

TB64LR-Type 10.3 Gb/s Lightwave 300-Pin Transponder with 16-Ch. 644 Mb/s Multiplexer/Demultiplexer



- Selectable MUX reference input clock:
161 MHz (LR)/155 MHz (LW) or
644 MHz (LR)/622 MHz (LW)
- Provides 10 GHz electrical system diagnostics loop-back
- Operating case temperature range:
— 0 °C to 65 °C, continuous
— 0 °C to 70 °C, in accordance with NEBS GR-63-CORE*
- Compact size: 3.6 in. x 2.6 in. x 0.53 in.
- Pigtailed, low-profile package with choice of industry-standard connectors

Features

- Supports long-reach optical 10GBASE-LR Ethernet (Serial LAN-LR) at data rate of 10.3125 Gb/s, with reaches up to 10 km
- Selectably supports 10GBASE-LW (Serial WAN-LW) at data rate of 9.9532 Gb/s and OC-192/STM-64 FEC at data rate of 10.6642 Gb/s
- Low power dissipating, uncooled, 1310 nm direct-modulated laser (DML) transmitter and PIN receiver
- Provides 16-channel 644 Mb/s (LR)/622 Mb/s (LW) electrical tributary access
- Compatible with *IEEE*® Standard 802.3ae-2002 and 300-pin, 10 GbE Transponder MSA
- Optional internal reference clock clean-up circuit for improved jitter performance
- Differential LVDS data interface
- Automatic transmitter optical power control
 - Laser bias monitor output
- Optical transmitter enable input
- Laser degrade alarms
- Laser back-facet monitor output
- Receiver loss-of-power (LOP) analog output
- Transponder alarm interrupt

Applications

- High-speed data communications:
 - Premise
 - Access
 - Metropolitan area networks
 - Wide area networks
- 10 GbE LAN/WAN architectures

Description

The TB64LR 10 GbE transponder is a bidirectional module designed to provide a 10GBASE-LR (Serial LAN)/10GBASE-LW (Serial WAN) Ethernet compliant electro-optical interface between the photonic physical media dependent layer and the electrical coding sub-layer. The module contains a 10.3 Gb/s optical transmitter and a 10.3 Gb/s optical receiver in the same physical package along with the electronics necessary to multiplex and demultiplex sixteen 644 Mb/s (LR)/622 Mb/s (LW) electrical channels. Clock synthesis and clock recovery circuits are also included within the module.

* Note that this device meets NEBS GR-63-CORE requirements of operation at 70 °C for 14 days (max) per year, or 96 hours of continuous operation.

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Conventions

All signals referenced in *italics* are for future use.

Description (continued)

Figure 1 shows a simplified block diagram of the TB64LR-type transponder.

In the transmitting direction, the transponder module multiplexes sixteen 644.53 Mb/s/622.08 Mb/s differential LVDS compatible electrical data signals into an optical signal at 10.3125 Gb/s (LR)/9.9532 Gb/s (LW) for launching into optical fiber. The optical transmitter is available with an uncooled, direct-modulated 1310 nm laser for up to 10 km applications. The optical output signal is compliant to *IEEE* Std. 802.3ae-2002 specifications.

In the receiving direction, the transponder module receives a 10.3125 Gb/s (LR)/9.9532 Gb/s (LW) optical signal and converts it to an electrical signal, extracts a clock signal, then demultiplexes the data into sixteen 644.53 Mb/s/622.08 Mb/s differential LVDS compatible data signals. The receiver operates over the wavelength range of 1.1 μm to 1.6 μm , and is fully compliant to *IEEE* Std. 802.3ae-2002 specifications.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect reliability.

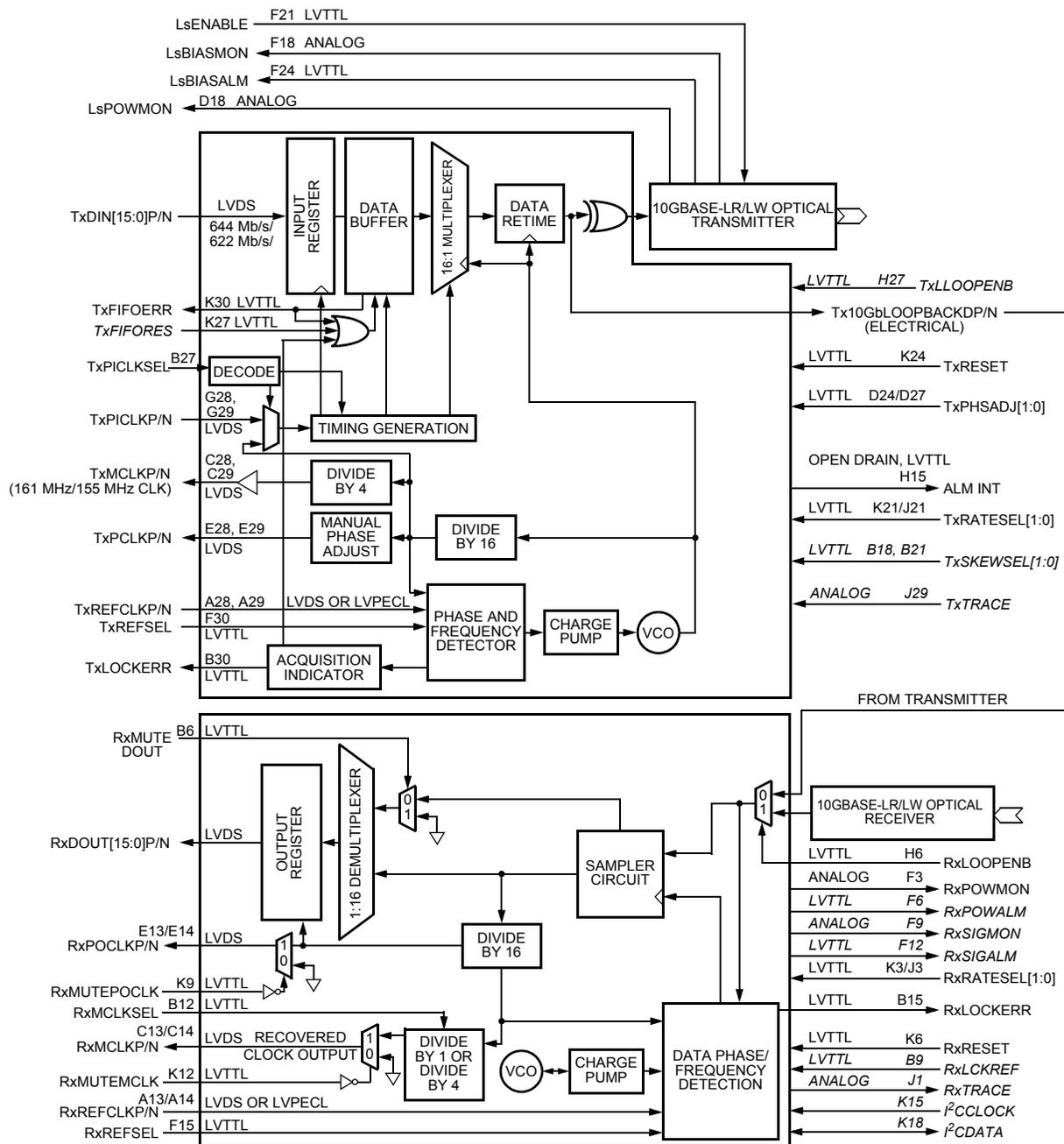
Table 1. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Operating Case Temperature Range	T _c	0	65 ¹	°C
Storage Case Temperature Range	T _s	-40	85	°C
-5.2 V Supply Voltage	VEE	0.5	-5.5	V
3.3 V Supply Voltage	VDD	-0.5	3.6	V
5.0 V Supply Voltage	VCC	-0.5	5.5	V
Voltage on Any LVDS Pin	—	0	V _{CC}	—
High-speed LVDS Output Source Current	—	—	50	mA
Static Discharge Voltage ²	ESD	—	500	V
Relative Humidity (non-condensing)	RH	—	85	%
Receiver Maximum Input Power PIN Diode	P _{IN}	—	8.0	dBm
Minimum Fiber Bend Radius	—	1.25 (31.8)	—	in. (mm)

1. Note that this device meets NEBS GR-63-CORE requirements of operation at 70 °C for 14 days (max) per year, or 96 hours of continuous operation.

2. Human-body target model is 500 V.

Block Diagram



* Signals referenced in italics are for future use.

Figure 1. TB64LR-Type Transponder Block Diagram

Pin Information

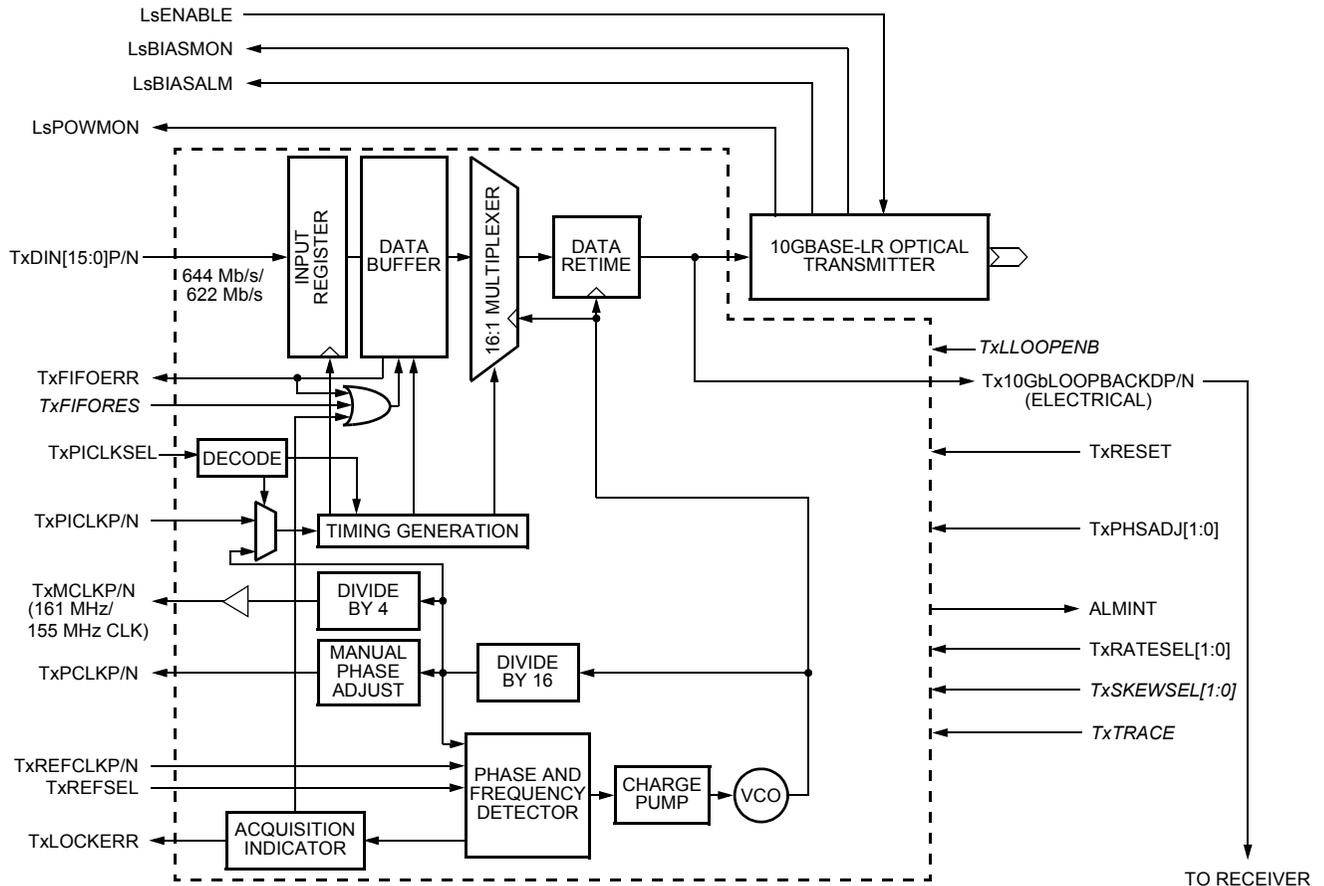


Figure 2. Transmitter Block Diagram

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Transmitter Input/Output Pin Descriptions

