



## OCTAL E1 SHORT HAUL LINE INTERFACE UNIT

IDT82V2058

### FEATURES

- ◆ Fully integrated octal E1 short haul line interface which supports 120W E1 twisted pair and 75W E1 coaxial applications
- ◆ Selectable single rail or dual rail mode and AMI or HDB3 line encoder/decoder
- ◆ Built-in transmit pre-equalization meets G.703
- ◆ Selectable transmit/receive jitter attenuator meets ETSI CTR12/13, ITU G.736, G.742 and G.823 specifications
- ◆ SONET/SDH optimized jitter attenuator meets ITU G.783 mapping jitter specification
- ◆ Digital/analog LOS detector meets ITU G.775 and ETS 300 233

- ◆ ITU G.772 non-intrusive monitoring for in-service testing for any one of channel1 to channel7
- ◆ Low impedance transmit drivers with tri-state
- ◆ Selectable hardware and parallel/serial host interface
- ◆ Local and remote loopback test functions
- ◆ Hitless Protection Switching (HPS) for 1 to 1 protection without relays
- ◆ JTAG boundary scan for board test
- ◆ 3.3V supply with 5V tolerant I/O
- ◆ Low power consumption
- ◆ Operating temperature range: -40°C to +85°C
- ◆ Available in 144-pin Thin Quad Flat Pack (TQFP\_144\_DA) and 160-pin Plastic Ball Grid Array (PBGA) packages

### FUNCTIONAL BLOCK DIAGRAM

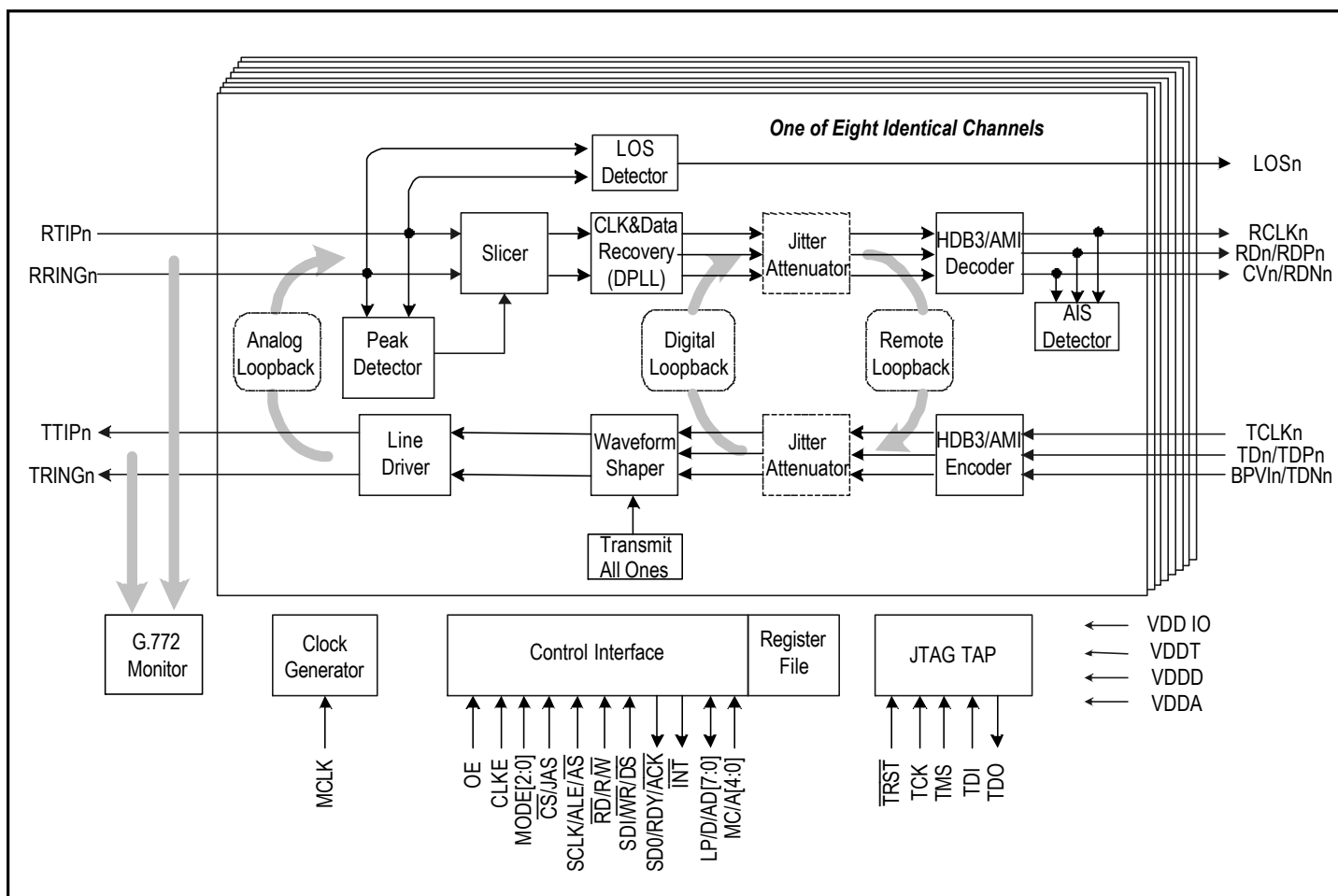


Figure - 1. Block Diagram

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**INDUSTRIAL TEMPERATURE RANGES**

**JANUARY 2003**

## DESCRIPTION:

The IDT82V2058 is a single chip, 8-channel E1 short haul PCM transceiver with a reference clock of 2.048MHz. It contains 8 transmitters and 8 receivers.

Both receivers and transmitters can be programmed to work either in single rail mode or dual rail mode. AMI or HDB3 encoder/decoder is selectable in single rail mode. Pre-encoded transmit data in NRZ format can be accepted when the device is configured in dual rail mode. The receivers perform clock and data recovery by using integrated digital phase-locked loop. As an option, the raw sliced data (no retiming) can be output on the receive data pins. Transmit equalization is implemented with low-impedance output drivers that provide shaped waveforms to the transformer, guaranteeing template conformance.

A jitter attenuator is integrated in the IDT82V2058 and can be switched into either the transmit path or the receive path. The jitter at-

tenuation performance meets ETSI CTR12/13, ITU G.736, G.742, and G.823 specifications.

The IDT82V2058 offers hardware control mode and software control mode. Software control mode works with either serial host interface or parallel host interface. The latter works via an Intel/Motorola compatible 8-bit parallel interface for both multiplexed or non-multiplexed applications. Hardware control mode uses multiplexed pins to select different operation mode when host interface is not available to the device.

The IDT82V2058 also provides loopback testing functions and JTAG boundary scan testing functions. As the monitoring function is integrated, IDT82V2058 can be configured as a 7-channel transceiver with non-intrusive protected monitoring points.

The IDT82V2058 can be used for SDH/SONET multiplexers, central office or PBX, digital access cross connects, digital radio base stations, remote wireless modules and microwave transmission systems.

## PIN CONFIGURATIONS

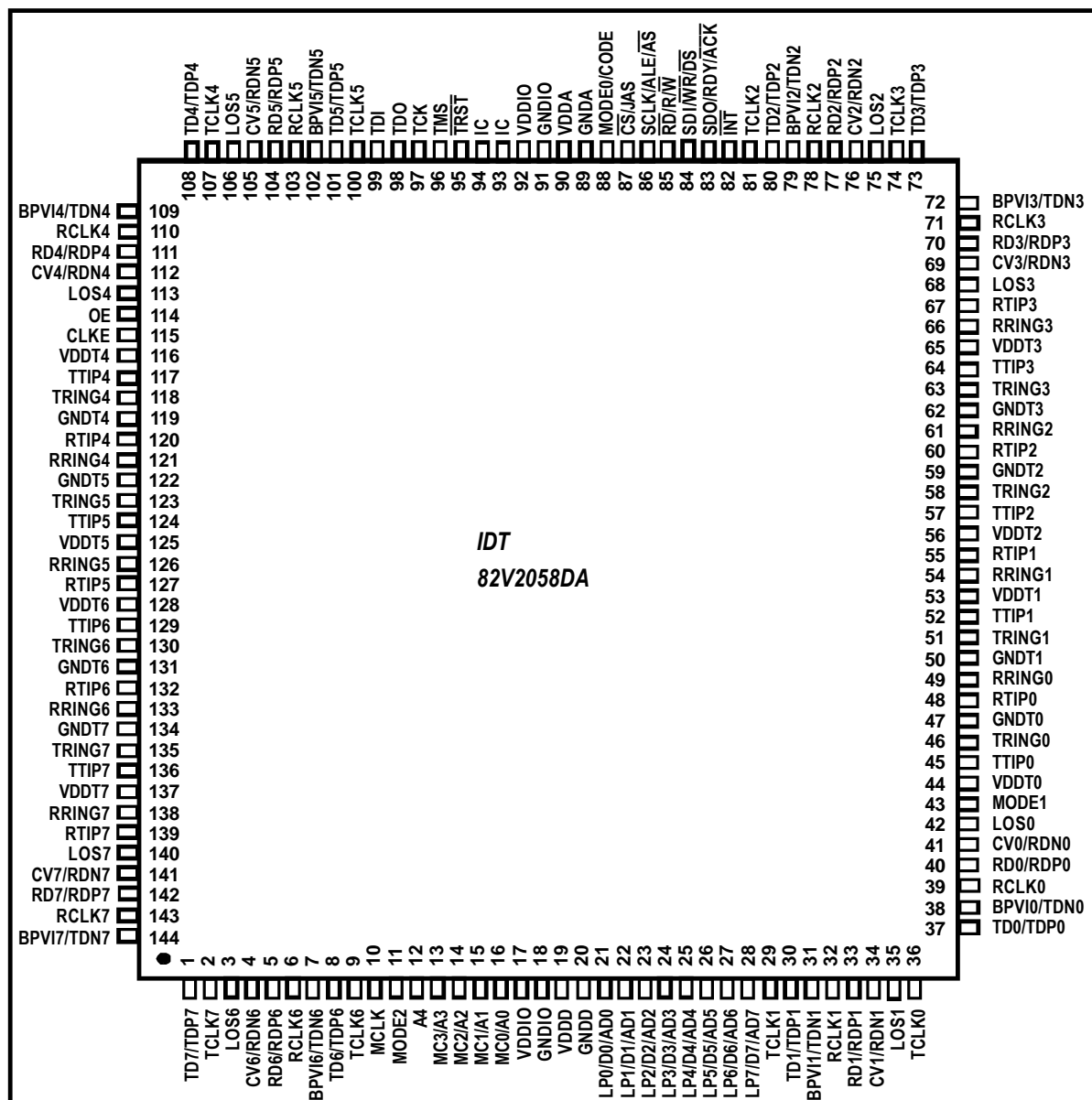


Figure - 2. TQFP144 Package Pin Assignment

## PIN CONFIGURATIONS (CONTINUED)

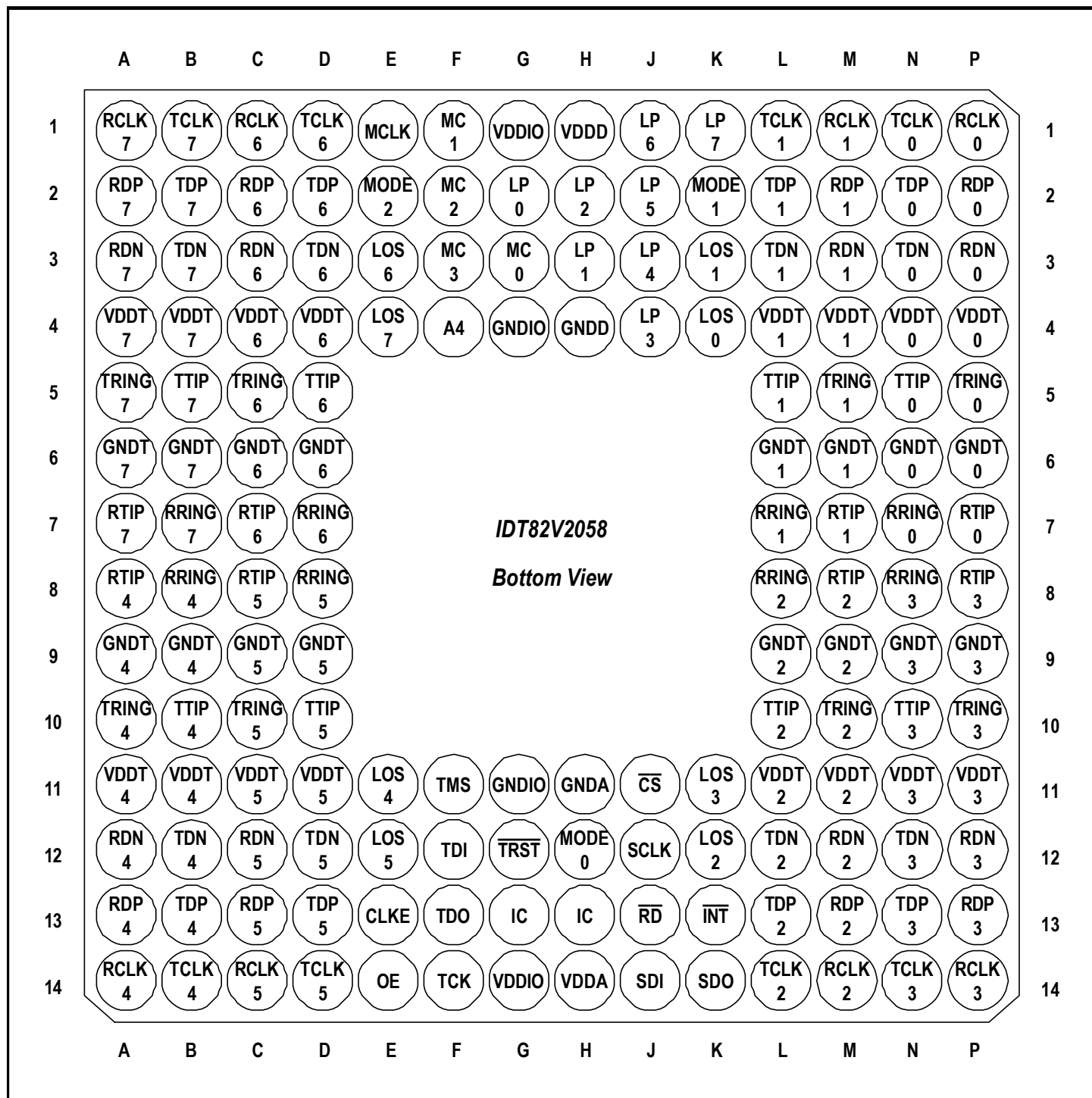


Figure - 2b. PBGA160 Package Pin Assignment

## PIN DESCRIPTION

| Name                                | Type          | Pin No. |        | Description  |
|-------------------------------------|---------------|---------|--------|--|
|                                     |               | QFP144  | BGA160 |  |
| Transmit and Receive Line Interface |               |         |        |  |
| TTIP0                               | Analog Output | 45      | N5     | <b>TTIPn/TRINGn: Transmit Bipolar Tip/Ring for Channel 0~7</b><br>These pins are the differential line driver outputs. They will be in high impedance state if pin OE is low or the corresponding pin TCLKn is low (pin OE is globe control, while pin TCLKn is per-channel control). In host mode, each pin can be in high impedance state by programming a “1” to the corresponding bit in Register <b>OE</b> <sup>1</sup> . |
| TTIP1                               |               | 52      | L5     |  |
| TTIP2                               |               | 57      | L10    |  |
| TTIP3                               |               | 64      | N10    |  |
| TTIP4                               |               | 117     | B10    |  |
| TTIP5                               |               | 124     | D10    |  |
| TTIP6                               |               | 129     | D5     |  |
| TTIP7                               |               | 136     | B5     |  |
| TRING0                              |               | 46      | P5     |  |
| TRING1                              |               | 51      | M5     |  |
| TRING2                              |               | 58      | M10    |  |
| TRING3                              |               | 63      | P10    |  |
| TRING4                              |               | 118     | A10    |  |
| TRING5                              |               | 123     | C10    |  |
| TRING6                              |               | 130     | C5     |  |
| TRING7                              |               | 135     | A5     |  |
| RTIP0                               | Analog Input  | 48      | P7     | <b>RTIPn/RRINGn: Receive Bipolar Tip/Ring for Channel 0~7</b><br>These pins are the differential line receiver inputs.   |
| RTIP1                               |               | 55      | M7     |  |
| RTIP2                               |               | 60      | M8     |  |
| RTIP3                               |               | 67      | P8     |  |
| RTIP4                               |               | 120     | A8     |  |
| RTIP5                               |               | 127     | C8     |  |
| RTIP6                               |               | 132     | C7     |  |
| RTIP7                               |               | 139     | A7     |  |
| RRING0                              |               | 49      | N7     |  |
| RRING1                              |               | 54      | L7     |  |
| RRING2                              |               | 61      | L8     |  |
| RRING3                              |               | 66      | N8     |  |
| RRING4                              |               | 121     | B8     |  |
| RRING5                              |               | 126     | D8     |  |
| RRING6                              |               | 133     | D7     |  |
| RRING7                              |               | 138     | B7     |  |

<sup>1</sup> Register name is indicated by bold capital letter. **OE**: Output Enable Register.

## PIN DESCRIPTION (CONTINUED)

| Name       | Type | Pin No.                           |  | Description  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
|------------|------|-----------------------------------|--|--|--|-------|------------------|---------|---------|------------------|---------|------------------|--|---------|-----------------|--|----------|------------------|------------------|------------------|----------------------------|--|---------------------------|--|--|--|----------|-----------------------------------|--|--|
|            |      | QFP144                            | BGA160   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD0/TDP0   | I    | 37                                | N2   | <b>TDn: Transmit Data for Channel 0~7</b><br>When the device is in Single Rail mode, the NRZ data to be transmitted is input on this pin. Data on TDn is sampled into the device on falling edges of TCLKn, and encoded by AMI or HDB3 line code rules before being transmitted to the line.<br><br><b>BPVIn: Bipolar Violation Insertion for Channel 0~7</b><br>Bipolar violation insertion is available in Signal Rail mode 2 (see <i>table-1</i> ) with AMI enabled. A low-to-high transition on this pin will make the next logic one to be transmitted on TDn pin the same polarity as the previous pulse, and violate the AMI rule. This is for testing.<br><br><b>TDPn/TDNn: Positive/Negative Transmit Data for Channel 0~7</b><br>When the device is in Dual Rail mode, the NRZ data to be transmitted for positive/negative pulse is input on this pin. Data on TDPn/TDNn are active high and sampled into the device on falling edges of TCLKn. The line code in Dual Rail mode is as the follows : <table><tr><th>TDPn</th><th>TDNn</th><th>Output Pulse</th></tr><tr><td>0</td><td>0</td><td>Space</td></tr><tr><td>0</td><td>1</td><td>Negative Pulse</td></tr><tr><td>1</td><td>0</td><td>Positive Pulse</td></tr><tr><td>1</td><td>1</td><td>Space</td></tr></table><br>Pulling pin TDNn high for more than 16 consecutive TCLK clock cycles will configure the corresponding channel into Single Rail mode 1 (see <i>table-1 on Page13</i> ).   | TDPn   | TDNn  | Output Pulse     | 0       | 0       | Space            | 0       | 1                | Negative Pulse   | 1       | 0               | Positive Pulse   | 1        | 1                | Space            |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TDPn       |      | TDNn                              | Output Pulse   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| 0          |      | 0                                 | Space  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| 0          |      | 1                                 | Negative Pulse   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| 1          |      | 0                                 | Positive Pulse   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| 1          |      | 1                                 | Space  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD1/TDP1   |      | 30                                | L2   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD2/TDP2   |      | 80                                | L13  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD3/TDP3   |      | 73                                | N13  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD4/TDP4   |      | 108                               | B13  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD5/TDP5   |      | 101                               | D13  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD6/TDP6   |      | 8                                 | D2   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TD7/TDP7   |      | 1                                 | B2   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI0/TDN0 |      | 38                                | N3   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI1/TDN1 | 31   | L3                                |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI2/TDN2 | 79   | L12                               |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI3/TDN3 | 72   | N12                               |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI4/TDN4 | 109  | B12                               |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI5/TDN5 | 102  | D12                               |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI6/TDN6 | 7    | D3                                |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| BPVI7/TDN7 | 144  | B3                                |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK0      | I    | 36                                | N1   | <b>TCLKn: Transmit Clock for Channel 0~7</b><br>The clock of 2.048 MHz to be transmitted is input on this pin. The transmit data at TDn/TDPn or TDNn is sampled into the device on falling edges of TCLKn.<br>Pulling TCLKn high for more than 16 MCLK cycles, the corresponding transmitter is set in Transmit All One (TAO) state (when MCLK is clocked). In TAO state, the TAO generator adopts MCLK as the time reference.<br>If TCLKn is Low, the corresponding transmit channel is set into power down state, while driver output ports become high impedance.<br>The different operating modes of TCLKn are summarized as follows: <table><tr><th>MCLK</th><th>TCLKn</th><th>Transmitter Mode</th></tr><tr><td>Clocked</td><td>Clocked</td><td>Normal operation</td></tr><tr><td>Clocked</td><td>High (≥ 16 MCLK)</td><td>Transmit All One (TAO) signals to line side in the corresponding transmit channel.</td></tr><tr><td>Clocked</td><td>Low (≥ 64 MCLK)</td><td>Corresponding transmit channel is set into power down state.</td></tr><tr><td rowspan="4">High/Low</td><td rowspan="4">TCLK1 is clocked</td><td>TCLKn is clocked</td><td>Normal operation</td></tr><tr><td>TCLKn is high (≥ 16 TCLK1)</td><td>Transmit All One (TAO) signals to the line side in the corresponding transmit channel.</td></tr><tr><td>TCLKn is low (≥ 64 TCLK1)</td><td>Corresponding transmit channel is set into power down state.</td></tr><tr><td colspan="2">The receive path is not affected by the status of TCLK1. When MCLK is high, all receive paths just slice the incoming data stream. When MCLK is low, all the receive paths are powered down.</td></tr><tr><td>High/Low</td><td>TCLK1 is not available (High/Low)</td><td colspan="2">All eight transmitters (TTIPn &amp; TRINGn) will be in high impedance state.</td></tr></table> | MCLK   | TCLKn | Transmitter Mode | Clocked | Clocked | Normal operation | Clocked | High (≥ 16 MCLK) | Transmit All One (TAO) signals to line side in the corresponding transmit channel. | Clocked | Low (≥ 64 MCLK) | Corresponding transmit channel is set into power down state. | High/Low | TCLK1 is clocked | TCLKn is clocked | Normal operation | TCLKn is high (≥ 16 TCLK1) | Transmit All One (TAO) signals to the line side in the corresponding transmit channel. | TCLKn is low (≥ 64 TCLK1) | Corresponding transmit channel is set into power down state. | The receive path is not affected by the status of TCLK1. When MCLK is high, all receive paths just slice the incoming data stream. When MCLK is low, all the receive paths are powered down. |  | High/Low | TCLK1 is not available (High/Low) | All eight transmitters (TTIPn & TRINGn) will be in high impedance state. |  |
| MCLK       |      | TCLKn                             | Transmitter Mode   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| Clocked    |      | Clocked                           | Normal operation   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| Clocked    |      | High (≥ 16 MCLK)                  | Transmit All One (TAO) signals to line side in the corresponding transmit channel.   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| Clocked    |      | Low (≥ 64 MCLK)                   | Corresponding transmit channel is set into power down state.   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| High/Low   |      | TCLK1 is clocked                  | TCLKn is clocked   |  | Normal operation   |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
|            |      |                                   | TCLKn is high (≥ 16 TCLK1)   |  | Transmit All One (TAO) signals to the line side in the corresponding transmit channel. |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
|            |      |                                   | TCLKn is low (≥ 64 TCLK1)  |  | Corresponding transmit channel is set into power down state.                           |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
|            |      |                                   | The receive path is not affected by the status of TCLK1. When MCLK is high, all receive paths just slice the incoming data stream. When MCLK is low, all the receive paths are powered down. |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| High/Low   |      | TCLK1 is not available (High/Low) | All eight transmitters (TTIPn & TRINGn) will be in high impedance state.   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK1      |      | 29                                | L1   |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK2      |      | 81                                | L14  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK3      |      | 74                                | N14  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK4      |      | 107                               | B14  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK5      | 100  | D14                               |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK6      | 9    | D1                                |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |
| TCLK7      | 2    | B1                                |  |  |  |       |                  |         |         |                  |         |                  |  |         |                 |  |          |                  |                  |                  |                            |  |                           |  |  |  |          |                                   |  |  |

**PIN DESCRIPTION (CONTINUED)**

| Name     | Type               | Pin No. |        | Description   |
|----------|--------------------|---------|--------|---|
|          |                    | QFP144  | BGA160 |   |
| RD0/RDP0 | O<br><br>Tri-state | 40      | P2     | <b>RDn: Receive Data for Channel 0~7</b><br>In Single Rail mode, the received NRZ data is output on this pin. The data is decoded by AMI or HDB3 line code rule.<br><br><b>CVn: Code Violation for Channel 0~7</b><br>In Single Rail mode, the bipolar violation, code violation and excessive zeros will be reported by driving pin CVn to high level for a full clock cycle. However, only bipolar violation is indicated when AMI decoder is selected.   |
| RD1/RDP1 |                    | 33      | M2     |   |
| RD2/RDP2 |                    | 77      | M13    |   |
| RD3/RDP3 |                    | 70      | P13    |   |
| RD4/RDP4 |                    | 111     | A13    |   |
| RD5/RDP5 |                    | 104     | C13    |   |
| RD6/RDP6 |                    | 5       | C2     |   |
| RD7/RDP7 |                    | 142     | A2     |   |
| CV0/RDN0 |                    | 41      | P3     | <b>RDPn/RDNn: Positive/Negative Receive Data for Channel 0~7</b><br>In Dual Rail mode with clock recovery, these pins output the NRZ data. A high signal on RDPn indicates the receipt of a positive pulse on RTIPn/RRINGn while a high signal on RDNn indicates the receipt of a negative pulse on RTIPn/RRINGn.<br>The output data at RDn or RDPn/RDNn are valid on the falling edges of RCLK when the CLKE input is in High level, or valid on the rising edges of RCLK when CLKE is Low.<br>In Dual Rail mode without clock recovery, these pins output the raw RZ sliced data. In this data recovery mode, the active polarity of RDPn/RDNn is determined by pin CLKE. When pin CLKE is Low, RDPn/RDNn is active low. When pin CLKE is High, RDPn/RDNn is active high.<br>In hardware mode, RDn or RDPn/RDNn will remain active during LOS. In host mode, these pins will either remain active or insert alarm indication signal (AIS) into the receive path, determined by bit AISE in register <b>GCF</b> (Global Configuration register).<br>RDn or RDPn/RDNn is set into high impedance when the corresponding receiver is power down. |
| CV1/RDN1 |                    | 34      | M3     |   |
| CV2/RDN2 |                    | 76      | M12    |   |
| CV3/RDN3 |                    | 69      | P12    |   |
| CV4/RDN4 |                    | 112     | A12    |   |
| CV5/RDN5 |                    | 105     | C12    |   |
| CV6/RDN6 |                    | 4       | C3     |   |
| CV7/RDN7 |                    | 141     | A3     |   |
| RCLK0    | O<br><br>Tri-state | 39      | P1     | <b>RCLKn: Receive Clock for Channel 0~7</b><br>In clock recovery mode, this pin outputs the recovered clock from signal received on RTIPn/RRINGn. The received data are clocked out of the device on rising edges of RCLKn if pin CLKE is low, or on falling edges of RCLKn if pin CLKE is high.<br>In data recovery mode, RCLKn is the output of an internal exclusive OR (XOR) which is connected with RDPn and RDNn. The clock is recovered from the signal on RCLKn externally.<br>If receiver n is power down, the corresponding RCLKn is in high impedance.   |
| RCLK1    |                    | 32      | M1     |   |
| RCLK2    |                    | 78      | M14    |   |
| RCLK3    |                    | 71      | P14    |   |
| RCLK4    |                    | 110     | A14    |   |
| RCLK5    |                    | 103     | C14    |   |
| RCLK6    |                    | 6       | C1     |   |
| RCLK7    |                    | 143     | A1     |   |
| MCLK     | I                  | 10      | E1     | <b>MCLK: Master Clock</b><br>This is the independent, free running reference clock. A clock of 2.048 MHz is supplied to this pin as the clock reference of the device for normal operation.<br>In receive path, when MCLK is high, the device slices the incoming bipolar line signal into RZ pulse (Data Recovery mode). When MCLK is low, all the receivers are power down, and the output pins RCLKn, RDPn and RDNn are switched to high impedance.<br>In transmit path, the operation mode is decided by the combination of MCLK and TCLKn (see TCLKn pin description for detail).<br>Note that wait state generation via RDY/ $\overline{ACK}$ is not available if MCLK is not provided.   |
| LOS0     | O                  | 42      | K4     | <b>LOSn: Loss of Signal Output for Channel 0~7</b><br>A high level on this pin indicates the loss of signal when there is no transition over a specified period of time or hasn't enough ones density in the received signal. The transition will return to low automatically when there is enough transitions over a specified period of time with a certain ones density in the received signal. The LOS assertion and desertion criteria are described in the <b>Functional Description</b> .  |
| LOS1     |                    | 35      | K3     |   |
| LOS2     |                    | 75      | K12    |   |
| LOS3     |                    | 68      | K11    |   |
| LOS4     |                    | 113     | E11    |   |
| LOS5     |                    | 106     | E12    |   |
| LOS6     |                    | 3       | E3     |   |
| LOS7     |                    | 140     | E4     |   |

