BPON ONU Triplexer Transceiver

RTXM170-403

Features

- *Single fiber & Tri-channel*
- *1310nm Tx,1490nm Rx, 1550nm video Rx*
- *LVPECL compatible interface*
- *Burst transmitter/Continuous receiver*
- *870MHz video bandwidth*
- *-40 to +95°C case temperature*
- *operation*
- *Compliant to FSAN G.983 Specifications*
- *Suitable for voice/data/video FTTx*
- *Low EMI and excellent ESD protection*
- *RoHS Compliant*

Application

- ***FTTx networks over APON&BPON***

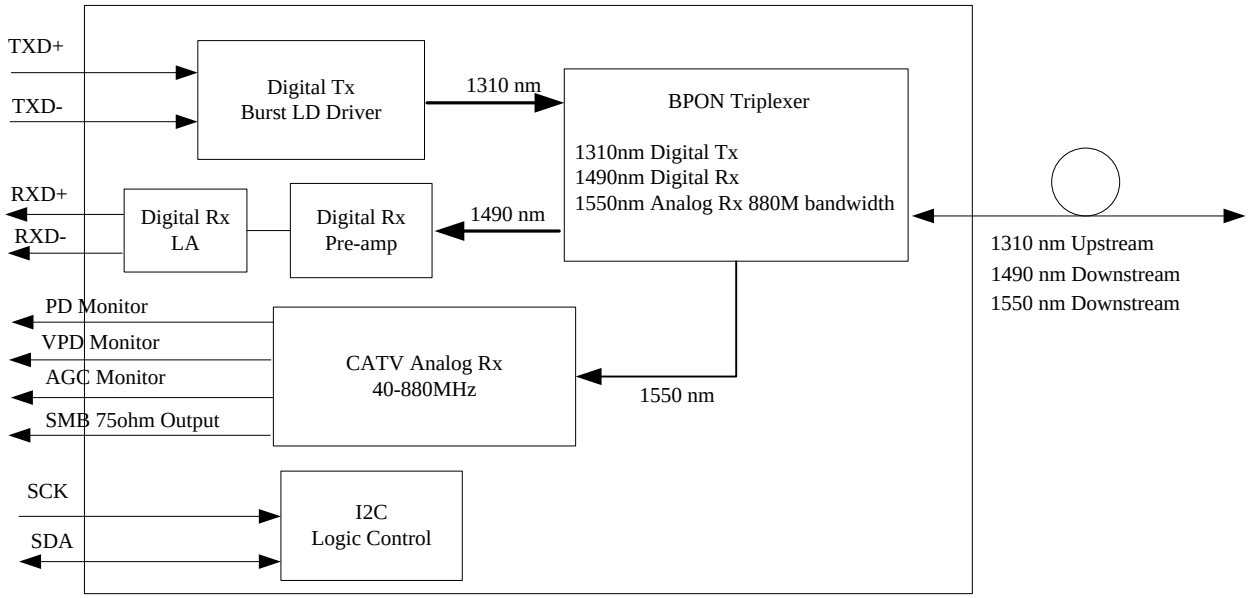
Standards

- ***Compliance with ITUT-T G.983.1 class B+ and G.983.3 class B+ (155.52Mb/s upstream and 622.08Mb/s downstream)***

Description

The transceiver operates at data rates from 155Mbps upstream and 622Mbps downstream. It comprises a Burst Mode optical transmitter and a Continuous Mode optical receiver and a CATV receiver. The transmitter incorporates an Automatic Laser Power Control circuit (APC) to maintain the optical power and extinction ratio over a case temperature of -40°C to +95°C. The transmitter data inputs, burst enable inputs, and receiver data outputs are LVPECL compatible. The transceiver features a diagnostic and control function through a digital serial I2C interface. The triplexer transceiver is contained in a single row, 20-pin package with a SMB RF connector and a single fiber with a standard SC/APC optional connector.

