



MBX

Modulator Bias Controller

User Guide



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Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm
	Caution: ESD Sensitive Component

Chapter 2 Safety

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



SHOCK WARNING



Before applying power to the instrument, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth contact of the socket outlet. Improper grounding can cause electric shock with damage to your health or even death.

The local supply voltage must be in the range specified on the rear panel, and the correct fuse must be installed in the fuse holder. If not, please replace the main fuse (see section on instrument maintenance).

Only use mains cable with sufficient current and voltage ratings for this instrument.

Do not position equipment in a way that makes it difficult for the user to operate the disconnecting device.

Do not remove covers. Refer servicing to qualified personnel.



EXPLOSION WARNING



The instrument must not be operated in explosion endangered environments.



LASER WARNING



Avoid Exposure – Radiation Emitted from apertures. Do not look into the laser aperture while the laser is on. Injury to the eye may result. Laser should not be turned on unless there is an optical fiber connected to the laser output port.

Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

**CAUTION**

This product is not suitable for household room illumination.

Inputs and outputs must only be connected with shielded connection cables.

Only with written consent from Thorlabs may changes to single components be carried out or components not supplied by Thorlabs be used.

Do not obstruct the air ventilation slots in housing.

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the accompanying documentation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules and meets all requirements of the Canadian Interference Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Thorlabs is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user. The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

This precision device should only be shipped if packed into the complete original packaging including the custom cut foam padding. If necessary, ask for replacement packing material.

**ESD CAUTION**

Caution – The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any connections to the unit.

**CAUTION**

This instrument should be kept clear of environments where liquid spills or condensing moisture are likely. It is not water resistant. To avoid damage to the instrument, do not expose it to spray, liquids, or solvents.

Chapter 3 MBX Introduction

3.1. Description

Thorlabs' MBX Bias Controller provides complete and precise control of DC bias and optical output power for any fiber-coupled lithium niobate (LiNbO₃) electro-optic intensity modulator, regardless of signal speed. The operational wavelength range of the MBX extends from 1250 nm to 1610 nm (O- through L-band), and the user may select from power calibration points at 1310 nm, 1550 nm, and 1590 nm using the touchscreen interface. Whether operated in an R&D laboratory or manufacturing environment, this fully-featured modulator bias controller is ideal for use within a customized setup that uses an external laser, LiNbO₃ intensity modulator, signal source, and RF amplifier.

The MBX can be controlled in two ways. The simplest method is directly via the built-in graphical user interface (GUI) and touchscreen. The instrument can also be operated remotely via the RS-232 or USB ports on the back panel. Remote control is enabled using simple SCPI-type serial commands from a PC. See the remote control user guide (RCUG), which can be downloaded from <https://www.thorlabs.com/manuals.cfm>, for details.

The most recent firmware and remote control software tool can be downloaded by visiting https://www.thorlabs.com/navigation.cfm?Guide_ID=2191 and entering the Item # into the search field. Thorlabs' technical support can provide up-to-date information on available firmware revisions and control functions.

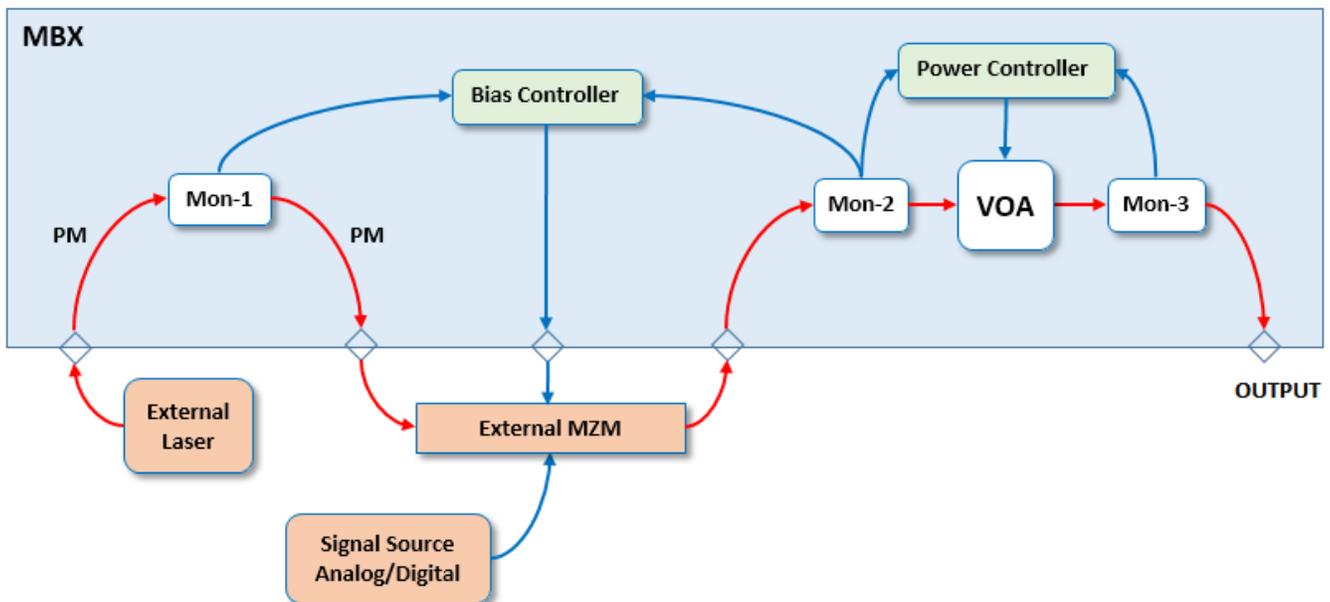
3.2. Parts List

Inspect the shipping container for damage. If the shipping container seems to be damaged, keep it until you have inspected the contents and tested the unit mechanically and electrically. Verify that you have received the following items within the package:

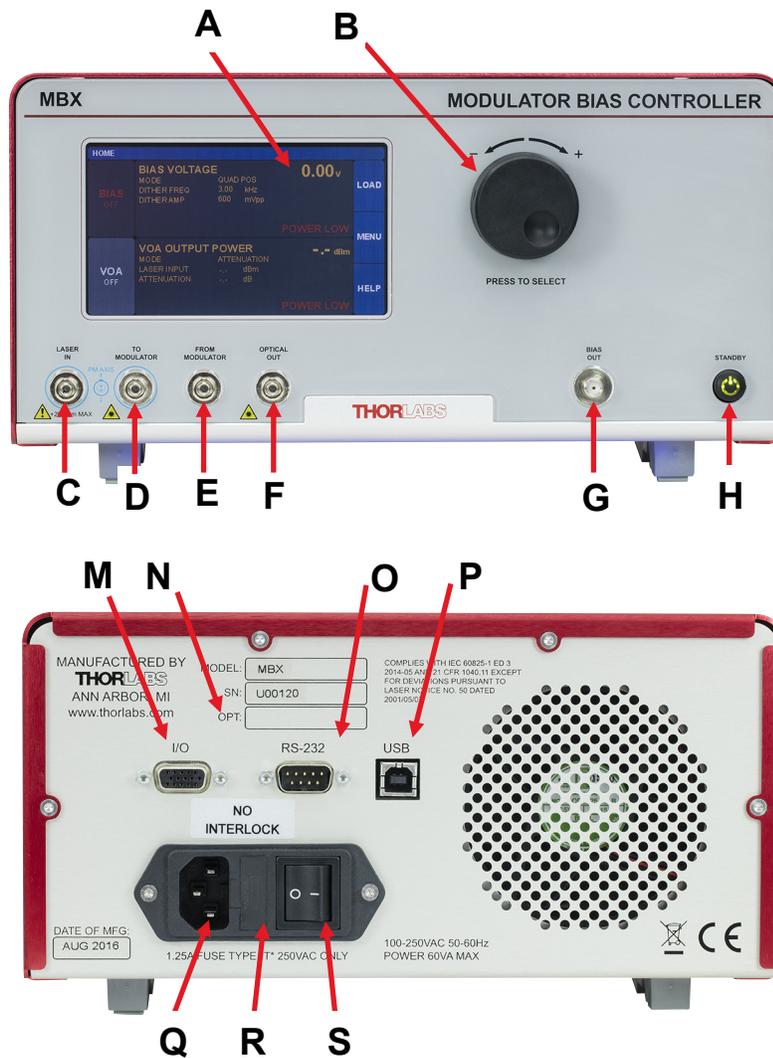
1. MBX Modulator Bias Controller Main Unit
2. Power Cord According to Local Power Supply
3. 1.25 A 250 VAC Fuse
4. USB Type A to Type B Cable, 6' Long

3.3. Block Diagram

The MBX instrument integrates a fully functional bias controller for external modulators along with full power control and stabilization at the output. This architecture allows the user to select their own laser source and their own external modulator for the most flexibility in system design. The MBX operates over a wide wavelength range (1250 nm to 1610 nm) and can be switched to maintain calibration at either 1310 nm, 1550 nm, or 1590 nm. The Laser In port uses PM fiber with light linearly polarized along the slow axis as shown on the front panel. Maximum input power is 20 dBm (100 mW). Output to the modulator is also PM fiber while return from the output of the modulator is not PM. Optical power is monitored in three places (Mon-1, -2, -3) for the purpose of enabling bias and power control. These power values are also available at the I/O port. Mon-1 is at the Laser Input, Mon-2 is at the modulator output, and Mon-3 is at the final Optical Output.



