

Calibration Executive

Software User Manual

Worldwide Technical Support and Product Information

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Conventions

The following conventions are used in this manual:

»

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



This icon denotes a tip, which alerts you to advisory information.



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



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

bold

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

italic

Italic text denotes variables, emphasis, a cross reference, 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.

`monospace italic`

Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

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Introduction to Calibration Executive

This manual describes how to install and use National Instruments Calibration Executive (version 2.1 and later) to calibrate hardware devices.

Related Documentation

Each device that Calibration Executive supports has its own calibration procedure document in PDF format. The default installation directory is `C:\Program Files\National Instruments\Calibration Executive\Documentation`.

Overview of Calibration Executive

Calibration Executive, developed primarily for metrology labs, provides an integrated software environment in which to verify and adjust NI measurement devices.

Features

Calibration Executive has the following capabilities:

- Externally calibrates many NI measurement devices
- Operates in automatic or manual mode through an intuitive user interface
- Configures and controls calibration instruments automatically
- Stores calibration reports in a central database
- Expands as new hardware calibration procedures are added

Engine and Modules

The Calibration Executive engine provides the core calibration, control, and reporting functionality. Each individual calibration procedure provides the calibration routines and automation for a specific measurement device family. With this modular architecture, you can easily add more calibration procedure modules as they are developed.

For a current list of supported products and required calibration hardware, visit ni.com/calibration.

Minimum System Requirements

For proper operation of the Calibration Executive software, your computer must meet the following requirements:

- Pentium 266 MHz processor or higher
- 64 MB of RAM
- VGA monitor capable of 800 × 600 resolution, 256 colors
- Windows 2000/NT/XP (Windows NT 4.0 requires Service Pack 6)



Note Calibration Executive is not compatible with operating systems that use wide characters (for example, Japanese or Chinese).

Calibration Executive only supports using periods (.) for decimal places. If your computer is configured to use commas as decimal places, change the settings on the Numbers tab as follows:

1. Select **Start»Settings»Control Panel**.
2. 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 a comma to a period.



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.

Installing Calibration Executive



Notes The Calibration Executive 2.1 (or later) installer deletes any users that you configured in Calibration Executive 2.0. You must recreate those user accounts after installation.

If you are running Windows 2000/NT/XP, you must log in with administrator privileges.

Before installing Calibration Executive, exit any virus detection software. In particular, ensure that the McAfee `vsstat.exe` file is not running from the Windows Task Manager. `vsstat.exe` may cause part of the Calibration Executive installer to hang.



Caution National Instruments recommends uninstalling Calibration Executive 2.0 and the associated calibration procedures before installing Calibration Executive 2.1 (or later). The Calibration Executive 2.0 uninstaller removes the `Calibration Executive\Databases\Calibration Reports.mdb` file, which is the database file where calibration reports are stored. To prevent the loss of your stored calibration data, back up this file before uninstalling Calibration Executive 2.0. After uninstalling, restore the `Calibration Reports.mdb`.

To install Calibration Executive and all available calibration procedures, complete the following steps:

1. Close all open applications on your computer.
2. Insert the Calibration Executive installation CD into the CD drive. The installer program starts automatically.
3. Follow the instructions that appear in the dialog boxes.

If the installer program does not start automatically, complete the following steps:

1. Select **Start»Run**.
2. In the command line box, enter `x:\setup.exe` (where `x` is the letter of the CD drive you are using).
3. Click **OK**.
4. Follow the instructions that appear in the dialog boxes.

What the Setup Program Installs

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

Table 1-1. Calibration Executive Directories and Supporting Files

File Name	Contents
Databases	Microsoft Access databases that store the calibration reports.
Buttons	Icon files that represent the buttons displayed on the user interface.
Procedures	Directory structure that contains the available calibration procedures, including specification databases and any support drivers or DLLs required to run a specific procedure.
Templates	HTML templates used to generate the calibration report.
TestStand	TestStand run-time engine required to run calibration procedures.



Note By default, the setup program installs NI-VISA and IVI drivers in the `c:\Vxiipnp` directory.

Loading and Running Calibration Procedures



Note Before you begin using Calibration Executive, thoroughly read the `Readme.html` file that is installed with Calibration Executive. This file contains important information on installation and compatibility issues. You can access `Readme.html` by going to **Start»Programs»National Instruments»Calibration Executive»Documentation**.

To load and run a calibration procedure, complete the following steps:

1. Launch Calibration Executive by selecting **Start»Programs»National Instruments»Calibration Executive**.
2. In the Login dialog box, select **administrator** by clicking the **User Name** control and selecting it from the drop-down list.
3. Click **OK** without entering a password. You can create, edit, and delete user names and passwords in Calibration Executive. For more information, refer to the *Configure Menu* section of Chapter 2, *Using Calibration Executive*.
4. Complete the steps in the Calibration Configuration Wizard. This wizard prompts you to supply the information needed to configure and load the calibration procedure for the device you are calibrating.

5. After completing the wizard, select **Execute»Run Procedure** from the menu bar, or click the **Run Procedures** button.
6. After the procedure finishes, select **View»Reports**.
7. Select **View** to view the calibration information in a printable HTML file or a text report.



Note For more information on loading and running specific procedures, refer to the individual procedure documents that are installed with the Calibration Executive software.

Uninstalling the Calibration Executive Software

Each of the installed software products supplied by NI has its own uninstall information. To remove any of these products from your system, use the Add/Remove Programs utility in your system control panel. Many of these programs update your Windows registry and place files in your system directory; manual deletion of these files is not recommended.

Using Calibration Executive

This chapter describes the main parts of the Calibration Executive user interface and explains how to use the Calibration Configuration Wizard, Cover Page Editor, calibration reports, and the calibration reports database.

Major Components of Calibration Executive

Calibration Executive is designed using National Instruments LabVIEW, CVI, IVI, TestStand, and NI-VISA. A core component of Calibration Executive is the calibration engine. This engine, which includes the user interface, communicates with the following drivers and databases to control the calibration process:

- **Interchangeable Virtual Instruments (IVI)**—A software standard for creating a common interface (API) to common test and measurement instruments. The IVI driver communicates with your standards during calibration, typically using GPIB.
- **Report Database**—A Microsoft Access database that stores the calibration results about assets you have calibrated, such as verification readings taken before and after calibration.
- **TestStand**—A test executive framework that manages the calibration procedures used to calibrate the asset.

The calibration engine also creates calibration reports. Figure 2-1 shows the calibration engine and its major components.

