

## Applications

- RF and Microwave Antenna Signal Distribution
- EW Systems
- Broadband Delay Line and Signal Processing Systems
- Frequency Distribution Systems
- Radar System Calibration
- Phased Array Antenna Systems, Interferometric Antenna Arrays

## Features

- Three Operating Bands - Eliminates the Performance and Cost Penalty of Block Up/Down Conversion
  - 50 MHz - 18 GHz
  - 50 MHz - 22 GHz
  - 50 MHz - 40 GHz
- Low RIN Source Laser, Laser and Modulator Bias Control Circuit and High Optical Input Power Photodiode - Provides High Dynamic Range of  $>110$  dB-Hz<sup>2/3</sup>
- Multiple Optical Output Powers - Provides the Correct Power Level for the Application
  - 7 dBm min
  - 10 dBm min
- DWDM Operation - Increases Transport Capacity Without Increasing Fiber Count
- Fully Integrated Unit - Reduces Integration Costs

## 0.05 - 40 GHz, 1550 nm Externally Modulated Self-Contained L - K-Band Transmitters and Fiber Optic Receivers

The EMCORE Small Integrated Transmitter Unit (SITU) and Small Integrated Receiver Unit (SIRU) are high performance broadband externally modulated transmitter and receiver modules. Three transmitter RF operating bandwidths are available: 0.05 – 18, 0.05 – 22 and 0.05 – 40 GHz. Two receiver RF operating bands are available: 0.05 – 22 and 0.05 – 40 GHz. In addition, the units are DC-coupled, so they will pass RF frequencies down to 10 kHz. Two optical output power ranges of 7-9 dBm or 10-12 dBm are available for each transmitter band.

The SITU-SIRU series modules are fully integrated units that contain both the optics and the control electronics. Only DC input voltages, fiber optic and the RF signal are required for operation.

The units can be used to construct transparent links for antenna remoting. The broad bandwidth is intended for applications such as electronic warfare and Ku-Band systems. Other applications include delay lines and signal processing systems.

The system operates at a nominal wavelength of 1550 nm. Wavelength selected transmitter lasers on the ITU grid are also available to support multi-channel DWDM applications.

## Performance Highlights

Parameter	Min	Typical	Max	Units
Frequency Range	.05	-	40	GHz
RF Input Power	-	-	+25	dBm
Wavelength	-	1550	-	nm
Optical Output Power	7	-	12	dBm
Temperature Range	-40	-	70	°C

# SITU-SIRU Series Externally-Modulated Transmitters & Receivers



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## Absolute Maximum Ratings

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.

Parameter	Symbol	Min	Max	Units
Operating Temperature (within specifications)	$T_{OP}$	0	50	°C
Operating Temperature (with degraded performance)	$T_{OP}$	-40	70	°C
Storage Temperature	$T_{STG}$	-40	70	°C
RF Input (damage level threshold)	$S_{IN}$	NA	25	dBm
Receiver Optical Input Power (damage level threshold)	SIRU3000	NA	+13	dBm
	SIRU3400	NA	+11	dBm

## SITU-Series Transmitter Optical Specifications

Parameter	Symbol	Condition	Min	Typical	Max	Unit
Wavelength	$\lambda$	-	1530	1550	1562	nm
Optical Output Power	$P_L$	SITUxxx0 Version	7	-	9	dBm
		SITUxxx1 Version	10	-	12	dBm
Transmitter Source Laser RIN	-	-	-	-165	-163	db-Hz
Connector Return Loss	-	-	60	-	-	dB
Optical Connector Type	-	SC/APC	-	-	-	-

Note: In order to prevent reflection-induced distortion degradation, the laser should be connected to an optical cable having a return loss of at least 55 dB for discrete reflections and 30 dB for distributed reflections.

