6.144Gb/s BIDI SFP+ transceiver

RTXM228-661/662

Features

- *Compliant to SFP+ MSA*
- *Up to 6.144Gbps data rate*
- *Transmission distance up to 15km*
- *Fully RoHS Compliant*
- *Single LC receptacle optical interface compliant*
- *Single +3.3V power supply*
- *Hot pluggable 20pin connector*
- *Low power consumption <1.2W*
- *-40°C to 85°C operating wide temperature range*
- *Digital Monitoring SFF-8472 Rev 10 compliant*
- *Real time monitoring of:*
  Transmitted optical power
  Received optical power
  Laser bias current
  Temperature
  Supply voltage

Application

- *Wireless and cellular base station system interconnect:*
  OBSAI rates 3.072 Gb/s, 6.144Gb/s
  CPRI rates 2.4576 Gb/s, 4.9152Gb/s, 6.144Gb/s

- *2G/4G FC Data Storage*

Standards

- *SFF-8431 Rev 2.0*
- *SFF-8472 Rev 10.2*

Absolute Maximum Ratings

Parameter	Symbol	Unit	Min	Max
Storage Temperature Range	Ts	°C	-40	+85
Relative Humidity	RH	%	5	95
Power Supply Voltage	Vcc	V	-0.3	+4

Recommended Operating Conditions

Parameter	Symbol	Unit	Min	Typ	Max
Operating Case Temperature Range	Tc	°C	-40		85
Power Supply Voltage	Vcc	V	3.13	3.3	3.46
Bit Rate	BR	Gb/s	2.4576		6.144
Bit Error Ratio	BER				10^{-12}
Max Supported Link Length	L	Km			15

Electrical Characteristics *(Tc= -40~85°C and Vcc= 3.14 to 3.46)*

Parameter	Symbol	Unit	Min	Typ	Max	Notes
Supply Voltage	V_{CC}	V	3.14	3.3	3.46	
Supply Current	Icc	mA			345	
Power Consumption	Pc	W			1.2	
Transmitter						
Input Differential Impedance	R_{IN}	Ω	80	100	120	
Differential Data Input Swing	V_{IN}	mVp-p	180		700	
Transmit Disable Voltage	V_{DIS}	V	2		V_{CCHOST}	
Transmit Enable Voltage	V_{EN}	V	V_{EE}		V_{EE}+0.8	
Transmit Fault Assert Voltage	V_{FA}	V	2.2		V_{CCHOST}	

Transmit Fault De-Assert Voltage	V_{FDA}	V	V_{EE}		V_{EE}+0.4
Receiver					
Differential Data Output Swing	V_{OD}	mVp-p	450	600	850
Output Rise Time	t_{RISE}	pS			60
Output Fall Time	t_{FALL}	pS			60
LOS Fault	V_{LOSFT}	V	2		V_{CCHOST}
LOS Normal	V_{LOSNR}	V	V_{EE}		V_{EE}+0.8

Optical Characteristics *(Tc= -40~85°C and Vcc= 3.14 to 3.46)*

Parameter	Symbol	Unit	Min	Typ	Max	Notes
Transmitter						
Average output power	Po	dBm	-8.4		+0.5	1
Center Wavelength	λc	nm	1263		1277	
			1323		1337	
Extinction Ratio	EX	dB	3.5			
Spectral Width (-20dB)	Δλ	nm			1	3
SMSR		dB	30			
Relative Intensity Noise	RIN	dB/Hz			-128	
Laser Off Power	P_{OFF}	dBm			-35	
Link Power Budget		dB		9.4		4,5
Receiver						
Center Wavelength	λc	nm	1263		1277	
			1323		1337	
Receiver Sensitivity (OMA)	R_{SENSE1}	dBm			-13.8	2
Overload Input Optical Power	Pover	dBm	+0.5			2
Receiver Reflectance	R_{REFL}	dB			-12	
LOS Assert LOS	LOS_D	dBm	-30			
LOS De-Assert LOS	LOS_A	dBm			-15	
LOS Hysteresis		dB	0.5			

