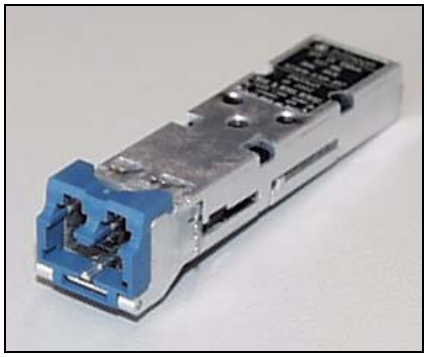
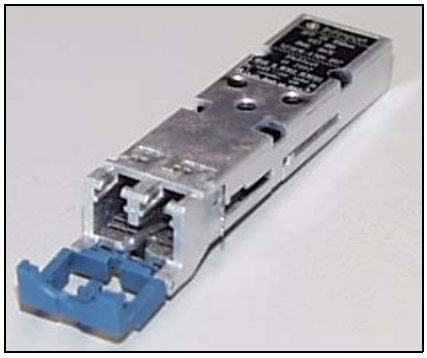
Small Form Factor Pluggable SFP Single Mode 1300 nm 2.125 and 1.0625 Gbit/s Fibre Channel Transceiver with LC™ Connector

V23818-M15-B57

Preliminary Data

Features





- Small Form Factor Pluggable 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 release mechanism
    MM: black color coding
    SM: blue color coding
- 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 1 per 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 V23818-S5-N1 for press fit and/or solderable
- Data rate autonegotiation between 1.0625 and 2.125 GBd
- Suitable for multi rate applications up to 2.125 Gbit/s

1) The SFP MSA can be found at www.Infineon.com/fiberoptics next to the transceiver datasheets.

