

RIO ORION™ Series 1550nm Low Phase Noise Narrow Linewidth Laser Source

Data Sheet
July 2019

Key features

- Single longitudinal mode
- Center wavelength: 1530nm-1565nm, ITU-T DWDM 100 GHz C-band or custom
- Very low phase and frequency noise
- Very narrow linewidth, long coherence length
- Ultra low RIN
- Excellent SMSR
- Unmatched wavelength stability over life and temperature
- Wavelength tunability
- Direct FM modulation
- Low sensitivity to vibration and acoustic noise
- SMF and PM fiber connector options
- Compact size, low power consumption
- Easy to set-up and use
- Digital controller and firmware with USB interface
- RoHS compliant

Applications

- Acoustic & seismic interferometric fiber optic sensing
- Defense and security
- Oil & Gas – exploration and production
- LIDAR
- Metrology
- RF and microwave photonics
- Coherent Communications



Description

The ORION™ laser sources are compact benchtop lasers based on the RIO high-performance External Cavity Laser (ECL). This laser design is based on RIO's proprietary planar technology (**PLANEX™**) and consists of a gain chip and a planar lightwave circuit including waveguides with Bragg gratings, forming a laser cavity with significant advantages.

The ORION™ laser source's features provide end users with a stable, self-contained, easy-to-use alternative to complicated and expensive fiber laser sources.

The ORION™ laser source uses reliable, Telcordia qualified and industry proven components, and employs low noise, digital laser bias current and temperature control circuitry to set and monitor laser performance.

External monitoring and control can be employed via a standard USB interface, using RIO-supplied software. The ORION™ laser source is an ideal source for R&D, commercial, and advanced fiber optic sensing applications, such as interferometric and Brillouin DTSS systems for oil & gas, security and smart infrastructure monitoring, coherent Doppler LIDAR for wind measurements, coherent and heterodyne metrology, photonic velocimetry and vibrometry, and coherent communications.

Absolute Maximum Ratings

Operation of the device beyond these maximum conditions may degrade device performance, lead to device failure, shorten product lifetime, and invalidates the device warranty.

Parameter	Min	Max	Unit
Storage temperature	- 40	+ 85	°C
Laser source supply voltage		5.5	V
ESD-susceptibility		500	V

Optical and Electrical Specifications

At recommended TEC set temperature T_s and bias current I_b

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output Optical Power	P_{out}	CW	See ordering information			mW
Power Stability over case temperature range ¹	dP_{out}	0 to +70 °C		±10		%
		+10 to +55 °C		±5		
		≤ ±1 °C			±0.3	
Center Wavelength (ITU grid)	λ	± 40 pm standard ²	1530		1565	nm
Wavelength tuning range ³	$\Delta\lambda_T$	via TEC temperature change	30 ⁴			pm
Wavelength stability over case temperature range ¹	$d\lambda$	0 to +70 °C		±10		pm
		+10 to +55 °C		±5		
		≤ ±1 °C			±0.5	
Frequency stability ⁵	ν_{t1}	Free running, over 1 hour		± 2	± 4	MHz
	ν_{t8}	Free running, over 8 hours		± 3	± 6	
Relative Intensity Noise	RIN	≥ 1kHz			-140	dB/Hz
		≥ 500 kHz	Shot noise limited			
Side Mode Suppression Ratio	SMSR	CW, at specified P_{out}	40			dB
Optical S/N Ratio	S/N	From spontaneous noise levels at +/-1 nm from λ	60			dB
Polarization Extinction Ratio ⁶	PER	For PM option, polarization and connector key aligned to slow axis	20			dB
Optical Isolation	ISO		40			dB
Voltage Supply	V_{cc}		4.75	5	5.25	V

1. Customized power and wavelength stability requirements are available upon request.
2. Customized center wavelength and set resolution, including ITU-T C-band is available. See ordering information page
3. Phase continuous wavelength tuning by changing TEC temperature settings. Some performance parameters will change over tuning range.
4. Tuning range is not symmetric around center wavelength, 30pm range is +10pm to -20pm as a minimum.
5. After 1 hour stabilization, tested with heterodyning of two lasers at constant case temperature.
6. With PM-fiber PANDA option. See ordering information page.

Modulation Specifications: Low Frequency [LF] (for both option RIO31XX- & RIO33XX-)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Frequency modulation bandwidth ¹	f_{mL}	Sinusoidal modulation	DC		100	kHz
Frequency tuning efficiency ^{1,2}	η_{mL}	Sinusoidal modulation at 10 kHz	25	50		MHz/V
Tuning voltage magnitude ¹	V_{tuneL}	Through BNC input	-4		+4	V
Output power modulation index ^{1,3}	M_L	Sinusoidal modulation at 10 kHz; wavelength tuning 100 MHz p-p		5	10	%

1. Via pin4 of ORION D-9 connector
2. Tuning efficiency will vary over modulation bandwidth. Contact RIO for more information.
3. Frequency will lead to modulation of output power.