## SITU-Series Transmitter RF Specifications

Parameter	Condition	Min	Typical	Max	Unit
Operational Bandwidth	SITU2800 Version	0.05	-	18	GHz
	SITU3000 Version	0.05	-	22	GHz
	SITU3040 Version	0.05	-	40	GHz
RF Input Impedance	-	-	50	-	$\Omega$
RF Return Loss	-	9	15	-	dB
2nd Harmonic Suppression	RF Input 0 dBm	-	-75	-45	dBc
1 dB Compression Point	@ 2 GHz	-	+16	-	dBm
	@ 10 GHz	-	+17	-	dBm
	@ 18 GHz	-	+19	-	dBm
	@ 22 GHz	-	+20	-	dBm
	@ 40 GHz	-	+25	-	dBm
RF Connector	SITU28xx Version - SMA (Female)	-	50	-	ohm
	SITU3xxx Version - K (Female)	-	2.9	-	mm

Note: Units provide signal transport above and below rated RF bandwidth with some degradation in signal gain and return loss.

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## SITU-Series Transmitter Physical Parameters

Parameter	Condition	Min	Typical	Max	Unit
Configuration	Self Contained Housing	-	-	-	-
Dimensions	1.3 H x 3.6 W x 9.2 D	-	-	-	in
Operating/Storage Temperature		-40	-	+70	°C
Weight	-	-	29	-	oz

## SITU-Series Transmitter DC Power Consumption

Input Voltage	Max Current
+5	2 A
+15	0.1 A
-5	0.65 A
-15	0.1 A

## SITU-Series Transmitter 15-Pin Male D-Connector Pin Out

Pin	Function	Comments
1	+15 VDC	
2	-15 VDC	
3	+5 VDC	
4	-5 VDC	
5	Laser Current Monitor	1 V/A
6	Optical Power Monitor	0.25 V/mW
7	Reserved for Factory Use	
8	Reserved for Factory Use	
9	Tx Power Control	0 V off; 5 V on
10	NC	
11	NC	
12	GND	
13	GND	
14	GND	
15	Reserved for Factory Use	

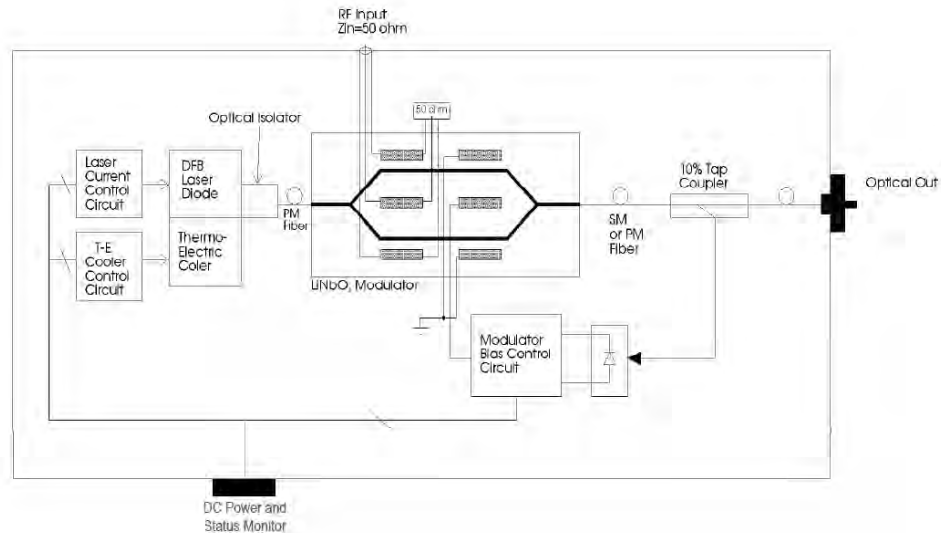
# SITU-SIRU Series Externally-Modulated Transmitters & Receivers



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## SITU-Series Transmitter Reference Block Diagram



The SITU-Series transmitter control circuits provides a “slow ramp” to the bias current of the high-power DFB source laser to limit the optical output power of the DFB laser and the transmitter throughout the initialization process. During initialization, it is possible for the transmitter optical output power to briefly exceed the maximum rated value by as much as 3 dB, creating the potential to exceed the optical power limit of the receiver photodiode and damage the receiver. Once the transmitter has completed the optimization process, the DFB laser bias ramp circuit set the laser bias current to the correct value to provide the specified transmitter optical output power.

