

Keysight U2722A/U2723A USB Modular Source Measure Units

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Safety Information

CAUTION

















A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions that must be taken to maintain safe operation of the instrument.

	Direct current (DC)		Equipment protected throughout by double insulation or reinforced insulation
	Alternating current (AC)		Off (supply)
	Both direct and alternating current		On (supply)
	Three-phase alternating current		Caution, risk of electric shock
	Earth (ground) terminal		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	Protective conductor terminal		Caution, hot surface
	Frame or chassis terminal		Out position of a bi-stable push control
	Equipotentiality		In position of a bi-stable push control

General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING

- Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.
 - Do not operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.
 - Only qualified, service-trained personnel who are aware of the hazards involved should remove the instrument casing. Always disconnect the power cable and any external circuits before removing the instrument casing.
 - Do not use the equipment if it does not operate properly. Ensure that the equipment is inspected by qualified service personnel.
 - Do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Keysight Sales and Service Office for service and repair to ensure that the safety features are maintained.
-

CAUTION

- Make all connections to the unit before applying power.
 - Take note of the instrument's external markings described under **Safety Symbols**.
 - Use the device with the provided cables.
 - Repair or service that is not covered in this manual should only be performed by qualified personnel.
 - Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.
-

Environmental Conditions

This instrument is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.





Environmental conditions	Requirements
Operating temperature	0 °C to 50 °C
Operating humidity	20% to 85% RH non-condensing
Storage temperature	-20 °C to 70 °C
Storage humidity	5% to 90% RH non-condensing

CAUTION

The U2722A/U2723A USB Modular Source Measure Units complies with the following safety and EMC requirements.

- IEC 61326-1:2005/EN61326-1:2006
- Canada: ICES-001:2004
- Australia/New Zealand: AS/NZS CISPR11:2004
- IEC 61010-1:2001/EN 61010-1:2001 (2nd Edition)
- Canada: CAN/CSA-C22.2 No. 61010-1-04
- USA: ANSI/UL 61010-1:2004

Regulatory Markings

	<p>The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives</p>		<p>The RCM mark is a registered trademark of the Australian Communications and Media Authority.</p>
<p>ICES/NMB-001</p>	<p>ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.</p>		<p>This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.</p>
	<p>The CSA mark is a registered trademark of the Canadian Standards Association.</p>		

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/U2722A
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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1 Getting Started

Introduction 18

This chapter discusses the self-test and self-calibration procedure for the U2722A/U2723A USB Modular Source Measure Units. It also provides the information for returning your U2722A/U2723A to Keysight for calibration or servicing.

If you have a defective module, you can return it to Keysight for repair or replacement.

Introduction

Self-test

- A brief power-on self-test occurs automatically whenever you turn on the instrument. This limited test assures that the instrument is capable of operation.
- If the self-test fails, the power indicator on the front panel will start blinking. You can use the **SYSTem:ERRor?** query command from the remote interface to read the error messages. If repair is required, contact a Keysight Service Center. Please refer to the programmer's reference guide for more information on the error messages.
- Self-test may be initiated remotely by sending the ***TST?** SCPI command to the instrument.

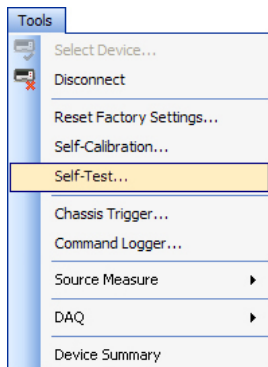
CAUTION

Disconnect all connections from the output terminals before performing the self-test procedure. Ensure that the output terminals are not connected to any load before you turn on the U2722A/U2723A. The U2722A/U2723A must be powered-up for at least 45 minutes before performing the self-test.

