RIO GRANDE 1550 nm High Power
Low Phase Noise Narrow Linewidth Laser Module

Data Sheet
October 2021

Key features

- Single longitudinal mode
- Center wavelength: 1541nm-1565nm, ITU-T DWDM 100 GHz C-band or custom
- Very low phase noise
- Ultra-low RIN
- Narrow linewidth
- High SMSR
- High OSNR
- Excellent wavelength stability over life and temperature
- SM and PM fiber options
- Easy to set-up and use
- Digital controller and firmware with RS-232
- ROHS compliant

Description

The RIO GRANDE devices are high power laser modules employing 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.

RIO high power narrow linewidth laser is integrated with high performance low noise EDFA. It provides narrow linewidth, low phase noise, ultra-low RIN, high output power and exceptionally reliable performance. An integrated RS232 interface enables easy control, diagnostic functions and data acquisition. The RIO high power module is an ideal candidate for OEM commercial and military fiber optic sensing, such as interferometric and Brillouin sensing systems for oil & gas, security, and also for metrology, LIDAR and other applications.

Applications

- Acoustic & seismic interferometric fiber optic sensing
- Defense and security
- Oil & Gas – exploration and production
- LIDAR
- Metrology

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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	ºC
Module supply voltage	11.5	12.5	V
ESD-susceptibility		500	V
Fiber bend radius	35		mm
Tensile strength, fiber to the package		5	N
Humidity (Non condensing)	5	95	**%**

Optical and Electrical Specifications

At room temperature (25 °C) unless noted otherwise, after min 5 min warm up time

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output Optical Power	P_{out}	CW, nominal	See ordering information			W
Power Stability (rms)	dP_{out_s}	Over 8 hrs, room temperature (25 ± 1 ºC)			1	%
Power Drift	dP_{out_d}	From output power at room temperature, over case temperature range	-5		+5	%
Center Wavelength (ITU grid)	λ	+/- 40 pm standard [1]	1541		1565	nm
Wavelength thermal tuning range [2]	$\Delta\lambda_T$	Setting via RS-232 interface	30 [3]			pm
Output power adjustment range	$P_{out}T$	vs. rated output power	10		100	**%**
Wavelength Stability	dλ	Over case temperature range		± 10		pm
Relative Intensity Noise [4]	RIN	≥100 Hz			-110	dB/Hz
		≥10 kHz			-125	
		≥ 800 kHz up to 50 MHz		-157	-155	
Side Mode Suppression Ratio	SMSR	CW, at specified P_{out}	40	50		dB
Optical S/N Ratio [5]	OSNR	From ASE levels at +/-1 nm from □	55			dB
Beam quality	BQ	-			1.1	M^2
Polarization extinction ratio	PER	For PM option, polarization and connector key aligned to slow axis	20			dB
Optical Isolation	ISO		30			dB
Voltage Supply	V_{cc}		11.5	12	12.5	V
Frequency stability [6]	v_{t1}	Free running, over 1 hour		± 2	± 4	MHz
	vv_{t8}	Free running, over 8 hours		± 3	± 6	

1. Customized center wavelength and build tolerance within 1530 to 1565 nm range, including ITU-T C-band is available upon request.
2. Phase continuous wavelength tuning by changing TEC temperature settings. Some performance parameters will change over tuning range.
3. Tuning range is not symmetric around center wavelength, 30pm range is +10pm to -20pm as a minimum. Customized extended wavelength tuning range available upon request up to +/-45pm.
4. Measured at 2 mW input power to OE converter.
5. 0.05 nm resolution.
6. After 1 hour stabilization, tested with heterodyning of two lasers at constant case temperature.

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Modulation Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Frequency modulation bandwidth [1]	f_{mL}	Sinusoidal modulation	DC		100	kHz
Frequency tuning efficiency [1, 2, 3]	η_{mL}	Sinusoidal modulation at 10 kHz	25[4]	50		MHz/V
Tuning voltage magnitude [1]	V_{tuneL}		-4		+4	V

1. Via pin17 of RIO GRANDE D-25 connector, frequency modulation will lead to modulation of output power
2. Tuning efficiency will vary over modulation bandwidth. Contact RIO for more information.
3. Frequency modulation will lead to modulation of output power.
4. If this modulation feature is ordered with grade 4 or grade 5L phase noise spec, this min spec value decreases to 20 MHz/V.

Linewidth and Phase Noise Specifications

Parameter	Symbol	Conditions	Grade 1	Grade 3	Grade 4	Grade 5L	Unit
Spectral Linewidth, FWHM [1]	$\Delta\lambda_L$		$\leq$ 15	$\leq$ 5	$\leq$ 2	$\leq$ 1	kHz
Phase Noise Typical Values [2]	PhN	@ 10 Hz	123	41	20	20	µrad/rt-Hz 1 m OPD
		@ 200 Hz	22	8	4	4	

1. Value based on Lorentzian linewidth model.
2. As measured with RIO's interferometric phase noise test setup, 1m OPD in the SM fiber.

