Professional high-speed optical transceiver

OPN-S1OD190-40LC2

16G FC / 50GHz DWDM / 40 km Digital Diagnostic SFP+ LC SINGLE-MODE TRANSCEIVER

PRODUCT FEATURES

- Up to 14.025 Gbps Bi-directional Data Links
- Complaint to SFP+ MSA
- Compliance with Fibre Channel 1600-SM-LC-L
- Maximum Link Length of 40 km
- Temperature-stabilized DWDM EML Transmitter
- 14 dB Power Budget at Least
- 50 GHz ITU Grid, C Band
- RX Rate Selection for 16G FC and 8G/4G FC
- Flexibility in RX data rate selection through eitherhardware or software control
- SFF-8472 Digital Diagnostic Function
- AC/AC Coupling according to MSA
- Single +3.3 V Power Supply
- RoHS Compliant
- 0 to 70°C Operating
- Class 1 Laser International Safety Standard IEC-60825Compliant

APPLICATIONS

- Multi-rate 16x / 8x / 4x Fibre Channel
- 10G FCoE

PRODUCT DESCRIPTION

The OPN-S1OD190-40LC2 series single mode transceiver is a small form factor pluggable module for bi-directional serial optical data communications such as 16x/8x/4x Fibre Channel. It is with the SFP+ 20-pin connector to allow hotplug capability. Digital diagnostic functions are available via an I^2C. This module is designed for single mode fiber and operates at a nominal wavelength of 50GHz ITU Grid,C Band DWDM wavelength. A guaranteed minimum optical link budget of 14 dB is offered. The transmitter section uses temperature-stabilized DWDM electrical-modulated laser (EML) and is a class 1 laser compliant according to International Safety Standard IEC-60825. The receiver section uses an integrated InGaAs detector preamplifier (IDP) mounted in an optical header and a rate selection clock data recovery (CDR) IC.

ORDER INFORMATION

P/No.	Bit Rate (Gb/s)	FC	Distance (km)	Spacing (GHz)	Wavelength (nm)	Package	Case Temp (°C)	RoHS Compliant
OPN-S1OD190-40LC2	14.025	16G/8G/4G	40	50	DWDM*	SFP+ with DMI	0 to 70	Yes

*XXX: 50GHz ITU Grid wavelength (Please see below)

Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
190	OPN-S1OD190-40LC2	191.90	1562.23	190
195	OPN-S1OD195-40LC2	191.95	1561.83	195
200	OPN-S1OD200-40LC2	192.00	1561.42	200
205	OPN-S1OD205-40LC2	192.05	1561.01	205
210	OPN-S1OD210-40LC2	192.10	1560.61	210
215	OPN-S1OD215-40LC2	192.15	1560.20	215
220	OPN-S1OD220-40LC2	192.20	1559.79	220
225	OPN-S1OD225-40LC2	192.25	1559.39	225
230	OPN-S1OD230-40LC2	192.30	1558.98	230
235	OPN-S1OD235-40LC2	192.35	1558.58	235
240	OPN-S1OD240-40LC2	192.40	1558.17	240
245	OPN-S1OD245-40LC2	192.45	1557.77	245
250	OPN-S1OD250-40LC2	192.50	1557.36	250
255	OPN-S1OD255-40LC2	192.55	1556.96	255

