



# MX40G Series

## 40 GHz E-O Converters

# MX70G Series

## 70 GHz E-O Converters

# User Guide





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## Chapter 1 Introduction

### 1.1 Description

Thorlabs' MX40G series and MX70G series of Electrical to Optical (E-O) Converters offer frequency response to 40 GHz and 70 GHz, respectively. Each converter incorporates a telecommunication grade lithium niobate ( $\text{LiNbO}_3$ ) modulator that is stabilized by a fully automatic bias controller. Select an internal tunable laser source, fixed-wavelength laser source, or couple an external laser operating from 1250 nm to 1610 nm to the PM FC/PC fiber optic connector on the input panel (not available for the MX40G-850 converter). The instrument is fully driven using the intuitive graphical user interface (GUI) touchscreen, and the RS-232 connection on the back panel enables remote control of many instrument functions. Please contact Thorlabs Technical Support for up-to-date information on the firmware revisions and control functions available.

These converters are particularly well suited for use as accessories that provide optical test capability for an all-electrical vector network analyzer (VNA). This pairing enables an optical to electrical (O-E) device under test (DUT) to be accurately measured. To support this use, each E-O converter ships with an \*.s2p file characterizing its frequency response. This frequency response can be used to de-embed the response of the O-E DUT by separating its response from the overall measurement response. Please see Section 4.2 for more information.

These instruments 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/software\\_pages/viewsoftwarepage.cfm?code=MX](https://www.thorlabs.com/software_pages/viewsoftwarepage.cfm?code=MX). Thorlabs' Technical Support can provide up-to-date information on available firmware revisions and control functions.

### 1.2 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. E-O Converter Main Unit
2. Power Cord According to Local Power Supply
3. PM Loopback Fiber Optic Cable (Not Included with MX40G-850 Converter)
4. Interlock Keys
5. 2.5 mm Interlock Pin (in Back Panel)
6. 1.25 A 250 VAC Fuse
7. USB Type A to Type B Cable, 6' Long
8. USB Storage Device with \*.s2p File Characterizing Instrument

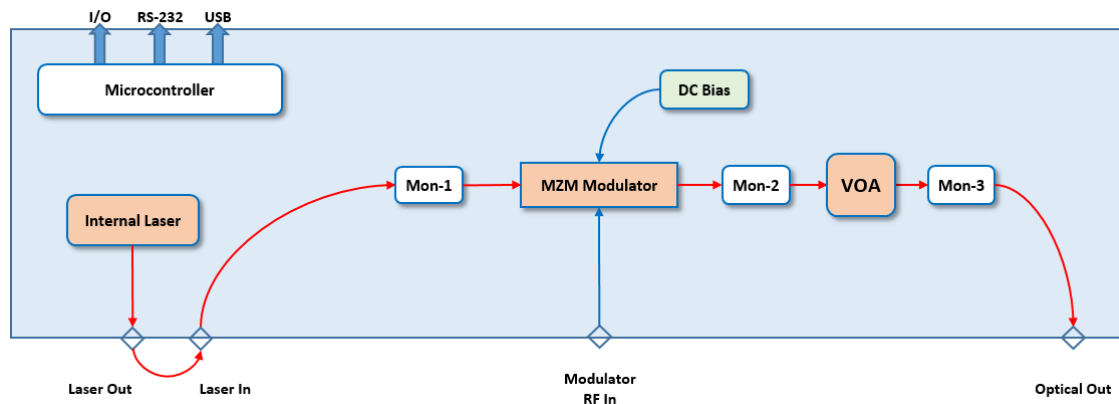
### 1.3 Block Diagram

Each E-O converter is fully integrated and contains the laser source, lithium niobate (LiNbO<sub>3</sub>) Mach-Zehnder intensity modulator (MZM), and automatic bias controller; the only required external input is the signal source to the Modulator RF In port.

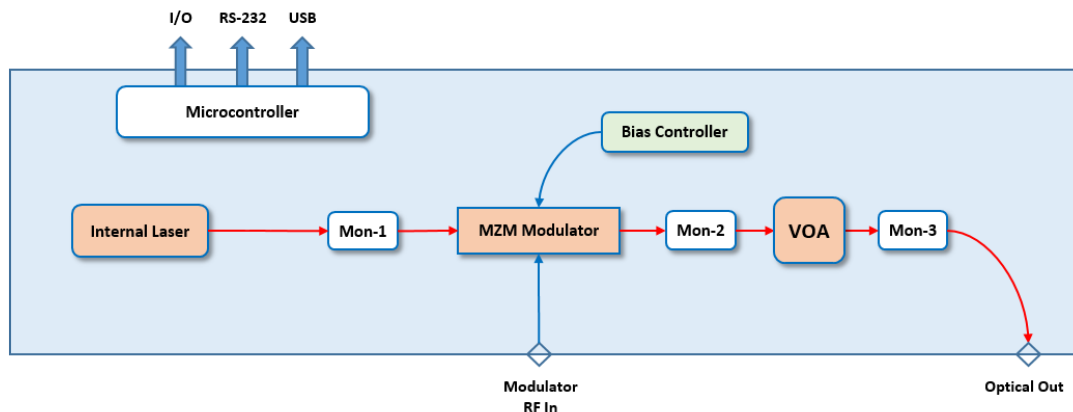
The MX40G/MX70G converters include a C-band tunable laser, the MX40G-LB/MX70G-LB converters include an L-band tunable laser, the MX40G-850 converter includes an 852 nm fixed-wavelength laser, the MX40G-1310/MX70G-1310 converters include a 1310 nm fixed-wavelength laser, and the MX70G-DB1 converter includes both a 1310 nm fixed-wavelength laser and a C-band tunable laser. Both the C- and L-band laser sources are tunable on the ITU 50 GHz grid and include a dither feature for wavelength stabilization.

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 MZM Output, and Mon-3 is at the final Optical Output.

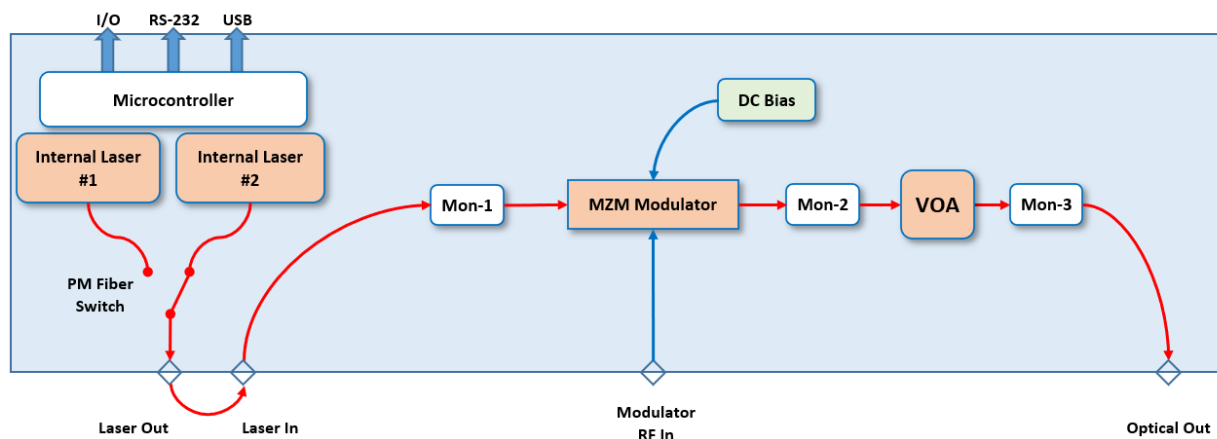
Excluding the MX40G-850 converter, which has a direct internal connection from the Internal Laser to Mon-1, an external laser source, operating from 1250 nm to 1610 nm, can also be used to provide the optical input. Either the internal laser or an external laser source may be coupled to the Laser In port, which uses PM fiber with light linearly polarized along the slow axis, as shown on the front panel. The maximum input power to the Laser In port is 20 dBm (100 mW).



**Figure 1** Key Components of E-O Converters (Excluding MX40G-850 Converter)



**Figure 2** Key Components of the MX40G-850 E-O Converter



**Figure 3** Key Components of the MX70G Dual Band E-O Converter

1.4 Front Panel (All Models Except MX40G-850)

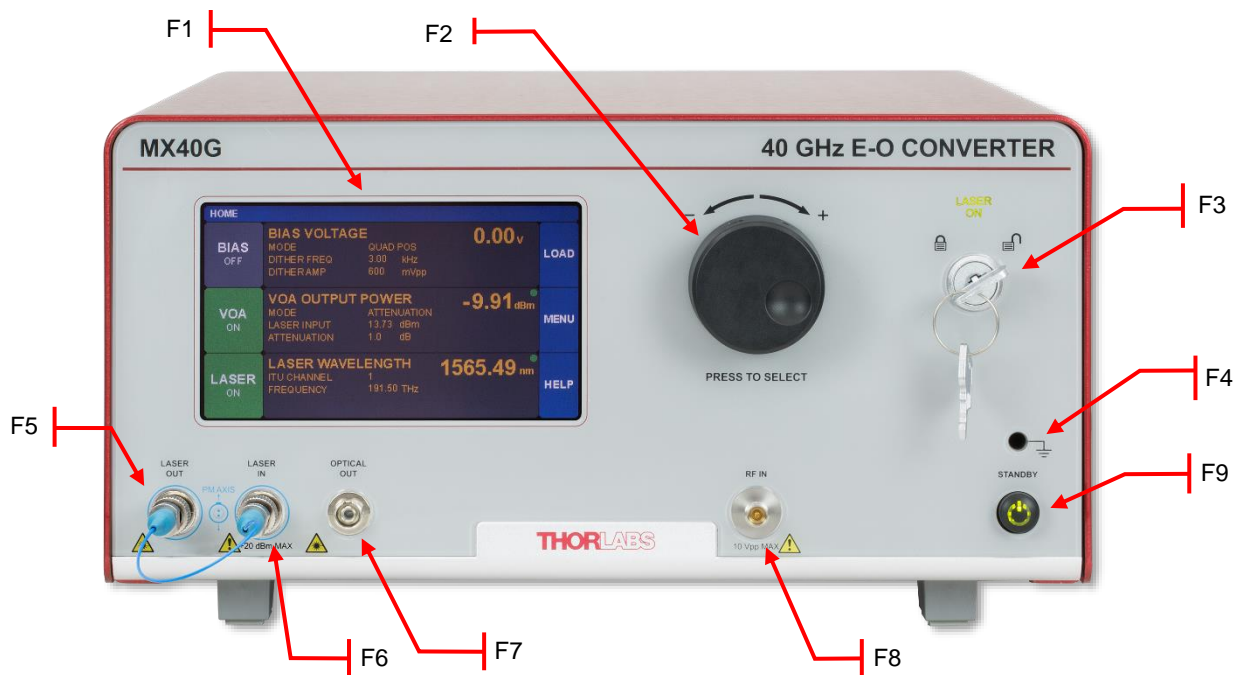
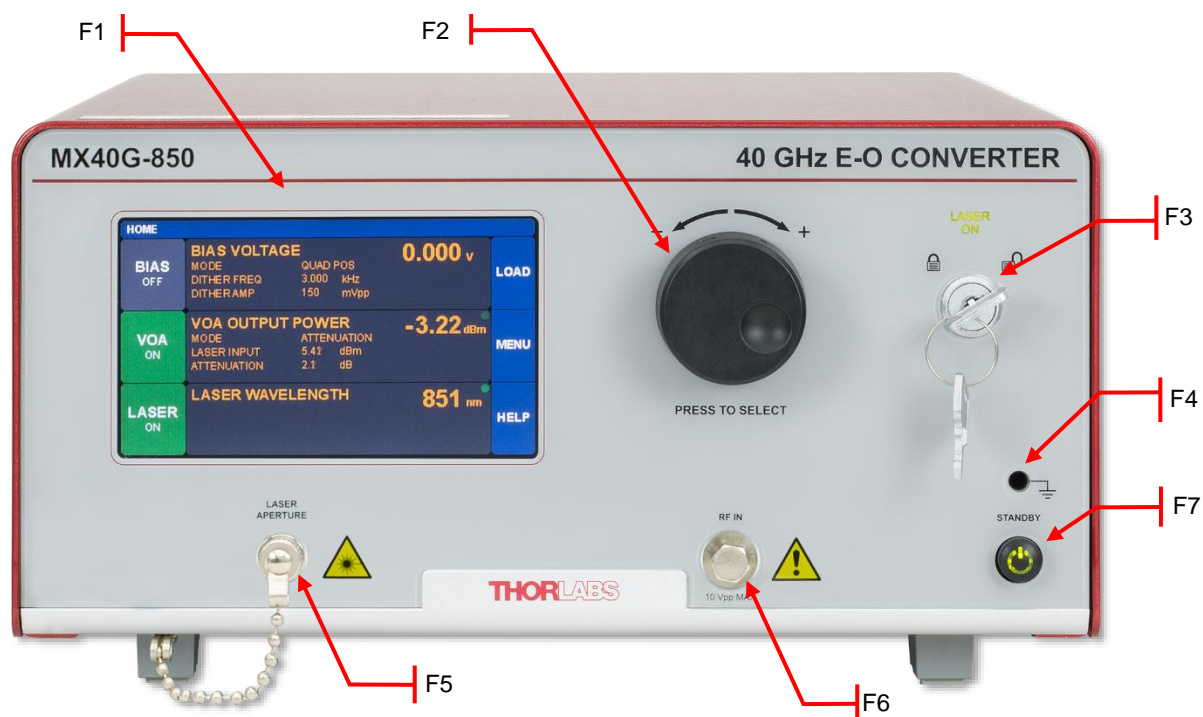


Figure 4 Front Panel

Callout	Description
F1	Touchscreen Display
F2	Adjustment Knob
F3	Key Switch and Status Indicator 🔒 Lasing Disabled; 🔓 Lasing Enabled
F4	Grounding Jack (Banana Connector) ⏚ Earth Ground
F5	Laser Output (PM FC/PC Connector)
F6	Laser Input (PM FC/PC Connector)
F7	Optical Output (FC/PC Connector)
F8	Modulator RF Input (MX40G Series: 2.92 mm Connector; MX70G Series: 1.85 mm Connector)
F9	Standby Button



## 1.5 Front Panel (MX40G-850)



**Figure 5 Front Panel**

Callout	Description
F1	Touchscreen Display
F2	Adjustment Knob
F3	Key Switch and Status Indicator 🔒 Lasing Disabled; 🔓 Lasing Enabled
F4	Grounding Jack (Banana Connector) ⏚ Earth Ground
F5	Laser Aperture (FC/PC Connector) with Screw-On Cap
F6	Modulator RF Input (2.92 mm Connector)
F7	Standby Button

