



The ModBox-CBC-2000nm is a proven and robust multi-channels phase modulation solution for multibeam coherent combination.

The ModBox operates at 2000 nm and is composed of 4 or 8 parallel and independent channels for adjusting the phase of each to match the others. Each channel allows an adjustment of the temporal phase for synchronization of all beams. The design integrates ixblue proprietary low frequency phase modulator combined with its matching RF electronic and associated with a selected for high accuracy and for wide delay range tunable optical delay line.

Specific effort is done for ModBox product: the ixblue electro-optical modulators are screened from our regular production to ensure very low insertion loss, high polarization extinction ratio, low Residual Amplitude Modulation, and high phase modulation stability. Additionally, ixblue phase modulator is well known to be the best planar phase modulator featuring the highest optical input power handling capability.

The component selection makes the ModBox-CBC-2000nm an accurate, adjustable, and reliable phase-lock modulation solution for Coherent Beam Combining technique.

## FEATURES

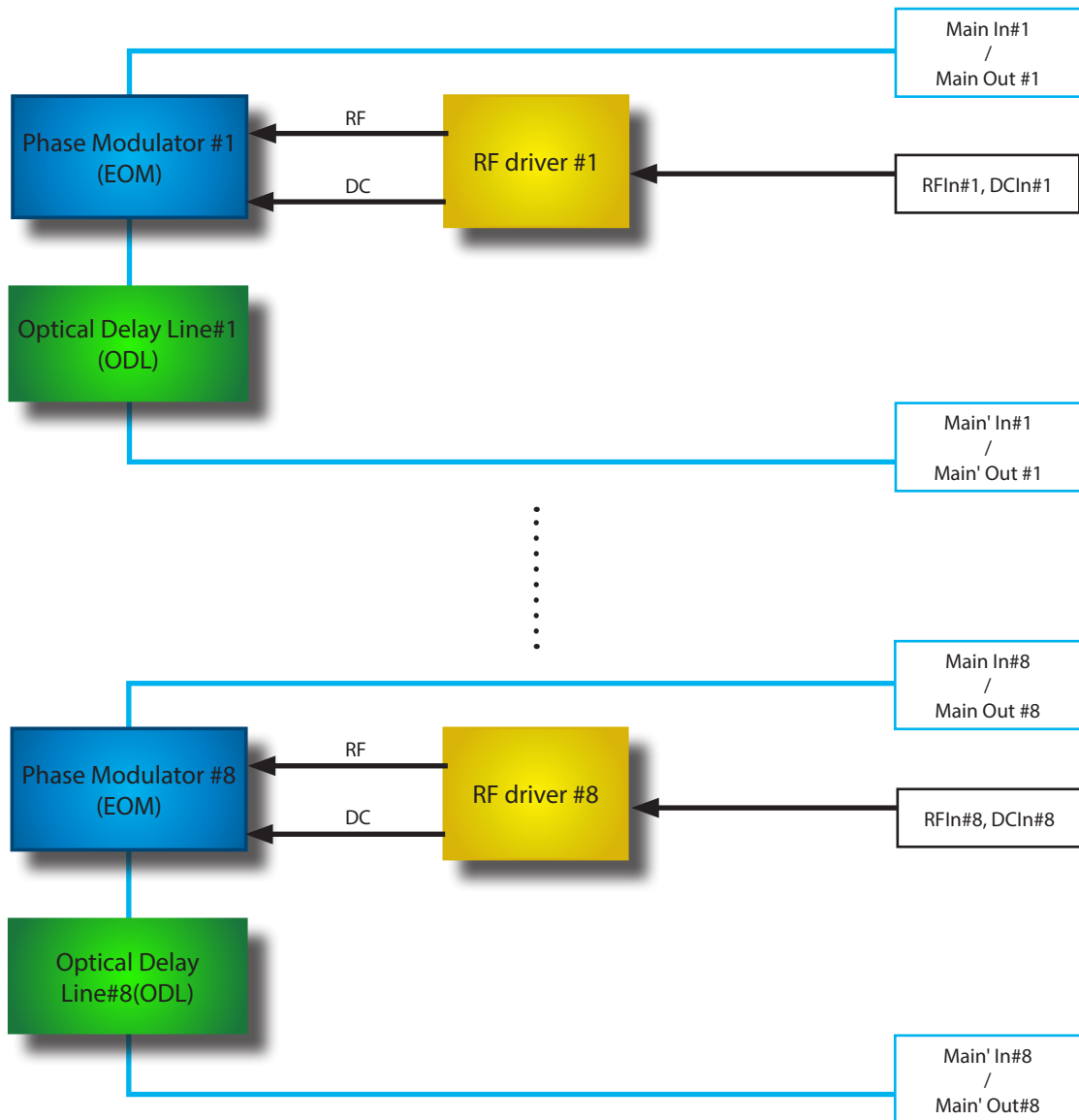
- Proven and reliable solution
- Adjustable delay range and temporal phase modulation per channel
- Scalable number of channels
- Adjustable Residual Amplitude Modulation
- Lower Insertion Loss
- Higher PER

The ModBox-CBC-2000nm can be associated with the Spectral Broadening unit ModBox-SB-2000nm based on high frequency phase modulation in order to counter the SBS effects caused by the amplification of a narrow linewidth laser source.