## SIRU-Series Receiver RF Specifications

Parameter	Condition	Min	Typical	Max	Unit
Frequency Range	SIRU3000	0.05	-	22	GHz
	SIRU3040	0.05	-	40	GHz
Electrical Power Requirements	SIRU3000	-	-	+15 V @ 50	mA
	SIRU3040	-	-	+15 V @ 70	mA
Photodiode Monitor Output	-	-	0.1	-	V/mA
RF Connector	K (Female)	-	2.99	-	mm
RF Output Impedance	-	-	50	0	$\Omega$

Note: Units provide signal transport above and below rated RF bandwidth with some degradation in signal gain and return loss.

## SIRU-Series Receiver Optical Specifications

Parameter	Condition	Min	Typical	Max	Unit
Wavelength	SIRU3000	1280	-	1580	nm
	SIRU3040	1300	-	1600	nm
Optical Power Input	SIRU3000	-	-	+11.8 (15 mW)	dBm
	SIRU3040	-	-	+10 (10 mW)	dBm
Responsivity (@1310 nm)	SIRU3000	> 0.7	-	-	A/W
	SIRU3040	> 0.55	-	-	A/W
Responsivity (@ 1550 nm)	SIRU3000	> 0.7	-	-	A/W
	SIRU3400	> 0.5	-	-	A/W
Connectors	FC/APC	-	-	-	-

# SITU-SIRU Series Externally-Modulated Transmitters & Receivers



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## SIRU-Series Receiver Physical Specifications

Parameter	Condition	Min	Typical	Max	Unit
Configuration	Self Contained Housing	-	-	-	-
Dimensions		-	0.8 H x 4.6 W x 3.4 D	-	in
		-	20.3 H x 116.8 W x 86.4 D	-	mm
Operating/Storage Temperature		-40	-	+70	°C
Weight		-	10	-	oz
		-	283.5	-	g

## SIRU-Series Receiver DC Power Consumption

Input Voltage	Max Current
+15	0.7 A

## SIRU-Series Receiver 9-Pin Male D-Connector Pin Out

Pin	Function
1	+15 V
2	n/c
3	n/c
4	GND
5	n/c
6	Photodiode Monitor
7	n/c
8	n/c
9	n/c

## Broadband Link Performance

**SITU2800 transmitter @ quadrature bias with 0 dBm RF input and SIRU3000 receiver with 0 dBm optical input (unless otherwise indicated)**

Parameter	Symbol	Condition	Min	Typical	Max	Unit
RF Bandwidth	-	-	0.05	-	18	GHz
Link Gain*	G	@ 10 GHz	-	-47	-	dB
		@ 18 GHz	-	-48	-	dB
Link Gain (+10 dBm RX optical input)*		@ 10 GHz	-	-27	-	dB
		@ 18 GHz	-	-28	-	dB
Noise Figure	NF	@ 10 GHz	-	55	-	dB
		@ 18 GHz	-	60	-	dB
Noise Figure (+10 dBm RX optical input)	NF	@ 10 GHz	-	28	-	dB
		@ 18 GHz	-	35	-	dB
Input IP3	IIP3	@ 10 GHz	-	+26	-	dBm
		@ 18 GHz	-	+28	-	dBm
Spurious Free Dynamic Range	SFDR	@ 0 dBm RX Optical Input	95	100	-	dB-Hz <sup>2/3</sup>
		@ +10 dBm RX Optical Input	100	105	-	dB-Hz <sup>2/3</sup>
Gain Variation		50 MHz to 1 GHz	-	-	5	dB
		1 GHz to 18 GHz	-	5	10	dB

Note: Units provide signal transport above and below rated RF bandwidth with some degradation in signal gain and return loss.

