Operation Manual

Electrical to Optical Converter MN4775A Series

MN4775A-0040 40 GHz 850 nm E/O Converter
MN4775A-0070 70 GHz 1550 nm E/O Converter
MN4775A-0071 70 GHz 1310 nm E/O Converter
MN4775A-0072 70 GHz 1310/1550 nm E/O Converter
MN4775A-0110 110 GHz 1550 nm E/O Converter
MN4775A-0111 110 GHz 1310 nm E/O Converter

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The latest service and sales contact information, and updated documents can be downloaded from the Anritsu Website at: http://www.anritsu.com

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Chapter 1 — Introduction

1-1 Introduction

The *MN4775A Operation Manual* covers the E/O Converter basic functions, safety considerations, user interface definitions, user controllable parameters, and basic troubleshooting. The MN4775A can be used as a stand-alone instrument, or as part of a measurement system such as the Anritsu VectorStar™-based ME7848A/E system.

Read the VectorStar *Product Information, Compliance, and Safety Guide* (PN: 10100-00063) for important safety, legal, and regulatory notices *before* operating the equipment. For additional information and literature covering your product, visit the product page of your instrument and select the Library tab:

https://www.anritsu.com/test-measurement/products/me7848A

This chapter provides an overview of the MN4775A E/O Converter and a description of its major functions.

1-2 Contacting Anritsu for Sales and Service

To contact Anritsu, please visit:

https://www.anritsu.com/contact-us

From here, you can select the latest sales, service, and support contact information in your country or region, provide online feedback, complete a Talk to Anritsu form to get your questions answered, or obtain other services offered by Anritsu.

Updated product information can be found by searching for your product number in the search function on the Anritsu instrumentation product page:

https://www.anritsu.com/test-measurement/products

On this web page, you can select various tabs for more information about your instrument. Included is a Library tab which contains links to all the latest technical documentation related to this instrument.

1-3 Description

Anritsu's MN4775A series of Electrical to Optical (E/O) Converters offer frequency response to 40 GHz, 70 GHz, and 110 GHz. Each converter incorporates a telecommunication grade lithium niobate ($LiNbO_3$) modulator that is stabilized by a fully automatic bias controller. Select an internal tunable laser source or fixed-wavelength laser source or couple an external laser to the PM FC/PC fiber optic connector on the input panel. 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, although this remote connection is not required for the ME7848A/E system operation. The E/O Converters include:

- MN4775A-0040
- MN4775A-0070
- MN4775A-0071
- MN4775A-0072
- MN4775A-0110
- MN4775A-0111

These converters are particularly well suited for use as accessories that provide optical test capability for an all-electrical vector network analyzer (VNA). The laser can be used as a stimulus together with a calibrated O/E module (such as the MN4765X) to measure modulators, or the MN4775A can be used as a stimulus to measure O/E devices. Refer to "RF Frequency Response" on page 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; this is how the unit is operated as part of the ME7848A/E system. 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.

The most recent firmware can be downloaded by visiting www.anritsu.com. Anritsu technical support can provide up-to-date information on available firmware revisions.

1-4 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 (For Options 007x and 011x)
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

1-5 Block Diagram

Each E/O converter is fully integrated and contains the laser source, lithium niobate ($LiNbO_3$) 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 MN4775A-0040, MN4775A-0070, and MN4775A-0071 include an 850 nm fixed-wavelength laser, a C-band tunable laser, and a 1310 nm fixed-wavelength laser, respectively. The C-band laser source is tunable on the ITU 50 GHz grid and includes a dither feature for wavelength stabilization. An external laser source, operating from 1250 nm to 1610 nm, can also be used to provide the optical input for the MN4775A-0070 and the MN4775A-0071. The MN4775A-0040 does not have an external loop between the laser and modulator. The MN4775A-0072 has both a C-band tunable laser and a 1310 nm fixed-wavelength laser connected by an optical switch to the Laser Out port. The MN4775A-0110 has a C-band tunable laser. The MN4775A-0111 has a 1310 nm fixed-wavelength laser.

Either the internal laser or an external laser source may be coupled to the Laser In port (MN4775A-007x/MN4775A-011x), 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). 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 In, Mon-2 is at the MZM Output, and Mon-3 is at the final Optical Output.

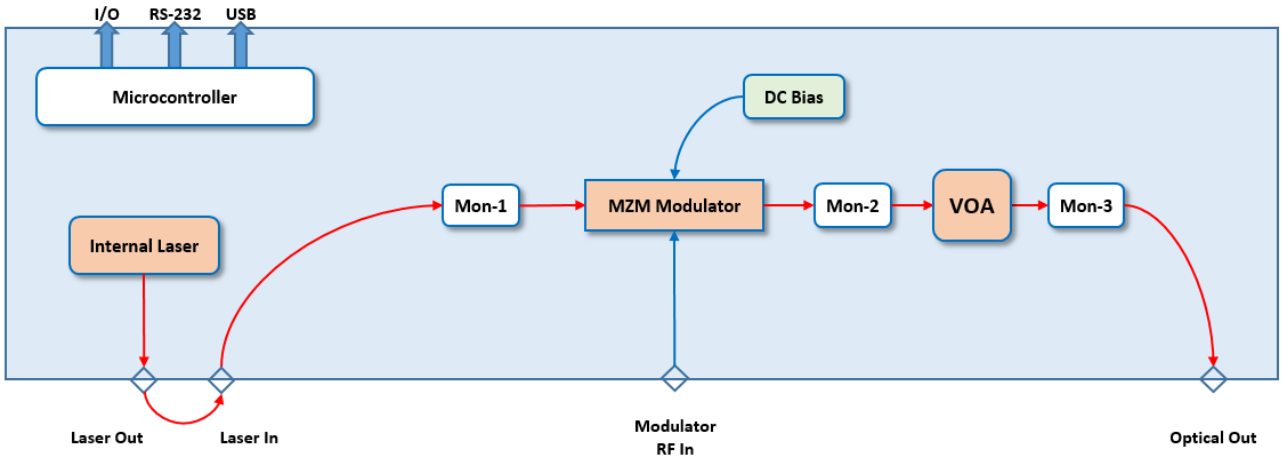


Figure 1-1. Key Components of the E/O Converter.

The Laser-Out to Laser-In loop is not present on the MN4775A-0040. In the MN4775A-0072, the 'internal laser' is actually two lasers connected by a switch.

1-6 Front and Back Panel Overview

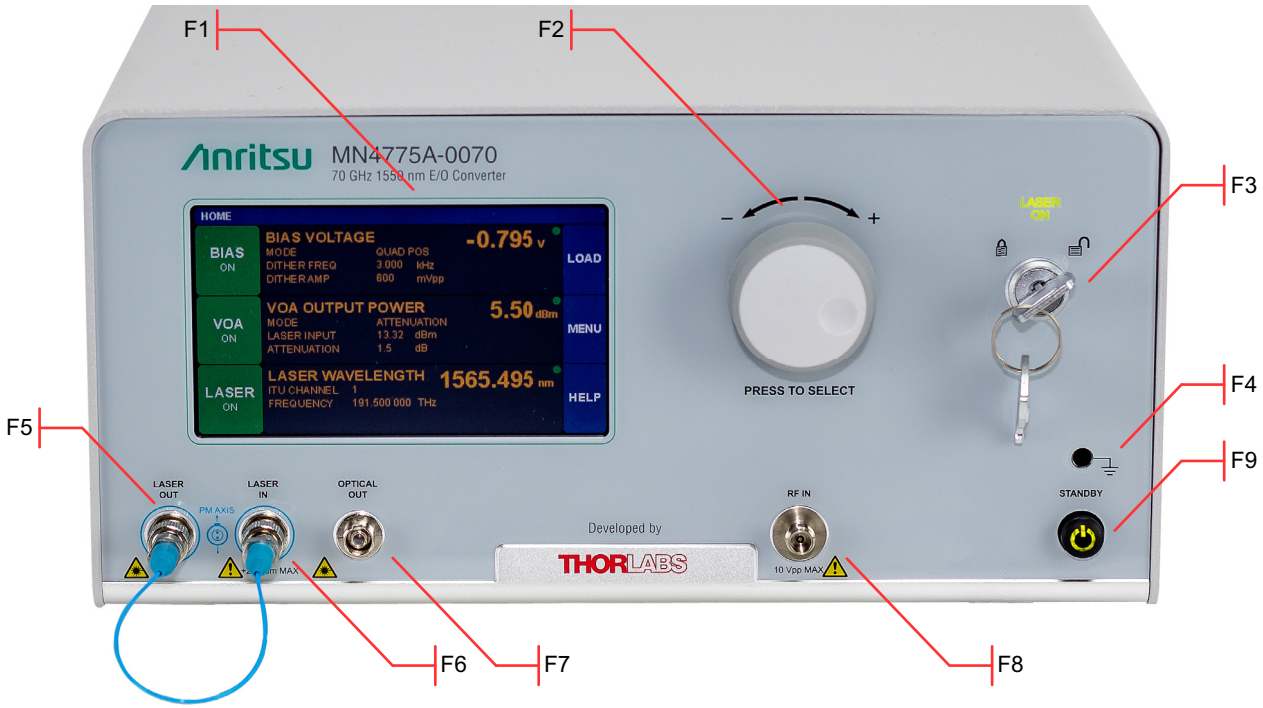


Figure 1-2. MN4775A-0070 Front Panel (Representative of all MN4775A Front Panels)

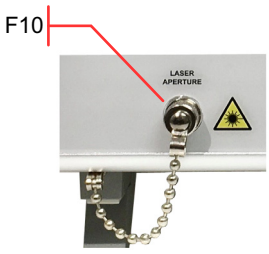


Figure 1-3. MN4775A-0040 Front Panel Laser Aperture Port and Cap

Table 1-1. MN4775A Front Panel Callouts (1 of 2)

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) Not available on the MN4775A-0040.
F6	Laser Input (PM FC/PC Connector) Not available on the MN4775A-0040.

Table 1-1. MN4775A Front Panel Callouts (2 of 2)

Callout	Description
F7	Optical Output (FC/PC Connector) Not available on the MN4775A-0040.
F8	Modulator RF Input MN4775A-0040: 2.92 mm Connector MN4775A-007x: 1.85 mm Connector MN4775A-011x: 1 mm Connector
F9	Standby Button
F10	Laser Aperture and Cap (FC/PC Connector) Not available on the MN4775A-007x/011x.

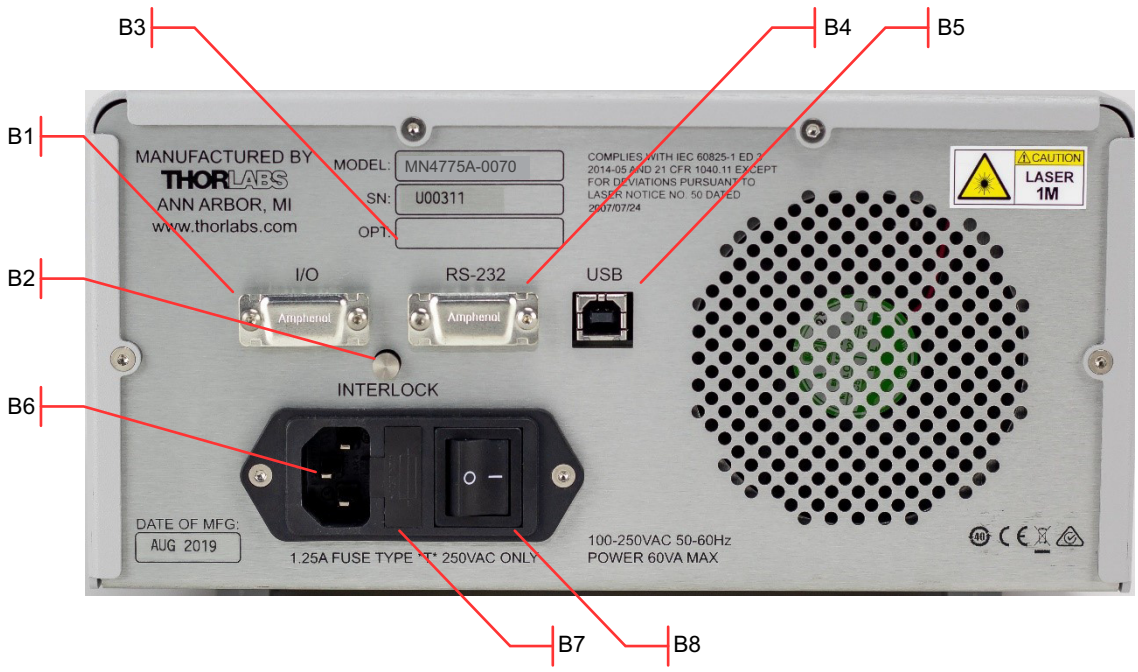


Figure 1-4. MN4775A-0070 Back Panel (Representative of all MN4775A Back Panels)

Table 1-2. MN4775A Rear Panel Callouts

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

1-7 Memory Volatility

The instrument retains no user measured data, but can retain setup parameters to include laser wavelength, optical power (and attenuation configuration), and modulator bias configuration when going in and out of Standby mode. These parameters can be cleared to factory default values by removing AC power, or by using the Load:Factory Defaults function.

