



Technical Specification for Small Form Factor Pluggable (SFP)

SCP6G78-GL-###E (Diagnostic Monitoring with External Calibration)

- | | | |
|--|--|--|
| <input type="checkbox"/> 155.52Mbps | <input type="checkbox"/> 622.08Mbps | <input checked="" type="checkbox"/> other <u>2488.32Mbps</u> |
| <input type="checkbox"/> Short Haul | <input checked="" type="checkbox"/> Long Haul | <input type="checkbox"/> other _____ |
| <input type="checkbox"/> Intermediate Reach | <input checked="" type="checkbox"/> Long Reach | <input type="checkbox"/> other _____ |
| <input type="checkbox"/> Single 5.0 V | <input checked="" type="checkbox"/> Single 3.3 V | <input type="checkbox"/> other _____ |
| <input type="checkbox"/> 1.3 μm | <input checked="" type="checkbox"/> 1.55 μm | <input type="checkbox"/> other _____ |
| <input checked="" type="checkbox"/> W / Diagnostic Monitor | <input checked="" type="checkbox"/> W / O Diagnostic Monitor | |



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#Safety Precaution Symbols This specification uses various picture symbols to prevent possible injury to operator or other persons or damage to properties for appropriate use of the product. The symbols and definitions are as shown below. Be sure to be familiar with these symbols before reading this specification.

| | |
|--|--|
| | Warning Wrong operation without following this instruction may lead to human death or serious injury. |
| | Caution Wrong operation without following this instruction may lead to human injury or property damage. |

Example of picture symbols indicates prohibition of actions. Action details are explained thereafter.
 indicates compulsory actions or instructions. Action details are explained thereafter.

1. General

Features and applications of SCP6G78-GL are listed below.

Features

- * RoHS6 Compliant
- * Compliant with SFP MSA.
- * SFF-8472 rev.9 compliant diagnostic monitoring implemented
- * SDH STM-16 L16.2/SONET OC-48 LR-2 Compliant
- * Power Supply Voltage Single +3.3V
- * Built-in DC-DC and APD Bias Control Circuit
- * Compact Package Size 56.5 X 13.7 X 8.6 mm
- * Electrical Interface AC coupled for DATA, LVTTTL for Tx Disable, open collector output for LOS and Tx Fault. Circuit ground is internally isolated from frame ground.
- * Fiber Coupled Power -2 to +3dBm (SMF)
- * Input Power Range -28 to -9dBm (SMF)
- * Optical Reflectance -27dB (max)
- * Connector Interface LC Duplex Connector
- * Serial ID Functionality
- * Alarm and Warning Flags

Applications

- > SONET/LR, SDH/LH Application
- > Metropolitan Area Network

2. Block Diagram

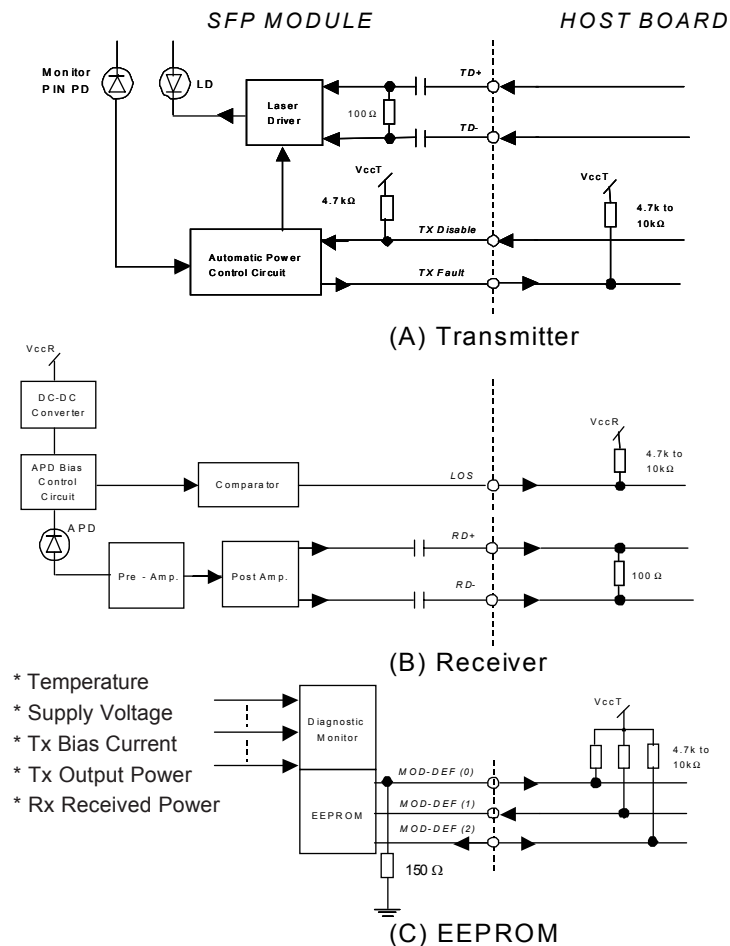
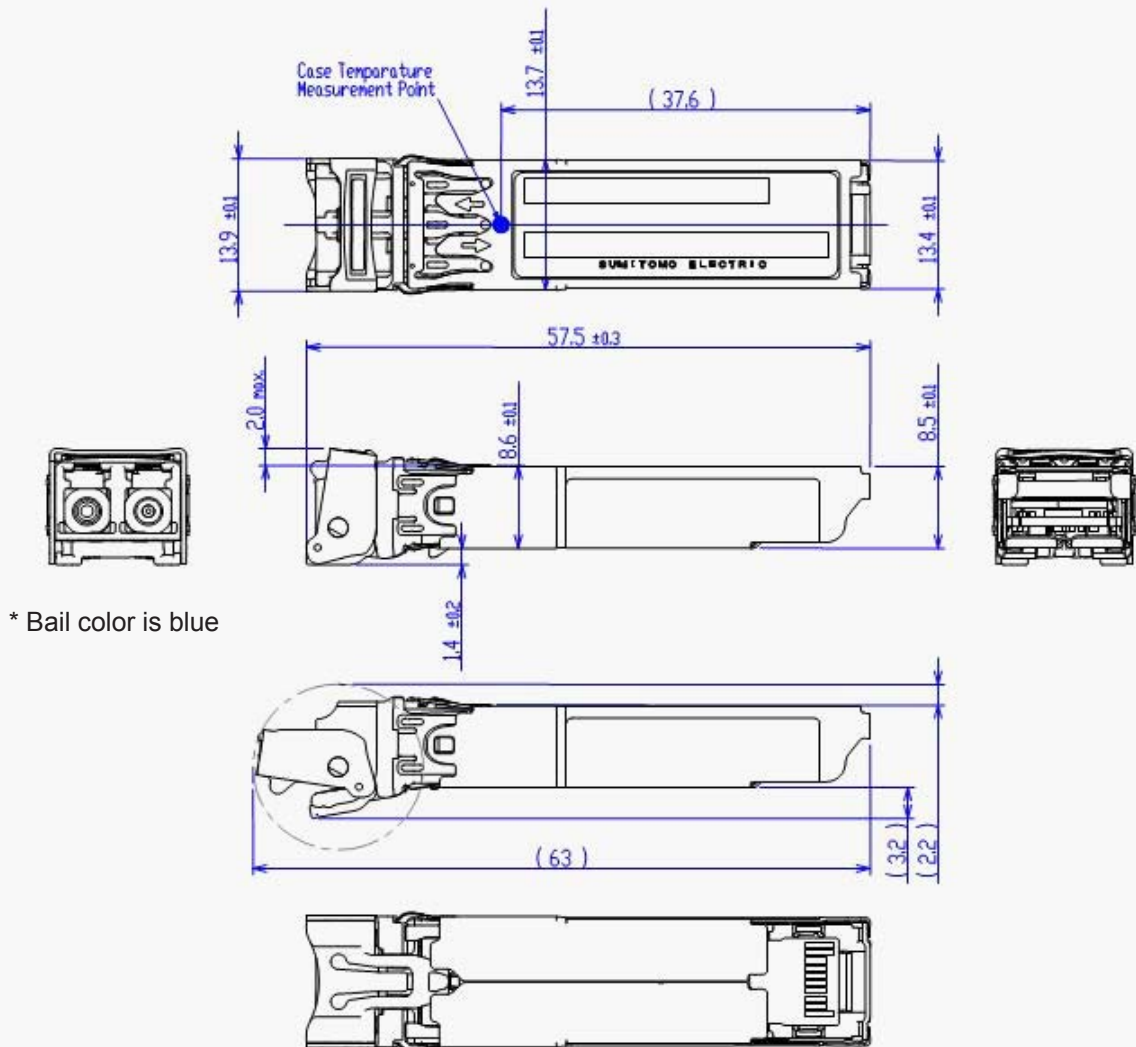


Figure 1. Block Diagram

⚠ Caution

⊘ Do not disassemble this product. Otherwise, failure, electrical shock, overheating or fire may occur.

