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

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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.
- Plug the PXI chassis and the calibrator into the same power strip to avoid ground loops.

- 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, select **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 version 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.

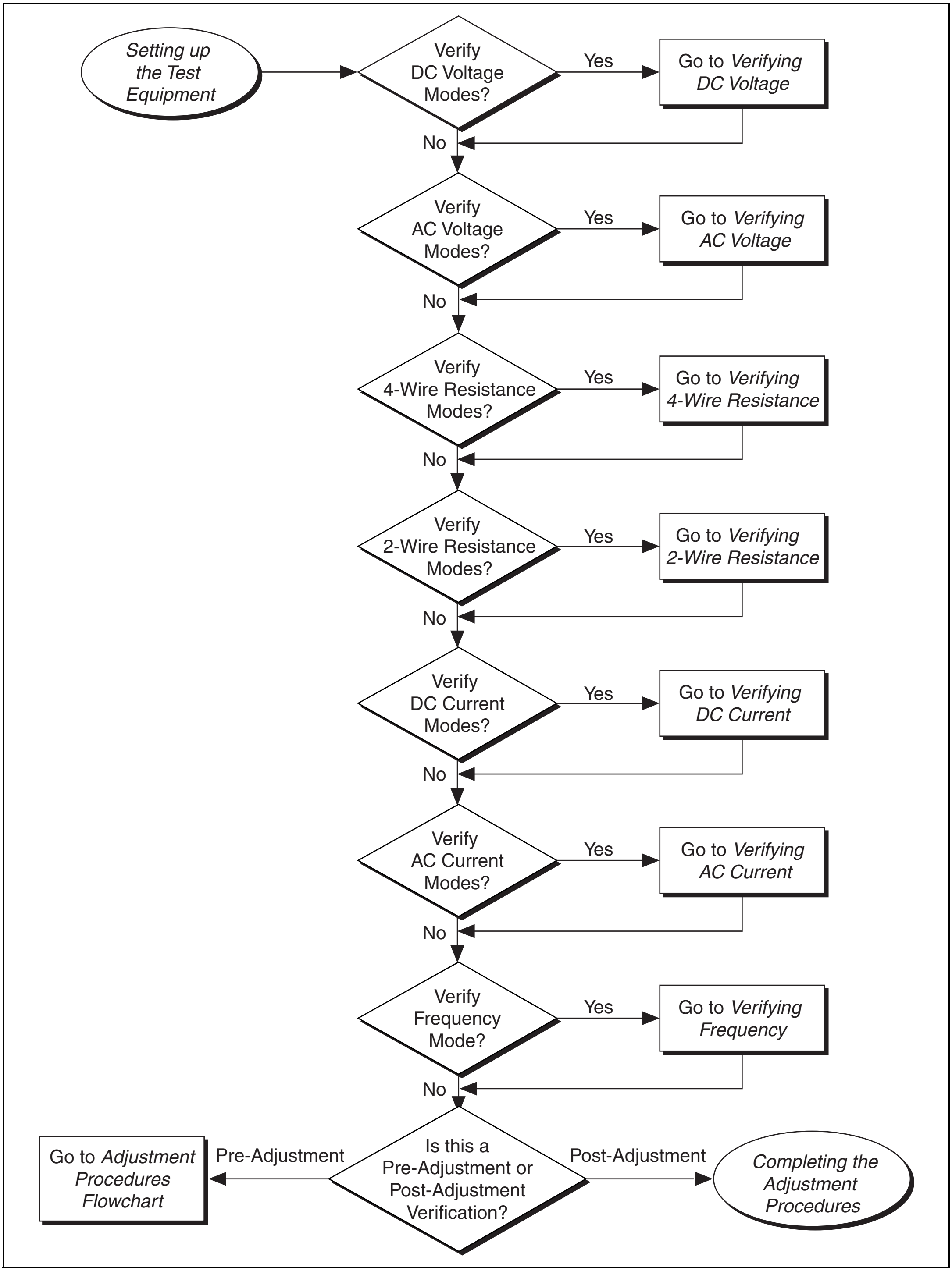


Figure 1. Verification Procedures Flowchart

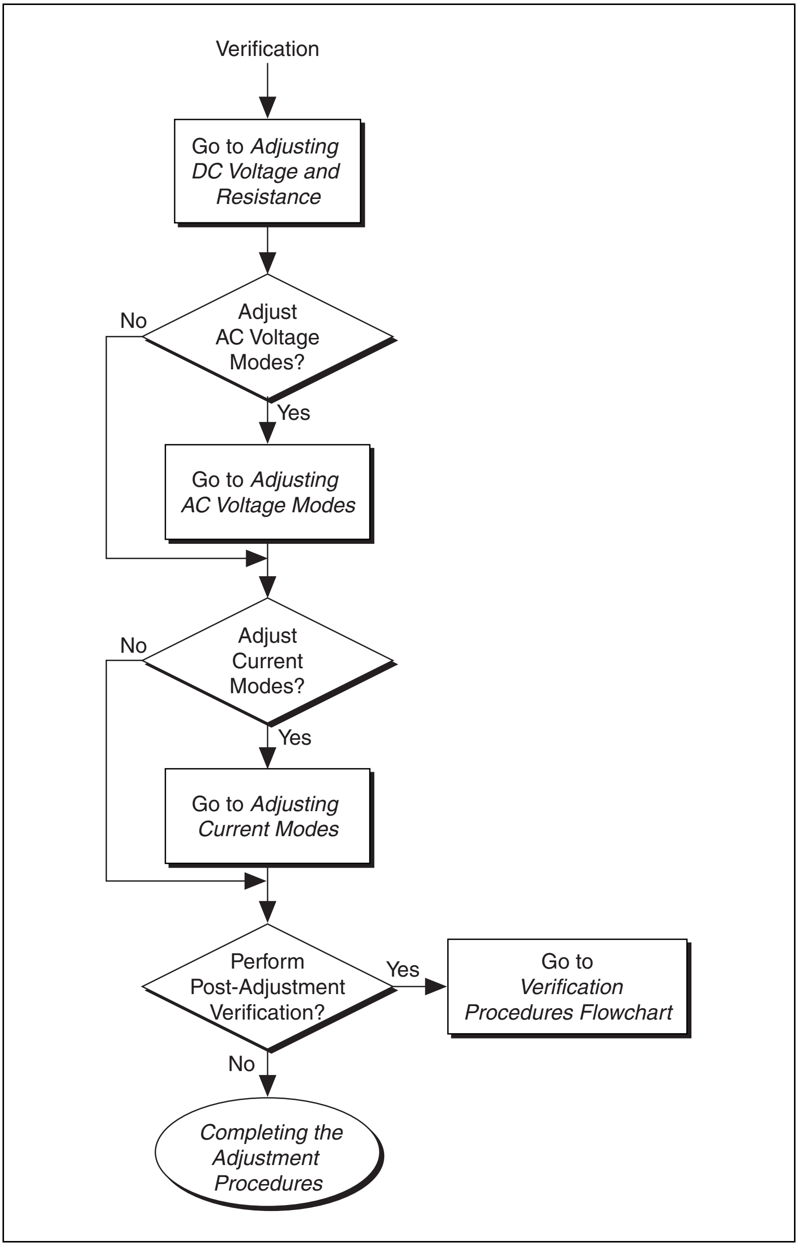


Figure 2. Adjustment Procedures Flowchart

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

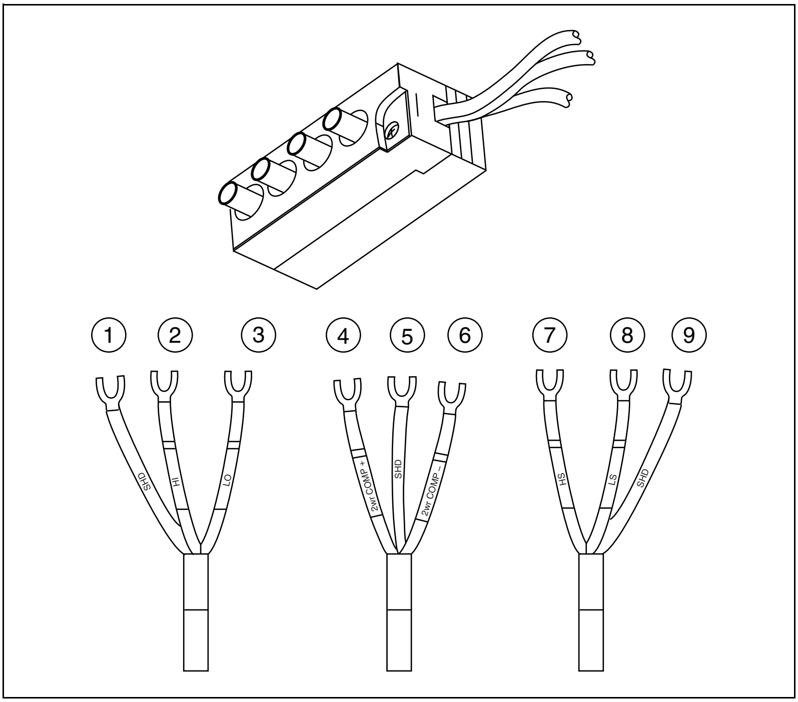
To verify DC voltage of the NI 4070, complete the following steps:

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 GΩ 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 MΩ 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** = `10e-6`

10. Set the input resistance of the NI 4070 to >10 GΩ 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 MΩ 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** = `100e-6`
15. Set the input resistance of the NI 4070 to 10 MΩ 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** = `300e-6`
18. Set the input resistance of the NI 4070 to 10 MΩ 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.



1	SHD	4	2wr COMP+	7	HS
2	HI	5	SHD	8	LS
3	LO	6	2wr COMP–	9	SHD

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 GΩ 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 GΩ mode offset.

