

## MODULATOR

# NIR-MPX and NIR-MPZ Series

## 1000 nm band Phase Modulators

The Exail NIR-MP series are phase modulators especially designed to operate in the 1000 nm wavelength band. They are available with various modulation bandwidths, from low frequency to 30 GHz and beyond. Like all Exail Near InfraRed (NIR) modulators, the NIR-MP series use a proton exchanged based waveguide process that confers them an unparalleled stability even when operating at high optical power and large range of temperature. The NIR-MP phase modulators come with high Polarization Extinction Ratio (PER), Low Insertion Loss (LIL), Low  $V_{\pi}$  (LVP), DC Coupled (DCC) options.



### Features

- High optical power up to 25 dBm
- High bandwidth version > 30 GHz
- High stability vs optical power
- Low  $V_{\pi}$
- Low insertion loss

### Applications

- Interferometric based sensors
- Spectral broadening
- Laser combining
- Pound-Drever-Hall locking (PDH)
- Optical comb

### Options

- Low IL, High PER, Low  $V_{\pi}$  (LVP)
- Lower Residual Amp Mod
- Space grade version (TRL9)

### Related Equipments

- Matched RF amplifiers
- NIR-MX intensity modulators
- Spectral Broadening ModBox-SB
- CoherentBeamCombiningModBox-CBC

### NIR-MPX-LN-0.1 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	950	-	1150	nm
Usable EO bandwidth	-	300	-	MHz
$V_{\pi}$ RF @50 kHz	-	1.5	-	V

### NIR-MPX-LN-02 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	950	-	1150	nm
Usable EO bandwidth	-	5	-	GHz
$V_{\pi}$ RF @50 kHz	-	1.5	-	V

### NIR-MPX-LN-05 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	950	-	1150	nm
Usable EO bandwidth	-	10	-	GHz
$V_{\pi}$ RF @50 kHz	-	4	-	V

### NIR-MPZ-LN-10-LVP Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	950	-	1150	nm
Usable EO bandwidth	-	16	-	GHz
$V_{\pi}$ RF @50 kHz	-	2	-	V

### NIR-MPZ-LN-20 Performance Highlights

Parameter	Min	Typ	Max	Unit
Operating wavelength	950	-	1150	nm
Usable EO bandwidth	-	30	-	GHz
$V_{\pi}$ RF @50 kHz	-	3.5	-	V

# NIR-MPX-LN-0.1

## 300 MHz Phase Modulator

### Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical (EO) bandwidth	$S_{21}$	-	150	-	-	MHz
Usable EO bandwidth	$t_r / t_f$	-	-	300	-	MHz
$V_{\pi}$ RF @50 kHz	$V_{\pi_{RF\ 50\ kHz}}$	RF electrodes	-	1.5	2	V
RF input impedance	$Z_{in-RF}$	-	-	10 000	-	$\Omega$

### Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Waveguide process	-	-	Proton exchange			
Operating wavelength	$\lambda$	-	950	1060	1150	nm
Insertion loss	IL	Without connectors <sup>(1)</sup>	-	3	4	dB
Low insertion loss	LIL	Without connectors <sup>(1)</sup>	-	-	3	dB
Polarization Extinction ratio	PER	Standard, Without connectors <sup>(1)</sup>	20	-	-	dB
		Optional, w/ or w/o connectors <sup>(1)</sup>	25	30	-	dB
Optical return loss	ORL	-	-40	-45	-	dB

All specifications given at 25°C, 1060 nm, unless differently specified.

<sup>(1)</sup> Consider an extra-loss up to 0.4 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
Modulation voltage range	$EV_{in}$	-20	+20	V
Optical input power (CW mode)	$OP_{in}$	-	+25	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

# NIR-MPX-LN-02

## 5 GHz Phase Modulator

### Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical (EO) bandwidth	$S_{21}$	-	2	-	-	GHz
Usable EO bandwidth	$S_{21}$	-	-	5	-	GHz
Ripple $S_{21}$	$\Delta S_{21}$	-	-	0.5	1	dB
Electrical return loss	$S_{11}$	-	-	-10	-8	dB
$V_{\pi}$ RF @50 kHz	$V_{\pi_{RF\ 50\ kHz}}$	-	-	1.5	2	V
RF input impedance	$Z_{in-RF}$	-	-	50	-	$\Omega$

### Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Waveguide process	-	-	Proton exchange			
Operating wavelength	$\lambda$	-	950	1060	1150	nm
Insertion loss	IL	Without connectors <sup>(1)</sup>	-	3	4	dB
Low insertion loss	LIL	Without connectors <sup>(1)</sup>	-	-	3	dB
Polarization Extinction ratio	PER	Standard, without connectors <sup>(1)</sup>	20	-	-	dB
		Optional, w/ or w/o connectors <sup>(1)</sup>	25	30	-	dB
Optical return loss	ORL	-	-40	-45	-	dB

All specifications given at 25°C, 1060 nm, unless differently specified.

