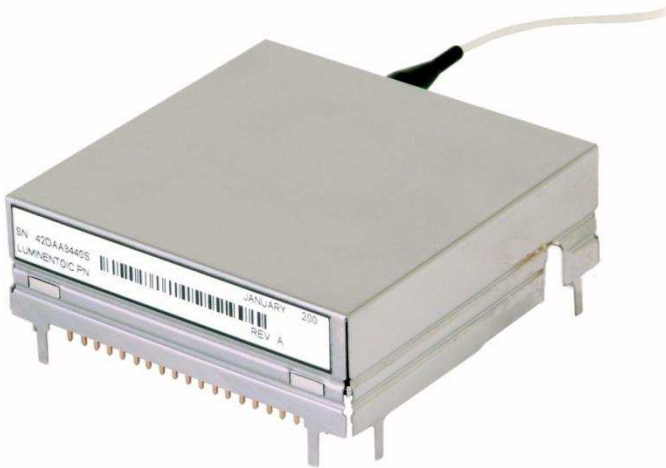


1310/1490/1555nm Integrated Triplexer Transceiver



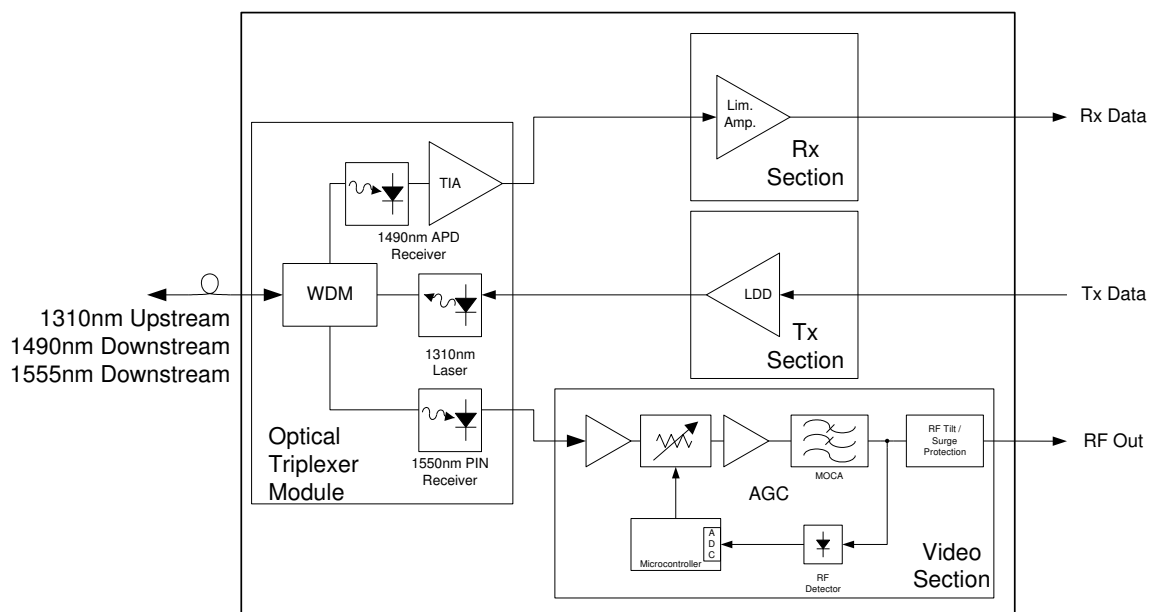
Features

- Single fiber, integrated triplexer transceiver
- Compliant to FSAN G.984.2& G.984.5 specifications
- Voice/Data/Video FTTx ONT/ONU applications
- 1310nm Tx, 1490nm Rx, 1555nm video Rx
- 1244Mbps Tx / 2488Mbps Rx asymmetric data rate
- Burst mode upstream transmission
- 1555nm CATV Wavelength Blocking Filter
- 870MHz Video Bandwidth
- -40 to 85°C Operation
- Feedback Video AGC Operation
- 20km reach
- 28dB power budget
- Meets UL 94V-1 flammability

- **Digital Transmitter:** A DFB laser diode is employed for upstream transmission at OC-24 (1244Mbps). The optical transmitter includes a back facet photodetector to monitor laser power for APC control.

