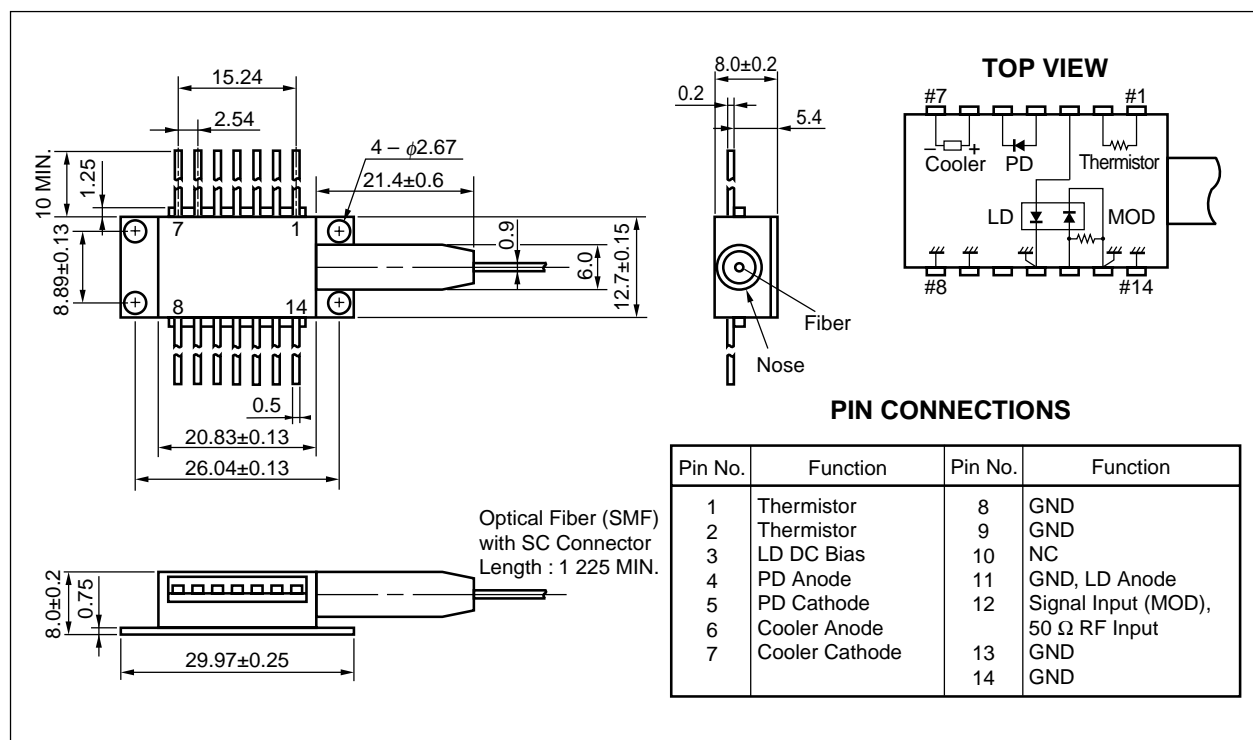# NEC

LASER DIODE

NX8566LE-CC

EA MODULATOR INTEGRATED
1 550 nm MQW-DFB LASER DIODE MODULE
FOR 2.5 Gb/s DWDM LONG-REACH 240 km APPLICATIONS

DESCRIPTION

The NX8566LE-CC is an Electro-Absorption (EA) modulator integrated, 1 550 nm Multiple Quantum Well (MQW) structured Distributed Feed-Back (DFB) laser diode. The module is capable of 2.5 Gb/s applications of over 240 km long-reach and available for Dense Wavelength Division Multiplexing (DWDM) wavelengths based on ITU-T recommendations, enabling a wide range of applications.

