

XFP
1310 nm Small Form Factor Module
10 Gigabit Pluggable Transceiver
Compatible with XFP MSA Rev. 3.1

V23833-Fx105-B001
V23833-Fx105-B002

Preliminary Data Sheet

Features

Standards

- Compatible with IEEE 802.3ae™-2002
- Compatible with Fibre Channel 10GFC Draft 3.5
- Compatible with ITU-T G.693 11/2001
- Compatible with XFP MSA Rev. 3.1
- Compatible with Telcordia GR-253-CORE



Optical

- IEEE Ethernet: Serial 1310 nm 10GBASE-LR
- T11 Fibre Channel: Serial 1310 nm 1200-SM-LL-L
- ITU-T G.693: VSR2000-2R1
- Telcordia: SR1
- Transmission distance 2 m up to 10 km
- Uncooled directly modulated Distributed Feedback (DFB) laser at 1310 nm
- According to XFP MSA Rev. 3.1
- LC connector, single mode fiber
- Full duplex transmission mode

Ordering Information

Part Number	Chassis/Signal Grounding Concept	Standard
V23833-F0105-B001	Separated	Ethernet/Fibre Channel
V23833-F9105-B001	Separated	Multi-Protocol
V23833-F0105-B002	Common	Ethernet/Fibre Channel
V23833-F9105-B002	Common	Multi-Protocol

Monitoring and Control

- Laser safety shut off
- Supply voltage 5 V / 3.3 V / 1.8 V
- Transmit power
- Received power RSSI
- Module temperature
- Laser bias current
- Tx_DIS
- Mod_NR
- Mod_DeSel
- Interrupt
- Mod_ABS
- P_Down/RST
- Rx_Los

Mechanical

- Color coded blue for 1310 nm
- Belly-to-belly applications
- Latching mechanism with low insertion force

Electrical

- Hot pluggable
- Power supply 5 V / 3.3 V / 1.8 V
- Total power consumption: < 3.5 W max.
- XFI electrical interface
- External reference clock (transmit data synchronization B/64)
- Management and control via 2-wire interface
- 30 pin connector, 0.8 mm pitch

Applications

- 10GBE, 10GFC, OC-192/STM-64 and G.709 transmission systems for short range
- Integration on PCI card, with eventually mid-board mounting
- Belly-to-belly for high density applications
- Enterprise and campus network applications
- Storage applications
- Backplane and switch applications
- Aggregation point for lower data rate
- XFP evaluation kit V23833-F9909-Z001 available upon request

Pin Configuration

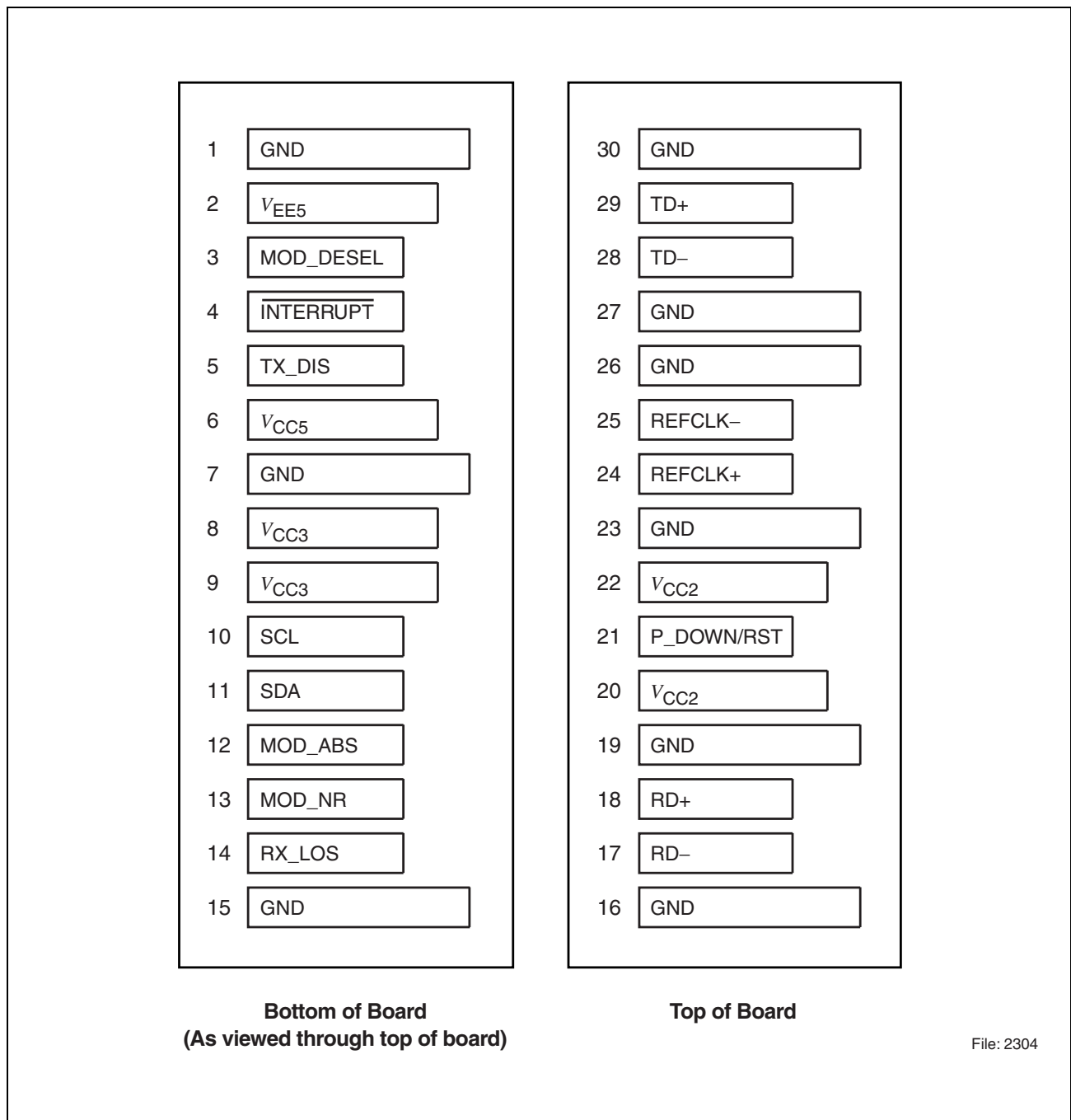


Figure 1 XFP Transceiver Electrical Pad Layout

Pin Configuration

Connector Pin Assignments

Pin No.	Signal Name
1	GND
2	V_{EE5}
3	MOD_DESEL
4	INTERRUPT
5	TX_DIS
6	V_{CC5}
7	GND
8	V_{CC3}
9	V_{CC3}
10	SCL
11	SDA
12	MOD_ABS
13	MOD_NR
14	RX_LOS
15	GND

Pin No.	Signal Name
30	GND
29	TD+
28	TD–
27	GND
26	GND
25	REFCLK–
24	REFCLK+
23	GND
22	V_{CC2}
21	P_DOWN
20	V_{CC2}
19	GND
18	RD+
17	RD–
16	GND

Pin Configuration

Pin Description

Signal Name	Level	I/O	Pin No.	Description
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Management and Monitoring Ports

MOD_DESEL	LVTTL	I	3	Module De-select: when “L” allows the module to respond to 2-wire serial interface command. “H” active
INTERRUPT	LVTTL	O	4	Interrupt: indicates presence of an important condition which can be read on the 2-wire serial interface. “H” active
TX_DIS	LVTTL	I	5	Transmitter Disable: transmitter laser source is turned off. “H” active
SCL	LVTTL	I	10	2-wire Interface Clock
SDA	LVTTL	I	11	2-wire Interface Data
MOD_ABS	LVTTL	O	12	Module Absent: indicating the modules not present. “H” active
MOD_NR	LVTTL	O	13	Module not ready: module operational fault
RX_LOS	LVTTL	O	14	Receiver Loss Of Signal Indicator
P_DOWN	LVTTL	I	21	Power Saving Mode: places the module in the stand-by condition. Active “H”. During the falling edge set the module reset

Transmit Functions

TD–	CML	I	28	Transmitter Inverted Data Input
TD+	CML	I	29	Transmitter Not-inverted Data Input

Receive Functions

RD–	CML	O	17	Receiver Data Output Inverted
RD+	CML	O	18	Receiver Data Output Not-inverted
REFCLK+	PECL	I	24	Reference Clock Not-inverted Input
REFCLK–	PECL	I	25	Reference Clock Inverted Input

