

Features:

- 125Mbps to 3.125Gbps duplex data links
- Compliant to 802.3z Ethernet, Fiber Channel (1x/2x/3x), Infiniband SDR, sFPDP, FCAV, and ARINC818
- 1310nm FP laser transmitter and PIN Receiver (LX Version)
- 1310nm DFB laser transmitter and PIN Receiver (EX Version)
- Class 1 Laser Int. Safety Std. IEC-825 compliant
- Up to 32km on 9/125µm SMF (EX version)
- 1x10 surface mount connector, standard
- 1x12 surface mount connector option providing Digital Diagnostics
- Rugged LC connector housing including screw mounted OSAs
- MIL-STD-883 compliant
- -40° to +85°C operating temperature
- Option for RoHS 6/6 compliant and lead free per Directive 2002/95/EC
- Single +3.3V power supply
- AC-Coupled Transmitter & Receiver Data
- Conformal coating options for harsh environment use
- COTSWORKS RJs are fully tested over the operating temperature range
- Pigtail Assembly option is available. Contact COTSWORKS for details



The RJ-3G-LX is ideal for harsh environment connectivity because of its low cost, availability, and wide operating parameters



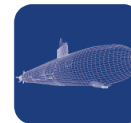
COMMERCIAL
AEROSPACE



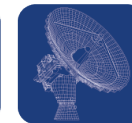
MILITARY
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MILITARY
TACTICAL



SUBSEA
NETWORKING



RADAR &
SENSING



OIL &
EXPLORATION

Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Unit | Note |
|----------------------------|------------------|------|------|------|----------------------------|
| Maximum Supply Voltage | V _{CC} | -0.5 | 4.5 | V | |
| Storage Temperature | T _{sto} | -55 | 100 | °C | |
| Case Operating Temperature | T _{OP} | -40 | 85 | °C | |
| Relative Humidity | RH | 0 | 85 | % | Based on conformal coating |
| Lead Soldering Temperature | | | 260 | °C | 10 seconds on leads only |
| Conformal Coating | | 0.8 | 1.2 | mil | See ruggedization notes |

Notes:

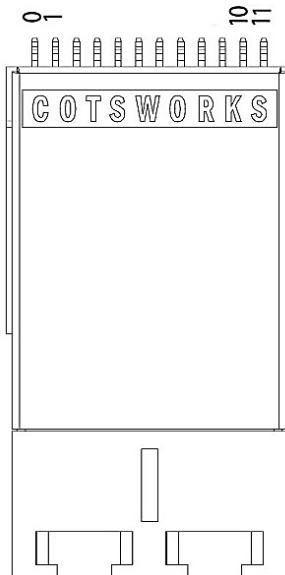
- 1) RJ transceivers may be water washed. The process must be followed by an 80°C bake for one hour to ensure the drying of any water inside the shell.
- 2) The components should not undergo Reflow Soldering under any circumstances.

General Specifications

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|-----------|--------|-------|------|-------|------|-------|
| Data Rate | BR | 0.125 | | 3.125 | Gb/s | |

Electrical Specifications ($T_{OP} = -40$ to 85°C , $V_{CC} = 3.14$ to 3.47 Volts)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|------------------------------------|---------------|------|------|----------|----------|----------------------------------|
| Supply Voltage | V_{CC} | 3.14 | | 3.47 | V | |
| Transmitter | | | | | | |
| Supply Current | I_{CC} | | 120 | 200 | mA | |
| Input Differential Impedance | R_{in} | | 100 | | Ω | |
| TX Common Mode Voltage | V_{CM} | 1.7 | | | V | LVPECL |
| TX Differential Input Voltage | V_{DTX} | 200 | | 2400 | mV | LVPECL |
| Transmit Disable Voltage Threshold | V_D | 2.0 | | V_{CC} | V | LVTTTL |
| Transmit Enable Voltage Threshold | V_{EN} | 0 | | 0.8 | V | LVTTTL |
| Receiver | | | | | | |
| Supply Current | I_{CC} | | 70 | 100 | mA | |
| RX Differential Output Voltage | V_{DRX} | 250 | | 800 | mV | CML |
| Signal Detect Assert Voltage | SD_{norm} | 2.4 | | V_{CC} | V | LVTTTL |
| Signal Detect De-Assert | SD_{fault} | 0 | | 0.4 | V | LVTTTL |
| Total Contributed Jitter (p-p) | $RX\Delta TJ$ | | | 0.4 | UI | FCPI-4 ($\delta_R - \gamma_R$) |
| Data Output Rise/Fall Time | t_r/t_f | | | 130 | ps | 20%–80% |