**PIN DESCRIPTION (CONTINUED)**

| Name                       | Type                                     | Pin No. |        | Description  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
|----------------------------|--|---------|--------|--|-------|--------------------------------------|-----|--------------------------|---------|----------------------------------|------|------------------------------------|-----------|----------------|-----|--|-----|---------------------------------------|-----|--------------------------------------|-----|-----------------------------------|
|                            |  | QFP144  | BGA160 |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| Hardware/Host Control Mode |  |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| MODE2                      | I<br><br>(Pulled to VDDIO /2)            | 11      | E2     | <b>MODE2: Control Mode Select 2</b><br>The signal on this pin determines which control mode is selected to control the device: <table><tr><th>MODE2</th><th>Control Interface</th></tr><tr><td>Low</td><td>Control by Hardware mode</td></tr><tr><td>VDDIO/2</td><td>Control by Serial Host Interface</td></tr><tr><td>High</td><td>Control by Parallel Host Interface</td></tr></table><br>Hardware control pins include MODE[2:0], TS[2:0], LOOP[7:0], CODE, CLKE, JAS and OE.<br>Serial host Interface pins include $\overline{CS}$ , SCLK, SDI, SDO and $\overline{INT}$ .<br>Parallel host Interface pins include $\overline{CS}$ , A[4:0], D[7:0], $\overline{WR/DS}$ , $\overline{RD/R/W}$ , $\overline{ALE/AS}$ , $\overline{INT}$ and $\overline{RDY/ACK}$ . The device supports multiple parallel host interface as follows (refer to MODE1 and MODE0 pin descriptions below for details): <table><tr><th>MODE[2:0]</th><th>Host Interface</th></tr><tr><td>100</td><td>Non-multiplexed Motorola mode interface.</td></tr><tr><td>101</td><td>Non-multiplexed Intel mode interface.</td></tr><tr><td>110</td><td>Multiplexed Motorola mode interface.</td></tr><tr><td>111</td><td>Multiplexed Intel mode interface.</td></tr></table> | MODE2 | Control Interface                    | Low | Control by Hardware mode | VDDIO/2 | Control by Serial Host Interface | High | Control by Parallel Host Interface | MODE[2:0] | Host Interface | 100 | Non-multiplexed Motorola mode interface. | 101 | Non-multiplexed Intel mode interface. | 110 | Multiplexed Motorola mode interface. | 111 | Multiplexed Intel mode interface. |
| MODE2                      | Control Interface                        |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| Low                        | Control by Hardware mode                 |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| VDDIO/2                    | Control by Serial Host Interface         |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| High                       | Control by Parallel Host Interface       |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| MODE[2:0]                  | Host Interface                           |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| 100                        | Non-multiplexed Motorola mode interface. |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| 101                        | Non-multiplexed Intel mode interface.    |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| 110                        | Multiplexed Motorola mode interface.     |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| 111                        | Multiplexed Intel mode interface.        |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| MODE1                      | I  | 43      | K2     | <b>MODE1: Control Mode Select 1</b><br>In parallel host mode, the parallel interface operates with separate address bus and data bus when this pin is Low, and operates with multiplexed address and data bus when this pin is High.<br>In serial host mode and hardware mode, this pin should be grounded.  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| MODE0 /CODE                | I  | 88      | H12    | <b>MODE0: Control Mode Select 0</b><br>In host mode, the parallel host interface is configured for Motorola compatible hosts when this pin is Low, or for Intel compatible hosts when this pin is High.<br><br><b>CODE: Line Code Rule Select</b><br>In hardware control mode, the HDB3 encoder/decoder is enabled when this pin is Low, and AMI encoder/decoder is enabled when this pin is High. The selections affect all the channels.<br><br>In serial host mode, this pin should be grounded.  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| $\overline{CS}$ /JAS       | I<br><br>(Pulled to VDDIO /2)            | 87      | J11    | <b><math>\overline{CS}</math>: Chip Select (Active Low)</b><br>In host mode, this pin is asserted low by the host to enable host interface. A transition from High to Low must occur on this pin for each Read/Write operation and the level must not return to High until the operation is over.<br><br><b>JAS: Jitter Attenuator Select</b><br>In hardware control mode, this pin globally determines the Jitter Attenuator position: <table><tr><th>JAS</th><th>Jitter Attenuator (JA) Configuration</th></tr><tr><td>Low</td><td>JA in transmit path</td></tr><tr><td>VDDIO/2</td><td>JA not used</td></tr><tr><td>High</td><td>JA in receive path</td></tr></table>   | JAS   | Jitter Attenuator (JA) Configuration | Low | JA in transmit path      | VDDIO/2 | JA not used                      | High | JA in receive path                 |           |                |     |  |     |                                       |     |                                      |     |                                   |
| JAS                        | Jitter Attenuator (JA) Configuration     |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| Low                        | JA in transmit path                      |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| VDDIO/2                    | JA not used                              |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |
| High                       | JA in receive path                       |         |        |  |       |                                      |     |                          |         |                                  |      |                                    |           |                |     |  |     |                                       |     |                                      |     |                                   |

**PIN DESCRIPTION (CONTINUED)**

| Name                | Type | Pin No. |        | Description   |
|---------------------|------|---------|--------|---|
|                     |      | QFP144  | BGA160 |   |
| SCLK<br>/ALE<br>/AS | I    | 86      | J12    | <p><b>SCLK: Shift Clock</b><br/>In serial host mode, the signal on this pin is the shift clock for the serial interface. Data on pin SDO is clocked out on falling edges of SCLK if pin CLKE is Low, or on rising edges of SCLK if pin CLKE is High. Data on pin SDI is always sampled on rising edges of SCLK.</p> <p><b>ALE: Address Latch Enable</b><br/>In parallel Intel multiplexed host mode, the address on AD[4:0] is sampled into the device on falling edges of ALE (Signals on AD[7:5] are ignored). In non-multiplexed host mode, ALE should be pulled High.</p> <p><b>AS: Address Strobe (Active Low)</b><br/>In parallel Motorola multiplexed host mode, the address on AD[4:0] is latched into the device on falling edges of AS (Signals on AD[7:5] are ignored). In non-multiplexed host mode, AS should be pulled High.</p> <p><i>(Note: This pin is ignored in hardware control mode.)</i></p>  |
| RD/RW               | I    | 85      | J13    | <p><b>RD: Read Strobe (Active Low)</b><br/>In parallel Intel multiplexed or non-multiplexed host mode, this pin is active low for read operation.</p> <p><b>RW: Read/Write Select</b><br/>In parallel Motorola multiplexed or non-multiplexed host mode, the pin is active low for write operation and high for read operation.</p> <p><i>(Note: This pin is ignored in hardware control mode.)</i></p>   |
| SDI<br>/WR<br>DS    | I    | 84      | J14    | <p><b>SDI: Serial Data Input</b><br/>In serial host mode, this pin input the data to the serial interface. Data on this pin is sampled on rising edges of SCLK.</p> <p><b>WR: Write Strobe (Active Low)</b><br/>In parallel Intel host mode, this pin is active low during write operation. The data on D[7:0] (in non-multiplexed mode) or AD[7:0] (in multiplexed mode) is sampled into the device on rising edges of WR.</p> <p><b>DS: Data Strobe (Active Low)</b><br/>In parallel Motorola host mode, this pin is active low. During a write operation (<math>R/\overline{W} = 0</math>), the data on D[7:0] (in non-multiplexed mode) or AD[7:0] (in multiplexed mode) is sampled into the device on rising edges of DS. During a read operation (<math>R/\overline{W}=1</math>), the data is driven to D[7:0] (in non-multiplexed mode) or AD[7:0] (in multiplexed mode) by the device on rising edges of DS.<br/>In parallel Motorola non-multiplexed host mode, the address information on the 5 bits of address bus A[4:0] are latched into the device on the falling edge of DS.</p> <p><i>(Note: This pin is ignored in hardware control mode.)</i></p> |
| SDO<br>/RDY<br>/ACK | O    | 83      | K14    | <p><b>SDO: Serial Data Output</b><br/>In serial host mode, the data is output on this pin. In serial write operation, SDO is always in High impedance. In serial read operation, SDO is in High impedance only when SDI is in address/command byte. Data on pin SDO is clocked out of the device on falling edges of SCLK if pin CLKE is Low, or on rising edges of SCLK if pin CLKE is High.</p> <p><b>RDY: Ready Output</b><br/>In parallel Intel host mode, the high level of this pin reports to the host that bus cycle can be completed, while low reports the host must insert wait states.</p> <p><b>ACK: Acknowledge Output (Active Low)</b><br/>In parallel Motorola host mode, the low level of this pin indicates that valid information on the data bus is ready for a read operation or acknowledges the acceptance of the written data during a write operation.</p>   |



**PIN DESCRIPTION (CONTINUED)**

| Name                    | Type                                | Pin No. |        | Description  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
|-------------------------|-------------------------------------|---------|--------|--|---------|--------------------------|------|-------------------------------------|---------|-----------------------|------|-----------------------|------|-----------------------|------|-----------------------|------|-----------------------|------|-----------------------|------|-----------------------|------|-------------------------------------|------|--------------------------|------|--------------------------|------|--------------------------|------|--------------------------|------|--------------------------|------|--------------------------|------|--------------------------|
|                         |                                     | QFP144  | BGA160 |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| $\overline{\text{INT}}$ | O<br>Open Drain                     | 82      | K13    | <b><math>\overline{\text{INT}}</math>: Interrupt (Active Low)</b><br>This is the open drain, active low interrupt output. Four sources may cause the interrupt (refer to <b>Interrupt Handling of Functional Description</b> for details).   |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP7/D7/AD7              | I/O                                 | 28      | K1     | <b>LPn: Loopback Select 7~0</b><br>In hardware control mode, pin LPn configures the corresponding channel in different loopback mode, as follows: <table><tr><th>LPn</th><th>Loopback Configuration</th></tr><tr><td>Low</td><td>Remote Loopback</td></tr><tr><td>VDDIO/2</td><td>No Loopback</td></tr><tr><td>High</td><td>Analog Loopback</td></tr></table> Refer to <b>Loopback Configuration of Functional Description</b> for details.<br><br><b>Dn: Data Bus 7~0</b><br>In non-multiplexed host mode, these pins are the bi-directional data bus.<br><br><b>ADn: Address/Data Bus 7~0</b><br>In multiplexed host mode, these pins are the multiplexed bi-directional address/data bus.<br><br>In serial host mode, these pins should be grounded.  | LPn     | Loopback Configuration   | Low  | Remote Loopback                     | VDDIO/2 | No Loopback           | High | Analog Loopback       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LPn                     | Loopback Configuration              |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| Low                     | Remote Loopback                     |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| VDDIO/2                 | No Loopback                         |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| High                    | Analog Loopback                     |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP6/D6/AD6              | Tri-State                           | 27      | J1     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP5/D5/AD5              |                                     | 26      | J2     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP4/D4/AD4              |                                     | 25      | J3     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP3/D3/AD3              |                                     | 24      | J4     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP2/D2/AD2              |                                     | 23      | H2     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP1/D1/AD1              |                                     | 22      | H3     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| LP0/D0/AD0              |                                     | 21      | G2     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
|                         |                                     |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| A4                      | I                                   | 12      | F4     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| MC3/A3                  |                                     | 13      | F3     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| MC2/A2                  |                                     | 14      | F2     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| MC1/A1                  |                                     | 15      | F1     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| MC0/A0                  |                                     | 16      | G3     |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
|                         |                                     |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
|                         |                                     |         |        | <b>MCn: Performance Monitor Configuration 4~0</b><br>In hardware control mode, A4 must be connected to GND. MC[3:0] are used to select one transmitter or receiver of the channel 1 to 7 for non-intrusive monitoring. Channel 0 is used as the monitoring channel. If a transmitter is monitored, signals on the corresponding pins TTIPn and TRINGn are internally transmitted to RTIP0 and RRING0. If a receiver is monitored, signals on the corresponding pins RTIPn and RRINGn are internally transmitted to RTIP0 and RRING0. The clock and data recovery circuit in receiver 0 can then output the monitored clock to pin RCLK0 as well as the monitored data to RDP0 and RDN0 pins. The signals monitored by channel 0 can be routed to TTIP0/TRING0 by activating the remote loopback in this channel. Performance Monitor Configuration determined by MC[3:0] is shown below. Note that if MC[2:0] = 000, the device is in normal operation of all the channels. <table><tr><th>MC[3:0]</th><th>Monitoring Configuration</th></tr><tr><td>0000</td><td>Normal operation without monitoring</td></tr><tr><td>0001</td><td>Monitoring receiver 1</td></tr><tr><td>0010</td><td>Monitoring receiver 2</td></tr><tr><td>0011</td><td>Monitoring receiver 3</td></tr><tr><td>0100</td><td>Monitoring receiver 4</td></tr><tr><td>0101</td><td>Monitoring receiver 5</td></tr><tr><td>0110</td><td>Monitoring receiver 6</td></tr><tr><td>0111</td><td>Monitoring receiver 7</td></tr><tr><td>1000</td><td>Normal operation without monitoring</td></tr><tr><td>1001</td><td>Monitoring transmitter 1</td></tr><tr><td>1010</td><td>Monitoring transmitter 2</td></tr><tr><td>1011</td><td>Monitoring transmitter 3</td></tr><tr><td>1100</td><td>Monitoring transmitter 4</td></tr><tr><td>1101</td><td>Monitoring transmitter 5</td></tr><tr><td>1110</td><td>Monitoring transmitter 6</td></tr><tr><td>1111</td><td>Monitoring transmitter 7</td></tr></table><br><b>An: Address Bus 4~0</b><br>When pin MODE1 is low, the parallel host interface operates with separate address and data bus. In this mode, the signal on this pin is the address bus of the host interface. | MC[3:0] | Monitoring Configuration | 0000 | Normal operation without monitoring | 0001    | Monitoring receiver 1 | 0010 | Monitoring receiver 2 | 0011 | Monitoring receiver 3 | 0100 | Monitoring receiver 4 | 0101 | Monitoring receiver 5 | 0110 | Monitoring receiver 6 | 0111 | Monitoring receiver 7 | 1000 | Normal operation without monitoring | 1001 | Monitoring transmitter 1 | 1010 | Monitoring transmitter 2 | 1011 | Monitoring transmitter 3 | 1100 | Monitoring transmitter 4 | 1101 | Monitoring transmitter 5 | 1110 | Monitoring transmitter 6 | 1111 | Monitoring transmitter 7 |
| MC[3:0]                 | Monitoring Configuration            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0000                    | Normal operation without monitoring |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0001                    | Monitoring receiver 1               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0010                    | Monitoring receiver 2               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0011                    | Monitoring receiver 3               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0100                    | Monitoring receiver 4               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0101                    | Monitoring receiver 5               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0110                    | Monitoring receiver 6               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 0111                    | Monitoring receiver 7               |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1000                    | Normal operation without monitoring |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1001                    | Monitoring transmitter 1            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1010                    | Monitoring transmitter 2            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1011                    | Monitoring transmitter 3            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1100                    | Monitoring transmitter 4            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1101                    | Monitoring transmitter 5            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1110                    | Monitoring transmitter 6            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |
| 1111                    | Monitoring transmitter 7            |         |        |  |         |                          |      |                                     |         |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                       |      |                                     |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |      |                          |

**PIN DESCRIPTION (CONTINUED)**

| Name   | Type           | Pin No.  |  | Description   |
|--|----------------|--|--|---|
|  |                | QFP144   | BGA160   |   |
| OE   | I              | 114  | E14  | <b>OE: Output Driver Enable</b><br>Pulling this pin to low can make all driver output into high impedance state immediately for redundancy application without external mechanical relays. In this condition, all the other internal circuits remain active.    |
| CLKE   | I              | 115  | E13  | <b>CLKE: Clock Edge Select</b><br>The signal on this pin determines the active edge of RCLKn and SCLK in clock recovery mode, or determines the active level of RDPn and RDNn in the data recovery mode. (Refer to <b>Functional Description and Table-2</b> ). |
| <b>JTAG Signals</b>  |                |  |  |   |
| TRST   | I<br>Pull up   | 95   | G12  | <b>TRST: JTAG Test Port Reset (Active Low)</b><br>This is the active low asynchronous reset to the JTAG Test Port. This pin has an internal pullup resistor and it can be left disconnected.  |
| TMS  | I<br>Pull up   | 96   | F11  | <b>TMS: JTAG Test Mode Select</b><br>The signal on this pin controls the JTAG test performance and is clocked into the device on rising edges of TCK. This pin has an internal pullup resistor and it can be left disconnected.                                 |
| TCK  | I              | 97   | F14  | <b>TCK: JTAG Test Clock</b><br>This pin input the clock of the JTAG Test. The data on TDI and TMS are clocked into the device on rising edges of TCK, while the data on TDO is clocked out of the device on falling edges of TCK.                               |
| TDO  | O<br>Tri-state | 98   | F13  | <b>TDO: JTAG Test Data Output</b><br>This pin output the serial data of the JTAG Test. The data on TDO is clocked out of the device on falling edges of TCK. TDO is a Tri-state output signal. It is active only when scanning of data is out.                  |
| TDI  | I<br>Pull up   | 99   | F12  | <b>TDI: JTAG Test Data Input</b><br>This pin input the serial data of the JTAG Test. The data on TDI is clocked into the device on rising edges of TCK. This pin has an internal pullup resistor and it can be left disconnected.                               |
| IC   | -              | 93   | G13  | <b>IC: Internal Connected</b><br>(Leave it open for normal operation.)  |
| IC   | -              | 94   | H13  | <b>IC: Internal Connected</b><br>(Leave it open for normal operation.)  |
| <b>Supplies and Grounds</b>  |                |  |  |   |
| VDDIO  | -              | 17<br>92   | G1<br>G14  | <b>3.3V I/O Power Supply</b>  |
| GNDIO  | -              | 18<br>91   | G4<br>G11  | <b>I/O GND</b>  |
| VDDT0<br>VDDT1<br>VDDT2<br>VDDT3<br>VDDT4<br>VDDT5<br>VDDT6<br>VDDT7 | -              | 44<br>53<br>56<br>65<br>116<br>125<br>128<br>137 | N4,P4<br>L4,M4<br>L11,M11<br>N11,P11<br>A11,B11<br>C11,D11<br>C4,D4<br>A4,B4 | <b>3.3V / 5V Power Supply for Transmitter Driver</b><br>All VDDT pins must be connected to either 3.3V or 5V. It is not allowed to leave any of the VDDT pins open (not-connected) even if the channel is not used.   |
| GNDT0<br>GNDT1<br>GNDT2<br>GNDT3<br>GNDT4<br>GNDT5<br>GNDT6<br>GNDT7 | -              | 47<br>50<br>59<br>62<br>119<br>122<br>131<br>134 | N6,P6<br>L6,M6<br>L9,M9<br>N9,P9<br>A9,B9<br>C9,D9<br>C6,D6<br>A6,B6         | <b>Analog GND for Transmitter Driver</b>  |
| VDDD<br>VDDA   | -              | 19<br>90   | H1<br>H14  | <b>3.3V Digital / Analog Core Power Supply</b>  |
| GNDD<br>GNDA   | -              | 20<br>89   | H4<br>H11  | <b>Digital / Analog Core GND</b>  |

## FUNCTIONAL DESCRIPTION

### OVERVIEW

The IDT82V2058 is a fully integrated octal short-haul line interface unit, which contains eight transmit and receive channels for use in E1 applications. The receiver performs clock and data recovery. As an option, the raw sliced data (no retiming) can be output to the system. Transmit equalization is implemented with low-impedance output drivers that provide shaped waveforms to the transformer, guaranteeing template conformance. A selectable jitter attenuation may be placed in the receive path or the transmit path. Moreover, multiple testing functions, such as error detection, loopback and JTAG boundary scan are also provided. The device is optimized for flexible software control through a serial or parallel host mode interface. Hardware control is also available. *Figure-1* shows One of the Eight Identical Channels operation.

### SYSTEM INTERFACE

The system interface of each channel can be configured to operate in different modes:

1. Single Rail interface with clock recovery.
2. Dual Rail interface with clock recovery.
3. Dual Rail interface with data recovery (that is, with raw data slicing only and without clock recovery).

Therefore, each signal pin on system side has multiple functions depending on which operation mode the device is in.

Dual Rail interface consists of TDPn<sup>1</sup>, TDNn, TCLKn, RDPn, RDNn and RCLKn. Data transmitted from TDPn and TDNn appears on TTIPn and TRINGn at the line interface; data received from the RTIPn and RRINGn at the line interface are transferred to RDPn and RDNn while the recovered clock extracting from the received data stream outputs on RCLKn. In Dual Rail operation, the clock/data recovery mode is selectable. Dual Rail interface with clock recovery shown in *Figure-3* is a default configuration mode. Dual Rail interface with data recovery is shown in *Figure-4*. Pin RDPn and RDNn, in this condition,

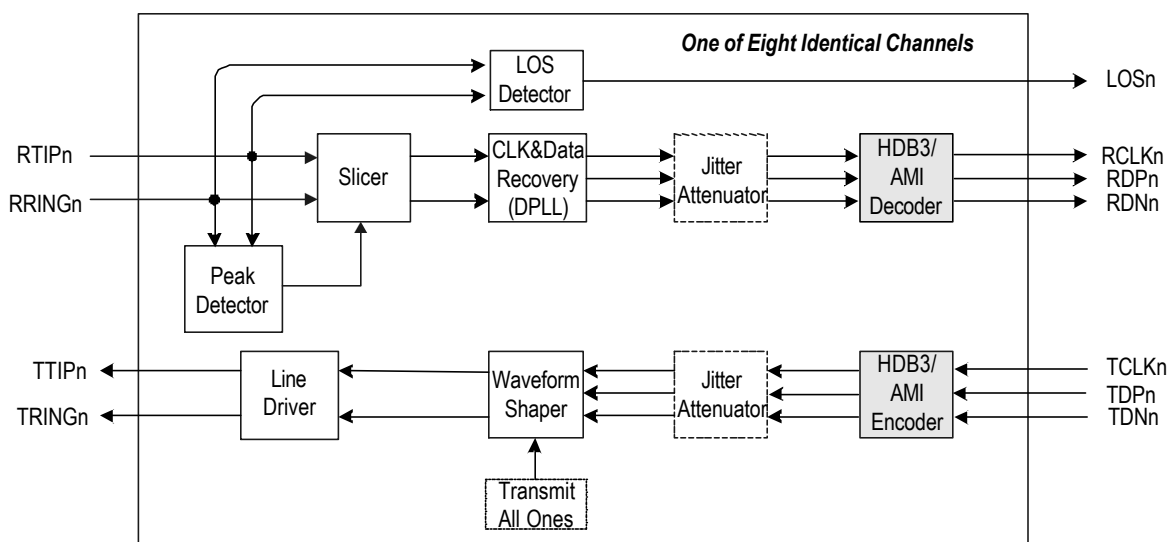
are raw RZ slice output and internally connected to an EXOR which is fed to the RCLKn output for external clock recovery applications.

In Single Rail mode, data transmitted from TDn appears on TTIPn and TRINGn at the line interface. Data received from the RTIPn and RRINGn at the line interface appears on RDn while the recovered clock extracting from the received data stream outputs on RCLKn. When the device is in Single Rail interface, the selectable AMI or HDB3 line encoder/decoder is available and any code violation in the received data will be indicated at the CVn pin. The Single Rail mode can be divided into 2 sub-modes. Single Rail mode1, whose interface is composed of TDn, TCLKn, RDn, CVn and RCLKn, is realized by pulling pin TDNn to high for more than 16 consecutive TCLK cycles. Single Rail mode 2, whose interface is composed of TDn, TCLKn, RDn, CVn, RCLKn and BPVn, is realized by setting bit CRS in **e-CRS**<sup>2</sup> and bit SING in **e-SING**. The difference between them is that, in the latter mode bipolar violation can be inserted via pin BPVn if AMI line code is selected.

The configuration of different system interface is summarized in *Table-1*.

### CLOCK EDGES

The active edge of RCLK and SCLK(serial interface clock) are also selectable. If pin CLKE is Low, the active edge of RCLK is the rising edge, as for SCLK, that is falling edge. On the contrary, if CLKE is High, the active edge of RCLK is the falling edge and that of SCLK is rising edge. Pins RDn/RDPn, CVn/RDNn and SDO are always active high, and those output signals are valid on the active edge of RCLK and SCLK respectively. See *Table-2* for details. However, in dual rail mode without clock recovery, pin CLKE is used to set the active level for RDPn/RDNn raw slicing output: High for active high polarity and Low for active low. It should be noted that data on pin SDI are always active high and is sampled on the rising edge of SCLK. The data on pin TD/TDP or BPVI/TDN are also always active high but is sampled on the falling edge of TCLK, despite the level on CLKE.