1.6 Back Panel (All Models)

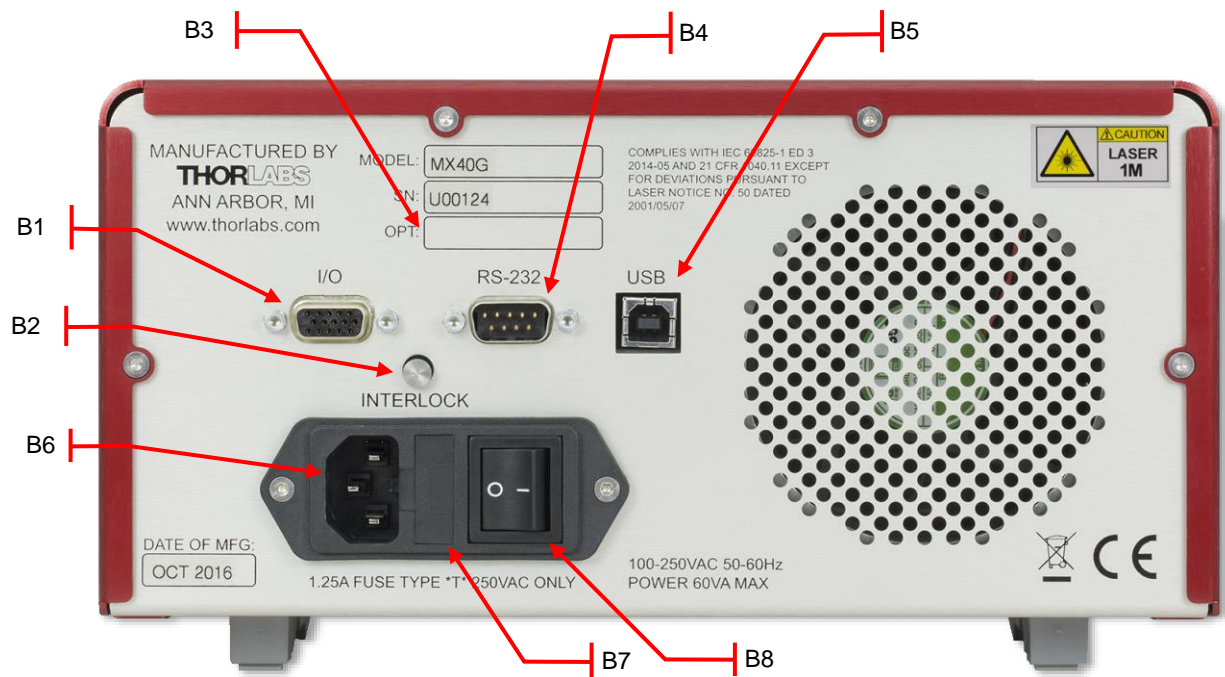


Figure 6 Back Panel

Callout	Description
B1	I/O Port (DB15 Connector)
B2	Laser Interlock (2.5 mm Connector)
B3	Option Label
B4	RS-232 Port (DB9 Connector)
B5	USB Port (USB Type B Connector)
B6	Power Connector
B7	Fuse Tray
B8	Power Switch I Supply On; O Supply Off

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



### Warning: Risk of Electrical Shock

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. Only use mains cable with sufficient current and voltage ratings for this instrument. 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 8.3). 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.



### Warning: Risk of Explosion

The instrument must not be operated in explosion endangered environments.



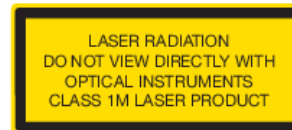
### Warning: Laser Radiation

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.



**MX40G-850 Converter**



**Other MX40 and MX70 Series Converters**



### Caution: ESD Sensitive Component

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: Components not Water Resistant

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.



### Caution: Follow Intended Usage Guidelines

This product is not suitable for household room illumination.

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

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.

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.

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).

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.

## Chapter 3 Quick Start Guide

### 3.1 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.



**Figure 7** Power Cable Port, Fuse, and Power Switch



**Figure 8** Indicator Glows Amber when Converter is In Standby

**For all models excluding MX40G-850:** Attach the PM loop-back fiber optic cable between the Laser Out and Laser In FC connectors on the front panel. Be sure to clean both ends of the fiber as described in the Maintenance Section of this manual.



**Figure 9** PM Loopback Fiber Cable Installed (Not Available for MX40G-850)

Insert the key into the interlock switch and turn it towards the unlock symbol (🔓). This allows the laser to be turned on, but the LASER ON indicator will not glow green until the laser is actually turned on by the touchscreen button. 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.



**Figure 10** Interlock Key Switch



**Figure 11** Indicator Glows Green when Converter is Fully Enabled

3.2 Controls on the Home Page

Full access to all of the converter's controls and functions is available using the resistive touchscreen display, which is sensitive to finger pressure or the tap of a plastic stylus. 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.

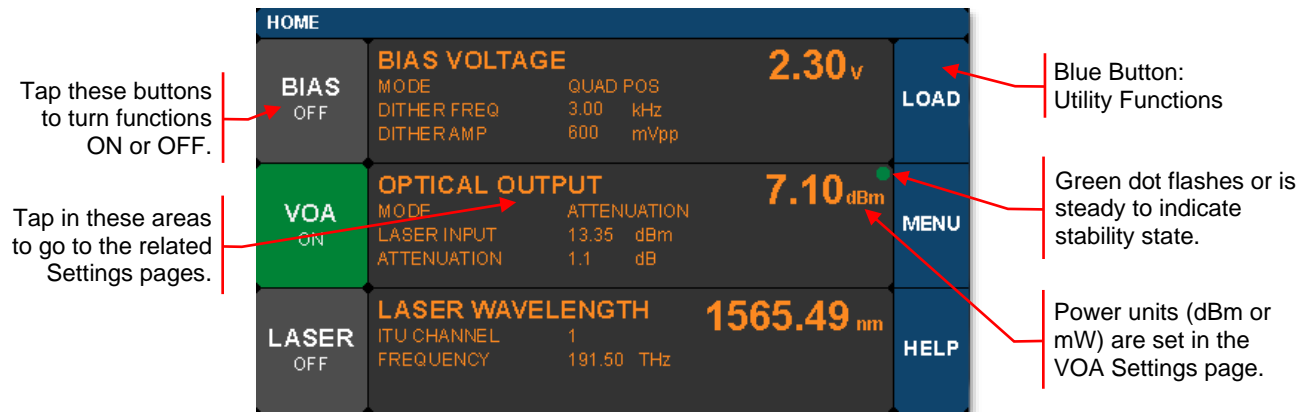


Figure 12 Home Screen Features

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 they 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 glows steadily to indicate the function is stable, and it blinks to indicate 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.

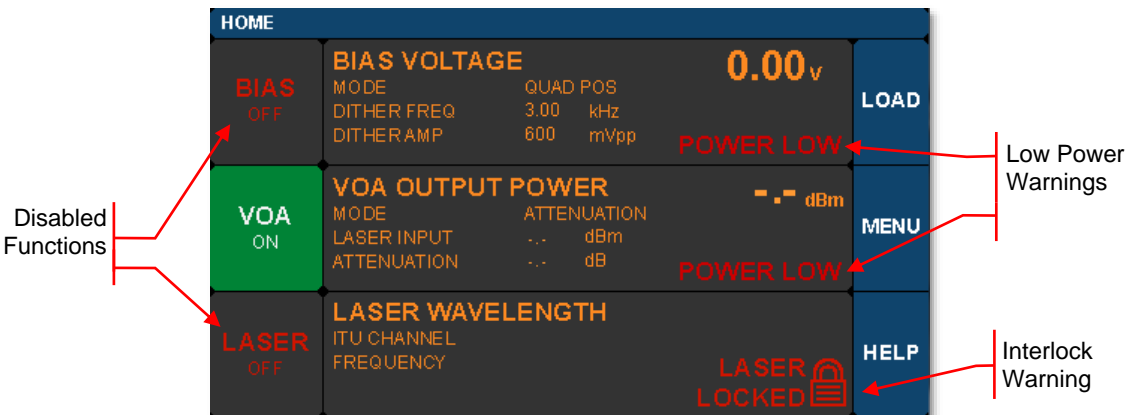


Figure 13 Home Screen Warnings and Indicators

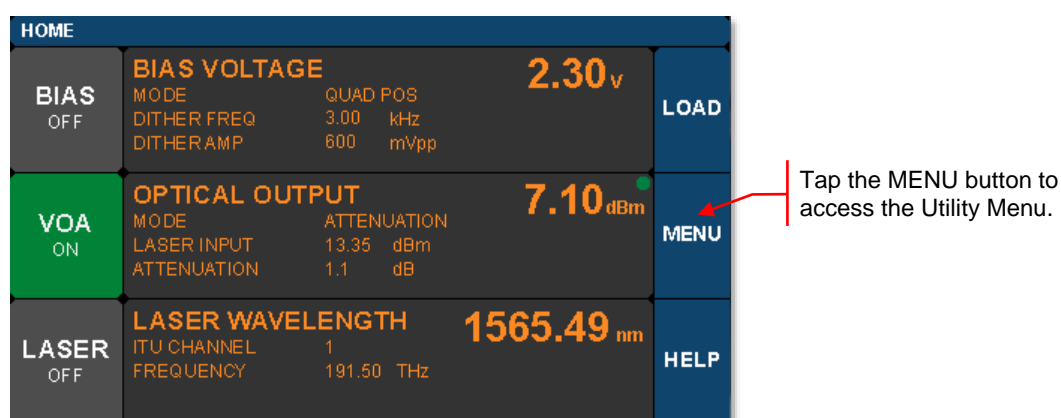
### 3.3 System Wavelength Setting (All Models Except MX40G-850)

**Note:** This section does not apply to the MX40G-850 converter which has a single calibration wavelength of 850 nm and no external laser input.

The operational wavelength range of each converter extends from 1250 nm to 1610 nm. The three calibration wavelengths of the power monitors, 1310 nm, 1550 nm, and 1590 nm, represent the centers of the O-band, C-band, and L-band and provide the user with accurate power readings at or near those wavelengths.

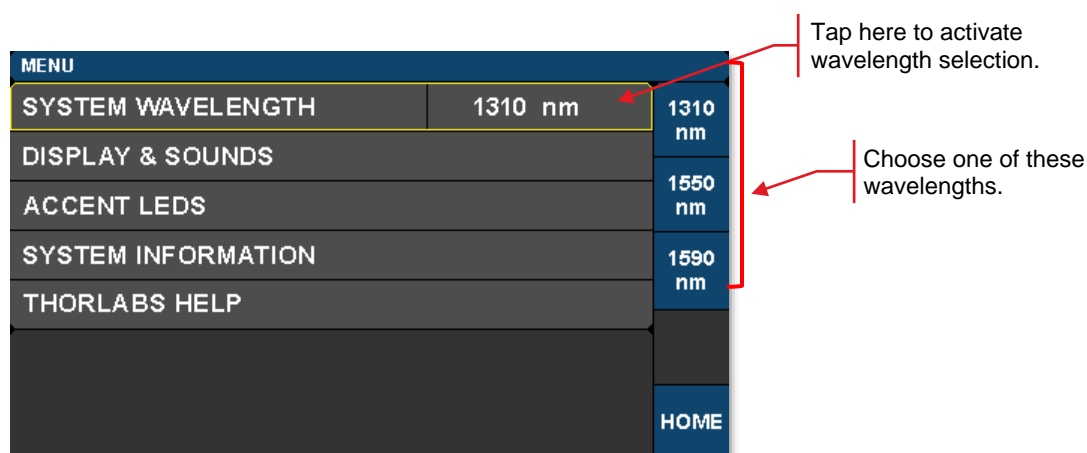
The system wavelength should always be set to the wavelength closest to that of the laser source coupled to the Laser In bulkhead. The converter's system wavelength is factory-preset to correspond to the wavelength band of the integrated laser source. The dual band model automatically changes the system wavelength to correspond to the wavelength band of the selected integrated laser source. If an external laser is to be used with the converter, the system wavelength may need to be changed. This function exists in the Utility Menu.

From the Home screen, tap the MENU button to bring up the Utility Menu as shown.



**Figure 14 Accessing the Utility Menu from the Home Screen**

Then tap the System Wavelength bar as shown below to bring up the three wavelength choices. Tap the desired wavelength to set the System Wavelength.



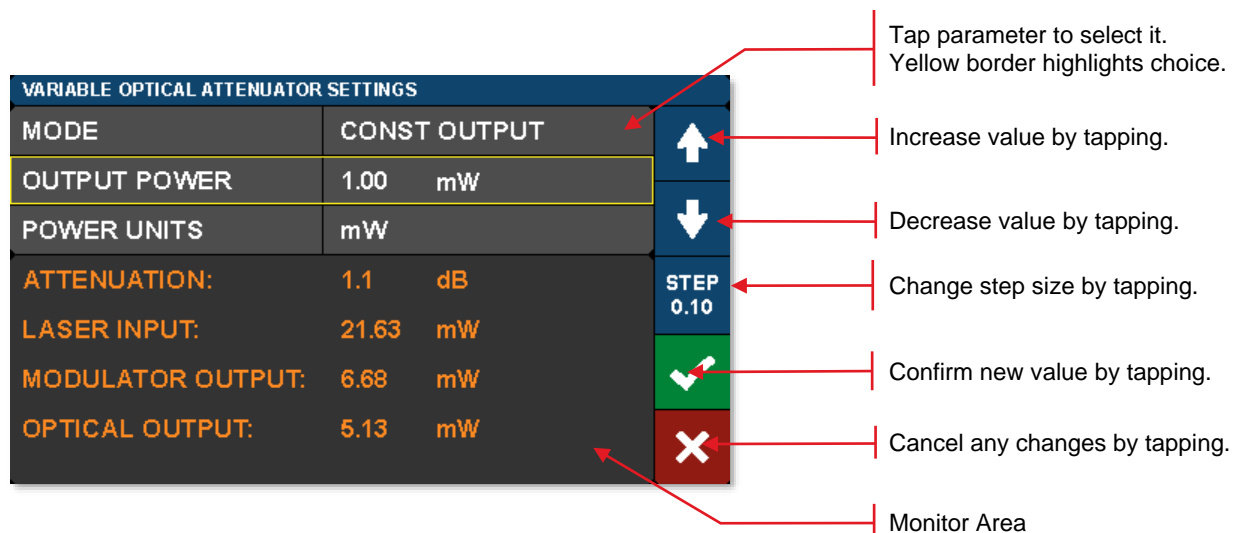
**Figure 15 System Wavelength is Selected from the Utility Menu**

### 3.4 Controls on the Settings Pages

The Settings pages all possess 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. A yellow border highlights the choice and controls for that parameter are presented.