Table 2. TB64LR-Type Transponder, Transmitter Input/Output Pin Descriptions

Pin Name	Pin Description
LsENABLE	Laser Enable Input. A logic low on this input pin enables the transmitter's laser. A logic high disables the laser so there is no optical output.
LsBIASMON	Laser Bias Monitor Voltage (Analog). Provides a measure of the laser's dc bias current as well as an indication of the health of the laser in the transmitter. This output power changes at the rate of 20 mV/mA of bias current to the laser. All of the monitoring voltage is defined with respect to GND.
LsBIASALM	Laser Bias Alarm. This alarm will go active-low when the bias current to the laser increases by 50% from its beginning-of-life (BOL) value.

Pin Information (continued)

Transmitter Input/Output Pin Descriptions (continued)

Table 2. TB64LR-Type Transponder, Transmitter Input/Output Pin Descriptions (continued)

Pin Name	Pin Description
LsPOWMON	Normalized Laser Power Monitor Voltage (Analog). Provides an indication of the optical output power level from the transmitter laser. LsPOWMON amplifier gain is normalized to 500 mV for the nominal transmitter optical output power. If the optical power decreases by 3 dB from the beginning of life (BOL), this output will drop to approximately 250 mV. Back-facet monitor transfer function varies from module to module, and as long as the automatic power control loop is working, the laser output power remains constant. LsPOWMON is not an alarm signal but rather a performance-monitoring feature. The user can measure the transmitter aging by summarizing the laser bias variation, temperature changes, and output power at the same time.
TxDIN[15:0]P/N	16-bit Differential LVDS Parallel Data Input. TxDIN15P/N is the most significant bit of the input word and is the first bit serialized. TxDIN0P/N is the least significant bit of the input word and is the last bit serialized. TxDIN[15:0]P/N is sampled on the rising edge of TxPICKL (when TxPICKLSEL = 0) or on the rising and falling edge of TxPICKL (when TxPICKLSEL = 1).
TxFIFOERR	Transmit FIFO Data Storage Overflow. Indicates active-low when an overflow has occurred in the parallel data storage element. Operationally, when TxFIFOERR occurs, the transponder automatically recenters the pointers in the parallel data storage element for fastest FIFO overrun recovery.
TxREFCLKP/N	644.53 MHz/622.08 MHz or 161.13 MHz/155.52 MHz Input Reference Clock. This input is used as the reference for the internal clock frequency synthesizer inside the MUX that generates the 9.9538 GHz bit-rate clock used to shift data out of the parallel-to-serial converter.
TxREFSEL	Transmitter Reference Select. Used for selection of the TxREFCLK frequency. Logic 0 is for 161 MHz (LR)/155 MHz (LW), logic 1 or no connection for 644 MHz (LR)/622 MHz (LW).
TxPCLKP/N	Transmitter Parallel Clock. A 644.53 MHz/622.08 MHz differential output reference parallel clock. It is normally used to coordinate transfers between customer board logic and the MUX device.
TxPHASADJ[1:0]	Transmitter Phase Adjust. Adjusts phase of TxPCLKP/N clock in 90° steps.
TxLOCKERR	Lock Detect/Phase Error (Active-Low). It goes low when MUX PLL has not locked to the TxREFCLK.
TxMCLKP/N	Transmitter 161 MHz (LR)/155 MHz (LW) Clock Output from the Clock Synthesizer of the MUX. This output can be connected to the reference clock input of the deMUX chip, thereby eliminating the need for a separate RxREFCLK VCO on the customer board.
TxPICKLP/N	Differential LVDS Compatible Parallel Input Clock. A 644.53 MHz/622.08 MHz nominally 50% duty cycle input clock, to which TxDIN[15:0]P/N is aligned. TxPICKL is used to transfer the data on the 16 TxDIN inputs into the holding register in the parallel-to-serial converter. Internally biased and terminated.
TxPICKLSEL	TxPICKL Clock Select. Used to select between the 644.53 MHz/622.08 MHz or 322.27 MHz/311.03 MHz dual-edge clock options of the TxPICKLP/N. Logic 0 is for 644.53 MHz/622.08 MHz, and logic 1 is for 322.27 MHz/311.03 MHz.
TxRESET	MUX Master Reset. Reset input for the device. Reset must be held active-low for a minimum of 6.4 ns. During a reset, the true data outputs are in the logic low state. For normal power sequencing on powerup, no reset is required.

Pin Information (continued)

Transmitter Input/Output Pin Descriptions (continued)

Table 2. TB64LR-Type Transponder, Transmitter Input/Output Pin Descriptions (continued)

Pin Name	Pin Description
ALMINT	Alarm Interrupt (Active-Low). Combined logic level (OR) output of <i>RxPOWALM</i> , <i>RxSIGALM</i> , <i>RxLOCKERR</i> , <i>LsBIASALM</i> , and <i>TxLOCKERR</i> . The signal is an open drain-type LVTTTL output.
TxRATESEL[1,0]	Transmitter Rate Select, FEC Rate Select (Active-Low). Selects the 10GGBASE-LR rate of 10.3125 Gb/s (serial LAN), the 10GBASE-LW rate of 9.9532 Gb/s (serial WAN), or the OC-192/STM-64 FEC rate of 10.6642 Gb/s: 0, 0 = 10GBASE-LR rate of 10.3125 Gb/s 0, 1 = TBD 1, 0 = OC-192/STM-64 FEC rate of 10.6642 Gb/s 1, 1 = 10GBASE-LW and OC-192/STM-64 rate of 9.9532 Gb/s Note that all input and output clock and data rates are scaled when operating at the FEC rate.
<i>TxFIFORES</i> <i>TxLLOOPENB</i> <i>TxSKEWSEL[1:0]</i> <i>TxTRACE</i>	<i>Pins reserved in MSA. Functions not implemented.</i>

Pin Information (continued)

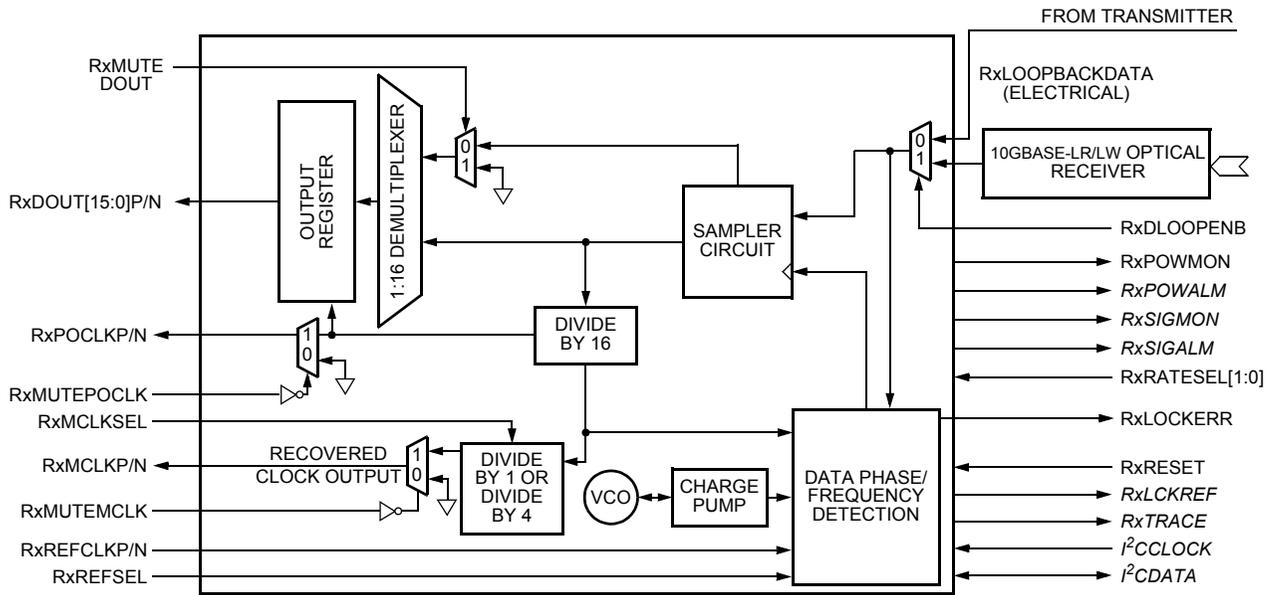


Figure 3. Receiver Block Diagram

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Receiver Input/Output Pin Descriptions

Table 3. TB64LR-Type Transponder, Receiver Input/Output Pin Descriptions

Pin Name	Pin Description
RxLOCKERR	Clock Recovery Error Indicator (Active-Low). Indicates when the internal clock recovery has not locked onto the incoming data stream. RxLOCKERR is an asynchronous output.
RxREFCLKP/N	Differential ac-Coupled Reference Clock Input at 161.13 MHz/155.52 MHz or 644.53 MHz/622.08 MHz. The PLL inside the deMUX will lock onto this reference in absence of optical serial input data. Note that this clock frequency must scale to the appropriate reference rate when not operating at the standard 10 GbE rate. Internally ac coupled and biased.
RxREFSEL	RxREFCLK Frequency Selector. Logic 0 for 161 MHz (LR)/155 MHz (LW) (divide by 64) and logic 1 or no connections for 644 MHz (LR)/622 MHz (LW) (divide by 16).
RxDOUT[15:0]P/N	16-bit Differential LVDS Parallel Output Data Bus. DOUT[15:0] is the 644 Mb/s (LR)/622 Mb/s (LW) 16-bit output word. DOUT15P/N is the most significant bit of the received word and is the first bit received. DOUT0P/N is the least significant bit of the received word and is the last bit received. Note that this clock frequency must scale to the appropriate reference rate when not operating at the standard 10 GbE rate. Internally ac coupled and biased.
RxPOCLKP/N	Recovered Differential LVDS Parallel Output Clock of 644 MHz (LR)/622 MHz (LW). (Nominally 50% Duty Cycle). This clock is recovered from the incoming optical signal and is aligned to the DOUT[15:0] output data. When RxPOCLKP/N is not locked to the incoming data signal, RxLOCKERR will be forced low. Pins are active but forced to differential logic low when RxMUTE DOUT = 0. Note that this clock frequency must scale to the appropriate reference rate when not operating at the standard 10 GBASE-LR/LW rate. Internally ac coupled and biased.
RxMUTEPOCLK	Disables the output clock of 644 MHz (LR)/622 MHz (LW).