**Figure - 3. Dual Rail Interface with Clock Recovery**<sup>3</sup>

#### NOTE:

1. The footprint 'n' (n = 0 - 7) indicates one of the eight channels
2. The first letter "e-" indicates expanded register.
3. The grey blocks are bypassed and the dotted blocks are selectable

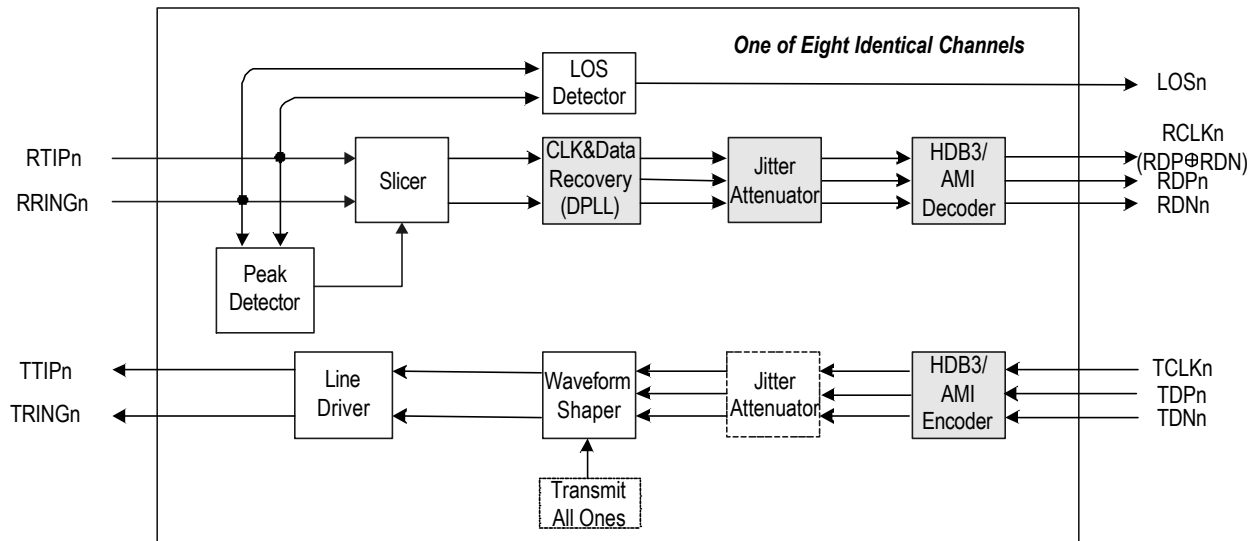


Figure - 4. Dual Rail Interface with Data Recovery

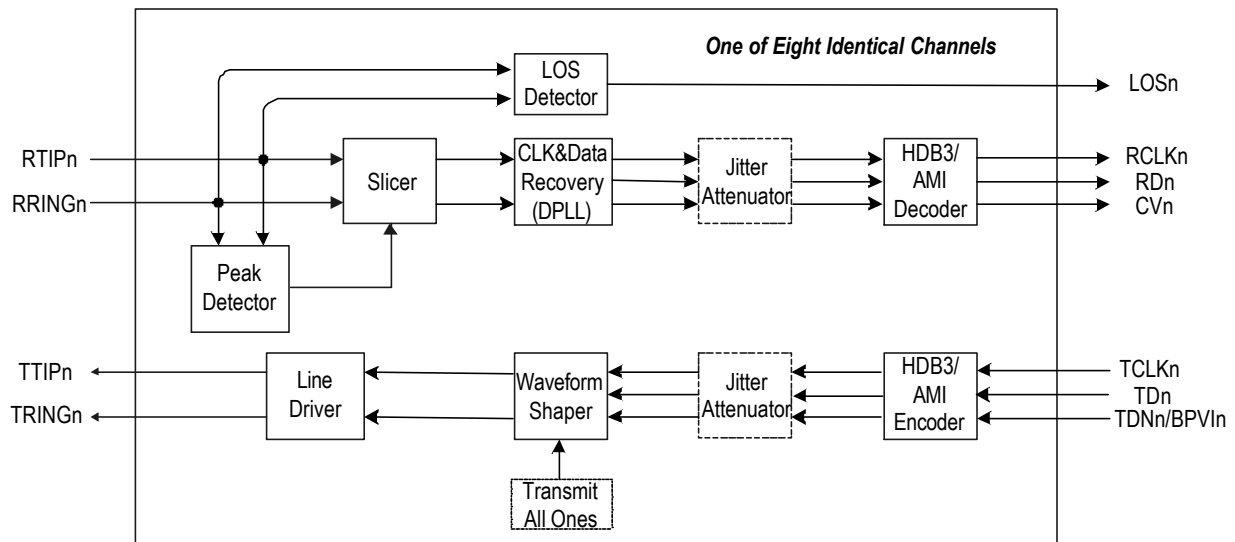


Figure - 6. Single Rail Mode


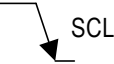

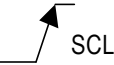
TABLE - 1a. SYSTEM INTERFACE CONFIGURATION (Host Mode)

| Host Mode |       |               |                 |   |
|-----------|-------|---------------|-----------------|---|
| MCLK      | TDNn  | CRSn in e-CRS | SINGn in e-SING | Interface   |
| clocked   | H     | 0             | 0               | Single Rail mode 1  |
| clocked   | pulse | 0             | 1               | Single Rail mode 2  |
| clocked   | pulse | 0             | 0               | Dual Rail with Clock Recovery   |
| clocked   | pulse | 1             | 0               | Dual Rail with Data Recovery  |
| H         | pulse | -             | -               | Receive just slice the incoming data.<br>Transmit is determined by the status of TCLKn. |
| L         | pulse | -             | -               | Receive is power down.<br>Transmit is determined by the status of TCLKn.                |

TABLE - 1b. SYSTEM INTERFACE CONFIGURATION (Hardware Mode)

| Hardware Mode |                     |  |
|---------------|---------------------|--|
| <i>MCLK</i>   | <i>TDNn</i>         | <i>Interface</i>   |
| clocked       | H ( $\geq 16$ MCLK) | Single Rail mode 1   |
| clocked       | pulse               | Dual Rail with Clock Recovery  |
| H             | pulse               | Receive just slice the incoming data. Transmit is determined by the status of TCLKn. |
| L             | pulse               | Receive is power down. Transmit is determined by the status of TCLKn.                |

TABLE - 2. ACTIVE CLOCK EDGE AND ACTIVE LEVEL

| Pin CLKE | RD/RDP and CV/RDN   |               | SDO   |             |
|----------|---|---------------|---|-------------|
|          | Clock recovery  | Slicer output |   |             |
| Low      |  | Active High   |  | Active High |
| High     |  | Active High   |  | Active High |

## RECEIVER

In receive path, the line signals couple into RRINGn and RTIPn via a transformer and are converted into RZ digital pulses by a data slicer. Adaptation for attenuation is achieved using an integral peak detector that sets the slicing levels. Clock and data are recovered from the received RZ digital pulses by a digital phase-locked loop that provides excellent jitter accommodation. After passing through the selectable jitter attenuator, the recovered data are decoded using HDB3 or AMI line code rules and clocked out of pin RDn in single rail mode, or presented on RDPn/RDNn in an undecoded dual rail NRZ format. Loss of signal, alarm indication signal, line code violations and excessive zero are detected. These various changes in status may be enabled to generate interrupts.

### Peak Detector and Slicer

The slicer determines the presence and polarity of the received pulses. In data recovery mode, the raw positive slicer output appears on RDPn while the negative slicer output appears on RDNn. In clock and data recovery mode, the slicer output is sent to Clock and Data Recovery circuit for abstracting retimed data and optional decoding. The slicer circuit has a built-in peak detector from which the slicing threshold is derived. The slicing threshold is default to 50% (typical) of the peak value.

Signals with an attenuation of up to 12 dB (from 2.4V) can be recovered accurately by the receiver. To provide immunity from impulsive noise, the peak detectors are held above a minimum level of 0.150 V typically, despite the received signal level.

### Clock and Data Recovery

The function of Clock and Data Recovery is accomplished by Digital Phase Locked Loop (DPLL). The DPLL is clocked 16 times of the received clock rate, i.e. 32.768 MHz in E1 mode. The recovered data and clock from DPLL is then sent to the selectable Jitter Attenuator or decoder circuit for further processing.

The clock recovery and data recovery mode can be selected on per channel basis by setting the bit CRSn in **e-CRS**. When bit CRSn is defaulted to '0', the corresponding channel operates in data and clock recovery mode. The recovered clock is output on pin RCLKn and retimed NRZ data are output on pin RDPn/RDNn in dual rail mode or on RDn in single rail mode. When CRSn is '1', dual rail with data recovery mode is enabled in the corresponding channel and the clock recovery function is bypassed. In this condition, the analog line signal are converted to RZ digital bit streams on the RDPn/RDNn pins and internally connected to an EXOR which is fed to the RCLKn output for external clock recovery applications.

Moreover, Pulling MCLK to H level, all the receivers will enter the dual rail with data recovery mode. In this case, **e-CRS** is ignored.

### HDB3/AMI Line Code Rule

Selectable HDB3 or AMI line coding/decoding is provided when the device is configured in single rail mode. HDB3 rules is enabled by setting bit CODE in register **GCF** (global control configuration) to '0' or pulling pin CODE to Low. AMI rule is enabled by setting bit CODE in **GCF** to '1' or pulling pin CODE to High. All the setting above are effected to eight channels.

Individual line code rule selection for each channel, if need, is available by setting bit SINGn in **e-SING** to '1' (to activate bit CODEn in **e-CODE**) and programming bit CODEn to select line code rules in the corresponding channel: '0' for HDB3, while '1' for AMI. In this case, the value in bit CODE in **GCF** or pin CODE for global control is unaffected in the corresponding channel and only affect in other channels.

In dual rail mode, the decoder/encoder are bypassed. Bit CODE in **GCF**, bit CODEn in **e-CODE** and pin CODE are ignored.

The configuration of the Line Code Rule is summarized in *Table-3*.

TABLE - 3. CONFIGURATION OF THE LINE CODE RULE

| Hardware Mode |                      | Host Mode   |                 |                  |                      |
|---------------|----------------------|-------------|-----------------|------------------|----------------------|
| CODE          | Line Code Rule       | CODE in GCF | CODEn in e-CODE | SINGn in e-SINGn | Line Code Rule       |
| L             | All channels in HDB3 | 0           | 0 / 1           | 0                | All channels in HDB3 |
|               |                      | 0           | 0               | 1                |                      |
|               |                      | 1           | 0 / 1           | 0                | All channels in AMI  |
|               |                      | 1           | 1               | 1                |                      |
| H             | All channels in AMI  | 0           | 1               | 1                | CHn in AMI           |
|               |                      | 1           | 0               | 1                | CHn in HDB3          |

TABLE - 4. LOS CONDITION IN CLOCK RECOVERY MODE

|              |                      | STANDARD   |  | Signal on pin LOSn |
|--------------|----------------------|--|--|--------------------|
|              |                      | G.775 for E1   | ETSI 300233 for E1   |                    |
| LOS Detected | Continuous Intervals | 32   | 2048 (1 ms)  | H                  |
|              | Amplitude            | below typ. 310mV (Vpp)   | below typ. 310mV (Vpp)   |                    |
| LOS Cleared  | Density              | 12.5% (4 marks in a sliding 32-bit period) with no more than 15 continuous zeros | 12.5% (4 marks in a sliding 32-bit period) with no more than 15 continuous zeros | L                  |
|              | Amplitude            | exceed typ. 540mV (Vpp)  | exceed typ. 540mV (Vpp)  |                    |

**Loss of Signal (LOS) Detection**

The Loss of Signal Detector monitors the amplitude and density of the received signal on Receiver line before the transformer (measured on port A, B in Figure 12). The loss condition is reported by pulling pin LOSn to high. In the same time, LOS alarm registers track LOS condition. When LOS detected or cleared, an interrupt will generate if not masked. In host mode, the detection supports the ITU-G.775 and ETSI 300233. In hardware mode, it only supports the ITU-G.775 specification.

Table-4 summarizes the conditions of LOS in clock recovery mode.

In data recovery mode, the LOS condition is cleared upon detecting the signal level exceeds 540mV.

During LOS, the RDPn/RDNn output the sliced data when bit

AISE(Alarm Indication Signal Enable) in register **GCF** is 0 or output all ones as AIS (Alarm Indication Signal) when bit AISE is set to 1; The RCLKn is replaced by MCLK only if the AISE is set.

**Alarm Indication Signal Detection (AIS)**

Alarm Indication Signal is available only in host mode with clock recovery, as Table-5 shows.

**Error Detection**

The device can detect excessive zero, bipolar violations and HDB3 code violations, refer to figure-7, 8, 9. All the three kinds of errors are reported in both host mode and hardware mode with HDB3 line code rule is used. Moreover, in host mode, the expanded registers **e-CZER** and **e-CODV** are used to determine whether the exces-

TABLE - 5. AIS CONDITION

|              | ITU G.755 for E1 (register LAC defaulted to 0)                                     | ETSI 300233 for E1 (register LAC is 1)                       |
|--------------|--|--|
| AIS Detected | Less than 3 zeros contained in each of two consecutive 512-bit stream are received | Less than 3 zeros contained in a 512-bit stream are received |
| AIS Cleared  | 3 or more zeros contained in each of two consecutive 512-bit stream are received   | 3 or more zeros contained in a 512-bit stream are received   |

TABLE - 6. ERROR DETECTION

| Hardware Mode |   | Host Mode |                        |                        |   |
|---------------|---|-----------|------------------------|------------------------|---|
| Line Code     | Pin CVn Reports   | Line Code | CODVn in <b>e-CODV</b> | CZERn in <b>e-CZER</b> | Pin CVn Reports                                     |
| AMI           | Bipolar Violation   | AMI       | -                      | -                      | Bipolar Violation                                   |
| HDB3          | Bipolar Violation<br>+ Code Violation<br>+ Excessive Zero | HDB3      | 0                      | 0                      | Bipolar Violation + Code Violation                  |
|               |   |           | 0                      | 1                      | Bipolar Violation + Code Violation + Excessive Zero |
|               |   |           | 1                      | 0                      | Bipolar Violation                                   |
|               |   |           | 1                      | 1                      | Bipolar Violation + Excessive Zero                  |

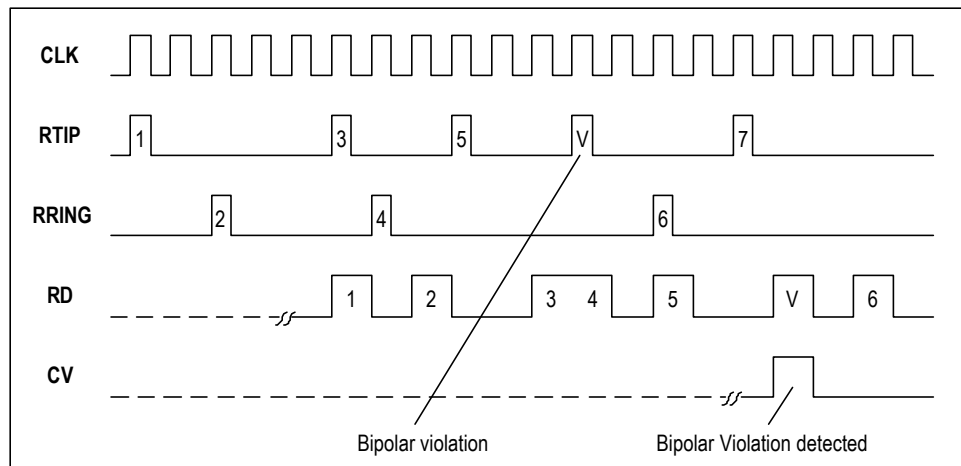


Figure - 7. AML Bipolar Violation

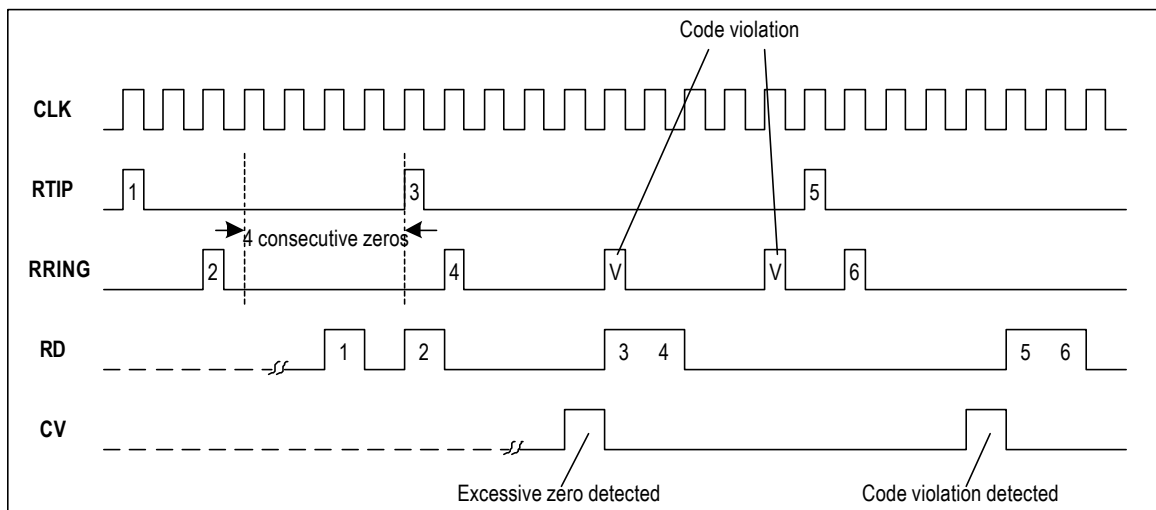


Figure - 8. HDB3 Code Violation &amp; Excessive Zero

sive zero and code violation are reported respectively. When configured in AML decoding mode, only bipolar violation can be reported.

The error detection is available only in single rail mode where the pin RDNn/CVn is used as error report output (CVn pin).

The configuration and report status of error detection are summarized in Table-6.

## TRANSMITTER

In transmit path, data in NRZ (non return to zero) format are clocked into the device on TDn and encoded by AML or HDB3 line code rules when single rail mode is configured or pre-encoded data in NRZ format are input on TDPn and TDNn when dual rail mode is configured. The data are sampled into the device on falling edges of TCLKn. Jitter attenuator, if enabled, is provided with a FIFO which the data to be transmitted are passing through. A low jitter clock is generated by an integral digital phase-locked loop and is used to read data from the FIFO. The shape of the pulses should meet the E1 pulse template after the signal is passed through different cable types. Bipolar violation, for diagnosing, can be inserted on pin BPVIn if AML line code rule is enabled.

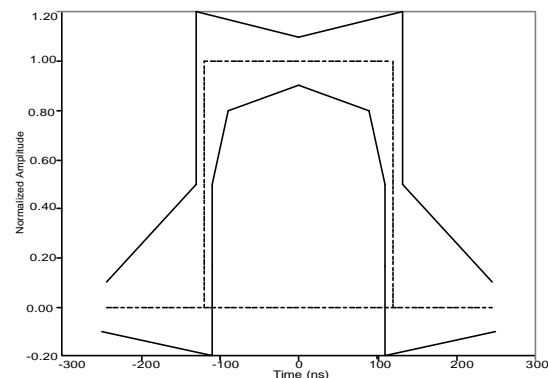


Figure - 9. CEPT Waveform Template

## Waveform Shaper

E1 pulse template, specified in ITU-T G.703, is shown in Figure-9. The device has built-in transmit waveform templates for cable of 75Ω or 120Ω.

The built-in waveform shaper use an internal high frequency clock which is 16XMCLK as clock reference. This function will be bypassed when MCLK is unavailable.

### Bipolar Violation Insertion

When configured in single rail mode 2 with AML line code enabled, pin TDn/BPVIn is used as BPVI input. A low-to-high transition on this pin inserts a bipolar violation on the next available mark in the transmit data stream. Sampling occurs on the falling edge of TCLK. But in TAOS with analog loopback mode and remote loopback mode, the BPVI is disabled. In TAOS with digital loopback mode, the BPVI is looped back to system side, so the data to be transmitted on TTINGn and TRINGn are all ones with no bipolar violation.

## JITTER ATTENUATOR

The jitter attenuator is provided for narrow-band width jitter transfer and can be selected to work either in transmit path or in receive path or not used. The selection is accomplished by setting pin JAS in hardware mode or configuring bits JACF1 and JACF0 in register **GCF** in host mode which are both effected to all the channels.

For applications which require line synchronization, the line clock is needed to be extracted for the internal synchronization, the jitter attenuator is set in the receive path. Another use of the jitter attenuator is to provide clock smoothing in the transmit path for applications such as synchronous/asynchronous demultiplexing applications. In these applications, TCLK will have an instantaneous frequency that is higher than the nominal E1 data rate and in order to set the average long-term TCLK frequency within the transmit line rate specifications, periods of TCLK are suppressed (gapped).

The jitter attenuator integrates a FIFO which can accommodate a gapped TCLK. In host mode, the FIFO length can be 32 X 2 or 64 X 2 bits by programming bit JADP in **GCF**. In hardware mode, it is fixed to 64 X 2 bits. The FIFO length determines the maximum permissible gap width (see *table-7*), exceeding these values will cause FIFO overflow or underflow. The data is 16 or 32 bits' delay through the jitter

attenuator in the corresponding transmit or receive path. The constant delay feature is crucial for the applications requiring “hitless” switching.

In host mode, bit JABW in **GCF** determines the jitter attenuator 3dB corner frequency (fc). In hardware mode, the fc is fixed to 1.7Hz. Generally, the lower the fc is, the higher the attenuation. However, lower fc comes at the expense of increased acquisition time. Therefore, the optimum fc is to optimize both the attenuation and the acquisition time. In addition, the longer FIFO length results in an increased throughput delay and also influences the 3dB corner frequency. Generally, it's recommended to use the lower corner frequency and the shortest FIFO length that can still meet jitter attenuation requirements.

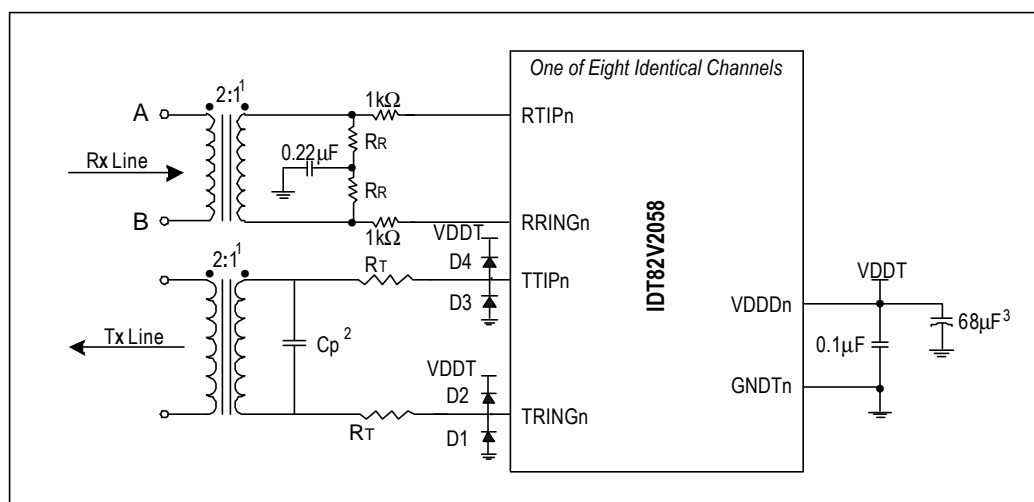
The output jitter specifications include: ITU-T G.736, ITU-T G.742, ITU-T G.783 and ETSI CTR 12/13.

**TABLE - 7. GAP WIDTH LIMITATION**

| FIFO Length | Max. Gap Width |
|-------------|----------------|
| 64 bit      | 56 UI          |
| 32 bit      | 28 UI          |

**TABLE - 8. EXTERNAL COMPONENTS VALUES**

| Component      | 75W Coax   | 120W Twisted Pair |
|----------------|--|-------------------|
| R <sub>T</sub> | 9.5Ω ± 1%  | 9.5Ω ± 1%         |
| R <sub>R</sub> | 9.31Ω ± 1%   | 15Ω ± 1%          |
| C <sub>p</sub> | 2200pf   |                   |
| D1 – D4        | Nihon Inter Electronics - EP05Q03L, 11EQS03L,<br>EC10QS04, EC10QS03L<br>Motorola – MBR0540T1 |                   |



**NOTE:**

1. Pulse T1124 transformer is recommended to use in Standard (STD) operating temperature range (0° to 70°C), while Pulse T1114 transformer is recommended to use in Extended (EXT) operating temperature range is -40° to +85°C. See Transformer Specifications Table for details.
2. Typical value. Adjust for actual board parasitics to obtain optimum return loss.
3. Common decoupling capacitor for all VDDT and GNDT pins.

**Figure - 10. External Transmit/Receive Line Circuitry**



TABLE - 9. TRANSFORMER SPECIFICATIONS

| Electrical Specification @ 25 °C |           |                           |         |                     |         |                         |         |                           |         |                       |
|----------------------------------|-----------|---------------------------|---------|---------------------|---------|-------------------------|---------|---------------------------|---------|-----------------------|
| Part No.                         |           | Turns Ratio (Pri: sec±2%) |         | OCL @ 25°C (mH MIN) |         | L <sub>L</sub> (μH MAX) |         | C <sub>www</sub> (pF MAX) |         | Package/<br>Schematic |
| STD Temp.                        | EXT Temp. | Transmit                  | Receive | Transmit            | Receive | Transmit                | Receive | Transmit                  | Receive |                       |
| T1124                            | T1114     | 1:2CT                     | 1CT:2   | 1.2                 | 1.2     | .6                      | .6      | 35                        | 35      | TOU/3                 |

cally.

### LINE INTERFACE CIRCUITRY

The transmit and receive interface RTIP/RRING and TTIP/TRING connections provide a matched interface to the cable. *Figure-12* shows the appropriate external components to connect with the cable for one transmit/receive channel. *Table-8* summarizes the component values based on the specific application.

### TRANSMIT DRIVER POWER SUPPLY

The nominal transmit driver power supply must be 5.0V or 3.3V.

Despite of the power supply voltage, the 75Ω/120Ω lines are driven through 9.5Ω series resistors and a 1:2 transformer.

However, in harsh cable environment, series resistors are required to improve the transmit return loss performance and protect the device from surges coupling into the device.

### SHORT CIRCUIT MONITOR

An internal Short Circuit Monitor (**SCM**), parallelly connected with TTIP<sub>n</sub> and TRING<sub>n</sub>, can detect short circuit in the transmit line side.

Bit SCPB in Register **GCF** decides whether the output driver short-circuit protection is enabled. (Refer to **Programming Information**). When it is enabled, the max driver's output current is limited to 150mA.

### LINE PROTECTION

In transmit side, the Schottky diodes D1~D4 are required to protect the line driver and improve the design robustness. In receive side, the series resistors of 1kΩ are used to protect the receiver against current surges coupled in the device. It does not affect the receiver sensitivity, since the receiver impedance is as high as 120kΩ typi-

### HITLESS PROTECTION SWITCHING (HPS)

The IDT82V2048 transceivers include an output driver tristatability feature for T1/E1 redundancy applications. This feature greatly reduces the cost of implementing redundancy protection by eliminating external relays. Details of HPS will be described in relative Application Note.

### RESET

Writing register **RS** can cause software reset by initiating about 1μs reset cycle. This operation set all the registers to their default value.

### POWER UP

During power up, an internal reset signal sets all the registers to default values. This procedure takes at least 2 machine cycles.

### POWER DOWN

Each transmitter channel will power down by pulling pin TCLK<sub>n</sub> to low for more than 64 MCLK cycles (if MCLK is available) or about 30us (when MCLK is not available). Each transmitter channel will also power down by setting bit TPDN<sub>n</sub> in **e-TPDN** to 1.

All the receivers will power down when MCLK is Low. When MCLK is clocked or High, setting bit RPDN<sub>n</sub> in **e-RPDN** to '1' will configure the corresponding receiver to power down.

### INTERFACE WITH 5V LOGIC

The IDT82V2048 can interface directly with 5V TTL family devices. The internal input pads are tolerant to 5V output from TTL and CMOS family devices.

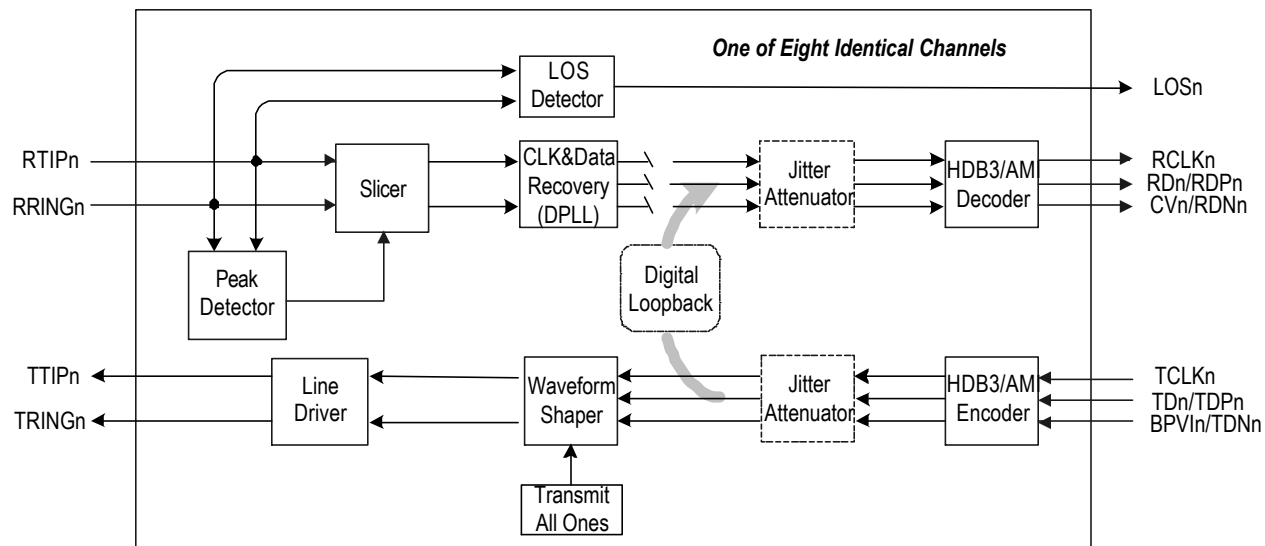


Figure - 11. Digital Loopback

## LOOPBACK MODE

The device provides four different diagnostic loopback configurations: Digital Loopback, Analog Loopback, Remote Loopback and Dual Loopback. In host mode, these functions are implemented by programming the registers **DLB**, **ALB** or **RLB**. In hardware mode, only analog loopback and remote loopback can be selected by pulling pin LPn to High and Low respectively.

