

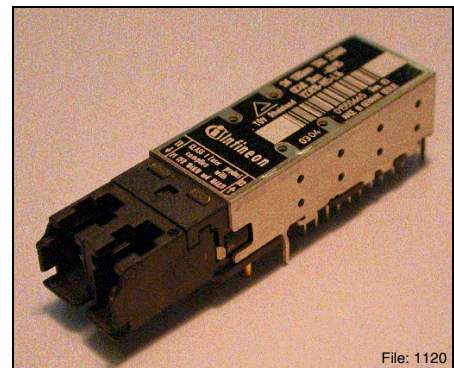
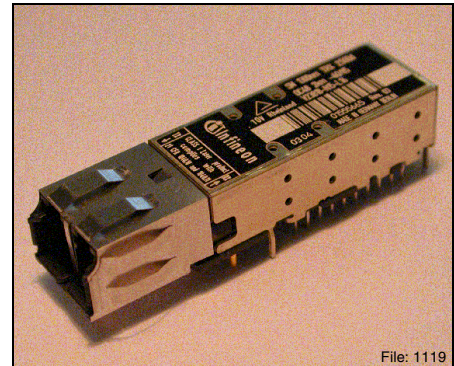
## Small Form Factor Single Mode 1300 nm 1.0625 Gbit/s Fibre Channel 1.25 Gigabit Ethernet Transceiver 2x5/2x10 Pinning with LC™ Connector

V23818-K15-Lxx

### Preliminary Data

#### Features

- Small Form Factor transceiver
- Complies with Fibre Channel and Gigabit Ethernet standards
- RJ-45 style LC™ connector system
- Available with or without collar
- Half the size of SC Duplex 1x9 transceiver
- Single power supply (3.3 V)
- Low power consumption, 650 mW typical
- Loss of optical signal indicator
- Laser disable input
- LVPECL differential inputs and outputs
- AC/AC coupling in accordance to SFF MSA or optional DC/DC coupling version
- For distance of up to 10 km on single mode fiber (SMF)
- Class 1 FDA and IEC laser safety compliant
- Multisource 2x5/2x10 footprint<sup>1)</sup>
- Small size for high port density
- UL 94 V-0 certified
- Compliant with FCC (Class B) and EN 55022
- Tx and Rx power monitor on 2x10 pinning version



<sup>1)</sup> Current MSA documentation can be found at [www.infineon.com/fiberoptics](http://www.infineon.com/fiberoptics)

For ordering information see next page.  
LC™ is a trademark of Lucent.

**Ordering Information**
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Part Number	Pinning	Temperature Range	Signal Detect	Collar	Input	Output
V23818-K15-L37	2x5	0°C to 70°C	LVPECL	yes	DC	DC
V23818-K15-L36		-40°C to 85°C				
V23818-K15-L47		0°C to 70°C	LVTTTL		AC	AC
V23818-K15-L46		-40°C to 85°C				
V23818-K15-L17	2x10	0°C to 70°C	LVPECL		DC	DC
V23818-K15-L16		-40°C to 85°C				
V23818-K15-L57		0°C to 70°C	LVTTTL		AC	AC
V23818-K15-L56		-40°C to 85°C				
V23818-K15-L35	2x5	0°C to 70°C	LVPECL	no	DC	DC
V23818-K15-L45			LVTTTL			

Pin Configuration

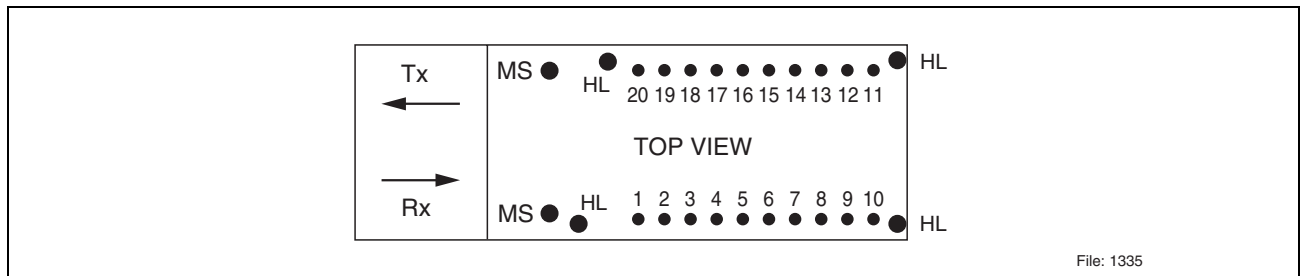


Figure 1 2x10 Pin Connect Diagram

2x10 Pin Description

Pin No.	Symbol	Level/Logic	Description
1	PDBias	DC current	PIN photo detector bias current
2	$V_{EEr}$	Ground	Receiver signal ground
3	$V_{EEr}$	Ground	Receiver signal ground
4	NC		Not connected
5	NC		Not connected
6	$V_{EEr}$	Ground	Receiver signal ground
7	$V_{CCr}$	Power supply	Receiver power supply
8	SD	LVTTTL or LVPECL output <sup>1)</sup>	Receiver optical input level monitor
9	RD-	LVPECL output	Receiver data out bar
10	RD+	LVPECL output	Receiver data out
11	$V_{CCt}$	Power supply	Transmitter power supply
12	$V_{EEt}$	Ground	Transmitter signal ground
13	TDis	LVTTTL input	Transmitter disable
14	TD+	LVPECL input	Transmitter data in
15	TD-	LVPECL input	Transmitter data in bar
16	$V_{EEt}$	Ground	Transmitter signal ground
17	BMon-	DC voltage	Laser diode bias current monitor
18	BMon+	DC voltage	Laser diode bias current monitor
19	PMon-	DC voltage	Laser diode optical power monitor
20	PMon+	DC voltage	Laser diode optical power monitor
MS			Mounting studs
HL			Housing leads

<sup>1)</sup> LVPECL output active high for V23818-K15-L17/L16.  
LVTTTL output active high for V23818-K15-L57/L56.

Pin Configuration

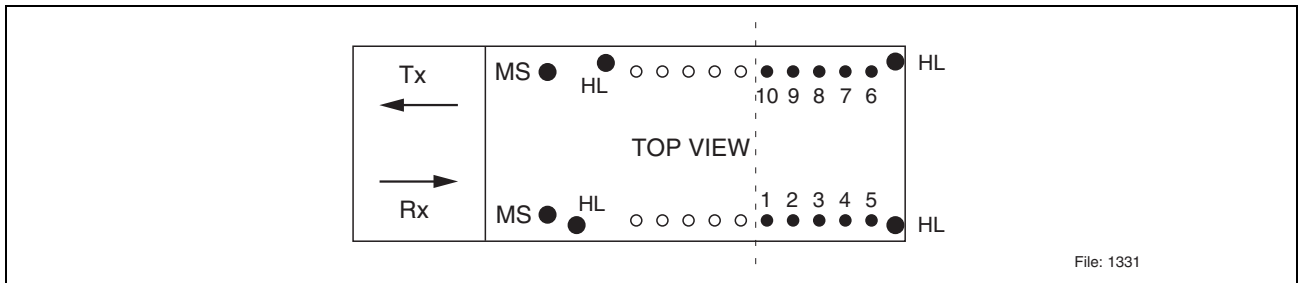


Figure 2 2x5 Pin Connect Diagram

2x5 Pin Description

Pin No.	Symbol	Level/Logic	Description
1	$V_{EEr}$	Ground	Receiver signal ground
2	$V_{CCr}$	Power supply	Receiver power supply
3	SD	LVTTTL or LVPECL output <sup>1)</sup>	Receiver optical input level monitor
4	RD-	LVPECL output	Receiver data out bar
5	RD+	LVPECL output	Receiver data out
6	$V_{CCt}$	Power supply	Transmitter power supply
7	$V_{EEt}$	Ground	Transmitter signal ground
8	TDis	LVTTTL input	Transmitter disable
9	TD+	LVPECL input	Transmitter data in
10	TD-	LVPECL input	Transmitter data in bar
MS			Mounting studs
HL			Housing leads

<sup>1)</sup> LVPECL output active high for V23818-K15-L37/L36/L35.  
LVTTTL output active high for V23818-K15-L47/L46/L45.

$V_{EEr} / V_{EEt}$

For 2x10 transceivers, connect pins 2, 3, 6, 12 and 16 to signal ground. For 2x5 transceivers, connect pins 1 and 7 to signal ground.

