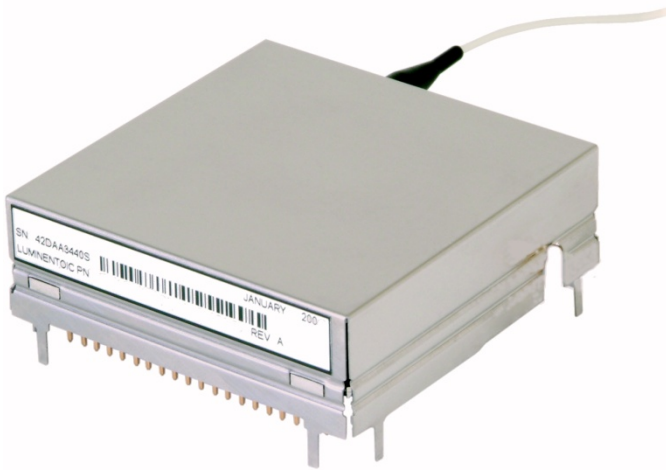


1310/1490/1555nm Integrated Triplexer Transceiver



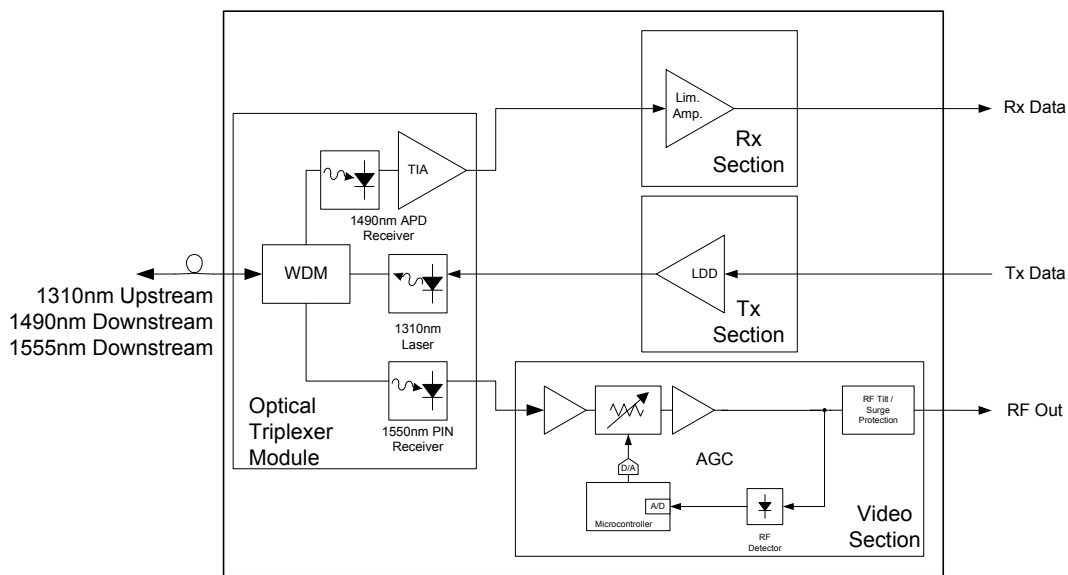
Features

- Single fiber, integrated triplexer transceiver
- Compliant to FSAN G.984.2 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
- 16.5dBmV minimum RF output power
- 1GHz video bandwidth, with feedback AGC operation, without MOCA filter
- -40 to 85°C operation
- 20km reach
- 28dB power budget
- RoHS-5/6 compliant (lead exemption)
- GR-326-CORE compliant SC/APC connector
- 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:** 1GHz 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
ESD Sensitivity (Human Body Model)	-	1000	V
Lead Soldering Temperature	-	260°C	10 sec
Vdd_+12V	-0.3	15	V
Vcc_Rx	-0.3	+4.2	V
Vcc_Tx	-0.3	+4.2	V; Vcc_Tx < (Vcc_Rx + 1V)
Vcc_3.3V	-0.3	+4.2	V
Lightning Surge	-1500	+1500	V

Recommended Operating Conditions

The following table identifies the recommended operating condition for optical transceiver use.

Table 2 – Recommended Operating Conditions

Parameter	Minimum	Typical	Maximum	Unit/Conditions
Operating Temperature ^a	-40	-	85	°C
Operating Humidity Range	10%	-	90%	non-condensing
Total 3.3V Supply Current	-	-	350	mA
Total 12V Supply Current	-	-	225	mA
Power Supply Ripple	-	-	100	mVp-p, 100Hz to 1MHz

^a Minimum is ambient temperature; maximum is module case temperature.