Pin Configuration


| PIN # | Symbol | Description | Logic Family |
|-------|-----------|--|--------------|
| GP | GP | Grounding Posts Connect to chassis ground | N/A |
| 0 | SCL | I2C Clock (1)(2) | I2C |
| 1 | TD+ | Transmitter DATA In + | LVPECL |
| 2 | V_{EET} | Transmitter Signal Ground | N/A |
| 3 | TD- | Transmitter DATA In - | LVPECL |
| 4 | V_{CCT} | Transmitter Power Supply | N/A |
| 5 | SD | Signal Detect output Satisfactory Optical Input: Logic "1" Output Fault Condition: Logic "0" Output | LVTTTL |
| 6 | T_{DIS} | Transmit Disable input Logic 1 = Disable Optical Output Logic 0 = Enable Optical Output Internal 10K ohm pull-down (enable) | LVTTTL |
| 7 | RD+ | Receiver DATA Out + | CML |
| 8 | V_{CCR} | Receiver Power Supply | N/A |
| 9 | RD- | Receiver DATA Out - | CML |
| 10 | V_{EER} | Receiver Signal Ground | N/A |
| 11 | SDA | I2C Data (1)(2) | I2C |

Notes:

- 1) Pins 0 and 11 are optional pins for the I2C bus that is used for Digital Diagnostics per SFF-8472.
- 2) Pins 1–10 are the only pins on a transceiver without DDMI.



Optical Characteristics (T_{OP} = -40 to 85°C, V_{CC} = 3.135 to 3.465 Volts)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|--|---------------------------------|------|------|------|-------|--|
| Transmitter | | | | | | |
| Output Power (-LX) | P _{OUT-LX} | -5 | - | 1 | dBm | (9/125 SMF) (1) |
| Output Power (-EX) | P _{OUT-EX} | -1 | - | 3 | dBm | (9/125 SMF) (1) |
| Optical Wavelength | λ | 1270 | 1310 | 1355 | nm | (2) |
| Spectral Width (-LX) | σ _{LX} | - | - | 2.5 | nm | (RJ-3G-LX)(2) |
| Spectral Width (-EX) | σ _{EX} | - | - | 1.0 | nm | (RJ-3G-EX)(2) |
| Extinction Ratio (-LX) | ER _{LX} | 9 | - | - | dB | (3) |
| Extinction Ratio (-EX) | ER _{EX} | 6 | - | - | - | - |
| Optical Rise/Fall Time: | t _r /t _f | - | - | 130 | ps | (3)(4) 20%– 80% |
| Relative Intensity Noise | RIN | - | - | -120 | dB/Hz | (3) FCPI-4 (δ _R - γ _R) |
| Total Jitter Contribution (p-p) | TXΔTJ | - | - | 119 | ps | - |
| Receiver | | | | | | |
| Receiver Sensitivity@1.25Gbps | RX _{SENS1} | - | - | -22 | dBm | (1)(4)(5) |
| Receiver Sensitivity@3.125Gbps | RX _{SENS2} | - | - | -20 | dBm | |
| Overload | RX _{MAX} | 0 | - | - | dBm | |
| Optical Center Wavelength | λ _c | 1270 | - | 1360 | nm | - |
| Return Loss | RL | 12 | - | - | dB | - |
| Signal Detect Assert | P _A | - | - | -25 | dBm | (1)(5) |
| Signal Detect De-Assert | P _D | -34 | - | - | dBm | (1)(5) |
| Signal Detect Hysteresis | P _A - P _D | 1 | - | - | dB | - |
| NOTES: | | | | | | |
| 1) Measured using a broad area detector optical power meter. | | | | | | |
| 2) Measured using an optical spectrum analyzer at 25°C per IEEE 802.3 1000BASE-LX. | | | | | | |
| 3) Measured using a high-speed oscilloscope. | | | | | | |
| 4) Measured using a BERT set running PRBS 2 ⁷ -1 at 3.125Gbps. | | | | | | |
| 5) Measured using a 9μm single-mode variable optical attenuator. | | | | | | |

Digital Diagnostics Information

The COTSWORKS RJ module is available with optional signal pins for a 2-wire bus required to access digital diagnostics compliant to SFF 8472 multi-source agreement. The transceiver pinout (including those pins required for 2-wire communication to access the digital diagnostics) appears on the previous page.

