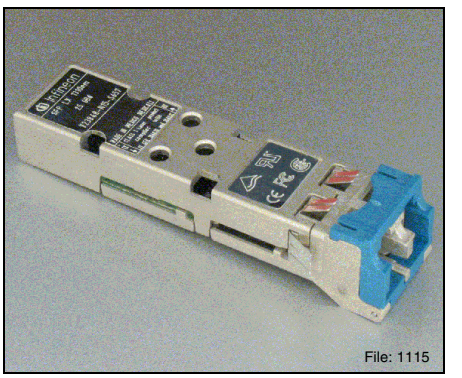
SFP - Small Form-factor Pluggable
Single Mode 1300 nm 1.0625 Gbit/s Fibre Channel
1.25 Gigabit Ethernet Transceiver with LC™ Connector

V23818-K15-B57

Features



- Small Form-factor Pluggable (SFP) transceiver
- Fully SFP MSA compliant[1)]
- Advanced release mechanism
  - Easy access, even in belly to belly applications
  - Grip for easy access – no tool is needed
  - Color coded blue (single mode)
- Excellent EMI performance
- RJ-45 style LC™ connector system
- Single power supply (3.3 V)
- Low power consumption
- Small size for high channel density
- UL-94 V-0 certified
- ESD Class 1C per JESD22-A114-B (MIL-STD 883D Method 3015.7)
- Compliant with FCC (Class B) and EN 55022
- For distances of up to 10 km
- Class 1 FDA and IEC laser safety compliant
- AC/AC Coupling according to SFP MSA
- Recommendation: Infineon Cage one-piece design V23838-S5-N1 for press fit and/or solderable
- SFP evaluation board V23818-S5-V2 available upon request

[1)] Current MSA documentation can be found at www.infineon.com/fiberoptics

LC™ is a trademark of Lucent

Pin Configuration

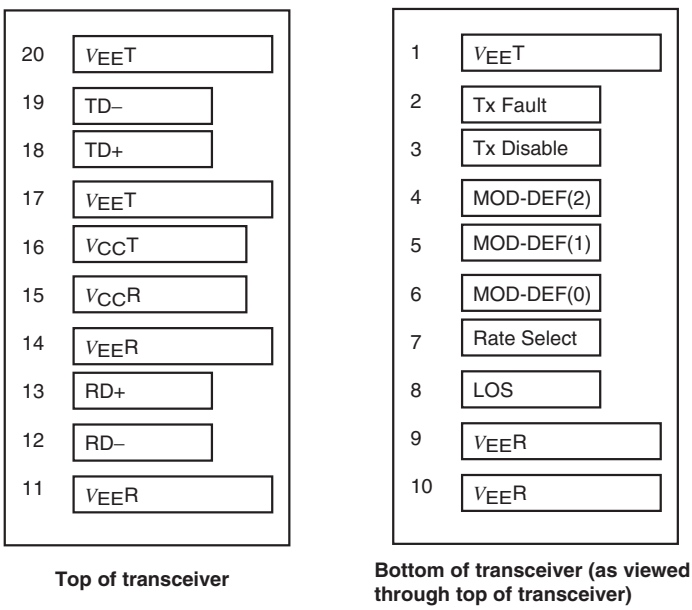


Figure 1 SFP Transceiver Electrical Pad Layout

Pin Description

Pin No.	Name	Logic Level	Function
1	V_{EE}T	N/A	Transmitter Ground[1)]
2	Tx Fault	LVTTL	Transmitter Fault Indication[2) 8)]
3	Tx Disable	LVTTL	Transmitter Disable[3)]
4	MOD-DEF(2)	LVTTL	Module Definition 2[4) 8)]
5	MOD-DEF(1)	LVTTL	Module Definition 1[5) 8)]
6	MOD-DEF(0)	N/A	Module Definition 0[6) 8)]
7	Rate Select	N/A	Not connected
8	LOS	LVTTL	Loss Of Signal[7) 8)]
9	V_{EE}R	N/A	Receiver Ground[1)]
10	V_{EE}R	N/A	Receiver Ground[1)]
11	V_{EE}R	N/A	Receiver Ground[1)]
12	RD–	LVPECL	Inv. Received Data Out[9)]
13	RD+	LVPECL	Received Data Out[9)]
14	V_{EE}R	N/A	Receiver Ground[1)]
15	V_{CC}R	N/A	Receiver Power
16	V_{CC}T	N/A	Transmitter Power
17	V_{EE}T	N/A	Transmitter Ground[1)]
18	TD+	LVPECL	Transmit Data In[10)]
19	TD–	LVPECL	Inv. Transmit Data In[10)]
20	V_{EE}T	N/A	Transmitter Ground[1)]

