

Bi-directional Programmable 6.0GHz RF over Fiber System



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RFOptic's bi-directional programmable RFoF system provides RF performance that is superior to coaxial cable interface. The system is composed of two terminals (B1, B2) that are connected to each other by single mode fibers (SMF). The system is tailored to the 5G cellular band and covers the entire 450MHz to 6GHz bandwidth. Each enclosure contains 4 RFoF terminals that use CWDM technology to route RF signal in both directions on a fiber connection. The bi-directional RFoF channels that are formed in this way provide excellent SFDR and are independently configurable. This flexibility of configuration and the sub-system remote management and control functionality through HTML/REST/SNMP interface allow the system to handle very different application requirements.

Key Features:

- Integrated and flexible bi-directional RFoF subsystem
- Full support for the 450MHz to 6.0GHz bandwidth.
- Excellent linearity, gain flatness, and gain control.
- Programmable RF and Optical performance.
- Built-in end-to-end diagnostics reduces installation and maintenance time.
- Integrated RF power sensors.
- Reduced gain variation over temperature option.
- Remote management and control via HTML/REST/SNMP interface

Both enclosures include are Tx and Rx RFoF terminal units. Each of these include LNAs and variable attenuators which can be used to customize the Noise Figure, Input P1dB, and IP3 over wide range of values. For special applications requiring temperature stability operation, a unique optional temperature compensation algorithm supports ± 0.5 dB over 100°C variation of the ambient temperature. The RFoF link has excellent gain flatness with 0.5dB gain adjustment and tracking between different links.

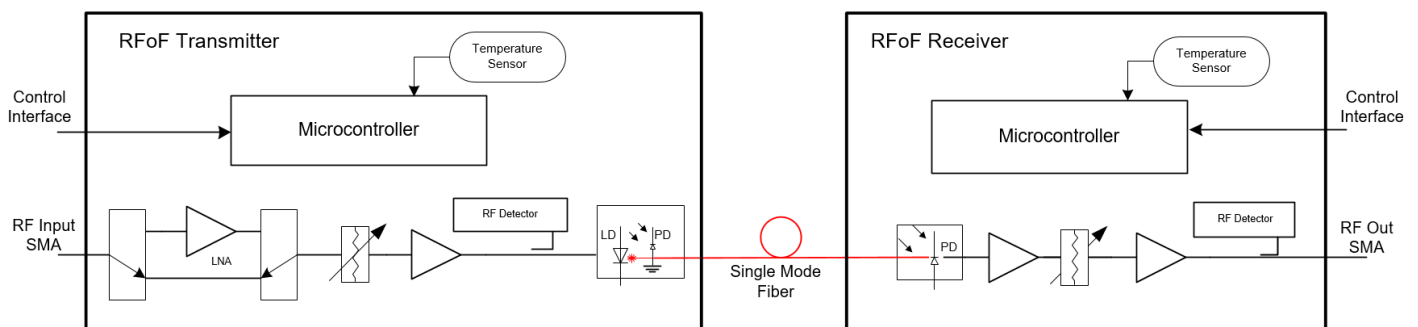
Configuration:

- Two 1U Indoor enclosures
- 4 bi-directional RF channels
- Outdoor Configuration is available

Applications:

- 5G test sites
- DAS
- Distributed Antenna

Each of the signals is transmitted over an RFoF programmable link. A simplified block diagram of such a link is shown below.



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RF Performance	Unit	Specification
		LNA Off
Frequency Range	MHz	0.5 - 6000
Adjustable Bi-Dir Link Gain (nominal value) ^[1]	dB	-5
Input Power Range ^[2]	dBm	(-60) – (+5)
Tx/Rx Attenuators 0 to 31dB, 0.5 step ^[3]	dB	0.5
Gain Flatness	dB	±2.5
Input P1dBc ^[4]	dBm	8
Noise Figure ^[4]	dB	32
Calculated SFDR ^[4]	dB/Hz ^{2/3}	106
Max Input Return Loss	dB	-11
Max Output Return Loss	dB	-11
Maximum Input No damage	dBm	+20
Input / Output impedance	Ohm	50
Optical and Electrical		
Laser diode wavelength	μm	1.31 and 1.55
System Monitor & Control	-	HTML/REST/SNMP
Optical Power in the fiber	mw	3
Power	-	110/220 VAC
Mechanical and Environmental Parameters		
19" 1U Enclosure dimensions	mm	445(W)* 476(L)*44(H)
No of Bi-Dir links (terminals) ^[5]	-	4
RF Input / Output Connector	-	SMA
Optical Connectors	-	FC/APC or SC/APC
Power Connector	-	HP Socket
Data Connector	-	RJ-45
Operating temperature	°C	-20 to +70
Storage temperature	°C	-40 to +85
EMC and Safety ^[6]	-	CE & FCC

[1] The link Gain can be adjusted by the Tx/Rx Attenuators, using the user software, subject to the below operating instructions.

