RF OVER FIBER

3/6/10 GHz RF Signal Transport Standalone Modules

OZ16xx

Features

- Upper Bandwidth of 3 GHz, 6 GHz, 10 GHz
- 30 MHz Lower Roll-off Frequency
- RF Gain Stable and Fixed Over Operating Temperature Range
- Rugged Dust-tight Cast Metal housing, 3 x 5 x 1.25 in. @ ¾ lb
- -40°C to +65°C Operating Temperature Range, Fixed RF Performance
- LD Bias, LD Power, and PD Monitoring and Alarms
- Exceptionally High SFDR Up to 115 dB/Hz $^{2/3}$
- Closed Loop Optical Power and Laser Diode Temperature Control
- Cooled DFB Lasers
- Laser Conforms to Class 1 Emission Level and IEC-825 (EN 60825) Standards

Options

- Lower Frequency Roll-off Down to 10 KHz
- DWDM Lasers
- -40°C to +85°C Operating Temperature Range
- Internal Transmitter LNA
- Manual Receiver Gain Control 30dB Range
- Multimode Fiber Compatibility
- +28 Volt Power Supply
- Low Power Dissipation
- Diagnostics and Control Functions Through Digital Serial Interface (I2C)

Applications

- MMDS
- Remote Antenna Location
- GPS Distribution
- Satellite Ground Station
- Optical Delay Lines
- L, C and X Band Links

Description

The OZ16xx is a broadband RF over Fiber standalone flange mount module which may be configured as a transmitter, a receiver, or a transceiver (transmitter + receiver). Fiber links may be configured for unidirectional or bidirectional RF traffic. The OZ16xx has a wide dynamic range and supports RF transport in situations where transport distance or flexibility of cabling may prohibit the use of coaxial cable. Packaged in a rugged dust-tight cast metal housing, the OZ16xx provides high Spurious Free Dynamic Range (SFDR) transport for RF signals in the frequency range 30 MHz up to 10 GHz. Optional extended bandwidths of 10 kHz (for lower rolloff) are also available. Manual Gain Control is available to adjust end-to-end RF link gain and to optimize the receiver output RF level.

The OZ16xx features a linear optically isolated cooled DFB laser diode operating at 1310 nm or 1550 nm and/or a high performance InGaAs photodiode. DWDM wavelengths are also available. Integrated WDMs within the module package allow for bidirectional signal traffic over a single fiber. The cooled laser diode is designed with a built-in Thermoelectric Cooler (TEC) which maintains the laser device at a constant temperature, over the ambient operating temperature range. By maintaining a constant laser diode temperature, laser noise is minimized and RF performance is maintained over the operating temperature range. The transmitter optical output power is also maintained at a constant level by means of closed loop control.

The OZ16xx module RF interface is 50Ω SMA. The standard optical interface is SC/APC bulkhead receptacle (FC/APC is also an option). The OZ16xx is designed for transport over 9/125 µm single mode fiber, however options exist for transporting over multimode fiber. Alarm and monitoring functions are available via a DB9 connector on the enclosure. LEDs provide status of laser bias current (transmitter) and received optical power (receiver). An optional I2C serial data interface is also an option, contact Optical Zonu for details. The OZ16xx module is powered from +12 VDC.

7510 Hazeltine Avenue, Los Angeles, CA 91405 · Tel: 818 780 9701 · Fax: 818 780 9739

Absolute Maximum Ratings

Parameter	Symbol	Min	Typical	Max	Units
Operating Temperature	T_{op}	-40	-	65	°C
Storage Temperature	$T_{storage}$	-40		85	°C
DC Supply Voltage	V_{CC}	11.5	12	12.5	V
Transmitter RF Input (no LNA)	RF_{in}	-	-	+17	dBm
Transmitter RF Input (LNA)	RF_{in}	-	-	+5	dBm
Transmitter Optical Output	$P_{Tx,out}$	-	-	+9.5	dBm
Receiver Optical Input	$P_{Rx,in}$	-	-	+11	dBm
Unpackaged Weight	-	-	-	345	g
Relative Humidity	RH	20	-	90	%
Altitude	-	-	-	10,000	MASL