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Unit	Min	Max
Storage Temperature Range	Ts	°C	-40	+95
Operating Ambient Temperature	To	°C	-40	+95
Relative Humidity	RH	%		95
Power Supply Voltage	Vcc	V		4
	Vdd_12V	V		15
	VDD_12V	V		15
Lead Solder Temperature	-	°C		260
Lead Solder Duration	-	S		10
Tensile Force on Pigtail	-	Kg	1.0	
Bending Radius of Pigtail Fiber	-	mm	20	
Buffered Fiber Diameter	-	um	900	
Fiber Length		inches	24.5	27.5
Connector		SC/APC		

Recommended Operating Conditions

Parameter	Symbol	Unit	Min	Max
Case Operating Temperature Range	Tc	°C	-40	+95
Relative Humidity	RH	%	5	95

Specifications *(Tc= -40 ~ +95°C)*

Transmitter and Digital Receiver Optical and Electrical Characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Notes
Transmitter Characteristics						
Power Supply Voltage	Vcc	V	3.135	3.3	3.465	
Power Supply Current	Icc	mA			140	
Bit Rate		Mbps		155.52		1
Operation Wavelength	λp	nm	1260	1310	1360	
Average Optical Output Power	Po	dBm	0	1.5	+4	
Spectral Width	Δλ	nm			4	RMS
Reflectance		dB	-6			@ 1310nm
Average Optical Power Output with Bias Control OR TX Disabled	PO disable	dBm			-40	
Burst Turn On Time	TBURST_ON	ns			12	2
Burst Turn Off Time	TBURST_OFF	ns			12	
Rise/Fall Time(20%-80%)	Tr/f	ps			1000	3
Extinction Ratio	ER	dB	12			3
Data Input Differential Swing	Vin	mv	240		460	4
Input Differential Impedance	Zin	Ω	90	100	110	
Transmitter Burst Control Input Differential Swing	VBURST	mV	240		460	4
Consecutive Identical Digit Immunity	CID	bits	72			
Receiver Digital Characteristics						
Power Supply Voltage	Vcc	V	3.135	3.3	3.465	
Power Supply Current	Icc	mA			125	9
Bit Rate		Mbps		622.08		1
Operation Wavelength	λp	nm	1480	1490	1500	
Maximum Input Power	Pmax	dBm	-6			
Sensitivity	Pmin	dBm			-29	5
Signal Detect Assert Level	PSDA	dBm			-29	6
Signal Detect Dessert Level	PSDD	dBm	-40			7
Signal Detect Hysteresis	PSDA-PSDD	dB	1			
Optical Return Loss		dB	20			@ 1490nm
Data Output Differential Swing		mV	800		1200	8

Isolation from 1550nm to 1490nm		dB	-38	
Isolation from 1310nm to 1490nm		dB	-25	
Rise Time(20% to 80%)	Tr	ps		1000
Jitter				Compliant with ITU-T G.983.3

Note 1: Test in continuous mode.

Note 2: Refer to Timing Parameter Definition in Burst Mode Sequence.

Note 3: Measure with a PRBS 223-1 test pattern @155bps.

Note 4: Compatible with LVPECL input

Note 5: Measure with a PRBS 223-1 test pattern @622bps and ER=10dB, Full Duplex, BER≤10-10

Note 6: A decrease in optical power below the specified level will cause the Signal Detect output to switch from a high state to a low state.

Note 7: An increase in optical power above the specified level will cause the Signal Detect output to switch from a low state to a high state.

Note 8: Compatible with LVPECL output

Note 9: All receiver parameters guaranteed when VCC_TX power to the device is turned off