**$V_{CCr} / V_{Cct}$** 

For 2x10 transceivers a 3.3 V DC power supply must be applied at pins 7 and 11. For 2x5 transceivers a 3.3 V DC power supply must be applied at pins 2 and 6. A recommended power supply filter network is given in the termination scheme. Locate power supply filtering directly at the transceiver power supply pins. Proper power supply filtering is essential for good EMI performance.

**TD+ / TD-**

Transmitter data LVPECL level inputs. For V23818-K15-L47/L46/L57/L56/L45 terminated and AC coupled internally. For V23818-K15-L37/L36/L17/L16/L35 use termination and coupling as shown in the termination scheme.

**RD- / RD+**

Receiver data LVPECL level outputs. For V23818-K15-L47/L46/L57/L56/L45 biased and AC coupled internally. For V23818-K15-L37/L36/L17/L16/L35 use termination and coupling as shown in the termination scheme.

**TDis**

A logical LVTTTL high input will disable the laser. To enable the laser, an LVTTTL low input must be applied. Leave pin unconnected if feature not required.

**SD**

LVTTTL output for V23818-K15-L47/L46/L57/L56/L45.

LVPECL output for V23818-K15-L37/L36/L17/L16/L35.

A logical high output indicates normal optical input levels to the receiver. Low optical input levels at the receiver result in a low output. Signal Detect can be used to determine a definite optical link failure; break in fiber, unplugging of a connector, faulty laser source. However it is not a detection of a bad link due to data-related errors.

**MS**

Mounting studs are provided for transceiver mechanical attachment to the circuit board. They also provide an optional connection of the transceiver to the equipment chassis ground. The holes in the circuit board must be tied to chassis ground.

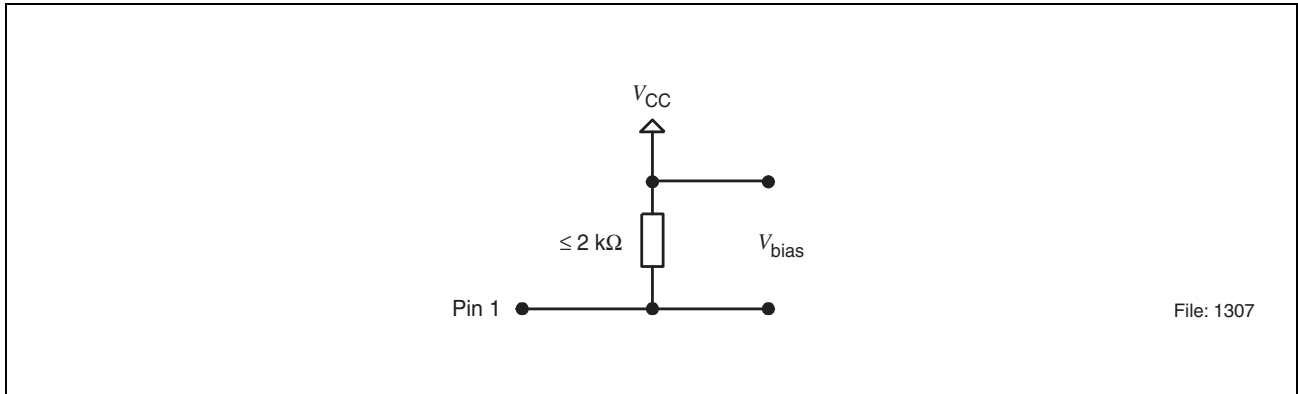
**HL**

Housing leads are provided for additional signal grounding. The holes in the circuit board must be included and tied to signal ground.

## 2x10 Transceiver Additional Functionality

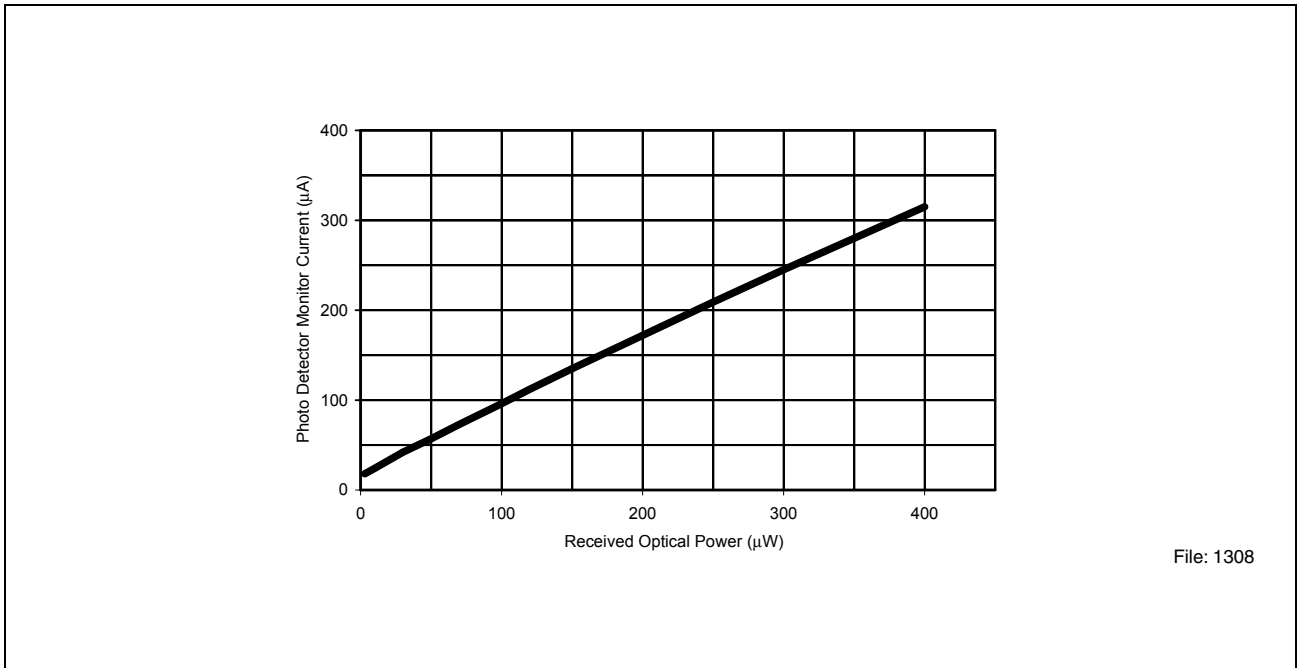
### PDBias

Connect pin 1 to  $V_{CC}$  through a bias resistor, of a value not exceeding  $2\text{ k}\Omega$ , as shown in **Figure 3** to monitor PIN photo detector bias current. Leave pin floating if not used. Typical behaviour is shown in **Figure 4** and **Figure 5** using a  $2\text{ k}\Omega$  load.

