Agilent 34410A/11A
6 ½ Digit Multimeter

Service Guide

Agilent Technologies

Notices

Manual Part Number

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

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Safety Notices

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 Information

Do not defeat power cord safety ground feature. Plug in to a grounded (earthed) outlet.

Do not use product in any manner not specified by the manufacturer.

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

Safety Symbols

Earth Ground

Chassis Ground

Risk of electric shock

Refer to manual for additional safety information

CAT II (300 v) IEC Measurement Category II. Inputs may be connected to mains (up to 300 VAC) under Category II overvoltage conditions.

WARNING

Main Power and Test Input Disconnect: Unplug instrument from wall outlet, remove power cord, and remove all probes from all terminals before servicing. Only qualified, service-trained personnel should remove the cover from the instrument.

WARNING

Line and Current Protection Fuses: For continued protection against fire, replace the line fuse and the current-protection fuse only with fuses of the specified type and rating.

WARNING

Front/Rear Switch: Do not change the position of the Front/Rear switch on the front panel while signals are present on either the front or rear set of terminals. The switch is not intended as an active multiplexer. Switching while high voltages or currents are present may cause instrument damage and lead to the risk of electric shock.

WARNING

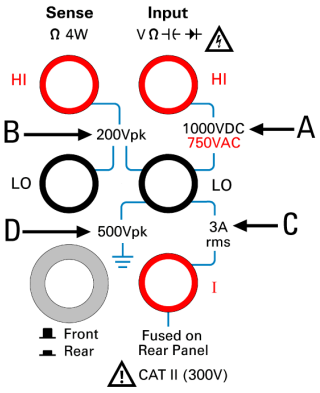
IEC Measurement Category II. The HI and LO input terminals may be connected to mains in IEC Category II installations for line voltages up to 300 VAC. To avoid the danger of electric shock, do not connect the inputs to mains for line voltages above 300 VAC. See "IEC Measurement Category II Overvoltage Protection" on the following page for further information.

WARNING

Protection Limits: To avoid instrument damage and the risk of electric shock, do not exceed any of the Protection Limits defined in the following section.

Protection Limits

The Agilent 34410A/11A Digital Multimeter provides protection circuitry to prevent damage to the instrument and to protect against the danger of electric shock, provided the Protection Limits are not exceeded. To ensure safe operation of the instrument, do not exceed the Protection Limits shown on the front and rear panel, and defined below:



Note: The front-panel terminals are shown above. The rear-panel terminals are identical. The Front/Rear switch selects the terminal set to be used. *Do not operate this switch while signals are present on the front or rear terminals*. The current-protection fuse is on the rear panel.

Input Terminal Protection Limits

Protection Limits are defined for the three input terminals:

Main Input (HI and LO) Terminals. The HI and LO input terminals are used for voltage, resistance, capacitance, and diode test measurements. Two Protection Limits are defined for these terminals:

HI to LO Protection Limit. The Protection Limit from HI to LO ("A" in the above figure) is 1000 VDC or 750 VAC, which is also the maximum voltage measurement. This limit can also be expressed as 1000 Vpk maximum.

LO to Ground Protection Limit. The LO input terminal can safely "float" a maximum of 500 Vpk relative to ground. This is Protection Limit "D" in the figure.

As is implied by the above limits, the Protection Limit for the HI input terminal is a maximum of 1500 Vpk relative to ground.

Current Input Terminal. The current input ("I") terminal has a Protection Limit of 3A (rms) maximum current flowing from the LO input terminal. This is Protection Limit "C" in the figure. Note that the current input terminal will be at approximately the same voltage as the LO terminal.

Note: The current-protection circuitry includes a fuse on the rear panel. To maintain protection, replace this fuse only with a fuse of the specified type and rating (see "Operator Maintenance" in Chapter 1).

Sense Terminal Protection Limits

The HI and LO sense terminals are used only for four-wire resistance measurements ("Ω 4W"). The Protection Limit is 200 Vpk for all of the terminal pairings ("B" in the figure):

LO sense to LO input.

HI sense to LO input.

HI sense to LO sense.

Note: The 200 Vpk limit on the sense terminals is the Protection Limit. Operational voltages in resistance measurements are much lower — less than 10 V in normal operation.

IEC Measurement Category II Overvoltage Protection

To protect against the danger of electric shock, the Agilent 34410A/11A Digital Multimeter provides overvoltage protection for line-voltage mains connections meeting ***both*** of the following conditions:

The HI and LO input terminals are connected to the mains under Measurement Category II conditions, defined below, ***and***

The mains are limited to a maximum line voltage of 300 VAC.

IEC Measurement Category II includes electrical devices connected to mains at an outlet on a branch circuit. Such devices include most small appliances, test equipment, and other devices that plug into a branch outlet or socket. The 34410A/11A may be used to make measurements with the HI and LO inputs connected to mains in such devices, or to the branch outlet itself (up to 300 VAC). However, the 34410A/11A may not be used with its HI and LO inputs connected to mains in permanently installed electrical devices such as the main circuit-breaker panel, sub-panel disconnect boxes, or permanently wired motors. Such devices and circuits are subject to overvoltages that may exceed the protection limits of the 34410A/11A.

Note: Voltages above 300 VAC may be measured only in circuits that are isolated from mains. However, transient overvoltages are also present on circuits that are isolated from mains. The Agilent 34410A/11A is designed to safely withstand occasional transient overvoltages up to 2500 Vpk. Do not use this equipment to measure circuits where transient overvoltages could exceed this level.

Agilent Technologies	**DECLARATION OF CONFORMITY** According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	CE

Manufacturer's Name: Agilent Technologies, Incorporated
Manufacturer's Address: 815 – 14th St. SW
Loveland, CO 80537
USA

Declares under sole responsibility that the product as originally delivered

Product Name: 6 ½ Digit Multimeter
Model Number: 34410A, 34411A
Product Options: This declaration covers all options of the above product(s)

complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

Low Voltage Directive (73/23/EEC, amended by 93/68/EEC)
EMC Directive (89/336/EEC, amended by 93/68/EEC)

and conforms with the following product standards:

EMC	**Standard**	**Limit**
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990 / EN 55011:1991	Group 1 Class A
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 4 kV AD
	IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	0.5 kV line-line, 1 kV line-ground
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	3 V, 0.15-80 MHz 1 cycle, 100%
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	Interrupts: 10 ms, 20 ms
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
	The product was tested in a typical configuration with Agilent Technologies test systems.	
Safety	IEC 61010-1:2001 / EN 61010-1:2001 Canada: CSA C22.2 No. 61010-1:2004 USA: UL 61010-1: 2004	

Supplementary Information:

This DoC applies to above-listed products placed on the EU market after:

20 October 2005
Date

Ray Corson
Product Regulations Program Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor, or Agilent Technologies Deutschland GmbH, Herrenberger Straße 130, D 71034 Böblingen, Germany.

Agilent 34410A/11A at a Glance

The Agilent Technologies 34410A and 34411A multimeters give you the performance you need for fast, accurate bench and system testing. These multimeters provides 6½–digits of resolution and 0.0015% basic 24–hr dcV accuracy.

Convenient bench–top features

- Continuity and diode testing
- Capacitance measurements
- A dual display of multiple measurement data, such as Frequency and ac voltage, at the same time
- Bar graph display to help you see limits exceeded in measurements
- Data logging that allows you to select a function, space measurements in time, and choose your logging duration
- Instrument state storage with user–defined names
- Portable, ruggedized case with non–skid feet

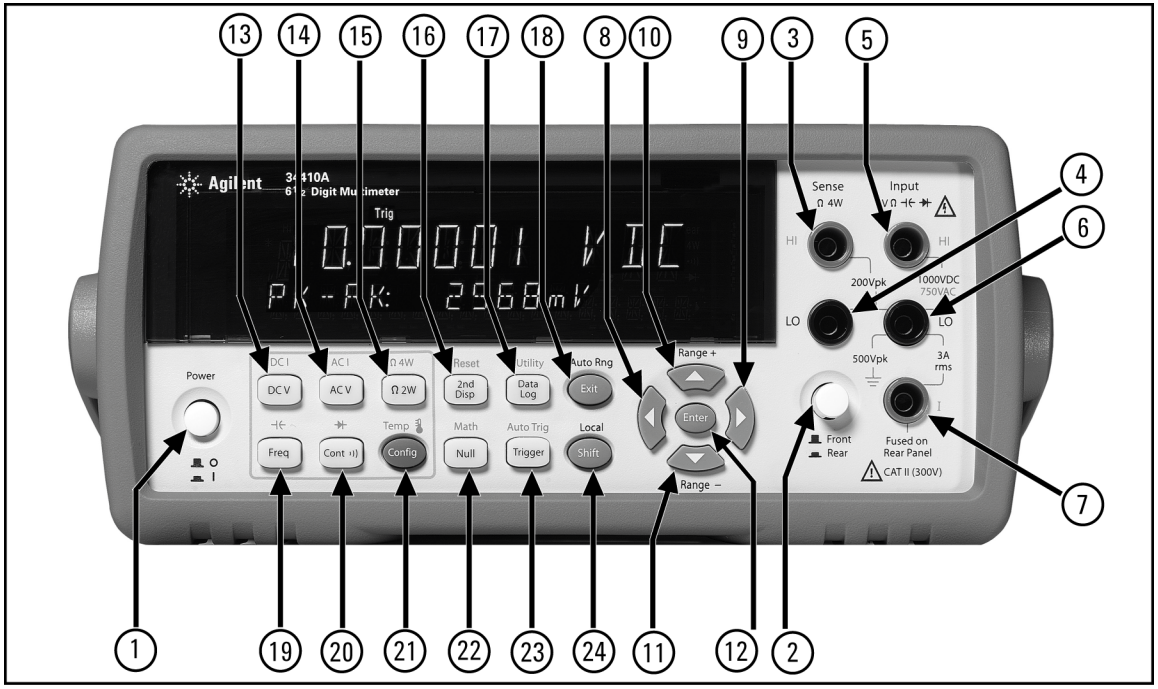
Flexible system features

- GPIB (IEEE–488), USB, and LAN remote interfaces are standard
- SCPI (Standard Commands for Programmable Instruments) compatibility
- Voltmeter Complete and External Trigger signals to synchronize to other instruments in your test system

Note: This manual covers the operation of the Agilent 34410A and 34411A 6½ Digit Multimeters. The features described in this manual, except where otherwise stated, apply to both Models 34410A and 34411A.

Model 34410A	Model 34411A
• Up to 10,000 readings per second	• Up to 50,000 readings per second
• Reading memory (buffer) up to 50,000 readings	• Reading memory (buffer) up to 1 million readings
	• Pretriggering, internal level triggering, and digitizer specifications.

The Front Panel at a Glance

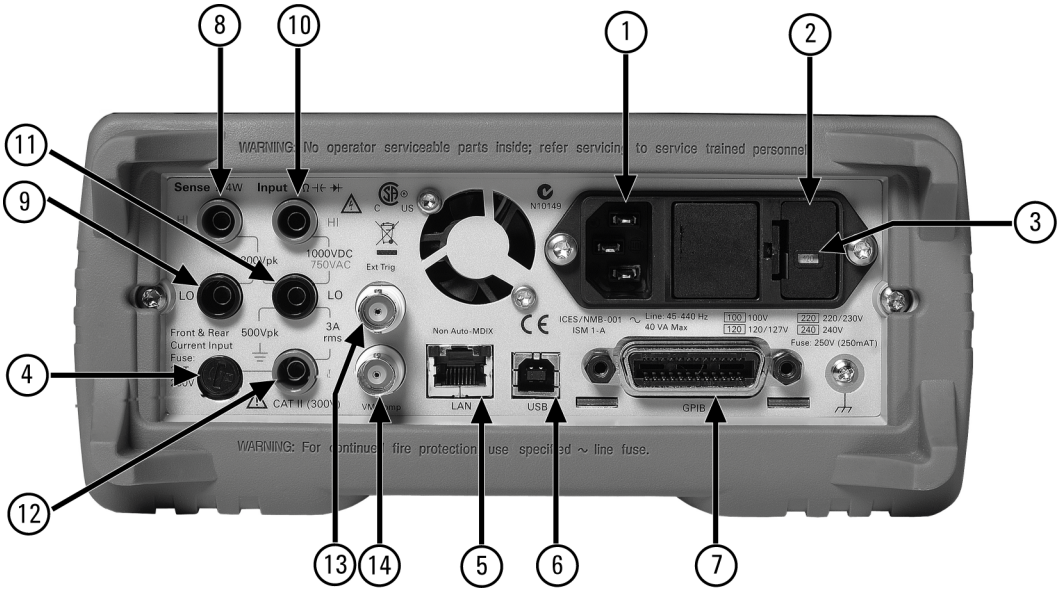


1	Multimeter On/Off Switch	13	DC Voltage measurement function key (*shifted function: DC Current*)
2	Front/Rear Terminal Selection Switch	14	AC Voltage measurement function key (*shifted function: AC Current*)
3	HI Sense Terminal (also 4-wire Ω)	15	2-wire Ohms measurement function key (*shifted function: 4-wire Ohms*)
4	LO Sense Terminal (also 4-wire Ω)	16	Second Display key (*shifted function: Multimeter Reset*)
5	HI Input terminal	17	Data Logger Function Key (*shifted function: Utility Menu*)
6	LO Input terminal	18	Exit key (*when not in a menu, also toggles Auto Range function on/off*)
7	Current Input terminal	19	Frequency/Period measurement function key (*shifted function: Capacitance*)
8	Left navigation key (< integration)	20	Continuity measurement function key (*shifted function: Diode Check*)
9	Right navigation key (> integration)	21	Configuration Menu key (*shifted function: Temperature*)
10	Up navigation key (> range)	22	Null function key (*shifted function: Math Menu*)
11	Down navigation key (< range)	23	Trigger key (*shifted function: Auto Trigger Menu*)
12	Enter key	24	Shift key (*also returns multimeter from remote to Local operation*)

WARNING

Front/Rear Switch: Do not change the position of the Front/Rear switch on the front panel while signals are present on either the front or rear set of terminals. This switch is not intended as an active multiplexer. Switching while high voltages or currents are present may cause instrument damage and lead to the risk of electric shock.

The Rear Panel at a Glance

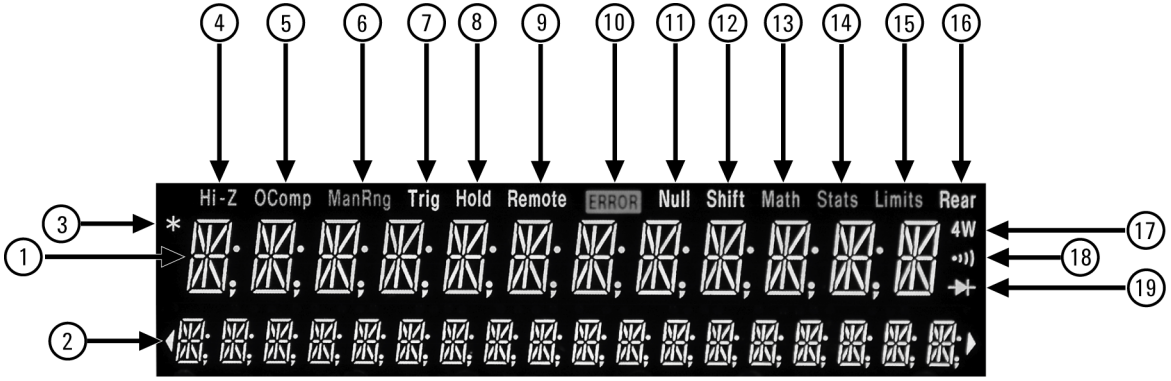


1	Power cord receptacle
2	Power-line fuse holder
3	Line voltage indicator
4	Current input fuse holder
5	LAN cable receptacle
6	USB cable receptacle
7	GPIB cable receptacle
8	HI Sense Terminal (also 4-wire Ω)
9	LO Sense Terminal (also 4-wire Ω)
10	HI Input terminal
11	LO Input terminal
12	Current Input terminal
13	External Trigger terminal
14	VM Comp (reading complete) terminal

WARNING

For protection from electrical shock, the power cord ground must not be defeated.

The Display at a Glance



1	Primary Display Line
2	Secondary Display Line
3	* Annunciator (on during a measurement)
4	**Hi-Z** (high input impedance) Annunciator
5	**OComp** (offset compensation) Annunciator
6	**ManRng** (manual ranging) Annunciator
7	**Trig** (wait-for-trigger state) Annunciator
8	**Hold** (reading hold) Annunciator
9	**Remote** (remote interface operation) Annunciator
10	**Error** (detected error) Annunciator
11	**Null** (null function enabled) Annunciator
12	**Shift** (shift key just pressed) Annunciator
13	**Math** (dB or dBm function enabled) Annunciator
14	**Stats** (statistics functions enabled) Annunciator
15	**Limits** (limit test function enabled) Annunciator
16	**Rear** Annunciator
17	**4W** (four-wire ohms or temperature) Annunciator
18	))) (continuity test function enabled) Annunciator
19	⊣▶⊢ (diode check function enabled) Annunciator

For a complete description of the front panel displays and annunciator indications, refer to the *Agilent 34410A/11A User's Guide*.