DC Characteristics

Parameter	Symbol	Min	Typical	Max	Units
DC Supply Voltage	V_{CC}	11.5	12	12.5	V
Transmitter Current (single) (no LNA)	$I_{CC,Tx}$	-	140	290	mA
Transmitter Current (single) (with LNA)	$I_{CC,Tx,\ LNA}$	-	220	370	mA
Receiver Current (single)	$I_{CC,Rx}$	-	170	180	mA
Transceiver Current (no LNA)	$I_{CC,TxRx}$	-	310	470	mA
Transceiver Current (with LNA)	$I_{CC,TxRx,\ LNA}$	-	390	550	mA

Optical Characteristics

Parameter	Symbol	Min	Typical	Max	Units
Transmitter Output Power	$P_{Tx,out}$	-	7.5	9	mW
Transmitter Wavelengths[1]	λ_{Tx}	1530	-	1562	nm
Receiver Wavelengths	λ_{Rx}	1270	-	1610	nm

[1] Cooled 1310 nm laser diode is also available.

RF Characteristics of OZ1603

Parameter	Symbol	Min	Typical	Max	Units	Notes
High Frequency Cutoff	HFC		3000		MHz	
Low Frequency Cutoff	LFC	20	30		MHz	
Frequency Response (30 - 3000 MHz) (without LNA)			± 1.0	± 1.5	dB	1
Frequency Response (30 - 3000 MHz) (with LNA)			± 1.25	± 1.5	dB	1
Input/Output Impedance	Z		50		Ohms	
Input/Output VSWR (30 - 3000 MHz)	VSWR		1.5:1	1.8:1		
Spur Free Dynamic Range @ 1 GHz (without LNA)	SFDR		112		dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 1 GHz (with LNA)	SFDR		110		dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 3 GHz (without LNA)	SFDR		108		dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 3 GHz (with LNA)	SFDR		107		dB/Hz $^{2/3}$	2
RF Link Gain (without LNA)		0	2	4	dB	2
RF Link Gain (with LNA)		18	20		dB	2
Equivalent Input Noise @ 1 GHz (without LNA)	EIN		-134		dBm-Hz	2, 3
Equivalent Input Noise @ 1 GHz (with LNA)	EIN		-154		dBm-Hz	2, 3
Equivalent Input Noise @ 3 GHz (without LNA)	EIN		-131		dBm-Hz	2, 3
Equivalent Input Noise @ 3 GHz (with LNA)	EIN		-149		dBm-Hz	2, 3
Input Third Order Intercept @ 1 GHz (without LNA)	IIP3		+33		dBm	4
Input Third Order Intercept @ 1 GHz (with LNA)	IIP3		+12		dBm	4
Input Third Order Intercept @ 3 GHz (without LNA)	IIP3		+30		dBm	4
Input Third Order Intercept @ 3 GHz (with LNA)	IIP3		+10		dBm	4
Gain Change Over Temp Range			± 0.5		dB	
Isolation (without LNA)		50	60		dB	
Isolation (with LNA)		45	55		dB	
Group Delay Variation Over (30-3000 MHz)			1		ns	

[1] Nominally there is a Tilt of -3dB from 3GHz to 6GHz, but flatter responses are available upon request. Contact Optical Zonu for details
[2] Measured and Specified with Optical loss budget of 0 dB, and 1 meter of fiber
[3] NF (dB) = EIN (dBm-Hz) + 174 (dBm/Hz).
[4] Measurements of Two-tone IMD at 0 dBm/tone per carrier at specified frequencies.
NOTE: Active low logic for Alarms is standard, but Active High Logic is available upon request.