Chapter 2 — Safety

2-1 Introduction

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 Anritsu may changes to single components be carried out or components not supplied by Anritsu 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 7-3 “Replacing the Main Fuse”). 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

The -007x and -011x options of the MN4775A are class 1M devices, while the MN4775A-0040 is a class 3B device (due to the shorter wavelength).

- **MN4775A-007x: Class 1M Laser**
- **MN4775A-011x: Class 1M Laser**

- **MN4775A-0040: Class 3B Laser**

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

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

Caution

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.

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).

Anritsu 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 Anritsu. 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. If necessary, ask for replacement packing material.

Chapter 3 — Quick Start Guide

3-1 Hardware Set-up

Caution

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 (|) position. The unit will now be in the “Standby” mode, and the front panel standby button should glow amber.

Figure 3-1. Power Cable Port, Fuse, and Power Switch

Figure 3-2. Indicator Glows Amber when Converter is In Standby

Attach the PM loopback fiber optic cable between the Laser Out and Laser In FC connectors on the front panel as shown in Figure 3-3. Be sure to clean both ends of the fiber as described in Chapter 7, “Maintenance”.

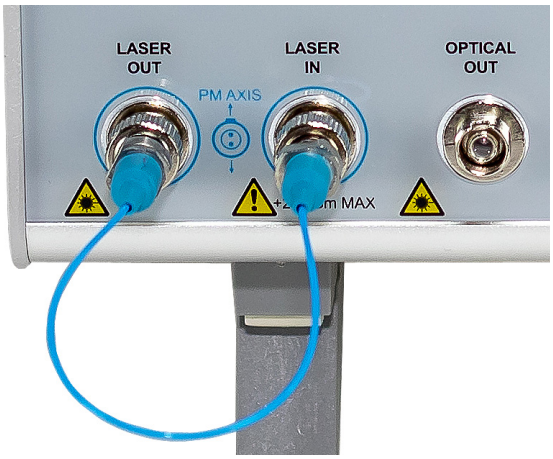


Figure 3-3. PM Loopback Fiber Cable Installed. This loopback is not present on the MN4775A-0040.

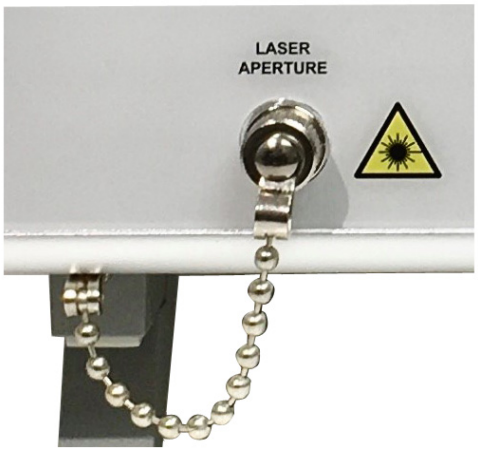


Figure 3-4. MN4775A-0040 Laser Aperture and Cap.

This aperture is only present on the MN4775A-004x models.

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 (as shown in Figure 3-5) 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, as shown in Figure 3-6. 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 with all functions OFF.

Figure 3-5. Interlock Key Switch

Figure 3-6. Indicator Glows Green when Converter is Fully Enabled

To return the unit to standby, press the Standby button again. When the unit is returned to standby, wait at least 30 seconds before disconnecting the power cord or turning off the main power switch on the rear panel.

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.

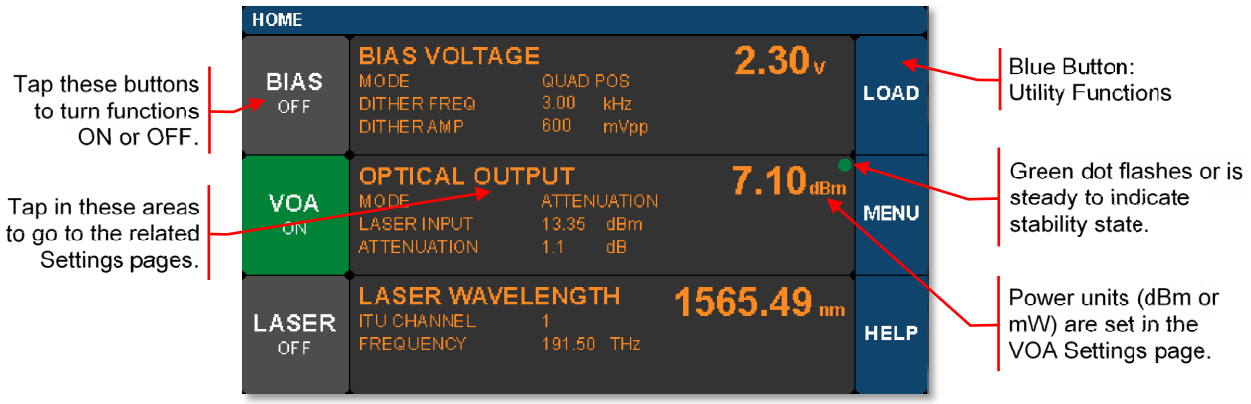


Figure 3-7. Home Screen Features

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.

Figure 3-8 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.

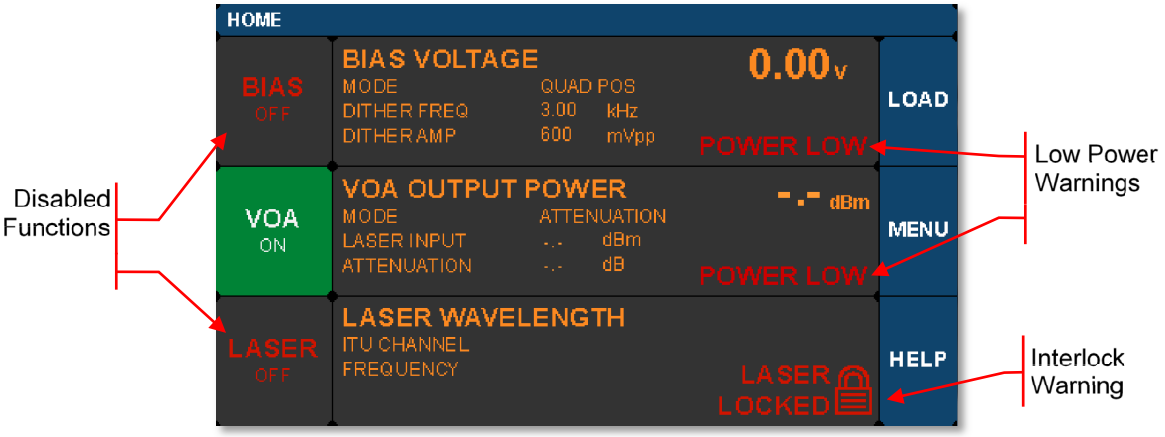


Figure 3-8. Home Screen Warnings and Indicators

3-3 System Wavelength Setting

Some versions of the MN4775A support multiple wavelengths and a selection is provided that is particularly useful when an external laser is used. In addition, some versions of the MN4775A have a tunable laser. Note that ME7848A/E system specifications are predicated on specific wavelength subranges (see the *ME7848A/E Technical Data Sheet* (11410-01145) for more information).

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. 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.

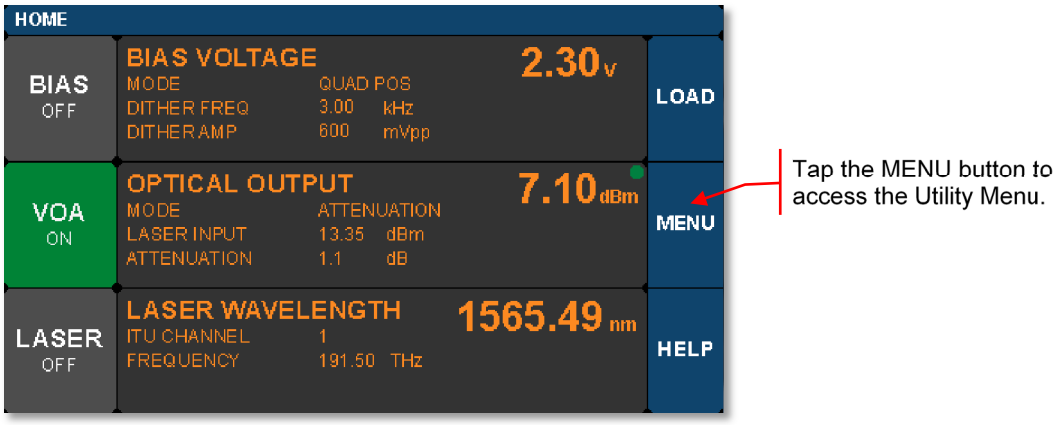


Figure 3-9. Accessing the Utility Menu from the Home Screen

Then tap the System Wavelength bar as shown in Figure 3-10 to bring up the wavelength choices. Tap the desired wavelength to set the System Wavelength.

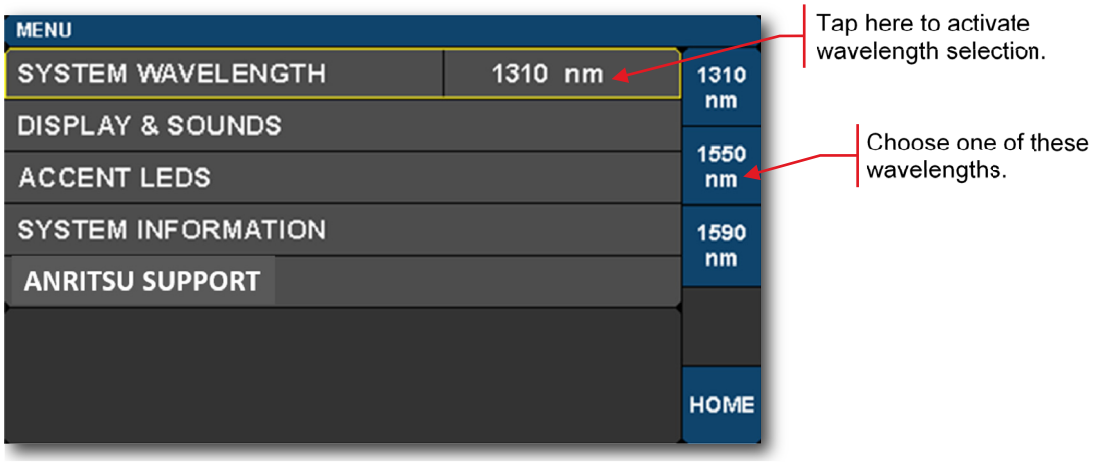


Figure 3-10. System Wavelength is Selected from the Utility Menu

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 in Figure 3-11. 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. Figure 3-11 shows examples of the touch-screen controls.

