

NI PXI-4070 6½ Digit FlexDMM™ Calibration Procedure

This document contains step-by-step instructions for writing an external calibration procedure for the NI PXI-4070 6½ digit FlexDMM and 1.8 MS/s isolated digitizer (NI 4070).

Contents

| | |
|---|----|
| Conventions | 2 |
| Calibration Overview | 2 |
| What Is Calibration? | 3 |
| Why Should You Calibrate? | 3 |
| How Often Should You Calibrate? | 3 |
| What Calibration Options Are Available? | 4 |
| How Much Time Does Calibration Require? | 4 |
| Equipment and Other Test Requirements | 4 |
| Required Test Equipment | 4 |
| Optional Test Equipment | 5 |
| Test Conditions | 5 |
| Documentation | 6 |
| Software | 6 |
| Verification Procedures | 9 |
| Setting Up the Test Equipment | 9 |
| Verifying DC Voltage | 10 |
| Verifying AC Voltage | 18 |
| Verifying 4-Wire Resistance | 26 |
| Verifying 2-Wire Resistance | 28 |
| Verifying DC Current | 33 |
| Verifying AC Current | 35 |
| Verifying Frequency | 36 |
| Adjustment Procedures | 38 |
| Setting Up the Test Equipment | 39 |
| Adjusting DC Voltage and Resistance | 39 |
| Adjusting AC Voltage (AC- and DC-Coupled) Modes | 45 |

CVI™, FlexDMM™, LabVIEW™, National Instruments™, NI™, ni.com™, and NI-DMM™ are trademarks of National Instruments Corporation. Product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering National Instruments products, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your CD, or ni.com/patents.

February 2003
370532A-01

| | |
|--|----|
| Adjusting Current Modes | 52 |
| Completing the Adjustment Procedures | 55 |
| Verification Limits | 56 |
| DC Voltage | 56 |
| AC Voltage | 56 |
| 4-Wire Resistance | 58 |
| 2-Wire Resistance | 59 |
| DC Current | 59 |
| AC Current | 60 |
| Frequency | 60 |
| Calibration Function Reference | 61 |
| Technical Support Resources | 61 |
| NI Web Support | 61 |
| Worldwide Support | 61 |

Conventions

The following conventions are used in this manual:

» The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.



This icon denotes a note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

bold

Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic

Italic text denotes variables, emphasis, a cross reference, hardware labels, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

monospace

Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

Calibration Overview

The complete calibration process for the NI 4070 consists of verifying all modes with the test limits provided and adjusting the calibration coefficients for all modes. Frequency is the only mode that does not require adjustment. Reverifying all modes after adjustments ensures that the adjustment procedures were performed correctly.

National Instruments can perform stringent in-house calibration of the NI 4070 and can generate either a basic or a detailed calibration certificate for you. Visit ni.com/calibration for more information on calibration certificates. This document is provided for those who wish to perform the calibration procedure themselves.

What Is Calibration?

Calibration is a set of operations that compares the values indicated by a measuring instrument or measuring system to the corresponding values realized by external standards. The result of a calibration can be used to determine the measurement error and can correct for it in the adjustment process.

The calibration process consists of verifying, adjusting, and reverifying a device. During verification, you compare the measured performance to an external standard of known measurement uncertainty to confirm that the product meets or exceeds specifications. During adjustment, you correct the measurement error of the device by adjusting the calibration constants and storing the new calibration constants in the EEPROM.

Normally, the calibration sequence is as follows:

1. Verify the NI 4070 using the 2-year accuracy limits (or the 90-day accuracy limits if it has been externally calibrated within that time).
2. Adjust the NI 4070.
3. Reverify the NI 4070 using the 24-hour accuracy limits (or the 2-year accuracy limits when the 24-hour limits are not specified).

Why Should You Calibrate?

Properties of the electrical components responsible for gain and offset errors may drift with time, temperature, and mechanical stress. Calibration is required to compensate for this drift and ensure that you, as a user, are confident that any measurements you make meet NI 4070 specifications.

How Often Should You Calibrate?

The accuracy requirements of your measurement application determine how often you should calibrate the NI 4070. NI recommends performing a complete calibration at least once every two years. NI does not guarantee the absolute accuracy of the NI 4070 beyond this two year calibration interval. You can shorten the calibration interval based on the demands of your application.

What Calibration Options Are Available?

Depending on your measurement and accuracy requirements, a complete calibration of the NI 4070 may not be necessary. A number of options are available that can shorten the time you spend on the calibration. The following options are available:

- Complete calibration—Performing the entire calibration procedure from beginning to end is the only way to guarantee that the performance of the NI 4070 will meet or exceed the published specifications for all modes and ranges.
- Complete calibration except AC voltage modes—If you do not use the AC voltage modes for any measurements or the accuracy is irrelevant, you have the option to skip these steps in the calibration procedure.
- Complete calibration except current modes—If you do not use the current modes (neither DC nor AC) or the accuracy is insignificant for your application, you have the option to skip the steps to calibrate both current modes.
- Complete calibration except AC voltage and current modes—You can choose to skip both the AC voltage modes calibration and the current modes calibration if your application does not require them or the accuracy is irrelevant.

How Much Time Does Calibration Require?

The amount of time required for calibrating varies depending on whether you are running in automated mode or in manual mode. In automated mode, the complete verification procedures for the NI 4070 take less than 30 minutes, and the complete adjustment procedures take approximately 50 minutes. If you choose to run the calibration in manual mode, the process requires more time and is more prone to operator error. NI recommends using an automated procedure, such as the procedures available with National Instruments Calibration Executive software. For more information on calibration, visit ni.com/calibration.

Equipment and Other Test Requirements

This section describes the equipment, test conditions, documentation, software, and connections required for calibration.

Required Test Equipment

The following equipment is required for calibrating the NI 4070:

- Fluke 5700A multifunction calibrator calibrated within the last 90 days or a Fluke 5720A multifunction calibrator calibrated within the last year
- Pomona 5145 insulated double banana plug shorting bar (or another means of creating a short with low thermal EMF (≤ 150 nV) across the HI and LO input banana connectors on the NI 4070)
- Two Pomona B-4 banana-to-banana patch cords (cables) or similar banana-to-banana cables with length not to exceed 4 in.
- Wire (≤ 22 AWG, ≤ 4 in.) for connecting the AUX CURRENT and SENSE HI binding posts of the calibrator (alternatively, you can use one of the Pomona B-4 cables instead of this wire)
- National Instruments PXI chassis and controller
- National Instruments calibration cable assembly for the NI 4070 (part number 161283A-01)

Optional Test Equipment

The following equipment is optional for calibrating the NI 4070 and is only used for frequency verification:

- NI PXI-6608
- National Instruments SH68-68-D1 shielded cable
- National Instruments TB-2715 terminal block
- Pomona MDP 4892 double banana plug with strain relief
- Coaxial cable (for example, RG178)

Test Conditions

Follow these guidelines to optimize the connections and the environment during calibration:

- Ensure that the PXI chassis fan speed is set to HI and that the fan filters are clean.
- Power on and warm up both the calibrator and the NI 4070 for at least 30 minutes before beginning this calibration procedure.
- Maintain an ambient temperature of 23 ± 1 °C.

- Maintain an ambient relative humidity of less than 60%.
- Allow the calibrator to settle fully before taking any measurements. Consult the Fluke 5700A/5720A user documentation for instructions.
- Allow the thermal EMF enough time to stabilize when you change connections to the calibrator or the NI 4070. The suggested time periods are stated where necessary throughout this document.
- Keep a shorting bar connected between the V GUARD and GROUND binding posts of the calibrator at all times.
- Clean any oxidation from the spade lugs on the calibration cable assembly before connecting them to the calibrator's binding posts. Oxidation is a discoloration that tarnishes the copper spade lugs so that they appear dull rather than shiny.
- Leave the spade lugs on the calibration cable assembly that are labeled *SHD* connected to the calibrator's V GUARD binding post at all times.
- Prevent the cables from moving or vibrating by taping or strapping them to a nonvibrating surface. Movement or vibration causes triboelectric effects that can result in measurement errors.

Documentation

In addition to this calibration document, you may find the following references helpful in writing your calibration utility:

- *NI Digital Multimeters Help*
- *NI-DMM Instrument Driver Quick Reference Guide*
- *NI Digital Multimeters Getting Started Guide*
- *Specifications for the NI PXI-4070*

All of these documents are installed on your computer when you install NI-DMM. To locate them, go to **Start»Programs»National Instruments»NI-DMM»Documentation**.

If you are performing the optional frequency verification procedure, you may need the following documents, which are available at ni.com/manuals:

- *TB-2715 Terminal Block Installation Guide*
- *About Your NI 6608 Device*

Software

The NI 4070 calibration procedure requires that NI-DMM version 2.1 or later be installed on the calibration system. NI-DMM supports a number of programming languages including LabVIEW, LabWindows™/CVI™, Microsoft Visual C++, and Microsoft Visual Basic. When you install

NI-DMM, you only need to install support for the language you intend to use to write your calibration utility.



Note NI-DMM versions earlier than 2.1 do not support NI 4070 calibration.

The procedures in this document are described using C function calls. You also can program in LabVIEW using the VIs that correspond to the C function calls. Figure 1 shows the procedural flow for verification. Figure 2 shows the procedural flow for adjustment.