RF Characteristics of OZ1604

Parameter	Symbol	Min	Typical	Max	Units	Notes
High Frequency Cutoff	HFC		4000		MHz	
Low Frequency Cutoff	LFC	20	30		MHz	
Frequency Response (30 - 4000 MHz) (without LNA)	-	-	± 1.5	± 1.75	dB	1
Frequency Response (30 - 4000 MHz) (with LNA)	-	-	± 1.75	± 2.0	dB	1
Input/Output Impedance	Z	-	50		Ohms	-
Input/Output VSWR (30 - 4000 MHz)	VSWR	-	1.5:1	1.8:1		-
Spur Free Dynamic Range @ 1 GHz (without LNA)	SFDR	-	108	-	dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 1 GHz (with LNA)	SFDR	-	108	-	dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 4 GHz (without LNA)	SFDR	-	104	-	dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 4 GHz (with LNA)	SFDR	-	104	-	dB/Hz $^{2/3}$	2
RF Link Gain (without LNA)	-	0	2	4	dB	2
RF Link Gain (with LNA)	-	16	18	-	dB	2
Equivalent Input Noise @ 1 GHz (without LNA)	EIN	-	-134	-	dBm-Hz	2, 3
Equivalent Input Noise @ 1 GHz (with LNA)	EIN	-	-154	-	dBm-Hz	2, 3
Equivalent Input Noise @ 4 GHz (without LNA)	EIN	-	-129	-	dBm-Hz	2, 3
Equivalent Input Noise @ 4 GHz (with LNA)	EIN	-	-147	-	dBm-Hz	2, 3
Input Third Order Intercept @ 1 GHz (without LNA)	IIP3	-	+28	-	dBm	4
Input Third Order Intercept @ 1 GHz (with LNA)	IIP3	-	+10	-	dBm	4
Input Third Order Intercept @ 4 GHz (without LNA)	IIP3	-	+26	-	dBm	4
Input Third Order Intercept @ 4 GHz (with LNA)	IIP3	-	+8	-	dBm	4
Gain Change Over Temp Range	-	-	± 0.5	-	dB	
Isolation (without LNA)	-	50	55	-	dB	
Isolation (with LNA)	-	45	50	-	dB	
Group Delay Variation Over (30-4000 MHz)	-	-	1	-	ns	-

[1] Nominally there is a Tilt of -3dB from 3GHz to 6GHz, but flatter responses are available upon request. Contact Optical Zonu for details
[2] Measured and Specified with Optical loss budget of 0 dB, and 1 meter of fiber
[3] NF (dB) = EIN (dBm-Hz) + 174 (dBm/Hz).
[4] Measurements of Two-tone IMD at 0 dBm/tone per carrier at specified frequencies.
NOTE: Active low logic for Alarms is standard, but Active High Logic is available upon request.

RF Characteristics of OZ1606

Parameter	Symbol	Min	Typical	Max	Units	Notes
High Frequency Cutoff	HFC	5900	6000	-	MHz	
Low Frequency Cutoff	LFC	20	30	-	MHz	
Frequency Response (30 - 6000 MHz) (without LNA)	-	-	± 1.5	± 1.75	dB	1
Frequency Response (30 - 6000 MHz) (with LNA)	-	-	± 1.75	± 2.0	dB	1
Input/Output Impedance	Z	-	50	-	Ohms	-
Input/Output VSWR (30 - 6000 MHz)	VSWR	-	1.6:1	2.1:1		-
Spur Free Dynamic Range @ 1 GHz (without LNA)	SFDR	-	108	-	dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 1 GHz (with LNA)	SFDR	-	108	-	dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 6 GHz (without LNA)	SFDR	-	100	-	dB/Hz $^{2/3}$	2
Spur Free Dynamic Range @ 6 GHz (with LNA)	SFDR	-	98	-	dB/Hz $^{2/3}$	2
RF Link Gain (without LNA)	-	0	2	4	dB	2
RF Link Gain (with LNA)	-	14	16	18	dB	2
Equivalent Input Noise @ 1 GHz (without LNA)	EIN	-	-134	-	dBm-Hz	2, 3
Equivalent Input Noise @ 1 GHz (with LNA)	EIN	-	-154	-	dBm-Hz	2, 3
Equivalent Input Noise @ 6 GHz (without LNA)	EIN	-	-126	-	dBm-Hz	2, 3
Equivalent Input Noise @ 6 GHz (with LNA)	EIN	-	-140	-	dBm-Hz	2, 3
Input Third Order Intercept @ 1 GHz (without LNA)	IIP3	-	+28	-	dBm	4
Input Third Order Intercept @ 1 GHz (with LNA)	IIP3	-	+10	-	dBm	4
Input Third Order Intercept @ 6 GHz (without LNA)	IIP3	-	+24	-	dBm	4
Input Third Order Intercept @ 6 GHz (with LNA)	IIP3	-	+6	-	dBm	4
Gain Change Over Temp Range	-	-	± 0.5	-	dB	
Isolation Average Broadband, @ 1 GHz (without LNA)	-	50	55	-	dB	-
Isolation Average Broadband, @ 1 GHz (with LNA)	-	40	50	-	dB	-
Group Delay Variation Over 30 - 6000 Mhz	-	-	1		ns	-

