MODULATOR

MX1300-LN series

O-Band Intensity Modulators

The MX1300-LN series are lithium niobate (LiNbO3) intensity modulators specially designed for operation in the 1310 nm wavelength band. Thanks to their O-Band optimized optical waveguides and their 1310 nm selected fibers, the MX1300-LN can be claimed genuine 1310 nm intensity modulators.

The X-cut design of these Mach-Zehnder modulator confers them an unmatched stability in a wide range of operational conditions, as well as a zero chirp performance. iXblue proprietary waveguide design offers a low insertion loss combined with a high contrast. Thanks to their low Vp, the MX1300 series are ideally suited for low to high bit rates optical transmission with NRZ, RZ, DPSK, PAM-4 and are key devices for a large variety of applications.

Features

- O-Band specific waveguides and fibers
- X-cut for high stability
- Low drive voltage
- Low insertion loss

Applications

- Up to NRZ-56 Gb/s - PAM4-32 Gbaud
- General purpose intensity modulation
- Test and measurements

Options

- Analog version
- 1060 nm, 850 nm band versions

Related Equipments

- Choice of RF drivers
- MBC-DG Automatic Bias Controllers
- ModBox-VNA-Oband
- ModBox-PON

MX1300-LN-10 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	1270	-	1330	nm
Insertion loss	-	3.5	-	dB
Electro-optical bandwidth	-	12	-	GHz
Vπ RF @50 kHz	-	4	-	V
Electro-optical bandwidth	10	-	-	GHz

MX1300-LN-20 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	1270	-	1330	nm
Insertion loss	-	3.5	-	dB
Electro-optical bandwidth	-	25	-	GHz
Vπ RF @50 kHz	-	4	-	V
Electro-optical bandwidth	20	-	-	GHz

MX1300-LN-40 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	1270	-	1330	nm
Insertion loss	-	3.5	-	dB
Electro-optical bandwidth	-	30	-	GHz
Vπ RF @50 kHz	-	4	-	V
Electro-optical bandwidth	28	-	-	GHz

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exail

MX1300-LN-10

12 GHz Intensity Modulator

Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical bandwidth	S_{21}	RF electrodes, -3 dB from 2 GHz	10	12	-	GHz
Ripple S_{21}	ΔS_{21}	RF electrodes	-	0.5	1	dB
Electrical return loss	S_{11}	RF electrodes, f < 10 GHz	-	-15	-10	dB
Vπ RF @50 kHz	$V\pi_{RF\ 50\ kHz}$	RF electrodes	-	4	5	V
Vπ RF @10 Gb/s PRBS	$V\pi_{RF\ 10\ Gb/s}$	RF electrodes	-	4.7	5.7	V
Vπ DC electrodes	$V\pi_{DC}$	DC electrodes	-	5.5	6	V
RF input impedance	Z_{in-RF}	-	-	50	-	Ω
DC input impedance	Z_{in-DC}	-	1	-	-	MΩ

50 Ω RF input

Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Operating wavelength	λ	-	1270	1310	1330	nm
Insertion loss	IL	Without optical connectors*	-	3.5	4.5	dB
DC Extinction ratio	ER	Measured with narrow source linewidth < 200 MHz	20	22	-	dB
Optical return loss	ORL	-	-40	-45	-	dB
Chirp	α	-	-0.1	0	+0.1	-

All specifications given at 25 °C, 1310 nm, unless differently specified.
(*) Consider an extra-loss up to 0.25 dB for each FC/APC optical connector

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
RF input power	EP_{in}	-	+28	dBm
Bias Voltage	V_{bias}	-20	+20	V
Optical input power	OP_{in}	-	+20	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

MX1300-LN-20

25 GHz Intensity Modulator

Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical bandwidth	S_{21}	RF electrodes, -3 dB from 2 GHz	20	25	-	GHz
Ripple S_{21}	ΔS_{21}	RF electrodes	-	0.5	1	dB
Electrical return loss	S_{11}	RF electrodes, f < 20 GHz	-	-15	-10	dB
Vπ RF @50 kHz	$V\pi_{RF\ 50\ kHz}$	RF electrodes	-	4	5	V
Vπ RF @10 Gb/s PRBS	$V\pi_{RF\ 10\ Gb/s}$	RF electrodes	-	5.5	6	V
Vπ DC electrodes	$V\pi_{DC}$	DC electrodes	-	5.5	6	V
RF input impedance	Z_{in-RF}	-	-	50	-	Ω
DC input impedance	Z_{in-DC}	-	1	-	-	MΩ

