VectorStar™ ME7848A Series
Opto-electronic Network Analyzer

ME7848A-0240 40 GHz, 850 nm system
ME7848A-0270 70 GHz, 1550 nm system
ME7848A-0271 70 GHz, 1310 nm system

ME7848A-0140 40 GHz, 850 nm system (VNA and O/E module only)
ME7848A-0170 70 GHz, 1550 nm system (VNA and O/E module only)
ME7848A-0171 70 GHz, 1310 nm system (VNA and O/E module only)
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Chapter 1 — General Information

1-1 Introduction
This manual provides general service and maintenance instructions for Anritsu ME7848A Opto-electronic Network Analyzer (ONA). The ME7848A series consists of:

- ME7848A-0240 40 GHz, 850 nm system
- ME7848A-0270 70 GHz, 1550 nm system
- ME7848A-0271 70 GHz, 1310 nm system
- ME7848A-0140 40 GHz, 850 nm system (VNA and O/E module only)
- ME7848A-0170 70 GHz, 1550 nm system (VNA and O/E module only)
- ME7848A-0171 70 GHz, 1310 nm system (VNA and O/E module only)

Each ME7848A Series System consists of a combination of the following components, specified by its respective TDS (Technical Data Sheet):

- VectorStar MS464xB Vector Network Analyzer
- MN4765B-XXXX O/E Calibration Module
- MN4775A-0040/0070/0071 E/O Converter (-02XX systems only)

This manual contains procedures for:

- Testing the system for proper operation
- Verifying System Performance, independent of any external equipment
- Troubleshooting the failed system to the failed instrument/module level

Throughout this manual, the term “ONA System” will be used interchangeably to refer to ME7848A Series Opto-electronic Network Analyzer.

1-2 Identification Number
All Anritsu instruments are assigned a unique identification number (up to seven-digit), such as “090201” or “1010222”. This number appears on a decal affixed to the rear panel of each instrument. Use the VectorStar VNA’s identification number during any correspondence with Anritsu Customer Service about Anritsu instruments.

1-3 Contacting Anritsu
To contact Anritsu, visit:

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 on your product page:
http://www.anritsu.com/en-us/test-measurement/products/me7848a

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.
1-4 Related Documentation

All documents listed below are available as free downloads at www.anritsu.com.

Product Information, Compliance, and Safety

• VectorStar Product Information, Compliance, and Safety (PICS) – 10100-00063

VectorStar™ MS464xB Series Vector Network Analyzers

• MS464xB Series VNA Technical Data Sheet – 11410-00611
• MS464xB Series VNA Operation Manual – 10410-00317
• MS464xB Series VNA Measurement Guide – 10410-00318
• MS464xB Series VNA User Interface Reference Manual – 10410-00319
• MS464xB Series VNA Maintenance Manual – 10410-00320
• MS464xB Series VNA Programming Manual – 10410-00322
• MS464xB Series VNA Programming Manual Supplement – 10410-00323
• MS464xB Series VNA User Help System – 10450-00040

VectorStar ME7838 Series 2-Port BB/mmW VNA Measurement System

• ME7838A Modular BB/mm-Wave Technical Data Sheet – 11410-00593
• ME7838D Modular BB/mm-Wave Technical Data Sheet – 11410-00778
• ME7838E Modular BB/mm-Wave Technical Data Sheet – 11410-00767
• ME7838A Modular BB/mm-Wave Quick Start Guide – 10410-00292
• ME7838D Modular BB/mm-Wave Quick Start Guide – 10410-00732
• ME7838E Modular BB/mm-Wave Quick Start Guide – 10410-00729
• ME7838 Series Modular BB/mm-Wave Installation Guide – 10410-00293
• VectorStar Broadband/Banded Millimeter-Wave Modules Reference Manual – 10410-00311
• ME7838 Series Modular BB/mm-Wave Maintenance Manual – 10410-00306

VectorStar ME7848A Series Opto-electronic Network Analyzer

• ME7848A ONA Technical Data Sheet – 11410-01145
• ME7848A ONA Quick Start Guide – 10410-00777

VectorStar™ MN4775A E/O Converter

• MN4775A E/O Converter Technical Data Sheet – 11410-01144
• MN4775A E/O Converter Operations Manual – 10410-00774
• MN4775A E/O Converter Quick Start Guide – 10410-00779

VectorStar MN4765B O/E Calibration Module

• MN4765B O/E Calibration Module Operating Manual – 10410-00742

Updates to Manuals

1-5 Electrostatic Discharge (ESD) Prevention

All electronic devices, components, and instruments can be damaged by electrostatic discharge. It is important to take preventative measures to protect the instrument and its internal subassemblies from electrostatic discharge.

An ESD safe work area and proper ESD handling procedures that conform to ANSI/ESD S20.20-1999 or ANSI/ESD S20.20-2007 is mandatory to avoid ESD damage when handling subassemblies or components found in the ME7848A Series Opto-electronic Network Analyzer.

1-6 ME7848A Series ONA System Overview


The tables below show the basic configuration and major system options for the standard broadband configurations and waveguide band configurations.

- Table 1-1, “ME7848A-02xx Standard ONA System Components
- Table 1-2, “ME7848A-01xx Standard ONA System Components

Additional configuration information is available in the relevant system technical data sheet.

ME7848A-02xx Standard Broadband VNA System Components

Table 1-1. ME7848A-02xx Standard ONA System Components (1 of 2)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Name</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS4644B</td>
<td>VectorStar MS4644B Vector Network Analyzer (VNA)</td>
<td>10 MHz to 40 GHz K (m) Test Ports</td>
</tr>
<tr>
<td>MN4765B with option 0040</td>
<td>O/E Calibration Module</td>
<td></td>
</tr>
<tr>
<td>MN4775A with option 0040</td>
<td>E/O Converter</td>
<td></td>
</tr>
</tbody>
</table>

MS4644B VNA Front Panel Options – Select One (1)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Name</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS4644B-051</td>
<td>Front Panel Loops</td>
<td>6 Front Panel Loops</td>
</tr>
<tr>
<td>MS4644B-061</td>
<td>Active Measurement Suite</td>
<td>2 Attenuators</td>
</tr>
<tr>
<td>MS4644B-062</td>
<td>Active Measurement Suite</td>
<td>4 Attenuators</td>
</tr>
<tr>
<td>2000-1957-R</td>
<td>850 nm Accessory Kit for 40 GHz ME7848A ONA system</td>
<td>850 nm Accessory Kit for 40 GHz ME7848A ONA system</td>
</tr>
</tbody>
</table>
### Table 1-1. ME7848A-02xx Standard ONA System Components (2 of 2)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Name</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard ME7848A-0270 Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4647B</td>
<td>VectorStar MS4647B Vector Network Analyzer (VNA)</td>
<td>10 MHz to 70 GHz V (m) Test Ports</td>
</tr>
<tr>
<td>MN4765B with option 0070</td>
<td>O/E Calibration Module</td>
<td></td>
</tr>
<tr>
<td>MN4775A with option 0070</td>
<td>E/O Converter</td>
<td></td>
</tr>
<tr>
<td><strong>MS4647B VNA Front Panel Options – Select One (1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4647B-051</td>
<td>Front Panel Loops</td>
<td>6 Front Panel Loops</td>
</tr>
<tr>
<td></td>
<td>• Provides front panel loops for b1, a1, Port 1 Source, Port 2 Source, a2, and b2</td>
<td></td>
</tr>
<tr>
<td>MS4647B-061</td>
<td>Active Measurement Suite</td>
<td>2 Attenuators</td>
</tr>
<tr>
<td></td>
<td>• Includes front panel loops above with two (2) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
<td></td>
</tr>
<tr>
<td>MS4647B-062</td>
<td>Active Measurement Suite</td>
<td>4 Attenuators</td>
</tr>
<tr>
<td></td>
<td>• Includes front panel loops above with four (4) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
<td></td>
</tr>
<tr>
<td>2000-1958-R</td>
<td>1310 and 1550 nm Accessory Kit for 70 GHz ME7848A ONA system</td>
<td></td>
</tr>
<tr>
<td><strong>Standard ME7848A-0271 Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4647B</td>
<td>VectorStar MS4647B Vector Network Analyzer (VNA)</td>
<td>10 MHz to 70 GHz V (m) Test Ports</td>
</tr>
<tr>
<td>MN4765B with option 0071</td>
<td>O/E Calibration Module</td>
<td></td>
</tr>
<tr>
<td>MN4775A with option 0071</td>
<td>E/O Converter</td>
<td></td>
</tr>
<tr>
<td><strong>MS4647B VNA Front Panel Options – Select One (1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4647B-051</td>
<td>Front Panel Loops</td>
<td>6 Front Panel Loops</td>
</tr>
<tr>
<td></td>
<td>• Provides front panel loops for b1, a1, Port 1 Source, Port 2 Source, a2, and b2</td>
<td></td>
</tr>
<tr>
<td>MS4647B-061</td>
<td>Active Measurement Suite</td>
<td>2 Attenuators</td>
</tr>
<tr>
<td></td>
<td>• Includes front panel loops above with two (2) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
<td></td>
</tr>
<tr>
<td>MS4647B-062</td>
<td>Active Measurement Suite</td>
<td>4 Attenuators</td>
</tr>
<tr>
<td></td>
<td>• Includes front panel loops above with four (4) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
<td></td>
</tr>
<tr>
<td>2000-1958-R</td>
<td>1310 and 1550 nm Accessory Kit for 70 GHz ME7848A ONA system</td>
<td></td>
</tr>
</tbody>
</table>
**ME7848A-01xx Standard Broadband VNA System Components**
*(VNA and O/E module only)*

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Name</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard ME7848A-0140 Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4644B</td>
<td>VectorStar MS4644B Vector Network Analyzer (VNA)</td>
<td>10 MHz to 40 GHz K (m) Test Ports</td>
</tr>
<tr>
<td>MN4765B with option 0040</td>
<td>O/E Calibration Module</td>
<td></td>
</tr>
<tr>
<td><strong>MS4644B VNA Front Panel Options – Select One (1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4644B-051</td>
<td>Front Panel Loops</td>
<td>6 Front Panel Loops • Provides front panel loops for b1, a1, Port 1 Source, Port 2 Source, a2, and b2</td>
</tr>
<tr>
<td>MS4644B-061</td>
<td>Active Measurement Suite</td>
<td>2 Attenuators • Includes front panel loops above with two (2) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
</tr>
<tr>
<td>MS4644B-062</td>
<td>Active Measurement Suite</td>
<td>4 Attenuators • Includes front panel loops above with four (4) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
</tr>
<tr>
<td>2000-1957-R</td>
<td></td>
<td>850 nm Accessory Kit for 40 GHz ME7848A ONA system</td>
</tr>
<tr>
<td><strong>Standard ME7848A-0170 Configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4647B</td>
<td>VectorStar MS4647B Vector Network Analyzer (VNA)</td>
<td>10 MHz to 70 GHz V (m) Test Ports</td>
</tr>
<tr>
<td>MN4765B with option 0070</td>
<td>O/E Calibration Module</td>
<td></td>
</tr>
<tr>
<td><strong>MS4647B VNA Front Panel Options – Select One (1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4647B-051</td>
<td>Front Panel Loops</td>
<td>6 Front Panel Loops • Provides front panel loops for b1, a1, Port 1 Source, Port 2 Source, a2, and b2</td>
</tr>
<tr>
<td>MS4647B-061</td>
<td>Active Measurement Suite</td>
<td>2 Attenuators • Includes front panel loops above with two (2) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
</tr>
<tr>
<td>MS4647B-062</td>
<td>Active Measurement Suite</td>
<td>4 Attenuators • Includes front panel loops above with four (4) attenuators, bias tees in test set, gain compression, and efficiency measurement software.</td>
</tr>
<tr>
<td>2000-1958-R</td>
<td></td>
<td>1310 and 1550 nm Accessory Kit for 70 GHz ME7848A ONA system</td>
</tr>
</tbody>
</table>
1-7 Recommended Test Equipment

The tables below list the recommended test equipment to be used for all maintenance activities for the ME7848A Opto-electronic Network Analyzer (ONA) systems.