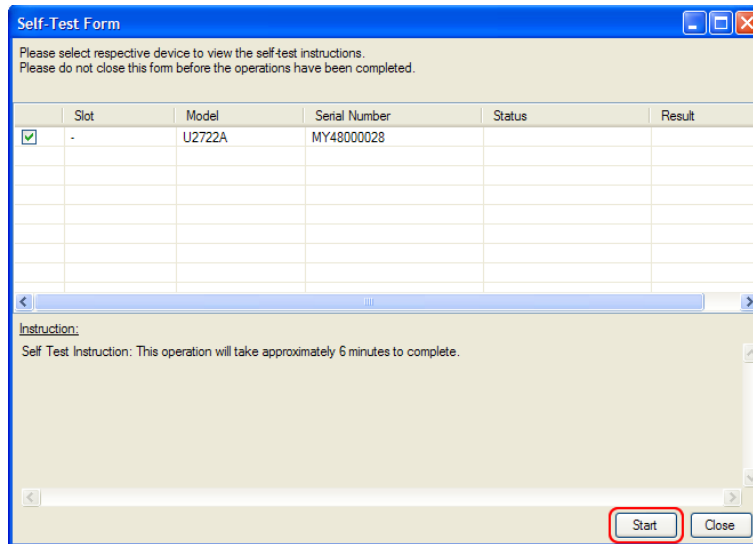
Keysight Measurement Manager

To start the self-test procedure using the Keysight Measurement Manager, perform the following steps.

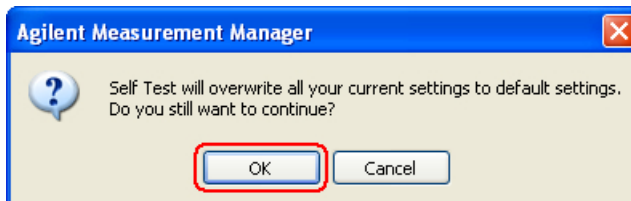
- 1 Click **Tools > Self-Test**.



- 2 Click **Start** on the Self-Test form.



- 3 Click **OK** to continue when the message box appears.

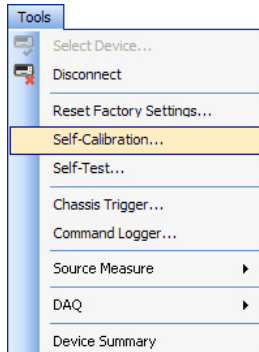


- 4 Wait for a few minutes for the self-test to complete.
- 5 The result is displayed on the form once the self-test has completed.

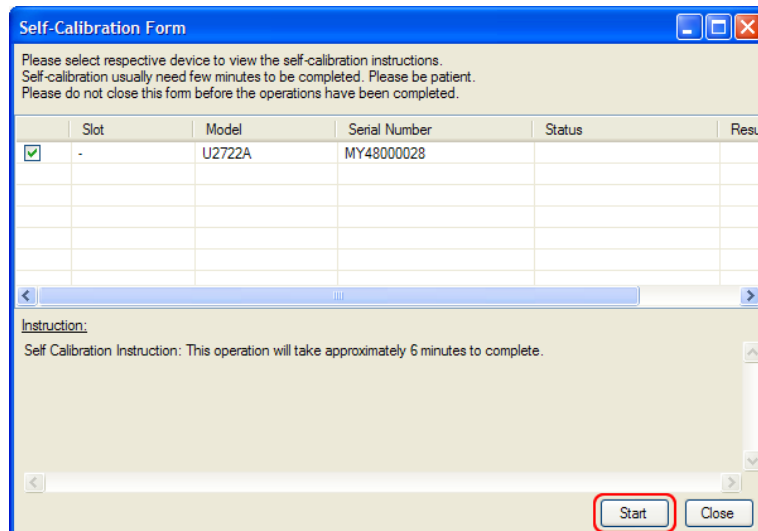
Self-calibration

To perform self-calibration using the U2722A/U2723A Keysight Measurement Manager, perform the following steps.

