OCTAL T1/E1/J1 LH/SH TRANSCEIVER WITH CLOCK RECOVERY AND JITTER ATTENUATOR

OCTOBER 2001 *REV. P1.2.3*

GENERAL DESCRIPTION

The XRT83L38 is a fully integrated Octal (eight channels) long-haul and short-haul line interface unit for T1(1.544Mbps) 100Ω, E1(2.048Mbps) 75Ω or 120Ω and J1 110Ω applications.

In long-haul applications the XRT83L38 accepts signals that have passed through cables from 0 feet to over 6000 feet in length and have been attenuated by 0 to 45dB at 772kHz in T1 mode or 0 to 43dB at 1024kHz in E1 mode. In T1 applications, the XRT83L38 can generate five transmit pulse shapes to meet the short-haul Digital Cross-Connect (DSX-1) template requirements as well as for Channel Service Units (CSU) Line Build Out (LBO) filters of 0dB, -7.5dB,-15dB and -22.5dB as required by FCC rules. It also provides programmable transmit pulse generators for each channel that can be used for output pulse shaping allowing performance improvement over a wide variety of conditions.

The XRT83L38 provides both a parallel Host microprocessor interface as well as a Hardware mode for programming and control. Both the B8ZS and HDB3 encoding and decoding functions are included and can be disabled as demanded by the system. An on-chip crystal-less jitter attenuator with a 32 or 64 bit FIFO can be placed either in the receive or the transmit path with loop bandwidths of less than 3Hz. The XRT83L38 provides a variety of loop-back and diagnostic features as well as transmit driver short circuit detection and receive loss of signal monitoring. It supports internal impedance matching for 75Ω, 100Ω, 110Ω and 120Ω for both transmitter and receiver. For each receiver this is accomplished through the combination of one single fixed value external resistor and programmable internal resistors. In the absence of the power supply, the transmit output and receive input are tri-stated allowing for redundancy applications The chip includes an integrated programmable clock multiplier that can synthesize T1 or E1 master clocks from a variety of external clock sources.

APPLICATIONS

- T1 Digital Cross-Connects (DSX-1)
- ISDN Primary Rate Interface
- CSU/DSU E1/T1/J1 Interface
- T1/E1/J1 LAN/WAN Routers
- Public switching Systems and PBX Interfaces
- T1/E1/J1 Multiplexer and Channel Banks

Features (See Page 2)

FIGURE 1. BLOCK DIAGRAM OF THE XRT83L38 T1/E1/J1 LIU (HOST MODE)

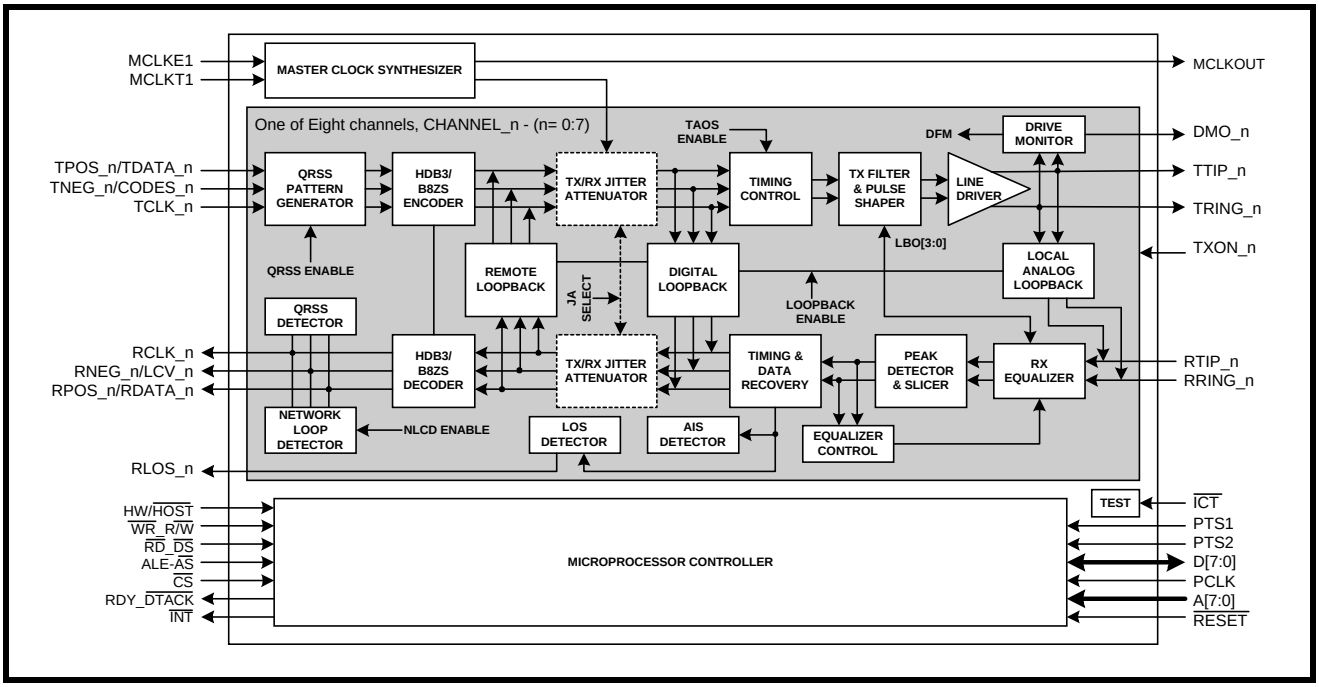
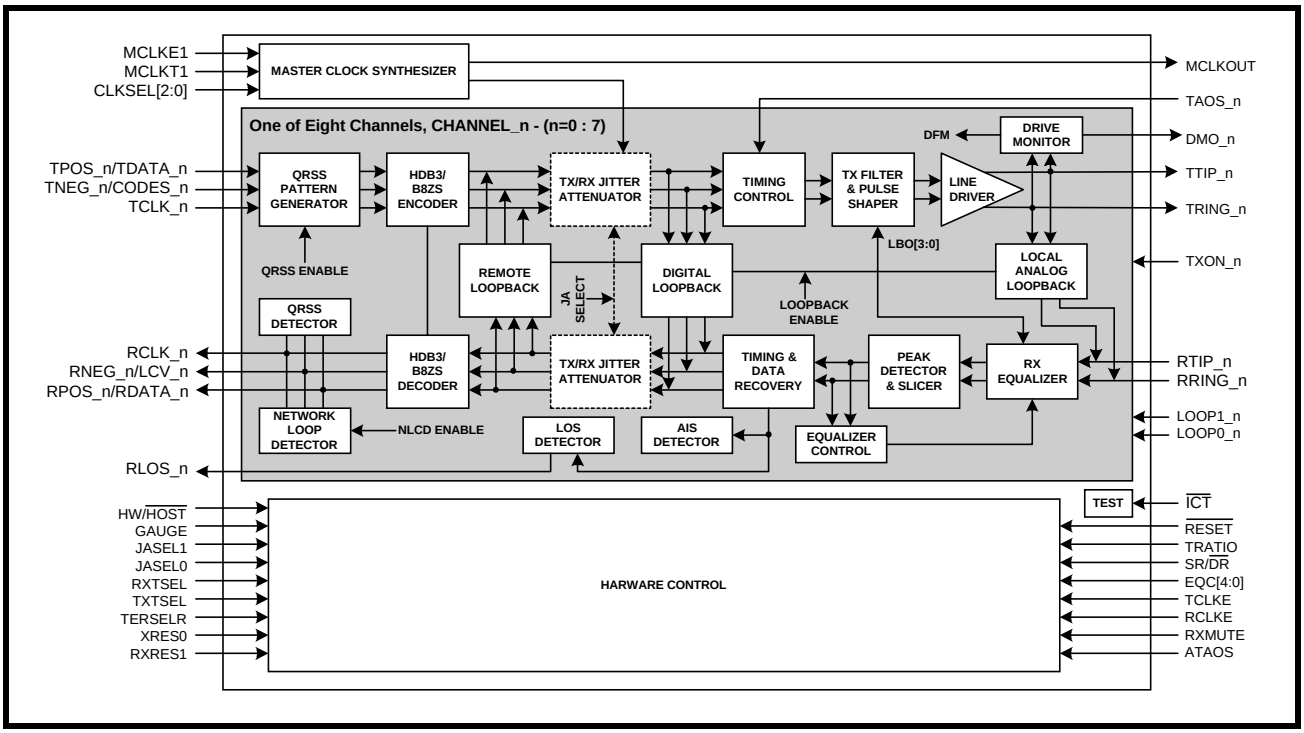


FIGURE 2. BLOCK DIAGRAM OF THE XRT83L38 T1/E1/J1 LIU (HARDWARE MODE)



FEATURES

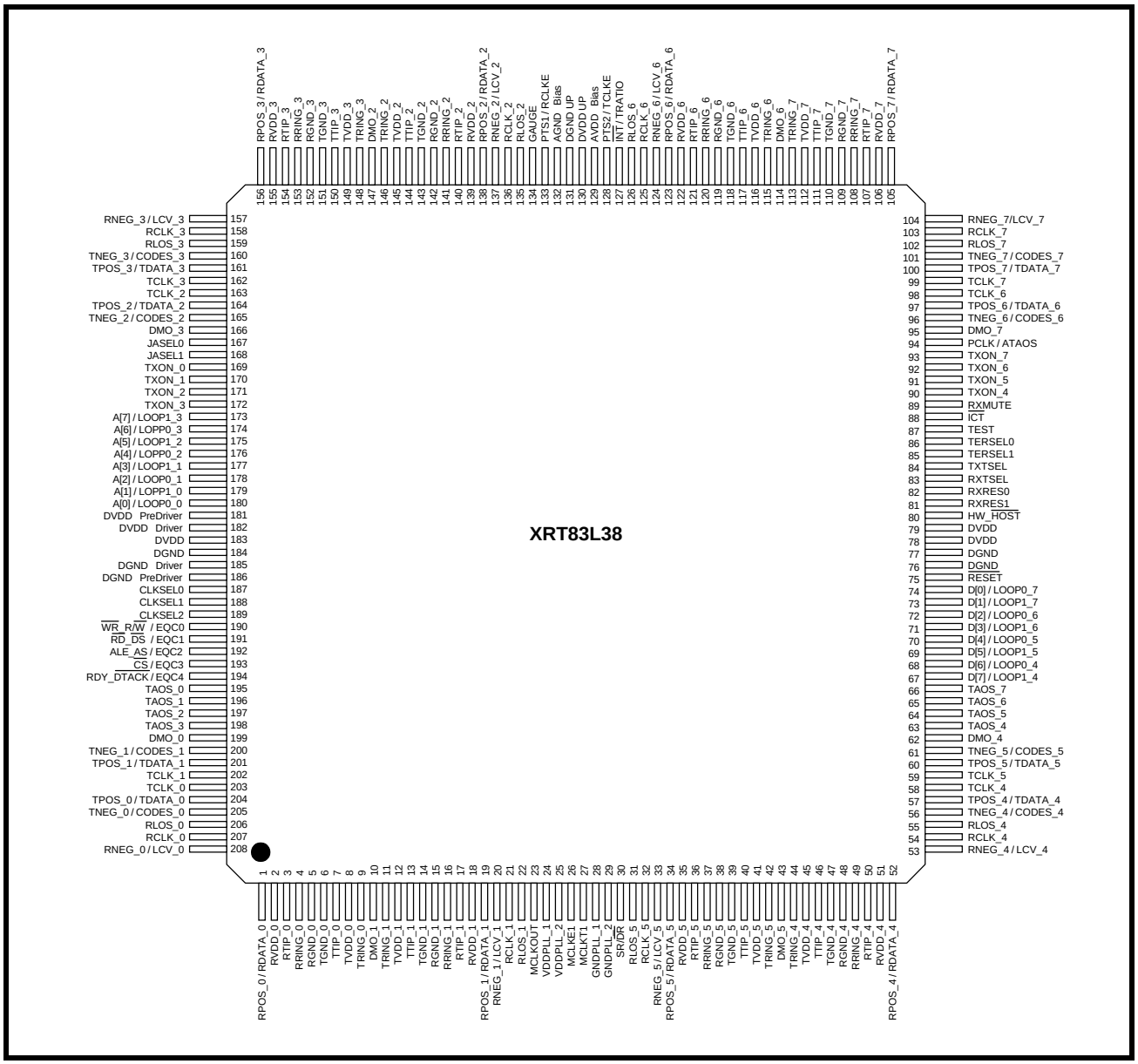
- Fully integrated eight channel long-haul or short-haul transceivers for E1,T1 or J1 applications.
- Adaptive Receive Equalizer for up to 45dB cable attenuation.
- Program able Transmit Pulse Shaper for E1,T1 or J1 short-haul interfaces.
- Five fixed transmit pulse settings for T1 short-haul applications plus a fully programmable waveform generator for transmit output pulse shaping.
- Transmit Line Build-Outs (LBO) for T1 long-haul application from 0dB to -22.5dB in three 7.5dB steps.
- Selectable receiver sensitivity from 0 to 36dB or 0 to 45dB cable loss for T1 @772kHz and E1 @1024kHz.
- Receive monitor mode handles 0 to 29dB resistive attenuation along with 0 to 6dB of cable attenuation for E1 and 0 to 3dB of cable attenuation T1 modes.
- Supports 75Ω and 120Ω (E1), 100Ω (T1) and 110Ω (J1) applications.
- Internal and external impedance matching for 75Ω, 100Ω, 110Ω and 120Ω.
- Tri-State transmit output and receive input capability for redundancy applications
- Transmit return loss meets or exceeds ETSI 300-166 standard
- On-chip digital clock recovery circuit for high input jitter tolerance
- Crystal-less digital jitter attenuator with 32-bit or 64-bit FIFO selectable either in transmit or receive path
- On-chip frequency multiplier generates T1 or E1 Master clocks from variety of external clock sources
- High receiver interference immunity
- On-chip transmit short-circuit protection and limiting, and driver fail monitor output (DMO)
- Receive loss of signal (RLOS) output
- On-chip HDB3/B8ZS/AMI encoder/decoder functions
- QRSS pattern generator and detection for testing and monitoring
- Error and Bipolar Violation Insertion and Detection
- Receiver Line Attenuation Indication Output in 1dB steps
- Network Loop-Code Detection for automatic Loop-Back Activation/Deactivation
- Transmit All Ones (TAOS) and In-Band Network Loop Up and Down code generators
- Supports Analog, Remote, Digital and Dual Loop-Back Modes

- Meets or exceeds T1 and E1 short-haul and long-haul network access specifications in ITU G.703, G.775, G.736 and G.823; TR-TSY-000499; ANSI T1.403 and T1.408; ETSI 300-166 and AT&T Pub 62411
- Supports both Hardware and Host (parallel Micro-processor) interface for programming
- Programmable Interrupt
- Low power dissipation
- Logic inputs accept either 3.3V or 5V levels
- Single 3.3V Supply Operation
- 208 pin TQFP package
- -40°C to +85°C Temperature Range

ORDERING INFORMATION

PART NUMBER	PACKAGE	OPERATING TEMPERATURE RANGE
XRT83L38IV	208 Lead TQFP (28 x 28 x 1.4mm)	-40°C to +85°C

FIGURE 3. PIN OUT OF THE XRT83L38



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PIN DESCRIPTION BY FUNCTION

RECEIVE SECTIONS

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
RLOS_0 **RLOS_1** **RLOS_2** **RLOS_3** **RLOS_4** **RLOS_5** **RLOS_6** **RLOS_7**	206 22 135 159 55 31 126 102	**O**	**Receiver Loss of Signal for Channel_ 0** This output signal goes "High" for at least one RCLK_0 cycle to indicate loss of signal at the receive 0 input. See “Receiver Loss of Signal (LOS)” on page 22. **Receiver Loss of Signal for Channel _1** **Receiver Loss of Signal for Channel _2** **Receiver Loss of Signal for Channel _3** **Receiver Loss of Signal for Channel _4** **Receiver Loss of Signal for Channel_ 5** **Receiver Loss of Signal for Channel _6** **Receiver Loss of Signal for Channel _7**
RCLK_0 **RCLK_1** **RCLK_2** **RCLK_3** **RCLK_4** **RCLK_5** **RCLK_6** **RCLK_7**	207 21 136 158 54 32 125 103	**O**	**Receiver Clock Output for Channel _0** **Receiver Clock Output for Channel _1** **Receiver Clock Output for Channel _2** **Receiver Clock Output for Channel _3** **Receiver Clock Output for Channel _4** **Receiver Clock Output for Channel _5** **Receiver Clock Output for Channel _6** **Receiver Clock Output for Channel _7**
RNEG_0 **LCV_0** **RNEG_1** **LCV_1** **RNEG_2** **LCV_2** **RNEG_3** **LCV_3** **RNEG_4** **LCV_4** **RNEG_5** **LCV_5** **RNEG_6** **LCV_6** **RNEG_7** **LCV_7**	208 20 137 157 53 33 124 104	**O** **O**	**Receiver Negative Data Output for Channel_0** In **dual rail mode**, this signal is the receive negative-rail output data. **Line Code Violation Output for Channel_0** **In Single-Rail Mode** this signal goes "High" for one RCLK_0 cycle to indicate a code violation is detected in the received data of Channel _0. If AMI coding is selected, every bipolar violation received will cause this pin to go "High". **Receiver Negative Data Output for Channel _1** **Line Code Violation Output for Channel _1** **Receiver Negative Data Output for Channel _2** **Line Code Violation Output for Channel _2** **Receiver Negative Data Output for Channel _3** **Line Code Violation Output for Channel _3** **Receiver Negative Data Output for Channel _4** **Line Code Violation Output for Channel _4** **Receiver Negative Data Output for Channel _5** **Line Code Violation Output for Channel _5** **Receiver Negative Data Output for Channel _6** **Line Code Violation Output for Channel _6** **Receiver Negative Data Output for Channel _7** **Line Code Violation Output for Channel _7**

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
RPOS_0	1	**O**	**Receiver Positive Data Output for Channel _0** **In Dual-Rail Mode,** this signal is the receive positive-rail output data sent to the Framer.
RDATA_0			**Receiver NRZ Data Output for Channel _0.** **In Single-Rail Mode,** this signal is the receive output data.
RPOS_1	19		**Receiver Positive Data Output for Channel _1**
RDATA_1			**Receiver NRZ Data Output for Channel _1**
RPOS_2	138		**Receiver Positive Data Output for Channel _2**
RDATA_2			**Receiver NRZ Data Output for Channel _2**
RPOS_3	156		**Receiver Positive Data Output for Channel _3**
RDATA_3			**Receiver NRZ Data Output for Channel _3**
RPOS_4	52		**Receiver Positive Data Output for Channel _4**
RDATA_4			**Receiver NRZ Data Output for Channel _4**
RPOS_5	34		**Receiver Positive Data Output for Channel _5**
RDATA_5			**Receiver NRZ Data Output for Channel _5**
RPOS_6	123		**Receiver Positive Data Output for Channel _6**
RDATA_6			**Receiver NRZ Data Output for Channel 6**
RPOS_7	105		**Receiver Positive Data Output for Channel _7**
RDATA_7			**Receiver NRZ Data Output for Channel _7**
RTIP_0	3	**I**	**Receiver Differential Tip Input for Channel _0** Positive differential receive input from the line
RTIP_1	17		**Receiver Differential Tip Input for Channel _1**
RTIP_2	140		**Receiver Differential Tip Input for Channel _2**
RTIP_3	154		**Receiver Differential Tip Input for Channel _3**
RTIP_4	50		**Receiver Differential Tip Input for Channel _4**
RTIP_5	36		**Receiver Differential Tip Input for Channel _5**
RTIP_6	121		**Receiver Differential Tip Input for Channel _6**
RTIP_7	107		**Receiver Differential Tip Input for Channel _7**
RRING_0	4	**I**	**Receiver Differential Ring Input for Channel _0** Negative differential receive input from the line
RRING_1	16		**Receiver Differential Ring Input for Channel _1**
RRING_2	141		**Receiver Differential Ring Input for Channel _2**
RRING_3	153		**Receiver Differential Ring Input for Channel _3**
RRING_4	49		**Receiver Differential Ring Input for Channel _4**
RRING_5	37		**Receiver Differential Ring Input for Channel _5**
RRING_6	120		**Receiver Differential Ring Input for Channel _6**
RRING_7	108		**Receiver Differential Ring Input for Channel _7**
RXMUTE	89	**I**	**Receive Data Muting.** **In Hardware Mode,** connect this pin "High" to mute RPOS_n/RNEG_n outputs to a "Low" state upon receipt of LOS condition for Channel _n to prevent data chattering. Connect this pin to "Low" to disable muting function. ***NOTES:*** 1. *In Hardware Mode, all receive channels share the same RXMUTE control function.* 2. *Internally pulled "High" with 50kΩ resistor.*

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
RXRES1 **RXRES0**	81 82	**I**	**Receive External Resistor Control Pin 1:** **Receive External Resistor Control Pin 0:** **In Hardware Mode,** these pins determine the value of the external Receive fixed resistor according to the following table: **RXRES1 / RXRES0 / Required Fixed External RX Resistor** **0 / 0 / No External Fixed Resistor** **0 / 1 / 60Ω** **1 / 0 / 52.5Ω** **1 / 1 / 37.5Ω** ***NOTE:*** *Internally pulled "Low" with 50kΩ resistor.*
RCLKE **PTS1**	133	**I**	**Receive Clock Edge.** **In Hardware Mode, (RCLKE)** with this pin set to "High" the output receive data of all channels are updated on the falling edge of RCLK_n. With this pin tied "Low", output data are updated on the rising edge of RCLK_n. **In Host Mode (PTS1),** this pin along with PTS2 (pin 128) is used to select the microprocessor type. See “Microprocessor Interface” on page 9. *Internally pulled "Low" with a 50kΩ resistor.*

TRANSMITTER SECTIONS

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
TCLKE **PTS2**	128	**I**	**Transmit Clock Edge** **In Hardware Mode** (TCLKE), with this pin set to a "High", transmit input data of all channels are sampled at the rising edge of TCLKE. With this pin tied "Low", input data are sampled at the falling edge of TCLKE. **In Host Mode (PTS2),** this pin along with PTS1 (pin 133) selects the micro-processor type. See “Microprocessor Interface” on page 9. ***NOTE:*** *Internally pulled "Low" with a 50kΩ resistor.*
TTIP_0 **TTIP_1** **TTIP_2** **TTIP_3** **TTIP_4** **TTIP_5** **TTIP_6** **TTIP_7**	7 13 144 150 46 40 117 111	**O**	**Transmitter Tip Output for Channel _0** Positive differential transmit output to the line. **Transmitter Tip Output for Channel _1** **Transmitter Tip Output for Channel _2** **Transmitter Tip Output for Channel _3** **Transmitter Tip Output for Channel _4** **Transmitter Tip Output for Channel _5** **Transmitter Tip Output for Channel _6** **Transmitter Tip Output for Channel _7**
TRING_0 **TRING_1** **TRING_2** **TRING_3** **TRING_4** **TRING_5** **TRING_6** **TRING_7**	9 11 146 148 44 42 115 113	**O**	**Transmitter Ring Output for Channel _0** Negative differential transmit output to the line. **Transmitter Ring Output for Channel _1** **Transmitter Ring Output for Channel _2** **Transmitter Ring Output for Channel _3** **Transmitter Ring Output for Channel _4** **Transmitter Ring Output for Channel _5** **Transmitter Ring Output for Channel _6** **Transmitter Ring Output for Channel _7**

