0D0A      | ACPI EC Interface      | 0                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 2 |
| 400F0D0B      | ACPI EC Interface      | 0                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 3 |
| 400F1000      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 0  |
| 400F1000      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 0  |
| 400F1001      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 1  |
| 400F1001      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 1  |
| 400F1002      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 2  |
| 400F1002      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 2  |
| 400F1003      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 3  |
| 400F1003      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Data Register Byte 3  |
| 400F1004      | ACPI EC Interface      | 1                     | ACPI_Runtime   | ACPI OS Command Register      |
| 400F1004      | ACPI EC Interface      | 1                     | ACPI_Runtime   | STATUS OS-Register            |
| 400F1005      | ACPI EC Interface      | 1                     | ACPI_Runtime   | Byte Control OS-Register      |
| 400F1100      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | EC2OS Data EC-Register Byte 0 |
| 400F1101      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | EC2OS Data EC-Register Byte 1 |
| 400F1102      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | EC2OS Data EC-Register Byte 2 |
| 400F1103      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | EC2OS Data EC-Register Byte 3 |
| 400F1104      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | STATUS EC-Register            |
| 400F1105      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | Byte Control EC-Register      |
| 400F1108      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 0 |
| 400F1108      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 0 |
| 400F1109      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 1 |
| 400F110A      | ACPI EC Interface      | 1                     | ACPI_EC_Only   | OS2EC Data EC-Register Byte 2 |

| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name       | Reg. Instance Name                                   |
|---------------|------------------------|-----------------------|----------------------|--|
| 400F110B      | ACPI EC Interface      | 1                     | ACPI_EC_Only         | OS2EC Data EC-Register Byte 3                        |
| 400F1400      | ACPI PM1               | 0                     | PM1_Runtime          | PM1 Status 1   |
| 400F1401      | ACPI PM1               | 0                     | PM1_Runtime          | PM1 Status 2   |
| 400F1402      | ACPI PM1               | 0                     | PM1_Runtime          | PM1 Enable 1   |
| 400F1403      | ACPI PM1               | 0                     | PM1_Runtime          | PM1 Enable 2   |
| 400F1404      | ACPI PM1               | 0                     | PM1_Runtime          | PM1 Control 1  |
| 400F1405      | ACPI PM1               | 0                     | PM1_Runtime          | PM1 Control 2  |
| 400F1406      | ACPI PM1               | 0                     | PM1_Runtime          | PM2 Control 1  |
| 400F1407      | ACPI PM1               | 0                     | PM1_Runtime          | PM2 Control 2  |
| 400F1500      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 Status 1   |
| 400F1501      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 Status 2   |
| 400F1502      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 Enable 1   |
| 400F1503      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 Enable 2   |
| 400F1504      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 Control 1  |
| 400F1505      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 Control 2  |
| 400F1506      | ACPI PM1               | 0                     | PM1_EC_Only          | PM2 Control 1  |
| 400F1507      | ACPI PM1               | 0                     | PM1_EC_Only          | PM2 Control 2  |
| 400F1510      | ACPI PM1               | 0                     | PM1_EC_Only          | PM1 EC PM Status                                     |
| 400F1800      | 8042 Host Interface    | 0                     | Legacy_Runtime       | PORT92 Register                                      |
| 400F1900      | 8042 Host Interface    | 0                     | Legacy_EC_Only       | GATEA20 Control Register                             |
| 400F1908      | 8042 Host Interface    | 0                     | Legacy_EC_Only       | SETGA20L Register                                    |
| 400F190C      | 8042 Host Interface    | 0                     | Legacy_EC_Only       | RSTGA20L Register                                    |
| 400F1B30      | 8042 Host Interface    | 0                     | Legacy_Configuration | PORT92 Enable Register                               |
| 400F1C00      | M16C550A UART          | 0                     | UART_EC_Only         | UART Programmable BAUD Rate Generator (LSB) Register |
| 400F1C00      | M16C550A UART          | 0                     | UART_EC_Only         | UART Receive Buffer Register                         |
| 400F1C00      | M16C550A UART          | 0                     | UART_EC_Only         | UART Transmit Buffer Register                        |
| 400F1C01      | M16C550A UART          | 0                     | UART_EC_Only         | UART Programmable BAUD Rate Generator (MSB) Register |
| 400F1C01      | M16C550A UART          | 0                     | UART_EC_Only         | UART Interrupt Enable Register                       |
| 400F1C02      | M16C550A UART          | 0                     | UART_EC_Only         | UART FIFO Control Register                           |
| 400F1C02      | M16C550A UART          | 0                     | UART_EC_Only         | UART Interrupt Identification Register               |
| 400F1C03      | M16C550A UART          | 0                     | UART_EC_Only         | UART Line Control Register                           |
| 400F1C04      | M16C550A UART          | 0                     | UART_EC_Only         | UART Modem Control Register                          |
| 400F1C05      | M16C550A UART          | 0                     | UART_EC_Only         | UART Line Status Register                            |