Modulation Specifications: High Frequency [HF] (for option RIO33XX- only)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Frequency modulation bandwidth ¹	f_{mH}	Sinusoidal modulation, AC coupled	0.01	100	200	MHz
Frequency tuning efficiency ^{1, 2}	η_{mH}	Sinusoidal modulation at 20 kHz	100	200		MHz/V
		Sinusoidal modulation at 500 kHz	25	50		
		Sinusoidal modulation at 20 – 200 MHz	50	100		
Tuning voltage magnitude ¹	V_{tuneH}	AC coupled, though SMC input			1	V_{p-p}
Output power modulation index ^{1, 3}	M_H	Sinusoidal modulation at 100 MHz; wavelength tuning 100 MHz			4	%

1. Via 50 Ω , SMC connector
2. Tuning efficiency will vary over modulation bandwidth. Contact RIO for more information.
3. Frequency will lead to modulation of output power.

Linewidth and Phase Noise Specifications

At recommended TEC set temperature T_s and bias current I_b ,

Parameter	Symbol	Conditions	Grade 1	Grade 3	Grade 4	Grade 5 ³	Unit
Spectral Linewidth, FWHM ¹	$\Delta\lambda_L$		≤ 15	≤ 5	≤ 2	≤ 1	kHz
Phase Noise Typical Values ²	PhN	@ 10 Hz	123	41	20	10	$\mu\text{rad}/\text{rt-Hz}$ 1 m OPD
		@ 200 Hz	22	8	4	2	

1. Value based on Lorentzian linewidth model.
2. As measured with RIO's interferometric phase noise test setup, 1m OPD in the SM fiber.
3. 10 mW output power version only.

Thermal Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating temperature range (ambient)	T_c		+15		+ 50	$^{\circ}\text{C}$
Power Consumption	P_d	Over operating temperature range			4	W
Total current	I_{max}	Over operating temperature range			1.0	A

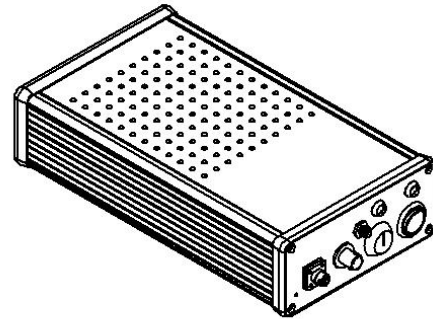
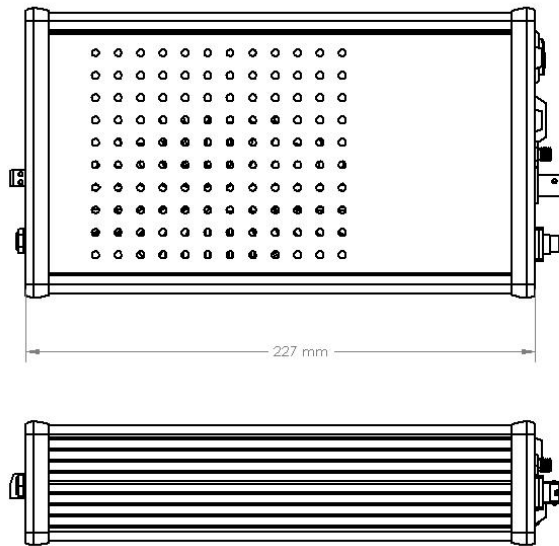
Front Panel Connectors

#	Description
F-1	FC/APC bulkhead connector with dust cap
F-2	BNC female connector for LF frequency modulation (option)
F-3	SMC female connector for HF frequency modulation (option)