FEATURES

* Integrated electroabsorption modulator
* Very low dispersion penalty over 240 km
* Low modulation voltage
* Available for DWDM wavelengths based on ITU-T recommendations
  (100 GHz grid, refer to ORDERING INFORMATION)
* 14-pin butterfly package with SC-UPC connector

PACKAGE DIMENSIONS (UNIT: mm, unless otherwise specified: ±0.2 mm)

PIN CONNECTIONS

Pin No.	Function	Pin No.	Function
1	Thermistor	8	GND
2	Thermistor	9	GND
3	LD DC Bias	10	NC
4	PD Anode	11	GND, LD Anode
5	PD Cathode	12	Signal Input (MOD),
6	Cooler Anode		50 Ω RF Input
7	Cooler Cathode	13	GND
		14	GND

Optical Fiber (SMF) with SC Connector Length : 1 225 MIN.

OPTICAL FIBER CHARACTERISTICS

Parameter	Specification	Unit
Mode Field Diameter	9.3±0.5	μm
Cladding Diameter	125±1	μm
Tight Buffer Diameter	900±100	μm
Cut-off Wavelength	< 1 270	nm
Attenuation 1 525 to 1 575 nm	< 0.3	dB/km
Fiber Length	1 225 MIN.	mm
Flammability	UL1581 VW-1	

35±2 mm

8.99±0.5 mm

SC-UPC Connector

Fiber Length: 1 225 mm MIN.
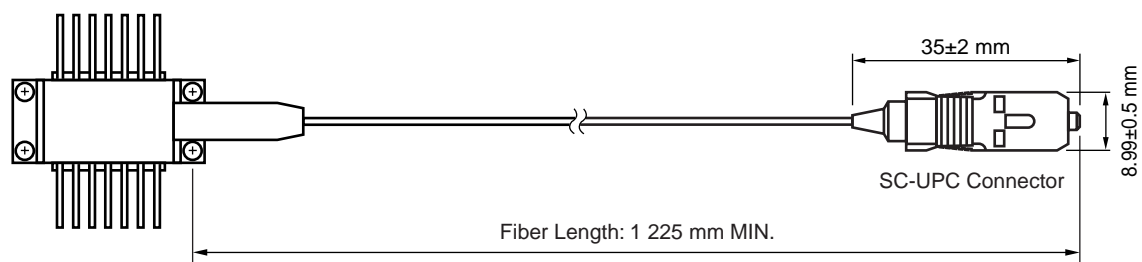
ORDERING INFORMATION: Wavelength is a certain point between 1 530 nm and 1 563 nm @ $T_{LD} = T_{set}$ (SC-UPC Connector)

Part Number	Available Connector
NX8566LE-CC	With SC-UPC Connector

ORDERING INFORMATION: Wavelength on ITU-T grid @ $T_{LD} = T_{set}$

Part Number With SC-UPC Connector	ITU-T Wavelength[1] (nm)	Frequency (THz)
NX8566LE303-CC	1530.33	195.90
NX8566LE311-CC	1531.11	195.80
NX8566LE318-CC	1531.89	195.70
NX8566LE326-CC	1532.68	195.60
NX8566LE334-CC	1533.46	195.50
NX8566LE342-CC	1534.25	195.40
NX8566LE350-CC	1535.03	195.30
NX8566LE358-CC	1535.82	195.20
NX8566LE366-CC	1536.60	195.10
NX8566LE373-CC	1537.39	195.00
NX8566LE381-CC	1538.18	194.90
NX8566LE389-CC	1538.97	194.80
NX8566LE397-CC	1539.76	194.70
NX8566LE405-CC	1540.55	194.60
NX8566LE413-CC	1541.35	194.50
NX8566LE421-CC	1542.14	194.40
NX8566LE429-CC	1542.93	194.30
NX8566LE437-CC	1543.73	194.20
NX8566LE445-CC	1544.52	194.10
NX8566LE453-CC	1545.32	194.00
NX8566LE461-CC	1546.11	193.90
NX8566LE469-CC	1546.91	193.80
NX8566LE477-CC	1547.71	193.70
NX8566LE485-CC	1548.51	193.60
NX8566LE493-CC	1549.31	193.50
NX8566LE501-CC	1550.11	193.40
NX8566LE509-CC	1550.91	193.30
NX8566LE517-CC	1551.72	193.20
NX8566LE525-CC	1552.52	193.10