3. Package Dimensions



Note1 All Dimensions in mm

Note2 Dimensions with parentheses indicate the bail and latch release position

Figure 2. Outline Dimensions

4. Pin Assignment

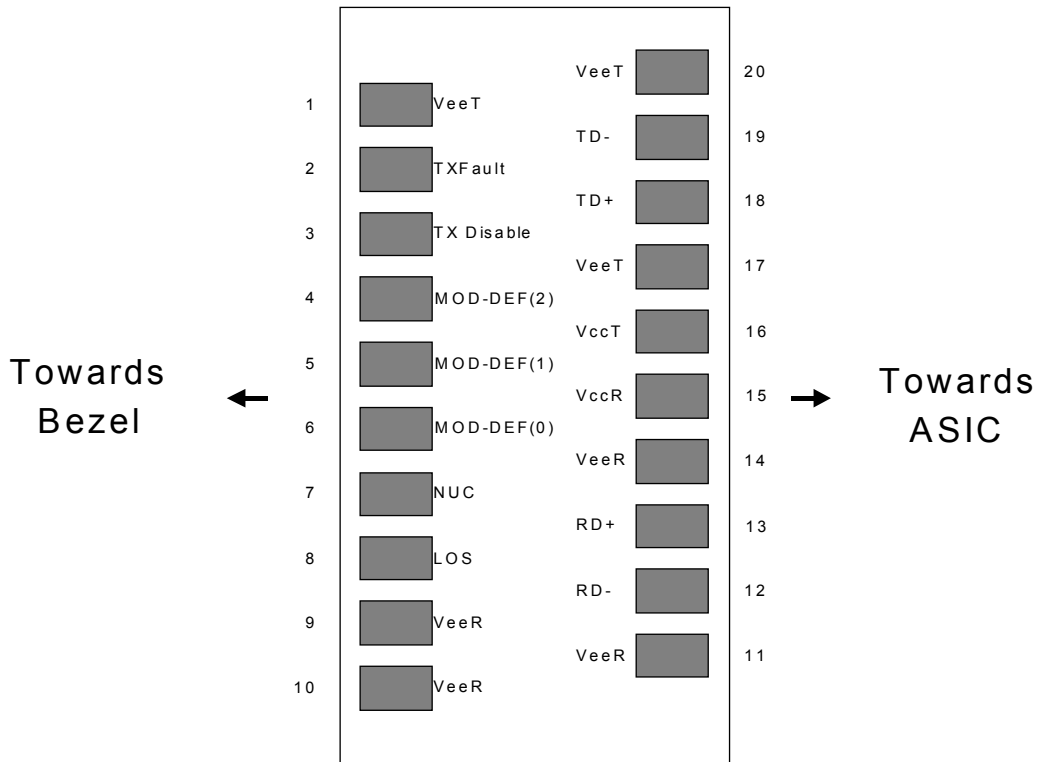


Figure 3. Diagram of Host Board Connector Block Pin Numbers and Names

| Pin Num. | Name | Function | Plug Seq. | Notes |
|----------|------------|------------------------------|-----------|---|
| 1 | VeeT | Transmitter Ground | 1 | |
| 2 | TX Fault | Transmitter Fault Indication | 3 | Note 1 |
| 3 | TX Disable | Transmitter Disable | 3 | Note 2 Module disables on high or open |
| 4 | MOD-DEF2 | Module Definition 2 | 3 | Note 3, 2 wire serial ID and Interface |
| 5 | MOD-DEF1 | Module Definition 1 | 3 | Note 3, 2 wire serial ID and Interface |
| 6 | MOD-DEF0 | Module Definition 0 | 3 | Note 3 Grounded internally via 100Ω |
| 7 | NUC | NUC | 3 | No User Connection, reserved for future function. |
| 8 | LOS | Loss of Signal | 3 | Note 4 |
| 9 | VeeR | Receiver Ground | 1 | |
| 10 | VeeR | Receiver Ground | 1 | |
| 11 | VeeR | Receiver Ground | 1 | |
| 12 | RD- | Inv. Receiver Data Out | 3 | Note 5 |
| 13 | RD+ | Receiver Data Out | 3 | Note 5 |
| 14 | VeeR | Receiver Ground | 1 | |
| 15 | VccR | Receiver Power | 2 | 3.3V± 5% |
| 16 | VccT | Transmitter Power | 2 | 3.3V± 5% |
| 17 | VeeT | Transmitter Ground | 1 | |
| 18 | TD+ | Transmitter Data In | 3 | Note 6 |
| 19 | TD- | Inv. Transmitter Data In | 3 | Note 6 |
| 20 | VeeT | Transmitter Ground | 1 | |

Plug Seq.: Pin engagement sequence during hot plugging.

Notes:

1. Datum and basic dimensions established by customer
2. Pads and vias are chassis ground, 11 places
3. Thru holes, plating optional