- **Digital Receiver:** An APD with TIA is employed for downstream data reception at OC-48 (2488Mbps). A post amplifier is also included for CML output compatibility.

- **Analog Receiver:** 870MHz forward path video (CATV) receiver with multiple gain stages, automatic gain control (AGC), and status indicators.



Triplexer Block Diagram

Absolute Maximum Ratings

Usage of this transceiver shall adhere to the following absolute maximum ratings. Stresses beyond those in Table 1 may cause permanent damage to the unit. These are stress ratings only, and functional operation of the unit at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect unit reliability.

Table 1 - Absolute Maximum Ratings

Parameter	Minimum	Maximum	Unit/Conditions
Ambient Storage Temperature	-40	85	°C
Operating Temperature*	-40	85	°C
Operating Case Humidity Range	10%	90%	non-condensing
ESD Sensitivity (Human Body Model)	-	1000	V
Lead Soldering Temperature	-	260°C	10 sec
Vdd_+12V	-0.3	15	V
Vdd power-on rise time	150	-	us
Vcc_Rx	-0.3	4	V
Vcc_Tx	-0.3	4	V
Vcc_μC	-0.3	+4.2	V

*Operating temp: minimum is ambient, maximum is case.

Module Characteristics

Table 2 - Optical Characteristics

Parameter	Minimum	Typical	Maximum	Unit/Conditions
Optical Isolation From external 1310 (1260 – 1360) nm to 1490 (1480 – 1500) nm Rx			-30	dB
Optical Isolation From external 1310 (1260 – 1360) nm to 1555 (1550 – 1560) nm Rx			-40	dB
Optical Cross-talk From internal 1310 (1260 – 1360) nm TX to 1490 (1480 – 1500) nm Rx			-47	dB
Optical Cross-talk From internal 1310 (1260 – 1360) nm TX to 1555 (1550 – 1560) nm Rx			-47	dB
Optical Isolation From external 1490 (1480 – 1500) nm to 1555 (1550 – 1560) nm Rx			-32	dB
Optical Isolation From external 1555 nm to 1490 nm Rx			-32	
Optical Isolation Wavelength Blocking Filter From external 1530 nm(>1530nm) to 1490 (1480 – 1500) nm Rx	30			dB
Optical Isolation Wavelength Blocking Filter From external 1450 nm(<1450nm) to 1490 (1480 – 1500) nm Rx	30			dB

Parameter	Minimum	Typical	Maximum	Unit/Conditions
Optical Isolation Wavelength Blocking Filter From external 1577 (1575 – 1625) nm to 1550 (1550 – 1560) nm Rx	30			dB
Optical Return Loss 1490 nm band 1555 nm band			-20	dB
Optical Return Loss @ 1310 nm	-	-	-6	dB

Functional Characteristics

The following tables list the performance specifications for the various functional blocks of the integrated optical transceiver module.

Table 3 – Digital Transmitter Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	3.15	3.30	3.45	V	V _{CC} referenced to GND_Tx
Data Rate	-	1244.16	-	Mbps	
Average Optical Output Power, P _O	0.5	-	5	dBm	
Output Power at Transmit Off	-	-	-40	dBm	
Side Mode Suppression Ration (SMSR)	30	-	-	dB	
Extinction Ratio	10	-	-	dB	PRBS 2 ²³ -1, NRZ, 50% duty cycle
Operational Wavelength	1290	-	1330	nm	
Transmitter Output Eye	G.984.2 Figure 3				
Optical Rise and Fall Time	-	250	-	ps	20% to 80%
Differential Input Voltage, V _{in}	200	-	1800	mVp-p	BEN+/- and TXD+/- . DC-coupled
Input Impedance, differential	-	100	-	Ω	BEN+/-, TXD+/- (see Figure 1)
Common-Mode Input Voltage	-	V _{CC} -1.32	-	V	DC coupled
Tx Burst Enable Time	-	-	12.86	ns	16 bits data @ 1244Mbps
Tx Burst Disable Time	-	-	12.86	ns	16 bits data @ 1244Mbps
TX_SD Delay (Timing "D")		40	200	ns	See Figure 2
TX_SD Width Difference (Timing "X")			100	ns	See Figure 2
TX_SD Startup Time (T _{TX_SD_STARTUP})			3	S	See Figure 3

