

Features:

- Duplex transceiver module
- Compliant operation at the following data rates:
 - 25.78 Gbps (25GBASE-SR)
 - 28.05 Gbps (Fibre Channel 32GFC)
- Supports the following data rates:
 - 3.1875 / 8.5 / 14.025 / 21.0375 Gbps (Fibre Channel 3GFC / 8GFC / 16GFC / 24GFC)
 - 10.3125 Gbps (10GBASE-SR)
- 850nm VCSEL transmitter and PIN receiver
- Compliant to IEC-60825-1, Class 1 laser eye safe
- Solder-down 1x13 electrical interface
- Supports Forward Error Correction (FEC) channel coding
- Screw posts for securing module to host
- SFF-8472 compliant control and diagnostics monitor interface
- Parylene conformal coating option



The RJ-28G-SR is a unique ruggedized fiber optic transceiver designed to provide peak performance in hazardous environments.



COMMERCIAL AEROSPACE



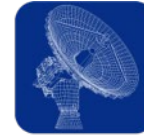
MILITARY AEROSPACE



MILITARY TACTICAL



SUBSEA NETWORKING



RADAR & SENSING



OIL & EXPLORATION

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
Maximum Supply Voltage 3.3V	$V_{CC\ 3V3}$	-0.3	4.0	V	
Maximum Supply Voltage 1.8V	$V_{CC\ 1V8}$	-0.5	2.0	V	
Storage Temperature	T_{sto}	-55	105	°C	
Case Operating Temperature	T_{op}	-40	85	°C	
Relative Humidity	RH	-	95	%	Based on conformal coating, (1)
Hot Bar Soldering Temperature	-	-	260	°C	10 seconds, leads only, (2)
Hand Lead Soldering Temperature	-	-	260	°C	10 seconds, leads only, (2)
Conformal Coating	-	0.8	1.2	mil	(3)

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 circumstance.
- 3) See ruggedization notes on page 10.

General Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Data Rate	BR_{Eth}	-	25.78125	-	Gbps	64b66b Encoding, Balanced NRZ
	BR_{FC}	-	28.05	-	Gbps	64b66b Encoding, Balanced NRZ
Center Wavelength	λ	-	850	-	nm	
Average Output Optical Power	P_{OUTEth}	-	-	2.4	dBm	(1)
	P_{OUTFC}	-	-	2.4	dBm	(2)
Optical Modulation Amplitude	OMA_{Eth}	-3	-	-	dBm	(1)
	OMA_{FC}	-3	-	-	dBm	(2)
Stressed Receiver OMA Sensitivity	RX_{STEth}	-	-	-6	dBm	(1)
	RX_{STFC}	-	-	-5.8	dBm	(2)

Notes:

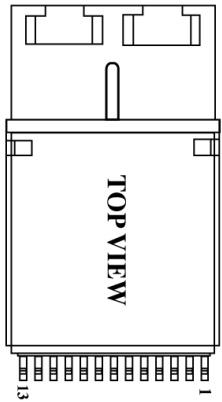
- 1) When optimized for 25.78125 Gbps via rate select controls on page 4. See conditions of stress under Optical Characteristics on page 3.
- 2) When optimized for 28.05 Gbps. See rate select controls on page 4. See conditions of stress under Optical Characteristics on page 3.