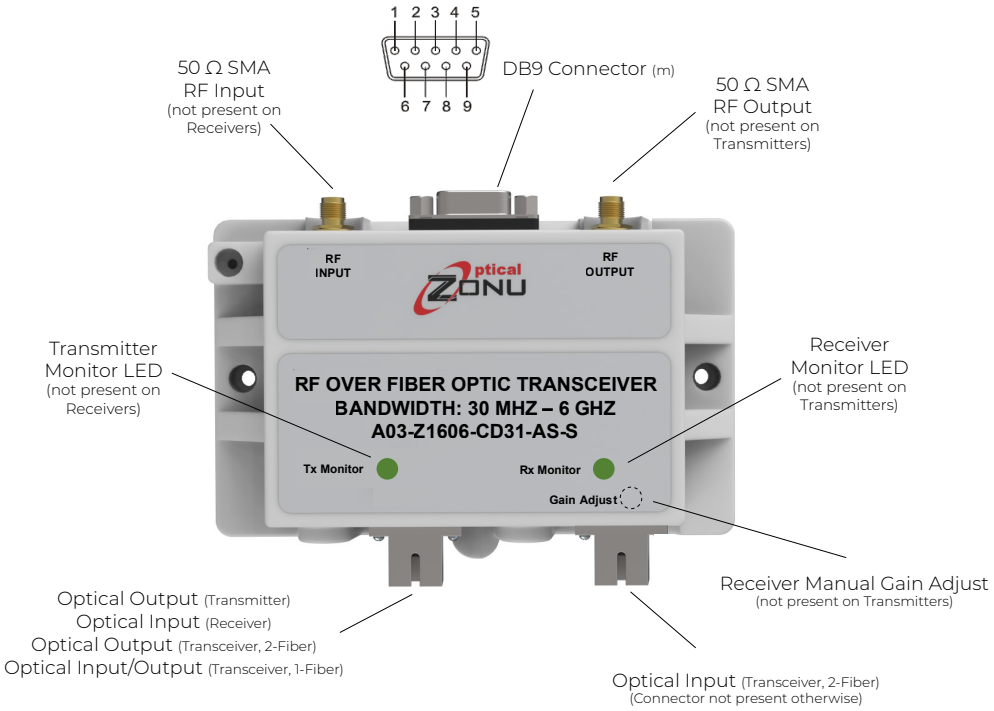
[1] Nominally there is a Tilt of -3dB from 3GHz to 6GHz, but flatter responses are available upon request. Contact Optical Zonu for details
[2] Measured and Specified with Optical loss budget of 0 dB, and 1 meter of fiber
[3] NF (dB) = EIN (dBm-Hz) + 174 (dBm/Hz).
[4] Measurements of Two-tone IMD at 0 dBm/tone per carrier at specified frequencies.
NOTE: Active low logic for Alarms is standard, but Active High Logic is available upon request.