For CML Tx Data

100Ω Differential Transmission Lines

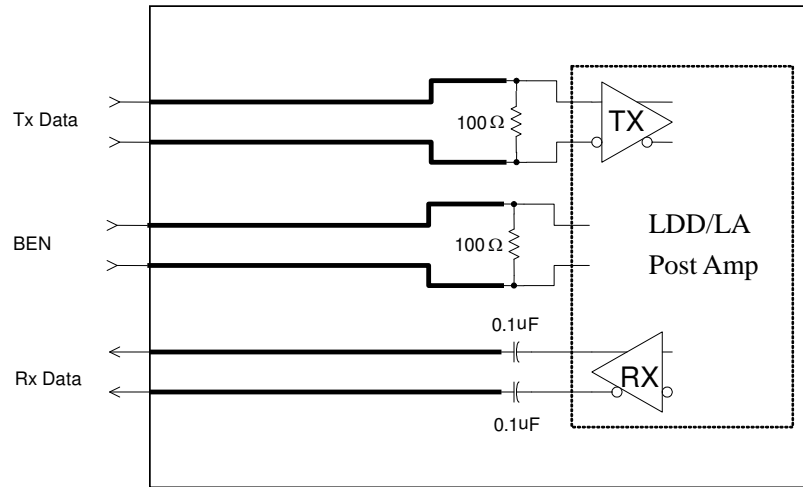


Figure 1 – Schematic representation of the module high speed inputs/outputs

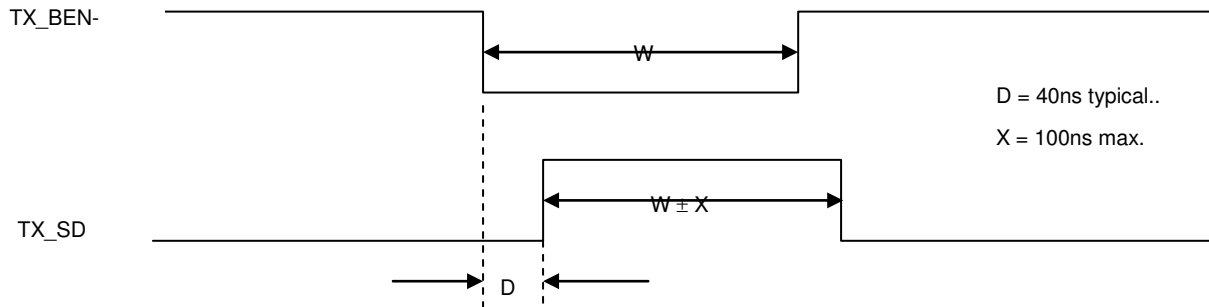


Figure 2: TX_SD timing diagram.

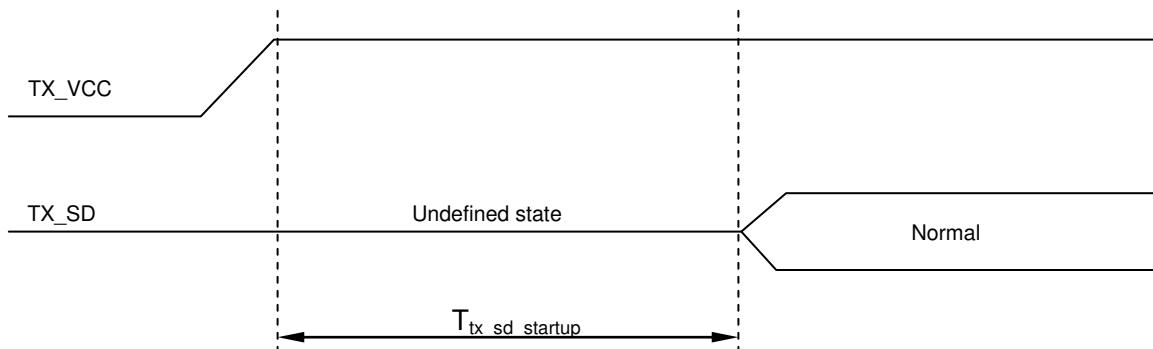


Figure 3: TX_SD startup timing diagram.