- Table 1-3, “Recommended Test Equipment for ME7848A ONA System

Test Equipment – ME7848A

Table 1-3. Recommended Test Equipment for ME7848A ONA System

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Critical Specification</th>
<th>Recommended Manufacturer and Model</th>
<th>Use Codes(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Power Meter</td>
<td></td>
<td>ThorLabs PM100D</td>
<td>P, T</td>
</tr>
<tr>
<td>Photodiode Power Sensor</td>
<td></td>
<td>Thorlabs S155C</td>
<td>P, T</td>
</tr>
</tbody>
</table>

\(^a\)Use Codes: P = Performance Verification; A = Adjustment; T = Troubleshooting
Chapter 2 — Replaceable Parts

2-1 Introduction

This chapter provides replaceable parts information for the following items:

- System level replaceable parts that are unique to ME7848A Series ONA System

Note: This chapter does not include the replaceable parts information for the MS4640B Vector Network Analyzer. For its replaceable parts information, refer to the VectorStar MS4640B Series VNA Maintenance Manual – 10410-00320.

2-2 ME7848A Series System Replaceable Parts

Part numbers and description of ME7848A Series system level replaceable parts are shown in Table 2-1.

Note: There are no serviceable components or subassemblies inside the MN4775A-0040, MN4775A-0070, and MN4775A-0071 E/O converters or the MN4765B-0040, MN4765B-0070, and MN4765B-0071 O/E modules. The modules must be returned to Anritsu Company for repair.

Table 2-1. ME7848A Series System Level Replaceable Parts List

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-1959-R</td>
<td>Fiber Connector Cleaner, 2.5mm</td>
</tr>
<tr>
<td>2000-1961-R</td>
<td>Ferrule Cleaner, 2.5mm</td>
</tr>
<tr>
<td>2000-1964-R</td>
<td>70 GHz Semi-rigid Cable Set (contains 2 cables part number 3-62109-249)</td>
</tr>
<tr>
<td>2000-1963-R</td>
<td>40 GHz Semi-rigid Cable Set (contains 2 cables part number 3-57989-67)</td>
</tr>
<tr>
<td>33VFVF50C</td>
<td>V F-F Adapter</td>
</tr>
<tr>
<td>33KFKF50C</td>
<td>K F-F Adapter</td>
</tr>
<tr>
<td>806-209-R</td>
<td>One meter F-M V RF cables</td>
</tr>
<tr>
<td>806-304-R</td>
<td>One meter F-M K RF cables</td>
</tr>
<tr>
<td>808-20-R</td>
<td>One meter 780-970 nm FC/PC-FC/APC fiber patch cord</td>
</tr>
<tr>
<td>808-21-R</td>
<td>One meter 1310-1550 nm FC/PC-FC/APC fiber patch cord</td>
</tr>
</tbody>
</table>
Chapter 3 — Performance Verification

3-1 Introduction

This chapter provides the following procedures to be used to verify the performance of the ME7848A Opto-electronic Network Analyzer systems:

- “ME7848A-0240 System Verification – 850 nm Configuration” on page 3-3
- “ME7848A-0271 System Verification – 1310 nm Configuration” on page 3-18
- “ME7848A-0270 System Verification – 1550 nm Configuration” on page 3-34

Note

There are no performance verifications for the ME7848A-0140, ME7848A-0170, or ME7848A-0171 systems.

3-2 Laser Safety

All statements regarding safety of operation and technical data in this 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.

Laser Radiation

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

- MN4775A-0070 or MN4775A-0071: Class 1M Laser
- MN4775A-0040: Class 3B Laser

Warning

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

Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
3-3 Calibration and Measurement Conditions

Many external factors affect system measurement integrity to a large extent. They include:

- Extremes in the surrounding environmental conditions
- The condition and stability of the optical fiber patch cord and the cleanliness of the connectors on the MN4775A and MN4765B
- The condition and stability of the interconnect coaxial cables linking host VNA, MN4775A, and MN4765B
- Orientation of the fiber patch cord, where the green connector must be installed on the MN4765B.

These are all user controlled conditions, and as such, should be evaluated periodically for impact on system performance. If these conditions vary significantly with time, the system verification procedures should be performed more often than the recommended annual cycle.

Standard Conditions

The standard conditions specified below must be observed when performing any of the operations in this chapter – both during calibration and during measurement.

- Warm-up Time:
  - 90 minutes
- Environmental Conditions
  - Temperature
    - 23 °C ± 3 °C, with < 1 °C variation from calibration temperature
  - Relative Humidity
    - 20-50% recommended
3-4 ME7848A-0240 System Verification – 850 nm Configuration

This section contains the following setup and measurement procedures:

- ME7848A-0240 850 nm System Setup
- Optical Power Meter (OPM) Measurement Setup – 850 nm Configuration
- Optical Power Meter Measurement – 850 nm Configuration
- Frequency Response Repeatability S21 Setup – 850 nm Configuration
- Frequency Response Repeatability S21-Mag Measurement – 850 nm Configuration
- Optical Noise Floor S21 Setup – 850 nm Configuration
- Optical Noise Floor S21 Measurement – 850 nm Configuration

ME7848A-0240 850 nm System Setup

1. Configure components (VNA, O/E, E/O, RF, and Optical cables) as shown in Figure 3-1.

**Note** The Anritsu MN4775A-0040 does not have Laser Out and Laser In connectors like the MN4775A-0070 and MN4775A-0071.

![Figure 3-1. Initial ME7848A-0240 850 nm Initial System Setup](image)

2. Apply power to MN4775A-0040 E/O Converter by pushing the Standby button until it turns green.
3. Apply power to the VNA.
4. Apply power to MN4765B-0040 O/E Calibration Module via +12 V power cube.
5. MN4775A-0040 E/O Converter:
   a. Keep Ignition-Key in OFF Position, as shown in Figure 3-1.

6. Make initial VNA RF Connections shown in Figure 3-1.
   a. Place KF-KF Adapter on VNA Port 2.
   b. Connect VNA Port 1 to VNA Port 2 via 3 ft. of combined two RF Cables.
   c. Verify the connection between the Male end on cable at Port 1 and Female End on cable at Port 2.

7. Make Optical connection to MN4775A-0040 as shown in Figure 3-1.

   **Note** There is a key on the optical fiber cable that needs to be oriented correctly before the screw will tighten correctly.

   b. Place the Green-colored cap onto the Green-colored end of the Optical cable.

8. Turn MN4775A-0040 E/O Converter Ignition Key to ON.

   **Note** The depiction of the touch screen settings above is for reference only; actual settings are as given below.

9. Make settings on MN4775A-0040 via the Display Touch Screen as described below, refer to Figure 3-2 (left side).
   a. Touch LASER ON square-pad to turn the LASER to ON state.
   b. Touch VOA ON square-pad to enable VOA Attenuator.
   c. Touch BIAS ON square-pad to enable BIAS Regulator.

10. Select ITU-Channel.
    • Not required for 850 System as wavelength is fixed at 852 nm.
11. Select VOA Mode:
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen as shown in Figure 3-2 (left side).
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Select and adjust output power to -3 dBm.

12. Select Bias Mode.
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen as shown in Figure 3-2 (right side).
   b. At Secondary Screen select MODE = QUADRATURE.

13. Typical default BIAS SETTINGS MN4775A-0040:
   a. Dither-Frequency 3 kHz
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE.

14. Turn E/O Converter LASER Inter-Lock Ignition Key to OFF.
Optical Power Meter (OPM) Measurement Setup – 850 nm Configuration

1. Verify Optical Sensor Model: S155C 800 – 1700nm, fitted to PM100D Meter.
2. Apply Power via black button adjacent to sensor (side panel).
3. Allow 1 minute warm up.

4. Verify following default settings:
   a. Range = Auto.
   b. Units = dBm.

5. Navigate to MEAS CONFIG menu via front panel buttons.
   a. Select Zero to zero the sensor (About 2 seconds).
   b. Exit MEAS CONFIG menu.

   a. On Front Panel select Lambda button as shown in Figure 3-3.
   b. Navigate to 850 nm Wavelength icon in menu bar area.
   c. On PM100D Meter select OK to choose 850 nm selection, as shown in Figure 3-3.

Figure 3-3. Power Meter – 850 nm Configuration
Optical Power Meter Measurement – 850 nm Configuration

**Figure 3-4. Optical Power Measurement – 850 nm Configuration**

1. Optical Power Measurement Using PM100D:
   a. Connect PM100D OPM to E/O Converter Output via Optical Cable, as shown in Figure 3-4.
   b. Verify the PM100D's power is **ON**.
   c. Turn E/O Converter Ignition Key = **ON**.
   d. Using E/O Touch Panel:
      i. Laser = **ON**.
      ii. VOA = **ON**, VOA Mode = Constant Output at -3 dBm.
      iii. BIAS = **ON**.
   e. Modify Bias Mode
      i. Press touch screen at Bias center to navigate to Secondary Bias settings screen.
      ii. Select Bias Mode = PEAK.
      iii. Select Reset Auto-Bias Cal.
   f. Wait for readings to stabilize; nominally less than ± 0.5 dB bounce.
   g. Enter nominal reading from PM100D Optical Power Meter into the test records in Table A-1, “Optical Power Measurement – 850 nm Band” on page A-1.
   h. Expected range for this measurement is -3 dBm ± 2 dB.

**Note**  Meter reading may fluctuate nominally ± 0.5 dB.

2. E/O Converter Inter-Lock to **OFF**:
   a. Set E/O Converter Gen Laser Interlock to **OFF** via Ignition Key.
   b. Power down Optical Power Meter.
3. Disconnect the Optical Power Meter.
Frequency Response Repeatability S21 Setup – 850 nm Configuration

1. Power on MN4775A-0040, MS464xB, and MN4765B and allow the instruments to warm up for 90 minutes.

2. Verify MN4775A-0040 E/O Converter Ignition key is set to **OFF**.

3. Connect **Yellow-colored** end of Optical patch cable to MN4775A-0040 E/O Converter as shown in Figure 3-5.

4. Connect **Green-colored** end of Optical cable to MN4765B-0040 as shown in Figure 3-5.

5. Connect the VNA Port 1 to Anritsu MN4775A-0040 E/O Converter RF Input as shown in Figure 3-5.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

6. Connect Anritsu MN4765B-0040 O/E Module Output to VNA Port 2 as shown in Figure 3-5.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

7. Set E/O Converter Ignition key to **ON**.

8. Make the following settings on MN4775A-0040 via the touch screen:
   - Touch LASER ON square-pad to turn the LASER to **ON** state.
   - Touch VOA ON square-pad to enable VOA Attenuator.
   - Touch BIAS ON square-pad to enable BIAS Regulator.

