Detailed specifications, application briefs and more for:

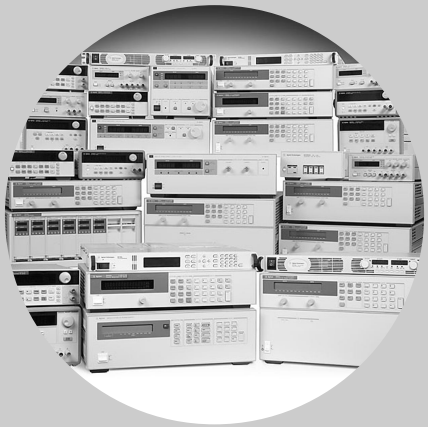
DC Power Supplies
DC Electronic Loads
AC Power Solutions
Digital Multimeters/Voltmeters
Function/Arbitrary
Waveform Generators
Data Acquisition and Switching
Frequency Counters
LXI

System and Bench Instruments Catalog July 2006

Agilent Technologies

Solutions

to match your new test and measurement challenges. From Power Supplies and Digital Multimeters to Data Acquisition and Switching Systems



One quick browse through this catalog will convince you that Agilent products offer so much more than simple power generation, or measurement, or signal switching. In each product category, we've integrated the capabilities you need for a complete solution. Our one-box approach improves test results while cutting costs, complexity and rack size.

This catalog contains detailed technical and application information on digital multimeters, DC power supplies, arbitrary waveform generators, and many more instruments. With over 180 products to choose from, it includes easy to use selection guides for each product category to help you select the best product for your application. Also highlighted are our most recent product introductions like the N6700 Low-Profile Modular Power System, the 34410A, 34411A and 34405A Digital Multimeters, and the new L4400 Series LXI Switching and Control Instruments.

For the most comprehensive product information, we've provided a unique URL to each product's website where you can find data sheets and application notes, download drivers, and view videos and interactive demos.

Products you can count on year after year

We've been a leader in the power and measurement business for more than four decades because engineers like you know they can count on Agilent performance and reliability. We specify and guarantee performance for the entire integrated system, so you know what you're really dealing with–unlike the typical "rack-and-stack" setup. Plus, every Agilent product in this catalog has a global warranty.

We know you have more important things to do than shop around for serveral different system and bench instruments. That's why we've made such a wide range of products available through Agilent. The experienced engineers at Agilent can help you select just the right solutions for your application and your budget, then arrange fast shipping so you can get to work in a hurry.

New Products

34410A and 34411A Digital Multimeters

The 34410/11A 6½ digit dual display DMMs are our latest generation of digital multimeters. Both models offer enhanced functionality for bench and system users. They provide precise triggering, extraordinary speed (up to 50,000 readings per second at 4½ digits on the 34411A), expanded memory, and datalogging wizard. With open connectivity, GPIB, USB and LAN are standard plus they are LXI class C compliant.

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34405A Digital Multimeter

The 34405A is an expansion of the 34401A, 34410A and 34411A product family, which offers value, performance, reliability and ease-of-use, and is part of the Agilent Open suite of products and services. The 34405A is an affordable digital multimeter specially designed to help manufacturers and educational institutions control costs on test and measurement equipment. The key benefits and features include easy-to-read AC and DC measurements with dual display capabilities, 0.025 percent DC accuracy and 120,000 counts resolution.

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N6700 Low-Profile Modular Power System

The small, flexible and fast N6700 MPS has been enhanced to provide 3x the power in the same space, creating the highest power and the highest number of outputs you can put in 1U of rack space. Two new mainframes (N6701A 600 W, N6702A 1200 W) provide 4 outputs in 1U. Four new basic DC modules (N6773A-76A) have been added at 300 W per 1 slot-wide module. All hardware is interchangeable; use new and existing modules in existing N6700B mainframes or any of the 20 modules in the 2 new mainframes. With open connectivity, GPIB, USB and LAN are standard, plus they are LXI class C compliant.

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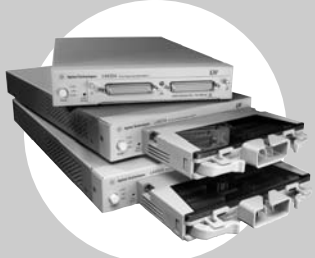

L4400 Series Switching and Control LXI Instruments

The seven new LXI instruments are self-contained, 1U, ½ rack LXI instruments with a broad offering of functionality in switching, digital I/O, D/A converters and counters. The standard LAN connectivity and fully-featured graphical web interface enable easy connection to the PC and remote access from anywhere in the world. With choices, you can select the low cost solution that best fits your needs.

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Agilent Open

Go beyond VXI, PXI and GPIB with LXI

LXI Products open new possibilities in testing

N5700 Series

N6700 System

L4400 Series

LXI (LAN eXtensions for Instrumentation) is a versatile architecture that enables you to create test systems with less effort. The LXI standard is based on proven, widely used standards with a long and stable history. This new open architecture enables you to turn on a system faster and gain faster throughput, all in a smaller space and in less time. The LXI Consortium is a not-for-profit corporation originally established by Agilent Technologies and VXI technologies. It has more than 40 members from test and measurement companies, industry professionals, system integrators and government representatives. See Agilent's extensive library of application notes, the Test System Developers Guide, code samples and other resources at **www.agilent.com/find/lxi**. To learn more about the LXI standard, go to **wwwlxistandard.org**

N5700 Series System DC Power Supplies

- Fully compliant to LXI class C specification
- Choose from 24 models up to 1500 W, up to 600 V, up to 180 A
- Operate on LAN, GPIB and USB interfaces
- Supports parallel and series connections of multiple supplies
- Simplify cabling with built-in measurements

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N6700 Low-Profile Modular Power System

- Fully compliant to LXI class C specification
- Create a system of up to 4 outputs of up to 300 W/output in 1U of rack space
- Change output voltage as fast as 200 microseconds
- Synchronize to other events with hardware and software triggering
- Capture transients with built-in digitizer (up to 50 kHz, 4096 points)
- Generate automated sequencing of up to 512 output settings

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L4400 Series LXI Switching and Control Instruments

- Fully compliant to LXI class C specification
- Compact, self-contained 1U, 1/2 rack size
- Choose from 7 instruments in switching, digital I/O, D/A converters
- Full-featured Graphical Web interface
- Standard Dsub connectors for flexible connection options
- Software drivers for most common programming environments

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Agilent Open

Agilent 34980A

Agilent 34980A Multifunction Switch/Measure Unit

- Fully compliant to LXI class C specification
- 8-slot Mainframe with optional integrated 6 1/2 digit DMM
- 19 plug-in modules to choose from - DC to 20 GHz switching, Digital I/O, D/A Converter, Counter/Totalizer
- Up to 560 Multiplexer channels or 1024 Matrix cross points in a single Mainframe
- Full-featured Graphical Web interface
- Standard drivers for most common programming environments

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Agilent 33220A

33220A Function/Arbitrary Waveform Generator, 20 MHz

- Fully compliant to LXI class C specification
- 20 MHz sine and square waveforms
- Ramp, triangle, noise, and DC waveforms
- Pulse generation with variable edge
- 14-bit, 50 MSa/s, 64 Kpoint arbitrary waveforms
- AM, FM, PM, FSK, and PWM modulation types
- Linear & logarithmic sweeps and burst operation modes

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Agilent 34410A & 34411A

34410A Digital Multimeter, 6-1/2 digit high performance

- Fully compliant to LXI class C specification
- 10,000 readings/s @ 5 1/2 digits continuous to the PC
- Capacitance & temperature measurements
- Peak measurements and dual display
  - Data logger with improved usability
  - 50,000 reading non-volatile memory

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34411A Digital Multimeter, 6-1/2 digit enhanced performance

- Fully compliant to LXI class C specification
- Same capability as 34410A *Plus*
  - 50,000 readings/s @ 4 1/2 digits continuous to the PC
  - 1 M reading volatile memory

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3	300	900	1	*	**6671A-J08**	Performance	51
3.3	1000	3300	1	*	**6680A-J04**	Performance	61
5	10	50	up to 4	*	**N6731B**	Basic	72
5	20	100	up to 4	*	**N6741B**	Basic	73
5	875	4400	1	*	**6680A**	Performance	61
5.7	20	100	up to 8	*	**66101A-J03**	Performance	77
6	2.5	15	3		**E3630A**	Basic	17
6	5	30	3	*	**E3631A**	Basic	18
6	60	360	1		**6551A-J03**	Performance	47
6	60	360	1		**6651A-J03**	Performance	43
6	100	600	1	*	**N5741A**	Basic	26
6	180	1080	1	*	**N5761A**	Basic	29
6.7	30	200	1	*	**6033A**	Autoranging	23
7	0.015	0.11	2	*	**6625A**	Performance	67
7	0.015	0.11	4	*	**6626A**	Performance	67
7	5	35	3	*	**6623A**	Performance	65
7	5	35	4	*	**6624A**	Performance	65
7	10	70	2	*	**6621A**	Performance	65
7	10	70	3	*	**6623A**	Performance	65
7	120	1000	1	*	**6031A**	Autoranging	23
8	3	24	1	*	**E3640A**	Basic	21
8	3	24	2	*	**E3646A**	Basic	22
8	3	30	1		**E3610A**	Basic	15
8	5	40	1	*	**6611C**	Performance	32
8	5	40	1	*	**E3642A**	Basic	21
8	5	40	2	*	**E3648A**	Basic	22
8	6	48	1		**E3614A**	Basic	15
8	6.25	50	up to 4	*	**N6732B**	Basic	72
8	8	80	1	*	**E3644A**	Basic	21
8	10	80	1	*	**6631B**	Performance	39
8	12.5	100	up to 4	*	**N6742B**	Basic	74
8	16	128	up to 8	*	**66101A**	Performance	76

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Maximum Volts	Maximum Amps	Maximum Watts	Number of Outputs	GPIB	Model Number	Type	Page Number
8	20	160	1		**6541A**	Performance	39
8	20	160	1	*	**6641A**	Performance	36
8	20	160	1	*	**E3633A**	Basic	19
8	50	400	1		**6551A**	Performance	46
8	50	400	1	*	**6651A**	Performance	42
8	90	720	1	*	**N5742A**	Basic	26
8	165	1320	1	*	**N5762A**	Basic	29
8	220	1760	1		**6571A**	Performance	57
8	220	1760	1	*	**6671A**	Performance	50
8	580	4600	1	*	**6681A**	Performance	61
10	5	50	1	*	**6611C-J05**	Performance	32
10	50	500	1		**6551A-J01**	Performance	47
10	50	500	1	*	**6651A-J01**	Performance	42
10	200	2000	1		**6571A-J04**	Performance	58
10	200	2000	1	*	**6671A-J04**	Performance	51
12	1.5	18	2	*	**66309B**	Mobile Communications	81
12	1.5	18	2	*	**66309D**	Mobile Communications	81
12	1.5	18	2	*	**66319B**	Mobile Communications	81
12	1.5	18	2	*	**66319D**	Mobile Communications	81
12	12	150	up to 8	*	**66101A-J05**	Performance	77
12.5	60	750	1	*	**N5743A**	Basic	26
12.5	120	1500	1	*	**N5763A**	Basic	29
13	15.3	200	1		**6541A-J04**	Performance	40
13	15.3	200	1	*	**6641A-J04**	Performance	37
14	150	2000	1		**6571A-J03**	Performance	57
14	150	2000	1	*	**6671A-J03**	Performance	51
15	2	30	1		**E3610A**	Basic	15
15	3	45	2	*	**66309B**	Mobile Communications	81
15	3	45	2	*	**66309D**	Mobile Communications	81
15	3	45	1	*	**66311B**	Mobile Communications	81
15	3	45	2	*	**66319B**	Mobile Communications	81
15	3	45	2	*	**66319D**	Mobile Communications	81
15	3	45	2	*	**66321B**	Mobile Communications	81
15	3	45	2	*	**66321D**	Mobile Communications	81

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Maximum Volts	Maximum Amps	Maximum Watts	Number of Outputs	GPIB	Model Number	Type	Page Number
15	7	105	1	*	**E3632A**	Basic	19
15	10	150	up to 8	*	**66102A-J05**	Performance	77
15	120	1800	1		**6571A-J17**	Performance	58
15	120	1800	1	*	**6671A-J17**	Performance	51
15	440	6600	1	*	**6690A**	Performance	63
16	0.2	3.2	2	*	**6625A**	Performance	67
16	0.2	3.2	4	*	**6626A**	Performance	67
16	0.2	3.2	2	*	**6628A**	Performance	67
16	0.2	3.2	4	*	**6629A**	Performance	67
17	30	510	1	*	**6651A-J09**	Performance	43
20	0.5	10	3		**E3630A**	Basic	17
20	1.5	30	1		**E3611A**	Basic	15
20	1.5	30	1	*	**E3640A**	Basic	21
20	1.5	30	2	*	**E3646A**	Basic	22
20	2	40	1	*	**6612C**	Performance	32
20	2	40	3	*	**6623A**	Performance	65
20	2	40	4	*	**6624A**	Performance	65
20	2	40	4	*	**6627A**	Performance	65
20	2.5	50	1	*	**E3642A**	Basic	21
20	2.5	50	2	*	**E3648A**	Basic	22
20	2.5	50	up to 4	*	**N6733B**	Basic	72
20	3	60	1		**E3615A**	Basic	16
20	4	80	2	*	**6621A**	Performance	65
20	4	80	2	*	**6622A**	Performance	65
20	4	80	3	*	**6623A**	Performance	65
20	4	80	1	*	**E3644A**	Basic	21
20	5	100	1	*	**6632B**	Performance	34
20	5	100	1	*	**66332A**	Mobile Communications	81
20	5	100	up to 4	*	**N6743B**	Basic	74
20	7.5	150	up to 8	*	**66102A**	Performance	76
20	10	200	1	*	**6033A**	Autoranging	23
20	10	200	1	*	**6038A**	Autoranging	23
20	10	200	1		**6542A**	Performance	39
20	10	200	1	*	**6642A**	Performance	36
20	10	200	1	*	**E3633A**	Basic	19
20	15	300	up to 4	*	**N6773A**	Basic	71
20	15	300	1	*	**6651A-J09**	Performance	43
20	25	500	1		**6552A**	Performance	46
20	25	500	1	*	**6652A**	Performance	42
20	38	760	1	*	**N5744A**	Basic	26
20	50	1000	1	*	**6031A**	Autoranging	23
20	50	1000	1	*	**6032A**	Autoranging	23

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Maximum Volts	Maximum Amps	Maximum Watts	Number of Outputs	GPIB	Model Number	Type	Page Number
20	76	1520	1	*	**N5764A**	Basic	29
20	100	2000	1		**6572A**	Performance	57
20	100	2000	1	*	**6672A**	Performance	50
21	240	5000	1	*	**6682A**	Performance	61
24	6	100	up to 8	*	**66103A-J12**	Performance	78
24	85	2000	1	*	**6672A-J04**	Performance	51
25	1	25	2		**E3620A**	Basic	17
25	1	25	3	*	**E3631A**	Basic	18
25	7	160	1	*	**E3634A**	Basic	19
25	7	175	1	*	**E3634A**	Basic	19
27	20	540	1	*	**6652A-J03**	Performance	43
28	5	140	up to 8	*	**66103A-J09**	Performance	78
30	3.3	100	1	*	**66332A-J01**	Mobile Communications	81
30	4	120	1	*	**E3632A**	Basic	19
30	17.5	500	1	*	**6653A-J17**	Performance	43
30	17.5	525	1		**6553A-J17**	Performance	47
30	25	750	1	*	**N5745A**	Basic	26
30	50	1500	1	*	**N5765A**	Basic	29
30	220	6600	1	*	**6691A**	Performance	63
32	160	5100	1	*	**6683A**	Performance	61
35	0.8	28	2	*	**E3647A**	Basic	22
35	0.8	30	1	*	**E3641A**	Basic	21
35	0.85	30	1		**E3611A**	Basic	15
35	1.25	40	up to 8	*	**66105A-J01**	Performance	78
35	1.4	49	2	*	**E3649A**	Basic	22
35	1.4	50	1	*	**E3643A**	Basic	21
35	1.5	50	up to 4	*	**N6734B**	Basic	72
35	1.7	60	1		**E3616A**	Basic	16
35	2.2	80	1	*	**E3645A**	Basic	22
35	3	80	3	*	**6623A-J03**	Performance	65
35	3	100	up to 4	*	**N6744B**	Basic	74
35	4.5	150	up to 8	*	**66103A**	Performance	76
35	6	210	1		**6543A**	Performance	39
35	6	210	1	*	**6643A**	Performance	36
35	8.5	300	up to 4	*	**N6774A**	Basic	71
35	15	525	1		**6553A**	Performance	46
35	15	525	1	*	**6653A**	Performance	42
35	60	2100	1		**6573A**	Performance	57
35	60	2100	1	*	**6673A**	Performance	50
37	4	150	up to 8	*	**66103A-J01**	Performance	77
37.5	45	1690	1		**6573A-J03**	Performance	58
37.5	45	1690	1	*	**6673A-J03**	Performance	51

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40	3.6	100	up to 8	*	**66103A-J02**	Performance	77
40	5	200	1	*	**6643A-J11**	Performance	37
40	12.5	500	1		**6553A-J04**	Performance	47
40	12.5	500	1	*	**6653A-J04**	Performance	43
40	19	760	1	*	**N5746A**	Basic	26
40	38	1520	1	*	**N5766A**	Basic	29
40	50	2000	1		**6573A-J08**	Performance	58
40	50	2000	1	*	**6673A-J08**	Performance	52
40	128	5100	1	*	**6684A**	Performance	61
43.5	11	480	1	*	**E4350B-J04**	Solor Array Simulator	89
50	0.5	25	2	*	**6625A**	Performance	67
50	0.5	25	4	*	**6626A**	Performance	67
50	0.8	40	3	*	**6623A**	Performance	65
50	0.8	40	4	*	**6624A**	Performance	65
50	0.8	40	4	*	**6627A**	Performance	65
50	1	50	1	*	**6613C**	Performance	32
50	1	50	2	*	**6625A**	Performance	67
50	1	50	4	*	**6626A**	Performance	67
50	1	50	2	*	**6628A**	Performance	67
50	1	50	4	*	**6629A**	Performance	67
50	1.5	50	up to 4	*	**N6761A**	Performance	69
50	2	80	2	*	**6622A**	Performance	65
50	2	100	1	*	**6633B**	Performance	34
50	3	100	up to 4	*	**N6762A**	Performance	69
50	4	200	1	*	**E3634A**	Basic	19
50	5	50	up to 4	*	**N6751A**	Performance	69
50	10	500	1	*	**6554A-J05**	Performance	48
50	10	500	1		**6654A-J05**	Performance	44
50	10	100	up to 4	*	**N6752A**	Performance	69
50	42	2000	1	*	**6574A-J07**	Performance	58
50	42	2000	1	*	**6674A-J07**	Performance	52
51.8	10	518	1	*	**E4350B-J03**	Solar Array Simulator	89
54	9.6	480	1	*	**E4350B-J01**	Solar Array Simulator	88
55	3	165	1	*	**66104A-J09**	Performance	78
56	38	2000	1		**6574A-J03**	Performance	58
56	38	2000	1	*	**6674A-J03**	Performance	52
60	0.5	30	1		**E3612A**	Basic	15
60	0.5	30	1	*	**E3641A**	Basic	21
60	0.5	30	2	*	**E3647A**	Basic	22

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60	0.8	48	2	*	**E3649A**	Basic	22
60	0.8	50	1	*	**E3643A**	Basic	21
60	0.8	50	up to 4	*	**N6735B**	Basic	72
60	1	60	1		**E3617A**	Basic	16
60	1.3	80	1	*	**E3645A**	Basic	22
60	1.6	100	up to 4	*	**N6745B**	Basic	74
60	2.5	150	up to 8	*	**66104A**	Performance	76
60	3.3	200	1	*	**6038A**	Autoranging	23
60	3.5	210	1		**6544A**	Performance	39
60	3.5	210	1	*	**6644A**	Performance	36
60	5	300	up to 4	*	**N6775A**	Basic	71
60	9	540	1		**6554A**	Performance	46
60	9	540	1	*	**6654A**	Performance	42
60	12.5	750	1	*	**N5747A**	Basic	28
60	17	1200	1	*	**6030A**	Autoranging	23
60	17.5	1200	1	*	**6032A**	Autoranging	23
60	25	1500	1	*	**N5767A**	Basic	30
60	35	2100	1		**6574A**	Performance	57
60	35	2100	1	*	**6674A**	Performance	50
60	110	6600	1	*	**6692A**	Performance	63
65	8	480	1	*	**E4350B**	Solar Array Simulator	88
68	7	480	1	*	**E4350B-J06**	Solar Array Simulator	89
70	3	200	1	*	**6644A-J09**	Performance	37
70	3	200	1	*	**6544A-J09**	Performance	40
70	7.5	500	1		**6554A-J04**	Performance	48
70	7.5	500	1	*	**6654A-J04**	Performance	44
80	6	480	1		**6554A-J12**	Performance	48
80	6	500	1	*	**6654A-J12**	Performance	44
80	9.5	760	1	*	**N5748A**	Basic	28
80	19	1520	1	*	**N5768A**	Basic	30
86	6	516	1	*	**E4350B-J02**	Solar Array Simulator	88
100	0.5	50	1	*	**6614C**	Performance	32
100	0.5	50	up to 4	*	**N6736B**	Basic	72
100	1	100	1	*	**6634B**	Performance	34
100	1	100	up to 4	*	**N6746B**	Basic	74
100	3	300	up to 4	*	**N6776A**	Basic	71
100	7.5	750	1	*	**N5749A**	Basic	28
100	15	1500	1	*	**N5769A**	Basic	30
100	22	2000	1		**6575A-J08**	Performance	59
70/80	30/26	2000	1	*	**E4356A**	Performance	55

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Maximum Volts	Maximum Amps	Maximum Watts	Number of Outputs	GPIB	Model Number	Type	Page Number
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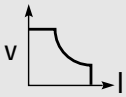
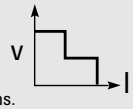
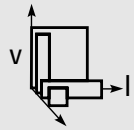
110	20	2000	1		**6575A-J09**	Performance	59
110	20	2000	1	*	**6675A-J09**	Performance	53
120	0.25	30	1		**E3612A**	Basic	15
120	1.25	150	up to 8	*	**66105A**	Performance	76
120	1.5	180	1		**6545A**	Performance	39
120	1.5	180	1	*	**6645A**	Performance	36
120	4.5	540	1		**6555A**	Performance	46
120	4	540	1	*	**6655A**	Performance	42
120	18	2160	1		**6575A**	Performance	57
120	18	2160	1	*	**6675A**	Performance	50
130	4	480	1	*	**E4351B**	Solar Array Simulator	88
135	16	2000	1		**6575A-J06**	Performance	59
135	16	2000	1	*	**6675A-J06**	Performance	52
150	1.2	150	1		**6545A-J05**	Performance	40
150	1.2	150	1	*	**6645A-J05**	Performance	37
150	3.2	500	1	*	**6655A-J05**	Performance	44
150	5	750	1	*	**N5750A**	Basic	28
150	10	1500	1	*	**N5770A**	Basic	30
150	15	2000	1	*	**6675A-J11**	Performance	53
150	15	2250	1		**6575A-J11**	Performance	59
156	3	500	1		**6555A-J10**	Performance	48
156	3	500	1	*	**6655A-J10**	Performance	44
160	13	2000	1		**6575A-J04**	Performance	59
160	13	2000	1	*	**6675A-J04**	Performance	52
170	1	170	1	*	**6645A-J06**	Performance	37
200	0.75	150	up to 8	*	**66106A**	Performance	76
200	5	1000	1	*	**6035A**	Autoranging	23
200	5	1200	1	*	**6030A**	Autoranging	23
200	11	2000	1		**6575A-J07**	Performance	59
200	11	2000	1	*	**6675A-J07**	Performance	53
300	2.5	750	1	*	**N5751A**	Basic	28
300	5	1500	1	*	**N5771A**	Basic	30
500	2	1000	1	*	**6035A**	Autoranging	23
600	1.3	780	1	*	**N5752A**	Basic	28
600	2.6	1560	1	*	**N5772A**	Basic	30

DC Power Supply
Feature Description Index

		6030 Series Autorangers	6610 & 6630 Series Single-Output	6620 Series Multiple-Output	6620 Series Precision Multiple-Output	6640 & 6650 Series Single-Output	6670-6690 Series Single-Output	66000 Modular Power Systems	66300 Series Mobile Communications	E3630 & E3640 Series Single & Multiple-Output	N5700 Series Single-Output	N6700 Series
DC Range	**Max Power**	200 W - 1000 W	40 W - 100 W	40 W & 80 W	25 W & 50 W	200 W - 500 W	2000 W - 6600 W	1200 W	40 W- 100 W	30 W - 200 W	700 W 1500 W	50 W 300 W
	Max Voltage	500 V	100 V	50 V	50 V	120 V	120 V	200 V	20 V	60 V	600 V	100 V
	Max Current	120 A	10 A	10 A	2 A	50 A	875 A	16 A	5 A	20 A	180 A	20 A
	Page	23	32, 34	65	67	36, 42	50, 61, 63	76	81	19, 21	26	69
Configuration Features												
"One-box" solution To preserve rack space and interconnections, the voltage and current programmers, current shunt, and DVM are built-in to one package.		•	•	•	•	•	•	•	•	•	•	•
Modular power system (multiple reconfigurable outputs) Modules can be installed into a mainframe, and configuration can be changed at any time.								• Up to 8				• Up to 4
Multiple non-reconfigurable outputs Up to four outputs are included in one package, and they share one GPIB address.				•	•				66309 B/D 66319 B/D	•		
Serial link Up to 16 power supply outputs can share one GPIB address when connected with a telephone style cable.		•				•	•	•				
Relay connect, disconnect, & polarity reversal Optionally integrated with the power supply								•	• 66332A Only	•		• Disconnect only
Auto-parallel, auto-series, parallel, and series operation When connected in auto-parallel or auto-series, only one unit has to be programmed to take advantage of the full power from all. **AP**=auto-parallel **AS**=auto-series **S**=series **P**=parallel		S AP		S P up to 2 identical outputs	S P up to 2 identical outputs	S AP	S AP	S, P		S, P	•	•
Analog programming and monitoring ports Analog programming ports allow the power supply to be used as a power amplifier, responding to an external voltage signal. Monitoring ports allow an external DMM to monitor the power-supply outputs.		•				•	•				•	

For more detailed specifications see the product manual at **www.agilent.com/find/power**

DC Power Supply Feature Description Index
(Continued)

		6030 Series Autorangers	6610 & 6630 Series Single-Output	6620 Series Multiple-Output	6620 Series Precision Multiple-Output	6640 & 6650 Series Single-Output	6670-6690 Series Single-Output	66000 Modular Power Systems	66300 Series Mobile Communications	E3630 & E3640 Series Single & Multiple-Output	N5700 Series Single-Output	N6700 Series
DC Range	**Max Power**	200 W - 1000 W	40 W - 100 W	40 W & 80 W	25 W & 50 W	200 W - 500 W	2000 W - 6600 W	1200 W	40 W- 100 W	30 W - 200 W	700 W 1500 W	50 W 300 W
	Max Voltage	500 V	100 V	50 V	50 V	120 V	120 V	200 V	20 V	60 V	600 V	100 V
	Max Current	120 A	10 A	10 A	2 A	50 A	875 A	16 A	5 A	20 A	180 A	20 A
	Page	23	32, 34	65	67	36, 42	50, 61, 63	76	81	19, 21	26	69
Output Voltage and Current Range Changing												
Single Range The output voltage is limited by a single maximum value. The output current is limited by a single maximum value. 			•			•	•	•			•	• N6730 N6740 N6770
Single Range + Peak Current Pulse A limited amplitude and limited width current pulse can be sourced beyond the maximum static current limit. 									•			
Autoranging A wide, continuous range of voltage and current combinations are available automatically at the maximum power level. 		•										• N6750 N6760
Multiple-output range changing Automatic range changing gives maximum power to two different voltage and current combinations. 				•	•					•		
Precision multiple-output range changing Voltage and current ranges can be chosen independently to provide greater resolution. 					•							• N6760
Performance Characteristics												
Output ripple and noise (Peak-to-peak, 20 Hz to 20 MHz)		30 - 160 mV	3 mV (10 mV to 25 mV in fast mode)	3 mV	3 mV	3 mV- 7 mV	7 mV- 25 mV	5-50 mV	3-10 mV	2-8 mV	60- 300 mV	6 mV N6750 N6760 10-30 mV N6730 N6740
Output programming response time Rise and fall time with full resistive load (10 to 90% and 90 to 10%) Does not include command processing time.		200 W: (100 ms - 200 ms) 1000 W: (300 ms - 2000 ms)	2 ms (0.4 ms in fast mode)	2-6 ms	6 ms	15 ms	9 ms- 195 ms	20 ms- 50 ms	0.4 ms- 2 ms	60 ms	0.08 s to 0.30 s	*
Programming resolution (percent of full scale)		0.025%	0.025%	0.03%	0.007%	0.025%	0.025%	0.03%	0.025%	0.025%/ 0.007%	*	*

*See Datasheet or User's Guide for complete details

For more detailed specifications see the product manual at **www.agilent.com/find/power**

DC Power Supply Feature Description Index
(Continued)

		6030 Series Autorangers	6610 & 6630 Series Single-Output	6620 Series Multiple-Output	6620 Series Precision Multiple-Output	6640 & 6650 Series Single-Output	6670-6690 Series Single-Output	66000 Modular Power Systems	66300 Series Mobile Communications	E3630 & E3640 Series Single & Multiple-Output	N5700 Series Single-Output	N6700 Series
DC Range	**Max Power**	200 W - 1000 W	40 W - 100 W	40 W & 80 W	25 W & 50 W	200 W - 500 W	2000 W - 6600 W	1200 W	40 W- 100 W	30 W - 200 W	700 W 1500 W	50 W 300 W
	Max Voltage	500 V	100 V	50 V	50 V	120 V	120 V	200 V	20 V	60 V	600 V	100 V
	Max Current	120 A	10 A	10 A	2 A	50 A	875 A	16 A	5 A	20 A	180 A	20 A
	Page	23	32, 34	65	67	36, 42	50, 61, 63	76	81	19, 21	26	69
GPIB Programming Features												
GPIB programming of voltage and current Self-documenting programming commands mean that programming is done in units of volts and amps, not in percentages or binary representations.		•	•	•	•	•	•	•	•	•	• GPIB LAN USB	• GPIB LAN USB
Measured voltage and current read-back over the GPIB The output is read back in units of volts and amps.		•	•	•	•	•	•	•	•	•	•	•
Store-recall states Complete operating states can be stored in nonvolatile memory. Each state specifies not only the output voltage and current, but also many of the programmable protection features.												
	Number nonvolatile states (One of these states is automatically accessed on turn-on)	0	4	0	4	5	6670-5 6680-4 6690-4	5	4	5	1	2
	Number volatile states	16/5	0	10	7	0	0	5	0	0	0	0
Standard Commands for Programmable Instruments (SCPI) SCPI is the standard language for test and measurement equipment. Standard codes make a software writing and maintenance more efficient. For example, using this standard, the output voltage of the power supply is measured with the same command (MEASURE: VOLTAGE?) by either a DMM or a power supply.		•	•			•	•	•	•	•	•	•
Protection Features												
GPIB programmable overvoltage protection Can be enabled to quickly down-program the output and set SRQ and/or DFI/RI. **T** = Can generate trigger. **M** = Overvoltage, the level is set manually with a front-panel control.		M	•	T	T	•	•	T	•	•	T M	T
GPIB programmable overcurrent protection Can be enabled to quickly down-program the output and set SRQ and/or DFI/RI. **T** = Can generate trigger.		•	•	•	•	•	•	T	•	E3630 only	T	T
Overtemperature protection Will down-program the output and can be enabled to set SRQ and/or DFI. **T** = Can generate trigger.		•	•	•	•	•	•	T	•		T	T

For more detailed specifications see the product manual at **www.agilent.com/find/power**

DC Power Supply Feature Description Index
(Continued)

DC Range		6030 Series Autorangers	6610 & 6630 Series Single-Output	6620 Series Multiple-Output	6620 Series Precision Multiple-Output	6640 & 6650 Series Single-Output	6670-6690 Series Single-Output	66000 Modular Power Systems	66300 Series Mobile Communications	E3630 & E3640 Series Single & Multiple-Output	N5700 Series Single-Output	N6700 Series
	Max Power	200 W - 1000 W	40 W - 100 W	40 W & 80 W	25 W & 50 W	200 W - 500 W	2000 W - 6600 W	1200 W	40 W- 100 W	30 W - 200 W	700 W- 1500 W	50 W- 300 W
	Max Voltage	500 V	100 V	50 V	50 V	120 V	120 V	200 V	20 V	60 V	600 V	100 V
	Max Current	120 A	10 A	10 A	2 A	50 A	875 A	16 A	5 A	20 A	180 A	20 A
	Page	23	32, 34	65	67	36, 42	50, 61, 63	76	81	19, 21	26	69
Protection Features (Continued)												
Discrete fault indicator/ remote inhibit (DFI/RI) Using these digital ports, power supplies can be connected independently of the GPIB. If any one experiences an error condition (overvoltage, for example), it can signal the other units to also downprogram their outputs. **O** = Optional		•	•	O	O	•	•	•	•		•	•
SRQ Almost any fault condition or change of state of the power supply can be enabled to generate an SRQ. This signals the computer to take the appropriate action.		•	•	•	•	•	•	•	•		•	•
Local lockout Front-panel or keyboard control can be disabled. This keeps unauthorized operators from changing the programmed states.		•	•	•	•	•	•	•	•	•	•	•
Fan-speed control Controls the fan-speed to provide only the required cooling, reducing unnecessary acoustic noise. **O** = Optional			•			•	•	•	•	•	•	•
Active down-programming Active circuits quickly drain the energy from the output when unit is programmed to a lower voltage. This means that a unit under test can be safely removed from its test fixture without danger of arcing. **F** = Full-rated output current **P** = Less than 100% rated output current		P	6610-P 6630-F	F	F	P	P	P	P			P N6750 N6760 only
Maintenance Features												
Electronic calibration in the rack Calibration requires no internal adjustments.			•	•	•	•	•	•	•	•	•	•
Calibration security Units can be protected from accidental access to calibration routines by either a password (P) or an internal jumper (J) or switch (s).			P, S	J	J	P, J	P, J	P, S	P, S	P, J	* P	* P
Self-test Extensive self-test is triggered automatically on power-up. Additional tests can be initialed by user programming or front-panel control.		•	•	•	•	•	•	•	•	•	•	•

*A nonvolatile status in SCPI mode only.