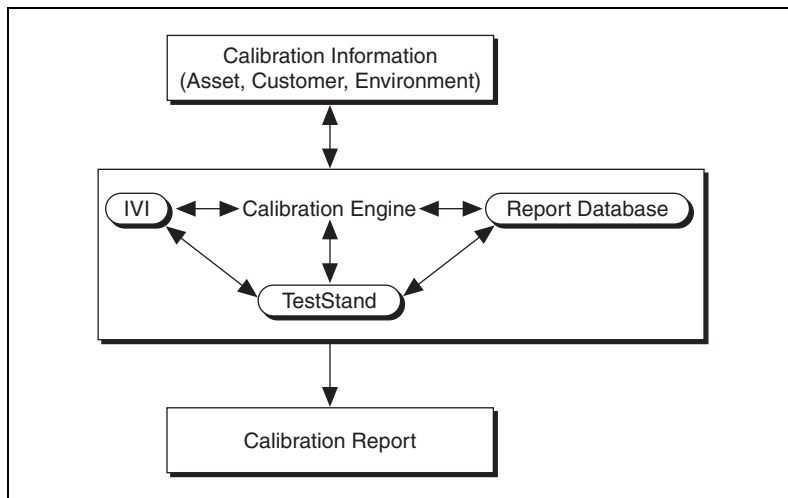


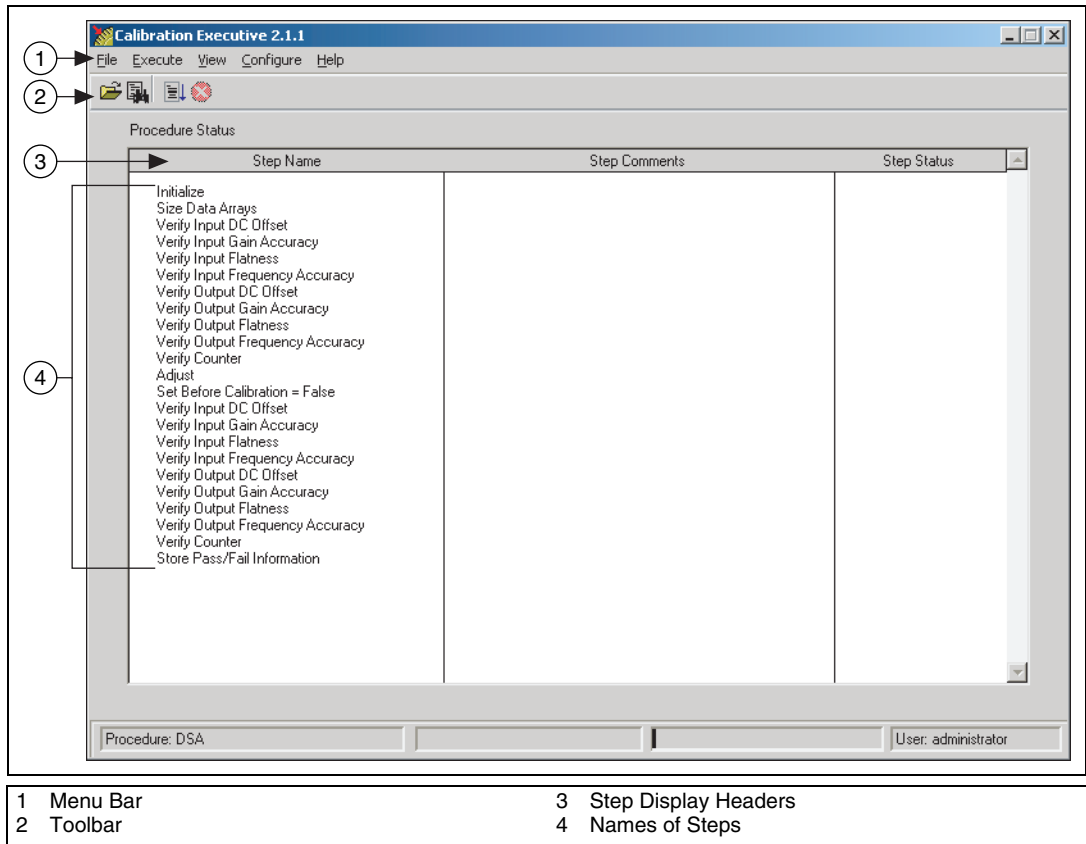
Figure 2-1. Calibration Engine

Automated Versus Manual Calibration

Calibration Executive calibrates devices in either automatic or manual mode. If the IVI driver supports the calibration standard(s) you are using *and* you have a GPIB card, Calibration Executive automates verification and adjustment by communicating directly with the calibration standards. If you do not have IVI-supported standard(s), you must run the procedure in manual mode. In manual mode, Calibration Executive prompts you to manually control the standard(s). Calibration Executive then makes the necessary verification and/or adjustment to the asset.

Calibration Executive User Interface

Figure 2-2 shows the main Calibration Executive user interface, the procedure status window and its main components.



- 1 Menu Bar
- 2 Toolbar

- 3 Step Display Headers
- 4 Names of Steps

Figure 2-2. Procedure Status Window

Menu Bar

The menu bar contains the following menus: File, Execute, View, Configure, and Help, which are described in the following sections.

File Menu

Using the File menu, you can log in as a new user, log out, open a new procedure, or exit from Calibration Executive.

Login

File»Login prompts you for a login name and password. This option is visible on the File menu only after you log out the current user. You can then use the Login option to log in as a different user. Each user can have different privileges, so logging in as a different user can change your privileges. For more information on user privileges, refer to the [User](#) section.



Note When you first launch Calibration Executive, a login dialog box appears automatically—you cannot use the File menu for login if another user is already logged in.

Logout

File»Logout logs out the current user and enables the Login selection under the File menu.

Open Procedure

File»Open Procedure loads and configures a calibration procedure. For more information, refer to the [Calibration Configuration Wizard](#) section.

Exit

File»Exit closes Calibration Executive. If a calibration procedure is currently loaded, the procedure unloads before the calibration engine closes.

Execute Menu

Using the Execute menu, you can run a procedure, stop a procedure, and select the run mode.

Run Procedure

Execute»Run Procedure executes the currently loaded procedure.

Stop Procedure

Execute»Stop Procedure ends a running procedure. You can stop the execution of a calibration procedure at any time. When you stop a procedure, Calibration Executive writes any data collected during the calibration to the calibration reports database.



Note You cannot restart a calibration procedure in the same position in which you stopped the procedure. You can, however, restart the procedure from the beginning by selecting **Execute»Run Procedure**. All of the settings configured in the Calibration Configuration Wizard remain the same.

Run Mode

Execute»Run Mode allows you to select from the following options:

- Verify Only
- Verify, Adjust Failed, Reverify Failed
- Verify, Adjust All, Reverify All
- Adjust Only



Note Not all calibration procedures support all of the run modes. If a run mode is not available in a procedure, the run mode entry will be disabled in the menu.

The default mode is Verify, Adjust All, Reverify All, in which the calibration procedure verifies the measurements of the asset, adjusts its measurement capability, and reverifies the measurements after adjustment. If you do not want to adjust the measurement capability of the asset but need to know how accurately it is measuring, select **Verify Only**.

View Menu

Using the View menu, you can view calibration reports and configuration information.

Reports

View»Reports opens the report viewer window. Use the report viewer window to select and view a stored calibration report. For more information on viewing, printing, and deleting a calibration report, refer to the [Calibration Reports](#) section.

Configuration

View»Configuration launches the Current Procedure Configuration dialog box, which displays all the information about assets, standards, environment, and users that you entered in the Calibration Configuration Wizard. To modify this information, you must launch the wizard by opening a procedure.

Configure Menu

Using the Configure menu, you can change user information, select applications to display calibration reports, select file locations for reports, and customize report generation.

Report Options

Configure»Report Options configures how Calibration Executive displays reports at the end of running a procedure. The choices are as follows:

- HTML report, the default report option, shows the calibration report as an HTML file in your configured browser.
- HTML Report with Cover Page creates an HTML cover page in addition to the HTML report. Click **Customize Cover Page** to launch the *Cover Page Editor*, which guides you through creating a custom cover page.
- Tab-delimited text report shows your report as a tab-delimited text file, which you can display as a text file or in a spreadsheet application such as Microsoft Excel.

Database Options

Configure»Database Options configures the database that stores calibration reports. The Database Options dialog box, shown in Figure 2-3, contains the Database Path information. Database Path is the complete path to the Microsoft Access database that stores the calibration reports.

