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**PXIe-1073**

## CALIBRATION PROCEDURE

# PXIe-5632

## 8.5 GHz Vector Network Analyzer

This document contains the verification and adjustment procedures for the PXIe-5632 Vector Network Analyzer.

Refer to [ni.com/calibration](http://ni.com/calibration) for more information about calibration solutions.

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# Required Software

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Calibrating the PXIe-5632 requires you to install the following software on the calibration system:

- NI-VNA 2.0.1

You can download all required software from [ni.com/downloads](https://ni.com/downloads).

# Related Documentation

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For additional information, refer to the following documents as you perform the calibration procedure:

- *NI PXIe-5632 Getting Started Guide*
- *PXIe-5632 Specifications*
- *NI Vector Network Analyzers Help*

Visit [ni.com/manuals](https://ni.com/manuals) for the latest versions of these documents.

# Test Equipment

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The following table lists the equipment NI recommends for the performance verification and adjustment procedures. If the recommended equipment is not available, select a substitute using the minimum requirements listed in the table.

**Table 1.** Recommended Equipment for PXIe-5632 Calibration

Equipment	Recommended Model	Where Used	Minimum Requirements
PXI Express chassis	PXIe-1073 with integrated MXI-Express controller	All procedures	Three adjacent, empty PXI Express slots
Power meter	Anritsu ML2438A	Verifications: <ul style="list-style-type: none"> <li>• Output power accuracy</li> </ul> Adjustments: <ul style="list-style-type: none"> <li>• Port 1 ALC</li> <li>• Port 2 ALC</li> <li>• LO level</li> </ul>	Display resolution: $\leq 0.01$ dB Settling: $\pm 0.1\%$ Instrumentation accuracy: $< \pm 0.5\%$ Noise, zero set, and drift: $< \pm 0.5\%$ full-scale (lowest range) Reference power uncertainty: $< \pm 0.9\%$ Reference output VSWR: $< 1.04 : 1$
Power sensor	Anritsu SC7413	Verifications: <ul style="list-style-type: none"> <li>• Output power accuracy</li> </ul> Adjustments: <ul style="list-style-type: none"> <li>• Port 1 ALC</li> <li>• Port 2 ALC</li> <li>• LO level</li> </ul>	Frequency range: 300 kHz to 8.5 GHz Dynamic range: -60 dBm to +20 dBm SWR: $< 1.04$ , 100 KHz to 10 MHz $< 1.17$ , 10 MHz to 150 MHz $< 1.12$ , 150 MHz to 2 GHz $< 1.22$ , 2 GHz to 12.4 GHz Linearity: 3%

**Table 1. Recommended Equipment for PXIe-5632 Calibration (Continued)**

<b>Equipment</b>	<b>Recommended Model</b>	<b>Where Used</b>	<b>Minimum Requirements</b>
Spectrum analyzer	Anritsu MS2720T-0720	Verifications: <ul style="list-style-type: none"><li>• Frequency accuracy</li><li>• Source harmonics</li><li>• Source nonharmonic spurious</li></ul> Adjustments: <ul style="list-style-type: none"><li>• Timebase</li></ul>	Frequency range: 300 kHz to 20 GHz DANL: -155 dBm TOI: +22 dBm, typical Amplitude accuracy: 100 kHz to 13 GHz = $\pm 1.3$ dB Timebase aging: $\pm 1.0$ ppm/10 years Frequency accuracy: $\pm 0.3$ ppm + aging
Precision coaxial cable (1.0 m, K-type)	NI 781611-01	Verifications: <ul style="list-style-type: none"><li>• Frequency accuracy</li><li>• Source harmonics</li><li>• Source nonharmonic spurious</li></ul> Adjustments: <ul style="list-style-type: none"><li>• Timebase</li></ul>	High-quality, (m)-to-(m) RF cable
K-type calibration device (open/short/load)	Anritsu OSLKF50 (included in NI 781590-01)	Verifications: <ul style="list-style-type: none"><li>• System dynamic range</li></ul>	No substitute
K-type airline	Anritsu SC7594 (included in NI 781590-01)	Verifications: <ul style="list-style-type: none"><li>• Corrected directivity (5 GHz to 8.5 GHz)</li><li>• Corrected source match (5 GHz to 8.5 GHz)</li></ul>	No substitute

**Table 1.** Recommended Equipment for PXIe-5632 Calibration (Continued)

Equipment	Recommended Model	Where Used	Minimum Requirements
K-type male short	Anritsu 23K50 (included in NI 781590-01)	Verifications: <ul style="list-style-type: none"> <li>Corrected source match (300 MHz to &lt;5 GHz)</li> </ul>	No substitute
K-type female short	Anritsu 23KF50 (included in NI 781590-01)	Verifications: <ul style="list-style-type: none"> <li>Corrected source match (5 GHz to 8.5 GHz)</li> </ul>	No substitute
20 dB offset termination	Anritsu SC4808 (included in NI 781590-01)	Verifications: <ul style="list-style-type: none"> <li>Corrected directivity (5 GHz to 8.5 GHz)</li> </ul>	No substitute
K-type male 50 $\Omega$ load termination	Anritsu SC7953 (included in NI 781590-01)	Verifications: <ul style="list-style-type: none"> <li>Corrected directivity (300 MHz to &lt;5 GHz)</li> </ul>	No substitute
10 dB fixed attenuator	Anritsu 41KC-10	Adjustments: <ul style="list-style-type: none"> <li>Port 1 ALC</li> <li>Port 2 ALC</li> <li>LO level</li> </ul>	Frequency range: DC to 18 GHz Power rating: 2 Watt Return loss: >16 dB
20 dB fixed attenuator	Anritsu 41KC-20	Verifications: <ul style="list-style-type: none"> <li>Source maximum leveled power</li> </ul>	Frequency range: DC to 18 GHz Power rating: 2 Watt Return loss: >16 dB
Torque wrench	NI 747832-01	All procedures	Refer to <a href="#">Test Conditions</a> for torque wrench specifications.

**Table 1.** Recommended Equipment for PXIe-5632 Calibration (Continued)

Equipment	Recommended Model	Where Used	Minimum Requirements
K-type thru line	NI 781607-01	Manually calibrating transmission frequency response  Verifications: <ul style="list-style-type: none"><li>• Source maximum leveled power</li><li>• Trace noise</li><li>• System dynamic range</li></ul>	Return loss: >16 dB
Automatic VNA calibration kit	NI 782364-01	Automatically calibrating port one reflection	K-type, male-female, 70 MHz to 9 GHz
Manual VNA calibration kit	NI 781587-01	Manually calibrating port one reflection	K-type

## Test Conditions

The following setup and environmental conditions are required to ensure the PXIe-5632 meets published specifications.

- Keep cabling as short as possible. Long cables and wires act as antennas, picking up extra noise that can affect measurements.
- Verify that all connections, including front panel connections and screws, are secure.
- Maintain an ambient temperature of  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ .
- Keep relative humidity between 10% and 90%, noncondensing.
- Allow a warm-up time of at least 45 minutes after the chassis is powered on and NI-VNA is loaded and recognizes the PXIe-5632. The warm-up time ensures that the PXIe-5632 and test instrumentation are at a stable operating temperature.
- In each verification procedure, insert a delay between configuring all instruments and acquiring the measurement. This delay may need to be adjusted depending on the instruments used but should always be at least 1,000 ms for the first iteration, 1,000 ms when the power level changes, and 100 ms for each other iteration.

- Ensure that the chassis fan speed is set to HIGH, that the fan filters, if present, are clean, and that the empty slots contain filler panels. For more information, refer to the *Maintain Forced-Air Cooling Note to Users* document available at [ni.com/manuals](https://ni.com/manuals).
- Use an appropriate torque wrench or torque screwdriver and SMA driver bit to tighten all module RF connectors (SMA or 3.5 mm). NI recommends use of 1 N · m (9 lb · in.).
- Use a 3.5 mm torque wrench (8 lb · in., NI 781615-01 or equivalent) to tighten 3.5 mm or 2.92 mm (K) connections without an SMA connector.

## Initial Setup

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Refer to the *PXIe-5632 Getting Started Guide* for information about how to install the software and the hardware and how to configure the device in Measurement & Automation Explorer (MAX).

## Test System Characterization

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The following procedures characterize the test equipment used during verification and adjustment.



**Notice** The connectors on the device under test (DUT) and test equipment are fragile. Perform the steps in these procedures with great care to prevent damaging any DUTs or test equipment.

## Zeroing and Calibrating the Power Sensor

1. Ensure that the power sensor is not connected to any signals.
2. Zero and calibrate the power sensor using the built-in functions in the power meter, according to the power meter documentation.

## Performing User Calibration on the PXIe-5632

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Allow a 45 minute warm-up period before you begin a user calibration.

The PXIe-5632 includes precise internal circuits and references used during user calibration to adjust for any errors caused by short-term fluctuations in the environment.



**Note** You must perform different user calibrations before verifying certain PXIe-5632 specifications.

The following verification procedures require you to perform either an automatic or manual port one reflection user calibration or a transmission frequency response user calibration prior to the completion of the verification procedure:

- [System Dynamic Range](#)
- [Corrected Directivity \(300 MHz to <5 GHz\)](#)
- [Corrected Source Match \(300 MHz to <5 GHz\)](#)



- [Corrected Directivity \(5 GHz to 8.5 GHz\)](#)
- [Corrected Source Match \(5 GHz to 8.5 GHz\)](#)

## Automatically Calibrating Port One Reflection

Complete the following procedure to automatically calibrate port one reflection using the NI-VNA Soft Front Panel (SFP).