The following key refers to the primary front–panel display.

```
-H.DDD,DDD EFFF
```

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 (VDC, OHM, HZ, dB)

In This Guide...

1 Specifications

This chapter lists the multimeter's specifications and describes how to interpret these specifications.

2 Quick Start

This chapter prepares the multimeter for use and helps you get familiar with a few of the front panel features.

3 Calibration

This chapter provides calibration, verification, and adjustment procedures for the multimeter.

4 Disassembly and Repair

This chapter provides guidelines for returning the multimeter to Agilent Technologies for servicing, or for servicing it yourself. The chapter includes disassembly instructions and a list of replaceable parts.

5 Backdating

This chapter describes the differences between this guide and older versions of this guide.

Contents

1 Specifications

These specifications apply when using the 34410A/34411A multimeter in an environment that is *free* of electromagnetic interference and electrostatic charge.

When using the multimeter in an environment where electromagnetic interference or significant electrostatic charge *is* present, measurement accuracy may be reduced. *Particularly note:*

- The voltage measurement probes are not shielded and can act as antennas, causing electromagnetic interference to be added to the signal being measured.
- Electrostatic discharges of 4000 V or greater may cause the multimeter to temporarily stop responding, resulting in a lost or erroneous reading.

Note: Specifications are subject to change without notice. For the latest specifications, go to the Agilent 34410A/11A product page.

www.agilent.com/find/34401A

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme à la norme NMB-001 du Canada.

DC Characteristics

Accuracy Specifications (% of reading + % of range) [1]

Function	Range [3]	Test Current or Burden Voltage	24 Hour [2] T_{CAL} ± 1 °C	90 Day T_{CAL} ± 5 °C	1 Year T_{CAL} ± 5 °C	Temperature Coefficient 0 °C – (T_{CAL} – 5 °C) (T_{CAL} + 5 °C) – 55 °C
DC	100.0000 mV		0.0030+0.0030	0.0040+0.0035	0.0050+0.0035	0.0005+0.0005
	1.000000 V		0.0020+0.0006	0.0030+0.0007	0.0035+0.0007	0.0005+0.0001
	10.00000 V		0.0015+0.0004	0.0020+0.0005	0.0030+0.0005	0.0005+0.0001
	100.0000 V		0.0020+0.0006	0.0035+0.0006	0.0040+0.0006	0.0005+0.0001
	1000.000 V [5]		0.0020+0.0006	0.0035+0.0006	0.0040+0.0006	0.0005+0.0001
Resistance [4]	100.0000 Ω	1 mA Current Source	0.0030+0.0030	0.008+0.004	0.010+0.004	0.0006+0.0005
	1.000000 KΩ	1 mA	0.0020+0.0005	0.007+0.001	0.010+0.001	0.0006+0.0001
	10.00000 KΩ	100 µA	0.0020+0.0005	0.007+0.001	0.010+0.001	0.0006+0.0001
	100.0000 KΩ	10 µA	0.0020+0.0005	0.007+0.001	0.010+0.001	0.0006+0.0001
	1.000000 MΩ	5.0 µA	0.0020+0.0010	0.010+0.001	0.012+0.001	0.0010+0.0002
	10.00000 MΩ	500 nA	0.0100+0.0010	0.030+0.001	0.040+0.001	0.0030+0.0004
	100.0000 MΩ	500 nA || 10 M Ω	0.200+0.001	0.600+0.001	0.800+0.011	0.1000+0.0001
	1000.000 MΩ	500 nA || 10 M Ω	2.000+0.001	6.000+0.001	8.000+0.001	1.0000+0.0001
DC Current	100.0000 µA	<0.03 V Burden V	0.010+0.020	0.040+0.025	0.050+0.025	0.0020+0.0030
	1.000000 mA	<0.3 V	0.007+0.006	0.030+0.006	0.050+0.005	0.0020+0.0005
	10.00000 mA	<0.03 V	0.007+0.020	0.030+0.020	0.050+0.020	0.0020+0.0020
	100.0000 mA	<0.3 V	0.010+0.004	0.030+0.005	0.050+0.005	0.0020+0.0005
	1.000000 A	<0.80 V	0.050+0.006	0.080+0.010	0.100+0.010	0.0050+0.0010
	3.00000 A	<2.0 V	0.100+0.020	0.120+0.020	0.150+0.020	0.0050+0.0020
Continunity	1000 Ohms	1 mA Test Current	0.002+0.010	0.008+0.020	0.010+0.020	0.0010+0.0020
Diode Test	1.0000 V [6]	1 mA Test Current	0.002+0.010	0.008+0.020	0.010+0.020	0.0010+0.0020

[1] Specifications are for 1–hour warm–up and integration setting of 100 NPLC.
[2] Relative to calibration standards.
[3] 20% overrange on all ranges, except 1000 Vdc, 3 A range.
[4] Specifications are for 4–wire ohms function, or 2–wire ohms using Math Null. Without Math Null, add 0.2 Ω additional error in 2–wire ohms function.
[5] For each additional volt over ± 500 VDC add 0.02 mV of error.
[6] Accuracy specifications are for the voltage measured at the input terminals only. 1 mA test current is typical. Variation in the current source will create some variation in the voltage drop across a diode junction

Performance Versus Integration Time – 60Hz (50Hz) Power line frequency

Integration Time Number of Power Line Cycles (NPLC)	Resolution ppm Range [1]	NMR db [2]	Readings / Second [3]	RMS Noise adder % range [4] DCV 10, 1000 V	DCV 1, 100 V Resistance 1K, 10K ohm	DCV 0.1 V Resistance 100 ohm DCI 1 amp
0.001 [6]	30	0	50,000	0.0060	0.0100	0.1000
0.002 [6]	15	0	25,000	0.0030	0.0060	0.0600
0.006	6	0	10,000	0.0012	0.0040	0.0600
0.02	3	0	3000	0.0006	0.0030	0.0300
0.06	1.5	0	1000	0.0003	0.0020	0.0200
0.2	0.7	0	300	0.0002	0.0015	0.0150
1	0.3	55	60(50)	0.0	0.0001	0.0010
2	0.2	110 [5]	30(25)	0.0	0.0001	0.0010
10	0.1	110 [5]	6(5)	0.0	0.0	0.0005
100	0.03	110 [5]	0.6(0.5)	0.0	0.0	0.0

[1] Resolution is defined as the typical 10 VDC range RMS noise.
[2] Normal mode rejection for power–line frequency ± 0.1%.
[3] Maximum rate for DCV, DCI, and 2–Wire resistance functions (using zero settling delay, autozero off, etc.).
[4] Autozero on for => 1 NPLC.
[5] For power–line frequency ± 1% 75 dB and for ± 3% 55 dB.
[6] Only for 34411A.

Transfer Accuracy (Typical)

All DC volts, <0.12 A DC Current, < 1.2 MΩ: (24 hour % of range error) / 2)
All other DC current and resistance: (24 hour % of range error + % of reading)/2
Conditions:
- Within 10 minutes and ±0.5 °C
- Within ±10% of initial value.
- Following a 2–hour warm–up.
- Fixed range.
- Using >= 10.
- Measurements are made using accepted metrology practices.

DC Voltage

Measurement Method:	Continuously integrating multi–slope IV
10 VDC Linearity:	0.0002% of reading + 0.0001% of range
Input Resistance:	
0.1 V, 1 V, 10 V Ranges	Selectable 10 MΩ or >10 GΩ (For these ranges, inputs beyond ±17 V are clamped through 100 kΩ typical)
100 V, 1000 V Ranges	10 MΩ ±1%
Input Bias Current:	< 30 pA at 25 °C
Input Terminals:	Copper alloy
Input Protection:	1000 V
DC CMRR	140 dB for 1 kΩ unbalance in LO lead. ±500 VDC maximum

Resistance

Measurement Method:	Selectable 4–wire or 2–wire ohms.
Max. Lead Resistance (4–wire ohms)	10% of range per lead for 100 Ω, 1 kΩ ranges. 1 kΩ per lead on all other ranges
Input Protection:	1000 V on all ranges
Offset Compensation:	Selectable on the 100 Ω, 1 kΩ, and 10 kΩ ranges

DC Current

Shunt Resistor:	0.1Ω for 1 A, 3 A. 2 Ω for 10 mA, 100 mA. 200 Ω for 100 µA, 1 mA.
Input Protection:	Externally accessible 3 A, 250 V fuse

Continuity / Diode Test

Response Time:	300 samples / sec with audible tone
Continuity Threshold:	Fixed at 10 Ω

Autozero OFF Operation (Typical)

Following instrument warm–up at a stable ambient temperature ±1 °C and <5 minutes.
Add 0.0002% of range + 2 µV for DCV or + 2 mΩ for resistance.

Settling Considerations

Reading settling times are affected by source impedance, cable dielectric characteristics, and input signal changes. Default delays are selected to give first reading right for most measurements.

Measurement Considerations

Agilent recommends the use of Teflon or other high–impedance, low–dielectric absorption wire insulation for these measurements.

AC Characteristics

Accuracy Specifications (% of reading + % of range) [1]

Function	Range [3]	Frequency Range	24 Hour [2] T_{CAL} ± 1 °C	90 Day T_{CAL} ± 5 °C	1 Year T_{CAL} ± 5 °C	Temperature Coefficient 0 °C – (T_{CAL} – 5 °C) (T_{CAL} + 5 °C) – 55 °C
True RMS AC Voltage [4]	100.0000 mV	3 Hz – 5 Hz	0.50 + 0.02	0.50 + 0.03	0.50 + 0.03	0.010 + 0.003
	to	5 Hz – 10 Hz	0.10 + 0.02	0.10 + 0.03	0.10 + 0.03	0.008 + 0.003
	750.000 V	10 Hz – 20 kHz	0.02 + 0.02	0.05 + 0.03	0.06 + 0.03	0.005 + 0.003
		20 kHz – 50 kHz	0.05 + 0.04	0.09 + 0.05	0.10 + 0.05	0.010 + 0.005
		50 kHz – 100 kHz	0.20 + 0.08	0.30 + 0.08	0.40 + 0.08	0.020 + 0.008
		100 kHz – 300 kHz	1.00 + 0.50	1.20 + 0.50	1.20 + 0.50	0.120 + 0.020
True RMS AC Current [5]	100.0000µA	3 Hz – 5 kHz	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.015 + 0.006
	to 3.00000A	5 kHz – 10 kHz	0.20 + 0.04	0.20 + 0.04	0.20 + 0.04	0.030 + 0.006

[1] Specifications are for 1–hour warm–up, slow ac filter, sinewave.
[2] Relative to calibration standards.
[3] 20% overrange on all ranges, except 750 Vac, 3 A range.
[4] Specifications are for sinewave input >0.3% of range and > 1mVrms.
Add 30 μV error to AC voltage specification for frequencies < 1kHz.
750 VAC range limited to 8 x 10^7 Volt–Hz.
750 VAC range add 0.7 mV of error for each additional volt over 300 VAC.
[5] Specifications are for sinewave input >1% of range and > 10uArms.
Frequencies > 5 kHz are typical for 1.0 A and 3.0 A ranges.
For 3.0 A range add 0.05 + 0.02.

Low Frequency Performance

Three filter settings are available: 3 Hz, 20 Hz, 200Hz.
Frequencies greater than these filter settings are specified with no additional errors.

AC Current Burden Voltage

ACI Ranges	Voltage
100.0000 uA	<0.03 V
1.000000 mA	<0.3 V
10.00000 mA	<0.03 V
100.0000 mA	<0.3 V
1.000000 A	<0.8 V
3.00000 A	<2.0 V

Voltage Transfer Accuracy (typical)

Frequency	Error
10 Hz to 300 kHz	(24 hour % of range + % of reading)/5
Conditions:	- Sinewave input only using slow filter. - Within 10 minutes and ±0.5 °C. - Within ±10% of initial voltage and ±1% of initial frequency. - Following a 2–hour warm–up. - Fixed range between 10% and 100% of full scale (and <120 V). - Measurements are made using accepted metrology practices

True RMS AC Voltage

Measurement Type	AC–coupled True RMS. Measures the AC component of the input.
Measurement Method:	Digital sampling with anti–alias filter.
AC Common Mode Rejection	70 dB For 1 kΩ unbalanced in LO lead and <60 Hz. ±500 V peak maximum.
Maximum Input:	400 Vdc, 1100 Vpeak
Input Impedance:	1 MΩ ± 2%, in parallel with <150 pF
Input Protection:	750 V rms all ranges

True RMS AC Current

Measurement Type:	Directly coupled to the fuse and shunt. AC–coupled True RMS measurement (measure the AC component only).
Measurement Method:	Digital sampling with anti–alias filter.
Maximum Input:	The peak value of the DC + AC current must be <300% of range. The RMS current <3 A including the DC current content.
Shunt Resistor:	0.1 Ω for 1A, 3A, 2 Ω for 10 mA 100 mA, 200 Ω for 100 uA, 1 mA
Input Protection:	Externally accessible 3A, 250 V fuse

Crest Factor and Peak Input

Crest Factor:	For <10:1 errors included. Limited by peak input and 300 kHz bandwidth.
Peak Input:	300% of Range. Limited by maximum input
Overload Ranging	Will select higher range if peak input overload is detected during auto range. Overload is reported in manual ranging.

Settling Considerations

Default delays are selected to give first reading right for most measurements. The input blocking RC time constant must be allowed to fully settle before the most accurate measurements are possible

Frequency and Period Characteristics

Accuracy Specifications (% of reading) [1, 3]

Function	Range	Frequency Range	24 Hour [2] $T_{CAL}C \pm 1$ °C	90 Day $T_{CAL} \pm 5$ °C	1 Year $T_{CAL} \pm 5$ °C	Temperature Coefficient 0 °C – (T_{CAL} – 5 °C) (T_{CAL} + 5 °C) – 55 °C
Frequency Period	100 mV to 750 V	3 Hz – 5 Hz	0.07	0.07	0.07	0.005
		5 Hz – 10 Hz	0.04	0.04	0.04	0.005
		10 Hz – 40 Hz	0.02	0.02	0.02	0.001
		40 Hz – 300 kHz	0.005	0.006	0.007	0.001

Additional Errors (% of reading) [3]

	Aperture (resolution / range			
Frequency	1 Second (0.1 ppm)	0.1 Second (1 ppm)	0.01 Second (10 ppm)	0.001 Second (100 ppm)
3 Hz – 5 Hz	0	0.11	0.11	0.11
5 Hz – 10 Hz	0	0.14	0.14	0.14
10 Hz – 40 Hz	0	0.16	0.16	0.16
40 Hz – 300 kHz	0	0.045	0.17	0.17

[1] Specifications are for 1–hour warm–up, using 1 second aperture.
[2] Relative to calibration standards.
[3] For AC input voltages 10% to 120% of range except where noted. 750 V range limited to 750 Vrms. 100 mV range specifications are for full scale or greater inputs. For inputs from 10 mV to 100 mV, multiply total % of reading error by 10.

Transfer Accuracy (typical) 0.0003% of reading

Conditions:
- Within 10 minutes and ± 0.5 °C.
- Within ±10% of initial voltage and ± 1% of initial frequency.
- Following a 2–hour warm–up.
- For inputs > 1 kHz and > 100 mV
- Using 1 second gate time
- Measurements are made using accepted metrology practices.

Frequency and Period

Measurement Type:	Reciprocal–counting technique. AC–coupled input using the AC voltage measurement function.
Input Impedance:	1 MΩ ±2%, in parallel with <150 pF
Input Protection:	750 V rms all ranges

Measurement Considerations

All frequency counters are susceptible to error when measuring low–voltage, low–frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors.

Settling Considerations

Errors will occur when attempting to measure the frequency or period of an input following a dc offset voltage change. The input blocking RC time constant must be allowed to fully settle (up to 1 sec.) before the most accurate measurements are possible.

Capacitance Characteristics

Accuracy Specifications (% of reading + % of range) [1]

Function	Range [2]	Test Current	1 Year 23 °C ± 5 °C	Temperature Coefficient 0 °C – (T_{CAL} – 5 °C) (T_{CAL} + 5 °C) – 55 °C
Capacitance	1 nF	500 nA	0.50 + 0.50	0.05 + 0.05
	10 nF	1 µA	0.40 + 0.10	0.05 + 0.01
	100 nF	10 µA	0.40 + 0.10	0.01 + 0.01
	1 µF	100 µA	0.40 + 0.10	0.01 + 0.01
	10 µF	1 mA	0.40 + 0.10	0.01 + 0.01

[1] Specifications are for 1–hour warm–up using Math Null. Measurement Method: Current input with measurement of resulting ramp. Additional errors may occur for non–film capacitors.

