

# 100BASE-LX SFP 1310nm 15km DOM Transceiver

E1MG-100FX-IR-OM-LL



## Application

- SONET OC-3/SDH STM-1
- Fast Ethernet
- Other Optical Links

## Features

- Up to 155M b/s Data Links
- Hot-Pluggable
- 1310nm FP Laser Transmitter
- Duplex LC Connector
- RoHS Compliant and Lead Free
- Up to 15km on 9/125 $\mu$ m SMF
- Single +3.3V Power Supply
- Commercial Operating Temperature Range: 0°C to 70°C
- Monitoring Interface Compliant with SFF-8472

## Description

The SFP transceivers are high performance, cost effective modules supporting data-rate of 100BASE and 15km transmission distance with MMF. The transceiver consists of three sections: a FP laser transmitter, a PIN photodiode integrated with a trans-impedance preamplifier (TIA) and MCU control unit. All modules satisfy class I laser safety requirements. The transceivers are compatible with SFP Multi-Source Agreement (MSA) and SFF-8472.

## Product Specifications

### I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
<b>Storage Temperature Range</b>	$T_s$	-40		+85	°C
<b>Relative Humidity</b>	RH	0		85	%
<b>Supply Voltage</b>	$V_{CC,R}$	-0.5		+4	V
<b>Case Operating Temperature</b>	$T_{op}$	0		70	°C

### II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
<b>Case Operating Temperature</b>	$T_C$	0		70	°C
<b>Supply Voltage</b>	$V_{CCT,R}$	3.0		3.6	V

### III. General Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
<b>Data Rate</b>	BR		155		Mb/s	
<b>Bit Error Rate</b>	BER			10 <sup>-12</sup>		
<b>Max.Supported Link Length on 9/125µm MMF@155Mb/s</b>	LMAX		15		km	1
<b>Total System Budget</b>	LB	21			dB	2

#### Notes:

1. Dispersion limited per FC-PI Rev. 13
2. Attenuation of 1dB/km is used for the link length calculations. Distances are indicative only. Please refer to the Optical Specifications in Table IV to calculate a more accurate link budget based on specific conditions in your application.

### III. Electrical Characteristics (T<sub>OP</sub> = 0 to 70 °C, V<sub>CC</sub> = 3.0 to 3.60 Volts)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
<b>Supply Voltage</b>	V <sub>CC</sub>	3.0	3.30	3.60	V	
<b>Supply Current</b>	I <sub>CC</sub>			300	mA	
<b>Inrush Current</b>	I <sub>surge</sub>			I <sub>CC</sub> +30	mA	
<b>Maximum Power</b>	P <sub>max</sub>			1.0	W	

#### Transmitter Section

<b>Input Differential Impedance</b>	R <sub>in</sub>	90	100	110	Ω	1
<b>Single Ended Data Input Swing</b>	V <sub>in PP</sub>	200		1200	mVp-p	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
<b>Transmit Disable Voltage</b>	$V_D$	$V_{CC}-1.3$		$V_{CC}$	V	2
<b>Transmit Enable Voltage</b>	$V_{EN}$	$V_{EE}$		$V_{EE}+0.8$	V	
<b>Transmit Disable Assert Time</b>	$T_{dessert}$			10	us	
<b>Receiver Section</b>						
<b>Single Ended Data Output Swing</b>	$V_{out,pp}$	300		1000	mV	3
<b>Data Output Rise Time</b>	$t_r$			1300	ps	4
<b>Data Output Fall Time</b>	$t_f$			1300	ps	4
<b>LOS Fault</b>	$V_{los\ fault}$	$V_{CC}-0.5$		$V_{CC\_host}$	V	5
<b>LOS Normal</b>	$V_{los\ norm}$	$V_{EE}$		$V_{EE}+0.5$	V	5
<b>Power Supply Rejection</b>	PSR	100			mVpp	6

**Notes:**

1. AC coupled.
2. Or open circuit.
3. Into 100 ohm differential termination.
4. 20 – 80 %
5. LOS is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
6. All transceiver specifications are compliant with a power supply sinusoidal modulation of 20 Hz to 1.5MHz up to specified value applied through the power supply filtering network shown on page 23 of the Small Form-factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 14, 2000.