Thermal Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating temperature range (case)	T_c		-10		+ 70	ºC
Power Dissipation @ 1W output power	P_{dt}	At 50 ºC case temperature		20		W
Power Dissipation over case temperature range	P_d	Output power 0.2 W			15	W
		Output power 1 W			25	
		Output power 2 W			40	
Total current	I_{max}	Over case temperature range			4	A

Connectors

#	Description
A	Optical FC/APC connector on output fiber (fiber length 1 meter, 3 mm diameter). Other connectors-optional.
B	Mating sleeve for FC/APC connector on monitor output, 20 dB below typ. from output optical power
C	DB25 Interface connector. Data interface RS-232

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Connector C

Function	I/O	DB25	Note
11.5 to 12.5 VDC Input	I	Pin 1,2,3,4	Power supply
GND	I	Pin 14,15,16	-
Output Power Monitor	O	Pin 5	Analog Output : 0 to 4 VDC.
Seed Power Monitor	O	Pin 6	Analog I output: 0 to 4 VDC. Voltage proportional to seed laser power expressed in mW. 1V@ 3.16 mW (+5 dBm).
EDFA Temperature Alarm	O	Pin 7	TTL output : Low –> Normal operation. High –> EDFA Temperature >70°C or <0°C. Alarm ON and pump currents are shut down.
Output Power Alarm	O	Pin 8	TTL output : Low –> Normal operation. High –> output power is below factory setting value. Alarm is ON and pump currents are shut down.
Diode Current Alarm	O	Pin 9	Output TTL: Low –> Normal operation. High –> diode current above EOL value. Alarm is ON and pump currents are shut down.
Diode Temperature Alarm	O	Pin 10	Output TTL: Low –> Normal operation. High –> Diode temperature different from settings by +/-5°C. Alarm is ON and pump current are shut down.
Case Temperature	O	Pin 11	Analog output of 10mV/°C. 750 mV@25°C.
Seed RS-232Rx	I	Pin 12	Serial input RS232 for wavelength control
Diode Current Monitor	O	Pin 13	Analog Output. Voltage proportional to diode current.
Direct modulation	I	Pin 17	Analog input for wavelength fast tuning/modulation
EDFA RS-232 TX Output	O	Pin 18	Serial output RS232 for power control
Seed Power Alarm	O	Pin 19	TTL output : Low – Normal operation. High – Input power is below user setting value (IPT). Alarm is ON and pump currents are shutdown
Output Power Disable	I	Pin 21	Low – Normal operation. High – Module is switched OFF. Alarm is ON and pump currents are shutdown – Pull up
EDFA RS-232 RX Input	I	Pin 22	Serial input RS232 for power control
Reset Manual	I	Pin 23	Microcontroller resets Low: Reset
Seed RS-232Tx	O	Pin 24	Serial output RS232 for wavelength control
Factory reserved	I	Pin 25	-

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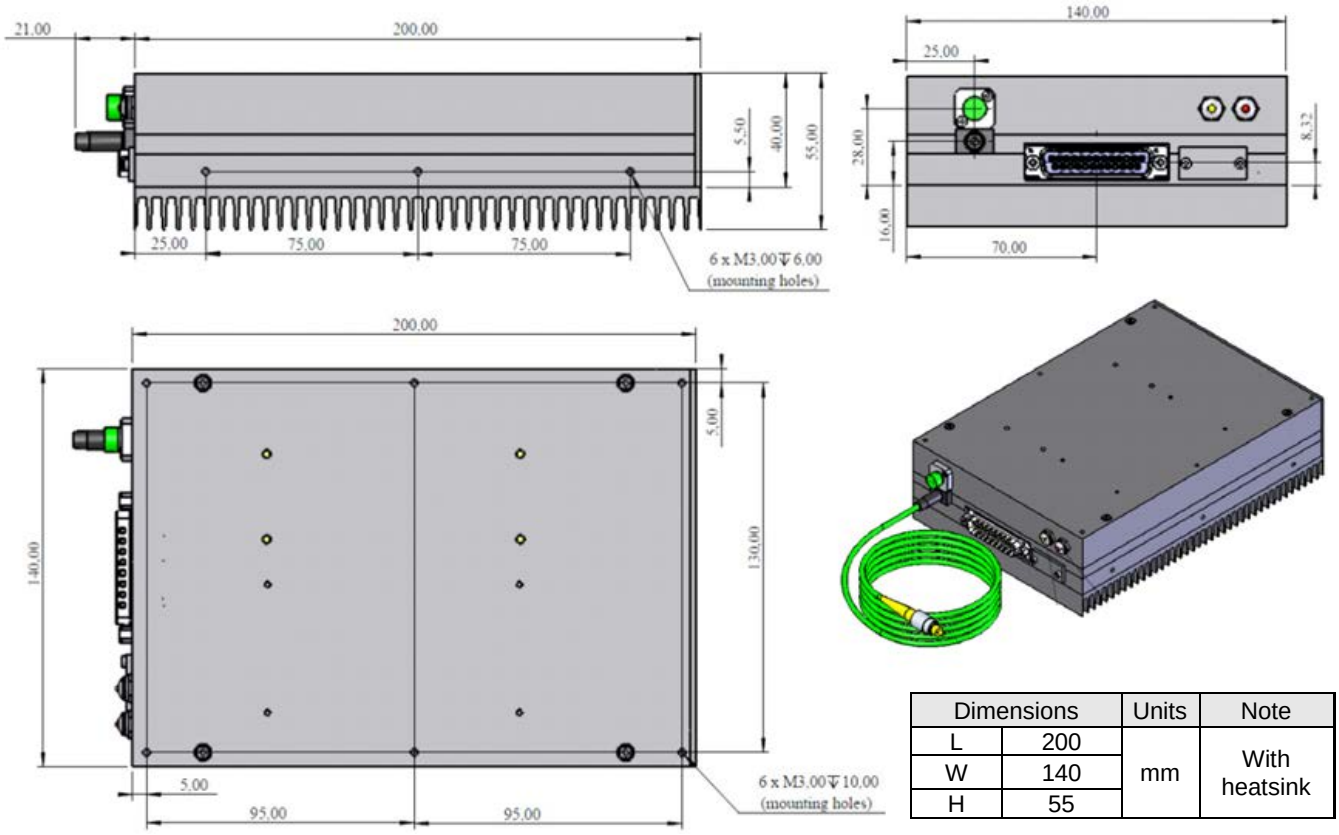
Mechanical Diagram



