



MX10A or MX40A

12.5 Gb/s Modulator Driver

40 Gb/s Modulator Driver

User Guide


















Table of Contents

Chapter 1	Warning Symbol Definitions.....	1
Chapter 2	Safety	2
Chapter 3	Introduction.....	4
	3.1. <i>Description</i>	4
	3.2. <i>Intensity or Phase Modulators</i>	4
	3.3. <i>Parts List</i>	4
	3.4. <i>Block Diagram</i>	5
	3.5. <i>Front and Rear Panel Overview</i>	6
Chapter 4	Quick Start Guide	7
	4.1. <i>Hardware Set-up</i>	7
	4.2. <i>Controls on the Home Page</i>	8
	4.3. <i>Controls in the Settings Pages</i>	9
Chapter 5	Operating Instructions.....	10
	5.1. <i>The Modulator Transmission Function (Intensity Modulators Only)</i>	10
	5.2. <i>Control Loop Diagram</i>	10
	5.3. <i>Bias Settings Page (Intensity Modulators Only)</i>	11
	5.4. <i>Amplifier Settings Page</i>	17
	5.5. <i>Variable Optical Attenuator Settings Page</i>	19
	5.6. <i>Load Page</i>	20
	5.7. <i>Menu Page</i>	21
Chapter 6	Specifications	24
	6.1. <i>General System Specifications</i>	24
	6.2. <i>Power & Environmental Specifications</i>	24
	6.3. <i>Internal Control Specifications</i>	24
	6.4. <i>Internal Amplifier Specifications</i>	25
Chapter 7	General Purpose I/O, RS-232, and USB Connections.....	26
Chapter 8	Mechanical Drawings.....	27
Chapter 9	Maintenance, Repair & Fuses.....	28
	9.1. <i>Maintenance & Repair</i>	28
	9.2. <i>Replacement Parts</i>	28
	9.3. <i>Replacing the Main Fuse</i>	29
Chapter 10	Troubleshooting	30

Chapter 11	Regulatory	31
Chapter 12	Declaration of Conformity.....	32
Chapter 13	Thorlabs Worldwide Contacts.....	34

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.

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. A front panel grounding jack is provided for connection to a wrist strap.

**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 Introduction

3.1. Description

Thorlabs' High-Speed LiNbO₃ Modulator Drivers provide control for fiber-coupled, lithium-niobate, electro-optic modulators. Depending on the model, each driver is compatible with modulators that can operate at up to speeds of 12.5 Gb/s or 40 Gb/s. The drivers' internal circuitry enables bias control with peak, null, and quadrature set points. The drivers also include a series of power monitors at the laser input, modulator output, and final optical output, as well as a variable optical attenuator, for fully automatic monitoring and control of optical power along the entire optical path. The operational wavelength range 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.

The instrument 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.

NOTE: This manual covers both the **MX10A** and **MX40A** models, as their architectures are very similar. Differences are clearly noted in the following sections.

3.2. Intensity or Phase Modulators

These drivers can be used for either intensity or phase modulators. For intensity modulators, the unit provides a full complement of biasing options, both manual and automatic.

However, in the case of phase modulators, the DC biasing circuitry is not needed as it performs no function. In that case, the user is advised to simply leave the Bias Control functionality turned OFF. All other functions will operate normally.

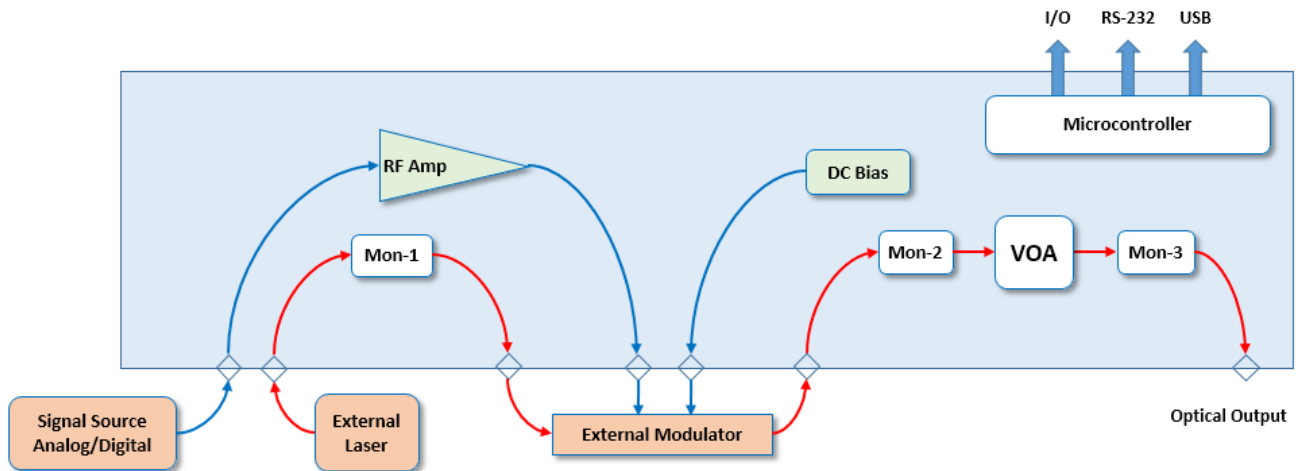
3.3. Parts List

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. MX10A or MX40A Modulator Driver 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

3.4. Block Diagram

These instruments provide all the electronics and control circuitry to bias and drive high-speed, fiber-coupled, intensity or phase modulators. The user supplies the laser source, the signal source, and the modulator of their choice. 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). 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.



3.5. Front and Rear Panel Overview



Feature	Description	MX10A	MX40A
Front Panel			
A	Touchscreen Display	-	-
B	Adjustment Knob	-	-
D	Grounding Jack	Banana	Banana
E	Laser Input	PM FC/PC	PM FC/PC
F	Laser Output to Modulator	PM FC/PC	PM FC/PC
G	Return from Modulator	FC/PC	FC/PC
H	Optical Output	FC/PC	FC/PC
J	Amplifier RF Output	SMA	2.92 mm
K	Bias Output	SMA	SMA
L	RF Input	SMA	2.92 mm
M	Standby Button	-	-
Back Panel			
N	I/O Port	DB-15	DB-15
O	Option Label	-	-
P	RS-232 Port	DB-9	DB-9
Q	USB Port	Type B	Type B
S	Power Connector	-	-
T	Fuse Tray	-	-
U	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. A front panel grounding jack is provided for connection to a wrist strap.

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.

