Applications:

10G Ethernet / 10G Fiber Channel

FCI's SCFF optical transceiver TRX10GVP2040 is built to a small cubic form factor (SCFF) that is mechanically modified from the SFP+ form factor. Its 11pin electrical interface complies with specifications in SFP+ MSA (SFF-8431) for high speed interface, including a 2 wire serial interface similar to I2C interface and power supply. It is RoHS 6/6 complaint per Directive 2002/95/EC and laser safety class 1 compliant per IEC/CDRH. The sub watt power consumption and the compact size allow system design with high port density. Adjustable input and output equalizers allow to overcome host board frequency loss and to optimize module performance in interaction with host board equalizers.

Product Features:

- Small Cubic Form Factor (SCFF)
- 11pin electrical interface
- Complies with 10GBE (Ethernet) and 10GFC (Fibre Channel)
- SFP+ compatible SFI high speed electrical interface
- Programmable input and output equalizers
- Low power consumption at <0.5W (typ.)
- Transmission of up to 300m over OM3 MMF
- Digital diagnostic through 2 wire serial interface (SFP+ compatible)
- 0°C to +70°C case operating temperature
- 850nm VCSEL laser
- Duplex LC connector
- SCFF is UL certified for use in Low Power Systems (LPS)
- Laser safety class 1
- RoHS 6/6 compliant

Supported Standards

Application	Standard	Data Rate
10G Ethernet LAN/WAN	IEEE 802.3 10GBASE-SR/SW	10.312 / 9.953 Gbps
10G Fibre Channel	1200-MX-SN-I	10.518 Gbps

Table of Contents

Electrical Characteristics

Absolute Maximum Ratings

Rating	Conditions	Symbol	Min	Max	Units
Storage Ambient Temperature		ϑ_{stg}	-40	+85	°C
Powered Case Temperature		ϑ_{c}	0	+75	°C
Operating Relative Humidity	Non condensing	RH	0	85	%
Supply Voltage Range		$V_{CCT/R}$	-0.5	4.0	V

Any stress beyond the maximum ratings may result in permanent damage to the device. Specifications are guaranteed only under recommended operating conditions.

Recommended Operating Conditions

Description	Conditions	Symbol	Min	Typ	Max	Unit
Operating Case Temperature		ϑ_{Case}	0		70	°C
Power Supply Voltage		$V_{CCT/R}$	3.135	3.3	3.465	V
DC Common Mode Voltage	SFI Signals	V_{CM}	-0.5		4.0	V
2 Wire Serial Interface Data Rate					400	kHz

Low Speed Characteristics

Description	Conditions	Symbol	Min	Typ	Max	Unit
Supply Current (Tx & Rx)		Icc @ V_{CC}		145	190	mA
Total Power Consumption				480	650	mW
RXRS Input Voltage	Low voltage TTL reserved input pin internal pull-up	V_{IL}	-0.5		0.8	V
		V_{IH}	2.0		V_{CCT} + 0.5	
SCL, SDA	Host Vcc Range: 3.13 V – 3.47 V, I_{OL_max} = 4 mA	V_{IL}	-0.3		VccT * 0.3	V
		V_{IH}	VccT * 0.7		VccT + 0.5	
		V_{OL}	0.0		0.4	
		V_{OH}	Host_Vcc – 0.5		Host_Vcc + 0.3	

SFI Transmitter Input Electrical Characteristics

Description	Conditions	Symbol	Min	Typ	Max	Unit
Input Dat Rate				10.31		GBd
Differential Input Voltage Swing		V_{ID}	175		1200	mVpp
Differential Input Impedance		Z_d	80	100	120	Ω

SFI inputs are internally AC coupled.

SFI Receiver Output Electrical Characteristics

Description	Conditions	Symbol	Min	Typ	Max	Unit
Output Data Rate				10.31		GBd
Differential Output Voltage Swing	R_{Load} = 100 ohm, 2 x |V(DOUT+) – V(DOUT-)|	V_{OD}	300	500	850	mVpp
Differential Output Impedance		Z_d	80	100	120	Ω
Data Output Total Jitter					0.7	UI (p-p)
Data Output Deterministic Jitter					0.42	UI (p-p)

SFI outputs are internally AC coupled.

