1000km 200G/2000km 100G Coherent CFP2-DCO Optical Transceiver Module

PRODUCT FEATURES

- Reach beyond 1000/2000 km over SMF for 200G/100G transmission
- Support PM-16QAM(200G), PM-DQPSK/PM-QPSK(100G) Modulation
- Support SD-FEC
- Support 100G/200G Flex-rate
- OTU4/OTUC2/2*100GE/100GE Signaling Supported
- Compliant CEI-28G-MR Specifications
- Compliant OTL4.4/OTLC2/CAUI-4 Signaling
- Hot-Pluggable
- CFP2 MSA Hardware Specification Rev. 1.0
- OIF-CFP2-DCO-01.0
- CFP MSA Management Interface Specification Version 2.6 (R06a)
- Line & Client PRBS Generator and Checker
- Line loopback, host terminal/facility loopback
- Power consumption 26W(200G)/21W(100G)

APPLICATIONS

The module is intended to be used on system integrators host board to support transmission over DWDM links in Metro networks. As shown in Figure 1, it is comprised of high- data lanes, a single reference clock from hosts, a single 3.3V power supply, an MDIO interface for module control and status report, and dedicated alarm and control pins.

DESCRIPTIONS

The NF2-S100-COH module uses a 104 pin CFP2 MSA connector for all electrical interfaces with the host card, whereas the optical interfaces on the line side are provided through the optical receptacles on the CFP2. The module can be portioned into three functional parts: Tx path, Rx path and Control & Power block.

All control interface pins are routed to the MCU and DSP. MCU is also used for other fast controls needed inside the module such as modulator bias adjustment, software image management, overall control coordination and status reporting.

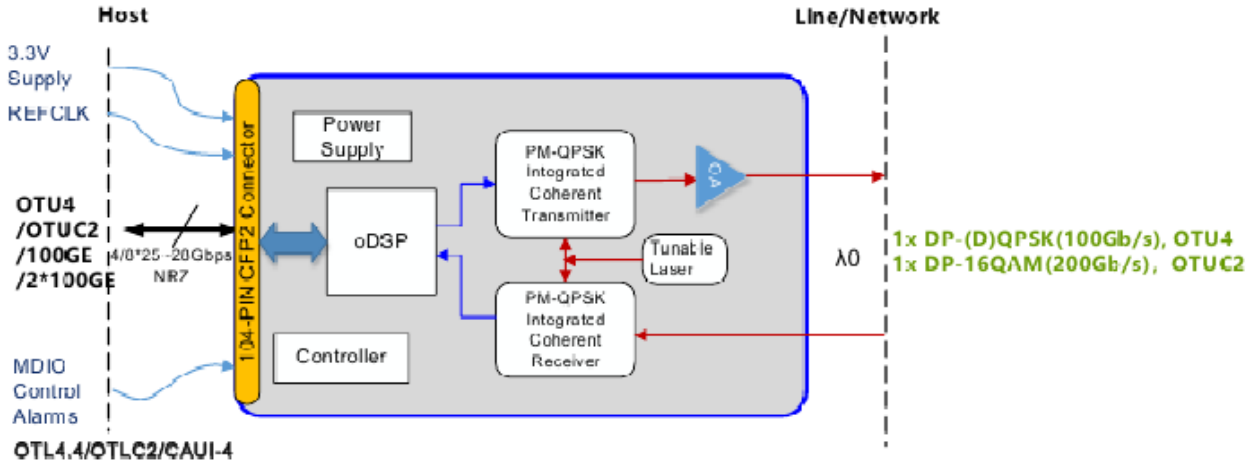

Figure 1. NF2-S100-COH Module block diagram

Host Interface Configuration

The module supports host signal types: OTUC2/ OTU4/100GE/2*100GE. Host Electrical Interface is compliant to CEI-28G-MR. The host rate is dependent on the framing type and the supported host rates are shown in the following table. Clock source is need for synchronization, Module REFCLK Input Clock = Host Baud Rate / 160.

