

Agilent E5070B/E5071B ENA Series RF Network Analyzers

Adapter Characterization

First Edition



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VBA Macro

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Calibration between Ports of Different Connector Types

Overview

When you perform calibration between ports of different connector type, you need to use a different calibration kit for each test port. In addition, for transmission measurement between 2 ports, you need to use adapters suitable for the connector types of both ports.

For example, in order to perform the full 2-port calibration between port 1 of the N-type connector and port 2 of the 3.5-mm connector, you need to use an N-type connector calibration kit (for example, 85032F) for reflection measurement of port 1, a 3.5-mm connector calibration kit (for example, 85033E) for reflection measurement of port 2, and an N-3.5 mm adapter for transmission measurement between ports 1 and 2.

Because you cannot use a different calibration kit for each port in normal calibration of the E5070B/E5071B, you have to use the following VBA macro to perform calibration between ports of different connector type.

Storage folder	VBA macro name (project name)
D:\Agilent	AdapterCharacterization.vba

NOTE

Never delete this VBA macro. Even if you execute system recovery, this VBA macro will not be recovered.

This VBA macro lets you select a calibration kit for each test port and each pair of test ports when performing calibration and, in addition, it lets you select any adapter (2-port touchstone file) whose characteristics have been determined for a standard between test ports.

NOTE

This VBA macro has the adapter characterization function to obtain the characteristics of an adapter and save them into a 2-port touchstone file. For more information, refer to “Adapter Characterization” in this document.

Operating procedure

NOTE

This VBA macro changes definition of the label of calibration kit 10 (calibration kit corresponding to the lowest softkey) temporarily, performs calibration, and restore the definition after completion of the calibration. Therefore, if the VBA macro is aborted for some reason, the definition of the label of calibration kit 10 may be lost.

When you use this VBA macro, it is recommended that you do not use calibration kit 10. If you are using calibration kit 10, it is recommended that you back up calibration kit 10 before using this VBA macro.

To back up a calibration kit, use the VBA macro (SavRecCalKit.vba). You can download this VBA macro through Internet from our product information web site of the Agilent Technologies E5070B/E5071B.

1. Setting stimulus condition

Set the stimulus condition of the channel for which you perform the calibration.

For information on the setting procedure, refer to Chapter 3 “Setting Measurement Conditions” in *User's Guide*.

2. Starting VBA macro

Load the VBA project and run it.

Step 1. Press **Macro Setup**.

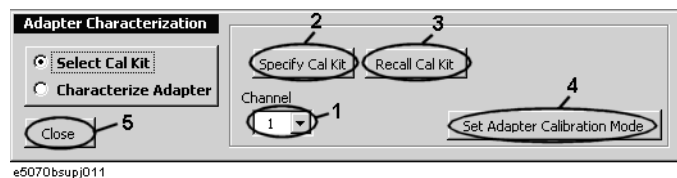
Step 2. Press **Load Project**.

Step 3. The Open dialog box appears. Specify the file name “D:\Agilent\AdapterCharacterization.vba” and press the **Open** button.

Step 4. Press **Macro Run** to start the macro. (See Figure 1-1)

Figure 1-1

The Adapter Characterization macro



3. Selecting a channel

Select a channel (1 in Figure 1-1).

NOTE

The selected channel does not relate to the active channel.

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4. Setting calibration kit

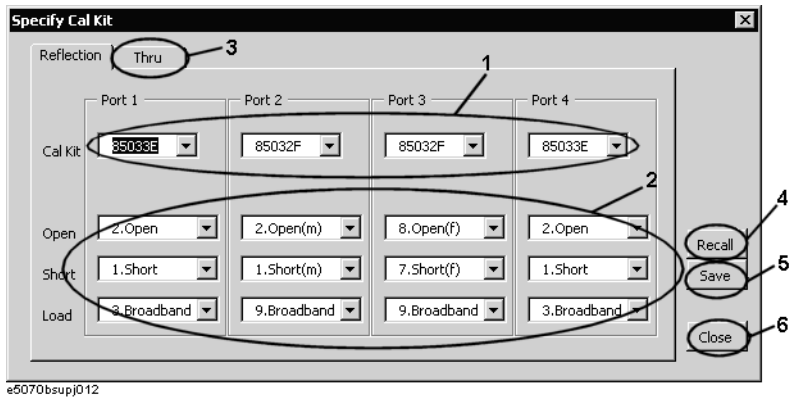
Select a calibration kit for each test port and each pair of test ports and select a standard you use for each reflection/transmission measurement.

Step 1. Press the **Specify Cal Kit** button (2 in Figure 1-1).

