

### GENERAL DESCRIPTION

The XRT86VL32 is a two-channel 1.544 Mbit/s or 2.048 Mbit/s DS1/E1/J1 framer and LIU integrated solution featuring R<sup>3</sup> technology (Relayless, Reconfigurable, Redundancy). The physical interface is optimized with internal impedance, and with the patented pad structure, the XRT86VL32 provides protection from power failures and hot swapping.

The XRT86VL32 contains an integrated DS1/E1/J1 framer and LIU which provide DS1/E1/J1 framing and error accumulation in accordance with ANSI/ITU-T specifications. Each framer has its own framing synchronizer and transmit-receive slip buffers. The slip buffers can be independently enabled or disabled as required and can be configured to frame to the common DS1/E1/J1 signal formats.

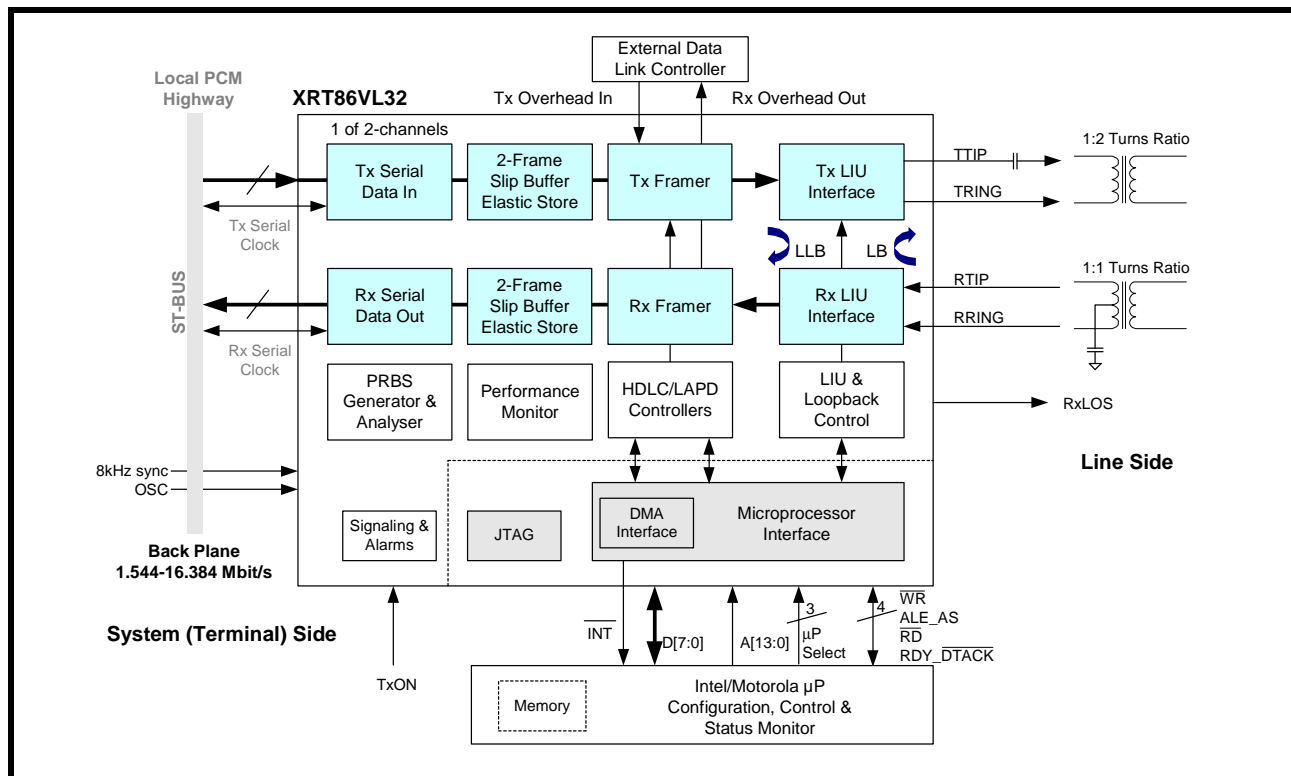
Each Framer block contains its own Transmit and Receive T1/E1/J1 Framing function. There are 3 Transmit HDLC controllers per channel which encapsulate contents of the Transmit HDLC buffers into LAPD Message frames. There are 3 Receive HDLC controllers per channel which extract the

payload content of Receive LAPD Message frames from the incoming T1/E1/J1 data stream and write the contents into the Receive HDLC buffers. Each framer also contains a Transmit and Overhead Data Input port, which permits Data Link Terminal Equipment direct access to the outbound T1/E1/J1 frames. Likewise, a Receive Overhead output data port permits Data Link Terminal Equipment direct access to the Data Link bits of the inbound T1/E1/J1 frames.

The XRT86VL32 fully meets all of the latest T1/E1/J1 specifications: ANSI T1/E1.107-1988, ANSI T1/E1.403-1995, ANSI T1/E1.231-1993, ANSI T1/E1.408-1990, AT&T TR 62411 (12-90) TR54016, and ITU G-703, G.704, G.706 and G.733, AT&T Pub. 43801, and ETS 300 011, 300 233, JT G.703, JT G.704, JT G.706, I.431. Extensive test and diagnostic functions include Loop-backs, Boundary scan, Pseudo Random bit sequence (PRBS) test pattern generation, Performance Monitor, Bit Error Rate (BER) meter, forced error insertion, and LAPD unchannelized data payload processing according to ITU-T standard Q.921.

### APPLICATIONS AND FEATURES (NEXT PAGE)

FIGURE 1. XRT86VL32 2-CHANNEL DS1 (T1/E1/J1) FRAMER/LIU COMBO



**APPLICATIONS**

- High-Density T1/E1/J1 interfaces for Multiplexers, Switches, LAN Routers and Digital Modems
- SONET/SDH terminal or Add/Drop multiplexers (ADMs)
- T1/E1/J1 add/drop multiplexers (MUX)
- Channel Service Units (CSUs): T1/E1/J1 and Fractional T1/E1/J1
- Digital Access Cross-connect System (DACs)
- Digital Cross-connect Systems (DCS)
- Frame Relay Switches and Access Devices (FRADS)
- ISDN Primary Rate Interfaces (PRA)
- PBXs and PCM channel bank
- T3 channelized access concentrators and M13 MUX
- Wireless base stations
- ATM equipment with integrated DS1 interfaces
- Multichannel DS1 Test Equipment
- T1/E1/J1 Performance Monitoring
- Voice over packet gateways
- Routers

**FEATURES**

- Two independent, full duplex DS1 Tx and Rx Framer/LIUs
- Two 512-bit (two-frame) elastic store, PCM frame slip buffers (FIFO) on TX and Rx provide up to 8.192 MHz asynchronous back plane connections with jitter and wander attenuation
- Supports input PCM and signaling data at 1.544, 2.048, 4.096 and 8.192 Mbits. Also supports 2-channel multiplexed 12.352/16.384 (HMVIP/H.100) Mbit/s on the back plane bus
- Programmable output clocks for Fractional T1/E1/J1
- Supports Channel Associated Signaling (CAS)
- Supports Common Channel Signalling (CCS)
- Supports ISDN Primary Rate Interface (ISDN PRI) signaling
- Extracts and inserts robbed bit signaling (RBS)
- 3 Integrated HDLC controllers per channel for transmit and receive, each controller having two 96-byte buffers (buffer 0 / buffer 1)
- HDLC Controllers Support SS7
- Timeslot assignable HDLC
- V5.1 or V5.2 Interface
- Automatic Performance Report Generation (PMON Status) can be inserted into the transmit LAPD interface every 1 second or for a single transmission
- Alarm Indication Signal with Customer Installation signature (AIS-CI)
- Remote Alarm Indication with Customer Installation (RAI-CI)
- Gapped Clock interface mode for Transmit and Receive.



- Intel/Motorola and Power PC interfaces for configuration, control and status monitoring
- Parallel search algorithm for fast frame synchronization
- Wide choice of T1 framing structures: SF/D4, ESF, SLC@96, T1DM and N-Frame (non-signaling)
- Direct access to D and E channels for fast transmission of data link information
- PRBS, QRSS, and Network Loop Code generation and detection
- Programmable Interrupt output pin
- Supports programmed I/O and DMA modes of Read-Write access
- Each framer block encodes and decodes the T1/E1/J1 Frame serial data
- Detects and forces Red (SAI), Yellow (RAI) and Blue (AIS) Alarms
- Detects OOF, LOF, LOS errors and COFA conditions
- Loopbacks: Local (LLB) and Line remote (LB)
- Facilitates Inverse Multiplexing for ATM
- Performance monitor with one second polling
- Boundary scan (IEEE 1149.1) JTAG test port
- Accepts external 8kHz Sync reference
- 1.8V Inner Core
- 3.3V CMOS operation with 5V tolerant inputs
- 225-pin PBGA package with -40°C to +85°C operation

**ORDERING INFORMATION**

| <b>PART NUMBER</b> | <b>PACKAGE</b>              | <b>OPERATING TEMPERATURE RANGE</b> |
|--------------------|-----------------------------|------------------------------------|
| XRT86VL32IB        | 225 Plastic Ball Grid Array | -40°C to +85°C                     |

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**1.0 PIN LIST**
**TABLE 1: LIST BY PIN NUMBER**

| PIN | PIN NAME   |
|-----|------------|
| A1  | GNDPLL     |
| A2  | AVDD18     |
| A3  | E1MCLKnOUT |
| A4  | MCLKIN     |
| A5  | VSS        |
| A6  | TRST       |
| A7  | RXSERCLK0  |
| A8  | RXCHCLK0   |
| A9  | RXOHCLK0   |
| A10 | TXMSYNC0   |
| A11 | TXOHCLK0   |
| A12 | TXSERCLK0  |
| A13 | TXCHNCLK0  |
| A14 | TXCHN0_3   |
| A15 | NC         |
| A16 | NC         |
| A17 | NC         |
| A18 | NC         |
| B1  | VDDPLL18   |
| B2  | JTAG_Ring  |
| B3  | AGND       |
| B4  | T1MCLKnOUT |
| B5  | aTEST      |
| B6  | TDI        |
| B7  | RXLOS0     |
| B8  | DVDD18     |
| B9  | RXCHN0_2   |
| B10 | RXCHN0_4   |
| B11 | TEST       |
| B12 | TXCHN0_0   |
| B13 | TXCHN0_2   |

| PIN | PIN NAME   |
|-----|------------|
| B14 | VSS        |
| B15 | NC         |
| B16 | NC         |
| B17 | NC         |
| B18 | NC         |
| C1  | GNDPLL     |
| C2  | VDDPLL18   |
| C3  | JTAG_Tip   |
| C4  | DVDD18     |
| C5  | DGND       |
| C6  | TMS        |
| C7  | TCLK       |
| C8  | RXCRCSYNC0 |
| C9  | RXCHN0_1   |
| C10 | RXCHN0_3   |
| C11 | RXOH0      |
| C12 | TXOH0      |
| C13 | NC         |
| C14 | TXCHN0_4   |
| C15 | NC         |
| C16 | VSS        |
| C17 | NC         |
| C18 | NC         |
| D1  | GNDPLL     |
| D2  | VDDPLL18   |
| D3  | VDDPLL18   |
| D4  | GNDPLL     |
| D5  | TDO        |
| D6  | RXSER0     |
| D7  | RXCHN0_0   |
| D8  | RXSYNC0    |
| D9  | TXSYNC0    |
| D10 | RXCASYNC0  |
| D11 | TXSER0     |

| PIN | PIN NAME  |
|-----|-----------|
| D12 | TXCHN0_1  |
| D13 | NC        |
| D14 | NC        |
| D15 | RXSERCLK2 |
| D16 | VDD       |
| D17 | NC        |
| D18 | NC        |
| E1  | RTIP0     |
| E2  | RGND0     |
| E3  | RVDD0     |
| E4  | TTIP0     |
| E5  | ANALOG    |
| E15 | NC        |
| E16 | NC        |
| E17 | NC        |
| E18 | NC        |
| F1  | RRING0    |
| F2  | TGND0     |
| F3  | TVDD0     |
| F4  | TRING0    |
| F15 | VSS       |
| F16 | NC        |
| F17 | NC        |
| F18 | RXSYNC2   |
| G1  | DGND      |
| G2  | RGND1     |
| G3  | RVDD1     |
| G4  | NC        |
| G15 | RXCHN2_1  |
| G16 | RXLOS2    |
| G17 | NC        |
| G18 | NC        |
| H1  | DGND      |
| H2  | TGND1     |

| PIN | PIN NAME   |
|-----|------------|
| H3  | TVDD1      |
| H4  | NC         |
| H15 | RXCASYNC2  |
| H16 | RXCHN2_0   |
| H17 | RXCHCLK2   |
| H18 | NC         |
| J1  | RTIP2      |
| J2  | RGND2      |
| J3  | RVDD2      |
| J4  | TTIP2      |
| J15 | TXSERCLK2  |
| J16 | DVDD18     |
| J17 | RXCRCSYNC2 |
| J18 | RXSER2     |
| K1  | RRING2     |
| K2  | TGND2      |
| K3  | TVDD2      |
| K4  | TRING2     |
| K15 | RXOH2      |
| K16 | RXCHN2_4   |
| K17 | RXOHCLK2   |
| K18 | RXCHN2_2   |
| L1  | DGND       |
| L2  | RGND3      |
| L3  | RVDD3      |
| L4  | NC         |
| L15 | TXSYNC2    |
| L16 | RXCHN2_3   |
| L17 | TXMSYNC2   |
| L18 | TXSER2     |
| M1  | DGND       |
| M2  | TGND3      |
| M3  | TVDD3      |
| M4  | NC         |



| PIN | PIN NAME                  |
|-----|---------------------------|
| M15 | VSS                       |
| M16 | VSS                       |
| M17 | TXCHN2_1                  |
| M18 | TXCHN2_0                  |
| N1  | TxON                      |
| N2  | LOP                       |
| N3  | NC                        |
| N4  | 8KEXTOSC                  |
| N15 | TXCHN2_4                  |
| N16 | TXCHN2_3                  |
| N17 | TXCHNCLK2                 |
| N18 | TXOHCLK2                  |
| P1  | $\overline{\text{RESET}}$ |
| P2  | E1OSCCLK                  |
| P3  | VDD                       |
| P4  | T1OSCCLK                  |
| P15 | TXOH2                     |
| P16 | NC                        |
| P17 | NC                        |
| P18 | NC                        |
| R1  | $\overline{\text{REQ0}}$  |
| R2  | 8KSYNC                    |
| R3  | $\overline{\text{REQ1}}$  |
| R4  | VSS                       |
| R5  | ADDR2                     |
| R6  | ADDR6                     |
| R7  | ADDR10                    |
| R8  | $\overline{\text{INT}}$   |
| R9  | ADDR11                    |
| R10 | ADDR12                    |
| R11 | DATA7                     |
| R12 | NC                        |
| R13 | DVDD18                    |
| R14 | VSS                       |

| PIN | PIN NAME                  |
|-----|---------------------------|
| R15 | VDD                       |
| R16 | NC                        |
| R17 | NC                        |
| R18 | NC                        |
| T1  | fADDR                     |
| T2  | $\overline{\text{ACK0}}$  |
| T3  | $\overline{\text{RDY}}$   |
| T4  | DATA0                     |
| T5  | VSS                       |
| T6  | ADDR3                     |
| T7  | ADDR7                     |
| T8  | PTYPE2                    |
| T9  | VDD                       |
| T10 | DATA4                     |
| T11 | NC                        |
| T12 | NC                        |
| T13 | NC                        |
| T14 | NC                        |
| T15 | NC                        |
| T16 | TXCHN2_2                  |
| T17 | NC                        |
| T18 | NC                        |
| U1  | iADDR                     |
| U2  | $\overline{\text{ACK1}}$  |
| U3  | DATA1                     |
| U4  | $\overline{\text{DBEN}}$  |
| U5  | ADDR0                     |
| U6  | ADDR4                     |
| U7  | DVDD18                    |
| U8  | ALE                       |
| U9  | ADDR9                     |
| U10 | $\overline{\text{BLAST}}$ |
| U11 | DATA6                     |
| U12 | NC                        |

| PIN | PIN NAME               |
|-----|------------------------|
| U13 | NC                     |
| U14 | NC                     |
| U15 | NC                     |
| U16 | VSS                    |
| U17 | NC                     |
| U18 | NC                     |
| V1  | PCLK                   |
| V2  | PTYPE0                 |
| V3  | $\overline{\text{RD}}$ |
| V4  | PTYPE1                 |
| V5  | ADDR1                  |
| V6  | ADDR5                  |
| V7  | ADDR8                  |
| V8  | DATA2                  |
| V9  | DATA3                  |
| V10 | DATA5                  |
| V11 | ADDR13                 |
| V12 | $\overline{\text{WR}}$ |
| V13 | $\overline{\text{CS}}$ |
| V14 | VSS                    |
| V15 | NC                     |
| V16 | NC                     |
| V17 | NC                     |
| V18 | NC                     |



**2.0 PIN DESCRIPTIONS**

There are six types of pins defined throughout this pin description and the corresponding symbol is presented in table below. The per-channel pin is indicated by the channel number or the letter 'n' which is appended at the end of the signal name, for example, TxSERn, where "n" indicates channels 0 and 2. All output pins are "tri-stated" upon hardware RESET.