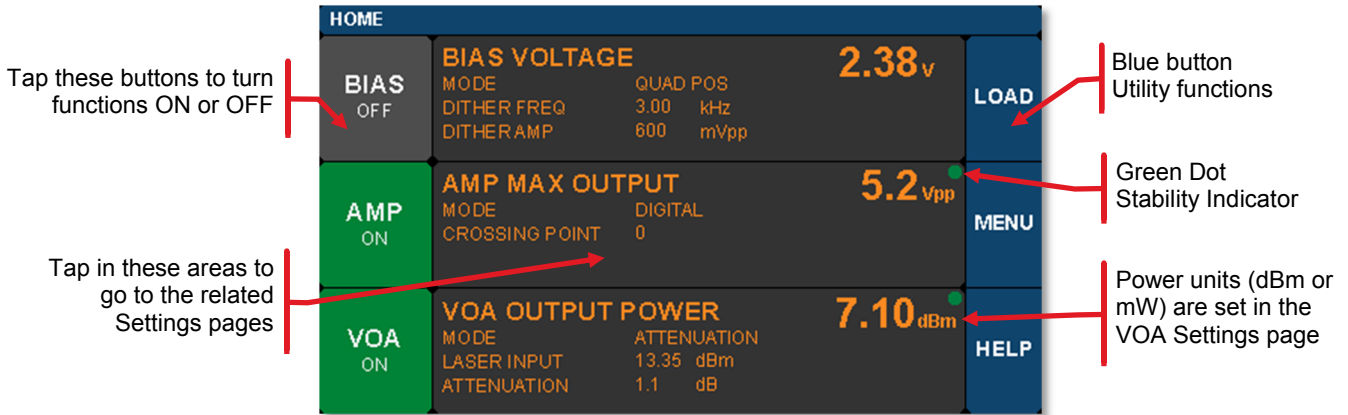


Turn on the unit by pressing the amber standby button on the front panel which will then turn green to indicate the unit is fully on. The touchscreen display will come up with a boot screen for about 5 seconds and then go to the home page. The unit will initialize in the factory default state with all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



4.2. Controls on the Home Page

The MX10A and MX40A can be fully controlled by using the resistive touchscreen display for all functions. You can use a 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.



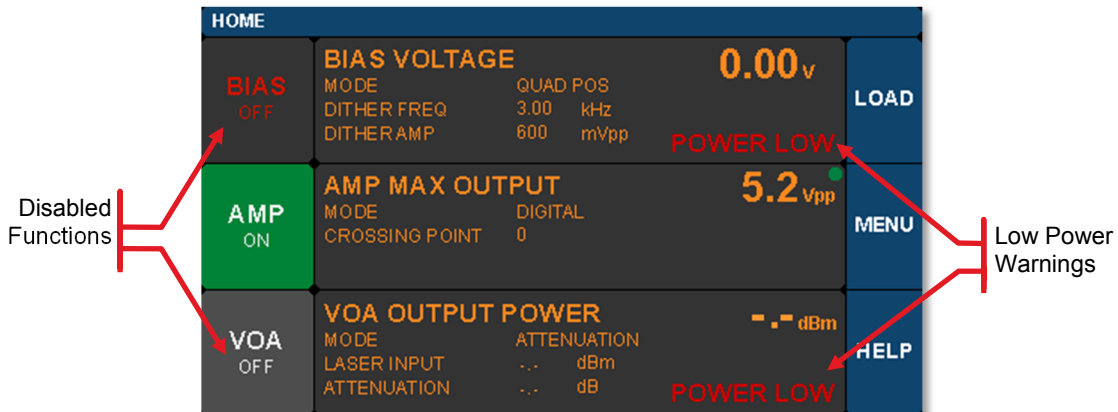
The Home screen (or dashboard) is organized into three main sections.

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.

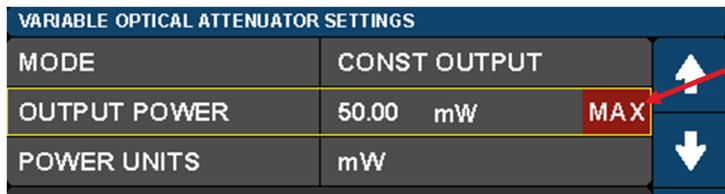
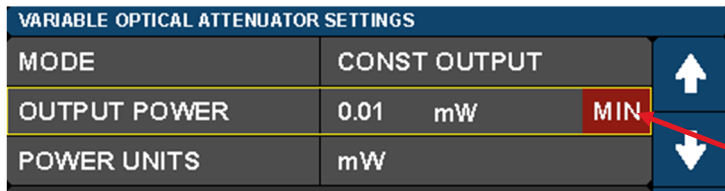
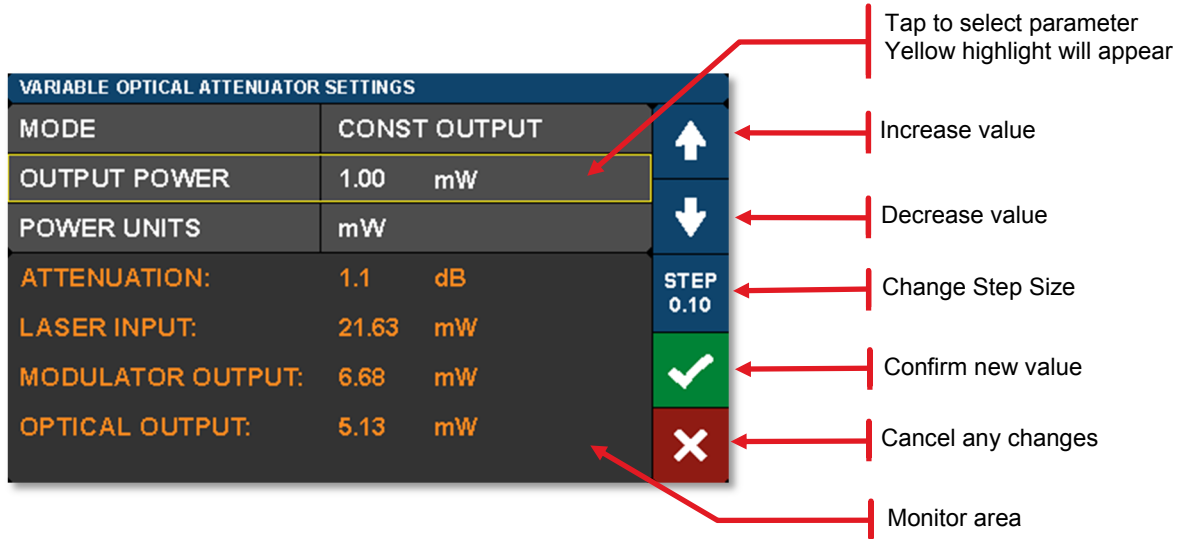


4.3. Controls in the Settings Pages

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.



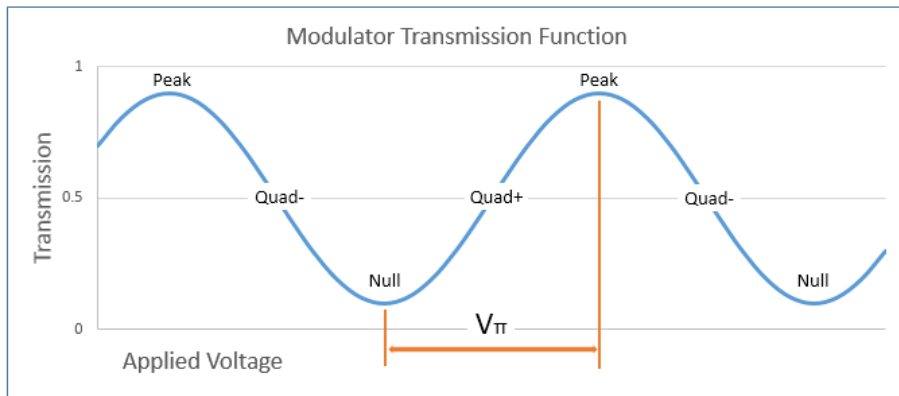
MIN / MAX warnings indicate that the setting limit for a particular parameter has been reached.

