



## XFP Multirate Optical Transceiver

### MF-10KSXA-008ZA

### MF-10KSXA-009ZA



#### ***Features:***

- Protocol Independent 10Gbps transceiver
- Hot pluggable
- Management interface compliant with I2C™ rev. 2 and XFP MSA
- Multi rate from 9.95Gbps to 11.0957Gbps (FEC)
- XFI compatible electrical interface thru 30pin connector
- Low power dissipation: < 3.5W
- Low cost

**1. Description**

This XFP optical transceiver is designed to provide high optical performance for S-64.2b (40km), and G.959.1 P1L1-2D2 (80km).

Transmitter side uses 1550nm EM Laser with specified driving circuit and signal conditioning circuit.

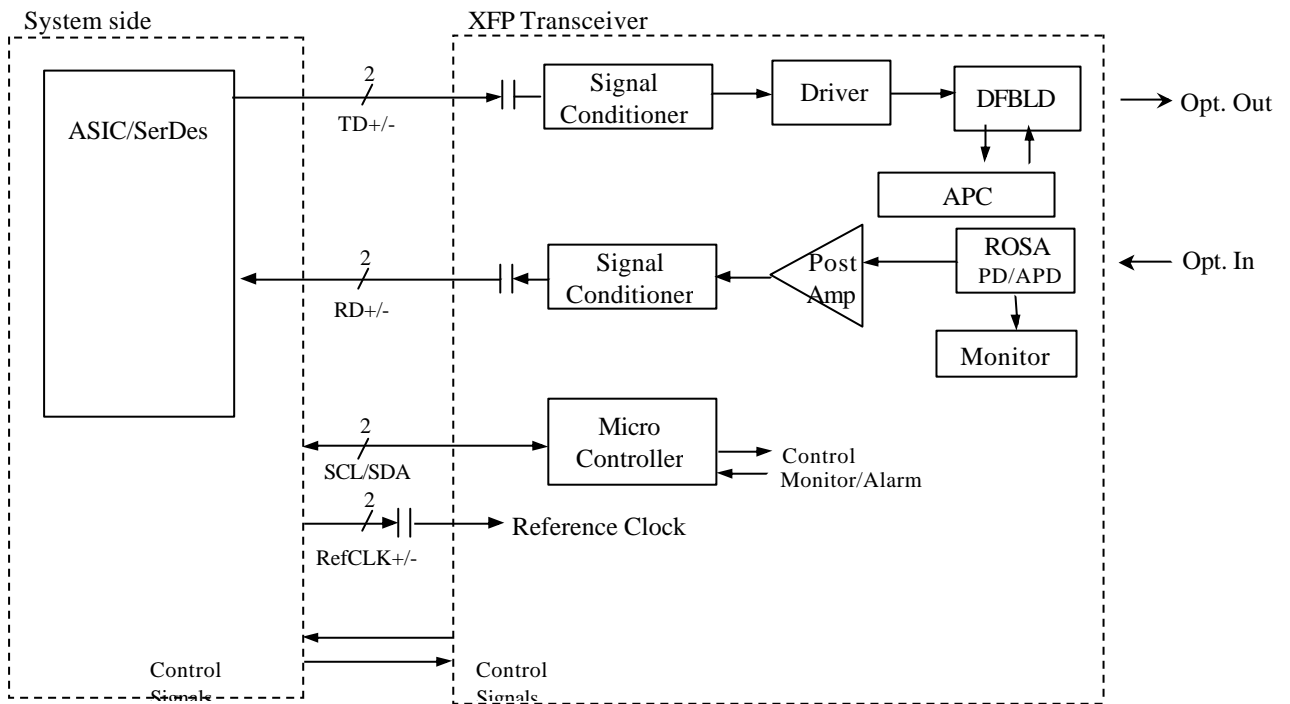
Receiver side uses PD/APD preamp-module and integrated circuits for re-shaping, re-timing and re-generating input optical signal.

Input and output signals handle NRZ format.

Digital diagnostic functions are also available via 2-wire interface according to the XFP MSA specification.

**2. Block Diagram**

**2.1 Total Block Diagram**



**Fig. 2.1 Block Diagram**



### 3. Absolute Maximum Ratings

Stress below listed absolute maximum rating may cause permanent damage to the module.

This is a stress only and functional operation of the module at these or any other conditions in excess of those given in the operational sections of this data sheet.

Exposure to Absolute Maximum Rating for extended periods may affect module reliability.

