

1442496F1C-A

10GBASE, SFP+, DWDM, ZR/OC-192, (SM)
1528.38 NM - 1568.77 NM, 80 KM REACH, LC

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10GBASE, SFP+, DWDM, ZR/OC-192 Transceiver

Features

- Hot-pluggable SFP+ footprint
- 50GHz DWDM ITU-T Full C-band Tunability
- Support 9.95Gb/s to 11.3Gb/s bit rates
- 80km 50GHz DWDM laser
- 80km APD photodiode receiver
- Single 3.3V power supply
- Power dissipation <1.7W
- -5°C to +70°C
- Duplex LC fiber connectors
- 10GBASE-ZR/ZW
- SDH STM-64ITU-T G.959.1 P1L1-2D2
- Full Digital Optical Monitoring
- Metal enclosure for lower EMI
- Complies with RoHS directive (2002/95/EC)
- Compliant with SFP+ Electrical MSA SFF-8431
- Compliant with SFP+ Mechanical MSA SFF-8432



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Applications

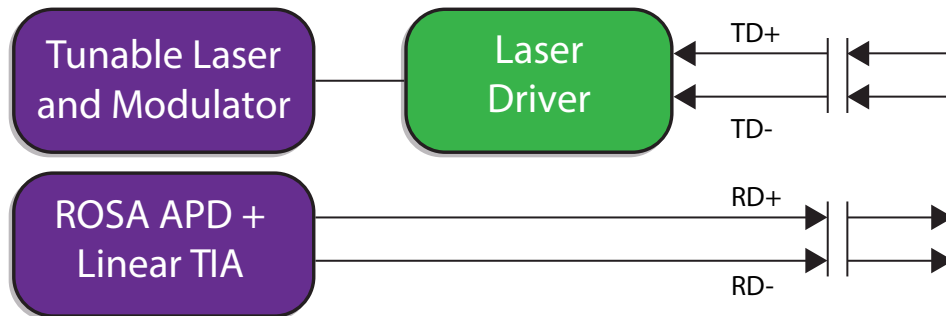
- Full C-band Tunable 10GBASE-ZR 10G Ethernet
- 8GB/10GB Fibre Channel
- SONET OC-192 LR-2
- SDH STM-64ITU-T G.959.1 P1L1-2D2
- Access DWDM Ethernet Switch or IP Router Interconnect

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1. Description

Approved Networks 50GHz Full C-band Tunable 1442496F1C-A transceivers are designed for use in 10Gb/s to 11.1Gb/s 50GHz DWDM links up to 80km of G.652 fiber. The SFP+ module supports 10GBASE-ZR and – ZW applications along with SONET OC-192 LR-2 and SDH STM-64 ITU-T G.959.1 P1L1-2D2 applications for Ethernet Switches, IP Routers or SONET/SDH optical interfaces. Digital Optical Monitoring interfaces are provided via the SFP+ standards compliant I2C interface



2. Transmitter E-O Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Support data rate	-	9.95	10.3125	11.1	Gb/s	-
Center Wavelength (DWDM)	λ	1528.38	-	1568.77	nm	ITU-T
Wavelength Stability after Startup	$\Delta\lambda_{EOL}$	λ_i-25	-	λ_i+25	pm	
DWDM Channel Spacing	$f_{SPACING}$		50		GHz	
Tuning Time	$\Delta TUNE$			1	sec	
Average Optical Output Power	P_o	-1.0	-	+3.0	dBm	
Optical Power of Off Transmitter	P_{off}	-	-	-30	dBm	
Extinction Ratio	E_r	9.0	-	-	dB	1
Side Mode Suppression Ratio	SMSR	35			dB	1
Tx Eye Crossing		45	60	%		
Output Eye Diagram	Compliant with IEEE and GR-253-CORE					

Notes:

1. Measured with 10.709Gbps, PRBS 2³¹-1

3. Receiver O-E Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Support data rate	-	9.95	10.3125	11.1	Gb/s	-
Operating Wavelength	-	1525	-	1570	nm	2
Sensitivity @ 10.3Gbps	Sen1			-24	dBm	3
Sensitivity @ 11.1Gbps	Sen2			-23	dBm	3