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
TPOS_0 **TDATA_0**	204	I	**Transmitter Positive Data Input for Channel _0** **Dual-Rail Mode:** This signal is the positive-rail input data for transmitter 0. **Transmitter 0 Data Input** **Single-Rail Mode:** This pin is used as the NRZ input data for transmitter 0.
TPOS_1 **TDATA_1**	201		**Transmitter Positive Data Input for Channel _1** **Transmitter 1 Data Input**
TPOS_2 **TDATA_2**	164		**Transmitter Positive Data Input for Channel _2** **Transmitter 2 Data Input**
TPOS_3 **TDATA_3**	161		**Transmitter Positive Data Input for Channel _3** **Transmitter 3 Data Input**
TPOS_4 **TDATA_4**	57		**Transmitter Positive Data Input for Channel _4** **Transmitter 4 Data Input**
TPOS_5 **TDATA_5**	60		**Transmitter Positive Data Input for Channel _5** **Transmitter 5 Data Input**
TPOS_6 **TDATA_6**	97		**Transmitter Positive Data Input for Channel _6** **Transmitter 6 Data Input**
TPOS_7 **TDATA_7**	100		**Transmitter Positive Data Input for Channel _7** **Transmitter 7 Data Input** ***NOTE:*** *Internally pulled "Low" with a 50kΩ resistor for each channels.*
TNEG_0 **CODES_0**	205	I	**Transmitter Negative NRZ Data Input for Channel _0** **Dual-Rail Mode:** This signal is the negative-rail input data for transmitter 0. **Single-Rail Mode:** This pin can be left unconnected. **Coding Select for Channel _0** **In Hardware Mode** and with **Single-Rail Mode** selected, connecting this pin "Low" enables HDB3 in E1or B8ZS in T1encoding and decoding for Channel _0. Connecting this pin "High" selects AMI data format.
TNEG_1 **CODES_1**	200		**Transmitter Negative NRZ Data Input for Channel _1** **Coding Select for Channel _1**
TNEG_2 **CODES_2**	165		**Transmitter Negative NRZ Data Input for Channel _2** **Coding Select for Channel _2**
TNEG_3 **CODES_3**	160		**Transmitter Negative NRZ Data Input for Channel _3** **Coding Select for Channel _3**
TNEG_4 **CODES_4**	56		**Transmitter Negative NRZ Data Input for Channel _4** **Coding Select for Channel _4**
TNEG_5 **CODES_5**	61		**Transmitter Negative NRZ Data Input for Channel _5** **Coding Select for Channel _5**
TNEG_6 **CODES_6**	96		**Transmitter Negative NRZ Data Input for Channel _6** **Coding Select for Channel _6**
TNEG_7 **CODES_7**	101		**Transmitter Negative NRZ Data Input for Channel _7** **Coding Select for Channel _7** ***NOTE:*** *Internally pulled "Low" with a 50kΩ resistor for each channels.*

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
TCLK_0	203	**I**	**Transmitter Clock Input for Channel _0** **E1** rate at 2.048MHz ± 50ppm. **T1** rate at 1.544MHz ± 32ppm. During normal operation, both in Host Mode and Hardware Mode, TCLk_0 is used for sampling input data at TPOS_0/TDATA_0 and TNEG_0/CODES_0 while MCLK is used as the timing reference for the transmit pulse shaping circuit. **In Hardware Mode**, if TCLK_0 is tied “High”, the Channel _0 transmitter will send TAOS (a continuous all one's AMI signal) to the line using MCLK as timing reference.
TCLK_1	202		**Transmitter Clock Input for Channel _1**
TCLK_2	163		**Transmitter Clock Input for Channel _2**
TCLK_3	162		**Transmitter Clock Input for Channel _3**
TCLK_4	58		**Transmitter Clock Input for Channel _4**
TCLK_5	59		**Transmitter Clock Input for Channel _5**
TCLK_6	98		**Transmitter Clock Input for Channel _6**
TCLK_7	99		**Transmitter Clock Input for Channel _7**
TAOS_0	195	**I**	**Transmit All Ones for Channel _0** **In Hardware Mode:**, setting this pin "High" enables the transmission of an “All Ones” Pattern from Channel _0. A "Low" level stops the transmission of the “All Ones” Pattern.
TAOS_1	196		**Transmit All Ones for Channel _1**
TAOS_2	197		**Transmit All Ones for Channel _2**
TAOS_3	198		**Transmit All Ones for Channel _3**
TAOS_4	63		**Transmit All Ones for Channel _4**
TAOS_5	64		**Transmit All Ones for Channel _5**
TAOS_6	65		**Transmit All Ones for Channel _6**
TAOS_7	66		**Transmit All Ones for Channel _7** ***NOTE:*** *This pin is internally pulled "Low" with a 50kΩ resistor for all channels.*
TXON_0	169	**I**	**Transmitter Turn On for Channel _0** **In Hardware Mode**, setting this pin "High" turns on the Transmit Section of Channel _0. In this mode, when TXON_0 = “0”, TTIP_0 and TRING_0 driver outputs will be tri-stated.
TXON_1	170		**Transmitter Turn On for Channel _1**
TXON_2	171		**Transmitter Turn On for Channel _2**
TXON_3	172		**Transmitter Turn On for Channel _3**
TXON_4	90		**Transmitter Turn On for Channel _4**
TXON_5	91		**Transmitter Turn On for Channel _5**
TXON_6	92		**Transmitter Turn On for Channel _6**
TXON_7	93		**Transmitter Turn On for Channel _7** **In Host Mode,** the TXON_n bits in the channel control registers turn the Transmit section ON or OFF. However, control of the transmit on/off function can be transferred to the Hardware pins by setting the TXONCTL bit (bit 7) to “1” in the register at address hex 0x82. ***NOTE:*** *Internally pulled “High” with a 50kΩ resistor for all channels.*

MICROPROCESSOR INTERFACE

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
HW_$\overline{\text{HOST}}$	80	**I**	**Mode Control Input** This pin is used for selecting Hardware or Host modes to control the device. Leave this pin unconnected or tie "High" to select Hardware Mode. For Host mode, this pin must be tied "Low". ***NOTE:*** *Internally pulled "High" with a 50kΩ resistor.*
$\overline{\text{WR}}$_R/$\overline{\text{W}}$ **EQC0**	190	**I**	**Write Input (Read/Write), Host Mode** With Intel bus timing, a “Low” pulse on $\overline{\text{WR}}$ selects a write operation when $\overline{\text{CS}}$ pin is "Low". With Motorola bus timing, a “High” pulse on R/$\overline{\text{W}}$ selects a read operation and a “Low” pulse on R/$\overline{\text{W}}$ selects a write operation when $\overline{\text{CS}}$ is "Low". **In Hardware Mode,** Pins EQC0, EQC1, EQC2, EQC3 and EQC4 select the Receive Equalizer and Transmitter Line Build Out, See “Alarm Functions/ Redundancy Support” on page 14.
$\overline{\text{RD}}$_$\overline{\text{DS}}$ **EQC1**	191	**I**	**Read Input (Data Strobe), Host Mode** With Intel bus timing, a "Low" pulse on $\overline{\text{RD}}$ selects a read operation when the $\overline{\text{CS}}$ pin is "Low". With Motorola bus timing, a "Low" pulse on $\overline{\text{DS}}$ indicates a read or write operation when the $\overline{\text{CS}}$ pin is "Low". **In Hardware Mode,** Pins EQC0, EQC1, EQC2, EQC3 and EQC4 select the Receive Equalizer and Transmitter Line Build Out, See “Alarm Functions/ Redundancy Support” on page 14.
ALE_$\overline{\text{AS}}$ **EQC2**	192	**I**	**Address Latch Input (Address Strobe), Host Mode** With Intel bus timing, the address inputs are latched into the internal register on the falling edge of ALE. With Motorola bus timing, the address inputs are latched into the internal register on the falling edge of $\overline{\text{AS}}$. **In Hardware Mode,** Pins EQC0, EQC1, EQC2, EQC3 and EQC4 select the Receive Equalizer and Transmitter Line Build Out, See “Alarm Functions/ Redundancy Support” on page 14.
$\overline{\text{CS}}$ **EQC3**	193	**I**	**Chip Select Input, Host Mode** This signal must be “Low” in order to access the parallel port. **In Hardware Mode,** Pins EQC0, EQC1, EQC2, EQC3 and EQC4 select the Receive Equalizer and Transmitter Line Build Out, See “Alarm Functions/ Redundancy Support” on page 14.
RDY_$\overline{\text{DTACK}}$ **EQC4**	194	**O**	**Ready Output (Data Transfer Acknowledge Output), Host Mode** With Intel bus timing, RDY is asserted “High” to indicate the device has completed a read or write operation. With Motorola bus timing, $\overline{\text{DTACK}}$ is asserted "Low" to indicate the device has completed a read or write cycle. **In Hardware Mode,** Pins EQC0, EQC1, EQC2, EQC3 and EQC4 select the Receive Equalizer and Transmitter Line Build Out, See “Alarm Functions/ Redundancy Support” on page 14.

<table>
<tr><th>SIGNAL NAME</th><th>PIN #</th><th>TYPE</th><th>DESCRIPTION</th></tr>
<tr><td>PTS1
PTS2 /

RCLKE
TCLKE</td><td>133
128

133
128</td><td>I</td><td>Processor Type Select Input Bit 1 -- Host Mode
Processor Type Select Input Bit 2

<table><tr><th>PTS1</th><th>PTS2</th><th>µP Type</th></tr><tr><td>0</td><td>0</td><td>68HC11, 8051, 80C188 (async.)</td></tr><tr><td>0</td><td>1</td><td>Motorola 68K (async.)</td></tr><tr><td>1</td><td>0</td><td>Intel x86 (sync.)</td></tr><tr><td>1</td><td>1</td><td>Intel i960, Motorola 860 (sync.)</td></tr></table>Hardware Mode
(RCLKE) Receive clock edge, See “Receive Sections” on page 4.
(TCLKE) Transmit clock edge, See “Transmitter Sections” on page 6.
NOTE: Internally pulled "Low" with a 50kΩ resistor.</td></tr>
<tr><td>D[7] / LOOP1_4
D[6] / LOOP0_4
D[5] / LOOP1_5
D[4] / LOOP0_5
D[3] / LOOP1_6
D[2] / LOOP0_6
D[1] / LOOP1_7
D[0] / LOOP0_7</td><td>67
68
69
70
71
72
73
74</td><td>I/O</td><td>Data Bus[7]; Microprocessor read/write data bus, Host Mode
Data Bus[6]
Data Bus[5]
Data Bus[4]
Data Bus[3]
Data Bus[2]
Data Bus[1]
Data Bus[0]
Hardware Mode Loop[0:1] Channel _[7-4]
Pins 67-74 and 173-180 control which Loop-Back mode is selected per channel, See “Alarm Functions/Redundancy Support” on page 14.
NOTE: This pin is internally pulled "Low" with a 50kΩ resistor.</td></tr>
<tr><td>A[7] / LOOP1_3
A[6] / LOOP0_3
A[5] / LOOP1_2
A[4] / LOOP0_2
A[3] / LOOP1_1
A[2] / LOOP0_1
A[1] / LOOP1_0
A[0] / LOOP0_0</td><td>173
174
175
176
177
178
179
180</td><td>I</td><td>Microprocessor Interface Address Bus[7], Host Mode
Microprocessor Interface Address Bus[6]
Microprocessor Interface Address Bus[5]
Microprocessor Interface Address Bus[4]
Microprocessor Interface Address Bus[3]
Microprocessor Interface Address Bus[2]
Microprocessor Interface Address Bus[1]
Microprocessor Interface Address Bus[0]

Hardware Mode Loop[0:1] Channel _[3-0]
Pins 67-74 and 173-180 control which Loop-Back mode is selected per channel, See “Alarm Functions/Redundancy Support” on page 14.
NOTE: This pin is internally pulled "Low" with a 50kΩ resistor.</td></tr>
<tr><td>PCLK

ATAOS</td><td>94</td><td>I</td><td>Microprocessor Clock Input, Host Mode
Input clock for synchronous microprocessor operation. Maximum clock rate is 20 MHz.
Hardware Mode (ATAOS), this pin functions as an Automatic Transmit All ”Ones”, See “Alarm Functions/Redundancy Support” on page 14.
NOTE: This pin is internally pulled "Low" with a 50kΩ resistor for asynchronous microprocessor interface when no clock is present.</td></tr>
</table>

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
$\overline{\text{INT}}$ TRATIO	127	I/O	**Interrupt Output -- Host Mode** This pin goes “Low” to indicate an alarm condition has occurred within the device. Interrupt generation can be globally disabled by setting the IMASK bit to a "1" in the command control register. **In Hardware Mode -- Transmitter Transformer Ratio Select,** the function of this pin is to select the transmitter transformer ratio. See “Alarm Functions/ Redundancy Support” on page 14. ***NOTE:*** *This pin is an open drain output and requires an external 10kΩ pull-up resistor.*

JITTER ATTENUATOR

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
JASEL0 JASEL1	167 168	I	**Jitter Attenuator select bit 0** **Jitter Attenuator select bit 1** **In Hardware Mode:** JASEL0 and JASEL1 bits are used to place the jitter attenuator in the transmit path, the receive path or to disable it. ***NOTE:*** *These pins are internally pulled "Low" with 50kΩ resistors.*

JASEL1	JASEL0	Path
0	0	JA Disabled
0	1	JA in Transmit Path - 32bit FIFO
1	0	JA in Receive Path - 32bit FIFO
1	1	JA in Receive Path - 64bit FIFO

CLOCK SYNTHESIZER

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
MCLKOUT	23	**O**	**Synthesized Master Clock Output:** This signal is the output of the Master Clock Synthesizer PLL which is at T1 or E1 rate based upon the mode of operation.
MCLKT1	27	**I**	**T1 Master Clock Input** This signal is an independent 1.544MHz clock for T1 systems with accuracy better than ±50ppm and duty cycle within 40% to 60%. MCLKT1 is used in the T1 mode. ***NOTES:*** *1. See pin 26 description for further explanation for the usage of this pin.* *2. Internally pulled "Low" with a 50kΩ resistor.*
MCLKE1	26	**I**	**E1 Master Clock Input** This input signal is an independent 2.048MHz clock for E1 system with required accuracy of better than ±50ppm and a duty cycle of 40% to 60%. MCLKE1 is used in the E1 mode. Its function is to provide internal timing for the PLL clock recovery circuit, transmit pulse shaping, jitter attenuator block, reference clock during transmit all ones data and timing reference for the microprocessor in Host Mode operation. The MCLKE1 and MCLKT1 inputs are useful in systems where multiple channels are used, and each channel should have the flexibility to be programmed independently in either T1 or E1 modes. These inputs eliminate the need for an external multiplexer to route the T1 or E1 clocks to the individual channel based on their operating mode. In systems that have only one master clock source available (E1 or T1), that clock should be connected to both MCLKE1 and MCLKT1 inputs for proper operation. MCLKE1 is also input to a programmable frequency synthesizer that under the control of the CLKSEL(2-0) inputs can be used to generate a master clock from an accurate outside source. (See pin descriptions for ClkSEL(2:0), pins 187 - 189, below for usable input frequencies and operation.) ***NOTE:*** *Internally pulled "Low" with a 50kΩ resistor.*

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
ClkSEL0 **ClkSEL1** **ClkSEL2**	187 188 189	I	**Clock Select inputs for Master Clock Synthesizer** **In Hardware Mode: CLKSEL2-0** are input signals to a programmable frequency synthesizer that can be used to generate a master clock from an external accurate clock source according to the following table: **In Hardware mode;** The MCLKRATE control signal is generated from the state of EQC0-EQC4 inputs. **In Host Mode;** The state of these pins are ignored and the master frequency PLL is controlled by the corresponding interface bits.

MCLKE1 kHz	MCLKT1 kHz	CLKSEL2	CLKSEL1	CLKSEL0	MCLKRATE	CLKOUT/ kHz
2048	2048	0	0	0	0	2048
2048	2048	0	0	0	1	1544
2048	1544	0	0	0	0	2048
1544	1544	0	0	1	1	2048
1544	1544	0	0	1	0	1544
2048	1544	0	0	1	1	1544
8	X	0	1	0	0	2048
8	X	0	1	0	1	1544
16	X	0	1	1	0	2048
16	X	0	1	1	1	1544
56	X	1	0	0	0	2048
56	X	1	0	0	1	1544
64	X	1	0	1	0	2048
64	X	1	0	1	1	1544
128	X	1	1	0	0	2048
128	X	1	1	0	1	1544
256	X	1	1	1	0	2048
256	X	1	1	1	1	1544

NOTE: *These pins are internally pulled "Low" with a 50kΩ resistor.*

ALARM FUNCTIONS/REDUNDANCY SUPPORT

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
GAUGE	134	**I**	**Twisted Pair Cable Wire Gauge Select** **In Hardware Mode,** connect this pin "High" to select 26 Gauge wir**e.** **Con**nect this pin “Low” to select 22 and 24 quage wire for all channels. ***NOTE:*** *Internally pulled “Low” with a 50kΩ resistor.*
DMO_0	199	**O**	**Driver Failure Monitor Channel _0** This pin transitions "High" if a short circuit condition is detected in the transmit driver of Channel _0, or no transmit output pulse is detected for more than 128 TCLK0 cycles.
DMO_1	10		**Driver Failure Monitor Channel _1**
DMO_2	147		**Driver Failure Monitor Channel _2**
DMO_3	166		**Driver Failure Monitor Channel _3**
DMO_4	62		**Driver Failure Monitor Channel _4**
DMO_5	43		**Driver Failure Monitor Channel _5**
DMO_6	114		**Driver Failure Monitor Channel _6**
DMO_7	95		**Driver Failure Monitor Channel _7**
ATAOS	94	**I**	**Automatic Transmit “All Ones” Pattern:** **In Hardware Mode ATAOS**, a "High" level on this pin enables the automatic transmission of an "All Ones" AMI pattern from the transmitter of any channel that the receiver of that channel has detected an LOS condition. A "Low" level on this pin disables this function.
PCLK		**I**	**Host Mode (PCLK),** this pin functions as the microprocessor clock input. ***NOTES:*** 1. *Note: All channels share the same ATAOS control function.* 2. *This pin is internally pulled "Low" for asynchronous microprocessor interface when no clock is present.*
TRATIO	127	**I**	**In Hardware Mode:** **Transmitter Transformer Ratio Select** **Hardware Mode (TRATIO)** In external termination mode (TXTSEL = 0), setting this pin "High" selects a transformer ratio of 1:2 for the transmitter. A "Low" on this pin sets the transmitter transformer ratio to 1:2.45. In the internal termination mode the transmitter transformer ratio is permanently set to 1:2 and the state of this pin is ignored.
$\overline{\text{INT}}$		**O**	**In Host Mode:** **Interrupt Output ($\overline{\text{INT}}$)** This pin is asserted low to indicate an alarm condition. See “Microprocessor Interface” on page 9. ***NOTE:*** *This pin is an open drain output and requires an external 10kΩ pull-up resistor.*
$\overline{\text{RESET}}$	75	**I**	**Hardware Reset (Active "Low")** When this pin is tied “Low” for more than 10µs, the device is put in the reset state. Pulling $\overline{\text{RESET}}$ and $\overline{\text{ICT}}$ pins “Low” simultaneously will put the chip in factory test mode. This condition should not be permitted during normal operation. ***NOTE:*** *Internally pulled "High" with a 50kΩ resistor.*

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
SR/$\overline{DR}$	30	I	**Single-Rail/Dual-Rail Data Format** **C**onnect this pin "Low" to select transmit and receive data format in dual-rail mode. In this mode, HDB3 or B8ZS encoder and decoder are not available. Connect this pin "High" to select single-rail data format. ***NOTE:*** *Internally pulled "Low"with a 50k**Ω** resistor.*
LOOP1_0 / A[1] **LOOP0_0 / A[0]** **LOOP1_1 / A[3]** **LOOP0_1 / A[2]** **LOOP1_2 / A[5]** **LOOP0_2 / A[1]** **LOOP1_3 / A[7]** **LOOP0_3 / A[6]** **LOOP1_4 / D[7]** **LOOP0_4 / D[6]** **LOOP1_5 / D[5]** **LOOP0_5 / D[4]** **LOOP1_6 / D[3]** **LOOP0_6 / D[2]** **LOOP1_7 / D[1]** **LOOP0_7 / D[0]**	179 180 177 178 175 176 173 174 67 68 69 70 71 72 73 74	I	**Loop-back control bit 1, Channel _0** **Loop-back control bit 0, Channel _0** **Loop-back control bit 1, Channel _1** **Loop-back control bit 0, Channel _1** **Loop-back control bit 1, Channel _2** **Loop-back control bit 0, Channel _2** **Loop-back control bit 1, Channel _3** **Loop-back control bit 0, Channel _3** **Loop-back control bit 1, Channel _4** **Loop-back control bit 0, Channel _4** **Loop-back control bit 1, Channel _5** **Loop-back control bit 0, Channel _5** **Loop-back control bit 1, Channel _6** **Loop-back control bit 0, Channel _6** **Loop-back control bit 1, Channel _7** **Loop-back control bit 0, Channel _7** **In Hardware Mode,** these pins control the Loop-Back mode for each channel_n per the following table; **LOOP1_n** / **LOOP0_n** / **MODE** 0 / 0 / Normal Mode No Loop-Back Channel_n 0 / 1 / Local Loop-Back Channel_n 1 / 0 / Remote Loop-Back Channel_n 1 / 1 / Digital Loop-Back Channel_n **In Host Mode**, these pins are microprocessor address and data bus pins, See “Microprocessor Interface” on page 9. ***NOTE:*** *Internally pulled “Low” with a 50kΩ resistor.*
EQC4 **EQC3** **EQC2** **EQC1** **EQC0** **RDY_$\overline{DTACK}$** **$\overline{CS}$** **ALE_AS** **$\overline{RD}$_$\overline{DS}$** **$\overline{WR}$_R/$\overline{W}$**	194 193 192 191 190 194 193 192 191 190	I	**Equalizer Control Input 4** **In Hardware Mode**, this pin together with EQC3-0 are used for controlling the transmit pulse shaping, transmit line build-out (LBO), receive monitoring and also T1, E1 or J1 Modes of operation. See Table 4 for description of Transmit Equalizer Control bits. **Equalizer Control Input 3** **Equalizer Control Input 2** **Equalizer Control Input 1** **Equalizer Control Input 0** ***NOTE:*** *In Hardware mode all transmit channels share the same pulse setting controls function.* **In Host Mode,** these pins perform various microprocessor functions. See “Microprocessor Interface” on page 9.