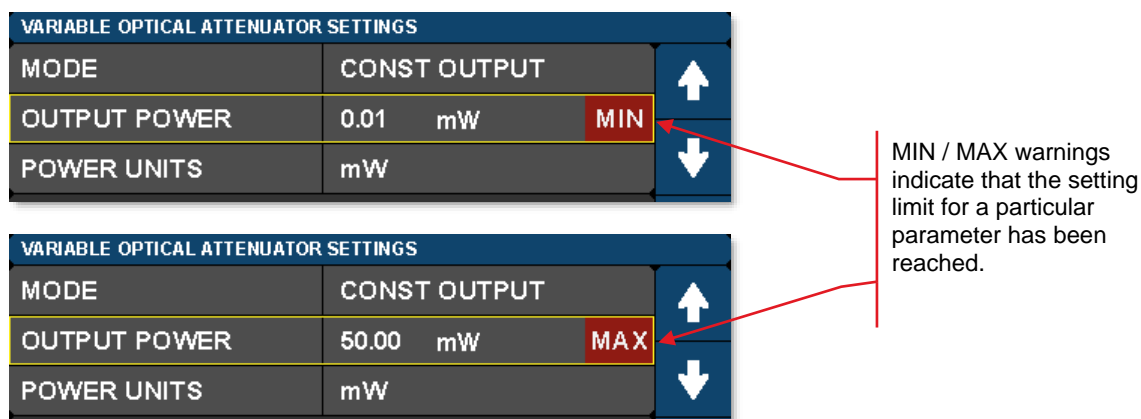
The lower section with amber letters displays selected related values convenient to monitor from the page.

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.



**Figure 16** Controls used to Adjust and Save Values of Selected Parameters

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.



**Figure 17** MIN and MAX Flags Indicate Bounds of Adjustable Value Ranges



### 3.5 Quick Start

The following steps summarize the setup procedure required to operate the converter in the standard mode. Please refer to previous sections in this chapter and the expanded operating instructions in Chapter 4 for additional information.

1. Turn on power to the converter via the power switch on the back panel (Figure 7).
2. Press and hold the button on the front panel until the indicator light changes from amber to green (Figure 8 and Figure 11).
3. Turn the key switch to unlock (Figure 10).
4. Turn the laser on by tapping the lower-left touchscreen button on the Home page (Figure 12).
  - a. Lower-left touchscreen button changing from grey to green indicates Laser On command has been received.
  - b. Front panel LASER ON indicator illuminates green to indicate the laser has power and is on.
  - c. Flashing green dot above laser wavelength in Laser section on the Home page indicates the laser is stabilizing (i.e. not yet settled at optical power/frequency setpoint). Solid green dot indicates that the laser is stable.
5. Enable the bias controller by tapping the top-left touchscreen button on the Home page (Figure 12). Wait for completion of the calibration process. The instrument will enable the default Quadrature mode with positive slope bias point (Section 4.4.1).
6. Take note of the output power, which is shown in the center right section of the Home page (Figure 12).
7. Turn on the VOA controller to adjust output power, if desired, by tapping the center-left touchscreen button on the Home page (Figure 12).
8. Apply the input RF signal to the female RF IN connector on the front panel (Figure 9); the maximum modulator RF input for linear response is specified in Chapter 5.



**Figure 18 Front Panel of the MX40G Converter**  
(The MX40G-850 Converter Does Not Have Laser In/Out Ports)

## Chapter 4 Operating Instructions

### 4.1 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 the MZM 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.

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  $V_{\pi}$ , 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.

The purpose of the Bias settings (Section 4.4) is to hold the modulator at the chosen operation point. Active control of the MZM bias point is essential, as the modulator is temperature sensitive and will drift over time.

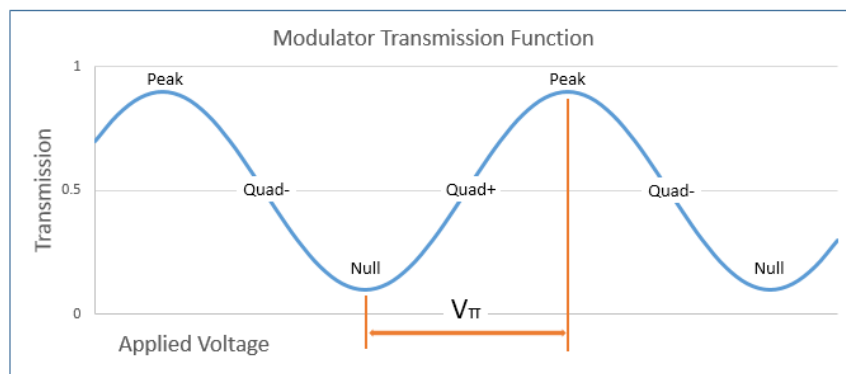


Figure 19 Illustration of the Modulator Transmission Function

### 4.2 De-Embedding Procedures

One of the primary applications of a calibrated electrical to optical (E-O) converter is enabling electrical to electrical (E-E) test equipment, like a VNA, to characterize optical to electrical (O-E) devices. As illustrated in Figure 20, the device converts the electrical signal from Port 1 of the E-E VNA to an optical signal that is input into the O-E DUT, and the electrical signal resulting from the O-E DUT is then provided to Port 2 of the E-E test equipment. The response of the entire E-E system, which consists of the converter and the O-E DUT together, is measured. Accurately recovering the response of the O-E DUT requires removing the response of the converter from the measured E-E system response. This is referred to as de-embedding.

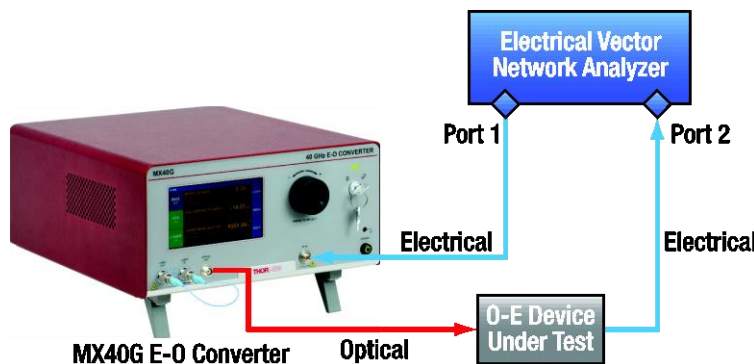


Figure 20 An E-O Converter Provides Optical Test Capability for an All-Electrical VNA

Thorlabs provides a file (.s2p format) with each E-O converter that contains the  $S_{21}$  magnitude and phase response of the modulator across its frequency range of operation. These data are used to perform the de-embedding process. Note that most modern E-E VNA systems provide a built in function for doing this type of de-embedding based on the user-supplied .s2p file. This is the easiest method. However, the de-embedding process can also be performed manually. These methods are described in detail in the "De-Embed Application Note" PDF document, which is accessible by visiting [www.thorlabs.com/manuals](http://www.thorlabs.com/manuals) and entering the item # of your E-O Converter.

A typical frequency response for each converter is plotted below in Figure 23. The phase response is not shown.

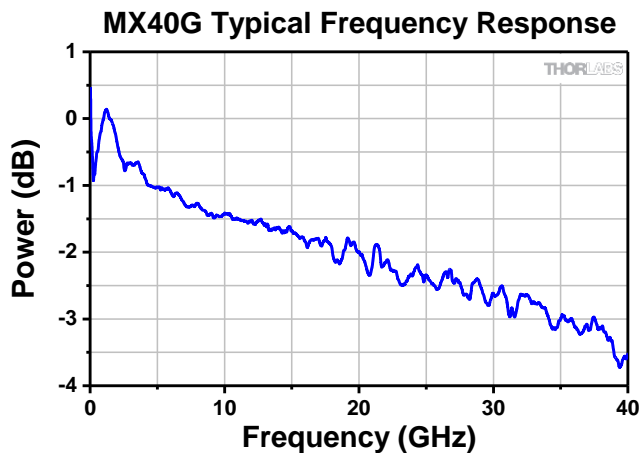


Figure 21 MX40G, MX40G-LB, and MX40G-1310 Typical Frequency Response

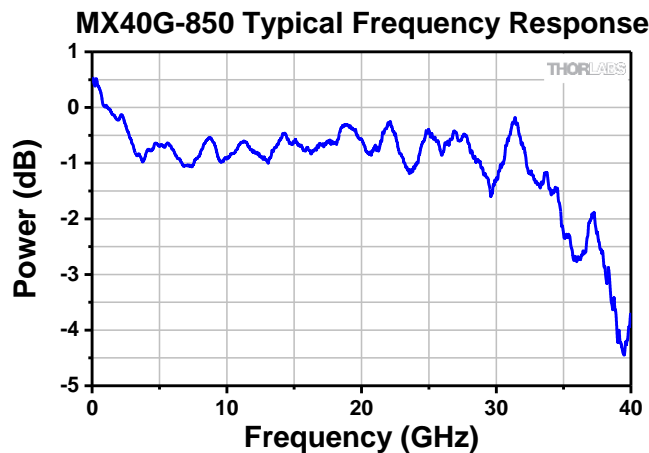


Figure 22 MX40G-850 Typical Frequency Response

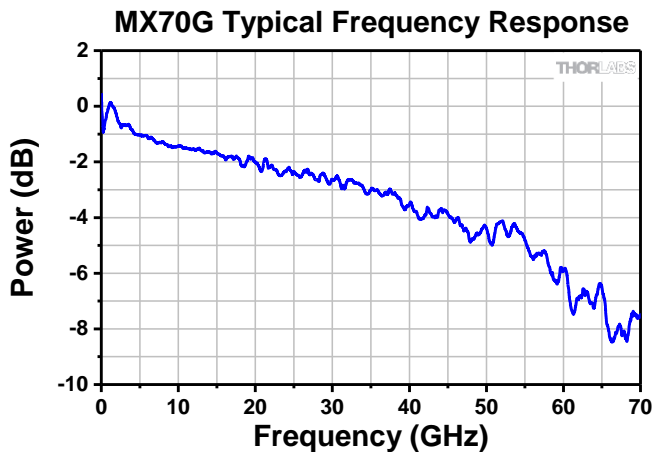
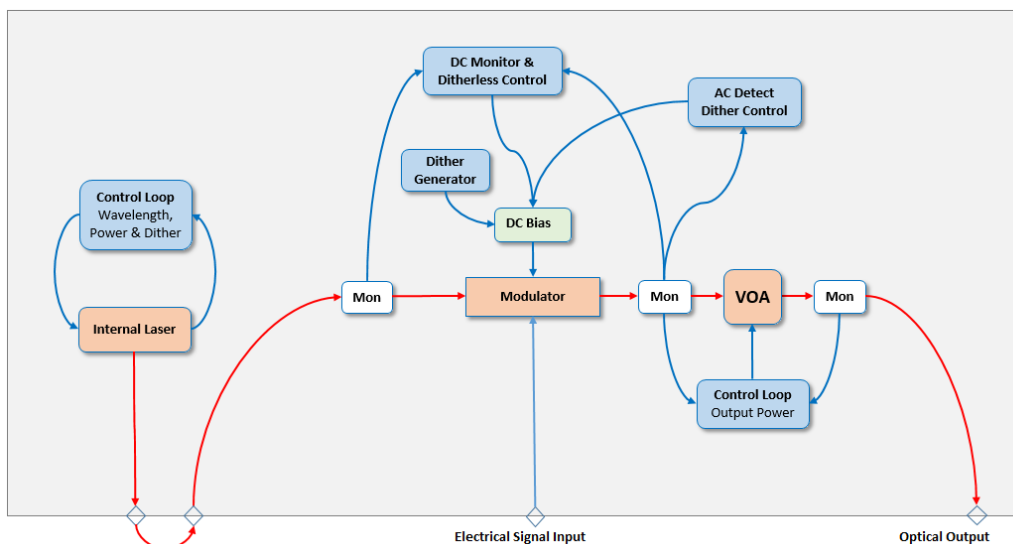


Figure 23 MX70G Series Typical Frequency Response

### 4.3 Control Loop Diagram

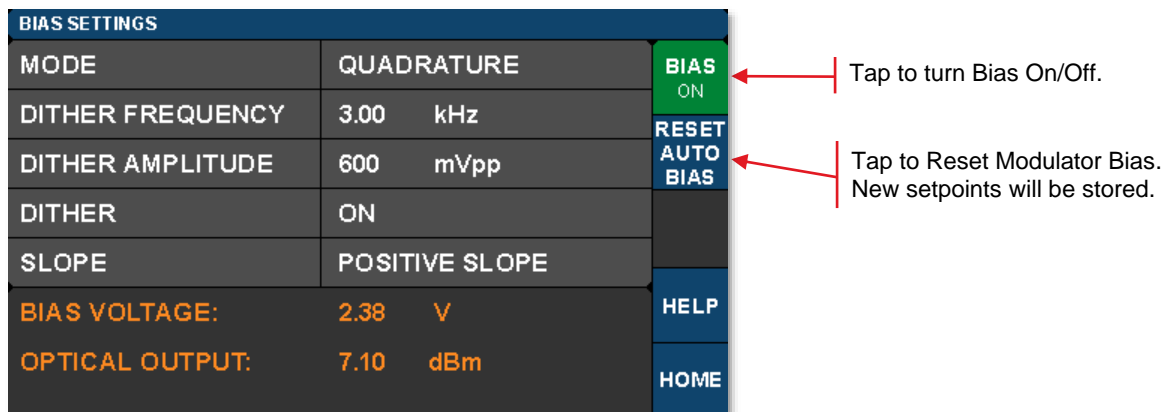
The following diagram shows the control loops added to the block diagram. From this picture, the user can see how the power monitors and VOA are used to provide stability and control to the whole system. It will be helpful to refer to this diagram to gain a better understanding of the functionality of the unit as described in the upcoming sections of the manual.