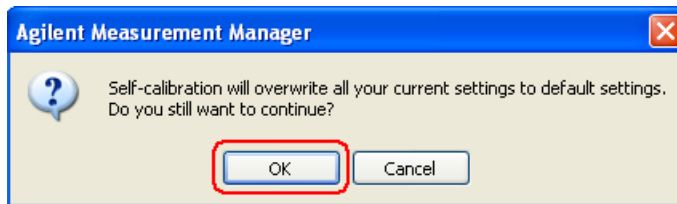
- 1 Click **Tools > Self-Calibration**.



- 2 Click **Start** on the Self-Calibration form.



- 3 Click **OK** to continue when the message box appears.



- 4 Wait for a few minutes for the self-calibration to complete.
- 5 The result is displayed on the form once the self-calibration has completed.

CAUTION

Disconnect all connections from the output terminals before performing the self-calibration procedure. Ensure that the output terminals are not connected to any load before you turn on the U2722A/U2723A. The U2722A/U2723A must be powered-up for at least 45 minutes before performing the self-calibration.

Keysight Technologies calibration services

When your instrument is due for calibration, contact your local Keysight Service Center for a low-cost recalibration. The U2722A/U2723A is supported on automated calibration systems, which allows Keysight to provide this service at a competitive price.

Calibration interval

A one-year interval is adequate for most applications. Accuracy specifications are under warranty only if adjustments are made at regular calibration intervals. Accuracy specifications will not be offered warranty beyond the one-year calibration interval. Keysight does not recommend extending calibration intervals beyond two years for any application. Keysight recommends that a complete readjustment should always be performed at the calibration interval. This will ensure that the U2722A/U2723A will remain within specifications for the next calibration interval. The readjustment provides the best long-term stability and accuracy.

Types of service available

If your instrument fails during the warranty period, Keysight will repair or replace it under the terms of your warranty. After your warranty expires, Keysight offers repair services at competitive prices.

Extended service contracts

Most Keysight products are provided with optional service contracts that extend the coverage period after the standard warranty expires. If you have this service contract and your instrument happens to fail during the coverage period, Keysight will repair or replace it according to the contract.

Obtaining repair service (worldwide)

To obtain service for your instrument (in-warranty, under service contract, or post-warranty), contact your nearest Keysight Service Center. They will arrange to have your unit repaired or replaced, and are able to provide warranty or repair cost information where applicable.

To obtain warranty, service, or technical support information you can contact Keysight at one of the following telephone numbers.

In the United States: 800 829 4444

In Europe: 31 20 547 2111

In Japan: (81) 426 56 7832

You can also use our Web link for the information on contacting Keysight worldwide:

www.keysight.com/find/assist

Or contact your Keysight representative.

Before shipping your instrument, ensure that you acquire shipping instructions, including the components to be shipped, from the Keysight Service Center. Keysight recommends that you retain the original shipping carton for use in such shipments.

Repackaging for shipment

If the unit is to be shipped to Keysight for service or repair, make sure that you do the following.

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model number and full serial number.
- Place the unit in its original container with appropriate packaging material for shipping.
- Secure the container with strong tape or metal bands.
- If the original shipping container is not available, place your unit in a container with at least four inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

NOTE

Keysight suggests that you always insure your shipments.

Cleaning

Clean the outer area of the instrument with a soft, lint-free, and slightly dampened cloth. Do not use detergent. Disassembly is not required for cleaning.

2 Performance Verification and Adjustment

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The performance verification procedures described in this chapter verify that the U2722A/U2723A USB Modular Source Measure Units is operating normally and is within its warranted specifications.

Performance Verification and Adjustment

This section contains the performance verification and adjustment procedures. If the U2722A/U2723A fails any of the tests or if any abnormal test results are obtained, return the unit to the Keysight Service Center for readjustment. Readjustment can also be carried out using Keysight Measurement Manager revision 1.7 or above.

Recommended test equipment

The recommended test equipment for the performance verification is listed in the table below. If the exact equipment is not available, substitute the performance verification standards of equivalent requirement(s).