DC Power

GND	0 V	–	1,7,15,16,19,23,26,27,30	Ground connection for both signal and chassis on the module
V _{CC5}	+5 V	I	6	Positive power supply, nominal
V _{CC3}	+3.3 V	I	8,9	Positive power supply, nominal
V _{CC2}	+1.8 V	I	20,22	Positive power supply, nominal

Description

System Block Diagram

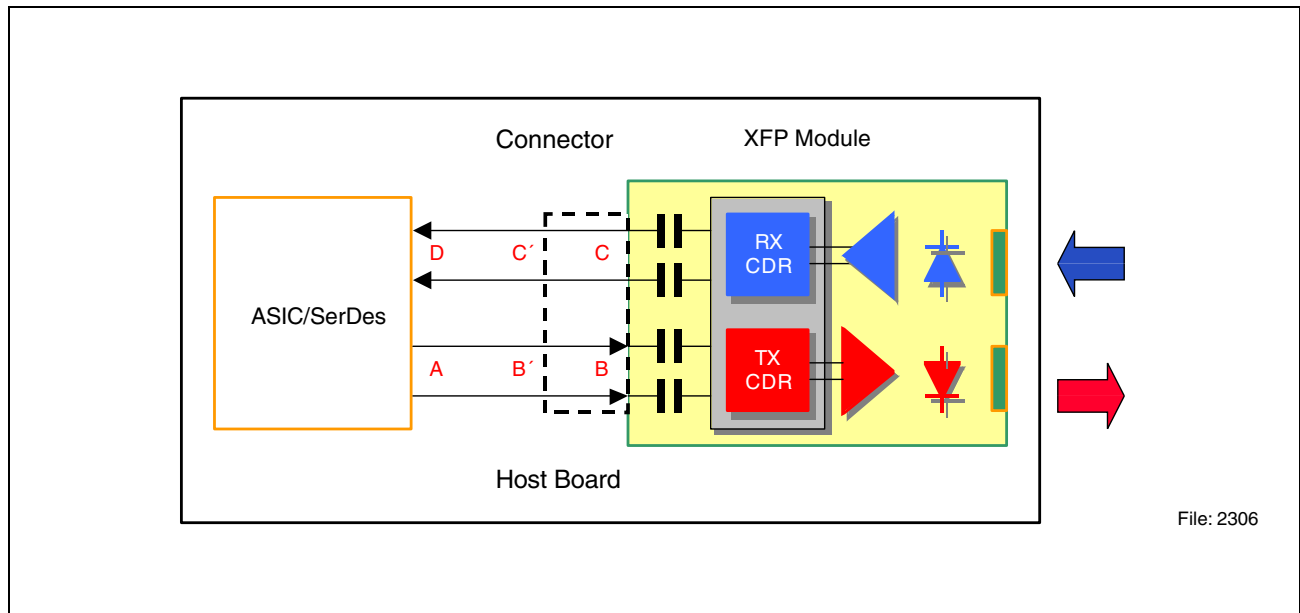


Figure 2

Optical Interface Standard Specifications

- IEEE 802.3ae™-2002 clause 52, 10GBASE-LR
- Fibre Channel 10GFC Draft 3.5, 1200-SM-LL-L
- ITU-T G.693: VSR2000-2R1
- Telcordia: SR1
- XFP MSA Rev. 3.1

Fiber Type	Minimum Modal Bandwidth at 1310 nm (MHz*km)	Operating Range (meters) ¹⁾
B1.1 SMF	10	2 to 10,000
B1.3 SMF	10	2 to 10,000

¹⁾ Operating range as defined by IEEE and Fibre Channel standards. Longer reach possible depending upon link implementation. A loopback connector is supported.

Electrical Interface Standard Specifications

- IEEE 802.3ae™-2002 clause 45 & 47
- XFP MSA Rev. 3.1

Environment: Thermal Management Recommendations

Operating air inlet temperature: 0°C - 50°C
Operating Airflow: 200 LFM (1.5 m/s)
Operating Humidity: 85% RH non-condensing
Maximum operating case temperature is 70°C as defined by UL 1950.

Module can withstand and operate within specification with case temperature of 75°C for up to 96 hrs/yr. Transceiver requires airflow parallel to cooling fins. Maximum airflow required per XFP MSA is 3 m/s.

Fibers and Connectors

The transceiver LC features a duplex receptacle and is designed for single mode LC cables, 0° polished end face (PC).

30-pin Connector

The module interface connector is a 30-pin, printed circuit board edge connection with a 0.8 mm pitch. The appropriate mating connector for the customer PCB is a 30-pin SMT, dual row, right angled, edge connector, 0.8 mm pitch (TycoAmp part number 788862C or equivalent).

Cage/Heatsink Requirement

The cage/heatsink assembly required to mount the XFP module is defined by the MSA.

Regulatory Compliance

Feature	Standard	Comments
ESD: Electrostatic Discharge to the Electrical Pins (HBM)	EIA/JESD22-A114-B (MIL-STD 883D Method 3015.7)	Class 1a (> 500 V)
Immunity: Against Electrostatic Discharge (ESD) to the Module Receptacle	EN 61000-4-2 IEC 61000-4-2	Discharges ranging from ± 2 kV to ± 15 kV to the front end / faceplate / receptacle cause no damage to module (under recommended conditions).
Immunity: Against Radio Frequency Electromagnetic Field	EN 61000-4-3 IEC 61000-4-3	With a field strength of 3 V/m, noise frequency ranges from 10 MHz to 2 GHz. No effect on module performance between the specification limits.
Emission: Electromagnetic Interference (EMI)	FCC 47 CFR Part 15, Class B EN 55022 Class B CISPR 22	Noise frequency range: 30 MHz to 40 GHz Radiated emission does not exceed specified limits when measured inside a shielding enclosure with MSA conform cutout.

Technical Data
Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Storage Ambient Temperature ¹⁾	T_S	-20	85	°C
Operating Ambient Temperature ^{1) 2)}	T_A	0	50	°C
Operating Case Temperature ^{1) 2)}	T_C	0	80	°C
Supply Voltage +5.0 V	V_5	0	6	V
Supply Voltage +3.3 V	V_3	0	4	V
Supply Voltage +1.8 V	V_{aps}	0	2	V
Static Discharge Voltage, All Pins	ST_d	-500	500	V
Average Receive Optical Power	$Rx_{P_{max}}$		1.5	dBm

¹⁾ Non condensing.

²⁾ With specified airflow (see “**Environment: Thermal Management Recommendations**”).

Exceeding any one of these values may permanently destroy the device.

Recommended Operating Conditions

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Operating Case Temperature ^{1) 2)}	T_C	0		70	°C
Transceiver Total Power Consumption	P		2.5	3.5	W
Supply Voltage +5.0 V	V_{CC5}	4.75	5	5.25	V
Supply Current +5.0 V	I_{CC5}			t.b.d.	mA
Supply Voltage +3.3 V	V_{CC3}	3.14	3.3	3.47	V
Supply Current +3.3 V	I_{CC3}			t.b.d.	mA
Supply Voltage +1.8 V	$V_{CC_{aps}}$	1.71	1.8	1.89	V
Supply Current +1.8 V	$I_{CC_{aps}}$			t.b.d.	mA

¹⁾ With specified airflow (see “**Environment: Thermal Management Recommendations**”).

²⁾ Worst case thermal location (see **Figure 15**).

