Maintenance Manual

ShockLine™
Modular
Vector Network Analyzer

MS46131A-010, 1 MHz to 8 GHz
MS46131A-020, 1 MHz to 20 GHz
MS46131A-043, 1 MHz to 43.5 GHz
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Chapter 1 — General Information

1-1 Introduction
This manual provides service and maintenance information for the Anritsu ShockLine MS46131A Vector Network Analyzer. The information includes product description, performance verification procedures, parts removal and replacement procedures, and troubleshooting information.

1-2 Description
The ShockLine MS46131A Vector Network Analyzer is a 1-port USB Vector Network Analyzer that is controlled from an external PC running ShockLine software. It is based on patented ShockLine VNA-on-chip technology, which simplifies the internal VNA architecture at high frequencies, reduces instrument cost, and enhances accuracy and measurement repeatability. The combination of low cost and good performance make MS46131A Vector Network Analyzer ideal candidates for testing RF and Microwave passive devices to 43.5 GHz.

Standard Accessories
Each instrument includes:
- Power Cord
- AC/DC Adapter
- USB Type A to Micro-B Cable

Available Options
The main system options are:
- MS46131A-002 – Time Domain with Time Gating
- MS46131A-010 – Frequency Option, 1 MHz to 8 GHz, type N(f) test port
- MS46131A-020 – Frequency Option, 1 MHz to 20 GHz, type K(m) test port
- MS46131A-043 – Frequency Option, 1 MHz to 43.5 GHz, type K(m) test port

Identification Number
All Anritsu MS46131A instruments are assigned a seven-digit ID number (Serial Number), such as “1934003”. This number appears on a decal affixed to the rear panel.

When corresponding with Anritsu Customer Service, please use this identification number with reference to the specific instrument model number, installed options, and serial number. For example, MS46131A, Option 2, Option 10, Serial Number 1934007.
1-3 Related Documents

Other documents are available for the MS46131A at the Anritsu web site at: www.anritsu.com

- ShockLine Product Information, Compliance, and Safety (PICS) – 10100-00067
- ShockLine MS46131A Series VNA Technical Data Sheet – 11410-01146
- ShockLine MS46131A VNA Operation Manual – 10410-00780
- ShockLine MS46121AB, MS46122AB, MS46131A, MS46322AB Software User Interface Reference Manual – 10410-00337
- ShockLine Programming Manual – 10410-00746

1-4 Basic Maintenance

Calibration/Certification

Test instruments are often put on a calibration cycle for performance verification in order to provide a quality check or assurance. The details of the performance verification procedures are included in Chapter 2 — Performance Verification.

Repair Service

In the event that the MS46131A VNA requires repair, contact your local Anritsu Service Center. See Section 1-5 “Anritsu Customer Service Centers” for contact information. When contacting Anritsu Service Center, please provide the following information:

- Your company name and address
- The model number and serial number of the instrument
- A detailed description of the problem

1-5 Anritsu Customer Service Centers

For the latest service and sales information in your area, please visit the following URL: http://www.anritsu.com/contact.asp

Choose a country for regional contact information.
1-6  Recommended Test Equipment

The following test equipment is recommended for use in testing and maintaining the ShockLine MS46131A.

Table 1-1.  Recommended Test Equipment for MS46131A (1 of 2)

| Equipment                          | Critical Specification | Recommended Manufacturer/Model | Use Codes
|-----------------------------------|------------------------|---------------------------------|------------
| **Airline (For Opt. 10)**         | Impedance: 50 Ohm      | Anritsu Model SC3833             | P          
|                                   | Connector: N(m)        |                                 |            
| **Short (For Opt. 10)**           | Connector: GPC-7       | Anritsu Model 22A50              |            
| **Offset Termination (For Opt. 10)** | Frequency: DC to 8 GHz | Anritsu Model SC8408             | P          
|                                   | Return Loss: 20 dB     |                                 |            
|                                   | Connector: GPC-7       |                                 |            
| **Calibration Kit (For Opt. 10)** | Frequency: DC to 8 GHz | Anritsu Model OSLN50A-8 or      | P          
|                                   | Connector: N(m)        | TOSLN50A-8                      |            
| **Torque Wrench (For Opt. 10)**   | 3/4 in. Open End Wrench| Anritsu Model 01-200             | P          
|                                   | 12 lbf·in (1.35 N·m)   |                                 |            
| **Airline (For Opt. 20 or 43)**   | Impedance: 50 Ohm      | Anritsu Model SC7760             | P          
|                                   | Connector: K(f)        |                                 |            
| **Short (For Opt. 20 or 43)**     | Connector: K(f)        | Anritsu Model 23KF50             | P          
| **Offset Termination (For Opt. 20 or 43)** | Frequency: DC to 43.5 GHz | Anritsu Model SC7888          | P          
|                                   | Return Loss: 20 dB     |                                 |            
|                                   | Connector: K(f)        |                                 |            
| **Calibration Kit (For Opt. 20 or 43)** | Frequency: DC to 43.5 GHz | Anritsu Model TOSLKF50A-43.5 | P          
|                                   | Connector: K(f)        |                                 |            
| **Torque Wrench (For Opt. 20 or 43)** | 5/16 in. Open End Wrench | Anritsu Model 01-201             | P          
|                                   | 8 lbf·in (0.90 N·m)    |                                 |            
| **Frequency Counter**             | Frequency: 10 MHz to 20 GHz | Anritsu Model MF2412B or MF2412C | P, A      
|                                   |                        | with Option 3                    |            
| **Frequency Reference**           | Frequency: 10 MHz      | Symmetricom Model RubiSource T&M | P, A       
|                                   |                        |                                 |            
| **RF Coaxial Cable**              | Impedance: 50 ohm      | Anritsu Part Number 2000-1627-R | P, A       
|                                   | Connector: BNC(m) to BNC(m) |                                 |            
| **Adapter (For Opt. 10)**         | Frequency: DC to 18 GHz| Anritsu Model 34NK50             | P, A       
|                                   | Connector: N(m) to K(m) |                                 |            
| **Adapter**                       | Frequency: DC to 18 GHz| Anritsu Model 34NKF50            | P, A       
|                                   | Connector: N(m) to K(f) |                                 |            
| **RF Coaxial Cable**              | Frequency: DC to 20 GHz| Anritsu Model 15KKF50-1.0A       | P, A       
|                                   | Connector: K(m) to K(f) |                                 |            
| **Power Meter**                   | Power Range: -70 to +20 dBm | Anritsu Model ML2438A          | A          
| **Power Sensor**                  | Frequency: 100 kHz to 40 GHz | Anritsu Model SC7413            | A          
|                                   | Connector Type: K(m)   |                                 |            
| **Fixed Attenuator**              | Frequency: 100 kHz to 40 GHz | Anritsu Model 41KC-10           | A          
|                                   | Attenuation: 10 dB     |                                 |            
|                                   | Connector: K(m) to K(f) |                                 |            
| **PC Controller**                 | Configuration:         |                                 | Any        
|                                   | – Intel Core i5-6300U Processor |                                 |            
|                                   | – 4 GB RAM             |                                 |            
|                                   | – 120 GB Disk          |                                 |            
|                                   | – Direct X Version 9   |                                 |            
|                                   | – Windows 10, 32 bit or 64 bit OS |                                 |            

*Notes:

- **P** indicates that the equipment is recommended for use in the specified instance.
- **A** indicates that the equipment is used in all instances.
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specification</th>
<th>Recommended Manufacturer/Model</th>
<th>Use Codes&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIB Adapter</td>
<td>USB to GPIB</td>
<td>National Instruments Model GPIB-USB-HS or GPIB-USB-HS+</td>
<td>A</td>
</tr>
</tbody>
</table>

<sup>a</sup>P= Performance Verification; A = Adjustment
1-7 Replaceable Parts and Assemblies

To ensure that the correct options are provided on the replacement assembly when ordering a VNA Module Assembly, all installed instrument options must be declared on the order.

The installed options are listed on a label on the rear panel of the MS46131A. They can also be viewed in the ShockLine Application About box display (Select 9 Help | 1. ShockLine Info.).

Table 1-2 summarizes the available replaceable parts and assemblies.