Table 2-1 Recommended test equipment

Equipment	Requirement(s)	Recommended model	Purpose	Used
Digital multimeter (DMM)	– 8½ digits resolution	Keysight 3458A	Measures DC voltage and current	Performance verification and adjustment

Test consideration

For optimum performance, all procedures should comply with the following recommendations.

- Ensure that the ambient temperature is stable and between 22 °C and 28 °C. The ideal temperature for performing performance verification should be 25 °C ± 1 °C.
- Make sure that the ambient relative humidity is less than 80%.
- Allow a three-hour warm-up period before performance verification.
- Keep the test connection cables as short as possible.

Performance Verification

Voltage tests

NOTE

Test each output channel individually. Refer to the appropriate test record form.

Source voltage mode programming and readback accuracy

This test verifies that the voltage programming and readback through the USB are within published specifications.

Test settings

Table 2-2 Test settings for source voltage mode programming and readback accuracy

Keysight 3458A settings ^[a]	
Function	Range
DC voltage	1 V (for U2722A/U2723A drives ≤ 1 V)
	10 V (for U2722A/U2723A drives ≤ 10 V)

[a] Use the highest resolution available on the DMM.

Test setup

The test setup for no load condition is shown in the following figure.

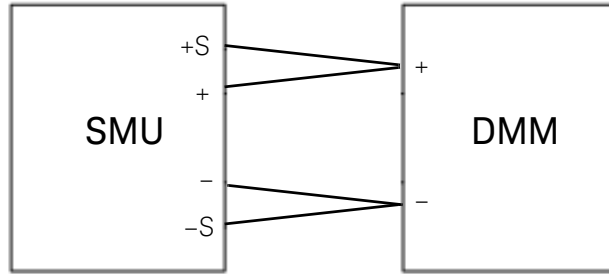


Figure 2-1 Voltage test setup (no load condition)

Test procedure

- 1** Turn off the U2722A/U2723A. Connect the DMM to the output to be tested (refer to [Figure 2-1](#)). Ensure that no load is connected. Turn on the U2722A/U2723A.
- 2** Configure the selected output as shown in the following.
 - a** Configure the NPLC to 10.
 - b** Configure the voltage range.
 - c** Configure the current range.
 - d** Program the clamp current, I_{clamp} .
 - e** Program the drive voltage, V_{drive} .
- 3** Enable the output.
- 4** Wait for a few seconds for the output to settle.
- 5** Record the voltage reading on the DMM, V_{meas} .
- 6** Read back the drive voltage over the USB.
- 7** Record the readback voltage reading over the USB, V_{rdbk} .
- 8** Compute $(V_{\text{meas}} - V_{\text{drive}})$ and $(V_{\text{rdbk}} - V_{\text{meas}})$. Compare the values with the test limit values.

- 9 Repeat **step 2** through **step 8** for each iteration to complete the performance verification for the selected output.
- 10 Repeat **step 1** through **step 9** for the rest of the outputs.

Current tests

Source current mode programming and readback accuracy

This test verifies that the current programming and readback through the USB are within published specifications.

Test settings

Table 2-3 Test settings for source current mode programming and readback accuracy

Keysight 3458A settings ^[a]	
Function	Range
DC current	1 μA (for U2722A/U2723A drives $\leq 1 \mu\text{A}$)
	10 μA (for U2722A/U2723A drives $\leq 10 \mu\text{A}$)
	100 μA (for U2722A/U2723A drives $\leq 100 \mu\text{A}$)
	1 mA (for U2722A/U2723A drives $\leq 1 \text{ mA}$)
	10 mA (for U2722A/U2723A drives $\leq 10 \text{ mA}$)
	100 mA (for U2722A/U2723A drives $\leq 100 \text{ mA}$)
	1 A (for U2722A/U2723A drives $>100 \text{ mA}$)

[a] Use the highest resolution available on the DMM

Test setup

The test setup for no load condition is shown in the following figure.

