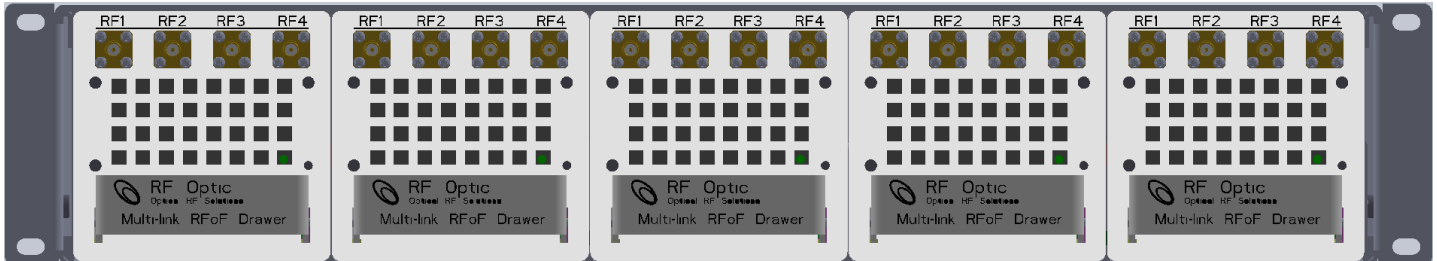


High-Density Multi-Channel Bidirectional RF over Fiber System



preliminary image used for illustration purpose only.

RFoF Bi-directional system provides RF performance that is superior to coaxial cable interface. RFOptic's solutions are tailored to the 5G/6G cellular band and covers the entire 0.5GHz to 6GHz bandwidth or narrower bandwidths (2.5GHz, 3GHz and 4GHz) should that be preferable.

RFOptic's high-density (HD) multi-channel mainframe provides a compact and flexible solution for 5G and 6G RFoF signal distribution applications. This 2U 19" rack mountable HD mainframe is designed to house up to 5 RFoF hot-swappable drawers each of which includes 8 RFoF units. With this modular approach, the HD mainframe provides high RFoF link density with modularity to simplify maintenance and configuration flexibility. It supports flexible drawer configurations to allow for growth as more RFoF channels become necessary over time and can seamlessly handle multiple drawer configurations and a wide range of application requirements. The HD mainframe provides redundant power supply, forced air thermal management along with remote management services to monitor and control of the system and each of its components through HTML/REST/SNMP interfaces.

The drawer configurations provide any combination of RFoF transmitters (Tx) and Receivers (Rx) and support components such as RF switches and combiners as may be necessary to achieve for example channel redundancy. The flexible monitoring and control management system in combination with the HD multi-link system modularity allow unmatched flexibility that can handle massive wideband connectivity and distribution multiple RF signals on independent fibers or common fibers using WDM technology.

A drawer holds 8 RFoF units which can be organized in number of configurations to provide diverse RFoF connectivity functions including unidirectional and bidirectional RFoF links using single, paired or multiple fibers. The bidirectional configuration of the drawer provides 4 one side terminals of the bidirectional links (4 half bi-dir terminals). This standard configuration includes optical multiplexing and wideband RF combiners integrated with suitable RF filters. In this configuration, a wideband high isolation RF combiner is used to deliver the RFoF to the RFoF Tx and combine the RF output from the RFoF Rx of each half bi-dir terminal. A High Pass Filter (HPF) with a 0.4GHz cut-off and sufficient stopband isolation is included in line of the RFoF Tx input in order to provide sufficient isolation outside the RF combiner's bandwidth. The uplink and downlink optical signals are separated by wavelength to insure complete isolation while using a single connecting fiber. Another bidirectional available drawer configuration excluding the optical multiplexing and uses 8 connecting fibers. Such configuration may be used in non-symmetrical bidirectional applications or in signal distribution cases where optical amplification is required.

The D1 and D2 drawer configurations provide both terminals respectively which complete a quad RFoF bidirectional link. The system is offered with (D1, D2) and without (D3, D4) optical wavelength multiplexing which can be used to transmit both uplink and downlink signals of each port over the same single-mode fiber. A block diagram on page 2 of this brochure provides details of the RF and Optical configuration.