Table 1-2. Replaceable Parts and Assemblies

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-ND85131&lt;R&gt;</td>
<td>VNA Assembly of MS46131A instruments with Option 10</td>
</tr>
<tr>
<td>3-ND85133&lt;R&gt;</td>
<td>VNA Assembly of MS46131A instruments with Option 20</td>
</tr>
<tr>
<td>3-ND85135&lt;R&gt;</td>
<td>VNA Assembly of MS46131A instruments with Option 43</td>
</tr>
<tr>
<td>3-513-149</td>
<td>N female Test Port Adapter</td>
</tr>
<tr>
<td>3-83829</td>
<td>Semi-rigid Coaxial Cable Assembly, SMA(m) to SMA(m)</td>
</tr>
<tr>
<td></td>
<td>– For instruments with Option 10</td>
</tr>
<tr>
<td></td>
<td>– Linking between N female Test Port Adapter and VNA Assembly</td>
</tr>
<tr>
<td>3-83773</td>
<td>Ruggedized K male Test Port Adapter</td>
</tr>
<tr>
<td></td>
<td>– For instruments with Options 20 and 43</td>
</tr>
<tr>
<td>3-ND85129</td>
<td>Fan Assembly</td>
</tr>
<tr>
<td>3-ND85130</td>
<td>Fan PCB Assembly</td>
</tr>
<tr>
<td>3-ND85171</td>
<td>Test Port Connector Plate with LED indicator</td>
</tr>
<tr>
<td>3-83515</td>
<td>Plastic End Cap</td>
</tr>
<tr>
<td>40-187-R</td>
<td>AC/DC Adapter</td>
</tr>
<tr>
<td>2000-1816-R</td>
<td>USB Type A to Micro-B Cable, 6 ft</td>
</tr>
</tbody>
</table>
Chapter 2 — Performance Verification

2-1 Introduction to Performance Verification

This chapter provides procedures to be used to verify the performance of ShockLine MS46131A. There are many levels to the concept of VNA “verification”.

On the explicit VNA hardware level are operational checkout items such as port power and noise levels.

On the calibrated instrument level (which includes the VNA and the calibration kit or AutoCal Automatic Calibrator) are the residual specifications (corrected directivity, source match, load match, and tracking) which are measured using traceable airlines (absolute impedance standards).

An intermediate level which can look at overall system behavior (VNA, calibration kit, cables, environment) in a traceable fashion is through the use of a verification kit. While not intended for day-to-day use, the verification kit can provide a periodic check on system behavior without going through the rigor needed for full residual analysis (which can usually be done less often).

2-2 VNA Traceability and Uncertainty

Vector Network Analyzers (VNAs) are precision instruments for making high frequency and broadband measurements in devices, components, and instrumentations. The accuracy of these measurements is affirmed by demonstrated and adequate traceability of measurement standards. Metrological traceability, per International vocabulary of metrology, JCGM 200:2012, is property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. For the accuracy of VNAs and quality assurance by users, two standard approaches were created to ensure sound metrology traceability. One is to construct tight uncertainty budget and specifications in three tiers from the ground up, and the other is to develop a calibration hierarchy for systematic verification.

The three-tier process is depicted in the sections below.

First Tier of Uncertainty — The VNA Calibration

A traceable VNA itself requires proper calibration for several key quantities, e.g., frequency, power level, and high level noise, via traceable standards to the SI units. Each contributing uncertainty was evaluated at the time of instrument calibration.

The inception of a precision VNA is accuracy-enhanced 50 ohm impedance, which is characterized in lieu of coaxial transmission lines all with proper propagation properties throughout the whole measurement systems including the device-under-test. A transmission line for VNAs is best represented by a coaxial airline, which was precisely selected and machined based on the electromagnetic properties such as conductivity, skin depth, and etc. Therefore, the dimensional measurement accuracy of the airline gives out the first tier of measurement uncertainty of impedance quantity.

- Basic time standards → frequency reference source → frequency accuracy
- Basic power standards → power sensors → power accuracy specifications
- Physical standards → airline dimensionality → impedance standard → residuals and port parameters
Second Tier of Uncertainty – Systematic Measurement Errors

The second tier of uncertainty, corrected or residual uncertainty, is the result of the accuracy enhancement of VNA calibration to remove systematic errors. Systematic measurement errors are components of measurement error that in replicate measurements remains constant or values in a predictable manner. This accuracy enhancement is usually the function of calibration kits. The choice of calibration kits used will dictate the level of uncertainties for the intended measurements or applications.

Third Tier of Uncertainty – Random Measurement Error

The third tier of uncertainty is random measurement error that in replicate measurements varies in an unpredictable manner. The examples are connector repeatability, cable stability, and etc. Random measurement error equals measurement error minus systematic measurement error.

2-3 Electrostatic Discharge Prevention

A Vector Network Analyzer is a precision electronic instrument consists of components and/or circuitries that are sensitive to electrostatic discharge (ESD). In order to prevent intrusion of electrostatic charge and mitigate risk of costly ESD damage, it is important to take preventive measures to protect the instrument against ESD before and during usage.

For example, prior to connecting a test port cable to the VNA test port, take steps to eliminate the static charges built-up on the test port cable. This can be done by terminating the open-end of the cable with the short from the calibration kit and then grounding the outer conductor of the connector on the cable.

2-4 Calibration and Measurement Conditions

The condition and stability of the test port connectors, through-cable, calibration kit and adapters (if used), and the surrounding environmental conditions determine system measurement integrity to a large extent.

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.

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:
  - 60 minutes
- Environmental Conditions
  - Temperature
    - For System Verification, 23 °C ± 3 °C, with < 1 °C variation from calibration temperature
    - For other tests, 25 °C ± 5 °C
  - Relative Humidity
    - 20-50% recommended
2-5 PASS/FAIL Determination

Figure 2-1 shows the rule that is used to determine the pass/fail status of test results that are associated with warranted specifications.

Measurement Uncertainty

The measurement uncertainty listed in each test record includes the best estimate of the errors contributed by the measurement, test equipment, standards, and other correction factors (for example, calibration factors and mismatch error) based on the suggested equipment, the equipment setup, and the prescribed test procedure. Most of the uncertainties are type-B per ISO/IEC Guide 98-3, Guide to the Expression of Uncertainty in Measurement (GUM).
2-6 System Verification – MS46131A

This section provides specific procedures to be used to verify the system performance of a single MS46131A. The procedures verify the calibration residuals such as corrected directivity and corrected port match after calibrating the MS46131A with a specified Calibration Kit.

Equipment Required

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specification</th>
<th>Manufacturer/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airline (For Opt. 10)</td>
<td>Impedance: 50 Ohm</td>
<td>Anritsu Model SC3833</td>
</tr>
<tr>
<td></td>
<td>Connector: N(m)</td>
<td></td>
</tr>
<tr>
<td>Short (For Opt. 10)</td>
<td>Connector: GPC-7</td>
<td>Anritsu Model 22A50</td>
</tr>
<tr>
<td>Offset Termination (For Opt. 10)</td>
<td>Frequency: DC to 8 GHz</td>
<td>Anritsu Model SC8408</td>
</tr>
<tr>
<td></td>
<td>Return Loss: 20 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector: GPC-7</td>
<td></td>
</tr>
<tr>
<td>Calibration Tee (For Opt. 10)</td>
<td>Frequency: DC to 8 GHz</td>
<td>Anritsu Model OSLN50A-8 or</td>
</tr>
<tr>
<td></td>
<td>Connector: N(m)</td>
<td>TOSLN50A-8</td>
</tr>
<tr>
<td>Torque Wrench (For Opt. 10)</td>
<td>3/4 in. Open End Wrench</td>
<td>Anritsu Model 01-200</td>
</tr>
<tr>
<td></td>
<td>12 lbf·in (1.35 N·m)</td>
<td></td>
</tr>
<tr>
<td>Airline (For Opt. 20 or 43)</td>
<td>Impedance: 50 Ohm</td>
<td>Anritsu Model SC7760</td>
</tr>
<tr>
<td></td>
<td>Connector: K(f)</td>
<td></td>
</tr>
<tr>
<td>Short (For Opt. 20 or 43)</td>
<td>Connector: K(f)</td>
<td>Anritsu Model 23KF50</td>
</tr>
<tr>
<td>Offset Termination (For Opt. 20 or 43)</td>
<td>Frequency: DC to 43.5 GHz</td>
<td>Anritsu Model SC7888</td>
</tr>
<tr>
<td></td>
<td>Return Loss: 20 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connector: K(f)</td>
<td></td>
</tr>
<tr>
<td>Calibration Tee (For Opt. 20 or 43)</td>
<td>Frequency: DC to 43.5 GHz</td>
<td>Anritsu Model TOSLKF50A-43.5</td>
</tr>
<tr>
<td></td>
<td>Connector: K(f)</td>
<td></td>
</tr>
<tr>
<td>Torque Wrench (For Opt. 20 or 43)</td>
<td>5/16 in. Open End Wrench</td>
<td>Anritsu Model 01-201</td>
</tr>
<tr>
<td></td>
<td>8 lbf·in (0.90 N·m)</td>
<td></td>
</tr>
<tr>
<td>Interface Cable</td>
<td>USB Type A to Micro-B Cable</td>
<td>Anritsu Part Number 2000-1816-R</td>
</tr>
<tr>
<td>Personal Computer</td>
<td>Configuration:</td>
<td>Any</td>
</tr>
<tr>
<td></td>
<td>– Intel Core i5-6300U Processor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– 4 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– 120 GB Disk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Direct X Version 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Windows 10, 32 bit or 64 bit OS</td>
<td></td>
</tr>
</tbody>
</table>

