

# DS-16G-ER-Dxxxx

SFP+, 16/8/4 Gbps FC/FICON, DWDM, SM, DDM, 13dB, 40km

## DS-16G-ER-Dxxxx OVERVIEW

The DS-16G-ER-Dxxxx fiber optical SFP+ (small form pluggable) transceivers are uniquely layer 1 tested and approved by Cisco. They include a PIN diode and temperature stabilized DFB-EML transmitter. The modules operate at data-rates up to 14.025 Gbps. The DWDM modules operate at nominal Dense Wavelength Division Multiplexing (DWDM) wavelengths on the 50GHz/100GHz grid as defined in the ITU-T 694.1 standard. The module has a duplex LC optical interface and all mechanical characteristics are compliant with the current SFP+ specification (SFF-8431 and SFF-8432). All SFP modules fulfill the content of the serial EEPROM described in the SFP MSA, Appendix B4, table 3.1, at base data fields (defined as addresses 0 to 63) and extended data fields (defined as addresses 64 to 95). The nominal transmitter output wavelength is stated at the reserved addresses 60-61 according to SFF document SFF-8472 rev 10.5, "Digital Diagnostics Monitoring Interface". Wavelengths stated in the specification are measured in vacuum. All requirements in this specification are valid throughout the specified lifetime and operational environmental temperature range unless otherwise stated. The transceiver modules are compliant to RoHS-6/6

## PRODUCT FEATURES

- Layer 1 tested and approved by Cisco
- Up to 14.025 Gbps data-rates
- Up to 40km on 9/125um SMF (G.652)
- TX and Rx clock data recovery (CDR) IC
- Enhanced EWRAP, OWRAP operational features
- Duplex LC connector
- Compliant with SFP+ MSA
- Hot-pluggable SFP footprint
- Single power supply 3.3V
- RoHS6 Compliant
- Class 1 laser product complies with EN 60825-1
- Operating temperature range: 0°C to 70°C.
- Power consumption <2.25W

## APPLICATIONS

- 16/8/4 Gbps Fibre Channel / FICON
- DWDM, SAN, WAN connectivity

## ORDERING INFORMATION

Part Number	Description
DS-16G-ER-Dxxxx	SFP+, 16/8/4 Gbps FC/FICON, DWDM, SM, DDM, 13dB, 40km

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For more information visit [smaroptics.com](http://smaroptics.com).

## GENERAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Data Rate	$DR$	4.25		14.025	Gbps	
Bit Error Rate	$BER$			$10^{-12}$		
Operating Temperature	$T_{OP}$	0		70	°C	Case temperature
Storage Temperature	$T_{STO}$	-40		85	°C	Ambient temperature
Supply Current	$I_S$		450	650	mA	For electrical power interface
Rush-in current	$I_{Rush}$			650	mA	
Input Voltage	$V_{CC}$	3.13	3.3	3.45	V	
Maximum Voltage	$V_{MAX}$	-0.5		3.6	V	For electrical power interface
Total Power Dissipation			1.9	2.25	W/1	

## OPTICAL CHARACTERISTICS – TRANSMITTER

End of Life, overall operating conditions

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Output Optical Power	$P_{TX}$	0		+4	dBm	Average, coupled into 9/125um SMF
Extinction ratio	$Er$	8.2			dB	
Optical Center Wavelength	$\lambda_c$	According to ITU-T 694.1			nm	$\pm 100$ pm, EOL value
Spectral Width (-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	$SMSR$	30			dB	
Transmitter and Dispersion Penalty				2	dB	800ps/nm, 14.025Gb/s
Relative Intensity noise	$RIN$			-130	dB/Hz	Peak-to-Peak
Launch Power OFF	$P_{off}$			-30	dBm	Average