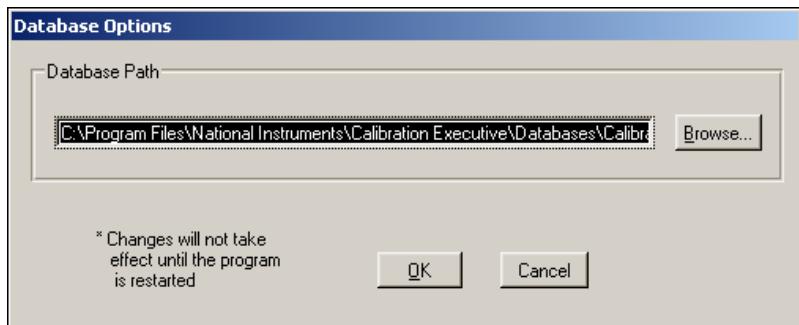


Figure 2-3. Database Options Dialog Box

Any changes you make to file locations do not take effect until you restart Calibration Executive.

Station Options

Configure»Station Options»Launch configuration wizard on startup launches the Calibration Configuration Wizard automatically when you open Calibration Executive. If this option is not selected, you must select **File»Open Procedure** to launch the wizard or click **Open Procedure** on the toolbar.

User

Configure»User displays the dialog box shown in Figure 2-4, in which you can add users, delete users, and edit user privileges.

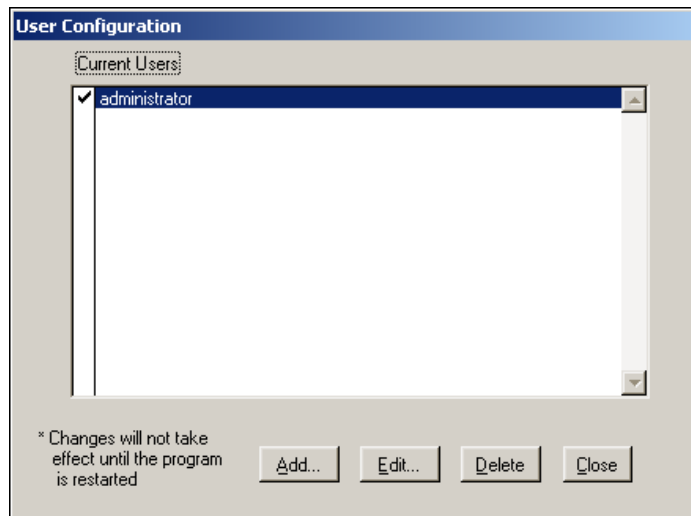


Figure 2-4. User Configuration Dialog Box

To add a new user, complete the following steps:

1. Click **Add** to display the New User dialog box.
2. Specify a case-sensitive login name and password in the User Name and Password controls, as shown in Figure 2-5.

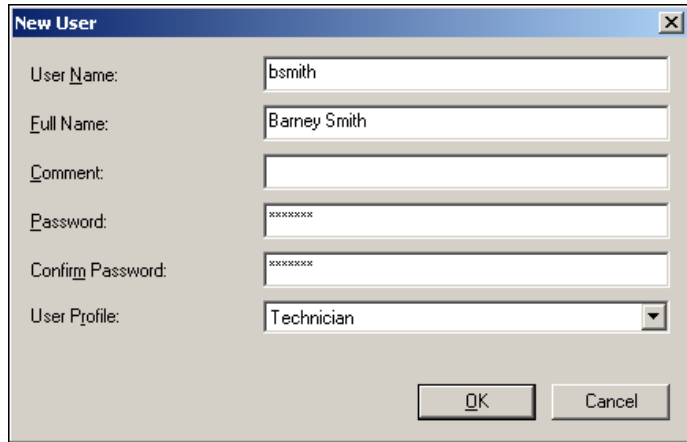


Figure 2-5. Add New User Dialog Box



Note The Full Name and Comment fields are optional.

3. Select a profile in the User Profile ring control to define an initial set of privileges for new users. Calibration Executive offers different features to users depending on their login privileges. Refer to Table 2-1 for specific user privileges.

Table 2-1. User Privileges

Feature	Non-Administrator Privilege	Administrator Privilege
Create/edit/delete users	No	Yes
Configure file locations	No	Yes
Delete calibration reports	No	Yes

4. Click **OK** to save your changes and close the dialog box.

To delete a user name, complete the following steps:

1. Highlight the name of the user you want to remove.
2. Click **Delete**.
3. Click **OK** to save your changes and close the dialog box.



Note You cannot delete your own login information.

To modify the login name, comments, or password associated with the selected user, complete the following steps:

1. Click **Edit** to open the Edit User dialog box, shown in Figure 2-6.

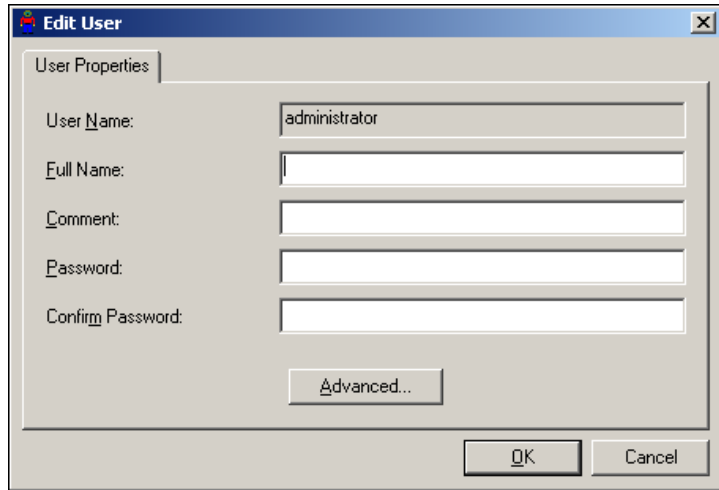


Figure 2-6. Edit User Dialog Box

2. Modify the information you want to change.
3. Click **OK** to save your changes and close the Edit User dialog box.



Note Clicking the **Advanced** button displays the Edit Flags dialog box, which contains TestStand property flags you can modify. You need to configure these property flags only when you are developing a relatively sophisticated custom type in TestStand. The **Advanced** button has no function in Calibration Executive.

Toolbar

The toolbar contains the following shortcuts to commonly used selections of the menu bar:

- Open Procedure
- View Calibration Reports
- Run Procedure
- Stop Procedure Execution

Procedure Status Window

The step information columns in the user interface display the following information about the calibration procedure:

- Step Name displays which values are being verified or adjusted.
- Step Comments provides feedback on individual steps while a calibration procedure is running.
- Step Status indicates whether a step passed or failed.

Status Bar

The status bar, located at the bottom of the user interface, displays the following information about the calibration procedure:

- Procedure displays the name of the currently loaded procedure. If no procedure is loaded, **none** is displayed.
- Percent Complete displays the percentage of a given procedure step that is complete.
- User displays the login name of the current user. If no user is logged in, **none** is displayed.

Calibration Configuration Wizard

The Calibration Configuration Wizard configures and loads calibration procedures for you. This wizard gathers the customer information, asset information, available standards, and calibration conditions necessary to calibrate your asset. When you complete the wizard, your asset is ready to calibrate. To see the data that the wizard has gathered, go to **View»Configuration**. The calibration report and the calibration reports database also contain this configuration data.

The Calibration Configuration Wizard launches automatically when you open Calibration Executive unless you deselect this option in the Configure menu at **Configure»Station Options»Launch configuration wizard on startup**.

To guarantee conformity between calibrations, you must enter data in all of the fields not marked as optional. If the required data is not entered, you cannot continue to the next configuration dialog box.

Customer Information

In the Customer Information dialog box, shown in Figure 2-7, enter the customer name, address, and purchase order. You must fill in all these fields before proceeding. If you do not have a purchase order number, enter N/A.