### Digital Loopback

By programming the bits of register **DLB**, each channel of the device can be set in Local Digital Loopback. In this configuration, the data and clock to be transmitted, after passing the encoder, is looped back to jitter attenuator (if enabled) and decoder in the receive path, then output on RCLKn, RDn/RDPn and CVn/RDNn. The data to be transmitted are still output on TTIPn and TRINGn while the data received on RTIPn and RRINGn are ignored. The Loss Detector is still in use. *Figure-11* shows the process.

### Analog Loopback

By programming the bits of **ALB** register or pulling pin LPn to High, each channel of the device can be set in Analog Loopback. In this configuration, the data to be transmitted output from the line driver are internally looped back to the slicer and peak detector in the receive path and output on RCLKn, RDn/RDPn and CVn/RDNn. The data to be transmitted are still output on TTIPn and TRINGn while the data received on RTIPn and RRINGn are ignored. The Loss Detector is still in use. *Figure-12* shows the process.

The TTIPn and RTIPn, TRINGn and RRINGn cannot be connected directly to do the external analog loopback test. Line impedance loading is required to conduct the external analog loopback test.

### Remote Loopback

By programming the bits of **RLB** register or pulling pin LPn to Low, each channel of the device can be set in Remote Loopback. In this configuration, the data and clock recovered by the Clock and Data Recovery circuits are looped to waveform shaper and output on TTIPn and TRINGn. The jitter attenuator is also included in loopback when enabled in the transmit or receive path. The received data and clock are still output on RCLKn, RDn/RDPn and CVn/RDNn while the data to be transmitted on TCLKn, TDn/TDPn and BPVIn/TDNn are ignored. The Loss Detector is still in use. *Figure-13* shows the process.

### Dual Loopback

Dual Loopback mode is set by setting both bit DLBn in register **DLB** and bit RLBn in register **RLB** to '1'. In this configuration, after passing the encoder, the data and clock to be transmitted are looped back to decoder directly and output on RCLKn, RDn/RDPn and CVn/RDNn. The recovered data from RTIPn and RRINGn are looped back to waveform shaper through JA (if selected) and output on TTIPn and TRINGn. The Loss Detector is still in use. *Figure-14* shows the process.

### Transmit All Ones

In hardware mode, the TAOS mode is set by pulling TCLKn High for more than 16 MCLK cycles. In host mode, TAOS mode is set by programming register **TAO**. In addition, automatic TAO signals are inserted by setting register **ATAO** when Loss of Signal occurs. Note that the TAOS generator adopts MCLK as a timing reference. In order to assure that the output frequency is within specification limits, MCLK must have the applicable stability.

This TAOS mode and Digital Loopback or Analog Loopback can be configured simultaneously. *Figure-15* shows their process.

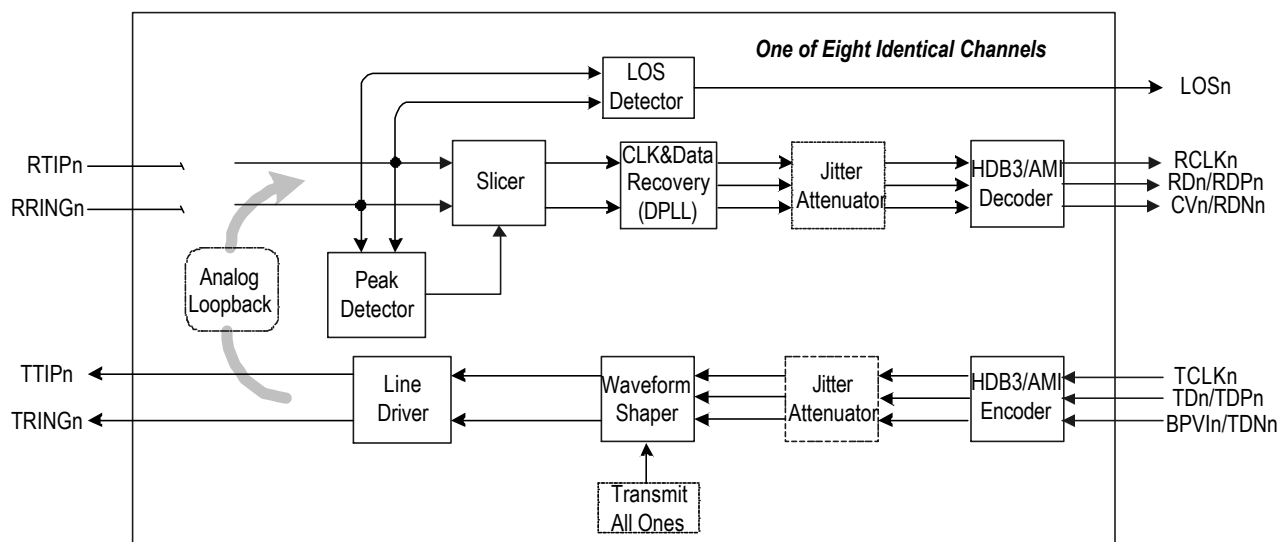


Figure - 12. Analog Loopback

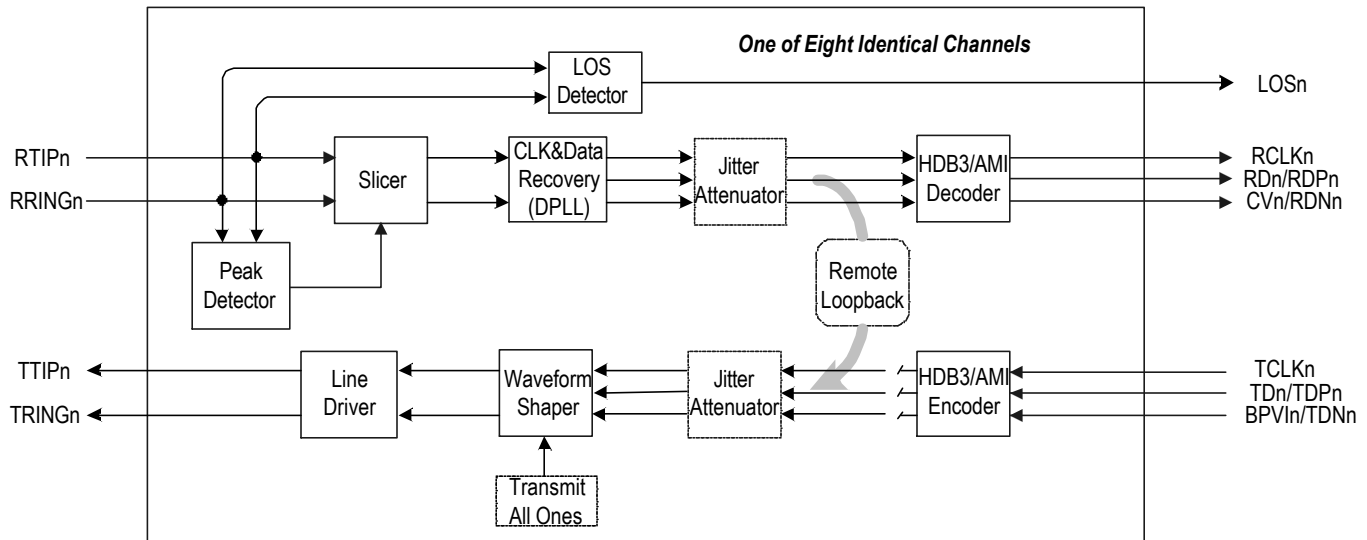


Figure - 13. Remote Loopback

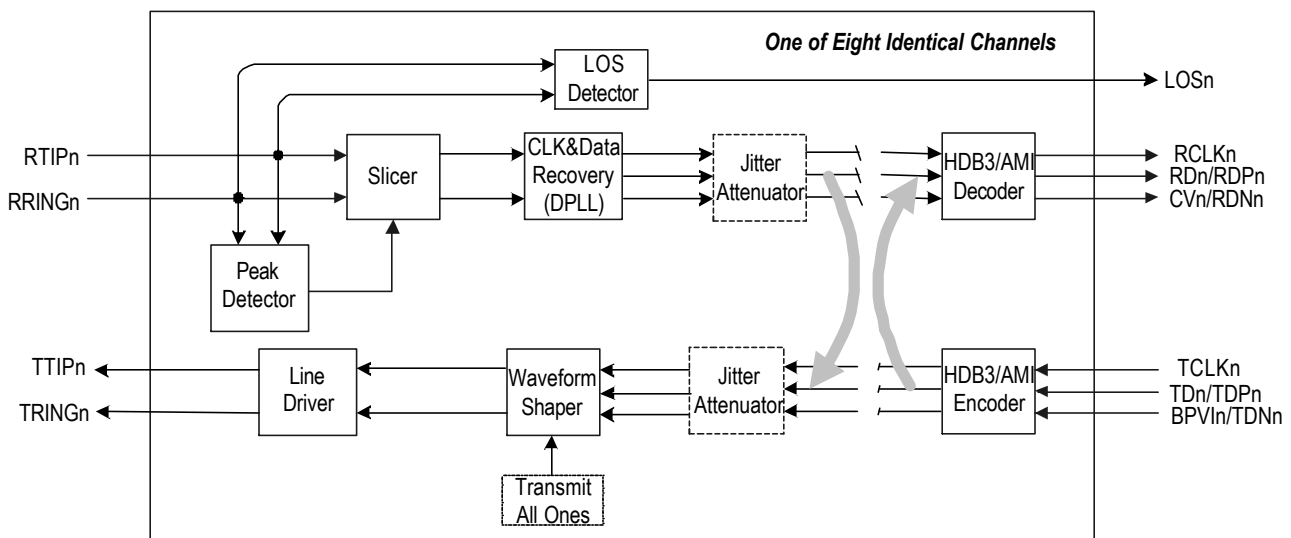


Figure - 14. Dual Loopback

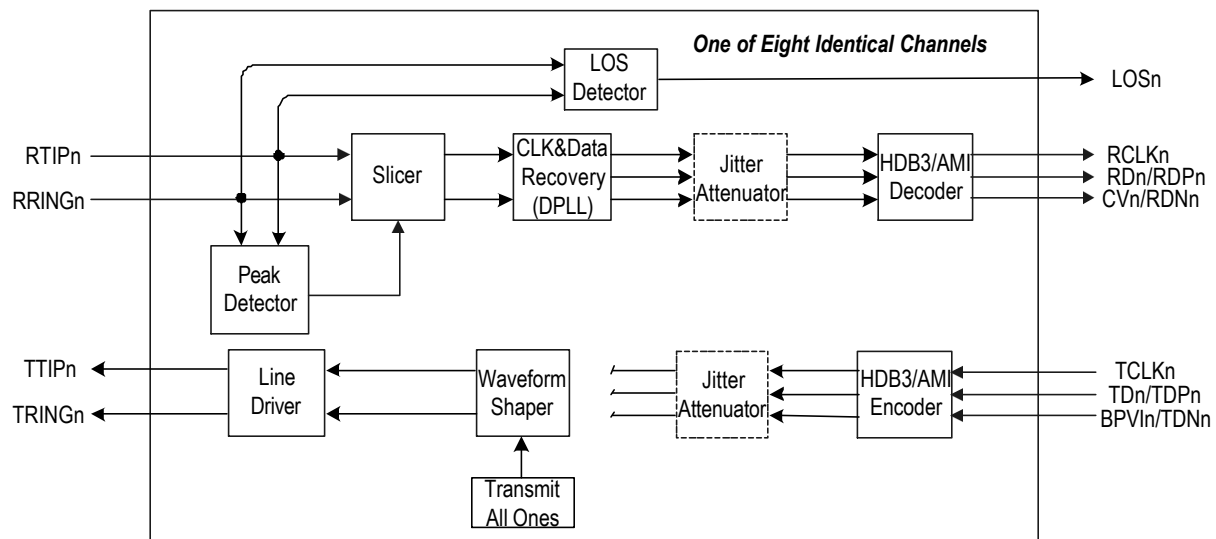


Figure - 15a. TAOS Data Path

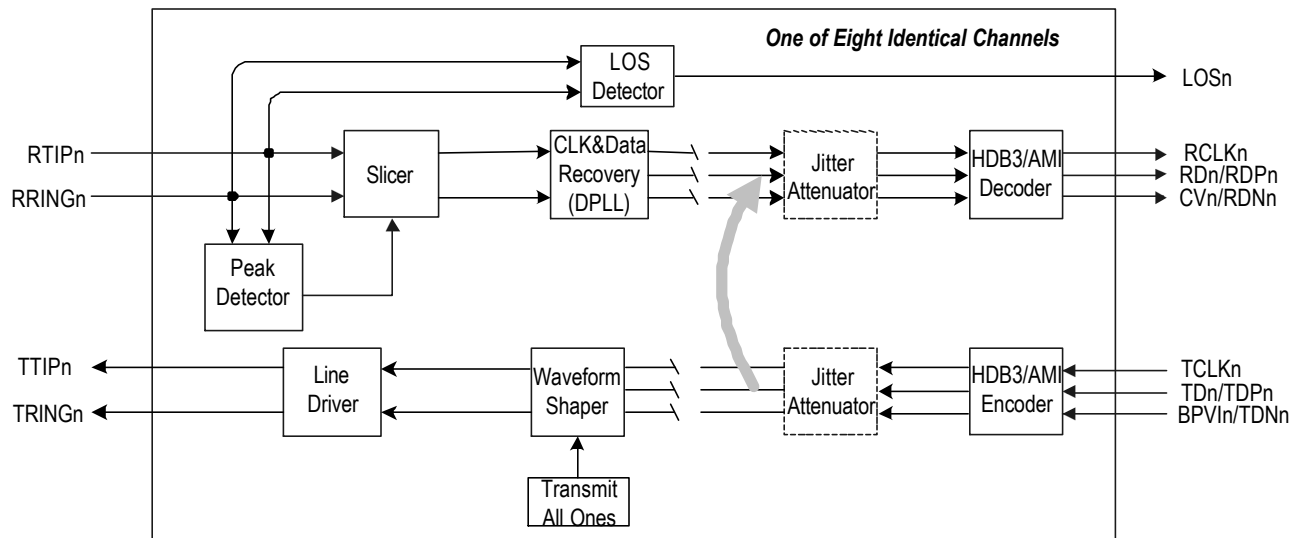


Figure - 15b. TAOS with Digital Loopback

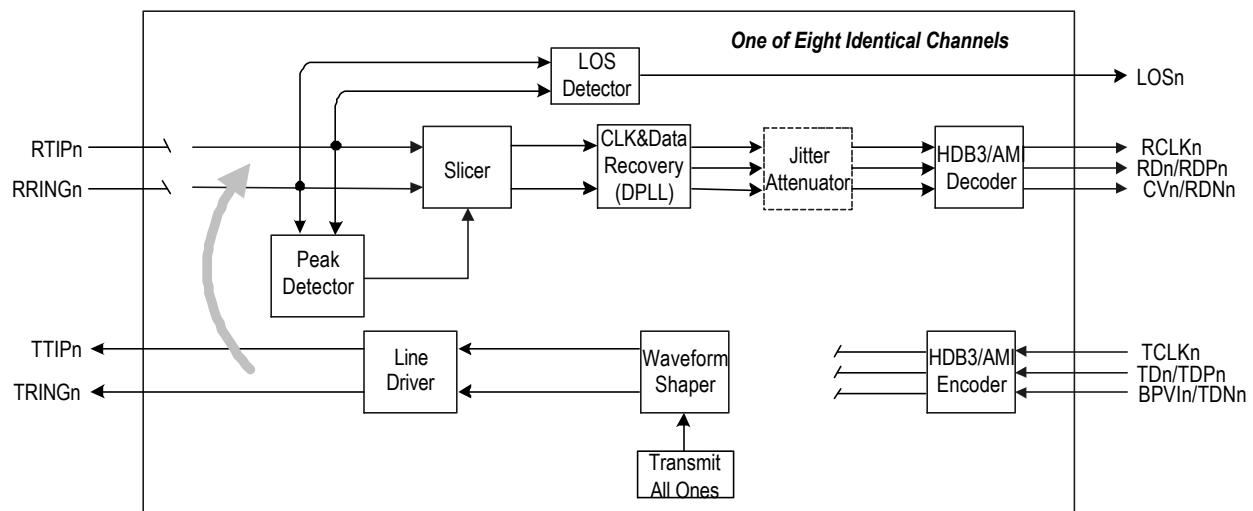


Figure - 15c. TAOS with Analog Loopback

## HOST INTERFACES

The host interface provides access to read and write the registers in the device. The interface consists of serial host interface and parallel host interface. By pulling pin MODE2 to VDDIO/2 or to High, the device can be set to work in serial mode and in parallel mode respectively.

### Parallel Host Interface

The interface is compatible with Motorola or Intel host. Pins MODE1 and MODE0 are used to select the operating mode of the parallel host interface. When pin MODE1 is pulled to Low, the host uses separate address bus and data bus. When High, multiplexed address/data bus is used. When pin MODE0 is pulled to Low, the parallel host interface is configured for Motorola compatible hosts. When High, for Intel compatible hosts. This is well described in the **Pin Description**. The host interface pins in each operation mode is tabulated in Table-10.

### Serial Host Interface

By pulling pin MODE2 to VDDIO/2, the device operates in the serial host Mode. In this mode, the registers are accessible through a 16-bit word which contains an 8-bit command/address byte (bit R/W and 5-address-bit A1~A5, A6 and A7 are ignored) and a subsequent 8-bit data byte (D0~D7). When bit R/W is 1, data is read out at pin SDO. When bit R/W is 0, data is written into pin SDI to the register which is indicated by address bits A5~A1.

## INTERRUPT HANDLING

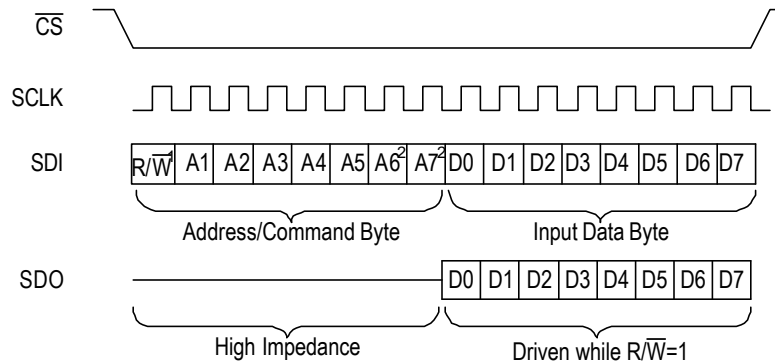
### Interrupt Sources

There are three kinds of interrupt sources:

1. Status change in the **LOS** (Loss of Signal) Status Register(04H). The analog/digital loss of signal detector continuously monitors the received signal to update the specific bit in **LOS** which indicates presence or absence of a LOS condition.

TABLE - 10. PARALLEL HOST INTERFACE PINS

| MODE[2:0] | Host interface                     | Generic control, data, and output pin name   |
|-----------|------------------------------------|--|
| 100       | Non-multiplexed Motorola interface | $\overline{CS}$ , $\overline{ACK}$ , $\overline{DS}$ , $R/\overline{W}$ , $\overline{AS}$ , A[4:0], D[7:0], $\overline{INT}$ |
| 101       | Non-multiplexed Intel interface    | $\overline{CS}$ , RDY, $\overline{WR}$ , $\overline{RD}$ , ALE, A[4:0], D[7:0], $\overline{INT}$                             |
| 110       | Multiplexed Motorola interface     | $\overline{CS}$ , $\overline{ACK}$ , $\overline{DS}$ , $R/\overline{W}$ , $\overline{AS}$ , AD[7:0], $\overline{INT}$        |
| 111       | Multiplexed Intel interface        | $\overline{CS}$ , RDY, $\overline{WR}$ , $\overline{RD}$ , ALE, AD[7:0], $\overline{INT}$                                    |

**NOTE:**

1. While  $R/\overline{W}=1$ , read from IDT82V2058; While  $R/\overline{W}=0$ , write to IDT82V2058.
2. Ignored.

Figure - 16. Serial Host Mode Timing

2. Status change in the **SC** (Short Circuit) Status Register(05H). The automatic power driver circuit continuously monitors the output drivers signal to update the specific bit in **SCM** which indicates presence or absence of the transmit line side short circuit condition.

3. Status change in the **AIS** (Alarm Indication Signal) Status Register(13H). The AIS detector monitors the received signal to update the specific bit in **AIS** which indicates presence or absence of a AIS condition.

**Interrupt Enable**

The IDT82V2058 provides a latched interrupt output ( $\overline{INT}$ ) and the three kinds of interrupts are all reported by this pin. When the Interrupt Mask register (**LOSM**, **SCM** and **AISM**) is set to '1', the Interrupt Status register (**LOSI**, **SCI** and **AISI**) is enabled respectively. Whenever there is a transition ('0' to '1' or '1' to '0') in the corresponding Status register, the Interrupt Status register will change into '1', which means an interrupt occurs, and there will be a transition from high to low on  $\overline{INT}$ . An external pull-up resistor of approximately 10k $\Omega$  is required to support the wire-OR operation of  $\overline{INT}$ . When any of the three Interrupt Mask registers is set to '0' (the power-on default value is '0'), the corresponding Interrupt Status register is disabled and the transition on status register is ignored.

**Interrupt Clearing**

When an interrupt occurs, the Interrupt Status registers (**LOSI**, **SCI** and **AISI**) are read to identify the interrupt source. And these registers will be cleared to '0' after the corresponding Status register (**LOS**, **SC** and **AIS**) being read. The Status registers will be cleared once the corresponding conditions are met.

Pin  $\overline{INT}$  is pulled High when there are no pending interrupt left. The interrupt handling in the interrupt service routine is showed Figure-17.

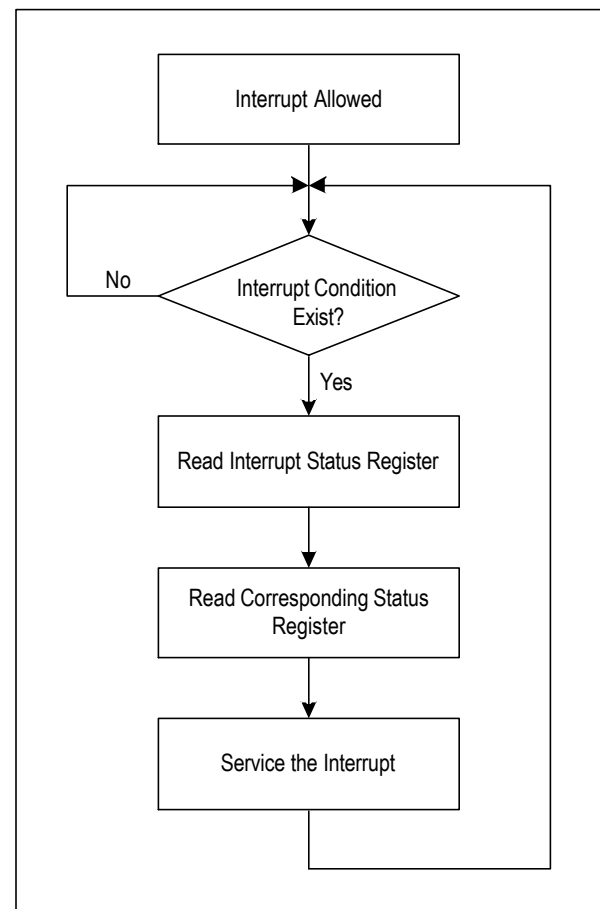


Figure - 17. Interrupt Service Routine

### G.772 MONITORING

The eight channels of IDT82V2058 can all be configured to work as regular transceivers. In applications using only seven channels (channels 1 to 7), channel 0 is configured to non-intrusively monitor any of the other channels' inputs or outputs on the line side. The monitoring is non-intrusive per ITU-T G.772. Figure-17 shows the Monitoring Principle. The receiver or transmitter path to be monitored is configured by pin MC[0:3] in hardware mode or by **PMON** in host mode (refer to **Programming Information** for details).

The signal which is monitored goes through the clock and data

recovery circuit of channel 0. The monitored clock can output on RCLK0 which can be used as a timing interfaces derived from E1 signal. The monitored data can be observed digitally at the output pin RCLK0, RD0/RDP0 and RDN0. LOS detector is still in use in channel 0 for the monitored signal.

In monitoring mode, channel 0 can be configured to the Remote Loopback. The signal which is being monitored will output on TTIP0 and TRING0. The output signal can then be connected to a standard test equipment with an E1 electrical interface for non-intrusive monitoring.

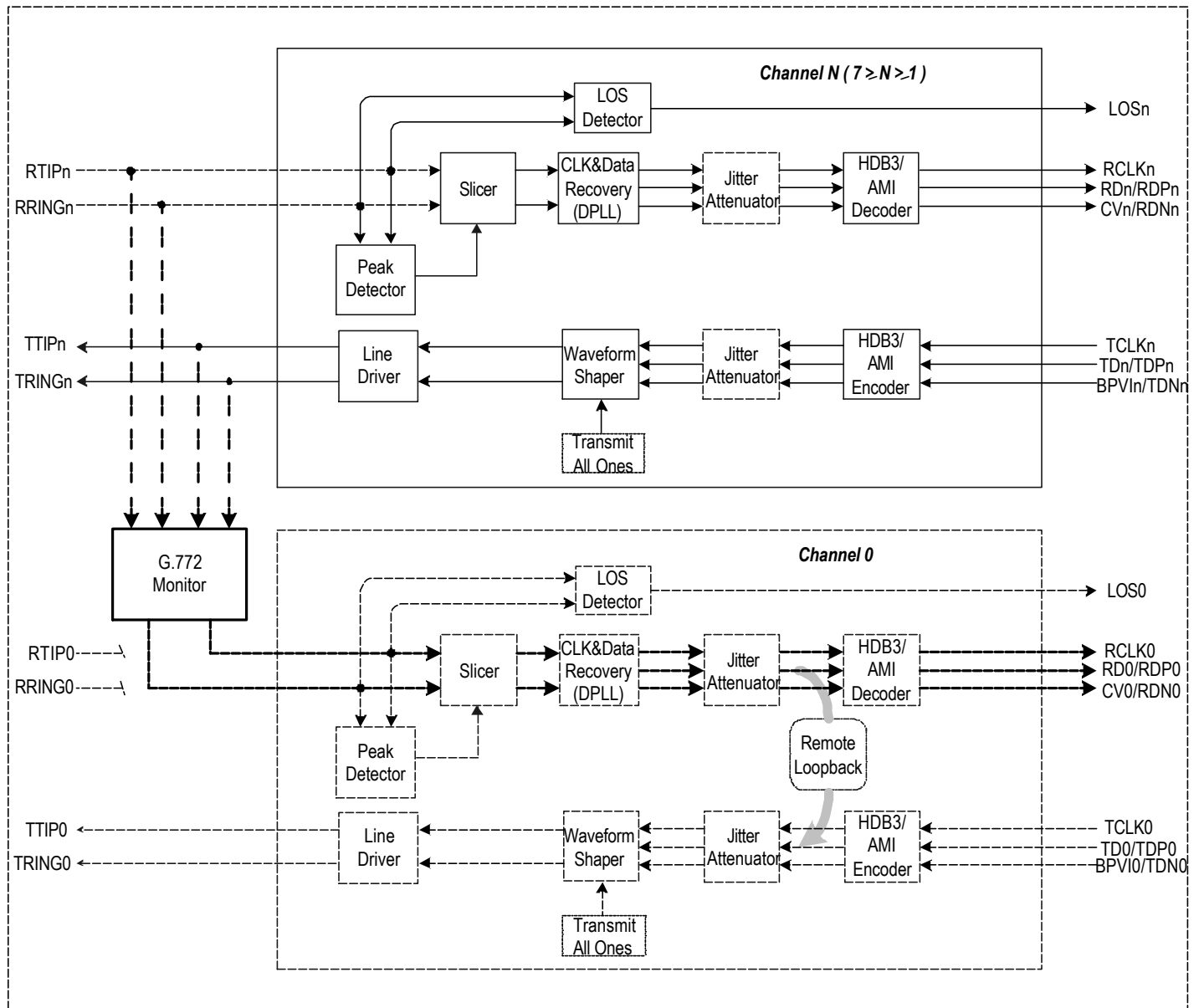


Figure - 17. Monitoring Principle

## PROGRAMMING INFORMATION

### REGISTER LIST AND MAP

There are 21 primary registers (including an Address Pointer Control Register), including 8 expanded registers in the device.

