CALIBRATION PROCEDURE

PXIe-5172

This document contains the verification and adjustment procedures for the PXIe-5172. Refer to *ni.com/calibration* for more information about calibration solutions.

Contents

Required Software

Calibrating the PXIe-5172 requires you to install the following software on the calibration system:

- Supported application development environment (ADE)—LabVIEW 2016 or later
- Verification can be performed using either of the following:
  - NI-SCOPE 17.1 or later. The PXIe-5172 was first supported in NI-SCOPE 17.1.
  - LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes 16.2 or later. The PXIe-5172 was first supported in LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes 16.2.
- Adjustment can only be performed using:
  - LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes 16.2 or later. The PXIe-5172 was first supported in LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes 16.2.

You can download all required software from *ni.com/downloads*.

Related Documentation

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

- *PXIe-5172 Getting Started Guide*
- *NI High-Speed Digitizers Help*
- *PXIe-5172 Specifications*
- *NI Reconfigurable Oscilloscopes Help*

Visit *ni.com/manuals* for the latest versions of these documents.

Test Equipment

Refer to the following table for a list of necessary equipment and model recommendations for calibration of the PXIe-5172.

If you do not have the recommended equipment, select a substitute calibration standard using the specifications listed in the minimum requirements column of the table.

Table 1. PXIe-5172 Test Equipment

Equipment	Recommended Model	Where Used	Minimum Requirements
Oscilloscope calibrator	Fluke 9500B/600 with Fluke 9530 Active Head	Verifications: • Timebase accuracy • DC accuracy Adjustment	Sine wave generation: • Amplitude: 1.25 $V_{pk\text{-}pk}$ into 50 Ω • Frequency: 11 MHz and 89 MHz • Frequency accuracy: ±0.25 ppm
			Square wave generation: • Amplitude: 0.7 $V_{pk\text{-}pk}$ to 20 $V_{pk\text{-}pk}$ into 1 MΩ symmetrical to ground (0 V) • Frequency: 500 Hz • Abberations: <2% of peak for the first 500 ns
			DC generation: • Amplitude: ±5 V into 50 Ω, ±40 V into 1 MΩ • Accuracy: ±(0.025% of output + 25 µV)
DMM	NI PXI-4071	Verifications: • AC amplitude accuracy	AC voltage measurement: • Range: 0.1 $V_{pk\text{-}pk}$ to 20 $V_{pk\text{-}pk}$ • Input impedance: ≥10 MΩ • Bandwidth: ≥50 kHz • Accuracy at 50 kHz – ±(0.07% of reading + 14 µV) for 0.1 $V_{pk\text{-}pk}$ test point – ±(0.06% of reading + 71 µV) for 0.7 $V_{pk\text{-}pk}$ to 1.4 $V_{pk\text{-}pk}$ test points – ±(0.06% of reading + 707 µV) for 2.5 $V_{pk\text{-}pk}$ to 5.0 $V_{pk\text{-}pk}$ test points – ±(0.12% of reading + 35 mV) for 20.0 $V_{pk\text{-}pk}$ test point

Table 1. PXIe-5172 Test Equipment (Continued)

Equipment	Recommended Model	Where Used	Minimum Requirements
Function generator	NI PXI-5402/5406, Keysight 33220A, or Keysight 33500B	Verifications: • AC amplitude accuracy	Sine wave generation: • Amplitude: – 0.1 $V_{pk\text{-}pk}$ to 5.0 $V_{pk\text{-}pk}$ into 50 Ω – 0.1 $V_{pk\text{-}pk}$ to 20 $V_{pk\text{-}pk}$ into 1 MΩ • Frequency: 50 kHz
SMB (plug) to BNC (f) adapter	Fairview Microwave SM3633	Verifications: • Timebase accuracy • DC accuracy Adjustment	• Frequency: DC to 89 MHz • Impedance: 50 Ω
SMA Tee (f-f-f)	Fairview Microwave SM4942	Verifications: • AC amplitude accuracy	Impedance: 50 Ω
Double banana plug to BNC (f)	Pasternack PE9008	Verifications: • AC amplitude accuracy	Impedance: 50 Ω
BNC (m)-to-SMA (m) cable (x2)	Fairview Microwave FMC0208315-36	Verifications: • AC amplitude accuracy	• Length: ≤1 meter • Impedance: 50 Ω

Table 1. PXIe-5172 Test Equipment (Continued)

Equipment	Recommended Model	Where Used	Minimum Requirements
Power sensor	Rohde & Schwarz NRP-Z91	Test system characterization Verifications: • Bandwidth	Power measurement: • Frequency range: 50 kHz to 101 MHz • Power range: -16 dBm to 10 dBm • VSWR: <1.11 • Absolute accuracy – <0.048 dB for 50 kHz to <100 MHz – <0.063 dB for 100.1 MHz • Relative accuracy at -4 dBm: <0.022 dB for 50 kHz to <101 MHz
Signal generator	Rohde & Schwarz SMA100A	Test system characterization Verifications: • Bandwidth	Sine wave generation: • Amplitude: -10 dBm to 16 dBm • Frequency: 50 kHz to 101 MHz • Harmonics: <-30 dBc
Power splitter	Aeroflex/ Weinschel 1593	Test system characterization Verifications: • Bandwidth	• Amplitude: -16 dBm to 16 dBm • Frequency: 50 kHz to 101 MHz • VSWR: <1.09
50 Ω SMA terminator (m)	Fairview Microwave ST1819	Test system characterization	• Amplitude: 10 dBm • Frequency: DC to 101 MHz • VSWR: <1.1
50 Ω SMB terminator (plug)	Fairview Microwave ST04B-P	Verifications: • RMS noise	• Frequency: DC to 200 MHz • VSWR: <1.2
SMA (m)-to-SMA (m) cable	Fairview Microwave FMC0202317-36	Test system characterization Verifications: • Bandwidth	• Frequency: DC to 101 MHz • VSWR: <1.1 • Length: ≤1 meter • Impedance: 50 Ω

Table 1. PXIe-5172 Test Equipment (Continued)

Equipment	Recommended Model	Where Used	Minimum Requirements
SMA (f)-to-N (m) adapter	Fairview Microwave SM4226	Test system characterization Verifications: • Bandwidth	• Frequency range: DC to 101 MHz • VSWR: <1.05 • Impedance: 50 Ω
SMA (m)-to-N (f) adapter	Fairview Microwave SM4268	Test system characterization Verifications: • Bandwidth	• Frequency range: DC to 101 MHz • VSWR: <1.1 • Impedance: 50 Ω
SMA (m)-to-SMB (plug) adapter	Fairview Microwave SM2069	Verifications: • Bandwidth • AC amplitude accuracy	• Frequency range: DC to 101 MHz • VSWR: <1.1 • Impedance: 50 Ω
SMA feed-thru terminator	Pasternack PE6026	Verifications: • Bandwidth	• Amplitude: 10 dBm • Frequency: 50 kHz to 100 MHz • VSWR: – <1.1 at 100 MHz • Impedance: 50 Ω

Test Conditions

The following setup and environmental conditions are required to ensure the PXIe-5172 meets published specifications:

- Allow all test instruments a warm-up time of at least the stated amount of time in their specifications document. The warm-up time ensures that the test instruments are at a stable operating temperature.
- Allow a warm-up time of at least 15 minutes after the chassis is powered on. The warm-up time ensures that the PXIe-5172 is at stable operating temperature.
- Keep cabling as short as possible. Long cables act as antennas, picking up extra noise that can affect measurements.
- Verify that all connections to the PXIe-5172, including front panel connections and screws, are secure.

