CALIBRATION PROCEDURE

NI 4071 7½-Digit FlexDMM™

This document contains instructions for writing an external calibration procedure for the National Instruments PXI-4071 (NI 4071) 7½-digit FlexDMM and 1.8 MS/s isolated digitizer. For more information on calibration, visit `ni.com/calibration`.

Contents

NATIONAL INSTRUMENTS™

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. When this symbol is marked on a product, refer to the *Read Me First: Safety and Radio-Frequency Interference* document included with the device for information about precautions to take.

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. Italic text 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.

Software Requirements

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 version 2.4 or later supports the NI 4071.

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.

Documentation Requirements

In addition to this calibration document, you may find the following references helpful in writing your calibration utility. All of these documents are installed on your computer with NI-DMM. To locate them, select **Start»All Programs»National Instruments»NI-DMM» Documentation**.

- *NI Digital Multimeters Help*
- *NI Digital Multimeters Getting Started Guide*

In addition, NI recommends referring to the following document online at `ni.com/manuals` to ensure that you are using the latest NI 4071 specifications:

- *NI 4071 Specifications*

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*

Calibration Function Reference

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

Password

The default calibration password in NI-DMM is `"NI"`.

Calibration Interval

The accuracy requirements of your measurement application determine how often you should calibrate the NI 4071. NI recommends performing a complete calibration at least once every two years. NI does not guarantee the absolute accuracy of the NI 4071 beyond this two-year calibration interval. You can shorten the calibration interval based on the demands of your application. Refer to *Appendix A: Calibration Options* for more information.

Test Equipment

This section describes the required and optional equipment for calibration.

Required Test Equipment

The following equipment is required for calibrating the NI 4071:

- Fluke 5700A multifunction calibrator calibrated within the last 90 days or a Fluke 5720A multifunction calibrator calibrated within the last year
- Two sets of Fluke 5440 low thermal electromotive force (EMF) copper cables
- Pomona 5145 insulated double banana plug shorting bar (or another means of creating a short (≤100 mΩ) with low thermal EMF (≤150 nV) across the *HI* and *LO* input banana plug connectors on the NI 4071)
- Two Pomona B-4 banana-to-banana patch cords (cables) or similar banana-to-banana cables with length not to exceed 4 in.
- National Instruments PXI chassis and controller

Optional Test Equipment

The following equipment is optional for calibrating the NI 4071 and is only used for frequency verification:

- NI PXI-6608 counter/timer module
- 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.
- Use PXI filler panels in all vacant slots to allow proper cooling.
- 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 4071 for at least 60 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 4071. 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 banana plugs on the Fluke 5440 cables before plugging them into the binding posts of the calibrator or the banana plug connectors of the NI 4071. Oxidation tarnishes the copper banana plugs so that they appear dull rather than shiny and leads to greater thermal EMF.
- Keep the blue banana plugs on the Fluke 5440 cables connected to the *V GUARD* binding post of the calibrator 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.

Calibration Procedures

The calibration process includes the following steps:

1. *Initial Setup*—Set up the test equipment.
2. *Verification Procedures*—Verify the existing operation of the device. This step confirms whether the device is operating within its specified range prior to calibration. Figure 4 shows the procedural flow for verification.
3. *Adjustment Procedures*—Perform an external adjustment of the device that adjusts the calibration constants with respect to a known voltage source. Figure 5 shows the procedural flow for adjustment.
4. Reverification—Repeat the verification procedure to ensure that the device is operating within its specifications after adjustment.

These steps are described in more detail in the following sections.

Note In some cases, the complete calibration procedure may not be required. Refer to *Appendix A: Calibration Options* for more information.

Initial Setup

Note This 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 plug connectors on the NI 4071.
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 4071 (installed in a powered-on PXI chassis) are warmed up for at least 60 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 `niDMM_init`, refer to the *NI Digital Multimeters Help*.

4. Call `niDMM_SelfCal`. This step is optional if you have adjusted the NI 4071 within the last 24 hours and the temperature has remained constant to within ±1 °C of the calibration temperature (T_{cal}).

Verification Procedures

You can use the verification procedures described in this section for both pre-adjustment and post-adjustment verification. The verification procedures and the steps within them must be performed in the order listed; however, you can opt to omit entire sections (for example, the entire *Verifying AC Current* section).

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 about parameter values.

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. Be sure to properly enter these values with the appropriate number of zeros. For example, you must enter the scientific notation number 10e–6 as `0.00001` and the number 100e3 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.

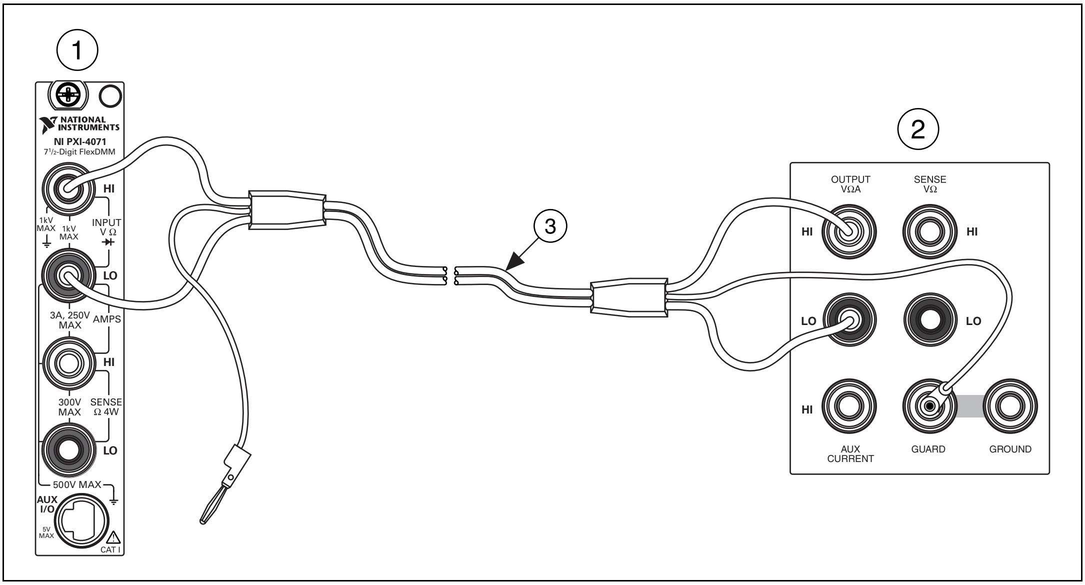
Verifying DC Voltage

To verify DC voltage of the NI 4071, complete the following steps:

1. Plug in the insulated banana plug shorting bar across the *HI* and *LO* banana plug connectors on the NI 4071.
2. Wait one minute for the thermal EMF to stabilize.
3. Call `niDMM_reset`.
4. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_VOLTS`
   - **Range** = `1`
   - **Resolution** = `7½`
5. Set the input resistance of the NI 4071 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 13.
7. Set the input resistance of the NI 4071 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 13.
9. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_VOLTS`
   - **Range** = `10`
   - **Resolution** = `7½`

10. Set the input resistance of the NI 4071 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 13.
12. Set the input resistance of the NI 4071 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 13.
14. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `100`
    - **Resolution** = `7½`
15. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
16. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `1000`
    - **Resolution** = `7½`
17. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
18. Remove the shorting bar from the NI 4071.
19. Reset the calibrator.

20. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 1. Table 1 lists the cable connections.



1	NI 4071	2	Fluke 5700A/5720A Calibrator	3	Fluke 5440 Cable

Figure 1. Cable Connections for Voltage and 2-Wire Resistance

Table 1. Fluke 5440 Cable Connections

Banana Plug Connector (NI 4071)	Banana Plug Color (Fluke 5440 Cable)	Binding Post Label (Fluke 5700A/5720A Calibrator)
HI	Red	OUTPUT HI
LO	Black	OUTPUT LO
(No connection)	Blue	V GUARD

21. Wait two minutes for the thermal EMF to stabilize.
22. Output 0 V on the calibrator.
23. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `0.1`
    - **Resolution** = `7½`

24. Set the input resistance of the NI 4071 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`
25. Call `niDMM_Read`. Store the result as the 100 mV >10 GΩ mode offset.
26. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
27. Call `niDMM_Read`. Store the result as the 100 mV 10 MΩ mode offset.
28. Output 100 mV on the calibrator with the range locked to 2.2 V.

Note This calibrator range prevents a 50 Ω output resistance from creating a voltage divider with the internal resistance of the NI 4071.

29. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `0.1`
    - **Resolution** = `7½`
30. Set the input resistance of the NI 4071 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`
31. 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 13.
32. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
33. 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 13.
34. Output –100 mV on the calibrator with the range locked to 2.2 V.

Note This calibrator range prevents a 50 Ω output resistance from creating a voltage divider with the internal resistance of the NI 4071.