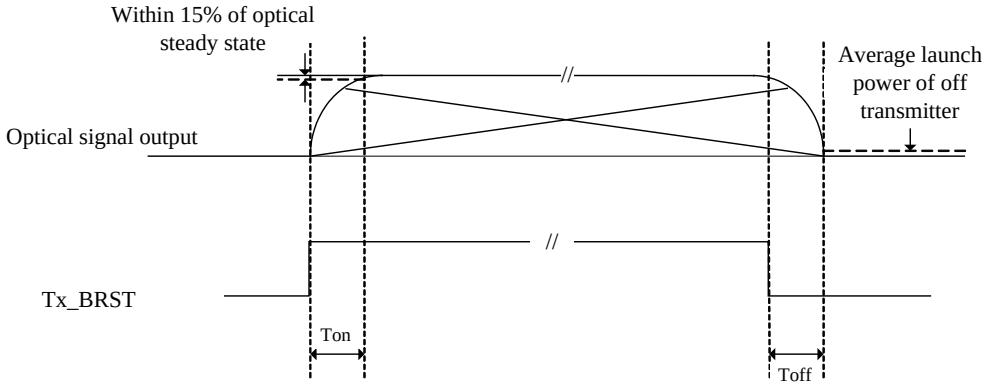


Figure 1 Timing Parameter Definition in Burst Mode Sequence

Analog receiver Optical and Electrical Characteristics

Parameter	Symbol	Unit	Min	Type	Max	Notes
Receiver CATV Characteristics						
Video Receiver Supply Voltage	VDD_12V	V	11.4	12	12.6	
Photo Diode Reverse Bias Supply Voltage	VPD_12V	V	11.4	12	12.6	
Power Supply Current	Icc	mA			200	
Operation Wavelength	λp	nm	1550	1555	1560	
Bandwidth		MHz	50		870	
RF output level		dBmV/ch	16		22	1
Frequency Tilt	S21	dB	3		8	2
RF Output Stability		dB			1	3
Flatness in Band		dB	0		3	
RF AGC Tolerance			0		3	4
Output Impedance	Ro	Ω		75		5
Output Return Loss	S22	dB	12			
CNR	CNR	dBc	48			6

CSO	CSO	dBc	56		7
CTB	CTB	dBc	59		7
Modulation Error Rate		dB	35		8
Optical Dynamic Range		dBm	-6	+1	
Optical Return Loss		dB	30		@1550nm
Analog Discrete Interference		dB		-60	9
Digital Discrete Interference		dB		-45	9

Note 1: Test at 552MHz, OMI=3.4% per channel.

Note 2: Two point tilt calculation:55MHz and 870MHz.

Note 3: RF Outputs level stability over any 5 minutes period

Note 4: Maximum AGC variation over specified Optical Input Range with any combination of channels.

Note 5: SMB jack RF Connector.

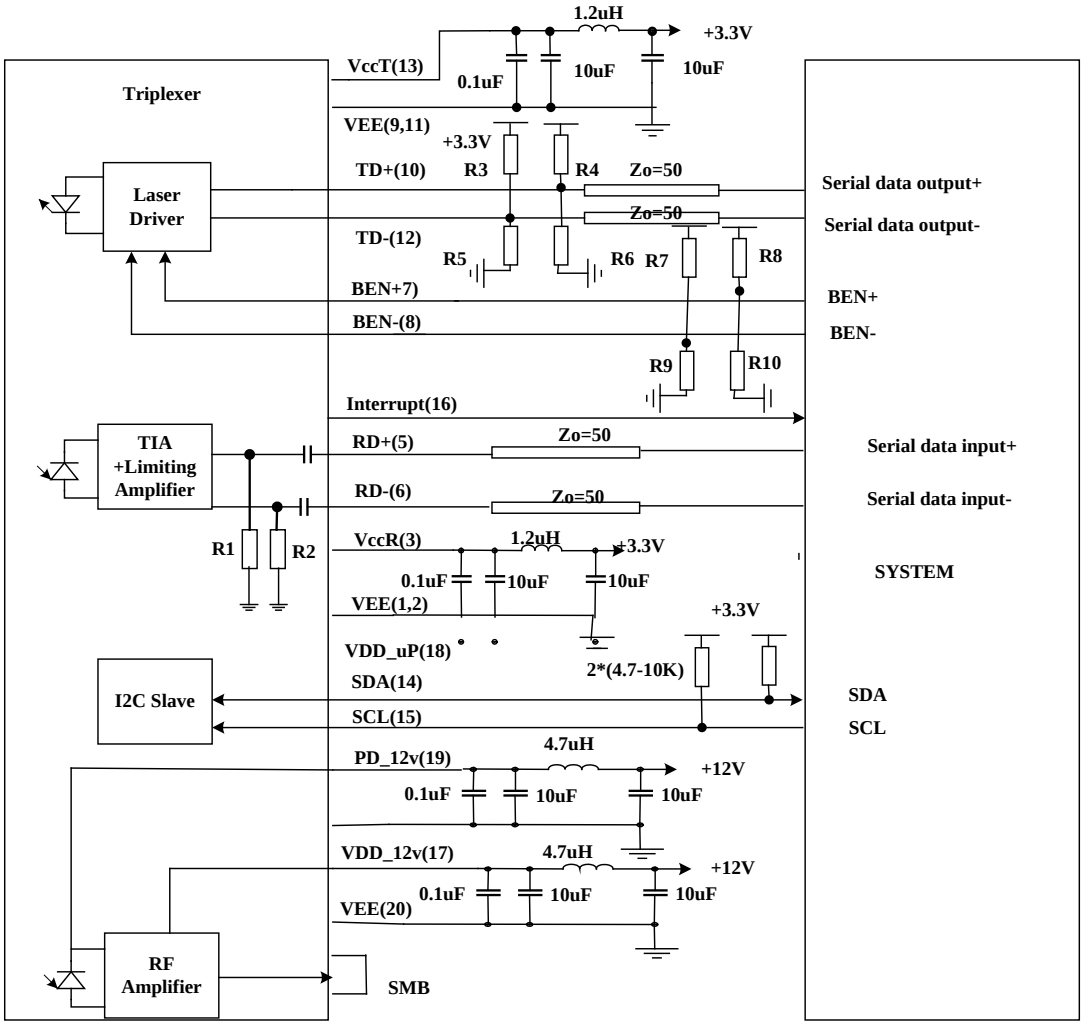
Note 6: Test at –5dBm, OMI=3.4%, 72CW Analog Channels,63 QAM.