- Use shielded copper wire for all cable connections to the device. Use twisted-pair wire to eliminate noise and thermal offsets.
- Maintain an ambient temperature of 23 °C ± 3 °C
- Keep relative humidity between 10% and 90%, noncondensing.
- Ensure that the PXI 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 about cooling, refer to the *Maintain Forced-Air Cooling Note to Users* document available at *ni.com/manuals*.
- Plug the chassis and the instrument standard into the same power strip to avoid ground loops.

Password

The default password for password-protected operations is `NI`.

Calibration Interval

Recommended calibration interval	2 years

As-Found and As-Left Limits

The as-found limits are the published specifications for the PXIe-5172. NI uses these limits to determine whether the PXIe-5172 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-5172, 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.

Calibration Overview

Install the device and configure it in NI Measurement & Automation Explorer (MAX) before calibrating.

Calibration includes the following steps:

1. Self-calibration—Adjust the self-calibration constants of the device.
2. Test system characterization—Characterize the amplitude balance of the output ports on your power splitter and amplitude loss through your power splitter.

The results of this step are used as a correction in the following procedures:

- *Verifying 50 Ω Bandwidth*
- *Verifying 1 MΩ Bandwidth*

3. Verification—Verify the existing operation of the device. This step confirms whether the device is operating within the published specification prior to adjustment.
4. Adjustment—Perform an external adjustment of the calibration constants of the device. The adjustment procedure automatically stores the calibration date and temperature in the nonvolatile memory to allow traceability.
5. Re-verification—Repeat the Verification procedure to ensure that the device is operating within the published specifications after adjustment.

Test System Characterization

The following procedures characterize the test equipment used during verification.

Caution 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 the Power Sensor

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

Characterizing Power Splitter Amplitude Balance and Loss

This procedure characterizes the amplitude balance of the two output ports of the power splitter and amplitude loss through the power splitter over a range of frequencies.

The results of the characterization are later used as a correction in the following procedures:

- *Verifying 50 Ω Bandwidth*
- *Verifying 1 MΩ Bandwidth*

Table 2. Power Splitter Characterization

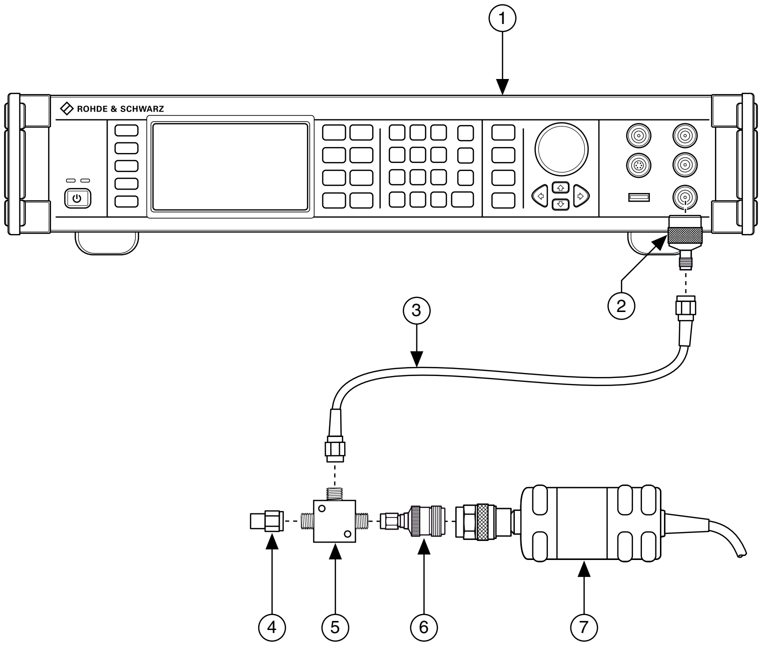
Config	Test Point: Frequency (MHz)
1	0.05
2	98.1
3	99.1
4	100.1

1. Connect the SMA (m)-to-N (f) adapter to the power sensor. Refer to this assembly as the *power sensor*.

2. Zero the power sensor as described in the *Zeroing the Power Sensor* section.
3. Connect the RF OUT connector of the signal generator to the input port of the power splitter using an SMA (f)-to-N (m) adapter and an SMA (m)-to-SMA (m) cable.
4. Select one of the power splitter output ports. Refer to this power splitter output port as *splitter output 1*.
5. Connect the 50 Ω SMA terminator (m) to *splitter output 1*.
6. Refer to the other power splitter output as *splitter output 2*.
7. Connect the power sensor to *splitter output 2*.

   The following figure illustrates the hardware setup.

Figure 1. Connection Diagram for Measuring at Splitter 2



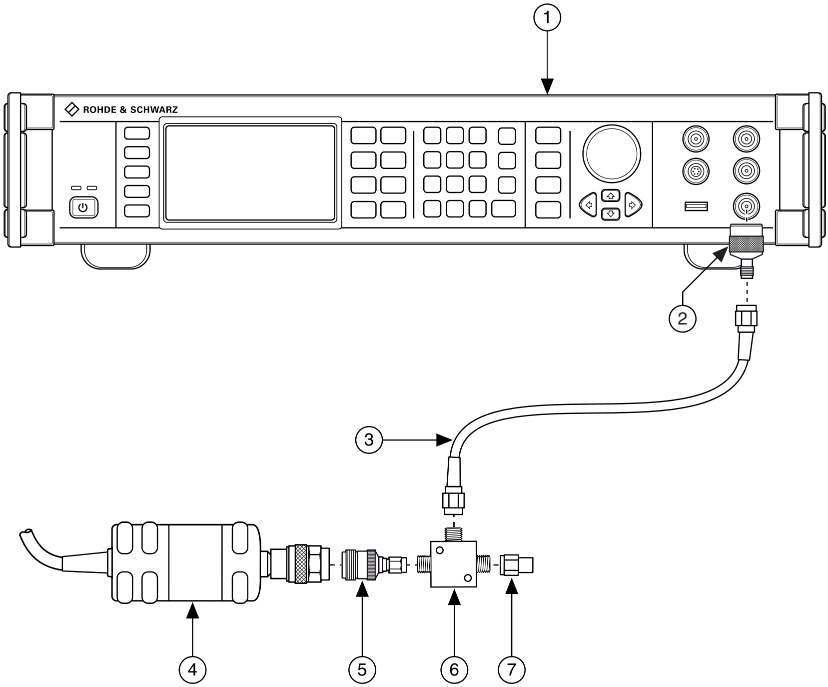
1. Signal generator
2. SMA (f)-to-N (m) adapter
3. SMA (m)-to-SMA (m) cable
4. 50 Ω SMA terminator (m)
5. Power splitter
6. SMA (m)-to-N (f) adapter
7. Power sensor

8. Configure the power sensor with the following settings:
   - Power measurement: continuous average
   - Path selection: automatic
   - Averaging: automatic
   - Averaging resolution: 4 (0.001 dB)
   - Aperture: 20 ms

9. Configure the signal generator to generate a sine waveform with the following characteristics:
   - Frequency: the *Test Point Frequency* value from the *Power Splitter Characterization* table
   - Amplitude level: 2.0 dBm
10. Configure the power sensor to correct for the *Test Point Frequency* value using the power sensor frequency correction function.
11. Wait 0.1 second for settling.
12. Use the power sensor to measure the power in dBm.
13. Repeat steps 9 through 12 for each configuration in the *Power Splitter Characterization* table, recording each result as *splitter output 2 power*, where each configuration has a corresponding value.
14. Disconnect the power sensor and 50 Ω SMA terminator (m) from *splitter output 2* and *splitter output 1*.
15. Connect the power sensor to *splitter output 1*.
16. Connect the 50 Ω SMA terminator (m) to *splitter output 2*.

    The following figure illustrates the hardware setup.

