

# 10GBASE-SR SFP+ 850nm 300m DOM Transceiver

MFM1T02A-SR-LL



## Application

- 10GBASE-SR/SW 10G Ethernet
- 1200-Mx-SN-I 10G Fibre Channel

## Features

- Hot-pluggable SFP+ footprint
- Supports 9.95 to 10.5 Gb/s bit rates
- Power dissipation < 1W
- RoHS-6 compliant (lead-free)
- Commercial temperature range 0° C to 70° C
- Single 3.3V power supply
- Up to 300m Transmission on MMF
- 4700 MHZ-km OM4 MMF
- Heated 850nm VCSEL laser
- Receiver limiting electrical interface
- Duplex LC connector
- Built-in digital diagnostic functions

## Description

10Gb/s SFP+ transceivers are designed for use in 10-Gigabit Ethernet links over multimode fiber. They are compliant with SFF-8431, SFF-8432, IEEE 802.3ae 10GBASE-SR/SW and 10G Fibre Channel 1200-Mx-SN-I. Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472.

The transceiver is a “limiting module”, i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer’s recommended settings for interoperating the host-board EDC PHY with a limiting receiver SFP+ module. The optical transceivers are compliant per the RoHS Directive 2011/65/EU.

## Product Specifications

### I.General Specifications

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Bit Rate</b>	BR	9.95		10.5	Gb/s	1
<b>Bit Error Ratio</b>	BER			10 <sup>-12</sup>		2

### Maximum Supported Distances

Fiber Type	850nm OFL Bandwidth					
<b>62.5µm</b>	160 MHz-km	Lmax		26	m	
	OM1 200 MHz-km			33		
<b>50µm</b>	400 MHz-km	Lmax		66	m	
	OM2 500 MHz-km			82		
	OM3 2000 MHz-km			300		
	OM4 4700 MHz-km			400		

#### Notes:

1. 10GBASE-SR/SW.
2. Tested with a 2 31 – 1 PRBS.

## II. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Maximum Supply Voltage	V <sub>CC</sub>	-0.5		4.0	V	
Storage Temperature	T <sub>S</sub>	-40		85	° C	
Case Operating Temperature	T <sub>A</sub>	0		70	° C	
Relative Humidity	RH	0		85	%	1

### Notes:

1.Non-condensing..

## III. Electrical Characteristics (TOP= 0 to 70 ° C, VCC = 3.14 to 3.46Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Supply Voltage	V <sub>CC</sub>	3.14		3.46	V	
Supply Current	I <sub>CC</sub>			289	mA	

### Transmitter

Input differential impedance	R <sub>in</sub>		100		Ω	1
Differential data input swing	V <sub>in,pp</sub>	180		700	mV	
Transmit Disable Voltage	V <sub>D</sub>	2		V <sub>CC</sub>	V	
Transmit Enable Voltage	V <sub>EN</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.8	V	

### Receiver

Differential data output swing	V <sub>out,pp</sub>	300		850	mV	2,6
Output rise time and fall time	t <sub>r</sub>	28			ps	3
LOS asserted	V <sub>LOSfault</sub>	2		V <sub>CCHOST</sub>	V	4
LOS de-asserted	V <sub>LOSnorm</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.8	V	4
Power Supply Noise Tolerance	V <sub>CC</sub> T/V <sub>CC</sub> R		Per SFF-8431 Rev 4.1		mVpp	5

**Notes:**

1. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
2. Into 100Ω differential termination.
3. 20 – 80 % . Measured with Module Compliance Test Board and OMA test pattern. Use of four 1' s and four 0' s in sequence in the PRBS<sup>9</sup> is an acceptable alternative. SFF-8431 Rev 4.1.
4. LOS is an open collector output. Should be pulled up with 4.7kΩ – 10kΩ on the host board. Normal operation is logic 0; loss of signal is logic 1.
5. Testing methodology per SFF-8431. Rev 4.1
6. The FTLX8573D3BTL is a “limiting module” , i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer' s recommended settings for interoperating the host-board EDC PHY with a limiting receiver SFP+ module.

**IV. Optical Characteristics (TOP = 0 to °C, VCC = 3.14 to 3.46V)**

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter (Tx)</b>						
<b>Optical Modulation Amplitude (OMA)</b>			-1.5		dBm	1
<b>Average Launch Power</b>	$P_{AVE}$	-7.3		-1	dBm	2
<b>Optical Wavelength</b>	$\lambda$	840	850	860	nm	1
<b>RMS Spectral Width</b>	$\Delta\lambda_{rms}$			0.45	dB	1
<b>Optical Extinction Ratio</b>	ER	3.0	5.5		dB	
<b>Transmitter and Dispersion Penalty</b>	TDP			3.9	dB	
<b>Average Launch power of OFF transmitter</b>	$P_{OFF}$			-30	dBm	
<b>Tx Jitter</b>	$Tx_j$	Per IEEE 802.3ae requirements				
<b>Encircled Flux</b>	<4.5μm			30	%	3
	<19μm	86				
<b>Relative Intensity Noise</b>	$RIN_{12OMA}$			-128	dB/Hz	

