

CALIBRATING NI 4050/4060 DMMs WITH CALIBRATION EXECUTIVE

This document contains step-by-step instructions for loading and running the National Instruments Calibration Executive procedure for NI 4050/4060 digital multimeters (DMMs).

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Conventions

The following conventions are used in this document:

» 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.

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, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

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

monospace bold Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

Equipment and Other Test Requirements

This section describes the equipment, test conditions, documentation, and software needed to calibrate NI 4050/4060 DMMs.

Test Equipment

To calibrate a National Instruments DMM, you need a calibrator. The calibration procedure runs in automated mode if you use a calibrator that is supported by IVI. NI recommends using the Fluke 5700A.

If you do not have an IVI-supported calibrator, use a calibrator that is four times as accurate as the analog-to-digital converter (ADC) on the device—at least 10 ppm (0.001%) accuracy for DC voltage specifications.

Connectors

You can perform the calibration procedure without banana connectors, but connecting and disconnecting are easier with the correct equipment. The automated calibration procedure for NI 4050/4060 DMMs is designed to work with banana connectors on the cables supplied with the calibrator.

For current measurements on the NI 4050, use an NI 4050 cable adapter and CSM-200 mA current shunt module, shown in Figure 1. Current verification is optional—refer to the [Loading and Running the Calibration Executive Procedure](#) section for more information.

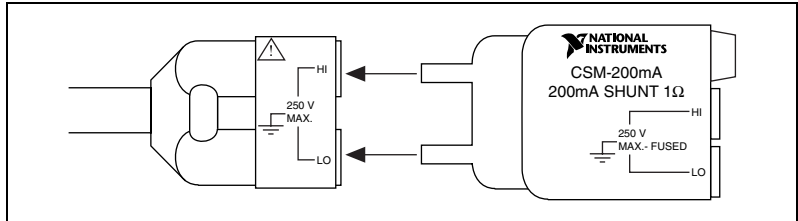


Figure 1. CSM-200 mA Current Shunt Module and NI 4050 Cable

Test Conditions

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

- Keep connections to the NI 4050/4060 short. Long cables and wires act as antennae, picking up extra noise that can affect measurements.
- Keep relative humidity between 10% and 90%, noncondensing, or consult the DMM documentation for the optimum relative humidity.
- Maintain the temperature between 18 °C and 28 °C.
- Allow a warm-up time of at least 30 minutes to ensure that the measurement circuitry of the DMM is at a stable operating temperature.

Documentation

In addition to this calibration procedure, you may find the following documents helpful:

- *Calibration Executive Software User Manual*
- *Specifications for the NI PCMCIA-4050*
- *Specifications for the NI PXI/PCI-4060*
- *NI Digital Multimeters Getting Started Guide*

You can download these documents from the NI Web site at ni.com/manuals.

You may also need to refer to the *NI Digital Multimeters Help*, which you can find at **Start»Programs»National Instruments»NI-DMM»Documentation**, and the *NI-DAQ Help*, which you can find at **Start»Programs»National Instruments»NI-DAQ»NI-DAQ Help**.

Software

For information on installing and uninstalling Calibration Executive procedures, refer to the *Calibration Executive Software User Manual*.

The Calibration Executive setup program installs Calibration Executive and the associated files listed in Table 1.

Table 1. Calibration Executive Directories and Supporting Files

Directory Name	Contents
Program Files\National Instruments\Calibration Executive\Procedures\NI4050 NI4060	Directory structure that contains the calibration procedure and this document.
Program Files\National Instruments\Calibration Executive\Procedures\NI4050 NI4060\Limits	Microsoft Access databases that store the calibration limits.
Program Files\National Instruments\Calibration Executive\Procedures\NI4050 NI4060\Support Files	Support files such as bitmaps and DLLs.

Calibration Temperatures

To account for temperature changes, the tested specifications include the effects of temperature drift. For NI 4050/4060 DMMs, the following temperature drifts are valid:

- 24-hour range—calibration temperature ± 3 °C
- 1-year range—calibration temperature ± 10 °C

Calibration Executive Procedures

This section explains how to set up and run the Calibration Executive procedure.