1) Common transmitter and receiver ground within the module.
2) A high signal indicates a laser fault of some kind and that laser is switched off.
3) A low signal switches the transmitter on. A high signal or when not connected switches the transmitter off.
4) MOD-DEF(2) is the data line of two wire serial interface for serial ID.
5) MOD-DEF(1) is the clock line of two wire serial interface for serial ID.
6) MOD-DEF(0) is grounded by the module to indicate that the module is present.
7) A low signal indicates normal operation, light is present at receiver input. A high signal indicates the received optical power is below the worst case receiver sensitivity.
8) Should be pulled up on host board to V_{CC} by 4.7 - 10 kΩ.
9) AC coupled inside the transceiver. Must be terminated with 100 Ω differential at the user SERDES.
10) AC coupled and 100 Ω differential termination inside the transceiver.

Description

The Infineon Fibre Channel / Gigabit Ethernet single mode transceiver – part of Infineon Small Form Factor transceiver family – is based on the Physical Medium Depend (PMD) sublayer and baseband medium, type 1000 Base-LX (long wavelength) compliant to 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.

Link Length as Defined by IEEE and Fibre Channel Standards

Fiber Type	Reach			Unit
	min.[1]	typ.	max.[2]	
at 1.0625 Gbit/s				
9 µm, SMF	2		10,000	meters
50 µm, 500 MHz*km	0.5	550		
62.5 µm, 200 MHz*km	0.5	550		
at 1.25 Gbit/s				
9 µm, SMF	2		5,000	meters
50 µm, 400/500 MHz*km	2		550	
62.5 µm, 500 MHz*km	2		550	

[1] Minimum reach as defined by IEEE and Fibre Channel Standards. A 0 m link length (loop-back connector) is supported.

[2] Maximum reach as defined by IEEE and Fibre Channel Standards. Longer reach possible depending upon link implementation.

The Infineon SFP single mode transceiver is a single unit comprised of a transmitter, a receiver, and an LC™ receptacle.

This transceiver supports the LC™ connectorization concept. It is compatible with RJ-45 style backpanels for high end datacom and telecom applications while providing the advantages of fiber optic technology.

The module is designed for low cost SAN, LAN, WAN, Fibre Channel and Gigabit Ethernet 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 (+3.3 V). The full differential data inputs and outputs are LVPECL compatible.