Table 4 – Digital Receiver Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	3.15	3.30	3.45	V	V _{CC} referenced to GND_RX
Data Rate	-	2488.32	-	Mbps	
Operational Wavelength Range	1480	-	1500	nm	
Sensitivity	-28	-	-	dBm	With Tx on
Overload	-	-	-8	dBm	
Bit Error Rate (BER)		-	10 ⁻¹⁰		
Optical Return Loss	20	-	-	dB	
Data Output Rise and Fall Time	-	160	-	ps	20% to 80%
Signal Detect Assertion Level	-		-28	dBm	Transition during increasing light
Signal Detect De-Assertion Level	-38	-	-	dBm	Transition during decreasing light
Signal Detect Hysteresis	0.5	-	6	dB	
Differential Output Voltage	750	900	1050	mV	CML output, ac coupled (0.1μF)
Signal Detect Output HIGH Voltage	2.0	-	-	V	LVTTTL with internal pull up resistor. Asserts HIGH when input data amplitude is above threshold.
Signal Detect Output LOW Voltage	-	-	0.4	V	LVTTTL. De-asserts LOW when input data amplitude is below threshold .
RSSI Range ^a	-28		-8	dBm	
RSSI Accuracy	-3	-	+3	dB	

a) Externally calibrated.

Table 5 – Video Receiver Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	11.7	-	13.2	V	
Supply Current	-	-	250	mA	
Frequency Range	54	-	870	MHz	
Receiver Wavelength	1550	1555	1560	nm	
Responsivity	0.8	-	-	A/W	
AGC Time Constant	0.5	-	15	s	
Video PD Monitor Accuracy	-3	-	3	dB	
Channel Bandwidth	-	4	-	MHz	
Channel Spacing	-	6	-	MHz	
Received Average Optical Power	-8	-	2	dBm	
OMI		4.3		%	Analog OMI% / carrier
		2.15		%	Digital OMI% / carrier (Freq > 550MHz)

Parameter	Minimum	Typical	Maximum	Unit	Notes
RF Output 550 MHz	19	-	26	dBmV	For digital channels > 550MHz, RF levels are 6dB lower
RF Output Power Tilt	2	-	7	dB	
AGC Tolerance with Respect to Optical Input Power at 550Mhz	0	-	3	dB	@97.25 MHz, min 19.5dBmV/Ch to 26 dBmV/Ch Max, Over temp
Peak to Peak Flatness	-2	-	2	dB	
S22 Output Return Loss	14	-	-	dB	75Ω
CSO	-	-	-55	dBc	For > 550MHz, CSO is 7dB higher
CTB	-	-	-55	dBc	For > 550MHz, CTB is 7dB higher
Carrier to Noise Ratio(CNR)	46	-	-	dB	CNR measurement correlated to SCTE standard, At -8dBm input power, 3.4% OMI

Table 6 – Microcontroller Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	3.15	3.30	3.45	V	
SDA ^a	-	-	-	-	LVTTTL, open collector serial data line from the I ² C bus to the on board Microcontroller
SCL ^{a,b}	-	-	-	-	LVTTTL, open collector serial clock line from the I ² C bus to the on board Microcontroller
Reset Hold ^c	30	-	-	ms	LVTTTL input, internal 50Ω pull-up. Active Low.

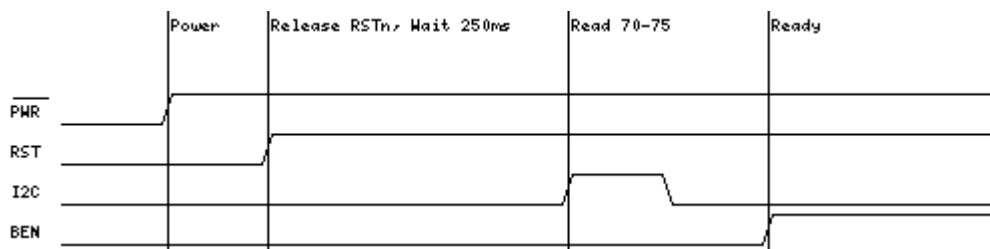
- a) I2C SDA and SCL must be open collector or open drain connections
b) Clock stretching, as per paragraph 13.2 of the I2C bus standard, must be implemented to operate correctly
c) Please see table & timing diagram below for a recommended system start-up sequence.