For more detailed specifications see the product manual at **www.agilent.com/find/power**

Basic DC Power Supplies...

essential features for a tight budget

Agilent Basic DC Power Supplies are the right choice for many applications. They provide quiet, stable DC power for both manual and automatic testing, in R&D and in manufacturing environments, where speed and accuracy are low considerations. At their price level, they have a surprising level of capability.

If you do not need the performance level and features of Agilent High Performance DC Power Supplies, then choose Agilent Basic DC Power Supplies. This summary table will help you decide which family of DC power supplies best meets your needs.

Comparison Summary	Agilent Basic DC Power Supplies	Agilent High Performance DC Power Supplies
Output Power	30 W-1500 W	40 W-6,600 W
Number of outputs	1-3	1-8
GPIB programming and measurement speed	Moderate	Fast
Output rise/fall time	Moderate	Fast
Convenient 1/2 rack-size for bench-top use	Yes	No
Active Downprogrammer for enhanced test throughput	No	Yes
Stored wake-up state	No	Yes
Programmable Capabilities	Moderate	Extensive
Protection for the DUT	Moderate	Extensive

More detailed specifications at **www.agilent.com/find/power**

E3610A-E3617A

Single-Output
30-60 W

Small, compact size for bench use
Low-noise and excellent regulation
Dual-range outputs (E3610A/11A/12A)

These linear-regulated DC power supplies provide reliable and convenient DC power on a lab bench. The 10-turn pots and clear voltage and current meters allow fine adjustments to be made easily. These models are CV/CC, so they can serve as either voltage or current sources. The "CC Set" button allows the current setting to be viewed, allowing easy adjustment of a current limit. Either the positive or negative terminal may be connected to ground, creating a positive or negative voltage, or floated up to 240 V from ground.

E3610A, E3611A, E3612A
These flexible 30 watt DC power supplies have 2 ranges, providing more current at lower voltage levels.

E3614A, E3615A, E3616A, E3617A
These DC power supplies provide remote sensing to eliminate the errors in voltage regulation due to voltage drops in the load leads. Delicate loads are protected by the overvoltage protection feature. Remote voltage signals can be used to control the power supply's output voltage and current levels.

Specifications (at 0° to 55°C unless otherwise specified)		**E3610A** ☎	**E3611A** ☎	**E3612A** ☎	**E3614A** ☎
Number of output ranges		2	2	2	1
GPIB		No	No	No	No
Output ratings[1]					
Range 1		0 to 8 V, 0 to 3 A[1]	0 to 20 V, 0 to 1.5 A[1]	0 to 60 V, 0 to 0.5 A[1]	0 to 8 V, 0 to 6 A
Range 2		0 to 15 V, 0 to 2 A[1]	0 to 35 V, 0 to 0.85 A[1]	0 to 120 V, 0 to 0.25 A[1]	—
Power (max)		30 W	30 W	30 W	48 W
Load and line regulation		0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV
Ripple and noise					
from 20 Hz to 20 MHz					
Voltage rms		200 µV	200 µV	200 µV	200 µV
peak-peak		2 mV	2 mV	2 mV	1 mV
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)			
Control mode		CV/CC	CV/CC	CV/CC	CV/CC
Meter resolution	Voltage	10 mV	100 mV	100 mV	10 mV
(minimum change using front-panel controls)	Current	10 mA	10 mA	1 mA	10 mA

☎ For 0ff-the-shelf shipment
[1]Maximum current is derated 1% per °C between 40° to 55°C.

Application Notes:

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

More detailed specifications at **www.agilent.com/find/E3600**

Single-Output: 30-60 W (Continued)

Supplemental Characteristics for all model numbers

Size: E3610A-E3612A: 91 mm H x 213 mm W x 319 mm D (3.6 in x 8.4 in x 12.6 in); E3614A-E3617A: 91 mm H x 213 mm W x 373 mm D (3.6 in x 8.4 in x 14.7 in)

Weight: E3610A-E3612A: 3.8 kg (8.4 lb) net, 5.1 kg (11.3 lb) shipping; E3614A-E3617A: 5.5 kg (12.1 lb) net, 6.75 kg (14.9 lb) shipping

Warranty: One year

Ordering Information

Opt 0E9 90 to 110 Vac, 47 to 63 Hz (Japan only)
Opt 0EM 104 to 126 Vac, 47 to 63 Hz
Opt 0E3 207 to 253 Vac, 47 to 63 Hz
Opt 1CM rack mount kit (E3614A-E3617A only)
Opt 0L2 extra documentation package

Specifications (at 0° to 55°C unless otherwise specified)		**E3615A** ☎	**E3616A** ☎	**E3617A** ☎
Number of output ranges		1	1	1
GPIB		No	No	No
Output ratings[1]				
Range 1		0 to 20 V, 0 to 3 A	0 to 35 V, 0 to 1.7 A	0 to 60 V, 0 to 1 A
Range 2		—	—	—
Power (max)		60 W	60 W	60 W
Load and line regulation		0.01% + 2 mV	0.01% + 2 mV	0.01% + 2 mV
Ripple and noise				
from 20 Hz to 20 MHz				
Voltage rms		200 µV	200 µV	200 µV
peak-peak		1 mV	1 mV	1 mV
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)		
Control mode		CV/CC	CV/CC	CV/CC
Meter resolution	Voltage	10 mV (0-20 V), 100 mV (>20 V)	10 mV (0-20 V), 100 mV (>20 V)	10 mV (0-20 V), 100 mV (>20 V)
(minimum change using front-panel controls)	Current	10 mA	1 mA	1 mA

☎ For 0ff-the-shelf shipment
[1]Maximum current is derated 1% per °C between 40° to 55°C.

More detailed specifications at **www.agilent.com/find/E3600**

E3620A, E3630A

Multiple-Output
35 W and 50 W

Dual and triple outputs
Small, compact size for bench use
Low-noise and excellent regulation
Overload indicator to monitor output

These linear-regulated DC power supplies provide reliable and convenient DC power on a lab bench. Voltage and current can be monitored simultaneously on the front panel meters. There is also an overload indicator for each output.

E3620A
The E3620A has two isolated, independent, CV/CL 25 volt outputs. It is easy to make precise adjustments using the 10-turn pots.

E3630A
The E3630A triple output power supply has two 20 volt outputs and one 6 volt output. The +6V output is an isolated constant-voltage/current-foldback output, and both the +20 volt output and the -20 volt output are constant-voltage/current-limit. An autotracking feature lets you use one voltage control to adjust both 20 volt outputs. These outputs track each other to within one percent, making it easy to adjust the power supply for circuits requiring balance voltages. The ±20 volt outputs are referenced together to a floating common.

Application Notes:

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Specifications (at 0° to 55°C unless otherwise specified)	**E3620A** ☎	**E3630A** ☎
Number of Outputs	2	3
GPIB	No	No
Output ratings*		
Output 1	0 to 25 V, 0 to 1 A	0 to 6 V, 0 to 2.5 A*
Output 2	0 to 25 V, 0 to 1 A	0 to +20 V, 0 to 0.5 A
Output 3	—	0 to -20 V, 0 to 0.5 A
Power (max)	50 W	35 W
Load regulation	0.01% + 2mV	0.01% + 2mV
Ripple and noise from 20 Hz to 20 MHz		
Normal mode voltage rms	350 µV	350 µV
peak-to-peak	1.5 mV	1.5 mV
Common mode current	1 µArms	1 µArms
Control mode	CV/CL	CV/CL (±20 V), CV/CL (6 V)
Meter resolution (Minimum change using front-panel controls)		
Voltage	10 mV (0-20 V), 100 mV, (>20 V)	10 mV
Current	1 mA	10 mA
Input power	115 Vac ± 10%, 47 to 63 Hz	115 Vac, ± 10%, 47 to 63 Hz

*Maximum current is derated 3.3% per °C from 40°C to 55°C
☎ For off-the-shelf shipment

Supplemental Characteristics

Size: E3620A:
213 mm W x 91 mm H x 401 mm D
(8.4 in x 3.6 in x 15.8 in)
E3630A:
213 mm W x 92 mm H x 320 mm D
(8.4 in x 3.6 in x 12.6 in)

Weight: E3620A: 5.5 kg (12.1 lbs)
E3630A: 3.8 kg (8.4 lbs)

Warranty: Three years

Ordering Information

Opt 0E9 90 to 110 Vac, 47 to 63 Hz (Japan only)
Opt 0EM 104 to 126 Vac, 47 to 63 Hz
Opt 0E3 207 to 253 Vac, 47 to 63 Hz
Opt 1CM rack mount kit
Opt 0L2 extra documentation package

More detailed specifications at **www.agilent.com/find/E3600**

E3631A

Triple-Output
80 W GPIB

- Small, compact size for bench use
- Low output ripple and noise
- Built-in measurements and basic programmable features
- Over-voltage protection to ensure DUT safety

This is the DC power supply for every engineer's or electronic technician's lab bench. It has two tracking 25 V outputs, which are together referenced to a floating common, and an isolated 6 volt output. It is easy to control from the front panel, or with industry standard SCPI commands via the GPIB or RS232. VXI*Plug&Play* drivers are available to further simplify computer control. Up to 3 complete states can be stored for later recall. The low noise, excellent regulation, and built-in voltmeter/ammeter make this reliable power supply well suited for the needs of the R&D lab.

Application Notes:

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Supplemental Characteristics for all model numbers

Product Regulation: Designed to comply with UL1244, IEC 1010-1; certified with CSA 22.2
Meets requirements for CE regulation

Software Driver:
- IVI-COM
- VXI*Plug&Play*
- IntuiLink Connectivity Software

Specifications
(at 0° to 55°C unless otherwise specified)

	E3631A		
DC outputs			
Voltage	0 to +25 V	0 to -25 V	0 to 6 V
Current	0 to 1 A	0 to 1 A	0 to 5 A
Load regulation			
Voltage	<0.01% + 2 mV	<0.01% + 2 mV	<0.01% + 2 mV
Current	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA
Line regulation			
Voltage	<0.01% + 2 mV	<0.01% + 2 mV	<0.01% + 2 mV
Current	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA
Ripple and noise from 20 Hz to 20 MHz			
Normal-mode voltage	<350 µV rms/2 mV p-p	<350 µV rms/2 mV p-p	<350 µV rms/2 mV p-p
Normal-mode current	<500 µA rms	<500 µA rms	<2 mA rms
Common-mode current	<1.5 µA rms	<1.5 µA rms	<1.5 µA rms
Programming accuracy at 25°C ±5°C			
Voltage	0.05% + 20 mV	0.05% + 20 mV	0.1% + 5 mV
Current	0.15% + 4 mA	0.15% + 4 mA	0.2% + 10 mA
Readback accuracy at 25°C ±5°C			
Voltage	0.05% + 10 mV	0.05% + 10 mV	0.1% + 5 mV
Current	0.15% + 4 mA	0.15% + 4 mA	0.2% + 10 mA
Resolution			
Program/readback	1.5 mV, 0.1 mA	1.5 mV, 0.1 mA	0.5 mV, 0.5 mA
Meter	10 mV, 1 mA	10 mV, 1 mA	1 mV, 1 mA
Transient response	50 µsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa		

☎ For off-the-shelf shipment

Warranty: One year

Size: E3631A
213 mm W x 133 mm H x 348 mm D
(8.4 in. x 5.2 in. x 14.2 in.)

Weight: E3631A
8.2 kg (18 lbs)

Ordering Information

Opt 0E9 90 to 110 Vac, 47 to 63 Hz (Japan only)
Opt 0EM 104 to 126 Vac, 47 to 63 Hz
Opt 0E3 207 to 253 Vac, 47 to 63 Hz
Opt 1CM rack mount kit
Opt 0L2 extra documentation package

More detailed specifications at **www.agilent.com/find/E3600**

E3632A-E3634A

Single-Output
120 W to 200 W GPIB

- Dual range outputs
- Small, compact size for bench use
- Low output ripple and noise
- Built-in measurements and basic programmable features
- Protection features to ensure DUT safety

These dual range DC power supplies provide the stable, accurate, and reliable DC power that the R&D engineer needs. These models are CV/CC, so they can serve as either voltage or current sources. They can be used either for manual or automated testing where moderate speed and accuracy are required. VXI*Plug&Play* drivers further simplify computer control.

These DC power supplies have many features to help the R&D engineer to quickly and easily bias and monitor prototype circuitry. Remote sensing eliminates the errors in voltage regulation due to voltage drops in the load leads. Delicate prototypes are protected by overvoltage and overcurrent protection features. Up to 3 frequently used operating states may be stored for later recall. The output is isolated from chassis ground.

For applications where even higher accuracy is needed, or speed must be optimized, see the Agilent 6600 Series of performance DC power supplies.

Specifications (at 0° to 55°C unless otherwise specified)	**E3632A** ☎	**E3633A** ☎	**E3634A** ☎
Number of Outputs	1	1	1
GPIB	Yes	Yes	Yes
Output ratings			
Range 1	0 to 15 V, 7 A	0 to 8 V, 20 A	0 to 25 V, 7 A
Range 2	0 to 30 V, 4 A	0 to 20 V, 10 A	0 to 50 V, 4 A
Load regulation			
Voltage	<0.01% + 2 mV	<0.01% + 2 mV	<0.01% + 2 mV
Current	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA
Line regulation			
Voltage	<0.01% + 2 mV	<0.01% + 2 mV	<0.01% + 2 mV
Current	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA
Ripple and noise from 20 Hz to 20 MHz			
Normal-mode voltage	<350 µVrms/2 mVpp	<350 µVrms/3 mVpp	<500 µVrms/3 mVp-p
Normal-mode current	<2 mA rms	<2 mA rms	<2 mA rms
Common-mode current	<1.5 µA rms	<1.5 µA rms	<1.5 µA rms
Programming accuracy at 25°C ±5°C			
Voltage	0.05% + 10 mV	0.05% + 10 mV	0.05% + 10 mV
Current	0.2% +10 mA	0.2% +10 mA	0.2% +10 mA
Readback accuracy at 25°C ±5°C			
Voltage	0.05% + 5 mV	0.05% + 5 mV	0.05% + 5 mV
Current	0.15% + 5 mA	0.15% + 5 mA	0.15% + 5 mA
Resolution			
Program	1 mV, 0.5 mA	1 mV, 1 mA	3 mV, 0.5 mA
Readback	0.5 mV, 0.1 mA	0.5 mV, 1 mA	1.5 mV, 0.5 mA
Meter	1 mV, 1 mA	1 mV, 1 mA (<10 A/10 mA (≥10 A))	1 mV, 1 mA (<10 A/10 mA (≥10 A))
Transient response	50 µsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa		

*Maximum current is derated 1% per °C from 40°C to 55°C %

☎ For off-the-shelf shipment

More detailed specifications at **www.agilent.com/find/E3600**

Single-Output: 120 W to 200 W (Continued)

Application Notes:

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Modern Connectivity - Using USB and LAN I/O Converters (AN 1475-1)
5989-0123EN

Supplemental Characteristics for all model numbers

Product Regulation: Designed to comply with UL1244, IEC 61010-1; certified with CSA 22.2
Meets requirements for CE regulation

Software Driver:
- IVI-COM
- VXI*Plug&Play*
- IntuiLink Connectivity Software

Warranty: One year

Size: 213 mm W x 132 mm H x 348 mm D (8.4 in. x 5.2 in. x 13.7 in.)

Weight: 9.5 kg (21 lbs)

Ordering Information

Opt 0E9 90 to 110 Vac, 47 to 63 Hz (Japan only)
Opt 0EM 104 to 126 Vac, 47 to 63 Hz
Opt 0E3 207 to 253 Vac, 47 to 63 Hz
Opt 1CM rack mount kit
Opt 0L2 extra documentation package

E3640A-E3649A

Single & Dual Output
30-100 W GPIB

- Dual range outputs
- Small, compact size for bench and system use
- Low output ripple and noise
- Built-in measurements and basic programmable features
- Over-voltage protection to ensure DUT safety

These isolated dual range DC power supplies provide the stable and reliable DC power that the manufacturing test system designer needs. These models offer constant-voltage/constant-current outputs, so they can serve as either voltage or current sources. They can be used either for manual or automated testing, and have VXI*Plug&Play* drivers to further simplify computer control.

The E3640A Series DC power supplies can be quickly integrated into a test system. Both front and rear panel terminals are provided for easy wiring. Remote sensing eliminates the errors in voltage regulation due to voltage drops in the load leads. Delicate DUTs are protected by overvoltage protection. Up to 5 operating states can be stored for later recall.

The E3640A Series DC power supplies are intended for manufacturing test systems where moderate speed and accuracy are required. For systems which require even higher accuracy for programming or measurement, or where test throughput must be optimized, consider the Agilent 6600A and N6700 Series of Performance DC Power Supplies.

Specifications (at 0° to 55°C unless otherwise specified)	**E3640A**	**E3641A**	**E3642A**	**E3643A**	**E3644A**
Number of outputs	1	1	1	1	1
GPIB	Yes	Yes	Yes	Yes	Yes
DC outputs					
Voltage Current	0 to 8 V 3 A	0 to 35 V 0.8 A	0 to 8 V 5 A	0 to 35 V 1.4 A	0 to 8 V 8 A
Voltage Current	0 to 20 V 1.5 A	0 to 60 V 0.5 A	0 to 20 V 2.5 A	0 to 60 V 0.8 A	0 to 20 V 4 A
Power (max)	30 W	30 W	50 W	50 W	80 W
Load and line regulation					
Voltage	<0.01% + 3 mV	<0.01% + 3 mV	<0.01% + 3 mV	<0.01% + 3 mV	<0.01% + 3 mV
Current	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA	<0.01% + 250 µA
Ripple and noise from 20 Hz to 20 MHz					
Normal-Mode Voltage	<500 µVrms 5 mVp-p	<1 mVrms 8 mVp-p	<500 µVrms 5 mVp-p	<1 mVrms 8 mVp-p	<500 µVrms 5 mVp-p
Normal-Mode Current	<4.0 mArms	<4.0 mArms	<4.0 mArms	<4.0 mArms	<4.0 mArms
Common-Mode Current	<1.5 µArms	<1.5 µArms	<1.5 µArms	<1.5 µArms	<1.5 µArms
Programming accuracy at 25°C ±5°C					
Voltage <0.05% +	10 mV	10 mV	10 mV	10 mV	10 mV
Current <0.2% +	10 mA	10 mA	10 mA	10 mA	10 mA
Readback accuracy at 25°C ±5°C					
Voltage <0.05% +	5 mV	5 mV	5 mV	5 mV	5 mV
Current <0.15% +	5 mA	5 mA	5 mA	5 mA	5 mA
Program resolution					
Voltage	5 mV	5 mV	5 mV	5 mV	5 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA
Readback resolution					
Voltage	2 mV	2 mV	2 mV	2 mV	2 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA
Meter resolution					
Voltage	10 mV	10 mV	10 mV	10 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA
Transient response	<50 µsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa.				

*Maximum current is derated 1% per °C from 40°C to 55°C

More detailed specifications at **www.agilent.com/find/E3600**

Single & Dual Output: 30-100 W GPIB (Continued)

Application Notes:

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Modern Connectivity - Using USB and LAN I/O Converters
(AN 1475-1)
5989-0123EN

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to 1 V can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Settling Time: Less than 90msec for the output voltage to change from 1% to 99% or vice versa following the receipt of VOLTage or APPLy command via direct GPIB or RS-232 interface.

Product Regulation:
Designed to comply with UL3111-1; certified to CSA 22.2 No. 1010.1; conforms to IEC 1010-1; complies with EMC directive 89/336/EEC(Group1, Class A)

OVP Accuracy: 0.5% + 0.5 V, activation time: ≥3 V, <1.5 ms, and <3 V, <10 ms

Isolation: ±240 Vdc

Stability: Voltage <0.02% + 2 mV; Current <0.1% + 1 mA

Temperature Coefficient: <0.01% + 3 mV, <0.02% + 3 mA change per °C over operating range 0-40 °C after 30 minute warm-up

Software Driver:
- IVI-COM
- VXI*Plug&Play*
- IntuiLink Connectivity Software

Warranty Period: One year

Specifications (at 0° to 55°C unless otherwise specified)	**E3645A**	**E3646A**	**E3647A**	**E3648A**	**E3649A**
Number of outputs	1	2	2	2	2
GPIB	Yes	Yes	Yes	Yes	Yes
DC outputs					
Voltage Current	0 to 35 V 2.2 A	0 to 8 V 3 A	0 to 35 V 0.8 A	0 to 8 V 5 A	0 to 35 V 1.4 A
Voltage Current	0 to 60 V 1.3 A	0 to 20 V 1.5 A	0 to 60 V 0.5 A	0 to 20 V 2.5 A	0 to 60 V 0.8 A
Power (max)	80 W	60 W	60 W	100 W	100 W
Load and line regulation					
Voltage <0.01% +	3 mV	3 mV	3 mV	3 mV	3 mV
Current <0.01% +	250 µA	250 µA	250 µA	250 µA	250 µA
Ripple and noise from 20 Hz to 20 MHz					
Normal-Mode Voltage	<1 mVrms 8 mVp-p	<500 µVrms 5 mVp-p	<1 mVrms 8 mVp-p	<500 µVrms 5 mVp-p	<1 mVrms 8 mVp-p
Normal-Mode Current	<4.0 mArms	<4.0 mArms	<4.0 mArms	<4.0 mArms	<4.0 mArms
Common-Mode Current	<1.5 µArms	<1.5 µArms	<1.5 µArms	<1.5 µArms	<1.5 µArms
Programming accuracy at 25°C ±5°C					
Voltage <0.05% + (<0.1% + 25 mA for output 2)	10 mV	10 mV	10 mV	10 mV	10 mV
Current <0.2% +	10 mA	10 mA	10 mA	10 mA	10 mA
Readback accuracy at 25°C ±5°C					
Voltage <0.05% + (<0.1% + 25 mV for output 2)	5 mV	5 mV	5 mV	5 mV	5 mV
Current <0.15% + (<0.15% + 10 mA for output 2)	5 mA	5 mA	5 mA	5 mA	5 mA
Program resolution					
Voltage	5 mV	5 mV	5 mV	5 mV	5 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA
Readback resolution					
Voltage	2 mV	2 mV	2 mV	2 mV	2 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA
Meter resolution					
Voltage	10 mV	10 mV	10 mV	10 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA
Transient response	<50 µsec for output to recover to within 15 mV following a change in output current from full load to half load or vice versa.				

*Maximum current is derated 1% per °C from 40°C to 55°C

Size: (E3640A-E3645A)
254.4 mm W x 104 mm H x 374 mm D
(10 in. x 4.1 in. x 14.8 in.)
(E3646A-E3649A)
213 mm W x 133 mm H x 348 mm D
(8.4 in. x 5.2 in. x 13.7 in.)

Weight: E3640A, E3641A: 5.3 kg (11.7 lbs)
E3642A, E3643A: 6.2 kg (13.7 lbs)
E3644A, E3645A: 6 kg (13.2 lbs)
E3646A, E3647A: 7.4 kg (16.3 lbs)
E3648A, E3649A: 9.5 kg (20.9 lbs)

Ordering Information

Opt 0E3 207 to 253 Vac, 47 to 63 Hz
Opt 0E9 90 to 110 Vac, 47 to 63 Hz (Japan only)
Opt 0EM 104 to 126 Vac, 47 to 63 Hz
Opt 1CM Rack mount kit (E3640A-E3645A p/n5063-9240; E3646A-E3649A p/n 5063-9243)
Opt 0L2 Extra documentation package
Opt 0B0 Delete documentation

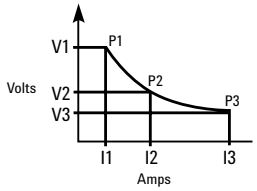
More detailed specifications at **www.agilent.com/find/E3600**

6030A, 6031A, 6032A, 6033A, 6035A, 6038A

Single-Output, Autoranging
200 W and 1000 W GPIB

- Autoranging outputs provide maximum power at a variety of operating voltages
- Analog/resistance control of output voltage and current
- Series and auto-parallel connections of multiple supplies
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

Autoranging Output:



This series of 200 watt and 1000 watt DC power supplies take the place of multiple power supplies in your test system by providing maximum power at a variety of operating points.

Industry standard SCPI commands and VXI*Plug&Play* drivers make system integration easy. Using the serial link, up to 16 power supplies can be connected through one GPIB address. These power supplies have excellent electrical efficiency, making them a good choice for large systems.

Application Notes:

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

Specifications (at 0° to 55°C unless otherwise specified)		6030A	6031A	6032A	6033A	6035A	6038A
Number of outputs		1	1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes	Yes
Output ratings							
Output Voltage		0 to 200 V	0 to 20 V	0 to 60 V	0 to 20 V	0 to 500 V	0 to 60 V
Output Current		0 to 17 A	0 to 120 A	0 to 50 A	0 to 30 A	0 to 5 A	0 to 10 A
Maximum power watts		1,200 W	1,064 W	1,200 W	242 W	1,050 W	240 W
Autoranging output	V1, I_1	200 V, 5 A	20 V, 50 A	60 V, 17.5 A	20 V, 10 A	500 V, 2 A	60 V, 3.3 A
	V2, I_2	120 V, 10 A	14 V, 76 A	40 V, 30 A	14 V, 17.2 A	350 V, 3 A	40 V, 6 A
	V3, I_3	60 V, 17 A	7 V, 120 A	20 V, 50 A	6.7 V, 30 A	200 V, 5 A	20 V, 10 A
Programming accuracy at 25°C ±5°C	Voltage	0.035% +145 mV	0.035% +15 mV	0.035% +40 mV	0.035% +9 mV	0.25% +400 mV	0.035% +40 mV
	Current	0.2% +25 mA	0.25% +250 mA	0.2% +85 mA	0.15% +20 mA	0.3% +63 mA	0.09% +10 mA
Ripple and noise 20 Hz to 20 MHz	Voltage rms	22 mV	8 mV	8 mV	3 mV	50 mV	3 mV
	p-p	50 mV	50 mV	40 mV	30 mV	160 mV	30 mV
	Current rms	15 mA	120 mA	25 mA	30 mA	50 mA	5 mA
Readback accuracy at 25°C ±5°C	Voltage	0.08% +80 mV	0.08% +7 mV	0.08% +20 mV	0.07% +6 mV	0.5% +200 mV	0.07% +50 mV
	Current	0.36% +15 mA	0.4% +100 mA	0.36% +35 mA	0.3% +25 mA	0.5% +50 mA	0.2% +11 mA
Load regulation							
Voltage	0.01%+	5 mV	3 mV	5 mV	2 mV	40 mV	3 mV
Current		0.01%+ 10 mA	0.01%+ 15 mA	0.01%+ 10 mA	0.01%+ 9 mA	0.03%+ 34 mA	0.01%+ 5 mA
Line regulation							
Voltage		0.01%+ 5 mV	0.01%+ 2 mV	0.01%+ 3 mV	0.01%+ 1 mV	0.03%+ 17 mV	0.01%+ 2 mV
Current		0.01%+ 5 mA	0.01%+ 25 mA	0.01%+ 10 mA	0.01%+ 6 mA	0.03%+ 17 mA	0.01%+ 2 mA
Transient response time 10% step change	Time	2 ms	2 ms	2 ms	1 ms	5 ms	1 ms
	Level	150 mV	100 mV	100 mV	50 mV	200 mV 7	5 mV

More detailed specifications at **www.agilent.com/find/6030**

Autoranging: 200 W and 1000 W GPIB (Continued)

Specifications

(at 0° to 55°C unless otherwise specified)

Supplemental Characteristics for all model numbers

Remote Sensing: Up to 2 V drop in each lead. Voltage regulation specification met with up to 0.5 V drop, but degrades for greater drops.

Modulation: (analog programming of output voltage and current)
Input signal: 0 to 5 V or 0 to 4 k Ohms

Software Driver:
VXI*Plug&Play*

Warranty: One year

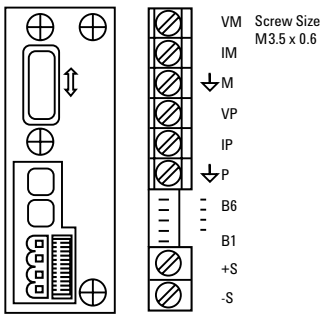
Size: 6030A–32A, 6035A:
425.5 mm W x 132.6 mm H x 503.7 mm D
(16.75 in x 5.25 in x 19.83 in).
6033A, 6038A:
212.3 mm W x 177.0 mm H x 516.4 mm D
(8.36 in x 6.97 in x 17.87 in).

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)

		6030A	6031A	6032A	6033A	6035A	6038A
Programming resolution	Voltage	50 mV	5 mV	15 mV	5 mV	125 mV 1	5 mV
	Current	4.25 mA	30 mA	12.5 mA	7.5 mA	1.25 mA	2.5 mA
DC floating voltage either terminal can be grounded or floated from chassis ground		±550 V	±240 V	±240 V	±240 V	±550 V	±240 V
AC input current	100 Vac	24 A	24 A	24 A	6 A	24 A	6 A
	120 Vac	24 A	24 A	24 A	6.5 A	24 A	6.5 A
	220 Vac	15 A	15 A	15 A	3.8 A	15 A	3.8 A
	240 Vac	14 A	14 A	14 A	3.6 A	14 A	3.6 A
Weight	Net	16.3 kg (36 lb)	17.2 kg (38 lb)	16.3 kg (36 lb)	9.6 kg (21 lb)	16.3 kg (36 lb)	9.6 kg (21 lb)
	Shipping	21.8 kg (48 lb)	22.7 kg (50 lb)	21.8 kg (48 lb)	11.4 kg (25 lb)	21.8 kg (48 lb)	11.4 kg (25 lb)

Agilent Models: 6030A, 6031A, 6032A, 6035A

Terminal Strip Detail



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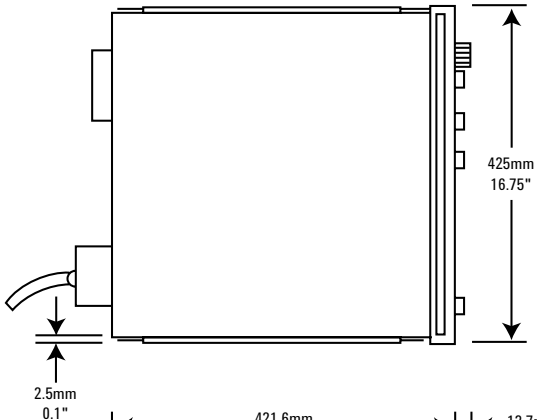
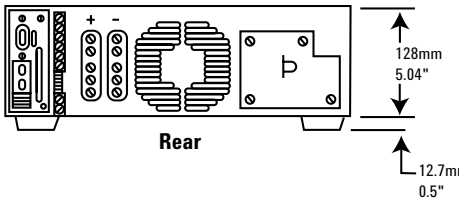




More detailed specifications at **www.agilent.com/find/6030**

Autoranging: 200 W and 1000 W GPIB (Continued)

Ordering Information

Opt 001 Front panel has only line switch, line indicator, and OVP adjust (6030A–33A and 6038A only)

Opt 100 87 to 106 Vac, 48 to 63 Hz (power supply output is derated to 75%)

Opt 120 104 to 127 Vac, 47 to 63 Hz

Opt 220 191 to 233 Vac, 48 to 63 Hz

Opt 240 209 to 250 Vac, 48 to 63 Hz

Opt 800 Rack-mount Kit for Two Half-rack Units Side by Side. Lock link Kit p/n 5061-9694 and 7 in Rack adapter Kit 5063-9215

* **Opt 908** Rack-mount Kit for a Single Half-rack Unit 6033A and 6038A (with blank filler panel); p/n 5062-3960, 6030A–32A and 6035A; p/n 5062-3977

* **Opt 909** Rack-mount Kit with Handles. For 6030A–32A, 6035A; p/n 5062-3983

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B3 Service Manual

Opt 0B0 Full documentation on CD-ROM only

Opt J01 Stabilization for loads up to 10 Henries (not available on 6033A)

A line cord option must be specified, see the AC line voltage and cord section.

* Support rails required

Accessories

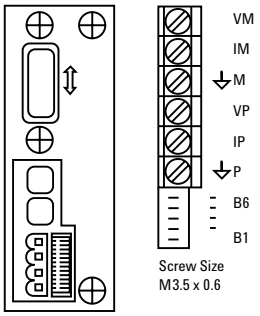
5080-2148 Serial Link Cable, 2 m (6.6 ft)

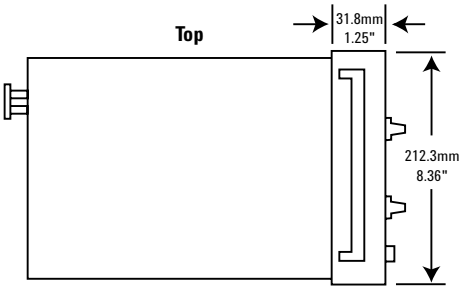
1494-0060 Rack Slide Kit

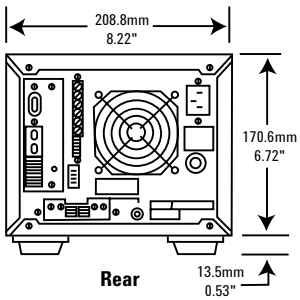
E3663AC Support rails for Agilent rack cabinets

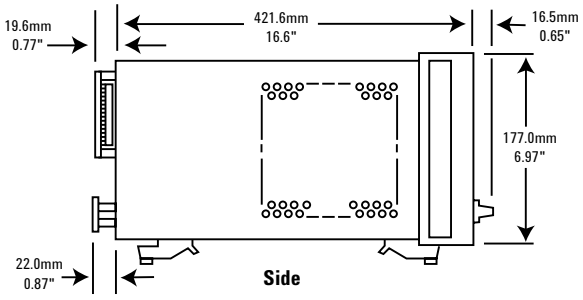
Agilent Models: 6033A, 6038A

Terminal Strip Detail









More detailed specifications at **www.agilent.com/find/6030**

Single-Output
750-1500 W GPIB, LAN, USB, LXI Class C

N5741A*

NEW N5741A - N5772A

- Small size: 1 U high
- Universal AC input (85-265 Vac)
- Analog/resistance control of output voltage and current
- Parallel and series connection of multiple supplies
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety
- LXI class C compliant

Agilent Open

The N5700 Series is a family of affordable 750 W and 1500 W switching regulated, single-output programmable DC power supplies. They offer 24 models for simple DC power application where speed and accuracy are not the primary concern. They provide stable output power, built-in voltage and current measurement, and output voltage and current from 6 V to 600 V and 1.3 A to 180 A.