LC™ is a trademark of Lucent

Pin Configuration

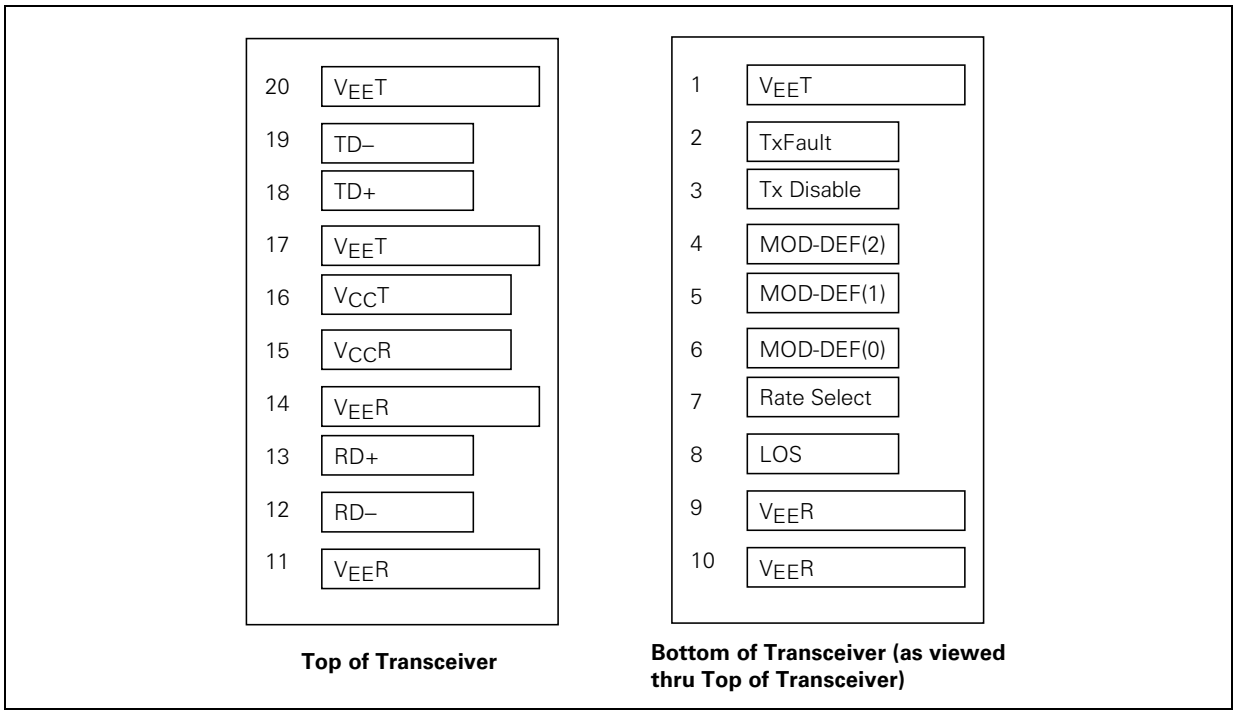


Figure 1 SFP Transceiver Electrical Pad Layout

Pin Description

Pin No.	Symbol	Level/ Logic	Function	Description
1	$V_{EE}T$	N/A	Transmitter Ground	
2	Tx Fault	TTL	Transmitter Fault Indication	Logical 1 indicates that Laser Shut-Down is active.
3	Tx Disable	TTL	Transmitter Disable	A low signal switches the laser on. A high signal switches the laser off.
4	MOD-DEF 2	TTL	Module Definition 2	Mod-Def 2 is the data line of two wire serial interface for serial ID.
5	MOD-DEF1	TTL	Module Definition 1	Mod-Def 1 is the clock line of two wire serial interface for serial ID.

Pin Description (cont'd)

Pin No.	Symbol	Level/ Logic	Function	Description
6	MOD-DEF0	N/A	Module Definition 0	Mod-Def 0 is grounded by the module to indicate that the module is present.
7	Rate Select	N/A	Not connected	
8	LOS	TTL	Loss of Signal	Normal Operation: Logic 0 Output, represents that light is present at receiver input. Fault Condition: Logic 1 Output.
9	V_{EE}R	N/A	Receiver Ground	
10	V_{EE}R	N/A	Receiver Ground	
11	V_{EE}R	N/A	Receiver Ground	
12	RD-	LVPECL	Inv. Received Data Out	AC Coupled inside the Transceiver.
13	RD+	LVPECL	Received Data Out	
14	V_{EE}R	N/A	Receiver Ground	
15	V_{CC}R	N/A	Receiver Power	
16	V_{CC}T	N/A	Transmitter Power	
17	V_{EE}T	N/A	Transmitter Ground	
18	TD+	LVPECL	Transmit Data In	AC Coupled inside the Transceiver and 100 Ω differential terminated.
19	TD-	LVPECL	Inv. Transmit Data In	
20	V_{EE}T	N/A	Transmitter Ground	

Description

The Infineon Fibre Channel multimode transceiver - part of Infineon Small Form Factor transceiver family - is based on the Physical Medium Depend (PMD) sublayer and baseband medium, type (long wavelength), Fibre Channel

FC-PI 200-M5-SN-I, 200-M6-SN-I

FC-PI 100-M5-SN-I, 100-M6-SN-I

FC-PH2 100-M5-SN-I, FC-PH2 100-M6-SN-I.

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

Operating Range

Fiber Type	Limit Values			Unit
	min.	typ.	max.	
at 2.125 GBd				
9 micron SMF	2	2,000	10,000	meters
62.5 micron MMF	0.5	2 to 150	700	
50.0 micron MMF	0.5	2 to 300	700	
at 1.0625 GBd				
9 micron SMF	2	2,000	10,000	meters
62.5 micron MMF	0.5	2 to 550	700	
50.0 micron MMF	0.5	2 to 550	700	

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 Data Com and Telecom applications while providing the advantages of fiber optic technology.

The module is designed for low cost LAN, WAN and up to 2.125 Gbit/s 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 / 2.125 Gbit/s from a single power supply (+3.3 V). The full differential data inputs and outputs are PECL and LVPECL compatible.