For more information on Digital Diagnostics, visit <https://cotsworks.com/support-documents/digital-diagnostic-overviews/>





Address A0h Data Fields (RJ-3G-LX)

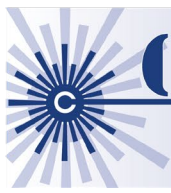
| A0h Address (dec) | # Bytes | Name | Description | Value (hex) |
|-----------------------|---------|------------------------------|--|-------------|
| Base ID Fields | | | | |
| 00 | 1 | Identifier | Type of transceiver | 02 |
| 01 | 1 | Ext. Identifier | Extended identifier of type of transceiver | 04 |
| 02 | 1 | Connector | Code for connector type | 07 |
| 03 | 8 | Transceiver | Code for electronic or optical compatibility | 04 |
| 04 | | | | 53 |
| 05 | | | | 00 |
| 06 | | | | 02 |
| 07 | | | | 22 |
| 08 | | | | 00 |
| 09 | | | | 01 |
| 10 | | | | 05 |
| 11 | 1 | Encoding | Code for high speed serial encoding algorithm | 01 |
| 12 | 1 | BR, Nominal | Nominal signaling rate, units of 100MBd | 1F |
| 13 | 1 | Rate Identifier | Type of rate select functionality | 00 |
| 14 | 1 | Length (SMF, km) | Link length supported for single mode fiber, units of km | 0F |
| 15 | 1 | Length (SMF) | Link length supported for single mode fiber, units of 100m | 96 |
| 16 | 1 | Length (50µm) | Link length supported for 50µm OM2 fiber, units of 10m | 00 |
| 17 | 1 | Length (62.5µm) | Link length supported for 62.5µm OM1 fiber, units of 10m | 00 |
| 18 | 1 | Length (OM4 or copper cable) | Link length supported for 50µm OM4 fiber, units of 10m. Alternatively copper or direct attach cable, units of m | 00 |
| 19 | 1 | Length (OM3) | Link length supported for 50µm OM3 fiber, units of 10m | 00 |
| 20 | 16 | Vendor Name | SFP vendor name (ASCII) | 43 |
| 21 | | | | 4F |
| 22 | | | | 54 |
| 23 | | | | 53 |
| 24 | | | | 57 |
| 25 | | | | 4F |
| 26 | | | | 52 |
| 27 | | | | 4B |
| 28 | | | | 53 |
| 29 | | | | 20 |
| 30 | | | | 20 |
| 31 | | | | 20 |
| 32 | | | | 20 |
| 33 | | | | 20 |
| 34 | | | | 20 |
| 35 | | | | 20 |
| 36 | 1 | Transceiver | Code for electronic or optical compatibility | 00 |
| 37 | 3 | Vendor OUI | SFP vendor IEEE company ID | 00 |





| | | | | |
|---------------------------|----|-------------|--|----|
| 38 | | | | 00 |
| 39 | | | | 00 |
| 40 | 16 | Vendor PN | Part number provided by SFP vendor (ASCII) | 52 |
| 41 | | | | 4A |
| 42 | | | | 33 |
| 43 | | | | 47 |
| 44 | | | | 4C |
| 45 | | | | 58 |
| 46 | | | | XX |
| 47 | | | | XX |
| 48 | | | | XX |
| 49 | | | | XX |
| 50 | | | | XX |
| 51 | | | | XX |
| 52 | | | | XX |
| 53 | | | | XX |
| 54 | | | | XX |
| 55 | | | | XX |
| 56 | 4 | Vendor rev | Revision level for part number provided by vendor (ASCII) | 30 |
| 57 | | | | 30 |
| 58 | | | | 30 |
| 59 | | | | 30 |
| 60 | 2 | Wavelength | Laser wavelength | 05 |
| 61 | | | | 1E |
| 62 | 1 | Unallocated | | 00 |
| 63 | 1 | CC_BASE | Check code for Base ID Fields (addresses 0 to 62) | XX |
| Extended ID Fields | | | | |
| 64 | 2 | Options | Indicates which optional transceiver signals are implemented | 10 |
| 65 | | | | 14 |
| 66 | 1 | BR, max | Upper bit rate margin, units of % | 00 |
| 67 | 1 | BR, min | Lower bit rate margin, units of % | 00 |
| 68 | 16 | Vendor SN | Serial number provided by vendor (ASCII) | XX |
| 69 | | | | XX |
| 70 | | | | XX |
| 71 | | | | XX |
| 72 | | | | XX |
| 73 | | | | XX |
| 74 | | | | XX |
| 75 | | | | XX |
| 76 | | | | XX |
| 77 | | | | XX |
| 78 | | | | XX |
| 79 | | | | XX |
| 80 | | | | XX |
| 81 | | | | XX |
| 82 | | | | XX |
| 83 | | | | XX |
| 84 | 8 | Date code | Vendor's manufacturing date code | XX |
| 85 | | | | XX |
| 86 | | | | XX |





| | | | | |
|----|---|----------------------------|--|----|
| 87 | | | | XX |
| 88 | | | | XX |
| 89 | | | | XX |
| 90 | | | | 20 |
| 91 | | | | 20 |
| 92 | 1 | Diagnostic Monitoring Type | Indicates which type of diagnostic monitoring is implemented (if any) in the transceiver | 68 |
| 93 | 1 | Enhanced Options | Indicates which optional enhanced features are implemented (if any) in the transceiver | 70 |
| 94 | 1 | SFF-8472 Compliance | Indicates which revision of SFF-8472 the transceiver complies with | 08 |
| 95 | 1 | CC_EXT | Check code for the Extended ID Fields (addresses 64 to 94) | XX |

