CEL

| NEC'S EA MODULATOR INTEGRATED InGaAsP MQW DFB LASER DIODE MODULE FOR 2.5 Gb/s ULTRALONG-REACH 360, 600, 240 km DWDM APPLICATIONS | NX8564/ NX8565/ NX8566LE Series |

FEATURES

- **INTEGRATED ELECTROABSORPTION MODULATOR**
- **VERY LOW DISPERSION PENALTY**
  NX8564LE-BC/CC - over 360 km (6480 ps/nm)
  NX8565LE-BC/CC - over 600 km (10800 ps/nm)
  NX8566LE-BC/CC - over 240 km (4320 ps/nm)
- **LOW MODULATION VOLTAGE**
- **AVAILABLE FOR DWDM WAVELENGHT BASED ON ITU-T RECOMMENDATION (100 GHz grid, refer to ordering information)**

DESCRIPTION

NEC's NX8564/8565/8566LE Series are Electro-Absorption (EA) modulator integrated, 1550 nm Multiple Quantum Well (MQW) structured Distributed Feed-Back (DFB) laser diodes. The module is capable of 2.5 Gb/s applications of over 360, 600, 240 km ultralong-reach and available for Dense Wavelength Division Multoplexing (DWDM) wavelenghts based on ITU-T recommendations, enabling a wide range of applications.

ELECTRO-OPTICAL CHARACTERISTICS $(T_{LD} = Tset, T_C = -20$ to $+70°C$, unless otherwise specified)

PART NUMBER				NX8564/8565/8566LE SERIES		
SYMBOLS	PARAMETERS AND CONDITIONS		UNITS	MIN	TYP	MAX
T_{SET}	Laser Set Temperature[1]		°C	20		35
I_{OP}	Operating Current		mA	50	60	100
V_{center}	Modulation Center Voltage[2]		V	-1.5	-1.2	-0.5
V_{mod}	Modulation Voltage[2]		V	–	2	3
V_{FLD}	Forward Voltage of LD, $I_{FLD} = I_{OP}$		V	–	1.6	2.0
I_{TH}	Threshold Current		mA	–	7	20
P_f	Optical Output Power from Fiber,	$I_{FLD} = I_{OP}$, Under modulation[2] (NX8564/65LE Series)	dBm	-5	-2	–
		$I_{FLD} = I_{OP}$, Under modulation[2] (NX8566LE Series)		0	1	–
λ_P	Peak Emission Wavelength, $I_{FLD} = I_{OP}$, $V_{EA} = 0$ V		nm	1530	Specified to ITU-T[3]	1563
				1574		1609
SMSR	Side Mode Suppression Ratio, $I_{FLD} = I_{OP}$, $V_{EA} = 0$ V		dB	30	>37	–
ER	Extinction Ratio, $I_{FLD} = I_{OP}$, Under modulation[2]		dB	10	>11	–
t_f	Rise Time, $I_{FLD} = I_{OP}$, 20-80%, Under modulation[2]		ps	–	70	125
t_r	Rise Time, $I_{FLD} = I_{OP}$, 80-20%, Under modulation[2]		ps	–	70	125

Notes:
1. NX8564/65/66LE Series   : Tset is a certain point between 20 and 35°C
   NX8564/65/66LExxx Series   : Tset is a certain point between 20 and 35C for ITU-T grid wavelength
2. NX8564LE: C-band 360 km, L-band 288 km (6480 ps/nm) SMF under modulation
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   2.48832 Gb/s, PRBS 223 -1, $V_{EA} = V_{center} \pm 1/2 V_{mod}$, $I_{FLD} = I_{op}$, $T_{LD} = Tset$, NEC Test System
   Vcenter   : a certain point between -1.5 and -0.5 V
   Vmod   : a certain point 3 V or below
   Iop   : a certain point between 50 and 80 mA
3. Available for DWDM wavelenght based on ITU-T recommendation (100 GHz grid). Please refer to ORDERING INFORMATION.