Whatever the control interface is, 5 address bits are used to set the registers. In non-multiplexed parallel interface mode, the five dedicated address bits are A[4:0]. In multiplexed parallel interface mode, AD[4:0]

carries the address information. In serial interface mode, A[5:1] are used to address the register.

The Address Pointer Control Register (**ADDP**), addressed as 11111 or 1F Hex, switches between primary registers bank and expanded registers bank.

By setting the content of **ADDP** to AAH, the 5 address bits point to the expanded register bank, that is, 16 expanded registers are then available to access. By clearing **ADDP**, the primary registers are accessible again.

TABLE - 11. PRIMARY REGISTER LIST

| Address |                           |                             | Register | R/W | Explanation   |
|---------|---------------------------|-----------------------------|----------|-----|---|
| Hex     | serial interface<br>A7-A1 | parallel interface<br>A7-A0 |          |     |   |
| 00      | XX00000                   | XXX00000                    | ID       | R   | Device ID Register  |
| 01      | XX00001                   | XXX00001                    | ALB      | R/W | Analog Loopback Configuration Register  |
| 02      | XX00010                   | XXX00010                    | RLB      | R/W | Remote Loopback Configuration Register  |
| 03      | XX00011                   | XXX00011                    | TAO      | R/W | Transmit All One Code Configuration Register  |
| 04      | XX00100                   | XXX00100                    | LOS      | R   | Loss of Signal Status Register  |
| 05      | XX00101                   | XXX00101                    | SC       | R   | Short Circuit Status Register   |
| 06      | XX00110                   | XXX00110                    | LOSM     | R/W | LOS Interrupt Mask Register   |
| 07      | XX00111                   | XXX00111                    | SCM      | R/W | Short Circuit Interrupt Mask Register   |
| 08      | XX01000                   | XXX01000                    | LOSI     | R   | LOS Interrupt Status Register   |
| 09      | XX01001                   | XXX01001                    | SCI      | R   | Short Circuit Interrupt Status Register   |
| 0A      | XX01010                   | XXX01010                    | RS       | W   | Software Reset Register   |
| 0B      | XX01011                   | XXX01011                    | PMON     | R/W | Performance Monitor Configuration Register  |
| 0C      | XX01100                   | XXX01100                    | DLB      | R/W | Digital Loopback Configuration Register   |
| 0D      | XX01101                   | XXX01101                    | LAC      | R/W | LOS/AIS Criteria Configuration Register   |
| 0E      | XX01110                   | XXX01110                    | ATAO     | R/W | Automatic TAO Configuration Register  |
| 0F      | XX01111                   | XXX01111                    | GCF      | R/W | Global Configuration Register   |
| 10      | XX10000                   | XXX10000                    | Reserved |     |   |
| 11      | XX10001                   | XXX10001                    |          |     |   |
| 12      | XX10010                   | XXX10010                    | OE       | R/W | Output Enable Configuration Register  |
| 13      | XX10011                   | XXX10011                    | AIS      | R   | AIS Status Register   |
| 14      | XX10100                   | XXX10100                    | AISM     | R/W | AIS Interrupt Mask Register   |
| 15      | XX10101                   | XXX10101                    | AISI     | R   | AIS Interrupt Status Register   |
| 16      | XX10110                   | XXX10110                    | Reserved |     |   |
| 17      | XX10111                   | XXX10111                    |          |     |   |
| 18      | XX11000                   | XXX11000                    |          |     |   |
| 19      | XX11001                   | XXX11001                    |          |     |   |
| 1A      | XX11010                   | XXX11010                    |          |     |   |
| 1B      | XX11011                   | XXX11011                    |          |     |   |
| 1C      | XX11100                   | XXX11100                    |          |     |   |
| 1D      | XX11101                   | XXX11101                    |          |     |   |
| 1E      | XX11110                   | XXX11110                    |          |     |   |
| 1F      | XX11111                   | XXX11111                    | ADDP     | R/W | Address pointer control Register for switching between primary register bank and expanded register bank |

TABLE - 12. EXPANDED (INDIRECT ADDRESS MODE) REGISTER LIST

| Address |                              |                                | Register | R/W | Explanation   |
|---------|------------------------------|--------------------------------|----------|-----|---|
| Hex     | serial<br>interface<br>A7-A1 | parallel<br>interface<br>A7-A0 |          |     |   |
| 00      | XX00000                      | XXX00000                       | e-SING   | R/W | Single Rail Mode Setting Register   |
| 01      | XX00001                      | XXX00001                       | e-CODE   | R/W | Encoder/Decoder Selection Register  |
| 02      | XX00010                      | XXX00010                       | e-CRS    | R/W | Clock Recovery Enable/Disable Register  |
| 03      | XX00011                      | XXX00011                       | e-RPDN   | R/W | Receiver n Powerdown Enable/Disable Register  |
| 04      | XX00100                      | XXX00100                       | e-TPDN   | R/W | Transmitter n Powerdown Enable/Disable Register   |
| 05      | XX00101                      | XXX00101                       | e-CZER   | R/W | Consecutive Zero Detect Enable/Disable Register   |
| 06      | XX00110                      | XXX00110                       | e-CODV   | R/W | Code Violation Detect Enable/Disable Register   |
| 07      | XX00111                      | XXX00111                       | e-EQUA   | R/W | Enable Equalizer Enable/Disable Register  |
| 08      | XX01000                      | XXX01000                       | Test     |     |   |
| 09      | XX01001                      | XXX01001                       |          |     |   |
| 0A      | XX01010                      | XXX01010                       |          |     |   |
| 0B      | XX01011                      | XXX01011                       |          |     |   |
| 0C      | XX01100                      | XXX01100                       |          |     |   |
| 0D      | XX01101                      | XXX01101                       |          |     |   |
| 0E      | XX01110                      | XXX01110                       |          |     |   |
| 0F      | XX01111                      | XXX01111                       |          |     |   |
| 10      | XX10000                      | XXX10000                       |          |     |   |
| 11      | XX10001                      | XXX10001                       |          |     |   |
| 12      | XX10010                      | XXX10010                       |          |     |   |
| 13      | XX10011                      | XXX10011                       |          |     |   |
| 14      | XX10100                      | XXX10100                       |          |     |   |
| 15      | XX10101                      | XXX10101                       |          |     |   |
| 16      | XX10110                      | XXX10110                       |          |     |   |
| 17      | XX10111                      | XXX10111                       |          |     |   |
| 18      | XX11000                      | XXX11000                       |          |     |   |
| 19      | XX11001                      | XXX11001                       |          |     |   |
| 1A      | XX11010                      | XXX11010                       |          |     |   |
| 1B      | XX11011                      | XXX11011                       |          |     |   |
| 1C      | XX11100                      | XXX11100                       |          |     |   |
| 1D      | XX11101                      | XXX11101                       |          |     |   |
| 1E      | XX11110                      | XXX11110                       |          |     |   |
| 1F      | XX11111                      | XXX11111                       | ADDP     | R/W | Address pointer control register for switching between primary register bank and expanded register bank |



TABLE - 13. PRIMARY REGISTER MAP

| Register | Address<br>R/W<br>Default | b7                 | b6                 | b5                 | b4                 | b3                 | b2                 | b1                 | b0                 |
|----------|---------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| ID       | 00 Hex<br>R/W<br>Default  | ID 7<br>R<br>0     | ID 6<br>R<br>0     | ID 5<br>R<br>0     | ID 4<br>R<br>1     | ID 3<br>R<br>0     | ID 2<br>R<br>0     | ID 1<br>R<br>0     | ID 0<br>R<br>0     |
| ALB      | 01 Hex<br>R/W<br>Default  | ALB 7<br>R/W<br>0  | ALB 6<br>R/W<br>0  | ALB 5<br>R/W<br>0  | ALB 4<br>R/W<br>0  | ALB 3<br>R/W<br>0  | ALB 2<br>R/W<br>0  | ALB 1<br>R/W<br>0  | ALB 0<br>R/W<br>0  |
| RLB      | 02 Hex<br>R/W<br>Default  | RLB 7<br>R/W<br>0  | RLB 6<br>R/W<br>0  | RLB 5<br>R/W<br>0  | RLB 4<br>R/W<br>0  | RLB 3<br>R/W<br>0  | RLB 2<br>R/W<br>0  | RLB 1<br>R/W<br>0  | RLB 0<br>R/W<br>0  |
| TAO      | 03 Hex<br>R/W<br>Default  | TAO 7<br>R/W<br>0  | TAO 6<br>R/W<br>0  | TAO 5<br>R/W<br>0  | TAO 4<br>R/W<br>0  | TAO 3<br>R/W<br>0  | TAO 2<br>R/W<br>0  | TAO 1<br>R/W<br>0  | TAO 0<br>R/W<br>0  |
| LOS      | 04 Hex<br>R/W<br>Default  | LOS 7<br>R<br>0    | LOS 6<br>R<br>0    | LOS 5<br>R<br>0    | LOS 4<br>R<br>0    | LOS 3<br>R<br>0    | LOS 2<br>R<br>0    | LOS 1<br>R<br>0    | LOS 0<br>R<br>0    |
| SC       | 05 Hex<br>R/W<br>Default  | SC 7<br>R<br>0     | SC 6<br>R<br>0     | SC 5<br>R<br>0     | SC 4<br>R<br>0     | SC 3<br>R<br>0     | SC 2<br>R<br>0     | SC 1<br>R<br>0     | SC 0<br>R<br>0     |
| LOSM     | 06 Hex<br>R/W<br>Default  | LOSM 7<br>R/W<br>0 | LOSM 6<br>R/W<br>0 | LOSM 5<br>R/W<br>0 | LOSM 4<br>R/W<br>0 | LOSM 3<br>R/W<br>0 | LOSM 2<br>R/W<br>0 | LOSM 1<br>R/W<br>0 | LOSM 0<br>R/W<br>0 |
| SCM      | 07 Hex<br>R/W<br>Default  | SCM 7<br>R/W<br>0  | SCM 6<br>R/W<br>0  | SCM 5<br>R/W<br>0  | SCM 4<br>R/W<br>0  | SCM 3<br>R/W<br>0  | SCM 2<br>R/W<br>0  | SCM 1<br>R/W<br>0  | SCM 0<br>R/W<br>0  |
| LOSI     | 08 Hex<br>R/W<br>Default  | LOSI 7<br>R<br>0   | LOSI 6<br>R<br>0   | LOSI 5<br>R<br>0   | LOSI 4<br>R<br>0   | LOSI 3<br>R<br>0   | LOSI 2<br>R<br>0   | LOSI 1<br>R<br>0   | LOSI 0<br>R<br>0   |
| SCI      | 09 Hex<br>R/W<br>Default  | SCI 7<br>R<br>0    | SCI 6<br>R<br>0    | SCI 5<br>R<br>0    | SCI 4<br>R<br>0    | SCI 3<br>R<br>0    | SCI 2<br>R<br>0    | SCI 1<br>R<br>0    | SCI 0<br>R<br>0    |
| RS       | 0A Hex<br>W<br>Default    | RS 7<br>W<br>1     | RS 6<br>W<br>1     | RS 5<br>W<br>1     | RS 4<br>W<br>1     | RS 3<br>W<br>1     | RS 2<br>W<br>1     | RS 1<br>W<br>1     | RS 0<br>W<br>1     |
| PMON     | 0B Hex<br>R/W<br>Default  | -<br>R/W<br>0      | -<br>R/W<br>0      | -<br>R/W<br>0      | -<br>R/W<br>0      | MC 3<br>R/W<br>0   | MC 2<br>R/W<br>0   | MC 1<br>R/W<br>0   | MC 0<br>R/W<br>0   |
| DLB      | 0C Hex<br>R/W<br>Default  | DLB 7<br>R/W<br>0  | DLB 6<br>R/W<br>0  | DLB 5<br>R/W<br>0  | DLB 4<br>R/W<br>0  | DLB 3<br>R/W<br>0  | DLB 2<br>R/W<br>0  | DLB 1<br>R/W<br>0  | DLB 0<br>R/W<br>0  |
| LAC      | 0D Hex<br>R/W<br>Default  | LAC 7<br>R/W<br>0  | LAC 6<br>R/W<br>0  | LAC 5<br>R/W<br>0  | LAC 4<br>R/W<br>0  | LAC 3<br>R/W<br>0  | LAC 2<br>R/W<br>0  | LAC 1<br>R/W<br>0  | LAC 0<br>R/W<br>0  |
| ATAO     | 0E Hex<br>R/W<br>Default  | ATAO 7<br>R/W<br>0 | ATAO 6<br>R/W<br>0 | ATAO 5<br>R/W<br>0 | ATAO 4<br>R/W<br>0 | ATAO 3<br>R/W<br>0 | ATAO 2<br>R/W<br>0 | ATAO 1<br>R/W<br>0 | ATAO 0<br>R/W<br>0 |
| GCF      | 0F Hex<br>R/W<br>Default  | -<br>R/W<br>0      | AISE<br>R/W<br>0   | SCPB<br>R/W<br>0   | CODE<br>R/W<br>0   | JADP<br>R/W<br>0   | JABW<br>R/W<br>0   | JACF 1<br>R/W<br>0 | JACF 0<br>R/W<br>0 |

TABLE - 13. PRIMARY REGISTER MAP (CONTINUED)

| Register | Address<br>R/W<br>Default | b7                 | b6                 | b5                 | b4                 | b3                 | b2                 | b1                 | b0                 |
|----------|---------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| OE       | 12 Hex<br>R/W<br>Default  | OE 7<br>R/W<br>0   | OE 6<br>R/W<br>0   | OE 5<br>R/W<br>0   | OE 4<br>R/W<br>0   | OE 3<br>R/W<br>0   | OE 2<br>R/W<br>0   | OE 1<br>R/W<br>0   | OE 0<br>R/W<br>0   |
| AIS      | 13 Hex<br>R/W<br>Default  | AIS 7<br>R<br>0    | AIS 6<br>R<br>0    | AIS 5<br>R<br>0    | AIS 4<br>R<br>0    | AIS 3<br>R<br>0    | AIS 2<br>R<br>0    | AIS 1<br>R<br>0    | AIS 0<br>R<br>0    |
| AISM     | 14 Hex<br>R/W<br>Default  | AISM 7<br>R/W<br>0 | AISM 6<br>R/W<br>0 | AISM 5<br>R/W<br>0 | AISM 4<br>R/W<br>0 | AISM 3<br>R/W<br>0 | AISM 2<br>R/W<br>0 | AISM 1<br>R/W<br>0 | AISM 0<br>R/W<br>0 |
| AISI     | 15 Hex<br>R/W<br>Default  | AISI 7<br>R<br>0   | AISI 6<br>R<br>0   | AISI 5<br>R<br>0   | AISI 4<br>R<br>0   | AISI 3<br>R<br>0   | AISI 2<br>R<br>0   | AISI 1<br>R<br>0   | AISI 0<br>R<br>0   |
| ADDP     | 1F Hex<br>R/W<br>Default  | ADDP 7<br>R/W<br>0 | ADDP 6<br>R/W<br>0 | ADDP 5<br>R/W<br>0 | ADDP 4<br>R/W<br>0 | ADDP 3<br>R/W<br>0 | ADDP 2<br>R/W<br>0 | ADDP 1<br>R/W<br>0 | ADDP 0<br>R/W<br>0 |

TABLE - 14. EXPANDED (INDIRECT ADDRESS MODE) REGISTER MAP

| Register | Address<br>R/W<br>Default | b7                 | b6                 | b5                 | b4                 | b3                 | b2                 | b1                 | b0                 |
|----------|---------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| e-SING   | 00 Hex<br>R/W<br>Default  | SING 7<br>R/W<br>0 | SING 6<br>R/W<br>0 | SING 5<br>R/W<br>0 | SING 4<br>R/W<br>0 | SING 3<br>R/W<br>0 | SING 2<br>R/W<br>0 | SING 1<br>R/W<br>0 | SING 0<br>R/W<br>0 |
| e-CODE   | 01 Hex<br>R/W<br>Default  | CODE 7<br>R/W<br>0 | CODE 6<br>R/W<br>0 | CODE 5<br>R/W<br>0 | CODE 4<br>R/W<br>0 | CODE 3<br>R/W<br>0 | CODE 2<br>R/W<br>0 | CODE 1<br>R/W<br>0 | CODE 0<br>R/W<br>0 |
| e-CRS    | 02 Hex<br>R/W<br>Default  | CRS 7<br>R/W<br>0  | CRS 6<br>R/W<br>0  | CRS 5<br>R/W<br>0  | CRS 4<br>R/W<br>0  | CRS 3<br>R/W<br>0  | CRS 2<br>R/W<br>0  | CRS 1<br>R/W<br>0  | CRS 0<br>R/W<br>0  |
| e-RPDN   | 03 Hex<br>R/W<br>Default  | RPDN 7<br>R/W<br>0 | RPDN 6<br>R/W<br>0 | RPDN 5<br>R/W<br>0 | RPDN 4<br>R/W<br>0 | RPDN 3<br>R/W<br>0 | RPDN 2<br>R/W<br>0 | RPDN 1<br>R/W<br>0 | RPDN 0<br>R/W<br>0 |
| e-TPDN   | 04 Hex<br>R/W<br>Default  | TPDN 7<br>R/W<br>0 | TPDN 6<br>R/W<br>0 | TPDN 5<br>R/W<br>0 | TPDN 4<br>R/W<br>0 | TPDN 3<br>R/W<br>0 | TPDN 2<br>R/W<br>0 | TPDN 1<br>R/W<br>0 | TPDN 0<br>R/W<br>0 |
| e-CZER   | 05 Hex<br>R/W<br>Default  | CZER 7<br>R/W<br>0 | CZER 6<br>R/W<br>0 | CZER 5<br>R/W<br>0 | CZER 4<br>R/W<br>0 | CZER 3<br>R/W<br>0 | CZER 2<br>R/W<br>0 | CZER 1<br>R/W<br>0 | CZER 0<br>R/W<br>0 |
| e-CODV   | 06 Hex<br>R/W<br>Default  | CODV 7<br>R/W<br>0 | CODV 6<br>R/W<br>0 | CODV 5<br>R/W<br>0 | CODV 4<br>R/W<br>0 | CODV 3<br>R/W<br>0 | CODV 2<br>R/W<br>0 | CODV 1<br>R/W<br>0 | CODV 0<br>R/W<br>0 |
| e-EQUA   | 07 Hex<br>R/W<br>Default  | EQUA 7<br>R/W<br>0 | EQUA 6<br>R/W<br>0 | EQUA 5<br>R/W<br>0 | EQUA 4<br>R/W<br>0 | EQUA 3<br>R/W<br>0 | EQUA 2<br>R/W<br>0 | EQUA 1<br>R/W<br>0 | EQUA 0<br>R/W<br>0 |
| ADDP     | 1F Hex<br>R/W<br>Default  | ADDP 7<br>R/W<br>0 | ADDP 6<br>R/W<br>0 | ADDP 5<br>R/W<br>0 | ADDP 4<br>R/W<br>0 | ADDP 3<br>R/W<br>0 | ADDP 2<br>R/W<br>0 | ADDP 1<br>R/W<br>0 | ADDP 0<br>R/W<br>0 |

## REGISTER DESCRIPTION

*Primary Register Description*

ID: Device ID Register (R, Address = 00 Hex)

| Symbol  | Position | Default | Description  |
|---------|----------|---------|--|
| ID[7:0] | ID.7-0   | 10 H    | An 8-bit word is pre-set into the device as the identification and revision number. This number is different with the functional changes and is mask programmed. |

ALB: Analog Loopback Configuration Register (R/W, Address = 01 Hex)

| Symbol   | Position | Default | Description   |
|----------|----------|---------|---|
| ALB[7:0] | ALB.7-0  | 00 H    | 0 = Normal operation. (Default)<br>1 = Analog Loopback enabled. |

RLB: Remote Loopback Configuration Register (R/W, Address = 02 Hex)

| Symbol   | Position | Default | Description   |
|----------|----------|---------|---|
| RLB[7:0] | RLB.7-0  | 00 H    | 0 = Normal operation. (Default)<br>1 = Remote Loopback enabled. |

TAO: Transmit All One Code Configuration Register (R/W, Address = 03 Hex)

| Symbol   | Position | Default | Description   |
|----------|----------|---------|---|
| TAO[7:0] | TAO.7-0  | 00 H    | 0 = Normal operation. (Default)<br>1 = Transmit all one code. |

LOS: Loss of Signal Status Register (R, Address = 04 Hex)

| Symbol   | Position | Default | Description   |
|----------|----------|---------|---|
| LOS[7:0] | LOS.7-0  | 00 H    | 0 = Normal operation. (Default)<br>1 = Loss of signal detected. |

SC: Short Circuit Status Register (R, Address = 05 Hex)

| Symbol  | Position | Default | Description  |
|---------|----------|---------|--|
| SC[7:0] | SC.7-0   | 00 H    | 0 = Normal operation. (Default)<br>1 = Short circuit detected. |

LOSM: Loss of Signal Interrupt Mask Register (R/W, Address = 06 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| LOSM[7:0] | LOSM.7-0 | 00 H    | 0 = LOS interrupt is not allowed. (Default)<br>1 = LOS interrupt is allowed. |

SCM: Short Circuit Interrupt Mask Register (R/W, Address = 07 Hex)

| Symbol   | Position | Default | Description  |
|----------|----------|---------|--|
| SCM[7:0] | SCM.7-0  | 00 H    | 0 = Short circuit interrupt is not allowed. (Default)<br>1 = Short circuit interrupt is allowed. |

LOSI: Loss of Signal Interrupt Status Register (R, Address = 08 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| LOSI[7:0] | LOSI.7-0 | 00 H    | 0 = (Default). Or after a LOS read operation.<br>1 = Any transition on LOS <sub>n</sub> (Corresponding LOSM <sub>n</sub> is set to 1). |

**SCI:** Short Circuit Interrupt Status Register (R, Address = 09 Hex)

| Symbol   | Position | Default | Description   |
|----------|----------|---------|---|
| SCI[7:0] | SCI.7-0  | 00 H    | 0 = (Default). Or after an <b>SC</b> read operation.<br>1 = Any transition on <b>SCn</b> (Corresponding <b>SCMn</b> is set to 1). |

**RS:** Software Reset Register (W, Address = 0A Hex)

| Symbol  | Position | Default | Description  |
|---------|----------|---------|--|
| RS[7:0] | RS.7-0   | FF H    | Writing to this register will not change the content in this register but initiate a 1μs reset cycle, which means all the registers in the device are set to their default values. |

**PMON:** Performance Monitor Configuration Register (R/W, Address = 0B Hex)

| Symbol  | Position | Default | Description                                      |
|---------|----------|---------|--|
| -       | PMON.7-4 | 0000    | 0 = Normal operation. (Default)<br>1 = Reserved. |
| MC[3:0] | PMON.3-0 | 0000    | <b>MC[3:0]</b>                                   |
|         |          |         | <b>Monitoring Configuration</b>                  |
|         |          |         | 0000 Normal operation without monitoring.        |
|         |          |         | 0001 Monitoring receiver 1.                      |
|         |          |         | 0010 Monitoring receiver 2.                      |
|         |          |         | 0011 Monitoring receiver 3.                      |
|         |          |         | 0100 Monitoring receiver 4.                      |
|         |          |         | 0101 Monitoring receiver 5.                      |
|         |          |         | 0110 Monitoring receiver 6.                      |
|         |          |         | 0111 Monitoring receiver 7.                      |
|         |          |         | 1000 Normal operation without monitoring.        |
|         |          |         | 1001 Monitoring transmitter 1.                   |
|         |          |         | 1010 Monitoring transmitter 2.                   |
|         |          |         | 1011 Monitoring transmitter 3.                   |
|         |          |         | 1100 Monitoring transmitter 4.                   |
|         |          |         | 1101 Monitoring transmitter 5.                   |
|         |          |         | 1110 Monitoring transmitter 6.                   |
|         |          |         | 1111 Monitoring transmitter 7.                   |

**DLB:** Digital Loopback Configuration Register (R/W, Address = 0C Hex)

| Symbol   | Position | Default | Description  |
|----------|----------|---------|--|
| DLB[7:0] | DLB.7-0  | 00 H    | 0 = Normal operation. (Default)<br>1 = Digital Loopback enabled. |

**LAC:** LOS/AIS Criteria Configuration Register (R/W, Address = 0D Hex)

| Symbol   | Position | Default | Description  |
|----------|----------|---------|--|
| LAC[7:0] | LAC.7-0  | 00 H    | 0 = G.775 mode. (Default)<br>1 = ETSI 300233 mode. |

**ATAO:** Automatic TAO Configuration Register (R/W, Address = 0E Hex)

| Symbol    | Position | Default | Description   |
|-----------|----------|---------|---|
| ATAO[7:0] | ATAO.7-0 | 00 H    | 0 = No automatic TAO. (Default)<br>1 = Automatic transmit all ones to the line side on LOS. |

**GCF:** Global Configuration Register (R/W, Address = 0F Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| -         | GCF.7    | 0       | 0 = Normal operation. (Default)<br>1 = Reserved.   |
| AISE      | GCF.6    | 0       | <b>AIS Enable During LOS.</b><br>0 = AIS insertion to the system side disabled on LOS. (Default)<br>1 = AIS insertion to the system side enabled on LOS. |
| SCPB      | GCF.5    | 0       | <b>Short Circuit Protection Enable.</b><br>0 = Short circuit protection is enabled. (Default)<br>1 = Short circuit protection is disabled.               |
| CODE      | GCF.4    | 0       | <b>Line Code Enable.</b><br>0 = B8ZS/HDB3 encoder/decoder enabled. (Default)<br>1 = AMI encoder/decoder enabled.   |
| JADP      | GCF.3    | 0       | <b>Jitter Attenuator Depth Select.</b><br>0 = 32-bit FIFO. (Default)<br>1 = 64-bit FIFO.   |
| JABW      | GCF.2    | 0       | <b>Jitter Transfer Function Bandwidth Select.</b><br>0 = 1.7Hz. (Default)<br>1 = 6.6Hz.  |
| JACF[1:0] | GCF.1-0  | 00      | <b>Jitter Attenuator Configuration.</b><br>00 = JA not used. (Default)<br>01 = JA in transmit path.<br>10 = JA not used.<br>11 = JA in receive path.     |

**OE:** Output Enable Configuration Register (R/W, Address = 12 Hex)

| Symbol  | Position | Default | Description   |
|---------|----------|---------|---|
| OE[7:0] | OE.7-0   | 00 H    | 0 = Transmit drivers enabled. (Default)<br>1 = Transmit drivers placed in high impedance state. |

**AIS:** Alarm Indication Signal Status Register (R, Address = 13 Hex)

| Symbol   | Position | Default | Description  |
|----------|----------|---------|--|
| AIS[7:0] | AIS.7-0  | 00 H    | 0 = Normal operation. (Default)<br>1 = AIS detected. |

**AISM:** Alarm Indication Signal Interrupt Mask Register (R/W, Address = 14 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| AISM[7:0] | AISM.7-0 | 00 H    | 0 = AIS interrupt is not allowed. (Default)<br>1 = AIS interrupt is allowed. |