Chapter 5 Operating Instructions

5.1. The Modulator Transmission Function (Intensity Modulators Only)

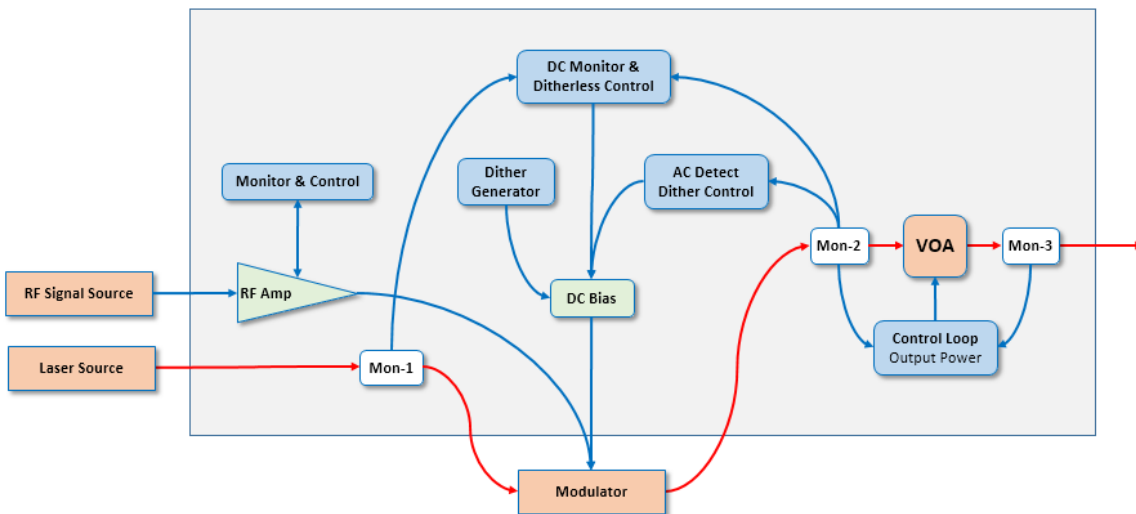
The intensity modulator (e.g. MZM) has a repetitive transmission function with applied voltage as can be seen in the diagram below. In order for it to work correctly, a DC bias voltage must be applied and maintained at the desired set point. The high-frequency, AC signal can then be applied to the modulator 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.



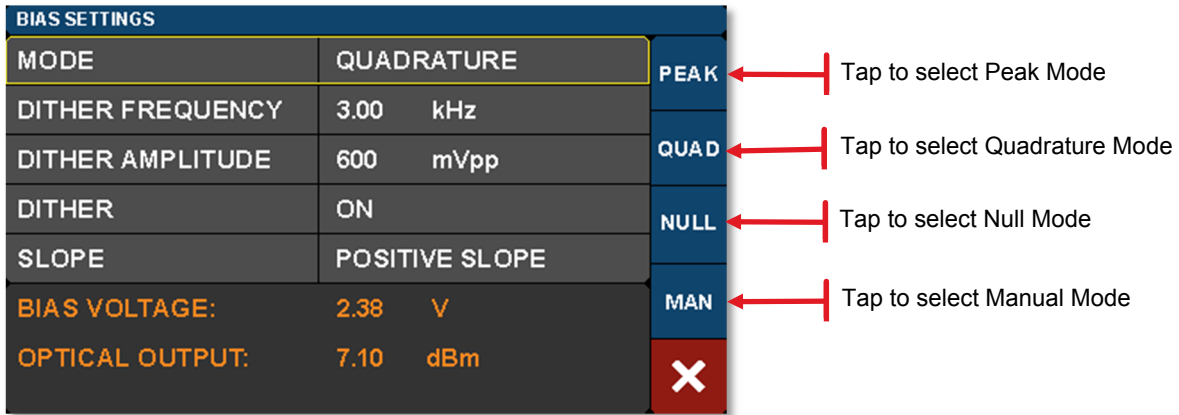
5.2. Control Loop Diagram

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. It will be helpful to refer to this diagram to gain a better understanding of the functionality of the unit as described in the upcoming sections of the manual.



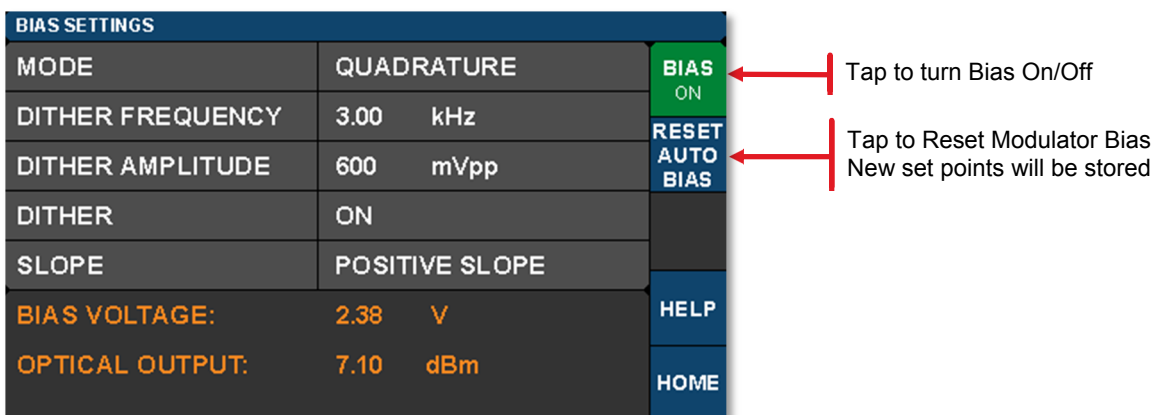
5.3. Bias Settings Page (Intensity Modulators Only)

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 modulator 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 modulator 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 modulator 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 modulator bias.

The first time you turn on the modulator Bias control, the instrument will perform a calibration routine to determine the approximate bias voltages required for the various modulator 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

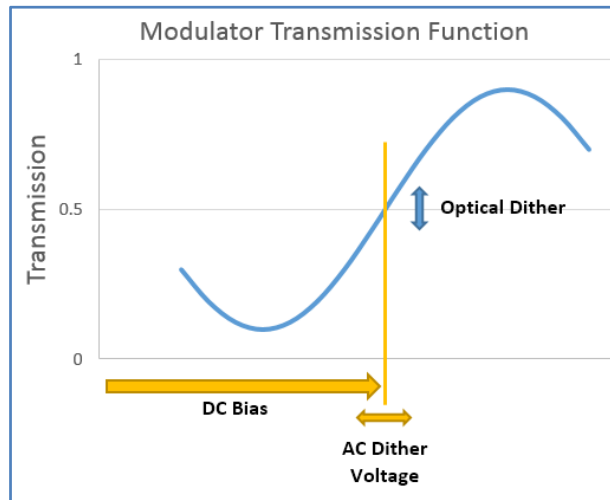
Quadrature is the default mode and biases the modulator at the 50% point on the modulator transmission curve (see figure). This is the recommended mode for digital signals such as On-Off-Keying (OOK) that require a high extinction ratio. The screen-shot below shows the parameters that can be controlled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