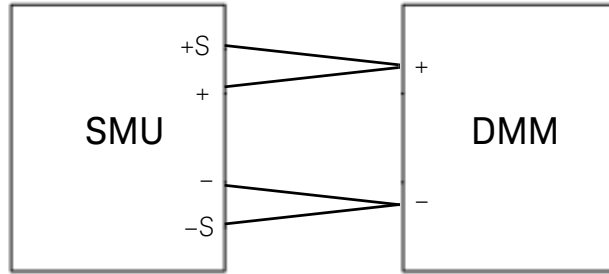


Figure 2-2 Current test setup (no load condition)

Test procedure

- 1 Turn off the U2722A/U2723A. Connect the DMM to the output to be tested (refer to [Figure 2-2](#)). Ensure that there is no load connected. Turn on the U2722A/U2723A.
- 2 Configure the selected output as shown in the following.
 - a Configure the NPLC to 10.
 - b Configure the voltage range.
 - c Configure the current range.
 - d Program the clamp voltage, V_{clamp} .
 - e Program the drive current, I_{drive} .
- 3 Enable the output.
- 4 Wait for a few seconds for the output to settle.
- 5 Record the current reading on the DMM, I_{meas} .
- 6 Read back the drive current over the USB.
- 7 Record the readback current reading over the USB, I_{rdbk} .
- 8 Compute $(I_{\text{meas}} - I_{\text{drive}})$ and $(I_{\text{rdbk}} - I_{\text{meas}})$. Compare the values with the test limit values.

- 9** Repeat **step 2** through **step 8** for each iteration to complete the performance verification for the selected output.
- 10** Repeat **step 1** through **step 9** for the rest of the outputs.

Test Record Forms

Source voltage mode programming and readback accuracy

Table 2-4 Source voltage mode programming and readback accuracy

Iteration	Test point	Voltage range	Clamp current	Current range	$V_{\text{meas}} - V_{\text{drive}}$	$V_{\text{rdbk}} - V_{\text{meas}}$	Limit
1	1 V	2 V	120 mA	120 mA			± 2.25 mV
2			10 mA	10 mA			
3			1 mA	1 mA			
4			100 μ A	100 μ A			
5			10 μ A	10 μ A			
6			1 μ A	1 μ A			
7	10 V	20 V	120 mA	120 mA			± 15 mV
8			10 mA	10 mA			
9			1 mA	1 mA			
10			100 μ A	100 μ A			
11			10 μ A	10 μ A			
12			1 μ A	1 μ A			

Source current mode programming and readback accuracy

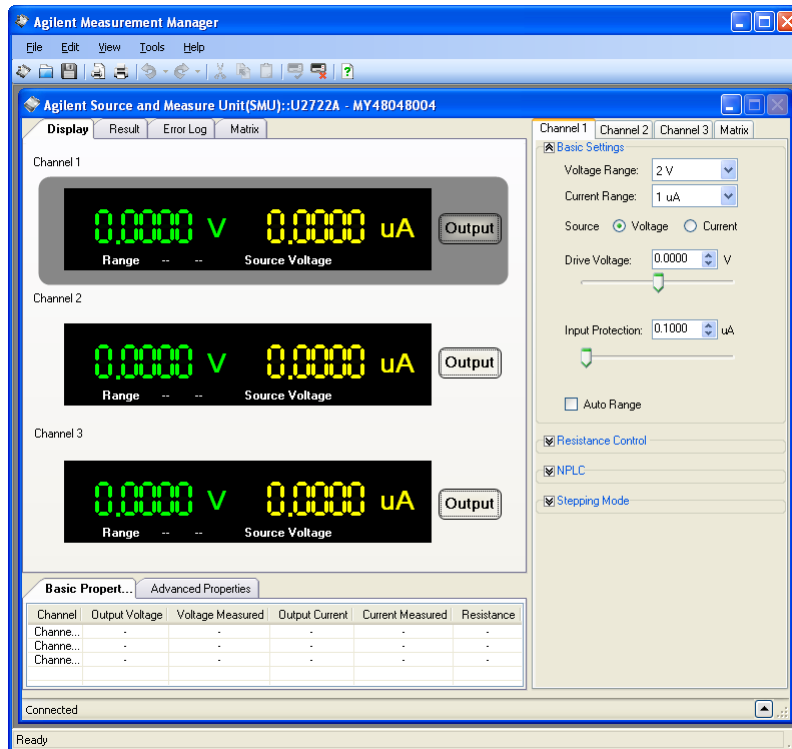
Table 2-5 Source current mode programming and readback accuracy