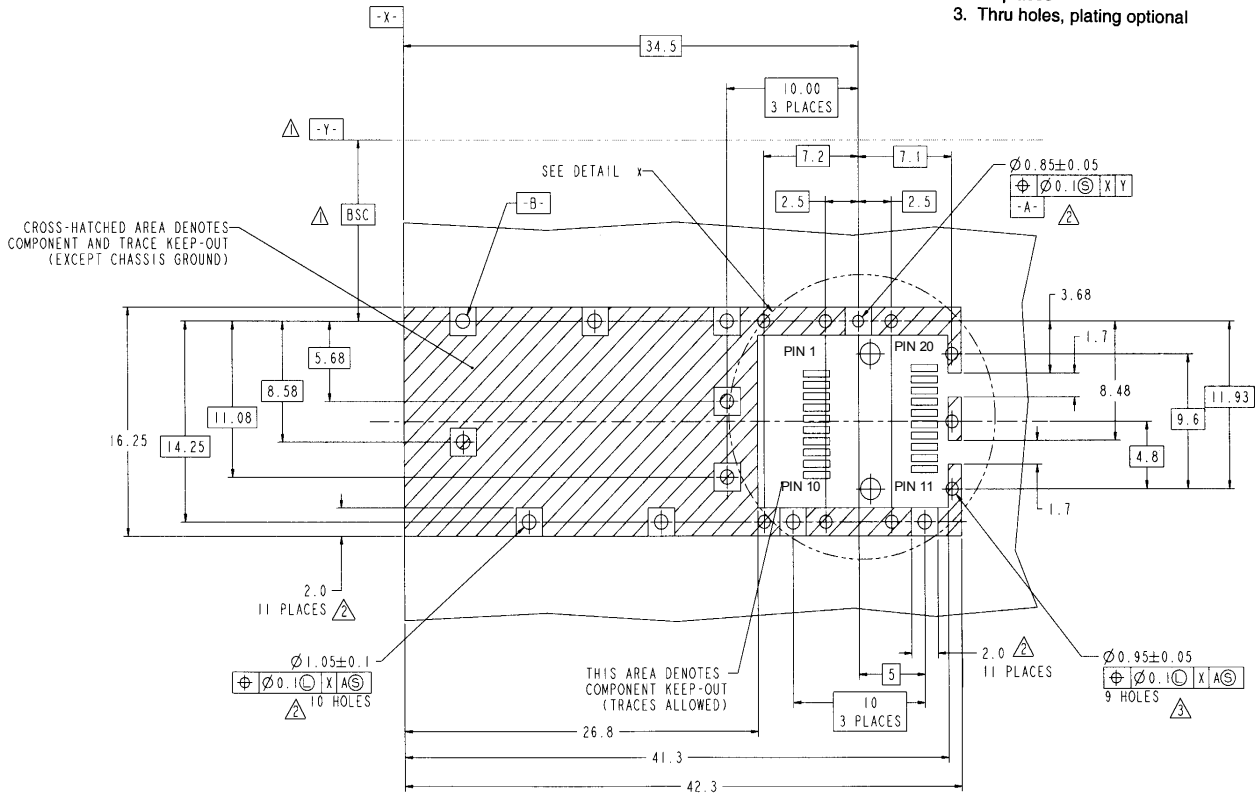
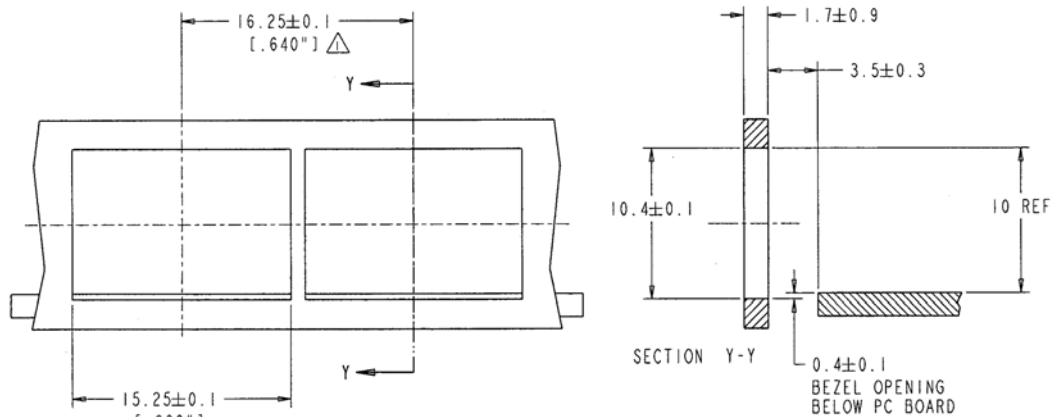


Figure 5. SFP Host Board Mechanical Layout (Cont.)



NOTES:

1. MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY
2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

Figure 6. Recommended Bezel Design

5. Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|--|--------------------|------|------|-----------------------|------------------|------|
| Storage Ambient Temperature | Ts | -40 | | 85 | °C | 1 |
| Operating Case Temperature | Tc | -5 | | 70 | | 2 |
| | | -5 | | 85 | | 3 |
| | | -40 | | 85 | | 4 |
| Optical Damage Input Level | P _{in} | | | -5.0 | dBm | |
| Supply Voltage | V _{ccT,R} | 0 | | 4.0 | V | |
| Input Voltage | V _i | 0 | | V _{ccT} +0.3 | V | 5 |
| Differential Input Voltage Sw ing (TD+, TD-) | V _{in} | | | 2.5 | V _{p-p} | |

Notes

1. No condensation allowed. 2. SCP6G78-GL-#N_ 3. SCP6G78-GL-#M_ 4. SCP6G78-GL-#W_ 5. For MOD-DEF (1:2), Tx Disable.

⚠ Warning

- ❗ Use the product with the rated voltage described in the specification. If the voltage exceeds the maximum rating, overheating or fire may occur.

⚠ Caution

- ⊘ Do not store the product in the area where temperature exceeds the maximum rating, where there is too much moisture or dampness, where there is acid gas or corrosive gas, or other extreme conditions. Otherwise, failure, overheating or fire may occur.

6. Electrical Interface

(Unless otherwise specified, V_{ccT,R} = 3.135 to 3.465 V and all operating temperature shall apply.)

6-1. Operating Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------|--------------------|-------|------|-------|------|------|
| Supply Voltage | V _{ccT,R} | 3.135 | 3.30 | 3.465 | V | |
| Power Dissipation | P _w | | | 1200 | mW | 1 |

Note 1. 2488.32Mbps, PRBS 2²³-1, NRZ, 50% duty cycle data.

6-2. Transmitter side

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|-----------------|---------------------|------|-----------------------|------------------|---------|
| Differential Input Voltage Sw ing (TD+,TD-) | V _{in} | 0.3 | | 2.4 | V _{p-p} | 1 |
| Input Differential Impedance | Z _{in} | 80 | 100 | 120 | Ω | |
| Tx Fault | Fault | V _{faultH} | 2.0 | V _{ccT} +0.3 | V | 2, 3 |
| | Normal | V _{faultL} | 0 | 0.8 | V | 2, 3, 4 |
| Tx Disable | Disable | V _{di} | 2.0 | V _{ccT} | V | 5 |
| | Enable | V _{ei} | 0 | 0.80 | V | |
| Tdis Input Current | I _{di} | -1 | | 50 | μA | |

Notes

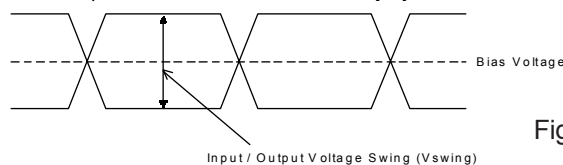
- Refer to Figure 7.
- Tx Fault is pulled up to V_{ccT} with a 4.7k - 10kΩ resistor on the host board.
When high, output indicates a laser fault of some kind. Low indicates normal operation.
- Refer to P.10 about Tx Fault and Tx Shutdown behavior.
- Sink Current : 1mA
- Tx Disable input is internally terminated to V_{ccT} via 4.7 kΩ resistor. If pin3 is left open, Tx is disabled.

6-3. Receiver side

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|--|---------------------------------|------------------|------|-----------------------|------------------|------|
| Differential Output Voltage Sw ing (RD+,RD-) | V _{out} | 0.5 | | 1.2 | V _{p-p} | 1 |
| LOS | High | V _{loh} | 2.0 | V _{ccR} +0.3 | V | 2 |
| | Low | V _{lol} | 0 | 0.8 | V | 2, 3 |
| Data Rise / Fall Time | t _r / t _f | | | 175 | psec | 4 |

Notes

- V_{cc}=+3.3V +/-5%, Output load resistance R_{di}=100Ω. Refer to Figure1-(B).
Refer to Figure7. about definition of differential sw ing.
- LOS is pulled up to V_{ccR} with a 4.7k - 10kΩ resistor on the host board. Low indicates normal operation.
- Sink Current : 1mA, 4. 20 to 80%, 2488.32Mbps, PRBS 2²³-1, NRZ, 50% duty cycle data



$$\text{Differential Input / Output Voltage Swing (V}_{in} / \text{V}_{out}) = 2 \times \text{V}_{swing}$$

Figure 7. Definition of Differential Input / Output Voltage Swing

6-4. Module Definition

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note | |
|-------------------------------|--------|------|---------|------|----------|------|------|
| MOD_DEF(1:2) Input Voltage | High | Vih | 0.7VccT | | VccT+0.3 | V | 1 |
| | Low | Vil | 0 | | 0.3VccT | V | |
| MOD_DEF(2) Output Voltage | High | Voh | 2.0 | | VccT | V | 1 |
| | Low | Vol1 | 0 | | 0.4 | V | 1, 2 |

Notes

1. They shall be pulled up to VccT with a 4.7k - 10kΩ resistor on the host board.
2. Sink Current : 3mA

7. Optical Interface

(Unless otherwise specified, VccT,R = 3.135 to 3.465 V and all operating temperature shall apply.)