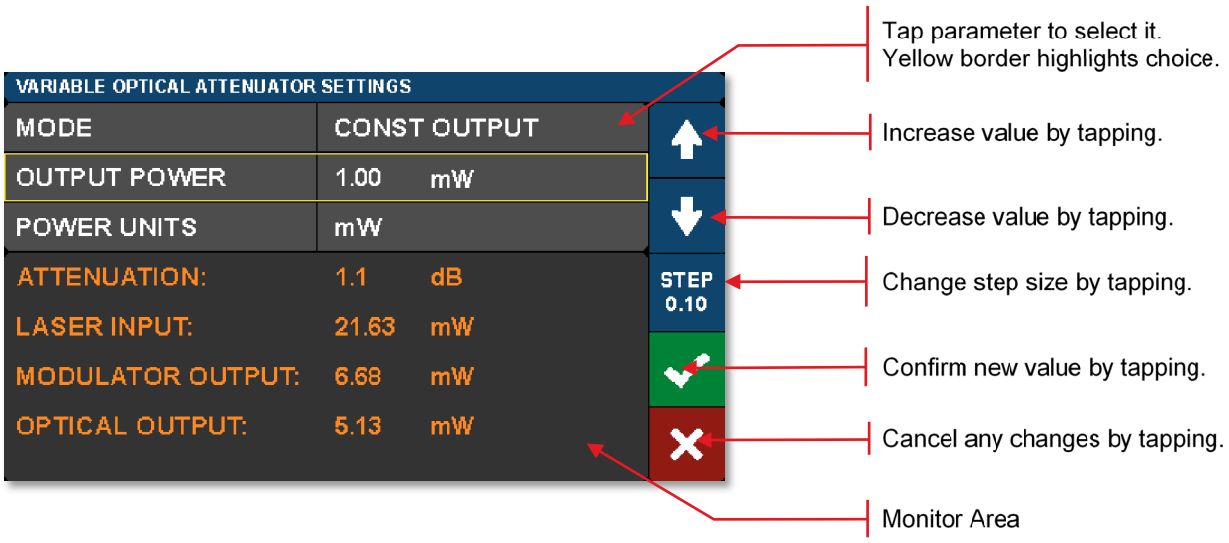


Figure 3-11. Controls used to Adjust and Save Values of Selected Parameters

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.

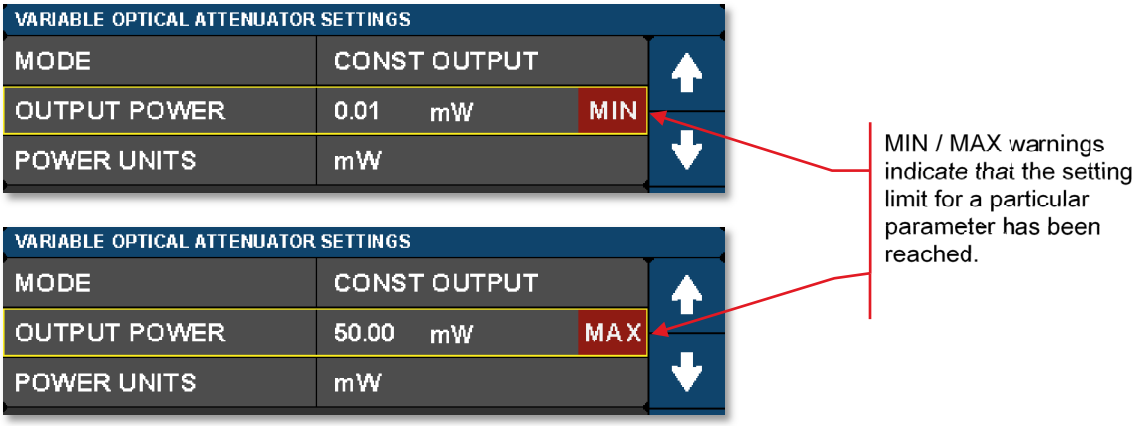


Figure 3-12. MIN and MAX Flags Indicate Bounds of Adjustable Value Ranges

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, "Operation Instructions" for additional information.

1. Turn on power to the converter via the power switch on the back panel (Figure 3-1).
2. Press and hold the button on the front panel until the indicator light changes from amber to green (Figure 3-2 and Figure 3-6).
3. Turn the key switch to unlock (Figure 3-5).
4. Turn the laser on by tapping the lower-left touchscreen button on the Home page (Figure 3-7).
5. Enable the bias controller by tapping the top-left touchscreen button on the Home page (Figure 3-7). Wait for completion of the calibration process. The instrument will enable the default Quadrature mode with positive slope bias point ("Quadrature Mode" on page 4-5). This is the desired mode for ME7848A/E system operation.
6. Take note of the output power, which is shown in the center right section of the Home page (Figure 3-7).
7. Turn on the VOA controller to adjust output power, if desired, by tapping the center-left touchscreen button on the Home page (Figure 3-7). Constant output is the desired mode for ME7848A/E system operation. Specified levels of optical power allow for the specified system dynamic range to be achieved:
   - -3 dBm for the -0040
   - +5 dBm for the -0070
   - +2 dBm for the -0071
   - +4 dBm for the -0072
   - +3 dBm for the -011x
8. Apply the input RF signal to the female RF IN connector on the front panel (Figure 3-13); the maximum modulator RF input for linear response is specified in the *MN4775A Technical Data Sheet* – 11410-01144.

Figure 3-13. MN4775A-0070 E/O Converter Front Panel

Chapter 4 — Operation 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 Figure 4-1. 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 in Figure 4-1.

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 Vπ, 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.

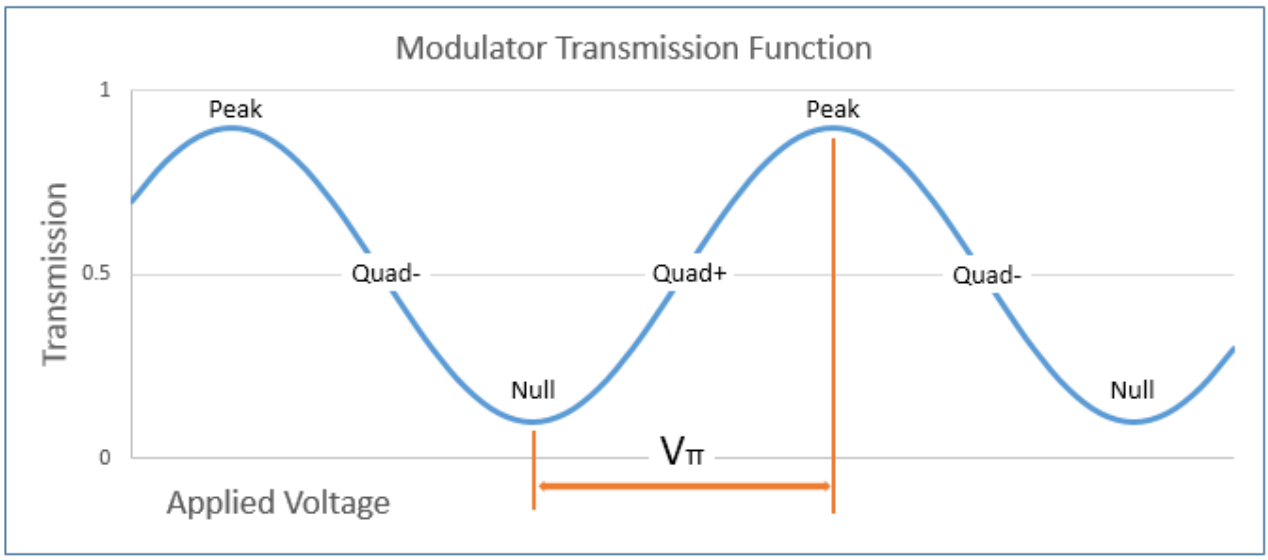


Figure 4-1. The Modulator Transmission Function

4-2 RF Frequency Response

One of the primary applications of the MN4775A is to facilitate O/E and E/O (as well as some O/O) device measurements. Typically, an MN4765X O/E module is used as the standard and its frequency response characteristics are de-embedded in order to analyze a modulator. For a modulator measurement, only the laser of the MN4775A might be used. When measuring O/E devices, the MN4765X is first used to characterize the MN4775A response and then the latter is used to characterize the DUT. Understanding the frequency response of the MN4775A is useful, as that will determine the accessible dynamic range in such a measurement.

An example frequency response for each converter is plotted in Figure 4-2 and Figure 4-3. The phase response is not shown.

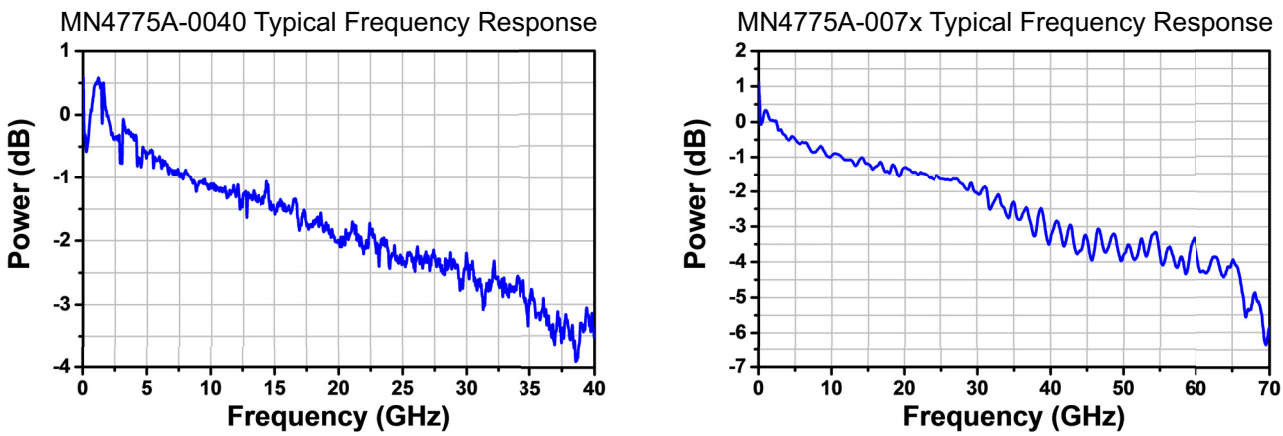


Figure 4-2. Example Frequency Response of the MN4775A-0040 Series and MN4775A-007x Series

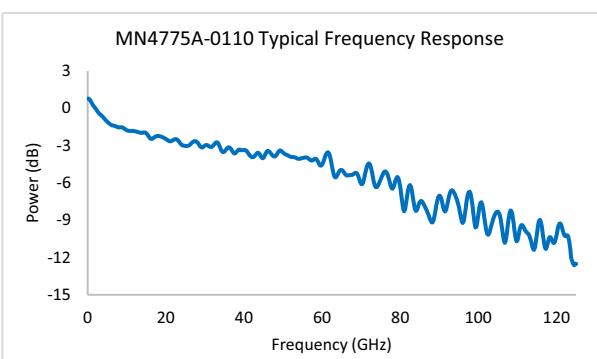


Figure 4-3. Example Frequency Response of the MN4775A-0110

4-3 Control Loop Diagram

Figure 4-4 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.