## OPTICAL CHARACTERISTICS – RECEIVER

End of Life, overall operating conditions

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Optical Receiver Power	$P_{RX}$			-2	dBm	Average
Optical Center Wavelength	$\lambda_c$	1480		1580	nm	
Receiver Sensitivity @ 14.25GBps	$RX\_SENS1$			-13	dBm	$BER < 10^{-12}$ , PRBS $2^{31}-1$
Receiver Sensitivity @ 8.5GBps	$RX\_SENS2$			-14	dBm	$BER < 10^{-12}$ , PRBS $2^7-1$
Receiver Sensitivity @ 4.25GBps	$RX\_SENS3$			-14	dBm	$BER < 10^{-12}$ , PRBS $2^7-1$
Loss of Signal-Asserted	$PLOS\_A$			-24	dBm	
Loss of Signal-Deasserted	$PLOS\_D$	-14			dBm	
Loss of Signal-Hysteresis	$PLOS\_H$	1		4	dB	

## ELECTRICAL CHARACTERISTICS – HIGH-SPEED SIGNAL INTERFACE (CML)

End of Life, overall operating conditions

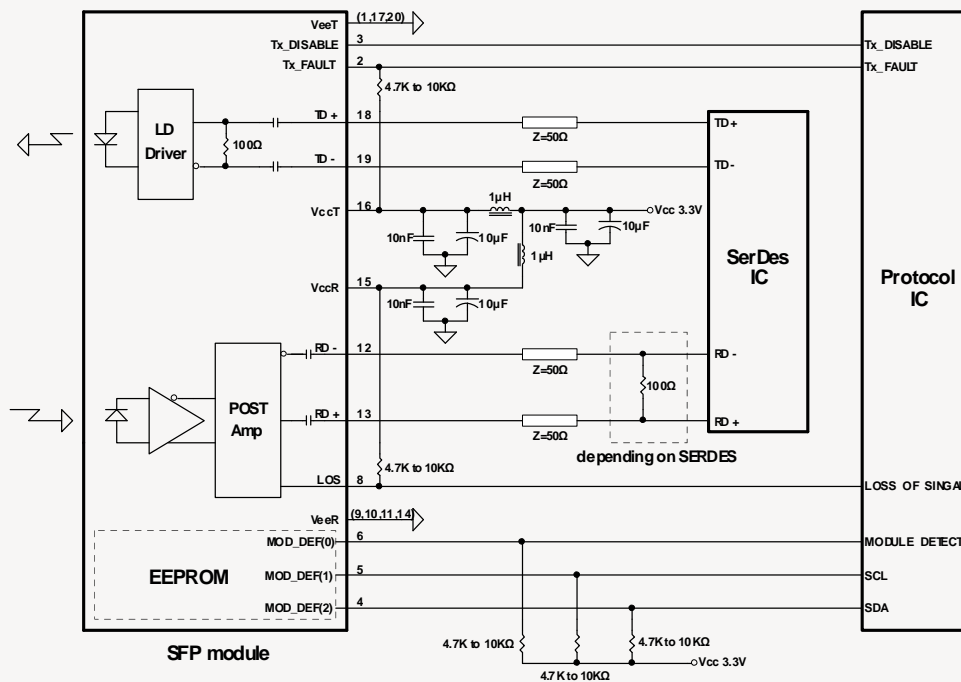
Parameter	Symbol	Min	Typ	Max	Unit	Notes
Input Data Rate		4.25	14.025		Gb/s	
TX Clock Tolerance				±100	ppm	
Differential Input Impedance	$R_{IN}$		100		$\Omega$	
Differential data input amplitude		170		700	mVpp	Internally AC coupled
Output Data Rate		4.25	14.025		Gb/s	
RX Clock Tolerance				±100	ppm	
Differential Output Impedance	$R_{OUT}$		100		$\Omega$	
Differential data output amplitude		300	600	850	mVpp	Internally AC coupled

## ELECTRICAL CHARACTERISTICS – LOW-SPEED SIGNAL INTERFACE (LVTTTL)

End of Life, overall operating conditions

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Input High Voltage		2.0		$V_{CC}+0.3$	V	TX-DIS, TX-FAULT
Input Low Voltage		GND		0.8	V	
Output High Voltage		2.4		$V_{CC}$	V	RX-LOS
Output Low Voltage		GND		0.5	V	