**AISI:** Alarm Indication Signal Interrupt Status Register (R, Address = 15 Hex)

| Symbol    | Position | Default | Description   |
|-----------|----------|---------|---|
| AISI[7:0] | AISI.7-0 | 00 H    | 0 = (Default), or after an <b>AIS</b> read operation<br>1 = Any transition on <b>AISn</b> . (Corresponding <b>AISMn</b> is set to 1.) |

**ADDP:** Address Pointer Control Register (R/W, Address = 1F Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| ADDP[7:0] | ADDP.7-0 | 00 H    | Two kinds of configuration in this register can be set to switch between primary register bank and expanded register bank. When power up, the address pointer will point to the top address of primary register bank automatically.<br>00H = The address pointer points to the top address of primary register bank (default).<br>AAH = The address pointer points to the top address of expanded register bank. |

**Expanded Register Description****e-SING:** Single Rail Mode Setting Register (R/W, Expanded Address = 00 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| SING[7:0] | SING.7-0 | 00 H    | 0 = Pin TDNn selects single rail mode or dual rail mode. (Default)<br>1 = Single rail mode enabled (with CRSn=0) |

**e-CODE:** Encoder/Decoder Selection Register (R/W, Expanded Address = 01 Hex)

| Symbol    | Position | Default | Description   |
|-----------|----------|---------|---|
| CODE[7:0] | CODE.7-0 | 00 H    | <b>Line Code Selection.</b><br>CODEn selects AMI or B8ZS/HDB3 encoder/decoder on per-channel basis with SINGn = 1 and CRSn = 0.<br>0 = B8ZS/HDB3 encoder/decoder enabled. (Default)<br>1 = AMI encoder/decoder enabled. |

**e-CRS:** Clock Recovery Enable/Disable Selection Register (R/W, Expanded Address = 02 Hex)

| Symbol   | Position | Default | Description   |
|----------|----------|---------|---|
| CRS[7:0] | CRS.7-0  | 00 H    | 0 = Clock recovery enabled. (Default)<br>1 = Clock recovery disabled. |

**e-RPDN:** Receiver n Powerdown Register (R/W, Expanded Address = 03 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| RPDN[7:0] | RPDN.7-0 | 00 H    | 0 = Normal operation. (Default)<br>1 = Power down in receiver n. |

**e-TPDN:** Transmitter n Powerdown Register (R/W, Expanded Address = 04 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| TPDN[7:0] | TPDN.7-0 | 00 H    | 0 = Normal operation. (Default)<br>1 = Power down in Transmitter n (the corresponding transmit output driver enters a low power high impedance mode).<br><i>Note that transmitter n is power down when either pin TCLKn is pulled to low or TPDNn is set to 1.</i> |

**e-CZER:** Consecutive Zero Detect Enable/Disable Register (R/W, Expanded Address = 05 Hex)

| Symbol    | Position | Default | Description   |
|-----------|----------|---------|---|
| CZER[7:0] | CZER.7-0 | 00 H    | 0 = Excessive zero detect disabled. (Default)<br>1 = Excessive zero detect enabled for B8ZS/HDB3 decoder in single rail mode. |

**e-CODV:** Code Violation Detect Enable/Disable Register (R/W, Expanded Address = 06 Hex)

| Symbol    | Position | Default | Description  |
|-----------|----------|---------|--|
| CODV[7:0] | CODV.7-0 | 00 H    | 0 = Code Violation Detect enable for HDB3 decoder in single rail mode. (Default)<br>1 = Code Violation Detect disable. |

**e-EQUA:** Receive Equalizer Enable/Disable Register (R/W, Expanded Address = 07 Hex)

| Symbol    | Position | Default | Description   |
|-----------|----------|---------|---|
| EQUA[7:0] | EQUA.7-0 | 00 H    | 0 = Normal operation. (Default)<br>1 = Equalizer in Receiver n enabled, which can improved the receive performance when transmission length is more than 200 m. |

**Reserved Registers:** Primary Registers 10, 11, 16 - 1E are reserved.

**Test Registers:** Expand Registers 08 - 1E are test registers. They must be set to 0.

## IEEE STD 1149.1 JTAG TEST ACCESS PORT

The IDT82V2048 supports the digital Boundary Scan Specification as described in the IEEE 1149.1 standards.

The boundary scan architecture consists of data and instruction registers plus a Test Access Port (TAP) controller. Control of the TAP is achieved through signals applied to the Test Mode Select (TMS) and Test Clock (TCK) input pins. Data is shifted into the registers via the Test Data Input (TDI) pin, and shifted out of the registers via the Test Data Output (TDO) pin. Both TDI and TDO are clocked at a rate determined by TCK.

The JTAG boundary scan registers includes BSR (Boundary Scan Register), IDR (Device Identification Register), BR (Bypass Register) and IR (Instruction Register). These will be described in the following pages. Refer to Figure-18 for architecture.

### JTAG INSTRUCTIONS AND INSTRUCTION REGISTER (IR)

The IR (Instruction Register) with instruction decode block is used to select the test to be executed or the data register to be accessed or both.

The instructions are shifted in LSB first to this 3-bit register. See Table-15 for details of the codes and the instructions related.

### JTAG DATA REGISTER

#### Device Identification Register (IDR)

The IDR can be set to define the producer number, part number and the device revision, which can be used to verify the proper version or revision number that has been used in the system under test. The IDR is 32 bits long and is partitioned as in Table-16. Data from the IDR is shifted out to TDO LSB first.

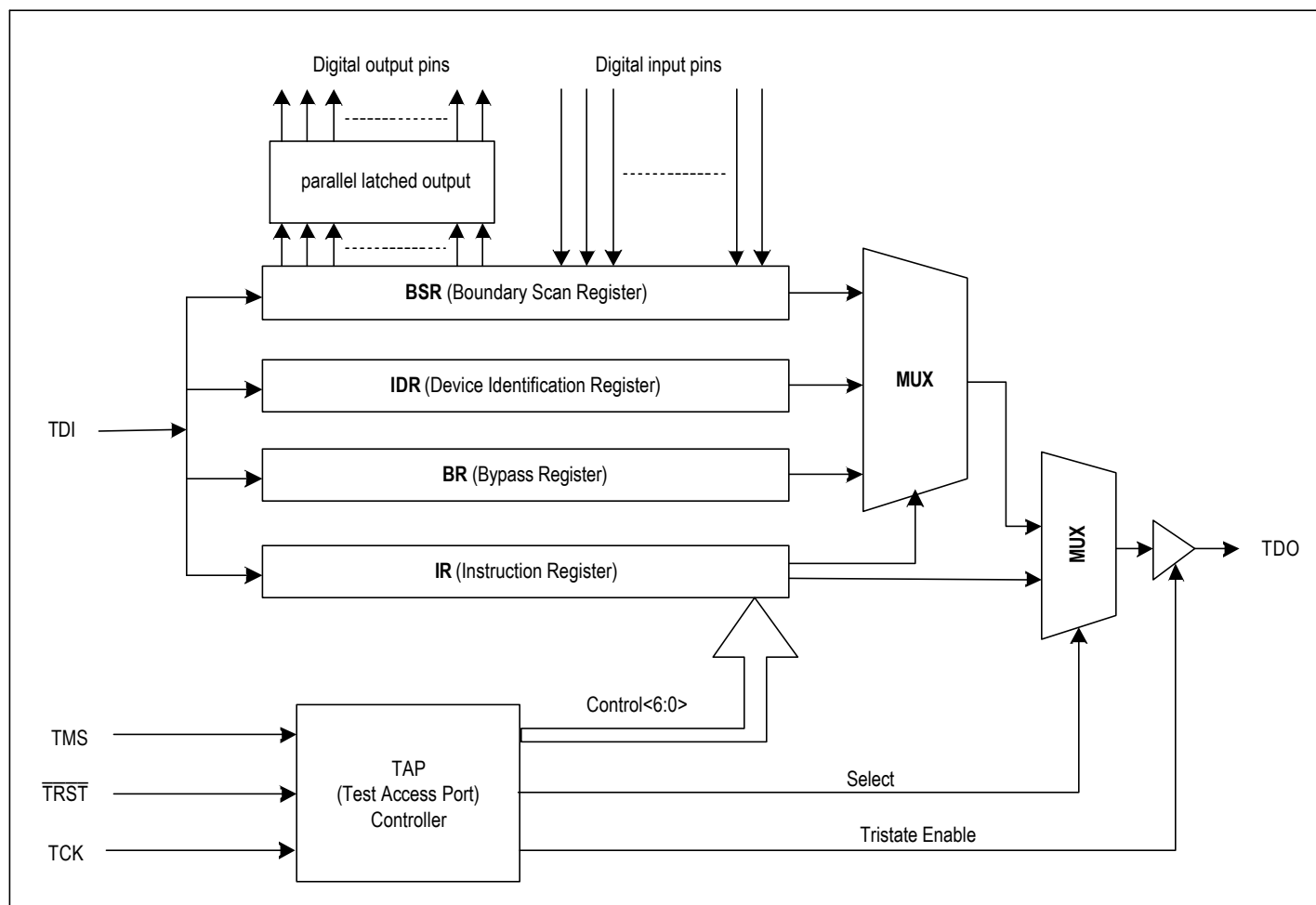


Figure - 18. JTAG Architecture



TABLE - 15. INSTRUCTION REGISTER DESCRIPTION

| IR CODE | INSTRUCTION      | COMMENTS   |
|---------|------------------|--|
| 000     | Extest           | The external test instruction allows testing of the interconnection to other devices. When the current instruction is the EXTEST instruction, the boundary scan register is placed between TDI and TDO. The signal on the input pins can be sampled by loading the boundary scan register using the Capture-DR state. The sampled values can then be viewed by shifting the boundary scan register using the Shift-DR state. The signal on the output pins can be controlled by loading patterns shifted in through input TDI into the boundary scan register using the Update-DR state. |
| 100     | Sample / Preload | The sample instruction samples all the device inputs and outputs. For this instruction, the boundary scan register is placed between TDI and TDO. The normal path between the IDT82V2058 logic and the I/O pins is maintained. Primary device inputs and outputs can be sampled by loading the boundary scan register using the Capture-DR state. The sampled values can then be viewed by shifting the boundary scan register using the Shift-DR state.   |
| 110     | Idcode           | The identification instruction is used to connect the identification register between TDI and TDO. The device's identification code can then be shifted out using the Shift-DR state.  |
| 111     | Bypass           | The bypass instruction shifts data from input TDI to output TDO with one TCK clock period delay. The instruction is used to bypass the device.   |

TABLE - 16. DEVICE IDENTIFICATION REGISTER DESCRIPTION

| BIT No. | COMMENTS        |
|---------|-----------------|
| 0       | Set to "1"      |
| 1~11    | Producer Number |
| 12~27   | Part Number     |
| 28~31   | Device Revision |

**Bypass Register (BR)**

The BR consists of a single bit. It can provide a serial path between the TDI input and TDO output, bypassing the BSR to reduce test access times.

**Boundary Scan Register (BSR)**

The BSR can apply and read test patterns in parallel to or from all the digital I/O pins. The BSR is a 98 bits long shift register and is initialized and read using the instruction EXTEST or SAMPLE/PRELOAD. Each pin is related to one or more bits in the BSR. *Please refer to Table-17 for details of BSR bits and their functions.*

**TEST ACCESS PORT CONTROLLER**

The TAP controller is a 16-state synchronous state machine. *Figure-19* shows its state diagram. A description of each state follows. Note that the figure contains two main branches to access either the data or instruction registers. The value shown next to each state transition in this figure states the value present at TMS at each rising edge of TCK. *Please refer to Table-18 for details of the state description.*

TABLE - 17. BOUNDARY SCAN REGISTER DESCRIPTION

| BIT No. | BIT SYMBOL | PIN SIGNAL | TYPE | COMMENTS |
|---------|------------|------------|------|----------|
| 0       | POUT0      | LP0        | I/O  |          |
| 1       | PIN0       | LP0        | I/O  |          |
| 2       | POUT1      | LP1        | I/O  |          |
| 3       | PIN1       | LP1        | I/O  |          |
| 4       | POUT2      | LP2        | I/O  |          |
| 5       | PIN2       | LP2        | I/O  |          |
| 6       | POUT3      | LP3        | I/O  |          |
| 7       | PIN3       | LP3        | I/O  |          |
| 8       | POUT4      | LP4        | I/O  |          |
| 9       | PIN4       | LP4        | I/O  |          |
| 10      | POUT5      | LP5        | I/O  |          |
| 11      | PIN5       | LP5        | I/O  |          |
| 12      | POUT6      | LP6        | I/O  |          |
| 13      | PIN6       | LP6        | I/O  |          |
| 14      | POUT7      | LP7        | I/O  |          |
| 15      | PIN7       | LP7        | I/O  |          |

TABLE - 17. BOUNDARY SCAN REGISTER DESCRIPTION (CONTINUED)

| BIT No. | BIT SYMBOL | PIN SIGNAL               | TYPE | COMMENTS   |
|---------|------------|--------------------------|------|--|
| 16      | PIOS       | N/A                      | -    | Controls pin LP7~0.<br>When "0", the pins are configured as outputs. The output values to the pins are set in POUT7~0.<br>When "1", the pins are tristated. The input values to the pins are read in PIN7~0. |
| 17      | TCLK1      | TCLK1                    | I    |  |
| 18      | TDP1       | TDP1                     | I    |  |
| 19      | TDN1       | TDN1                     | I    |  |
| 20      | RCLK1      | RCLK1                    | O    |  |
| 21      | RDP1       | RDP1                     | O    |  |
| 22      | RDN1       | RDN1                     | O    |  |
| 23      | HZEN1      | N/A                      | -    | Controls pin RDP1, RDN1 and RCLK1.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated.  |
| 24      | LOS1       | LOS1                     | O    |  |
| 25      | TCLK0      | TCLK0                    | I    |  |
| 26      | TDP0       | TDP0                     | I    |  |
| 27      | TDN0       | TDN0                     | I    |  |
| 28      | RCLK0      | RCLK0                    | O    |  |
| 29      | RDP0       | RDP0                     | O    |  |
| 30      | RDN0       | RDN0                     | O    |  |
| 31      | HZEN0      | N/A                      | -    | Controls pin RDP0, RDN0 and RCLK0.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated.  |
| 32      | LOS0       | LOS0                     | O    |  |
| 33      | MODE1      | MODE1                    | I    |  |
| 34      | LOS3       | LOS3                     | O    |  |
| 35      | RDN3       | RDN3                     | O    |  |
| 36      | RDP3       | RDP3                     | O    |  |
| 37      | HZEN3      | N/A                      | -    | Controls pin RDP3, RDN3 and RCLK3.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated.  |
| 38      | RCLK3      | RCLK3                    | O    |  |
| 39      | TDN3       | TDN3                     | I    |  |
| 40      | TDP3       | TDP3                     | I    |  |
| 41      | TCLK3      | TCLK3                    | I    |  |
| 42      | LOS2       | LOS2                     | O    |  |
| 43      | RDN2       | RDN2                     | O    |  |
| 44      | RDP2       | RDP2                     | O    |  |
| 45      | HZEN2      | N/A                      | -    | Controls pin RDP2, RDN2 and RCLK2.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated.  |
| 46      | RCLK2      | RCLK2                    | O    |  |
| 47      | TDN2       | TDN2                     | I    |  |
| 48      | TDP2       | TDP2                     | I    |  |
| 49      | TCLK2      | TCLK2                    | I    |  |
| 50      | INT        | $\overline{\text{INT}}$  | O    |  |
| 51      | ACK        | $\overline{\text{ACK}}$  | O    |  |
| 52      | SDORDYS    | N/A                      | -    | Control pin $\overline{\text{ACK}}$ .<br>When "0", the output is enabled on pin $\overline{\text{ACK}}$ .<br>When "1", the pin is tristated.   |
| 53      | WRB        | $\overline{\text{DS}}$   | I    |  |
| 54      | RDB        | R/ $\overline{\text{W}}$ | I    |  |
| 55      | ALE        | ALE                      | I    |  |

TABLE - 17. BOUNDARY SCAN REGISTER DESCRIPTION (CONTINUED)

| BIT No. | BIT SYMBOL | PIN SIGNAL      | TYPE | COMMENTS  |
|---------|------------|-----------------|------|---|
| 56      | CSB        | $\overline{CS}$ | I    |   |
| 57      | MODE0      | MODE0           | I    |   |
| 58      | TCLK5      | TCLK5           | I    |   |
| 59      | TDP5       | TDP5            | I    |   |
| 60      | TDN5       | TDN5            | I    |   |
| 61      | RCLK5      | RCLK5           | O    |   |
| 62      | RDP5       | RDP5            | O    |   |
| 63      | RDN5       | RDN5            | O    |   |
| 64      | HZEN5      | N/A             | -    | Controls pin RDP5, RDN5 and RCLK5.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated. |
| 65      | LOS5       | LOS5            | O    |   |
| 66      | TCLK4      | TCLK4           | I    |   |
| 67      | TDP4       | TDP4            | I    |   |
| 68      | TDN4       | TDN4            | I    |   |
| 69      | RCLK4      | RCLK4           | O    |   |
| 70      | RDP4       | RDP4            | O    |   |
| 71      | RDN4       | RDN4            | O    |   |
| 72      | HZEN4      | N/A             | -    | Controls pin RDP4, RDN4 and RCLK4.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated. |
| 73      | LOS4       | LOS4            | O    |   |
| 74      | OE         | OE              | I    |   |
| 75      | CLKE       | CLKE            | I    |   |
| 76      | LOS7       | LOS7            | O    |   |
| 77      | RDN7       | RDN7            | O    |   |
| 78      | RDP7       | RDP7            | O    |   |
| 79      | HZEN7      | N/A             | -    | Controls pin RDP7, RDN7 and RCLK7.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated. |
| 80      | RCLK7      | RCLK7           | O    |   |
| 81      | TDN7       | TDN7            | I    |   |
| 82      | TDP7       | TDP7            | I    |   |
| 83      | TCLK7      | TCLK7           | I    |   |
| 84      | LOS6       | LOS6            | O    |   |
| 85      | RDN6       | RDN6            | O    |   |
| 86      | RDP6       | RDP6            | O    |   |
| 87      | HZEN6      | N/A             | -    | Controls pin RDP6, RDN6 and RCLK6.<br>When "0", the outputs are enabled on the pins.<br>When "1", the pins are tristated. |
| 88      | RCLK6      | RCLK6           | O    |   |
| 89      | TDN6       | TDN6            | I    |   |
| 90      | TDP6       | TDP6            | I    |   |
| 91      | TCLK6      | TCLK6           | I    |   |
| 92      | MCLK       | MCLK            | I    |   |
| 93      | MODE2      | MODE2           | I    |   |
| 94      | A4         | A4              | I    |   |
| 95      | A3         | A3              | I    |   |
| 96      | A2         | A2              | I    |   |
| 97      | A1         | A1              | I    |   |
| 98      | A0         | A0              | I    |   |

TABLE - 18. TAP CONTROLLER STATE DESCRIPTION

| STATE            | DESCRIPTION  |
|------------------|--|
| Test Logic Reset | <p>In this state, the test logic is disabled. The device is set to normal operation. During initialization, the device initializes the instruction register with the IDCODE instruction.</p> <p>Regardless of the original state of the controller, the controller enters the Test-Logic-Reset state when the TMS input is held high for at least 5 rising edges of TCK. The controller remains in this state while TMS is high. The device processor automatically enters this state at power-up.</p>   |
| Run-Test/Idle    | <p>This is a controller state between scan operations. Once in this state, the controller remains in the state as long as TMS is held low. The instruction register and all test data registers retain their previous state. When TMS is high and a rising edge is applied to TCK, the controller moves to the Select-DR state.</p>  |
| Select-DR-Scan   | <p>This is a temporary controller state and the instruction does not change in this state. The test data register selected by the current instruction retains its previous state. If TMS is held low and a rising edge is applied to TCK when in this state, the controller moves into the Capture-DR state and a scan sequence for the selected test data register is initiated. If TMS is held high and a rising edge applied to TCK, the controller moves to the Select-IR-Scan state.</p>  |
| Capture-DR       | <p>In this state, the Boundary Scan Register captures input pin data if the current instruction is EXTEST or SAMPLE/PRELOAD. The instruction does not change in this state. The other test data registers, which do not have parallel input, are not changed. When the TAP controller is in this state and a rising edge is applied to TCK, the controller enters the Exit1-DR state if TMS is high or the Shift-DR state if TMS is low.</p>   |
| Shift-DR         | <p>In this controller state, the test data register connected between TDI and TDO as a result of the current instruction shifts data on stage toward its serial output on each rising edge of TCK. The instruction does not change in this state. When the TAP controller is in this state and a rising edge is applied to TCK, the controller enters the Exit1-DR state if TMS is high or remains in the Shift-DR state if TMS is low.</p>  |
| Exit1-DR         | <p>This is a temporary state. While in this state, if TMS is held high, a rising edge applied to TCK causes the controller to enter the Update-DR state, which terminates the scanning process. If TMS is held low and a rising edge is applied to TCK, the controller enters the Pause-DR state. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state.</p>   |
| Pause-DR         | <p>The pause state allows the test controller to temporarily halt the shifting of data through the test data register in the serial path between TDI and TDO. For example, this state could be used to allow the tester to reload its pin memory from disk during application of a long test sequence. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state. The controller remains in this state as long as TMS is low. When TMS goes high and a rising edge is applied to TCK, the controller moves to the Exit2-DR state.</p>                      |
| Exit2-DR         | <p>This is a temporary state. While in this state, if TMS is held high, a rising edge applied to TCK causes the controller to enter the Update-DR state, which terminates the scanning process. If TMS is held low and a rising edge is applied to TCK, the controller enters the Shift-DR state. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state.</p>   |
| Update-DR        | <p>The Boundary Scan Register is provided with a latched parallel output to prevent changes while data is shifted in response to the EXTEST and SAMPLE/PRELOAD instructions. When the TAP controller is in this state and the Boundary Scan Register is selected, data is latched into the parallel output of this register from the shift-register path on the falling edge of TCK. The data held at the latched parallel output changes only in this state. All shift-register stages in the test data register selected by the current instruction retain their previous value and the instruction does not change during this state.</p> |
| Select-IR-Scan   | <p>This is a temporary controller state. The test data register selected by the current instruction retains its previous state. If TMS is held low and a rising edge is applied to TCK when in this state, the controller moves into the Capture-IR state, and a scan sequence for the instruction register is initiated. If TMS is held high and a rising edge is applied to TCK, the controller moves to the Test-Logic-Reset state. The instruction does not change during this state.</p>  |
| Capture-IR       | <p>In this controller state, the shift register contained in the instruction register loads a fixed value of '100' on the rising edge of TCK. This supports fault-isolation of the board-level serial test data path. Data registers selected by the current instruction retain their value and the instruction does not change during this state. When the controller is in this state and a rising edge is applied to TCK, the controller enters the Exit1-IR state if TMS is held high, or the Shift-IR state if TMS is held low.</p>   |
| Shift-IR         | <p>In this state, the shift register contained in the instruction register is connected between TDI and TDO and shifts data one stage towards its serial output on each rising edge of TCK. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state. When the controller is in this state and a rising edge is applied to TCK, the controller enters the Exit1-IR state if TMS is held high, or remains in the Shift-IR state if TMS is held low.</p>  |

TABLE - 19. TAP CONTROLLER STATE DESCRIPTION (CONTINUED)

| STATE     | DESCRIPTION   |
|-----------|---|
| Exit1-IR  | This is a temporary state. While in this state, if TMS is held high, a rising edge applied to TCK causes the controller to enter the Update-IR state, which terminates the scanning process. If TMS is held low and a rising edge is applied to TCK, the controller enters the Pause-IR state. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state. |
| Pause-IR  | The pause state allows the test controller to temporarily halt the shifting of data through the instruction register. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state. The controller remains in this state as long as TMS is low. When TMS goes high and a rising edge is applied to TCK, the controller moves to the Exit2-IR state.          |
| Exit2-IR  | This is a temporary state. While in this state, if TMS is held high, a rising edge applied to TCK causes the controller to enter the Update-IR state, which terminates the scanning process. If TMS is held low and a rising edge is applied to TCK, the controller enters the Shift-IR state. The test data register selected by the current instruction retains its previous value and the instruction does not change during this state. |
| Update-IR | The instruction shifted into the instruction register is latched into the parallel output from the shift-register path on the falling edge of TCK. When the new instruction has been latched, it becomes the current instruction. The test data registers selected by the current instruction retain their previous value.  |

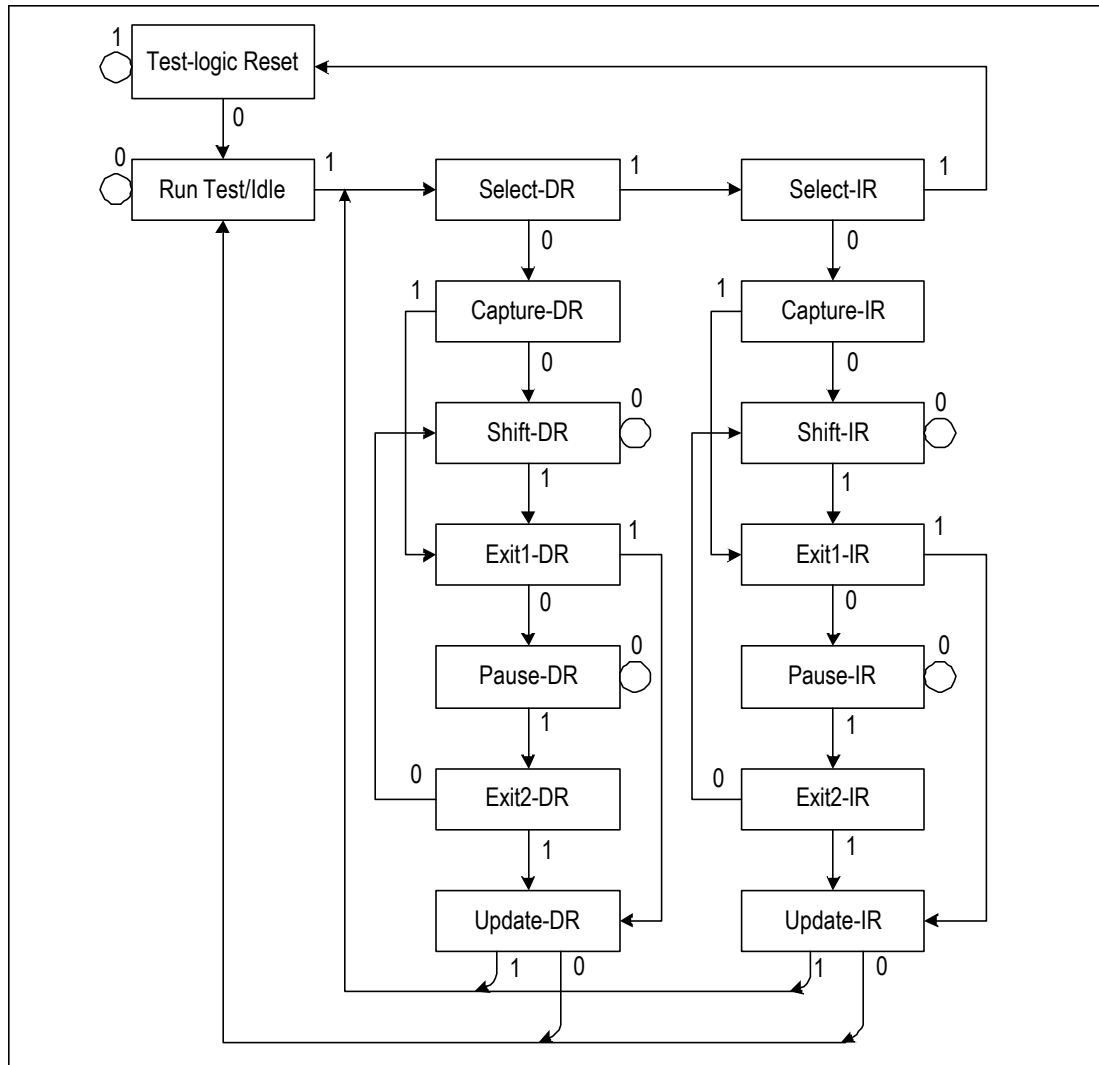


Figure - 19. JTAG State Diagram

## ABSOLUTE MAXIMUM RATING

| Symbol   | Parameter  | Min     | Max                  | Unit |
|--|--|---------|----------------------|------|
| VDDA,VDDD  | Core Power Supply                                    | -0.5    | 4.0                  | V    |
| VDDIO0,VDDIO1  | I/O Power Supply                                     | -0.5    | 4.0                  | V    |
| VDDT0-7  | Transmit Power Supply                                | -0.5    | 7.0                  | V    |
| Vin  | Input Voltage, Any Digital Pin                       | GND-0.5 | 5.5                  | V    |
|  | Input Voltage, Any RTIP and RRING pin <sup>(1)</sup> | GND-0.5 | VDDA+0.5<br>VDDD+0.5 | V    |
|  | ESD Voltage, any pin <sup>(2)</sup>                  | 2000    |                      | V    |
| Iin  | Transient latch-up current, any pin                  |         | 100                  | mA   |
|  | Input current, any digital pin <sup>(3)</sup>        | -10     | 10                   | mA   |
|  | DC Input current, any analog pin <sup>(3)</sup>      |         | ±100                 | mA   |
| Pd   | Maximum power dissipation in package                 |         | 1.6                  | W    |
| Tc   | Case Temperature                                     |         | 120                  | °C   |
| Ts   | Storage Temperature                                  | -65     | +150                 | °C   |
| <b>CAUTION</b><br>Exceeding these values may cause permanent damage. Functional operation under these conditions is not implied.<br>Exposure to absolute maximum rating conditions for extended periods may affect device reliability. |  |         |                      |      |

**NOTE:**

1. Referenced to ground
2. Human body model
3. Constant input current

## RECOMMENDED OPERATING CONDITIONS

| Symbol             | Parameter  | Min  | Typ | Max  | Unit |
|--------------------|--|------|-----|------|------|
| VDDA,VDDD          | Core Power Supply  | 3.13 | 3.3 | 3.47 | V    |
| VDDIO              | I/O Power Supply   | 3.13 | 3.3 | 3.47 | V    |
| VDDT               | Transmitter Supply   |      |     |      |      |
|                    | 3.3V   | 3.13 | 3.3 | 3.47 | V    |
|                    | 5V   | 4.75 | 5.0 | 5.25 | V    |
| T <sub>A</sub>     | Ambient operating temperature                                      | -40  | 25  | 85   | °C   |
| R <sub>L</sub>     | Output load at TTIP and TRING                                      | 25   |     |      | Ω    |
| I <sub>VDD</sub>   | Average core power supply current <sup>(1)</sup>                   |      | 40  | 60   | mA   |
| I <sub>VDDIO</sub> | IO power supply current <sup>(3)</sup>                             |      | 15  | 25   | mA   |
| I <sub>VDDT</sub>  | Average transmitter power supply current, E1 mode <sup>(1,2)</sup> |      |     |      |      |
|                    | 75Ω      50% ones density data:                                    |      |     | 125  | mA   |
|                    |  |      |     | 220  |      |
|                    | 120Ω    50% ones density data:                                     |      |     | 100  |      |
|                    |  |      |     | 200  |      |

**NOTE:**

1. Maximum power and current consumption over the full operating temperature and power supply voltage range. Includes all channels.
2. Power consumption includes power absorbed by line load and external transmitter components.
3. Digital output is driving 50pF load, digital input is within 10% of the supply rails.