35. Set the input resistance of the NI 4071 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`
36. 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 13.
37. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
38. 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 13.
39. Output 1 V on the calibrator.
40. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `1`
    - **Resolution** = `7½`
41. Set the input resistance of the NI 4071 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`
42. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
43. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
44. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
45. Output –1 V on the calibrator.
46. Set the input resistance of the NI 4071 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`

47. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
48. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
49. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
50. Output 10 V on the calibrator.
51. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `10`
    - **Resolution** = `7½`
52. Set the input resistance of the NI 4071 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`
53. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
54. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`
55. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
56. Output –10 V on the calibrator.
57. Set the input resistance of the NI 4071 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`
58. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
59. Set the input resistance of the NI 4071 to 10 MΩ by calling `niDMM_SetAttributeViReal64` with the following parameters:
    - **Attribute_ID** = `NIDMM_ATTR_INPUT_RESISTANCE`
    - **Attribute_Value** = `NIDMM_VAL_10_MEGAOHM`

60. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.

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

61. Output 100 V on the calibrator.
62. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `100`
    - **Resolution** = 7½
63. Set the input resistance of the NI 4071 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 13.
65. Output –100 V on the calibrator.
66. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
67. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_VOLTS`
    - **Range** = `1000`
    - **Resolution** = 7½
68. Call `niDMM_Read`. Before you apply the voltage, the DMM must be in the 1000 V range.
69. Output 1000 V on the calibrator.
70. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
71. Output –1000 V on the calibrator.
72. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 13.
73. Reset the calibrator for safety reasons.

You have completed verifying the DC voltage of the NI 4071. 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 4071, complete the following steps:

1. Reset the calibrator.
2. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 1. Table 1 lists the cable connections.
3. Output 5 mV at 1 kHz on the calibrator.
4. Call `niDMM_reset` to reset the NI 4071 to a known state.
5. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_AC_VOLTS`
   - **Range** = `0.05`
   - **Resolution** = `6½`
6. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
7. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
   - **Range** = `0.05`
   - **Resolution** = `6½`
8. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
9. Output 50 mV at 30 Hz on the calibrator.
10. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
    - **Range** = `0.05`
    - **Resolution** = `6½`
11. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.

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_ConfigureMeasurementDigits` 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 14.
    d. Call `niDMM_ConfigureMeasurementDigits` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
    e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
13. Repeat step 12 for each of the remaining iterations shown in Table 2.

Table 2. niDMM_ConfigureMeasurementDigits Parameters

	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
Iteration	**Amplitude**	**Frequency**	**Function**	**Range**	**Resolution**
1	50 mV	50 Hz	`NIDMM_VAL_AC_VOLTS`	0.05	6½
	50 mV	50 Hz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.05	6½
2	50 mV	1 kHz	`NIDMM_VAL_AC_VOLTS`	0.05	6½
	50 mV	1 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.05	6½
3	50 mV	1 kHz	`NIDMM_VAL_AC_VOLTS`	0.5	6½
	50 mV	1 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.5	6½
4	50 mV	20 kHz	`NIDMM_VAL_AC_VOLTS`	0.05	6½
	50 mV	20 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.05	6½
5	50 mV	50 kHz	`NIDMM_VAL_AC_VOLTS`	0.05	6½
	50 mV	50 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.05	6½
6	50 mV	100 kHz	`NIDMM_VAL_AC_VOLTS`	0.05	6½
	50 mV	100 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.05	6½
7	50 mV	300 kHz	`NIDMM_VAL_AC_VOLTS`	0.05	6½
	50 mV	300 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	0.05	6½

14. Output 500 mV at 30 Hz on the calibrator.

15. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
    - **Range** = `0.5`
    - **Resolution** = `6½`
16. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
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_ConfigureMeasurementDigits` 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 14.
    d. Call `niDMM_ConfigureMeasurementDigits` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
    e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.

Table 3. niDMM_ConfigureMeasurementDigits Parameters

Iteration	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
	Amplitude	**Frequency**	**Function**	**Range**	**Resolution**
1	500 mV	50 Hz	NIDMM_VAL_AC_VOLTS	0.5	6½
	500 mV	50 Hz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	6½
2	500 mV	1 kHz	NIDMM_VAL_AC_VOLTS	0.5	6½
	500 mV	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	6½
3	500 mV	1 kHz	NIDMM_VAL_AC_VOLTS	5	6½
	500 mV	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	6½
4	500 mV	20 kHz	NIDMM_VAL_AC_VOLTS	0.5	6½
	500 mV	20 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	6½
5	500 mV	50 kHz	NIDMM_VAL_AC_VOLTS	0.5	6½
	500 mV	50 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	6½
6	500 mV	100 kHz	NIDMM_VAL_AC_VOLTS	0.5	6½
	500 mV	100 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	6½

Table 3. niDMM_ConfigureMeasurementDigits Parameters (Continued)

Iteration	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
	Amplitude	Frequency	Function	Range	Resolution
7	500 mV	300 kHz	`NIDMM_VAL_AC_VOLTS`	`0.5`	6½
	500 mV	300 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	`0.5`	6½

18. Output 5 V at 30 Hz on the calibrator.
19. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
    - **Range** = `5`
    - **Resolution** = `6½`
20. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
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_ConfigureMeasurementDigits` 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 14.
    d. Call `niDMM_ConfigureMeasurementDigits` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
    e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.

Table 4. niDMM_ConfigureMeasurementDigits Parameters

Iteration	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
	Amplitude	Frequency	Function	Range	Resolution
1	5 V	50 Hz	`NIDMM_VAL_AC_VOLTS`	`5`	6½
	5 V	50 Hz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	`5`	6½
2	5 V	1 kHz	`NIDMM_VAL_AC_VOLTS`	`5`	6½
	5 V	1 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	`5`	6½
3	5 V	1 kHz	`NIDMM_VAL_AC_VOLTS`	`50`	6½
	5 V	1 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	`50`	6½

Table 4. niDMM_ConfigureMeasurementDigits Parameters (Continued)

Iteration	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
	Amplitude	Frequency	Function	Range	Resolution
4	5 V	20 kHz	NIDMM_VAL_AC_VOLTS	5	6½
	5 V	20 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	6½
5	5 V	50 kHz	NIDMM_VAL_AC_VOLTS	5	6½
	5 V	50 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	6½
6	5 V	100 kHz	NIDMM_VAL_AC_VOLTS	5	6½
	5 V	100 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	6½
7	5 V	300 kHz	NIDMM_VAL_AC_VOLTS	5	6½
	5 V	300 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	6½

22. Output 50 V at 30 Hz on the calibrator.
23. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
    - **Range** = `50`
    - **Resolution** = `6½`
24. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
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_ConfigureMeasurementDigits` 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 14.
    d. Call `niDMM_ConfigureMeasurementDigits` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.
    e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.

Table 5. niDMM_ConfigureMeasurementDigits Parameters

Iteration	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
	Amplitude	Frequency	Function	Range	Resolution
1	50 V	50 Hz	NIDMM_VAL_AC_VOLTS	50	6½
	50 V	50 Hz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	6½
2	50 V	1 kHz	NIDMM_VAL_AC_VOLTS	50	6½
	50 V	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	6½
3	50 V	1 kHz	NIDMM_VAL_AC_VOLTS	700	6½
	50 V	1 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	6½
4	50 V	20 kHz	NIDMM_VAL_AC_VOLTS	50	6½
	50 V	20 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	6½
5	50 V	50 kHz	NIDMM_VAL_AC_VOLTS	50	6½
	50 V	50 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	6½
6	50 V	100 kHz	NIDMM_VAL_AC_VOLTS	50	6½
	50 V	100 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	6½
7	50 V	300 kHz	NIDMM_VAL_AC_VOLTS	50	6½
	50 V	300 kHz	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	6½

26. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_VOLTS_DCCOUPLED`
    - **Range** = `700`
    - **Resolution** = `6½`
27. Call `niDMM_Read`. The DMM must be in the 700 V range before you apply the voltage.
28. Output 219 V at 30 Hz on the calibrator.
29. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.
30. 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_ConfigureMeasurementDigits` 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 14.

d. Call `niDMM_ConfigureMeasurementDigits` again, changing **Mode** to `NIDMM_VAL_AC_VOLTS_DCCOUPLED`.

e. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 14.

