

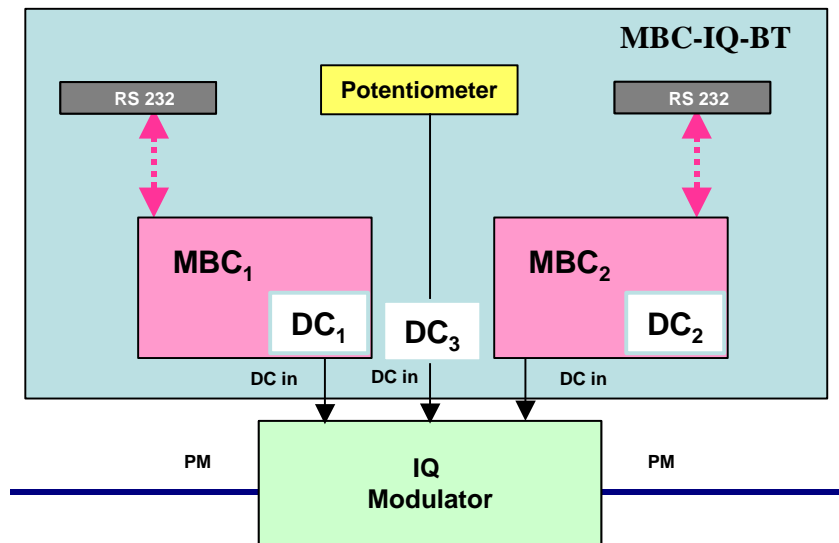
Modulator Bias Controller For Single and Dual Drive IQ modulators



The Modulator Bias Controller for IQ Modulator

The **MBC-DG-Board**, **MBC-DG-BT** and **MBC-IQ-BT with or without PD option** are a family of bias controller specially designed to stabilize the operating point of LiNbO_3 Mach-Zehnder modulators by monitoring the bias voltage applied on the DC electrodes of the device.

The **MBC-IQ-BT** model is especially designed for IQ modulator. The **MBC-IQ-BT** is preset at operating point MIN and lock automatically the DC_1 and DC_2 from an IQ modulator (refer to appendix 1 for modulator input ports definition). Additionally, a continuous supply voltage output is available for manual (knob adjustable) DC_3 for phase difference between the two sub-MZ's. The **MBC-IQ-BT** is an efficient component for either single drive (X-cut design) and differential biasing.