Functional Description of SFP Transceiver

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

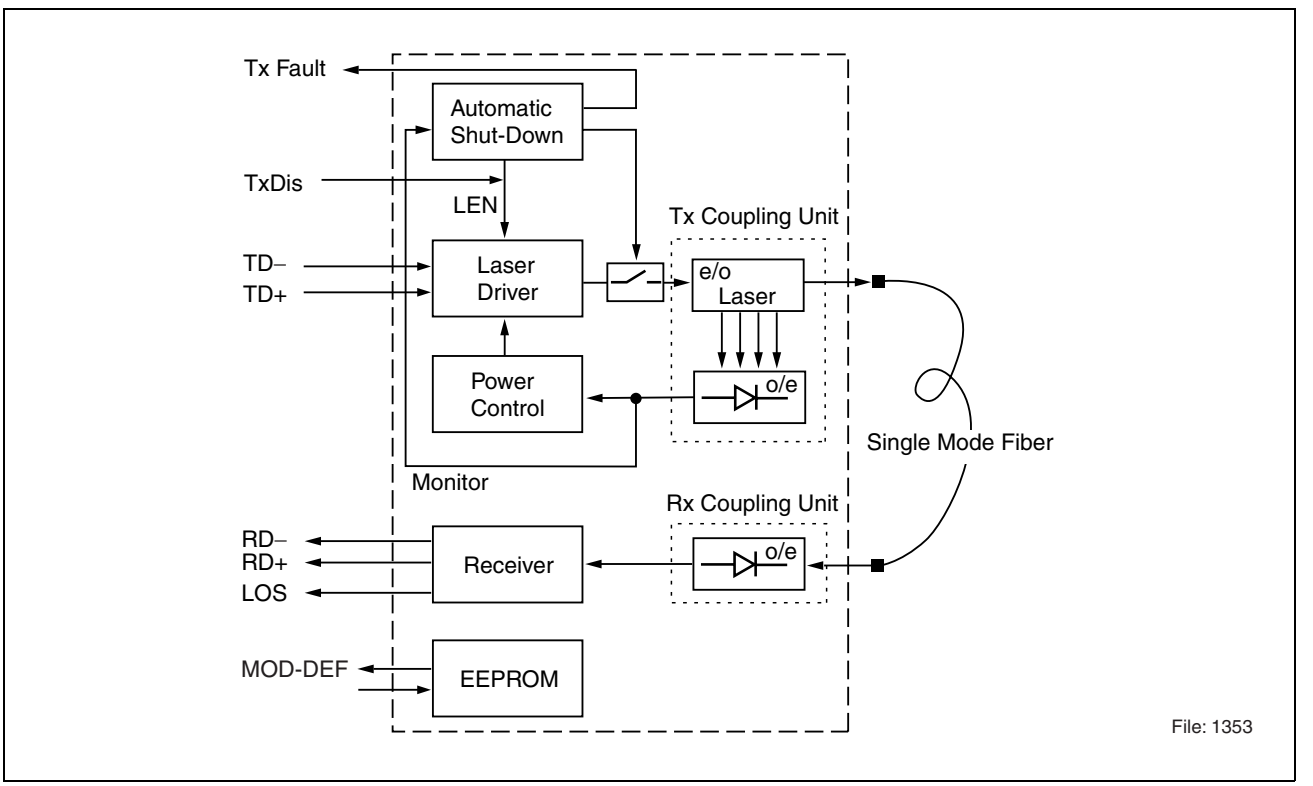


Figure 2 Functional Diagram

The receiver component converts the optical serial data into LVPECL compatible electrical data (RD+ and RD–). The Loss Of Signal (LOS) shows whether an optical signal is not present (lost).

The transmitter converts LVPECL compatible electrical serial data (TD+ and TD–) into optical serial data. Data lines are differentially 100 Ω terminated.

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.

Single fault condition is ensured by means of an integrated automatic shutdown circuit that disables the laser when it detects laser fault to guarantee the laser Eye Safety.

The transceiver contains a supervisory circuit to control the power supply. This circuit makes an internal reset signal whenever the supply voltage drops below the reset threshold. It keeps the reset signal active for at least 140 milliseconds after the voltage has risen above the reset threshold. During this time the laser is inactive.

A low signal on TxDis enables transmitter. If TxDis is high or not connected the transmitter is disabled.

The information which kind of SFP module has been plugged into an SFP port can be read through the MOD-DEF interface. The information is stored in an I^2C-EEprom inside the SFP Transceiver.

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 ±2 kV to ±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

Technical Data

Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Package Power Dissipation			0.9	W
Data Input Levels			V_{CC}+0.5	V
Differential Data Input Voltage Swing	V_{ID}pk-pk		5	V
Storage Ambient Temperature		–40	85	°C
V_{CC} max			5.5	V
ECL-Output Current Data			50	mA

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

Recommended Operating Conditions

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Ambient Temperature	T_{AMB}	0		70	°C
Power Supply Voltage	V_{CC}–V_{EE}	3.1	3.3	3.6	V
Transmitter					
Differential Data Input Voltage Swing	V_{ID}pk-pk	500		3200	mV
Receiver					
Input Center Wavelength	λ_C	1260		1580	nm

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

Transmitter Electro-Optical Characteristics

Transmitter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Launched Power (Average)[1]	P_O	–9.5		–3	dBm
Optical Modulation Amplitude[2]	OMA	180			µW
Center Wavelength	λ_C	1285		1350	nm
Spectral Width (RMS)	σ_I			2.5	nm
Relative Intensity Noise	RIN			–120	dB/Hz
Extinction Ratio (Dynamic)	ER	9			dB
Total Tx Jitter	TJ		53	130	ps
Optical Rise/Fall Time[3]	t_R, t_F			260	ps
Reset Threshold[4]	V_{TH}	2.5	2.75	2.99	V
Reset Time Out[4]	t_{RES}	140	240	300	ms
Supply Current			80	150	mA

1) Into single mode fiber, 9 µm diameter.
2) Fibre Channel PI Standard.
3) Measured without filter (20% - 80%).
4) 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}.