Table 6. niDMM_ConfigureMeasurementDigits Parameters

Iteration	Calibrator Output		niDMM_ConfigureMeasurementDigits Parameters		
	Amplitude	Frequency	Function	Range	Resolution
1	219 V	50 Hz	`NIDMM_VAL_AC_VOLTS`	700	6½
	219 V	50 Hz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	700	6½
2	219 V	1 kHz	`NIDMM_VAL_AC_VOLTS`	700	6½
	219 V	1 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	700	6½
3	219 V	20 kHz	`NIDMM_VAL_AC_VOLTS`	700	6½
	219 V	20 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	700	6½
4	219 V	50 kHz	`NIDMM_VAL_AC_VOLTS`	700	6½
	219 V	50 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	700	6½
5	219 V	100 kHz	`NIDMM_VAL_AC_VOLTS`	700	6½
	219 V	100 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	700	6½
6	70 V	300 kHz	`NIDMM_VAL_AC_VOLTS`	700	6½
	70 V	300 kHz	`NIDMM_VAL_AC_VOLTS_DCCOUPLED`	700	6½

31. Reset the calibrator for safety reasons.

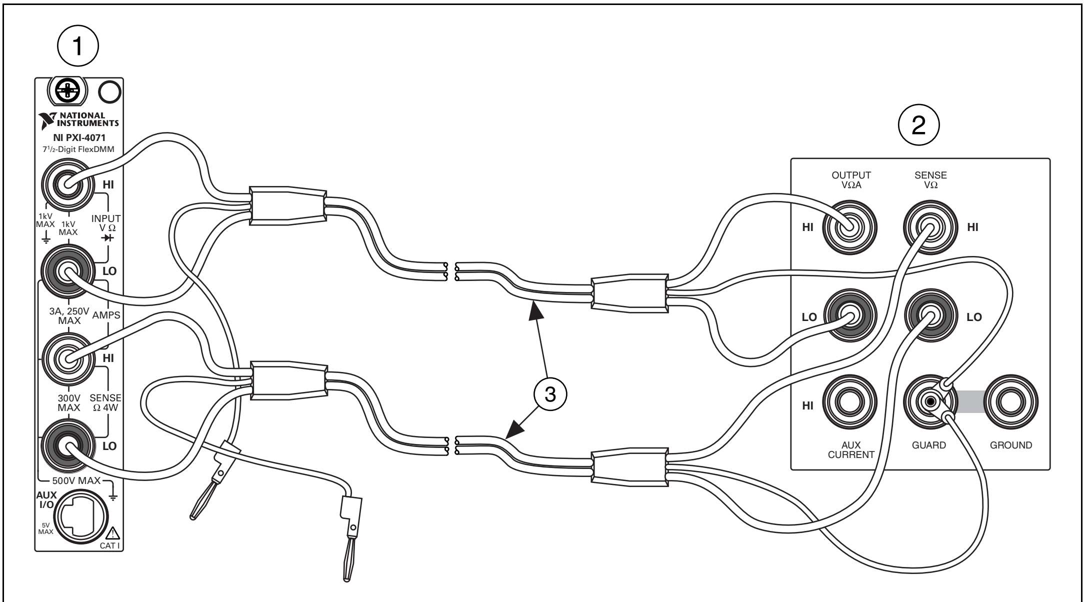
You have completed verifying the AC voltage of the NI 4071. Select one of the following options:

- 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 4071, complete the following steps:

1. Reset the calibrator.
2. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cables, as shown in Figure 2. Table 7 lists the cable connections.



1 NI 4071	2 Fluke 5700A/5720A Calibrator	3 Fluke 5440 Cables

Figure 2. Cable Connections for 4-Wire Resistance

Table 7. Fluke 5440 Cable Connections

Fluke 5440 Cable Identification	Banana Plug Connector (NI 4071)	Banana Plug Color (Fluke 5440 Cable)	Binding Post (Fluke 5700A/5720A Calibrator)
First cable	HI	Red	OUTPUT HI
	LO	Black	OUTPUT LO
	(No connection)	Blue	V GUARD
Second cable	HI SENSE	Red	SENSE HI
	LO SENSE	Black	SENSE LO
	(No connection)	Blue	V GUARD

3. Wait two minutes for the thermal EMF to stabilize if the Fluke 5440 cables were not previously connected in this configuration.

4. Call `niDMM_reset`.
5. Refer to Table 8 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 8 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_ConfigureMeasurementDigits` with the parameters set as shown in Table 8 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 8 for the current iteration.
   d. Call `niDMM_Read`. Verify that this measurement falls between the tolerances listed in Table 15. 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 8.

Table 8. niDMM_ConfigureMeasurementDigits Parameters

Iteration	Calibrator Output	niDMM_ConfigureMeasurementDigits Parameters			OffsetCompOhms
		Function	Range	Resolution	
1	10 MΩ	NIDMM_VAL_4_WIRE_RES	10e6	7½	OFF
2	1 MΩ	NIDMM_VAL_4_WIRE_RES	1e6	7½	OFF
3	100 kΩ	NIDMM_VAL_4_WIRE_RES	100e3	7½	OFF
4	10 kΩ	NIDMM_VAL_4_WIRE_RES	10e3	7½	ON
5	1 kΩ	NIDMM_VAL_4_WIRE_RES	1e3	7½	ON
6	100 Ω	NIDMM_VAL_4_WIRE_RES	100	7½	ON
7	0 Ω	NIDMM_VAL_4_WIRE_RES	10e6	7½	OFF
8	0 Ω	NIDMM_VAL_4_WIRE_RES	1e6	7½	OFF
9	0 Ω	NIDMM_VAL_4_WIRE_RES	100e3	7½	OFF
10	0 Ω	NIDMM_VAL_4_WIRE_RES	10e3	7½	ON
11	0 Ω	NIDMM_VAL_4_WIRE_RES	1e3	7½	ON
12	0 Ω	NIDMM_VAL_4_WIRE_RES	100	7½	ON

You have completed verifying the 4-wire resistance of the NI 4071. 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 4071, complete the following steps:

1. Plug in the insulated banana plug shorting bar across the *HI* and *LO* banana plug connectors on the NI 4071.
2. Wait one minute for the thermal EMF to stabilize.
3. Call `niDMM_reset`.
4. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_2_WIRE_RES`
   - **Range** = `10e3`
   - **Resolution** = `7½`
5. Call `niDMM_ConfigureOffsetCompOhms` with **OffsetCompOhms** set to `NIDMM_VAL_OFFSET_COMP_OHMS_ON`.
6. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.
7. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_2_WIRE_RES`
   - **Range** = `1e3`
   - **Resolution** = `7½`
8. Call `niDMM_ConfigureOffsetCompOhms with` **OffsetCompOhms** set to `NIDMM_VAL_OFFSET_COMP_OHMS_ON`.
9. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.

10. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100`
    - **Resolution** = `7½`
11. Call `niDMM_ConfigureOffsetCompOhms` with **OffsetCompOhms** set to `NIDMM_VAL_OFFSET_COMP_OHMS_ON`.
12. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 16.
13. Remove the shorting bar from the NI 4071.
14. Reset the calibrator.
15. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 1. Table 1 lists the cable connections.
16. Wait two minutes for the thermal EMF to stabilize if the Fluke 5440 cable was not just previously used in this configuration.
17. Output 0 Ω on the calibrator with 2-wire compensation turned on, but with external sense turned off.
18. Call `niDMM_reset` to reset the NI 4071 to a known state.
19. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `1e6`
    - **Resolution** = `7½`
20. Call `niDMM_Read` and store the result as the 1 MΩ range offset.
21. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100e3`
    - **Resolution** = `7½`
22. Call `niDMM_Read`. Store the result as the 100 kΩ range offset.
23. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `10e3`
    - **Resolution** = `7½`

24. Call `niDMM_Read`. Store the result as the 10 kΩ range offset.
25. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `1e3`
    - **Resolution** = `7½`
26. Call `niDMM_Read`. Store the result as the 1 kΩ range offset.
27. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100`
    - **Resolution** = `7½`
28. Call `niDMM_ConfigureMultiPoint` with the following parameters:
    - **Trigger Count** = `1`
    - **Sample Count** = `10`
    - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
    - **Sample Interval** = `-1`
29. 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.
30. Output 100 MΩ on the calibrator without external sense or 2-wire compensation.
31. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `5e9`
    - **Resolution** = `7½`
32. Call `niDMM_Read`. Verify that this measurement falls between the tolerances listed in Table 16.
33. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100e6`
    - **Resolution** = `7½`

34. Call `niDMM_Read`. Verify that this measurement falls between the tolerances listed in Table 16.
35. Output 10 MΩ on the calibrator without external sense or 2-wire compensation.
36. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `10e6`
    - **Resolution** = 7½
37. Call `niDMM_Read`. Verify that this measurement falls between the tolerances listed in Table 16.
38. Output 1 MΩ on the calibrator without external sense or 2-wire compensation.
39. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `1e6`
    - **Resolution** = 7½
40. 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 16.
41. Output 100 kΩ on the calibrator without external sense or 2-wire compensation.
42. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100e3`
    - **Resolution** = 7½
43. 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 16.
44. Output 10 kΩ on the calibrator with 2-wire compensation turned on, but with external sense turned off.
45. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `10e3`
    - **Resolution** = 7½

46. 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 16.
47. Output 1 kΩ on the calibrator with 2-wire compensation turned on, but with external sense turned off.
48. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `1e3`
    - **Resolution** = 7½
49. 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 16.
50. Output 100 Ω on the calibrator with 2-wire compensation turned on, but with external sense turned off.
51. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100`
    - **Resolution** = 7½
52. 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 16.