# SITU-SIRU Series Externally-Modulated Transmitters & Receivers



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## SITU3000 transmitter @ quadrature bias with 0 dBm RF input and SIRU3000 receiver with 0 dBm optical input (unless otherwise indicated)

Parameter	Symbol	Condition	Min	Typical	Max	Unit
RF Bandwidth	-	-	0.05	-	22	GHz
Link Gain*	G	@ 10 GHz	-	-42	-	dB
		@ 22 GHz	-	-43	-	dB
Link Gain (+10 dBm RX optical input)*		@ 10 GHz	-	-22	-	dB
		@ 22 GHz	-	-23	-	dB
Noise Figure	NF	@ 10 GHz	-	51	-	dB
		@ 22 GHz	-	51	-	dB
Noise Figure (+10 dBm RX optical input)	NF	@ 10 GHz	-	35	-	dB
		@ 22 GHz	-	38	-	dB
Input IP3	IIP3	@ 10 GHz	-	+26	-	dBm
		@ 22 GHz	-	+29	-	dBm
Spurious Free Dynamic Range	SFDR	@ 0 dBm RX Optical Input	100	105	-	dB-Hz <sup>2/3</sup>
		@ +10 dBm RX Optical Input	105	110	-	dB-Hz <sup>2/3</sup>
Gain Variation		50 MHz to 1 GHz	-	-	5	dB
		1 GHz to 22 GHz	-	7	10	dB

Note: Units provide signal transport above and below rated RF bandwidth with some degradation in signal gain and return loss.

## SITU3040 transmitter @ quadrature bias with 0 dBm RF input and SIRU3040 receiver with 0 dBm optical input (unless otherwise indicated)

Parameter	Symbol	Condition	Min	Typical	Max	Unit
RF Bandwidth	-	-	0.05	-	40	GHz
Link Gain*	G	@ 20 GHz	-	-48	-	dB
		@ 40 GHz	-	-53	-	dB
Link Gain (+10 dBm RX optical input)*		@ 20 GHz	-	-28	-	dB
		@ 40 GHz	-	-33	-	dB
Noise Figure	NF	@ 20 GHz	-	55	-	dB
		@ 40 GHz	-	59	-	dB
Noise Figure (+10 dBm RX optical input)	NF	@ 20 GHz	-	38	-	dB
		@ 40 GHz	-	46	-	dB
Input IP3	IIP3	@ 20 GHz	-	+29	-	dBm
		@ 40 GHz	-	+34	-	dBm
Spurious Free Dynamic Range	SFDR	@ 0 dBm RX Optical Input	100	105	-	dB-Hz <sup>2/3</sup>
		@ +10 dBm RX Optical Input	105	110	-	dB-Hz <sup>2/3</sup>
Gain Variation		50 MHz to 1 GHz	-	-	5	dB
		1 GHz to 40 GHz	-	10	15	dB

Note: Units provide signal transport above and below rated RF bandwidth with some degradation in signal gain and return loss.

\*Receiver RF output level will change 2 dB for each 1 dB of RX optical input level change.

