12GHz RF over Fiber Ultra

Key Features:

- Frequency Range: 0.1GHZ - 12GHz
- High IP1dBc: +19dBm
- Low noise floor level < -90dBm
- High SFDR 112dB/Hz$^{2/3}$
- Excellent phase linearity
- Optical wavelength 1550nm
- Low power consumption
- Low weight

Configurations:

- Standard (stand-alone) and bidirectional
- 1U Generic enclosure (8 units)
- 1U Removable panel enclosure (4 units)
- Outdoor (4/8 units)
- Mini RFoF

Applications:

EW

- Distributed Antenna
- 5G testing at 7.1GHz
- Satcom
- Radio telescopes
- Telecommunication:
  - Antenna remoting
  - Long RF links via fiber

Options:

- Customize RF Gain, P1dB, Noise Figure by adding internal Pre and/or Post amplifier(s)
- Extended low-frequency bandwidth
- DWDM (4 links)
- Phase matched multi-links (4)

RFOptic's analog RFoF compact modules enable long-distance transport of wideband RF signals. The Tx unit is an optical transmitter that modulates wideband RF signals on an optical beam transmitted on an optical fiber to the Rx unit which converts the modulated optical signal back to an RF signal. The single mode fiber that connects the two is generally provided by the customer except for in special application where it is provided as a part of the RFoF link.

In general, a high spurious-free dynamic range (SFDR) is desirable when multiple signals of very different power levels are expected. High IP1dBc (Input power at 1dB gain compression) allows applications to drive the RFoF Ultra RFoF at common application signal levels without additional attenuation. Noise figure may be improved by ordering the RFoF Ultra Tx module with a pre-amplifier. Applications including 5G testing at 7.1GHz and above with better ACLR. The RFoF Ultra links provide a high dynamic range and can handle 5G and 6G cellular traffic with better ACLR and EVM. Other applications such as antenna testing, RADAR and altimeter system testing can also benefit from high SFDR. This dynamic range allows concurrent signals with large amplitude differences to be transmitted with minimal interactions. Such signals may arise from an antenna main lobe signal and signals received by side lobes or received from close and distant targets. The same applies to DF/ELINT systems which have to handle strong jammers concurrent with weak signals of interest.

RFOptic's 12GHz and 18GHz, RFoF Ultra solutions provide high SFDR of better than 112dB/Hz$^{2/3}$. Due to their improved IP1dBc higher signal levels can be tolerated and transmitted without distortion. These high-performance products are used in applications such as civil communication, antenna remoting, telemetry, point-to-point, defense systems, satellite communications, and more.

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RFoF-12GHz-N0-Ultra Specifications

RF Parameter RF Tx-Rx Link	Unit	Specification (typical)
Frequency Range [1]	GHz	0.1 - 12
RF Gain [2,3]	dB	-26
Gain Flatness for the entire frequency range [5]	dB	± 1.5
1dB compression point [3]	dBm	23
Noise Figure [2,3]	dB	38
SFDR (calculated) [3,4]	$dB/Hz^{2/3}$	112
Maximum RF input level (No damage)	dBm	25
VSWR Input & Output	-	2:1
Noise floor [5]	dBm	≤-90
Spurious (Signal at Ip1dBc-3dB, 1GHz, >10KHz deviation)	dBm	≤-80
Input / Output impedance	Ohm	50
Optical and Electrical and Environmental (Tx, Rx)		
Laser diode optical wavelength	µm	1.55
Receiver photodiode optical wavelength	µm	1.5-1.58
Operating temperature range	°C	-20 to +70
Storage temperature	°C	-40 to +85
LED status indicators (Tx/Rx)	-	Blue/Green/Red
Power voltage [6]	VDC	5 - 12
Power consumption Tx module [5,7]	Watt	1.5
Power consumption Rx module [5,7]	Watt	0.3
Mechanical (Tx/Rx)		
Dimensions Tx/Rx unit	mm	70*70*22
Weight Tx/Rx unit	grams	120 each
RF Input / Output connectors	mm	SMA
Optical Connector	-	FC/APC
Power Connector	-	PIN 3.5*1.3*9 mm
Data/monitor connector [8]	-	USB-C

