Keysight 34420A Nano Volt/ Micro Ohm Meter

KEYSIGHT TECHNOLOGIES

Service Guide

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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 which must be taken to maintain safe operation of the instrument.

	Earth (ground) terminal		Frame or chassis (ground) terminal

Safety Considerations

Read the information below before using this instrument.

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 for design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING

- Only qualified, service-trained personnel who are aware of the hazards involved should remove the cover from the instrument.
- For continued protection against fire, replace the line fuse only with a fuse of the specified type and rating.
- Do not operate the instrument around flammable gases or fumes, vapor, or wet environments.
- The input voltage range for the instrument is 100 / 120 (127) / 220 (230) / 240 Vac, 45-440 Hz. Mains supply voltage fluctuations are not to exceed ±10% of the nominal supply voltage.

NOTE

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Technologies Sales and Service Office for service and repair to ensure that safety features are maintained.

Environmental Conditions

The 34420A is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Operating temperature	Full accuracy at 0 °C to 55 °C
Operating humidity	Full accuracy to 80% RH at 40°C (non-condensing) Full accuracy to 40% RH for 41°C to 55°C (non-condensing)
Storage temperature	–40 °C to 75 °C
Altitude	Up to 2000 m
Pollution degree	Pollution Degree 2
Overvoltage category	II

Product Regulatory and Compliance

This 34420A complies with safety and EMC requirements.

Refer to Declaration of Conformity at http://www.keysight.com/go/conformity for the latest revision.

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/34420A
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

The 34420A is a 71/2 digit, high performance nanovolt, micro-ohm meter. Its combination of bench-top and system features makes this meter a versatile solution for your testing requirements now and in the future.

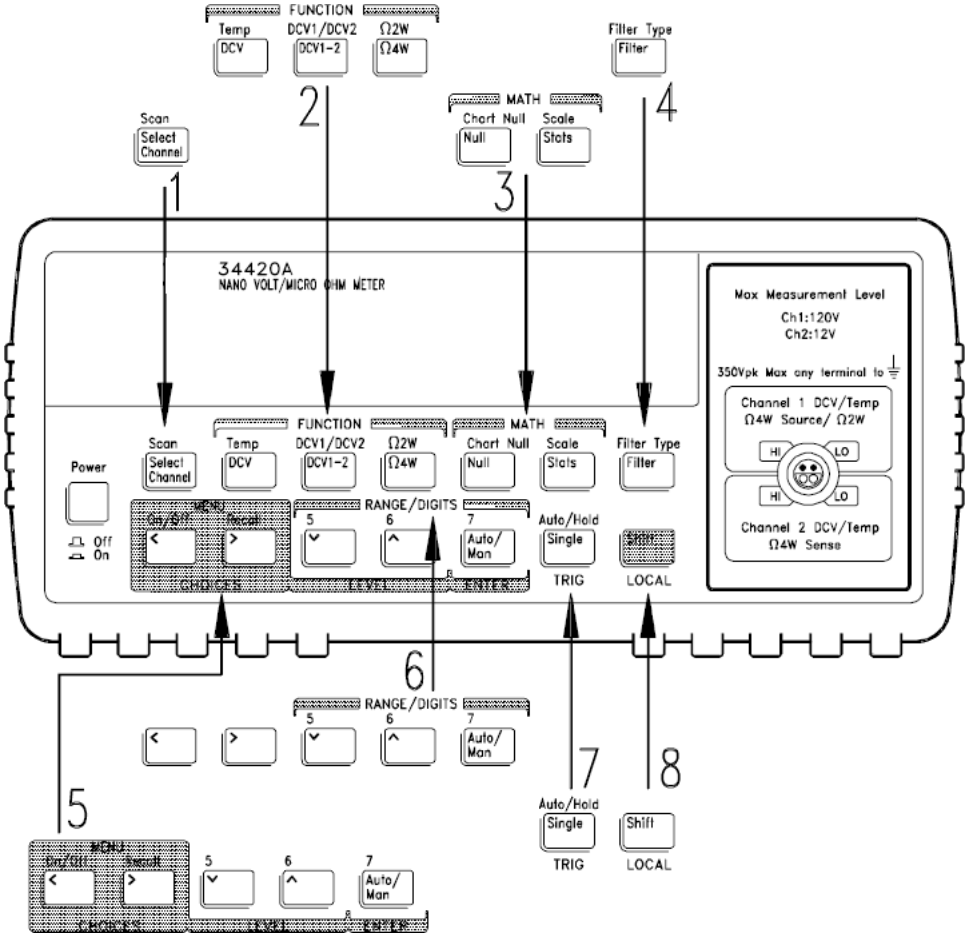
Convenient bench-top features

- Built-in math operations including thermistor, thermocouple and RTD temperature measurements
- Two channel input allows ratio and difference functions for voltage measurements
- Highly visible vacuum-fluorescent display
- Portable, ruggedized case with non-skid feet

Flexible system features

- GPIB (IEEE-488) interface and RS-232 interface are standard
- SCPI (Standard Commands for Programmable Instruments) and Keithley 181 compatibility
- Readings at up to 250 per second

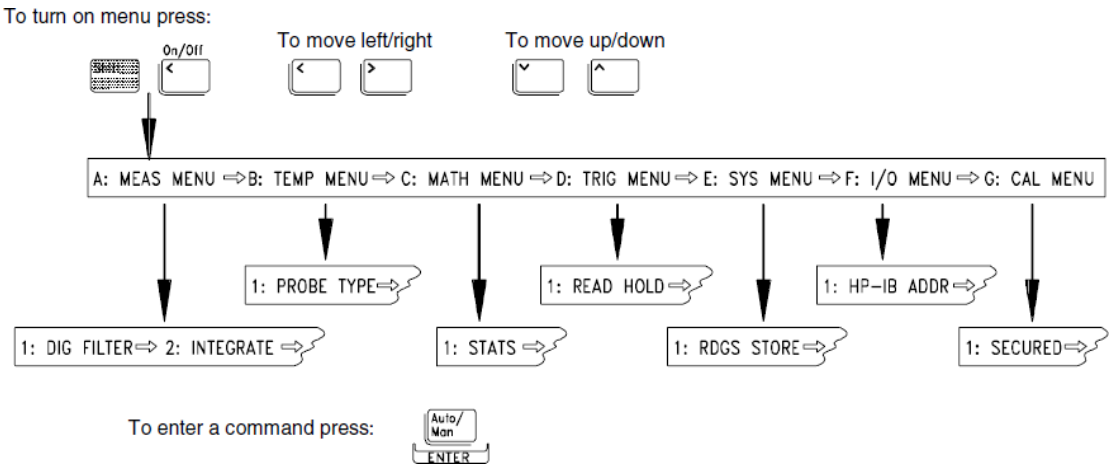
The Front-Panel at a Glance



1	Input channel select	**5**	Menu operation keys
2	Measurement function keys	**6**	Range/number of digits displayed keys
3	Math operation keys	**7**	Single trigger/autotrigger/auto hold key
4	Filter select key	**8**	Shift / local key

The Front-Panel Menu at a Glance

The menu is organized in a top-down tree structure with three levels.



A: MEASurement MENU

1: DIG FILTER ⇒ 2: INTEGRATE ⇒ 3: OCOMP Ω ⇒ 4: LOW POWER Ω ⇒ 5: LOW VOLT Ω ⇒ 6: LoV LIMIT Ω

B: TEMPerature MENU

1:PROBE TYPE ⇒ 2: UNITS ⇒ 3: RTD TYPE ⇒ 4:RTD Ro ⇒ 5:T/C TYPE ⇒ 6: COLD JUNCT ⇒ 7:JUNCT

C: MATH MENU

1: STATS ⇒ 2: NULL VALUE ⇒ 3: SCALE GAIN ⇒ 4 : SCALE OFST

D: TRIGger MENU

1: READ HOLD ⇒ 2: TRIG DELAY ⇒ 3: N SAMPLES

E: SYStem MENU

1: RDGS STORE ⇒ 2: SAVED RDGS ⇒ 3: ERROR ⇒ 4: TEST ⇒ 5: CHART OUT ⇒ 6: CHART SPAN ⇒
7: CHART NULL ⇒ 8: DISPLAY ⇒ 9: COMMA ⇒ 10: PRESET ⇒ 11: REVISION

F: Input/Output MENU

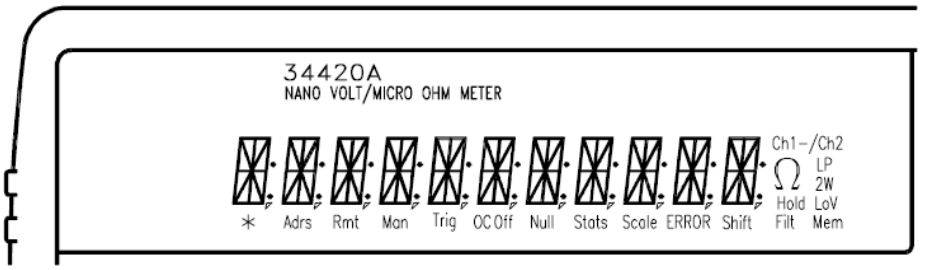
1: GPIB ADDR ⇒ 2: INTERFACE ⇒ 3: BAUD RATE ⇒ 4: PARITY ⇒ 5: LANGUAGE

G: CALibration MENU

1: SECURED ⇒ [1: UNSECURED] ⇒ [2:CALIBRATE] ⇒ [3: CHART ZERO] ⇒ [4 : CHART GAIN] ⇒
[5: INJECTED I] ⇒ 6:CAL COUNT ⇒ 7:MESSAGE

NOTE The commands enclosed in square brackets ([ ]) in the CAL MENU are "hidden" unless the meter is UNSECURED for calibration.

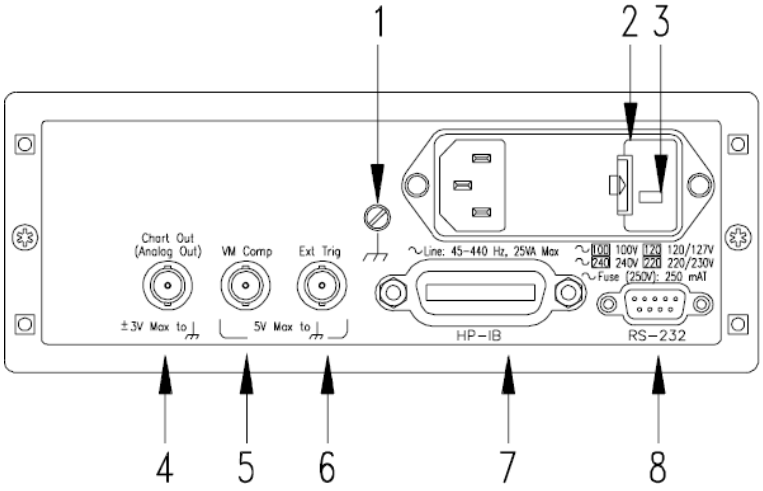
Display Annunciators



*****	Turns on during a measurement.
Adrs	Meter is addressed to listen or talk over the GPIB interface.
Rmt	Meter is in remote mode (using remote interface).
Man	Meter is using manual ranging (autorange is disabled).
Trig	Meter is waiting for a single trigger or external trigger.
OC Off	Offset compensation is turned off.
Null	A null value is being used.
Stats	Math statistics operations are being used.
Scale	Math scaling operations are being used.
ERROR	Hardware or remote interface command error(s) detected.
Shift	"Shift" key has been pressed.
Ch1	Meter input is on Channel 1.
Ch2	Meter input is on Channel 2.
Ch1 - Ch2	Meter is indicating the difference between inputs on channel 1 and channel 2.
Ch1 / Ch2	Meter is indicating the ratio of the inputs on channel 1 and channel 2.
W	Meter is measuring resistance (Ohms).
LP	Meter is using low power Ohms.
2W	Meter is using 2-wire Ohms (annunciator off indicates a 4-wire measurement).
LoV	Meter is using voltage limited Ohms.
Hold	Automatic reading hold is enabled.
Filt	The analog and/or the digital filter is enabled.
Mem	Turns on when reading memory is enabled.

To review the display annunciators, hold down the **Shift** key as you turn on the meter.

The Rear Panel at a Glance



1	Chassis ground	**5**	Voltmeter complete output terminal
2	Power-line fuse-holder assembly	**6**	External trigger input terminal
3	Power-line voltage setting	**7**	GPIB (IEEE-488) interface connector
4	Chart recorder output terminal (Analog out)	**8**	RS-232 interface connector

Use the front-panel Input / Output Menu to:

- Select the GPIB or RS-232 interface
- Set the GPIB bus address
- Set the RS-232 baud rate and parity

In This Book

Quick Start Chapter 1 prepares the meter for use and helps you get familiar with a few of its front-panel features.

Front-Panel Operation Chapter 2 introduces you to the front-panel menu and describes some of the meter's menu features.

Calibration Procedures Chapter 3 provides calibration, verification, and adjustment procedures for the meter.

Theory of Operation Chapter 4 describes block and circuit level theory related to the operation the meter.

Service Chapter 4 provides guidelines for returning your meter to Keysight Technologies for servicing, or for servicing it yourself.

Replaceable Parts Chapter 5 contains a detailed parts lists of the meter.

Backdating Chapter 7 describes the differences between this manual and older issues or this manual.

Schematics Chapter 8 contains the meter's block diagram, schematics, disassembly drawings, and component locator drawings.

Characteristics and Specifications Chapter 6 lists the meter's specifications and describes how to interpret these specifications.

NOTE If you have questions relating to the operation of the meter, call **1-800-452-4844** in the United States, or contact your nearest Keysight Technologies Sales Office.

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Table of Contents

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List of Figures

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List of Tables

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1 Quick Start

Quick Start

This chapter helps you prepare the meter for use and contains exercises designed to get you started with the meter, its menus, and the front panel.

The front panel has two rows of keys to select various functions and operations. Most keys have a shifted function printed in blue above the key. To perform a shifted function, press **Shift** (the **Shift** display annunciator will turn on). Then, press the key that has the desired label above it. For example, to select the temperature measurement function, press **Shift** **DCV** .

If you accidentally press **Shift** , just press it again to turn off the **Shift** annunciator.

NOTE The rear cover of this book is a fold-out Quick Reference Guide. On this cover you will find a quick summary of various meter features. Inside the rear cover is a diagram of the front panel menu options.

To Prepare the Meter For Use

The following steps help you verify that the meter is ready for use.

1 Check the list of supplied items.

Verify that you have received the following items with your meter. If any item is missing, contact your nearestKeysight Technologies Sales Office.

- One low thermal input cable.
- One low thermal four-wire shorting plug.
- One power cord.
- This *User's Guide*.
- One *Service Guide*.
- One folded *Quick Reference* card.
- Certificate of Calibration with removable calibration label.
- One bottle of DeoxIT™ contact cleaner.[1]

2 Connect the power cord and turn the meter on.

The front panel display will light up while the meter performs its power-on self-test. The GPIB bus address is displayed. The meter is left in 61/2 digit resolution, channel 1 input, and digital filter on.

To view the display with all annunciators turned on, hold down **Shift** *as you turn on the meter.*

3 Perform a complete self-test.

The complete self-test performs a more extensive series of tests than those performed at power-on. Hold down Shift as you press the power switch to turn on the meter; *continue to hold* **Shift** *for more than 5 seconds*. The self-test will begin when you release the key.

If the self-test is successful, "PASS" is displayed on the front panel. If the test is not successful, "FAIL" is displayed and the **ERROR** annunciator turns on. See the *Service Guide* for instructions on returning the meter to Keysight Technologies for service.

[1] DeoxIT™ is a trademark of CAIG Laboratories, Inc., San Diego, California.

If the Meter Does Not Turn On

Use the following steps to help solve problems you might experience when turning on the meter. If you need more help, see the *Service Guide* for instructions on returning the meter to Keysight Technologies for service.

1 **Verify there is ac power to the meter.**

First verify that the meter's power switch is in the "On" position. Make sure the power cord is firmly plugged into the power module on the meter's rear panel. Verify that the power source is energized.

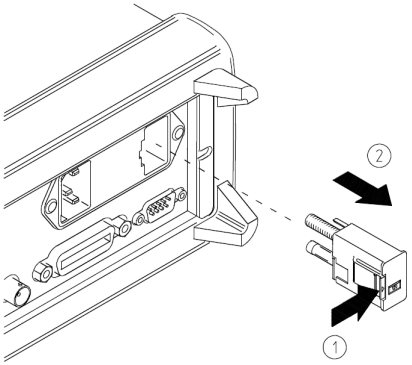
2 **Verify the power-line voltage setting.**

The line voltage is set to the proper value for your country when the meter is shipped from the factory. Change the voltage setting if it is not correct. The settings are: 100, 120, 220, or 240 Vac (for 230 Vac operation, use the 220 Vac setting).