# SITU-SIRU Series Externally-Modulated Transmitters & Receivers

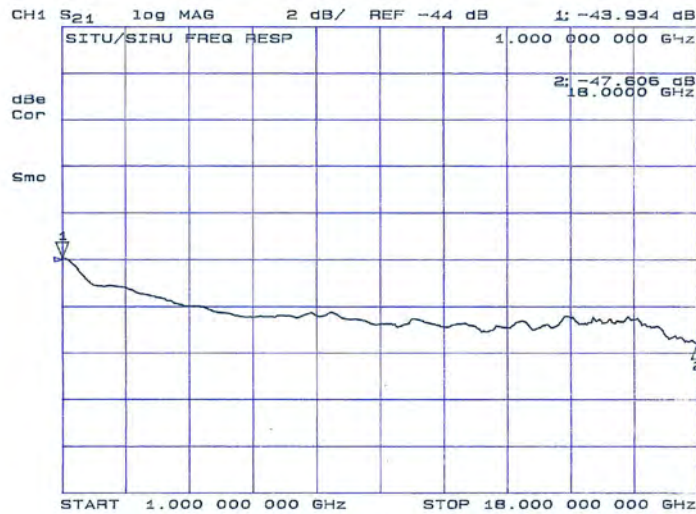


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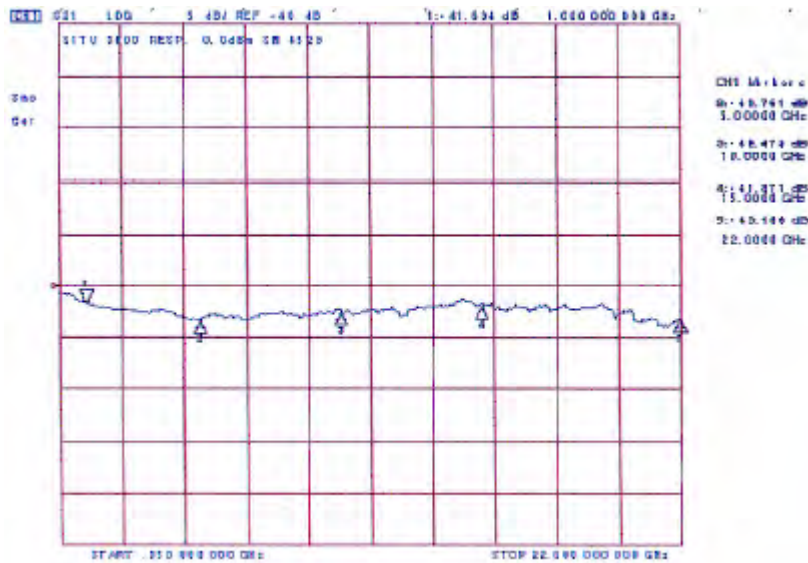
## Typical S21 Frequency Response

SITU2800 transmitter with 0 dBm RF input and SIRU3000 receiver with 0 dBm optical input



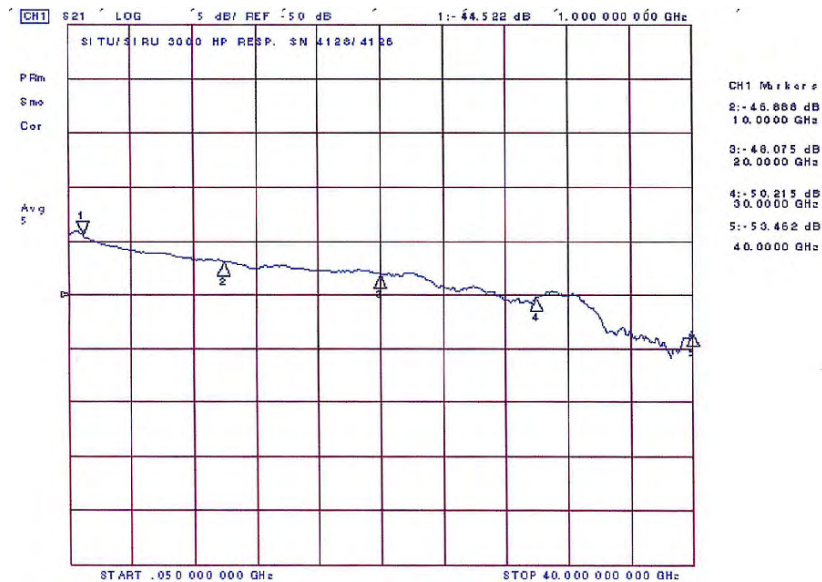
## Typical S21 Frequency Response

SITU3000 transmitter with 0 dBm RF input and SIRU3000 receiver with 0 dBm optical input