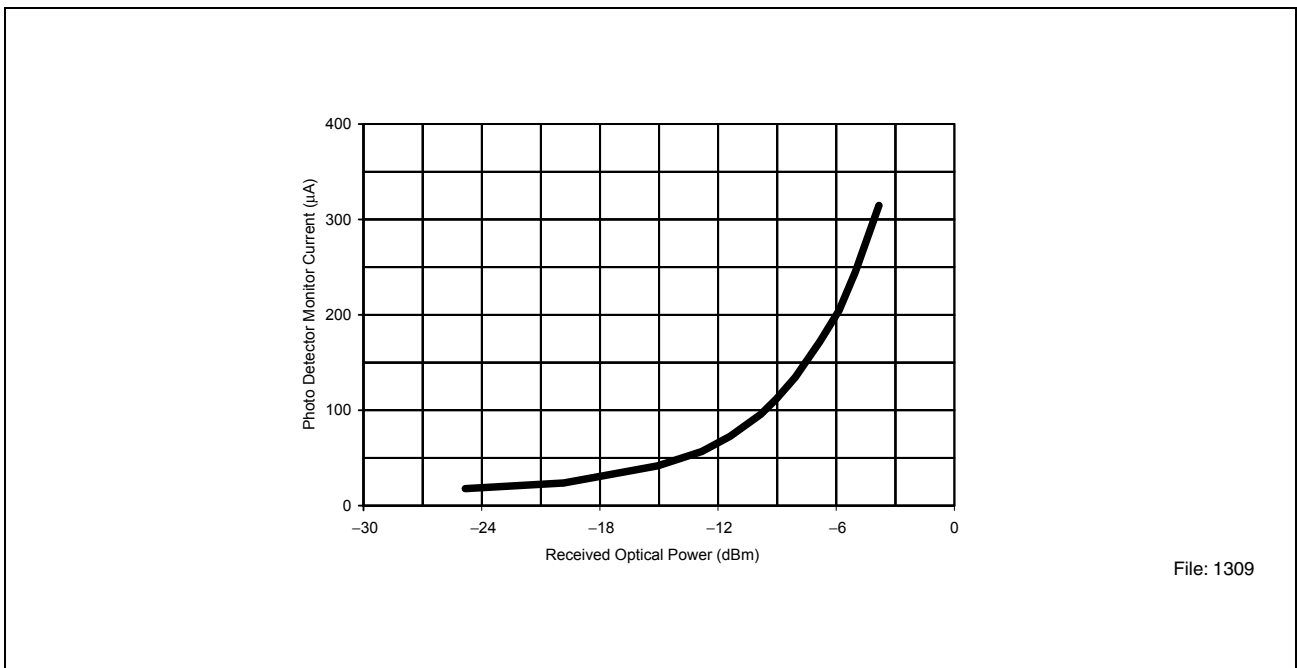


**Figure 3** Photo Detector Bias Interface

**Typical Responsivity of PIN Photo Detector Bias Current Monitor**



**Figure 4 Linear Response**



**Figure 5 Logarithmic Response**

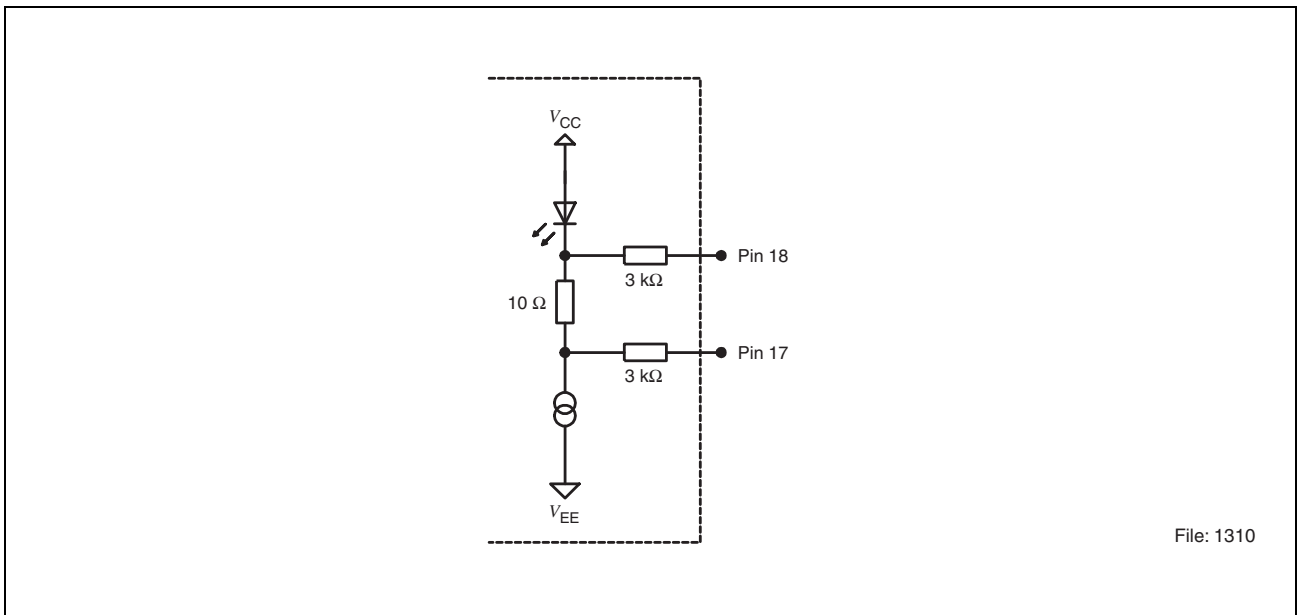
Pin Configuration

**BMon- / BMon+**

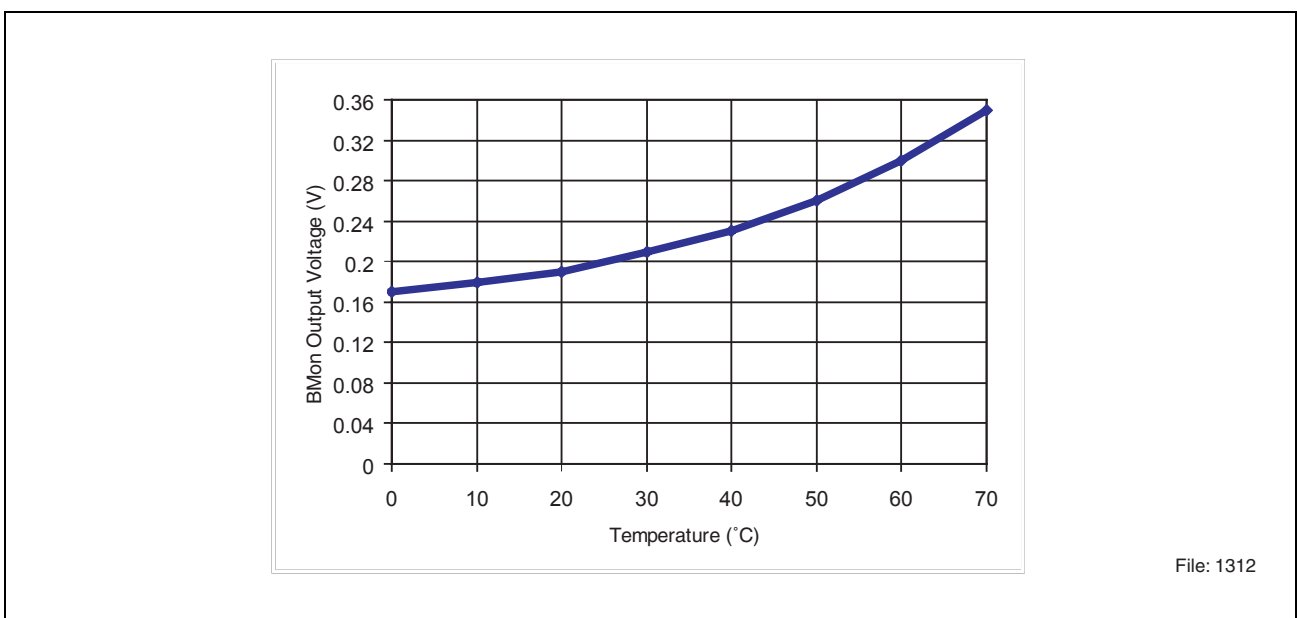
The DC voltage measured across pins 17 and 18 is proportional to the laser bias current. Use the equation:

$$I_{\text{bias}} = V_{\text{bias}} / 10 \Omega$$

Use this output to monitor laser performance and EOL conditions. A schematic and typical behaviour are shown in **Figure 6** and **Figure 7**.  $I_{\text{bias}}$  @ ambient 25°C < 60 mA. Leave pins floating if function is not required.



**Figure 6 Bias Monitor – Transceiver Internal**



**Figure 7 Typical Variations of Bias Monitor Voltage over Temperature**



**PMon- / PMon+**

This output is derived from the Tx monitor diode. Output voltage is in the range of  $1.2 \pm 0.2$  V. Source resistance  $R_S = 100$  k $\Omega$ .

*Note: This voltage level is not MSA compliant.*

**Description**

The Infineon single mode transceiver is based on and compliant to the Physical Medium Depend (PMD) sublayer and baseband medium, type 1000-Base-LX (long wavelength) as specified in IEEE Std 802.3 and Fibre Channel FC-PI Rev. 13 100-SM-LC-L.

The appropriate fiber optic cable is 9 μm single mode fiber with LC connector.

The Infineon single mode transceiver is a single unit comprised of a transmitter, a receiver, and an LC receptacle. This design frees the customer from many alignment and PC board layout concerns.