7-1. Transmitter side

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------------------------------|--|------|------|------|------------------|------|
| Average Output Power (Enable) | Po | -2.0 | | 3.0 | dBm | 1 |
| Average Output Power (Disable) | Pdis | | | -45 | dBm | |
| Extinction Ratio | Er | 8.2 | | | dB | |
| Center Wavelength | λc | 1500 | | 1580 | nm | |
| Spectral Width (-20dB Width) | Δλ | | | 1 | nm | |
| Dispersion Penalty | Dp | | | 2.0 | dB | 1, 2 |
| Side Mode Suppression Ratio | Sr | 30 | | | dB | 1 |
| Eye Mask for Optical Output | Compliant with Telcordia GR-253 CORE and ITU G.957 | | | | | |
| Jitter Generation | Tjpk | | | 0.1 | U _{p-p} | 3 |
| | Tjrms | | | 0.01 | U _{rms} | |

Note 1. Measured at 2488.32Mbps PRBS2²³-1, 50% duty cycle, NRZ

2. Maximum dispersion values correspond to the approximate worst-case dispersion (~1600ps/nm) at 1550nm.

3. SONET OC-48c data pattern filled with a 2²³-1 PRBS payload.

Measured with a bandpass filter having a high-pass cutoff frequency of 12kHz and a low-pass cutoff frequency of 20MHz.

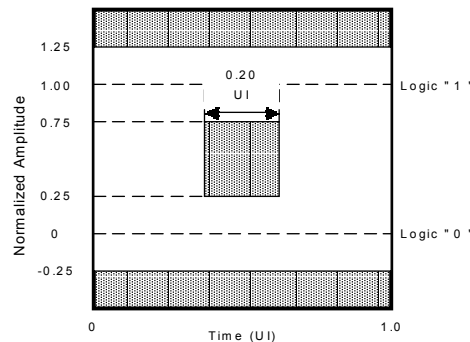


Figure 8. Optical Pulse Mask with Fourth Order Bessel-Thomson Filter Specified in ITU-T G.957

⚠ Warning



Do not look at the laser beam projection area (e.g. end of optical connector) with naked eyes or through optical equipment while the power is supplied to this product. Otherwise, your eyes may be injured.

7-2. Receiver side

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|------------------------|--------|-------|------|-------|------|------|
| Center Wavelength | - | 1500 | | 1580 | nm | |
| Minimum Sensitivity | Pmin | | | -28.0 | dBm | 1, 2 |
| Overload | Pmax | -9.0 | | | dBm | |
| LOS Activation Level | PLa | -45.0 | | -28.3 | dBm | 2 |
| LOS Deactivation Level | PLd | -44.7 | | -28.0 | dBm | |
| LOS Hysteresis | Phys | 0.3 | | 6.0 | dB | |
| Optical Reflectance | Or | | | -27 | dB | |

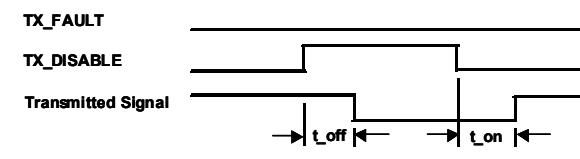
Note 1. BER=10⁻¹⁰ 2. Measured at 2488.32Mbps, PRBS 2²³-1, NRZ

7-3. Transceiver Timing Characteristics

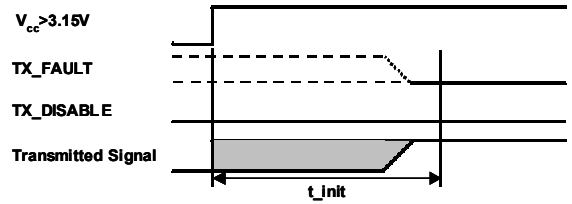
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|------------------------|---------------------|------|------|------|------|------|
| Tx Disable Assert Time | t_{off} | | | 10 | us | 1 |
| Tx Disable Negate Time | t_{on} | | | 1 | ms | 2 |
| Time to Initialize | t_{init} | | | 300 | ms | 3 |
| Tx Fault Assert Time | t_{fault} | | | 100 | us | 4 |
| Tx Disable to Reset | t_{reset} | 10 | | | us | 5 |
| LOS Assert Time | t_{loss_on} | 2.3 | | 100 | us | 6 |
| LOS Deassert Time | t_{loss_off} | | | 100 | us | 7 |
| Serial ID Clock Rate | f_{serial_clock} | | | 100 | KHz | |

Notes

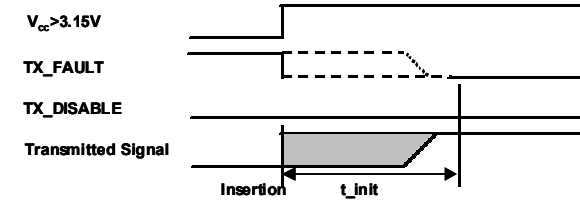
1. Time from rising edge of TX Disable to when the optical output falls below 10% of nominal.
2. Time from falling edge of TX Disable to when the modulated optical output rises above 90% of nominal.
3. From power on or negation of TX Fault using TX Disable.
4. Time from fault to TX fault on.
5. Time TX Disable must be held high to reset TX_fault.
6. Time from LOS state to RX LOS assert.
7. Time from non-LOS state to RX LOS deassert.



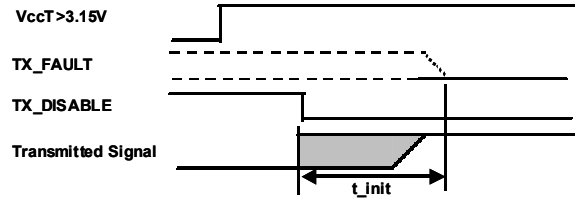
TX_DISABLE timing during normal operation.



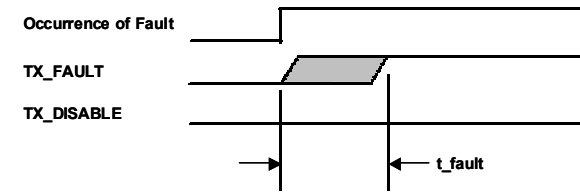
Power on initialization of SFP transceiver, TX_DISABLE negated



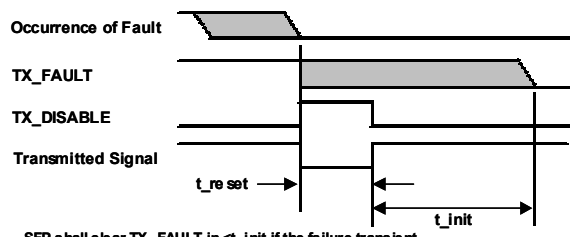
Example of initialization during hot plugging, TX_DISABLE negated



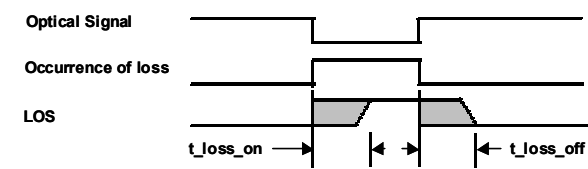
Power on initialization of SFP, TX_DISABLE asserted



Detection of transmitter safety fault condition



Successful recovery from transient safety fault condition (Except for Type "B" and "Y". Refer to next page.)