Note 7: Test at +1dBm, OMI=3.4%, 72CW Analog Channels,63 QAM.

Note 8: Shall meet minimum for 72CW Analog Channels, 63 QAM.

Note 9: Shall meet minimum RF Output ratio of carrier to any discrete interference. (Ingress Noise)

Typical Application Circuit



R1=R2=150Ω;R3=R4=R9=R10=130Ω:R5=R6=R7=R8=82Ω

Pin Description

Pin	Function	Description	Notes
1	GND	Common ground for entire device	
2	GND_RX	Digital Receiver ground	
3	VCC_RX	Digital Receiver Power:+3.3V	
4	C2CK/RST	Reset Bar	
5	RXD+	Digital Receiver RX+ Data Positive Output	1
6	RXD-	Digital Receiver RX- Data Negative Output	1
7	BEN+	TX Burst Enable Positive (Logic 0 is enabled)	1
8	BEN-	TX Burst Enable Negative (Logic 1 is enabled)	1
9	GND_TX	Digital Transmitter Ground	
10	TXD+	Input for Digital TX Data Positive	2
11	C2Data	C2 Data for programming microP.	3
12	TXD-	Input for Digital TX Data Negative	2
13	VCC_TX	Digital Transmitter Power:+3.3V	
14	SDA	I2C Data Output (Optical Transceiver is a slave device)	4
15	SCL	I2C Clock Input (Optical Transceiver is a slave device)	4
16	Interrupt	Interrupt signal of the Micro Processor	
17	VDD_12V	Video Receiver Power: +12V	
18	Vcc_uP	Micro Processor Power: +3.3V	
19	Video Vdd PD	+12V Video 1550nm Photo Diode Reverse Bias	
20	GND	Common ground for entire device	
SMB	RF Output	Analog Receiver RF Analog Output (75Ω), SMB	5

Note 1: LVPECL logic output, AC coupled internally.

Note 2: LVPECL logic input, which is DC coupled without internal termination.