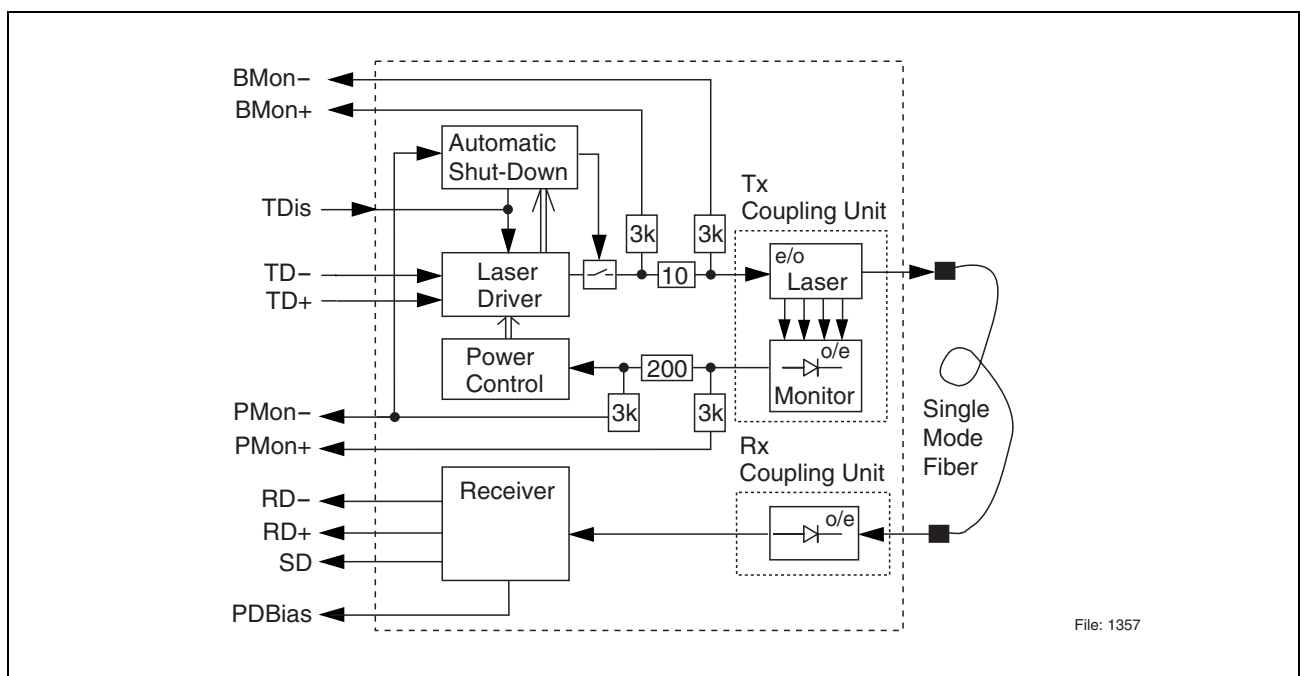
This transceiver supports the LC connectorization concept, which competes with UTP/CAT 5 solutions. It is compatible with RJ-45 style backpanels for fiber-to-the-desktop applications while providing the advantages of fiber optic technology. The receptacle accepts the new LC connector. The Small Form Factor is specially developed for distances of up to 10 km.

The module is designed for low cost LAN and WAN applications. It can be used as the network end device interface in mainframes, workstations, servers, and storage devices, and in a broad range of network devices such as bridges, routers, hubs, and local and wide area switches.

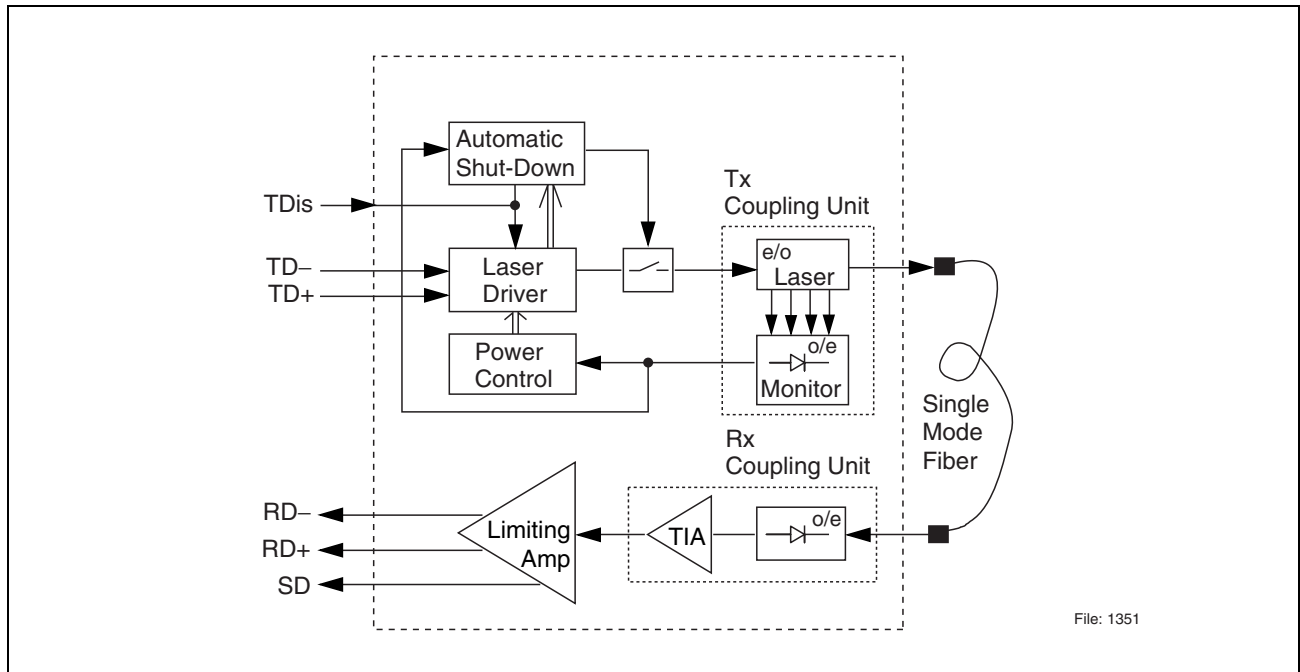
This transceiver operates at 1.0625 and 1.25 Gbit/s from a single power supply. The full differential data inputs and outputs are LVPECL compatible.

**Functional Description of SFF Transceiver**

This transceiver is designed to transmit serial data via single mode fiber.



**Figure 8 Functional Diagram 2x10 Pin Rows**



**Figure 9 Functional Diagram 2x5 Pin Rows**

The receiver component converts the optical serial data into an electrical data (RD+ and RD-). The Signal Detect output (SD) shows whether an optical signal is present.

The transmitter part converts electrical LVPECL compatible serial data (TD+ and TD-) into optical serial data.

The module has an integrated shutdown function that switches the laser off in the event of an internal failure.

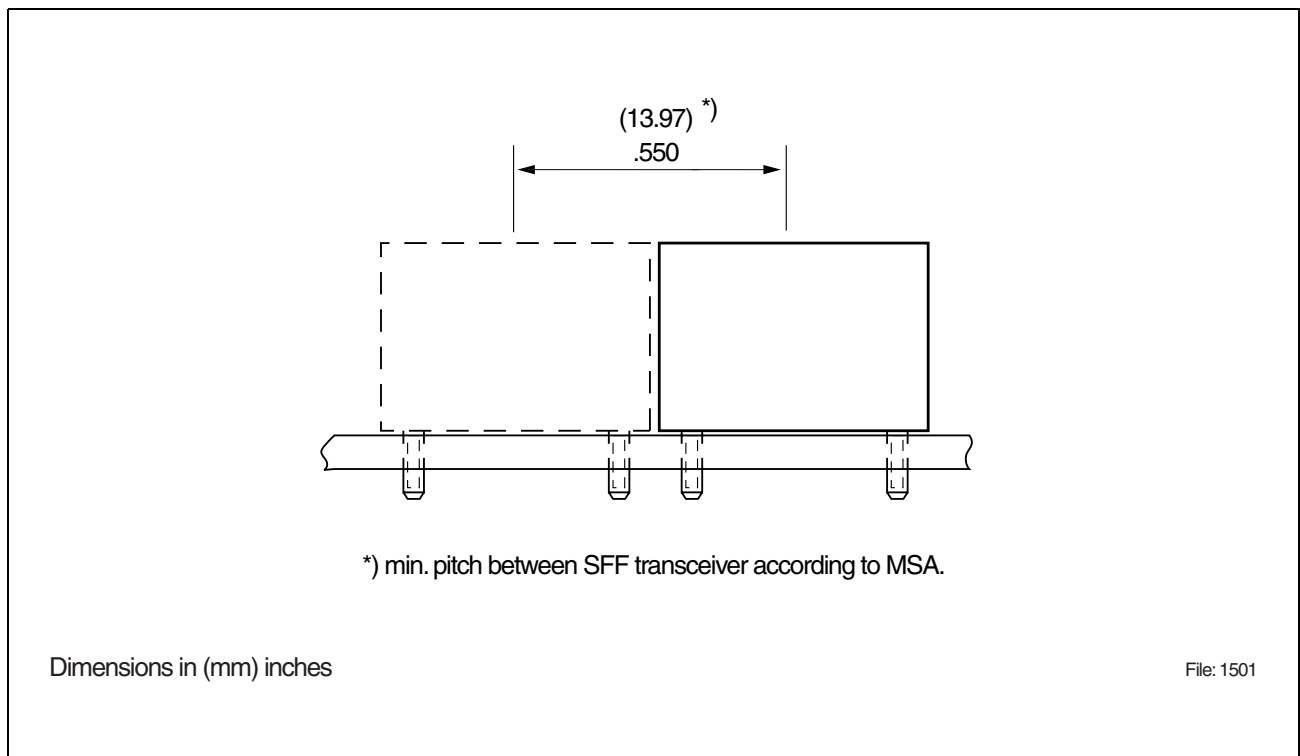
Reset is only possible if the power is turned off, and then on again. ( $V_{CCt}$  switched below  $V_{TH}$ ).