[2] Specifications are for 1% to 120% of range on the 1 nF range and 10% to 120% of range on all other ranges.

Capacitance

Measurement Type: Current input with measurement of resulting ramp.

Connection Type: 2 Wire

Temperature Characteristics

Accuracy Specifications (% of reading + % of range) [1]

Function	Probe Type	R_0	Best Range	1 Year	Temperature Coefficient
Temperature	RTD	from 49 Ω to 2.1 kΩ	–200 °C to 600 °C	0.06 °C	0.003 °C
	Thermistor	N/A	–80 °C to 150 °C	0.08 °C	0.002 °C

[1] For total measurement accuracy, add temperature probe error

Measurement and System Speeds

DMM Measurements Speeds

Function	Resolution (NPLC)	Direct I/O Measurements [1] Single Reading – Measure and I/O Time GPIB Sec	USB 2.0 Sec	LAN (VXI-11) Sec	LAN (Sockets) Sec	Measurement Into Memory (Readins/Sec) (VM Complete)
DCV (10 V Range)	0.006	0.0030	0.0036	0.0050	0.0035	10000
	0.06	0.0035	0.0044	0.0048	0.0043	1000
	1	0.0200	0.0200	0.0200	0.0200	60
ACV (10 V Range)	Slow Filter	0.0100	0.0100	0.0100	0.0100	50
	Medium Filter	0.0100	0.0100	0.0100	0.0100	150
	Fast Filter	0.0100	0.0100	0.0100	0.0100	500
2–Wire Ω (10 kΩ Range)	0.006	0.0035	0.0036	0.0049	0.0035	10000
	0.06	0.0043	0.0045	0.0049	0.0043	1000
	1	0.0195	0.0200	0.0200	0.0200	60
4–wire Ω (10 kΩ Range)	0.006	0.0054	0.0040	0.0045	0.0056	1200
	0.06	0.0074	0.0078	0.0078	0.0074	380
	1	0.0390	0.0390	0.0390	0.0390	30
Frequency 1 KHz, 10 V Range Fast Filter	1 ms Gate	0.0100	0.0100	0.0100	0.0100	500
	10 mS Gate	0.0200	0.0200	0.0200	0.0200	80
	100 mS Gate	0.1150	0.1150	0.1130	0.1130	10
	1 S Gate	1.0200	1.0200	1.0200	1.0200	1
Capacitance (100 nF Rage)		0.0820	0.0820	0.0820	0.0820	11

[1] ½ scale input signal, immediate trigger, trigger delay 0, autozero off, autorange off, no math, 60 Hz line, null off, sample count 1, trig count 1

Direct I/O Measurements [1] (any remote interface)
Sustained maximum reading rate to I/O, 32–bit BINARY data ("SAMP:COUN 50000;:R?")

Function	Resolution (NPLC)	rdgs/Sec
DCV	0.006	10000
ACV	Fast Filter	500
2–Wire Ω	0.006	10000
4–Wire Ω	0.006	1200
Frequency/Period (1 k rdgs)	1 mS gate, fast filter	450
Capacitance (100 rdgs)		10

[1] ½ scale input signal, immediate trigger, trigger delay 0, autozero off, autorange off, no math, 60 Hz line, null off, sample count 50000, trig count 1

Data From Memory

Maximum reading rate out of memory
(Sample count 50000, trigger count 1, "FETC?" or "R?")

Readings	GPIB rdg/Sec	USB 2.0 rdg/Sec	LAN (VXI-11) rgs/Sec	LAN (Sockets) rdg/Sec
ASCII	2850	2000	4800	4000
4–byte Binary	89,000	265,000	110,000	270,000
8–byte Binary	47,000	154,000	60,000	160,000

System Speeds

	Configuration [2] (Sec)	Range [3] Change (Sec)	Auto Range [4] (Sec)	Maximum External Trigger Rate [1]	Maximum Internal Trigger Rate [1]
DCV	0.022	0.0055	0.0075	5000 /S	10000 / S
ACV	0.037	0.0065	0.019	500 / S	500 / S
2/4–Wire Ω	0.022	0.0055	0.0075	5000 / S	10000 / S
Frequency/Period	0.037	0.0065	0.019	500 / S	500 / S

[1] Readings to memory.

[2] Time for configuration change from 2W ohms to listed function (or from dc volts to 2W ohms) using appropriate FUNCtion command.

[3] Time to change from one range to next higher range, <=10V, <=10Mohm.

[4] Time to automatically change one range and be ready for new measurement, <=10V, <=10Mohm.

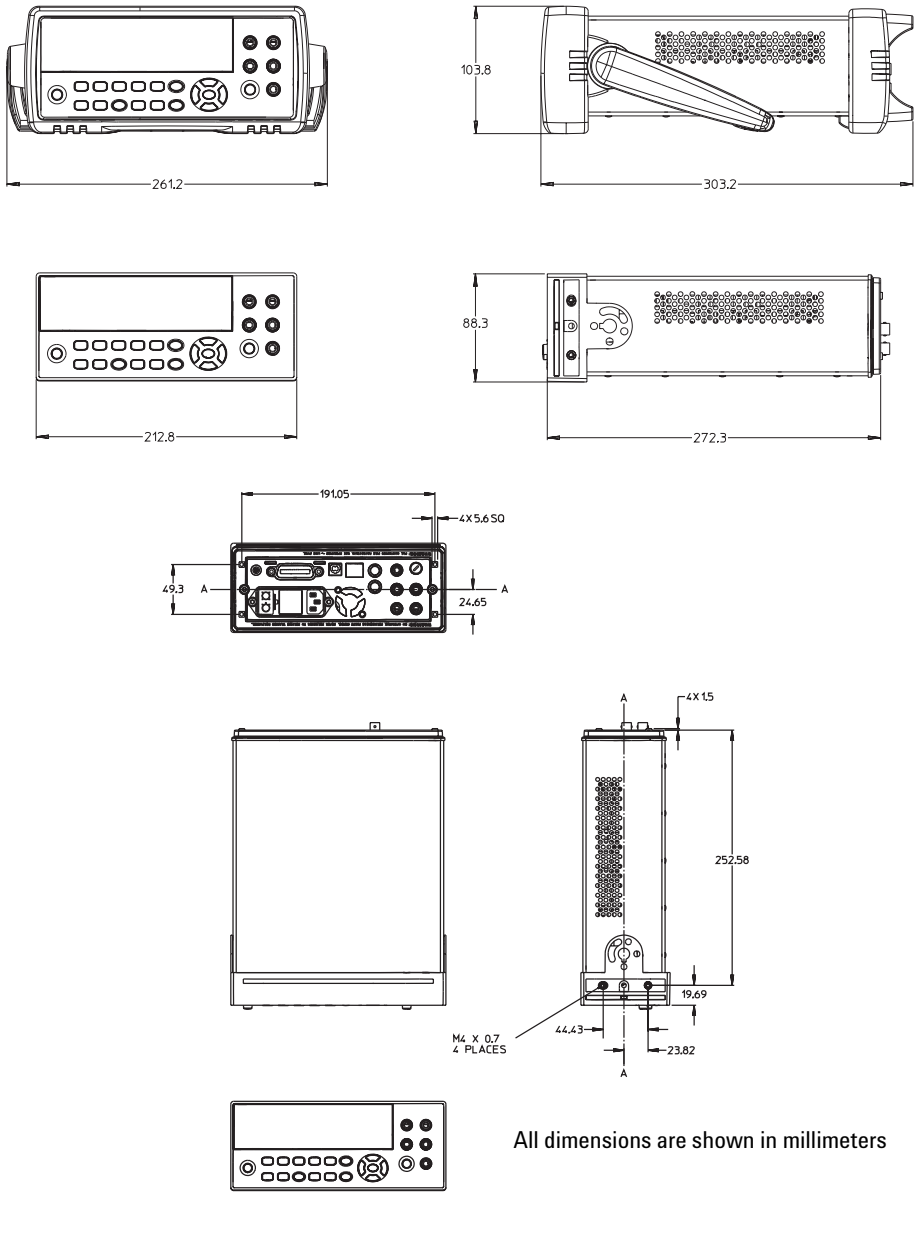
General Specifications

Power Supply:	100V/120V/ 220V / 240V ± 10%
Power Line Frequency:	50–60 Hz ± 10%, 400 Hz ± 10%. Automatically sensed at power–on, 400 Hz defaults to 50Hz.
Power Consumption:	25 VA peak (16 W average)
Operating Environment:	Full accuracy for 0 °C to 55 °C Full accuracy to 95% R.H. at 40 °C Non–condensing
Storage Temperature	–40 °C to 70 °C
Operating Altitude	Up to 3000m
Rack Dimensions (WxHxD):	212.8mm x 88.3mm x 272.3mm
Bench Dimensions (WxHxD):	261.2mm x 103.8mm x 303.2mm
Weight:	3.72 kg (8.2 lbs)
Safety:	IEC 61010-1 EN 61010-1 UL 61010-1 CAN/CSA-C22.2 No. 61010-1 Refer to Declaration of Conformity for current revisions. Measurement CAT II 300V, CAT I 1000V Pollution Degree 2
EMC:	IEC 61326 EN 61326 CISPR 11 ICES-001 AS/NZS 2064.1 Refer to Declaration of Conformity for current revisions.
Vibration & Shock:	MIL-T-28800, type III, Class 5
Acoustic Noise	37 dBa
Display:	Dual–line, 17–segment vacuum florescent display
State Storage Memory	Power Off state automatically saved, 4 User Configurable Stored States
Remote Interfaces	GPIB IEEE–488, 10/100Mbit LAN, USB 2.0 Standard
Language	SCPI – 1999, IEEE–488.2
LXI Compliance	Level C without auto–MDIX
Warm–up Time	1 hour

Triggering and Memory

Reading Hold Sensitivity:	1% of reading
Samples per Trigger:	1 to 50,000
Trigger Delay:	0 to 3600 sec (20 μs step size)
External Trigger	Low–power TTL compatible input programmable edge triggered
Delay:	< 1us
Jitter:	< 1us
Max rate	up to 5 kHz
Min Pulsewidth	1 us
Voltmeter Complete	3 V Logic output
Polarity	Programmable edge pulse
Pulsewidth	Approximately 2 μs
Non–volatile Memory	50,000 reading
Sample Timer	
Range	Up to 3600 sec in 20 μs steps
Jitter	< 100 ns

Dimensions



All dimensions are shown in millimeters

To Calculate Total Measurement Error

The multimeter's accuracy specifications are expressed in the form: (% of reading + % of range). In addition to the reading error and range error, you may need to add additional errors for certain operating conditions. Check the list below to make sure you include all measurement errors for a given function. Also, make sure you apply the conditions as described in the footnotes on the specification pages.

- If you are operating the multimeter outside the temperature range specified, apply an additional temperature coefficient error.
- For dc voltage, dc current, and resistance measurements, you may need to apply an additional reading speed error or autozero OFF error.
- For ac voltage and ac current measurements, you may need to apply an additional low frequency error or crest factor error.

Understanding the " % of reading " Error The reading error compensates for inaccuracies that result from the function and range you select, as well as the input signal level. The reading error varies according to the input level on the selected range. This error is expressed in percent of reading. The following table shows the reading error applied to the multimeter's 24–hour dc voltage specification.

Range	Input Level	Reading Error (% of reading)	Reading Error (Voltage)
10 VDC	10 VDC	0.0015	±150 μV
10 VDC	1 VDC	0.0015	±15 μV
10 VDC	0.1 VDC	0.0015	±1.5 μV

Understanding the " % of range " Error The range error compensates for inaccuracies that result from the function and range you select. The range error contributes a constant error, expressed as a percent of range, independent of the input signal level. The following table shows the range error applied to the multimeter's 24–hour dc voltage specification.

Range	Input Level	Range Error (% of range)	Range Error (Voltage)
10 VDC	10 VDC	0.0004	±40 μV
10 VDC	1 VDC	0.0004	±40 μV
10 VDC	0.1 VDC	0.0004	±40 μV

Total Measurement Error To compute the total measurement error, add the reading error and range error. You can then convert the total measurement error to a "percent of input" error or a "ppm (parts–per–million) of input" error as shown below.

$$\%\ of\ input\ error = \frac{\text{Total Measurement Error}}{\text{Input Signal Level}} \times 100$$

$$ppm\ of\ input\ error = \frac{\text{Total Measurement Error}}{\text{Input Signal Level}} \times 1{,}000{,}000$$

Error Example Assume that a 5 VDC signal is input to the multimeter on the 10 V range. Compute the total measurement error using the 90–day accuracy specifications: ± (0.0020% of reading + 0.0005% of range).

Reading Error = 0.0020% x 5 VDC = 100 μV

Reading Error = 0.0020% x 5 VDC = 100 μV

Total Error = 100 μV + 50 μV = ±150 μV
= ±0.003% of 5 VDC
= ±30 ppm of 5 VDC

Accuracy Specifications

Transfer Accuracy

Transfer accuracy refers to the error introduced by the multimeter due to noise and short–term drift. This error becomes apparent when comparing two nearly–equal signals for the purpose of "transferring" the known accuracy of one device to the other.

24–Hour Accuracy

The 24–hour accuracy specification indicates the multimeter's relative accuracy over its full measurement range for short time intervals and within a stable environment. Short–term accuracy is usually specified for a 24–hour period and for a ±1 °C temperature range.

90–Day and 1–Year Accuracy

These long–term accuracy specifications are valid for a 23 °C ± 5 °C temperature range. These specifications include the initial calibration errors plus the multimeter's long–term drift errors.

Temperature Coefficients

Accuracy is usually specified for a 23 °C ± 5 °C temperature range. This is a common temperature range for many operating environments. You must add additional temperature coefficient errors to the accuracy specification if you are operating the multimeter outside a 23 °C ± 5 °C temperature range (the specification is per °C).

Configuring for Highest Accuracy Measurements

The measurement configurations shown below assume that the multimeter is in its power–on or reset state. It is also assumed that auto–ranging is enabled to ensure proper full scale range selection.

DC Voltage, DC Current, and Resistance Measurements:

- Select NPLC and 100 (NPLCs) for INTEGRATION.
- Set INPUT Z to HI–Z (for the 100 mV, 1 V, and 10 V ranges) for the best dc voltage accuracy.
- Use the 4–wire ohms function (Ω 4W) for the best resistance measurement accuracy.
- For 2–wire ohms, dc voltage and dc current measurements, set AUTOZERO to ON to remove thermal EMF and offset errors.
- Null the test lead resistance for 2–wire ohms measurements, and to remove any interconnection offset for dc voltage measurements.

AC Voltage and AC Current Measurements:

- Set the AC FILTER to 3 Hz: SLOW.

Frequency and Period Measurements:

- Set the GATE TIME to 1 sec.

1 Specifications

2 Quick Start

This chapter is provided to help you become acquainted with the front panel and basic metering functions.

To Prepare the Multimeter for Use

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

1 Check the list of supplied items.

Verify that you have received the following items with your multimeter. If anything is missing, contact your nearest Agilent Sales Office.

- One test lead set.
- One power cord.
- One USB 2.0 cable
- *Product Reference* CD–ROM.
- *Agilent Automation Ready* (IO Libraries) CD–ROM.
- One folded *Quick Reference Card*.
- *Certificate of Calibration*.

The product documentation, including the *Programmer's Reference Help* and the product manuals, are included on the *Product Reference* CD–ROM. Printed (hardcopy) manuals are optional, and included only if you ordered them.

2 Connect the power cord and turn on the multimeter.

The front–panel display will light up while the multimeter performs its power–on self–test. The multimeter powers up in the dc voltage function with autoranging enabled (unless a previous user has configured power–up using a non–default stored state (refer to the *Agilent 34410A/11A User's Guide*).

Basic Measurement Operation

Each of the next several subsections will introduce a type of measurement and showe front–panel connections. **Basic measurements can be taken with the factory default settings.** A more complete description of all multimeter functions, measurement parameter configuration and remote interface operation can be found in the *Agilent 34410A/11A User's Guide*. Some basics of operation follow:

Test Lead Connections

For each measurement, connect the leads as shown. The arrangement of the test lead connections illustrated are the same for the front or rear terminals.

Before making test lead connections, press the **Front/Rear** button in to use the rear terminals, or leave it extended to use the front terminals.