**Note** Specific values are not provided in the following procedure, because values are defined by the particular test being performed.

1. Connect the AutoCal module power supply to an appropriate AC power source.

The green Power LED on the AutoCal module should light.

2. Wait for the internal heating element inside the AutoCal module to stabilize the internal temperature of the module.

The blue Operate LED on the AutoCal module lights when the module is warmed up and ready to use.

3. Connect the serial cable between the AutoCal module and the PXI Express embedded controller serial port or external computer if using an MXI-Express controller.
4. Launch the NI-VNA SFP.

The Measuring State indicator at the bottom of the Display Window shows **UNCORR**, which indicates that the PXIe-5632 is initially uncalibrated and is not applying correction factors.

5. Load the AutoCal correction factors, if not already loaded, by completing the following steps:
  - a) Select **Calibration** from the menu.
  - b) Select **CalKit»AutoCal Characterization»Load Charac. File** from the softkey menu.
  - c) Ensure the USB flash memory drive that came with the AutoCal module is plugged into the PXI Express controller or external computer if you are using an MXI-Express controller.
  - d) Select your AutoCal module characterization file from the USB flash memory drive in the **Open** dialog box.

The filename format is *serialnumber.ACD*, where *serialnumber* is the serial number printed on the bottom of the AutoCal module.

- e) Click **OK** to exit the dialog box.
6. Specify the AutoCal setup by completing the following steps:
    - a) Select **Calibration** from the menu.
    - b) Select **Calibrate»AutoCal** from the softkey menu, and enter the Comm Port number where the AutoCal is connected.
    - c) Select **1-Port Cal»Modify Cal Setup** from the softkey menu.
    - d) Ensure both Port 1 and Port 2 are selected and that the left port is selected for both ports from the **Modify 1-Port AutoCal Setup** dialog box.
    - e) Click **OK** to exit the dialog box.

- f) Connect Port 1 to the left port on the AutoCal module.
- g) Select **Begin Cal** from the softkey menu.

Calibration is complete when the NI-VNA SFP shows a Measuring State of **CORR**, which indicates that the module is applying correction factors. With no connections to the ports, the  $S_{11}$  and  $S_{22}$  amplitude and phase responses should be flat.

To store the calibration data, select **File»Save Setup** to save the sweep settings and current calibration correction factors to the disk for recall later. To recall the settings later, select **File»Recall Setup**.

## Manually Calibrating Port One Reflection

Complete the following procedure to manually calibrate port one reflection using the NI-VNA Soft Front Panel (SFP).



**Note** Specific values are not provided in the following procedure, because values are defined by the particular test being performed.

1. Launch the NI-VNA SFP.

The Measuring State indicator at the bottom of the Display Window shows **UNCORR**, which indicates that the PXIe-5632 is initially uncalibrated and is not applying correction factors.

2. Specify the manual calibration setup by completing the following steps:
  - a) Select **Calibration** from the menu.
  - b) Select **Calibrate»Manual Cal»1 Port Cal»Modify Cal Setup»Edit Cal Params** from the softkey menu.
  - c) Select Test Port 1 and Test Port 2 for calibration.
  - d) Select **Broadband Load** as the Load Type in each of the **Port Setup** dialog boxes.
  - e) Specify the connector type that is present on the manual calibration standards in the **DUT Connector** control for each port.
  - f) Click **OK** to close the dialog box.
3. Click the **Back** button at the bottom of the softkey menu.
4. Select **Port 1 Reflective Devices** from the softkey menu.
5. Attach the open manual calibration standard to the PXIe-5632 PORT 1 connector.
6. Select **Open** from the softkey menu.
7. Attach the short manual calibration standard to the PXIe-5632 PORT 1 connector.
8. Select **Short** from the softkey menu.
9. Attach the load manual calibration standard to the PXIe-5632 PORT 1 connector.
10. Select **Load** from the softkey menu.
11. Click the **Back** button at the bottom of the softkey menu.
12. Select **Port 2 Reflective Devices** from the softkey menu.
13. Repeat steps 4 through 10 to complete calibration for Port 2 standards.
14. Click the **Back** button at the bottom of the softkey menu.

15. Click the **Done** in the softkey menu.

Calibration is complete when the NI-VNA SFP shows a Measuring State of **CORR**, which indicates that the module is applying correction factors. With no connections to the ports, the  $S_{11}$  and  $S_{22}$  amplitude and phase responses should be flat.

To store the calibration data, select **File»Save Setup** to save the sweep settings and current calibration correction factors to the disk for recall later. To recall the settings later, select **File»Recall Setup**.

## Manually Calibrating Transmission Frequency Response

Complete the following procedure to manually calibrate transmission frequency response using the NI-VNA Soft Front Panel (SFP).



**Note** Specific values are not provided in the following procedure, because values are defined by the particular test being performed.

1. Launch the NI-VNA SFP.

The Measuring State indicator at the bottom of the Display Window shows **UNCORR**, which indicates that the PXIe-5632 is initially uncalibrated and is not applying correction factors.

2. Specify the manual calibration setup by completing the following steps:

- Select **Calibration** from the menu.
- Select **Calibrate»Manual Cal»Transmission Freq. Response»Modify Cal Setup»Edit Cal Params** from the softkey menu.
- Select both directions (port one and port two) for calibration.
- Click **OK** to close the dialog box.

3. Click the **Back** button at the bottom of the softkey menu.

4. Attach a K-type thru line between PORT 1 and PORT 2 on the PXIe-5632 module front panel.

5. Select **Thru/Recip** from the softkey menu.

6. Select **Thru** from the softkey menu.

7. Click the **Back** button at the bottom of the softkey menu.

8. Click the **Done** button from the softkey menu.

Calibration is complete when the NI-VNA SFP shows a Measuring State of **CORR**, which indicates that the module is applying correction factors. With the thru connection to the ports, the  $S_{21}$  and  $S_{12}$  amplitude and phase responses should be flat.

To store the calibration data, select **File»Save Setup** to save the sweep settings and current calibration correction factors to the disk for recall later. To recall the settings later, select **File»Recall Setup**.

# As-Found and As-Left Limits

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The as-found limits are the published specifications for the PXIe-5632. NI uses these limits to determine whether the PXIe-5632 meets the specifications when it is received for calibration. Use the as-found limits during initial verification.

The as-left calibration limits are equal to the published NI specifications for the PXIe-5632, less guard bands for measurement uncertainty, temperature drift, and drift over time. NI uses these limits to reduce the probability that the instrument will be outside the published specification limits at the end of the calibration cycle. Use the as-left limits when performing verification after adjustment.

## Verification

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The performance verification procedures assume that adequate traceable uncertainties are available for the calibration references.



**Note** Some verification tests require user calibration prior to the completion of the verification procedure.

### Related Information

[Performing User Calibration on the PXIe-5632](#) on page 7

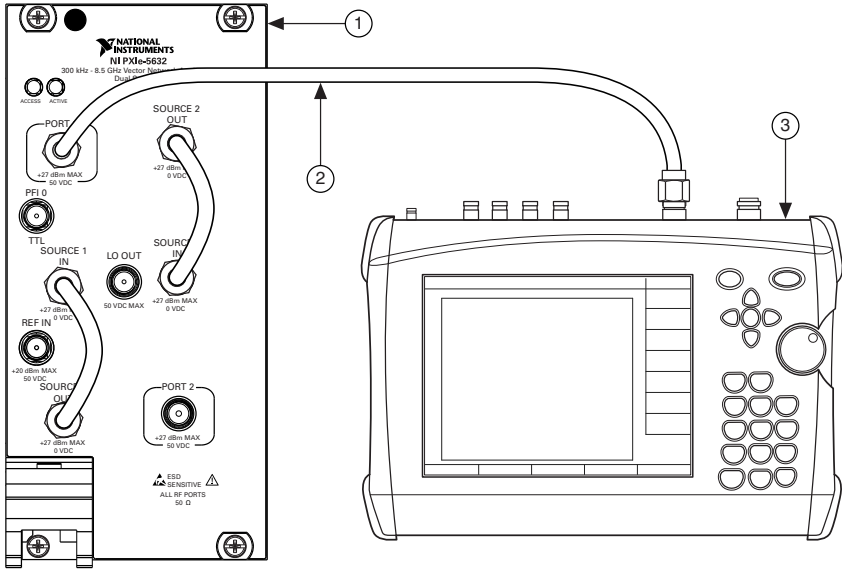
## Verifying Frequency Accuracy

This procedure verifies the PXIe-5632 RF source frequency accuracy.

1. Connect the PXIe-5632 PORT 1 connector to the spectrum analyzer RF IN connector.

The following figure illustrates the hardware setup.

**Figure 1. Frequency Accuracy Verification Equipment Setup**



1. PXIe-5632
  2. Precision Coaxial Cable
  3. Spectrum Analyzer
2. Launch the NI-VNA SFP.
  3. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
  4. Select **Channel»Power** from the menu.
  5. Set **Port 1 Power** to 0 dBm.
  6. Select **Channel»Averaging** from the menu.
  7. Set **IFBW** to 100 Hz.
  8. Select **Trace»Trace Menu** from the menu.
  9. Set **Number of Traces** to 1.
  10. Select **Trace»Response** from the menu.
  11. Select **S11** as the measurement to make.
  12. Select **Channel»Frequency** from the menu.
  13. Set **Number of Points** to 3.
  14. Toggle **CW Mode** to ON.
  15. Set **Start frequency** to the first test frequency in the following list.
    - 1,000 MHz
    - 3,250 MHz
    - 8,500 MHz

- 16. Set the spectrum analyzer center frequency to the same frequency as the PXIe-5632, and select a span of 10 kHz.
- 17. Measure the frequency using the spectrum analyzer, and compare the value measured to the test limits in the following table.