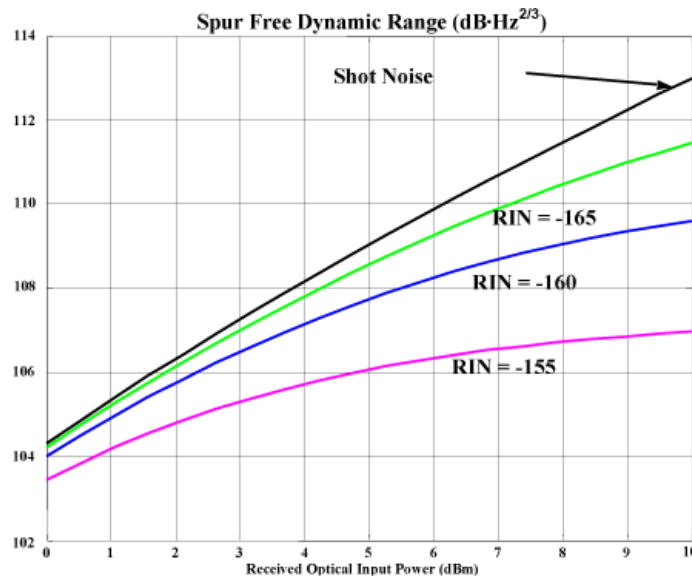


## Typical S21 Frequency Response

SITU3040 transmitter with 0 dBm RF input and SIRU3040 receiver with 0 dBm optical input



## Typical Link Spur Free Dynamic Range vs Transmitter Source Laser RIN and Received Optical Input Power





# SITU-SIRU Series Externally-Modulated Transmitters & Receivers

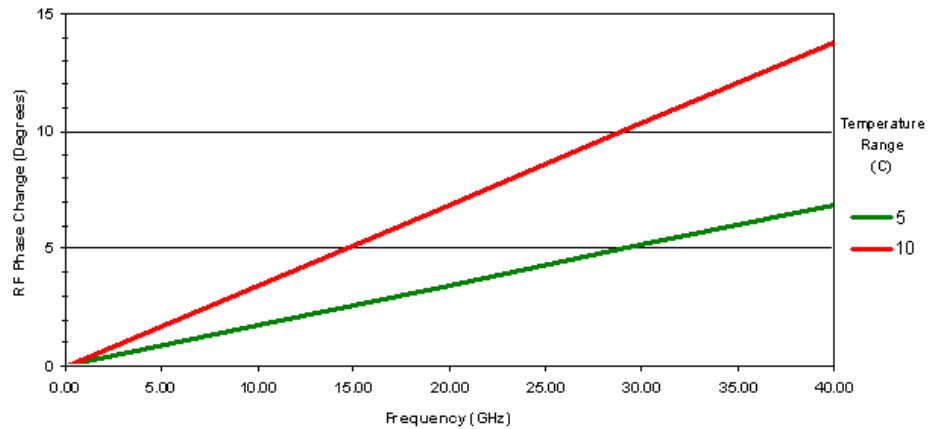


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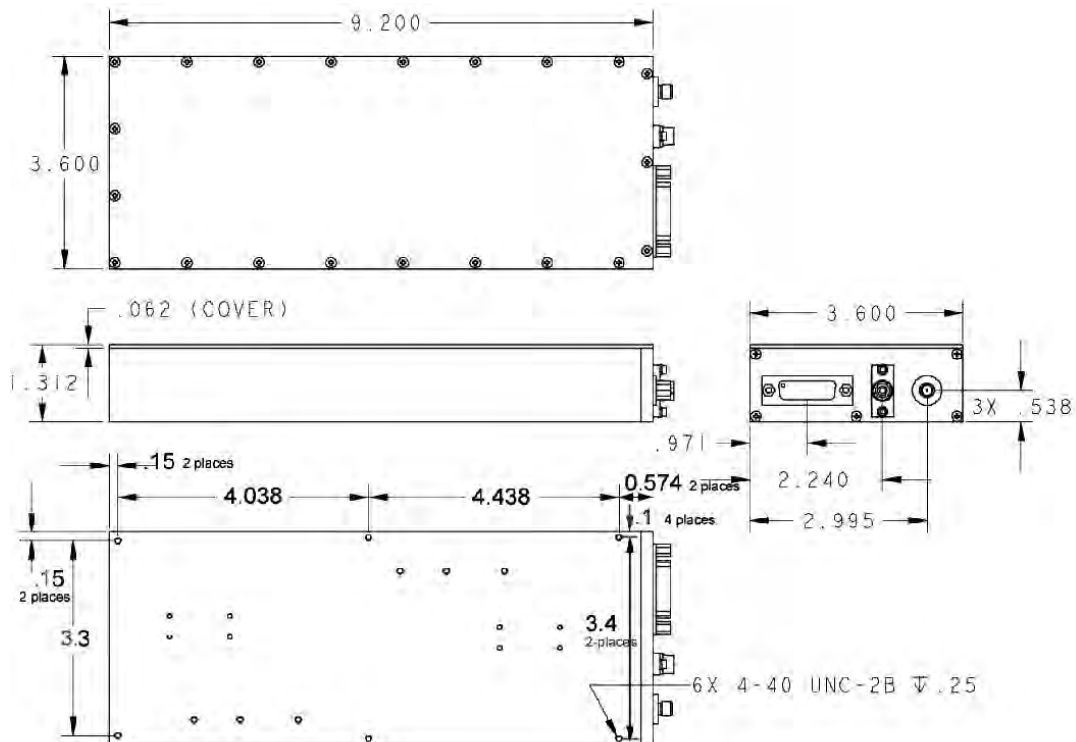
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## Typical Link Thermal Phase Stability