Table 1: Host Rates

Host Frame	Host Data Rate (Gb/s)	Signaling	Data Rate(Gb/s)	REFCLK Clock
200G OTUC2	2*112.305	OTLC2 NRZ	28.076	175.476 MHz, +/-20ppm
100G OTU4	111.81	OTL4.4 NRZ	27.952	174.703 MHz , +/-20ppm
100GE	103.125	CAUI-4 NRZ	25.78125	NA

Line Framing Format

The actual line rate depends on the configured FEC mode and the host data format.

Table 2: Line Modulation formats

Line Data Rate	Min Grid Spacing (GHz)	Baud Rate (Gbaud)	Modulation Format	FEC OH	Rx OSNR(dB) EOL @Pre-FEC BER
200G	50	39.7	PM-16QAM	25%	17
100G	50	33.6	PM-QPSK /PM-DQPSK	25%	11.5/13

Configuration Overview

The table below summarizes the possible combinations of host type, Line side (Modulation) that can be configured through the MDIO interface. Refer to the NF2-S100-COH Software Interface specification for the register details needed to configure the CFP2 for the desired application.

Table 3: Configuration Overview Table

Host Format	Host Signaling	Line side Configuration	FEC
OTUC2	OTLC2	PM-16QAM	SD-FEC
OTU4	OTL4.4	PM-DQPSK	SD-FEC
OTU4	OTL4.4	PM-QPSK	SD-FEC
2*OTU4	OTL4.4	PM-16QAM	SD-FEC
2*100GE	2*CAUI-4	PM-16QAM	SD-FEC
100GE	CAUI-4	PM-QPSK	SD-FEC

Environmental Specifications

The table below defines the environmental specifications of the NF2-S100-COH module.

Table 4: environmental specifications

Parameter	Conditions	Min	Max	Unit
Environmental Storage Temperature		-40	85	℃
Environmental Storage (relative) Humidity		-	85	%
Environmental Operating (relative) Humidity			85	%
Operating Temperature	This temperature is monitored through an internal thermal sensor (MDIO register B02F).The temperature reading represents the module case temperature at the specified location.	-5	70	℃
Short term operating at high temperature	The module operates up to a maximum temperature for short term (96 Hours continuously, no more than15 days per year). This temperature is monitored through an internal thermal sense (MDIO register B02F). The temperature reading represents the module case temperature at the specified location.		75	℃

Absolute Maximum Ratings

Operating or handling the module out of any specified absolute maximum rating is subject to permanent damage of the module.

Table 5: Absolute Maximum Operating Conditions

Parameter	Min	Max	Unit	Conditions
Operating case temperature	-10	80	℃	This temperature is monitored through an internal thermal sensor (MDIO register). Represents the module case temperature at the specified location.
Power supply	-0.3	3.7	V	
Rx input power	-	14	dBm	Same modulation format; same wavelength as Rx local oscillator; continuous or peak power

Electrical Characteristics

A single +3.3V power supply shall be provided by host card through the 104 pin connector, internal DC/DC power converters are used to regulate the power for different components inside the module. The +3.3V power supply provided by the host shall adhere to the specifications in table below of the CFP2 MSA Hardware Specification version1.0 available at www.cfp-msa.org.The electrical ground is isolated from the module chassis ground.

The power supply requirements are specified in the table below. 1 Those power classes for which the maximum current per pin exceeds 1125mA will require agreement from an electrical connecter supplier.