Dimensions		Units	Note
L	200	mm	With heatsink
W	140		
H	55		

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Ordering Information

R	I	O	1	X	7	X	-	X	-	X	X	-	X

Product Family	
1	GRANDE

Modulation	
0	CW
1	Modulation

Controller Interface	
7	RS-232

Fiber/Connector	
4	SMF/FC-APC
5	PMF/FC-APC
6	SMF/E2000
7	Custom

Linewidth/Phase Noise	
1	Grade 1
3	Grade 3
4	Grade 4
5	Grade 5L

Wavelength and Tolerance	
00	1555±10 nm
01	Custom (contact RIO)
02	1550 ± 2 nm
ITU	see DWDM ITU table

Output Power (min.)	
7	0.2 W
8	1 W
9	2 W

* Use PN extension L00 for Grade 5L only.

Accessories

Accessory PN	Description
RIO10XX-KIT	GUI software & RS232 interface cable
RIO11XX-KIT	GUI software & RS232 interface cable (w. BNC port)

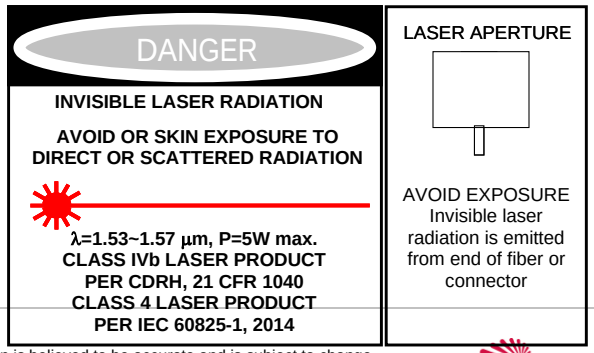
DWDM ITU Wavelength[1]

ITU channel number	ITU Frequency THz	Wavelength nm	ITU channel number	ITU Frequency THz	Wavelength nm	ITU channel number	ITU Frequency THz	Wavelength nm
16	191.60	1564.68	**26**	192.60	1556.55	**36**	193.60	1548.51
17	191.70	1563.86	**27**	192.70	1555.75	**37**	193.70	1547.72
18	191.80	1563.05	**28**	192.80	1554.94	**38**	193.80	1546.92
19	191.90	1562.23	**29**	192.90	1554.13	**39**	193.90	1546.12
20	192.00	1561.42	**30**	193.00	1553.33	**40**	194.00	1545.32
21	192.10	1560.61	**31**	193.10	1552.52	**41**	194.10	1544.53
22	192.20	1559.79	**32**	193.20	1551.72	**42**	194.20	1543.73
23	192.30	1558.98	**33**	193.30	1550.92	**43**	194.30	1542.94
24	192.40	1558.17	**34**	193.40	1550.12	**44**	194.40	1542.14
25	192.50	1557.36	**35**	193.50	1549.32	**45**	194.50	1541.35

1. Standard wavelength build tolerance is +/-40pm. Custom build tolerances as tight as +/-5pm available upon request.

Laser Safety Information

The RIO GRANDE laser module is classified as FDA/CDRH Class IVb laser products per CDRH, 21 CFR 1040 laser safety requirements, and complies as Class 4 laser product per international standard IEC 60825-1, 2014.



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