



V23818-K305-B57

Small Form Factor Pluggable SFP

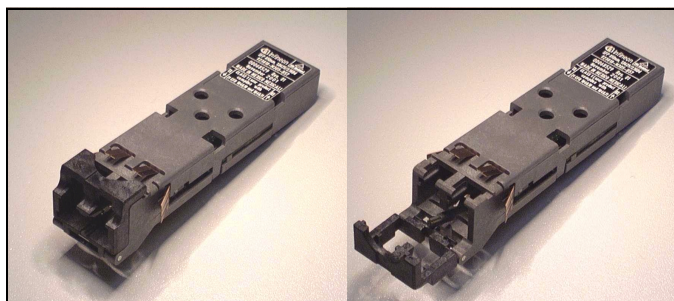
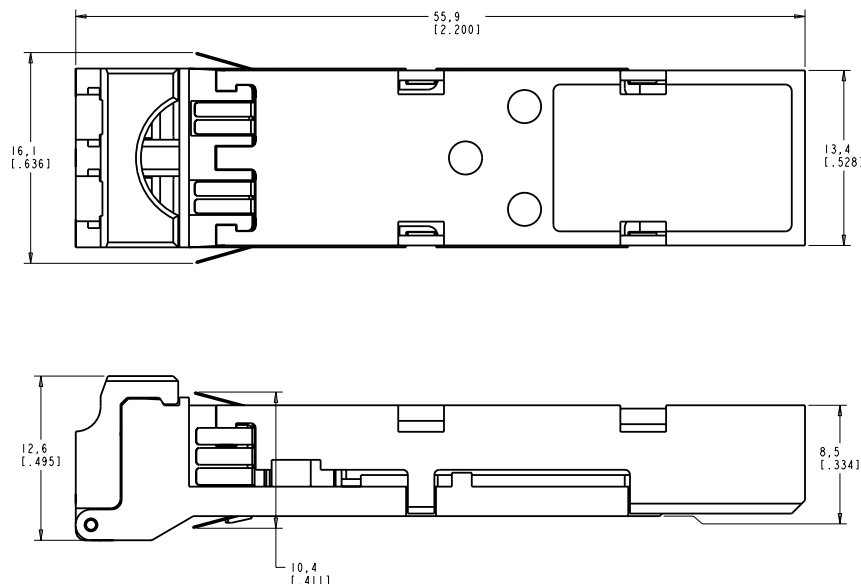
Multimode 850 nm 1.0625 GBd Fibre Channel

1.25 Gigabit Ethernet Transceiver

with LC™ Connector

Preliminary

Dimensions in mm [inches]



- 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 700 m (50 µm fiber)
- 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
- Operating case temperature: -10°C to 85°C

Note

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

Absolute Maximum Ratings

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

| | |
|---------------------------------------|------------------------|
| Package Power Dissipation..... | 1.5 W |
| Data Input Levels (PECL) | V _{CC} +0.5 V |
| Differential Data Input Voltage | 2.4 V |
| Storage Ambient Temperature | -40°C to 85°C |
| V _{CC} max..... | 5.5 V |
| ECL-Output current data | 50 mA |

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)
- Extremely low power consumption of 415 mW typical

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 1000 Base-SX (short wavelength) and Fibre Channel

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 62.5 µm or 50 µm multimode fiber with LC™ connector.

Operating range over each optical fiber type

| Fiber type | Min. | Typ. (meters) | Max. |
|-----------------|------|---------------|------|
| 62.5 micron MMF | 0.5 | 2 to 300 | 400 |
| 50.0 micron MMF | 0.5 | 2 to 550 | 700 |

The Infineon Fibre Channel / Gigabit Ethernet multimode 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.