**Table 3.1 Absolute Maximum Ratings (MF-10KSXA-008/009ZA)**

<i>Parameter</i>	<i>Symbol</i>	<i>Min</i>	<i>Max</i>	<i>Unit</i>
Supply Voltage	VDD5	0	+6.0	V
	VDD3	0	+3.6	V
	VEE5	-6.0	0	V
Storage temperature	Tstg	-40	+85	degC
Operating temperature (Case)	Tcase	-5	+70	degC
Relative humidity (Non condensation)	-	5	90	%



#### 4. Pin Descriptions

Table 4.1 shows the Pin descriptions of XFP connector and Fig.4.2 shows the Diagram of Host Board Connector Pin Numbers and Names.

**Table 4.1 Pin Descriptions of XFP Connector**

<i>Pin</i>	<i>Logic</i>	<i>Symbol</i>	<i>Name/Description</i>	<i>Note</i>
1		GND	Module Ground	1
2		VEE5	Optional -5.2V Power Supply	
3	LVTTL-I	Mod_Desel	Prevent module from communicating via I2C	
4	LVTTL-O	/Interrupt	Indicates presence of an important conditions	2
5	LVTTL-I	Tx_Dis	Laser source turned off	
6		VDD5	+5V Power Supply	
7		GND	Module Ground	1
8		VDD3	+3.3V Power Supply	
9		VDD3	+3.3V Power Supply	
10	LVTTL-I/O	SCL	I2C Serial Interface Clock	2
11	LVTTL-I/O	SDA	I2C Serial Interface Data Line	2
12	LVTTL-O	Mod_Abs	Module-Absent indicator	2
13	LVTTL-O	Mod_Nr	Module-Not-Ready indicator	2
14	LVTTL-O	Rx_Los	Receive-Loss-Of-Signal Indicator	2
15		GND	Module Ground	1
16		GND	Module Ground	1
17	CML-O	RDN	Inverted Receiver Data Output	
18	CML-O	RDP	Receiver Data Output	
19		GND	Module Ground	1
20		VDD2	+1.8V Power Supply	
21	LVTTL-I	PDown/RST	Power down / Reset command	
22		VDD2	+1.8V Power Supply	
23		GND	Module GND	1
24	PECL-I	CRefP	Reference Clock Input	
25	PECL-I	CRefN	Inverted Reference Clock Input	
26		GND	Module GND	1
27		GND	Module GND	1
28	CML-I	TDN	Inverted Transmitter Data Input	
29	CML-I	TDP	Transmitter Data Input	
30		GND	Module GND	1

Note;

1. Module ground pins GND are isolated from the module case and chassis ground within the module.
2. Shall be pulled up with 4.7k-10kohms to a voltage between 3.15V and 3.45V on the board

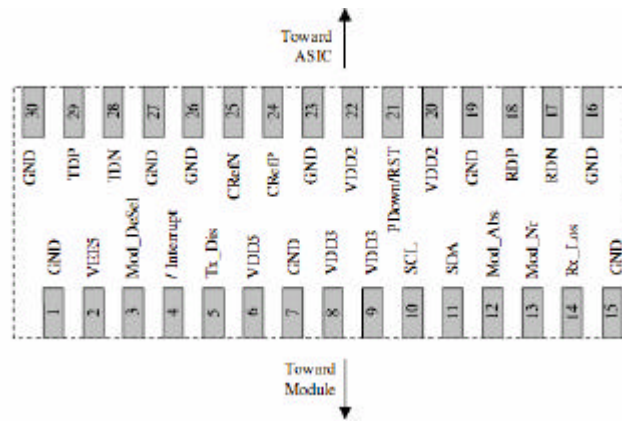


Fig. 4.2 Diagram of Host Board Connector Block Pin Numbers and Names

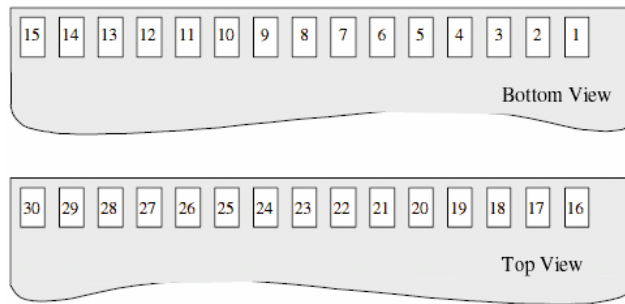


Fig. 4.3 Diagram of Transceiver card edge connector Numbers and Names (See Fig. 8.1)

**5. Electrical Characteristics**

All parameters are specified over the operating case temperature.