In automated mode, the calibration procedure takes approximately one hour. In manual mode, the calibration procedure can take up to six hours.



Note For an explanation of automated versus manual calibration, refer to the *Calibration Executive Software User Manual*.

Setting Up the NI 4050/4060 for Calibration

To set up the NI 4050/4060 for calibration, complete the following steps:

1. Install the NI 4050/4060 in the host computer according to the instructions in the *NI Digital Multimeters Getting Started Guide*.
2. Configure the hardware using Measurement & Automation Explorer (MAX).

Loading and Running the Calibration Executive Procedure

To run the Calibration Executive procedure, complete the following steps:

1. Launch Calibration Executive.
2. Follow the Calibration Configuration Wizard to load the correct calibration procedure. For more information on loading and running the calibration procedure, refer to the *Calibration Executive Software User Manual*.
3. When the procedure is loaded, click **Run Procedure**.
4. When the calibration procedure asks you whether to calculate measurement uncertainty, select **Yes** or **No**. If you select Yes, you are prompted to select the appropriate uncertainty file based on the calibrator you are using and when the calibrator was last calibrated.
5. When the calibration procedure prompts you for information about the installed hardware, enter the following information:
 - **Device Number**—The number assigned to the DMM by MAX when you configured the hardware.
 - **Supported Products**—The appropriate device from the menu that lists all of the National Instruments DMMs supported by the calibration procedure.



Note If you are calibrating an NI 4050, Calibration Executive also presents the option to verify current measurements. Current verification is optional because the NI 4050 is

dependent on the CSM-200 mA external current shunt module for current measurements. The NI 4050 measures voltage drop across the precision resistor within the CSM-200 mA, then translates that voltage into a current. If the NI 4050 fails current verification after you have calibrated for voltage measurements, try using another CSM-200 mA or another 1 Ω precision resistor.

6. Follow any further instructions you receive from Calibration Executive.

Viewing the Calibration Report

When the calibration procedure is finished, complete the following steps to view the calibration report:

1. Select **View»Reports**.
2. Click **View**.

Modifying the Font Size in a Calibration Report

If you have selected the HTML format and the text size in the calibration report is too large, you can decrease the size as follows:

- In Internet Explorer, modify the text size by selecting **View»Text Size** and selecting the appropriate size from the menu.
- In Netscape, modify the text size by selecting **View»Decrease Font**.



Note If the NI 4050/4060 fails after calibration, refer to the [Troubleshooting Guidelines](#) section. If the device still fails after you complete the troubleshooting procedures, return it to NI for repair or replacement.

Measurement Uncertainty Considerations and Calculations

For information on how Calibration Executive handles measurement uncertainty, refer to Chapter 3, *Measurement Uncertainty*, of the *Calibration Executive Software User Manual*.

The NI 4050/4060 calibration procedure runs five main tests. Each test takes the same uncertainty components into account. After Calibration Executive calculates all the components of uncertainty, the components are converted to a 1-sigma normal distribution, then combined using the root-sum-square method. The reported expanded uncertainty of measurement corresponds to a coverage probability of approximately 95%.

Table 2 contains the uncertainty budget for resistance, AC voltage, DC voltage, AC current, and DC current uncertainties for the NI 4050/4060.

Table 2. Uncertainty Components

Uncertainty Component	Description
Calibrator uncertainty	Retrieved from the calibrator uncertainty text file ¹ .
Resolution uncertainty of the NI 4050/4060	Retrieved from the limits files.
Type A uncertainty	$= \frac{\text{Standard Deviation of Measurements Taken}}{\sqrt{10}} \times 1.06$ <p>where 10 is the number of measurements taken and 1.06 accounts for the t-distribution. Including the t-distribution is only necessary in cases where the number of degrees of freedom is not considered infinite.</p>
Leads and wiring	Insignificant compared with other uncertainty components.
¹ For more information on the text file format, refer to the <i>Calibration Executive Software User Manual</i> .	