Address A0h Data Fields (RJ-3G-EX)

| A0h Address (dec) | # Bytes | Name | Description | Value (hex) |
|-----------------------|---------|------------------------------|---|-------------|
| Base ID Fields | | | | |
| 00 | 1 | Identifier | Type of transceiver | 02 |
| 01 | 1 | Ext. Identifier | Extended identifier of type of transceiver | 04 |
| 02 | 1 | Connector | Code for connector type | 07 |
| 03 | 8 | Transceiver | Code for electronic or optical compatibility | 04 |
| 04 | | | | 14 |
| 05 | | | | 40 |
| 06 | | | | 02 |
| 07 | | | | 12 |
| 08 | | | | 00 |
| 09 | | | | 01 |
| 10 | | | | 05 |
| 11 | 1 | Encoding | Code for high speed serial encoding algorithm | 01 |
| 12 | 1 | BR, Nominal | Nominal signaling rate, units of 100MBd | 1F |
| 13 | 1 | Rate Identifier | Type of rate select functionality | 00 |
| 14 | 1 | Length (SMF, km) | Link length supported for single mode fiber, units of km | 28 |
| 15 | 1 | Length (SMF) | Link length supported for single mode fiber, units of 100m | FF |
| 16 | 1 | Length (50µm) | Link length supported for 50µm OM2 fiber, units of 10m | 00 |
| 17 | 1 | Length (62.5µm) | Link length supported for 62.5µm OM1 fiber, units of 10m | 00 |
| 18 | 1 | Length (OM4 or copper cable) | Link length supported for 50µm OM4 fiber, units of 10m. Alternatively copper or direct attach cable, units of m | 00 |
| 19 | 1 | Length (OM3) | Link length supported for 50µm OM3 fiber, units of 10m | 00 |
| 20 | 16 | Vendor Name | SFP vendor name (ASCII) | 43 |
| 21 | | | | 4F |
| 22 | | | | 54 |
| 23 | | | | 53 |





| | | | | |
|---------------------------|----|-------------|--|----|
| 24 | | | | 57 |
| 25 | | | | 4F |
| 26 | | | | 52 |
| 27 | | | | 4B |
| 28 | | | | 53 |
| 29 | | | | 20 |
| 30 | | | | 20 |
| 31 | | | | 20 |
| 32 | | | | 20 |
| 33 | | | | 20 |
| 34 | | | | 20 |
| 35 | | | | 20 |
| 36 | 1 | Transceiver | Code for electronic or optical compatibility | 00 |
| 37 | | | | 00 |
| 38 | 3 | Vendor OUI | SFP vendor IEEE company ID | 00 |
| 39 | | | | 00 |
| 40 | | | | 52 |
| 41 | | | | 4A |
| 42 | | | | 33 |
| 43 | | | | 47 |
| 44 | | | | 45 |
| 45 | | | | 58 |
| 46 | | | | XX |
| 47 | | | | XX |
| 48 | 16 | Vendor PN | Part number provided by SFP vendor (ASCII) | XX |
| 49 | | | | XX |
| 50 | | | | XX |
| 51 | | | | XX |
| 52 | | | | XX |
| 53 | | | | XX |
| 54 | | | | XX |
| 55 | | | | XX |
| 56 | | | | 30 |
| 57 | 4 | Vendor rev | Revision level for part number provided by vendor (ASCII) | 30 |
| 58 | | | | 30 |
| 59 | | | | 30 |
| 60 | | | | 05 |
| 61 | 2 | Wavelength | Laser wavelength | 1E |
| 62 | 1 | Unallocated | | 00 |
| 63 | 1 | CC_BASE | Check code for Base ID Fields (addresses 0 to 62) | C9 |
| Extended ID Fields | | | | |
| 64 | | | | 10 |
| 65 | 2 | Options | Indicates which optional transceiver signals are implemented | 14 |
| 66 | 1 | BR, max | Upper bit rate margin, units of % | 00 |
| 67 | 1 | BR, min | Lower bit rate margin, units of % | 00 |
| 68 | | | | XX |
| 69 | | | | XX |
| 70 | 16 | Vendor SN | Serial number provided by vendor (ASCII) | XX |
| 71 | | | | XX |
| 72 | | | | XX |