WARNING **Do not change the position of the Front/Rear button on the front panel while signals are present on either the front or rear set of terminals. Switching while high voltages or currents are present may cause instrument damage, and increase the risk of electric shock.**

Front Panel Keys

The front panel has two rows of keys to select various functions and operations. Pressing a measurement function key (e.g. DC V) selects that function. Press Config to enter the configuration menu for the selected measurement function.

Most keys have a shifted function printed in blue above the key. To perform a shifted function, press Shift. Then, press the key that has the desired label above it.

To view menu selections, use the navigation keypad (i.e. the ◀ or ▶ keys. The current (or default) selection is displayed in **FULL BRIGHTNESS**. All other choices are displayed in HALF BRIGHTNESS. The selections on each menu level scroll, but do not wrap. Arrow annunciators on the second display line indicate additional selections to the left or right. To *select* a choice, press Enter.

To set numeric parameters, use ◀ or ▶ to select a digit, and ▲ or ▼ to increase or decrease that digit.

Front–Panel Display Shortcuts

Direct front–panel shortcuts are provided for three commonly used display functions: ranging, digit masking and integration time.

Ranging The multimeter's manual range can be set directly from the navigation keypad.

- To manually change the current multimeter range, press ▲ or ▼. The **ManRng** annunciator will light, and the selected range (e.g. 100mV RANGE) will be briefly displayed on the second line.

Digit Masking The navigation keypad provides a shortcut to mask (change the number of digits displayed) the reading on the main display, easing readability.

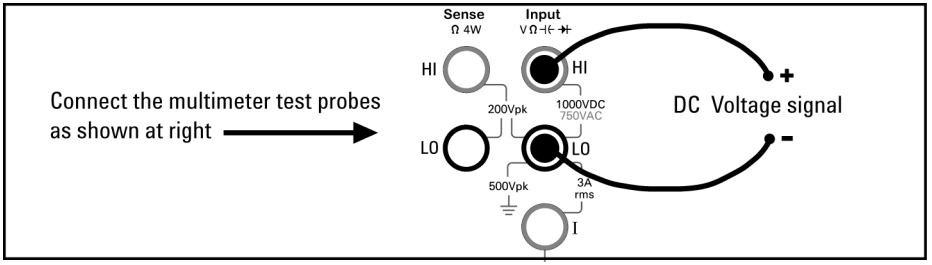
- To enable digit masking during any measurement function, press Shift ◀ or Shift ▶. DIGIT MASK will be displayed, along with a list of choices (3.5, 4.5, 5.5, 6.5 and AUTO) on the secondary display line. Press ◀ or ▶ to scroll through and select one of these settings, then press Enter.

Integration Time (Bandwidth, Gate Time) Four measurement functions allow you to select the multimeter's integration time: dc voltage, dc current, resistance, and temperature. The ac voltage and current measurements allow you to select the ac signal filter (bandwidth). The frequency/period function allows you to select gate time. The navigation keypad provides a shortcut for quickly changing these settings.

- If the multimeter is configured to take the measurement using an integration time in *NPLCs*, pressing ◀ or ▶ during front panel measurement operations will increase or decrease the integration time setting.
- If either the ac voltage or ac current measurement function is selected, pressing ◀ or ▶ during front panel measurement operations will increase or decrease the bandwidth setting.
- If the frequency/period measurement function is selected, pressing ◀ or ▶ during front panel measurement operations will increase or decrease the gate time setting.

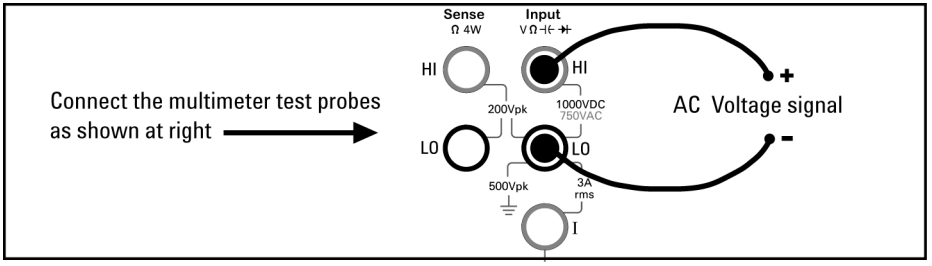
To Measure DC Voltage

- Ranges: 100 mV, 1 V, 10 V, 100 V, 1000 V
- Maximum resolution: 100 nV (*on 100 mV range*)
- Configurable parameters: INTEGRATION, RANGE, INPUT Z (input impedance), AUTO ZERO, NULL, and NULL VALUE



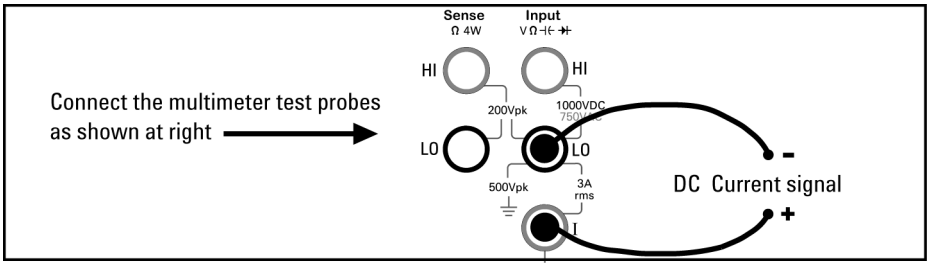
To Measure AC Voltage

- Ranges: 100 mV, 1 V, 10 V, 100 V, 750 V
- Maximum resolution: 100 nV (*on 100 mV range*)
- Resolution: Fixed at 6 1/2 digits
- AC Technique: true–RMS, ac–coupled
- Configurable parameters: AC FILTER, RANGE, NULL and NULL VALUE



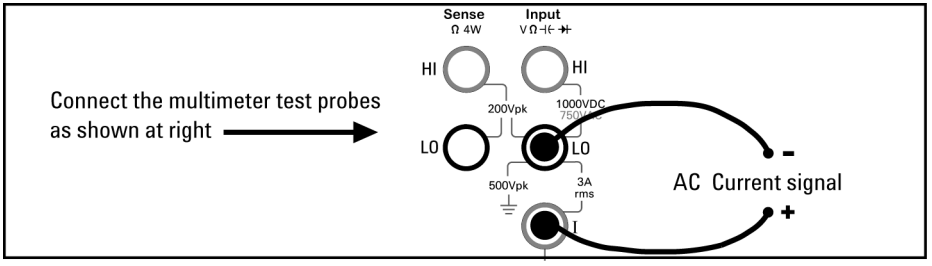
To Measure DC Current

- Ranges: 100 µA, 1 mA, 10 mA, 100 mA, 1A, 3A
- Maximum resolution: 10 nA (*on 100 µA range*)
- Configurable parameters: INTEGRATION, RANGE, AUTO ZERO, NULL, and NULL VALUE



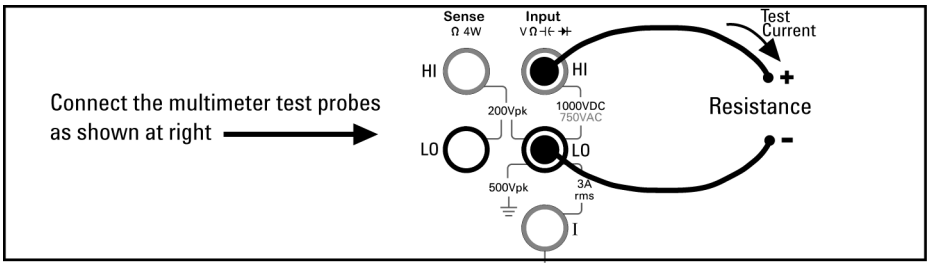
To Measure AC Current

- Ranges: 100 µA, 1 mA, 10 mA, 100 mA, 1A, 3A
- Maximum resolution: 100 nV (*on 100 mV range*)
- Resolution: Fixed at 6 1/2 digits
- AC Technique: true–RMS, ac–coupled
- Configurable parameters: AC FILTER, RANGE, NULL and NULL VALUE



To Make a 2–Wire Resistance Measurement

- Ranges: 100Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ, 10 MΩ, 100 MΩ
- Maximum resolution: 100 μΩ (*on 100Ω range*)
- Configurable parameters: INTEGRATION, RANGE, OFFSET COMP, AUTO ZERO, NULL, and NULL VALUE

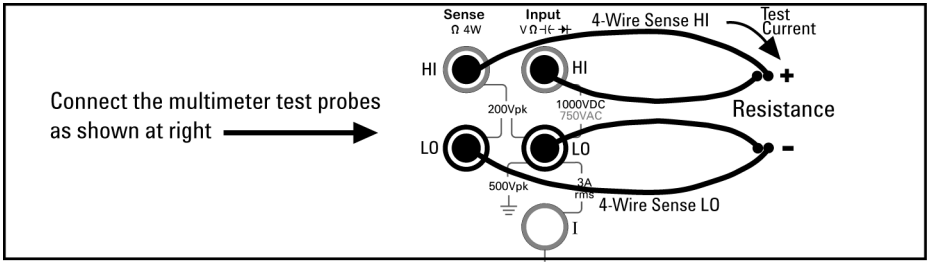


To null–out the test lead resistance:

1. Connect one end of the test leads at the meter, and short the probe ends together.
2. Press null.
3. Connect the probe ends to the test circuit, and measure the corrected resistance value.

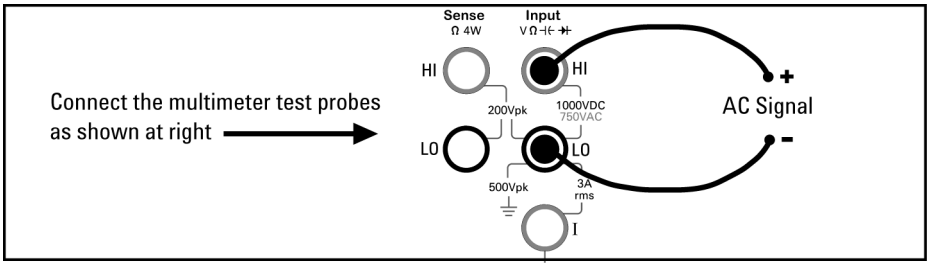
To Make a 4–wire Resistance Measurement

- Ranges: 100Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ, 10 MΩ, 100 MΩ
- Maximum resolution: 100 μΩ (*on 100Ω range*)
- Configurable parameters: INTEGRATION, RANGE, OFFSET COMP, AUTO ZERO, NULL, and NULL VALUE



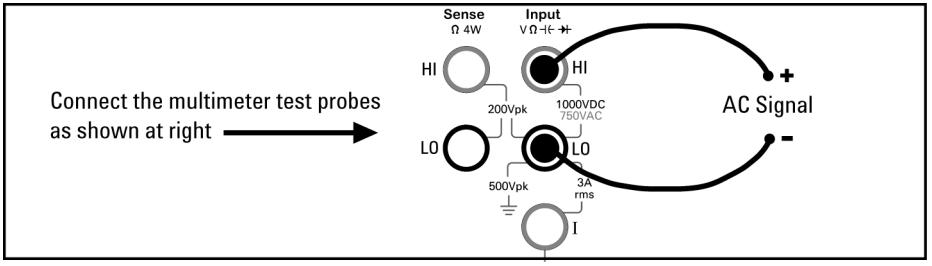
To Measure Frequency

- Measurement band: 3Hz to 300 kHz (0.33 sec to 3.3 μsec)
- Input signal range: 100 mVAC to 750 VAC
- Maximum resolution:
  - 0.1 ppm for 1 sec gate time
  - 1 ppm for 100 ms gate time
  - 10 ppm for 10 ms gate time
  - 100 ppm for 1 ms gate time
- Technique: reciprocal counting
- Configurable parameters: GATE TIME, RANGE, AC FILTER, NULL and NULL VALUE



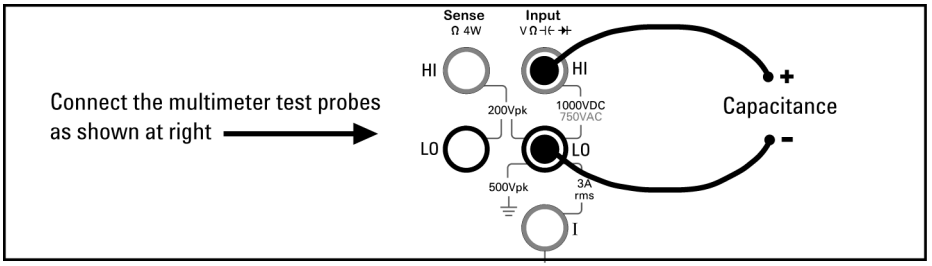
To Measure Period

- Measurement band: (0.33 sec to 3.3 μsec)
- Input signal range: 100 mVAC to 750 VAC
- Maximum resolution:
  - 0.1 ppm for 1 sec gate time
  - 1 ppm for 100 ms gate time
  - 10 ppm for 10 ms gate time
  - 100 ppm for 1 ms gate time
- Technique: reciprocal counting
- Configurable parameters: GATE TIME, RANGE, AC FILTER, NULL and NULL VALUE



To Measure Capacitance

- Ranges: 1 nF, 10 nF, 100 nF, 1 μF, 10 μF
- Maximum resolution: 100 pF (*on 1 nF range*)
- Configurable parameters: RANGE, NULL, and NULL VALUE

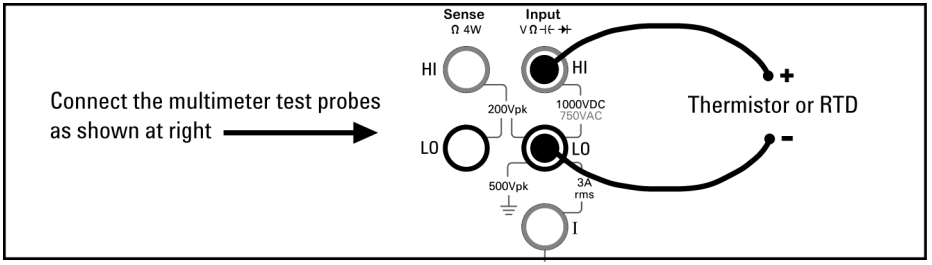


To null–out the test lead capacitance:

1. Disconnect the + lead's probe end from the test circuit, and leave open.
2. Press null.
3. Reconnect the + lead's probe end to the test circuit, and measure the corrected capacitance value.

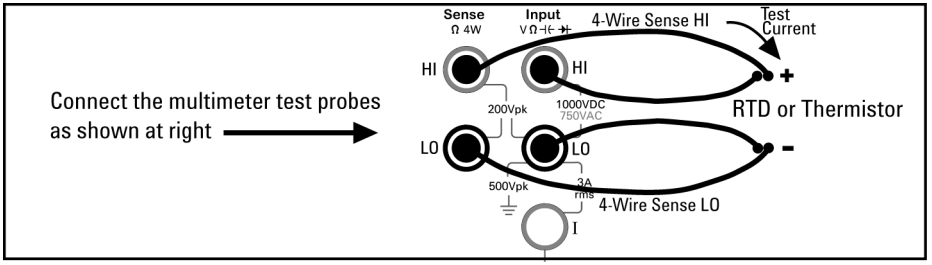
To Make a 2-Wire Temperature Measurement

- Probe types: 2.2 kΩ, 5 kΩ, 10 kΩ thermistors; 0.00385%/ºC RTD
- Maximum resolution: 0.001° for RTDs; 0.01° for thermistors
- Configurable parameters: PROBE TYPE, THERMISTOR or RTD value, AUTO ZERO (2–wire thermistor probes only), OFFSET COMP (*RTD probes only*), INTEGRATION, NULL, NULL VALUE, and UNITS



To Make a 4-Wire Temperature Measurement

- Probe types: 2.2 kΩ, 5 kΩ, 10 kΩ thermistors; 0.00385%/ºC RTD
- Maximum resolution: 0.001° for RTDs; 0.01° for thermistors
- Configurable parameters: PROBE TYPE, THERMISTOR or RTD value, OFFSET COMP (*RTD probes only*), INTEGRATION, NULL, NULL VALUE, and UNITS



Other Basics of Operation

If the Multimeter Does Not Turn On

Use the following steps to help solve problems you might encounter when turning on the multimeter. If you need more help, see the *Service Guide* for instructions on returning the multimeter to Agilent for service.

1 Verify that there is ac power to the multimeter.

First, verify that the multimeter's Power switch is in the "On" position. Also, make sure that the power cord is firmly plugged into the power module on the rear panel. You should also make sure that the power source you plugged the multimeter into is energized.

2 Verify the power–line voltage setting.

The line voltage is set to the proper value for your country when the multimeter 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 "To Replace the Power Line Fuse" on page 48 if you need to change the line–voltage setting.