Small, High-Density Package
The N5700 provides up to 1500 W in a small space-saving 1 U-high, 19-inch wide package. Its air vents are in the front, side and rear (not on the top or bottom), so you can stack other instruments directly above or below it to save valuable rack space.

Universal AC input
All models have universal AC input so they can be automatically operated from any AC mains input worldwide. They can be operated from line voltages of 85 – 265 VAC, 47 to 63 Hz, with no switch to set or fuses to change when you switch from one voltage standard to another. They also provide power factor correction.

Specifications (at 0˚ to 40˚C unless otherwise specified)		**N5741A**	**N5742A**	**N5743A**	**N5744A**	**N5745A**	**N5746A**
Number of Outputs		1	1	1	1	1	1
GPIB, LAN, USB		Yes	Yes	Yes	Yes	Yes	Yes
Ouput Ratings							
Voltage		6 V	8 V	12.5 V	20 V	30 V	40 V
Current		100 A	90 A	60 A	38 A	25 A	19 A
Power		600 W	720 W	750 W	760 W	750 W	760 W
Programming Accuracy							
Voltage	0.05%+	3 mV	4 mV	6.25 mV	10 mV	15 mV	20 mV
Current	0.1%+	100 mA	90 mA	60 mA	38 mA	25 mA	19 mA
Output Ripple and Noise							
CV p-p (Up to 20 MHz)		60 mV	60 mV	60 mV	60 mV	60 mV	60 mV
CV rms (From 5 Hz – 1 MHz)		8 mV	8 mV	8 mV	8 mV	8 mV	8 mV
Readback Accuracy							
Voltage	0.1%+	6 mV	8 mV	12.5 mV	20 mV	30 mV	40 mV
Current	0.1%+	300 mA	270 mA	180 mA	114 mA	75 mA	57 mA
Load Regulation (change from 10% to 90%)							
Voltage		2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current		25 mA	23 mA	17 mA	12.6 mA	10 mA	8.8 mA
Line Regulation (change from 85-132 VAC input or 170-265 VAC input)							
Voltage		2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current		12 mA	11 mA	8 mA	5.8 mA	4.5 mA	3.9 mA
Transient Response Time[1]							
Time		≤1.5 ms	≤1.5 ms	≤1.5 ms	≤1 ms	≤1 ms	≤1 ms

Notes:

[1] Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10% to 100% of rated output

* AC input connector: IEC 320 connector for 750 W models, and wire clamp connector for 1500 W models

More detailed specifications at **www.agilent.com/find/N5700**

Single-Output 750 W & 1500 W GPIB, LAN, USB (Continued)

Specifications

(at 0° to 40°C unless otherwise specified)

	N5741A	N5742A	N5743A	N5744A	N5745A	N5746A

Supplemental Characteristics

(Non-warranted characteristics determined by design that are useful in applying the product)

Output Response Time (settle to within ±1.0% of the rated output, with a resistive load)						
Up, full load	0.08 s	0.08 s	0.08 s	0.08 s	0.08 s	0.08 s
Down, full load	0.05 s	0.05 s	0.05 s	0.05 s	0.08 s	0.08 s
Down, no load	0.5 s	0.6 s	0.7 s	0.8 s	0.9 s	1.0 s
Remote Sense Compensation						
Volts/load lead	1 V	1 V	1 V	1 V	1.5 V	2 V
Output Ripple and Noise[2]						
CC rms	200 mA	180 mA	120 mA	76 mA	63 mA	48 m
Programming Resolution/ Measurement Resolution						
Voltage	0.72 mV	0.96 mV	1.5 mV	2.4 mV	3.6 mV	4.8 mV
Current	12 mA	10.8 mA	7.2 mA	4.56 mA	3 mA	2.3 mA

Notes:

[2] From 5 Hz – 1 MHz, at 10% to 100% of output voltage at full load (for 6 V units from 33% to 100% of output voltage)

Extensive Device Protection
To safeguard your device from damage, the N5700 Series power supplies provide over-temperature, over-current and over-voltage protect (OVP) to shut down the power supply output when a fault occurs. They also offer an undervoltage limit (UVL) that prevents adjustment of the output voltage below a certain limit. The combination of UVL and OVP capabilities lets you create a protection window for sensitive load circuitry

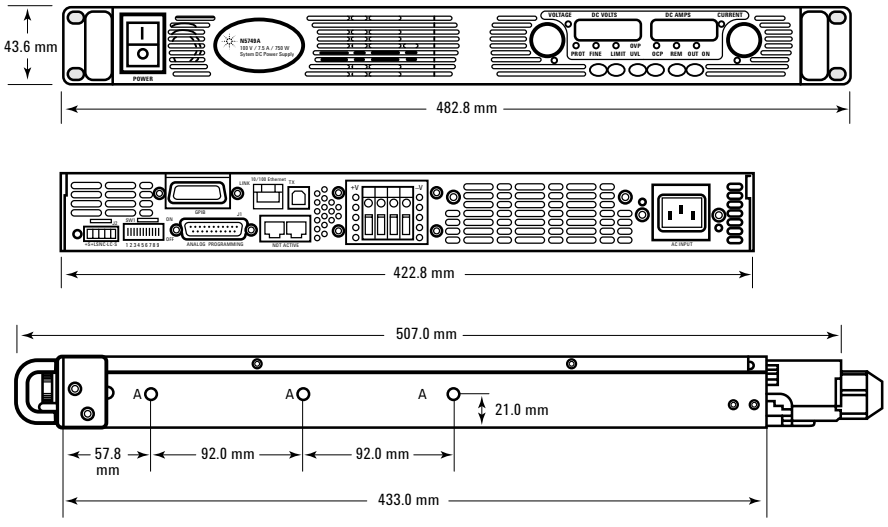
Simplify System Connection
The N5700 offers many system oriented features to simplify and accelerate test system development. They support the industry standard SCPI commands and come standard with software drivers.

With built-in GPIB, Ethernet/LAN, and USB 2.0 interfaces, the N5700 gives you the flexibility to use your I/O interface of choice today and in the future.

Additionally, the built-in Web server lets you operate, configure, and monitor the N5700 remotely via a standard browser such as Microsoft Internet Explorer.

Command Compatibility
The N5700 includes a compatibility command set for the Xantrex XFR series power supplies, the Sorensen DLM series power supplies, and the Agilent 603x series power supplies. This simplifies system integration when converting to the N5700.

Agilent Models: N5741A - N5772A



More detailed specifications at **www.agilent.com/find/N5700**

Single-Output 750 W & 1500 W GPIB, LAN, USB (Continued)

Analog/Resistance Programming
For greater programming flexibility and to minimize the time associated with computer interaction, both the output voltage and current can be controlled by an external voltage or resistance programming signal.

Connect Multiple Units in Parallel and Series
Should you need greater output power, the N5700 Series power supplies give you the flexibility to connect in parallel up to four similarly rated units for greater output current and connect two similarly rated units in series for greater output voltage (see DC float voltage information)

Fan Speed Control
Lab bench use is enhanced by the fan speed control, which helps to minimize the acoustic noise.

Application Notes:

Side-by-Side Comparison: Agilent N5700 System DC Source and Sorensen DLM Power Supply
5989-1628EN

Side-by-Side Comparison: Agilent N5700 System DC Source and Xantrex XFR DC Power Supply
5989-1630EN

Trends in Programmable Medium Power (~1 kW) System DC Power Supplies
5989-1331EN

Specifications (at 0° to 40°C unless otherwise specified)	N5747A	N5748A	N5749A	N5750A	N5751A	N5752A
Number of Outputs	1	1	1	1	1	1
GPIB, LAN, USB	Yes	Yes	Yes	Yes	Yes	Yes
Ouput Ratings						
Voltage	60 V	80 V	100 V	150 V	300 V	600 V
Current	12.5 A	9.5 A	7.5 A	5 A	2.5 A	1.3 A
Power	750 W	760 W	750 W	750 W	750 W	780 W
Programming Accuracy						
Voltage 0.05%+	30 mV	40 mV	50 mV	75 mV	150 mV	300 mV
Current 0.1%+	12.5 mA	9.5 mA	7.5 mA	5 mA	2.5 mA	1.3 mA
Output Ripple and Noise						
CV p-p (Up to 20 MHz)	60 mV	80 mV	80 mV	100 mV	150 mV	300 mV
CV rms (From 5 Hz – 1 MHz)	8 mV	8 mV	8 mV	12 mV	20 mV	60 mV
Readback Accuracy						
Voltage 0.1%+	60 mV	80 mV	100 mV	150 mV	300 mV	600 mV
Current 0.1%+	37.5 mA	28.5 mA	22.5 mA	15 mA	7.5 mA	3.9 mA
Load Regulation (change from 10% to 90%)						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	7.5 mA	6.9 mA	6.5 mA	6 mA	5.5 mA	5.26 mA
Line Regulation (change from 85-132 VAC input or 170-265 VAC input)						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	3.25 mA	2.95 mA	2.75 mA	2.5 mA	2.25 mA	2.13 mA
Transient Response Time[1]						
Time	≤ 1 ms	≤ 1 ms	≤ 1 ms	≤ 2 ms	≤ 2 ms	≤ 2 ms

Supplemental Characteristics (Non-warranted characteristics determined by design that are useful in applying the product)

Output Response Time (settle to within ±1.0% of the rated output, with a resistive load)						
Up, full load	0.08 s	0.15 s	0.15 s	0.15 s	0.15 s	0.25 s
Down, full load	0.08 s	0.15 s	0.15 s	0.15 s	0.15 s	0.30 s
Down, no load	1.1 s	1.2 s	1.5 s	2.0 s	3.0 s	4.0 s
Remote Sense Compensation						
Volts/load lead	3 V	4 V	5 V	5 V	5 V	5 V
Output Ripple and Noise[2]						
CC rms	38 mA	29 mA	23 mA	18 mA	13 mA	8 mA
Programming Resolution/ Measurement Resolution						
Voltage	7.2 mV	9.6 mV	12 mV	18 mV	36 mV	72 mV
Current	1.5 mA	1.14 mA	0.9 mA	0.6 mA	0.3 mA	0.156 mA

Notes:

1 Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10% to 100% of rated output

2 From 5 Hz – 1 MHz, at 10% to 100% of output voltage at full load (for 6 V units from 33% to 100% of output voltage)

More detailed specifications at **www.agilent.com/find/N5700**

Single-Output 750 W & 1500 W GPIB, LAN, USB (Continued)

Supplemental Characteristics for all model numbers

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 55 ms.

DC Floating Voltage:

6 V to 60 V units
No output terminal may be more than ±60 VDC from any other terminal or chassis ground

80 V to 600 V units
No output terminal may be more than ±600 VDC from any other terminal or chassis ground

Modulation: (Analog programming of output voltage and current)

Input Signal: selectable, 0 to 5 V/0 to 10 V full scale

Input Impedance: selectable, 0 to 5 kΩ/0 to 10 kΩ full scale

I/O Interface: GPIB, LAN, USB standard

Software Driver:

- IVI-COM
- LabVIEW

AC Input:

Input Range: 85 – 265 VAC; 47 – 63 Hz

Input Current 750 W: 10.5 A at 100 VAC nominal; 5 A at 200 VAC nominal

Input Current 1500 W: 21 A at 100 VAC nominal; 11 A at 200 VAC nominal

Notes:

1 Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10% to 100% of rated output

2 From 5 Hz – 1 MHz, at 10% to 100% of output voltage at full load (for 6 V units from 33% to 100% of output voltage)

Specifications (at 0° to 40°C unless otherwise specified)		N5761A	N5762A	N5763A	N5764A	N5765A	N5766A
Number of Outputs		1	1	1	1	1	1
GPIB, LAN, USB		Yes	Yes	Yes	Yes	Yes	Yes
Ouput Ratings							
Voltage		6 V	8 V	12.5 V	20 V	30 V	40 V
Current		180 A	165 A	120 A	76 A	50 A	38 A
Power		1080 W	1320 W	1500 W	1520 W	1500 W	1520 W
Programming Accuracy							
Voltage	0.05%+	3 mV	4 mV	6.25 mV	10 mV	15 mV	20 mV
Current	0.1%+	180 mA	165 mA	120 mA	76 mA	50 mA	38 mA
Output Ripple and Noise							
CV p-p (Up to 20 MHz		60 mV	60 mV	60 mV	60 mV	60 mV	60 mV
CV rms (From 5 Hz – 1 MHz		8 mV	8 mV	8 mV	8 mV	8 mV	8 mV
Readback Accuracy							
Voltage	0.1%+	6 mV	8 mV	12.5 mV	20 mV	30 mV	40 mV
Current	0.1%+	540 mA	495 mA	360 mA	228 mA	150 mA	114 mA
Load Regulation (change from 10% to 90%)							
Voltage		2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current		41 mA	38 mA	29 mA	20.2 mA	15 mA	12.6 mA
Line Regulation (change from 85-132 VAC input or 170-265 VAC input)							
Voltage		2.6 mV	2.8 mV	3.25 mV	4 mV	5 mV	6 mV
Current		20 mA	18.5 mA	14 mA	9.6 mA	7 mA	5.8 mA
Transient Response Time[1]							
Time		≤ 1.5 ms	≤ 1.5 ms	≤ 1.5 ms	≤ 1 ms	≤ 1 ms	≤ 1 ms

Supplemental Characteristics (Non-warranted characteristics determined by design that are useful in applying the product)

Output Response Time (settle to within ±1.0% of the rated output, with a resistive load)							
Up, full load		0.08 s	0.08 s	0.08 s	0.08 s	0.08 s	0.08 s
Down, full load		0.05 s	0.05 s	0.05 s	0.05 s	0.08 s	0.08 s
Down, no load		0.5 s	0.6 s	0.7 s	0.8 s	0.9 s	1.0 s
Remote Sense Compensation							
Volts/load lead		1 V	1 V	1 V	1 V	1.5 V	2 V
Output Ripple and Noise[2]							
CC rms		360 mA	330 mA	240 mA	152 mA	125 mA	95 mA
Programming Resolution/ Measurement Resolution							
Voltage		0.72 mV	0.96 mV	1.5 mV	2.4 mV	3.6 mV	4.8 mV
Current		21.6 mA	19.8 mA	14.4 mA	9.12 mA	6 mA	4.6 mA

More detailed specifications at **www.agilent.com/find/N5700**

Single-Output 750 W & 1500 W GPIB, LAN, USB (Continued)

Power Factor: 0.99 at nominal input and rated output power

Regulatory Compliance: European EMC directive 89/336/EEC for Class A products, Australian C-Tick mark, This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada. European Low Voltage Directive 73/23/EEC.

Size: 43.6 mm H x 422.8 mm W x 432.8 mm D (1.72 in x 16.65 in x 17.04 in), excluding connectors and handles

Weight: Net, 750 W – 7 Kg (15.4 lbs); 1500 W – 8.5 Kg (18.7 lbs)

Warranty Period: One year

Ordering Information

For N574x and N575x (750 W Models)

Opt 900 Power Cord, United Kingdom

Opt 902 Power Cord, Europe

Opt 903 Power Cord, USA, Canada

Opt 918 Power Cord, Japan

Opt 922 Power Cord, China

For N576x and N577x (1500 W Models)

Opt 861 Unterminated Power Cord, USA, Canada, China, Japan, Other

Opt 862 Harmonized Unterminated Power Cord, Europe

Accessories for all N5700 Models

N5740A Rack Mount Slide Kit (required for rack mounting; standard system II rack mounting hardware will not work).

Notes:

1 Time for output voltage to recover within 0.5% of its rated output for a load change from 10 to 90% of its rated output current. Voltage set point from 10% to 100% of rated output

2 From 5 Hz – 1 MHz, at 10% to 100% of output voltage at full load (for 6 V units from 33% to 100% of output voltage)

Specifications (at 0° to 40°C unless otherwise specified)	N5767A	N5768A	N5769A	N5770A	N5771A	N5772A
Number of Outputs	1	1	1	1	1	1
GPIB, LAN, USB	Yes	Yes	Yes	Yes	Yes	Yes
Ouput Ratings						
Voltage	60 V	80 V	100 V	150 V	300 V	600 V
Current	25 A	19 A	15 A	10 A	5 A	2.6 A
Power	1500 W	1520 W	1500 W	1500 W	1500 W	1560 W
Programming Accuracy						
Voltage 0.05%+	30 mV	40 mV	50 mV	75 mV	150 mV	300 mV
Current 0.1%+	25 mA	19 mA	15 mA	10 mA	5 mA	2.6 mA
Output Ripple and Noise						
CV p-p (Up to 20 MHz)	60 mV	80 mV	80 mV	100 mV	150 mV	300 mV
CV rms (From 5 Hz – 1 MHz)	8 mV	8 mV	8 mV	12 mV	20 mV	60 mV
Readback Accuracy						
Voltage 0.1%+	60 mV	80 mV	100 mV	150 mV	300 mV	600 mV
Current 0.1%+	75 mA	57 mA	45 mA	30 mA	15 mA	7.8 mA
Load Regulation (change from 10% to 90%)						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	10 mA	8.8 mA	8 mA	7 mA	6 mA	5.5 mA
Line Regulation (change from 85-132 VAC input or 170-265 VAC input)						
Voltage	8 mV	10 mV	12 mV	17 mV	32 mV	62 mV
Current	4.5 mA	3.9 mA	3.5 mA	3 mA	2.5 mA	2.26 mA
Transient Response Time[1]						
Time	≤ 1 ms	≤ 1 ms	≤ 1 ms	≤ 2 ms	≤ 2 ms	≤ 2 ms

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)

Output Response Time (settle to within ±1.0% of the rated output, with a resistive load)						
Up, full load	0.08 s	0.15 s	0.15 s	0.15 s	0.15 s	0.25 s
Down, full load	0.08 s	0.15 s	0.15 s	0.15 s	0.15 s	0.30 s
Down, no load	1.1 s	1.2 s	1.5 s	2.0 s	3.0 s	4.0 s
Remote Sense Compensation						
Volts/load lead	3 V	4 V	5 V	5 V	5 V	5 V
Output Ripple and Noise[2]						
CC rms	75 mA	57 mA	45 mA	35 mA	25 mA	12 mA
Programming Resolution/ Measurement Resolution						
Voltage	7.2 mV	9.6 mV	12 mV	18 mV	36 mV	72 mV
Current	3 mA	2.28 mA	1.8 mA	1.2 mA	0.6 mA	0.312 mA

More detailed specifications at **www.agilent.com/find/N5700**

High Performance DC Power Supplies...

speed and accuracy for test optimization

Agilent Performance DC Power Supplies provide the features and performance necessary to satisfy the most demanding requirements. For system designers who are striving to shorten test time and maximize production throughput, the Agilent High Performance DC power supplies will help them achieve their goals.

Multiple output power supplies reduce rack space. The advanced programmable capabilities allow for efficient system design and maintenance. Also their programming and measurement accuracy, and their DUT protection features, make them an excellent value for the R&D lab.

Comparison Summary	Agilent Basic DC Power Supplies	Agilent High Performance DC Power Supplies
Output Power	30 W-1500 W	40 W-6600 W
Number of outputs	1-3	1-8
GPIB programming and measurement speed	Moderate	Fast
Output rise/fall time	Moderate	Fast
Convenient 1/2 rack-size for bench-top use	Yes	No
Active Downprogrammer for enhanced test throughput	No	Yes
Stored wake-up state	No	Yes
Programmable Capabilities	Moderate	Extensive
Protection for the DUT	Moderate	Extensive

More detailed specifications at **www.agilent.com/find/power**

6611C - 6614C

Single-Output
40-50 W GPIB

Small, compact size for bench and system use
Fast, low-noise outputs
Dual-range, precision low current measurement
Built-in measurements and advanced programmable features
Protection features to ensure DUT safety

This series of linear-regulated 40-50 W DC power supplies is designed to maximize the throughput of DUTs through the manufacturing test process with fast programming and measurement, and also active downprogramming. It offers many advanced programmable features including stored states and status reporting. Programming is done using industry standard SCPI commands via the GPIB or RS-232. Test system integration is further simplified by using the VXI*Plug&Play* drivers. The optional relays simplify system design and troubleshooting.

The half-rack size of the 6610A series makes it a convenient DC power supply for the R&D lab bench. The built-in microamp measurement system helps the engineer to easily and accurately monitor the output voltage and current without a complicated test setup.

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

Specifications (at 0° to 55°C unless otherwise specified)			**6611C**	**6612C**	**6613C**	**6614C**	**6611C-J05** Special Order Option
Number of outputs			1	1	1	1	1
GPIB			Yes	Yes	Yes	Yes	Yes
Output Ratings							
Voltage			0 to 8 V	0 to 20 V	0 to 50 V	0 to 100 V	0 to 10 V
Current			0 to 5 A	0 to 2 A	0 to 1 A	0 to 0.5 A	0 to 5 A
Programming accuracy (at 25°C ±5°C)							
Voltage			5 m V	10 m V	20 m V	50 m V	5 m V
+Current		0.05% +	2 m A	1 m A	0.75 m A	0.5 m A	2 m A
Ripple and noise 20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded							
Voltage		rms	0.5 mV	0.5 mV	0.5 mV	0.5 mV	0.5 mV
		peak -to-peak	3 mV	3 mV	4 mV	5 mV	3 mV
Normal mode		rms	2 mA	1 mA	1 mA	1 mA	2 mA
DC measurement accuracy via GPIB or front-panel meters with respect to actual output at 25°C ±5°C							
Voltage		0.03% +	2 mV	3 mV	6 mV	12 mV	2 mV
Low current range	-20 mA to + 20 mA	0.1% +	2.5 µA	2.5 µA	2.5 µA	2.5 µA	2.5 µA
High current range	+20 mA to + rated 1	0.2% +	0.5 mA	0.25 mA	0.2 mA	0.1 mA	0.5 mA
	-20 mA to - rated 1	0.2% +	1.1 mA	0.85 mA	0.8 mA	0.7 mA	1.1 mA
Load regulation							
Voltage			2 mV	2 mV	4 mV	5 mV	2 mV
Current			1 mA	0.5 mA	0.5 mA	0.5 mA	1 mA
Line regulation							
Voltage			0.5 mV	0.5 mV	1 mV	1 mV	0.5 mV
Current			0.5 mA	0.5 mA	0.25 mA	0.25 mA	0.5 mA

Transient response time Less than 100 µs for the output to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of the output current rating of the supply

Supplemental Characteristics	(Non-warranted characteristics determined by design and useful in applying the product)				
Average programming resolution					
Voltage	2 mV	5 mV	12.5 mV	25 mV	3 mV
Current	1.25 mA	0.5 mA	0.25 mA	0.125 mA	1.25 mA
Sink current	3 A	1.2 A	0.6 A	0.3 A	3 A

More detailed specifications at **www.agilent.com/find/6610**

Single-Output: 40-50 W GPIB (Continued)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground

Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the postive output lead due to load current change.

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital date is 4 ms for the power supplies connected directly to the GPIB.

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms.

GPIB Interface Capabilities: IEEE-488.2, SCPI command set, and 6630A Series programming compatability

Input Power: (full load): 1.6 A, 100 W (6611C: 2.2 A, 120 W)

Regulatory Compliance: Complies with EMC directive 89/336/EEC (ISM 1B).

Software Driver: VXI*Plug&Play*

Warranty Period: One year

Size: 212.8 mm W x 88.1 mm H x 368.3 mm D (8.4 in x 3.5 in x 14.5 in)

Weight: 8.2 kg (18.16 lb) net; 10.6 kg (23.5 lb) shipping

Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz

Opt 120 104 to 127 Vac, 47 to 63 Hz

Opt 220 191 to 233 Vac, 47 to 63 Hz

Opt 230 207 to 253 Vac, 47 to 63 Hz

Opt 760 Isolation and Reversal relays

* **Opt ICM** Rack-mount Kit (p/n 5063-9240)

* **Opt AXS** Rack-mount Kit side-by-side mounting of two units, Lock-link Kit p/n 5061-9694; Flange Kit p/n 5062-3974

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Opt 0B3 Service Manual

*Support rails required

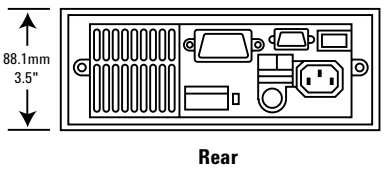
Accessories

Rack-mount and slide for two side-by-side units of different lengths p/n 1494-0015, 5063-9255 and filler panel 5002-3999

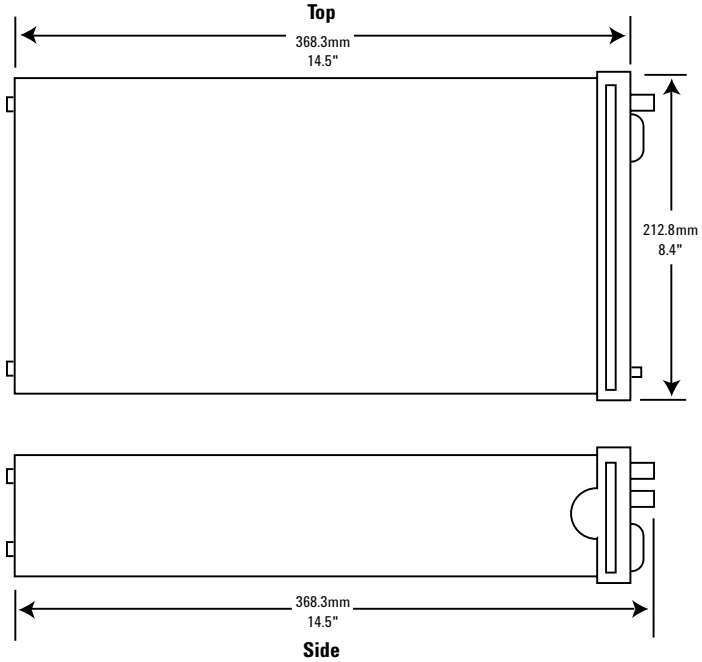
Rack-mount slide and support for one instrument p/n 1494-0015, 5063-9255 and filler panel 5002-3999

E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6611C, 6612C, 6613C, 6614C



Rear



Side

More detailed specifications at **www.agilent.com/find/6610**

Single-Output
80-100 W GPIB

6631B - 6634B

- Fast, low-noise outputs
- Programmable active down-programmer sinks the full rated current
- Dual-range, precision low current measurement
- Optional isolation and polarity reversal relays
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

This series of linear-regulated 80-100 W DC power supplies is designed to maximize the throughput of DUTs through the manufacturing test process. Both programming and measurement are optimized for speed. The active downprogrammer can sink up to the full rated current of the power supply, which quickly brings the power supply output to zero volts. The 6630B Series offers many advanced programmable features including stored states and status reporting. Programming is done using industry standard SCPI commands via the GPIB or RS-232. Test system integration is further simplified by using the VXI*Plug&Play* drivers. The optional relays simplify system design and troubleshooting.

The optional front panel binding posts make the 6630B Series convenient on the R&D lab bench. The built-in microamp measurement system helps the engineer to easily and accurately monitor the output voltage and current without a complicated test setup.

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Specifications (at 0° to 55°C unless otherwise specified)			**6631B**	**6632B**	**6633B**	**6634B**
Number of outputs			1	1	1	1
GPIB			Yes	Yes	Yes	Yes
Output ratings						
Voltage			0 to 8 V	0 to 20 V	0 to 50 V	0 to 100 V
Current			0 to 10 A	0 to 5 A	0 to 2 A	0 to 1 A
Programming accuracy at 25°C ±5°C						
Voltage			5 mV	10 mV	20 mV	50 mV
+ Current		0.05% +	4 mA	2 mA	1 mA	0.5 mA
Ripple and noise (20 Hz to 20 MHz, with outputs ungrounded or with either terminal grounded)						
Voltage Normal mode		rms	0.3 mV	0.3 mV	0.5 mV	0.5 mV
		peak-to-peak	3 mV	3 mV	3 mV	3 mV
Fast mode		rms	1 mV	1 mV	1 mV	2 mV
		peak-to-peak	10 mV	10 mV	15 mV	25 mV
Current		rms	3 mA	2 mA	2 mA	2 mA
DC measurement accuracy via GPIB or front panel meters with respect to actual output at 25°C ±5°C						
Voltage		0.03% +	2 mV	3 mV	6 mV	12 mV
Low current range	–20 mA to +20 mA	0.1% +	2.5 µA	2.5 µA	2.5 µA	2.5 µA
High current range	+20 mA to + rated I	0.2% +	1 mA	0.5 mA	0.25 mA	0.25 mA
	–20 mA to –rated I	0.2% +	1.6 mA	1.1 mA	0.85 mA	0.85 mA
Load regulation						
Voltage			2 mV	2 mV	4 mV	5 mV
Current			2 mA	1 mA	1 mA	1 mA
Line regulation						
Voltage			0.5 mV	0.5 mV	1 mV	1 mV
Current			1 mA	0.5 mA	0.25 mA	0.25 mA

Transient response time Less than 100 µs (50 µs in the fast mode) for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV) following any step change in load current of up to 50% of the output current rating of the supply.

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

More detailed specifications at **www.agilent.com/find/6630**

Single-Output: 80-100 W GPIB (Continued)

Specifications

(at 0° to 55°C unless otherwise specified)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground

Remote Sensing: Up to two volts dropped in each load lead. Add 2 mV to the voltage load regulation specification for each one volt change in the positive output lead due to load current change.

Command-Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 4 ms for the power supplies connected directly to the GPIB. (Display disabled).

Output-Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 2 ms (400 µs in fast mode). The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 6 ms (2 ms in the fast mode).

GPIB Interface Capabilities: IEEE-488.2, SCPI command set and 6630A Series programming compatability

Software Driver:
VXI*Plug&Play*

Measurement Time: Average time to make a voltage or current measurement is 50 ms.

Input Power (full load): 3.5 A, 250 W

Regulatory Compliance: Complies with EMC directive 89/336/EEC (ISM 1B).

Warranty Period: One year

Size: 425.5 mm W x 88.1 mm H x 364.4 mm D (16.8 in x 3.5 in x 14.3 in).

Weight: Net, 12.7 kg (28 lb) net; 15.0 kg (33 lb) shipping

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)

	6631B	6632B	6633B	6634B
Average programming resolution				
Voltage	2 mV	5 mV	12.5 mV	25 mV
Current	2.5 mA	1.25 mA	0.5 mA	0.25 mA
Sink current	10 A	5 A	2 A	1 A
Sink current tracking				
SCPI mode	0.4% + 4 mA	0.4% + 2 mA	0.4% + 1 mA	0.4% + 0.5 mA
Compatability mode	-500 mA	-250 mA	-100 mA	-50 mA
Minimum current in constant current mode*	40 mA	20 mA	8 mA	4 mA

*When programming in the 6630A Series language compatibility mode.

Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 230 207 to 253 Vac, 47 to 63 Hz
Opt 020 Front-panel Binding Posts (N/A on 6631B)
Opt 760 Isolation and Reversal Relays, only available at time of order (N/A on 6631B)
* **Opt 1CM** Rack-mount Kit, p/n 5063-9212
* **Opt 1CP** Rack-mount Kit with Handles, p/n 5063-9219

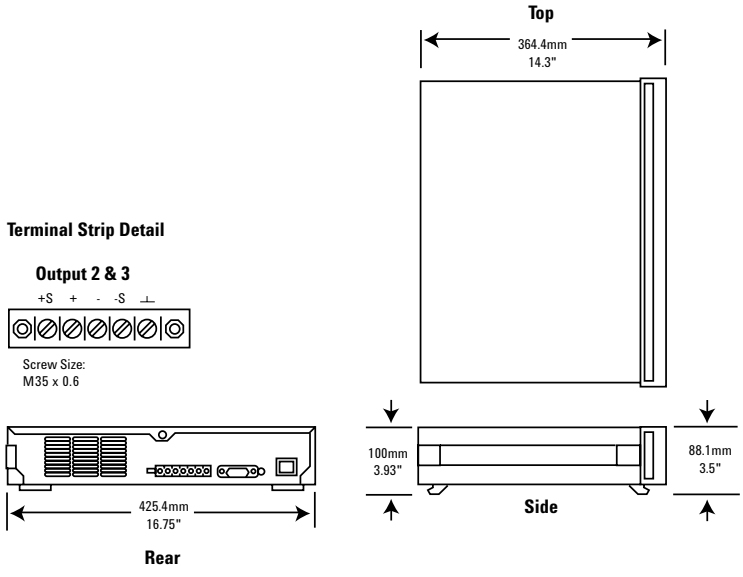
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual

* Support rails required

Accessories

p/n 1494-0060 Rack Slide Kit
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6631B, 6632B, 6633B, 6634B



More detailed specifications at **www.agilent.com/find/6630**

Single-Output
200 W GPIB

6641A - 6645A

- Fast, low-noise outputs
- Analog control of output voltage and current
- Fan-speed control to minimize acoustic noise
- Parallel and series connections of multiple units
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

This series of 200 W linear-regulated DC power supplies is designed to maximize the throughput of DUTs through the manufacturing test process with fast up and down programming time.

Valuable assemblies can be destroyed by a minor component failure that can allow a surge of voltage or current to flow to the DUT. Fast protection features, including fast crowbar, mode crossover protection, and the ability to connect the protection circuitry of multiple power supplies can increase production yield.

Programming of the DC output and the protection features can be done either from the front panel or using industry standard SCPI commands, via the GPIB. Using the serial link, up to 16 power supplies can be connected through one GPIB address. Test system integration can be further simplified be using the VXI*Plug&Play* drivers. The output voltage and current can also be controlled with analog signals. This is helpful for certain types of noisy environments, and also immediate reactions to process changes.