Iteration	Test point	Current range	Clamp voltage	Voltage range	$I_{\text{meas}} - I_{\text{drive}}$	$I_{\text{rdbk}} - I_{\text{meas}}$	Limit
1	0.5 μA	1 μA	20 V	20 V			$\pm 1.275 \text{ nA}$
2			2 V	2 V			$\pm 1.275 \text{ nA}$
3	5 μA	10 μA	20 V	20 V			$\pm 12.75 \text{ nA}$
4			2 V	2 V			$\pm 12.75 \text{ nA}$
5	50 μA	100 μA	20 V	20 V			$\pm 112.5 \text{ nA}$
6			2 V	2 V			$\pm 112.5 \text{ nA}$
7	0.5 mA	1 mA	20 V	20 V			$\pm 1.125 \mu\text{A}$
8			2 V	2 V			$\pm 1.125 \mu\text{A}$
9	5 mA	10 mA	20 V	20 V			$\pm 11.25 \mu\text{A}$
10			2 V	2 V			$\pm 11.25 \mu\text{A}$
11	60 mA	120 mA	20 V	20 V			$\pm 0.16 \text{ mA}$
12			2 V	2 V			$\pm 0.16 \text{ mA}$

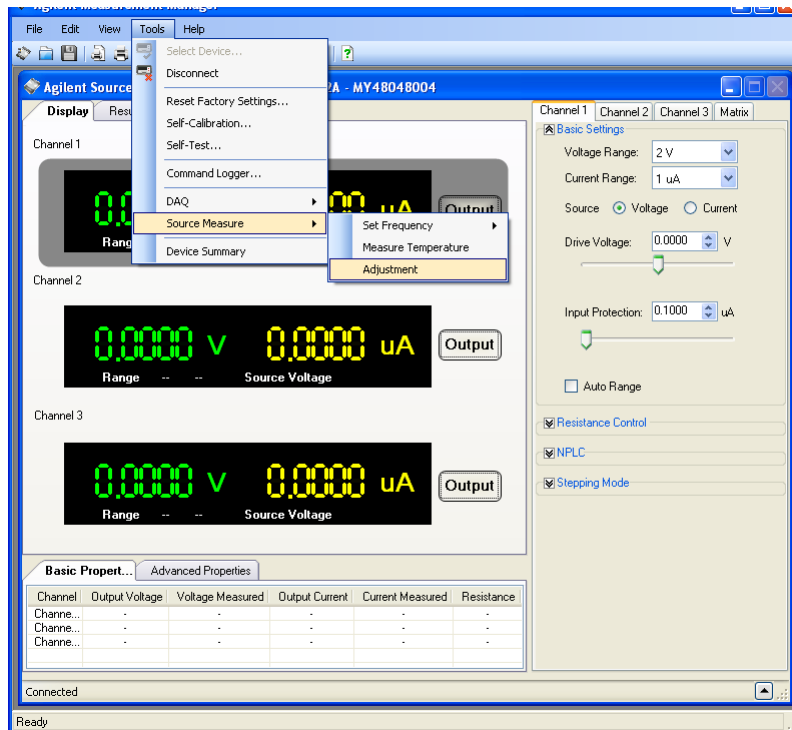
Adjustment

The following information describes the procedure for voltage and current adjustments for the U2722A/U2723A using Keysight Measurement Manager revision 1.7 or above.