Receiver (Rx)						
<b>Receiver Sensitivity (OMA) @ 10.3Gb/s</b>	$R_{SENS1}$			-11.1	dBm	4
<b>Stressed Receiver Sensitivity (OMA) @ 10.3Gb/s</b>	$R_{SENS2}$			-7.5	dBm	5
<b>Maximum Input Power</b>	$P_{MAX}$	+0.5			dBm	
<b>Wavelength Range</b>	$\lambda_C$	840		860	nm	
<b>Receiver Reflectance</b>	$LOS_D$			-12	dB	
<b>LOS De-Assert</b>	$LOS_A$			-14	dBm	
<b>LOS Assert</b>	$LOS_A$	-30	-23		dBm	
<b>LOS Hysteresis</b>		0.5			dB	

**Notes:**

1. Per Tradeoff Table 52.8, IEEE 802.3ae 2005
2. Average Power figures are informative only, per IEEE802.3ae.
3. Measured into Type A1a (50/125  $\mu$ m multimode) fiber per ANSI/TIA/EIA-455-203-2.
4. Measured with worst ER; BER<10<sup>-12</sup>; 231 – 1 PRBS.
5. Per IEEE 802.3ae.

**V. Digital Diagnostic Specifications**

The transceiver can be used in host systems that require either internally or externally calibrated digital diagnostics.

Parameter	Symbol	Min	Typ.	Max	Units	Ref.
<b>Accuracy</b>						
<b>Internally measured transceiver temperature</b>	$DD_{Temp}$	-3		3	°C	
<b>Internally measured transceiver supply voltage</b>	$DD_{Voltage}$	-100		100	mV	
<b>Measured TX bias current</b>	$DD_{Bias}$	-10		10	%	1
<b>Measured TX output power</b>	$DD_{Tx-Power}$	-2		2	dB	
<b>Measured RX received average optical power</b>	$DD_{Rx-Power}$	-2		2	dB	

Parameter	Symbol	Min	Typ.	Max	Units	Ref.
<b>Dynamic Range for Rated Accuracy</b>						
<b>Internally measured transceiver temperature</b>	DD <sub>Temp</sub>	0		70	°C	
<b>Internally measured transceiver supply voltage</b>	DD <sub>Voltage</sub>	3.14		3.46	V	
<b>Measured TX bias current</b>	DD <sub>Bias</sub>	0		20	mA	
<b>Measured TX output power</b>	DD <sub>Tx-Power</sub>	-9		-2.5	dBm	
<b>Measured RX received average optical power</b>	DD <sub>Rx-Power</sub>	-20		0	dBm	
<b>Max Reporting Range</b>						
<b>Internally measured transceiver temperature</b>	DD <sub>Temp</sub>	-40		125	°C	
<b>Internally measured transceiver supply voltage</b>	DD <sub>Voltage</sub>	2.8		4.0	V	
<b>Measured TX bias current</b>	DD <sub>Bias</sub>	0		20	mA	
<b>Measured TX output power</b>	DD <sub>Tx-Power</sub>	-10		-3	dBm	
<b>Measured RX received average optical power</b>	DD <sub>Rx-Powe</sub>	-22		0	dBm	

**Notes:**

1. Accuracy of Measured Tx Bias Current is 10% of the actual Bias Current from the laser driver to the laser.

## VI. Pin Description

Pin	Symbol	Name/Description	Ref.
1	V <sub>EET</sub>	Transmitter Ground(Common with Receiver Ground)	1
2	T <sub>FAULT</sub>	Transmitter Fault	2
3	T <sub>DIS</sub>	Transmitter Disable. Laser output disabled on high or open.	3
4	SDA	2-wire Serial Interface Data Line	4
5	SCL	2-wire Serial Interface Clock Line	4
6	MOD_ABS	Module Absent. Grounded within the module	4
7	RS0	No connection required	
8	RX_LOS	Loss of Signal indication. Logic 0 indicates normal operation.	5
9	RS1	No connection required	
10	V <sub>EER</sub>	Receiver Ground(Common with Transmitter Ground)	1
11	V <sub>EER</sub>	Receiver Ground(Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled.	
13	RD+	Receiver Non-inverted DATA out. AC Coupled.	
14	V <sub>EER</sub>	Receiver Ground(Common with Transmitter Ground)	1
15	V <sub>CCR</sub>	Receiver Power Supply	
16	V <sub>CCT</sub>	Transmitter Power Supply	
17	V <sub>EET</sub>	Transmitter Ground(Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	V <sub>EET</sub>	Transmitter Ground(Common with Receiver Ground)	1

**Notes:**

1. Circuit ground is internally isolated from chassis ground.
2. T FAULT is an open collector/drain output, which should be pulled up with a 4.7k – 10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to Vcc + 0.3V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
3. Laser output disabled on T DIS >2.0V or open, enabled on T DIS <0.8V.
4. Should be pulled up with 4.7kΩ – 10kΩ on host board to a voltage between 2.0V and 3.6V. MOD\_ABS pulls line low to indicate module is plugged in.
5. LOS is open collector output. Should be pulled up with 4.7kΩ – 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