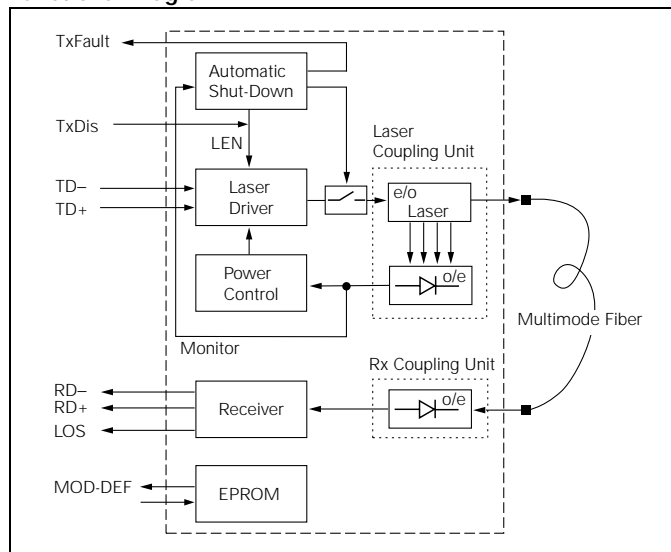
The module is designed for low cost SAN, LAN, WAN, Fibre Channel and Gigabit Ethernet applications. It can be used as the network end device interface in mainframes, workstations, servers, and storage devices, and in a broad range of network devices such as bridges, routers, hubs, and local and wide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

This transceiver operates at 1.0625 GBd / 1.25 GBd 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 multimode cable.

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 I²C-Eprom inside the SFP Transceiver.

TECHNICAL DATA

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

Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|---------------------------------|-----------------|------|------|------|-------|
| Case Temperature | T_C | -10 | | 85 | °C |
| Power Supply Voltage | $V_{CC}-V_{EE}$ | 3.1 | 3.3 | 3.5 | V |
| Transmitter | | | | | |
| Data Input Differential Voltage | V_{DIFF} | 250 | | 2400 | mV |
| Receiver | | | | | |
| Input Center Wavelength | λ_C | 770 | | 860 | nm |

Transmitter Electro-Optical Characteristics

| Transmitter | Symbol | Min. | Typ. | Max. | Units |
|---|-------------|------|------|------|-------|
| Launched Power (Average) ⁽¹⁾ | P_O | -9.5 | -6 | -4 | dBm |
| Optical Modulation Amplitude ⁽³⁾ | OMA | 156 | 450 | | μW |
| Center Wavelength | λ_C | 830 | 850 | 860 | nm |
| Spectral Width (RMS) | σ_I | | | 0.85 | |
| Relative Intensity Noise | RIN | | | -116 | dB/Hz |
| Extinction Ratio (Dynamic) | ER | 9 | 15 | | dB |
| Total Tx Jitter | TJ | | 53 | 130 | ps |
| Reset Threshold ⁽²⁾ | V_{TH} | 2.5 | 2.75 | 2.99 | V |
| Reset Time Out ⁽²⁾ | t_{RES} | 140 | 240 | 560 | ms |
| Rise Time, 20%–80% | t_R | | | 260 | ps |
| Supply Current | | | 45 | 65 | mA |

Notes

1. Into multimode fiber, 62.5 μm or 50 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} .
3. Fibre Channel PI Standard.

Receiver Electro-Optical Characteristics

| Receiver | Symbol | Min. | Typ. | Max. | Units |
|--|---------------------|------|-------|-------|-------------------|
| Sensitivity (Average Power) ⁽¹⁾ | P_{IN} | | -19.5 | -17 | dBm |
| Saturation (Average Power) | P_{SAT} | 0 | | | |
| Min. Optical Modulation Amplitude ⁽⁸⁾ | OMA | | 19 | 31 | μW |
| Stressed Receiver Sensitivity 50 μm Fiber | SPIN 50 μm | | 24 | 55 | μW ⁽⁶⁾ |
| | | | -17 | -13.5 | dB ⁽⁷⁾ |
| Stressed Receiver Sensitivity 62.5 μm Fiber | SPIN 62.5 μm | | 32 | 67 | μW ⁽⁶⁾ |
| | | | -16 | -12.5 | dB ⁽⁷⁾ |
| LOS of Signal Assert Level ⁽²⁾ | P_{LOSA} | | -22 | -18 | dBm |
| LOS of Signal Deassert Level ⁽³⁾ | P_{LOSD} | -30 | -24 | | |
| LOS of Signal Hysteresis | $P_{LOSA}-P_{LOSD}$ | 0.5 | 2 | | dB |
| LOS of Signal Assert Time | t_{ASS} | | | 100 | μs |
| LOS of Signal Deassert Time | t_{DAS} | | | 350 | |
| Receiver 3 dB cut off Frequency ⁽⁸⁾ | | | 1.25 | 1.5 | GHz |
| Receiver 10 dB cut off Frequency ⁽⁸⁾ | | | 1.5 | 3 | |
| Data Output Differential Voltage ⁽⁴⁾ | V_{DIFF} | 0.5 | 0.7 | 1.23 | V |
| Return Loss of Receiver | A_{RL} | 12 | | | dB |
| Supply current ⁽⁵⁾ | | | 80 | 90 | mA |