Note 1: *Minimum output optical level is at end of life*

Note 2: *Sensitivity for PRBS 2^7-1 and BER better than or equal to 10E-12*

Note 3: *Spectral width has to be defined over -20dBm*

Note 4: *Budget numbers are rounded to nearest 0.1 dB*

Note 5: *Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.*

Pin function definitions

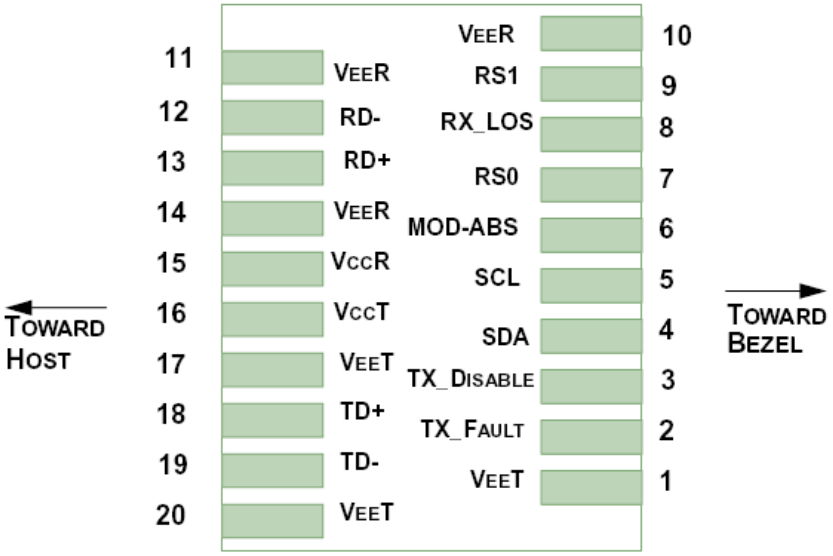


Figure 2: Pin function definitions

Table 1: Transceiver pin descriptions

Pin Number	Symbol	Name	Description
1,17,20	VeeT	Transmitter Signal Ground	These pins should be connected to signal ground on the host board.
2	TX Fault	Transmitter Fault Out (OC)	Logic “1” Output = Laser Fault (Laser off before t_fault) Logic “0” Output = Normal Operation This pin is open collector compatible, and should be pulled up to Host Vcc with a 10kΩ resistor.
3	TX Disable	Transmitter Disable In (LVTTL)	Logic “1” Input (or no connection) = Laser off Logic “0” Input = Laser on This pin is internally pulled up to VccT with a 10 kΩ resistor.
4	SDA	Module Definition Identifiers	Serial ID with SFF 8472 Diagnostics Module Definition pins should be pulled up to Host Vcc with 10 kΩ resistors.
5	SCL		
6	MOD-ABS		
7	RS0	Receiver Rate Select (LVTTL) Transmitter Rate Select (LVTTL)	These pins have an internal 33kΩ pull-down to ground. A signal on either of these pins will not affect module performance.
9	RS1		
8	LOS	Loss of Signal Out (OC)	Sufficient optical signal for potential BER < $1x10^{-12}$ = Logic “0” Insufficient optical signal for potential

			BER < $1x10^{-12}$ = Logic "1" This pin is open collector compatible, and should be pulled up to Host Vcc with a 10kΩ resistor.
10,11,14	VeeR	Receiver Signal Ground	These pins should be connected to signal ground on the host board.
12	RD-	Receiver Negative DATA Out (CML)	Light on = Logic "0" Output Receiver DATA output is internally AC coupled and series terminated with a 50Ω resistor.
13	RD+	Receiver Positive DATA Out (CML)	Light on = Logic "1" Output Receiver DATA output is internally AC coupled and series terminated with a 50Ω resistor.
15	VccR	Receiver Power Supply	This pin should be connected to a filtered +3.3V power supply on the host board. See Figure 3.Recommended power supply filter
16	VccT	Transmitter Power Supply	This pin should be connected to a filtered +3.3V power supply on the host board. See Figure 3.Recommended power supply filter
18	TD+	Transmitter Positive DATA In (CML)	Logic "1" Input = Light on Transmitter DATA inputs are internally AC coupled and terminated with a differential 100Ω resistor.
19	TD-	Transmitter Negative DATA In (CML)	Logic "0" Input = Light on Transmitter DATA inputs are internally AC coupled and terminated with a differential 100Ω resistor.