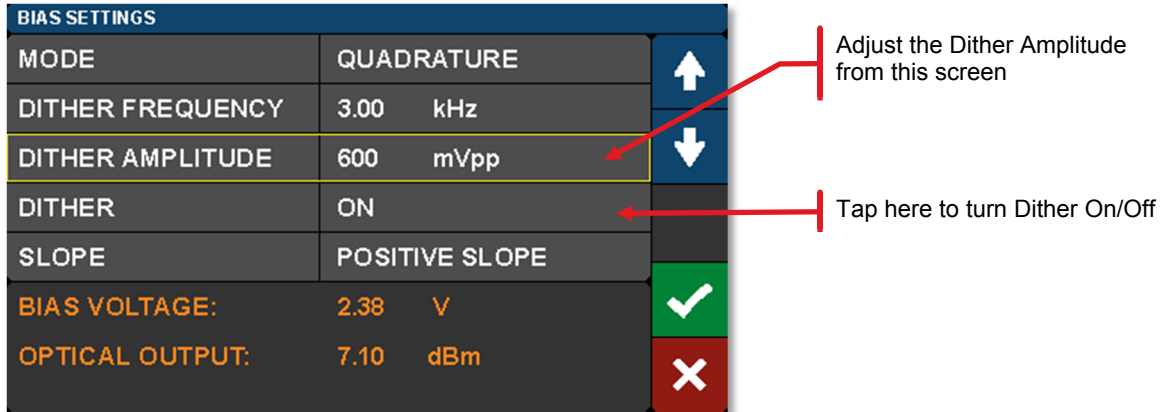
The bias control circuit uses an AC dither tone to stabilize the bias point of the modulator. The graphic below shows how it works:



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.

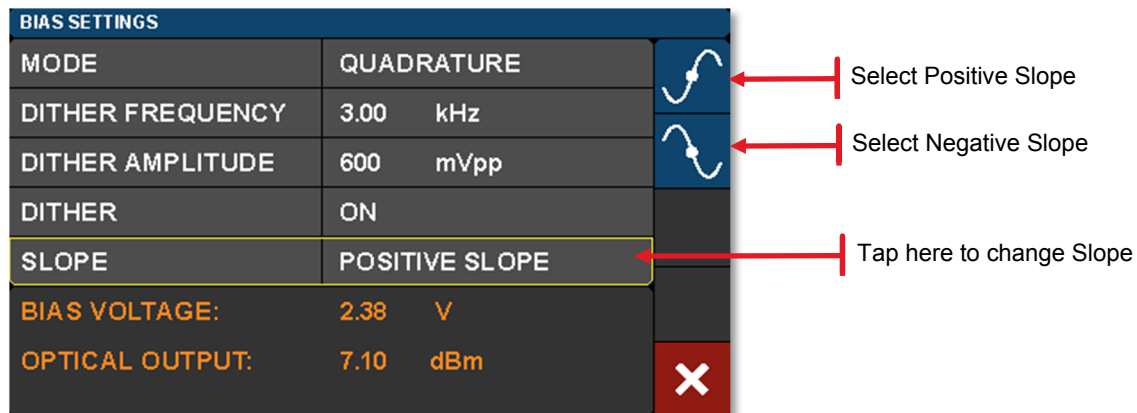
The frequency of the dither tone (under 10kHz) is usually well below the low frequency cut-off for the RF signal of interest, so it does not interfere. The dither tone can also be turned if other methods of bias control are desired (e.g. manual control, or input/output ratio control as described later).

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 modulator drift and broadband RF signals, but larger dither tones also decrease SNR. If the amplitude is too low, the modulator 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 modulator results in increasing optical output power. Negative slope is the inverting operating point where increasing voltage on the modulator 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 180° shifted on opposite sides of the Null point.

BIAS SETTINGS		
MODE	PEAK	BIAS ON
DITHER FREQUENCY	3.00 kHz	RESET
DITHER AMPLITUDE	600 mVpp	AUTO
BIAS VOLTAGE:	2.38 V	BIAS
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
DITHER AMPLITUDE	600 mVpp	AUTO
BIAS VOLTAGE:	2.38 V	BIAS
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 modulator. This can be useful for performing brief measurements that only take a few minutes. During longer duration experiments, the modulator is more likely to drift.

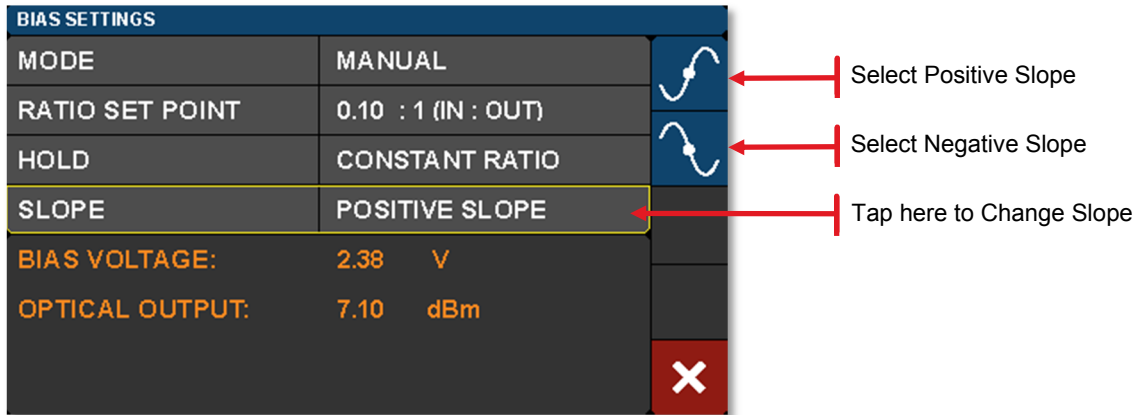
The Constant Ratio mode employs active control of the modulator bias, but without using a dither tone. As a result, it can achieve superior SNR compared to the Quadrature mode. This mode is recommended for analog signals or higher level Pulse-Amplitude Modulation (PAM) formats.

Constant Ratio works by holding the modulator 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 modulator. 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 modulator insertion loss is listed in the specifications.

BIAS SETTINGS		
MODE	MANUAL	↑
RATIO SET POINT	0.10 : 1 (IN : OUT)	↓
HOLD	CONSTANT RATIO	STEP
SLOPE	POSITIVE SLOPE	0.10
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 modulator results in increasing optical output power. Negative slope is the inverting operating point where increasing voltage on the modulator results in decreasing optical output power.



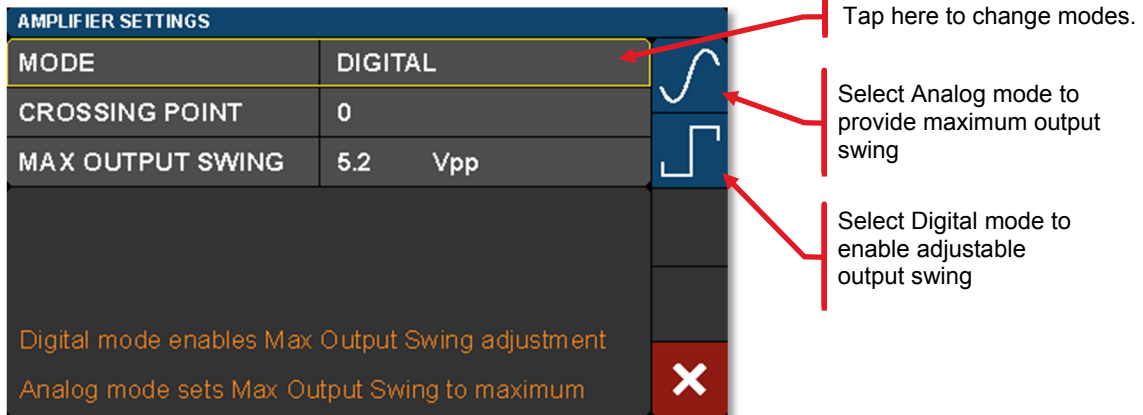
When switching to one of the Manual modes from a different bias mode, the Manual mode set point is automatically calculated to keep the modulator at the same location on the transmission function. For example, in order to switch to Constant Ratio mode at the Quadrature location, follow these steps:

- 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 modulator biased at the Quadrature location.
- From here, the ratio set point can be adjusted to further tune performance.