**5.1 Power Supply**

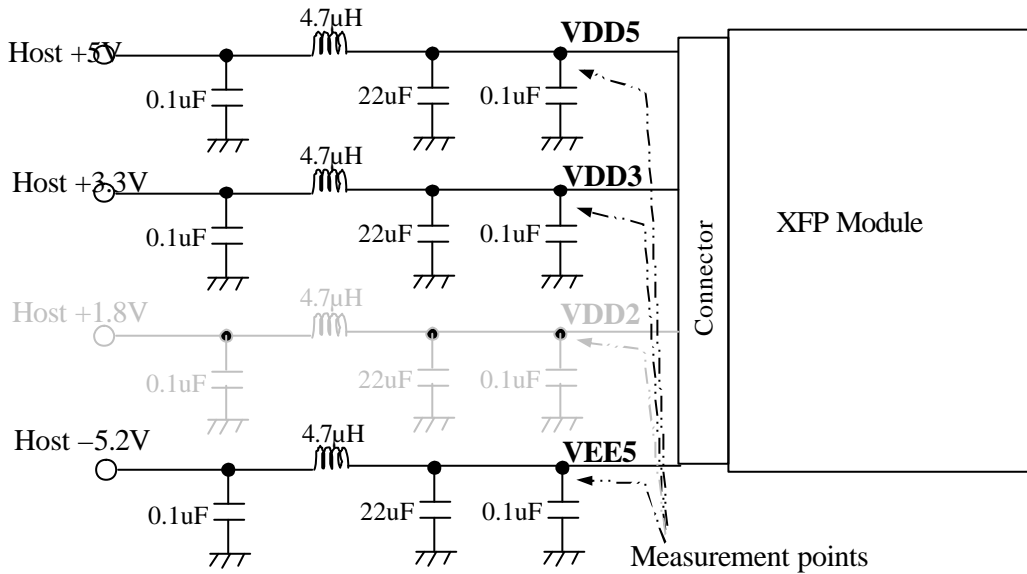
**Table 5.1.1 Power Supply**

Tc : -5 to +70degC

Parameters		Min.	Typ.	Max.	Unit
Supply Voltage	VDD5	+4.75	+5.0	+5.25	V
	VDD3	+3.13	+3.3	+3.47	V
	VEE5	-5.46	-5.2	-4.94	V
Supply Current	Idd5	-	-	500	mA
	Idd3	-	-	700	mA
	Iee5	-	-	500	mA
Power Consumption	MF-10KSXA-008ZA	-	-	3.5	W
	MF-10KSXA-009ZA	-	-	3.5	

**5.2 Host Filtering and Supply Voltage Measurement Points**

The example host board power supply filtering and Supply voltage measurement points are shown in Fig 5.2.1. Host board power supply must meet XFP MSA specification.



**Fig. 5.2.1 Example of Host Board Supply Filtering Network and Supply Voltage measurement points**

### 5.3 High Speed Electrical Interface

XFP Module high-speed electrical interface specification is shown in table 5.3.1 and the High Speed Electrical Interface definition point is shown in Fig. 5.3.1.

**Table 5.3.1 High Speed Electrical Interface**

Tc : -5 to +70degC

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Transmitter Input</b>						
Input Differential Impedance	Zd	80	100	120	ohm	
Termination Mismatch	?Z <sub>M</sub>			5	%	
Source to Sink DC Potential Difference	V <sub>cm</sub>	0		3.6	V	
Input AC Common mode Voltage				25	mV(RMS)	
Differential Input Return Loss	SDD11	8			dB	Up to 8GHz
Common Mode Input Return Loss	SCC11	3			dB	0.1-15GHz
Differential to Common Mode Conversion	SCD11	10			dB	0.1-15GHz
Total Non-DDJ Jitter				0.41	UI <sub>pp</sub>	
Total Jitter	TJ			0.61	UI <sub>pp</sub>	
Sinusoidal Jitter Tolerance	SJ			See 2		
Eye Mask	X1			0.305	UI	See 3, Fig. 5.3.2
	Y1	60			mV	Fig. 5.3.2
	Y2			410	mV	See 4, Fig. 5.3.2
<b>Receiver Output</b>						
Reference Differential Output Impedance	Zd	80	100	120	ohm	
Termination Mismatch	?Z <sub>M</sub>			5	%	
DC Common Mode Potential	V <sub>cm</sub>	0		3.6	V	
Output AC Common Mode Voltage				15	mV(RMS)	
Output Rise and Fall time	t <sub>RH</sub> /t <sub>FH</sub>	24			ps	20-80%
Differential Output Return Loss	SDD22	8			dB	Up to 8GHz
Common Mode Output Return Loss	SCC22	3			dB	0.1-15GHz
Deterministic Jitter	DJ			0.18	UI <sub>pp</sub>	
Total Jitter	TJ			0.34	UI <sub>pp</sub>	
Eye Mask	X1			0.17	UI	Fig. 5.3.3
	X2			0.42	UI	Fig. 5.3.3
	Y1	170			mV	Fig. 5.3.3
	Y2			425	mV	Fig. 5.3.3
<b>Reference Clock</b>						
Clock Differential Input Impedance	Zd	80	100	120	ohm	
Differential Input Clock Amplitude		640		1600	mV <sub>pp</sub>	AC Coupled PECL
Reference Clock Duty Cycle		40	50	60	%	
Reference Clock Rise/Fall time	Tr/Tf	200		1250	ps	20-80%
Reference Clock Frequency	f <sub>0</sub>		Baud/64			
RMS Jitter Random Jitter	s			10	ps	Up to 100MHz
Reference Clock Frequency Tolerance	?f	-100		100	ppm	V.S. Baud/64