Figure 2. Connection Diagram for Measuring at Splitter 1



1. Signal generator
2. SMA (f)-to-N (m) adapter
3. SMA (m)-to-SMA (m) cable
4. Power sensor
5. SMA (m)-to-N (f) adapter
6. Power splitter
7. 50 Ω SMA terminator (m)

17. Configure the signal generator to generate a sine waveform with the following characteristics:
    - Frequency: the *Test Point Frequency* value from the Power Splitter Characterization table
    - Amplitude level: 2.0 dBm
18. Configure the power sensor to correct for the *Test Point Frequency* value using the power sensor frequency correction function.
19. Wait 0.1 second for settling.
20. Use the power sensor to measure the power in dBm.
21. Repeat steps 17 through 20 for each configuration in the Power Splitter Characterization table, recording each result as *splitter output 1 power*, where each configuration has a corresponding value.
22. Calculate the splitter balance for each frequency point using the following equation:

    splitter balance = splitter output 2 power - splitter output 1 power
23. Calculate the splitter loss for each frequency point using the following equation:

splitter loss = amplitude level - splitter output 2 power

24. Disconnect the 50 Ω SMA terminator (m) from *splitter output 2*. Refer to the remaining assembly as the *power sensor assembly*.

    The *power sensor assembly* is used in the following procedures:
    - *Verifying 50 Ω Bandwidth*
    - *Verifying 1 MΩ Bandwidth*

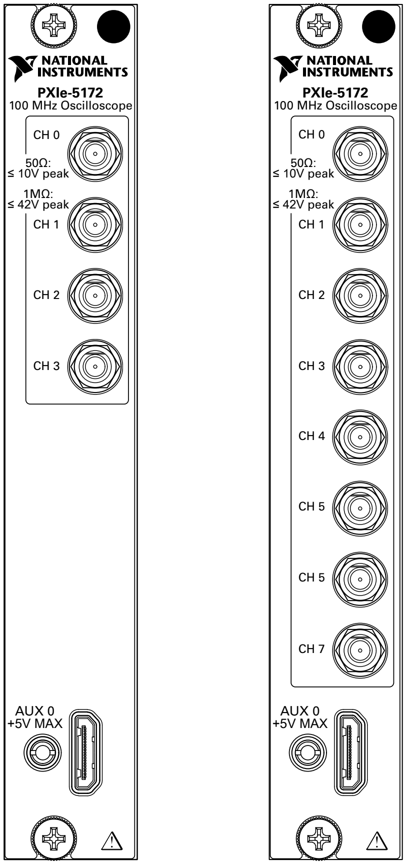
Verification

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

Verification of the PXIe-5172 is complete only after you have successfully completed all tests in this section using the *As-Found Limits*.

Refer to the following figure for the names and locations of the PXIe-5172 front panel connectors. You can find information about the functions of these connectors in the device getting started guide.

Figure 3. PXIe-5172 (4CH and 8CH) Front Panel



Verifying DC Accuracy

This procedure verifies the DC accuracy of the PXIe-5172 by comparing the voltage measured by the device to the value sourced by the voltage standard.

Caution Avoid touching the connections when generating a high voltage from the calibrator.

Refer to the following table as you complete the following steps.

Table 3. DC Accuracy Verification

Config	Input Impedance (Ω)	Vertical Range (V_{pk-pk})	Vertical Offset (V)	Test Points (V)	As-Found Limits (mV)	As-Left Limits (mV)	Measurement Uncertainty (mV)[1]
1	50	0.2	0	0.090	±0.91	±0.51	±0.049
2	50	0.2	0	-0.090	±0.91	±0.51	±0.049
3	50	0.2	0.5	0.590	±2.91	±1.56	±0.15
4	50	0.2	-0.5	-0.590	±2.91	±1.56	±0.15
5	50	0.7	0	0.315	±2.17	±1.15	±0.12
6	50	0.7	0	-0.315	±2.17	±1.15	±0.12
7	50	0.7	0.5	0.815	±4.17	±2.20	±0.22
8	50	0.7	-0.5	-0.815	±4.17	±2.20	±0.22
9	50	1.4	0	0.630	±3.94	±2.06	±0.21
10	50	1.4	0	-0.630	±3.94	±2.06	±0.21
11	50	1.4	0.5	1.130	±5.94	±3.11	±0.39
12	50	1.4	-0.5	-1.130	±5.94	±3.11	±0.39
13	50	5	0	2.250	±13.0	±6.33	±0.74
14	50	5	0	-2.250	±13.0	±6.33	±0.74
15	50	5	2.5	4.750	±23.0	±11.6	±1.55
16	50	5	-2.5	-4.750	±23.0	±11.6	±1.55
17	50	10	0	4.500	±25.7	±12.6	±1.62
18	50	10	0	-4.500	±25.7	±12.6	±1.62
19	1 M	0.2	0	0.090	±0.91	±0.49	±0.049
20	1 M	0.2	0	-0.090	±0.91	±0.49	±0.049
21	1 M	0.2	0.5	0.590	±2.91	±1.54	±0.15

[1] Measurement uncertainty based on Fluke 9500B with Fluke 9530 test head specifications that apply at T_{cal} ± 5 °C, where Factory T_{cal} = 23 °C. Uncertainty of the 9500B includes long-term stability of 1 year, temperature coefficient, linearity, load, and line regulation and traceability of factory and National Calibration Standard.

Table 3. DC Accuracy Verification (Continued)

Config	Input Impedance (Ω)	Vertical Range (V_{pk-pk})	Vertical Offset (V)	Test Points (V)	As-Found Limits (mV)	As-Left Limits (mV)	Measurement Uncertainty (mV)[1]
22	1 M	0.2	-0.5	-0.590	±2.91	±1.54	±0.15
23	1 M	0.7	0	0.315	±2.17	±1.14	±0.12
24	1 M	0.7	0	-0.315	±2.17	±1.14	±0.12
25	1 M	0.7	0.5	0.815	±4.17	±2.19	±0.22
26	1 M	0.7	-0.5	-0.815	±4.17	±2.19	±0.22
27	1 M	1.4	0	0.630	±3.94	±2.04	±0.21
28	1 M	1.4	0	-0.630	±3.94	±2.04	±0.21
29	1 M	1.4	0.5	1.130	±5.94	±3.09	±0.39
30	1 M	1.4	-0.5	-1.130	±5.94	±3.09	±0.39
31	1 M	5	0	2.250	±13.0	±6.50	±0.74
32	1 M	5	0	-2.250	±13.0	±6.50	±0.74
33	1 M	5	4.5	6.750	±31.0	±16.0	±1.64
34	1 M	5	-4.5	-6.750	±31.0	±16.0	±1.64
35	1 M	10	0	4.500	±25.7	±13.0	±1.62
36	1 M	10	0	-4.500	±25.7	±13.0	±1.62
37	1 M	10	4.5	9.000	±43.7	±22.5	±2.85
38	1 M	10	-4.5	-9.000	±43.7	±22.5	±2.85
39	1 M	40	0	18.00	±101.4	±42.8	±6.48
40	1 M	40	0	-18.00	±101.4	±42.8	±6.48
41	1 M	40	20	38.00	±201.4	±91.8	±14.8
42	1 M	40	-20	-38.00	±201.4	±91.8	±14.8

[1] Measurement uncertainty based on Fluke 9500B with Fluke 9530 test head specifications that apply at T_{cal} ± 5 °C, where Factory T_{cal} = 23 °C. Uncertainty of the 9500B includes long-term stability of 1 year, temperature coefficient, linearity, load, and line regulation and traceability of factory and National Calibration Standard.