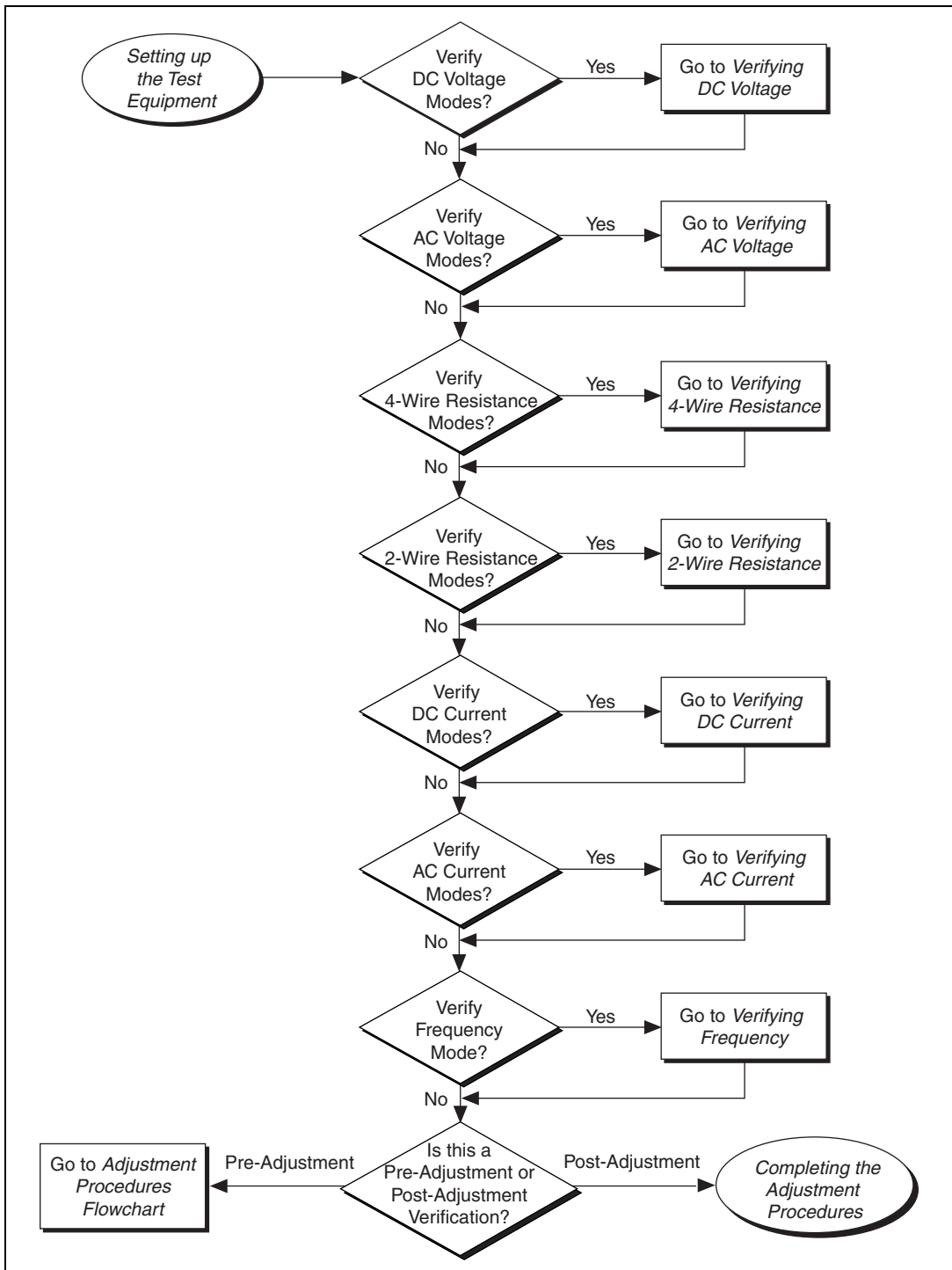


Figure 1. Verification Procedures Flowchart

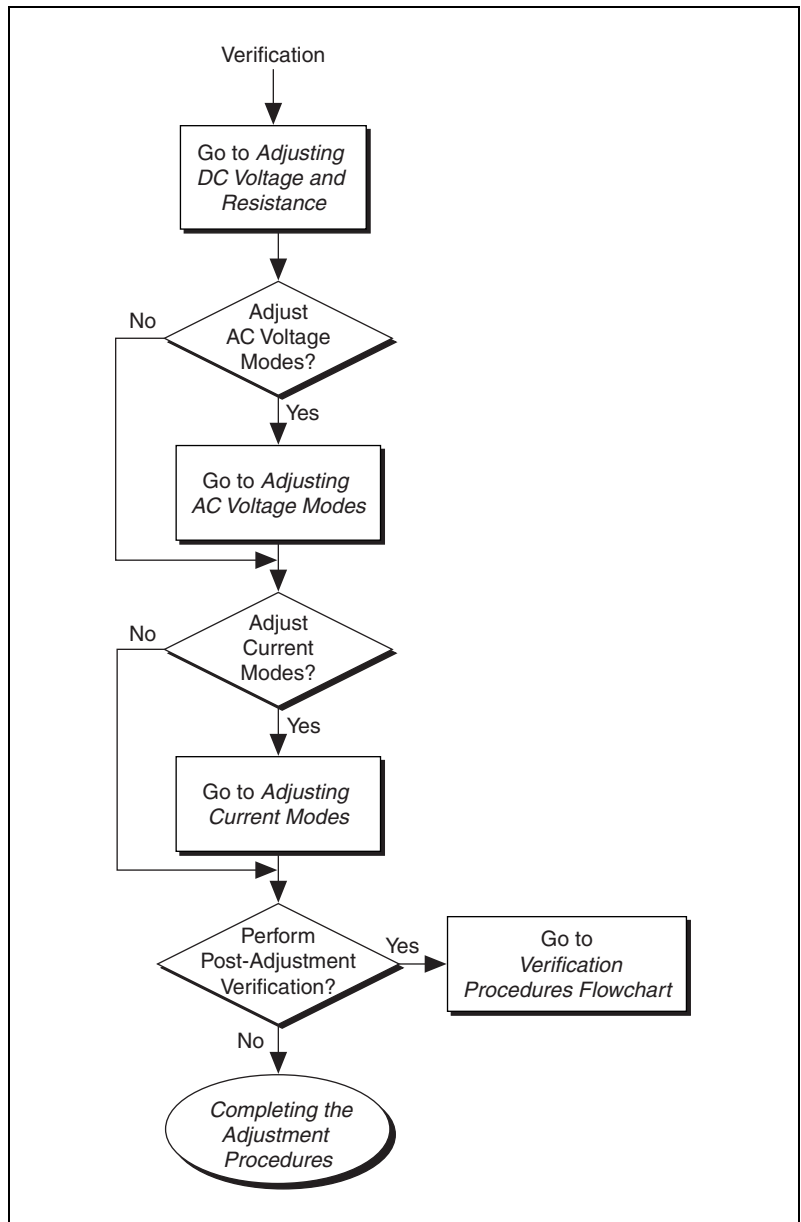


Figure 2. Adjustment Procedures Flowchart

Verification Procedures

You can use the verification procedures described in this section for both pre-adjustment and post-adjustment verification. The steps of each verification procedure must be performed in the order listed; however, you can omit entire sections (for example, the entire [Verifying AC Current](#) section), if necessary.

The parameters **Range**, **Resolution**, and **Sample Interval** used in function calls throughout this section have floating point values. For example, if **Range** = 1, the floating point value is 1.0. The parameters **Trigger Count**, **Sample Count**, **Array Size**, and **ParamValue** have integer values. Refer to the *NI Digital Multimeters Help* for more information.



Note Many of the parameter values listed in this document are expressed in scientific notation. Some programming languages do not support the direct entry of numbers in this format. Care must be taken to properly enter these values with the appropriate number of zeros. For example, the scientific notation number $10e-6$ must be entered as 0.00001, and the number $100e3$ must be entered as 100000. If your programming language supports numeric entries in scientific notation, NI recommends that you use this feature to minimize possible data entry errors.

Setting Up the Test Equipment



Note The *Setting Up the Test Equipment* section is necessary for pre-adjustment verifications only. If you are performing a post-adjustment verification, skip the setup and go directly to the [Verifying DC Voltage](#) section.

To set up the test equipment, complete the following steps:

1. Remove all connections from the four input banana connectors on the NI 4070.
2. Verify that the calibrator has been calibrated within the time limits specified in the [Required Test Equipment](#) section, and that dc zeros calibration has been performed within the last 30 days. Consult the Fluke 5700A/5720A user documentation for instructions on calibrating these devices.



Note Ensure that both the calibrator and the NI 4070 (installed in a powered-on PXI chassis) are warmed up for at least 30 minutes before you begin this procedure.

3. Call `niDMM_init` with the resource name of the device to create a **Session**.



Note You will use the **Session** in all subsequent function calls throughout the verification procedures.

For more information on using the `niDMM_init` function, refer to the *NI Digital Multimeters Help*.

4. Call `niDMM_SelfCal`. This step is optional if you have adjusted the NI 4070 within the last 24 hours and the temperature has remained constant to within ± 1 °C of the calibration temperature (T_{cal}).

Verifying DC Voltage

To verify DC voltage of the NI 4070, complete the following steps:

1. Plug in the insulated banana plug shorting bar across the HI and LO banana plug connectors on the NI 4070.
2. Wait one minute for the thermal EMF to stabilize.
3. Call `niDMM_reset`.
4. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 1
 - **Resolution** = `1e-6`
5. Set the input resistance of the NI 4070 to >10 G Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
6. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
7. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
8. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
9. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 10
 - **Resolution** = `1e-6`

10. Set the input resistance of the NI 4070 to $>10\text{ G}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
11. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
12. Set the input resistance of the NI 4070 to $10\text{ M}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
13. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
14. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 100
 - **Resolution** = $1\text{e-}6$
15. Set the input resistance of the NI 4070 to $10\text{ M}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
16. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
17. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 300
 - **Resolution** = $300\text{e-}6$
18. Set the input resistance of the NI 4070 to $10\text{ M}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
19. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
20. Remove the shorting bar from the NI 4070.
21. Reset the calibrator.



Caution The following step must be performed correctly to avoid shorting on unconnected spade lugs.

22. Connect the calibration cable assembly with the connector block plugged into the NI 4070, and with the spade lugs connected to the appropriate calibrator binding posts. Figure 3 shows the calibrator cable assembly. Table 1 lists the assignments of the spade lugs to the corresponding calibrator binding posts.

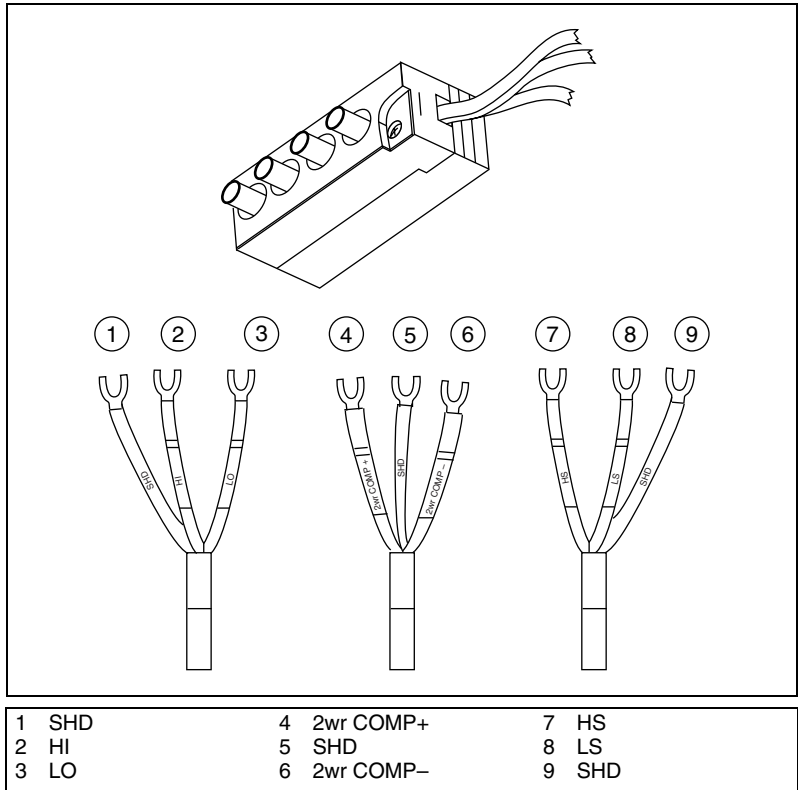


Figure 3. NI Calibration Cable Assembly

Table 1. Spade Lug to Calibrator Binding Post Assignments

| Calibration Cable Assembly Spade Lugs | Calibrator Binding Posts |
|--|--------------------------|
| SHD | V GUARD |
| HI | OUTPUT HI |
| LO | OUTPUT LO |
| 2wr COMP+ | OUTPUT HI |
| SHD | V GUARD |
| 2wr COMP- | OUTPUT LO |
| HS | SENSE HI |
| LS | SENSE LO |
| SHD | V GUARD |

23. Wait two minutes for the thermal EMF to stabilize.
24. Output 0 V on the calibrator.
25. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = `0.1`
 - **Resolution** = `100e-9`
26. Set the input resistance of the NI 4070 to >10 G Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
27. Call `niDMM_ConfigureMultiPoint` with the following parameters:
 - **Trigger Count** = `1`
 - **Sample Count** = `10`
 - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
 - **Sample Interval** = `-1`
28. Call `niDMM_ReadMultiPoint` with the following parameters:
 - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
 - **Array Size** = `10`

Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Store the result as the 100 mV >10 G Ω mode offset.

29. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
30. Call `niDMM_ConfigureMultiPoint` with the following parameters:
 - **Trigger Count** = 1
 - **Sample Count** = 10
 - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
 - **SampleInterval** = -1
31. Call `niDMM_ReadMultiPoint` with the following parameters:
 - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
 - **Array Size** = 10

Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Store the result as the 100 mV 10 M Ω mode offset.
32. Output 100 mV on the calibrator with the range locked to 2.2 V. This range prevents a 50 Ω calibrator output resistance from creating a voltage divider with the internal resistance of the NI 4070.
33. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 0.1
 - **Resolution** = 100e-9
34. Set the input resistance of the NI 4070 to >10 G Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
35. Call `niDMM_Read`. Subtract the previously stored 100 mV >10 G Ω mode offset from this measurement and verify that the result falls between the limits listed in Table 11.
36. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
37. Call `niDMM_Read`. Subtract the previously stored 100 mV >10 M Ω mode offset from this measurement and verify that the result falls between the limits listed in Table 11.

38. Output -100 mV on the calibrator with the range locked to 2.2 V. This range prevents a $50\ \Omega$ calibrator output resistance from creating a voltage divider with the internal resistance of the NI 4070.
39. Set the input resistance of the NI 4070 to >10 G Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
40. Call `niDMM_Read`. Subtract the previously stored 100 mV >10 G Ω mode offset from this measurement and verify that the result falls between the limits listed in Table 11.
41. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
42. Call `niDMM_Read`. Subtract the previously stored 100 mV >10 M Ω mode offset from this measurement and verify that the result falls between the limits listed in Table 11.
43. Output 1 V on the calibrator.
44. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = `1`
 - **Resolution** = `1e-6`
45. Set the input resistance of the NI 4070 to >10 G Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
46. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
47. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
48. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
49. Output -1 V on the calibrator.

50. Set the input resistance of the NI 4070 to $>10\text{ G}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
51. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
52. Set the input resistance of the NI 4070 to $10\text{ M}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
53. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
54. Output 10 V on the calibrator.
55. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = `10`
 - **Resolution** = `10e-6`
56. Set the input resistance of the NI 4070 to $>10\text{ G}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
57. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
58. Set the input resistance of the NI 4070 to $10\text{ M}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
59. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
60. Output -10 V on the calibrator.
61. Set the input resistance of the NI 4070 to $>10\text{ G}\Omega$ by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
62. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.

63. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
64. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
65. Output 100 V on the calibrator.
66. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 100
 - **Resolution** = `100e-6`
67. Set the input resistance of the NI 4070 to 10 M Ω by calling `niDMM_SetAttributeViReal64` with the following parameters:
 - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
 - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
68. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
69. Output -100 V on the calibrator.
70. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
71. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 300
 - **Resolution** = `300e-6`
72. Call `niDMM_Read`. The NI 4070 must be in the 300 V range before applying the voltage.
73. Output 300 V on the calibrator.
74. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
75. Output -300 V on the calibrator.
76. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 11.
77. Reset the calibrator for safety reasons.

You have completed verifying the DC voltage of the NI 4070. Select one of the following options:

- If you want to continue verifying other modes, go to the *Verifying AC Voltage* section.
- If you do not want to verify other modes and you are performing a post-adjustment verification, go to the *Completing the Adjustment Procedures* section.
- If you do not want to verify any additional modes and you are performing a pre-adjustment verification, call `niDMM_close` to close the session.

Verifying AC Voltage

To verify AC voltage of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting or electrical shock from high voltage on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
3. Output 5 mV 1 kHz on the calibrator.
4. Call `niDMM_reset` to reset the NI 4070 to a known state.
5. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_AC_VOLTS`
 - **Range** = `0.05`
 - **Resolution** = `50e-9`
6. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
7. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
 - **Range** = `0.05`
 - **Resolution** = `50e-9`
8. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
9. Output 50 mV at 30 Hz on the calibrator.

10. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
 - **Range** = `0.05`
 - **Resolution** = `50e-9`
11. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
12. Refer to Table 2 for the appropriate calibrator outputs and parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed under Calibrator Output in Table 2 for the current iteration.
 - b. Call `niDMM_ConfigureMeasurement` with **Mode** set to `NIDMM_VAL_AC_VOLTS` and the remaining parameters as shown in Table 2 for the current iteration.
 - c. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
 - d. Call `niDMM_ConfigureMeasurement` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
 - e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
13. Repeat step 12 for each of the remaining iterations shown in Table 2.

Table 2. `niDMM_ConfigureMeasurement` Parameters

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---|-------|---------------------|
| | Amplitude | Frequency | Function | Range | Resolution |
| 1 | 50 mV | 50 Hz | <code>NIDMM_VAL_AC_VOLTS</code> | 0.05 | <code>50e-9</code> |
| | 50 mV | 50 Hz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 0.05 | <code>50e-9</code> |
| 2 | 50 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 0.05 | <code>50e-9</code> |
| | 50 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 0.05 | <code>50e-9</code> |
| 3 | 50 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 0.5 | <code>500e-9</code> |
| | 50 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 0.5 | <code>500e-9</code> |
| 4 | 50 mV | 20 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 0.05 | <code>50e-9</code> |
| | 50 mV | 20 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 0.05 | <code>50e-9</code> |

Table 2. niDMM_ConfigureMeasurement Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---------------------------------------|-------|------------|
| | Amplitude | Frequency | Function | Range | Resolution |
| 5 | 50 mV | 50 kHz | NIDMM_VAL_AC_VOLTS | 0.05 | 50e-9 |
| | 50 mV | 50 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 50e-9 |
| 6 | 50 mV | 100 kHz | NIDMM_VAL_AC_VOLTS | 0.05 | 50e-9 |
| | 50 mV | 100 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 50e-9 |
| 7 | 50 mV | 300 kHz | NIDMM_VAL_AC_VOLTS | 0.05 | 50e-9 |
| | 50 mV | 300 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 50e-9 |

14. Output 500 mV at 30 Hz on the calibrator.
15. Call niDMM_ConfigureMeasurement with the following parameters:
 - **Function** = NIDMM_VAL_AC_VOLTS_DCCOUPLED
 - **Range** = 0.5
 - **Resolution** = 500e-9
16. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.
17. Refer to Table 3 for the appropriate calibrator outputs and parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed under Calibrator Output in Table 3 for the current iteration.
 - b. Call niDMM_ConfigureMeasurement with **Mode** set to NIDMM_VAL_AC_VOLTS and the remaining parameters as shown in Table 3 for the current iteration.
 - c. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.
 - d. Call niDMM_ConfigureMeasurement again, changing **Mode** to NIDMM_VAL_AC_VOLTS_DCCOUPLED.
 - e. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.

Table 3. niDMM_ConfigureMeasurement Parameters

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---------------------------------------|-------|------------|
| | Amplitude | Frequency | Function | Range | Resolution |
| 1 | 500 mV | 50 Hz | NIDMM_VAL_AC_VOLTS | 0.5 | 500e-9 |
| | 500 mV | 50 Hz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e-9 |
| 2 | 500 mV | 1 kHz | NIDMM_VAL_AC_VOLTS | 0.5 | 500e-9 |
| | 500 mV | 1 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e-9 |
| 3 | 500 mV | 1 kHz | NIDMM_VAL_AC_VOLTS | 5 | 5e-6 |
| | 500 mV | 1 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 5e-6 |
| 4 | 500 mV | 20 kHz | NIDMM_VAL_AC_VOLTS | 0.5 | 500e-9 |
| | 500 mV | 20 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e-9 |
| 5 | 500 mV | 50 kHz | NIDMM_VAL_AC_VOLTS | 0.5 | 500e-9 |
| | 500 mV | 50 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e-9 |
| 6 | 500 mV | 100 kHz | NIDMM_VAL_AC_VOLTS | 0.5 | 500e-9 |
| | 500 mV | 100 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e-9 |
| 7 | 500 mV | 300 kHz | NIDMM_VAL_AC_VOLTS | 0.5 | 500e-9 |
| | 500 mV | 300 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e-9 |

18. Output 5 V at 30 Hz on the calibrator.
19. Call niDMM_ConfigureMeasurement with the following parameters:
 - **Function** = NIDMM_VAL_AC_VOLTS_DCCOUPLED
 - **Range** = 5
 - **Resolution** = 5e-6
20. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.

21. Refer to Table 4 for the appropriate calibrator outputs and parameter values as you complete the following steps:
- On the calibrator, output the value listed under Calibrator Output in Table 4 for the current iteration.
 - Call `niDMM_ConfigureMeasurement` with **Mode** set to `NIDMM_VAL_AC_VOLTS` and the remaining parameters as shown in Table 4 for the current iteration.
 - Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
 - Call `niDMM_ConfigureMeasurement` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
 - Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.

Table 4. `niDMM_ConfigureMeasurement` Parameters

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---|-------|------------|
| | Amplitude | Frequency | Function | Range | Resolution |
| 1 | 5 V | 50 Hz | <code>NIDMM_VAL_AC_VOLTS</code> | 5 | 5e-6 |
| | 5 V | 50 Hz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 5 | 5e-6 |
| 2 | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 5 | 5e-6 |
| | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 5 | 5e-6 |
| 3 | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 50 | 50e-6 |
| | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 50 | 50e-6 |
| 4 | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 300. | 300e-6 |
| | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | 300e-6 |
| 5 | 5 V | 20 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 5 | 5e-6 |
| | 5 V | 20 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 5 | 5e-6 |
| 6 | 5 V | 50 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 5 | 5e-6 |
| | 5 V | 50 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 5 | 5e-6 |

Table 4. niDMM_ConfigureMeasurement Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---------------------------------------|-------|------------|
| | Amplitude | Frequency | Function | Range | Resolution |
| 7 | 5 V | 100 kHz | NIDMM_VAL_AC_VOLTS | 5 | 5e-6 |
| | 5 V | 100 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 5e-6 |
| 8 | 5 V | 300 kHz | NIDMM_VAL_AC_VOLTS | 5 | 5e-6 |
| | 5 V | 300 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 5e-6 |

22. Output 50 V at 30 Hz on the calibrator.
23. Call niDMM_ConfigureMeasurement with the following parameters:
 - **Function** = NIDMM_VAL_AC_VOLTS_DCCOUPLED
 - **Range** = 50
 - **Resolution** = 50e-6
24. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.
25. Refer to Table 5 for the appropriate calibrator outputs and parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed under Calibrator Output in Table 5 for the current iteration.
 - b. Call niDMM_ConfigureMeasurement with **Mode** set to NIDMM_VAL_AC_VOLTS and the remaining parameters as shown in Table 5 for the current iteration.
 - c. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.
 - d. Call niDMM_ConfigureMeasurement again, changing **Mode** to NIDMM_VAL_AC_VOLTS_DCCOUPLED.
 - e. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 12.