Note If you do not enter something in all of the required fields, you cannot continue to the next step in the Calibration Configuration Wizard.

If you have any additional notes, you can enter them in the Notes field.

Calibration Configuration Wizard (Step 1 of 5)

Customer Information

Name: NI

Address: 11500 N Morac Expy

Purchase Order Number: N/A

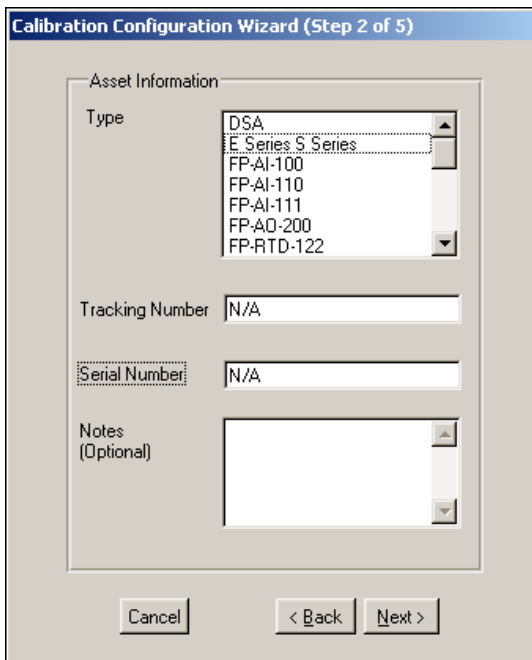
Notes (Optional)

Cancel < Back Next >

Figure 2-7. Customer Information

Asset Information

In the Asset Information dialog box, shown in Figure 2-8, select the asset you want to calibrate from the displayed list, and enter the tracking number and serial number for the asset. A tracking number is a number that certain organizations assign to their equipment that keeps track of the user, the location, and the calibration data of the equipment. If the asset does not have a tracking number, enter N/A in the Tracking Number field.



The screenshot shows a dialog box titled "Calibration Configuration Wizard (Step 2 of 5)". Inside the dialog, there is a section labeled "Asset Information". This section contains four fields:

- Type:** A list box with the following items: DSA, E Series S Series, FP-AI-100, FP-AI-110, FP-AI-111, FP-AO-200, and FP-RTD-122. The "E Series S Series" item is currently selected.
- Tracking Number:** A text input field containing "N/A".
- Serial Number:** A text input field containing "N/A".
- Notes (Optional):** A text area that is currently empty.

At the bottom of the dialog box, there are three buttons: "Cancel", "< Back", and "Next >".

Figure 2-8. Asset Information

Standard Information

A dialog box displays a list of standards you need for the calibration procedure you have selected, as shown in Figure 2-9.

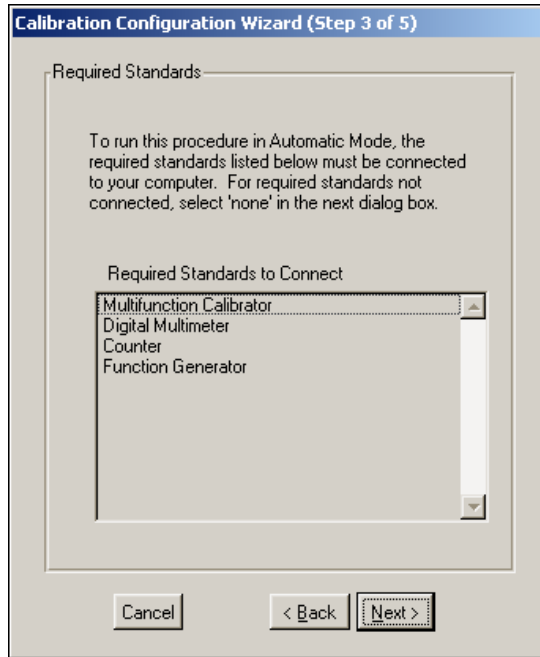


Figure 2-9. Required Standards Information

You can select and configure the standards required to calibrate an asset. Each standard (for example, the calibrator, the DMM, or the counter/timer device) has its own information dialog box. When you complete the information for the first standard, click **Next**, and complete the information for the next standard.

The Standard list displays all of the standards that Calibration Executive supports—for example, calibrators and DMMs. If you are using a standard that is displayed in the list, select it by highlighting the name of the standard. If you are using a standard that is not listed, you can still calibrate the asset in manual mode. In manual mode, Calibration Executive prompts you to enter values on your standard when you run a calibration procedure. Calibration Executive then verifies or adjusts the measurement.

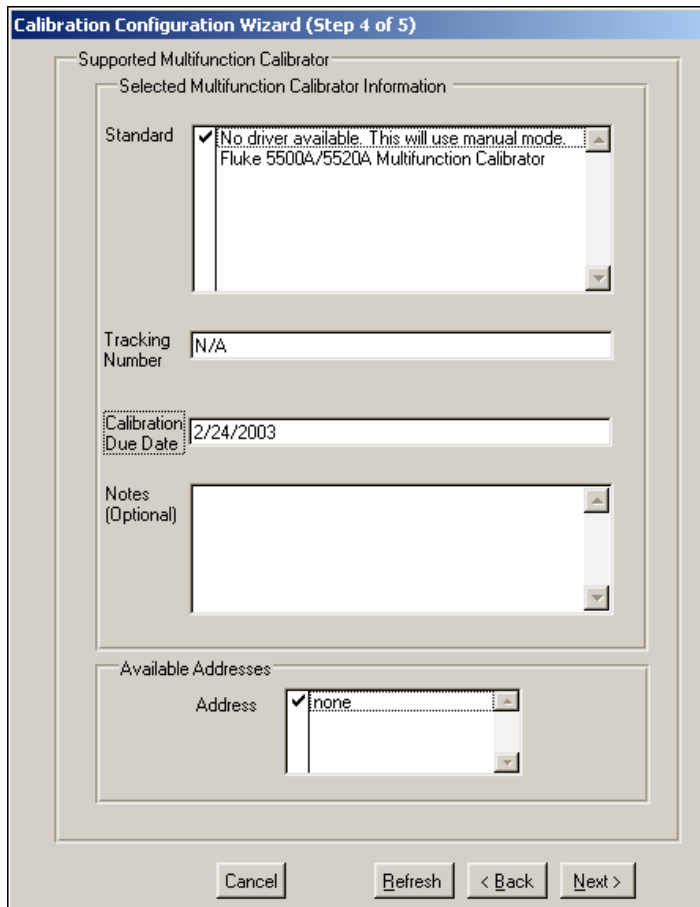


Figure 2-10. Supported Standards

The Available Addresses list displays all of the GPIB instruments that are connected to your computer. If the address of your instrument is not displayed in the list, ensure that the instrument is connected, and click **Refresh**.



Note To run a calibration procedure in automated mode, you must select the standard and its associated GPIB address.

If you do not have one of the supported standards or if the standard is not connected through GPIB, select the following items:

- In the Standard window, select **No driver available. This will use manual mode.**
- In the Address window, select **none.**



Note In manual mode, the procedure prompts you to manually control your standards.

Calibration Conditions

In the Calibration Conditions dialog box, shown in Figure 2-11, enter temperature and humidity information as numerals or characters (for example, 28 C). Temperature can be in Celsius or Fahrenheit.

Figure 2-11. Calibration Conditions

Click **Finish** to complete the Calibration Configuration Wizard and return to the Procedure Status window.

Calibration Reports

The calibration reports are stored in a central database. Calibration Executive retrieves the data from this database and displays the report in the configured viewer. Each report includes the customer name, purchase order number, calibration date, and asset type for all assets that have been calibrated.