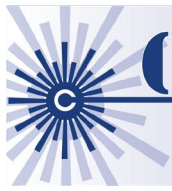


Electrical Specifications (TOP = -40 to 85°C, V_{CC_3V3} = 3.14 to 3.47 Volts, V_{CC_1V8} = 1.71 to 1.89 Volts)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Total Module Power Dissipation	P _{DISS}	-	-	1.2	W	(3)(4)
3.3V Supply Current	I _{CC3V3}	-	-	200	mA	
1.8V Supply Current	I _{CC1V8}	-	-	250	mA	
Transmitter						
Input Differential Impedance	R _{in}	-	100	-	Ω	
TX Single-Ended Input Voltage Swing @25.78 Gbps	V _{in}	20	-	500	mV	
TX Single-Ended Input Voltage Swing @28.05 Gbps	V _{in}	20	-	500	mV	
TX Disable Input Voltage	V _D	2.4	-	-	V	LVTTTL
TX Enable Input Voltage	V _{EN}	-	-	0.4	V	LVTTTL
Receiver						
Rx Single-Ended Output Voltage Swing @25.78 Gbps	V _O	225	-	525	mV	
Rx Single-Ended Output Voltage Swing @28.05 Gbps	V _O	225	-	525	mV	
Data Output Rise Time	t _r	-	24	-	ps	(1)
Data Output Fall Time	t _f	-	24	-	ps	(1)
Total Contributed Jitter	RXΔTJ	-	-	0.46	UI	
Signal Detect Assert	SD _A	V _{CC} - 0.5	-	V _{CC} + 0.3	V	(2) 3V3
Signal Detect De-Assert	SD _D	0	-	0.4	V	(2) 3V3
Signal Detect Assert Time	t _d	-	10	80	μs	
Signal Detect De-Assert Time	t _a	-	10	80	μs	
Serial Bus						
Data, Clock Input Low Voltage	V _{IL}	-0.3	-	0.3*V _{CC}	V	3V3
Data, Clock Input High Voltage	V _{IH}	0.7*V _{CC}	-	V _{CC} +0.3	V	3V3
Data, Clock Output Low Voltage	V _{OL}	-	-	0.4	V	3V3
Data, Clock Output High Voltage	V _{OH}	V _{CC} -0.4	-	-	V	3V3
Notes:						
1) 20% to 80%.						
2) SD is LVTTTL. Logic 1 indicates normal operation; logic 0 indicates no signal is detected.						
3) 1.2 W is used for total power dissipation when Clock Data Recovery (CDR) is turned on.						
4) If CDR is turned off, total power dissipation can be reduced by up to 0.15W.						
a. Only recommended for applications where the system link is short and link budget requirements are low. Contact COTSWORKS for additional info.						

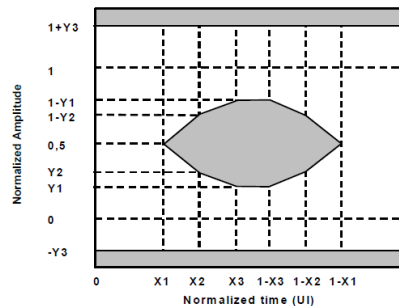
Pin Configuration

	PIN #	Symbol	Description	Notes
	1	SDA	I2C Data	I2C
2	SCL	I2C Clock	I2C	
3	V _{CC_3V3}	3.3V Supply	3.3V	
4	GND	Ground	0V	
5	TX-	Transmitter Data Input, Negative	CML	
6	TX+	Transmitter Data Input, Positive	CML	
7	GND	Ground	0V	
8	RX+	Receiver Data Output, Positive	CML	
9	RX-	Receiver Data Output, Negative	CML	
10	GND	Ground	0V	
11	V _{CC_1V8}	1.8V Supply	1.8V	
12	TX_DIS	Transmitter Disable	LVTTTL	
13	SD	Receiver Signal Detect	LVTTTL	



Optical Characteristics (TOP = -40 to 85°C, VCC_3V3 = 3.14 to 3.47 Volts, VCC_1V8 = 1.71 to 1.89 Volts)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter						
Average Output Optical Power	P _{OUTEth}	-	-	2.4	dBm	(1)(2)(9)
	P _{OUTFC}	-	-	2.4	dBm	(1)(2)(10)
Optical Modulation Amplitude	OMA _{Eth}	-3	-	-	dBm	(9)
	OMA _{FC}	-3	-	-	dBm	(10)
Optical Wavelength	λ	840	850	860	nm	
Spectral Width (RMS)	σ	-	-	0.57	nm	(9)
		-	-	0.57	nm	(10)
Extinction ratio	ER	2	-	-	dB	
Transmitter and Dispersion Eye Closure	TDEC _{Eth}	-	-	4.3	dB	(3)
	TDEC _{FC}	-	-	4.4	dB	(3)
TX Mask Compliance	-	{X1, X2, X3, Y1, Y2, Y3}				(4)
		{0.30, 0.38, 0.45, 0.35, 0.41, 0.50}				