Pin Information (continued)

Receiver Input/Output Pin Descriptions (continued)

Table 3. TB64LR-Type Transponder, Receiver Input/Output Pin Descriptions (continued)

Pin Name	Pin Description
RxPOWMON	Input Power Monitor Voltage (Analog). Provides a relative measure of the average input optical (ac + dc) power to the receiver. This signal is referenced to ground. Output voltage to input optical transfer function is 1.0 V/mW.
RxPOWALM	Receive Loss-of-Signal Alarm (Active Low). Activates when the received optical power falls 3dB below the EOL receiver sensitivity.
RxRATESEL[1:0]	Receiver Rate Select (Active-Low). Selects the 10GBASE-LR rate of 10.3125 Gb/s (Serial LAN), the 10GBASE-LW rate of 9.9532 Gb/s (Serial WAN), or the OC-192/STM-64 FEC rate of 10.6642 Gb/s: 0, 0 = 10GBASE-LR rate of 10.3125 Gb/s 0, 1 = TBD 1, 0 = OC-192/STM-64 FEC rate of 10.6642 Gb/s 1, 1 = 10GBASE-LW rate of 9.9532 Gb/s Note that all input and output clock and data rates are scaled when operating at the FEC rate.
RxMCLKP/N	Receiver 161 MHz (LR)/155 MHz (LW) or 644 MHz (LR)/622 MHz (LW) Output Clock.
RxMUTEMCLK	When RxMUTEMCLK is 0, it mutes RxMCLK. Normal operation, when RxMUTEMCLK is 1.
RxMCLKSEL	When 0, RxMCLKSEL selects the RxMCLK frequency of 161 MHz (LR)/155 MHz (LW). When 1, RxMCLKSEL selects the RxMCLK frequency of 644 MHz (LR)/622 MHz (LW).
RxRESET	Active-low. Resets all synchronous logic. During a reset, the data outputs are in the logic low state. Reset must be held active-low for a minimum of 6.4 ns while the internal oscillator is active: 0 = reset 1 or no connection = normal operation
RxDLOOPENB	Diagnostic Loopback Enable (Active-Low). Enables diagnostic loopback (10 Gb/s MUX to 10 Gb/s deMUX).
RxMUTEDOUT	Receiver Mute DOUT (Active-Low). When RxMUTEDOUT is active, it forces all deMUX output data RxDout[15:0]P/N to a logic low level. When RxMUTEDOUT is inactive, data to the deMUX will be processed normally. 0 = deMUX output muted. 1 or no connection = normal operation.
RxSIGMON RxSIGALM RxLCKREF RxTRACE I ² CCLOCK I ² CDATA	<i>Pins reserved in MSA. Functions not implemented.</i>

Pin Information (continued)

Transponder Pin Map

Table 4. Transponder Pin Map

Receiver Section										
	K	J	H	G	F	E	D	C	B	A
1	5.0 V Analog	RxTRACE	Frame GND	RxDout12P	1.8 V Digital	RxDout8P	Digital GND	RxDout4P	Digital GND	RxDout0P
2	5.0 V Analog	FFU	Frame GND	RxDout12N	1.8 V Digital	RxDout8N	Digital GND	RxDout4N	Digital GND	RxDout0N
3	RxRATESEL0	RxRATESEL1	FFU	Digital GND	RxPOWMON	Digital GND	FFU	Digital GND	FFU	Digital GND
4	3.3 V Analog	NUC	Frame GND	RxDOUT13P	3.3 V Digital	RxDout9P	Digital GND	RxDout5P	Digital GND	RxDout1P
5	3.3 V Analog	NUC	Frame GND	RxDOUT13N	3.3 V Digital	RxDout9N	Digital GND	RxDout5N	Digital GND	RxDout1N
6	RxRESET	NUC	RxDLOOPENB	Digital GND	RxPOWALM	Digital GND	FFU	Digital GND	RxMUTEDout	Digital GND
7	FFU	FFU	Analog GND	RxDout14P	3.3 V Digital	RxDout10P	Digital GND	RxDout6P	Digital GND	RxDout2P
8	FFU	FFU	Analog GND	RxDout14N	3.3 V Digital	RxDout10N	Digital GND	RxDout6N	Digital GND	RxDout2N
9	RxMUTEPOCLK	NUC	FFU	Digital GND	RxSIGMON	Digital GND	FFU	Digital GND	RxLCKREF	Digital GND
10	-5.2 V Analog	FFU	Analog GND	RxDout15P	-5.2 V Digital	RxDout11P	Digital GND	RxDout7P	Digital GND	RxDout3P
11	-5.2 V Analog	FFU	Analog GND	RxDout15N	-5.2 V Digital	RxDout11N	Digital GND	RxDout7N	Digital GND	RxDout3N
12	RxMUTEMCLK	NUC	FFU	Digital GND	RxSIGALM	Digital GND	FFU	Digital GND	RxMCLKSEL	Digital GND
13	-5.2 V Analog	FFU	Analog GND	FFU	-5.2 V Digital	RxPOCLKP	Digital GND	RxMCLKP	Digital GND	RxREFCLKP
14	-5.2 V Analog	RxALMINT	Analog GND	FFU	-5.2 V Digital	RxPOCLKN	Digital GND	RxMCLKN	Digital GND	RxREFCLKN
15	I ² CCLOCK	NUC	ALMINT	Digital GND	RxREFSEL	Digital GND	FFU	Digital GND	RxLOCKERR	Digital GND
Transmitter Section										
	K	J	H	G	F	E	D	C	B	A
16	5.0 V Analog	TxALMINT	Analog GND	TxDin12P	1.8 V Digital	TxDin8P	Digital GND	TxDin4P	Digital GND	TxDin0P
17	5.0 V Analog	FFU	Analog GND	TxDin12N	1.8 V Digital	TxDin8N	Digital GND	TxDin4N	Digital GND	TxDin0N
18	I ² C DATA	NUC	LsTUNE0*	Digital GND	LsBIASMON	Digital GND	LsPOWMON	Digital GND	TxSKEWSEL0	Digital GND
19	3.3 V Analog	FFU	Analog GND	TxDin13P	3.3 V Digital	TxDin9P	Digital GND	TxDin5P	Digital GND	TxDin1P
20	3.3 V Analog	FFU	Analog GND	TxDin13N	3.3 V Digital	TxDin9N	Digital GND	TxDin5N	Digital GND	TxDin1N
21	TxRATESEL0	TxRATESEL1	LsTUNE1*	Digital GND	LsENABLE	Digital GND	LsTEMPMON*	Digital GND	TxSKEWSEL1	Digital GND
22	3.3 V Analog	FFU	Analog GND	TxDin14P	3.3 V Digital	TxDin10P	Digital GND	TxDin6P	Digital GND	TxDin2P
23	3.3 V Analog	FFU	Analog GND	TxDin14N	3.3 V Digital	TxDin10N	Digital GND	TxDin6N	Digital GND	TxDin2N
24	TxRESET	NUC	LsTUNE2*	Digital GND	LsBIASALM	Digital GND	TxPHSADJ0	Digital GND	LsTWEAK*	Digital GND
25	-5.2 V Analog	NUC	Frame GND	TxDin15P	-5.2 V Digital	TxDin11P	Digital GND	TxDin7P	Digital GND	TxDin3P
26	-5.2 V Analog	NUC	Frame GND	TxDin15N	-5.2 V Digital	TxDin11N	Digital GND	TxDin7N	Digital GND	TxDin3N
27	TxFIFOES	NUC	TxLLOOPENB	Digital GND	LsTEMPALM*	Digital GND	TxPHSADJ1	Digital GND	TxPICKSEL	Digital GND
28	-5.2 V Analog	FFU	Frame GND	TxPICKLP	-5.2 V Digital	TxPCLKP	Digital GND	TxMCLKP	Digital GND	TxREFCLKP
29	-5.2 V Analog	TxTRACE	Frame GND	TxPICKLN	-5.2 V Digital	TxPCLKN	Digital GND	TxMCLKN	Digital GND	TxREFCLKN
30	TxFIFOERR	NUC	TxLINETIMSEL	Digital GND	TxREFSEL	Digital GND	FFU	Digital GND	TxLOCKERR	Digital GND

* This feature is only available on lasers using thermoelectric coolers. For uncooled transponders, the associated pin is considered NUC.

Receiver Section	Transmitter Section	Other
Rx power and GND supplies	Tx power and GND supplies	NUC: no user connection
Rx dc signals	Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)		<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Truth Tables

Table 5. TB64LR-Type Transponder Pin-Map Truth Table (Transmitter)

Pin Name and Pin Configuration		Description
LsENABLE 0 1		Normal Operation. Laser Disabled.
LsBIASALM 0 1		Laser Bias Alarm Active. Normal Operation.
TxREFSEL 0 1		Selects a TxREFCLK Frequency of 161 MHz (LR)/155 MHz (LW). Selects a TxREFCLK Frequency of 644 MHz (LR)/622 MHz (LW).
TxPICKSEL ¹ 0 1		Selects the TxPICK Frequency of 644 MHz (LR)/622 MHz (LW). Selects the TxPICK Frequency of 322 MHz/311 MHz.
TxLOCKERR 0 1		Indicates Loss of PLL Lock. Normal Operation.
TxRESET 0 1		Asynchronous MUX System Reset. Normal Operation.
TxFIFOERR 0 1		Indicates a MUX FIFO Error. Normal Operation.
ALMINT 0 1		Indicates an Alarm. Normal Operation.
<i>TxRATESEL1</i> 0 0 1 1	<i>TxRATESEL0</i> 0 1 0 1	10GBASE-LR rate of 10.3125 Gb/s. TBD OC-192/STM-64 FEC rate of 10.6642 Gb/s. 10GBASE-LW rate of 9.9532 Gb/s.
<i>TxPHSADJ1</i> 0 0 1 1	<i>TxPHSADJ0</i> 0 1 0 1	Adjusts the Phase of the TxPLCK by 0°. Adjusts the Phase of the TxPLCK by 90°. Adjusts the Phase of the TxPLCK by 180°. Adjusts the Phase of the TxPLCK by 270°.