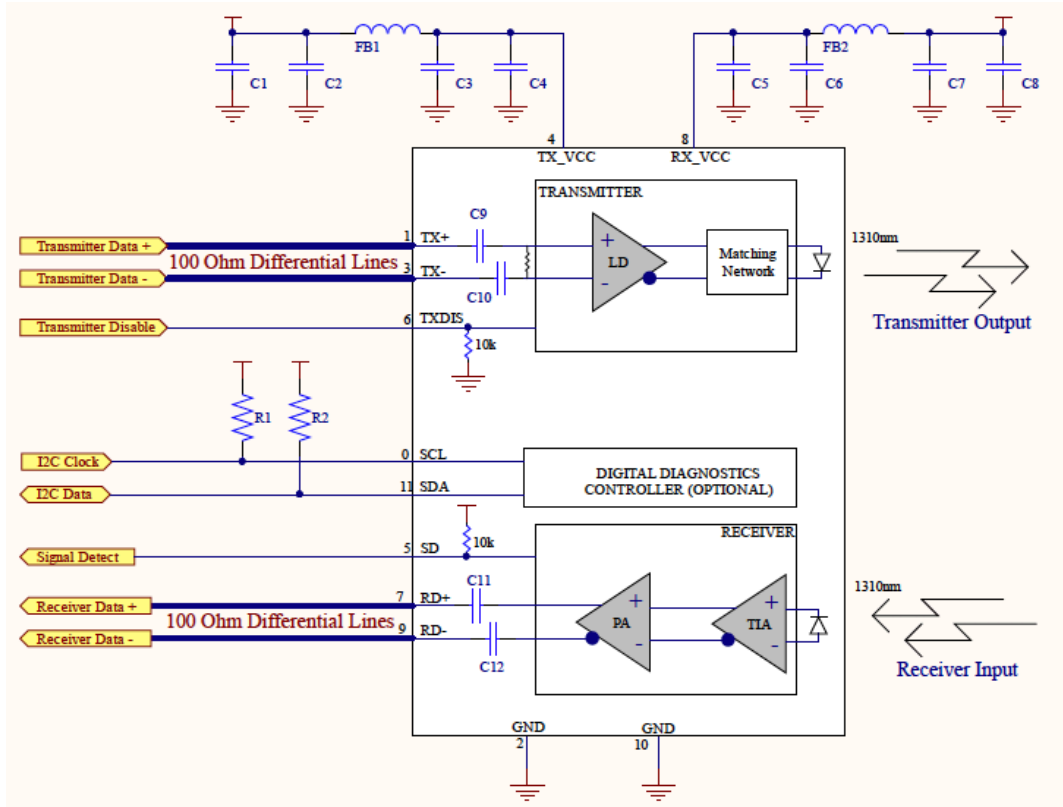
| | | | | |
|----|---|----------------------------|--|----|
| 73 | | | | XX |
| 74 | | | | XX |
| 75 | | | | XX |
| 76 | | | | XX |
| 77 | | | | XX |
| 78 | | | | XX |
| 79 | | | | XX |
| 80 | | | | XX |
| 81 | | | | XX |
| 82 | | | | XX |
| 83 | | | | XX |
| 84 | 8 | Date code | Vendor's manufacturing date code | XX |
| 85 | | | | XX |
| 86 | | | | XX |
| 87 | | | | XX |
| 88 | | | | XX |
| 89 | | | | XX |
| 90 | | | | 20 |
| 91 | | | | 20 |
| 92 | 1 | Diagnostic Monitoring Type | Indicates which type of diagnostic monitoring is implemented (if any) in the transceiver | 68 |
| 93 | 1 | Enhanced Options | Indicates which optional enhanced features are implemented (if any) in the transceiver | 70 |
| 94 | 1 | SFF-8472 Compliance | Indicates which revision of SFF-8472 the transceiver complies with | 08 |
| 95 | 1 | CC_EXT | Check code for the Extended ID Fields (addresses 64 to 94) | XX |





Application Schematics

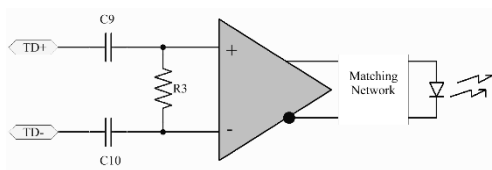
HOST BOARD APPLICATION SCHEMATIC



Notes:

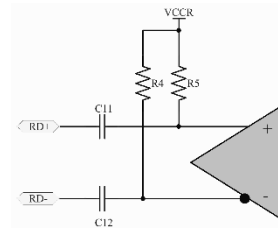
- Recommend host routes separate supply voltages and filtering for RJ-module transmitter and receiver as shown in the schematic above
 - FB1/FB2 ferrite bead for power supply noise suppression; Murata BLM18KG601SN1, 0603, 600Ω @ 100MHz, 1300mA
 - C1/C4/C5/C8 bulk capacitance; Murata GRM21BR61C106KE15L, 0805, 10μF, 16V
 - C2/C3/C6/C7 de-coupling capacitors; Murata GRM155R71C104KA88D, 0402, 0.1μF, 16V
- R1/R2 2-wire bus pull-up resistors required on host for implementing optional digital diagnostics; 4.7kΩ to 10kΩ
- Recommend screw or solder posts be connected to chassis ground if available otherwise they should be tied to local signal ground
- For host with LVPECL electrical interface contact COTSWORKS' applications engineering

TRANSMITTER EQUIVALENT INPUT CIRCUIT



- C9/C10 0.1μF internal input data coupling capacitors
- R3 internal 100Ω input differential termination
- Transmitter electrical input is LVPECL compatible

RECEIVER EQUIVALENT OUTPUT CIRCUIT

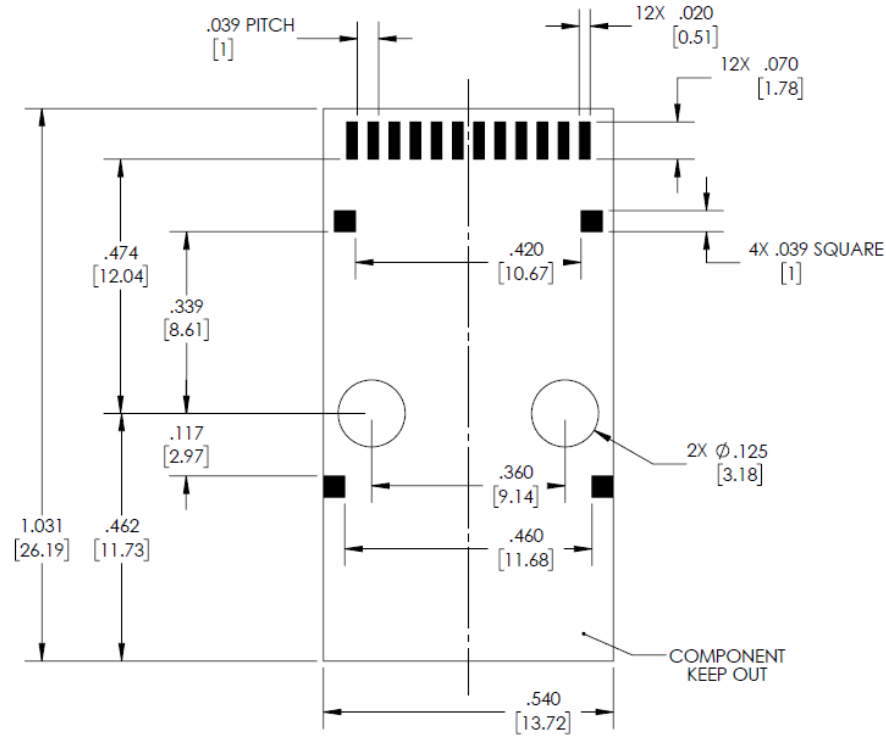


- C11/C12 are 0.1μF output data coupling capacitors
- R4/R5 are 50Ω pull-up resistors to VCCR
- Receiver electrical output is CML compatible