RF Characteristics of OZ1610

Parameter	Symbol	Min	Typical	Max	Units	Notes
High Frequency Cutoff	HFC	9000	10000	-	MHz	
Low Frequency Cutoff	LFC	20	30	-	MHz	
Frequency Response (30 - 10000 MHz) (without LNA)	-	-	± 2.25	± 2.5	dB	1
Frequency Response (30 - 10000 MHz) (with LNA)	-	-	± 2.5	± 2.75	dB	1
Input/Output Impedance	Z	-	50	-	Ohms	-
Input/Output VSWR (30 - 10000 MHz)	VSWR	-	1.6:1	1.9:1	-	-
Spur Free Dynamic Range @ 1 GHz (without LNA)	SFDR	-	105	-	$dB/Hz^{2/3}$	2
Spur Free Dynamic Range @ 1 GHz (with LNA)	SFDR	-	105	-	$dB/Hz^{2/3}$	2
Spur Free Dynamic Range @ 10 GHz (without LNA)	SFDR	-	100	-	$dB/Hz^{2/3}$	2
Spur Free Dynamic Range @ 10 GHz (with LNA)	SFDR	-	100	-	$dB/Hz^{2/3}$	2
RF Link Gain (without LNA)		-2.0	0.0	+2.0	dB	2
RF Link Gain (with LNA) - 14.0dB Option Contact Factory		+12	+14	+16	dB	2
Equivalent Input Noise @ 1 GHz (without LNA)	EIN	-	-133	-	dBm-Hz	2, 3
Equivalent Input Noise @ 1 GHz (with LNA)	EIN	-	-148	-	dBm-Hz	2, 3
Equivalent Input Noise @ 10 GHz (without LNA)	EIN	-	-129	-	dBm-Hz	2, 3
Equivalent Input Noise @ 10 GHz (with LNA)	EIN	-	-144	-	dBm-Hz	2, 3
Input Third Order Intercept @ 1 GHz (without LNA)	IIP3	-	+24	-	dBm	4
Input Third Order Intercept @ 1 GHz (with LNA)	IIP3	-	+12	-	dBm	4
Input Third Order Intercept @ 10 GHz (without LNA)	IIP3	-	+19	-	dBm	4
Input Third Order Intercept @ 10 GHz (with LNA)	IIP3	-	+8	-	dBm	4
Gain Change Over Temp Range	-	-	± 0.5	-	dB	
Isolation Average Broadband, @ 1 GHz (without LNA)	-	40	45	-	dB	-
Group Delay Variation Over 30 - 10000 Mhz	-	-	1		ns	-

[1] Nominally there is a Tilt of -3dB from 3GHz to 6GHz, but flatter responses are available upon request. Contact Optical Zonu for details
[2] Measured and Specified with Optical loss budget of 0 dB, and 1 meter of fiber
[3] NF (dB) = EIN (dBm-Hz) + 174 (dBm/Hz).
[4] Measurements of Two-tone IMD at 0 dBm/tone per carrier at specified frequencies.
NOTE: Active low logic for Alarms is standard, but Active High Logic is available upon request.