3 Verify that the power–line fuse is good.

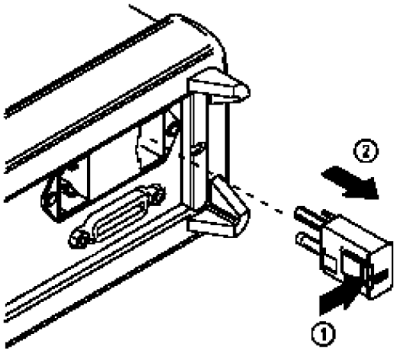
The multimeter is shipped from the factory with a power–line fuse installed. The supplied fuse is a **250 mAT, 250V, slow–blow, 5x20mm fuse**, **Agilent part number 2110–0817**. If you determine that the fuse is faulty, replace it with one of the same size and rating.

See "To Replace the Power Line Fuse" on page 48 if you need to replace the power–line fuse.

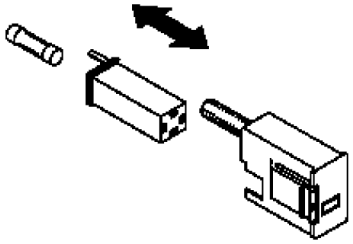
The *current input path* is also fused. The supplied fuse is a **3 AT, 250V, slow–blow, 5x20mm fuse**, **Agilent part number 2110–0780,** and is housed in a standard screw–in fuse holder on the left side of the rear panel. If you determine that the fuse is faulty, replace it with one of the same size and rating.

To Replace the Power Line Fuse

1 Remove the power cord. Then depress tab ① and pull fuse holder ② from the rear panel.

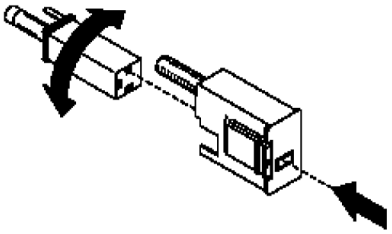


2 Remove the line voltage selector from the fuse holder assembly.

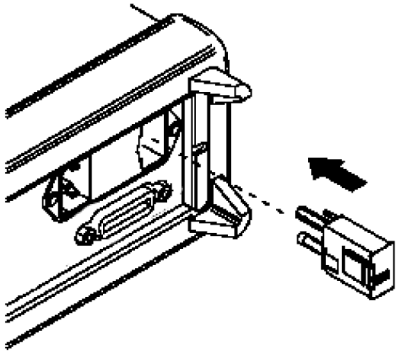


Agilent Part Number 2110-0817
(250 mAT, 250V, slow-blow, 5x20mm)

3 Rotate the line-voltage selector, and reinstall so the correct voltage appears in the fuse holder window.



4 Replace the fuse holder assembly in the rear panel.

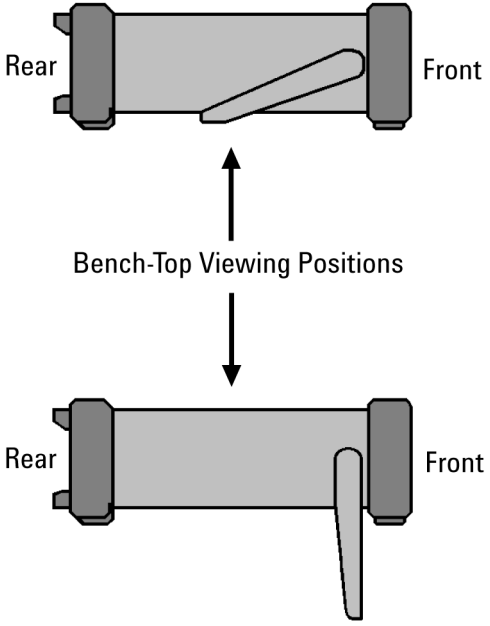


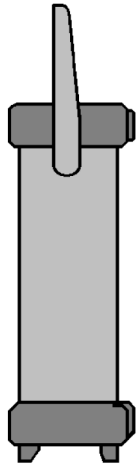
Verify that the correct line voltage is selected and the power line fuse is good.

NOTE For multimeter operations with a 230 VAC supply, set the line–voltage selector to 220V.

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.



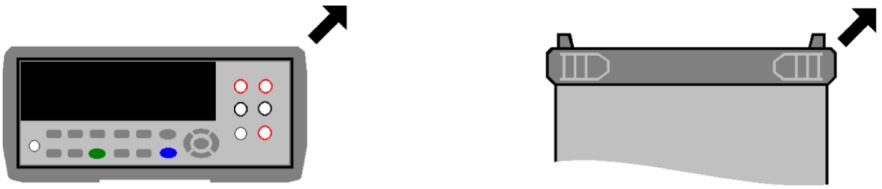


Carrying Position

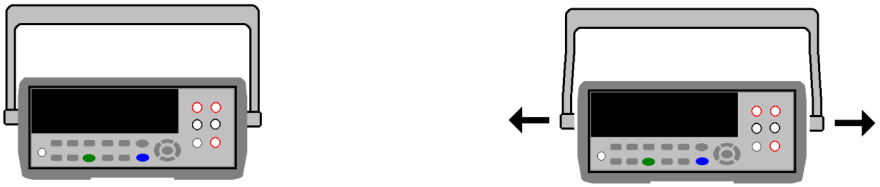
To Rack-Mount the Multimeter

You can mount the multimeter 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 Agilent System II instrument of the same size can be rack–mounted side–by–side with the 34410A/34411A.

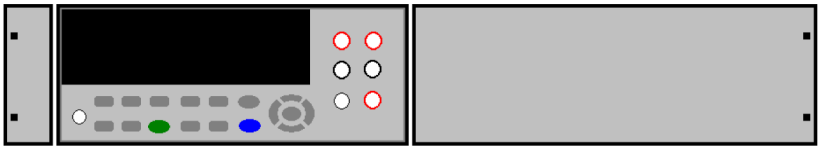
You must remove the carrying handle, and the front and rear rubber bumpers, *before* rack–mounting the multimeter.



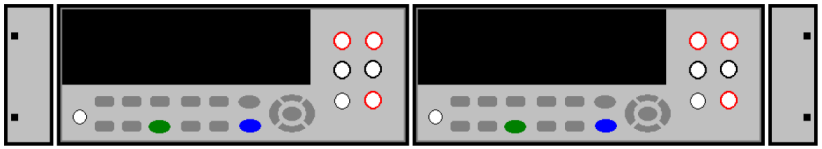
To remove each rubber bumper, stretch a corner and slide it off



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



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



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

Calibration Information

From the front panel you can:

- Read the calibration count
- Read and set the calibration message.
- Secure and unsecure the instrument for calibration.

To Read the Calibration Count

You can query the instrument to determine how many calibrations have been performed. Note that your instrument was calibrated before it left the factory. When you receive your instrument, read the count to determine its initial value. The count value increments by one for each calibration point, and a complete calibration will increase the value by many counts.

1 Press Shift Data Log (Utility) .

2 Select CALIBRATION from UTILITY MENU.

3 Select COUNT from CALIBRATION.

4 Make note of the CAL COUNT.

To Read the Calibration Message

The instrument allows you to store a message in calibration memory. For example, you can store such information as the date when the last calibration was performed, the date when the next calibration is due, the instrument's serial number, or even the name and phone number of the person to contact for a new calibration.

You can record a calibration message only when the instrument is unsecured. You can read the calibration message whether the instrument is secured or unsecured.

1 Press Shift Data Log (Utility) .

2 Select CALIBRATION from UTILITY MENU.

3 Select MESSAGE from CALIBRATION.

To Store a Calibration Message

You can record a calibration message only when the instrument is unsecured (see "To Unsecure for Calibration" on page 54).

1 Press Shift Data Log (Utility) .

2 Select CALIBRATION from UTILITY MENU.

3 Select MESSAGE from CALIBRATION.

4 Use ◀ or ▶ to select each character in the message. Change the characters by pressing ▲ or ▼ to cycle through all the possible display characters. The full alphabet is available as well as the digits 0 through 9, spaces, and special characters.

5 Press Enter when done.

To Secure for Calibration

This feature allows you to enter a security code to prevent accidental or unauthorized adjustments of the instrument. When you first receive your instrument, it is secured. Before you can adjust the instrument, you must unsecure it by entering the correct security code.

The security code is set to AT34410 (AT34411 for the Agilent 34411A) when the instrument is shipped from the factory. The security code is stored in non–volatile memory, and does not change when power has been off, after a Factory Reset (*RST command), or after an Instrument Preset (SYSTem:PRESet command).

The security code may contain up to 12 alphanumeric characters. The first character must be a letter, but the remaining characters can be letters, numbers, or an underscore (_). You do not have to use all 12 characters but the first character must always be a letter.

1 Press Shift Data Log (Utility) .

2 Select CALIBRATION from UTILITY MENU.

3 Select SECURE from CALIBRATION.

4 The currently set security code is shown. Use ◀ or ▶ to select each character in the code. Change the characters by pressing ▲ or ▼ to cycle through all the possible display characters. The full alphabet is available as well as the digits 0 through 9. The first character must be a letter.

5 Press Enter when done.

To Unsecure for Calibration

Before you can adjust the instrument, you must unsecure it by entering the correct security code. The security code is set to AT34410 when the instrument is shipped from the factory. The security code is stored in non–volatile memory, and does not change when power has been off, after a Factory Reset (`*RST` command), or after an Instrument Preset (`SYSTem:PRESet` command).

The security code may contain up to 12 alphanumeric characters. The first character must be a letter, but the remaining characters can be letters, numbers, or an underscore (_). You do not have to use all 12 characters but the first character must always be a letter.

NOTE If you forget your security code, you can disable the security feature by applying a temporary short inside the instrument as described in "To Unsecure the Instrument Without the Security Code" on page 73

1. Press Shift Data Log (Utility) .
2. Select CALIBRATION from UTILITY MENU.
3. Select UNSECURE from CALIBRATION.
4. Use ◀ or ▶ to set each character in the code. Change the characters by pressing ▲ or ▼ to cycle through all the possible display characters. The full alphabet is available as well as the digits 0 through 9. The first character must be a letter.
5. Press Enter when done.

3
Calibration Procedures

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

Closed–Case Electronic Calibration The instrument features closed–case electronic calibration. No internal mechanical adjustments are required. The instrument 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 EEPROM calibration memory does not change when power has been off or after a remote interface reset.

Agilent Technologies Calibration Services

When your instrument is due for calibration, contact your local Agilent Service Center for a low–cost recalibration. The 34410A/11A is supported on automated calibration systems which allow Agilent to provide this service at competitive prices.

Calibration Interval

The instrument should be calibrated on a regular interval determined by the measurement accuracy requirements of your application.

A 1–year interval is adequate for most applications. Accuracy specifications are warranted only if adjustment is made at regular calibration intervals. Accuracy specifications are not warranted beyond the 1–year calibration interval. Agilent does not recommend extending calibration intervals beyond 2 years for any application.

Adjustment is Recommended

Specifications are only guaranteed within the period stated from the last adjustment. Whatever calibration interval you select, Agilent recommends that complete re–adjustment should always be performed at the calibration interval. This will assure that the 34410A/11A will remain within specification for the next calibration interval. This criteria for re–adjustment provides the best long–term stability.

Performance data measured during Performance Verification Tests does not guarantee the instrument will remain within these limits unless the adjustments are performed.

Use the Calibration Count feature (see page 75) to verify that all adjustments have been performed.

Time Required for Calibration

The 34410A/11A can be automatically calibrated under computer control. With computer control you can perform the complete calibration procedure and performance verification tests in less than 30 minutes once the instrument is warmed–up (see Test Considerations on page 61).

Automating Calibration Procedures

The adjustment procedures provided in this Service Guide demonstrate front panel adjustment. You can automate the complete verification and adjustment procedures outlined in this manual. You can program the instrument configurations specified for each test over the remote interface. You can then enter read back verification data into a test program and compare the results to the appropriate test limit values.

The instrument must be unsecured prior to initiating the calibration procedure (see “Calibration Security” on page 73).

Refer to the *34410A/11A Programmer's Reference Help File* for more information.

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.

A suggested alternate method would be to use the Agilent 3458A 8½–digit Digital Multimeter to measure less accurate yet stable sources. The output value measured from the source can be entered into the instrument as the target calibration value.

Application	Recommended Equipment	Accuracy Requirements
Zero Calibration	Agilent 34172A (2 recommended)	4 –terminal low thermal short
DC Voltage	Fluke 5720A	<1/5 instrument 24 hour spec
DC Current	Fluke 5720A	<1/5 instrument 24 hour spec
Resistance	Fluke 5720A	<1/5 instrument 24 hour spec
AC Voltage	Fluke 5720A	<1/5 instrument 24 hour spec
AC Current	Fluke 5720A	<1/5 instrument 24 hour spec
Frequency	Agilent 33220A	<1/5 instrument 24 hour spec
Capacitance	IET SCA–1μF	<1/5 instrument 24 hour spec

Performance Verification Tests

Use the Performance Verification Tests to verify the measurement performance of the instrument. The performance verification tests use the instrument's specifications listed in the 34410A/11A's Product Data Sheet.

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 instrument 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 instrument or after performing adjustments.
- **Optional Verification Tests** Tests not performed with every calibration. Perform these tests to verify additional specifications or functions of the instrument.

Self–Test

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

- During the self–test all display segments and annunciators are lit.
- If the self–test fails, the ERROR annunciator turns on. Read any errors using the front panel View menu, or use the `SYSTem:ERRor?` command query from the remote interface. If repair is required, contact an Agilent Service Center.
- If all tests pass, you have a high confidence (~90%) that the instrument is operational.
- You can initiate a more complete self test by sending the `*TST?` command to the instrument. This command returns a "+0" if all the self–tests pass, or a "+1" if a failure occurred. This command may take up to 30 seconds to complete. You may need to set an appropriate interface time–out value.

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 instrument'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 instrument's performance for the quick check points (designated by a Q) verifies performance for "normal" accuracy drift mechanisms. This test does not check for abnormal component failures.

To perform the quick performance check, do the following:

- Perform a self–test as described on page 59.
- Perform only the performance verification tests indicated with the letter **Q**.

If the instrument 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 instrument. 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.

If the instrument fails performance verification, adjustment or repair is required.

Adjustment is recommended at every calibration interval. If adjustment is not made, you must establish a 'guard band', using no more than 80% of the specifications, as the verification limits.

Input Connections

Test connections to the instrument are best accomplished using an Agilent Technologies 34172A calibration short for low–thermal offset measurements and a 34171A DMM connector configured to interface to the calibrator output. Shielded, twisted–pair, Teflon interconnect cables of minimum length are recommended between the calibrator and the multimeter. HI and HI Sense should be a twisted pair. LO and LO Sense should be a twisted pair. Cable shields should be earth ground referenced. This configuration is recommended for optimal noises and settling time performance during calibration.

Test Considerations

Errors may be induced by ac signals present on the input leads during a self–test. Long test leads can also act as an antenna causing pick–up of ac signals.

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

- Assure that the calibration ambient temperature is stable and between 18 °C and 28 °C. Ideally the calibration should be performed at 23 °C ±1 °C.
- Assure ambient relative humidity is less than 80%.
- Allow a 1–hour warm–up period with a copper short connected.
- Use shielded twisted pair Teflon–insulated cables to reduce settling and noise errors. Keep the input cables as short as possible.
- Connect the input cable shields to earth ground. Except where noted in the procedures, connect the calibrator LO source to earth ground at the calibrator. It is important that the LO to earth ground connection be made at only *one* place in the circuit to avoid ground loops.

Because the instrument is capable of making highly accurate measurements, you must take special care to ensure that the calibration standards and test procedures used do not introduce additional errors. Ideally, the standards used to verify and adjust the instrument should be an order of magnitude more accurate than each instrument range full scale error specification.

For the dc voltage, dc current, and resistance gain verification measurements, you should take care to ensure the calibrator's "0" output is correct. You will need to set the offset for each range of the measuring function being verified.

Verification Tests

Zero Offset Verification

This procedure is used to check the zero offset performance of the instrument. Verification checks are only performed for those functions and ranges with unique offset calibration constants. Measurements are checked for each function and range as described in the procedure on the next page.

Zero Offset Verification Procedure

1. Make sure you have read "Test Considerations" on page 61.
2. Short all the inputs on the front panel input test connector (see page 60). Leave the Current input open. Connect the shorts as close to the input connector as possible. Select the Front panel inputs.
3. Select each function and range in the order shown in the table below. Make a measurement and return the result. Compare measurement results to the appropriate test limits shown in the table on the next page.
4. Short all the inputs on the rear panel input test connector (see page 60). Leave the Current input open. Connect the shorts as close to the input connector as possible. Select the rear panel inputs.
5. Select each function and range in the order shown in the table below. Make a measurement and return the result. Compare measurement results to the appropriate test limits shown in the table below.