9. Select ITU-Channel
   - Channel setting not required on 850 nm systems.
10. Select VOA Mode
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen.
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Set Power to -3 dBm. Touch green checkmark.
   d. Touch Home to return to the main screen.

11. Restore Bias Mode as QUADRATURE from PEAK mode utilized to measure power.
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen.
   b. At Secondary Screen select MODE = QUADRATURE.

12. Verify the default Bias settings for the MN4775A-0040.
   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE SLOPE.
   e. Touch Home to return to the main screen.

13. Preset the VectorStar VNA as follows:
   a. Select Preset button on the icon bar and then the OK button.
Frequency Response Repeatability S21-Mag Measurement – 850 nm Configuration

1. On the VectorStar VNA:
   a. Touch Trace and set the # of Traces to 1.
   b. Double click on TR1 to make the trace full screen.
   c. Touch on Display and change Trace Format to Log Mag.
   d. Touch Response and change to S21.

2. Configure the VectorStar VNA: using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-6.
   a. Select Channel, then select Sweep.
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
   c. In this new screen, enter the information from the first entry in Figure 3-6.
   d. Select Add and repeat until all the segments are entered
   e. Set Sweep type to Segmented Sweep (Freq Based).

   ![Figure 3-6. MS4644B Frequency-Based Segmented Sweep Settings](image)

3. Normalize the trace (data divided by memory).
   a. Select Display.
   b. Select View Trace.
   c. Select Store Data to Memory.
   d. Select Data, Memory Math.

4. Select Sweep and then Hold functions. Select Single Sweep & Hold.

5. Select File and then Save Data, file name HLN#1, file type .csv.

6. Repeat Step 4 and Step 5 twenty four (24) more times. When saving the data, increment the number at the end of the file name by one (e.g. HLN#2, HLN#3, and so on.).

7. Copy the twenty five (25) saved data files off the MS464xB onto a USB flash drive for transferring to a Personal Computer.

8. On a separate Windows Personal Computer, import the saved data from the HLN#n files into Microsoft Excel so the RMS values can be calculated.
9. There are many ways one can set up Microsoft Excel for calculating the RMS values. Below is an example:

   a. Assume the data are in an Excel worksheet as follows:
      i. Row 1 is the header: Freq, Data1 through Data25, RMS Linear Mag, RMS Log Mag.
      ii. Column A: Freq (Imported from the HLN#n files).
      iii. Column B through Column AO: Data1 through Data25 (Imported from the HLN#n files).

   b. Set up cell AA2 to calculate the RMS value in Linear Mag by entering the following formula into the cell:
      \[=\text{STDEV.P(B2:Z2)}\]

   c. Copy the formula to the next cell on Column AA until it reaches the last frequency point.

   d. For magnitude measurements only:
      i. Set up cell AB2 to calculate the RMS value in Log Mag by entering the following formula into the cell:
         \[=20 \times \log(V2 + 1, 10)\]
      ii. Copy the formula to the next cell on Column AB until it reaches the last frequency point.

   e. Rename Sheet 1 to Frequency Response S21 by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

   f. Record the largest calculated RMS value of each frequency band listed in the Frequency Response S21 worksheet into Table A-2, “Frequency Response Repeatability – 850 nm Band” on page A-1.
Optical Noise Floor S21 Setup – 850 nm Configuration

1. Power on MN4775A-0040, MS464xB, and MN4765B and allow the instruments to warm up for 90 minutes.

2. Verify MN4775A-0040 E/O Converter Ignition key is set to OFF.

3. Connect Yellow-colored end of optical patch cable to MN4775A-0040 E/O Converter as shown in Figure 3-7.

4. Connect Green-colored end of optical cable to MN4765B-0040 as shown in Figure 3-7.

5. Connect the VNA Port 1 to Anritsu MN4775A-0040 E/O Converter RF Input as shown in Figure 3-7.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

6. Connect Anritsu MN4765B-0040 O/E Module Output to VNA Port 2 as shown in Figure 3-7.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

7. Set E/O Converter Ignition key to ON.

8. Make settings on MN4775A-0040 via the display touch screen:
   a. Touch LASER ON Square-Pad to turn the LASER to ON state.
   b. Touch VOA ON Square-Pad to enable VOA Attenuator.
   c. Touch BIAS ON Square-Pad to enable BIAS Regulator.

9. Select ITU-Channel
   a. Channel setting not required on 850 nm systems.
10. Select VOA Mode:
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen.
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Set Power to -3 dBm. Touch green checkmark.
   d. Touch Home to return to the main screen.

11. Restore Bias Mode as QUADRATURE from PEAK mode utilized to measure power:
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen.
   b. At secondary screen select MODE = QUADRATURE.

12. Verify the default BIAS SETTINGS MN4775A-0040:
   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE SLOPE.
   e. Touch Home to return to the main screen.

13. Preset the VectorStar VNA as follows:
   a. Select Preset button on the icon bar and then the OK button.

14. On VectorStar VNA:
   a. Touch Trace and set the # of Traces to 1.
   b. Double click on TR1 to make the trace full screen.
   c. Touch Display and change Trace Format to Log Mag.
   d. Touch Response and change to S21.

15. Configure the VectorStar VNA: using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-8.
   a. Select Channel, then select Sweep.
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
   c. In this new screen, enter the information from the first entry in Figure 3-8.
   d. Select Add and repeat until all the segments are entered.
   e. Set Sweep type to Segmented Sweep (Freq Based).

<table>
<thead>
<tr>
<th>Seq</th>
<th>On</th>
<th>Freq Def. for F1 &amp; F2</th>
<th>F1</th>
<th>F2</th>
<th># of Pts</th>
<th>Step/Step Freq</th>
<th>IFBW</th>
<th>P1 Stop Per (S1n)</th>
<th>P2 Stop Per (S1n)</th>
<th>P1 Attenuation (dB)</th>
<th>P2 Attenuation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Start &amp; Stop</td>
<td>70 kHz</td>
<td></td>
<td>11</td>
<td>13 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Start &amp; Stop</td>
<td>311.002 kHz</td>
<td>200 kHz</td>
<td>22</td>
<td>99 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Start &amp; Stop</td>
<td>3.35 MHz</td>
<td>3.99 MHz</td>
<td>20</td>
<td>402.152631 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Start &amp; Stop</td>
<td>10.01 MHz</td>
<td>2.499 GHz</td>
<td>17</td>
<td>155.561875 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Start &amp; Stop</td>
<td>25.0 GHz</td>
<td>5 GHz</td>
<td>17</td>
<td>155.25 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Start &amp; Stop</td>
<td>50.01 GHz</td>
<td>20 GHz</td>
<td>51</td>
<td>299.98 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Start &amp; Stop</td>
<td>20.001 GHz</td>
<td>40 GHz</td>
<td>67</td>
<td>303.015151 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Figure 3-8.** MS4644B Frequency-Based Segmented Sweep Setting
Optical Nose Floor S21 Measurement – 850 nm Configuration

1. On VectorStar VNA, select Calibration.
2. Select Calibrate.
5. Select Modify Cal Setup.
6. Select Edit Cal Params (see Figure 3-9).

![Figure 3-9. TRANSMISSION FREQUENCY RESPONSE CAL SETUP (SOLT/R, Coaxial) Dialog]
7. Click on Thru1-2 Info and the THRU INFO dialog appears (see Figure 3-10) and verify that Length (mm), Line loss (dB/mm), and @Frequency (GHz) are set to 0.000.

8. Click OK and OK again to close EDIT CALIBRATION PARAMETERS dialog.

9. Select Back.

10. Perform a Transmission Frequency Response-only calibration. Select Done and observe that the Green Calibration lamp in VNA is ON:
   a. Select Thru/Recip.
   b. Select Thru and wait for green checkmark to appear.
   c. Select Back.
   d. Select Done.
   e. Verify Green Calibration lamp is ON.
11. Set E/O Converter Ignition key to **OFF** (see figure **Figure 3-11**).

12. Select Scale.
   
   a. Click on Reference Value and set it to -50 dB.

13. Select Sweep and then Hold Functions. Select Single Sweep & Hold.

14. Select File and then Save Data, file name NF#1, file type .csv.

15. Repeat Step 13 and Step 14 fifteen (15) more times. When saving the data, increment the number at the end of the file name by one (e.g. NF#2, NF#3 and so on.).

16. Copy the sixteen (16) saved data files off the MS464xB onto a USB flash drive for transferring to a Personal Computer.

17. On a separate Windows Personal Computer, import the saved data from the NF#n files into Microsoft Excel so the RMS values can be calculated.
18. There are many ways one can set up Microsoft Excel for calculating the RMS values. Here is an example:

   a. Assume the data are in an Excel worksheet as follows:
      i. Row 1 is the headers: Freq, Data1 through Data16, RMS Linear Mag, RMS Log Mag.
      ii. Column A: Freq (Imported from the NF#n files).
      iii. Column B through Column Q: Data1 through Data16 (Imported from the HLN#n files).
   
   b. Set up cell R to calculate the RMS value in Linear Mag by entering the following formula into the cell:
      = STDEV.P(B2:Q2)
      
   c. Copy the formula to the next cell on Column R until it reaches the last frequency point.
   
   d. For magnitude measurements only:
      i. Set up cell S to calculate the RMS value in Log Mag by entering the following formula into the cell:
         = 20 x log(R2 + 1, 10)
      ii. Copy the formula to the next cell on Column S until it reaches the last frequency point.
   
   e. Rename Sheet 1 to S16 Magnitude by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.
   
   f. Record the highest calculated RMS value of each frequency band listed in Table A-3, “Optical Noise Floor S21 (Option 51) – 850 nm Band” on page A-2 or Table A-4, “Optical Noise Floor S21 (Option 61 or 62) – 850 nm Band” on page A-2.
3-5 ME7848A-0271 System Verification – 1310 nm Configuration

This section contains the following setup and measurement procedures:

- ME7848A-0271 1310 nm System Setup
- Optical Power Meter (OPM) Measurement Setup – 1310 nm Configuration
- Optical Power Meter Measurement – 1310 nm Configuration
- Frequency Response Repeatability S21 Setup – 1310 nm Configuration
- Frequency Response Repeatability S21-Mag Measurement – 1310 nm Configuration
- Optical Noise Floor S21 Setup – 1310 nm Configuration
- Optical Noise Floor S21 Measurement – 1310 nm Configuration

ME7848A-0271 1310 nm System Setup

1. Configure components (VNA, O/E, E/O, RF and Optical cables) as shown in Figure 3-12.

![Figure 3-12. Initial ME7848A-0271 1310 nm Initial System Setup](image)

2. Apply power to MN4775A-0071 E/O Converter by pushing the Standby button until it turns green.
3. Apply power to the VNA.
4. Apply power to MN4765B-0071 O/E Calibration Module via +12 V power cube.