**TABLE 2: PIN TYPES**

| <b>SYMBOL</b> | <b>PIN TYPE</b> |
|---------------|-----------------|
| I             | Input           |
| O             | Output          |
| I/O           | Bidirectional   |
| GND           | Ground          |
| PWR           | Power           |
| NC            | No Connect      |

The structure of the pin description is divided into thirteen groups, as presented in the table below

**TABLE 3: PIN DESCRIPTION STRUCTURE**

| <b>SECTION</b>                 | <b>PAGE NUMBER</b> |
|--------------------------------|--------------------|
| Transmit System Side Interface | page 7             |
| Transmit Overhead Interface    | page 15            |
| Receive Overhead Interface     | page 17            |
| Receive System Side Interface  | page 18            |
| Receive Line Interface         | page 26            |
| Transmit Line Interface        | page 28            |
| Timing Interface               | page 28            |
| JTAG Interface                 | page 30            |
| Microprocessor Interface       | page 31            |
| Power Pins (3.3V)              | page 40            |
| Power Pins (1.8V)              | page 40            |
| Ground Pins                    | page 41            |
| No Connect Pins                | page 41            |

**TRANSMIT SYSTEM SIDE INTERFACE**

| SIGNAL NAME                            | BALL#          | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION  |
|--|----------------|------|------------------|--|
| TxSER0/<br>TxPOS0<br>TxSER2/<br>TxPOS2 | D11<br><br>L18 | I    | -                | <p><b>Transmit Serial Data Input (TxSERn)/Transmit Positive Digital Input (TxPOSn):</b><br/>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>DS1/E1 Mode - TxSERn</b><br/>These pins function as the transmit serial data input on the system side interface, which are latched on the rising edge of the TxSER-CLKn pin. Any payload data applied to this pin will be inserted into an outbound DS1/E1 frame and output to the line. In DS1 mode, the framing alignment bits, facility data link bits, CRC-6 bits, and signaling information can also be inserted from this input pin if configured appropriately. In E1 mode, all data intended to be transported via Time Slots 1 through 15 and Time slots 17 through 31 must be applied to this input pin. Data intended for Time Slots 0 and 16 can also be applied to this input pin If configured accordingly.</p> <p><b>DS1 or E1 High-Speed Multiplexed Mode* - TxSERn</b><br/>In this mode, these pins are used as the high-speed multiplexed data input pin on the system side. High-speed multiplexed data of channels 0-3 must be applied to TxSER0 in a byte or bit-interleaved way. The framer latches in the multiplexed data on TxSER0 using TxMSYNC/TxINCLK and demultiplexes this data into 4 serial streams. The LIU block will then output the data to the line interface using TxSERCLKn.</p> <p><b>DS1 or E1 Framer Bypass Mode - TxPOSn</b><br/>In this mode, TxSERn is used for the positive digital input pin (TxPOSn) to the LIU.</p> <p><b>NOTE:</b></p> <ol style="list-style-type: none"> <li><i>*High-speed multiplexed modes include (For T1/E1) 16.384MHz H MVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</i></li> <li><i>In DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</i></li> <li><i>These 8 pins are internally pulled "High" for each channel.</i></li> </ol> |

**TRANSMIT SYSTEM SIDE INTERFACE**

| SIGNAL NAME  | BALL#          | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION  |
|--|----------------|------|------------------|--|
| TxSERCLK0/<br>TxLINECLK0<br>TxSERCLK2/<br>TxLINECLK2 | A12<br><br>J15 | I/O  | 12               | <p><b>Transmit Serial Clock (TxSERCLKn)/Transmit Line Clock (TxSERCLKn):</b><br/>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>In Base-Rate Mode (1.544MHz/2.048MHz) - TxSERCLKn:</b><br/>This clock signal is used by the transmit serial interface to latch the contents on the TxSERn pins into the T1/E1 framer on the rising edge of TxSERCLKn. These pins can be configured as input or output as described below.</p> <p><b>When TxSERCLKn is configured as Input:</b><br/>These pins will be inputs if the TxSERCLK is chosen as the timing source for the transmit framer. Users must provide a 1.544MHz clock rate to this input pin for T1 mode of operation, and 2.048MHz clock rate in E1 mode.</p> <p><b>When TxSERCLKn is configured as Output:</b><br/>These pins will be outputs if either the recovered line clock or the MCLK PLL is chosen as the timing source for the T1/E1 transmit framer. The transmit framer will output a 1.544MHz clock rate in T1 mode of operation, and a 2.048MHz clock rate in E1 mode.</p> <p><b>DS1/E1 High-Speed Backplane Modes* - TxSERCLKn as INPUT ONLY</b><br/>In this mode, TxSERCLK is an optional clock signal input which is used as the timing source for the transmit line interface, and is only required if TxSERCLK is chosen as the timing source for the transmit framer. If TxSERCLK is chosen as the timing source, system equipment should provide 1.544MHz (For T1 mode) or 2.048MHz (For E1 mode) to the TxSERCLKn pins on each channel. TxSERCLK is not required if either the recovered clock or MCLK PLL is chosen as the timing source of the device.<br/>High speed or multiplexed data is latched into the device using the TxMSYNC/TxINCLK high-speed clock signal.</p> <p><b>DS1 or E1 Framer Bypass Mode - TxLINECLKn</b><br/>In this mode, TxSERCLKn is used as the transmit line clock (TxLINECLK) to the LIU.</p> <p><b>NOTE:</b> *High-speed backplane modes include (For T1/E1) 2.048MVIP, 4.096MHz, 8.192MHz, 16.384MHz HMVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</p> <p><b>NOTE:</b> In DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</p> <p><b>NOTE:</b> These 8 pins are internally pulled "High" for each channel.</p> |

TRANSMIT SYSTEM SIDE INTERFACE

| SIGNAL NAME                              | BALL#         | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION   |
|--|---------------|------|------------------|---|
| TxSYNC0/<br>TxNEG0<br>TxSYNC2/<br>TxNEG2 | D9<br><br>L15 | I/O  | 12               | <p><b>Transmit Single Frame Sync Pulse (TxSYNCn) / Transmit Negative Digital Input (TxNEGn):</b></p> <p>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>DS1/E1 Base Rate Mode (1.544MHz/2.048MHz) - TxSYNCn:</b></p> <p>These TxSYNCn pins are used to indicate the single frame boundary within an outbound T1/E1 frame. In both DS1 or E1 mode, the single frame boundary repeats every 125 microseconds (8kHz).</p> <p>In DS1/E1 base rate, TxSYNCn can be configured as either input or output as described below.</p> <p><b>When TxSYNCn is configured as an Input:</b></p> <p>Users must provide a signal which must pulse "High" for one period of TxSERCLK during the first bit of an outbound DS1/E1 frame. It is imperative that the TxSYNC input signal be synchronized with the TxSERCLK input signal.</p> <p><b>When TxSYNCn is configured as an Output:</b></p> <p>The transmit T1/E1 framer will output a signal which pulses "High" for one period of TxSERCLK during the first bit of an outbound DS1/E1 frame.</p> <p><b>DS1/E1 High-Speed Backplane Modes* - TxSYNCn as INPUT ONLY:</b></p> <p>In this mode, TxSYNCn must be an input regardless of the clock source that is chosen to be the timing source for the transmit framer. In 2.048MVIP/4.096/8.192MHz high-speed modes, TxSYNCn pins must be pulsed 'High' for one period of TxSERCLK during the first bit of the outbound T1/E1 frame. In HMVIP mode, TxSYNC0 must be pulsed 'High' for 4 clock cycles of the TxMSYNC/TxINCLK signal in the position of the first two and the last two bits of a multiplexed frame. In H.100 mode, TxSYNC0 must be pulsed 'High' for 2 clock cycles of the TxMSYNC/TxINCLK signal in the position of the first and the last bit of a multiplexed frame.</p> <p><b>DS1 or E1 Framer Bypass Mode - TxNEGn</b></p> <p>In this mode, TxSYNCn is used as the negative digital input pin (TxNEG) to the LIU.</p> <p><b>NOTE:</b> *High-speed backplane modes include (For T1/E1) 2.048MVIP, 4.096MHz, 8.192MHz, 16.384MHz HMVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</p> <p><b>NOTE:</b> In DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</p> <p><b>NOTE:</b> These 8 pins are internally pulled "Low" for each channel.</p> |

**TRANSMIT SYSTEM SIDE INTERFACE**

| SIGNAL NAME                                    | BALL#                      | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
|--|----------------------------|------|------------------|--|----------------|----------------------------|---------------------------|-------|--------------------------|-------|--------------------------|-------|--------------------------------------|--------|---------------------------|--------|-------------------------------|--------|-------------------------------|--------|
| TxMSYNCO/<br>TxINCLK0<br>TxMSYNC2/<br>TxINCLK2 | A10<br><br>L17             | I/O  | 12               | <p><b>Multiframe Sync Pulse (TxMSYNcn) / Transmit Input Clock (TxINCLKn)</b></p> <p>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>DS1/E1 Base Rate Mode (1.544MHz/2.048MHz) - TxMSYNcn</b></p> <p>In this mode, these pins are used to indicate the multi-frame boundary within an outbound DS1/E1 frame.</p> <p>In DS1 ESF mode, TxMSYNcn repeats every 3ms.</p> <p>In DS1 SF mode, TxMSYNcn repeats every 1.5ms.</p> <p>In E1 mode, TxMSYNcn repeats every 2ms.</p> <p>If TxMSYNcn is configured as an input, TxMSYNcn must pulse "High" for one period of TxSERCLK during the first bit of an outbound DS1/E1 multi-frame. It is imperative that the TxMSYNc input signal be synchronized with the TxSERCLK input signal.</p> <p>If TxMSYNcn is configured as an output, the transmit section of the T1/E1 framer will output and pulse TxMSYNc "High" for one period of TxSERCLK during the first bit of an outbound DS1/E1 frame.</p> <p><b>DS1/E1 High-Speed Backplane Modes* - (TxINCLKn as INPUT ONLY)</b></p> <p>In this mode, TxINCLK0 must be used as the high-speed input clock pin for the backplane interface to latch in high-speed or multiplexed data on the TxSERn pin. The frequency of TxINCLK0 is presented in the table below.</p> <table border="1" data-bbox="812 1087 1390 1556"> <thead> <tr> <th>OPERATION MODE</th> <th>FREQUENCY OF TxINCLK0(MHz)</th> </tr> </thead> <tbody> <tr> <td>2.048MVIP non-multiplexed</td> <td>2.048</td> </tr> <tr> <td>4.096MHz non-multiplexed</td> <td>4.096</td> </tr> <tr> <td>8.192MHz non-multiplexed</td> <td>8.192</td> </tr> <tr> <td>12.352MHz Bit-multiplexed (DS1 ONLY)</td> <td>12.352</td> </tr> <tr> <td>16.384MHz Bit-multiplexed</td> <td>16.384</td> </tr> <tr> <td>16.384 HMVIP Byte-multiplexed</td> <td>16.384</td> </tr> <tr> <td>16.384 H.100 Byte-multiplexed</td> <td>16.384</td> </tr> </tbody> </table> <p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li><i>*High-speed backplane modes include (For T1/E1) 2.048MVIP, 4.096MHz, 8.192MHz, 16.384MHz HMVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</i></li> <li><i>In DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</i></li> <li><i>These 8 pins are internally pulled "Low" for each channel.</i></li> </ol> | OPERATION MODE | FREQUENCY OF TxINCLK0(MHz) | 2.048MVIP non-multiplexed | 2.048 | 4.096MHz non-multiplexed | 4.096 | 8.192MHz non-multiplexed | 8.192 | 12.352MHz Bit-multiplexed (DS1 ONLY) | 12.352 | 16.384MHz Bit-multiplexed | 16.384 | 16.384 HMVIP Byte-multiplexed | 16.384 | 16.384 H.100 Byte-multiplexed | 16.384 |
| OPERATION MODE                                 | FREQUENCY OF TxINCLK0(MHz) |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 2.048MVIP non-multiplexed                      | 2.048                      |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 4.096MHz non-multiplexed                       | 4.096                      |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 8.192MHz non-multiplexed                       | 8.192                      |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 12.352MHz Bit-multiplexed (DS1 ONLY)           | 12.352                     |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 16.384MHz Bit-multiplexed                      | 16.384                     |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 16.384 HMVIP Byte-multiplexed                  | 16.384                     |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |
| 16.384 H.100 Byte-multiplexed                  | 16.384                     |      |                  |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                               |        |                               |        |

**TRANSMIT SYSTEM SIDE INTERFACE**

| SIGNAL NAME          | BALL#      | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION   |
|----------------------|------------|------|------------------|---|
| TxCHCLK0<br>TxCHCLK2 | A13<br>N17 | O    | 8                | <p><b>Transmit Channel Clock Output Signal (TxCHCLKn):</b></p> <p>The exact function of this pin depends on whether or not the transmit framer enables the transmit fractional/signaling interface to input fractional data, as described below.</p> <p><b>If transmit fractional/signaling interface is disabled:</b></p> <p>This pin indicates the boundary of each time slot of an outbound DS1/E1 frame. In T1 mode, each of these output pins is a 192kHz clock which pulses "High" during the LSB of each 24 time slots. In E1 mode, each of these output pins is a 256kHz clock which pulses "High" during the LSB of each 32 time slots. The Terminal Equipment can use this clock signal to sample the TxCHN0 through TxCHN4 time slot identifier pins to determine which time slot is being processed.</p> <p><b>If transmit fractional/signaling interface is enabled:</b></p> <p>TxCHCLKn is the fractional interface clock which either outputs a clock signal for the time slot that has been configured to input fractional data, or outputs an enable signal for the fractional time slot so that fractional data can be clocked into the device using the TxSERCLK pin.</p> <p><b>NOTE:</b> <i>Transmit fractional interface can be enabled by programming to bit 4 - TxFr1544/TxFr2048 bit from register 0xn120 to '1'.</i></p> |



**TRANSMIT SYSTEM SIDE INTERFACE**

| SIGNAL NAME                                | BALL#          | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION   |
|--|----------------|------|------------------|---|
| TxCHN0_0/<br>TxSIG0<br>TxCHN2_0/<br>TxSIG2 | B12<br><br>M18 | I/O  | 8                | <p><b>Transmit Time Slot Octet Identifier Output 0 (TxCHNn_0) / Transmit Serial Signaling Input (TxSIGn):</b></p> <p>The exact function of these pins depends on whether or not the transmit framer enables the transmit fractional/signaling interface, as described below:</p> <p><b>If transmit fractional/signaling interface is disabled - TxCHNn_0:</b></p> <p>These output pins (TxCHNn_4 through TxCHNn_0) reflect the five-bit binary value of the current time slot being processed by the transmit serial interface. Terminal Equipment can use the TxCH-CLK to sample the five output pins of each channel in order to identify the time slot being processed. This pin indicates the Least Significant Bit (LSB) of the time slot channel being processed.</p> <p><b>If transmit fractional/signaling interface is enabled - TxSIGn:</b></p> <p>These pins can be used to input robbed-bit signaling data to be inserted within an outbound DS1 frame or to input Channel Associated Signaling (CAS) data within an outbound E1 frame, as described below.</p> <p><b>T1 Mode:</b> Signaling data (A,B,C,D) of each channel must be provided on bit 4,5,6,7 of each time slot on the TxSIG pin if 16-code signaling is used. If 4-code signaling is selected, signaling data (A,B) of each channel must be provided on bit 4, 5 of each time slot on the TxSIG pin. If 2-code signaling is selected, signaling data (A) of each channel must be provided on bit 4 of each time slot on the TxSIG pin.</p> <p><b>E1 Mode:</b> Signaling data in E1 mode can be provided on the TxSIGn pins on a time-slot-basis as in T1 mode, or it can be provided on time slot 16 only via the TxSIGn input pins. In the latter case, signaling data (A,B,C,D) of channel 1 and channel 17 must be inserted on the TxSIGn pin during time slot 16 of frame 1, signaling data (A,B,C,D) of channel 2 and channel 18 must be inserted on the TxSIGn pin during time slot 16 of frame 2...etc. The CAS multiframe Alignments bits (0000 bits) and the extra bits/ alarm bit (xyxx) must be inserted on the TxSIGn pin during time slot 16 of frame 0.</p> <p><b>NOTE:</b> <i>Transmit fractional interface can be enabled by programming to bit 4 - TxFr1544/TxFr2048 bit from register 0xn120 to '1'.</i></p> <p><b>NOTE:</b> <i>These 8 pins are internally pulled "Low" for each channel.</i></p> |

TRANSMIT SYSTEM SIDE INTERFACE

| SIGNAL NAME                                    | BALL#          | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION  |
|--|----------------|------|------------------|--|
| TxCHN0_1/<br>TxFrTD0<br>TxCHN2_1/<br>TxFrTD2   | D12<br><br>M17 | I/O  | 8                | <p><b>Transmit Time Slot Octet Identifier Output 1 (TxCHNn_1) / Transmit Serial Fractional Input (TxFrTDn):</b></p> <p>The exact function of these pins depends on whether or not the transmit framer enables the transmit fractional/signaling interface, as described below:</p> <p><b>If transmit fractional/signaling interface is disabled - TxCHNn_1</b></p> <p>These output signals (TxCHNn_4 through TxCHNn_0) reflect the five-bit binary value of the current time slot being processed by the transmit serial interface. Terminal Equipment can use the TxCH-CLK to sample the five output pins of each channel in order to identify the time slot being processed. This pin indicates Bit 1 of the time slot channel being processed.</p> <p><b>If transmit fractional/signaling interface is enabled - TxFrTDn</b></p> <p>These pins are used as the fractional data input pins to input fractional DS1/E1 payload data which will be inserted within an out-bound DS1/E1 frame. In this mode, terminal equipment can use either TxCHCLK or TxSERCLK to clock in fractional DS1/E1 payload data depending on the framer configuration.</p> <p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1. Transmit fractional/Signaling interface can be enabled by programming to bit 4 - TxFr1544/TxFr2048 bit from register 0xn120 to '1'.</li> <li>2. These 8 pins are internally pulled "Low" for each channel.</li> </ol> |
| TxCHN0_2/<br>Tx32MHz0<br>TxCHN2_2/<br>Tx32MHz2 | B13<br><br>T16 | O    | 8                | <p><b>Transmit Time Slot Octet Identifier Output 2 (TxCHNn_2) / Transmit 32.678MHz Clock Output (Tx32MHZ):</b></p> <p>The exact function of these pins depends on whether or not the transmit framer enables the transmit fractional/signaling interface, as described below:</p> <p><b>If transmit fractional/signaling interface is disabled - TxCHNn_2</b></p> <p>These output signals (TxCHNn_4 through TxCHNn_0) reflect the five-bit binary value of the current time slot being processed by the transmit serial interface. Terminal Equipment can use the TxCH-CLK to sample the five output pins of each channel in order to identify the time slot being processed. This pin indicates Bit 2 of the time slot channel being processed.</p> <p><b>If transmit fractional/signaling interface is enabled - Tx32MHZ</b></p> <p>These pins are used to output a 32.678MHz clock reference which is derived from the MCLKIN input pin.</p> <p><b>NOTE:</b> Transmit fractional interface can be enabled by programming to bit 4 - TxFr1544/TxFr2048 bit from register 0xn120 to '1'.</p>  |



**TRANSMIT SYSTEM SIDE INTERFACE**

| SIGNAL NAME                                     | BALL#          | TYPE       | OUTPUT DRIVE(MA) | DESCRIPTION  |
|---|----------------|------------|------------------|--|
| TxCHN0_3/<br>TxOHSYNCO<br>TxCHN2_3/<br>TxOHSYN2 | A14<br><br>N16 | O<br><br>O | 8                | <p><b>Transmit Time Slot Octet Identifier Output 3 (TxCHNn_3) / Transmit Overhead Synchronization Pulse (TxOHSYNcn):</b></p> <p>The exact function of these pins depends on whether or not the transmit framer enables the transmit fractional/signaling interface, as described below:</p> <p><b>If transmit fractional/signaling interface is disabled - TxCHNn_3</b></p> <p>These output signals (TxCHNn_4 through TxCHNn_0) reflect the five-bit binary value of the current time slot being processed by the transmit serial interface. Terminal Equipment can use the TxCH-CLK to sample the five output pins of each channel in order to identify the time slot being processed. This pin indicates Bit 3 of the time slot channel being processed.</p> <p><b>If transmit fractional/signaling interface is enabled - TxOHSYNcn</b></p> <p>These pins are used to output an Overhead Synchronization Pulse which indicates the first bit of each multi-frame.</p> <p><i>NOTE: Transmit fractional interface can be enabled by programming to bit 4 - TxFr1544/TxFr2048 bit from register 0xn120 to '1'.</i></p> |
| TxCHN0_4<br>TxCHN2_4                            | C14<br>N15     | O          | 8                | <p><b>Transmit Time Slot Octet Identifier Output-Bit 4 (TxCHNn_4):</b></p> <p>These output signals (TxCHNn_4 through TxCHNn_0) reflect the five-bit binary value of the current time slot being processed by the transmit serial interface. Terminal Equipment can use the TxCH-CLK to sample the five output pins of each channel in order to identify the time slot being processed. This pin indicates the Most Significant Bit (MSB) of the time slot channel being processed.</p>   |

**TRANSMIT OVERHEAD INTERFACE**

| SIGNAL NAME    | BALL #     | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION  |
|----------------|------------|------|------------------|--|
| TxOH0<br>TxOH2 | C12<br>P15 | I    | -                | <p><b>Transmit Overhead Input (TxOHn):</b><br/>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>DS1 Mode</b><br/>These pins operate as the source of Datalink bits which will be inserted into the Datalink bits within an outbound DS1 frame if the framer is configured accordingly. Datalink Equipment can provide data to this input pin using the TxOHCLKn clock at either 2kHz or 4kHz depending on the transmit datalink bandwidth selected.</p> <p><i>NOTE: This input pin will be disabled if the framer is using the Transmit HDLC Controller, or the TxSER input as the source for the Data Link Bits.</i></p> <p><b>E1 Mode</b><br/>These pins operate as the source of Datalink bits or Signaling bits depending on the framer configuration, as described below.</p> <p><b>Sourcing Datalink bits from TxOHn:</b><br/>The E1 transmit framer will output a clock edge on TxOHCLKn for each Sa bit that has been configured to carry datalink information. Terminal equipment can then use TxOHCLKn to provide datalink bits on TxOHn to be inserted into the Sa bits within an outbound E1 frame.</p> <p><b>Sourcing Signaling bits from TxOHn:</b><br/>Users must provide signaling data on TxOHn pins on time slot 16 only. Signaling data (A,B,C,D) of channel 1 and channel 17 must be inserted on the TxOHn pin during time slot 16 of frame 1, signaling data (A,B,C,D) of channel 2 and channel 18 must be inserted on the TxOHn pin during time slot 16 of frame 2...etc. The CAS multiframe Alignments bits (0000 bits) and the extra bits/alarm bit (xyxx) must be inserted on the TxOHn pin during time slot 16 of frame 0.</p> <p><i>NOTE: These 8 pins are internally pulled "Low" for each channel.</i></p> |