Table 3. DC Accuracy Verification (Continued)

Config	Input Impedance (Ω)	Vertical Range ($V_{pk\text{-}pk}$)	Vertical Offset (V)	Test Points (V)	As-Found Limits (mV)	As-Left Limits (mV)	Measurement Uncertainty (mV)[1]
43	1 M	80	0	36.00	±202.4	±86.4	±15.1
44	1 M	80	0	-36.00	±202.4	±86.4	±15.1

1. Connect the calibrator test head via DC coupling to channel 0 of the PXIe-5172 using an SMB (plug) to BNC (f) adapter.
2. Configure the PXIe-5172 with the following settings:
   - Input impedance: the Input Impedance value from the *DC Accuracy Verification* table
   - Maximum input frequency: 100 MHz
   - Vertical offset: the Vertical Offset value from the *DC Accuracy Verification* table
   - Vertical range: the Vertical Range value from the *DC Accuracy Verification* table
   - Sample rate: 250 MS/s
   - Minimum number of points: 2,500,000 samples
   - NI-SCOPE scalar measurement: Voltage Average
3. Configure the calibrator output impedance to match the impedance of the PXIe-5172.
4. Configure the calibrator to output the Test Point value from the *DC Accuracy Verification* table.
5. Enable the calibrator output.
6. Wait one second for settling, then record the measured voltage.
7. Use the following formula to calculate the voltage error:

   $DC\ voltage\ error = V_{\mathrm{measured}} - Test\ Point$
8. Compare the voltage error to the appropriate limit from the *DC Accuracy Verification* table.
9. Repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
10. Disable the calibrator output.
11. Connect the calibrator test head to channel 1 of the PXIe-5172 using an SMB (plug) to BNC (f) adapter and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
12. Disable the calibrator output.

[1] Measurement uncertainty based on Fluke 9500B with Fluke 9530 test head specifications that apply at T_{cal} ± 5 °C, where Factory T_{cal} = 23 °C. Uncertainty of the 9500B includes long-term stability of 1 year, temperature coefficient, linearity, load, and line regulation and traceability of factory and National Calibration Standard.

13. Connect the calibrator test head to channel 2 of the PXIe-5172 using an SMB (plug) to BNC (f) and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
14. Disable the calibrator output.
15. Connect the calibrator test head to channel 3 of the PXIe-5172 using an SMB (plug) to BNC (f) and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
16. Disable the calibrator output.

    Note If you are verifying the PXIe-5172 (8CH), proceed to the next step. If you are verifying the PXIe-5172 (4CH), DC Accuracy Verification is complete.

17. Connect the calibrator test head to channel 4 of the PXIe-5172 using an SMB (plug) to BNC (f) and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
18. Disable the calibrator output.
19. Connect the calibrator test head to channel 5 of the PXIe-5172 using an SMB (plug) to BNC (f) and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
20. Disable the calibrator output.
21. Connect the calibrator test head to channel 6 of the PXIe-5172 using an SMB (plug) to BNC (f) and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
22. Disable the calibrator output.
23. Connect the calibrator test head to channel 7 of the PXIe-5172 using an SMB (plug) to BNC (f) and repeat steps 2 through 8 for each configuration listed in the *DC Accuracy Verification* table.
24. Disable the calibrator output.

Verifying AC Amplitude Accuracy

Follow this procedure to verify the AC amplitude accuracy of the PXIe-5172 by comparing the voltage measured by the PXIe-5172 to the voltage measured by the DMM.

Refer to the following table as you complete the following steps:

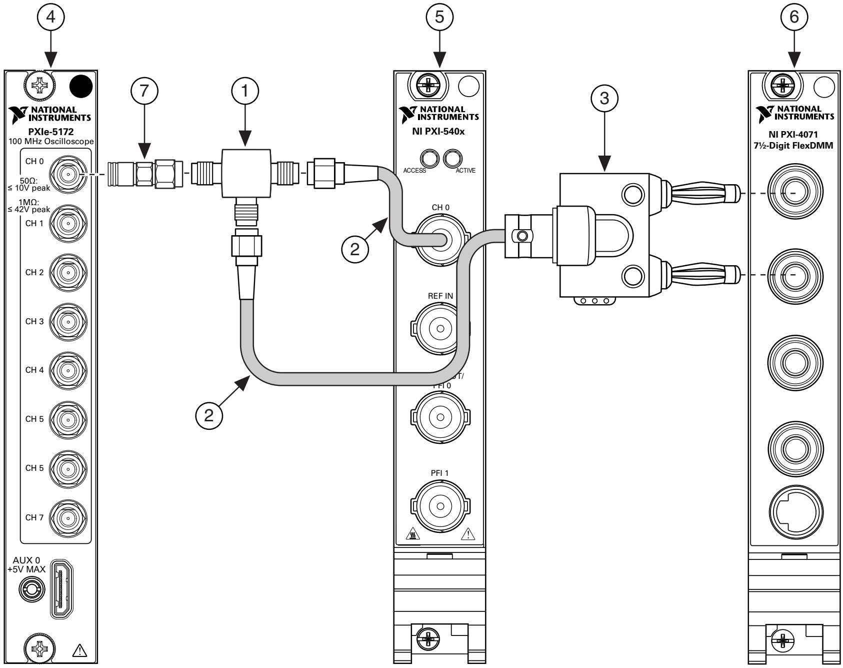
Table 4. AC Amplitude Accuracy Verification

Config	Input Impedance (Ω)	Vertical Range (V_{pk-pk})	Test Point (V_{pk-pk})	DMM Range (Vrms)	As-Found Limits (dB)	As-Left Limits (dB)	Measurement Uncertainty (dB)[2]
1	50	0.2	0.1	0.05	±0.15	±0.10	±0.018
2	50	0.7	0.35	0.50	±0.15	±0.10	±0.012
3	50	1.4	0.7	0.50	±0.15	±0.10	±0.014
4	50	5	2.5	5.00	±0.15	±0.10	±0.013
5	50	10	5	5.00	±0.15	±0.10	±0.017
6	1 M	0.2	0.1	0.05	±0.15	±0.10	±0.018
7	1 M	0.7	0.35	0.50	±0.15	±0.10	±0.011
8	1 M	1.4	0.7	0.50	±0.15	±0.10	±0.014
9	1 M	5	2.5	5.0	±0.15	±0.10	±0.013
10	1 M	10	5	5.0	±0.15	±0.10	±0.017
11	1 M	40	20	50.0	±0.25	±0.18	±0.048
12	1 M	80	20	50.0	±0.25	±0.18	±0.048

[2] *Measurement Uncertainty* is based on the following equipment and conditions:

- NI PXI-4071 specifications apply after self-calibration is performed and in an ambient temperature of 23 °C ± 5 °C.

Figure 4. AC Verification Test Connections



1. SMA tee (f-f-f)
2. BNC (m)-to-SMA (m) cable
3. BNC (f) to Double Banana Plug
4. PXIe-5172
5. Function Generator
6. DMM
7. SMA (m)-to-SMB (plug) adapter

1. Connect the DMM and function generator to channel 0 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure.
2. Configure the DMM with the following settings:
   - Function: AC voltage
   - Resolution: 6.5 digits
   - Min frequency: 49 kHz
   - Auto Zero: Enabled
   - Range: the DMM Range value from the *AC Amplitude Accuracy Verification* table
3. Configure the PXIe-5172 with the following settings:
   - Input impedance: the Input Impedance value from the *AC Amplitude Accuracy Verification* table
   - Maximum input frequency: 100 MHz
   - Vertical offset: 0 V
   - Vertical range: the Vertical Range value from the *AC Amplitude Accuracy Verification* table

- Sample rate: 125 MS/s
- Minimum number of points: 1,048,576 samples

4. Configure the function generator and generate a waveform with the following characteristics:
   - Waveform: Sine wave
   - Amplitude: the Test Point value from the *AC Amplitude Accuracy Verification* table
   - Frequency: 50 kHz
   - Load impedance: the Input Impedance value from the *AC Amplitude Accuracy Verification* table