50 Ω RF input

Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Operating wavelength	λ	-	1270	1310	1330	nm
Insertion loss	IL	Without optical connectors*	-	3.5	4.5	dB
DC Extinction ratio	ER	Measured with narrow source linewidth < 200 MHz	20	22	-	dB
Optical return loss	ORL	-	-40	-45	-	dB
Chirp	α	-	-0.1	0	+0.1	-

All specifications given at 25 °C, 1310 nm, unless differently specified.
(*) Consider an extra-loss up to 0.25 dB for each FC/APC optical connector

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
RF input power	EP_{in}	-	+28	dBm
Bias Voltage	V_{bias}	-20	+20	V
Optical input power	OP_{in}	-	+20	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

MX1300-LN-40

40 GHz Intensity Modulator

Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical bandwidth	S_{21}	RF electrodes, -3 dB from 2 GHz	28	30	-	GHz
Ripple S_{21}	ΔS_{21}	RF electrodes	-	0.5	1	dB
Electrical return loss	S_{11}	RF electrodes, f < 20 GHz	-	-15	-10	dB
Vπ RF @50 kHz	$V\pi_{RF\ 50\ kHz}$	RF electrodes	-	4	5	V
Vπ DC electrodes	$V\pi_{DC}$	DC electrodes	-	5.5	6	V
RF input impedance	Z_{in-RF}	-	-	50	-	Ω
DC input impedance	Z_{in-DC}	-	1	-	-	MΩ

50 Ω RF input

Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Operating wavelength	λ	-	1270	1310	1330	nm
Insertion loss	IL	Without optical connectors*	-	3.5	4.5	dB
DC Extinction ratio	ER	Measured with narrow source linewidth < 200 MHz	20	22	-	dB
Optical return loss	ORL	-	-40	-45	-	dB
Chirp	α	-	-0.1	0	+0.1	-

All specifications given at 25 °C, 1310 nm, unless differently specified.
(*) Consider an extra-loss up to 0.25 dB for each FC/APC optical connector

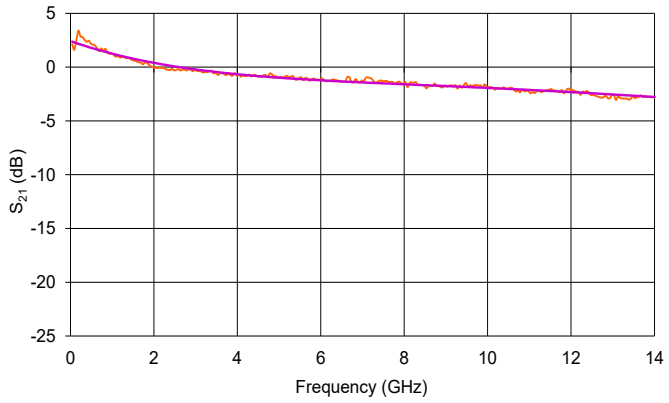
Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

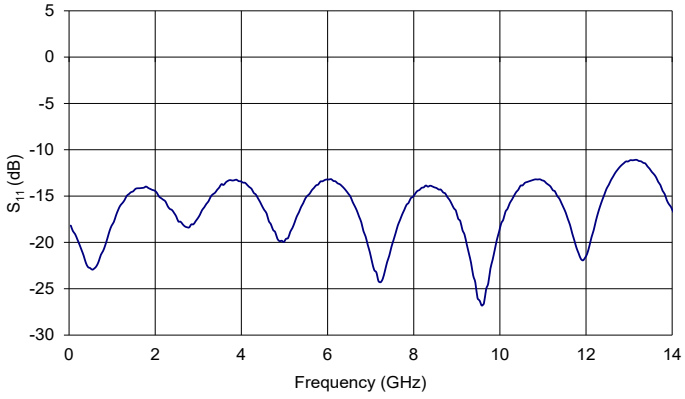
Parameter	Symbol	Min	Max	Unit
RF input power	EP_{in}	-	+28	dBm
Bias Voltage	V_{bias}	-20	+20	V
Optical input power	OP_{in}	-	+20	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