Procedure

1. Power on the Personal Computer.
2. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.
3. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.
4. Run the ShockLine software on the Personal Computer.
5. Allow the instrument to warm up for 60 minutes.
6. On the ShockLine Software graphic user interface (GUI), click on the Preset icon and then the OK button.
   a. Ensure that only S11 Log Mag is displayed on the PC monitor.
7. Click on the Freq icon and then change # of Points to 401.
8. Click on the Calibration icon and then select:
    Calibrate | Manual Cal | Reflection Only | Modify Cal Setup | Edit Cal Params
9. On the Cal Kit drop-down menu on the One Port Cal Setup (SOL, Coax) dialog box, select:
   • TOSLN50A for MS46131A with Option 10
   • TOSLKF50A for MS46131A with Option 20 or 43
10. Select Back.
11. Select Port 1 Reflective Devices.
12. Install the Open standard to the test port of MS46131A. Use torque wrench to tighten the connection.
13. Select Open to start the measurement. Once the measurement is complete, disconnect the Open standard from the test port of MS46131A.
14. Install the Short standard to the test port of MS46131A. Use torque wrench to tighten the connection.
15. Select Short to start the measurement. Once the measurement is complete, disconnect the Short standard from the test port of MS46131A.
16. Install the Load standard to the test port of MS46131A. Use torque wrench to tighten the connection.
17. Select Load to start the measurement. Once the measurement is complete, disconnect the Load standard from the test port of MS46131A.
18. Click OK on the displayed dialog and then select Done.

Corrected Directivity Measurement
19. Connect the Airline to the test port of the MS46131A and then terminate the Airline with the Offset Termination.

| Caution | Finger tighten only. Do not use torque wrench to tighten the connector connection beginning with this step. |

20. Click on the Scale icon and then select Auto Scale Active Trace.
21. Click on the Marker icon and then select Marker 1, Marker 2 and Marker 3 to turn these markers On.
22. Use the mouse to move Marker 1 and Marker 3 to adjacent peaks of the ripple with the greatest negative trough (or adjacent troughs if the ripple has the greatest positive peak) in the frequency band of interest. For frequency band information, refer to the following applicable table in “ShockLine MS46131A Test Record” on page A-2:
   • Table A-1, “Corrected Directivity of MS46131A with Option 10
   • Table A-2, “Corrected Directivity of MS46131A with Option 20 or 43
   • Table A-3, “Corrected Port Match of MS46131A with Option 10
   • Table A-4, “Corrected Port Match of MS46131A with Option 20 or 43
23. Position Marker 2 to the bottom of the trough (or to the top of the peak if the ripple has the greatest positive peak).
24. Sum the magnitude values of Marker 1 and Marker 3 at the peaks (or troughs) and divide the result by two. This is the average value of the two peaks or (troughs).

For example, Marker 1 = -15.9634 dB and Marker 3 = -15.641 dB, then:

\[
\text{Average Value} = \frac{(\text{Marker 1} + \text{Marker 3})}{2} = \frac{(-15.9634 \, \text{dB}) + (-15.641 \, \text{dB})}{2} = -15.8022 \, \text{dB}
\]

25. Calculate the peak-to-peak ripple value (absolute difference between Marker 2 value and the Average Value calculated in Step 24).

For example, Marker 2 = -17.452 dB, then:

\[
\text{dB}_{p-p} = |\text{Marker 2 value} - |\text{Average Value}| = 17.452 \, \text{dB} - 15.8022 \, \text{dB} = 1.6498 \, \text{dB}
\]

26. Use the RF Measurement Chart in Figure 2-2 on page 2-7 to find the corresponding return loss value of the peak-to-peak ripple value calculated in Step 25.

For example, the corresponding return loss value of 1.6498 dB\(_{p-p}\) is approximately 20 dB

27. Also find the corresponding Ref + X or Ref - X value from the RF Measurement Chart.

28. Use the following formula to calculate the corrected directivity:

- For ripple with a negative trough:
  \[
  \text{Directivity} = \text{Return Loss value} + |\text{Marker 2 value} - |\text{Ref - X value}|
  \]

- For ripple with a positive peak:
  \[
  \text{Directivity} = \text{Return Loss value} + |\text{Marker 2 value} - |\text{Ref + X value}|
  \]

- Example:
  \[
  \text{Directivity} = 20 \, \text{dB} + 17.452 \, \text{dB} - 0.9151 \, \text{dB} = 36.5369 \, \text{dB}
  \]

29. Record the calculated directivity value into the Measured column of the following applicable table in “ShockLine MS46131A Test Record” on page A-2:

- Table A-1, “Corrected Directivity of MS46131A with Option 10
- Table A-2, “Corrected Directivity of MS46131A with Option 20 or 43

30. Repeat Step 22 to Step 29 for other frequency bands in the applicable table listed in Step 29.

Corrected Port Match Measurement

31. Disconnect the Offset Termination from the Airline and connect a short.

32. Click on the Scale icon and then select Auto Scale Active Trace.

33. Repeat Step 22 to Step 26. Record the calculated Return Loss value to the Measured column of the following table in “ShockLine MS46131A Test Record” on page A-2:

- Table A-3, “Corrected Port Match of MS46131A with Option 10
- Table A-4, “Corrected Port Match of MS46131A with Option 20 or 43

34. Repeat Step 33 for other frequency bands listed in the applicable table listed in Step 33.
The first three columns are conversion tables for return loss, reflection coefficient, and SWR.

The last four columns are values for interactions of a small phasor X with a large phasor (unity reference) expressed in dB related to the reference.

The RF Measurement Chart can be used to determine the uncertainty due to bridge/autotester VNA directivity. The "X dB Below Reference" column represents the difference between the directivity and the measured reflection (return loss). The "Ref + X dB" and "Ref – X dB" values are 360°. Therefore, the peak-to-peak ripple (1 ± X) is the total measurement uncertainty caused by the error signal.

For example, if a 30 dB return loss is measured with a 40 dB directivity autotester, the X dB Below Reference value is 10 dB. The Ref + X dB value is 2.3866 dB and the Ref – X dB value is 3.3018 dB.

The actual return loss is between 27.6134 dB (–30 + 2.3866) and 33.3018 dB (–30 – 3.3018). The peak-to-peak ripple on a swept measurement will be 5.6884 dB. If the error and directivity signals are equal, the Ref + X dB value equals 6 dB (voltage doubling causes a 6 dB change) and the Ref – X dB value becomes infinite, since the two signals are equal in amplitude and 180° out of phase (zero voltage).
2-7 Instrument Key Parameter Performance Test

The Instrument Key Parameter test verifies the key performance parameter of the MS46131A Vector Network Analyzer as an independent instrument.

The Instrument Key Performance Test consists of the following:

- Frequency Accuracy
- High-level Noise

2-8 Frequency Accuracy

This test verifies the internal time base of the MS46131A.