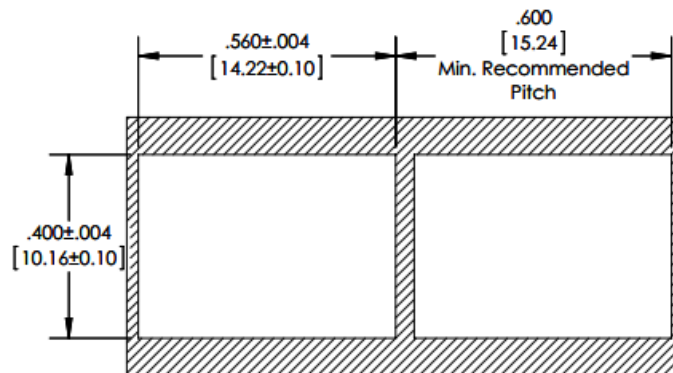
PCB Design Guidelines



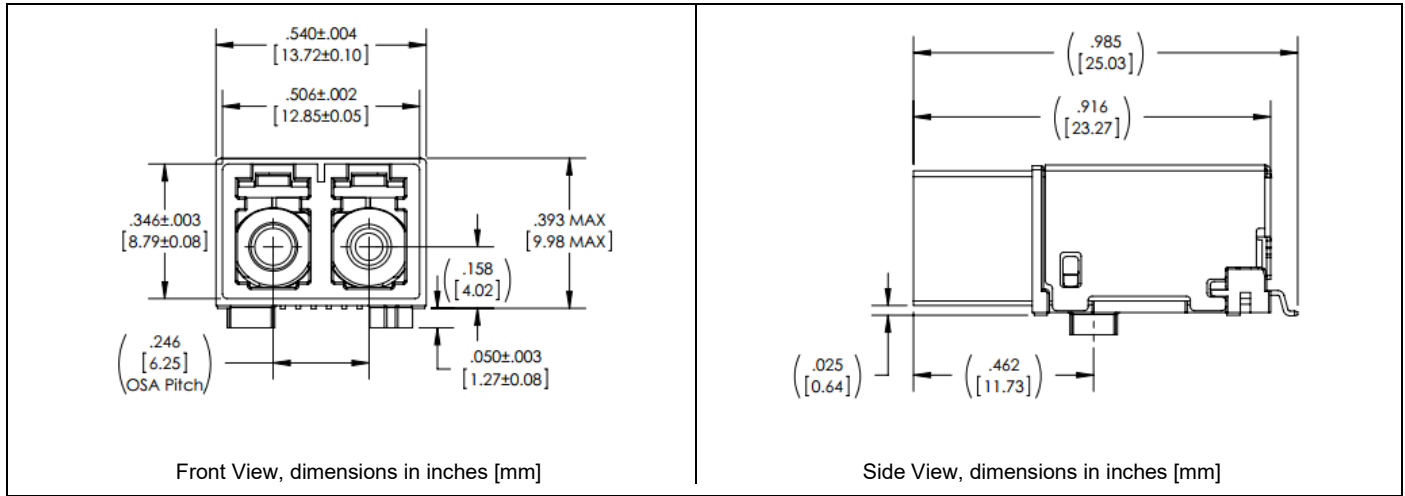
Notes:

- 1) Pads 0 and 11 are the 2-wire bus signal pin pads for the digital diagnostics option

