

## **XP85PG1-02D**

### **SFP64G Fibre Channel 850nm Transceiver**

#### **PRODUCT FEATURES**

- Supports 16GFC/32GFC/64GFC data rates
- Up to 100m transmission on multi-mode fiber
- VSCSEL laser and PIN receiver
- 2-wire interface with integrated Digital Diagnostic Monitoring
- Hot-pluggable SFP footprint
- Compliant with SFP MSA with LC connector
- Single 3.3V power supply
- Power dissipation < 1.5W
- Case operating temperature range: 0°C to 70°C

#### **STANDARDS**

- Fibre Channel FC-PI-7, FC-PI-6, FC-PI-5
- SFF-8431 Low Speed Electrical Interface
- SFF-8472 Management Interface
- SFF-8432, SFF-8083, SFF-8081, SFF-8402 Mechanical Specifications
- RoHS Compliant

#### **ORDERING INFORMATION**

<b>Product Part Number</b>	<b>Signaling Rate (GBd)</b>	<b>Media</b>	<b>Wavelength (nm)</b>	<b>Transmission Distance (m)</b>	<b>Case Temperature Range</b>
XP85PG1-02D	28.9 PAM4	Multi-mode fiber	850	100	0°C to 70 °C

## I. Absolute Maximum Ratings

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

## II. Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit	Note
Case Operating Temperature	0	-	70	°C	
Power Supply Voltage	3.135	3.3	3.465	V	
Power Supply Current		400		mA	
64GFC Signaling Rate		28.9		GBd	
32GFC Signaling Rate		28.05		GBd	
16GFC Signaling Rate		14.025		GBd	
64GFC Transmission Distance			70 (OM3) 100 (OM4/OM5)	m	
32GFC Transmission Distance			20 (OM2) 70 (OM3) 100 (OM4)	m	
16GFC Transmission Distance			35 (OM2) 100 (OM3) 125 (OM4)	m	
64GFC Bit Error Rate		10 <sup>-10</sup>	1.31x10 <sup>-4</sup>		1
32GFC/16GFC Bit Error Rate			10 <sup>-12</sup>		2
Coupled fiber	Multi-mode fiber				50/125um MMF

### Notes:

1. PRBS31Q for 64GFC
2. PRBS31 for 32GFC/16GFC

### III. Optical Characteristics

#### 64GFC Optical Parameters

Parameter	Min	Typ	Max	Unit	Note
<b>Transmitter (module output)</b>					
Center wavelength	840	850	860	nm	
RMS spectral width			0.6	nm	
TDECQ			5.5	dB	
TDECQ-10log10(Ceq)			5.5	dB	
OMA <sub>outer</sub>	-4.5		3	dBm	
OMA <sub>outer</sub> extinction ratio	3			dB	
Launched power in OMA <sub>outer</sub> minus TDECQ	-5.9			dBm	
Average launched power	-7.5		4	dBm	
RIN <sub>12</sub> OMA			-128	dB/Hz	
Transition Time 20%-80%			34	ps	
Encircled flux	≥86% at 19um, ≤30% at 4.5um				
<b>Receiver (module input)</b>					
Damage Threshold	5			dBm	1
Average received power	-9.4		4	dBm	
Receiver power (OMA <sub>outer</sub> )			3	dBm	
Return Loss of Receiver	12			dB	
Receiver sensitivity, OMA <sub>outer</sub>			-7	dBm	
Stressed receiver sensitivity, OMA <sub>outer</sub>			-2.4	dBm	
LOS De-Assert			-14	dBm	
LOS Assert	-30		-17	dBm	

#### **Notes:**

1. The receiver should be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this received power.

### 32GFC Optical Parameters

Parameter	Min	Typ	Max	Unit	Note
<b>Transmitter (module output)</b>					
Center wavelength	840	850	860	nm	
RMS spectral width			0.570	nm	
Average launched power	0.240 (-6.2)		1.585 (2)	mW (dBm)	
Optical modulation amplitude	0.479 (-3.2)			mW (dBm)	
Vertical Eye Closure Penalty (VECP <sub>q</sub> )			3.13	dB	
RIN <sub>12</sub> OMA			-129	dB/Hz	
Encircled flux	≥86% at 19um, ≤30% at 4.5um				
<b>Receiver (module input)</b>					
Average received power			1.585 (2)	mW (dBm)	
Unstressed receiver sensitivity, OMA			0.095 (-10.2)	mW (dBm)	
Return loss of receiver	12			dB	
Rx jitter tracking test, OMA	0.295(-5.3)			mW(dBm)	
RX jitter tracking test, jitter frequency and pk-pk amplitude	(500,1) (100,5)			(kHz,UI)	
Receiver electrical 3 dB upper cutoff frequency			32	GHz	
Stressed receiver sensitivity, OMA			0.263 (-5.8)	mW (dBm)	
LOS De-Assert			-14	dBm	
LOS Assert	-30		-17	dBm	