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| Address (Hex) | HW Block Instance Name      | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                                   |
|---------------|-----------------------------|-----------------------|----------------|--|
| 400F1C06      | M16C550A UART               | 0                     | UART_EC_Only   | UART Modem Status Register                           |
| 400F1C07      | M16C550A UART               | 0                     | UART_EC_Only   | UART Scratchpad Register                             |
| 400F1C00      | M16C550A UART               | 0                     | UART_Runtime   | UART Transmit Buffer Register                        |
| 400F1C00      | M16C550A UART               | 0                     | UART_Runtime   | UART Programmable BAUD Rate Generator (LSB) Register |
| 400F1C00      | M16C550A UART               | 0                     | UART_Runtime   | UART Receive Buffer Register                         |
| 400F1C01      | M16C550A UART               | 0                     | UART_Runtime   | UART Interrupt Enable Register                       |
| 400F1C01      | M16C550A UART               | 0                     | UART_Runtime   | UART Programmable BAUD Rate Generator (MSB) Register |
| 400F1C02      | M16C550A UART               | 0                     | UART_Runtime   | UART FIFO Control Register                           |
| 400F1C02      | M16C550A UART               | 0                     | UART_Runtime   | UART Interrupt Identification Register               |
| 400F1C03      | M16C550A UART               | 0                     | UART_Runtime   | UART Line Control Register                           |
| 400F1C04      | M16C550A UART               | 0                     | UART_Runtime   | UART Modem Control Register                          |
| 400F1C05      | M16C550A UART               | 0                     | UART_Runtime   | UART Line Status Register                            |
| 400F1C06      | M16C550A UART               | 0                     | UART_Runtime   | UART Modem Status Register                           |
| 400F1C07      | M16C550A UART               | 0                     | UART_Runtime   | UART Scratchpad Register                             |
| 400F1F30      | M16C550A UART               | 0                     | UART_Config    | UART Activate Register                               |
| 400F1FF0      | M16C550A UART               | 0                     | UART_Config    | UART Config Select Register                          |
| 400F2400      | Mailbox Registers Interface | 0                     | MBX_Runtime    | MBX_Index Register                                   |
| 400F2401      | Mailbox Registers Interface | 0                     | MBX_Runtime    | MBX_Data_Register                                    |
| 400F2500      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | HOST-to-EC Mailbox Register                          |
| 400F2504      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | EC-to-Host Mailbox Register                          |
| 400F2508      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | SMI Interrupt Source Register                        |
| 400F250C      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | SMI Interrupt Mask Register                          |
| 400F2510      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [3:0]                               |
| 400F2514      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [7:4]                               |
| 400F2518      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [Bh:8]                              |