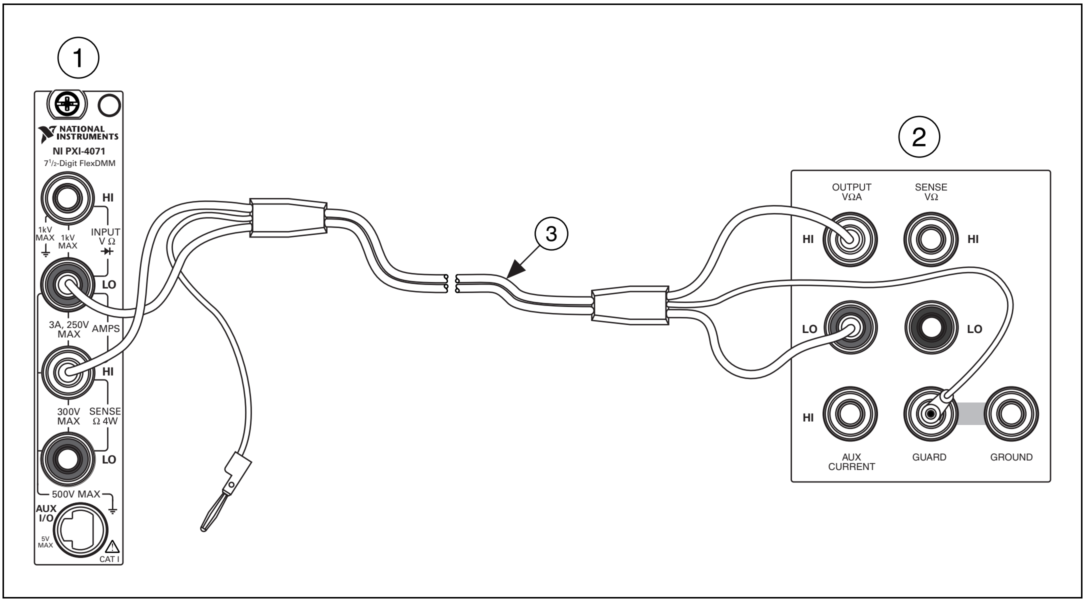
You have completed verifying the 2-wire resistance of the NI 4071. Select one of the following options:

- 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 4071, complete the following steps:

1. Reset the calibrator.
2. Remove all connections from the four input banana plug connectors on the NI 4071.
3. Call `niDMM_reset` to reset the NI 4071 to a known state.
4. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `1e-6`
   - **Resolution** = `6½`
5. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
6. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `10e-6`
   - **Resolution** = `6½`
7. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
8. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `100e-6`
   - **Resolution** = `6½`
9. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
10. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e-3`
    - **Resolution** = `6½`
11. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
12. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 3. Table 9 lists the cable connections.
13. Wait two minutes for the thermal EMF to stabilize.



1 NI 4071	2 Fluke 5700A/5720A Calibrator	3 Fluke 5440 Cable

Figure 3. Cable Connections for Current

Table 9. Fluke 5440 Cable Connections

Banana Plug Connector (NI 4071)	Banana Plug Color (Fluke 5440 Cable)	Binding Post (Fluke 5700A/5720A Calibrator)
HI SENSE	Red	OUTPUT HI
LO	Black	OUTPUT LO
(No connection)	Blue	V GUARD

14. Output 0 A on the calibrator with the current output set to `NORM`.
15. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e-6`
    - **Resolution** = `6½`
16. Call `niDMM_ConfigureMultiPoint` with the following parameters:
    - **Trigger Count** = `1`
    - **Sample Count** = `40`
    - **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** = `40`

    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 µA range offset.
18. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `10e-6`
    - **Resolution** = `6½`
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 10 µA range offset.
21. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `100e-6`
    - **Resolution** = `6½`
22. Call `niDMM_Read`. Store the result as the 100 µA range offset.
23. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e-3`
    - **Resolution** = `6½`
24. Call `niDMM_Read`. Store the result as the 1 mA range offset.

25. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.01`
    - **Resolution** = `6½`
26. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
27. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.1`
    - **Resolution** = `6½`
28. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
29. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1`
    - **Resolution** = `6½`
30. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
31. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `3`
    - **Resolution** = `6½`
32. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.
33. Output 1 μA on the calibrator with the current output set to `NORM`.
34. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e-6`
    - **Resolution** = `6½`

35. Call `niDMM_ConfigureMultipoint` with the following parameters:
    - **Trigger Count** = `1`
    - **Sample Count** = `40`
    - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
    - **Sample Interval** = `-1`
36. Call `niDMM_ReadMultiPoint` with the following parameters:
    - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
    - **Array Size** = `40`

    Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Subtract the previously stored 1 µA range offset from this average. Verify that the result falls between the limits listed in Table 17.
37. Output –1 µA on the calibrator with the current output set to `NORM`.
38. Call `niDMM_ReadMultiPoint` with the following parameters:
    - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
    - **Array Size** = `40`

    Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Subtract the previously stored 1 µA range offset from this average. Verify that the result falls between the limits listed in Table 17.
39. Output 10 µA on the calibrator with the current output set to `NORM`.
40. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `10e-6`
    - **Resolution** = `6½`
41. Call `niDMM_ConfigureMultiPoint` with the following parameters:
    - **Trigger Count** = `1`
    - **Sample Count** = `4`
    - **Sample Trigger** = `NIDMM_VAL_IMMEDIATE`
    - **Sample Interval** = `-1`
42. Call `niDMM_ReadMultiPoint` with the following parameters:
    - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
    - **Array Size** = `40`

    Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Subtract the previously stored 10 µA range offset from this average. Verify that the result falls between the limits listed in Table 17.

43. Output –10 μA on the calibrator with the current output set to `NORM`.
44. Call `niDMM_ReadMultiPoint` with the following parameters:
    - **Maximum Time** = `NIDMM_VAL_TIME_LIMIT_AUTO`
    - **Array Size** = `40`

    Average the results by summing the returned reading array of the function and dividing by the returned actual number of points. Subtract the previously stored 10 μA range offset from this average. Verify that the result falls between the limits listed in Table 17.
45. Output 100 μA on the calibrator with the current output set to `NORM`.
46. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `100e-6`
    - **Resolution** = `6½`
47. Call `niDMM_Read`. Subtract the previously stored 100 μA range offset from this measurement. Verify that the result falls between the limits listed in Table 17.
48. Output –100 μA on the calibrator with the current output set to `NORM`.
49. Call `niDMM_Read`. Subtract the previously stored 100 μA range offset from this measurement. Verify that the result falls between the limits listed in Table 17.
50. Output 1 mA on the calibrator with the current output set to `NORM`.
51. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e-3`
    - **Resolution** = `6½`
52. Call `niDMM_Read`. Subtract the previously stored 1 mA range offset from this measurement. Verify that the result falls between the limits listed in Table 17.
53. Output –1 mA on the calibrator with the current output set to `NORM`.
54. Call `niDMM_Read`. Subtract the previously stored 1 mA range offset from this measurement. Verify that the result falls between the limits listed in Table 17.
55. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.01`

- **Resolution** = 6½

56. Output 10 mA on the calibrator with the current output set to NORM.
57. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.
58. Output –10 mA on the calibrator with the current output set to NORM.
59. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.
60. Output 100 mA on the calibrator with the current output set to NORM.
61. Call niDMM_ConfigureMeasurementDigits with the following parameters:
    - **Function** = NIDMM_VAL_DC_CURRENT
    - **Range** = 0.1
    - **Resolution** = 6½
62. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.
63. Output –100 mA on the calibrator with the current output set to NORM.
64. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.
65. Output 1 A on the calibrator with the current output set to NORM.
66. Call niDMM_ConfigureMeasurementDigits with the following parameters:
    - **Function** = NIDMM_VAL_DC_CURRENT
    - **Range** = 1
    - **Resolution** = 6½
67. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.
68. Output –1 A on the calibrator with the current output set to NORM.
69. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.
70. Output 2.2 A on the calibrator with the current output set to NORM.
71. Call niDMM_ConfigureMeasurementDigits with the following parameters:
    - **Function** = NIDMM_VAL_DC_CURRENT
    - **Range** = 3
    - **Resolution** = 6½
72. Call niDMM_Read. Verify that this measurement falls between the limits listed in Table 17.

73. Output –2.2 A on the calibrator with the current output set to `NORM`.
74. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 17.

You have completed verifying the DC current of the NI 4071. 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 4071, complete the following steps:

1. Reset the calibrator.
2. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 3. Table 9 lists the cable connections.
3. Call `niDMM_reset` to reset the NI 4071 to a known state.
4. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `100e-6`
    - **Resolution** = `6½`
5. Call `niDMM_Read` to configure the NI 4071 for a current mode before applying current.
6. Output 9 µA at 1 kHz on the calibrator with the current output set to `NORM`.
7. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
8. Output 100 µA at 1 kHz on the calibrator with the current output set to `NORM`.
9. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
10. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_CURRENT`

- **Range** = `1e-3`
- **Resolution** = `6½`

11. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
12. Output 1 mA at 1 kHz on the calibrator with the current output set to `NORM`.
13. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
14. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `0.01`
    - **Resolution** = `6½`
15. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
16. Output 10 mA at 1 kHz on the calibrator with the current output set to `NORM`.
17. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
18. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `0.1`
    - **Resolution** = `6½`
19. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
20. Output 100 mA at 1 kHz on the calibrator with the current output set to `NORM`.
21. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
22. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `1`
    - **Resolution** = `6½`
23. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.