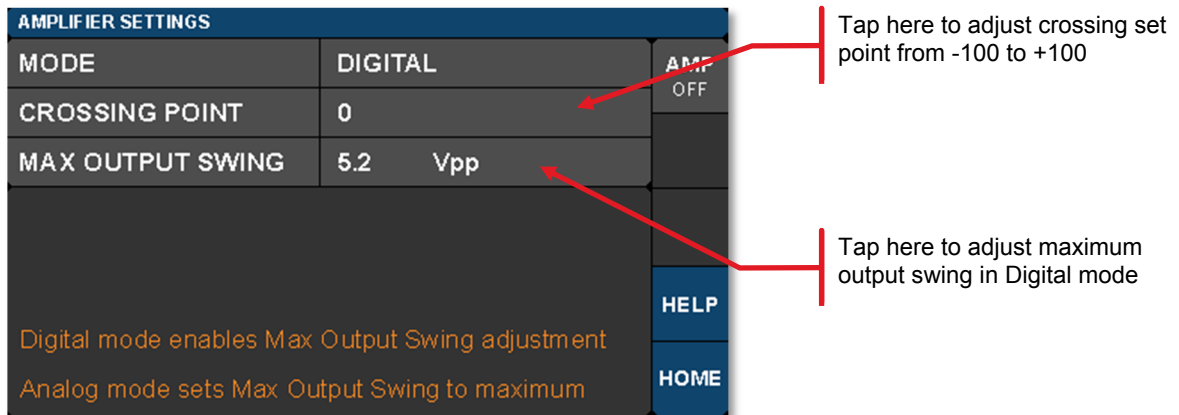
5.4. Amplifier Settings Page

To get to the Amplifier Settings page, tap on the Amplifier monitor pane on the Home page. The amplifier has a fixed gain that it applies to a user input signal. The signal is then routed to the RF input port of the modulator via the front panel loop-back cable.

There are two Modes for the amplifier: 1) Digital and 2) Analog, but both work with the same fixed gain. Analog mode simply sets the output swing of the amplifier to maximum.

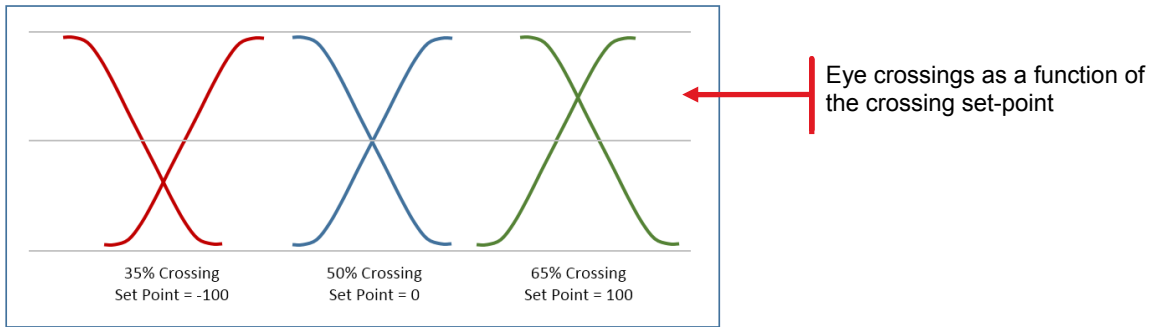


The default amplifier mode is Digital, in which case the output swing and crossing point can both be adjusted while the gain is held constant. This digital mode is recommended for OOK (On-Off Keying) digital signals. The V_{π} Swing button is provided to conveniently set the Max Output Swing to the optimum value to achieve high extinction modulation with the internal modulator.



The Max Output Swing field allows the user to set the peak-to-peak output voltage of the amplifier, assuming the amplifier input signal is large enough to cause the amplifier to start clipping. The Max Output Swing essentially controls the output amplitude at which the amplifier starts clipping. When operating in the digital mode, it is expected the user will supply a signal with sufficient input amplitude to cause the amplifier to clip.

The Crossing Point field allows the user to adjust the eye crossing point in the eye diagram as depicted in the diagram below. It provides an adjustment to optimize the bit-error-rate (BER) performance of a transmission link by adjusting the amplifier's internal threshold levels.



In the Analog mode, the Max Output Swing is locked at the maximum set point of 7.0 Vpp, so the amplifier can drive the modulator linearly with minimal distortion. However, in order to do this, the user must supply a signal with small enough amplitude so the amplifier does not saturate, or clip. This mode is recommended for analog signals or higher order modulation formats such as PAM4. The crossing point adjustment can usually be left at 0, but the user may find other values achieve lower distortion. Maximum linear input is listed in the specifications.

AMPLIFIER SETTINGS	
MODE	ANALOG
CROSSING POINT	0
MAX OUTPUT SWING:	7.0 Vpp
Digital mode enables Max Output Swing adjustment	
Analog mode sets Max Output Swing to maximum	

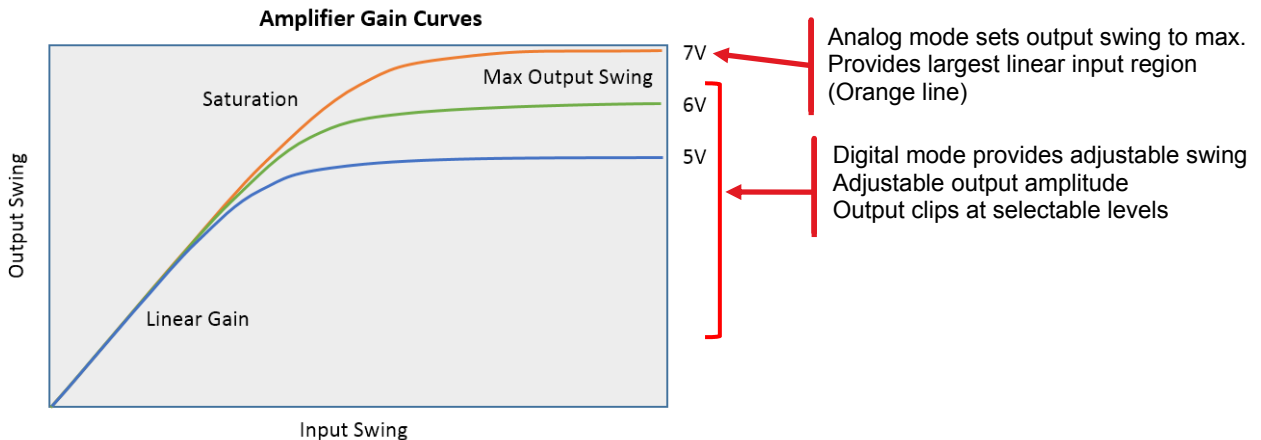
AMP OFF

HELP

HOME

Amplifier in Analog mode
This sets the output swing to its maximum value.