29. Set the input resistance of the NI 4070 to 10 MΩ 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 MΩ 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 GΩ 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 GΩ 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 MΩ 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 MΩ 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 Ω 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 GΩ 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 GΩ 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 MΩ 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 MΩ 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 GΩ 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 MΩ 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 GΩ 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 MΩ 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 GΩ 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 MΩ 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 GΩ 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 MΩ 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 MΩ 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 at 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	NIDMM_VAL_AC_VOLTS	0.05	50e–9
	50 mV	50 Hz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.05	50e–9
2	50 mV	1 kHz	NIDMM_VAL_AC_VOLTS	0.05	50e–9
	50 mV	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.05	50e–9
3	50 mV	1 kHz	NIDMM_VAL_AC_VOLTS	0.5	500e–9
	50 mV	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	500e–9
4	50 mV	20 kHz	NIDMM_VAL_AC_VOLTS	0.05	50e–9
	50 mV	20 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.05	50e–9

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** = 500`e-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:
    a. On the calibrator, output the value listed under Calibrator Output in Table 4 for the current iteration.
    b. Call `niDMM_ConfigureMeasurement` with **Mode** set to `NIDMM_VAL_AC_VOLTS` and the remaining parameters as shown in Table 4 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 4. niDMM_ConfigureMeasurement Parameters