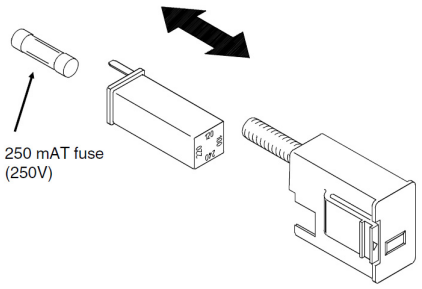
See the diagram on the next page to verify or change the setting.

NOTE To replace the 250 mAT 250 V fuse, order part number 2110-0817. This fuse is used for all power line voltage settings.

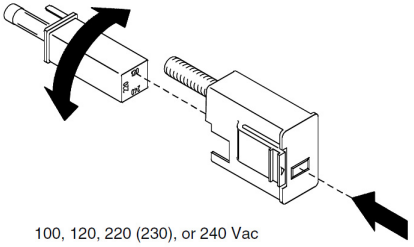
1 **Remove the power cord.** Remove the fuse holder assembly from the rear



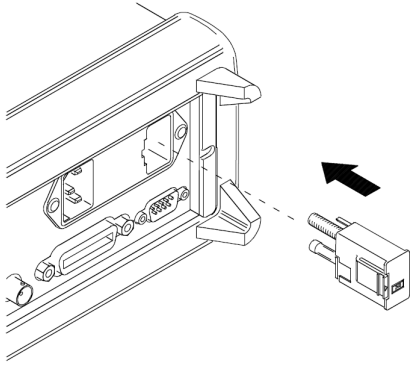
2 *Install the fuse.* Remove the line-voltage selector from the assembly.



3 Rotate the line-voltage selector until the correct voltage appears in the window.



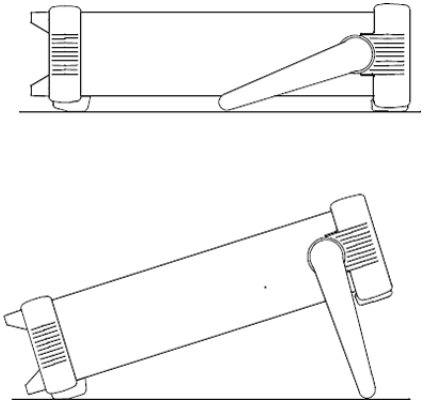
4 Replace the fuse-holder assembly in the rear panel.



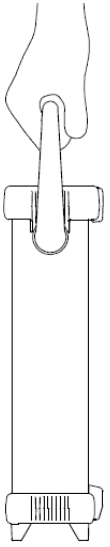
Install the correct fuse and verify that the correct line voltage appears in the window.

To Adjust the Carrying Handle

To adjust the position, grasp the handle by the sides and *pull outward*. Then, rotate the handle to the desired position.



Bench-top viewing positions

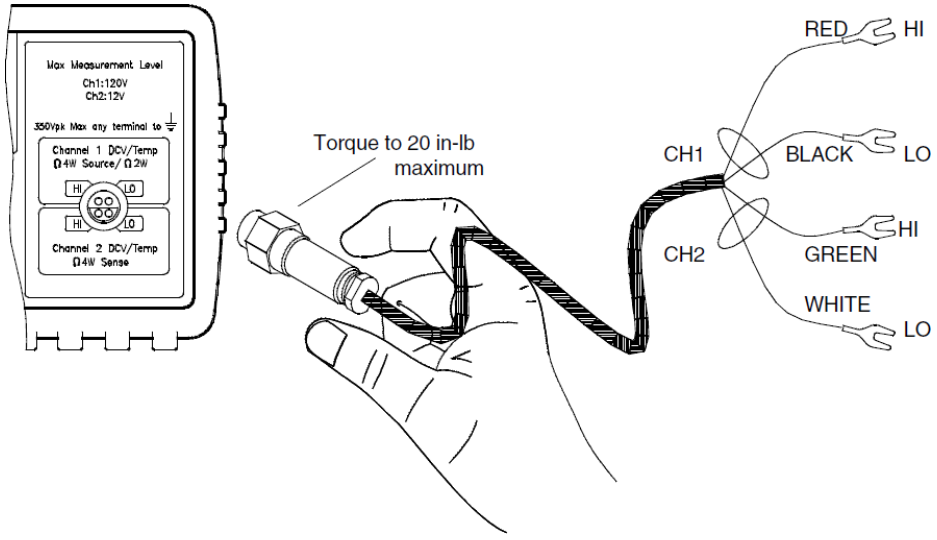


Carrying Position

To Make Input Connections

Using the Cable Provided

Align the front panel connector and cable conductors, press in.Tighten coupling nut.

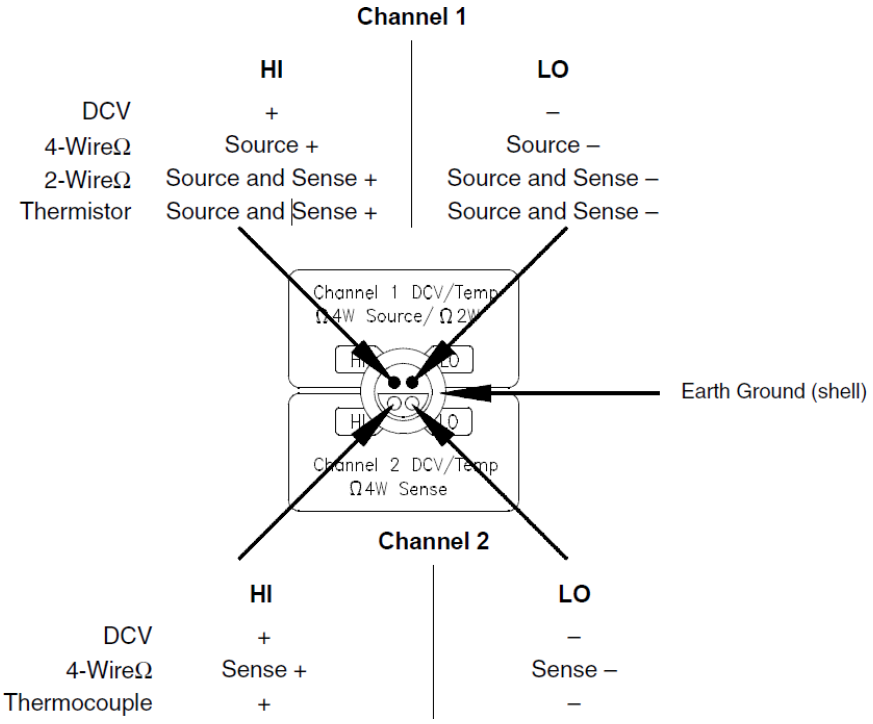


NOTE The connector and cable are an integral part of the measurement system. For the highest accuracy, use the copper cable and connectors supplied by Keysight Technologies.

The conductors may require occasional cleaning to remove oxides. Cleaning the conductors is described on page 117.

WARNING The connector body and cable shield are connected to earth ground.

Using a Custom Cable



Refer to page 117 for additional information about building custom input cables.

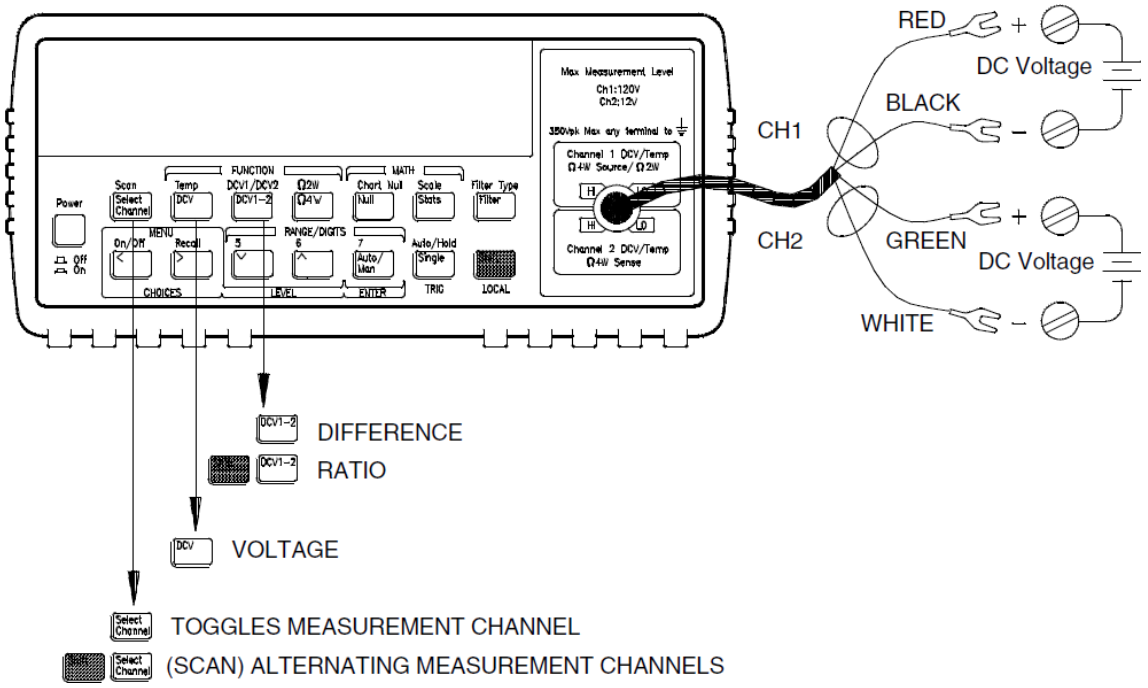
To Measure Voltage

Channel 1 Ranges: 1 mV, 10 mV, 100 mV, 1 V, 10 V, 100 V
Maximum resolution: 0.1 nV (*on 1 mV range*)

Channel 2 Ranges: 1 mV, 10 mV, 100 mV, 1 V, 10 V
Maximum resolution: 0.1 nV (*on 1 mV range*)

Independent NULL for each channel

Channel 1 LO to Channel 2 LO isolated to 150 Vpeak.

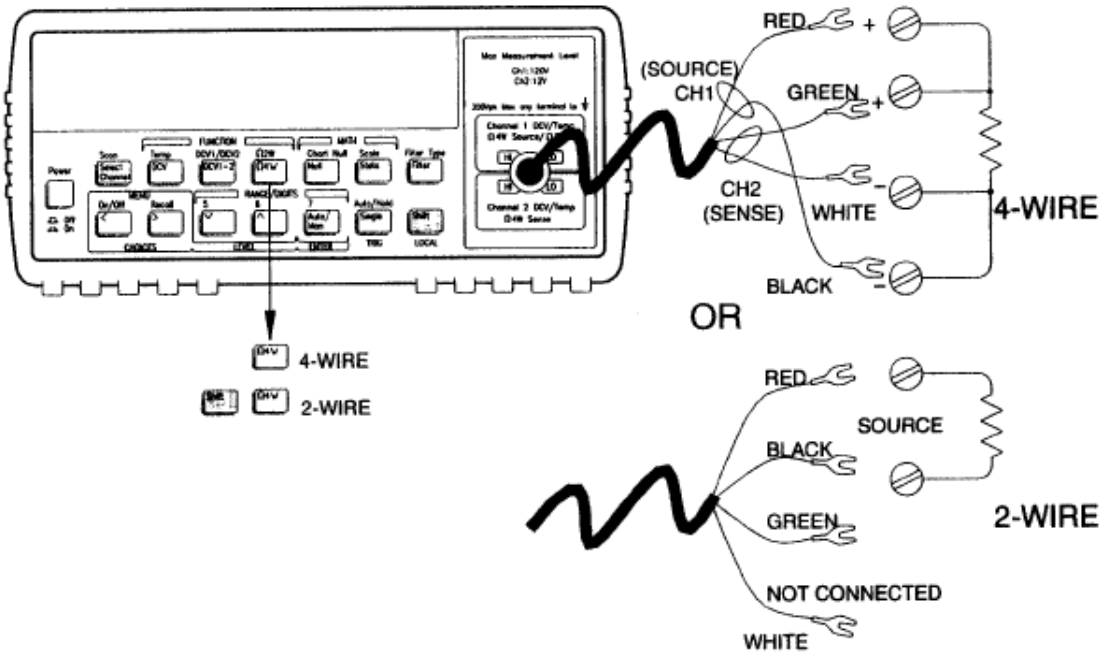


NOTE Scan mode alternates between input channels every 3 seconds or every measurement, whichever is longer.

To Measure Resistance

Ranges: 1 Ω, 10 Ω, 100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ

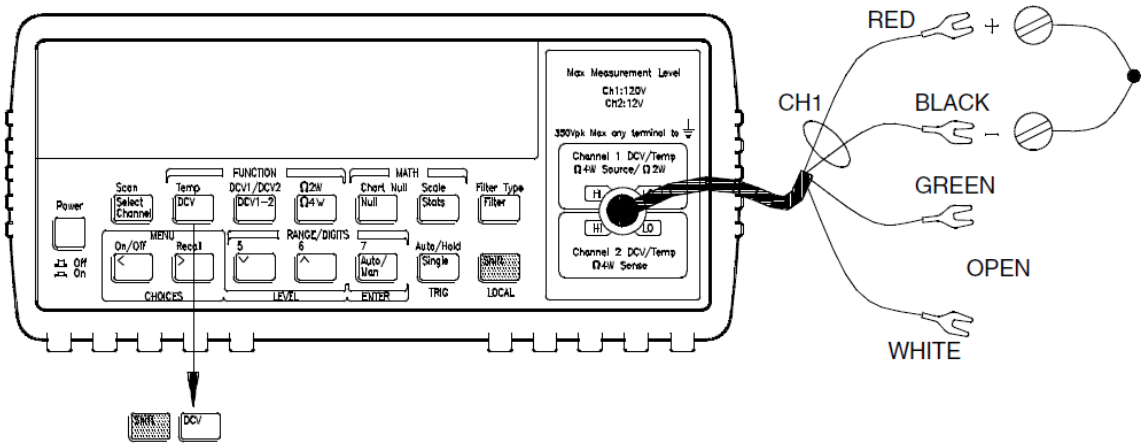
Maximum resolution: 0.1 μΩ (*on 1 ohm range*).



NOTE Resistance measurements use offset compensation. Offset compensation can be disabled if desired.