Table 5. niDMM_ConfigureMeasurement Parameters

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---------------------------------------|-------|------------|
| | Amplitude | Frequency | Function | Range | Resolution |
| 1 | 50 V | 50 Hz | NIDMM_VAL_AC_VOLTS | 50 | 50e-6 |
| | 50 V | 50 Hz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e-6 |
| 2 | 50 V | 1 kHz | NIDMM_VAL_AC_VOLTS | 50 | 50e-6 |
| | 50 V | 1 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e-6 |
| 3 | 50 V | 20 kHz | NIDMM_VAL_AC_VOLTS | 50 | 50e-6 |
| | 50 V | 20 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e-6 |
| 4 | 50 V | 50 kHz | NIDMM_VAL_AC_VOLTS | 50 | 50e-6 |
| | 50 V | 50 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e-6 |
| 5 | 50 V | 100 kHz | NIDMM_VAL_AC_VOLTS | 50 | 50e-6 |
| | 50 V | 100 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e-6 |
| 6 | 50 V | 300 kHz | NIDMM_VAL_AC_VOLTS | 50 | 50e-6 |
| | 50 V | 300 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e-6 |

26. Call niDMM_ConfigureMeasurement with the following parameters:

- **Function** = NIDMM_VAL_AC_VOLTS_DCCOUPLED
- **Range** = 300
- **Resolution** = 300e-6

27. Call niDMM_Read. The NI 4070 must be in the 300 V measurement mode before applying the voltage.

28. Output 219 V at 30 Hz on the calibrator.

29. Call niDMM_ConfigureMeasurement with the following parameters:

- **Function** = NIDMM_VAL_AC_VOLTS_DCCOUPLED
- **Range** = 300
- **Resolution** = 300e-6

30. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
31. Refer to Table 6 for the appropriate calibrator outputs and parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed under Calibrator Output in Table 6 for the current iteration.
 - b. Call `niDMM_ConfigureMeasurement` with **Mode** set to `NIDMM_VAL_AC_VOLTS` and the remaining parameters as shown in Table 6 for the current iteration.
 - c. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.
 - d. Call `niDMM_ConfigureMeasurement` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
 - e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 12.

Table 6. `niDMM_ConfigureMeasurement` Parameters

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---|-----------|------------|
| | Amplitude | Frequency | Function | Range (V) | Resolution |
| 1 | 219 V | 50 Hz | <code>NIDMM_VAL_AC_VOLTS</code> | 300 | 300e-6 |
| | 219 V | 50 Hz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | 300e-6 |
| 2 | 219 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 300 | 300e-6 |
| | 219 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | 300e-6 |
| 3 | 219 V | 20 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 300 | 300e-6 |
| | 219 V | 20 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | 300e-6 |
| 4 | 219 V | 50 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 300 | 3300e-6 |
| | 219 V | 50 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | 300e-6 |
| 5 | 219 V | 100 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 300 | 300e-6 |
| | 219 V | 100 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | 300e-6 |

Table 6. (Continued)niDMM_ConfigureMeasurement Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|-----------|---------------------------------------|-----------|------------|
| | Amplitude | Frequency | Function | Range (V) | Resolution |
| 6 | 70 V | 300 kHz | NIDMM_VAL_AC_VOLTS | 300 | 300e-6 |
| | 70 V | 300 kHz | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 300e-6 |

32. Reset the calibrator for safety reasons.

You have completed verifying the AC voltage of the NI 4070. Select one of the following options:

- If you want to continue verifying other modes, go to the *Verifying 4-Wire Resistance* section.
- If you do not want to verify other modes and you are performing a post-adjustment verification, go to the *Completing the Adjustment Procedures* section.
- If you do not want to verify any additional modes and you are performing a pre-adjustment verification, call `niDMM_close` to close the session.

Verifying 4-Wire Resistance

To verify the 4-wire resistance of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
3. Wait two minutes for the thermal EMF to stabilize if the calibration cable assembly was not previously connected in this configuration.
4. Call `niDMM_reset`.
5. Call `niDMM_ConfigureOffsetCompOhms` with **OffsetCompOhms** set to `NIDMM_VAL_OFFSET_COMP_OHMS_ON`.

6. Refer to Table 7 for the appropriate calibrator output and function parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed in the Calibrator Output column in Table 7 for the current iteration. Make sure that the external sense is turned on, but 2-wire compensation is turned off.



Note After setting the calibrator output to 0 Ω in the seventh iteration, you do not need to continually set the calibrator to 0 Ω for iterations 8 through 12.

- b. Call `niDMM_ConfigureMeasurement` with the parameters set as shown in Table 7 for the current iteration.
- c. Call `niDMM_Read`. Verify that this measurement falls between the tolerances listed in Table 13. Tolerances are provided instead of absolute limits because your calibrator will have different discrete resistance values.

7. Repeat step 6 for each of the remaining iterations listed in Table 7.

Table 7. `niDMM_ConfigureMeasurement` Parameters

| Iteration | Calibrator Output | niDMM_ConfigureMeasurement Parameters | | |
|-----------|-------------------|---------------------------------------|-------|------------|
| | | Function | Range | Resolution |
| 1 | 10 M Ω | NIDMM_VAL_4_WIRE_RES | 10e6 | 10 |
| 2 | 1 M Ω | NIDMM_VAL_4_WIRE_RES | 1e6 | 1 |
| 3 | 100 k Ω | NIDMM_VAL_4_WIRE_RES | 100e3 | 0.1 |
| 4 | 10 k Ω | NIDMM_VAL_4_WIRE_RES | 10e3 | 0.01 |
| 5 | 1 k Ω | NIDMM_VAL_4_WIRE_RES | 1e3 | 1e-3 |
| 6 | 100 Ω | NIDMM_VAL_4_WIRE_RES | 100 | 100e-6 |
| 7 | 0 Ω | NIDMM_VAL_4_WIRE_RES | 10e6 | 10 |
| 8 | 0 Ω | NIDMM_VAL_4_WIRE_RES | 1e6 | 1 |
| 9 | 0 Ω | NIDMM_VAL_4_WIRE_RES | 100e3 | 0.1 |
| 10 | 0 Ω | NIDMM_VAL_4_WIRE_RES | 10e3 | 0.01 |
| 11 | 0 Ω | NIDMM_VAL_4_WIRE_RES | 1e3 | 1e-3 |
| 12 | 0 Ω | NIDMM_VAL_4_WIRE_RES | 100 | 100e-6 |

8. Call `niDMM_ConfigureOffsetCompOhms` with **OffsetCompOhms** set to `NIDMM_VAL_OFFSET_COMP_OHMS_OFF`.

You have completed verifying the 4-wire resistance of the NI 4070. Select one of the following options:

- If you want to continue verifying other modes, go to the *Verifying 2-Wire Resistance* section.
- If you do not want to verify other modes and you are performing a post-adjustment verification, go to the *Completing the Adjustment Procedures* section.
- If you do not want to verify any additional modes and you are performing a pre-adjustment verification, call `niDMM_close` to close the session.

Verifying 2-Wire Resistance

To verify the 2-wire resistance of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
3. Wait two minutes for the thermal EMF to stabilize if the calibration cable assembly was not used previously in this configuration.
4. Output $0\ \Omega$ on the calibrator with 2-wire compensation turned on, but with external sense turned off.
5. Call `niDMM_reset` to reset the NI 4070 to a known state.
6. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100e6`
 - **Resolution** = `100`
7. Call `niDMM_Read` and store the result as the 100 M Ω range offset.
8. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `10e6`
 - **Resolution** = `10`
9. Call `niDMM_Read` and store the result as the 10 M Ω range offset.

10. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `1e6`
 - **Resolution** = `1`
11. Call `niDMM_Read` and store the result as the 1 M Ω range offset.
12. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100e3`
 - **Resolution** = `0.1`
13. Call `niDMM_ConfigureMultiPoint` with the following parameters:
 - **Trigger Count** = `1`
 - **Sample Count** = `4`
 - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
 - **Sample Interval** = `-1`
14. Call `niDMM_ReadMultiPoint` with the following parameters:
 - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
 - **Array Size** = `4`

Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Store the result as the 100 k Ω range offset.
15. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `10e3`
 - **Resolution** = `0.01`
16. Call `niDMM_ConfigureMultiPoint` with the following parameters:
 - **Trigger Count** = `1`
 - **Sample Count** = `4`
 - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
 - **Sample Interval** = `-1`
17. Call `niDMM_ReadMultiPoint` with the following parameters:
 - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
 - **Array Size** = `4`

Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Store the result as the 10 k Ω range offset.

18. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `1e3`
 - **Resolution** = `1e-3`

19. Call `niDMM_ConfigureMultiPoint` with the following parameters:
 - **Trigger Count** = `1`
 - **Sample Count** = `4`
 - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
 - **Sample Interval** = `-1`

20. Call `niDMM_ReadMultiPoint` with the following parameters:
 - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
 - **Array Size** = `4`

Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Store the result as the 1 k Ω range offset.

21. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100`
 - **Resolution** = `100e-6`

22. Call `niDMM_ConfigureMultiPoint` with the following parameters:
 - **Trigger Count** = `1`
 - **Sample Count** = `10`
 - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
 - **Sample Interval** = `-1`

23. Call `niDMM_ReadMultiPoint` with the following parameters:
 - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
 - **Array Size** = `10`

Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Store the result as the 100 Ω range offset.

24. Output 100 M Ω on the calibrator with no external sense or 2-wire compensation.

25. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100e6`
 - **Resolution** = `100`
26. Call `niDMM_Read`. Subtract the previously stored 100 M Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
27. Output 10 M Ω on the calibrator with no external sense or 2-wire compensation.
28. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `10e6`
 - **Resolution** = `10`
29. Call `niDMM_Read`. Subtract the previously stored 10 M Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
30. Output 1 M Ω on the calibrator with no external sense or 2-wire compensation.
31. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `1e6`
 - **Resolution** = `1`
32. Call `niDMM_Read`. Subtract the previously stored 1 M Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
33. Output 100 k Ω on the calibrator with no external sense or 2-wire compensation.
34. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100e3`
 - **Resolution** = `0.1`
35. Call `niDMM_Read`. Subtract the previously stored 100 k Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.