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Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
260	OPN-S1OD260-40LC2	192.60	1556.55	260
265	OPN-S1OD265-40LC2	192.65	1556.15	265
270	OPN-S1OD270-40LC2	192.70	1555.75	270
275	OPN-S1OD275-40LC2	192.75	1555.34	275
280	OPN-S1OD280-40LC2	192.80	1554.94	280
285	OPN-S1OD285-40LC2	192.85	1554.54	285
290	OPN-S1OD290-40LC2	192.90	1554.13	290
295	OPN-S1OD295-40LC2	192.95	1553.73	295
300	OPN-S1OD300-40LC2	193.00	1553.33	300
305	OPN-S1OD305-40LC2	193.05	1552.93	305
310	OPN-S1OD310-40LC2	193.10	1552.52	310
315	OPN-S1OD315-40LC2	193.15	1552.12	315
320	OPN-S1OD320-40LC2	193.20	1551.72	320
325	OPN-S1OD325-40LC2	193.25	1551.32	325
330	OPN-S1OD330-40LC2	193.30	1550.92	330
335	OPN-S1OD335-40LC2	193.35	1550.52	335
340	OPN-S1OD340-40LC2	193.40	1550.12	340
345	OPN-S1OD345-40LC2	193.45	1549.72	345
350	OPN-S1OD350-40LC2	193.50	1549.32	350
355	OPN-S1OD355-40LC2	193.55	1548.91	355
360	OPN-S1OD360-40LC2	193.60	1548.51	360
365	OPN-S1OD365-40LC2	193.65	1548.11	365
370	OPN-S1OD370-40LC2	193.70	1547.72	370
375	OPN-S1OD375-40LC2	193.75	1547.32	375
380	OPN-S1OD380-40LC2	193.80	1546.92	380
385	OPN-S1OD385-40LC2	193.85	1546.52	385
390	OPN-S1OD390-40LC2	193.90	1546.12	390
395	OPN-S1OD395-40LC2	193.95	1545.72	395
400	OPN-S1OD400-40LC2	194.00	1545.32	400
405	OPN-S1OD405-40LC2	194.05	1544.92	405
410	OPN-S1OD410-40LC2	194.10	1544.53	410
415	OPN-S1OD415-40LC2	194.15	1544.13	415
420	OPN-S1OD420-40LC2	194.20	1543.73	420
425	OPN-S1OD425-40LC2	194.25	1543.33	425
430	OPN-S1OD430-40LC2	194.30	1542.94	430
435	OPN-S1OD435-40LC2	194.35	1542.54	435
440	OPN-S1OD440-40LC2	194.40	1542.14	440
445	OPN-S1OD445-40LC2	194.45	1541.75	445
450	OPN-S1OD450-40LC2	194.50	1541.35	450
455	OPN-S1OD455-40LC2	194.55	1540.95	455
460	OPN-S1OD460-40LC2	194.60	1540.56	460
465	OPN-S1OD465-40LC2	194.65	1540.16	465
470	OPN-S1OD470-40LC2	194.70	1539.77	470
475	OPN-S1OD475-40LC2	194.75	1539.37	475
480	OPN-S1OD480-40LC2	194.80	1538.98	480
485	OPN-S1OD485-40LC2	194.85	1538.58	485
490	OPN-S1OD490-40LC2	194.90	1538.19	490
495	OPN-S1OD495-40LC2	194.95	1537.79	495
500	OPN-S1OD500-40LC2	195.00	1537.40	500
505	OPN-S1OD505-40LC2	195.05	1537.00	505
510	OPN-S1OD510-40LC2	195.10	1536.61	510
515	OPN-S1OD515-40LC2	195.15	1536.22	515
520	OPN-S1OD520-40LC2	195.20	1535.82	520
525	OPN-S1OD525-40LC2	195.25	1535.43	525
530	OPN-S1OD530-40LC2	195.30	1535.04	530
535	OPN-S1OD535-40LC2	195.35	1534.64	535
540	OPN-S1OD540-40LC2	195.40	1534.25	540
545	OPN-S1OD545-40LC2	195.45	1533.86	545
550	OPN-S1OD550-40LC2	195.50	1533.47	550
555	OPN-S1OD555-40LC2	195.55	1533.07	555
560	OPN-S1OD560-40LC2	195.60	1532.68	560