Functional Description of SFP Transceiver

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

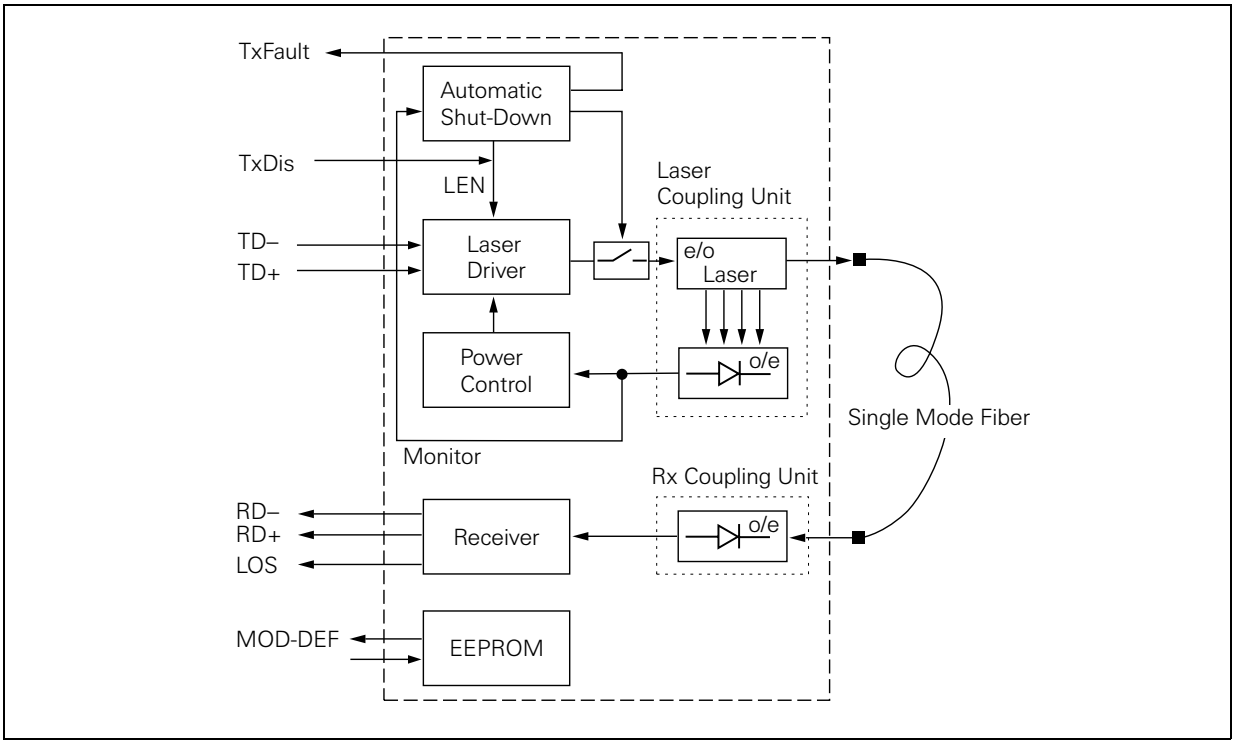


Figure 2 Functional Diagram

The receiver component converts the optical serial data into PECL compatible electrical data (RD+ and RD-). The LOS of Signal (LOS, active low) shows whether an optical signal is present.

The transmitter converts PECL 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-A (MIL-STD 883D method 3015.7)	Class 1 (> 1000 V)
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 rms, 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 (PECL)			V_{CC} + 0.5	V
Differential Data Input Voltage $\lvert V_D - V_{DN}\rvert$			2.5	
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	3.5	V
Transmitter					
Data Input Differential Voltage	$\lvert V_D - V_{DN}\rvert$	250		1600	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	-10		-3	dBm
Optical Modulation	OMA	100			µW
Center Wavelength	λ_C	1266		1360	nm
Spectral Width (RMS)	σ_I			4	
Relative Intensity Noise	RIN			-117	dB/Hz
Extinction Ratio (Dynamic)	ER	9			dB
Total Tx Jitter	TJ		40	80	ps
Reset Threshold[2]	V_{TH}	2.5	2.75	2.99	V
Reset Time Out[2]	t_{RES}	140	240	560	ms
Rise/Fall Time	$t_{R\text{-}Tx}$, $t_{F\text{-}Tx}$			160	ps
Supply Current			100	150	mA

[1] Into single mode fiber, 9 µm diameter.