## Performance Highlights

Parameter	Typical
Operating wavelength	2000 nm
Insertion loss	5 dB typical
Polarisation extinction ratio	> 25 dB
Adjustable delay range	600 ps
RAM	Adjustable

Functional Block Diagram



The ModBox-CBC-2000nm-xCH is an independent 4 or 8 channels, each integrates:

- an high speed temporal phase modulator,
- a modulator matching RF amplifier,
- a tunable and remotely controllable optical delay line.

The ModBox is a reciprocal modulation unit: each main input (respectively output) can be seen as an output (respectively input) without any alterations to the specification.

## Input Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Electrical Input Specifications						
Input RF voltage	$V_{RF\_IN}$	50 $\Omega$	-	110	-	mVpp
Input RF frequency	$F_{RF\_IN}$	50 $\Omega$	-	-	200	MHz
Input DC voltage	$V_{DC\_IN}$	50 $\Omega$	-	$\pm 250$	-	mV

## Output Specifications <sup>(1)</sup>

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating wavelength	$\lambda$	-	1900	2000	2200	nm
Maximum insertion loss	IL	Including $\Delta IL_{ODL}$ / Per channel	-	5	6	dB
Insertion loss uniformity	$\Delta IL_{ODL}$	Loss variation over delay range	-	0.5	-	dB
Insertion loss inter-channels	$\Delta IL$	-	-	0.8	1	dB
Polarisation extinction ratio	PER	Optimized for 2000 nm	25	30	-	dB
Temporal modulation	BW	From EOM	-	-	200	MHz
Adjustable delay range	DR	ODL, remotely controllable	-	600	-	ps
Inter-channel delay range	$\Delta DR$	-	0	-	150	ps
Delay resolution	DRes	-	-	2.6	-	fs
Optical return loss	ORL	-	-40	-45	-	dB
RF driver gain	G	DC & RF	25 <sup>(2)</sup>	26 <sup>(2)</sup>	-	dB
Modulation rise & fall times	Rt / Ft	20 % - 80 %	8	-	-	ns

(1): The proposed system/components will properly work either with a kHz linewidth laser as well as with a 27 GHz one.

(2): The driver's gain will be not affected by the temperature when it ranges 25 °C  $\pm$  10 °C.

## 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 voltage	$EV_{in}$	-	-	10	Vpp
DC input voltage	$DCV_{IN}$	-	-	$\pm 1$	V
Optical input power	$OP_{in}$	To the EOM input port (Main In)	-	25	dBm
		To the ODL input port (Main' In)	-	27	dBm
Operating temperature	OT		0	+55	°C

Software interface

The ModBox-CBC is coming with a Graphical User Interface (GUI) allowing the controls of the Optical Delay Lines delays. Each channel can be adjusted individually.

The screenshot displays the '8CH-MP ModBox Control' software interface. It features a list of eight channels, each with a 'Find Home' button, a 'Time Delay' control (set to 599.999 ps), a 'Motor Speed' control (set to 100.0%), and a 'Status' indicator (IDLE). The 'Actual Delay' for each channel is also shown as 599.999 ps. A gear icon is visible in the top right corner, and the version 'v1.0' and 'ixblue' logo are in the bottom right corner.

Channel	Find Home	Time Delay	Motor Speed	Status	Actual Delay
ODL1	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL2	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL3	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL4	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL5	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL6	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL7	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps
ODL8	Find Home	599.999 ps	100.0 %	IDLE	599.999 ps

## Panels

Parameter	Condition	Min	Typ	Max	Unit
Rear Panel					
Remote port	-			USB	
Front panel					
Optical ports	"Main in #N" <sup>(1)</sup>	Narrow key FC/APC, free space divergence			
	"Main Out #N" <sup>(1)</sup>	Narrow key FC/APC, free space divergence, cable gnd, 2 meters fiber length			
MFD (Mode Field Diameter)	"Main in #N" / "Main Out #N" <sup>(1)</sup>	8 μm @1850 nm			
Fiber core-diameter	"Main in #N" / "Main Out #N" <sup>(1)</sup>	7 μm			
Numerical aperture	"Main in #N" / "Main Out #N" <sup>(1)</sup>	0.2			
Optical fiber	"Main in #N" / "Main Out #N" <sup>(1)</sup>	Polarization maintaining fiber, Nufern PM1950			
RF & DC input port	"RFin#N, DCInN" <sup>(1)</sup>	BNC			

With N = 1, ..., 8

## Compliance and safety

Parameter	Condition	Min	Typ	Max	Unit
Compliance	-			BS EN 60825 - CE certified	

## Dimensions

Parameter					
Size	19 inches 3U				
Weight	ModBox-CBC-2000nm-4CH: 8 kG		ModBox-CBC-2000nm-8CH: 8 kG		
Power supply	100 - 120 V / 220 - 240 V automatic switch, 50 - 60 Hz				

## Ordering information

### ModBox-CBC-2000nm-xCH

xCH = Number of parallel channels: 4CH 4 channels or 8CH: 8 channels

## About us

ixblue Photonics includes ixblue ixFiber brand that produces specialty optical fibers and Bragg gratings based fiber optics components and ixblue Photline brand that provides optical modulation solutions based on the company lithium niobate (LiNbO<sub>3</sub>) modulators and RF electronic modules.

ixblue 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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