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Channel #	Product code	Frequency (THz)	Center Wavelength (nm)	Label
565	OPN-S1OD565-40LC2	195.65	1532.29	565
570	OPN-S1OD570-40LC2	195.70	1531.90	570
575	OPN-S1OD575-40LC2	195.75	1531.51	575
580	OPN-S1OD580-40LC2	195.80	1531.12	580
585	OPN-S1OD585-40LC2	195.85	1530.72	585
590	OPN-S1OD590-40LC2	195.90	1530.33	590
595	OPN-S1OD595-40LC2	195.95	1529.94	595
600	OPN-S1OD600-40LC2	196.00	1529.55	600
605	OPN-S1OD605-40LC2	196.05	1529.16	605
610	OPN-S1OD610-40LC2	196.10	1528.77	610

Absolute Maximum Ratings					
Parameter	**Symbol**	**Min**	**Max**	**Units**	**Notes**
Storage Temperature	Tstg	-50	85	°C	
Relative Humidity	RH	5	85	%	Non-condensing
Operating Case Temperature	Topr	0	70	°C	
Power Supply Voltage	Vcc	-0.5	3.6	V	
Receiver Input Optical Power	Mip		3	dBm	Average power

Recommended Operating Conditions					
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units / Notes**
Power Supply Voltage	Vcc	3.135	3.3	3.465	V
Operating Case Temperature	Topr	0		70	°C
Relative Humidity	RH	5		85	% / Non-condensing
Power Supply Current	$I_{CC\ (TX+RX)}$		350	550	mA
Data Rate		4.25	14.025		Gb/s

Transmitter Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)						
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Notes**
Average Launch Power	Po, AVG	0		4	dBm	1
Extinction Ratio	ER	8.2			dB	
Center Wavelength Spacing			50		GHz	2
Transmitter Center Wavelength -- over life time	λc	X-60	X	X+60	pm	3
Output Spectrum Width	Δλ	---		1	nm	-20 dB width
Side Mode Suppression Ratio	SMSR	30			dB	
Transmitter and Dispersion Penalty @ 800 ps/nm	TDP			2	dB	
Relative Intensity Noise	RIN			-130	dB/Hz	
Average Launch Power of OFF Transmitter				-30	dBm	

1. Output power is power coupled into a 9/125 μm single-mode fiber.
2. Corresponds to approximately 0.8 nm.
3. X = specified ITU Grid wavelength.

Receiver Optical Specifications (0°C < Topr < 70°C, 3.13V < Vcc < 3.47V)						
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Notes**
Sensitivity				-14	dBm	4
Receiver Overload	P_{MAX}	1	---		dBm	
LOS – Deasserted	LOS_D	---	---	-14	dBm	Transition: low to high
LOS – Asserted	LOS_A	-24	---	---	dBm	Transition: high to low
Wavelength of Operation	λc	1480		1580	nm	
Optical Return Loss	ORL			-27	dB	

4. Measured with worst ER; BER < 10^{-12} and PRBS 2^{31}-1. Equivalent to -14.3 dBm OMA at ER=8.2 dB.

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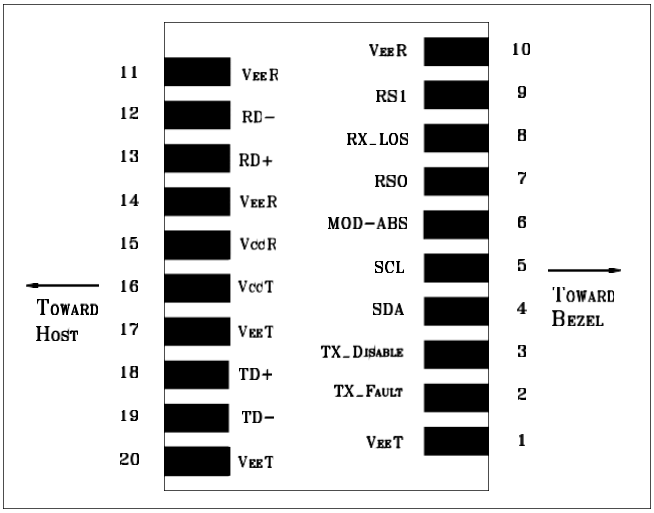
Electrical Characteristics						
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Notes**
High-Speed Signal (CML) Interface Specification						
Input Data Rate		4.25	14.025		Gb/s	
TX Clock Tolerance		-100		+100	ppm	5
Differential Input Impedance	Rin		100		Ω	
Differential Data Input Amplitude		150		1200	mVpp	Internally AC coupled
Output Data Rate		4.25	14.025		Gb/s	
RX Clock Tolerance		-100		+100	ppm	5
Differential Output Impedance	Rout		100		Ω	
Differential Data Output Amplitude		350	600	700	mVpp	Internally AC coupled
Low-Speed Signal (LVTTL) Interface Specification						
Input High Voltage		2.0		Vcc+0.3	V	
Input Low Voltage		GND		0.8	V	
Output High Voltage		2.4		Vcc	V	
Output Low Voltage		GND		0.5	V	