Input	Function[1]	Range	Quick Check	Error from Nominal		
				24 hour	90 day	1 year
Open	DC Current	100 µA		± 0.02 µA	± 0.025 µA	± 0.025 µA
Open		1 mA		± 0.006 µA	± 0.006 µA	± 0.005 µA
Open		10 mA		± 2 µA	± 2 µA	± 2 µA
Open		100 mA	**Q**	± 4 µA	± 5 µA	± 5 µA
Open		1 A		± 60 µA	± 100 µA	± 100 µA
Open		3 A		± 600 µA	± 600 µA	± 600 µA
Short	DC Volts	100 mV	**Q**	± 3 µV	± 3.5 µV	± 3.5 µV
Short		1 V		± 6 µV	± 7 µV	± 7 µV
Short		10 V		± 40 µV	± 50 µV	± 50 µV
Short		100 V		± 600 µV	± 600 µV	± 600 µV
Short		1000 V		± 6 mV	± 6 mV	± 6mV
Short	4–Wire Ohms[2]	100 Ω		± 3 mΩ	± 4 mΩ	± 4 mΩ
Short		1 kΩ		± 5 mΩ	± 10 mΩ	± 10 mΩ
Short		10 kΩ	**Q**	± 50 mΩ	± 100 mΩ	± 100 mΩ
Short		100 kΩ		± 500 mΩ	± 1 Ω	± 1 Ω
Short		1 MΩ		± 10 Ω	± 10 Ω	± 10 Ω
Short		10 MΩ		± 100 Ω	± 100 Ω	± 100 Ω
Short		100 MΩ		± 1 kΩ	± 1 kΩ	± 1 kΩ

[1] Select 100 NPLC.

[2] Specifications are for 4–wires Ohms function or 2–wire Ohms function using math null. Without math null, add 0.2 Ω additional error in the 2–wire Ohm function.

Q: Quick performance verification test points.

Gain Verification

This procedure is used to check the "full scale" reading accuracy of the instrument. Verification checks are performed only for those functions and ranges with unique gain calibration constants.

DC Volts Gain Verification Test

1. Make sure you have read "Test Considerations" on page 61.
2. Connect the calibrator to the front panel input connectors. Select the front panel inputs.
3. Select each function and range in the order shown below. Provide the input shown in the table below.
4. Make a measurement and return the result. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling when using the Fluke 5720A.)

Input	Function[1]	Range	Quick Check	Error from Nominal		
				24 hour	90 day	1 year
100 mV	DC Volts	100 mV		± 6 µV	± 7.5 µV	± 8.5 µV
–100 mV		100 mV		± 6 µV	± 7.5 µV	± 8.5 µV
1 V		1 V		± 26 µV	± 37 µV	± 42 µV
10 V		10 V	Q	± 190 µV	± 250 µV	± 350 µV
–10 V		10 V		± 190 µV	± 250 µV	± 350 µV
100 V		100 V	Q	± 2.6 mV	± 4.1 mV	± 4.6 mV
1000 V		1000 V		± 26 mV	± 41 mV	± 46 mV

[1] Select 100 NPLC.

Q: Quick performance verification test points.

DC Current Gain Verification Test

1 Make sure you have read "Test Considerations" on page 61

2 Connect the calibrator to the front panel input connectors. Select the front panel inputs.

3 Select each function and range in the order shown below. Provide the input shown in the table below.

4 Make a measurement and return the result. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling when using the Fluke 5720A.)

Input	Function[1]	Range	Quick Check	Error from Nominal		
				24 hour	90 day	1 year
100 µA	DC Current	100 µA		± 0.03 µA	± 0.065 µA	± 0.075 µA
1 mA		1 mA		± 0.13 µA	± 0.36 µA	± 0.55 µA
10 mA		10 mA	Q	± 2.7 µA	± 5 µA	± 7 µA
100 mA		100 mA		± 14 µA	± 35 µA	± 55 µA
1 A		1 A	Q	± 560 µA	± 900 µA	± 1.1 mA
2 A		3 A		± 2.6 mA	± 3 mA	± 3.6 mA

[1] Select 100 NPLC.

Q: Quick performance verification test points.

Ohms Gain Verification Test

Configuration: 4–Wire Ohms (`CONFigure:FRESistance`)

1. Make sure you have read "Test Considerations" on page 61.
2. Set the OHMS function and select the front panel input terminals.
3. Select each range in the order shown below. Provide the resistance value indicated. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input	Function [1]	Range	Quick Check	Error from Nominal		
				24 hour	90 day	1 year
100 Ω	4–Wire Ohms	100 Ω		± 6 mΩ	± 12 mΩ	± 14 mΩ
1 kΩ		1 kΩ	**Q**	± 25 mΩ	± 80 mΩ	± 110 mΩ
10 kΩ		10 kΩ		± 250 mΩ	± 800 mΩ	± 1.1 Ω
100 kΩ		100 kΩ		± 2.5 Ω	± 8 Ω	± 11 Ω
1 MΩ		1 MΩ		± 30 Ω	± 110 Ω	± 130 Ω
10 MΩ		10 MΩ	**Q**	± 1.1 kΩ	± 3.1 kΩ	± 4.1 kΩ
100 MΩ[2]		100 MΩ		± 201 kΩ	± 601 kΩ	± 801 kΩ

[1] Select 100 NPLC.

[2] Verify only, no adjustment. 2–Wire Ohms.

Q: Quick performance verification test points.

Frequency Gain Verification Test

Configuration: `Frequency (CONFigure:FREQuency DEF, MIN)`

1 Make sure you have read "Test Considerations" on page 61.

2 Select the FREQUENCY function, default range, and minimum resolution (1 second aperture).

3 Connect the Agilent 33220A to the input terminals. Select each range in the order shown below. Provide the input voltage and frequency indicated. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input			Quick Check	Error from Nominal		
Voltage	Frequency	Range		24 hour	90 day	1 year
10 mV	40 Hz	100 mV		± 20 mHz	± 24 mHz	± 28 mHz
10 V	10 kHz	10 V	Q	± 0.5 Hz	± 0.6 Hz	± 0.7 Hz

Q: Quick performance verification test points.

AC Volts Verification Test

Configuration: AC Volts (`CONFigure[:VOLTage]:AC`)

LF 3 HZ:SLOW (`[SENSe:]VOLTage:AC:BANDwidth 3`)

1 Make sure you have read "Test Considerations" on page 61.

2 Set the AC VOLTS function and the 3 Hz input filter. With the slow filter selected, each measurement takes 2.5 seconds to complete.

3 Select each range in the order shown below. Provide the indicated input voltage and frequency. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input			Quick Check	Error from Nominal		
Vrms	Frequency	Range		24 hour	90 day	1 year
100 mV	1 kHz	100 mV		± 40 µV	± 80 µV	± 90 µV
100 mV	50 kHz	100 mV	Q	± 90 µV	± 140 µV	± 150 µV
100 mV	300 kHz	100 mV		± 1.53 mV	± 1.73 mV	± 1.73 mV
1 V	1 kHz	1 V		± 400 µV	± 800 µV	± 900 µV
1 V	50 kHz	1 V		± 900 µV	± 1.4 mV	± 1.5 mV
1 V	300 kHz	1 V		± 15 mV	± 17 mV	± 17 mV
10 V	10 Hz	10 V		± 4.03 mV	± 8.03 mV	± 9.03 mV
10 V	1 kHz	10 V		± 4 mV	± 8 mV	± 9 mV
10 V	50 kHz	10 V	Q	± 9 mV	± 14 mV	± 15 mV
10 V	300 kHz	10 V		± 150 mV	± 170 mV	± 170 mV
100 V	1 kHz	100 V	Q	± 40 mV	± 80 mV	± 90 mV
100 V	50 kHz	100 V		± 90 mV	± 140 mV	± 1500 mV
50 V	300 kHz	100 V		± 1 V	± 1.1 V	± 1.1 V
750 V	1 kHz	750 V		± 615 mV	± 915 mV	± 990 mV
210 V	50 kHz	750 V		± 192mV	± 330 mV	± 351mV
70 V	300 kHz	750 V		± 4.45 V	± 4.59 V	± 4.59 V

Q: Quick performance verification test points.

AC Current Verification Test

Configuration: AC Current (`CONFigure:CURRent:AC`)

LF 3 HZ:SLOW (`[SENSe:]CURRent:AC:BANDwidth 3`)

1 Make sure you have read "Test Considerations" on page 61.

2 Set the AC CURRENT function and the 3 Hz input filter. With the slow filter selected, each measurement takes 1.7 seconds to complete.

3 Select each range in the order shown below. Provide the input current and frequency indicated. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input			Quick Check	Error from Nominal		
Current	Frequency	Range		24 hour	90 day	1 year
100 µA	1 kHz	100 µA		± 0.14 µA	± 0.14 µA	± 0.14 µA
100 µA	10 kHz	100 µA	Q	± 0.24 µA	± 0.24 µA	± 0.24 µA
1 mA	1 kHz	1 mA		± 1.4 µA	± 1.4 µA	± 1.4 µA
1 mA	10 kHz	1 mA		± 2.4 µA	± 2.4 µA	± 2.4 µA
10 mA	1 kHz	10 mA		± 14 µA	± 14 µA	± 14 µA
10 mA	10 kHz	10 mA		± 24 µA	± 24 µA	± 24 µA
100 mA	1 kHz	100 mA		± 140 µA	± 140 µA	± 140 µA
100 mA	10 kHz	100 mA		± 240 µA	± 240 µA	± 240 µA
1 A	1 kHz	1 A		± 1.4 mA	± 1.4 mA	± 1.4 mA
1 A	5 kHz	1 A		± 1.4 mA	± 1.4 mA	± 1.4 mA
2 A	1 kHz	3 A		± 4.8 mA	± 4.8 mA	± 4.8 mA
2 A	5 kHz	3 A		± 4.8 mA	± 4.8 mA	± 4.8 mA

Q: Quick performance verification test points.

Optional AC Voltage Performance Verification Tests

Configuration: AC Volts (`CONFigure[:VOLTage]:AC`)

LF 3 HZ:SLOW (`[SENSe:]VOLTage:AC:BANDwidth 3`)

1. Make sure you have read "Test Considerations" on page 61.
2. Set the AC VOLTS function and the 3 Hz input filter. With the slow filter selected, each measurement takes 2.5 seconds to complete.
3. Select each range in the order shown below. Provide the indicated input voltage and frequency. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input			Error from Nominal		
Voltage	Frequency	Range	24 hour	90 day	1 year
1 V	10 Hz	1 V	± 430 µV	± 830 µV	± 930 µV
1 V	1 kHz	1 V	± 400 µV	± 800 µV	± 900 µV
1 V	20 kHz	1 V	± 400 µV	± 800 µV	± 900 µV
1 V	50 kHz	1 V	± 900 µV	± 1.4 mV	± 1.5 mV
1 V	100 kHz	1 V	± 2.8 mV	± 3.8 mV	± 4.8 mV
1 V	300 kHz	1 V	± 15 mV	± 17 mV	± 17 mV
10 V	1 kHz	10 V	± 4 mV	± 8 mV	± 9 mV
1 V	1 kHz	10 V	± 2.2 mV	± 3.5 mV	± 3.6 mV
0.1 V	1 kHz	10 V	± 2.02 mV	± 3.05 mV	± 3.06 mV

Optional AC Current Performance Verification Tests

Configuration: AC Current (`CONFigure:CURRent:AC`)

LF 3 HZ:SLOW (`[SENSe:]VOLTage:AC:BANDwidth 3`)

1 Make sure you have read "Test Considerations" on page 61

2 Set the AC CURRENT function and the 3 Hz input filter. With the slow filter selected, each measurement takes 2.5 seconds to complete.

3 Select each range in the order shown below. Provide the indicated input voltage and frequency. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input			Error from Nominal		
Current	Frequency	Range	24 hour	90 day	1 year
1 mA	10 Hz	1 mA	± 1.4 µA	± 1.4 µA	± 1.4 µA
1 mA	1 kHz	1 mA	± 1.4 µA	± 1.4 µA	± 1.4 µA
1 mA	5 kHz	1 mA	± 1.4 µA	± 1.4 µA	± 1.4 µv
1 mA	10 kHz	1 mA	± 2.4 µA	± 2.4 µA	± 2.4 µA
100 mA	1 kHz	100 mA	± 140 µA	± 140 µA	± 140 µA
10 mA	1 kHz	100 mA	± 50 µA	± 50 µA	± 50 µA
1 mA	1 kHz	100 mA	± 41 µA	± 41 µA	± 41 µA

Optional Capacitance Performance Verification Tests

Configuration: Capacitance

```
CONFigure:CAPacitance
```

1 Make sure you have read "Test Considerations" on page 61.

2 Set the CAPACITANCE function.

3 Select each range in the order shown below. Provide the indicated input voltage and frequency. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input		Error from Nominal
Capacitance	Range	1 year
1 μF	1 μF	± 0.005 μF
1 μF	10 μF	± 0.014 μF

Calibration Security

This feature allows you to enter a security code to prevent accidental or unauthorized adjustments of the instrument. When you first receive your instrument, it is secured. Before you can adjust the instrument, you must unsecure it by entering the correct security code.

See "To Unsecure for Calibration" on page 54 for a procedure to enter the security code from the front panel. Use the `CAL:SEC:STAT ON` command to enter the security code using the remote interface.

NOTE If you forget your security code, you can disable the security feature by following the procedure below.

- The security code is set to AT34410 (or AT34411) when the instrument is shipped from the factory. The security code is stored in non–volatile memory, and does not change when power has been off, after a Factory Reset (*RST command), or after an Instrument Preset (SYSTem:PRESet command).
- The security code may contain up to up to 12 characters. You do not have to use all 12 characters but the first character must always be a letter (A–Z). The remaining 11 characters can be letters, numbers (0–9), or the underscore character ("_"). Blank spaces are not allowed

To Unsecure the Instrument Without the Security Code

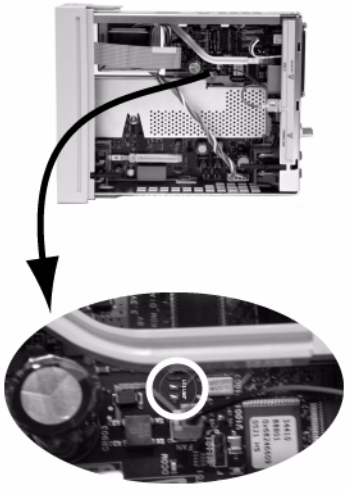
To unsecure the instrument without the correct security code, follow the steps below. See "To Unsecure for Calibration" on page 54. See "Electrostatic Discharge (ESD) Precautions" on page 108 before beginning this procedure.

NOTE If you do not have a record of the security code, there are two codes you may wish to try before you use the procedure below. First try **AT34410** or **AT34411** (the factory default code). If that code does not work, you may wish to try the single letter **A** as the security code. If someone has re–secured calibration without entering a new code, the default code is the letter **A**.

1 Disconnect the power cord and all input connections.

2 Disassemble the instrument using the "General Disassembly" on page 109.

3 Apply a temporary short between the two exposed metal pads on the main PC board assembly. The general location is shown in the figure below. On the PC board, the pads are marked JM101.



4 Apply power and turn on the instrument.

WARNING **Be careful not to touch the power line connections or high voltages on the power input module and transformer. Power is present even if the instrument is turned off when the line cord is connected.**

5 The display will show the message "Calibration security has been disabled". The instrument is now unsecured.

6 Turn off the instrument and remove the power cord.

7 Reassemble the instrument.

Now you can enter a new security code, see "To Secure for Calibration" on page 53. Be sure you record the new security code.

Calibration Message

The instrument allows you to store a message in calibration memory. For example, you can store such information as the date when the last calibration was performed, the date when the next calibration is due, the instrument's serial number, or even the name and phone number of the person to contact for a new calibration. The calibration message may contain up to 40 characters.

You can record a calibration message only when the instrument is unsecured. You can read the calibration message whether the instrument is secured or unsecured.

See "To Read the Calibration Message" on page 52 and "To Store a Calibration Message" on page 52. Use the `CALibration:STRing` and `CALibration:STRing?` commands from the remote interface.

Calibration Count

You can query the instrument to determine how many calibrations have been performed. Note that your instrument was calibrated before it left the factory. When you receive your instrument, be sure to read the count to determine its initial value.

The calibration count increments up to a maximum of 2^{32} after which it rolls over to "0". Since the value increments by one for each calibration point, a complete calibration may increase the value by many counts.

See "To Read the Calibration Count" on page 51. Use the `CALibration:COUNt?` command from the remote interface.

Calibration Process

The following general procedure is the recommended method to complete a full instrument calibration.