To Measure Temperature With Thermistors

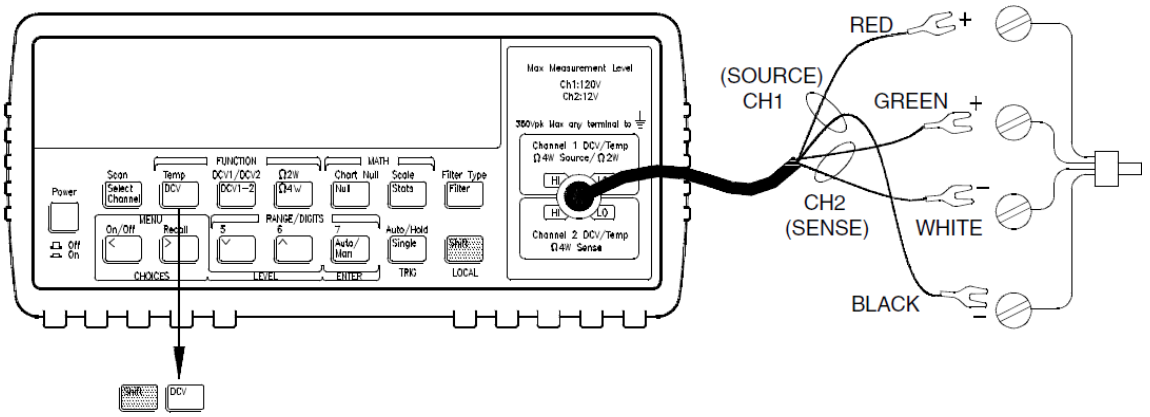
Thermistor type: 5 kΩ



To Measure Temperature With RTDs

4-wire, type: α = .00385 (DIN/IEC 751) or α = .00391

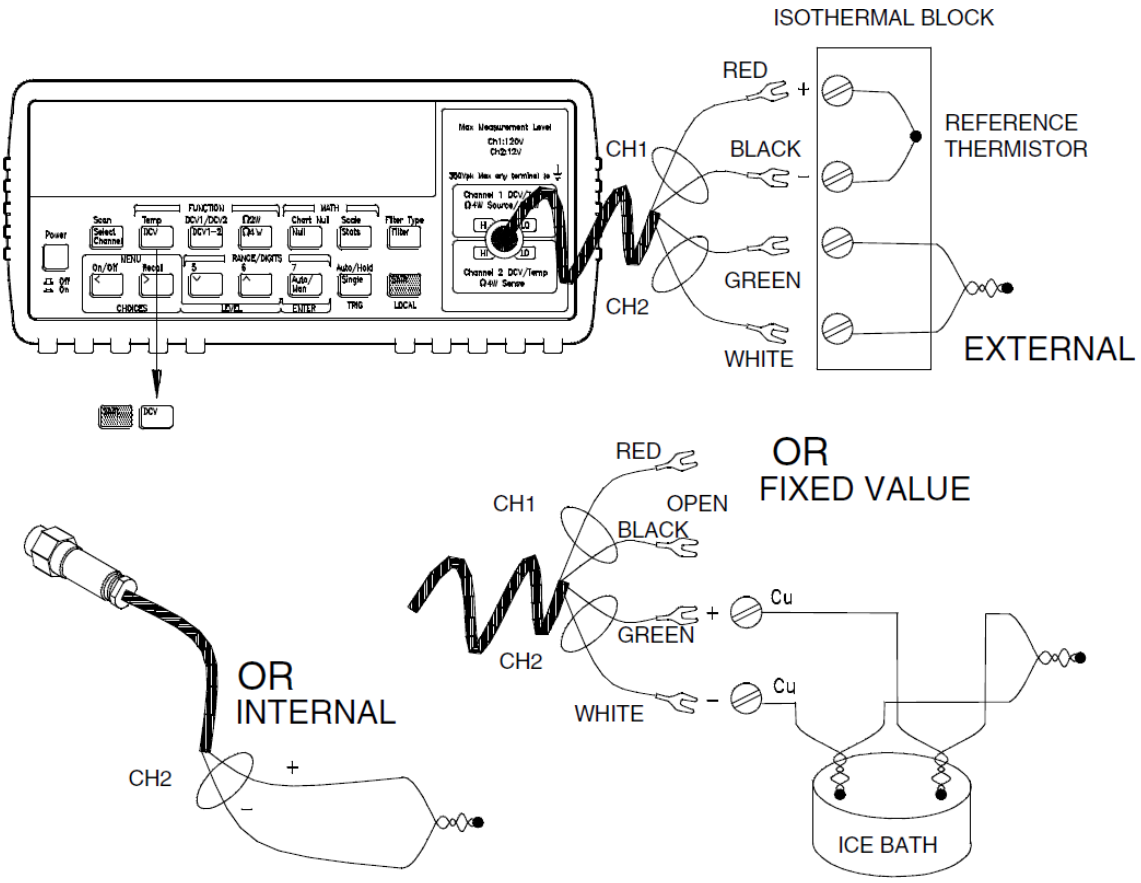
R_0 = 4.9 Ω to 2.1 kΩ



To Measure Temperature With Thermocouples

Thermocouple types: B, E, J, K, N, R, S, T

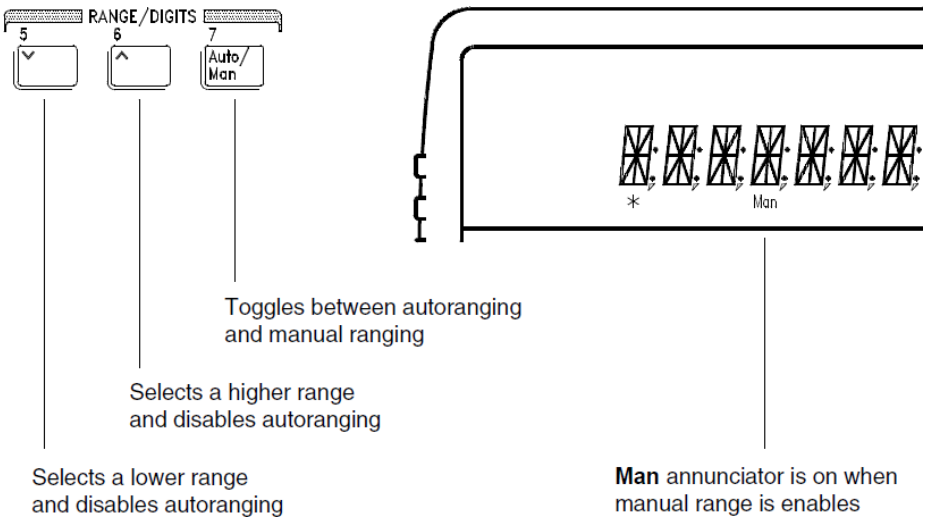
Reference: external thermistor, external fixed value, or internal thermistor. Channel 2 only.



NOTE When using the internal thermistor as the temperature reference, you should make a custom cable to connect the thermocouple wire directly to the input terminals (*see page 117*).

To Select a Range

You can let the meter automatically select the range using *autoranging* or you can select a fixed range using *manual ranging*.



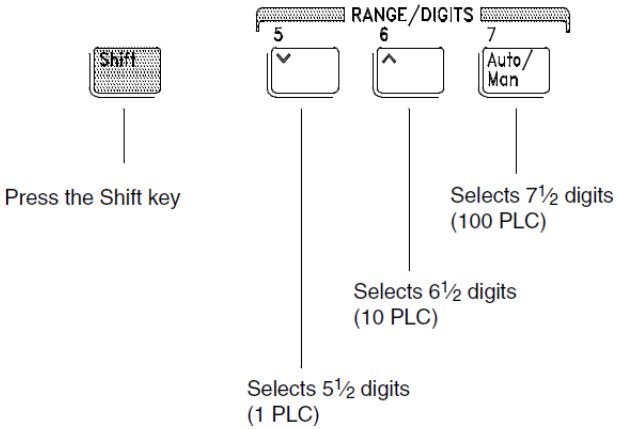
- Autoranging is selected at power-on and after a remote interface reset.
- Autorange thresholds:

  Down range at <10% of range
  Up range at >120% of range
- If the input signal is greater than the present range can measure, the meter will give an *overload* indication ("OVLD").
- When making difference or ratio measurements, an overload on either channel will give an overload indication ("OVLD").

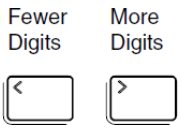
NOTE For voltage measurements, ranging is local to the selected channel. This means that you can select the ranging method (auto or manual) for each channel independently. When manually ranging, the selected range is local to the active channel; the meter remembers the range when you switch between channels.

To Set the Number of Digits

You can set the display to show 4½, 5½, 6½, or 7½ digits. In this book, the most significant digit (leftmost on the display) is referred to as the "½" digit, since it can only be a "0" or "1". *The number of digits displayed also depends upon the integration time set, see* *page 40*.



- The number of digits is set to 6½ digits at power-on and after a remote interface reset.
- The number of digits shown is dependent upon integration time and filter settings. The meter will not allow you to show more digits than the practical measurement capability of the meter. You can, however, reduce the number of digits shown.



To Set the Integration Time

Integration time is specified in Number of Power Line Cycles (NPLC). You can set the NPLC to 0.02, 0.2, 1, 2, 10, 20, 100, or 200.

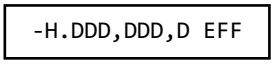
- You can set the integration time to one of three fixed values by choosing the number of digits displayed, see page 39.
- You can set the integration time in the MEASure menu using the INTEGRATE command.
- The Integration Time is directly related to the maximum number of digits the meter will display.

NPLC	Filter Off Max Digits Shown	Filter On Max Digits Shown
0.02	4½	5½
0.2	5½	6½
1	6½	7½
2	6½	7½
10	6½	7½
20	7½	7½
100	7½	7½
200	7½	7½

- You can always show fewer digits than the maximum allowed (the minimum number of digits shown is 4½).

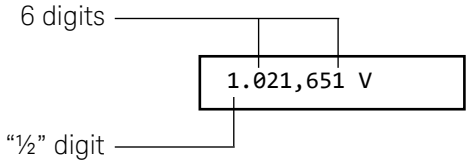
NOTE Integration Time is local to the selected function. This means that you can select the integration time for each function independently. The meter remembers integration time when you switch between functions.

Front-Panel Display Formats

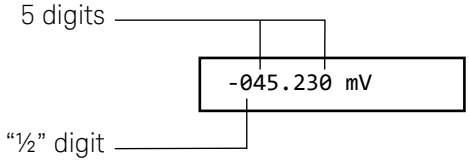


Front-panel display format

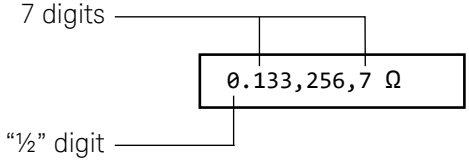
- **–** Negative sign or blank (positive)
- **H** "½" digit (0 or 1)
- **D** Numeric Digits
- **E** Exponent (m, k, M)
- **F** Measurement units



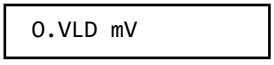
This is the 1 V range, 6½ digits are displayed.



This is the 100 mV range, 5½ digits are displayed.



This is the 1 ohm range, 7½ digits are displayed.

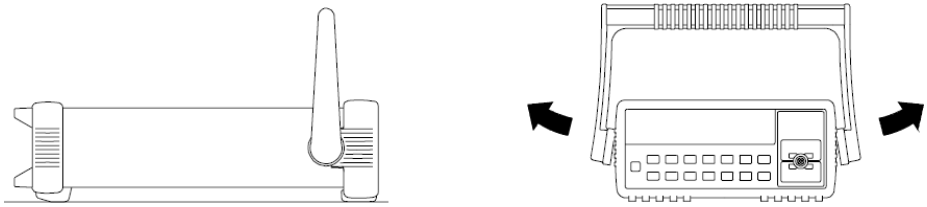


This is an overload indication on the 1 mV range.

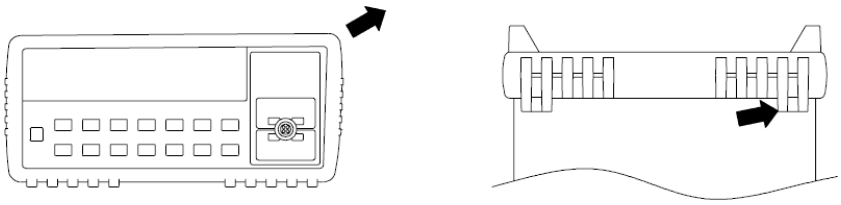
To Rack Mount the Meter

You can mount the meter in a standard 19-inch rack cabinet using one of three optional kits available. Instructions and mounting hardware are included with each rack-mounting kit. Any *System II* instrument of the same size can be rack-mounted beside the 34420A meter.

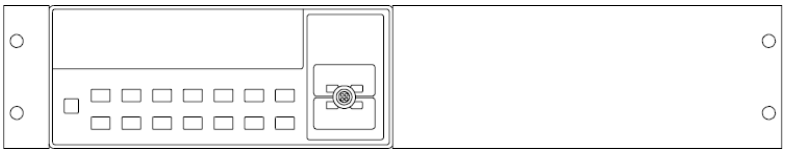
Remove the carrying handle, and the front and rear rubber bumpers, before rack-mounting the meter.



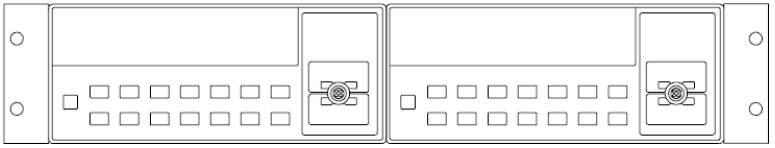
To remove the handle, rotate it to the vertical position and pull the ends outward.



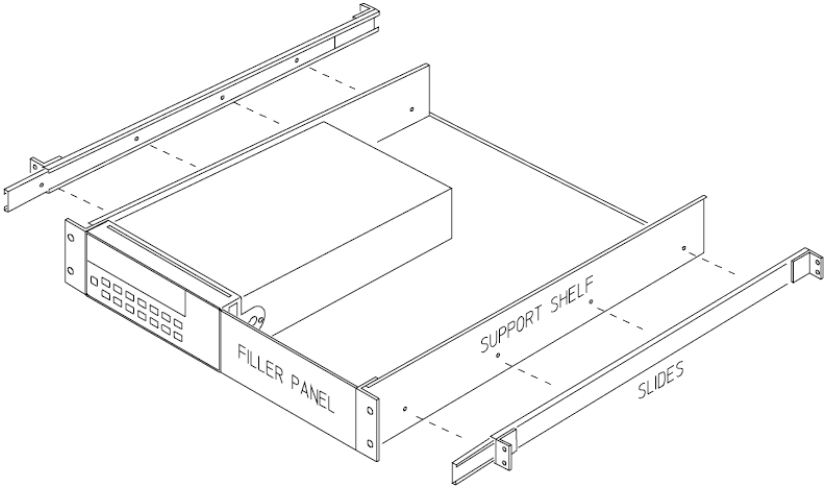
To remove the rubber bumper, stretch a corner and then slide it off.



To rack mount a single instrument, order adapter kit 5063-9240.



To rack mount two instruments side-by-side, order lock-link kit 5061-9694 and flange kit 5063-9212.



To install one or two instruments in a sliding support shelf, order shelf 5063-9255, and slide kit 1494-0015 (for a single instrument, also order filler panel 5002-3999).

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2 Front-Panel Operation

Front-Panel Operation

This chapter assumes you are familiar with the meter and menu operations. You should also understand how to make connections for the various types of measurements. If you are not familiar with this information, please read Chapter 1, "Quick Start" starting on page 25.

This chapter does not give a detailed description of every front-panel key or menu operation. It does, however, give you a good overview of the front-panel menu and the most common front-panel operations. See *Chapter 3, "Features and Functions"*, of the *Keysight 34420A User's Guide* for a complete discussion of the meter's capabilities and operation.

Front-Panel Menu Reference

A: MEASurement MENU

1: DIG FILTER ⇒ 2: INTEGRATE ⇒ 3: OCOMP Ω ⇒ 4: LOW POWER Ω ⇒ 5: LOW VOLT Ω ⇒ 6: LoV LIMIT Ω

1: DIG FILTER	Selects the digital filter speed. Can be set to FAST, MEDIUM, or SLOW.
2: INTEGRATE	Sets the measurement integration time.
3: OCOMP Ω	Enables or disables offset compensation for resistance measurements.
4: LOW POWER Ω	Enables or disables low power ohms measurements.
5: LOW VOLT Ω	Enables or disables voltage limited resistance measurements.
6: LoV LIMIT Ω	Sets the voltage limit for voltage limited resistance measurements.

B: TEMPerature MENU

1:PROBE TYPE ⇒ 2: UNITS ⇒ 3: RTD TYPE ⇒ 4:RTD Ro ⇒ 5:T/C TYPE ⇒ 6: COLD JUNCT ⇒ 7:JUNCT

1: PROBE TYPE	Selects thermocouples, thermistors, or RTDs as the temperature probe.
2: UNITS	Sets the measurement units to either °C, °F, or Kelvins.
3: RTD TYPE	Sets the type of RTD in use.
4: RTD Ro	Sets the nominal (0°C) value for the RTD in use.
5: T/C TYPE	Selects the type of thermocouple in use.
6: COLD JUNCT	Sets the source of the temperature reference junction.
7: JUNCT TEMP	Allows direct entry of reference junction temperature.

C: MATH MENU

1: STATS ⇒ 2: NULL VALUE ⇒ 3: SCALE GAIN ⇒ 4 : SCALE OFST

1:STATS	Recalls the values of minimum, maximum, standard deviation, average, peak-to-peak, and number of readings.
2: NULL VALUE	Selects independent null settings for voltage on channels 1 and 2, resistance, and temperature functions.
3: SCALE GAIN	Sets the gain for linear scaling of the data.
4: SCALE OFST	Sets the offset for linear scaling of data.

D: TRIGger MENU

1: READ HOLD ⇒ 2: TRIG DELAY ⇒ 3: N SAMPLES

1: READ HOLD	Selects the reading hold sensitivity band.
2: TRIG DELAY	Specifies a time delay between the trigger and the start of the measurement.
3: N SAMPLES	Sets the number of samples taken per trigger.