   Note These values assume you are using a NI 5402/5406 function generator. For other function generators, the output voltage varies with load output impedance, up to doubling the voltage for a high impedance load.
5. Wait 0.1 second for the output of the function generator to settle.
6. Acquire and measure the amplitude of the sine wave using the PXIe-5172 and the Extract Single Tone Information VI. Convert the result from V_{pk} to V_{rms}. Record the result as $V_{\text{PXIe-5172 Measured}}$.
7. Measure the amplitude of the sine wave in V_{rms} using the DMM. Record the result as $V_{\text{DMM Measured}}$.
8. Calculate the amplitude error using the following formula:

   $$\mathit{AC\ Voltage\ Error} = 20 \times \log_{10}(V_{\text{PXIe-5172 Measured}}/V_{\text{DMM Measured}})$$
9. Compare the amplitude error to the appropriate Limit from the *AC Amplitude Accuracy Verification* table.
10. Repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
11. Disable the function generator output.
12. Connect the DMM and function generator to channel 1 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
13. Disable the function generator output.
14. Connect the DMM and function generator to channel 2 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
15. Disable the function generator output.
16. Connect the DMM and function generator to channel 3 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
17. Disable the function generator output.

    Note If you are verifying the PXIe-5172 (8CH), proceed to the next step. If you are verifying the PXIe-5172 (4CH), AC Amplitude Verification is complete.

18. Connect the DMM and function generator to channel 4 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
19. Disable the function generator output.
20. Connect the DMM and function generator to channel 5 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
21. Disable the function generator output.
22. Connect the DMM and function generator to channel 6 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
23. Disable the function generator output.
24. Connect the DMM and function generator to channel 7 of the PXIe-5172 as shown in the *AC Verification Test Connections* figure and repeat steps 2 through 9 for each configuration listed in the *AC Amplitude Accuracy Verification* table.
25. Disable the function generator output.

Verifying 50 Ω Bandwidth

Follow this procedure to verify the 50 Ω analog bandwidth of the PXIe-5172 by generating a sine wave and comparing the amplitude measured by the PXIe-5172 to the amplitude measured by the power sensor.

Before performing this procedure, complete the *Test System Characterization* procedures and calculate the *splitter balance* and *splitter loss* of your power splitter.

Table 5. 50 Ω Bandwidth Verification

Config	Sample Rate (S/s)	Vertical Range (V_{pk-pk})	Test Point		As-Found Limits (dB)	As-Left Limits (dB)	Measurement Uncertainty (dB)[3]
			Frequency (MHz)	Amplitude (dBm)			
1	125 M	0.2	0.05	-13	—	—	—
2	250 M	0.2	99.1	-13	-3.0 to 1.0	-2.5 to 0.9	±0.107
3	125 M	0.7	0.05	-2.1	—	—	—
4	250 M	0.7	100.1	-2.1	-3.0 to 1.0	-2.5 to 0.9	±0.113

[3] Measurement uncertainty is based on the following equipment and conditions:
- Rohde & Schwarz NRP-Z91 at 20 °C to 25 °C.
- Harmonics from the signal generator are less than -30 dBc.

Table 5. 50 Ω Bandwidth Verification (Continued)

Config	Sample Rate (S/s)	Vertical Range ($V_{pk\text{-}pk}$)	Test Point		As-Found Limits (dB)	As-Left Limits (dB)	Measurement Uncertainty (dB)[3]
			Frequency (MHz)	Amplitude (dBm)			
5	125 M	1.4	0.05	3.9	—	—	—
6	250 M	1.4	100.1	3.9	-3.0 to 1.0	-2.5 to 0.9	±0.113
7	125 M	5	0.05	9.0	—	—	—
8	250 M	5	100.1	9.0	-3.0 to 1.0	-2.5 to 0.9	±0.113
9	125 M	10	0.05	9.0	—	—	—
10	250 M	10	100.1	9.0	-3.0 to 1.0	-2.5 to 0.9	±0.113

1. Connect *splitter output 2* of the power sensor assembly from the *Test System Characterization* section to channel 0 of the PXIe-5172 using an SMB (plug) to SMB (m) adapter.

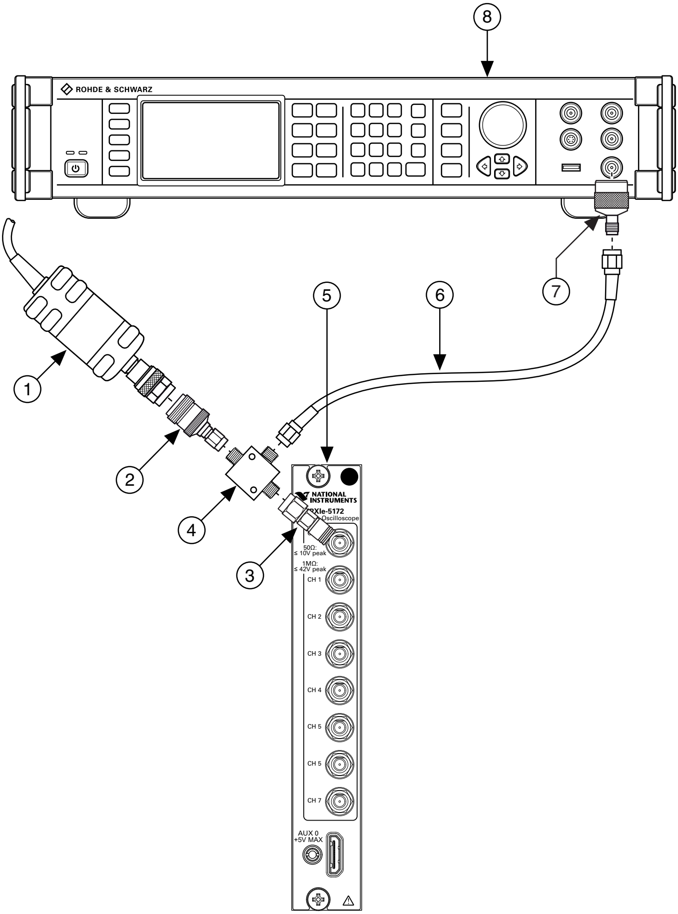
Note The *power sensor assembly* must match the configuration used in the *Test System Characterization* section, in which the power sensor is connected to *splitter output 1* and the signal generator is connected to the input port of the power splitter.

The following figure illustrates the hardware setup.

[3] Measurement uncertainty is based on the following equipment and conditions:

- Rohde & Schwarz NRP-Z91 at 20 °C to 25 °C.
- Harmonics from the signal generator are less than -30 dBc.