Receiver						
Stressed Receiver OMA Sensitivity	RX _{STEth}	-	-	-6	dBm	(5)(6)
	RX _{STFC}	-	-	-5.8	dBm	(7)(8)
Unstressed Receiver OMA Sensitivity	RX _{USEth}	-	-	-11.1	dBm	(5)(9)
	RX _{USFC}	-	-	-10.2	dBm	(7)(10)
Receiver Saturation	RX _{SAT}	3	-	-	dBm	
Optical Center Wavelength	λ _C	840	850	860	nm	
Return Loss	RL	12	-	-	dB	
Signal Detect Assert	SD _A	-	-	-14	dBm	
Signal Detect De-Assert	SD _D	-28	-	-	dBm	
Signal Detect Hysteresis	SD _H	-	0.5	-	dBm	

- Notes:**
- Class 1 Laser Safety per IEC-60825-1 regulations.
 - Measured with 2–5 meter patch cord consisting of laser optimized OM3 or OM4 fiber.
 - Measured with an electrical filter equivalent to 70m on OM3 fiber.
 - Hit ratio 1.5E-3 hits per sample.
 - Measured at BER of 5E-5; assuming industry standard RS-FEC on the host, this will ensure a BER greater than 1E-12 post-FEC.
 - Measured with an OMA of 3 dBm, Stressed eye J2 Jitter of 0.39 UI, Stressed eye Jitter J4 of 0.53 UI, and Stressed Eye Closure (SEC) value of 4.3 dB for 25.78 Gbps.
 - Measured at BER of 1E-6; assuming industry standard RS-FEC on the host, this will ensure a BER greater than 1E-12 post-FEC.
 - Measured with an OMA of 2 dBm Vertical Eye Closure value of 3.1 dB, and Deterministic Jitter of 0.1 UI for 28.05 Gbps.
 - When optimized for 25.78125 Gbps. See rate select controls on page 4.
 - When optimized for 28.05 Gbps. See rate select controls on page 4.





NOTE: The RJ-28G-SR transceiver can be set to operate at multiple data rates and corresponding CDR setpoints through i2C controls as shown in the table below. The corresponding HEX value must be set in the specified address location for the desired data rate for optimal performance. The CDR can also be bypassed and powered down if desired. Where possible, it is recommended to enable the CDRs as bypassing the CDR feature will result in reduced link performance.

Rate Select and CDR i2C Controls

Input to byte 248 in A2h (HEX)	Recommended Data Rate	Retimer / CDR
08	28.05 Gbps (32GFC)	CDRs on with VCO set to high, data rate to full
07	*25.78 Gbps (25GBASE-SR)	CDRs on with VCO set to high, data rate to full <i>*DEFAULT VALUE</i>
06	21.04 Gbps (24GFC)	CDRs on with VCO set to low, data rate to full
05	14.02 Gbps (16GFC)	CDRs on with VCO set to low, data rate to half
04	10.31 Gbps (10GBASE-SR)	CDRs on with VCO set to low, data rate to half
03	8.5 Gbps (8GFC)	CDRs on with VCO set to low, data rate to half
02	**3.19 Gbps (3GFC)	Bypass <i>**Also usable as CDR bypass for other data rates</i>
01	RESERVED	RESERVED
00	RESERVED	RESERVED

NOTE: COTSWORKS has developed the below table to use as reference for transceiver implementation. These values should be used as reference only to determine the detailed link budgets at 25G. For specific use case/conditions (length of fiber and fiber type), the customer should contact their COTSWORKS sales representative to discuss a detailed link budget model for their application.