<table>
<tr><th>SIGNAL NAME</th><th>PIN #</th><th>TYPE</th><th>DESCRIPTION</th></tr>
<tr><td>RXTSEL</td><td>83</td><td>I</td><td>Receiver Termination Select:
In Hardware Mode, when this pin is “low” the receive line termination is determined only by the external resistor. When “High”, the receive termination is realized by internal resistors or the combination of internal and external resistors. These conditions are described in the following table;

<table><tr><th>RXTSEL</th><th>RX Termination</th></tr><tr><td>0</td><td>External</td></tr><tr><td>1</td><td>Internal</td></tr></table>
NOTE: In Hardware Mode all channels share the same RTXSEL control function.
In Host Mode, the RXTSEL_n bits in the channel control registers determines if the receiver termination is external or internal. However the function of RXTSEL can be transferred to the Hardware pin by setting the TERCNTL bit (bit 6) to “1” in the register address hex 0x82.
NOTE: This pin is internally pulled "Low"with a 50kΩ resistor.</td></tr>
<tr><td>TXTSEL</td><td>84</td><td>I</td><td>Transmit Termination Select:
In Hardware Mode, when this pin is “low” the transmit line termination is determined only by an external resistor. When “High”, the transmit termination is realized only by an internal resistor. These conditions are described in the following table;

<table><tr><th>TXTSEL</th><th>TX Termination</th></tr><tr><td>0</td><td>External</td></tr><tr><td>1</td><td>Internal</td></tr></table>
NOTES:
1. This pin is internally pulled "Low" with a 50kΩ resistor.
2. In Hardware Mode all channels share the same TXTSEL control function.</td></tr>
</table>

<table>
<tr><th>SIGNAL NAME</th><th>PIN #</th><th>TYPE</th><th>DESCRIPTION</th></tr>
<tr><td>TERSEL1
TERSEL0</td><td>85
86</td><td>I</td><td>Termination Impedance Select bit 1:
Termination Impedance Select bit 0:
In the Hardware Mode and in the internal termination mode (TXTSEL="1" and RXTSEL="1") TERSEL1-0 control the transmit and receive termination impedance according to the following table;

<table>
<tr><th>TERSEL1</th><th>TERSEL0</th><th>Termination</th></tr>
<tr><td>0</td><td>0</td><td>100Ω</td></tr>
<tr><td>0</td><td>1</td><td>110Ω</td></tr>
<tr><td>1</td><td>0</td><td>75Ω</td></tr>
<tr><td>1</td><td>1</td><td>120Ω</td></tr>
</table>

In the internal termination mode the receiver termination of each receiver is realized completely by internal resistors or by the combination of internal and one fixed external resistor (see description of RXRES1-0 pins).
In the internal termination mode the transformer ratio of 1:2 and 2:1 is required for transmitter and receiver respectively with the transmitter output AC coupled to the transformer.
NOTES:
1. This pin is internally pulled "Low"with a 50kΩ resistor.
2. In Hardware Mode all channels share the same TERSEL control function.</td></tr>
<tr><td>TEST</td><td>87</td><td>I</td><td>Manufacturing Test:
NOTE: For normal operation this pin must be tied to ground.</td></tr>
<tr><td>$\overline{\text{ICT}}$</td><td>88</td><td>I</td><td>In-Circuit Testing (Active "Low"):
When this pin is tied "Low", all output pins are forced to a High impedance state for in-circuit testing.
Pulling $\overline{\text{RESET}}$ and $\overline{\text{ICT}}$ pins "Low" simultaneously will put the chip in factory test mode. This condition should not be permitted during normal operation.
NOTE: Internally pulled "High" with a 50kΩ resistor.</td></tr>
<tr><td>DMO_0

DMO_1
DMO_2
DMO_3
DMO_4
DMO_5
DMO_6
DMO_7</td><td>199

10
147
166
62
43
114
95</td><td>O</td><td>Driver Failure Monitor Channel _0
This pin transitions "High" if a short circuit condition is detected in the transmit driver of Channel _0, or no transmit output pulse is detected for more than 128 TCLK0 cycles.
Driver Failure Monitor Channel _1
Driver Failure Monitor Channel _2
Driver Failure Monitor Channel _3
Driver Failure Monitor Channel _4
Driver Failure Monitor Channel _5
Driver Failure Monitor Channel _6
Driver Failure Monitor Channel _7</td></tr>
</table>

POWER AND GROUND

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
TGND_0	6	****	Transmitter Analog Ground for Channel _0
TGND_1	14		Transmitter Analog Ground for Channel _1
TGND_2	143		Transmitter Analog Ground for Channel _2
TGND_3	151		Transmitter Analog Ground for Channel _3
TGND_4	47		Transmitter Analog Ground for Channel _4
TGND_5	39		Transmitter Analog Ground for Channel _5
TGND_6	118		Transmitter Analog Ground for Channel _6
TGND_7	110		Transmitter Analog Ground for Channel _7
TVDD_0	8	****	Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _0
TVDD_1	12		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _1
TVDD_2	145		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _2
TVDD_3	149		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _3
TVDD_4	45		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _4
TVDD_5	41		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _5
TVDD_6	116		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _6
TVDD_7	112		Transmitter Analog Positive Supply (3.3V ± 5%) for Channel _7
RVDD_0	2	****	Receiver Analog Positive Supply (3.3V± 5%) for Channel _0
RVDD_1	18		Receiver Analog Positive Supply (3.3V± 5%) for Channel _1
RVDD_2	139		Receiver Analog Positive Supply (3.3V± 5%) for Channel _2
RVDD_3	155		Receiver Analog Positive Supply (3.3V± 5%) for Channel _3
RVDD_4	51		Receiver Analog Positive Supply (3.3V± 5%) for Channel _4
RVDD_5	35		Receiver Analog Positive Supply (3.3V± 5%) for Channel _5
RVDD_6	122		Receiver Analog Positive Supply (3.3V± 5%) for Channel _6
RVDD_7	106		Receiver Analog Positive Supply (3.3V± 5%) for Channel _7
RGND_0	5	****	Receiver Analog Ground for Channel _0
RGND_1	15		Receiver Analog Ground for Channel _1
RGND_2	142		Receiver Analog Ground for Channel _2
RGND_3	152		Receiver Analog Ground for Channel _3
RGND_4	48		Receiver Analog Ground for Channel _4
RGND_5	38		Receiver Analog Ground for Channel _5
RGND_6	119		Receiver Analog Ground for Channel _6
RGND_7	109		Receiver Analog Ground for Channel _7
AVDD	129	****	Analog Positive Supply (3.3V± 5%)
VDDPLL_1	24		Analog Positive Supply for Master Clock Synthesizer PLL (3.3V± 5%)
VDDPLL_2	25		Analog Positive Supply for Master Clock Synthesizer PLL (3.3V± 5%)
AGND	132	****	Analog Ground
GNDPLL_1	28		Analog Ground for Master Clock Synthesizer PLL
GNDPLL_2	29		Analog Ground for Master Clock Synthesizer PLL
DVDD	78	****	Digital Positive Supply (3.3V± 5%)
DVDD	79		Digital Positive Supply (3.3V± 5%)
DVDD	130		Digital Positive Supply (3.3V± 5%)
DVDD	181		Digital Positive Supply (3.3V± 5%)
DVDD	182		Digital Positive Supply (3.3V± 5%)
DVDD	183		Digital Positive Supply (3.3V± 5%)

SIGNAL NAME	PIN #	TYPE	DESCRIPTION
DGND	76	****	**Digital Ground**
DGND	77		**Digital Ground**
GND	114		**Ground**
DGND	131		**Digital Ground**
DGND	184		**Digital Ground**
DGND	185		**Digital Ground**
DGND	186		**Digital Ground**

FUNCTIONAL DESCRIPTION

The XRT83L38 is a fully integrated long-haul and short-haul transceiver intended for T1, J1 and E1 systems. Simplified block diagrams of the chip are shown in Figure 1 (**Host** mode) and Figure 2 (**Hardware** mode). The XRT83L38 can receive signals that have been attenuated (0 to 6000 feet cable loss) from 0 to 45dB at 772kHz for T1 and from 0 to 45dB at 1.024MHz for E1 systems.

In T1 application, the XRT83L38 can generate five transmit pulse shapes to meet the short-haul Digital Cross-connect (DSX-1) template requirement as well as four CSU Line Build-Out (LBO) filters of 0dB, -7.5dB, -15dB and -22.5dB as required by FCC rules. It also provides programmable transmit output pulse generators for each channel that can be used for output pulse shaping allowing performance improvement over a wide variety of conditions. The operation and configuration of the XRT83L38 can be controlled through a parallel Host interface or Hardware control.

MASTER CLOCK GENERATOR

Using a variety of external clock sources, the on-chip frequency synthesizer generates the T1 (1.544MHz) and E1 (2.048MHz) master clocks necessary for the transmit pulse shaping and receive clock recovery circuit.

There are two master clock inputs MCLKE1 and MCLKT1. In systems where both T1 and E1 master clocks are available these clocks can be connected to the respective pins. This feature is useful in systems where multiple channels are used, and each channel should have the flexibility to be programmed independently in T1 or E1 modes based system requirements. These inputs eliminate the need for an external multiplexer to route the T1 or E1 clocks to the individual channels. In systems that have only one master clock source available (E1 or T1), that clock should be connected to both MCLKE1 and MCLKT1 inputs for proper operation. MCLKE1 is also the input to a programmable frequency synthesizer that under the control of the CLKSEL2-0 inputs the chip will generate a master clock from an accurate outside clock source. T1 and E1 master clocks can be generated from 8kHz, 16kHz, 56kHz, 64kHz, 128kHz and 256kHz external clocks under the control of CLKSEL2-0 inputs according to Table 1.

NOTE: *EQC4 and EQC3 determine the T1/E1 operating mode. (See Table 4 for details.)*

TABLE 1: MASTER CLOCK GENERATOR

MCLKE1 kHz	MCLKT1 kHz	CLKSEL2	CLKSEL1	CLKSEL0	MCLKRATE	MASTER CLOCK kHz
2048	2048	0	0	0	0	2048
2048	2048	0	0	0	1	1544
2048	1544	0	0	0	0	2048
1544	1544	0	0	1	1	1544
1544	1544	0	0	1	0	2048
2048	1544	0	0	1	1	1544
8	x	0	1	0	0	2048
8	x	0	1	0	1	1544
16	x	0	1	1	0	2048
16	x	0	1	1	1	1544
56	x	1	0	0	0	2048
56	x	1	0	0	1	1544
64	x	1	0	1	0	2048
64	x	1	0	1	1	1544
128	x	1	1	0	0	2048
128	x	1	1	0	1	1544
256	x	1	1	1	0	2048
256	x	1	1	1	1	1544

In Table 1, the MCLKRATE control signal is generated from the EQC0-EQC4 inputs based on the selected mode of operation. In **Host** mode the programming is achieved through the corresponding interface control bits and the state of the CLKSEL[2:0] control bits and the state of the MCLKRATE interface control bit.

RECEIVER

RECEIVER INPUT

At the receiver input, a cable attenuated AMI signal can be coupled to the receiver through a capacitor or a 2:1 transformer. The input signal is first applied to a selective equalizer for signal conditioning. The maximum equalizer gain is up to 45dB for both T1 and E1 modes. In long-haul mode the maximum equalizer gain can be limited to 36dB through the input interface control bits for improved performance over shorter loops. The equalized signal is subsequently applied to a peak detector which in turn controls the equalizer settings and the data slicer. The slicer threshold is typically set for both E1 and T1 at 50% of the peak amplitude at the equalizer output. After the slicers, the digital representation of the AMI signals are applied to the clock and data recovery circuit. The recovered data subsequently goes through the jitter attenuator and decoder (if selected) for HDB3 or B8ZS decoding before being applied to the RPOS/RDATA and RNEG/LCV pins. Clock recovery is accomplished by a digital phase-locked loop (DPLL) which does not require any external components and can tolerate high levels of input jitter that either meets or exceeds the ITU-G.823 and TR-TSY000499 standards.

RECEIVE MONITOR MODE

In applications where Monitor mode is desired, the equalizer can be configured in a gain mode which handles input signals attenuated resistively up to 29dB, along with 0 to 6dB cable attenuation for both T1 and E1 applications (refer to Table 4 for details). This feature is available in both **Hardware** and **Host** modes.

RECEIVER LOSS OF SIGNAL (LOS)

For compatibility with ITU G.775 requirements, the receiver loss of signal monitoring function is implemented using both analog and digital detection schemes. When the input signal amplitude at RTIP/RRING drops more than 43dB for E1, (36dB for T1), below the 0dB nominal level. A digital detector is activated to count for 32 consecutive “zeros” in E1 (4096 bits in Extended LOS mode, EXLOS="1") or 175 consecutive “zeros” in T1 mode before RLOS is asserted to indicate input signal loss. If the extended input level is activated for T1 mode, the input level before declaring RLOS is extended to 43dB below the nominal 0dB input level. Signal loss condition is cleared when the input signal rises above the 43dB below 0dB nominal level and meets 12.5% “ones” density of 4 “ones” in a 32 bit window, with no more than 16 consecutive zeros for E1. In T1 mode, RLOS is cleared when the input signal level rises above the 36dB, (45dB if the extended input level is activated), below 0dB nominal level and contains 16 “ones” in a 128 bits window with no more than 100 consecutive zeros in the data stream. This feature is supported on a per channel basis in both **Hardware** and **Host** modes.

HDB3/B8ZS ENCODER/DECODER

The Encoder and Decoder functions are available in both **Hardware** and **Host** modes on a per channel basis by controlling the CODES pin or interface bit. The decoder function is only active in single-rail Mode. When selected, receive data in this mode will be decoded according to HDB3 rules for E1 and B8ZS for T1 system. Bipolar violations that do not conform to the coding scheme will be reported as Line Code Violation at the LCV pin of each channel. The length of the LCV pulse is one RCLK cycle for each code violation. Excessive number of zeros in the receive data stream is also reported as error at the same output pin. If AMI decoding is selected in single rail mode, every bipolar violation in the receive data stream will be reported as an error at the LCV pin.

RECOVERED CLOCK (RCLK) SAMPLING EDGE

This feature is available in both **Hardware** and **Host** modes on a global basis. In **Host** mode, the sampling edge of RCLK output can be changed through the interface control bit RCLKE. If a “1” is written in the RCLKE interface bit, receive data output at RPOS/RDATA and RNEG are updated on the falling edge of RCLK for all eight channels. Writing a “0” to the RCLKE register, updates the receive data on the rising edge of RCLK. In **Hardware** mode the same feature is available under the control of the RCLKE pin.

JITTER ATTENUATOR

To reduce phase and frequency jitter in the recovered clock, the jitter attenuator can be placed in the receive signal path. The jitter attenuator uses a data FIFO with a programmable depth that can vary between 2x32 and 2x64. The jitter attenuator can also be placed in the transmit signal path or disabled altogether depending upon the system requirements. The jitter attenuator, other than using the master clock as reference, requires no external components. With the jitter attenuator selected, the typical throughput delay from input to output is 16 bits for 32 bit FIFO size or 32 bit for 64 bit FIFO size. When the read and write pointers of the FIFO in the jitter attenuator are within two bits of over or under-flowing, the bandwidth of the jitter attenuator is widened to track the short term input jitter, thereby avoiding data corruption. When this situation occurs, the jitter attenuator will not attenuate input jitter until the read/write pointer's position is outside the two bits window. Under normal condition, the jitter transfer characteristic meets the narrow bandwidth requirement as specified in ITU-G.736, ITU- I.431 and AT&T Pub 62411 standards.

In T1 mode the Jitter Attenuator Bandwidth is always set to 3Hz. In E1 mode, the bandwidth can be reduced through the JABW control signal. When JABW is set “High” the bandwidth of the jitter attenuator is reduced from 10Hz to 1.5Hz. Under this condition the FIFO length is automatically set to 64 bits and the 32 bits FIFO length will not be available in this mode. Jitter attenuator controls are available on a per channel basis in the **Host** mode and on a global basis in the **Hardware** mode.

TRANSMITTER

DIGITAL DATA FORMAT

Both the transmitter and receiver can be configured to operate in dual or single-rail data formats. This feature is available under both **Hardware** and **Host** control modes on a global basis. The dual or single-rail data format is determined by the state of the SR/$\overline{DR}$ pin in **Hardware** mode or SR/$\overline{DR}$ interface bit in the **Host** mode. In single-rail mode, transmit clock and NRZ data are applied to TCLK and TPOS/TDATA pins respectively. In this mode the TNEG input is used for selecting encoding and decoding function. With

TNEG tied High, HDB3 or B8ZS encoding and decoding are enabled for E1 and T1 modes respectively. With TNEG tied Low, the AMI coding scheme is selected. In both dual or single-rail modes of operations, the transmitter converts digital input data to a bipolar format before being transmitted to the line.

TRANSMIT CLOCK (TCLK) SAMPLING EDGE

Serial transmit data at TPOS/TDATA and TNEG are clocked into the XRT83L38 under the synchronization of TCLK. With a "0" written to the TCLKE interface bit, or by pulling the TCLKE pin "Low", input data is sampled on the falling edge of TCLK. The sampling edge is inverted with a "1" written to TCLKE interface bit, or by connecting the TCLKE pin "High". The sampling edge control is available in both **Hardware** and **Host** modes on a global basis.

HDB3/B8ZS ENCODER

The Encoder and Decoder functions are available in both **Hardware** and **Host** modes on a per channel basis by controlling the CODES pin or interface bit. The encoder is only available in single-rail mode. In E1mode and with HDB3 encoding selected, any sequence with more than four consecutive zeros in the input serial data from TPOS/TDATA, will be removed and replaced with 000V or B00V, where "B" indicates a pulse conforming with the bipolar rule and "V" representing a pulse violating the rule. An example of HDB3 Encoding is shown in Table 2. In a T1 system, an input data sequence with more than 8 consecutive zeros will be removed and replaced using the B8ZS encoding rule. An example of Bipolar with 8 Zero Substitution (B8ZS) encoding scheme is shown in Table 3. Writing a "0" into the CODES interface bit or connecting the CODES pin to a "Low" level selects the AMI coding for both E1 or T1 system.

TABLE 2: EXAMPLES OF HDB3 ENCODING

	NUMBER OF PULSE BEFORE NEXT 4 ZEROS	NEXT 4 BITS
Input		0000
HDB3(case1)	odd	000V
HDB3(case2)	even	B00V

TABLE 3: EXAMPLES OF B8ZS ENCODING

CASE 1	PRECEDING PULSE	NEXT 8 BITS
Input	+	00000000
B8ZS		000VB0VB
AMI Output	+	000+ -0- +
CASE 2		
Input	-	00000000
B8ZS		000VB0VB
AMI Output	-	000- +0+ -

TRANSMIT PULSE SHAPER & LINE BUILD OUT (LBO) CIRCUIT

The transmit pulse shaper circuit uses the high speed clock from the Master timing generator to control the shape and width of the transmitted pulse. The internal high-speed timing generator eliminates the need for a tightly controlled transmit clock (TCLK) duty cycle. With the jitter attenuator not in the transmit path, the transmit output will generate no more than 0.025Unit Interval (UI) peak-to-peak jitter. In **Hardware** mode, the state of the EQC4-EQC0 pins determine the transmit pulse shape for all eight channels. In **Host** mode transmit pulse shape can be controlled on a per channel basis using the interface bits EQC4-EQC0. The chip supports five fixed transmit pulse settings for T1 Short-haul applications plus a fully programmable waveform generator for arbitrary transmit output pulse shapes. Transmit Line Build-Outs for T1 long-haul application are supported from 0dB to -22.5dB in four 7.5dB steps. The choice of the transmit pulse shape and LBO under the control of the interface bits are summarized in Table 4. For CSU LBO transmit pulse design information, refer to ANSI T1.403-1993 Network-to-Customer Installation specification, Annex E.

NOTE: *EQC4 - EQC0 determine the T1/E1 operating mode of the XRT83L38. When EQC4 = "1" and EQC3 = "1", the XRT83L38 is in the E1 mode, otherwise it is in the T1/J1 mode.*

DRIVER FAILURE MONITOR (DMO)

The driver monitor circuit is used to detect transmit driver failure by monitoring the activities at TTIP and TRING outputs. Driver failure may be caused by a short circuit in the primary transformer or system problems at the transmit input. If the transmitter of a channel has no output for more than 128 clock cycles, the corresponding DMO pin goes "High" and remains "High" until a valid transmit pulse is detected. In **Host** mode, the failure of the transmit channel is reported in the corresponding interface bit. If DMOIE bit is also enabled, any transition on the DMO interface bit will generate an interrupt. The driver failure monitor is supported in both **Hardware** and **Host** modes on a per channel basis.

TABLE 4: RECEIVE EQUALIZER CONTROL AND TRANSMIT LINE BUILD-OUT SETTINGS

EQC4	EQC3	EQC2	EQC1	EQC0	E1/T1 MODE & RECEIVE SENSITIVITY	TRANSMIT LBO	CABLE	CODING
0	0	0	0	0	T1 Long Haul/36dB	0dB	100Ω/ TP	B8ZS
0	0	0	0	1	T1 Long Haul/36dB	-7.5dB	100Ω/ TP	B8ZS
0	0	0	1	0	T1 Long Haul/36dB	-15dB	100Ω/ TP	B8ZS
0	0	0	1	1	T1 Long Haul/36dB	-22.5dB	100Ω/ TP	B8ZS
0	0	1	0	0	T1 Long Haul/45dB	0dB	100Ω/ TP	B8ZS
0	0	1	0	1	T1 Long Haul/45dB	-7.5dB	100Ω/ TP	B8ZS
0	0	1	1	0	T1 Long Haul/45dB	-15dB	100Ω/ TP	B8ZS
0	0	1	1	1	T1 Long Haul/45dB	-22.5dB	100Ω/ TP	B8ZS
0	1	0	0	0	T1 Short Haul/15dB	0-133 ft./ 0.6dB	100Ω/ TP	B8ZS
0	1	0	0	1	T1 Short Haul/15dB	133-266 ft./ 1.2dB	100Ω/ TP	B8ZS
0	1	0	1	0	T1 Short Haul/15dB	266-399 ft./ 1.8dB	100Ω/ TP	B8ZS
0	1	0	1	1	T1 Short Haul/15dB	399-533 ft./ 2.4dB	100Ω/ TP	B8ZS
0	1	1	0	0	T1 Short Haul/15dB	533-655 ft./ 3.0dB	100Ω/ TP	B8ZS
0	1	1	0	1	T1 Short Haul/15dB	Arbitrary Pulse	100Ω/ TP	B8ZS
0	1	1	1	0	T1 Gain Mode/29dB	0-133 ft./ 0.6dB	100Ω/ TP	B8ZS
0	1	1	1	1	T1 Gain Mode/29dB	133-266 ft./ 1.2dB	100Ω/ TP	B8ZS
1	0	0	0	0	T1 Gain Mode/29dB	266-399 ft./ 1.8dB	100Ω/ TP	B8ZS
1	0	0	0	1	T1 Gain Mode/29dB	399-533 ft./ 2.4dB	100Ω/ TP	B8ZS
1	0	0	1	0	T1 Gain Mode/29dB	533-655 ft./ 3.0dB	100Ω/ TP	B8ZS
1	0	0	1	1	T1 Gain Mode/29dB	Arbitrary Pulse	100Ω/ TP	B8ZS
1	0	1	0	0	T1 Gain Mode/29dB	0dB	100Ω/ TP	B8ZS
1	0	1	0	1	T1 Gain Mode/29dB	-7.5dB	100Ω/ TP	B8ZS

TABLE 4: RECEIVE EQUALIZER CONTROL AND TRANSMIT LINE BUILD-OUT SETTINGS

EQC4	EQC3	EQC2	EQC1	EQC0	E1/T1 MODE & RECEIVE SENSITIVITY	TRANSMIT LBO	CABLE	CODING
1	0	1	1	0	T1 Gain Mode/29dB	-15dB	100Ω/ TP	B8ZS
1	0	1	1	1	T1 Gain Mode/29dB	-22.5dB	100Ω/ TP	B8ZS
1	1	0	0	0	E1 Long Haul/36dB	ITU G.703	75Ω Coax	HDB3
1	1	0	0	1	E1 Long Haul/36dB	ITU G.703	120Ω TP	HDB3
1	1	0	1	0	E1 Long Haul/45dB	ITU G.703	75Ω Coax	HDB3
1	1	0	1	1	E1 Long Haul/45dB	ITU G.703	120Ω TP	HDB3
1	1	1	0	0	E1 Short Haul	ITU G.703	75Ω Coax	HDB3
1	1	1	0	1	E1 Short Haul	ITU G.703	120Ω TP	HDB3
1	1	1	1	0	E1 Gain Mode	ITU G.703	75Ω Coax	HDB3
1	1	1	1	1	E1 Gain Mode	ITU G.703	120Ω TP	HDB3

TRANSMIT AND RECEIVE TERMINATIONS

The XRT83L38 is a versatile LIU that can be programmed to use one Bill of Materials (BOM) for worldwide applications: T1, J1 and E1. For specific applications the internal terminations can be disabled to allow the use of existing components and/or designs.