Table 7 – Microcontroller Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
DDM Temp Accuracy	-5	-	+5	°C	Note: MCU temp
DDM VCC Accuracy	-5	-	+5	%	
DDM RSSI Accuracy	-3	-	+3	dB	
DDM VpdMon Accuracy	-3	-	+3	dB	
DDM RfMon Accuracy	-3	-	+3	dB	
DDM Bias Current Accuracy	-15	-	15	%	
DDM TX Power Accuracy	-3	-	+3	dB	

Table 8 – Suggested Start-up Sequence

Step	Action
1	Power up the host system, with the RESET pin pulled to ground via a $\leq 4.7k_{\Omega}$ resistor.
2	Drive the RESET pin LOW.
3	Set the BEN control lines to disable the transmitter (BEN lines must be driven with differential logic).
4	Ensure power to the unit is on.
5	Drive the RESET pin HIGH to release the unit to become operational.
6	Wait approximately 250ms
7	Read bytes A2.70/71/74/75 to clear the interrupt condition. Verify that byte A2.75 bit 7 was set. Use multi-byte read of bytes 70/71 and bytes 74/75. (If software interrupt feature is not used, this step may be skipped)
8	The unit is now ready for normal operation.


Figure 4 - Recommended transceiver module start-up sequence

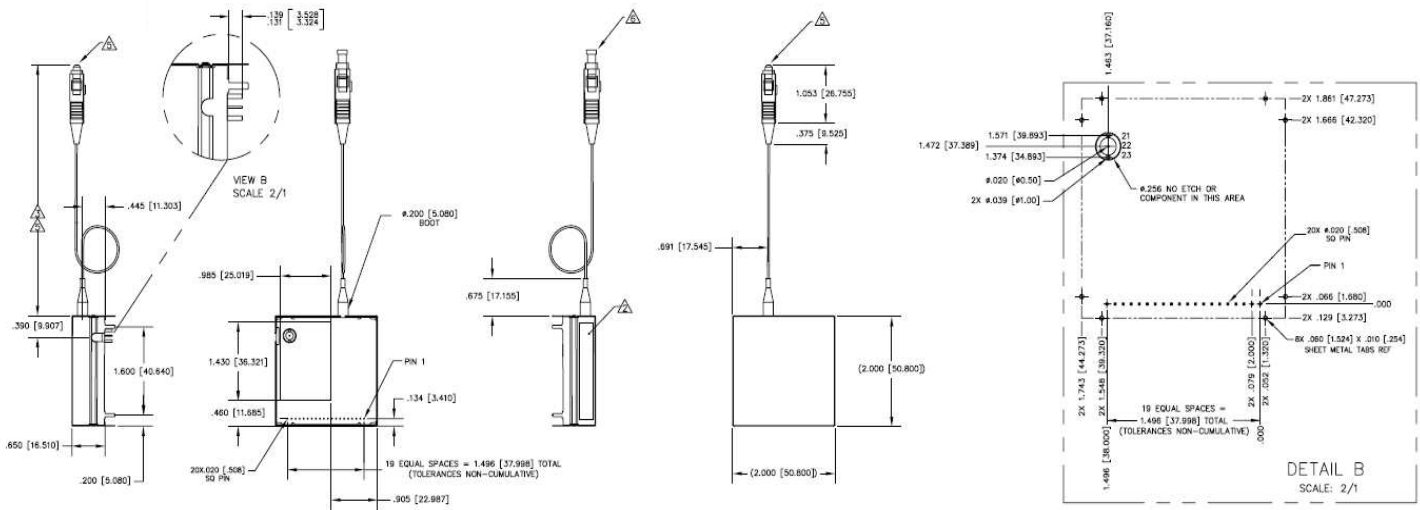
Pin Definitions

Table 9 - Module Pin Definitions

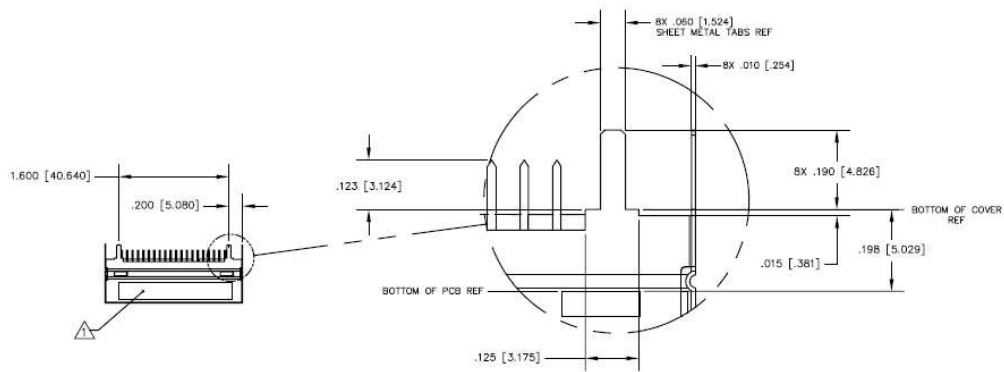
Pin Number	Label	Definition
1	GND_A	Common ground
2	GND_Rx	Digital Rx ground
3	Vcc_Rx	Digital Rx Vcc
4	SD	Signal Detect output. LVTTTL with internal 3.3k Ω pull-up. Asserts HIGH when input optical signal level is above threshold.
5	RXD+	RX data output, CML. 50 Ω terminated to Vcc and AC coupled to module output (0.1 μ F)
6	RXD-	RX data bar output, CML. 50 Ω terminated to Vcc and AC coupled to module output (0.1 μ F)
7	BEN+	Burst Enable input, internally DC coupled.
8	BEN-	Burst Enable bar input, internally DC coupled.
9	GND_Tx	Digital Tx ground
10	TXD+	Tx data input, LVPECL. Internally DC coupled. 100 Ω differential termination.

Pin Number	Label	Definition
11	GND_Tx	Digital Tx ground
12	TXD-	Tx data bar input, LVPECL. Internally DC coupled. 100Ω differential termination.