Optical Characteristics

General Parameters

Parameter	Conditions	Min Modal Bandwidth (MHz*km)	Symbol	Min	Typical 10GBd	Units
Operating Range	62.5 µm MMF	160	l_{OP}	2	26	m
	50 µm MMF	400		2	66	
	62.5 µm MMF	200		0.5	33	
	50 µm MMF	500		0.5	82	
	50 µm MMF	2000		0.5	300	

Optical Transmitter

Description	Conditions	Symbol	Min	Typ	Max	Unit
Center Wavelength		λ	840	850	860	nm
RMS Spectral Width		$\Delta\lambda$			0.45	nm
Average Launch Power		P_{avg}	-7.3		-1	dBm
Optical Modulation Amplitude (OMA)		P_{OMA}	-3.0			dBm
Extinction Ratio		ER	3.5			dB
Relative Intensity Noise		RIN			-128	dB/Hz

Optical Receiver

Description	Conditions	Symbol	Min	Typ	Max	Unit
Unstressed Receiver Sensitivity in OMA	PRBS 2^{31}-1, BER < $1*10^{-12}$ @10.3125GBd	P_{IN-OMA}		-14	-12	dBm
Stressed Receiver Sensitivity in OMA	PRBS 2^{31}-1, BER < $1*10^{-12}$ @10.3125GBd	P_{IN-OMA}		-10	-8	dBm
Maximum Average Input Power		P_{MAX}	0			dBm
Loss of Signal Assert	In average power	P_{avg-as}	-30			dBm
Loss of Signal De-Assert	In OMA	$P_{oma-deas}$			-13	dBm
Loss of Signal Hysteresis			1			dB

Application Information

Electrical Connector

The electrical interface at the back-end of the SCFF module has 11 pins. The pin configuration is as follows:

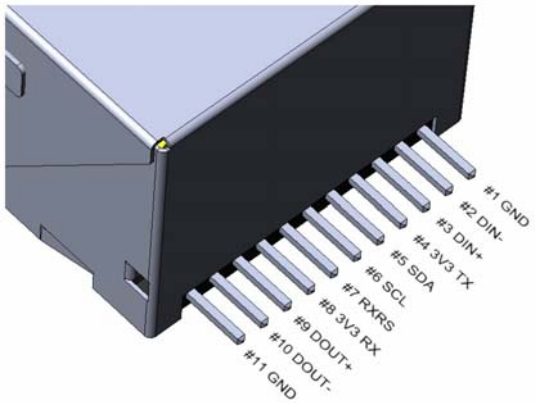


Figure 1

Pin Description

Pin	Logic	Symbol	Description	Plug Sequence
1		GND	Ground (1)	1
2	CML-I	DIN-	Transmitter inverted data input; AC coupled	1
3	CML-I	DIN+	Transmitter non-inverted data input; AC coupled	1
4		3V3TX (VCCT)	3.3V TX Vcc +/- 5% (2)	1
5		SDA	2 wire serial interface data/clock line must be pull up on host board	1
6		SCL		1
7		RXRS	Reserved input; pulled up with 47kOhm in module (3)	1
8		3V3RX (VCCR)	3.3V RX Vcc +/- 5% (2)	1
9	CML-O	DOUT+	Receiver non-inverted output data; AC coupled	1
10	CML-O	DOUT-	Receiver inverted output data; AC coupled	1
11		GND	Ground (1)	1

1) GND is common for signal and power supply in the SCFF module. All module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.
2) 3V3RX and 3V3TX are the receiver (VCCR) and transmitter (VCCT) power supplies and shall be applied concurrently. The connector pins are each rated for a maximum current of 500 mA.
3) This input is reserved. Floats to high when left open (recommended).

Application Schematics

Recommended electrical connections to transceiver are shown below.