Module Features



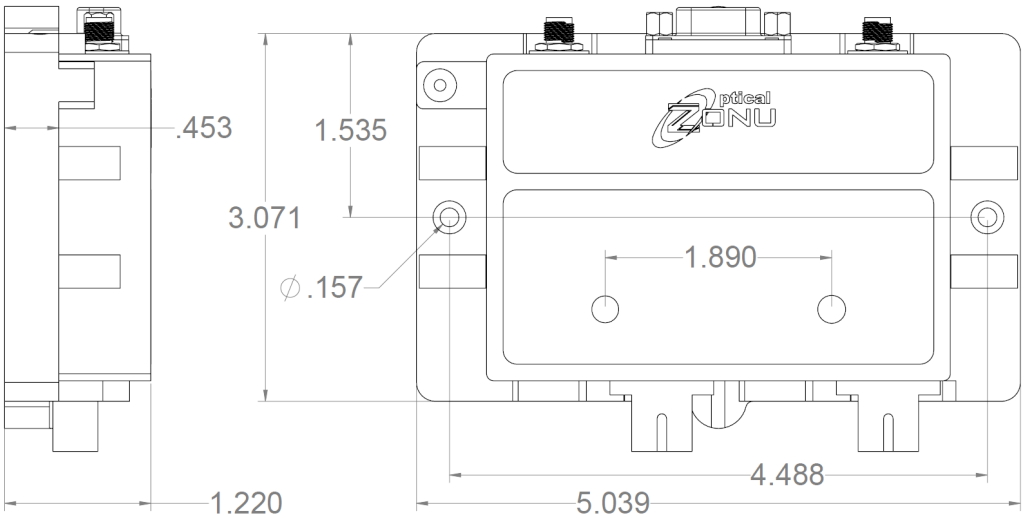
NOTE: To use Receiver Manual Gain Adjust, refer to the Optical Zonu User Manual.

DB9 Pin Assignments

Pin	Transmitter	Receiver	Transceiver
1	Laser ENABLE[1]	N/C	Laser ENABLE[1]
2[2]	N/C	N/C	N/C
3[3]	N/C	N/C	N/C
4	VCC (+12V)	VCC (+12V)	VCC (+12V)
5	Ground	Ground	Ground
6	Laser Bias Monitor (0.1V per 10 mA)	N/C	Laser Bias Monitor (0.1V per 10 mA)
7	Laser Bias Alarm (open collector, 25 mA)	N/C	Laser Bias Alarm (open collector, 25 mA)
8	N/C	Received Power Monitor (0.1V per 1 mW)	Received Power Monitor (0.1V per 1 mW)
9	N/C	Received Power Alarm (open collector, 25 mA)	Received Power Alarm (open collector, 25 mA)

[1] Laser ON = +12V, Laser OFF = Ground, Laser OFF = Floating/Not Connected
[2] I2C SCL if activated
[3] I2C SDA if activated

Mechanical Drawing

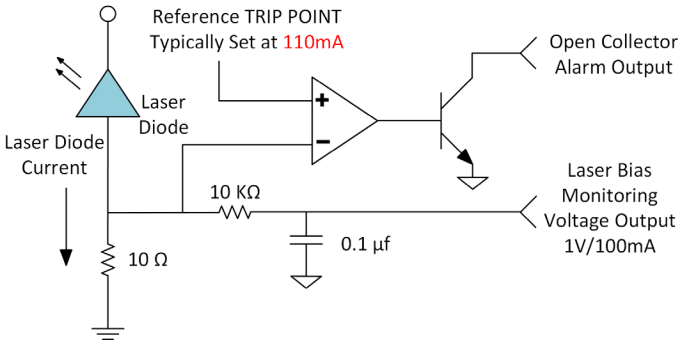


NOTE: Not all connectors are present on some models.

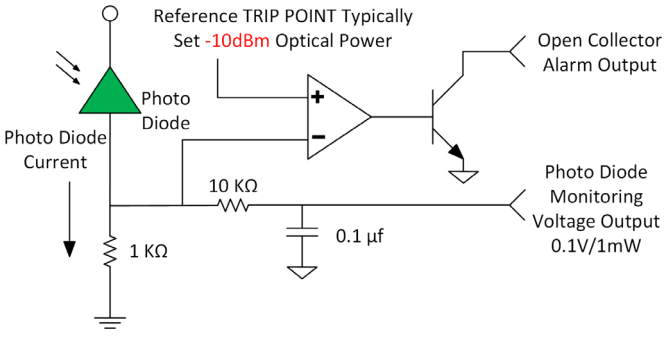
LED Definitions

LED State	Transmitter	Receiver
OFF	Module Not Powered	Module Not Powered
GREEN	Normal Operation	Normal Operation
RED	Laser Bias Current High (> 110 mA)	Optical Input Power Low (< -10 dBm)

Tx Alarm & Monitoring Circuit Diagram



Rx Alarm & Monitoring Circuit Diagram



All alarms are Open Collector topology, with Active Low for Normal operations and during Alarm condition the open collector will Pull to High logic levels. Reverse polarity alarm is also available upon request. Under normal conditions the Open Collector will be High and vice versa under fault conditions.