Table 6: Electrical Power Specifications

Parameter	Symbol	Min	Typi-cal	Max	Unit	Note
3.3V DC Sup-ply Voltage	P3V3	3.2	3.3	3.4	V	Measured at the electrical connector
3.3V DC Sup-ply Current	P3V3_Icc1	-		9	A	Max current/pin shall not exceed 1.125A
Power Supply Noise	P3V3_noise	-		2	%p-p	DC- 500MHz
Power Supply Ripple	P3V3_ripple	-		1	%p-p	DC- 20MHz
lnrush current	P3V3_Iir			500	mA/us	
Turn-off cur-rent	P3V3_Ito	-500			mA/us	
Total capaci-tance	P3V3_Ctotal			TBD	uF	On Vcc
Power Con-sumption	Pwlp	-		2	W	Low power mode
Power Con-sumption	Pwc4	-	26*[1,*2]	TBD	W	200G PM-16QAM
		-	21[*2]	TBD	W	100G PM-DQPSK/QPSK

*[1] Power consumption depends on the actual application condition. For 200G PM-16QAM typical application, optical link should have enough OSNR margin with preBER better than 1.5e-2， power consumption is less than 26w(with framer enabled).

*[2] With framer disabled, the power consumption will be reduced to 25 W for 200G or 20 W for 100G.

The NF2-S100-COH module supports alarm, control, and monitor functions over a MDIO bus. This interface consists of eight pins listed in the table below.

Table 7: MDIO Pins

Signal	I/O	Logic	Description
MDC	I	1.2V LVCMOS	Management data clock, 4 MHz max
MDIO	I/O	1.2V LVCMOS	Management data input output, 4 Mb/s max
PRTADR[2:0]	I	1.2V LVCMOS	Physical port address
GLB_ALRMN	O	3.3V LVCMOS	Global alarm, active low, indicates FAWS condition.

There are six control pins as listed in the following table to support real -time control via hardware pins.

Table 8: Host – Control Pins

Signal	I/O	Logic	Description
MOD_RSTN	I	3.3V LVCMOS	Module reset, active L, internal PD
TX_DIS	I	3.3V LVCMOS	Transmitter disable, active H, internal PU
MOD_LOPWR	I	3.3V LVCMOS	Module low power, active H, internal PU
PRG_CNTL[2:1]	I	3.3V LVCMOS	Programmable control [2:1], internal PU

The PRG_CNTRL[2:1] signals have MSA defined default meanings that are listed in the CFP MSA implementation agreement. The lower two bits (hardware interlock) define the power class of the module and must be kept static during initialization. When MOD_LOPWR is active, the maximum power consumption is <2W and the host can still communicate to the module via the MDIO interface.

The MOD_RSTN signal is run to a reset chip to generate a reset to internal MCU and oDSP ASIC (RST_N).There are five alarm pins from the module back to the host.

Table 9: Module – Host Alarm Pins

Signal	I/O	Logic	Description
RX_LOS	O	3.3V LVCMOS	Receiver loss of signal, active H
MOD_ABS	O	3.3V LVCMOS	Module absent, active H, internal PD
PRG_ALRM[2:1]	O	3.3V LVCMOS	Programmable alarm [2:1]

All but MOD_ABS interface to the DSP ASIC. The PRG_ALRM[2:1] signals have MSA defined default meanings that are listed in the CFP2 implementation agreement.

The transmitter and receiver comply with the CEI-28G-MR electrical specification. The data lines are AC- coupled and terminated in the module per the following figure from the CFP2 MSA. The termination also ap- plies to the reference clock, TX monitor clock, and RX monitor clock.

Table 10: Transmitter Electrical Output Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Signaling rate per lane	TBaud	25.78		28.3	Gbps	CEI-28G-MR
Differential voltage pk-pk	TVdiff	800		1200	mVpp	
Differential Output Impedance	TRD	80	100	120	Ω	
Common mode noise(rms)	Vrms	/	/	/	mV	AC-coupled
Transition time	Trise/Tfall		TBD		ps	20%~80%
Common Return Loss	TSCC22			-6	dB	<10GHz
				-4	dB	10GHz~Baud Rate
Total Jitter				0.28	UIpp	