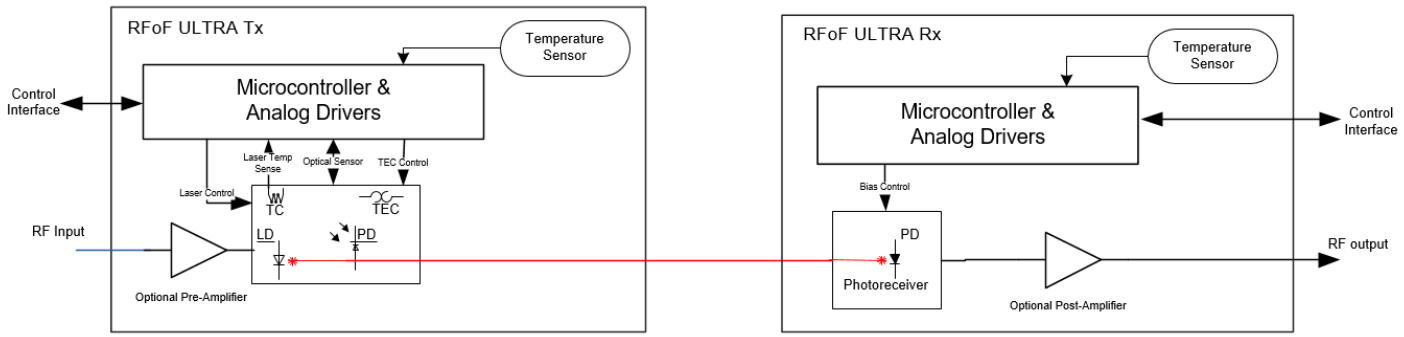
[1] Extended low frequency 0.02-12.0 GHz is optional.
[2] Excluding customer fiber loss.
[3] Measured at 10GHz. Gain, P1dB, and typical NF values for RFoF HSFDR with Pre/Post Amps are indicated in the table on page 3.
[4] Excluding in-band harmonics. SFDR (calculated) ≈ $2/3x[(IP1dB+10) +174-NF]$ $dB/Hz^{2/3}$.
[5] Spur levels of the link without Pre/Post amplifiers. Spur levels with a 17dB pre-amplifier is under -80dBm. Spur levels with a 17dB post-amplifier is about -80dBm. Each amplifier adds about ±1.5dB to the gain flatness and about 1.4W to the module power consumption.
[6] See table on page 3 for RFoF enclosure options.
[7] Recommended Power Supplies: Meanwell P/N GSM25U05-P1J (USA); GSM25E05-P1J (Europe); GE40I05-P1J (all purpose).
[8] For USB monitor, download the software here: https://rfoptic.com/software-download-rfof/ (ask your local representative for the password).

RFoF Ultra 12GHz Module Options

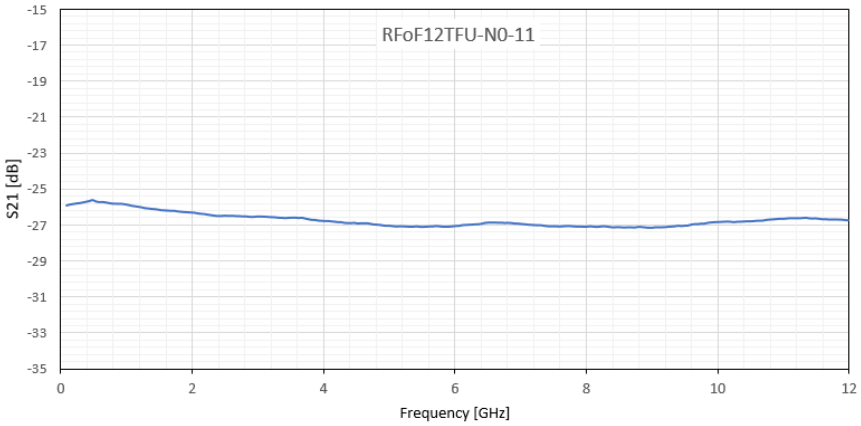
Parameter	Unit	Ultra 12GHz Transceiver	Ultra 12GHz Transceiver with Pre-Amp	Ultra 12GHz Transceiver with Post-Amp	Ultra 12GHz Transceiver with Pre- and Post-Amp
P/N	-	**RFoF-12GHz-N0-Ultra**	**RFoF-12GHz-A0- Ultra**	**RFoF-12GHz-A1- Ultra**	**RFoF-12GHz-A2- Ultra**
Gain Flatness	dB	± 1.5	± 3.0	± 3.0	± 4.5
Gain*	dB	-26	-10	-10	7
Input P1dB*	dBm	23	5	23	5
Noise Figure*	dB	38	21	39	22
SFDR*	dBc/Hz	112	111	112	113