**Figure 24** Block Diagram of the Converter Showing Control Loops

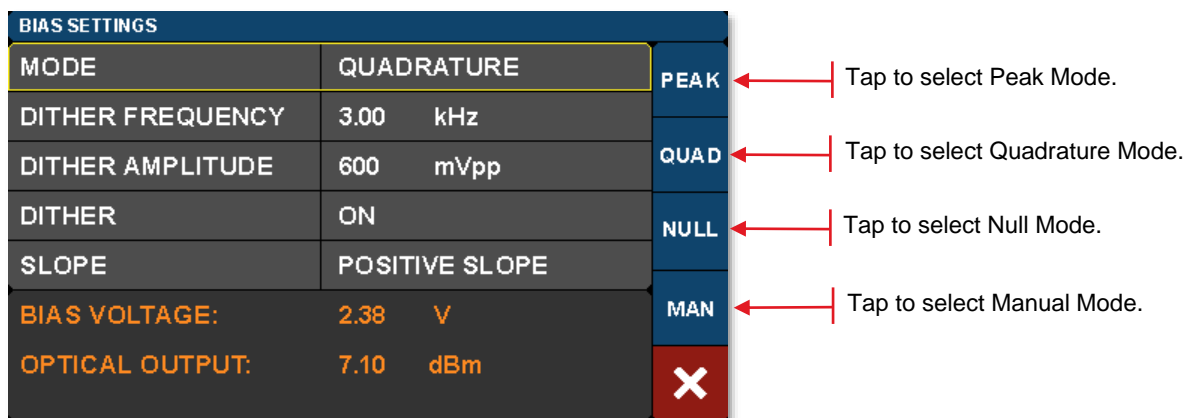
## 4.4 Bias Settings Page

The Bias Settings page is accessed by tapping the center bias monitors pane on the Home page. When the MZM Bias control is first turned on, the converter performs 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.



**Figure 25** Bias Settings Home Screen

The Bias Settings 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 the information presented and the controls available when the Mode field is selected while the controller is operating in Quadrature mode. The blue buttons enable switching between modes.



**Figure 26** Bias Settings Screen when Mode Field is Selected while Quadrature Mode is Enabled

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.

4.4.1 Quadrature Mode

Quadrature mode is the default mode and biases the MZM at the 50% point on the MZM transmission curve shown in Figure 28. Quadrature mode is essential for VNA applications in which linear response is critical. The screen shot below shows the parameters that can be controlled in the Quadrature mode.

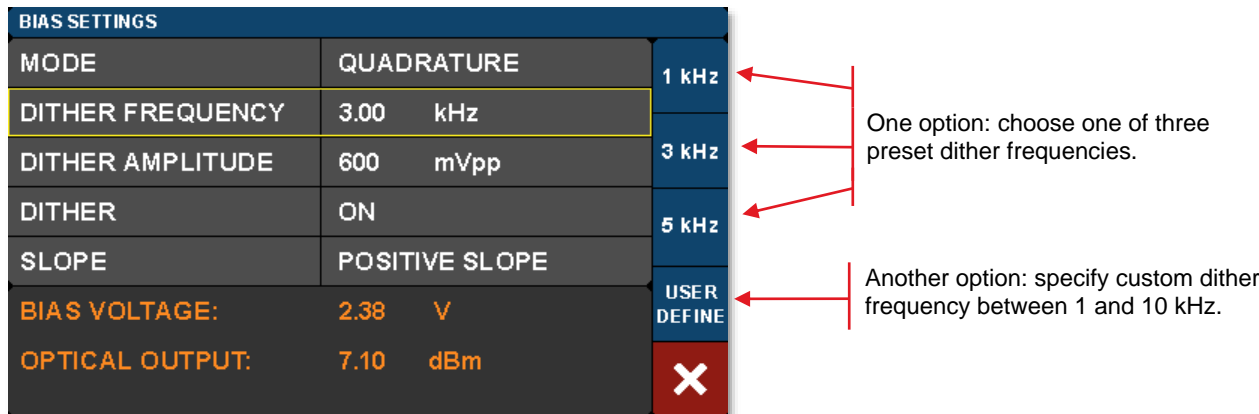


Figure 27 Dither Frequency Selection while Quadrature Mode Enabled

The bias control circuit uses an AC dither tone to stabilize the bias point of the modulator, as illustrated below. 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 (Quadrature, Peak or Null). The DC bias voltage is then continuously adjusted to maintain the correct set-point.

The frequency of the dither tone will not exceed 10 kHz. This frequency limit, which is usually well below the low frequency cut-off for the RF signal of interest, is chosen to prevent interference. As described in the following, the dither tone can also be disabled if other methods of bias control are desired (e.g. manual or input/output ratio control).

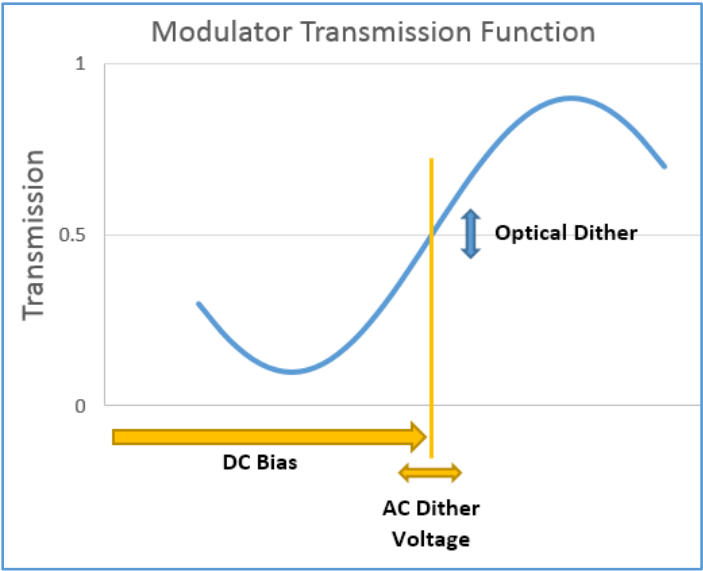
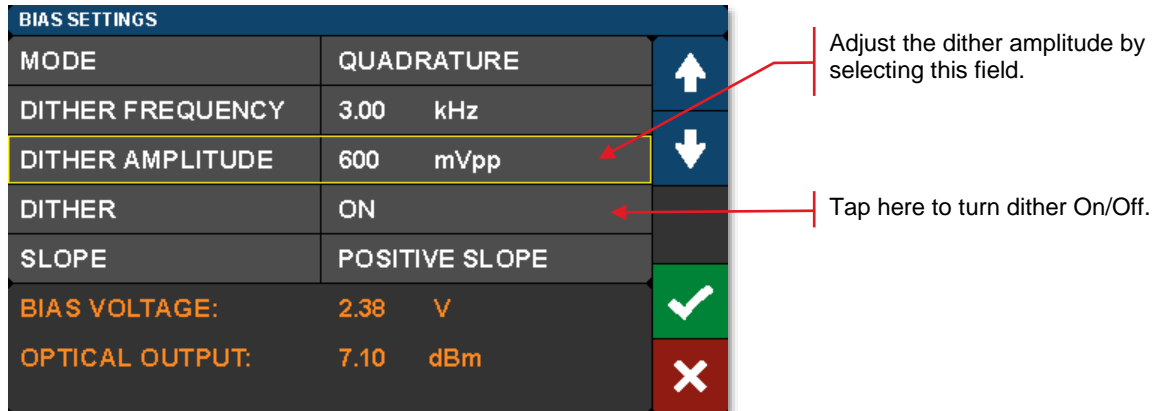


Figure 28 AC dither tone stabilizes the bias point of the modulator.

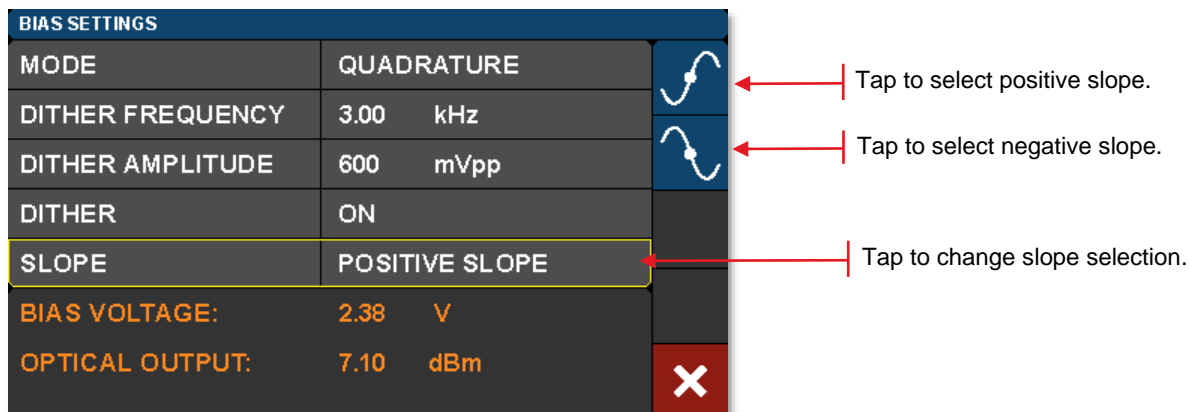
The dither tone frequency may be changed by tapping the Dither Frequency field, which is highlighted in Figure 27. Standard frequencies are selected using the blue buttons, or a custom frequency may be chosen by pressing User Define. The dither tone frequency usually has very little effect on the accuracy of the bias control, but in some cases a different frequency may work better or be desirable depending on the RF signal applied or on 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.



**Figure 29 Dither Amplitude Adjustment**

The dither tone amplitude can also be adjusted to any amplitude between 20 mV and 2 V with 1 mV resolution by tapping the Dither Amplitude field highlighted in Figure 29. Higher amplitudes 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 from 300 mV to 500 mV is a good starting point.

The dither tone can be optionally disabled to accommodate applications requiring the highest SNR. The user may 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. Manual Mode should be used for longer-term measurements without dither, so that a constant ratio method can be used to stabilize the bias point, as described in Section 4.4.4.



**Figure 30 Choose the Positive or Negative Slope of the Transmission Function**

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.

4.4.2 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 and 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.

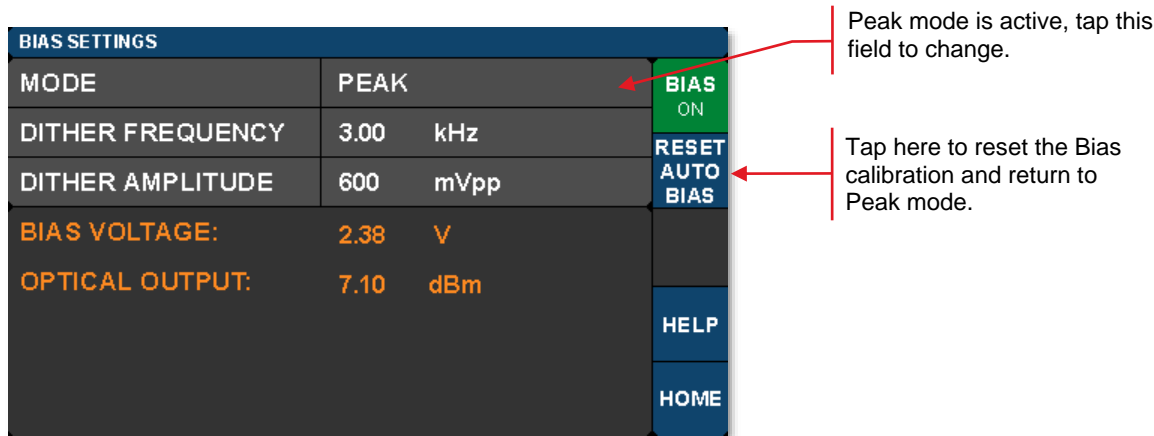


Figure 31 Peak Mode Settings

4.4.3 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

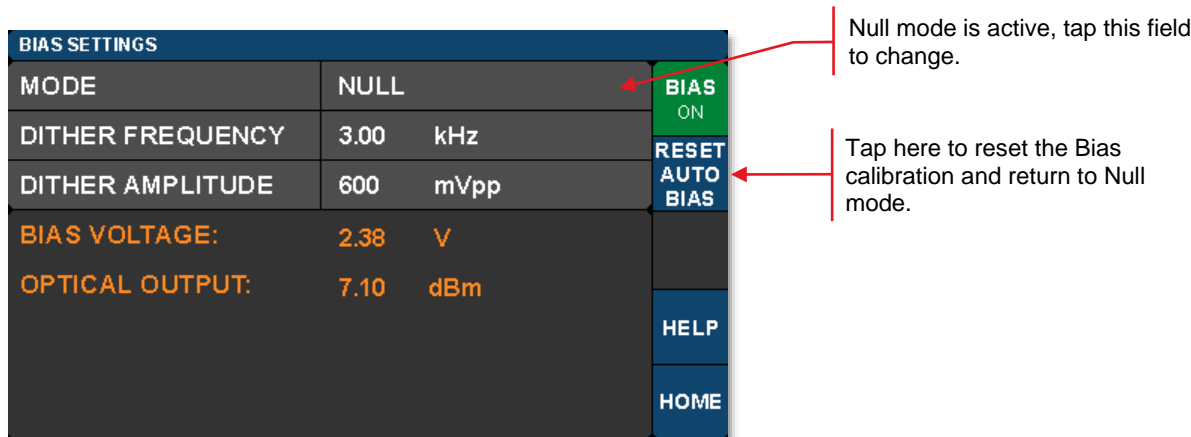
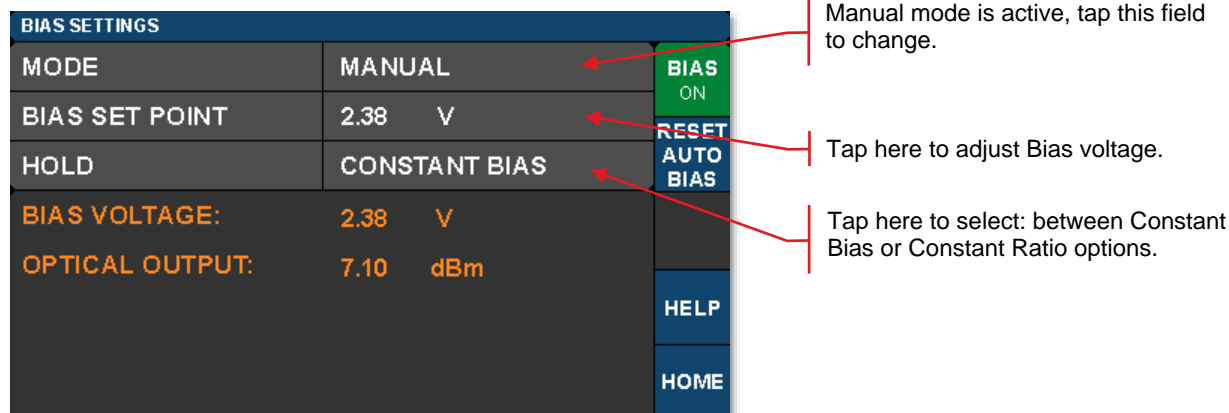


Figure 32 Null Mode Settings



#### 4.4.4 Manual Mode

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

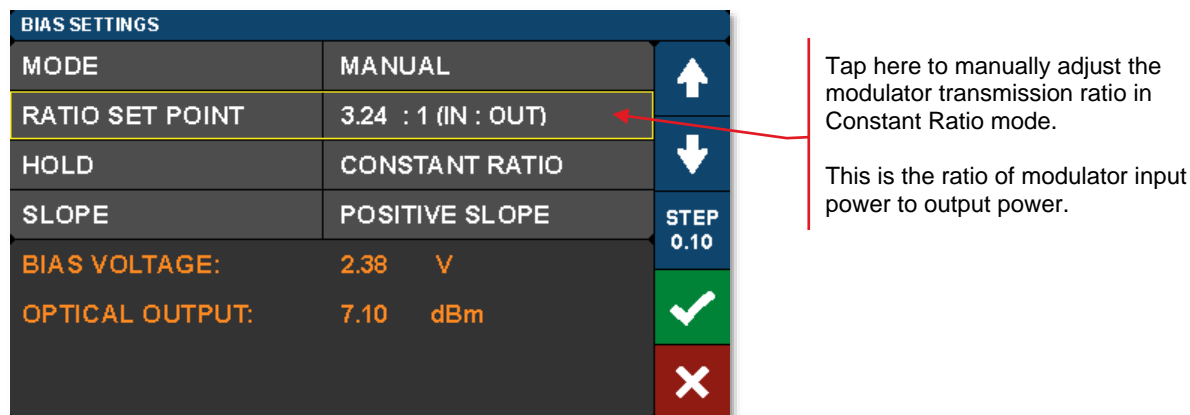


**Figure 33** Constant Bias Manual Mode Settings

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.