Equipment Required

Table 2-2. Equipment Required for Frequency Accuracy Verification

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specification</th>
<th>Recommended Manufacturer/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Counter</td>
<td>Frequency: 10 MHz to 20 GHz</td>
<td>Anritsu Model MF2412B or MF2412C with Option 3</td>
</tr>
<tr>
<td>Frequency Reference</td>
<td>Frequency: 10 MHz</td>
<td>Symmetricom Model RubiSource T&amp;M</td>
</tr>
<tr>
<td>RF Coaxial Cable</td>
<td>Impedance: 50 ohm</td>
<td>Anritsu Part Number 2000-1627-R</td>
</tr>
<tr>
<td>Adapter (For Opt. 10)</td>
<td>Frequency: DC to 18 GHz</td>
<td>Anritsu Model 34NK50</td>
</tr>
<tr>
<td>Adapter</td>
<td>Frequency: DC to 18 GHz</td>
<td>Anritsu Model 34NKF50</td>
</tr>
<tr>
<td>RF Coaxial Cable</td>
<td>Frequency: DC to 20 GHz</td>
<td>Anritsu Model 15KKF50-1.0A</td>
</tr>
<tr>
<td>Interface Cable</td>
<td>USB Type A to Micro-B Cable</td>
<td>Anritsu Part Number 2000-1816-R</td>
</tr>
<tr>
<td>Personal Computer</td>
<td>Configuration:</td>
<td>Any</td>
</tr>
<tr>
<td></td>
<td>– Intel Core i5-6300U Processor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– 4 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– 120 GB Disk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Direct X Version 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Windows 10, 32 bit or 64 bit OS</td>
<td></td>
</tr>
</tbody>
</table>

Procedure

1. Connect the BNC cable between the output BNC(f) connector of the external Time Base Reference to the Reference Input BNC (f) connector of the Frequency Counter.
2. Install the 34NKF50 Adapter to Input 1 N(f) connector of the Frequency Counter.
3. Install the 15KKF50-1.0A Cable to the 34NKF50 Adapter.
4. Power on both the external Time Base Reference and Frequency Counter.
5. Setup the Frequency Counter as follows:
   a. Press the Preset key to restore the factory setting.
   b. Set the Resolution to 0.1 Hz.
   c. Set the Sample rate to 11 ms.

7. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the *MS46131A Operation Manual*, PN 10410-00780, for setup procedures.

8. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.


10. Allow the MS46131A to warm up for at least 60 minutes.

11. On the ShockLine Software graphic user interface (GUI), click on the *Preset* icon and then the OK button.
   
   a. Ensure that only S11 Log Mag is displayed on the PC monitor.

12. Click on the *Freq* icon and then turn CW Mode to ON.

13. Change # of Points to 801.

14. Change Start Frequency to 1 GHz. (This changes the CW Frequency to 1 GHz.)

15. Connect the open end of the 15KKF50-1.0A Cable from the Frequency Counter to the test port of the MS46131A.

16. Record the Frequency Counter reading in Table A-5, “Frequency Accuracy” on page A-3.

### 2-9 High-level Noise

This test verifies the High-level Noise performance of the MS46131A.

#### Equipment Required

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specification</th>
<th>Recommended Manufacturer/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration Tee (For Opt 10)</td>
<td>Frequency: DC to 8 GHz Connector: N(m)</td>
<td>Anritsu Model OSLN50A-8 or TOSLN50A-8</td>
</tr>
<tr>
<td>Calibration Tee (For Opt 20 or 43)</td>
<td>Frequency: DC to 43.5 GHz Connector: K(f)</td>
<td>Anritsu Model TOSLKF50A-43.5</td>
</tr>
</tbody>
</table>

#### Procedure

1. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the *MS46131A Operation Manual*, (10410-00780), for setup procedure.

2. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC Adapter to AC power source.

3. Run the ShockLine software on the external Personal Computer.

4. Allow the MS46131A to warm up at least 60 minutes.

5. On the ShockLine software user interface (GUI), select *Preset* button on the Icon Bar and then the OK button.

6. Set up the VNA display as follows:
   
   a. Ensure that only S11 Log Mag is displayed.
   
   b. Select Display icon and then change Trace Format to Linear And Phase.
   
   c. Select Scale icon and then change Log Mag Resolution to 0.01.
   
   d. Select 8 Utilities, System, and Utility; and then turn Factory RF Cal to OFF.

7. Set up the VNA for segmented sweep as follows:
a. Select Sweep Setup.
b. Select Freq-based Seg. Sweep Setup.
c. Enter the data from the first row of Table 2-4 into the setup table on the bottom of the display of the VNA.
d. Select Add.
e. Enter the data from the next row of Table 2-4.
f. Repeat Step d through Step e until $F_2 = 8000$ MHz for Option 10 unit, $F_2 = 20000$ MHz for Option 20 unit, or $F_2 = 43500$ MHz for Option 43 unit.
g. Select Back.
h. Select Sweep type and then Segmented Sweep (Freq-based).
i. Select Back.
j. This completes the Segmented Sweep setup.

Table 2-4. VNA Segmented Sweep Setup for High-level Noise Test (1 of 2)

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th># of Pts</th>
<th>IFBW</th>
<th>Src Pwr</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MHz</td>
<td>10 MHz</td>
<td>10</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>15 MHz</td>
<td>20 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>20.1 MHz</td>
<td>30 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>40 MHz</td>
<td>100 MHz</td>
<td>7</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>150 MHz</td>
<td>250 MHz</td>
<td>3</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>301 MHz</td>
<td>350 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>401 MHz</td>
<td>450 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>475 MHz</td>
<td>501 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>550 MHz</td>
<td>601 MHz</td>
<td>2</td>
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<td>1</td>
</tr>
<tr>
<td>650 MHz</td>
<td>701 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>750 MHz</td>
<td>801 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>850 MHz</td>
<td>901 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>950 MHz</td>
<td>1000 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1001 MHz</td>
<td>1050 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1101 MHz</td>
<td>1150 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1201 MHz</td>
<td>1250 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1301 MHz</td>
<td>1350 MHz</td>
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<tr>
<td>1401 MHz</td>
<td>1450 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1501 MHz</td>
<td>1550 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1600 MHz</td>
<td>2450 MHz</td>
<td>18</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2499.99 MHz</td>
<td>2500.01 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2600 MHz</td>
<td>3900 MHz</td>
<td>14</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3950 MHz</td>
<td>3975 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4001 MHz</td>
<td>4100 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4200 MHz</td>
<td>8000 MHz</td>
<td>39</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8000.1 MHz</td>
<td>8100 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8200 MHz</td>
<td>8500 MHz</td>
<td>4</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
8. Connect a short to the test port of the MS46131A.
9. On the ShockLine Software GUI, select Display and then View Trace.
10. Select Store Data to Memory.
11. Select Data, Memory Math. Ensure that Data Mem. Op. is set to [Data/Mem1].
12. Select Sweep and then Hold Functions. Select Single Sweep & Hold.
13. Select File and then Save Data.
14. Change the Type of File to Active Channel TXT File (*.txt).
15. Change the file name to HLN#1 and then click the Save button. Note the location the data file is being saved to.
16. Repeat Step 12 through Step 15 thirty-nine (39) 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 etc.).
17. Import the saved data from the HLN#n files into Microsoft Excel so the RMS values can be calculated.
18. There are many ways one can set up Microsoft Excel to calculate 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 Data40, RMS Linear Mag, RMS Log Mag (or RMS Deg)
      ii. Column A: Freq (Imported from the HLN#n file)
      iii. Column B through Column AO: Data1 through Data40 (Imported from the HLN#n file)
   b. Set up Cell AP2 to calculate the RMS value in Linear Mag by entering the following formula into the cell:
      = STDEV.P(B2:AO2)
   c. Copy the formula to the next cell in Column AP until it reaches the last frequency point.
   d. For magnitude measurements only,
      i. Set up Cell AQ2 to calculate the RMS values in Log Mag by entering the following formula into the cell:
         = 20*LOG(AP2+1,10)
      ii. Copy the formula to the next cell in Column AQ until it reaches the last frequency point.
   e. Assume Sheet 1 is set up for Magnitude measurements, rename Sheet 1 to S11 Magnitude by right-clicking on the Sheet 1 tab, selecting Rename and typing in the new name.
   f. Rename Sheet 2 to S11 Phase.
   g. Import the Magnitude and Phase data to the appropriate worksheet for RMS value calculation as required.
19. Record the calculated RMS value of each frequency point listed in Table A-6, “High-level Noise - S11 Magnitude” on page A-3 and Table A-7, “High Level Noise - S11 Phase” on page A-5.