**Table 2.** Frequency Accuracy Test Limits

Frequency	As-Found Limit (ppm)	As-Left Limit (ppm)
1 GHz to ≤8.5 GHz	±14.5	±1.5

- 18. Set the **Start frequency** of the PXIe-5632 to the next test frequency listed in step 15.
- 19. Repeat steps 16 through 18 for the remaining test frequencies listed in step 15.

## Verifying Output Power Accuracy (+0 dBm Set Level Check)

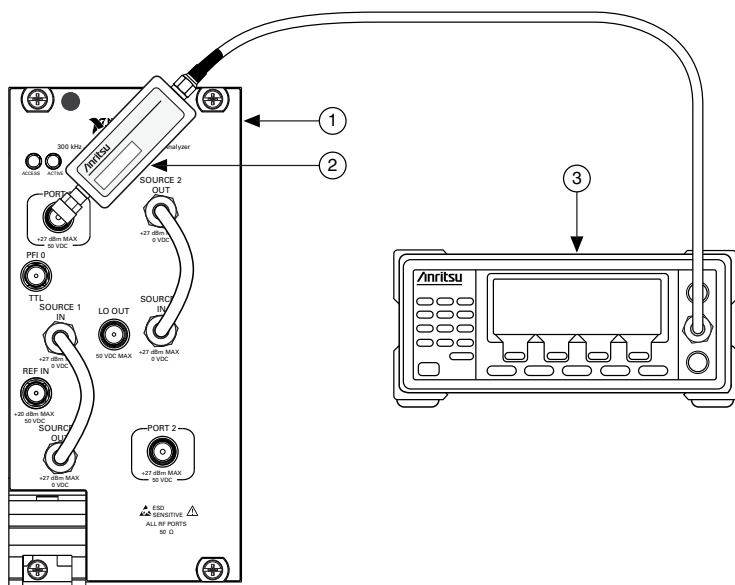
This procedure verifies the PXIe-5632 output power accuracy.

Zero and calibrate the power sensor as described in the [Zeroing the Power Sensor](#) section prior to starting this procedure.

- 1. Connect the PXIe-5632 PORT 1 connector to an RMS power sensor.

The following figure illustrates the initial hardware setup.

**Figure 2. Output Power Accuracy Verification Equipment Setup**



1. PXIe-5632
  2. Power Sensor
  3. Power Meter
2. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
  3. Select **Channel»Power** from the menu.
  4. Set **Port 1 Power** to 0 dBm.
  5. Select **Channel»Averaging** from the menu.
  6. Set **IFBW** to 100 Hz.
  7. Select **Trace»Trace Menu** from the menu.
  8. Set **Number of Traces** to 1.
  9. Select **Trace»Response** from the menu.
  10. Select **S11** as the measurement to make.
  11. Select **Channel»Frequency** from the menu.
  12. Set **Number of Points** to 3.
  13. Toggle **CW Mode** to ON.
  14. Set **CW frequency** to the first frequency listed in [Appendix A: Power Accuracy Test Frequency List](#).
  15. Set the calibration factor on the power meter to match the frequency of the PXIe-5632, and measure the output power level using the power sensor.
  16. Set **CW frequency** to the next test frequency listed in [Appendix A: Power Accuracy Test Frequency List](#), and verify the output power.

- 17. Compare the output power accuracy value measured to the test limits in the *Output Power Accuracy Test Limits* table at the end of this procedure.
- 18. Repeat steps 15 through 17 for all remaining test frequencies listed in *Appendix A: Power Accuracy Test Frequency List*.
- 19. Complete the *Adjusting Port 2 ALC* procedure.
- 20. Connect the PXIe-5632 PORT 2 connector to an RMS power sensor.
- 21. Select **Trace»Response** from the menu.
- 22. Select **S22** as the measurement to make.
- 23. Select **Channel»Frequency** from the menu.
- 24. Set **CW frequency** to the first frequency listed in *Appendix A: Power Accuracy Test Frequency List*.
- 25. Set the calibration factor on the power meter to match the frequency of the PXIe-5632, and measure the output level using the power sensor.
- 26. Set **CW frequency** to the next test frequency listed in *Appendix A: Power Accuracy Test Frequency List*.
- 27. Compare the output power accuracy value measured to the test limits in the *Output Power Accuracy Test Limits* table.
- 28. Repeat steps 25 through 27 on the PXIe-5632 PORT 2 for all remaining test frequencies listed in *Appendix A: Power Accuracy Test Frequency List*.

**Table 3.** Output Power Accuracy Test Limits

Frequency	As-Found Limit (dB)	As-Left Limit (dB)
300 kHz to <8.5 GHz	±1.00	±0.42

## Verifying Source Maximum Leveled Power

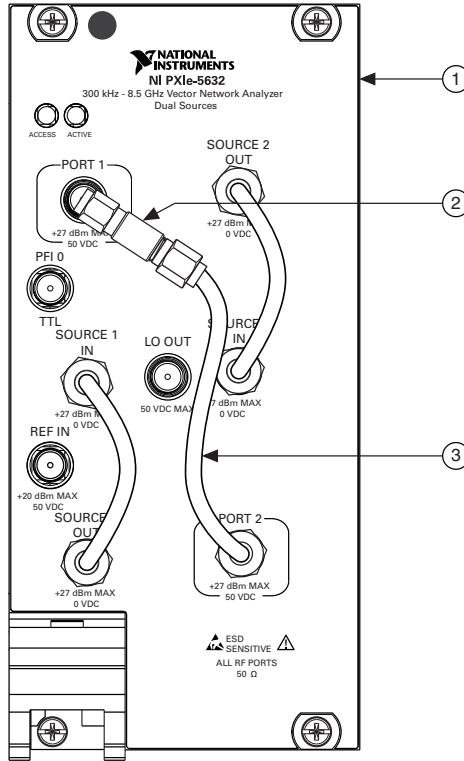
This procedure verifies the PXIe-5632 source maximum leveled power.

- 1. Connect a 20 dB fixed attenuator to the PXIe-5632 PORT 1 connector.
- 2. Connect a K-type thru line between the 20 dB fixed attenuator and the PXIe-5632 PORT 2 connectors.

The following figure illustrates the hardware setup.



**Figure 3. Source Maximum Levelled Power Verification Equipment Setup**



1. PXIe-5632
  2. 20 dB Fixed Attenuator
  3. K-Type Thru Line
3. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
  4. Select **Channel»Power** from the menu.
  5. Set **Port 1 Power** to 0 dBm.
  6. Select **Channel»Averaging** from the menu.
  7. Set **IFBW** to 100 Hz.
  8. Select **Trace»Trace Menu** from the menu.
  9. Set **Number of Traces** to 1.
  10. Select **Trace»Response** from the menu.
  11. Select **User-defined**.
  12. Change **Numerator** to **B2**.
  13. Change **Denominator** to **1**.

14. Select **Trace»Display** from the menu.
15. Select **View Trace** and **Store Data to Memory**.
16. Select **Data, Memory Math**.
17. Select **Channel»Power** from the menu.
18. Set **Port 1 Power** to +30 dBm.
19. Examine the measurement trace on the PXIe-5632, and compare the maximum power output value to the test limits in the *Source Maximum Leveled Power Test Limits* table at the end of this procedure.
20. Select **Channel»Power** from the menu.
21. Set **Port 2 Power** to 0 dBm.
22. Select **Trace»Response** from the menu.
23. Select **User-defined**.
24. Change **Numerator** to **B2**.
25. Change **Driver Port** to **Port 2**.
26. Select **Trace»Display** from the menu.
27. Select **View Trace** and **Store Data to Memory**.
28. Select **Channel»Power** from the menu.
29. Set **Port 2 Power** to +30 dBm.
30. Examine the measurement trace on the PXIe-5632, and compare the maximum power output value to the test limits in the following table.

**Table 4.** Source Maximum Leveled Power Test Limits

Frequency	As-Found Limit (dBm)	As-Left Limit (dBm)
300 kHz to <6 GHz	+15	+16.25
6 GHz to ≤8 GHz	+12	+13.25
>8 GHz	+10	+11.25

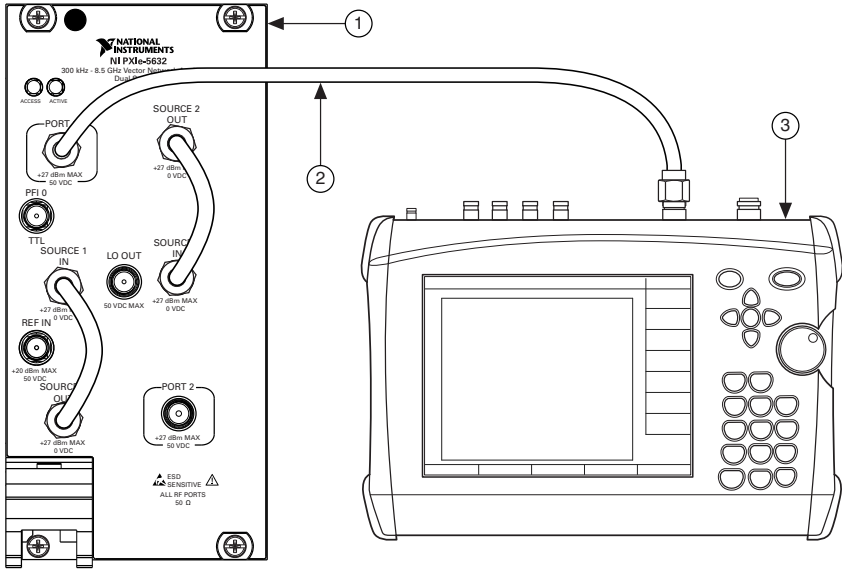
# Verifying Source Harmonics

This procedure verifies the PXIe-5632 source harmonics.