The XRT83L38 can be controlled through a **Hardware** mode (external pins) or through a **Host** mode (microprocessor interface). Each of the different operating modes is explained below.

RECEIVER (CHANNELS 0 - 7)

INTERNAL RECEIVE TERMINATION MODE

In **Hardware** mode, RxTSEL (Pin 83) can be tied high to select internal termination mode for all receive channels (Individual channel control can only be done in **Host** mode). In **Host** mode, bit 7 in the appropriate channel register, (Table 19, “Microprocessor Register 1 bit description,” on page 39), is set high to select the internal termination mode for that specific receive channel. See Table 5 for selecting the receive termination control mode.

TABLE 5: RECEIVE TERMINATION CONTROL

RXTSEL	RX TERMINATION
0	EXTERNAL
1	INTERNAL

For internal receive termination mode, there are 4 options available for selecting the line impedance, which are shown in Table 6. (RxRES[1:0] in the **Hardware** mode applies to all channels. Control of individual channels can be done only through **Host** mode).

TABLE 6: RECEIVER FIXED INPUT RESISTOR CONTROL

RXRES1	RXRES0	REQUIRED EXTERNAL FIXED RX RESISTOR
0	0	No External Fixed Resistor Required
0	1	60Ω
1	0	52.5Ω
1	1	37.5Ω

If an external resistor value is selected, the external resistor is used along with an internal programmable resistor to provide correct impedance matching for a chosen application, whether it is T1, J1 or E1. This allows one bill of materials for all three receive applications. Figure 4 is a simplified diagram for the internal receive and transmit termination mode.

FIGURE 4. SIMPLIFIED DIAGRAM FOR THE INTERNAL RECEIVE AND TRANSMIT TERMINATION MODE

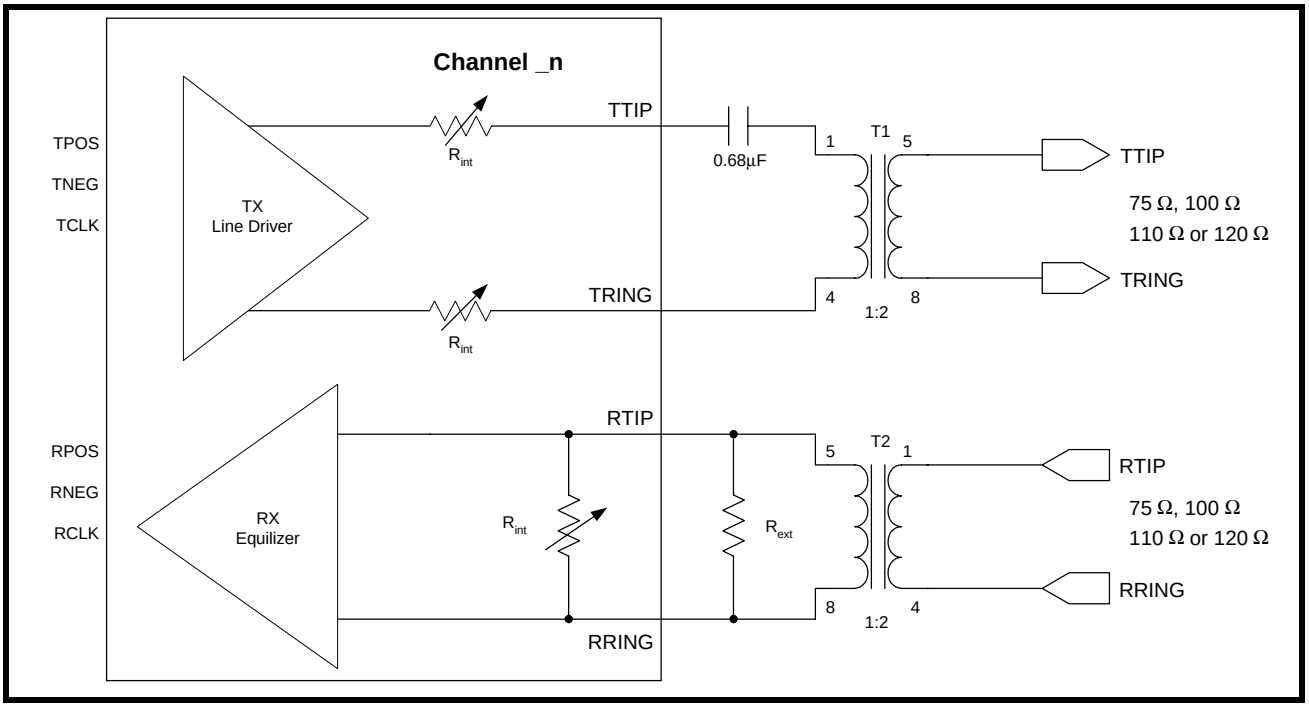


Table 7 summarizes the receive termination in the different modes of operation.

TABLE 7: RECEIVE TERMINATIONS

MODE	RXTSEL	TERSEL1	TERSEL0	RXRES1	RXRES0	R_{ext}	R_{int}	$4R_{eff}$
External	0	x	x	x	x	R_{ext}	∞	$4R_{ext}$
Internal	1	0	0	0	0	∞	25Ω	100Ω/T1
Internal	1	0	1	0	0	∞	27.5Ω	110Ω/J1
Internal	1	1	0	0	0	∞	18.75Ω	75Ω/E1
Internal	1	1	1	0	0	∞	30Ω	120Ω/E1
Redundancy	1	0	0	0	1	60Ω	43Ω	100Ω/T1
Redundancy	1	0	1	0	1	60Ω	51Ω	110Ω/J1
Redundancy	1	1	0	0	1	60Ω	27Ω	75Ω/E1
Redundancy	1	1	1	0	1	60Ω	60Ω	120Ω/E1
Redundancy	1	0	0	1	0	52.5Ω	48Ω	100Ω/T1
Redundancy	1	0	1	1	0	52.5Ω	58Ω	110Ω/J1
Redundancy	1	1	0	1	0	52.5Ω	29Ω	75Ω/E1
Redundancy	1	1	1	1	0	52.5Ω	70Ω	120Ω/E1
Redundancy	1	0	0	1	1	37.5Ω	75Ω	100Ω/T1
Redundancy	1	0	1	1	1	37.5Ω	103Ω	110Ω/J1
Redundancy	1	1	0	1	1	37.5Ω	37.5Ω	75Ω/E1
Redundancy	1	1	1	1	1	37.5Ω	150Ω	120Ω/E1

EXTERNAL RECEIVE TERMINATION MODE

In **Hardware** mode, RxTSEL (Pin 83) can be tied low to select external termination mode for all channels, (Individual channel control can be done only in **Host** mode). (By default the XRT83L38 is set for external termination mode at power up or at Hardware reset.) See Table 5. In **Host** mode, bit 7 in the appropriate channel register can be set low to select external termination mode for that specific channel, see Table 21, “Microprocessor Register 3 bit description,” on page 43.

For external receive termination mode, the internal program able resistor is bypassed. The value of the external resistor is given by the following equation:

R_{ext} = (Line Impedance ÷ 4) Example: For T1, the twisted pair line impedance is 100Ω, therefore a 25Ω resistor is placed in the receive path of the transformer. Figure 5 is a simplified diagram for T1 (100Ω) in the external receive termination mode. Figure 6 is a simplified diagram for E1 (75Ω) in the external receive termination mode.

FIGURE 5. SIMPLIFIED DIAGRAM FOR T1 IN THE EXTERNAL TERMINATION MODE (RXTSEL=0)

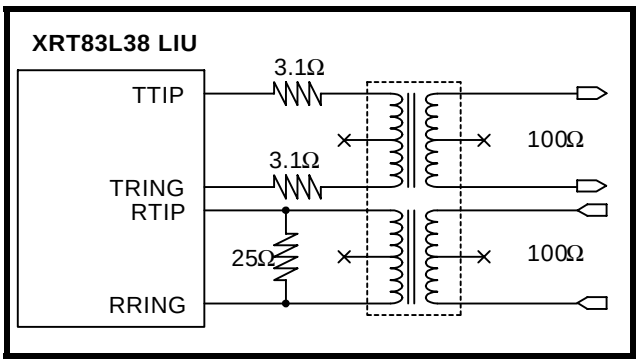
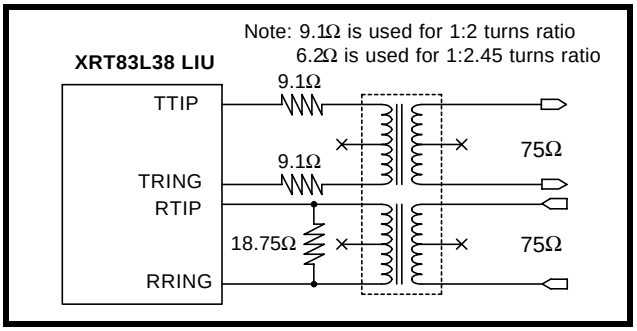


FIGURE 6. SIMPLIFIED DIAGRAM FOR E1 IN EXTERNAL TERMINATION MODE (RXTSEL= 0)



TRANSMITTER (CHANNELS 0 - 7)

INTERNAL TRANSMIT TERMINATION MODE

In **Hardware** mode, TxTSEL (Pin 84) can be tied high to select internal termination mode for all transmit channels (Individual channel control can be done only in **Host** mode), see Table 8.

TABLE 8: TRANSMIT TERMINATION CONTROL

TXTSEL	TX TERMINATION
0	EXTERNAL
1	INTERNAL

In **Host** mode, bit 6 in the appropriate register for a given channel is set high to select the internal termination mode for that specific transmit channel, see Table 19, “Microprocessor Register 1 bit description,” on page 39

For internal termination, the transformer turns ratio is always 1:2. In this mode, no external resistors are used. An external capacitor of 0.68µF is used for proper operation of the internal termination circuitry, see Figure 4. Simply choose the line impedance for a specific application, whether it be T1, J1 or E1. This can be done by setting TERSEL[1:0] shown in Table 9. This allows one bill of materials for all three applications (T1/J1/E1). TERSEL[1:0] in the **Hardware** mode applies to all channels. Control of individual channels can be done only through **Host** mode.

TABLE 9: TERMINATION SELECT CONTROL

TERSEL1	TERSEL0	TERMINATION
0	0	100Ω
0	1	110Ω
1	0	75Ω
1	1	120Ω

EXTERNAL TRANSMIT TERMINATION MODE

In **Hardware** mode, TxTSEL (Pin 84) can be tied low to select external transmit termination mode for all transmit channels (Individual channel control can be done only in **Host** mode). (By default the XRT83L38 is set for external termination mode at power up or at Hardware reset.) See Table 8. In **Host** mode, bit 6 in the appropriate register for a given channel can be set low to select external termination mode for that specific channel, see Table 19, “Microprocessor Register 1 bit description,” on page 39.

For external transmit termination mode, the internal termination circuitry is disabled. The value of the external resistors is chosen for a specific application according to the turns ratio selected by TRATIO (Pin 127) in **Hardware** mode or bit 0 in the appropriate register for a specific channel in **Host** mode, see Table 10 and Table 21, “Microprocessor Register 3 bit description,” on page 43. Figure 5 is a simplified block diagram for T1 (100**Ω**) in the external termination mode. Figure 6 is a simplified block diagram for E1 (75**Ω**) in the external termination mode.

TABLE 10: TRANSMIT TERMINATION CONTROL

TRATIO	TURNS RATIO
0	1:2.45
1	1:2

REDUNDANCY

For redundancy applications, RxTSEL and RxRES[1:0] must be set to zero and an appropriate external Receive input resistor must be chosen. The value can range from 2kΩ to 20kΩ. The recommended value for the external resistor is 4.7kΩ at the receive input path. The XRT83L38 offers two options for redundancy applications, See Figure 7 and Figure 8.

FIGURE 7. ONE SET OF TRANSFORMERS FOR LOWEST COST SOLUTION

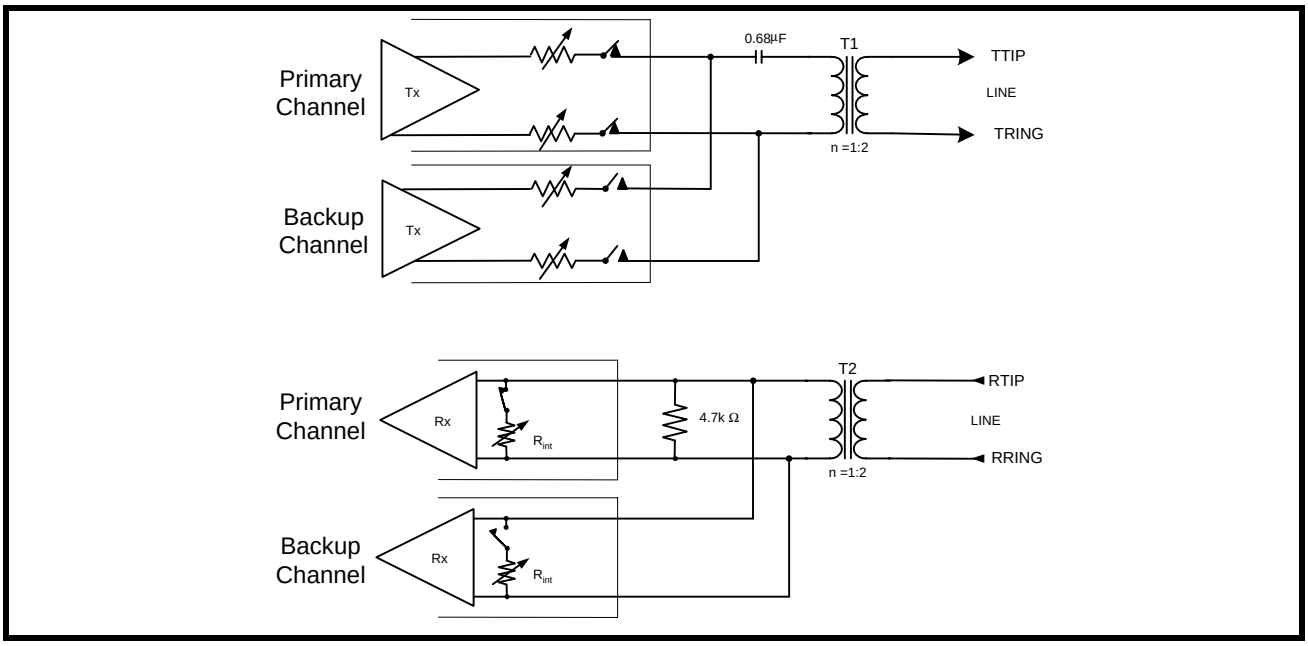
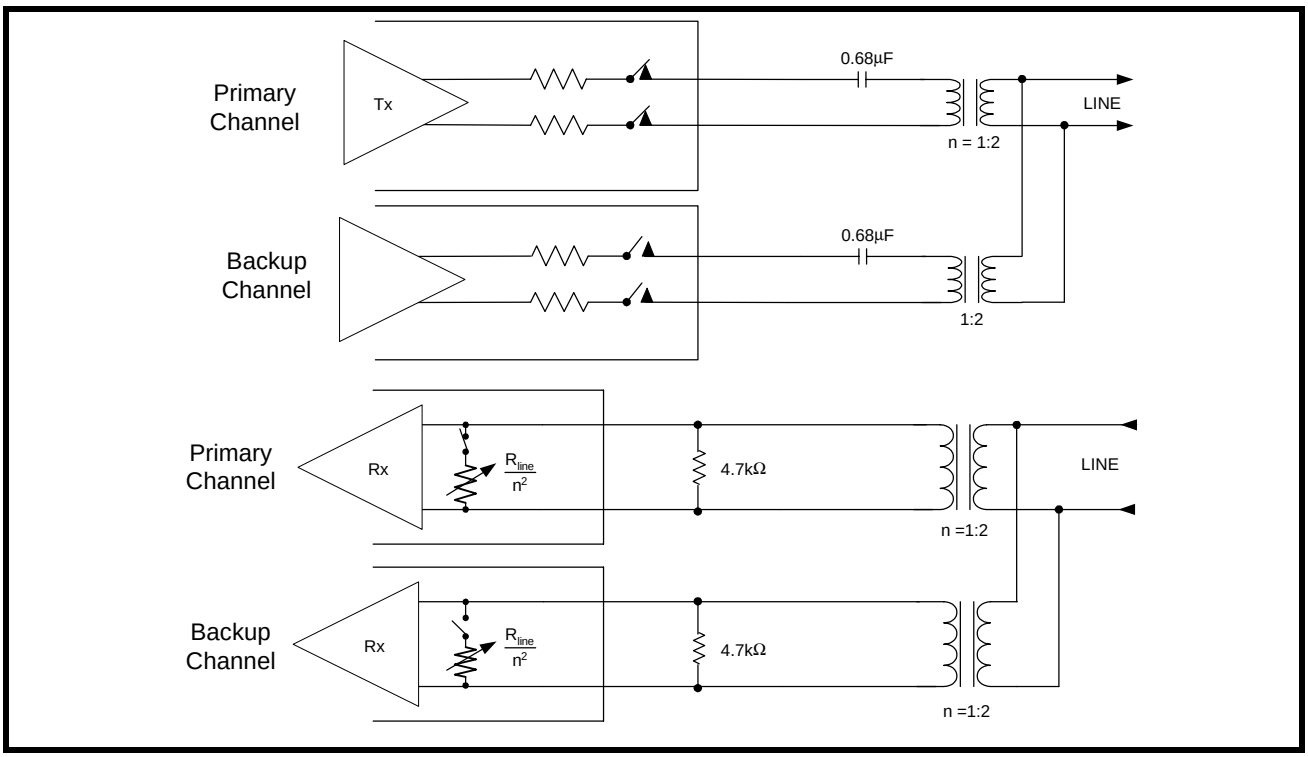


FIGURE 8. TWO IDENTICAL BOARDS FOR 1+1 REDUNDANCY



PATTERN TRANSMIT AND DETECT FUNCTION

Several test and diagnostic patterns can be generated and detected by the chip. In **Hardware** mode each channel can be independently programmed to transmit an All Ones pattern by applying a "High" level to the corresponding TAOS pin. In **Host** mode, the three interface bits TXTEST2-0 control the pattern generation and detection independently for each channel according to Table 11. More detailed Description of each mode is given in the following paragraphs.

TABLE 11: PATTERN TRANSMISSION CONTROL

TXTEST2	TXTEST1	TXTEST0	TEST PATTERN
0	x	x	None
1	0	0	TDQRSS
1	0	1	TAOS
1	1	0	TLUC
1	1	1	TLDC

TRANSMIT ALL ONES (TAOS)

This feature is available in both **Hardware** and **Host** modes on a per channel basis. With the TAOS-n pin connected to a "High" level or when interface bits TXTEST2="1", TXTEST1="0" and TXTEST0="0" the transmitter ignores input from TPOS/TDATA and TNEG pins and sends a continuous AMI encoded all ones signal to the line using TCLK clock as the reference. When TCLK is not available, MCLK is used. In addition, when the Hardware pin and interface bit ATAOS is activated, the chip will automatically transmit the All Ones data from any channel that detects an RLOS condition. This feature is not available on a per channel basis. TCLK-n must not be tied low.

NETWORK LOOP CODE DETECTION AND TRANSMISSION

This feature is available in **Host** mode only. When the interface bits TXTEST2="1", TXTEST1="1" and TXTEST0="0" the chip is enabled to transmit the "00001" Network Loop-Up Code from the selected channel requesting a Loop-Back condition from the remote terminal. Simultaneously setting the interface bits NLCDE1="0" and NLCDE0="1" enables the Network Loop-Up code detection in the receiver. If the "00001" Network Loop-Up code is detected in the receive data for longer than 5 seconds, the NLCD bit in the interface register is set indicating that the remote terminal has activated remote Loop-Back and the chip is receiving its own transmitted data. When the interface bits TXTEST2="1", TXTEST1="1" and TXTEST0="1" the chip is enabled to transmit the Network Loop-Down Code (TLDC) "001" from the selected channel requesting the remote terminal the removal of the Loop-Back condition.

In the **Host** mode each channel is capable of monitoring the contents of the receive data for the presence of Loop-Up or Loop-Down code from the remote terminal. In the **Host** mode the two interface bits NLCDE1 and NLCDE0 control the Loop-Code detection independently for each channel according to Table 12.

TABLE 12: LOOP-CODE DETECTION CONTROL

NLCDE1	NLCDE0	CONDITION
0	0	Disable Loop-Code Detection
0	1	Detect Loop-Up Code in Receive Data
1	0	Detect Loop-Down Code in Receive Data
1	1	Automatic Loop-Code detection and Remote Loop-Back Activation

Setting the interface bits to NLCDE1="0" and NLCDE0="1" activates the detection of the Loop-Up code in the receive data. If the "00001" Network Loop-Up code is detected in the receive data for longer than 5 seconds the NLCD interface bit is set to "1" and stays in this state for as long as the receiver continues to receive the Network Loop-Up Code. In this mode if the NLCD interrupt is enabled, the chip will initiate an interrupt on every transition of NLCD. The host has the option to ignore the request from the remote terminal, or to respond to the request and manually activate Remote Loop-Back. The Host can subsequently activate the detection of the Loop-Down Code by setting NLCDE1="1" and NLCDE0="0". In this case, receiving the "001" Loop-Down Code for longer than 5 seconds will set the NLCD bit to "1" and if the NLCD interrupt is enabled, the chip will initiate an interrupt on every transition of NLCD. The Host can respond to the request from the remote terminal and remove Loop-Back condition. In the manual Network Loop-Up (NLCDE1="0" and NLCDE0="1") and Loop-Down (NLCDE1="1" and NLCDE0="0") Code

detection modes, the NLCD interface bit will be set to "1" upon receiving the corresponding code in excess of 5 seconds in the receive data. The chip will initiate an interrupt any time the status of the NLCD bit changes and the Network Loop-code interrupt is enabled.

In the **Host** mode, setting the interface bits NLCDE1="1" and NLCDE0="1" enables the automatic Loop-Code detection and Remote Loop-Back activation mode if, TXTEST[2:0] is NOT equal to “110”. As this mode is initiated, the state of the NLCD interface bit is reset to "0" and the chip is programmed to monitor the receive input data for the Loop-Up Code. If the "00001" Network Loop-Up Code is detected in the receive data for longer than 5 seconds in addition to the NLCD bit in the interface register being set, Remote Loop-Back is automatically activated. The chip stays in remote Loop-Back even if it stops receiving the "00001" pattern. After the chip detects the Loop-Up code, sets the NLCD bit and enters Remote Loop-Back, it automatically starts monitoring the receive data for the Loop-Down code. In this mode however, the NLCD bit stays set even if the receiver stops receiving the Loop-Up code, which is an indication to the Host that the Remote Loop-Back is still in effect. Remote Loop-Back is removed if the chip detects the "001" Loop-Down code for longer than 5 seconds. Detecting the "001" code also results in resetting the NLCD interface bit and initiating an interrupt. The Remote Loop-Back can also be removed by taking the chip out of the Automatic detection mode by programming it to operate in a different state. The chip will not respond to remote Loop-Back request if an Analog Loop-Back is activated locally. When programmed in Automatic detection mode the NLCD interface bit stays high for the whole time the Remote Loop-Back is activated and initiates an interrupt any time the status of the NLCD bit changes provided the Network Loop-code interrupt is enabled.