Optical Characteristics

The following table summarizes the performance specifications for the integrated optical block located within the transceiver module.

Table 3 - Optical Characteristics

Parameter	Minimum	Typical	Maximum	Unit/Conditions
1555nm external to 1490 nm Rx Isolation	32	-	-	dB
1490nm external to 1555nm Rx Isolation	32	-	-	dB
1310nm external to 1555nm Video Isolation	40	-	-	dB
1310nm external to 1490nm data Isolation	30	-	-	dB
1310nm Tx to 1490nm Rx Optical Crosstalk	-	-	-47	dB
1310nm Tx to 1555nm Rx Optical Crosstalk	-	-	-47	dB
Back Reflection @ 1310nm	-	-	-6	dB
Back Reflection @ 1555nm	-	-	-32	dB
Back Reflection @ 1490nm	-	-	-20	dB

Functional Characteristics

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

Table 4 – Digital Transmitter Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	3.14	3.30	3.46	V	Vcc 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	
Extinction Ratio	10	-	-	dB	PRBS 223-1, NRZ, 50% duty cycle
Transmitter Output Eye	G.984.2 Figure 3				
Optical Rise and Fall Time	-	250	-	ps	20% to 80%
Side Mode Suppression Ratio (SMSR)	See below				
Center Wavelength, λ_c	1290	-	1330	nm	Dual DFB modes allowed; RMS Spectral line width <1.5nm; SMSR >30dB for FP modes
Differential Input Voltage, V _{in}	300	-	1800	mVp-p	BEN+/- and TXD+/- DC-coupled
Input Impedance, differential	-	100	-	Ω	BEN+/-, TXD+/-
Common-Mode Input Voltage	GND_Tx + 1.4	-	Vcc - (V _{in} /2) - 0.1	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

Refer to

Figure 1 which schematically describes the high speed data inputs/outputs of the optical transceiver module.

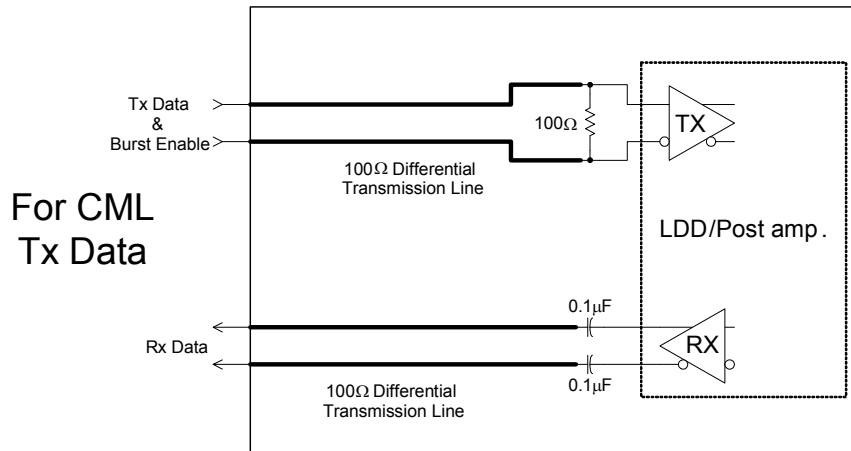


Figure 1 - Schematic representation of the module high speed inputs/outputs

Table 5 – Digital Receiver Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	3.14	3.30	3.46	V	V _{CC} referenced to GND_RX
Data Rate	-	2488.32	-	Mbps	
Operational Wavelength Range	1480	-	1500	nm	
Received Optical Power	-28	-	-8	dBm	PRBS 2 ²³ -1, 50% duty cycle
Bit Error Rate (BER)		-	10 ⁻¹⁰		
CID		72		bits	
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 ^a	-38	-	-	dBm	Transition during decreasing light
Signal Detect Hysteresis	0.5	-	-	dB	
Differential Output Voltage	600	-	900	mV	CML output, ac coupled (0.1μF)
Signal Detect Output HIGH Voltage	2.4	-	-	V	LVTTL with internal pull up resistor. Asserts HIGH when input data amplitude is above threshold.
Signal Detect Output LOW Voltage	-	-	0.5	V	LVTTL. De-asserts LOW when input data amplitude is below threshold.
RSSI Range ^b	-28	-	-8	dBm	
RSSI Accuracy	-3	-	+3	dB	

^a Rx outputs are squelched upon Signal Detect de-assert

^b Externally calibrated.