Key Features:

- Integrated high-density and flexible multi-channel RFoF sub- system.
- Full support for the 0.5GHz to 6GHz 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

Configuration:

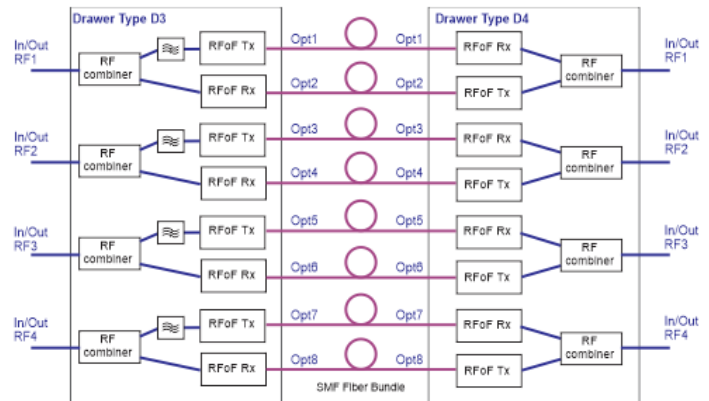
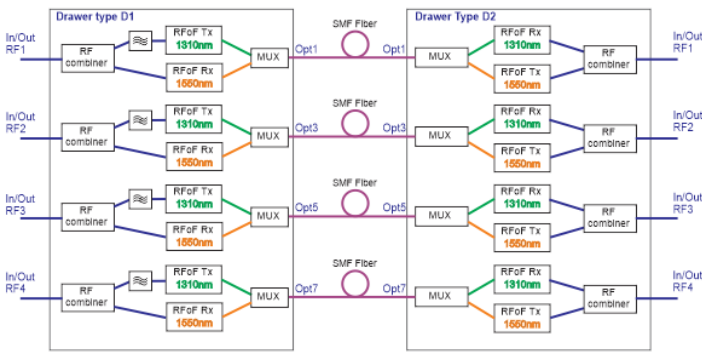
- Mainframe 19" 2U indoor enclosure with 5 drawer bays, dual redundant power supply, remote management support and thermal management.
- Drawers with 4-channel half bi-dir RFoF terminals each integrated optical MUX, RF combiner and suitable isolation filter.
- Drawer with 8 unidirectional RFoF terminals in custom configuration.

Each RFoF link uses RFOptic programmable RFoF technology and includes a 30dB LNA that can be bypassed along with Tx and Rx variable attenuators which can be used to customize the Noise Figure, Input P1dB, and IP3 over wide range of values. For special applications requiring improved temperature stability, 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.

Applications:

- 5G/6G test sites
- DAS
- Distributed Antenna

Drawer to Drawer RFoF Links Block diagrams for Standard Configurations

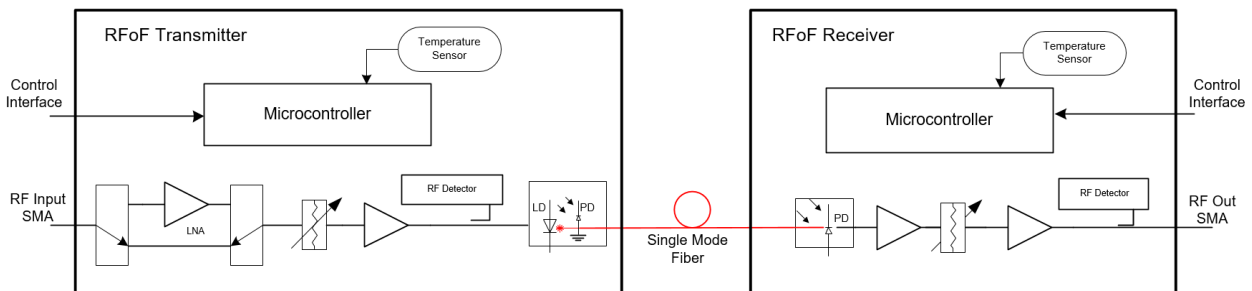


CWDM2 4 Channel Bidirectional Configuration

8 Fiber 4 Channel Bidirectional Configuration

RFoF Programmable Link Simplified Block diagram

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



High-Density RF over Fiber System and Mainframe Specifications

| Mainframe Specifications | | |
|---|------|--------------------------|
| Electrical Parameters | Unit | |
| System Monitor & Control | - | HTML/REST/SNMP |
| Thermal Management | - | Front to rear forced air |
| Power and consumption | - | 110/220 VAC, 60W |
| Mechanical and Environmental Parameters | | |
| 19" 2U Enclosure dimensions | mm | 445(W)* 700(L)*88(H) |
| Number of High-Density Drawers | - | 5 |
| Power Connectors | - | HP Socket |
| Data Connector | | RJ-45 |
| Operating temperature | °C | -20 to +70 |
| Storage temperature | °C | -40 to +85 |
| Weight including 5 HD drawers | kg | 47 |

| Drawer Specifications | | |
|-----------------------|------|---|
| Parameters | Unit | |
| RFoF capacity | - | 8 unidirectional or 4 bidirectional terminals |
| RF connectors | - | SMA |
| Optical connectors | - | LC/UPC |
| Storage temperature | °C | -40 to +85 |