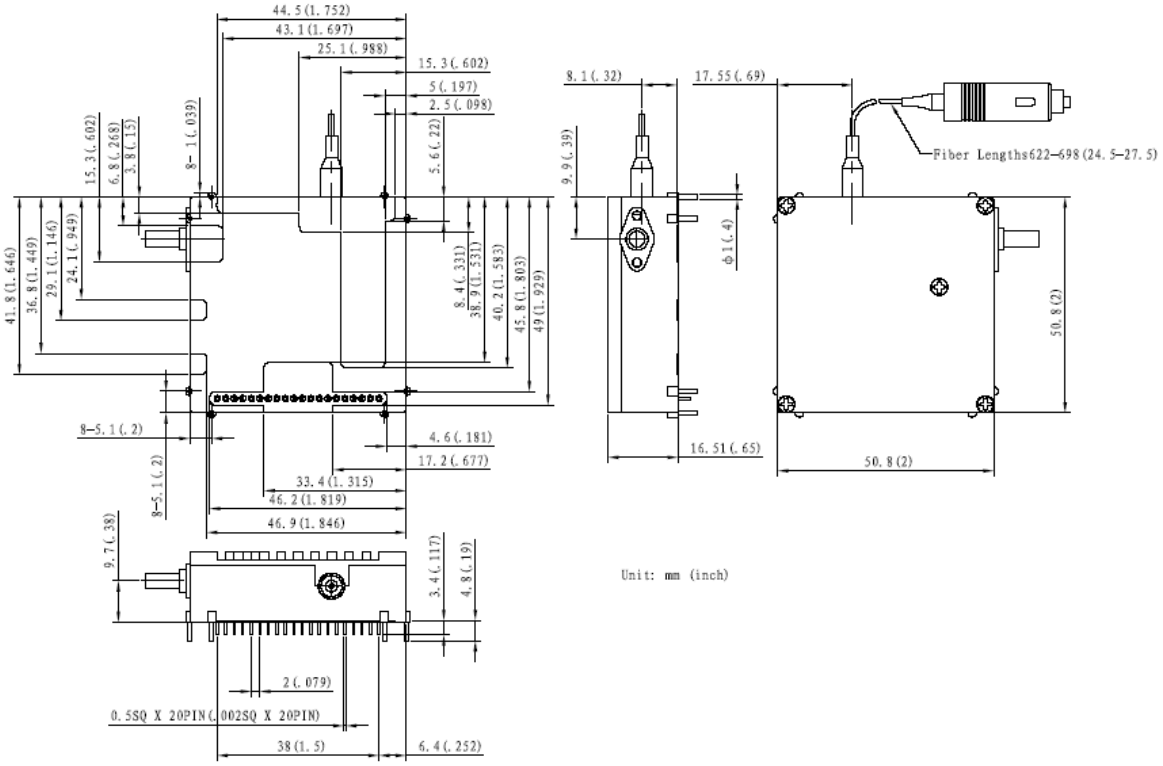
Note 3: The system is permitted to connect this pin to ground

Note 4: I^2C bus

Note 5: SMB Jack connector.

Package Outline

Unit:mm



I²C address information *(Compliance with SFF-8472 protocol)*

I²C address	Address	number	description	property	Example values
A0	00-0B	12	Customer Module part Number	ASCII code	
A0	0C	1	Upstream Bit Rate	Unsigned Binary	16d
A0	0D	1	Downstream Bit Rate	Unsigned Binary	62d
A0	10	1	Min. RF Level Output level	Unsigned Binary	1 d
A0	11	1	Low Level Optical Video Pwr	2 Comp binary	-50 d
A0	12	1	High Level Optical Video Pwr	2 Comp binary	10 d
A0	13	1	Nominal RF Tilt	Unsigned Binary	40 d
A0	14-23	16	Module Vendor Name	ASCII code	WTD
A0	25	1	RF Bandwidth	Unsigned Binary	1 d
A0	32	1	1550 PD Responsivity	Unsigned Binary	85 d
A0	38-3B	4	Revision Level	ASCII code	
A0	3C	1	Digital TX wavelength	Unsigned Binary	131d
A0	3D	1	Digital RX wavelength	Unsigned Binary	149d
A0	44-53	16	Serial Number	ASCII code	006
A0	54-5B	8	Manufactured Date code	ASCII code	070924
A0	5D	1	Diagnostic Monitoring(if Any)	Unsigned Binary	24 d

A0	60-7D	30	Vendor Part Number	ASCII code	RTXM170-403

Customer Module Part Number

The Customer Part Number is a 12-character field that contains ASCII characters, left-aligned and padded to the right with ASCII spaces (20h). This field contains the customer specific part number, if required.
Module Vendor Name
The Vendor Name is a 16-character field that contains ASCII characters, left-aligned and padded to the right with ASCII spaces (20h).

Vendor Rev

The Vendor Revision Number (Vendor Rev) is a 4-byte field that contains ASCII characters, left-aligned and padded on the right with ASCII spaces (20h), defining the vendor's product revision number. A value of all zero in the 4-byte field indicates that the vendor revision number is unspecified.

Serial Number

The Vendor Serial Number (vendor SN) is a 16-character field that contains ASCII characters, left-aligned and padded on the right with ASCII spaces (20h), defining the serial number for the transceiver. A value of all zero in the 16-byte field indicates that the vendor serial number is unspecified.