**Note**

Refer to the MN4775A Operation Manual – 10410-00774 regarding proper operation of the Anritsu E/O Converter.
5. MN4775A-0071 E/O Converter:
   a. Verify **Optical Loop** is in place on MN4775A-0071 E/O Converter.
   
   **Note**
   There is a key on the optical fiber cable that needs to be oriented correctly before the screw will tighten correctly.

   b. Keep **Ignition-Key** in OFF Position as shown in Figure 3-12.

6. Make initial VNA RF Connections shown in Figure 3-12.
   a. Place VF-VF Adapter on VNA Port 2.
   b. VNA Port 1 to VNA Port 2 via 3 ft. RF Cables.
   c. Verify connection between **Male end** on cable at Port 1 and **Female End** on Cable at Port 2.

7. Make Optical connection shown to MN4775A-0071 as shown in Figure 3-12.
   a. Connect **Yellow-colored** end of Optical Patch cable to MN4775A-0071 E/O Converter.
   b. Place the **Green-colored** cap onto the **Green-colored** end of the Optical cable.

8. Turn MN4775A-0071 E/O Converter Ignition Key to **ON**.

9. Make settings on MN4775A-0071 via the display touch screen as described below; refer to Figure 3-13.
   a. Touch **LASER ON** square-pad to turn the LASER to **ON** state.
   b. Touch **VOA ON** square-pad to enable VOA Attenuator.
   c. Touch **BIAS ON** square-pad to enable BIAS Regulator.

10. Select ITU-Channel.
    • Not required for 1310 System as wavelength is fixed.

**Figure 3-13.** E/O Converter Setup Screen

**Note**
The depiction of the touch screen settings above is for reference only; actual settings are as given below.
11. Select VOA Mode.
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen as shown in Figure 3-13 (left side).
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Select and adjust output power to +2 dBm.

12. Select Bias Mode.
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen as shown in Figure 3-13 (right side).
   b. At secondary screen select MODE = QUADRATURE.

13. Typical default BIAS SETTINGS MN4775A-0071:
   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE.

14. Turn E/O Converter LASER Inter-Lock Ignition Key to OFF.
Optical Power Meter (OPM) Measurement Setup – 1310 nm Configuration

1. Verify Optical Sensor Model: S155C 800 – 1700nm, fitted to PM100D Meter
2. Apply Power via black button adjacent to sensor (on side panel).
3. Allow 1 minute warm up.

4. Verify following default settings.
   a. Range = Auto.
   b. Units = dBm.

5. Navigate to MEAS CONFIG menu via front panel buttons.
   a. Select Zero to zero the sensor (About 2 seconds).
   b. Exit MEAS CONFIG menu.

   a. On Front Panel select Lambda button as shown in Figure 3-14.
   b. Navigate to 1310 nm Wavelength icon in menu bar area.
   c. On PM100D Meter select OK to choose 1310 nm selection, as shown in Figure 3-14.
Optical Power Meter Measurement – 1310 nm Configuration

1. Optical Power Measurement Using PM100D:
   a. Connect PM100D OPM to E/O Converter Output via Optical Cable as shown in Figure 3-15.
   b. Verify the PM100D’s power is ON.
   c. Turn E/O Converter Ignition Key = ON.
   d. Using E/O Touch Panel:
      i. Laser = ON.
      ii. VOA = ON, VOA Mode = Constant Output at +2 dBm.
      iii. BIAS = ON.
   e. Modify Bias Mode:
      i. Push touch screen at Bias center navigate to Secondary Bias settings screen
      ii. Select Bias Mode = PEAK.
      iii. Select Trigger Auto-Bias Cal.
   f. Wait for readings to stabilize; nominally less than ± 0.5 dB bounce.
   g. Enter nominal reading from PM100D Optical Power Meter into the test records in Table A-5, “Optical Power Measurement – 1310 nm Band” on page A-3.
   h. Expected range for this measurement is +2 dBm ± 2 dB

   Note: Meter reading may fluctuate nominally ± 0.5 dB.

2. E/O Converter Inter-Lock to OFF:
   a. Set E/O Converter Gen Laser Inter-Lock to OFF via Ignition Key
   b. Power down Optical Power Meter
3. Disconnect the Optical Power Meter.
Frequency Response Repeatability S21 Setup – 1310 nm Configuration

1. Power on MN4775A-0071, MS464xB, and MN4765B and allow the instrument to warm up for 90 minutes.

2. Verify MN4775A-0071 E/O Converter Ignition key is set to OFF.

3. Connect **Yellow-colored** end of Optical Patch cable to MN4775A-0071 E/O Converter as shown in Figure 3-16.

4. Connect **Green-colored** end of Optical cable to MN4765B-0071 as shown in Figure 3-16.

5. Connect the VNA Port 1 to Anritsu MN4775A-0071 E/O Converter RF Input as shown in Figure 3-16.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

6. Connect Anritsu MN4765B-0071 O/E Module Output to VNA Port 2 as shown in Figure 3-16.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

7. Set E/O Converter Ignition key to **ON**.

8. Verify that **Optical Loop** is in place on MN4775A-0071 E/O Converter as shown in Figure 3-16.

9. Make settings on MN4775A-0071 via the display touch screen as described below.
   - Touch **LASER ON** square-pad to turn the LASER to **ON** state.
   - Touch **VOA ON** square-pad to enable VOA Attenuator.
   - Touch **BIAS ON** square-pad to enable BIAS Regulator.

10. Select **ITU-Channel**
   - Channel setting not required on 1310 nm systems.

---

**Figure 3-16. Optical Connection to MN4765B-0071**

3. Connect **Yellow-colored** end of Optical Patch cable to MN4775A-0071 E/O Converter as shown in Figure 3-16.

4. Connect **Green-colored** end of Optical cable to MN4765B-0071 as shown in Figure 3-16.

5. Connect the VNA Port 1 to Anritsu MN4775A-0071 E/O Converter RF Input as shown in Figure 3-16.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

6. Connect Anritsu MN4765B-0071 O/E Module Output to VNA Port 2 as shown in Figure 3-16.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.

7. Set E/O Converter Ignition key to **ON**.

8. Verify that **Optical Loop** is in place on MN4775A-0071 E/O Converter as shown in Figure 3-16.

9. Make settings on MN4775A-0071 via the display touch screen as described below.
   - Touch **LASER ON** square-pad to turn the LASER to **ON** state.
   - Touch **VOA ON** square-pad to enable VOA Attenuator.
   - Touch **BIAS ON** square-pad to enable BIAS Regulator.

10. Select **ITU-Channel**
   - Channel setting not required on 1310 nm systems.
11. Select VOA Mode
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen.
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Set Power to +2 dBm. Touch green checkmark.
   d. Touch Home to return to the main screen.

12. Restore Bias Mode as QUADRATURE from PEAK Mode utilized to measure power.
   a. Touch center section of BIAS VOLTAGE region to bring Up Secondary Screen.
   b. At Secondary Screen select MODE = QUADRATURE.

   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE SLOPE.
   e. Touch Home to return to the main screen.

14. Preset the VectorStar VNA as follows:
   a. Select Preset button on the icon bar and then the OK button.
Frequency Response Repeatability S21-Mag Measurement – 1310 nm Configuration

1. On VectorStar VNA:
   a. Touch Trace and set the # of Traces to 1.
   b. Double click on TR1 to make the trace full screen.
   c. Touch on Display and change Trace Format to Log Mag.
   d. Touch Response and change S21.

2. Configure the VectorStar VNA; using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-17.
   a. Select Channel, then select Sweep.
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
   c. In this new screen, enter the information from the first entry in Figure 3-17.
   d. Select Add and repeat until all the segments are entered.
   e. Set Sweep type to Segmented Sweep (Freq Based).

3. Normalize the trace (data divided by memory):
   a. Select Display.
   b. Select View Trace.
   c. Select Store Data to Memory.
   d. Select Data, Memory Math.

4. Select Sweep and then Hold Functions. Select Single Sweep & Hold.

5. Select File and then Save Data, file name HLN#1, file type .csv.

6. Repeat Step 4 through Step 5 twenty four (24) more times. When saving the data, increment the number at the end of the file name by one (e.g. HLN#2, HLN#3, and so on.).

7. Copy the twenty five (25) saved data files off the MS465xB onto a USB flash drive for transferring to a Personal Computer.

8. On a separate Windows Personal Computer, import the saved data from the HLN#n files into Microsoft Excel so the RMS values can be calculated.
9. There are many ways one can set up Microsoft Excel for calculating the RMS values. Below is an example:

   a. Assume the data are in an Excel worksheet as follows:

      i. Row 1 is the header: Freq, Data1 through Data25, RMS Linear Mag, RMS Log Mag.

      ii. Column A: Freq (Imported from the HLN#n files).

      iii. Column B through Column AO: Data1 through Data25 (Imported from the HLN#n files).

   b. Set up cell AA2 to calculate the RMS value in Linear Mag by entering the following formula into the cell:

      \[ = \text{STDEV.P}(B2:Z2) \]

   c. Copy the formula to the next cell on Column AA until it reaches the last frequency point.

   d. For magnitude measurements only:

      i. Set up cell AB2 to calculate the RMS value in Log Mag by entering the following formula into the cell:

      \[ = 20 \times \log(V2 + 1, 10) \]

      ii. Copy the formula to the next cell on Column AB until it reaches the last frequency point.

   e. Rename Sheet 1 to Frequency Response S21 by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

   f. Record the largest calculated RMS value of each frequency band listed in the Frequency Response S21 worksheet into Table A-6, “Frequency Response Repeatability – 1310 nm Band” on page A-3.
Optical Noise Floor S21 Setup – 1310 nm Configuration

1. Power on MN4775A-0071, MS464xB, and MN4765B and allow the instrument to warm up for 90 minutes.
2. Verify MN4775A-0071 E/O Converter Ignition key to OFF.

Figure 3-18. Optical Connection to MN4765B-0071

3. Connect Yellow-colored end of Optical Patch cable to MN4775A-0071 E/O Converter as shown in Figure 3-18.
4. Connect Green-colored end of Optical cable to MN4765B-0071 as shown in Figure 3-18.
5. Connect the VNA Port 1 to Anritsu MN4775A-0071 E/O Converter RF Input as shown in Figure 3-18.
   • Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.
6. Connect Anritsu MN4765B-0071 O/E Module Output to VNA Port 2 as shown in Figure 3-18.
   • Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.
7. Set E/O Converter Ignition key to ON.
8. Verify Optical Loop is in place on MN4775A-0071 E/O Converter.
9. Make settings on MN4775A-0071 via the display touch screen as below.
   a. Touch LASER ON square-pad to turn the LASER to ON state.
   b. Touch VOA ON square-pad to enable VOA Attenuator.
   c. Touch BIAS ON square-pad to enable BIAS Regulator.
10. Select ITU-Channel
    a. Channel setting not required on 1310 nm systems
11. Select VOA Mode:
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen.
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Set Power to +2 dBm. Touch green checkmark.
   d. Touch Home to return to the main screen.

12. Restore Bias Mode as QUADRATURE from PEAK mode utilized to measure power.
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen.
   b. At secondary screen select MODE = QUADRATURE.