| Address (Hex) | HW Block Instance Name      | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                |
|---------------|-----------------------------|-----------------------|----------------|-----------------------------------|
| 400F251C      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [Fh:Ch]          |
| 400F2520      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [13h:10h]        |
| 400F2524      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [17h:14h]        |
| 400F2528      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [1Bh:18h]        |
| 400F252C      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [1Fh:1Ch]        |
| 400F2530      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [23h:20h]        |
| 400F2534      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [27h:24h]        |
| 400F2538      | Mailbox Registers Interface | 0                     | MBX_EC_Only    | Mailbox Register [2Ah:28h]        |
| 400F2C00      | RTC                         | 0                     | RTC            | Seconds                           |
| 400F2C01      | RTC                         | 0                     | RTC            | Seconds Alarm                     |
| 400F2C02      | RTC                         | 0                     | RTC            | Minutes                           |
| 400F2C03      | RTC                         | 0                     | RTC            | Minutes Alarm                     |
| 400F2C04      | RTC                         | 0                     | RTC            | Hours                             |
| 400F2C05      | RTC                         | 0                     | RTC            | Hours Alarm                       |
| 400F2C06      | RTC                         | 0                     | RTC            | Day of Week                       |
| 400F2C07      | RTC                         | 0                     | RTC            | Day of Month                      |
| 400F2C08      | RTC                         | 0                     | RTC            | Month                             |
| 400F2C09      | RTC                         | 0                     | RTC            | Year                              |
| 400F2C0A      | RTC                         | 0                     | RTC            | Register A                        |
| 400F2C0B      | RTC                         | 0                     | RTC            | Register B                        |
| 400F2C0C      | RTC                         | 0                     | RTC            | Register C                        |
| 400F2C0D      | RTC                         | 0                     | RTC            | Register D                        |
| 400F2C10      | RTC                         | 0                     | RTC            | RTC Control                       |
| 400F2C14      | RTC                         | 0                     | RTC            | Week Alarm                        |
| 400F2C18      | RTC                         | 0                     | RTC            | Daylight Savings Forward          |
| 400F2C1C      | RTC                         | 0                     | RTC            | Daylight Savings Backward         |
| 400F2C20      | RTC                         | 0                     | RTC            | RTC Test Mode                     |
| 400F3000      | LPC                         | 0                     | LPC_Runtime    | Configuration Port Index Register |
| 400F3001      | LPC                         | 0                     | LPC_Runtime    | Configuration Port Data Register  |
| 400F3100      | LPC                         | 0                     | LPC_EC_Only    | Reserved                          |
| 400F3104      | LPC                         | 0                     | LPC_EC_Only    | LPC Bus Monitor Register          |
| 400F3108      | LPC                         | 0                     | LPC_EC_Only    | Host Bus Error Register           |
| 400F310C      | LPC                         | 0                     | LPC_EC_Only    | EC SERIRQ Register                |
| 400F3110      | LPC                         | 0                     | LPC_EC_Only    | EC Clock Control Register         |
| 400F3114      | LPC                         | 0                     | LPC_EC_Only    | Reserved                          |
| 400F3118      | LPC                         | 0                     | LPC_EC_Only    | Reserved                          |