1. TxPICK frequency of 644 MHz (LR)/622 MHz (LW) is the MSA standard. The TxPICK function should be tied to ground when not used.

Pin Information (continued)

Truth Tables (continued)

Table 6. TB64LR-Type Transponder Pin-Map Truth Table (Receiver)

Pin Name and Pin Configuration		Description
RxRESET 0 1		Asynchronous DeMUX System Reset. Normal Operation.
RxMUTEPOCLK 0 1		Mutes the RxPOCLK. Normal Operations.
RxMUTEMCLK 0 1		Mutes the RxMCLK. Normal Operations.
RxDLOOPENB 0 1		Enables Diagnostic Loopback (10 Gb/s MUX to 10 Gb/s DeMUX). Normal Operation.
RxMUTEDOUT 0 1		Mutes the RxDOOUT[15:0]. Normal Operation.
RxLCKREF 0 1		RxPOCLK Locks to RxREFCLK. Normal Operation.
RxMCLKSEL 0 1		Selects the RxMCLK Frequency of 161 MHz (LR)/155 MHz (LW). Selects the RxMCLK Frequency of 644 MHz (LR)/622 MHz (LW).
RxLOCKERR 0 1		Indicates Loss of PLL Lock. Normal Operation.
RxPOWALM 0 1		Indicates Alarm Active. Normal Operation.
RxSIGALM 0 1		Indicates Alarm Active. Normal Operation.
RxREFSEL 0 1		Selects an RxREFCLK Frequency of 161 MHz (LR)/155 MHz (LW). Selects an RxREFCLK Frequency of 644 MHz (LR)/622 MHz (LW).
RxRATESEL1 0 0 1 1	RxRATESEL0 0 1 0 1	10GBASE-LR rate of 10.3125 Gb/s. TBD. OC-192/STM-64 FEC rate of 10.6642 Gb/s. 10GBASE-LW rate of 9.9532 Gb/s.

Pin Information (continued)

Pin-Map Definitions

Table 7. TB64LR-Type Transponder Pin-Map Definitions

Pin #	Pin Name	I/O	Logic	Description
A1	RxDOUT0P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A2	RxDOUT0N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A3	Digital GND	I	Supply	Receiver Digital Ground.
A4	RxDOUT1P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A5	RxDOUT1N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A6	Digital GND	I	Supply	Receiver Digital Ground.
A7	RxDOUT2P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A8	RxDOUT2N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A9	Digital GND	I	Supply	Receiver Digital Ground.
A10	RxDOUT3P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A11	RxDOUT3N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
A12	Digital GND	I	Supply	Receiver Digital Ground.
A13	RxREFCLKP	I	LVDS or LVPECL	Receiver Reference Clock.
A14	RxREFCLKN	I	LVDS or LVPECL	Receiver Reference Clock.
A15	Digital GND	I	Supply	Receiver Digital Ground.
A16	TxDIN0P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A17	TxDIN0N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A18	Digital GND	I	Supply	Transmitter Digital Ground.
A19	TxDIN1P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A20	TxDIN1N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A21	Digital GND	I	Supply	Transmitter Digital Ground.
A22	TxDIN2P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A23	TxDIN2N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A24	Digital GND	I	Supply	Transmitter Digital Ground.
A25	TxDIN3P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A26	TxDIN3N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
A27	Digital GND	I	Supply	Transmitter Digital Ground.
A28	TxREFCLKP	I	LVDS or LVPECL	Transmitter Reference Clock.
A29	TxREFCLKN	I	LVDS or LVPECL	Transmitter Reference Clock.
A30	Digital GND	I	Supply	Transmitter Digital Ground.

Receiver Section	Transmitter Section	Other
Rx power and GND supplies	Tx power and GND supplies	NUC: no user connection
Rx dc signals	Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)		<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
B1	Digital GND	I	Supply	Receiver Digital Ground.
B2	Digital GND	I	Supply	Receiver Digital Ground.
B3	FFU	—	—	Reserved for Future Use.
B4	Digital GND	I	Supply	Receiver Digital Ground.
B5	Digital GND	I	Supply	Receiver Digital Ground.
B6	RxMUTEDOUT	I	LVTTL	Mutes the Data Outputs of the DeMUX.
B7	Digital GND	I	Supply	Receiver Digital Ground.
B8	Digital GND	I	Supply	Receiver Digital Ground.
B9	RxLCKREF	I	LVTTL	Locks RxPOCLK to RxREFCLK.
B10	Digital GND	I	Supply	Receiver Digital Ground.
B11	Digital GND	I	Supply	Receiver Digital Ground.
B12	RxMCLKSEL	I	LVTTL	Selects Speed of Output RxMCLK.
B13	Digital GND	I	Supply	Receiver Digital Ground.
B14	Digital GND	I	Supply	Receiver Digital Ground.
B15	RxLOCKERR	O	LVTTL	Loss of Lock of RxPOCLK (active-low).
B16	Digital GND	I	Supply	Transmitter Digital Ground.
B17	Digital GND	I	Supply	Transmitter Digital Ground.
B18	TxSKEWSEL0	I	LVTTL	Adjusts Skew of TxPICKL (LSB).
B19	Digital GND	I	Supply	Transmitter Digital Ground.
B20	Digital GND	I	Supply	Transmitter Digital Ground.
B21	TxSKEWSEL1	I	LVTTL	Adjusts Skew of TxPICKL (MSB).
B22	Digital GND	I	Supply	Transmitter Digital Ground.
B23	Digital GND	I	Supply	Transmitter Digital Ground.
B24	LsTWEAK	I	Analog	Laser Fine Tuning of DWDM Wavelength.
B25	Digital GND	I	Supply	Transmitter Digital Ground.
B26	Digital GND	I	Supply	Transmitter Digital Ground.
B27	TxPICKLSEL	I	LVTTL	Selects Speed of Input TxPICKL.
B28	Digital GND	I	Supply	Transmitter Digital Ground.
B29	Digital GND	I	Supply	Transmitter Digital Ground.
B30	TxLOCKERR	O	LVTTL	Indicates Loss of TxPLL Lock.

Receiver Section	Transmitter Section	Other
Rx power and GND supplies	Tx power and GND supplies	NUC: no user connection
Rx dc signals	Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)		<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
C1	RxDOUT4P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C2	RxDOUT4N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C3	Digital GND	I	Supply	Receiver Digital Ground.
C4	RxDOUT5P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C5	RxDOUT5N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C6	Digital GND	I	Supply	Receiver Digital Ground.
C7	RxDOUT6P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C8	RxDOUT6N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C9	Digital GND	I	Supply	Receiver Digital Ground.
C10	RxDOUT7P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C11	RxDOUT7N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
C12	Digital GND	I	Supply	Receiver Digital Ground.
C13	RxMCLKP	O	LVDS	VCO-Derived Output Rx Clock.
C14	RxMCLKN	O	LVDS	VCO-Derived Output Rx Clock.
C15	Digital GND	I	Supply	Receiver Digital Ground.
C16	TxDIN4P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C17	TxDIN4N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C18	Digital GND	I	Supply	Transmitter Digital Ground.
C19	TxDIN5P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C20	TxDIN5N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C21	Digital GND	I	Supply	Transmitter Digital Ground.
C22	TxDIN6P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C23	TxDIN6N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C24	Digital GND	I	Supply	Transmitter Digital Ground.
C25	TxDIN7P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C26	TxDIN7N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
C27	Digital GND	I	Supply	Transmitter Digital Ground.
C28	TxMCLKP	O	LVDS	VCO-Derived Output Tx Clock.
C29	TxMCLKN	O	LVDS	VCO-Derived Output Tx Clock.
C30	Digital GND	I	Supply	Transmitter Digital Ground.

Receiver Section		Transmitter Section		Other
	Rx power and GND supplies		Tx power and GND supplies	NUC: no user connection
	Rx dc signals		Tx dc signals	FFU: reserved for future use
	644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)			<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
D1	Digital GND	I	Supply	Receiver Digital Ground.
D2	Digital GND	I	Supply	Receiver Digital Ground.
D3	FFU	—	—	Reserved for Future Use.
D4	Digital GND	I	Supply	Receiver Digital Ground.
D5	Digital GND	I	Supply	Receiver Digital Ground.
D6	FFU	—	—	Reserved for Future Use.
D7	Digital GND	I	Supply	Receiver Digital Ground.
D8	Digital GND	I	Supply	Receiver Digital Ground.
D9	FFU	—	—	Reserved for Future Use.
D10	Digital GND	I	Supply	Receiver Digital Ground.
D11	Digital GND	I	Supply	Receiver Digital Ground.
D12	FFU	—	—	Reserved for Future Use.
D13	Digital GND	I	Supply	Receiver Digital Ground.
D14	Digital GND	I	Supply	Receiver Digital Ground.
D15	FFU	—	—	Reserved for Future Use.
D16	Digital GND	I	Supply	Transmitter Digital Ground.
D17	Digital GND	I	Supply	Transmitter Digital Ground.
D18	LsPOWMON	O	Analog	Laser Output Power Monitor.
D19	Digital GND	I	Supply	Transmitter Digital Ground.
D20	Digital GND	I	Supply	Transmitter Digital Ground.
D21	LsTEMPMON	O	Analog	Laser Temperature Monitor.
D22	Digital GND	I	Supply	Transmitter Digital Ground.
D23	Digital GND	I	Supply	Transmitter Digital Ground.
D24	TxPHSADJ0	I	LVTTL	Adjusts Phase of TxPCLK (LSB).
D25	Digital GND	I	Supply	Transmitter Digital Ground.
D26	Digital GND	I	Supply	Transmitter Digital Ground.
D27	TxPHSADJ1	I	LVTTL	Adjusts Phase of TxPCLK (MSB).
D28	Digital GND	I	Supply	Transmitter Digital Ground.
D29	Digital GND	I	Supply	Transmitter Digital Ground.
D30	FFU	—	—	Reserved for Future Use.

Receiver Section	Transmitter Section	Other
Rx power and GND supplies	Tx power and GND supplies	NUC: no user connection
Rx dc signals	Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)		<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
E1	RxDOUT8P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E2	RxDOUT8N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E3	Digital GND	I	Supply	Receiver Digital Ground.
E4	RxDOUT9P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E5	RxDOUT9N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E6	Digital GND	I	Supply	Receiver Digital Ground.
E7	RxDOUT10P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E8	RxDOUT10N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E9	Digital GND	I	Supply	Receiver Digital Ground.
E10	RxDOUT11P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E11	RxDOUT11N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
E12	Digital GND	I	Supply	Receiver Digital Ground.
E13	RxPOCLKP	O	LVDS	Receiver Parallel Output Clock.
E14	RXPOCLKN	O	LVDS	Receiver Parallel Output Clock.
E15	Digital GND	I	Supply	Receiver Digital Ground.
E16	TxDIN8P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E17	TxDIN8N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E18	Digital GND	I	Supply	Transmitter Digital Ground.
E19	TxDIN9P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E20	TxDIN9N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E21	Digital GND	I	Supply	Transmitter Digital Ground.
E22	TxDIN10P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E23	TXDIN10N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E24	Digital GND	I	Supply	Transmitter Digital Ground.
E25	TxDIN11P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E26	TXDIN11N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
E27	Digital GND	I	Supply	Transmitter Digital Ground.
E28	TxPCLKP	O	LVDS	Transmitter Parallel Output Clock.
E29	TxPCLKN	O	LVDS	Transmitter Parallel Output Clock.
E30	Digital GND	I	Supply	Transmitter Digital Ground.