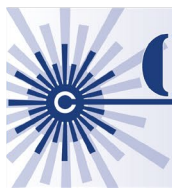
Informative Link Budget

Use Case/Condition	25.78 Gbps, 40m on OM3	25.78 Gbps, 40m on OM4	25.78 Gbps, 10m on OM1	25.78 Gbps, 5m on 100/140 μm
Power Budget	9.4	9.4	9.4	9.4
Fiber Attenuation	0.14	0.14	0.04	0.02
TDEC	2.91	2.75	3.90	3.90
Eye Closure Penalties Not Captured by TDEC	0.24	0.20	0.26	0.26
Excess Loss Available for Connectors	6.11	6.31	5.2	5.22



Address A0h Data Fields

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	00
04				00
05				00
06				00
07				60
08				40
09				0C
10				68
11	1	Encoding	Code for high speed serial encoding algorithm	06
12	1	BR, Nominal	Nominal signaling rate, units of 100 MBd	FF
13	1	Rate Identifier	Type of rate select functionality	0C
14	1	Length (SMF, km)	Link length supported for single mode fiber, units of km	00
15	1	Length (SMF)	Link length supported for single mode fiber, units of 100 m	00
16	1	Length (50um)	Link length supported for 50 um OM2 fiber, units of 10 m	02
17	1	Length (62.5um)	Link length supported for 62.5 um OM1 fiber, units of 10 m	01