Figure 5. 50 Ω Bandwidth Verification Cabling Diagram



1. Power sensor
2. SMA (m)-to-N (f) adapter
3. SMA (m)-to-SMB (plug) adapter
4. Power splitter
5. PXIe-5172
6. SMA (m)-to-SMA (m) cable
7. SMA (f)-to-N (m) adapter
8. Signal generator

2. Configure the power sensor with the following settings:
   - Power measurement: continuous average
   - Path selection: automatic
   - Averaging: automatic
   - Averaging resolution: 4 (0.001 dB)
   - Aperture: 20 ms

3. Configure the PXIe-5172 with the following settings:
   - Input impedance: 50 Ω
   - Maximum input frequency: 100 MHz
   - Vertical offset: 0 V
   - Vertical range: the Vertical Range value from the *50 Ω Bandwidth Verification* table
   - Sample rate: the Sample Rate value from the *50 Ω Bandwidth Verification* table
   - Minimum number of points: 1,048,576 samples
4. Configure the signal generator to generate a sine waveform with the following characteristics into a 50 Ω load:
   - Frequency: the Test Point Frequency value from the *50 Ω Bandwidth Verification* table
   - Amplitude: the Test Point Amplitude value from the *50 Ω Bandwidth Verification* table plus *splitter loss*

   Note Select the *splitter loss* value from the list of test points from the *Test System Characterization* section for the current Test Point Frequency.
5. Configure the power sensor to correct for the Test Point Frequency using the power sensor frequency correction function.
6. Wait 0.1 seconds for settling.
7. Use the power sensor to measure the power in dBm. Record the result as *measured input power*.
8. Calculate the corrected input power using the following equation:

   corrected input power = *measured input power* + *splitter balance*

   Note Select the *splitter balance* value from the list of test points from the *Test System Characterization* section for the current Test Point Frequency.
9. Use the PXIe-5172 to acquire and measure the power using the Extract Single Tone Information VI, converting the result from Vpk to dBm. Record the result as *device input power*.
10. If the Test Point Frequency value from the *50 Ω Bandwidth Verification* table is 50 kHz, proceed to the following step. Otherwise, go to step 13.
11. Calculate the *power reference* using the following equation:

    power reference = *device input power* - *corrected input power*
12. Go to step 15. The power error is not calculated for this configuration.
13. Calculate the *power error* using the following equation:

    power error = *device input power* - *corrected input power* - *power reference*
14. Compare the power error to the appropriate Limit from the *50 Ω Bandwidth Verification* table.
15. Repeat steps 3 through 14 for each configuration in the *50 Ω Bandwidth Verification* table.
16. Disable the signal generator output.

17. Connect splitter output 2 of the power sensor assembly to channel 1 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
18. Disable the signal generator output.
19. Connect splitter output 2 of the power sensor assembly to channel 2 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
20. Disable the signal generator output.
21. Connect splitter output 2 of the power sensor assembly to channel 3 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
22. Disable the signal generator output.

    Note If you are verifying the PXIe-5172 (8CH), proceed to the next step. If you are verifying the PXIe-5172 (4CH), 50 Ω Bandwidth Verification is complete.

23. Connect splitter output 2 of the power sensor assembly to channel 4 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
24. Disable the signal generator output.
25. Connect splitter output 2 of the power sensor assembly to channel 5 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
26. Disable the signal generator output.
27. Connect splitter output 2 of the power sensor assembly to channel 6 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
28. Disable the signal generator output.
29. Connect splitter output 2 of the power sensor assembly to channel 7 of the PXIe-5172 and repeat steps 3 through 14 for each configuration listed in the *50 Ω Bandwidth Verification* table.
30. Disable the signal generator output.

Verifying 1 MΩ Bandwidth

Follow this procedure to verify the 1 MΩ analog bandwidth accuracy of the PXIe-5172 by generating a sine wave and comparing the amplitude measured by the PXIe-5172 to the amplitude measured by the power sensor.

Before performing this procedure, complete the *Test System Characterization* procedures and calculate the *splitter balance* and *splitter loss* of your power splitter.

Table 6. 1 MΩ Bandwidth Verification

Config	Sample Rate (S/s)	Vertical Range (V_{pk-pk})	Test Point		As-Found Limits (dB)	As-Left Limits (dB)	Measurement Uncertainty (dB)[4]
			Frequency (MHz)	Amplitude (dBm)			
1	125 M	0.2	0.05	-13	—	—	—
2	250 M	0.2	98.1	-13	-3.0 to 1.0	-2.5 to 0.9	±0.134
3	125 M	0.7	0.05	-2.1	—	—	—
4	250 M	0.7	98.1	-2.1	-3.0 to 1.0	-2.5 to 0.9	±0.133
5	125 M	1.4	0.05	3.9	—	—	—
6	250 M	1.4	98.1	3.9	-3.0 to 1.0	-2.5 to 0.9	±0.134
7	125 M	5	0.05	9	—	—	—
8	250 M	5	98.1	9	-3.0 to 1.0	-2.5 to 0.9	±0.133
9	125 M	10	0.05	9	—	—	—
10	250 M	10	98.1	9	-3.0 to 1.0	-2.5 to 0.9	±0.134
11	125 M	40	0.05	9	—	—	—
12	250 M	40	98.1	9	-3.0 to 1.0	-2.5 to 0.9	±0.134
13	125 M	80	0.05	9	—	—	—
14	250 M	80	98.1	9	-3.0 to 1.0	-2.5 to 0.9	±0.134

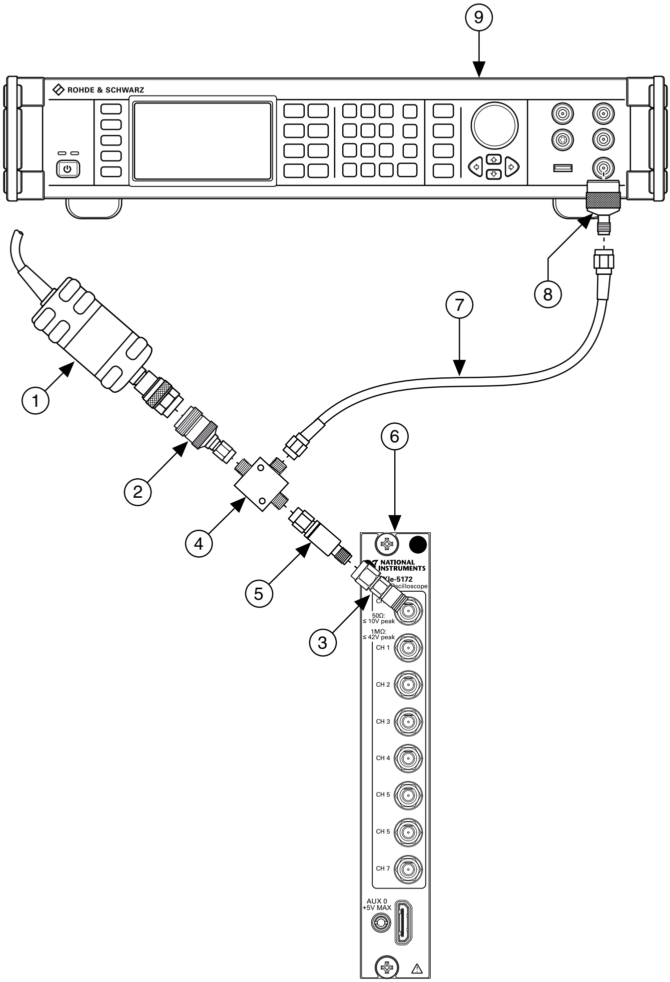
[4] Measurement uncertainty is based on the following equipment and conditions:
- Rohde & Schwarz NRP-Z91 at 20 °C to 25 °C.
- Harmonics from the signal generator are less than -30 dBc.

1. Place the 50 Ω SMA feed-thru terminator between the splitter output and the SMA (m)-to-SMB (plug) adapter of *splitter output 2*. Connect *splitter output 2* of the power sensor assembly from the *Test System Characterization* section to channel 0 of the PXIe-5172.

   Note The *power sensor assembly* must match the configuration used in the *Test System Characterization* section, in which the power sensor is connected to *splitter output 1* and the signal generator is connected to the input port of the power splitter.

   The following figure illustrates the hardware setup.