#### IV. Optical Characteristics (T<sub>OP</sub> = 0 to 70 °C, V<sub>CC</sub> = 3.0 to 3.60 Volts)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
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##### Transmitter Section

Center Wavelength	$\lambda_c$	1270	1310	1360	nm	1
Spectral Width	$\sigma$			3	nm	
Optical Output Power	P <sub>out</sub>	-15		-8	dBm	2
Optical Rise/Fall Time	t <sub>r</sub> /t <sub>f</sub>			1300	ps	3
Extinction Ratio	ER	9.2			dB	

##### Eye Mask for Optical Output

Compliant with Eye Mask Defined in IEEE 802.3 Standard

##### Receiver Section

Optical Input Wavelength	$\lambda$	1100		1670	nm	
Optical Input Power	P <sub>in</sub>	-36		-3	dBm	4.5
Receiver Reflectance		12			dB	
Receiver Overload	P <sub>ol</sub>			-3	dBm	4.5
RX Sensitivity	Sen			-34	dBm	4.5
RX_LOS Assert	LOS <sub>A</sub>	-45			dBm	
RX_LOS Deassert	LOS <sub>D</sub>			-38	dBm	
RX_LOS Hysteresis	LOS <sub>H</sub>		2	2.5	dB	

**Notes:**

1. Also specified to meet curves in FC-PI 13.0 Figures 18 and 19, which allow trade-off between wavelength spectral width.
2. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
3. Unfiltered, 20-80%. Complies with IEEE 802.3 (Gig. E), FC 1x and 2x eye masks when filtered.
4. Measured with conformance signals defined in FC-PI 13.0 specifications.
5. Measured with PRBS 231 -1at  $10^{-12}$  BER

**V. Digital Diagnostic Monitor Characteristics**

Parameter	Symbol	Min.	Max.	Unit
<b>Temperature Monitor Absolute Error</b>	DMI_Temp	-3	3	degC
<b>Laser Power Monitor Absolute Error</b>	DMI_TX	-3	3	dB
<b>RX Power Monitor Absolute Error</b>	DMI_RX	-3	3	dB
<b>Supply Voltage Monitor Absolute Error</b>	DMI_V <sub>CC</sub>	-0.1	0.1	V
<b>Bias Current Monitor Absolute Error</b>	DMI_Ibias	-10%	10%	mA