Troubleshooting Guidelines

This section describes common problems you might encounter when calibrating an NI 4050/4060 and explains how to correct the problem.

If the NI 4050/4060 is not recognized in MAX, make sure that you followed the configuration guidelines. Additional configuration information is available at ni.com/support/daq. If MAX fails to recognize the NI 4050/4060 after you reconfigure, contact NI technical support.

If the NI 4050/4060 fails after calibration, try the following:

1. Check the connections and run the Calibration Executive procedure again.
2. If the calibration still fails after trying step 1, try inputting or outputting the failed test points using the test panel in MAX or the DMM Soft Front Panel, which is located at **Start»Programs»National Instruments»NI-DMM»NI-DMM Soft Front Panel**. For example, if the analog input (AI) failed at 1.99 VDC, input that value from the calibrator.
 - a. Launch the test panel in MAX.

- b. Set the **Input Limits** to ± 2.00 V and set the **Data Mode** to DC voltage.
- c. Check the Average Reading indicator.

If the Average Reading falls outside the range of limits shown in the calibration report after you complete steps 1 and 2, contact NI for repair or replacement. If the Average Reading falls within the limits, you can change the calibration report to indicate the passing value.



Note If you have Microsoft Access 2000 or later installed on the computer, you can also modify the database containing the test results. By default, this database is located in Program Files\National Instruments\Calibration Executive\Databases\Calibration Reports.mdb.

NI-DAQ Errors and Other Errors

This section describes some of the common errors that can occur when calibrating NI 4050/4060 DMMs.

Error Code -10005

Error code **-10005** indicates that the device number you selected is not configured or recognized in MAX. Configure the device in MAX and restart Calibration Executive.

Error Code -15

Error code **-15** at the beginning of the calibration procedure indicates that the computer may be configured to use commas as decimal places. Calibration Executive only supports using periods (.) for decimal places. To change this configuration on the computer, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. If you are using Windows Me/98, click **Regional Settings**. If you are using Windows 2000/NT/XP, click **Regional Options**.
3. Click the **Numbers** tab and change the Decimal Symbol from a comma (,) to a period (.). Change the Digit Grouping Symbol from (.) to (,).



Note If you change the Regional Settings or Regional Options on the computer, you may want to change them back to the default settings after running the Calibration Executive procedure.

You can find more information on other error codes in the *Status Codes* section of the *NI-DAQ Function Reference Help*. To launch this help file, select **Start»Programs»National Instruments»NI-DAQ»NI-DAQ Help**.

Specifications

For specification information on the NI 4050/4060 you are calibrating, refer to one of the following documents:

- The manual calibration procedure for the device, which is available for download at ni.com/calibration.
- The product data sheet, which is available for download at ni.com/products.
- The hardware documentation for the device, which is available for download at ni.com/manuals.

Technical Support Resources

NI Web Support

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

Worldwide Support

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

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

Australia 61 2 9672 8846, Austria 43 0 662 45 79 90 0,
Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada (Calgary) 403 274 9391, Canada (Montreal) 514 288 5722,
Canada (Ottawa) 613 233 5949, Canada (Québec) 514 694 8521,
Canada (Toronto) 905 785 0085, Canada (Vancouver) 514 685 7530,

China 86 21 6555 7838, Czech Republic 42 02 2423 5774,
Denmark 45 45 76 26 00, Finland 385 0 9 725 725 11,
France 33 0 1 48 14 24 24, Germany 49 0 89 741 31 30,
Greece 30 2 10 42 96 427, Hong Kong 2645 3186, India 91 80 4190000,
Israel 972 0 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970,
Korea 82 02 3451 3400, Malaysia 603 9059 6711,
Mexico 001 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 64 09 914 0488, Norway 47 0 32 27 73 00,
Poland 48 0 22 3390 150, Portugal 351 210 311 210,
Russia 7 095 238 7139, Singapore 65 6 226 5886,
Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
Switzerland 41 56 200 51 51, Taiwan 886 2 2528 7227,
United Kingdom 44 0 1635 52354



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