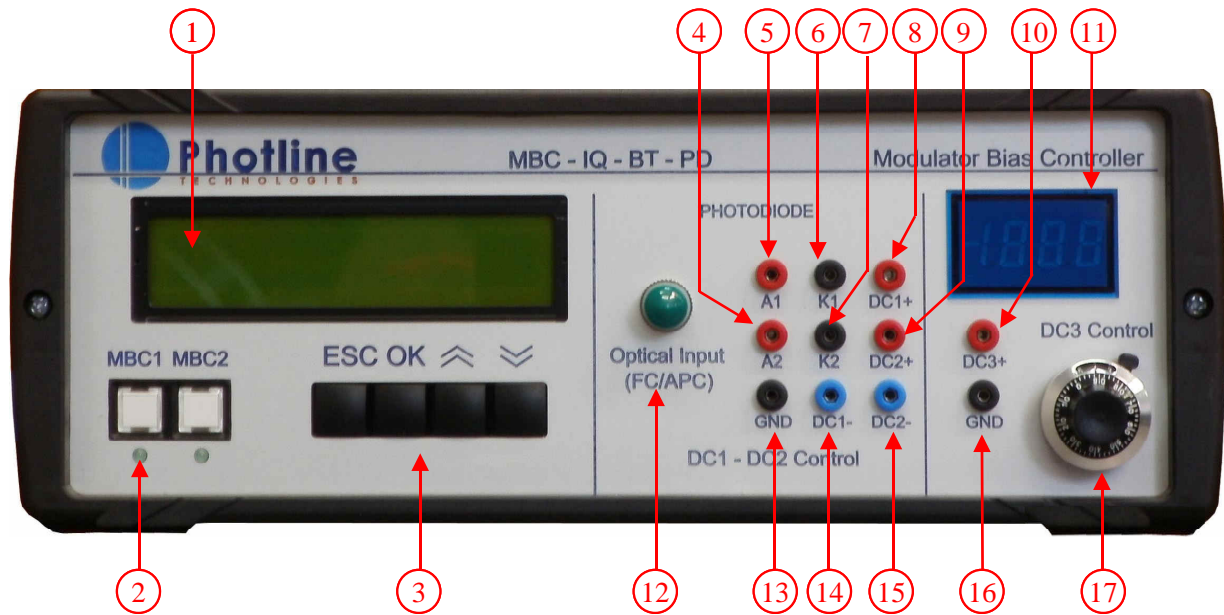
MBC-IQ-BT set-up with IQ modulator

The **MBC-IQ-BT** will ensure:

- ✓ biasing of one LiNbO_3 IQ modulators, DC_1 and DC_2 automatic, DC_3 manual
- ✓ parallel biasing of two LiNbO_3 intensity modulators using the two MBC-boards
- ✓ a stable continuous supply voltage for modulator, driver, amplifiers, ...biasing
- ✓ independent control of each MBC (using MBC front panel or remote by RS232)
- ✓ stabilisation of preset working point MIN, MAX, QUAD+, QUAD-
- ✓ tuneable locked-working point
- ✓ tuning mode Manual/Auto

OPTION

- ✓ Internal photodiode
- ✓ Tap coupler



MBC-IQ-BT-PD front panel with optional internal photodiode

The **MBC-IQ-BT-PD** front panel features :

- ✓ (1) Main display
- ✓ (2) **MBC1, MBC2** : MBC_1 and MBC_2 selection
- ✓ (3) **ESC, OK, \nearrow , \searrow** : Keypad for $MBC_{1,2}$ circuit parameters control – Manual mode
- ✓ (4) **A2** : Anode 2- MBC_2 input port when modulator's internal photodiode is used
- ✓ (5) **A1** : Anode 1- MBC_1 input port when modulator's internal photodiode is used
- ✓ (6) **K1** : Cathode 1- MBC_1 input port when modulator's internal photodiode is used
- ✓ (7) **K2** : Cathode 2- MBC_2 input port when modulator's internal photodiode is used
- ✓ (8) **DC1+** : Positive DC_1 output port (single drive modulator)
- ✓ (9) **DC2+** : Positive DC_2 output port (single drive modulator)
- ✓ (10) **DC3+** : DC_3 output port (single drive modulator)
- ✓ (11) Display for DC_3 control
- ✓ (12) **Optical Input** : Optical input port when modulator external PD is used (Opt-PD)
- ✓ (13) **GND** : Ground port for DC_1 and DC_2
- ✓ (14) **DC1-** : Negative DC_1 output port (additional port for dual drive modulator)
- ✓ (15) **DC2-** : Negative DC_2 output port (additional port for dual drive modulator)
- ✓ (16) **GND** : Ground port for DC_3
- ✓ (17) Knob for DC_3 voltage control

The **MBC-IQ-BT** rear panel features two RS-232 interfaces (USB port in Option) for remote adjustment of the bias control circuit parameters. Moreover, automatic and manual bias control functions selection is also available.

SPECIFICATIONS

DC₁ & DC₂ Optical Characteristics

PARAMETERS	CONDITIONS	UNIT	MIN	TYP	MAX
Wavelength of operation	-	nm	780	-	1 650
Input optical power	with internal PD and tap coupler	dBm	-	-4	-
Optical dynamic range	range over 4 user selectable gains, with internal PD & tap coupler	dBm	-	22	-

DC₁ & DC₂ Electrical Characteristics

PARAMETERS DC ₁ & DC ₂	CONDITIONS	UNIT	MIN	TYP	MAX
Bias voltage	-	V	-10	-	10
Bias voltage step	in manual mode	V	-	0.1	-
Input photocurrent	range over 4 user selectable gains	μA	3	-	500
	gain 1	μA	100	-	500
	gain 2	μA	20	-	200
	gain 3	μA	10	-	100
	gain 4	μA	3	-	30
Photocurrent dynamic range	range over 4 user selectable gains	dB	-	22	-
	range over 1 user selectable gain	dB	7	8	10
DC₃					
Voltage range	-	V	-18	-	+18
Voltage step	manual	mV	-	10	-
Output current	-	mA	-	-	20