Viewing a Calibration Report

You can view calibration reports in one of three formats: HTML, HTML with a cover page, or tab-delimited text.

To configure the report format and view the report, complete the following steps:

1. Select **View»Reports**.
2. Select **Text** or **HTML**. If you select HTML, select the HTML report type also.
3. In the Calibration Reports dialog box, highlight a calibration report from the displayed list.
4. Click **View** to view the calibration report, or double-click the name of a report in the list.
5. Click **Close** when you have finished viewing the report.



Note If you choose to view an HTML report with a cover page and your browser is already open, you may see only the cover page without the report. To view both the cover page and the report, deselect all of your Web browser windows and click **View** in the Calibration Reports dialog box.

When you view a report, Calibration Executive retrieves the calibration data from the reports database, formats the data into an HTML or tab-delimited text file, and launches your viewer to display the file. If you need a printout of the calibration report, use the print functions for your browser or other external viewer.

To remove the highlighted calibration report, click **Delete**. Deleted reports are permanently removed from the database and cannot be recovered. You can delete reports only if you log in with Administrator privileges. For more information on user privileges, refer to the [User](#) section.

End of Procedure Report Options

You also can choose to view your report automatically at the end of a procedure by completing the following steps:

1. Select **Configure»Report Options**.
2. Check the box labeled **View the calibration report at the end of the procedure**, as shown in Figure 2-12.

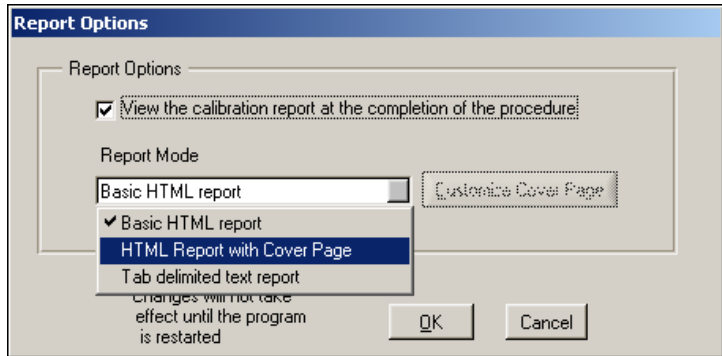


Figure 2-12. Report Options

3. Select a format from the Report Mode listbox.
4. If you have selected HTML Report with Cover Page, click **Customize Cover Page** and follow the instructions in the [Cover Page Editor](#) section. If you have selected another report format, click **OK**.

Modifying the Font Size in a Calibration Report

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

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

Understanding the Calibration Report

Several terms are common to all of the calibration report tables. Low Limit is the lower limit of the reading allowable to meet specifications. Reading is the actual reading taken during the calibration procedure. High Limit is the upper limit allowable to meet specifications. For an ideal calibration, the reading value always lies between the upper and lower limits. If the reading is outside this range, the calibration fails and **FAILED** appears in the Pass/Fail column.

Also common to these tables are the As Found and As Left columns. The As Found column details the response of the asset prior to any adjustment, or as received at the calibration lab. Therefore, if the asset is out of calibration, the As Found tests can fail. The As Left column represents the asset performance after calibration, or as the asset left the calibration lab. The asset should pass the As Left tests.

Cover Page Editor

This section describes the Cover Page Editor and explains how to design and create a cover page template. The Cover Page Editor is a drag-and-drop editor that allows you to design and customize your calibration report cover page. A calibration report cover page can consist of up to 20 each of the following fields:

- Graphics
- Full-width text
- Resizable text
- A table listing the standards used during calibration
- Properties that are part of the calibration procedure

When you use the Cover Page Editor, you create an HTML template file. When you finish designing the cover page, you can preview it using your HTML browser and/or you can save the template.

Launching the Cover Page Editor

To launch the Cover Page Editor, complete the following steps:

1. Select **View»Reports** from the main menu. The Calibration Reports dialog box appears, as shown in Figure 2-13.

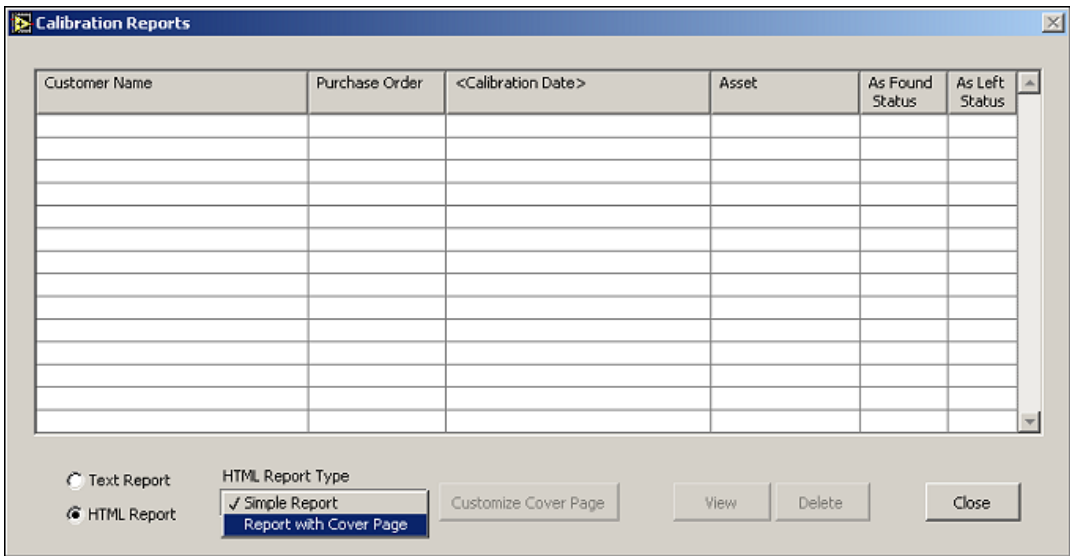


Figure 2-13. Calibration Reports Dialog Box

- a. Select **HTML Report**.
 - b. In the HTML Report Type control, select **Report with Cover Page**.
2. Click **Customize Cover Page**. The Cover Page Editor displays a blank template, as shown in Figure 2-14.