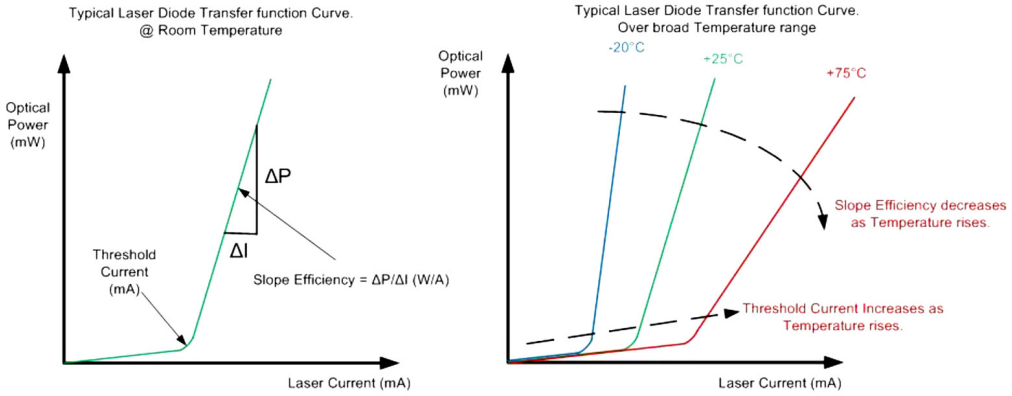
Description

Critical Benefits of Cooled RFoF Transmitters

The OZ16xx Broadband 30 MHz (up to) 10 GHz RFoF Transceiver Module utilizes a state-of-the-art Ultra Linear Cooled DFB Laser, packaged with an Integral thermoelectric cooling/heating (TEC) device, and an optical isolator to deliver the highest level of RFoF performance. The typical cooled DFB Laser has a high "slope efficiency", which means that the Laser is highly sensitive and requires a lower modulation current in order to achieve the usual high modulation index. In all Lasers, the slope efficiency parameter is also very temperature sensitive. As the Laser temperature changes, so does the slope efficiency of the Laser, and consequently, all of the other critical Laser parameters such as Gain/OMI, NF, IP3, etc. The characteristic temperature of the Laser diode is such that as the threshold current increases, the slope efficiency of the device decreases, with the increasing Laser temperature. This makes the Laser less efficient, thus reducing RF signal gain and increasing the link Noise figure, with additional degradation in the Laser linearity.

Since analog RF parameters of many lasers depend upon the temperature of the Laser diode, Transmitters such as the OZ16xx, utilize a TEC that locks the temperature of the Laser at a constant level, which stabilizes the Laser wavelength, power, Relative Intensity Noise (RIN), and more. The Integrated TEC controller provides stable thermal operation over a broad range of temperatures (-20°C to +65°C) otherwise not possible.

The thermoelectric cooler concept is based upon the Peltier Effect. In order to maintain a constant temperature, TEC modules act as semiconductor "heat pumps" that move heat from one side of the device to the other. Depending upon the direction that the current flows through the TE cooler, it may either heat or cool a Laser diode. In many applications, and especially long reach applications, the ability of the Laser diode to perform well at elevated temperatures is of key importance, when maintaining high linearity and low noise figures are critical. The plots below demonstrate the fundamental Laser characteristics over broad temperature changes, but due to the TEC cooling and heating capability, the Laser operates at the same temperature regardless of the surrounding ambient temperature.



Ordering Information

TRANSMITTER PART NO.