E: SYStem MENU

1: RDGS STORE ⇒ 2: SAVED RDGS ⇒ 3: ERROR ⇒ 4: TEST ⇒ 5: CHART OUT ⇒ 6: CHART SPAN ⇒
7: CHART NULL ⇒ 8: DISPLAY ⇒ 9: COMMA ⇒ 10: PRESET ⇒ 11: REVISION

1: RDGS STORE	Enables or disables reading memory.
2: SAVED RDGS	Recalls readings stored in memory (up to 1024 readings).
3: ERROR	Retrieves errors from the error queue (up to 20 errors).
4: TEST	Performs a complete self-test or individual self-tests.
5: CHART OUT	Enables or disables the chart recorder output (Analog Out).
6: CHART SPAN	Sets the chart recorder output range (Analog Out).
7: CHART NULL S	Sets the chart recorder output offset (Analog Out).
8: DISPLAY	Enables or disables the front panel display.
9: COMMA	Enables or disables a comma separator between digits in the display.
10: PRESET	Returns the meter to factory default settings.
11: REVISION	Displays the meter's firmware revision code.

F: Input / Output MENU

1: GPIB ADDR ⇒ 2: INTERFACE ⇒ 3: BAUD RATE ⇒ 4: PARITY ⇒ 5: LANGUAGE

1: GPIBADDR	Sets the GPIB bus address (0 to 30, default 22).
2: INTERFACE	Selects either the GPIB or RS-232 remote interface.
3: BAUD RATE	Sets the baud rate for RS-232 operation.
4: PARITY	Selects even, odd, or no parity for RS-232 operation.
5: LANGUAGE	Selects interface language, either SCPI or Keithley 181.

G: CALibration MENU[1]

1: SECURED ⇒ [1: UNSECURED] ⇒ [2:CALIBRATE] ⇒ [3: CHART ZERO] ⇒ [4 : CHART GAIN] ⇒ [5: INJECTED I] ⇒ 6:CAL COUNT ⇒ 7:MESSAGE

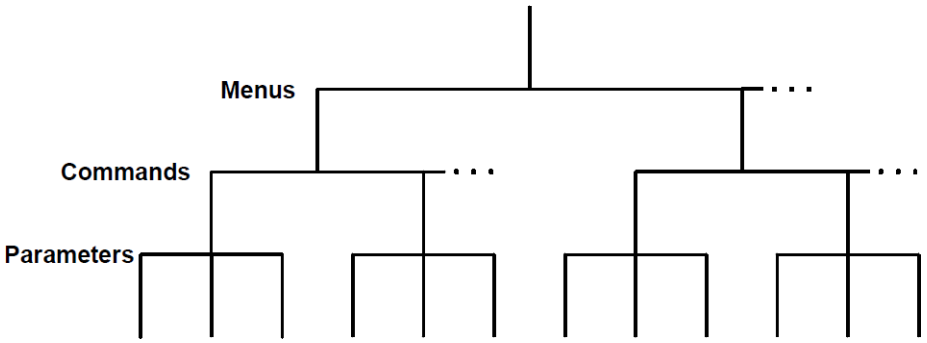
1: SECURED	The meter is secured against calibration; enter code to unsecure.
1: UNSECURED	The meter is unsecured for calibration; enter code to secure.
2: CALIBRATE	Performs a calibration of meter; must be UNSECURED.
3: CHART ZERO	Performs a calibration of the chart recorder output zero level.
4: CHART GAIN	Performs a calibration of the chart recorder output gain.
5: INJECTED I	Performs a calibration to minimize the injected current.
6: CAL COUNT	Reads the total number of times the meter has been calibrated.
7: MESSAGE	Reads the first 11 characters of a calibration string, if any, entered from the remote interface.

[1] The commands enclosed in square brackets ([ ]) are “hidden” unless the meter is UNSECURED for calibration.

A Front-Panel Menu Tutorial

This section is a step-by-step tutorial which shows how to use the front-panel menu. We recommend that you spend a few minutes with this tutorial to get comfortable with the structure and operation of the menu.

The menu is organized in a top-down tree structure with three levels (menus, commands, and parameters). You move down [^] or up [v] the menu tree to get from one *level* to the next. Each of the three levels has several horizontal *choices* which you can view by moving left [<] or right [>].



- To *turn on* the menu, press [Shift] [<] (Menu On/Off).
- To *turn off* the menu, press [Shift] [<] (Menu On/Off), or press any of the function or math keys on the top row of front-panel keys.
- To *execute* a menu command, press [Auto/Man].
- To *recall* the last menu command that was executed, press [Shift] [>] (Menu Recall).
- To *turn off* the menu at any time without saving changes, press any function key

NOTE **If you become confused or get lost at any point during the tutorial, simply turn off the menu and start over again with step 1 for that example.**

Messages Displayed During Menu Use

TOP OF MENU -You pressed ∧ while on the menus level; this is the top level of the menu and you cannot go any higher.

To turn off the menu, press Shift < (Menu On/Off). To move across the choices on a level, press < or > . To move down a level, press ∨ .

MENUS - You are on the menus level. Press < or > view the choices.

COMMANDS - You are on the commands level. Press < or > to view the command choices within the selected menu group.

PARAMETER - You are on the parameter level. Press < or > to view and edit the parameter for the selected command.

MENU BOTTOM - You pressed ∨ while on the parameter level; this is the bottom level of the menu and you cannot go any lower.

To turn off the menu, press **Shift** < *(Menu On/Off). To move up a level, press* ∧ .

ENTERED - The change made on the parameter level is saved. This is displayed after you press Auto/Man (Menu Enter) to execute the command.

MIN VALUE - The value you specified on the parameter level is too small for the selected command. The minimum value allowed is displayed for you to edit.

MAX VALUE - The value you specified on the parameter level is too large for the selected command. The maximum value allowed is displayed for you to edit.

EXITING - You will see this message if you turn off the menu by pressing **Auto/Man** (Menu On/Off) or a front-panel function/math key. You did not edit any values on the parameter level and changes were NOT saved.

NOT ENTERED - You will see this message if you turn off the menu by pressing **Shift** < (Menu On/Off) or a front-panel function/math key. You did some editing of parameters but the changes were NOT saved. Press **Auto/Man** (Menu Enter) to save changes made on the parameter level.

VOLTS ONLY - The requested function is only available for voltage measurements.

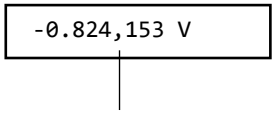
UNAVAILABLE - The action requested is NOT allowed in the present configuration.

Menu Example 1

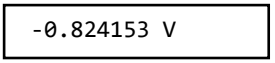
The following steps show you how to turn on the menu, move up or down between levels, move across the choices on each level, and turn off the menu.

In this example, you will turn off the display comma separator.

The meter can display readings on the front panel with or without a comma separator. The following steps show how to disable the comma.



With comma separator (factory setting)



Without comma separator

1 Turn on the menu.

Shift On/Off <

You enter the menu on the *menus* level. The MEAS MENU is your first choice on this level.

2 Move across to the SYS MENU choice on this level.

> > > >

There are six menu group choices available on the *menus* level. Each choice has a letter prefix for easy identification (**A:** , **B:** , etc.).

3 Move down to the *commands* level within the SYS MENU.

[V]

The RDGS STORE command is your first choice on this level.

```
1: RDGS STORE
```

4 Move across to the COMMA command on the *commands* level.

[>] [>] [>] [>]

[>] [>] [>] [>]

There are eleven command choices available in the SYS MENU. Each choice on this level has a number prefix for easy identification (**1:** , **2:** , etc.).

```
9: COMMA
```

5 Move down a level to the COMMA parameter choices.

[V]

The first parameter choice is ON for the COMMA command (the comma setting is stored in non-volatile memory and ON is the factory setting).

```
ON
```

6 Move across to the *OFF* choice.

[>]

There are two parameter choices for COMMA.

```
OFF
```

7 Save the change and turn off the menu.

Auto/Man
ENTER

The meter beeps and displays a message to show that the change is now in effect. You are then exited from the menu. The meter will no longer show commas in the display.

```
ENTERED
```

Menu Example 2

The following exercise demonstrates how to use the *menu recall* feature as a shortcut to set the COMMA command back to its original setting. *You must perform the steps in Menu Example 1 before you start this example.*

1 Use menu recall to return to the COMMA command.

Shift Recall
>

This returns you to the COMMA command, which was the last command used before you exited the menu in the Example 1.

```
9: COMMA
```

2 Move down to the COMMA parameter choices.

V

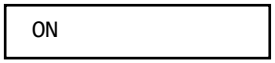
The first parameter choice is OFF (the current setting from Example 1).

```
OFF
```

3 Move across to the *ON* choice.

[>]

Set the parameter back to its original value.



4 Save the change and turn off the menu.

[Auto/Man]
ENTER

The meter beeps and displays a message to show that the change is now in effect. You are then exited from the menu.

Menu Example 3

Some commands in the menu require that you enter a numeric parameter value. The following steps show you how to enter a number in the menu. For this example, you will set the null value for channel 1 to –30 millivolts.

Make sure the meter has channel 1 selected, is in the dc voltage function, and has 6½ digits displayed. Connect the four-wire short to the meter input.

1 Turn on the menu.

[Shift] On/Off [<]

You enter the menu on the menus level. The MEAS MENU is your first choice on this level.

2 Move across to the MATH MENU choice on this level.

[>] [>]

There are six menu group choices available on this level.

```
C: MATH MENU
```

3 Move down to the *commands* level within the MATH MENU.

[V]

The STATS command is your first choice on this level.

```
1: STATS
```

4 Move across to the NULL VALUE command.

[>]

```
2: NULL VALUE
```

5 Move down to edit the NULL VALUE parameter.

[V]

The null value should be 0.000000 V when you come to this point in the menu for the first time. For this example, you will first set the null value to –0.300000 volts.

```
^ 0.000,000,0 V
```

When you see the flashing "^" on the left side of the display, you can abort the edit and return to the "commands" level by pressing [^].

6 Make the number negative.

[V] [V]

The left most character on the display toggles between +, –, and ^.

```
– 0.000,000,0 V
```

7 Move the flashing cursor over to edit the second digit.

[>] [>]

Notice that the digit to the right of the decimal point is flashing.

```
– 0.000,000,0 V
```

8 Increment the digit until "3" is displayed.

[^] [^] [^]

You decrement or increment each digit independently. Neighboring digits are not affected.

```
– 0.300,000,0 V
```

9 Move the flashing cursor over to the *units* location.

[>] [>] [>] [>]

[>] [>] [>]

Notice that the units are flashing on the right side of the display.

```
– 0.300,000,0 V
```

10 Decrease the displayed number by a factor of 10.

[v]

Notice that the position of the decimal point changes and the displayed number increases by a factor of 10 and the **mV** annunciator is on.

```
- 030.000,00 mV
```

11 Save the change and turn off the menu.

Auto/Man
ENTER

The meter beeps and displays a message to show that the change is now in effect. You are then exited from the menu.

```
ENTERED
```

You will be returned to the normal measurement display, and, if you have installed the four-wire short, the display will show a positive measurement in the approximate amount of the null value just entered.

The **Null** annunciator is on in the display.

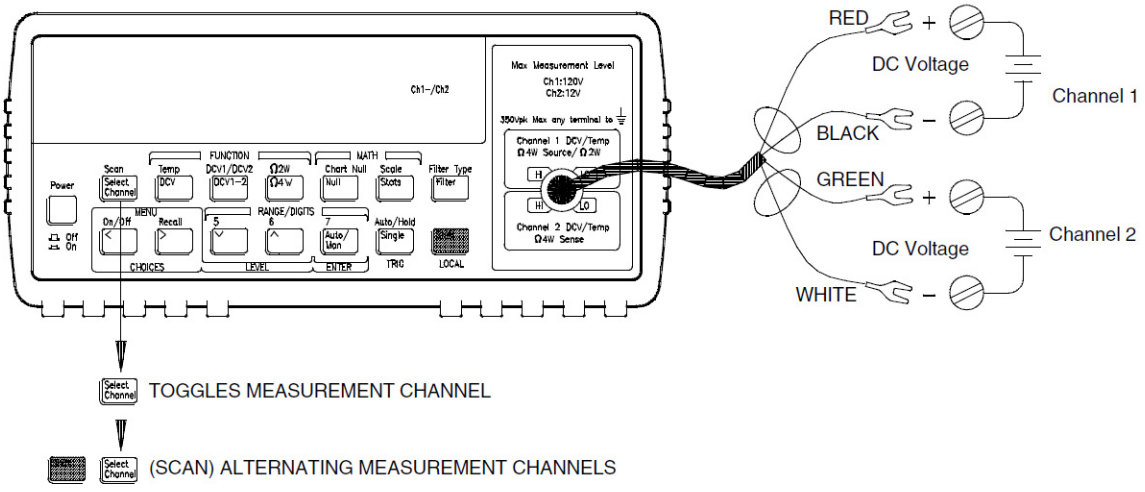
Keep in mind that null is turned on and - 0.03 volts is used as the null value for measurements. To clear the null value, press **Null**.

Hint You can use the menu recall feature to save steps when entering the null value. First, press **Null** on the front panel and then press **Shift** [>] (Menu Recall). The meter will jump to the **2:** NULL VALUE command. Press [v]. The null value in the display is the first reading taken after you turned NULL on. You can then edit this number as described.

NOTE This is the end of the front-panel menu tutorial. The remainder of the chapter discusses several of the most common front-panel operations.

To Select an Input Channel

For *voltage measurements*, you have two independent input channels.

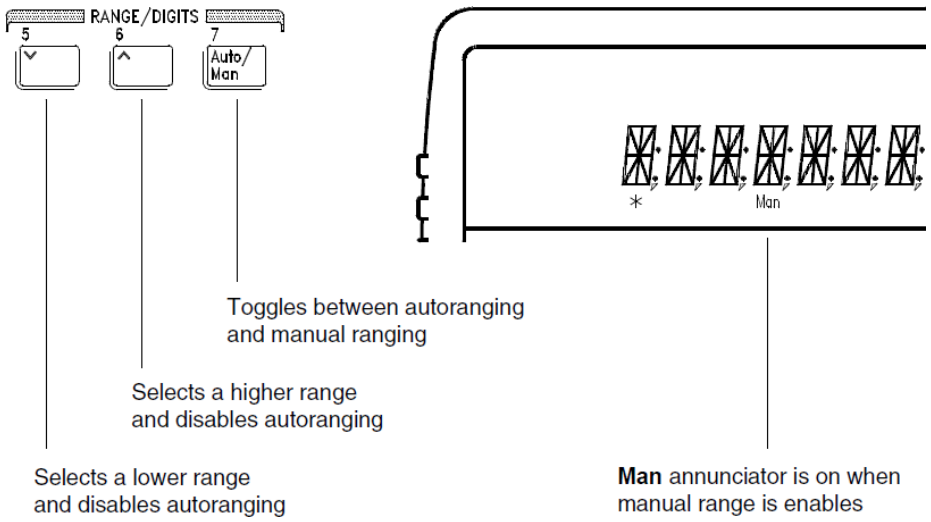


- Pressing **Channel** toggles the display between Channel 1 and Channel 2.
- Pressing **Shift** **Channel** (Scan) creates an alternating Channel 1 and Channel 2 display. Press **Channel** again to cancel.

NOTE Scan mode alternates between input channels every 3 seconds or every measurement, whichever is longer. If you are using the scan mode, turn off all the input filters (both digital and analog).

To Select a Range

You can let the meter automatically select the range using *autoranging* or you can select a fixed range using *manual ranging*.



- Autoranging is selected at power-on and after a remote interface reset.
- Autorange thresholds:

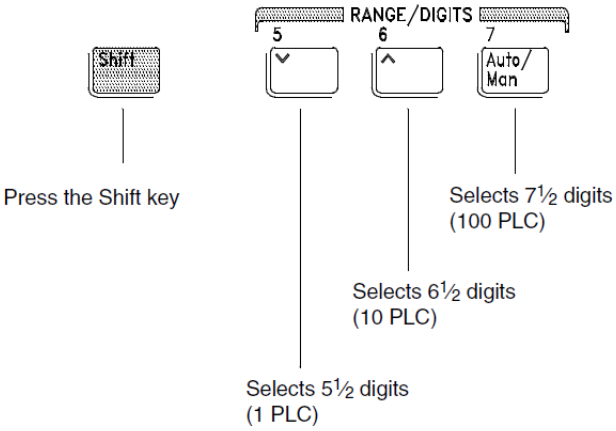
  Down range at <10% of range
  Up range at >120% of range

- If the input signal is greater than the present range can measure, the meter will give an *overload* indication ("OVLD").
- When making difference or ratio measurements, an overload on either channel will give an overload indication ("OVLD").