MX1300-LN-10, 20 & 40

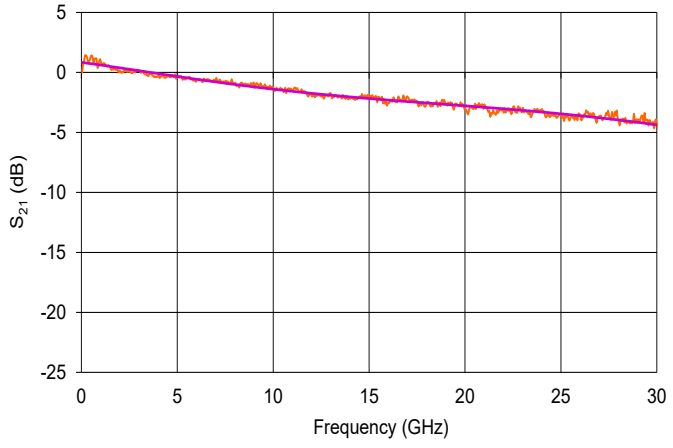
MX1300-LN-10 Typical S_{21} Curve



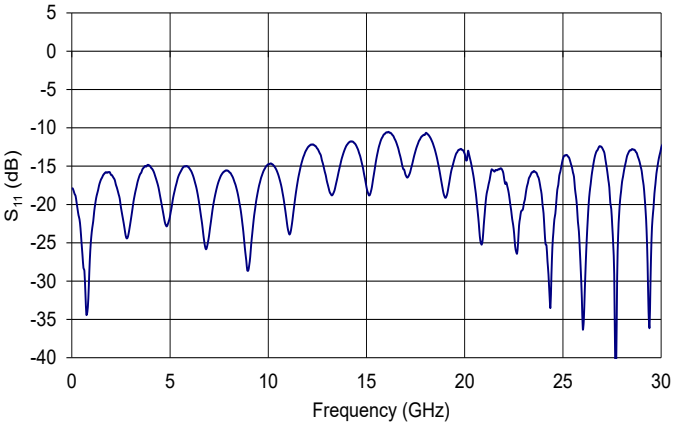
MX1300-LN-10 Typical S_{11} Curve



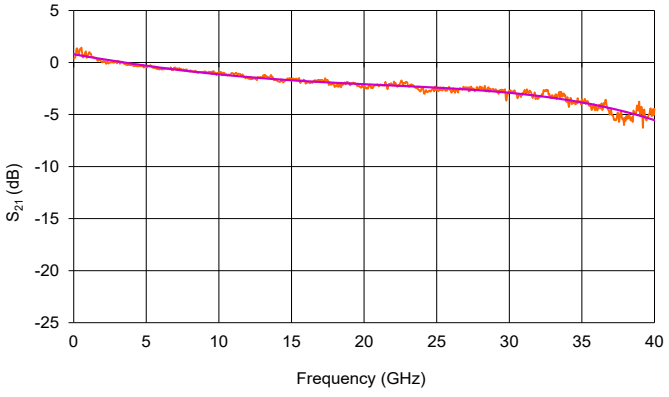
MX1300-LN-20 Typical S_{21} Curve



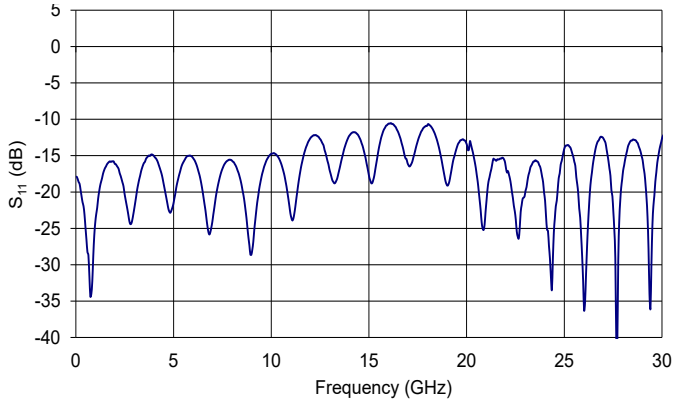
MX1300-LN-20 Typical S_{11} Curve



MX1300-LN-40 Typical S_{21} Curve

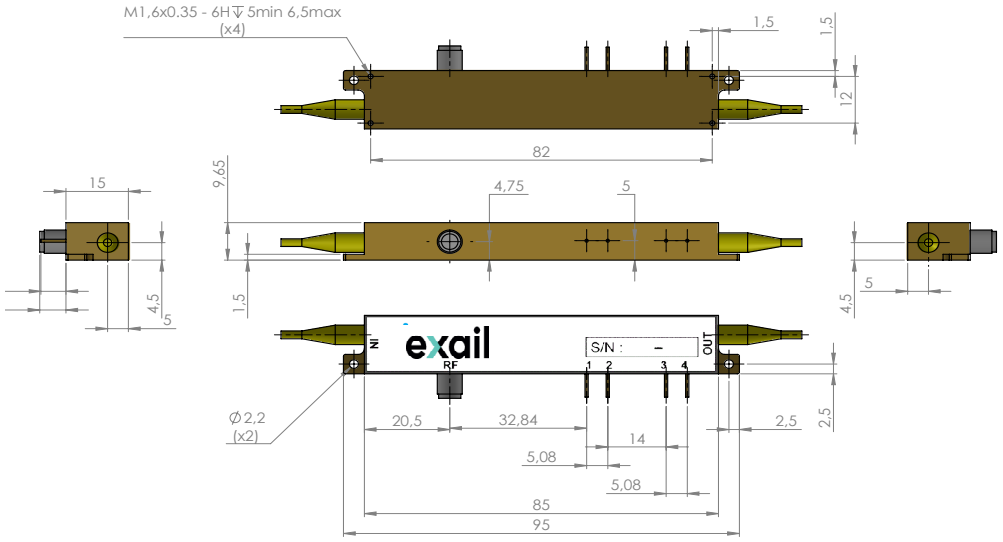


MX1300-LN-40 Typical S_{11} Curve



Mechanical Diagram and Pinout

All measurements in mm



Port	Function	Note
IN	Optical input port	Polarization maintaining 1310 nm Corning PM 13-U25D Length: 1.5 meter, buffer diameter: 900 µm
OUT	Optical output port	Polarization maintaining 1310 nm Corning PM 13-U25D Length: 1.5 meter, buffer diameter: 900 µm
RF	RF input port	MX1300-LN-10: Female K (SMA comptatible) MX1300-LN-20: Female K or 2.4 mm (optional) MX1300-LN-40: 2.4 mm, female, compatible to mate with V / 1.85 mm connectors (K option)
1	Ground	Pin feed through diameter 1.0 mm
2	DC	Pin feed through diameter 1.0 mm
3, 4	Photodiode cathode, anode	Pin feed through diameter 1.0 mm

Ordering information

Bandwidth : **10** (10 GHz), **20** (20 GHz), **40** (40 GHz)

Internal photodiode: "PD": integrated,"00": not integrated (by default)

Input fiber: P Polarization maintaining

Output fiber: P Polarization maintaining, S Standard single mode

Input connector: **00** (bare fiber), **FA** (FC/APC)

Output connector: **00** (bare fiber), **FA** (FC/APC)

MX1300-LN -□-□-□-□-□-□

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MODULATOR

MXAN1300-LN-20

High Optical handling capability O-band Analog Intensity Modulators

The new MXAN1300-LN-20 modulator design is based on an X-cut crystal etched with an optical waveguide using Annealed Proton Exchange on a selected $LiNbO_3$ substrate. This fabrication method yields outstanding performance with higher optical input power handling capabilities. Indeed, we guarantee operation with as high as 25 dBm CW optical input without photorefractive limitation effects that could affect the optical insertion loss, extinction ratio stability and modulator drift.