Receiver Electro-Optical Characteristics

Receiver	Symbol	Limit Values			Unit
		min.	typ.	max.	
Sensitivity (Average Power)[1]	P_{IN}			–20	dBm
Saturation (Average Power)	P_{SAT}	–3			dBm
Min. Optical Modulation Amplitude[2]	OMA			15	µW
Loss Of Signal (LOS) Assert Level[3]	P_{LOSA}	–37			dBm
Loss Of Signal (LOS) Deassert Level[4]	P_{LOSD}			–22	dBm
Loss Of Signal (LOS) Hysteresis	$P_{LOSA} - P_{LOSD}$	0.5	1	6	dB
Loss Of Signal (LOS) Assert Time	t_{ASS}			100	µs
Loss Of Signal (LOS) Deassert Time	t_{DAS}			100	µs
Receiver 3 dB Cut-off Frequency[2]				1.5	GHz
Receiver 10 dB Cut-off Frequency[2]				3	GHz
Differential Data Output Voltage Swing[5]	V_{OD}pk-pk	600		1200	mV
Return Loss of Receiver	ORL	12			dB
Output Data Rise/Fall Time	t_R, t_F			200	ps
Supply Current[6]			90	130	mA

[1] Minimum average optical power at which the BER is less than $1x10^{-12}$. Measured with a $2^7–1$ NRZ PRBS.

[2] Fibre Channel PI Standard.

[3] An increase in optical power above the specified level will cause the LOS output to switch from a high state to a low state.

[4] A decrease in optical power below the specified level will cause the LOS to change from a low state to a high state.

[5] AC/AC for data. Load 50 Ω to GND or 100 Ω differential. For dynamic measurement a tolerance of 50 mV should be added.

[6] Supply current excluding Rx output load.

Timing of Control and Status I/O

Parameter	Symbol	Limit Values		Unit	Condition
		min.	max.		
Tx Disable Assert Time	t_off		10	µs	Time from rising edge of Tx Disable to when the optical output falls below 10% of nominal.
Tx Disable Negate Time	t_on		1	ms	Time from falling edge of Tx Disable to when the modulated optical output rises above 90% of nominal.
Time to Initialize, Including Reset of Tx Fault	t_init		300		From power on or negation of Tx Fault using Tx Disable.
Tx Fault Assert Time	t_fault		100	µs	Time from fault to Tx Fault on.
Tx Disable to Reset	t_reset	10			Time Tx Disable must be held high to reset Tx Fault.
LOS Assert Time	t_loss_on		100		Time from LOS state to Rx LOS assert.
LOS Deassert Time	t_loss_off		100		Time from non-LOS state to Rx LOS deassert.
I^2C Bus Clock Rate	f_i2cbus_clock		100	kHz	

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)	< 195 µW
Beam Divergence	6°

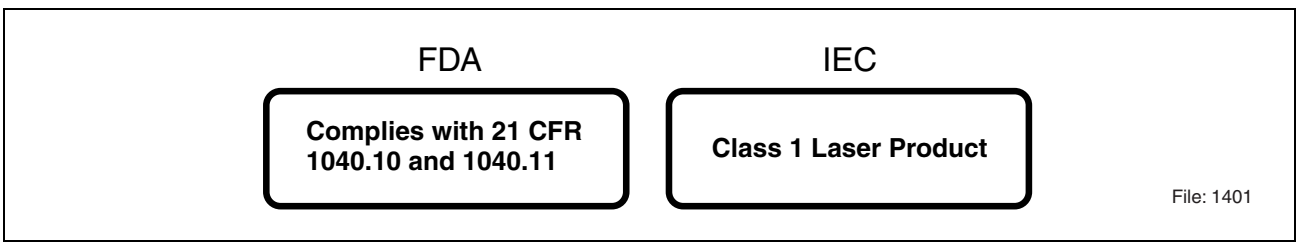


Figure 3 Required Labels

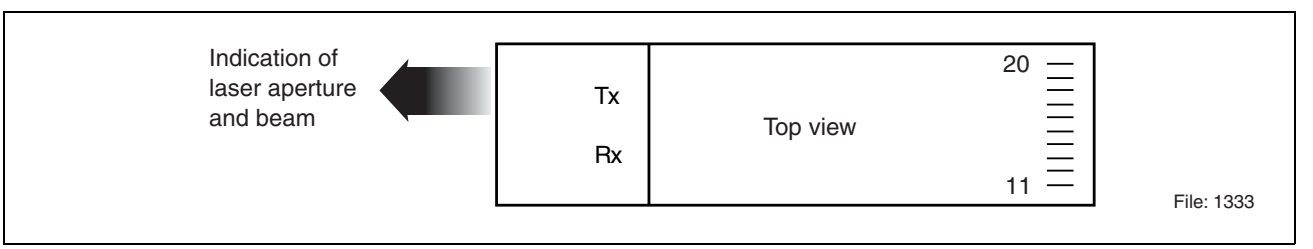


Figure 4 Laser Emission

Application Notes

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 Ω should be placed at the end of each matched line. An alternative termination can be provided with a 50 Ω resistor at each (D, Dn). In DC coupled systems a thevenin equivalent 50 Ω resistance can be achieved as follows: for 3.3 V: 125 Ω to V_{CC} and 82 Ω to V_{EE}, for 5 V: 82 Ω to V_{CC} and 125 Ω 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/cage 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.