Manufactured Date Code

The manufacturing date code is an 8-byte field that contains the date code in ASCII characters. The date code is stored in the format specified
84-85 ASCII code, two low order digits of year. (07 = 2007)
86-87 ASCII code, digits of month (01 = Jan through 12 = Dec)
88-89 ASCII code, day of month (01 - 31)
90-91 ASCII code, vendor specific lot code, may be blank

Diagnostic Monitoring Type

This field is adapted directly from the small-form-factor transceiver diagnostic monitoring interface specification. This 8-bit field indicates which type of diagnostic monitoring is implemented. Table below describes the significance of each bit.

Data Address	Bits	Description	Setting
92	7	Reserved for legacy diagnostic implementations. Must be '0' for compliance with this document	0
92	6	Digital diagnostic monitoring implemented per SFF-8472	0
92	5	Internally Calibrated	0

92	4	Externally Calibrated	1
92	3	Received power measurement type, 0 = OMA, 1 = Average Power	1
92	2	1 = Address change required. 0 = not required. See SFF-8472 for "addressing modes change".	0
92	1-0	Reserved	0

Vendor Part Number

The vendor part number is a 30-byte field that contains ASCII characters, left-aligned and padded on the right with ASCII spaces (20h), defining the part number or product name. A value of all zero in the 30-byte field indicates that the vendor PN is unspecified.

BR, Upstream

The nominal upstream bit rate is specified in units of 10 Megabits per second, rounded off to the nearest 10 Megabits per second. The upstream bit rate includes those bits necessary to encode and delimit the signal as well as those bits carrying data information. A value of 0 indicates that the bit rate is not specified and must be determined from the module technology. The actual information transfer rate will depend on the encoding of the data, as defined by the encoding value. For example, a value of 16d is interpreted as 160Mbps.

BR, Downstream

The nominal downstream bit rate is specified in units of 10 Megabits per second, rounded off to the nearest 10 Megabits per second. The downstream bit rate includes those bits necessary to encode and delimit the signal as well as those bits carrying data information. A value of 0 indicates that the bit rate is not specified and must be determined from the module technology. The actual information transfer rate will depend on the encoding of the data, as defined by the encoding value. For example, a value of 62d is interpreted as 620Mbps.

Digital TX Wavelength

The digital TX Wavelength is the nominal transmitter output wavelength at room temperature represented as an unsigned binary number. This 8-bit value is specified in units of 10nm, rounded off to the nearest 10nm. For example, a value of 131d is interpreted as 1310nm.

Digital RX Wavelength

The digital RX Wavelength is the nominal digital receiver input wavelength at room temperature represented as an unsigned binary number. This 8-bit value is specified in units of 10nm, rounded off to the nearest 10nm. For example, a value of 149d is interpreted as 1490nm.

Minimum RF Output Level

The Minimum RF Output Level is the specified minimum peak RF level output per channel for a defined set of conditions including frequency, OMI, channel loading, and carrier. The Minimum RF Output Level is represented as an unsigned binary number corresponding to the lookup table provided by the vendor.
The default value is 1 for current release.

Byte Value	RF(dBmV)	Freq (MHz)	OMI (%)	Loading Condition	Carrier Type
1	16.0	550	3.5	72 Analog + 63 digital	Modulated

Low Video Input Power

The Low Video Input Power is the specified minimum video optical input power. The Low Video Input Power is represented as a two's complement binary number. The MSB represents the sign bit, where a "1" indicates a negative number. If the MSB is a "1", then standard two's complement conversion to decimal applies to determine the negative decimal equivalent number. The converted decimal value represents the Low Video Input Power in units of 0.1 dBm. For example, a 10110010 value (-32h or -50d) is interpreted as –5.0dBm.

High Video Input Power

The High Video Input Power is the specified maximum video optical input power. The High Video Input Power is represented as a two's complement binary number. The MSB represents the sign bit, where a "1" indicates a negative number. If the MSB is a "1", then standard two's complement conversion to decimal applies to determine the negative decimal equivalent number. The converted decimal value represents the High Video Input Power in units of 0.1 dBm. For example, a 00001010 value (0Ah or 10d) is interpreted as +1 .0dBm.

Nominal RF Tilt

The Nominal RF Tilt is the specified nominal change in RF output power over the RF Bandwidth under the condition of (or corrected for) a flat RF input. The Nominal RF Tilt is represented as an unsigned binary number. The converted decimal value represents the Nominal RF Tilt in units of 0.1dB. For example, a 00101000 value (or 40d) is interpreted as +4.0dB.