Table 2-4. VNA Segmented Sweep Setup for High-level Noise Test (2 of 2)

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th># of Pts</th>
<th>IFBW</th>
<th>Src Pwr</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>8525 MHz</td>
<td>10000 MHz</td>
<td>60</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10050 MHz</td>
<td>20000 MHz</td>
<td>200</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>20000.1 MHz</td>
<td>20050 MHz</td>
<td>2</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>20100 MHz</td>
<td>35000 MHz</td>
<td>299</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>35100 MHz</td>
<td>40000 MHz</td>
<td>50</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>40125 MHz</td>
<td>43500 MHz</td>
<td>136</td>
<td>100 Hz</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Chapter 3 — Adjustment

3-1 Introduction
This chapter contains procedures that are used to restore and optimize the operation of the MS46131A Vector Network Analyzer.

3-2 Adjustment Menu Access
The hardware adjustment functions are accessed by selecting the Diagnostics button under the System menu. The Diagnostics menu is password-protected to prevent a casual VNA user from changing the correction coefficients inadvertently.

Procedure
To access the Diagnostics menu, do the following:

1. Power on the external Personal Computer.
2. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.
3. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.
4. Run the ShockLine software on the external Personal Computer.
5. On the ShockLine Software graphic user interface (GUI), click on the System button on the right-side menu and then click on the Diagnostics button.
6. The Diagnostics Access dialog box appears providing an entry field to enter the diagnostics access password as shown below in Figure 3-1.

7. Enter the password ModVna in the Password field and click the OK button.

Figure 3-1. DIAGNOSTICS ACCESS Dialog Box
8. The Diagnostics menu appears as shown in Figure 3-2.

9. Click on the Hardware Cal button to access the Hardware Cal menu as shown in Figure 3-3.
3-3 Time Base Adjustment

This section provides the procedure to adjust internal Time Base of the MS46131A. Perform this procedure to restore or optimize the operation of MS46131A related to the frequency accuracy of VNA Test Port stimulus signal.

Note
Performing Time Base adjustment procedure is normally not required after the VNA Assembly has been replaced. Each replacement VNA Assembly has its time base pre-adjusted prior to shipping from the factory.

Equipment Required

Table 3-1. Equipment Required for Time Base Adjustment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specification</th>
<th>Recommended Manufacturer/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Counter</td>
<td>Frequency: 10 MHz to 20 GHz</td>
<td>Anritsu Model MF2412B or MF2412C with Option 3</td>
</tr>
<tr>
<td>Frequency Reference</td>
<td>Frequency: 10 MHz</td>
<td>Symmetricom Model RubiSource T&amp;M</td>
</tr>
<tr>
<td>RF Coaxial Cable</td>
<td>Impedance: 50 ohm Connector: BNC(m) to BNC(m)</td>
<td>Anritsu Part Number 2000-1627-R</td>
</tr>
<tr>
<td>Adapter (For Opt. 10)</td>
<td>Frequency: DC to 18 GHz Connector: N(m) to K(m)</td>
<td>Anritsu Model 34NK50</td>
</tr>
<tr>
<td>Adapter</td>
<td>Frequency: DC to 18 GHz Connector: N(m) to K(f)</td>
<td>Anritsu Model 34NKF50</td>
</tr>
<tr>
<td>RF Coaxial Cable</td>
<td>Frequency: DC to 20 GHz Connector: K(m) to K(f)</td>
<td>Anritsu Model 15KKF50-1.0A</td>
</tr>
<tr>
<td>Interface Cable</td>
<td>USB Type A to Micro-B Cable</td>
<td>Anritsu Part Number 2000-1816-R</td>
</tr>
<tr>
<td>Personal Computer</td>
<td>Configuration:</td>
<td>Any</td>
</tr>
<tr>
<td></td>
<td>– Intel Core i5-6300U Processor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– 4 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– 120 GB Disk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Direct X Version 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Windows 10, 32 bit or 64 bit OS</td>
<td></td>
</tr>
</tbody>
</table>

Procedure

1. Connect the BNC cable between the output BNC(f) connector of the external Time Base Reference to the Reference Input BNC (f) connector of the Frequency Counter.
2. Install the 34NKF50 Adapter to Input 1 N(f) connector of the Frequency Counter.
3. Install the 15KKF50-1.0A Cable to the 34NKF50 Adapter.
4. Power on both the external Time Base Reference and Frequency Counter.
5. Setup the Frequency Counter as follows:
   a. Press the Preset key to restore the factory setting.
   b. Set the Resolution to 0.1 Hz.
   c. Set the Sample rate to 11 ms.
7. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.
8. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.


10. Allow the MS46131A to warm up for at least 60 minutes.

11. On the ShockLine Software graphic user interface (GUI), access the Hardware Cal menu. Refer to “Adjustment Menu Access” on page 3-1.

12. Click on the Time Base Cal button and then follow the instructions on the Time Base Calibration dialog box.

8. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.


10. Allow the MS46131A to warm up for at least 60 minutes.

11. On the ShockLine Software graphic user interface (GUI), access the Hardware Cal menu. Refer to “Adjustment Menu Access” on page 3-1.

12. Click on the Time Base Cal button and then follow the instructions on the Time Base Calibration dialog box.

Figure 3-4. Time Base Calibration Dialog

13. Adjust the DAC Number until the frequency displayed on the Frequency Counter is within the required range.

14. Click on the Close button when the adjustment is complete.
3-4 Factory Power Adjustment

This section provides the procedure to restore or optimize the operation of MS46131A related to the RF leveling at the VNA Test Port. Perform this procedure after test port adapter or VNA Assembly have been replaced.

Equipment Required

Table 3-2. Equipment Required for Factory Power Adjustment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specification</th>
<th>Recommended Manufacturer/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Meter</td>
<td>Power Range: -70 to +20 dBm</td>
<td>Anritsu Model ML2438A</td>
</tr>
<tr>
<td>Power Sensor</td>
<td>Frequency: 100 kHz to 40 GHz</td>
<td>Anritsu Model SC7413</td>
</tr>
<tr>
<td>Fixed Attenuator</td>
<td>Frequency: 100 kHz to 40 GHz</td>
<td>Anritsu Model 41KC-10</td>
</tr>
<tr>
<td></td>
<td>Attenuation: 10 dB</td>
<td></td>
</tr>
<tr>
<td>Adapter</td>
<td>Frequency: DC to 18 GHz</td>
<td>Anritsu Model 34NKF50</td>
</tr>
<tr>
<td></td>
<td>Connector: N(m) to K(f)</td>
<td></td>
</tr>
<tr>
<td>Interface Cable</td>
<td>USB Type A to Micro-B Cable</td>
<td>Anritsu Part Number 2000-1816-R</td>
</tr>
<tr>
<td>Personal Computer</td>
<td>Configuration:</td>
<td>Any</td>
</tr>
<tr>
<td></td>
<td>- Intel Core i5-6300U Processor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 4 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 120 GB Disk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Direct X Version 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Windows 10, 32 bit or 64 bit OS</td>
<td></td>
</tr>
<tr>
<td>GPIB Adapter</td>
<td>USB to GPIB</td>
<td>National Instruments Model GPIB-USB-HS or GPIB-USB-HS+</td>
</tr>
</tbody>
</table>

Procedure

1. Power on the external Personal Computer.

| Note | Software and driver should already been installed to the Personal Computer for the National Instruments USB to GPIB adapter. The USB to GPIB Adapter should also been plugged into a USB Type A port on the Personal computer. |

2. Connect the GPIB end of the USB to GPIB Adapter to the GPIB port on the rear panel of the ML2438A Power Meter.

3. Install the Power Sensor to the Power Meter and then power on the Power Meter.

4. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.

5. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.

6. Run the ShockLine software on the external Personal Computer.

7. Allow both instruments to warm up for at least 60 minutes.

8. On the Power Meter, zero and calibrate the Power Sensor.

9. Disconnect the Power Sensor from the Calibrator port of the Power Meter.

10. Install the 10 dB Fixed Attenuator to the input of the Power Sensor.

11. On the Power Meter, press Sensor key, More soft key and then Offset soft key.
12. Press Type soft key until Offset TYPE is Fixed as shown on the display.
13. Press Value soft key.
14. Use the numeric keypad to enter 10.
15. Press Enter soft key to accept the value.
16. Press the Sensor key.
17. On the ShockLine Software graphic user interface (GUI), access the Hardware Cal menu. Refer to “Adjustment Menu Access” on page 3-1.
18. Click on the Hardware Cal button to access the Hardware Cal menu as shown in Figure 3-3.
19. Click on the Factory Power Cal button and then click on the Perform Cal button; the Power Calibration dialog box appears. See Figure 3-5.