1. Connect the PXIe-5632 PORT 1 connector to the spectrum analyzer RF IN connector.

The following figure illustrates the initial hardware setup.

**Figure 4. Source Harmonics Verification Equipment Setup**



1. PXIe-5632
  2. Precision Coaxial Cable
  3. Spectrum Analyzer
2. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
  3. Select **Channel»Power** from the menu.
  4. Set **Port 1 Power** to 0 dBm.
  5. Select **Channel»Averaging** from the menu.
  6. Set **IFBW** to 100 Hz.
  7. Select **Trace»Trace Menu** from the menu.
  8. Set **Number of Traces** to 1.
  9. Select **Trace»Response** from the menu.
  10. Select **S11** as the measurement to make.
  11. Select **Channel»Frequency** from the menu.
  12. Set **Number of Points** to 3.
  13. Toggle **CW Mode** to ON.
  14. Set **CW frequency** to the first frequency listed in [Appendix B: Second Harmonic Test Frequency List](#).
  15. Measure the level of the fundamental signal using the spectrum analyzer.

16. Measure the second harmonic of the signal, and compare the values measured to the test limits in the *Source Second Harmonics Test Limits* table at the end of this procedure.



**Note** The fundamental signal is the CW frequency from Appendix B or Appendix C. You can find the second harmonic by tuning the spectrum analyzer to two times the fundamental frequency. You can find the third harmonic by tuning the spectrum analyzer to three times the fundamental frequency.



**Note** To measure the decibels relative to the carrier (dBc) value of the harmonics, set a marker to the peak of the fundamental signal and record the value. Tune the spectrum analyzer center frequency to the harmonic being measured, and set a marker to the peak and record the value. Obtain the value in dBc using the following equation:

$$\text{harmonic (dBc)} = -(\text{recorded fundamental marker value} - \text{recorded harmonic marker value})$$

17. Set **CW frequency** to the next test frequency listed in [Appendix B: Second Harmonic Test Frequency List](#).
18. Repeat steps 15 through 17 for all remaining test frequencies listed in [Appendix B: Second Harmonic Test Frequency List](#).
19. Set **CW frequency** to the next test frequency listed in [Appendix C: Third Harmonic Test Frequency List](#).
20. Measure the level of the fundamental signal using the spectrum analyzer.
21. Measure the third harmonic of the signal, and compare the values measured to the test limits in the *Source Third Harmonics Test Limits* table at the end of this procedure.
22. Repeat steps 20 through 21 for all remaining test frequencies listed in [Appendix C: Third Harmonic Test Frequency List](#).
23. Connect the PXIe-5632 PORT 2 connector to the spectrum analyzer RF IN connector.
24. Select **Trace»Response** from the menu.
25. Select **S22** as the measurement to make.
26. Select **Channel»Frequency** from the menu.
27. Repeat steps 14 through 20 on the PXIe-5632 PORT 2.

**Table 5.** Source Second Harmonics Test Limits

Frequency	As-Found Limit (dBc)	As-Left Limit (dBc)
300 kHz to <50 MHz	-20	-23
50 MHz to <2.5 GHz	-30	-33
2.5 GHz to 2.7 GHz	-27	-27
>2.7 GHz to <6.5 GHz	-30	-33
6.5 GHz to 8.5 GHz	-30	-34

**Table 6. Source Third Harmonics Test Limits**

Frequency	As-Found Limit (dBc)	As-Left Limit (dBc)
300 kHz to <50 MHz	-20	-23
50 MHz to <4.333 GHz	-30	-33
4.333 GHz to 8.5 GHz	-30	-34

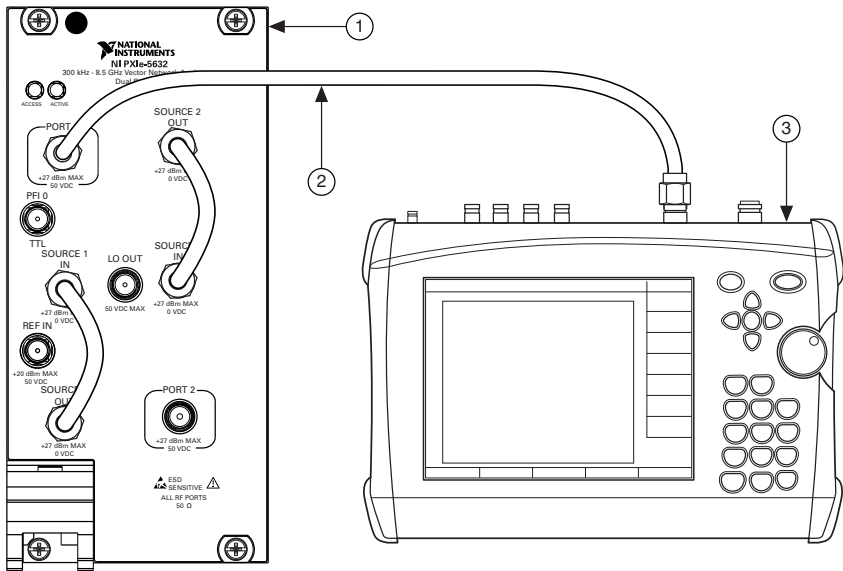
## Verifying Source Nonharmonic Spurious

This procedure verifies the PXIe-5632 source nonharmonic spurious.

1. Connect the PXIe-5632 PORT 1 connector to the spectrum analyzer RF IN connector.

The following figure illustrates the initial hardware setup.

**Figure 5. Source Nonharmonic Spurious Verification Equipment Setup**



1. PXIe-5632
  2. Precision Coaxial Cable
  3. Spectrum Analyzer
2. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
  3. Select **Channel»Power** from the menu.
  4. Set **Port 1 Power** to 0 dBm.
  5. Select **Channel»Averaging** from the menu.

6. Set **IFBW** to 100 Hz.
7. Select **Trace»Trace Menu** from the menu.
8. Set **Number of Traces** to 1.
9. Select **Trace»Response** from the menu.
10. Select **S11** as the measurement to make.
11. Select **Channel»Frequency** from the menu.
12. Set **Number of Points** to 3.
13. Toggle **CW Mode** to ON.
14. Set **CW frequency** to the first *Fundamental Test Frequency* listed in the following table.

**Table 7.** Source Nonharmonic Spurious Test Frequencies

<b>Fundamental Test Frequency (MHz)</b>	<b>Spurious Measurement Frequency (MHz)</b>
2,001	2
2,499	1,501
2,499	3,600
2,499	7,200
3,999	8,000

15. Set the spectrum analyzer center frequency to the *Spurious Measurement Frequency* in the preceding table.
16. Measure the signal level at the relevant spurious frequencies for the test frequency as listed in the preceding table.
17. Compare the measured signal level to the test limits in the following table.

**Table 8.** Source Nonharmonic Spurious Test Limits (Measured at 0 dBm Source Power)

<b>Frequency</b>	<b>As-Found Limit (dBc)</b>	<b>As-Left Limit (dBc)</b>
300 kHz to $\leq 8.5$ GHz	<-30	<-33

18. Set **CW frequency** to the next *Fundamental Test Frequency* listed in the *Source Nonharmonic Spurious Test Frequencies* table.
19. Repeat steps 15 through 18 for all remaining test frequencies listed in the *Source Nonharmonic Spurious Test Frequencies* table.
20. Connect the PXIe-5632 PORT 2 connector to the spectrum analyzer RF IN connector.
21. Select **Trace»Response** from the menu.
22. Select **S22** as the measurement to make.
23. Select **Channel»Frequency** from the menu.
24. Set **CW frequency** to the first *Fundamental Test Frequency* listed in the *Source Nonharmonic Spurious Test Frequencies* table.
25. Repeat steps 15 through 18 on the PXIe-5632 PORT 2 for all remaining test frequencies listed in the *Source Nonharmonic Spurious Test Frequencies* table.

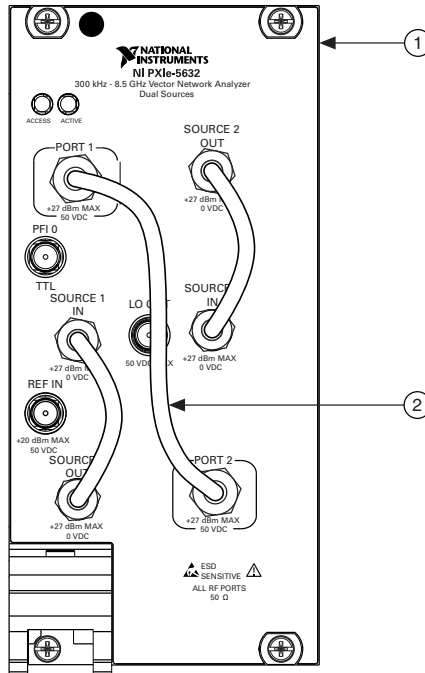
# Verifying Trace Noise

This procedure verifies the PXIe-5632 trace noise.

