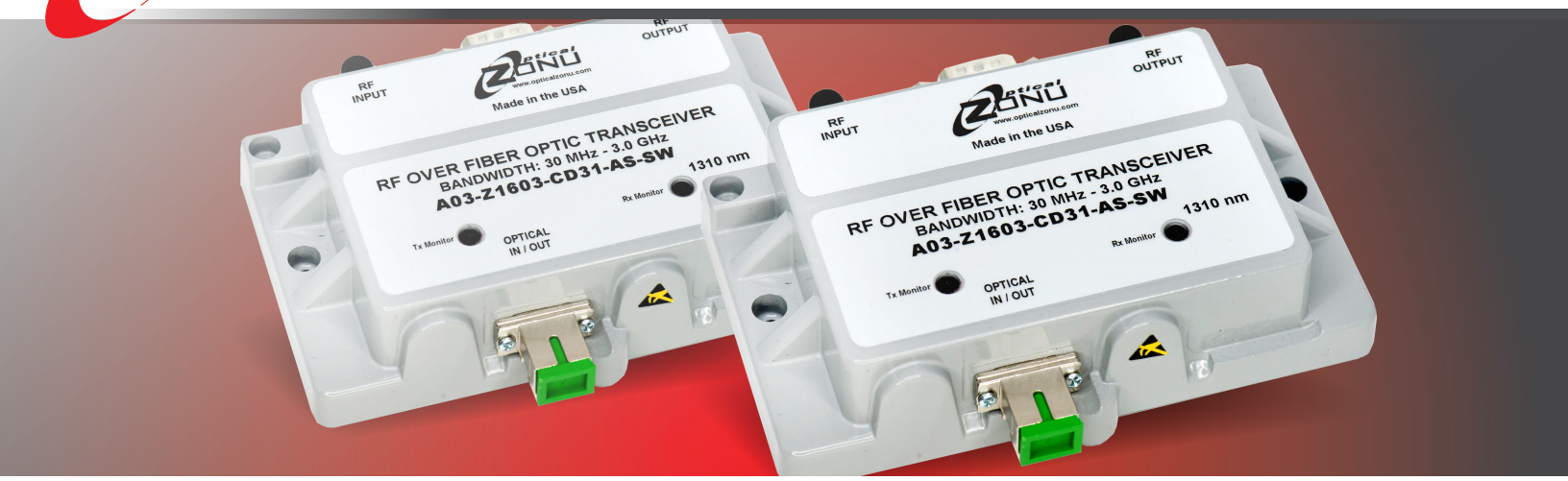
# ULTRA BROADBAND RF OVER FIBER TRANSCEIVER

OZ1603 Series – Premium Grade 3 GHz




## Features

- 30 MHz to 3.0 GHz Bandwidth
- Rugged Dust-tight Cast Metal housing, 3 x 5 x 1.25 in. @ ¾ lb
- -40°C to +65°C Operating Temp Range, FIX RF PERFORMACE
- LD Bias, LD Power and PD Monitoring and Alarms
- Exceptionally High SFDR up 115 (dB/Hz)⅔ Band specific
- Auto Optical Power Control
- 1.3 and/or 1.5 µm Cooled DFB Lasers with Thermoelectric Cooler
- Laser Conforms to Class IIIB Emission Level and IEC-825 (EN 60825) standards

## Options

- Bandwidth of 10 KHz to 3 GHz
- WDM/CWDM/DWDM Lasers
- -40°C to +85°C TOP Range
- Internal Transmitter LNA
- MGC 30dB Dynamic Range
- Multimode Fiber compatibility
- +28 Volt Power Supply
- Low Power dissipation
- Diagnostics and control functions through digital Serial interface (I2C)

## Applications

- 4G LTE/ Cellular Backhaul
- C-Band/ L-Band Satcom
- MMDS
- Remote Antenna Location
- Wireless/Outdoor DAS
- GPS Distribution
- Shipboard RF distribution
- Satellite Ground station
- Public Safety
- 10MHz low phase noise Clock

# OZ1603

## Description

The OZ1603 is an Ultra Broadband Fiber Optics Transceiver, with exceptionally high Spurious Free Dynamic Range (SFDR) for RF over Fiber applications that require premium and Fix RF performance over wide temperature range. Our Transceiver was designed with a built-in Thermoelectric Cooler (TEC) to assure a stable level of RF performance over a wide range of temperature variations. A pair of OZ1603 transceivers will create a two-way bidirectional RF to Optical and Optical to RF link. OZ1603 may also be configured as individual Transmitter (Tx) or Receiver (Rx) units if necessary. The OZ1603 is packaged in a rugged dust-tight Cast Metal Housing with optional Integral WDM for bidirectional transmission on a single SMF-28 fiber.