Consistent with the performance and requirements of our MXAN modulators family, the MXAN1300-LN-20 is also a linear modulator for demanding analog transmission links in military and civil applications up to 40 GHz. It features low insertion loss for optimal link gain and high linearity in order to preserve the signal quality.

The MXAN1300-LN-20 is therefore the best candidate for high output power modulated signal solutions using $LiNbO_3$ waveguide technology. It is especially suitable for microwave links and remote antennas as well as overload receiver tests for the data-com market and modulation schemes such as NRZ-44 Gb/s and PAM4-28 Gbauds.

Features

- High linearity
- Bandwidth > 20 GHz
- High optical stability vs optical power
- Low insertion loss
- High optical input power capability

Applications

- RFoF
- Antenna remoting
- Microwave and radar links
- Overload receiver test

Related Equipments

- Digital and linear RF amplifiers
- MBC Bias Controllers
- VNA, NRZ, PAM reference Transmitters

MXAN1300-LN-20 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	1260	1310	1350	nm
Insertion loss	-	4	5.5	dB
Electro-optical bandwidth	20	25	-	GHz
Vπ RF @50 kHz	-	5.5	-	V

Specifications given at 25 °C, 50 Ω, 1310 nm

MXAN1300-LN-20

20 GHz Analog Intensity Modulator

Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical bandwidth	S_{21}	RF electrodes, from 2 GHz	20	25	-	GHz
Ripple S_{21}	ΔS_{21}	RF electrodes, f < 20 GHz	-	0.5	1	dB
Electrical return loss	S_{11}	RF electrodes, f < 20 GHz	-	-13	-9	dB
Vπ RF @50 kHz	$V\pi_{RF\ 50\ kHz}$	RF electrodes	-	5.5	6	V
Vπ DC electrodes	$V\pi_{DC}$	DC electrodes	-	4	4.5	V
2nd Harmonic suppression ratio	$H_1 - H_2$	Measured @5 GHz, RFIN = 0 dBm	-	60	-	dB
Input 3rd order intercept	IIP3	Measured @5 GHz	28	30	-	dBm
RF input impedance	Z_{in-RF}	-	-	50	-	Ω
DC input impedance	Z_{in-DC}	-	1	-	-	MΩ

Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Operating wavelength	λ	-	1260	1310	1350	nm
Insertion loss	IL	Without optical connectors*	-	4	5.5	dB
DC Extinction ratio	ER	Measured with narrow source linewidth < 200 MHz	20	25	-	dB
Optical return loss	ORL	-	-40	-45	-	dB
Chirp	α	-	-0.1	0	0.1	-

All specifications given at 25 °C, 1310 nm, unless differently specified.
(*) Consider an extra-loss up to 0.25 dB for each FC/APC optical connector

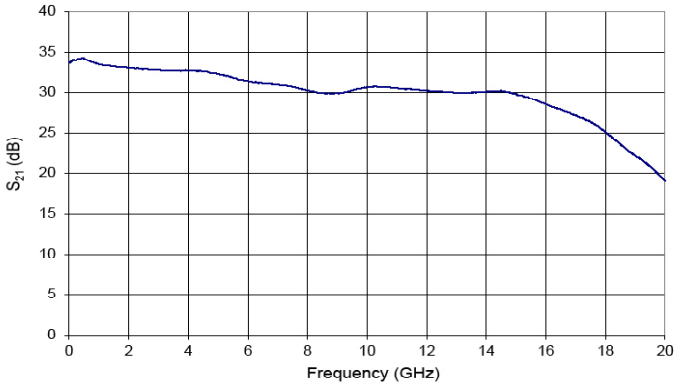
Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

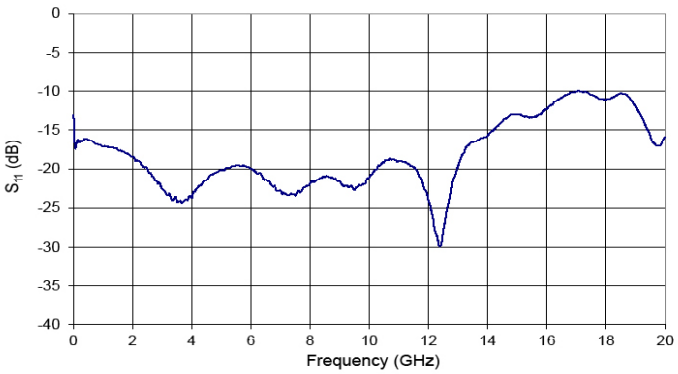
Parameter	Symbol	Min	Max	Unit
RF input power	EP_{in}	-	28	dBm
Bias Voltage	V_{bias}	-20	+20	V
Optical input power	OP_{in}	-	25	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

