

## ModBox-CBand-CSSSB C&L Bands - Carrier Suppressed Single Side Band

### ModBox



The ModBox-CBand-CSSSB is an Optical Transmitter Frequency shifter based on high order optical Carrier Suppressed Single Side Band modulation. The ModBox operates in the C&L Bands and with microwave frequencies up to 15 GHz.

The ModBox-CSSSB is dedicated to applications that require a coarse tuning (in the 10 s of GHz range) and very fine tuning frequency shift (limited by the input synthesizer frequency resolution). Tunability and accurate control of your wavelength can be useful for precision laser spectroscopy, quantum optics, cold-atom inertial sensors and atomic clocks, optical measurements, and optical fiber sensors.

The ModBox-CBand-CSSSB is a fully optimized CS-SSB optical transmitter based on one LiNbO<sub>3</sub> IQ modulator and its automatized bias controller, it generates one Carrier Suppressed Single Side Band (CS-SSB).

#### FEATURES

- High carrier and side band attenuation
- High attenuation stability
- Low insertion loss
- Proven solution
- Remote control

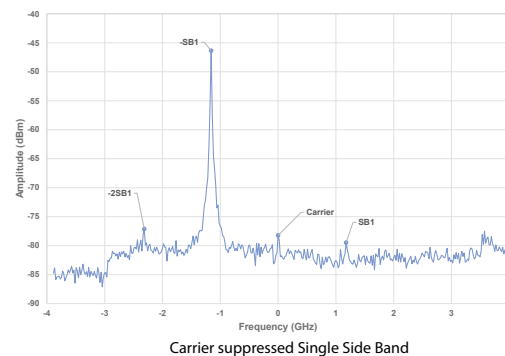
#### APPLICATIONS

- High resolution laser spectroscopy
- Atomic clocks
- Quantum optics
- Cold-atom accelerometers
- Optical measurements
- Optical fiber sensors

#### Performance Highlights

Parameter	Min	Typ	Max
Operating wavelength		C-L Bands	
Optical carrier attenuation		35 dB	
Side band attenuation		50 dB	
Offset SSB modulation frequency		Up to 15 GHz	
Insertion loss		5 dB	
PER		Up to 25 dB (option)	

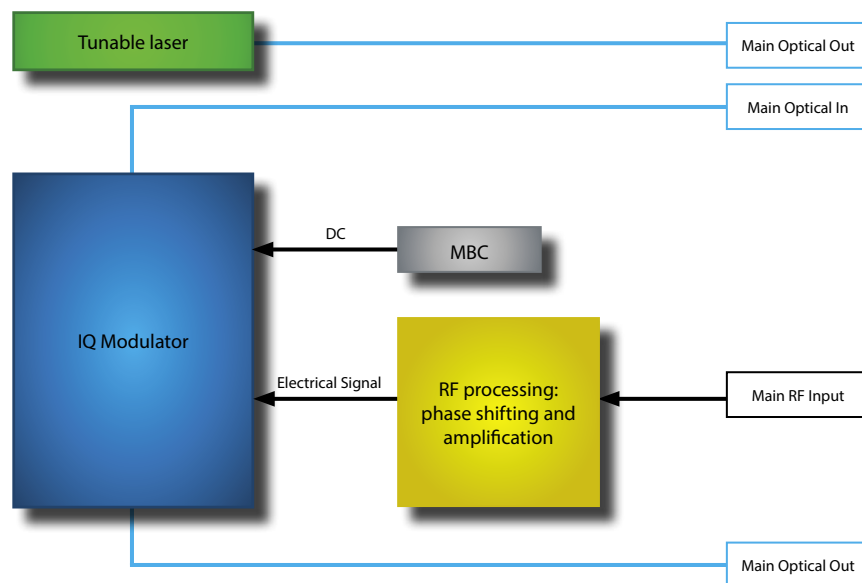
#### Optical CS-SSB ModBox Response



ModBox-CBand-CSSSB  
C&L Bands - Carrier Suppressed Single Side Band

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Functional Block Diagram



The ModBox-CBand-CSSSB is designed around a Dual Parallel Mach-Zehnder Modulator, a fully automatic bias control circuit and RF signal processing. The equipment is expected to operate with a user supplied RF sinusoidal signal, delivered for instance by a signal synthesizer. The ModBox embeds a high purity C-band tunable laser source. A L-Band tunable laser may be integrated on customer request.

The equipment incorporates an input RF coupler that splits the RF signal toward the I and Q sub-Mach-Zehnders RF inputs, tunable delay lines and RF driver with tunable gain from front panel adjustment. The carrier attenuation and the side band attenuation are depending on several factors including the RF power driven to the modulator, the RF power balance between the two sub-Mach-Zehnders, the wavelength of the optical signal, the frequency of the RF modulation signal and the I/Q phase shift (that one is set with the DC<sub>3</sub> voltage).