3.4. Front and Rear Panel Overview



Callout	Description	Type
A	Touchscreen Display	-
B	Adjustment Knob	-
C	Laser Input	PM FC/PC
D	Output to Modulator	PM FC/PC
E	Return from Modulator	FC/PC
F	Final Output	FC/PC
G	Bias Output	SMA
H	Standby Button	
M	I/O Port	DB-15
N	Option Label	-
O	RS-232 Port	DB-9
P	USB Port, Type B	-
Q	Power Connector	-
R	Fuse Tray	-
S	Power Switch	-

Chapter 4 Quick Start Guide



ESD CAUTION



Caution – The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any connections to the unit.

4.1. Hardware Set-up

For first use, plug the main power cable into the rear panel connector, and then plug the other end into an AC wall receptacle. Flip the power switch on the rear panel to the ON (I) position. The unit will now be in the “Standby” mode, and the front panel standby button should glow amber.



Connect laser to the Laser In port as well as connections to and from the external modulator. Note that the fibers before the modulator are all PM. Fibers after the modulator are usually not PM. Also connect the Bias Output port to the bias port of the modulator. All these connections must be made in order for the controller to correctly calibrate the modulator at start up.

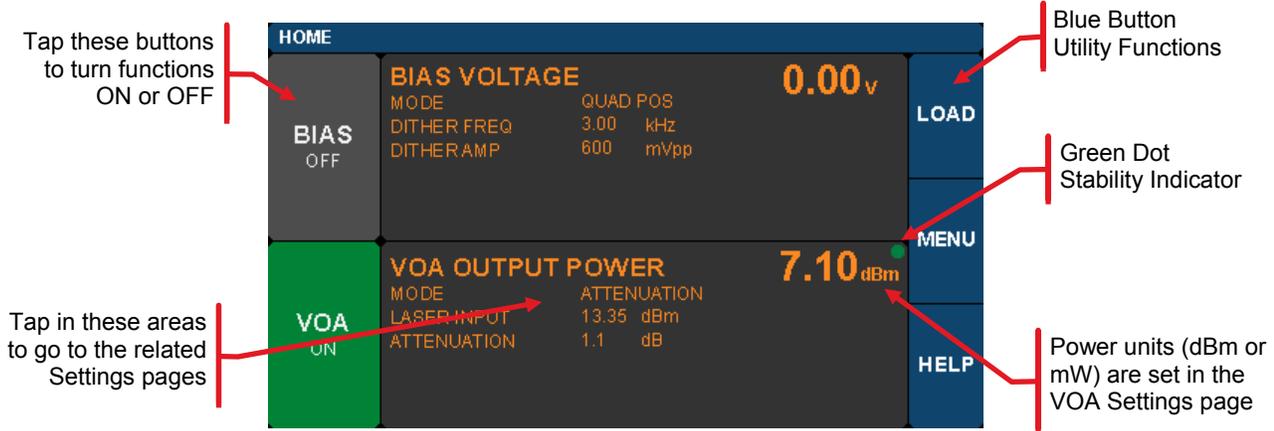


Turn on the MBX by pressing the amber standby button on the front panel until it turns green (about 1 sec) to indicate the unit is fully on. The touchscreen display will come up with a boot screen for about 5 seconds and then go to the home page. The unit will initialize in the factory default state with all functions OFF.

Be sure to set the System Wavelength before turning the Bias function on. Do this by pressing the Menu button on the home page; select the System Wavelength function and then choose the desired wavelength (either 1310nm, 1550nm or 1590nm). See the Operating Instructions Chapter for details.

4.2. Controls on the Home Page

The instrument can be fully controlled by using the resistive touchscreen display for all functions. You can use your finger or a plastic stylus to make selections on the screen. In addition, the knob on the front panel can be used in place of the on-screen arrow buttons for quickly changing set-point values. Pressing (clicking) the knob will confirm a new set-point value.



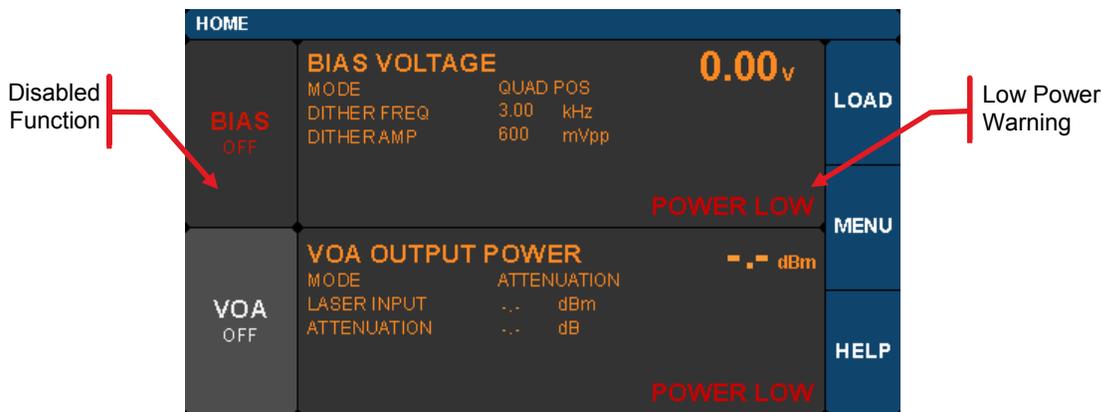
The Home screen (or dashboard) is organized into three main sections.

The left side contains the ON/OFF buttons for each of the main instrument functions. Tapping any of these buttons will toggle the function on and off. The same ON/OFF functionality is also available on the individual Settings pages. The power buttons turn green to indicate the function is ON, and turn red to indicate the function is disabled.

The central section is the main dashboard for reporting operational values of each section. Tapping the screen in this middle area will take the user to the corresponding Settings page for each section. Note that the green dot in each of these sections indicates the function is stable. A blinking green dot indicates the function is still stabilizing.

The right side of the screen provides access to the main utility functions of the box.

The screen shot below shows some of the common warning indicators on the HOME page. Some functions can be disabled when the laser power is low. In this case, buttons may be disabled and warnings indicators may appear.



4.3. Controls in the Settings Pages

The Settings pages all follow the same general design and functionality as shown in the example screen shot below. The upper section with white letters displays the parameters that can be changed. Simply tap on the parameter of interest to highlight it, and the controls for that parameter will be presented.

The lower section with amber letters displays selected values that are convenient to monitor on that page.

The right-hand column provides the controls for changing the values for the selected parameters. The main control knob on the front panel can also be used to adjust and confirm selected values. The screen shots below show examples of the touch-screen controls.

Annotations for the screenshot:

- Tap to select parameter
Yellow highlight will appear
- Increase Value
- Decrease Value
- Change Step Size
- Confirm New Value
- Cancel Any Changes
- Monitor Area

Fields that have adjustable values will show a flag if the minimum or maximum values have been reached. These are set by firmware at the factory.

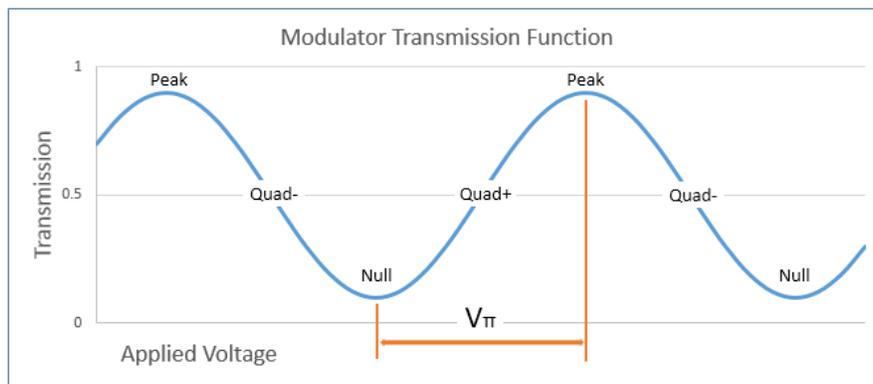
MIN / MAX warnings indicate that the setting limit for a particular parameter has been reached.