Notes

1. Average optical power at which the BER is 1×10^{-12} . Measured with a 2⁷-1 NRZ PRBS and ER=9 dB.
2. 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.
3. 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.
4. AC/AC for data. Load 50 Ω to GND or 100 Ω differential. For dynamic measurement a tolerance of 50 mV should be added.
5. Supply current excluding Rx output load.
6. Measured at the given Stressed Receiver Eyeclosure Penalty and DCD component given in Fibre Channel PI Standard (2.03/2.18 dB & 40/80 ps).
7. Measured according to IEEE 802.3
8. Fibre Channel PI Standard.


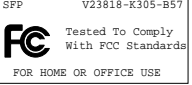
Timing of Control and Status I/O

| Parameter | Symbol | Min. | Max. | Units | Condition |
|---|----------------|------|------|-------|---|
| 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 | |

Pin Description

| Pin Name | | Level/Logic | Pin# | Description |
|-------------------|------------------------------|-------------|------|---|
| V _{EE} T | Transmitter Ground | N/A | 1 | |
| Tx Fault | Transmitter Fault Indication | TTL | 2 | Logical 1 indicates that Laser Shut-Down is active. |
| Tx Disable | Transmitter Disable | TTL | 3 | A low signal switches the laser on. A high signal switches the laser off. If not connected the Tx is disabled. |
| MOD-DEF2 | Module Definition 2 | TTL | 4 | Mod-Def 2 is the data line of two wire serial interface for serial ID. |
| MOD-DEF1 | Module Definition 1 | TTL | 5 | Mod-Def 1 is the clock line of two wire serial interface for serial ID. |
| MOD-DEF0 | Module Definition 0 | N/A | 6 | Mod-Def 0 is grounded by the module to indicate that the module is present. |
| Rate Select | Not connected | N/A | 7 | |
| LOS | Loss of Signal | TTL | 8 | Normal Operation: Logic "0" Output, represents that light is present at receiver input. Fault Condition: Logic "1" Output. |
| V _{EE} R | Receiver Ground | N/A | 9 | |
| V _{EE} R | Receiver Ground | N/A | 10 | |
| V _{EE} R | Receiver Ground | N/A | 11 | |
| RD- | Inv. Received Data Out | LV PECL | 12 | AC Coupled inside the Transceiver. |
| RD+ | Received Data Out | LV PECL | 13 | |
| V _{EE} R | Receiver Ground | N/A | 14 | |
| V _{CC} R | Receiver Power | N/A | 15 | |
| V _{CC} T | Transmitter Power | N/A | 16 | |
| V _{EE} T | Transmitter Ground | N/A | 17 | |
| TD+ | Transmit Data In | LV PECL | 18 | AC Coupled inside the Transceiver and 100 Ω differential terminated. |
| TD- | Inv. Transmit Data In | LV PECL | 19 | |
| V _{EE} T | Transmitter Ground | N/A | 20 | |

Regulatory Compliance

| Feature | Standard | Comments |
|---|---|---|
|  | Compliant with 89/336/EEC | EN 55022 EN 55024 |
| 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 |
|  | | This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: 1. This device may not cause harmful interference. 2. This device must accept any interference received, including interference that may cause undesired operation. |

EYE SAFETY

This laser based multimode 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.

Caution

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)).

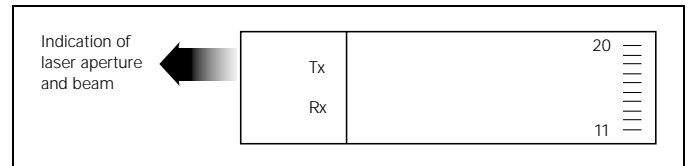
Laser Data

| | |
|--|--------------|
| Wavelength | 850 nm |
| Total output power (as defined by IEC: 7 mm aperture at 1.4 cm distance) | <675 μ W |
| Total output power (as defined by FDA: 7 mm aperture at 20 cm distance) | <70 μ W |
| Beam divergence | 12° |