Optical Characteristics

($V_{CC5} = 4.75 \text{ V to } 5.25 \text{ V}$, $V_{CC3} = 3.14 \text{ V to } 3.47 \text{ V}$, $V_{CC\text{aps}} = 1.71 \text{ V to } 1.89 \text{ V}$, $T_C = 0^\circ\text{C to } 70^\circ\text{C}$)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

Transmitter

Launch Power in OMA minus TDP	$P_{\text{O-OMA}}$	-6.2			dBm
Average Launch Power	$P_{\text{O-Avg}}$	-8.2	-1	0.5	dBm
Center Wavelength Range	$\lambda_{\text{C-Tx}}$	1290	1310	1330	nm
Spectral Width (-20 dB)	σ_I		0.5	0.6	nm
Side Mode Suppression Ratio	SMSR	30			dB
Extinction Ratio	ER	3.5	5		dB
Relative Intensity Noise ₁₂ OMA	RIN			-128	dB/Hz
Optical Modulation Amplitude (OMA)	OMA	-5.2			dBm
Transmitter and Dispersion Penalty	TDP			3.2	dB
Average Launch Power of OFF Transmitter	$P_{\text{O-OFF}}$			-30	dBm
Optical Return Loss Tolerance	ORL_T			12	dB
Transmitter Reflectance	REF_{Tx}			-12	dB
Eye Mask Definition	According to IEEE and Fibre Channel				

Receiver

Stressed Receiver Sensitivity	$P_{\text{IN-S}}$			-10.3	dBm
Sensitivity in OMA ¹⁾	P_{IN}			-12.6	dBm
Average Receive Power	$P_{\text{IN-max}}$			0.5	dBm
Loss Of Signal Assert Level	P_{LOSa}		-17	-13	dBm
Loss Of Signal Hysteresis	P_{LOSh}	1	2	4	dB
Receiver Reflectance	REF_{Rx}			-12	dB
Center Wavelength Range	$\lambda_{\text{C-Rx}}$	1260		1355	nm

¹⁾ Receiver sensitivity, which is defined for an ideal input signal is informative only.

Electrical DC Characteristics

($V_{CC5} = 4.75 \text{ V to } 5.25 \text{ V}$, $V_{CC3} = 3.14 \text{ V to } 3.47 \text{ V}$, $V_{CC\text{aps}} = 1.71 \text{ V to } 1.89 \text{ V}$, $T_C = 0^\circ\text{C to } 70^\circ\text{C}$)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

3.3 V CMOS I/O DC Characteristics
(Management, Logic and Monitoring Ports)

External Pull-up Resistor for Open Drain	R_{pullup}	10		22	k Ω
Output High Voltage ¹⁾	V_{oh}	2.4		3.5	V
Output Low Voltage ¹⁾	V_{ol}			0.4	V
Input High Voltage	V_{ih}			2	V
Input Low Voltage	V_{il}	0		0.8	V
Input Pull-up Current ²⁾	I_{pd}	-10	0	10	μA

LVPECL I/O Characteristics
(REFCLK+/-)

Differential Input Voltage (pk-pk) ³⁾	$V_{\text{in_diff}}$	400		2000	mV p-p
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XFI I/O DC Characteristics
(TD+/-; RD+/-)

Differential Input Amplitude (pk-pk) ⁴⁾	TD+/-	240		1640	mV p-p diff
Differential Output Amplitude (pk-pk) ⁵⁾	RD+/-	680		1700	mV p-p diff

¹⁾ $R_{\text{pull-up}} = 10 \text{ k}\Omega \text{ to } 3.3 \text{ V}$.

²⁾ $V_{\text{in}} = 3.3 \text{ V}$.

³⁾ AC coupled in transceiver.

⁴⁾ AC coupled input at host board.

⁵⁾ AC coupled output at host board.

Electrical AC Characteristics

($V_{CC5} = 4.75 \text{ V to } 5.25 \text{ V}$, $V_{CC3} = 3.14 \text{ V to } 3.47 \text{ V}$, $V_{CC\text{aps}} = 1.71 \text{ V to } 1.89 \text{ V}$, $T_C = 0^\circ\text{C to } 70^\circ\text{C}$)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**XFI Input AC Characteristics
(TD+/-)**

Baud Rate	TD+/-	9.95	10.3125	10.75	Gbit/s
Baud Rate Tolerance	TD _{tol}	-500		500	ppm
Differential Input Impedance	Z _{IN}	80	100	120	Ω
Differential Return Loss ¹⁾	S ₁₁	8			dB
Input Differential Skew ²⁾	T _{SKEWIN}		t.b.d.		ps
Total Jitter ³⁾	TJ _{TD}			0.61	UI pp
Deterministic Jitter ³⁾	TJ _{TD}			0.2	UI pp

**XFI Output AC Characteristics
(RD+/-)**

Baud Rate	RD+/-	9.95	10.3125	10.75	Gbit/s
Baud Rate Tolerance	RD _{tol}	-100		100	ppm
Rise and Fall Times ⁴⁾	t _r , t _f	24			ps
Output Differential Skew	T _{SKEWOUT}		t.b.d.		ps
Output Differential Impedance	Z _{OUT}	80	100	120	Ω
Differential Output Return Loss ¹⁾	S ₂₂	8			dB
Total Jitter ⁵⁾	TJ _{RD}			0.34	UI
Deterministic Jitter ⁵⁾	DJ _{RD}			0.18	UI

**LVPECL Input AC Characteristics
(REFCLK+/-)**

REFCLK+/- Frequency ⁶⁾	f _{REF}		164.1328		MHz
REFCLK+/- Frequency ⁷⁾	f _{REF}		164.3554		MHz
REFCLK+/- Frequency Tolerance	f _{TOLREF}	-100		100	ppm
REFCLK+/- Duty Cycle	t _W	40		60	%
REFCLK+/- Rise and Fall Time ⁴⁾	t _r , t _f	200		1250	ps

Electrical AC Characteristics (cont'd)

($V_{CC5} = 4.75 \text{ V to } 5.25 \text{ V}$, $V_{CC3} = 3.14 \text{ V to } 3.47 \text{ V}$, $V_{CC\text{aps}} = 1.71 \text{ V to } 1.89 \text{ V}$, $T_C = 0^\circ\text{C to } 70^\circ\text{C}$)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

3.3 V CMOS I/O AC Characteristics for I²C Signals (SDA; SCL)

SCL Clock Frequency	f_{SCL}	0		400	kHz
SCL Period Low	t_{LOW}	1.3			μs
SCL Period High	t_{HIGH}	0.6			μs
Bus Free Time ⁸⁾	t_{BUF}	1.3			μs
Start Condition Setup Time	$t_{\text{SU_START}}$	0.6			μs
Stop Condition Setup Time	$t_{\text{SU_STOP}}$	0.6			μs
Start Condition Hold Time	$t_{\text{H_START}}$	0.6			μs
Data Hold Time	$t_{\text{H_DATA}}$	0			μs
Data Setup Time	$t_{\text{SU_DATA}}$	100			ns
SDA and SCL Rise and Fall Time	t_r, t_f			300	ns

¹⁾ 100 MHz - 5.5 GHz above 5.5 GHz see XFP MSA 3.1.

²⁾ Not defined at crossing point.

³⁾ Per XFP MSA 3.1 table 17, 1 UI = 96.97 ps.

⁴⁾ 20%, 80%.

⁵⁾ Per XFP MSA 3.1 table 19, 1 UI = 96.97 ps.

⁶⁾ 10 GBE data rate.

⁷⁾ 10 GFC data rate.

⁸⁾ Between stop and start condition.

Timing Parameters for XFP Management

Parameter	Symbol	Values		Unit
		min.	max.	
TX_DIS Assert Time ¹⁾	t_off		10	μs
TX_DIS Negate Time ²⁾	t_on		2	ms
Time to Initialize ³⁾	t_init		300	ms
INTERRUPT Assert Delay ⁴⁾	Interrupt_on		200	ms
INTERRUPT Negate Delay ⁵⁾	Interrupt_off		500	μs
P_DOWN/RST Assert Delay ⁶⁾	P_Down/RST_on		100	μs
MOD_NR Assert Delay ⁷⁾	Mod_nr_on		1	ms
MOD_NR Negate Delay ⁸⁾	Mod_nr_off		1	ms
P_DOWN Reset Time ⁹⁾		10		μs
RX_LOS Assert Delay ¹⁰⁾	t_loss_on		100	μs
RX_LOS Negate Delay ¹¹⁾	t_loss_off		100	μs

- ¹⁾ Rising edge of TX_DIS to fall of output signal below 10% of nominal.
²⁾ Falling edge of TX_DIS to rise of output signal above 90% of nominal.
³⁾ From power on or hot plug after supply or from falling edge of P_DOWN/RST.
⁴⁾ From occurrence of the condition triggering INTERRUPT.
⁵⁾ From clear on read INTERRUPT flags.
⁶⁾ From power down initiation.
⁷⁾ From occurrence of fault to assertion of MOD_NR.
⁸⁾ From clearance of signal to negation of MOD_NR.
⁹⁾ Min. length of P_DOWN assert to initiate reset.
¹⁰⁾ From occurrence of loss of signal to assertion of RX_LOS.
¹¹⁾ From occurrence of presence of signal to negation of RX_LOS.

Eye Safety

This laser based single mode transceiver is a Class 1 product. It complies with IEC 60825-1/A2: 2001 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated July 26, 2001.

