

## Model 1935F/R/W Coaxial DFB Laser Diode O-Band CWDM, 5 MHz – 4000 MHz



Emcore's Model 1935 DFB lasers offer a low cost solution for linear fiberoptic links. These components can be cooled with external thermo-electric coolers for high stability, or run without TEC's to reduce power consumption. The DFB laser builds upon Ortel's long history of high performance, leading edge designs in CATV, wireless, and high speed digital applications. The laser diode devices are packaged in a compact hermetic assembly together with monitor photodiode and isolator, for flexible integration into various transmitter configurations.

### Applications

- Video signal distribution in HFC and FTTx nodes
- Signal distribution in L-band and wireless remoting links
- High linearity, low power fiber links

### Features

- Linear DFB laser design
- Output power up to 10 dBm available
- Bandwidth 47 - 1002 MHz
- Optical Isolator
- Low power consumption
- Monitor photodiode
- RoHS

### Performance Highlights

	Min	Typical	Max	Units
Operating Case Temperature Range	-40	-	85	°C
Optical Output Power <sup>(1)</sup>	3	-	4.9	dBm
	5	-	5.9	
	6	-	8.9	
	9	-	9.9	
10	-	11.9		
Frequency Range	5	-	4000	MHz
Carrier-to-Noise Ratio (79 channels) <sup>(1)</sup>	51	-	-	dB
Composite Second Order (79 channels) <sup>(1)</sup>	Standard Linearity	-	-57	dBc
	Enhanced Linearity	-	-60	
Composite Triple Beat (79 channels) <sup>(1)</sup>	Standard Linearity	-	-65	dBc
	Enhanced Linearity	-	-68	
O-Band CWDM Wavelength	1271, 1291, 1311, 1331, 1351, 1371			nm
Optical Return Loss <sup>(1)</sup>	45	-	-	dB
Side Mode Suppression Ratio, CW <sup>(1)</sup>	30	-	-	dB

(1) Performance at Tcase = 25°C

See following pages for complete specifications and conditions.

## Absolute Maximum Ratings<sup>1</sup>

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameters	Symbol	Condition/Notes	MIN	MAX	Unit
Storage Temperature	T <sub>STG</sub>	Non-Operating	-40	85	°C
Operating Case Temperature	T <sub>OP</sub>	Continuous	-40	85	°C
Laser Diode Forward Current	I <sub>OP</sub>	CW	-	150	mA
Laser Diode Reverse Voltage	V <sub>R</sub>	Continuous	-	1.0	V
Photodiode Forward Current	I <sub>MPD</sub>	Continuous	-	2	mA
Photodiode Reverse Voltage	V <sub>MPD,R</sub>	Continuous	-	10	V
Average RF Input Power	PIN	60 Seconds	-	62	dBmV
Lead Soldering Temperature/Time	-	-	-	260/10	°C/sec
Relative Humidity	RH	Continuous	-	85	%
ESD	-	Human Body Model	-500	+500	V

1. Absolute maximum data are limited to system design only; proper device performance is not guaranteed over rating listed above. Operation beyond these maximum conditions may degrade device performance, lead to device failure, shorter lifetime, and will invalidate the device warranty.

**Electrical/Optical Characteristics**

Parameters	Symbol	Conditions/Notes	Min	Typ	Max	Unit
Optical Output Power	$P_O$	3 dBm version 5 dBm Version 6 dBm version 9 dBm version 10 dBm version	3 5 6 9 10	- - - - -	4.9 5.9 8.9 9.9 11.9	dBm
Threshold Current	$I_{TH}$	$T_{case} = 25^{\circ}C$ $T_{case} = 45^{\circ}C$	- -	8 13	15 20	mA
Laser Bias Current	$I_{OP}$		-	-	80	mA
Forward Voltage	$V_F$	$I_{op}$	-	1.17	1.8	V
Slope Efficiency	SE	$T_{case} = 25^{\circ}C, I_{op}$	0.07	-	0.3	mW/mA
Thermal Slope Efficiency	TSE	$SE(T_c)/SE(25^{\circ}C)$ $T_{case} = -20^{\circ}C$ to $85^{\circ}C$	0.4	-	1.2	-
Laser Input Impedance	Z	-	2	4	8	$\Omega$
MPD Current	$I_{MPD}$	$V_{MPD} = 5V, I_{op}$	50	-	2000	$\mu A$
MPD Dark Current	$I_D$	$V_{MPD} = 5V, I_{op} = 0$ $T_{case} = 25^{\circ}C$	-	-	50	nA
O-Band CWDM Center Wavelength	$\lambda_c$	$I_{op}$ $T_{case} = 25^{\circ}C$	1267	1271	1275	nm
			1287	1291	1295	
			1307	1311	1315	
			1327	1331	1335	
			1347	1351	1355	
			1367	1371	1375	
Relative Intensity Noise	RIN	CW, $I_{op}$ , 5 MHz - 1002 MHz	-	-	-150	dB/Hz
Optical Isolation	ISO	Double Isolator $T_{case} = 25^{\circ}C$	45	-	-	dB
Spectral Width (-20 dB)	$\Delta\lambda$	$I_{op}, T_{case} = 25^{\circ}C$	-	0.1	1.0	nm
Side Mode Suppression Ratio	SMSR	$I_{op}, T_{case} = 25^{\circ}C$	30	45	-	dB
Tracking Error	ER	$I_{MON} = const$ $ER = 10\log(P_O/2.0)$ [dB]	-1	-	+1	dB
Optical Return Loss	ORL	$T_{case} = 25^{\circ}C$	35	-	-	dB