18	1	Length (OM4 or copper cable)	Link length supported for 50um OM4 fiber, units of 10m. Alternatively copper or direct attach cable, units of m	10
19	1	Length (OM3)	Link length supported for 50 um OM3 fiber, units of 10 m	07
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	02
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				32
43				38
44				47



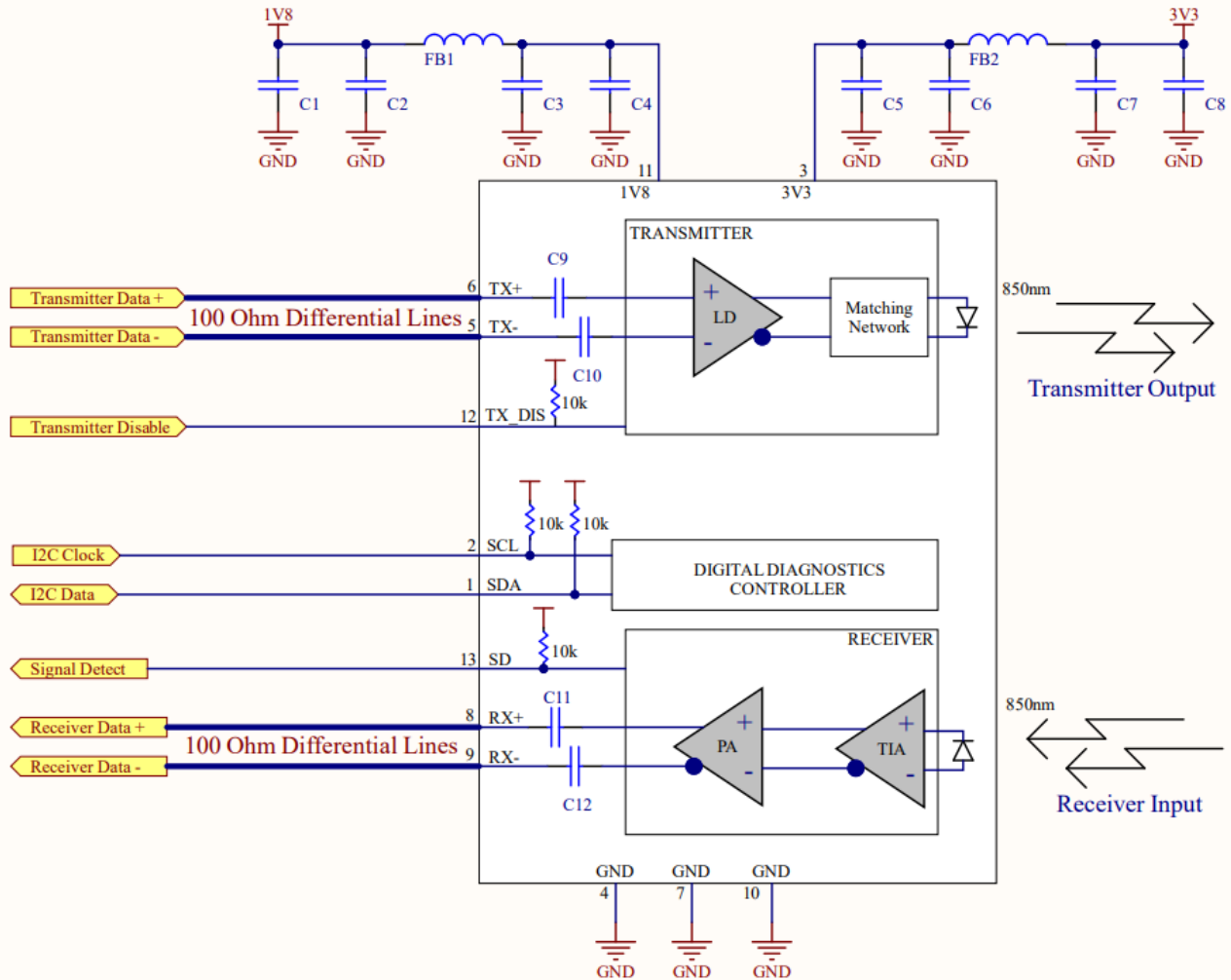
45				53
46				52
47				XX
48				XX
49				XX
50				XX
51				XX
52				XX
53				XX
54				XX
55				XX
56				30
57	4	Vendor rev	Revision level for part number provided by vendor (ASCII)	30
58				30
59				30
60				03
61	2	Wavelength	Laser wavelength	52
62	1	Unallocated		00
63	1	CC_BASE	Check code for Base ID Fields (addresses 0 to 62)	XX
Extended ID Fields				
64	2	Options	Indicates which optional transceiver signals are implemented	0A
65				14
66	1	BR, max	Upper bit rate margin, units of %	70
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	60
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	09
95	1	CC_EXT	Check code for the Extended ID Fields (addresses 64 to 94)	XX