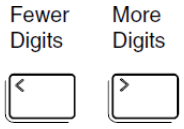
NOTE For voltage measurements, ranging is local to the selected channel. This means that you can select the ranging method (auto or manual) for each channel independently. When manually ranging, the selected range is local to the active channel; the meter remembers the range when you switch between channels.

To Set or Change the Number of Digits

You can set the display to show 4½, 5½, 6½, or 7½ digits. In this book, the most significant digit (leftmost on the display) is referred to as the "½" digit, since it can only be a "0" or "1". *The number of digits displayed also depends upon the integration time set, see* *page 63*.



- The number of digits is set to 6½ digits at power-on and after a remote interface reset.
- The number of digits shown is dependent upon integration time and filter settings. The meter will not allow you to show more digits than the practical measurement capability of the meter. You can, however, reduce the number of digits shown.



To Set the Integration Time

Integration time is specified in Number of Power Line Cycles (NPLC). You can set the NPLC to 0.02, 0.2, 1, 2, 10, 20, 100, or 200.

- You can set the integration time to one of three fixed values by choosing the number of digits displayed, see page 62.
- You can set the integration time in the MEASure menu using the INTEGRATE command.
- The Integration Time is directly related to the maximum number of digits the meter will display.

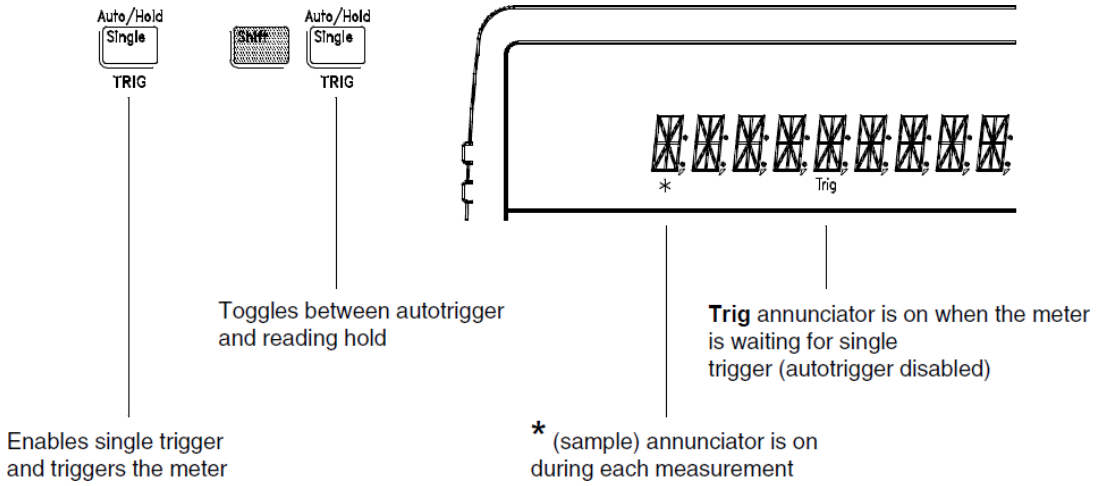
NPLC	Filter Off Max Digits Shown	Filter On Max Digits Shown
0.02	4½	5½
0.2	5½	6½
1	6½	7½
2	6½	7½
10	6½	7½
20	7½	7½
100	7½	7½
200	7½	7½

- You can always show fewer digits than the maximum allowed (the minimum number of digits shown is 4½).

NOTE Integration Time is local to the selected function. This means that you can select the integration time for each function independently. The meter remembers integration time when you switch between functions.

To Trigger the Meter

You can trigger the meter from the front panel using *single trigger* or *autotrigger*.



- Autotriggering is enabled when you turn on the meter. Notice that the * (sample) annunciator turns on during each measurement.
- Single triggering takes one reading each time you press **Single** and then waits for the next trigger. Continue pressing this key to trigger the meter.

Using an External Trigger

The external trigger mode is also enabled by pressing **Single** . It is like the single trigger mode except that you apply a trigger pulse to the rear-panel *Ext Trig* terminal. The meter is triggered on the negative edge of a TTL pulse.

The front-panel **Single** key is disabled when in remote.

Null (Relative) Operation

When making null measurements, also called *relative*, each reading is the difference between the input signal and a stored null value. You could, for example, make a more accurate two-wire ohms measurement by shorting the test leads and pressing Null to remove the test lead resistance.

Reading = *measurement – null value*

- The null value is adjustable and you can set it to any value between 0 and ± 120% of the highest range, for the present function.
- The null value is stored in *volatile* memory; the value is cleared when power has been off or after a remote interface reset.
- Each function and channel has an independent null value. For voltage measurements, each input channel has an independent null. Temperature measurement null is applied to all temperature measurements (if you change the probe type, null is still enabled and applied). The null for resistance measurements applies to both 2-wire and 4-wire measurements.
- The null value is stored in the meter's Null Register. There are two ways you can specify the null value. First, you can enter a specific number into the register from the front-panel menu or from the remote interface. Any previously stored value is replaced with the new value. *If you are operating the meter from the front panel, entering a null value also turns on the null function.*

  The second way to enter the null value is to let the meter store the first reading in the register. Press the Null key to make the displayed measurement the null value and enable the Null operation. After you enable null, the first reading displayed will be zero. If you entered a number into the register, as described in the paragraph above, the first reading *does not* overwrite the stored value.
- Since an independent null value is stored for each input channel, difference or ratio functions also use these null values. Additionally, when using the difference function, an additional difference null can be applied (the difference null is only available from the front panel).

To Use Math (Stats)

There are two math operations available, only one of which can be enabled at a time. The meter can either scale the readings as they are taken, or can keep statistics on a group of reading. The selected math operation remains in effect until you disable it, change functions, turn off the power, or perform a remote interface reset.

The scaling math operation is described in the *Keysight 34420A User's Guide.* This discussion applies to stats (statistics) operations only.

Enable the statistics by pressing the **Stats** key. Read the statistics gathered in the MATH menu under the STATS command.

After viewing the stored statistics, press **Shift** < (Menu On/Off) to return to the measurement and continue taking statistics.

After you enable statistics, the first reading that the meter takes is stored as both the minimum and maximum value. The minimum is replaced with any subsequent value that is less. The maximum is replaced with any subsequent value that is greater.

All values are stored in *volatile* memory; the meter clears the values when stats is turned on, when power has been off, or after a remote interface reset or preset.

When enabled, the following statistics are available:

MIN	minimum reading
MAX	maximum reading
AVER	arithmetic average of all readings
STD DEV	standard deviation of all readings
PEAK-PEAK	peak to peak value of minimum and maximum
COUNT	the total number of readings

Hint You can use the menu recall feature to save steps when using the math operations. After pressing **Stats** on the front panel, press **Shift** > (Menu Recall). The meter will jump to the 1:STATS command and you can press v to

view the statistics taken. After viewing the stored statistics, press Shift < (Menu On/Off) to return to the measurement and continue taking statistics.

To Set the Number of Samples

Normally, the meter takes one reading (or sample) each time it receives a trigger from the selected trigger source (if the meter is in the wait-for-trigger state). You can, however, instruct the meter to take multiple readings for each trigger received.

- Number of samples: 1 to 50,000. *The default is 1 sample per trigger.*
- The sample count is stored in *volatile* memory; the meter sets the sample count to 1 when power has been off or after a remote interface reset. The CONFigure and MEASure? commands automatically set the sample count to 1.
- **Front Panel operation:** set the number of samples per trigger in the **3: N SAMPLES** command under the TRIGger menu.
- **Remote operation:** use the following command:

  ```
  SAMPle:COUNt {<value>|MIN|MAX}
  ```

Chart Output (Analog Output)

You can use the Chart Output (Analog Output) connector on the rear panel to run a strip chart recorder or similar instrument. The connector provides an output voltage proportional to the measured voltage.

- Enable the chart output under the **5: CHART OUT** command in the SYStem menu.

  Set the chart span under the **6: CHART SPAN** command in the SYStem menu.

  Set the chart offset under the **7: CHART NULL** command in the SYStem menu.

  You can also press **Shift** **Null** (Chart Null) to null the chart output voltage based upon the displayed reading. This action places a null value in the Chart Offset register. Pressing **Shift** **>** (Menu Recall) will take you to the **7: CHART NULL** command where you can manually edit the null value.
- The output can range from –3.00 V to +3.00 V.
- When chart output is disabled (Off), the output is set to 0 V.
- The output impedance is 1 kΩ.
- The output voltage is related to the input signal as follows:

$$\frac{(reading - chart\ null)}{span} = chart\ output\ voltage$$

  Note that *reading* includes the results of measurement unit conversion, filtering, null, and any math operation performed on the measurement.
- The chart output state (including the span and null values) is stored in *non-volatile* memory.
- *span* cannot have a negative value.
- The chart output has a voltage “rollover” to prevent the loss of data, *see the Keysight 34420A User’s Guide*.

To Unsecure the Meter for Calibration

The meter can use a calibration security code to prevent unauthorized or accidental calibration. This procedure shows you how to unsecure the meter for calibration.

Shift < **1** Turn on the menu.

```
A: MEAS MENU
```

2 Move across to the CAL MENU choice on this level.

<

```
G: CAL MENU
```

v **3** Move down a level to the SECURED command.

```
1: SECURED
```

NOTE **If the display shows UNSECURED, you do not need to perform this procedure to perform calibration.**

4 Move down to the "parameters" level.

```
^000000: CODE
```

5 Enter the security code.

```
^034420: CODE
```

6 Save the change and exit.

The security code is set to “KT34420” when the meter is shipped from the factory. The security code is stored in non-volatile memory and does not change when the power has been off or after a remote interface reset.

To enter the security code from the front panel, enter only the six digits. To enter the security code from the remote interface, you may use up to 11 characters.

Use the arrow keys to move left or right between digits. Use the up or down arrow keys to change the digits.

NOTE **To re-secure the meter (following calibration), perform this procedure again.**

Additional information about the calibration security feature is given on page 91.

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3 Calibration Procedures

This chapter contains procedures for verification of the meter's performance and adjustment (calibration).

Closed-Case Electronic Calibration The meter features closed-case electronic calibration. No internal mechanical adjustments are required. The meter calculates correction factors based upon the input reference value you set. The

new correction factors are stored in non-volatile memory until the next calibration adjustment is performed. (Non-volatile memory does not change when power has been off or after a remote interface reset.)

Keysight Technologies Calibration Services

When your meter is due for calibration, contact your local Keysight Technologies Service Center for a low-cost recalibration. The Keysight 34420A is supported on automated calibration systems which allow Keysight Technologies to provide this service at competitive prices. Calibrations to MIL-STD-45662 are also available at competitive prices.

Calibration Interval

The meter should be calibrated on a regular interval determined by the measurement accuracy requirements of your application. A 1-year or 2-year interval is adequate for most applications. Keysight Technologies does not recommend extending calibration intervals beyond 2 years for any application.

Whatever calibration interval you select, Keysight Technologies recommends that complete re-adjustment should always be performed at the calibration interval. This will increase your confidence that the Keysight 34420A will remain within specification for the next calibration interval. This criteria for re-adjustment provides the best long-term stability. Performance data measured using this method can be used to extend future calibration intervals.

Time Required for Calibration

The Keysight 34420A can be automatically calibrated under computer control. With computer control you can perform the complete calibration procedure and performance verification tests in less than 50 minutes. Manual calibrations using the recommended test equipment will take approximately 2 hours.

Automating Calibration Procedures

You can automate the complete verification and adjustment procedures outlined in this chapter if you have access to programmable test equipment. You can program the instrument configurations specified for each test over the remote interface. You can then enter readback verification data into a test program and compare the results to the appropriate test limit values.

You can also enter calibration constants from the remote interface. Remote operation is similar to the local front-panel procedure. You can use a computer to

perform the adjustment by first selecting the required setup. The calibration value is sent to the meter and then the calibration is initiated over the remote interface. The meter must be unsecured prior to initiating the calibration procedure. For further information on programming the meter, see Chapter 4 in the *Keysight 34420A User's Guide*.

Recommended Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, substitute calibration standards of equivalent accuracy.

Instrument	Requirements	Recommended model	Use[a]
Low thermal 4-wire shorting plug	Low EMF four-wire short	Keysight 34103A (provided with meter)	Q,P,O,T
Low thermal input connector and cable	Low EMF, all copper	Keysight 34102A (provided with meter)	Q,P,O,T
Multifunction Calibrator	DC Volts O to 100 V resistance o to 1 MΩ	Fluke 5700	Q,P
Capacitor	1000 pF	none	0
1000:1 Voltage Divider	Low Thermal Noise	none	0
Temperature Measurement Device (RTD or thermistor)	± 0.2° C	none	0
6 1/2 Digit Digital Multimeter (DMM)	10 Vdc ± 0.01%	Keysight 34401A	O,T

[a] Q = Quick verification

P = Performance verification Tests

O = Optional Verification Tests

T = Troubleshooting

Test Considerations

To ensure proper instrument operation, verify that you have selected the correct power line voltage prior to attempting any test procedure in this chapter. See "To Prepare the Meter For Use" on page 27 for more information.

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

- Assure that the calibration ambient temperature is stable and between 18° C and 28° C.
- Assure ambient relative humidity is less than 80%.
- Allow a 3-hour warm-up period with the low thermal shorting plug connected before verification or adjustment.
- Assure that low noise connections are made to the meter and calibrator. Chapter 7 of the Keysight 34420A User's Guide describes low noise input connections.
- Allow 5 minutes for thermal offset stabilization after handling the input connector or shorting plug before making measurements or performing calibrations.
- Ensure the input connector or low thermal shorting plug coupling nut is properly tightened (torque to 20 in-lb maximum).

Performance Verification Tests

The performance verification tests use the meter's specifications listed in datasheet.

You can perform four different levels of performance verification tests:

- **Self-Test** A series of internal verification tests that give a high confidence that the meter is operational.
- **Quick Verification** A combination of the internal self-tests and selected verification tests.
- **Performance Verification Tests** An extensive set of tests that are recommended as an acceptance test when you first receive the meter or aft.er performing adjustments.
- **Optional Verification Tests** Tests not performed with every calibration. Perform these tests to verify additional specifications or functions of the meter.

Self-Test

A brief power-on self-test occurs automatically whenever you turn on the meter. This limited test assures that the meter is capable of operation.

To perform a complete self-test hold down the **Shift** key as you press the Power switch to turn on the meter; hold down the key for more than 5 seconds (a complete description of these tests can be found in chapter 6). The meter will automatically perform the complete self-test procedure when you release the key. The self-test will complete in approximately 10 seconds.

You can perform many tests individually (or all tests at once) using the TEST command in the SYS MENU. You can also perform a self-test from the remote interface. See Chapter 4 in the *Keysight 34420A User's Guide*.

- If the self-test is successful, “PASS” is displayed on the front panel.
- If the self-test fails, “FAIL” is displayed and the ERROR annunciator turns on. If repair is required, see Chapter 4, "Service" for further details.
- If all tests pass, you have a high confidence (90%) that the meter is operational.

Quick Performance Check

The quick performance check is a combination of internal self-test and an abbreviated performance test (specified by the letter Q in the performance verification tests). This test provides a simple method to achieve high confidence in the meter's ability to functionally operate and meet specifications. These tests represent the absolute minimum set of performance checks recommended following any service activity. Auditing the meter's performance for the quick check points (designated by a Q) verifies performance for “normal” accuracy drift mechanisms.

NOTE This test does not check for abnormal component failures.

To perform the quick performance check, do the following:

- Perform a complete self-test. A procedure is given on page 72.
- Perform only the performance verification tests indicated with the letter Q.

If the meter fails the quick performance check, adjustment or repair is required.

NOTE If the meter fails the quick performance check, adjustment or repair is required.

Performance Verification Tests

The performance verification tests are recommended as acceptance tests when you first receive the meter. The acceptance test results should be compared against the 90 day test limits. You should use the 24-hour test limits only for verification within 24 hours after performing the adjustment procedure. After acceptance, you should repeat the performance verification tests at every calibration interval.

NOTE If the meter fails performance verification, adjustment or repair is required

---

Zero Offset Verification

This procedure verifies the zero performance of the meter. Verification checks are only performed for those functions and ranges with unique zero calibration constants. A low thermal 4-wire shorting plug is applied to the input of the meter for these checks.