TRANSMIT AND DETECT QUASI-RANDOM SIGNAL SOURCE (TDQRSS)

Each channel of XRT83L38 includes a QRSS pattern generation and detection block for diagnostic purposes that can be activated only in the **Host** mode by setting the interface bits TXTEST2="1", TXTEST1="0" and TXTEST0="0". For T1 systems, the QRSS pattern is a 2^{20}-1pseudo-random bit sequence (PRBS) with no more than 14 consecutive zeros. For E1 systems, the QRSS pattern is 2^{15} -1 PRBS with an inverted output. With QRSS and Analog Local Loop-Back enabled simultaneously, and by monitoring the status of the QRPD interface bit, all main functional blocks within the transceiver can be verified.

When the receiver achieves QRSS synchronization with fewer than 4 errors in a 128 bits window, QRPD changes from Low to High. After pattern synchronization, any bit error will cause QRPD to go Low for one clock cycle. If the QRPDIE bit is enabled, any transition on the QRPD bit will generate an interrupt.

With TDQRSS activated, a bit error can be inserted in the transmitted QRSS pattern by transitioning the INSBER interface bit from "0" to "1". Bipolar violation can also be inserted either in the QRSS pattern, or input data when operating in the single-rail mode by transitioning the INSBPV interface bit from "0" to "1". The state of INSBER and INSBPV bits are sampled on the rising edge of the TCLK. To insure the insertion of the bit error or bipolar violation, a "0" should be written in these bit locations before writing a "1".

LOOP-BACK MODES

The chip supports several Loop-Back modes under both Hardware and Host control. In **Hardware** mode the two LOOP1 and LOOP0 pins control the Loop-Back functions for each channel independently according to Table 13.

TABLE 13: LOOP-BACK CONTROL IN HARDWARE MODE

LOOP1	LOOP0	LOOP-BACK MODE
0	0	None
0	1	Analog
1	0	Remote
1	1	Digital

In **Host** mode the Loop-Back functions are controlled by the three LOOP2, LOOP1 and LOOP0 interface bits. Each channel can be programmed independently according to Table 14.

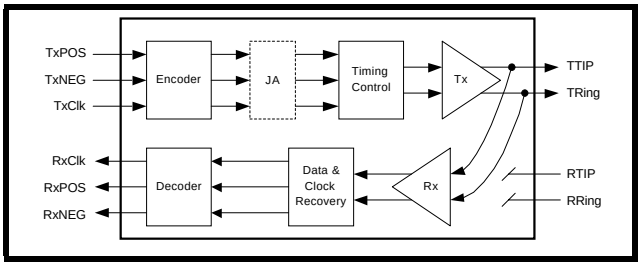
TABLE 14: LOOP-BACK CONTROL IN HOST MODE

LOOP2	LOOP1	LOOP0	LOOP-BACK MODE
0	X	X	None
1	0	0	Dual
1	0	1	Analog
1	1	0	Remote
1	1	1	Digital

ANALOG LOOP-BACK (ALOOP)

With Analog Loop-Back activated, the transmit data at TTIP and TRING are looped-back to the analog input of the receiver. External inputs at RTIP/RRING in this mode are ignored while valid transmit data continues to be sent to the line. Analog Loop-Back exercises most of the functional blocks of the XRT83L38 including the jitter attenuator which can be selected in either the transmit or receive paths. Analog Loop-Back is shown in Figure 9.

FIGURE 9. ANALOG LOOP-BACK SIGNAL FLOW

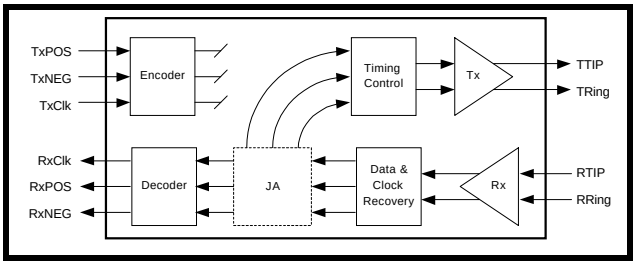


In this mode, the jitter attenuator (if selected) can be placed in the transmit or receive path

REMOTE LOOP-BACK (RLOOP)

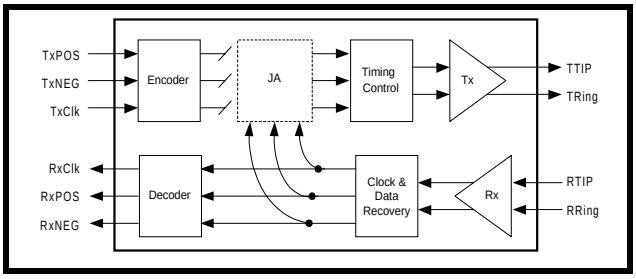
With Remote Loop-Back activated, receive data after the jitter attenuator (if selected in the receive path) is looped back to the transmit path using RCLK as transmit timing. In this mode transmit clock and data are ignored, while RCLK and receive data will continue to be available at their respective output pins. Remote Loop-Back with jitter attenuator selected in the receive path is shown in Figure 10.

FIGURE 10. REMOTE LOOP-BACK MODE WITH JITTER ATTENUATOR SELECTED IN RECEIVE PATH



In the Remote Loop-Back mode if the jitter attenuator is selected in the transmit path, the receive data after the Clock and Data Recovery block is looped back to the transmit path and passes through the jitter attenuator using RCLK as transmit timing. In this mode transmit clock and data are also ignored, while RCLK and received data will continue to be available at their respective output pins. Remote Loop-Back with the jitter attenuator selected in the transmit path is shown in Figure 11.

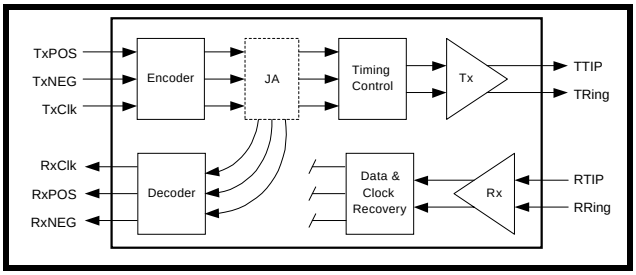
FIGURE 11. REMOTE LOOP-BACK MODE WITH JITTER ATTENUATOR SELECTED IN TRANSMIT PATH



DIGITAL LOOP-BACK (DLOOP)

Digital Loop-Back or Local Loop-Back allows the transmit clock and data to be looped back to the corresponding receiver output pins through the encoder/decoder and jitter attenuator. In this mode, receive data and clock are ignored, but the transmit data will be sent to the line uninterrupted. This loop back feature allows users to configure the line interface as a pure jitter attenuator. The Digital Loop-Back signal flow is shown in Figure 12

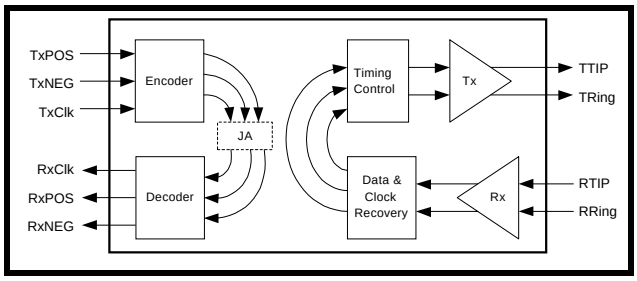
FIGURE 12. DIGITAL LOOP-BACK MODE WITH JITTER ATTENUATOR SELECTED IN TRANSMIT PATH



DUAL LOOP-BACK

Figure 13 depicts the data flow in dual-loopback. In this mode, selecting the jitter attenuator in the transmit path will have the same result as placing the jitter attenuator in the receive path. In dual Loop-Back mode the recovered clock and data from the line are looped back through the transmitter to the TTIP and TRING without passing through the jitter attenuator. The transmit clock and data are looped back through the jitter attenuator to the RCLK and RPOS/RDATA and RNEG pins.

FIGURE 13. SIGNAL FLOW IN DUAL LOOP-BACK MODE



MICROPROCESSOR INTERFACE

XRT83L38 is equipped with a microprocessor interface for easy device configuration. The parallel port of the XRT83L38 is compatible with both Intel and Motorola address and data buses. The XRT83L38 has an 8-bit address ADD[7:0] input and 8-bit bi-directional data bus D[7:0]. The signals required for a generic microprocessor to access the internal registers are described in Table 15.

TABLE 15: MICROPROCESSOR INTERFACE SIGNAL DESCRIPTION

<table>
<tr><td>D[7:0]</td><td>Data Input (Output): 8 bits bi-directional Read/Write data bus for register access.</td></tr>
<tr><td>ADD[7:0]</td><td>Address Input: 8 bit address to select internal register location.</td></tr>
<tr><td>PTS1
PTS2</td><td>Processor Type Select:
<table>
<tr><th>PTS1</th><th>PTS2</th><th>µP Type</th></tr>
<tr><td>0</td><td>0</td><td>68HC11, 8051, 80C188 (async.)</td></tr>
<tr><td>0</td><td>1</td><td>Motorola 68K (async.)</td></tr>
<tr><td>1</td><td>0</td><td>Intel x86 (sync.)</td></tr>
<tr><td>1</td><td>1</td><td>Intel i960, Motorola 860 (sync.)</td></tr>
</table></td></tr>
<tr><td>PCLK</td><td>Process Clock Input: Input clock for synchronous microprocessor operation. Maximum clock speed is 20MHz. This pin is internally pulled “High” for asynchronous microprocessor operation when no clock is present.</td></tr>
<tr><td>ALE_$\overline{AS}$</td><td>Address Latch Input (Address Strobe):
-Intel bus timing, the address inputs are latched into the internal register on the falling edge of ALE.
-Motorola bus timing, the address inputs are latched into the internal register on the falling edge of $\overline{AS}$.</td></tr>
<tr><td>$\overline{CS}$</td><td>Chip Select Input: This signal must be low in order to access the parallel port.</td></tr>
<tr><td>$\overline{RD}$_$\overline{DS}$</td><td>Read Input (Data Strobe):
-Intel bus timing, a low pulse on $\overline{RD}$ selects a read operation when $\overline{CS}$ pin is low.
-Motorola bus timing, a low pulse on $\overline{DS}$ indicates a read or write operation when $\overline{CS}$ pin is low.</td></tr>
<tr><td>$\overline{WR}$_R/$\overline{W}$</td><td>Write Input (Read/Write):
-Intel bus timing, a low pulse on $\overline{WR}$ selects a write operation when $\overline{CS}$ pin is low.
-Motorola bus timing, a high pulse on R/$\overline{W}$ selects a read operation and a low pulse on R/$\overline{W}$ selects a write operation when $\overline{CS}$ pin is low.</td></tr>
<tr><td>RDY_$\overline{DTACK}$</td><td>Ready Output (Data Transfer Acknowledge Output):
-Intel bus timing, RDY is asserted high to indicate the XRT83L38 has completed a read or write operation.
-Motorola bus timing, $\overline{DTACK}$ is asserted low to indicate the XRT83L38 has completed a read or write operation.</td></tr>
<tr><td>$\overline{INT}$</td><td>Interrupt Output: This pin is asserted low to indicate an interrupt caused by an alarm condition in the device status registers. The activation of this pin can be blocked by the contents of the interrupt mask register.</td></tr>
</table>

MICROPROCESSOR REGISTER TABLES

The microprocessor interface consists of 256 addressable locations. Each channel uses 16 dedicated 8 byte registers for independent programming and control. There are four additional registers for global control of all channels and two registers for device identification and revision numbers. The remaining registers are for factory test and future expansion. The control register map and the function of the individual bits are summarized in Table 16 and Table 17 respectively.

TABLE 16: MICROPROCESSOR REGISTER ADDRESS

REGISTER NUMBER	REGISTER ADDRESS		FUNCTION
	HEX	BINARY	
0 - 15	0x00 - 0x0F	00000000 - 00001111	Channel 0 Control Registers
16 - 31	0x10 -0x1F	00010000 - 00011111	Channel 1 Control Registers
32 - 47	0x20 - 0x2F	00100000 - 00101111	Channel 2 Control Registers
48 - 63	0x30 - 0x3F	00110000 - 00111111	Channel 3 Control Registers
64 - 79	0x40 - 0x4F	01000000 - 01001111	Channel 4 Control Registers
80 - 95	0x50 - 0x5F	01010000 - 01011111	Channel 5 Control Registers
96-111	0x60 - 0x6F	01100000 - 01101111	Channel 6 Control Registers
112 - 127	0x70 - 0x7F	01110000 - 01111111	Channel 7 Control Registers
128 - 131	0x80 - 0x83	10000000 - 10000011	Command Control registers for all 8 channels
132 -139	0x84 - 0x8B	10000100 - 10001011	R/W registers reserved for testing channels 0-3
140 - 195	0x8C - 0xC3	10001100 - 11000011	Reserved
196 - 203	0xC4 - 0xCB	11000100 - 11001011	R/W registers reserved for testing channels 4 - 7
204 - 253	0xCC - 0xFD	11001100 - 11111101	Reserved
254	0xFE	11111110	Device "ID"
255	0xFF	11111111	Device "Revision ID"

TABLE 17: MICROPROCESSOR REGISTER BIT DESCRIPTION

REG. #	ADDRESS	REG. TYPE	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
Channel 0 Control Registers										
0	00000000 Hex 0x00	R/W	Reserved	Reserved	Reserved	EQC4_n	EQC3_n	EQC2_n	EQC1_n	EQC0_n
1	00000001 Hex 0x01	R/W	RXTSEL_n	TXTSEL_n	TERSEL1_n	TERSEL0_n	JASEL1_n	JASEL0_n	JABW_n	FIFOS_n
2	00000010 Hex 0x02	R/W	INVQRSS_n	TXTEST2_n	TXTEST1_n	TXTEST0_n	TXON_n	LOOP2_n	LOOP1_n	LOOP0_n
3	00000011 Hex 0x03	R/W	NLCDE1_n	NLCDE0_n	CODES_n	RXRES1_n	RXRES0_n	INSBPV_n	INSBER_n	TRATIO_n
4	00000100 Hex 0x04	R/W	GCHIE_n	DMOIE_n	FLSIE_n	LCVIE_n	NLCDIE_n	AISDIE_n	RLOSIE_n	QRPDIE_n
5	00000101 Hex 0x05	RO	GCHI _n	DMO_n	FLS_n	LCV_n	NLCD_n	AISD_n	RLOS_n	QRPD_n

TABLE 17: MICROPROCESSOR REGISTER BIT DESCRIPTION

REG. #	ADDRESS	REG. TYPE	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
6	00000110 Hex 0x06	RUR	GCHIS_n	DMOIS_n	FLSIS_n	LCVIS_n	NLCDIS_n	AISDIS_n	RLOSIS_n	QRPDIS_n
7	00000111 Hex 0x07	RO	Reserved	Reserved	CLOS5_n	CLOS4_n	CLOS3_n	CLOS2_n	CLOS1_n	CLOS0_n
8	00001000 Hex 0x08	R/W	X	B6S1_n	B5S1_n	B4S1_n	B3S1_n	B2S1_n	B1S1_n	B0S1_n
9	00001001 Hex 0x09	R/W	X	B6S2_n	B5S2_n	B4S2_n	B3S2_n	B2S2_n	B1S2_n	B0S2_n
10	00001010 Hex 0x0A	R/W	X	B6S3_n	B5S3_n	B4S3_n	B3S3_n	B2S3_n	B1S3_n	B0S3_n
11	00001011 Hex 0x0B	R/W	X	B6S4_n	B5S4_n	B4S4_n	B3S4_n	B2S4_n	B1S4_n	B0S4_n
12	00001100 Hex 0x0C	R/W	X	B6S5_n	B5S5_n	B4S5_n	B3S5_n	B2S5_n	B1S5_n	B0S5_n
13	00001101 Hex 0x0D	R/W	X	B6S6_n	B5S6_n	B4S6_n	B3S6_n	B2S6_n	B1S6_n	B0S6_n
14	00001110 Hex 0x0E	R/W	X	B6S7_n	B5S7_n	B4S7_n	B3S7_n	B2S7_n	B1S7_n	B0S7_n
15	00001111 Hex 0x0F	R/W	X	B6S8_n	B5S8_n	B4S8_n	B3S8_n	B2S8_n	B1S8_n	B0S8_n
			Reset 0	Reset 0	Reset 0	Reset 0	Reset 0	Reset 0	Reset 0	Reset 0
Command Control Global Registers for all 8 channels										
16-31	00001xxxx Hex 0x10-0x1F	R/W	Channel 1Control Register (see Registers 0-15 for description)							
32-47	00010xxxx Hex 0x20-ox2F	R/W	Channel 2 Control Register (see Registers 0-15 for description)							
48-63	00011xxxx Hex 0x30-0x3F	R/W	Channel 3 Control Register (see Registers 0-15 for description)							
64-79	0100xxxx Hex 0x40-0x4F	R/W	Channel 4 Control Register (see Registers 0-15 for description)							
80-95	0101xxxx Hex 0x50-0x5F	R/W	Channel 5 Control Register (see Registers 0-15 for description)							
96-111	0110xxxx Hex 0x60-0x6F	R/W	Channel 6 Control Register (see Registers 0-15 for description)							
112-127	0111xxxx Hex 0x70-0x7F	R/W	Channel 7 Control Register (see Registers 0-15 for description)							
128	10000000 Hex 0x80	R/W	SR/$\overline{DR}$	ATAOS	RCLKE	TCLKE	DATAP	Reserved	GIE	SRESET
129	10000001 Hex 0x81	R/W	Reserved	CLKSEL2	CLKSEL1	CLKSEL0	MCLKRATE	RXMUTE	EXLOS	ICT
130	10000010 Hex 0x82	R/W	TxONCNTL	TERCNTL	Reserved	Reserved	MONITOR_3	MONITOR_2	MONITOR_1	MONITOR_0
131	10000011 Hex 0x83	R/W	GAUGE1	GAUGE0	Reserved	Reserved	SL_1	SL_0	EQG_1	EQG_0

TABLE 17: MICROPROCESSOR REGISTER BIT DESCRIPTION

REG. #	ADDRESS	REG. TYPE	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
Test Registers for channels 0 - 3										
132	10000100	R/W	Test byte 0							
133	10000101	R/W	Test byte 1							
134	10000110	R/W	Test byte 2							
135	10000111	R/W	Test byte 3							
136	10001000	R/W	Test byte 4							
137	10001001	R/W	Test byte 5							
138	10001010	R/W	Test byte 6							
139	10001011	R/W	Test byte 7							
Unused Registers										
140-195	110000xx									
Test Registers for channels 4 - 7										
196	11000100	R/W	Test byte 0							
197	11000101	R/W	Test byte 0							
198	11000110	R/W	Test byte 0							
199	11000111	R/W	Test byte 0							
200	11001000	R/W	Test byte 0							
201	11001001	R/W	Test byte 0							
202	11001010	R/W	Test byte 0							
203	11001011	R/W	Test byte 0							
Unused Registers										
204	11001100									
….										
253	11111101									
ID Registers										
254	11111110 Hex 0xFE	RO	DEVICE ID							
255	11111111 Hex 0xFF	RO	DEVICE "Revision ID"							

MICROPROCESSOR REGISTER DESCRIPTIONS

TABLE 18: MICROPROCESSOR REGISTER 0 BIT DESCRIPTION

REGISTER ADDRESS 00000000 00010000 00100000 00110000 01000000 01010000 01100000 01110000	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6	Reserved		R/W	
D5	Reserved		R/W	0
D4	EQC4_n	**Equalizer Control bit 4:** This bit together with EQC3-0 are used for controlling transmit pulse shaping, transmit line build-out (LBO), receive monitoring and also T1 or E1 Mode of operation. See Table 4 for description of Equalizer Control bits.	R/W	0
D3	EQC3_n	**Equalizer Control bit 3:** See bit 4 description for function of this bit	R/W	0
D2	EQC2_n	**Equalizer Control bit 2:** See bit 4 description for function of this bit	R/W	0
D1	EQC1_n	**Equalizer Control bit 1:** See bit 4 description for function of this bit	R/W	0
D0	EQC0_n	**Equalizer Control bit 0:** See bit 4 description for function of this bit	R/W	0

TABLE 19: MICROPROCESSOR REGISTER 1 BIT DESCRIPTION

<table>
<tr><td>REGISTER ADDRESS
00000001
00010001
00100001
00110001
01000001
01010001
01100001
01110001</td><td>CHANNEL_0
CHANNEL_1
CHANNEL_2
CHANNEL_3
CHANNEL_4
CHANNEL_5
CHANNEL_6
CHANNEL_7</td><td>FUNCTION</td><td>REGISTER TYPE</td><td>RESET VALUE</td></tr>
<tr><td>BIT #</td><td>NAME</td><td></td><td></td><td></td></tr>
<tr><td>D7</td><td>RXTSEL_n</td><td>Receiver Termination Select: In Software mode this bit is used to select between the internal and external line termination modes for the receiver according to the following table;
<table><tr><th>RXTSEL</th><th>RX Termination</th></tr><tr><td>0</td><td>External</td></tr><tr><td>1</td><td>Internal</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>D6</td><td>TXTSEL_n</td><td>Transmit Termination Select: In Software mode this bit is used to select between the internal and external line termination modes for the transmitter according to the following table;
<table><tr><th>TXTSEL</th><th>TX Termination</th></tr><tr><td>0</td><td>External</td></tr><tr><td>1</td><td>Internal</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>D5</td><td>TERSEL1_n</td><td>Termination Impedance Select1:
In Host mode and in internal termination mode, (TXTSEL = “1” and RXTSEL = “1”) TERSEL1-0 control the transmit and receive termination impedance according to the following table.
<table><tr><th>TERSEL1</th><th>TERSEL0</th><th>Termination</th></tr><tr><td>0</td><td>0</td><td>100Ω</td></tr><tr><td>0</td><td>1</td><td>110Ω</td></tr><tr><td>1</td><td>0</td><td>75Ω</td></tr><tr><td>1</td><td>1</td><td>120Ω</td></tr></table>In the internal termination mode, the receiver termination of each receiver is realized completely by internal resistors or by the combination of internal and one fixed external resistor.
In the internal termination mode, the transmitter output should be AC coupled to the transformer.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 19: MICROPROCESSOR REGISTER 1 BIT DESCRIPTION

<table>
<tr><td>D4</td><td>TERSEL0_n</td><td>Termination Impedance Select bit 0:</td><td>R/W</td><td>0</td></tr>
<tr><td>D3</td><td>JASEL1_n</td><td>Jitter Attenuator select bit 1: The JASEL1, JASEL0 and FIFOS bits are used to select the FIFO depth and place the jitter attenuator of each channel independently in the transmit or receive path or to disable it.
<table>
<tr><th>JASEL1_n bit D3</th><th>JASEL0_n bit D2</th><th>FIFOS_n bit D0</th><th>JA Path</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>JA Disabled</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>JA Disabled</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Transmit - 32bit FIFO</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Transmit - 64bit FIFO</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Receive - 32bit FIFO</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Receive - 64bit FIFO</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Receive - 32bit FIFO</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Receive - 64bit FIFO</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>D2</td><td>JASEL0_n</td><td>Jitter Attenuator select bit 0: See description of bit 3 for the function of this bit.</td><td>R/W</td><td>0</td></tr>
<tr><td>D1</td><td>JABW_n</td><td>Jitter Attenuator Bandwidth Select: In E1 mode, set this bit to "1" to select a 1.5Hz Bandwidth for the Jitter Attenuator In E1 mode. The FIFO length will be automatically set to 64 bits. Set this bit to "0" to select 10Hz Bandwidth for the Jitter Attenuator in E1 mode. In T1 mode the Jitter Attenuator Bandwidth is permanently set to 3Hz, and the state of this bit has no effect on the Bandwidth.</td><td>R/W</td><td>0</td></tr>
<tr><td>D0</td><td>FIFOS_n</td><td>FIFO Size Select: See description of bit D3 for the function of this bit.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 20: MICROPROCESSOR REGISTER 2 BIT DESCRIPTION