[2] 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			
Min. Optical Modulation Amplitude[2]	OMA			15	µW
LOS of Signal Assert Level[3]	P_{LOSA}			-21	dBm
LOS of Signal Deassert Level[4]	P_{LOSD}	-37			
LOS of Signal Hysteresis	P_{LOSA} - P_{LOSD}	0.5	1		dB
LOS of Signal Assert Time	t_{ASS}			100	µs
LOS of Signal Deassert Time	t_{DAS}			350	
Receiver 3 dB Cut-off Frequency[2]				1.5	GHz
Receiver 10 dB Cut-off Frequency[2]				3	
Return Loss of Receiver	ARL	12			dB
Data Output Differential Voltage[5]	V_{DIFF}	0.5		1.23	V
Output Data Rise/Fall Time	$t_{R\text{-}Rx}$, $t_{F\text{-}Rx}$			250	ps
Supply Current[6]			100	130	mA

[1] Minimum average optical power at which the BER is less than $1x10^{-12}$. Measured with a 2^{23}–1 NRZ PRB as recommended by ANSI T1E1.4, SONET OC-24, and ITU-T G.957.

[2] Fibre Channel PI Standard.

[3] An increase in optical power above the specified level will cause the LOS of Signal 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 of Signal 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.
Serial ID Clock Rate	f_serial_ 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	t.b.d.

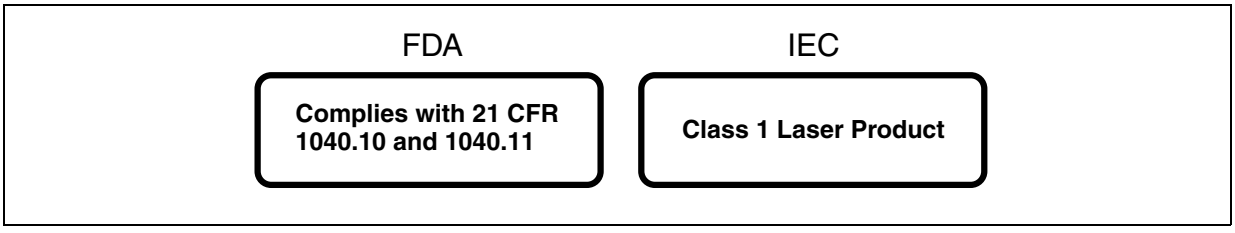


Figure 3 Required Labels

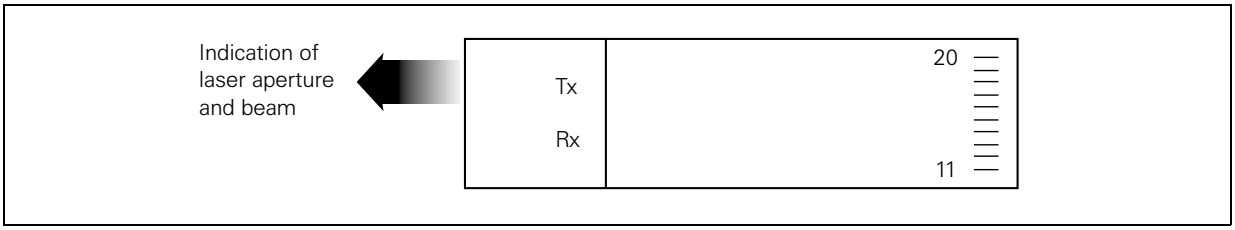


Figure 4 Laser Emission

Application Notes

EMI-Recommendation

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 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 possible, 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 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 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: V23818-S5-N1