SITU3000 - SIRU3000 Typical Link RF Phase Change VS Temperature and Frequency

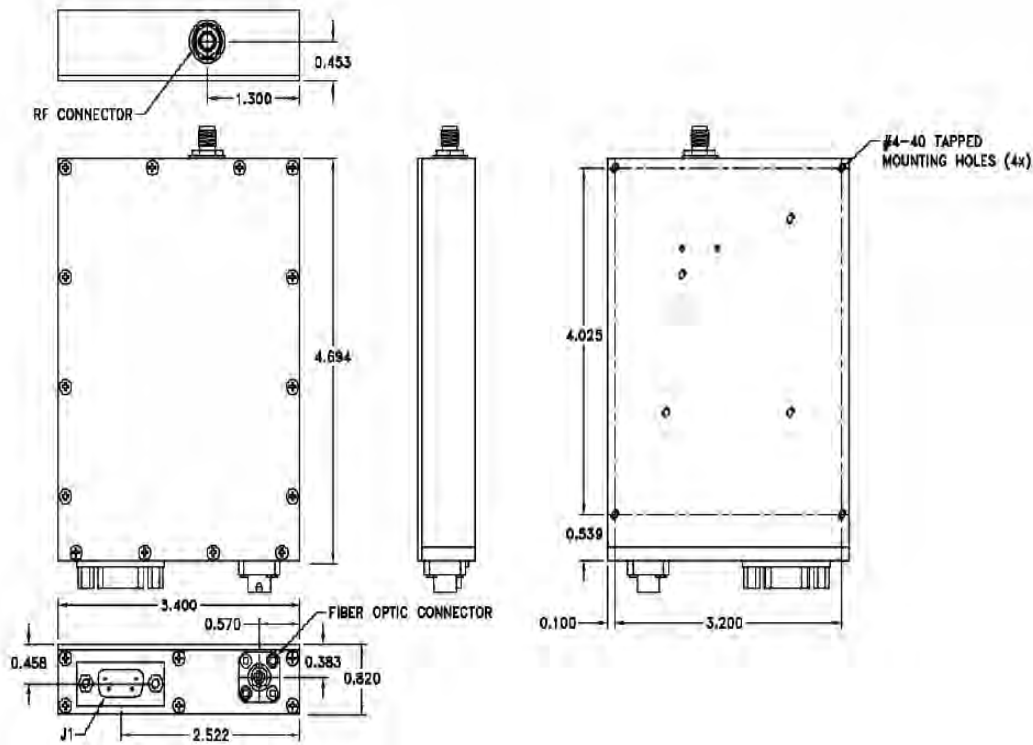


## SITU-Series Transmitter Package Outline



# SITU-SIRU Series Externally-Modulated Transmitters & Receivers

## SIRU-Series Receiver Package Outline



## Ordering Information

### Transmitter Modules:

Product Name	Description
SITU2800-00	0.05 - 18 GHz Externally Modulated Fiber Optic Transmitter Module, 7 dBm Optical Output
SITU2801-00	0.05 - 18 GHz Externally Modulated Fiber Optic Transmitter Module, 10 dBm Optical Output
SITU3000-00	0.05 - 22 GHz Externally Modulated Fiber Optic Transmitter Module, 7 dBm Optical Output
SITU3001-00	0.05 - 22 GHz Externally Modulated Fiber Optic Transmitter Module, 10 dBm Optical Output
SITU3040-00	0.05 - 40 GHz Externally Modulated Fiber Optic Transmitter Module, 7 dBm Optical Output
SITU3041-00	0.05 - 40 GHz Externally Modulated Fiber Optic Transmitter Module, 10 dBm Output

### Receiver Modules:

Product Name	Description
SIRU3000	0.05 - 22 GHz Fiber Optic Receiver Module
SIRU3040	0.05 - 40 GHz Fiber Optic Receiver Module

# SITU-SIRU Series Externally-Modulated Transmitters & Receivers



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ITU-TX Option - Insert ITU Channel Number in -yy suffix to any TX module to indicate ITU wavelength channel (00 = default 1520-1580 nm) Available ITU Channels are show below:

ITU Channel	Frequency (THz)	Wavelength (nm)
62	196.2	1527.99
61	196.1	1528.77
60	196.0	1529.55
59	195.9	1530.33
58	195.8	1531.12
57	195.7	1531.90
56	195.6	1532.68
55	195.5	1533.47
54	195.4	1534.25
53	195.3	1535.04
52	195.2	1535.82