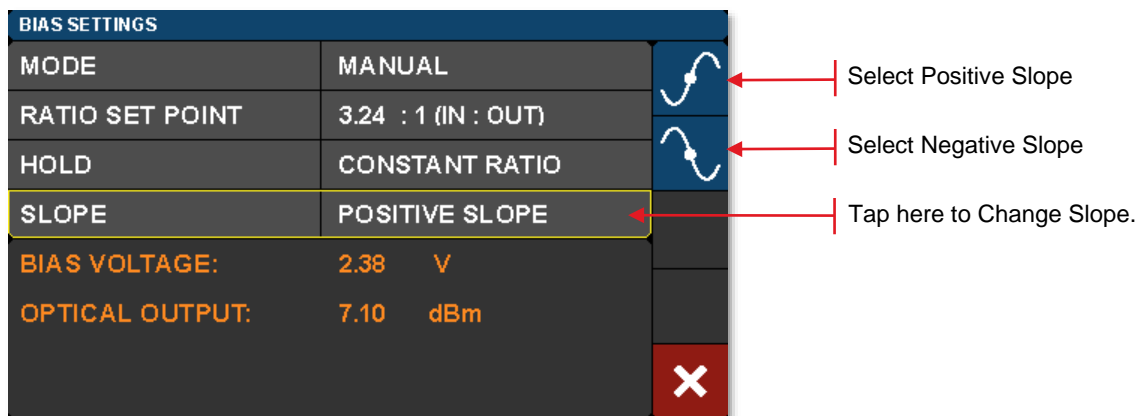
The Constant Ratio mode employs active control of the MZM bias, but without using a dither tone. As a result, it can achieve superior SNR compared to the Quadrature mode. This mode is recommended for analog signals or higher level Pulse-Amplitude Modulation (PAM) formats.

Constant Ratio works by holding the MZM ratio of input light (at Mon-1) to output light (at Mon-2), see Figure 1 for reference, at a constant value (typically at or close to Quadrature). Note that Constant Ratio does NOT take into account the insertion loss (IL) of the MZM. Therefore, the user must have some knowledge of the IL between Mon-1 and Mon-2, which is equivalent to the IL of the modulator. 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.



**Figure 34** Constant Ratio Manual Modes Settings

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.



**Figure 35** Selecting Operating Point in Constant Ratio Mode

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.

## 4.5 Variable Optical Attenuator Settings Page

Tap in the VOA monitors pane on the Home page to access the Variable Optical Attenuator (VOA) Settings page shown below. The VOA provides the means for adjusting and stabilizing the output power after the MZM. The VOA can operate in either of two modes: 1) Constant Attenuation, and 2) Constant Output Power.

Note that units of all power measurements are determined by the Power Units setting this page, see Figure 37.

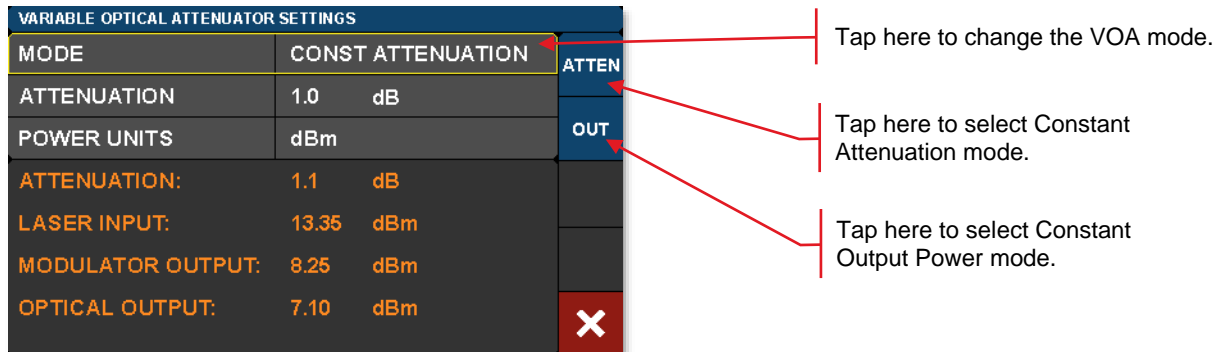


Figure 36 Select between Constant Attenuation and Constant Output Power VOA Modes

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

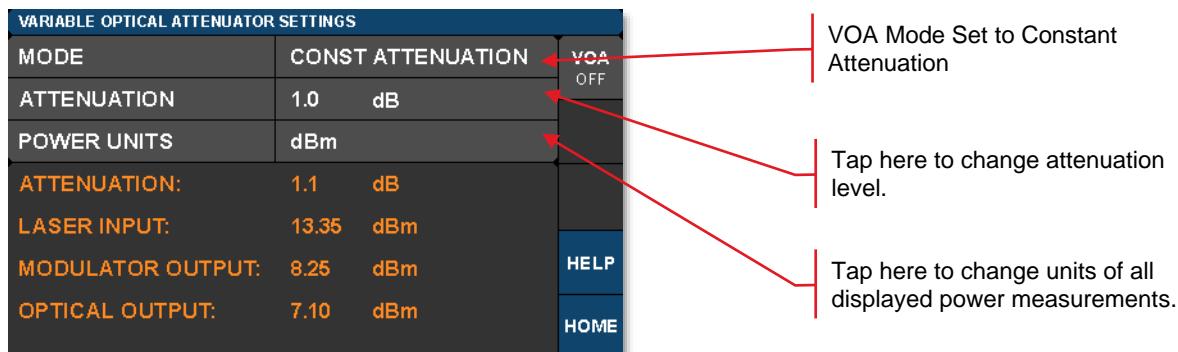


Figure 37 Constant Attenuation VOA Mode Page Options

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).

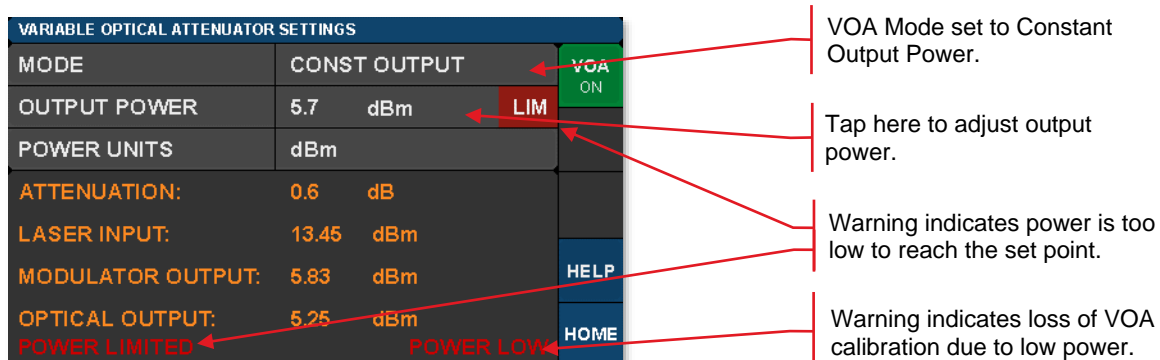


Figure 38 Constant Output Power VOA Mode Page Functions and Possible Warnings

## 4.6 Laser Settings Page (Tunable Laser and Dual Band Models Only)



To access the Laser Settings page, tap on the Laser monitors pane on the Home page. Here the user can control the laser wavelength and choose whether or not to use the dither feature to stabilize the wavelength. Turning the dither off will result in lower phase and intensity noise, but the wavelength may drift slightly over time. The monitors on this page provide live readings of many parameters.

When the internal laser source is a C-band or L-band tunable laser, tap on the Laser Monitors pane on the home page to access the Laser Settings page. This page is not available when the 850 nm or 1310 nm fixed-wavelength source is the internal laser. When the internal laser is not the standard C-band tunable laser, the laser type is denoted in the Options label on the rear panel of the instrument (please see Figure 6 for location of the Options label).

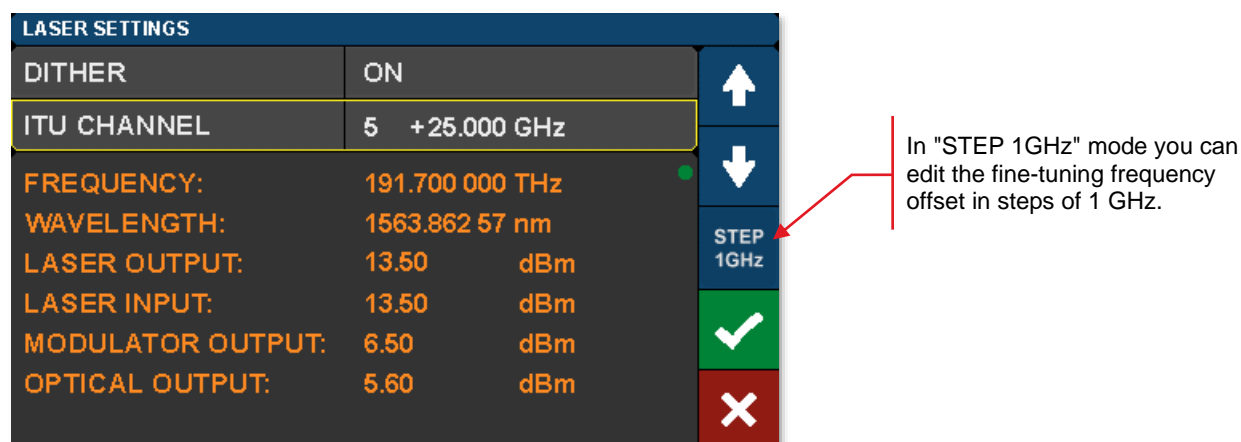
Optical frequency can be set at increments of 50 GHz for C-band or L-band tunable internal lasers. C-band and L-band lasers also support a fine tuning frequency offset feature, allowing the frequency to be adjusted by an offset from -30.000 GHz to +30.000 GHz. The ITU channel number on these pages is an index number given only for convenience, which is unique to this instrument; actual frequencies and spacings are specified by the ITU standard.

To adjust the ITU channel, tap on the ITU CHANNEL row and use the arrow buttons to increment or decrement the channel. Press the green check mark to accept the new channel, or the red cancel button to abort the change. You may also use the adjustment knob. Note that you are initially editing by channel, as indicated by the STEP CHAN button. Note that the frequency and wavelength value are estimated based on the laser's nominal 50 GHz channel spacing, not measured by the instrument.



**Figure 39 Changing the ITU Channel Number**

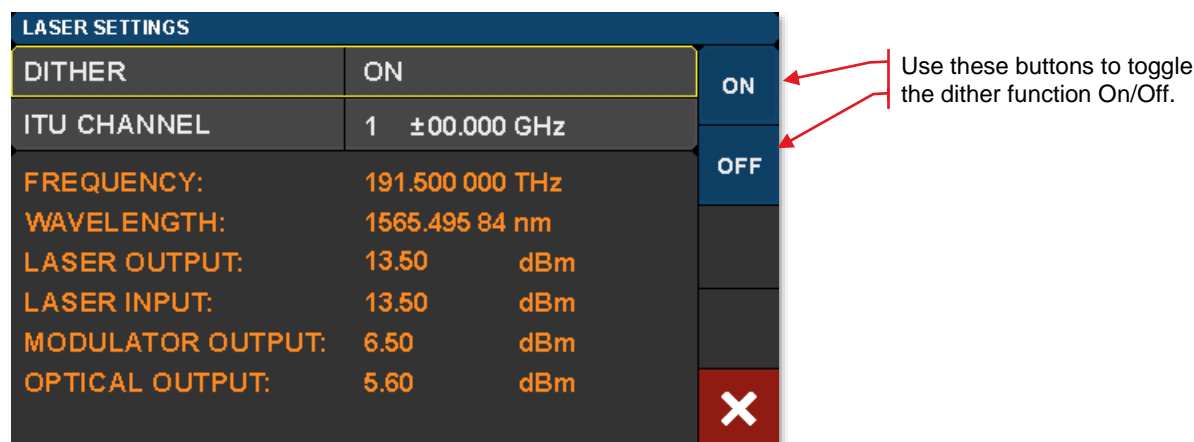
To apply a fine-tuning frequency offset, tap the STEP CHAN button. The button will cycle to the next mode, STEP 10GHz. In this mode, using the up or down arrows or control knob will adjust the most significant digit of the frequency offset. Tapping the button repeatedly will cycle through the STEP 1GHz, STEP 100MHz, STEP 10MHz, and STEP 1MHz modes, allowing you to edit the offset in finer units of 1GHz, 100MHz, 10MHz, or 1MHz. Tapping the button one more time will cycle back to STEP CHAN mode.