Timing of LOS detection

Figure 9. Transceiver Timing Charts

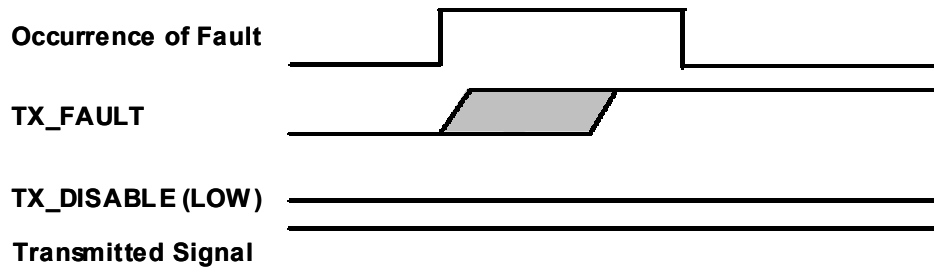
7-4. Tx_Fault / Tx Shutdown Options

SCP6G78-GL-□ # E

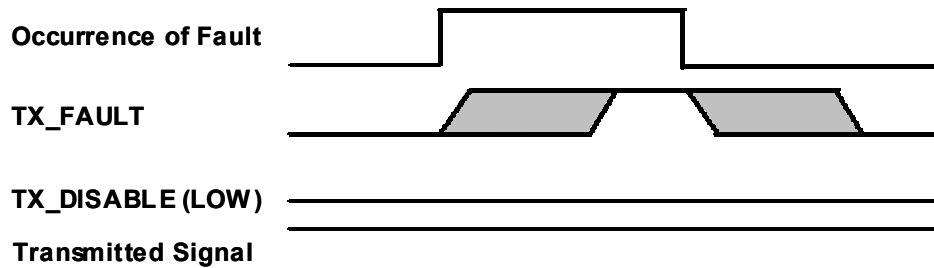
└ Tx_Fault Type

| Type | Actuator | Tx Shutdown on Tx Fault |
|------|----------|-------------------------|
| A | Bail | No |
| B | Bail | No |
| C | Bail | Yes |

Type:"A"



Type:"B"



Type:"C"

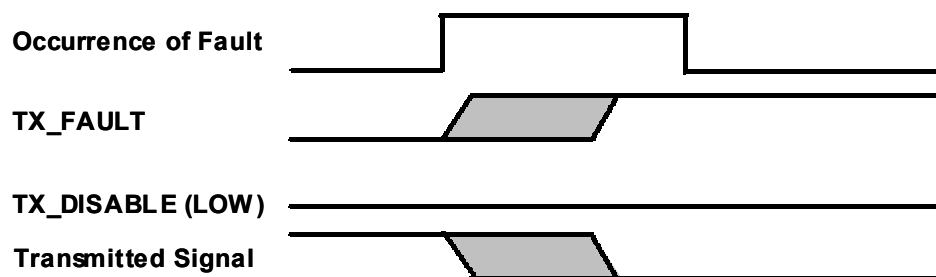


Figure 10. Part Number Identification For Tx_Fault / Tx Shutdown Behavior

8. Digital Diagnostic Memory Map

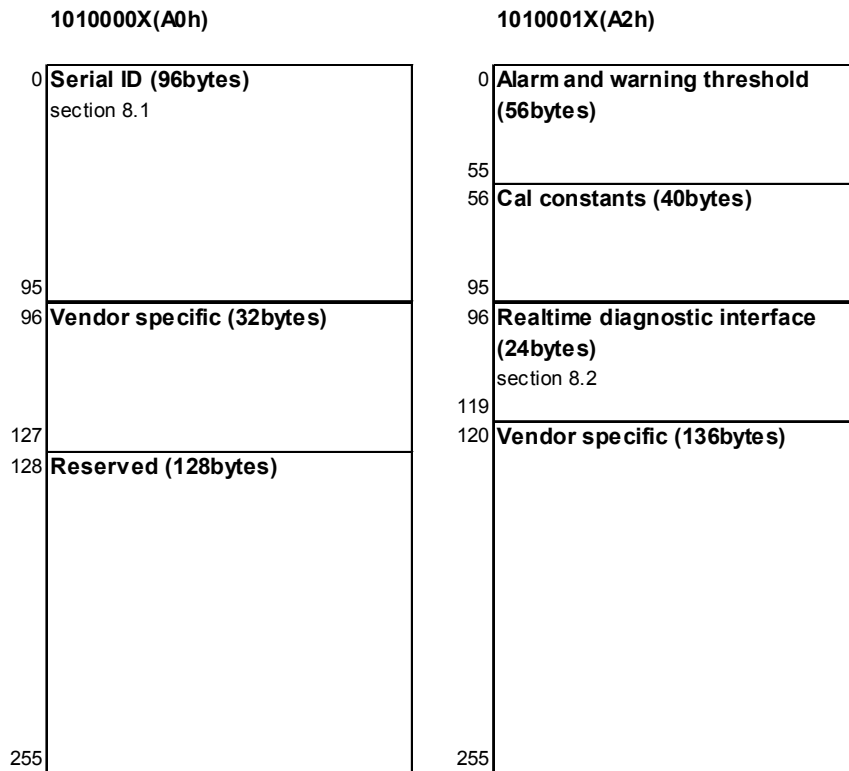


Figure 11. Digital Diagnostic Memory Map

9. EEPROM Serial ID Memory Contents

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

2 wire address 1010000X (A0h)

| Address | Name of field | Hex | ASCII | Description | Address | Name of field | Hex | ASCII | Description | | |
|-----------------------|------------------|----------------|-------------|----------------------------|----------------------------------|---------------|-------|----------------------------|-------------|--|-----------------------|
| BASE ID FIELDS | | | | | EXTENDED ID FIELDS | | | | | | |
| 0 | Identifier | 03 | | SFP Transceiver | 64 | Options | 00 | | | | |
| 1 | Ext. Identifier | 04 | | | 65 | | 1A | | | | |
| 2 | Connector | 07 | | LC Connector | 66 | BR_max | 00 | | | | |
| 3 | Transceiver | 00 | | | 67 | BR_min | 00 | | | | |
| 4 | | 0C | | OC-48 LR-2 | 68 | Vendor SN | Note2 | | Year | | |
| 5 | | 00 | | | 69 | | | | Month | | |
| 6 | | 00 | | | 70 | | | | | | |
| 7 | | 00 | | | 71 | | | | | | |
| 8 | | 00 | | | 72 | | | | | | |
| 9 | 00 | | | 73 | | | | | | | |
| 10 | 00 | | | 74 | | | | | | | |
| 11 | Encoding | 05 | | SONET Scrambled | 75 | | | | | | |
| 12 | BR_Nominal | 19 | | 2.5Gbps | 76 | | | | | | |
| 13 | Reserved | 00 | | | 77 | | | | | | |
| 14 | Length(9um) - km | 50 | | 80km | 78 | | | | | | |
| 15 | Length (9um) | FF | | | 79 | | | | | | |
| 16 | Length (50um) | 00 | | | 80 | | | | | | |
| 17 | Length (62.5um) | 00 | | | 81 | | | | | | |
| 18 | Length (Copper) | 00 | | | 82 | | | | | | |
| 19 | Reserved | 00 | | | 83 | | | | | | |
| 20 | Vendor name | 53 | S | | 84 | Date code | Note3 | | | | |
| 21 | | 75 | u | | 85 | | | | | | |
| 22 | | 6D | m | | 86 | | | | | | |
| 23 | | 69 | i | | 87 | | | | | | |
| 24 | | 74 | t | | 88 | | | | | | |
| 25 | | 6F | o | | 89 | | | | | | |
| 26 | | 6D | m | | 90 | | | | | | |
| 27 | | 6F | o | | 91 | | | | | | |
| 28 | | 45 | E | | 92 | | | Diagnostic Monitoring Type | 58(Note 4) | | Diagnostics(Ext. Cal) |
| 29 | | 6C | I | | 93 | | | Enhanced Options | B0(Note 4) | | Diagnostics |
| 30 | 65 | e | | 94 | SFF-8472 Compliance | 01 | | Diagnostics | | | |
| 31 | 63 | c | | 95 | CC_EXT | Note5 | | | | | |
| 32 | | 74 | t | | VENDOR SPECIFIC ID FIELDS | | | | | | |
| 33 | | 72 | r | | 96 | Read-only | 20 | | | | |
| 34 | | 69 | i | | 97 | | 20 | | | | |
| 35 | | 63 | c | | 98 | | 20 | | | | |
| 36 | Reserved | 00 | | | 99 | | 20 | | | | |
| 37 | | 00 | | | 100 | | 20 | | | | |
| 38 | Vendor OUI | 00 | | | 101 | | 20 | | | | |
| 39 | | 5F | | | 102 | | 20 | | | | |
| 40 | | 53 | S | | 103 | | 20 | | | | |
| 41 | | 43 | C | | 104 | | 20 | | | | |
| 42 | | 50 | P | | 105 | | 20 | | | | |
| 43 | | 36 | 6 | | 106 | | 20 | | | | |
| 44 | | 47 | G | | 107 | | 20 | | | | |
| 45 | | 37 | 7 | | 108 | | 20 | | | | |
| 46 | | 38 | 8 | | 109 | | 20 | | | | |
| 47 | Vendor PN | 2D | - | | 110 | | 20 | | | | |
| 48 | | 47 | G | | 111 | | 20 | | | | |
| 49 | | 4C | L | | 112 | | 20 | | | | |
| 50 | | 2D | - | | 113 | | 20 | | | | |
| 51 | | 41, 42, 43 | A, B, C | Actuator and Tx Fault Type | 114 | 20 | | | | | |
| 52 | | 4E or 4D or 57 | N or M or W | | 115 | 20 | | | | | |
| 53 | | 45 | E | Diagnostics(Ext. Cal) | 116 | 20 | | | | | |
| 54 | | 20 | | | 117 | 20 | | | | | |
| 55 | | 20 | | | 118 | 20 | | | | | |
| 56 | | 41 to 5A | A to Z | Variable | 119 | 20 | | | | | |
| 57 | Vendor rev | 20 | | | 120 | 20 | | | | | |
| 58 | | 20 | | | 121 | 20 | | | | | |
| 59 | | 20 | | | 122 | 20 | | | | | |
| 60 | Wavelength | 06 | | 1550nm | 123 | 20 | | | | | |
| 61 | | 0E | | | 124 | 20 | | | | | |
| 62 | Reserved | 00 | | | 125 | 20 | | | | | |
| 63 | CC BASE | Note1 | | | 126 | 20 | | | | | |
| | | | | | 127 | 20 | | | | | |