1. Connect a K-type thru line between the PXIe-5632 PORT 1 and PORT 2 connectors.

The following figure illustrates the hardware setup.

**Figure 6. Trace Noise Verification Equipment Setup**



1. PXIe-5632
2. K-Type Thru Line
3. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
4. Select **Channel»Frequency** from the menu.
5. Set **Stop frequency** to 8.000 GHz.
6. Select **Channel»Power** from the menu.
7. Set **Port 1 Power** to +10 dBm.
8. Select **Trace»Trace Menu** from the menu.
9. Set **Number of Traces** to 1.
10. Select **Trace»Display** from the menu.
11. Set **Trace Format** to **Linear Mag**.

11. Select **Trace»Response** from the menu.
12. Select **S21** as the measurement to make.
13. Acquire and save 10 sets of measurement data.
14. At each frequency, post-process the data using the RMS from mean method and the following equation:

$$\text{RMS} = \sqrt{\frac{\sum_{i=1}^N (x_i - \mu)^2}{N}}$$

where

- $N$  is the number of data points
- $X_i$  is the linear value of each measurement
- $\mu$  is the linear mean of the measurements
- $i$  is the measurement point index

15. Compare the RMS trace noise you calculate for each frequency to the test limits in the following table.

**Table 9. Trace Noise Test Limits**

Frequency	As-Found Limit (mdB <sub>rms</sub> )	As-Left Limit (mdB <sub>rms</sub> )
300 kHz to <8 GHz	6	4

16. Select **Trace»Response** from the menu.
17. Select **S12** as the measurement to make.
18. Repeat steps 13 through 15 to verify trace noise in the reverse direction.

# Verifying System Dynamic Range

This procedure verifies the PXIe-5632 system dynamic range.

1. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
2. Select **Channel»Sweep** from the menu.
3. Select **Freq-based Seg. Sweep Setup**.
4. Enter the table values, as shown in the following table, in the table at the bottom of the NI-VNA SFP Display Window for Segment 1.



**Note** For each segment, set the *Averaging* column value to 1 and the *IFBW* column value to 10 Hz.



**Tip** Select a specific table column to activate and enter a corresponding table value. The NI-VNA SFP automatically calculates the *Step/Stop Frequency* column values.



**Table 10. Segmented Sweep Setup for Dynamic Range**

<b>Segment</b>	<b>Frequency Def. for F1 and F2</b>	<b>F1</b>	<b>F2</b>	<b>Number of Points</b>	<b>Step/Stop Frequency</b>	<b>Port 1 Source Power</b>	<b>Port 2 Source Power</b>
1	Start & Stop	500 kHz	1 MHz	6	100 kHz	15	15
2	Start & Stop	2 MHz	2.99 MHz	2	990 kHz	15	15
3	Start & Stop	3 MHz	5 MHz	3	1 MHz	15	15
4	Start & Stop	10 MHz	90 MHz	9	10 MHz	15	15
5	Start & Stop	100 MHz	950 MHz	18	50 MHz	15	15
6	Start & Stop	1.0001 GHz	1.1 GHz	2	99.9 MHz	15	15
7	Start & Stop	1.2 GHz	1.8 GHz	7	100 MHz	15	15
8	Start & Stop	1.9 GHz	2.0001 GHz	2	100.1 MHz	15	15
9	Start & Stop	2.1 GHz	2.4 GHz	4	100 MHz	15	15
10	Start & Stop	2.49999 GHz	2.50001 GHz	2	20 kHz	15	15
11	Start & Stop	2.6 GHz	3.9 GHz	14	100 kHz	15	15
12	Start & Stop	3.99999 GHz	4.00001 GHz	2	20 kHz	15	15
13	Start & Stop	4.1 GHz	5.8 GHz	18	100 MHz	15	15
14	Start & Stop	5.9 GHz	5.99999 GHz	2	99.99 MHz	15	15
15	Start & Stop	6 GHz	7.8 GHz	19	100 MHz	12	12
16	Start & Stop	7.9 GHz	7.99999 GHz	2	99.99 MHz	12	12

5. Select **Add** to create an additional frequency segment and modify its parameters according to the preceding table.
6. Continue entering table values until all segments are defined, as shown in the preceding table.
7. Select **Channel»Sweep** from the menu.
8. Set **Sweep Types** to **Segmented Sweep (Freq-based)**.
9. Perform a *manual transmission frequency response calibration* for both port one and port two of the PXIe-5632.
10. Connect the K-type thru line to the PXIe-5632 PORT 1 connector.
11. Connect the K-type calibration device to the end of the K-type thru line.



**Note** The K-type calibration device is a three-port device that contains an open, short, and load port. As shown in the following figure, each port is labeled on the device.

12. Connect the K-type 50  $\Omega$  male termination to the PXIe-5632 PORT 2 connector.

The following figure illustrates the hardware setup.



where

$N$  is the number of data points

$X_i$  is the linear value of each measurement

$i$  is the measurement point index

21. Compare the RMS dynamic range you calculate for each frequency to the test limits in the following table.

**Table 11.** System Dynamic Range Test Limits

Frequency	As-Found Limit (dB)	As-Left Limit (dB)
500 kHz to <3 MHz	95	98
3 MHz to <1.5 GHz	100	103
1.5 GHz to <6 GHz	110	113
6 GHz to <8 GHz	105	108

22. Select **Trace»Response** from the menu.
23. Select **S12** to be measured.
24. Repeat steps 19 through 21 to verify dynamic range in the reverse direction.

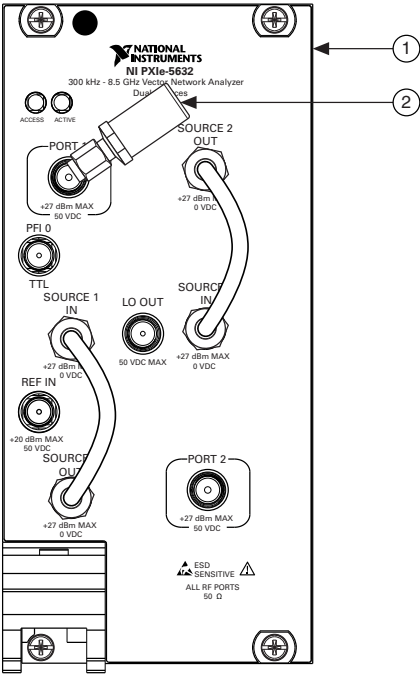
## Verifying Corrected Directivity (500 kHz to <5 GHz)

This procedure verifies the PXIe-5632 corrected directivity from 500 kHz to <5 GHz.

1. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
2. Set **Start frequency** to 500 kHz.
3. Select **Channel»Frequency** from the menu.
4. Set **Stop frequency** to 4.999 GHz.
5. Set **Number of Points** to 201.
6. Select **Channel»Averaging** from the menu.
7. Set **IFBW** to 100 Hz.
8. Perform a *manual* or *automatic port one reflection calibration* for both port one and port two of the PXIe-5632.
9. Select **Trace»Trace Menu** from the menu.
10. Set **Number of Traces** to 1.
11. Select **Trace»Response** from the menu.
12. Select **S11** as the measurement to make.
13. Connect the K-type male 50  $\Omega$  load termination to the PXIe-5632 PORT 1 connector.

The following figure illustrates the initial hardware setup.

**Figure 8.** Corrected Directivity (500 kHz to <5 GHz) Verification Equipment Setup



- 1. PXIe-5632
- 2. K-Type Male 50 Ω Load Termination

- 14. Compare the measured  $S_{11}$  values in the Display Window of the NI-VNA SFP to the test limits in the *Corrected Directivity (500 kHz to <5 GHz) Test Limits* table at the end of this procedure.
- 15. Select **Trace»Response** from the menu.
- 16. Select **S22** as the measurement to make.
- 17. Connect the Type-K male 50 Ω load termination to the PXIe-5632 PORT 2 connector.
- 18. Compare the measured  $S_{22}$  values in the Display Window of the NI-VNA SFP to the test limits in the following table.

**Table 12.** Corrected Directivity (500 kHz to <5 GHz) Test Limits

Frequency	As-Found Limit (dB)	As-Left Limit (dB)
500 kHz to <1 GHz	>42	>48
1 GHz to <5 GHz	>42	>44

## Verifying Corrected Source Match (300 kHz to <5 GHz)

This procedure verifies the PXIe-5632 corrected source match from 300 kHz to <5 GHz.

1. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
2. Select **Channel»Frequency** from the menu.
3. Set the **Stop frequency** to 4.999 GHz.
4. Set **Number of Points** to 201.
5. Select **Channel»Averaging** from the menu.
6. Set **IFBW** to 100 Hz.
7. Perform a *manual* or *automatic port one reflection calibration* for both port one and port two of the PXIe-5632.

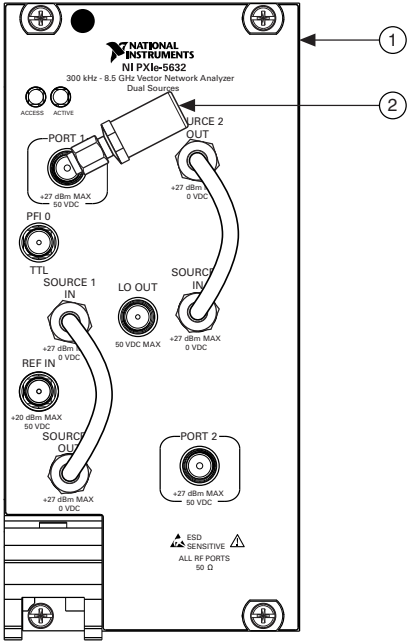


**Note** If you performed the *Verifying Corrected Directivity (300 kHz to <5 GHz)* test prior to this procedure, you can use the same calibration by recalling the settings.