1. Read "Test Considerations" on page 61.
2. Perform the verification tests to characterize the instrument (incoming data).
3. Unsecure the instrument for calibration ("Calibration Security" on page 73).
4. Perform the adjustment procedures ("""Adjustments" on page 78).
5. Secure the instrument against calibration.
6. Note the new security code and calibration count in the instrument's maintenance records.

Using the Front Panel for Adjustments

This is the general process used to perform adjustments from the front panel. Refer to the *34410A/11A Programmer's Reference Help File* for remote interface commands.

Selecting the Adjustment Mode

Press Shift Data Log (Utility). Select CALIBRATION from UTILITY MENU. Select CALIBRATE from CALIBRATION. Select ADC or DMM from CALIBRATE.

Entering Adjustment Values

In the DMM adjustment procedures, to enter an input calibration value using the front panel, use ◀ or ▶ to select each character in the displayed value. Change the value by pressing ▲ or ▼ to cycle through the digits 0 through 9. Press Enter when done.

Storing the Calibration Constants

Press Shift Data Log (Utility). Select CALIBRATION from UTILITY MENU. Select CALIBRATE from CALIBRATION. Select STORE from CALIBRATE. This stores the constants in non–volatile memory.

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 on any module by turning off the power. You can abort a calibration by issuing a remote interface device clear message.

CAUTION

If you abort a calibration in progress when the instrument is attempting to write new calibration constants to EEPROM, you may lose all calibration constants for the function. Typically, upon re–applying power, the instrument will report error **705 Cal:Aborted**. You may also generate errors 740 through 746. If this occurs, you should not use the instrument until a complete re–adjustment has been performed. A list of the possible calibration errors is given on page 107.

Adjustments

You will need a test input cable and connectors set and a low thermal input short, Agilent 34172A (two are recommended), to adjust the instrument (see "Input Connections" on page 60).

ADC and Zero Adjustment

Each time you perform a zero adjustment, the instrument stores a new set of offset correction constants for every measurement function and range. The instrument will sequence through all required functions and ranges automatically and store new zero offset calibration constants. All offset corrections are determined automatically. You may not correct a single range or function without re–entering ALL zero offset correction constants automatically. This feature is intended to save calibration time and improve zero calibration consistency.

NOTE Never turn off the instrument during Zero Adjustment. This may cause ALL calibration memory to be lost.

ADC and Zero Adjustment Procedure Be sure to allow the instrument to warm up and stabilize for 1 hour before performing the adjustments.

1. Follow the steps outlined below. Review "Test Considerations" on page 61 before beginning this test.
2. This procedure will use a low–thermal shorting block installed on both the front panel and rear panel input connectors. Leave the Current input connections open.

NOTE A single shorting block can be used, but care should be exercised to minimize thermal offsets associated with temperature differentials between the shorting block and measurement terminals when changing the block between the front and rear panel.

Adjust the ADC

3 Select the front panel input terminals. If using a single shorting block, install the block on the front panel input terminals.

4 Select the ADC adjustment mode (see "Selecting the Adjustment Mode" on page 76).

5 The display will show the ADC calibration steps as they progress. The ADC adjustment requires approximately 2 minutes to complete. When finished, the display will show **CAL SUCCEEDED**.

Front Terminals Zero Adjustment

6 Select the DMM adjustment mode (see "Selecting the Adjustment Mode" on page 76). Enter a calibration value of +0.000 E+0 (see "Entering Adjustment Values" on page 76).

7 The display will show the functions and offset as the adjustments progress. The Zero Adjustment requires approximately 1.5 minutes to complete. When finished, the display will show **CAL SUCEEDED**.

Rear Terminals Zero Adjustment

8 Select the rear input terminals. If using a single shorting block, install the block on the rear panel input terminals.

9 Repeat steps 6 and 7 for the rear input terminals.

Store The Calibration Constants

10 Store the new ADC and Zero adjustment constants (see "Storing the Calibration Constants" on page 76).

11 Perform the "Zero Offset Verification" on page 62 to check zero calibration results.

Gain Adjustments

The instrument calculates and stores gain corrections for each input value. The gain constant is computed from the calibration value entered for the calibration command and from measurements made automatically during the adjustment procedure.

Most measuring functions and ranges have gain adjustment procedures. The 100 MΩ and 1 GΩ ranges do not have gain calibration procedures.

Adjustments for each function should be performed ONLY in the order shown.

Gain Adjustment Considerations

- The ADC and zero adjustment procedure must have been recently performed prior to beginning any gain adjustment procedures.
- Gain adjustments can be made using either the front or rear input terminals. Make sure the front/rear input selection switch matches the terminals in use.

NOTE Never turn off the instrument during a Gain Adjustment. This may cause calibration memory for the present function to be lost.

Valid Gain and Flatness Adjustment Input Values Gain adjustment can be accomplished using the following input values.

Function	Range	Valid Amplitude Input Values
DC VOLTS	100 mV to 1000 V	0.9 to 1.1 x Full Scale
DC CURRENT	100 μA to 1 A	0.9 to 1.1 x Full Scale
	3 A	1.8 A to 2.2 A
OHMS, OHMS 4W	100 Ω to 10 MΩ	0.9 to 1.1 x Full Scale
FREQUENCY	Any	Input > 100 mV rms, 990 Hz to 110 kHz
AC CURRENT [1]	100 μA to 1 A	.9 to 1.1 x Full Scale
	3 A	1.8 A to 2.2 A
AC VOLTS [1]	100 mV to 100 V [2]	0.9 to 1.1 x Full Scale
	750 V	189 V to 219 V

[1] Valid frequencies are nominal frequencies ±1%.

[2] 100 Vac flatness adjustment performed at 50 V ±10%.

DC Voltage Gain Calibration Procedure

Review the "Test Considerations" on page 61 and "Gain Adjustment Considerations" on page 80 sections before beginning this procedure.

Configuration: DC Voltage

1. Configure each function and range shown in the adjustment table below.
2. Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3. Enter the actual applied input (see "Entering Adjustment Values" on page 76).
   a. Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.
   b. If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
4. Repeat steps 1 through 3 for each gain adjustment point shown in the table.
5. Store the new calibration constants ("Storing the Calibration Constants" on page 76).
6. Verify the DC Voltage Gain adjustments using the verification procedures beginning on page 64.

NOTE Each range in the gain adjustment procedure takes less than 2 seconds to complete.

Input	Instrument Settings	
	Function	Range
100 mV	DC Volts	100 mV
–100 mV		100 mV
1 V		1 V
10 V		10 V
–10 V		10 V
100 V		100 V
500 V		1000 V

DC Current Gain Calibration Procedure

Review the "Test Considerations" on page 61 and "Gain Adjustment Considerations" on page 80 sections before beginning this procedure.

Configuration: DC Current

1. Configure each function and range shown in the adjustment table below.
2. Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3. Enter the actual applied input (see "Entering Adjustment Values" on page 76).
   a. Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.
   b. If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
4. Repeat steps 1 through 3 for each gain adjustment point shown in the table.
5. Store the new calibration constants ("Storing the Calibration Constants" on page 76.
6. Verify the DC Current Gain adjustments using the verification procedures beginning on page 65.

NOTE Each range in the gain adjustment procedure takes less than 3 seconds to complete.

Input	Instrument Settings	
	Function	Range
100 µA	DC Current	100 µA
1 mA		1 mA
10 mA		10 mA
100 mA		100 mA
1 A		1 A
2 A		3 A

AC Voltage Gain Calibration Procedure

Review the ""Test Considerations" on page 61 and "Gain Adjustment Considerations" on page 80 sections before beginning this procedure.

Configuration: AC Voltage

1 Configure each function and range shown in the adjustment table below.

2 Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3 Enter the actual applied input (see "Entering Adjustment Values" on page 76).

   a Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.

   b If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

4 Repeat steps 1 through 3 for each gain adjustment point shown in the table.

5 Store the new calibration constants ("Storing the Calibration Constants" on page 76.

6 Verify the AC Voltage Gain adjustments using the verification procedures beginning on page 68.

NOTE Each range in the gain adjustment procedure takes less than 6 seconds to complete.

Input		Instrument Settings	
Vrms	Frequency	Function	Range
100 mV	1 kHz	AC Volts	100 mV
1 V	1 kHz		1 V
10 V	1 kHz		10 V
100 V	1 kHz		100 V
210 V	1 kHz		750 V

AC Current Gain Calibration Procedure

Review the "Test Considerations" on page 61 and "Gain Adjustment Considerations" on page 80 sections before beginning this procedure.

Configuration: AC Current

1 Configure each function and range shown in the adjustment table below.

2 Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3 Enter the actual applied input (see "Entering Adjustment Values" on page 76).

- **a** Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.
- **b** If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

4 Repeat steps 1 through 3 for each gain adjustment point shown in the table.

5 Store the new calibration constants ("Storing the Calibration Constants" on page 76.

6 Verify the AC Current Gain adjustments using the verification procedures beginning on page 69.

NOTE Each range in the gain adjustment procedure takes less than 7 seconds to complete.

Input		Instrument Settings	
Current	**Frequency**	**Function**	**Range**
100 µA	1 kHz	AC Current	100 µA
1 mA	1 kHz		1 mA
10 mA	1 kHz		10 mA
100 mA	1 kHz		100 mA
1 A	1 kHz		1 A
2 A	1 kHz		3 A

Ohms Gain Calibration Procedure

Review the "Test Considerations" on page 61 and "Gain Adjustment Considerations" on page 80 sections before beginning this procedure.

Configuration: 4–Wire Ohms

This procedure adjusts the gain for both the 4–wire and 2–wire Ohms functions, and the offset compensated Ohms function. The 100 MΩ and 1 GΩ ranges gain is derived from the 10 MΩ range and do not have separate adjustment points.

1 Configure each function and range shown in the adjustment table below.

2 Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3 Enter the actual applied input (see "Entering Adjustment Values" on page 76).

   a Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.

   b If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

4 Repeat steps 1 through 3 for each gain adjustment point shown in the table.

5 Store the new calibration constants ("Storing the Calibration Constants" on page 76.

6 Verify the Ohms Gain adjustments using the verification procedures beginning on page 66.

NOTE Each range in the gain adjustment procedure takes less than 10 seconds to complete.

Input	Instrument Settings	
	Function	Range
100 Ω	4–Wire Ohms	100 Ω
1 kΩ		1 kΩ
10 kΩ		10 kΩ
100 kΩ		100 kΩ
1 MΩ		1 MΩ
10 MΩ		10 MΩ

Frequency Gain Calibration Procedure

Review the "Test Considerations" on page 61 and "Gain Adjustment Considerations" on page 80 sections before beginning this procedure.

Configuration: Frequency 10 V range

The frequency accuracy of the Fluke 5720A is insufficient to calibrate the DMM. It's frequency output needs to be calibrated against more accurate reference. Use the Agilent 33220A for this adjustment.

1. Configure the function and range shown in the adjustment table below.
2. Apply the input signal shown in the "Input" column of the table.
3. Enter the actual applied input frequency (see "Entering Adjustment Values" on page 76).
   a. Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.
   b. If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
4. Store the new calibration constants ("Storing the Calibration Constants" on page 76.
5. Verify the Frequency Gain adjustments using the verification procedures beginning on page 67.

NOTE Frequency adjustment procedure takes less than 2 seconds to complete.

Input		Instrument
Voltage	Frequency	Range
10 V	10 kHz	10 V

Flatness Adjustments

The instrument stores new flatness correction constants each time this procedure is followed. Flatness constants adjust the DMM for AC Volts and AC current measurements across the usable input frequency band. The flatness constant is computed from the calibration value entered for the calibration command and from measurements made automatically during the adjustment procedure.

Adjustments for each ranges and frequency should be performed ONLY in the order shown.

Flatness Adjustment Considerations

- The ADC and zero adjustment procedure must have been recently performed prior to beginning any gain adjustment procedures.
- Flatness adjustments can be made using either the front or the rear input terminals. Make sure the front/rear selection switch matches the terminals being used.

NOTE Never turn off the instrument during a Flatness Adjustment. This may cause calibration memory for the present function to be lost.

Valid Flatness Adjustment Input Values

Refer to the table on page page 81.

AC Voltage Low Frequency Flatness Calibration Procedure

Review the "Test Considerations" on page 61 and "Flatness Adjustment Considerations" on page 91 sections before beginning this procedure.

Configuration: AC Voltage — 10 V range

1. Configure each function and range shown in the adjustment table below.
2. Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3. Enter the actual applied input voltage value (see "Entering Adjustment Values" on page 76).
   a. Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.
   b. If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
4. Repeat steps 1 through 3 for each flatness adjustment point shown in the table.
5. Store the new calibration constants ("Storing the Calibration Constants" on page 76.
6. Verify the AC Low Frequency Flatness adjustments using the verification procedures beginning on page 68.

NOTE Each voltage and frequency in the flatness adjustment procedure takes less than 7 seconds to complete.

Input		Instrument
Voltage	Frequency	Range
7 V	10 Hz	10 V
7 V	40 Hz	10 V

AC Voltage Flatness Calibration Procedure

Review the "Test Considerations" on page 61 and "Flatness Adjustment Considerations" on page 91 sections before beginning this procedure.

Configuration: AC Voltage

The 100V AC range is adjusted with 50Vac input. All AC adjustments uses the 3 Hz bandwidth measurement filter

1 Configure each function and range shown in the adjustment table below.

2 Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3 Enter the actual applied voltage input amplitude (see "Entering Adjustment Values" on page 76).

   a Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.

   b If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

4 Repeat steps 1 through 3 for each flatness adjustment point shown in the table.

   a Repeat steps 1 through 4 for each input voltage range table 100 mV, 1 V, 10 V, and 100 V).

5 Store the new calibration constants ("Storing the Calibration Constants" on page 76.

6 Verify the AC Flatness adjustments using the verification procedures beginning on page 68.

NOTE Each range in the flatness adjustment procedure takes less than 10 seconds to complete.

Input		Instrument
Voltage	Frequency	Range
100 mV	1 kHz	100 mV
	5 kHz	
	10 kHz	
	20 kHz	
	35 kHz	
	50 kHz	
	75 kHz	
	100 kHz	
	200 kHz	
	300 kHz	
	390 kHz	
	400 kHz	
	220 Hz	

Input		Instrument
Voltage	Frequency	Range
1 V	1 kHz	1 V
	5 kHz	
	10 kHz	
	20 kHz	
	35 kHz	
	50 kHz	
	75 KHz	
	100 kHz	
	200 kHz	
	300 kHz	
	390 kHz	
	400 kHz	
	220 Hz	

Input		Instrument
Voltage	Frequency	Range
10 V	1 kHz	10 V
	5 kHz	
	10 kHz	
	20 kHz	
	35 kHz	
	50 kHz	
	75 kHz	
	100 kHz	
	200 kHz	
	300 kHz	
	390 kHz	
	400 kHz	
	220 Hz	

Input		Instrument
Voltage	Frequency	Range
50 V	1 kHz	100 V
	5 kHz	
	10 kHz	
	20 kHz	
	35 kHz	
	50 kHz	
	75 kHz	
	100 kHz	
	200 kHz	
	300 kHz	
	390 kHz	
	400 kHz	
	220 Hz	

AC Current Flatness Calibration Procedure

Review the "Test Considerations" on page 61 and "Flatness Adjustment Considerations" on page 91 sections before beginning this procedure.

Configuration: AC Current

All AC adjustments use the 3 Hz bandwidth measurement filter

1. Configure each function and range shown in the adjustment table below.
2. Apply the input signal shown in the "Input" column of the table.

NOTE Always complete tests in the same order as shown in the appropriate table.

3. Enter the actual applied input current amplitude (see "Entering Adjustment Values" on page 76).
   a. Successful completion of each adjustment value is indicated by the message **CAL SUCCEEDED** flashing in the display.
   b. If a problem is encountered, the display will flash the message **CAL FAILED**. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
4. Repeat steps 1 through 3 for each flatness adjustment point shown in the table.
   a. Repeat steps 1 through 4 for each input voltage range table 100 µA, 1 mA, 10 mA, 100 mA and 1 A).
5. Store the new calibration constants ("Storing the Calibration Constants" on page 76.
6. Verify the AC Current Flatness adjustments using the verification procedures beginning on page 69.

NOTE Each current and frequency in the flatness adjustment procedure takes less than 10 seconds to complete.