Note1. Address 63 is check sum of bytes 0-62 Note2. Address 68-83 is Vendor Serial Number

Note3. Address 84-91 is Date code Note4. Refer to Section 10.(Enhanced Monitoring Functions)

Note5. Address 95 is check sum of bytes 64-94.

10. Enhanced Monitoring Functions (SCP6G78-GL-##E)

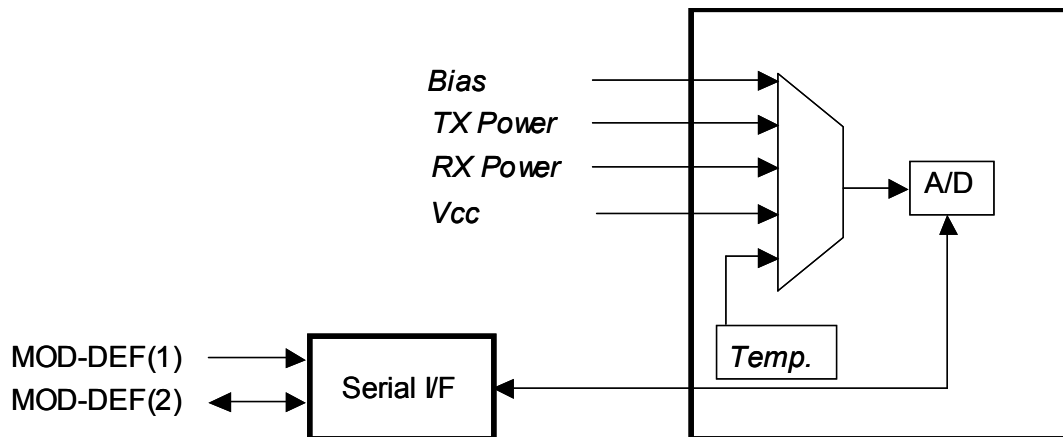


Figure 12. Block Diagram

Diagnostic Monitoring Type, 2 wire address A0h

| Data Address | Bits | Description | Status(SEI) |
|--------------|------|--|-------------|
| 92 | 7 | Reserved for legacy diagnostic implementations. Must be '0' for compliance with SFF-8472. | 0 |
| 92 | 6 | Digital diagnostic monitoring implemented (described in SFF-8472). Must be '1' for compliance with SFF-8472. | 1 |
| 92 | 5 | Internally Calibrated | 0 |
| 92 | 4 | Externally Calibrated | 1 |
| 92 | 3 | Received power measurement type 0 = OMA, 1 = Average Power | 1 |
| 92 | 2 | Address change required. (Refer to SFF-8472) | 0 |
| 92 | 1-0 | Reserved | 0 |

Enhanced Options, 2 wire address A0h

| Data Address | Bits | Description | Status(SEI) |
|--------------|------|---|-------------|
| 93 | 7 | Optional Alarm/warning flags implemented for all monitored quantities | 1 |
| 93 | 6 | Optional Soft TX_DISABLE control and monitoring implemented | 0 |
| 93 | 5 | Optional Soft TX_FAULT monitoring implemented | 1 |
| 93 | 4 | Optional Soft RX_LOS monitoring implemented | 1 |
| 93 | 3 | Optional Soft RATE_SELECT control and monitoring implemented | 0 |
| 93 | 2-0 | Reserved | 0 |

11. Calibration Calculation (SCP6G78-GL-##E)

Calibration constants for External Calibration Option, 2 wire address A2h

| Address | #Bytes | Name | Description |
|---------|--------|----------------------|--|
| 56-59 | 4 | RP ₄ | Single precision floating-point calibration data for received power. Byte 56 is MSB. Byte 59 is LSB. |
| 60-63 | 4 | RP ₃ | Single precision floating-point calibration data for received power. Byte 60 is MSB. Byte 63 is LSB. |
| 64-67 | 4 | RP ₂ | Single precision floating-point calibration data for received power. Byte 64 is MSB. Byte 67 is LSB. |
| 68-71 | 4 | RP ₁ | Single precision floating-point calibration data for received power. Byte 68 is MSB. Byte 71 is LSB. |
| 72-75 | 4 | RP ₀ | Single precision floating-point calibration data for received power. Byte 72 is MSB. Byte 75 is LSB. |
| 76-77 | 2 | I _{SLOPE} | Unsigned fixed-point calibration data for laser bias current. Byte 76 is MSB. Byte 77 is LSB. |
| 78-79 | 2 | I _{OFFSET} | 16-bit signed 2's complement calibration data for laser bias current. Byte 78 is MSB. Byte 79 is LSB. |
| 80-81 | 2 | TP _{SLOPE} | Unsigned fixed-point calibration data for laser output power. Byte 80 is MSB. Byte 81 is LSB. |
| 82-83 | 2 | TP _{OFFSET} | 16-bit signed 2's complement calibration data for laser output power. Byte 82 is MSB. Byte 83 is LSB. |
| 84-85 | 2 | T _{SLOPE} | Unsigned fixed-point calibration data for transceiver temperature. Byte 84 is MSB. Byte 85 is LSB. |
| 86-87 | 2 | T _{OFFSET} | 16-bit signed 2's complement calibration data for transceiver temperature. Byte 86 is MSB. Byte 87 is LSB. |
| 88-89 | 2 | V _{SLOPE} | Unsigned fixed-point calibration data for supply voltage. Byte 88 is MSB. Byte 89 is LSB. |
| 90-91 | 2 | V _{OFFSET} | 16-bit signed 2's complement calibration data for supply voltage. Byte 90 is MSB. Byte 91 is LSB. |
| 92-94 | 3 | Reserved | Reserved |
| 95 | 1 | Checksum | Byte 95 contains the low order 8 bits of the sum at data address bytes 0-94. |

Transceiver temperature: Temperature, T, is given by

$$T = T_{SLOPE} * T_{AD} + T_{OFFSET}$$

Where T_{AD} is 16-bit signed 2's complement A/D value at bytes 96-97, T_{SLOPE} is unsigned fixed-point value at bytes 84-85 and T_{OFFSET} is signed 2's complement value with LSB equal to 1/256 deg-C at bytes 86-87. The result, T, is 16-bit signed 2's complement value with LSB equal to 1/256 deg-C. The monitored output is the junction temperature of the diode inside the transceiver, hence, there is some discrepancy between the output and transceiver case temperature of the point illustrated in section 3 mechanical dimension.