## POWER CONSUMPTION

| Symbol | Parameter                   | LEN | Min | Typ  | Max <sup>(1,2)</sup> | Unit |
|--------|-----------------------------|-----|-----|------|----------------------|------|
|        | E1, 3.3V, 75 $\Omega$ Load  |     |     |      |                      |      |
|        | 50% ones density data:      | 000 | -   | 612  | -                    | mW   |
|        | 100% ones density data:     | 000 | -   | 1050 | 1125                 |      |
|        | E1, 3.3V, 120 $\Omega$ Load |     |     |      |                      |      |
|        | 50% ones density data:      | 000 | -   | 526  | -                    | mW   |
|        | 100% ones density data:     | 000 | -   | 880  | 940                  |      |
|        | E1, 5.0V, 75 $\Omega$ Load  |     |     |      |                      |      |
|        | 50% ones density data:      | 000 | -   | 835  | -                    | mW   |
|        | 100% ones density data:     | 000 | -   | 1510 | 1610                 |      |
|        | E1, 5.0V, 120 $\Omega$ Load |     |     |      |                      |      |
|        | 50% ones density data:      | 000 | -   | 710  | -                    | mW   |
|        | 100% ones density data:     | 000 | -   | 1240 | 1330                 |      |

### NOTE:

1. Maximum power and current consumption over the full operating temperature and power supply voltage range. Includes all channels.
2. Power consumption includes power absorbed by line load and external transmitter components.
3. T1 maximum values measured with maximum cable length (LEN = 111). Typical values measured with typical cable length (LEN = 101).

## DC CHARACTERISTICS

| Symbol          | Parameter  | Min                              | Typ                   | Max                              | Unit               |
|-----------------|--|----------------------------------|-----------------------|----------------------------------|--------------------|
| V <sub>IL</sub> | Input Low Level Voltage<br>MODE2, JAS, LPn pins<br>All other digital inputs pins     |                                  |                       | $\frac{1}{3}V_{DDIO}-0.2$<br>0.8 | V                  |
| V <sub>IM</sub> | Input Mid Level Voltage<br>MODE2, JAS, LPn pins                                      | $\frac{1}{3}V_{DDIO}+0.2$        | $\frac{1}{2}V_{DDIO}$ | $\frac{2}{3}V_{DDIO}-0.2$        | V                  |
| V <sub>IH</sub> | Input High Voltage<br>MODE2, JAS, LPn pins<br>All other digital inputs pins          | $\frac{2}{3}V_{DDIO}+0.2$<br>2.0 |                       |                                  | V                  |
| V <sub>OL</sub> | Output Low level Voltage <sup>(1)</sup><br>(I <sub>out</sub> =1.6mA)                 |                                  |                       | 0.4                              | V                  |
| V <sub>OH</sub> | Output High level Voltage <sup>(1)</sup><br>(I <sub>out</sub> =400 $\mu$ A)          | 2.4                              |                       | V <sub>DDIO</sub>                | V                  |
| V <sub>MA</sub> | Analog Input Quiescent Voltage<br>(RTIP, RRING pin while floating)                   | 1.33                             | 1.4                   | 1.47                             | V                  |
| I <sub>H</sub>  | Input High Level Current<br>(MODE2, JAS, LPn pin)                                    |                                  |                       | 50                               | $\mu$ A            |
| I <sub>L</sub>  | Input Low Level Current<br>(MODE2, JAS, LPn pin)                                     |                                  |                       | 50                               | $\mu$ A            |
| I <sub>I</sub>  | Input Leakage Current<br>TMS, TDI, $\overline{TRST}$<br>All other digital input pins | -10                              |                       | 50<br>10                         | $\mu$ A<br>$\mu$ A |
| I <sub>ZL</sub> | Tri-state Leakage Current  | -10                              |                       | 10                               | $\mu$ A            |
| Z <sub>OH</sub> | Output High Impedance on (TTIP, TRING Pins)  | 150                              |                       |                                  | K $\Omega$         |

### NOTE:

1. Output drivers will output CMOS logic levels into CMOS loads.

## TRANSMITTER CHARACTERISTICS

| Symbol             | Parameter   |                       | Min    | Typ   | Max   | Unit                   |
|--------------------|---|-----------------------|--------|-------|-------|------------------------|
| V <sub>0-p</sub>   | Output pulse amplitudes <sup>(1)</sup>  |                       |        |       |       |                        |
|                    | E1, 75Ω load  |                       | 2.14   | 2.37  | 2.6   | V                      |
|                    | E1, 120Ω load   |                       | 2.7    | 3.0   | 3.3   | V                      |
| V <sub>0-s</sub>   | Zero (space) level  |                       |        |       |       |                        |
|                    | E1, 75 Ω load   |                       | -0.237 |       | 0.237 | V                      |
|                    | E1, 120 Ω load  |                       | -0.3   |       | 0.3   | V                      |
|                    | Transmit amplitude variation with supply  |                       | -1     |       | +1    | %                      |
|                    | Difference between pulse sequences for 17 consecutive pulses                                |                       |        |       | 200   | mV                     |
| T <sub>PW</sub>    | Output Pulse Width at 50% of nominal amplitude:   |                       | 232    | 244   | 256   | ns                     |
|                    | Ratio of the amplitudes of Positive and Negative Pulses at the center of the pulse interval |                       | 0.95   |       | 1.05  |                        |
| RTX                | Transmit Return Loss <sup>(2)</sup>   |                       |        |       |       |                        |
|                    | E1, 75Ω   | 51 KHz – 102 KHz      | 15     |       |       | dB                     |
|                    |   | 102 KHz - 2.048 MHz   | 15     |       |       | dB                     |
|                    |   | 2.048 MHz – 3.072 MHz | 15     |       |       | dB                     |
|                    | E1, 120Ω  | 51 KHz – 102 KHz      | 15     |       |       | dB                     |
|                    |   | 102 KHz - 2.048 MHz   | 15     |       |       | dB                     |
|                    |   | 2.048 MHz – 3.072 MHz | 15     |       |       | dB                     |
| JTX <sub>P-P</sub> | Intrinsic Transmit Jitter (TCLK is jitter free, JA enable)                                  |                       |        |       |       |                        |
|                    | E1: 20 HZ – 100 KHz   |                       |        | 0.050 |       | U.I.                   |
| T <sub>d</sub>     | Transmit path delay (JA is disabled)  |                       |        |       |       |                        |
|                    | Single rail   |                       |        | 8     |       | U.I.                   |
|                    | Dual rail   |                       |        | 3     |       | U.I.                   |
| I <sub>sc</sub>    | Line short circuit current <sup>(3)</sup>   |                       |        |       | 150   | mA<br>I <sub>p-p</sub> |

### NOTE:

1. E1: measured at the line output ports
2. Test at IDT82V2058 evaluation board
3. Measured at 2x9.5Ω series resistors and 1:2 transformer



## RECEIVER CHARACTERISTICS

| Symbol             | Parameter   | Min  | Typ  | Max    | Unit           |
|--------------------|---|------|------|--------|----------------|
| ATT                | Permissible Cable Attenuation (@1024kHz)                  |      |      | 15     | dB             |
| IA                 | Input Amplitude   | 0.1  |      | 0.8    | V <sub>p</sub> |
| SIR                | Signal to Interference Ratio Margin <sup>(1)</sup>        | -14  |      |        | dB             |
| SRE                | Data decision threshold (reference to peak input voltage) |      | 50   |        | %              |
|                    | Data slicer threshold                                     |      | 150  |        | mV             |
|                    | Analog loss of signal <sup>(2)</sup>                      |      |      |        |                |
|                    | Threshold:  |      | 310  |        | mV             |
|                    | Hysteresis:   |      | 230  |        | mV             |
|                    | Allowable consecutive zeros before LOS                    |      |      |        |                |
|                    | E1, G.775:  |      | 32   |        |                |
|                    | E1, ETSI300233:   |      | 2048 |        |                |
|                    | LOS reset   |      |      |        |                |
|                    | Clock recovery mode                                       | 12.5 |      |        | % ones         |
| JRX <sub>p-p</sub> | Peak to Peak Intrinsic Receive Jitter (JA disabled)       |      |      | 0.0625 | U.I.           |
| JTRX               | Jitter Tolerance  |      |      |        |                |
|                    | 1 Hz – 20 Hz  | 18.0 |      |        | U.I.           |
|                    | 20 Hz – 2.4 KHz   | 1.5  |      |        | U.I.           |
|                    | 18 KHz – 100 KHz  | 0.2  |      |        | U.I.           |
| ZDM                | Receiver Differential Input Impedance                     |      | 120  |        | K $\Omega$     |
| ZCM                | Receiver Common Mode Input Impedance to GND               | 10   |      |        | K $\Omega$     |
| RRX                | Receive Return Loss                                       |      |      |        |                |
|                    | 51 KHz – 102 KHz  | 20   |      |        | db             |
|                    | 102 KHz - 2.048 MHz                                       | 20   |      |        | dB             |
|                    | 2.048 MHz – 3.072 MHz                                     | 20   |      |        | dB             |
|                    | Receive path delay  |      |      |        |                |
|                    | Dual rail   |      | 3    |        | U.I.           |
|                    | Single rail   |      | 8    |        | U.I.           |

### NOTE:

1. E1: per G.703, O.151 @6dB cable attenuation.
2. The test circuit for this parameter is shown in Figure 12. The analog signal is measured on the Receiver line before the transformer (port A and port B in Figure 12). And the receive line is a T1/E1 cable simulator.

## JITTER ATTENUATOR CHARACTERISTICS

| Symbol            | Parameter  | Min   | Typ | Max  | Unit |
|-------------------|--|-------|-----|------|------|
| f <sub>-3dB</sub> | Jitter Transfer Function Corner (-3dB) Frequency         |       |     |      |      |
|                   | Host mode:   |       |     |      |      |
|                   | 32/64 bit FIFO   |       | 1.7 |      | Hz   |
|                   | JABW = 0:  |       | 6.6 |      | Hz   |
|                   | JABW = 1:  |       |     |      |      |
|                   | Hardware mode  |       | 1.7 |      | Hz   |
|                   | Jitter Attenuator <sup>(1)</sup>                         |       |     |      |      |
|                   | @ 3 Hz   | -0.5  |     |      | dB   |
|                   | @ 40 Hz  | -0.5  |     |      |      |
|                   | @ 400 Hz   | +19.5 |     |      |      |
|                   | @ 100kHz   | +19.5 |     |      |      |
| td                | Jitter Attenuator Latency Delay                          |       |     |      |      |
|                   | 32bit FIFO:  |       | 16  |      | U.I. |
|                   | 64bit FIFO:  |       | 32  |      | U.I. |
|                   | Input jitter tolerance before FIFO overflow or underflow |       |     |      |      |
|                   | 32bit FIFO:  |       | 28  |      | U.I. |
|                   | 64bit FIFO:  |       | 56  |      | U.I. |
|                   | Output jitter in remote loopback <sup>(2)</sup>          |       |     | 0.11 | U.I. |

### NOTE:

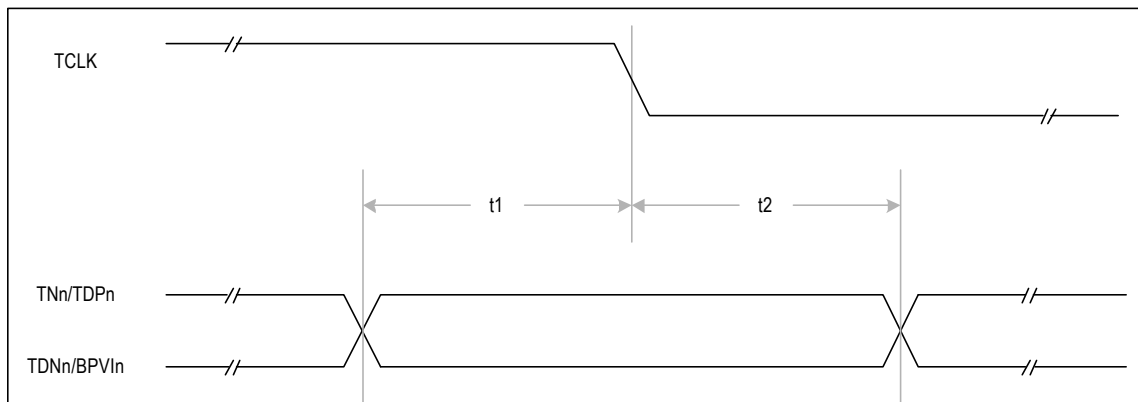
1. Per G.736, see Fig-35.
2. Per ETSI CTR12/13 Output jitter.

## TRANSCEIVER TIMING CHARACTERISTICS

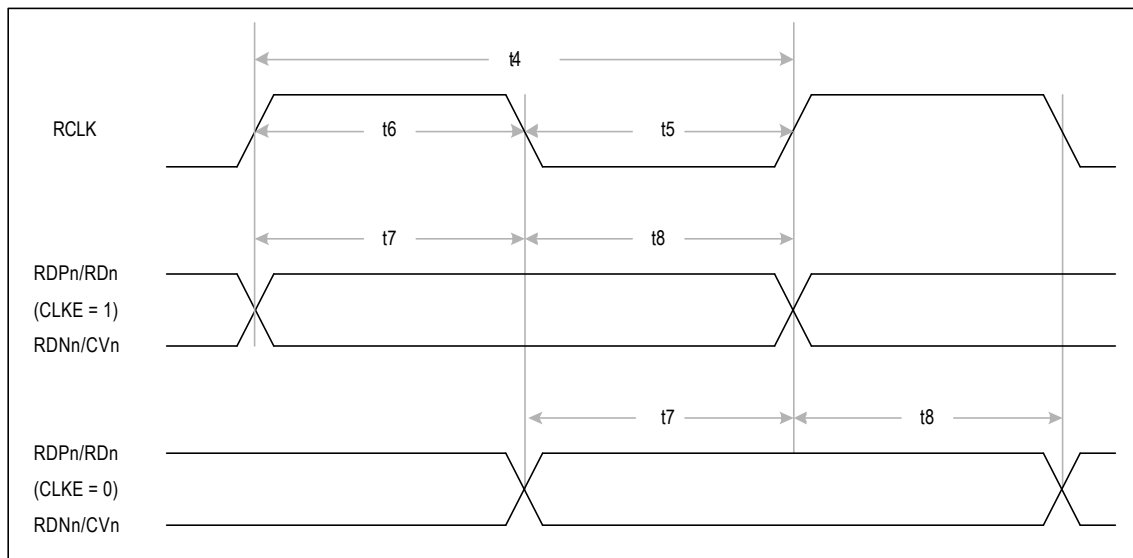
| Symbol               | Parameter                                     | Min  | Typ    | Max | Unit |
|----------------------|---|------|--------|-----|------|
|                      | MCLK frequency                                |      | 2.048  |     | MHz  |
|                      | MCLK tolerance                                | -100 |        | 100 | ppm  |
|                      | MCLK duty cycle                               | 40   |        | 60  | %    |
| <i>Transmit path</i> |   |      |        |     |      |
|                      | TCLK frequency                                |      | 2.048  |     | MHz  |
|                      | TCLK tolerance                                | -50  |        | +50 | ppm  |
|                      | TCLK Duty Cycle                               | 10   |        | 90  | %    |
| t1                   | Transmit Data Setup Time                      | 40   |        |     | ns   |
| t2                   | Transmit Data Hold Time                       | 40   |        |     | ns   |
|                      | Delay time of OE low to driver High Z         |      |        | 1   | us   |
|                      | Delay time of TCLK low to driver High Z       | 40   | 44     | 48  | us   |
| <i>Receive path</i>  |   |      |        |     |      |
|                      | Clock recovery capture range <sup>(1)</sup>   |      | +/- 80 |     | ppm  |
|                      | RCLK duty cycle <sup>(2)</sup>                | 40   | 50     | 60  | %    |
| t4                   | RCLK pulse width <sup>(2)</sup>               | 457  | 488    | 519 | ns   |
| t5                   | RCLK pulse width low time                     | 203  | 244    | 285 | ns   |
| t6                   | RCLK pulse width high time                    | 203  | 244    | 285 | ns   |
|                      | Rise/fall time <sup>(3)</sup>                 | 20   |        |     | ns   |
| t7                   | Receive Data Setup Time                       | 200  | 244    |     | ns   |
| t8                   | Receive Data Hold Time                        | 200  | 244    |     | ns   |
| t9                   | RDN/RDP pulse width (MCLK = H) <sup>(4)</sup> | 200  | 244    |     | ns   |

### NOTE:

1. Relative to nominal frequency, MCLK=+/-100 ppm
2. RCLK duty cycle widths will vary depending on extent of received pulse jitter displacement. Maximum and minimum RCLK duty cycles are for worst case jitter conditions (0.2UI displacement for E1 per ITU G.823).
3. For all digital outputs. C load = 15 pF
4. Clock recovery is disabled in this mode.



**Figure - 21. Transmit System Interface Timing**



**Figure - 22. Receive System Interface Timing**

## JTAG TIMING CHARACTERISTICS

| Symbol | Parameter                                      | Min | Typ | Max | Unit | Comments |
|--------|--|-----|-----|-----|------|----------|
| t1     | TCK Period                                     | 200 |     |     | ns   |          |
| t2     | TMS to TCK setup Time<br>TDI to TCK Setup Time | 50  |     |     | ns   |          |
| t3     | TCK to TMS Hold Time<br>TCK to TDI Hold Time   | 50  |     |     | ns   |          |
| t4     | TCK to TDO Delay Time                          |     |     | 100 | ns   |          |

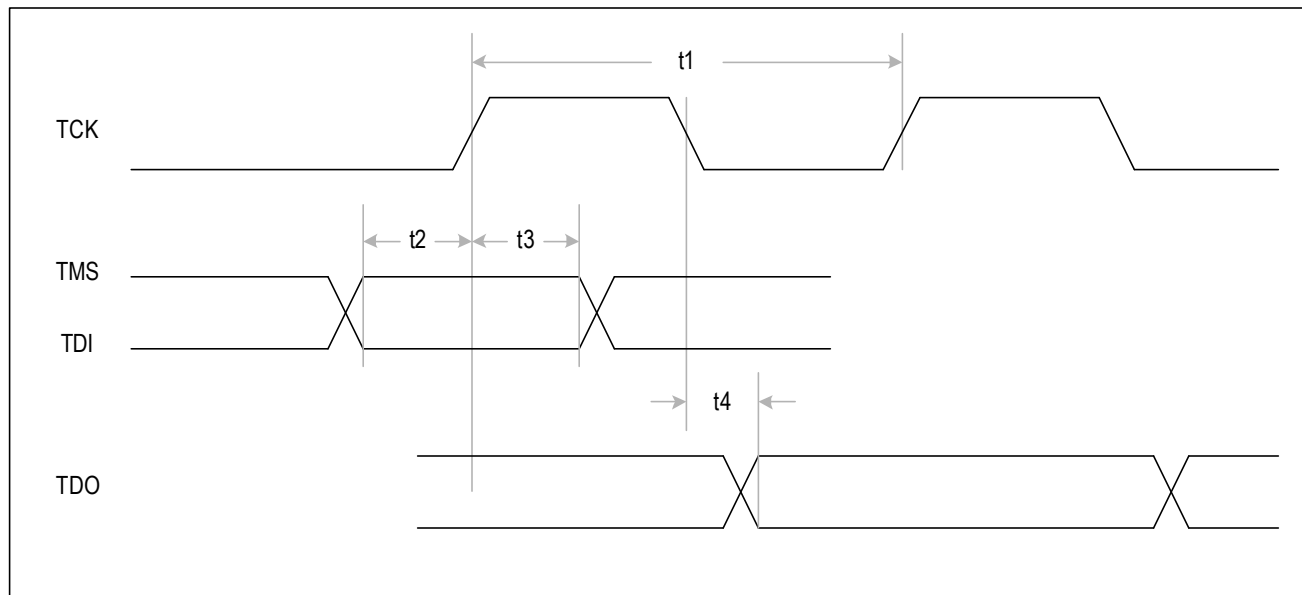


Figure - 23. JTAG Interface Timing

## PARALLEL HOST INTERFACE TIMING CHARACTERISTICS

### INTEL MODE READ TIMING CHARACTERISTICS

| Symbol | Parameter  | Min | Typ | Max | Unit | Comments |
|--------|--|-----|-----|-----|------|----------|
| t1     | Active $\overline{RD}$ Pulse Width   | 90  |     |     | ns   | note 1   |
| t2     | Active $\overline{CS}$ to Active $\overline{RD}$ Setup Time  | 0   |     |     | ns   |          |
| t3     | Inactive $\overline{RD}$ to Inactive $\overline{CS}$ Hold Time   | 0   |     |     | ns   |          |
| t4     | Valid Address to Inactive ALE Setup Time (in Multiplexed Mode)   | 5   |     |     | ns   |          |
| t5     | Invalid $\overline{RD}$ to Address Hold Time (in Non-Multiplexed Mode)   | 0   |     |     | ns   |          |
| t6     | Active $\overline{RD}$ to Data Output Enable Time  | 7.5 |     | 15  | ns   |          |
| t7     | Inactive $\overline{RD}$ to Data Tri-State Delay Time  | 7.5 |     | 15  | ns   |          |
| t8     | Active $\overline{CS}$ to RDY delay time   | 6   |     | 12  | ns   |          |
| t9     | Inactive $\overline{CS}$ to RDY Tri-state Delay Time   | 6   |     | 12  | ns   |          |
| t10    | Inactive $\overline{RD}$ to Inactive $\overline{INT}$ Delay Time   |     |     | 20  | ns   |          |
| t11    | Address Latch Enable Pulse Width (in Multiplexed Mode)   | 10  |     |     | ns   |          |
| t12    | Address Latch Enable to $\overline{RD}$ Setup Time (in Multiplexed Mode)   | 0   |     |     | ns   |          |
| t13    | Address Setup time to Valid Data Time (in Non-Multiplexed Mode)<br>Inactive ALE to Valid Data Time (in Multiplexed Mode) | 18  |     | 32  | ns   |          |
| t14    | Inactive $\overline{RD}$ to Active RDY Delay Time  | 10  |     | 15  | ns   |          |
| t15    | Active $\overline{RD}$ to Active RDY Delay Time  | 30  |     | 85  | ns   |          |
| t16    | Inactive ALE to Address Hold Time (in Multiplexed Mode)  | 5   |     |     | ns   |          |

Note 1: the t1 is determined by the start time of the valid data when the RDY signal is not used.