Figure 6. 1 MΩ Bandwidth Verification Cabling Diagram



1. Power sensor
2. SMA (m)-to-N (f) adapter
3. SMA (m)-to-SMB (plug) adapter
4. Power splitter
5. 50 Ω SMA feed-thru terminator
6. PXIe-5172
7. SMA (m)-to-SMA (m) cable
8. SMA (f)-to-N (m) adapter
9. Signal generator

2. Configure the power sensor with the following settings:
   - Power measurement: Continuous average
   - Path selection: automatic
   - Averaging: automatic

- Averaging resolution: 4 (0.001 dB)
- Aperture: 20 ms

3. Configure the PXIe-5172 with the following settings:
   - Input impedance: 1 MΩ
   - Maximum input frequency: 100 MHz
   - Vertical offset: 0 V
   - Vertical range: the Vertical Range value from the *1 MΩ Bandwidth Verification* table
   - Minimum number of points: 1,048,576 samples
4. Configure the signal generator to generate a sine waveform with the following characteristics into a 50 Ω load:
   - Frequency: the Test Point Frequency value from the *1 MΩ Bandwidth Verification* table
   - Amplitude: the Test Point Amplitude value from the *1 MΩ Bandwidth Verification* table plus *splitter loss*

   Note Select the splitter loss value from the list of test points from the *Test System Characterization* section for the current Test Point Frequency.
5. Configure the power sensor to correct for the Test Point Frequency using the power sensor frequency correction function.
6. Wait 0.1 second for settling.
7. Use the power sensor to measure the power in dBm. Record the result as *measured input power*.
8. Calculate the corrected input power using the following equation:

   corrected input power = *measured input power* + *splitter balance*

   Note Select the *splitter balance* value from the list of test points from the *Test System Characterization* section for the current Test Point Frequency.
9. Use the PXIe-5172 to acquire and measure the power using the Extract Single Tone Information VI, converting the result from Vpk to dBm. Record the result as *device input power*.
10. If the Test Point Frequency value from the *1 MΩ Bandwidth Verification* table is 50 kHz, proceed to the following step. Otherwise, go to step 13.
11. Calculate the *power reference* using the following equation:

    power reference = *device input power* - *corrected input power*
12. Go to step 15. The power error is not calculated for this configuration.
13. Calculate the *power error* using the following equation:

    power error = *device input power* - *corrected input power* - *power reference*
14. Compare the power error to the appropriate Limit from the *1 MΩ Bandwidth Verification* table.
15. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification* table.
16. Disable the signal generator output.

17. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 1 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
18. Disable the signal generator output.
19. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 2 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
20. Disable the signal generator output.
21. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 3 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
22. Disable the signal generator output.

    Note If you are verifying the PXIe-5172 (8CH), proceed to the next step. If you are verifying the PXIe-5172 (4CH), 1 MΩ Bandwidth Verification is complete.

23. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 4 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
24. Disable the signal generator output.
25. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 5 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
26. Disable the signal generator output.
27. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 6 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
28. Disable the signal generator output.
29. Connect splitter output 2 of the power sensor assembly from the *Test System Characterization* section to channel 7 of the PXIe-5172. Repeat steps 3 through 14 for each configuration in the *1 MΩ Bandwidth Verification Table*.
30. Disable the signal generator output.

Verifying Timebase Accuracy

Follow this procedure to verify the frequency accuracy of the PXIe-5172 onboard timebase using an oscilloscope calibrator.

Table 7. Timebase Accuracy Verification

As-Found Limits	As-Left Limits	Measurement Uncertainty[5]
±25.0 PPM (±2,225 Hz)	±10.0 PPM (±890 Hz)	±0.6 PPM (±54 Hz)

[5] Measurement uncertainty based on Fluke 9500B with Fluke 9530 test head specifications that apply at T_{cal} ±5 °C, where Factory T_{cal} = 23 °C. Uncertainty of the 9500B includes long-term

1. Connect the calibrator test head to channel 0 of the PXIe-5172 using an SMB (plug) to BNC (f) adapter.
2. Configure the PXIe-5172 with the following settings:
   - Input impedance: 50 Ω
   - Maximum input frequency: 100 MHz
   - Vertical range: 1.4 V_{pk-pk}
   - Sample rate: 250 MS/s
   - Minimum number of points: 1,048,576 samples
3. Configure the calibrator and generate a waveform with the following characteristics:
   - Waveform: Sine wave
   - Amplitude 1.25 V_{pk-pk}
   - Frequency: 89 MHz
   - Load impedance: 50 Ω
4. Enable the calibrator output.
5. Wait 1 second for settling, then measure and record the peak frequency using the Extract Single Tone Information VI.
6. Calculate the timebase error using the following formula:

   $Timebase\ error = (F_{measured} - (89 \times 10^6))/89$
7. Compare the timebase error to the appropriate limit from the *Timebase Accuracy Verification* table.

   Note Timebase verification is only required on one channel.
8. Disable the calibrator output.

Verifying RMS Noise

Follow this procedure to verify the RMS noise of the PXIe-5172 using a 50 Ω terminator.

Table 8. RMS Noise Verification

Config	Input Impedance (Ω)	Vertical Range (V_{pk-pk})	Max Input Frequency (MHz)	Test Limit (% of FS)	Measurement Uncertainty (% of FS)
1	50	0.2	100	0.045	±1.13E-3
2	50	0.7	100	0.018	±387E-6
3	50	1.4	100	0.018	±256E-6
4	50	5	100	0.018	±185E-6

stability of 1 year (5 years for frequency), temperature coefficient, linearity, load, and line regulation and traceability of factory and National Calibration Standard.

Table 8. RMS Noise Verification (Continued)

Config	Input Impedance (Ω)	Vertical Range ($V_{pk\text{-}pk}$)	Max Input Frequency (MHz)	Test Limit (% of FS)	Measurement Uncertainty (% of FS)
5	50	10	100	0.018	±238E-6
6	1 M	0.2	100	0.045	±1.15E-3
7	1 M	0.7	100	0.018	±406E-6
8	1 M	1.4	100	0.018	±339E-6
9	1 M	5	100	0.018	±357E-6
10	1 M	10	100	0.018	±276E-6
11	1 M	40	100	0.018	±460E-6
12	1 M	80	100	0.018	±356E-6

1. Connect the 50 Ω SMB terminator (plug) to channel 0 of the PXIe-5172.
2. Configure the PXIe-5172 with the following settings:
   - Input impedance: the Input Impedance value from the *RMS Noise Verification* table
   - Maximum input frequency: 100 MHz
   - Vertical offset: 0 V
   - Vertical range: the Vertical Range value from the *RMS Noise Verification* table
   - Sample rate: 250 MS/s
   - Minimum number of points: 1,048,576 samples
3. Use the PXIe-5172 to acquire a waveform, then calculate the standard deviation of the acquired waveform. Use the standard deviation to compute the RMS noise using the following formula:

   $\textit{RMS noise (\% of FS)} = (100 \times \sigma)/\textit{Vertical range}$
   where σ is the standard deviation of the acquired waveform.
4. Compare the RMS noise to the appropriate Limit from the *RMS Noise Verification* table.
5. Repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.
6. Connect the 50 Ω SMB terminator (plug) to channel 1 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.
7. Connect the 50 Ω SMB terminator (plug) to channel 2 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.
8. Connect the 50 Ω SMB terminator (plug) to channel 3 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.

Note If you are verifying the PXIe-5172 (8CH), proceed to the next step. If you are verifying the PXIe-5172 (4CH), RMS Noise Verification is complete.

9. Connect the 50 Ω SMB terminator (plug) to channel 4 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.
10. Connect the 50 Ω SMB terminator (plug) to channel 5 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.
11. Connect the 50 Ω SMB terminator (plug) to channel 6 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.
12. Connect the 50 Ω SMB terminator (plug) to channel 7 of the PXIe-5172 and repeat steps 2 through 4 for each configuration listed in the *RMS Noise Verification* table.

Adjustment

This section describes the steps needed to adjust the PXIe-5172 to meet published specifications.

