

## 50GHz Full C-band Tunable 10GBASE-ZR/OC-192 10Gb/s SFP+ 80km

### NS-SFP+Tunable-C-Band-L80D

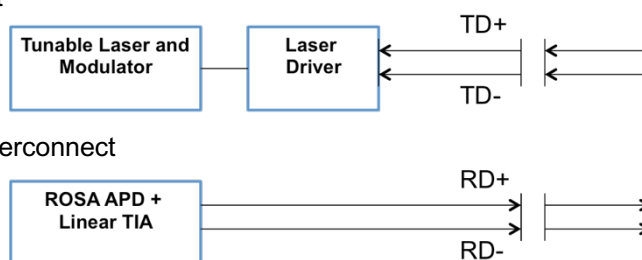
#### Features

- 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
- Laser Class 1 IEC/CDRH compliant



#### 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



#### Descriptions

NewNets 50GHz Full C-band Tunable SFP+ 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

## 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)	$\lambda$	1528.38	-	1568.77	nm	ITU-T
Wavelength Stability after Startup	$\Delta\lambda_{EOL}$	$\lambda_i-25$	-	$\lambda_i+25$	pm	
DWDM Channel Spacing	$f_{SPACING}$		50		GHz	
Tuning Time	$\Delta T_{TUNE}$			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 2<sup>31</sup>-1

## Receiver O-E Characteristics

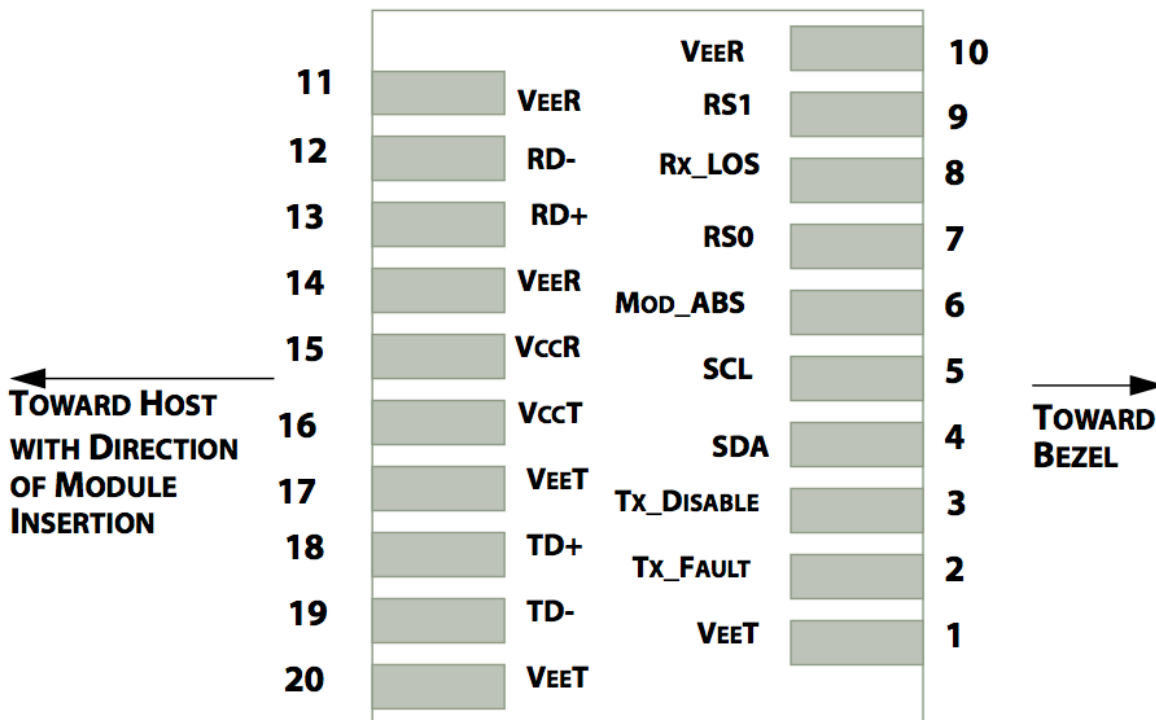
Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Support data rate	-	9.95	10.3125	11.1	Gb/s	-
Operating Wavelength	-	1525	-	1570	nm	2
Sensitivity @ 10.3Gbps	$Sen_1$			-24	dBm	3
Sensitivity @ 11.1Gbps	$Sen_2$			-23	dBm	3
Saturation	$P_s$	-7			dBm	3
Optical Path Penalty @ 10.3Gbps 1600ps/nm	$OPP_1$			2	dB	3
Optical Path Penalty @ 11.1Gbps 1600ps/nm	$OPP_2$			2.5	dB	3
OSNR @ 10.3Gbps	$OSNR_1$	24			dB	4
OSNR @ 10.3Gbps with Disp	$OSNR_2$	26			dB	5
OSNR @ 11.1Gbps	$OSNR_3$	16			dB	6