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

For the SFP transceiver a connection of the SFP cage pins to chassis GND is recommended. If no separate chassis GND is available on the users PCB the pins should be connected to signal GND. In this case take care of the notes above.

Please consider that the PCB may behave like a waveguide. With an ε_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.

The SFP transceiver can be assembled onto the host board together with all cages and host board connectors complying with the SFP multi source agreement.

Infineon Proposes

Cage:
Infineon Technologies
Part Number: V23838-S5-N1

Host board connector:
Tyco Electronics
Part Number: 1367073-1

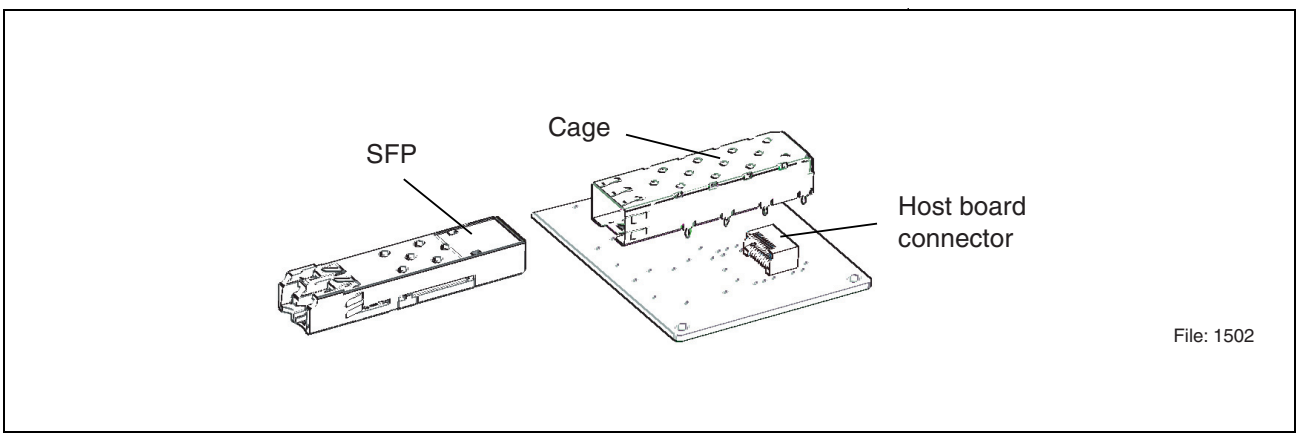


Figure 5

Handling Notes

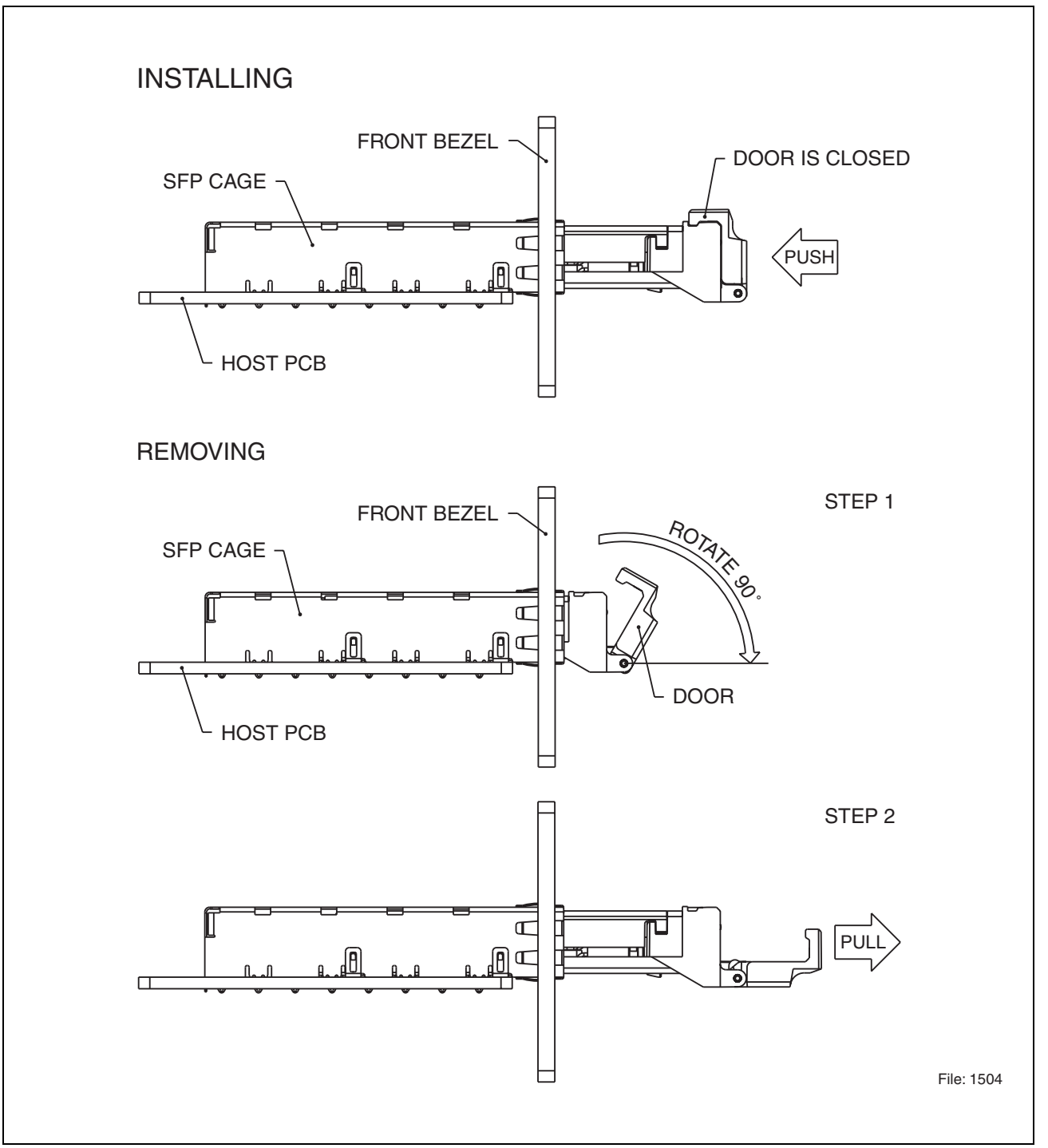


Figure 6 Installing and Removing of SFP-Transceiver

EEPROM Serial ID Memory Contents

Data Address	Hex	MSA Name/Description	Content/Value
0	03	Transceiver type	SFP