The transmitter contains a laser driver circuit that drives the modulation and bias current of the laser diode. The currents are controlled by a power control circuit to guarantee constant output power of the laser over temperature and aging. The power control uses the output of the monitor PIN diode (mechanically built into the laser coupling unit) as a controlling signal, to prevent the laser power from exceeding the operating limits.

Description

**Regulatory Compliance**

Feature	Standard	Comments
ESD: Electrostatic Discharge to the Electrical Pins	EIA/JESD22-A114-B (MIL-STD 883D Method 3015.7)	Class 1C
Immunity: Against Electrostatic Discharge (ESD) to the Duplex LC Receptacle	EN 61000-4-2 IEC 61000-4-2	Discharges ranging from $\pm 2$ kV to $\pm 15$ kV on the receptacle cause no damage to transceiver (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 transceiver 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 18 GHz



**Figure 10 Transceiver Pitch**

**Technical Data**
**Absolute Maximum Ratings**

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Package Power Dissipation			0.95	W
Supply Voltage	$V_{CC}-V_{EE}$		4	V
Data Input Levels		$V_{CC}+0.5$	$V_{EE}-0.5$	V
Differential Data Input Voltage Swing	$V_{IDpk-pk}$		5	V
Storage Ambient Temperature		-40	85	°C
Hand Lead Soldering Temp/Time			260/10	°C/s
Wave Soldering Temp/Time			260/10	°C/s
Aqueous Wash Pressure			< 110	psi

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

**Recommended Operating Conditions**

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Ambient Temperature <sup>1), 3)</sup>	$T_{AMB}$	-40		85	°C
Ambient Temperature <sup>2), 3)</sup>		0		70	
Power Supply Voltage	$V_{CC}-V_{EE}$	3.14	3.3	3.46	V

**Transmitter**

Data Input High Voltage DC/DC	$V_{IH}-V_{CC}$	-1165		-880	mV
Differential Data Input Voltage Swing AC/AC	$V_{IDpk-pk}$	500		3200	mV
Data Input Low Voltage DC/DC	$V_{IL}-V_{CC}$	-1810		-1475	mV
Data Input Rise/Fall Time	$t_i$			120	ps
Supply Current Tx	$I_{CCt}$			140	mA

**Receiver**

Input Center Wavelength	$\lambda_{Rx}$	1260		1580	nm
Supply Current Rx	$I_{CCr}$			130	mA

<sup>1)</sup> For V23818-K15-L36/L46/L16/L56.

<sup>2)</sup> For V23818-K15-L37/L47/L17/L57/L35/L45.

<sup>3)</sup> Ambient operating temperature requires a 2 ms<sup>-1</sup> airflow over the device.

The electro-optical characteristics described in the following tables are valid only for use under the recommended operating conditions.

**Transmitter Electro-Optical Characteristics**

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Output Power (Average) <sup>1)</sup>	$P_O$	-9.5		-3	dBm
Center Wavelength	$\lambda_C$	1270		1355	nm
Spectral Width (RMS)	$\sigma$			4	nm
Extinction Ratio (Dynamic)	ER	9			dB
Reset Threshold for $V_{CCt}$ <sup>2)</sup>	$V_{TH}$		2.7		V
Power on Delay <sup>2)</sup>	$t_{DEL}$		30		ms
Total Tx Jitter	TJ		53	130	ps
$T_{Dis}$ Assert Voltage LVTTL	$V_{TDH}$	2			V
$T_{Dis}$ Deassert Voltage LVTTL	$V_{TDL}$			0.8	V
$T_{Dis}$ Assert Time <sup>3)</sup>	$t_{ASS}$		0.4	1	ms
$T_{Dis}$ Deassert Time <sup>4)</sup>	$t_{DAS}$		0.06	10	$\mu$ s

<sup>1)</sup> Into single mode fiber, 9  $\mu$ m diameter

<sup>2)</sup> Laser power is shut down if power supply is below  $V_{TH}$  and switched on if power supply is above  $V_{TH}$  after  $t_{RES}$ .

<sup>3)</sup>  $T_{Dis}$  assertion to laser shutdown.

<sup>4)</sup>  $T_{Dis}$  reassertion to laser startup.

**Receiver Electro-Optical Characteristics**

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Sensitivity (Average Power) <sup>1)</sup>	$P_{IN}$			-20	dBm
Saturation (Average Power)	$P_{SAT}$	-3			dBm
Min. Optical Modulation Amplitude <sup>2)</sup>	OMA			15	$\mu$ W
Signal Detect Assert Level <sup>3)</sup>	$P_{SDA}$			-20	dBm
Signal Detect Deassert Level <sup>2), 4)</sup>	$P_{SDD}$	-37			dBm
Signal Detect Hysteresis	$P_{SDA}$ $-P_{SDD}$		3		dB
Signal Detect Assert Time <sup>3)</sup>	$t_{ASS}$			0.1	ms
Signal Detect Deassert Time <sup>4)</sup>	$t_{DAS}$			0.35	ms
Receiver 3 dB Cut off Frequency <sup>2)</sup>				1.5	GHz

**Receiver Electro-Optical Characteristics (cont'd)**

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Receiver 10 dB Cut off Frequency <sup>2)</sup>				3	GHz
Output Voltage <sup>5)</sup>	$V_{OH}-V_{CC}$	-1110		-650	mV
Output Voltage <sup>5)</sup>	$V_{OL}-V_{CC}$	-1800		-1300	mV
Differential Data Output Voltage Swing <sup>5)</sup>	$V_{OD}pk-pk$	1000		2000	mV
Signal Detect Output High Voltage LVPECL <sup>6), 7)</sup>	$V_{SDH}-V_{EE}$	$V_{CC}$ -1200		$V_{CC}$ -820	mV
Signal Detect Output Low Voltage LVPECL <sup>6), 7)</sup>	$V_{SDL}-V_{EE}$	$V_{CC}$ -1900		$V_{CC}$ -1580	mV
Signal Detect Output High Voltage LVTTTL <sup>6), 8)</sup>	$V_{SDH}$	2.4			V
Signal Detect Output Low Voltage LVTTTL <sup>6), 8)</sup>	$V_{SDL}$			0.5	V
Rx-Monitor <sup>9), 10)</sup>	Rx-Mon	0.5		1	A/W

<sup>1)</sup> Minimum average optical power at which the BER is less than  $1 \times 10^{-10}$ . Measured with a  $2^7-1$  NRZ PRBS.

<sup>2)</sup> Fibre Channel PI Standard.

<sup>3)</sup> An increase in optical power above the specified level will cause the Signal Detect to switch from a low state to a high state (high active output).

<sup>4)</sup> A decrease in optical power below the specified level will cause the Signal Detect to switch from a high state to a low state.

<sup>5)</sup> Load is 100  $\Omega$  differential.

<sup>6)</sup> Internal load is 510  $\Omega$  to GND, no external load necessary. Signal Detect is a high active output. High level means signal is present, low level means loss of signal.

<sup>7)</sup> For V23818-K15-L37/L36/L17/L16/L35.