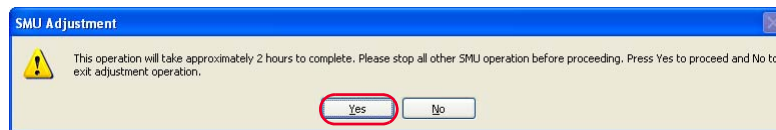
- 1 Establish the connection between the U2722A/U2723A and the PC. Launch the Keysight Measurement Manager as shown below.



- 2 Select **Tools > Source Measure > Adjustment** to start the adjustment.

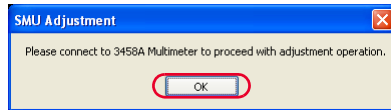


- 3 A message box will appear to inform that the adjustment operation will take approximately two hours. During this period, you will not be able to operate the U2722A/U2723A. Click **Yes** to continue with the adjustment operation.

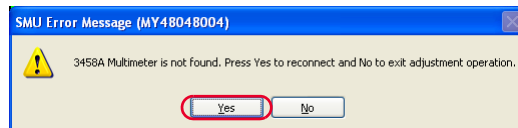


2 Performance Verification and Adjustment

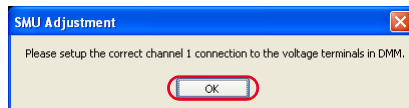
- 4 Establish the connection between the 3458A and the PC to proceed with the adjustment operation. Click **OK** to continue.



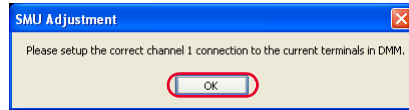
If the 3458A is not detected, an error message will appear as shown in the following figure. Reconnect the 3458A to the PC and click **Yes** to proceed. Select **No** to exit the adjustment operation.



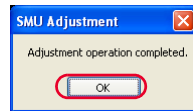
- 5 The 3458A and U2722A/U2723A will be triggered to perform self-test and self-calibration. During this process, make sure that there is no connection on the instruments terminals. If self-test or self-calibration fails, cycle the U2722A/U2723A power and repeat **step 1** through **step 5**. In the unlikely event that self-test or self-calibration repeatedly fails, contact your nearest Keysight Sales Office.
- 6 After the self-test and self-calibration have completed, a message box shown in the following will appear to indicate you to connect the respective U2722A/U2723A output to the voltage terminal of the 3458A. After the connection is established, click **OK** to continue. The Keysight Measurement Manager will now perform voltage adjustment on channel 1.



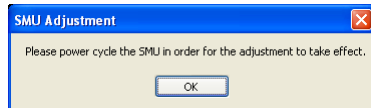
- 7 When the voltage adjustment has completed, connect the respective U2722A/U2723A output to the current terminal of the 3458A. After the connection is established, click **OK** to continue with current adjustment for channel 1.



- 8 After the voltage and current adjustments for channel 1 have completed, the 3458A will proceed with voltage and current adjustments for channel 2 followed by voltage and current adjustments for channel 3. Follow the instructions on the message box to complete the adjustment operation.
- 9 When the adjustment operation has completed, a message box as shown in the following will appear. Click **OK** to end the adjustment operation.



- 10 A message box will appear as shown below prompting you to power cycle the U2722A/U2723A for the adjustment to take effect. To power cycle the U2722A/U2723A, power off the U2722A/U2723A and restart it. Ensure that the U2722A/U2723A is powered-off properly before restarting.



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3 Characteristics and Specifications

For the characteristics and specifications of the U2722A/U2723A USB Modular Source Measure Units, refer to the datasheet at <http://literature.cdn.keysight.com/litweb/pdf/5990-7416EN.pdf>.

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