*1 The value which omitted and computed the 3rd place below the decimal point

Part Number With SC-UPC Connector	ITU-T Wavelength[1] (nm)	Frequency (THz)
NX8566LE533-CC	1553.32	193.00
NX8566LE541-CC	1554.13	192.90
NX8566LE549-CC	1554.94	192.80
NX8566LE557-CC	1555.74	192.70
NX8566LE565-CC	1556.55	192.60
NX8566LE573-CC	1557.36	192.50
NX8566LE581-CC	1558.17	192.40
NX8566LE589-CC	1558.98	192.30
NX8566LE597-CC	1559.79	192.20
NX8566LE606-CC	1560.60	192.10
NX8566LE614-CC	1561.41	192.00
NX8566LE622-CC	1562.23	191.90
NX8566LE630-CC	1563.04	191.80
NX8566LE745-CC	1574.54	190.40
NX8566LE753-CC	1575.36	190.30
NX8566LE761-CC	1576.19	190.20
NX8566LE770-CC	1577.02	190.10
NX8566LE778-CC	1577.85	190.00
NX8566LE786-CC	1578.68	189.90
NX8566LE795-CC	1579.51	189.80
NX8566LE803-CC	1580.35	189.70
NX8566LE811-CC	1581.18	189.60
NX8566LE820-CC	1582.01	189.50
NX8566LE828-CC	1582.85	189.40
NX8566LE836-CC	1583.68	189.30
NX8566LE845-CC	1584.52	189.20
NX8566LE853-CC	1585.36	189.10
NX8566LE862-CC	1586.20	189.00
NX8566LE870-CC	1587.04	188.90
NX8566LE878-CC	1587.88	188.80
NX8566LE887-CC	1588.72	188.70
NX8566LE895-CC	1589.56	188.60
NX8566LE904-CC	1590.41	188.50
NX8566LE912-CC	1591.25	188.40
NX8566LE921-CC	1592.10	188.30
NX8566LE929-CC	1592.94	188.20

[1] The value which omitted and computed the 3rd place below the decimal point

Part Number With SC-UPC Connector	ITU-T Wavelength[*1] (nm)	Frequency (THz)
NX8566LE937-CC	1593.79	188.10
NX8566LE946-CC	1594.64	188.00
NX8566LE954-CC	1595.48	187.90
NX8566LE963-CC	1596.33	187.80
NX8566LE971-CC	1597.18	187.70
NX8566LE980-CC	1598.04	187.60
NX8566LE988-CC	1598.89	187.50
NX8566LE997-CC	1599.74	187.40
NX8566LE6006-CC	1600.60	187.30
NX8566LE6014-CC	1601.45	187.20
NX8566LE6023-CC	1602.31	187.10
NX8566LE6031-CC	1603.16	187.00
NX8566LE6040-CC	1604.02	186.90
NX8566LE6048-CC	1604.88	186.80
NX8566LE6057-CC	1605.74	186.70
NX8566LE6066-CC	1606.60	186.60
NX8566LE6074-CC	1607.46	186.50
NX8566LE6083-CC	1608.32	186.40

*1 The value which omitted and computed the 3rd place below the decimal point

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Optical Output Power from Fiber	P_f	10	mW
Forward Current of LD	I_{FLD}	150	mA
Reverse Voltage of LD	V_{RLD}	2.0	V
Forward Voltage of Modulator	V_{FEA}	1	V
Reverse Voltage of Modulator	V_{REA}	4	V
Forward Current of PD	I_{FPD}	1	mA
Reverse Voltage of PD	V_{RPD}	10	V
Cooler Current	I_C	1.5	A
Cooler Voltage	V_C	2.5	V
Operating Case Temperature	T_C	−20 to +70	°C
Storage Temperature	T_{stg}	−40 to +85	°C
Lead Soldering Temperature	T_{sld}	260 (10 sec.)	°C