OSNR @ 11.1Gbps with Disp	OSNR <sub>4</sub>	18.5			dB	7
Rx Damage Threshold	RX <sub>DAMAGE</sub>			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 2<sup>31</sup>-1 at 10<sup>-12</sup> BER
- Measured with PRBS 2<sup>31</sup>-1 at 10<sup>-12</sup> BER, 0ps/nm, -7 to -19dBm Rx power
- Measured with PRBS 2<sup>31</sup>-1 at 10<sup>-12</sup> BER, -400 to +1600ps/nm, -7 to -19dBm Rx power
- Measured with PRBS 2<sup>31</sup>-1 at 10<sup>-4</sup> BER, 0ps/nm, -7 to -19dBm Rx power
- Measured with PRBS 2<sup>31</sup>-1 at 10<sup>-4</sup> BER, -400 to +1600ps/nm, -7 to -19dBm Rx power

**Pin Out**



Contact	Logic	Symbol	Power Sequence	Name/Description	Note
case		case	See 1	Module case	
1		VeeT	1 <sup>st</sup>	Module Transmitter Ground	2
2	LVTTTL-O	Tx_Fault	3 <sup>rd</sup>	Module Transmitter Fault	3
3	LVTTTL-I	Tx_Disable	3 <sup>rd</sup>	Transmitter Disable; Turns off transmitter laser output	4
4	LVTTTL-I/O	SDA	3 <sup>rd</sup>	2-wire Serial Interface Data Line	
5	LVTTTL-I/O	SCL	3 <sup>rd</sup>	2-wire Serial Interface Clock	
6		Mod_ABS	3 <sup>rd</sup>	Module Absent	
7	LVTTTL-I	RS0	3 <sup>rd</sup>	Rate Select 0 (Not used)	
8	LVTTTL-O	Rx_LOS	3 <sup>rd</sup>	Receiver Loss of Signal Indication	3
9	LVTTTL-I	RS1	3 <sup>rd</sup>	Rate Select 1 (Not used)	
10		VeeR	1 <sup>st</sup>	Module Receiver Ground	2
11		VeeR	1 <sup>st</sup>	Module Receiver Ground	2
12	CML-O	RD-	3 <sup>rd</sup>	Receiver Inverted Data Output	
13	CML-O	RD+	3 <sup>rd</sup>	Receiver Non-Inverted Data Output	
14		VeeR	1 <sup>st</sup>	Module Receiver Ground	2
15		VccR	2 <sup>nd</sup>	Module Receiver 3.3 V Supply	
16		VccT	2 <sup>nd</sup>	Module Transmitter 3.3 V Supply	
17		VeeT	1 <sup>st</sup>	Module Transmitter Ground	2
18	CML-I	TD+	3 <sup>rd</sup>	Transmitter Non-Inverted Data Input	
19	CML-I	TD-	3 <sup>rd</sup>	Transmitter Inverted Data Input	
20		VeeT	1 <sup>st</sup>	Module Transmitter Ground	2

## 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.

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply	Vcc	-0.5		3.7	V	
Storage Temperature	T <sub>STORAGE</sub>	-40		85	C	
Operating Temperature	T <sub>OP</sub>	-5		70	C	
Relative Humidity (non condensing)	RH	5		85	%	

## Electrical Characteristics

### Power Supply

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply	V <sub>CC</sub>	3.135		3.465	V	
Supply Current, Sustained	I <sub>CC</sub>			500	mA	
Power Dissipation	P <sub>DIS</sub>			1.7	W	

### Low Speed Control and Sense Signals

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Tx_Fault, Rx_LOS	V <sub>OL</sub>	-0.3		0.40	V	
	I <sub>OH</sub>	-50		37.5	μA	1
Tx_Disable, RS0, RS1	V <sub>IL</sub>	-0.3		0.8	V	
	I <sub>IH</sub>	2.0		V <sub>CC</sub> T + 0.3	V	

### Notes

1. Measured with a 4.7 kΩ load pulled up to V<sub>CC</sub>\_Host where V<sub>CC</sub>\_Host\_min < V<sub>CC</sub>\_host < V<sub>CC</sub>\_Host\_max

### High Speed Signals

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Input Differential Impedance	R <sub>IN</sub>		100		Ω	
Differential Swing	V <sub>IN, PP</sub>	180		700	mV	
Differential Data Output Swing	V <sub>OUT, PP</sub>	300		850	mV	1
Output Rise Time and Fall Time	T <sub>R</sub> , T <sub>F</sub>	28			ps	2