8. Select **Trace»Trace Menu** from the menu.
9. Set **Number of Traces** to 1.
10. Set the PXIe-5632 data type to linear magnitude by selecting **Trace»Display»Trace Format»Linear Mag** from the menu.
11. Select **Trace»Response** from the menu.
12. Select **S11** as the measurement to make.
13. Connect the K-type male short to the PXIe-5632 PORT 1 connector.

The following figure illustrates the initial hardware setup.

**Figure 9.** Corrected Source Match (300 kHz to <5 GHz) Verification Equipment Setup



1. PXIe-5632
2. K-Type Male Short

14. To calculate the corrected source match, locate the worst case point on the trace within the Display Window of the NI-VNA SFP, and determine the corresponding *Reflection Coefficient* value in [Appendix D: RF Measurement Chart](#).
15. Compare the calculated corrected source match to the test limits in the following table.

**Table 13.** Corrected Source Match (300 kHz to <5 GHz) Test Limits

Frequency	As-Found Limit (dB)	As-Left Limit (dB)
300 kHz to <1 GHz	>35	>39
1 GHz to <5 GHz	>35	>37

16. Select **Trace»Response** from the menu.
17. Select **S22** as the measurement to make.
18. Connect the K-type male short to the PXIe-5632 PORT 2 connector.
19. Repeat steps 14 to 15 for the PXIe-5632 PORT 2 connector.

## Verifying Corrected Directivity (5 GHz to 8.5 GHz)

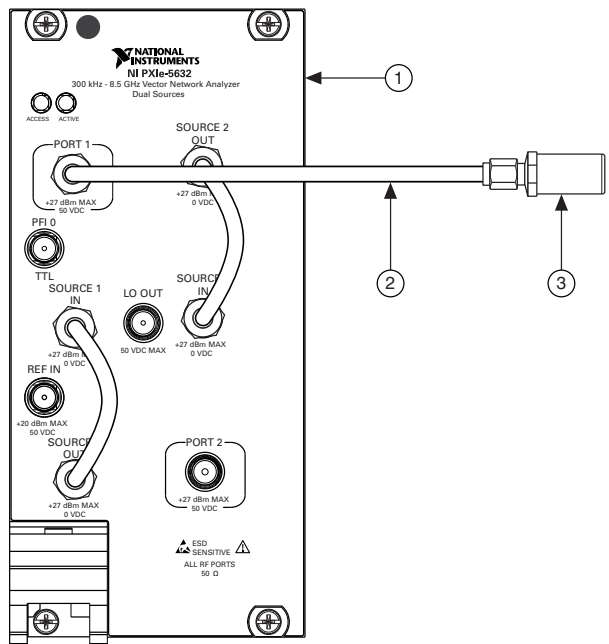
This procedure verifies the PXIe-5632 corrected directivity from 5 GHz to 8.5 GHz.

1. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
2. Select **Channel»Frequency** from the menu.
3. Set **Start frequency** to 5 GHz.
4. Set **Stop frequency** to 8.5 GHz.
5. Set **Number of Points** to 201.
6. Select **Channel»Averaging** from the menu.
7. Set **IFBW** to 100 Hz.
8. Perform a *manual* or *automatic port one reflection calibration* for both port one and port two of the PXIe-5632.
9. Select **Trace»Trace Menu** from the menu.
10. Set **Number of Traces** to 1.
11. Select **Trace»Response** from the menu.
12. Select **S11** as the measurement to make.
13. Align the beadless end of the K-type airline to connect to the PXIe-5632 PORT 1 connector.
14. Connect the 20 dB offset termination to the exposed beaded end of the K-type airline.

The following figure illustrates the initial hardware setup.



**Figure 10.** Corrected Directivity (5 GHz to 8.5 GHz) Verification Equipment Setup



- 1. PXIe-5632
- 2. K-Type Airline
- 3. 20 dB Offset Termination

- 15. Examine the measurement for the largest peak-to-peak magnitude ripple, and calculate the ripple magnitude ( $Ref \pm X$  Peak-to-Peak Ripple) and the mean value ( $Ref$ ) using [Appendix D: RF Measurement Chart](#).
- 16. Calculate the corrected directivity for frequencies greater than 5 GHz by completing the following steps:
  - a) Using [Appendix D: RF Measurement Chart](#), find the offset  $X$  dB Below Reference value that corresponds to the  $Ref \pm X$  Peak-to-Peak Ripple value from step 15.
  - b) Add the offset value to the mean value.
- 17. Compare the calculated corrected directivity to the test limits in the following table.

**Table 14.** Corrected Directivity (5 GHz to 8.5 GHz) Test Limits

Frequency	As-Found Limit (dB)	As-Left Limit (dB)
5 GHz to $\leq$ 8.5 GHz	>36	>38

- 18. Select **Trace»Response** from the menu.
- 19. Select **S22** as the measurement to make.
- 20. Align the beadless end of the K-type airline to connect to the PXIe-5632 PORT 2 connector.

21. Repeat steps 14 through 17 for the PXIe-5632 PORT 2 connector.

## Verifying Corrected Source Match (5 GHz to 8.5 GHz)

This procedure verifies the PXIe-5632 corrected source match from 5 GHz to 8.5 GHz.

1. Within the NI-VNA SFP, select **Utilities»Preset**. Click **OK** to set the default sweep configuration.
2. Select **Channel»Frequency** from the menu.
3. Set **Start frequency** to 5 GHz.
4. Set **Stop frequency** to 8.5 GHz.
5. Set **Number of Points** to 201.
6. Select **Channel»Averaging** from the menu.
7. Set **IFBW** to 100 Hz.
8. Perform a *manual* or *automatic port one reflection calibration* for both port one and port two of the PXIe-5632.

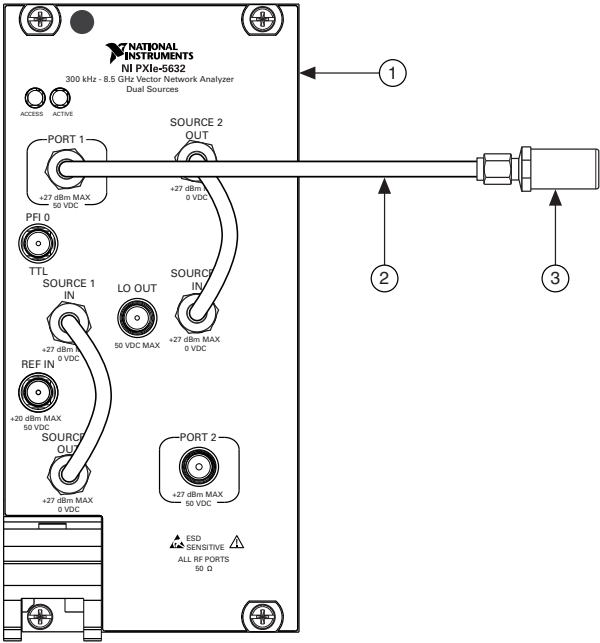


**Note** If you performed the *Verifying Corrected Directivity (5 GHz to 8.5 GHz)* test prior to this procedure, you can use the same calibration by recalling the settings.

9. Select **Trace»Trace Menu** from the menu.
10. Set **Number of Traces** to 1.
11. Select **Trace»Response** from the menu.
12. Select **S11** as the measurement to make.
13. Align the beadless end of the K-type airline to connect to the PXIe-5632 PORT 1 connector.
14. Connect the K-type female short to the exposed beaded end of the K-type airline.

The following figure illustrates the initial hardware setup.

**Figure 11. Corrected Source Match (5 GHz to 8.5 GHz) Verification Equipment Setup**



1. PXIe-5632
2. K-Type Airline
3. K-Type Female Short

15. Examine the measurement for the largest peak-to-peak magnitude ripple, and calculate the ripple magnitude ( $Ref \pm X$  Peak-to-Peak Ripple) and the mean value ( $Ref$ ) using [Appendix D: RF Measurement Chart](#).
16. Calculate the corrected source match for frequencies greater than 5 GHz by completing the following steps:
  - a) Using [Appendix D: RF Measurement Chart](#), find the offset  $X$  dB Below Reference value that corresponds to the  $Ref \pm X$  Peak-to-Peak Ripple value from step 15.
  - b) Add the offset value to the mean value.
17. Compare the calculated corrected source match to the test limits in the following table.

**Table 15. Corrected Source Match (5 GHz to 8.5 GHz) Test Limits**

Frequency	As-Found Limit (dB)	As-Left Limit (dB)
5 GHz to $\leq$ 8.5 GHz	>35	>37

18. Select **Trace»Response** from the menu.
19. Select **S22** as the measurement to make.
20. Align the beadless end of the K-type airline to connect to the PXIe-5632 PORT 2 connector.

21. Repeat steps 14 through 17 for the PXIe-5632 PORT 2 connector.

## Adjustment

This section describes the steps needed to adjust the PXIe-5632 to meet published specifications.