13. Verify the default BIAS SETTINGS MN4775A-0071:
   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE SLOPE.
   e. Touch Home to return to the main screen.

14. Preset the VectorStar VNA as follows:
   a. Select Preset button on the icon bar and then the OK button.

15. On VectorStar VNA:
   a. Touch Trace and set the # of Traces to 1.
   b. Double click on TR1 to make the trace full screen.
   c. Touch Display and change Trace Format to Log Mag.
   d. Touch Response and change to S21.

16. Configure the VectorStar VNA; using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-19.
   a. Select Channel, then select Sweep.
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
   c. In this new screen, enter the information from the first entry in Figure 3-19.
   d. Select Add and repeat until all the segments are entered.
   e. Set Sweep type to Segmented Sweep (Freq Based).

<table>
<thead>
<tr>
<th>Seg. On</th>
<th>Freq Def for F1 &amp; F2</th>
<th>F1</th>
<th>F2</th>
<th># of Points</th>
<th>Stop/Stop Freq</th>
<th>IFBW</th>
<th>P1 Srf Pow (Srf Acen = 0 dB)</th>
<th>P2 Srf Pow (Srf Acen = 0 dB)</th>
<th>P1 Abs Power</th>
<th>P2 Abs Power</th>
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<tr>
<td>1</td>
<td>Start &amp; Stop</td>
<td>20 kHz</td>
<td>200 kHz</td>
<td>11</td>
<td>13 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Start &amp; Stop</td>
<td>31 kHz</td>
<td>2.01 MHz</td>
<td>22</td>
<td>80 Hz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Start &amp; Stop</td>
<td>2.25 MHz</td>
<td>5.99 MHz</td>
<td>20</td>
<td>402 Hz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Start &amp; Stop</td>
<td>10.01 MHz</td>
<td>2.499 MHz</td>
<td>17</td>
<td>155 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Start &amp; Stop</td>
<td>2.5 GHz</td>
<td>5 MHz</td>
<td>17</td>
<td>156.25 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Start &amp; Stop</td>
<td>5 kHz</td>
<td>20 GHz</td>
<td>51</td>
<td>209.98 Hz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Start &amp; Stop</td>
<td>20 kHz</td>
<td>30 GHz</td>
<td>61</td>
<td>209.98 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Start &amp; Stop</td>
<td>50 kHz</td>
<td>50 GHz</td>
<td>41</td>
<td>209.98 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Start &amp; Stop</td>
<td>100 kHz</td>
<td>65 GHz</td>
<td>51</td>
<td>209.98 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>Start &amp; Stop</td>
<td>65 kHz</td>
<td>67 GHz</td>
<td>11</td>
<td>199.9 MHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Start &amp; Stop</td>
<td>67 kHz</td>
<td>70 GHz</td>
<td>15</td>
<td>214.21 kHz</td>
<td>10 Hz</td>
<td>-10</td>
<td>-10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 3-19. MS4647B Frequency-Based Segmented Sweep Settings
Optical Nose Floor S21 Measurement – 1310 nm Configuration

1. On VectorStar VNA, select Calibration.
2. Select Calibrate.
5. Select Modify Cal Setup.
6. Select Edit Cal Params (see Figure 3-20).

Figure 3-20. TRANSMISSION FREQUENCY RESPONSE CAL SETUP (SOLT/R, Coaxial) Dialog
7. Click on Thru1-2 Info and the THRU INFO dialog appears (see Figure 3-21) and verify that Length (mm), Line loss (dB/mm), and @Frequency (GHz) are set to 0.000.

8. Click OK and OK again to close EDIT CALIBRATION PARAMETERS dialog.

9. Select Back.

10. Perform a Transmission Frequency Response-only calibration. Select Done and observe that the Green Calibration lamp in VNA is ON.
   a. Select Thru/Recip.
   b. Select Thru and wait for green checkmark to appear.
   c. Select Back.
   d. Select Done.
   e. Verify Green Calibration lamp is ON.
11. Set E/O Converter Ignition key to **OFF** (see figure Figure 3-22).
12. Select Scale
   a. Click on Reference Value and set it to -50 dB. The screen should look like Figure 3-23.

![Typical Noise Floor Display—Reference Only](image)

**Figure 3-23.** Typical Noise Floor Display—Reference Only

13. Select Sweep and then Hold Functions. Select Single Sweep & Hold.
14. Select File and then Save Data, file name NF#1, file type .csv.
15. Repeat Step 13 and Step 14 fifteen (15) more times. When saving the data, increment the number at the end of the file name by one (e.g. NF#2, NF#3, and so on.).
16. Copy the sixteen (16) saved data files off the MS465xB onto a USB flash drive for transferring to a Personal Computer.
17. On a separate Windows Personal Computer, import the saved data from the NF#n files into Microsoft Excel so the RMS values can be calculated.
18. There are many ways one can set up Microsoft Excel for calculating the RMS values. Here is an example:

   a. Assume the data are in an Excel worksheet as follows:
      i. Row 1 is the header: Freq, Data1 through Data16, RMS Linear Mag, RMS Log Mag.
      ii. Column A: Freq (Imported from the NF#n files).
      iii. Column B through Column Q: Data1 through Data16 (Imported from the NF#n files).

   b. Set up cell R to calculate the RMS value in Linear Mag by entering the following formula into the cell:
      \[ \text{= STDEV.P(B2:Q2)} \]

   c. Copy the formula to the next cell on Column R until it reaches the last frequency point.

   d. For magnitude measurements only:
      i. Set up cell S to calculate the RMS value in Log Mag by entering the following formula into the cell:
         \[ \text{= 20 x log(R2 + 1, 10)} \]
      ii. Copy the formula to the next cell on Column S until it reaches the last frequency point.

   e. Rename Sheet 1 to S16 Magnitude by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

   f. Record the highest calculated RMS value of each frequency band listed in Table A-7, “Optical Noise Floor S21 (Option 51) – 1310 nm Band” on page A-4 or Table A-8, “Optical Noise Floor S21 (Option 61 or 62) – 1310 nm Band” on page A-4.
This section contains the following setup and measurement procedures:

- ME7848A-0270 1550 nm System Setup
- Optical Power Meter (OPM) Measurement Setup – 1550 nm Configuration
- Optical Power Meter Measurement – 1550 nm Configuration
- Frequency Response Repeatability S21 Setup – 1550 nm Configuration
- Frequency Response Repeatability S21-Mag Measurement – 1550 nm Configuration
- Optical Noise Floor S21 Setup – 1550 nm Configuration
- Optical Noise Floor S21 Measurement – 1550 nm Configuration

ME7848A-0270 1550 nm System Setup

1. Configure components (VNA, O/E, E/O, RF and Optical cables) as shown in Figure 3-24.

2. Apply power to MN4775A-0070 E/O Converter by pushing the Standby button until it turns green.
3. Apply power to the VNA.
4. Apply power to MN4765B-0070 O/E Calibration Module via +12 V power cube.
5. MN4775A-0070 E/O Converter:
   a. Verify **Optical Loop** is in place on MN4775A-0070 E/O Converter.

   **Note** There is a key on the optical fiber cable that needs to be oriented correctly before the screw will tighten correctly.

   b. Keep **Ignition-Key** in **OFF** Position as shown in **Figure 3-24**.

6. Make initial VNA RF Connections shown in **Figure 3-24**.
   a. Place VF-VF Adapter on VNA Port 2.
   b. VNA Port 1 to VNA Port 2 via 3 ft. RF Cables.
   c. Verify the connection between the **Male end** on cable at Port 1 and **Female End** on cable at Port 2.

7. Make Optical connection to MN4775A-0070 as shown in **Figure 3-24**.
   a. Connect **Yellow-colored** end of Optical Patch cable to MN4775A-0070 E/O Converter.
   b. Place the **Green-colored** cap onto the **Green-colored** end of the Optical cable.

8. Turn MN4775A-0070 E/O Converter Ignition Key to **ON**.

9. Make settings on MN4775A-0070 via the display touch screen as described below; refer to **Figure 3-25** (left side).
   a. Touch **LASER ON** square-pad to turn the **LASER** to **ON** state.
   b. Touch **VOA ON** square-pad to enable VOA Attenuator.
   c. Touch **BIAS ON** square-pad to enable BIAS Regulator.

**Figure 3-25.** E/O Converter Setup Screen

**Note** The depiction of the touch screen settings above is for reference only; actual settings are as given below.
10. Select ITU Channel:
   a. Touch center section of LASER WAVELENGTH region to bring up secondary screen (not shown in figure 3-2).
   b. At secondary screen select ITU Channel 34 = 1550.12 nm WAVE LENGTH. Touch green checkmark.
   c. Touch Home to return to the main screen.

11. Select VOA Mode:
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen as shown in Figure 3-25 (left side).
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Select and adjust output power to +5 dBm.

12. Select Bias Mode:
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen as shown in Figure 3-25 (right side).
   b. At secondary screen select MODE = QUADRATURE.

13. Typical default BIAS SETTINGS MN4775A-0070:
   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE.

14. Turn E/O Converter LASER Inter-Lock Ignition Key to OFF.
Optical Power Meter (OPM) Measurement Setup – 1550 nm Configuration

1. Apply Power via black button adjacent to sensor (side panel).
2. Allow 1 minute warm up

3. Verify following default settings.
   a. Range = Auto.
   b. Units = dBm.
4. Navigate to MEAS CONFIG menu via front panel buttons.
   a. Select Zero to zero the sensor (About 2 seconds).
   b. Exit MEAS CONFIG menu.
5. Set Measurement Wavelength.
   a. On Front Panel select Lambda button as shown in Step 3-26.
   b. Navigate to 1550nm Wavelength icon in menu bar area.
   c. On PM100D Meter select OK to choose 1550 nm selection, as shown in Figure 3-26.
Optical Power Meter Measurement – 1550 nm Configuration

1. Optical Power Measurement Using PM100D:
   a. Connect PM100D OPM to E/O Converter Output via Optical Cable, as shown in Figure 3-27.
   b. Verify that the PM100D’s power is **ON**.
   c. Turn E/O Converter Ignition Key = **ON**.
   d. Using E/O Touch Panel:
      i. Laser = **ON**.
      ii. VOA = **ON**, VOA Mode = **Constant Output** at +5 dBm.
      iii. BIAS = **ON**.
   e. Modify Bias Mode
      i. Push touch screen at Bias center navigate to Secondary Bias settings screen.
      ii. Select Bias Mode = **PEAK**.
      iii. Select Reset Auto-Bias Cal.
   f. Wait for readings to stabilize; nominally less than ±0.5 dB bounce.
   g. Enter nominal reading from PM100D Optical Power Meter into the test records in Table A-9, “Optical Power Measurement – 1550 nm Band” on page A-5.
   h. Expected range for this measurement is +5 dBm ±2 dB.

   **Note**    Meter reading may fluctuate nominally ± 0.5 dB.

2. Set E/O Converter Inter-Lock to **OFF**;
   a. Set E/O Converter Gen Laser Interlock to **OFF** via Ignition Key.
   b. Power down Optical Power Meter.
3. Disconnect the Optical Power Meter.
Frequency Response Repeatability S21 Setup – 1550 nm Configuration

1. Power on MN4775A-0070, MS464xB, and MN4765B and allow the instrument to warm up for 90 minutes.
2. Verify MN4775A-0070 E/O Converter Ignition key to OFF.