Application Schematics

HOST BOARD APPLICATION SCHEMATIC



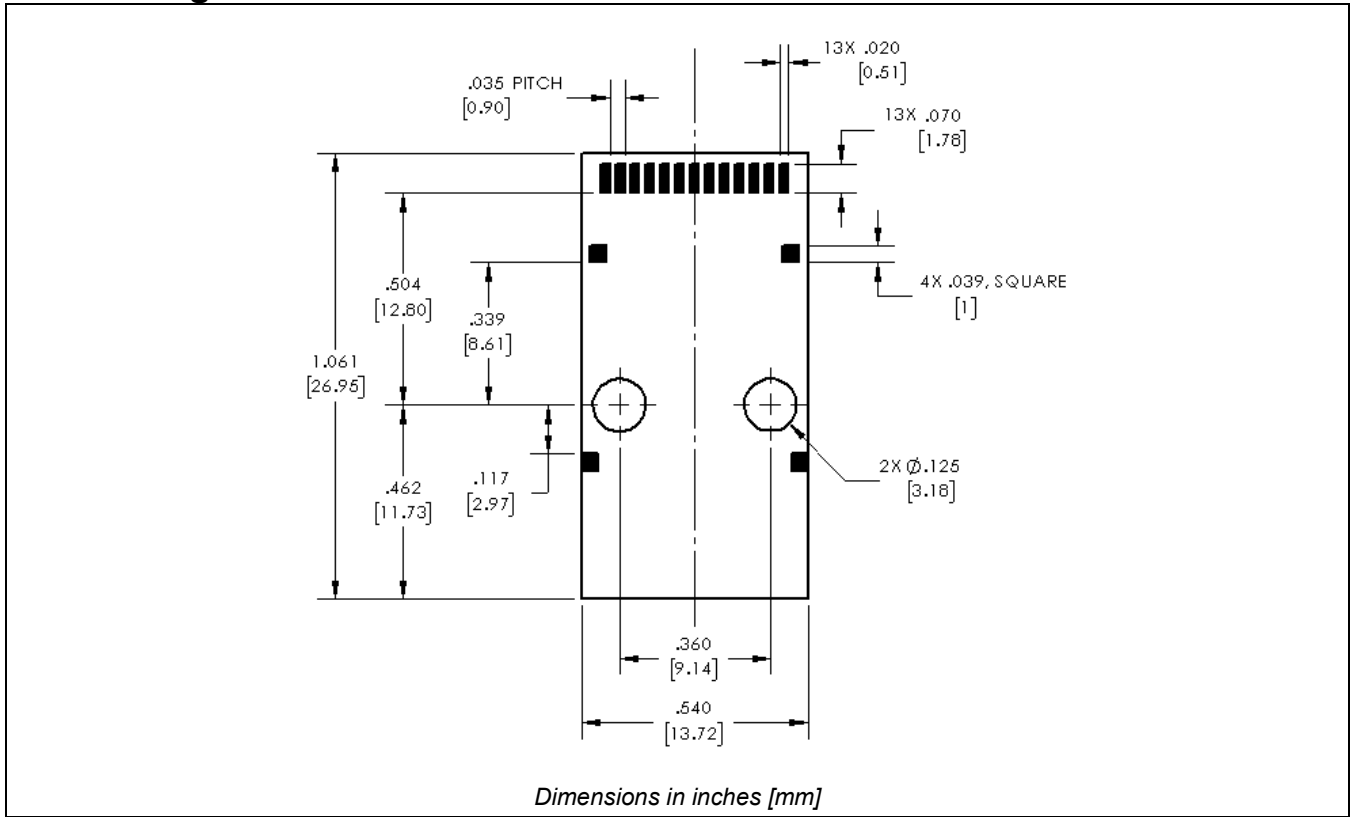
Notes:

- 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.
- Screw posts are not internally connected to signal ground. Recommend screw posts be connected to chassis ground if available, otherwise they should be tied to local signal ground.