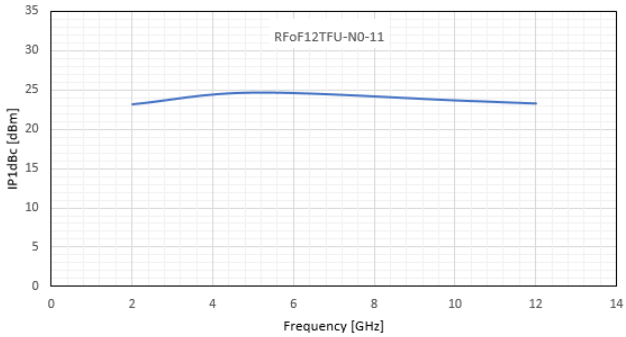
* Measured at 10GHz. For Ultra units integrated in Indoor or Outdoor enclosures: NF and P1dB values will increase in ~2dB and Gain will decrease in ~2dB.

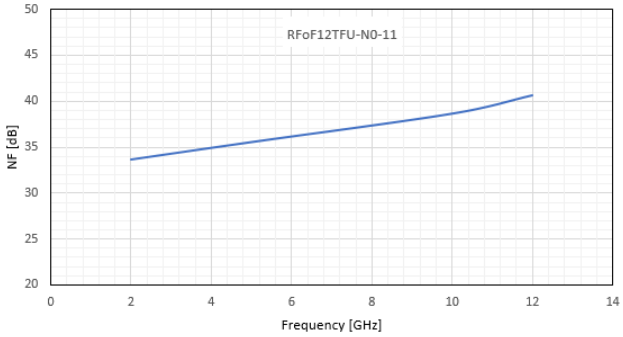
RFoF 12GHz – Simplified Block Diagram



RFoF 12GHz Ultra – Typical Test Results





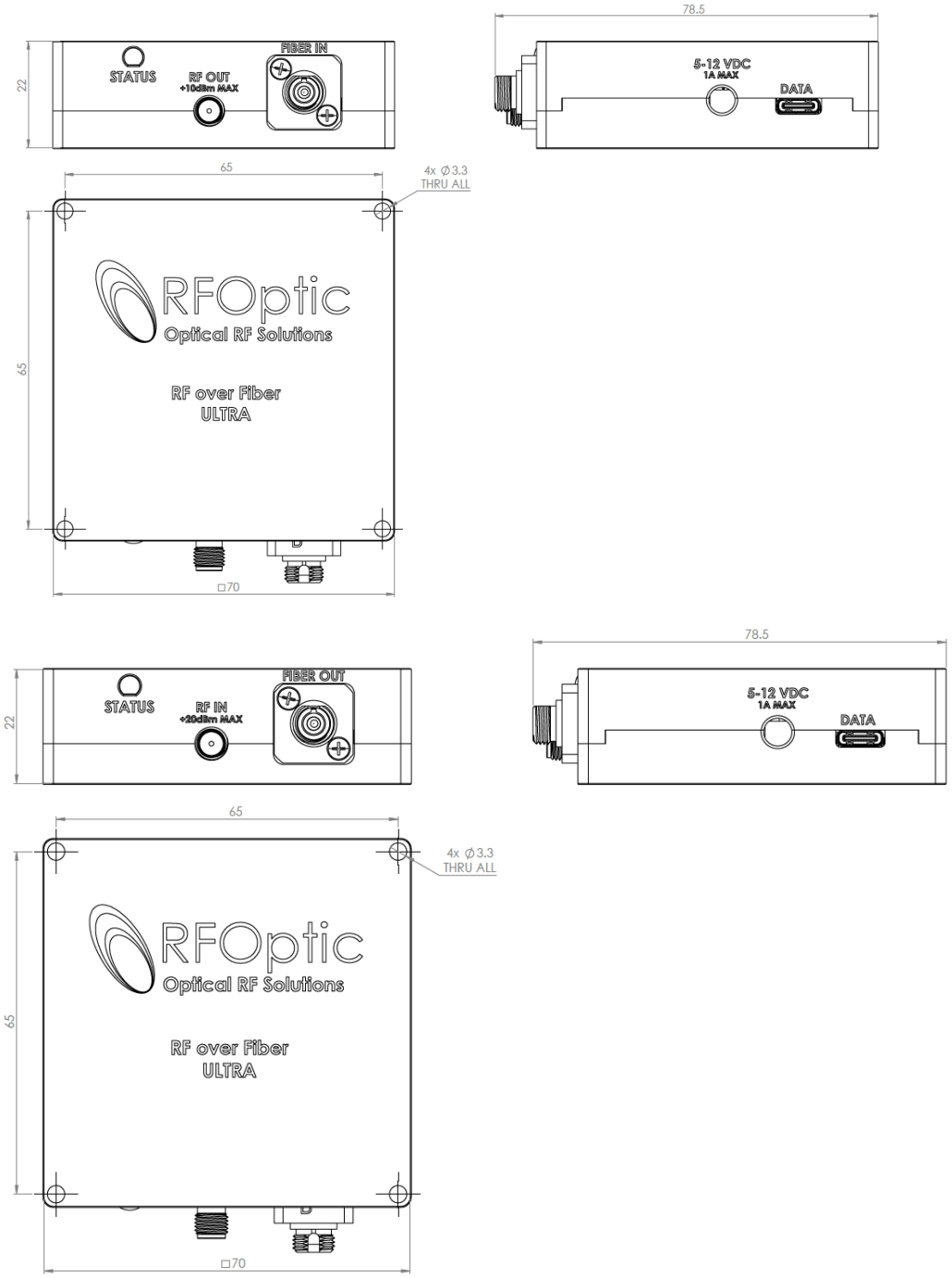


RFoF Enclosure Options

Parameter	19" 1U Enclosure for RFoF	Outdoor Enclosure for RFoF
Dimensions (mm)	19" 1U Generic: 445(W)* 476(L)*44(H) 19" 1U Removable: 442(W)* 402(L)*44(H)	Small Outdoor: 270(W)*230(L)*85(H) Large Outdoor: 330(W)*350(L)*85(H)
RF Input / Output Connector	SMA female	N Type female
Optical Connector	FC/APC or SC/APC	MPO/APC 4/8 male [1]
Data Connector	USB2/RJ-45	RJ45 female [2]
Power Connector	HP Socket	DC female/ AC male [2,3]
Power	110/220 VAC	9-36DC / 110/220VAC [2,3]

[1] MPO 4/8 optical cable (female) should be ordered by the customer according to the required length and conditions.
Example: GoFoton: P/N BPF3P1SM015FLR020 (4 fibers) / BPF3P1FM015FLR021 (8 fibers). XXX = 015m fiber length.