Zero Offset Verification Procedure

1. Set the meter to the following configuration for each function, channel, and range in the table on the next page:

   7 ½ digits (100 PLC)
   Filters OFF

2. Read "Test Considerations" on page 78.
3. Apply the low thermal 4-wire shorting plug (Keysight PN 34103A) to the meter's input terminal. Ensure the connector coupling nut is properly tightened.
4. Allow 5 minutes for the thermal shorting plug and input connector to temperature stabilize.
5. Select each function and range in the order shown in the table on the next page. Compare each measurement result to the test limits shown in the table.

CAUTION

- **Zero offset calibration using a multifunction calibrator is NOT possible.**
- **Use only the low thermal 4-wire shorting plug provided.**

Table 3-1 Zero Offset Verification Procedure

				± Error From Zero		
	Step#	Function/Channel	Range	24 hour	90day	1 year
	1	Voltage / Channel 1	1 mV	120 nV[a]	120 nV[a]	120 nV[a]
Q	2	Voltage / Channel 1	10mV	120 nV[a]	120 nV[a]	130 nV[a]
	3	Voltage / Channel 1	100 mV	300 nV	400 nV	400 nV
	4	Voltage / Channel 1	1 V	3 µV	4 µV	4 µV
	5	Voltage / Channel 1	10V	10 µV	40 µV	40 µV
Q	6	Voltage / Channel 1	100V	400 µV	500 µV	500 µV
	1	Voltage /Channel 2	1 mV	120 nV[a]	120 nV[a]	120 nV[a]
Q	2	Voltage / Channel 2	10 mV	120 nV[a]	120 nV[a]	130 nV[a]
	3	Voltage / Channel 2	100mV	300 nV	400 nV	400 nV
	4	Voltage / Channel 2	1 V	3 µV	4 µV	4 µV
	5	Voltage I Channel 2	10V	10 µV	40 µV	40 µV
	7	4-wire Ohms	1 Ω	2 µΩ	2 µΩ	2 µΩ
	8	4-wire Ohms	10 Ω	20 µΩ	20 µΩ	20 µΩ
	9	4-wire Ohms	100 Ω	200 µΩ	200 µΩ	200 µΩ
Q	10	4-wire Ohms	1 kΩ	2 mΩ	2 mΩ	2 mΩ
	11	4-wire Ohms	10 kΩ	20 mΩ	20 mΩ	20 mΩ
	12	4-wire Ohms	100 kΩ	300 mΩ	400 mΩ	400 mΩ
	13	4-wire Ohms	1 MΩ	3 Ω	4 Ω	4 Ω
	14	Low Power Ohms	1 Ω	2 µΩ	2 µΩ	2 µΩ

Table 3-1 Zero Offset Verification Procedure

				± Error From Zero		
	Step#	Function/Channel	Range	24 hour	90day	1 year
	15	Low Power Ohms	10 Ω	20 μΩ	20 μΩ	20 μΩ
	16	Low Power Ohms	100 Ω	200 μΩ	200 μΩ	200 μΩ
	17	Low Power Ohms	1 kΩ	2 mΩ	2 mΩn	2 mΩ
	18	Low Power Ohms	10 kΩ	40 mΩ	40 mΩ	40 mΩ
	19	Low Power Ohms	100 kΩ	1.2 Ω	1.5 Ω	1.5 Ω
Q	20	Low Power Ohms	1 MΩ	3 Ω	4 Ω	4 Ω
	21	Voltage Limited Ohms	10 Ω	20 μΩ	20 μΩ	20 mΩ
	22	Voltage Limited Ohms	100 Ω	200 μΩ	200 μΩ	200 μΩ
	Optional[b]	2-wire Ohms	All	Use 4-wire Ohms specifications[b]		

[a] This value includes 100 nV for NULL off, see the specifications in datasheet.

[b] For 2-wire Ohms with Null ON (within ± 1°C of NULL), add 2 mΩ to the listed specification. If null is not used, add 0.2 Ω to the listed specification.

Gain Verification

This procedure is used to check the “full scale” reading calibration of the meter. Verification checks are only performed for those functions, channels, and ranges with unique gain calibration constants.

Gain Verification Procedure

1. Set the meter to the following configuration:

   7 ½ digits (100 PLC)
   Filters OFF

2. Read “Test Considerations” on page 78.
3. Connect a multifunction calibrator to the meter's input terminals using the low thermal input cable provided (Keysight PN 34102A). Ensure the connector coupling nut is properly tightened.
4. Allow 5 minutes for the input connections to temperature stabilize.
5. Select each function and range on the meter in the order shown in the table on the next page. At each function and range apply a full scale (input with the multifunction calibrator. Compare each measurement result to the test limits shown in the table.

NOTE The 1 mV and 10 mV gain verification is an optional verification test (see page 86). These range gains are internally derived from the 100mV, 1V, and 10V range calibrations.

Table 3-2 Gain Verification Procedure

					± Error From Full Scale		
	Step#	Calibrator Output	Function/Channel	Range	24 hours	90day	1 year
	1	100mV	Voltage/ Channel 1	100 mV	1.8 µV	3.4 µV	4.4 µV
	2	1 V	Voltage/ Channel 1	1 V	13 µV	29 µV	39 µV
Q	3	10 V	Voltage/ Channel 1	10 V	30 µV	240 µV	340 µV

Table 3-2 Gain Verification Procedure

					± Error From Full Scale		
	Step#	Calibrator Output	Function/Channel	Range	24 hours	90day	1 year
	4	100 V	Voltage/ Channel 1	100V	1.4 mV	3 mV	4mV
	5	100mV	Voltage/ Channel 2[a]	100mV	1.8µV	3.4µV	4.4µV
	6	1 V	Voltage/ Channel 2[a]	1 V	13µV	29µV	39µV
Q	7	10 V	Voltage/ Channel 2[a]	10V	30µV	240µV	340µV
	8	1 Ω	4-wire Ohms	1 Ω	17 µΩ	52 µΩ	72 µΩ
	9	10 Ω	4-wire Ohms	10 Ω	110 µΩ	420 µΩ	620 µΩ
	10	100 Ω	4-wire Ohms	100 Ω	1.7 mΩ	4.2 mΩ	6.2 mΩ
Q	11	1 kΩ	4-wire Ohms	1 kΩ	17 mΩ	42 mΩ	62 mΩ
	12	10 kΩ	4-wire Ohms	10 kΩ	170 mΩ	420 mΩ	620 mΩ
	13	100 kΩ	4-wire Ohms	100 kΩ	1.8 Ω	4.4 Ω	6.4 Ω
	14	1 MΩ	4-wire Ohms	1 MΩ	23 Ω	54 Ω	74 Ω
	15	1 Ω	Low Power Ohms	1 Ω	17 µΩ	52 µΩ	72 µΩ
	16	10 Ω	Low Power Ohms	10 Ω	170 µΩ	420 µΩ	620 µΩ
	17	100 Ω	Low Power Ohms	100 Ω	1.7 mΩ	4.2 mΩ	6.2 mΩ
	18	1 kΩ	Low Power Ohms	1 kΩ	17 mΩ	42 mΩ	62 mΩ
	19	10 kΩ	Low Power Ohms	10 kΩ	190 mΩ	440 mΩ	640 mΩ
	20	100 kΩ	Low Power Ohms	100 kΩ	2.1 Ω	5.5 Ω	7.5 Ω
	21	1 MΩ	Low Power Ohms	1 MΩ	23 Ω	54Ω	74 Ω
	22	10Ω	Voltage Limited Ohms	10Ω	220 µΩ	520 µΩ	720 µΩ
	23	100 Ω	Voltage Limited Ohms	100 Ω	2.7 mΩ	5.2 mΩ	7.2 mΩ
	Optional		2-wire Ohms	All	Use 4-wire Ohms specifications[b]		

[a] Channel 2 can be verified only, no channel 2 gain calibration exists. Channel 2 gain calibration is derived from channel 1 gain calibration.

[b] For 2-wire Ohms with Null ON (within± 1°C of NULL), add 2 mΩ to the listed specification. If null is not used, add 0.2 Ω to the listed specification.

1 mV and 10 mV Gain Verification (Optional)

This optional procedure checks the “full scale” gain for the 1 mV and 10 mV ranges. Because of the low voltage levels used to verify these ranges and the inherent inaccuracies of multifunction calibrators at these levels, a voltage divider is used to check these ranges.

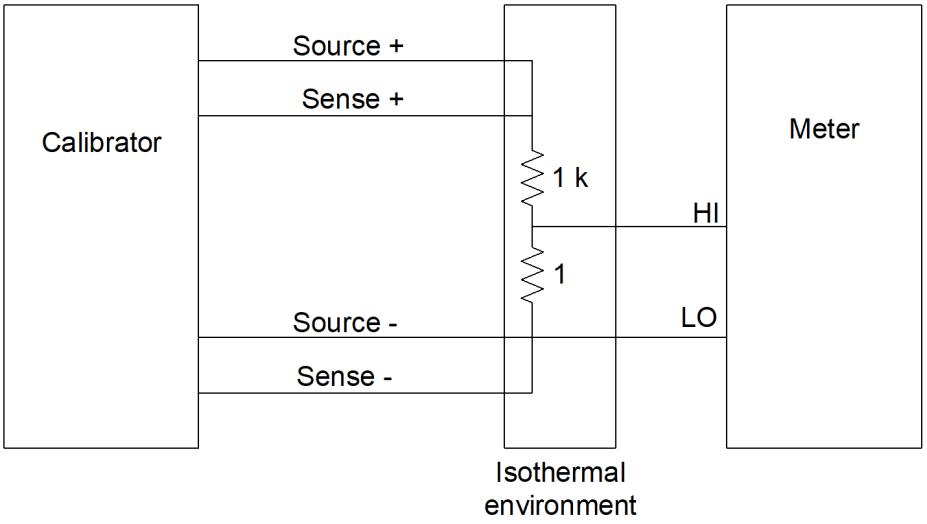
NOTE **These ranges can only be verified. The gain calibrations for these ranges are derived from the calibrations on the 100mV, JV, and 10 V ranges.**

1 mV and 10 mV gain verification procedure

1. Set the meter to the following configuration:

   Channel 1 input
   7 ½ digits (100 PLC)
   Filters OFF

2. Connect the calibrator, resistive divider, and meter as shown.



3. Measure or calculate the divider ratio.

4 Set the calibrator to fixed range (2.2 Volt range on range lock) and O Volt output.

5 Null the reading on the meter.

6 Set the calibrator to 1 Volt output. Adjust the calibrator output from nominal by the divider ratio to produce a 1 mV input to the meter.

NOTE Step 4, step 5 and step 6 should be performed quickly to minimize thermal offsets.

7 Verify the meter reading against the table below.

8 Repeat step 4 through step 7 using the calibrator 11 Volt range and applying a 10 V output to produce a 10 mV input on the meter.

NOTE You should repeat step 4 through step 8 several times and average the results to reduce the effects of measurement noise.

Table 3-3 1 mV and 10 mV gain verification procedure

		± Error From Full Scale		
Function/Channel	Range	24 hour	90day	1 year
Voltage/ Channel 1	1 mV	45nV	60 nV	70 nV
Voltage/ Channel 1	10mV	270nV	420 nV	530nV

Injected Current Verification (Optional)

This optional procedure checks the injected current level. Injected current varies with the power line configuration and frequency. You should, therefore, verify injected current using the same power line configuration as the intended use.

Injected Current Verification Procedure

1 Connect the DMM and the meter to the same power line receptacle.

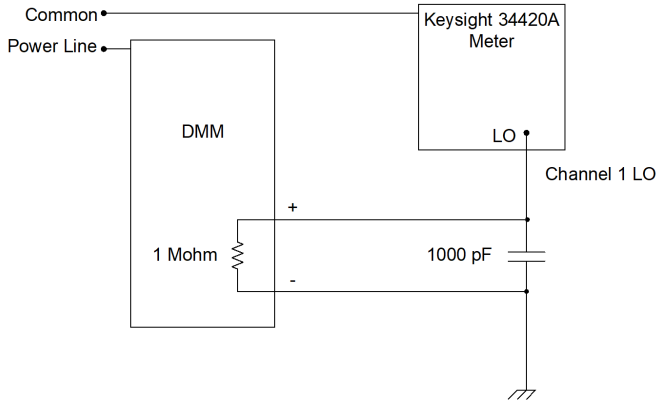
2 Set the DMM to measure AC Volts rms on the 100 mV range.

NOTE **The DMM input impedance must be 1 MQ to perform this procedure.**

3 Set the Keysight 34420A to the following configuration:

Channel 1 input
7½ digits (100 PLC)
Filters OFF

4 Connect the DMM, capacitor, and meter as shown.



5 Measure the rms voltage on the DMM. With the setup shown, 1 mV rms is equivalent to 1 nA rms of injected current. Verify the measured voltage is <18 mV rms (for peak-to-peak values, multiple the measured rms voltage by 2.8).

Chart Output Verification (Optional)

This optional procedure checks the chart output (analog output) for zero and gain calibration. Before beginning this procedure, you should check and record any settings for the chart span and chart null (see page 63) so that these values can be restored at the end of the procedure.

Chart Output Verification Procedure

1 Set the meter to the following configuration:

6 1/2 digits (10 PLC)
Channel 1 DCV
Math OFF
Null OFF

2 Read "Test Considerations" on page 78.

3 Connect the low thermal 4-wire shorting plug to the meter's input terminals.

4 Connect the rear panel chart output terminal to a DMM.

Shift (On/Off) < **5** Turn on the menu.

> > > > **6** Select the `E:SYS` menu.

v < < < < **7** Move down to the commands level and across to the `6:CHART SPAN` command.

v **8** Move down to the parameters level and set the value to 1.000,000 V.

Auto/Man ENTER **9** Execute the command.

Shift (Recall) > **10** Use menu recall to return to the `6:CHART SPAN` command.

> **11** Move to the `7:CHART NULL` command.

v **12** Move down to the parameters level and set the value shown to 0.000,000 V.

Auto/Man ENTER **13** Execute the command.

Shift Recall >

14 Use menu recall to return to the `7: CHART NULL` command.

< <

V

15 Move to the 5:CHART OUT command.

16 Move down to the parameters level and set the value to ON.

Auto/Man ENTER

17 Execute the command.

18 Measure the chart output with the DMM and verify that the output is:

0 Volts ±l mV.

Shift Recall >

19 Use menu recall to return to the `5: CHART OUT` command.

> >

20 Move to the 7:CHART NULL command.

V

21 Move down to the parameters level and set the value to -1.000,000 V.

Auto/Man ENTER

22 Execute the command.

23 Measure the chart output with the DMM and verify that the output is:

1.000 Volt ±2 mV.

24 Restore chart null and chart span to the values set before beginning this procedure.

Calibration Security Code

This feature allows you to enter a security code (electronic key) to prevent accidental or unauthorized calibrations of the meter. When you first receive your meter, it is secured. Before you can adjust calibration constants you must unsecure the meter by entering the correct security code. A procedure to unsecure the meter is given on "To Unsecure the Meter for Calibration" on page 70.

- The security code is set to "KT034420" when the meter is shipped from the factory. The security code is stored in non-volatile memory, and does not change when power has been off or after a remote interface reset.
- To secure the meter from the remote interface, the security code may contain up to 11 alphanumeric characters as shown below. The first character must be a letter, but the remaining characters can be letters or numbers. You do not have to use all 11 characters but the first character must always be a letter.

  A _ _ _ _ _ _ _ _ _ _ _ (*11 characters*)
- To secure the meter from the remote interface but allow it to be unsecured from the front panel, use the eight-character format shown below. The first two characters must be "KT" and the remaining characters must be numbers. Only the last six characters are recognized from the front panel, but all eight characters are required. (To unsecure the meter from the front panel, omit the "KT" and enter the remaining numbers.)

  K T _ _ _ _ _ _ _ _ (*8 characters*)

NOTE **If you secure the meter from the remote interface and the secure code you use does not have the first two characters "KT" and the next 6 characters as digits, you cannot unsecure the meter from the front panel.**

- If you forget your security code, you can disable the security feature by adding a jumper inside the meter, and then entering a new code. See the procedure on the following page.

To Unsecure the Meter Without the Security Code

To unsecure the meter without the correct security code, follow the steps below. A procedure to unsecure the meter is given on "To Unsecure the Meter for Calibration" on page 70. Also see Chapter 4, "Electrostatic Discharge (ESD) Precautions" before beginning this procedure.