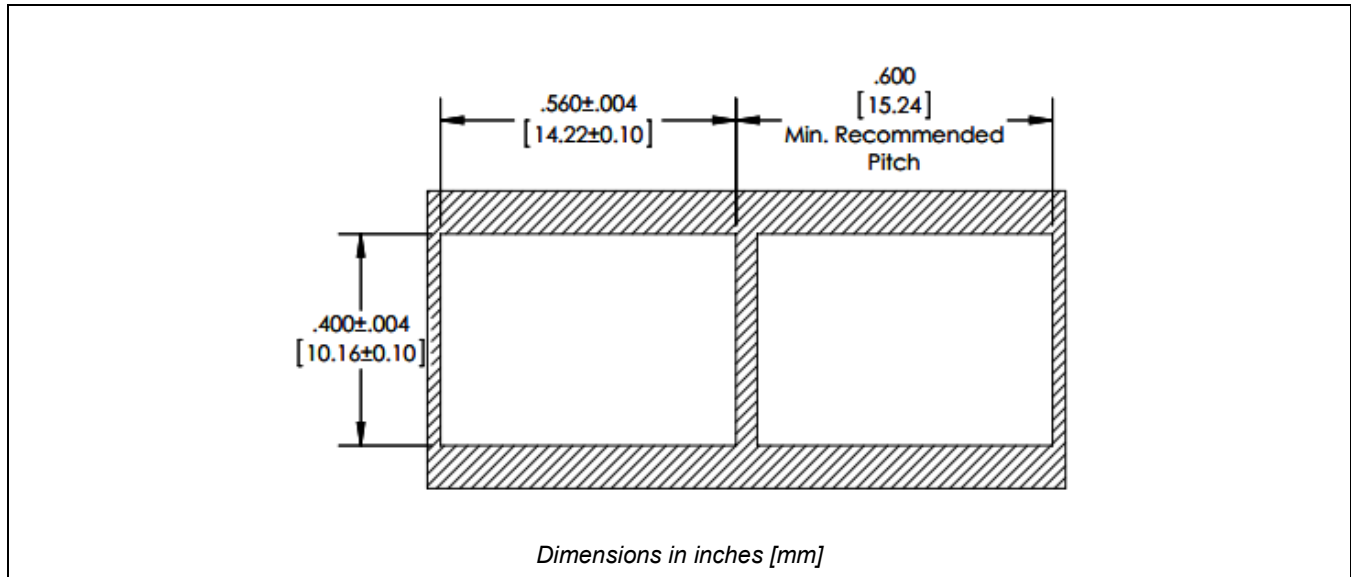




PCB Design Guidelines

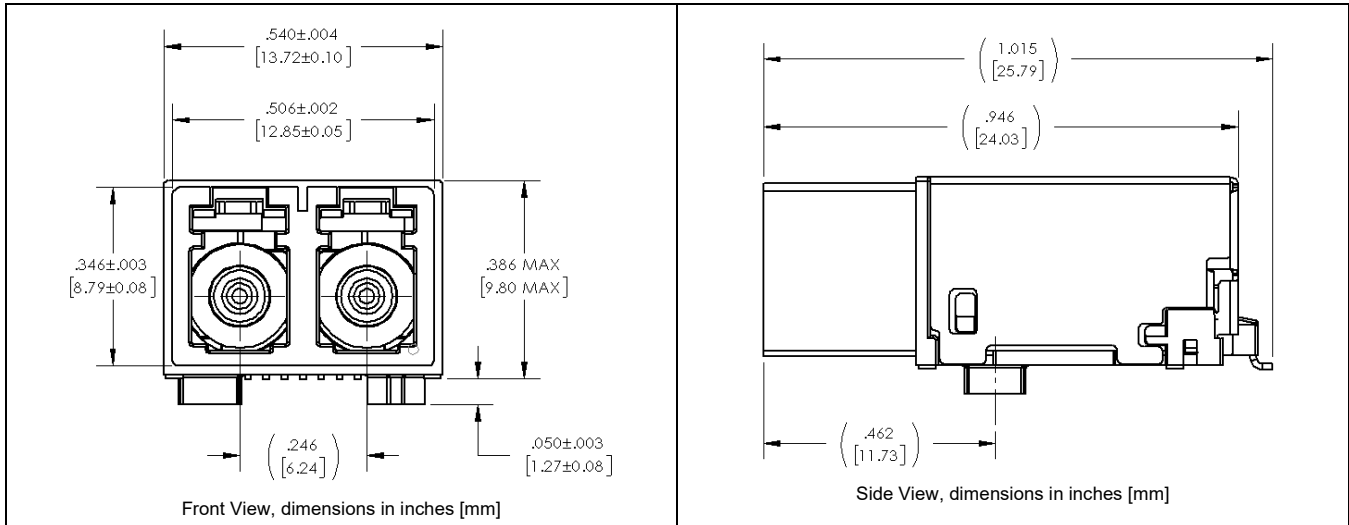


Panel Cutout

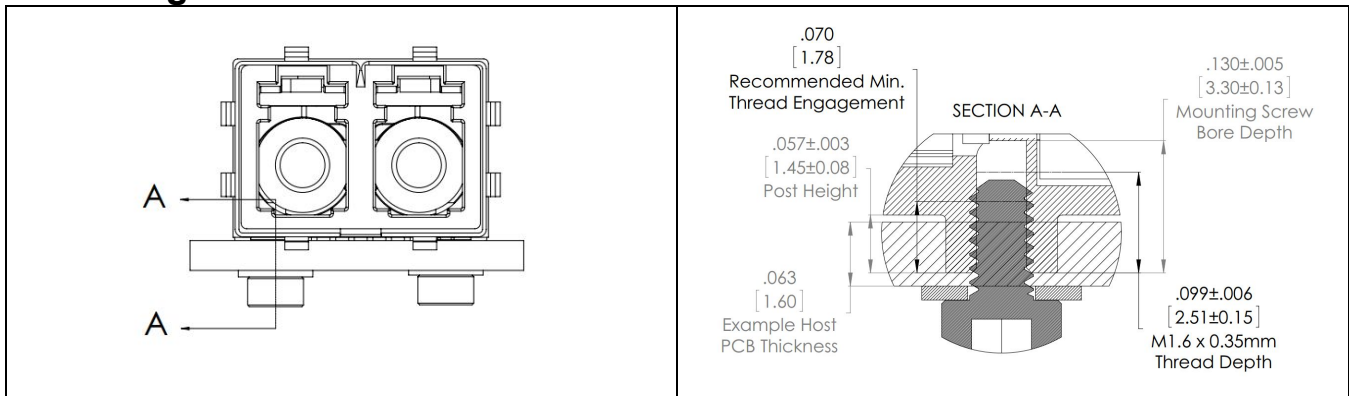




Standard Mechanical Dimensions



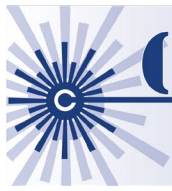
Mounting Hardware Guidelines



Notes:

- 1) An example illustrating a possible hardware combination to secure RJ-28G to host PCB.
- 2) Imperial-threaded Posts. #0-80 thread size.
- 3) Metric-threaded Posts. M1.6 thread size.
- 4) For further mounting hardware options and support contact COTSWORKS Application Engineering.
- 5) When installing the RJ module:
 - a. Install the washers and partially tighten the screws.
 - b. Solder the leads
 - c. Tighten the screws to 12 in-oz.





Ruggedization Notes

- Parylene Type C coating can be used for conformal coating with a 1.0 mil ± 0.2 mil thickness through a deposition process.
- Parylene Type C has a 5600 VPM rating, withstands high temperatures, and is extremely resistant to oil, dirt, and object impact.
- Contact COTSWORKS for all MSDS and case composition information.

Reference Information

- 1) IEEE Standard 802.3by CL112 25GBASE-SR.
- 2) IEEE Standard 802.3bm CL95 100GBASE-SR4.
- 3) T11 Standard FC-PI-6 32GFC.

Regulatory Compliance

- COTSWORKS transceivers are Class 1 Laser Products and comply with US FDA regulations.