RF Bandwidth

The RF Bandwidth is the specified upper and lower limit of the input video bandwidth. The RF Bandwidth is represented as an unsigned binary number corresponding to the lookup table A.5 below. The default value is 1 for current release.

Byte Value	Lower Limit (MHz)	Upper Limit (MHz)
1	54	870

Responsivity

The Responsivity is the specific measured value for the unit at the Low Video Input Power. The Responsivity is represented as an unsigned binary number. This 8-bit value is specified in units of 0.01mA/mW. For example, a value of 85d is interpreted as 0.85mA/mW.

A2	00-01	2	Temperature High Alarm	16 bit signed	Set to 95 °C
A2	02-03	2	Temperature High Warn	16 bit signed	Set to 85 °C
A2	04-05	2	Temperature Low Alarm	16 bit signed	Set to -50 °C
A2	06-07	2	Temperature Low Warn	16 bit signed	Set to-40 °C
A2	08-09	2	Vcc High Alarm	16 bit unsigned	Set to 3.6 V
A2	0A-0B	2	Vcc High Warn	16 bit unsigned	Set to 3.5 V
A2	0C-0D	2	Vcc Low Alarm	16 bit unsigned	Set to 3.0 V
A2	0E-0F	2	Vcc Low Warn	16 bit unsigned	Set to 3.1 V
A2	10-11	2	VideoOpt High Alarm	16 bit unsigned	Set to -6.0 dBm
A2	12-13	2	VideoOpt HighWarn	16 bit unsigned	Set to -5.0 dBm
A2	14-15	2	VideoOpt Low Alarm	16 bit unsigned	Set to +2.0 dBm
A2	16-17	2	VideoOpt Low Warn	16 bit unsigned	Set to +1.0 dBm
A2	18-19	2	RFMon High Alarm	16 bit unsigned	Set to 1300mV
A2	1A-1B	2	RFMon High Warn	16 bit unsigned	Set to 1200 mV
A2	1C-1D	2	RFMon Low Alarm	16 bit unsigned	Set to 900mV
A2	1E-1F	2	RFMon Low Warn	16 bit unsigned	Set to 1000 mV
A2	20-21	2	Reserved		
A2	22-23	2	Reserved		
A2	24-25	2	Reserved		
A2	26-27	2	Reserved		
A2	30	1	Reserved	8 bit unsigned	
A2	32	1	RF Offset	8 bit signed	
A2	3A-3B	2	RFMON delta	16 bit signed	
A2	5D-5E	2	Version	16 bit unsigned	
A2	60-61	2	Temperature realtime monitor	16 bit signed	
A2	62-63	2	Vcc-Up Voltage realtime monitor	16 bit unsigned	
A2	64-65	2	CATV Power realtime monitor	16 bit unsigned	
A2	66-67	2	RF Power realtime monitor	16 bit unsigned	
A2	68-69	2			
A2	6E	1	Unit Status Control	8 bit unsigned	
				Bit7	
				Bit6	
				Bit5	Hold AGC
				Bit4	Tx-Dis
				Bit3	Video-EN
				Bit2	TX -Fault
				Bit1	Interrupt
				Bit0	SD
A2	6F	1	Reserved	8 bit unsigned	

A2	70	1	Interrupt Service Routine0	8 bit unsigned
A2	71	1	Interrupt Service Routine1	8 bit unsigned
A2	72	1	Interrupt Mask0	8 bit unsigned
A2	73	1	Interrupt Mask1	8 bit unsigned
A2	74	1	Interrupt Service Routine2	8 bit unsigned
A2	78	1	Save/Reset	8 bit unsigned 0x01=Reset 0x02=Save Data

RF Offset

The RF Offset is stored as an 8-bit signed binary and is read or write. For feedback operation: the function of the RF_offset is to correct the output RF levels for different channel plan conditions. Each incremental step above/below zero in registrar 32 results in a corresponding 0.1 dB increase/decrease in the RF level (i.e.02h =+0.2dB RF, FEh = -0.2dB RF).

For the default condition, 72 analog channels+63 digital channels with OMI=3.5%

Internal Temp

The Internal Temp field indicates the nominal module internal temperature level. The data is stored in a 16-bit, 2's complement binary format. The high order byte represents a temperature value in the range from -128 °C to +127 °C. The low order byte represents the fractional temperature value. To calculate the value of the temperature, treat the 2's complement binary number as an unsigned number, convert it to decimal, and divide by 256. If the result is greater than or equal to 128, then subtract 256 from the result. Table A.6 defines the bit weights of the 16 bit binary representation of the temperature. Table A.7 illustrates some temperature conversion examples.