24. Output 1 A at 1 kHz on the calibrator with the current output set to `NORM`.
25. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
26. Output 300 mA at 1 kHz on the calibrator with the current output set to `NORM`.
27. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
    - **Function** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `3`
    - **Resolution** = `6½`
28. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.
29. Output 2.2 A at 1 kHz on the calibrator with the current output set to `NORM`.
30. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 18.

You have completed verifying the AC current of the NI 4071. 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

This verification procedure is optional and requires additional test equipment. If you do *not* want to verify frequency, select one of the following options:

- If you do *not* want to verify other modes *and* 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.

Note The frequency of the NI 4071 is *not* user adjustable. If this verification procedure indicates that the frequency is out of specification, return the NI 4071 to NI for repair.

To verify the frequency of the NI 4071, complete the following steps:

1. Remove all connections from the NI 4071.

Note Polarity is *not* important in steps 2, 3, and 5.

2. Connect one end of the coaxial cable to the Pomona 4892 double banana plug.
3. Tighten the other end of the coaxial cable in the screw terminal channels 5 and 39 of the TB-2715 terminal block.
4. Connect the TB-2715 with the coaxial cable attached to the NI 6608.
5. Plug the Pomona 4892 into the *HI* and *LO* terminals of the NI 4071.
6. Call `niDMM_reset` to reset the NI 4071 to a known state.
7. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_FREQ`
   - **Range** = `1`
   - **Resolution** = `0`
8. Call `niDMM_ConfigureFrequencyVoltageRange` with **Voltage Range** set to `5`.
9. 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`
10. 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`
11. 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`

12. 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`
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_PROGRAM`
14. Call `niDMM_Read`. Verify that this measurement falls between the limits listed in Table 19.
15. 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`
16. Repeat steps 10 through 15 with the following modification: in steps 11 and 12, change **paramValue** to `500` when you call the function `GPCTR_Change_Parameter`.
17. Repeat steps 10 through 15 with the following modification: in steps 11 and 12, change **paramValue** to `20` when you call the function `GPCTR_Change_Parameter`.

You have completed verifying the frequency of the NI 4071. Select one of the following options:

- 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.

Adjustment Procedures

This section explains how to adjust the NI 4071. 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 about parameter values.

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 plug connectors on the NI 4071.
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 60 minutes before you begin this procedure.

3. Reset the calibrator.
4. If you have not already done so, allow the NI 4071 to warm up for 60 minutes within a powered-on PXI chassis.

Adjusting DC Voltage and Resistance

To adjust the DC voltage and resistance of the NI 4071, complete the following steps:

1. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 1. Table 1 lists the cable connections.

2. Wait two minutes for the thermal EMF to stabilize if the cable was not previously connected in this configuration.
3. Call `niDMM_InitExtCal` with the resource descriptor of the NI 4071 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.

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

The default user password for adjusting the NI 4071 is `NI`. Use `niDMM_SetCalPassword` to change the password.

4. Call `niDMM_ConfigurePowerLineFrequency` with **PowerLine Frequency** set to `50` or `60`, depending on the power line frequency (in hertz) 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. Disconnect the Fluke 5440 cable from the NI 4071 banana plug connectors, leaving the other end of the cable connected to the calibrator binding posts.
14. Plug in the insulated banana plug shorting bar across the *HI* and *LO* banana plug connectors of the NI 4071.
15. Wait two minutes for the thermal EMF to stabilize.
16. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_DC_VOLTS
    - **Range** = 10
    - **Input Resistance** = NIDMM_VAL_GREATER_THAN_10_GIGAOHM
17. Call niDMM_CalAdjustMisc with **Type** set to NIDMM_EXTCAL_MISCCAL_VREF.
18. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_DC_VOLTS
    - **Range** = 0.1
    - **Input Resistance** = NIDMM_VAL_10_MEGAOHM
19. Remove the shorting bar, and plug the Fluke 5440 cable back into the NI 4071 banana plug connectors, as shown in Figure 1.
20. Wait one minute for the thermal EMF to stabilize.
21. Output 10 MΩ from the calibrator without external sense.
22. 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*
23. Output 0 Ω from the calibrator without external sense or 2-wire compensation.
24. 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*

25. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `10e6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
26. Disconnect the Fluke 5440 cable from the NI 4071.
27. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_ZINT`.
28. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_2WIRELEAKAGE`.

Caution In the following step, verify that the insulation of the cables does *not* touch. Failing to do so could result in a potential leakage path leading to an inaccurate leakage resistance reading.

29. On the NI 4071, plug a Pomona B-4 banana cable from the *HI* input to the *HI SENSE* input. Plug another Pomona B-4 banana cable from the *LO* input to the *LO SENSE* input.
30. Call `niDMM_CalAdjustMisc` with **Type** set to `NIDMM_EXTCAL_MISCCAL_4WIRELEAKAGE`.
31. Remove the banana cables, and plug the two sets of Fluke 5440 cables into the appropriate banana plug connectors on the NI 4071, as shown in Figure 2 for 4-wire resistance.
32. Wait two minutes for the thermal EMF to stabilize.
33. Output 100 MΩ from the calibrator without external sense.
34. 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*
35. Output 0 Ω from the calibrator without external sense or 2-wire compensation.
36. 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*

37. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_2_WIRE_RES`
    - **Range** = `100e6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
38. Output 100 kΩ on the calibrator with external sense turned on, but without 2-wire compensation.
39. 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*
40. Output 0 Ω on the calibrator with external sense turned on, but without 2-wire compensation.
41. 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*
42. Output 10 kΩ on the calibrator with external sense turned on, but without 2-wire compensation.
43. 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*
44. Output 0 Ω on the calibrator with external sense turned on, but without 2-wire compensation.
45. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `100e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
46. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_4_WIRE_RES`
    - **Range** = `10e3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`

47. Call niDMM_CalAdjustMisc with **Type** set to NIDMM_EXTCAL_MISCAL_RREF.
48. Call niDMM_SelfCal to self-calibrate the NI 4071.
49. Output 0 Ω on the calibrator with external sense turned on, but with 2-wire compensation turned off.
50. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_4_WIRE_RES
    - **Range** = 10e6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
51. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_4_WIRE_RES
    - **Range** = 1e6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
52. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_4_WIRE_RES
    - **Range** = 1e3
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
53. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_4_WIRE_RES
    - **Range** = 100
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
54. Remove the Fluke 5440 cables from the NI 4071, leaving the other end of the cables connected to the calibrator.
55. Plug in the insulated shorting bar across the *HI* and *LO* banana plug connectors of the NI 4071.
56. Wait two minutes for the thermal EMF to stabilize.
57. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_2_WIRE_RES
    - **Range** = 10e6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
58. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_2_WIRE_RES
    - **Range** = 1e6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA

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

You have completed adjusting the DC voltage and resistance modes of the NI 4071. Select one of the following options:

- If you are performing additional adjustments, refer to the following sections, as applicable:
  - *Adjusting AC Voltage (AC- and DC-Coupled) Modes*
  - *Adjusting Current Modes*
  - *Completing the Adjustment Procedures*
- If you are *not* performing additional adjustments, refer to one of the following sections:
  - *Verification Procedures*—to verify your new calibration coefficients before saving them to the EEPROM
  - *Completing the Adjustment Procedures*—if you do *not* want to verify the adjustments you have just made

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 and go directly to the *Adjusting Current Modes* section.

To adjust the AC voltage of the NI 4071, complete the following steps:

1. Reset the calibrator.
2. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 1. Table 1 lists the cable connections.
3. Refer to Table 10 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 10 for the current iteration.
   b. Call `niDMM_CalAdjustGain` with **Mode** set to `NIDMM_VAL_AC_VOLTS`. Set the remaining parameters as shown in Table 10 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 10.

Table 10. niDMM_CalAdjustGain Parameters

Iteration	Calibrator Output		niDMM_CalAdjustGain Parameters			
	Amplitude	f (kHz)	Mode	Range (V)	Input Resistance	Expected Value
1	50 mV	1	NIDMM_VAL_AC_VOLTS	0.05	NIDMM_VAL_10_MEGAOHM	0.05
	50 mV	1	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.05	NIDMM_VAL_10_MEGAOHM	0.05
2	500 mV	1	NIDMM_VAL_AC_VOLTS	0.5	NIDMM_VAL_10_MEGAOHM	0.5
	500 mV	1	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	NIDMM_VAL_10_MEGAOHM	0.5
3	5 V	1	NIDMM_VAL_AC_VOLTS	5	NIDMM_VAL_10_MEGAOHM	5
	5 V	1	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	NIDMM_VAL_10_MEGAOHM	5
4	50 V	1	NIDMM_VAL_AC_VOLTS	50	NIDMM_VAL_10_MEGAOHM	50
	50 V	1	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	NIDMM_VAL_10_MEGAOHM	50
5	100 V	1	NIDMM_VAL_AC_VOLTS	700	NIDMM_VAL_10_MEGAOHM	100
	100 V	1	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	NIDMM_VAL_10_MEGAOHM	100

5. Refer to Table 11 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 11 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 11.