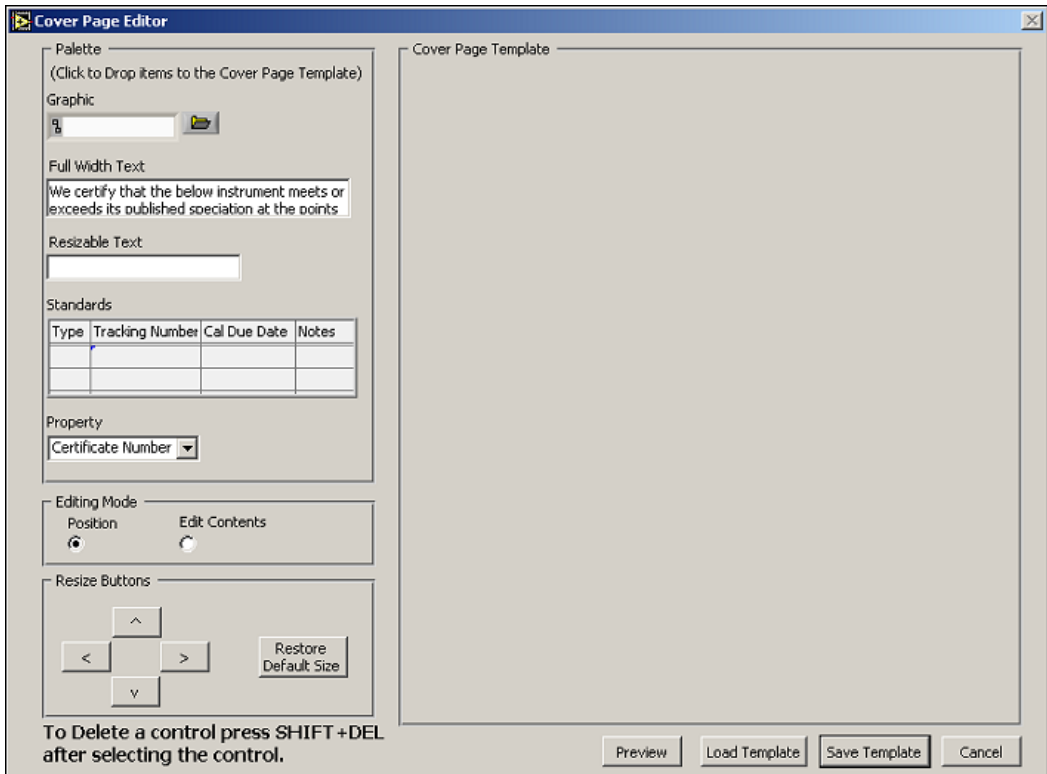


Figure 2-14. The Cover Page Editor Template



Tip Instead of starting a new cover page from scratch, you can click **Load Template** to display the saved template. You can then modify the existing template as needed.

Creating a Customized Cover Page

Using the controls in the left side of the template, you can do the following:

- **Add Fields**—To add a field to your cover page, select the field on the left side of the template. When you click the field, the cursor changes to a four-point arrow. Drag the field to the right side of the template and click to drop it where you want it. You can drag and drop each of the

fields up to 20 times. However, you can only add one field at a time. To add Property fields, select one property at a time from the drop-down list and drag to the template.

- **Move Fields**—To move a field to a different location on the template, select the **Position** editing mode, as shown in Figure 2-15, then drag and drop the field in the new location.

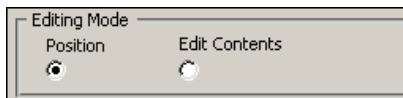


Figure 2-15. Position Mode

- **Edit Contents**—To modify the contents of a field, select the **Edit Contents** mode, as shown in Figure 2-16, then highlight the contents of the field and enter the new information.

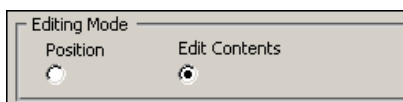


Figure 2-16. Edit Contents Mode

- **Delete Fields**—To remove a field from the template, click the field and press <Shift-Delete>.
- **Resize Fields**—To resize a field, click the field and use the resize buttons, shown in Figure 2-17. You can return a field to its original size by clicking **Restore Default Size**.

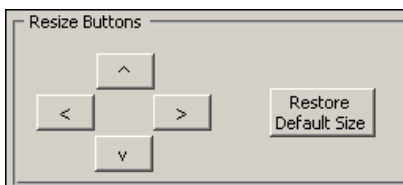


Figure 2-17. Resize Buttons



Note At any time, you can switch between the two editing modes, Position and Edit, to arrange or customize the fields as needed.

- **Preview Cover Page**—To preview the cover page in your Web browser, click **Preview**. Calibration Executive launches the current configuration in the default browser, providing a Web preview of the cover page.
- **Load Template**—To use a previously saved template, click **Load Template**. You can modify this template as needed for your new cover page.
- **Save Template**—To save the template you are currently configuring, click **Save Template**. This action also closes the editor.

Field Types and Capabilities

Table 2-2 lists each of the field types available in the Cover Page Editor and what you can do with each type.

Table 2-2. Cover Page Fields

Field Type	Editing Capability
Graphic	Browse for graphic files. The Cover Page Editor supports JPEG and GIF files. The Cover Page Editor stores an absolute path to the graphic file.
Full Width Text—Occupies the full width of the HTML page	Modify the text.
Resizable Text—Small strings, for example, Seal, Calibration Engineer, and so on	Modify the text.
Standards—Table listing the calibration standards used. Occupies the full width of the HTML page.	Include the standards table in the cover page template.

Table 2-2. Cover Page Fields (Continued)

Field Type	Editing Capability
Property (Properties can be displayed in the form of a table.)	<p>You can change the label for the property by editing the text box. Select from any of the following properties:</p> <ul style="list-style-type: none"> • Manufacturer • Asset/DUT Type • Model/Asset • Serial Number • Tracking Number • Asset/DUT Notes • Customer • Customer Address • Purchase Order • Customer Notes • Temperature • Humidity • Calibration Date • Calibration Due Date • Technician <p>The information for many of these properties comes from the <i>Calibration Configuration Wizard</i> or from the calibration procedure.</p>

Calibration Reports Database

The calibration reports database, a Microsoft Access database, contains all of the results for each calibration. By default, the database is named `Calibration Reports.mdb` and is stored in the `Databases` folder of `Calibration Executive`. If you installed `Calibration Executive` in the default location, this database is located in `x:/Program Files/National Instruments/Calibration Executive/Databases`, where `x` is the drive in which `Calibration Executive` is installed.

The calibration reports database responds to standard structured query language (SQL) commands. Therefore, you can write your own report-handling routine to retrieve data from the database. You could write such a routine in LabVIEW, C, Visual Basic, or any other language that supports SQL communication.

The calibration reports database consists of the following seven tables:

- `ASSET` contains all of the information about the calibrated asset.
- `CALIBRATION_DATA` contains all the data acquired during the calibration, as well as the uncertainty data, if applicable.

- CUSTOMER contains all of the customer information associated with the asset.
- ENGINE contains information about the operator and the calibration date.
- ENVIRONMENT contains information about the environmental conditions during the calibration.
- STANDARD contains information about the standards, such as calibrators and DMMs, that were used during the calibration.
- REPORT keeps track of all of the relationships between the six other tables.

The REPORT table contains a search value for each of the other tables. The search value is a unique number that represents all of the data associated with a specific calibration report—all the customer information, calibration condition information, and so on. To locate data associated with a given calibration, you must first find the search value for that data in the REPORT table. When you know the search value number for a specific report, you can search for a match to that number in the other search value fields of the table.

Example: Using the Calibration Reports Database

Suppose you want to find out all the calibration-related information—the calibration conditions, asset specifics, calibration data, and so on—about the assets you have calibrated for a customer. To find that information, start by opening the CUSTOMER table and locating the name of your client. In the same row that the customer name appears, there is a numeric search value. With that search value, you can open the REPORT table and use that value to search the other tables for that customer’s asset information, calibration data, and so on. You could also use that search value to write your own asset-handling routine.

Specifications

To find the specifications of the device you are calibrating, select one of the following methods:

- Visit ni.com/calibration to find the manual calibration procedure for the device.
- Visit ni.com/products to find the data sheet for the device.
- Refer to the hardware documentation for the device.

Measurement Uncertainty

This chapter describes how Calibration Executive handles measurement uncertainty. To determine if a particular procedure supports automatic uncertainty calculations, refer to the calibration procedure documentation for the device you are calibrating. For procedures that do not include automatic uncertainty calculations, you can calculate the uncertainty manually.

What Is Measurement Uncertainty?

Measurement uncertainty is defined by NCSL RP3-1988 as an estimate of the range of values about the measured value in which the accepted value is believed to lie. A total uncertainty value represents the combination of a measure of the random error and estimated bounds of the systematic error, and considers all factors that contribute to the measurement uncertainty. For detailed information about measurement uncertainty, refer to ANSI/NCSL Z540-2-1997, *U.S. Guide to the Expression of Uncertainty in Measurement*.