Typical application circuit

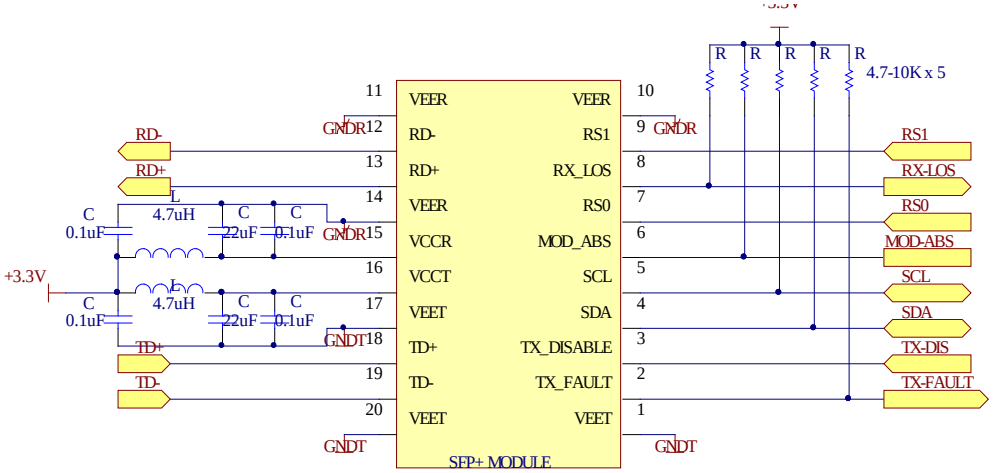


Figure 3: Typical application schematics

Electrostatic Discharge (ESD)

The RTXM228 is compatible with ESD levels found in typical manufacturing and operating environments as described in Table 2. In the normal handling and operation of optical transceivers, ESD is of concern in two circumstances.

The first case is during handling of the transceiver prior to insertion into an SFP+ compliant cage. To protect the device, it's important to use normal ESD handling pre-cautions. These include use of grounded wrist straps, work-benches and floor wherever a transceiver is handled.

The second case to consider is static discharges to the exterior of the host equipment chassis after installation. If the optical interface is exposed to the exterior of host equipment cabinet, the transceiver may be subject to system level ESD requirements.

Electromagnetic Interference (EMI)

Equipment incorporating gigabit transceivers is typically subject to regulation by the FCC in the United States, CENELEC EN55022 (CISPR 22) in Europe and VCCI in Japan. The RTXM228 compliance to these standards is detailed in Table 2. The metal housing and shielded design of the RTXM228 minimizes the EMI challenge facing the equipment designer.

EMI Immunity (Susceptibility)

Due to its shielded design, the EMI immunity of the RTXM228 exceeds typical industry standards.

Table 2: Regulatory compliance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883C Method 3015.4	Class 1 (> 1500 Volts)
Electrostatic Discharge (ESD) to the Duplex LC Receptacle	Variation of IEC 61000-4-2	Typically, no damage occurs with 15 kV when the duplex LC connector receptacle is contacted by a Human Body Model probe.
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.
RoHS Compliance		Less than 1000 ppm of cadmium, lead, mercury, hexavalent chromium, polybrominated biphenyls, and polybrominated biphenyl ethers.

Digital Diagnostic Interface Definition

The 2-wire serial interface addresses of the SFP+ module are 1010000x (A0h) and 1010001x (A2h). Shown in Figure 4.