36. Output 10 k Ω on the calibrator with 2-wire compensation turned on, but with external sense turned off.
37. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `10e3`
 - **Resolution** = `0.01`
38. Call `niDMM_Read`. Subtract the previously stored 10 k Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
39. Output 1 k Ω on the calibrator with 2-wire compensation turned on, but with external sense turned off.
40. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `1e3`
 - **Resolution** = `1e-3`
41. Call `niDMM_Read`. Subtract the previously stored 1 k Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
42. Output 100 Ω on the calibrator with 2-wire compensation turned on, but with external sense turned off.
43. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100`
 - **Resolution** = `100e-6`
44. Call `niDMM_Read`. Subtract the previously calculated 100 Ω range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.

You have completed verifying the 2-wire resistance of the NI 4070. Select one of the following options:

- If you want to continue verifying other modes, go to the [Verifying DC Current](#) section.
- If you do not want to verify other modes and you are performing a post-adjustment verification, go to the [Completing the Adjustment Procedures](#) section.

- If you do not want to verify any additional modes and you are performing a pre-adjustment verification, call `niDMM_close` to close the session.

Verifying DC Current

To verify the DC current of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
3. Connect a banana-to-banana cable or a wire (AWG ≤ 22) between the AUX CURRENT binding post and the SENSE HI binding post of the calibrator.
4. Output 0 A on the calibrator with the current output set to AUX.
5. Call `niDMM_reset` to reset the NI 4070 to a known state.
6. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = `0.02`
 - **Resolution** = `20e-9`
7. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
8. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = `0.2`
 - **Resolution** = `200e-9`
9. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
10. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = `1`
 - **Resolution** = `1e-6`

11. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
12. Output 20 mA on the calibrator with the current output set to AUX.
13. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = 0.02
 - **Resolution** = $20e-9$
14. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
15. Output -20 mA on the calibrator with the current output set to AUX.
16. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
17. Output 200 mA on the calibrator with the current output set to AUX.
18. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = 0.2
 - **Resolution** = $200e-9$
19. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
20. Output -200 mA on the calibrator with the current output set to AUX.
21. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
22. Output 1 A on the calibrator with the current output set to AUX.
23. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = 1
 - **Resolution** = $1e-6$
24. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
25. Output -1 A on the calibrator with the current output set to AUX.
26. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.

You have completed verifying the DC current of the NI 4070. Select one of the following options:

- If you want to continue verifying other modes, go to the *Verifying AC Current* section.
- If you do not want to verify other modes and you are performing a post-adjustment verification, go to the *Completing the Adjustment Procedures* section.
- If you do not want to verify any additional modes and you are performing a pre-adjustment verification, call `niDMM_close` to close the session.

Verifying AC Current

To verify the AC current of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
3. Connect a banana-to-banana cable or a wire (AWG ≤ 22) between the *AUX CURRENT* binding post and the *SENSE HI* binding post of the calibrator.
4. Call `niDMM_reset` to reset the NI 4070 to a known state.
5. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_AC_CURRENT`
 - **Range** = `0.01`
 - **Resolution** = `10e-9`
6. Call `niDMM_Read` to configure the NI 4070 for a current mode before applying current.
7. Output 1 mA at 1 kHz on the calibrator with the current output set to *AUX*.
8. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.
9. Output 10 mA at 1 kHz on the calibrator with the current output set to *AUX*.
10. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.

11. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_AC_CURRENT`
 - **Range** = 0.1
 - **Resolution** = `100e-9`
12. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.
13. Output 100 mA at 1 kHz on the calibrator with the current output set to AUX.
14. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.
15. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_AC_CURRENT`
 - **Range** = 1
 - **Resolution** = `1e-6`
16. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.
17. Output 1 A at 1 kHz on the calibrator with the current output set to AUX.
18. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.

You have completed verifying the AC current of the NI 4070. Select one of the following options:

- If you want to continue verifying other modes, go to the [Verifying Frequency](#) section.
- If you do not want to verify other modes and you are performing a post-adjustment verification, go to the [Completing the Adjustment Procedures](#) section.
- If you do not want to verify any additional modes and you are performing a pre-adjustment verification, call `niDMM_close` to close the session.

Verifying Frequency



Note The frequency of the NI 4070 is not user adjustable. If this verification procedure indicates that the frequency is out of specification, return the NI 4070 to NI for repair.

To verify the frequency of the NI 4070, complete the following steps:

1. Remove the calibration cable assembly from the NI 4070.
2. Connect one end of the coaxial cable to the Pomona 4892 double banana plug. Tighten the other end of the coaxial cable in the screw terminal channels 5 and 39 of the TB-2715 terminal block.



Note Polarity is not important in steps 2 and 3.

3. Connect the TB-2715 with the coaxial cable attached to the NI 6608, and plug the Pomona 4892 into the HI and LO terminals of the NI 4070.
4. Call `niDMM_reset` to reset the NI 4070 to a known state.
5. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_FREQ`
 - **Range** = 1
 - **Resolution** = 0
6. Call `niDMM_ConfigureFrequencyVoltageRange` with **Voltage Range** set to 5.
7. Call `GPCTR_Control` with the following parameters:
 - **deviceNumber** = *the device number of the NI 6608 assigned by Measurement and Automation Explorer (MAX)*
 - **gpctrNum** = `ND_COUNTER_0`
 - **action** = `ND_RESET`
8. Call `GPCTR_Set_Application` with the following parameters:
 - **deviceNumber** = *the device number of the NI 6608 assigned by MAX*
 - **gpctrNum** = `ND_COUNTER_0`
 - **application** = `ND_PULSE_TRAIN_GNR`
9. Call `GPCTR_Change_Parameter` with the following parameters:
 - **deviceNumber** = *the device number of the NI 6608 assigned by MAX*
 - **gpctrNum** = `ND_COUNTER_0`

- **paramID** = ND_COUNT_1
 - **paramValue** = 10e6
10. Call `GPCTR_Change_Parameter` with the following parameters:
 - **deviceNumber** = *the device number of the NI 6608 assigned by MAX*
 - **gpctrNum** = ND_COUNTER_0
 - **paramID** = ND_COUNT_2
 - **paramValue** = 10e6
 11. Call `GPCTR_Control` with the following parameters:
 - **deviceNumber** = *the device number of the NI 6608 assigned by MAX*
 - **gpctrNum** = ND_COUNTER_0
 - **action** = ND_PROGRAM
 12. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
 13. Call `GPCTR_Control` with the following parameters:
 - **deviceNumber** = *the device number of the NI 6608 assigned by MAX*
 - **gpctrNum** = ND_COUNTER_0
 - **action** = ND_RESET
 14. Repeat steps 8 through 13 with the following modification: in steps 9 and 10, change **paramValue** to 500 when you call the function `GPCTR_Change_Parameter`.
 15. Repeat steps 8 through 13 with the following modification: in steps 9 and 10, change **paramValue** to 20 when you call the function `GPCTR_Change_Parameter`.
 16. Call `niDMM_close` to close the verification session.

You have completed verifying the frequency of the NI 4070. If you are performing a post-adjustment verification, go to the [Completing the Adjustment Procedures](#) section.

Adjustment Procedures

This section explains how to adjust the NI 4070. You can choose to perform these adjustment procedures with or without performing the verification procedures first.

The parameters **Range**, **Resolution**, **Expected Measurement**, and **Frequency** used in function calls in this section have floating point values.

For example, if **Range** = 1, the floating point value is 1.0. Refer to the *NI Digital Multimeters Help* for more information.



Note NI recommends repeating the verification procedures after you perform these adjustment procedures. Reverification ensures that the device you have calibrated is operating within specifications after adjustments.



Caution If you skip any of the steps within a section of the adjustment procedures, NI-DMM does *not* allow you to store your new calibration coefficients. Instead, NI-DMM restores the original coefficients to the EEPROM.

Setting Up the Test Equipment

If you have not already set up the test equipment, complete the following steps:

1. Remove all connections from the four input banana connectors on the NI 4070.
2. Verify that the calibrator has been calibrated within the time limits specified in the *Required Test Equipment* section, and that dc zeros calibration has been performed within the last 30 days. Consult the Fluke 5700A/5720A user documentation for instructions on calibrating these devices.



Note Ensure that the calibrator is warmed up for at least 30 minutes before you begin this procedure.

3. Reset the calibrator.
4. If you have not already done so, allow the NI 4070 to warm up for 30 minutes within a powered-on PXI chassis.

Adjusting DC Voltage and Resistance

To adjust the DC voltage and resistance of the NI 4070, complete the following steps:



Caution Step 1 must be performed correctly to avoid shorting on unconnected spade lugs.

1. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
2. Wait two minutes for the thermal EMF to stabilize if the calibration cable assembly was not previously connected in this configuration.

3. Call `niDMM_InitExtCal` with the resource descriptor of the NI 4070 and your valid user password to output a calibration session (**Cal Session**) that you can use to perform NI-DMM calibration or regular measurement functions.



Note You will use **Cal Session** in all subsequent function calls.



Note The default user password for adjusting the NI 4070 is NI.

4. Call `niDMM_ConfigurePowerLineFrequency` with **PowerLine Frequency** set to 50 or 60, depending on the power line frequency (in Hz) that your instruments are powered from; select 50 for 400 Hz power line frequencies
5. Output 100 mV on the calibrator with the range locked to 2.2 V.
6. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 0.1
 - **Input Resistance** = `NIDMM_VAL_10_MEGAOHM`
 - **Expected Measurement** = 0.1
7. Output -100 mV on the calibrator with the range locked to 2.2 V.
8. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 0.1
 - **Input Resistance** = `NIDMM_VAL_10_MEGAOHM`
 - **Expected Measurement** = -0.1
9. Output 10 V on the calibrator.
10. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 10
 - **Input Resistance** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
 - **Expected Measurement** = 10
11. Output -10 V on the calibrator.
12. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 10
 - **Input Resistance** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
 - **Expected Measurement** = -10

13. Remove the connector block from the NI 4070, leaving the spade lugs connected to the calibrator. Plug in the insulated banana plug shorting bar across the HI and LO banana plug connectors of the NI 4070.
14. Wait two minutes for the thermal EMF to stabilize.
15. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 10
 - **Input Resistance** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
16. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_VREF`.
17. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_VOLTS`
 - **Range** = 0.1
 - **Input Resistance** = `NIDMM_VAL_GREATER_THAN_10_GIGAOHM`
18. Remove the shorting bar and plug the connector block of the calibration cable assembly back into the NI 4070.
19. Wait one minute for the thermal EMF to stabilize.
20. Output 10 M Ω from the calibrator without external sense.
21. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = 10e6
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = *the display on the calibrator for 10 M Ω*
22. Output 0 Ω from the calibrator without external sense or 2-wire comp.
23. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = 10e6
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = *the display on the calibrator for 0 Ω*
24. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = 10e6
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
25. Disconnect the connector block from the NI 4070.

26. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_ZINT`.
27. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_2WIRELEAKAGE`.



Caution Make sure that the insulation of these cables does not touch.

