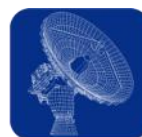


**Features:**

- Four Tx and four Rx parallel optical channels
- 850nm VCSEL and SWDM compliant PIN photodiode
- **MT-T™** optical receptacle, designed to securely hold MT ferrule with tab through high shock and vibration environments
- **FDS™** (Ferrule Detection Sensor) monitors the presence and secure connection of the MT-T connector
- Tight tolerance industry standard QSFP+ electrical interface
- IEC-60825-1 Class 1 eye safe optical power
- IEEE 802.3x performance at 1.25 and 10.3125 Gbps
 - 4x 1000BASE-SX for 550m over OM2, 3, or OM4
 - 4x 10GBASE-SR for 300m over OM3 or OM4
 - 40GBASE-SR4 for 150m on OM4
- Digital Diagnostics per SFF-8636
- –40 to +85°C operation standard, –40 to +95°C option
- –50 to +105°C storage temperature



SPOT-CE is a high-speed rugged pluggable transceiver with a secure MT-T receptacle for harsh environment connectivity.

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EXPLORATION**General Specifications**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Data Rate per Channel (1G)	DR _{1G}	-	1.25	-	Gbps	(1)
Data Rate per Channel (10G)	DR _{10G}	-	10.3125	-	Gbps	(2)
Transmitting Optical Wavelength	λ	840	850	860	nm	
Average Output Optical Power (1G)	P _{OUT1G}	–5	-	0	dBm	
Average Output Optical Power (10G)	P _{OUT10G}	–5	-	0	dBm	
Unstressed Receiver Sensitivity (1G)	RX _{ST1G}	-	-	–17	dBm	
Unstressed Receiver Sensitivity (10G, OMA)	RX _{ST10G}	-	-	–11.3	dBm	
Total Module Power Dissipation	P _{DISS}	-	-	1.5	W	

Notes:

- 1) 8b/10b encoding.
- 2) 64b/66b encoding.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
Maximum Supply Voltage	V _{MAX}	–0.5	3.6	V	
Storage Temperature	T _{STO}	–50	105	°C	
Operating Temperature	T _{OP}	–40	85	°C	
Relative Humidity	RH	0	85	%	Based on conformal coating, non-condensing
Conformal Coating	-	0.8	1.2	mil	See ruggedization notes on page 7



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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Total Module Power Dissipation	P_{DISS}	-	-	1.5	W	
Total Module Supply Current	I_{CC}	-	-	750	mA	
Transmitter						
TX Differential Input Voltage Swing	V_{DIX}	180	-	1200	mV	
TX Single-Ended Input Voltage Tolerance	V_{IN_TOL}	-0.3	-	3.8	V	
TX Disable Input Voltage	V_D	$V_{CC} - 1.3$	-	V_{CC}	V	
Receiver						
RX Differential Output Voltage Swing	V_{DRX}	340	-	800	mV	
RX Differential Output Amplitude in Squelched State	V_{DSQ}	-	-	50	mV	
RX Single-Ended Output Voltage Tolerance	V_{OUT_TOL}	-0.3	-	3.8	V	
Output AC Common Mode Voltage	V_{CM}	-	-	7.5	mV	
Data Output Rise / Fall Time	t_r / t_f	28	-	-	ps	(1)
Total Jitter	TJ	-	-	0.7	UI	
Deterministic Jitter	DJ	-	-	0.4	UI	
Serial Bus						
Data, Clock Input Low Voltage	V_{IL}	-0.3	-	$V_{CC} * 0.3$	V	
Data, Clock Input High Voltage	V_{IH}	$V_{CC} * 0.7$	-	$V_{CC} + 0.5$	V	
Data, Clock Output Low Voltage	V_{OL}	0	-	0.4	V	
Data, Clock Output High Voltage	V_{OH}	$V_{CC} - 0.5$	-	$V_{CC} + 0.3$	V	
Notes:						
1) 20% to 80%						

FDS (Ferrule Detection Sensor)

The COTSWORKS SPOT-CE transceiver includes a real-time monitoring system for the MT-T receptacle. The sensor monitors whether the MT-T receptacle is populated with an MT-T connector. This information is reported in digital diagnostics via I²C, at location 00h Byte 224. The table below indicates how to interpret the possible values in this register:

Byte	Hex	Meaning
224	10	No MT-T connector present
224	FF	MT-T connector present

Digital Diagnostics Information:

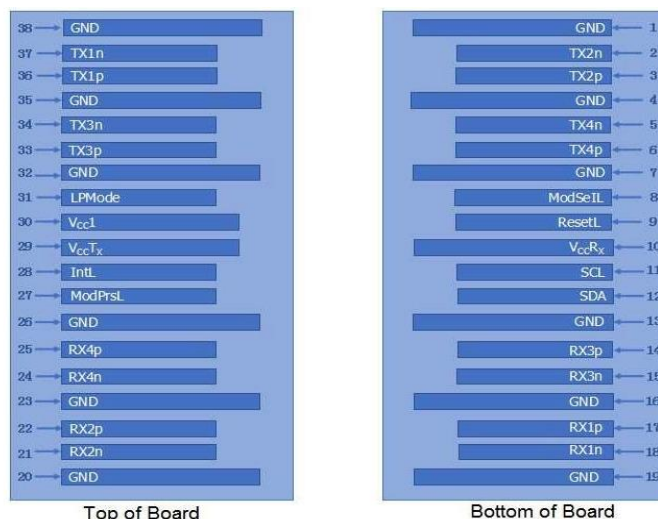
The COTSWORKS SPOT-CE module supports a 2-wire bus required to access digital diagnostics compliant to SFF-8636 multi-source agreement. The transceiver pinout (including those pins required for 2-wire communication to access the digital diagnostics) appears on the Electrical Pin Assignment table on pages 3 and 4.

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





Electrical Pad Assignment



Electrical Pad Assignment Details

PIN #	Symbol	Description	Notes
1	GND	Ground	(5)
2	Tx2n	Transmitter Inverted Data Input, LAN2	
3	Tx2p	Transmitter Non-Inverted Data Input, LAN2	
4	GND	Ground	(5)
5	Tx4n	Transmitter Inverted Data Input, LAN4	
6	Tx4p	Transmitter Non-Inverted Data Input, LAN4	
7	GND	Ground	(5)
8	ModSelL	Module select pin, the module responds to two-wire serial communication when low level	(1)
9	ResetL	Module Reset	(2)
10	VccRX	+3.3V Power Supply Receiver	
11	SCL	2-Wire Serial Interface Clock	
12	SDA	2-Wire Serial Interface Data	
13	GND	Ground	(5)
14	Rx3p	Receiver Non-Inverted Data Output, LAN3	
15	Rx3n	Receiver Inverted Data Output, LAN3	
16	GND	Ground	(5)
17	Rx1p	Receiver Non-Inverted Data Output, LAN1	
18	Rx1n	Receiver Inverted Data Output, LAN1	
19	GND	Ground	(5)
20	GND	Ground	(5)
21	Rx2n	Receiver Inverted Data Output, LAN2	
22	Rx2p	Receiver Non-Inverted Data Output, LAN2	
23	GND	Ground	(5)
24	Rx4n	Receiver Inverted Data Output, LAN4	
25	Rx4p	Receiver Non-Inverted Data Output, LAN4	
26	GND	Ground	(5)





27	ModPRsL	Module Present	
28	IntL	Interrupt	(4)
29	VccTX	+3.3V Power Supply Transmitter	
30	Vcc1	+3.3V Power Supply	
31	LPMODE	Low Power Mode	(3)
32	GND	Ground	(5)
33	Tx3p	Transmitter Non-Inverted Data Input, LAN3	
34	Tx3n	Transmitter Inverted Data Input, LAN3	
35	GND	Ground	(5)
36	Tx1p	Transmitter Non-Inverted Data Input, LAN1	
37	Tx1n	Transmitter Inverted Data Input, LAN1	
38	GND	Ground	(5)

Notes:

- 1) ModSelL is the input pin. The module responds to 2-wire serial communication commands when it is held low by the host. ModSelL allows multiple SPOT-CE modules to be used on a single 2-wire interface bus. If ModSelL is High, the module will not respond to any 2-wire interface communication from the host. ModSelL has internal pull-up resistors in the module.
- 2) The module reset pin, when the low level on the ResetL pin lasts longer than the minimum pulse length, resets the module and restores all user modules to their default state. When performing reset device, the host should ignore all status bits. Until the module reset interrupt is completed, please note that during hot plugging, the module will issue this information to complete the reset interrupt without resetting.
- 3) This pin is active high, indicating that the module is running under a low power module.
- 4) IntL is the output pin, which is the open collector output and must be pulled up to Vcc on the motherboard. When it is low, it indicates that the module may malfunction. The host uses a 2-wire serial interface to identify the interrupt source.
- 5) Circuit ground is internally isolated from chassis ground.