Only crossing point can be adjusted.



5.5. 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	OUT
POWER UNITS	dBm	
ATTENUATION:	1.1 dB	X
LASER INPUT:	13.35 dBm	
MODULATOR OUTPUT:	8.25 dBm	
OPTICAL OUTPUT:	7.10 dBm	

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 OUT)

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	HELP
POWER UNITS	dBm	
ATTENUATION:	1.1 dB	HOME
LASER INPUT:	13.35 dBm	
MODULATOR OUTPUT:	8.25 dBm	
OPTICAL OUTPUT:	7.10 dBm	

Annotations:

- VOA in Constant Attenuation mode (points to VOA OFF)
- Tap here to change attenuation level (points to ATTENUATION)
- Tap here to change units for power measurement (points to POWER UNITS)

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).

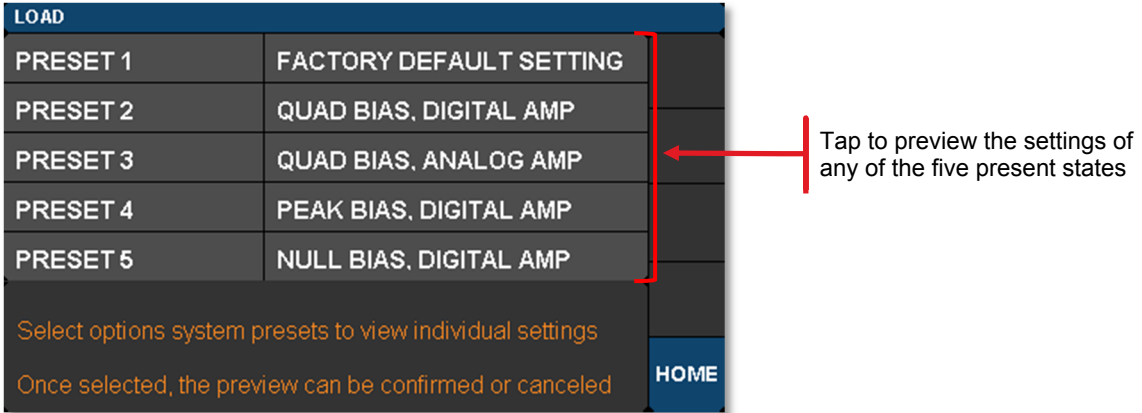
VARIABLE OPTICAL ATTENUATOR SETTINGS		
MODE	CONST OUTPUT	VOA ON
OUTPUT POWER	0.0 dBm	HELP
POWER UNITS	dBm	
ATTENUATION:	1.1 dB	HOME
LASER INPUT:	13.35 dBm	
MODULATOR OUTPUT:	8.25 dBm	
OPTICAL OUTPUT:	7.10 dBm	

Annotations:

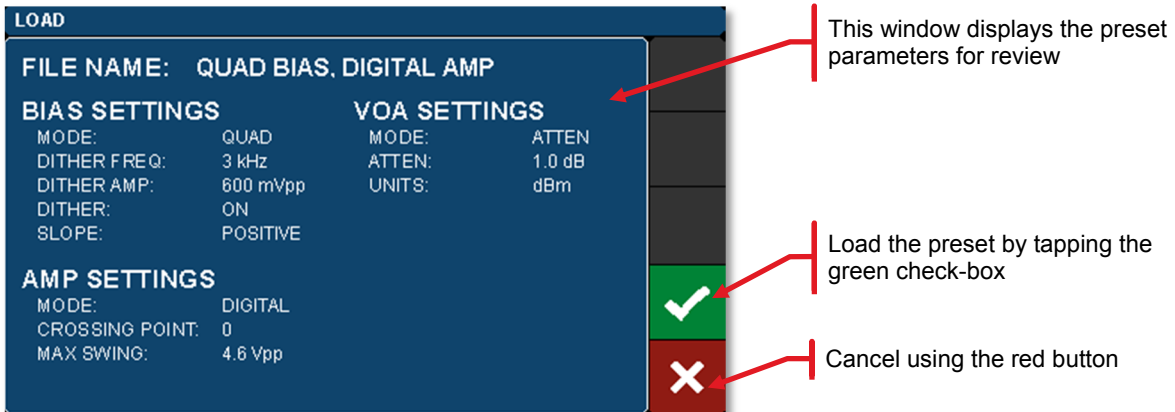
- VOA in Constant Output Power mode (points to VOA ON)
- Tap here to adjust output power (points to OUTPUT POWER)
- Not enough power to reach the set point (points to a green dot next to ATTENUATION)
- Loss of VOA calibration due to low power (points to POWER LIMITED and POWER LOW)

5.6. Load Page

To get to this page, tap the blue Load button on the Home page. The Load page has several instrument settings stored as presets for operating the instrument in different standard modes. Applying a preset is a fast way to put the instrument in a known state. Future firmware revisions will have the ability to store instrument states defined by the user as well.

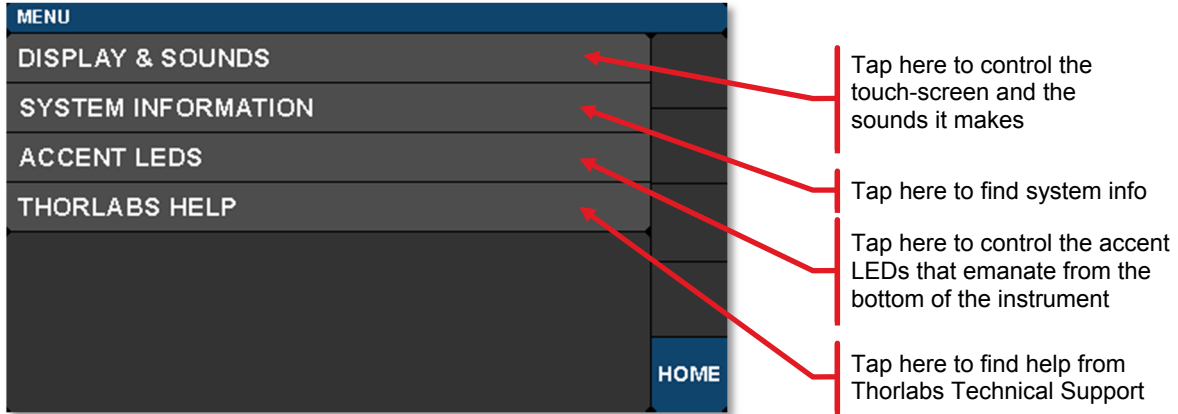


Tapping on one of the presets will bring up a window that displays all the stored settings. The user can then review the choice before confirming with the green check-mark.