28. On the NI 4070, plug a Pomona B-4 banana cable from the HI input to the HI_SENSE input, and another banana cable from the LO input to the LO_SENSE input.
29. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_4WIRELEAKAGE`.
30. Remove the banana cables and plug the connector block of the calibration cable assembly back into the NI 4070.
31. Wait two minutes for the thermal EMF to stabilize.
32. Output 100 M Ω from the calibrator without external sense.
33. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = 100e6
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = *the display on the calibrator for 100 M Ω*
34. Output 0 Ω from the calibrator without external sense or 2-wire compensation.
35. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = 100e6
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = *the display on the calibrator for 0 Ω*
36. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = 100e6
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
37. Output 100 k Ω on the calibrator with external sense turned on, but without 2-wire compensation.
38. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_4_WIRE_RES`
 - **Range** = 100e3

- **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 - **Expected Value** = *the display on the calibrator for 100 k Ω*
39. Output 10 k Ω on the calibrator with external sense turned on, but without 2-wire compensation.
40. Call `niDMM_CalAdjustGain` with the following parameters:
- **Mode** = NIDMM_VAL_4_WIRE_RES
 - **Range** = 10e3
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 - **Expected Value** = *the display on the calibrator for 10 k Ω*
41. Output 0 Ω on the calibrator with external sense turned on, but without 2-wire compensation.
42. Call `niDMM_CalAdjustGain` with the following parameters:
- **Mode** = NIDMM_VAL_4_WIRE_RES
 - **Range** = 100e3
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 - **Expected Value** = *the display on the calibrator for 0 Ω*
43. Call `niDMM_CalAdjustOffset` with the following parameters:
- **Mode** = NIDMM_VAL_4_WIRE_RES
 - **Range** = 100e3
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
44. Call `niDMM_CalAdjustOffset` with the following parameters:
- **Mode** = NIDMM_VAL_4_WIRE_RES
 - **Range** = 10e3
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
45. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCAL_RREF`.
46. Call `niDMM_SelfCal` to self-calibrate the NI 4070.
47. Output 0 Ω on the calibrator with external sense turned on, but with 2-wire compensation turned off.
48. Call `niDMM_CalAdjustOffset` with the following parameters:
- **Mode** = NIDMM_VAL_4_WIRE_RES
 - **Range** = 10e6
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA

49. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_4_WIRE_RES`
 - **Range** = `1e6`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
50. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_4_WIRE_RES`
 - **Range** = `1e3`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
51. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_4_WIRE_RES`
 - **Range** = `100`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
52. Make the following changes to the connections between the calibrator and the calibration cable assembly spade lugs:
 - a. Remove the spade lugs labeled *HS* and *LS* from the calibrator. Leave these spade lugs unplugged and ensure that they do not touch each other.
 - b. Reconnect the 2wr COMP+ spade lug to the SENSE HI binding post of the calibrator.
 - c. Reconnect the 2wr COMP- spade lug to the SENSE LO binding post of the calibrator.
53. Wait two minutes for the thermal EMF to stabilize.
54. Output $0\ \Omega$ on the calibrator with external sense and 2-wire compensation turned on.
55. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `10e6`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
56. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `1e6`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
57. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100e3`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`

58. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `10e3`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
59. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `1e3`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
60. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_2_WIRE_RES`
 - **Range** = `100`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
61. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_SECTION`.

You have completed adjusting the DC voltage and resistance modes of the NI 4070. Select one of the following options:

- If you want to perform additional adjustments, go to the *Adjusting AC Voltage (AC- and DC-Coupled) Modes* section, or to the *Adjusting Current Modes* section if you have opted not to adjust AC voltage.
- If you are not performing the AC voltage or the current adjustments, go to the *Verification Procedures* section to verify your new calibration coefficients before saving them to the EEPROM.
- If you do not want to verify the adjustments you have just made, go to the *Completing the Adjustment Procedures* section.

Adjusting AC Voltage (AC- and DC-Coupled) Modes



Note If you do not use the AC voltage modes for any measurements, or the accuracy of these modes is irrelevant, you can skip this section in the calibration procedure and go directly to the *Adjusting Current Modes* section.

To adjust the AC voltage of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting or electrical shock from high voltage on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the

appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.

3. Refer to Table 8 for the appropriate calibrator output and parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed under Calibrator Output in Table 8 for the current iteration.
 - b. Call `niDMM_CalAdjustGain` with **Mode** set to `NIDMM_VAL_AC_VOLTS`. Set the remaining parameters as shown in Table 8 for the current iteration.
 - c. Call `niDMM_CalAdjustGain` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
4. Repeat step 3 for each of the remaining iterations listed in Table 8.

Table 8. `niDMM_CalAdjustGain` Parameters

| Iteration | Calibrator Output | | niDMM_CalAdjustGain Parameters | | | |
|-----------|-------------------|-----------|---|-----------|----------------------------------|----------------|
| | Amplitude | Frequency | Mode | Range (V) | Input Resistance | Expected Value |
| 1 | 50 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 0.05 | <code>NIDMM_VAL_1_MEGAOHM</code> | 0.05 |
| | 50 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 0.05 | <code>NIDMM_VAL_1_MEGAOHM</code> | 0.05 |
| 2 | 500 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 0.5 | <code>NIDMM_VAL_1_MEGAOHM</code> | 0.5 |
| | 500 mV | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 0.5 | <code>NIDMM_VAL_1_MEGAOHM</code> | 0.5 |
| 3 | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 5 | <code>NIDMM_VAL_1_MEGAOHM</code> | 5 |
| | 5 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 5 | <code>NIDMM_VAL_1_MEGAOHM</code> | 5 |
| 4 | 50 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 50 | <code>NIDMM_VAL_1_MEGAOHM</code> | 50 |
| | 50 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 50 | <code>NIDMM_VAL_1_MEGAOHM</code> | 50 |
| 5 | 100 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS</code> | 300 | <code>NIDMM_VAL_1_MEGAOHM</code> | 100 |
| | 100 V | 1 kHz | <code>NIDMM_VAL_AC_VOLTS_DCCOUPLED</code> | 300 | <code>NIDMM_VAL_1_MEGAOHM</code> | 100 |

5. Refer to Table 9 for the appropriate parameter values as you complete the following steps:
 - a. Output 0 V on the calibrator.
 - b. Call `niDMM_CalAdjustOffset` with **Mode** set to `NIDMM_VAL_AC_VOLTS` and the remaining parameters as shown in Table 9 for the current iteration.
 - c. Call `niDMM_CalAdjustOffset` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
6. Repeat step 5 for each of the remaining iterations shown in Table 9.

Table 9. `niDMM_CalAdjustOffset` Parameters

| Iteration | niDMM_CalAdjustOffset Parameters | | |
|-----------|----------------------------------|-----------|-------------------------------|
| | Mode | Range (V) | Input Resistance (Ω) |
| 1 | NIDMM_VAL_AC_VOLTS | 0.05 | NIDMM_VAL_1_MEGAOHM |
| | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | NIDMM_VAL_1_MEGAOHM |
| 2 | NIDMM_VAL_AC_VOLTS | 0.5 | NIDMM_VAL_1_MEGAOHM |
| | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | NIDMM_VAL_1_MEGAOHM |
| 3 | NIDMM_VAL_AC_VOLTS | 5 | NIDMM_VAL_1_MEGAOHM |
| | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | NIDMM_VAL_1_MEGAOHM |
| 4 | NIDMM_VAL_AC_VOLTS | 50 | NIDMM_VAL_1_MEGAOHM |
| | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | NIDMM_VAL_1_MEGAOHM |
| 5 | NIDMM_VAL_AC_VOLTS | 300 | NIDMM_VAL_1_MEGAOHM |
| | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | NIDMM_VAL_1_MEGAOHM |

7. Refer to Table 10 for the appropriate calibrator outputs and parameter values as you complete the following steps:
 - a. On the calibrator, output the value listed under Calibrator Output in Table 10 for the current iteration.
 - b. Call `niDMM_CalAdjustACFilter` with **Mode** set to `NIDMM_VAL_AC_VOLTS` and the remaining parameters as shown in Table 10 for the current iteration.



Note The **Session** parameter remains the same for all instances of this function.

- c. Call `niDMM_CalAdjustACFilter` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
8. Repeat step 7 for each of the remaining iterations shown in Table 10.

Table 10. `niDMM_CalAdjustACFilter` Parameters

| Iteration | Calibrator Output | | niDMM_CalAdjustACFilter Parameters | | |
|-----------|-------------------|-----------------|------------------------------------|-----------|----------------|
| | Amplitude | Frequency (kHz) | Mode | Range (V) | Frequency (Hz) |
| 1 | 50 mV | 1 | NIDMM_VAL_AC_VOLTS | 0.05 | 1e3 |
| | 50 mV | 1 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 1e3 |
| 2 | 50 mV | 5 | NIDMM_VAL_AC_VOLTS | 0.05 | 5e3 |
| | 50 mV | 5 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 5e3 |
| 3 | 50 mV | 20 | NIDMM_VAL_AC_VOLTS | 0.05 | 20e3 |
| | 50 mV | 20 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 20e3 |
| 4 | 50 mV | 50 | NIDMM_VAL_AC_VOLTS | 0.05 | 50e3 |
| | 50 mV | 50 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 50e3 |
| 5 | 50 mV | 100 | NIDMM_VAL_AC_VOLTS | 0.05 | 100e3 |
| | 50 mV | 100 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 100e3 |
| 6 | 50 mV | 200 | NIDMM_VAL_AC_VOLTS | 0.05 | 200e3 |
| | 50 mV | 200 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 200e3 |
| 7 | 50 mV | 300 | NIDMM_VAL_AC_VOLTS | 0.05 | 300e3 |
| | 50 mV | 300 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 300e3 |
| 8 | 50 mV | 500 | NIDMM_VAL_AC_VOLTS | 0.05 | 500e3 |
| | 50 mV | 500 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.05 | 500e3 |

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_CalAdjustACFilter Parameters | | |
|-----------|-------------------|-----------------|------------------------------------|-----------|----------------|
| | Amplitude | Frequency (kHz) | Mode | Range (V) | Frequency (Hz) |
| 9 | 500 mV | 1 | NIDMM_VAL_AC_VOLTS | 0.5 | 1e3 |
| | 500 mV | 1 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 1e3 |
| 10 | 500 mV | 5 | NIDMM_VAL_AC_VOLTS | 0.5 | 5e3 |
| | 500 mV | 5 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 5e3 |
| 11 | 500 mV | 20 | NIDMM_VAL_AC_VOLTS | 0.5 | 20e3 |
| | 500 mV | 20 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 20e3 |
| 12 | 500 mV | 50 | NIDMM_VAL_AC_VOLTS | 0.5 | 50e3 |
| | 500 mV | 50 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 50e3 |
| 13 | 500 mV | 100 | NIDMM_VAL_AC_VOLTS | 0.5 | 100e3 |
| | 500 mV | 100 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 100e3 |
| 14 | 500 mV | 200 | NIDMM_VAL_AC_VOLTS | 0.5 | 200e3 |
| | 500 mV | 200 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 200e3 |
| 15 | 500 mV | 300 | NIDMM_VAL_AC_VOLTS | 0.5 | 300e3 |
| | 500 mV | 300 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 300e3 |
| 16 | 500 mV | 500 | NIDMM_VAL_AC_VOLTS | 0.5 | 500e3 |
| | 500 mV | 500 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 0.5 | 500e3 |
| 17 | 5 V | 1 | NIDMM_VAL_AC_VOLTS | 5 | 1e3 |
| | 5 V | 1 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 1e3 |