![Power Calibration Dialog Box](image)

**Figure 3-5.** Power Calibration Dialog Box

20. For MS46131A with Option 10, install the 34NK50 Adapter to the open end of the Fixed Attenuator at the Power Sensor Input.
21. Connect the power sensor to VNA Test Port.
22. Click on the Start Cal button to begin the calibration (adjustment).
23. When the calibration is complete, click on the Close button and disconnect the power sensor from VNA Test Port.
3-5 IF Adjustment

This section provides the procedure to restore or optimize the operation of MS46131A related to the IF level in the VNA Receivers.

Equipment Required

- For units with N(f) test ports:
  - Anritsu Model OSLN50A-8 or TOSLN50A-8 Calibration Kit
- For units with K(m) test ports:
  - Anritsu Model TOSLF50A-43.5 Calibration Kit

Procedure

1. Power on the external Personal Computer.
2. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.
3. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.
4. Run the ShockLine software on the external Personal Computer.
5. Allow the MS46131A to warm up for at least 60 minutes.
6. Connect the Short standard to the MS46131A VNA Test Port.
7. Select the Calibration button on the right side menu.
8. Select IF Cal button and follow the prompt to perform the calibration.
9. Select File | Exit to shut down the ShockLine Application software.
10. Launch the ShockLine Application software from the Windows desktop. The new calibration coefficients will take effect afterward.
3-6 Factory RF Calibration (RF Cal)

The Factory RF Calibration represents a subset of a 6-term error correction so that simple reflection and transmission standards will read somewhat close to their true value, even without a User Measurement Calibration.

Equipment Required

- For units with N(f) test ports:
  - Anritsu Model OSLN50A-8 or TOSLN50A-8 Calibration Kit
- For units with K(m) test ports:
  - Anritsu Model TOSLKF50A-43.5 Calibration Kit

Procedure

1. Power on the external Personal Computer.
2. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.
3. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.
4. Run the ShockLine software on the external Personal Computer.
5. Allow the MS46131A to warm up for at least 60 minutes.
6. On the ShockLine Software graphic user interface (GUI), access the Diagnostics menu. Refer to “Adjustment Menu Access” on page 3-1.
7. Click on the Factory Cal button.
8. Click on the Calibrate button to display the Factory RF Cal dialog box.
9. Connect each calibration standard from the calibration kit in sequence to the test port. Click the appropriate button when ready.
10. When all calibration standards have been measured, click the Done button to complete the procedure.
Chapter 4 — Troubleshooting

4-1  Introduction

This chapter provides information about troubleshooting tests that can be used to check the MS46131A Vector Network Analyzer for proper operation. These tests are intended to be used as a troubleshooting tool for identifying the faulty components and checking the functionality of internal components and sub-assemblies in the MS46131A VNA.

Only qualified service personnel should replace internal assemblies. Major subassemblies that are shown in the replaceable parts list are typically the items that may be replaced.

Because they are highly fragile, items that must be soldered may not be replaced without special training. Removal of RF shields from PC boards or adjustment of screws on or near the RF shields will de-tune sensitive RF circuits and will result in degraded instrument performance.

4-2  General Safety Warnings

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

| Caution | Many assemblies and modules in the MS46131A VNA 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. |
4-3 Troubleshooting Test — Non-Ratio Power Level Check

The Non-Ratio Power Level Check is very useful to verify if the VNA Module Assembly is faulty. This test assumes that only one MS46131A is connected to the Personal Computer running the ShockLine Software.

Equipment Required

- For units with N(f) test ports:
  - Anritsu Model TOSLN50A-8 Calibration Kit
- For units with K(m) test ports:
  - Anritsu Model TOSLKF50A-43.5 Calibration Kit

Procedure

1. Power on the external Personal Computer.
2. Connect a USB Type A to Micro-B cable between the MS46131A and a USB Type A port of the Personal Computer. Refer to the MS46131A Operation Manual, PN 10410-00780, for setup procedures.
3. Connect the DC connector from the AC/DC Adapter to the MS46131A and connect the AC power cord of AC/DC adapter to AC power source.
4. Run the ShockLine software on the external Personal Computer.
5. Install the Short of the Calibration to the VNA Test Port.
6. Click on the Trace icon and then change the # of Traces to 2.
7. Click on the Trace Layout button and select the third button from the top. See Figure 4-1.

8. Click on Tr1.
9. Click on the Response icon and then click on the User-defined button. The User-defined menu appears.
10. Set Numerator to A1, Denominator to 1, and Driver Port to Port 1.
11. Use a mouse to move the Reference Line to one graticule below top scale.
12. Repeat Step 8 thru Step 10 for Tr2, setting Numerator to B1, Denominator to 1, and Driver Port to Port 1.
13. Observe whether any portions of these traces show any abnormality (e.g. very low power level).

Figure 4-1. Trace Layout Menu
4-4 Troubleshooting Turn-on Problems

ShockLine Application Cannot Launch
If the ShockLine Application does not launch on the Personal Computer, do the following:

1. ShockLine Application Software update may not have completed. Re-install software.
2. If the problem still exists, verify that the Personal Computer USB port is functioning properly or verify that the MS46131A is working properly with another Personal Computer.
3. If the MS46131A is not working with another Personal Computer, replace VNA Assembly.
4. If the MS46131A is working with another Personal Computer, Windows dependencies files on the non-operating Personal Computer might have been corrupted or changed. Verify that Microsoft Visual C++ 2015 Redistributable version 14.0.24212 is installed on the Personal Computer using Program and Features in Windows Control Panel. If necessary, download the ‘Redistributable’ from the following link and then re-install.

5. If the problem still exists, replace the VNA Assembly.

ShockLine Application Displays ‘No Hardware Detected’

1. Open Device Manager on the Personal Computer and check if Anritsu Programmed USB is present under Universal Serial Bus controllers. See Figure 4-2.

   ![Device Manager](device_manager.png)

   **Figure 4-2.** Windows Device Manager

2. If it is displayed as Anritsu Programmed USB with an exclamation mark (!) on it, right-click on it and then select Uninstall. On the next dialog box, check Delete the driver software for this device and click the OK button. You may have to do this step several times.
3. After uninstalling the driver, the instrument will appear in the Device Manager as Other Device.
4. If ShockLine Application Software is not installed, install the latest ShockLine Software and it will automatically install the driver.
5. If latest ShockLine Application Software has already been installed, right-click on the Other Device in Device Manager and select Update Driver Software. On the next dialog box, browse to C:\Program Files (x86)\Anritsu Company\ShockLine\Application and then click the Next button.
6. If the problem still exists, replace the VNA Assembly.
ShockLine Application Displays ‘Anritsu hardware is unavailable’

If the ShockLine Application displays the ‘Anritsu hardware is unavailable’ message, do the following:

1. Wait until the IVI client finishes its task and re-try after 15 minutes.

2. If the problem still exists, the IVI client might not be properly closed. Try manually restarting the IVI Server to release the hardware using the following steps:
   a. Right-click on the ShockLine Tray Daemon icon on the lower right hand corner of the display. Select Stop IVI Server and then select Start IVI Server. See Figure 4-4.
   b. Check the color of the indicator on the ShockLine Tray Daemon to verify if it is in conditions that allows the ShockLine Application software to run.

ShockLine Tray Daemon Indicator Color Definitions

- **Green**
  The IVI Server is not running and no IVI connections are available. Only ShockLine Application Software can be run.

- **Yellow**
  The IVI Server is running. The IVI Clients or ShockLine Application Software can be run.
• **Red**
  The tray menu provides two status states when Red.
  
  • If the state is CONNECTED, an IVI Client is connected and the hardware is busy so ShockLine Application Software could not be used.
  
  • If the state is WAITING, the server is waiting for an IVI client but the hardware is not busy so the ShockLine Application Software or an IVI Client can be run.

4-5  Troubleshooting Operating Problems

**Frequency-Related Problems**

If the instrument exhibits frequency related problem, do the following:

1. Apply external 10 MHz Reference to the front panel 10 MHz Ref In.
2. If the problem does not show with the external reference, the problem is in the internal reference oscillator. Replace the VNA Assembly.