S	26	25	24	23	22	21	20
2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8

Temperature word bit weights.

MSB (Hex)	LSB (Hex)	Temperature (°C)
2D	00	45.000
2D	0F	45.059
EC	00	-20.000
D8	00	-40.000
FF	FF	-0.004

Digital VCC

The digital VCC level is stored as a 16-bit unsigned binary number. To calculate the value of VCC, convert the

unsigned 16-bit value to decimal and perform the necessary conversion.

$$V_{CC} = 2.44V \times \left(1 + \frac{X_d}{512}\right)$$

For example: C4h => 196d => 3.374V

CATV Power Monitor Voltage

The Photo-Diode (PD) Monitor Voltage level is stored as a 16-bit unsigned binary number.

$$VPDMON = 2.44V \times \frac{X_d}{1024}$$

To determine the actual analog optical power level, the photocurrent needs to be divided by the photodetector Responsivity, usually expressed in mA/mW. The Responsivity of the analog photodetector is available in the memory position 32h of the memory block A0h. The analog photodetector optical power level is given by:

$$P_{Analog}(mW) = \frac{VPDMON}{Resistor \times Responsivity}$$

and in dBm:

$$P_{Analog}(dBm) = 10 * \log_{10}\left(\frac{VPDMON}{Resistor \times Responsivity}\right)$$

The vendor shall calibrate the data Xd in this register so that the above formula results in an accurate analog input power level. The default resister value is 500 Ohm

RF Monitor Voltage

The RF Monitor Voltage is stored as a 16-bit unsigned binary number. To calculate the value of the RF Monitor Voltage, convert the unsigned 16-bit value to decimal and perform the necessary conversion.

$$RFMON = 2.44V \times \frac{X_d}{1024}$$

When the AGC is locked, the RF power is independent of optical input power but not independent of OMI or channel loading. When the AGC is not locked due to low optical input power, then the RF Monitor Voltage will decrease around 20 mV per 1 dB drop in output RF level.

Byte 6E, bit 0: SD

The Signal Detect is stored as a bit and is read only. Active high with 1490nm RX data is present.

Byte 6E, bit 1: Interrupt

The Interrupt is accessible via the two-wire serial bus and is stored as a single, read only bit stored in location 6Eh, bit 1.

Byte 6E, bit 2: TX_Fail

The TX_Fail is stored as a bit and is read only. 0=TX fail, 1=TX normal.

Byte 6E, bit 3: V_EN

The Video Circuit On is stored as a bit and is read or write. 1=Video enabled, 0=Video disabled. This feature drops the current consumption of the 12Vsupply from <200mA to <10mA and drops the RF output power by >50dB.

Byte 6E, bit 4: TX_DIS

The TX Disable is stored as a bit and is read or write. 0=TX enabled, 1=TX disabled.

Byte 6E, bit 5: HOLD_AGC

Hold AGC (clears on boot). If set, AGC will not attempt to correct for changes on VPD, instead it will hold the attenuator at the current level.

Regulatory Compliance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class 1 (>1.5kV) – Human Body Model
Electrostatic Discharge (ESD) Immunity	IEC61000-4-2	Class 2(>4.0kV)
Electromagnetic Interference (EMI)	CISPR22 ITE Class B EN55022 Class B	Compliant with standards
Immunity	IEC61000-4-3 Class 2 EN55024	Typically show no measurable effect from a 3V/m field swept from 80 to 1000MHz applied to the transceiver without a chassis enclosure.
Eye Safety	FDA 21 CFR 1040.10 And 1040.11 UL TUV	Compliant with Class 1 laser product
	GR-468 –CORE GR-1089-CORE GR-78-CORE	

Ordering Information

Part No	Specifications								Application
	Package	Rate	Tx	Pout	Rx	Sensitivity	Temp	others	
RTXM170-403	1×20	Tx: 155Mbps Rx: 622Mbps CATV:50~870MHz	1310nm FP-LD	0~4dBm	Digital: 1490nm PIN CATV: 1550nm PIN	< -29dBm	-40~+95°C	RoHS	APON BPON

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