CLASS 1 LASER PRODUCT

To meet laser safety requirements the transceiver shall be operated within the Absolute Maximum Ratings.

Note: All adjustments have been made at the factory prior to shipment of the devices. No maintenance or alteration to the device is required.

Tampering with or modifying the performance of the device will result in voided product warranty.

Failure to adhere to the above restrictions could result in a modification that is considered an act of "manufacturing", and will require, under law, recertification of the modified product with the U.S. Food and Drug Administration (ref. 21 CFR 1040.10 (i)).

Laser Emission Data

Wavelength	1310 nm
Maximum total output power (as defined by IEC: 7 mm aperture at 14 mm distance)	15.6 mW / 11.9 dBm
Beam divergence (full angle) / NA (half angle)	11° / 0.1 rad

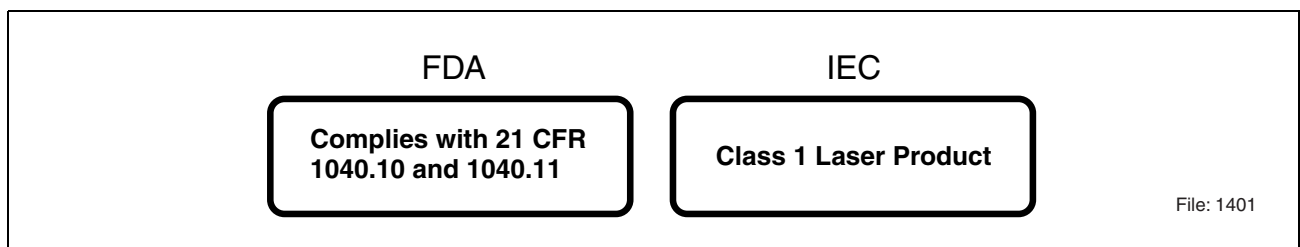


Figure 3 Required Labels

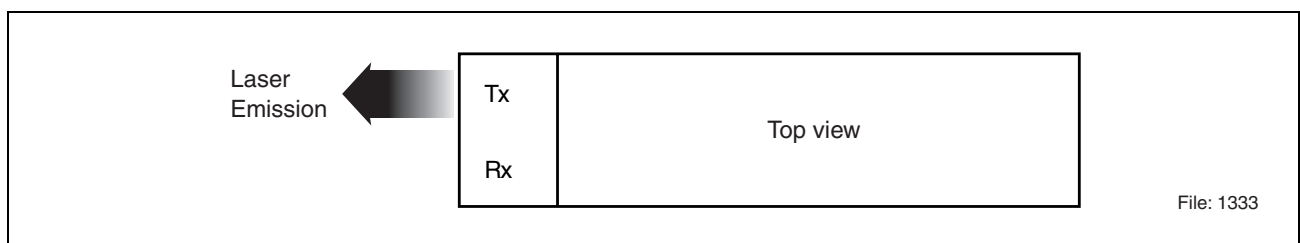