The Specify Cal Kit dialog box (Reflection tab) as shown in Figure 1-2 appears.

Figure 1-2

Specify Cal Kit dialog box (Reflection tab)

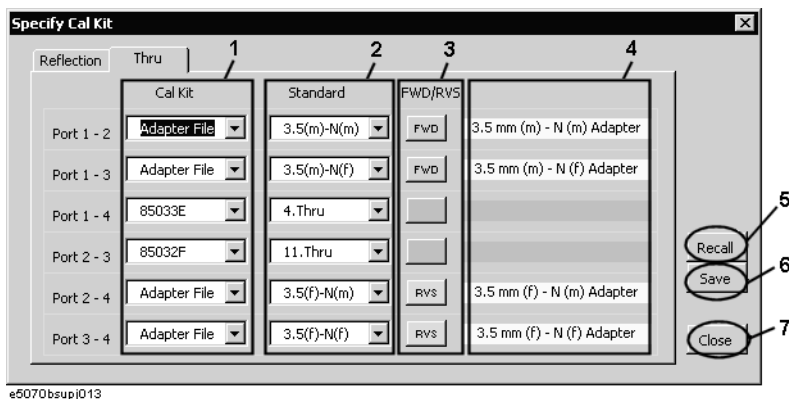


Step 2. For each test port, select a calibration kit you use (1 in Figure 1-2) and select a standard you use in the open/short/load reflection measurement from the calibration kits (2 in Figure 1-2).

Step 3. Select the **Thru** tab (3 in Figure 1-2). The Specify Cal Kit dialog box (Thru tab) as shown in Figure 1-3 appears.

Figure 1-3

Specify Cal Kit dialog box (Thru tab)



Step 4. For each test port, select a calibration kit you use (1 in Figure 1-3). In addition to the 10 calibration kits you can select for normal calibration, you can select Adapter File. When you want to use the adapter as the standard, select Adapter File.

From the calibration kits you have selected, select a standard you use for transmission measurement (2 in Figure 1-3). If you select Adapter File as the calibration kit, you can select an adapter file (2-port touchstone file) under the D:\Agilent\Data\AdapterCharacterization folder as the standard. In this case, you have to

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specify the port connection mode (FWD/RVS) between the E5070B/E5071B and the adapter (3 in Figure 1-3).

FWD	Port 1 of the adapter (port 1 of the 2-port touchstone file) is connected to the test port of the smaller port number of the E5070B/E5071B.
RVS	Port 2 of the adapter (port 2 of the 2-port touchstone file) is connected to the test port of the smaller port number of the E5070B/E5071B.

For example, when setting ports 2 to 4, if you want to connect port 1 of the adapter to test port 4 of the E5070B/E5071B and port 2 of the adapter to test port 2 of the E5070B/E5071B, select RVS as the port connection mode.

When you select Adapter File, the comment contained in the adapter file is displayed at 4 in Figure 1-2.

Saving and loading calibration kit settings

You can save the selection of the calibration kit and standard for each test port (the setting in the Reflection tab) and that for each pair of test ports (the setting in the Thru tab), as well as load them for restoring whenever needed.

Press the **Save** button (5 in Figure 1-2/6 in Figure 1-3) to save the setting into a file.

Press the **Recall** button (4 in Figure 1-2/5 in Figure 1-3) or the **Recall Cal Kit** button (3 in Figure 1-1) to recall the setting from the file.

NOTE

If the calibration kit definition is changed after saving the file resulting contradiction between information in the file and the calibration kit definition, you can no longer recall the settings from the file.

- Step 5.** Press the **Close** button (6 in Figure 1-2/7 in Figure 1-3) to finish the setting of the calibration kits.

5. Performing calibration

Set the E5070B/E5071B to the special calibration mode in which you can use a different calibration kit for each test port (adapter calibration mode) and then perform the calibration.

- Step 1.** Press the **Set Adapter Calibration Mode** button (4 in Figure 1-1) to set the E5070B/E5071B to the adapter calibration mode.

NOTE

Do not terminate the VBA macro forcefully.

In the adapter calibration mode, if you terminate the VBA macro forcefully, for example, with the **Macro Break** key before returning to the normal calibration mode with the **Exit** button, normal calibration can no longer be performed and the label of calibration kit 10 remains altered. To return to the normal calibration mode, restart the firmware of the E5070B/E5071B. In this case, you cannot restore the label of calibration kit 10.