**TRANSMIT OVERHEAD INTERFACE**

| SIGNAL NAME          | BALL #     | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION   |
|----------------------|------------|------|------------------|---|
| TxOHCLK0<br>TxOHCLK2 | A11<br>N18 | O    | 8                | <b>Transmit OH Serial Clock Output Signal(TxOHCLKn)</b><br>This pin functions as an overhead output clock signal for the transmit overhead interface, and its function is explained below.<br><b>DS1 Mode</b><br>If the TxOH pins have been configured to be the source for Datalink bits, the DS1 transmit framer will provide a clock edge for each Data Link Bit. In DS1 ESF mode, the TxOHCLK can either be a 2kHz or 4kHz output signal depending on the selection of Data Link Bandwidth (Register 0xn10A).<br>Data Link Equipment can provide data to the TxOHn pin on the rising edge of TxOHCLK. The framer latches the data on the falling edge of this clock signal.<br><b>E1 Mode</b><br>If the TxOH pins have been configured to be the source for Data Link bits, the E1 transmit framer will provide a clock edge for each National Bit (Sa bits) that has been configured to carry data link information. (Register 0xn10A) |

**RECEIVE OVERHEAD INTERFACE**

| SIGNAL NAME          | BALL #     | TYPE | OUTPUT DRIVE(MA) | DESCRIPTION   |
|----------------------|------------|------|------------------|---|
| RxOH0<br>RxOH2       | C11<br>K15 | O    | 8                | <p><b>Receive Overhead Output (RxOHn):</b><br/>These pins function as the Receive Overhead output, or Receive Signaling Output depending on the receive framer configuration, as described below.</p> <p><b>DS1 Mode</b><br/>If the RxOH pins have been configured as the destination for the Data Link bits within an inbound DS1 frame, datalink bits will be output to the RxOHn pins at either 2kHz or 4kHz depending on the Receive datalink bandwidth selected. (Register 0xn10C).<br/>If configured appropriately, signaling information in the receive signaling array registers (Registers 0xn500-0xn51F) can also be output to the RxOHn output pins.</p> <p><b>E1 Mode</b><br/>These output pins will always output the contents of the National Bits (Sa4 through Sa8) if these Sa bits have been configured to carry Data Link information (Register 0xn10C). The Receive Overhead Output Interface will provide a clock edge on RxOHCLKn for each Sa bit carrying Data Link information.<br/>If configured appropriately, signaling information in the receive signaling array registers (Registers 0xn500-0xn51F) can also be output to the RxOHn output pins.</p> |
| RxOHCLK0<br>RxOHCLK2 | A9<br>K17  | O    | 8                | <p><b>Receive Overhead Clock Output (RxOHCLKn):</b><br/>This pin functions as an overhead output clock signal for the receive overhead interface, and its function is explained below.</p> <p><b>DS1 Mode</b><br/>If the RxOH pins have been configured to be the destination for Datalink bits, the DS1 transmit framer will output a clock edge for each Data Link Bit. In DS1 ESF mode, the RxOHCLK can either be a 2kHz or 4kHz output signal depending on the selection of Data Link Bandwidth (Register 0xn10C). Data Link Equipment can clock out datalink bits on the RxOHn pin using this clock signal.</p> <p><b>E1 Mode</b><br/>The E1 receive framer provides a clock edge for each National Bit (Sa bits) that is configured to carry data link information.<br/>Data Link Equipment can clock out datalink bits on the RxOHn pin using this clock signal.</p>   |

**RECEIVE SYSTEM SIDE INTERFACE**

| SIGNAL NAME                              | BALL #        | TYPE | OUTPUT DRIVE (MA) | DESCRIPTION   |
|--|---------------|------|-------------------|---|
| RxSYNC0/<br>RxNEG0<br>RxSYNC2/<br>RxNEG2 | D8<br><br>F18 | I/O  | 12                | <p><b>Receive Single Frame Sync Pulse (RxSYNCn):</b><br/>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>DS1/E1 Base Rate Mode (1.544MHz/2.048MHz) - RxSYNCn:</b><br/>These RxSYNCn pins are used to indicate the single frame boundary within an inbound T1/E1 frame. In both DS1 or E1 mode, the single frame boundary repeats every 125 microseconds (8kHz).<br/>In DS1/E1 base rate, RxSYNCn can be configured as either input or output depending on the slip buffer configuration as described below.</p> <p><b>When RxSYNCn is configured as an Input:</b><br/>Users must provide a signal which must pulse "High" for one period of RxSERCLK and repeats every 125µS. The receive serial Interface will output the first bit of an inbound DS1/E1 frame during the provided RxSYNC pulse.</p> <p><i>NOTE: It is imperative that the RxSYNC input signal be synchronized with the RxSERCLK input signal.</i></p> <p><b>When RxSYNCn is configured as an Output:</b><br/>The receive T1/E1 framer will output a signal which pulses "High" for one period of RxSERCLK during the first bit of an inbound DS1/E1 frame.</p> <p><b>DS1/E1 High-Speed Backplane Modes* - RxSYNCn as INPUT ONLY:</b><br/>In this mode, RxSYNCn must be an input regardless of the slip buffer configuration. In 2.048MVIP/4.096/8.192MHz high-speed modes, RxSYNCn pins must be pulsed 'High' for one period of RxSERCLK during the first bit of the inbound T1/E1 frame. In H.MVIP mode, RxSYNC0 must be pulsed 'High' for 4 clock cycles of the RxSERCLK signal in the position of the first two and the last two bits of a multiplexed frame. In H.100 mode, RxSYNC0 must be pulsed 'High' for 2 clock cycles of the RxSERCLK signal in the position of the first and the last bit of a multiplexed frame.</p> <p><b>DS1 or E1 Framer Bypass Mode - RxNEGn</b><br/>In this mode, RxSYNCn is used as the Receive negative digital output pin (RxNEG) from the LIU.</p> <p><i>NOTE: *High-speed backplane modes include (For T1/E1) 2.048MVIP, 4.096MHz, 8.192MHz, 16.384MHz H.MVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</i></p> <p><i>NOTE: In DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</i></p> <p><i>NOTE: These 8 pins are internally pulled "Low" for each channel.</i></p> |

**RECEIVE SYSTEM SIDE INTERFACE**

| SIGNAL NAME              | BALL #     | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--------------------------|------------|------|-------------------|--|
| RxCRCSYNC0<br>RxCRCSYNC2 | C8<br>J17  | O    | 12                | <p><b>Receive Multiframe Sync Pulse (RxCRCSYNCn):</b></p> <p>The RxCRCSYNCn pins are used to indicate the receive multi-frame boundary. These pins pulse "High" for one period of RxSERCLK when the first bit of an inbound DS1/E1 Multi-frame is being output on the RxCRCSYNCn pin.</p> <ul style="list-style-type: none"> <li>• In DS1 ESF mode, RxCRCSYNCn repeats every 3ms</li> <li>• In DS1 SF mode, RxCRCSYNCn repeats every 1.5ms</li> <li>• In E1 mode, RxCRCSYNCn repeats every 2ms.</li> </ul> |
| RxCASYNC0<br>RxCASYNC2   | D10<br>H15 | O    | 12                | <p><b>Receive CAS Multiframe Sync Pulse (RxCASYNCn):</b></p> <p><b>- E1 Mode Only</b></p> <p>The RxCASYNCn pins are used to indicate the E1 CAS Multiframe boundary. These pins pulse "High" for one period of RxSERCLK when the first bit of an E1 CAS Multi-frame is being output on the RxCASYNCn pin.</p>  |

**RECEIVE SYSTEM SIDE INTERFACE**

| SIGNAL NAME  | BALL #                     | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
|--|----------------------------|------|-------------------|--|----------------|----------------------------|---------------------------|-------|--------------------------|-------|--------------------------|-------|--------------------------------------|--------|---------------------------|--------|--------------------------------|--------|-------------------------------|--------|
| RxSERCLK0/<br>RxLINECLK0<br>RxSERCLK2/<br>RxLINECLK2 | A7<br><br>D15              | I/O  | 12                | <p><b>Receive Serial Clock Signal (RxSERCLKn) / Receive Line Clock (RxLINECLKn):</b></p> <p>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>In Base-Rate Mode (1.544MHz/2.048MHz) - RxSERCLKn:</b></p> <p>These pins are used as the receive serial clock on the system side interface which can be configured as either input or output. The receive serial interface outputs data on RxSERn on the rising edge of RxSERCLKn.</p> <p><b>When RxSERCLKn is configured as Input:</b></p> <p>These pins will be inputs if the slip buffer on the Receive path is enabled. System side equipment must provide a 1.544MHz clock rate to this input pin for T1 mode of operation, and 2.048MHz clock rate in E1 mode.</p> <p><b>When RxSERCLKn is configured as Output:</b></p> <p>These pins will be outputs if slip buffer is bypassed. The receive framer will output a 1.544MHz clock rate in T1 mode of operation, and a 2.048MHz clock rate in E1 mode.</p> <p><b>DS1/E1 High-Speed Backplane Modes* - (RxSERCLK as INPUT ONLY)</b></p> <p>In this mode, this pin must be used as the high-speed input clock for the backplane interface to output high-speed or multiplexed data on the RxSERn pin. The frequency of RxSERCLK is presented in the table below.</p> <table border="1" data-bbox="797 1079 1378 1549"> <thead> <tr> <th>OPERATION MODE</th> <th>FREQUENCY OF RxSERCLK(MHz)</th> </tr> </thead> <tbody> <tr> <td>2.048MVIP non-multiplexed</td> <td>2.048</td> </tr> <tr> <td>4.096MHz non-multiplexed</td> <td>4.096</td> </tr> <tr> <td>8.192MHz non-multiplexed</td> <td>8.192</td> </tr> <tr> <td>12.352MHz Bit-multiplexed (DS1 ONLY)</td> <td>12.352</td> </tr> <tr> <td>16.384MHz Bit-multiplexed</td> <td>16.384</td> </tr> <tr> <td>16.384 HMOVIP Byte-multiplexed</td> <td>16.384</td> </tr> <tr> <td>16.384 H.100 Byte-multiplexed</td> <td>16.384</td> </tr> </tbody> </table> <p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li><i>*High-speed backplane modes include (For T1/E1) 2.048MVIP, 4.096MHz, 8.192MHz, 16.384MHz HMOVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</i></li> <li><i>For DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</i></li> </ol> | OPERATION MODE | FREQUENCY OF RxSERCLK(MHz) | 2.048MVIP non-multiplexed | 2.048 | 4.096MHz non-multiplexed | 4.096 | 8.192MHz non-multiplexed | 8.192 | 12.352MHz Bit-multiplexed (DS1 ONLY) | 12.352 | 16.384MHz Bit-multiplexed | 16.384 | 16.384 HMOVIP Byte-multiplexed | 16.384 | 16.384 H.100 Byte-multiplexed | 16.384 |
| OPERATION MODE                                       | FREQUENCY OF RxSERCLK(MHz) |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 2.048MVIP non-multiplexed                            | 2.048                      |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 4.096MHz non-multiplexed                             | 4.096                      |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 8.192MHz non-multiplexed                             | 8.192                      |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 12.352MHz Bit-multiplexed (DS1 ONLY)                 | 12.352                     |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 16.384MHz Bit-multiplexed                            | 16.384                     |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 16.384 HMOVIP Byte-multiplexed                       | 16.384                     |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |
| 16.384 H.100 Byte-multiplexed                        | 16.384                     |      |                   |  |                |                            |                           |       |                          |       |                          |       |                                      |        |                           |        |                                |        |                               |        |

RECEIVE SYSTEM SIDE INTERFACE

| SIGNAL NAME  | BALL #        | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|--|---------------|------|-------------------|---|
| RxSERCLK0/<br>RxLINECLK0<br>RxSERCLK2/<br>RxLINECLK2 | A7<br><br>D15 | I/O  | 12                | <p><b>(Continued)</b></p> <p><b>DS1 or E1 Framer Bypass Mode - RxLINECLKn</b><br/>In this mode, RxSERCLKn is used as the Receive Line Clock output pin (RxLineClk) from the LIU.</p> <p><i>NOTE: These 8 pins are internally pulled "High" for each channel.</i></p>  |
| RxSER0/<br>RxPOS0<br>RxSER2/<br>RxPOS2               | D6<br><br>J18 | O    | 12                | <p><b>Receive Serial Data Output (RxSERn):</b><br/>The exact function of these pins depends on the mode of operation selected, as described below.</p> <p><b>DS1/E1 Mode - RxSERn</b><br/>These pins function as the receive serial data output on the system side interface, which updates on the rising edge of the RxSERCLKn pin. All the framing alignment bits, facility data link bits, CRC bits, and signaling information will also be extracted to this output pin.</p> <p><b>DS1 or E1 High-Speed Multiplexed Mode* - RxSERn</b><br/>In this mode, these pins are used as the high-speed multiplexed data output pin on the system side. High-speed multiplexed data of channels 0-3 will output on RxSER0 in a byte or bit-interleaved way. The framer outputs the multiplexed data on RxSER0 using the high-speed input clock (RxSERCLKn).</p> <p><b>DS1 or E1 Framer Bypass Mode</b><br/>In this mode, RxSERn is used as the positive digital output pin (RxPOSn) from the LIU.</p> <p><i>NOTE: *High-speed multiplexed modes include (For T1/E1) 16.384MHz HMMVIP, H.100, Bit-multiplexed modes, and (For T1 only) 12.352MHz Bit-multiplexed mode.</i></p> <p><i>NOTE: In DS1 high-speed modes, the DS-0 data is mapped into an E1 frame by ignoring every fourth time slot (don't care).</i></p> |



**RECEIVE SYSTEM SIDE INTERFACE**

| SIGNAL NAME                                | BALL #        | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--|---------------|------|-------------------|--|
| RxCHN0_0/<br>RxSig0<br>RxCHN2_0/<br>RxSig2 | D7<br><br>H16 | O    | 8                 | <p><b>Receive Time Slot Octet Identifier Output (RxCHNn_0) / Receive Serial Signaling Output (RxSIGn):</b></p> <p>The exact function of these pins depends on whether or not the receive framer enables the receive fractional/signaling interface, as described below:</p> <p><b>If receive fractional/signaling interface is disabled - RxCHNn_0:</b></p> <p>These output pins (RxCHNn_4 through RxCHNn_0) reflect the five-bit binary value of the current time slot being output by the receive serial interface. System equipment can use the RxCH-CLKn to sample the five output pins of each channel to identify the time slot being output on these pins. RxCHNn_0 indicates the Least Significant Bit (LSB) of the time slot channel being output.</p> <p><b>If receive fractional/signaling interface is enabled - RxSIGn:</b></p> <p>These pins can be used to output robbed-bit signaling data within an inbound DS1 frame or to output Channel Associated Signaling (CAS) data within an inbound E1 frame, as described below.</p> <p><b>T1 Mode:</b> Signaling data (A,B,C,D) of each channel will be output on bit 4,5,6,7 of each time slot on the RxSIG pin if 16-code signaling is used. If 4-code signaling is selected, signaling data (A,B) of each channel will be output on bit 4, 5 of each time slot on the RxSIG pin. If 2-code signaling is selected, signaling data (A) of each channel will be output on bit 4 of each time slot on the RxSIG pin.</p> <p><b>E1 Mode:</b> Signaling data in E1 mode will be output on the RxSIGn pins on a time-slot-basis as in T1 mode, or it can be output on time slot 16 only via the RxSIGn output pins. In the latter case, signaling data (A,B,C,D) of channel 1 and channel 17 will be output on the RxSIGn pin during time slot 16 of frame 1, signaling data (A,B,C,D) of channel 2 and channel 18 will be output on the RxSIGn pin during time slot 16 of frame 2...etc. The CAS multiframe Alignments bits (0000 bits) and the extra bits/alarm bit (xyxx) will be output on the RxSIGn pin during time slot 16 of frame 0.</p> <p><b>NOTE:</b> Receive Fractional/signaling interface can be enabled by programming to bit 4 - RxFr1544/RxFr2048 bit from register 0xn122 to '1'.</p> |

RECEIVE SYSTEM SIDE INTERFACE

| SIGNAL NAME                                  | BALL #        | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|--|---------------|------|-------------------|---|
| RxCHN0_1/<br>RxFrTD0<br>RxCHN2_1/<br>RxFrTD2 | C9<br><br>G15 | O    | 8                 | <p><b>Receive Time Slot Octet Identifier Output Bit 1 (RxCHNn_1) / Receive Serial Fractional Output (RxFrTDn):</b></p> <p>The exact function of these pins depends on whether or not the receive framer enables the receive fractional/signaling interface, as described below:</p> <p><b>If receive fractional/signaling interface is disabled - RxCHNn_1:</b></p> <p>These output pins (RxCHNn_4 through RxCHNn_0) reflect the five-bit binary value of the current time slot being output by the receive serial interface. System equipment can use the RxCH-CLKn to sample the five output pins of each channel to identify the time slot being output on these pins. RxCHNn_1 indicates Bit 1 of the time slot channel being output.</p> <p><b>If receive fractional/signaling interface is enabled - RxFrTDn:</b></p> <p>These pins are used as the fractional data output pins to output fractional DS1/E1 payload data within an inbound DS1/E1 frame. In this mode, system equipment can use either RxCH-CLK or RxSERCLK to clock out fractional DS1/E1 payload data depending on the framer configuration.</p> <p><i>NOTE: Receive Fractional/Signaling interface can be enabled by programming to bit 4 - RxFr1544/RxFr2048 bit from register 0xn122 to '1'.</i></p> |
| RxCHN0_2/<br>RxCHN0<br>RxCHN2_2/<br>RxCHN2   | B9<br><br>K18 | O    | 8                 | <p><b>Receive Time Slot Octet Identifier Output-Bit 2 (RxCHNn_2) / Receive Time Slot Identifier Serial Output (RxCHNn):</b></p> <p>The exact function of these pins depends on whether or not the receive framer enables the receive fractional/signaling interface, as described below:</p> <p><b>If receive fractional/signaling interface is disabled - RxCHNn_2:</b></p> <p>These output pins (RxCHNn_4 through RxCHNn_0) reflect the five-bit binary value of the current time slot being output by the receive serial interface. System equipment can use the RxCH-CLKn to sample the five output pins of each channel to identify the time slot being output on these pins. RxCHNn_2 indicates Bit 2 of the time slot channel being output.</p> <p><b>If receive fractional/signaling interface is enabled - RxCHNn</b></p> <p>These pins serially output the five-bit binary value of the time slot being output by the receive serial interface.</p> <p><i>NOTE: Receive Fractional/Signaling interface can be enabled by programming to bit 4 - RxFr1544/RxFr2048 bit from register 0xn122 to '1'.</i></p>  |