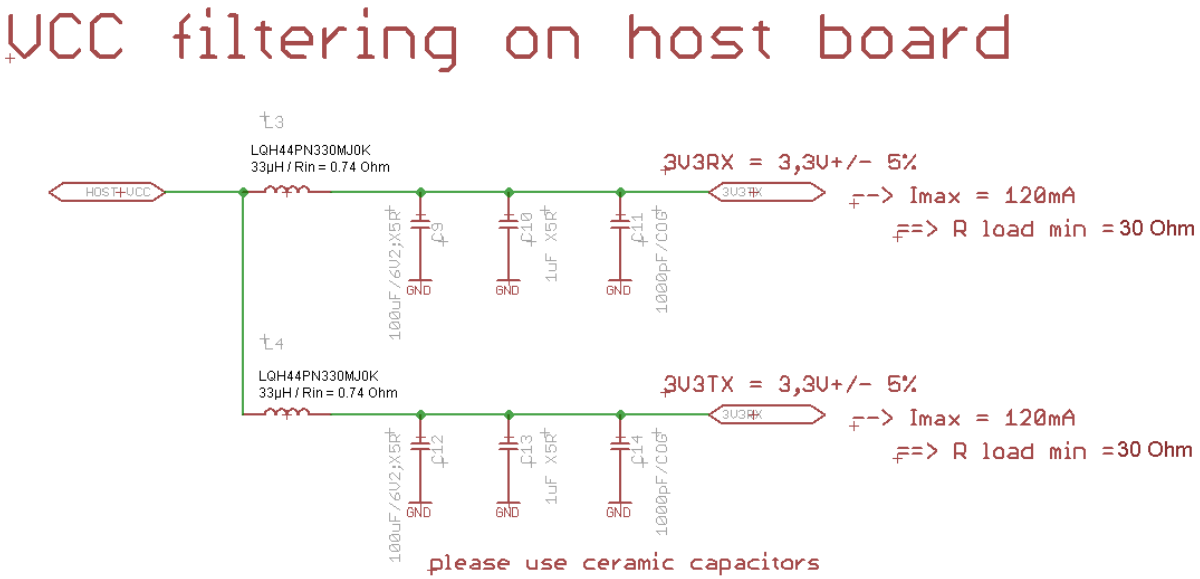


Figure 2: Recommended host board power supply filtering

Optical Interface

Optical port on the SCFF module is a duplex LC connector. The TX is located on the left hand side and the RX to the right hand side, when looked into the optical port.