<sup>8)</sup> For V23818-K15-L47/L46/L57/L56/L45.

<sup>9)</sup> Monitor current needs to be sunk to  $V_{CC}$ .

<sup>10)</sup> Only available on 2x10 transceivers: V23818-K15-L17/L16/L57/L56.



**Eye Safety**

This laser based single mode transceiver is a Class 1 product. It complies with IEC 60825-1 and FDA 21 CFR 1040.10 and 1040.11.

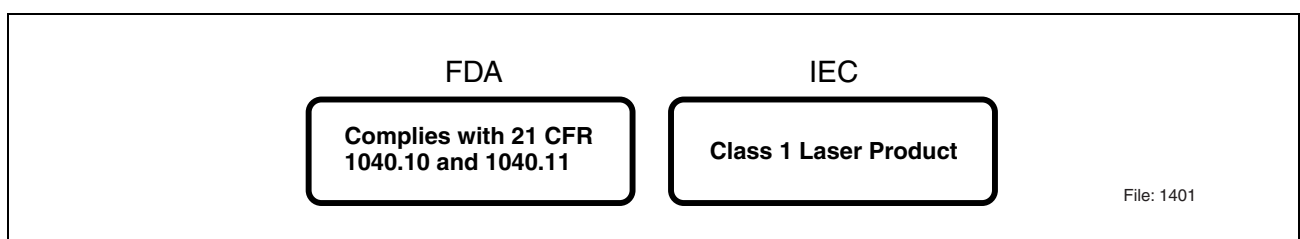
To meet laser safety requirements the transceiver shall be operated within the Absolute Maximum Ratings.

**Attention: 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.**

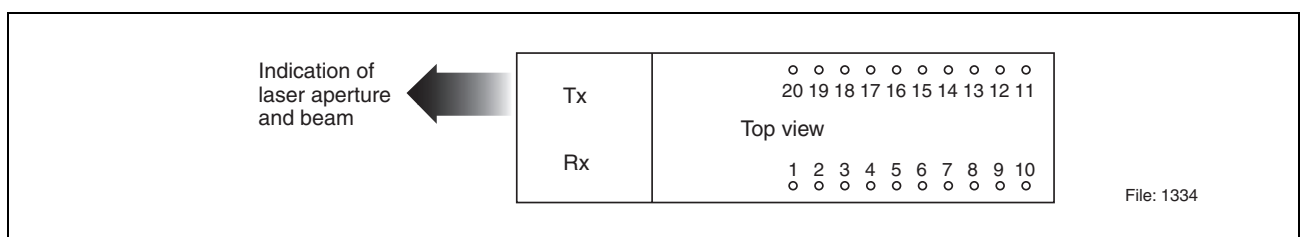
*Note: Failure to adhere to the above restrictions could result in a modification that is considered an act of “manufacturing”, and will require, under law, recertification of the modified product with the U.S. Food and Drug Administration (ref. 21 CFR 1040.10 (i)).*

**Laser Data**

Wavelength	1300 nm
Total output power (as defined by IEC: 7 mm aperture at 14 mm distance)	< 2 mW
Total output power (as defined by FDA: 7 mm aperture at 20 cm distance)	< 180 μW
Beam divergence	6°



**Figure 11 Required Labels**



**Figure 12 Laser Emission**

**EMI-Recommendations**

To avoid electromagnetic radiation exceeding the required limits please take note of the following recommendations.

When Gigabit switching components are found on a PCB (multiplexers, clock recoveries etc.) any opening of the chassis may produce radiation also at chassis slots other than that of the device itself. Thus every mechanical opening or aperture should be as small as possible.

On the board itself every data connection should be an impedance matched line (e.g. strip line, coplanar strip line). Data, Datanot should be routed symmetrically, vias should be avoided. A terminating resistor of 100  $\Omega$  should be placed at the end of each matched line. An alternative termination can be provided with a 50  $\Omega$  resistor at each (D, Dn). In DC coupled systems a thevenin equivalent 50  $\Omega$  resistance can be achieved as follows: for 3.3 V: 125  $\Omega$  to  $V_{CC}$  and 82  $\Omega$  to  $V_{EE}$ , for 5 V: 82  $\Omega$  to  $V_{CC}$  and 125  $\Omega$  to  $V_{EE}$  at Data and Datanot. Please consider whether there is an internal termination inside an IC or a transceiver.

In certain cases signal GND is the most harmful source of radiation. Connecting chassis GND and signal GND at the plate/bezel/chassis rear e.g. by means of a fiber optic transceiver may result in a large amount of radiation. Even a capacitive coupling between signal GND and chassis may be harmful if it is too close to an opening or an aperture.

If a separation of signal GND and chassis GND is not planned, it is strongly recommended to provide a proper contact between signal GND and chassis GND at every location where possible. This concept is designed to avoid hotspots. Hotspots are places of highest radiation which could be generated if only a few connections between signal and chassis GND exist. Compensation currents would concentrate at these connections, causing radiation.

By use of Gigabit switching components in a design, the return path of the RF current must also be considered. Thus a split GND plane of Tx and Rx portion may result in severe EMI problems.

A recommendation is to connect the housing leads to signal GND. However, in certain applications it may improve EMI performance by connecting them to chassis GND.

The cutout should be sized so that all contact springs make good contact with the face plate.

Please consider that the PCB may behave like a waveguide. With an  $\epsilon_r$  of 4, the wavelength of the harmonics inside the PCB will be half of that in free space. In this scenario even the smallest PCBs may have unexpected resonances.