**16GFC Optical Parameters (compliant with all other parameters in FC-PI-5)**

Parameter	Min	Typ	Max	Unit	Note
<b>Transmitter (module output)</b>					
Center wavelength	840	850	860	nm	
RMS spectral width			0.59	nm	
Average launched power	-7.8		0	dBm	1
Optical modulation amplitude	0.331 (-4.8)			mW (dBm)	
Vertical Eye Closure Penalty (VECP <sub>q</sub> )			2.56	dB	
RIN <sub>12</sub> OMA			-128	dB/Hz	
Encircled flux	≥86% at 19um, ≤30% at 4.5um				
<b>Receiver (module input)</b>					
Average received power			0	dBm	
Unstressed receiver sensitivity, OMA			0.089 (-10.5)	mW (dBm)	
Return loss of receiver	12			dB	
Rx jitter tolerance test, OMA	0.214(-6.7)			mW(dBm)	
RX jitter tracking test, jitter frequency and pk-pk amplitude	(840,1) (168,5)			(kHz,UI)	
Receiver electrical 3 dB upper cutoff frequency			18	GHz	
Stressed receiver sensitivity, OMA			0.170 (-7.7)	mW (dBm)	
LOS De-Assert			-14	dBm	
LOS Assert	-30		-17	dBm	

**Notes:**

1. Max average launched power shall be the lesser of the value listed here or the Class 1 laser safety limits (CDRH and EN 60825)

## IV. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Power supply voltage	V <sub>CC</sub>	3.135	3.3	3.465	V	
Power supply current	I <sub>CC</sub>		400		mA	
<b>Low Speed Signals</b>						
Tx_Fault, Rx_LOS Output voltage	V <sub>OL</sub>	-0.3		0.40	V	At 0.7 mA
Tx_Disable, RS0, RS1 Input voltage	V <sub>IL</sub>	-0.3		0.8	V	
	V <sub>IH</sub>	2.0		V <sub>CC</sub> +0.3	V	

## 64G Electrical Parameters

Parameter	Min	Typ	Max	Unit	Note
<b>Transmitter (module input)</b>					
Differential input voltage tolerance	900			mV	
Differential termination resistance mismatch			10	%	
Differential return loss SDD11	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -9.5 + 0.368 \cdot f & 0.01 < f < 8 \text{ GHz} \\ -4.75 + 7.4 \cdot \log_{10}(f/14.025 \text{ GHz}) & 8 < f < 21 \text{ GHz} \end{cases}$			dB	
Differential-mode to common conversion SCD11	$SDC22, SCD11 \text{ (dB)} < \begin{cases} -22 + 20 \cdot f/25.78 \text{ GHz} & 0.01 < f < 12.89 \text{ GHz} \\ -15 + 6 \cdot f/25.78 \text{ GHz} & 12.89 < f < 21 \text{ GHz} \end{cases}$			dB	
Input equalization			10	dB	
<b>Receiver (module output)</b>					
Differential Voltage, pk-pk			900	mV	
Differential Voltage with transmitter disabled, pk-pk			35	mV	
Common-mode noise rms			17.5	mV	
Differential termination resistance mismatch			10	%	At 1 MHz
Differential return loss SDD22	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -9.5 + 0.368 \cdot f & 0.01 < f < 8 \text{ GHz} \\ -4.75 + 7.4 \cdot \log_{10}(f/14.025 \text{ GHz}) & 8 < f < 21 \text{ GHz} \end{cases}$			dB	
Common-mode to differential conversion SDC22	$SDC22, SCD11 \text{ (dB)} < \begin{cases} -22 + 20 \cdot f/25.78 \text{ GHz} & 0.01 < f < 12.89 \text{ GHz} \\ -15 + 6 \cdot f/25.78 \text{ GHz} & 12.89 < f < 21 \text{ GHz} \end{cases}$			dB	
Source transition time 20%-80%	9.5			ps	
Eye Width at 10 <sup>-5</sup> probability EW5	0.265			UI	
Eye Height at 10 <sup>-5</sup> probability EH5	70			mV	
Vertical Eye Closure VEC			12	dB	
Output emphasis			5	dB	