For some devices, Calibration Executive can calculate measurement uncertainties for you. When you run the procedure, the software prompts you to select whether to perform measurement uncertainty calculations. If you select **No**, the procedure runs without calculating uncertainty. If you select **Yes**, the procedure prompts you for which uncertainty file you want to use.

How Does Calibration Executive Calculate Measurement Uncertainty?

When calculating measurement uncertainty, Calibration Executive accounts for Type A uncertainty and Type B uncertainty. Table 3-1 explains the calculations for these uncertainty components.



Note Type B uncertainty consists of two parts: uncertainty of the reference standard and resolution uncertainty of the UUT.

Table 3-1. Uncertainty Components

Component	Description
Type A uncertainty	Defined as the standard deviation of the measurements divided by the square root of the number of measurements. This calculation is based on different numbers of measurements for different products. Degrees of freedom is taken into account in cases where the number of degrees of freedom is not considered infinite.
Type B uncertainty, part 1: uncertainty of the reference standard	$= \frac{\text{Standard Deviation of Measurements Taken}}{\sqrt{N}} \times f$ <p>where N is the number of measurements taken and f 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>
Type B uncertainty, part 2: resolution uncertainty of the device	$= \frac{1}{2} \left(\frac{\text{Resolution of the Device}}{\sqrt{3}} \right)$ <p>where <i>Resolution of the Device</i> is the accuracy of the smallest meaningful displayed digit normalized using a rectangular distribution. The $\sqrt{3}$ term comes from assuming a rectangular distribution of probabilities of the values of measurements.</p>

After the standard uncertainty components are calculated, they are combined using the square root of the sum of the squares method to arrive at the combined standard uncertainty. The expanded uncertainty of measurement that Calibration Executive prints on the calibration report is this combined standard uncertainty of measurement multiplied by the coverage factor $k = 1.96$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Example: Calculating the Uncertainty for a Test Point

The following example is the uncertainty calculation for the PCI-MIO-16XE-10 at the 9.98 V analog input test point, 20 V range, bipolar mode (± 10 V), using a Fluke 5720A calibrator that was calibrated one year ago.

- Calibrator uncertainty—the specification for the Fluke 5720A calibrator at 1 year, 95% confidence level ($k = 1.96$ for normal distribution) is $3.5 \text{ ppm} + 2.5 \text{ } \mu\text{V}$.

$$3.5 \text{ ppm} \times 9.98 \text{ V} + 2.5 \text{ } \mu\text{V} = 37.43 \text{ } \mu\text{V}$$

$$\text{Standard Uncertainty} = (37.43 \text{ } \mu\text{V})/1.96 = 19.1 \text{ } \mu\text{V}$$

- Resolution of device:

$$\text{Resolution} = \text{Range/Number of Levels of 16-bit ADC}$$

$$= 20 \text{ V}/2^{16}$$

$$= 305.175 \text{ } \mu\text{V}$$

$$\text{Standard Uncertainty} = \frac{1}{2} \left(\frac{\text{Resolution}}{\sqrt{3}} \right) = 88.1 \text{ } \mu\text{V}$$

- Noise and other Type A uncertainty—standard deviation from 10,000 measurements was $207 \text{ } \mu\text{V}$.

$$\text{Standard Uncertainty of Mean} = \frac{\text{Standard Deviation}}{\sqrt{N}}$$

$$= \frac{207 \text{ } \mu\text{V}}{\sqrt{10,000}}$$

$$= 2.07 \text{ } \mu\text{V}$$

- Combined standard uncertainty—use the square root of sum of squares method:

$$\text{Combined Standard Uncertainty}$$

$$= \sqrt{19.1 \text{ } \mu\text{V}^2 + 88.1 \text{ } \mu\text{V}^2 + 2.07 \text{ } \mu\text{V}^2}$$

$$= 90.2 \text{ } \mu\text{V} \text{ (1 sigma normal distribution)}$$

- Final expanded uncertainty—To convert into 95% confidence level, multiply the standard uncertainty by the coverage factor.

$$90.2 \mu\text{V} \times 1.96 = \pm 177 \mu\text{V}$$

$\pm 177 \mu\text{V}$ is the value printed on the calibration report.

Uncertainty Files for Standards

Calibration Executive stores uncertainty information for common standards, including calibrators and DMMs, in tab-delimited text files under the `Calibration Executive\Uncertainty` directory. Calibration Executive prompts you to select whether to include uncertainty information when you run a procedure.

The Calibrator Uncertainty Information dialog box, shown in Figure 3-1, displays the list of calibrators for which Calibration Executive has uncertainty files. You can select a calibrator from the displayed list, or you can browse to select another uncertainty file.

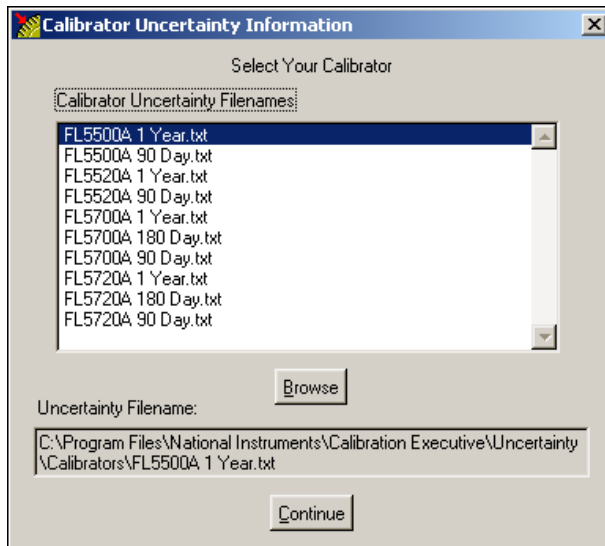


Figure 3-1. Calibrator Uncertainty Information

The DMM Uncertainty Information dialog box, shown in Figure 3-2, displays the list of DMMs for which Calibration Executive has uncertainty files. You can select the DMM model you are using from the displayed list, or you can browse to select another uncertainty file.

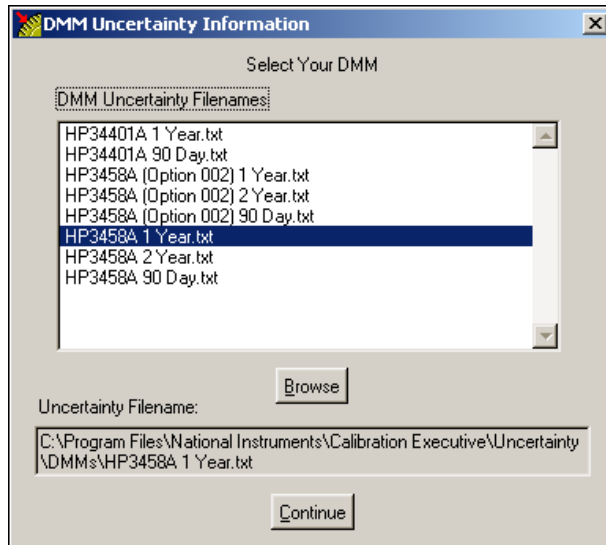


Figure 3-2. DMM Uncertainty Information

Each uncertainty file contains a confidence level that corresponds to a coverage factor, as listed in Table 3-2. These coverage factors assume an infinite number of degrees of freedom.

Table 3-2. Confidence Levels and Corresponding Coverage Factors

90%	95%	95.45%	99%	99.73%
1.645	1.960	2.000	2.576	3.000



Note For a more detailed table of confidence levels and coverage factors, refer to *Annex G* in ANSI/NCSL Z540-2-1997, *U.S. Guide to the Expression of Uncertainty in Measurement*.