Supply voltage: Voltage, V, is given by

$$V = V_{SLOPE} * V_{AD} + V_{OFFSET}$$

Where V_{AD} is 16-bit unsigned A/D value at bytes 98-99, V_{SLOPE} is unsigned fixed-point value at bytes 88-89 and V_{OFFSET} is signed 2's complement value with LSB equal to 100 μV at bytes 90-91. The result, V, is 16-bit unsigned value with LSB equal to 100 μV.

Laser bias current: Current, I, is given by

$$I = I_{\text{SLOPE}} * I_{\text{AD}} + I_{\text{OFFSET}}$$

Where I_{AD} is 16-bit unsigned A/D value at bytes 100-101, I_{SLOPE} is unsigned fixed-point value at bytes 76-77 and I_{OFFSET} is signed 2's complement value with LSB equal to 2 μA at bytes 78-79. The result, I, is 16-bit unsigned value with LSB equal to 2 μA .

Laser output power: Power, TP, is given by

$$TP = TP_{\text{SLOPE}} * TP_{\text{AD}} + TP_{\text{OFFSET}}$$

Where TP_{AD} is 16-bit unsigned A/D value at bytes 102-103, TP_{SLOPE} is unsigned fixed-point value at bytes 80-81 and TP_{OFFSET} is signed 2's complement value with LSB equal to 0.1 μW at bytes 82-83. The result, TP, is 16-bit unsigned value with LSB equal to 0.1 μW .

Received power: Power, RP, is given by

$$RP = RP_4 * RP_{\text{AD}}^4 + RP_3 * RP_{\text{AD}}^3 + RP_2 * RP_{\text{AD}}^2 + RP_1 * RP_{\text{AD}} + RP_0$$

Where RP_{AD} is 16-bit unsigned A/D value at bytes 104-105 and RP_4 , RP_3 , RP_2 , RP_1 and RP_0 are single precision floating-point values at bytes 56-75. The result, RP, is 16-bit unsigned value with LSB equal to 0.1 μW .

A/D Accuracy, 2 wire address A2h

| Data Address | Parameter | Accuracy | Units Display | Note |
|---------------------|------------------|----------------------------|-------------------------------------|---|
| 96-97 | Temperature | +/-3 deg-C | Signed 2's complement integer deg-C | Junction temperature of monitoring IC. |
| 98-99 | Vcc | +/-3% | x100 μVolt | |
| 100-101 | TX Bias | +/-10% | x2 μA | Specified by nominal value |
| 102-103 | TX Power | +/-3dB | x0.1 μW | -2 to +3dBm |
| 104-105 | RX Power | +/-3dB (-28 to -9dBm) | x0.1 μW | At specified transmitter wavelength (Section 7-1) |

12. A/D Values and Status (SCP6G78-GL-##E)

Converted analog values, 2wire address A2h

| Byte | Bit | Name | Description |
|---------|-----|-----------------|--|
| 96 | All | Temperature MSB | Signed 2's complement integer temperature(-40 to +125C) Based on internal temperature measurement |
| 97 | All | Temperature LSB | Fractional part of temperature(count/256) |
| 98 | All | Vcc MSB | Internally measured supply voltage in transceiver. Actual voltage is full 16 bit value *100uVolt.(Yields range of 0-6.55V) |
| 99 | All | Vcc LSB | |
| 100 | All | TX Bias MSB | Measured Laser Bias Current in mA. Bias current is full 16 bit value *2μA.(Full range of 0-131mA) |
| 101 | All | TX Bias LSB | |
| 102 | All | TX Power MSB | Measured TX output power in mW. TX power is full 16 bit value*0.1μW.(Full range of -40 to +8.2dBm) |
| 103 | All | TX Power LSB | |
| 104 | All | RX Power MSB | Measured RX input power in mW. RX power is full 16 bit value*0.1μW.(Full range of -40 to +8.2dBm) |
| 105 | All | RX Power LSB | |
| 106-109 | All | Reserved | |

Optional Status Bits, 2wire address A2h

| Byte | Bit | Name | Description |
|------|-----|----------------|---|
| 110 | 0 | Data_Ready_Bar | Indicates transceiver has achieved power up and data is ready. Bit remains high until data is ready to be read at which time the device sets the bit low. |

13. Alarm and Warning Flags (SCP6G78-GL-###E)

Alarm and Warning Flags, 2wire address A2h

| Byte | Bit | Name | Description |
|------|-----|-----------------------|--|
| 112 | 7 | Temp High Alarm | Set when internal temperature exceeds high alarm level. |
| 112 | 6 | Temp Low Alarm | Set when internal temperature is below low alarm level. |
| 112 | 5 | Vcc High Alarm | Set when internal supply voltage exceeds high alarm level. |
| 112 | 4 | Vcc Low Alarm | Set when internal supply voltage is below low alarm level. |
| 112 | 3 | TX Bias High Alarm | Set when TX Bias current exceeds high alarm level. |
| 112 | 2 | TX Bias Low Alarm | Set when TX Bias current is below low alarm level. |
| 112 | 1 | TX Power High Alarm | Set when TX output power exceeds high alarm level. |
| 112 | 0 | TX Power Low Alarm | Set when TX output power is below low alarm level. |
| 113 | 7 | RX Power High Alarm | Set when Received Power exceeds high alarm level. |
| 113 | 6 | RX Power Low Alarm | Set when Received Power is below low alarm level. |
| 113 | 5-0 | Reserved | |
| 114 | All | Reserved | |
| 115 | All | Reserved | |
| 116 | 7 | Temp High Warning | Set when internal temperature exceeds high warning level. |
| 116 | 6 | Temp Low Warning | Set when internal temperature is below low warning level. |
| 116 | 5 | Vcc High Warning | Set when internal supply voltage exceeds high warning level. |
| 116 | 4 | Vcc Low Warning | Set when internal supply voltage is below low warning level. |
| 116 | 3 | TX Bias High Warning | Set when TX Bias current exceeds high warning level. |
| 116 | 2 | TX Bias Low Warning | Set when TX Bias current is below low warning level. |
| 116 | 1 | TX Power High Warning | Set when TX output power exceeds high warning level. |
| 116 | 0 | TX Power Low Warning | Set when TX output power is below low warning level. |
| 117 | 7 | RX Power High Warning | Set when Received Power exceeds high warning level. |
| 117 | 6 | RX Power Low Warning | Set when Received Power is below low warning level. |
| 117 | 5-0 | Reserved | |
| 118 | All | Reserved | |
| 119 | All | Reserved | |