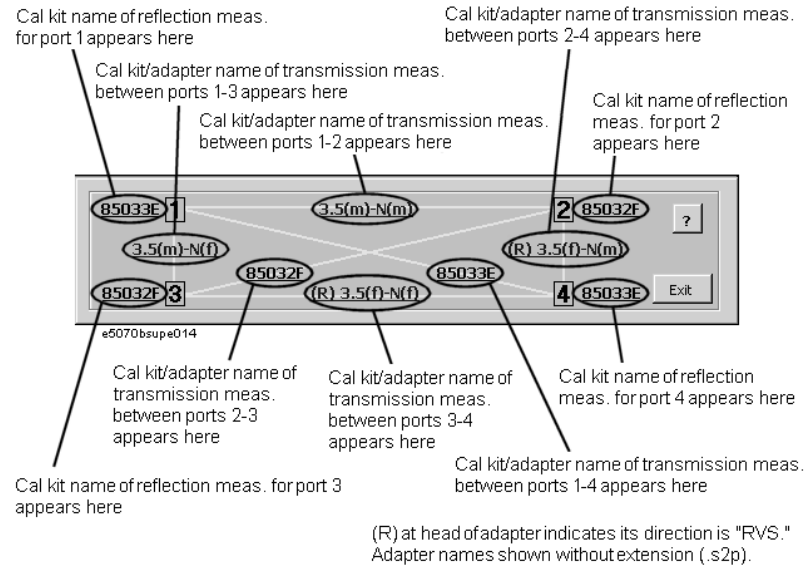
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Step 2. The screen showing the selected calibration kits for each test port and each pair of test ports based on the setting in “4. Setting calibration kit” appears (refer to Figure 1-4).

Figure 1-4

Calibration kit setting display screen for adapter calibration mode



Calibration procedure in the adapter calibration mode is the same as that in the normal calibration except that the standard connected for each calibration data measurement differs. Therefore, when performing the calibration, you use the softkeys (the menu displayed by **Cal** - **Calibrate**) you use in the normal calibration.

In the adapter calibration mode, the standard name is displayed in the softkey to perform each calibration data measurement based on the setting in “4. Setting calibration kit” on page 22.

According to the on-screen information in Figure 1-4 and the softkey label, connect the appropriate standard and measure each type of calibration data to perform calibration.

Step 3. After the calibration, press the **Exit** button to return the E5070B/E5071B to the normal calibration mode.

6. Closing VBA macro

Press the **Close** button (5 in Figure 1-1) to close the macro.

Adapter Characterization

To perform calibration between ports of different connector types, you have to obtain characteristics of the adapter you use in transmission measurement in advance.

The adapter characterization function lets you obtain the characteristics of the adapter (S-parameter) and save them into a 2-port touchstone file.

Use the following VBA macro to execute the adapter characterization.

Storage folder	VBA macro name (project name)
D:\Agilent	AdapterCharacterization.vba

NOTE

Never delete this VBA macro. Even if you execute system recovery, this VBA macro will not be recovered.

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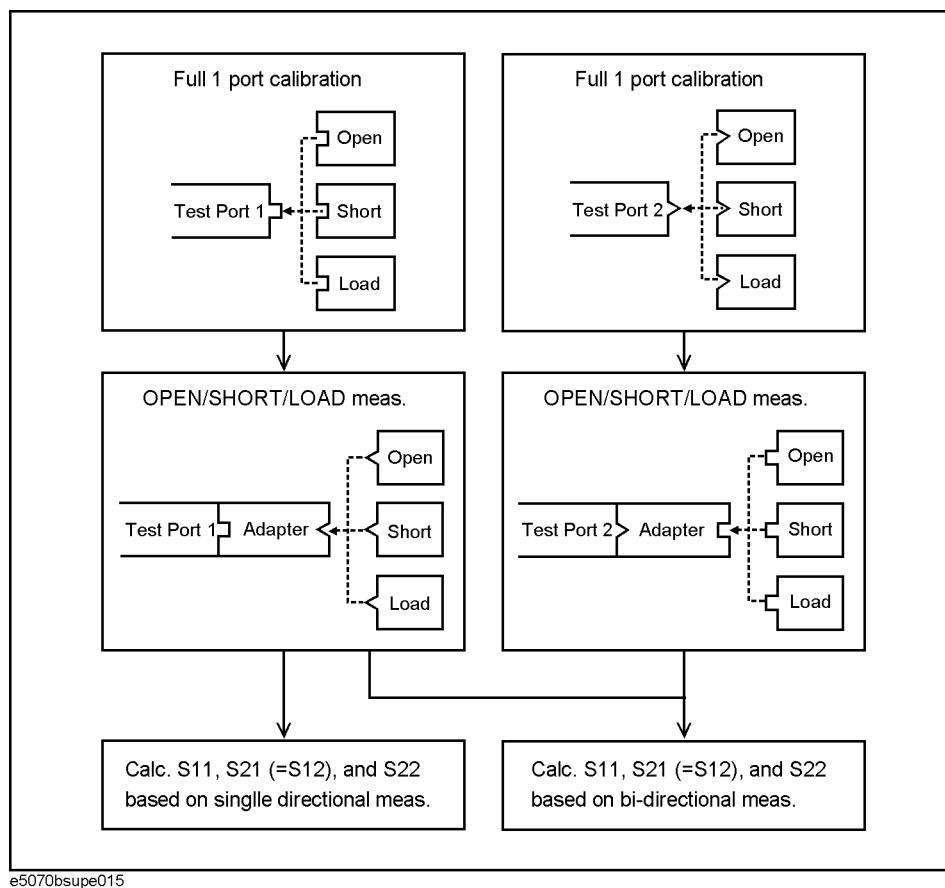
Concept