Table 11. niDMM_CalAdjustOffset Parameters

Iteration	niDMM_CalAdjustOffset Parameters		
	Mode	**Range (V)**	**Input Resistance (Ω)**
1	NIDMM_VAL_AC_VOLTS	0.05	NIDMM_VAL_10_MEGAOHM
	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.05	NIDMM_VAL_10_MEGAOHM
2	NIDMM_VAL_AC_VOLTS	0.5	NIDMM_VAL_10_MEGAOHM
	NIDMM_VAL_AC_VOLTS_DCCOUPLED	0.5	NIDMM_VAL_10_MEGAOHM
3	NIDMM_VAL_AC_VOLTS	5	NIDMM_VAL_10_MEGAOHM
	NIDMM_VAL_AC_VOLTS_DCCOUPLED	5	NIDMM_VAL_10_MEGAOHM
4	NIDMM_VAL_AC_VOLTS	50	NIDMM_VAL_10_MEGAOHM
	NIDMM_VAL_AC_VOLTS_DCCOUPLED	50	NIDMM_VAL_10_MEGAOHM
5	NIDMM_VAL_AC_VOLTS	700	NIDMM_VAL_10_MEGAOHM
	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	NIDMM_VAL_10_MEGAOHM

7. Refer to Table 12 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 12 for the current iteration.

b. Call niDMM_CalAdjustACFilter with **Mode** set to NIDMM_VAL_AC_VOLTS and the remaining parameters as shown in Table 12 for the current iteration.

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 12.

Table 12. 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

Table 12. niDMM_CalAdjustACFilter Parameters (Continued)

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

Table 12. niDMM_CalAdjustACFilter Parameters (Continued)

Iteration	Calibrator Output		niDMM_CalAdjustACFilter Parameters		
	Amplitude	Frequency (kHz)	Mode	Range (V)	Frequency (Hz)
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
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 12. 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	700	1e3
	100 V	1	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	1e3
34	100 V	5	NIDMM_VAL_AC_VOLTS	700	5e3
	100 V	5	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	5e3
35	100 V	20	NIDMM_VAL_AC_VOLTS	700	20e3
	100 V	20	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	20e3
36	100 V	50	NIDMM_VAL_AC_VOLTS	700	50e3
	100 V	50	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	50e3
37	100 V	100	NIDMM_VAL_AC_VOLTS	700	100e3
	100 V	100	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	100e3
38	100 V	200	NIDMM_VAL_AC_VOLTS	700	200e3
	100 V	200	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	200e3
39	50 V	300	NIDMM_VAL_AC_VOLTS	700	300e3
	50 V	300	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	300e3
40	10 V	500	NIDMM_VAL_AC_VOLTS	700	500e3
	10 V	500	NIDMM_VAL_AC_VOLTS_DCCOUPLED	700	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 4071. Select one of the following options:

- If you are performing additional adjustments, refer to the following sections, as applicable:
  - *Adjusting Current Modes*

– *Completing the Adjustment Procedures*

- If you are *not* performing additional adjustments, refer to one of the following sections:
  - *Verification Procedures*—to verify your new calibration coefficients before saving them to the EEPROM
  - *Completing the Adjustment Procedures*—if you do *not* want to verify the adjustments you have just made

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 *Verifying DC Voltage*).
- 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 4071, complete the following steps:

1. Reset the calibrator.
2. Connect the NI 4071 and the Fluke 5700A/5720A calibrator using the Fluke 5440 cable, as shown in Figure 3. Table 9 lists the cable connections.
3. Wait two minutes for the thermal EMF to stabilize.
4. Call `niDMM_ConfigureMeasurementDigits` with the following parameters:
   - **Function** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `1e-6`
   - **Resolution** = `6½`
5. Call `niDMM_Read` to configure the NI 4071 for a current mode before applying current.
6. Output 1 µA on the calibrator with the current output set to `NORM`.
7. Call `niDMM_CalAdjustGain` with the following parameters:
   - **Mode** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `1e-6`
   - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
   - **Expected Value** = `1e-6`
8. Output –1 µA on the calibrator with the current output set to `NORM`.

9. Call `niDMM_CalAdjustGain` with the following parameters:
   - **Mode** = `NIDMM_VAL_DC_CURRENT`
   - **Range** = `1e-6`
   - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
   - **Expected Value** = `–1e-6`
10. Output 10 µA on the calibrator with the current output set to `NORM`.
11. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `10e-6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `10e-6`
12. Output –10 µA on the calibrator with the current output set to `NORM`.
13. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `10e-6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `–10e-6`
14. Output 100 µA on the calibrator with the current output set to `NORM`.
15. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `100e-6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `100e-6`
16. Output –100 µA on the calibrator with the current output set to `NORM`.
17. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `100e-6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `–100e-6`
18. Output 1 mA on the calibrator with the current output set to `NORM`.
19. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e-3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `1e-3`

20. Output –1 mA on the calibrator with the current output set to `NORM`.
21. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e–3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `–1e–3`
22. Output 10 mA on the calibrator with the current output set to `NORM`.
23. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.01`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `0.01`
24. Output –10 mA on the calibrator with the current output set to `NORM`.
25. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.01`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `–0.01`
26. Output 100 mA on the calibrator with the current output set to `NORM`.
27. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.1`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `0.1`
28. Output –100 mA on the calibrator with the current output set to `NORM`.
29. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.1`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
    - **Expected Value** = `–0.1`
30. Output 1 A on the calibrator with the current output set to `NORM`.
31. Call `niDMM_CalAdjustGain` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1`

- **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
- **Expected Value** = 1

32. Output –1 A on the calibrator with the current output set to NORM.
33. Call niDMM_CalAdjustGain with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 1
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
    - **Expected Value** = –1
34. Output 2.2 A on the calibrator with the current output set to NORM.
35. Call niDMM_CalAdjustGain with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 3
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
    - **Expected Value** = 2.2
36. Output –2.2 A on the calibrator with the current output set to NORM.
37. Call niDMM_CalAdjustGain with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 3
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
    - **Expected Value** = –2.2
38. Remove all connections from the four input banana plug connectors on the NI 4071.
39. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 1e–6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
40. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 10e–6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
41. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 100e–6
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA

42. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `100e–6`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
43. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1e–3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
44. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `1e–3`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
45. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.01`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
46. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `0.01`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
47. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `0.1`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
48. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_AC_CURRENT`
    - **Range** = `0.1`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`
49. Call `niDMM_CalAdjustOffset` with the following parameters:
    - **Mode** = `NIDMM_VAL_DC_CURRENT`
    - **Range** = `1`
    - **Input Resistance** = `NIDMM_VAL_RESISTANCE_NA`

50. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_AC_CURRENT
    - **Range** = 1
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
51. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_DC_CURRENT
    - **Range** = 3
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
52. Call niDMM_CalAdjustOffset with the following parameters:
    - **Mode** = NIDMM_VAL_AC_CURRENT
    - **Range** = 3
    - **Input Resistance** = NIDMM_VAL_RESISTANCE_NA
53. Call niDMM_CalAdjustMisc with **Type** set to NIDMM_EXTCAL_MISCCAL_SECTION.

You have completed adjusting the current modes of the NI 4071. Select one of the following options:

- To verify your new calibration coefficients before saving them to the EEPROM, refer to the *Verification Procedures*.
- If you do *not* want to verify the adjustments you have just made, refer to the *Completing the Adjustment Procedures* section.

Completing the Adjustment Procedures

To complete the adjustment procedure for the NI 4071 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 4071. Compare these limits to the results you obtain in the *Verification Procedures* section.

Notes Use the 24-Hour Limits for a post-adjustment verification *only*. Otherwise, use the 2-Year Limits.

Limits in the following tables are based upon the February 2007 edition of the *NI 4071 Specifications*. Refer to the most recent NI 4071 specifications online at `ni.com/manuals`. If a more recent edition of the specifications is available, recalculate the limits based upon the latest specifications.