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_CalAdjustACFilter Parameters | | |
|-----------|-------------------|-----------------|------------------------------------|-----------|----------------|
| | Amplitude | Frequency (kHz) | Mode | Range (V) | Frequency (Hz) |
| 18 | 5 V | 5 | NIDMM_VAL_AC_VOLTS | 5 | 5e3 |
| | 5 V | 5 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 5e3 |
| 19 | 5 V | 20 | NIDMM_VAL_AC_VOLTS | 5 | 20e3 |
| | 5 V | 20 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 20e3 |
| 20 | 5 V | 50 | NIDMM_VAL_AC_VOLTS | 5 | 50e3 |
| | 5 V | 50 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 50e3 |
| 21 | 5 V | 100 | NIDMM_VAL_AC_VOLTS | 5 | 100e3 |
| | 5 V | 100 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 100e3 |
| 22 | 5 V | 200 | NIDMM_VAL_AC_VOLTS | 5 | 200e3 |
| | 5 V | 200 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 200e3 |
| 23 | 5 V | 300 | NIDMM_VAL_AC_VOLTS | 5 | 300e3 |
| | 5 V | 300 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 300e3 |
| 24 | 5 V | 500 | NIDMM_VAL_AC_VOLTS | 5 | 500e3 |
| | 5 V | 500 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 5 | 500e3 |
| 25 | 50 V | 1 | NIDMM_VAL_AC_VOLTS | 50 | 1e3 |
| | 50 V | 1 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 1e3 |
| 26 | 50 V | 5 | NIDMM_VAL_AC_VOLTS | 50 | 5e3 |
| | 50 V | 5 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 5e3 |

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_CalAdjustACFilter Parameters | | |
|-----------|-------------------|-----------------|------------------------------------|-----------|----------------|
| | Amplitude | Frequency (kHz) | Mode | Range (V) | Frequency (Hz) |
| 27 | 50 V | 20 | NIDMM_VAL_AC_VOLTS | 50 | 20e3 |
| | 50 V | 20 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 20e3 |
| 28 | 50 V | 50 | NIDMM_VAL_AC_VOLTS | 50 | 50e3 |
| | 50 V | 50 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 50e3 |
| 29 | 50 V | 100 | NIDMM_VAL_AC_VOLTS | 50 | 100e3 |
| | 50 V | 100 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 100e3 |
| 30 | 50 V | 200 | NIDMM_VAL_AC_VOLTS | 50 | 200e3 |
| | 50 V | 200 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 200e3 |
| 31 | 50 V | 300 | NIDMM_VAL_AC_VOLTS | 50 | 300e3 |
| | 50 V | 300 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 300e3 |
| 32 | 10 V | 500 | NIDMM_VAL_AC_VOLTS | 50 | 500e3 |
| | 10 V | 500 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 50 | 500e3 |
| 33 | 100 V | 1 | NIDMM_VAL_AC_VOLTS | 300 | 1e3 |
| | 100 V | 1 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 1e3 |
| 34 | 100 V | 5 | NIDMM_VAL_AC_VOLTS | 300 | 5e3 |
| | 100 V | 5 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 5e3 |
| 35 | 100 V | 20 | NIDMM_VAL_AC_VOLTS | 300 | 20e3 |
| | 100 V | 20 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 20e3 |

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

| Iteration | Calibrator Output | | niDMM_CalAdjustACFilter Parameters | | |
|-----------|-------------------|-----------------|------------------------------------|-----------|----------------|
| | Amplitude | Frequency (kHz) | Mode | Range (V) | Frequency (Hz) |
| 36 | 100 V | 50 | NIDMM_VAL_AC_VOLTS | 300 | 50e3 |
| | 100 V | 50 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 50e3 |
| 37 | 100 V | 100 | NIDMM_VAL_AC_VOLTS | 300 | 100e3 |
| | 100 V | 100 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 100e3 |
| 38 | 100 V | 200 | NIDMM_VAL_AC_VOLTS | 300 | 200e3 |
| | 100 V | 200 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 200e3 |
| 39 | 50 V | 300 | NIDMM_VAL_AC_VOLTS | 300 | 300e3 |
| | 50 V | 300 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 300e3 |
| 40 | 10 V | 500 | NIDMM_VAL_AC_VOLTS | 300 | 500e3 |
| | 10 V | 500 | NIDMM_VAL_AC_VOLTS_DCCOUPLED | 300 | 500e3 |

9. Reset the calibrator for safety reasons.

10. Call niDMM_CalAdjustMisc with **Type** set to NIDMM_EXTCAL_MISCCAL_SECTION.

You have completed adjusting the AC voltage modes of the NI 4070. Select one of the following options:

- If you want to perform additional adjustments, go to the [Adjusting Current Modes](#) section.
- If you do not want to perform the current mode adjustments, go to the [Verification Procedures](#) section to verify your new calibration coefficients before saving them to the EEPROM.
- If you do not want to verify the adjustments you have just made, go to the [Completing the Adjustment Procedures](#) section.

Adjusting Current Modes

If you do not use the current modes (DC and AC), or the accuracy is insignificant for your application, you can skip this section and select one of the following options:

- If you skip this section and you want to verify the new calibration coefficients before saving them to the EEPROM, repeat the [Verification Procedures](#) section (except for [Setting Up the Test Equipment](#)).
- If you skip this section and you do not want to verify the new calibration coefficients, go to the [Completing the Adjustment Procedures](#) section.

To adjust the current modes of the NI 4070, complete the following steps:

1. Reset the calibrator.



Caution Step 2 must be performed correctly to avoid shorting on unconnected spade lugs.

2. Connect the calibration cable assembly with the connector block plugged into the NI 4070 and with the spade lugs connected to the appropriate binding posts on the calibrator, as described in Figure 3 and Table 1.
3. Connect a banana-to-banana cable or a wire (AWG ≤ 22) between the the *AUX CURRENT* binding post and the *SENSE HI* binding post of the calibrator.
4. Call `niDMM_ConfigureMeasurement` with the following parameters:
 - **Function** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = `0.02`
5. Call `niDMM_Read` to configure the NI 4070 for a current mode before applying current.
6. Output 20 mA on the calibrator with the current output set to *AUX*.
7. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = `0.02`
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = `0.02`
8. Output -20 mA on the calibrator with the current output set to *AUX*.
9. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = `0.02`

- **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 - **Expected Value** = -0.02
10. Output 0 A on the calibrator with the current output set to AUX.
 11. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = NIDMM_VAL_DC_CURRENT
 - **Range** = 0.02
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 12. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = NIDMM_VAL_AC_CURRENT
 - **Range** = 0.01
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 13. Output 200 mA on the calibrator with the current output set to AUX.
 14. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = NIDMM_VAL_DC_CURRENT
 - **Range** = 0.2
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 - **Expected Value** = 0.2
 15. Output -200 mA on the calibrator with the current output set to AUX.
 16. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = NIDMM_VAL_DC_CURRENT
 - **Range** = 0.2
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 - **Expected Value** = -0.2
 17. Output 0 A on the calibrator with the current output set to AUX.
 18. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = NIDMM_VAL_DC_CURRENT
 - **Range** = 0.2
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 19. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = NIDMM_VAL_AC_CURRENT
 - **Range** = 0.1
 - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
 20. Output 1 A on the calibrator with the current output set to AUX.

21. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = 1
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = 1
22. Output -1 A on the calibrator with the current output set to AUX.
23. Call `niDMM_CalAdjustGain` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = 1
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
 - **Expected Value** = -1
24. Output 0 A on the calibrator with the current output set to AUX.
25. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_DC_CURRENT`
 - **Range** = 1
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
26. Call `niDMM_CalAdjustOffset` with the following parameters:
 - **Mode** = `NIDMM_VAL_AC_CURRENT`
 - **Range** = 1
 - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
27. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_SECTION`.

You have completed adjusting the current modes of the NI 4070. Select one of the following options:

- To verify that the NI 4070 is now operating within its specifications, go to the [Verification Procedures](#) section and complete the appropriate procedures.
- To finish the calibration and close the session, go to the [Completing the Adjustment Procedures](#) section.

Completing the Adjustment Procedures

To complete the adjustment procedure for the NI 4070 and close the session, call `niDMM_CloseExtCal` with the following parameter:

- **Action** = `NIDMM_EXTCAL_ACTION_SAVE` if the results of the calibration were satisfactory and you want to save the new calibration coefficients to the EEPROM.

Otherwise,

- **Action** = `NIDMM_EXTCAL_ACTION_ABORT` if the results of the calibration were unsatisfactory and you want to restore the original calibration coefficients to the EEPROM.

Verification Limits

This section includes the verification limits for DC voltage, AC voltage, 4-wire resistance, 2-wire resistance, DC current, AC current, and frequency for the NI 4070. Compare these limits to the results you obtain in the [Verification Procedures](#) section.

DC Voltage

Table 11. NI 4070 DC Voltage Verification Limits

| Calibrator Amplitude | Range | Input Resistance | 2-Year Limits | | 24-Hour Limits | |
|----------------------|--------|------------------|---------------|-------------|----------------|-------------|
| | | | Lower | Upper | Lower | Upper |
| 0 V | 1 V | >10 GΩ/10 MΩ | -6 μV | 6 μV | -2 μV | 2 μV |
| 0 V | 10 V | >10 GΩ/10 MΩ | -60 μV | 60 μV | -20 μV | 20 μV |
| 0 V | 100 V | 10 MΩ | -600 μV | 600 μV | -200 μV | 200 μV |
| 0 V | 300 V | 10 MΩ | -6 mV | 6 mV | -1.8 mV | 1.8 mV |
| 100 mV | 100 mV | >10 GΩ/10 MΩ | 0.099994 V | 0.100006 V | 0.099998 V | 0.100002 V |
| -100 mV | 100 mV | >10 GΩ/10 MΩ | -0.100006 V | -0.099994 V | -0.100002 V | -0.099998 V |
| 1 V | 1 V | >10 GΩ/10 MΩ | 0.999969 V | 1.000031 V | 0.999992 V | 1.000008 V |
| -1 V | 1 V | >10 GΩ/10 MΩ | -1.000031 V | -0.999969 V | -1.000008 V | -0.999992 V |
| 10 V | 10 V | >10 GΩ/10 MΩ | 9.99969 V | 10.00031 V | 9.99994 V | 10.00006 V |
| -10 V | 10 V | >10 GΩ/10 MΩ | -10.00031 V | -9.99969 V | -10.00006 V | -9.99994 V |
| 100 V | 100 V | 10 MΩ | 99.9959 V | 100.0041 V | 99.9992 V | 100.0008 V |
| -100 V | 100 V | 10 MΩ | -100.0041 V | -99.9959 V | -100.0008 V | -99.9992 V |
| 300 V | 300 V | 10 MΩ | 299.9835 V | 300.0165 V | 299.9964 V | 300.0036 V |
| -300 V | 300 V | 10 MΩ | -300.0165 V | -299.9835 V | -300.0036 V | -299.9964 V |