MXAN1300-LN-20

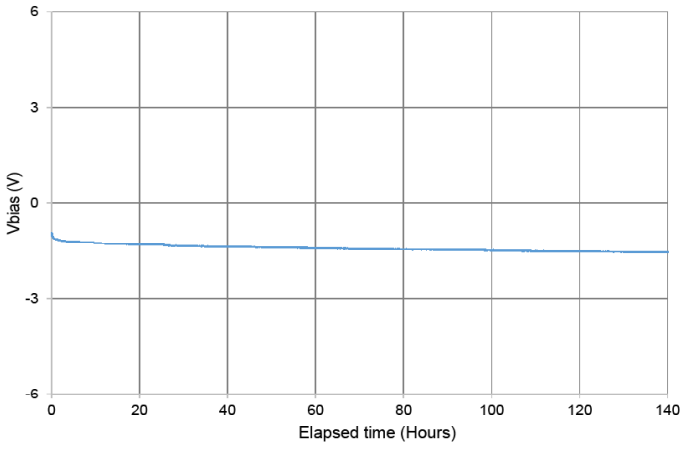
MXAN1300-LN-20 Typical S_{21} Curve



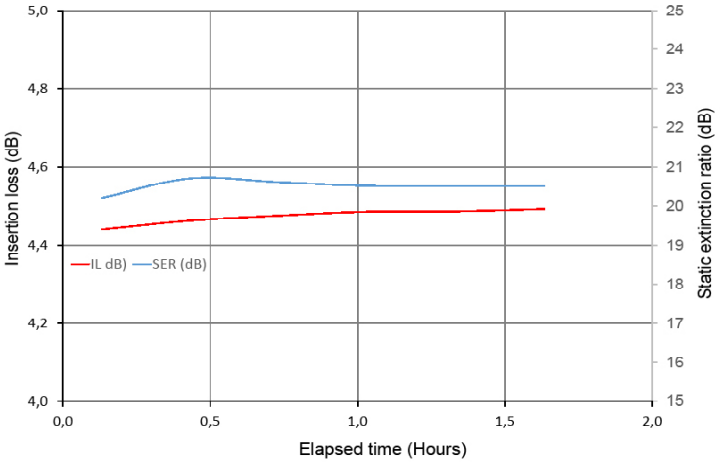
MXAN1300-LN-20 Typical S_{11} Curve



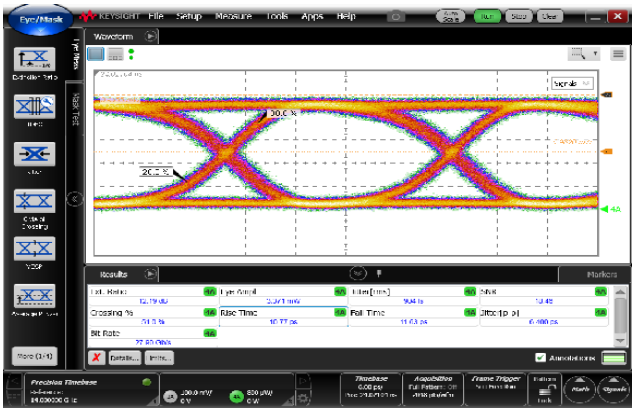
Modulator stability with time @25 °C and 80 mW



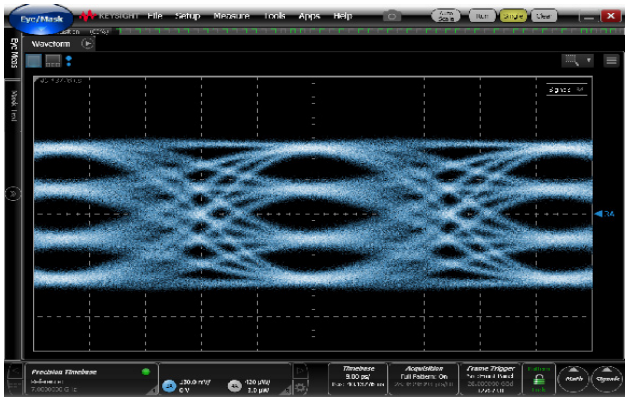
IL & SER stability @25° C and Pin = 300 mW



28 Gb/s OOK-NRZ eye diagram



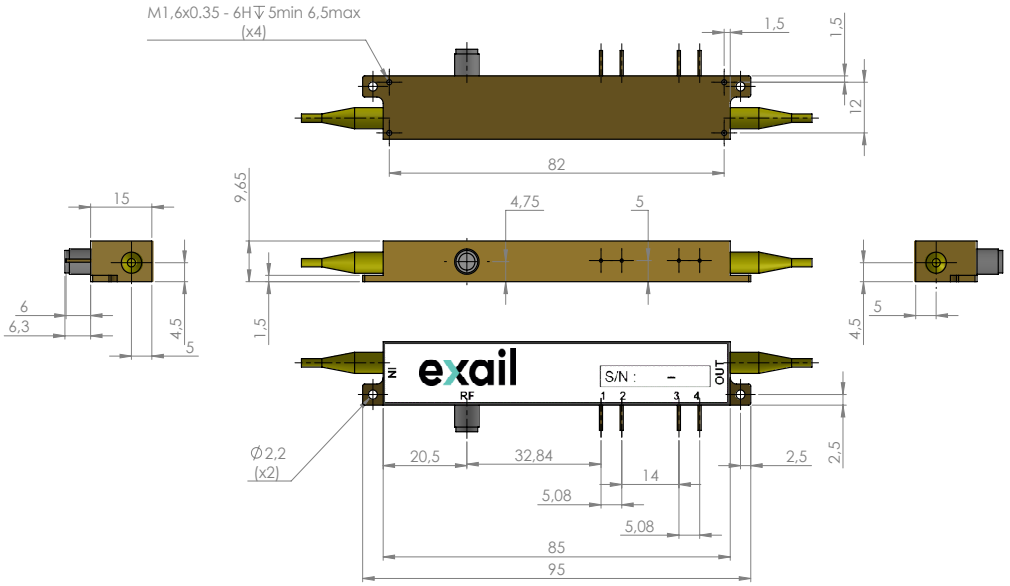
28 Gbauds PAM-4 eye diagram



MODULATOR | **MXAN1300-LN-20** | 4/4

Mechanical Diagram and Pinout

All measurements in mm



Port	Function	Note
IN	Optical input port	Polarization maintaining fiber Corning PM 13-U25D Length: 1.5 meter, buffer diameter: 900 µm
OUT	Optical output port	Polarization maintaining fiber Corning PM 13-U25D Length: 1.5 meter, buffer diameter: 900 µm
RF	RF input port	Female K (V in option)
1	Ground	Pin feed through diameter 1.0 mm
2	DC	Pin feed through diameter 1.0 mm
3, 4	Not connected	Not connected