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

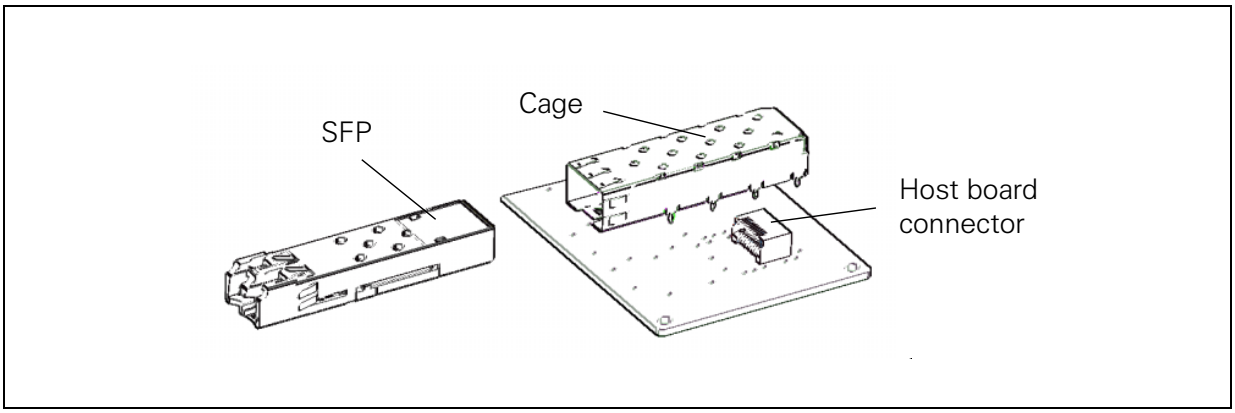


Figure 5

Handling Notes

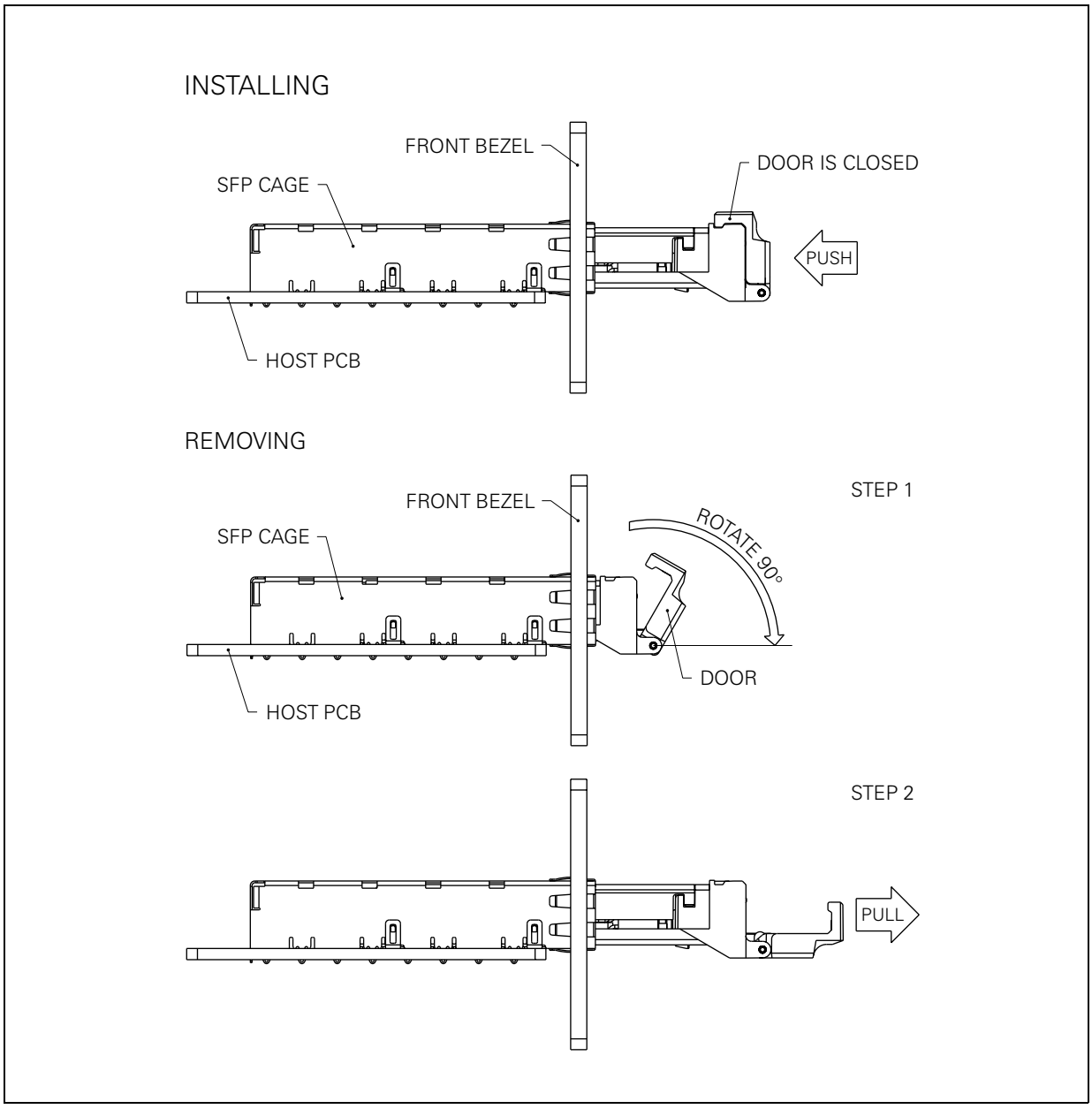


Figure 6 Installing and Removing of SFP-Transceiver

EEPROM Serial ID Memory Contents

The data can be read using the 2-wire serial CMOS E2PROM protocol of the Atmel AT24C01A or equivalent.

Addr.	Hex	ASCII	Addr.	Hex	ASCII	Addr.	Hex	ASCII	Addr.	Hex	ASCII
0	03		32	20		64	00		96	20	
1	04		33	20		65	1A		97	20	
2	07		34	20		66	69		98	20	
3	00		35	20		67	2D		99	20	
4	00		36	00		68 [2]			100	20	
5	00		37	00		69 [2]			101	20	
6	02		38	03		70 [2]			102	20	
7	12		39	19		71 [2]			103	20	
8	00		40	56	V	72 [2]			104	20	
9	01		41	32	2	73 [2]			105	20	
10	05		42	33	3	74 [2]			106	20	
11	00		43	38	8	75 [2]			107	20	
12	15		44	31	1	76 [2]			108	20	
13	00		45	38	8	77 [2]			109	20	
14	0A		46	2D	-	78 [2]			110	20	
15	64		47	4D	M	79 [2]			111	20	
16	37		48	31	1	80 [2]			112	20	
17	37		49	35	5	81 [2]			113	20	
18	00		50	2D	-	82 [2]			114	20	
19	00		51	42	B	83 [2]			115	20	
20	49	I	52	35	5	84 [3]			116	20	
21	6E	n	53	37	7	85 [3]			117	20	
22	66	f	54	20		86 [3]			118	20	
23	69	i	55	20		87 [3]			119	20	
24	6E	n	56	35		88 [3]			120	20	
25	65	e	57	34		89 [3]			121	20	
26	6F	o	58	20		90 [3]			122	20	
27	6E	n	59	20		91 [3]			123	20	
28	20		60	00		92	00		124	20	
29	41	A	61	00		93	00		125	20	
30	47	G	62	00		94	00		126	20	
31	20		63 [1]	00		95 [4]			127	20	

[1] Address 63 is check sum of bytes 0 - 63
[2] Address 68 - 83 Vendor Serial Number
[3] Date code
[4] Address 95 is check sum of bytes 64 - 94