Chapter 5 Operating Instructions

5.1. The Modulator Transmission Function

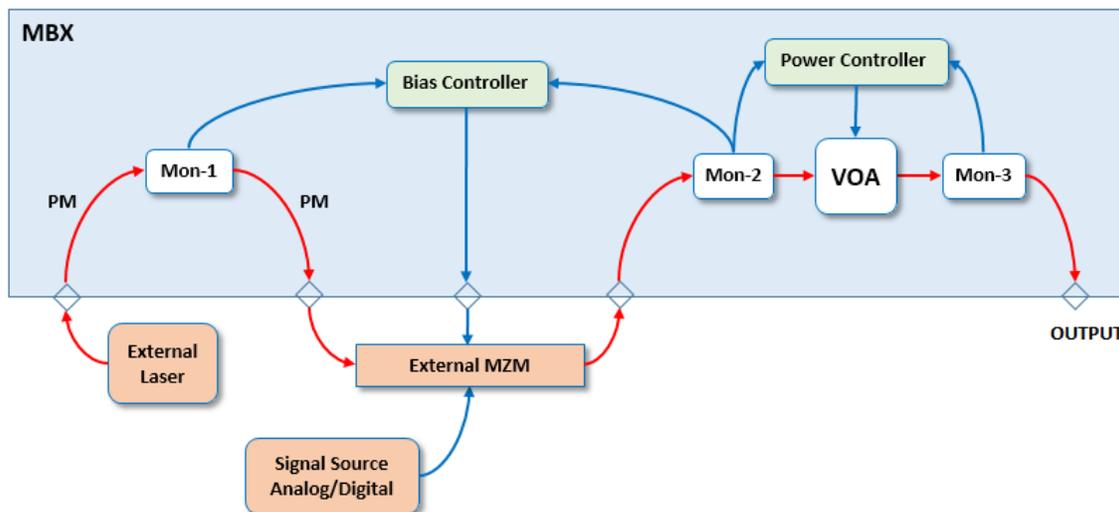
The Mach-Zehnder Modulator (MZM) has a repetitive transmission function with applied voltage as can be seen in the diagram below. In order for it to work correctly, a DC bias voltage must be applied and maintained at the desired set point. The high-frequency AC signal can then be applied to the modulator to enable the correct optical modulation of the laser beam. The most common operating points are the peak, null, and quadrature points as shown below.

The purpose of the Bias settings is to hold the modulator at one of these chosen points. Note that a real transmission function does not go perfectly from 0% to 100%. This is characterized by the Extinction Ratio of the modulator (Peak power / Null power). The efficiency of the modulator is also characterized by V_{π} , which is defined as the voltage necessary to change the transmission from Null to Peak. The most linear response of the modulator is achieved by biasing it at one of the Quadrature points where the transmission is closest to 50%. Some non-linear, frequency doubling, and phase modulation applications require biasing at the Null or Peak.



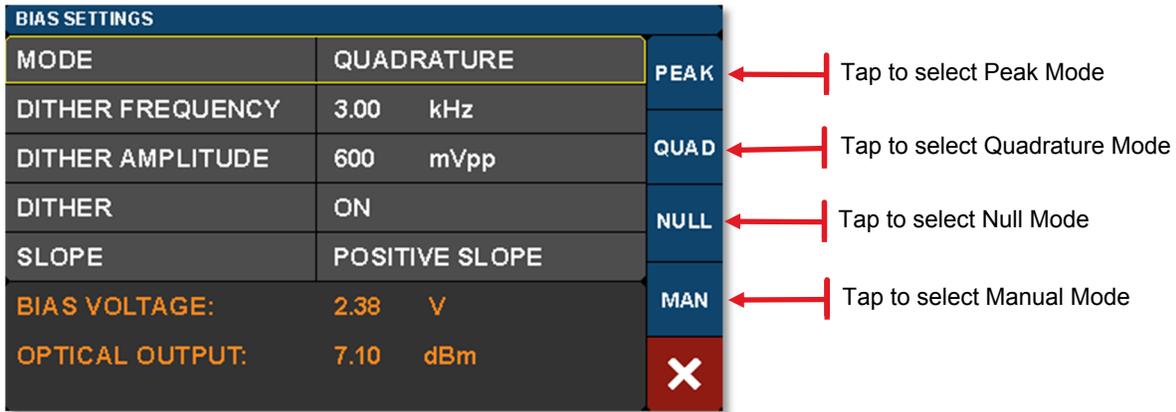
5.2. Control Loop Diagram

The following diagram shows the control loops added to the block diagram. From this picture, the user can see how the power monitors and VOA are used to provide stability and control to the whole system.



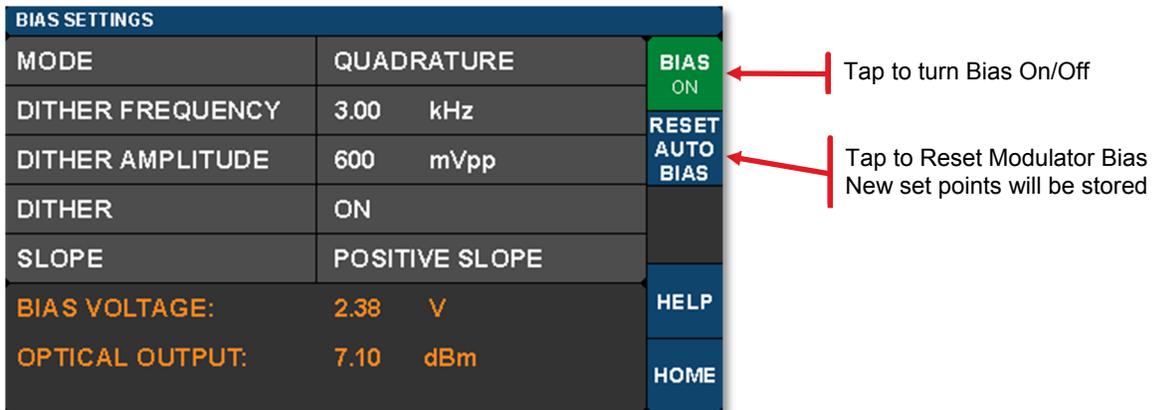
5.3. Bias Settings Page

To get to the Bias Settings page tap the Bias monitors pane on the Home page. The Bias page contains the settings for controlling the modulator bias and operating modes. There are four modes for MZM bias control: 1) Quadrature, 2) Peak, 3) Null, and 4) Manual. The screen shot below is an example of how the bias settings page opens up if the controller is in the Quadrature mode. The blue buttons enable switching between modes.



Active control of the MZM bias point is essential as the modulator is temperature sensitive and will drift over time. The Quadrature, Peak, and Null modes use a dither tone as part of a lock-in control scheme to keep the MZM bias stable. The dither tone allows the control algorithm to track the drifting, but at the cost of decreased signal-to-noise ratio (SNR) due to the injection of a single frequency tone into the MZM bias.

The first time you turn on the MZM Bias control, the instrument will perform a calibration routine to determine the approximate bias voltages required for the various MZM operating points. This allows the instrument to quickly and effectively switch between Bias modes. The user may perform this calibration anytime by pressing the Reset Auto Bias button on the right side of the Bias Settings page. This button is not available if the Bias is off or in Manual mode.



5.3.1. Quadrature Mode

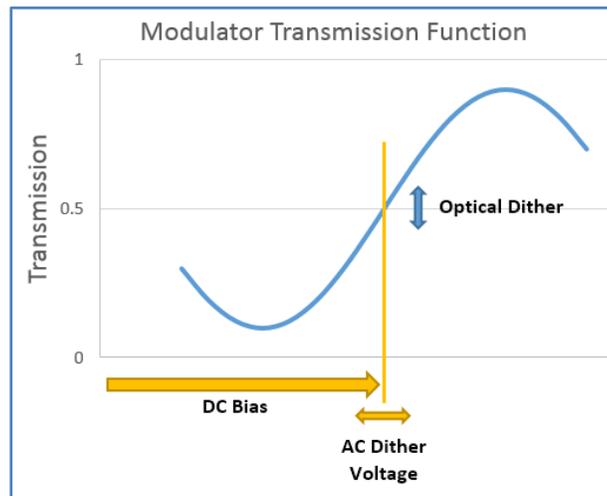
Quadrature is the default mode and biases the MZM at the 50% point on the MZM transmission curve (see figure). This is the recommended mode for digital signals such as On-Off-Keying (OOK) that require a high extinction ratio. The screen-shot below shows the parameters that can be controlled in the Quadrature mode.