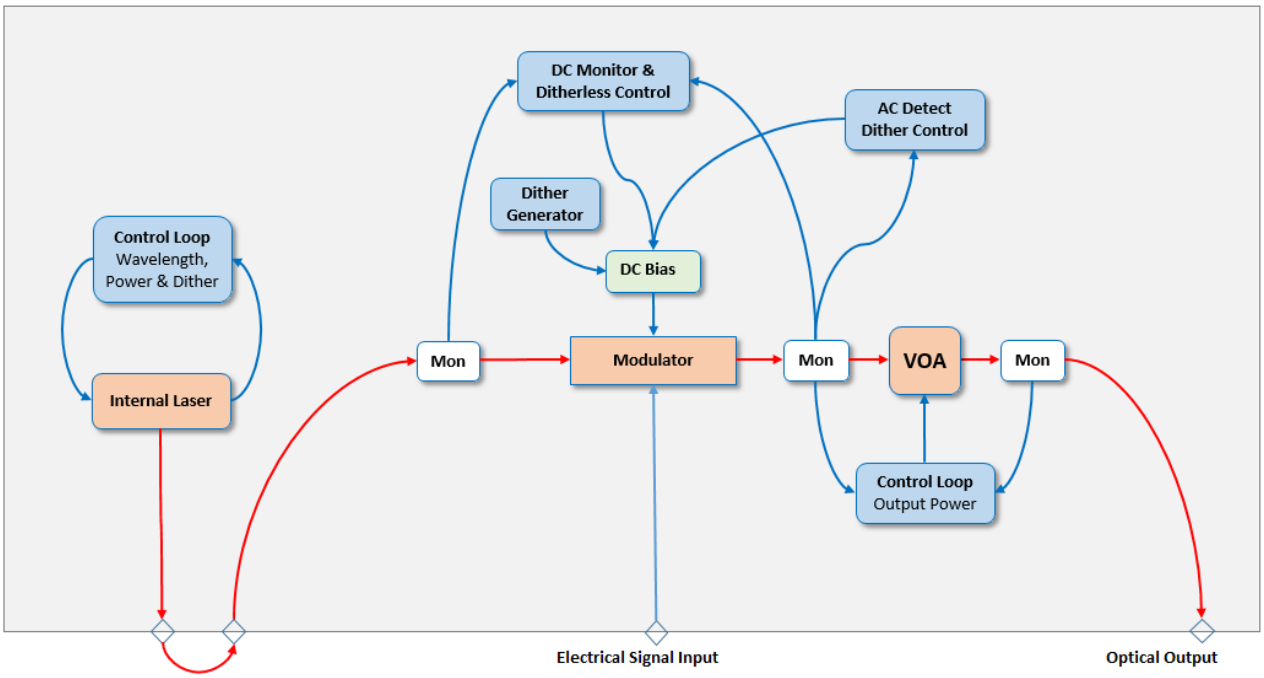


Figure 4-4. Block Diagram of the Converter Showing Control Loops

The external loop shown at the Internal Laser Output is not present on the MN4775A-0040.

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. If the laser is changed (between C-band and 1310 nm) in the MN4775A-0072, the Reset Auto Bias should be used. The bias settings screen is different for -011x models, in that dither selections are not available (a different centering scheme is used).

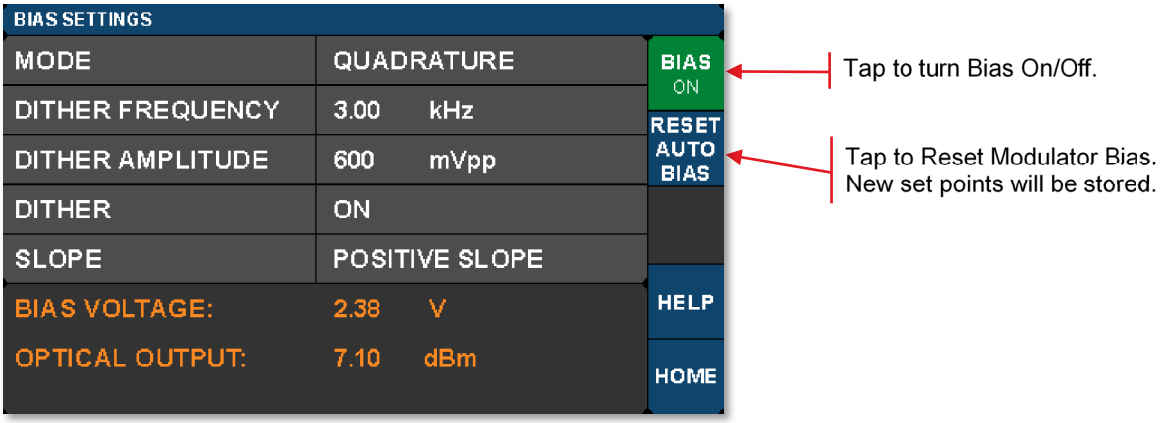


Figure 4-5. Bias Settings Home Screen for -004x and -007x models

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. Figure 4-6 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.

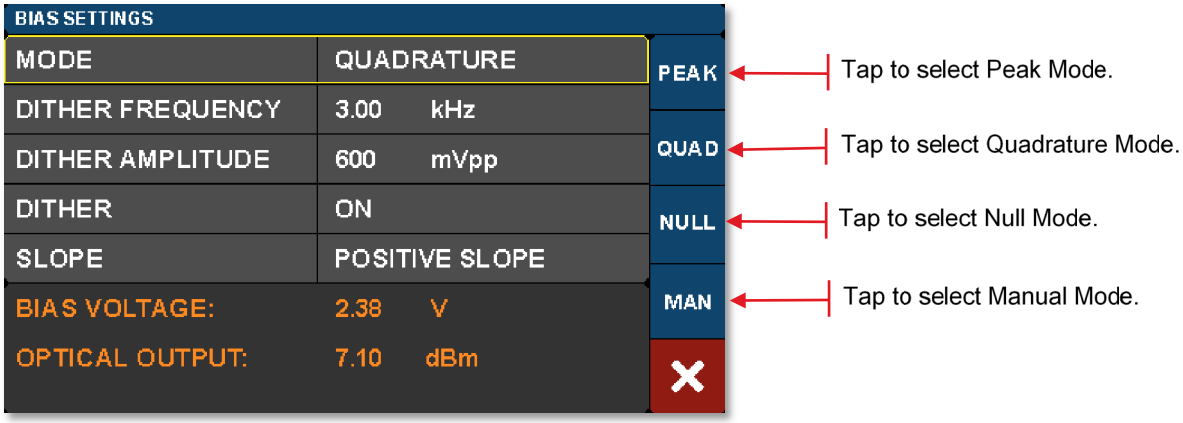


Figure 4-6. Bias Settings Screen for -004x and -007x models when Mode Field is Selected while Quadrature Mode is Enabled

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 (except -011x models) 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.

ME7848A/E system specifications are dependent on active bias control when using the modulator and the default settings of quadrature bias with dither are expected. The dither frequency and amplitude can be adjusted in individual measurements to optimize trace noise. Typically the dither frequency should be higher than the measurement IF bandwidth if conducting measurements on a fine scale.

Quadrature Mode

Quadrature mode is the default mode and biases the MZM at the 50% point on the MZM transmission curve shown in Figure 4-8. Quadrature mode is essential for VNA applications in which linear response is critical. Figure 4-7 shows the parameters that can be controlled in the Quadrature mode

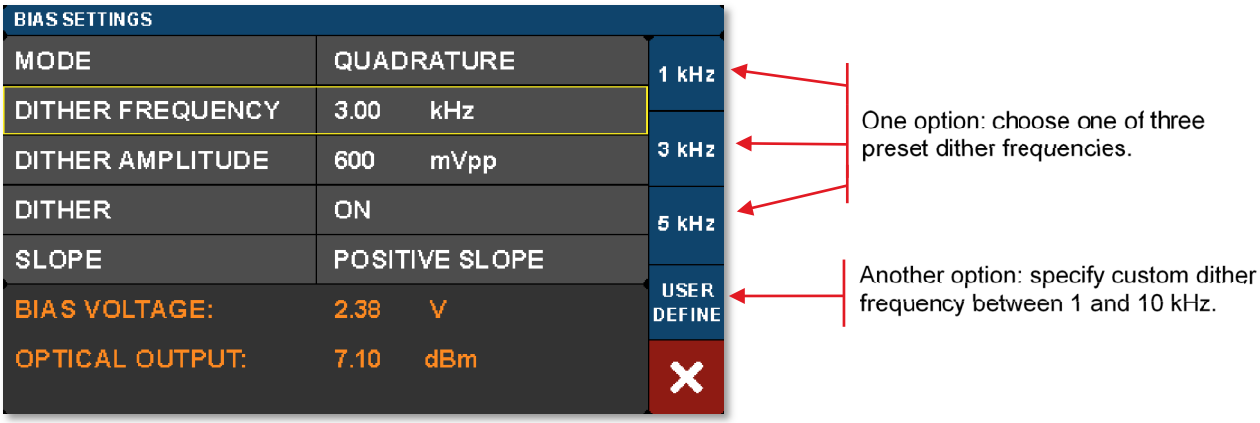


Figure 4-7. Dither Frequency Selection while Quadrature Mode Enabled (-004x and -007x models)

The bias control circuit uses an AC dither tone (except -011x models) to stabilize the bias point of the modulator, as illustrated in Figure 4-8. 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 turned off if other methods of bias control are desired (e.g. manual or input/output ratio control).

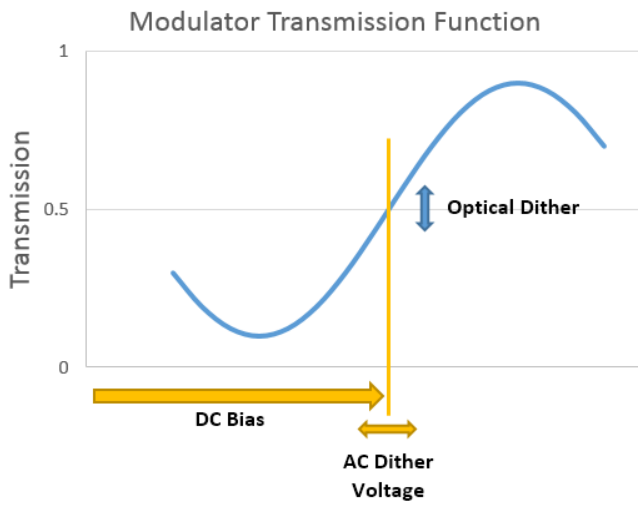


Figure 4-8. AC Dither Tone Stabilizes the Bias Point of the Modulator

The dither tone frequency may be changed by tapping the Dither Frequency field, which is highlighted in Figure 4-7. 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.

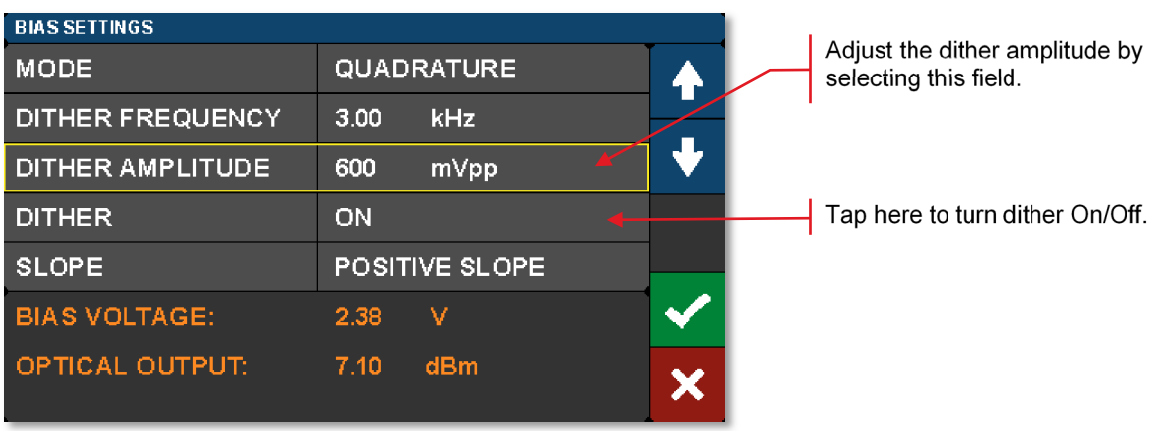


Figure 4-9. Dither Amplitude Adjustment

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 4-9. 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 “Manual Mode” on page 4-8.