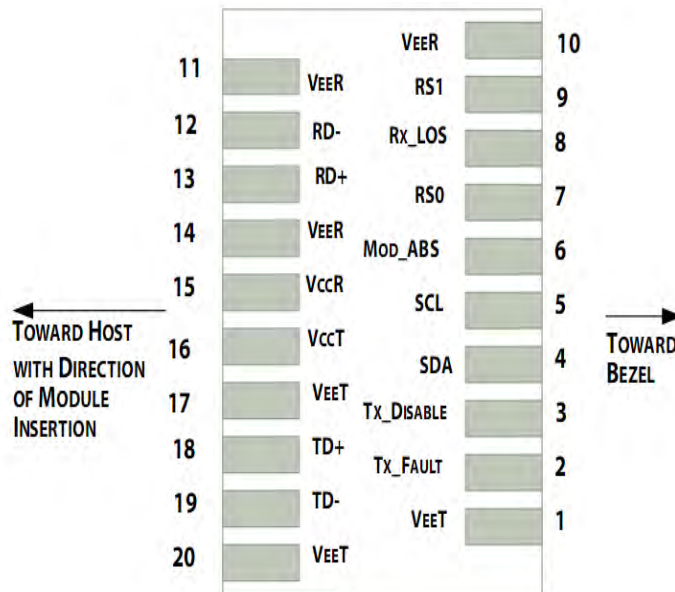
### 32G Electrical Parameters

Parameter	Min	Typ	Max	Unit	Note
<b>Transmitter (module input)</b>					
Differential termination resistance mismatch			10	%	
Differential return loss SDD11	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -11 & 0.05 < f < 4 \text{ GHz} \\ -6.0 + 9.2 \cdot \log_{10}(f/14.025 \text{ GHz}) & 4 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Common mode to differential conversion SDC11	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Differential mode to common conversion SCD11	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Input equalization			10	dB	
<b>Receiver (module output)</b>					
Differential Voltage, pk-pk			900	mV	
Common-mode noise rms			17.5	mV	
Differential termination resistance mismatch			10	%	At 1 MHz
Differential return loss SDD22	$SDD11, SDD22 \text{ (dB)} < \begin{cases} -11 & 0.05 < f < 4 \text{ GHz} \\ -6.0 + 9.2 \cdot \log_{10}(f/14.025 \text{ GHz}) & 4 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Common mode to differential conversion SDC22	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Differential mode to common conversion SCD22	$SDC11, SCD11 \text{ (dB)} < \begin{cases} -22 + 14 \cdot f/28.05 \text{ GHz} & 0.05 < f < 14.025 \text{ GHz} \\ -18 + 6 \cdot f/28.05 \text{ GHz} & 14.025 < f < 28.05 \text{ GHz} \end{cases}$			dB	
Common mode return loss SCC22			-2	dB	
Source transition time 20%-80%	9.5			ps	
Vertical eye closure			4	dB	
Eye Width at $10^{-6}$ probability EW6	0.65			UI	
Eye Height at $10^{-6}$ probability EH6	250			mV	
Output emphasis			5	dB	

### 16G Electrical Parameters (compliant with all other parameters in FC-PI-5)

Parameter	Min	Typ	Max	Unit	Note
<b>Transmitter (module input)</b>					
Common mode Voltage (rms)			30	mV	
Common mode voltage, (spectral peak)(rms)			20	mV	
Input equalization			10	dB	
<b>Receiver (module output)</b>					
Output emphasis			5	dB	

## V. Pin Descriptions



Pin out of Connector Block on Host Board

Pin	Symbol	Name/Description	NOTE
1	V <sub>EE T</sub>	Transmitter Ground (Common with Receiver Ground)	1
2	Tx_Fault	Transmitter Fault	
3	Tx_Disable	Transmitter Disable – Logic 1 disables laser output	
4	SDA	2-wire Serial Interface Data Line	
5	SCL	2-wire Serial Interface Clock Line	
6	MOD_ABS	Module Absent. Grounded within the module.	2
7	RS0	Rate Select 0 – Rx signaling rate	3
8	Rx_LOS	Loss of Signal indication – Logic 1 indicates loss of signal	
9	RS1	Rate Select 1 – Tx signaling rate	3
10	V <sub>EE R</sub>	Receiver Ground (Common with Transmitter Ground)	1
11	V <sub>EE R</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>EE R</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:**

2. *Circuit ground is internally isolated from chassis ground.*
3. *MOD\_ABS is pulled low in the module to indicate that the module is plugged in.*
4. *The signal is internally pulled down per SFF-8431 Rev 4.1.*

## VI. Management Interface and Digital Diagnostic Functions

### Rate Select

The signaling rates for the transmitter and receiver can each be configured by either the rate select (RS) hard pin signals or the soft register bits according to the following table:

Fibre Channel Rate	Signaling Rate (GBd)	Modulation	Logic OR of RS hard pin and soft bit	A2h, Byte 119, Bit 2 (64GFC Mode bit)	Notes
64GFC	28.9	PAM4	-	1	When the 64GFC Mode bit is set, the RS pins and bits are ignored.
32GFC	28.05	NRZ	1	0	
16GFC	14.025	NRZ	0	0	

### Monitor Data

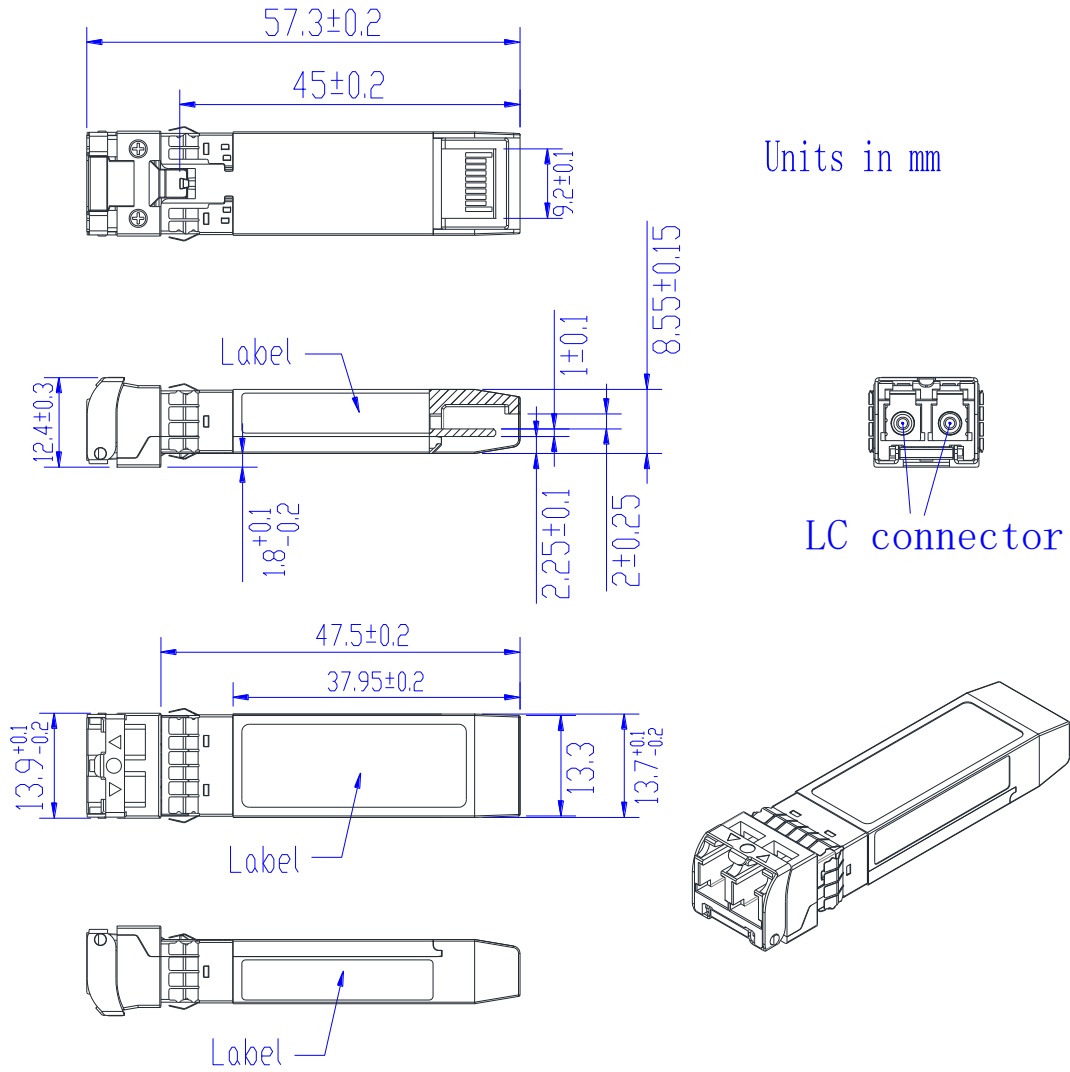
The following monitors are supported using the “internal calibration” method described in SFF-8472 Rev 12.3:

- Temperature
- Supply Voltage
- Tx Bias Current
- Rx Optical Power
- Tx optical power

### Alarm / Warning Flags

All alarm and warning flag bits are latched and are clear-on-read registers.

**VII. Outline Dimensions**



**Appendix A. Document Revision**

<b>Version No.</b>	<b>Date</b>	<b>Description</b>
1.0	October 11, 2021	Initial Release