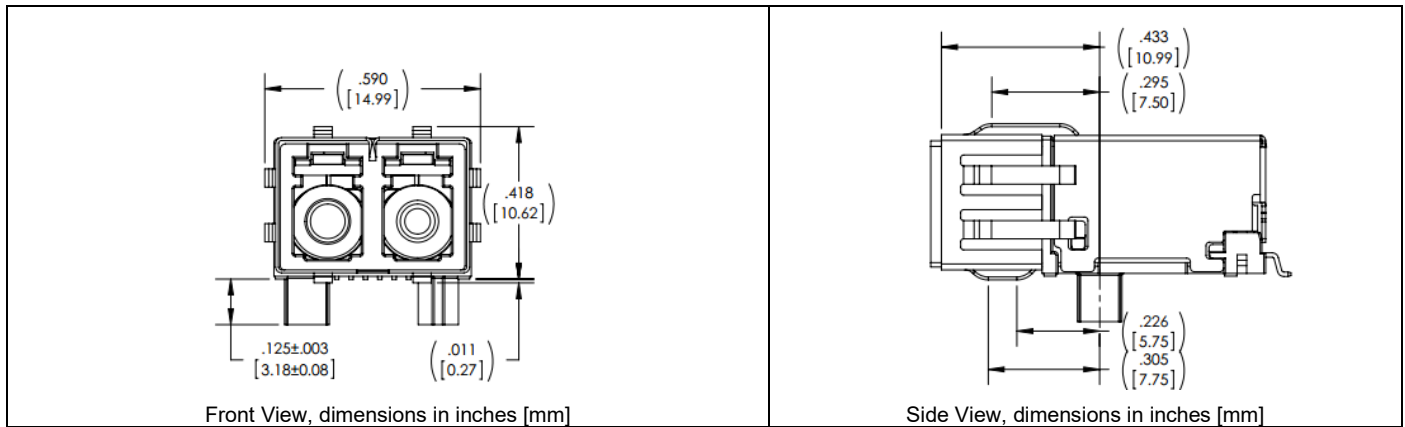
Panel Cutout



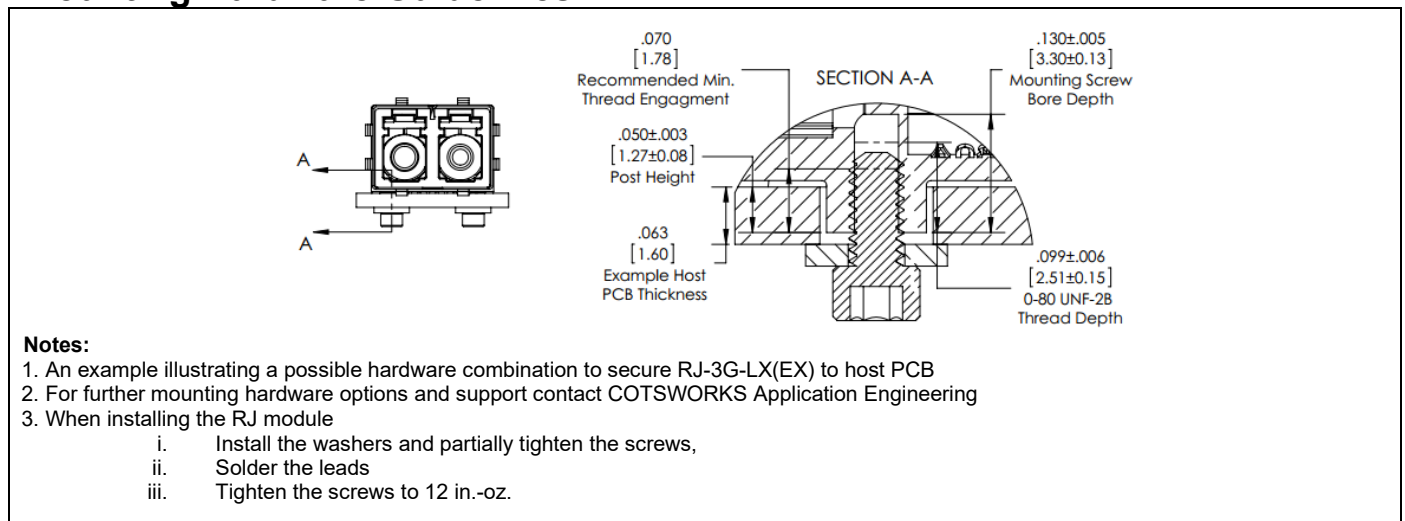
Screw Post Mechanical Dimensions



Solder Post Mechanical Dimensions



Mounting Hardware Guidelines



Ruggedization Notes

- Parylene Type C coating can be used with a 1.0mil ± 0.2mil thickness through a deposition process. Parylene C has a 5600VPM rating, withstands temperatures of 350°F, and is extremely resistant to oil/dirt, and object impact.
- This part can come in a pigtail fiber optic version.
- Contact COTSWORKS for all MSDS, case composition, and burn analysis.

Reference Information

- 1) IEEE Standard 802.3, 2002 Edition, Clause 38, PMD Type 1000BASE-LX. IEEE Standards Department, 2002
- 2) "Fibre Channel Draft Physical Interface Specification (FC-PI-2 Rev. 10.0)". American National Standard for Information Systems
- 3) ARINC 818 specification at 1.0625Gb/s, <http://www.arinc.com/>
- 4) Directive 2002/95/EC of the European Council Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment." January 27, 2003

Regulatory Compliance

- COTSWORKS transceivers are Class 1M Laser Products and comply with US FDA regulations.
- These products are compliant to the Class 1M eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950.
- This part has an option for compliance with Directive 2002/95/EC covering restriction on certain hazardous substances (RoHS). It invokes item 5 of the Annex which allows "Pb in the glass of cathode ray tubes, electronic components, and fluorescent tubes." This part may contain Pb for components such as lenses, windows, isolators, and other electronic components.

Warnings:

Handling Precautions: This device is susceptible to damage from electrostatic discharge (ESD). A static free environment is highly recommended.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

Ordering Information

| RJ-3G | -xx | -x | -DPLX-xx | -x | -x | -x | -x | -x |
|---------------------|------------------------------------|-----------------------------------|--------------------------------|--------------------|---|------------------|--------------|--|
| RJ Form Factor | Transmitter | Pins and Diagnostics | Receptacle Type | Ruggedized Coating | Operating Temp Range | EMI Shield | RoHS Level | Mounting |
| 3Gbps Max Data Rate | LX: 20km, SMF Fabry-Perot Tx | (): 1x10 No Diagnostics | LC: LC Receptacle | (): Non-coated | A: -40 to 85°C | (): No Shield | (): Lvl 5 | (): Imperial Screw |
| Long Reach (SMF) | EX: 32 km, SMF DFB Tx | D: 1x12 Digital Diagnostics | LX: ARINC-801 Receptacle | R: Parylene | *M: -40 to 95°C (only available for RJ-3G-LX) | E: Shield | 6: Lvl 6 | U: Metric Screw P: Solder Posts |

Example part number: RJ-3G-LX-DPLX-LC-R-A-U

[3G RJ Transceiver, 1310nm, long-reach, Duplex LC connectors, Parylene-coated, -40 to 85°C operating temp range, imperial-threaded screw posts]

Contact COTSWORKS for mechanical dimensional information and other configuration options.

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