1. Disconnect the power cord and all input connections (both front and rear terminals).
2. Remove the instrument cover. Refer to the disassembly drawing on page 155.
3. Connect the power cord and turn on the meter. Be careful not to touch the power line connections.

WARNING Do not touch exposed mains.

4. Apply a short between the two exposed metal pads on JM500 as shown in Figure 3-1.

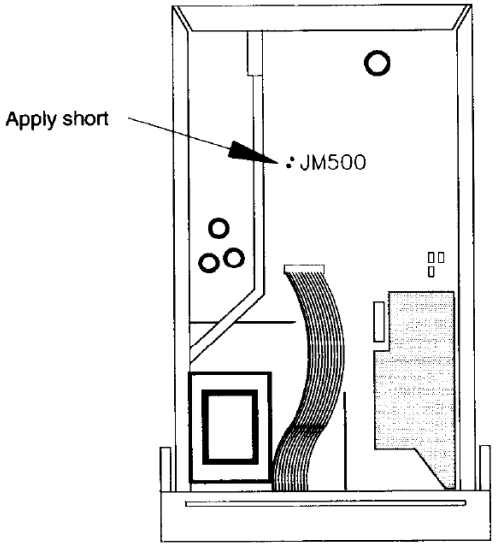


Figure 3-1 Applying short on JM500

5 While maintaining the short, enter any unsecure code. The meter is now unsecured.

6 Remove the short at JM500.

7 Turn off the meter and remove the power cord. Reassemble the meter.

8 The meter is now unsecured and you can enter a new security code. Be sure you take note of the new security code.

Calibration Count

The calibration count feature provides an independent “serialization” of your calibrations. You can determine the number of times that your meter has been calibrated. By monitoring the calibration count, you can determine whether an unauthorized calibration has been performed.

Since the value increments by one for each calibration, a complete calibration increases the value by approximately 24 counts.

- The calibration count is stored in *non-volatile* memory and *does not* change when power has been off or after a remote interface reset. Your meter was calibrated before it left the factory. When you receive your meter read the calibration count to determine its value.
- The calibration count increments up to a maximum of 32,767 after which it wraps around to 0. There is no way provided to program or reset the calibration count. It is an independent electronic calibration “serialization” value.

Calibration Message

You can use the calibration message feature to record calibration information about your meter. For example, you can store such information as the last calibration date, the next calibration due date, the meter's serial number, or even the name and phone number of the person to contact for a new calibration.

You can record information in the calibration message only from the remote interface. You can read the message from either the front-panel menu or the remote interface.

- The calibration message may contain up to 40 characters. The meter can display up to 11 characters of the message on the front panel; any additional characters are truncated.
- The calibration message is stored in non-volatile memory, and does not change when power has been off or after a remote interface reset.

Calibration Procedure

The adjustment procedures use the CALibrate menu to initiate internal procedures to generate and set calibration constants. The general menu procedure is the same for all calibration setups.

Before beginning any calibration procedure the meter must be unsecured for calibration (see page 70). The following procedure is the recommended method to complete a meter calibration.

- Read "Test Considerations" on page 78.
- "To Unsecure the Meter for Calibration" on page 70.
- Perform the Zero Calibration procedure (page 81).
- Perform the Gain Calibration procedure (page 84).
- Secure the meter against calibration.
- Note the new security code and calibration count in the meter's maintenance records.

Aborting a Calibration in Progress

Sometimes it may be necessary to abort a calibration after the procedure has already been initiated. You can abort a calibration at any time by pressing any front-panel key (except **Shift**). When performing a calibration from the remote interface, you can abort a calibration by issuing a remote interface device clear message or by pressing the front-panel LOCAL key.

Zero Calibration

A new set of zero offset correction constants are stored each time a zero calibration is performed. Each channel, function, and range has a unique offset correction. Once the procedure is started, the meter will automatically sequence through all the required input channels, functions, and ranges and store a new zero offset constant for each.

You may not perform a zero calibration for a single input channel, function or range. All zero offset constants are determined when a zero calibration is begun.

As a part of the Zero Calibration, the input amplifier bias current is minimized. This error current is dependent upon temperature. You should perform the Zero Calibration procedures whenever the meter is used in environments with temperatures greater than ±5° C from the calibration temperature.

Zero Calibration Procedure

The automatic zero calibration takes approximately 10 minutes to complete.

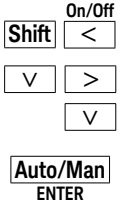
The procedure is outlined below. You should review "Test Considerations" on page 78 before beginning this procedure.

1 Set the meter to the following configuration:

61/2 digits (10 PLC)
Channel 1 DCV
Filters OFF

2 Connect the low thermal 4-wire shorting plug to the meter's input terminals. Ensure the connector coupling nut is properly tightened.

3 Allow 5 minutes for the thermal shorting plug and input connector to temperature stabilize.



4 Turn on the menu and select `G:CAL` menu.

5 Move to the commands level and select `2:CALIBRATE`.

6 Move down to the parameters level and set the value shown to 0.000,000,0 V.

7 Execute the command to begin the automatic zero calibration. The calibration will take approximately 10 minutes to complete. The display will indicate the calibration progress as each channel, range, and function is calibrated.

8 Perform the Zero Offset Verification procedure (page 81) to check the results.

Gain Calibration

The meter stores new gain correction constants each time this procedure is followed. The gain constants are calculated from calibration values entered and from measurements made automatically by the meter.

The 1 mV and 10 mV ranges use an internally derived gain constant and do not have a separate gain calibration. The 1 mV and 10 mV gain constants are based upon measurements performed during the 100 mV, 1 V and 10 V gain calibrations. Channel 1 gain is used for both channel 1 and channel 2. No separate channel 2 gain constants are stored.

NOTE **It is recommended that the calibration procedure be followed in the order given here. If you are performing adjustments for an individual function, perform the adjustments ONLY in the order shown.**

Gain Adjustment Considerations

- The zero calibration procedure *must* have been recently performed before beginning these gain adjustment procedures.
- When performing the 4-wire ohms gain adjustment, new gain constants are also stored for the 2-wire ohms gain constants.
- Gain adjustments can be made with calibrator input values that are within 0.9 to 1.1 of Full Scale.

Gain Calibration Procedure

Perform the adjustments for each function only in the order shown.

1. Read "Test Considerations" on page 78.
2. Set the meter to the following configuration for each function, channel, and range in Table 3-4:

   7 1/2 digits (100 PLC)
   Null OFF
   Filters OFF

3 Connect a multifunction calibrator to the meter's input terminals using the provided cable (Keysight PN 34102A). Ensure the connector coupling nut is properly tightened.

4 Allow 5 minutes for the input connector to temperature stabilize.

5 Select each function and range in the order shown in Table 3-4. Apply the input signal shown.

6 Turn on the menu and select `G:CALIBRATE` menu.

7 Move to the commands level and select `2:CALIBRATE`.

8 Move down to the parameters level and set the value in the display to the calibrator input value.

9 Execute the command to begin the gain calibration.

10 Repeat step 1 through step 9 for each function and gain listed in the table.

11 Perform the "Gain Verification Procedure" on page 84 to check the results.

Table 3-4 Gain calibration procedure

Step#	Calibrator Output[a]	Function/Channel	Range
1	100.00000 mV [b]	DCV / Channel 1	100mV
2	1.0000000 V [b]	DCV / Channel 1	1 V
3	10.000000 V [b]	DCV / Channel 1	10 V
4	100.00000 V	DCV / Channel 1	100V
5	1.000,0000 Ω	4-wire Ohms	1 Ω
6	10.000000 Ω	4-wire Ohms	10 Ω
7	100.00000 Ω	4-wire Ohms	100 Ω
8	1,000.0000 Ω	4-wire Ohms	1 kΩ
9	10,000.000 Ω	4-wire Ohms	10 kΩ
10	100,000.00 Ω	4-wire Ohms	100 kΩ
11	1,000,000.0 Ω	4-wire Ohms	1 MΩ

[a] Gain calibration can be performed with an input that is within 0.9 to 1.1 of range.

[b] The constants calculated for these ranges are used to derive the gain calibration constants for the 1 mV and 10 mV ranges.

Injected Current Calibration (Optional)

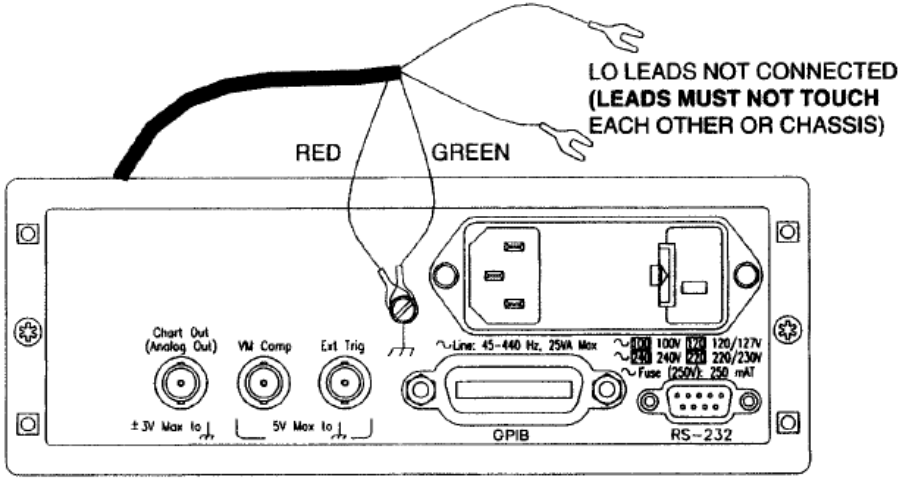
This calibration minimizes the effects of injected current in the input circuits. Injected current varies with the power line configuration and frequency (these vary by country). You should, therefore, only calibrate injected current using the same power line configuration as the intended use.

NOTE **The injected current is calibrated at the factory using 120 Vac line power with a hot lead, neutral lead, and an earth ground lead. You should recalibrate injected current if you are using the meter with different line power configurations. You should only recalibrate injected current using the same power line configuration as the intended use.**

1 Set the meter to the following configuration:

6 1/2 digits (10 PLC)
Channel 1 input

2 Connect channel 1 **HI** and channel 2 **HI** leads to the rear panel chassis ground screw.



Shift On/Off <

3 Turn on the menu.

< V

4 Select G:CAL menu and go to the command level.

```
1:UNSECURED
```

> > > >

V

5 Select 5:INJECTED I command and enter the parameter level.

```
INITIATE
```

Auto/Man
ENTER

6 Enter the command to begin the calibration. The calibration takes approximately 30 seconds to complete.

7 The display will show intermediate values of the injected current as the calibration progresses.

8 When the calibration is finished, the display shows

```
COMPLETED
```

9 The display will then show the final injected current value. You may wish to record this value. After a pause, the meter returns to the measurement mode.

```
3.8 nA RMS
```

Internal Temperature Reference Calibration (Optional)

This procedure calibrates the internal reference junction temperature reference used with thermocouple measurements. Perform this calibration if you are using the meter to make thermocouple measurements and are using the internal temperature sensor as a reference. The internal temperature sensor measures the cold junction temperature at the meter's input connector.

1 Set the meter to:

   Temperature measurement function

   1:PROBE TYPE to T/C

2 Put the temperature measuring device as close to the meter's input connections as possible. Make physical contact with the connector shell.

WARNING The input connector shell is at earth ground potential.

Shift (On/Off) < <

V >

V

3 Turn on the menu and select `G:CALIBRATE` menu.

4 Move to the commands level and select `2:CALIBRATE.`

5 Move down to the parameters level and set the value in the display to the measured temperature value.

Auto/Man ENTER

6 Execute the command to begin the gain calibration.

NOTE The temperature units shown will be the currently set temperature units (°F, °C, or Kelvins).

Chart Output Calibration (Optional)

The chart output (analog output) uses two calibration constants, a zero and a gain. Chart Output calibrations are performed with an external DMM.

1 Set the meter to the power-on state. Connect the low thermal shorting plug to the meter's input.

2 Connect the chart output to the input of the DMM. Set the DMM to measure DC volts.

Shift On/Off <

3 Turn on the Menu.

<

4 Select the `G:CALIBRATE` menu.

V > >

5 Go to the command level and select the `3:CHART ZERO` command.

V

6 Go to the parameter level.

7 Edit the displayed value to match the value indicated on the DMM. Execute the command. The zero calibration takes approximately 2 seconds to perform.

Shift Recall >

8 Use menu recall to return to the `3:CHART ZERO` command.

> V

9 Scroll to the `4:CHART GAIN` command and go to the parameter level.

10 Edit the displayed value to match the value indicated on the DMM. Execute the command. The gain calibration takes approximately 2 seconds to perform.

11 Perform the "Chart Output Verification Procedure" on page 89.

Error Messages

The following tables are abbreviated lists of meter's error messages. They are intended to include errors which are likely to be encountered during the procedures described in this chapter. For a more complete list of error messages and descriptions see *Chapter 5* in the *Keysight 34420A User's Guide*.

Table 3-5 System error messages

Error	Error Message
-330	Self-test Failed
-350	Queue Overflow
501	Isolator UART framing error
502	Isolator UART overrun error
511	RS-232 framing error
512	RS-232 overrun error
513	RS-232 parity error
514	Command allowed only with RS-232
521	Input buffer overflow
522	Output buffer overflow
531	Insufficient Memory
532	Cannot achieve requested resolution
540	Cannot use overload as math reference
550	Command not allowed in Local
552	Command not allowed in current function

Table 3-6 Self-test error messages

Error	Error message
601	Front panel does not respond
602	RAM read/write fail
603	AID sync stuck
604	AID slope convergence failed
605	Cannot calibrate rundown gain
606	Rundown gain out of range
607	Rundown too noisy
608	Serial configuration readback failed
609	DC gain ×1 failed
610	DC gain ×10 failed
611	DC gain ×100 failed
613	Ohms 5 µA source failed
614	Ohms 10 µA source failed
615	Ohms 100 µA source failed
616	Ohms 1 mA source failed
617	Ohms 1O mA source failed
618	Ohms 20 mV voltage clamp failed
619	Ohms 100 mV voltage clamp failed
620	Ohms 500 mV voltage clamp failed
621	Low impedance DC gain ×100 failed
622	High impedance DC gain ×100 failed
623	Cannot calibrate precharge
624	Unable to sense line frequency
625	I/O Processor did not respond
626	I/O Processor failed self-test

Table 3-6 Self-test error messages

Error	Error message
627	Hardware overload comparator failed
630	Bias Current DAC test failed

Table 3-7 Calibration error messages

Error	Error message
701	Cal security disabled by jumper
702	Cal secured
703	Invalid secure code
704	Secure code too long
705	Cal aborted
706	Cal value out of range
707	Cal signal measurement out of range
709	No cal for this function or range
710	Full scale correction out of range
720	Cal DCV offset out of range
722	Cal RES offset out of range
723	Cal FRES offset out of range
730	Precharge DAC convergence failed
731	A/D turnover correction out of range
737	Bias current selfcal failed
738	Charge compensation selfcal failed
739	Injected current selfcal failed
740	Cal checksum failed, secure state
741	Cal checksum failed, string data
742	Cal checksum failed, DCV correction

Table 3-7 Calibration error messages

Error	Error message
743	Cal checksum failed, Low Power FAES
744	Cal checksum failed, RES corrections
745	Cal checksum failed, FAES corrections
746	Cal checksum failed, Low Voltage FAES corrections
747	Cal checksum failed, GPIB address

4 Service

This chapter discusses the procedures involved for returning a failed meter to Keysight Technologies for service or repair.

Operating Checklist

Before returning your meter to Keysight Technologies for service or repair check the following items:

Is the meter inoperative?

- Verify that the ac power cord is connected to the meter.
- Verify that the front-panel Power switch is depressed.
- Verify that the power-line fuse is installed and not open (see page 28):

Use a 250 mAT, 250V fuse for all power line settings.

- Verify the power-line voltage setting.

See "To Prepare the Meter For Use" on page 27.

Does the meter fail self-test?

Verify that the correct power-line voltage is selected.

See "To Prepare the Meter For Use" on page 27.

Types of Service Available

If your meter fails within three years of original purchase, Keysight Technologies will repair or replace it free of charge. If your unit fails after your three year warranty expires, Keysight will repair or replace it at a very competitive price. Keysight will make the decision locally whether to repair or replace your unit.

Standard Repair Services (worldwide)

Contact your nearest Keysight Service Center. They will arrange to have your meter repaired or replaced.

Express Exchange (U.S.A. only)

You can receive a replacement Keysight 34420A via overnight shipment for low downtime.