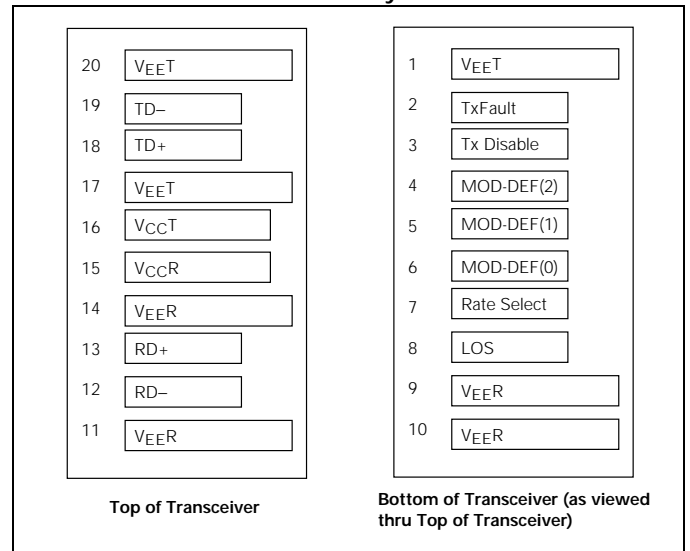
Required Labels

| FDA | IEC |
|---|------------------------------|
| Complies with 21 CFR 1040.10 and 1040.11 | Class 1 Laser Product |

Laser Emission



SFP Transceiver Electrical Pad Layout



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 $100\ \Omega$ 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 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 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:

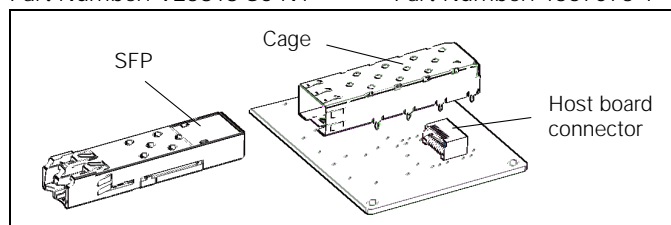
Infineon Technologies

Part Number: V23818-S5-N1

Host board connector:

Tyco Electronics

Part Number: 1367073-1



EEPROM Serial ID Memory Contents

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

| Address | Hex | ASCII |
|---------|-----|-------|
| 0 | 03 | |
| 1 | 04 | |
| 2 | 07 | |
| 3 | 00 | |
| 4 | 00 | |
| 5 | 00 | |
| 6 | 01 | |
| 7 | 40 | |
| 8 | 40 | |
| 9 | 0C | |
| 10 | 01 | |
| 11 | 01 | |
| 12 | 0D | |
| 13 | 00 | |
| 14 | 00 | |
| 15 | 00 | |
| 16 | 32 | |
| 17 | 1E | |
| 18 | 00 | |
| 19 | 00 | |
| 20 | 49 | l |
| 21 | 6E | n |
| 22 | 66 | f |
| 23 | 69 | i |
| 24 | 6E | n |
| 25 | 65 | e |
| 26 | 6F | o |
| 27 | 6E | n |
| 28 | 20 | |
| 29 | 41 | A |
| 30 | 47 | G |
| 31 | 20 | |

| Address | Hex | ASCII |
|-------------------|-----|-------|
| 32 | 20 | |
| 33 | 20 | |
| 34 | 20 | |
| 35 | 20 | |
| 36 | 00 | |
| 37 | 00 | |
| 38 | 03 | |
| 39 | 19 | |
| 40 | 56 | V |
| 41 | 32 | 2 |
| 42 | 33 | 3 |
| 43 | 38 | 8 |
| 44 | 31 | 1 |
| 45 | 38 | 8 |
| 46 | 2D | - |
| 47 | 4B | K |
| 48 | 33 | 3 |
| 49 | 30 | 0 |
| 50 | 35 | 5 |
| 51 | 2D | - |
| 52 | 42 | B |
| 53 | 35 | 5 |
| 54 | 37 | 7 |
| 55 | 20 | |
| 56 | 00 | |
| 57 | 00 | |
| 58 | 00 | |
| 59 | 00 | |
| 60 | 00 | |
| 61 | 00 | |
| 62 | 00 | |
| 63 ⁽¹⁾ | FB | |