## RECOMMENDED CIRCUIT SCHEMATIC



## PIN FUNCTION DEFINITIONS

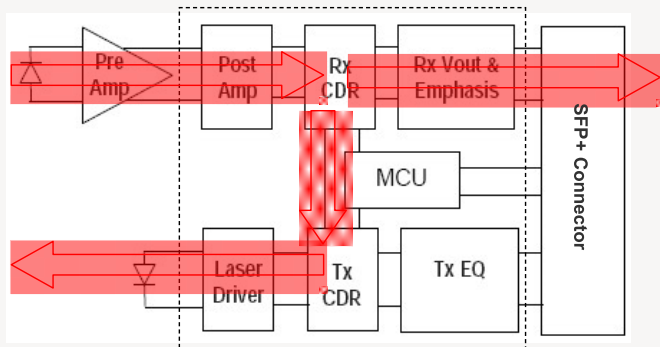
PIN	Signal Name	Description	PIN	Signal Name	Description
1	V <sub>EE</sub> T	Transmitter Signal Ground	11	V <sub>EE</sub> R	Receiver Signal Ground
2	TX_Fault	Transmitter Fault Indication. Logic "1" Output = Laser Fault. Logic "0" Output = Normal Operation	12	RD-	Inverse Receiver Data Out
3	TX_Disable	Logic "1" Input (or no connection) = Laser off, Logic "0" = Laser on.	13	RD+	Receiver Data Out
4	SDA	Modulation Definition 2 – Two wires serial ID Interface	14	V <sub>EE</sub> R	Receiver Signal Ground
5	SDL	Modulation Definition 1 – Two wires serial ID Interface	15	V <sub>CC</sub> R	Receiver Power – 3.3V±5%
6	MOD-ABS	Modulation Definition 0 – Ground in Module	16	V <sub>CC</sub> T	Transmitter Power – 3.3V±5%
7	RS0	RX Rate Select (LVTTL). This pin has an internal 30k pulldown to ground. A signal on this pin will not affect module performance.	17	V <sub>EE</sub> T	Transmitter Signal Ground
8	RX_LOS	Loss of Signal Out (OC).	18	TD+	Transmitter Data In
9	RS1	TX Rate Select (LVTTL). This pin has an internal 30k pulldown to ground. A signal on this pin will not affect module performance.	19	TD-	Inverse Transmitter Data In
10	V <sub>EE</sub> R	Receiver Signal Ground	20	V <sub>EE</sub> T	Transmitter Signal Ground

## WRAP OPERATION FUNCTIONS – SOFT CONTROL (ADDRESS A2H, BYTE 111)

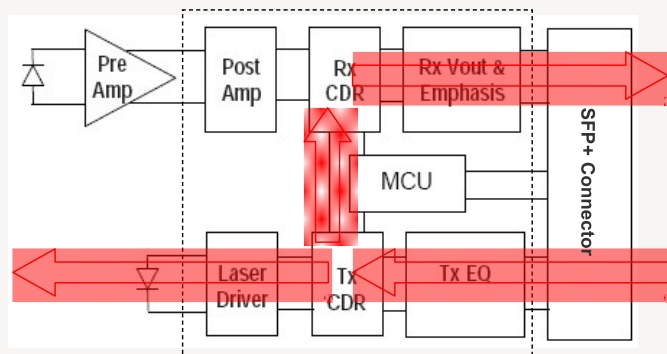
To assist with local host or remote diagnostic and optimization sequences, electrical and optical wrap functions can be enabled. Optical wrap (OWRAP) takes the received optical signal through CDRs and retransmits it optically out. Electrical wrap (EWRAP) takes the received electrical signal through CDRs and retransmits it electrically out. Optional forward functions can be transmitted outbound the wrapped information via i2c control.