Recommended Termination Schemes

Recommended Termination Schemes

2x10 DC/DC Transceiver

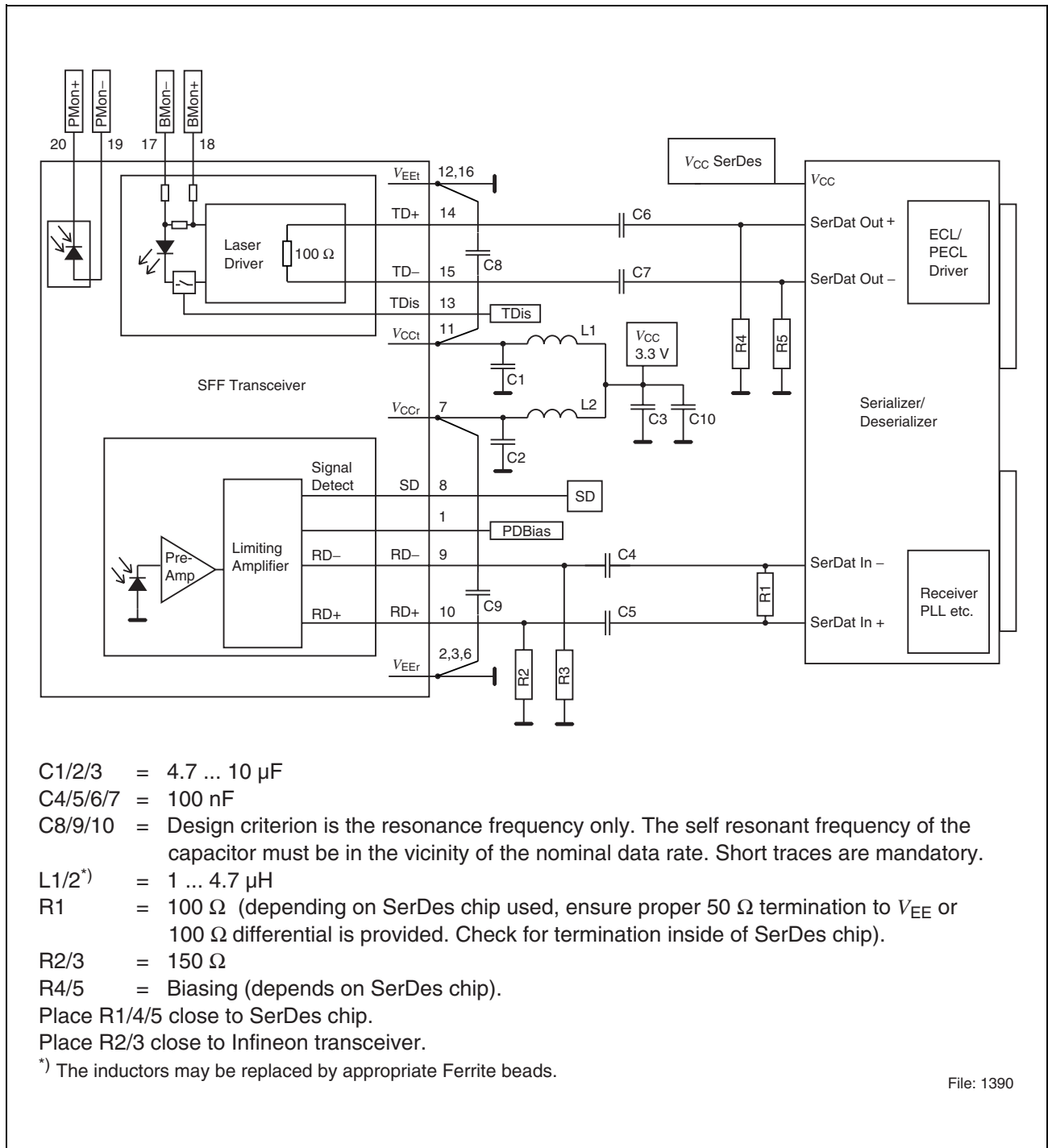


Figure 13

Recommended Termination Schemes

2x10 AC/AC Transceiver

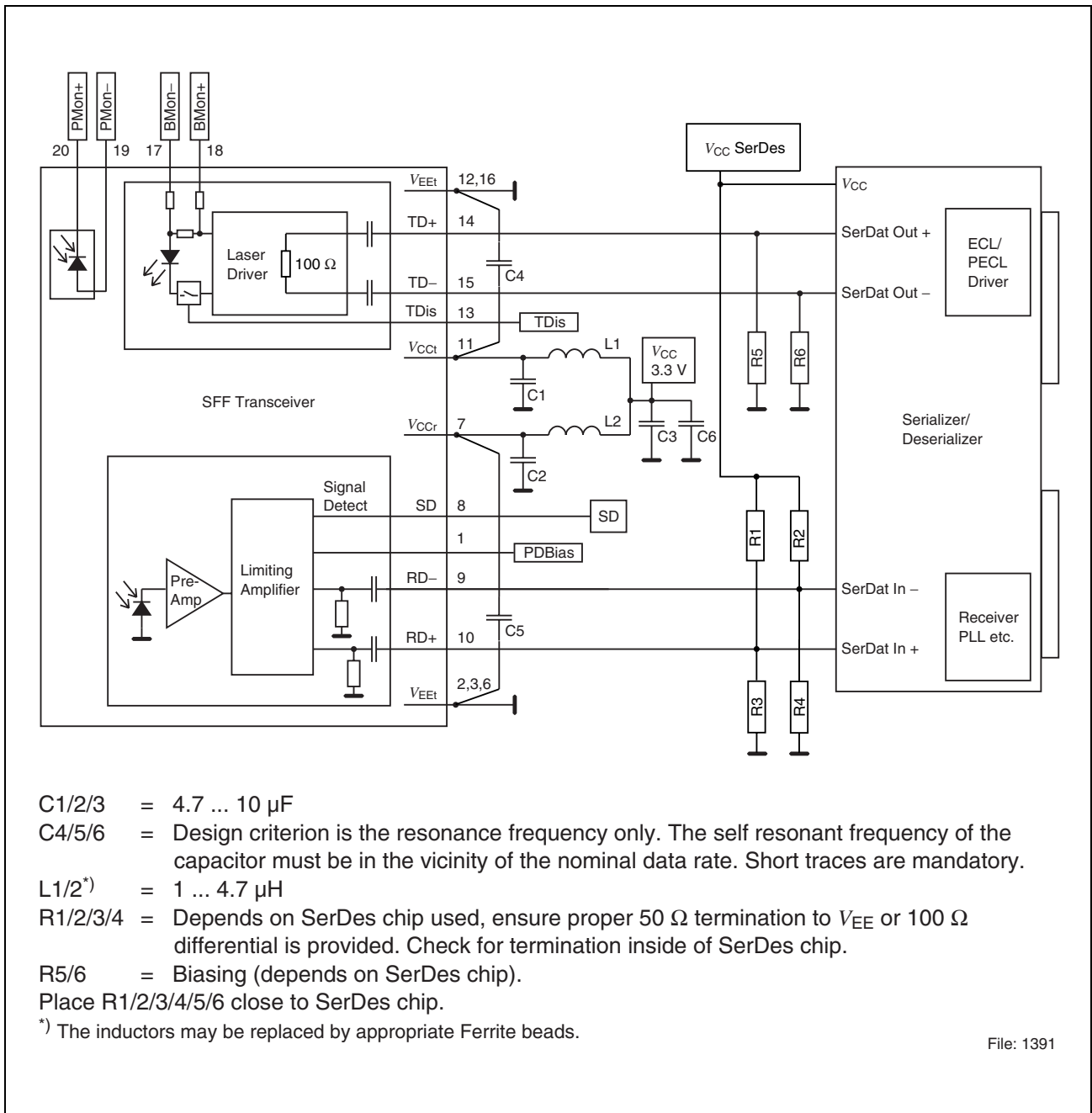


Figure 14

Recommended Termination Schemes