5. Clock tolerance for 14.025 Gb/s, 8.5Gb/s and 4.25 Gb/s.

CONNECTION DIAGRAM



PIN	Signal Name	Description	PIN	Signal Name	Description
1	VEET	Transmitter Signal Ground	11	VEER	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	VEER	Receiver Signal Ground
5	SCL	Modulation Definition 1 – Two wires serial	ID15	VCCR	Receiver Power – 3.3V±5%
		Interface			
6	MOD-ABS	Modulation Definition 0 – Ground in Module	16	VCCT	Transmitter Power – 3.3V±5%
7	RS0	RX Rate Select: Open or Low: 8.5 or 4.25 Gb/s FC. High: enable CDR for 16GFC.	17	VEET	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	$V_{EE}R$	Receiver Signal Ground	20	$V_{EE}T$	Transmitter Signal Ground

MODULE DEFINITION

Module Definition	PIN 4	PIN 5	PIN 6	Interpretation by Host
4	SDA	SCL	MOD-ABS	Serial module definition protocol

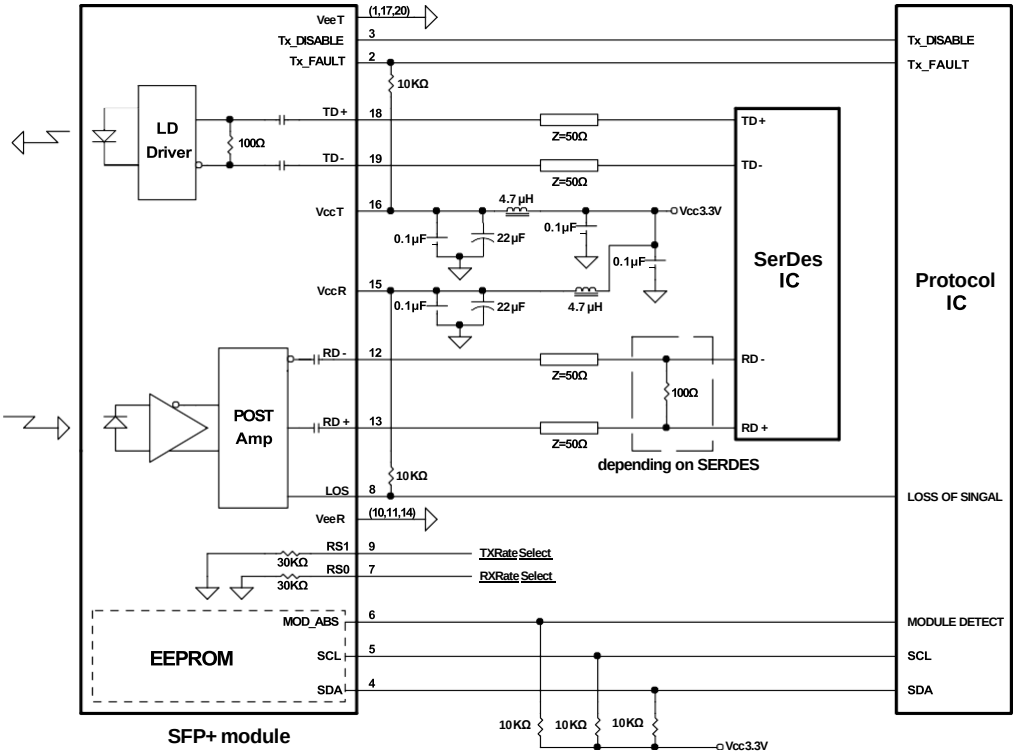
Module Definition 4 specifies a serial definition protocol. For this definition, upon power up, SDA and SCL appear as no connection (NC) and MOD-ABS is TTL LOW. When the host system detects this condition, it activates the serial protocol. The protocol uses the 2-wire serial CMOS E^2PROM protocol of the ATMEL AT24C01A/02/04 family of components.