Single Mode 1300 nm SFP Transceiver, AC/AC TTL

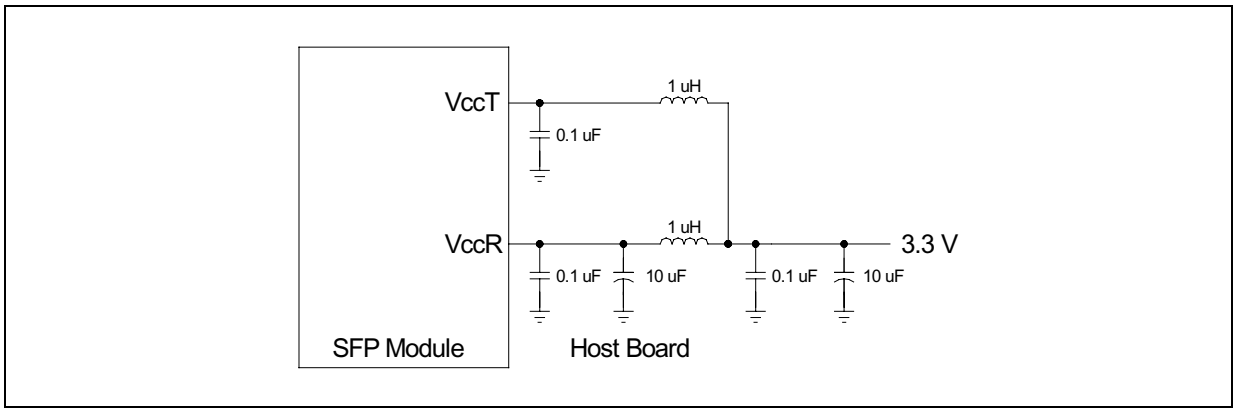


Figure 7 Recommended Host Board Supply Filtering Network

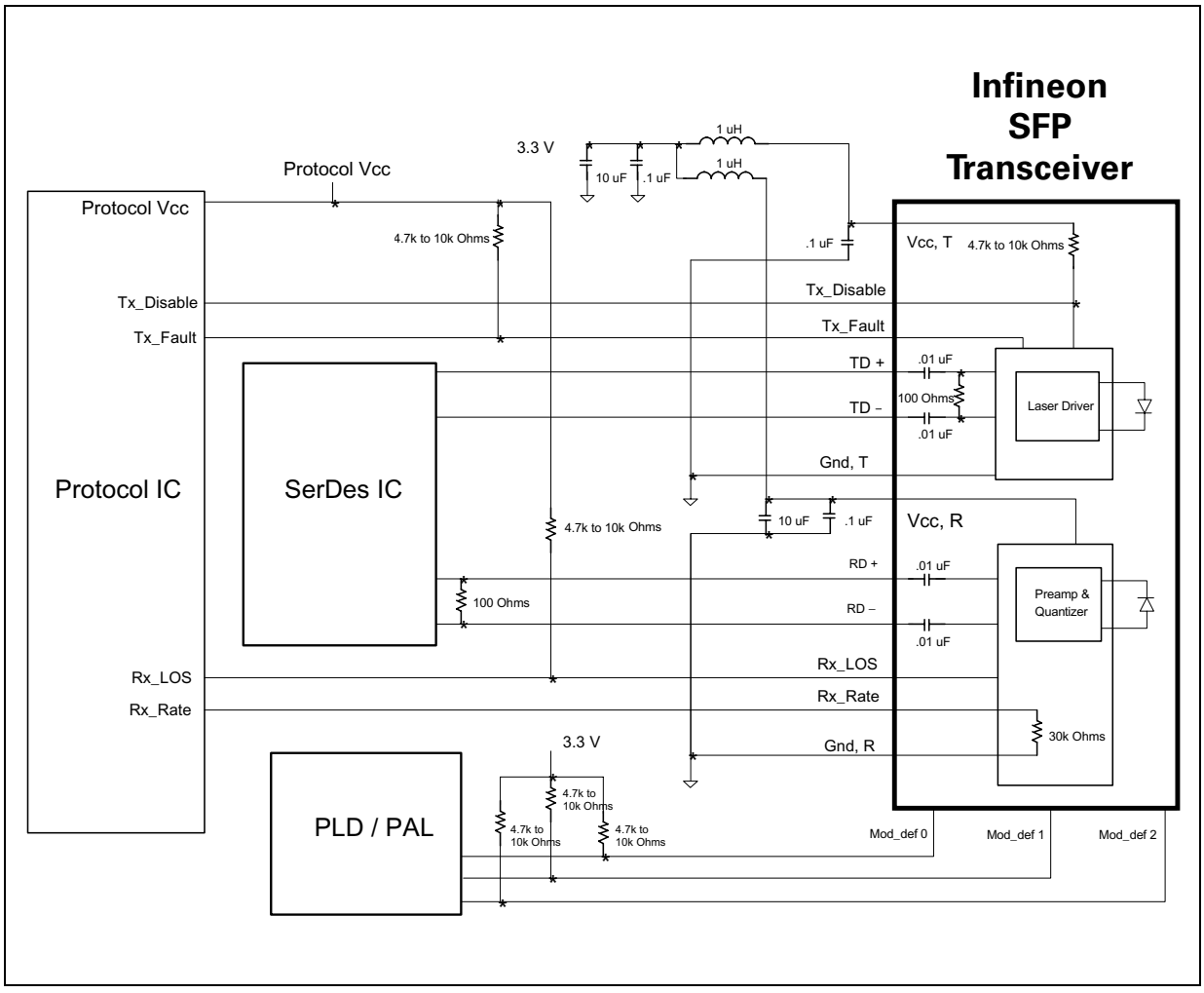
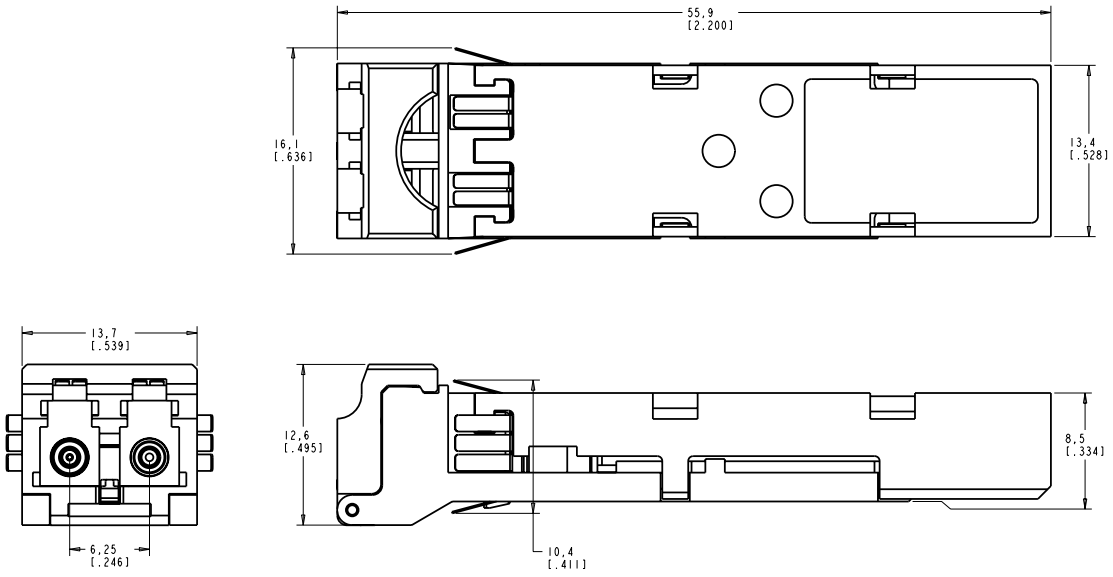


Figure 8 Example SFP Host Board Schematic

Package Outlines



Dimensions in mm [inches]

Figure 9

V23818-M15-B57

Revision History: 2002-05-06 DS0

Previous Version:

Page	Subjects (major changes since last revision)
	Document's layout has been changed: 2002-Aug.

For questions on technology, delivery and prices please contact the Infineon Technologies Offices in Germany or the Infineon Technologies Companies and Representatives worldwide: see our webpage at http://www.infineon.com.

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