<table>
<tr><th>REGISTER ADDRESS
00000010
00010010
00100010
00110010
01000010
01010010
01100010
01110010</th><th>CHANNEL_0
CHANNEL_1
CHANNEL_2
CHANNEL_3
CHANNEL_4
CHANNEL_5
CHANNEL_6
CHANNEL_7</th><th>FUNCTION</th><th>REGISTER TYPE</th><th>RESET VALUE</th></tr>
<tr><th>BIT #</th><th>NAME</th><th></th><th></th><th></th></tr>
<tr><td>D7</td><td>INVQRSS_n</td><td>Invert QRSS Pattern: When TQRSS is active, Writing a "1" to this bit inverts the polarity of transmitted QRSS pattern. Writing a "0" sends the QRSS pattern with no inversion.</td><td>R/W</td><td>0</td></tr>
<tr><td>D6</td><td>TXTEST2_n</td><td>Transmit Test Pattern bit 2: This bit together with TXTEST1 and TXTEST0 are used to generate and transmit test patterns according to the following table:

<table>
<tr><th>TXTEST2</th><th>TXTEST1</th><th>TXTEST0</th><th>Test Pattern</th></tr>
<tr><td>0</td><td>X</td><td>X</td><td>No Pattern</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>TDQRSS</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>TAOS</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>TLUC</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>TLDC</td></tr>
</table>
TDQRSS (Transmit/Detect Quasi-Random Signal): This condition when activated enables Quasi-Random Signal Source generation and detection for the selected channel number n. In a T1 system QRSS pattern is a 2^{20}-1 pseudo-random bit sequence (PRBS) with no more than 14 consecutive zeros. In a E1 system, QRSS is a 2^{15}-1 PRBS pattern.
TAOS (Transmit All Ones): Activating this condition enables the transmission of an All Ones Pattern from the selected channel number n.
TLUC (Transmit Network Loop-Up Code): Activating this condition enables the Network Loop-Up Code of "00001" to be transmitted to the line for the selected channel number n. When Network Loop-Up code is being transmitted the XRT83L38 will automatically disable the NLCDAE bit (if activated) in order to avoid activating Remote Digital Loop-Back automatically when the remote terminal responds to the Loop-Back request.
TLDC (Transmit Network LOOP-Down Code): Activating this condition enables the network Loop-Down Code of "001" to be transmitted to the line for the selected channel number n.</td><td>R/W</td><td>0</td></tr>
<tr><td>D5</td><td>TXTEST1_n</td><td>Transmit Test pattern bit 1: See description of bit 6 for the function of this bit.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 20: MICROPROCESSOR REGISTER 2 BIT DESCRIPTION

<table>
<tr><td>D4</td><td>TXTEST0_n</td><td>Transmit Test Pattern bit 0: See description of bit 6 for the function of this bit.</td><td>R/W</td><td>0</td></tr>
<tr><td>D3</td><td>TXON_n</td><td>Transmitter ON: Writing a "1" into this bit location turns on the Transmit Section of channel n. Writing a “0” shuts off the Transmit Section of channel n. In this mode, TTIP-n and TRING-n driver outputs will be tri-stated for power reduction or redundancy applications.</td><td>R/W</td><td>0</td></tr>
<tr><td>D2</td><td>LOOP2_n</td><td>Loop-Back control bit 2: This bit together with the LOOP1 and LOOP0 bits control the Loop-Back modes of the chip according to the following table:
<table>
<tr><th>LOOP2</th><th>LOOP1</th><th>LOOP0</th><th>Loop-Back Mode</th></tr>
<tr><td>0</td><td>X</td><td>X</td><td>No Loop-Back</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Dual Loop-Back</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Analog Loop-Back</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Remote Loop-Back</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Digital Loop-Back</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>D1</td><td>LOOP1_n</td><td>Loop-Back control bit 1: See description of bit 2 for the function of this bit.</td><td>R/W</td><td>0</td></tr>
<tr><td>D0</td><td>LOOP0_n</td><td>Loop-Back control bit 0: See description of bit 1 for the function of this bit.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 21: MICROPROCESSOR REGISTER 3 BIT DESCRIPTION

<table>
<tr><th>REGISTER ADDRESS
00000011
00010011
00100011
00110011
01000011
01010011
01100011
01110011</th><th>CHANNEL_0
CHANNEL_1
CHANNEL_2
CHANNEL_3
CHANNEL_4
CHANNEL_5
CHANNEL_6
CHANNEL_7</th><th>FUNCTION</th><th>REGISTER TYPE</th><th>RESET VALUE</th></tr>
<tr><th>BIT #</th><th>NAME</th><th></th><th></th><th></th></tr>
<tr><td>D7</td><td>NLCDE1_n</td><td>Network Loop Code Detection Enable Bit 1:
This bit together with NLCDE0_n control the Loop-Code detection of each channel.
<table>
<tr><th>NLCDE1</th><th>NLCDE0</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>Disable Loop-code detection</td></tr>
<tr><td>0</td><td>1</td><td>Detect Loop-Up code in receive data</td></tr>
<tr><td>1</td><td>0</td><td>Detect Loop-Down code in receive data</td></tr>
<tr><td>1</td><td>1</td><td>Automatic Loop-Code detection</td></tr>
</table>
When NLCDE1 =”0” and NLCDE0 = “1” or NLCDE1 = “1” and NLCDE0 = “0”, the chip is manually programmed to monitor the receive data for the Loop-Up or Loop-Down code respectively.When the presence of the “00001” or “001” pattern is detected for more than 5 seconds, the status of the NLCD bit is set to “1” and if the NLCD interrupt is enabled, an interrupt is initiated.The Host has the option to control the Loop-Back function manually.
Setting the NLCDE1 = “1” and NLCDE0 = “1” enables the Automatic Loop-Code detection and Remote Loop-Back activation mode. As this mode is initiated, the state of the NLCD interface bit is reset to “0” and the chip is programmed to monitor the receive data for the Loop-Up code. If the “00001” pattern is detected for longer than 5 seconds, the NLCD bit is set “1”, Remote Loop-Back is activated and the chip is automatically programmed to monitor the receive data for the Loop_Down code. The NLCD bit stays set even after the chip stops receiving the Loop-Up code. The Remote Loop-Back condition is removed when the chip receives the Loop-Down code for more than 5 seconds or if the Automatic Loop-Code detection mode is terminated.</td><td>R/W</td><td>0</td></tr>
<tr><td>D6</td><td>NLCDE0_n</td><td>Network Loop Code Detection Enable Bit 0:</td><td>R/W</td><td>0</td></tr>
<tr><td>D5</td><td>CODES_n</td><td>ENCODING AND DECODING SELECT:
Writing a “0” to this bits selects HDB3 or B8ZS encoding and decoding for channel number n. Writing “1” selects an AMI coding scheme. This bit is only active when single rail mode is selected.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 21: MICROPROCESSOR REGISTER 3 BIT DESCRIPTION

<table>
<tr><td>D4</td><td>RXRES1-n</td><td>Receive External Resistor Control Pin 1: In Host mode this bit along with the RXRES0-n bit selects the value of the external Receive fixed resistor according to the following table:
<table>
<tr><th>RXRES1_n</th><th>RXRES0_n</th><th>Required Fixed External RX Resistor</th></tr>
<tr><td>0</td><td>0</td><td>No external Fixed Resistor</td></tr>
<tr><td>0</td><td>1</td><td>60Ω</td></tr>
<tr><td>1</td><td>0</td><td>52.5Ω</td></tr>
<tr><td>1</td><td>1</td><td>37.5Ω</td></tr>
</table></td><td>R/W</td><td>0</td></tr>
<tr><td>D3</td><td>RXRES0-n</td><td>Receive External Resistor Control Pin 0: For function of this bit see description of D4 the RXRES1-n bit.</td><td>R/W</td><td>0</td></tr>
<tr><td>D2</td><td>INSBPV_n</td><td>Insert Bipolar Violation: When this bit this bit transitions from "0" to "1", a bipolar violation is inserted in the transmitted data stream of the selected channel number n. Bipolar violation can be inserted either in the QRSS pattern, or input data when operating in single-rail mode. The state of this bit is sampled on the rising edge of the respective TCLKn.
NOTE: To ensure the insertion of a bipolar violation, a "0" should be written in this bit location before writing a "1".</td><td>R/W</td><td>0</td></tr>
<tr><td>D1</td><td>INSBER_n</td><td>Insert Bit Error: With TDQRSS enabled, when this bit transitions from "0" to "1", a bit error will be inserted in the transmitted QRSS pattern of the selected channel number n. The state of this bit is sampled on the rising edge of the respective TCLKn.
NOTE: To ensure the insertion of bit error, a "0" should be written in this bit location before writing a "1".</td><td>R/W</td><td>0</td></tr>
<tr><td>D0</td><td>TRATIO_n</td><td>Transformer Ratio Select: In the external termination mode, setting this pin "High" selects a transformer ratio of 1:2 for the transmitter. A "Low" on this pin sets the transmitter transformer ratio to 1:2.45. In the internal termination mode the transmitter transformer ratio is permanently set to 1:2 and the state of this bit has no effect.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 22: MICROPROCESSOR REGISTER 4 BIT DESCRIPTION

REGISTER ADDRESS 00000100 00010100 00100100 00110100 01000100 01010100 01100100 01110100	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	GCHIE_n	**Global Channel Interrupt Enable:** Writing a "0" into this bit, globally masks all the interrupt requests for the selected channel. Writing a "1" into this bit removes the global mask and returns the interrupt control function to the respective Interrupt mask register.	R/W	0
D6	DMOIE_n	**DMO Interrupt Enable:** Writing a "1" to this bit enables DMO interrupt generation, writing a "0" masks it.	R/W	0
D5	FLSIE_n	**FIFO Limit Status Interrupt Enable:** Writing a "1" to this bit enables interrupt generation when the FIFO limit is within to 3 bits, writing a "0" to masks it.	R/W	0
D4	LCVIE_n	**Line Code Violation Interrupt Enable:** Writing a "1" to this bit enables Line Code Violation interrupt generation, writing a "0" masks it.	R/W	0
D3	NLCDIE_n	**Network Loop-Code Detection Interrupt Enable:** Writing a "1" to this bit enables Network Loop-code detection interrupt generation, writing a "0" masks it.	R/W	0
D2	AISDIE_n	**AIS Interrupt Enable:** Writing a "1" to this bit enables Alarm Indication Signal detection interrupt generation, writing a "0" masks it.	R/W	0
D1	RLOSIE_n	**Receive Loss of Signal Interrupt Enable:** Writing a "1" to this bit enables Loss of Receive Signal interrupt generation, writing a "0" masks it.	R/W	0
D0	QRPDIE_n	**QRSS Pattern Detection Interrupt Enable:** Writing a "1" to this bit enables QRSS pattern detection interrupt generation, writing a "0" masks it.	R/W	0

TABLE 23: MICROPROCESSOR REGISTER 5 BIT DESCRIPTION

REGISTER ADDRESS 00000101 00010101 00100101 00110101 01000101 01010101 01100101 01110101 BIT #	NAME	FUNCTION	REGISTER TYPE	RESET VALUE
D7	GCHI_n	**Global Channel Interrupt:** This bit is set to a "1" to indicate that an Interrupt has been generated by this channel.	RO	0
D6	DMO_n	**Driver Monitor Output:** This bit is set to a "1" to indicate transmit driver failure is detected. The value of this bit is based on the current status of DMO for the corresponding channel. If the DMOIE bit is enabled, any transition on this bit will generate an Interrupt.	RO	0
D5	FLS_n	**FiFo Limit Status:** This bit is set to a "1" to indicate that the jitter attenuator read/write FIFO pointers are within +/- 3 bits. If the FLSIE bit is enabled, any transition on this bit will generate an Interrupt.	RO	0

TABLE 23: MICROPROCESSOR REGISTER 5 BIT DESCRIPTION

D4	LCV_n	**Line Code Violation:** This bit is set to a "1" to indicate that the receiver of channel n is currently detecting a Line Code Violation or an excessive number of zeros in the B8ZS or HDB3 modes. If the LCVIE bit is enabled, any transition on this bit will generate an Interrupt.	RO	0
D3	NLCD_n	**Network Loop-Code Detection:** This bit operates differently in the Manual or the Automatic Network Loop-Code detection modes. In the **Manual Loop-Code detection mode**,(NLCDE1 = “0” and NLCDE0 = “1” or NLCDE1 = “1” and NLCDE0 = “0”) this bit get set to “1” as soon as the Loop-Up (“00001”) or Loop_Down (“001”) code is detected in the receive data for longer than 5 seconds. The NLCD bit stays in the “1” state for as long as the chip detects the presence of the Loop-code in the receive data and it is reset to “0” as soon as it stops receiving it. In this mode, if the NLCD interrupt is enabled, the chip will initiate an interrupt on every transition of the NLCD. When the **Automatic Loop-code detection mode** (NLCDE1 = “1” and NLCDE0 =”1”) is initiated, the state of the NLCD interface bit is reset to “0” and the chip is programmed to monitor the receive input data for the Loop-Up code. This bit is set to a “1” to indicate that the Network Loop Code is detected for more than 5 seconds. Simultaneously the Remote Loop-Back condition is automatically activated and the chip is programmed to monitor the receive data for the Network Loop Down code. The NLCD bit stays in the “1” state for as long as the Remote Loop-Back condition is in effect even if the chip stops receiving the Loop-Up code. Remote Loop-Back is removed if the chip detects the “001” pattern for longer than 5 seconds in the receive data.Detecting the “001” pattern also results in resetting the NLCD interface bit and initiating an interrupt provided the NLCD interrupt enable bit is active.When programmed in Automatic detection mode, the NLCD interface bit stays “High” for the entire time the Remote Loop-Back is active and initiate an interrupt anytime the status of the NLCD bit changes. In this mode, the Host can monitor the state of the NLCD bit to determine if the Remote Loop-Back is activated.	RO	0
D2	AISD_n	**Alarm Indication Signal Detect:** This bit is set to a "1" to indicate All Ones Signal is detected by the receiver. The value of this bit is based on the current status of Alarm Indication Signal detector of channel n. If the AISDIE bit is enabled, any transition on this bit will generate an Interrupt.	RO	0
D1	RLOS_n	**Receive Loss of Signal:** This bit is set to a "1" to indicate that the receive input signal is lost. The value of this bit is based on the current status of the receive input signal of channel n. If the RLOSIE bit is enabled, any transition on this bit will generate an Interrupt.	RO	0
D0	QRPD_n	**Quasi-random Pattern Detection:** This bit is set to a "1" to indicate the receiver is currently in synchronization with QRSS pattern. The value of this bit is based on the current status of Quasi-random pattern detector of channel n. If the QRPDIE bit is enabled, any transition on this bit will generate an Interrupt.	RO	0

TABLE 24: MICROPROCESSOR REGISTER 6 BIT DESCRIPTION

REGISTER ADDRESS 00000110 00010110 00100110 00110110 01000110 01010110 01100110 01110110	 CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	GCHIS_n	**Global Channel Interrupt Status:** This bit is set to a "1" every time the status of GCHI for this channel has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D6	DMOIS_n	**Driver Monitor Output Interrupt Status:** This bit is set to a "1" every time when DMO status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D5	FLSIS_n	**FIFO Limit Interrupt Status:** This bit is set to a "1" every time when FIFO Limit (Read/Write pointer with +/- 3 bits apart) status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D4	LCVIS_n	**Line Code Violation Interrupt Status:** This bit is set to a "1" every time when LCV status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D3	NLCDIS_n	**Network Loop-Code Detection Interrupt Status:** This bit is set to a "1" every time when NLCD status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D2	AISDIS_n	**AIS Detection Interrupt Status:** This bit is set to a "1" every time when AISD status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D1	RLOSIS_n	**Receive Loss of Signal Interrupt Status:** This bit is set to a "1" every time RLOS status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0
D0	QRPDIS_n	**Quasi-Random Pattern Detection Interrupt Status:** This bit is set to a "1" every time when QRPD status has changed since last read. ***NOTE:*** *This bit is reset upon read.*	RUR	0

TABLE 25: MICROPROCESSOR REGISTER 7 BIT DESCRIPTION

REGISTER ADDRESS 00000111 00010111 00100111 00110111 01000111 01010111 01100111 01110111	 CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		RO	0
D6	Reserved		RO	0
D5	CLOS5_n	**Cable Loss bit 5:** CLOS5_n -thru-CLOS0_n are the six bit receive selective equalizer setting which is also a binary word that represents the cable attenuation indication within ±1dB. CLOS5_n is the most significant bit (MSB) and CLOS0_n is the least significant bit (LSB).	RO	0
D4	CLOS4_n	**Cable Loss bit 4:** See description of D5 for function of this bit.	RO	0
D3	CLOS3_n	**Cable Loss bit 3:** See description of D5 for function of this bit.	RO	0
D2	CLOS2_n	**Cable Loss bit 2:** See description of D5 for function of this bit.	RO	0
D1	CLOS1_n	**Cable Loss bit 1:** See description of D5 for function of this bit.	RO	0
D0	CLOS0_n	**Cable Loss bit 0:** See description of D5 for function of this bit.	RO	0

TABLE 26: MICROPROCESSOR REGISTER 8 BIT DESCRIPTION

REGISTER ADDRESS 00001000 00011000 00101000 00111000 01001000 01011000 01101000 01111000	 CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S1_n - B0S1_n	**Transmit Pulse Sample Number 1:** This seven bit unsigned binary number represents the magnitude of the first of eight transmit samples in the given transmit period. Here B6S1 represents the Most Significant bit (MSB) and B0S1 represents the Least Significant Bit (LSB).	R/W	0

TABLE 27: MICROPROCESSOR REGISTER 9 BIT DESCRIPTION

REGISTER ADDRESS 00001001 00011001 00101001 00111001 01001001 01011001 01101001 01111001	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S2_n - B0S2_n	**Transmit Pulse Sample Number 2:** This seven bit unsigned binary number represents the magnitude of the second of eight transmit samples in the given transmit period. Here B6S2 represents the Most Significant bit (MSB) and B0S2 represents the Least Significant Bit (LSB).	R/W	0

TABLE 28: MICROPROCESSOR REGISTER 10 BIT DESCRIPTION

REGISTER ADDRESS 00001010 00011010 00101010 00111010 01001010 01011010 01101010 01111010	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S3_n - B0S3_n	**Transmit Pulse Sample Number 3:** This seven bit unsigned binary number represents the magnitude of the third of eight transmit samples in the given transmit period. Here B6S3 represents the Most Significant bit (MSB) and B0S3 represents the Least Significant Bit (LSB).	R/W	0

TABLE 29: MICROPROCESSOR REGISTER 11 BIT DESCRIPTION

REGISTER ADDRESS 00001011 00011011 00101011 00111011 01001011 01011011 01101011 01111011	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S4_n - B0S4_n	**Transmit Pulse Sample Number 4:** This seven bit unsigned binary number represents the magnitude of the fourth of eight transmit samples in the given transmit period. Here B6S4 represents the Most Significant bit (MSB) and B0S4 represents the Least Significant Bit (LSB).	R/W	0

TABLE 30: MICROPROCESSOR REGISTER 12 BIT DESCRIPTION

REGISTER ADDRESS 00001100 00011100 00101100 00111100 01001100 01011100 01101100 01111100	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S5_n - B0S5_n	**Transmit Pulse Sample Number 5:** This seven bit unsigned binary number represents the magnitude of the fifth of eight transmit samples in the given transmit period. Here B6S5 represents the Most Significant bit (MSB) and B0S5 represents the Least Significant Bit (LSB).	R/W	0

TABLE 31: MICROPROCESSOR REGISTER 13 BIT DESCRIPTION

REGISTER ADDRESS 00001101 00011101 00101101 00111101 01001101 01011101 01101101 01111101	 CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S6_n - B0S6_n	**Transmit Pulse Sample Number 6:** This seven bit unsigned binary number represents the magnitude of the sixth of eight transmit samples in the given transmit period. Here B6S6 represents the Most Significant bit (MSB) and B0S6 represents the Least Significant Bit (LSB).	R/W	0

TABLE 32: MICROPROCESSOR REGISTER 14 BIT DESCRIPTION

REGISTER ADDRESS 00001110 00011110 00101110 00111110 01001110 01011110 01101110 01111110	 CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S7_n - B0S7_n	**Transmit Pulse Sample Number 7:** This seven bit unsigned binary number represents the magnitude of the seventh of eight transmit samples in the given transmit period. Here B6S7 represents the Most Significant bit (MSB) and B0S7 represents the Least Significant Bit (LSB).	R/W	0

TABLE 33: MICROPROCESSOR REGISTER 15 BIT DESCRIPTION

REGISTER ADDRESS 00001111 00011111 00101111 00111111 01001111 01011111 01101111 01111111	CHANNEL_0 CHANNEL_1 CHANNEL_2 CHANNEL_3 CHANNEL_4 CHANNEL_5 CHANNEL_6 CHANNEL_7	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #	NAME			
D7	Reserved		R/W	0
D6-D0	B6S8_n - B0S8_n	**Transmit Pulse Sample Number 8:** This seven bit unsigned binary number represents the magnitude of the last of eight transmit samples in the given transmit period. Here B6S8 represents the Most Significant bit (MSB) and B0S8 represents the Least Significant Bit (LSB).	R/W	0

TABLE 34: MICROPROCESSOR REGISTER 128 BIT DESCRIPTION

REGISTER ADDRESS 10000000	NAME	FUNCTION	REGISTER TYPE	RESET VALUE
BIT #				
D7	SR/$\overline{DR}$	**Single-rail/Dual-rail Select:** Writing a "1" to this bit configures all 8 channels in the XRT83L38 to operate in the Single-rail mode. Writing a "0" configures the XRT83L38 to operate in Dual-rail mode.	R/W	0
D6	ATAOS	**Automatic Transmit All Ones Upon RLOS:** Writing a "1" to this bit enables the automatic transmission of All Ones data to the line for the channel that detects an RLOS condition. Writing a "0" disables this feature.	R/W	0
D5	RCLKE	**Receive Clock Edge:** Writing a "1" to this bit selects receive output data of all channels to be updated on the negative edge of RCLK. Wring a "0" selects data to be updated on the positive edge of RCLK.	R/W	0

TABLE 34: MICROPROCESSOR REGISTER 128 BIT DESCRIPTION

D4	TCLKE	**Transmit Clock Edge:** Writing a "0" to this bit selects transmit data at TPOS/TDATA and TNEG of all channels to be sampled on the falling edge of TCLK. Writing a "1" selects the rising edge of the TCLK for sampling.	R/W	0
D3	DATAP	**DATA Polarity:** Writing a "0" to this bit selects transmit input and receive output data of all channels to be active-high. Writing a "1" selects an active-low state.	R/W	0
D2	CODES	**Encoding and Decoding Select:** Writing a "0" to this bit selects HDB3 or B8ZS encoding and decoding for all channels. Writing a "1" selects an AMI coding scheme. This bit is only active when Single-Rail mode is selected.	R/W	0
D1	GIE	**Global Interrupt Enable:** Writing a "1" to this bit globally enables interrupt generation for all channels. Writing a "0" disables interrupt generation.	R/W	0
D0	SRESET	**Software Reset µP Registers:** Writing a "1" to this bit longer than 10ms resets all register bits in the microprocessor registers to "0". The reset must be removed by writing a "0" in this bit location in order to initiate a Write operation through the parallel interface. Upon power-up, the content of each register bit is also reset to "0".	R/W	0