[2] This is the Input power range assuming 20MHz signal bandwidth and 9dB SNR.

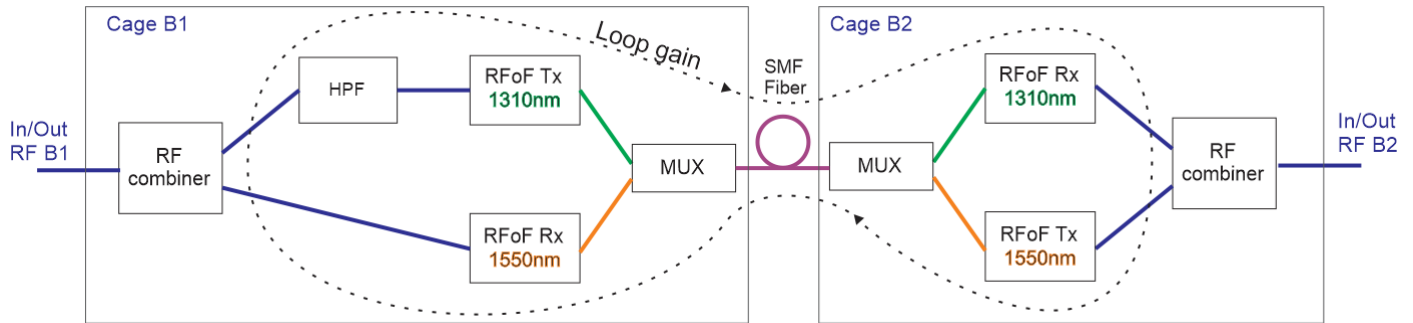
[3] Tx Attenuators are set to 0 dB during the manufacturing. Rx Attenuators are set to about 2dB to limit the Bi-Dir loop gain.

[4] Noise Figure and Input P1 dB are measured at 3.0GHz; It can be adjusted by using the Tx Attenuator and 'LNA Off/On'.

[5] Bidirectional RFoF System includes suitable RF Combiners and filters.

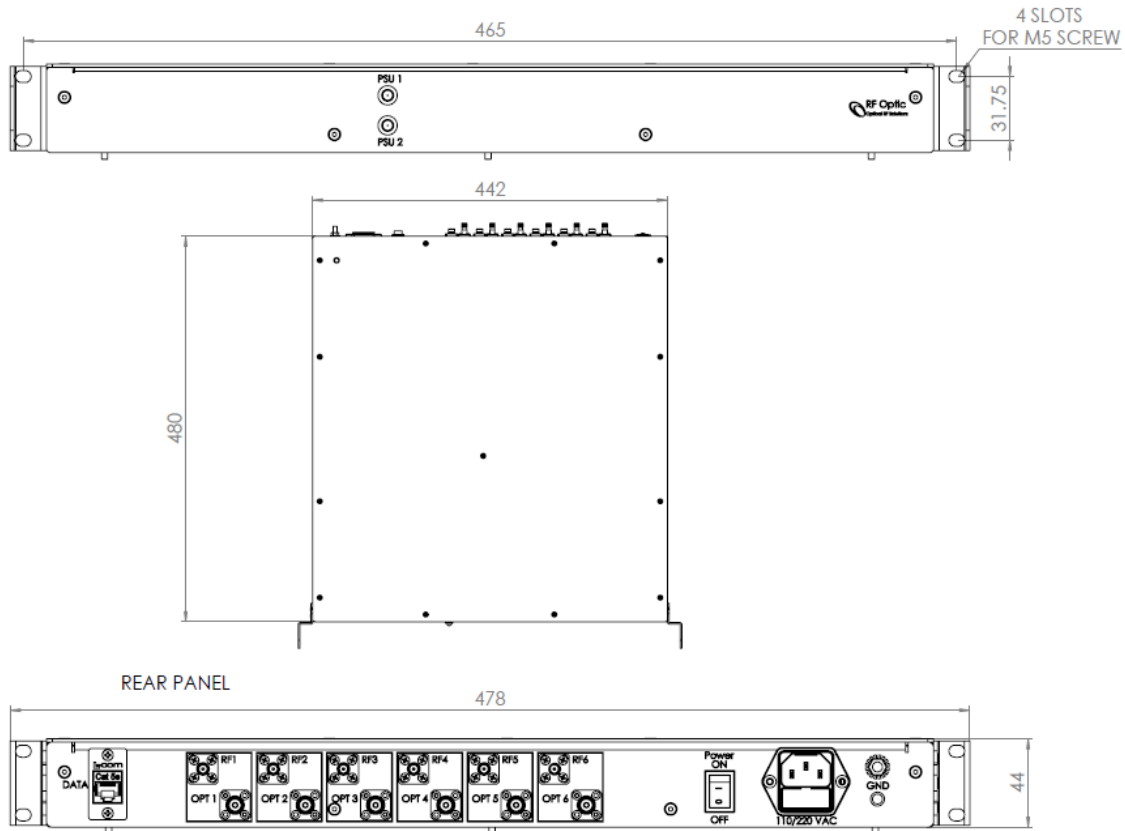
[6] Safety EN60950-1:2006(2nd); EMC: ETSI EN 300 386 v1.6.1 (2012-04) and FCC CFR-47 part 15 Sub part B.