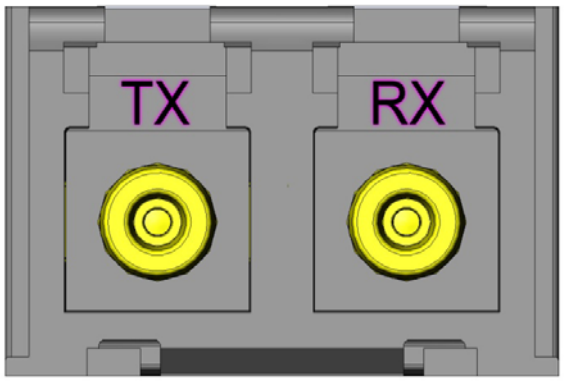


Figure 3

Module Mechanical Dimension Outline

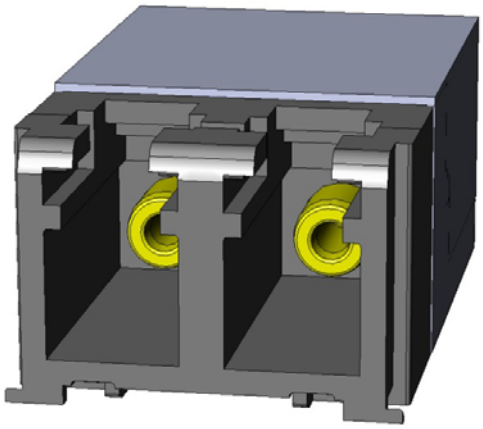


Figure 4: Front-end (optical port) of the module

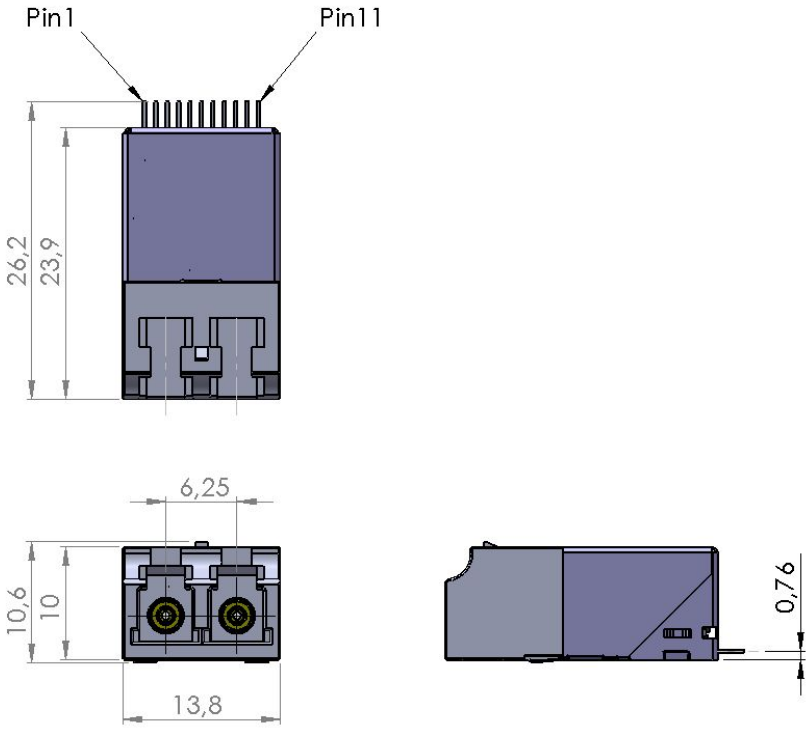


Figure 5: SCFF Module without the Cage (Dimensions in millimeters)

Interfacing the Transceiver through Serial Interface

Communication is done by a serial 2-wire interface compatible to the I2C bus protocol. Refer to SFF-8472 for a more detailed register explanation of the registers:

Base Address A0h	
Register	**Content**
0 - 95	Serial Transceiver ID as defined in SFP MSA
96 - 127	FCI Specific
128 - 255	Reserved

Base Address A2h	
Register	**Content**
0 - 55	Alarm & Warnings Thresholds & Limits
56 - 95	External calibration constants (not used)
96 – 119	Values from real time diagnostic monitoring
120 – 123	Passcode change field
124-127	Passcode entry field
128 – 247	Customer specific, writable area
248	Equalizer settings
249 - 253	Reserved
254	Feature code
255	Reserved

Module Identifier & Specific Data

Refer to SFF-8472 and a separate FCI application note for detailed register map and data.

Digital Optical Monitoring

The transceiver offers the ability to monitor important module parameter during operation. All five parameters listed below are continuously monitored for getting information about the current module status. All data is calibrated internally; there is no need for external post processing.

Temperature

Internally measured temperature data is represented as two's complement of a signed 16-bit value in increments of 1/256 °C over a range of -40 to +100°C. Accuracy is better than +/-3°C.

Supply Voltage (VCC)

Internally measured supply voltage. Represented as a 16-bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100 µVolt, which yields to a total range of 0 to +6.55 Volts. Accuracy is better than +/-3%.

Laser Bias Current

The VCSEL bias current is represented as a 16 bit unsigned integer with the current defined as the full 16-bit value (0 – 65535) with LSB equal to 2 µA. Accuracy is better than +/-10%.

Optical Transmitter Power

TX output power measurement is based on internal monitor diode feedback. Represented as a 16-bit unsigned integer with the power defined as the full 16 bit value (0 – 65535) with LSB equal to 0.1 µW. Accuracy is better than +/-3dB over a range of $Pavg_{min}$ to $Pavg_{max}$.

Receiver Optical Power

RX input power measurement is based on photodiode current. Represented as a 16-bit unsigned integer with the power defined as the full 16 bit value (0 – 65535) with LSB equal to 0.1 µW. Accuracy is better than +/-3dB over a range of -12dBm to -1dBm.

Note: The specified characteristics are met within the recommended range of operating conditions regarding temperature and voltage.

Tx Input & Rx Output Equalizer Adjustment

The transceiver is equipped with equalizers at the transmitter input and at the receiver output (at the electrical module interface) to compensate for high frequency signal loss on the host board printed circuit board (Host-PCB) into which the transceiver is plugged and to allow performance optimization in interaction with host board equalizers (if there are any).
There are different module equalizer settings available to adjust the strength of the equalization which may be selected according to the line length of Host-PCB signal tracks.