13	Vcc_Tx	Digital Tx Vcc
14	SDA	I ² C Data input/output. LVTTTL
15	SCL	I ² C Clock input. LVTTTL
16	Tx_SD	Tx signal detect. Active high
17	Vdd_+12V	Video Rx 12V Vdd
18	Vcc_3.3V	Microcontroller Vcc
19	Reset	Reset input. LVTTTL. Internal pull up. Active low.
20	GND_A	Common ground
21	RF_GND	RF ground
22	RF_SIGNAL	RF signal
23	RF_GND	RF ground







Package Diagram



SEE DETAIL B



VIEW A
SCALE 6/1

-  PICTURED WITH DUST COVER.
-  PICTURED WITHOUT DUST COVER.
- 4. TOLERANCE $\pm .08$ [2.07].
-  39.37 ± 1.18 INCH LONG (1000 $+/-$ 30).
-  900 μ M BUFFERED FIBER TERMINATED WITH SC CONNECTOR.
-  SOURCE PHOTONICS LABEL.
-  CUSTOMER LABEL.

NOTES: UNLESS OTHERWISE SPECIFIED

Ordering Information

Table11 – Valid Part Numbers

Part Number	Description
ITR-D3T-SD9	GPON ONT triplexer optical transceiver,SC/APC, I-temp operation

Table 12 - Device Handling/ESD Protection

The devices are static sensitive and may easily be damaged if care is not taken during handling. The following handling practices are recommended.

1	Devices should be handled on benches with conductive and grounding surfaces.
2	All personnel, test equipment and tools shall be grounded.
3	Do not handle the devices by their leads.
4	Store devices in protective foam or carriers.
5	Avoid the use of non-conductive plastics, rubber, or silk in the area where the devices are handled
6	All modules shall be packaged in materials that are anti-static to protect against adverse electrical environments.
7	Avoid applications of any voltage higher than maximum rated voltages to this part. For proper operation, any VIN or VOUT should be constrained to the range $GND \leq (VIN \text{ or } VOUT) \leq VCC$. Unused inputs must always be tied to an appropriate logic voltage (e.g. either GND or VCC). Unused outputs must be left open.

Warnings

Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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