The ModBox will be fully pre-set with fine adjustments of the RF driver gains, delay lines and DC<sub>3</sub> bias voltage in order to obtain the maximum extinction of the carrier and the side band. The user has access to these operating points from the front panel using the embedded computer software and / or remotely from a Graphical User Interface (GUI) that is provided.

## ModBox-CBand-CSSSB

### C&L Bands - Carrier Suppressed Single Side Band

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#### Input Optical Specifications User supplied, not a ModBox specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operation	$\lambda$	CW	C+L Bands			-
Polarization	-	-	Linear and controlled			-
Power	P	-	10	-	20	dBm

#### Input RF Specifications User supplied, not a ModBox specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Shape	$RF_{IN}$	-	Sinusoidal			-
level	$V_{IN}$	AC coupled - 50 $\Omega$ - Single ended	200	500	-	mV
Frequency	F	-	1	-	15	GHz

#### C-Band Tunable Laser Specifications The laser is embedded by default.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Laser type	-	CW	Tunable			-
Wavelength	$\lambda$	Embedded by default	1527.60	-	1565.50	nm
Wavelength accuracy	$\Delta\lambda_{acc}$	-	-1.5	-	1.5	GHz
Spectrum linewidth	$\Delta\lambda$	FWHM @-3 dB, instantaneous	-	-	100	kHz
Optical output power	-	CW	10	15	17	dBm
Optical output power adjustment	-	-	0	-	100	%
Optical Return Loss	ORL	-	30	-	-	dB
Side Mode Suppression Ratio	SMSR	-	40	-	-	dB

#### Main Output Specifications

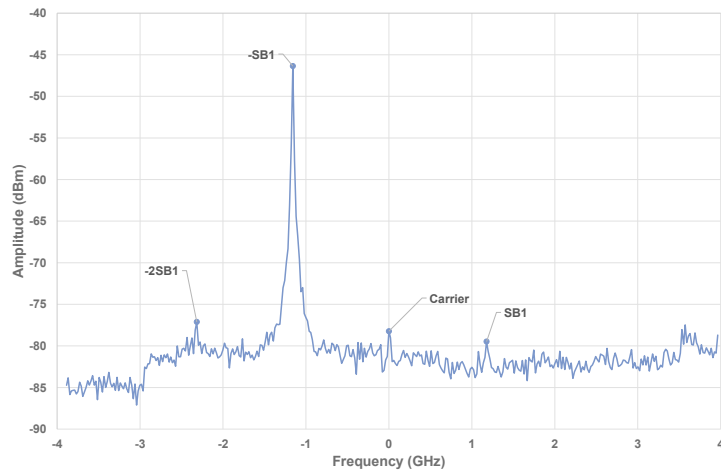
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Single side band mode control	-	-	Fully automatic bias control			-
Optical pass insertion loss	IL	At the maximum transmission points	-	5	6	dB
SSB conversion loss	-	$J_0$ to $J_1$ conversion efficiency	-	4.7	-	dB
Offset SSB modulation frequency	F	-	1	-	15	GHz
Optical carrier attenuation	CS	CS-SSB mode - C-Band	30	35	-	dB
Optical carrier attenuation stability	$\Delta CS$	-	-	1	-	dB <sub>RMS</sub>
Optical side band attenuation	SSB	CS-SSB mode - C-Band	45	50	-	dB
Optical side band attenuation stability	$\Delta SSB$	-	-	1	-	dB
Polarization extinction ratio	PER	-	20	23	-	dB
High Polarization extinction ratio	HPER	Option	23	25	-	dB

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ModBox Optical Outputs Examples

A high resolution optical spectrum analyzer is recommended to carry out these measurements.



CS-SSB: Carrier Suppressed Single Side Band  
Carrier, and Side Bands  
RF-IN: 1.2 GHz

## ModBox-CBand-CSSSB C&L Bands - Carrier Suppressed Single Side Band

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### Interfaces, Dimensions and Compliance

Interfaces	
Optical	Polarization maintaining fiber PM1550 - FC/APC (by default, other connectors type in option)
Optical norm	NF EN 60825-1 & EN 60825 Ed.2014
RF input	SMA female RF connector - 50 Ω
EMC norm	EN61326-1 Ed. 2006
Control	Smart Interface - GUI (USB)
Rotary knob	E Phase I and E Phase Q - To allow Phase delay adjustment between I and Q
Power supply	100-120V/220-240 automatic switch 50-60Hz (Rear panel)
Weight	6 kg
Dimensions	Rack 19" 3U, Depth 375 mm



### Ordering information

#### ModBox-CBand-CSSSB

CBand = Full band of operation, embeds laser, C-Band Tunable laser by default  
 CSSSB = Single Side Band with Carrier Suppression

#### Opt-YY

YY = Output connectors, FA : FC/APC - FC : FC/UPC - SA : SC/APC - SC : SC/UPC

### About us

iXBlue Photonics includes iXBlue iXBlue 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, defence, telecommunications, space and fiber lasers as well as research laboratories all over the world.

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