ELECTRO-OPTICAL CHARACTERISTICS
(T_{LD} = 25°C, T_C = 25°C, BOL, unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Laser Set Temperature	T_{set}	[1]	20		35	°C
Operating Current	I_{op}	T_{LD} = T_{set}	50	60	80	mA
Modulation Center Voltage	V_{center}	Under modulation[2]	−1.5	−1.2	−0.5	V
Modulation Voltage	V_{mod}	Under modulation[2]	2		3	V
Forward Voltage of LD	V_{FLD}	I_{FLD} = I_{op}		1.6	2.0	V
Threshold Current	I_{th}	T_{LD} = T_{set}		7	20	mA
Optical Output Power from Fiber	P_f	I_{FLD} = I_{op}, T_{LD} = T_{set}, Under modulation[2]	0			dBm
Peak Emission Wavelength	λ_p	I_{FLD} = I_{op}, V_{EA} = 0 V, T_{LD} = T_{set}	1 530	ITU-T[3]	1 563	nm
			1 574		1 609	
Side Mode Suppression Ratio	SMSR	I_{FLD} = I_{op}, V_{EA} = 0 V	30	37		dB
Extinction Ratio	ER	I_{FLD} = I_{op}, Under modulation[2]	10	11		dB
Rise Time	t_r	I_{FLD} = I_{op}, 20-80%, Under modulation[2]		70	125	ps
Fall Time	t_f	I_{FLD} = I_{op}, 80-20%, Under modulation[2]		70	125	ps
Dispersion Penalty	DP	I_{FLD} = I_{op}, 240 km SMF under modulation[2, 4]		1.5	2.0	dB
Optical Isolation	I_s		23			dB
Relative Intensity Noise	RIN	10 MHz to 10 GHz, V_{EA} = 0 V, I_{FLD} = I_{op}		−135	−130	dB
Input Return Loss	S_{11}	I_{FLD} = I_{op}, V_{EA} = −1 V, 50 Ω, f = 130 MHz to 2 GHz			−10	dB
		I_{FLD} = I_{op}, V_{EA} = −1 V, 50 Ω, f = 2 GHz to 2.5 GHz			−5	
		I_{FLD} = I_{op}, V_{EA} = −1 V, 50 Ω, f = 2.5 GHz to 3.5 GHz			−3	

[1] NX8566LE-CC : T_{set} is a certain point between 20°C and 35°C

NX8566LE×××-CC : T_{set} is set at a certain point between 20°C and 35°C for ITU-T grid wavelength

[2] 240 km SMF under modulation, 2.48832 Gb/s, PRBS $2^{23}-1$, V_{EA} = V_{center} ± 1/2V_{mod}, I_{FLD} = I_{op}, T_{LD} = T_{set}, NEC Test System

V_{center} : a certain point between −0.5 V and −1.5 V

V_{mod} : a certain point between 2 V and 3 V

I_{op} : a certain point between 50 mA and 80 mA

192 km (@ L-band) SMF under modulation, 2.48832 Gb/s, PRBS $2^{23}-1$, V_{EA} = V_{center} ± 1/2V_{mod}, I_{FLD} = I_{op}, T_{LD} = T_{set}, NEC Test System

[3] Available for DWDM wavelengths based on ITU-T recommendations (100 GHz grid).
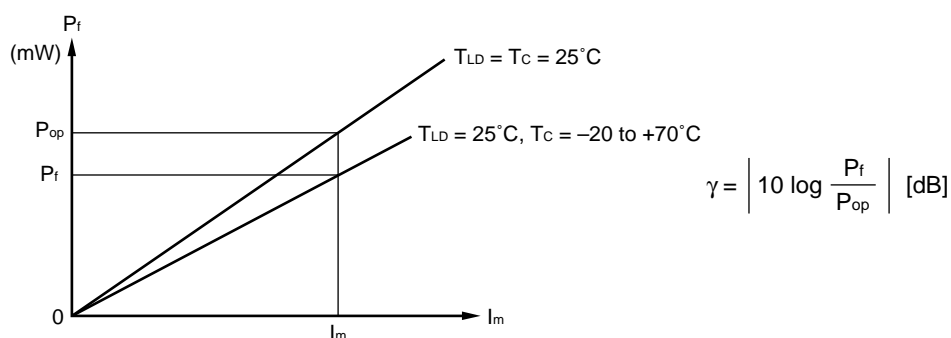
Please refer to ORDERING INFORMATION.