1. Sinusoidal jitter tolerance for Telecom and Datacom respectively given by XFP MSA specification.
2. Mask coordinate X1=0.205 if total non-DDJ is measured.
3. Out of 410mV,50mV is allocated for multiple reflection.
4. Differential Return Loss given by equation  $SDD22(dB)=8-22.66 \log_{10}(f/5.5)$ , f=frequency(GHz)

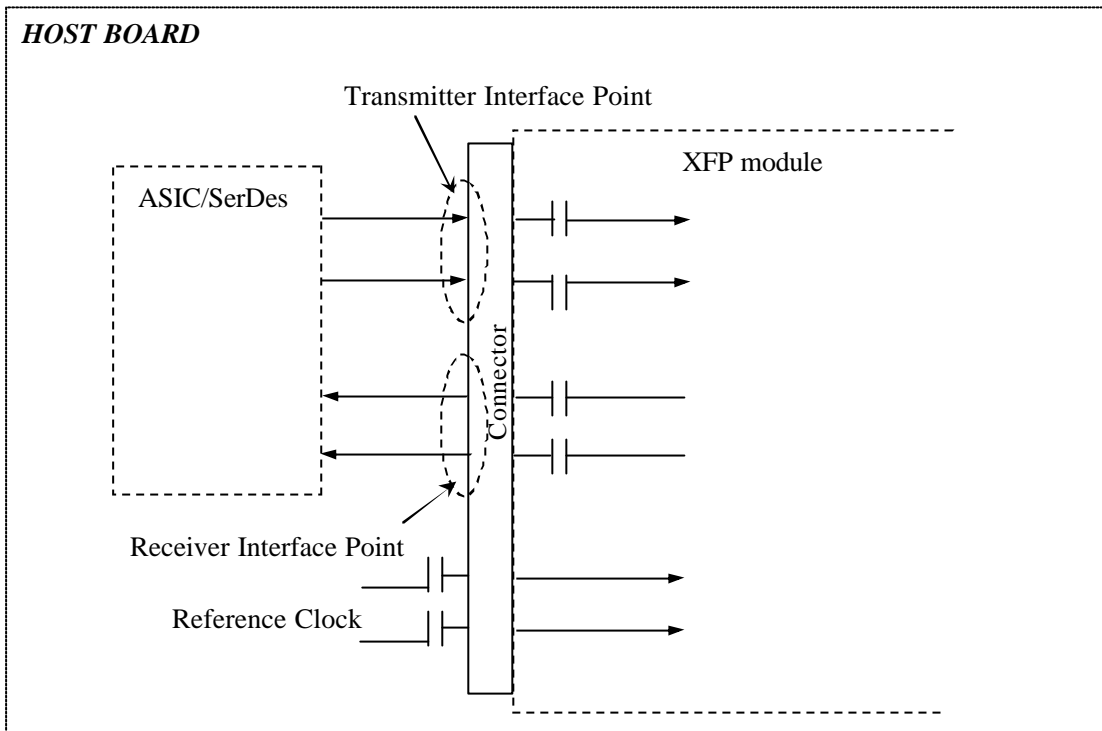


Fig. 5.3.1 XFP Module Electrical Interface Point

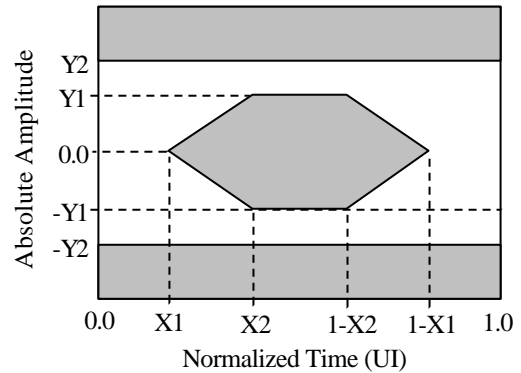
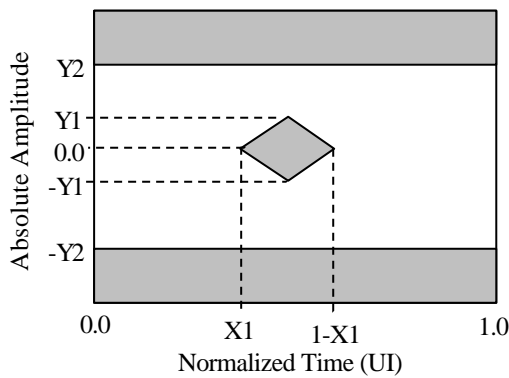


Fig. 5.3.2 Transmitter Differential Input Compliance Mask Fig. 5.3.3 Receiver Differential Output Compliance Mask



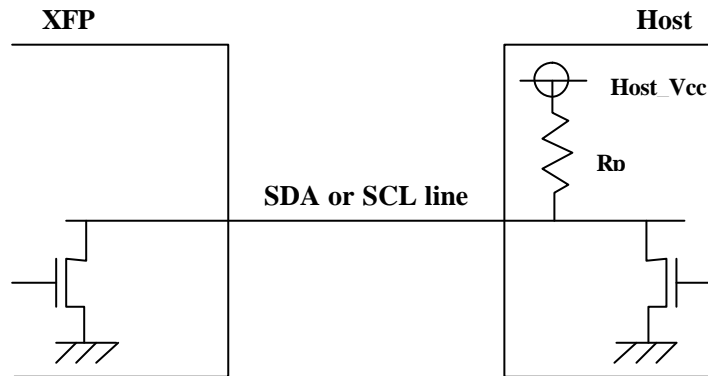
**5.4 Low Speed Electrical Interface**

XFP Module low speed electrical interface specification is shown in Table 5.4.1.

**Table 5.4.1 Low Speed Electrical Interface**

Tc : -5 to +70degC

Parameter	Symbol	Min.	Max.	Unit	Note
LVTTL-I (Tx_Dis, P_Down/RST)	V <sub>IH</sub>	2.0	VDD3+0.3	V	VDD3 as same as Pull-up Vcc
	V <sub>IL</sub>	-0.3	0.8	V	
LVTTL-O (Interrupt, Mod_Nr, Rx_Los)	V <sub>OH</sub>	VDD3-0.5	VDD3+0.3	V	VDD3 as same as Pull-up Vcc
	V <sub>OL</sub>	0.0	0.4	V	
LVTTL-I (SCL, SDA)	V <sub>IH</sub>	VDD3*0.7	VDD3+0.5	V	VDD3 as same as Pull-up Vcc
	V <sub>IL</sub>	-0.3	VDD3*0.3	V	VDD3 as same as Pull-up Vcc
LVTTL-O (SCL, SDA)	V <sub>OH</sub>	VDD3-0.5	VDD3+0.3	V	VDD3 as same as Pull-up Vcc
	V <sub>OL</sub>	0.0	0.4	V	