TABLE 35: MICROPROCESSOR REGISTER 129 BIT DESCRIPTION

<table>
<tr><th>REGISTER ADDRESS 10000001
BIT #</th><th>NAME</th><th>FUNCTION</th><th>REGISTER TYPE</th><th>RESET VALUE</th></tr>
<tr><td>D7</td><td>Reserved</td><td></td><td>R/W</td><td>0</td></tr>
<tr><td>D6</td><td>CLKSEL2</td><td>Clock Select Inputs for Master Clock Synthesizer bit 2: In Host mode CLKSEL2-0 are input signals to a programmable frequency synthesizer that can be used to generate a master clock from an external accurate clock source according to the following table;
<table>
<tr><th>MCLKE 1/kHz</th><th>MCLKT1/ kHz</th><th>CLKSEL2</th><th>CLKSEL1</th><th>CLKSEL0</th><th>MCLKRATE</th><th>CLKOUT/ kHz</th></tr>
<tr><td>2048</td><td>2048</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2048</td></tr>
<tr><td>2048</td><td>2048</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1544</td></tr>
<tr><td>2048</td><td>1544</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2048</td></tr>
<tr><td>1544</td><td>1544</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1544</td></tr>
<tr><td>1544</td><td>1544</td><td>0</td><td>0</td><td>1</td><td>0</td><td>2048</td></tr>
<tr><td>2048</td><td>1544</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1544</td></tr>
<tr><td>8</td><td>X</td><td>0</td><td>1</td><td>0</td><td>0</td><td>2048</td></tr>
<tr><td>8</td><td>X</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1544</td></tr>
<tr><td>16</td><td>X</td><td>0</td><td>1</td><td>1</td><td>0</td><td>2048</td></tr>
<tr><td>16</td><td>X</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1544</td></tr>
<tr><td>56</td><td>X</td><td>1</td><td>0</td><td>0</td><td>0</td><td>2048</td></tr>
<tr><td>56</td><td>X</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1544</td></tr>
<tr><td>64</td><td>X</td><td>1</td><td>0</td><td>1</td><td>0</td><td>2048</td></tr>
<tr><td>64</td><td>X</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1544</td></tr>
<tr><td>128</td><td>X</td><td>1</td><td>1</td><td>0</td><td>0</td><td>2048</td></tr>
<tr><td>128</td><td>X</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1544</td></tr>
<tr><td>256</td><td>X</td><td>1</td><td>1</td><td>1</td><td>0</td><td>2048</td></tr>
<tr><td>256</td><td>X</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1544</td></tr>
</table>
In Hardware mode the state of these signals are ignored and the master frequency PLL is controlled by the corresponding Hardware pins.</td><td>R/W</td><td>0</td></tr>
<tr><td>D5</td><td>CLKSEL1</td><td>Clock Select inputs for Master Clock Synthesizer bit1: See description of bit D6 for function of this bit.</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 35: MICROPROCESSOR REGISTER 129 BIT DESCRIPTION

D4	CLKSEL0	**Clock Select inputs for Master Clock Synthesizer bit0:** See description of bit D6 for function of this bit.	R/W	0
D3	MCLKRATE	**Master clock Rate Select:** The state of this bit programs the Master Clock Synthesizer to generate the T1/J1 or E1 clock. The Master Clock Synthesizer will generate the E1 clock when MCLKRATE = “0”, and the T1/J1 clock when MCLKRATE = “1”.	R/W	0
D2	RXMUTE	**Receive Output Mute:** Writing a "1" to this bit, mutes receive outputs at RPOS/RDATA and RNEG/LCV pins to a "0" state for any channel that detects an RLOS condition. ***NOTE:*** *RCLK is not muted.*	R/W	0
D1	EXLOS	**Extended LOS:** Writing a "1" to this bit extends the number of zeros at the receive input of each channel before RLOS is declared to 4096 bits. Writing a "0" reverts to the normal mode (175+75 bits for T1 and 32 bits for E1).	R/W	0
D0	ICT	**In-Circuit-Testing:** Writing a "1" to this bit configures all the output pins of the chip in high impedance mode for In-Circuit-Testing. The software ICT function is equivalent to connecting the Hardware pin 117 to ground.	R/W	0

TABLE 36: MICROPROCESSOR REGISTER 130 BIT DESCRIPTION

REGISTER ADDRESS 10000010 BIT #	NAME	FUNCTION	REGISTER TYPE	RESET VALUE
D7	TxONCNTL	**Transmit On Control.** In **Host** mode, setting this bit to “1” transfers the control of the Transmit On/Off function to the TxON-n Hardware control pins. ***NOTE:*** *This provides a faster On/Off capability for redundancy application.*	R/W	0
D6	TERCNTL	Termination Control. In **Host** mode, setting this bit to “1” transfers the control of the RXTSEL to the RXTSEL Hardware control pin. ***NOTE:*** *This provides a faster On/Off capability for redundancy application.*	R/W	0

TABLE 36: MICROPROCESSOR REGISTER 130 BIT DESCRIPTION

<table>
<tr><td>D5-D4</td><td colspan="4">Reserved</td></tr>
<tr><td>D3</td><td>MONITOR_3</td><td>Protected Monitoring. With protected monitoring enabled, the receiver 7 inputs at RTIP_7 and RRING_7 are internally connected to one of the other seven transmit and receive channels.Receiver 7 recovers the input data and clock and output them to RPOS_7/RNEG_7 and RCLK_7 respectively. In addition, the data to be monitored can be routed to TTIP_7 and TRING_7 by means of activating Remote Loop-Back for channel 7.
With MONITOR_3,2,1 and 0 bits set to “0”, the Protected Monitoring feature is disabled and the XRT83L38 is configured as an octal line transceiver.

Protected Monitoring Channel Select
<table><tr><th>Monitor_3</th><th>Monitor_2</th><th>Monitor_1</th><th>Monitor_0</th><th>Selection</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>No Monitoring</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>Receiver 0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>Receiver 1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>Receiver 2</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>Receiver 3</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td><td>Receiver 4</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>Receiver 5</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>Receiver 6</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>No Monitoring</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>Transmitter 0</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>Transmitter 1</td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>Transmitter 2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>Transmitter 3</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>Transmitter 4</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>Transmitter 5</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>Transmitter 6</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>D2</td><td>MONITOR_2</td><td>Protected Monitoring
See description for MONITOR_3</td><td>R/W</td><td>0</td></tr>
<tr><td>D1</td><td>MONITOR_1</td><td>Protected Monitoring
See Description for MONITOR_3</td><td>R/W</td><td>0</td></tr>
<tr><td>D0</td><td>MONITOR_0</td><td>Protected Monitoring
See description for MONITOR_3</td><td>R/W</td><td>0</td></tr>
</table>

TABLE 37: MICROPROCESSOR REGISTER 131 BIT DESCRIPTION

<table>
<tr><th>REGISTER ADDRESS 10000000
BIT #</th><th>NAME</th><th>FUNCTION</th><th>REGISTER TYPE</th><th>RESET VALUE</th></tr>
<tr><td>D7</td><td>GUAGE1</td><td>Wire Gauge Selector Bit 1
This bit together with bit D6 are used to select wire gauge size as shown in the table below.

<table><tr><th>GAUGE1</th><th>GAUGE0</th><th>Wire Size</th></tr><tr><td>0</td><td>0</td><td>22 and 24 Gauge</td></tr><tr><td>0</td><td>1</td><td>22 Gauge</td></tr><tr><td>1</td><td>0</td><td>24 Gauge</td></tr><tr><td>1</td><td>1</td><td>26 Gauge</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>D6</td><td>GUAGE0</td><td>Wire Gauge Selector Bit 0
See bit D7.</td><td>R/W</td><td>0</td></tr>
<tr><td>D5</td><td>Reserved</td><td></td><td>R/W</td><td>0</td></tr>
<tr><td>D4</td><td>Reserved</td><td></td><td>R/W</td><td>0</td></tr>
<tr><td>D3</td><td>SL_1</td><td>Slicer Level Control bit 1: This bit and bit D2 control the slicing level for the slicer per the following table.

<table><tr><th>SL_1</th><th>SL_0</th><th>Slicer Mode</th></tr><tr><td>0</td><td>0</td><td>Normal</td></tr><tr><td>0</td><td>1</td><td>Decrease by 5% from Normal</td></tr><tr><td>1</td><td>0</td><td>Increase by 5% from Normal</td></tr><tr><td>1</td><td>1</td><td>Normal</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>D2</td><td>SL_0</td><td>Slicer Level Control bit 0: See description bit D3.</td><td>R/W</td><td>0</td></tr>
<tr><td>D1</td><td>EQG_1</td><td>Equalizer Gain Control bit 1: This bit together with bit D0 control the gain of the equalizer as shown in the table below.

<table><tr><th>EQG_1</th><th>EQG_0</th><th>Equalizer Gain</th></tr><tr><td>0</td><td>0</td><td>Normal</td></tr><tr><td>0</td><td>1</td><td>Reduce Gain by 1 dB</td></tr><tr><td>1</td><td>0</td><td>Reduce Gain by 3 dB</td></tr><tr><td>1</td><td>1</td><td>Normal</td></tr></table></td><td>R/W</td><td>0</td></tr>
<tr><td>D0</td><td>EQG_0</td><td>Equalizer Gain Control bit 0: See description of bit D1</td><td>R/W</td><td>0</td></tr>
</table>

ELECTRICAL CHARACTERISTICS

TABLE 38: ABSOLUTE MAXIMUM RATINGS

Storage Temperature.....-65°C to + 150°C
Operating Temperature.....-40°C to + 85°C
Supply Voltage.....-0.5V to + 6.0V
Vin.....-0.5V to + 6.0V

TABLE 39: DC DIGITAL INPUT AND OUTPUT ELECTRICAL CHARACTERISTICS

VDD=3.3V±5%, T_A=25°C, UNLESS OTHERWISE SPECIFIED)					
PARAMETER	**SYMBOL**	**MIN**	**TYP**	**MAX**	**UNITS**
Power Supply Voltage	VDD	3.13	3.3	3.46	V
Input High Voltage	V_{IH}	2.0	-	5.0	V
Input Low Voltage	V_{IL}	-0.5	-	0.8	V
Output High Voltage @ IOH=-2.0mA	V_{OH}	2.4	-	-	V
Output Low Voltage @IOL=-2.	V_{OL}	-	-	0.4	V
Input Leakage Current (except Input pins with Pull-up or Pull- down resistor).	I_L	-	-	±10	mA
Input Capacitance	C_I	-	5.0	-	pF
Output Load Capacitance	C_L	-	-	25	pF

TABLE 40: XRT83L38 POWER CONSUMPTION

(Vdd=3.3V±5%, T_A=25°C unless otherwise specified)

MODE	SUPPLY VOLTAGE	IMPEDANCE	TERMINATION RESISTOR	TRANSFORMER RATIO		TYP	MAX	UNIT	TEST CONDITIONS
				RECEIVER	TRANSMITTER				
E1	3.3V	75Ω	6.2Ω	2:1	1:2.42	935 1340		mW mW	50% “1’s” 100% “1’s”
E1	3.3V	75Ω	9.1Ω	2:1	1:2	910 1140		mW mW	50% “1’s” 100% “1’s”
E1	3.3V	120Ω	6.2Ω	2:1	1:2.42	825 875		mW mW	50% “1’s” 100% “1’s”
E1	3.3V	120Ω	9.1Ω	2:1	1:2	760 800		mW mW	50% “1’s” 100% “1’s”
T1	3.3V	100Ω	3Ω	2:1	1:2.42	1310 1870		mW mW	50% “1’s” 100% “1’s”
T1	3.3V	100Ω	3Ω	2:1	1:2	1490 2090		mW mW	50% “1’s” 100% “1’s”
---	3.3V	---	---	---	---	430		mW	All transmitters off

TABLE 41: E1 RECEIVER ELECTRICAL CHARACTERISTICS

(VDD=3.3V±5%, T_A= -40° TO 85°C, UNLESS OTHERWISE SPECIFIED)					
PARAMETER	**MIN**	**TYP**	**MAX**	**UNIT**	**TEST CONDITIONS**
Receiver loss of signal: Number of consecutive zeros before RLOS is set Input signal level at RLOS RLOS De-asserted	 15 12.5	 32 20 	 	 dB % ones	Cable attenuation @1024KHz ITU-G.775, ETSI 300 233
Receiver Sensitivity (Short Haul with cable loss)	0		11	dB	With nominal pulse amplitude of 3.0V for 120W and 2.37V for 75Ω application. With -18dB interference signal added.
Receiver Sensitivity (Long Haul with cable loss)	0		43	dB	With nominal pulse amplitude of 3.0V for 120Ω and 2.37V for 75Ω application. With -18dB interference signal added.
Input Impedance		13		kΩ	
Input Jitter Tolerance: 1 Hz 10kHz-100kHz	37 0.2			UIpp UIpp	ITU G.823
Recovered Clock Jitter Transfer Corner Frequency Peaking Amplitude	-	36	 - 0.5	kHz dB	ITU G.736
Jitter Attenuator Corner Frequency (-3dB curve) (JABW=0) (JABW=1)	-	10 1.5	-	Hz Hz	ITU G.736
Return Loss: 51kHz - 102kHz 102kHz - 2048kHz 2048kHz - 3072kHz	14 20 16	-	-	dB dB dB	ITU-G.703

TABLE 42: T1 RECEIVER ELECTRICAL CHARACTERISTICS

(VDD=3.3V±5%, T_A=-40° TO 85°C, UNLESS OTHERWISE SPECIFIED)					
PARAMETER	**MIN**	**TYP**	**MAX**	**UNIT**	**TEST CONDITIONS**
Receiver loss of signal:					
Number of consecutive zeros before RLOS is set	160	175	190		
Input signal level at RLOS	15	20	-	dB	Cable attenuation @772KHz
RLOS Clear	12.5	-	-	% ones	ITU-G.775, ETSI 300 233
Receiver Sensitivity (Short Haul with cable loss)	0	-	12	dB	With nominal pulse amplitude of 3.0V for 100Ω termination
Receiver Sensitivity (Long Haul with cable loss)		-			With nominal pulse amplitude of 3.0V
Normal	0		36	dB	for 100Ω termination
Extended	0		45	dB	
Input Impedance		13	-	kΩ	
Jitter Tolerance:					
1Hz	138	-	-	UIpp	AT&T Pub 62411
10kHz - 100kHz	0.4	-	-		
Recovered Clock Jitter					
Transfer Corner Frequency	-	9.8	-	KHz	TR-TSY-000499
Peaking Amplitude	-		0.1	dB	
Jitter Attenuator Corner Frequency (-3dB curve)	-	6		-Hz	AT&T Pub 62411
Return Loss:					
51kHz - 102kHz	-	20	-	dB	
102kHz - 2048kHz	-	25	-	dB	
2048kHz - 3072kHz	-	25	-	dB	

TABLE 43: E1 TRANSMIT RETURN LOSS REQUIREMENT

FREQUENCY	RETURN LOSS	
	G.703/CH-PTT	**ETS 300166**
51-102kHz	8dB	6dB
102-2048kHz	14dB	8dB
2048-3072kHz	10dB	8dB

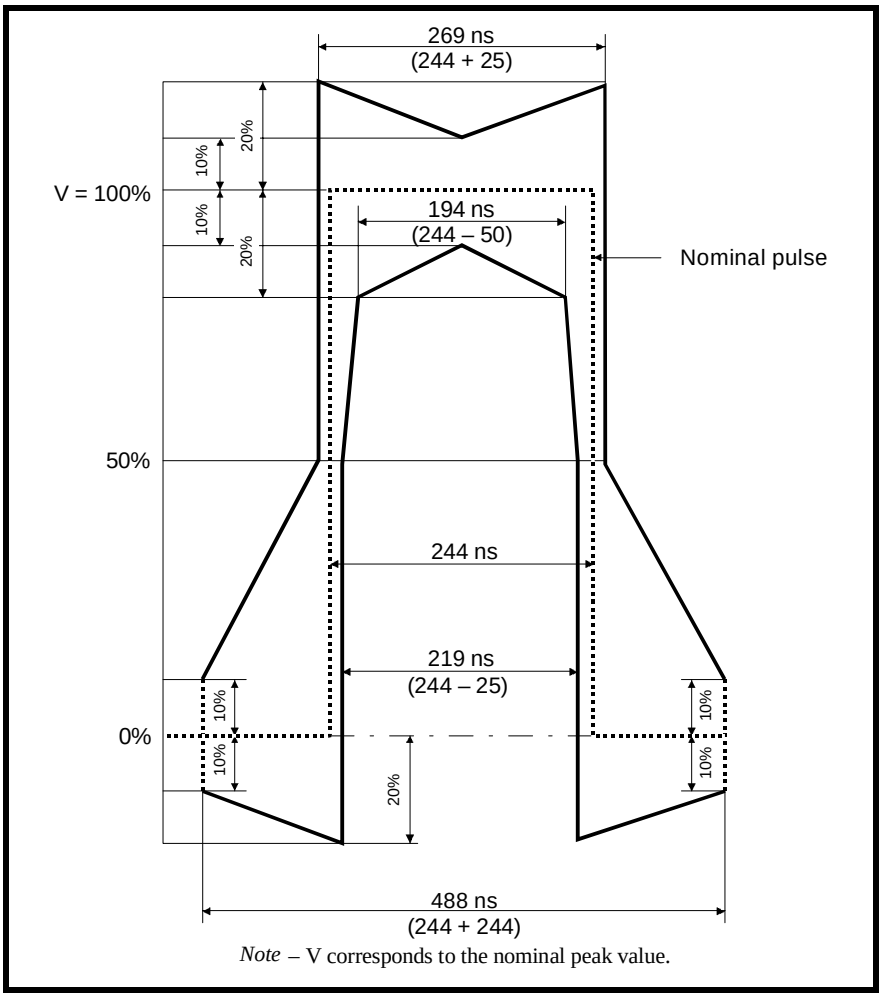
TABLE 44: E1 TRANSMITTER ELECTRICAL CHARACTERISTICS

(VDD=3.3V±5%, T_A=-40° TO 85°C, UNLESS OTHERWISE SPECIFIED)					
PARAMETER	**MIN**	**TYP**	**MAX**	**UNIT**	**TEST CONDITIONS**
AMI Output Pulse Amplitude: 75Ω Application 120Ω Application	 2.13 2.70	 2.37 3.00	 2.60 3.30	 V V	Transformer with 1:2 ratio and 9.1Ω resistor in series with each end of primary.
Output Pulse Width	224	244	264	ns	
Output Pulse Width Ratio	0.95	-	1.05	-	ITU-G.703
Output Pulse Amplitude Ratio	0.95	-	1.05	-	ITU-G.703
Jitter Added by the Transmitter Output	-	0.025	0.05	UIpp	Broad Band with jitter free TCLK applied to the input.
Output Return Loss: 51kHz -102kHz 102kHz-2048kHz 2048kHz-3072kHz	 8 14 10	 - - -	 - - -	 dB dB dB	ETSI 300 166, CHPTT

TABLE 45: T1 TRANSMITTER ELECTRICAL CHARACTERISTICS

(VDD=3.3V±5%, T_A=-40° TO 85°C, UNLESS OTHERWISE SPECIFIED)					
PARAMETER	**MIN**	**TYP**	**MAX**	**UNIT**	**TEST CONDITIONS**
AMI Output Pulse Amplitude:	2.4	3.0	3.60	V	Use transformer with 1:2.45 ratio and measured at DSX-1
Output Pulse Width	338	350	362	ns	ANSI T1.102
Output Pulse Width Imbalance	-	-	20	-	ANSI T1.102
Output Pulse Amplitude Imbalance	-	-	±200	mV	ANSI T1.102
Jitter Added by the Transmitter Output	-	0.025	0.05	UIpp	Broad Band with jitter free TCLK applied to the input.
Output Return Loss: 51kHz -102kHz 102kHz-2048kHz 2048kHz-3072kHz	 - - -	 15 15 15	 - - -	 dB dB dB	

FIGURE 14. ITU G.703 PULSE TEMPLATE



Note – V corresponds to the nominal peak value.