2x5 DC/DC Transceiver

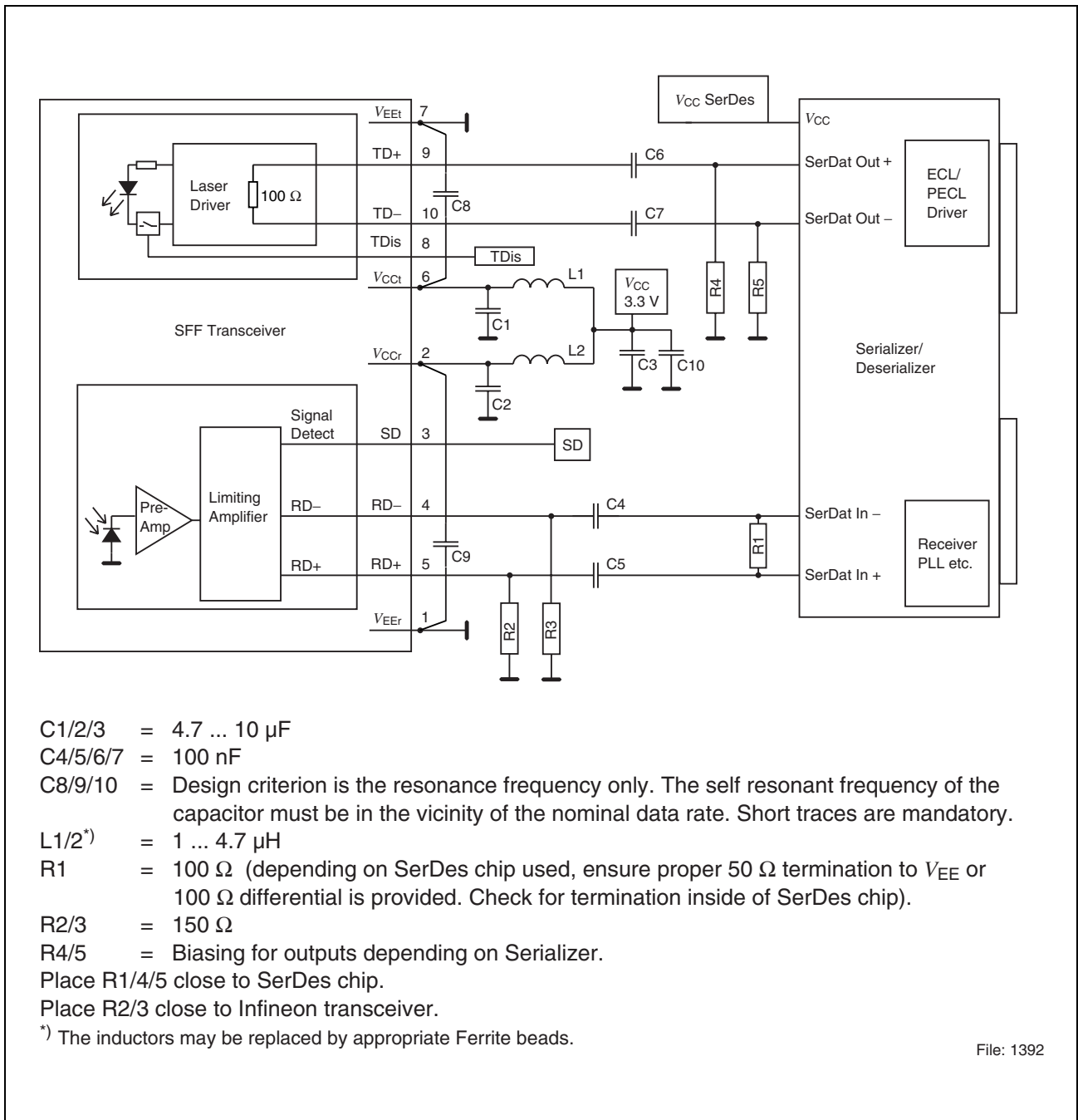


Figure 15

Recommended Termination Schemes

2x5 AC/AC Transceiver

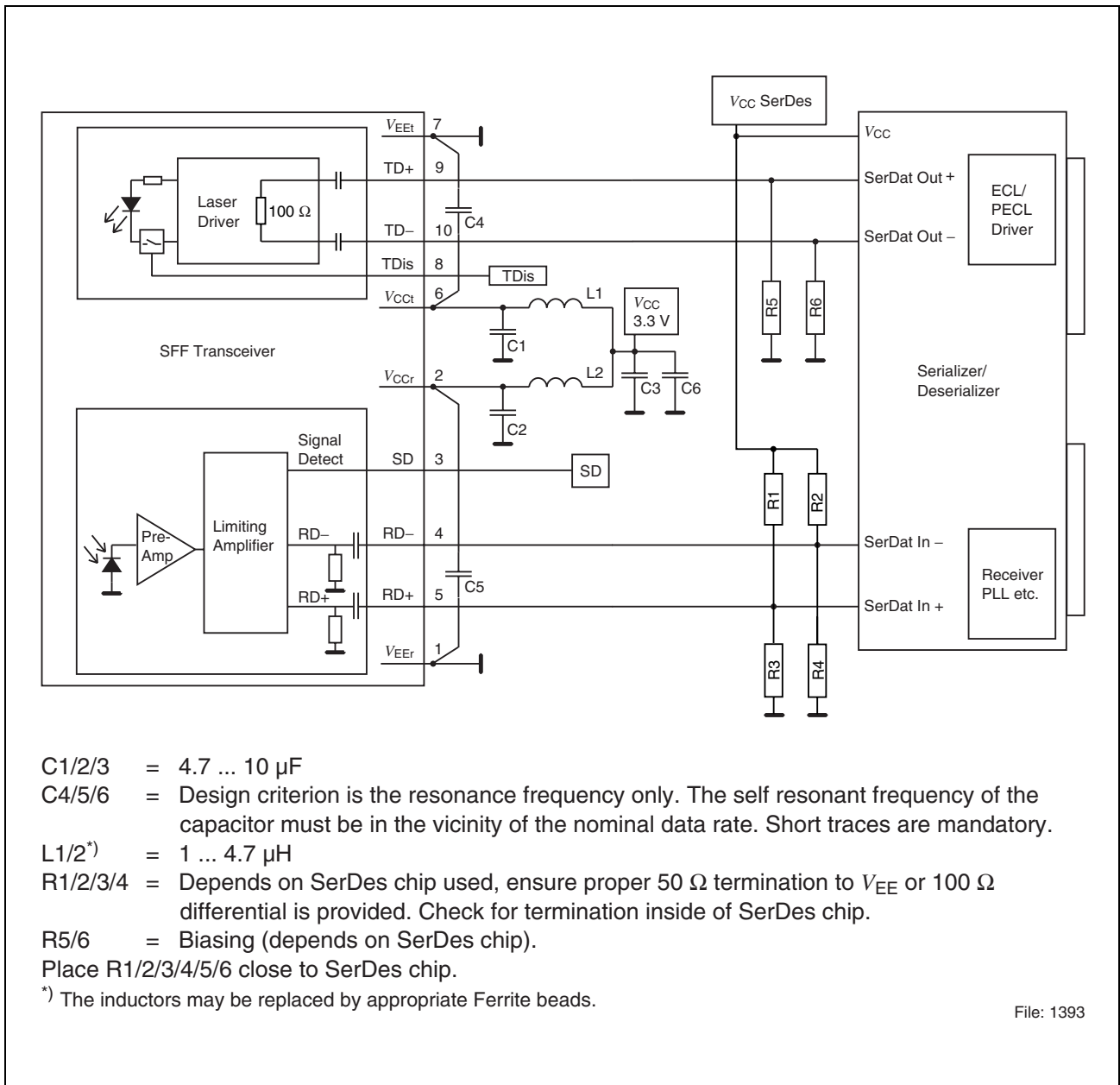


Figure 16

Package Outlines

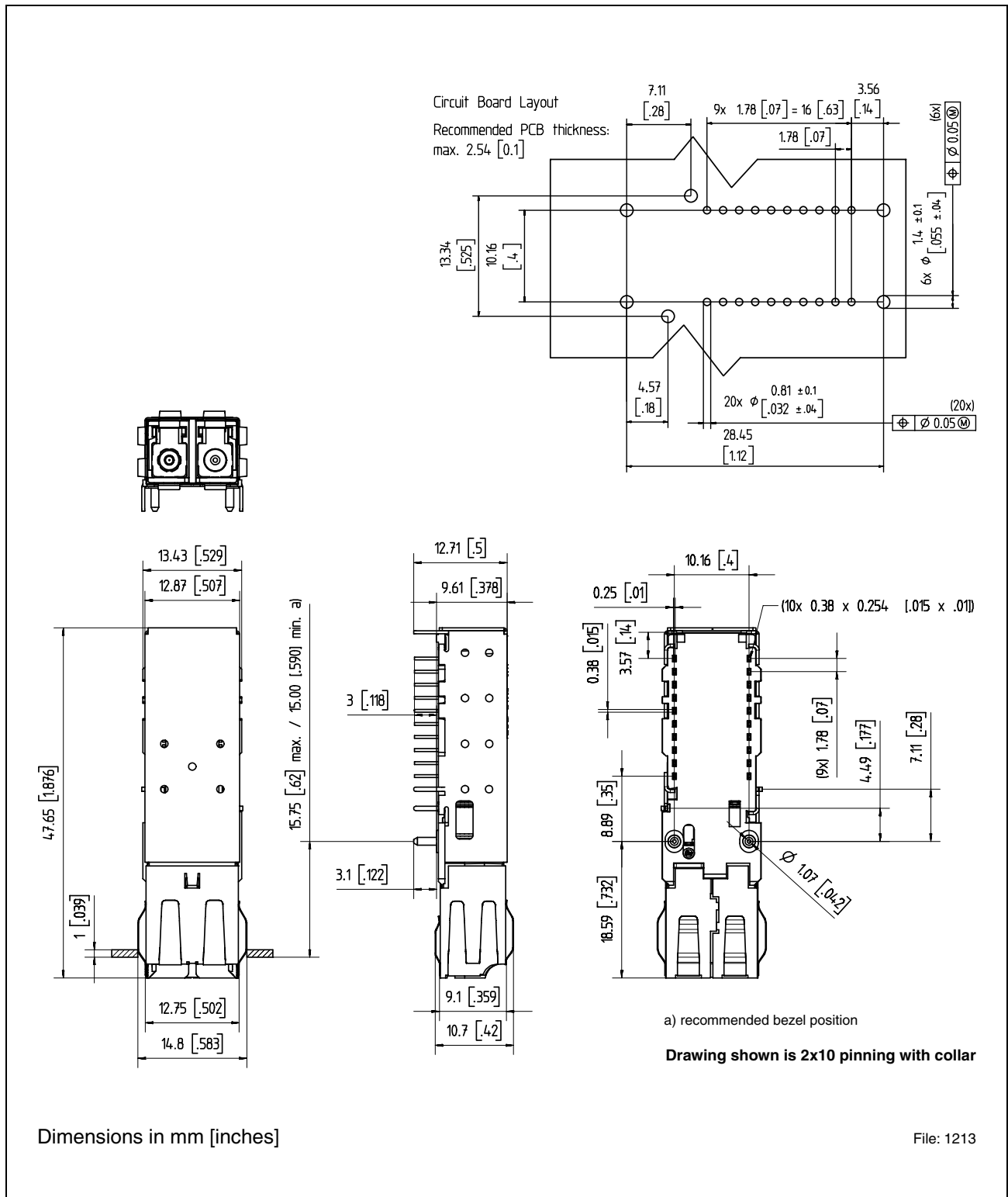


Figure 17