California Eastern Laboratories

ELECTRO-OPTICAL CHARACTERISTICS $(T_{LD} = 25°C, T_C = -20$ to $+70°C)$

| SYMBOLS	PARAMETERS AND CONDITIONS		UNITS	MIN	TYP	MAX
	PART NUMBER			**NX8564/8565/8566LE SERIES**		
DP	Dispension Penalty, $I_{FLD} = I_{OP}$, SMF Under modulation[2,4]		dB		<1.5	2
I_S	Isolation		dB	23		
RIN	Relative Intensity Noise10 MHz to 10 GHz, $V_{RM} = 0$ V, T_{LD}, I_{OP}		dB		<-135	-130
S_{11}	Input Return Loss	$I_{FLD} = I_{OP}$, $V_{EA} = -1$ V, 50 Ω 130 MHz to 2 GHz	dB			-8
		$I_{FLD} = I_{OP}$, $V_{EA} = -1$ V, 50 Ω 2 GHz to 2.5 GHz				-5

Notes:
2. NX8564LE: C-band 360 km, L-band 288 km (6480 ps/nm) SMF under modulation
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   Vcenter   : a certain point between -1.5 and -0.5 V
   Vmod   : a certain point 3 V or below
   Iop   : a certain point between 50 and 80 mA
4. BER 10^{-10}

SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
Applicable to Monitor PD, $(T_{LD} = T_{set}, T_C = -20$ to $+70°C)$					
I_m	Monitor Current, $I_{FLD} = I_{OP}$, $V_{EA} = 0$ V	μA	20	100	1000
I_D	Dark Current, $V_{RPD} = 5$ V, $V_{EA} = 0$ V	nA			10
$γ^1$	Tracking Error, I_m = const.	dB			0.5
C_t	Terminal Capacitance, $V_{RPD} = 5$ V, f = 1 MHz	pF			15
Applicable to Thermistor and TEC, $(T_{LD} = T_{set}, T_C = -20$ to $+70°C)$					
R	Thermistor Resistance, $T_{LD} = 25°C$	kΩ	9.5	10.0	10.5
B	B Constant	K	3350	3450	3550
I_C	Cooler Current	A			1.2
V_C	Cooler Voltage	V			2.4

Note:
1. Tracking error: γ

(at Pf (25°C) = Pop)

$$γ = \left| 10 \log \frac{P_f}{P_{OP}} \right| [dB]$$
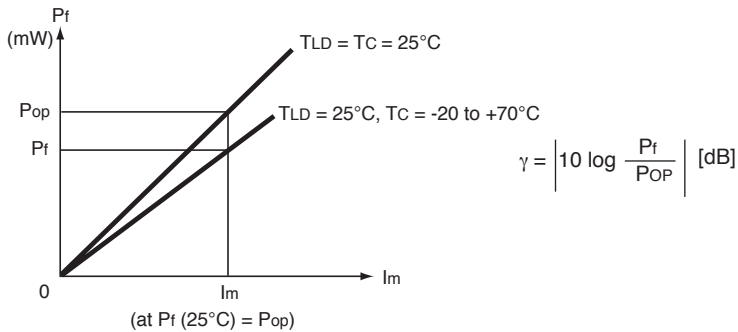
ABSOLUTE MAXIMUM RATINGS[1]
(T_C = 25°C, unless otherwise specified)

SYMBOLS	PARAMETERS	UNITS	RATINGS
P_f	Optical Output Power from Fiber	mW	10
I_{FLD}	Forward Current of LD	mA	150
V_{RLD}	Reverse Voltage of LD	V	2.0
V_{Fm}	Forward Voltage of Modulator	V	1
V_{Rm}	Reverse Voltage of Modulator	V	5
I_{FPD}	Forward Current of PD	mA	1
V_{RPD}	Reverse Voltage of PD	V	10
I_C	Cooler Current	A	1.5
V_C	Cooler Voltage	V	2.5
T_C	Operating Case Temperature	°C	-20 to +70
T_{STG}	Storage Temperature	°C	-40 to +85
T_{SLD}	Lead Soldering Temp. (10 s)	°C	260