**RECEIVE SYSTEM SIDE INTERFACE**

| SIGNAL NAME                                  | BALL #         | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--|----------------|------|-------------------|--|
| RxCHN0_3/<br>Rx8KHZ0<br>RxCHN2_3/<br>Rx8KHZ2 | C10<br><br>L16 | O    | 8                 | <p><b>Receive Time Slot Octet Identifier Output-Bit 3 (RxCHNn_3) / Receive 8KHz Clock Output (Rx8KHZn):</b></p> <p>The exact function of these pins depends on whether or not the receive framer enables the receive fractional/signaling interface, as described below:</p> <p><b>If receive fractional/signaling interface is disabled - RxCHNn_3:</b></p> <p>These output pins (RxCHNn_4 through RxCHNn_0) reflect the five-bit binary value of the current time slot being output by the receive serial interface. System equipment can use the RxCH-CLKn to sample the five output pins of each channel to identify the time slot being output on these pins. RxCHNn_3 indicates Bit 3 of the time slot channel being output.</p> <p><b>If receive fractional/signaling interface is enabled - Rx8KHZn:</b></p> <p>These pins output a reference 8KHz clock signal derived from the MCLKIN input.</p> <p><i>NOTE: Receive Fractional/Signaling interface can be enabled by programming to bit 4 - RxFr1544/RxFr2048 bit from register 0xn122 to '1'.</i></p>  |
| RxCHN0_4/<br>RxSCLK0<br>RxCHN2_4/<br>RxSCLK2 | B10<br><br>K16 | O    | 8                 | <p><b>Receive Time Slot Octet Identifier Output-Bit 4 (RxCHNn_4) / Receive Recovered Line Clock Output (RxSCLKn):</b></p> <p>The exact function of these pins depends on whether or not the receive framer enables the receive fractional/signaling interface, as described below:</p> <p><b>If receive fractional/signaling interface is disabled - RxCHNn_4:</b></p> <p>These output pins (RxCHNn_4 through RxCHNn_0) reflect the five-bit binary value of the current time slot being output by the receive serial interface. System equipment can use the RxCH-CLKn to sample the five output pins of each channel to identify the time slot being output on these pins. RxCHNn_4 indicates the Most Significant Bit (MSB) of the time slot channel being output.</p> <p><b>If receive fractional/signaling interface is enabled - Receive Recovered Line Clock Output (RxSCLKn):</b></p> <p>These pins output the recovered T1/E1 line clock (1.544MHz in T1 mode and 2.048MHz in E1 mode) for each channel.</p> <p><i>NOTE: Receive Fractional/Signaling interface can be enabled by programming to bit 4 - RxFr1544/RxFr2048 bit from register 0xn122 to '1'.</i></p> |

**RECEIVE SYSTEM SIDE INTERFACE**

| SIGNAL NAME          | BALL #    | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|----------------------|-----------|------|-------------------|---|
| RxCHCLK0<br>RxCHCLK2 | A8<br>H17 | O    | 8                 | <p><b>Receive Channel Clock Output (RxCHCLKn):</b><br/>The exact function of this pin depends on whether or not the receive framer enables the receive fractional/signaling interface to output fractional data, as described below.</p> <p><b>If receive fractional/signaling interface is disabled:</b><br/>This pin indicates the boundary of each time slot of an inbound DS1/E1 frame. In T1 mode, each of these output pins is a 192kHz clock which pulses "High" during the LSB of each 24 time slots. In E1 mode, each of these output pins is a 256kHz clock which pulses "High" during the LSB of each 32 time slots. System Equipment can use this clock signal to sample the RxCHN0 through RxCHN4 time slot identifier pins to determine which time slot is being output.</p> <p><b>If receive fractional/signaling interface is enabled:</b><br/>RxCHCLKn is the fractional interface clock which either outputs a clock signal for the time slot that has been configured to output fractional data, or outputs an enable signal for the fractional time slot so that fractional data can be clocked out of the device using the RxSERCLK pin.</p> <p><b>NOTE:</b> <i>Receive fractional interface can be enabled by programming to bit 4 - RxFr1544/RxFr2048 bit from register 0xn122 to '1'.</i></p> |

**RECEIVE LINE INTERFACE**

| SIGNAL NAME        | BALL #    | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--------------------|-----------|------|-------------------|--|
| RTIP0<br>RTIP2     | E1<br>J1  | I    | -                 | <p><b>Receive Positive Analog Input (RTIPn):</b><br/> RTIP is the positive differential input from the line interface. This input pin, along with the RRING input pin, functions as the "Receive DS1/E1 Line Signal" input for the XRT86VL32 device.<br/> The user is expected to connect this signal and the RRING input signal to a 1:1 transformer for proper operation. The center tap of the receive transformer should have a bypass capacitor of 0.1µF to ground (Chip Side) to improve long haul application receive capabilities.</p>   |
| RRING0<br>RRING2   | F1<br>K1  | I    | -                 | <p><b>Receive Negative Analog Input (RRINGn):</b><br/> RRING is the negative differential input from the line interface. This input pin, along with the RTIP input pin, functions as the "Receive DS1/E1 Line Signal" input for the XRT86VL32 device.<br/> The user is expected to connect this signal and the RTIP input signal to a 1:1 transformer for proper operation. The center tap of the receive transformer should have a bypass capacitor of 0.1µF to ground (Chip Side) to improve long haul application receive capabilities.</p>   |
| RxLOS_0<br>RxLOS_1 | B7<br>G16 | O    | 4                 | <p><b>Receive Loss of Signal Output Indicator (RLOSn):</b><br/> The XRT86VL32 device will assert this output pin (i.e., toggle it "high") anytime (and for the duration that) the Receive DS1/E1 Framer or LIU block declares the LOS defect condition.<br/> Conversely, the XRT86VL32 device will tri-state this output pin anytime (and for the duration that) the Receive DS1/E1 Framer or LIU block is NOT declaring the LOS defect condition.</p> <p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li><i>This output pin will toggle "high" (to denote that LOS is being declared) whenever either the Receive DS1/E1 Framer or the Receive DS1/E1 LIU block (associated with Channel N) declares the LOS defect condition. In other words, the state of this output pin is a logic OR of the Framer LOS and the LIU LOS condition.</i></li> <li><i>Since the XRT86VL32 device tri-states this output pin (anytime the channel is NOT declaring the LOS defect condition). Therefore, the user MUST connect a "pull-down" resistor (ranging from 1K to 10K) to each RxLOS output pin, in order to pull this output pin to the logic "LOW" condition, whenever the Channel is NOT declaring the LOS defect condition.</i></li> </ol> |

RECEIVE LINE INTERFACE

| SIGNAL NAME                                   | BALL #         | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |              |                |   |          |   |          |   |  |
|---|----------------|------|-------------------|--|--------------|----------------|---|----------|---|----------|---|--|
| RxTSEL  | N3             | I    | -                 | <p><b>Receive Termination Control (RxTSEL):</b><br/>                     Upon power up, the receivers are in "High" impedance. Switching to internal termination can be selected through the microprocessor interface by programming the appropriate channel register. However, to switch control to the hardware pin, RxTCNTL must be programmed to "1" in the appropriate global register (0x0FE2). Once control has been granted to the hardware pin, it must be pulled "High" to switch to internal termination.</p> <p><b>NOTE:</b> Internally pulled "Low" with a 50kΩ resistor.</p> <table border="1" data-bbox="802 636 1328 827"> <thead> <tr> <th>RxTSEL (pin)</th> <th>Rx Termination</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>External</td> </tr> <tr> <td>1</td> <td>Internal</td> </tr> <tr> <td colspan="2"><i>Note: RxTCNTL (bit) must be set to "1"</i></td> </tr> </tbody> </table> | RxTSEL (pin) | Rx Termination | 0 | External | 1 | Internal | <i>Note: RxTCNTL (bit) must be set to "1"</i> |  |
| RxTSEL (pin)                                  | Rx Termination |      |                   |  |              |                |   |          |   |          |   |  |
| 0   | External       |      |                   |  |              |                |   |          |   |          |   |  |
| 1   | Internal       |      |                   |  |              |                |   |          |   |          |   |  |
| <i>Note: RxTCNTL (bit) must be set to "1"</i> |                |      |                   |  |              |                |   |          |   |          |   |  |

**TRANSMIT LINE INTERFACE**

| SIGNAL NAME      | BALL #   | TYPE | DESCRIPTION   |
|------------------|----------|------|---|
| TTIP0<br>TTIP2   | E4<br>J4 | O    | <p><b>Transmit Positive Analog Output (TTIPn):</b><br/>TTIP is the positive differential output to the line interface. This output pin, along with the corresponding TRING output pin, function as the Transmit DS1/E1 output signal drivers for the XRT86VL32 device.</p> <p>The user is expected to connect this signal and the corresponding TRING output signal to a 1:2 step up transformer for proper operation.</p> <p>This output pin will be tri-stated whenever the user sets the “TxON” input pin or register bit (0xnF02, bit 3) to “0”.</p> <p><i>NOTE: This pin should have a series line capacitor of 0.68μF for DC blocking purposes.</i></p>   |
| TRING0<br>TRING2 | F4<br>K4 | O    | <p><b>Transmit Negative Analog Output (TRINGn):</b><br/>TRING is the negative differential output to the line interface. This output pin, along with the corresponding TTIP output pin, function as the Transmit DS1/E1 output signal drivers for the XRT86VL32 device.</p> <p>The user is expected to connect this signal and the corresponding TRING output signal to a 1:2 step up transformer for proper operation.</p> <p><i>NOTE: This output pin will be tri-stated whenever the user sets the “TxON” input pin or register bit (0xnF02, bit 3) to “0”.</i></p>  |
| TxON             | N1       | I    | <p><b>Transmitter On</b></p> <p>This input pin permits the user to either enable or disable the Transmit Output Driver within the Transmit DS1/E1 LIU Block. If the TxON pin is pulled “Low”, all 8 Channels are tri-stated. When this pin is pulled ‘High’, turning on or off the transmitters will be determined by the appropriate channel registers (address 0x0Fn2, bit 3)</p> <p><b>LOW</b> = Disables the Transmit Output Driver within the Transmit DS1/E1 LIU Block. In this setting, the TTIP and TRING output pins of all 8 channels will be tri-stated.</p> <p><b>HIGH</b> = Enables the Transmit Output Driver within the Transmit DS1/E1 LIU Block. In this setting, the corresponding TTIP and TRING output pins will be enabled or disabled by programming the appropriate channel register. (address 0x0Fn2, bit 3)</p> <p><i>NOTE: Whenever the transmitters are turned off, the TTIP and TRING output pins will be tri-stated.</i></p> |

**TIMING INTERFACE**

| SIGNAL NAME | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|-------------|--------|------|-------------------|--|
| MCLKIN      | A4     | I    | -                 | <p><b>Master Clock Input:</b><br/>This pin is used to provide the timing reference for the internal master clock of the device. The frequency of this clock is programmable from 8kHz to 16.384MHz in register 0x0FE9.</p> |
| E1MCLKnOUT  | A3     | O    | 12                | <p><b>LIU E1 Output Clock Reference</b><br/>This output pin is defaulted to 2.048MHz, but can be programmed to 4.096MHz, 8.192MHz, or 16.384MHz in register 0x0FE4.</p>  |

**TIMING INTERFACE**

| SIGNAL NAME | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|-------------|--------|------|-------------------|--|
| T1MCLKnOUT  | B4     | O    | 12                | <b>LIU T1 Output Clock Reference</b><br>This output pin is defaulted to 1.544MHz, but can be programmed to output 3.088MHz, 6.176MHz, or 12.352MHz in register 0x0FE4.   |
| E1OSCCLK    | P2     | O    | 8                 | <b>Framer E1 Output Clock Reference</b><br>This output pin is defaulted to 2.048MHz, but can be programmed to 65.536MHz in register 0x011E.  |
| T1OSCCLK    | P4     | O    | 8                 | <b>Framer T1 Output Clock Reference</b><br>This output pin is defaulted to 1.544MHz, but can be programmed to output 49.408MHz in register 0x011E.   |
| 8KSYNC      | R2     | O    | 8                 | <b>8kHz Clock Output Reference</b><br>This pin is an output reference of 8kHz based on the MCLKIN input. Therefore, the duty cycle of this output is determined by the time period of the input clock reference.   |
| 8KEXTOSC    | N4     | I    | -                 | <b>External Oscillator Select</b><br>For normal operation, this pin should not be used, or pulled "Low". This pin is internally pulled "Low" with a 50kΩ resistor.   |
| ANALOG      | E5     | O    |                   | <b>Factory Test Mode Pin</b><br><i>NOTE: For Internal Use Only</i>   |
| LOP         | N2     | I    | -                 | <b>Loss of Power for E1 Only</b><br>This is a Loss of Power pin in the E1 application only. Upon detecting LOP in E1 mode, the device will automatically transmit the Sa5 and Sa6 bit to a different pattern, so that the Receive terminal can detect a power failure in the network.<br>Please see register 0xn131 for the Transmit SA control. |



**JTAG INTERFACE**

The XRT86VL32 device's JTAG features comply with the IEEE 1149.1 standard. Please refer to the industry specification for additional information on boundary scan operations.

| SIGNAL NAME | BALL # | TYPE | OUTPUT DRIVE (MA) | DESCRIPTION  |
|-------------|--------|------|-------------------|--|
| TCK         | C7     | I    | -                 | <b>Test clock: Boundary Scan Test clock input:</b><br>The TCLK signal is the clock for the TAP controller, and it generates the boundary scan data register clocking. The data on TMS and TDI is loaded on the positive edge of TCK. Data is observed at TDO on the falling edge of TCK. |
| TMS         | C6     | I    | -                 | <b>Test Mode Select:</b> Boundary Scan Test Mode Select input. The TMS signal controls the transitions of the TAP controller in conjunction with the rising edge of the test clock (TCK).<br><b>NOTE:</b> For normal operation this pin MUST be pulled "High".                           |
| TDI         | B6     | I    | -                 | <b>Test Data In:</b> Boundary Scan Test data input<br>The TDI signal is the serial test data input.<br><b>NOTE:</b> This pin is internally pulled 'high'.  |
| TDO         | D5     | O    | 8                 | <b>Test Data Out:</b> Boundary Scan Test data output<br>The TDO signal is the serial test data output.   |
| TRST        | A6     | I    | -                 | <b>Test Reset Input:</b><br>The TRST signal (Active Low) asynchronously resets the TAP controller to the Test-Logic-Reset state.<br><b>NOTE:</b> This pin is internally pulled 'high'  |
| TESTMODE    | B11    | I    | -                 | <b>Factory Test Mode Pin</b><br><b>NOTE:</b> This pin is internally pulled 'low', and should be pulled 'low' for normal operation.   |
| aTESTMODE   | B5     | I    | -                 | <b>Factory Test Mode Pin</b><br><b>NOTE:</b> This pin is internally pulled 'low', and should be pulled 'low' for normal operation.   |
| ATP_Ring    | B2     | I    | -                 | <b>ATP_Ring Test Pin</b><br>This analog test pin is used for testing the continuity between the TTIP/TRING, RTIP/RRING of each channel and the on-board transformer.   |
| ATP_Tip     | C3     | I    | -                 | <b>ATP_Tip Test Pin</b><br>This analog test pin is used for testing the continuity between the TTIP/TRING, RTIP/RRING of each channel and the on-board transformer.  |

**MICROPROCESSOR INTERFACE**

| SIGNAL NAME  | BALL #   | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--|--|------|-------------------|--|
| DATA0<br>DATA1<br>DATA2<br>DATA3<br>DATA4<br>DATA5<br>DATA6<br>DATA7 | T4<br>U3<br>V8<br>V9<br>T10<br>V10<br>U11<br>R11 | I/O  | 8                 | <p><b>Bidirectional Microprocessor Data Bus</b></p> <p>These pins are used to drive and receive data over the bi-directional data bus, whenever the Microprocessor performs READ or WRITE operations with the Microprocessor Interface of the XRT86VL32 device.</p> <p>When DMA interface is enabled, these 8-bit bidirectional data bus is also used by the T1/E1 Framer or the external DMA Controller for storing and retrieving information.</p>   |
| $\overline{\text{REQ0}}$   | R1   | O    | 8                 | <p><b>DMA Cycle Request Output—DMA Controller 0 (Write):</b></p> <p>These output pins are used to indicate that DMA transfers (Write) are requested by the T1/E1 Framer.</p> <p>On the transmit side (i.e., To transmit data from external DMA controller to HDLC buffers within the XRT86VL32), DMA transfers are only requested when the transmit buffer status bits indicate that there is space for a complete message or cell.</p> <p>The DMA Write cycle starts by T1/E1 Framer asserting the DMA Request (<math>\overline{\text{REQ0}}</math>) 'low', then the external DMA controller should drive the DMA Acknowledge (<math>\overline{\text{ACK0}}</math>) 'low' to indicate that it is ready to start the transfer. The external DMA controller should place new data on the Microprocessor data bus each time the Write Signal is Strobed low if the <math>\overline{\text{WR}}</math> is configured as a Write Strobe. If <math>\overline{\text{WR}}</math> is configured as a direction signal, then the external DMA controller would place new data on the Microprocessor data bus each time the Read Signal (<math>\overline{\text{RD}}</math>) is Strobed low.</p> <p>The Framer asserts this output pin (toggles it "Low") when at least one of the Transmit HDLC buffers are empty and can receive one more HDLC message.</p> <p>The Framer negates this output pin (toggles it "High") when the HDLC buffer can no longer receive another HDLC message.</p> |

**MICROPROCESSOR INTERFACE**

| SIGNAL NAME              | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--------------------------|--------|------|-------------------|--|
| $\overline{\text{REQ1}}$ | R3     | O    | 8                 | <p><b>DMA Cycle Request Output—DMA Controller 1 (Read):</b><br/>                     These output pins are used to indicate that DMA transfers (Read) are requested by the T1/E1 Framer.</p> <p>On the receive side (i.e., To transmit data from HDLC buffers within the XRT86VL32 to external DMA Controller), DMA transfers are only requested when the receive buffer contains a complete message or cell.</p> <p>The DMA Read cycle starts by T1/E1 Framer asserting the DMA Request (<math>\overline{\text{REQ1}}</math>) 'low', then the external DMA controller should drive the DMA Acknowledge (<math>\overline{\text{ACK1}}</math>) 'low' to indicate that it is ready to receive the data. The T1/E1 Framer should place new data on the Microprocessor data bus each time the Read Signal is Strobed low if the <math>\overline{\text{RD}}</math> is configured as a Read Strobe. If RD is configured as a direction signal, then the T1/E1 Framer would place new data on the Microprocessor data bus each time the Write Signal (<math>\overline{\text{WR}}</math>) is Strobed low.</p> <p>The Framer asserts this output pin (toggles it "Low") when one of the Receive HDLC buffer contains a complete HDLC message that needs to be read by the <math>\mu\text{C}/\mu\text{P}</math>.</p> <p>The Framer negates this output pin (toggles it "High") when the Receive HDLC buffers are depleted.</p> |
| $\overline{\text{INT}}$  | R8     | O    | 8                 | <p><b>Interrupt Request Output:</b><br/>                     This active-low output signal will be asserted when the XRT86VL32 device is requesting interrupt service from the Microprocessor. This output pin should typically be connected to the "Interrupt Request" input of the Microprocessor.</p> <p>The Framer will assert this active "Low" output (toggles it "Low"), to the local <math>\mu\text{P}</math>, anytime it requires interrupt service.</p>  |
| PCLK                     | V1     | I    | -                 | <p><b>Microprocessor Clock Input:</b><br/>                     This clock input signal is only used if the Microprocessor Interface has been configured to operate in the Synchronous Modes (e.g., Power PC 403 Mode). If the Microprocessor Interface is configured to operate in this mode, then it will use this clock signal to do the following.</p> <ol style="list-style-type: none"> <li>1. To sample the <math>\text{CS}^*</math>, <math>\text{WR}^*/\text{R/W}^*</math>, <math>\text{A}[14:0]</math>, <math>\text{D}[7:0]</math>, <math>\text{RD}^*/\text{DS}^*</math> and DBEN input pins, and</li> <li>2. To update the state of the <math>\text{D}[7:0]</math> and the <math>\text{RDY}/\text{DTACK}</math> output signals.</li> </ol> <p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1. The Microprocessor Interface can work with PCLK frequencies ranging up to 33MHz.</li> <li>2. This pin is inactive if the user has configured the Microprocessor Interface to operate in either the Intel-Asynchronous or the Motorola-Asynchronous Modes. In this case, the user should tie this pin to GND.</li> </ol> <p>When DMA interface is enabled, the PCLK input pin is also used by the T1/E1 Framer to latch in or latch out receive or output data respectively.</p>   |
| iADDR                    | U1     | I    | -                 | <p><b>This Pin Must be Tied "Low" for Normal Operation.</b><br/>                     This pin is internally pulled "High" with a 50k<math>\Omega</math> resistor.</p>  |