1. Referenced to base of TO header.

**Forward Path RF Characteristics**

1935F Performance Parameters	Symbol	Conditions/Notes	Min	Typ	Max	Unit
Frequency Response Flatness <sup>1</sup>	S <sub>21</sub>	47 MHz – 1002 MHz	-	-	1	dB <sub>p-p</sub>
		5 MHz – 4000 MHz	-	-	4	dB <sub>p-p</sub>
Response Up-tilt <sup>1</sup>		47 MHz < f < 1002 MHz	-1		3	dB
Carrier-to-Noise Ratio <sup>2,3,4</sup>	CNR	I <sub>op</sub> T <sub>case</sub> = 25°C	51	-	-	dB
Composite Second Order <sup>2,3,4</sup> Standard Linearity Enhanced Linearity	CSO	I <sub>op</sub> T <sub>case</sub> = 25°C	-	-	-57	dBc
			-	-	-60	
Composite Triple Beat <sup>2,3,4</sup> Standard Linearity Enhanced Linearity	CTB	I <sub>op</sub> T <sub>case</sub> = 25°C	-	-	-65	dBc
			-	-	-68	

1. I<sub>op</sub>, T<sub>case</sub> = 25°C. Test with the laser Input pin matched to a 50Ω system.
2. 3.7% OMI, 79 NTSC unmodulated carriers (50 MHz to 550 MHz). 0 km fiber.
3. Received power = 0 dBm.
4. I<sub>op</sub>, T<sub>case</sub> = 25°C. Test with the laser Input pin matched to a 75Ω system.

**Return Path RF Characteristics**

1935R Performance Parameters	Symbol	Conditions/Notes	Min	Typ	Max	Unit
Frequency Response Flatness <sup>1</sup>	S <sub>21</sub>	5 MHz - 200 MHz	-	-	1	dB <sub>p-p</sub>
Second Order Distortion <sup>2</sup> Standard Linearity Enhanced Linearity	DSO	P <sub>F</sub> = 3 dBm, OMI = 10% each 2-tone test: f1=7MHz, f2=56MHz 20 km of fiber (7.5 dB total loss with connector) f1 + f2	-	-	-52	dBc
			-	-	-58	
Third Order Distortion <sup>2</sup> Standard Linearity Enhanced Linearity	DTB	P <sub>F</sub> = 3 dBm, OMI = 10% each 2-tone test: f1=7MHz, f2=56MHz 20 km of fiber (7.5 dB total loss with connector) 2f2-f1	-	-	-63	dBc
			-	-	-65	