DC Voltage

Table 13. NI 4071 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	–2.1 µV	2.1 µV	–2.1 µV	2.1 µV
0 V	10 V	>10 GΩ/10 MΩ	–5 µV	5 µV	–5 µV	5 µV
0 V	100 V	10 MΩ	–200 µV	200 µV	–200 µV	200 µV
0 V	1000 V	10 MΩ	–500 µV	500 µV	–500 µV	500 µV
100 mV	100 mV	>10 GΩ/10 MΩ	0.0999972 V	0.1000028 V	0.09999889 V	0.10000111 V
–100 mV	100 mV	>10 GΩ/10 MΩ	–0.1000028 V	–0.0999972 V	–0.10000111 V	–0.09999889 V
1 V	1 V	>10 GΩ/10 MΩ	0.9999829 V	1.0000171 V	0.9999924 V	1.0000076 V
–1 V	1 V	>10 GΩ/10 MΩ	–1.0000171 V	–0.9999829 V	–1.0000076 V	–0.9999924 V
10 V	10 V	>10 GΩ/10 MΩ	9.999875 V	10.000125 V	9.999975 V	10.000025 V
–10 V	10 V	>10 GΩ/10 MΩ	–10.000125 V	–9.999875 V	–10.000025 V	–9.999975 V
100 V	100 V	10 MΩ	99.9978 V	100.0022 V	99.99916 V	100.00084 V
–100 V	100 V	10 MΩ	–100.0022 V	–99.9978 V	–100.00084 V	–99.99916 V
1000 V	1000 V	10 MΩ	999.9595 V	1000.0405 V	999.9705 V	1000.0295 V
–1000 V	1000 V	10 MΩ	–1000.0405 V	–999.9595 V	–1000.0295 V	–999.9705 V

AC Voltage

Table 14. NI 4071 AC Voltage Verification Limits

Calibrator Output		Range	Coupling	2-Year Limits	
Amplitude	Frequency			Lower	Upper
5 mV	1 kHz	50 mV	AC/DC	4.9875 mV	5.0125 mV
50 mV	30 Hz	50 mV	DC	49.94 mV	50.06 mV
50 mV	50 Hz	50 mV	AC/DC	49.965 mV	50.035 mV

Table 14. NI 4071 AC Voltage Verification Limits (Continued)

Calibrator Output		Range	Coupling	2-Year Limits	
Amplitude	Frequency			Lower	Upper
50 mV	1 kHz	50 mV	AC/DC	49.965 mV	50.035 mV
50 mV	1 kHz	500 mV	AC/DC	49.95 mV	50.05 mV
50 mV	20 kHz	50 mV	AC/DC	49.965 mV	50.035 mV
50 mV	50 kHz	50 mV	AC/DC	49.955 mV	50.045 mV
50 mV	100 kHz	50 mV	AC/DC	49.84 mV	50.16 mV
50 mV	300 kHz	50 mV	AC/DC	49.6 mV	50.4 mV
500 mV	30 Hz	500 mV	DC	499.475 mV	500.525 mV
500 mV	50 Hz	500 mV	AC/DC	499.725 mV	500.275 mV
500 mV	1 kHz	500 mV	AC/DC	499.725 mV	500.275 mV
500 mV	1 kHz	5 V	AC/DC	499.5 mV	500.5 mV
500 mV	20 kHz	500 mV	AC/DC	499.725 mV	500.275 mV
500 mV	50 kHz	500 mV	AC/DC	499.65 mV	500.35 mV
500 mV	100 kHz	500 mV	AC/DC	498.95 mV	501.05 mV
500 mV	300 kHz	500 mV	AC/DC	496.25 mV	503.75 mV
5 V	30 Hz	5 V	DC	4.99475 V	5.00525 V
5 V	50 Hz	5 V	AC/DC	4.99725 V	5.00275 V
5 V	1 kHz	5 V	AC/DC	4.99725 V	5.00275 V
5 V	1 kHz	50 V	AC/DC	4.992 V	5.008 V
5 V	20 kHz	5 V	AC/DC	4.99725 V	5.00275
5 V	50 kHz	5 V	AC/DC	4.9965 V	5.0035 V
5 V	100 kHz	5 V	AC/DC	4.9895 V	5.0105 V
5 V	300 kHz	5 V	AC/DC	4.9625 V	5.0375 V
50 V	30 Hz	50 V	DC	49.9475 V	50.0525 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	1 kHz	700 V	AC/DC	49.9 V	50.1 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	49.84 V	50.16 V
50 V	300 kHz	50 V	AC/DC	48.975 V	51.025 V

Table 14. NI 4071 AC Voltage Verification Limits (Continued)

Calibrator Output		Range	Coupling	2-Year Limits	
Amplitude	Frequency			Lower	Upper
219 V	30 Hz	700 V	DC	218.746 V	219.254 V
219 V	50 Hz	700 V	AC/DC	218.7986 V	219.2014 V
219 V	1 kHz	700 V	AC/DC	218.7986 V	219.2014 V
219 V	20 kHz	700 V	AC/DC	218.7986 V	219.2014 V
219 V	50 kHz	700 V	AC/DC	218.6629 V	219.3371 V
219 V	100 kHz	700 V	AC/DC	218.203 V	219.797 V
70 V	300 kHz	700 V	AC/DC	68.25 V	71.75 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 15. NI 4071 4-Wire Resistance Verification Tolerances

Calibrator Resistance	Range	2-Year Tolerance (ppm of Range)	24-Hour Tolerance (ppm of Range)
10 MΩ	10 MΩ	±100 ppm	±65 ppm
1 MΩ	1 MΩ	±52.5 ppm	±10.6 ppm
100 kΩ	100 kΩ	±55 ppm	±6.5 ppm
10 kΩ	10 kΩ	±48.5 ppm	±5.5 ppm
1 kΩ	1 kΩ	±48.5 ppm	±10.7 ppm
100 Ω	100 Ω	±60 ppm	±13.5 ppm
0 Ω	10 MΩ	±10 ppm	±5 ppm
0 Ω	1 MΩ	±0.5 ppm	±0.5 ppm
0 Ω	100 kΩ	±5 ppm	±1 ppm
0 Ω	10 kΩ	±0.5 ppm	±0.5 ppm
0 Ω	1 kΩ	±0.5 ppm	±0.5 ppm
0 Ω	100 Ω	±4 ppm	±2.5 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 16. NI 4071 2-Wire Resistance Verification Tolerances

Calibrator Resistance	Range	2-Year Tolerance (ppm of Range)	24-Hour Tolerance (ppm of Range)
0 Ω	10 kΩ	±40 ppm	±20 ppm
0 Ω	1 kΩ	±400 ppm	±200 ppm
0 Ω	100 Ω	±4000 ppm	±2000 ppm
100 MΩ	5 GΩ	±1000.2 ppm	±490 ppm
100 MΩ	100 MΩ	±6020 ppm	±506 ppm
10 MΩ	10 MΩ	±100 ppm	±65 ppm
1 MΩ	1 MΩ	±52.5 ppm	±10.6 ppm
100 kΩ	100 kΩ	±50.5 ppm	±13.6 ppm
10 kΩ	10 kΩ	±48.5 ppm	±11.9 ppm
1 kΩ	1 kΩ	±48.5 ppm	±10.8 ppm
100 Ω	100 Ω	±60 ppm	±17.7 ppm

DC Current

Table 17. NI 4071 DC Current Verification Limits

Calibrator Amplitude	Range	2-Year Limits		24-Hour Limits	
		Lower	Upper	Lower	Upper
0 A	1 µA	–40 pA	40 pA	–20 pA	20 pA
0 A	10 µA	–150 pA	150 pA	–20 pA	20 pA
0 A	100 µA	–2 nA	2 nA	–2 nA	2 nA
0 A	1 mA	–20 nA	20 nA	–20 nA	20 nA
0 A	10 mA	–200 nA	200 nA	–200 nA	200 nA
0 A	100 mA	–2 µA	2 µA	–2µA	2 µA
0 A	1 A	–20 µA	20 µA	–20 µA	20 µA
0 A	3 A	–90 µA	90 µA	–90 µA	90 µA
1 µA	1 µA	0.99961 µA	1.00039 µA	0.999835 µA	1.000165 µA

Table 17. NI 4071 DC Current Verification Limits (Continued)

Calibrator Amplitude	Range	2-Year Limits		24-Hour Limits	
		Lower	Upper	Lower	Upper
–1 µA	1 µA	–1.00039 µA	–0.99961 µA	–1.000165 µA	–0.999835 µA
10 µA	10 µA	9.99635 µA	10.00365 µA	9.99973 µA	10.00027 µA
–10 µA	10 µA	–10.00365 µA	–9.99635 µA	–10.00027 µA	–9.99973 µA
100 µA	100 µA	99.988 µA	100.012 µA	99.997 µA	100.003 µA
–100 µA	100 µA	–100.012 µA	–99.988 µA	–100.003 µA	–99.997 µA
1 mA	1 mA	0.99988 mA	1.00012 mA	0.999976 mA	1.000024 mA
–1 mA	1 mA	–1.00012 mA	–0.99988 mA	–1.000024 mA	–0.999976 mA
10 mA	10 mA	9.9987 mA	10.0013 mA	9.99968 mA	10.00032 mA
–10 mA	10 mA	–10.0013 mA	–9.9987 mA	–10.00032 mA	–9.99968 mA
100 mA	100 mA	99.9815 mA	100.0185 mA	99.9971 mA	100.0029 mA
–100 mA	100 mA	–100.0185 mA	–99.9815 mA	–100.0029 mA	–99.9971 mA
1 A	1 A	0.99969 A	1.00031 A	0.999945 A	1.000055 A
–1 A	1 A	–1.00031 A	–0.99969 A	–1.000055 A	–0.999945 A
2.2 A	3 A	2.198282 A	2.201718 A	2.199877 A	2.200123 A
–2.2 A	3 A	–2.201718 A	–2.198282 A	–2.200123 A	–2.199877 A

AC Current

Table 18. NI 4071 AC Current Verification Limits

Calibrator Output		Range	2-Year Limits	
Amplitude	Frequency		Lower	Upper
9 µA	1 kHz	100 µA	8.9773 µA	9.0227 µA
100 µA	1 kHz	100 µA	99.95 µA	100.05 µA
100 µA	1 kHz	1 mA	99.79 µA	100.21 µA
1 mA	1 kHz	1 mA	0.9997 mA	1.0003 mA
1 mA	1 kHz	10 mA	0.99789 mA	1.00211 mA
10 mA	1 kHz	10 mA	9.9969 mA	10.0031 mA
10 mA	1 kHz	100 mA	9.978 mA	10.022 mA
100 mA	1 kHz	100 mA	99.96 mA	100.04 mA
100 mA	1 kHz	1 A	99.76 mA	100.24 mA

Table 18. NI 4071 AC Current Verification Limits (Continued)

Calibrator Output		Range	2-Year Limits	
Amplitude	Frequency		Lower	Upper
1 A	1 kHz	1 A	0.9994 A	1.0006 A
300 mA	1 kHz	3 A	299.1 mA	300.9 mA
2.2 A	1 kHz	3 A	2.1972 A	2.2028 A

Frequency

Table 19. 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

Appendix A: Calibration Options

The complete 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. Figure 4 shows the procedural flow for verification. During adjustment, you correct the measurement error of the device by adjusting the calibration constants and storing the new calibration constants in the EEPROM. Figure 5 shows the procedural flow for adjustment.