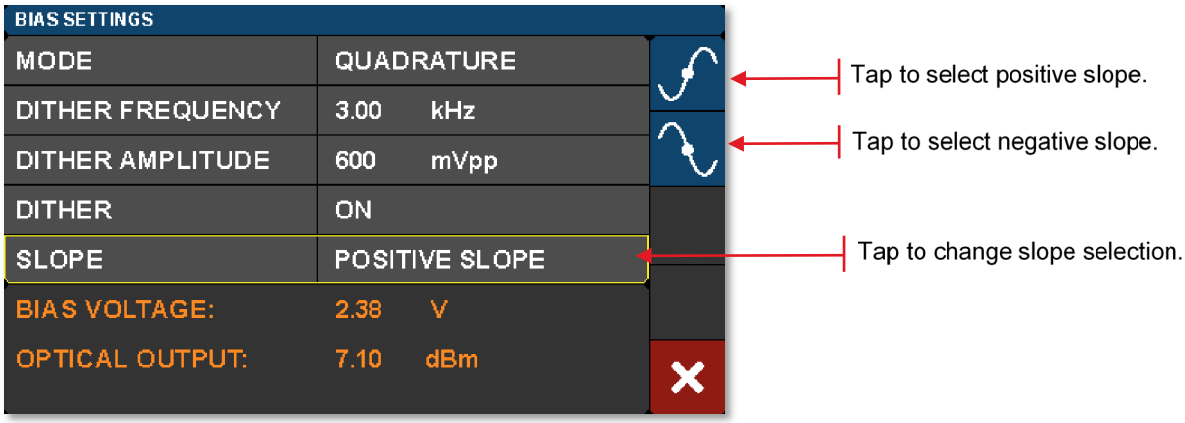


Figure 4-10. Choose the Positive or Negative Slope of the Transmission Function

Quadrature mode also allows the user to select between two operating points by selecting the Slope field (highlighted in Figure 4-10). 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.

In the ME7848A/E system, quadrature mode with dithering on at the default frequency and amplitude settings is recommended, and stability specifications are dependent on the use of this mode.

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.

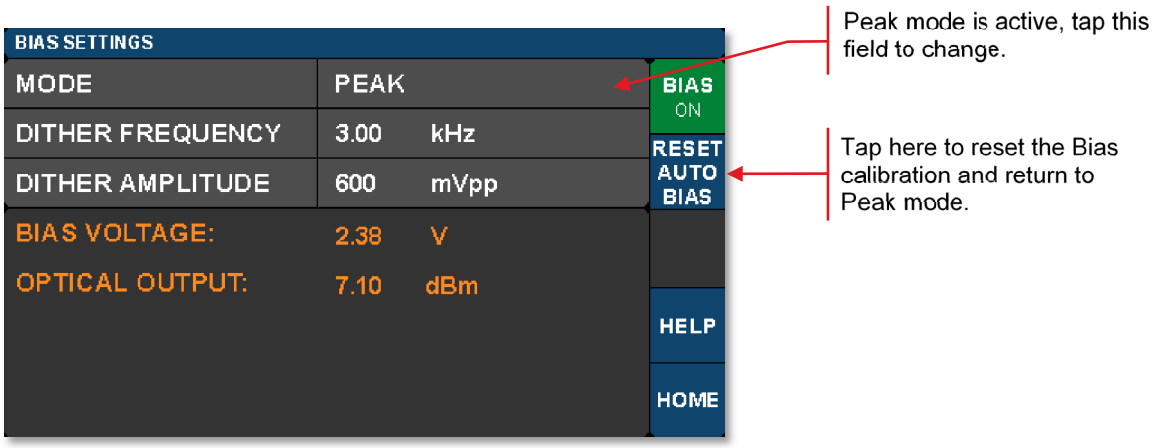


Figure 4-11. Peak Mode Settings

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

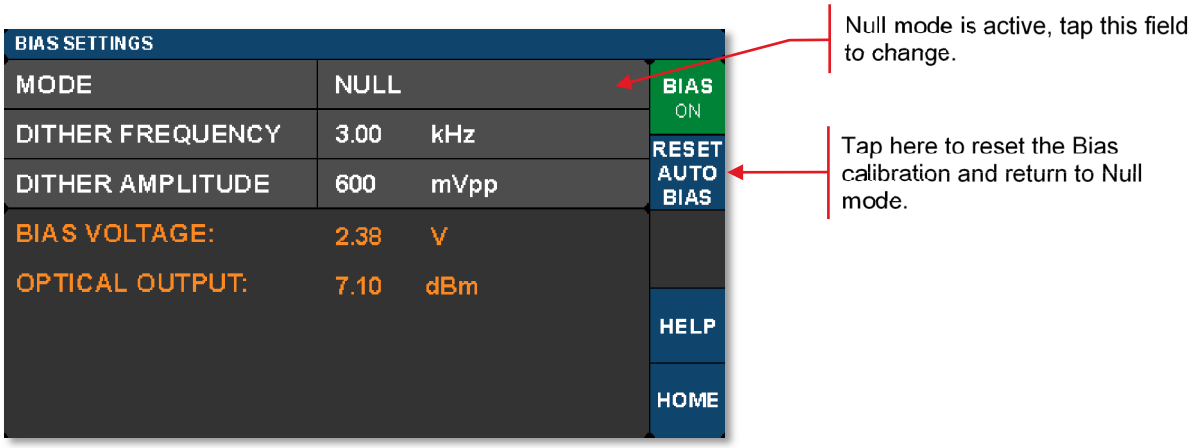


Figure 4-12. Null Mode Settings

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.

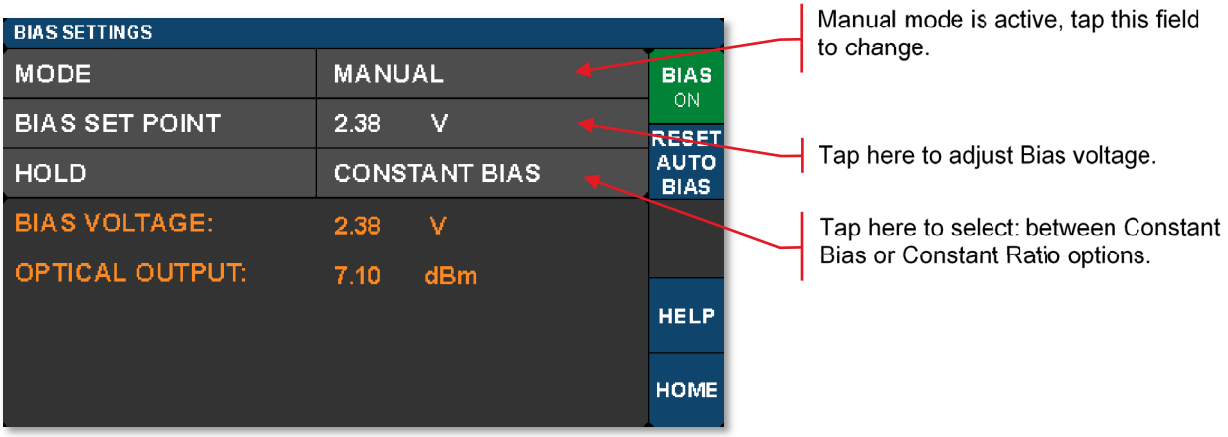


Figure 4-13. Constant Bias Manual Mode Settings

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 1-1 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.

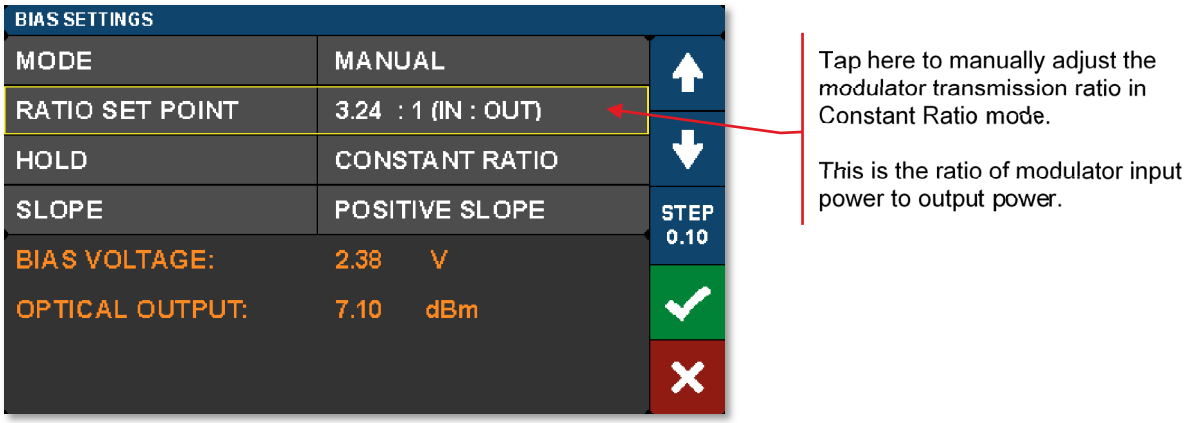


Figure 4-14. Constant Ratio Manual Modes Settings

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.

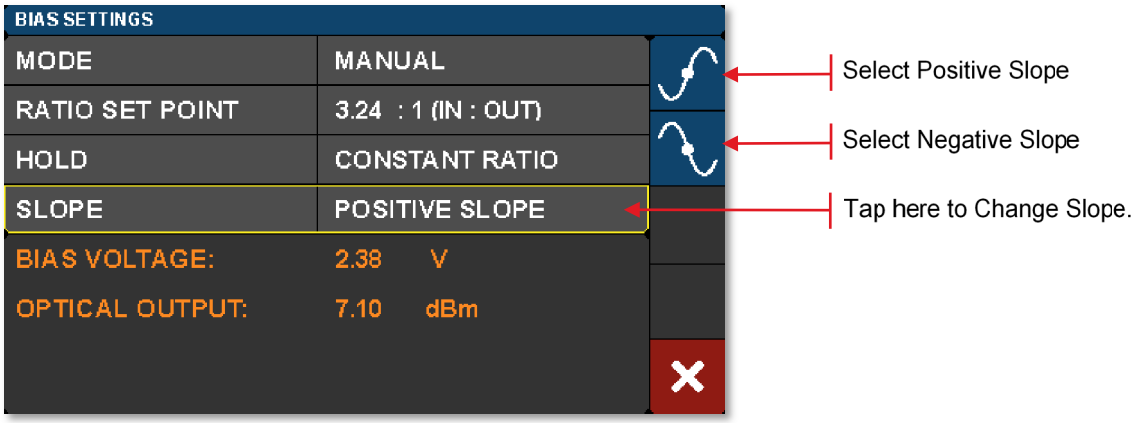


Figure 4-15. Selecting Operating Point in Constant Ratio Mode

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:

1. Turn the bias on, and choose Quadrature mode.
2. Wait for the green indicator dot to stop blinking (indicating the bias is locked at quadrature).

3. 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.
4. Now change the bias mode to Manual and select Constant Ratio.
5. The instrument will calculate the ratio to keep the MZM biased at the Quadrature location.
6. 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 in Figure 4-16. The VOA provides the means for adjusting and stabilizing the output power after the MZM.

Note that units of all power measurements are determined by the Power Units setting on this page, see Figure 4-17.

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

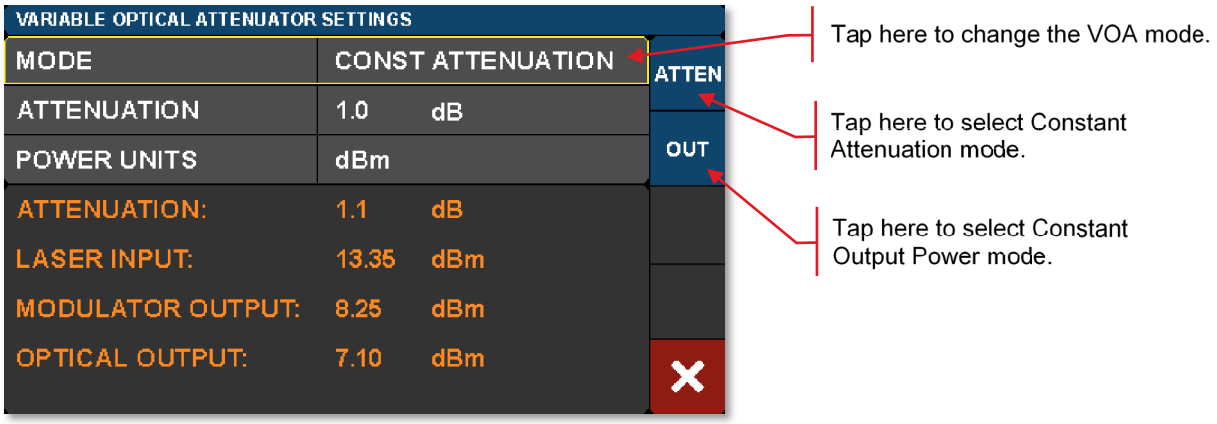


Figure 4-16. Select between Constant Attenuation and Constant Output Power VOA Modes

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.