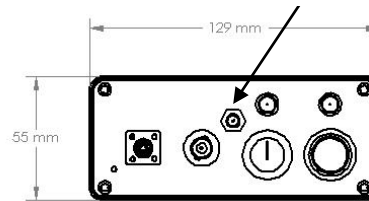
Back Panel Connectors

#	Description
B-1	5V DC adaptor for power supply
B-2	Interface USB type B connector for external monitoring and control.

Mechanical Diagram



Optional SMC connector

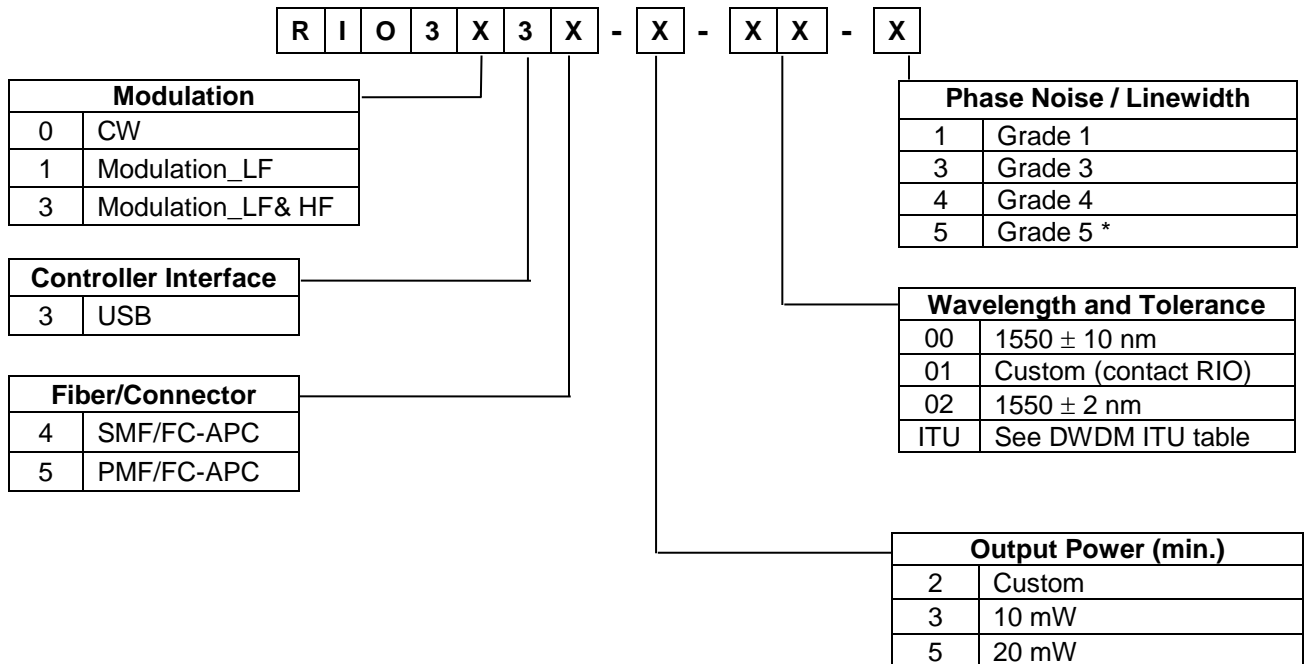


Dimensions		Units
L	227	mm
W	129	
H	55	

Reliability and Certifications

- Qualified according to Telcordia GR-468-CORE
- CE certified

Ordering Information



* Grade 5: 10 mW output power version only

Accessories Included

- 5V DC power supply
- GUI installation Flash Drive including operational manual
- USB cable
- SMC to SMA cable (for PN33XX- only)



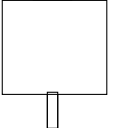
DWDM ITU Wavelength¹

ITU channel number	ITU Frequency THz	Wavelength nm	ITU channel number	ITU Frequency THz	Wavelength nm	ITU channel number	ITU Frequency THz	Wavelength nm
15	191.50	1565.50	30	193.00	1553.33	45	194.50	1541.35
16	191.60	1564.68	31	193.10	1552.52	46	194.60	1540.56
17	191.70	1563.86	32	193.20	1551.72	47	194.70	1539.77
18	191.80	1563.05	33	193.30	1550.92	48	194.80	1538.98
19	191.90	1562.23	34	193.40	1550.12	49	194.90	1538.19
20	192.00	1561.42	35	193.50	1549.32	50	195.00	1537.40
21	192.10	1560.61	36	193.60	1548.51	51	195.10	1536.61
22	192.20	1559.79	37	193.70	1547.72	52	195.20	1535.82
23	192.30	1558.98	38	193.80	1546.92	53	195.30	1535.04
24	192.40	1558.17	39	193.90	1546.12	54	195.40	1534.25
25	192.50	1557.36	40	194.00	1545.32	55	195.50	1533.47
26	192.60	1556.55	41	194.10	1544.53	56	195.60	1532.68
27	192.70	1555.75	42	194.20	1543.73	57	195.70	1531.90
28	192.80	1554.94	43	194.30	1542.94	58	195.80	1531.12
29	192.90	1554.13	44	194.40	1542.14	59	195.90	1530.33

1. Standard wavelength tolerance is +/-40pm

Laser Safety Information

The ORION laser module is classified as FDA/CDRH Class IIIb laser products per CDRH, 21 CFR 1040 laser safety requirements, and complies as Class 3R laser product per international standard IEC 60825-1, 2014.

 <p>DANGER</p> <p>INVISIBLE LASER RADIATION</p> <p>AVOID DIRECT EYE EXPOSURE</p>  <p>OUTPUT POWER: 50 mW max WAVELENGTH: 1.53~1.57 μm BEAM DIVERGENCE AT FIBER OUTPUT: 0.21 rad CLASS IIIb LASER, CDRH, 21 CFR 1040 CLASS 3R LASER, IEC60825-1</p>	<p>LASER APERTURE</p>  <p>AVOID EXPOSURE Invisible laser radiation is emitted from end of fiber or connector</p>
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