Receiver Section		Transmitter Section		Other
	Rx power and GND supplies		Tx power and GND supplies	NUC: no user connection
	Rx dc signals		Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)				<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
F1	1.8 V Digital	I	Supply	Receiver Digital Power.
F2	1.8 V Digital	I	Supply	Receiver Digital Power.
F3	RxPOWMON	O	Analog	Receiver Power Monitor (ac + dc).
F4	3.3 V Digital	I	Supply	Receiver Digital Power.
F5	3.3 V Digital	I	Supply	Receiver Digital Power.
F6	RxPOWALM	O	LVTTL	Loss of Receiver Average Power Alarm.
F7	3.3 V Digital	I	Supply	Receiver Digital Power.
F8	3.3 V Digital	I	Supply	Receiver Digital Power.
F9	RxSIGMON	O	Analog	Receiver Signal Monitor (ac only).
F10	-5.2 V Digital	I	Supply	Receiver Digital Power.
F11	-5.2 V Digital	I	Supply	Receiver Digital Power.
F12	RxSIGALM	O	LVTTL	Loss of Receiver ac Power Alarm
F13	-5.2 V Digital	I	Supply	Receiver Digital Power.
F14	-5.2 V Digital	I	Supply	Receiver Digital Power.
F15	RxREFSEL	I	LVTTL	Selects RxREFCLK Frequency.
F16	1.8 V Digital	I	Supply	Transmitter Digital Power.
F17	1.8 V Digital	I	Supply	Transmitter Digital Power.
F18	LsBIASMON	O	Analog	Laser Bias Current Monitor.
F19	3.3 V Digital	I	Supply	Transmitter Digital Power.
F20	3.3 V Digital	I	Supply	Transmitter Digital Power.
F21	LsENABLE	I	LVTTL	Laser Enable (disable is inverse).
F22	3.3 V Digital	I	Supply	Transmitter Digital Power.
F23	3.3 V Digital	I	Supply	Transmitter Digital Power.
F24	LsBIASALM	O	LVTTL	Laser Bias Current Alarm.
F25	-5.2 V Digital	I	Supply	Transmitter Digital Ground.
F26	-5.2 V Digital	I	Supply	Transmitter Digital Ground.
F27	LsTEMPALM	O	LVTTL	Laser Temperature Alarm.
F28	-5.2 V Digital	I	Supply	Transmitter Digital Power.
F29	-5.2 V Digital	I	Supply	Transmitter Digital Power.
F30	TxREFSEL	I	LVTTL	Selects TxREFCLK Frequency.

Receiver Section		Transmitter Section		Other
	Rx power and GND supplies		Tx power and GND supplies	NUC: no user connection
	Rx dc signals		Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)				<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
G1	RxDOUT12P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G2	RxDOUT12N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G3	Digital GND	I	Supply	Receiver Digital Ground.
G4	RxDOUT13P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G5	RxDOUT13N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G6	Digital GND	I	Supply	Receiver Digital Ground.
G7	RxDOUT14P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G8	RxDOUT14N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G9	Digital GND	I	Supply	Receiver Digital Ground.
G10	RxDOUT15P	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G11	RxDOUT15N	O	LVDS	Receiver 644 Mb/s/622 Mb/s Data Output.
G12	Digital GND	I	Supply	Receiver Digital Ground.
G13	FFU	—	—	Reserved for Future Use.
G14	FFU	—	—	Reserved for Future Use.
G15	Digital GND	I	Supply	Receiver Digital Ground.
G16	TxDIN12P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G17	TxDIN12N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G18	Digital GND	I	Supply	Transmitter Digital Ground.
G19	TxDIN13P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G20	TxDIN13N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G21	Digital GND	I	Supply	Transmitter Digital Ground.
G22	TxDIN14P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G23	TxDIN14N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G24	Digital GND	I	Supply	Transmitter Digital Ground.
G25	TxDIN15P	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G26	TxDIN15N	I	LVDS	Transmitter 644 Mb/s/622 Mb/s Data Input.
G27	Digital GND	I	Supply	Transmitter Digital Ground.
G28	TxPICLKP	I	LVDS	Transmitter Parallel Input Clock.
G29	TxPICLKN	I	LVDS	Transmitter Parallel Input Clock.
G30	Digital GND	I	Supply	Transmitter Digital Ground.

Receiver Section	Transmitter Section	Other
Rx power and GND supplies	Tx power and GND supplies	NUC: no user connection
Rx dc signals	Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)		<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
H1	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H2	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H3	FFU	—	—	Reserved for Future Use.
H4	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H5	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H6	RxDLOOPENB	I	LVTTL	Diagnostic Loopback Enable.
H7	Analog GND	I	Supply	Receiver Analog Ground.
H8	Analog GND	I	Supply	Receiver Analog Ground.
H9	FFU	—	—	Reserved for Future Use.
H10	Analog GND	I	Supply	Receiver Analog Ground.
H11	Analog GND	I	Supply	Receiver Analog Ground.
H12	FFU	—	—	Reserved for Future Use.
H13	Analog GND	I	Supply	Receiver Analog Ground.
H14	Analog GND	I	Supply	Receiver Analog Ground.
H15	ALMINT	O	Open Drain	Electrical OR of All Rx and Tx Alarms.
H16	Analog GND	I	Supply	Transmitter Analog Ground.
H17	Analog GND	I	Supply	Transmitter Analog Ground.
H18	<i>LsTUNE0</i>	I	LVTTL	Wavelength-Select Pin 0 (LSB).
H19	Analog GND	I	Supply	Transmitter Analog Ground.
H20	Analog GND	I	Supply	Transmitter Analog Ground.
H21	<i>LsTUNE1</i>	I	LVTTL	Wavelength-Select Pin 1.
H22	Analog GND	I	Supply	Transmitter Analog Ground.
H23	Analog GND	I	Supply	Transmitter Analog Ground.
H24	<i>LsTUNE2</i>	I	LVTTL	Wavelength-Select Pin 2 (MSB).
H25	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H26	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H27	<i>TxLLOOPENB</i>	I	LVTTL	Line Loopback Enable.
H28	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H29	Frame GND	I	Supply	Frame GND Tied to Chassis Ground.
H30	<i>TxLINETIMSEL</i>	I	LVTTL	Line Timing Select.

Receiver Section		Transmitter Section		Other
	Rx power and GND supplies		Tx power and GND supplies	NUC: no user connection
	Rx dc signals		Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)				<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
J1	RxTRACE	O	Analog	Low-Frequency PhotoDiode Output.
J2	FFU	—	—	Reserved for Future Use.
J3	RxRATESEL1	I	LVTTL	Receiver Bit Rate Select (MSB)
J4	NUC	—	—	No User Connection.
J5	NUC	—	—	No User Connection.
J6	NUC	—	—	No User Connection.
J7	FFU	—	—	Reserved for Future Use.
J8	FFU	—	—	Reserved for Future Use.
J9	NUC	—	—	No User Connection.
J10	FFU	—	—	Reserved for Future Use.
J11	FFU	—	—	Reserved for Future Use.
J12	NUC	—	—	No User Connection.
J13	FFU	—	—	Reserved for Future Use.
J14	RxALMINT	O	Open Drain	Electrical OR of All Rx Alarms.
J15	NUC	—	—	No User Connection.
J16	TxALMINT	O	Open Drain	Electrical OR of All Tx Alarms.
J17	FFU	—	—	Reserved for Future Use.
J18	NUC	—	—	No User Connection.
J19	FFU	—	—	Reserved for Future Use.
J20	FFU	—	—	Reserved for Future Use.
J21	TxRATESEL1	I	LVTTL	Receiver Bit Rate Select (MSB)
J22	FFU	—	—	Reserved for Future Use.
J23	FFU	—	—	Reserved for Future Use.
J24	NUC	—	—	No User Connection.
J25	NUC	—	—	No User Connection.
J26	NUC	—	—	No User Connection.
J27	NUC	—	—	No User Connection.
J28	FFU	—	—	Reserved for Future Use.
J29	TxTRACE	I	Analog	Low-Frequency Transmitter Input.
J30	NUC	—	—	No User Connection

Receiver Section		Transmitter Section		Other
	Rx power and GND supplies		Tx power and GND supplies	NUC: no user connection
	Rx dc signals		Tx dc signals	FFU: reserved for future use
	644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)			<i>Italics</i> : future feature (not immediately available)

Pin Information (continued)

Pin-Map Definitions (continued)

Table 7. TB64LR-Type Transponder Pin-Map Definitions (continued)

Pin #	Pin Name	I/O	Logic	Description
K1	5.0 V Analog	I	Supply	Receiver Analog Power.
K2	5.0 V Analog	I	Supply	Receiver Analog Power.
K3	RxRATESEL0	I	LVTTL	Receiver Bit Rate Select (LSB).
K4	3.3 V Analog	I	Supply	Receiver Analog Power.
K5	3.3 V Analog	I	Supply	Receiver Analog Power.
K6	RxRESET	I	LVTTL	Receiver Asynchronous System Reset.
K7	FFU	—	—	Reserved for Future Use.
K8	FFU	—	—	Reserved for Future Use.
K9	RxMUTEPOCLK	I	LVTTL	Mutes the RxPOCLK.
K10	-5.2 V Analog	I	Supply	Receiver Analog Power.
K11	-5.2 V Analog	I	Supply	Receiver Analog Power.
K12	RxMUTEMCLK	I	LVTTL	Mutes the RxMCLK.
K13	-5.2 V Analog	I	Supply	Receiver Analog Power.
K14	-5.2 V Analog	I	Supply	Receiver Analog Power.
K15	I ² CLOCK	I	LVTTL	I ² C Clock Input for Remote Access.
K16	5.0 V Analog	I	Supply	Transmitter Analog Power.
K17	5.0 V Analog	I	Supply	Transmitter Analog Power.
K18	I ² C DATA	I/O	LVTTL	I ² C Data Input/Output for Remote Access.
K19	3.3 V Analog	I	Supply	Transmitter Analog Power.
K20	3.3 V Analog	I	Supply	Transmitter Analog Power.
K21	TxRATESEL0	I	LVTTL	Transmitter Bit Rate Select (LSB).
K22	3.3 V Analog	I	Supply	Transmitter Analog Power.
K23	3.3 V Analog	I	Supply	Transmitter Analog Power.
K24	TxRESET	I	LVTTL	Transmitter Asynchronous System Reset.
K25	-5.2 V Analog	I	Supply	Transmitter Analog Power.
K26	-5.2 V Analog	I	Supply	Transmitter Analog Power.
K27	TxFIFORES	I	LVTTL	MUX FIFO Reset.
K28	-5.2 V Analog	I	Supply	Transmitter Analog Power.
K29	-5.2 V Analog	I	Supply	Transmitter Analog Power.
K30	TxFIFOERR	O	LVTTL	MUX FIFO Error Indicator.