Lab bench use is enhanced by the fan speed control, which helps to minimize the acoustic noise.

Specifications (at 0° to 55°C unless otherwise specified)		**6641A**	**6642A**	**6643A**	**6644A**	**6645A**
Number of outputs		1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes
Output ratings						
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
Output current (40° C)		0 to 20 A	0 to 10 A	0 to 6 A	0 to 3.5 A	0 to 1.5 A
Maximum current (50° C/55° C)		18 A/17 A	9 A/8.5 A	5.4 A/5.1 A	3.2 A/3 A	1.4 A/1.3 A
Programming accuracy at 25°C ±5°C						
Voltage	0.06% +	5 mV	10 mV	15 mV	26 mV	51 mV
Current	0.15% +	26 mA	13 mA	6.7 mA	4.1 mA	1.7 mA
Ripple and noise from 20 Hz to 20 MHz						
Voltage	rms	300 µV	300 µV	400 µV	500 µV	700 µV
	peak-peak	3 mV	3 mV	4 mV	5 mV	7 mV
Current	rms	10 mA	5 mA	3 mA	1.5 mA	1 mA
Readback accuracy at 25°C ±5°C (percent of reading plus fixed)						
Voltage	0.07% +	6 mV	15 mV	25 mV	40 mV	80 mV
+Current	0.15% +	18 mA	9.1 mA	5 mA	3 mA	1.3 mA
-Current	0.35% +	40 mA	20 mA	12 mA	6.8 mA	2.9 mA
Load regulation						
Voltage		1 mV	2 mV	3 mV	4 mV	5 mV
Current		1 mA	0.5 mA	0.25 mA	0.25 mA	0.25 mA
Line regualtion						
Voltage		0.5 mV	0.5 mV	1 mV	1mV	2 mV
Current		1 mA	0.5 mA	0.25 mA	0.25 mA	0.25 mA

Transient response time Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current

Supplemental Characteristics	(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution					
Voltage	2 mV	5 mV	10 mV	15 mV	30 mV
Current	6 mA	3 mA	2 mA	1.2 mA	0.5 mA
OVP	13 mV	30 mV	54 mV	93 mV	190 mV
OVP accuracy	160 mV	400 mV	700 mV	1.2 V	2.4 V

More detailed specifications at **www.agilent.com/find/6640**

Single-Output: 200 W GPIB (Continued)

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

Modern Connectivity - Using USB and LAN I/O Converters (AN 1475-1)
5989-0123EN

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms.

Down Programming: An active down programmer sinks approximately 20% of the rated output current

Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to –5 V
Input Impedance: 10 k Ohm nominal

Specifications (at 0° to 55°C unless otherwise specified)		**6641A-J04** Special Order Option	**6643A-J11** Special Order Option	**6644A-J09** Special Order Option	**6645A-J05** Special Order Option	**6645A-J06** Special Order Option
Number of Outputs		1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes
Output ratings						
Output voltage		13 V	40 V	70 V	150 V	170 V
Output current (40°C)		15.3 A	5 A	3 A	1.2 A	1 A
Maximum current (50°C/55°C)		13.77 A/13 A	4.5 A/4.25 A	2.7 A/2.55 A	1.08 A/1.02 A	0.9 A/0.85 A
Programming accuracy at 25°C ±5°C						
Voltage	0.06% +	8.5 mV	17.5 mV	31 mV	65 mV	74 mV
Current	0.15% +	21 mA	6.7 mA	4.1 mA	1.7 mA	1.7 mA
Ripple and noise						
from 20 Hz to 20 MHz						
Voltage	rms	300 µV	450 µV	600 µV	900 µV	1 mV
	peak-peak	3 mV	3.5 mV	6 mV	9 mV	10 mV
	Current rms	8 mA	3 mA	1.5 mA	1 mA	1 mA
Readback accuracy at 25°C ±5°C (percent of reading plus fixed)						
Voltage	0.07% +	10 mV	30 mV	47 mV	100 mV	140 mV
+Current	0.15% +	15 mA	5 mA	3 mA	1.3 mA	1.3 mA
–Current	0.35% +	40 mA	12 mA	6.8 mA	2.9 mA	2.9 mA
Load regulation						
Voltage		1 mV	3 mV	4.5 mV	7 mV	8 mV
Current		1 mA	0.25 mA	0.25 mA	0.25 mA	0.25 mA
Line regulation						
Voltage		0.5 mV	1 mV	1.5 mV	2.5 mV	3 mV
Current		1 mA	0.25 mA	0.25 mA	0.25 mA	0.25 mA

Transient response time Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)						
Average resolution						
Voltage		3.5 mV	12 mV	1.4 mV	37.5 mV	42.5 mV
Current		5 mA	2 mA	1.2 mA	0.5 mA	0.5 mA
OVP		23 mV	62 mV	110 mV	250 mV	285 mV
OVP accuracy		260 mV	800 mV	1.5 mV	3 V	3.4 V

More detailed specifications at **www.agilent.com/find/6640**

Single-Output: 200 W GPIB (Continued)

AC Input: (AC input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	4.4 A	3.8 A	2.2 A	2.0 A

Input Power 480 VA, 400 W at full load; 60 W at no load

GPIB Interface Capabilities SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, E1, and C0. IEEE-488.2 and SCPI-compatible command set

Software Driver:
- IVI-COM
- VXI*Plug&Play*

Regulatory Compliance: Complies with UL 3111-1, IEC 61010-1.

Size: 425.5 mm W x 88.1 mm H x 439 mm D (16.75 in x 3.5 in x 17.3 in)

Weight: Net, 14.2 kg (31.4 lb); shipping, 16.3 kg (36 lb)

Warranty Period: One year

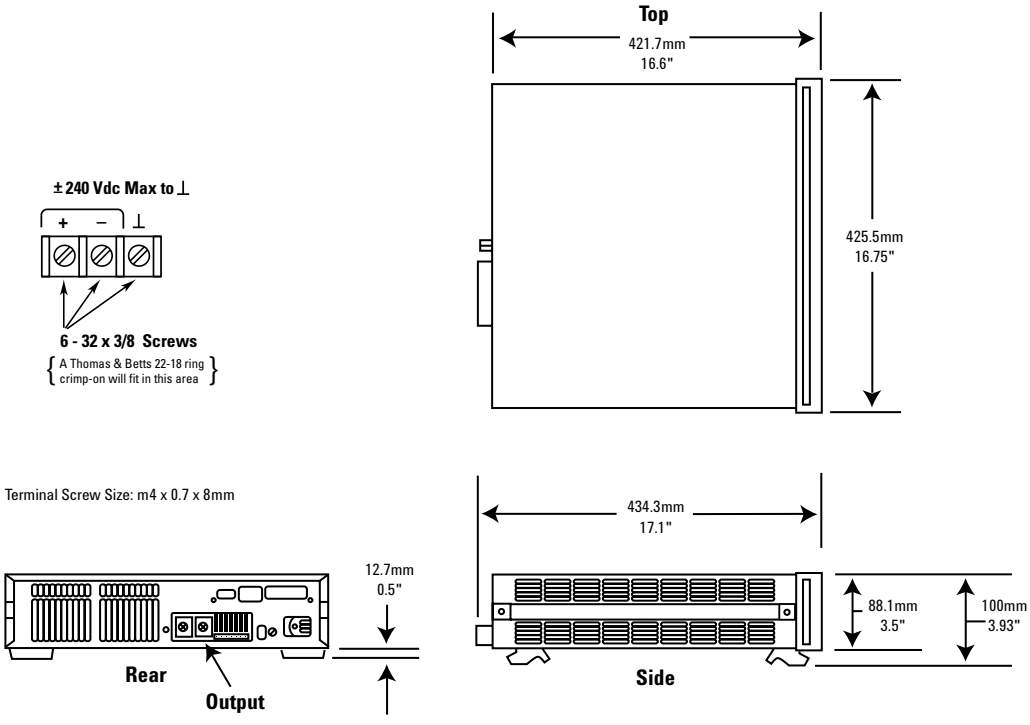
Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
* **Opt 908** Rack-mount Kit (p/n 5063-9212)
* **Opt 909** Rack-mount Kit w/ Handles (p/n 5063-9219)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories

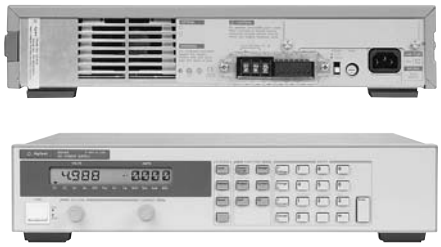
p/n 1494-0060 Accessory Slide Kit
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6641A, 6642A, 6643A, 6644A, 6645A



More detailed specifications at **www.agilent.com/find/6640**

Single-Output
200 W



6541A-6545A

- Front panel and analog control of output voltage and current
- Fast, low-noise outputs
- Fan-speed control to minimize acoustic noise
- Protection features to ensure DUT safety

This reliable series of 200 W DC power supplies can be controlled either from the front panel or via an analog programming voltage. When used in a test system, the fast up and down programming helps decrease test time. Quickly reacting protection features, including fast crowbar, CV/CC mode crossover and over-voltage protection help protect your valuable assemblies from damage. The linear topology produces very low ripple and noise, which allows you to make extremely accurate measurements of the devices which you are testing.

Lab bench use is enhanced by the fan speed control, which helps to minimize the acoustic noise.

Specifications (at 0° to 55°C unless otherwise specified)		**6541A**	**6542A**	**6543A**	**6544A**	**6545A**
Number of outputs		1	1	1	1	1
GPIB		No	No	No	No	No
Output ratings						
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
Output current (40° C)		0 to 20 A	0 to 10 A	0 to 6 A	0 to 3.5 A	0 to 1.5 A
Maximum current (50° C/55° C)		18 A/17 A	9 A/8.5 A	5.4 A/5.1 A	3.2 A/3 A	1.4 A/1.3 A
Programming accuracy	at 25°C ±5°C					
Voltage	0.06% +	5 mV	10 mV	15 mV	26 mV	51 mV
Current	0.14% +	26 mA	13 mA	6.7 mA	4.1 mA	1.7 mA
Ripple and noise						
from 20 Hz to 20 MHz						
Voltage rms		300 µV	300 µV	400 µV	500 µV	700 µV
peak-peak		3 mV	3 mV	4 mV	5 mV	7 mV
Current rms		10 mA	5 mA	3 mA	1.5 mA	1 mA
Load regulation						
Voltage		1 mV	2 mV	3 mV	4 mV	5 mV
Current		1 mA	0.5 mA	0.25 mA	0.25 mA	0.25 mA
Line regulation						
Voltage		0.5 mV	0.5 mV	1 mV	1mV	2 mV
Current		1 mA	0.5 mA	0.25 mA	0.25 mA	0.25 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current				
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution						
Voltage		2 mV	5 mV	10 mV	15 mV	30 mV
Current		6 mA	3 mA	2 mA	1.2 mA	0.5 mA
OVP		13 mV	30 mV	54 mV	93 mV	190 mV
OVP accuracy		160 mV	400 mV	700 mV	1.2 V	2.4 V

More detailed specifications at **www.agilent.com/find/6540**

Single-Output: 200 W (Continued)

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Understanding Linear Power Supply Operation (AN1554)
5989-2291EN

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms.

Down Programming: An active down programmer sinks approximately 20% of the rated output current

Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to –5 V
Input Impedance: 10 k Ohm nominal

AC Input: (AC input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	4.4 A	3.8 A	2.2 A	2.0 A

Input Power: 480 VA, 400 W at full load; 60 W at no load
Regulatory Compliance: Conforms to UL1244 and IEC 61010-1.

Size: 425.5 mm W x 88.1 mm H x 439 mm D (16.75 in x 3.5 in x 17.3 in)

Weight: Net, 14.2 kg (31.4 lb); shipping, 16.3 kg (36 lb)

Warranty Period: One year

Specifications (at 0° to 55°C unless otherwise specified)		**6541A-J04** Special Order Option	**6544A-J09** Special Order Option	**6545A-J05** Special Order Option
Number of outputs		1	1	1
GPIB		No	No	No
Output ratings				
Output voltage		13 V	70 V	150 V
Output current (40° C)		15.3 A	3 A	1.2 A
Maximum current (50° C/55° C)		13.77 A/13 A	2.7 A/2.55 A	1.08 A/1.02 A
Programming accuracy	at 25°C ±5°C			
Voltage	0.06% +	8.5 mV	31 mV	65 mV
Current	0.15% +	21 mA	4.1 mA	1.7 mA
Ripple and noise				
from 20 Hz to 20 MHz				
Voltage rms		300 µV	600 µV	900 µV
peak-peak		3 mV	6 mV	9 mV
Current rms		8 mA	1.5 mA	1 mA
Load regulation				
Voltage		1 mV	4.5 mV	7 mV
Current		1 mA	0.25 mA	0.25 mA
Line regulation				
Voltage		0.5 mV	1.5 mV	2.5 mV
Current		1 mA	0.25 mA	0.25 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current		
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)		
Average resolution				
Voltage		3.5 mV	1.4 mV	37.5 mV
Current		5 mA	1.2 mA	0.5 mA
OVP		23 mV	110 mV	250 mV
OVP accuracy		260 mV	1.5 mV	3 V

More detailed specifications at **www.agilent.com/find/6540**

Single-Output: 200 W (Continued)

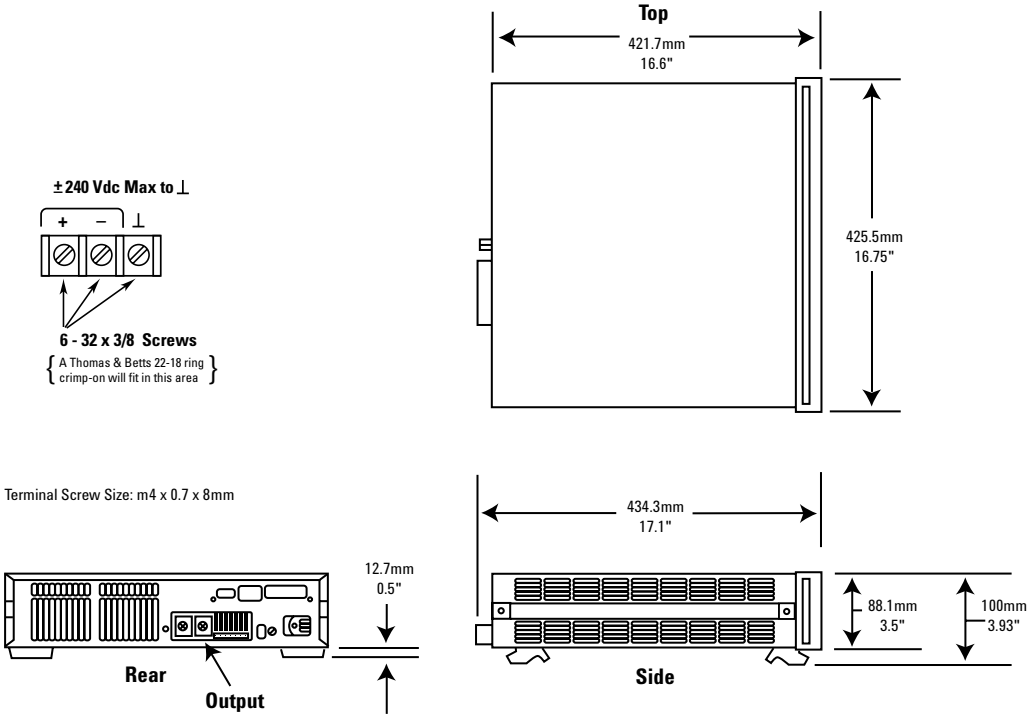
Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
* **Opt 908** Rack-mount Kit (p/n 5063-9212)
* **Opt 909** Rack-mount Kit w/ Handles (p/n 5063-9219)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories

p/n 1494-0060 Accessory Slide Kit
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6541A, 6542A, 6543A, 6544A, 6545A



More detailed specifications at **www.agilent.com/find/6540**

6651A-6655A

Single-Output
500 W GPIB

- Fast, low-noise outputs
- Analog control of output voltage and current
- Fan-speed control to minimize acoustic noise
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

This series of 500 W linear-regulated DC power supplies is designed to maximize the throughput of DUTs through the manufacturing test process with fast up and down programming time.

Valuable assemblies can be destroyed by a minor component failure that causes a surge of current to flow into the DUT. Fast protection features, including fast crowbar, mode crossover protection, and the ability to connect the protection circuitry of multiple power supplies can increase production yield.

Programming of the DC output and the protection features can be done either from the front panel or using industry standard SCPI commands, via the GPIB. Using the serial link, up to 16 power supplies can be connected through one GPIB address. Test system integration can be further simplified be using the VXI*Plug&Play* drivers. The output voltage and current can also be controlled with analog signals. This is helpful for certain types of noisy environments, and also immediate reactions to process changes.

Lab bench use is enhanced by the fan speed control, which helps to minimize the acoustic noise.

Specifications (at 0° to 55°C unless otherwise specified)		**6651A**	**6652A**	**6653A**	**6654A**	**6655A**	**6651A-J01** Special Order Option
Number of outputs		1	1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes	Yes
Output ratings							
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V	10 V
Output current (40°C)		0 to 50 A	0 to 25 A	0 to 15 A	0 to 9 A	0 to 4 A	50 A
Maximum current (50°C/55°C)		45 A/42.5 A	22.5 A/21.3 A	13.5 A/12.8 A	8.1 A/7.7 A	3.6 A/3.4 A	45 A/42.5 A
Programming accuracy at 25°C ±5°C							
Voltage	0.06% +	5 mV	10 mV	15 mV	26 mV	51 mV	6 mV
Current	0.15% +	60 mA	25 mA	13 mA	8 mA	4 mA	60 mA
Ripple and noise							
from 20 Hz to 20 MHz							
Voltage rms		300 µV	300 µV	400 µV	500 µV	700 µV	300 µV
peak-peak		3 mV	3 mV	4 mV	5 mV	7 mV	3 mV
Current rms		25 mA	10 mA	5 mA	3 mA	2 mA	25 mA
Readback accuracy at 25°C ±5°C (percent of reading plus fixed) System models only							
Voltage	0.07% +	6 mV	15 mV	25 mV	40 mV	80 mV	7.5 mV
+Current	0.15% +	67 mA	26 mA	15 mA	7 mA	3 mA	67 mA
–Current	0.35% +	100 mA	44 mA	24 mA	15 mA	7 mA	100 mA
Load regulation							
Voltage		1 mV	2 mV	3 mV	4 mV	5 mV	1 mV
Current		2 mA	1 mA	0.5 mA	0.5 mA	0.5 mA	2 mA
Line regulation							
Voltage		0.5 mV	0.5 mV	1 mV	1mV	2 mV	0.5 mV
Current		2 mA	1 mA	0.75 mA	0.5 mA	0.5 mA	2 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current					
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)					
Average resolution							
Voltage		2 mV	5 mV	10 mV	15 mV	30 mV	2.5 mV
Current		15 mA	7 mA	4 mA	2.5 mA	1.25 mA	15 mA
OVP		12 mV	30 mV	54 mV	93 mV	190 mV	16 mV
OVP accuracy		160 mV	400 mV	700 mV	1.2 V	2.4 V	200 mV

More detailed specifications at **www.agilent.com/find/6650**

Single-Output: 500 W GPIB (Continued)

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Understanding Linear Power Supply Operation
(AN1554)
5989-2291EN

Modern Connectivity - Using USB and LAN I/O Converters
(AN 1475-1)
5989-0123EN

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

Specifications (at 0° to 55°C unless otherwise specified)		**6651A-J03** Special Order Option	**6651A-J09** Special Order Option	**6652A-J03** Special Order Option	**6653A-J04** Special Order Option	**6653A-J17** Special Order Option
Number of outputs		1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes
Output ratings						
Output voltage		6 V	17V/20 V	27 V	40 V	30 V
Output current (40°C)		60 A	30 A/15 A	18.5 A	12.5 A	17.5 A
Maximum current (50°C/55°C)		54 A/5 1A	27 A/25.5 A 13.5 A/12.75 A	16.65 A/15.72 A	11.25 A/10.6 A	15.75 A/14.87 A
Programming accuracy at 25°C ±5°C						
Voltage	0.06% +	5 mV	10 mV	13.5 mV	17.5 mV	15 mV
Current	0.15% +	75 mA	36 mA	25 mA	13 mA	16 mA
Ripple and noise						
from 20 Hz to 20 MHz						
Voltage rms		300 µV	300 µV	450 µV	1.6 mV	400 µV
peak-peak		3 mV	4 mV	4.5 mV	5 mV	4 mV
Current rms		30 mA	13 mA	10 mA	5 mA	6 mA
Readback accuracy at 25°C ±5°C (percent of reading plus fixed) System models only						
Voltage	0.07% +	6 mV	15 mV	20.5 mV	30 mV	25 mV
+Current	0.15% +	80 mA	40 mA	26 mA	15 mA	18 mA
–Current	0.35% +	150 mA	55 mA	44 mA	24 mA	28 mA
Load regulation						
Voltage		1 mV	2 mV	2 mV	3.5 mV	3 mV
Current		6.5 mA	2 mA	1 mA	1 mA	0.5 mA
Line regulation						
Voltage		0.5 mV	0.5 mV	0.5 mV	1 mV	1 mV
Current		2 mA	2 mA	2 mA	0.75 mA	0.75 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current				
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution						
Voltage		2 mV	5 mV	6.75 mV	12mV	10 mV
Current		18 mA	9 mA	7 mA	4 mA	5 mA
OVP		12 mV	30 mV	30 mV	65 mV	54 mV
OVP accuracy		160 mV	500 mV	400 mV	750 mV	700 mV

More detailed specifications at **www.agilent.com/find/6650**

Single-Output: 500 W GPIB (Continued)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms.

Down Programming: An active down programmer sinks approximately 20% of the rated output current

Modulation: (Analog programming of output voltage and current)
Input signal: 0 to –5 V
Input impedance: 10 k Ohm nominal

AC Input: (AC input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	12 A	10 A	5.7 A	5.3 A

Input Power: 1,380 VA, 1,100 W at full load; 120 W at no load

GPIB Interface Capabilities: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, E1, and C0. IEEE-488.2 and SCPI-compatible command set.

Software Driver:
- IVI-COM
- VXI*Plug&Play*

Regulatory Compliance: Listed to UL 1244; conforms to IEC 61010-1.

Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.22 in x 19.6 in)

Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)

Warranty Period: One year

Specifications (at 0˚ to 55˚C unless otherwise specified)		**6654A-J04** Special Order Option	**6654A-J05** Special Order Option	**6654A-J12** Special Order Option	**6655A-J05** Special Order Option	**6655A-J10** Special Order Option
Number of outputs		1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes
Output ratings						
Output voltage		70 V	50 V	80 V	150 V	156 V
Output current (40˚C)		7.5 A	10 A	6 A	3.2 A	3 A
Maximum current (50˚C/55˚C)		6.75 A/6.37 A	9 A/8.5 A	5.4 A/5.1 A	2.88 A/2.72 A	2.7 A/2.55 A
Programming accuracy at 25˚C ±5˚C						
Voltage	0.06% +	30 mV	26 mV	35 mV	64 mV	71 mV
Current	0.15% +	7 mA	9 mA	7 mA	3.5 mA	4 mA
Ripple and noise from 20 Hz to 20 MHz						
Voltage rms		600 µV	500 µV	700 µV	800 µV	900 µV
peak-peak		6 mV	5 mV	7 mV	8 mV	8 mV
Current rms		5 mA	4 mA	3 mA	2 mA	3 mA
Readback accuracy at 25˚C ±5˚C (percent of reading plus fixed) System models only						
Voltage	0.07% +	50 mV	40 mV	58 mV	100 mV	110 mV
+Current	0.15% +	6 mA	8 mA	6 mA	2.5 mA	3 mA
–Current	0.35% +	13 mA	17 mA	16 mA	6.5 mA	7.5 mA
Load regulation						
Voltage		4 mV	4 mV	4 mV	6 mV	7 mV
Current		0.5 mA	0.5 mA	0.5 mA	0.5 mA	1 mA
Line regulation						
Voltage		1 mV	1 mV	4.5 mV	2 mV	2 mV
Current		0.5 mA	0.5 mA	0.5 mA	0.5 mA	1 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current				
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution						
Voltage		17.5 mV	15 mV	20 mV	37.5 mV	39.5 mV
Current		1.9 mA	2.75 mA	1.7 mA	8 mA	8 mA
OVP		110 mV	93 mV	130 mV	240 mV	250 mV
OVP accuracy		1.4 V	1.2 V	1.6 V	3 V	3.3 V

More detailed specifications at **www.agilent.com/find/6650**

Single-Output: 500 W GPIB (Continued)

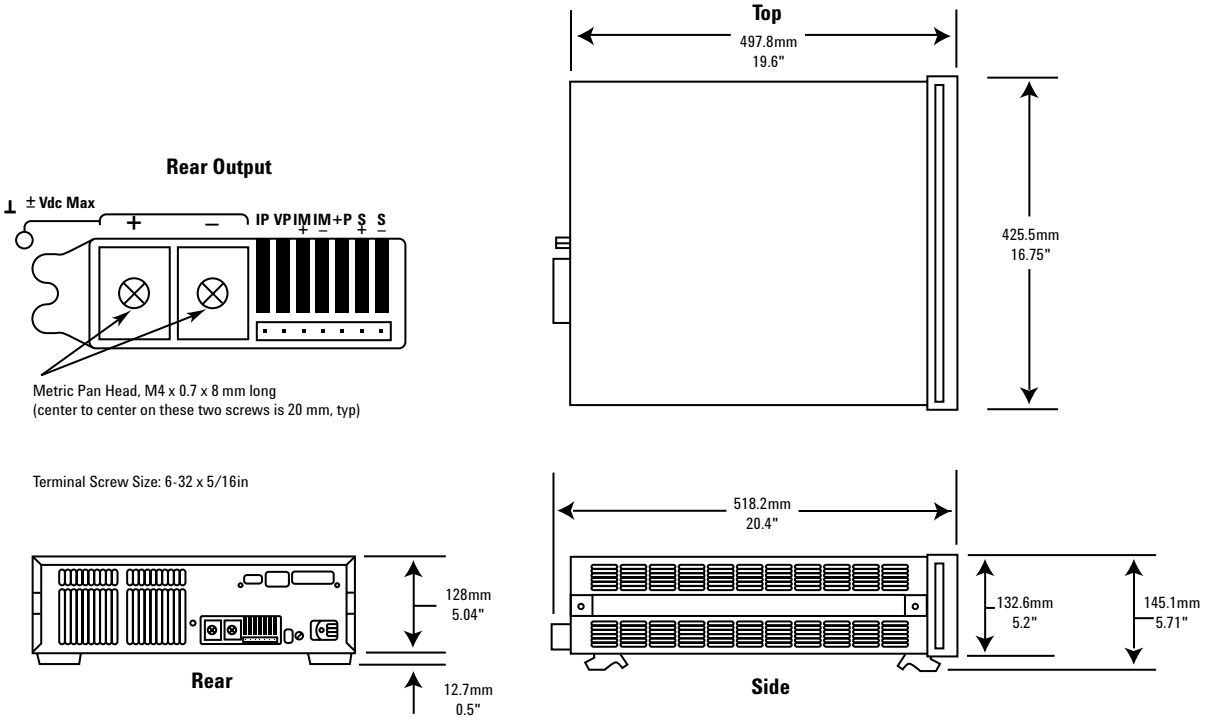
Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
* **Opt 908** Rack-mount Kit (p/n 5062-3977)
* **Opt 909** Rack-mount Kit w/ Handles (p/n 5063-9221)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories

p/n 1494-0059 Accessory Slide Kit
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6651A, 6652A, 6653A, 6654A, 6655A



More detailed specifications at **www.agilent.com/find/6650**

Single-Output
500 W

6551A-6555A

Front panel and analog control of output voltage and current
Fast, low-noise outputs
Fan-speed control to minimize acoustic noise
Protection features to ensure DUT safety

This reliable series of 500 W DC power supplies can be controlled either from the front panel or via an analog programming voltage. When used in a test system, the fast up and down programming helps decrease test time. Quickly reacting protection features, including fast crowbar, CV/CC mode crossover and over-voltage protection help protect your valuable assemblies from damage. The linear topology produces very low ripple and noise, which allows you to make extremely accurate measurements of the devices which you are testing.

Lab bench use is enhanced by the fan speed control, which helps to minimize the acoustic noise.

Specifications (at 0° to 55°C unless otherwise specified)		**6551A**	**6552A**	**6553A**	**6554A**	**6555A**
Number of outputs		1	1	1	1	1
GPIB		No	No	No	No	No
Output ratings						
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
Output current (40° C)		0 to 50 A	0 to 25 A	0 to 15 A	0 to 9 A	0 to 4 A
Maximum current (50° C/55° C)		45 A/42.5 A	22.5 A/21.3 A	13.5 A/12.8 A	8.1 A/7.7 A	3.6 A/3.4 A
Programming accuracy at 25°C ±5°C						
Voltage	0.06% +	5 mV	10 mV	15 mV	26 mV	51 mV
Current	0.15% +	60 mA	25 mA	13 mA	8 mA	4 mA
Ripple and noise from 20 Hz to 20 MHz						
Voltage rms		300 µV	300 µV	400 µV	500 µV	700 µV
peak-peak		3 mV	3 mV	4 mV	5 mV	7 mV
Current rms		25 mA	10 mA	5 mA	3 mA	2 mA
Load regulation						
Voltage		1 mV	2 mV	3 mV	4 mV	5 mV
Current		2 mA	1 mA	0.5 mA	0.5 mA	0.5 mA
Line regulation						
Voltage		0.5 mV	0.5 mV	1 mV	1mV	2 mV
Current		2 mA	1 mA	0.75 mA	0.5 mA	0.5 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current				
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution						
Voltage		2 mV	5 mV	10 mV	15 mV	30 mV
Current		15 mA	7 mA	4 mA	2.5 mA	1.25 mA
OVP		12 mV	30 mV	54 mV	93 mV	190 mV
OVP accuracy		160 mV	400 mV	700 mV	1.2 V	2.4 V

More detailed specifications at **www.agilent.com/find/6550**

Single-Output: 500 W (Continued)

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Understanding Linear Power Supply Operation
(AN1554)
5989-2291EN

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

Specifications (at 0˚ to 55˚C unless otherwise specified)		**6551A-J01** Special Order Option	**6551A-J03** Special Order Option	**6553A-J04** Special Order Option	**6553A-J17** Special Order Option
Number of outputs		1	1	1	1
GPIB		No	No	No	No
Output ratings					
Output voltage		10 V	6 V	40 V	30 V
Output current (40° C)		50 A	60 A	12.5 A	17.5 A
Maximum current (50° C/55° C)		45 A/42.5 A	54 A/51 A	11.25 A/10.6 A	15.75 A/14.87 A
Programming accuracy at 25°C ±5°C					
Voltage	0.06% +	6 mV	5 mV	17.5 mV	15 mV
Current	0.15% +	60 mA	75 mA	13 mA	16 mA
Ripple and noise from 20 Hz to 20 MHz					
Voltage rms		300 µV	300 µV	1.6 mV	400 µV
peak-peak		3 mV	3 mV	5 mV	4 mV
Current rms		25 mA	30 mA	5 mA	6 mA
Load regulation					
Voltage		1 mV	1 mV	3.5 mV	3 mV
Current		2 mA	6.5 mA	1 mA	0.5 mA
Line regulation					
Voltage		0.5 mV	0.5 mV	1 mV	1 mV
Current		2 mA	2 mA	0.75 mA	0.75 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current			
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)			
Average resolution					
Voltage		2.5 mV	2 mV	12 mV	10 mV
Current		15 mA	18 mA	4 mA	5 mA
OVP		16 mV	12 mV	65 mV	54 mV
OVP accuracy		200 mV	160 mV	750 mV	700 mV

More detailed specifications at **www.agilent.com/find/6550**

Single-Output: 500 W (Continued)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Output Programming Response Time: The rise and fall time (10/90% and 90/10%) of the output voltage is less than 15 ms. The output voltage change settles within 1 LSB (0.025% x rated voltage) of final value in less than 60 ms.

Down Programming: An active down programmer sinks approximately 20% of the rated output current

Modulation: (Analog programming of output voltage and current)
Input signal: 0 to –5 V
Input impedance: 10 k Ohm nominal

AC Input: (AC input frequency 47 to 63 Hz)

Voltage	100 Vac	120 Vac	220 Vac	240 Vac
Current	12 A	10 A	5.7 A	5.3 A

Input Power: 1,380 VA, 1,100 W at full load; 120 W at no load

Regulatory Compliance: Listed to UL 1244; certified to CSA556B; conforms to IEC 61010-1.

Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.22 in x 19.6 in)

Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)

Warranty Period: One year

Specifications (at 0° to 55°C unless otherwise specified)		**6554A-J04** Special Order Option	**6554A-J05** Special Order Option	**6554A-J12** Special Order Option	**6555A-J10** Special Order Option
Number of outputs		1	1	1	1
GPIB		No	No	No	No
Output ratings					
Output voltage		70 V	50 V	80 V	156 V
Output current (40° C)		7.5 A	10 A	6 A	3 A
Maximum current (50° C/55° C)		6.75 A/6.37 A	9 A/8.5 A	5.4 A/5.1 A	2.7 A/2.55 A
Programming accuracy at 25°C ±5°C					
Voltage	0.06% +	38 mV	26 mV	35 mV	71 mV
Current	0.15% +	7 mA	9 mA	7 mA	4 mA
Ripple and noise from 20 Hz to 20 MHz					
Voltage rms		600 µV	500 µV	700 µV	900 µV
peak-peak		6 mV	5 mV	5 mV	8 mV
Current rms		5 mA	4 mA	3 mA	3 mA
Load regulation					
Voltage		4 mV	4 mV	4 mV	7 mV
Current		0.5 mA	0.5 mA	0.5 mA	1 mA
Line regulation					
Voltage		1 mV	1 mV	4.5 mV	2 mV
Current		0.5 mA	0.5 mA	0.5 mA	1 mA
Transient response time		Less than 100 µs for the output voltage to recover to its previous level (within 0.1% of the voltage rating of the supply or 20 mV, whichever is greater) following any step change in load current of up to 50% of rated current			
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)			
Average resolution					
Voltage		17.5 mV	15 mV	20 mV	39.5 mV
Current		1.9 mA	2.75 mA	1.7 mA	8 mA
OVP		110 mV	93 mV	130 mV	250 mV
OVP accuracy		1.4 V	1.2 V	1.6 V	3.3 V

More detailed specifications at **www.agilent.com/find/6550**

Single-Output: 500 W (Continued)

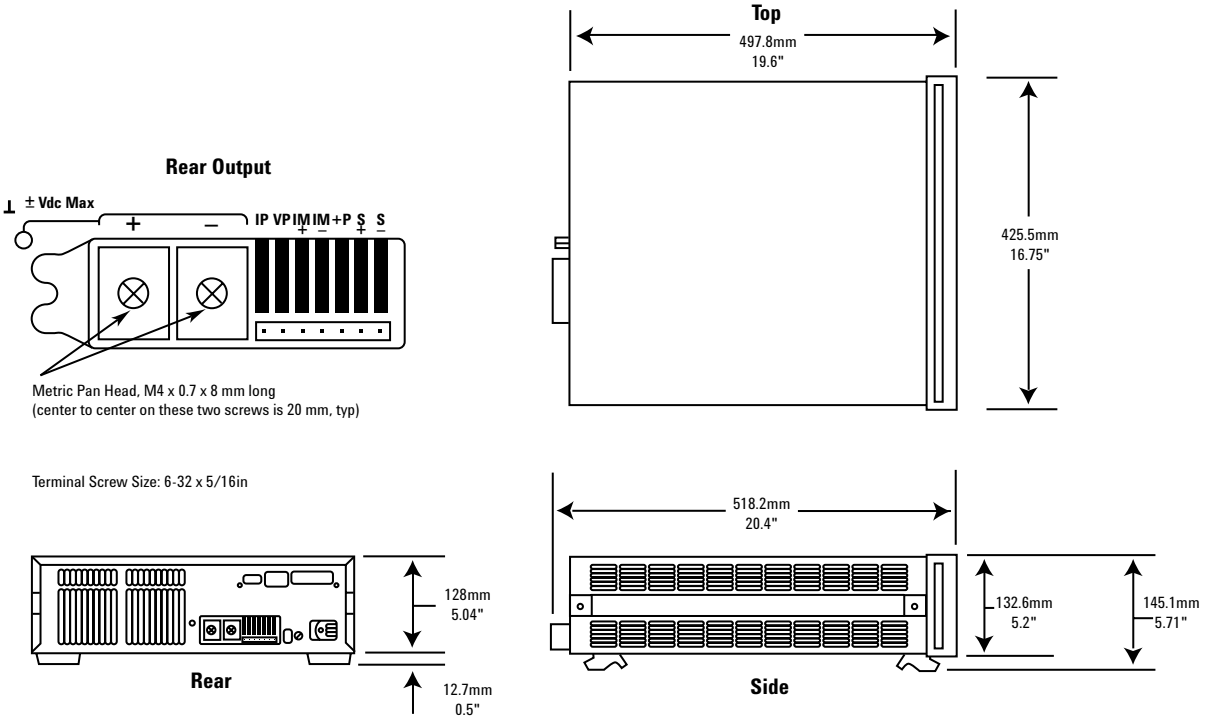
Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
* **Opt 908** Rack-mount Kit (p/n 5062-3977)
* **Opt 909** Rack-mount Kit w/ Handles (p/n 5063-9221)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories

p/n 1494-0059 Accessory Slide Kit
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6551A, 6552A, 6553A, 6554A, 6555A



More detailed specifications at **www.agilent.com/find/6550**

6671A - 6675A

Single-Output
2000 W GPIB

- Fast, low-noise outputs
- Analog control of output voltage and current
- Fan-speed control to minimize acoustic noise
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

This series of 2000 watt DC power supplies has the exceptional, proven reliability that test system engineers look for. It also has the unusual combination of high efficiency and low noise operation.

Programming of the DC output and the extensive protection features can be done either from the front panel or using industry standard SCPI commands, via the GPIB. Using the serial link, up to 16 power supplies can be connected through one GPIB address. Test system integration can be further simplified be using the VXI*Plug&Play* drivers. The output voltage and current can also be controlled with analog signals. This is helpful for certain types of noisy environments, and also immediate reactions to process changes.

Lab-bench use is enhanced by the fan-speed control, which minimizes acoustic noise. The extremely low ripple and noise helps the built-in measurement system make extremely accurate current and voltage measurements.

Specifications (at 0° to 55°C unless otherwise specified)		**6671A**	**6672A**	**6673A**	**6674A**	**6675A**
Number of outputs		1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes
Output ratings						
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V
Output current		0 to 220 A	0 to 100 A	0 to 60 A	0 to 35 A	0 to 18 A
Programming accuracy at 25°C ±5°C						
Voltage	0.04% +	8 mV	20 mV	35 mV	60 mV	120 mV
Current	0.1% +	125 mA	60 mA	40 mA	25 mA	12 mA
Ripple and noise						
from 20 Hz to 20 MHz						
Voltage rms		650 µV	750 µV	800 µV	1.25 mV	1.9 mV
Voltage peak to peak		7 mV	9 mV	9 mV	11 mV	16 mV
Current rms		200 mA	100 mA	40 mA	25 mA	12 mA
Readback accuracy at 25°C ±5°C (percent of reading plus fixed)						
Voltage	0.05% +	12 mV	30 mV	50 mV	90 mV	180 mV
±Current	0.1% +	150 mA	100 mA	60 mA	35 mA	18 mA
Load regulation						
Voltage	0.002%+	300 µV	650 µV	1.2 mV	2 mV	4 mV
Line regulation						
Current	0.005%+	10 mA	7 mA	4 mA	2 mA	1 mA
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50% or 50% to 100% of the output current rating of the supply				
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution						
Voltage		2 mV	5 mV	10 mV	15 mV	30 mV
Current		55 mA	25 mA	15 mA	8.75 mA	4.5 mA
OVP		15 mV	35 mV	65 mV	100 mV	215 mV
Output Voltage programming response time*						
(excluding command processing time)		30 ms	60 ms	130 ms	130 ms	195 ms

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

More detailed specifications at **www.agilent.com/find/6670**

Single-Output: 2000 W GPIB (Continued)

Application Notes:

6671A/72A/81A/82A/90A System DC Power Supplies Product Overview
5988-3050EN

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Specifications (at 0˚ to 55˚C unless otherwise specified)		**6671A-J03** Special Order Option	**6671A-J04** Special Order Option	**6671A-J08** Special Order Option	**6671A-J17** Special Order Option	**6672A-J04** Special Order Option	**6673A-J03** Special Order Option
Number of outputs		1	1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes	Yes
Output ratings							
Output voltage		14 V	10 V	3 V	15 V	24 V	37.5 V
Output current		150 A	200 A	300 A	120 A	85 A	45 A
Programming accuracy at 25˚C ±5˚C							
Voltage	0.04%+	14 mV	10 mV	4 mV	15 mV	25 mV	37.5 mV
Current	0.1%+	90 mA	125 mA	250 mA	90 mA	60 mA	40 mA
Ripple and noise							
from 20 Hz to 20 MHz							
Voltage rms		1.5 mV	750 µV	1 mV	1.5 mV	1 mV	800 µV
Voltage peak to peak		15 mV	9 mV	25 mV	15 mV	11 mV	9 mV
Current rms		150 mA	200 mA	275 mA	150 mA	100 mA	40 mA
Readback accuracy at 25˚C ±5˚C (percent of reading plus fixed) System models only							
Voltage	0.05% +	25 mV	15 mV	6 mV	27 mV	40 mV	53.5 mV
±Current	0.1% +	110 mA	150 mA	250 mA	110 mA	100 mA	60 mA
Load regulation							
Voltage	0.002%+	600 µV	300 µV	300 µV	650 µV	650 µV	1.2 mV
Line regulation							
Current	0.005%+	7 mA	10 mA	15 mA	7 mA	7 mA	4 mA
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50% or 50% to 100% of the output current rating of the supply					
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)					
Average resolution							
Voltage		4 mV	2.5 mV	1 mV	4 mV	6 mV	10 mV
Current		40 mA	55 mA	75 mA	35 mA	22 mA	15 mA
OVP		28 mV	20 mV	8 mV	30 mV	42 mV	65 mV
Output Voltage programming response time*							
(excluding command programming processing time)		30 ms	35 ms	30 ms	35 ms	70 ms	130 ms

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

More detailed specifications at **www.agilent.com/find/6670**

Single-Output: 2000 W GPIB (Continued)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Output Common-Mode Noise Current: (to signal ground binding post) 500 µA rms, 4 mA peak-to-peak

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB.

Modulation: (Analog programming of output voltage and current)
- **Input Signal:** 0 to –4 V for voltage, 0 to 7 V for current
- **Input Impedance:** 60 k Ohm or greater

Input Power: 3,800 VA, 2,600 W at full load; 170 W at no load

GPIB Interface Capabilities: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, E1, and C0. IEEE-488.2 and SCPI-compatible command set

Software Driver:
- IVI-COM
- VXI*Plug&Play*

Regulatory Compliance: Listed to UL1244; certified to CSA556B; conforms to IEC 61010-1.

Size: 425.5 mm W x 132.6 mm H x 640 mm D (16.75 in x 5.22 in x 25.2 in)

Weight: Net, 28.2 kg (62 lbs); shipping, 31.8 kg (70 lbs)

Warranty Period: One year

Specifications (at 0° to 55°C unless otherwise specified)		**6673A-J08** Special Order Option	**6674A-J03** Special Order Option	**6674A-J07** Special Order Option	**6675A-J04** Special Order Option	**6675A-J06** Special Order Option
Number of outputs		1	1	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes
Output ratings						
Output voltage		40 V	56 V	50 V	160 V	135 V
Output current		50 A	38 A	42 A	13 A	16 A
Programming accuracy at 25°C ±5°C						
Voltage	0.04%+	40 mV	60 mV	60 mV	160 mV	125 mV
Current	0.1%+	35 mA	28 mA	30 mA	10 mA	12 mA
Ripple and noise						
from 20 Hz to 20 MHz						
Voltage rms		1 mV	1.25 mV	1.25 mV	2.8 mV	2 mV
Voltge peak to peak		10.5 mV	11 mV	11 mV	20 mV	18 mV
Current rms		40 mA	28 mA	25 mA	18 mA	12 mA
Readback accuracy at 25°C ±5°C (percent of reading plus fixed) System models only						
Voltage	0.05%+	60 mV	90 mV	90 mV	240 mV	185 mV
±Current	0.1%+	60 mA	38 mA	42 mA	14 mA	18 mA
Load regulation						
Voltage	0.002%+	1.4 mV	2 mV	2 mV	6 mV	4 mV
Line regulation						
Current	0.005%+	4 mA	2 mA	2 mA	1 mA	4 mV
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50% or 50% to 100% of the output current rating of the supply				
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)				
Average resolution						
Voltage		10.5 mV	14 mV	12 mV	40 mV	34 mV
Current		12.5 mA	9.5 mA	11 mA	3.25 mA	4 mA
OVP		75 mV	100 mV	85 mV	300 mV	242 mV
Output Voltage programming response time*						
(excluding command programming processing time)		130 ms	130 ms	130 ms	280 ms	250 ms

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

More detailed specifications at **www.agilent.com/find/6670**

Single-Output: 2000 W GPIB (Continued)

Ordering Information

Opt 200 174 to 220 Vac, 47 to 63 Hz (Japan only)

Opt 230 191 to 250 Vac, 47 to 63 Hz

* **Opt 908** Rack-mount Kit (p/n 5062-3977)

* **Opt 909** Rack-mount Kit w/handles (p/n 5063-9221)

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Opt 0B3 Service Manual

A line cord option must be specified, see the AC line voltage and cord section.

* Support rails required

Accessories

p/n 1494-0059 Accessory Slide Kit

p/n 1252-3698 7-pin Analog Plug

p/n 1252-1488 4-pin Digital Plug

p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)

E3663AC Support rails for Agilent rack cabinets

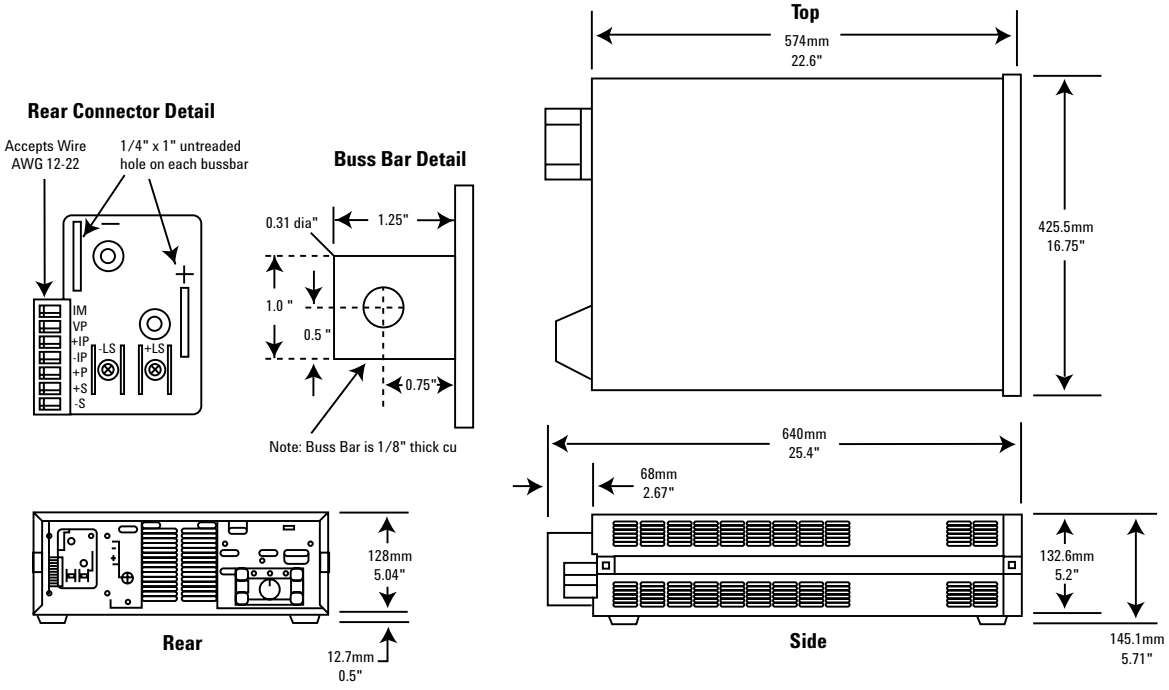
Specifications (at 0˚ to 55˚C unless otherwise specified)		**6675A-J07** Special Order Option	**6675A-J08** Special Order Option	**6675A-J09** Special Order Option	**6675A J11** Special Order Option
Number of outputs		1	1	1	1
GPIB		Yes	Yes	Yes	Yes
Output ratings					
Output voltage		200 V	100 V	110 V	150 V
Output current		11 A	22 A	20 A	15 A
Programming accuracy at 25˚C ±5˚C					
Voltage	0.04%+	200 mV	120 mV	120 mV	150 mV
Current	0.1%+	8 mA	15 mA	13.5 mA	11 mA
Ripple and noise					
from 20 Hz to 20 MHz					
Voltage rms		3.5 mV	1.9 mV	1.9 mV	2.5 mV
Voltge peak to peak		25 mV	16 mV	16 mV	18 mV
Current rms		15 mA	15 mA	13.5 mA	12 mA
Readback accuracy at 25˚C ±5˚C (percent of reading plus fixed) System models only					
Voltage	0.05%+	300 mV	180 mV	180 mV	225 mV
±Current	0.1%+	12 mA	22 mA	20 mA	15 mA
Load regulation					
Voltage	0.002% +	7 mV	4 mV	4 mV	6 mV
Line regulation					
Current	0.005% +	1 mA	4 mV	4 mV	1 mA
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50% or 50% to 100% of the output current rating of the supply			
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)			
Average resolution					
Voltage		50 mV	30 mV	30 mV	37.5 mV
Current		2.75 mA	4.5 mA	4.5 mA	3.75 mA
OVP		360 mV	215 mV	215 mV	270 mV
Output Voltage programming response time*					
(excluding command programming processing time)		350 ms	195 ms	195 ms	250 ms

* Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.

More detailed specifications at **www.agilent.com/find/6670**

Single-Output: 2000 W GPIB (Continued)

Agilent Models: 6671A, 6672A, 6673A, 6674A, 6675A



More detailed specifications at **www.agilent.com/find/6670**

E4356A

Single-Output
2000 W GPIB

Dual range output
Fast, low-noise outputs
Analog control of output voltage and current
Fan-speed control to minimize acoustic noise
Built-in measurements and advanced programmable features
Protection features to ensure DUT safety

This 2000 W DC power supply provides over 2000 watts at either 70 or 80 volts. This makes it particularly suitable for a variety of test scenarios for 48 volt systems. Telephone network equipment is one example of such a 48 volt bus application. It also has the unusual combination of high efficiency and low noise operation.

Programming of the DC output and the extensive protection features can be done either from the front panel or using industry standard SCPI commands, via the GPIB. Using the serial link, up to 16 power supplies can be connected through one GPIB address. Test system integration can be further simplified by using the VXI*Plug&Play* drivers. The output voltage and current can also be controlled with analog signals. This is helpful for certain types of noisy environments, and also immediate reactions to process changes.

Lab-bench use is enhanced by the fan-speed control, which minimizes acoustic noise. The extremely low ripple and noise helps the built-in measurement system make extremely accurate current and voltage measurements.

Specifications (at 0° to 55°C unless otherwise specified)	**E4356A**
Number of outputs	1
GPIB	Yes
Output ratings	
Voltage	0 to 70 V/0 to 80 V
Current	0 to 30 A/0 to 26 A
Programming accuracy at 25°C ±5°C (% of setting plus fixed)	
Voltage	0.04% + 80 mV
+Current	0.1% + 25 mA
Ripple and noise	
20 Hz to 20 MHz	
Voltage rms	2 mV
peak-peak	16 mV
Current rms	25 mA
DC measurement accuracy (via GPIB or front panel meters with respect to actual output at 25°C ±5°C	
Voltage	0.05% + 120 mV
Current	0.1% + 35 mA
Transient response time Time for the output voltage to recover to within 20 mV or 0.1% of the voltage rating of the unit following a change in load current of up to 50% of the output current rating.	<900 µs

Application Notes:

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc maximum from chassis ground.

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

More detailed specifications at **www.agilent.com/find/E4356**

Single-Output: 2000 W GPIB
(Continued)

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for the power supplies connected directly to the GPIB. (Display disabled.)

Output Voltage Rise Time/Fall Time: 100 ms/200 ms for output to change from 90% to 10% or from 10% to 90% of its total excursion with full resistive load (excludes command processing time).

Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to -4 V for voltage and current
Input Impedance: 60 k Ohm nominal

Input Power: 3800 VA, 2600 W at full load; 100 W at no load

GPIB Interface Capabilities: SH1, AH1, TE6, LE4, SR1, RL1, PP0, DC1, DT1, E1 and C0. IEEE-488.2 and SCPI-compatible command set

Software Driver:
- IVI-COM
- VXI*Plug&Play*

Regulatory Compliance: Listed to UL1244; certified to CSA556B, conforms to EN61010.

Warranty Period: One year

Size: 425.5 mm W x 132.6 mm H x 640 mm D
See page 102 for more details

Weight: 27.7 kg (61 lbs) net, 31.4 kg (69 lbs) shipping.

Ordering Information

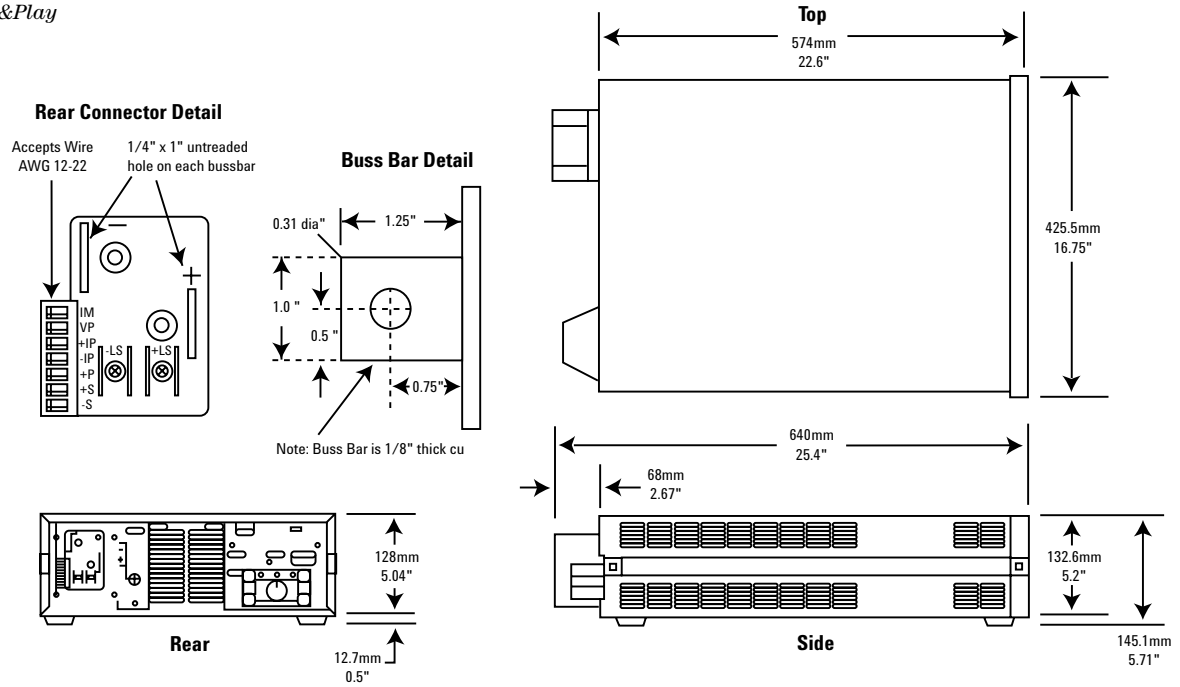
Opt 200 174 to 220 Vac, 47 to 63 Hz (Japan only)
Opt 230 191 to 250 Vac, 47 to 63 Hz
* **Opt 908** Rack-mount Kit (p/n 5062-3977)
* **Opt 909** Rack-mount Kit w/Handles (p/n 5063-9221)

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
A line cord option must be specified, see the AC line voltage and cord section.
* Support rails required

Accessories

p/n 1494-0059 Accessory Slide Kit
p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digitial Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
E3663AC Support rails for Agilent rack cabinets

Agilent Models: E4356A



More detailed specifications at **www.agilent.com/find/E4356**

Single-Output
2000 W

6571A-6575A

- Front panel and analog control of output voltage and current
- Fast, low-noise outputs
- Fan-speed control to minimize acoustic noise
- Protection features to ensure DUT safety

This series of 2000 watt DC power supplies has the exceptional, proven reliability that test system engineers look for. It also has the unusual combination of high efficiency and low noise operation.

These DC power supplies can be controlled either from the front panel or via an analog programming voltage. When used in a test system, the fast up and down programming helps decrease test time. Quickly reacting protection features, including CV/CC mode crossover and over-voltage protection help protect your valuable assemblies from damage.

Lab-bench use is enhanced by the fan-speed control, which minimizes acoustic noise. The extremely low ripple and noise helps the test engineer make extremely accurate current and voltage measurements.

Specifications (at 0° to 55°C unless otherwise specified)		6571A	6572A	6573A	6574A	6575A	6571A-J03 Special Order Option
Number of outputs		1	1	1	1	1	1
GPIB		No	No	No	No	No	No
Output ratings							
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V	14 V
Output current		0 to 220 A	0 to 100 A	0 to 60 A	0 to 35 A	0 to 18 A	150 A
Programming accuracy at 25°C ±5°C							
Voltage	0.04% +	8 mV	20 mV	35 mV	60 mV	120 mV	14 mV
Current	0.1% +	125 mA	60 mA	40 mA	25 mA	12 mA	90 mA
Ripple and noise from 20 Hz to 20 MHz							
Voltage rms		650 µV	750 µV	800 µV	1.25 mV	1.9 mV	1.5 mV
peak-peak		7 mV	9 mV	9 mV	11 mV	16 mV	15 mV
Current rms		200 mA	100 mA	40 mA	25 mA	12 mA	150 mA
Load regulation and line regulation							
Voltage	0.002%+	300 µV	650 µV	1.2 mV	2 mV	4 mV	600 µV
Current	0.005%+	10 mA	7 mA	4 mA	2 mA	1 mA	7 mA
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from 100% to 50% or 50% to 100% of the output current rating of the supply					
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)					
Average resolution							
Voltage		2 mV	5 mV	9 mV	15 mV	30 mV	4 mV
Current		55 mA	25 mA	15 mA	8.75 mA	4.5 mA	40 mA
OVP		15 mV	35 mV	65 mV	100 mV	215 mV	28 mV
Output voltage programming response time*							
*Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.		30 ms	60 ms	130 ms	130 ms	195 ms	30 ms

More detailed specifications at **www.agilent.com/find/6570**

Single-Output: 2000 W (Continued)

Application Notes:

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Output Common-Mode Noise Current: (to signal ground binding post) 500 µA rms, 4 mA peak-to-peak

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Modulation: (Analog programming of output voltage and current)
Input Signal: 0 to –4 V for voltage, 0 to 7 V for current
Input Impedance: 30 k Ohm or greater

Input Power: 3,800 VA, 2,600 W at full load; 170 W at no load

Regulatory Compliance: Listed to UL1244; certified to CSA556B; conforms to IEC 61010-1.

Size: 425.5 mm W x 132.6 mm H x 640 mm D (16.75 in x 5.22 in x 25.2 in)

Weight: Net, 28.2 kg (62 lb); shipping, 31.8 kg (70 lb)

Warranty Period: One year

Specifications (at 0˚ to 55˚C unless otherwise specified)		**6571A-J04** Special Order Option	**6571A-J17** Special Order Option	**6573A-J03** Special Order Option	**6573A-J08** Special Order Option	**6574A-J03** Special Order Option	**6574A-J07** Special Order Option
Number of outputs		1	1	1	1	1	1
GPIB		No	No	No	No	No	No
Output ratings							
Output voltage		10 V	15 V	37.5V	40 V	56 V	50 V
Output current		200 A	120 A	45 A	50 A	38 A	42 A
Programming accuracy at 25°C ±5°C							
Voltage	0.04% +	10 mV	15 mV	37.5 mV	40 mV	60 mV	60 mV
Current	0.1% +	125 mA	90 mA	40 mA	35 mA	28 mA	30 mA
Ripple and noise from 20 Hz to 20 MHz							
Voltage rms		750 µV	1.5 mV	800 µV	1 mV	1.25 mV	1.25 mV
peak-peak		9 mV	15 mV	9 mV	10.5 mV	11 mV	11 mV
Current rms		200 mA	150 mA	40 mA	40 mA	28 mA	25 mA
Load regulation and line regulation							
Voltage	0.002%+	300 uV	650 uV	1.2 mV	1.4 mV	2 mV	2 mV
Current	0.005%+	10 mA	7 mA	4 mA	4 mA	2 mA	2 mA
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from response time 100% to 50% or 50% to 100% of the output current rating of the supply					
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)					
Average resolution							
Voltage		2.5 mV	4 mV	10 mV	10.5 mV	14 mV	12 mV
Current		55 mA	35 mA	15 mA	12.5 mA	9.5 mA	11 mA
OVP		20 mV	30 mV	65 mV	75 mV	100 mV	85 mV
Output voltage programming response time*							
*Full load programming rise/fall time (10% to 90% or 90% to 10%) with full resistive load equal to rated output voltage/rated output current.		35 ms	35 ms	130 ms	130 ms	130 ms	130 ms

More detailed specifications at **www.agilent.com/find/6570**

Single-Output: 2000 W (Continued)

Ordering Information

Opt 200 174 to 220 Vac, 47 to 63 Hz (Japan only)

Opt 230 191 to 250 Vac, 47 to 63 Hz

* **Opt 908** Rack-mount Kit (p/n 5062-3977)

* **Opt 909** Rack-mount Kit w/ Handles (p/n 5063-9221)

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Opt 0B3 Service Manual

A line cord option must be specified, see the AC line voltage and cord section.

* Support rails required

Accessories

p/n 1494-0059 Accessory Slide Kit

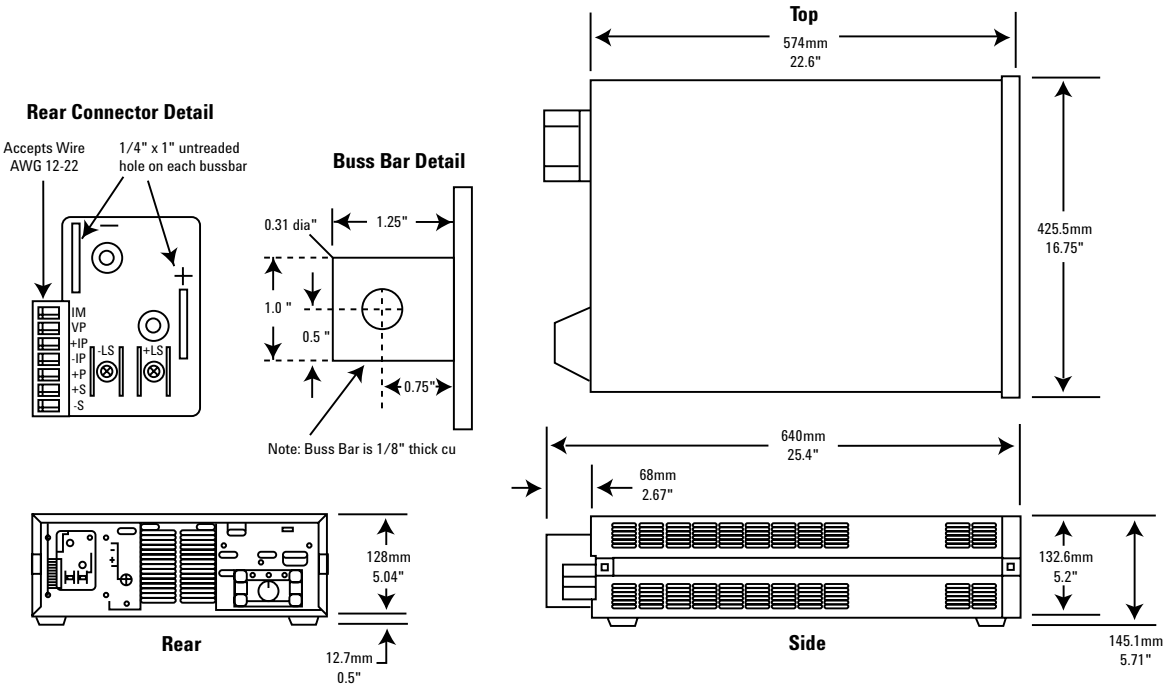
E3663AC Support rails for Agilent rack cabinets

Specifications (at 0˚ to 55˚C unless otherwise specified)		**6575A-J04** Special Order Option	**6575A-J06** Special Order Option	**6575A-J07** Special Order Option	**6575A-J08** Special Order Option	**6575A-J09** Special Order Option	**6575A-J11** Special Order Option
Number of outputs		1	1	1	1	1	1
GPIB		No	No	No	No	No	No
Output ratings							
Output voltage		160 V	135 V	200 V	100 V	110 V	150 V
Output current		13 A	16 A	11 A	22 A	20 A	15 A
Programming accuracy at 25°C ±5°C							
Voltage	0.04% +	160 mV	125 mV	200 mV	120 mV	120 mV	150 mV
Current	0.1% +	10 mA	12 mA	8 mA	15 mA	13.5 mA	11 mA
Ripple and noise from 20 Hz to 20 MHz							
Voltage rms		2.8 mV	2 mV	3.5 mV	1.9 mV	1.9 mV	2.5 mV
peak-peak		20 mV	18 mV	25 mV	16 mV	16 mV	18 mV
Current rms		18 mA	12 mA	15 mA	15 mA	13.5 mA	12 mA
Load regulation and line regulation							
Voltage	0.002%+	6 mV	4 mV	7 mV	4 mV	4 mV	6 mV
Current	0.005%+	1 mA	4 mV	1 mA	4 mV	4 mV	1 mA
Transient response time		Less than 900 µs for the output voltage to recover 100 mV following a change in load from response time 100% to 50% or 50% to 100% of the output current rating of the supply					
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)					
Average resolution							
Voltage		40 mV	34 mV	50 mV	30 mV	30 mV	37.5 mV
Current		3.25 mA	4 mA	2.75 mA	4.5 mA	4.5 mA	3.75 mA
OVP		300 mV	242 mV	360 mV	215 mV	215 mV	270 mV
Output voltage programming response time*							
*Full load programming rise/fall time (10% to 90% or 90%to 10%) with full resistive load equal to rated output voltage/rated output current.		280 ms	250 ms	350 ms	195 ms	195 ms	250 ms

More detailed specifications at **www.agilent.com/find/6570**

Single-Output: 2000 W (Continued)

Agilent Models: 6571A, 6572A, 6573A, 6574A, 6575A



More detailed specifications at **www.agilent.com/find/6570**

6680A-6684A

Single-Output
5000 W GPIB

- Low output ripple and noise
- Selectable compensation for inductive loads
- Analog control of output voltage and current
- Fan-speed control to minimize acoustic noise
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

Reliable DC power for manufacturing test and long-term burn-in
This series of 5000 watt DC power supplies has the exceptional, proven reliability that test system engineers look for. It also has the features needed for easy test system integration.

Programming of the DC output and the extensive protection features can be done either from the front panel or using industry standard SCPI commands, via the GPIB. Using the serial link, up to 16 power supplies can be connected through one GPIB address. Test system integration can be further simplified by using the VXI*Plug&Play* drivers. The output voltage and current can also be controlled with analog signals. This is helpful for certain types of noisy environments, and also immediate reactions to process changes.

The 6680A Series has extremely low ripple and noise for a 5000 watt DC power supply. This helps the built-in measurement system make extremely accurate current and voltage measurements.

Selectable compensation is provided for problem-free powering of inductive loads.