Description and Operating instructions:



1. Each RFOF bi directional link is assembled to operate as shown in the diagram. In this diagram the Loop gain is the cumulative gain along the path shown by the dashed line.
2. To achieve bi-directional transmission the uplink and downlink signals are transmitted on two separate optical wavelengths. The signals are combined at the RF terminals using reactive RF power combiner. These combiners have high isolation between the uplink and downlink signals only within its operation frequency range (450MHz to 6.0GHz). To insure that the Loop gain remains below 0dB below this frequency range a suitable HPF is added to insure good isolation and maximize the possible Loop gain.
3. This arrangement can become unstable if the Loop gain exceeds 0dB. If the Loop gain as shown exceeds 0dB oscillations will form.
4. The RF combiner has good isolation between the uplink and downlink signals as long as the common port has a good VSWR. Otherwise, the isolation between the ports of the RF Combiner drops to about 7dB.
5. To provide care free operation the factory configuration sets the gain in either direction such that the Loop gain will not exceed 0dB under all termination conditions in the LNA Off state. In that state the Loop gain component of each of the Bi-Directional links is set to 6dB so that the total Loop gain is 12dB. This results in the Link gain values as measured in the ATR table and is set by the Rx attenuator to avoid effecting the Noise Figure of the links.
6. Under the optimal termination on both RF ports of the bi-directional link the total Loop gain within the link can be set to a maximum of about 35dB.
7. If one of the ports is poorly terminated in any frequency within the operating frequency range of the RF combiner while the second port is terminated well over that entire frequency range then the Loop gain can be set to a maximum of about 21dB.

19" 1U enclosure drawings



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Ordering Information:

For specific configuration, define the following:

1. Enclosure type - 1U Generic
2. Upper Frequency - 6.0GHz
3. Number of bidirectional terminals - 4* bi-dir terminals
4. Communication type - HTML
5. Power - 220VAC
6. Optical connector - SC/APC
7. RF connector – SMA
8. Combiner & Filter / Combiner

Part Number	Description
RFoFc-I1SS4T4RIHNA06-B1	19" 1U Enclosure with 4 X RFoF 6.0GHz bidirectional terminals, HTML, 220VAC, SC/APC, SMA and Combiners & Filters
RFoFc-I1SS4T4RIHNA06-B2	19" 1U Enclosure with 4 X RFoF 6.0GHz bidirectional terminals, HTML, 220VAC, SC/APC, SMA and Combiners

The Bi-directional Programmable 6.0GHz RF over Fiber System is comprised of two 19" 1U Bi-Directional enclosures: P/N RFoFc-I1SS4T4RIHNA06-B1 and P/N RFoFc-I1SS4T4RIHNA06-B2. Each of the two enclosures includes four (4) Bidirectional terminals. Each Bidirectional terminal includes Tx unit, Rx unit, optical mux (1310/1550nm) and power divider. P/N RFoFc-I1SS4T4RIHNA06-B1 includes also an RF filter to improve the loop gain isolation.