Parameter	Symbol	Min	Typ	Max	Unit	Note
Saturation	Ps	-7			dBm	3
Optical Path Penalty @ 10.3Gbps 1600ps/nm	OPP1			2	dB	3
Optical Path Penalty @ 11.1Gbps 1600ps/nm	OPP2			2.5	dB	3
OSNR @ 10.3Gbps	OSNR1	24			dB	4
OSNR @ 10.3Gbps with Disp	OSNR2	26			dB	5
OSNR @ 11.1Gbps	OSNR3	16			dB	6
OSNR @ 11.1Gbps with Disp	OSNR4	18.5			dB	7
Rx Damage Threshold	RXDAMAGE			1	dBm	
LOS Asserted (EOL)	T_loss_on	-33.5			dBm	High level: Alarm
LOS De-Asserted	T_loss_off			-26	dBm	
LOS Hysteresis (EOL)	T_loss_Hs	0.5			dB	

Notes:

- Rx wavelength range is 1270nm to 1610nm with 2dB penalty outside of specified operating range
- Measured with PRBS 231-1 at 10-12 BER
- Measured with PRBS 231-1 at 10-12 BER, 0ps/nm, -7 to -19dBm Rx power
- Measured with PRBS 231-1 at 10-12 BER, -400 to +1600ps/nm, -7 to -19dBm Rx power
- Measured with PRBS 231-1 at 10-4 BER, 0ps/nm, -7 to -19dBm Rx power
- Measured with PRBS 231-1 at 10-4 BER, -400 to +1600ps/nm, -7 to -19dBm Rx power

4. Pin Description

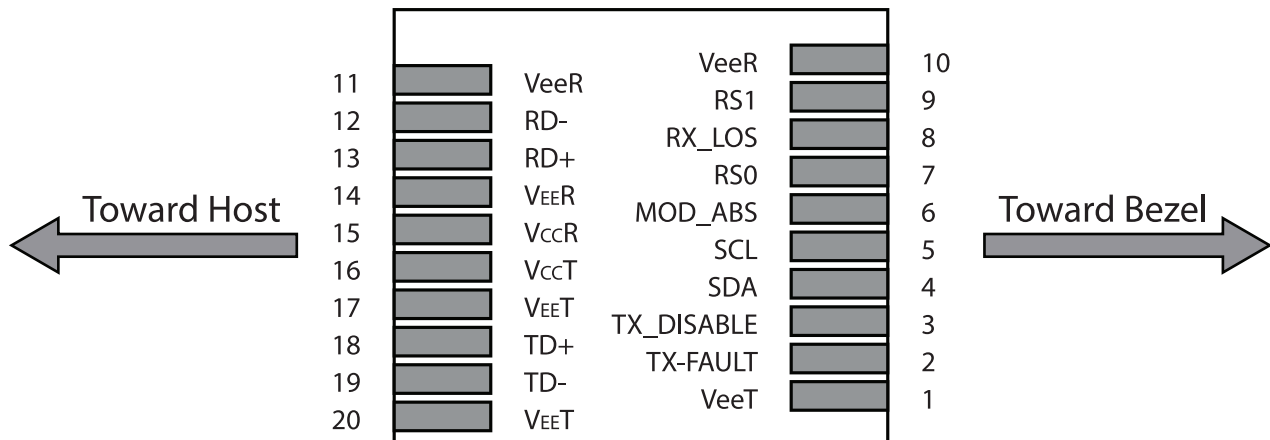


Figure 1. Pin out of Connector Block on Host Board

Pin	Symbol	Name/Description	Notes
case	case	Module case (note 1)	
1	VEET	Transmitter Ground (Common with Receiver Ground)	1
2	TFAULT	Transmitter Fault.	2
3	TDIS	Transmitter Disable. Laser output disabled on high or open.	3
4	SDA	2-wire Serial Interface Data Line	4
5	SCL	2-wire Serial Interface Clock Line	4
6	MOD_ABS	Module Absent. Grounded within the module	4
7	RS0	Rate Select 0	5
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation.	6
9	RS1	No connection required	1
10	VEER	Receiver Ground (Common with Transmitter Ground)	1
11	VEER	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	VEER	Receiver Ground (Common with Transmitter Ground)	1
15	VCCR	Receiver Power Supply	
16	VCCT	Transmitter Power Supply	
17	VEET	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	VEET	Transmitter Ground (Common with Receiver Ground)	1

Notes:

1. The case makes electrical contact to the cage before any of the board edge contacts are made.
2. The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.
3. This contact is an open collector/drain output contact and shall be pulled up on the host.
4. Tx_Disable is an input contact with a 4.7 kΩ to 10 kΩ pullup to VccT inside the module.

5. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Note
Power Supply	Vcc	-0.5		3.7	V	
Storage Temperature	T _{STORAGE}	-40		85	°C	
Operating Temperature	T _{OP}	0		70	°C	
Relative Humidity (non condensing)	RH	5		85	%	

6. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Power Supply	Vcc	3.135		3.465	V	
Supply Current, Sustained	Icc			500	mA	
Power Dissipation	PDIS			1.7	W	

7. Low Speed Control and Sense Signals

Parameter	Symbol	Min	Typ	Max	Unit	Note
Tx_Fault, Rx_LOS	VoL	-0.3		0.40	V	
	IoH	-50		37.5	μA	1
Tx_Disable, RS0, RS1	ViL	-0.3		0.8	V	
	IiH	2.0		VccT +0.3	V	

Notes:

1. Measured with a 4.7 kΩ load pulled up to Vcc_Host where Vcc_Host_min < Vcc_host < Vcc_Host_max

8. High Speed Signals

Parameter	Symbol	Min	Typ	Max	Unit	Note
Input Differential Impedance	RIN		100		Ω	
Differential Swing	VIN, PP	180		700	mV	
Differential Data Output Swing	VOU, PP	300		850	mV	1
Output Rise Time and Fall Time	TR,TF	28			ps	2

Notes:

1. Into 100 Ω differential termination

2. 20% - 80%, PRBS 2⁷-1

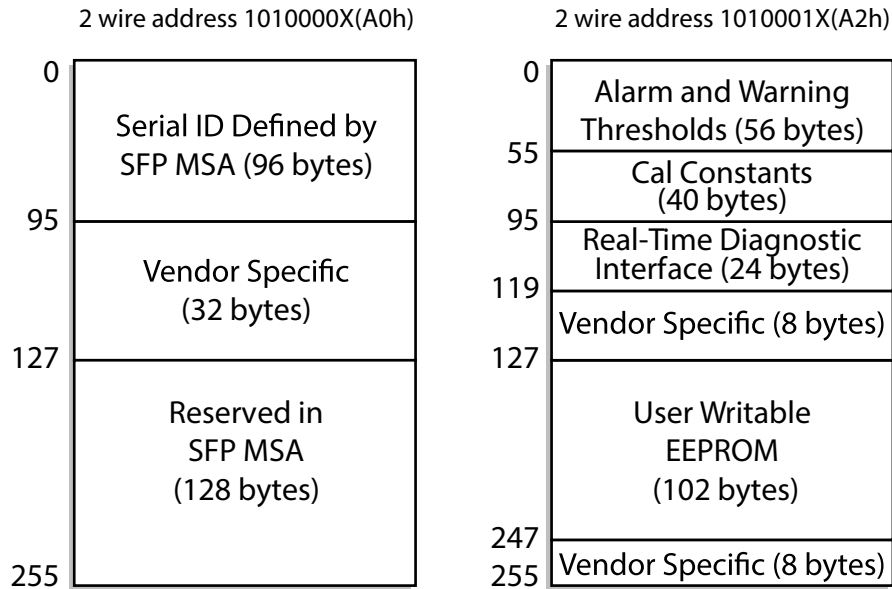
9. Management Timing Parameters

Parameter	Symbol	Min	Max	Unit	Note
Tx_Disable assert time	t_off		100	ms	Rising edge of Tx_Disable to fall of output signal below 10% of nominal
Tx_Disable negate time	t_on		2	ms	Falling edge of Tx_Disable to rise of output signal above 90% of nominal. This only applies in normal operation, not during start up or fault recovery.
Time to initialize 2-wire interface	t_2w_start_up		300	ms	From power on or hot plug
Time to initialize	t_start_up		300	ms	From power supplies meeting required specification or hot plug or Tx disable negated during power up, or Tx_Fault recovery, until non-cooled part is fully operational.
Tx_Fault assert	Tx_Fault_on		1	ms	From occurrence of fault to assertion of Tx_Fault
Tx_Fault Reset	t_reset	10		μs	Time Tx_Disable must be held high to reset Tx_Fault
Rx_LOS assert delay	t_los_on		100	μs	From occurrence of loss of signal to assertion of Rx_LOS
Rx_LOS negate delay	t_los_off		100	μs	From occurrence of presence of signal to negation of Rx_LOS

10. Management Interface

The Tunable SFP+ supports the enhanced digital diagnostic interface. The enhanced interface uses the two wire serial bus address 1010001X (A2h) to provide diagnostic information about the module's present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture.