[4] BER = 10^{-10}

ELECTRO-OPTICAL CHARACTERISTICS
(Applicable to Monitor PD: T_{LD} = 25°C, T_C = –20 to +70°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Monitor Current	I_m	V_{RPD} = 5 V, $I_{FLD} = I_{op}$, V_{EA} = 0 V	20	100	1 000	μA
Dark Current	I_D	V_{RPD} = 5 V, V_{EA} = 0 V			10	nA
Terminal Capacitance	C_t	V_{RPD} = 5 V, f = 1 MHz			15	pF
Tracking Error	γ [*1]	I_m = const.			0.5	dB

*1 Tracking error: γ

$$\gamma = \left| 10 \log \frac{P_f}{P_{op}} \right| \text{ [dB]}$$

ELECTRO-OPTICAL CHARACTERISTICS
(Applicable to Thermistor and TEC: T_{LD} = 25°C, T_C = –20 to +70°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Thermistor Resistance	R	T_{LD} = 25°C	9.5	10.0	10.5	kΩ
B Constant	B		3 350	3 450	3 550	K
Cooler Current	I_C	ΔT = 50°C			1.2	A
Cooler Voltage	V_C	ΔT = 50°C			2.4	V

TYPICAL CHARACTERISTICS (T_LD = 25°C, unless otherwise specified)

OPTICAL OUTPUT POWER FROM FIBER (CW) vs. FORWARD CURRENT

X-axis: Forward Current I_F (mA), 0 to 150
Y-axis: Optical Output Power from Fiber P_f (mW), 0 to 4.0
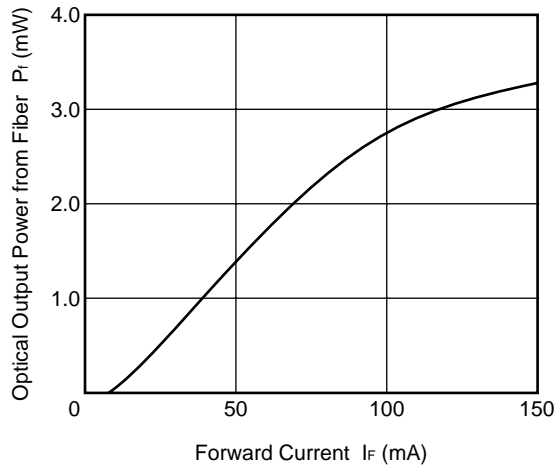
FORWARD CURRENT vs. FORWARD VOLTAGE

X-axis: Forward Voltage V_F (V), 0 to 2.0
Y-axis: Forward Current I_F (mA), 0 to 150
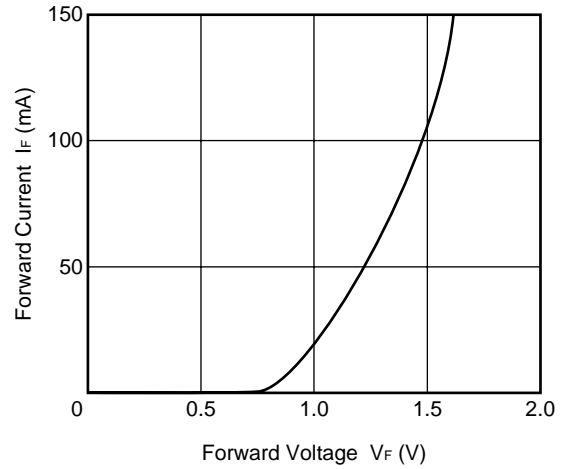
EXTINCTION RATIO vs. MODULATOR VOLTAGE