The adapter characterization is a function to calculate S-parameters of an adapter based on 3 measurement results with open/short/load standards that are connected to the test port, via the adapter, for which full 1-port calibration has been performed. This VBA macro uses test port 1 for this measurement.

The S-parameters of the adapter can be calculated from the above 3 measurement results. However, you can calculate the S-parameters more accurately by connecting the adapter to the test port in the reverse direction, measuring 3 more results in the same way as above, and using the above 3 results and these 3 results (the total of the 6 measurement results). This VBA macro uses test port 2 for the measurement in which the adapter is connected in the reverse direction.

Figure 1-5

Adapter characterization



How to execute adapter characterization

1. Setting stimulus conditions

Set stimulus conditions of the channel for which you execute the adapter characterization.

For information on the setting procedure, refer to Chapter 3 “Setting Measurement Conditions” in *User's Guide*.

2. Performing calibration

Perform full 1-port calibration for test port 1 and test port 2 in the channel for which the stimulus condition has been set. Use the connector type appropriate for the adapter for the calibration surface of test port 1 and test port 2.

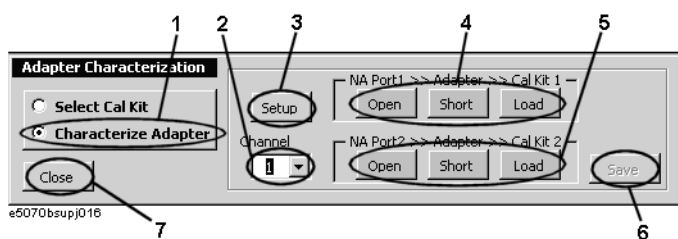
For information on the performing procedure, refer to Chapter 4 “Calibration” in *User's Guide*.

3. Starting VBA macro

- Step 1.** Press **Macro Setup**.
- Step 2.** Press **Load Project**.
- Step 3.** The Open dialog box appears. Specify the file name “D:\Agilent\AdapterCharacterization.vba” and press the **Open** button.
- Step 4.** Press **Macro Run** to start the macro.
- Step 5.** Select **Characterize Adapter** (1 in Figure 1-6) to display the Adapter Characterization screen.

Figure 1-6

Adapter Characterization macro (Adapter Characterization screen)



4. Selecting channel

Select the channel for which calibration has been performed (2 in Figure 1-6).

NOTE

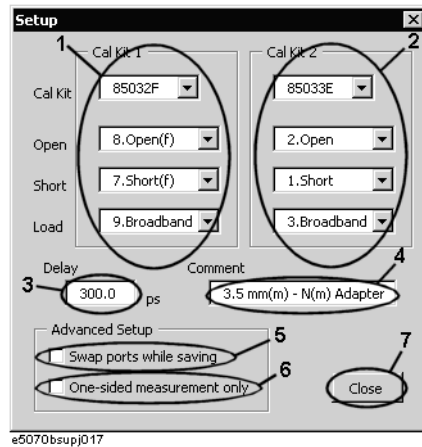
The selected channel does not relate to the active channel.

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5. Setting adapter characterization

- Step 1.** Press the **Setup** button (3 in Figure 1-6). The Setup dialog box as shown in Figure 1-7 appears.

Figure 1-7 Setup dialog box



- Step 2.** Make the setting of the calibration kit you connect to the adapter that is connected to test port 1 of the E5070B/E5071B in Cal Kit 1 (1 in Figure 1-7).
- Step 3.** Make the setting of the calibration kit you connect to the adapter that is connected to test port 2 of the E5070B/E5071B in Cal Kit 2 (2 in Figure 1-7).