Rate Select Logic and i2C Controls

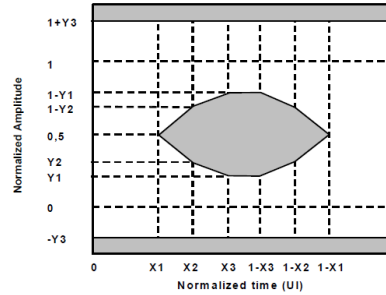
Input byte address in A0h	Bits	Bit Configuration	Notes
87	7 / 6	0 / 0	RX_4 optimized for data rates less than 6.6 Gbps.
87	7 / 6	1 / 0	RX_4 optimized for 6.6 Gbps data rates and above.
87	5 / 4	0 / 0	RX_3 optimized for data rates less than 6.6 Gbps.
87	5 / 4	1 / 0	RX_3 optimized for 6.6 Gbps data rates and above.
87	3 / 2	0 / 0	RX_2 optimized for data rates less than 6.6 Gbps.
87	3 / 2	1 / 0	RX_2 optimized for 6.6 Gbps data rates and above.
87	1 / 0	0 / 0	RX_1 optimized for data rates less than 6.6 Gbps.
87	1 / 0	1 / 0	RX_1 optimized for 6.6 Gbps data rates and above.
88	7 / 6	0 / 0	TX_4 optimized for data rates less than 6.6 Gbps.
88	7 / 6	1 / 0	TX_4 optimized for 6.6 Gbps data rates and above.
88	5 / 4	0 / 0	TX_3 optimized for data rates less than 6.6 Gbps.
88	5 / 4	1 / 0	TX_3 optimized for 6.6 Gbps data rates and above.
88	3 / 2	0 / 0	TX_2 optimized for data rates less than 6.6 Gbps.
88	3 / 2	1 / 0	TX_2 optimized for 6.6 Gbps data rates and above.
88	1 / 0	0 / 0	TX_1 optimized for data rates less than 6.6 Gbps.
88	1 / 0	1 / 0	TX_1 optimized for 6.6 Gbps data rates and above.





Optical Characteristics (T_{OP} = –40 to 85°C, V_{CC} = 3.14 to 3.47 Volts)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter						
Average Output Optical Power per Lane (1G)	P _{OUT1G}	–5	-	0	dBm	(1)
Average Output Optical Power per Lane (10G)	P _{OUT10G}	–5	-	0	dBm	(2)
OMA Output Optical Power per Lane (10G)	OMA _{10G}	–4.3	-	-	dBm	(2)
OMA Output Optical Power per Lane, Minus TDP (10G)	OMA-T _{10G}	–6.5	-	-	dBm	(2)
Optical Wavelength	λ	840	850	860	nm	
Spectral Width (RMS)	σ	-	-	0.45	nm	
Extinction Ratio (1G)	ER _{1G}	9	-	-	dB	(1)
Extinction Ratio (10G)	ER _{10G}	3	-	-	dB	(2)(6)
Relative Intensity Noise	RIN	-	-	–128	dB / Hz	
Transmitter Dispersion Penalty (10G)	TDP	-	-	3.5	dB	(2)
Output Optical Power TX Disable per Lane	P _{OUT_OFF}	-	-	–30	dBm	(5)
TX Mask Compliance (10G)	-	{X1, X2, X3, Y1, Y2, Y3} = {0.25, 0.40, 0.45, 0.25, 0.28, 0.40}				(2)



Receiver						
Unstressed Receiver Sensitivity (1G)	RX _{SENS1G}	-	-	–17	dBm	(3)
Unstressed Receiver Sensitivity (10G)	RX _{SENS10G}	-	-	–9.9	dBm	(4)
Unstressed Receiver Sensitivity in OMA (10G)	RX _{SENS10G_OMA}	-	-	–11.3	dBm	(4, 7)
Stressed Receiver Sensitivity in OMA (10G)	RX _{ST10G_OMA}	-	-	–7.5	dBm	(4)
Receiver Saturation (1G)	RX _{SAT1G}	2.4	-	-	dBm	(3)
Receiver Saturation (10G)	RX _{SAT10G}	2.4	-	-	dBm	(4)
Receiver Saturation in OMA (10G)	RX _{SAT10G_OMA}	3	-	-	dBm	(4)
Receiver Overload	RX _{OV}	3.4	-	-	dBm	
Optical Center Wavelength (1G)	λ _{C1G}	770	-	860	nm	
Optical Center Wavelength (10G)	λ _{C10G}	840	-	860	nm	
Receiver Reflectance	RL	-	-	–12	dB	
Vertical Eye Closure Penalty	VECP	-	-	3.5	dB	
Loss of Signal De-Assert (1G)	LOS _{D1G}	-	-	–12	dBm	(3)
Loss of Signal De-Assert (10G)	LOS _{D10G}	-	-	–18	dBm	(4)
Loss of Signal Assert	LOS _A	–26	-	-	dBm	
Loss of Signal Hysteresis	LOS _H	0.5	-	-	dB	