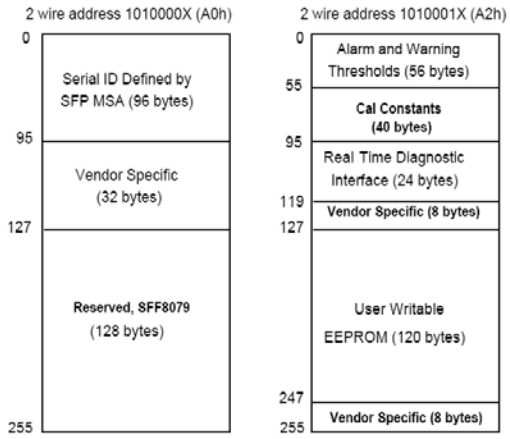


Figure 4: Digital Diagnostic Memory Map

Accessing Serial ID Memory uses the 2 wire address 1010000X (A0). Memory Contents of Serial ID are shown in Table 3.

Table 3: Serial ID Memory Contents

Data Address	Size (Bytes)	Name of Field	Contents(Hex)	Description
		BASE ID FIELDS		
0	1	Identifier	03	SFP+
1	1	Ext. Identifier	04	SFP function is defined by serial ID only
2	1	Connector	07	LC Connector
3-10	8	Transceiver		Transceiver Codes
11	1	Encoding	03	NRZ
12	1	BR, Nominal	3D	6.144Gbit/s
13	1	Reserved		
14	1	Length (9μm) km	0F	Transceiver transmit distance 15km
15	1	Length (9μm) 100m	00	
16	1	Length (50μm) 10m	00	
17	1	Length(62.5μm)10m	00	
18	1	Length (Copper)	00	Not compliant
19	1	Reserved		
20-35	16	Vendor name	57 54 44 20 20 20 20 20 20 20 20 20 20 20 20 20	“WTD”(ASCII)
36	1	Reserved		
37-39	3	Vendor OUI	00 1C AD	
40-55	16	Vendor PN		Transceiver part number
56-59	4	Vendor rev	20 20 20 20	

60-61	2	Wavelength		Transceiver wavelength
62	1	Reserved		
63	1	CC_BASE	Check Sum (Variable)	Check code for Base ID Fields
			EXTENDED ID FIELDS	
64-65	2	Options	00 1A	TX_DISABLE, TX_FAULT and Loss of Signal implemented.
66	1	BR,max	00	
67	1	BR,min	00	
68-83	16	Vendor SN	42 30 30 39 38 32 32 20 20 20 20 20 20 20 20 20	Serial Number of transceiver (ASCII). For example “B009822”.
84-91	8	Date code	30 32 31 30 30 35 20 20	Manufactory date code. For example “021005”.
92	1	Diagnostic Monitoring Type	68	Digital diagnostic monitoring implemented, “internal calibrated” is implemented, RX measurement type is Average Power.
93	1	Enhanced Options	F6	Optional Alarm/Warning flags implemented for all monitored quantities, Optional Soft TX_FAULT monitoring implemented, Optional Soft RX_LOS monitoring implemented.
94	1	SFF_8472 Compliance	03	Includes functionality described in Rev10.2 SFF-8472.
95	1	CC_EXT	Check Sum (Variable)	Check sum for Extended ID Field.
			VENDOR SPECIFIC ID FIELDS	
96-127	32	Vendor Specific	Read only	Depends on customer information
128-255	128	Reserved	Read only	

Diagnostic Monitor Functions

Diagnostic Monitor Functions interface uses the 2 wire address 1010001X (A2). Memory contents of Diagnostic Monitor Functions are shown in Table 4

Table 4: Memory contents of Diagnostic Monitor Function

Data Address	Field Size (bytes)	Name	Contents and Description
		Alarm and Warning Thresholds	
00-01	2	Temperature High Alarm	
02-03	2	Temperature Low Alarm	
04-05	2	Temperature High Warning	
06-07	2	Temperature Low Warning	
08-09	2	Vcc High Alarm	
10-11	2	Vcc Low Alarm	
12-13	2	Vcc High Warning	