	Calibrator Output		niDMM_ConfigureMeasurement Parameters		
Iteration	**Amplitude**	**Frequency**	**Function**	**Range**	**Resolution**
1	5 V	50 Hz	NIDMM_VAL_AC_VOLTS	5	5e–6
	5 V	50 Hz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	5	5e–6
2	5 V	1 kHz	NIDMM_VAL_AC_VOLTS	5	5e–6
	5 V	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	5	5e–6
3	5 V	1 kHz	NIDMM_VAL_AC_VOLTS	50	50e–6
	5 V	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	50	50e–6
4	5 V	1 kHz	NIDMM_VAL_AC_VOLTS	300	300e–6
	5 V	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	300	300e–6
5	5 V	20 kHz	NIDMM_VAL_AC_VOLTS	5	5e–6
	5 V	20 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	5	5e–6
6	5 V	50 kHz	NIDMM_VAL_AC_VOLTS	5	5e–6
	5 V	50 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	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	NIDMM_VAL_AC_VOLTS	300	300e–6
	219 V	50 Hz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	300	300e–6
2	219 V	1 kHz	NIDMM_VAL_AC_VOLTS	300	300e–6
	219 V	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	300	300e–6
3	219 V	20 kHz	NIDMM_VAL_AC_VOLTS	300	300e–6
	219 V	20 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	300	300e–6
4	219 V	50 kHz	NIDMM_VAL_AC_VOLTS	300	300e–6
	219 V	50 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	300	300e–6
5	219 V	100 kHz	NIDMM_VAL_AC_VOLTS	300	300e–6
	219 V	100 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	300	300e–6

Table 6. 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. 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_ConfigureOffsetCompOhms` with **OffsetCompOhms** set to either `NIDMM_VAL_OFFSET_COMP_OHMS_ON` or `NIDMM_VAL_OFFSET_COMP_OHMS_OFF` according to Table 7 for the current iteration.

d. 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.