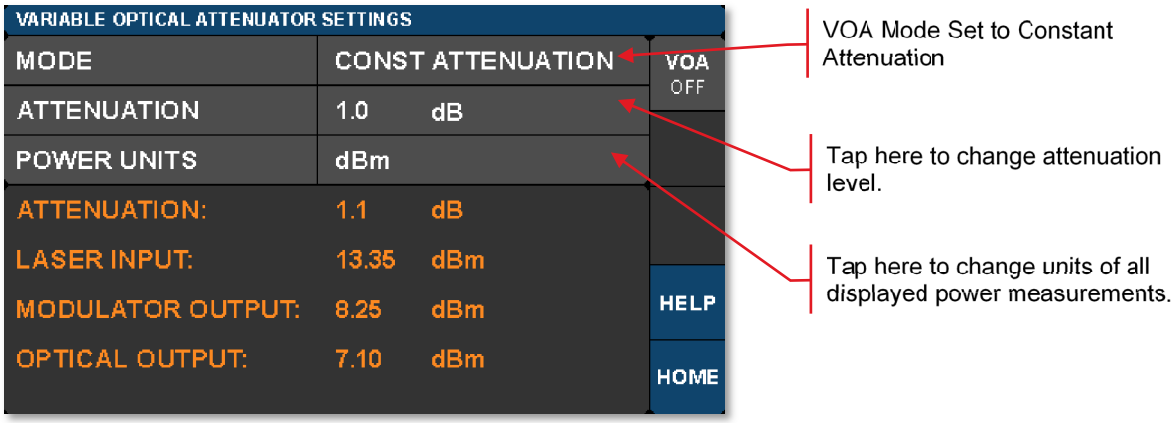


Figure 4-17. Constant Attenuation VOA Mode Page Options

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). ME7848A/E system stability is better when using the constant output mode and stability specifications are dependent on this setting.

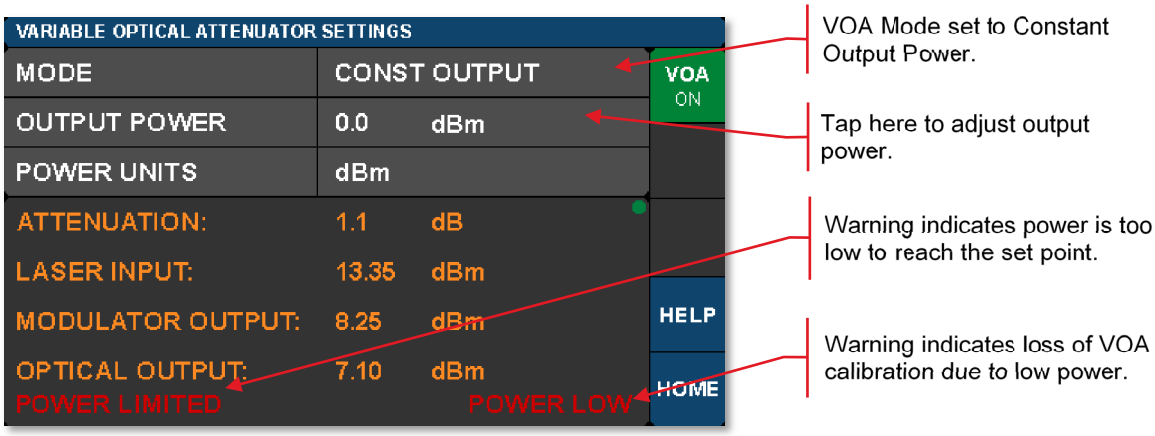


Figure 4-18. Constant Output Power VOA Mode Page Functions and Possible Warnings

4-6 Laser Settings Page

Note	Some versions of the MN4775A have a tunable laser. This section pertains to adjustments for such instruments.

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 tunable laser, tap on the Laser Monitors pane on the Home page to access the Laser Settings page. This page is not available when a fixed-wavelength source is the internal laser.

Optical frequency can be set at increments of 50 GHz for tunable internal lasers. 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.

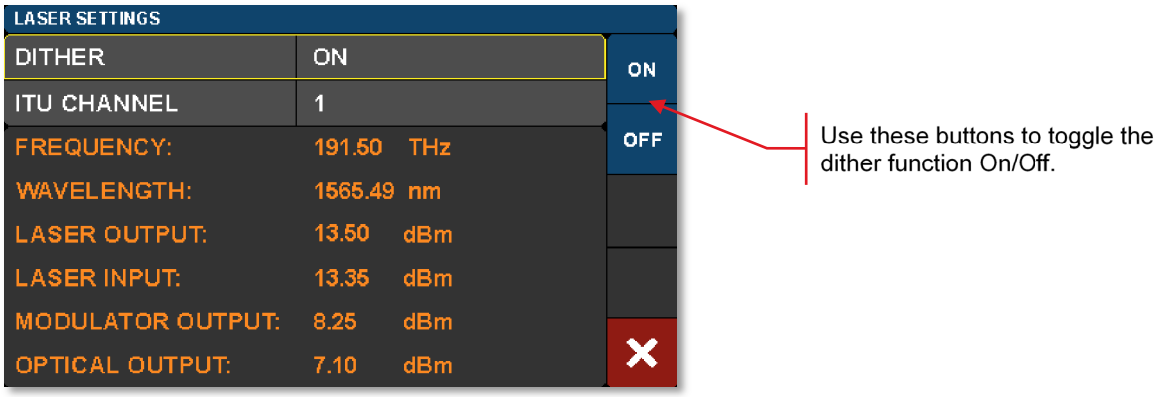


Figure 4-19. Controls for Enabling/Disabling Dither Function

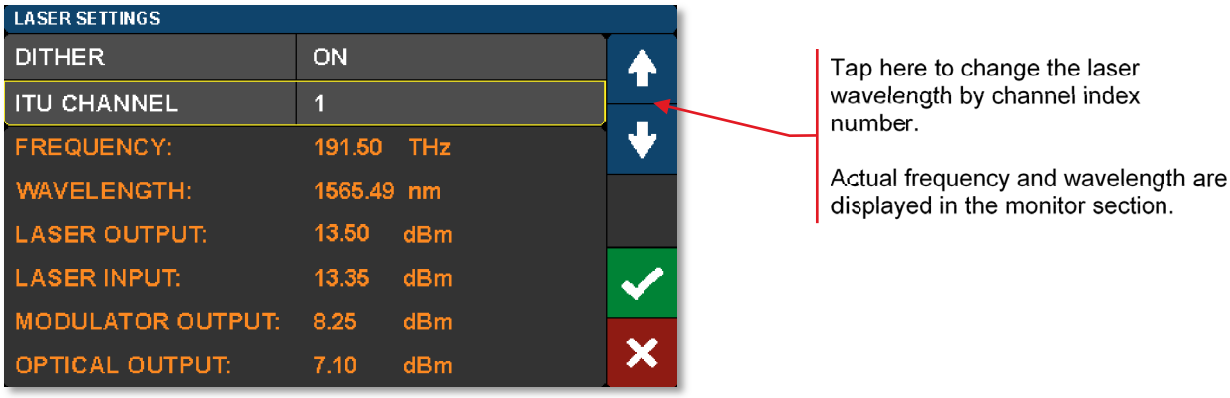


Figure 4-20. Controls for Adjusting Laser Wavelength by Choosing Index Number of ITU Channel

Figure 4-21 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.

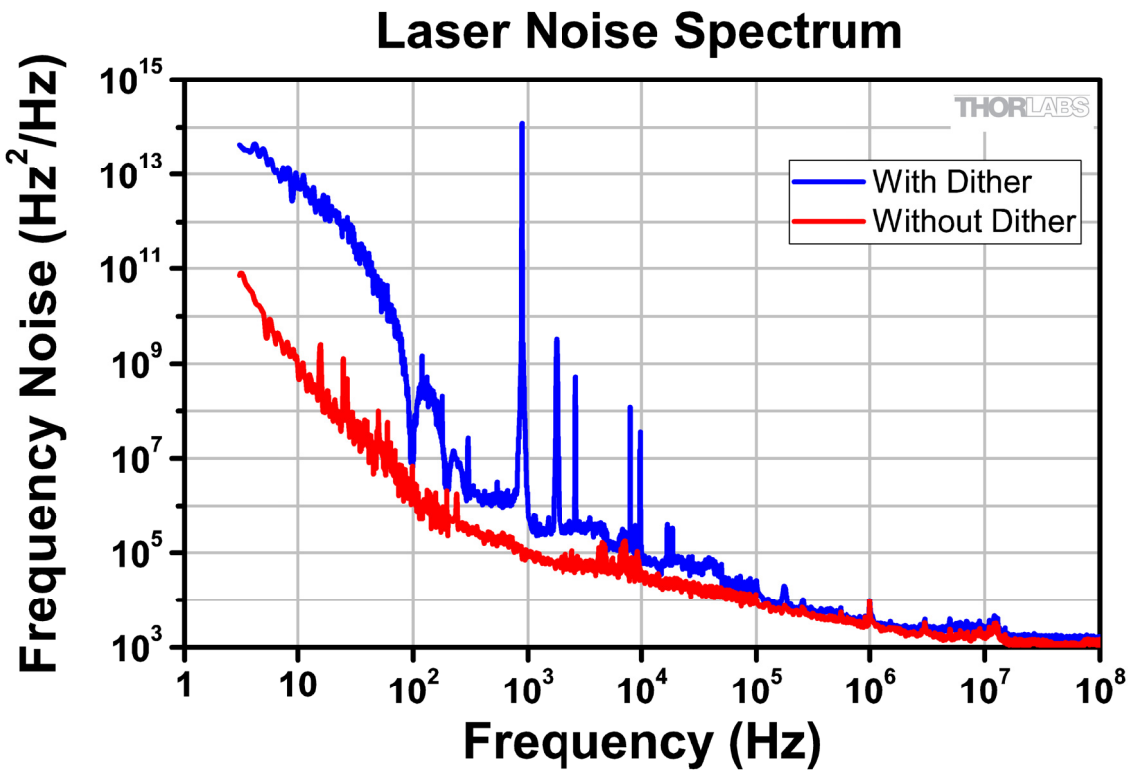


Figure 4-21. FM Noise Spectrum of C-Band Laser with and without Dither

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.

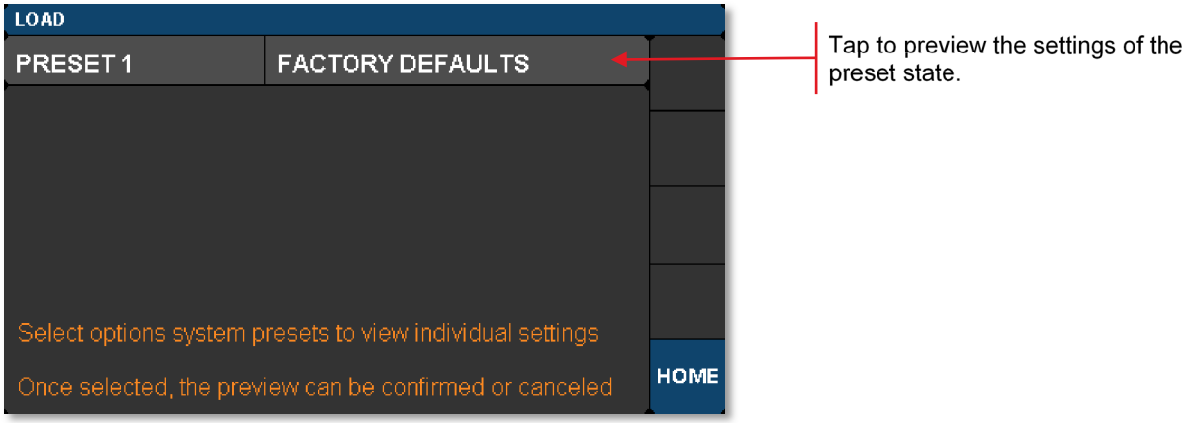


Figure 4-22. Preset State Option Accessed Through the Load Page

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.