**RF Power-Related Problems**

If the instrument exhibits RF Power Related Problems, do the following:

1. Perform “Troubleshooting Test — Non-Ratio Power Level Check” on page 4-2.
2. If the power level shows any abnormality, do the following:
   
   a. Verify that the connection between test port adapter and VNA Assembly. Re-torque if necessary.
   b. Verify that the test port adapter is worn or damaged. Replace the test port adapter if necessary.
   c. Replace VNA Assembly.
4-6 Troubleshooting Measurement Problems

If the MS46131A measurement quality is suspect, the following paragraphs provide guidelines and hints for determining possible quality problems.

VNA Measurement Quality

The quality of MS46131A VNA measurements is determined by the following test conditions and variable:

- The condition of the MS46131A.
- The quality and condition of the interface connections and connectors.
- The quality and condition of the calibration components, adapters and fixtures.
- The surrounding environmental conditions at the time of the measurement.
- The selection and performance of the calibration for the DUT being measured.

Checking Possible Measurement Problems

When determining possible measurement problems, check the following items:

1. Check the DUT and the calibration conditions:
   a. Ensure that the proper calibration was done for the device being measured:
      - For high return-loss device measurements, a high quality precision load should be used during calibration.
   b. Check the condition of DUT mating connectors and their pin depth.
   c. If possible, measure an alternate known good DUT.
   d. Check if the environment is stable enough for the accuracy required for the DUT measurement:
      - The VNA should not be subjected to variations in temperature.
      - The VNA should not be placed in direct sun light or next to a changing cooling source, such as a fan or air conditioning unit.

2. Check the calibration using known good components from the calibration kit. If measurements of these devices do not produce good results, try the following:
   a. Check condition and pin depth of calibration kit components. Replace with known good components, if necessary.
   b. Check condition and pin depth of test port adapters. Replace with known good ones if necessary.

3. Check the system performance as described in Chapter 2, “Performance Verification”
Chapter 5 — Assembly Removal and Replacement

5-1 Introduction

This chapter describes the removal and replacement procedures for the various assemblies. Illustrations (drawings or photographs) in this manual may differ slightly from the instrument that you are servicing, but the basic removal and replacement functions will remain as specified. The illustrations are meant to provide assistance with identifying parts and their locations.

5-2 Electrostatic Discharge Prevention

An ESD safe work area and proper ESD handling procedures that conform to ANSI/ESD S20.20-2014 is mandatory to avoid ESD damage when handling subassemblies or components found in the MS46131A Vector Network Analyzer.

| Warning | 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. |
5-3 Disassembly Procedure

Use this procedure to prepare the MS46131A for removal and replacement procedures for all of its replaceable components. All replacement components require this common disassembly procedure.

Reference Figures

- Figure 5-1, “MS46131A Instrument Enclosure” on page 5-2
- Figure 5-2, “Top View of MS46131A Enclosure” on page 5-3

---

1 – End Cap
2 – Top/Bottom Covers
3 – Vent Side Cover
4 – Fan Side Cover
5 – M2.5 x 4 Flat Head Phillips Screws (Qty 12)

Figure 5-1. MS46131A Instrument Enclosure
Common Disassembly Procedures

1. Prepare a clean and static free work area. Make sure that the work area is well grounded. Cover the work surface with a soft, clean anti-static mat.

2. Provide all personnel with appropriate anti-static grounding wrist straps and similar equipment.

3. Remove both End Caps from the MS46131A and place the instrument on the anti-static mat with the Model ID label side facing upward.

**Top Cover Removal**

4. Remove the Top Cover as follows:
   a. Remove the four M2.5 x 4 Flat Head Phillips screws that secure the Top Cover.
   b. Remove the Top Cover.

**Vent Side Cover Removal**

5. Remove the Vent Side Cover as follows:
   a. Remove the two M2.5 x 4 Flat Head Phillips screws that secure the Vent Side Cover.
   b. Remove the Vent Side cover.
Fan Side Cover Removal
6. Remove the Fan Side Cover as follows:
   a. Unplug the four Fan Wiring Harnesses from the Fan PCB Assembly. Refer to Figure 5-2.
   b. Remove the two M2.5 x 4 Flat Head Phillips screws that secure the Fan Side Cover.
   c. Remove the Fan Side Cover.

Bottom Cover Removal
7. Remove the Bottom Cover as follows:
   a. Flip the instrument so that the Bottom Cover is facing upward.
   b. Remove four M2.5 x 4 Flat Head Phillips screws that secure the Bottom Cover.
   c. Remove the Bottom Cover.

Test Port Connector Panel Removal
8. Remove the Test Port Connector Panel as follows:
   a. Flip the instrument so that the Fan PCB Assembly is facing upward.
   b. Unplug the LED Wiring Harness from the Fan PCB Assembly.
   c. Flip the instrument so that the Fan PCB Assembly is facing downward.
   d. Remove the two M3 x 6 Flat Head Phillips Screws that secure the Test Port Connector Panel to the VNA Assembly.
   e. For instruments with Option 10, disconnect the connection between the RF Coaxial Cable Assembly from the VNA Assembly and the Test Port Adapter.
   f. For instruments with Option 20 or 43, disconnect the connection between the Test Port Adapter and the Sampler Module of the VNA Assembly.
   g. Slide the Test Port Connector Panel off the VNA Assembly.

Face Panel Removal
9. Remove the Face Panel as follows:
   a. Remove the two M3 x 6 Flat Head Phillips Screws that secure the Face Panel to the VNA Assembly.
   b. Carefully slide the Face Panel off the VNA Assembly.
5-4 Fan PCB Assembly

Use this procedure to replace the Fan PCB Assembly.

Replacement Parts

- Fan PCB Assembly – 3-ND85130

Reference Figures

- Figure 5-2, “Top View of MS46131A Enclosure” on page 5-3

Replacement Procedure

1. Refer to the “Common Disassembly Procedures” on page 5-3 when performing this replacement procedure.
2. Remove the End Caps and Top Cover.
3. Unplug the Fan Wiring Harnesses from the Fan PCB Assembly
4. Unplug the LED Wiring Harness from the Fan PCB Assembly.
5. Remove the Four M3 x 6 Pan Head Phillips screws that secure the Fan PCB Assembly to the VNA Assembly.
6. Carefully unplug the Fan PCB Assembly from the VNA Assembly.
7. Install the replacement Fan PCB Assembly to the VNA Assembly.
8. Secure the Fan PCB Assembly with screws that were removed in Step 4.
9. Re-connect the Fan Wiring Harnesses and LED Wiring Harness to the Fan PCB Assembly.
10. Install the Top Cover.
11. Install the End Caps.
5-5 Fan Assembly

Use this procedure to replace the Fan Assembly.

Replacement Parts

- Fan Assembly – 3-ND85129

Reference Figures

- Figure 5-1, “MS46131A Instrument Enclosure” on page 5-2
- Figure 5-2, “Top View of MS46131A Enclosure” on page 5-3

Replacement Procedure

1. Refer to the “Common Disassembly Procedures” on page 5-3 when performing this replacement procedure.
2. Remove the End Caps and Top Cover.
3. Unplug the Fan Wiring Harnesses from the Fan PCB Assembly.
4. Remove the Fan Side Cover.
5. Lay the Fan Side Cover with Fan Assemblies facing upward on a flat working surface.
6. Remove the two M2.5 Stainless Steel Hex Nuts that secure the Fan Assembly to the Fan Side Cover.
7. Carefully slide the Fan Assembly from the studs of the Fan Side Cover.
8. Install the replacement Fan Assembly to the Fan Side Cover.
9. Apply threadlocker (Loctite 242 or equivalent) to the threads of the studs on the Fan Side Cover.
10. Secure the Fan Assembly with Hex Nuts that were removed in Step 6.
11. Install the Fan Side Cover.
12. Re-connect the Fan Wiring Harnesses to the Fan PCB Assembly.
13. Install the Top Cover.
5-6 VNA Assembly

Use this procedure to replace the VNA Assembly.