RX Rate Select Control

RX rate can be independently controlled by either RS0 input pin (Hardware) or via register write to soft RS0 select bit (Software). RS0 input pin (pin 7) is used to select RX rate. Status of RS0 input pin logic level is reflected to register byte 110 bit 4 on address A2h. RX rate can also be controlled by register write to soft RS0 select bit (byte 110 bit 3 on address A2h). Power on default of soft RS0 select bit is logic low. Hardware and software control inputs are OR'd to allow flexible control. See following RX operation logic table:

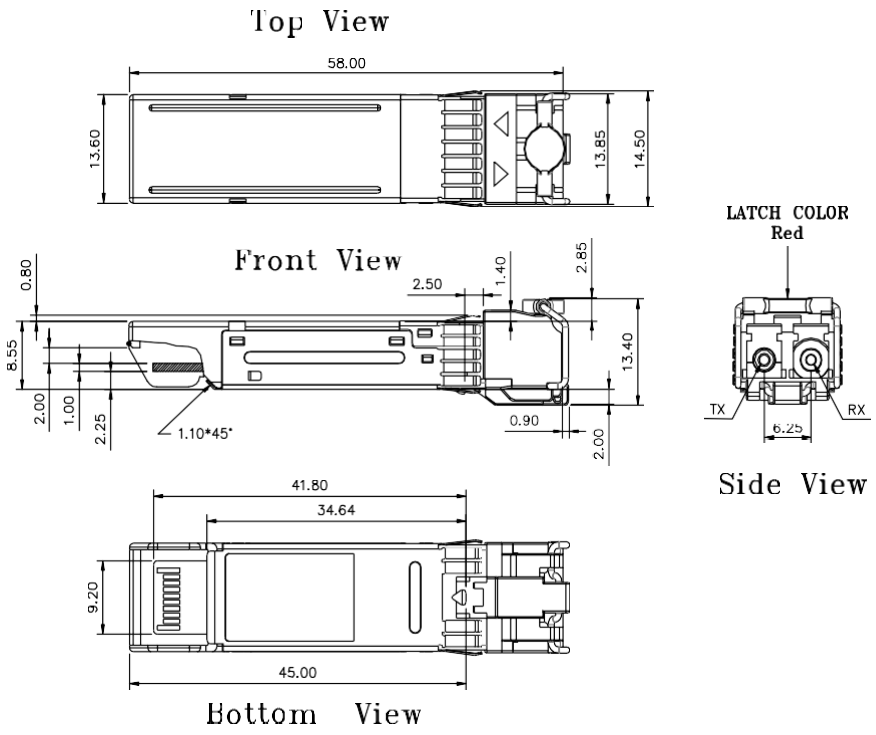
RS0 Control Input		RX Speed	RX CDR
RS0 Input Pin (Hardware: Pin 7)	Soft RS0 Select Bit (Software: Byte 110 Bit 3, A2h)		
0	0	4G/8G FC	Bypassed
0	1	16G FC	Enabled
1	0		
1	1		

RECOMMENDED CIRCUIT SCHEMATIC



PACKAGE DIAGRAM

Units in mm



Note: Specifications subject to change without notice.