Leakage Current	I <sub>I</sub>	-10	10	uA	
Capacitance for XFP SCL and SDA I/O Pin	C <sub>i</sub>		14	pF	
Total bus capacitance load for SCL and for SDA	C <sub>b</sub>		100	pF	At 400kHz, 3.0kohm R <sub>p</sub> , max
			400	pF	At 100kHz, 8.0kohm R <sub>p</sub> , max



**Fig. 5.4.1 An Example Open Drain Type Connection for I2C**

## 6. Optical Characteristics

All parameters are specified over the operating case temperature.

### 6.1 SONET SDH 40km/ IEEE Optical Characteristics

**Table 6.1.1 Optical Characteristics**

Tc : -5 to +70degC

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Bit Rate	B	9.953	-	11.0957	Gbps	
<b>Transmitter Part</b>						
Center Wavelength	-	1530	-	1565	nm	
Optical Source	-	EM			-	
Optical Output Power	S <sub>nom</sub>	-1	-	+2	dBm	
Shutdown Optical Power	S <sub>idle</sub>	-	-	-40	dBm	
Extinction Ratio with Filter	ER	8.2	-	-	dB	
Optical Modulation Amplitude	OMA	0.7	-	-	dBm	10.3Gbps
Dispersion Penalty	-	-	-	2.0	dB	800ps/nm
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Eye Mask *1	-	GR-253-CORE / ITU-T G.691			-	Fig.6.1.1
		IEEE802.3ae			-	10.3Gbps, Fig.6.1.2
<b>Receiver Part</b>						
Center Wavelength	-	1530	-	1565	nm	
Sensitivity	-	-	-	-14	dBm	@BER=10 <sup>-12</sup>
Overload	OL	-1	-	-	dBm	
Stressed Sensitivity in OMA	-	-	-	-11.3	dBm	10.3Gbps, @BER=10 <sup>-12</sup>
Maximum Reflectance	-	-	-	-27	dB	

\*1 : Eye mask compliance is shown in Fig.6.1.1 and Fig.6.1.2.