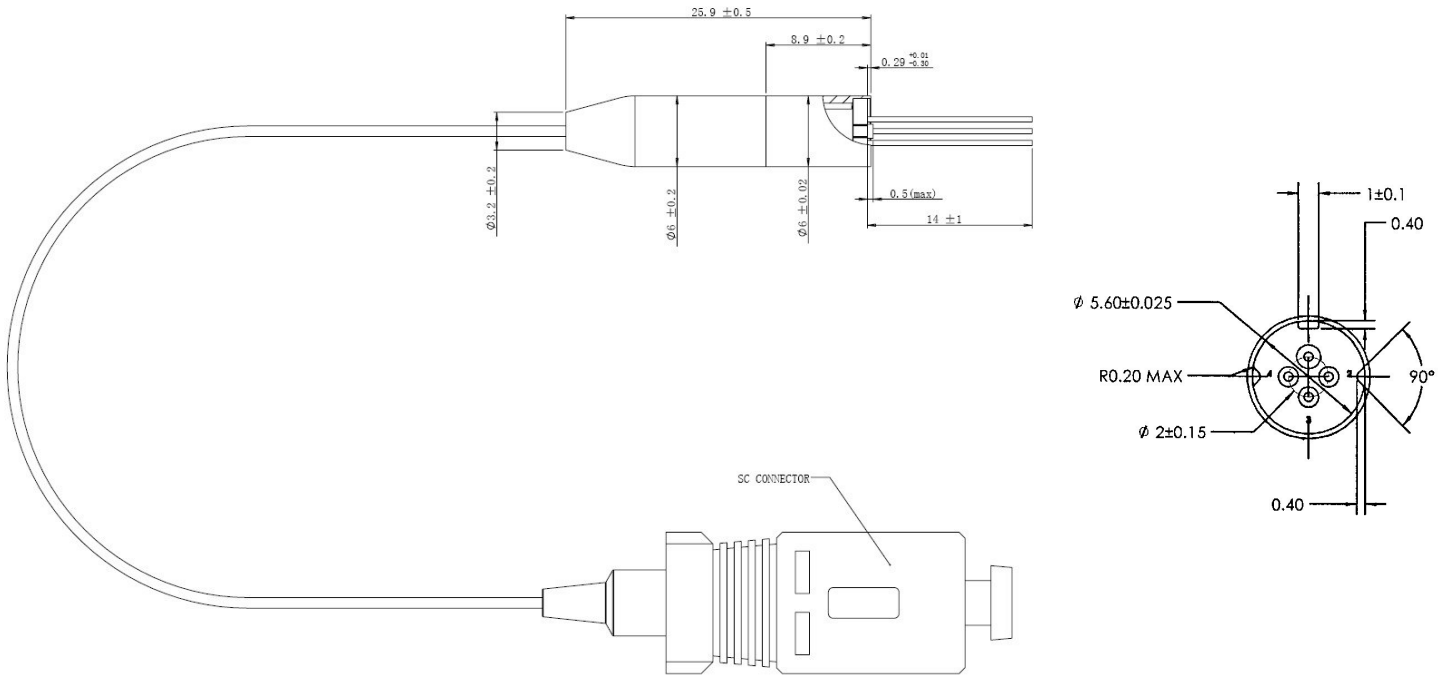
1. I<sub>op</sub>, T<sub>case</sub> = 25°C. Test with the laser Input pin matched to a 50Ω system.
2. I<sub>op</sub>, T<sub>case</sub> = 25°C. Test with laser input pin matched to a 75Ω system.

**Wide Bandwidth Path RF Characteristics**

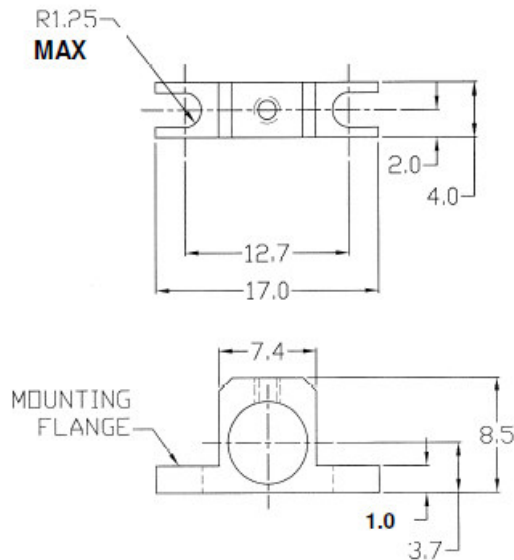
1935W Performance Parameters	Symbol	Conditions/Notes	Min	Typ	Max	Unit
Frequency Response Flatness <sup>1</sup>	S <sub>21</sub>	900 MHz – 4000 MHz	-	-	4	dB <sub>p-p</sub>
Input Third Order Intercept <sup>2</sup>	IIP3	Standard Linearity, I <sub>bb</sub>	30	-	-	dB
1dB Compression Point <sup>3</sup>	P <sub>1dB</sub>	I <sub>bb</sub>	16	-	-	dB

1. I<sub>op</sub>, T<sub>case</sub> = 25°C. Test with the laser Input pin matched to a 50Ω system.
2. IIP3 is measured at I<sub>bb</sub> where I<sub>bb</sub> is the bias point at which simultaneously the laser is at its best linearity and the optical power is within specification. Test Frequency F1 = 2700MHz, F2 = 2703MHz, RF in = 0dBm/frequency. 0km fiber.
3. Test at 2700MHz. 0km fiber.

**Package Outline Drawing**



**Mounting Bracket**



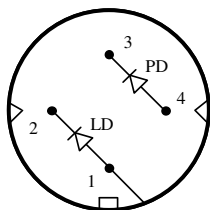
NOTES:

1. UNIT: mm
2. TOLERANCE: ±0.1mm UNLESS OTHERWISE SPECIFIED

## Reliability/Quality

Designed to meet qualification requirements of Telcordia™ (Bellcore) GR-468-CORE.