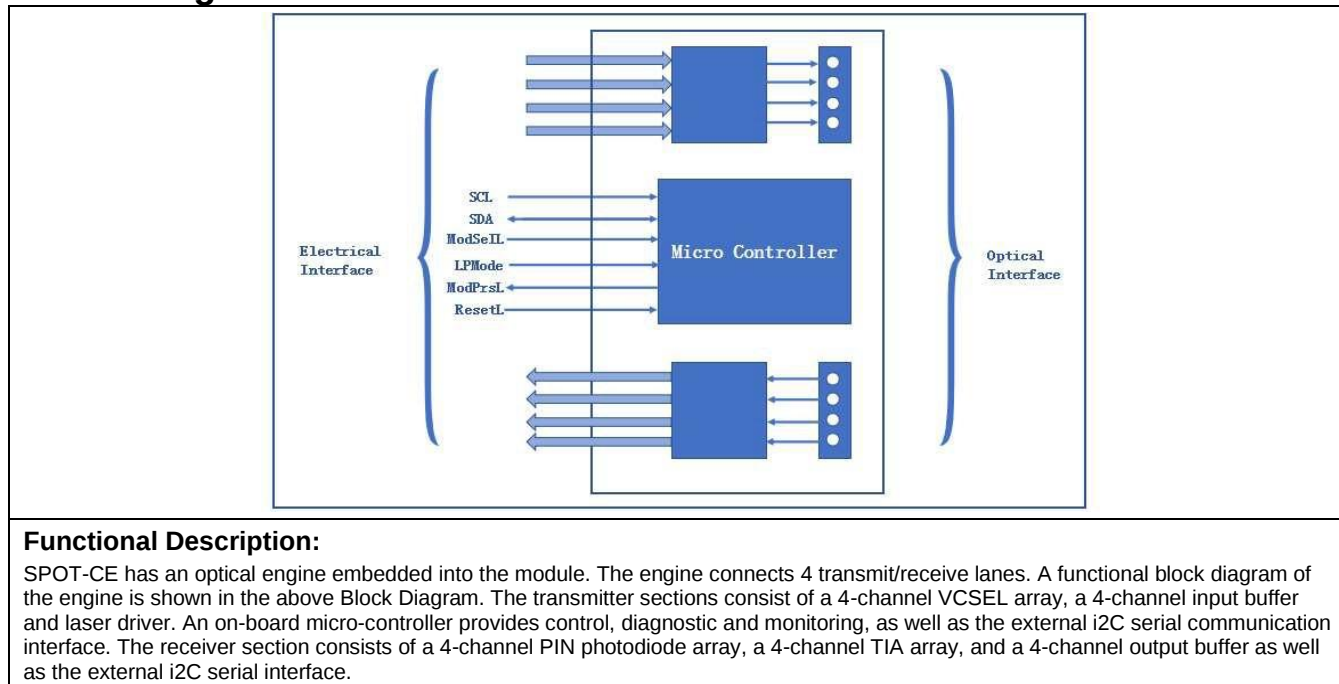
Notes:

- 1) Rate Select TX Low.
- 2) Rate Select TX High.
- 3) Rate Select RX Low; BER 1E–12.
- 4) Rate Select RX High; BER 1E–12.
- 5) Average.
- 6) At low transmit OMA, the product supports a higher extinction ratio than 3dB to achieve the minimum average output power spec listed.
- 7) Better than IEEE performance (increased link budget) available. Contact COTSWORKS for more information.