BIAS SETTINGS		
MODE	QUADRATURE	1 kHz
DITHER FREQUENCY	3.00 kHz	3 kHz
DITHER AMPLITUDE	600 mVpp	5 kHz
DITHER	ON	USER DEFINE
SLOPE	POSITIVE SLOPE	X
BIAS VOLTAGE:	2.38 V	
OPTICAL OUTPUT:	7.10 dBm	

Choose one of three preset Dither Frequencies

Select your own Dither Frequency here

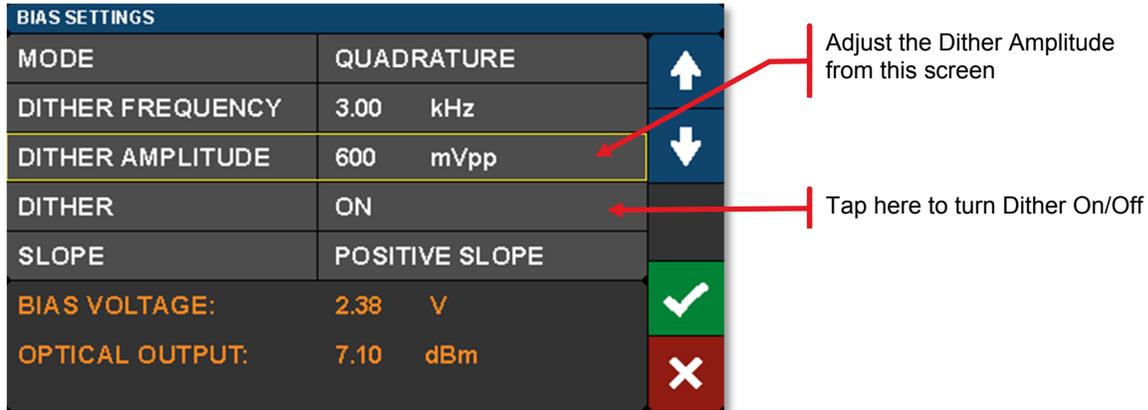
The bias control circuit uses an AC dither tone to stabilize the bias point of the modulator. The graphic below shows how it works:



A small AC voltage is applied to the DC bias so that the optical output is also slightly modulated. Both the amplitude and the frequency of AC dither tone can be selected by the user. The modulated optical output is detected by a frequency and phase sensitive detector which can then interpret whether the DC bias is at the correct level for the chosen set-point (Quad, Peak or Null). The DC bias voltage is then continuously adjusted to maintain the correct set-point.

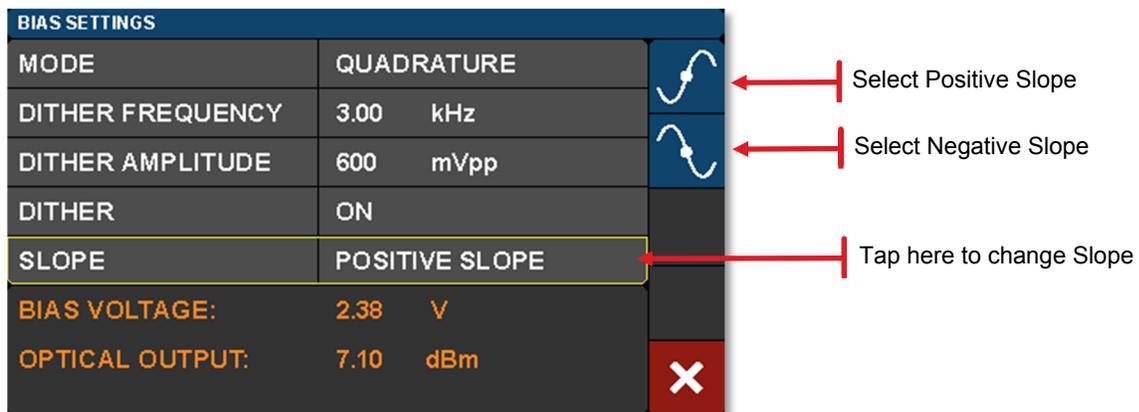
The frequency of the dither tone (under 10kHz) is usually well below the low frequency cut-off for the RF signal of interest, so it does not interfere. The dither tone can also be turned off if other methods of bias control are desired (e.g. manual control, or input/output ratio control as described later).

The dither tone frequency may be changed by tapping the Dither Frequency field. Standard frequencies are available on the blue buttons, or a custom frequency may be chosen by pressing User Define. The dither tone frequency usually has very little effect on the accuracy of the bias control, but in some cases a different frequency may work better or be desirable depending on the RF signal applied, or the specific application. The User Define button allows for the selection of an arbitrary frequency between 1 kHz and 10 kHz with 10 Hz resolution.



The dither tone amplitude can also be adjusted to any amplitude between 20 mV and 2 V with 1 mV resolution. Higher amplitude will typically be more stable in the presence of MZM drift and broadband RF signals, but larger dither tones also decrease SNR. If the amplitude is too low, the MZM bias may not stay locked. Typically, a value between 300 mV and 500 mV is a good starting point.

In applications where the highest SNR is desired, there is also the option to disable the dither tone. This allows the user to quickly turn the dither off, perform a measurement requiring low noise, and then turn the dither back on. When the dither is turned off, the bias is simply held at the previous bias voltage. For longer term measurements without dither, you can switch to Manual Mode and use a constant ratio method for stabilizing the bias point. (See the Manual Mode section)



The Quadrature mode also allows the user to select between two operating points by selecting the Slope field. Positive slope is the non-inverting operating point where increasing voltage on the MZM results in increasing optical output power. Negative slope is the inverting operating point where increasing voltage on the MZM results in decreasing optical output power. This effectively changes the phase of the response function.

5.3.2. Peak Mode

The Peak Mode adjusts the DC bias voltage so the transmission is centered at a nearby transmission maximum. In this mode only dither frequency and amplitude settings are available. These controls & settings are the same as previously described for the Quadrature mode.

Peak and Null modes are often used to obtain phase modulation and non-linear frequency doubling. The optical phase is 180deg shifted on opposite sides of the Null point.

BIAS SETTINGS		
MODE	PEAK	BIAS ON
DITHER FREQUENCY	3.00 kHz	RESET AUTO BIAS
DITHER AMPLITUDE	600 mVpp	
BIAS VOLTAGE:	2.38 V	
OPTICAL OUTPUT:	7.10 dBm	
		HELP
		HOME

Bias control in Peak mode; Tap to change

Tap here to reset the Bias calibration and return to Peak mode.

5.3.3. Null Mode

The Null Mode adjusts the DC bias voltage so the transmission is centered at a nearby transmission minimum. In the Null mode only dither frequency and amplitude settings are available. These settings are the same as previously described for the Quadrature mode.

BIAS SETTINGS		
MODE	NULL	BIAS ON
DITHER FREQUENCY	3.00 kHz	RESET AUTO BIAS
DITHER AMPLITUDE	600 mVpp	
BIAS VOLTAGE:	2.38 V	
OPTICAL OUTPUT:	7.10 dBm	
		HELP
		HOME

Bias control in Null mode; Tap to change

Tap here to reset the Bias calibration and return to Null mode.

5.3.4. Manual Mode

The Manual mode allows the user to bias the modulator at any point of the transmission function desired. Manual mode offers two modes of operation: 1) Constant Bias, and 2) Constant Ratio. In both of these modes, the dither function is not active, and the controller uses different techniques to hold the bias steady.

BIAS SETTINGS		
MODE	MANUAL	BIAS ON
BIAS SET POINT	2.38 V	RESET
HOLD	CONSTANT BIAS	AUTO BIAS
BIAS VOLTAGE:	2.38 V	
OPTICAL OUTPUT:	7.10 dBm	
		HELP
		HOME

Bias control in Manual mode; Tap here to change mode.
 Tap here to adjust Bias voltage.
 Tap here to select Hold mode: Constant Bias or Constant Ratio

Constant Bias is the most basic mode of operation and will apply a user selected DC voltage to the MZM. This can be useful for performing brief measurements that only take a few minutes. During longer duration experiments, the MZM is more likely to drift.