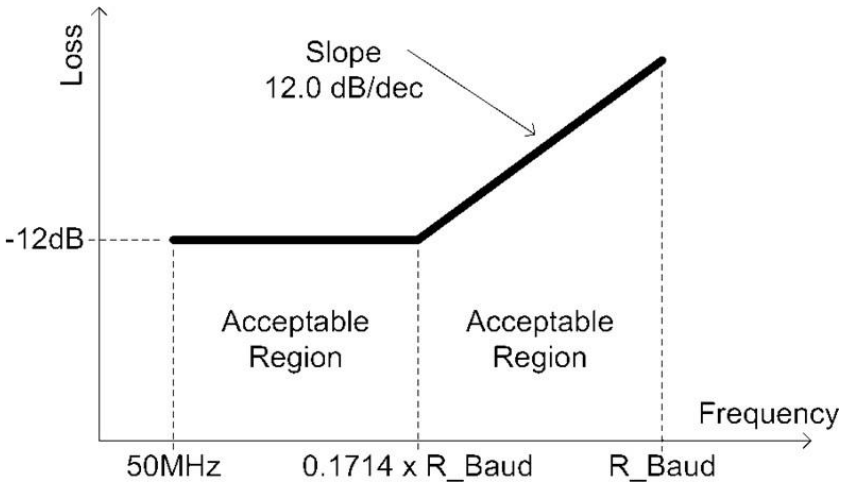

Figure 1: Transmitter Diff return Loss

Mask Table 11: Receiver Electrical Input

Parameter	Symbol	Min	Typ	Max	Unit	Note
Signaling rate per lane	RBaud	25.78		28.3	Gbps	CEI-28G-MR
Differential voltage pk-pk	RVdiff		TBD		mVppd	Compliant to CEI-28G-MR
Common mode noise (rms)	Vrms		TBD		mV	AC coupled
Transition time	Trise/Tfall		TBD		ps	20%~80%
Differential Input Impedance	RRD	80	100	120	Ω	
Common Return Loss	RSCC11			-6	dB	<10GHz
				-4	dB	10GHz~Baud Rate
Sinusoidal Jitter, Maximum	R_SJ-max			5	UIpp	
Sinusoidal Jitter, High Frequency	R_SJ-hi			0.05	UIpp	
Offset of Frequency				20/100	ppm	OTN/ETH

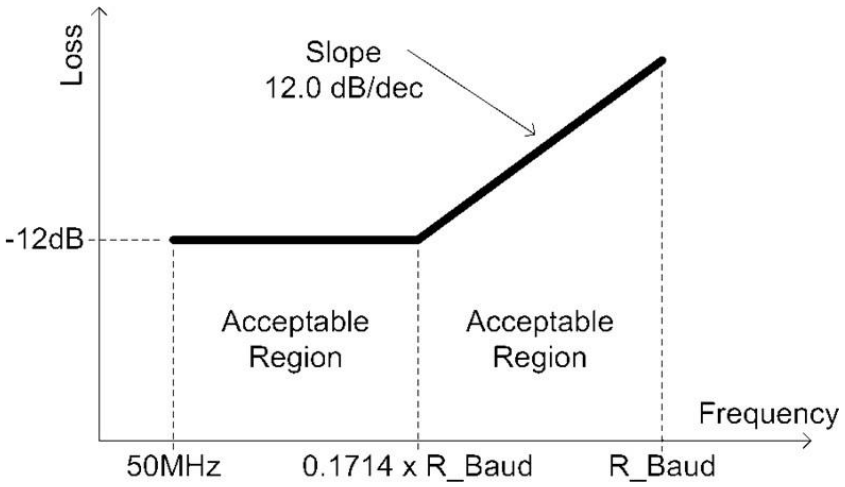

Figure 2: Receiver Diff return Loss Mask

Optical Characteristics

All specifications given in this document are End -of-Life numbers and are valid over the operating temperature. Section below contains the general transmitter specifications and the general receiver.