### Schematic and Pinout A

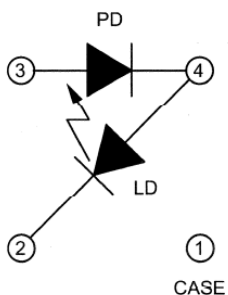


Pinout A  
Bottom View

### Pin Definitions for Pinout A

Pin	Description
1	LD Anode, Case Ground
2	LD Cathode
3	PD Cathode
4	PD Anode

### Schematic and Pinout C



Bottom View

### Pin Definitions for Pinout C

Pin	Description
1	Case
2	LD Cathode
3	PD Anode
4	LD Anode, PD Cathode

**Laser Safety**

This product meets the appropriate standard in Title 21 of the Code of Federal Regulations (CFR). FDA/CDRH Class 1 laser product. This device has been classified with the FDA/CDRH under accession number 0220191.

All Versions of this laser are Class 1 laser product, tested according to IEC 60825-1:2007/EN 60825-1:2007 Single-mode fiber pigtail with SC/APC connectors (standard).

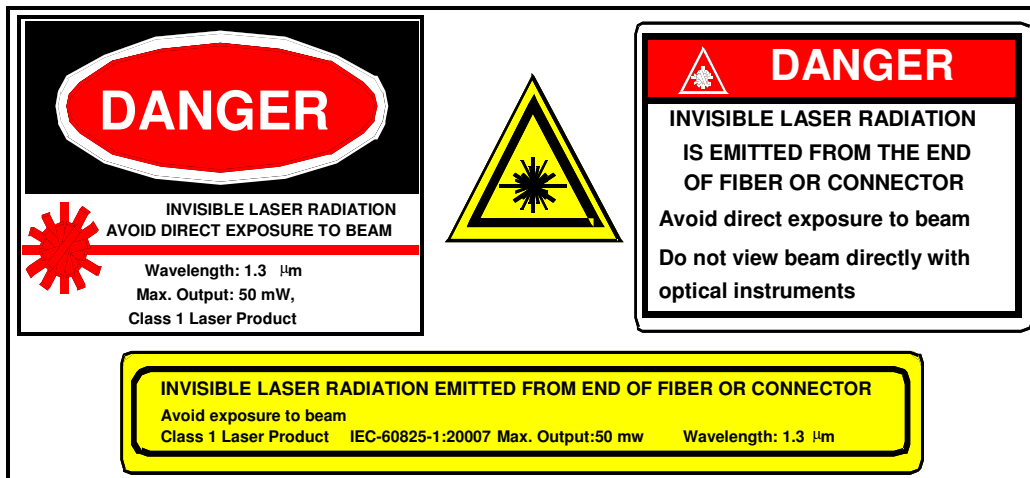
Wavelength = 1.3  $\mu\text{m}$ .

Maximum power = 50 mW.

Because of size constraints, laser safety labeling (including an FDA class 1 label) is not affixed to the module, but attached to the outside of the shipping carton.

Product is not shipped with power supply.

**Caution: Use of controls, adjustments and procedures other than those specified herein may result in hazardous laser radiation exposure.**



## Ordering Code Definitions

### 1935x-a-bb-c-dddd-ww-yy-z

#### Family Name

1935F: Forward Path  
1935R: Return Path  
1935W: Wide Bandwidth

#### Distortion Performance

a = A: Standard Linearity  
a = B: Enhanced Linearity (**not available for 1935W**)

#### Optical Isolator

bb = DI: Double Isolator (only **available for 3 – 6dBm optical power models**)  
bb = SI: Single Isolator

#### Pinout Option

c = A: Pinout A  
c = C: Pinout C

#### O-Band Wavelength

dddd = 1271: 1271 nm  
dddd = 1291: 1291 nm  
dddd = 1311: 1311 nm  
dddd = 1331: 1331 nm  
dddd = 1351: 1351 nm  
dddd = 1371: 1371 nm

#### Fiber Length, Optical Connector

ww = FA: FC/APC, 900 micron buffer, 1.0 – 1.4 meter  
ww = SA: SC/APC, 900 micron buffer, 1.0 – 1.4 meter

#### Optical Output Power

yy = 03: 3 dBm (2 mW)  
yy = 05: 5 dBm (3mW)  
yy = 06: 6 dBm (4mW)  
yy = 09: 9 dBm (8 mW) – (**only available for 1935F and 1935W**)  
yy = 10: 10dBm (10 mW) – (**only available for 1935F and 1935W**)

#### Mounting Bracket

z = B: Mounting Bracket  
z = N: No Mounting Bracket

## Example

**1935F-B-DI-A-1271-SA-10-N:** Forward Path Uncooled O-Band CWDM Coaxial Laser, Enhanced Linearity, Double Isolator, Pinout A, 1271nm, SC/APC optical connector, 10 dBm optical power, no mounting bracket.

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