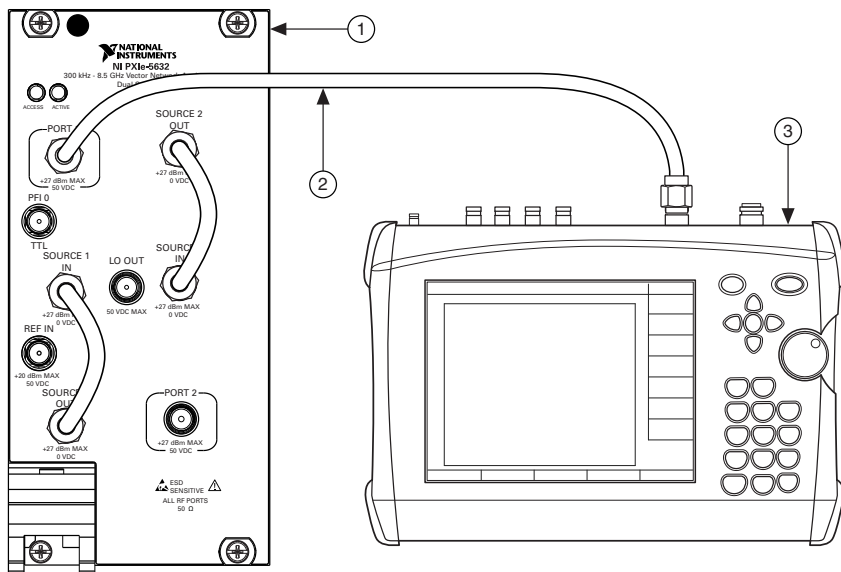
### Adjusting Timebase

This procedure adjusts the PXIe-5632 timebase performance.

1. Connect the PXIe-5632 PORT 1 connector to the spectrum analyzer RF IN connector.

The following figure illustrates the hardware setup.

**Figure 12. Timebase Adjustment Equipment Setup**



1. PXIe-5632
  2. Precision Coaxial Cable
  3. Spectrum Analyzer
2. With the NI-VNA SFP running, select **Utilities»System»Diagnostics** from the menu.
  3. Enter NIVNA when prompted for a password, then click **OK**.
  4. Click the **Hardware Cal** button.
  5. Click the **Time Base Cal** button.
  6. Set the spectrum analyzer center frequency to 5 GHz with a span of 10 kHz, and select the peak search function to display the current frequency of the PXIe-5632.
  7. Adjust the **DAC Number** to move the signal frequency as close to 5 GHz as possible. The adjusted value should be within  $\pm 5$  kHz.

8. Save the changes, then close the NI-VNA SFP.
9. Disconnect the PXIe-5632 PORT 1 connector from the spectrum analyzer.

## Adjusting Port 1 ALC

This procedure adjusts the PXIe-5632 port one automatic level control (ALC).

Zero and calibrate the power sensor as described in the [Zeroing the Power Sensor](#) section prior to starting this procedure.

1. Connect a 10 dB fixed attenuator to the power sensor.
2. Set the power meter to an offset of 10 dB.
3. Within the NI-VNA SFP, select **Utilities»System»Diagnostics** from the menu.
4. Enter NIVNA when prompted for a password, then click **OK**.
5. Click the **Hardware Cal** button.
6. Click the **ALC Cal** button.
7. Click the **Port 1 ALC Cal** button.
8. Verify the Power Meter Address is correct.

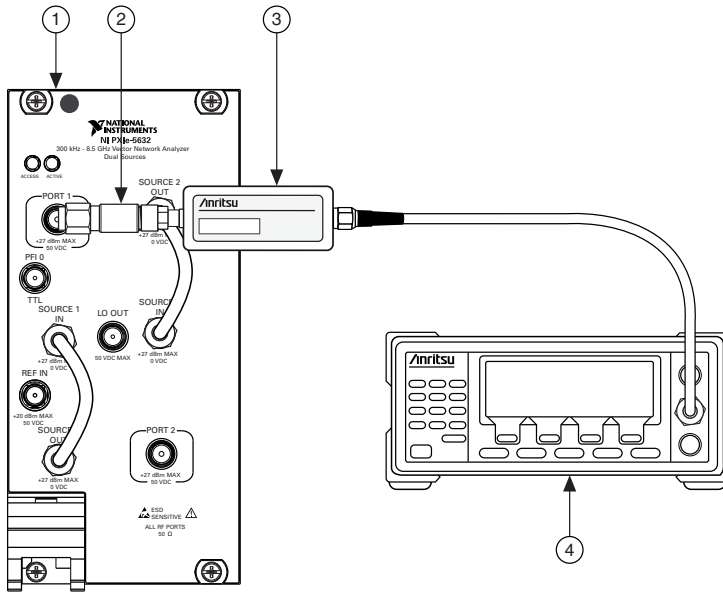


**Note** The Power Meter Address is typically Address 13.

9. Connect the 10 dB fixed attenuator and power sensor to the PXIe-5632 PORT 1 connector.

The following figure illustrates the hardware setup.

**Figure 13. Port 1 ALC Adjustment Equipment Setup**



1. PXIe-5632
2. 10 dB Fixed Attenuator
3. Power Sensor
4. Power Meter

10. Select **Start Cal** to begin calibration of the PXIe-5632 PORT 1 power.
11. When the calibration is complete, verify that the calibration was successful.
12. Close the NI-VNA SFP and relaunch to apply the new calibration.
13. Disconnect the power sensor from the PXIe-5632 PORT 1 connector.

## Adjusting Port 2 ALC

Zero and calibrate the power sensor as described in the [Zeroing the Power Sensor](#) section prior to starting this procedure.

This procedure adjusts the PXIe-5632 port two automatic level control (ALC).

1. Connect a 10 dB fixed attenuator to the power sensor.
2. Set the power meter to an offset of 10 dB.
3. Within the NI-VNA SFP, select **Utilities»System»Diagnostics** from the menu.
4. Enter **NI-VNA** when prompted for a password, then click **OK**.
5. Click the **Hardware Cal** button.
6. Click the **ALC Cal** button.
7. Click the **Port 2 ALC Cal** button.

8. Verify the Power Meter Address is correct.

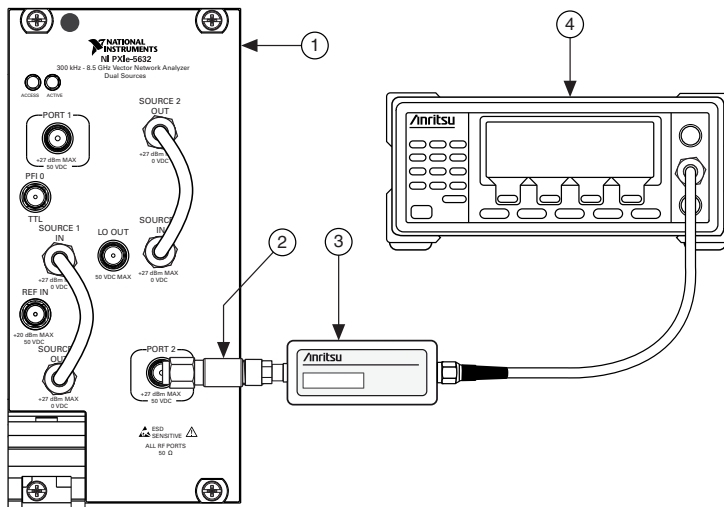


**Note** The Power Meter Address is typically Address 13.

9. Connect the 10 dB fixed attenuator and power sensor to the PXIe-5632 PORT 2 connector.

The following figure illustrates the hardware setup.

**Figure 14. Port 2 ALC Adjustment Equipment Setup**



- |                           |                 |
|---------------------------|-----------------|
| 1. PXIe-5632              | 3. Power Sensor |
| 2. 10 dB Fixed Attenuator | 4. Power Meter  |

10. Select **Start Cal** to begin calibration of the PXIe-5632 PORT 2 power.
11. When the calibration is complete, verify that the calibration was successful.
12. Close the NI-VNA SFP and relaunch to apply the new calibration.
13. Disconnect the power sensor from the PXIe-5632 PORT 2 connector.

## Adjusting the LO Level

This procedure adjusts the PXIe-5632 local oscillator (LO) level.

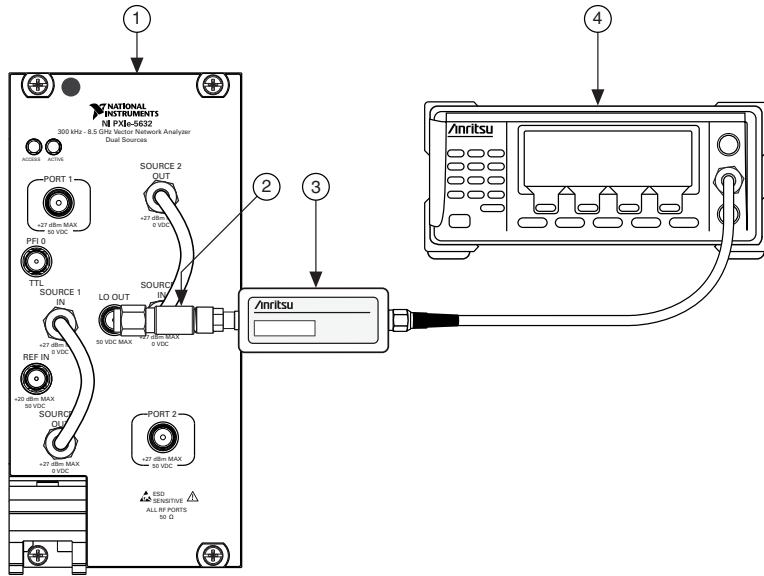
Zero and calibrate the power sensor as described in the [Zeroing the Power Sensor](#) section prior to starting this procedure.