51	195.1	1536.61
50	195.0	1537.40
49	194.9	1538.19
48	194.8	1538.98
47	194.7	1539.77
46	194.6	1540.56
45	194.5	1541.35
44	194.4	1542.14
43	194.3	1542.94
42	194.2	1543.73
41	194.1	1544.53
40	194.0	1545.32

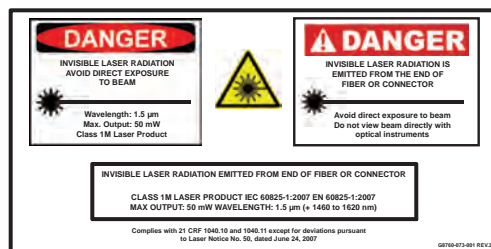
ITU Channel	Frequency (THz)	Wavelength (nm)
39	193.9	1546.12
38	193.8	1546.92
37	193.7	1547.72
36	193.6	1548.51
35	193.5	1549.32
34	193.4	1550.12
33	193.3	1550.92
32	193.2	1551.72
31	193.1	1552.52
30	193.0	1553.33
29	192.9	1554.13
28	192.8	1554.94
27	192.7	1555.75
26	192.6	1556.56
25	192.5	1557.36
24	192.4	1558.17
23	192.3	1558.98
22	192.2	1559.79
21	192.1	1560.61
20	192.0	1561.42
19	191.9	1562.23
18	191.8	1563.05

## Laser Safety

This product meets the appropriate standard in Title 21 of the Code of Federal Regulations (CFR). FDA/CDRH Class 1M laser product. This device has been classified with the FDA/CDRH under accession number 0220191. All Versions of this laser are Class 1M laser product, tested according to IEC 60825-1:2007 / EN 60825-1:2007. An additional warning for Class 1M laser products. For diverging beams, this warning shall state that viewing the laser output with certain optical instruments (for example: eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. For collimated beams, this warning shall state that viewing the laser output with certain instruments designed for use at a distance (for example: telescopes and binoculars) may pose an eye hazard.

Wavelength = 1.3/1.5  $\mu$ m.

Maximum power = 30 mW.



\*Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

\*IEC is a registered trademark of the International Electrotechnical Commission.