Specifications (at 0° to 55°C unless otherwise specified)	**6680A**	**6681A**	**6682A**	**6683A**	**6684A**	**6680A-J04** Special Order Option
Number of outputs	1	1	1	1	1	1
GPIB	Yes	Yes	Yes	Yes	Yes	Yes
Output ratings						
Voltage	0 to 5 V	0 to 8 V	0 to 21 V	0 to 32 V	0 to 40 V	0 to 3.3 V
Current (40°C then derate linearly 1%/°C from 40°C to 55°C)	0 to 875 A	0 to 580 A	0 to 240 A	0 to 160 A	0 to 128 A	0 to 1000 A
Programming accuracy at 25°C ±5°C						
Voltage 0.04% +	5 mV	8 mV	21 mV	32 mV	40 mV	5 mV
Current 0.1% +	450 mA	300 mA	125 mA	85 mA	65 mA	450 mV
Ripple and noise constant voltage mode from 20 Hz to 20 MHz						
rms	1.5 mV	1.5 mV	1.5 mV	1.0 mV	1.0 mV	3.4 mV
Peak to peak	10 mV	10 mV	10 mV	10 mV	10 mV	15 mV
Readback accuracy at 25°C ±5°C	(percent of reading plus fixed)					
Voltage 0.05% +	7.5 mV	12 mV	32 mV	48 mV	60 mV	7.5 mV
Current 0.1% +	600 mA	400 mA	165 mA	110 mA	90 mA	600 mA
Load and line regulation						
Voltage 0.002% +	0.19 mV	0.3 mV	0.65 mV	1.1 mV	1.5 mV	0.19 mV
Current 0.005% +	65 mA	40 mA	17 mA	12 mA	9 mA	77 mA
Transient response time	Less than 900 µs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply					
Supplemental Characteristics	(Non-warranted characteristics determined by design that are useful in applying this product)					
Ripple and noise constant current mode from 20 Hz to 20 MHz						
rms	290 mA	190 mA	40 mA	28 mA	23 mA	—
Average programming resolution						
Voltage	1.35 mV	2.15 mV	5.7 mV	8.6 mV	10.8 mV	12 mV
Current	235 mA	155 mA	64 mA	43 mA	34 mA	260 mA
OVP	30 mV	45 mV	120 mV	180 mV	225 mV	25 mV
Output voltage programming response time	9 ms	12 ms	45 ms	60 ms	60 ms	9 ms
(excludes command-processing time)	Full-load progrmming rise or fall time (10 to 90% or 90 to 10%, resistive load)					
Output common-mode noise current rms	1.5 mA	1.5 mA	3 mA	3 mA	3 mA	2.0 mA
(to signal-ground binding post) peak-to-peak	10 mA	10 mA	20 mA	20 mA	20 mA	12.5 mA

Note 1: Option 6680A-J04 is not available outside the USA because certification process is not complete.

More detailed specifications at **www.agilent.com/find/6680**

Single-Output: 5000 W GPIB (Continued)

Application Notes:

6671A/72A/81A/82A/90A System DC Power Supplies Product Overview
5988-3050EN

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±60 Vdc maximum from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available for the load.

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB

Modulation: (analog programming of output voltage and current):
Input Signal: 0 to –5 V for voltage, 0 to +5 V for current
Input Impedance: 30 kΩ/or greater

AC Input (47 to 63 Hz): 180 to 235 Vac (line-to-line, 3 phase), 27.7 A rms maximum worst case, 21.4 A rms nominal; 360 to 440 Vac, 14.3 A rms maximum worst case, 10.7 A rms nominal (maximum line current includes 5% unbalanced phase voltage condition.) Output voltage derated 5% at 50 Hz and below 200 Vac.

Input Power: 7350 VA and 6000 W maximum; 160 W at no load

GPIB Interface Capabilities: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, E1, and C0. IEEE-488.2 and SCPI command set.

Software Driver:
- IVI-COM
- VXI*Plug&Play*

Size: 425.5 mm W x 221.5 mm H x 674.7 mm D (16.75 in x 8.75 in x 25.56 in)

Weight: Net, 51.3 kg (113 lbs); shipping, 63.6 kg (140 lbs)

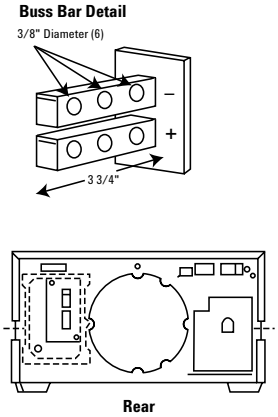
Warranty Period: One year

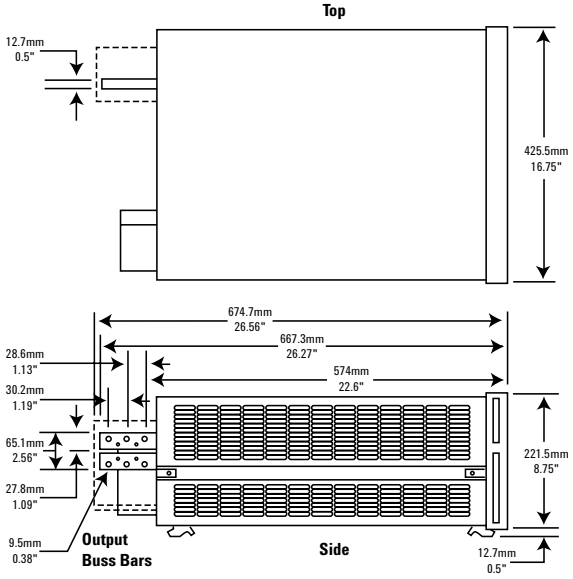
Ordering Information

Opt 208 180 to 235 Vac, 3 phase, 47 to 63 Hz
Opt 400 360 to 440 Vac, 3 phase, 47 to 63 Hz
Opt 602 Two Bus Bar Spacers for paralleling power supplies (p/n 5060-3514)
* **Opt 908** Rack-mount Kit (p/n 5062-3977 and p/n 5062-3974)
* **Opt 909** Rack-mount Kit with Handles (p/n 5063-9221 and p/n 5063-9219).
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories
p/n 5060-3513 Three 30-A Replacement Fuses for 180 to 235 Vac line
p/n 5060-3512 Three 16-A Replacement Fuses for 360 to 440 Vac line
E3663AC Support rails for Agilent rack cabinets
p/n 5080-2148 Serial link cable 2m (6.6 ft.)

Agilent Models: 6680A, 6681A, 6682A, 6683A, 6684A





More detailed specifications at **www.agilent.com/find/6680**

6690A-6692A

Single-Output
6600 W GPIB

- Low output ripple and noise
- Analog control of output voltage and current
- Fan-speed control to minimize acoustic noise
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

Reliable DC power for manufacturing test and long-term burn-in
This series of 6600 watt DC power supplies has the exceptional, proven reliability that test system engineers look for. It also has the features needed for easy test system integration.

Programming of the DC output and the extensive protection features can be done either from the front panel or using industry standard SCPI commands, via the GPIB. Using the serial link, up to 16 power supplies can be connected through one GPIB address. Test system integration can be further simplified by using the VXI*Plug&Play* drivers. The output voltage and current can also be controlled with analog signals. This is helpful for certain types of noisy environments, and also immediate reactions to process changes.

The 6690A Series has extremely low ripple and noise for a 6600 watt DC power supply. This helps the built-in measurement system make extremely accurate current and voltage measurements.

Specifications (at 0° to 55°C unless otherwise specified)		**6690A**	**6691A**	**6692A**
Number of outputs		1	1	1
GPIB		Yes	Yes	Yes
Output ratings				
Voltage		0 to 15 V	0 to 30 V	0 to 60 V
Current (derated linearly 1%/°C from 40°C to 55°C)		0 to 440 A	0 to 220 A	0 to 110 A
Programming accuracy at 25°C ±5°C				
Voltage	0.04% +	15 mV	30 mV	60 mV
Current	0.1% +	230 mA	125 mA	65 mA
Ripple and noise constant voltge mode from 20 Hz to 20 MHz				
	rms	2.5 mV	2.5 mV	2.5 mV
	Peak to peak	15 mV	25 mV	25 mV
Readback accuracy at 25°C ±5°C (percent of reading plus fixed offset) System models only				
Voltage	0.05% +	22.5 mV	45 mV	90 mV
Current	0.1% +	300 mA	165 mA	80 mA
Load regulation				
Voltage	0.002% +	0.65 mV	1.1 mV	2.2 mV
Current	0.005% +	40 mA	17 mA	9 mA
Line regulation				
Voltage	0.002% +	0.65 mV	0.65 mV	0.65 mV
Current	0.005% +	40.5 mA	17 mA	9 mA
Transient response time		Less than 900 µs for the output voltage to recover within 150 mV following a change in load from 100% to 50%, or 50% to 100% of the output current rating of the supply		

Application Notes:

6671A/72A/81A/82A/90A System DC Power Supplies Product Overview
5988-3050EN

Using Agilent 6690A Series System DC Power Supplies for Testing Data Storage Control Boards
(PN 6690A-1)
5988-3062EN

Using Agilent 6690A Series System DC Power Supplies for Automobile Battery Simulation
(PN 6690A-2)
5988-3061EN

More detailed specifications at **www.agilent.com/find/6690**

Single-Output: 6600 W GPIB (Continued)

Specifications (at 0˚ to 55˚C unless otherwise specified)	**6690A**	**6691A**	**6692A**

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminal can be floated up to ±60 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped in each load lead. The drop in the load leads subtracts from the voltage available at the load.

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is 20 ms for power supplies connected directly to the GPIB.

Modulation: (analog programming of output voltage and current):
Input Signal: 0 to –5 V for voltage, and 0 to +5 V for current.
Input Impedance: 30 kΩ or greater.

AC Input (47 to 63 Hz): 180 to 235 Vac (line-to-line 3 phase) 36 A rms maximum worst case, 28 A rms nominal; 360 to 440 Vac, 18 A rms maximum worst case, 14 A rms nominal. (Maximum line current includes 5% unbalanced phase voltage condition).

Software Driver:
- IVI-COM
- VXI*Plug&Play*

Input Power: 9000 VA and 7950 W maximum; 175 W at no load.

Size: 425.5 mm W x 221.5 mm H x 674.7 mm D (16.75 in x 8.75 in x 25.56 in).

Warranty Period: One year

Ordering Information

Opt 208 180 to 235 Vac, 3 phase, 47 to 63 Hz

Opt 400 360 to 440 Vac, 3 phase, 47 to 63 Hz

Opt 602 Two Bus Bar Spacers for paralleling power supplies (p/n 5060-3514)

* **Opt 908** Rack-mount Kit (p/n 5062-3977 and p/n 5063-9212)

* **Opt 909** Rack-mount Kit with Handles (p/n 5063-9221 and p/n 5063-9219).

Supplemental Characteristics (Non-warranted characteristics determined by design that are useful in applying this product)

	6690A	**6691A**	**6692A**
Ripple and noise constant current mode from 20 Hz to 20 MHz			
rms	200 mA	50 mA	30 mA
Average programming resolution			
Voltage	4.1 mV	8.1 mV	16 mV
Current	118.5 mA	59 mA	30 mA
OVP	90 mV	170 mV	330 mV
Output voltage programming response time (excludes command-processing time) Full-load progrmming rise or fall time (10 to 90% or 90 to 10%, resistive load)	45 ms	60 ms	100 ms
Output common-mode noise current rms (to signal-ground peak-to-peak binding post)	3 mA 20 mA	3.5 mA 20 mA	4 mA 25 mA

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Opt 0B3 Service Manual

* Support rails required

Accessories

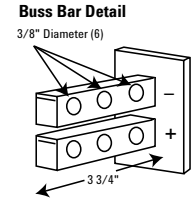
p/n 5065-6935 Replacement fuse kit for 360-440 Vac line.

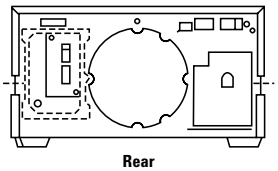
p/n 5065-6934 Replacement fuse kit for 180-235 Vac line.

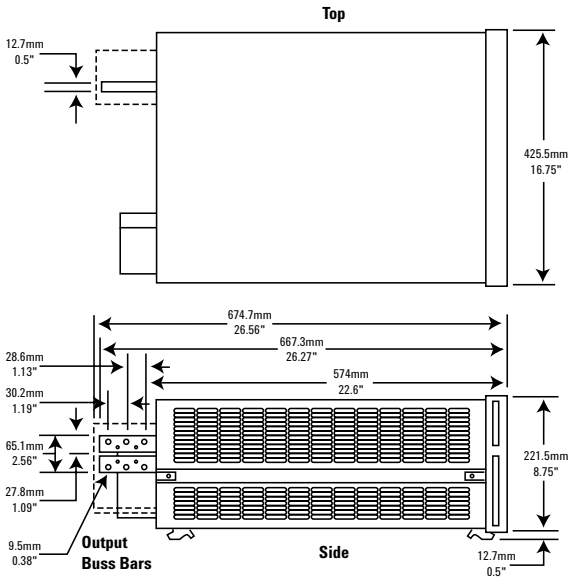
E3663AC Support rails for Agilent rack cabinets.

p/n 5080-2148 Serial link cable 2m (6.6 ft.)

Agilent Models: 6690A, 6691A, 6692A







More detailed specifications at **www.agilent.com/find/6690**

6621A-6624A, 6627A

Multiple-Output
40 W-105 W GPIB

Up to four fully isolated power supplies in a 3 U package
Dual-range outputs
Fast, low-noise outputs
Built-in measurements and advanced programmable features
Protection features to ensure DUT safety

Two, three, or four isolated outputs are integrated into one package, conserving rack space and GPIB addresses. Most of the outputs also provide dual ranges, for more current at lower voltage levels. The outputs can be connected in parallel or series to further increase the flexibility that these products offer the system designer.

Programming is done using industry standard SCPI commands. Test system integration can be further simplified be using the VXI*Plug&Play* drivers. These power supplies help reduce test time with fast up and down programming, which is enhanced by an active downprogrammer which can sink the full rated current.

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Understanding Linear Power Supply Operation
(AN1554)
5989-2291EN

Modern Connectivity - Using USB and LAN I/O Converters
(AN 1475-1)
5989-0123EN

Specifications (at 0° to 55°C unless otherwise specified)		40 W output	40 W output	80 W output	80 W output	105 W output
Output power	Low-range volts, amps	0 to 7 V, 0 to 5 A	0 to 20 V, 0 to 2 A	0 to 7 V, 0 to 10 A	0 to 20 V, 0 to 4 A	0-35 V, 0-3 A
	High range volts, amps	0 to 20 V, 0 to 2 A	0 to 50 V, 0 to 0.8 A	0 to 20 V, 0 to 4 A	0 to 50 V, 0 to 2 A	— —
Output combinations for each model (total number of outputs)	**6621A (2)**	—	—	2	—	—
	6622A (2)	—	—	—	2	—
	6623A (3)	1	1	1	—	—
	6624A (4)	2	2	—	—	—
	6627A (4)	—	4	—	—	—
	6623A-J03 (3) Special Order Option	—	2	—	—	1
Programming accuracy	Voltage	19 mV + 0.06%	50 mV + 0.06%	19 mV + 0.06%	50 mV + 0.06%	35 mV + 0.06%
	Current	50 mA + 0.16%	20 mA + 0.16%	100 mA + 0.16%	40 mA + 0.16%	30 mA + 0.16%
Readback accuracy (at 25°C ±5°C)	Voltage	20 mV + 0.05%	50 mV + 0.05%	20 mV + 0.05%	50 mV + 0.05%	35 mV + 0.05%
	+Current	10 mA + 0.1%	4 mA + 0.1%	20 mA + 0.1%	8 mA + 0.1%	6 mA + 0.1%
	-Current	25 mA + 0.2%	8 mA + 0.2%	50 mA + 0.2%	20 mA + 0.2%	15 mA + 0.2%
Ripple and noise (peak-to-peak, 20 Hz to 20 MHz; rms, 20 Hz to 10 MHz)						
	Constant voltage rms	500 µV	500 µV	500 µV	500 µV	500 µV
	peak-to-peak	3 mV	3 mV	3 mV	3 mV	3 mV
	Constant current rms	1 mA	1 mA	1 mA	1 mA	1 mA
Load regulation	Voltage	2 mV	2 mV	2 mV	2 mV	2 mV
	Current	1 mA	0.5 mA	2 mA	1 mA	2 mA
Load cross regulation	Voltage	1 mV	2.5 mV	1 mV	2.5 mV	N/A
	Current	1 mA	0.5 mA	2 mA	1 mA	N/A
Line regulation	Voltage	0.01% + 1 mV	0.01% + 1 mV	0.01% + 1 mV	0.01% + 1 mV	0.01% + 1 mV
	Current	0.06% + 1 mA	0.06% + 1 mA	0.06% + 1 mA	0.06% + 1 mA	0.06% + 1 mA

Transient response time Less than 75 µs for the output to recover to within 75 mV of nominal value following a load change within specfications

More detailed specifications at **www.agilent.com/find/6620**

Multiple-Output: 40 W-105 W GPIB (Continued)

Specifications

(at 0˚ to 55˚C unless otherwise specified)

40 W output	40 W output	80 W output	80 W output	105 W output

Supplemental Characteristics

(Non-warranted characteristics determined by design and useful in applying the product)

Average programming resolution	Voltage	6 mV	15 mV	6 mV 20 mV (high)	6 mV 20 mV (high)	10.5 mV
	Current	25 mA	10 mA	50 mA 20 mA (high)	50 mA 20 mA (high)	15 mA
OVP		100 mV	250 mV	100 mV 2	50 mV	175 mV
Output programming response time (time to settle within 0.1% of full scale output, after Vset command has been processed)		2 ms	6 ms	2 ms	6 ms	6 ms

Supplemental Characteristics for all model numbers

DC Floating Voltage: All outputs can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to 1 V drop per load lead. The drop in the load leads is subtracted from the voltage available for the load.

Command Processing Time: 7 ms typical with front-panel display disabled

Down Programming: Current sink limits are fixed approximately 10% higher than source limits for a given operating voltage above 2.5 V

Input Power: 550 W max., 720 VA max.

GPIB Interface Capabilities: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT0.

Software Driver: VXI*Plug&Play*

Regulatory Compliance: Listed to UL1244; conforms to IEC 61010-1; carries the CE mark.

Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.22 in x 19.6 in)

Weight: Net, 17.4 kg (38 lb); shipping, 22.7 kg (50 lb)

Warranty Period: One year

Ordering Information

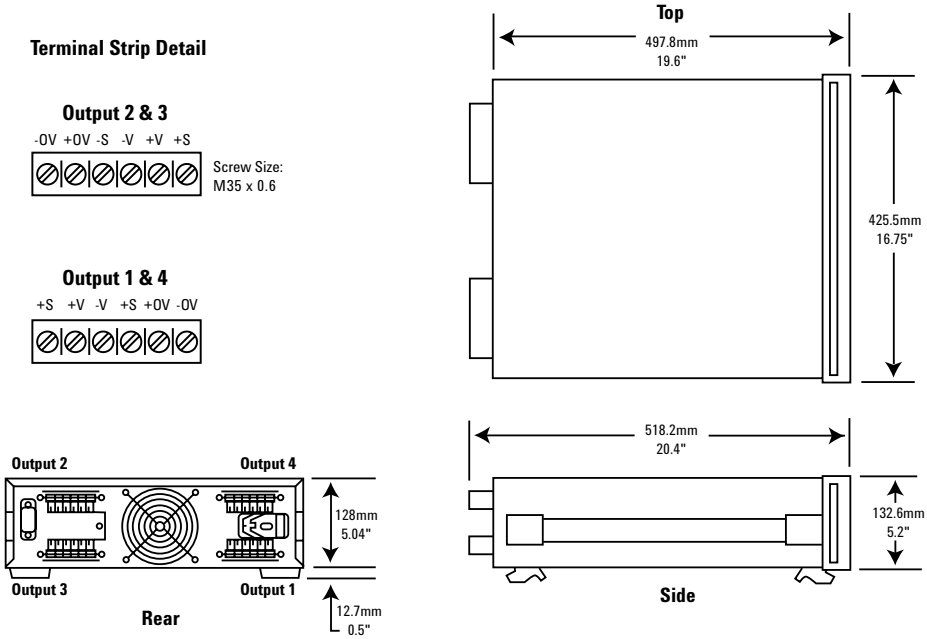
Opt 100 87 to 106 Vac, 47 to 66 Hz Input, 6.3 A (Japan only)
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 66 Hz, 3.0 A
Opt 240 209 to 250 Vac, 47 to 66 Hz, 3.0 A
Opt 750 Relay Control and DFI/RI
Opt S50 similar to option 750, however the remote inhibit does not latch
* **Opt 908** Rack-mount Kit (p/n 5062-3977)
* **Opt 909** Rack-mount Kit w/Handles (p/n 5063-9221)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual

* Support rails required

Accessories

p/n 1494-0059 Rack Slide Kit
E3663A Support rails for Agilent rack cabinets

Agilent Models: 6621A, 6622A, 6623A, 6624A, 6627A



More detailed specifications at **www.agilent.com/find/6620**

6625A, 6626A, 6628A, 6629A

Precision Multiple-Output
25 W-50 W GPIB

- Up to four fully isolated power supplies in a 3 U package
- Fast, low-noise outputs
- Dual-range, precision low current measurement
- Built-in measurements and advanced programmable features
- Protection features to ensure DUT safety

Two or four isolated outputs are integrated into one package, conserving rack space and GPIB addresses. Dual ranges allow for more current at lower voltage levels. The outputs can be connected in parallel or series to further increase the flexibility that these products offer the system designer. Programming is done using industry standard SCPI commands and test system integration can be further simplified be using the VXI*Plug&Play* drivers. These power supplies help reduce test time with fast up and down programming, which is enhanced by the active down-programmer which can sink the full rated current.

These power supplies are very useful on the R&D bench. The accuracy of both the programming and the measurement systems allow precise control and monitoring of prototype bias power. The extensive protection features protect valuable prototypes, including very fast CV/CC crossover. The power supply can be controlled from either the front panel keypad or, for automated testing, from the GPIB.

Specifications (at 0° to 55°C unless otherwise specified)		**25 W output**	**50 W output**
Output power	Low-range volts, amps	0 to 7 V, 0 to 15 mA	0 to 16 V, 0 to 200 mA
	High range volts, amps	0 to 50 V, 0 to 500 mA	0 to 50 V, 0 to 1 A or 0 to 16 V, 0 to 2 A
Output combinations for each model (total number of outputs)	**6625A (2) Precision**	1	1
	6626A (4) Precision	2	2
	6628A (2) Precision	—	2
	6629A (4) Precision	—	4
Programming accuracy (at 25°C ±5°C)	Voltage	1.5 mV + 0.016% (low) 10 mV + 0.016% (high)	3 mV + 0.016% (low) 10 mV + 0.016% (high)
	Current	15 µA + 0.04% (low) 100 µA + 0.04% (high)	185 µA + 0.04% (low) 500 µA + 0.04% (high)
Readback accuracy (at 25°C ±5°C)	Voltage	0.016% + 2 mV (low) 0.016% + 10 mV (high)	0.016% + 3.5 mV (low) 0.016% + 10 mV (high)
	+/-Current	0.03% + 15 µA (low) 0.03% + 130 µA (high)	0.04% + 250 µA (low) 0.04% + 550 µA (high)
Ripple and noise	Constant voltage rms	500 µV	500 µV
(peak-to-peak, 20 Hz to 20 MHz; rms, 20 Hz to 10 MHz)	peak-to-peak	3 mV	3 mV
	Constant current rms	0.1 mA	0.1 mA
Load regulation	Voltage	0.5 mV	0.5 mV
	Current	0.005 mA	0.01 mA
Load cross regulation	Voltage	0.25 mV	0.25 mV
	Current	0.005 mA	0.01 mA
Line regulation	Voltage	0.5 mV	0.5 mV
	Current	0.005 mA	0.01 mA
Transient response time change within specfications		Less than 75 µs for the output to recover to within 75 mV of nominal value following a load	
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)	
		25-watt output	**50-watt output**
Average programming resolution	Voltage	460 µV (low)	1 mV (low)
		3.2 mV (high)	3.2 mV (high)
	Current	1 µA (low)	13 µA (low)
		33 µA (high)	131 µA (high)
	OVP	230 mV	230 mV
Output programming response time		6 ms	6 ms
(time to settle within 0.1% of full scale output, after Vset command has been processed)			

More detailed specifications at **www.agilent.com/find/6620**

Precision Multiple-Output: 25 W-50 W GPIB (Continued)

Application Notes:

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Understanding Linear Power Supply Operation
(AN1554)
5989-2291EN

Modern Connectivity - Using USB and LAN I/O Converters
(AN 1475-1)
5989-0123EN

Supplemental Characteristics for all model numbers

DC Floating Voltage: All outputs can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to 10 V drop per load lead. The drop in the load leads is subtracted from the voltage available for the load.

Command Processing Time: 7 ms typical with front-panel display disabled

Input Power: 550 W max., 720 VA max.

GPIB Interface Capabilities: SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT0, C0, E1.

Software Driver:
VXI*Plug&Play*

Regulatory Compliance: Listed to UL 1244; conforms to IEC 61010-1.

Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.22 in x 19.6 in)

Weight: 6626A, 6629A: Net, 17.4 kg (38 lb); shipping, 22.7 kg (50 lb) 6625A, 6628A: Net, 15.5 kg (34 lb); shipping, 20.8 kg (46 lb)

Warranty Period: One year

Ordering Information

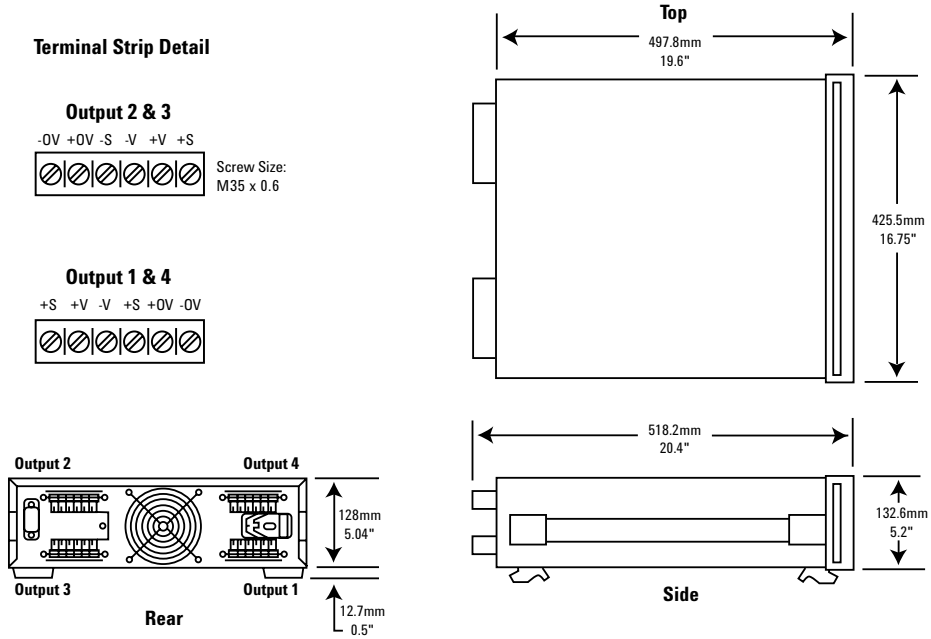
Opt 100 87 to 106 Vac, 47 to 66 Hz Input, 6.3 A (Japan only)
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 66 Hz, 3.0 A
Opt 240 209 to 250 Vac, 47 to 66 Hz, 3.0 A
Opt 750 Relay Control and DFI/RI
Opt S50 Similar to option 750, however the remote inhibit does not latch
* **Opt 908** Rack-mount Kit (p/n 5062-3977)
* **Opt 909** Rack-mount Kit w/Handles (p/n 5063-9221)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual

* Support rails required

Accessories

p/n 1494-0059 Rack Slide Kit
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6625A, 6626A, 6628A, 6629A



More detailed specifications at **www.agilent.com/find/6620**

Low-Profile Modular Power System
50-300 W GPIB, LAN, USB, LXI Class C

NEW N6700B, N6701A, N6702A, N6710B-N6712A, N6731-36B, N6741B-46B, N6751A-52A, N6761A-62A, N6773A-N6776A

- Small size: up to 4 outputs in 1 U of rack space
- 20 DC power modules: basic, performance and precision models
- Fast output programming with active downprogramming
- Ultra fast command processing time
- Output sequencing and advanced triggering system
- Optional LIST mode, built-in digitizer and disconnect relays
- LXI class C compliant

Agilent Open

The Agilent N6700 Low-Profile Modular Power System (MPS) is a switching regulated, multiple-output programmable DC power supply system with the performance of a linear power supply. The N6700 is a flexible modular platform that allows you to mix and match 20 different DC power modules to create a 1- to 4-channel DC power system to optimized performance, power and price to match test needs. Test system engineers can invest in high-performance outputs where speed and accuracy are needed, or purchase basic performance outputs for simple DC power requirements.

Small Size
The Agilent N6700 MPS uses an advanced switching power supply design that fits within 1U of rack space. It has side air vents (no top or bottom air vents) so other instruments can be mounted directly above or below it. (Requires rack mount kit)

Protection Features
Each N6700 module is protected against over-voltage, over-current, and over-temperature. A fault condition in one module can be detected within 10 microseconds by other modules so that they can be quickly shut down to avoid hazardous conditions on your DUT.

Specifications (at 0° to 55°C, and derated above 40°C)		N6751A	N6752A	N6761A	N6762A
Output Ratings					
Voltage		50 V	50 V	50 V	50 V
Current		5 A	10 A	1.5 A	3 A
Power		50 W	100 W	50 W	100 W
Programming Accuracy (at 23°C ±5°C)					
Voltage high range		0.06% + 19 mV	0.006% + 19 mV	0.016% + 6 mV	0.016% + 6 mV
Voltage low range (≤ 5.5 V)		N/A	N/A	0.016% + 1.5 mV	0.016% + 1.5 mV
Current high range		0.1% + 20 mA	0.1% + 20 mA	0.04% + 200 µA	0.04% + 200 µA
Current low range	≤ 100 mA, @ 0 - 7 V	N/A	N/A	0.04% + 15 µA	0.04% + 15 µA
	≤ 100 mA, @ 0 - 50 V	N/A	N/A	0.04% + 55 µA	0.04% + 55 µA
Readback Accuracy (at 23°C ±5°C)					
Voltage high range		0.05% + 20 mV	0.05% + 20 mV	0.016% + 6 mV	0.016% + 6 mV
Voltage low range	≤ 5.5 V	N/A	N/A	0.016% + 1.5 mV	0.016% + 1.5 mV
Current high range		0.1% + 4 mA	0.1% + 4 mA	0.04% + 160 µA	0.04% + 160 µA
Current low range	≤ 100 mA, @ 0 - 7 V[1]	N/A	N/A	0.03% + 15 µA	0.03% + 15 µA
	≤ 100 mA, @ 0 - 50 V	N/A	N/A	0.03% + 55 µA	0.03% + 55 µA
Output Ripple and Noise (PARD) (from 20 Hz to 20 MHz)					
CV peak-to-peak		4.5 mV	4.5 mV	4.5 mV	4.5 mV
CV rms		350 µV	350 µV	350 µV	350 µV
Load Regulation					
Voltage		2 mV	2 mV	0.5 mV	0.5 mV
Current		2 mA	2 mA	65 µA	65 µA
Line Regulation					
Voltage		1 mV	1 mV	0.5 mV	0.5 mV
Current		1 mA	1 mA	30 µA	30 µA

[1] Applies when measuring 4006 data points (SENSe:SWEep:POINts = 4096).

More detailed specifications at **www.agilent.com/find/N6700**

Low-Profile Modular Power System
50-300 W GPIB (Continued)

Connectivity
The N6700 offers many system oriented features to simplify and accelerate test system development. They support the industry standard SCPI commands and come standard with software drivers.

The N6700 MPS comes standard with GPIB, USB 2.0, and 10/100 Base-T Ethernet LAN interfaces. While GPIB is best suited for use with existing systems, Agilent offers USB and LAN to allow you to take advantage of the availability, speed, and ease-of-use of common computer industry standard interfaces.

The N6700 is designed to comply with the LXI class C specification. The N6700 contains a Web server that provides Web pages for monitor, control and setup of the MPS.

Output Sequencing
Each DC power module can be individually set to turn on or to turn off with a delay. By adjusting the delay times and then commanding the N6700 to turn on/off, you can set the N6700 modules to sequence on/off in a particular order.

Programmable Voltage Slew
For some applications, like inrush limiting or powering rate-sensitive devices, it is necessary to slow down and control the speed of the power supply to maintain a specific voltage slew rate. The N6700 provides programmable voltage slew rate, so that with a single command, you can generate a zero to full-scale voltage change controllable from 1 millisecond to 10 seconds.