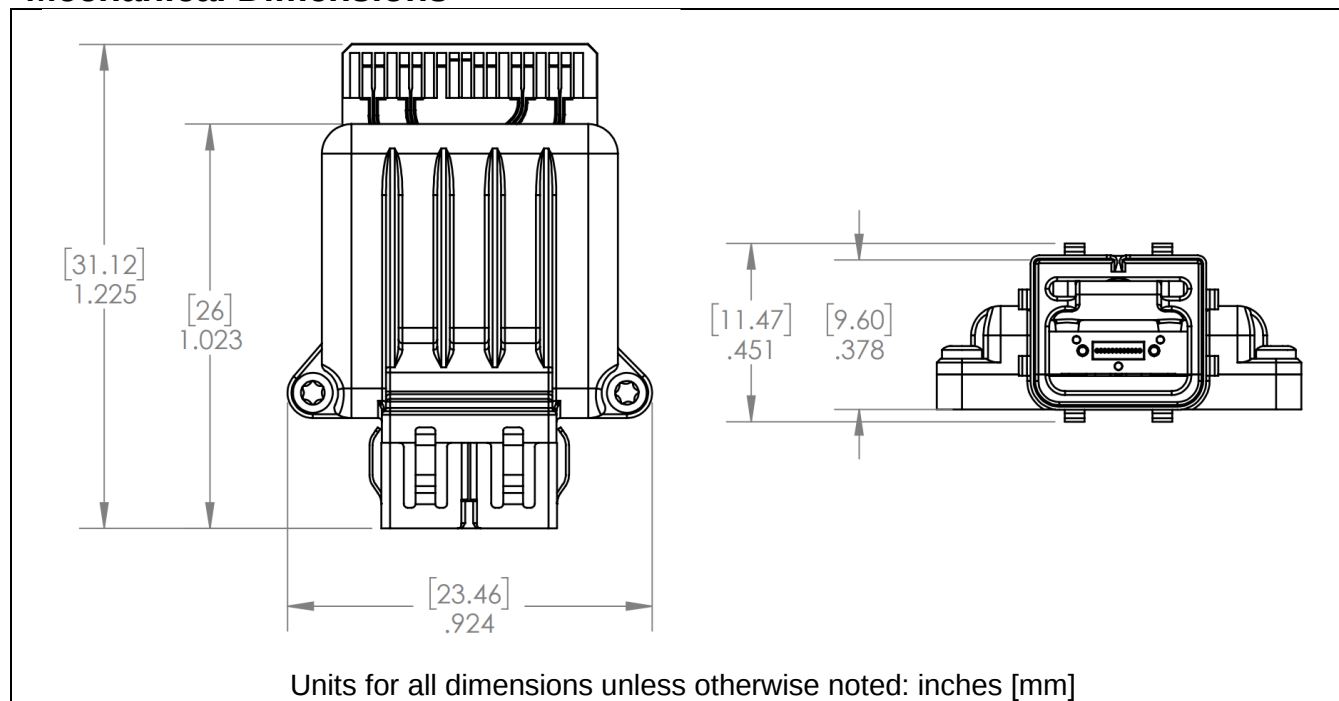
Block Diagram of Transceiver



Functional Description:

SPOT-CE has an optical engine embedded into the module. The engine connects 4 transmit/receive lanes. A functional block diagram of the engine is shown in the above Block Diagram. The transmitter sections consist of a 4-channel VCSEL array, a 4-channel input buffer and laser driver. An on-board micro-controller provides control, diagnostic and monitoring, as well as the external i2C serial communication interface. The receiver section consists of a 4-channel PIN photodiode array, a 4-channel TIA array, and a 4-channel output buffer as well as the external i2C serial interface.

Mechanical Dimensions





Ruggedization Notes

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

Reference Information

- 1) SFF-8636 Specification for monitoring and management via I²C bus of fixed and operating parameters
- 2) IEEE 802.3z CL38 1000BASE-SX ethernet data specification
- 3) IEEE 802.3ae CL49/52 10GBASE-SR ethernet data specification
- 4) IEEE 802.3ba CL82/86 40GBASE-SR4 ethernet data specification

Regulatory Compliance

- These products are designed to comply with Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950.

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.

SPOT-CE	-SR4	-X	-X	-X	-X
Secure Parallel Optical Transceiver – Card Edge	Wavelength	Ruggedized Coating	Operating Temperature Range	RoHS Level	EMI Shield
Rate Selectable for 1, 10, 40 Gbps		(): Non-Coated	A: -40 to 85°C	(): Level 5	(): No Shield
FDS Ferrule Detection Sensor	850nm Short Reach	R: Coated	M: -40 to 95°C	6: Level 6	E: Shield
MT-T Receptacle					

Contact COTSWORKS for mechanical dimensional information, lead times and other configuration options (including operating specification customization).





MT-T



The SPOT-CE module is designed to accept a COTSWORKS MT-T™ connector (pictured above) which has been designed for high shock and vibration environments. Contact COTSWORKS for more information.

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