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| Address (Hex) | HW Block Instance Name | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                      |
|---------------|------------------------|-----------------------|----------------|---|
| 400F3120      | LPC                    | 0                     | LPC_EC_Only    | BAR Inhibit Register                    |
| 400F3130      | LPC                    | 0                     | LPC_EC_Only    | LPC BAR Init Register                   |
| 400F3140      | LPC                    | 0                     | LPC_EC_Only    | Memory BAR Inhibit                      |
| 400F31FC      | LPC                    | 0                     | LPC_EC_Only    | Memory Host Configuration Register      |
| 400F3330      | LPC                    | 0                     | LPC_Config     | LPC Activate                            |
| 400F3340      | LPC                    | 0                     | LPC_Config     | SIRQ0 Interrupt Configuration Register  |
| 400F3341      | LPC                    | 0                     | LPC_Config     | SIRQ1 Interrupt Configuration Register  |
| 400F3342      | LPC                    | 0                     | LPC_Config     | SIRQ2 Interrupt Configuration Register  |
| 400F3343      | LPC                    | 0                     | LPC_Config     | SIRQ3 Interrupt Configuration Register  |
| 400F3344      | LPC                    | 0                     | LPC_Config     | SIRQ4 Interrupt Configuration Register  |
| 400F3345      | LPC                    | 0                     | LPC_Config     | SIRQ5 Interrupt Configuration Register  |
| 400F3346      | LPC                    | 0                     | LPC_Config     | SIRQ6 Interrupt Configuration Register  |
| 400F3347      | LPC                    | 0                     | LPC_Config     | SIRQ7 Interrupt Configuration Register  |
| 400F3348      | LPC                    | 0                     | LPC_Config     | SIRQ8 Interrupt Configuration Register  |
| 400F3349      | LPC                    | 0                     | LPC_Config     | SIRQ9 Interrupt Configuration Register  |
| 400F334A      | LPC                    | 0                     | LPC_Config     | SIRQ10 Interrupt Configuration Register |
| 400F334B      | LPC                    | 0                     | LPC_Config     | SIRQ11 Interrupt Configuration Register |
| 400F334C      | LPC                    | 0                     | LPC_Config     | SIRQ12 Interrupt Configuration Register |
| 400F334D      | LPC                    | 0                     | LPC_Config     | SIRQ13 Interrupt Configuration Register |
| 400F334E      | LPC                    | 0                     | LPC_Config     | SIRQ14 Interrupt Configuration Register |
| 400F334F      | LPC                    | 0                     | LPC_Config     | SIRQ15 Interrupt Configuration Register |
| 400F3360      | LPC                    | 0                     | LPC_Config     | LPC Interface BAR Register              |
| 400F3364      | LPC                    | 0                     | LPC_Config     | EM Interface 0 BAR                      |
| 400F3368      | LPC                    | 0                     | LPC_Config     | UART 0 BAR Register                     |
| 400F3378      | LPC                    | 0                     | LPC_Config     | Keyboard Controller BAR                 |
| 400F3388      | LPC                    | 0                     | LPC_Config     | ACPI EC Interface 0 BAR                 |
| 400F338C      | LPC                    | 0                     | LPC_Config     | ACPI EC Interface 1 BAR                 |
| 400F3390      | LPC                    | 0                     | LPC_Config     | ACPI PM1 Interface BAR                  |
| 400F3394      | LPC                    | 0                     | LPC_Config     | Legacy (GATEA20) Interface BAR          |

| Address (Hex) | HW Block Instance Name         | HW Block Instance No. | Reg. Bank Name | Reg. Instance Name                  |
|---------------|--------------------------------|-----------------------|----------------|-------------------------------------|
| 400F3398      | LPC                            | 0                     | LPC_Config     | Mailbox Registers Interface BAR     |
| 400F33C0      | LPC                            | 0                     | LPC_Config     | Mailbox Registers I/F Memory BAR    |
| 400F33C6      | LPC                            | 0                     | LPC_Config     | ACPI EC Interface 0 Memory BAR      |
| 400F33CC      | LPC                            | 0                     | LPC_Config     | ACPI EC Interface 1 Memory BAR      |
| 400F33D2      | LPC                            | 0                     | LPC_Config     | EM Interface 0 Memory BAR           |
| 400FFF00      | Global Configuration Registers | 0                     | GCR            | GCR Reserved Registers              |
| 400FFF07      | Global Configuration Registers | 0                     | GCR            | Logical Device Number Register      |
| 400FFF08      | Global Configuration Registers | 0                     | GCR            | GCR Reserved Registers              |
| 400FFF20      | Global Configuration Registers | 0                     | GCR            | Device ID Register                  |
| 400FFF21      | Global Configuration Registers | 0                     | GCR            | Device Revision Hard Wired Register |
| 400FFF22      | Global Configuration Registers | 0                     | GCR            | GCR Reserved                        |
| 400FFF25      | Global Configuration Registers | 0                     | GCR            | GCR Reserved                        |
| 400FFF28      | Global Configuration Registers | 0                     | GCR            | GCR Build Register                  |
| 400FFF2A      | Global Configuration Registers | 0                     | GCR            | GCR Reserved Registers              |
| 400FFF2C      | Global Configuration Registers | 0                     | GCR            | GCR Scratch Register                |

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## APPENDIX A: REVISION HISTORY