Specifications (at 0° to 55°C, and derated above 40°C)	N6751A	N6752A	N6761A	N6762A
Transient Response Time (time to recover to within the settling band following a load change)				
from 60% to 100% and from 100% to 60% of full load for models N6751A & N6761A				
from 50% to 100% and from 100% to 50% of full load for models N6752A & N6762A				
Voltage settling band	± 75 mV	± 75 mV	± 75 mV	± 75 mV
Time	< 100 µs	< 100 µs	< 100 µs	< 100 µs

Supplemental Characteristics (Non-warranted characteristics determined by design that are useful in applying the product)

Programming Resolution				
Voltage high range	3.5 mV	3.5 mV	880 µV	880 µV
Voltage low range (≤ 5.5 V)	N/A	N/A	90 µV	90 µV
Current high range	3.25 mA	3.25 mA	60 µA	60 µA
Current low range (≤ 0.1 A)	N/A	N/A	2 µA	2 µA
Output Ripple and Noise (PARD)				
CC rms	2 mA	2 mA	2 mA	2 mA
Over-voltage Protection				
Accuracy	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV
Response Time	50 µs from ocurence of OV condition to start of output shutdown			
Down-programming Capability				
Continuous power	7 W	7 W	7 W	7 W
Peak current	7 A	7 A	3.8 A	3.8 A
Modules can discharge a 1000 µF capacitor from 50 V to 0 V at a rate of 4 times/second.				
Maximum Up-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion)				
Voltage setting from 0 V to 10 V	0.2 ms	0.2 ms	0.6 ms	0.6 ms
Voltage setting from 0 V to 50 V	1.5 ms	1.5 ms	2.2 ms	2.2 ms
Maximum Up-programming Settling Time with full resistive load: (time from start of voltage change to within 50 mV of final value)				
Voltage setting from 0 V to 10 V	0.5 ms	0.5 ms	0.9 ms	0.9 ms
Voltage setting from 0 V to 50 V	4.0 ms	4.0 ms	4.0 ms	4.0 ms
Maximum Down-programming Time with no load: (time from start of voltage change to output voltage <0.5 V)				
Voltage setting from 10 V to 0 V	0.3 ms	0.3 ms	0.3 ms	0.3 ms
Voltage setting from 50 V to 0 V	1.3 ms	1.3 ms	1.3 ms	1.3 ms
Maximum Down-programming Settling Time with no load: (time from start of voltage change to within 50 mV of final value)				
Voltage setting from 10 V to 0 V	0.45 ms	0.45 ms	0.45 ms	0.45 ms
Voltage setting from 50 V to 0 V	1.4 ms	1.4 ms	1.4 ms	1.4 ms
Down-programming with 1000 µF load:[1] (time from start of voltage change to output voltge <0.5 V)				
Voltage setting from 10 V to 0 V	2.1 ms	2.1 ms	4.5 ms	4.5 ms
Voltage setting from 50 V to 0 V	11 ms	11 ms	23 ms	23 ms
Down-programming Capability: Continuous power	7 W	7 W	7 W	7 W
Peak current	7 A	7 A	3.8 A	3.8 A

[1] Modules can discharge a 1000 µF capacitor from 50 V to 0 V at a rate of 4 times/second

More detailed specifications at **www.agilent.com/find/N6700**

Low-Profile Modular Power System
50-300 W GPIB (Continued)

Power Management Feature Allows You Allocate Mainframe Power
To further optimize your investment you may choose to save money configuring a system where the sum of the power modules installed in a mainframe exceeds the total power available from the mainframe. In this case, the new power management features of the N6700 allow you to allocate mainframe power to the outputs where it's needed and reduce power to the outputs where it is not needed, achieving maximum asset utilization and flexibility. This feature provides the safety from unexpected and dangerous shutdowns that can occur with power systems without power management when operated in a similar way.

Series and Parallel Operation
To increase the available power, similarly rated outputs can be operated in series for greater output voltage or in parallel for greater output current.

To simplify parallel operation, the N6700 offers virtual channels, a firmware based feature that allows the N6700 system to treat up to 4 channels as a single, synchronized channel. Once configured, all functions (sourcing, measurements, triggering, protection, and status monitoring) behave as if there is 1 channel of up to 4 times the capacity of a single channel, without writing a single line of code to manage the interaction and synchronization of the paralleled power supplies.

Specifications (at 0° to 55°C, and derated above 40°C)	**N6773A**	**N6774A**	**N6775A**	**N6776A**
Output Ratings				
Voltage	20 V	35 V	60 V	100 V
Current [1]	15 A[2]	8.5 A	5 A	3 A
Power	300 W	300 W	300 W	300 W
Programming Accuracy (at 23°C ±5°C)				
Voltage	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 60 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 30 mA
Readback Accuracy (at 23°C ±5°C)				
Voltage	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 15 mA	0.15% + 12 mA	0.15% + 12 mA	0.15% + 6 mA
Output Ripple and Noise (PARD) (from 20 Hz to 20 MHz)				
CV peak-to-peak CV rms	20 mV 3 mV	22 mV 5 mV	35 mV 9 mV	45 mV 18 mV
Load Regulation[4]				
Voltage	13 mV	16 mV	24 mV	45 mV
Current	6 mA	6 mA	6 mA	6 mA
Line Regulation				
Voltage	2 mV	4 mV	6 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA
Transient Response Time (time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)				
Voltage settling band	± 0.3 V[3]	± 0.3 V[3]	± 0.5 V	± 1.0 V
Time	<250 µs	<250 µs	<250 µs	<250 µs
Programming Resolution				
Voltage	7 mV	10 mV	18 mV	28 mV
Current	9 mA	6 mA	3 mA	1.5 mA
Output Ripple and Noise (PARD)				
CC rms	6 mA	6 mA	6 mA	6 mA
Over-voltage Protection				
Accuracy	0.25% + 100 mV	0.25% + 130 mV	0.25% + 260 mV	0.25% + 650 mV
Accuracy w/opt 760	0.25% + 700 mV	0.25% + 700 mV	0.25% + 400 mV	0.25% + 650 mV
Accuracy w/opt 761	0.25% + 500 mV	0.25% + 350 mV	0.25% + 350 mV	0.25% + 650 mV
Maximum setting	22 V	38.5 V	66 V	110 V
Response Time	50 µs from ocurence of OV condition to start of output shutdown			
Maximum Up-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion)				
Voltage setting from 0 V to 10 V	20 ms	20 ms	20 ms	20 ms
Maximum Up-programming Settling Time with full resistive load: (time from start of voltage change to within 50 mV of final value)				
Voltage setting from 0 V to 10 V	100 ms	100 ms	100 ms	100 ms

[1] Output current is derated 1% per °C above 40°C.
[2] When relay Option 760 is installed, the maximum output current will be limited to 10 A.
[3] When relay Option 760 or 761 is installed, the settling band is ±0.35 V.
[4] With output change from no load to full load, up to a maximum load-lead drop of 1 V/lead.

More detailed specifications at **www.agilent.com/find/N6700**

Low-Profile Modular Power System
50-300 W GPIB (Continued)

Triggering
The N6700 MPS mainframe has hardware trigger in/trigger out signals which permit the N6700 to be synchronized with external events.

Output Disconnect Relays
Modules in the N6700 can be individually ordered with optional Output Disconnect Relays (option 761) or Output Disconnect/Polarity Reversal Relays (option 760). With option 761, Output Disconnect Relays, mechanical relays disconnect both the plus and minus side of the power supply, including the sense leads. With option 760, Output Disconnect/Polarity Reversal Relays switch the leads on both the plus and minus side of the power supply, including the sense leads, resulting in a voltage polarity reversal at the DUT.

Universal AC Input
The N6700 has a universal input that operates from 100-240 Vac, 50/60/400 Hz. There are no switches to set or fuses to change when switching from one voltage standard to another. The AC input employs power factor correction.

Choosing the right DC Power Modules to meet your ATE needs

N6750 Family
The Agilent N6750 family of high-performance, autoranging DC power modules provides low noise, high accuracy and includes, auto-ranging output capabilities enabling one power supply to do the job of several traditional power supplies. In addition, it includes optional high-speed test extensions that offers an oscilloscope-like digitizer and ultra-fast programming speed.

Specifications (at 0° to 55°C, and derated above 40°C)	**N6731B**	**N6732B**	**N6733B**	**N6734B**	**N6735B**	**N6736B**
Output Ratings						
Voltage	5 V	8 V	20 V	35 V	60 V	100 V
Current	10 A	6.25 A	2.5 A	1.5 A	0.8 A	0.5 A
Power	50 W	50 W	50 W	50 W	50 W	50 W
Programming Accuracy[2] (at 23°C ±5°C)						
Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 10 mA
Readback Accuracy (at 23°C ±5°C)						
Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 20 mA	0.15% + 10 mA	0.15% + 5 mA	0.15% + 4 mA	0.15% + 4 mA	0.15% + 2 mA
Output Ripple and Noise (PARD) (from 20 Hz – 20 MHz)						
CV peak-to-peak	10 mV	12 mV	14 mV	15 mV	25 mV	30 mV
CV rms	2 mV	2 mV	3 mV	5 mV	9 mV	18 mV
Load Regulation[1]						
Voltage Current	5 mV 2 mA	6 mV 2 mA	9 mV 2 mA	11 mV 2 mA	13 mV 2 mA	20 mV 2 mA
Line Regulation						
Voltage Current	1 mV 1 mA	2 mV 1 mA	2 mV 1 mA	4 mV 1 mA	6 mV 1 mA	10 mV 1 mA
Transient Response Time	(time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)					
Voltage settling band	± 80 mV	± 80 mV	± 200 mV	± 200 mV	± 400 mV	± 500 mV
Time	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs

1 With an output change from no load to full load, up tp a maximum load-lead drop of 1 V per lead.
2 Applies from minimum to maximum programming range. (see Supplemental Characteristics)

N6760 Family
The Agilent N6760 family of precision DC power modules provides precise control and measurements in the milliampere and microampere region with the ability to simultaneously digitize voltage and current, and capture those measurements in an oscilloscope-like data buffer. These precision DC power modules offer dual ranges on both programming and measurement and are ideally suited for semiconductor and passive device testing.

N6750/60 Low Noise Outputs
This switching power supply outperforms most linear power supplies on the market with low normal and common mode noise.

More detailed specifications at **www.agilent.com/find/N6700**

Low-Profile Modular Power System
50-300 W GPIB (Continued)

Specifications
(at 0˚ to 55˚C, and derated above 40˚C)

Supplemental Characteristics (Non-warranted characteristics determined by design that are useful in applying the product)

	N6731B	N6732B	N6733B	N6734B	N6735B	N6736B
Programming Resolution						
Voltage	3.5 mV	4 mV	7 mV	10 mV	18 mV	28 mV
Current	7 mA	4 mA	3 mA	2 mA	1 mA	0.5 mA
Output Ripple and Noise (PARD)						
CC rms	8 mA	4 mA	2 mA	2 mA	2 mA	2 mA
Over-voltage Protection						
Accuracy (without relay option)	0.25% + 50 mV	0.25% + 50 mV	0.25% + 75 mV	0.25% + 100 mV	0.25% + 200 mV	0.25% + 250 mV
Response Time	50 µs from occurence of OV condition to start of output shutdown					
Maximum Up-programming and Down-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion)						
Voltage setting from 0 V to full scale and full scale to 0 V	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
Maximum Up-programming and Down-programming Settling Time with full resistive load: (time from start of voltage change until voltage settles within 0.1% of the full-scale voltage of its final value)						
Voltage setting from 0 V to full scale and full scale to 0 V	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms

N6750/60 Output Programming Speed
The N6750/60 achieves performance unlike a typical DC power supply with up to 10 to 50 times faster than other programmable power supplies. Thanks to an active down-programming circuit to rapidly pull down the output when lowering the module's output voltage, the N6750/60 can rapidly program both up and down in voltage. These output speeds allow the N6750/60 to give maximum system throughput when your test calls for frequent changes in power supply voltage settings.

N6750/60 Autoranging for Flexibility
The N6750/60 gives test system designers even more flexibility by providing autoranging outputs. This autoranging capability provides maximum output power at any output voltage up to 50 V. This allows one power supply to do the job of several power supplies because its operating range covers low voltage, high current as well as high voltage, low current operating points.

N6750/60 High-Speed Test Extensions
To make your testing go even faster, the N6750/60 offer High-Speed Test Extensions (HSTE) which comes standard on the N6760 and optional on the N6750. This enhancement to the N6750/60 DC Power Modules extends the capabilities to include features similar to a built-in arbitrary waveform generator and a built-in oscilloscope. Through the LIST mode of HSTE, you can download up to 512 setpoints of voltage and current. In LIST mode, you can program the output to execute a LIST of voltage and current setpoints. For each setpoint, a dwell time can be specified and the power supply will stay (i.e., dwell) at that setpoint for the programmed dwell time value.

The HSTE also provides an oscilloscope-like digitizer built into the power module to capture voltage and current measurements.

N6730/40/70 Family
The Agilent N6730, N6740, and N6770 families of DC power modules provide programmable voltage and current, measurement and protection features at a very economical price, making these modules suitable to power the DUT or to provide power for ATE system resources, such as fixture control. The N6730/40/70 families give you clean, reliable DC power without advanced features, plus gives you the added benefits of being apart of the N6700 MPS including small size (true 1U), mix-and-match with other N6700 DC Power Modules when you need performance along with basic DC outputs, connectivity via LAN, USB, and GPIB, and fast command processing time of less than 1 ms.

More detailed specifications at **www.agilent.com/find/N6700**

Low-Profile Modular Power System
50-300 W GPIB (Continued)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 VDC from chassis ground

Remote Sensing: Output can maintain specifications with up to 1-volt drop per load lead

Command Processing Time: Average time required for the output voltage to begin to change following receipt of digital data is ≤ 1ms.

High Speed Test Extentions:

List Mode:

- Number of steps = 1 to 512
- Dwell time = 1 to 262 s
- Maximum list repetitions = 256, or infinite

Digitizer:

- Measurement points = 1 to 4096
- Sample rate = 0.000025 Hz to 50 kHz

I/O Interface:

GPIB, LAN, USB standard

Software Driver:

- IVI-COM
- VXI*Plug&Play*

AC Input:

- Input Range: 85 – 265 VAC; 50/60/400 Hz
- Power Consumption:
  - N6700B–1000 VA typical (with power factor correction)
  - N6701A–1500 VA typical (with power factor correction)
  - N6702A–3000 VA typical (with power factor correction)

Specifications (at 0° to 55°C, and derated above 40°C)	**N6741B**	**N6742B**	**N6743B**	**N6744B**	**N6745B**	**N6746B**
Ouput Ratings						
Voltage	5 V	8 V	20 V	35 V	60 V	100 V
Current	20 A	12.5 A	5 A	3 A	1.6 A	1 A
Power	100 W	100 W	100 W	100 W	100 W	100 W
Programming Accuracy[2] (at 23°C ±5°C)						
Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 10 mA
Readback Accuracy (at 23°C ±5°C)						
Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
Current	0.15% + 20 mA	0.15% + 10 mA	0.15% + 5 mA	0.15% + 4 mA	0.15% + 4 mA	0.15% + 2 mA
Output Ripple and Noise (PARD) (from 20 Hz – 20 MHz)						
CV peak-to-peak	11 mV	12 mV	14 mV	15 mV	25 mV	30 mV
CV rms	2 mV	2 mV	3 mV	5 mV	9 mV	18 mV
Load Regulation[1]						
Voltage Current	5 mV 2 mA	6 mV 2 mA	9 mV 2 mA	11 mV 2 mA	16 mV 2 mA	30 mV 2 mA
Line Regulation						
Voltage Current	1 mV 1 mA	2 mV 1 mA	2 mV 1 mA	4 mV 1 mA	6 mV 1 mA	10 mV 1 mA
Transient Response Time	(time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)					
Voltage settling band	± 100 mV	± 100 mV	± 300 mV	± 300 mV	± 500 mV	± 1000 mV
Time	200 µs	200 µs	200 µs	200 µs	200 µs	200 µs
Programming Resolution						
Voltage	3.5 mV	4 mV	7 mV	10 mV	18 mV	28 mV
Current	7 mA	4 mA	3 mA	2 mA	1 mA	0.5 mA
Output Ripple and Noise (PARD)						
CC rms	8 mA	4 mA	2 mA	2 mA	2 mA	2 mA
Over-voltage Protection						
Accuracy (without relay option)	0.25% + 50 mV	0.25% + 50 mV	0.25% + 75 mV	0.25% + 100 mV	0.25% + 200 mV	0.25% + 250 mV
Response Time	50 µs from occurence of OV condition to start of output shutdown					
Maximum Up-programming and Down-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion)						
Voltage setting from 0 V to full scale and full scale to 0 V	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
Maximum Up-programming and Down-programming Settling Time with full resistive load: (time from start of voltage change until voltage settles within 0.1% of the full-scale voltage of its final value)						
Voltage setting from 0 V to full scale and full scale to 0 V	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms

[1] With an output change from no load to full load, up tp a maximum load-lead drop of 1 V per lead.
[2] Applies from minimum to maximum programming range. (see Supplemental Characteristics)

More detailed specifications at **www.agilent.com/find/N6700**

Low-Profile Modular Power System
50-300 W GPIB (Continued)

Specifications (at 0° to 55°C, and derated above 40°C)	N6700B	N6701A	N6702A

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)

Maximum Total Output Power (= Sum of total module output power)	400 W when operating from 100 -240 VAC input	600 W when operating from 100 -240 VAC input	1200 W when operating from 200 -240 VAC input
			600 W when operating from 100 -120 VAC input

Regulatory Compliance: European EMC directive 89/336/EEC for Class A products, Australian C-Tick mark, This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada. European Low Voltage Directive 73/23/EEC.

Size:

- Height 44.45 mm; 1.75 in
- Width 432.5 mm; 17.03 in
- Depth (including handles)
  585.6 mm; 23.06 in (N6700B/N6701A)
  633.9 mm; 24.96 in (N6702A)

Weight:

- N6700B with 4 installed modules
  Net: 12.73 kg; 28 lbs.
- N6701A with 4 installed modules
  Net: 11.82 kg; 26 lbs.
- N6702A with 4 installed modules
  Net: 14.09 kg; 31 lbs.
- Single power module
  Net: 1.23 kg; 2.71 lbs.

Warranty Period: One year

Ordering Information

Options for N6700 Mainframes

Opt 908 Rack Mount Kit

Opt FLR Filler Panel Kit

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Opt 900 Power Cord, United Kingdom

Opt 901 Power Cord, Australia

Opt 902 Power Cord, Europe

Opt 903 Power Cord, USA, Canada, 120 V

Opt 904 Power Cord, USA, Canada, 240 V

Opt 906 Power Cord, Switzerland

Opt 912 Power Cord, Denmark

Opt 917 Power Cord, South Africa, India

Opt 918 Power Cord, Japan

Opt 919 Power Cord, Israel

Opt 920 Power Cord, Argentina

Opt 921 Power Cord, Chile

Opt 922 Power Cord, China

Opt 927 Power Cord, Thailand

Accessories for N6700 Mainframes

N6709A Rack Mount Kit (Opt 908)
Required for rack mounting of N6700B, N6701A, N6702A, N6710B, N6711A, or N6712A. Standard rack mount hardware will not work)

N6708A Filler Panel Kit (Opt FLR)
Required when you have < 4 modules in an N6700B, N6701A, or N6702A. Each filler panel kit contains 3 filler panels.

Options for Modules

Opt 760 Open/Close and Polarity Reverse Relays
(only available at time of order on models N6731B-N6736B, N6742B-N6746B, N6773A-N6776A)

Opt 761 Output Disconnect Relays
(only available at time of order)

Opt UK6 Commercial calibration with test result data

Opt 1A7 ISO 17025 Cal Certificate

Opt 054 High-Speed Test Extension
(N675x only) Comes standard on the N676xA, not available on N673x/4x/7x

Modular Power System
1200 W per mainframe GPIB

Modular system permits up to 8 outputs of 150 W per output in 4 U of rack space
Reconfigure fast with easily swappable modules
Fast, low-noise outputs
LIST mode and advance triggering system
Optional isolation and polarity reversal relays
Built-in measurements and advanced programmable features
Protection features to ensure DUT safety

66000A (mainframe)
66001A (keyboard)

66000 Modular Power System

The Agilent 66000 modular power system simplifies test-system assembly, cabling, programming, debugging and operation. It is ideal for ATE and production test environments, where it can supply bias power and stimulus to sub-assemblies and final products. The modular power system saves rack space, the 7-inch-high (4-EIA units) mainframe can accommodate up to eight DC power modules.

Key Features

- GPIB-programmable voltage and current
- Programmable over-voltage and over-current protection
- Self-test initiated at power-up or from GPIB command
- Electronic calibration over GPIB or from keyboard
- Over-temperature protection
- Discrete fault indicator/remote inhibit (DFI/RI)
- Five nonvolatile store-recall states per output
- User-definable power-on state

Multiple Mainframes at One GPIB Address

The Agilent serial link feature will allow you to control up to 16 outputs at one GPIB address by connecting an auxiliary mainframe. The serial link cable comes standard with the

Specifications (at 0° to 55°C unless otherwise specified)		66101A	66102A	66103A	66104A	66105A	66106A
Output ratings at 40°C							
Output voltage		0 to 8 V	0 to 20 V	0 to 35 V	0 to 60 V	0 to 120 V	0 to 200 V
Output current		0 to 16 A	0 to 7.5 A	0 to 4.5 A	0 to 2.5 A	0 to 1.25 A	0 to 0.75 A
Maximum power		128 W	150 W	150 W	150 W	150 W	150 W
Programming accuracy at 25°C ±5°C							
Voltage	0.03% +	3 mV	8 mV	13 mV	27 mV	54 mV	90 mV
Current	0.03% +	6 mA	3 mA	2 mA	1.2 mA	0.6 mA	0.4 mA
Readback accuracy (via GPIB or keyboard display at 25°C ±5°C)							
Voltage	0.02%+	2 mV	5 mV	8 mV	16 mV	32 mV	54 mV
Current	0.02%+	6 mA	3 mA	2 mA	1 mA	0.6 mA	0.3 mA
Ripple and noise (20 Hz to 20 MHz)							
Constant Voltage rms		2 mV	3 mV	5 mV	9 mV	18 mV	30 mV
peak-peak		5 mV	7 mV	10 mV	15 mV	25 mV	50 mV
Constant Current rms		8 mA	4 mA	2 mA	1 mA	1 mA	1 mA
Line regulation							
Voltage		0.5 mV	0.5 mV	1 mV	2 mV	3 mV	5 mV
Current		0.75 mA	0.5 mA	0.3 mA	0.1 mA	50 µA	30 µA
Load regulation							
Voltage		1 mV	1 mV	1 mV	2 mV	4 mV	7 mV
Current		0.5 mA	0.2 mA	0.2 mA	0.1 mA	50 µA	30 µA
Transient response time		Less than 1 ms for the output voltage to recover within 100 mV of its previous level following any step change in load current up to 10 percent of rated current					
Supplemental Characteristics		(Non-warranted characteristics determined by design that are useful in applying the product)					
Average resolution							
Voltage		2.4 mV	5.9 mV	10.4 mV	18.0 mV	36.0 mV	60.0 mV
Current		4.6 mA	2.3 mA	1.4 mA	0.75 mA	0.39 mA	0.23 mA
Output voltage programming (OVP)		50 mV	120 mV	200 mV	375 mV	750 mV	1.25 mV
OVP accuracy		250 mV	500 mV	800 mV	1 V	1.5 V	2.5 V

More detailed specifications at **www.agilent.com/find/66000**

Modular Power System
1200 W per mainframe GPIB (Continued)

66000 MPS mainframe. For applications with a broader range of power requirements, one 66000 mainframe can be connected with up to eight of the 6640, 6650, 6670, 6680, 6690 or 6030 series of system power supplies. This solution provides power ranges from 150 watts to 5000 watts at one primary GPIB address.

Output Connections

System assembly is simplified thanks to a quick-disconnect connector assembly on each module. Once your wires are connected to the load, the connector design permits the modules to be removed from the front of the mainframe without disconnecting cabling or removing the mainframe from the rack. One connector assembly is shipped with each module.

Output Sequencing

Increase test throughput by using the output sequencing feature of the 66000 MPS. This powerful feature allows you to download up to 20 voltage, current, and dwell-time parameter sets per output. This sequence can be paced by the programmed dwell times. As an alternative, triggers can be used to step through the output list. The output sequences can be executed without controller intervention, thereby increasing overall test system throughput. More detailed information on the triggering and output sequencing capabilities can be obtained by ordering the 66000 Modular Power System Product Note (p/n 5091-2497E) described below.

Specifications (at 0° to 55°C unless otherwise specified)		**66101A-J03** Special Order Option	**66101A-J05** Special Order Option	**66102A-J05** Special Order Option	**66103A-J01** Special Order Option	**66103A-J02** Special Order Option
Output ratings at 40°C						
Output voltage		5.7 V	12 V	15 V	37 V	40 V
Output current		20 A	12 A	10 A	4.5 A	3.6 A
Maximum power		114 W	144 W	150 W	167 W	144 W
Programming accuracy at 25°C ±5°C						
Voltage	0.03% +	2.5 mV	5 mV	8 mV	13 mV	15 mV
Current	0.03% +	8 mA	6 mA	4 mA	2 mA	2 mA
Readback accuracy (via GPIB keyboard display at 25°C ±5°C)						
Voltage	0.02% +	2 mV	3 mV	5 mV	8 mV	9.2 mV
Current	0.02% +	8 mA	6 mA	4 mA	2 mA	2 mA
Ripple and noise (20 Hz to 20 MHz)						
Constant Voltage rms		2 mV	3 mV	3 mV	5.3 mV	6 mV
peak-peak		5 mV	7 mV	7 mV	10.6 mV	11.5 mV
Constant Current rms		10 mA	8 mA	6 mA	2 mA	2 mA
Line regulation						
Voltage		0.5 mV	0.5 mV	0.5 mV	1 mV	1 mV
Current		0.5 mA	0.75 mA	0.5 mA	0.3 mA	0.3 mA
Load regulation						
Voltage		1 mV	1 mV	1 mV	1 mV	1 mV
Current		1 mA	0.5 mA	0.3 mA	0.2 mA	0.2 mA
Transient response time		Less than 1 ms for the output voltage to recover within 100 mV of its previous level following any step change in load current up to 10 percent of rated current				
Supplemental Characteristics		(Non-warranted characteristics determined by design that are useful in applying the product)				
Average resolution						
Voltage		2 mV	3.6 mV	4.5 mV	11 mV	12 mV
Current		6 mA	4.6 mA	3.1 mA	1.4 mA	1.2 mA
OVP		45 mV	75 mV	90 mV	200 mV	230 mV
OVP accuracy		250 mV	375 mV	375 mV	850 mV	920 mV

Application Notes:

66000 Modular Power System Product Note
5988-2800EN

10 Practical Tips You Need to Know About Your Power Products
5965-8239E

10 Hints for Using Your Power Supply to Decrease Test Time
5968-6359E

Agilent DC Power Supplies for Base Station Testing
5988-2386EN

More detailed specifications at **www.agilent.com/find/66000**

Modular Power System
1200 W per mainframe GPIB (Continued)

Supplemental Characteristics for all model numbers

DC Floating Voltage: Output terminals can be floated up to ±240 Vdc from chassis ground

Remote Sensing: Up to half the rated output voltage can be dropped across each load lead. Add 2 mV to the voltage load regulation specification for each 1–V change in the negative output lead caused by a load current change.

Command Processing Time: The average time for the output voltage to change after getting an GPIB command is 20 ms

Output Programming Response Time (with full resistive load): The rise and fall time (10% to 90% and 90% to 10%) of the output voltage is less than 20 ms. The output voltage change settles within 0.1% of the final value in less than 120 ms.

Down Programming: An active down-programmer sinks approximately 10% of the rated output current

Calibration Interval: One year

AC Input of System Mainframe

Voltage	100 Vac	120 Vac	200 Vac	220 Vac	230 Vac	240 Vac
Max. Current	29 A	25 A	16 A	16 A	15 A	15 A

Input Power of System Mainframe: 3200 VA (max.), 1800 W (max.), 1600 W (typ.)

GPIB Capabilities: SH1, AH1, TE6, LE4, SR1, RL1, PP0, DC1, DT1, E1, and C0, and a command set compatible with IEEE-488.2 and SCPI

Software Driver: VXI*Plug&Play*

Regulatory Compliance: Listed to UL 1244; certified to CSA 22.2 No. 231; conforms to IEC 61010-1.

Weight: Net, 66000A, 15 kg (33 lb); 66001A, 1.05 kg (2.3 lb); 66101-66106A, 2.8 kg (6 lb). Shipping, 66000A, 19 kg (42 lb); 66001A, 1.34 kg (2.95 lb); 66101–66106A, 4.1 kg (9 lb).

Size: 66000A: 425.7 mm W x 192 mm H x 677.93 mm D (16.76 in x 7.28 in x 26.69 in), including feet and rear connectors

Warranty Period: One year

Specifications (at 0° to 55°C unless otherwise specified)	**66103A-J09** Special Order Option	**66103A-J12** Special Order Option	**66104A-J09** Special Order Option	**66105A-J01** Special Order Option
Output ratings at 40°C				
Output voltage	28.5 V	24 V	55 V	35 V
Output current	5.5 A	6 A	3 A	1.25 A
Maximum power	157 W	144 W	165 W	44 W
Programming accuracy at 25°C ±5°C				
Voltage 0.03% +	13 mV	13 mV	25 mV	15 mV
Current 0.03% +	3 mA	3 mA	1.5 mA	0.6 mA
Readback accuracy (via GPIB or keyboard display at 25°C ±5°C)				
Voltage 0.02% +	8 mV	8 mV	15 mV	9 mV
Current 0.02% +	3 mA	3 mA	1.2 mA	0.6 mA
Ripple and noise (20 Hz to 20 MHz)				
Constant Voltage rms	5 mV	5 mV	9 mV	6 mV
peak-peak	10 mV	10 mV	15 mV	11.5 mV
Constant Current rms	4 mA	4 mA	1.2 mA	1 mA
Line regulation				
Voltage	1 mV	1 mV	2 mV	1 mV
Current	0.3 mA	0.3 mA	0.1 mA	50 µA
Load regulation				
Voltage	1 mV	1 mV	2 mV	1 mV
Current	0.2 mA	0.2 mA	0.1 mA	50 µA
Transient response time	Less than 1 ms for the output voltage to recover within 100 mV of its previous level following any step change in load current up to 10 percent of rated current			
Supplemental Characteristics	(Non-warranted characteristics determined by design that are useful in applying the product)			
Average resolution				
Voltage	10.4 mV	8 mV	16.5 mV	2 mV
Current	2 mA	2 mA	0.9 mA	1.2 mA
OVP	200 mV	150 mV	350 mV	230 mV
OVP accuracy	800 mV	600 mV	950 mV	920 mV

More detailed specifications at **www.agilent.com/find/66000**

Modular Power System
1200 W per mainframe GPIB (Continued)

Ordering Information

66000A MPS Mainframe
* **Opt 908** Rack-mount Kit (p/n 5063-9215)
* **Opt 909** Rack-mount Kit with Handles (p/n 5063-9222)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual

* **Note:** Options 908 and 909 require cabinet rails (E3663AC) or a slide kit (p/n 1494-0059) to support the loaded mainframe's weight.

A line cord option must be specified, see the AC line voltage and cord section.

66001A MPS Keyboard includes 2m (6 ft) cables
66002A Rack kit for 66001A keyboard

Module Options

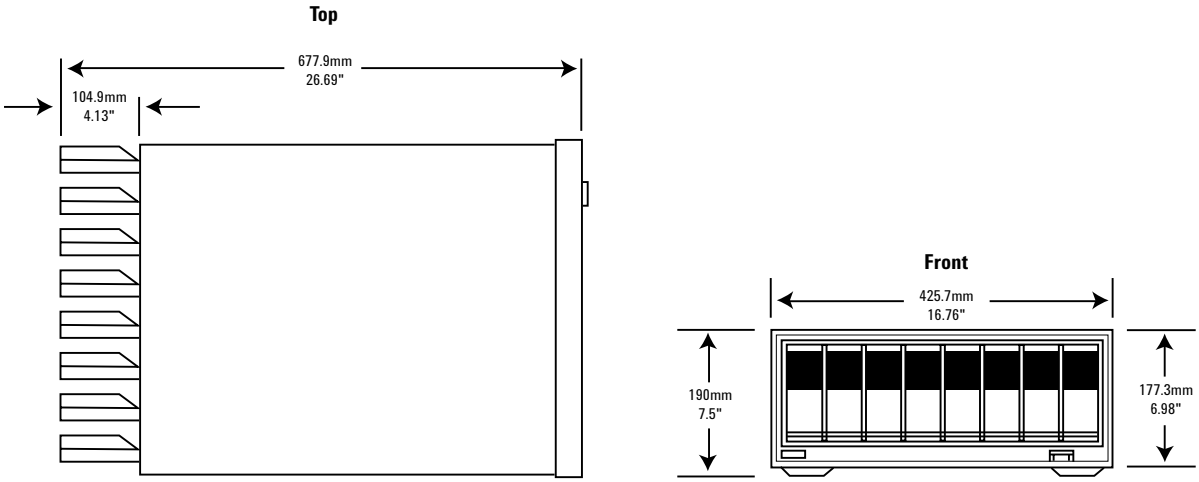
Opt 760 Open/Close and Polarity Reversal Relays
Opt J17 External Imon
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual

Accessories

p/n 5060-3351 Field-Installable Relay Kit
p/n 5060-3386 Standard Connector Assembly
p/n 5060-3387 Standard Connector Assembly with installed relays (Option 760)

p/n 66000-90001 Mainframe Installation Guide
p/n 5959-3360 DC Power Module User's Guide
p/n 5959-3362 DC Power Module Programming Guide
p/n 66000-90003 Mainframe Service Manual
p/n 5959-3364 DC Power Module Service Manual
p/n 1252-1488 4-Pin FLT/Inhibit Connector
E3663AC Support rails for Agilent rack cabinets

Agilent Models: 66000A



More detailed specifications at **www.agilent.com/find/66000**

Application Specific DC Power Supplies...

tailored solutions for specific needs

Some applications require specialized DC power supplies. This section contains DC power supplies that provide the solutions needed to solve some very specific application problems.

Mobile Communication DC Sources

Battery life is a critical parameter for battery powered digital mobile communications devices such as cell phones, WLAN and Bluetooth™ enabled appliances. The pulsed characteristics of battery drain create unique powering and measuring requirements. With fast transient response, to react to pulsed current draw, and a flexible and fast measurement system, these DC sources are optimized for the needs of digital mobile communications devices.

Solar Array Simulators

Solar panels consisting of multiple solar arrays provide power to satellites. They have unique V-I characteristics. Since the output power of a solar array varies with environmental conditions (i.e. temperature, darkness, light intensity), a specialized power supply must be used for accurate simulation.

Component Test DC Source

Mixed signal IC testing requires speed, accuracy, and multiple DC outputs. This quad output DC source provides cost effective and compact biasing and measurement for semiconductor test systems.

Mobile Communications DC Sources
40-100 W

66319B/D, 66321B/D

Ideal for testing wireless and battery powered devices

Several times improvement in measurement throughput over general purpose DC sources

Superior output transient performance with short or long load leads (up to 6 meters)

Dynamic measurement system for accurate battery current drain measurement

Easy-to-use Graphical User Interface and analysis tools for bench top use

Overcome Battery Powered Device Testing Challenges
Digital communications devices and digital battery powered devices present a unique testing challenge: they draw rapid pulses of current. By offering superior transient performance, unmatched in the marketplace, the Agilent Mobile Communications DC Sources dramatically reduce the transient voltage drop due to pulse loading characteristics of digital communications devices. The Agilent Mobile Communications DC Sources enable you to maximize test throughput by minimizing test interruption due to false trigger of device low voltage shutdown.