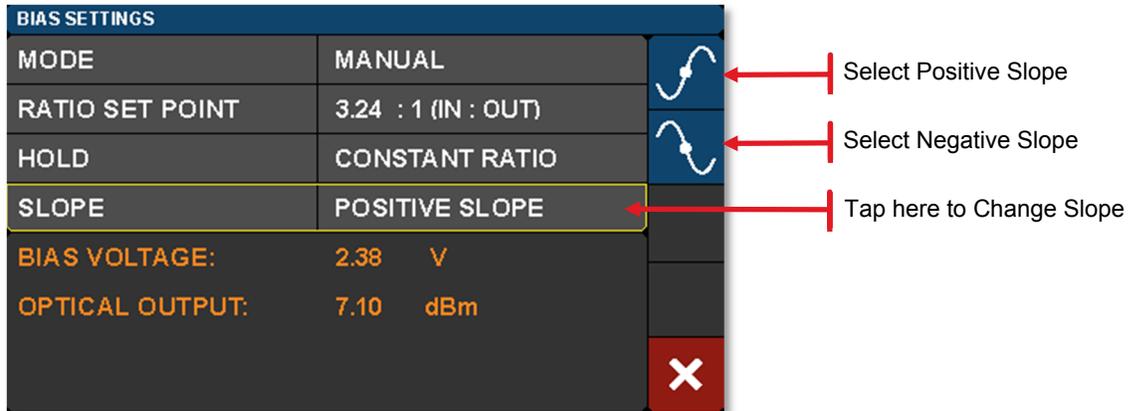
The Constant Ratio mode employs active control of the MZM bias, but without using a dither tone. As a result, it can achieve superior SNR compared to the Quadrature mode. This mode is recommended for analog signals or higher level Pulse-Amplitude Modulation (PAM) formats.

Constant Ratio works by holding the MZM ratio of input light (at Mon-1) to output light (at Mon-2) at a constant value (typically at or close to Quadrature). Note that it does NOT take into account the insertion loss of the MZM. Therefore, the user must have some knowledge of the IL between the Monitors. For example. If the modulator has an IL of 3 dB, then the I/O ratio at maximum transmission is already 2:1. To bias the modulator at the 50% point, the ratio must be doubled to 4:1. The MZM insertion loss is listed in the specifications.

BIAS SETTINGS		
MODE	MANUAL	↑
RATIO SET POINT	3.24 : 1 (IN : OUT)	↓
HOLD	CONSTANT RATIO	STEP 0.10
SLOPE	POSITIVE SLOPE	
BIAS VOLTAGE:	2.38 V	✓
OPTICAL OUTPUT:	7.10 dBm	✗

Tap here to manually adjust the modulator transmission ratio in Constant Ratio mode.
 This is the ratio of modulator input power to output power.

In the Constant Ratio mode there is an option to select between the two available operating regions by selecting the Slope field. Positive slope is the non-inverting operating point where increasing voltage on the MZM results in increasing optical output power. Negative slope is the inverting operating point where increasing voltage on the MZM results in decreasing optical output power.



When switching to one of the Manual modes from a different bias mode, the Manual mode set point is automatically calculated to keep the MZM at the same location on the transmission function. For example, in order to switch to Constant Ratio mode at the Quadrature location, follow these steps:

- Turn the bias on, and choose Quadrature mode.
- Wait for the green indicator dot to stop blinking (indicating the bias is locked at quadrature)
- Optional: For greater accuracy at this point, slowly reduce the dither tone amplitude to ~100 mV in order to remove errors that can occur due to second order effects with a large dither tone. Make sure the green dot is not blinking
- Now change the bias mode to Manual and select Constant Ratio.
- The instrument will calculate the ratio to keep the MZM biased at the Quadrature location.
- From here, the ratio set point can be adjusted to further tune performance.

5.4. Variable Optical Attenuator Settings Page

To get to the Variable Optical Attenuator (VOA) Settings page tap in the VOA monitors pane on the Home page. The VOA provides the means for adjusting and stabilizing the output power after the modulator. **Note that the power measurement units for the entire interface are set on this page.**

The VOA can operate in either of two modes: 1) Constant Attenuation, and 2) Constant Output Power.

VARIABLE OPTICAL ATTENUATOR SETTINGS		
MODE	CONST ATTENUATION	ATTEN
ATTENUATION	1.0 dB	
POWER UNITS	dBm	OUT
ATTENUATION:	1.1 dB	
LASER INPUT:	13.35 dBm	
MODULATOR OUTPUT:	8.25 dBm	
OPTICAL OUTPUT:	7.10 dBm	X

Annotations:

- Tap here to change Modes (points to ATTEN)
- Tap here to select Constant Attenuation mode (points to OUT)
- Tap here to select Constant Output Power mode (points to X)

Constant Attenuation Mode maintains a fixed attenuation level between the output of the modulator and the output port on the front panel. Any fluctuations at the input are transferred to the output.

VARIABLE OPTICAL ATTENUATOR SETTINGS		
MODE	CONST ATTENUATION	VOA OFF
ATTENUATION	1.0 dB	
POWER UNITS	dBm	
ATTENUATION:	1.1 dB	
LASER INPUT:	13.35 dBm	
MODULATOR OUTPUT:	8.25 dBm	HELP
OPTICAL OUTPUT:	7.10 dBm	HOME

Annotations:

- VOA in Constant Attenuation mode (points to VOA OFF)
- Tap here to change attenuation level (points to 1.0 dB)
- Tap here to change units for power measurement (points to dBm)

Constant Output Power Mode acts as a stabilizer by holding the final optical power constant independent of input fluctuations (within controllable limits such as input power and attenuation).

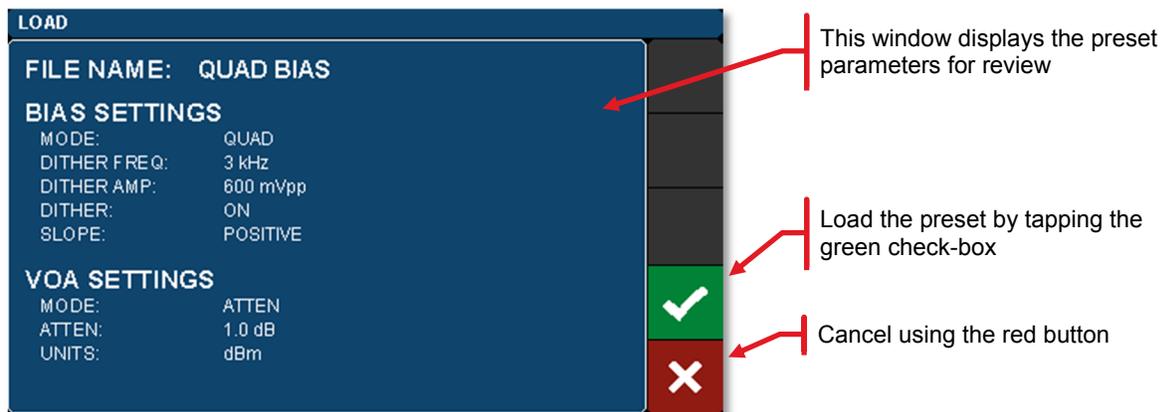
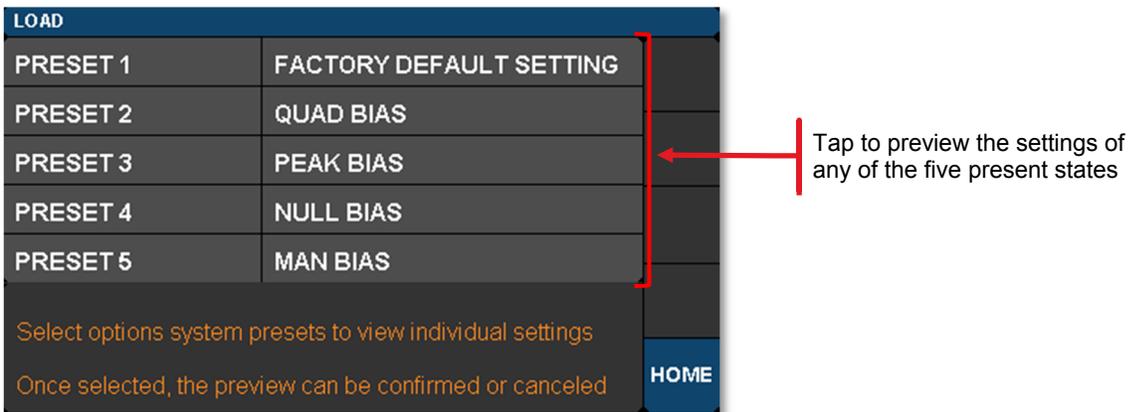
VARIABLE OPTICAL ATTENUATOR SETTINGS		
MODE	CONST OUTPUT	VOA ON
OUTPUT POWER	0.0 dBm	
POWER UNITS	dBm	
ATTENUATION:	1.1 dB	
LASER INPUT:	13.35 dBm	
MODULATOR OUTPUT:	8.25 dBm	HELP
OPTICAL OUTPUT:	7.10 dBm	HOME