Normally, the calibration sequence is as follows:

1. Verify the NI 4071 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 4071.
3. Reverify the NI 4071 using the 24-hour accuracy limits (or the 2-year accuracy limits when the 24-hour limits are not specified).

Note You must compare the verification limits provided in this procedure with the most recent specifications. Refer to the latest NI 4071 specifications at `ni.com/manuals`.

Depending on your measurement and accuracy requirements, a complete calibration of the NI 4071 may not be necessary. A number of options are available that can shorten the calibration time. The following options are available:

- Complete calibration—Performing the entire calibration procedure from beginning to end; guarantees that the NI 4071 performs within the published specifications for all modes and ranges
- Complete calibration with exceptions:
  - Omitting AC voltage mode steps if you do not use the AC voltage modes or if the AC voltage accuracy is irrelevant
  - Omitting DC/AC current mode steps if you do not use the current modes or if the DC/AC current accuracy is irrelevant
  - Omitting both AC voltage and DC/AC current mode steps if you do not use those modes or if the accuracy of those measurements is irrelevant

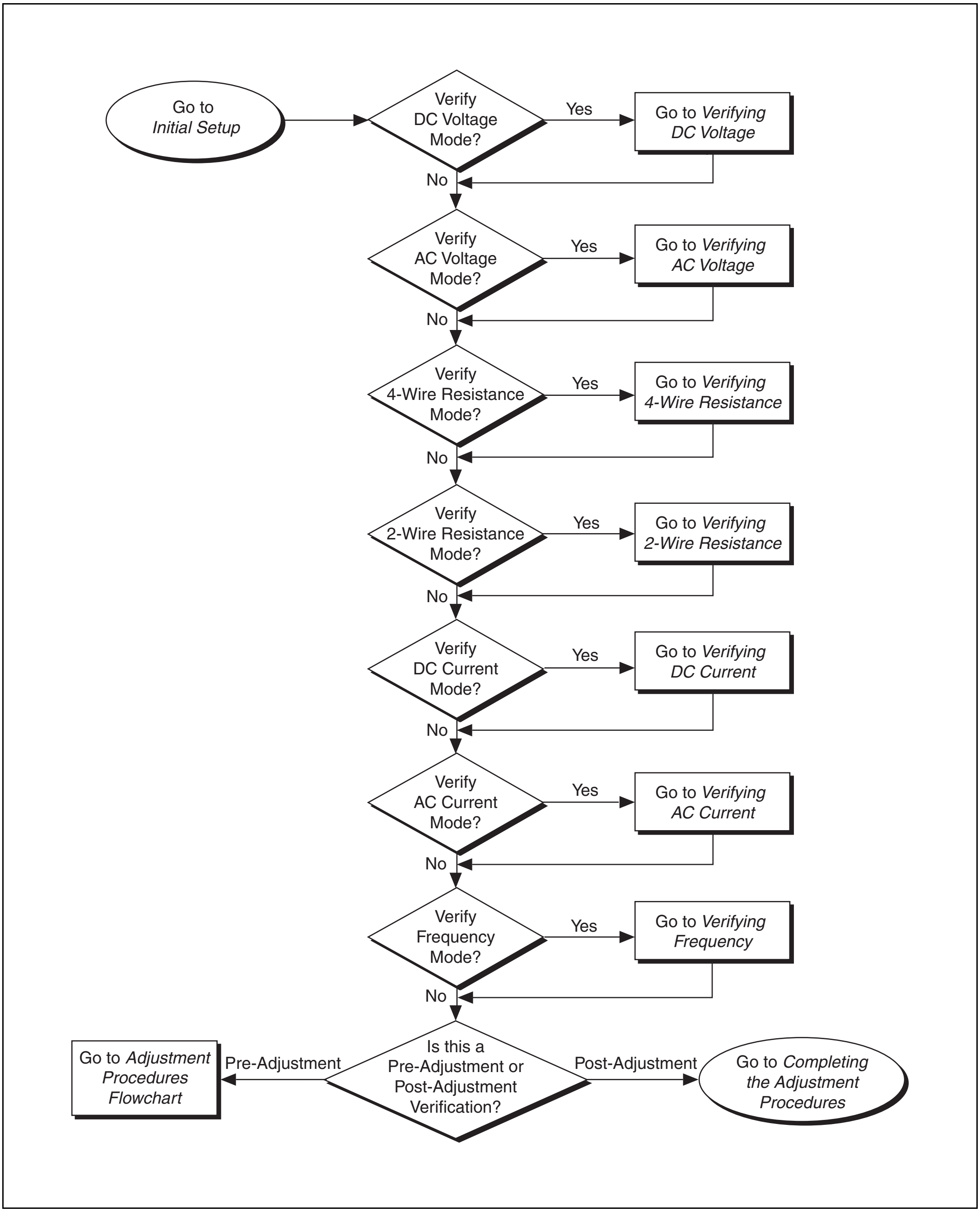


Figure 4. Verification Procedures Flowchart

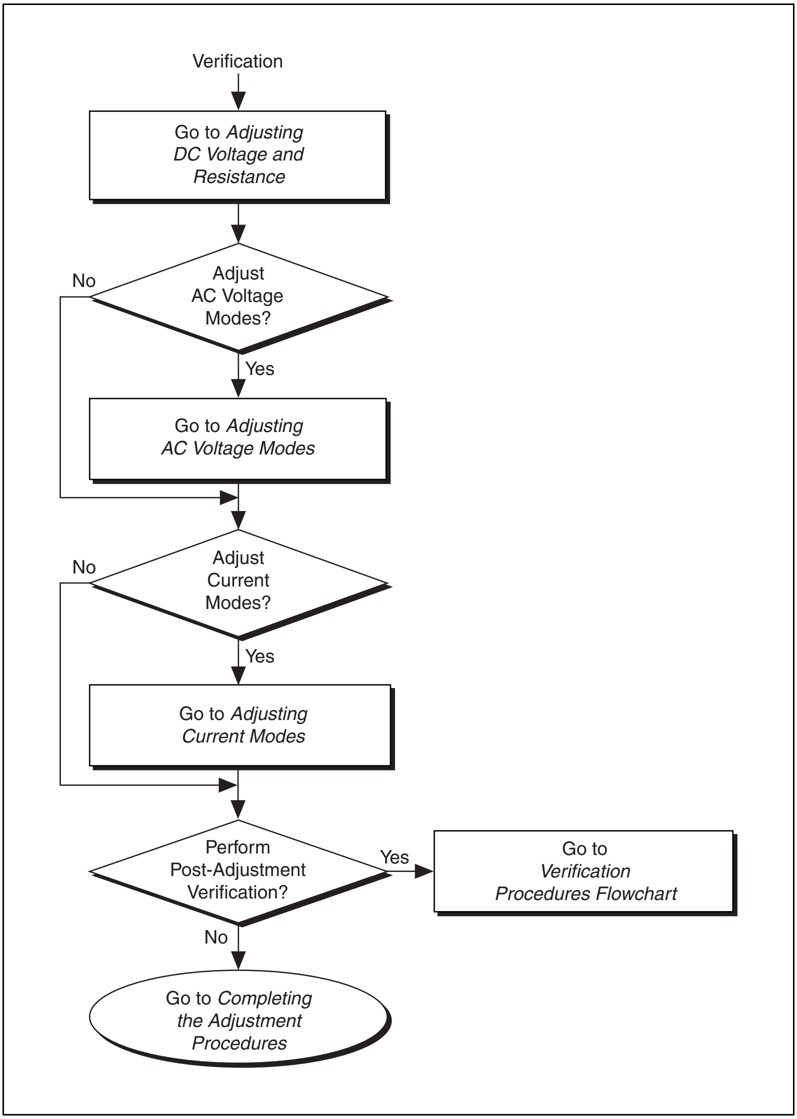


Figure 5. Adjustment Procedures Flowchart

Where to Go for Support

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

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