Receiver Section	Transmitter Section	Other
Rx power and GND supplies	Tx power and GND supplies	NUC: no user connection
Rx dc signals	Tx dc signals	FFU: reserved for future use
644 Mb/s/622 Mb/s differential signals (transmitter and receiver sections)		<i>Italics</i> : future feature (not immediately available)

Electrical/Optical Characteristics

Maximum and minimum values are specified over operating case temperature range at 50% duty cycle.

Table 8. Receiver Electrical I/O Characteristics (T_c = 0 °C to 65 °C)

Parameter	Symbol	Logic	Min	Typ	Max	Unit
Receiver Input Power Monitor	RxPOWMON	Analog	0.8	1	1.2	V/mW
<i>Receiver Input ac Power Monitor</i>	<i>RxSIGMON</i>	<i>Analog</i>	—	<i>TBD</i>	—	V/mV
Clock Recovery Lock Error: Output High, V _{OH} Output Low, V _{OL}	RxLOCKERR	LVTTTL	2.4 0	— —	3.47 0.8	V V
Select MCLK (161 MHz/155 MHz/644 MHz/ 622 MHz): Input High, V _{IH} Input Low, V _{IL}	RxMCLKSEL	LVTTTL*	2.1 0	— —	3.47 0.8	V V
Select Reference Clock: Input High, V _{IH} Input Low, V _{IL}	RxREFSEL	LVTTTL*	2.1 0	— —	3.47 0.8	V V
Mute Parallel Output Clock: Input High, V _{IH} Input Low, V _{IL}	RxMUTEPOCLK	LVTTTL*	2.1 0	— —	3.47 0.8	V V
Reset: Input High, V _{IH} Input Low, V _{IL}	RXRESET	LVTTTL*	2.1 0	— —	3.47 0.8	V V
Rate Select: Input High, V _{IH} Input Low, V _{IL}	RxRATESEL[1:0]	LVTTTL*	2.1 0	— —	3.47 0.8	V V
Rx Mute Data Out: Input High, V _{IH} Input Low, V _{IL}	RxMUTE DOUT	LVTTTL*	2.1 0	— —	3.47 0.8	V V
Parallel Data Outputs: Output High, V _{OH} Output Low, V _{OL} Differential Output Voltage Swing	RxDOUT[15:0]P/N	LVDS	— 0.925 250	— — —	1.475 — 400	V V mVp-p
Reference Clock Input: Input Voltage Frequency Tolerance Input Duty Cycle Rise and Fall Times (20%—80%)	RxREFCLKP/N	Differential ac-coupled LVDS or LVPECL	100 —20 40 100	— — 50 —	800 20 60 TBD	mVp-p ppm % ps
161/155 MHz Clock Output: Output High, V _{OH} Output Low, V _{OL} Output Voltage Swing Duty Cycle	RxMCLKP/N	LVDS	— 0.925 250 40	— — — 50	1.475 — 400 60	V V mVp-p %
Recovered Parallel Output Clock: Output High, V _{OH} Output Low, V _{OL} Output Voltage Swing Duty Cycle	RxPOCLKP/N	LVDS	— 0.925 250 40	— — — 50	1.475 — 400 60	V V mVp-p %

* Note that LVTTTL input and output values are different. Input values take board signal losses into consideration.

Electrical/Optical Characteristics (continued)

Maximum and minimum values are specified over operating case temperature range at 50% duty cycle.

Table 9. Transmitter Electrical I/O Characteristics (T_c = 0 °C to 65 °C)

Parameter	Symbol	Logic	Min	Typ	Max	Unit
Laser Enable: ¹ Input High, V _{IH} Input Low, V _{IL}	LSENABLE	LVTTTL ²	2.1 0	— —	3.47 0.8	V V
Laser Bias Output	LsBIASMON	Analog	0	500	2500	mV
Laser Degrade Alarm Output: ³ Output High, V _{OH} Output Low, V _{OL}	LsBIASALM	LVTTTL	2.4 0	— —	3.47 0.5	V V
Laser Power Monitor Output	LsPOWMON	Analog	400	500	600	mV
Lock Error of MUX PLL: ⁴ Output High, V _{OH} Output Low, V _{OL}	TxLOCKERR	LVTTTL	2.4 0	— —	3.47 0.8	V V
Reference Clock: Differential Input Voltage Swing Frequency Tolerance Input Duty Cycle Rise and Fall Times (20%—80%)	TxREFCLKP/N	Differential ac-coupled LVDS or LVPECL	100 –20 40 100	— — 50 —	800 20 60 TBD	mVp-p ppm % ps
Input Data Signal Level: Input Voltage Range Differential Input Voltage Swing Differential Input Impedance	TxDIN[15:0]P/N	LVDS	0 100 80	1200 — 100	2400 400 120	mV mVp-p Ω
Parallel Input Clock: Input Common Voltage Range Differential Input Voltage Swing Differential Input Impedance Frequency	TxPICLKP/N	LVDS	0 100 80 —	1200 — 100 644.53/ 622.08	2400 400 120 —	mV mVp-p Ω MHz
644 MHz/622 MHz Parallel Output Clock: Output High, V _{OH} Output Low, V _{OL} Differential Output Voltage Swing Duty Cycle	TxPCLKP/N	LVDS	— 0.925 250 40	— — — 50	1.475 — 400 60	V V mVp-p %
161 MHz/155 MHz Output Clock: Output High, V _{OH} Output Low, V _{OL} Diff. Output Voltage Swing Duty Cycle	TxMCLKP/N	LVDS	— 0.925 250 40	— — — 50	1.475 — 400 60	V V mV %
TxREFCLK Reference Select: Input High, V _{IH} Input Low, V _{IL}	TxREFSEL	LVTTTL ²	2.1 0	— —	3.47 0.8	V V

1. The transmitter is normally enabled and requires only an active-high external voltage to disable.

2. Please note that LVTTTL input and output values are different. Input values take board signal losses into consideration.

3. The alarm will go active-low when the bias current to the laser increases by 50% or decreases by 50% from its beginning-of-life (BOL) value.

4. Active-low.

Electrical/Optical Characteristics (continued)

Maximum and minimum values are specified over operating case temperature range at 50% duty cycle.

Table 9. Transmitter Electrical I/O Characteristics (T_c = 0 °C to 65 °C) (continued)

Parameter	Symbol	Logic	Min	Typ	Max	Unit
Tx FIFO Buffer Reset: Input High, V _{IH} Input Low, V _{IL}	TxFIFORES	LVTTL ²	2.1 0	— —	3.47 0.8	V V
Diagnostic Loop Enable: Input High, V _{IH} Input Low, V _{IL}	RxDLOOPENB	LVTTL ²	2.1 0	— —	3.47 0.8	V V
Tx Reset: Input High, V _{IH} Input Low, V _{IL}	TxRESET	LVTTL ²	2.1 0	— —	3.47 0.8	V V
Alarm Interrupt: Output High, V _{OH} Output Low, V _{OL}	ALMINT	LVTTL ⁵	2.4 0	— —	3.47 0.8	V V
Tx Rate Select: Input High, V _{IH} Input Low, V _{IL}	TxRATESEL[1:0]	LVTTL ²	2.1 0	— —	3.47 0.8	V V

1. The transmitter is normally enabled and requires only an active-high external voltage to disable.
2. Please note that LVTTL input and output values are different. Input values take board signal losses into consideration.
3. The alarm will go active-low when the bias current to the laser increases by 50% or decreases by 50% from its beginning-of-life (BOL) value.
4. Active-low.
5. Open-drain output.

Electrical/Optical Characteristics (continued)

Maximum and minimum values are specified over operating case temperature range at 50% duty cycle.

Table 10. 10GBASE-LR/LW Transmitter Optical Characteristics ($T_c = 0\text{ }^\circ\text{C}$ to $65\text{ }^\circ\text{C}$)

Parameter	Symbol	Min	Typ	Max	Unit
Average Output Power ¹	P _O	-4	—	0.5	dBm
Operating Wavelength	λ	1260	1310	1355	nm
Spectral Width ²	—	—	—	1	nm
Side-mode Suppression Ratio (DFB laser) ³	SMSR	30	—	—	dB
Extinction Ratio ⁴	ER	3.5	—	—	dB
Optical Modulation Amplitude	OMA	-5.2	—	—	dBm
Transmitter and Dispersion Penalty	TDP	—	—	3.2	dB
OMA-TDP	—	-6.2	—	—	dB
Transmitter Reflectance	—	—	—	-12	dB
Optical Link Budget	—	9.4	—	—	dB
Eye Mask of Optical Output	Compliant to <i>IEEE</i> Standard 802.3ae-2002				
Transmitter Jitter	Compliant to <i>IEEE</i> Standard 802.3ae-2002				

1. Output power definitions and measurements per ITU-T Recommendation G.691.

2. Full spectral width measured 20 dB down from the central wavelength peak under fully modulated conditions.

3. Ratio of the average output power in the dominant longitudinal mode to the power in the most significant side mode under fully modulated conditions.

4. Ratio of logic 1 output power to logic 0 output power under fully modulated conditions.

Table 11. 10GBASE-LR/LW Receiver Optical Characteristics ($T_c = 0\text{ }^\circ\text{C}$ to $65\text{ }^\circ\text{C}$)

Parameter	Symbol	Min	Typ	Max	Unit
Wavelength (range)	λ	1260	1310	1355	nm
Receiver Sensitivity in OMA (EOL) ¹	PR _{MIN}	—	—	-12.6	dBm
Average Receiver Overload (EOL)	—	0.5	—	—	dBm
Receiver Reflectance	RR	—	—	-12	dB
Stressed Receiver Sensitivity in OMA ² (EOL)	—	—	—	-10.3	dBm
Jitter Tolerance ²	Compliant to <i>IEEE</i> Standard 802.3ae-2002				

1. PIN receiver at 1310 nm, 1×10^{-12} BER, $2^{31} - 1$ pseudorandom data input.

2. At 1310 nm, BER < 1×10^{-12} , $2^{31} - 1$ pseudorandom data input, measured with a transmit signal having a 3.5 dB extinction ratio, 2.2 dB vertical eye closure penalty, and 0.3 UI peak-peak jitter.