Annotations:

- VOA in Constant Output Power mode (points to VOA ON)
- Tap here to adjust output power (points to 0.0 dBm)
- Not enough power to reach the set point (points to 7.10 dBm)
- Loss of VOA calibration due to low power (points to POWER LIMITED and POWER LOW)

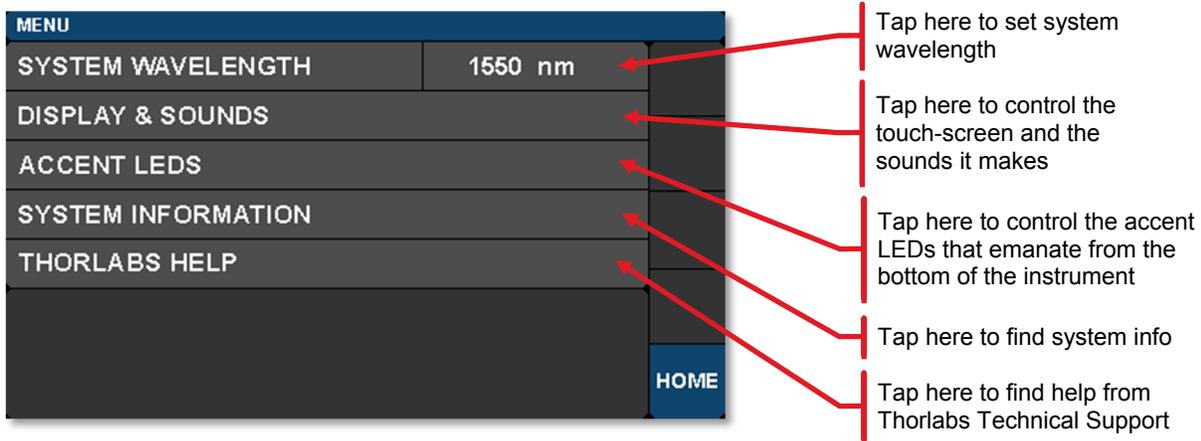
5.5. Load Page

To get to this page, tap the blue Load button on the Home page. The Load page allows the user to revert back to the factory default settings. Future firmware revisions will have the ability to store and load instrument states defined by the user.



5.6. Menu Page

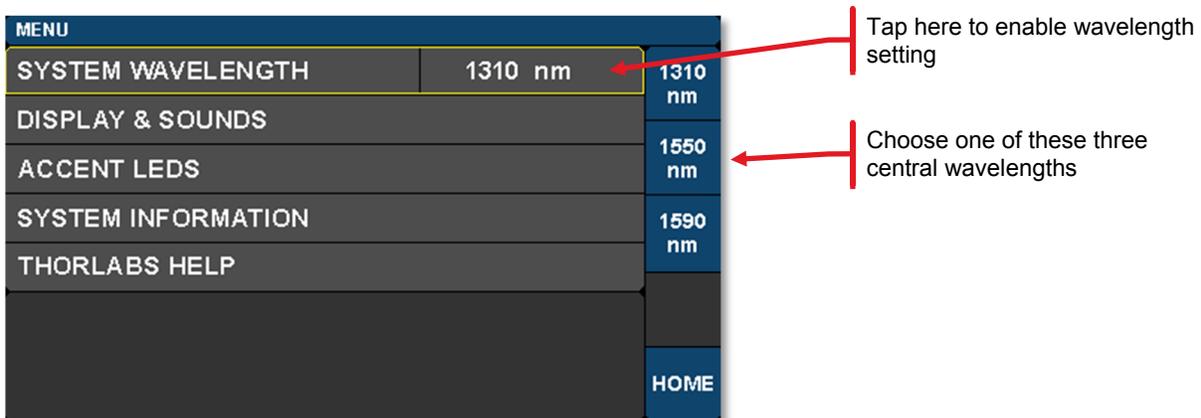
To get to this page tap the blue Menu button on the Home page. The Menu page has links to several pages that allow the user to control the display, sounds, lights, and get help information. The following sections describe these functions in more detail.



5.6.1. System Wavelength

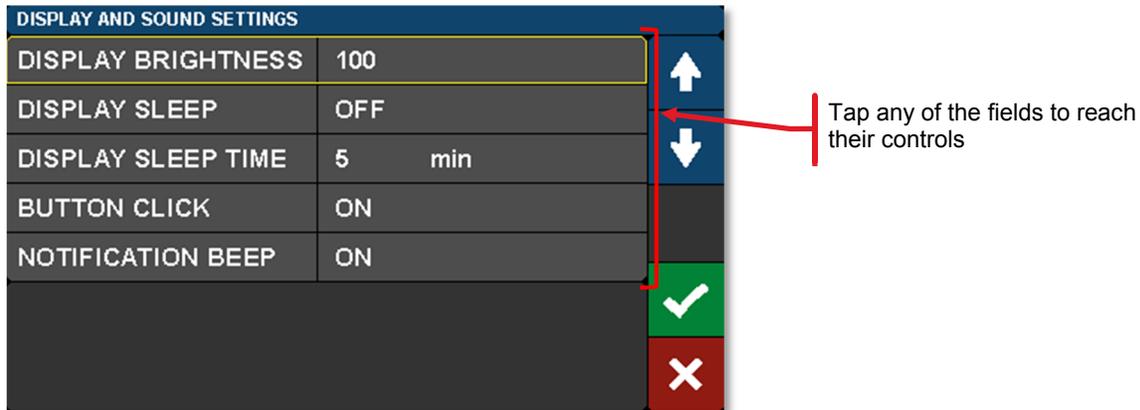
Path here: Home > Menu > System Wavelength

The instrument can be used at wavelengths anywhere between 1250nm and 1605nm, but the power monitors are only calibrated at three main wavelengths: 1310nm, 1550nm, and 1590nm. These wavelengths represent the centers of the O-Band, C-Band, and L-Band and therefore provide the user with accurate power readings at or near those wavelengths. The system wavelength should be set to one of the wavelengths that is closest to that of the laser source used with the modulator.



5.6.2. Display and Sound Settings Page

Path here: Home > Menu > Display & Sounds.

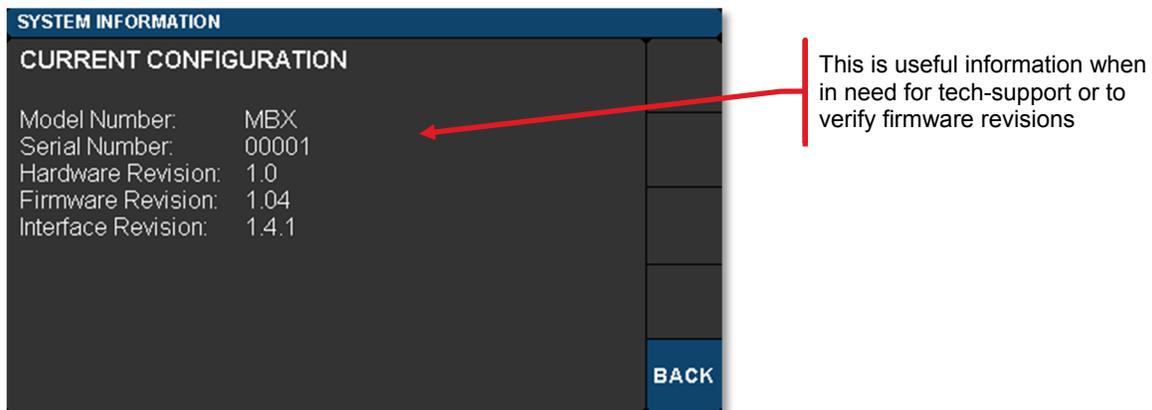


- DISPLAY BRIGHTNESS controls the overall brightness of the touch-screen display
- DISPLAY SLEEP TIME controls how long the touch-screen display is visible before it sleeps
- BUTTON CLICK toggles the sound produced when tapping buttons (On/Off)
- NOTIFICATION BEEP toggles the sound associated with certain on screen notifications (On/Off)

5.6.3. System Information Page

Path here: Home > Menu > System Information.