Figure 4 Laser Emission

Application Notes

Host Board Layouts

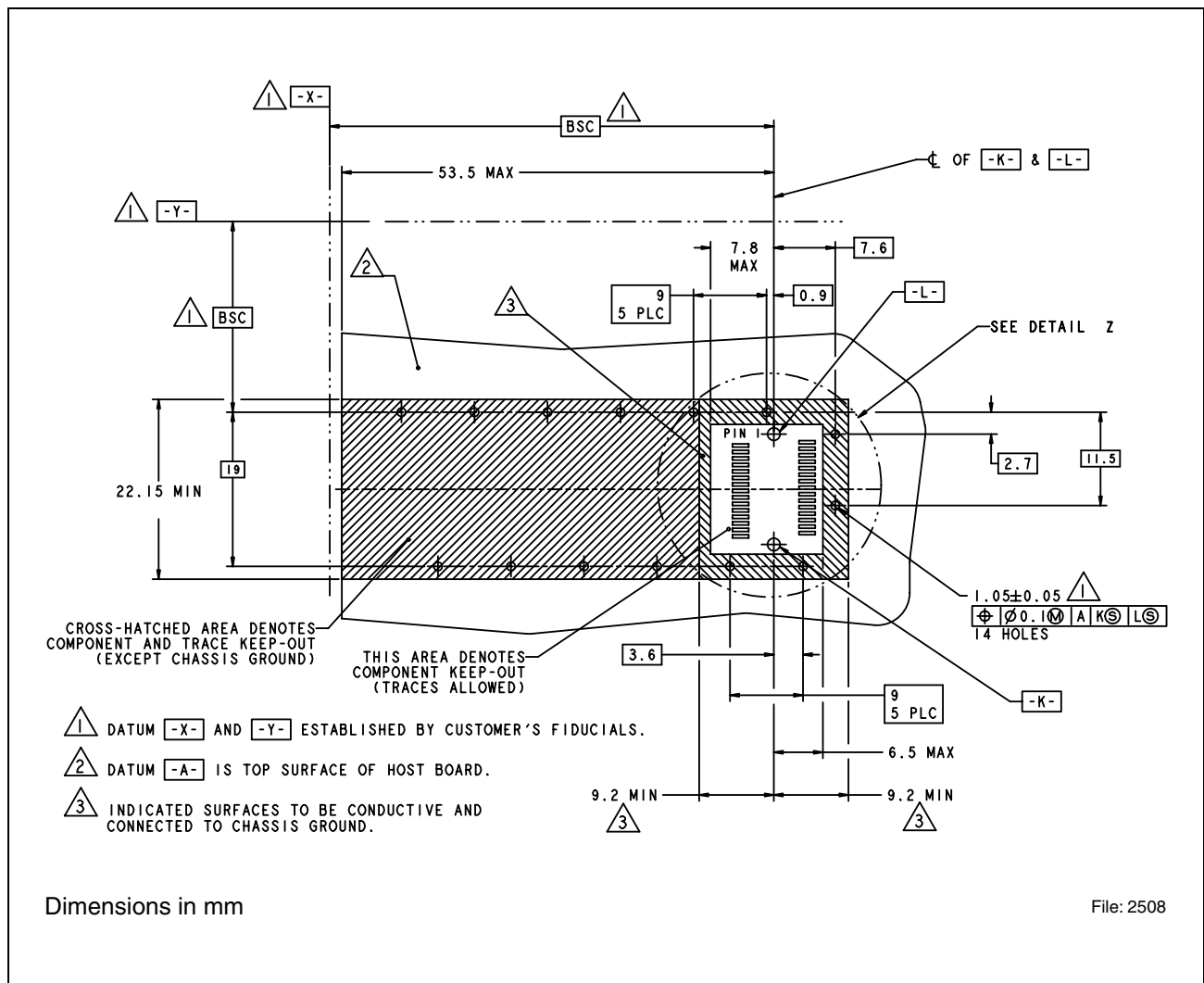


Figure 5 XFP Host Board Mechanical Layout

Detail Z see **Figure 6.**

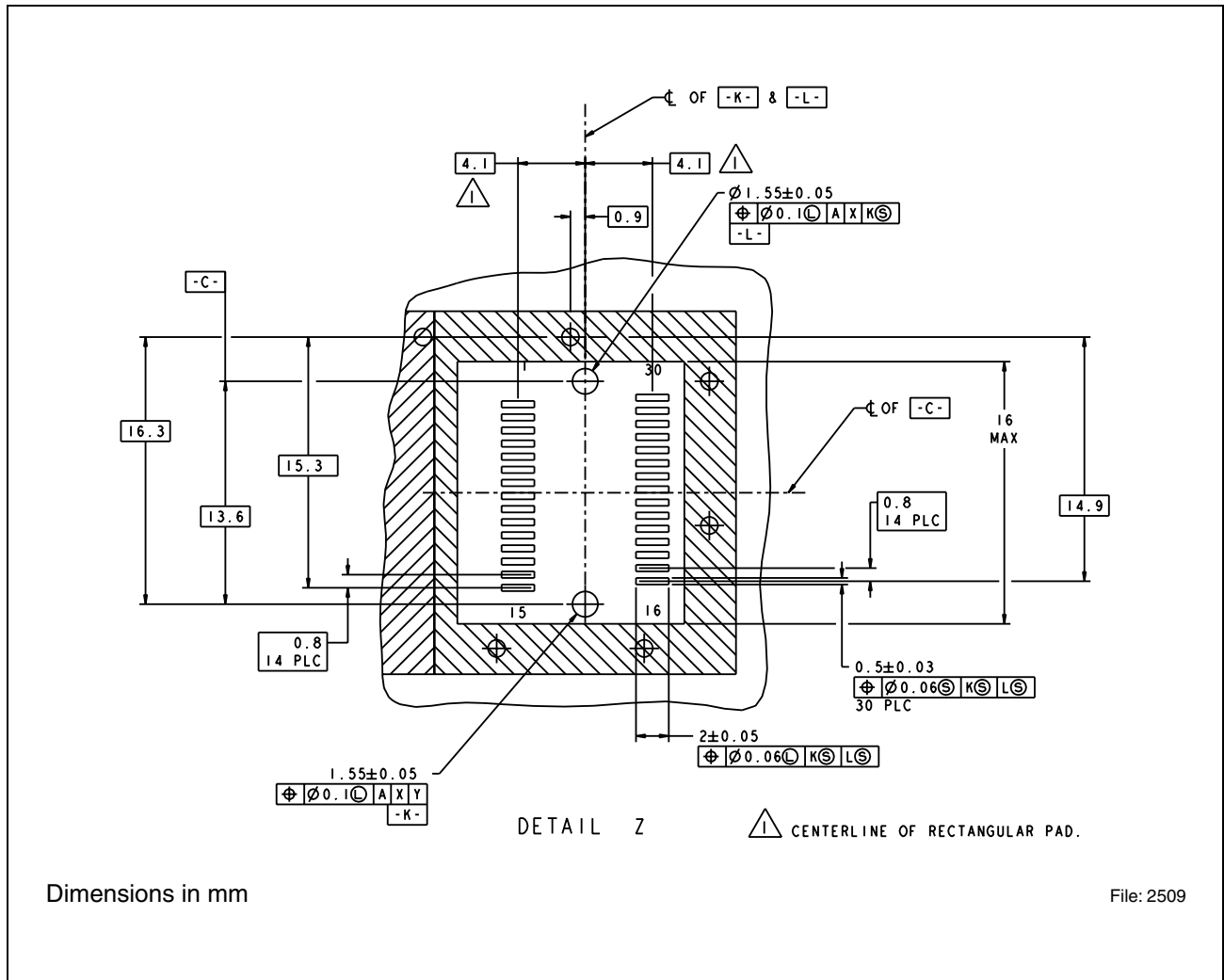


Figure 6 **XFP Host Board Mechanical Layout, Detail Z**

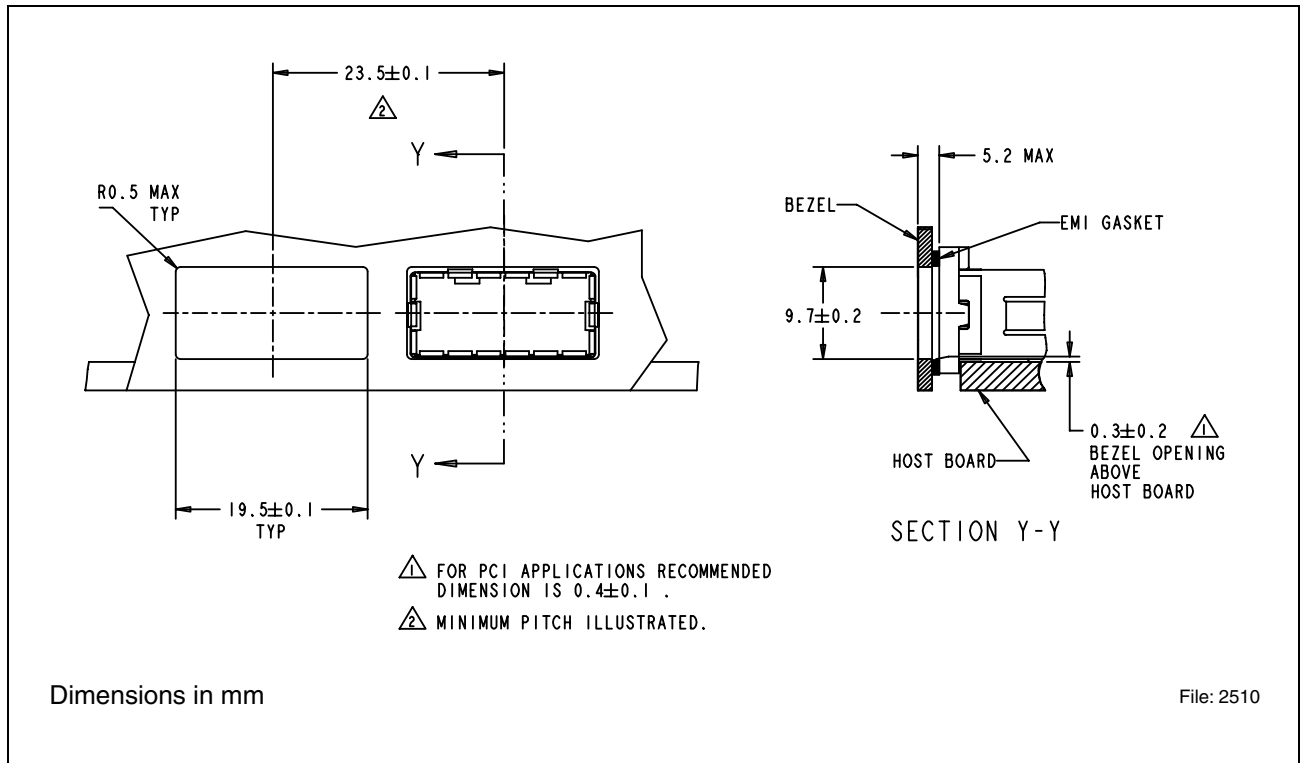


Figure 7 Recommended Single Sided Bezel Design

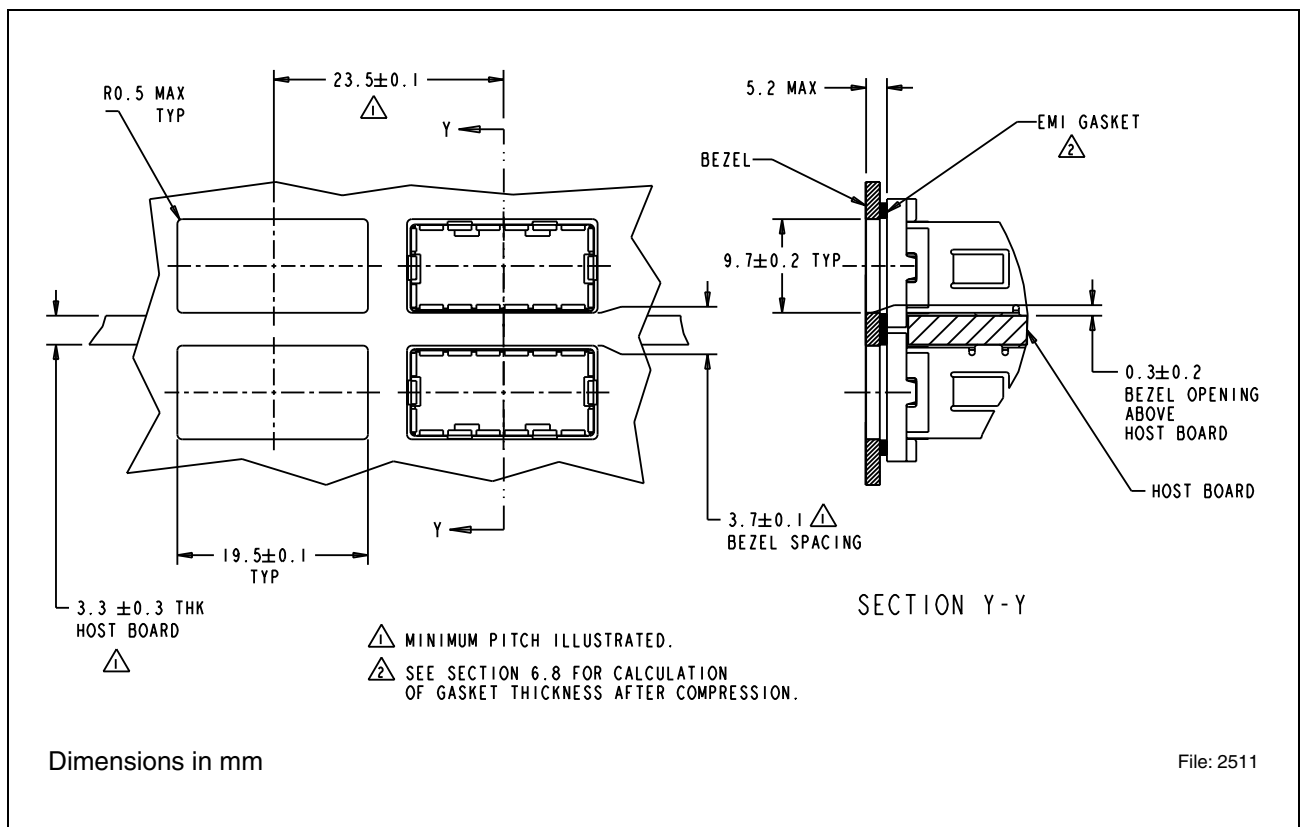
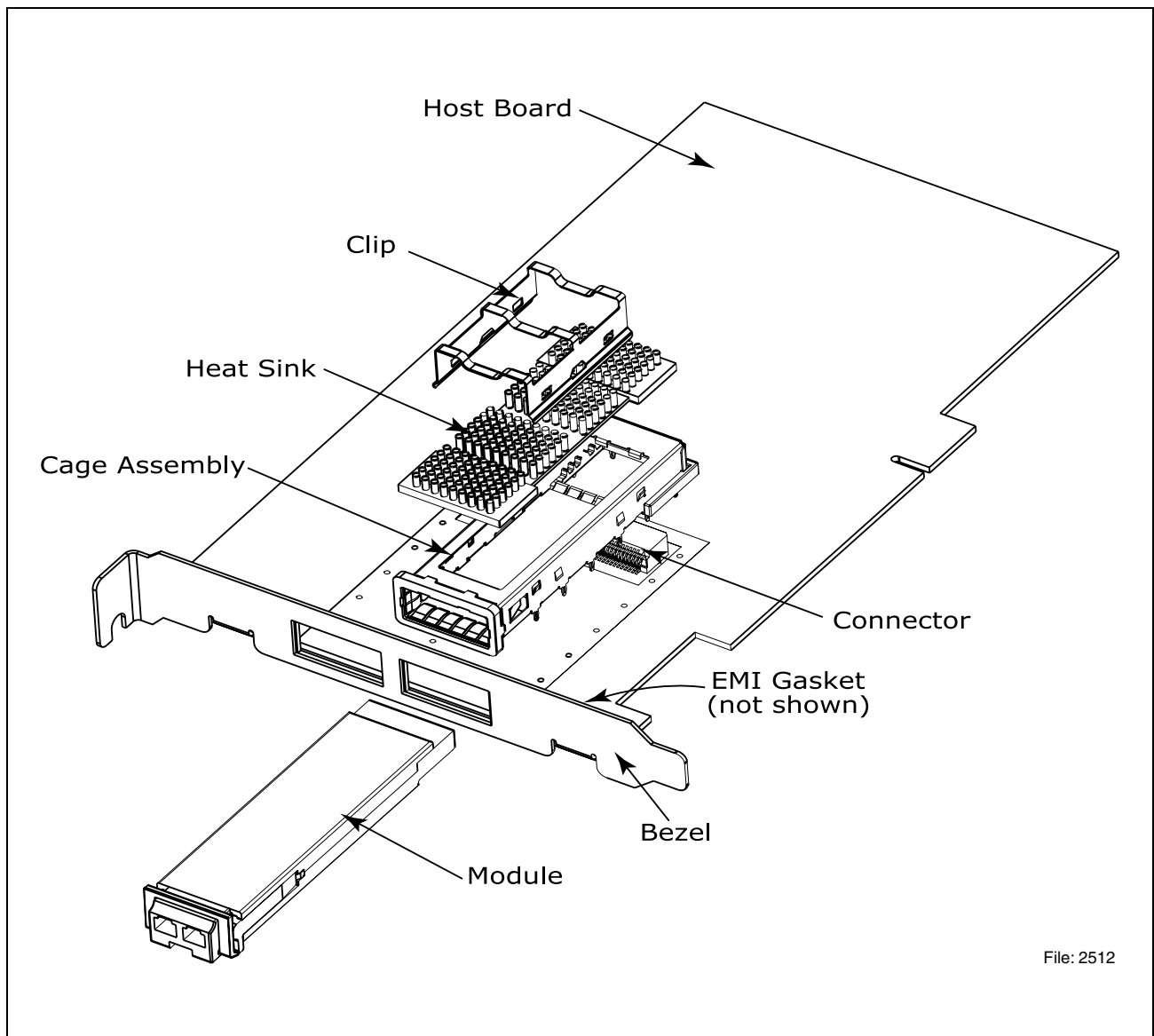