High-Density RF over Fiber Bidirectional Link Specifications – CWDM2 version

| Bidirectional Link Performance (two RFoF terminals using a single fiber) | | | |
|--|----------------------|-------------------------|------------|
| RF Performance – Bidirectional channel | Unit | Specification (typical) | |
| | | LNA Off | LNA ON |
| Frequency Range | MHz | 500 - 6000 | 500 - 6000 |
| Nominal Link Gain (adjustable) ^[1,2] | dB | 0 | 31 |
| Gain adjustment Tx & Rx attenuators range/step | dB | 31.5/0.5 | 31.5/0.5 |
| Gain Flatness | dB | ±2.5 | ±2.5 |
| Input P1dBc ^[3] | dBm | 4 | -26 |
| Noise Figure ^[3] | dB | 33 | 10 |
| Calculated SFDR ^[3] | dB/Hz ^{2/3} | 103 | 95 |
| Max Input Return Loss | dB | -11 | -11 |
| Max Output Return Loss | dB | -11 | -11 |
| Maximum Input No damage | dBm | +23 | +23 |
| Input / Output impedance | Ohm | 50 | 50 |
| Optical and Electrical | | | |
| Laser diode wavelength | µm | 1.310 & 1.550 | |
| Optical Power ^[4] | mw | 8 | |
| Mechanical and Environmental Parameters | | | |
| RF Input / Output Connectors | - | SMA | |
| Optical Connectors | - | LC/UPC | |
| Operating temperature | °C | -20 to +70 | |
| Storage temperature | °C | -40 to +85 | |

[1] The link Gain and IP1dB can be adjusted by the Tx Attenuator using the user software.

[2] In the block diagram of Figure 1 below the Loop Gain is the cumulative gain along the path shown by the dashed line. The bidirectional link can become unstable if the Loop gain exceeds 0dB in which case RF loop oscillations will form. Under optimal

termination on both RF ports of the bidirectional link, the sum total of the gain or loss in both directions is limited by the RF combiner isolation and may be set to a maximum of 32dB. If one or both RF ports is poorly terminated, reflection from the port will reduce the RF combiner isolation and thereby lower the sum total of the loop gain that could be supported by the bidirectional link.