The SFP+ memory map is shown on the following page:



11. DOM Accuracy and I2C Locations

MSA Register	Size	Name	Accuracy	Description
96-97	2	Transceiver Temperature	+/- 3 Degrees C	MSB at low address
98-99	2	Vcc, measured internally	+/- 3%	MSB at low address
100-101	2	Laser Bias Current	+/- 10%	MSB at low address
102-103	2	Laser Output Power	+/- 3dB	MSB at low address
104-105	2	Receive Optical Power	+/- 3dB (from -5dBm to -28dBm)	MSB at low address

12. Regulatory Compliance

Feature	Reference	Performance
Electrostatic discharge (ESD)	IEC/EN 61000-4-2	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022 Class B (CISPR 22A)	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10, 1040.11 IEC/EN 60825-1, 2	Class 1 laser product
Component Recognition	IEC/EN 60950, UL	Compatible with standards
ROHS	2002/95/EC	Compatible with standards
EMC	EN61000-3	Compatible with standards

13. Wavelengths Supported

The following table provides correlation of the ITU-T DWDM channel number, wavelength and frequency.

Freq (THz)	Wavelength	ITU Ch.	Freq (THz)	Wavelength	ITU Ch.
196.15	1528.38	61.5	196.10	1528.77	61
196.05	1529.16	60.5	196.00	1529.55	60
195.95	1529.94	59.5	195.90	1530.33	59
195.85	1530.72	58.5	195.80	1531.12	58
195.75	1531.51	57.5	195.70	1531.90	57
195.65	1532.29	56.5	195.60	1532.68	56
195.55	1533.07	55.5	195.50	1533.47	55
195.45	1533.86	54.5	195.40	1534.25	54
195.35	1534.64	53.5	195.30	1535.04	53
195.25	1535.43	52.5	195.20	1535.82	52
195.15	1536.22	51.5	195.10	1536.61	51
195.05	1537.00	50.5	195.00	1537.40	50
194.95	1537.79	49.5	194.90	1538.19	49
194.85	1538.58	48.5	194.80	1538.98	48
194.75	1539.37	47.5	194.70	1539.77	47
194.65	1540.16	46.5	194.60	1540.56	46
194.55	1540.95	45.5	194.50	1541.35	45
194.45	1541.75	44.5	194.40	1542.14	44
194.35	1542.54	43.5	194.30	1542.94	43
194.25	1543.33	42.5	194.20	1543.73	42
194.15	1544.13	41.5	194.10	1544.53	41
194.05	1544.92	40.5	194.00	1545.32	40
193.95	1545.72	39.5	193.90	1546.12	39
193.85	1546.52	38.5	193.80	1546.92	38
193.75	1547.32	37.5	193.70	1547.72	37
193.65	1548.11	36.5	193.60	1548.51	36
193.55	1548.91	35.5	193.50	1549.32	35
193.45	1549.72	34.5	193.40	1550.12	34
193.35	1550.52	33.5	193.30	1550.92	33
193.25	1551.32	32.5	193.20	1551.72	32
193.15	1552.12	31.5	193.10	1552.52	31
193.05	1552.93	30.5	193.00	1553.33	30
192.95	1553.73	29.5	192.90	1554.13	29
192.85	1554.54	28.5	192.80	1554.94	28

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1528.38 NM - 1568.77 NM, 80 KM REACH, LC

Freq (THz)	Wavelength	ITU Ch.	Freq (THz)	Wavelength	ITU Ch.
192.75	1555.34	27.5	192.70	1555.75	27
192.65	1556.15	26.5	192.60	1556.55	26
192.55	1556.96	25.5	192.50	1557.36	25
192.45	1557.77	24.5	192.40	1558.17	24
192.35	1558.58	23.5	192.30	1558.98	23
192.25	1559.39	22.5	192.20	1559.79	22
192.15	1560.20	21.5	192.10	1560.61	21
192.05	1561.01	20.5	192.00	1561.42	20
191.95	1561.83	19.5	191.90	1562.23	19
191.85	1562.64	18.5	191.80	1563.05	18
191.75	1563.45	17.5	191.70	1563.86	17
191.65	1564.27	16.5	191.60	1564.68	16
191.55	1565.09	15.5	191.50	1565.50	15
191.45	1565.90	14.5	191.40	1566.31	14
191.35	1566.72	13.5	191.30	1567.13	13
191.25	1567.54	12.5	191.20	1567.95	12
191.15	1568.36	11.5	191.10	1568.77	11

14. Contact Information

Approved Networks is a leading supplier of Network Transceivers and Connectivity products to Channel Partners, Resellers, and OEMs. With more than 9 years of direct industry experience, our products are resident in the most demanding and mission critical functional networks Worldwide. We serve as a Master Distributor to the largest CMs in the world and deploy the most rigorous testing and firmware management programs to bring the highest level of functional product to the market at a cost that makes sense.

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