Note:
1. Operation in excess of any one of these parameters may result
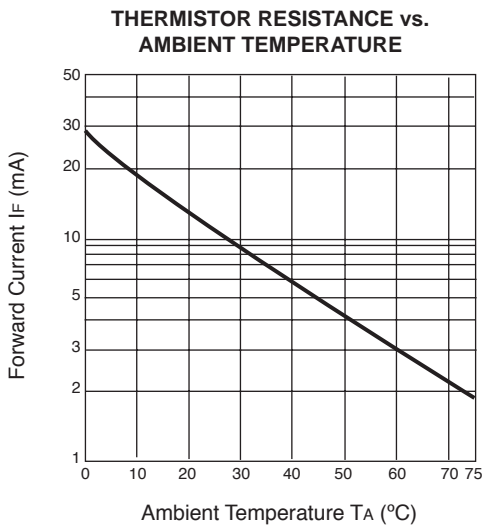   in permanent damage.

ORDERING INFORMATION

NX856☐LE☐☐☐-☐☐

CC : SC-UPC connector
BC : FC-UPC connector (option)

Without wavelength code : Wavelength is a certain point between
      1528.77 to 1563.04 nm
With wavelength code   : Refer to **Table A**

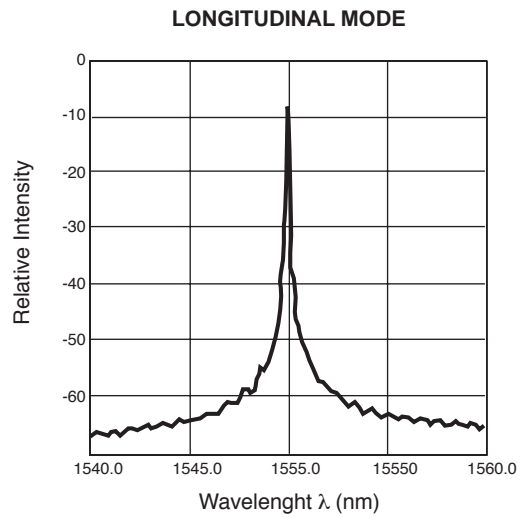4 : 360 km (6480 ps/nm)
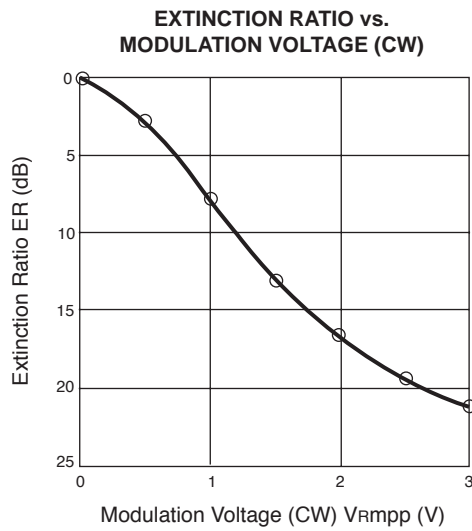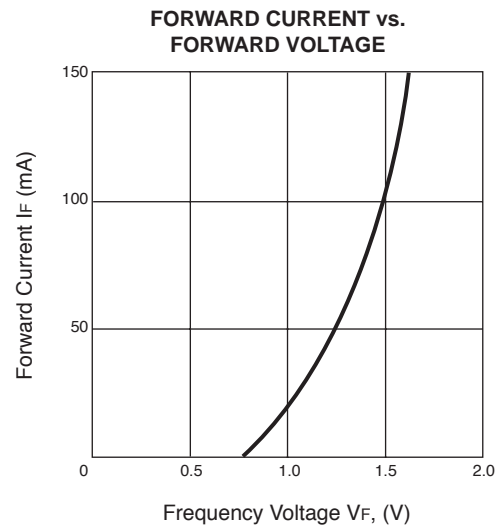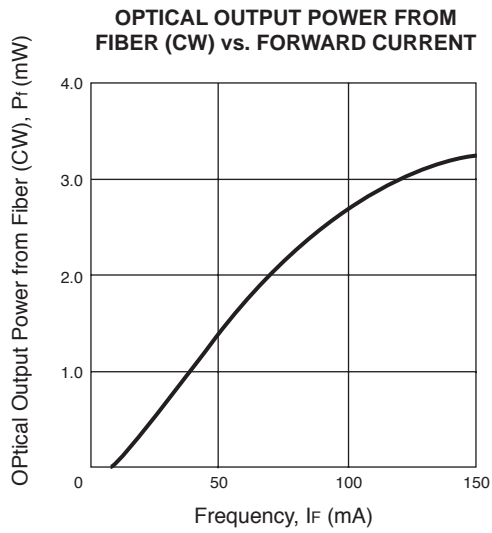5 : 600 km (10800 ps/nm)
6 : 240 km (4320 ps/nm)
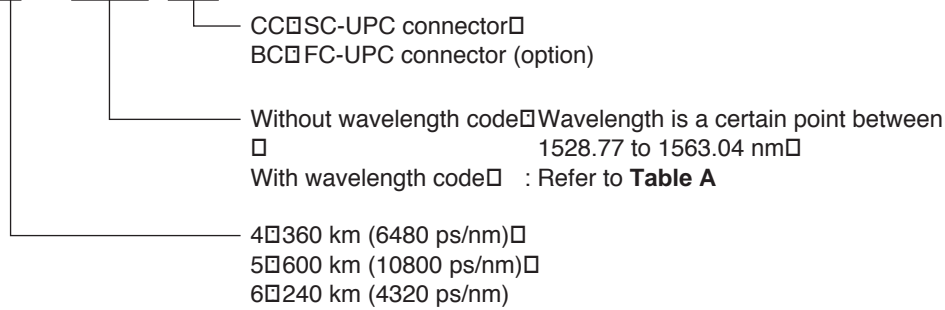
TABLE A: DWDM wavelengths based on ITU-T recommendations (@ TLD = Tset)