[2] IP-54 Data, AC and DC opposite connectors are provided as accessories with the module (cables are not included).
[3] DC and AC versions of the outdoor enclosures are available.

Mechanical Outline Drawing - RFoF Ultra 12GHz Tx and Rx modules



Connector: Positive center plug OD: 3.5mm, ID: 1.3mm, L: 9mm

Ordering Information

P/N	Description	Tx	Rx
RFoF-12G-N0-Ultra	Transceiver 12GHz, Ultra	RFoF12TFU-N0-11	RFoF12RFU-N0-11
RFoF-12G-A0- Ultra	Transceiver 12GHz, Ultra with Pre-Amp	RFoF12TFU-A0-11	RFoF12RFU-N0-11
RFoF-12G-A1- Ultra	Transceiver 12GHz, Ultra, with Post-Amp	RFoF12TFU-N0-11	RFoF12RFU-A0-11
RFoF-12G-A2- Ultra	Transceiver 12GHz, Ultra with Pre and Post-Amp	RFoF12TFU-A0-11	RFoF12RFU-A0-11
Outdoor Data & AC set [1]	Data and 110/220 AC opposite connectors – accessories	For outdoor enclosure with AC supply	
Outdoor Data & DC set [1]	Data and VDC opposite connectors – accessories	For outdoor enclosure with DC supply	

[1] Accessories / connectors for Outdoor enclosures are supplied with the product.