**MICROPROCESSOR INTERFACE**

| SIGNAL NAME                | BALL #         | TYPE     | OUTPUT DRIVE (mA)     | DESCRIPTION   |          |          |          |                     |   |   |   |                    |   |   |   |                       |   |   |   |                  |
|----------------------------|----------------|----------|-----------------------|---|----------|----------|----------|---------------------|---|---|---|--------------------|---|---|---|-----------------------|---|---|---|------------------|
| fADDR                      | T1             | I        | -                     | <b>This Pin Must be Tied “High” for Normal Operation.</b><br>This pin is internally pulled “Low” with a 50kΩ resistor.  |          |          |          |                     |   |   |   |                    |   |   |   |                       |   |   |   |                  |
| PTYPE0<br>PTYPE1<br>PTYPE2 | V2<br>V4<br>T8 | I        | -                     | <p><b>Microprocessor Type Input:</b><br/>These input pins permit the user to specify which type of Microprocessor/Microcontroller to be interfaced to the XRT86VL32 device. The following table presents the three different microprocessor types that the XRT86VL32 supports.</p> <table border="1" data-bbox="857 583 1289 833"> <thead> <tr> <th>° PType2</th> <th>° PType1</th> <th>° PType0</th> <th>MICROPROCESSOR TYPE</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Intel Asynchronous</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>Motorola Asynchronous</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>IBM POWER PC 403</td> </tr> </tbody> </table> <p><b>NOTE:</b> These pins are internally pulled “Low” with a 50kΩ resistor.</p> | ° PType2 | ° PType1 | ° PType0 | MICROPROCESSOR TYPE | 0 | 0 | 0 | Intel Asynchronous | 0 | 0 | 1 | Motorola Asynchronous | 1 | 0 | 1 | IBM POWER PC 403 |
| ° PType2                   | ° PType1       | ° PType0 | MICROPROCESSOR TYPE   |   |          |          |          |                     |   |   |   |                    |   |   |   |                       |   |   |   |                  |
| 0                          | 0              | 0        | Intel Asynchronous    |   |          |          |          |                     |   |   |   |                    |   |   |   |                       |   |   |   |                  |
| 0                          | 0              | 1        | Motorola Asynchronous |   |          |          |          |                     |   |   |   |                    |   |   |   |                       |   |   |   |                  |
| 1                          | 0              | 1        | IBM POWER PC 403      |   |          |          |          |                     |   |   |   |                    |   |   |   |                       |   |   |   |                  |

**MICROPROCESSOR INTERFACE**

| SIGNAL NAME | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|-------------|--------|------|-------------------|---|
| RDY         | T3     | O    | 12                | <p><b>Ready/Data Transfer Acknowledge Output:</b><br/>           The exact behavior of this pin depends upon the type of Microprocessor/Microcontroller the XRT86VL32 has been configured to operate in, as defined by the PTYPE[2:0] pins.</p> <p><b>Intel Asynchronous Mode - RDY* - Ready Output</b><br/>           This output pin will function as the “active-low” READY output. During a READ or WRITE cycle, the Microprocessor Interface block will toggle this output pin to the logic low level, ONLY when the Microprocessor Interface is ready to complete or terminate the current READ or WRITE cycle. Once the Microprocessor has determined that this input pin has toggled to the logic “low” level, then it is now safe for it to move on and execute the next READ or WRITE cycle.</p> <p>If (during a READ or WRITE cycle) the Microprocessor Interface block is holding this output pin at a logic “high” level, then the Microprocessor is expected to extend this READ or WRITE cycle, until it detects this output pin being toggled to the logic low level.</p> <p><b>Motorola Asynchronous Mode - DTACK* - Data Transfer Acknowledge Output</b><br/>           This output pin will function as the “active-low” DTACK output. During a READ or WRITE cycle, the Microprocessor Interface block will toggle this output pin to the logic low level, ONLY when the Microprocessor Interface is ready to complete or terminate the current READ or WRITE cycle. Once the Microprocessor has determined that this input pin has toggled to the logic “low” level, then it is now safe for it to move on and execute the next READ or WRITE cycle.</p> <p>If (during a READ or WRITE cycle) the Microprocessor Interface block is holding this output pin at a logic “high” level, then the Microprocessor is expected to extend this READ or WRITE cycle, until it detects this output pin being toggled to the logic low level.</p> <p><b>Power PC 403 Mode - RDY Ready Output:</b><br/>           This output pin will function as the “active-high” READY output. During a READ or WRITE cycle, the Microprocessor Interface block will toggle this output pin to the logic high level, ONLY when the Microprocessor Interface is ready to complete or terminate the current READ or WRITE cycle. Once the Microprocessor has sampled this signal being at the logic “high” level upon the rising edge of PCLK, then it is now safe for it to move on and execute the next READ or WRITE cycle.</p> <p>If (during a READ or WRITE cycle) the Microprocessor Interface block is holding this output pin at a logic “low” level, then the Microprocessor is expected to extend this READ or WRITE cycle, until it samples this output pin being at the logic low level.</p> <p><b>NOTE:</b> <i>The Microprocessor Interface will update the state of this output pin upon the rising edge of PCLK.</i></p> |

## MICROPROCESSOR INTERFACE

| SIGNAL NAME  | BALL #   | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|--|--|------|-------------------|--|
| ADDR0<br>ADDR1<br>ADDR2<br>ADDR3<br>ADDR4<br>ADDR5<br>ADDR6<br>ADDR7<br>ADDR8<br>ADDR9<br>ADDR10<br>ADDR11<br>ADDR12<br>ADDR13 | U5<br>V5<br>R5<br>T6<br>U6<br>V6<br>R6<br>T7<br>V7<br>U9<br>R7<br>R9<br>R10<br>V11 | I    | -                 | <p><b>Microprocessor Interface Address Bus Input</b></p> <p>These pins permit the Microprocessor to identify on-chip registers and Buffer/Memory locations within the XRT86VL32 device whenever it performs READ and WRITE operations with the XRT86VL32 device.</p> <p><b>NOTE:</b> These pins are internally pulled "Low" with a 50k<math>\Omega</math> resistor, except ADDR [8:13].</p>  |
| $\overline{\text{DBEN}}$   | U4   | I    | -                 | <p><b>Data Bus Enable Input pin.</b></p> <p>This active-low input pin permits the user to either enable or tri-state the Bi-Directional Data Bus pins (D[7:0]), as described below.</p> <ul style="list-style-type: none"> <li>Setting this input pin "low" enables the Bi-directional Data bus.</li> <li>Setting this input pin "high" tri-states the Bi-directional Data Bus.</li> </ul>   |
| ALE  | U8   | I    | -                 | <p><b>Address Latch Enable Input Address Strobe</b></p> <p>The exact behavior of this pin depends upon the type of Microprocessor/Microcontroller the XRT86VL32 has been configured to operate in, as defined by the PTYPE[2:0] pins.</p> <p><b>Intel-Asynchronous Mode - ALE</b></p> <p>This active-high input pin is used to latch the address (present at the Microprocessor Interface Address Bus pins (A[14:0])) into the XRT86VL32 Microprocessor Interface block and to indicate the start of a READ or WRITE cycle.</p> <p>Pulling this input pin "high" enables the input bus drivers for the Address Bus input pins (A[14:0]). The contents of the Address Bus will be latched into the XRT86VL32 Microprocessor Interface circuitry, upon the falling edge of this input signal.</p> <p><b>Motorola-Asynchronous (68K) Mode - AS*</b></p> <p>This active-low input pin is used to latch the data residing on the Address Bus, A[14:0] into the Microprocessor Interface circuitry of the XRT86VL32 device.</p> <p>Pulling this input pin "low" enables the input bus drivers for the Address Bus input pins. The contents of the Address Bus will be latched into the Microprocessor Interface circuitry, upon the rising edge of this signal.</p> <p><b>Power PC 403 Mode - No Function -Tie to GND:</b></p> <p>This input pin has no role nor function and should be tied to GND.</p> |



**MICROPROCESSOR INTERFACE**

| SIGNAL NAME     | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION  |
|-----------------|--------|------|-------------------|--|
| $\overline{CS}$ | V13    | I    | -                 | <p><b>Microprocessor Interface—Chip Select Input:</b><br/>The user must assert this active low signal in order to select the Microprocessor Interface for READ and WRITE operations between the Microprocessor and the XRT86VL32 on-chip registers and buffer/memory locations.</p>  |
| $\overline{RD}$ | V3     | I    | -                 | <p><b>Microprocessor Interface—Read Strobe Input:</b><br/>The exact behavior of this pin depends upon the type of Microprocessor/Microcontroller the Framer has been configured to operate in, as defined by the PTYPE[2:0] pins.</p> <p><b>Intel-Asynchronous Mode - RD* - READ Strobe Input:</b><br/>This input pin will function as the RD* (Active Low Read Strobe) input signal from the Microprocessor. Once this active-low signal is asserted, then the XRT86VL32 device will place the contents of the addressed register (or buffer location) on the Microprocessor Interface Bi-directional data bus (D[7:0]). When this signal is negated, then the Data Bus will be tri-stated.</p> <p><b>Motorola-Asynchronous (68K) Mode - DS* - Data Strobe:</b><br/>This input pin will function as the DS* (Data Strobe) input signal.</p> <p><b>Power PC 403 Mode - WE* - Write Enable Input:</b><br/>This input pin will function as the WE* (Write Enable) input pin. Anytime the Microprocessor Interface samples this active-low input signal (along with CS* and WR/R/W*) also being asserted (at a logic low level) upon the rising edge of PCLK, then the Microprocessor Interface will (upon the very same rising edge of PCLK) latch the contents on the Bi-Directional Data Bus (D[7:0]) into the "target" on-chip register or buffer location within the XRT86VL32 device.</p> |

**MICROPROCESSOR INTERFACE**

| SIGNAL NAME     | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|-----------------|--------|------|-------------------|---|
| $\overline{WR}$ | V12    | I    | -                 | <p><b>Microprocessor Interface—Write Strobe Input</b></p> <p>The exact behavior of this pin depends upon the type of Microprocessor/Microcontroller the XRT86VL32 has been configured to operate in, as defined by the PTYPE[2:0] pins.</p> <p><b>Intel-Asynchronous Mode - WR* - Write Strobe Input:</b></p> <p>This input pin functions as the WR* (Active Low WRITE Strobe) input signal from the Microprocessor. Once this active-low signal is asserted, then the input buffers (associated with the Bi-Directional Data Bus pin, D[7:0]) will be enabled.</p> <p>The Microprocessor Interface will latch the contents on the Bi-Directional Data Bus (into the “target” register or address location, within the XRT86VL32) upon the rising edge of this input pin.</p> <p><b>Motorola-Asynchronous Mode - R/W* - Read/Write Operation Identification Input Pin:</b></p> <p>This pin is functionally equivalent to the “R/W*” input pin. In the Motorola Mode, a “READ” operation occurs if this pin is held at a logic “1”, coincident to a falling edge of the RD/DS* (Data Strobe) input pin. Similarly a WRITE operation occurs if this pin is at a logic “0”, coincident to a falling edge of the RD/DS* (Data Strobe) input pin.</p> <p><b>Power PC 403 Mode - R/W* - Read/Write Operation Identification Input:</b></p> <p>This input pin will function as the “Read/Write Operation Identification Input” pin.</p> <p>Anytime the Microprocessor Interface samples this input signal at a logic low (while also sampling the CS* input pin “low”) upon the rising edge of PCLK, then the Microprocessor Interface will (upon the very same rising edge of PCLK) latch the contents of the Address Bus (A[14:0]) into the Microprocessor Interface circuitry, in preparation for this forthcoming READ operation. At some point (later in this READ operation) the Microprocessor will also assert the DBEN*/OE* input pin, and the Microprocessor Interface will then place the contents of the “target” register (or address location within the XRT86VL32 device) upon the Bi-Directional Data Bus pins (D[7:0]), where it can be read by the Microprocessor.</p> <p>Anytime the Microprocessor Interface samples this input signal at a logic high (while also sampling the CS* input pin a logic “low”) upon the rising edge of PCLK, then the Microprocessor Interface will (upon the very same rising edge of PCLK) latch the contents of the Address Bus (A[14:0]) into the Microprocessor Interface circuitry, in preparation for the forthcoming WRITE operation. At some point (later in this WRITE operation) the Microprocessor will also assert the RD*/DS*/WE* input pin, and the Microprocessor Interface will then latch the contents of the Bi-Directional Data Bus (D[7:0]) into the contents of the “target” register or buffer location (within the XRT86VL32).</p> |



**MICROPROCESSOR INTERFACE**

| SIGNAL NAME               | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|---------------------------|--------|------|-------------------|---|
| $\overline{\text{ACK0}}$  | T2     | I    | -                 | <p><b>DMA Cycle Acknowledge Input—DMA Controller 0 (Write):</b><br/>           The external DMA Controller will assert this input pin “Low” when the following two conditions are met:</p> <ol style="list-style-type: none"> <li>1. After the DMA Controller, within the Framer has asserted (toggled “Low”), the Req_0 output signal.</li> <li>2. When the external DMA Controller is ready to transfer data from external memory to the selected Transmit HDLC buffer.</li> </ol> <p>At this point, the DMA transfer between the external memory and the selected Transmit HDLC buffer may begin.<br/>           After completion of the DMA cycle, the external DMA Controller will negate this input pin after the DMA Controller within the Framer has negated the <math>\overline{\text{Req}}_0</math> output pin. The external DMA Controller must do this in order to acknowledge the end of the DMA cycle.</p> <p><b>DMA Cycle Acknowledge Input—DMA Controller 1 (Read):</b><br/>           The external DMA Controller asserts this input pin “Low” when the following two conditions are met:</p> <ol style="list-style-type: none"> <li>1. After the DMA Controller, within the Framer has asserted (toggled “Low”), the Req_1 output signal.</li> <li>2. When the external DMA Controller is ready to transfer data from the selected Receive HDLC buffer to external memory.</li> </ol> <p>At this point, the DMA transfer between the selected Receive HDLC buffer and the external memory may begin.<br/>           After completion of the DMA cycle, the external DMA Controller will negate this input pin after the DMA Controller within the Framer has negated the <math>\overline{\text{Req}}_1</math> output pin. The external DMA Controller will do this in order to acknowledge the end of the DMA cycle.</p> <p><b>NOTE:</b> This pin is internally pulled “High” with a 50k<math>\Omega</math> resistor.</p> |
| $\overline{\text{ACK1}}$  | U2     |      |                   |   |
| $\overline{\text{BLAST}}$ | U10    | I    | -                 | <p><b>Last Cycle of Burst Indicator Input:</b><br/>           If the Microprocessor Interface is operating in the Intel-I960 Mode, then this input pin is used to indicate (to the Microprocessor Interface block) that the current data transfer is the last data transfer within the current burst operation.<br/>           The Microprocessor should assert this input pin (by toggling it “Low”) in order to denote that the current READ or WRITE operation (within a BURST operation) is the last operation of this BURST operation.</p> <p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1. If the user has configured the Microprocessor Interface to operate in the Intel-Asynchronous, the Motorola-Asynchronous or the Power PC 403 Mode, then he/she should tie this input pin to GND.</li> <li>2. This pin is internally pulled “High” with a 50k<math>\Omega</math> resistor.</li> </ol>  |

**MICROPROCESSOR INTERFACE**

| SIGNAL NAME | BALL # | TYPE | OUTPUT DRIVE (mA) | DESCRIPTION   |
|-------------|--------|------|-------------------|---|
| RESET       | P1     | I    | -                 | <b>Hardware Reset Input</b><br>Reset is an active low input. If this pin is pulled "Low" for more than 10 $\mu$ S, the device will be reset. When this occurs, all output will be 'tri-stated', and all internal registers will be reset to their default values. |

**POWER SUPPLY PINS (3.3V)**

| SIGNAL NAME | BALL #                 | TYPE | DESCRIPTION                                     |
|-------------|------------------------|------|---|
| VDD         | D16<br>P3<br>R15<br>T9 | PWR  | Framer Block Power Supply (I/O)                 |
| RVDD        | E3<br>J3               | PWR  | Receiver Analog Power Supply for LIU Section    |
| TVDD        | F3<br>K3               | PWR  | Transmitter Analog Power Supply for LIU Section |

**POWER SUPPLY PINS (1.8V)**

| SIGNAL NAME | BALL #                       | TYPE | DESCRIPTION                          |
|-------------|------------------------------|------|--------------------------------------|
| DVDD18      | B8<br>C4<br>J16<br>R13<br>U7 | PWR  | Digital Power Supply for LIU Section |
| AVDD18      | A2                           | PWR  | Analog Power Supply for LIU Section  |
| VDDPLL18    | B1<br>C2<br>D2<br>D3         | PWR  | Analog Power Supply for PLL          |

**GROUND PINS**

| SIGNAL NAME | BALL #  | TYPE | DESCRIPTION                                      |
|-------------|---|------|--|
| VSS         | A5<br>B14<br>C16<br>M15<br>M16<br>R4<br>T5<br>U16 | GND  | <b>Framer Block Ground</b>                       |
| DGND        | C5  | GND  | <b>Digital Ground for LIU Section</b>            |
| AGND        | B3  | GND  | <b>Analog Ground for LIU Section</b>             |
| RGND        | E2<br>J2  | GND  | <b>Receiver Analog Ground for LIU Section</b>    |
| TGND        | F2<br>K2  | GND  | <b>Transmitter Analog Ground for LIU Section</b> |
| GNDPLL18    | A1<br>C1<br>D1<br>D4                              | GND  | <b>Analog Ground for PLL</b>                     |

**NO CONNECT PINS**

| SIGNAL NAME | TYPE | DESCRIPTION  |
|-------------|------|--|
| NC          | NC   | <b>No Connect Pins</b><br>A15, A16, A17, A18, B15, B16, B17, B18, C13, C15, C17, C18, D13, D14, D17, D18, E15, E16, E17, E18, F15, F16, F17, G1, G2, G3, G4, G17, G18, H1, H2, H3, H4, H18, L1, L2, L3, L4, M1, M2, M3, M4, P16, P17, P18, R12, R14, R16, R17, R18, T11, T12, T13, T14, T15, T17, T18, U12, U13, U14, U15, U17, U18, V14, V15, V16, V17, V18 |



**ELECTRICAL CHARACTERISTICS**

**ABSOLUTE MAXIMUMS**

|   |   |
|---|---|
| Power Supply.....                             | Power Rating PBGA Package.....1.39W<br>(at zero air flow) |
| VDD <sub>IO</sub> .. -0.5V to +3.465V         |   |
| VDD <sub>CORE</sub> .....-0.5V to +1.890V     |   |
| Storage Temperature .....-65°C to 150°C       | Input Logic Signal Voltage (Any Pin) .....-0.5V to + 5.5V |
| Operating Temperature Range.....-40°C to 85°C | ESD Protection (HBM).....>2000V                           |
| Supply Voltage ..... GND-0.5V to +VDD + 0.5V  | Input Current (Any Pin) ..... ± 100mA                     |