3. Connect Yellow-colored end of Optical Patch cable to MN4775A-0070 E/O Converter as shown in Figure 3-28.
4. Connect Green-colored end of Optical cable to MN4765B-0070 as shown in Figure 3-28.
5. Connect the VNA Port 1 to Anritsu MN4775A-0070 E/O Converter RF Input as shown in Figure 3-28.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.
6. Connect Anritsu MN4765B-0070 O/E Module Output to VNA Port 2 as shown in Figure 3-28.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.
7. Set E/O Converter Ignition key to ON.
8. Verify Optical Loop is in place on MN4775A-0070 E/O Converter as shown in Figure 3-28.
9. Make settings on MN4775A-0070 via the display touch screen as below.
   a. Touch LASER ON square-pad to turn the LASER to ON state.
   b. Touch VOA ON square-pad to enable VOA Attenuator.
   c. Touch BIAS ON square-pad to enable BIAS Regulator.
10. Select ITU-Channel:
   a. Touch center section of LASER WAVELENGTH region to bring up secondary screen.
   b. At Secondary Screen select ITU Channel 31 = 1550.041 nm WAVE LENGTH.
   c. Touch Home to return to the main screen.
11. Select VOA Mode:
   a. Touch center section of VOA OUTPUT POWER region to bring Up Secondary Screen.
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.
   c. Set Power to +5 dBm. Touch green checkmark.
   d. Touch Home to return to the main screen.

12. Restore Bias Mode as QUADRATURE from PEAK mode utilized to measure power.
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen.
   b. At secondary screen select MODE = QUADRATURE.

13. Verify the default BIAS SETTINGS MN4775A-0070.
   a. Dither-Frequency 3 kHz.
   b. Dither-Amplitude 600 mVpp.
   c. Dither ON.
   d. Dither Slope POSITIVE SLOPE.
   e. Touch Home to return to the main screen.

14. Preset the VectorStar VNA as follows:
   a. Select Preset button on the icon bar and then the OK button.
Performance Verification 3-6 ME7848A-0270 System Verification – 1550 nm Configuration

Frequency Response Repeatability S21-Mag Measurement – 1550 nm Configuration

1. On VectorStar VNA:
   a. Touch Trace and set the # of Traces to 1.
   b. Double click on TR1 to make the trace full screen.
   c. Touch on Display and change Trace Format to Log Mag.
   d. Touch Response and change S21.

2. Configure the VectorStar VNA; using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-29.
   a. Select Channel, then select Sweep.
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.
   c. In this new screen, enter the information from the first entry in Figure 3-29.
   d. Select Add and repeat until all the segments are entered.
   e. Set Sweep type to Segmented Sweep (Freq Based).

<table>
<thead>
<tr>
<th>Seg. Chn</th>
<th>Freq Def. for F1 &amp; F2</th>
<th>F1</th>
<th>F2</th>
<th># ofPts</th>
<th>Step/Stop Freq</th>
<th>IFBW</th>
<th>P1 Sca Pror (Sc</th>
<th>P2 Sca Pror (Sc</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Start &amp; Stop</td>
<td>311 kHz</td>
<td>201 MHz</td>
<td>3</td>
<td>649.5 kHz</td>
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<td>-10</td>
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<td>3</td>
<td>Start &amp; Stop</td>
<td>2.35 kHz</td>
<td>999 kHz</td>
<td>4</td>
<td>2.5446 GHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>4</td>
<td>Start &amp; Stop</td>
<td>10.01 MHz</td>
<td>2.455 GHz</td>
<td>5</td>
<td>6222.245 MHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>5</td>
<td>Start &amp; Stop</td>
<td>3.5 kHz</td>
<td>5 GHz</td>
<td>5</td>
<td>625 MHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>6</td>
<td>Start &amp; Stop</td>
<td>5.001 GHz</td>
<td>20 GHz</td>
<td>31</td>
<td>4999.965 GHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>7</td>
<td>Start &amp; Stop</td>
<td>20.001 GHz</td>
<td>30 GHz</td>
<td>56</td>
<td>514.257 MHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>8</td>
<td>Start &amp; Stop</td>
<td>38.001 GHz</td>
<td>50 GHz</td>
<td>24</td>
<td>531.695 MHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
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<td>9</td>
<td>Start &amp; Stop</td>
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<td>31</td>
<td>4999.965 GHz</td>
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<td>-10</td>
</tr>
<tr>
<td>10</td>
<td>Start &amp; Stop</td>
<td>65.001 GHz</td>
<td>67 GHz</td>
<td>6</td>
<td>6683.33333 MHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
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<td>11</td>
<td>Start &amp; Stop</td>
<td>67.001 GHz</td>
<td>70 GHz</td>
<td>6</td>
<td>596.8 MHz</td>
<td>10</td>
<td>-10</td>
<td>-10</td>
</tr>
</tbody>
</table>

Figure 3-29. MS4647B Frequency-Based Segmented Sweep Settings

3. Normalize the trace (data divided by memory).
   a. Select Display.
   b. Select View Trace.
   c. Select Store Data to Memory.
   d. Select Data, Memory Math.

4. Select Sweep and then Hold Functions. Select Single Sweep & Hold.

5. Select File and then Save Data, file name HLN#1, file type .csv.

6. Repeat Step 4 through Step 5 twenty four (24) more times. When saving the data, increment the number at the end of the file name by one (e.g. HLN#2, HLN#3, and so on.).

7. Copy the twenty five (25) saved data files off the MS464xB onto a USB flash drive for transferring to a Personal Computer.

8. On a separate Windows Personal Computer, import the saved data from the HLN#n files into Microsoft Excel so the RMS values can be calculated.
9. There are many ways one can set up Microsoft Excel for calculating the RMS values. Here is an example:

a. Assume the data are in an Excel worksheet as follows:
   i. Row 1 is the header: Freq, Data1 through Data25, RMS Linear Mag, RMS Log Mag
   ii. Column A: Freq (Imported from the HLN\#n files)
   iii. Column B through Column AO: Data1 through Data25 (Imported from the HLN\#n files)

b. Set up cell AA2 to calculate the RMS value in Linear Mag by entering the following formula into the cell:
   \[ = \text{STDEV.P}(B2:Z2) \]

c. Copy the formula to the next cell on Column AA until it reaches the last frequency point.

d. For magnitude measurements only:
   i. Set up cell AB2 to calculate the RMS value in Log Mag by entering the following formula into the cell:
   \[ = 20 \times \log(V2 + 1, 10) \]
   ii. Copy the formula to the next cell on Column AB until it reaches the last frequency point.

e. Rename Sheet 1 to Frequency Response S21 by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

f. Record the largest calculated RMS value of each frequency band listed in Frequency Response S21 worksheet into Table A-10, “Frequency Response Repeatability – 1550 nm Band” on page A-5.
Optical Noise Floor S21 Setup – 1550 nm Configuration

1. Power on MN4775A-0070, MS464xB, and MN4765B and allow the instrument to warm up for 90 minutes.
2. Verify MN4775A-0070 E/O Converter Ignition key is set to OFF.

3. Connect Yellow-colored end of Optical Patch cable to MN4775A-0070 E/O Converter as shown in Figure 3-30.
4. Connect Green-colored end of Optical cable to MN4765B-0070 as shown in Figure 3-30.
5. Connect the VNA Port 1 to Anritsu MN4775A-0070 E/O Converter RF Input as shown in Figure 3-30.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.
6. Connect Anritsu MN4765B-0070 O/E Module Output to VNA Port 2 as shown in Figure 3-30.
   - Use torque wrench to tighten the connectors to ensure that the connections do not work themselves loose during the test.
7. Set E/O Converter Ignition key to ON.
8. Verify Optical Loop is in place on MN4775A-0070 E/O Converter as shown in Figure 3-30.
9. Make settings on MN4775A-0070 via the display touch screen as below.
   a. Touch LASER ON square-pad to turn the LASER to ON state.
   b. Touch VOA ON square-pad to enable VOA Attenuator.
   c. Touch BIAS ON square-pad to enable BIAS Regulator.

Figure 3-30. Optical Connection to MN4765B-0070
10. Select ITU-Channel  
   a. Touch center section of LASER WAVELENGTH region to bring up secondary screen.  
   b. At secondary screen select ITU Channel 31 = 1550.041 nm WAVE LENGTH.  
   c. Touch Home to return to the main screen.  

11. Select VOA Mode  
   a. Touch center section of VOA OUTPUT POWER region to bring up secondary screen.  
   b. At secondary screen, touch Mode and then touch Out to change mode to CONSTANT OUTPUT.  
   c. Set Power to +5 dBm. Touch green checkmark.  
   d. Touch Home to return to the main screen.  

12. Restore Bias Mode as QUADRATURE from PEAK mode utilized to measure power.  
   a. Touch center section of BIAS VOLTAGE region to bring up secondary screen.  
   b. At secondary screen select MODE = QUADRATURE.  

13. Verify the default BIAS SETTINGS MN4775A-0070:  
   a. Dither-Frequency 3 kHz.  
   b. Dither-Amplitude 600 mVpp.  
   c. Dither ON.  
   d. Dither Slope POSITIVE SLOPE.  
   e. Touch Home to return to the main screen.  

14. Preset the VectorStar VNA as follows:  
   a. Select Preset button on the icon bar and then the OK button  

15. On VectorStar VNA:  
   a. Touch Trace and set the # of Traces to 1.  
   b. Double click on TR1 to make the trace full screen.  
   c. Touch Display and change Trace Format to Log Mag.  
   d. Touch Response and change to S21.  

16. Configure the VectorStar VNA: using Frequency Based Segmented Sweep, create a segmented sweep table as shown in Figure 3-31.  
   a. Select Channel, then select Sweep.  
   b. Select Freq-based Seg. Sweep Setup and a new window appears at the bottom of the screen.  
   c. In this new screen, enter the information from the first entry in Figure 3-31.  
   d. Select Add and repeat until all the segments are entered.
e. Set Sweep type to Segmented Sweep (Freq Based).

<p>| | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
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<td></td>
</tr>
</tbody>
</table>

Figure 3-31. MS4647B Frequency-Based Segmented Sweep Settings
Optical Nose Floor S21 Measurement – 1550 nm Configuration

1. VectorStar VNA, select Calibration.
2. Select Calibrate.
5. Select Modify Cal Setup.
6. Select Edit Cal Params (see Figure 3-32).

Figure 3-32. TRANSMISSION FREQUENCY RESPONSE CAL SETUP (SOLT/R, Coaxial) Dialog
7. Click on Thru1-2 Info and the screen appears (see Figure 3-33) and verify Length (mm), Line loss (dB/mm), and @Frequency (GHz) are set to 0.000.