X-axis: Reverse Voltage of Modulator V_REA (V), 0 to 3
Y-axis: Extinction Ratio ER (dB), 0 to 25
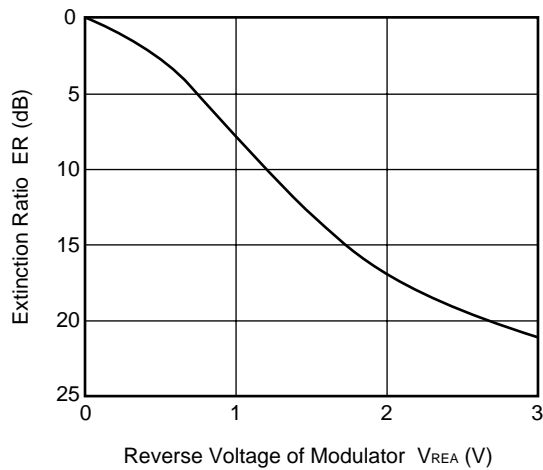
INPUT RETURN LOSS CHARACTERISTICS (S_11)

X-axis: Frequency f (GHz), 0 to 5
Y-axis: Input Return Loss S_11 (dB), −28 to 0

SPECTRUM

X-axis: Wavelength λ (nm), 1 540.0 to 1 560.0
Y-axis: Relative Intensity (dB), −70 to 0
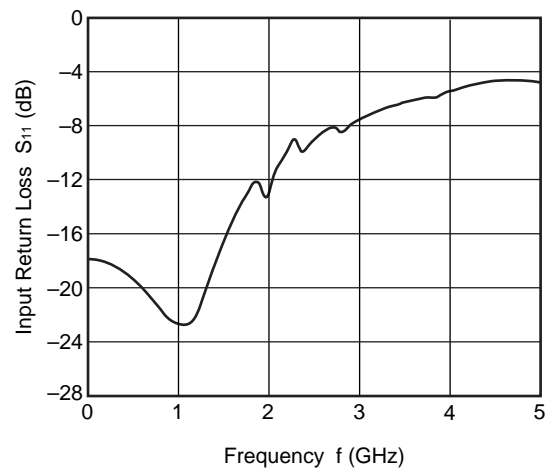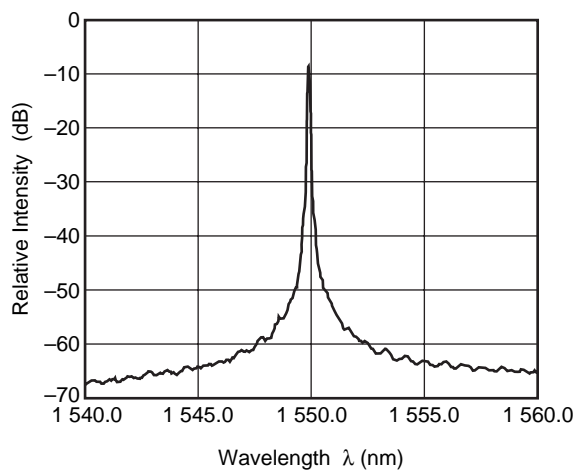
THERMISTOR RESISTANCE vs. AMBIENT TEMPERATURE

X-axis: Ambient Temperature T_A (°C), 0 to 75
Y-axis: Thermistor Resistance R (kΩ), 1 to 50
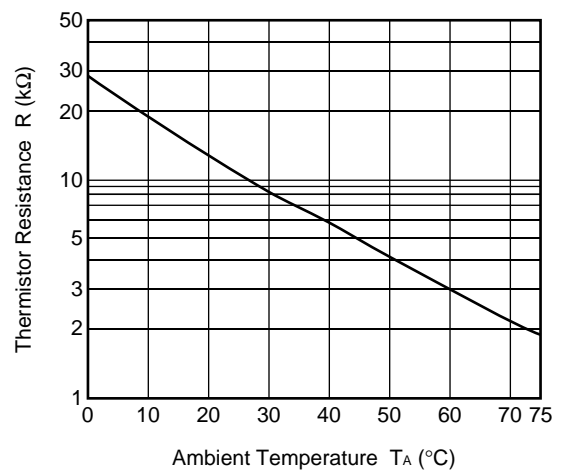
Remark The graphs indicate nominal characteristics.