Uncertainty Files for Commonly-Used Standards

The information in the uncertainty files is taken from the manufacturer's specifications for each particular instrument, at a confidence level shown in the specifications and at the top of the uncertainty file.



Note Uncertainty files contain specifications expressed in specific units. For example, calibrator uncertainty files generally contain ppm output and μV offset, whereas DMM uncertainty files generally contain ppm reading and ppm range. If the specifications for your instrument are not in this format, you must convert them to the same units.

For example, if the specifications of your calibrator are given in percent output and mV offset, you must convert them correctly to ppm output and μV offset, respectively. If the confidence level is not given in the instrument specifications, you can assume a 95% confidence level and set the coverage factor to 1.96. For more information, refer to Annex G in ANSI/NCSL Z540-2-1997, *U.S. Guide to the Expression of Uncertainty in Measurement*.

Template Files

If you use instruments that do not have uncertainty files provided by Calibration Executive, you can create your own uncertainty files by using the template files. Template files named `Calibrator_Template.txt` and `DMM_Template.txt` are provided in their respective directories under `Calibration_Executive\Uncertainty`.



Tip Instead of using the template files, you can modify an existing DMM or calibrator uncertainty file by making a copy of the file and changing the appropriate information for the standard you are using.

Uncertainty Calculations of Reference Standards

The uncertainty of the calibrator depends on what range it is operating in and what output value it is returning. Calibration Executive calculates the uncertainty of a DC voltage test point for a calibrator as follows:

1. Searches in the proper uncertainty file for the row in which the test value is less than the range.
2. Retrieves the ppm output and μV offset from that row.
3. Calculates uncertainty using the formula

$$\text{Uncertainty} = \frac{\text{ppm Output} \times \text{Test Value}}{1,000,000} + \frac{\mu\text{V Offset}}{1,000,000}$$

4. Calculates standard uncertainty using the formula

$$\text{Standard Uncertainty} = \frac{\text{Uncertainty}}{1.96}$$

because a 95% confidence level corresponds to a coverage factor of 1.96.

The standard uncertainty is the value that Calibration Executive combines with the other standard uncertainties using the root-sum-square method to determine the combined standard uncertainty.

The uncertainty of the DMM depends on what range it is operating in and the value that it is reading. Calibration Executive calculates the uncertainty of a DC voltage test point for a DMM as follows:

1. Searches in the proper uncertainty file for the row in which the test value is less than the *Range*.
2. Retrieves the *Range*, *ppm Reading*, and *ppm Range* from that row.
3. Calculates uncertainty using the formula

$$\text{uncertainty} = \frac{\text{ppm Reading} \times \text{Reading}}{1,000,000} + \frac{\text{ppm Range} \times \text{Range}}{1,000,000}$$

4. Calculates standard uncertainty using the formula

$$\text{Standard Uncertainty} = \frac{\text{Uncertainty}}{1.96}$$

The standard uncertainty is the value Calibration Executive combines with the other standard uncertainties using the root-sum-square method to determine the combined standard uncertainty. The combined standard uncertainty is then multiplied by a coverage factor of 1.96, corresponding to a final expanded uncertainty with a 95% confidence level and a normal distribution.

Adding Uncertainty Components

If you want to add other uncertainty components, you can copy and modify an existing uncertainty file. For example, if you want to add an offset uncertainty component to all analog input tests, make a copy of the proper calibrator uncertainty file, rename it, and modify it by adding the offset to the μV offset column.

If your DMM is operating outside of its normal temperature range and you want to account for the temperature difference, make a copy of the proper DMM uncertainty file and add the temperature coefficients to the absolute uncertainty specifications. When you run the Calibration Executive procedure, a dialog box prompts you for information on which calibrator and DMM you are using. If you want to use your modified uncertainty files and they are not in the list, click **Browse** and select your modified uncertainty files.

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources include the following:
 - **Self-Help Resources**—For immediate answers and solutions, visit our extensive library of technical support resources available in English, Japanese, and Spanish at ni.com/support. These resources are available for most products at no cost to registered users and include software drivers and updates, a KnowledgeBase, product manuals, step-by-step troubleshooting wizards, conformity documentation, example code, tutorials and application notes, instrument drivers, discussion forums, a measurement glossary, and so on.
 - **Assisted Support Options**—Contact NI engineers and other measurement and automation professionals by visiting ni.com/support. Our online system helps you define your question and connects you to the experts by phone, discussion forum, or email.
- **Training**—Visit ni.com/training for self-paced tutorials, videos, and interactive CDs. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, NI Alliance Program members can help. To learn more, call your local NI office or visit ni.com/alliance.

If you searched ni.com and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of ni.com/niglobal to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

Symbol	Prefix	Value
μ	micro	10^{-6}
M	mega	10^6

A

- adjust** To correct the measurement error of a device by adjusting the calibration constants and storing the new calibration constants in the EEPROM. The host computer reads the calibration constants and the software uses them to compensate for errors in the data and to present calibrated data to the user.
- asset** A hardware device that you are calibrating. With Calibration Executive, you can calibrate assets such as E Series devices and SCXI modules.

C

- calibration** A set of operations that compares the values indicated by a measuring instrument or measuring system to the corresponding values realized by external standards. The result of a calibration can be used to determine the measurement error and can correct for it in the adjustment process.
- combined standard uncertainty** The standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or covariances of these other quantities weighted according to how the measurement result varies with changes in these quantities.
- confidence** The probability that a predicted result will occur.
- confidence level** Confidence, expressed either as a fraction (between 0 and 1) or a percentage.
- coverage factor** A numerical factor used as a multiplier of the standard uncertainty to obtain an expanded uncertainty.

D

degrees of freedom	Any of the unrestricted, statistically independent values of a sample that are used to determine a property of the sample.
DLL	Dynamic-Link Library for Windows—libraries that link to a program and load at run time instead of being compiled into the program.
driver	Software that controls specific hardware device such as a DAQ device or a GPIB interface board.

E

expanded uncertainty	A quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the quantity being measured.
----------------------	--

G

GPIB	General Purpose Interface Bus—the standard bus used for controlling electronic instruments with a computer.
------	---

H

HTML	Hyper Text Markup Language—a hypertext document format used on the Web.
------	---

I

IVI	Interchangeable Virtual Instrumentation—an advanced architecture for instrument drivers that includes features such as simulation and state caching.
-----	--

M

MB	Megabytes of memory.
MHz	Megahertz.

N

NI-VISA The National Instruments implementation of the VISA standard—an interface-independent software that provides a unified programming interface for VXI, GPIB, and serial instruments.

R

resolution The smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, proportions, digits, or percent of full scale.

S

SCXI Signal Conditioning eXtensions for Instrumentation—the National Instruments product line for conditioning low-level signals within an external chassis near sensors.

standard The instruments used in calibration such as calibrators, DMMs, and counters.

standard uncertainty The uncertainty of the result of a measurement expressed as a standard deviation.

structured query language (SQL) An industry-standard language for retrieving, updating, and managing data.

T

TestStand A test executive program that allows you to organize and execute sequences of reusable test modules. In Calibration Executive, TestStand manages the calibration procedures used to calibrate your asset.

Type A evaluation (of uncertainty) A method of evaluation of uncertainty by the statistical analysis of a series of observations.

Type B evaluation (of uncertainty) A method of evaluation of uncertainty by means other than the statistical analysis of a series of observations.

U

uncertainty An estimate of the range of values about the measured value in which the accepted value is believed to lie.

uncertainty of measurement A parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the quantity being measured.

V

verify To compare the measured performance of a device to an external standard of known measurement uncertainty to confirm that the device meets or exceeds its specifications.

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