Byte	Bit	Name	Description
	4-7	Reserved	Reserved
	3	OWRAP Forward Enable Bit	When set in combination with OWRAP Enable, OWRAP Forward routes incoming SFP+ Rx optical data to both the Tx optical output and the Rx electrical output. Enabling sets bit 2 and clears all other bits in byte 111.
111	2	OWRAP Enable Bit	When set, OWRAP routes incoming SFP+ Rx optical data to the Tx optical output. Enabling clears all other bits in byte 111.
	1	EWRAP Forward Enable Bit	When set in combination with EWRAP Enable, EWRAP Forward routes incoming SFP+ Tx electrical data to both Rx electrical output and Tx optical output. Enabling sets bit 0 and clears all other bits in byte 111.
	0	EWRAP Enable Bit	When set, EWRAP Enable routes incoming SFP+ Tx electrical data to the Rx electrical output. Enabling clears all other bits in byte 111.

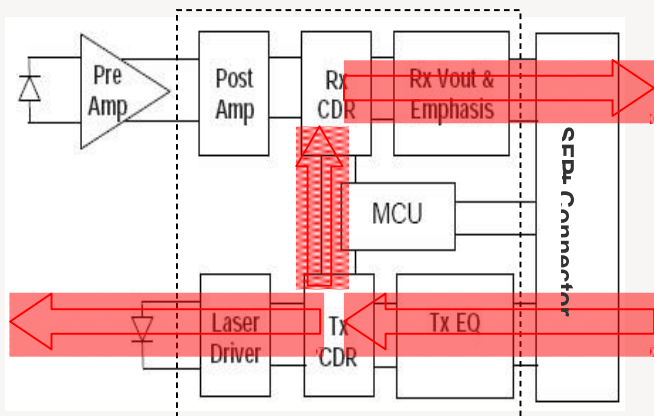
### OWRAP FORWARD ENABLE MODE (I2C CONTROLLED)



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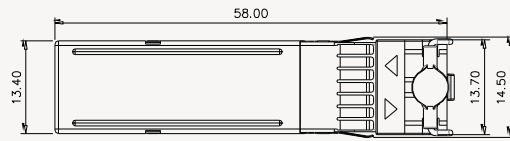