Wavelength Code	ITU-T Wavelength [1] (nm)	Frequency (THz)	Wavelength Code	ITU-T Wavelength [1] (nm)	Frequency (THz)
287	1528.77	196.10	485	1548.51	193.60
295	1529.55	196.00	493	1549.31	193.50
303	1530.33	195.90	501	1550.11	193.40
311	1531.11	195.80	509	1550.91	193.30
318	1531.89	195.70	517	1551.72	193.20
326	1532.68	195.60	525	1552.52	193.10
334	1533.46	195.50	533	1553.32	193.00
342	1534.25	195.40	541	1554.13	192.90
350	1535.03	195.30	549	1554.94	192.80
358	1535.82	195.20	557	1555.74	192.70
366	1536.60	195.10	565	1556.55	192.60
373	1537.39	195.00	573	1557.36	192.50
381	1538.18	194.90	581	1558.17	192.40
389	1538.97	194.80	589	1558.98	192.30
397	1539.76	194.70	597	1559.79	192.20
405	1540.55	194.60	606	1560.60	192.10
413	1541.34	194.50	614	1561.41	192.00
421	1542.14	194.40	622	1562.23	191.90
429	1542.93	194.30	630	1563.04	191.80
437	1543.73	194.20			
445	1544.52	194.10			
453	1545.32	194.00			
461	1546.11	193.90			
469	1546.91	193.80			
477	1547.71	193.70			