These linear RFoF Transceivers are an excellent alternative to using coaxial cable systems. They offer significant improvements in the transport of RF signals in their native format reliably over many optical networks and across a broad range of frequencies. The standard optical connector is the SC/APC (FC/APC is also available) for low back reflection applications. The Manual Gain Control and AGC enable installers an easy way to adjust receiver output RF level to facilitate simple field installations.

The Transceiver features a high performance InGaAs photodiode and a linear Isolated Cooled DFB Laser operating at 1.3 µm (A) and 1.5µm (B) over 9/125 µm single mode fiber. The integral Thermoelectric Cooler control circuitry provides stable thermal characteristics for the Laser chip. The TEC allows for heating and cooling of the Laser to maintain the temperature at a constant +25 °C, over the entire ambient Operating Temperature Range of –40 °C to +65 °C. Average Automatic Power Control (AAPC) is utilized for optimal optical power stability over the full temperature range.

The RF interface is via a 50 Ohms SMA connector and the Alarm and Monitoring Functions are available through a DB9. Optional Digital Diagnostics and control functions through digital Serial interface (I2C) are available upon request.

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## Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Units | Notes |
|---|---|---|---|---|---|
| Storage Temperature (Case) | $T_S$ | -40 | +85 | °C | |
| Operating Temperature (Case) | $T_0$ | -40 | +65 | °C | |
| DC Supply Voltage | $V_{PD}$ | +11.5 | +12.5 | Volts | |
| Maximum RF Input into TX (no LNA) | | | +17 | dBm | 10 |
| Maximum RF Input into TX (with LNA) | | | +5 | dBm | 10 |
| Maximum Optical Input into Rx | | | 12 | mW | |

This product meets the appropriate standard in Title 21 of the Code of Federal Regulations (CFR). It is classified by FDA/CDRH as Class IIIb laser product. Invisible laser radiation is emitted from the end of fiber or connector. Avoid direct exposure to beam.

## Characteristics of OZ1603

| Parameter | Symbol | Min | Typical | Max | Units | Notes |
|---|---|---|---|---|---|---|
| Power Supply Voltage | VCC | | 12 | | Volts | |
| Power Supply Current | ICC | | 310 | 470 | mA | 9 |
| Power Supply Current (with LNA) | ICC | | 390 | 550 | mA | 9 |
| Laser Optical Output Power | | | 7.5 | 9 | mW | |
| Laser Optical Output Power (with LNA) | | | 6.8 | 9 | mW | |
| Transmitter Operating Wavelength A/B | λ | 1270 | 1310/1550 | 1610 | nm | 1 |
| Receiver Operating Wavelength B/A | λ | 1270 | | 1610 | nm | 2 |
| High Frequency Cutoff | HFC | | 3000 | 3100 | MHz | 3 |
| Low Frequency Cutoff | LFC | 20 | 30 | | MHz | 4 |
| Frequency Response (30 - 3000 MHz) | | | ± 1.0 | ± 1.5 | dB | |
| Frequency Response (30 - 3000 MHz) (with LNA) | | | ± 1.25 | ± 1.5 | dB | |
| Input/Output Impedance | Z | | 50 | | Ohms | |
| Input/Output VSWR (30 - 3000 MHz) | | | 1.5:1 | 1.8:1 | | |
| Spur Free Dynamic Range @ 1GHz | SFDR | | 112 | 115 | $(dB/Hz)^{2/3}$ | 5 |
| Spur Free Dynamic Range @ 1GHz (with LNA) | SFDR | | 110 | | $(dB/Hz)^{2/3}$ | 5 |
| Spur Free Dynamic Range @ 3GHz | SFDR | | 108 | | $(dB/Hz)^{2/3}$ | 5 |
| Spur Free Dynamic Range @ 3GHz (with LNA) | SFDR | | 107 | | $(dB/Hz)^{2/3}$ | 5 |