**DC ELECTRICAL CHARACTERISTICS**

| Test Conditions: TA = 25°C, VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5% unless otherwise specified |  |      |      |      |       |                          |
|--|--|------|------|------|-------|--------------------------|
| SYMBOL   | PARAMETER                              | MIN. | TYP. | MAX. | UNITS | CONDITIONS               |
| I <sub>LL</sub>  | Data Bus Tri-State Bus Leakage Current | -10  |      | +10  | µA    |                          |
| V <sub>IL</sub>  | Input Low voltage                      |      |      | 0.8  | V     |                          |
| V <sub>IH</sub>  | Input High Voltage                     | 2.0  |      | VDD  | V     |                          |
| V <sub>OL</sub>  | Output Low Voltage                     | 0.0  |      | 0.4  | V     | I <sub>OL</sub> = -1.6mA |
| V <sub>OH</sub>  | Output High Voltage                    | 2.4  |      | VDD  | V     | I <sub>OH</sub> = 40µA   |
| I <sub>OC</sub>  | Open Drain Output Leakage Current      |      |      |      | µA    |                          |
| I <sub>IH</sub>  | Input High Voltage Current             | -10  |      | 10   | µA    | V <sub>IH</sub> = VDD    |
| I <sub>IL</sub>  | Input Low Voltage Current              | -10  |      | 10   | µA    | V <sub>IL</sub> = GND    |

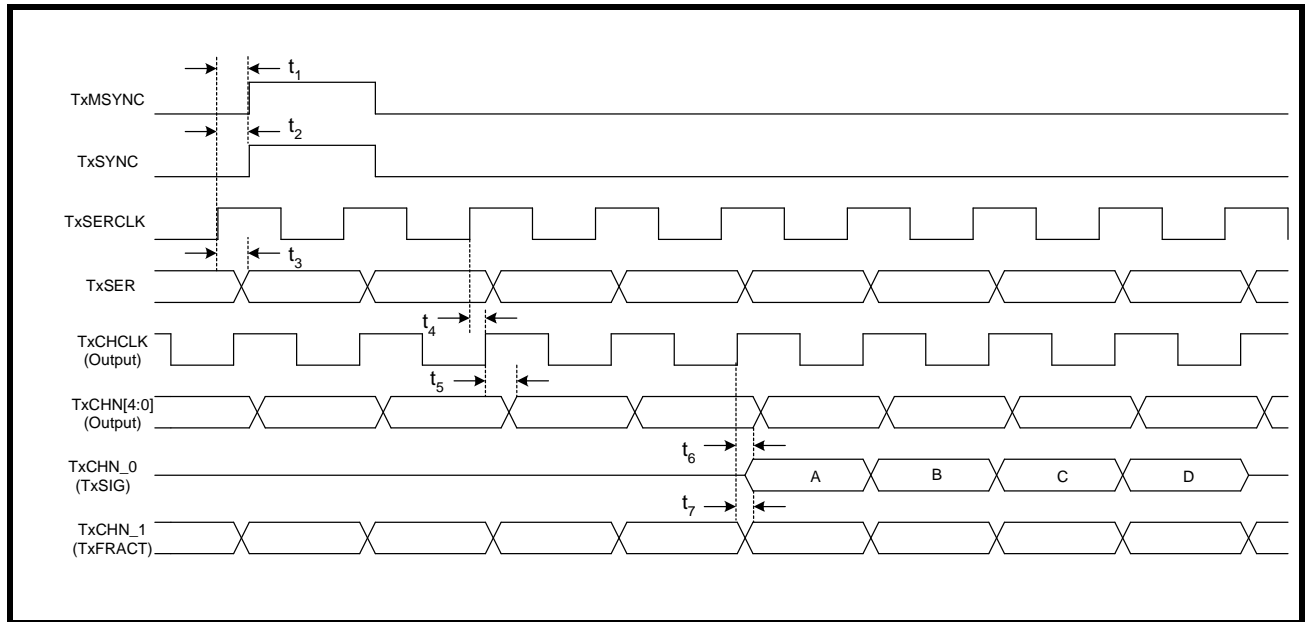
**TABLE 4: XRT86VL32 POWER CONSUMPTION**

| VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5% , T <sub>A</sub> =25°C, UNLESS OTHERWISE SPECIFIED |                |           |                      |                   |             |      |      |      |                 |
|--|----------------|-----------|----------------------|-------------------|-------------|------|------|------|-----------------|
| MODE   | SUPPLY VOLTAGE | IMPEDANCE | TERMINATION RESISTOR | TRANSFORMER RATIO |             | TYP. | MAX. | UNIT | TEST CONDITIONS |
|  |                |           |                      | RECEIVER          | TRANSMITTER |      |      |      |                 |
| E1   | 3.3V           | 75Ω       | Internal             | 1:1               | 1:2         | 776  |      | mW   | PRBS Pattern    |
| E1   | 3.3V           | 120Ω      | Internal             | 1:1               | 1:2         | 724  |      | mW   | PRBS Pattern    |
| T1   | 3.3V           | 100Ω      | Internal             | 1:1               | 1:2         | 829  |      | mW   | PRBS Pattern    |

**AC ELECTRICAL CHARACTERISTICS TRANSMIT FRAMER (BASE RATE/NON-MUX)**

| Test Conditions: TA = 25°C, VDD = 3.3V ± 5% unless otherwise specified |  |      |      |      |       |            |
|--|--|------|------|------|-------|------------|
| SYMBOL   | PARAMETER  | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
| t <sub>1</sub>   | TxSERCLK to TxMSYNC delay                          |      |      | 234  | nS    |            |
| t <sub>2</sub>   | TxSERCLK to TxSYNC delay                           |      |      | 230  | nS    |            |
| t <sub>3</sub>   | TxSERCLK to TxSER data delay                       |      |      | 230  | nS    |            |
| t <sub>4</sub>   | Rising Edge of TxSERCLK to Rising Edge of TxCH-CLK |      |      | 13   | nS    |            |
| t <sub>5</sub>   | Rising Edge of TxCHCLK to Valid TxCHN[4:0] Data    |      |      | 6    | nS    |            |
| t <sub>6</sub>   | TxSERCLK to TxSIG delay                            |      |      | 230  | nS    |            |
| t <sub>7</sub>   | TxSERCLK to TxFRACT delay                          |      |      | 110  | nS    |            |

**FIGURE 2. FRAMER SYSTEM TRANSMIT TIMING DIAGRAM (BASE RATE/NON-MUX)**



**AC ELECTRICAL CHARACTERISTICS RECEIVE FRAMER (BASE RATE/NON-MUX)**

| Test Conditions: TA = 25°C, VDD = 3.3V ± 5% unless otherwise specified |   |      |      |      |       |            |
|--|---|------|------|------|-------|------------|
| SYMBOL   | PARAMETER   | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
| <b>RxSERCLK as an Output</b>   |   |      |      |      |       |            |
| t <sub>8</sub>   | Rising Edge of RxSERCLK to Rising Edge of RxCASync                  |      |      | 4    | nS    |            |
| t <sub>9</sub>   | Rising Edge of RxSERCLK to Rising Edge of RxCRCSync                 |      |      | 4    | nS    |            |
| t <sub>10</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSYNC (RxSYNC as Output) |      |      | 4    | nS    |            |
| t <sub>11</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSER                     |      |      | 6    | nS    |            |
| t <sub>12</sub>  | Rising Edge of RxSERCLK to Rising Edge of Valid RxCHN[4:0] data     |      |      | 6    | nS    |            |
| <b>RxSERCLK as an Input</b>  |   |      |      |      |       |            |
| t <sub>13</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxCASync                  |      |      | 8    | nS    |            |
| t <sub>14</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxCRCSync                 |      |      | 8    | nS    |            |
| t <sub>15</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSYNC (RxSYNC as Output) |      |      | 10   | nS    |            |
| t <sub>15</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSYNC (RxSYNC as Input)  |      |      | 230  | nS    |            |
| t <sub>16</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSER                     |      |      | 10   | nS    |            |
| t <sub>17</sub>  | Rising Edge of RxSERCLK to Rising Edge of Valid RxCHN[4:0] data     |      |      | 9    | nS    |            |

**FIGURE 3. FRAMER SYSTEM RECEIVE TIMING DIAGRAM (RxSERCLK AS AN OUTPUT)**

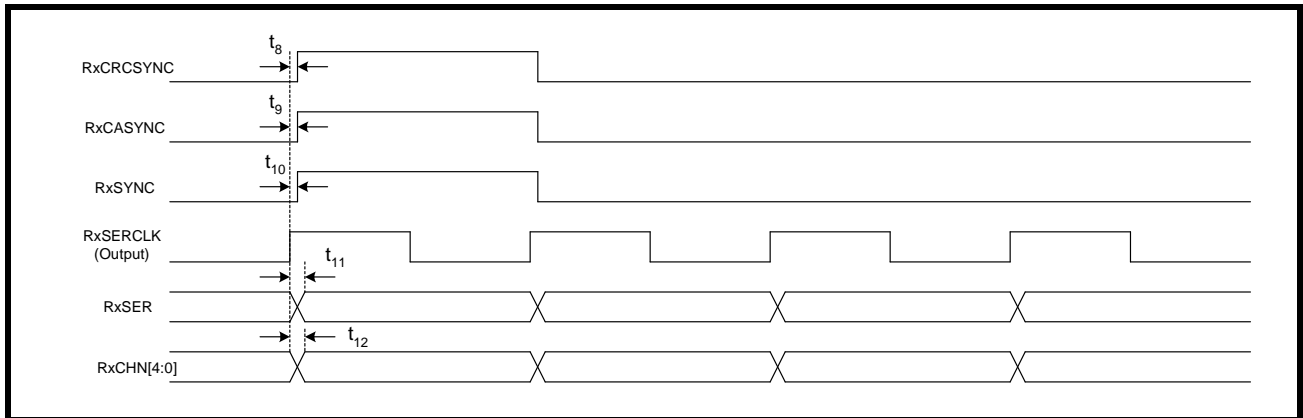
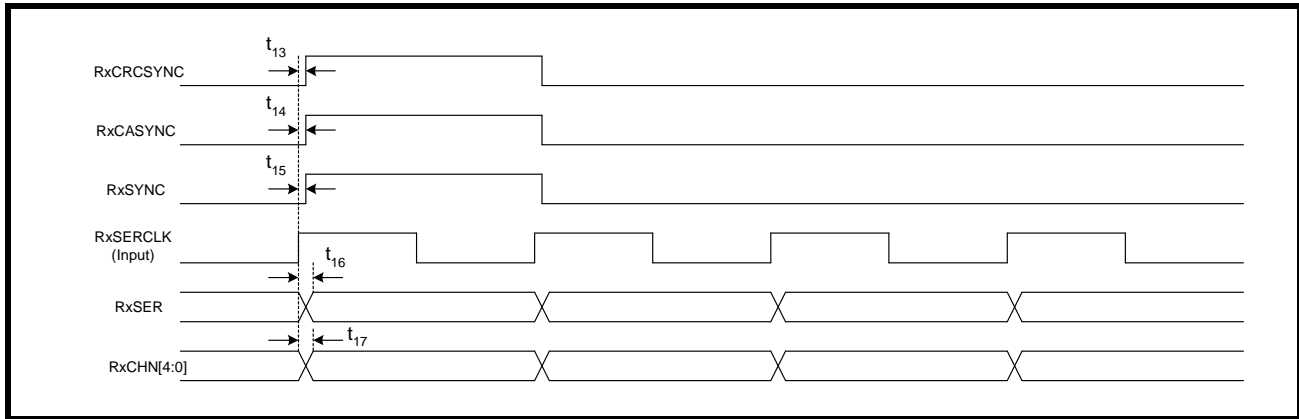


FIGURE 4. FRAMER SYSTEM RECEIVE TIMING DIAGRAM (RxSERCLK AS AN INPUT)

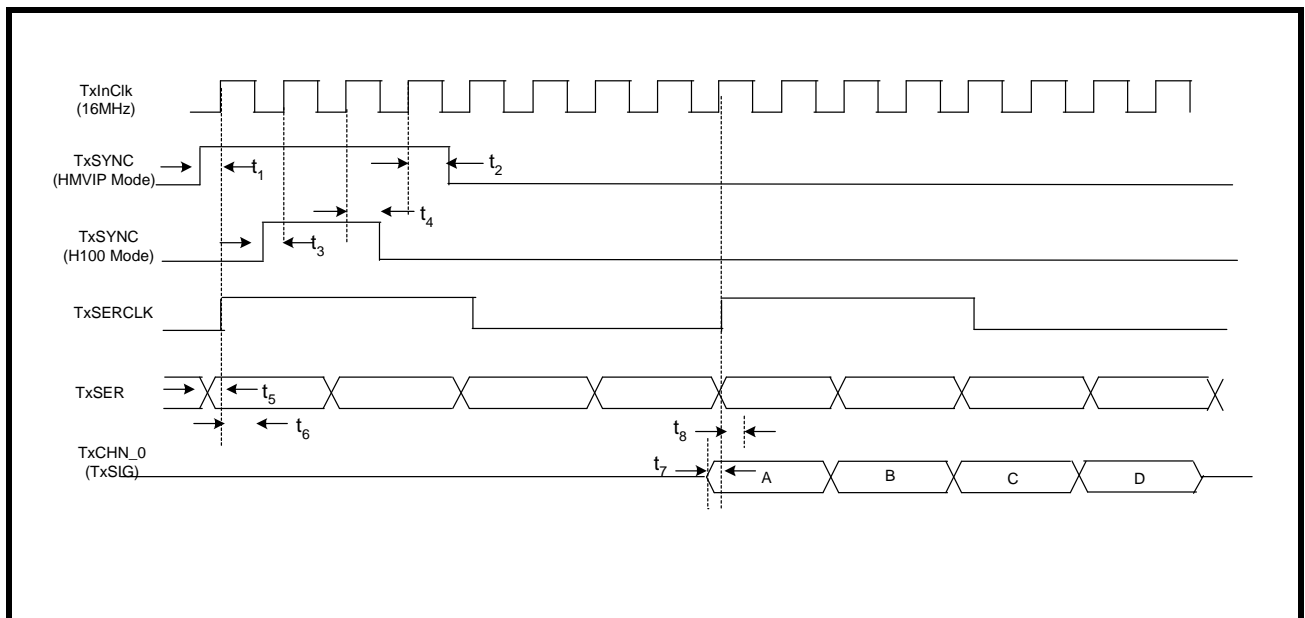




AC ELECTRICAL CHARACTERISTICS TRANSMIT FRAMER (HMVIP/H100 MODE)

| Test Conditions: TA = 25°C, VDD = 3.3V ± 5% unless otherwise specified |  |      |      |      |       |            |
|--|--|------|------|------|-------|------------|
| SYMBOL   | PARAMETER                              | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
| t <sub>1</sub>   | TxSYNC Setup Time - HMVIP Mode         | 7    |      |      | nS    |            |
| t <sub>2</sub>   | TxSYNC Hold Time - HMVIP Mode          | 4    |      |      | nS    |            |
| t <sub>3</sub>   | TxSYNC Setup Time - H100 Mode          | 7    |      |      | nS    |            |
| t <sub>4</sub>   | TxSYNC Hold Time - H100 Mode           | 4    |      |      | nS    |            |
| t <sub>5</sub>   | TxSER Setup Time - HMVIP and H100 Mode | 6    |      |      | nS    |            |
| t <sub>6</sub>   | TxSER Hold Time - HMVIP and H100 Mode  | 3    |      |      | nS    |            |
| t <sub>7</sub>   | TxSIG Setup Time - HMVIP and H100 Mode | 6    |      |      | nS    |            |
| t <sub>8</sub>   | TxSIG Hold Time - HMVIP and H100 Mode  | 3    |      |      | nS    |            |

FIGURE 5. FRAMER SYSTEM TRANSMIT TIMING DIAGRAM (HMVIP AND H100 MODE)



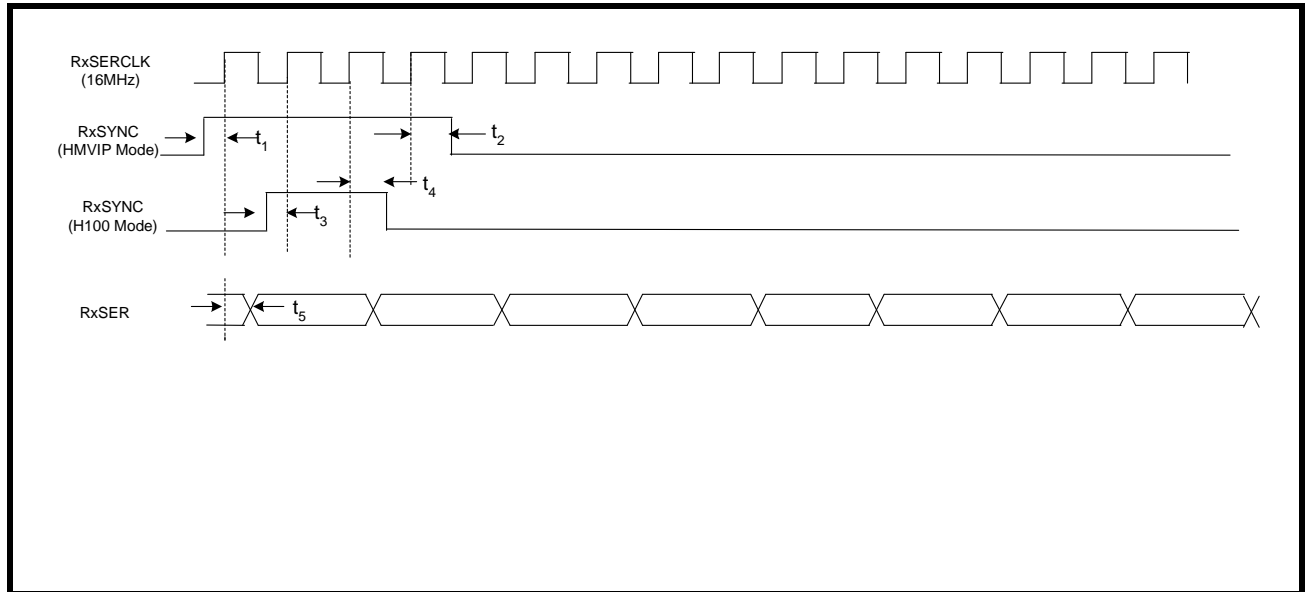
**NOTE:** Setup and Hold time is not valid from TxInClk to TxSERCLK as TxInClk is used as the timing source for the back plane interface and TxSERCLK is used as the timing source on the line side.