Table 12. Power Supply Characteristics ($T_c = 0\text{ }^\circ\text{C}$ to $65\text{ }^\circ\text{C}$)

Parameter	Symbol	Min	Typ	Max	Unit
3.3 V Supply Voltage	V _{DD}	3.13	3.3	3.46	V
Supply Current Drain	I _{DD}	1100	1150	1300	mA
5.0 V Supply Voltage	V _{CC}	4.75	5.0	5.25	V
Supply Current Drain	I _{CC}	100	250	300	mA
-5.2 V Supply Voltage	V _{EE}	-4.94	-5.2	-5.46	V
Supply Current Drain	I _{EE}	20	100	200	mA
Package Power	P _{DISS}	4.6	5.6	7.0	W

Functional Description

Receiver

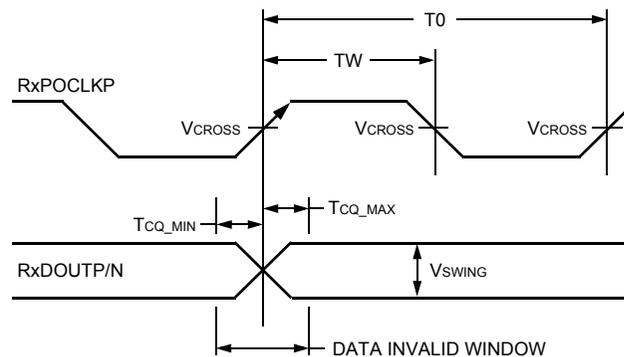
The optical receiver in the TB64LR-type transponder is optimized for the particular 10GBASE-LR/LW application segment in which it was designed to operate and will have a PIN photodetector. The detected serial data output of the optical receiver is connected to a clock and data recovery circuit (CDR) that extracts a 10312.5 MHz/9953.28 MHz clock signal for normal 10GBASE-LR/LW Ethernet rate, 10664.2 MHz at OC-192/STM-64 FEC rate. This recovered serial bit

clock signal and a retimed serial data signal are presented to the 16-bit serial-to-parallel converter.

The receiver contains a lock-detect circuit that monitors the integrity of the serial data inputs. If the received serial data fails the frequency test, the PLL will be forced to lock to the local reference clock. This will maintain the correct frequency of the recovered clock output under loss-of-signal or loss-of-power conditions.

Table 13. TB64LR-Type Transponder Receiver Timing Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Clock Period (RxPOCLK)	T0	—	1.55	—	ns
Duty Cycle	TW/T0	40	50	60	%
Rise/Fall Time (20%—80%)	tR/tF	—	—	300	ps
Data/Clock Skew	TCQ-MIN/TCQ-MAX	—	—	250/250	ps



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Figure 4. TB64LR-Type Transponder Receiver Timing Characteristics

Functional Description (continued)

Transmitter

The optical transmitter in the TB64LR-type transponder is optimized for the particular 10GBASE-LR/LW Ethernet segment in which it is designed to operate. The transmitter has an uncooled direct-modulated laser as the optical element and operates at the 1310 nm window. A serial data stream developed in the parallel-to-serial conversion logic input drives the transmitter.

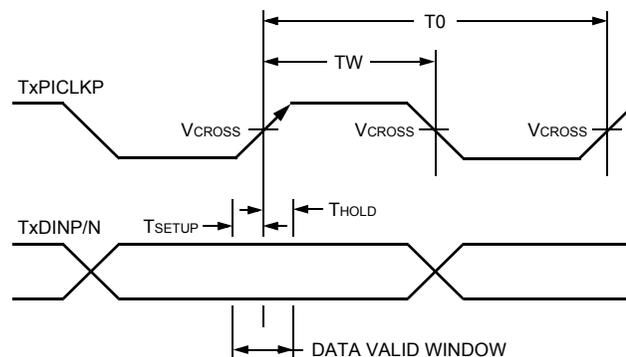
The parallel-to-serial converter block shown in Figure 1 is comprised of two byte-wide registers. The first register latches the 16 bits of parallel input data (TxDin[15:0]) on the rising edge of TxPICKLK. The second register is a 16-bit parallel load, serial-out shift register that is loaded from the input register. An internally generated byte clock, which is phase aligned to the 10312.5 MHz serial transmit clock, activates the data transfer between the input register and the parallel-to-serial register.

The clock-divider and phase-detect circuitry shown in Figure 1 generates internal reference clocks and timing functions for the transmitter. Therefore, it is important that the TxREFCLKP/N input is generated from a precise and stable source. It is required that the TxREFCLKP/N input be generated from a crystal oscillator or other source having a frequency accuracy better than ± 20 ppm.

The timing generation circuitry provides two separate functions. One is a byte-rate clock that is synchronized to the 10312.5 MHz/9.9532 MHz transmit serial clock; the other is a mechanism for aligning the phase between the incoming byte clock (TxPICLKP/N) and the clock that loads the parallel data from the input register into the parallel-to-serial shift register. The TxPCLKP/N output is a byte-rate (644 MHz/622 MHz) version of the serial transmit clock and is intended for use by upstream multiplexing and overhead processing circuits. Using TxPCLKP/N for upstream circuits will ensure a stable frequency and phase relationship between the parallel data coming into the transmitter and the subsequent parallel-to-serial timing functions.

Table 14. TB64LR-Type Transponder Receiver Timing Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Clock Period (TxPICLK)	T0	—	1.55	—	ns
Duty Cycle	TW/T0	40	50	60	%
Rise/Fall Time (20%—80%)	tR/tF	100	—	300	ps
Setup Time/Hold Time	TSETUP/THOLD	—	—	300/300	ps



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Figure 5. TB64LR-Type Transponder Transmitter Timing Characteristics

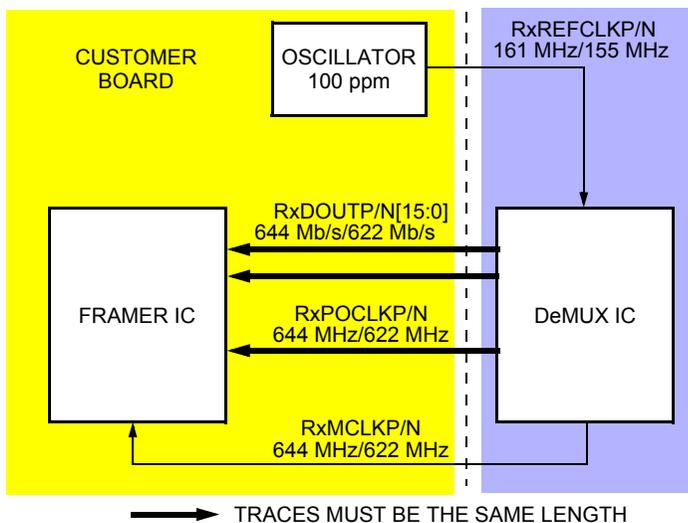
Transponder Interfacing

Receiver Interface Board Layout

All the receiver data outputs (RxDOU_TP/N[15:0]) on the customer board should have equal trace lengths, and in most cases, be matched to that of the parallel output clock RxPOCLKP/N. The similar lengths ensure that these signals maintain the propagation delay time values.

It is not required to match the trace length of the RxMCLKP/N. RxMCLKP/N is derived from the RxREFCLKP/N, i.e., from a VCO inside the deMUX. This allows a clock signal to be delivered to the framer even if the RxPOCLKP/N is not locked to any incoming optical signal.

Figure 6 shows the TB64LR receiver interface board layout.



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Note: RxMCLKP/N may not be required for all framers.

Figure 6. TB64LR-Type Receiver Interface Board Layout

Transponder Interfacing (continued)

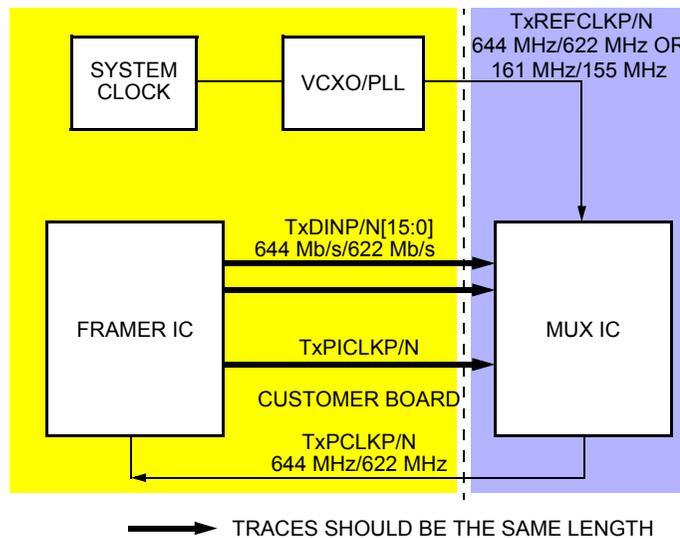
Transmitter Interface Board Layout

All the transmitter data inputs, (TxDINP/N[15:0]) should have equal trace lengths on the customer board. There should also be a certain phase relationship between TxDINP/N[15:0] and the parallel input clock (TxPICLKP/N) at the transponder electrical connector input to allow proper MUX operation, as shown by the setup and hold times (T_{SETUP} and T_{HOLD}) in Table 14, page 28. This phase relationship can be ensured if the trace length of the TxPICLKP/N is matched to the trace length of the TxDINP/N data inputs. For TxREFCLKP/N

clock, a tolerance of ±20 ppm is required to meet Serial WAN output frequency specifications. To ensure this, using VCXO/PLL circuit is recommended.

The VCO/VCXO chosen should be of a Serial WAN quality. The clock should have low phase noise and frequency stability of better than ±20 ppm.

Figure 7 shows the TB64LR-type transmitter interface board layout. Please contact TriQuint Optoelectronics for more details.