14-15	2	Vcc Low Warning	
16-17	2	Bias High Alarm	
18-19	2	Bias Low Alarm	
20-21	2	Bias High Warning	
22-23	2	Bias Low Warning	
24-25	2	TX Power High Alarm	
26-27	2	TX Power Low Alarm	
28-29	2	TX Power High Warning	
30-31	2	TX Power Low Warning	
32-33	2	RX Power High Alarm	
34-35	2	RX Power Low Alarm	
36-37	2	RX Power High Warning	
38-39	2	RX Power Low Warning	
40-55	16	Reserved	
		Calibration Constants	
56-59	4	RX Power Calibration Data4	00 00 00 00
60-63	4	RX Power Calibration Data3	00 00 00 00
64-67	4	RX Power Calibration Data2	00 00 00 00
68-71	4	RX Power Calibration Data1	3F 80 00 00
72-75	4	RX Power Calibration Data0	00 00 00 00
76-77	2	Bias Calibration Data1	01 00
78-79	2	Bias Calibration Data0	00 00
80-81	2	TX Power Calibration Data1	01 00
82-83	2	TX Power Calibration Data0	00 00
84-85	2	Temperature Calibration Data1	01 00
86-87	2	Temperature Calibration Data0	00 00
88-89	2	Vcc Calibration Data1	01 00
90-91	2	Vcc Calibration Data0	00 00
92-94	3	Reserved	
95	1	Check Sum	
		Real Time Diagnostic Monitor Interface	
96-97	2	Measured Temperature	
98-99	2	Measured Vcc	
100-101	2	Measured Bias	
102-103	2	Measured TX Power	
104-105	2	Measured RX Power	
106-109	4	Reserved	
110	1	Logic Status	
111	1	AD Conversion Updates	
112-119	8	Alarm and Warning Flags	
		Vendor Specific	
120-127	8	Vendor Specific	

128-247	120	User writable EEPROM
248-255	8	Vendor Specific

Transceiver Timing Characteristics

(Tc=-40 °C to 85 °C and VccT, VccR = 3.145 to 3.465)

Parameter	Symbol	Minimum	Maximum	Unit	Notes
Hardware TX_DISABLE Assert Time	t_off		10	μs	1
Hardware TX_DISABLE Negate Time	t_on		1	ms	2
Time to initialize including reset of TX_FAULT	t_init		300	ms	3
Hardware TX_FAULT Assert Time	t_fault		100	μs	4
Hardware TX_DISABLE to Reset	t_reset	10		μs	5
Hardware RX_LOS DeAssert Time	t_loss_on		100	μs	6
Hardware RX_LOS Assert Time	t_loss_off		100	μs	7
Software TX_DISABLE Assert Time	t_off_soft		100	ms	8
Software TX_DISABLE Negate Time	t_on_soft		100	ms	9
Software Tx_FAULT Assert Time	t_fault_soft		100	ms	10
Software Rx_LOS Assert Time	t_loss_on_soft		100	ms	11
Software Rx_LOS De-Assert Time	t_loss_off_soft		100	ms	12
Analog parameter data ready	t_data		1000	ms	13
Serial bus hardware ready	t_serial		300	ms	14
Write Cycle Time	t_write		10	ms	15
Serial ID Clock Rate	f_serial_clock		400	kHz	

Note 1: *Time from rising edge of TX_DISABLE to when the optical output falls below 10% of nominal.*

Note 2: *Time from falling edge of TX_DISABLE to when the modulated optical output rises above 90% of nominal.*

Note 3: *Time from power on or falling edge of Tx_Disable to when the modulated optical output rises above 90% of nominal.*

Note 4: *From power on or negation of TX_FAULT using TX_DISABLE.*

Note 5: *Time TX_DISABLE must be held high to reset the laser fault shutdown circuitry.*

Note 6: *Time from loss of optical signal to Rx_LOS Assertion.*

Note 7: *Time from valid optical signal to Rx_LOS De-Assertion.*

Note 8: *Time from two-wire interface assertion of TX_DISABLE (A2h, byte 110, bit 6) to when the optical output falls below 10% of nominal. Measured from falling clock edge after stop bit of write transaction.*

Note 9: *Time from two-wire interface de-assertion of TX_DISABLE (A2h, byte 110, bit 6) to when the modulated optical output rises above 90% of nominal.*