Table 6 – Video Receiver Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
12V Operating Voltage Range	11.7	-	13.2	V	
Frequency Range	54	-	1000	MHz	
Receiver Wavelength (Bandwidth)	1550	1555	1560	nm	
Responsivity	0.8	-	-	A/W	
Video PD Monitor Accuracy	-	-	10	%	
AGC Time Constant	1	5	15	s	
S22 Output Return Loss	14	20		dB	75Ω

Table 7 - Supported Video Channel Plans

Parameter	Minimum	Typical	Maximum	Unit	Notes	
Channel Plan						
Analog Channels ^a	82	-	-		OMI = 3.4% / channel	
Digital Channels	34	-	-		OMI = 1.7% / channel	
Channel Bandwidth		4	-	MHz		
Channel Spacing	-	6	-	MHz		
Received Average Optical Power	-6		1	dBm		
RF Channel Output Power	55MHz	16.5	-	-	dBmV	Linear lower bound from 55-1000MHz
RF Channel Output Power	1000MHz	19.5	-	-	dBmV	
Distortion	CSO	-	-65	-55	dBc	For digital channels, CSO max. and CTB max. will be 7dB higher
	CTB	-	-62	-55		
Carrier to Noise Ratio (CNR)	45	-	-	dB		

^a Total OMI = 32%

Table 8 - Microcontroller Specifications

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operating Voltage	3.14	3.30	3.46	V	
SDA ^a	-	-	-	-	LVTTTL, open collector serial data line from the I ² C bus to the on board Microcontroller.
SCL ^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 50kΩ pull-up. Active Low
Interrupt	-	-	-	-	LVTTTL output, internal 100kΩ 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 9 and the timing diagram in Figure 2 below for the recommended system start-up sequence.

Table 9 – Suggested Start-up Sequence

Step	Action
1	Power up the host system, with the RESET pin pulled to ground via a ≤4.7kΩ 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 until the INTERRUPT pin goes LOW.
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.
8	Wait 50ms. Verify that the INTERRUPT pin has changed to HIGH.
9	The unit is now ready for normal operation.