A13 - Z16XX- XXX - AX - XXX[1]

03 - 3 GHz	**CD31** - 1310 nm	**S** - SC/APC	**S** - Single mode	**(blank)** - no LNA	**(blank)** - no Bias-T
04 - 4 GHz	**CD55** - 1550 nm	**F** - FC/APC	**M** - 62.5µm Multimode	**L** - LNA	**B** - 5V Bias-T
06 - 6 GHz	**DWXX** - DWDM ITU Channel XX		**M50** - 50µm Multimode		
10 - 10 GHz					

[1] For 12V bias-T, contact Optical Zonu

RECEIVER PART NO.

A23 - Z16XX- 00 - AS - X

03 - 3 GHz	**S** - SC/APC	**S** - Single mode
04 - 4 GHz	**F** - FC/APC	**M** - 62.5µm Multimode
06 - 6 GHz		**M50** - 50µm Multimode
10 - 10 GHz		

[1] For 12V bias-T, contact Optical Zonu

TRANSCEIVER PART NO.

A03 - Z16XX- XXX - AX - XXXX[1]

03 - 3 GHz	**CD31** - 1310 nm	**S** - SC/APC	**S** - Single mode	**(blank)** - no LNA	**(blank)** - no WDM	**(blank)** - no Bias-T
04 - 4 GHz	**CD55** - 1550 nm	**F** - FC/APC	**M** - 62.5µm Multimode	**L** - LNA	**W** - Integrated WDM	**B** - 5V Bias-T
06 - 6 GHz	**DWXX** - DWDM ITU Channel XX		**M50** - 50µm Multimode			
10 - 10 GHz						

[1] For 12V bias-T, contact Optical Zonu

POWER SUPPLY PART NO.

ZA1 - 1 - 12 - 15 - D[1]

[1] For North America only. For other international power supplies contact Optical Zonu

Contacts

HEADQUARTERS

7510 Hazeltine Avenue, Van Nuys, CA 91405
Main: 818-780-9701 Fax: 818-780-9739 info@opticalzonu.com

INSIDE SALES
818-780-9701 x122 ;
818-616-2043
sales@opticalzonu.com

CUSTOMER SUPPORT
818-780-9701 x276 ;
818-452-5131
support@opticalzonu.com

SALES - RF
818-780-9701 x122 ;
818-579-9630
sales@opticalzonu.com

SALES - RF EAST
818-780-9701 x140 ;
818-579-9594
sales@opticalzonu.com

SALES - SATCOM
818-780-9701 x242 ;
818-452-5896
sales@opticalzonu.com

SALES - DIGITAL
818-780-9701 x131 ;
818-579-9592
sales@opticalzonu.com

TECHNICAL SUPPORT
818-780-9701 x134 ;
818-579-2359
support@opticalzonu.com

Related Products

OZ81x Transmitter/Receiver/Transceiver Standalone Modules (30 - 6000 MHz), optional Optical AGC, CWDM, RS232 Transport, I2C Serial Interface

J3U Cooled Transmitter/Receiver Plug-in Modules (30 - 10000 MHz), DWDM, optional Redundancy Architectures, Remote Access via HTTP, Graphical User Interface, SNMP v2 and v3

J-Chassis Cooled Transmitter/Receiver Plug-in Modules (30 - 10000 MHz), DWDM, Remote Access via HTTP, Graphical User Interface, SNMP v2 and v3

OZR12 Photodetector/Receiver Component (10 - 12000 MHz), High Responsivity, -40C to +85C Operating Temperature Range

Additional Resources

Standalone RF Over Fiber Modules

RF Over Fiber Rack Mount Integrated Subsystems

RF Over Fiber Rack Mount Modular Subsystems

RF Over Fiber Applications

19" 1RU J-Chassis

19" 3RU J3U Chassis

19" 1RU OZC9500 Chassis

19" 1RU OZ9800 Chassis

MADE IN U. S. A.

CE RoHS

MADE IN CA a solid economy with manufacturing