| Address | Hex | ASCII |
|-------------------|-----|-------|
| 64 | 00 | |
| 65 | 1A | |
| 66 | 78 | |
| 67 | 32 | |
| 68 ⁽²⁾ | | |
| 69 ⁽²⁾ | | |
| 70 ⁽²⁾ | | |
| 71 ⁽²⁾ | | |
| 72 ⁽²⁾ | | |
| 73 ⁽²⁾ | | |
| 74 ⁽²⁾ | | |
| 75 ⁽²⁾ | | |
| 76 ⁽²⁾ | | |
| 77 ⁽²⁾ | | |
| 78 ⁽²⁾ | | |
| 79 ⁽²⁾ | | |
| 80 ⁽²⁾ | | |
| 81 ⁽²⁾ | | |
| 82 ⁽²⁾ | | |
| 83 ⁽²⁾ | | |
| 84 ⁽³⁾ | | |
| 85 ⁽³⁾ | | |
| 86 ⁽³⁾ | | |
| 87 ⁽³⁾ | | |
| 88 ⁽³⁾ | | |
| 89 ⁽³⁾ | | |
| 90 ⁽³⁾ | | |
| 91 ⁽³⁾ | | |
| 92 | 00 | |
| 93 | 00 | |
| 94 | 00 | |
| 95 ⁽⁴⁾ | | |

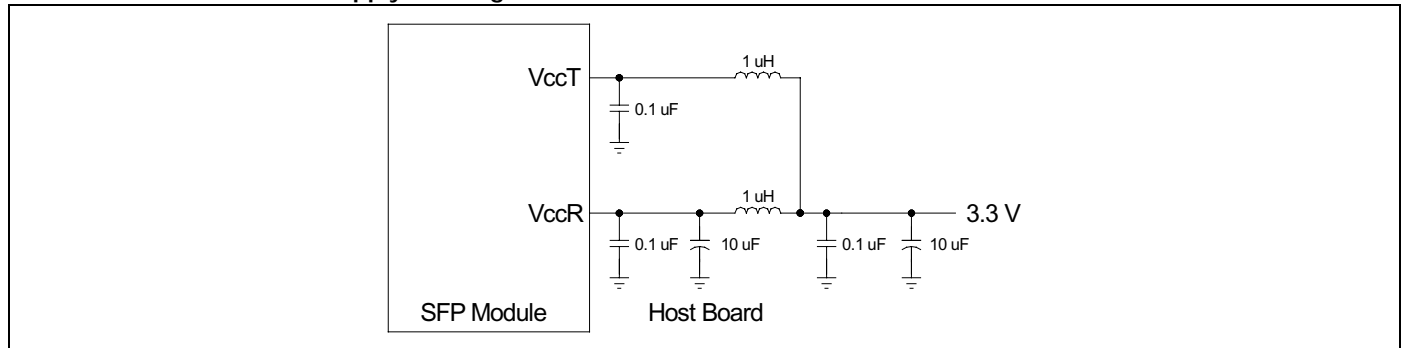
| Address | Hex | ASCII |
|---------|-----|-------|
| 96 | 20 | |
| 97 | 20 | |
| 98 | 20 | |
| 99 | 20 | |
| 100 | 20 | |
| 101 | 20 | |
| 102 | 20 | |
| 103 | 20 | |
| 104 | 20 | |
| 105 | 20 | |
| 106 | 20 | |
| 107 | 20 | |
| 108 | 20 | |
| 109 | 20 | |
| 110 | 20 | |
| 111 | 20 | |
| 112 | 20 | |
| 113 | 20 | |
| 114 | 20 | |
| 115 | 20 | |
| 116 | 20 | |
| 117 | 20 | |
| 118 | 20 | |
| 119 | 20 | |
| 120 | 20 | |
| 121 | 20 | |
| 122 | 20 | |
| 123 | 20 | |
| 124 | 20 | |
| 125 | 20 | |
| 126 | 20 | |
| 127 | 20 | |