Figure 3-33. THRU INFO Dialog

8. Click OK and OK again to close EDIT CALIBRATION PARAMETERS dialog.

9. Select Back.

10. Perform a Transmission Frequency Response-only calibration. Select Done and observe that the Green Calibration lamp in VNA is on.
   a. Select Thru/Recip.
   b. Select Thru and wait for green checkmark to appear.
   c. Select Back.
   d. Select Done.
   e. Verify Green Calibration lamp is ON.
11. Set E/O Converter Ignition key to **OFF**, see figure **Figure 3-34**.
12. Select Scale
   a. Click on Reference Value and set it to -50 dB. The screen should look like Figure 3-35.

![Figure 3-35. Typical Noise Floor Display—Reference Only](image)

13. Select Sweep and then Hold Functions. Select Single Sweep & Hold.
14. Select File and then Save Data, file name NF#1, file type .csv.
15. Repeat Step 13 and Step 14 fifteen (15) more times. When saving the data, increment the number at the end of the file name by one (e.g. NF#2, NF#3, and so on.).
16. Copy the sixteen (16) saved data files off the MS464xB onto a USB flash drive for transferring to a Personal Computer.
17. On a separate Windows Personal Computer, import the saved data from the NF#n files into Microsoft Excel so the RMS values can be calculated.
18. There are many ways one can set up Microsoft Excel for calculating the RMS values. Here is an example:

a. Assume the data are in an Excel worksheet as follows:
   i. Row 1 is the header: Freq, Data1 through Data16, RMS Linear Mag, RMS Log Mag.
   ii. Column A: Freq (Imported from the NF#n files).
   iii. Column B through Column Q: Data1 through Data16 (Imported from the HLN#n files).

b. Set up cell R to calculate the RMS value in Linear Mag by entering the following formula into the cell:
   \[ = \text{STDEV.P}(B2:Q2) \]

c. Copy the formula to the next cell on Column R until it reaches the last frequency point.

d. For magnitude measurements only:
   i. Set up cell S to calculate the RMS value in Log Mag by entering the following formula into the cell:
      \[ = 20 \times \log(R2 + 1, 10) \]
   ii. Copy the formula to the next cell on Column S until it reaches the last frequency point.

e. Rename Sheet 1 to S16 Magnitude by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.

f. Record the highest calculated RMS value of each frequency band listed in Table A-11, “Optical Noise Floor S21 (Option 51) – 1550 nm Band” on page A-6 or Table A-12, “Optical Noise Floor S21 (Option 61 or 62) – 1550 nm Band” on page A-6.
Chapter 4 — Theory of Operation

4-1 Introduction

This chapter provides a brief functional description of the ME7848A Series ONA system. It also briefly describes the operation of each major instrument or assembly.

4-2 System Description

The ME7848A opto-electronic network analyzer (ONA) system comprises a VNA, a calibration O/E module, and a laser/modulator converter assembly. Together, they allow calibrated RF response measurements of E/O, O/E, and certain O/O devices.

The VectorStar ME7848A opto-electronic network analyzer (ONA) is a VNA-based system for characterizing opto-electronic components used in photonic high-speed data transmission networks. The VectorStar ME7848A 200 series ONA consists of an MN4775A E/O converter, an MN4765B O/E calibration module/detector, and the appropriate frequency range VectorStar VNA. The ME7848A 100 series ONA includes the VectorStar VNA and MN4765B O/E calibration module without the converter.

For measurements of E/O DUTs (when not using the ME7848A 200 system), the VectorStar VNA is combined with the MN4765B O/E calibration module. When the DUT is an O/E device, then the user's E/O modulator is characterized with the MN4765B calibration module and the measurement reference is transferred to the E/O modulator. The lack of a dedicated, stable E/O modulator results in a system where guaranteed performance specifications cannot be provided. With availability of a full performance E/O converter that includes a bias-stable laser and modulator, the new ME7848A 200 series ONA can quickly and easily switch between E/O, O/O, and O/E measurements with specified accuracy.

4-3 System Components

The ME7848A-100 Series ONA System consists of the following major components:

- VectorStar MS464xB Series VNA (e.g. MS4647B)
- MN4765B O/E calibration module

The ME7848A-200 Series ONA System consists of the following major components:

- VectorStar MS464xB Series VNA (e.g. MS4647B)
- MN4775A E/O converter
- MN4765B O/E calibration module

Figure 4-1 on page 4-2 shows the ME7848A Series ONA system configuration and illustrates the interconnections among the VNA, E/O converter, and O/E calibration module.
Figure 4-1. ME7848A Series ONA System Interconnections
4-4 Functional Description of System Components

This section contains brief descriptions of each system component.

VectorStar MS464xB Vector Network Analyzer

The VectorStar MS464xB VNA performs the following tasks:

- Controlling the operation of the entire ME7848A Series ONA system
- Providing stimulus signal
- Handling complex vector signal measurements

Figure 4-2 shows the components in the MS4647B that are essential for the operation of the ME7848A Series ONA System.

1. Items with broken (dashed) lines are optional connections.

Figure 4-2. VectorStar MS4640B Series VNA Simplified Block Diagram
MN4775A E/O Converter

Each E/O converter is fully integrated and contains the laser source, lithium niobate (LiNbO3) 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.

Either the internal laser or an external laser source may be coupled to the Laser In port (MN4775A-0070 and-0071), 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 Input, Mon-2 is at the MZM Output, and Mon-3 is at the final Optical Output.

Figure 4-3 shows the block diagram of the E/O Converter.

MN4765B O/E Calibration Module

The MN4765B converts the modulated optical signal back to an electrical signal that is measured by the VNA.

The MN4765B is a characterized, unamplified photodiode module. It is used as an optical receiver with the Anritsu MS464xB and MS4652xB Series VNAs to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E). Bandwidth and wavelength coverage depends on the option selected when the module is ordered. The MN4765B allows error-corrected Transfer Function, Group Delay, and Return Loss measurements of optoelectronic components.
4-5 ME7848A ONA System Operation

This section describes the system operation of the ME7848A ONA System.

Stimulus Signal Generation

The MS464xB VNA outputs a stimulus signal from its test port and feeds directly to the MN4775A via coaxial cable. These stimulus signal modulates the MN4775A E/O converter's internal laser. The modulated optical signal is then sent to the MN4765B. The MN4765B O/E Calibration Module removes frequency from the optical signal so test signal processing can occur.

Test Signal Processing

The test signal from the MN4765B RF connector is then fed back to the test port of the MS464xB VNA for further signal processing.

| Note | In the MS4640B Series Microwave Vector Network Analyzer Maintenance Manual - 10410-00320, refer to Chapter 2 - Theory of Operation for signal processing details. |
Chapter 5 — Troubleshooting

5-1  Introduction

This chapter provides information about troubleshooting tests that can be used to check the ME7848A Series VNA System for proper operation. These tests are intended to be used as a troubleshooting tool for identifying the faulty system components.

5-2  General Safety Warnings

Many of the troubleshooting procedures presented in this chapter require the removal of instrument covers to gain access to subassemblies and modules. When using these procedures, observe the warning and caution notices.

### Warning

Hazardous voltages are presented inside the instrument when AC line power is connected. Before removing any covers, turn off the instrument via the Main power switch on the front panel and unplug the AC power cord.

### Caution

Many assemblies and modules contain static-sensitive components. Improper handling of these assemblies and modules may result in damage to the assemblies and modules. Always observe the static-sensitive component handling precautions.

### Caution

To provide protection for the rear panel connectors, when the top cover is removed, the rear feet should be reattached onto the chassis after removing the top cover.

All statements regarding safety of operation and technical data in this 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.

### 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, replace 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.
### Laser Radiation

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

- **MN4775A-0070 or MN4775A-0071**: Class 1M Laser

![Laser Radiation Warning](image)

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

![Laser Radiation Warning](image)

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.
Follow Intended Usage Guidelines

**Caution**

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.
5-3 Troubleshooting Strategy

The ME7848A Series ONA System consists of the following major components:

- MS464X Series VectorStar VNA
- MN4775A-00xx E/O Converter
- MN4765B-0xxx O/E Calibration Module

A good understanding of the respective ME7848A Series ONA System operation is an important aid to troubleshoot system failures. Refer to Section 4-4 “Functional Description of System Components” on page 4-3 and Section 4-5 “ME7848A ONA System Operation” on page 4-5.

It is also imperative to isolate whether the system fault is in the MS4640 Series VectorStar VNA, the MN4775A-00xx E/O Converter, or MN4765B-0xxx O/E Calibration Module.

Suggested Troubleshooting Steps

The suggested troubleshooting steps for ME7848A ONA System are as follows:

- Ensure that the VNA, E/O Converter, and O/E Calibration Module all can be powered up.
- Ensure that no setup and installation errors exist (e.g. cabling error and cable connection). Refer to the VectorStar ME7848A ONA Quick Start Guide – part number 10410-00777.
- Isolate the fault to a system component (e.g. VNA, E/O Converter, or O/E Calibration Module) using a process of elimination. Refer to the “General Troubleshooting of the System” on page 5-4.

Note: The critical information to know is the frequency at which the fault occurs.

5-4 General Troubleshooting of the System

This section provides general troubleshooting procedures of the ME7848A ONA System. It assumes that setup and installation errors have been eliminated.

Procedure

1. Verify the MN4775A-00xx laser is off and the key is set to Lock.
2. Remove both ends of the optical cable between the MN4775A-00xx and MN4765B-0xxx modules and verify they are seated correctly. These cables have a notch on them which aligns to the connector. Reinstall the cables.
3. Remove the blue optical patch cable on the MN4775A-007x (this optical cable is not present on the MN4775A-0040 module) and verify it is seated correctly. This cable has notches on it which align to the connector. Reinstall the cable.
4. Use the performance verification setup “Frequency Response Repeatability S21 Setup and Frequency Response Repeatability S21 Setup measurement” in Chapter 3 to set the unit up and verify it is sweeping correctly. Turn the laser on and off to verify that the level changes.
5. If you have low power, clean all of optical cables and optical connectors. Also, verify the RF coaxial cables are clean and correctly torqued.
Appendix A — ME7848A ONA Test Records

A-1 Introduction

This appendix provides test records that can be used to record the performance of the ME7848A Millimeter-Wave configuration VNA system.

Make a copy of the following Test Record pages and document the measured values each time performance verification is performed. Continuing to document this process each performance verification session provides a detailed history of the instrument’s performance.