**TABLE A-1: DATA SHEET REVISION HISTORY**

| Revision               | Section/Figure/Entry   | Correction  |
|------------------------|--|---|
| DS00001719D (09-14-15) | Table 37-1, "Absolute Maximum Thermal Ratings", Table 37-8, "Thermal Operating Conditions" and Table 37-10, "VCC1 Supply Current, I_VCC1"                            | Updated tables to add Industrial temperature information.                                     |
|                        | Table 37-11, "VBAT Supply Current, I_VBAT (VBAT=3.0V)" and Table 37-12, "VBAT Supply Current, I_VBAT (VBAT=3.3V)"  | Updated tables to remove internal 32kHz oscillator information.                               |
|                        | Product Identification System  | Added industrial ordering information.  |
| DS00001719C (06-15-15) | Table 27-9, "EC-Only Register Base Address Table"  | Updated Base addresses  |
|                        | Table 15-3, "Interrupt Event Aggregator Routing Summary" and Table 15-22, "Bit definitions for GIRQ19 Source, Enable, and Result Registers"                          | Updated locations for LRESET# and VCC_PWRGD bits  |
|                        | Section 29.15.4, "PS2 Status Register"   | Updated description of REC_TIMEOUT bit  |
|                        | Table 37-8, "Thermal Operating Conditions" and Table 37-9, "Thermal Packaging Characteristics"   | Updated tables.   |
|                        | Product Features   | Added 144 WFBGA package   |
|                        | Table 1-3, "MEC1322 144 WFBGA Pin Configuration", Figure 1-1, "MEC1322 PIN NAME TO 144-PIN WFBGA BALL MAPPING (TOP)" and Figure 1-5, "144-pin WFBGA Package Outline" | Added 144 WFBGA pinout and package drawing.   |
|                        | Product Identification System  | Added 144 WFBGA package ordering information  |
|                        | Section 8.0, "RAM and ROM"   | Described the distinction between SRAM optimized for instructions and optimized for data.     |
|                        | Section 20.7, "Pin Multiplexing Control"   | Updated note on GPIO pins that do not exist in the 128 pin package.                           |
| DS00001719B (06-03-14) | Throughout document  | Part number changed from MEC1322/24 to MEC1322.   |
|                        | PIS page   | "C0" added to package information   |
|                        | Features   | Sub-bullet added following "LPC Interface": "Supports LPC Bus frequencies of 19MHz to 33MHz". |
| DS00001719A (04-14-14) | REV A - Document Release   |   |

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## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| <u>PART NO.</u> <sup>(1)</sup> | <u>XX</u>              | - | <u>XXX</u> <sup>(2)</sup> | - | <u>XX</u>      | - | <u>IXI</u> <sup>(3)</sup> |
|--------------------------------|------------------------|---|---------------------------|---|----------------|---|---------------------------|
| Device                         | Temperature Range      |   | Package                   |   | ROM Version    |   | Tape and Reel Option      |
| Device:                        | MEC1322 <sup>(1)</sup> |   |                           |   |                |   |                           |
| Temperature Range:             | Blank                  | = | Commercial                |   | 0°C to 70°C    |   |                           |
|                                | I                      | = | Industrial                |   | -40°C to 85°C  |   |                           |
| Package:                       | NU                     | = | 128 pin VTQFP             |   | <sup>(2)</sup> |   |                           |
|                                | LZY                    | = | 132 pin DQFN              |   | <sup>(2)</sup> |   |                           |
|                                | SZ                     | = | 144 pin WFBGA             |   | <sup>(2)</sup> |   |                           |
| ROM Version:                   | C0                     | = | Standard ROM              |   |                |   |                           |
| Tape and Reel Option:          | Blank                  | = | Tray packaging            |   |                |   |                           |
|                                | TR                     | = | Tape and Reel             |   | <sup>(3)</sup> |   |                           |

### Examples:

- a) MEC1322-NU-C0 = 128-pin VTQFP, Commercial
- b) MEC1322I-LZY-C0 = 132-pin DQFN, Industrial
- c) MEC1322-SZ-C0 = 144-pin WFBGA, Commercial

**Note 1:** These products meet the halogen maximum concentration values per IEC61249-2-21.

**Note 2:** All package options are RoHS compliant. For RoHS compliance and environmental information, please visit <http://www.microchip.com/pagehandler/en-us/aboutus/ehs.html>.

**Note 3:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

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**Телефон:** 8 (812) 309 58 32 (многоканальный)

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**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.