- These products are designed to comply with the Class 1 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 2011/65/EU covering restriction on certain hazardous substances (RoHS).
- Contact COTSWORKS support for a product compliance matrix.

Warnings:

Handling Precautions: This device is susceptible to damage as a result of 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-28G-SR	-XX	-X	-X	-X	-X	-X
RJ Form Factor	Connector Type	Ruggedized Coating	Operating Temp Range	EMI Shield	RoHS Level	Mounting
28.05 Gbps Max Data Rate	LC: Standard LC	N: Non-coated	A: -40 to 85°C	N: No Shield	5: Lvl 5	I: Imperial Screw
Short Reach 850nm MMF	LX: ARINC-801	R: Parylene		E: Shield	6: Lvl 6	U: Metric Screw

Example part number: RJ-28G-SR-LC-R-A-N-5-I

[Rugged Jack Surface Mount, 28.05 Gbps Short Reach Transceiver, Digital Diagnostics, Duplex Configuration, Standard LC Receptacle, Parylene-Coated, -40 to 85°C Operating Temp Range, No EMI Shield, RoHS Level 5(6), Imperial Threaded Screw Mounting]

Contact COTSWORKS for mechanical dimensional information, lead times and other configuration options.

COTSWORKS and the COTSWORKS logo are registered trademarks of COTSWORKS, INC. COTSWORKS reserves the right to change, alter, or revise this document without notice unless otherwise agreed to.