6. Repeat step 5 for each of the remaining iterations listed in Table 7.

Table 7. niDMM_ConfigureMeasurement Parameters

Iteration	Calibrator Output	niDMM_ConfigureMeasurement Parameters			OffsetCompOhms
		Function	Range	Resolution	
1	10 MΩ	NIDMM_VAL_4_WIRE_RES	10e6	10	OFF
2	1 MΩ	NIDMM_VAL_4_WIRE_RES	1e6	1	OFF
3	100 kΩ	NIDMM_VAL_4_WIRE_RES	100e3	0.1	OFF
4	10 kΩ	NIDMM_VAL_4_WIRE_RES	10e3	0.01	ON
5	1 kΩ	NIDMM_VAL_4_WIRE_RES	1e3	1e–3	ON
6	100 Ω	NIDMM_VAL_4_WIRE_RES	100	100e–6	ON
7	0 Ω	NIDMM_VAL_4_WIRE_RES	10e6	10	OFF
8	0 Ω	NIDMM_VAL_4_WIRE_RES	1e6	1	OFF
9	0 Ω	NIDMM_VAL_4_WIRE_RES	100e3	0.1	OFF
10	0 Ω	NIDMM_VAL_4_WIRE_RES	10e3	0.01	ON
11	0 Ω	NIDMM_VAL_4_WIRE_RES	1e3	1e–3	ON
12	0 Ω	NIDMM_VAL_4_WIRE_RES	100	100e–6	ON

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 Ω 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 MΩ 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 MΩ 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 MΩ 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 kΩ 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 kΩ 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 kΩ 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 MΩ 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 MΩ range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
27. Output 10 MΩ 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 MΩ range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
30. Output 1 MΩ 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 MΩ range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
33. Output 100 kΩ 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 kΩ range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
36. Output 10 kΩ 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 kΩ range offset from this measurement. Verify that the result falls between the tolerances listed in Table 14.
39. Output 1 kΩ 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 kΩ 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. Call `niDMM_reset` to reset the NI 4070 to a known state.
5. Call `niDMM_ConfigureMeasurement` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `0.02`
   - **Resolution** = `20e-9`
6. Call `niDMM_Read` to configure the NI 4070 for a current mode before applying current.
7. Output 20 mA 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 15.
9. Output –20 mA 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 15.
11. Output 0 A on the calibrator with the current output set to `AUX`.

12. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
13. Call `niDMM_ConfigureMeasurement` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.2`
    - **Resolution** = `200e-9`
14. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 15.
15. Call `niDMM_ConfigureMeasurement` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1`
    - **Resolution** = `1e-6`
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 & 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_10_MEGAOHM`
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 MΩ 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 MΩ*
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 MΩ 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 MΩ*
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 kΩ 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 kΩ*
39. Output 0 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** = `100e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = *the display on the calibrator for 0 Ω*
41. Output 10 kΩ 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** = `10e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = *the display on the calibrator for 10 kΩ*
43. Output 0 Ω on the calibrator with external sense turned on, but without 2-wire compensation.
44. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `100e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`

45. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `10e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
46. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCAL_RREF`.
47. Call `niDMM_SelfCal` to self-calibrate the NI 4070.
48. Output 0 Ω on the calibrator with external sense turned on, but with 2-wire compensation turned off.
49. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `10e6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
50. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `1e6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
51. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `1e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
52. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `100`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
53. 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.
54. Wait two minutes for the thermal EMF to stabilize.
55. Output 0 Ω on the calibrator with external sense and 2-wire compensation turned on.

56. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `10e6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
57. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `1e6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
58. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
59. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `10e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
60. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `1e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
61. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
62. 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

	Calibrator Output		niDMM_CalAdjustGain Parameters			
Iteration	**Amplitude**	**Frequency**	**Mode**	**Range (V)**	**Input Resistance**	**Expected Value**
1	50 mV	1 kHz	NIDMM_VAL_AC_VOLTS	0.05	NIDMM_VAL_ 1_MEGAOHM	0.05
	50 mV	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	0.05	NIDMM_VAL_ 1_MEGAOHM	0.05
2	500 mV	1 kHz	NIDMM_VAL_AC_VOLTS	0.5	NIDMM_VAL_ 1_MEGAOHM	0.5
	500 mV	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	0.5	NIDMM_VAL_ 1_MEGAOHM	0.5

Table 8. niDMM_CalAdjustGain Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustGain Parameters			
	Amplitude	**Frequency**	**Mode**	**Range (V)**	**Input Resistance**	**Expected Value**
3	5 V	1 kHz	NIDMM_VAL_AC_VOLTS	5	NIDMM_VAL_ 1_MEGAOHM	5
	5 V	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	5	NIDMM_VAL_ 1_MEGAOHM	5
4	50 V	1 kHz	NIDMM_VAL_AC_VOLTS	50	NIDMM_VAL_ 1_MEGAOHM	50
	50 V	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	50	NIDMM_VAL_ 1_MEGAOHM	50
5	100 V	1 kHz	NIDMM_VAL_AC_VOLTS	300	NIDMM_VAL_ 1_MEGAOHM	100
	100 V	1 kHz	NIDMM_VAL_AC_VOLTS _DCCOUPLED	300	NIDMM_VAL_ 1_MEGAOHM	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

Table 9. niDMM_CalAdjustOffset Parameters

Iteration	niDMM_CalAdjustOffset Parameters		
	Mode	**Range (V)**	**Input Resistance (Ω)**
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

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustACFilter Parameters		
	Amplitude	Frequency (kHz)	Mode	Range (V)	Frequency (Hz)
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
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

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustACFilter Parameters		
	Amplitude	Frequency (kHz)	Mode	Range (V)	Frequency (Hz)
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
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

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustACFilter Parameters		
	Amplitude	Frequency (kHz)	Mode	Range (V)	Frequency (Hz)
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
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

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustACFilter Parameters		
	Amplitude	Frequency (kHz)	Mode	Range (V)	Frequency (Hz)
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
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

Table 10. niDMM_CalAdjustACFilter Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustACFilter Parameters		
	Amplitude	Frequency (kHz)	Mode	Range (V)	Frequency (Hz)
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

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

Calibrator Output		Range	Coupling	2-Year Limits	
Amplitude	Frequency			Lower	Upper
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
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

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

Calibrator Output		Range	Coupling	2-Year Limits	
Amplitude	Frequency			Lower	Upper
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 MΩ	10 MΩ	±410 ppm	±102 ppm
1 MΩ	1 MΩ	±100 ppm	±22 ppm
100 kΩ	100 kΩ	±86 ppm	±14 ppm
10 kΩ	10 kΩ	±83 ppm	±14 ppm
1 kΩ	1 kΩ	±83 ppm	±14 ppm
100 Ω	100 Ω	±90 ppm	±25 ppm
0 Ω	10 MΩ	±10 ppm	±2 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)
0 Ω	1 MΩ	±10 ppm	±2 ppm
0 Ω	100 kΩ	±6 ppm	±2 ppm
0 Ω	10 kΩ	±3 ppm	±2 ppm
0 Ω	1 kΩ	±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 MΩ	100 MΩ	±2040 ppm	±920 ppm
10 MΩ	10 MΩ	±410 ppm	±102 ppm
1 MΩ	1 MΩ	±100 ppm	±22 ppm
100 kΩ	100 kΩ	±86 ppm	±14 ppm
10 kΩ	10 kΩ	±83 ppm	±14 ppm
1 kΩ	1 kΩ	±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
20 mA	20 mA	19.9905 mA	20.0095 mA
–20 mA	20 mA	–20.0095 mA	–19.9905 mA
0 A	20 mA	–1.5 µA	1.5 µA
0 A	200 mA	–4 µA	4 µA
0 A	1 A	–20 µA	20 µA
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 of 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`.

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