Replacement Part

- VNA Assembly of MS46131A with Option 10 – 3-ND85131<R>
- VNA Assembly of MS46131A with Option 20 – 3-ND85133<R>
- VNA Assembly of MS46131A with Option 43 – 3-ND85135<R>

Reference Figure

- Figure 5-1, “MS46131A Instrument Enclosure” on page 5-2

Replacement Procedure

1. Refer to the “Common Disassembly Procedures” on page 5-3 when performing this replacement procedure.
2. Remove the Top Cover.
3. Unplug the Fan Wiring Harnesses and LED Wiring Harness from the Fan PCB Assembly.
4. Remove both the Fan Side Cover and Vent Side Cover.
5. Remove the Bottom Cover.
6. Remove the two M3 x 6 Flat Head Phillips Screws that secure the Test Port Connector Panel to the VNA Assembly.
7. For instruments with Option 10, disconnect the connection between the RF Coaxial Cable Assembly from the VNA Assembly and the Test Port Adapter.
8. For instruments with Option 20 or 43, disconnect the connection between the Test Port Adapter and the VNA Assembly.
9. Remove the Test Port Connector Panel.
10. Remove the Face Panel.
11. Remove the Fan PCB Assembly from the VNA Assembly and install it onto the replacement VNA Assembly.
12. Install the Face Panel to the replacement VNA Assembly.
13. For instruments with Option 10:
   a. Slide the Test Port Connector Panel onto the VNA Assembly.
   b. Connect the RF Coaxial Cable Assembly from the VNA Assembly to the Test Port Adapter.
   c. Secure the Test Port Connector Panel to the VNA Assembly with the two M3 x 6 Flat Head Phillips Screws and then tighten the cable connection to the Test Port Adapter with an 8 in·lb torque wrench.
14. For instruments with Option 20 or 43:
   a. Loosen the Hex Nut that secures the Test Port Adapter to the Test Port Connector Panel slightly.
   b. Slide the Test Port Connector Panel onto the VNA Assembly and check for alignment. Make adjustment if necessary and then tighten Hex Nut to secure the Test Port Adapter to the panel.
   c. Connect the Test Port Adapter to the Sampler Module of the VNA Assembly.
   d. Secure the Test Port Connector Panel to the VNA Assembly with the two M3 x 6 Flat Head Phillips Screws and then tighten the connection between the Test Port Adapter and the Sampler Module of the VNA Assembly with an 8 in·lb torque wrench.
15. Install the Fan Side Cover and the Vent Side Cover.
16. Install the Bottom Cover.
17. Re-connect the Fan Wiring Harnesses and LED Wiring Harness from the Fan PCB Assembly.
18. Install the Top Cover.
19. Install both End Caps.
5-7 Test Port Adapter

Use this procedure to replace the Test Port Adapters.

Replacement Part

- Test Port Adapter of MS46131A with Option 10 – 3-513-149
- Test Port Adapter of MS46131A with Option 20 or Option 43 – 3-83773

Reference Figure

- Figure 5-1, “MS46131A Instrument Enclosure” on page 5-2
- Figure 5-3, “Test Port Adapters” on page 5-9

Replacement Procedure

1. Refer to the “Common Disassembly Procedures” on page 5-3 when performing this replacement procedure.
2. Remove the Top Cover.
3. Unplug the Fan Wiring Harnesses and LED Wiring Harness from the Fan PCB Assembly.
4. Remove both the Fan Side Cover and Vent Side Cover.
5. Remove the Bottom Cover.
6. Remove the two M3 x 6 Flat Head Phillips Screws that secure the Test Port Connector Panel to the VNA Assembly.
7. For instruments with Option 10, disconnect the connection between the RF Coaxial Cable Assembly from the VNA Assembly and the Test Port Adapter.
8. For instruments with Option 20 or 43, disconnect the connection between the Test Port Adapter and the Sampler Module of the VNA Assembly.
9. Remove the Test Port Connector Panel.
10. Remove the Hex Nut and Washer.
11. Remove the Test Port Adapter from the Test Port Connector Panel.
12. For instruments with Option 10:
    a. Install the replacement Test Port Adapter to the Test Port Connector Panel.
b. Secure the adapter to the Test Port Connector Panel with the Hex Nut and Washer supplied with the replacement adapter.

c. Connect the RF Coaxial Cable Assembly from the VNA Assembly to the Test Port Adapter.

d. Secure the Test Port Connector Panel to the VNA Assembly with the two M3 x 6 Flat Head Phillips Screws and then tighten the cable connection to the Test Port Adapter with an 8 in·lb torque wrench.

13. For instruments with Option 20 or 43:
   a. Install the replacement Test Port Adapter to the Test Port Connector Panel.
   b. Secure the adapter to the Test Port Connector Panel with the Hex Nut and Washer supplied with the replacement adapter but do not tighten.
   c. Slide the Test Port Connector Panel onto the VNA Assembly and check for alignment. Make adjustment if necessary and then tighten Hex Nut to secure the Test Port Adapter to the panel.
   d. Connect the Test Port Adapter to the Sampler Module of the VNA Assembly.
   e. Secure the Test Port Connector Panel to the VNA Assembly with the two M3 x 6 Flat Head Phillips Screws and then tighten the connection between the Test Port Adapter and the Sampler Module of the VNA Assembly with an 8 in·lb torque wrench.


15. Install the Bottom Cover.

16. Re-connect the Fan Wiring Harnesses and LED Wiring Harness from the Fan PCB Assembly.

17. Install the Top Cover.

18. Install both End Caps.
5-8  RF Coaxial Cable Assembly (For Instruments with Option 10)

Use this procedure to replace the RF Coaxial Cable Assembly linking between the Test Port Adapter and the VNA Assembly of MS46131A with Option 10.

Replacement Part
RF Coaxial Cable Assembly – 3-83829

Replacement Procedure

1. Refer to the “Common Disassembly Procedures” on page 5-3 when performing this replacement procedure.
2. Remove the Top Cover.
3. Unplug the Fan Wiring Harnesses and LED Wiring Harness from the Fan PCB Assembly.
4. Remove both the Fan Side Cover and Vent Side Cover.
5. Remove the Bottom Cover.
6. Remove the two M3 x 6 Flat Head Phillips Screws that secure the Test Port Connector Panel to the VNA Assembly.
7. Disconnect the connection between the RF Coaxial Cable Assembly and the Test Port Adapter.
8. Remove the Test Port Connector Panel.
9. Disconnect the RF Coaxial Cable Assembly from the VNA Assembly.
10. Install the replacement RF Coaxial Cable Assembly to the VNA Assembly.
11. Slide the Test Port Connector Panel onto the VNA Assembly and connect the RF Coaxial Cable Assembly to the Test Port Adapter.
12. Secure the Test Port Connector Panel to the VNA Assembly with the two M3 x 6 Flat Head Phillips Screws.
13. Tighten the connections at both ends of the RF Coaxial Cable Assembly with with an 8 in·lb torque wrench.
15. Install the Bottom Cover.
16. Re-connect the Fan Wiring Harnesses and LED Wiring Harness from the Fan PCB Assembly.
17. Install the Top Cover.
18. Install both End Caps.
Appendix A — Test Records

A-1 Introduction

This appendix provides test record that can be used to record the performance of the ShockLine MS46131A. 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.

The following test record forms are available:

- “ShockLine MS46131A Test Record” on page A-2
- “ShockLine MS46131A Instrument Key Parameter Test Record” on page A-3
Instrument Information

Serial Number:  
Firmware Revision:  
Operator:  
Options:  
Date:  

A-2 ShockLine MS46131A Test Record

corrected Directivity

Table A-1. Corrected Directivity of MS46131A with Option 10

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Specification (dB)</th>
<th>Measured (dB)</th>
<th>Uncertainty (dB)</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 to 6</td>
<td>≥ 42</td>
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Table A-2. Corrected Directivity of MS46131A with Option 20 or 43

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corrected Port Match

Table A-3. Corrected Port Match of MS46131A with Option 10

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Table A-4. Corrected Port Match of MS46131A with Option 20 or 43

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Instrument Information

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Options: Date:

A-3 ShockLine MS46131A Instrument Key Parameter Test Record

Frequency Accuracy

Table A-5. Frequency Accuracy

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Note: Specification is ± 1 ppm (1 kHz at 1 GHz) at time of calibration (adjustment). Stability and Aging values must be added to determine the limit when the instrument is re-verified at its regular calibration intervals.

High Level Noise (100 Hz IFBW, RMS)

Table A-6. High-level Noise - S11 Magnitude (1 of 2)

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Table A-6.  High-level Noise - S11 Magnitude (2 of 2)

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Table A-7. High Level Noise - S11 Phase (2 of 2)

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Anritsu Service Center .............................. 1-2
Application Cannot Launch message ............... 4-3
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Anritsu utilizes recycled paper and environmentally conscious inks and toner.