TABLE 46: TRANSMIT PULSE MASK SPECIFICATION

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

FIGURE 15. DSX-1 PULSE TEMPLATE (NORMALIZED AMPLITUDE)

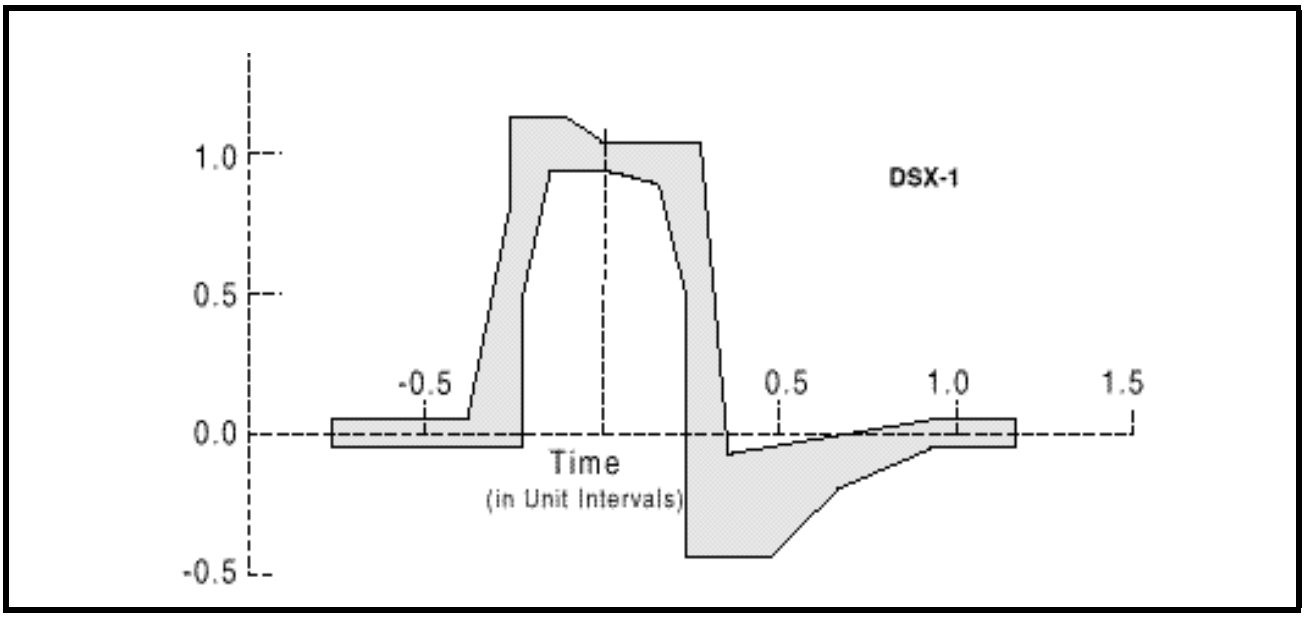


TABLE 47: DSX1 INTERFACE ISOLATED PULSE MASK AND CORNER POINTS

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

TABLE 48: AC ELECTRICAL CHARACTERISTICS

(VDD=3.3V±5%, TA=25°C, UNLESS OTHERWISE SPECIFIED)					
PARAMETER	**SYMBOL**	**MIN**	**TYP**	**MAX**	**UNITS**
E1 MCLK Clock Frequency		-	2.048		MHz
T1 MCLK Clock Frequency		-	1.544		MHz
MCLK Clock Duty Cycle		40	-	60	%
MCLK Clock Tolerance		-	±50	-	ppm
TCLK Duty Cycle	T_{CDU}	30	50	70	%
Transmit Data Setup Time	T_{SU}	50	-	-	ns
Transmit Data Hold Time	T_{HO}	30	-	-	ns
TCLK Rise Time(10%/90%)	$TCLK_R$	-	-	40	ns
TCLK Fall Time(90%/10%)	$TCLK_F$	-	-	40	ns
RCLK Duty Cycle	R_{CDU}	45	50	55	%
Receive Data Setup Time	R_{SU}	150	-	-	ns
Receive Data Hold Time	R_{HO}	150	-	-	ns
RCLK to Data Delay	R_{DY}	-	-	40	ns
RCLK Rise Time(10% to 90%) with 25pF Loading.	$RCLK_R$	-	-	40	ns
RCLK Fall Time(90% to 10%) with 25pF Loading.	$RCLK_F$			40	ns

FIGURE 16. TRANSMIT CLOCK AND INPUT DATA TIMING

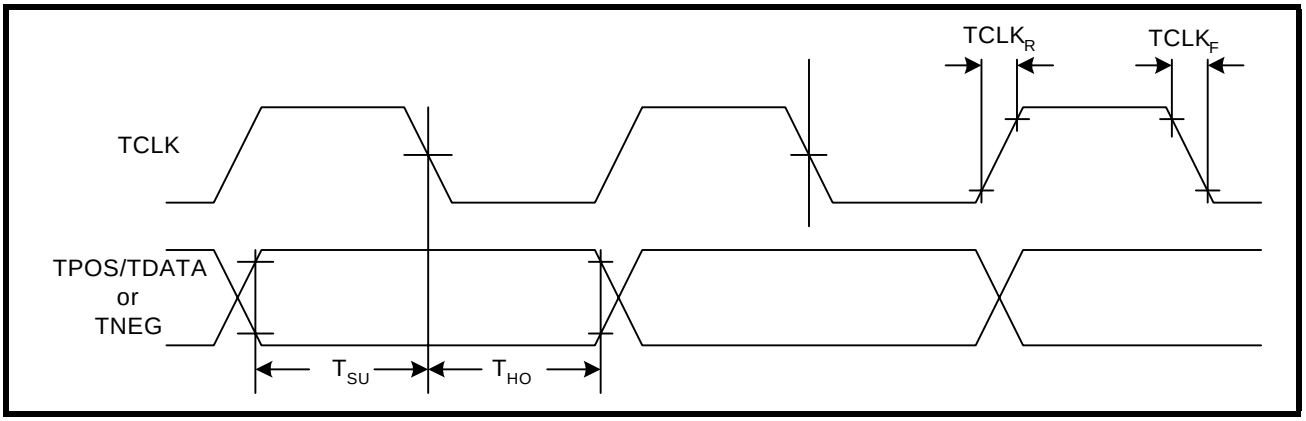
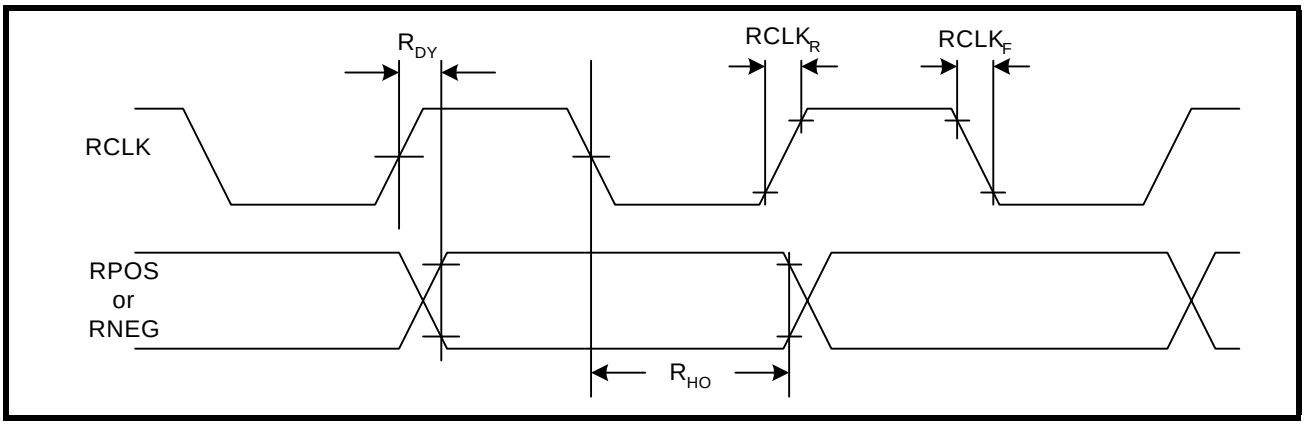


FIGURE 17. RECEIVE CLOCK AND OUTPUT DATA TIMING



MICROPROCESSOR INTERFACE I/O TIMING

INTEL INTERFACE TIMING

The signals used for the Intel microprocessor interface are: Address Latch Enable (ALE), Read Enable ($\overline{RD}$), Write Enable ($\overline{WR}$), Chip Select ($\overline{CS}$), Address and Data bits. The microprocessor interface uses minimum external glue logic and is compatible with the timings of the 8051 or 80C188 with an 8-16 MHz clock frequency, and with the timings of x86 or i960 family or microprocessors. The interface timing shown in Figure 18 and Figure 19 is described in Table 49.

FIGURE 18. INTEL INTERFACE TIMING (READ)

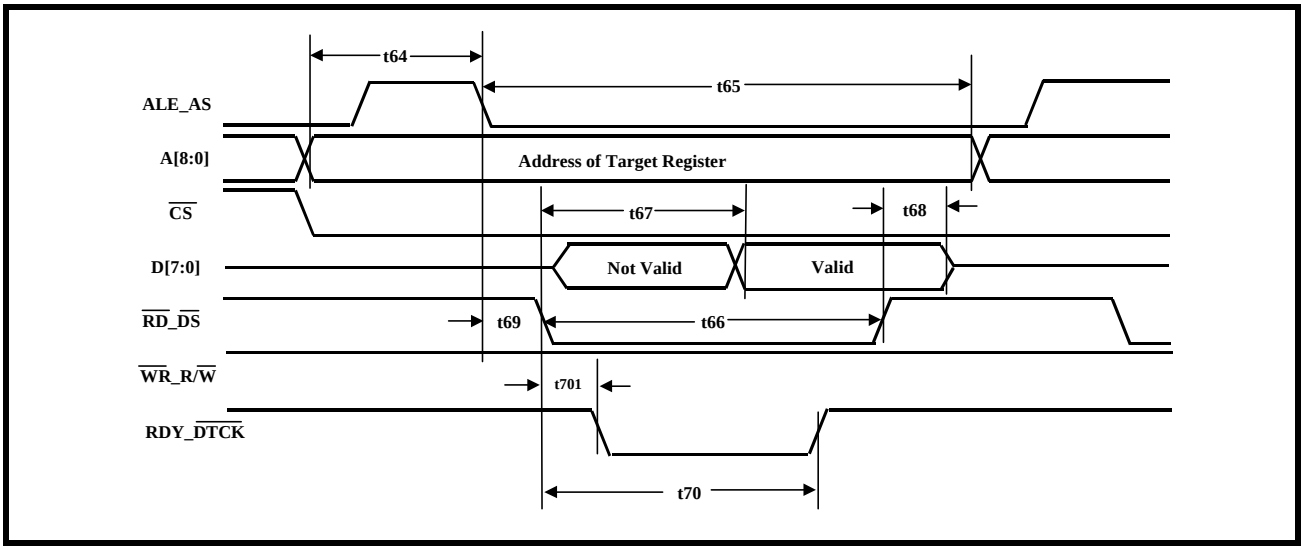


FIGURE 19. INTEL INTERFACE TIMING (WRITE)

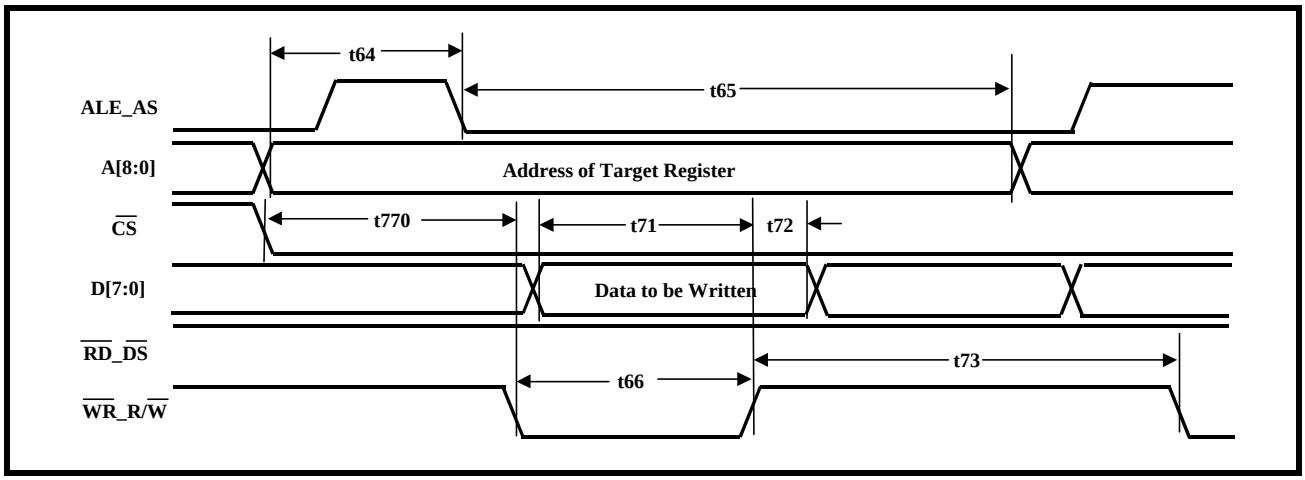


TABLE 49: INTEL INTERFACE TIMING SPECIFICATIONS

SR.	PARAMETER	SYMBOL	MIN	MAX	REMARKS
t_{64}	A8 - A0 Setup Time to ALE_AS Low	4			ns
t_{65}	A8 - A0 Hold Time from ALE_AS Low.	2			ns
Read Operation					
t_{66}	$\overline{RD}\_\overline{DS}$ Pulse Width	260			ns
t_{67}	Data Valid from $\overline{RD}\_\overline{DS}$ Low.	240			ns

TABLE 49: INTEL INTERFACE TIMING SPECIFICATIONS

SR.	PARAMETER	SYMBOL	MIN	MAX	REMARKS
t_{68}	Data Bus Floating from $\overline{RD}$_$\overline{DS}$ High	2			ns
t_{69}	ALE to $\overline{RD}$ Time	4			ns
t_{701}	$\overline{RD}$ Time to "NOT READY" (e.g., RDY_$\overline{DTCK}$ toggling "Low")			145	ns
t_{76}	Minimum Time between Read Burst Access (e.g., the rising edge of $\overline{RD}$ to falling edge of $\overline{RD}$)	60			ns
Write Operations					
t_{71}	Data Setup Time to $\overline{WR}$_R/$\overline{W}$ High	160			ns
t_{72}	Data Hold Time from $\overline{WR}$_R/$\overline{W}$ High	0			ns
t_{73}	Min Time between Write Burst Access (e.g., the rising edge of $\overline{WR}$ to the falling edge of $\overline{WR}$)	60			ns
t_{74}	ALE to $\overline{WR}$ Time	4			ns
t_{770}	$\overline{CS}$ Assertion to falling edge of $\overline{WR}$_R/$\overline{W}$	20			ns

MOTOROLA INTERFACE TIMING

The signals used in the Motorola microprocessor interface mode are: Address Strobe (AS), Data Strobe ($\overline{DS}$), Read/Write Enable (R/$\overline{W}$), Chip Select ($\overline{CS}$), Address and Data bits. The interface is compatible with the timing of a Motorola 68000 microprocessor family with up to 16.67 MHz clock frequency. The interface timing is shown in Figure 20, Figure 21 and Figure 22. The I/O specifications are shown in Table 50.

FIGURE 20. MICROPROCESSOR INTERFACE TIMING - MOTOROLA TYPE PROGRAMMED I/O READ OPERATION

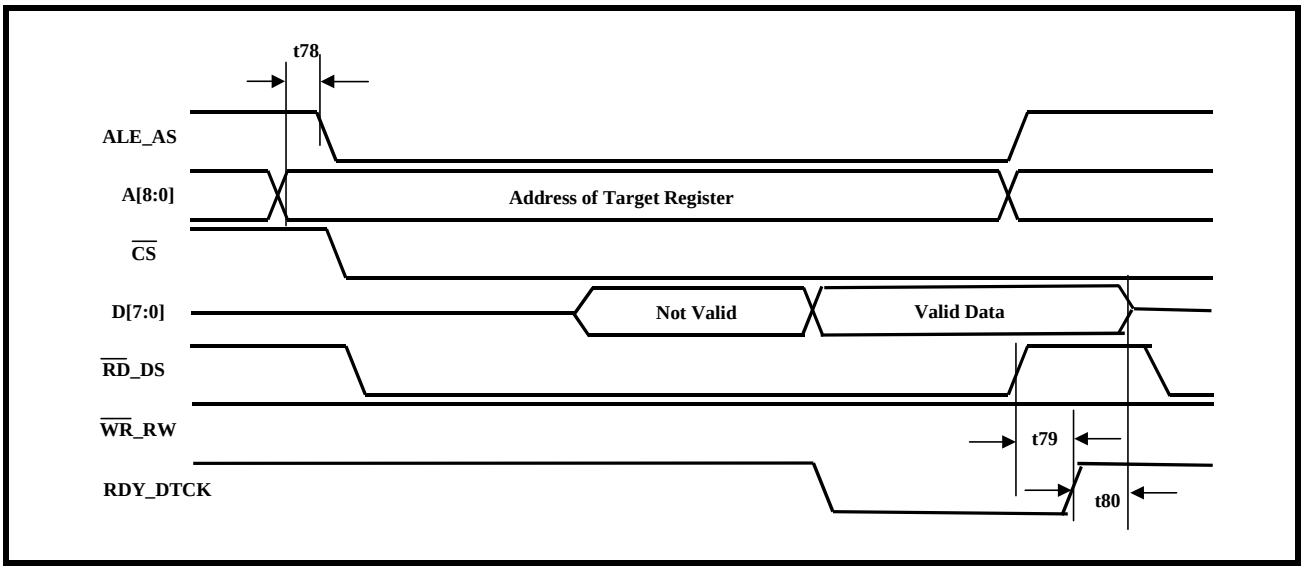


FIGURE 21. MICROPROCESSOR INTERFACE TIMING - MOTOROLA TYPE PROGRAMMED I/O WRITE OPERATION

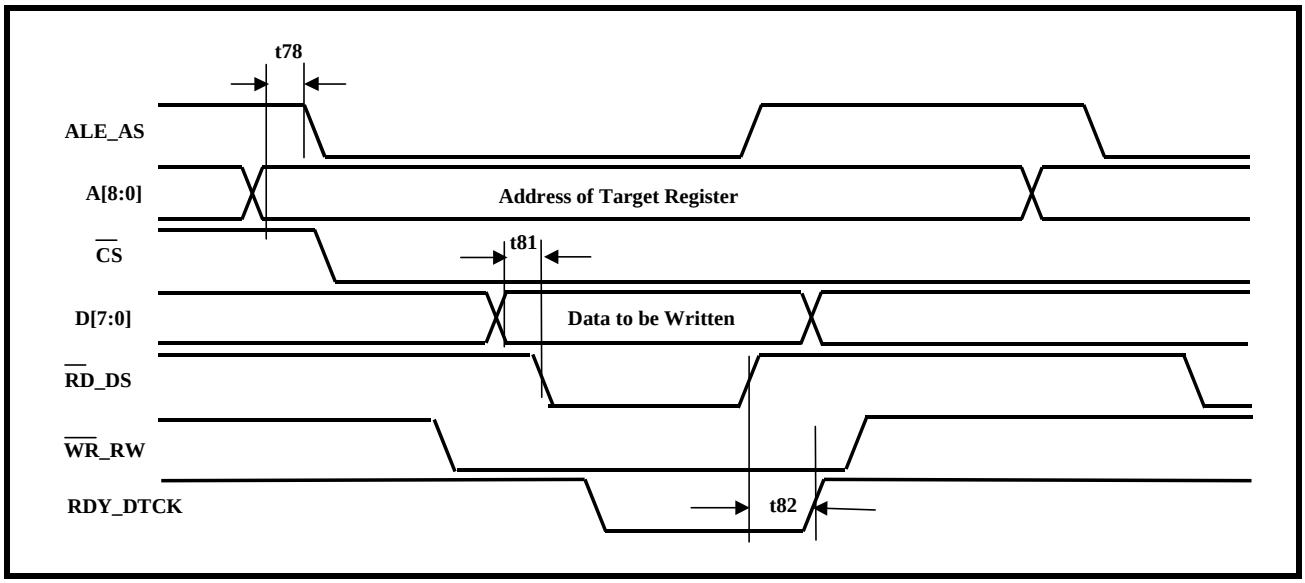


FIGURE 22. MICROPROCESSOR INTERFACE TIMING - RESET PULSE WIDTH

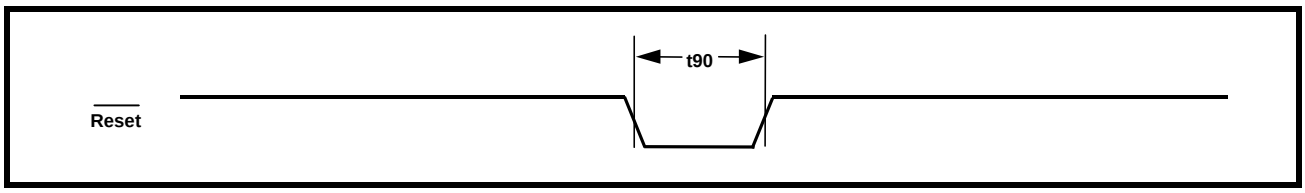


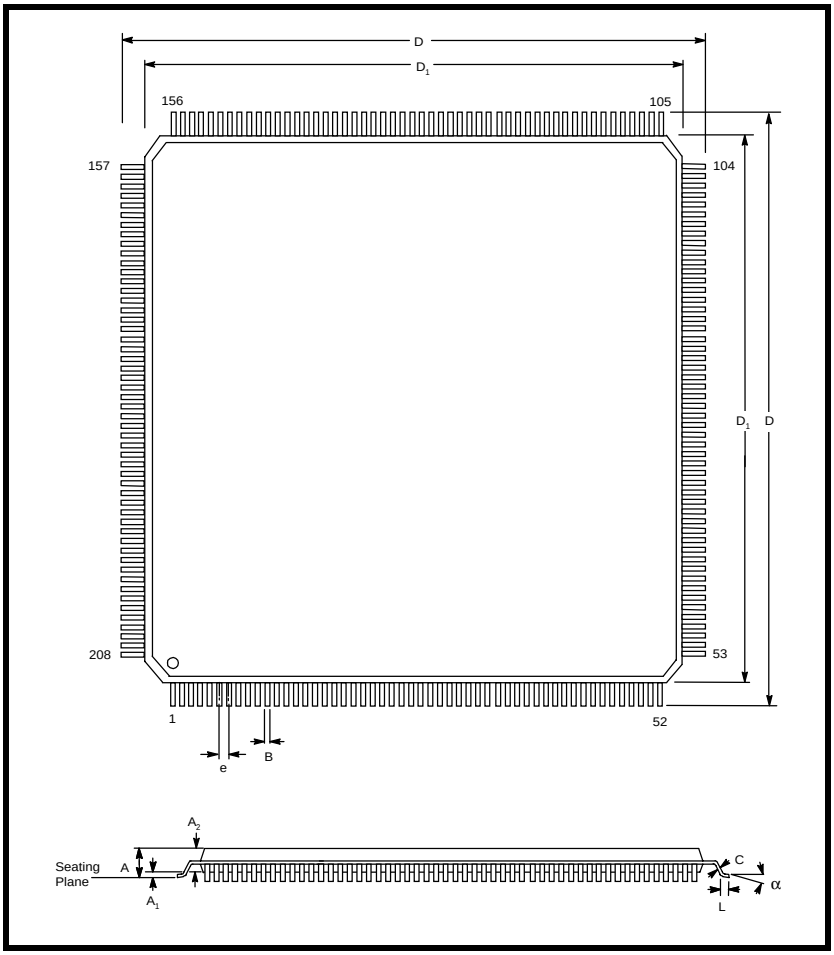
TABLE 50: MOTOROLA INTERFACE TIMING SPECIFICATION

SR.	PARAMETER	SYMBOL	MIN	MAX	REMARKS
Read Operations (see Figure 20)					
t_{78}	A3 - A0 Setup Time to falling edge of ALE_AS	5			ns
t_{79}	Rising edge of $\overline{RD}$_DS to rising edge of RDY_DTCK delay	0			ns
t_{80}	Rising edge of RDY_$\overline{DTCK}$ to tri-state of D[7:0]	0			ns
Write Operations (see Figure 21)					
t_{78}	A3 - A0 Setup Time to falling edge of ALE_AS	5			ns
t_{81}	D[7:0] Setup Time to falling edge of $\overline{RD}$_DS	10			ns
t_{82}	Rising edge of $\overline{RD}$_DS to rising edge of RDY_DTCK delay	0			ns
Reset pulse width - both Motorola and Intel Operations (see Figure 22)					
t_{90}	$\overline{Reset}$ pulse width	30			ns

ORDERING INFORMATION

PART NUMBER	PACKAGE	OPERATING TEMPERATURE RANGE
XRT83L38IV	208 Pin TQFP(28 x 28 x 1.4 mm)	-40°C to +85°C

PACKAGE DIMENSIONS



Note: The control dimension is the millimeter column

SYMBOL	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.055	0.063	1.40	1.60
A_1	0.002	0.006	0.05	0.15
A_2	0.053	0.057	1.35	1.45
B	0.007	0.011	0.17	0.27
C	0.004	0.008	0.09	0.20
D	1.173	1.189	29.80	30.20
D_1	1.098	1.106	27.90	28.10
e	0.0197 BSC		0.50 BSC	
L	0.018	0.030	0.45	0.75
a	0°	7°	0°	7°

REVISIONS

Rev. A1.0.0 thru A1.0.5 Advanced Versions

Rev. P1.1.0 Preliminary release with modified register tables.

Rev. P1.1.1 Corrected description of RXTSEL pin 83. ...by setting the TERCNTL bit (**bit 6**) to...

Rev. P1.2.0 Added SL_1, SL_0, EQG_1 and EQG_0 to Control Global Register 131. Separated Microprocessor description table by register number. Moved absolute maximum and Dc electrical characteristics before AC electrical characteristics. Replaced TBD's in electrical ables. Reformated table of contents.

Rev. P1.2.1 Added GAUGE1 and GAUGE0 to Control Global Register 131. Corrected control register binary bits.

P1.2.2 Renamed FIFO pin to GAUGE, edited definition and edited defintion of JASEL[1:0] to reflect the FIFO size is selected by the jitter attenuator select.

P1.2.3 Redefined bits D3, D2 and D0 of register 1, in combination these bits set the jitter attenuator path and FIFO size.