AC ELECTRICAL CHARACTERISTICS RECEIVE FRAMER (HMVIP/H100 MODE)

| Test Conditions: TA = 25°C, VDD = 3.3V ± 5% unless otherwise specified |   |      |      |      |       |            |
|--|---|------|------|------|-------|------------|
| SYMBOL   | PARAMETER   | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
| t <sub>1</sub>   | RxSYNC Setup Time - HMVIP Mode                        | 4    |      |      | nS    |            |
| t <sub>2</sub>   | RxSYNC Hold Time - HMVIP Mode                         | 3    |      |      | nS    |            |
| t <sub>3</sub>   | RxSYNC Setup Time - H100 Mode                         | 5    |      |      | nS    |            |
| t <sub>4</sub>   | RxSYNC Hold Time - H100 Mode                          | 3    |      |      | nS    |            |
| t <sub>5</sub>   | Rising Edge of RxSERCLK to Rising Edge of RxSER delay |      |      | 11   | nS    |            |

NOTE: Both RxSERCLK and RxSYNC are inputs

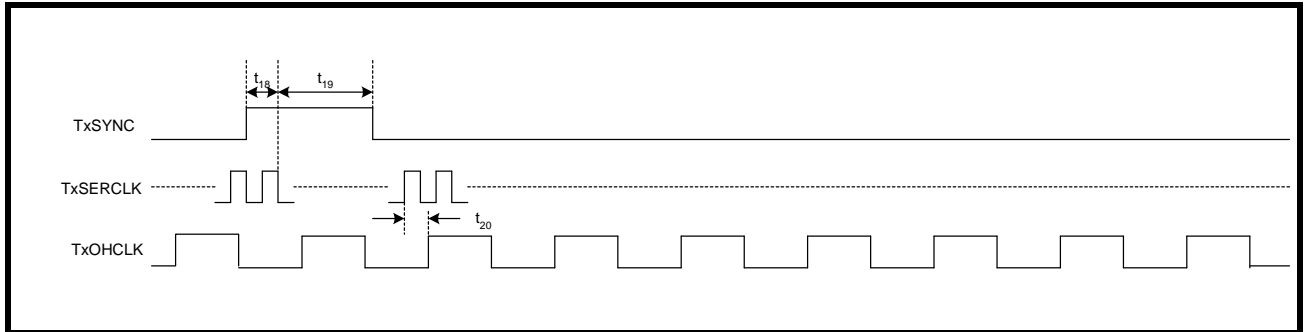
FIGURE 6. FRAMER SYSTEM RECEIVE TIMING DIAGRAM (HMVIP/H100 MODE)



**AC ELECTRICAL CHARACTERISTICS TRANSMIT OVERHEAD FRAMER**

| Test Conditions: TA = 25°C, VDD = 3.3V ± 5% unless otherwise specified |   |      |      |      |       |            |
|--|---|------|------|------|-------|------------|
| SYMBOL   | PARAMETER                                 | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
| t <sub>18</sub>  | TxSYNC Setup Time (Falling Edge TxSERCLK) | 6    |      |      | nS    |            |
| t <sub>19</sub>  | TxSYNC Hold Time (Falling Edge TxSERCLK)  | 4    |      |      | nS    |            |
| t <sub>20</sub>  | Rising Edge of TxSERCLK to TxOHCLK        |      |      | 12   | nS    |            |

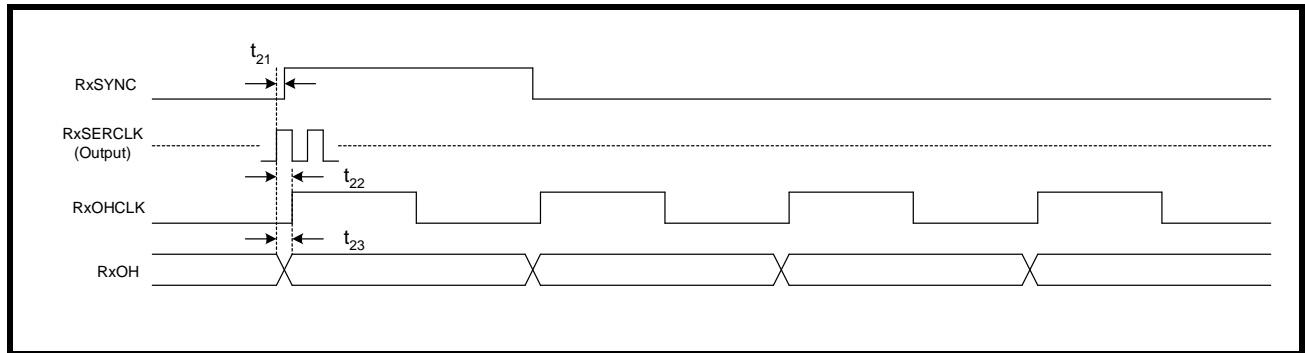
**FIGURE 7. FRAMER SYSTEM TRANSMIT OVERHEAD TIMING DIAGRAM**



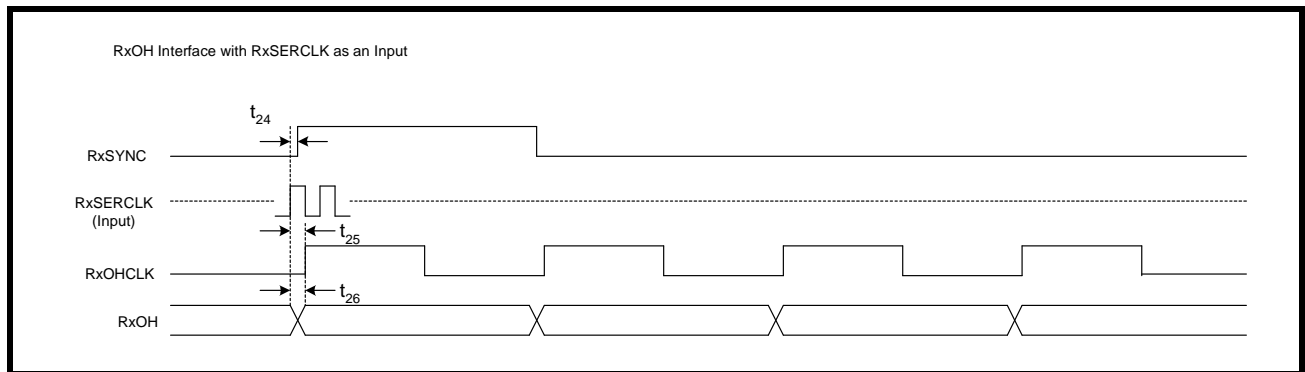
**AC ELECTRICAL CHARACTERISTICS RECEIVE OVERHEAD FRAMER**

| Test Conditions: TA = 25°C, VDD = 3.3V ± 5% unless otherwise specified |   |      |      |      |       |            |
|--|---|------|------|------|-------|------------|
| SYMBOL   | PARAMETER   | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
| <b>RxSERCLK as an Output</b>   |   |      |      |      |       |            |
| t <sub>21</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSYNC (RxSYNC as Output) |      |      | 4    | nS    |            |
| t <sub>22</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxO-HCLK                  |      |      | 6    | nS    |            |
| t <sub>23</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxOH                      |      |      | 8    | nS    |            |
| <b>RxSERCLK as an Input</b>  |   |      |      |      |       |            |
| t <sub>24</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSYNC (RxSYNC as Output) |      |      | 12   | nS    |            |
| t <sub>24</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxSYNC (RxSYNC as Input)  |      |      | 230  | nS    |            |
| t <sub>25</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxO-HCLK                  |      |      | 12   | nS    |            |
| t <sub>26</sub>  | Rising Edge of RxSERCLK to Rising Edge of RxOH                      |      |      | 15   | nS    |            |

**FIGURE 8. FRAMER SYSTEM RECEIVE OVERHEAD TIMING DIAGRAM (RxSERCLK AS AN OUTPUT)**



**FIGURE 9. FRAMER SYSTEM RECEIVE OVERHEAD TIMING DIAGRAM (RxSERCLK AS AN INPUT)**



**TABLE 5: E1 RECEIVER ELECTRICAL CHARACTERISTICS**

| VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5%, T <sub>A</sub> = -40° to 85°C, unless otherwise specified |              |             |             |                                      |  |
|--|--------------|-------------|-------------|--------------------------------------|--|
| PARAMETER  | MIN.         | TYP.        | MAX.        | UNIT                                 | TEST CONDITIONS  |
| Receiver loss of signal:<br>Number of consecutive zeros before RLOS is set   |              | 32          |             |                                      | Cable attenuation @1024kHz   |
| Input signal level at RLOS   | 15           | 20          |             | dB                                   | ITU-G.775, ETSI 300 233  |
| RLOS De-asserted   | 12.5         |             |             | % ones                               |  |
| Receiver Sensitivity<br>(Short Haul with cable loss)   | 11           |             |             | dB                                   | With nominal pulse amplitude of 3.0V for 120Ω and 2.37V for 75Ω application. |
| <b>Receiver Sensitivity</b><br>(Long Haul with cable loss)   | 0            |             | 43          | dB                                   | With nominal pulse amplitude of 3.0V for 120Ω and 2.37V for 75Ω application. |
| Input Impedance  |              | 15          |             | kΩ                                   |  |
| <b>Input Jitter Tolerance:</b><br>1 Hz<br>10kHz-100kHz   | 37<br>0.3    |             |             | U <sub>Ipp</sub><br>U <sub>Ipp</sub> | ITU G.823  |
| Recovered Clock Jitter<br>Transfer Corner Frequency<br>Peaking Amplitude   | -            | 20          | 0.5         | kHz<br>dB                            | ITU G.736  |
| <b>Jitter Attenuator Corner Frequency</b> (-3dB curve) (JABW=0)<br>(JABW=1)  | -            | 10<br>1.5   | -           | Hz<br>Hz                             | ITU G.736  |
| <b>Return Loss:</b><br>51kHz - 102kHz<br>102kHz - 2048kHz<br>2048kHz - 3072kHz   | 12<br>8<br>8 | -<br>-<br>- | -<br>-<br>- | dB<br>dB<br>dB                       | ITU-G.703  |

TABLE 6: T1 RECEIVER ELECTRICAL CHARACTERISTICS

| VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5%, T <sub>A</sub> =-40° to 85°C, unless otherwise specified |      |      |      |        |   |
|---|------|------|------|--------|---|
| PARAMETER   | MIN. | TYP. | MAX. | UNIT   | TEST CONDITIONS   |
| Receiver loss of signal:  |      |      |      |        |   |
| Number of consecutive zeros before RLOS is set  |      | 175  |      |        |   |
| Input signal level at RLOS  | 15   | 20   | -    | dB     | Cable attenuation @772kHz                                 |
| RLOS Clear  | 12.5 | -    | -    | % ones | ITU-G.775, ETSI 300 233                                   |
| Receiver Sensitivity (Short Haul with cable loss)   | 12   | -    |      | dB     | With nominal pulse amplitude of 3.0V for 100Ω termination |
| Receiver Sensitivity (Long Haul with cable loss)  |      | -    |      |        | With nominal pulse amplitude of 3.0V for 100Ω termination |
| Normal  | 0    |      | 36   | dB     |   |
| Extended  | 0    |      | 45   | dB     |   |
| Input Impedance   |      | 15   | -    | kΩ     |   |
| Jitter Tolerance:   |      |      |      |        |   |
| 1Hz   | 138  | -    | -    | UIpp   | AT&T Pub 62411  |
| 10kHz - 100kHz  | 0.4  | -    | -    |        |   |
| Recovered Clock Jitter  |      |      |      |        |   |
| Transfer Corner Frequency   | -    | 10   | -    | KHz    | TR-TSY-000499   |
| Peaking Amplitude   | -    |      | 0.1  | dB     |   |
| Jitter Attenuator Corner Frequency (-3dB curve)   | -    | 3    |      | Hz     | AT&T Pub 62411  |
| Return Loss:  |      |      |      |        |   |
| 51kHz - 102kHz  | -    | 14   | -    | dB     |   |
| 102kHz - 2048kHz  | -    | 20   | -    | dB     |   |
| 2048kHz - 3072kHz   | -    | 16   | -    | dB     |   |

TABLE 7: E1 TRANSMITTER ELECTRICAL CHARACTERISTICS

| VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5%, T <sub>A</sub> =-40° to 85°C, unless otherwise specified |      |       |      |                  |  |
|---|------|-------|------|------------------|--|
| PARAMETER   | MIN. | TYP.  | MAX. | UNIT             | TEST CONDITIONS  |
| AMI Output Pulse Amplitude:   |      |       |      |                  | 1:2 Transformer  |
| 75Ω Application   | 2.13 | 2.37  | 2.60 | V                |  |
| 120Ω Application  | 2.70 | 3.00  | 3.30 | V                |  |
| Output Pulse Width  | 224  | 244   | 264  | ns               |  |
| Output Pulse Width Ratio  | 0.95 | -     | 1.05 | -                | ITU-G.703  |
| Output Pulse Amplitude Ratio  | 0.95 | -     | 1.05 | -                | ITU-G.703  |
| Jitter Added by the Transmitter Output  | -    | 0.025 | 0.05 | U <sub>lpp</sub> | Broad Band with jitter free TCLK applied to the input. |
| Output Return Loss:   |      |       |      |                  | ETSI 300 166   |
| 51kHz -102kHz   | 15   | -     | -    | dB               |  |
| 102kHz-2048kHz  | 9    | -     | -    | dB               |  |
| 2048kHz-3072kHz   | 8    | -     | -    | dB               |  |

TABLE 8: E1 TRANSMIT RETURN LOSS REQUIREMENT

| FREQUENCY    | RETURN LOSS<br>ETS 300166 |
|--------------|---------------------------|
| 51-102kHz    | 6dB                       |
| 102-2048kHz  | 8dB                       |
| 2048-3072kHz | 8dB                       |

TABLE 9: T1 TRANSMITTER ELECTRICAL CHARACTERISTICS

| VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5%, T <sub>A</sub> =-40° to 85°C, unless otherwise specified |      |       |      |      |  |
|---|------|-------|------|------|--|
| PARAMETER   | MIN. | TYP.  | MAX. | UNIT | TEST CONDITIONS  |
| AMI Output Pulse Amplitude:   | 2.4  | 3.0   | 3.60 | V    | 1:2 Transformer measured at DSX_1.                     |
| Output Pulse Width  | 338  | 350   | 362  | ns   | ANSI T1.102  |
| Output Pulse Width Imbalance  | -    | -     | 20   | -    | ANSI T1.102  |
| Output Pulse Amplitude Imbalance  | -    | -     | ±200 | mV   | ANSI T1.102  |
| Jitter Added by the Transmitter Output  | -    | 0.025 | 0.05 | UIpp | Broad Band with jitter free TCLK applied to the input. |
| Output Return Loss:   |      |       |      |      |  |
| 51kHz -102kHz   | -    | 17    | -    | dB   |  |
| 102kHz-2048kHz  | -    | 12    | -    | dB   |  |
| 2048kHz-3072kHz   | -    | 10    | -    | dB   |  |



FIGURE 10. ITU G.703 PULSE TEMPLATE

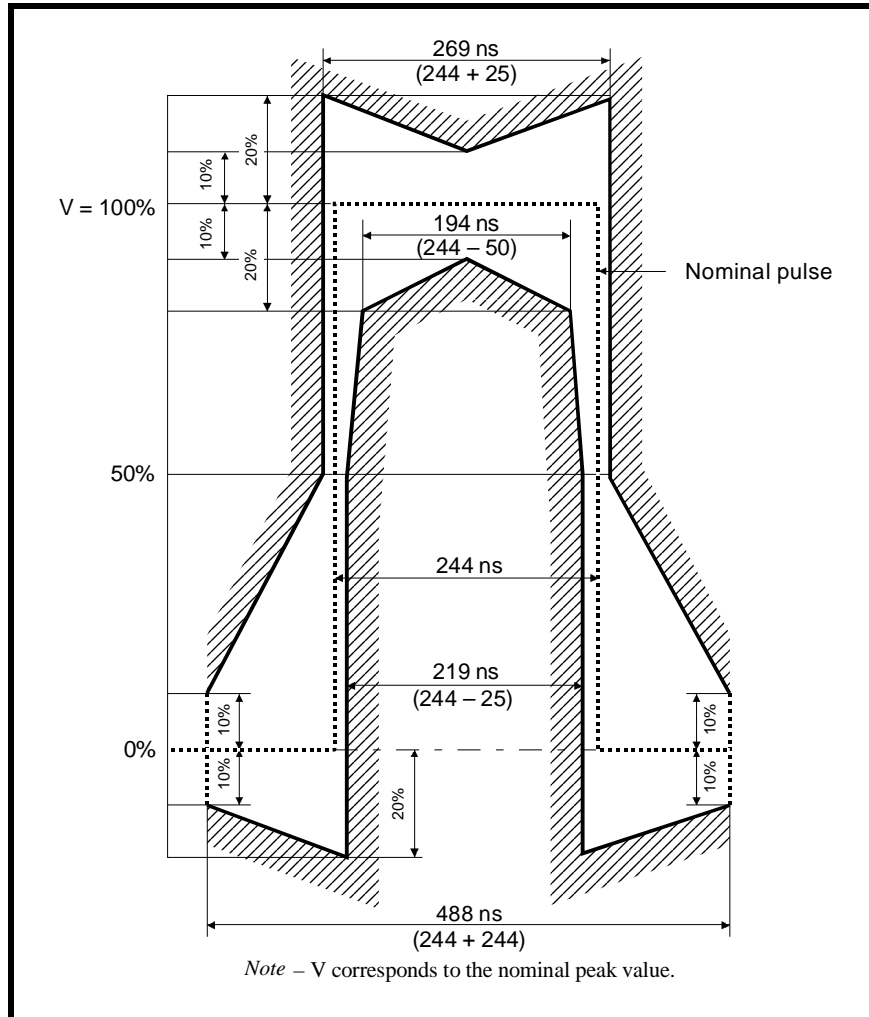


TABLE 10: TRANSMIT PULSE MASK SPECIFICATION

| Test Load Impedance                             | 75Ω Resistive (Coax) | 120Ω Resistive (twisted Pair) |
|---|----------------------|-------------------------------|
| Nominal Peak Voltage of a Mark                  | 2.37V                | 3.0V                          |
| Peak voltage of a Space (no Mark)               | 0 ± 0.237V           | 0 ± 0.3V                      |
| Nominal Pulse width                             | 244ns                | 244ns                         |
| Ratio of Positive and Negative Pulses Imbalance | 0.95 to 1.05         | 0.95 to 1.05                  |

FIGURE 11. DSX-1 PULSE TEMPLATE (NORMALIZED AMPLITUDE)

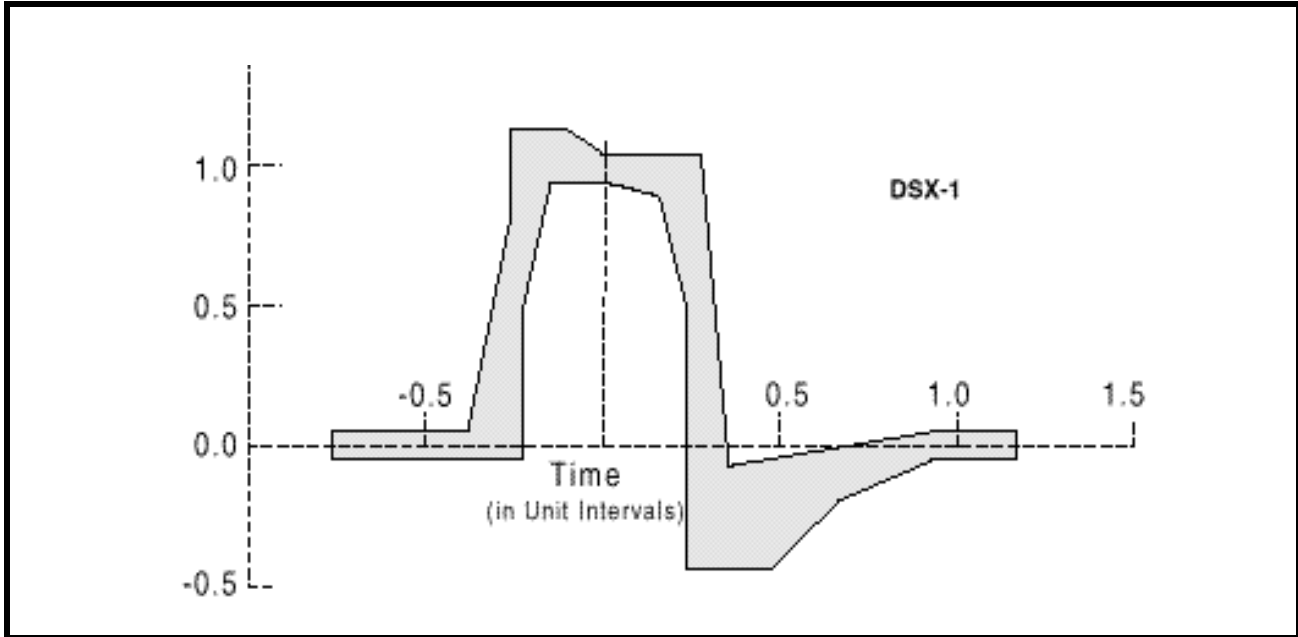


TABLE 11: DSX1 INTERFACE ISOLATED PULSE MASK AND CORNER POINTS

| MINIMUM CURVE |                      | MAXIMUM CURVE |                      |
|---------------|----------------------|---------------|----------------------|
| TIME (UI)     | NORMALIZED AMPLITUDE | TIME (UI)     | NORMALIZED AMPLITUDE |
| -0.77         | -0.05V               | -0.77         | .05V                 |
| -0.23         | -0.05V               | -0.39         | .05V                 |
| -0.23         | 0.5V                 | -0.27         | .8V                  |
| -0.15         | 0.95V                | -0.27         | 1.15V                |
| 0.0           | 0.95V                | -0.12         | 1.15V                |
| 0.15          | 0.9V                 | 0.0           | 1.05V                |
| 0.23          | 0.5V                 | 0.27          | 1.05V                |
| 0.23          | -0.45V               | 0.35          | -0.07V               |
| 0.46          | -0.45V               | 0.93          | 0.05V                |
| 0.66          | -0.2V                | 1.16          | 0.05V                |
| 0.93          | -0.05V               |               |                      |
| 1.16          | -0.05V               |               |                      |