## VI. Pin Function Definitions

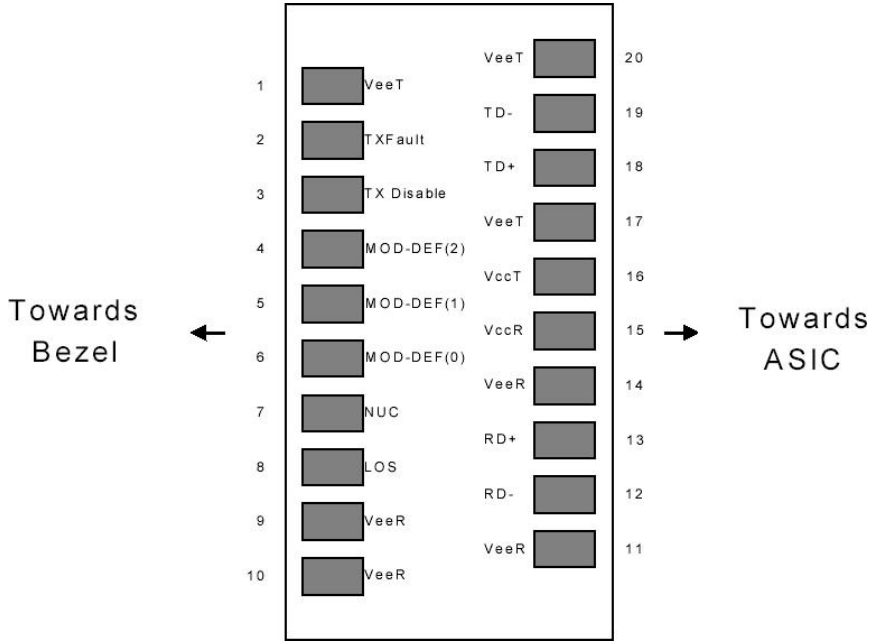


Figure 1 Diagram of Host Board Connector Block Pin Numbers and Names

## VII. Block Diagram

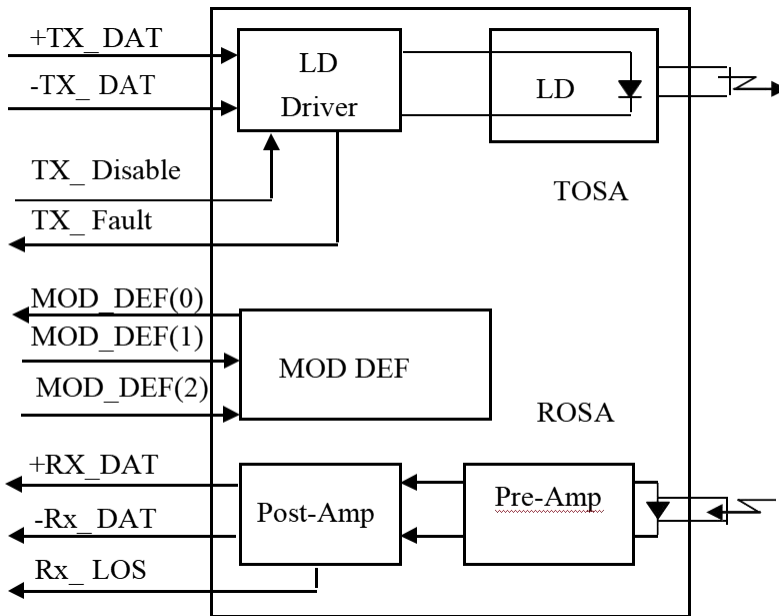


Figure 2 Block Diagram

## VIII. Pin Descriptions

Pin No	Name	Function	Plug Seq	Notes
1	VeeT	Transmitter Ground	1	1
2	TX Fault	Transmitter Fault Indication	3	
3	TX Disable	Transmitter Disable	3	2
4	MOD-DEF2	Module Definition	2	3
5	MOD-DEF1	Module Definition 1	3	3
6	MOD-DEF0	Module Definition 0	3	3
7	Rate Select	Not Connected	3	4
8	LOS	Loss of Signal	3	5
9	VeeR	Receiver Ground	1	1
10	VeeR	Receiver Ground	1	1
11	VeeR	Receiver Ground		1
12	RD-	Inv. Received Data Out	3	6
13	RD+	Received Data Out	3	6
14	VeeR	Receiver Ground	3	1
15	VccR	Receiver Power	2	1



Pin No	Name	Function	Plug Seq	Notes
<b>16</b>	VccT	Transmitter Power	2	
<b>17</b>	VeeT	Transmitter Ground	1	
<b>18</b>	TD+	Transmit Data In	3	6
<b>19</b>	TD-	Inv.Transmit In	3	6
<b>20</b>	VeeT	Transmitter Ground	1	

**Notes:**

1. Circuit ground is internally isolated from chassis ground.
2. Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V.
3. Should be pulled up with 4.7k - 10 kohms on host board to a voltage between 2.0V and 3.6V. MOD\_DEF(0) pulls line low to indicate module is plugged in.
4. Rate select is not used
5. LOS is open collector output. Should be pulled up with 4.7k – 10 kohms on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
6. AC Coupled

### IX. Recommended Circuit

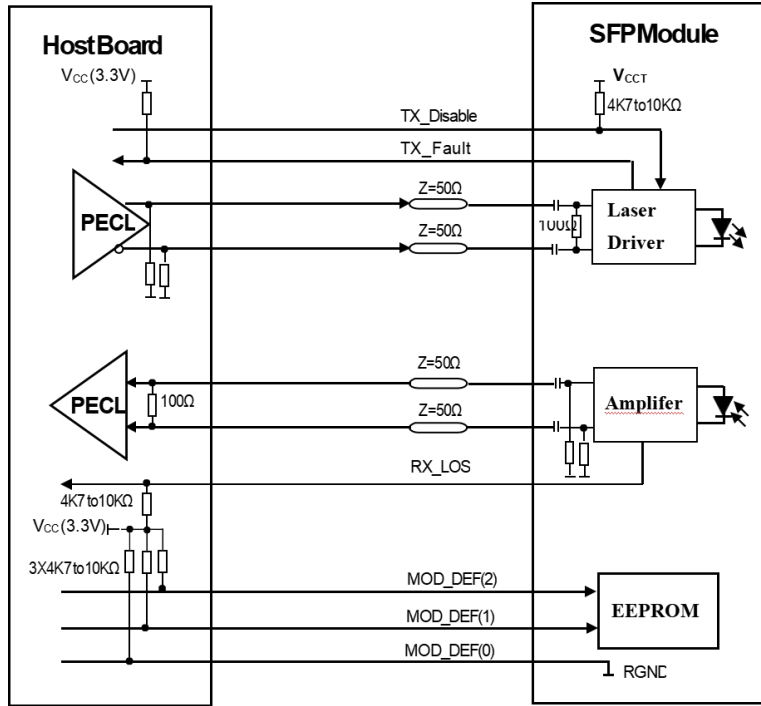


Figure 3. SFP Host Recommended Circuit

### X. Serial ID Memory Contents

Data Address	Length (Byte)	Name of Length	Description and Contents
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#### Base ID Fields