AC Voltage

Table 12. NI 4070 AC Voltage Verification Limits

| Calibrator Output | | Range | Coupling | 2-Year Limits | |
|-------------------|-----------|--------|----------|---------------|-------------|
| Amplitude | Frequency | | | Lower | Upper |
| 5 mV | 1 kHz | 50 mV | AC/DC | 0.0049775 V | 0.0050225 V |
| 50 mV | 30 Hz | 50 mV | DC | 0.04993 V | 0.05007 V |
| 50 mV | 50 Hz | 50 mV | AC/DC | 0.049955 V | 0.050045 V |
| 50 mV | 1 kHz | 50 mV | AC/DC | 0.049955 V | 0.050045 V |
| 50 mV | 1 kHz | 500 mV | AC/DC | 0.049875 V | 0.050125 V |
| 50 mV | 20 kHz | 50 mV | AC/DC | 0.049955 V | 0.050045 V |
| 50 mV | 50 kHz | 50 mV | AC/DC | 0.049935 V | 0.050065 V |
| 50 mV | 100 kHz | 50 mV | AC/DC | 0.04971 V | 0.05029 V |
| 50 mV | 300 kHz | 50 mV | AC/DC | 0.04845 V | 0.05155 V |
| 500 mV | 30 Hz | 500 mV | DC | 0.49945 V | 0.50055 V |
| 500 mV | 50 Hz | 500 mV | AC/DC | 0.49965 V | 0.50035 V |
| 500 mV | 1 kHz | 500 mV | AC/DC | 0.49965 V | 0.50035 V |
| 500 mV | 1 kHz | 5 V | AC/DC | 0.49875 V | 0.50125 V |
| 500 mV | 20 kHz | 500 mV | AC/DC | 0.49965 V | 0.50035 V |
| 500 mV | 50 kHz | 500 mV | AC/DC | 0.49945 V | 0.50055 V |
| 500 mV | 100 kHz | 500 mV | AC/DC | 0.4974 V | 0.5026 V |
| 500 mV | 300 kHz | 500 mV | AC/DC | 0.48475 V | 0.51525 V |
| 5 V | 30 Hz | 5 V | DC | 4.9945 V | 5.0055 V |
| 5 V | 50 Hz | 5 V | AC/DC | 4.9965 V | 5.0035 V |
| 5 V | 1 kHz | 5 V | AC/DC | 4.9965 V | 5.0035 V |
| 5 V | 1 kHz | 50 V | AC/DC | 4.9875 V | 5.0125 V |
| 5 V | 1 kHz | 300 V | AC/DC | 4.9375 V | 5.0625 V |
| 5 V | 20 kHz | 5 V | AC/DC | 4.9965 V | 5.0035 V |
| 5 V | 50 kHz | 5 V | AC/DC | 4.9945 V | 5.0055 V |
| 5 V | 100 kHz | 5 V | AC/DC | 4.974 V | 5.026 V |

Table 12. NI 4070 AC Voltage Verification Limits (Continued)

| Calibrator Output | | Range | Coupling | 2-Year Limits | |
|-------------------|-----------|-------|----------|---------------|------------|
| Amplitude | Frequency | | | Lower | Upper |
| 5 V | 300 kHz | 5 V | AC/DC | 4.8475 V | 5.1525 V |
| 50 V | 30 Hz | 50 V | DC | 49.945 V | 50.055 V |
| 50 V | 50 Hz | 50 V | AC/DC | 49.965 V | 50.035 V |
| 50 V | 1 kHz | 50 V | AC/DC | 49.965 V | 50.035 V |
| 50 V | 20 kHz | 50 V | AC/DC | 49.965 V | 50.035 V |
| 50 V | 50 kHz | 50 V | AC/DC | 49.945 V | 50.055 V |
| 50 V | 100 kHz | 50 V | AC/DC | 49.74 V | 50.26 V |
| 50 V | 300 kHz | 50 V | AC/DC | 48.475 V | 51.525 V |
| 219 V | 30 Hz | 300 V | DC | 218.751 V | 219.249 V |
| 219 V | 50 Hz | 300 V | AC/DC | 218.8305 V | 219.1695 V |
| 219 V | 1 kHz | 300 V | AC/DC | 218.8305 V | 219.1695 V |
| 219 V | 20 kHz | 300 V | AC/DC | 218.8305 V | 219.1695 V |
| 219 V | 50 kHz | 300 V | AC/DC | 218.7429 V | 219.2571 V |
| 219 V | 100 kHz | 300 V | AC/DC | 217.845 V | 220.155 V |
| 70 V | 300 kHz | 300 V | AC/DC | 67.75 V | 72.25 V |

4-Wire Resistance



Note Tolerances are provided for 4-wire resistance instead of absolute limits because the limits depend on the actual resistance value output by your calibrator.

Table 13. NI 4070 4-Wire Resistance Verification Tolerances

| Calibrator Resistance | Range | 2-Year Tolerance (ppm of Range) | 24-Hour Tolerance (ppm of Range) |
|-----------------------|----------------|---------------------------------|----------------------------------|
| 10 M Ω | 10 M Ω | ± 410 ppm | ± 102 ppm |
| 1 M Ω | 1 M Ω | ± 100 ppm | ± 22 ppm |
| 100 k Ω | 100 k Ω | ± 86 ppm | ± 14 ppm |
| 10 k Ω | 10 k Ω | ± 83 ppm | ± 14 ppm |

Table 13. NI 4070 4-Wire Resistance Verification Tolerances (Continued)

| Calibrator Resistance | Range | 2-Year Tolerance (ppm of Range) | 24-Hour Tolerance (ppm of Range) |
|-----------------------|----------------|---------------------------------|----------------------------------|
| 1 k Ω | 1 k Ω | ± 83 ppm | ± 14 ppm |
| 100 Ω | 100 Ω | ± 90 ppm | ± 25 ppm |
| 0 Ω | 10 M Ω | ± 10 ppm | ± 2 ppm |
| 0 Ω | 1 M Ω | ± 10 ppm | ± 2 ppm |
| 0 Ω | 100 k Ω | ± 6 ppm | ± 2 ppm |
| 0 Ω | 10 k Ω | ± 3 ppm | ± 2 ppm |
| 0 Ω | 1 k Ω | ± 3 ppm | ± 2 ppm |
| 0 Ω | 100 Ω | ± 10 ppm | ± 10 ppm |

2-Wire Resistance



Note Tolerances are provided for 2-wire resistance instead of absolute limits because the limits depend on the actual resistance value output by your calibrator.

Table 14. NI 4070 2-Wire Resistance Verification Tolerances

| Calibrator Resistance | Range | 2-Year Tolerance (ppm of Range) | 24-Hour Tolerance (ppm of Range) |
|-----------------------|----------------|---------------------------------|----------------------------------|
| 100 M Ω | 100 M Ω | ± 2040 ppm | ± 920 ppm |
| 10 M Ω | 10 M Ω | ± 410 ppm | ± 102 ppm |
| 1 M Ω | 1 M Ω | ± 100 ppm | ± 22 ppm |
| 100 k Ω | 100 k Ω | ± 86 ppm | ± 14 ppm |
| 10 k Ω | 10 k Ω | ± 83 ppm | ± 14 ppm |
| 1 k Ω | 1 k Ω | ± 83 ppm | ± 14 ppm |
| 100 Ω | 100 Ω | ± 90 ppm | ± 25 ppm |

DC Current

Table 15. NI 4070 DC Current Verification Limits

| Calibrator Amplitude | Range | 2-Year Limits | |
|----------------------|--------|---------------|-------------|
| | | Lower | Upper |
| 0 A | 20 mA | -1.5 μ A | 1.5 μ A |
| 0 A | 200 mA | -4 μ A | 4 μ A |
| 0 A | 1 A | -20 μ A | 20 μ A |
| 20 mA | 20 mA | 19.9905 mA | 20.0095 mA |
| -20 mA | 20 mA | -20.0095 mA | -19.9905 mA |
| 200 mA | 200 mA | 199.916 mA | 200.084 mA |
| -200 mA | 200 mA | -200.084 mA | -199.916 mA |
| 1 A | 1 A | 0.99948 A | 1.00052 A |
| -1 A | 1 A | -1.00052 A | -0.99948 A |

AC Current

Table 16. NI 4070 AC Current Verification Limits

| Calibrator Output | | Range | 2-Year Limits | |
|-------------------|-----------|--------|---------------|-----------|
| Amplitude | Frequency | | Lower | Upper |
| 1 mA | 1 kHz | 10 mA | 0.9976 mA | 1.0024 mA |
| 10 mA | 1 kHz | 10 mA | 9.994 mA | 10.006 mA |
| 10 mA | 1 kHz | 100 mA | 9.976 mA | 10.024 mA |
| 100 mA | 1 kHz | 100 mA | 99.94 mA | 100.06 mA |
| 100 mA | 1 kHz | 1 A | 99.7 mA | 100.3 mA |
| 1 A | 1 kHz | 1 A | 0.9988 A | 1.0012 A |

Frequency

Table 17. Frequency Limits

| NI 6608 Output Frequency | 2-Year Limits | |
|-----------------------------|---------------|------------|
| | Lower | Upper |
| 1 Hz | 0.9999 Hz | 1.0001 Hz |
| 20 kHz | 19.998 kHz | 20.002 kHz |
| 500 kHz | 499.95 kHz | 500.05 kHz |

Calibration Function Reference

For detailed information about the NI-DMM calibration functions used in this procedure, refer to the *VI Reference* or the *C/C++/VB Function Reference* topics in the *NI Digital Multimeters Help*, located at **Start» Programs» National Instruments» NI-DMM» Documentation**.

Technical Support Resources

NI Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of ni.com.

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 electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/hardref.nsf. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of ni.com. Branch office Web sites provide up-to-date contact information, support phone numbers, email addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 61 2 9672 8846, Austria 43 0 662 45 79 90 0, Belgium 32 0 2 757 00 20,
Brazil 55 11 3262 3599, Canada (Calgary) 403 274 9391,
Canada (Montreal) 514 288 5722, Canada (Ottawa) 613 233 5949,
Canada (Québec) 514 694 8521, Canada (Toronto) 905 785 0085,
Canada (Vancouver) 514 685 7530, China 86 21 6555 7838,
Czech Republic 420 2 2423 5774, Denmark 45 45 76 26 00,
Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24,
Germany 49 0 89 741 31 30, Greece 30 2 10 42 96 427, Hong Kong 2645 3186,
India 91 80 51190000, Israel 972 0 3 6393737, Italy 39 02 413091,
Japan 81 3 5472 2970, Korea 82 02 3451 3400, Malaysia 603 9059 6711,
Mexico 001 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 64 09 914 0488, Norway 47 0 32 27 73 00,
Poland 48 0 22 3390 150, Portugal 351 210 311 210, Russia 7 095 238 7139,
Singapore 65 6 226 5886, Slovenia 386 3 425 4200, South
Africa 27 0 11 805 8197, Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
Switzerland 41 56 200 51 51, Taiwan 886 2 2528 7227,
United Kingdom 44 0 1635 523545