14. Recommended Interface Circuit

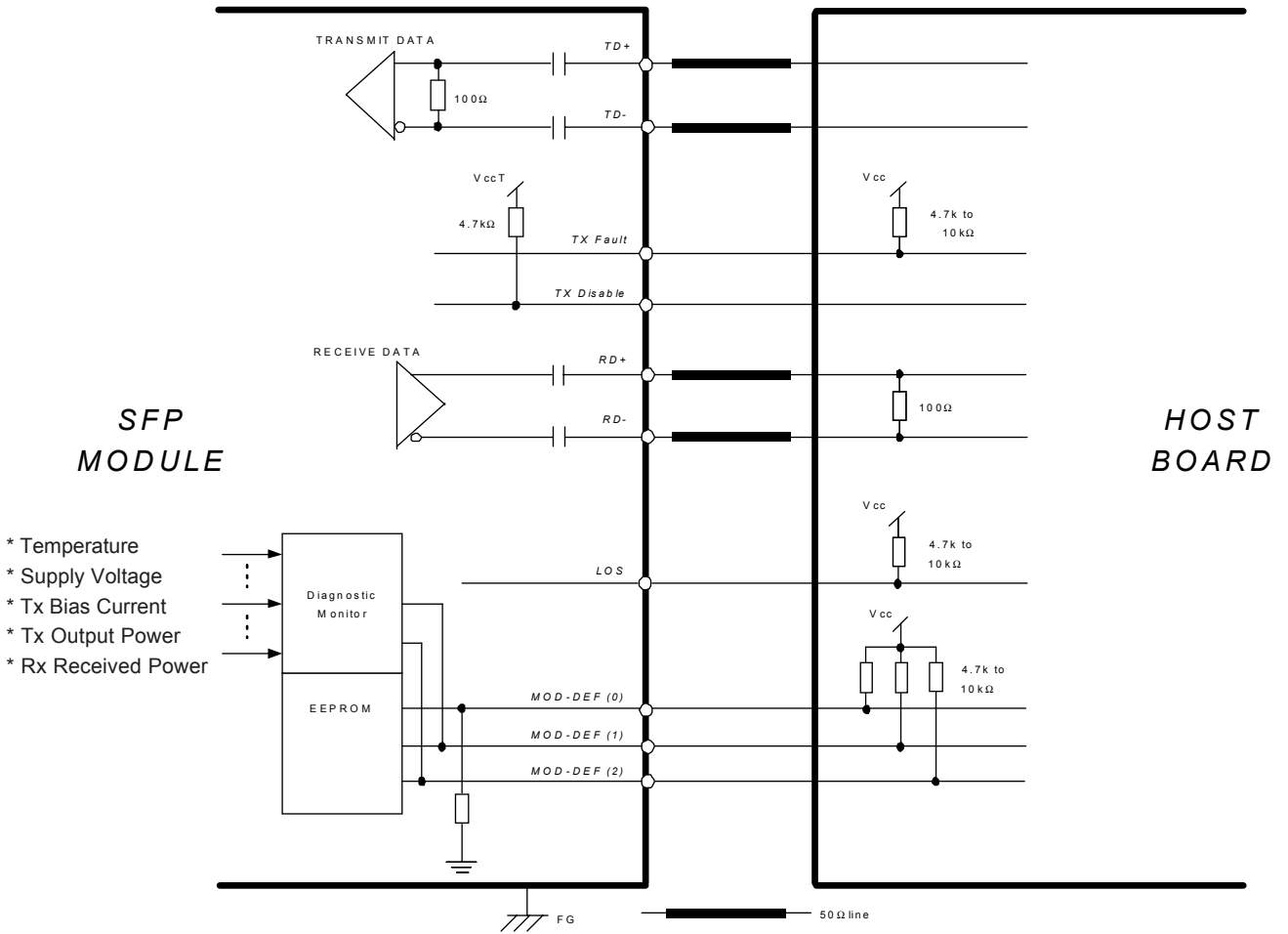


Figure 13. Recommended Interface Circuit

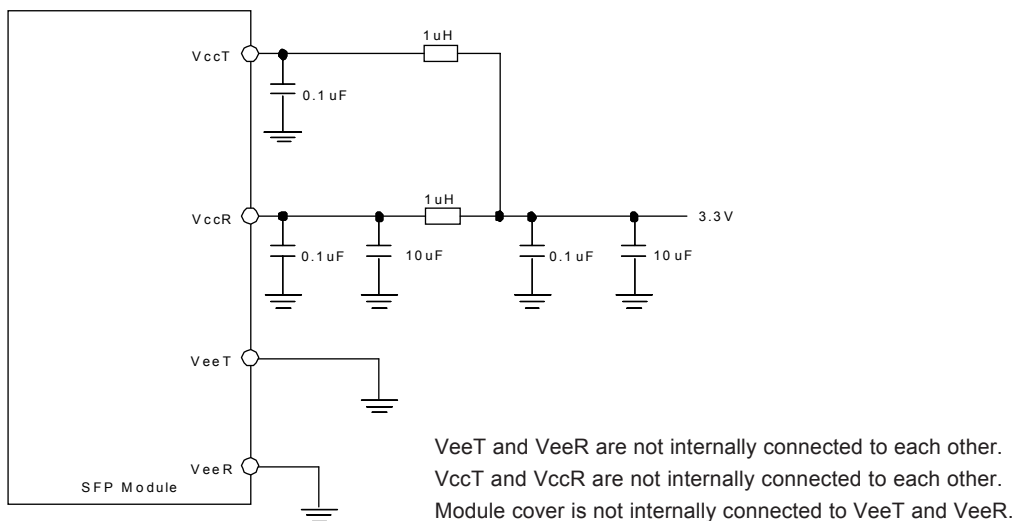
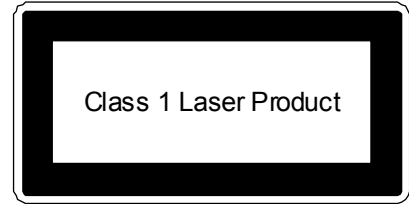


Figure 14. Recommended Supply Filtering Network

15. Laser Safety

This product uses a semiconductor laser system and is a laser class 1 product acceptable FDA, complies with 21CFR 1040. 10 and 1040.11. Also this product is a laser class 1 product acceptable IEC 60825-1:2001.



| ⚠ Caution | |
|------------------|--|
| ⊘ | If this product is used under conditions not recommended in the specification or this product is used with unauthorized revision, classification for laser product safety standard is invalid. Classify the product again at your responsibility and take appropriate actions. |

16. Other Precaution

Under such a strong vibration environment as in automobile, the performance and reliability are not guaranteed. The governmental approval is required to export this product to other countries. To dispose of these components, the appropriate procedure should be taken to prevent illegal exportation.

This module must be handled, used and disposed of according to your company's safe working practice.

| ⚠ Warning | |
|------------------|--|
| ⊘ | Operating transceiver products can have an outer package temperature exceeding 70 degC. To reduce the risk of injury from burns, do not touch the transceiver module under any circumstances while it is operational. When installing or uninstalling products that have been operating, handle with extreme care. |

| ⚠ Warning | |
|------------------|--|
| ⊘ | Do not put this product or components of this product into your mouth. This product contains material harmful to health. |

| ⚠ Caution. | |
|-------------------|--|
| ⊘ | Dispose this product or equipment including this product properly as an industrial waste according to the regulations. |

17. Ordering Information

SCP6G78 - GL - E (LC Duplex Receptacle, Metallized)

- └─ Diagnostic Monitoring with External Calibration
- └─ Operating Case Temperature
 - N :Tc = -5 to 70°C
 - M :Tc = -5 to 85°C
 - W :Tc = -40 to 85°C
- └─ Actuator and Tx Fault Type

| Type | Actuator | Tx Fault | Tx Shutdown on Tx Fault | Part Number on Label |
|------|----------|-------------|-------------------------|---|
| A | Bail | Latched | No | SCP6G78-GL-A- <input type="checkbox"/> <input type="checkbox"/> E |
| B | Bail | Not Latched | No | SCP6G78-GL-B- <input type="checkbox"/> <input type="checkbox"/> E |
| C | Bail | Latched | Yes | SCP6G78-GL-C- <input type="checkbox"/> <input type="checkbox"/> E |

18. For More Information

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