240 km STANDARD FIBER TRANSMISSION EXAMPLE

Test Setup

P_{in} (EDFA) : −20 to −21 dBm
P_{out} (EDFA) : +7 dBm

120 km

2.5 Gb/s

TX — EDFA — 120 km — EDFA

RX — EDFA — 120 km

ERROR RATE CHARACTERISTICS

2.48832 Gb/s, NRZ 2 V_{P-P},
PRBS 2^{23}−1, I_{op} = 60 mA,
T_C = 25˚C, V_{center} = −1.2 V

Bit Error Rate

back to back

after 240 km

10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}

−34   −33   −32   −31   −30   −29   −28

Received Power (dBm)
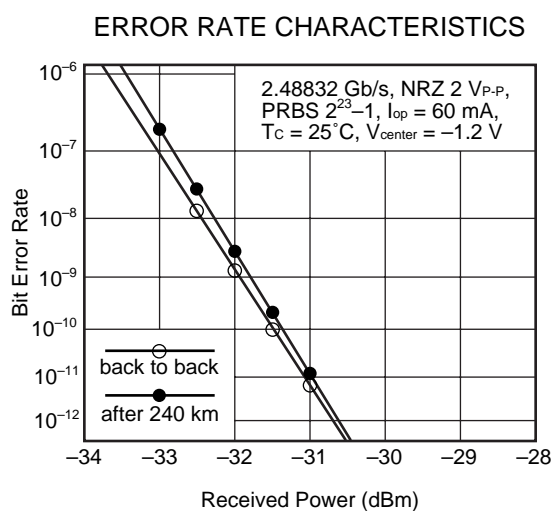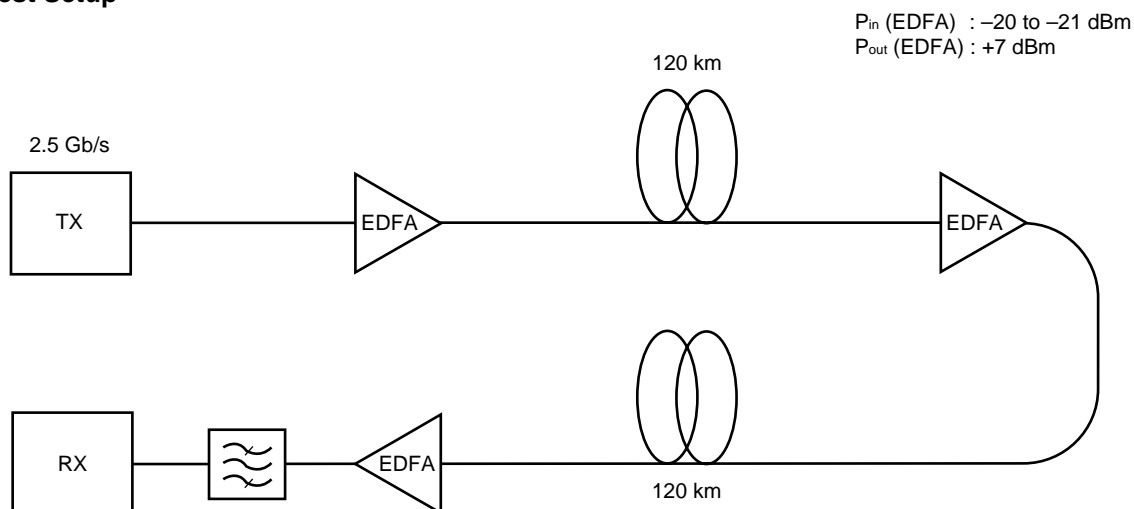
Remark The graph indicates nominal characteristics.