Note 10: *Time from fault to two-wire interface TX_FAULT (A2h, byte 110, bit 2) asserted.*

Note 11: *Time for two-wire interface assertion of Rx_LOS (A2h, byte 110, bit 1) from loss of optical signal.*

Note 12: *Time for two-wire interface de-assertion of Rx_LOS (A2h, byte 110, bit 1) from presence of valid optical signal.*

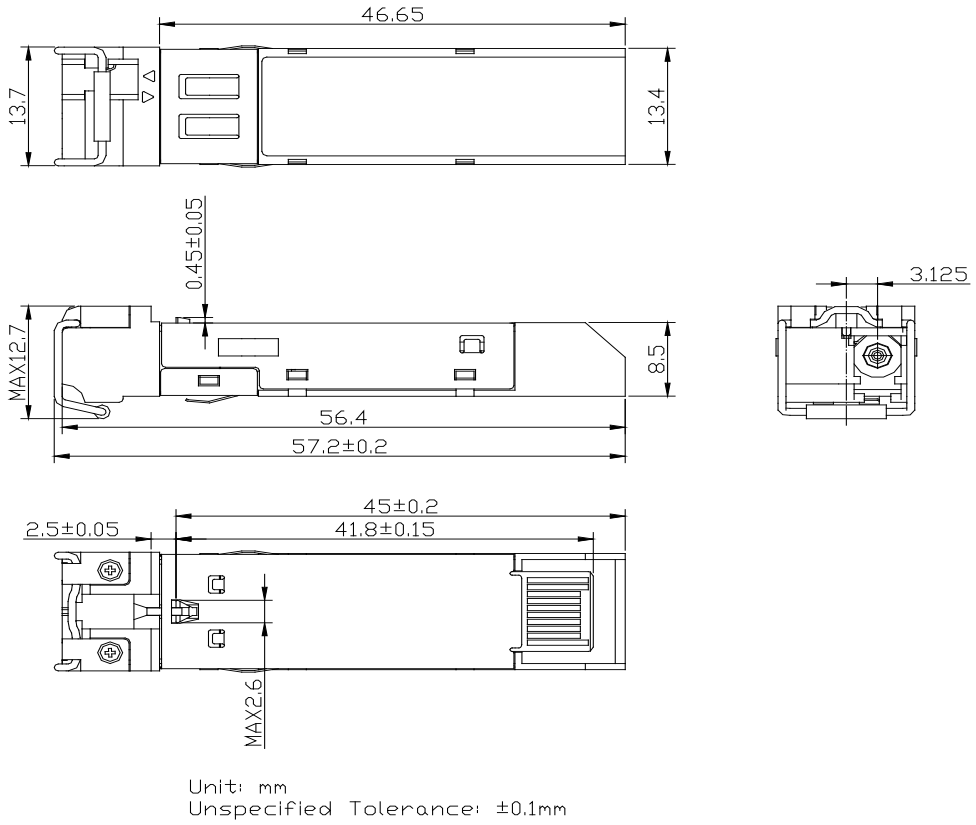
Note 13: *From power on to data ready bit asserted (A2h, byte 110, bit 0). Data ready indicates analog*

monitoring circuitry is functional.

Note 14: *Time from power on until module is ready for data transmission over the serial bus (reads or writes over A0h and A2h).*

Note 15: *Time from stop bit to completion of a 1-8 byte write command.*

Package outline *(Unit: mm)*



Ordering Information

Part No	Specifications									Application
	Package	Data rate	Laser	Optical Power	Detector	Sensitivity OMA	Temp	Reach	Others	
RTXM228-661	SFP+	2.4576~6.144 Gb/s	1270nm DFB	-8.4 ~+0.5dBm	1330nm PIN	<-13.8 dBm	-40~85 °C	15 km	DDM	CPRI/OBSAI
RTXM228-662	SFP+	2.4576~6.144 Gb/s	1330nm DFB	-8.4 ~+0.5dBm	1270nm PIN	<-13.8 dBm	-40~85 °C	15 km	DDM	CPRI/OBSAI

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