Ordering information

- 00: no integrated PD (by default)
- Input fiber: P Polarization maintaining
- Output fiber: P Polarization maintaining
- Input connector: **00** (bare fiber), **FA** (FC/APC), **FC** (FC/SPC)
- Output connector: **00** (bare fiber), **FA** (FC/APC), **FC** (FC/SPC)

MXAN1300-LN-20-□-□-□-□-□

About us

Exail Photonics produces specialty optical fibers and Bragg gratings based fiber optics components and provides optical modulation solutions based on the company lithium niobate ($LiNbO_3$) modulators and RF electronic modules.
Exail Photonics serves a wide range of industries: sensing and instruments, defense, telecommunications, space and fiber lasers as well as research laboratories all over the world.

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MXER1300-LN-10-PD-P-P-FA-FA-30dB

All specifications given at 25°C, 1310 nm. As per internal specifications SP-0237-PR-01.

ELECTRICAL				
		Min	Typ	Max
Electro-optic bandwidth S_{21} @-3 dB (from 2 GHz)	GHz	10	12	-
Electrical return loss S_{11} 0 - 10 GHz	dB	-	-15	-10
Vπ RF electrodes @ 50 kHz	V	-	4	5
Vπ RF electrodes @ 10 GHz	V	-	5.5	6.5
Vπ DC electrodes	V	-	5.5	6
Ripple S_{21}	dB	-	0.5	1
RF port impedance matching	Ω	-	50	-
DC port input resistance	MΩ	1	-	-
OPTICAL				
Operating wavelength	nm	1260	1310	1350
Insertion loss (without connector) (1)	dB	-	3.5	4.5
DC Extinction ratio (measured with narrow source, linewidth ≤ 200 MHz)	dB	26	30	-
Optical return loss	dB	-40	-45	-
Chirp	-	-0.1	-	+0.1
INTERFACES				
Input and output fibers	Polarization maintaining 1310 nm, Corning PM13-U25D length: 1.5 meter, buffer diameter: 900 µm			
Package size	85 x 15 x 9.65 mm^3			
Input RF connector	Female K			
DC electrodes and PD connectors	Pins			
Optical connector – Input	FC/APC (slow axis parallel to the key)			
Optical connector – Output	FC/APC (slow axis parallel to the key)			
ENVIRONMENTAL				
Operating temperature	0 °C to +70 °C			
Storage temperature	-40 °C to +85 °C			
MAXIMUM RATINGS				
Maximum RF input power (CW mode)	+28 dBm			
Bias voltage range	V	-20	-	20
Maximum optical input power recommended to keep optimal performance (CW mode)	+12 dBm			
Optical damage threshold (CW mode)	+20 dBm			

(1): Consider an extra-loss up to 0.25 dB for each FC/APC optical connector.