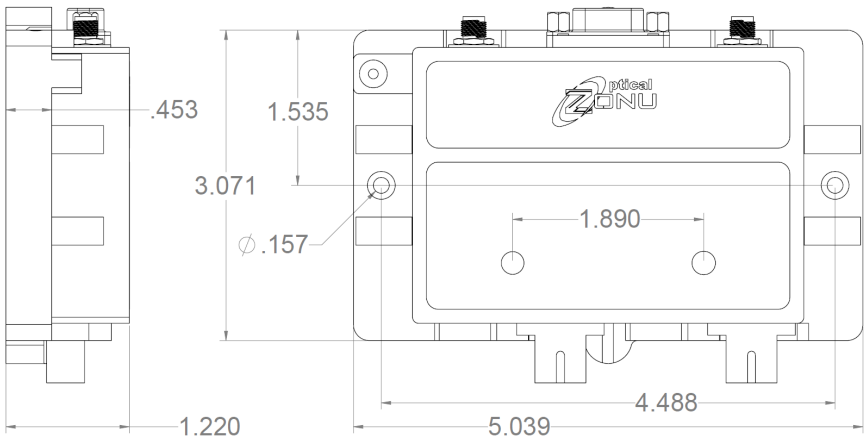
| Parameter | Symbol | Min | Typical | Max | Units | Notes |
|---|---|---|---|---|---|---|
| RF Link Gain Option A | | 0 | 2 | 4 | dB | 5 |
| RF Link Gain Option A (with LNA) | | 14 | 16 | | dB | 5 |
| RF Link Gain Option B | | | +8 | 10 | dB | 5 |
| Input Noise Floor @ 1GHz | EIN | | -134 | | dBm-Hz | 5 |
| Input Noise Floor @ 1GHz (with LNA) | EIN | | -154 | | dBm-Hz | 5 |
| Input Noise Floor @ 3GHz | EIN | | -131 | | dBm-Hz | 5 |
| Input Noise Floor @ 3GHz (with LNA) | EIN | | -149 | | dBm-Hz | 5 |
| Input Third Order Intercept @ 1GHz | IIP3 | | 33 | | dBm | 5, 6 |
| Input Third Order Intercept @ 1GHz (with LNA) | IIP3 | | 12 | | dBm | 5, 6 |
| Input Third Order Intercept @ 3GHz | IIP3 | | 30 | | dBm | 5, 6 |
| Input Third Order Intercept @ 3GHz (with LNA) | IIP3 | | 10 | | dBm | 5, 6 |
| Gain change over Temp | | | ± 0.5 | | dB | 7 |
| Isolation | | 50 | 60 | | dB | 8 |
| Isolation (with LNA) | | 45 | 55 | | dB | 8 |
| Group Delay over 4MHz (48 - 2700 MHz), Fiber delay not included | | | | 1 | ns | |

[1] 1310/1550 nm WDM integration for single fiber transceiver applications.
[2] 1310/1550 nm WDM integration for single fiber transceiver applications.
[3] Typical High frequency cutoff (HFC) is 3000 MHz. For higher HFC (7GHz) contact Factory.
[4] Typical Low frequency cutoff (LFC) is 20 MHz. For lower LFC contact Factory.
[5] Measured and Specified with Optical loss budget of 0 dB, and 1 meter of SMF28 optical Fiber, optimized for a specific bandwidth.
[6] IMD measurements of Two-tone measurement at 0 dBm/tone per carrier at specified frequencies.
[7] -40 to +60 C. For other operating temperature ranges, or extended temp range contact the Factory.
[8] Typical value across the whole band but Measured at 1GHz.
[9] Nominal average current at RT for Option-A Link gain, Peak surge current at initial Turn-On will be as much 1 Amp.
[10] Contact Factory for RF limiter Option, for higher max RF input power rating.

**NOTE:** Active low logic for the Alarms is standard in our products, but Active High Logic is available upon request.

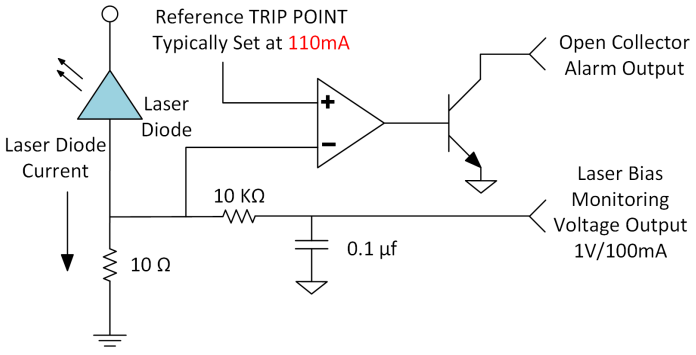
## DB-9 Configuration

| Pin | Function |
|---|---|
| 1 | Laser Enable (+12V = Laser ON) |
| 2 | **NC or IIC (SCL)** |
| 3 | Laser Power Monitor (0.1V = 1mW) or IIC (SDA) |
| 4 | +12 volts (550 mA max) |
| 5 | Ground |
| 6 | Laser Bias Monitor (10mV = 1 mA) |
| 7 | Laser Bias Alarm (open collector, 25 mA) |
| 8 | Received Power Monitor (1V = 1mW) |
| 9 | Received Power Alarm (open collector, 25 mA) |