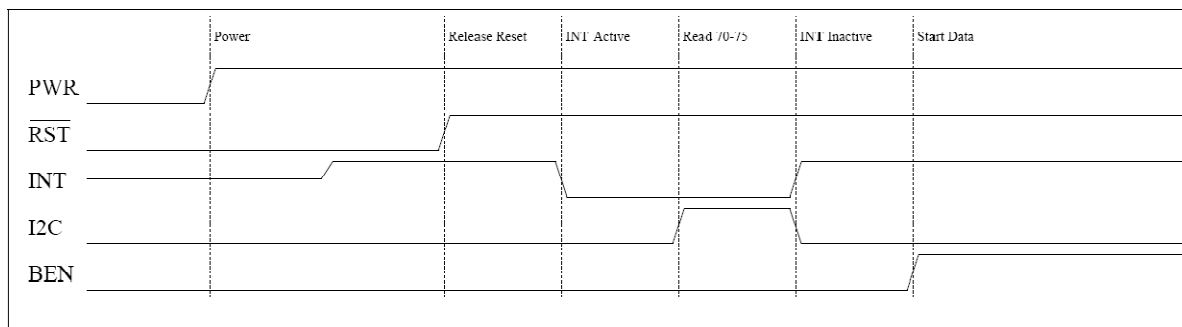


Figure 2 - Recommended transceiver module start-up sequence

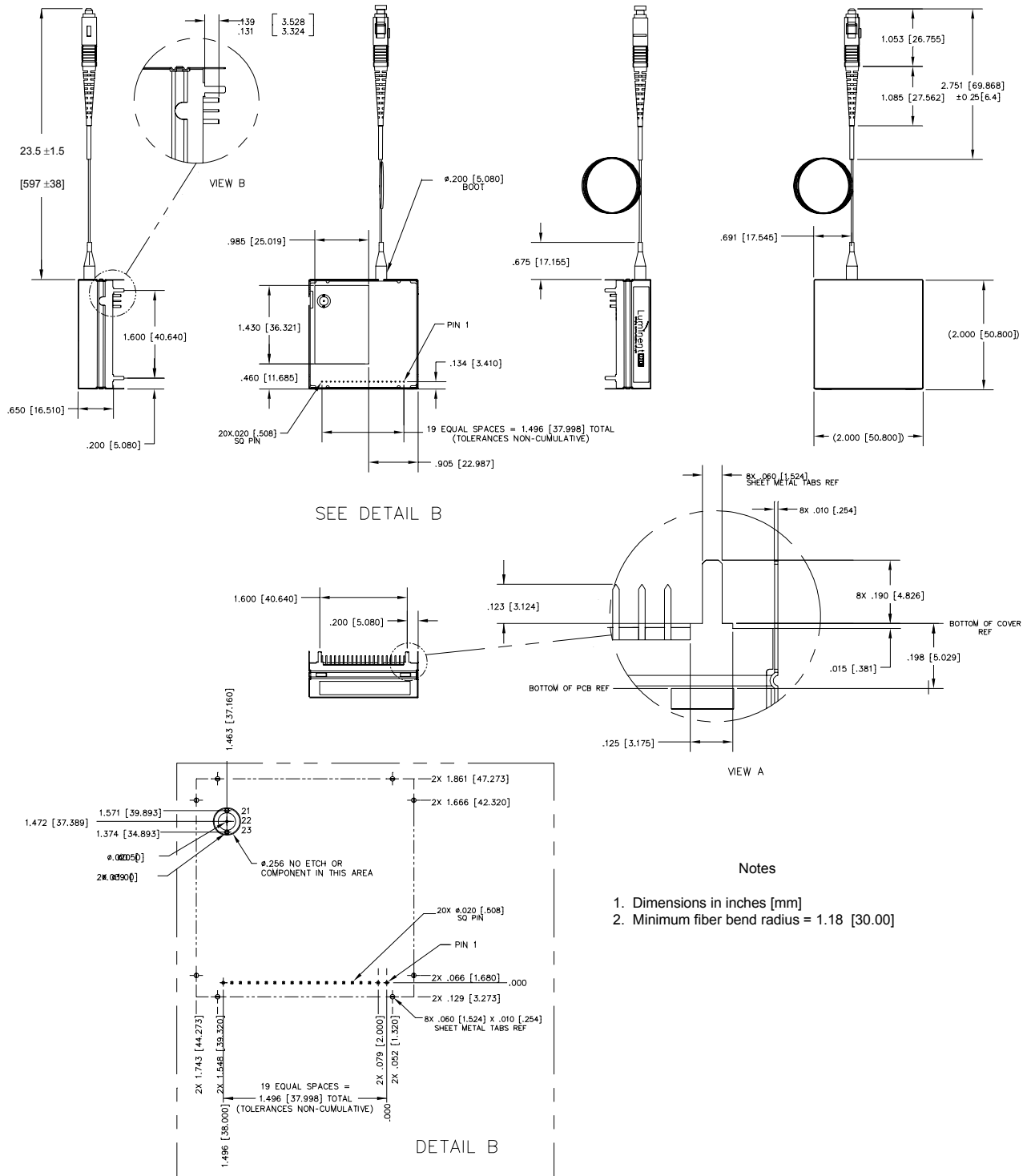
Pin Definitions

Refer to Table 10 for a description of the function of each I/O pin.

Table 10 - 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, CML. Internally DC coupled. 100 Ω differential termination.
8	BEN-	Burst Enable bar input, CML. Internally DC coupled. 100 Ω differential termination.
9	GND_Tx	Digital Tx ground
10	TXD+	Tx data input, CML. Internally DC coupled. 100 Ω differential termination.
11	GND_Tx	Digital Tx ground
12	TXD-	Tx data bar input, CML. Internally DC coupled. 100 Ω differential termination.
13	Vcc_Tx	Digital Tx Vcc
14	SDA	I2C Data input/output. LVTTTL
15	SCL	I2C Clock input. LVTTTL
16	INT	Interrupt output. LVTTTL with internal 100k Ω pull-up. Active LOW.
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



Ordering Information

Table 11 - Ordering Information

Part No.	Application	Data Rate	Laser Source	Temp. Range
ITR-D3T-SD6-A	GPON ONT	1244.16Mb/s / 2488.32Mb/s	1310nm DFB	-40 to 85°C

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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