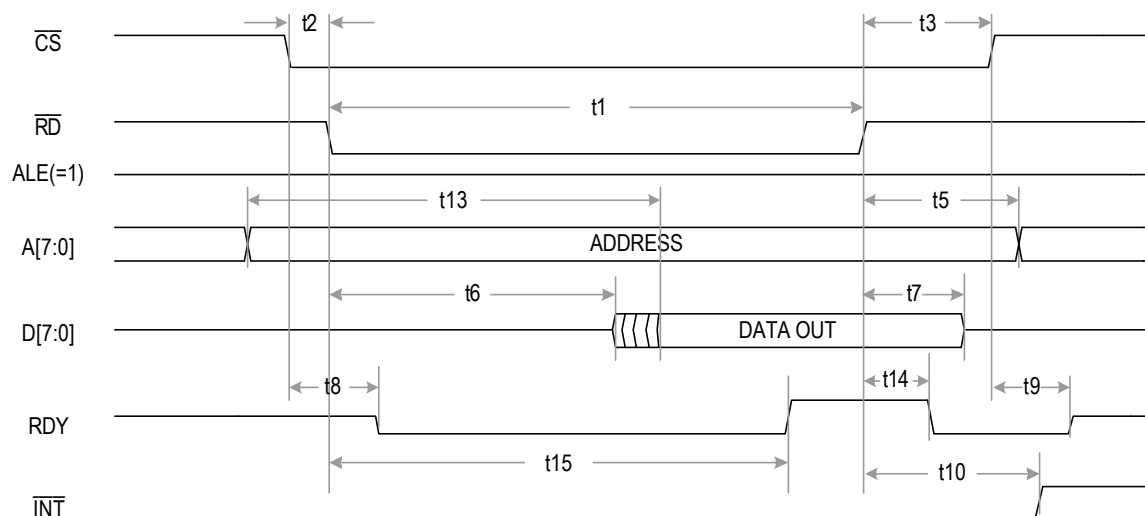


Figure - 24. Non-Multiplexed Intel Mode Read Timing

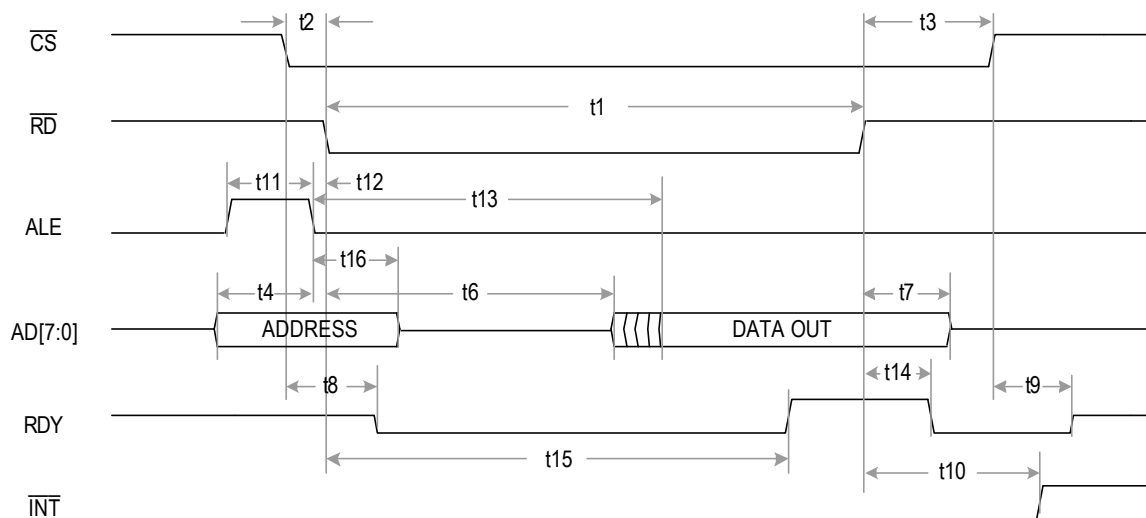


Figure - 25. Multiplexed Intel Mode Read Timing

## INTEL MODE WRITE TIMING CHARACTERISTICS

| Symbol | Parameter   | Min | Typ | Max | Unit | Comments |
|--------|---|-----|-----|-----|------|----------|
| t1     | Active $\overline{WR}$ Pulse Width  | 90  |     |     | ns   | note 1   |
| t2     | Active $\overline{CS}$ to Active $\overline{WR}$ Setup Time                   | 0   |     |     | ns   |          |
| t3     | Inactive $\overline{WR}$ to Inactive $\overline{CS}$ Hold Time                | 0   |     |     | ns   |          |
| t4     | Valid Address to Latch Enable Setup Time (in Multiplexed Mode)                | 5   |     |     | ns   |          |
| t5     | Invalid $\overline{WR}$ to Address Hold Time (in Non-Multiplexed Mode)        | 2   |     |     | ns   |          |
| t6     | Valid Data to Inactive $\overline{WR}$ Setup Time                             | 5   |     |     | ns   |          |
| t7     | Inactive $\overline{WR}$ to Data Hold Time                                    | 10  |     |     | ns   |          |
| t8     | Active $\overline{CS}$ to Inactive RDY Delay Time                             | 6   |     | 12  | ns   |          |
| t9     | Active $\overline{WR}$ to Active RDY Delay Time                               | 30  |     | 85  | ns   |          |
| t10    | Inactive $\overline{WR}$ to Inactive RDY Delay Time                           | 10  |     | 15  | ns   |          |
| t11    | Invalid $\overline{CS}$ to RDY Tri-State Delay Time                           | 6   |     | 12  | ns   |          |
| t12    | Address Latch Enable Pulse Width (in Multiplexed Mode)                        | 10  |     |     | ns   |          |
| t13    | Inactive ALE to $\overline{WR}$ Setup Time (in Multiplexed Mode)              | 0   |     |     | ns   |          |
| t14    | Inactive ALE to Address hold time (in Multiplexed Mode)                       | 5   |     |     | ns   |          |
| t15    | Address setup time to Inactive $\overline{WR}$ time (in Non-Multiplexed Mode) | 5   |     |     | ns   |          |

Note 1: the t1 can be 15ns when RDY signal is not used.

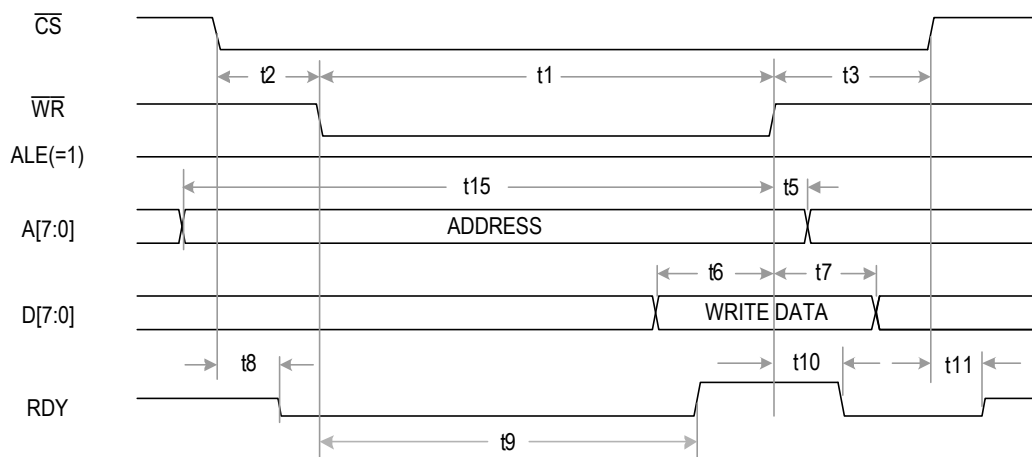


Figure - 26. Non-Multiplexed Intel Mode Write Timing

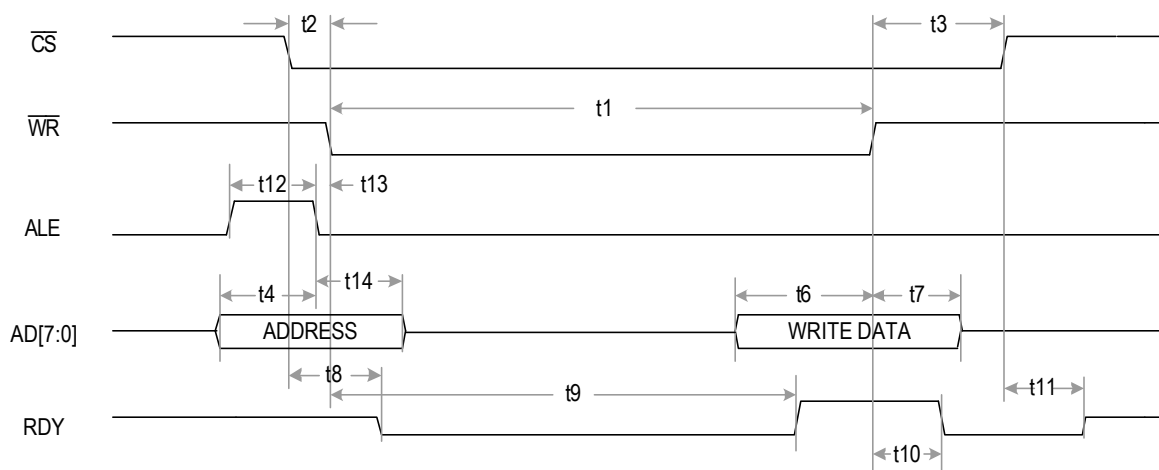


Figure - 27. Multiplexed Intel Mode Write Timing

## MOTOROLA MODE READ TIMING CHARACTERISTICS

| Symbol | Parameter  | Min | Typ | Max | Unit | Comments |
|--------|--|-----|-----|-----|------|----------|
| t1     | Active $\overline{DS}$ Pulse Width   | 90  |     |     | ns   | note 1   |
| t2     | Active $\overline{CS}$ to Active $\overline{DS}$ Setup Time  | 0   |     |     | ns   |          |
| t3     | Inactive $\overline{DS}$ to Inactive $\overline{CS}$ Hold Time   | 0   |     |     | ns   |          |
| t4     | Valid $R/\overline{W}$ to Active $\overline{DS}$ Setup Time  | 0   |     |     | ns   |          |
| t5     | Inactive $\overline{DS}$ to $R/\overline{W}$ Hold Time   | 0.5 |     |     | ns   |          |
| t6     | Valid Address to Active $\overline{DS}$ Setup Time (in Non-Multiplexed Mode)<br>Valid Address to $\overline{AS}$ Setup Time (in Multiplexed Mode)  | 5   |     |     | ns   |          |
| t7     | Active $\overline{DS}$ to Address Hold Time (in Non-Multiplexed Mode)<br>Active $\overline{AS}$ to Address Hold Time (in Multiplexed Mode)         | 10  |     |     | ns   |          |
| t8     | Active $\overline{DS}$ to Data Valid Delay Time (in Non-Multiplexed Mode)<br>Active $\overline{AS}$ to Data Valid Delay Time (in Multiplexed Mode) | 20  |     | 35  | ns   |          |
| t9     | Active $\overline{DS}$ to Data Output Enable Time  | 7.5 |     | 15  | ns   |          |
| t10    | Inactive $\overline{DS}$ to Data Tri-State Delay Time  | 7.5 |     | 15  | ns   |          |
| t11    | Active $\overline{DS}$ to Active $\overline{ACK}$ Delay Time   | 30  |     | 85  | ns   |          |
| t12    | Inactive $\overline{DS}$ to Inactive $\overline{ACK}$ Delay Time   | 10  |     | 15  | ns   |          |
| t13    | Inactive $\overline{DS}$ to Invalid $\overline{INT}$ Delay Time  |     |     | 20  | ns   |          |
| t14    | Active $\overline{AS}$ to Active $\overline{DS}$ Setup Time (in Multiplexed Mode)  | 5   |     |     | ns   |          |

Note 1: the t1 is determined by the start time of the valid data when the  $\overline{ACK}$  signal is not used.

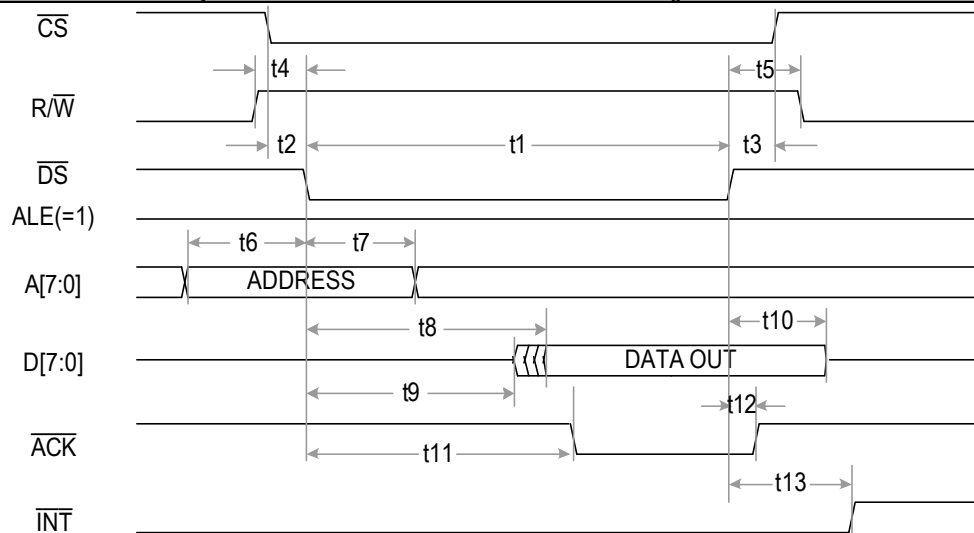


Figure - 28. Non-Multiplexed Motorola Mode Read Timing

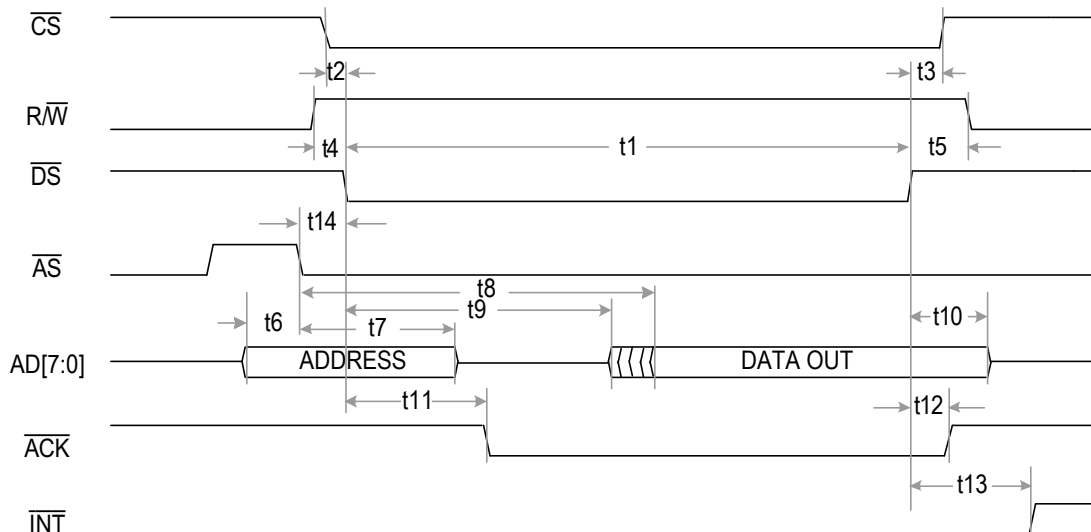


Figure - 29. Multiplexed Motorola Mode Read Timing



## MOTOROLA MODE WRITE TIMING CHARACTERISTICS

| Symbol | Parameter   | Min | Typ | Max | Unit | Comments |
|--------|---|-----|-----|-----|------|----------|
| t1     | Active $\overline{DS}$ Pulse Width  | 90  |     |     | ns   | note 1   |
| t2     | Active $\overline{CS}$ to Active $\overline{DS}$ Setup Time   | 0   |     |     | ns   |          |
| t3     | Inactive $\overline{DS}$ to Inactive $\overline{CS}$ Hold Time  | 0   |     |     | ns   |          |
| t4     | Valid $R/\overline{W}$ to Active $\overline{DS}$ Setup Time   | 10  |     |     | ns   |          |
| t5     | Inactive $\overline{DS}$ to $R/\overline{W}$ Hold Time  | 0   |     |     | ns   |          |
| t6     | Valid Address to Active $\overline{DS}$ Setup Time (in Non-Multiplexed Mode)<br>Valid Address to $\overline{AS}$ Setup Time (in Multiplexed Mode) | 10  |     |     | ns   |          |
| t7     | Valid $\overline{DS}$ to Address Hold Time (in Non-Multiplexed Mode)<br>Valid $\overline{AS}$ to Address Hold Time (in Multiplexed Mode)          | 10  |     |     | ns   |          |
| t8     | Valid Data to Inactive $\overline{DS}$ Setup Time   | 5   |     |     | ns   |          |
| t9     | Inactive $\overline{DS}$ to Data Hold Time  | 10  |     |     | ns   |          |
| t10    | Active $\overline{DS}$ to Active $\overline{ACK}$ Delay Time  | 30  |     | 85  | ns   |          |
| t11    | Inactive $\overline{DS}$ to Inactive $\overline{ACK}$ Delay Time  | 10  |     | 15  | ns   |          |
| t12    | Active $\overline{AS}$ to Active $\overline{DS}$ (in Multiplexed Mode)  | 0   |     |     | ns   |          |
| t13    | Inactive $\overline{DS}$ to Inactive $\overline{AS}$ Hold Time (in Multiplexed Mode)  | 15  |     |     | ns   |          |

Note 1: the t1 can be 15ns when the  $\overline{ACK}$  signal is not used.

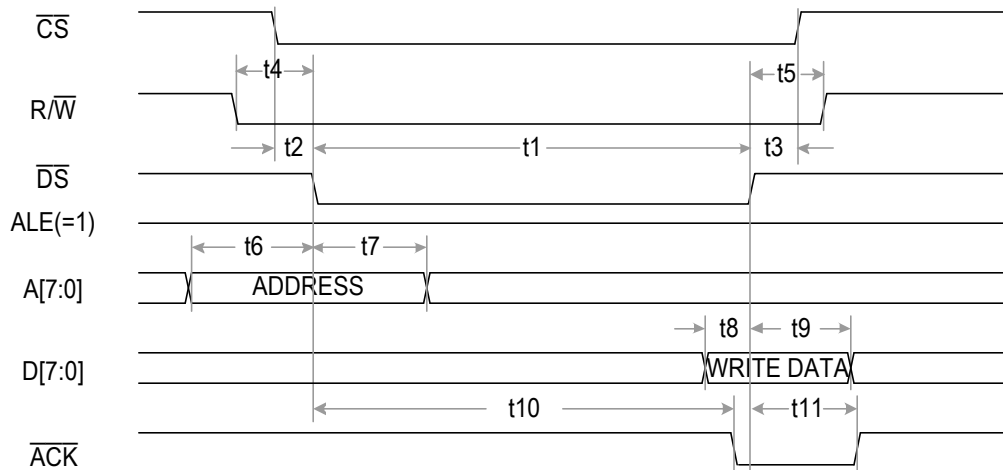


Figure - 30. Non-Multiplexed Motorola Mode Write Timing

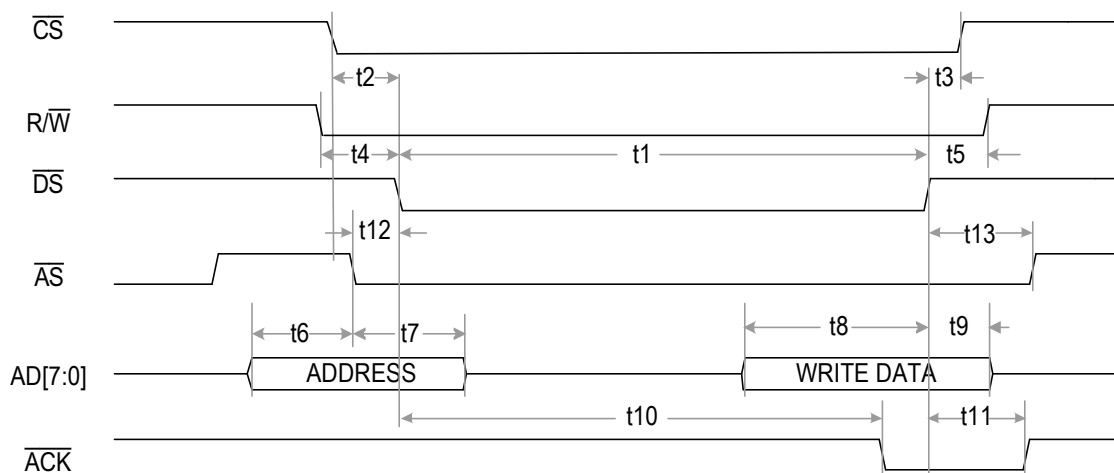


Figure - 31. Multiplexed Motorola Mode Writing Timing

## SERIAL HOST INTERFACE TIMING CHARACTERISTICS

| Symbol | Parameter   | Min | Typ | Max | Unit | Comments |
|--------|---|-----|-----|-----|------|----------|
| t1     | SCLK High Time  | 25  |     |     | ns   |          |
| t2     | SCLK Low Time   | 25  |     |     | ns   |          |
| t3     | Active CS to SCLK Setup Time  | 10  |     |     | ns   |          |
| t4     | Last SCLK Hold Time to Inactive CS Time   | 50  |     |     | ns   |          |
| t5     | CS Idle Time  | 50  |     |     | ns   |          |
| t6     | SDI to SCLK Setup Time  | 5   |     |     | ns   |          |
| t7     | SCLK to SDI Hold Time   | 5   |     |     | ns   |          |
| t8     | Rise/Fall Time (any pin)  |     |     | 100 | ns   |          |
| t9     | SCLK Rise and Fall Time   |     |     | 50  | ns   |          |
| t10    | SCLK to SDO Valid Delay Time  |     |     | 100 | ns   |          |
| t11    | SCLK Falling Edge to SDO tri-state Hold Time (CLKE = 0)<br>CS Rising Edge to SDO tri-state Hold Time (CLKE = 1) |     | 100 |     | ns   |          |

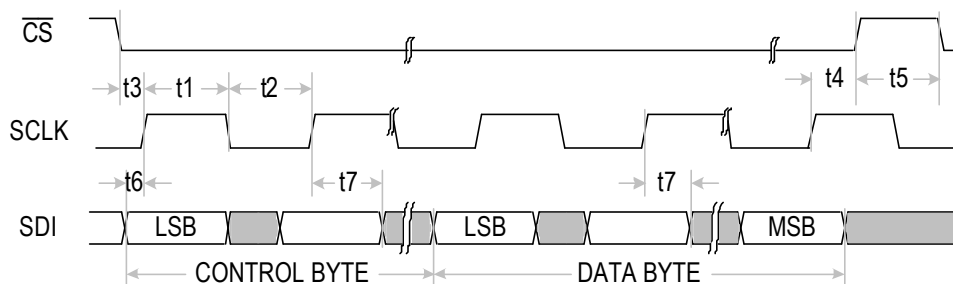


Figure - 32. Serial Interface Write Timing

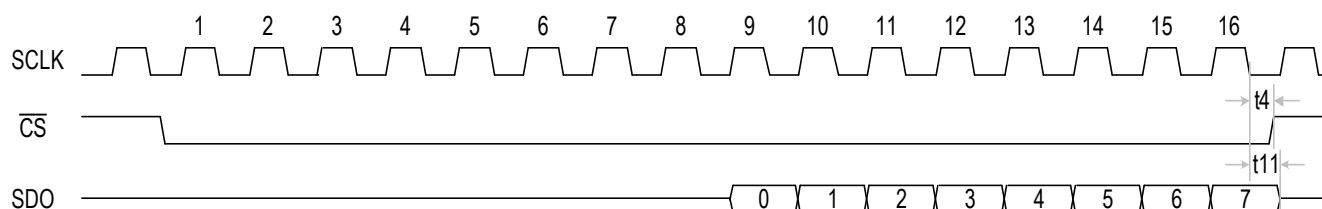


Figure - 33. Serial Interface Read Timing with CLKE = 0

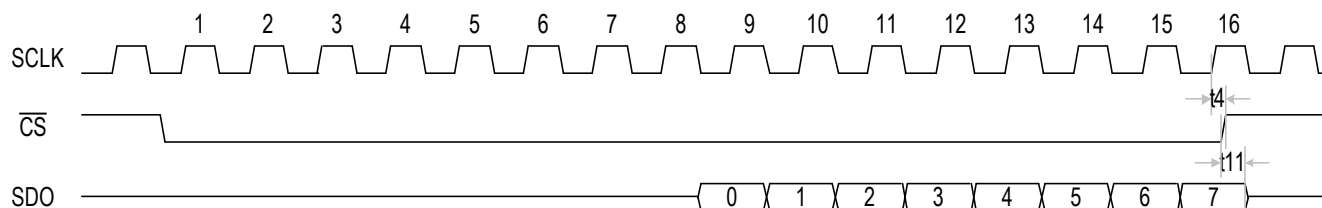


Figure - 34. Serial Interface Read Timing with CLKE = 1

## JITTER TOLERANCE PERFORMANCE

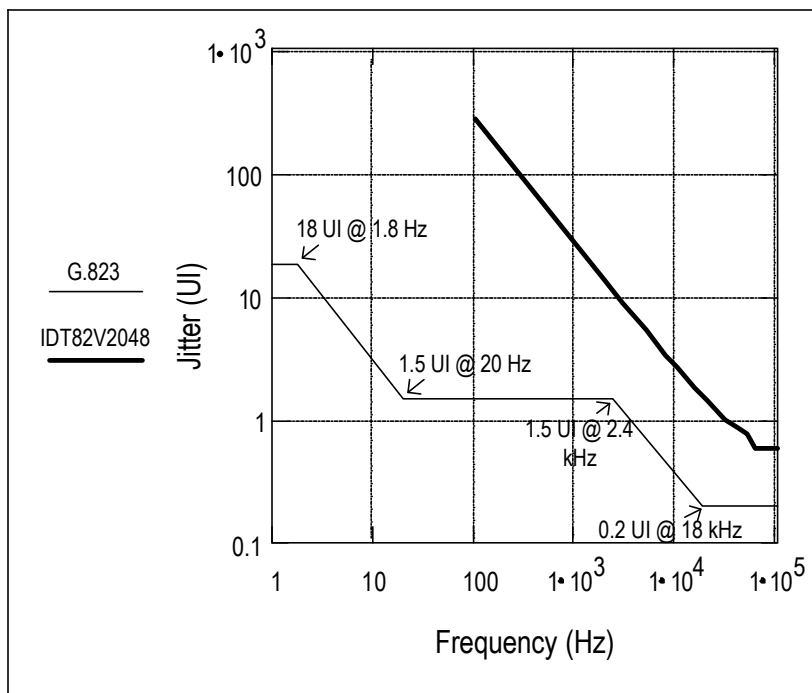


Figure - 35. E1 Jitter Tolerance Performance

Test condition: PRBS 2<sup>15</sup>-1; Line code rule HDB3 is used.

## JITTER TRANSFER PERFORMANCE

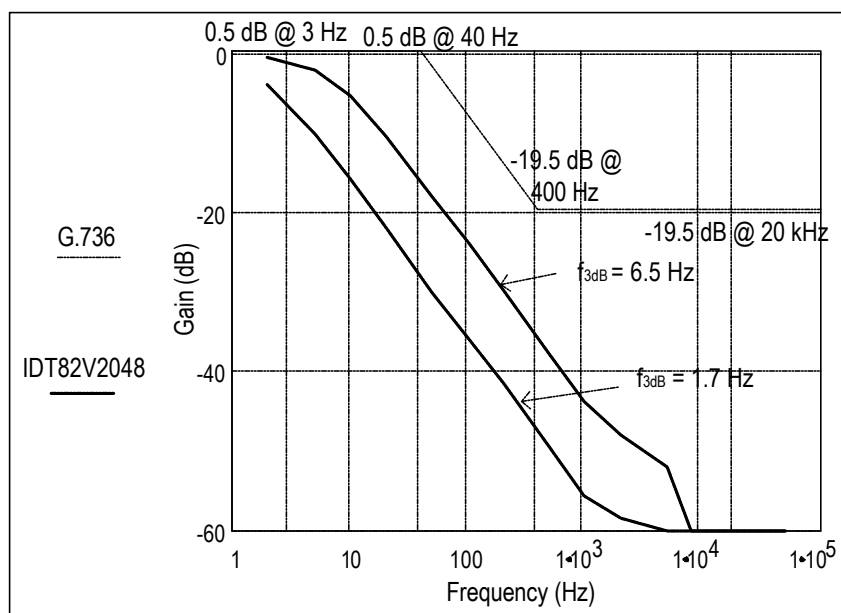


Figure - 36. E1 Jitter Transfer Performance

Test condition: PRBS 2<sup>15</sup>-1; Line code rule HDB3 is used.

| IDT | XXXXXXX<br>Device Type | XX | X<br>Process/<br>Temperature<br>Range |          |   |
|-----|------------------------|----|---------------------------------------|----------|---|
|     |                        |    |                                       | Blank    | Industrial (-40 °C to +85 °C)   |
|     |                        |    |                                       | BB<br>DA | Plastic Ball Grid Array (PBGA, BB160)<br>Thin Quad Flatpack (TQFP, DA144) |
|     |                        |    |                                       | 82V2058  | E1 Short Haul LIU   |

|            |   |
|------------|---|
| 11/4/2001  | pgs. 2, 3, 10, 17                                     |
| 11/20/2001 | pgs. 5, 6, 11, 13, 16, 17, 24, 26, 31, 38, 39, 40, 50 |
| 11/28/2001 | pgs. 5, 24, 26, 31                                    |
| 11/29/2001 | pgs. 5  |
| 12/5/2001  | pgs. 9  |
| 1/24/2002  | pgs. 2, 3, 9, 14, 39, 40                              |
| 2/21/2002  | pgs. 14, 16, 41                                       |
| 3/25/2002  | pgs. 1, 2, 52   |
| 4/17/2002  | pgs. 17   |
| 5/7/2002   | pgs. 14, 44, 45, 48                                   |
| 1/15/2003  | pgs. 1, 52  |

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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