**Figure 40 Changing the Fine-Tuning Step Size**

Note that while the L-band and C-band lasers can have their frequency adjusted by increments as small as 1 MHz, the laser's actual tuning accuracy is not this fine. See Section 5.4 below for more information.

To turn the dither setting on or off, tap on the DITHER row and use the ON or OFF buttons to change the setting, or the red cancel button to abort the change.



**Figure 41 Enabling and Disabling Laser Dither**

For the dual band MX variant with two internal lasers, the user can also select the laser source on the Laser Settings page. Tap on the LASER SELECT row and use the buttons on the right to select the laser source (Figure 42). Note that changing the laser source using the touchscreen GUI will automatically change the system wavelength to the wavelength option closest to the laser wavelength. It will take several seconds to switch from one laser to the other. The Laser On/Off, Bias On/Off, Bias Mode, and VOA settings will persist once the laser switchover is complete. For example, if the 1310 nm laser is currently selected and turned on with the modulator operating in Quadrature bias mode, the user may choose to switch to the C-band laser. The MX instrument will then automatically go through the following sequence with no further user intervention: turn off the 1310 nm laser, switch the PM fiber switch to the C-band laser, turn on the C-band laser, switch the system wavelength to 1550 nm, complete a bias calibration, and resume operation at the previously configured bias point. If the laser source is changed while bias control is off, the sequence above still takes place but configures the bias point at quadrature to reduce the likelihood of accidentally oversaturating a detector downstream.

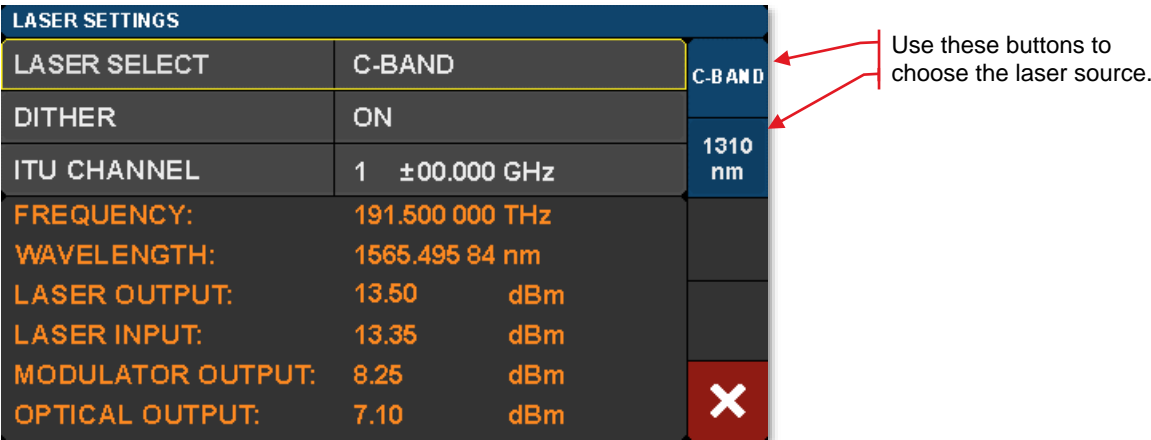


Figure 42 Changing Laser Source in the Dual Band Model

Figure 43 shows laser frequency noise as a function of optical frequency when the laser is operated with and without dither enabled. The red trace shows low noise operation when dither is turned off. Wavelength stability is improved by operating with dither, but the blue trace shows that this comes at the expense of added noise.

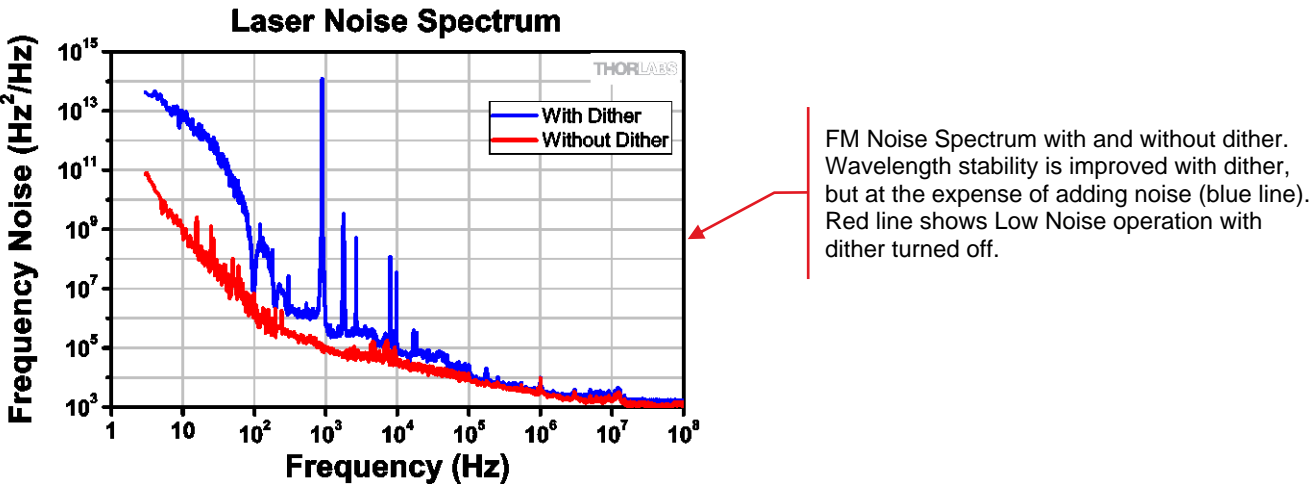


Figure 43 FM Noise Spectrum of the Laser

4.7 Load Page

Access the Load page by tapping the blue Load button on the Home page. The Load page has a factory-defined, standard operating mode stored as a preset. Applying the preset configures the converter with the stored instrument settings and is a fast way to put the instrument in a known state.

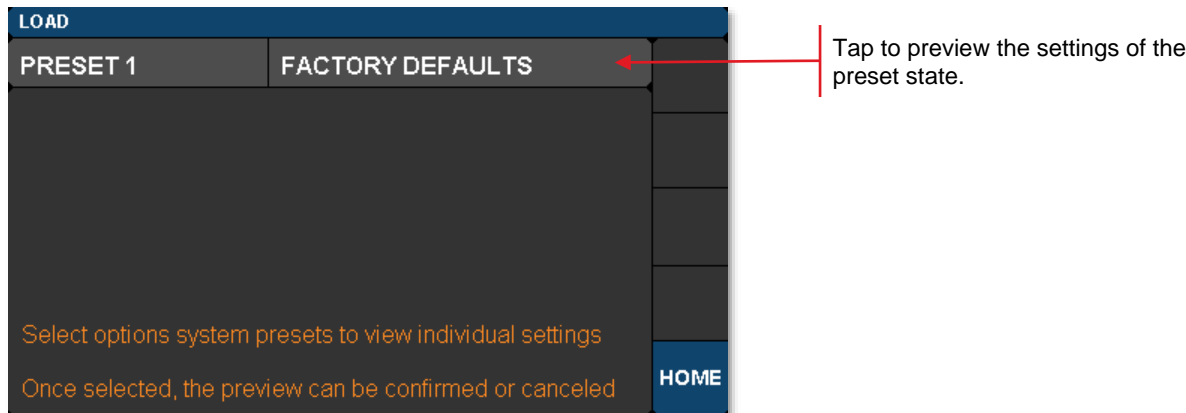


Figure 44 Preset State Option Accessed through the Load Page

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.

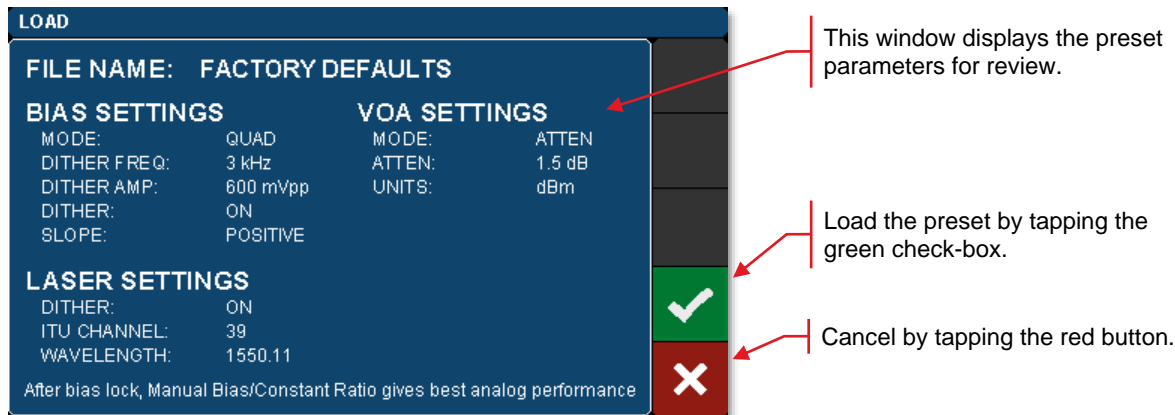


Figure 45 Stored Instrument Settings of a Preset

4.8 Menu Page

Access the Menu page by tapping the blue Menu button on the Home page. The Menu page links to pages that allow the user to control the system wavelength, display, sounds, and accent lights. Links to system information and guidance for obtaining help from Thorlabs' Technical Support are also included on this page. The functions and information available through this page are described in the following sections.

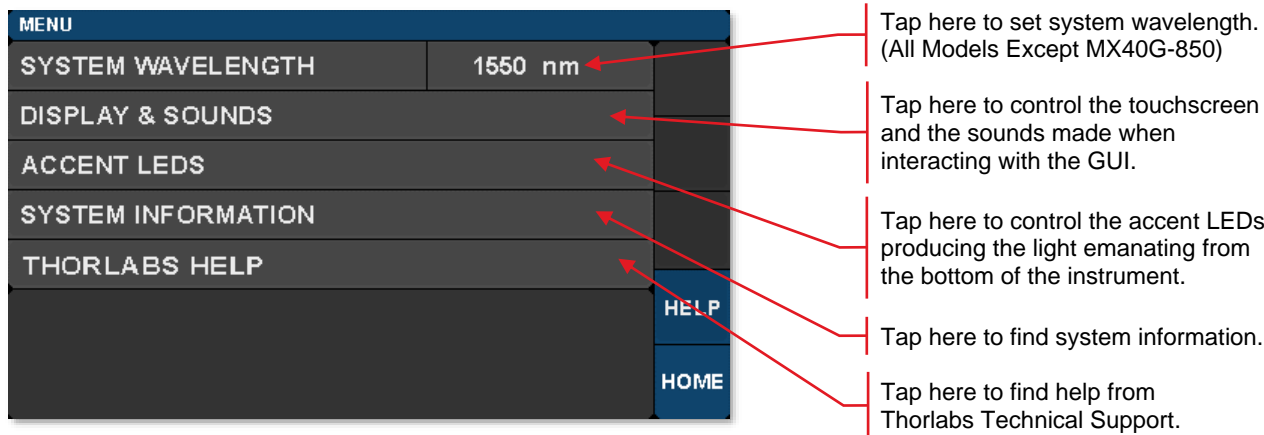


Figure 46 Controls on the Menu Page

4.8.1 System Wavelength (All Models Except MX40G-850)

**Note:** This section does not apply to the MX40G-850 converter which has a single calibration wavelength of 850 nm and no external laser input.

The path to access this screen: Home Page> Menu Page> System Wavelength.

The operational wavelength range of the MX40G and MX70G series of converters extends from 1250 nm to 1610 nm. The three calibration wavelengths of the power monitors, 1310 nm, 1550 nm, and 1590 nm, represent the centers of the O-band, C-band, and L-band and provide the user with accurate power readings at or near those wavelengths.

The system wavelength should always be set to the wavelength closest to that of the laser source. Each converter's system wavelength is factory-preset to correspond to the wavelength band of the integrated laser source. The dual band model automatically changes the system wavelength to correspond to the wavelength band of the selected integrated laser source. If an external laser is used with the converter, the system wavelength may need to be changed as shown in Figure 47.

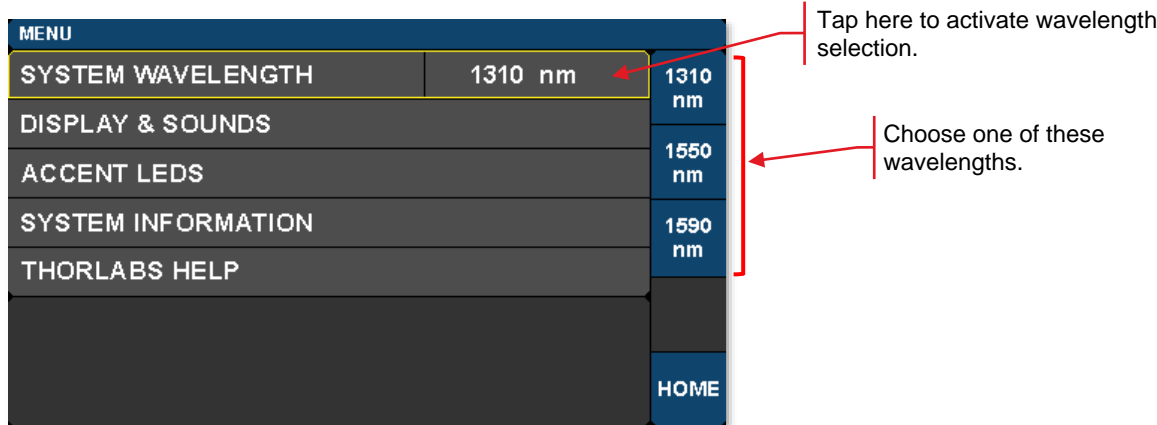
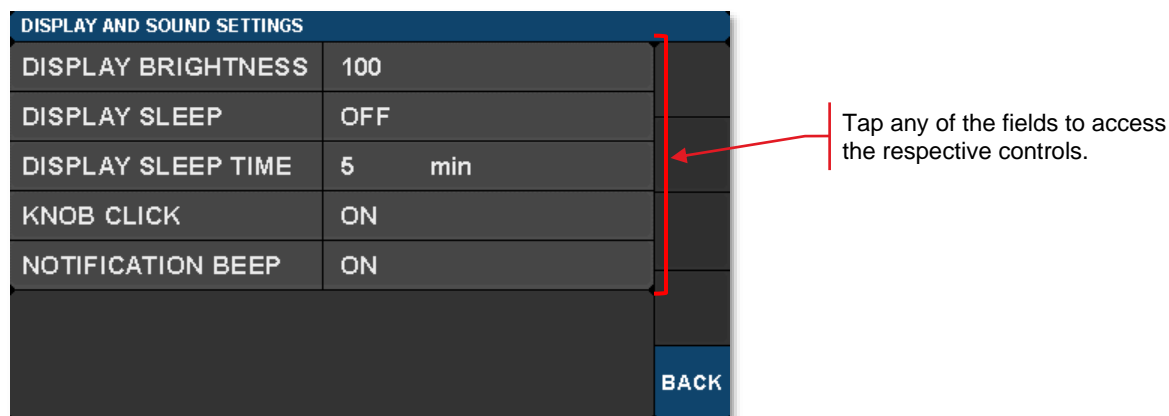


Figure 47 Selecting the System Wavelength



### 4.8.2 Display and Sound Settings Page

To open the screen shown below, tap the DISPLAY AND SOUNDS button on the Menu pane.