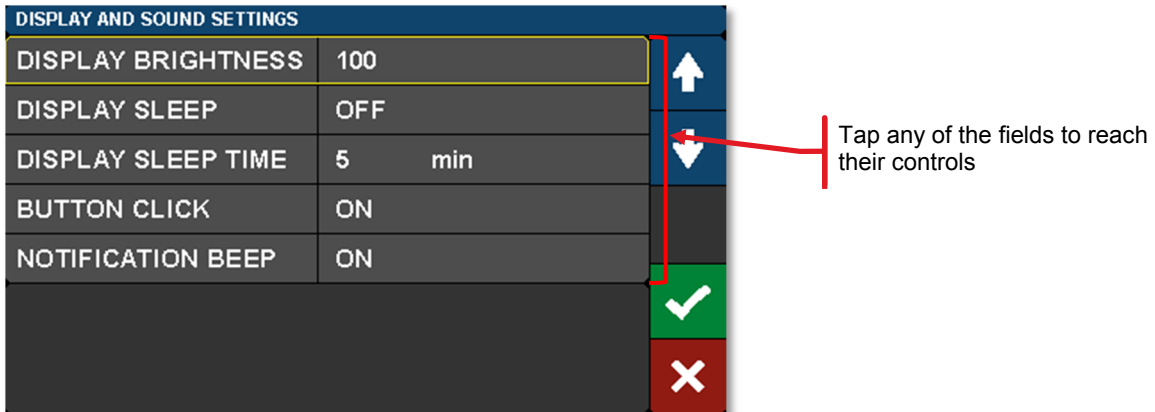
5.7. Menu Page

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.



5.7.1. 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 the touch-screen display is visible before it sleeps

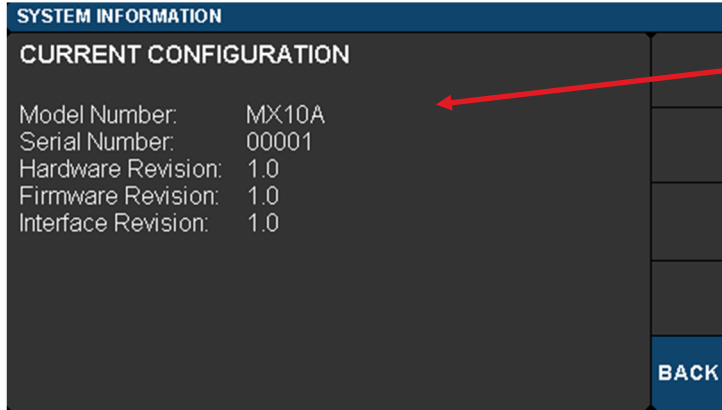
BUTTON CLICK toggles the sound produced when tapping buttons (On/Off)

NOTIFICATION BEEP toggles the sound associated with certain on screen notifications (On/Off)

5.7.2. System Information Page

Path here: Home > Menu > System Information.

The System Information page displays the installed hardware and software versions

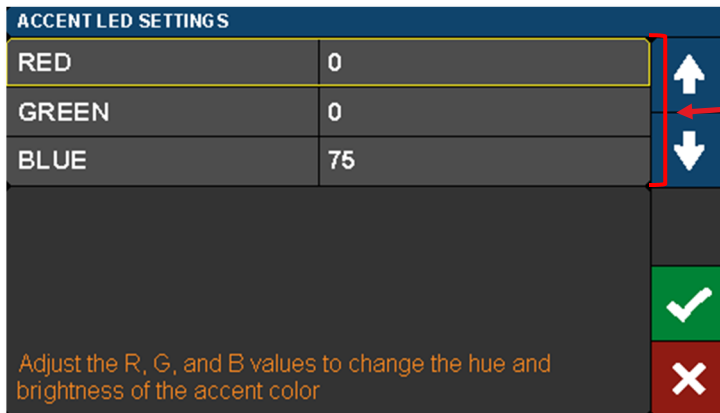


This is useful information when in the need for tech-support or to verify firmware revisions

5.7.3. 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.

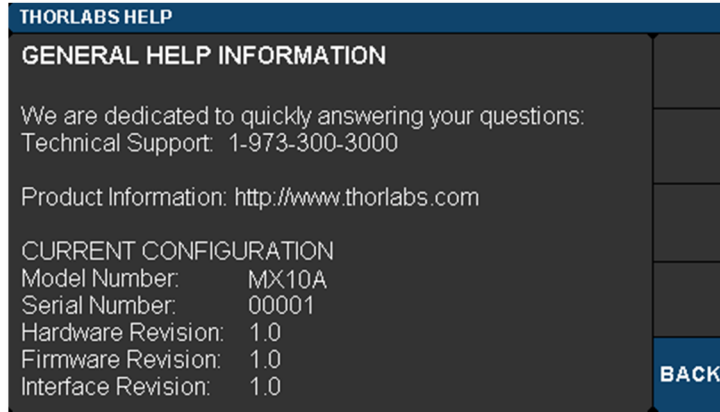


Tap any of the three color fields to access the up/down controls. Learn to mix colors.

5.7.4. 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. Specifications that are specific to the MX10A or MX40A will be marked as (MX10) or (MX40).

6.1. General System Specifications

Parameter	Typical Values	Notes
Max Optical Input Power	20 dBm	22 dBm Abs. Max
External Laser Wavelength Range	1525 nm – 1605 nm	-
Max Bit Rate (Digital)	12.5 Gb/s (MX10A) 40 Gb/s (MX40A)	Large, digital signal
Small Signal Bandwidth	7 GHz (MX10A) 20 GHz (MX40A)	Linear, analog response
Low Frequency Cutoff	100 kHz	-
Amplifier RF Input (Linear Response)	100 mV Max (MX10A) 120 mV Max (MX40A)	<5% THD at 1 GHz
Amplifier RF Input – MX10A (Digital Mode)	400 mV (Typ)	3.5 V Max, 4 V Abs. Max
Amplifier RF Input – MX40A (Digital Mode)	400 mV (Typ)	4 V Max, 6 V Abs. Max
Amplifier DC Input (Max)	±15 V (MX10A) ±10 V (MX40A)	Input is AC-Coupled
Amplifier RF Output Swing	3 V – 7 V	Adjustable Swing

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

Parameter	Typical	Notes
Power Monitors Accuracy	±0.5 dBm	@ 1550 nm
Power Monitors Resolution	0.01 dBm	-
Power Monitor Insertion Loss	0.1 dB Typical	per Monitor
VOA Insertion Loss	0.4 dB Typical	-
VOA Response Time	1 sec	-

6.4. Internal Amplifier Specifications

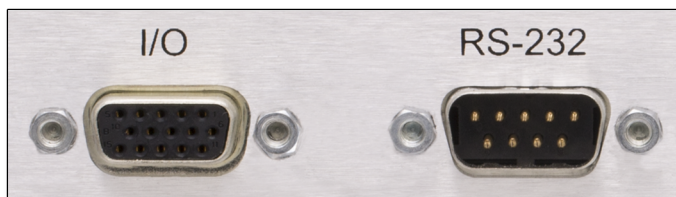
Parameter	Typical Values	Notes
Rise/Fall Time	35 ps (MX10A) 8 ps (MX40A)	Large signal, digital response
RF Amplifier Gain	34 dB (MX10A) 30 dB (MX40A)	
Small Signal Bandwidth	7 GHz (MX10A) 20 GHz (MX40A)	Linear, analog response
RF Amplifier Max Output Swing	3 V – 7 V	Adjustable
Low Frequency Cutoff	100 kHz	-
Electrical Return Loss	-10 dB	Any RF Port (to -3 dB BW)

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 MX10A and MX40A 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.