Table 12: Optical Transmitter Specifications

Parameter	Min	Typ.	Max	Unit	Condition/comments
Transmitter frequency range	191.3		196.05	THz	ITU-T 50GHz grid
Transmitter laser frequency stability	-1.5		1.5	GHz	
Transmitter output power range	-10		1	dBm	Default 0.5dBm
Output power stability (standard range)	-0.3		0.3	dB	
Output power accuracy and stability(standard range)	-1		1	dB	
Transmitter laser disable time	-		10	ms	
Transmitter wavelength switching time	-		60	s	
Transmitter turn-up time from cold start		60	120	s	
Transmitter OSNR	35			dB/0.1nm	OSNR at Transmitter output (in-band)
Transmitter signal -to-max ASE	TBD			dB/0.1nm	Signal to the maximum out-of-band ASE level
Transmitter optical return loss	24			dB	
Transmitter output power with TX disabled			-35	dBm	E.g., ma x output power when changing laser frequency.
Transmitter polarization dependent power			1	dB	Power deference between X and Y polarization

Table 13: Optical Receiver Specification

Parameter	Min	Typ	Max	Unit	Condition/comments
Receiver frequency range	191.3		196.05	THz	
Optimum Input power range	-14		0	dBm	Signal power of the selected channel. The input power range gets optimum OSNR performance
Extended Input power range	-18		0	dBm	@0.5dB OSNR penalty
OSNR tolerance(BOL)		16.2	16.7	dB/0.1nm	200G PM-16QAM
		10.6	11	dB/0.1nm	100G PM-QPSK
		12.3	12.8	dB/0.1nm	100G PM-DQPSK
CD tolerance	-10,000		40,000	ps /nm	200G PM-16QAM with less than 0.5dB OSNR penalty
	-10,000		100,000	ps /nm	100G PM-DQPSK/QPSK with less than 0.5dB OSNR penalty
PMD tolerance			25	ps	200G PM-16QAM
PMD tolerance			30	ps	100G PM-DQPSK/QPSK
PDL tolerance	6			dB	
Optical input power transient tolerance	6			dB	
Tolerance to change i n SOP	628			rad/ms	200G PM-16QAM
	1000		-	rad/ms	100G PM-DQPSK/QPSK
Dispersion reading ac-curacy	-150		150	ps /nm	
DGD reading accuracy	-10		10	ps	
Input power reading ac-curacy	-1.5		1.5	dB	within the range of 0 to -18 dBm
Input power reading ac-curacy	-2.5		2.5	dB	within the range of -18 to -25 dBm
Optical return loss	27			dB	

Mechanical Specifications

The CFP2 module is designed to be inserted into a host board with a railing system that includes a heat sink. The module is 107.5x41.5x12.4mm in size and is mechanically compliant to the requirements detailed the CFP2 HW Baseline Design Rev.1L.

Note: Please check the cage whether matches before using the module because of the side has dissipation hole structure, such as the cage part CN121C-104-0029(H1) (YAMAICHI**) have side openings and the side without sharp protrusions.**