Input		
Current	**Frequency**	**Range**
100 μA	1 kHz	100 μA
	5 kHz	
	7.5 kHz	
	9.7 kHz	
	10 kHz	
	220 Hz	
1 mA	1 kHz	1 mA
	5 kHz	
	7.5 kHz	
	9.7 kHz	
	10 kHz	
	220 Hz	
10 mA	1 kHz	10 mA
	5 kHz	
	7.5 kHz	
	9.7 kHz	
	10 kHz	
	220 Hz	

Input		
Current	Frequency	Range
100 mA	1 kHz	100 mA
	5 kHz	
	7.5 kHz	
	9.7 kHz	
	10 kHz	
	220 Hz	
1 A	1 kHz	1 A
	5 kHz	
	7.5 kHz	
	9.7 kHz	
	10 kHz	
	220 Hz	

Finishing Adjustments

1. Remove all shorting blocks and connections from the instrument.
2. Reset the Calibration Message (see page 75).
3. Reset the Calibration Security (see page 73).
4. Record the new Calibration Count (see page 75).

4
Disassembly and Repair

This chapter will help you troubleshoot a failing multimeter. It also describes how to obtain repair services and lists replaceable assemblies.

Operating Checklist

Before returning your multimeter to Agilent for service or repair check the following items:

Is the multimeter inoperative?

❑ Verify that the power cord is connected to the multimeter and to ac line power.

❑ Verify the front panel power switch is depressed.

❑ Verify the power line fuse is installed.

Use a 250 V 250 mAT fuse.

❑ Verify the power line voltage setting.

See page 47

Does the multimeter fail self–test?

❑ Verify the correct power line voltage is selected.

See page 47

❑ Remove all test connections to the multimeter and run the self–test again.

Errors may be induced by ac signals present on the multimeter input terminals during self–test. Long test leads can act as an antenna causing pick–up of ac signals.

Is the mutimeter's current input inoperative?

❑ Verify the current input fuse.

Does the multimeter fail to respond to input signals?

❑ Verify the front/rear selector switch is in the correct position for the terminals you are using.

Types of Service Available

If your instrument fails during the warranty period, Agilent Technologies will replace or repair it free of charge. After your warranty expires, Agilent will replace or repair it at a competitive price. The standard repair process is “whole unit exchange”. The replacement units are fully refurbished and are shipped with new calibration certificates.

Standard Repair Service (worldwide)

Contact your nearest Agilent Technologies Service Center (www.agilent.com/find/assist). They will arrange to have your instrument repaired or replaced.

Agilent Express Unit Exchange (U.S.A. Only)

You will receive a refurbished, calibrated replacement multimeter in 1 to 4 days.

1 Call 1–877–447–7278 (toll free) to place your Agilent Express order.

You will be asked for your serial number, shipping address, and a credit card number to guarantee the return of your failed unit.

If you do not return your failed unit within 15 business days, your credit card will be billed for the cost of a new multimeter.

2 Agilent will immediately send a replacement multimeter directly to you.

The replacement unit will come with instructions for returning your failed unit. Please retain the shipping carton and packing materials to return the failed unit to Agilent. If you have any questions regarding these instructions, please call 1–877–447–7278.

The replacement unit will have a different serial number than your failed unit. If you need to track your original serial number, a blank label will be shipped with the replacement unit to record your original serial number.

NOTE Your replacement unit will not include accessories, bumpers, or the handle. Remove any accessories and transfer them to the replacement unit before returning the failed unit.

Repackaging for Shipment

If the unit is to be shipped to Agilent for service or repair, be sure to:

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model number and full serial number.
- Place the unit in its original container with appropriate packaging material for shipping.
- Secure the container with strong tape or metal bands.
- If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static–free packaging materials to avoid additional damage to your unit.

Agilent suggests that you always insure shipments.

Cleaning

Clean the outside of the instrument with a soft, lint–free, slightly dampened cloth. Do not use detergent. Disassembly is not required or recommended for cleaning.

To Replace the Power Line Fuse

The power line fuse is located within the multimeter's fuse–holder assembly on the rear panel (see page 47). The multimeter is shipped from the factory with a power–line fuse installed. The supplied fuse is a **250mAT, 250V, slow–blow, 5x20mm fuse**, **Agilent part number 2110–0817**. If you determine that the fuse is faulty, replace it with one of the same size and rating.

To Replace the Current Input Fuse

The front and rear current input terminals are protected by a fuse. This fuse is located on the rear panel (see page 9). The supplied fuse is a **3AT, 250V, slow–blow, 5x20mm fuse**, **Agilent part number 2110–0780**. If you determine that the fuse is faulty, replace it with one of the same size and rating

Self Test Procedures

Power–On Self–Test

Each time the instrument is powered on, a subset of self–tests are performed. These tests check that the minimum set of logic and output hardware are functioning properly.

Complete Self–Test

To perform a complete self–test:

Press Shift Data Log (Utility) . on the front panel.

Select **SELF–TEST**.

The instrument will automatically perform the complete self–test procedure when you release the key. The self–test will complete in approximately 30 seconds.

If the self–test is successful, **SELF–TEST PASSED** is displayed on the front panel.

If the self–test fails, **SELF–TEST FAILED** is displayed and an error number is shown. Self–test error numbers and their meaning are shown in the table on the next page.

Self Test Error Numbers

NOTE On the remote interface, a self–test failure will generate SCPI error –330 and a supplemental message indicating one of the test numbers shown below. On the front panel, only the failing test is shown.

Test #	Test Name:
600	Front Panel Communications
601	Front Panel All On Test
602	A/D Feedback Test
603	Fine A/D Test
604	Fine A/D Linearity
605	A/D & FE Measure Zero
606	Input Amplifier x100 Zero Test
607	Input Amplifier x10 Zero Test
608	Input Amplifier x1 Zero Test
609	Input Leakage Test
610	Input Amplifier x10 Gain Test
611	Input Amplifier x1 Gain Test
612	Ohms 500nA Current Source
613	DC High Voltage Divider Test
614	Ohms 5uA Current Source Test
615	Ohms 10uA Current Source
616	Ohms 100uA to 200 Ohm Shunt
617	Ohms 1mA to 2 Ohm Shunt
618	High Current Shunt Test
619	AC 0.1VAC Zero Test
620	Precharge Amplifier Gain Test
621	Precharge Offset Range Test
622	FPGA Ping Test

Calibration Errors

The following errors indicate failures that may occur during a calibration.

Error #	Meaning
701	Calibration error; security defeated by hardware jumper
702	Calibration error; calibration memory is secured
703	Calibration error; secure code provided was invalid
704	Calibration error: secure code too long
705	Calibration error; calibration aborted
706	Calibration error: value out of range
707	Calibration error: signal measurement out of range
708	Calibration error: signal frequency out of range
709	Calibration error: no cal for this function or range
710	Calibration error: full scale correction out of range
711	Calibration error: ADC calibration failed
720	Calibration error: DCV offset out of range
721	Calibration error: DCI offset out of range
722	Calibration error: RES offset out of range
726	Calibration error: ACV offset out of range
727	Calibration error: ACI offset out of range
730	Calibration error: precharge DAC convergence failed
731	Calibration error: A/D turnover correction out of range
732	Calibration error: AC flatness DAC convergence failed
733	Calibration error: AC low frequency convergence failed
734	Calibration error: AC low frequency correction out of range
747	Calibration variable does not exist
748	Cal: mainframe cal memory write failure

Display and Keypad Tests

You can test the keyboard and display.

Hold down SHIFT and turn on the instrument. Hold the shift key for approximately 15 seconds. When you release the SHIFT key, the instrument begins the keypad test. The second display line shows the names of the keys. Press each key as shown. When all the keys have been pressed, the display test is available. press the left or right arrow keys to cycle the disp[lay through all the segments and annunciators. Press EXIT when finished.

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 instrument or any electronic device.

- Disassemble instruments only in a static–free work area.
- Use a conductive work area to reduce static charges.
- Use a conductive wrist strap to reduce 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.

Mechanical Disassembly

For procedures in this manual, the following tools are required for disassembly:

- T20 Torx driver (most disassembly)
- T15 Torx driver (fan removal)
- Flat Blade screw driver

The following tools may also be needed if further disassembly is required.

- 7 mm nut driver (rear–panel GPIB connector)
- #2 Pozi–drive (fuse holder assembly)

CAUTION **SHOCK HAZARD**. Only service–trained personnel who are aware of the hazards involved should remove the instrument covers. To avoid electrical shock and personal injury, make sure to disconnect the power cord from the instrument before removing the covers. Some circuits are active and have power applied even when the power switch is turned off.

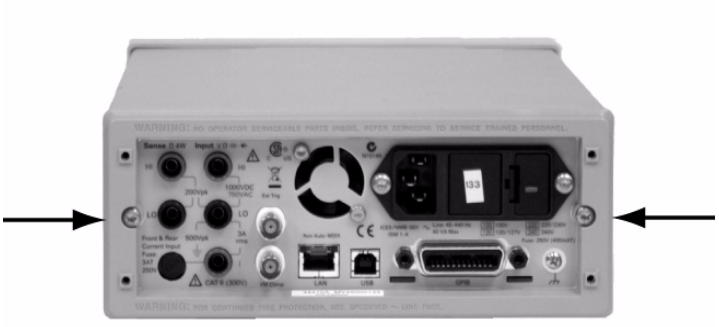
General Disassembly

1 Turn off the power. Remove all cables from the instrument.

2 **Remove the Carry Handle.** Rotate the handle upright and pull out from the sides of the instrument.

3 **Remove the instrument bumpers**. Pull from a corner and stretch the bumpers off the instrument.

4 **Remove the Rear Bezel.** Loosen the two captive screws in the rear bezel and remove the rear bezel.



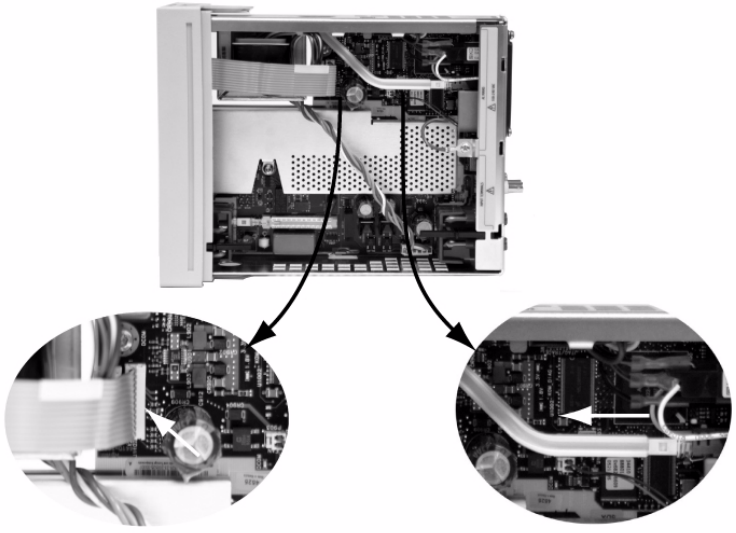
5 **Remove the Cover**. Remove the Torx drive screw in the bottom of the cover and slide the cover off the instrument.

Front Panel Removal

6 **Remove Push Rod and Disconnect Display Cable.**

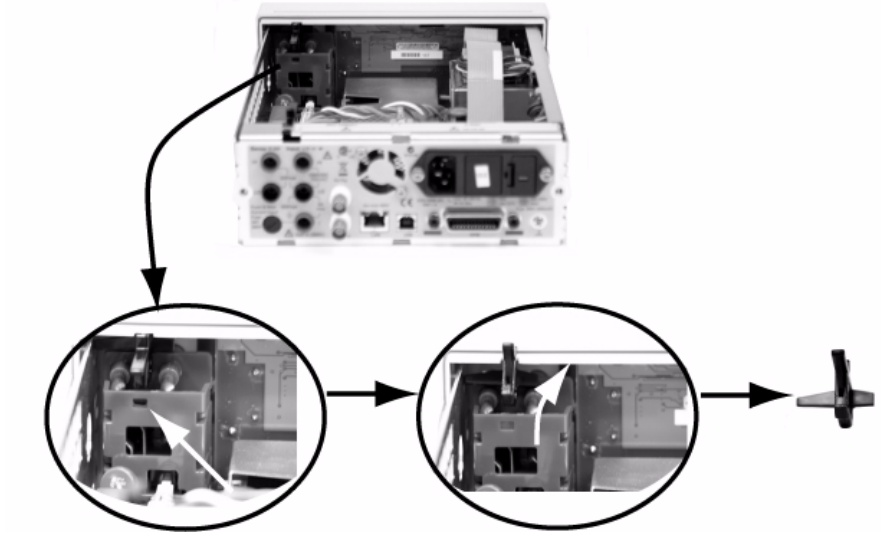
a Gently move the power switch push rod toward the front of the instrument to disengage it from the switch. Be careful not to twist or bend the push rod. Remove the front/rear push rod in the dame manner.

b Push down on the front panel cable connector latch and disconnect the cable from the main board.

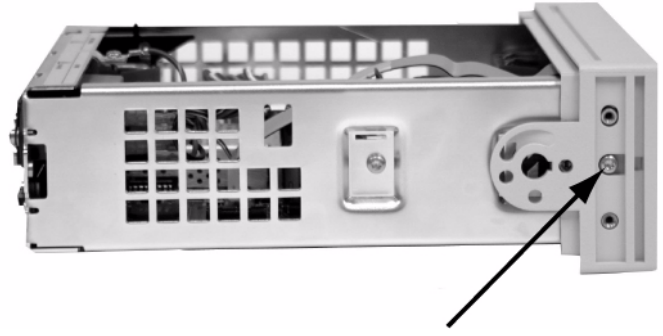


7 Remove Front Panel.

a Using a small bladed screwdriver, gently pry the black terminal latch from the red terminal housing. Rotate the Terminal larch up and remove it from the instrument.



b Remove the Torx screw holding the front panel assembly.

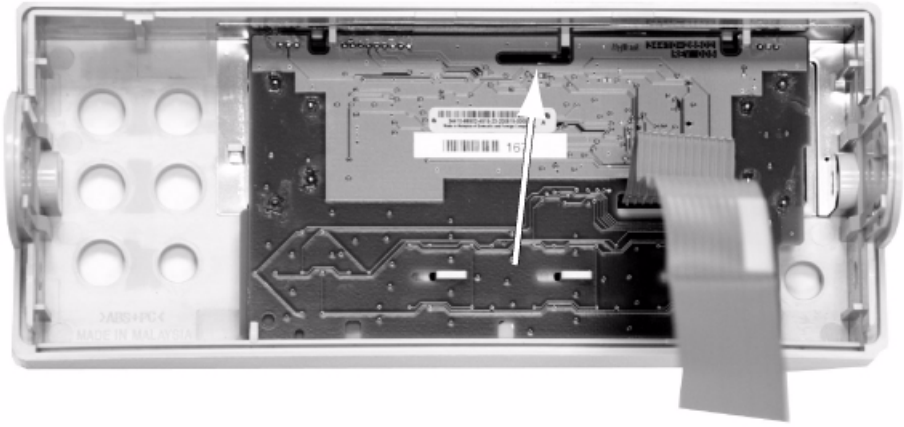


c There is now enough play to allow the side of the front panel to be pried from the chassis and removed as an assembly.

Front Panel Disassembly

1 Remove the Keyboard and Display Assembly.

a Using a flat blade screwdriver, gently pry up on the circuit board tab (shown below) and slide the board to disengage from the tabs. Lift the keyboard and display assembly from the plastic housing.



b The rubber keypad can now be pulled from the plastic housing.

Replaceable Parts

This section contains information for ordering replacement parts for your instrument. The parts lists are divided into the following sections.

Parts are listed in alphanumeric order according to their reference designators. The parts lists include a brief description of each part with applicable Agilent part number.

To Order Replaceable Parts

You can order replaceable parts from Agilent using the Agilent part number. Note that not all parts listed in this chapter are available as field–replaceable parts. To order replaceable parts from Agilent, do the following:

1. Contact your nearest Agilent Sales Office or Service Center.
2. Identify the parts by the Agilent part number shown in the replaceable parts list.
3. Provide the instrument model number and serial number.

Parts List

Agilent Part Number	Description
2110-0817	Line Fuse
2110-0780	Current Fuse
33220-88304	Bezel Rear
34401-45012	Latch-Terminal
34401-45021	Handle
34401-86013	Safety-Cover
34401-86020	Kit Bumper
34410-00602	Shield-Bottom
34410-00603	Shield-Top
34410-00611	Shield-ESD, VFD
34410-40201	Panel, Front
34410-43711	Pushrod-Power
34410-43712	Pushrod-Rear Terminals
34410-49321	Window 34410A
34411-49321	Window 34411A
34410-66502	PCA, Display
34410-68502	Assembly-Fan
34410-80101	Assembly-Chassis
34410-81912	Keypad
34410-84101	Cover
34401-86201	PWR-Module/Fuse Drwr and Fuse
34410-87920	Transformer-Power

5 Backdating

This chapter contains information necessary to adapt this manual to instruments not directly covered by the current content. At this printing, however, the manual applies to all instruments. Therefore, no information is included in this chapter.

5 Backdating