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Figure 7. TB64LR-Type Transmitter Interface Board Layout

Transponder Grounding

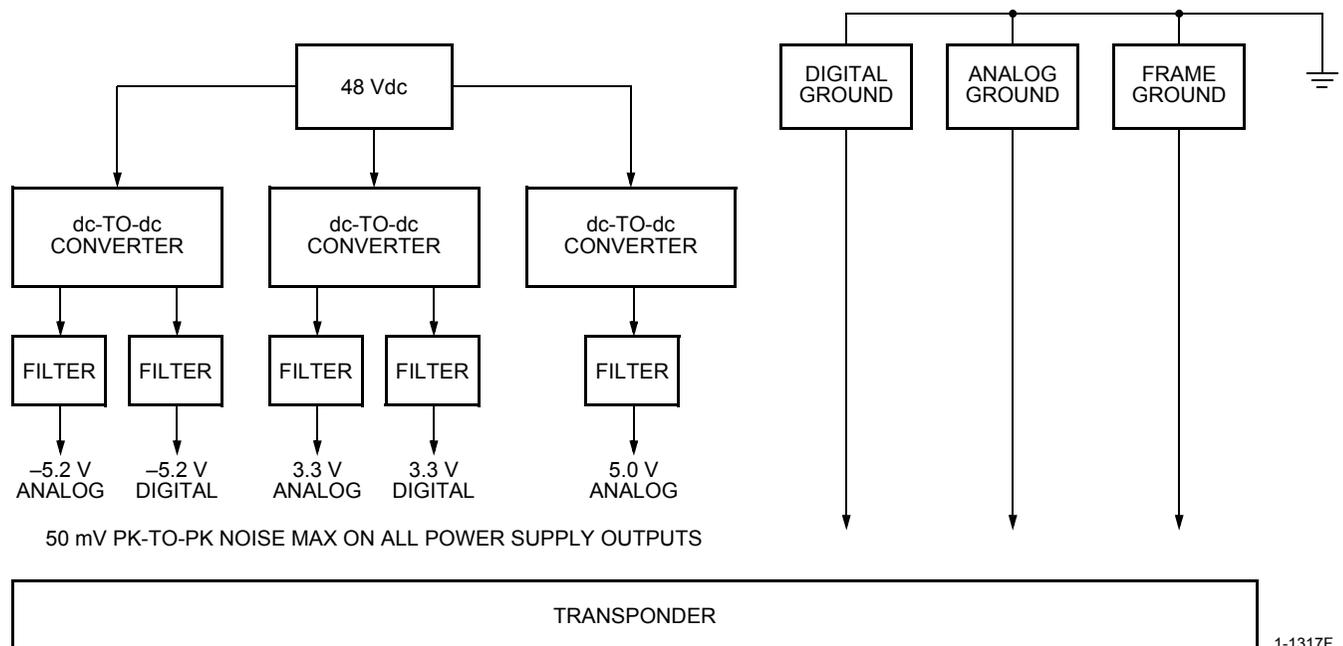


Figure 8. Recommended Grounding Scheme

Qualification and Reliability

To help ensure high product reliability and customer satisfaction, TriQuint Optoelectronics is committed to an intensive quality program that starts in the design phase and proceeds through the manufacturing process. Optoelectronics modules are qualified to our internal standards using MIL-STD-883 test methods and procedures and using sampling techniques consistent with *Telcordia Technologies*™ requirements. This qualification program fully meets the intent of *Telcordia Technologies* reliability practices TR-NWT-000468 for optoelectronic parts, and the transponder as a subsystem meets NEBS GR-63-CORE requirements. In addition, our design, development, and manufacturing facility has been certified to be in full compliance with the latest ISO® 9001 quality system standards.

Electrostatic Discharge

CAUTION: This device is susceptible to damage as a result of electrostatic discharge. Take proper precautions during both handling and testing. Follow guidelines such as JEDEC Publication No. 108-A (Dec. 1988).

TriQuint employs a human-body model (HBM) for ESD-susceptibility testing and protection-design evaluation. ESD voltage thresholds are dependent on the critical parameters used to define the model. A standard HBM (resistance = 1.5 k Ω , capacitance = 100 pF) is widely used and can be used for comparison purposes.

Regulatory and Voluntary Compliance

Table 15. Regulatory and Voluntary Compliance

Feature	Standard	Test Parameters/Performance
Electrostatic Discharge (ESD) to the Electrical Pins	Sensitivity Classification: MIL-STD-883E, Method 3015.7	Class 1 (0 V to 1,999 V)
Electrostatic Discharge (ESD) to Housing and Optical Connector	EN 61000-4-2, IEC [®] 61000-4-2	Full recovery following ± 8 kV contact discharge and ± 15 kV air discharge
Electromagnetic Compatibility: Radiated Emissions	FCC Part 15, Class B EN55022, Class B GR-1089_CORE*	Full compliance within the frequency range of 10 KHz—20 GHz
Immunity	EN 61000-4-3 GR-1089_CORE*	Full compliance within the frequency range of 10 KHz—10 GHz at a field strength of 8.5 V/m
Safety of Information Technology Equipment	IEC 60950 EN 60950 UL [®] 60950 CAN/CSA [®] -C22.2 No. 60950	CB Scheme: Test Report Reference No. 01RT14477-02252002, Reference Certificate No. US/5754/UL, UL/CSA Recognition File No. E225949
Laser Safety	21 CFR 1040.10 and 1040.11, includes Laser Notice No. 50, IEC 60825-1:1993, A1:1997, and A2:2001	CDRH Accession No. (8720009-59) AEL Class 1
CE Mark	LVD 73/23/EEC EMC 89/336/EEC	EC Declaration of Conformity
Component Recognition	UL and CSA Joint Component Recognition for Information Technology Equipment	UL File Number: E225949
Compositional Analysis	Standard ICPS, GC/MS, FTIR Analytical Processes	Analytical test results: elements, organic compounds

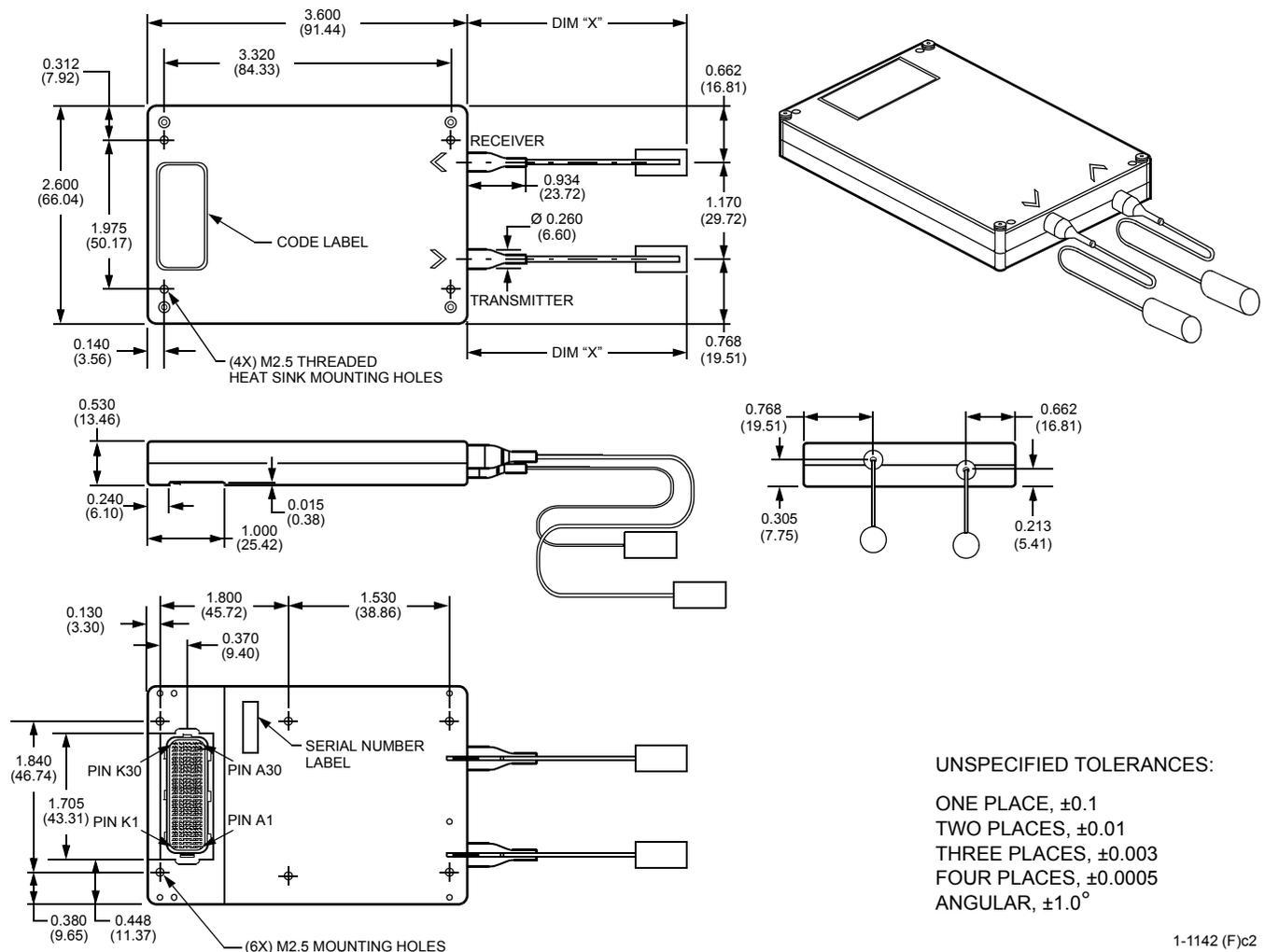
*Complies with applicable *Telcordia* NEBS Level 1—3 EMC requirements for components in a standalone configuration.

CAUTION: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.

NOTICE
Unterminated optical connectors can emit laser radiation.
Do not view with optical instruments.

Outline Diagram

Dimensions are in inches and (millimeters).



1-1142 (F)c2

Notes:

Compact size of 3.6 in. x 2.6 in. x 0.53 in.

Package properties:

- Material: aluminum alloy 6061-T6 per QQ-A-250/11.
- Finish: clear chromate (conductive) per MIL-C-5541, Class 3.

Four M2.5 threaded holes are to mount the transponder on the customer board:

- Transponder mounting holes (bottom cover): maximum screw depth = 0.080 in. (2.00 mm) (thread 0.080 in. [2 mm] deep).

Four M2.5 threaded holes are for possible mounting of an external heat sink:

- External heat sink mounting holes (top cover): maximum screw depth = 0.100 in. (2.54 mm) (thread 0.100 in. [2.54 mm] deep).

TriQuint Optoelectronics recommends that customers use a 300-pin plug FCI Berg #84500-102 (30 min gold plated) that meets *Telcordia Technologies'* 100 insertions criterion.

TriQuint Optoelectronics also recommends that the distance between the Berg connector center-line and the nearest customer components behind the transponder be 0.8 in. minimum to ensure that future transponders are accommodated without any board layout change.

The pigtails are 100cm ± 10 cm in length (39.4 in. ± 3.9 in.) as specified by dimension X in Figure 9. A yellow sleeve *UL*®-approved (TBD, 94V-2) jacket is placed at the receiver end of the pigtail.

The minimum recommended operational fiber bend radius is 1.25 in. (3.18 cm).

Figure 9. Mechanical Dimensions

Ordering Information

Table 16. Ordering Information

Device Code	Comcode	Connector Type	Device Description
TB64LRCAA	700013079	SC	10.3125 Gb/s (LR)/9.9532 Gb/s (LW) Ethernet 1310 nm transponder, SFI-4 interface, with pigtailed SC connector, 300-pin connector, 10 km reach, standard configuration
TB64LRWAA	700017638	LC	10.3125 Gb/s (LR)/9.9532 Gb/s (LW) Ethernet 1310 nm transponder, SFI-4 interface, with pigtailed LC connector, 300-pin connector, 10 km reach, standard configuration

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ISO is a registered trademark of The International Organization for Standardization.

IEC is a registered trademark of The International Electrotechnical Commission.

UL is a registered trademark of Underwriters Laboratories, Inc.

Additional Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

Web: www.triquint.com

Tel: (503) 615-9000

E-mail: info_opto@tqs.com

Fax: (503) 615-8902

For technical questions and additional information on specific applications:

E-mail: info_opto@tqs.com

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