### 6.2 SONET SDH 80km/ IEEE Optical Characteristics

**Table 6.2.1 Optical Characteristics**

Tc : -5 to +70degC

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Bit Rate	B	9.953	-	11.0957	Gbps	
<b>Transmitter Part</b>						
Center Wavelength	-	1530	-	1565	nm	
Optical Source	-	EM			-	
Optical Output Power	S <sub>nom</sub>	0	-	+4	dBm	
Shutdown Optical Power	S <sub>idle</sub>	-	-	-40	dBm	
Extinction Ratio with Filter	ER	9	-	-	dB	
Dispersion Penalty	-	-	-	2.0	dB	1600ps/nm
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Eye Mask *1	-	GR-253-CORE / ITU-T G.691			-	Fig.6.1.1
		IEEE802.3ae			-	10.3Gbps, Fig.6.1.2
<b>Receiver Part</b>						
Center Wavelength	-	1530	-	1565	nm	
Overload	OL	-7	-	-	dBm	
Sensitivity	-	-	-	-24	dBm	@BER=10 <sup>-12</sup>
Maximum Reflectance	-	-	-	-27	dB	

\*1 : Eye mask compliance is shown in Fig.6.1.1 and Fig.6.1.2.

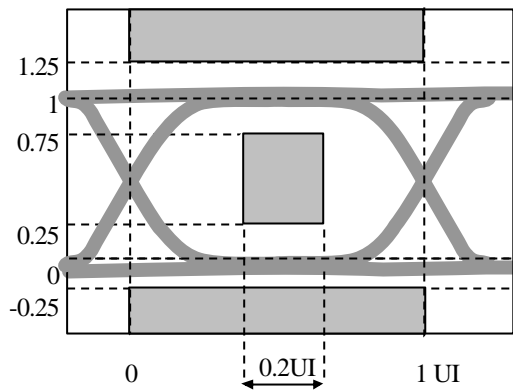


Fig. 6.1.1 MASK for GR-253/G.691

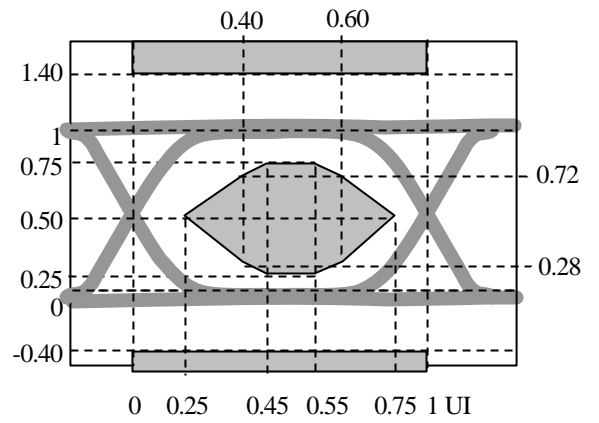


Fig. 6.1.2 MASK for IEEE802.3ae



## 7. 2-Wire Serial Interface

XFP module has 2-Wire Serial Interface (SDA, SCL), which allows host to monitor some operating parameters and to set some parameters to control the XFP module. As for the detail information of 2-Wire Interface, please see the XFP MSA specification document.

### 7.1 Digital Diagnostic Functions

Digital Diagnostic Functions are provided using 2-Wire Interface. It provides the following operating monitoring function to Host.

#### 1) Internally Measured Transceiver Temperature

Represented as a 16 bit signed two's complement value in increments of 1/256 degrees Celsius valid. The accuracy is better than +/-3 degrees Celsius over specified operating case temperature and voltage.

#### 2) Measured TX Bias Current in $\mu$ A

Represented as a 16 bit unsigned integer with the current defined as the full 16 bit value with LSB equal to 2 $\mu$ A, yielding a total measurement range of 0 to 131 $\mu$ A. The accuracy is better than +/-10% over specified operating case temperature and voltage.

#### 3) Measured Tx Output Power in mW

Represented as a 16 bit unsigned integer with the power defined as the full 16 bit value with LSB equal to 0.1 $\mu$ W, yielding a total measurement range of 0 to 6.5535mW (8.2dBm). Data is based on measurement of laser monitor photodiode current. The accuracy is better than +/-2dB over specified operating case temperature and voltage.