Notes

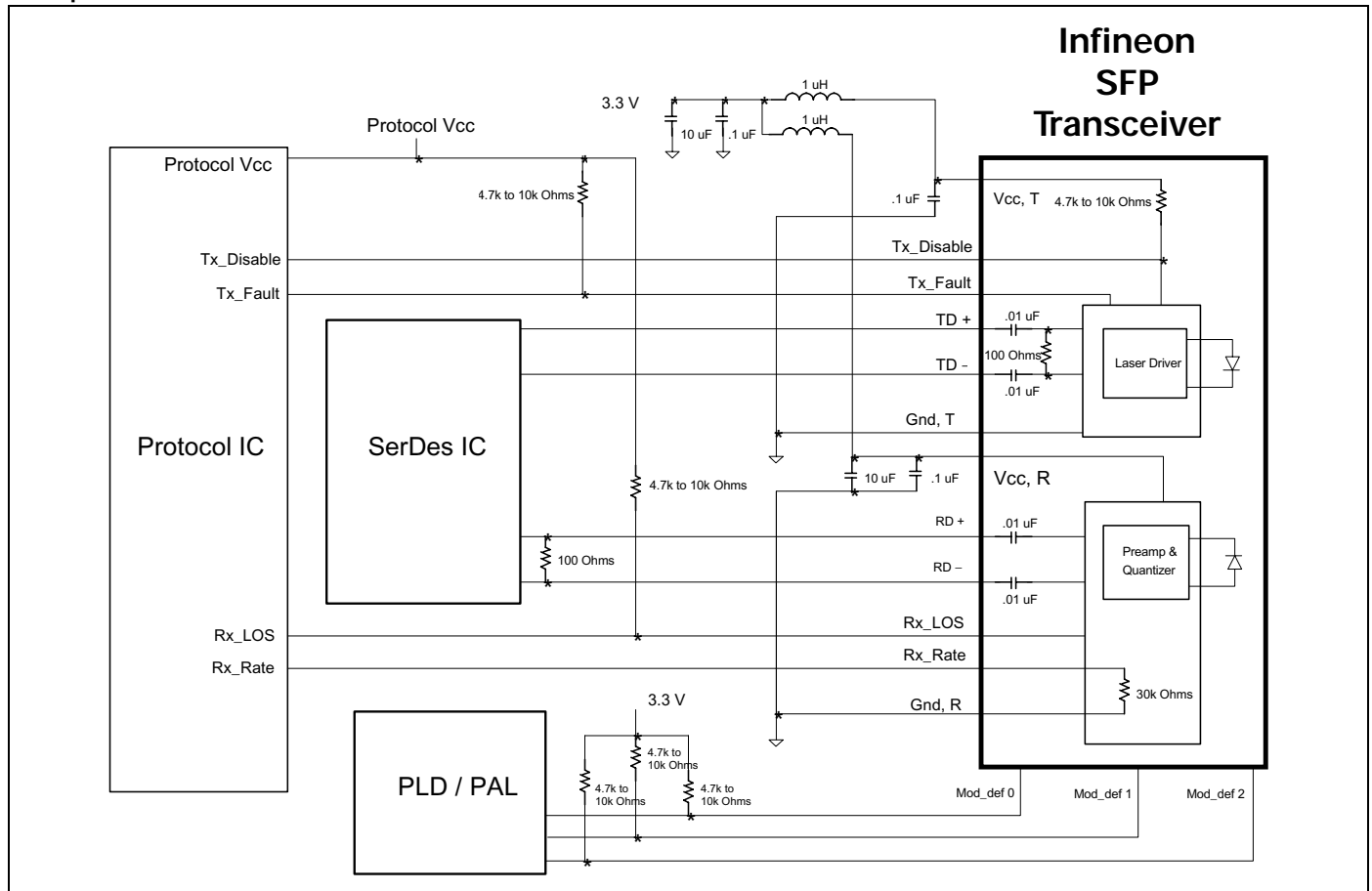
1. Address 63 is check sum of bytes 0–63
2. Address 61–83 Vendor Serial Number
3. Date code
4. Address 95 is check sum of bytes 64–94

Multimode 850 nm Fibre Channel SFP Transceiver, AC/AC TTL

Recommended Host Board Supply Filtering Network



Example SFP Host Board Schematic



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Attention please!

The information herein is given to describe certain components and shall not be considered as warranted characteristics.
Terms of delivery and rights to technical change reserved.
We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.
Infineon Technologies is an approved CECC manufacturer.

Information

For further information on technology, delivery terms and conditions and prices please contact the Infineon Technologies offices or our Infineon Technologies Representatives worldwide - see our webpage at www.infineon.com/fiberoptics

Warnings

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your Infineon Technologies offices.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.