0	1	Identifier	Type of Serial transceiver (03h=SFP)
1	1	Reserved	Extended identifier of type serial transceiver (04h)
2	1	Connector	Code of optical connector type(07=LC)
3-10	8	Transceiver	SONET
11	1	Encoding	SONETS crambled
12	1	BR, Nominal	Nominal baud rate,unit of 100Mbps

Data Address	Length (Byte)	Name of Length	Description and Contents
<b>13</b>	1	Reserved	(0000h)
<b>14</b>	1	Length (9um, km)	Link length supported for 9/125um fiber, units of km
<b>15</b>	1	Length (9um)	Link length supported for 9/125um fiber, units of 100m
<b>16</b>	1	Length (50um)	Link length supported for 50/125um fiber, units of 10m
<b>17</b>	1	Length (62.5um)	Link length supported for 62.5/125um fiber, units of 10m
<b>18</b>	1	Length (Copper)	Link length supported for copper, units of meters
<b>19</b>	1	Reserved	
<b>20-35</b>	16	Vendor Name	SFP vendor name
<b>36</b>	1	Reserved	
<b>37-39</b>	3	Vendor OUI	SFP transceiver vendor OUI ID
<b>40-55</b>	16	Vendor PN	Part Number: "Longlinexxxxx" "(ASCII)
<b>56-59</b>	4	Vendor Rev	Revision level for part number
<b>60-61</b>	2	Wavelength	Laser wavelength
<b>62</b>	1	Reserved	
<b>63</b>	1	CCID	Least significant byte of sum of data in address 0-62

Data Address	Length (Byte)	Name of Length	Description and Contents
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### Extended ID Fields

<b>64-65</b>	2	Option	Indicates which optical SFP signals are implemented (001Ah=LOS, TX_FAULT, TX_DISABLE all supported)
<b>66</b>	1	BR, Max	Upper bit rate margin, units of %
<b>67</b>	1	BR, Min	Lower bit rate margin, units of %
<b>68-83</b>	16	Vendor SN	Serialnumber (ASCII)
<b>84-91</b>	8	Date Code	Manufacturing date code
<b>92</b>	1	Diagnostic Type	Diagnostics
<b>93</b>	1	Enhanced Options	Diagnostics
<b>94</b>	1	SFF-8472	Diagnostics
<b>95</b>	1	CCEX	Check code for the extended ID Fields (addresses 64 to 94)

### Vendor Specific ID Fields

<b>96-127</b>	32	Readable	Vendor specific date, read only
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## XI. Diagnostics Memory Contents (A2h)

Data Address	Length (Byte)	Name of Length	Description and Contents
<b>Diagnostic and Control/Status Fields</b>			
<b>0-39</b>	40	A/W Thresholds	Diagnostic Flag Alarm and Warning Thresholds
<b>40-55</b>	16	Unallocated	
<b>56-91</b>	16	Ext Cal Constants	Diagnostic Calibration Constants for Optional External Calibration
<b>92-94</b>	3	Unallocated	
<b>95</b>	1	CC_DMI	Check Code for Base Diagnostic Fields (addresses 0 to 94)
<b>96-105</b>	10	Diagnostics	Diagnostic Monitor Data (internally or externally calibrated)
<b>106-109</b>	4	Unallocated	
<b>110</b>	1	Status/Control	Optional Status and Control Bits
<b>111</b>	1	Reserved	Reserved for SFF-8079
<b>112-113</b>	2	Alarm Flags	Diagnostic Alarm Flag Status Bits
<b>114-115</b>	2	Unallocated	
<b>116-117</b>	2	Warning Flags	Diagnostic Warning Flag Status Bits
<b>118-119</b>	2	ExtStatus/Control	Extended Module Control and Status Bytes

Data Address	Length (Byte)	Name of Length	Description and Contents
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### General Use Fields

<b>120-127</b>	8	Vendor Specific	Vendor specific memory addresses
<b>128-247</b>	120	User EEPROM	User writable non-volatile memory
<b>248-255</b>	8	Vendor Control	Vendor specific control addresses

## XII. References

- 1.Small Form-factor Pluggable (SFP) Transceiver Multi-source Agreement (MSA) September 14, 2000.
2. Bellcore GR-253 and ITU-T G.957 Specifications.

## XIII. Mechanical Outline