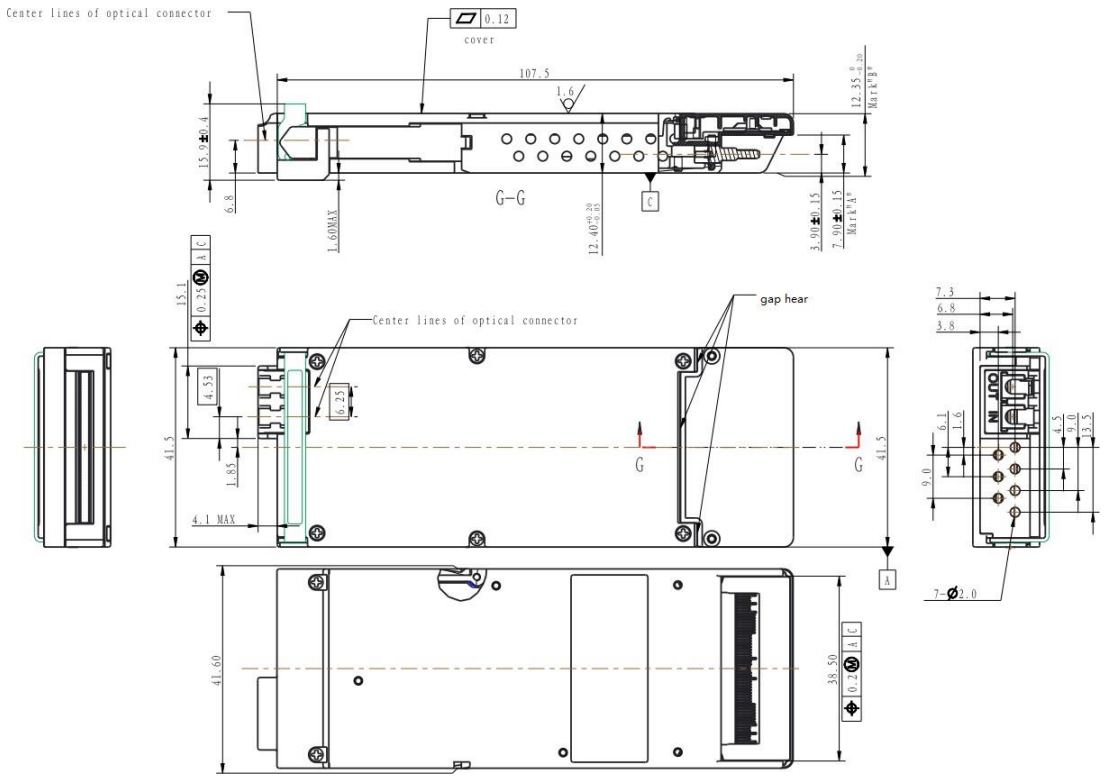

Figure 3: Mechanical Dimensions

The module plug connector is a sub-component within the CFP2 module. The PCB inserts into the connector with a top and bottom row of pins (primary and secondary side PCB). The host connector has a physical offset of the pin contacts to ensure certain signals make and break contact before others. Ground mates first, the 3.3V and 3.3V ground mate second, the control and status signals mate third, and the MOD_LOPWR, MOD_ABS and high speed data signals mate last.

The module connector is a 104-pin plug connector. The connector pinout defined by the CFP2 MSA, (including debug and sub -modulation signals using VND_IO_x pins) follows. Customers must **not** connect to any of the VND_IO_x pins unless specifically allowed to do so.

Table 14: CFP2 MSA Host Connector Pinout

	Bottom		Top (4x25G)		Top (8x25G)
1	GND	104	GND	104	GND
2	*(TX_MCLKn) or Vendor_Out0n*	103	N.C.	103	TX4n
3	*(TX_MCLKp) or Vendor_Out0p*	102	N.C.	102	TX4p
4	GND	101	GND	101	GND
5	Vendor_In0n	100	TX3n	100	TX3n
6	Vendor_In0p	99	TX3p	99	TX3p
7	3.3V_GND	98	GND	98	GND
8	3.3V_GND	97	TX2n	97	TX2n
9	3.3V	96	TX2p	96	TX2p
10	3.3V	95	GND	95	GND
11	3.3V	94	N.C.	94	TX5n
12	3.3V	93	N.C.	93	TX5p
13	3.3V_GND	92	GND	92	GND
14	3.3V_GND	91	N.C.	91	TX6n
15	VND_IO_A	90	N.C.	90	TX6p
16	VND_IO_B	89	GND	89	GND
17	PRG_CNTL1	88	TX1n	88	TX1n
18	PRG_CNTL2	87	TX1p	87	TX1p
19	PRG_CNTL3	86	GND	86	GND
20	PRG_ALRM1	85	TX0n	85	TX0n
21	PRG_ALRM2	84	TX0p	84	TX0p
22	PRG_ALRM3	83	GND	83	GND
23	GND	82	N.C.	82	TX7n
24	TX_DIS	81	N.C.	81	TX7p
25	RX_LOS	80	GND	80	GND
26	MOD_LOPWR	79	*(REFCLKn)*	79	*(REFCLKn)*
27	MOD_ABS	78	*(REFCLKp)*	78	*(REFCLKp)*