1	04	Extended identifier	Serial ID
2	07	Connector type	LC
3	00	Reserved	
4	00	SONET OC-48	
5	00	SONET OC-3/12	
6	02	Gigabit Ethernet	
7	12	FC reach/technology	
8	00	FC technology	
9	0D	FC media	
10	01	FC speed	
11	01	Encoding	
12	0D	Nominal bit rate	
13	00	Reserved	
14	0A	Length (9 µm) x 1 km	
15	64	Length (9 µm) x 100 m	
16	37	Length (50 µm) x 10 m	
17	37	Length (62.5 µm) x 10 m	
18	00	Length (copper) x 1 m	
19	00	Reserved	
20 - 35		Vendor name	Infineon AG
36	00	Reserved	
37 - 39		Vendor IEEE OUI	00-03-19
40 - 55		Vendor part number	V23818-K15-B57
56		Vendor revision	Infineon production code
57 - 59		Vendor revision	1.0
60 - 61		Wavelength	1310
62	00	Reserved	
63		Check code (0 to 62)	
64	00	Reserved	
65	1A	Transceiver options	Tx Disable, Tx Fault, LOS
66	69	Upper bit rate margin (%)	
67	55	Lower bit rate margin (%)	
68 - 83		Vendor serial number	
84 - 91		Vendor date code	
92 - 94		Diagnostic / SFF-8472 compliance	Not implemented
95		Check code (64-94)	
96 - 127	00	Vendor specific data	