Adjusting the PXIe-5172

1. Call the niHsai Group A External Cal API v1 Host.lvclass:Open Ext Cal Session VI to obtain an external calibration session. To perform an adjustment, you must specify the calibration password. By default, the calibration password is `NI`.
2. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 0.
3. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 0.
4. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 0.
5. Complete the *Adjusting Timebase* procedure on channel 0. This procedure only needs to run on one channel.
6. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 1.
7. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 1.
8. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 1.
9. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 2.
10. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 2.
11. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 2.
12. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 3.
13. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 3.
14. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 3.

Note If you are adjusting the PXIe-5172 (8CH), proceed to the next step. If you are adjusting the PXIe-5172 (4CH), proceed to step 27.

15. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 4.
16. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 4.
17. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 4.
18. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 5.
19. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 5.
20. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 5.

21. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 6.
22. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 6.
23. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 6.
24. Complete the *Adjusting the 1 MΩ Compensation Attenuator* procedure on channel 7.
25. Complete the *Adjusting the 1 MΩ DC Reference* procedure on channel 7.
26. Complete the *Adjusting 50 Ω DC Reference* procedure on channel 7.
27. Call the niHsai Group A External Cal API v1 Host.lvclass:Close Ext Cal Session VI with the following settings to close the external calibration session:

    action: Set this control to Commit to store the new calibration constants, adjustment time, adjustment date, and adjustment temperature to nonvolatile memory of the oscilloscope. If any errors occurred that were not corrected during any of the external adjustment steps, or if you want to abort the operation, set this control to Cancel to discard the new calibration constants without changing any of the calibration data stored in the nonvolatile memory of the oscilloscope.
28. Call the niScope Initialize VI to obtain an NI-SCOPE session.
29. Self-calibrate the PXIe-5172 using the niScope Cal Self Calibrate VI.
30. Call the niScope Close VI to close the NI-SCOPE session.

Adjusting 1 MΩ Compensation Attenuator

Follow this procedure to adjust the 1 MΩ compensation attenuator of the PXIe-5172.

1. Connect the calibrator test head to the specified channel of the PXIe-5172 using an SMB (plug) to BNC (f) adapter.
2. Call the niHsai Group A External Cal API v1 Host.lvclass:Compensated Attenuator Cal Initialize VI with the following settings:
    - **channel**: The specified channel
    - **input impedance**: 1 MΩ
3. Call the niHsai Group A External Cal API v1 Host.lvclass:Compensated Attenuator Cal Configure VI to obtain the amplitude and frequency of the square waveform to generate. Configure the calibrator to output a symmetrical-polarity square waveform with the specified amplitude and frequency into 1 MΩ.
4. Enable the calibrator output if not already enabled.
5. Wait 1 second for settling.
6. Call the niHsai Group A External Cal API v1 Host.lvclass:Compensated Attenuator Cal Adjust VI with the following settings:
    - **frequency generated (Hz)**: The frequency of the square waveform present on the specified channel of the PXIe-5172
    - **amplitude generated (Vpk-pk)**: The amplitude of the square waveform present on the specified channel of the PXIe-5172
7. Repeat steps 3 through 6 until the **compensated attenuator cal complete** indicator from the niHsai Group A External Cal API v1 Host.lvclass:Compensated Attenuator Cal Adjust VI returns TRUE.
8. Disable the calibrator output.

Return to the main *Adjusting the PXIe-5172* task.

Adjusting 1 MΩ DC Reference

Follow this procedure to adjust the DC gain and offset of the 1 MΩ DC reference of the PXIe-5172.

Caution Avoid touching the connections when generating a high voltage from the calibrator.

1. Connect the calibrator test head to the specified channel of the PXIe-5172 using an SMB (plug) to BNC (f) adapter.
2. Call the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Initialize VI with the following settings:
   - **channel**: The specified channel
   - **input impedance**: 1 MΩ
3. Call the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Configure VI to obtain the DC voltage to generate and configure the calibrator to output the specified DC voltage into 1 MΩ.
4. Enable the calibrator output if not already enabled.

   Note To configure the calibrator to output 0V, enable ground selection. Otherwise, disable ground selection to generate a nonzero voltage.
5. Wait 1 second for settling.
6. Call the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Adjust VI with the following settings:
   - **actual voltage generated (V)**: The DC voltage present on the specified channel of the PXIe-5172
7. Repeat steps 3 through 6 until the **DC cal complete** indicator from the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Adjust VI returns TRUE.
8. Disable the calibrator output.

Return to the main *Adjusting the PXIe-5172* task.

Adjusting 50 Ω DC Reference

Follow this procedure to adjust the DC gain and offset of the 50 Ω DC reference of the PXIe-5172.

1. Connect the calibrator test head to the specified channel of the PXIe-5172 using an SMB (plug) to BNC (f) adapter.
2. Call the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Initialize VI with the following settings:
   - **channel**: The specified channel
   - **input impedance**: 50 Ω
3. Call the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Configure VI to obtain the DC voltage to generate and configure the calibrator to output the specified DC voltage into 50 Ω.

4. Enable the calibrator output if not already enabled.

Note To configure the calibrator to output 0V, enable ground selection. Otherwise, disable ground selection to generate a nonzero voltage.

5. Wait 1 second for settling.
6. Call the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Adjust VI with the following settings:
   - **actual voltage generated (V)**: The DC voltage present on the specified channel of the PXIe-5172
7. Repeat steps 3 through 6 until the **DC cal complete** indicator from the niHsai Group A External Cal API v1 Host.lvclass:DC Reference Cal Adjust VI returns TRUE.
8. Disable the calibrator output.

Return to the main *Adjusting the PXIe-5172* task.

Adjusting Timebase

Follow this procedure to adjust the internal timebase reference of the PXIe-5172.

1. Connect the calibrator test head to the specified channel of the PXIe-5172 using an SMB (plug) to BNC (f) adapter.
2. Call the niHsai Group A External Cal API v1 Host.lvclass:Timebase Cal Initialize VI with the following settings:
   - **channel**: The specified channel
3. Call the niHsai Group A External Cal API v1 Host.lvclass:Timebase Cal Configure VI to obtain the frequency to generate and configure the calibrator to output a 1.25 V_{pk-pk} sine wave at the specified frequency into 50 Ω.
4. Enable the calibrator output if not already enabled.
5. Wait 1 second for settling.
6. Call the niHsai Group A External Cal API v1 Host.lvclass:Timebase Cal Adjust VI with the following settings:
   - **actual frequency generated (Hz)**: The frequency of the sine wave present on the specified channel of the PXIe-5172
7. Repeat steps 3 through 6 until the **Timebase Cal Complete** indicator from the Timebase Cal Adjust VI returns TRUE.
8. Disable the calibrator output.

Return to the main *Adjusting the PXIe-5172* task.

Reverification

Repeat the *Verification* section to determine the as-left status of the PXIe-5172.

Note If any test fails reverification after performing an adjustment, verify that you have met the test conditions before returning your PXIe-5172 to NI. Refer to the

Worldwide Support and Services section for information about support resources or service requests.

Updating Verification Date and Time

This procedure updates the date and time of the last PXIe-5172 verification.

Prior to updating the verification date and time, you must successfully complete all required verifications or reverifications following adjustment.

Call the niHSAI Calibration API v1 Host.lvlib:Set Verification Date and Time VI with the following settings:

- Wire the current date and time to the **verification date** parameter.
- Wire the current calibration password to the **calibration password** parameter. The default password is `NI`.

Worldwide Support and Services

The NI website is your complete resource for technical support. At *ni.com/support*, you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit *ni.com/services* for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit *ni.com/register* to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting *ni.com/certification*. If your product supports calibration, you can obtain the calibration certificate for your product at *ni.com/calibration*.

NI corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. NI also has offices located around the world. For telephone support in the United States, create your service request at *ni.com/support* or dial 1 866 ASK MYNI (275 6964). For telephone support outside the United States, visit the *Worldwide Offices* section of *ni.com/niglobal* to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

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