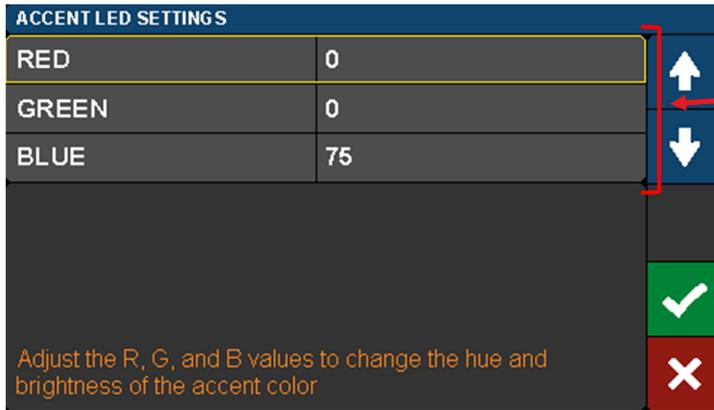
The System Information page displays the installed hardware and software versions



5.6.4. Accent LED Settings Page

Path here: Home > Menu > Accent LEDs

The accent LED settings control the intensity of the color LEDs that emanate from the bottom of the instrument. These can be used for a variety of purposes. Their primary function, however, is to look cool. You can set them to your favorite color.

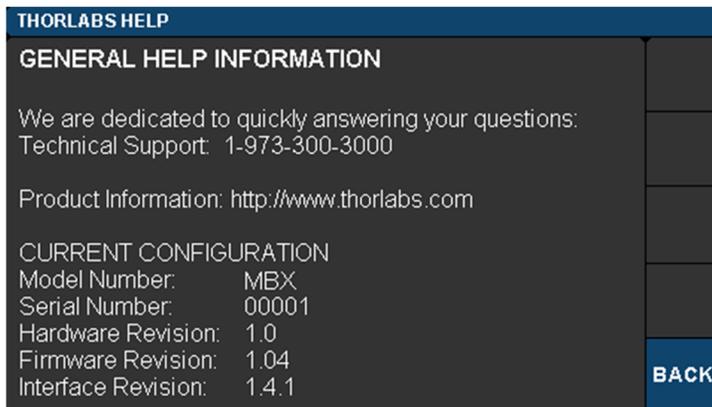


Tap any of the three color fields to access the up/down controls. Learn to mix colors!

5.6.5. Thorlabs Help Page

Path here: Home > Menu > Thorlabs Help

The Thorlabs Help page displays the Tech Support phone number, Thorlabs web site, and the installed hardware and software versions. This information will be useful when speaking with Tech Support.



Chapter 6 Specifications

All Specifications are at 1550 nm and 25 °C ambient temperature, unless otherwise noted.

6.1. General System Specifications

Parameter	Values	Notes
Optical Input Power	20 dBm Max	22 dBm Absolute Max; From External Laser
Wavelength Range	1250 nm – 1610 nm	
Power Calibration Points	1310 nm, 1550 nm, 1590 nm	
Bias Voltage Range	±10 V	
Bias Modes	Quad/Peak/ Null	Quad Pos & Neg Slope
Dither Freq Range	1 kHz to 10 kHz	Adjustable
Dither Amplitude Range	20 mV to 2 V	Adjustable
Automatic mode settling time	1 - 5 secs	Typical

6.2. Power & Environmental Specifications

Parameter	Min	Max
Main AC Voltage	100 VAC	250 VAC
Power Consumption	-	60 VA
Line Frequency	50 Hz	60 Hz
Operating Temperature	10 °C	40 °C
Storage Temperature	0 °C	50 °C
Humidity	5% RH	85% RH

6.3. Internal Control Specifications (at power calibration points)

Parameter	Typical	Notes
Power Monitor Accuracy	±0.5 dBm	All Monitors
Power Monitor Resolution	0.01 dBm	All Monitors
Power Monitor Insertion Loss	0.1 dB Typical	Per Monitor
VOA Insertion Loss	0.4 dB Typical	-
VOA Response Time	1 sec	-

Chapter 7 General Purpose I/O, RS-232, and USB Connections

The back panel has connectors for monitor and control functions, as well as for upgrading the firmware. Both the RS-232 and the USB connections can be used for remotely controlling the MBX Bias Controller via SCPI type serial commands. Which connector to choose for remote control operation depends on the demands of the application and the user's preference. See the remote control user guide (RCUG), which can be downloaded from <https://www.thorlabs.com/manuals.cfm>, for information about the commands and connecting the unit to a PC.

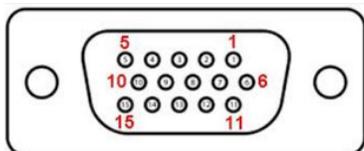
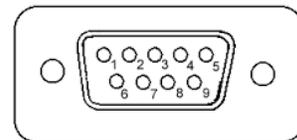
The most recent firmware and remote control software tool are available through Thorlabs' website: visit https://www.thorlabs.com/navigation.cfm?Guide_ID=2191 and enter the Item # into the search field. The instrument's firmware can be updated by uploading the new version from a PC via the USB port. Thorlabs' technical support can provide up-to-date information on available firmware revisions and control functions.

The 15-pin I/O connector provides outputs from the power monitors in the optical path (see the block diagram in Chapter 3). The power monitors provide a voltage that is proportional to the optical power with one of two gain settings. These values are available on the I/O DB15 connector. The gain setting for each monitor is determined by software, and reported on the corresponding Gain Indicator pins. 0.0 V indicates Low Gain (40 V/W) and 3.3 V indicates High Gain (4000 V/W). Maximum output voltage at the monitor pin is less than 12 V (into a high impedance). Power monitor bandwidth is limited to about 150 Hz.



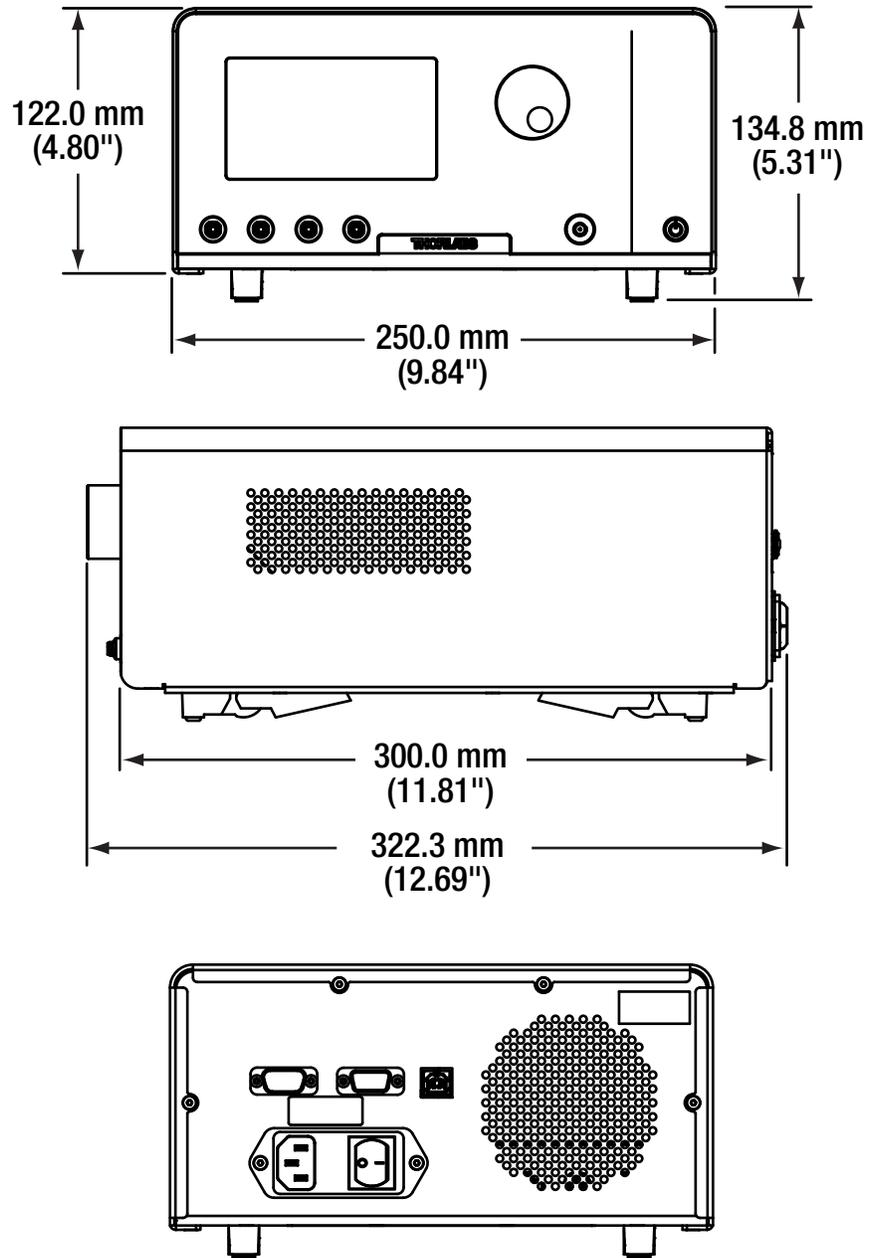
I/O Conn.	Pin #	Description
HD DB15	1	Power Monitor 1
HD DB15	2	Power Monitor 2
HD DB15	3	Power Monitor 3
HD DB15	4	Reserved for Future Use
HD DB15	5	Analog Ground
HD DB15	6	Analog Ground
HD DB15	7	Analog Ground
HD DB15	8	Analog Ground
HD DB15	9	Analog Ground
HD DB15	10	Analog Ground
HD DB15	11	Reserved for Future Use
HD DB15	12	Reserved for Future Use
HD DB15	13	Mon 1 Gain Indicator
HD DB15	14	Mon 2 Gain Indicator
HD DB15	15	Mon 3 Gain Indicator