1. Connect a 10 dB fixed attenuator to the power sensor.
2. Set the power meter to an offset of 10 dB.
3. Within the NI-VNA SFP, select **Utilities»System»Diagnostics** from the menu.
4. Enter NIVNA when prompted for a password, then click **OK**.
5. Click the **Hardware Cal** button.

6. Click the **LO Cal** button.
7. Connect the power sensor to the PXIe-5632 LO OUT connector.

The following figure illustrates the hardware setup.

**Figure 15. LO Level Adjustment Equipment Setup**



- |                           |                 |
|---------------------------|-----------------|
| 1. PXIe-5632              | 3. Power Sensor |
| 2. 10 dB Fixed Attenuator | 4. Power Meter  |

8. Click the **Start Calibration** button to begin calibration of the LO level.
9. When the calibration is complete, verify that the calibration was successful.
10. Close the NI-VNA SFP and relaunch to apply the new calibration.
11. Disconnect the power sensor from the PXIe-5632 LO OUT connector.

## Adjusting the IF Filter

This procedure adjusts the PXIe-5632 IF filter performance.

1. Within the NI-VNA SFP, select **Utilities»System»Diagnostics** from the menu.
2. Enter NIVNA when prompted for a password, then click **OK**.
3. Click the **Hardware Cal** button.
4. Click the **IF Filter Cal** button.
5. When the calibration is complete, verify that the calibration was successful.
6. Close the NI-VNA SFP and relaunch to apply the new calibration.



# Reverification

Repeat the [Verification](#) section to determine the as-left status of the PXIe-5632.



**Note** If any test fails reverification after performing an adjustment, verify that you have met the test conditions before returning your PXIe-5632 to NI. Refer to the [Worldwide Support and Services](#) section for information about support resources or service requests.

## Appendix A: Power Accuracy Test Frequency List



**Note** Read the following table left-to-right.

**Table 16.** Power Accuracy Test Frequency List (MHz)

0.3	0.5	1	3	5	9
10	20	30	49.99	50	75
100	149.99	150	200	300	400
500	600	700	800	900.1	1,000
1,100	1,200	1,300	1,400	1,500	1,600
1,700	1,800	1,900	1,999.99	2,000	2,250
2,499.99	2,500.01	2,700	2,900	3,100	3,300
3,500	3,700	3,850	3,999.99	4,000.01	4,200
4,400	4,600	4,800	5,000	5,200	5,400
5,600	5,800	6,000	6,200	6,400	6,600
6,800	7,000	7,200	7,400	7,600	7,800
8,000	8,200	8,350	8,500		

## Appendix B: Second Harmonic Test Frequency List



**Note** Read the following table left-to-right.

**Table 17. Second Harmonic Test Frequency List (MHz)**

0.3	0.4	0.5	1	2	5
10	20	25	49.9	50	125
250	375	500	625	750	875
1,000	1,200.1	1,400	1,550	1,800	2,000
2,250	2,499.99	2,500.01	2,510	2,600	2,700
2,701	2,750	3,000	3,250	3,600	3,999.99
4,000.01	4,250	4,500	5,000	5,500	6,000
6,500	6,501	7,000	7,500	8,000	8,500

## Appendix C: Third Harmonic Test Frequency List



**Note** Read the following table left-to-right.

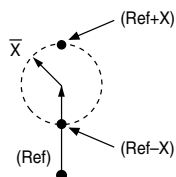
**Table 18. Third Harmonic Test Frequency List (MHz)**

0.3	0.4	0.5	1	2	5
10	20	25	49.9	50	100
200	300	400	500	600	700
800	900.1	1,000.1	1,200.1	1,400	1,600
1,800	2,000	2,250	2,499.99	2,500.01	2,750
3,000	3,250	3,500	3,750	3,999.99	4,000.01
4,333	4,334	5,000	5,500	6,000	6,500
7,000	7,500	8,000	8,500		

## Appendix D: RF Measurement Chart

The following table shows conversion values for return loss, reflection coefficient, and SWR. The *Ref + X* and *Ref - X* columns contain resultant error values for interaction of a small phasor *X* with a large phasor (unity reference) according to the relative magnitude of the smaller phasor, which is expressed as *X db Below Reference*.

**Figure 16. Phasor Interaction**



**Table 19. RF Measurement Chart**

SWR	Reflection Coefficient	Return Loss	X dB Below Reference	Ref + X (dB)	Ref - X (dB)	Ref ± X Peak-to-Peak Ripple
17.3910	0.8913	1	1	5.5350	19.2715	24.8065
8.7242	0.7943	2	2	5.0780	13.7365	18.8145
5.8480	0.7079	3	3	4.6495	10.6907	15.3402
4.4194	0.6310	4	4	4.2489	8.6585	12.9073
3.5698	0.5623	5	5	3.8755	7.1773	11.0528
3.0095	0.5012	6	6	3.5287	6.0412	9.5699
2.6146	0.4467	7	7	3.5287	5.1405	8.3480
2.3229	0.3981	8	8	3.5287	4.4096	7.3204
2.0999	0.3548	9	9	3.5287	3.8063	6.4439
1.9250	0.3162	10	10	2.3866	3.3018	5.6884
1.7849	0.2818	11	11	2.1567	2.8756	5.0322
1.6709	0.2512	12	12	1.9465	2.5126	4.4590
1.5769	0.2239	13	13	1.7547	2.2013	3.9561
1.4985	0.1995	14	14	1.5802	1.9331	3.5133
1.4326	0.1778	15	15	1.4216	1.9331	3.1224
1.3767	0.1585	16	16	1.2778	1.4988	2.7766
1.3290	0.1413	17	17	1.1476	1.3227	2.4703
1.2880	0.1259	18	18	1.0299	1.1687	2.1986
1.2528	0.1122	19	19	0.9237	1.0337	1.9574

**Table 19. RF Measurement Chart (Continued)**

<b>SWR</b>	<b>Reflection Coefficient</b>	<b>Return Loss</b>	<b>X dB Below Reference</b>	<b>Ref + X (dB)</b>	<b>Ref - X (dB)</b>	<b>Ref ± X Peak-to-Peak Ripple</b>
1.2222	0.1000	20	20	0.8279	0.9151	1.7430
1.1957	0.0891	21	21	0.7416	0.8108	1.5524
1.1726	0.0794	22	22	0.6639	0.7189	1.3828
1.1524	0.0708	23	23	0.5941	0.6378	1.3828
1.1347	0.0631	24	24	0.5314	0.5661	1.0975
1.1192	0.0562	25	25	0.4752	0.5027	0.9779
1.1055	0.0501	26	26	0.4248	0.4466	0.8714
1.0935	0.0447	27	27	0.3798	0.3969	0.7765
1.0829	0.0398	28	28	0.3391	0.3529	0.6919
1.0736	0.0355	29	29	0.3028	0.3138	0.6166
1.0653	0.0316	30	30	0.2704	0.2791	0.5495
1.0580	0.0282	31	31	0.2414	0.2483	0.4897
1.0515	0.0251	32	32	0.2155	0.2210	0.4365
1.0458	0.0224	33	33	0.1923	0.1967	0.3890
1.0407	0.0200	34	34	0.1716	0.1751	0.3467
1.0362	0.0178	35	35	0.1531	0.1558	0.3090
1.0322	0.0158	36	36	0.1366	0.1388	0.2753
1.0287	0.0141	37	37	0.1218	0.1236	0.2454
1.0255	0.0126	38	38	0.1087	0.1100	0.2187
1.0227	0.0112	39	39	0.0969	0.0980	0.1949
1.0202	0.0100	40	40	0.0864	0.0873	0.1737
1.0180	0.0089	41	41	0.0771	0.0778	0.1548
1.0160	0.0079	42	42	0.0687	0.0693	0.1380
1.0143	0.0071	43	43	0.0613	0.0617	0.1230

**Table 19. RF Measurement Chart (Continued)**

<b>SWR</b>	<b>Reflection Coefficient</b>	<b>Return Loss</b>	<b>X dB Below Reference</b>	<b>Ref + X (dB)</b>	<b>Ref - X (dB)</b>	<b>Ref ± X Peak-to-Peak Ripple</b>
1.0127	0.0063	44	44	0.0546	0.0550	0.1096
1.0113	0.0056	45	45	0.0487	0.0490	0.0977
1.0101	0.0050	46	46	0.0434	0.0436	0.0871
1.0090	0.0045	47	47	0.0387	0.0389	0.0776
1.0080	0.0045	48	48	0.0345	0.0346	0.0692
1.0071	0.0035	49	49	0.0308	0.0309	0.0616
1.0063	0.0032	50	50	0.0274	0.0275	0.0549
1.0057	0.0028	51	51	0.0244	0.0245	0.0490
1.0050	0.0025	52	52	0.0218	0.0218	0.0436
1.0045	0.0022	53	53	0.0194	0.0195	0.0389
1.0040	0.0020	54	54	0.0173	0.0173	0.0347
1.0036	0.0018	55	55	0.0154	0.0155	0.0309
1.0032	0.0016	56	56	0.0138	0.0138	0.0275
1.0028	0.0014	57	57	0.0123	0.0123	0.0245
1.0025	0.0013	58	58	0.0109	0.0109	0.0219
1.0022	0.0011	59	59	0.0097	0.0098	0.0195
1.0020	0.0010	60	60	0.0087	0.0087	0.0174

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