- “ME7848A-0240 850 nm Test Records”
- “ME7848A-0271 1310 nm Test Records”
- “ME7848A-0270 1550 nm Test Records”

A-2 ME7848A-0240 850 nm Test Records

Instrument Information

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<thead>
<tr>
<th>ME7848A</th>
<th>Operator:</th>
<th>Date:</th>
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<tbody>
<tr>
<td>VectorStar VNA Model:</td>
<td>S/N</td>
<td>VectorStar VNA Options:</td>
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RF Test Band and Wave Length

Table A-1. Optical Power Measurement – 850 nm Band

<table>
<thead>
<tr>
<th>Model</th>
<th>E/O Module</th>
<th>Measured Value (dBm)</th>
<th>Upper Specification (dBm)</th>
<th>Lower Specification (dBm)</th>
<th>Measurement Uncertainty (dB)</th>
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<td>ME7848A-0240</td>
<td>MN4775A-0040</td>
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Table A-2. Frequency Response Repeatability – 850 nm Band

<table>
<thead>
<tr>
<th>ME7848A-0240 Frequency Response Repeatability S21-Mag</th>
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<tbody>
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<td>RF Test Band</td>
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<tr>
<td>Band (0.070-0.300 MHz)</td>
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<tr>
<td>Band (0.300-0.0002 MHz)</td>
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<tr>
<td>Band (00002-0010 MHz)</td>
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<td>Band (00010-02500 MHz)</td>
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<td>Band (02500-05000 MHz)</td>
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<td>Band (05000-20000 MHz)</td>
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<td>Band (20000-40000 MHz)</td>
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### Table A-3. Optical Noise Floor S21 (Option 51) – 850 nm Band

<table>
<thead>
<tr>
<th>RF Test Band</th>
<th>E/O Module</th>
<th>Measured Value (dBm rms)</th>
<th>Upper Specification (dBm rms)</th>
<th>Lower Specification (dBm rms)</th>
<th>Measurement Uncertainty (dB)</th>
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<tr>
<td>Band (0.070-0.300 MHz)</td>
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<tr>
<td>Band (00010-02500 MHz)</td>
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<td>Band (02500-05000 MHz)</td>
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### Table A-4. Optical Noise Floor S21 (Option 61 or 62) – 850 nm Band

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<th>E/O Module</th>
<th>Measured Value (dBm rms)</th>
<th>Upper Specification (dBm rms)</th>
<th>Lower Specification (dBm rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0040</td>
<td>-32</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-00002 MHz)</td>
<td>MN4775A-0040</td>
<td>-37</td>
<td>N/A</td>
<td>0.49</td>
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<tr>
<td>Band (00002-00010 MHz)</td>
<td>MN4775A-0040</td>
<td>-42</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (00010-02500 MHz)</td>
<td>MN4775A-0040</td>
<td>-50</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (02500-05000 MHz)</td>
<td>MN4775A-0040</td>
<td>-52</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (05000-20000 MHz)</td>
<td>MN4775A-0040</td>
<td>-47</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (20000-40000 MHz)</td>
<td>MN4775A-0040</td>
<td>-32</td>
<td>N/A</td>
<td>0.58</td>
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</tr>
</tbody>
</table>
A-3 ME7848A-0271 1310 nm Test Records

Instrument Information

<table>
<thead>
<tr>
<th>ME7848A</th>
<th>Operator:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>VectorStar VNA Model:</td>
<td>S/N</td>
<td>VectorStar VNA Options:</td>
</tr>
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</table>

RF Test Band and Wave Length

Table A-5. Optical Power Measurement – 1310 nm Band

<table>
<thead>
<tr>
<th>Model</th>
<th>E/O Module</th>
<th>Measured Value (dBm)</th>
<th>Upper Specification (dBm)</th>
<th>Lower Specification (dBm)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME7848A-0271</td>
<td>MN4775A-0071</td>
<td>4</td>
<td>0</td>
<td>0.31</td>
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Table A-6. Frequency Response Repeatability – 1310 nm Band

<table>
<thead>
<tr>
<th>RF Test Band</th>
<th>E/O Module</th>
<th>Measured Value (dB rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0071</td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-0.0002 MHz)</td>
<td>MN4775A-0071</td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>Band (0.0002-0.0010 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.0010-0.0250 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
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<tr>
<td>Band (0.0250-0.0500 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
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<td>Band (0.0500-0.2000 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
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</tr>
<tr>
<td>Band (0.2000-0.3800 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
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<tr>
<td>Band (0.3800-0.5000 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
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<tr>
<td>Band (0.5000-0.6500 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.6500-0.7000 MHz)</td>
<td>MN4775A-0071</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.6700-0.7000 MHz)</td>
<td>MN4775A-0071</td>
<td>0.02</td>
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### Table A-7. Optical Noise Floor S21 (Option 51) – 1310 nm Band

<table>
<thead>
<tr>
<th>RF Test Band (MHz)</th>
<th>E/O Module</th>
<th>Measured Value (dBm rms)</th>
<th>Upper Specification (dBm rms)</th>
<th>Lower Specification (dBm rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0071</td>
<td>-49</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-0.600 MHz)</td>
<td>MN4775A-0071</td>
<td>-54</td>
<td>N/A</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Band (0.600-0.900 MHz)</td>
<td>MN4775A-0071</td>
<td>-59</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.900-1.200 MHz)</td>
<td>MN4775A-0071</td>
<td>-69</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (1.200-1.500 MHz)</td>
<td>MN4775A-0071</td>
<td>-69</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (1.500-1.800 MHz)</td>
<td>MN4775A-0071</td>
<td>-65</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (1.800-2.100 MHz)</td>
<td>MN4775A-0071</td>
<td>-62</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (2.100-2.400 MHz)</td>
<td>MN4775A-0071</td>
<td>-54</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (2.400-2.700 MHz)</td>
<td>MN4775A-0071</td>
<td>-49</td>
<td>N/A</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Band (2.700-3.000 MHz)</td>
<td>MN4775A-0071</td>
<td>-46</td>
<td>N/A</td>
<td>0.90</td>
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</tr>
<tr>
<td>Band (3.000-3.300 MHz)</td>
<td>MN4775A-0071</td>
<td>-41</td>
<td>N/A</td>
<td>1.32</td>
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### Table A-8. Optical Noise Floor S21 (Option 61 or 62) – 1310 nm Band

<table>
<thead>
<tr>
<th>RF Test Band (MHz)</th>
<th>E/O Module</th>
<th>Measured Value (dBm rms)</th>
<th>Upper Specification (dBm rms)</th>
<th>Lower Specification (dBm rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0071</td>
<td>-49</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-0.600 MHz)</td>
<td>MN4775A-0071</td>
<td>-54</td>
<td>N/A</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Band (0.600-0.900 MHz)</td>
<td>MN4775A-0071</td>
<td>-59</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.900-1.200 MHz)</td>
<td>MN4775A-0071</td>
<td>-69</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (1.200-1.500 MHz)</td>
<td>MN4775A-0071</td>
<td>-69</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (1.500-1.800 MHz)</td>
<td>MN4775A-0071</td>
<td>-65</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (1.800-2.100 MHz)</td>
<td>MN4775A-0071</td>
<td>-62</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (2.100-2.400 MHz)</td>
<td>MN4775A-0071</td>
<td>-53</td>
<td>N/A</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Band (2.400-2.700 MHz)</td>
<td>MN4775A-0071</td>
<td>-47</td>
<td>N/A</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Band (2.700-3.000 MHz)</td>
<td>MN4775A-0071</td>
<td>-43</td>
<td>N/A</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Band (3.000-3.300 MHz)</td>
<td>MN4775A-0071</td>
<td>-38</td>
<td>N/A</td>
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</table>
A-4 ME7848A-0270 1550 nm Test Records

Instrument Information

<table>
<thead>
<tr>
<th>ME7848A</th>
<th>Operator:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>VectorStar VNA Model:</td>
<td>S/N</td>
<td>VectorStar VNA Options:</td>
</tr>
</tbody>
</table>

RF Test Band and Wave Length

Table A-9. Optical Power Measurement – 1550 nm Band

<table>
<thead>
<tr>
<th>Model</th>
<th>E/O Module</th>
<th>Measured Value (dBm)</th>
<th>Upper Specification (dBm)</th>
<th>Lower Specification (dBm)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME7848A-0270</td>
<td>MN4775A-0070</td>
<td>7</td>
<td>3</td>
<td>0.31</td>
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Table A-10. Frequency Response Repeatability – 1550 nm Band

<table>
<thead>
<tr>
<th>RF Test Band</th>
<th>E/O Module</th>
<th>Measured Value (dB rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0070</td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-0.3002 MHz)</td>
<td>MN4775A-0070</td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>Band (0.0002-0.0010 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.0010-0.02500 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.02500-0.05000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.05000-0.20000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.20000-0.38000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.38000-0.50000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.50000-0.65000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.65000-0.67000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Band (0.67000-0.70000 MHz)</td>
<td>MN4775A-0070</td>
<td>0.02</td>
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### Table A-11. Optical Noise Floor S21 (Option 51) – 1550 nm Band

<table>
<thead>
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<th>RF Test Band (MHz)</th>
<th>E/O Module</th>
<th>Measured Value (dBm rms)</th>
<th>Upper Specification (dBm rms)</th>
<th>Lower Specification (dBm rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0070</td>
<td>-56</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-0.0002 MHz)</td>
<td>MN4775A-0070</td>
<td>-61</td>
<td>N/A</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Band (0.0002-0.0010 MHz)</td>
<td>MN4775A-0070</td>
<td>-66</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.0010-0.0250 MHz)</td>
<td>MN4775A-0070</td>
<td>-76</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (0.02500-0.05000 MHz)</td>
<td>MN4775A-0070</td>
<td>-76</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (0.05000-0.20000 MHz)</td>
<td>MN4775A-0070</td>
<td>-72</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (0.20000-0.38000 MHz)</td>
<td>MN4775A-0070</td>
<td>-69</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (0.38000-0.50000 MHz)</td>
<td>MN4775A-0070</td>
<td>-61</td>
<td>N/A</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Band (0.50000-0.65000 MHz)</td>
<td>MN4775A-0070</td>
<td>-56</td>
<td>N/A</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Band (0.65000-0.70000 MHz)</td>
<td>MN4775A-0070</td>
<td>-53</td>
<td>N/A</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Band (0.67000-0.70000 MHz)</td>
<td>MN4775A-0070</td>
<td>-48</td>
<td>N/A</td>
<td>1.32</td>
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### Table A-12. Optical Noise Floor S21 (Option 61 or 62) – 1550 nm Band

<table>
<thead>
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<th>RF Test Band (MHz)</th>
<th>E/O Module</th>
<th>Measured Value (dBm rms)</th>
<th>Upper Specification (dBm rms)</th>
<th>Lower Specification (dBm rms)</th>
<th>Measurement Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band (0.070-0.300 MHz)</td>
<td>MN4775A-0070</td>
<td>-56</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.300-0.0002 MHz)</td>
<td>MN4775A-0070</td>
<td>-61</td>
<td>N/A</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Band (0.0002-0.0010 MHz)</td>
<td>MN4775A-0070</td>
<td>-66</td>
<td>N/A</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Band (0.0010-0.0250 MHz)</td>
<td>MN4775A-0070</td>
<td>-76</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (0.02500-0.05000 MHz)</td>
<td>MN4775A-0070</td>
<td>-76</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (0.05000-0.20000 MHz)</td>
<td>MN4775A-0070</td>
<td>-72</td>
<td>N/A</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Band (0.20000-0.38000 MHz)</td>
<td>MN4775A-0070</td>
<td>-69</td>
<td>N/A</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Band (0.38000-0.50000 MHz)</td>
<td>MN4775A-0070</td>
<td>-60</td>
<td>N/A</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Band (0.50000-0.65000 MHz)</td>
<td>MN4775A-0070</td>
<td>-53</td>
<td>N/A</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Band (0.65000-0.70000 MHz)</td>
<td>MN4775A-0070</td>
<td>-50</td>
<td>N/A</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Band (0.67000-0.70000 MHz)</td>
<td>MN4775A-0070</td>
<td>-44</td>
<td>N/A</td>
<td>1.32</td>
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</tbody>
</table>
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