TABLE 12: AC ELECTRICAL CHARACTERISTICS

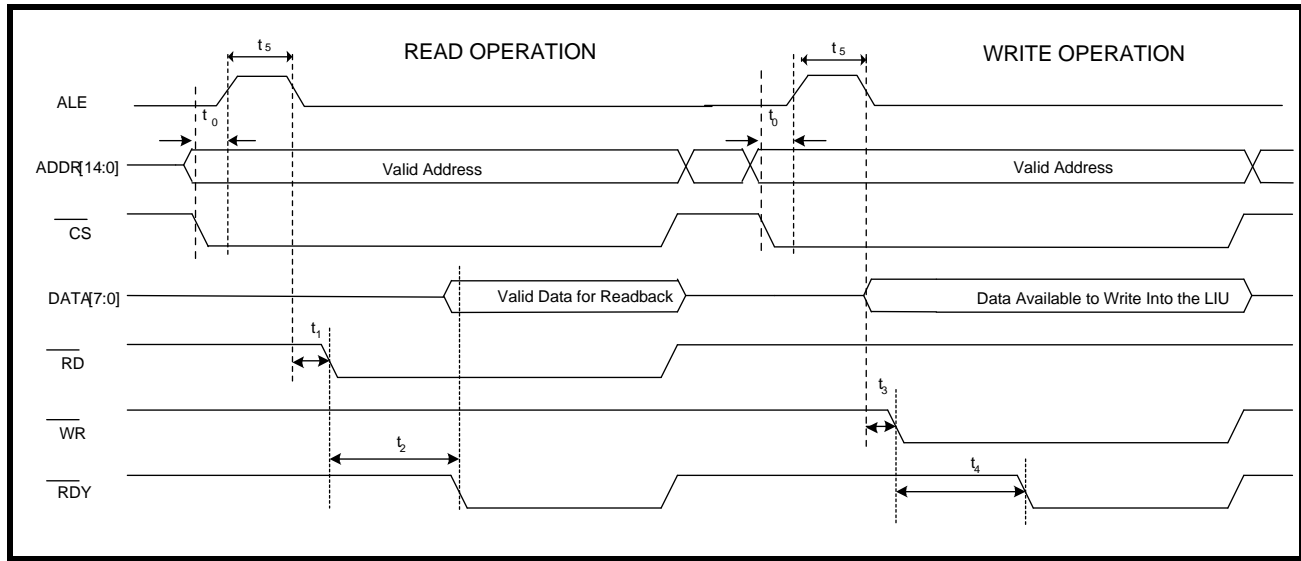
| VDD <sub>IO</sub> = 3.3V ± 5% , VDD <sub>CORE</sub> = 1.8V ± 5%, TA=25°C, UNLESS OTHERWISE SPECIFIED |        |      |      |      |       |
|--|--------|------|------|------|-------|
| PARAMETER  | SYMBOL | MIN. | TYP. | MAX. | UNITS |
| MCLKIN Clock Duty Cycle  |        | 40   | -    | 60   | %     |
| MCLKIN Clock Tolerance   |        | -    | ±50  | -    | ppm   |

**MICROPROCESSOR INTERFACE I/O TIMING**

**INTEL INTERFACE TIMING - ASYNCHRONOUS**

The signals used for the Intel microprocessor interface are: Address Latch Enable (ALE), Read Enable ( $\overline{RD}$ ), Write Enable ( $\overline{WR}$ ), Chip Select ( $\overline{CS}$ ), Address and Data bits. The microprocessor interface uses minimum external glue logic and is compatible with the timings of the 8051 or 80188 family of microprocessors. The ALE signal can be tied 'HIGH' if this signal is not available, and the corresponding timing interface is shown in **Figure 13** and **Table 14**.

**FIGURE 12. INTEL  $\mu$ P INTERFACE TIMING DURING PROGRAMMED I/O READ AND WRITE OPERATIONS WHEN ALE IS NOT TIED 'HIGH'**



**TABLE 13: INTEL MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS**

| SYMBOL | PARAMETER   | MIN | MAX | UNITS |
|--------|---|-----|-----|-------|
| $t_0$  | Valid Address to $\overline{CS}$ Falling Edge and ALE Rising Edge | 0   | -   | ns    |
| $t_1$  | ALE Falling Edge to $\overline{RD}$ Assert                        | 5   | -   | ns    |
| $t_2$  | $\overline{RD}$ Assert to $\overline{RDY}$ Assert                 | -   | 320 | ns    |
| NA     | $\overline{RD}$ Pulse Width ( $t_2$ )                             | 320 | -   | ns    |
| $t_3$  | ALE Falling Edge to $\overline{WR}$ Assert                        | 5   | -   | ns    |
| $t_4$  | $\overline{WR}$ Assert to $\overline{RDY}$ Assert                 | -   | 320 | ns    |
| NA     | $\overline{WR}$ Pulse Width ( $t_4$ )                             | 320 | -   | ns    |
| $t_5$  | ALE Pulse Width( $t_5$ )  | 10  | -   | ns    |

FIGURE 13. INTEL  $\mu$ P INTERFACE TIMING DURING PROGRAMMED I/O READ AND WRITE OPERATIONS WHEN ALE IS TIED 'HIGH'

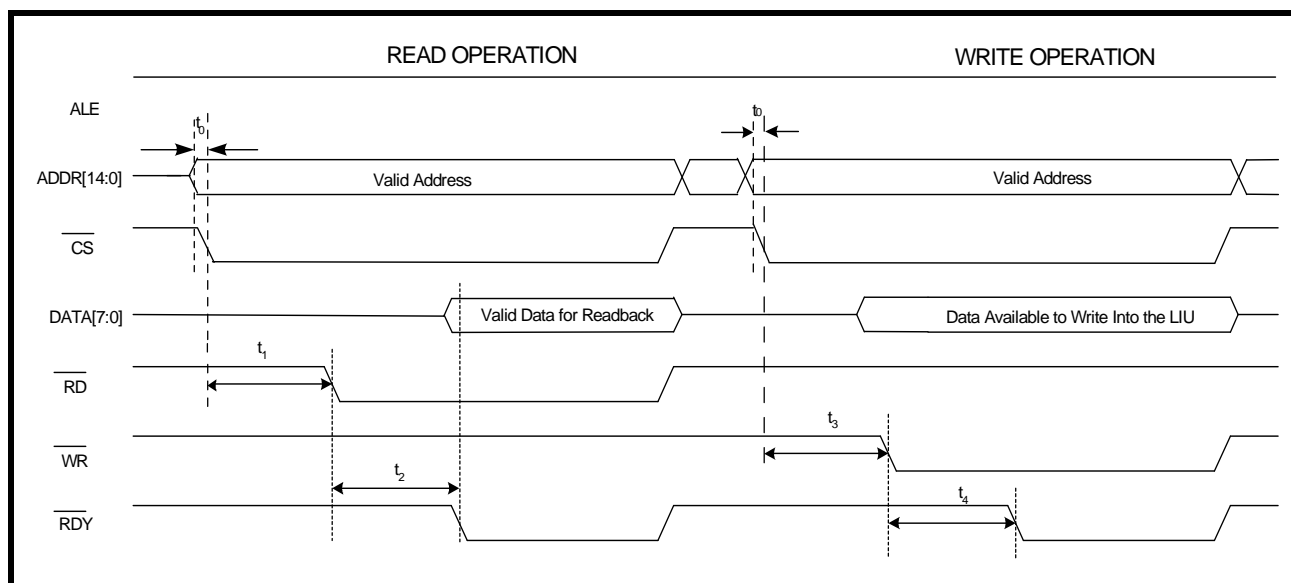


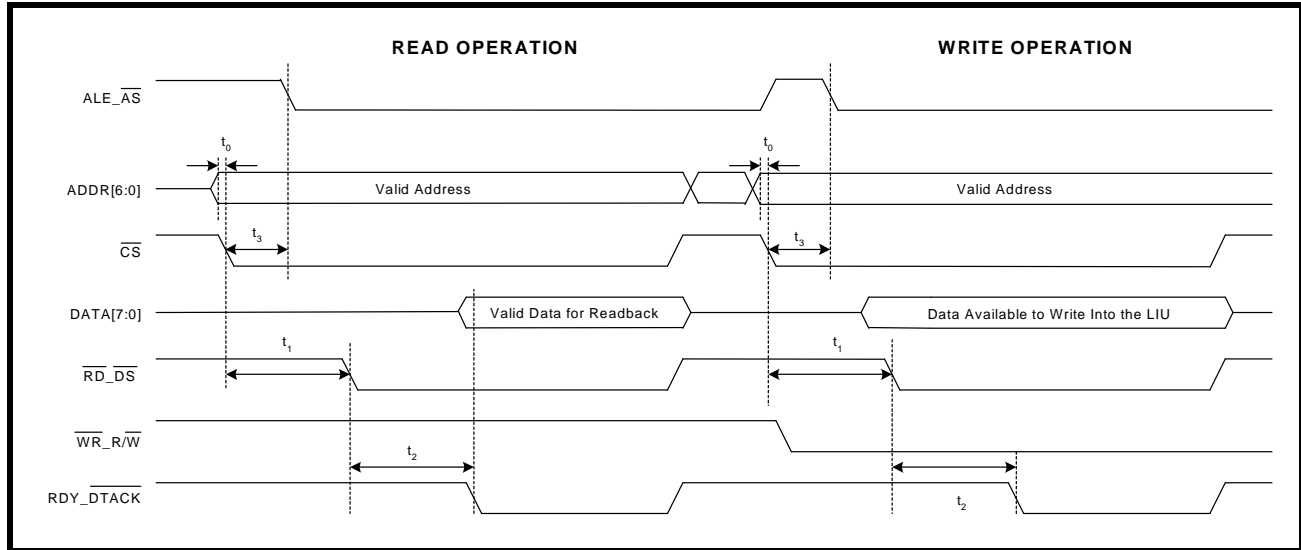
TABLE 14: INTEL MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS

| SYMBOL | PARAMETER  | MIN | MAX | UNITS |
|--------|--|-----|-----|-------|
| $t_0$  | Valid Address to $\overline{CS}$ Falling Edge          | 0   | -   | ns    |
| $t_1$  | $\overline{CS}$ Falling Edge to $\overline{RD}$ Assert | 0   | -   | ns    |
| $t_2$  | $\overline{RD}$ Assert to $\overline{RDY}$ Assert      | -   | 320 | ns    |
| NA     | $\overline{RD}$ Pulse Width ( $t_2$ )                  | 320 | -   | ns    |
| $t_3$  | $\overline{CS}$ Falling Edge to $\overline{WR}$ Assert | 0   | -   | ns    |
| $t_4$  | $\overline{WR}$ Assert to $\overline{RDY}$ Assert      | -   | 320 | ns    |
| NA     | $\overline{WR}$ Pulse Width ( $t_4$ )                  | 320 | -   | ns    |

**MOTOROLA ASYNCHRONOUS INTERFACE TIMING**

The signals used in the Motorola microprocessor interface mode are: Address Strobe (AS), Data Strobe ( $\overline{DS}$ ), Read/Write Enable ( $R/\overline{W}$ ), Chip Select ( $\overline{CS}$ ), Address and Data bits. The interface is compatible with the timing of a Motorola 68000 microprocessor family. The interface timing is shown in **Figure 14**. The I/O specifications are shown in **Table 15**.

**FIGURE 14. MOTOROLA ASYNCHRONOUS MODE INTERFACE SIGNALS DURING PROGRAMMED I/O READ AND WRITE OPERATIONS**



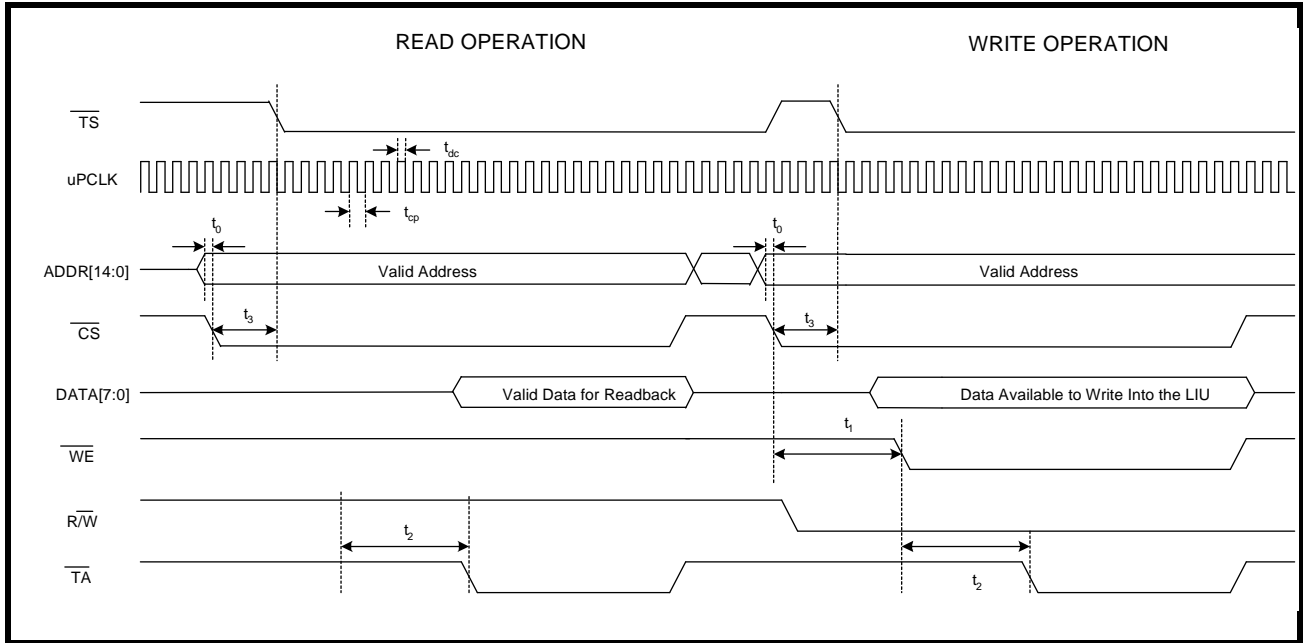
**TABLE 15: MOTOROLA ASYNCHRONOUS MODE MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS**

| SYMBOL | PARAMETER   | MIN | MAX | UNITS |
|--------|---|-----|-----|-------|
| $t_0$  | Valid Address to $\overline{CS}$ Falling Edge                                     | 0   | -   | ns    |
| $t_1$  | $\overline{CS}$ Falling Edge to $\overline{DS}$ (Pin $\overline{RD\_DS}$ ) Assert | 0   | -   | ns    |
| $t_2$  | $\overline{DS}$ Assert to $\overline{DTACK}$ Assert                               | -   | 320 | ns    |
| NA     | $\overline{DS}$ Pulse Width ( $t_2$ )   | 320 | -   | ns    |
| $t_3$  | $\overline{CS}$ Falling Edge to $\overline{AS}$ (Pin ALE_AS) Falling Edge         | 0   | -   | ns    |

**POWER PC 403 SYNCHRONOUS INTERFACE TIMING**

The signals used in the Power PC 403 Synchronous microprocessor interface mode are: Address Strobe (AS), Microprocessor Clock ( $\mu$ PCLK), Data Strobe ( $\overline{DS}$ ), Read/Write Enable ( $\overline{R/W}$ ), Chip Select ( $\overline{CS}$ ), Address and Data bits. The interface timing is shown in **Figure 15**. The I/O specifications are shown in **Table 16**.

**FIGURE 15. POWER PC 403 INTERFACE SIGNALS DURING PROGRAMMED I/O READ AND WRITE OPERATIONS**



**TABLE 16: POWER PC 403 MICROPROCESSOR INTERFACE TIMING SPECIFICATIONS**

| SYMBOL   | PARAMETER  | MIN | MAX | UNITS |
|----------|--|-----|-----|-------|
| $t_0$    | Valid Address to $\overline{CS}$ Falling Edge                | 0   | -   | ns    |
| $t_1$    | $\overline{CS}$ Falling Edge to $\overline{WE}$ Assert       | 0   | -   | ns    |
| $t_2$    | $\overline{WE}$ Assert to $\overline{TA}$ Assert             | -   | 320 | ns    |
| NA       | $\overline{WE}$ Pulse Width ( $t_2$ )                        | 320 | -   | ns    |
| $t_3$    | $\overline{CS}$ Falling Edge to $\overline{TS}$ Falling Edge | 0   | -   |       |
| $t_{dc}$ | $\mu$ PCLK Duty Cycle  | 40  | 60  | %     |
| $t_{cp}$ | $\mu$ PCLK Clock Period                                      | 20  | -   | ns    |

ORDERING INFORMATION

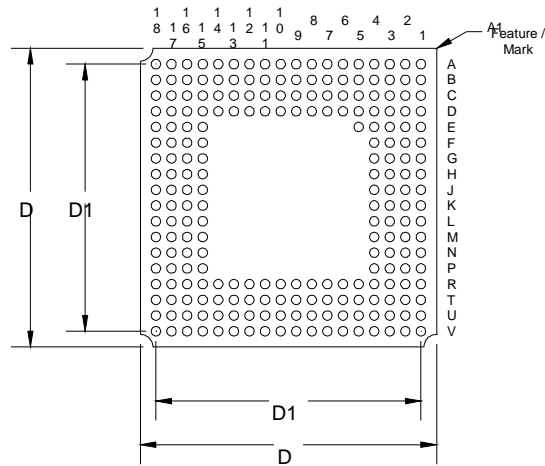
| PRODUCT NUMBER | PACKAGE       | OPERATING TEMPERATURE RANGE |
|----------------|---------------|-----------------------------|
| XRT86VL32IB    | 225 LEAD PBGA | -40°C to +85°C              |

PACKAGE DIMENSIONS

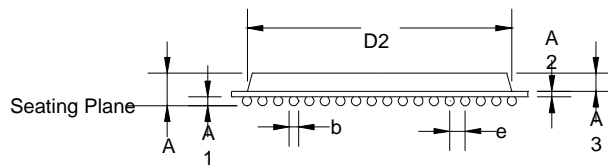
E

225 Ball Plastic Ball Grid Array  
(19.0 mm x 19.0 mm, 1.0mm pitch  
PBGA)

Rev.  
1.00



(A1 corner feature is mfg option)



Note: The control dimension is in millimeter.

| SYMBOL | INCHES    |       | MILLIMETERS |       |
|--------|-----------|-------|-------------|-------|
|        | MIN       | MAX   | MIN         | MAX   |
| A      | 0.049     | 0.096 | 1.24        | 2.45  |
| A1     | 0.016     | 0.024 | 0.40        | 0.60  |
| A2     | 0.013     | 0.024 | 0.32        | 0.60  |
| A3     | 0.020     | 0.048 | 0.52        | 1.22  |
| D      | 0.740     | 0.756 | 18.80       | 19.20 |
| D1     | 0.669 BSC |       | 17.00 BSC   |       |
| D2     | 0.665     | 0.669 | 16.90       | 17.00 |
| b      | 0.020     | 0.028 | 0.50        | 0.70  |
| e      | 0.039 BSC |       | 1.00 BSC    |       |



**REVISION HISTORY**

| REVISION # | DATE               | DESCRIPTION   |
|------------|--------------------|---|
| V1.2.0     | January 29, 2007   | Released to production.   |
| V1.2.1     | September 12, 2007 | Changed Pin E16 to NC on page 4. The Pin description has the correct name, but the pin list had a typo. |

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