MSB	Content of Register 248 in Table A2h						LSB
reserved	Tx2	Tx1	Tx0	reserved	Rx2	Rx1	Rx0

Register 248 is always readable, but only writable if a valid passcode has been written to registers 124 – 127 of table A2h before (see paragraph Passcode Entry and Modification below). Reserved bits of register 248 should be written to 0. After power up, the module always comes up with its factory programmed default equalizer settings.

Transmitter Input Signal Equalizer Settings:

Tx2	Tx1	Tx0	Description
0	X	X	Input equalizer off
1	0	0	Low equalization
1	0	1	Reserved
1	1	0	Default equalization (factory setting)
1	1	1	Reserved

X: don't care

Receiver Output Signal Equalizer (Peaking) Settings:

Rx2	Rx1	Rx0	Description
0	0	0	Output peaking off
0	0	1	Lowest peaking
…			Increased peaking between 001 up to 111
1	1	1	Strongest peaking

Programmability Feature Code

Register 254 of table A2h indicates the programmability features available and an implementation code to distinguish different implementations. This is a read only register.

MSB	Content of Register 254 in Table A2h						LSB
Tx Equal.	Rx Equal.	reserved	reserved	reserved	I-Code2	I-Code1	I-Code0

Tx Equal.: is set to 1 if the transceiver supports programming of the Tx equalizer.
Rx Equal.: is set to 1 if the transceiver supports programming of the Rx equalizer.
I-Code2…0: implementation code.

Passcode Entry and Modification

Write-access to the transceiver programmability features and to the customer specific writable area (128 – 247 of table A2h) is granted via a valid passcode which has to be written to the passcode entry field (registers 124-127 of table A2h). Please contact FCI for the factory preset initial passcode. The passcode may be changed to a proprietary one by entering the new one in the passcode change field (registers 120-123 of table A2h) after a valid passcode has been written to the passcode entry field.

Related Information & Compliance

Requirements	Standard
RoHS	RoHS 6/6 Directive 2002/95/EC Amendment 4054 (2005/747/EC)

Requirements	Standard	Value
ESD (Electrical connector)	JEDEC JESD22-A114-B	1kV
ESD (Module case)	Air Discharge EN61000-4-2 criterion B	15kV
ESD (Module case)	Contact Discharge EN61000-4-2 criterion B	8kV

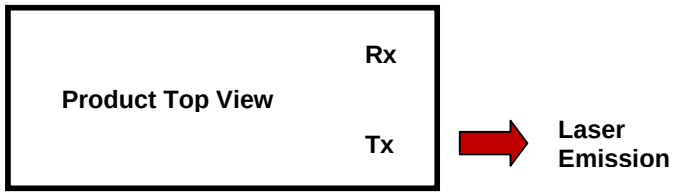
Eye Safety

This laser based multimode transceiver is a Class 1 product. It complies with IEC 60825-1 Edition 2 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated June 24, 2007.

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)).



Wavelength	>840 nm
Accessible Emission Limit (as defined by IEC: 7 mm aperture at 70 mm distance)	<743 µW

Annex

Small Cubical Form Factor (SCFF) Cage

The Cage provides the electrical interface between the SCFF transceiver and the host board. The electrical interface between the transceiver and the host board is a 11 pin female header which is part of the bottom cage. The SCFF cage is RoHS compliant.

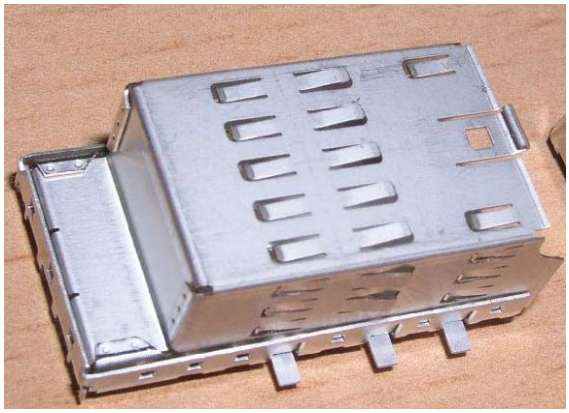


Figure 6: SCFF Cage assembly

The Cage for the SCFF transceiver consists of two components, Cage_Top and Cage_Bottom.

Cage_Top

The Cage_Top provides good electrical contact between the transceiver, the Cage_Bottom and the back panel of the system through the spring contacts on its surface. On the top front side of Cage_Top there is a latch which serves as the retainer of the transceiver in the cage.