Single Mode 1300 nm SFP Transceiver, AC/AC TTL

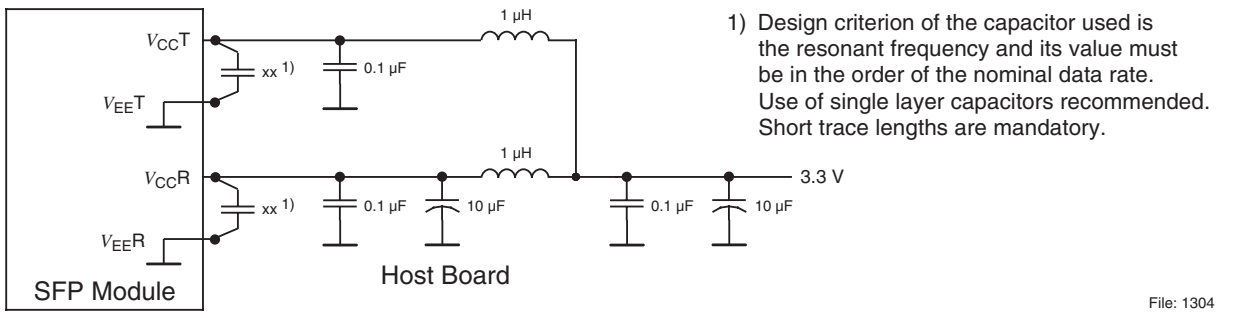


Figure 7 Recommended Host Board Supply Filtering Network

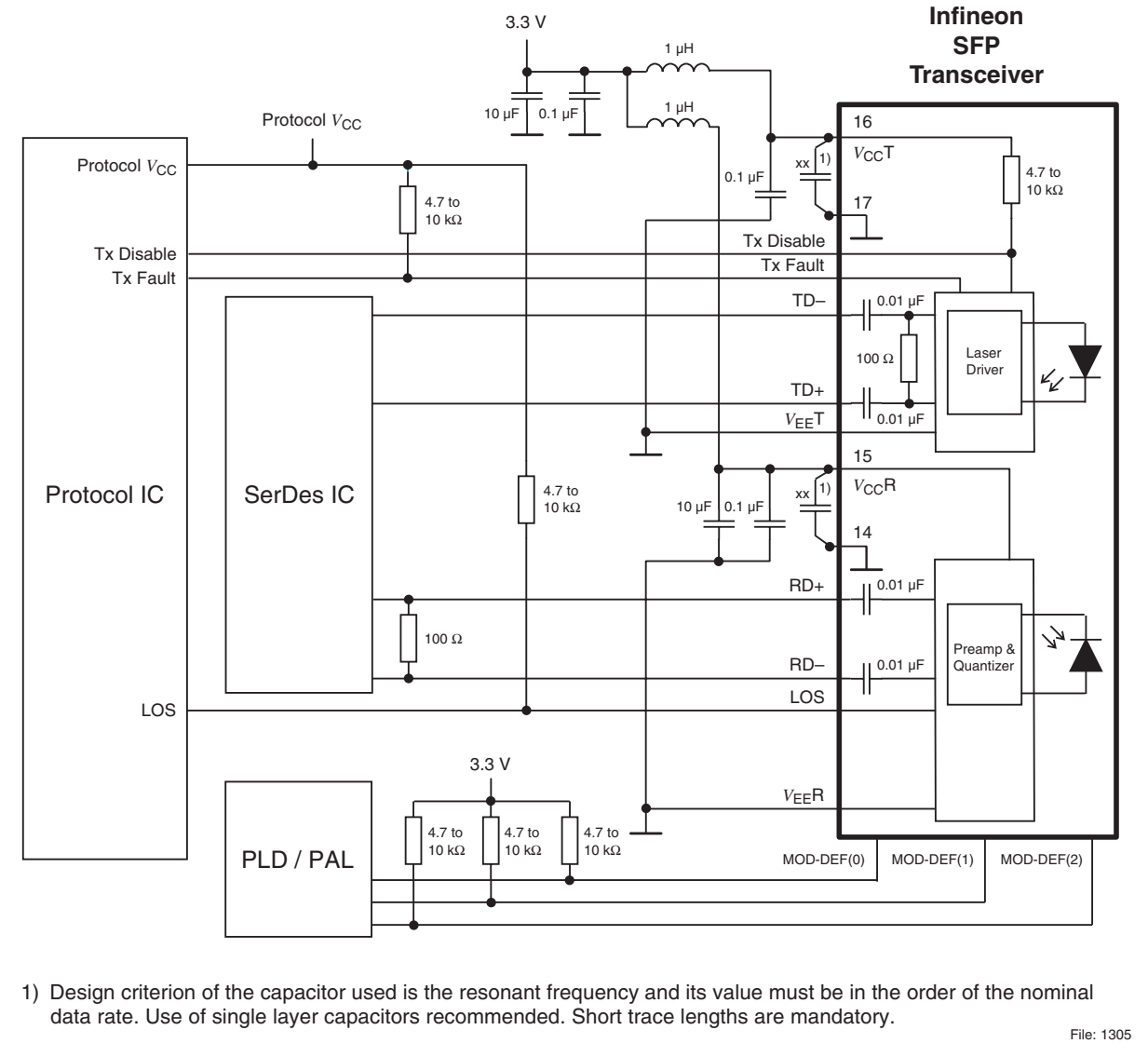


Figure 8 Example SFP Host Board Schematic

Package Outlines

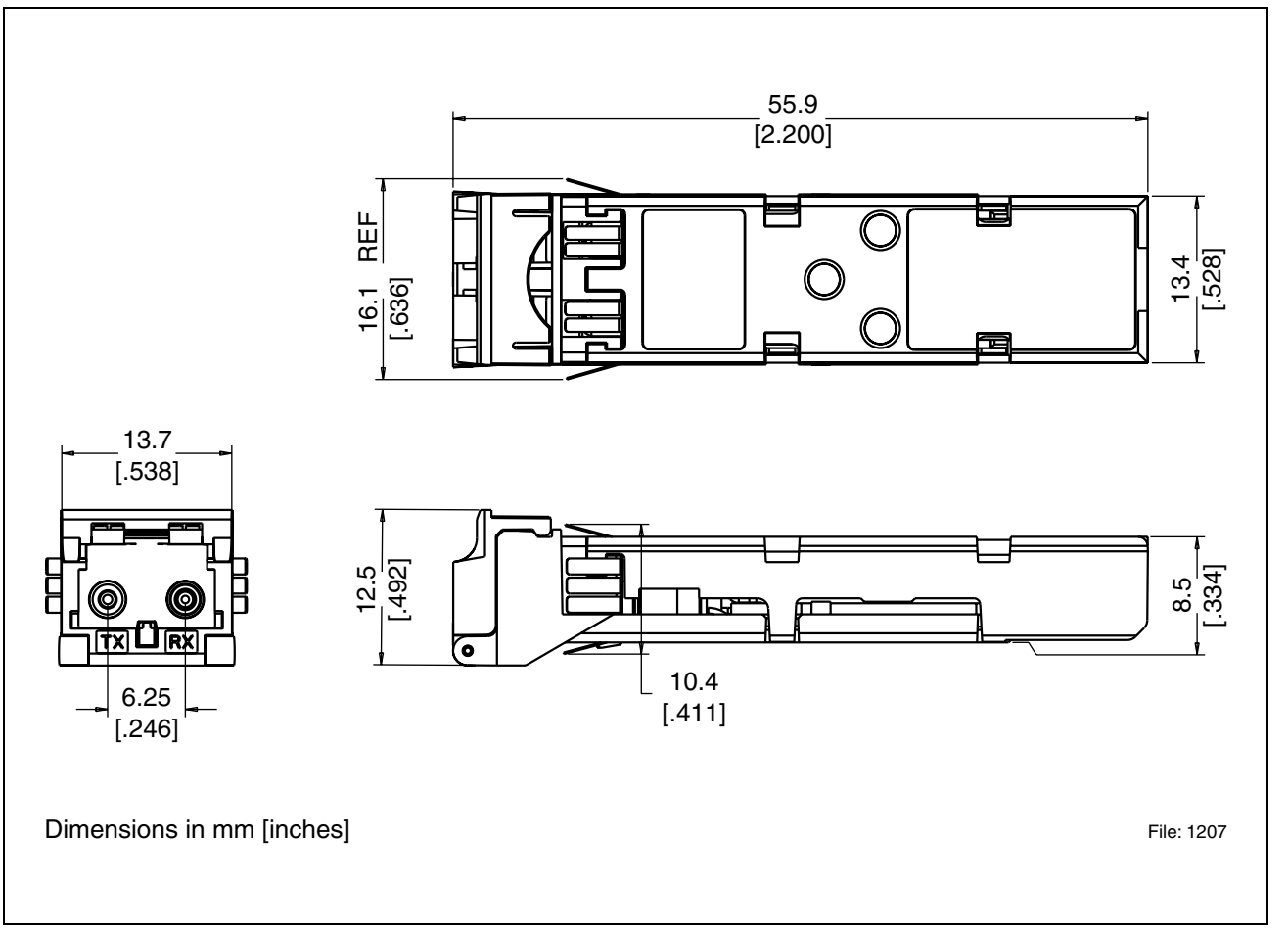


Figure 9

V23818-K15-B57

Revision History:	**2003-04-25**	DS1
Previous Version:	2002-05-06	

Page	**Subjects (major changes since last revision)**
	Document completely revised

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Edition 2003-04-25

Published by Infineon Technologies AG,
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