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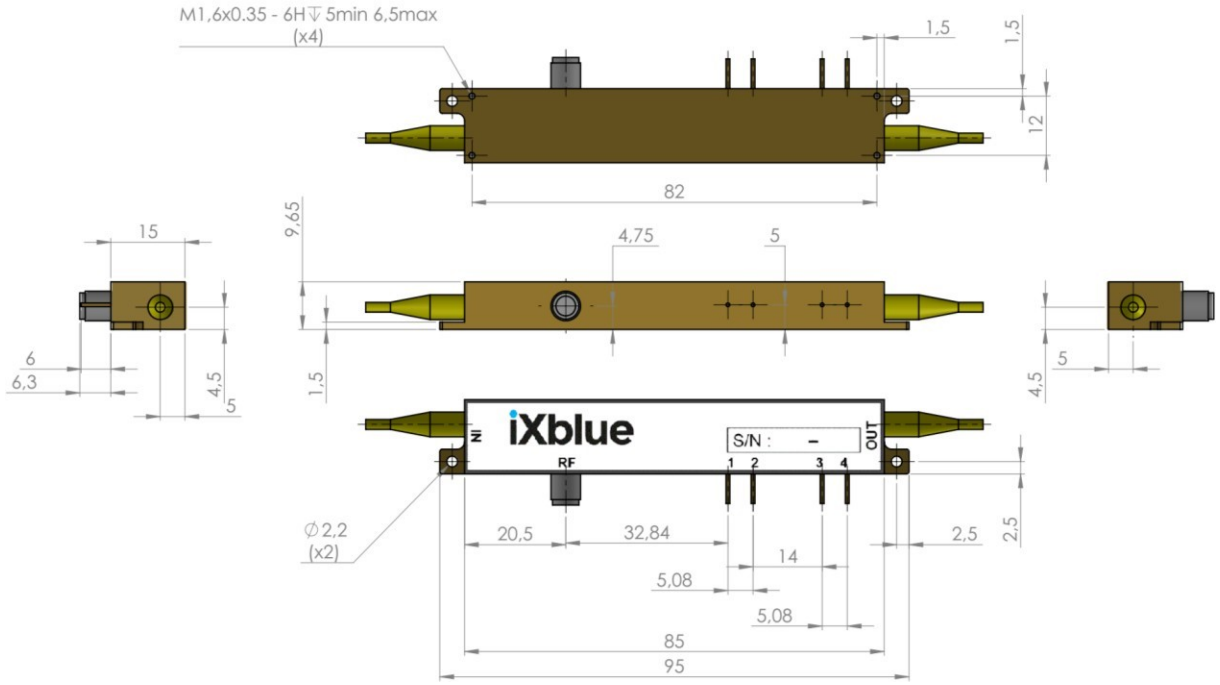
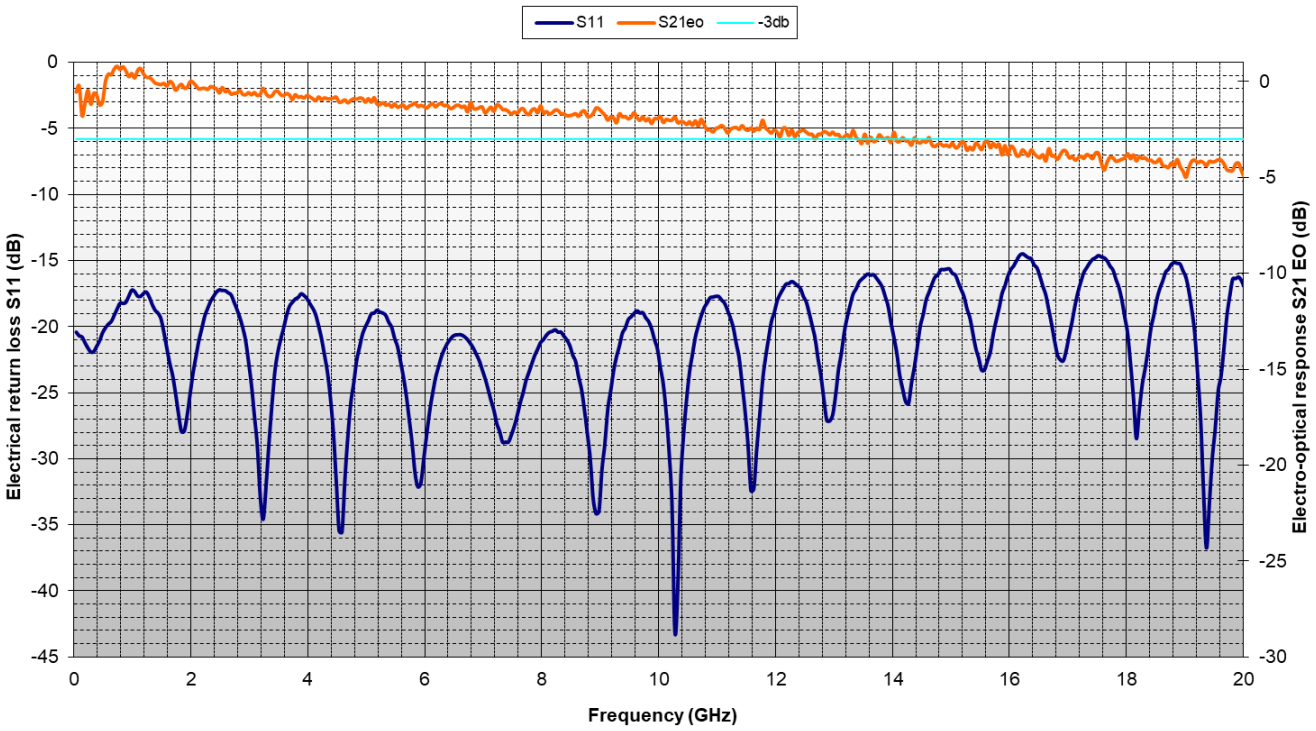
Mechanical drawing



Electro-optic bandwidth S21 / S11



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