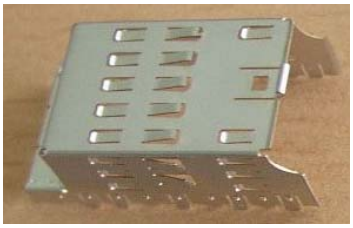


Figure 7: Cage_Top

Cage_Bottom

The Cage_Bottom provides the electrical interface between the SCFF transceiver and the PCB of the host system (host board) by a 11 pin female header attached to Cage_Bottom. The Cage_Bottom has 5 through-hole pins (3 at the front and 2 in the middle of Cage_Bottom). These 5 pins assist the alignment of the Cage on the host board.

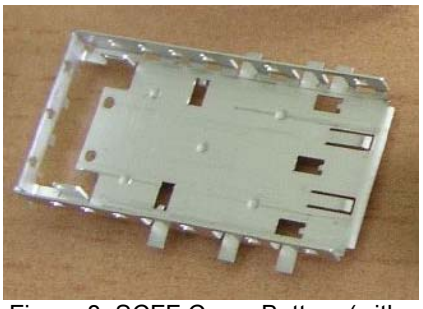
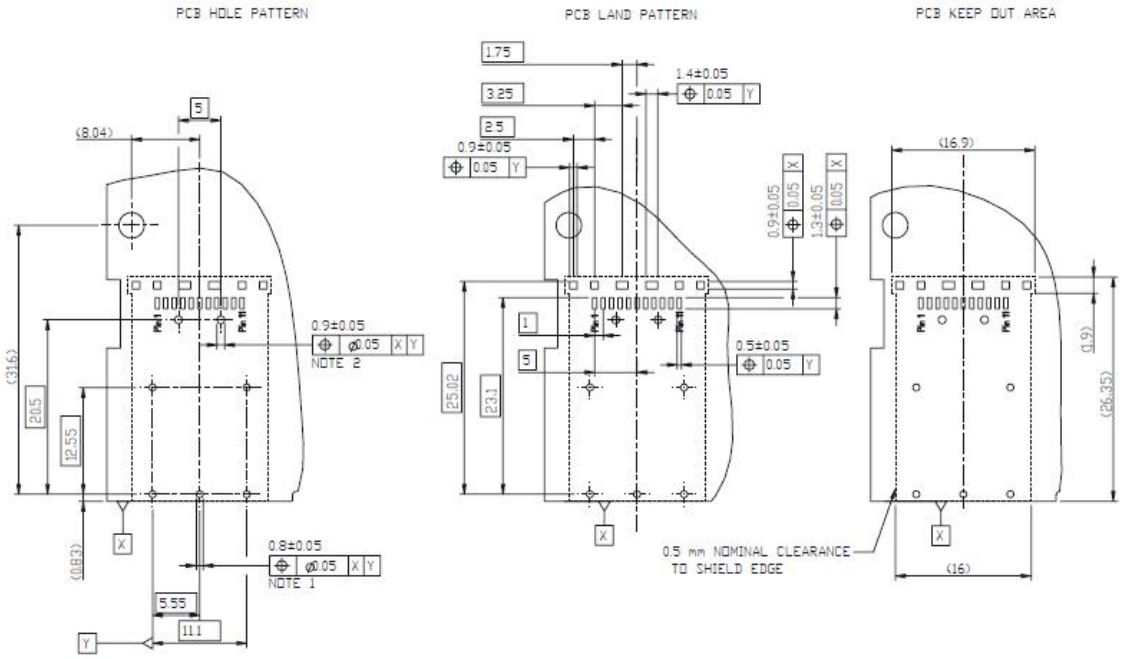


Figure 8: SCFF Cage_Bottom (without the 11 pin female header)

Land Pattern



Ordering Information

Application	Standard / Comment	Part Number
SCFF Transceiver	IEEE 802.3 10GBASE - SR/SW 10GFC 1200-MX-SN-I	TRX10GVP2040
Cage Top		CTSCFF0802
Cage Bottom	with mounted 11 pin female header	CBSCFF0802

REVISION RECORD

Rev	Page	Description	EC#	Date
A		Initial version.		19 Nov. 2012