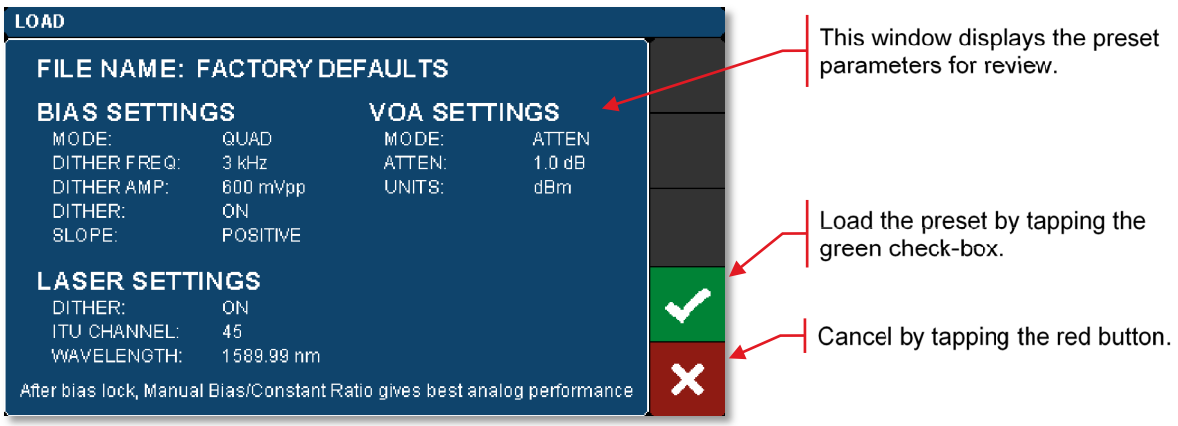


Figure 4-23. Stored Instrument Settings of a Preset

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 Anritsu's technical support are also included on this page. The functions and information available through this page are described in the following sections.

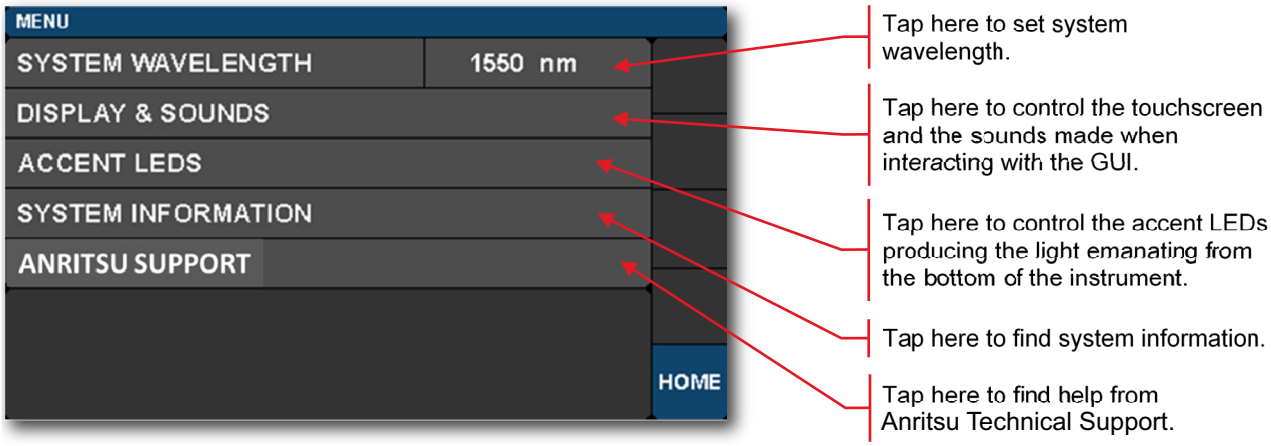


Figure 4-24. Controls on the Menu Page

System Wavelength

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

Certain versions of the MN4775A have adjustable wavelength ranges and/or a tunable laser.

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. If an external laser is used with the converter, the system wavelength may need to be changed as shown in Figure 4-25.

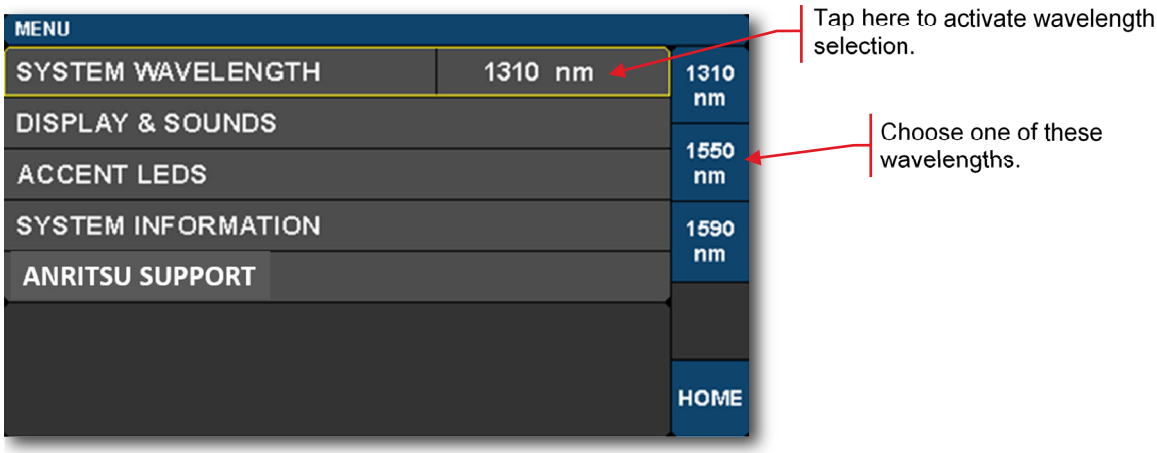


Figure 4-25. Selecting the System Wavelength

For the -0072 dual wavelength module, one switches between the lasers through the main Laser Frequency submenu, accessible from the home screen (see Fig. 3-7). From here, one can select either the 1310 nm laser or the C-band laser (covers 1550 nm).

Display and Sound Settings Page

To open the screen shown in Figure 4-26, tap the Display and Sounds button on the Menu pane.

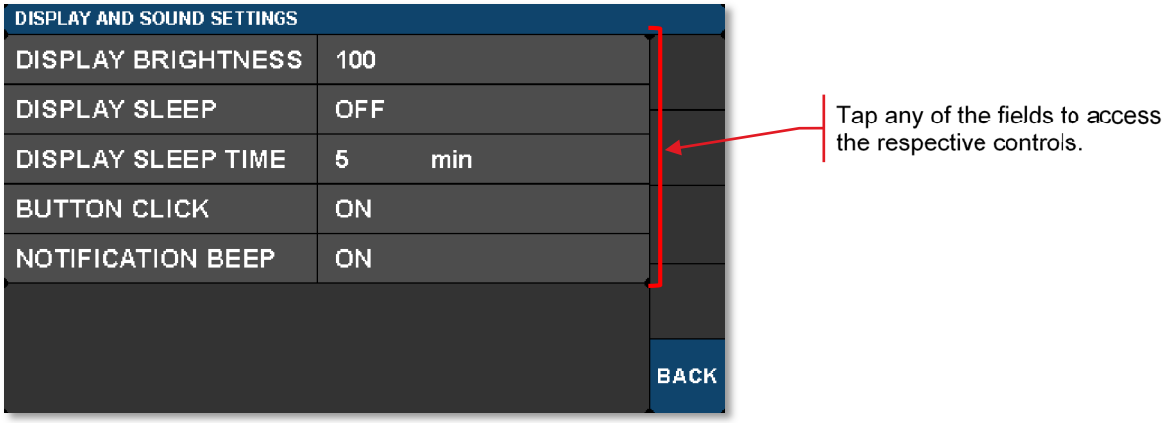


Figure 4-26. Display and Sound Settings Page

- Display Brightness – Controls the overall brightness of the touch-screen display.
- Display Sleep Time – Controls how long the touch-screen display is visible before it sleeps.
- Button Click – Toggles the sound produced when tapping buttons (On/Off).
- Notification Beep – Toggles the sound associated with certain on screen notifications (On/Off).

System Information Page

To open the screen shown in Figure 4-27, tap the SYSTEM INFORMATION button on the Menu pane.

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

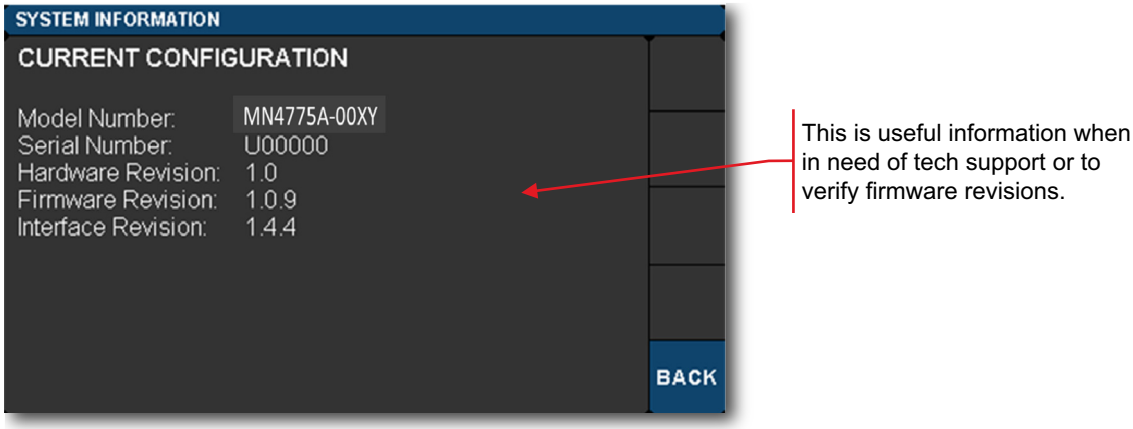


Figure 4-27. System Information Page

Accent LED Settings Page

To open the screen shown in Figure 4-28, 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.

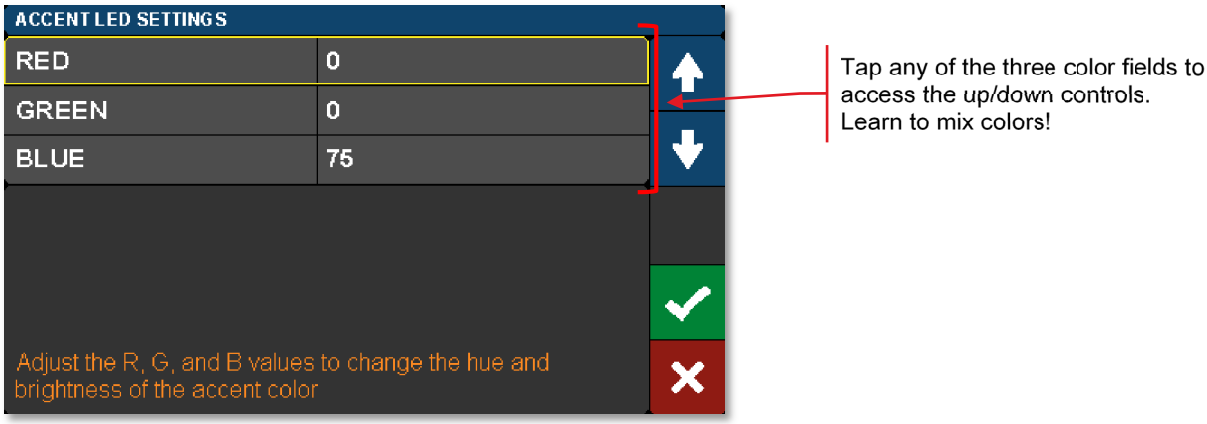


Figure 4-28. Controls to Adjust the LEDs Providing the Under-Instrument Accent Light

Anritsu Support Page

To open the screen shown in Figure 4-29, tap the Anritsu Support button on the Menu page.

The Anritsu Support page displays the Anritsu web site and the installed hardware and software versions. This information will be useful when speaking with Tech Support.