DFB-LD FAMILY

Part Number	Absolute Maximum Ratings		Electro-Optical Characteristics (T_C = 25°C)			Application	Package
	T_C (°C)	T_{stg} (°C)	I_{th} (mA)	P_f (mW)	λ_p (nm)		
			TYP.	MIN.	TYP.		
NX8300BE-CC NX8300CE-CC	0 to +75	−40 to +85	15	2[*1]	1 310	2.5 Gb/s: STM-16 (S-16.1, L-16.1)	Coaxial
NX8303BG-CC NX8303CG-CC	−10 to +85	−40 to +85	15	2[*1]	1 310	622 Mb/s: STM-4 (L-4.1)	Coaxial
NX8503BG-CC NX8503CG-CC	−10 to +85	−40 to +85	15	2[*1]	1 550	156 Mb/s: STM-1 (L-1.2, L-1.3)	Coaxial
						622 Mb/s: STM-4 (L-4.2, L-4.3)	
NX8504BE-CC NX8504CE-CC	−10 to +85	−40 to +85	15	2[*1]	1 550	622 Mb/s: STM-4 (L-4.2, L-4.3)	Coaxial
NX8560LJ-CC	−20 to +70	−40 to +85	6	−1 dBm	1 550[*2]	≤ 10 Gb/s: STM-64	BFY with GPO™
NX8562LB	−20 to +65	−40 to +85	20	20	1 550[*2]	CW Light Source for external modulator	BFY
NX8563LB	−20 to +65	−40 to +85	20	10	1 550[*2]	CW Light Source for external modulator	BFY
NX8564LE-CC	−20 to +70	−40 to +85	7	−2 dBm[*1]	1 550[*2]	2.5 Gb/s: STM-16, 360 km EA modulator integrated	BFY
NX8565LE-CC	−20 to +70	−40 to +85	7	−2 dBm[*1]	1 550[*2]	2.5 Gb/s: STM-16, 600 km EA modulator integrated	BFY
NX8566LE-CC	−20 to +70	−40 to +85	7	0 dBm	1 550[*2]	2.5 Gb/s: STM-16, 240 km EA modulator integrated	BFY
NX8570 Series	−20 to +70	−40 to +85	20	20	1 550[*2]	CW Light Source with λ monitoring PD	BFY
NX8571 Series	−20 to +70	−40 to +85	20	10	1 550[*2]	CW Light Source with λ monitoring PD	BFY

*1 TYP.

*2 Available for DWDM Wavelengths based on ITU-T recommendations

REFERENCE

Document Name	Document No.
Optical semiconducrtor devices for fiberoptic communications Selection Guide	P12480E
Opto-Electronics Devices Pamphlet	P13623E
Opto-Electronics Devices (CD-ROM)	P12944X
NEC semiconductor device reliability/quality control system[1]	C11159E
Quality grades on NEC semiconductor devices[1]	C11531E
SEMICONDUCTOR SELECTION GUIDE −Products and Packages−[1]	X13769E

*1 Published by NEC Corporation

- **PATENT**

  USP 4,826,295

  CA 1,286,848

  EP 143 000

- **GPO is a trademark of Gilbert Engineering Co., Inc.**

SAFETY INFORMATION ON THIS PRODUCT

DANGER

INVISIBLE LASER RADIATION
AVOID DIRECT EXPOSURE TO BEAM
OUTPUT POWER ____ mW MAX
WAVELENGTH _____ nm
CLASS IIIb LASER PRODUCT

SEMICONDUCTOR LASER

AVOID EXPOSURE-Invisible
Laser Radiation is emitted from
this aperture

Warning	Laser Beam	A laser beam is emitted from this diode during operation. The laser beam, visible or invisible, directly or indirectly, may cause injury to the eye or loss of eyesight. • Do not look directly into the laser beam. • Avoid exposure to the laser beam, any reflected or collimated beam.
Caution	GaAs Products	The product contains gallium arsenide, GaAs. GaAs vapor and powder are hazardous to human health if inhaled or ingested. • Do not destroy or burn the product. • Do not cut or cleave off any part of the product. • Do not crush or chemically dissolve the product. • Do not put the product in the mouth. Follow related laws and ordinances for disposal. The product should be excluded from general industrial waste or household garbage.
Caution	Optical Fiber	A glass-fiber is attached on the product. Handle with care. • When the fiber is broken or damaged, handle carefully to avoid injury from the damaged part or fragments.

0110