DC₁ & DC₂ Bias Control Characteristics

PARAMETERS	CONDITIONS	UNIT	MIN	TYP	MAX
Preset locking point	with IQ modulator	MIN (0%)			
Locking range	manual and automatic control	Degree	-	360	-
Bias voltage step	at quad	Degree	89.5	90	90.5
Extinction ratio (Min mode)	with proper modulator, width internal PD & tap coupler option	dB	-	-	50
Extinction ratio stability (Min mode)	with proper modulator, internal PD & tap coupler option, over 1 hour	dB	-	±0.05	-
Dither frequency	by 40 Hz frequency step	Hz	400	-	1 400
Dither amplitude	by 10 mV amplitude step	mV	50	-	1 000

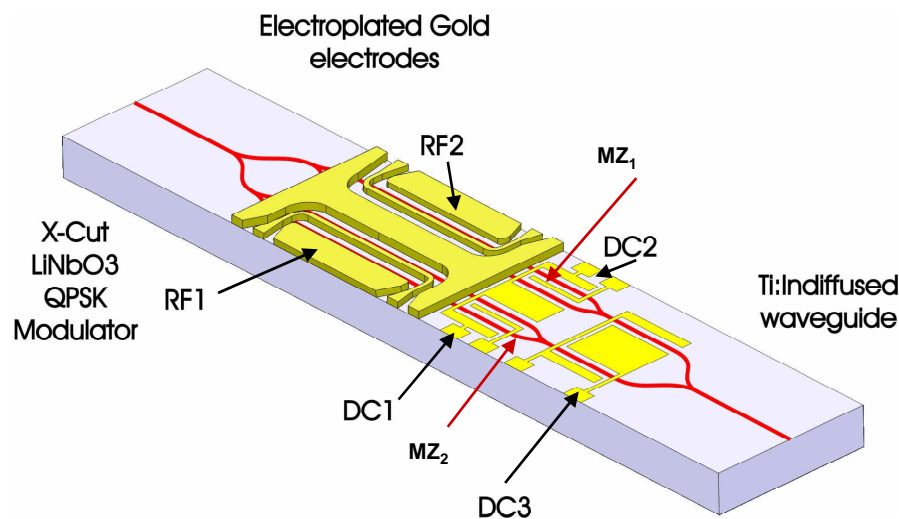
Other

PARAMETERS	UNIT	MIN	TYP	MAX
Operating temperature	℃	-10	-	+45
Storage Temperature	℃	-40	-	+75
POWER SUPPLY				
AC Voltage (automatic switch)	V	90	110	240
	Hz	50	-	60
Electrical plug	Rear panel			
DIMENSIONS				
Bench-top unit	30 cm W x 21 cm H x 8 cm D			
SOFTWARE				
Minimum computer requirements	Windows 98/NT/2000/XP			

Appendix 1 : MXIQ-LN-40 modulator

A IQ modulator is basically composed of four waveguides. The two first waveguides are linked together with input and output Y-junctions forming a first sub-Mach-Zehnder modulator (MZ_1). The two last waveguides are linked together with Y-junctions as well, forming a second sub-Mach-Zehnder modulator (MZ_2). Each output port of the Y-junctions is linked with a larger Y-junction. In conclusion, the IQ modulator is of two Mach-Zehnder modulator nested into a larger Mach-Zehnder modulator.

Electrodes are placed parallel to the waveguide arms. Two sets of high speed electrodes allows to applied RF signal to each of the sub-MZ's. Two sets of DC electrodes allows to control the static phase of each sub-MZ's. A last set of DC electrodes allows to control the static phase between the two sub-MZ's. In (D)QPSK / SSB / OFDM / QAM modulation formats, each DC voltage (DC_1 and DC_2) of the sub-MZ's is adjusted in order to introduce a phase shift equal to π , while the voltage applied to the phase difference between the two sub-MZ's is adjusted to introduce a phase shift of $\pi/2$.



Simplified Scheme of a IQ modulator integrated on an X-cut lithium niobate crystal