28	MOD_RSTn	77	GND	77	GND
29	GLB_ALRMn	76	N.C.	76	RX4n
30	GND	75	N.C.	75	RX4p
31	MDC	74	GND	74	GND
32	MDIO	73	RX3n	73	RX3n
33	PRTADR0	72	RX3p	72	RX3p
34	PRTADR1	71	GND	71	GND
35	PRTADR2	70	RX2n	70	RX2n
36	VND_IO_C	69	RX2p	69	RX2p
37	VND_IO_D	68	GND	68	GND
38	VND_IO_E	67	N.C.	67	RX5n
39	3.3V_GND	66	N.C.	66	RX5p
40	3.3V_GND	65	GND	65	GND
41	3.3V	64	N.C.	64	RX6n
42	3.3V	63	N.C.	63	RX6p
43	3.3V	62	GND	62	GND
44	3.3V	61	RX1n	61	RX1n
45	3.3V_GND	60	RX1p	60	RX1p
46	3.3V_GND	59	GND	59	GND
47	Vendor_In1n	58	RX0n	58	RX0n
48	Vendor_In1p	57	RX0p	57	RX0p
49	GND	56	GND	56	GND
50	*(RX_MCLKn) or Vendor_Out1n*	55	N.C.	55	RX7n
51	*(RX_MCLKp) or Vendor_Out1p*	54	N.C.	54	RX7p
52	GND	53	GND	53	GND

Note:

100G OTU4/100GE: TX (RX) 0~3 for OTL4.4/CAUI-4 Signaling.

200G OTUC2/2*100GE: TX (RX) 0~3 for one OTLC/CAUI-4 Signaling, TX (RX) 4~7 for another OTLC/CAUI-4 Signaling.

The optical port connections on the front of CFP2 are showed in Figure above, the Mechanical Dimensions. The CFP2 will support LC receptacles for standard single mode fiber. As mention in the OIF-CFP2-DCO- 01.0, the position of the optical connector in the Y and Z axes shall be specified by the CFP2-DCO module manufacturer. In

addition to the centered duplex LC connector location specified by the CFP MSA, the CFP2- DCO IA also optionally allows the optical port position on the front of the module to be either left or right- justified if needed to enable a certain vendor-specific implementation technology.

Regulatory and Reliability

Specifications Laser Safety

The module is designed to comply with Class 1 laser, according to IEC/EN 60825-1/A2: 2001, or FDA CDRH21 CFR-1040. Don't directly look into the transmitter fiber connector at any time while the module is in operation.

ESD

The module is designed to meet ESD susceptibility up to 500V according to GR-78 (Human Body Model us- ing C =100pF, R = 1.5kOhm) on the high speed pins, 2000V for all other pins. Handle only at Static Safe Work Stations.

Electromagnetic Emission

The module is designed to comply with Class B electromagnetic emission according to GR-1089-CORE Sections 3.2.1.1 and 3.2.1.3 .

Electromagnetic Immunity

The module is designed to comply with EMI 8.5V/m per GR.1089-CORE section 3.3.1 .

Flammability

The module is designed to comply with GR-63 section 4.2.3 for fire resistance.

RoHS

The module complies with Directive 2002/95/EC on the restriction on the use of certain hazardous substances in electrical and electronic equipment and with exception 6a, 6c, 7b and 13a permitted by Commission Decision (2010/571/EU).

Reliability

The module is designed to comply with GR-468 for general reliability. Target FIT < 2700 at 55 degree operating case temperature.

Ordering Information

Part Number	Description
NF2-S100-COH	200G/100G , PM-16QAM /PM-DQPSK/ PM-QPSK, Coherent CFP2