**Figure 48** Display and Sound Settings Page

DISPLAY BRIGHTNESS controls the overall brightness of the touch-screen display. Adjusting the brightness to 0 forces the display to enter Sleep mode. Exit Sleep mode by touching the display or turning/pressing the adjustment knob.

DISPLAY SLEEP toggles the ability to enter Sleep mode (On/Off). When On, Sleep mode will be entered when the sleep time has expired due to no user interaction with the touch-screen display or adjustment knob. When Sleep mode is entered, the touch-screen display turns off while allowing the unit to continue to function. Exit Sleep mode by touching the display or turning/pressing the adjustment knob.

DISPLAY SLEEP TIME controls how long the touch-screen display is visible before entering Sleep mode.

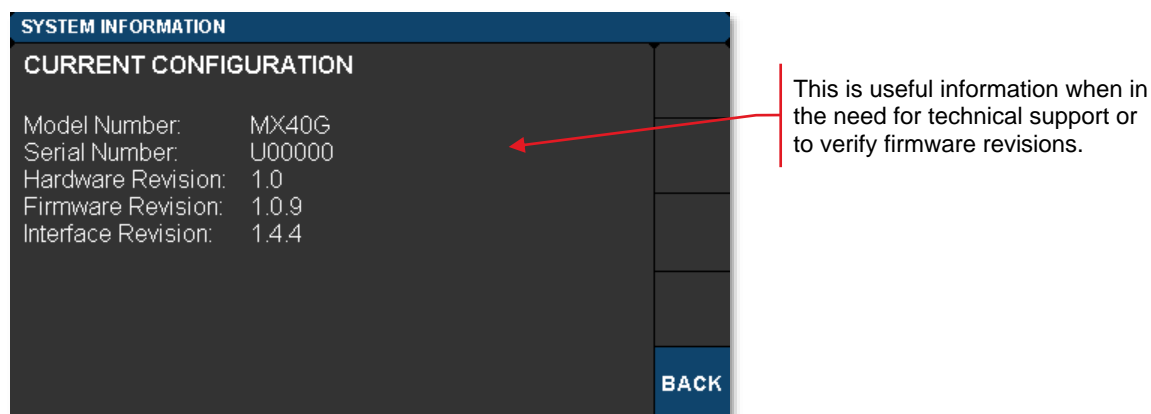
KNOB CLICK toggles the sound produced when turning the adjustment knob (On/Off).

NOTIFICATION BEEP toggles the sound associated with on-screen notifications (On/Off). Any notification or error that appears on the screen will produce a beep (MIN/MAX adjustment, Power Limited, Power Low, etc).

### 4.8.3 System Information Page

To open the screen shown below, tap the SYSTEM INFORMATION button on the Menu pane.

The System Information page displays the installed hardware and software versions.

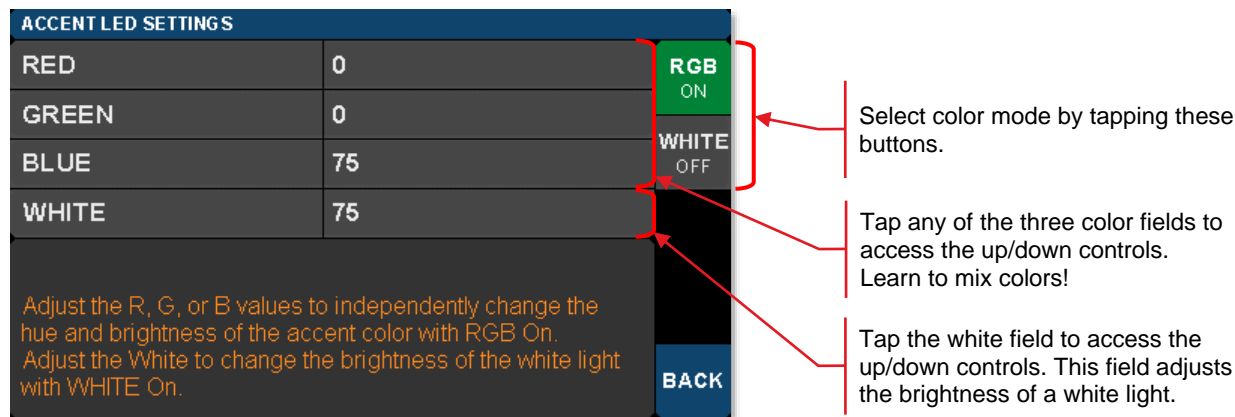


**Figure 49** System Information Page

#### 4.8.4 Accent LED Settings Page

To open the screen shown below, tap the ACCENT LEDS button on the Menu pane.

The accent LED settings control the intensity of the color LEDs that emanate from the bottom of the instrument. These are a fun aesthetic feature. You can set them to your favorite color.

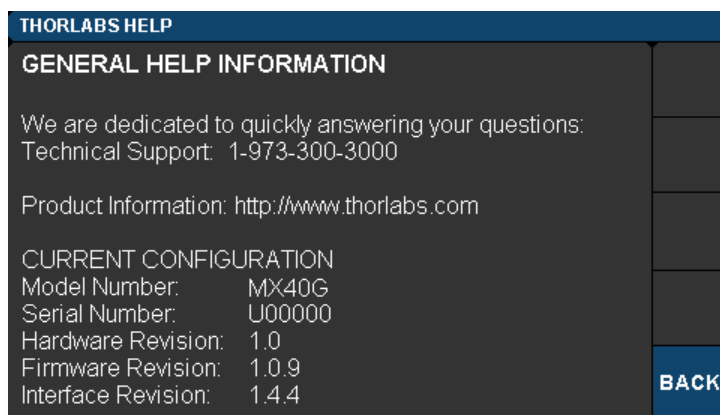


**Figure 50 Controls to Adjust the LEDs Providing the Under-Instrument Accent Light**

#### 4.8.5 Thorlabs Help Page

To open the screen shown below, tap the THORLABS HELP button on the Menu pane.

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.



**Figure 51 Thorlabs Help Page**

## Chapter 5 Specifications

### 5.1 General System Specifications

#### 5.1.1 All Models Except MX40G-850

All Specifications are at 1550 nm and 25 °C ambient temperature, unless otherwise noted. Specifications that are specific to models in the MX40G or MX70G series will be marked as such.

Parameter		Typical Values	Notes
Laser Output Power	MX40G, MX40G-LB, MX40G-1310 MX70G, MX70G-LB, MX70G-1310	13.5 dBm Max	From Internal Laser
	MX70G-DB1	12.5 dBm Max	
Optical Input Power		20 dBm Max	From External Laser, 22 dBm Absolute Max
Optical Output Power <sup>1,2</sup>	MX40G, MX40G-LB, MX40G-1310 MX70G, MX70G-LB, MX70G-1310	8.5 dBm at 1550 nm 6.5 dBm at 1310 nm	Biased for Peak Optical Output
	MX70G-DB1	7.5 dBm at 1550 nm 5.5 dBm at 1310 nm	
Internal Laser Wavelength Range	MX40G, MX70G	C-Band	Tunable in 50 GHz Steps
	MX40G-LB, MX70G-LB	L-Band	Tunable in 50 GHz Steps
	MX40G-1310, MX70G-1310	1310 nm	Fixed-Wavelength
	MX70G-DB1	1310 nm C-Band	Fixed Wavelength Tunable in 50 GHz Steps
External Laser Wavelength Range <sup>3</sup>		1250 nm - 1610 nm	-
Calibrated Wavelengths		1310 nm, 1550 nm, 1590 nm	User Selectable
RF Optical Extinction Ratio		13 dB Max	-
Input RF Connector Type	MX40G Series	2.92 mm Connector <sup>4</sup>	-
	MX70G Series	1.85 mm Connector <sup>5</sup>	
Frequency Response <sup>6</sup>	MX40G Series	DC - 40 GHz	-
	MX70G Series	DC - 70 GHz	
Uncertainty of Supplied Magnitude Response <sup>7</sup>	MX40G Series	±0.85 dB	From 40 MHz to 40 GHz
		±0.85 dB	From 40 MHz to 40 GHz
	MX70G Series	±1.75 dB	From 40 GHz to 70 GHz
Modulator RF Input		1 V <sub>pp</sub> Max for Linear Response <sup>8</sup>	±5 V Absolute Max DC 10 V <sub>pp</sub> Absolute Max RF
Modulator V <sub>π</sub>		5.5 V <sub>pp</sub>	At 1 GHz

<sup>1</sup> When using internal laser and supplied loopback cable, can be reduced by using the internal VOA

<sup>2</sup> Insertion loss is typically 3 dB higher when bias is set at quadrature point

<sup>3</sup> Using the modulator at another wavelength (e.g. visible light) may cause an increase in insertion loss and will void the warranty.

<sup>4</sup> The 2.92 mm connector can mate directly to an SMA, 3.5 mm, or K connector.

<sup>5</sup> The 1.85 mm connector can mate directly to a 2.4 mm or V connector.

<sup>6</sup> Measured frequency response provided in \*.s2p file on a USB drive with each unit.

<sup>7</sup> At each frequency specified in the frequency response file.

<sup>8</sup> With Bias Point at Quadrature

Parameter	Typical Values	Notes
Optical Insertion Loss	5.0 dB at 1550 nm 7.0 dB at 1310 nm	From Laser IN to Optical OUT
Absolute Stability <sup>9</sup>	0.20 dB (Dither Mode) 0.25 dB (Ratio Mode)	Stability of Modulation Amplitude at any Single Frequency Point
Relative Stability <sup>9</sup>	0.2 dB (Dither Mode) 0.2 dB (Ratio Mode)	Stability of Modulation Amplitude Between Frequency Points (Response Shape)
Fiber Type	PM1310-XP (Loopback Fiber) SMF-28 (Optical out)	-

<sup>9</sup> Biased at quadrature for a temperature range of 3 °C and a time period of 4 hours, following a 15-minute warm-up period.

### 5.1.2 MX40G-850

All Specifications are at 850 nm and 25 °C ambient temperature, unless otherwise noted.

Parameter	Typical Values	Notes
Laser Output Power (Max)	10 dBm	From Internal Laser <sup>10</sup>
Internal Laser Wavelength	852 nm	-
Optical Output Power <sup>11,12</sup>	4.5 dBm	Biased for Peak Optical Output
RF Optical Extinction Ratio	13 dB	-
Input RF Connector Type	2.92 mm Connector <sup>13</sup>	-
Frequency Response <sup>14</sup>	DC - 40 GHz	-
Uncertainty of Supplied Magnitude Response <sup>14</sup>	±1.20 dB	From 40 MHz to 20 GHz
	±2.30 dB	From 20 GHz to 40 GHz
Modulator RF Input	±1 V Max for Linear Response <sup>15</sup> ±5 V Absolute Max	-
Modulator $V_{\pi}$	4.8 V <sub>pp</sub>	At 1 GHz
RF Optical Insertion Loss	5.5 dB	From Internal Laser Output to Optical OUT
Absolute Stability <sup>16</sup>	0.2 dB (Dither Mode)	Stability of Modulation Amplitude at any Single Frequency Point
Relative Stability <sup>16</sup>	0.2 dB (Dither Mode)	Stability of Modulation Amplitude between Frequency Points (Response Shape)
Fiber Type	780HP	At Laser Aperture

<sup>10</sup> Laser is internal to the instrument and laser output is not user accessible.

<sup>11</sup> Can be reduced by using the internal VOA.

<sup>12</sup> Output power is typically 3 dB lower when bias is set at quadrature point.

<sup>13</sup> The 2.92 mm connector can mate directly to an SMA, 3.5 mm, or K connector.

<sup>14</sup> Measured frequency response provided in \*.s2p file on a USB drive with each unit.

<sup>15</sup> With Bias Point at Quadrature

<sup>16</sup> Biased at quadrature for a temperature range of 5 °C and a time period of 4 hours, following a 15-minute warm-up period.