<sup>(1)</sup> Consider an extra-loss up to 0.4 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
Modulation voltage range	$E_{V_{in}}$	-	+33	dBm
Optical input power (CW mode)	$OP_{in}$	-	+25	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

# NIR-MPX-LN-05

## 10 GHz Phase Modulator

### Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical (EO) bandwidth	$S_{21}$	-	5	-	-	GHz
Usable EO bandwidth	$S_{21}$	-	-	10	-	GHz
Ripple $S_{21}$	$\Delta S_{21}$	-	-	0.5	1	dB
Electrical return loss	$S_{11}$	-	-	-12	-10	dB
$V_{\pi}$ RF @50 kHz	$V_{\pi_{RF\ 50\ kHz}}$	-	-	4	5	V
RF input impedance	$Z_{in-RF}$	-	-	50	-	$\Omega$

### Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate X-Cut Y-Prop			
Waveguide process	-	-	Proton exchange			
Operating wavelength	$\lambda$	-	950	1060	1150	nm
Insertion loss	IL	Without connectors <sup>(1)</sup>	-	3	4	dB
Low insertion loss	LIL	Without connectors <sup>(1)</sup>	-	-	3	dB
Polarization Extinction ratio	PER	Standard, without connectors <sup>(1)</sup>	20	-	-	dB
		Optional, w/ or w/o connectors <sup>(1)</sup>	25	30	-	dB
Optical return loss	ORL	-	-40	-45	-	dB

All specifications given at 25°C, 1060 nm, unless differently specified.

<sup>(1)</sup> Consider an extra-loss up to 0.4 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
Modulation voltage range	$EP_{in}$	-	+33	dBm
Optical input power (CW mode)	$OP_{in}$	-	+25	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

# NIR-MPZ-LN-10-LVP

## 20 GHz Phase Modulator

### Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical (EO) bandwidth	$S_{21}$	-	10	12	-	GHz
Usable EO bandwidth	$S_{21}$	-	-	20	-	GHz
Ripple $S_{21}$	$\Delta S_{21}$	-	-	0.5	1	dB
Electrical return loss	$S_{11}$	-	-	-13	-10	dB
V $\pi$ RF @50 kHz / 1 GHz	$V\pi_{RF\ 50\ kHz/1\ GHz}$	-	-	2 / 2.3	-	V
V $\pi$ RF @10 GHz	$V\pi_{RF\ 10\ GHz}$	-	-	3	-	V
RF input impedance	$Z_{in-RF}$	-	-	50	-	$\Omega$

### Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate Z-Cut Y-Prop			
Waveguide process	-	-	Proton exchange			
Operating wavelength	$\lambda$	-	950	1060	1150	nm
Insertion loss	IL	Without connectors <sup>(1)</sup>	-	3	4	dB
Polarization Extinction ratio	PER	Standard, without connectors <sup>(1)</sup>	20	-	-	dB
		Optional, w/ or w/o connectors <sup>(1)</sup>	25	30	-	dB
Optical return loss	ORL	-	-40	-45	-	dB

All specifications given at 25°C, 1060 nm, unless differently specified.  
<sup>(1)</sup> Consider an extra-loss up to 0.4 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
Modulation voltage range	$EV_{in}$	-	+33	dBm
Optical input power (CW mode)	$OP_{in}$	-	+25	dBm
Operating temperature	OT	0	+70	°C
Storage temperature	ST	-40	+85	°C

# NIR-MPZ-LN-20

## 30 GHz Phase Modulator

### Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electro-optical (EO) bandwidth	$S_{21}$	-	16	20	-	GHz
Usable EO bandwidth	$S_{21}$	-	-	30	-	GHz
Ripple $S_{21}$	$\Delta S_{21}$	-	-	0.5	1	dB
Electrical return loss	$S_{11}$	-	-	-13	-10	dB
$V_{\pi}$ RF @50 kHz	$V_{\pi_{RF50\text{ kHz}}}$	-	-	3.5	4	V
$V_{\pi}$ RF @20 GHz	$V_{\pi_{RF20\text{ GHz}}}$	-	-	6	-	V
RF input impedance	$Z_{in-RF}$	-	-	50	-	$\Omega$

### Optical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Crystal	-	-	Lithium Niobate Z-Cut Y-Prop			
Waveguide process	-	-	Proton exchange			
Operating wavelength	$\lambda$	-	950	1060	1150	nm
Insertion loss	IL	Without connectors <sup>(1)</sup>	-	3	4	dB
Low insertion loss	LIL	Without connectors <sup>(1)</sup>	-	2.5	3	dB
Polarization Extinction ratio	PER	Standard, without connectors <sup>(1)</sup>	20	-	-	dB
Optical return loss	ORL	-	-40	-45	-	dB

All specifications given at 25 °C, 1060 nm, unless differently specified.

<sup>(1)</sup> Consider an extra-loss up to 0.4 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 (CW mode)	$EP_{in}$	-	+33	dBm
Optical input power (CW mode)	$OP_{in}$	-	+25	dBm
Operating temperature	OT	-30	+70	°C
Operating temperature variation rate	$OT_{vr}$	-	1	°C/min
Storage temperature	ST	-40	+85	°C
Vibration	Vib	MIL-STD-883J method 2007.3 - Test condition B		
Mechanical shock	Shock	MIL-STD-882J method 2002.5 - Test condition B		