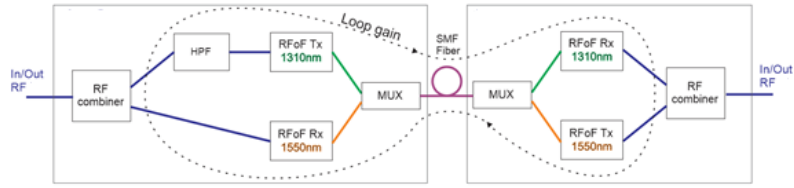
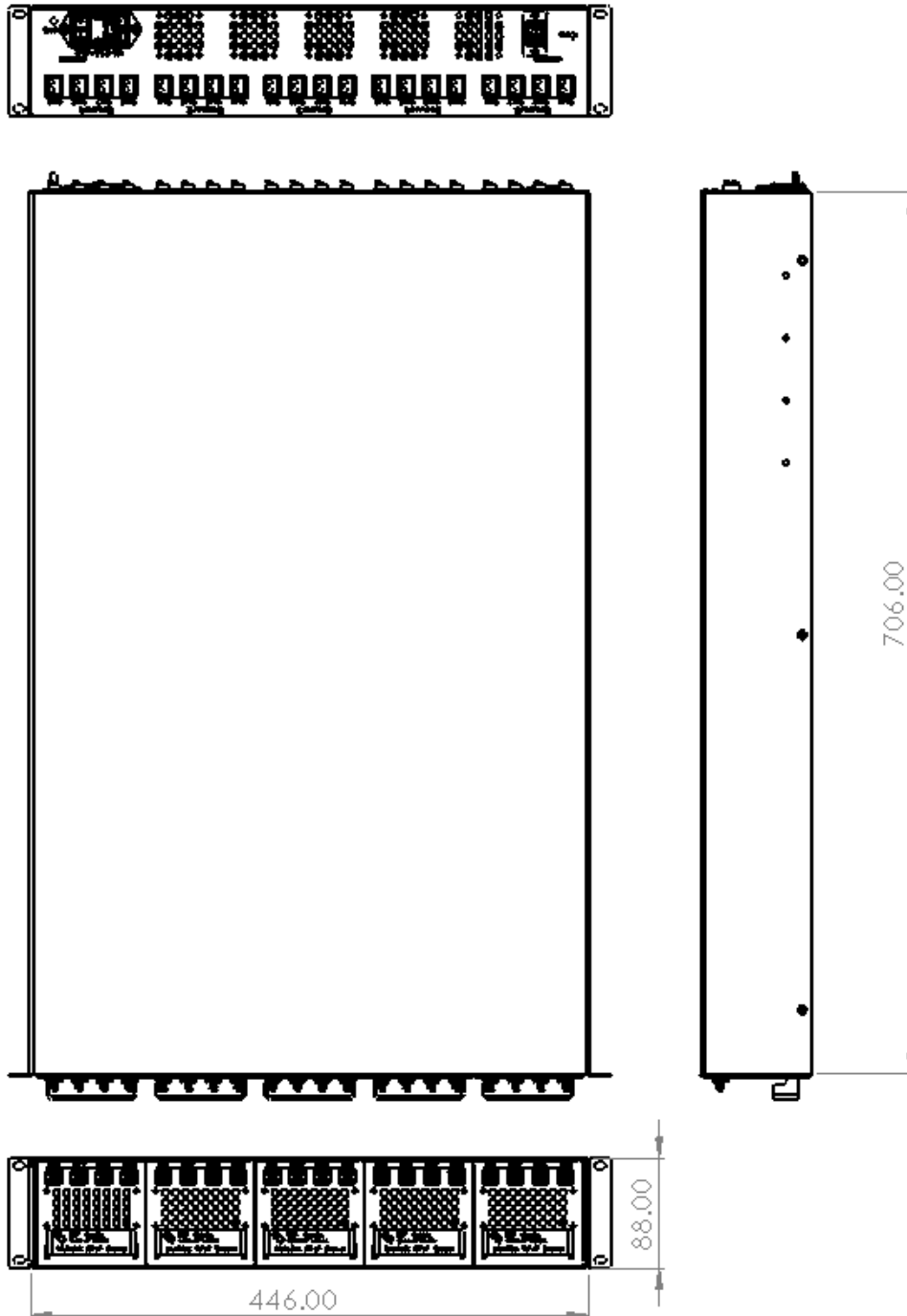


Figure 1: Simplified Block diagram of each RFoF bidirectional Link indicating the loop gain path

- [3] Noise Figure and Input P1 dB are measured at 3GHz and can be adjusted by using the Tx Attenuator and 'LNA Off/On'.
- [4] Minimum optical power 7mW.

19" 2U enclosure drawings



Ordering Information

The HD Multilink system can be ordered in several Drawer configurations as shown below. Normally, drawer types 1 and 2 are used as a bidirectional pair for a 4 fiber interface. Alternatively, for the 8 fiber interface, drawer types 3 and 4 are used. For most applications a mainframe enclosure is required at both terminals to achieve a complete the RFoF Multi-link configuration. Other custom drawer RFoF configurations can be configured upon request including unidirectional Tx and Rx multi-links.

| Part Number | Description |
|------------------|---|
| RFoFc-HDNIHR04 | 19" 2U HD Mainframe enclosure with 5 drawer bays, dual redundant power supply, remote management with HTML/REST/SNMP and thermal management. |
| RFoFc-D1SU4T4R06 | HD Drawer with 4 6GHz half bidirectional terminals 4 RFoF Tx 1310nm units, 4 RFoF Rx units, RF Combiners, filters and 1310/1550nm multiplexers with SMA, LC/UPC connectors. |
| RFoFc-D2SU4T4R06 | HD Drawer with 4 6GHz half bidirectional terminals 4 RFoF Tx 1550nm units, 4 RFoF Rx units, RF Combiners and 1310/1550nm multiplexers with SMA, LC/UPC connectors. |
| RFoFc-D3SU4T4R06 | HD Drawer with 4 6GHz half bidirectional terminals 4 RFoF Tx 1310nm units, 4 RFoF Rx units, RF Combiners and filters with SMA, LC/UPC connectors. |
| RFoFc-D4SU4T4R06 | HD Drawer with 4 6GHz half bidirectional terminals 4 RFoF Tx 1550nm units, 4 RFoF Rx units and RF Combiners with SMA, LC/UPC connectors. |