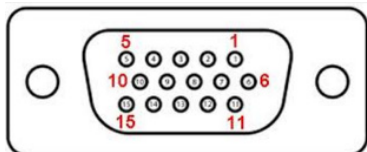
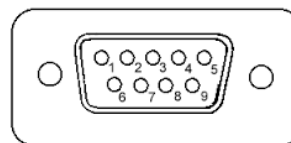
The most recent firmware and remote control software tool are available through Thorlabs' website: visit https://www.thorlabs.com/navigation.cfm?Guide_ID=2191 and enter the Item # into the search field. The instrument's firmware can be updated by uploading the new version from a PC via the USB port.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

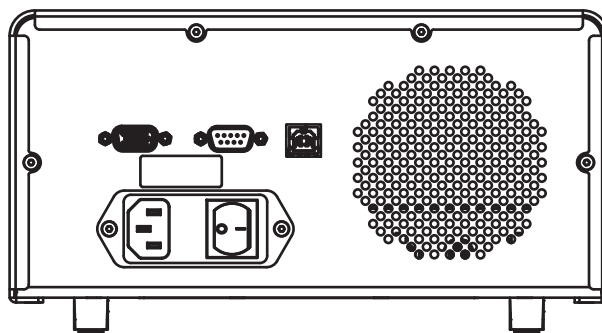
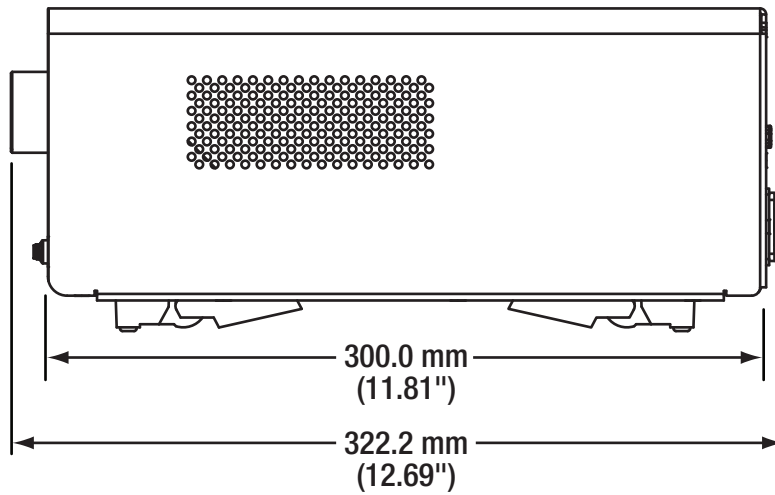
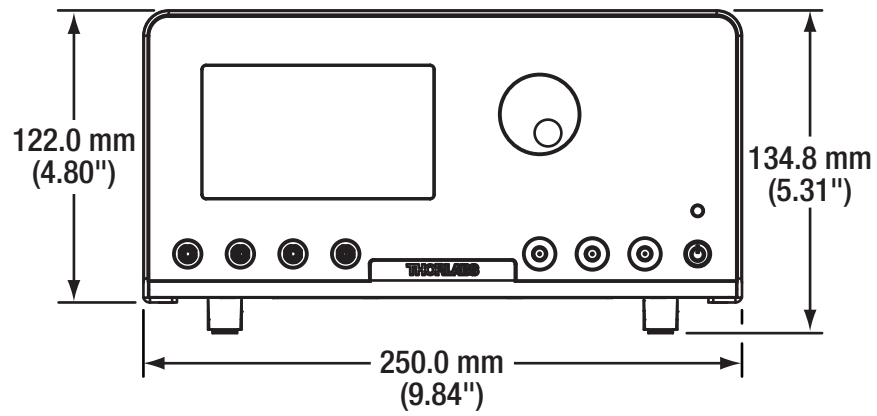


I/O Conn.	Pin #	Description
HD DB15	1	Power Monitor 1
HD DB15	2	Power Monitor 2
HD DB15	3	Power Monitor 3
HD DB15	4	Reserved for Future Use
HD DB15	5	Analog Ground
HD DB15	6	Analog Ground
HD DB15	7	Analog Ground
HD DB15	8	Analog Ground
HD DB15	9	Analog Ground
HD DB15	10	Analog Ground
HD DB15	11	Reserved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



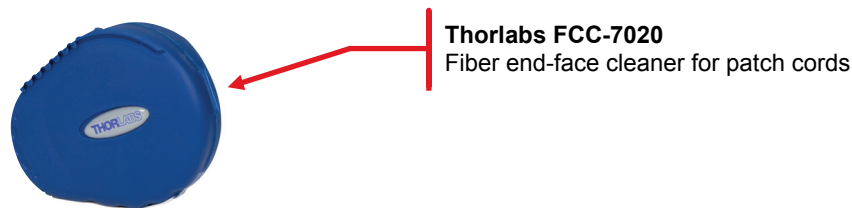
Chapter 9 Maintenance, Repair & Fuses

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.

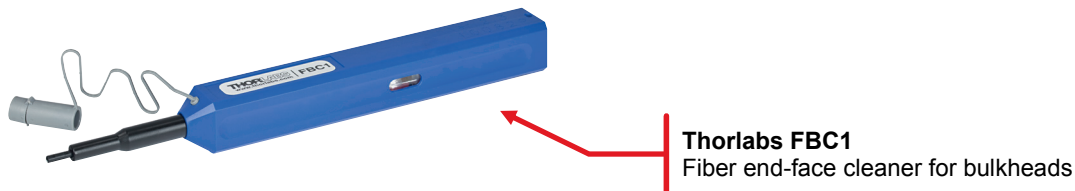
The instrument does not contain any modules that can be repaired by the user. If a malfunction occurs, please contact Thorlabs Technical Support and arrangements will be made to investigate the problem. Do not remove the cover. There are no user serviceable components inside.

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

- SMA 50Ω loads (used for front panel RF connectors)
- 1.25A 250VAC 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:

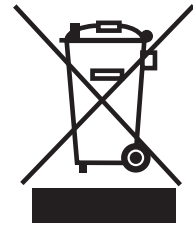
Standby Button Color	Condition
Solid Green	Indicates normal ON state
Solid Amber	Indicates unit is in Standby Mode Press the button to turn the instrument ON
Blinking Green	Indicates the main AC power is unstable. When the AC power is restored, the instrument will return to the standby mode (amber)
Blinking 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 <i>in accordance with EN ISO 17050-1:2010</i>	
We:	Thorlabs Inc.
Of:	56 Sparta Avenue, Newton, New Jersey, 07860, USA
in accordance with the following Directive(s):	
	Low Voltage Directive (LVD)
	Electromagnetic Compatibility (EMC) Directive
	Restriction of Use of Certain Hazardous Substances (RoHS)
	Eco-Design Directive
hereby declare that:	
Model:	MX10A
Equipment:	12.5 Gb/s Modulator Driver
is in conformity with the applicable requirements of the following documents:	
EC No 1194/2012	Eco-Design Requirements for Directional Lamps, LED Lamps, & Related Equipment 2012
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	
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: 14 March 2016
Name:	Ann Strachan
Position:	Compliance Manager
	EDC - MX10A -2016-03-14
	



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):

- Low Voltage Directive (LVD)
- Electromagnetic Compatibility (EMC) Directive
- Restriction of Use of Certain Hazardous Substances (RoHS)
- Eco-Design Directive

hereby declare that:
Model: **MX40A**

Equipment: **40 Gb/s Modulator Driver**


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

EC No 1194/2012 Eco-Design Requirements for Directional Lamps, LED Lamps, & Related Equipment 2012

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

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 April 2016

Name: Ann Strachan
Position: Compliance Manager

EDC - MX40A -2016-04-12



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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techsupport@thorlabs.com

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