1 Call 1-800-258-5165 and ask for "Express Exchange."

- You will be asked for your shipping address and a credit card number to guarantee return of your failed meter.
- If you do not return your failed meter within 45 days, your credit card will be billed for a new Keysight 34420A.
- If you choose not to supply a credit card number, you will be asked to send your failed unit to a designated Keysight Service Center. After the failed unit is received, Keysight will send your replacement unit.

2 Keysight will immediately send a replacement Keysight 34420A to you via overnight shipment.

- The replacement unit will have a different serial number than your failed unit.
- If you can not accept a new serial number for the replacement unit, use the Standard Repair Service option described above.
- If your failed unit was "in-warranty", your replacement unit continues the original three year warranty period. You *will* not be billed for the replacement unit as long as the failed unit is received by Keysight.

– If your three year warranty has expired, Keysight will bill you for the Keysight 34420A exchange price - less than a new unit price. Keysight warrants exchange units against defects for 90 days.

Repackaging for Shipment

For the *Express Exchange Service* described on the previous page, return your failed Keysight 34420A to the designated Keysight Service Center using the shipping carton of the exchange unit. A shipping label will be supplied. Keysight will notify you when your failed unit has been received.

If the instrument is to be shipped to Keysight for service or repair, be sure to:

- Attach a tag to the meter identifying the owner and indicating the required service or repair. Include the instrument model number and full serial number.
- Place the meter in its original container with appropriate packaging material.
- Secure the container with strong tape or metal bands.

If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the meter. Use static-free packaging materials to avoid additional damage to your unit.

NOTE Keysight suggests that you always insure shipments.

Electrostatic Discharge (ESD) Precautions

Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damage can occur at electrostatic discharge voltages as low as 50 volts.

The following guidelines will help prevent ESD damage when servicing the meter or any electronic device.

- Disassemble instruments *only* in a static-free work area.
- Use a conductive work area to dissipate static charge.
- Use a conductive wrist strap to dissipate static charge accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, foam, vinyl, paper, and other static-generating materials from the immediate work area.
- Use *only* anti-static solder suckers.

Surface Mount Repair

NOTE

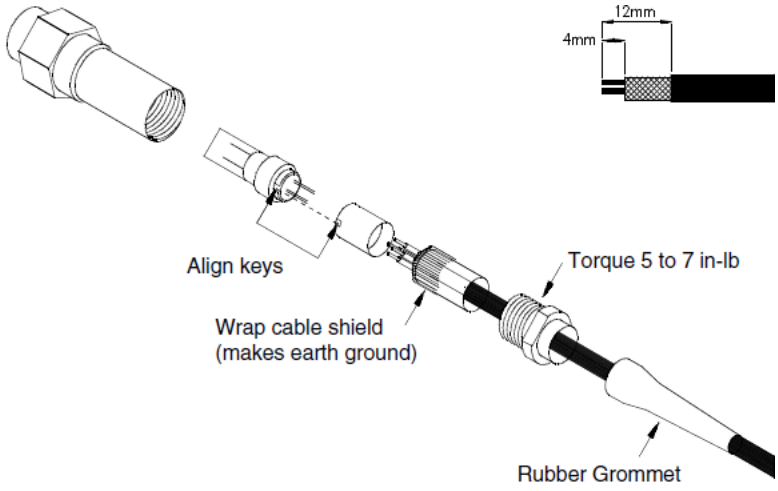
Surface mount components should only be removed using soldering irons or desoldering stations *expressly* designed for surface mount components. **Use of conventional solder removal equipment will almost always result in permanent damage to the printed circuit board and will void your Keysight Technologies factory warranty.**

To Replace the Power-Line Fuse

The power-line fuse is located within the meter's fuse-holder assembly on the rear panel (see page 28). Use a 250 mAT slow-blow fuse (Keysight part number 2110-0817). This fuse is used for all power line settings.

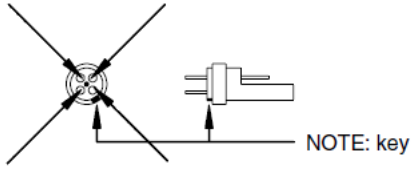
Input Connector

WIRE: 22 - 28 guage copper



Channel 1

	HI	LO
DCV	+	–
4-WireΩ	Source +	Source –
2-WireΩ	Source and Sense +	Source and Sense –
Thermistor	Source and Sense +	Source and Sense –



Channel 2

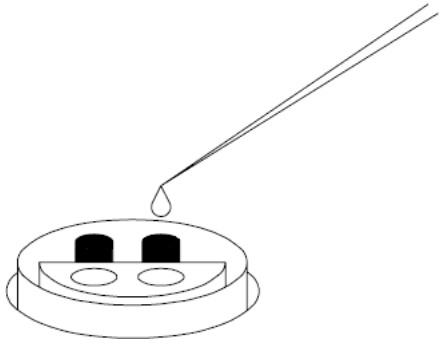
	HI	LO
DCV	+	–
4-WireΩ	Sense +	Sense –
Thermocouple	+	–

Cleaning the Connector Contacts

Because the meter uses connector contacts that are almost pure copper, they are subject to oxidation. Oxidation can cause measurement errors. *See Chapter 7 of the Keysight 34420A User's Guide for a discussion of the cause of measurement error*.

To help prevent the formation of oxides on the connector contacts, keep the connector engaged whenever possible. After extended periods of time, it may be necessary to treat the connector contacts. The recommended treatment uses DeoxIT™[1] and a small bottle of DeoxIT was included with the 34420A. Use the following procedure to apply DeoxIT to the connector terminals.

1. Remove the power cord from the meter.
2. Remove the input connector.
3. Stand the meter on a smooth level surface so that the front panel is up.
4. Apply one drop of DeoxIT to each connector pin in the input connector. A convenient method to apply a single drop is to use a clean piece of wire to transfer the liquid from the container provided to the connector.



5. Remove any excess DeoxIT from the connector by wiping with a clean soft cloth.
6. Engage and disengage the input cable several times to distribute the DeoxIT evenly over both halves of the connector.

[1] DeoxIT™ is a trademark of CAIG Laboratories, Inc., San Diego, California.

Troubleshooting Hints

This section provides a brief check list of common failures. Before troubleshooting or repairing the meter, make sure the failure is in the instrument rather than any external connections. Also make sure that the instrument is accurately calibrated. The meter's circuits allow troubleshooting and repair with basic equipment such as a 61/2-digit multimeter.

Unit is inoperative

- Verify that the ac power cord is connected to the meter.
- Verify that the front-panel Power switch is depressed.
- Verify the power-line fuse is not open (refer to page 28):

Use a 250 mAT, 250V fuse for all power line settings.

- Verify the power-line voltage setting.

See"To Prepare the Meter For Use" on page 27.

Unit reports error 705

This error may be produced if you accidentally turn off power the unit during a calibration or while changing a non-volatile state of the instrument. Recalibration or resetting the state should clear the error. If the error persists, a hardware failure may have occurred.

Unit fails self-test

Verify that the correct power-line voltage setting is selected. Also, ensure that all terminal connections (both front panel and rear terminals) are removed while the self-test is performed.

Power supply problems

Check that the input to the supply voltage regulator is at least 1 V greater than its output.

Circuit failures can cause heavy supply loads which may pull down the regulator output voltage.

Check the main supply voltages as tabulated in Table 4-1.

Table 4-1 Main supply voltages

Power Supply	Minimum	Maximum	Check At
+5 Ground Ref.	4.75 V	5.25V	U751 pin 3
-5 Ground Ref.	-5.25 V	-4.75 V	U611 pin 1
+5 Floating	4.75 V	5.25V	U553 pin 2
+ 18 Floating	17.8 V	20.1V	U551 pin 2
-18 Floating	-20.1 V	-18.2V	U552 pin 3
+7 REF Floating	6.8 V	7.1 V	U400 pin 7
+5VSP Floating	4.75V	5.25V	U401 pin 7

Some circuits produce their own local power supplies derived from the main supplies. Be sure to check that these local supplies are active.Local supplies are included in the display and front panel, the input amplifier, and the input and protection circuits. Always check that the power supplies are free of ac oscillations using an oscilloscope.

Self-Test Procedures

Power-On Self-Test

Each time the meter is powered on, a small set of self-tests are performed. These tests check that the minimum set of logic and measurement hardware are functioning properly. The power-on self-test performs checks 601, 625, and 626.

Complete Self-Test

Hold the shift key for 5 seconds while turning on the power to perform a complete self-test. The meter beeps when the test starts. The tests are performed in the order shown below.

Performing Individual Tests

You can perform individual self-tests through the SYStem menu and TEST command. At the parameter level, you can choose to TEST ALL or scroll through a list of test numbers. All numbered tests are looped to give a continuous pass/fail indication when started from the menu (they will repeat the test until interrupted).

601 **Front panel does not respond** The main CPU U500 attempts to establish serial communications with the front panel processor U602. During this test, U602 turns on all display segments. Communication must function in both directions for this test to pass. If this error is detected during power-up self-test, the meter will beep twice. This error is only readable from the remote interface.

602 **RAM read/write failed** This test writes and reads a 55h and checkerboard pattern to each address of ram U503. Any incorrect readback will cause a test failure.

603 **A/D sync stuck** The main CPU issues an A/ D sync pulse to U500 and U501 to latch the value in the ADC slope counters. A failure is detected when a sync interrupt is not recognized and a subsequent time-out occurs.

604 **A/D slope convergence failed** The input amplifier is configured to the measure zero (MZ) state in the 10 V range. This test checks whether the ADC integrator produces nominally the same number of positive and negative slope decisions (±10%) during a 20 ms interval.

605 **Cannot calibrate rundown gain** This test checks the nominal gain between the integrating ADC and the U500 on-chip ADC. This error is reported if the procedure can not run to completion due to a hardware failure.

606 **Rundown gain out of range** This test checks the nominal gain between the integrating ADC and the U500 on-chip ADC. The nominal gain is check to ±10% tolerance.

607 **Rundown too noisy** This test checks the gain repeatability between the integrating ADC and the U500 on-chip ADC. The gain test (606) is performed eight times. Gain noise must be less than ±64 lsb's of the U500 on-chip ADC.

608 **Serial configuration readback failed** This test re-sends the last 9 byte serial configuration data to all the serial path (SERDAT, SERBCK, SERCLK). The data is then clocked back into U501 and compared against the original 9 bytes sent. A failure occurs if the data do not match. This tests checks the serial data path through U501, U101, U150, and U601 through U606.

609 **DC gain X1 failed** This test configures for the 10 V range. The DC amplifier gain is set to X1. The measure customer (MC) input is connected to the internal TSENSE source which produces 0.6 volts. A 20 ms ADC measurement is performed and checked against a limit of 0.6 V ±0.3V.

610 **DC gain X10 failed** This test configures for the 1 V range. The DC amplifier gain is set to X10. The measure customer (MC) input is connected to the internal TSENSE source which produces 0.6 volts. A 20 ms ADC measurement is performed and checked against a limit of 0.6 V ±0.3V.

611 **DC gain X100 failed** This test configures for the 100 mV range. The DC amplifier gain is set to X100. The measure customer (MC) input is created from the 1mA current source and 20mV Ohms Clamp circuit with the inputs open. A 20 ms ADC measurement is performed and checked against a limit of 20 mV ±11 mV.

613 **Ohms 5 µA source failed** This test configures the 10 V range with the internal 499 Q test resistor (R109) connected across the input. the 5 µA current source is connected. A 40 ms ADC measurement is performed and the result is checked against a limit of 0.0025 V ±0.001 V.

614 **Ohms 10 µA source failed** This test configures the 10 V range with the internal 499 Q test resistor (R109) connected across the input. The 10 µA current source is connected. A 40 ms ADC measurement is performed and the result is checked against a limit of 0.005 V ±0.0015 V.

615 **Ohms 100 µA source failed** This test configures the 10 V range with the internal 499 Q test resistor (R109) connected across the input. The 100 µA current source is connected. A 40 ms ADC measurement is performed and the result is checked against a limit of 0.05 V ±0.01 V.

616 **Ohms 1 mA source failed** This test configures the 10 V range with the internal 499 Q test resistor (R109) connected across the input. The 1 mA current source is connected. A 40 ms ADC measurement is performed and the result is checked against a limit of 0.5 V ±0.1 V.

617 **Ohms 10 mA source failed** This test configures the 10 V range with the internal 499 Q test resistor (R109) connected across the input. The 10 mA current source is connected. A 40 ms ADC measurement is performed and the result is checked against a limit of 5 V ±1 V.

618 **Ohms 20 mV voltage clamp failed** This test configures the 10 V range. The 10 mA current source is connected into an open circuit and the 20 mV ohms clamp voltage is selected and measured. The result is checked for 20 mV ±10 mV.

619 **Ohms 100 mV voltage clamp failed** This test configures the 10 V range. The 10 mA current source is connected into an open circuit and the 100 mV ohms clamp voltage is selected and measured. The result is checked for 85 mV ±35 mV.

620 **Ohms 500 mV voltage clamp failed** This test configures the 10 V range. The 10 mA current source is connected into an open circuit and the 500 mV ohms clamp voltage is selected and measured. The result is checked for 425 mV ±175 mV.

621 **Low impedance DC gain X100 failed** This test configures the 100 mV range. The 10 mA current source is connected into an open circuit and the 20 mV ohms clamp voltage is selected and measured. The input gain is set to X100 through U307B, RP1A pin 2, and U303C/D. The result is checked to 20 mV ±11 mV.

622 **High impedance DC gain X1OO failed** This test configures the 100 mV range. The 10 mA current source is connected into an open circuit and the 20 mV ohms clamp voltage is selected and measured. The input gain is set to X1OO through U307B, Ul02C pin 14, U102C pin 31, and U304D. The result is checked to 20 mV ±11 mV.

623 **Cannot calibrate precharge** This test configures to the 1 V range with the input internally grounded. The ADC is configured for 200 ms measurements. The U500 pulse width modulated (PWM) DAC output (C512) is set to about 4 volts. A reading is taken in with U101 in the MC state. A second reading is taken in the PRE state. The precharge amplifier voltage offset is calculated. The U500 DAC output is set to about 1.5 volts and the precharge offset is measured again. The gain of the offset adjustment is calculated. This test assures a precharge amplifier offset is achievable.

624 **Unable to sense line frequency** This test checks that the LSENSE logic input to U500 is toggling. If no logic input is detected, the meter will assume a 50 Hz line operation for all future measurements.

625 **I/0 processor did not respond** This test checks that communications can be established between U500 and U700 through the optically isolated (U506 and U704) serial data link. Failure to establish communication in either direction will generate an error. If this condition is detected at power-on self-test, the meter will beep and the error annunciator will be on.

626 **I/0 processor failed self-test** This test causes the earth referenced processor U700 to execute an internal, RAM test. Failure will generate an error.

627 **Hardware overload comparator failed** This test configures the 10 V range. The +18 V power supply is internally applied to the input. The overload comparator (U311A/B) bit is checked for an overload condition (bit set to 0). Only the positive comparator is checked.

630 **Bias current DAC failed** This test configures the 1 V range with the input internally grounded through R227. The bias current DAC, U301, is then programmed to both extremes and a measurement taken at each. A check is made to ensure that O V is between the two measurements.

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5 Replaceable Parts

This chapter contains information ordering replacement parts for your meter.

– Input Connector Replaceable Parts

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– Input Connector Replaceable Parts

To Order Replace Parts

You can order replaceable parts from Keysight using the Keysight part number or directly from the manufacturer using the manufacturer's part number. To order replaceable parts from Keysight, do the following:

1 Contact your nearest Keysight Sales Office of Keysight Service Center.

2 Identify the parts by the Keysight part number shown in the replaceable parts list.

3 Provide the instrument model number and serial number.

Input Connector Replaceable Parts

Use the following Keysight Technologies part numbers to obtain replacement input connectors and cables. Contact your nearest Keysight Technologies Sales Office for replaceable parts.

Keysight part number	Description
34104A	Low thermal input connector (blank)
34103A	Low thermal 4-wire shorting plug
34102A	Low thermal input connector and 4 foot cable with spade lugs.

You can obtain additional DeoxIT™, part number D100L2, from:

CAIG Laboratories, Inc.
16744 West Bernardo Drive
San Diego, CA 92172-1904

6 Characteristics and Specifications

For the characteristics and specifications of the 34420A Nano Volt/Micro Ohm Meter, refer to the datasheet at https://literature.cdn.keysight.com/litweb/pdf/5968-0161EN.pdf.

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