Note:
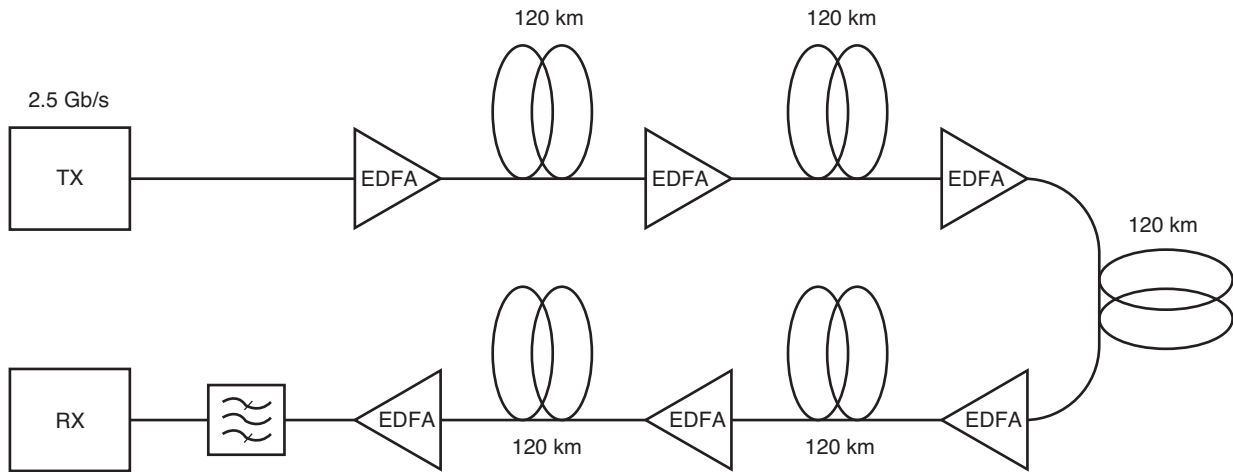1. The value which omitted and computed the 3rd place below the decimal point.

TYPICAL PERFORMANCE CURVES (T$_{LD}$ = +25°C, Unless otherwise specified)

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

OPtical Output Power from Fiber (CW), P$_t$ (mW)

4.0

3.0

2.0

1.0

0   50   100   150

Frequency, I$_F$ (mA)

**FORWARD CURRENT vs.
FORWARD VOLTAGE**

Forward Current I$_F$ (mA)

150

100

50

0   0.5   1.0   1.5   2.0

Frequency Voltage V$_F$, (V)

**EXTINCTION RATIO vs.
MODULATION VOLTAGE (CW)**

Extinction Ratio ER (dB)

0

5

10

15

20

25

0   1   2   3

Modulation Voltage (CW) V$_{Rmpp}$ (V)

LONGITUDINAL MODE

Relative Intensity

0

-10

-20

-30

-40

-50

-60

1540.0   1545.0   1555.0   15550   1560.0

Wavelenght λ (nm)

**THERMISTOR RESISTANCE vs.
AMBIENT TEMPERATURE**

Forward Current I$_F$ (mA)

50
30
20

10

5

3

2

1

0   10   20   30   40   50   60   70 75

Ambient Temperature T$_A$ (°C)

Remark:The graphs indicate nominal characteristics.

600 km STANDARD FIBER TRANSMISSION EXAMPLE (NX8565LE SERIES)

TEST SETUP

120 km   120 km

2.5 Gb/s

TX   EDFA   EDFA   EDFA

120 km

RX   EDFA   EDFA   EDFA

120 km   120 km

ERROR RATE CHARACTERISTICS

2.48832 Gb/s,
NRZ 2 V_{P-P},
PRBS $2^{23}-1$,
I_{op} = 70 mA,
T_C = 25°C,
V_{center} = -1.2 V,
V_{mod} = 2.0 V

Bit Error Rate

10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}

back to back

after 600 km

-42   -40   -38   -36   -34   -32   -30   -28

Received Power, $\overline{P}$ (dBm)

EYE DIAGRAM

Relative Intensity (20 mV/div.)

Back to Back (100 ps/div.)

EYE DIAGRAM

Relative Intensity (10 mV/div.)

After 600 km (100 ps/div.)

Remark: The graphs indicate nominal characteristics.