RS-232	Pin #	Description
DB9	1	N/C
DB9	2	RS232 Input
DB9	3	RS232 Output
DB9	4	N/C
DB9	5	Digital Ground
DB9	6	N/C
DB9	7	N/C
DB9	8	N/C
DB9	9	N/C



Chapter 8 Mechanical Drawings

8.1. MBX



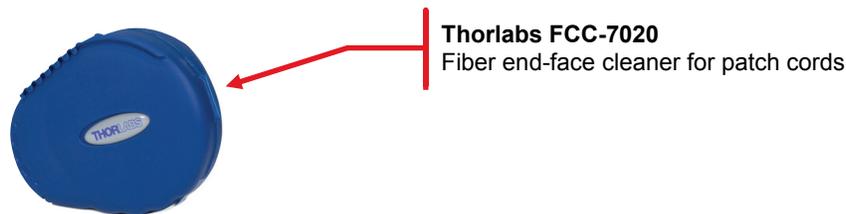
Chapter 9 Maintenance, Repair & Fuses

9.1. Maintenance & Repair

The instrument should not need regular maintenance by the user. If necessary the display, housing, and front panel can be cleaned using a soft cloth moistened with normal, mild glass cleaner. Do not use any chemical solvents or harsh cleaners on the display. Do not spray any cleaning solutions directly onto any part of the unit.

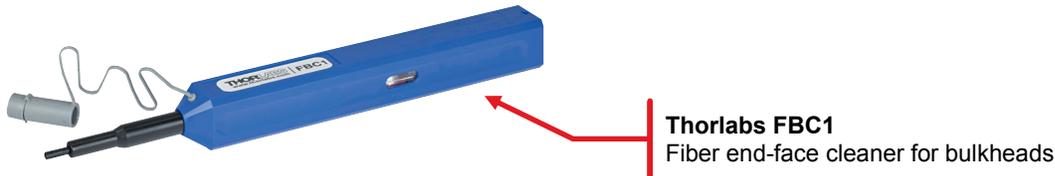
The instrument does not contain any modules that can be repaired by the user. If a malfunction occurs, please contact Thorlabs Technical Support and arrangements will be made to investigate the problem. Do not remove the cover. There are no user serviceable components inside.

Optical patch cords used to connect to the front panel of the instrument should have their end faces cleaned every time a new connection is made. The end faces of the internal fiber connectors can easily be damaged by the use of dirty fiber ends. If damage occurs, the instrument will need to be sent back for repair. We suggest using a fiber end-face cleaning product such as the Thorlabs FCC-7020 shown below. Alternatively, a lint-free cloth moistened with isopropyl alcohol or methanol can be used. Never use acetone.



Thorlabs FCC-7020
Fiber end-face cleaner for patch cords

The optical connectors on the front panel may be cleaned using a 2.5 mm bulkhead cleaner such as the Thorlabs FBC1. This allows the user to clean the fiber end-face without removing it from the internal bulkhead adapter.



Thorlabs FBC1
Fiber end-face cleaner for bulkheads

9.2. Replacement Parts

The following parts can be obtained by contacting Thorlabs Technical Support

- 1.25 A 250 VAC Fuse for Main Power
- Instrument IEC Main Power Cord
- Instrument Flip Foot

9.3. Replacing the Main Fuse

The system is protected by a main fuse located in the power entry module where the main power cable plugs into the back panel of the instrument. If the instrument does not appear to power-up, especially after a power outage or storm, you can check the condition of the main power fuse without removing the cover of the instrument by following the following steps.

1. Put the instrument in “Standby” mode by pressing the standby button on the front of the instrument. Wait until the button turns from green to amber.
2. Turn the power off using the switch on the back panel of the instrument.
3. Unplug the main power cable.
4. Carefully remove the fuse holder slide from the power entry module (use a flat screwdriver).



5. Investigate the fuse. This can be done with a simple continuity check. If in doubt, replace the fuse. A spare fuse is stored in the fuse holder. Additional replacement fuses can be purchased from Thorlabs. **Always use fuses of the same type as the original.**



6. Reinstall the fuse holder slide into the power entry module, taking care that it fully seats until the top is flush with the rest of the power entry module.
7. Plug the main power cable back into the unit and power on as described in the *Getting Started* section of the manual.

If the fuse blows repeatedly, it is likely that an internal failure has occurred. Do not attempt to bypass the fuse as this can create a dangerous situation that could further damage the instrument or harm personnel. In this case, please contact Technical Support for directions.

Chapter 10 Troubleshooting

General Troubleshooting

In case you experience any problems, below are a few checks to help in troubleshooting the problem. If you have any questions, please contact your local Thorlabs Technical Support office.

If the unit does not appear to turn on correctly, please check the following items:

- Ensure that the main AC receptacle is powered
- Ensure that main power cable is fully seated at both ends
- Ensure that rear power switch is in the “I” position
- Check the main power fuse (see Maintenance & Repair section)

The front panel standby button color also indicates certain conditions as follows:

Standby Button Color	Condition
Solid Green	Indicates normal ON state
Solid Amber	Indicates unit is in Standby Mode Press the button to turn the instrument ON
Blinking Green	Indicates the main AC power is unstable. When the AC power is restored, the instrument will return to the standby mode (amber)
Blinking Amber	Indicates the instrument is overheated. Make sure the fan is running and none of the vents are blocked. If there are no ventilation issues, then the box should cool itself and return to the standby. Do not operate, or leave the instrument in standby mode, in an environment above 40°C.
Blinking Amber/Green	Indicates the instrument is both overheated and the main AC power is unstable (see individual troubleshooting for these conditions above).
Fading Amber/Green	Indicates the instrument is in the firmware upgrade mode If this condition appears after attempting to upgrade the firmware, the update may have failed, or the unit may have been left in the update mode. Try running the firmware update again. This condition may have also been reached by holding down the standby button for a long time while turning on the power. In this case, turn the unit off, wait for a few seconds, and turn it back on. If this condition for any other reason, turn the unit off, wait for a few seconds, and turn it back on. If these attempts to recover continue to fail, the instrument's firmware may have been corrupted. Contact Tech Support for help.

If the optical power at any point of the system is lower than expected, always start by cleaning the optical fiber ends, as this is a very common issue when using single-mode fibers. Follow the suggestions provided in the Maintenance section of this manual.

Chapter 11 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self-contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 12 Declaration of Conformity



THORLABS

www.thorlabs.com

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs Inc.
 Of: 56 Sparta Avenue, Newton, New Jersey, 07860, USA

in accordance with the following Directive(s):

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:
 Model: **MBX1**

Equipment: **Modulator Bias Controller**

is in conformity with the applicable requirements of the following documents:

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013
EN 62471-1	Photobiological Safety of Lamps and Lamp Systems	2008

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed:  On: 12 August 2016

Name: Ann Strachan
 Position: Compliance Manager

CE¹⁶

EDC - MBX1 -2016-08-12

Chapter 13 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



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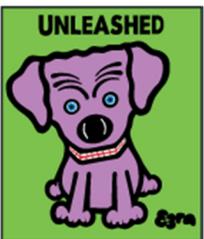
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