#### 4) Measured RX Received Optical Power in mW

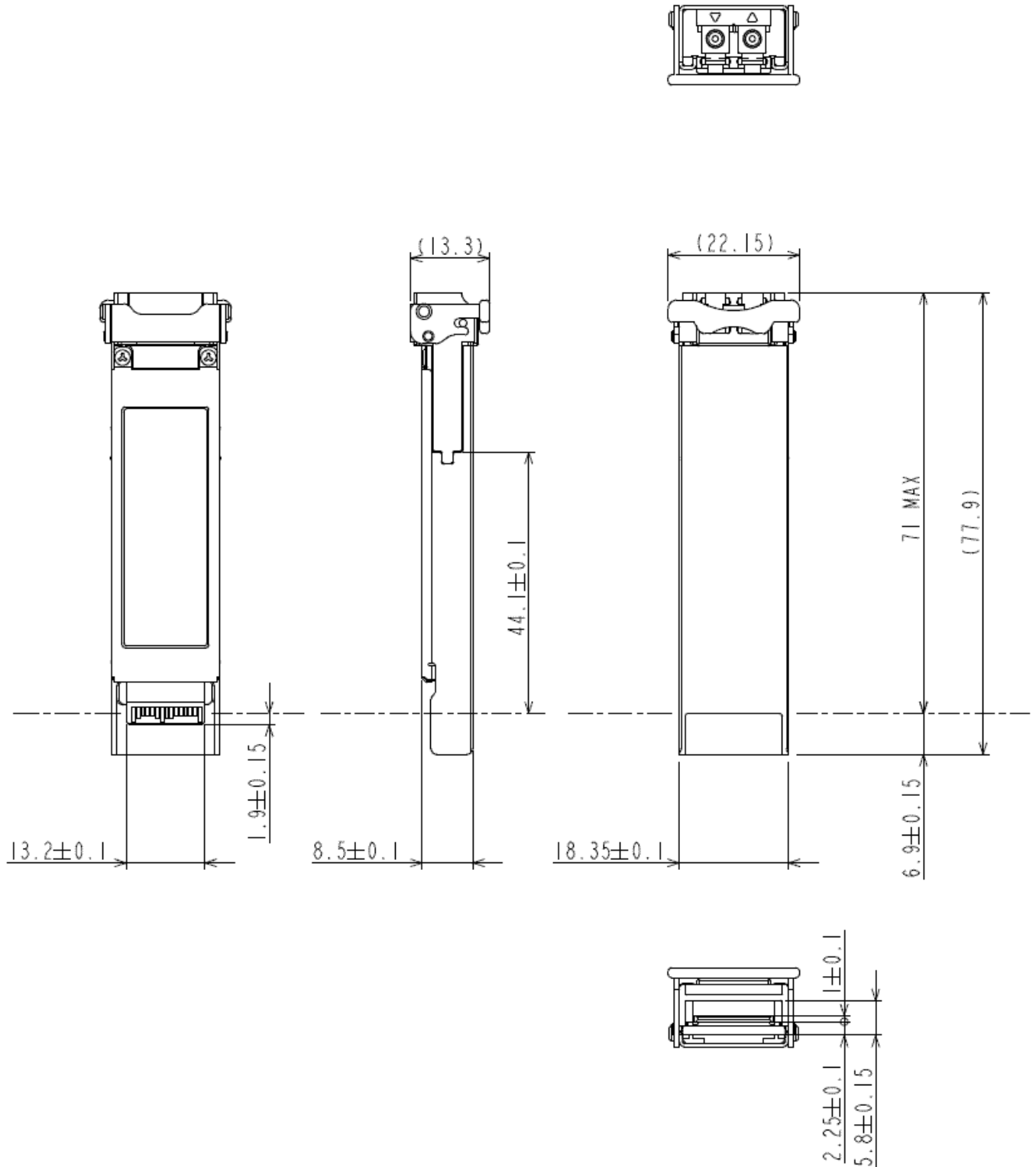
Value can represent either the average received power. Represented as a 16 bit unsigned integer with the power defined as the full 16 bit value with LSB equal to 0.1 $\mu$ W, yielding a total measurement range of 0 to 6.5535mW (+8.2dBm). The accuracy is better than +/-2dB over specified operating case temperature and voltage.

#### 5) Internally Measured Transceiver Supply Voltage

Represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value with LSB equal to 100 $\mu$ V, yielding a total measurement range of 0 to +6.55V. The accuracy is better than +/- 3% over specified operating case temperature and voltage.