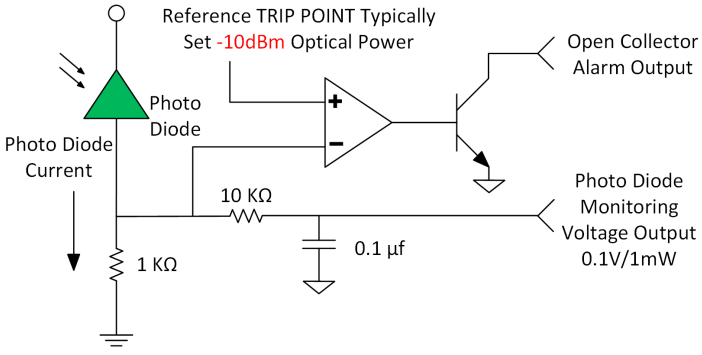



RF Connector = SMA Female
Optical Connector = SC/APC or FC/APC
DATA + ALARM = DB9

## Individual Tx Alarm & Monitoring Circuit Diagram




## Individual 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, such as under normal conditions the Open collector will be High and vice versa under fault conditions.

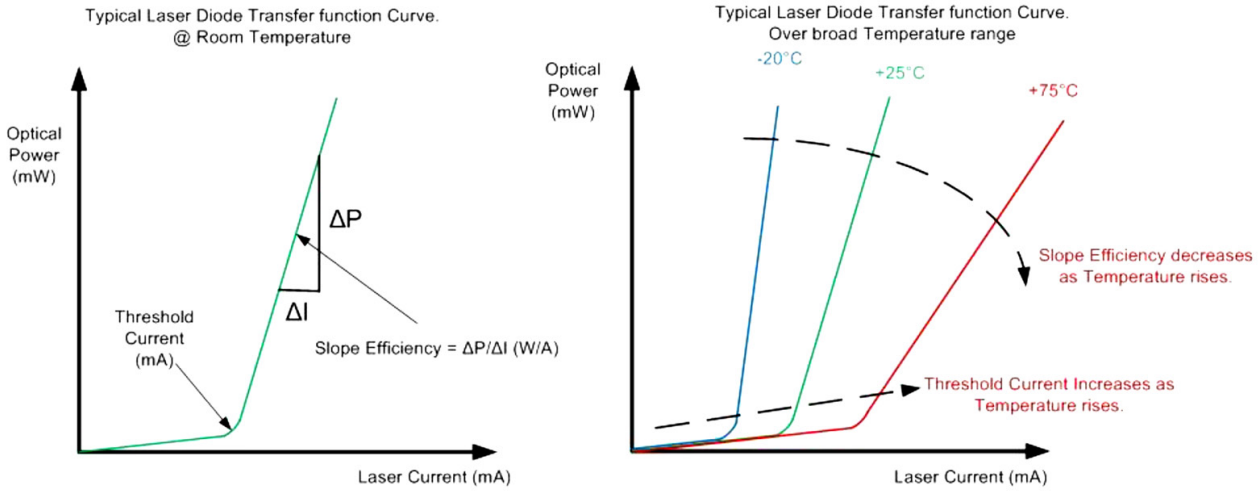
# APPLICATION NOTE

## Critical Benefits of Cooled RFoF Transmitters (OZ1603 Series)

The OZ1603 Ultra Broadband 20 MHz to 3 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 many Lasers analog RF parameters depend upon the temperature of the Laser diode, Transmitters such as OZ1600, 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. Our state-of-the-art 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 figure are critical. The plots below demonstrate the fundamental Laser characteristics over broad temperature changes, but due to TEC cooling and heating capability the Laser operates at the same temperature regardless of the ambient temperature.




## Ordering Information

PART NO.

**AX3- Z1603 – CDXX – AX – XXX**

| | | | | | |
|---|---|---|---|---|---|
| **0** – Transceiver | **CD31** – 1310 nm | **S** – SC / APC | **S** – Single Mode Fiber Compatible | **L** – Built-in LNA on Tx | **W** – Internal WDM |
| **1** – Transmitter | **CD55** – 1550 nm | **F** – FC / APC | **M** – Multimode Fiber Compatible | – No LNA | – No Internal WDM |
| **2** – Receiver | **00** – Rx only | | | | |

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