Figure 8 Recommended Double Sided Mounting Bezel Design

Mechanical



File: 2512

Figure 9 PCI Card Application

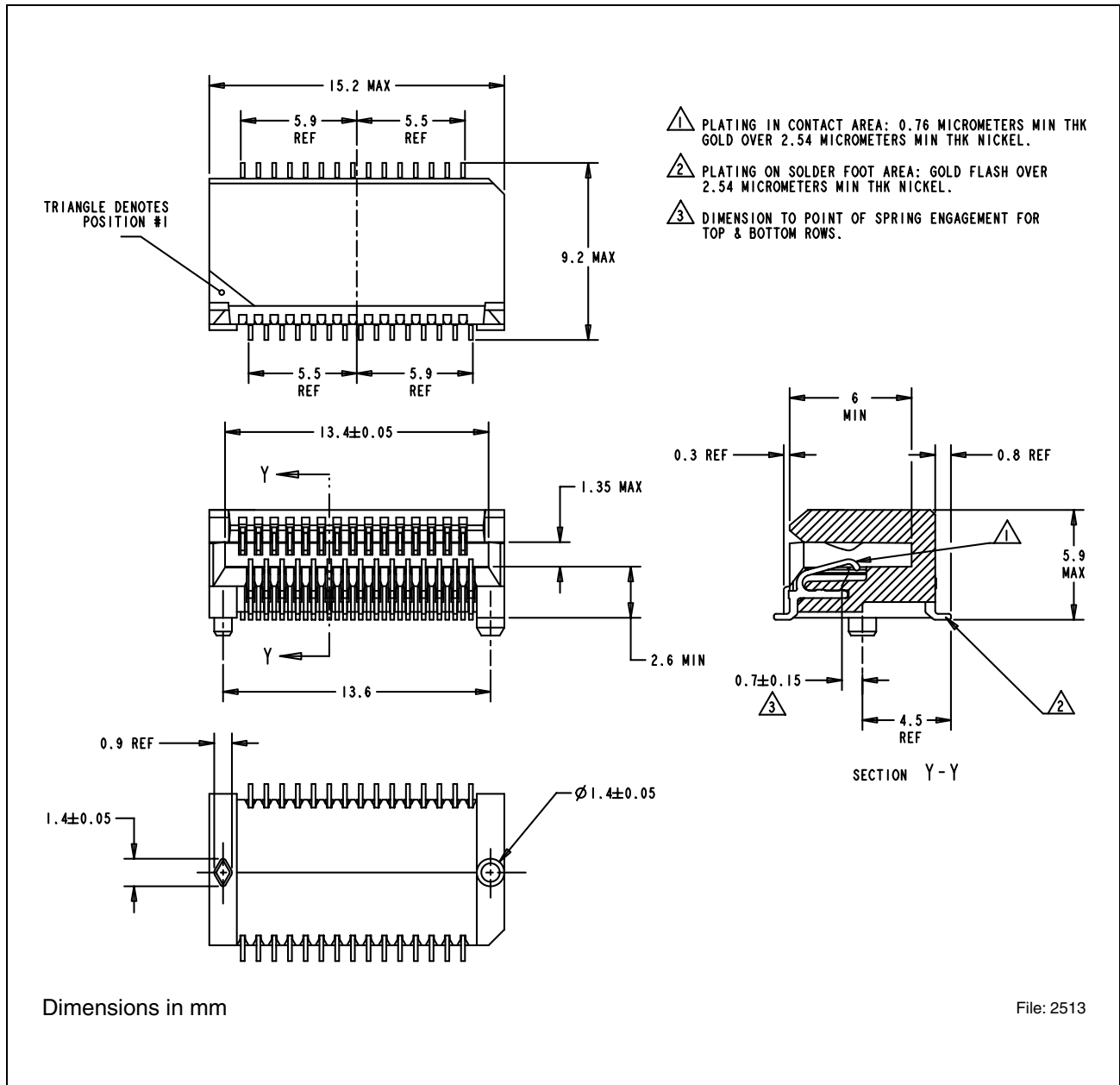


Figure 10 XFP Transceiver Connector Illustration

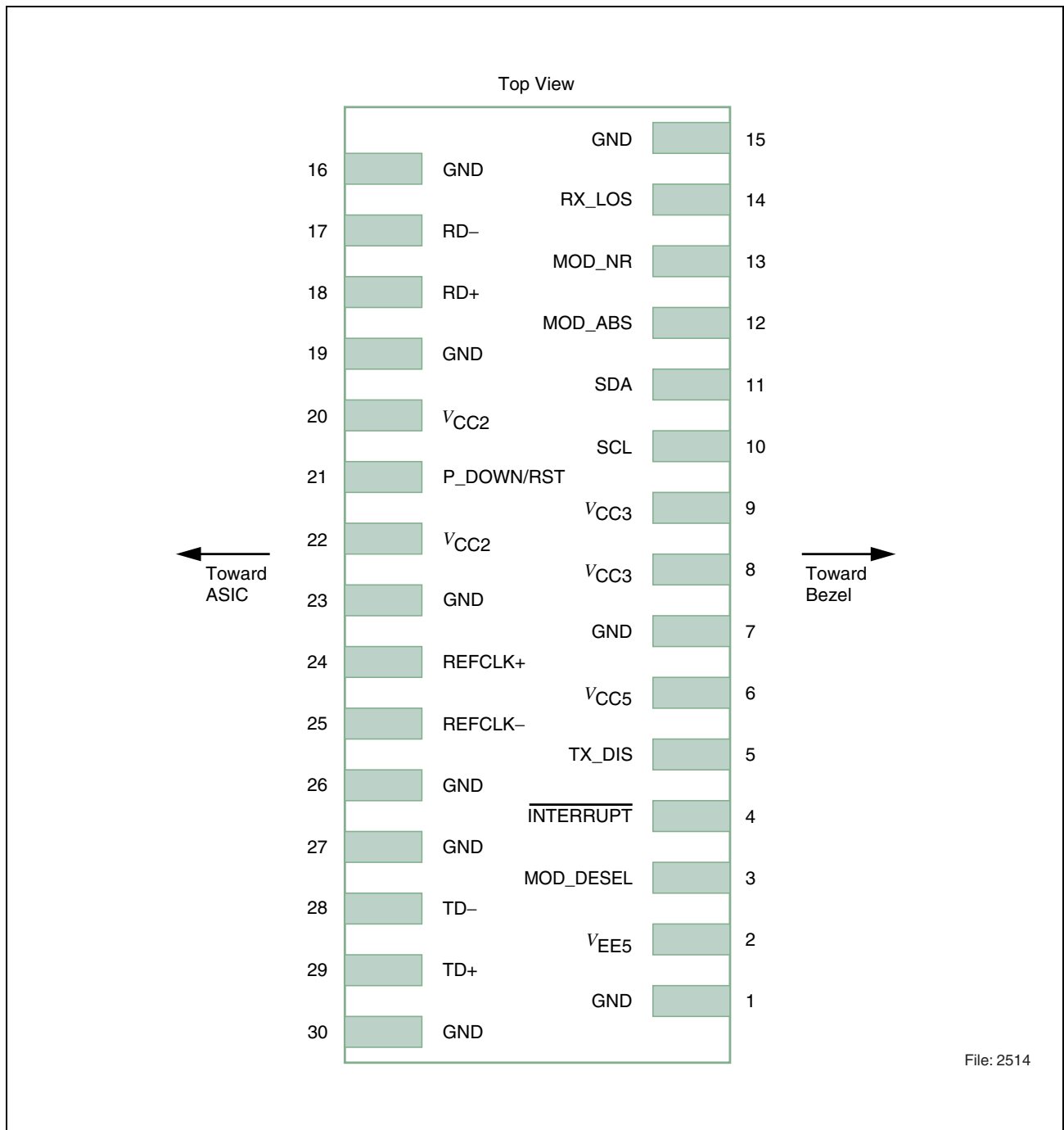
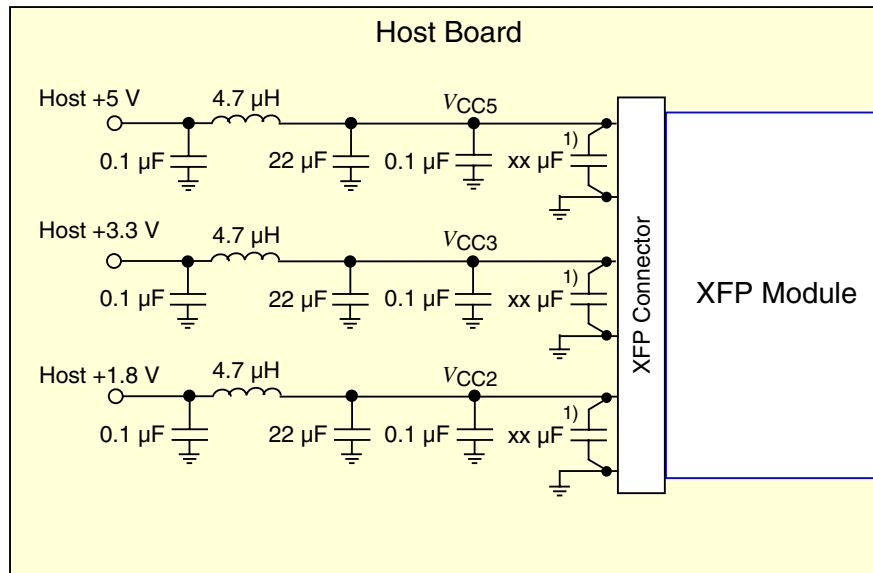


Figure 11 Host PCB XFP Pinout



- 1) Design criterion of the capacitor used is the resonant frequency and its value must be in the order of the nominal data rate. Use of single layer capacitors recommended. Short trace lengths are mandatory.

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Figure 12 Recommended Host Board Supply Filtering Network