8. General Outline Drawing



## ***9. Environment Considerations***

### ***9.1 Mechanical Shock***

MIL-STD-883 Method 2002

### ***9.2 Mechanical Vibration***

MIL-STD-883 Method 2004

### ***9.3 Thermal Shock***

MIL-STD-883 Method 1011

### ***9.4 Laser Class***

Class 1 Laser Products

### ***9.5 ESD***

IEC 61004-2, 500V, HBM

## ***10. Reference Document***

- 1) 10 Gigabit Small Form Factor Pluggable Module (XFP) Multi-Source Agreement (MSA), Rev 4.0 – April 2003.  
[http://www.xfpmsa.org/XFP\\_SFF\\_INF\\_8077i\\_Rev4\\_0.pdf](http://www.xfpmsa.org/XFP_SFF_INF_8077i_Rev4_0.pdf)



**11. Ordering Information**

**11.1 Transceiver Type Number**

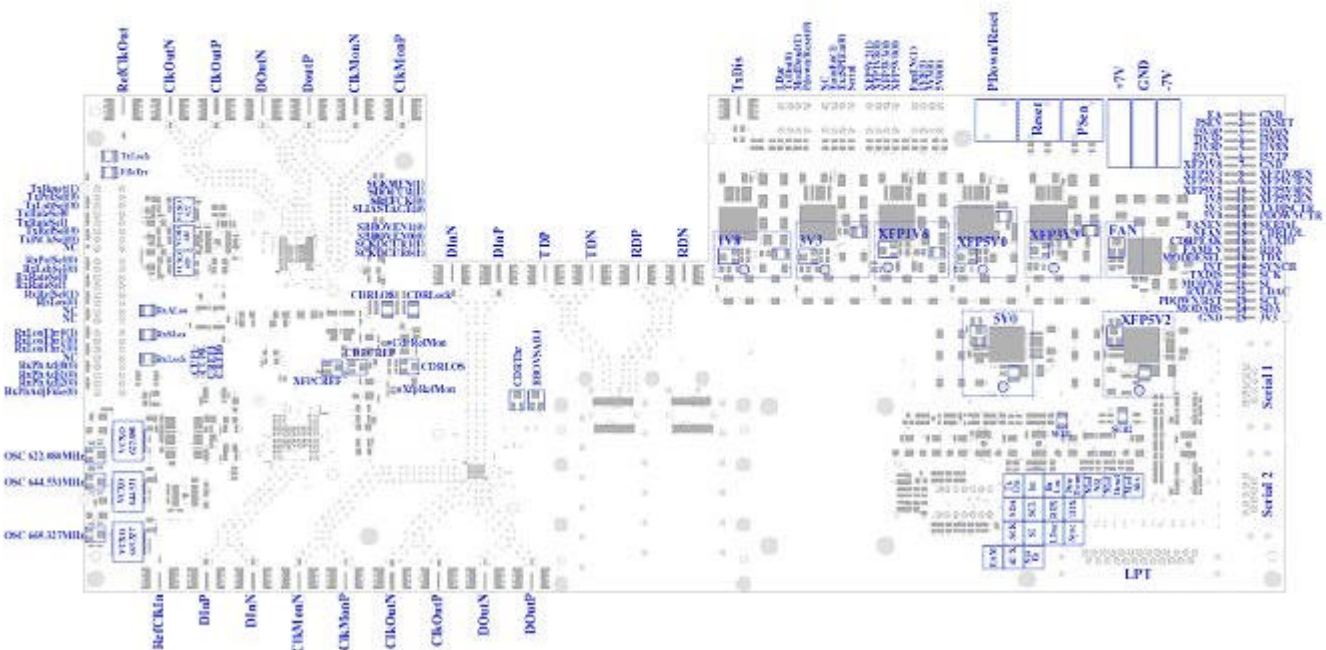
Type Number	Features	Optical Connector
MF-10KSXA-008ZA	MITSUBISHI Standard type (1550nm 40km version)	LC Receptacle
MF-10KSXA-009ZA	MITSUBISHI Standard type (1550nm 80km version)	LC Receptacle

**11.2 Optional Test Board**

Type Number	Features
	XFP Test Board

Please refer following figure.

	9.953280	10.312500	10.709225	Ext. CkRef
CUP1	0	0	1	
CUP0	0	1	0	
CRFP1	0	0	1	1
CRFP0	0	1	0	1
TxRateSel0	0	1	1	
TxRateSel1	0	1	0	
RxRateSel0	0	1	1	
RxRateSel1	0	1	0	





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*History*

*Note*

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