## 5.2 Power and 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
Relative Humidity	5%	85%

## 5.3 Internal Control Specifications

Parameter	Typical	Notes
Power Monitors Accuracy	±0.5 dBm	Each Monitor, At Calibrated Wavelength
Power Monitors Resolution	0.01 dBm	Each Monitor
Power Monitor Insertion Loss	0.1 dB Typical	Per Monitor
VOA Attenuation Range	1 dB - 20 dB	-
VOA Response Time	1 s	-

## 5.4 Laser Specifications

### 5.4.1 Tunable Lasers

Parameter		Unit	Min	Typ.	Max
<b>C-Band Tunable Laser (MX40G, MX70G, MX70G-DB1)</b>					
Optical Output Power	MX40G, MX70G	dBm	12.5	13.5	14.5
	MX70G-DB1		11.5	12.5	
Frequency Range		THz	191.50	-	196.25
Wavelength Range		nm	1527.6	-	1565.5
Frequency Accuracy		GHz	-1.5	-	1.5
Tuning Resolution		GHz	-	50	-
Tuning Speed (Between Wavelengths)		s	-	10	-
Fine Tuning Resolution		MHz	-	1	-
Fine Tuning Speed		GHz/s	-	1	-
Fine Tuning Range		GHz	-30	-	30
Side Mode Suppression Ratio (SMSR)		dB	40	55	-
Optical Signal to Noise Ratio (OSNR)		dB	40	60	-
Intrinsic Linewidth		kHz	-	10	15
Relative Intensity Noise (RIN)		dB/Hz	-	-	-145
Back Reflection		dB	-	-	-14
Polarization Extinction Ratio (PER)		dB	18	-	-
<b>L-Band Tunable-Laser (MX40G-LB, MX70G-LB)</b>					
Optical Output Power		dBm	12.5	13.5	14.5
Frequency Range		THz	186.35	-	190.95
Wavelength Range		nm	1570.0	-	1608.8
Frequency Accuracy		GHz	-1.5	-	1.5
Tuning Resolution		GHz	-	50	-
Tuning Speed (Between Wavelengths)		s	-	10	-
Fine Tuning Resolution		MHz	-	1	-
Fine Tuning Speed		GHz/s	-	1	-
Fine Tuning Range		GHz	-30	-	30
SMSR		dB	40	55	-
OSNR		dB	40	60	-
Intrinsic Linewidth		kHz	-	10	15
RIN		dB/Hz	-	-	-145
Back Reflection		dB	-	-	-14
PER		dB	18	-	-

### 5.4.2 Fixed-Wavelength Lasers

Parameter		Unit	Min	Typ.	Max
<b>1310 nm Fixed-Wavelength Laser (MX40G-1310, MX70G-1310, MX70G-DB1)</b>					
<b>Optical Output Power</b>	MX40G-1310, MX70G-1310	dBm	12.5	13.5	14.5
	MX70G-DB1		11.5	12.5	
<b>Wavelength</b>		nm	1300	1310	1320
<b>SMSR</b>		dB	35	-	-
<b>Intrinsic Linewidth</b>		MHz	-	2	3
<b>PER</b>		dB	-	20	-
<b>852 nm Fixed-Wavelength Laser (MX40G-850)</b>					
<b>Optical Output Power</b>		dBm	-	10	-
<b>Wavelength</b>		nm	850	852	854
<b>SMSR</b>		dB	35	-	-
<b>Intrinsic Linewidth</b>		MHz	-	2	3
<b>PER</b>		dB	-	20	-



## Chapter 6 Control and PC Connections

### 6.1 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 MX40G and MX70G converters 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. When using the RS-232 connector, a null modem cable is required to operate with most USB to RS-232 adapters. 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 tools are available from Thorlabs' website at [https://www.thorlabs.com/software\\_pages/viewsoftwarepage.cfm?code=MX](https://www.thorlabs.com/software_pages/viewsoftwarepage.cfm?code=MX). 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 and 3.3 V indicates High Gain. For all models except the MX40G-850, Low Gain is 40 V/W and High Gain is 4000 V/W. For the MX40G-850, Low Gain is 50 V/W for Mon 1 and 100 V/W for Mon 2 and Mon 3 while High Gain is 5000 V/W for Mon 1 and 10,000 V/W for Mon 2 and Mon 3.

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.

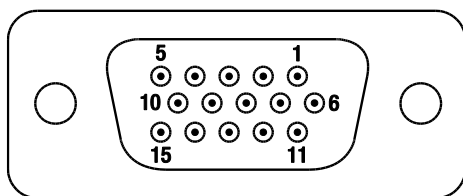


Figure 52 I/O Connector Pin Configuration

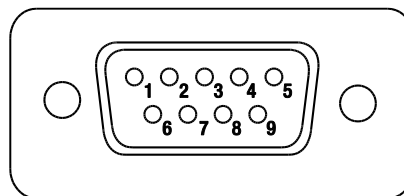


Figure 53 RS-232 Connector Pin Configuration

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

RS-232 Connector (DB9)	
Pin #	Description
1	Not Connected
2	RS-232 Input
3	RS-232 Output
4	Not Connected
5	Digital Ground
6	Not Connected
7	Not Connected
8	Not Connected
9	Not Connected

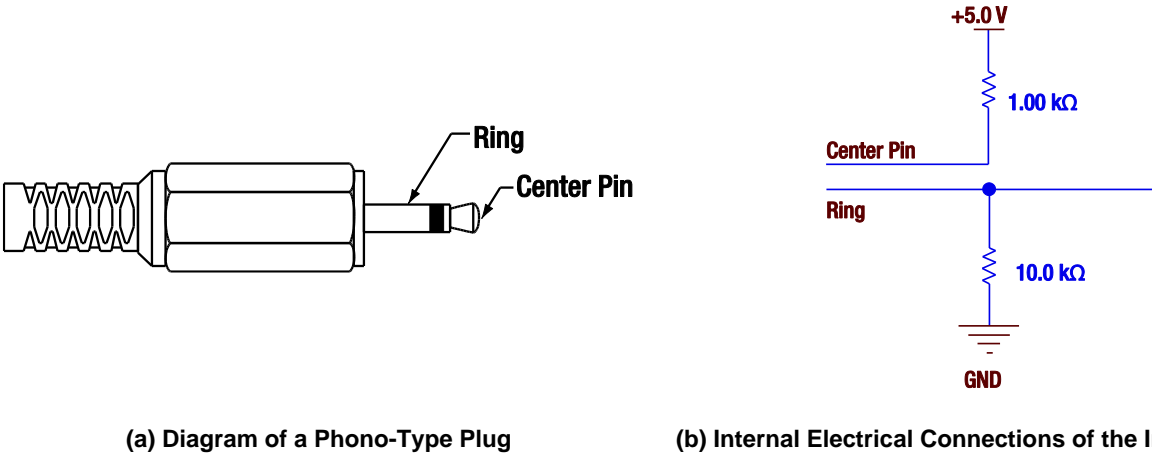
## 6.2 The Laser Safety Interlock

The laser is equipped with a phono-type interlock jack located on the back panel. To enable the laser source, a short circuit must be applied across the terminals of the interlock connector. The shorting device (interlock pin) installed in all units shipped from Thorlabs performs this function. Leave the shorting device installed unless using an external safety circuit or other type of remotely controlled switch to enable laser output.

Making use of the Interlock feature requires the appropriate 2.5 mm phono-type plug, which is diagrammed in Figure 54(a) and is readily available through most electronics retailers. The plug should be wired to the external safety circuit or switch and then plugged into the back panel's interlock jack in place of the shorting device. The electrical specifications of the interlock jack are listed in the following table, and the circuit schematic describing how the interlock jack is connected inside the laser head is shown in Figure 54(b).

Specification	Value
Interlock Switch Requirements	Must be Normally Open Dry Contacts Apply no External Voltages to the Interlock Input
Type of Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	<5 VDC (Center Pin is at 5 VDC, Ring is Ground)
Short Circuit Current (Typical)	7 mA
Connector Polarity	Tip is Ground, Barrel is at 5 VDC Max

The user's safety circuit must be attached to the phono plug and wired such that the ring and center pin are shorted when it is safe to enable the laser. The laser will be enabled when connection is closed. If it changes to an open state, the laser source will turn off.



**Figure 54** The interlock circuitry internal to the laser head applies a 5 VDC bias across the ring and center pin of the plug. An external circuit that shorts the ring and center pin enables the laser.

Chapter 7      Mechanical Drawings

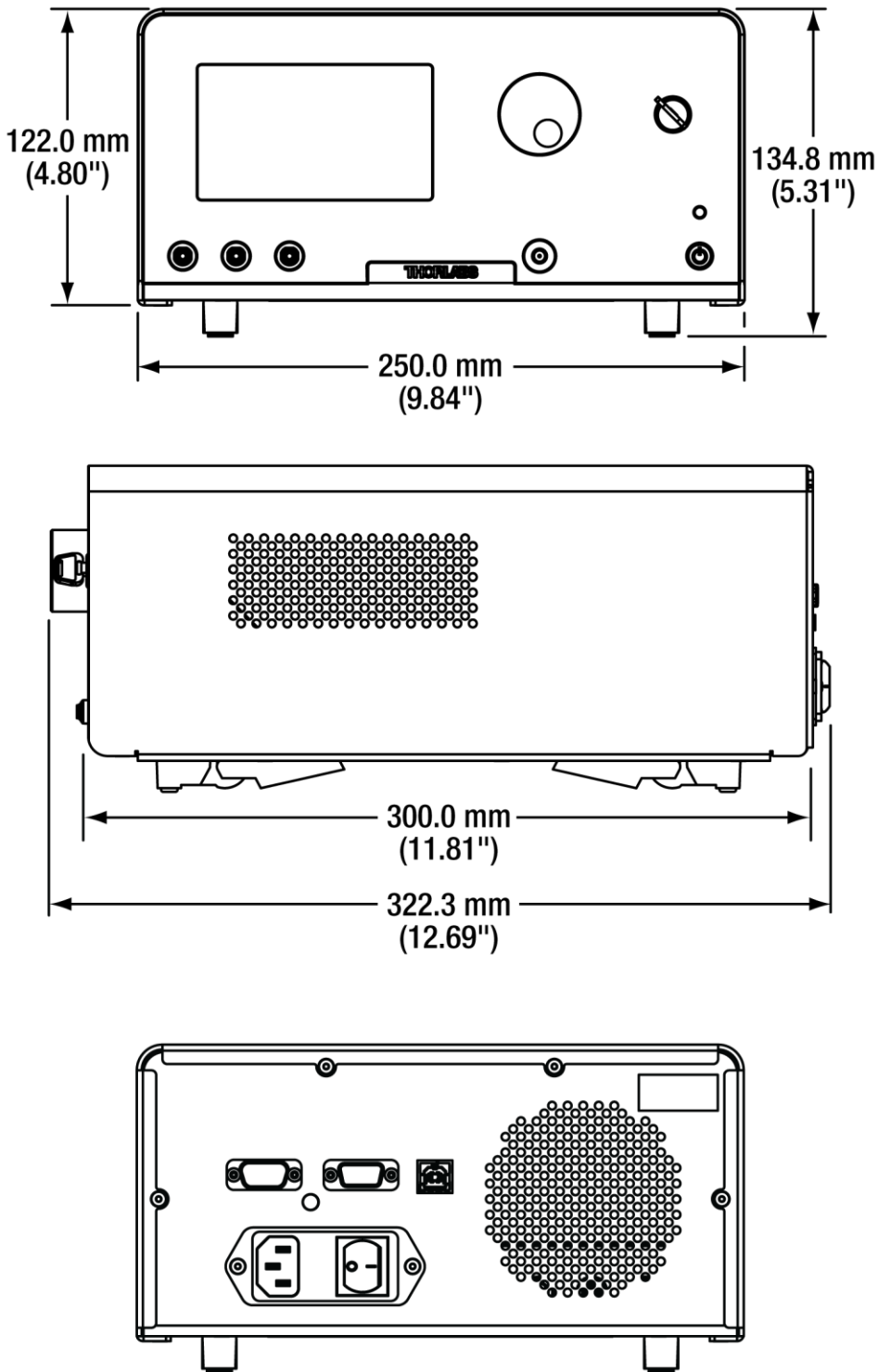


Figure 55    E-O Converter Mechanical Drawing

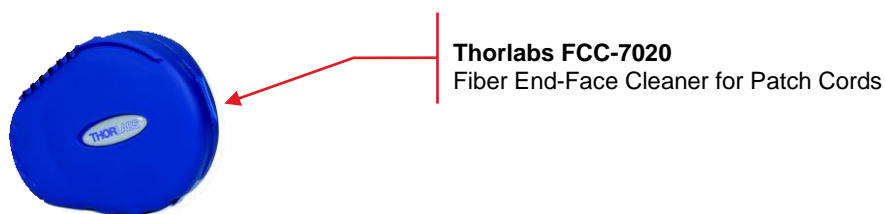
## Chapter 8 Maintenance, Repair, and Fuses

### 8.1 Maintenance and 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 FBC250. This allows the user to clean the fiber end-face without removing it from the internal bulkhead adapter.



**Thorlabs FBC250**  
Fiber End-Face Cleaner for Bulkheads

### 8.2 Replacement Parts

The following parts can be obtained by contacting Thorlabs Technical Support

- SMA 50  $\Omega$  Loads (Used for Front Panel RF Connectors)
- PM Loopback Fiber Patch Cord for Front Panel (All Models Except MX40G-850)
- Laser Interlock Keys for Front Panel Switch
- 2.5 mm Interlock Pin (for Back Panel)
- 1.25 A 250 VAC Fuse for Main Power
- Instrument IEC Main Power Cord
- Instrument Flip Foot

### 8.3 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)



**Figure 56** Power Entry Module



**Figure 57** Removing the Fuse Holder Slide

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.**



**Figure 58** Fuse

1. 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.
2. 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 9 Troubleshooting

Below is some information about status indicators and a few checks to help in troubleshooting general problems. 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 back power switch is in the "I" position
- Check the main power fuse (see Maintenance and Repair Section)

**The color of the Standby Button, which is on the front panel, indicates several status conditions as follows:**

Standby Button Color	Condition
<b>Solid Green</b>	Indicates normal ON state.
<b>Solid Amber</b>	Indicates unit is in Standby Mode. Press the button to turn the instrument ON.
<b>Blinking Green</b>	Indicates the main AC power is unstable. When the AC power is restored, the instrument will return to the standby mode (amber).
<b>Blinking Amber</b>	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.
<b>Blinking Amber/Green</b>	Indicates the instrument is both overheated and the main AC power is unstable (see individual troubleshooting for these conditions above).
<b>Fading Amber/Green</b>	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**, resolving the problem always starts by cleaning the optical fiber ends. Contaminated fiber ends, which attenuates the intensity of the transmitted light, is a very common issue when using single-mode fibers. Follow the suggestions provided in the Maintenance and Repair section of this manual to clean the optical fiber ends.

## Chapter 10 Declaration of Conformity



### 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: MX40G, MX40G-850 MX40G-1310, MX40G-LB, MX70G, MX70G-1310, MX70G-LB  
MX70G-DB1**

**Equipment: 40GHz O-E Converter & 70GHz O-E Converter**

*is/are 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 60825-1	Safety of laser products	2014-05

*and which, issued under the sole responsibility of Thorlabs, is/are 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: 15 March 2017

Name: Danielle Strong

Position: Director of Quality and Compliance

EDC - MX40G, MX40G-850 MX40G-...



## Chapter 11 Thorlabs Worldwide Contacts

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



### USA, Canada, and South America

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### France

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### Japan

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sales@thorlabs.jp

### UK and Ireland

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### Scandinavia

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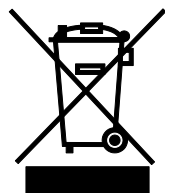
### Brazil

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### China

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Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return "end of life" Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out "wheelie bin" logo (see right), were sold to and are currently owned by a company or institute within the EC, and are not disassembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. "End of life" units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.



**Annex I**







**THORLABS**  
[www.thorlabs.com](http://www.thorlabs.com)

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