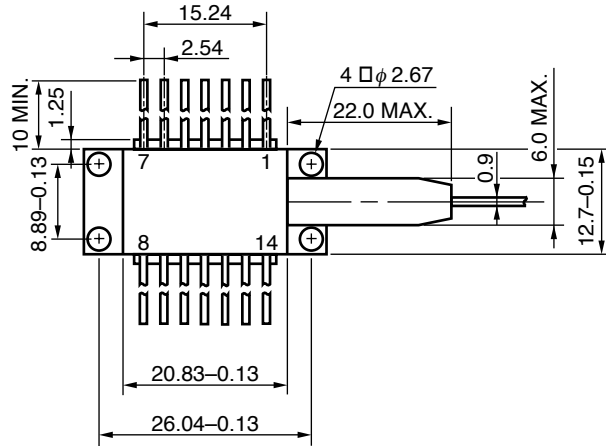## OUTLINE DIMENSIONS (Units in mm)

TOP VIEW

Cooler   PD   Thermistor

LD   MOD

#7   #1
#8   #14

Optical Fiber (SMF)
Length : 1 000 MIN.
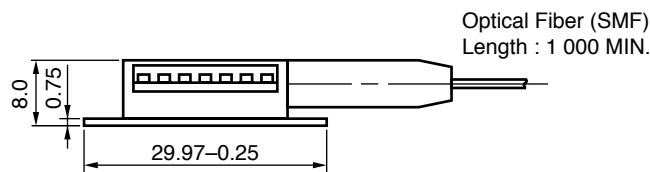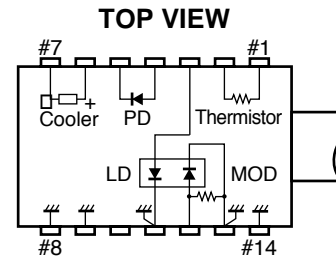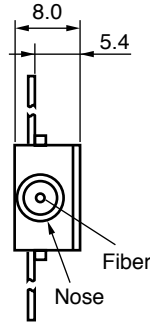
PIN CONNECTIONS

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
5	PD Cathode	12	Signal Input (MOD), 50 Ω RF Input
6	Cooler Anode	13	GND
7	Cooler Cathode	14	GND

OPTICAL FIBER CHARACTERISTICS

PARAMETER	UNITS	SPECIFICATION
Mode Field Diameter	μm	9.3±0.5
Cladding Diameter	μm	125±1
Tight Buffer Diameter	μm	900±100
Cut-off Wavelenght	nm	< 1270
Attenuation 1525 to 1575 nm	dB/km	< 0.3
Minimum Fiber Bending Radius	mm	30
Fiber Length	mm	1225 MIN
Flammability		UL1581VW-1

35±2 mm

8.99±0.5 mm

-CC : SC-UPC connector
-BC : FC-UPC connector

Fiber Length: 1 000 mm MIN.
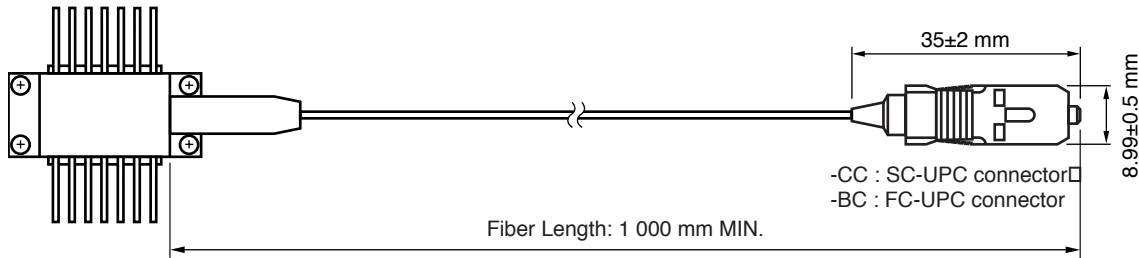
Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.