Package Outlines

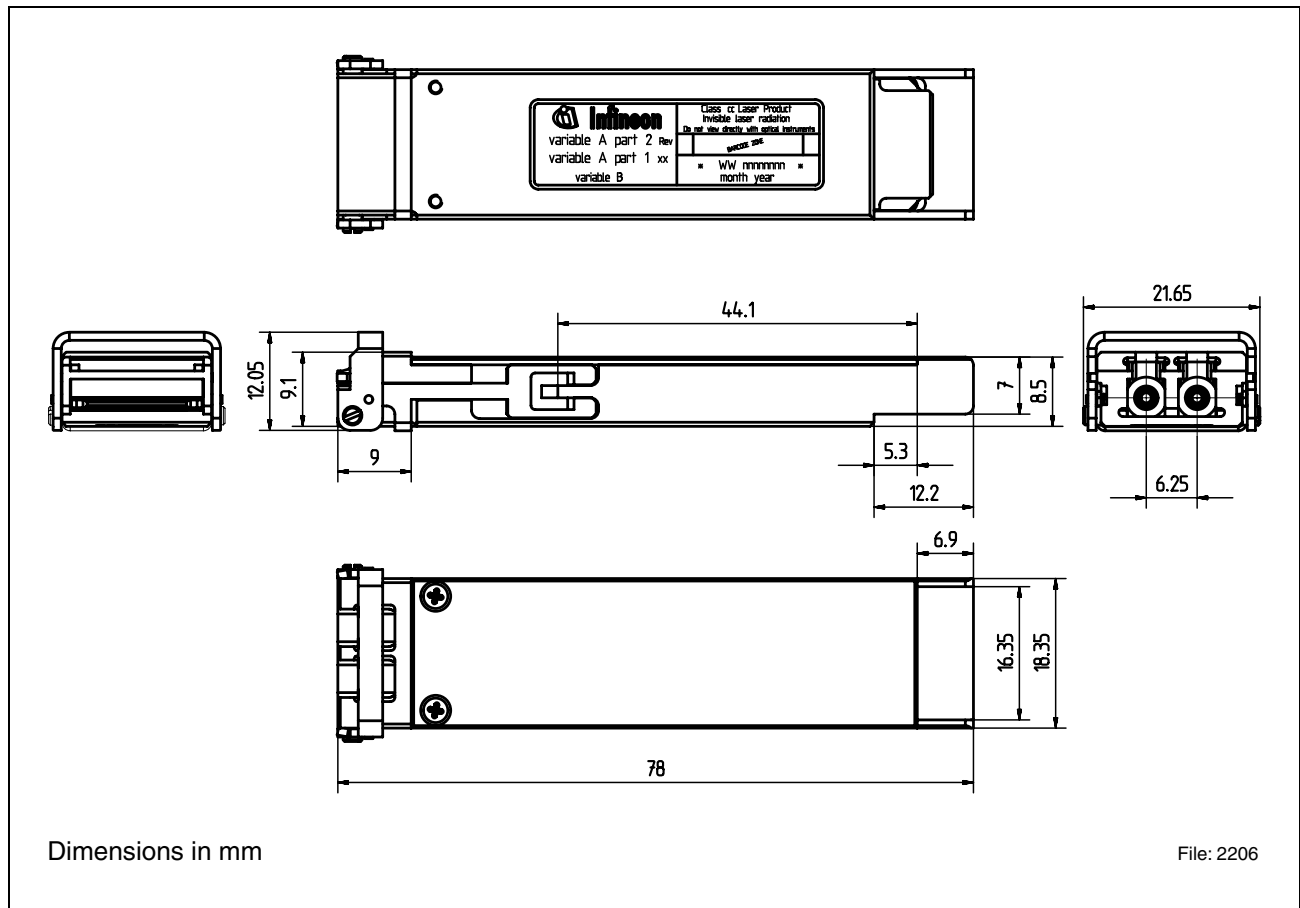


Figure 13 Mechanical Dimensions

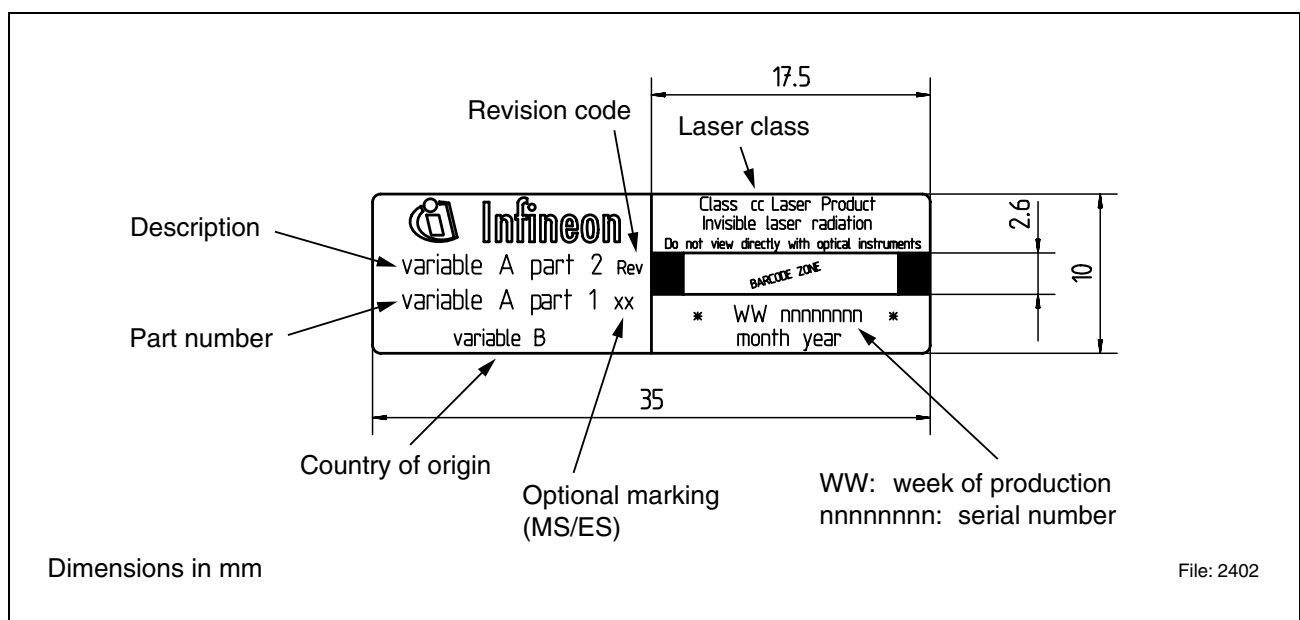


Figure 14 Label Description

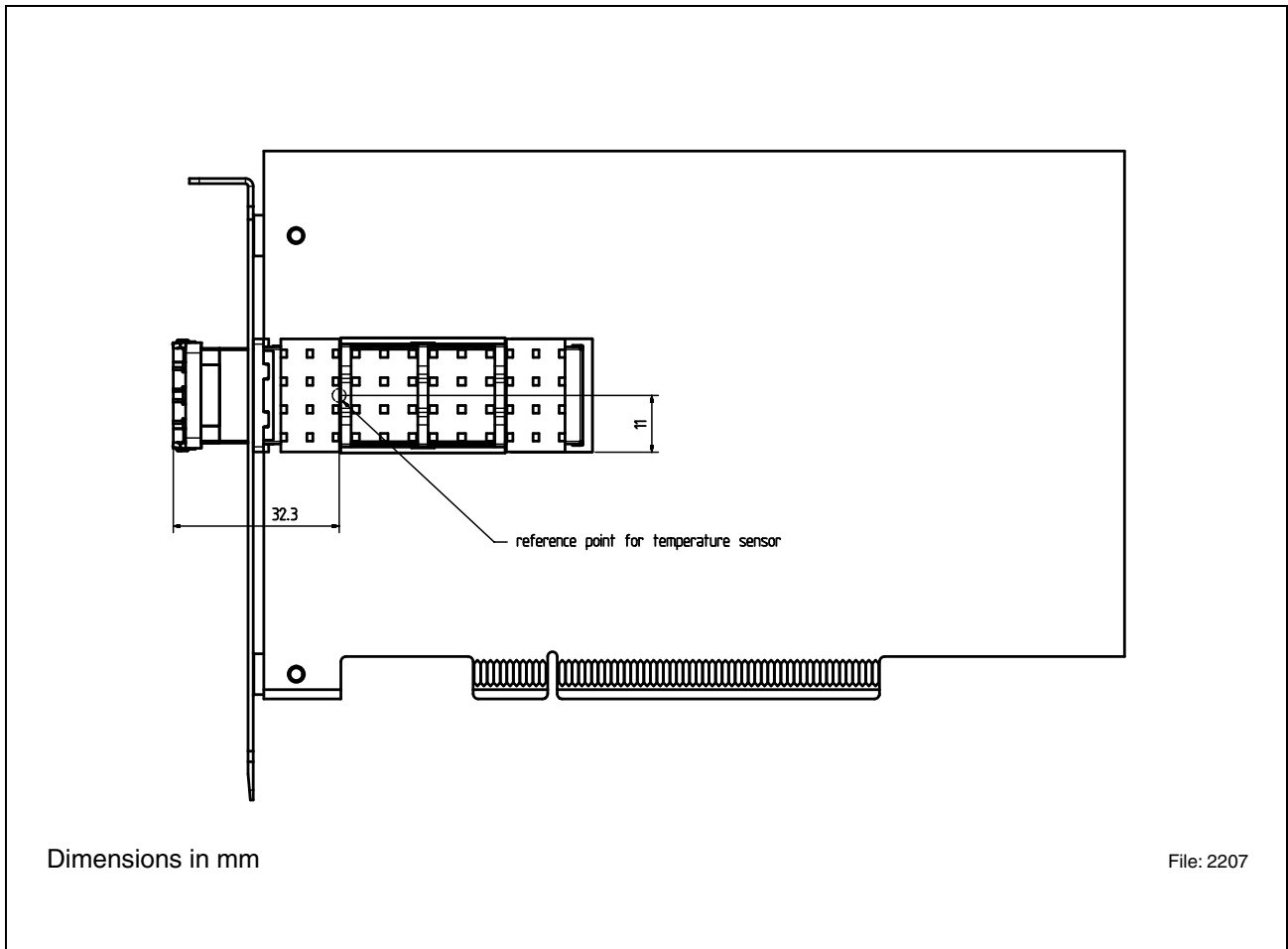


Figure 15 XFP Temperature Reference Point

V23833-Fx105-B001

V23833-Fx105-B002

Revision History: **2004-06-04**

DS0

Previous Version: none

Page	Subjects (major changes since last revision)
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