When you calculate the S-parameters using measurement data in one direction only, you do not have to make the setting in Cal Kit 2. In this case, give a check mark to the left of One-sided measurement Only (6 in Figure 1-7).

- Step 4.** Enter the Delay of the adapter (3 in Figure 1-7) within an error of $\pm \frac{1}{4 \times f}$ [s]. Where f is the maximum measurement frequency [Hz]. For example, when the maximum value is 1 GHz, enter a value within an error of ± 250 ps.
- Step 5.** Enter a comment about the adapter (4 in Figure 1-7). The comment entered here is displayed in the comment field in the Specify Cal Kit dialog box (4 in Figure 1-2).
- Step 6.** By default, the S-parameters are saved so that the port of the adapter connected to test port 1 of the E5070B/E5071B corresponds to port 1 of the 2-port touchstone file. To save the S-parameters in the reverse order, which means that the port of the adapter connected to test port 1 of the E5070B/E5071B corresponds to port 2 of the 2-port touchstone file, give a check mark to the left of Swap ports while saving (5 in Figure 1-7).
- Step 7.** Press the **Close** button (7 in Figure 1-7) to finish the setting of the adapter characterization.

6. Measuring data

Measure data when each standard is connected.

Step 1. Connect the adapter to test port 1 of the E5070B/E5071B.

Step 2. According to the setting of Cal Kit 1, connect each standard to the adapter and then press the corresponding button (4 in Figure 1-6). When the data measurement is complete, the button turns to yellow.

When you calculate the S-parameters using measurement data in one direction only, the data measurement is complete here.

Step 3. Connect the adapter to test port 2 of the E5070B/E5071B in the reverse direction.

Step 4. According to the setting of Cal Kit 2, connect each standard to the adapter and then press the corresponding button (5 in Figure 1-6). When the data measurement is complete, the button turns to yellow.

7. Saving to file

Calculate the S-parameters and save them into a file.

Step 1. Press the **Save** button (6 in Figure 1-6).

Step 2. The Save As dialog box appears. Enter a file name and press the **Save** button.

If you save the file under the D:\Agilent\Data\AdapterCharacterization folder, you can select it as the standard when selecting Adapter file when you make the setting for the adapter calibration mode in the Specify Cal Kit dialog box.

8. Closing VBA macro

Press the **Close** button (7 in Figure 1-6) to close the macro.

Execution procedure of characterization for test fixture using probe

The adapter characterization function also lets you obtain characteristics of a test fixture inserted between a DUT that cannot be connected directly to the instrument and the instrument using a probe, and save them into a 2-port touchstone file. The obtained result can be eliminated using the network de-embedding function of the fixture simulator function, which provides measurement where the effect of the test fixture is eliminated.

NOTE

For more information on the test fixture characterization using a probe, refer to Product Note E5070/71-4.

1. Setting stimulus conditions

Set the stimulus condition of the channel for which you execute the test fixture characterization.

2. Performing calibration

Perform full 1-port calibration for the probe in the channel for which the stimulus condition has been set.

3. Starting VBA macro

Start the VBA macro to display the Adapter Characterization screen (Figure 1-6).

4. Selecting channel

Select the channel for which calibration has been performed (2 in Figure 1-6).

5. Setting characterization

- Step 1.** Press the **Setup** button (3 in Figure 1-6) to display the Setup dialog box (Figure 1-7).
 - Step 2.** Make the setting of the calibration kit you use in Cal Kit 1 (1 in Figure 1-7).
 - Step 3.** Enter the Delay of the test fixture (3 in Figure 1-7).
 - Step 4.** Enter a comment about the test fixture (4 in Figure 1-7). This comment is added to the comment line at the beginning of the touchstone file.
 - Step 5.** Give a check mark to the left of Swap ports while saving (5 in Figure 1-7) in order to align the direction when specifying a file in the network de-embedding function.
 - Step 6.** Give a check mark to the left of One-sided measurement Only (6 in Figure 1-7).
 - Step 7.** Press the **Close** button (7 in Figure 1-7) to close the Setup dialog box.
-

6. Measuring data

- Step 1.** Connect the probe to the DUT side end of the test fixture.
- Step 2.** According to the setting of Cal Kit 1, connect each standard to the connector side of the test fixture and then press the corresponding button (4 in Figure 1-6). When the data measurement is complete, the button turns to yellow.

7. Saving to file

Press the **Save** button (6 in Figure 1-6) to save the calculated S-parameters into a 2-port touchstone file.

8. Closing VBA macro

Press the **Close** button (7 in Figure 1-6) to close the macro.