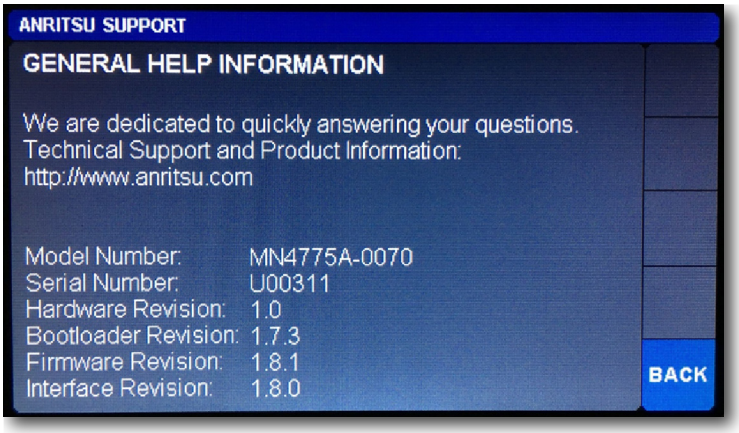


Figure 4-29. Anritsu Support Page

Chapter 5 — Control and PC Connections

5-1 General Purpose I/O, RS-232, and USB Connections

Note	These connections are not used for normal ME7848A/E system operation, but are available for other applications.

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 MN4775-series 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.

The 15-pin I/O connector provides outputs from the power monitors in the optical path (see Figure 4-4, “Block Diagram of the Converter Showing Control Loops” on page 4-3). 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.

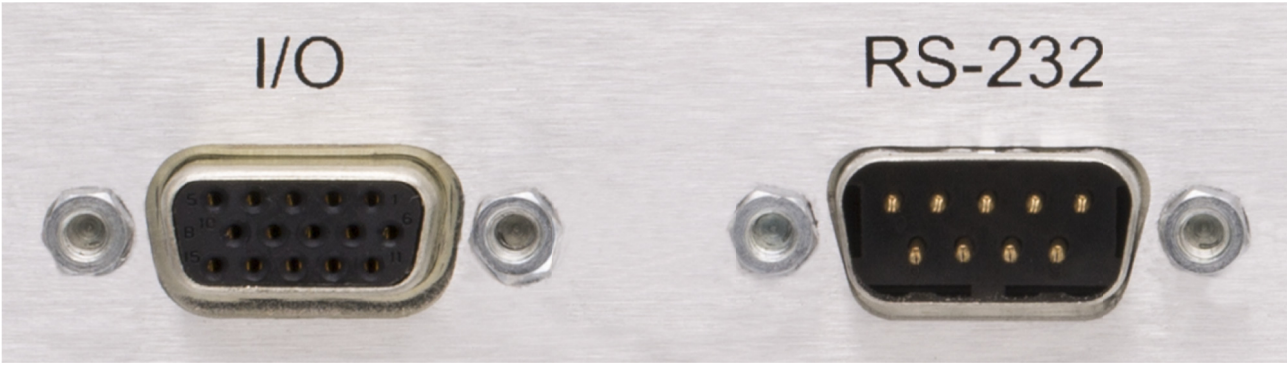


Figure 5-1. 15-Pin I/O and RS-232 Connectors on the Back Panel

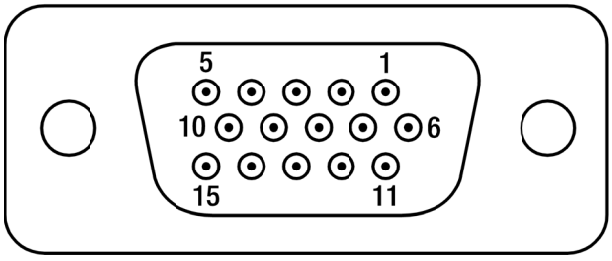


Figure 5-2. 15-Pin I/O Connector Pin Configuration

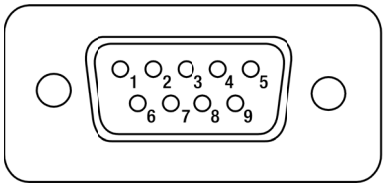


Figure 5-3. RS-232 Connector Pin Configuration

Table 5-1. 15-Pin I/O Connector and RS-232 Connector Pin Descriptions

I/O Conn.	Pin #	Description		RS-232	Pin #	Description
HD DB15	1	Power Monitor 1 (Mon-1)		DB9	1	Not Connected
HD DB15	2	Power Monitor 2 (Mon-2)		DB9	2	RS-232 Input
HD DB15	3	Power Monitor 3 (Mon-3)		DB9	3	RS-232 Output
HD DB15	4	Reserved for Future Use		DB9	4	Not Connected
HD DB15	5	Analog Ground		DB9	5	Digital Ground
HD DB15	6	Analog Ground		DB9	6	Not Connected
HD DB15	7	Analog Ground		DB9	7	Not Connected
HD DB15	8	Analog Ground		DB9	8	Not Connected
HD DB15	9	Analog Ground		DB9	9	Not Connected
HD DB15	10	Analog Ground				
HD DB15	11	Reserved for Future Use				
HD DB15	12	Reserved for Future Use				
HD DB15	13	Power Monitor 1 (Mon-1) Gain Indicator				
HD DB15	14	Power Monitor 2 (Mon-2) Gain Indicator				
HD DB15	15	Power Monitor 3 (Mon-3) Gain Indicator				

5-2 Remote Control

The MN4775A series of instruments may be remotely controlled via SCPI-type serial commands. This requires connecting a computer running the Microsoft Windows 7 operating system, or later versions, to the instrument using a USB cable, or connecting a computer running any operating system to the RS-232 port on the instrument. The touchscreen interface remains active while the instrument is controlled remotely, and instrument functionality remains accessible through the touchscreen interface.

Commands are available to control the Laser, Mach-Zehnder E/O intensity Modulator, Variable Optical Attenuator (VOA), and general system settings.

Documentation describing the process of interfacing with the controlling computer, definition of the serial commands, information about a remote control software tool that will serve as an example and a tutorial for sending the serial commands can be found in the Thorlabs *Remote Control User Guide for the MX / MBX / TLX Series* located at https://www.thorlabs.com/manuals.

5-3 The Laser Safety Interlock

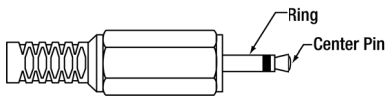
The laser is equipped with a phono-type interlock jack located on the back panel. To enable the laser source, a short circuit must be applied across the terminals of the interlock connector. The shorting device (interlock pin) installed in all units shipped from Anritsu performs this function. Leave 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 5-4(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 5-4(b).

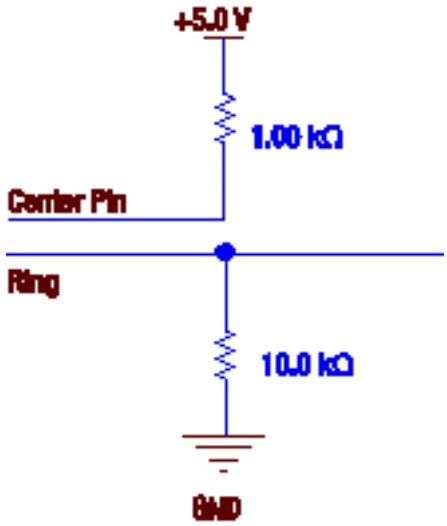
Table 5-2. Laser Interlock Specifications

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.



(a) Diagram of a Phono-Type Plug



(b) Internal Electrical Connections of the Interlock Jack

Figure 5-4. 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 6 — Mechanical Drawings

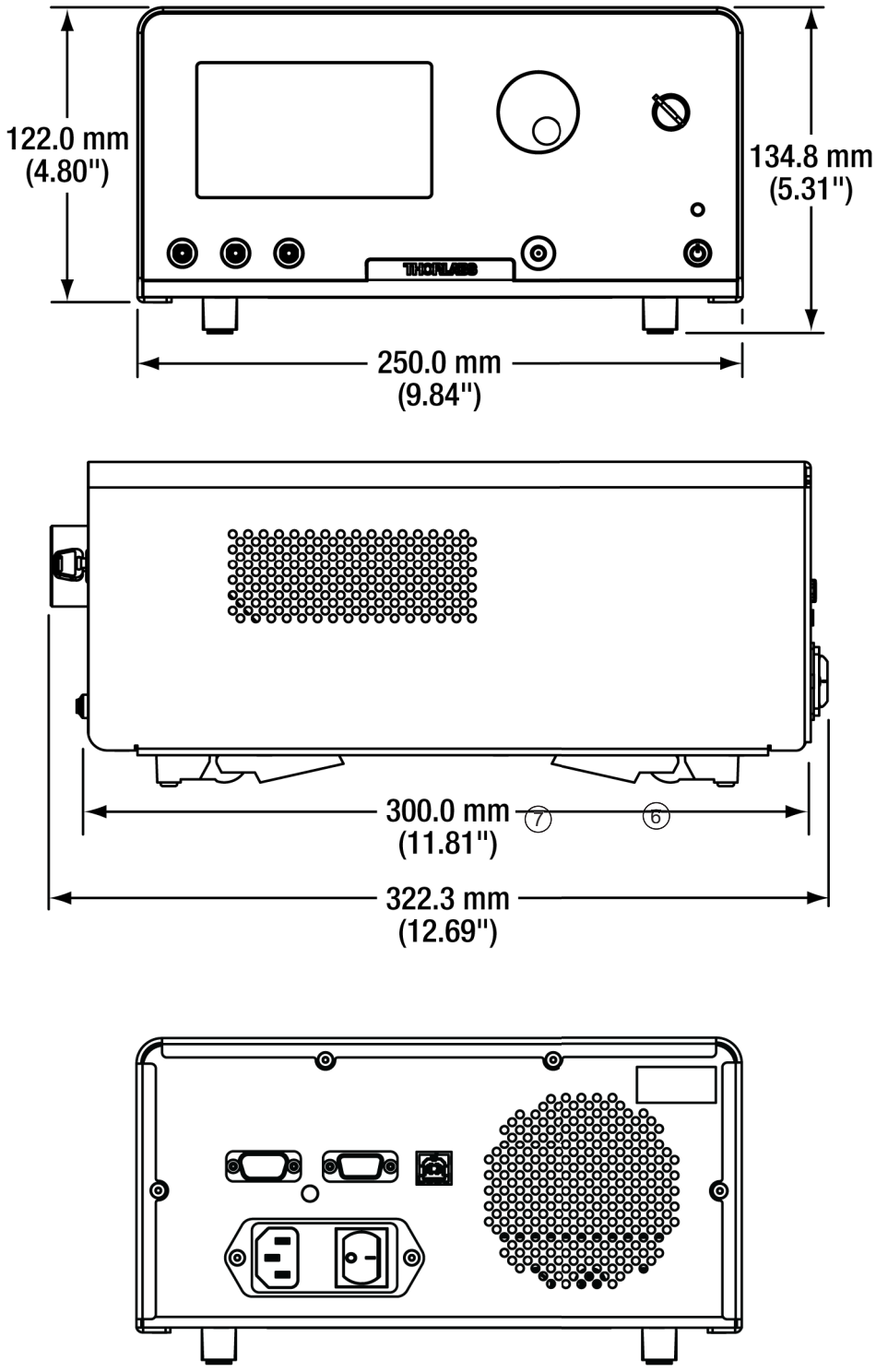


Figure 6-1. E/O Converter Mechanical Drawing

Chapter 7 — Maintenance

7-1 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 Anritsu 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. Alternatively, a lint-free cloth moistened with isopropyl alcohol or methanol can be used. Never use acetone.

The optical connectors on the front panel may be cleaned using a 2.5 mm bulkhead cleaner. This allows the user to clean the fiber end-face without removing it from the internal bulkhead adapter. (Cleaners are included as part of an orderable accessory kit.)

7-2 Replacement Parts

The following parts can be obtained by contacting Anritsu Technical Support:

- PM Loopback Fiber Patch Cord for Front Panel
- 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

7-3 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 7-1. Power Entry Module

Figure 7-2. Removing the Fuse Holder Slide

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 Anritsu. Always use fuses of the same type as the original.

Figure 7-3. Fuse

6. 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 8 — Troubleshooting

Table 8-1 lists some information about status indicators, and a few checks to help in troubleshooting general problems. If you have any questions, please contact your local Anritsu 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:

Table 8-1. Status Indicators

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, 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.

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