### Notes

1. Into 100 Ω differential termination
2. 20% - 80%, PRBS 2<sup>7</sup>-1

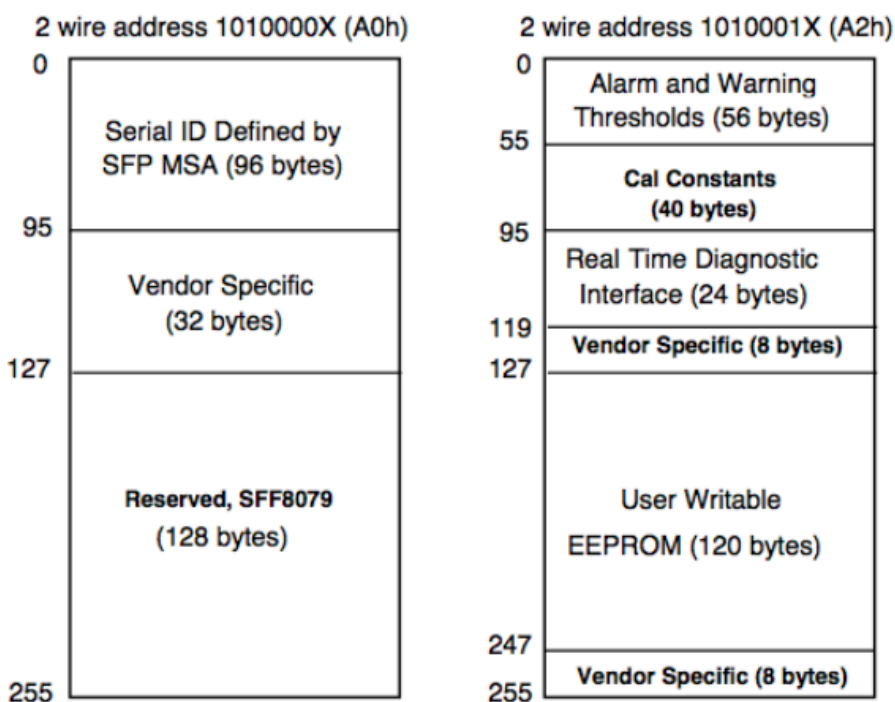
## Management Timing Parameters

Parameter	Symbol	Min.	Max.	Unit	Note
Tx_Disable assert time	t_off		100	□s	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

## 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 below:



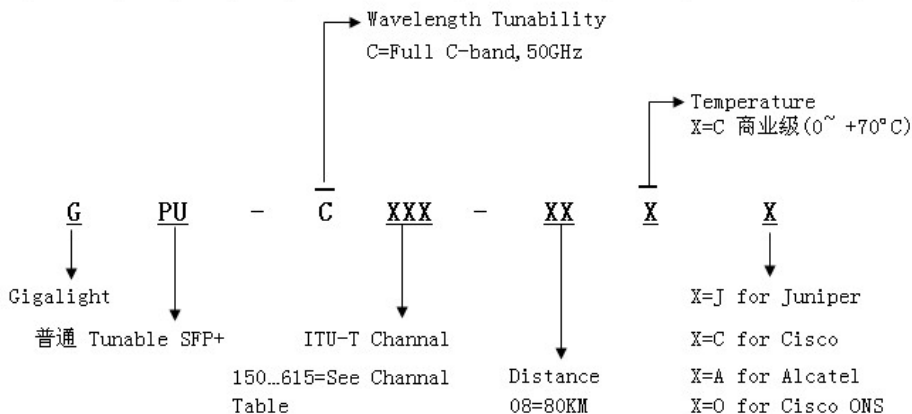
## DOM Accuracy and I2C Locations

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

## Regulatory and Safety Compliance

Parameter	Standard	Note
Product safety	UL 60950-1 CSA C22.2 No. 60950-1 EN 60950-1 IEC 60950-1 Flame Class V-0 Low Voltage Directive 2006/95/EC	
Laser safety	EN 60825-1, EN 60825-2 IEC 60825-1 U. S. 21CFR 1040.10	Class 1 Laser
Radiated emission	EMC Directive 2004/108/EC FCC rules 47 CFR Part 15 CISPR 22 AS/NZS CISPR22 EN 55022 ICES-003, Issue 5 VCCI V-3	Class B
Immunity	EMC Directive 2004/108/EC CISPR 24 EN 55024	
Radiated immunity	IEC/EN 61000-4-3	
RoHS	EU Directive 2002/95/EC + EU Directive 2011/65/EU	ROHS 6

## Ordering Information



e. g. GPU-C165-08CJ

Full C-band Tunable SFP+, ITU-T Channel 16.5 Default Wavelength, 80KM, for Juniper Switch

## Wavelengths Supported

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

Freq (THz)	Wave-length	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

Freq (THz)	Wave-length	ITU Ch.
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
192.75	1555.34	27.5

Freq (THz)	Wave-length	ITU Ch.
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