### EWRAP FORWARD ENABLE MODE (I2C CONTROLLED)

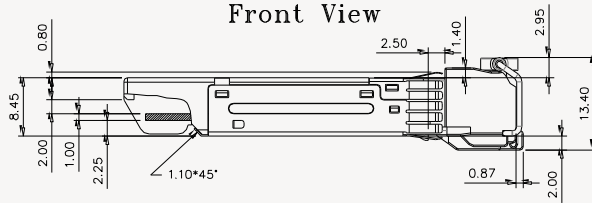


MECHANICAL DRAWING

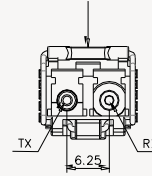
Top View



Front View

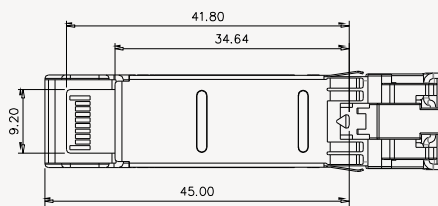


LATCH COLOR  
White



Side View

Bottom View



## ORDERING INFORMATION (EVEN WAVELENGTHS)

Label part number	Frequency (THz)	Center Wavelength (nm)
DS-16G-ER-D6142	192.0	1561.42
DS-16G-ER-D6061	192.1	1560.61
DS-16G-ER-D5979	192.2	1559.79
DS-16G-ER-D5898	192.3	1558.98
DS-16G-ER-D5817	192.4	1558.17
DS-16G-ER-D5736	192.5	1557.36
DS-16G-ER-D5655	192.6	1556.55
DS-16G-ER-D5575	192.7	1555.75
DS-16G-ER-D5494	192.8	1554.94
DS-16G-ER-D5413	192.9	1554.13
DS-16G-ER-D5333	193.0	1553.33
DS-16G-ER-D5252	193.1	1552.52
DS-16G-ER-D5172	193.2	1551.72
DS-16G-ER-D5092	193.3	1550.92
DS-16G-ER-D5012	193.4	1550.12
DS-16G-ER-D4932	193.5	1549.32
DS-16G-ER-D4851	193.6	1548.51
DS-16G-ER-D4772	193.7	1547.72
DS-16G-ER-D4692	193.8	1546.92
DS-16G-ER-D4612	193.9	1546.12
DS-16G-ER-D4532	194.0	1545.32
DS-16G-ER-D4453	194.1	1544.53
DS-16G-ER-D4373	194.2	1543.73
DS-16G-ER-D4294	194.3	1542.94
DS-16G-ER-D4214	194.4	1542.14
DS-16G-ER-D4135	194.5	1541.35
DS-16G-ER-D4056	194.6	1540.56
DS-16G-ER-D3977	194.7	1539.77
DS-16G-ER-D3898	194.8	1538.98
DS-16G-ER-D3819	194.9	1538.19
DS-16G-ER-D3740	195.0	1537.40
DS-16G-ER-D3661	195.1	1536.61
DS-16G-ER-D3582	195.2	1535.82
DS-16G-ER-D3504	195.3	1535.04
DS-16G-ER-D3425	195.4	1534.25
DS-16G-ER-D3347	195.5	1533.47
DS-16G-ER-D3268	195.6	1532.68
DS-16G-ER-D3190	195.7	1531.90
DS-16G-ER-D3112	195.8	1531.12
DS-16G-ER-D3033	195.9	1530.33
DS-16G-ER-D2955	196.0	1529.55

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## ORDERING INFORMATION (ODD WAVELENGTHS)

Label part number	Frequency (THz)	Center Wavelength (nm)
DS-16G-ER-D6142	192.05	1561.42
DS-16G-ER-D6061	192.15	1560.61
DS-16G-ER-D5979	192.25	1559.79
DS-16G-ER-D5898	192.35	1558.98
DS-16G-ER-D5817	192.45	1558.17
DS-16G-ER-D5736	192.55	1557.36
DS-16G-ER-D5655	192.65	1556.55
DS-16G-ER-D5575	192.75	1555.75
DS-16G-ER-D5494	192.85	1554.94
DS-16G-ER-D5413	192.95	1554.13
DS-16G-ER-D5333	193.05	1553.33
DS-16G-ER-D5252	193.15	1552.52
DS-16G-ER-D5172	193.25	1551.72
DS-16G-ER-D5092	193.35	1550.92
DS-16G-ER-D5012	193.45	1550.12
DS-16G-ER-D4932	193.55	1549.32
DS-16G-ER-D4851	193.65	1548.51
DS-16G-ER-D4772	193.75	1547.72
DS-16G-ER-D4692	193.85	1546.92
DS-16G-ER-D4612	193.95	1546.12
DS-16G-ER-D4532	194.05	1545.32
DS-16G-ER-D4453	194.15	1544.53
DS-16G-ER-D4373	194.25	1543.73
DS-16G-ER-D4294	194.35	1542.94
DS-16G-ER-D4214	194.45	1542.14
DS-16G-ER-D4135	194.55	1541.35
DS-16G-ER-D4056	194.65	1540.56
DS-16G-ER-D3977	194.75	1539.77
DS-16G-ER-D3898	194.85	1538.98
DS-16G-ER-D3819	194.95	1538.19
DS-16G-ER-D3740	195.05	1537.40
DS-16G-ER-D3661	195.15	1536.61
DS-16G-ER-D3582	195.25	1535.82
DS-16G-ER-D3504	195.35	1535.04
DS-16G-ER-D3425	195.45	1534.25
DS-16G-ER-D3347	195.55	1533.47
DS-16G-ER-D3268	195.65	1532.68
DS-16G-ER-D3190	195.75	1531.90
DS-16G-ER-D3112	195.85	1531.12
DS-16G-ER-D3033	195.95	1530.33
DS-16G-ER-D2955	196.05	1529.55

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