Dynamic Measurement Capabilities
The Agilent Mobile Communications DC Sources offer a built-in advanced measurement system to accurately measure battery current drains when the device operates in different modes (such as talk mode, active mode, standby mode, and off/sleep mode). Measurements made during these modes are critical for ensuring that your devices are operating properly and that you are getting the most out of the battery.

Simulate both Main Battery and Charger
Single output models are recommended when you need to provide power as a replacement to your

Specifications (at 0° to 55°C unless otherwise specified)		66309B/D	66311B	66319B/D	66321B/D	66332A	66332A-J01 Special Order Option
Number of outputs		2	1	2	1	1	1
GPIB		Yes	Yes	Yes	Yes	Yes	Yes
Output ratings							
Voltage		0 to 15 V	0 to 15 V	0 to 15 V	0 to 15 V	0 to 20 V	0 to 30 V
Current		0 to 3 A	0 to 3 A	0 to 3 A	0 to 3 A	0 to 5 A	0 to 3.3 A
Peak current for up to 7 ms		5 A	5 A	5 A	5 A	5 A	3.3 A
Programming accuracy at 25°C ±5°C (% of setting plus fixed)							
Voltage	0.05%+	10 mV	10 mV	10 mV	10 mV	10 mV	15 mV
+Current	0.05%+	1.33 mA	1.33 mA	1.33 mA	1.33 mA	2 mA	2 mA
Ripple and Noise (20 Hz to 20 MHz)							
Voltage	rms	1 mV	1 mV	1 mV	1 mV	0.3 mV	0.5 mV
	peak-to-peak	6 mV	6 mV	6 mV	6 mV	3 mV	5 mV
Current	rms	2 mA	2 mA	2 mA	2 mA	2 mA	2 mA
DC measurement accuracy							
Voltage	0.03%+	5 mV	5 mV	5 mV	5 mV	3 mV	5 mV
+20 mA to + rated current	0.2%+	0.5 mA[2]	0.5 mA[2]	—	—	0.5 mA	0.5 mA
-20 mA to - rated current	0.2%+	1.1 mA	1.1 mA	—	—	1.1 mA	1.1 mA
-3 A to + 5 A	0.2%	—	—	0.5 mA[2]	0.5 mA[2]	—	—
-1 A to + 1 A	0.1%	—	—	0.2 mA	0.2 mA	—	—
-20 mA to + 20 mA range	0.1%+	2.5 µA	2.5 µA	2.5 µA	2.5 µA	2.5 µA	2.5 µA
Dynamic measurement system							
Buffer size		4096 points	4096 points	4096 points	4096 points	4096 points	4096 points
Sampling interval		15 µs - 31,200 s	15 µs - 31,200 s	15 µs - 31,200 s	15 µs - 31,200 s	15 µs - 31,200 s	15 µs - 31,200 s
Transient response time		<35 µs[3]	<35 µs[3]	<20 µs[3]	<20 µs	<100 µs[4]	<100 µs[4]
Transient voltage dip (typical with up to 15 feet 22 AWG wiring)		70 mV	70 mV	40 mV	40 mV	500 mV	650 mV
Programmable output resistance							
Range		—-	—	-40 mΩ to +1 Ω	-40 mΩ to +1 Ω	—	—
Programming accuracy		—	—	0.5% + 2 mΩ	0.5% + 2 mΩ	—	—
Resolution		—	—	1 mΩ	1 mΩ	—	—

More detailed specifications at **www.agilent.com/find/66300**

Mobile Communications DC Sources
40-100 W (Continued)

device's main battery during testing. Dual output models are recommended when you need to provide power as a replacement to your device's main battery and when you need to simulate the battery charger power; Use one output to supply current to the battery charger input port and the second output to connect in place of the main battery (which sinks current to simulate the main battery being charged).

Performs Like a Battery

With their battery emulation features, the Agilent 66319B/D and 66321B/D allow you to test your devices under the same power conditions that exist in actual use. Emulating the battery is key when characterizing battery operating life and detecting early product failures. These DC sources simulate the effects of internal resistance of the battery, enabling them to emulate the operation of various battery types or batteries in different charge states. Plus, these DC sources can simulate negative resistance so that you can compensate for voltage drop due to wiring in a fixture.

Feature Summary

Agilent has designed in the capability and flexibility that is required for accurately testing today's communications devices as well as your next generation designs for cell phones (formats include: 3G, cdma2000, WCDMA, CDMA, TDMA, GSM, PCS, DECT, TETRA, PHS, NADC), PDAs, *Bluetooth*™ enabled devices, and Wireless LAN access devices.

Specifications (at 0° to 55°C unless otherwise specified)		66309B/D	66311B	66319B/D	66321B/D	66332A	66332A-J01 Special Order Option
Voltmeter input (66309D, 66319D, and 66321D only)							
Input range		-25 to +25 Vdc	— —	-25 to +25 Vdc	-25 to +25 Vdc	— —	— —
DC readback accuracy (at 25°C ±5°C)		0.04% + 5 mV	— —	0.04% + 5 mV	0.04% + 5 mV	— —	— —
AC + DC readback accuracy (at 25°C ±5°C) with DC plus a sinewave input > 25 mV rms		1% + 5 mV (60 Hz to 10 kHz)	— — — —	1% + 5 mV (60 Hz to 10 kHz)	1% + 5 mV (60 Hz to 10 kHz)	— — — —	— — — —
Auxilary output (66309B/D and 66319B/D)							
Output ratings	Voltage	0 to 12V	—	0 to 12V	—	—	—
	Current	0 to 1.5 A	—	0 to 1.5 A	—	—	—
Programming accuracy	Voltage	0.2% + 40 mV	—	0.2% + 40 mV	—	—	—
	+Current	0.2% + 4.5 mA	—	0.2% + 4.5 mA	—	—	—
DC measurement accuracy	Voltage	0.2% + 15 mV	—	0.2% + 15 mV	—	—	—
	+Current	0.2% + 3 mA	—	0.2% + 3 mA	—	—	—
Ripple and Noise (20 Hz to 20 MHz)							
Voltage	rms	1 mV	—	1 mV	—	—	—
	peak-to-peak	6 mV		6 mV			
Current	rms	2 mA	—	2 mA	—	—	—

Notes:

[1] 66332A also has RS-232 interface.

[2] Applies with current detector set to DC.

[3] Time for the output voltage to recover to within 20 mV of final value after 0.1 to 1.5 A load change in high capacitance compensation range.

[4] Time for the output voltage to recover to within 20 mV or 0.1% of the voltage rating of the unit following a change in load current of up to 50% of the output current rating.

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)

DC Floating Voltage
Output terminals can be floated up to +/- 50 Vdc maximum from chassis ground (+/- 240 Vdc for 66332A)

Remote Sensing Voltage Drop
For 66332A: Up to 2 V can be dropped in each load lead. Add 2 mV to the load regulation specification for each 1 V drop in the positive output lead. For 66309B/D, 66311B: Up to 4 V can be dropped in each load lead. Add 2 mV to the load regulation specification for each 1 V drop in the positive output lead. For 66319B/D main output, 66321B/D main output: Up to 3 V total can be dropped in both load leads. For 66319B/D auxiliary output, 66321B/D auxiliary output: Up to 4 V total can be dropped in both load leads.

Command Processing Time
Average time required for the output voltage to begin to change following receipt of GPIB data is 4 ms (with display disabled).

More detailed specifications at **www.agilent.com/find/66300**

Mobile Communications DC Sources
40-100 W (Continued)

All models offer:

- Fast output response technology
- Programmable output response compensation
- Advanced DSP-based dynamic measurements
- Current sinking for testing and calibrating charger circuitry
- Extensive protection features (including broken sense lead detection)
- GPIB Interface, SCPI (Standard Commands for Programmable Instruments), VXI*plug&play* drivers

In addition, the 66319B/D and 66321B/D high performance models offer:

- Output resistance programming (positive and negative)
- Superior output stability with up to 6 meters of load leads
- Excellent transient voltage drop (typically < 30 mV)
- Three current measurement ranges
- NEW! Additional advanced battery drain measurements (CCDF, long term battery drain)

The new and improved 66319B/D and 66321B/D high performance models are recommended for new automated test system platforms and for R&D applications. The 66309B/D and the 66311B are available for those customers who need to replicate existing test platforms and who do not want to re-engineer existing automated test system designs.

Supplemental Characteristics (Non-warranted characteristics determined by design and useful in applying the product)

(Continued)

Output Programming Response Time
For 66332A: The rise and fall time (10/90% and 90/10%) of the output voltage is < 2 ms (400 µs in fast mode). The output voltage change settles within 1 LSB (0.025% x full scale voltage) of final value in < 6 ms (2 ms in fast mode). For 66311B, 66321B/D, 66309B/D output 1, 66319B/D output 1: The rise and fall time (10/90% and 90/10%) of the output voltage is < 200 µs.

Measurement Time
Average time to process query, calculate measurement parameter and return data is 50 ms (includes the default time of 30 ms for acquiring data and 20 ms data processing overhead).

GPIB Interface Capabilities
IEEE-488.2, SCPI command set, 6630A series programming capability (not supported in 66309B/D, 66319B/D, 66321B/D)

Software Driver:
- VXI*Plug&Play*
- IntuiLink Connectivity Software

Input power
(at worst case conditions: full load, 100 Vac mains)
For 66311B, 66321B/D: 1.7 A, 125 W.
For 66309B/D, 66319B/D: 2 A, 170 W.
For 66332A: 3.5 A, 250 W.

Regulatory Compliance
Complies with EMC directive 89/336/EEC (ISM 1B).

Warranty Period One year

Size
For 66309B/D, 66311B, 66319B/D, 66321B/D: 212.8 mm W x 88.1 mm H x 435 mm D (8.4 in x 3.5 in x 17.13 in).
For 66332A: 425.5 mm W x 88.1 mm H x 364.4 mm D (16.8 in x 3.5 in x 14.3 in).

Weight
For 66309B/D, 66311B, 66319B/D, 66321B/D: 9.07 kg (20 lb) net, 11.1 kg (24.5 lb) shipping. For 66332A: 12.7 kg (28 lb) net, 15.0 kg (33 lb) shipping.

Application Notes:

Mobile Communications Device Testing
(AN 1310)
5968-2424EN

Evaluating Battery Run-down Performance Using the Agilent 66319D or 66321D with Option #053 14565A Device Characterization Software
(AN 1427)
5988-8157EN

Using Battery Drain Analysis to Improve Mobile-Device Operating Time
5988-7772EN

Current Drain Analysis Enhances WLAN Network Card Design and Test
(AN 1468)
5989-0565EN

More detailed specifications at **www.agilent.com/find/66300**

Mobile Communications DC Sources
40-100 W (Continued)

Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz

Opt 120 104 to 127 Vac, 47 to 63 Hz

Opt 220 191 to 233 Vac, 47 to 63 Hz

Opt 230 207 to 253 Vac, 47 to 63 Hz

Opt 004 Make "Hi Compensation Mode" as default setting

Opt 020 Front-panel Binding Posts (66332A only)

Opt UJ0 No front panel binding posts (66332A only)

Opt 053 Add 14565A Device Characterization Software with Battery Drain Analysis (66319B/D, 66321B/D)

Opt 521 Solid State Relays (66309B/D, 66319B/D)

Opt AYK No Solid State Relays (66309B/D,66319B/D)

Opt 760 Isolation and Reversal Relays (66332A only)

Opt 8ZJ Delete feet

Opt 8ZL Include feet

* **Opt 1CM** Rack-mount kit 66309B/D, 66311B, 66319B/D, 66321B/D: p/n 5062-3972; 66332A: p/n 5062-1912

* **Opt 1CP** Rack-mount Kit with Handles, p/n 5062-3975 (66332A only)

* **Opt AXS** Rack-mount Kit for side-by-side mounting, (N/A for 66332A) Locking Kit p/n 5061-9694; Flange Kit p/n 5062-3974

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Opt 0B3 Service manual

*Support rails required

Accessories

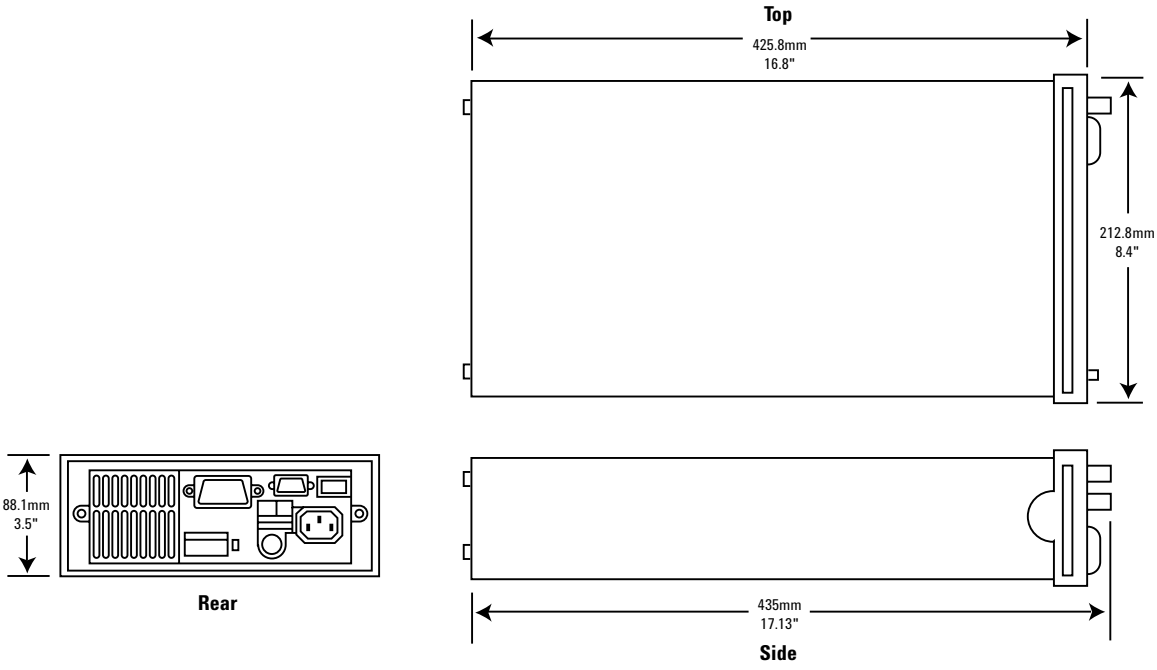
p/n 1494-0060 Rack Slide Kit (66332A only)

E3663AC Support rails for Agilent rack cabinets

14565A Device Characterization Software with Battery Drain Analysis

Note: Battery Drain Analysis means Data Logging and CCDF measurements. These capabilities require models 66319B, 66319D, 66321B or 66321D with version A.03.00 firmware or higher and 14565A software version 3.01 or higher.

Agilent Models: 66309B/D, 66311B/D, 66319B/D, 66321B/D



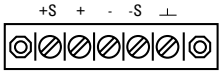
More detailed specifications at **www.agilent.com/find/66300**

Mobile Communications DC Sources
40-100 W (Continued)

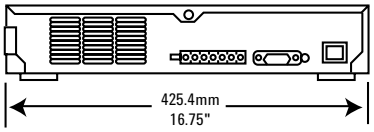
Agilent Models: 66332A

Terminal Strip Detail

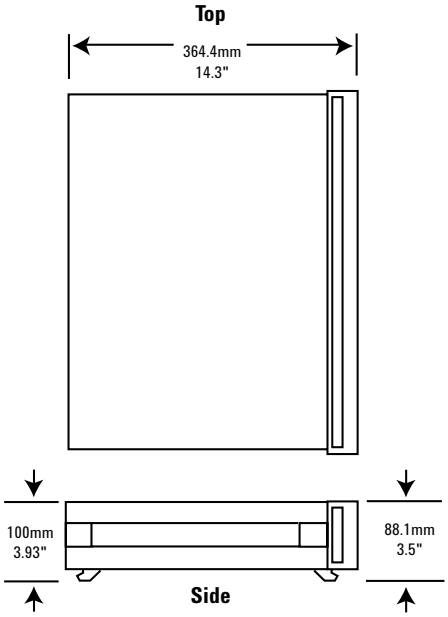
Output 2 & 3



Screw Size:
M35 x 0.6



Rear



More detailed specifications at **www.agilent.com/find/66300**

Mobile Communications DC Sources
14565A Device Characterization Software

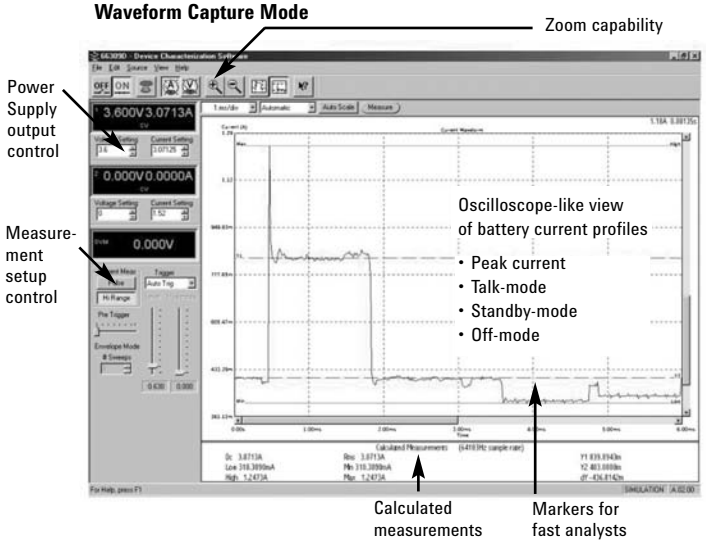
- Ideal for testing wireless and battery powered devices
- Converts Mobile Communications DC Source into a powerful bench top tool for R&D and Repair
- Easy-to-use Graphical User Interface and analysis tools
- No programming required

Simplify test and analysis in R&D or on the repair bench

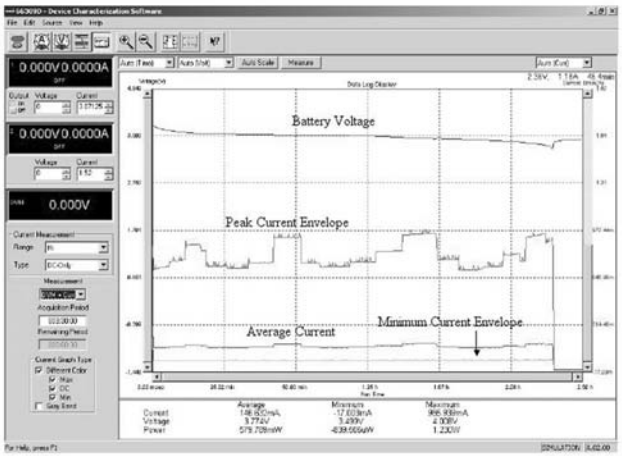
With the Agilent 14565A Device Characterization Software, testing, analyzing, and troubleshooting wireless and battery powered devices is made simple. The 14565A provides a graphical user interface that lets you easily control the Mobile Communications DC Sources. It gives you access to the Mobile Communications DC Source's high-powered measurement system and provides an oscilloscope-like view of the voltage or current waveforms of the device under test. The 14565A provides reference waveform save/recall, and provides oscilloscope-like measurement and analysis including voltage and current waveform parameter measurements, triggering, markers, zoom control, and more. By using the advanced capabilities built into the power supply, you can spend more time testing and analyzing instead of configuring and reconfiguring multiple pieces of test equipment, such as a current shunt, oscilloscope, current probe, DMM, and datalogger.

(Continued)

Waveform Capture Mode



Data Logging Mode



More detailed specifications at **www.agilent.com/find/14565A**

Mobile Communications DC Sources
Device Characterization Software (Continued)

When coupled with the 66319B/D or the 66321B/D, the 14565A also provides Battery Drain Analysis capabilities. More than just measuring battery run time, Battery Drain Analysis allows you to characterize current out of the battery and make tradeoffs in design that impact the current drain and battery life. This new version of the 14565A includes the measurement and data reduction tools needed to analyze and visualize the current being drained from your battery. By providing CCDF measurements and long-term battery drain data logging, the 14565A and 66319/21 provide a complete solution for analyzing current drain so that you can optimize your device designs to achieve maximum battery run time.

Key features

For R&D

- Fast and easy test setup
- Digitize current waveforms
- Accurately log battery current drain measurements from 10 seconds to 1000 hours at 64,000 measurements per second
- Test designs simulating different battery conditions with programmable output resistance
- Zoom capability for analyzing waveform anomalies
- Adjust markers for fast measurements on digitized waveforms
- Easily document your test results
- Record test data to files for archive or analysis by other software packages

For Repair

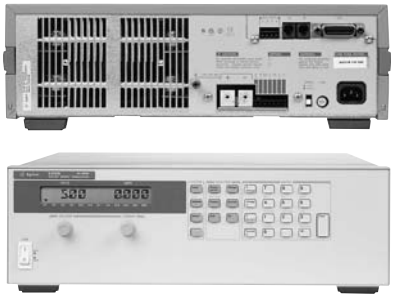
- Compact design with multiple instrument functionality
- Fast and easy test setup
- Graphical user software, no programming required
- Dual DC outputs for replacing the main battery and the power adapter/charger power source
- Electronic load for testing the battery charger circuitry
- Programmable soft limits to protect against incorrect voltage settings

Ordering Information

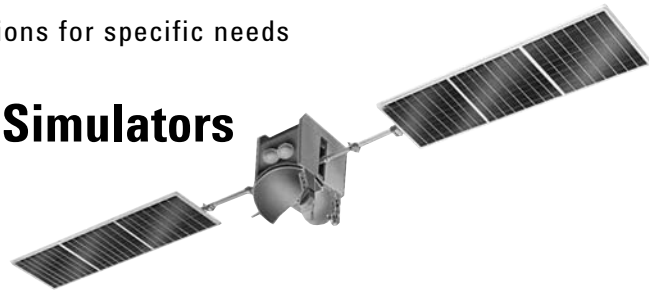
14565A Device Characterization Software with Battery Drain Analysis

Note: Battery Drain Analysis means Data Logging and CCDF measurements. These capabilities require models 66319B, 66319D, 66321B or 66321D with version A.03.00 firmware or higher and 14565A software version 3.01 or higher.

Solar Array Simulators



E4350B, E4351B



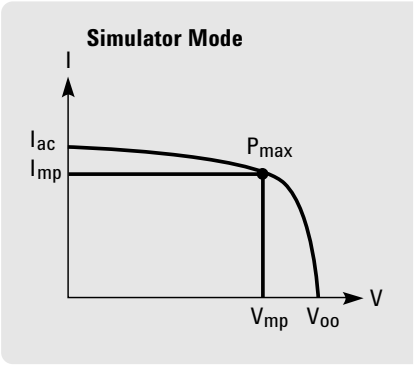
- Fast and accurate simulation of any type of solar array
- Multiple simulation modes
- Fast recovery time
- Easy to simulate environmental conditions

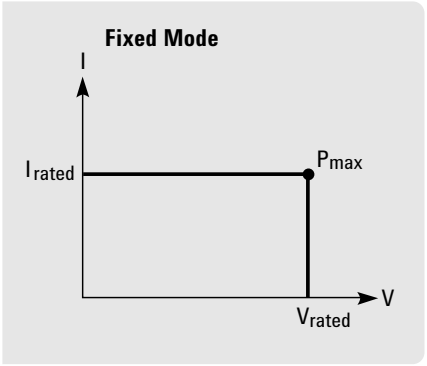
The Agilent one-box Solar Array Simulator (SAS) is a DC power source that simulates the output characteristics of a solar array. The SAS is primarily a current source with very low output capacitance and is capable of simulating the I-V curve of different arrays under different conditions (i.e., temperature, age etc.). The I-V curve is programmable over the IEEE-488.2 bus and is conveniently generated within the SAS. The SAS provides three current operating modes:

1. Simulator Mode: An internal algorithm is used to approximate a SAS I-V curve. Four input parameters: Voc (open circuit voltage), Isc (short circuit current), Imp and Vmp (current and voltage at the peak power point on the curve) are needed to establish a curve in this mode.

2. Table Mode: For a fast and accurate I-V simulation, the SAS provides a table mode. The I-V curve is set by a user-defined table of points. A table can have any length up to 4000 points (a point corresponds to a specific value of I and V). As many as 30 tables may be stored in each of the SAS built-in volatile and non-volatile memory.

Specifications (at 0° to 55°C unless otherwise specified)	**E4350B**	**E4351B**	**E4350B-J01** Special Order Option	**E4350B-J02** Special Order Option
Number of outputs	1	1	1	1
GPIB	Yes	Yes	Yes	Yes
Output ratings (Simulator and Table Modes)				
Max. Power	480 W	480 W	480 W	480 W
Voc. Max.	65 V	130 V	54 V	86.6 V
Isc. Max.	8 A	4A	9.6 A	6 A
Output ratings (for mixed mode)				
Max Power	480 W	480 W	480 W	480 W
V rated	0-60 V	0-120 V	0-50 V	0-80 V
I rated	0-8 A	0-4 A	0-9.6 A	0-6 A
Programming accuracy at 25°C ±5°C				
Voltage (Fixed Mode)	0.075% + 10 mV	0.075% + 20 mV	0.075% + 8.5 mV	0.075% + 13.5 mV
Current (Simulator and Fixed Mode)	0.2% + 20 mA	0.2% + 10 mA	0.2% + 25 mA	0.2% + 15 mA
Ripple and noise				
from 20 Hz to 20 MHz				
Voltage rms	16 mV	24 mV	16 mV	21 mV
Voltage p-p	125 mV	195 mV	125 mV	175 mV
Current rms	4 mA	4 mA	4 mA	4 mA





More detailed specifications at **www.agilent.com/find/E4350**

Solar Array Simulators (Continued)

Non-volatile memory can store a maximum of 3500 points. The tables (I-V curves) are easily stored and recalled with an IEEE-488.2 command. The table(s) stored in this memory will be retained when the power is turned off. Volatile memory greatly increases the flexibility by saving up to 30,000 points. Multiple tables are easily accessed with IEEE-488.2 command. These tables will be erased after power is removed.

In Table Mode, current and voltage offsets can be applied to the selected table to simulate a change in the operating conditions of the solar array.

3. Fixed Mode: This is the default mode when the unit is powered on. The unit has the rectangular I-V characteristics of a standard power supply, when an output capacitor is added in this mode.

Application Notes:

Sequential Shunt Regulation
(AN 1293)
5965-7329E

Modern Connectivity -
Using USB and LAN I/O Converters
(AN 1475-1)
5989-0123EN

Specifications (at 0˚ to 55˚C unless otherwise specified)	**E4350B-J03** Special Order Option	**E4350B-J04** Special Order Option	**E4350B-J06** Special Order Option
Number of outputs	1	1	1
GPIB	Yes	Yes	Yes
Output ratings (Simulator and Table Modes)			
Max. Power	480 W	480 W	480 W
Voc. Max.	52 V	47 V	74 V
Isc. Max.	10 A	11 A	7 A
Output ratings (for mixed mode)			
Max Power	480 W	480 W	480 W
V rated	0 - 48 V	0 - 43.5 V	0 - 68 V
I rated	0.10 A	0 - 10 A	0 - 7 A
Programming accuracy at 25˚C ±5˚C			
Voltage (Fixed Mode)	0.075% + 8 mV	0.075% + 8 mV	0.075% + 11.5 mV
Current (Simulator and Fixed Mode)	0.2% + 27.5 mA	0.2% + 30.5 mA	0.2% + 17.5 mA
Ripple and noise			
from 20 Hz to 20 MHz			
Voltage rms	16 mV	16 mV	19 mV
Voltage p-p	125 mV	125 mV	150 mV
Current rms	5.5 mA	6.5 mA	4 mA

Supplemental Characteristics for all model numbers

Load Switching Recovery Time: < 5 µs when switched from short circuit to variable load, to within 1.5 A of an operating point on the I-V curve.

Remote Sensing: Up to 2 V+ (Voc-Vmp). Add 3 mV to the voltage load regulation specification for each 1 volt change in the positive output lead due to load current change.

Analog Programming of Output Current
Input Signal: 0 to -4.0 V
Input Impedance: 20 k Ohms nominal

Shunt Regulation: Switching frequency up to 50 kHz

Series Regulation: Switching frequency up to 50 kHz

OVP and OCP: Overvoltage and overcurrent protection triggers in ≤100 us

Capacitive Load: In fixed mode, the maximum load capacitance (without causing instability) is 2000 uF. In simulator and table mode, it is unconditionally stable at all capacitive loads.

Inductive Load: The maximum load inductance (without causing instability) is 200 µH

Software Driver:
VXI*Plug&Play*

Regulatory Compliance: Listed to UL3101, certified to CSA 22.2 No. 1010.1, complies with EN 61010-1.

RFI Suppression: Complies with CISPR-11, Group 1, Class A

Size: 425.5 mm W x 132.6 mm H x 497.8 mm D (16.75 in x 5.25 in x 19.6 in)

Weight: Net, 25 kg (54 lb); shipping, 28 kg (61 lb)

Warranty: One year

More detailed specifications at **www.agilent.com/find/E4350**

Solar Array Simulators (Continued)

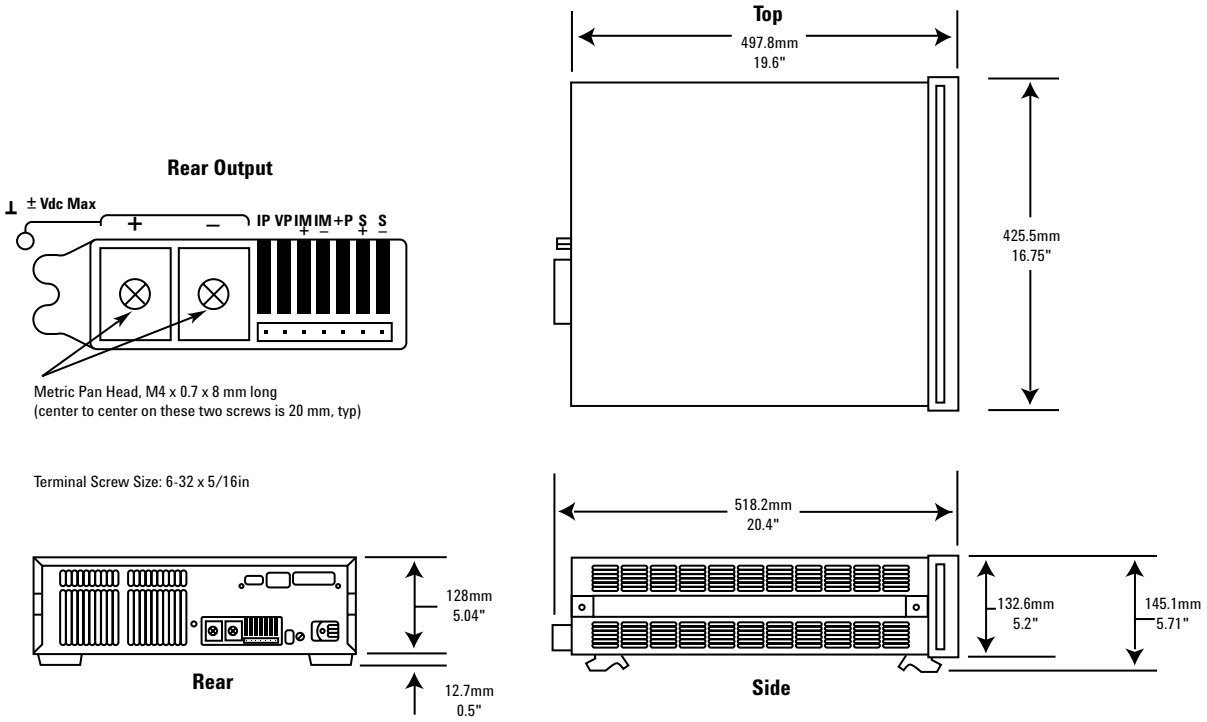
Ordering Information

Opt 100 87 to 106 Vac, 47 to 63 Hz
Opt 120 104 to 127 Vac, 47 to 63 Hz
Opt 220 191 to 233 Vac, 47 to 63 Hz
Opt 240 209 to 250 Vac, 47 to 63 Hz
* **Opt 908** Rackmount Kit, p/n 5062-3977
* **Opt 909** Rackmount Kit with Handles, p/n 5063-9221
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories

p/n 1252-3698 7-pin Analog Plug
p/n 1252-1488 4-pin Digital Plug
p/n 5080-2148 Serial Link Cable 2 m (6.6 ft)
p/n 1494-0059 Accessory Slide Kit

Agilent Models: E4350B, E4351B



More detailed specifications at **www.agilent.com/find/E4350**

DC Electronic Loads...

maximize thoughput with real life loading conditions

Agilent DC Electronic Loads provide solutions for the problems of testing DC power sources.

Multiple Input Electronic Loads

The Agilent N3300A series of DC electronic loads has been optimized for the needs of high volume manufacturing test. Test throughput is maximized with both faster speed and specialized programming and measurement capabilities. The accuracy is enhanced over previous Agilent electronic loads, to meet the needs of testing today's smaller power supplies.

Single Input Electronic Loads

The 6060B and 6063B are single input DC electronic loads. They are convenient for testing of one single output DC power supply. They provide a total solution, with built-in measurement functions. However, to maximize either speed or accuracy, the N3300A Series electronic loads are recommended.

Multiple-Input
150 W to 600 W

Standard DC connectors

Option UJ1 8 mm screw connectors

N3300A-N3307A

- Decrease system development time
- Increase system reliability
- Increase system flexibility
- DC connection terminal for ATE applications
- Lower cost of ownership
- Increase test system throughput
- Stable operation down to zero volts

Increase Test Throughput

Today's high volume manufacturing requires optimization of test system throughput, to maximize production volume without increasing floor-space. The N3300A Series electronic loads can help you in a number of ways to achieve this goal.

Reduced command processing time: Commands are processed more than 10 times faster than previous electronic loads.

Automatically execute stored command sequences: "Lists" of downloaded command sequences can execute independent of the computer, greatly reducing the electronic load command processing time and computer interaction time during product testing.

Programmable delay allows for either simultaneous or sequential load changes: This is the most efficient way to conduct testing of multiple output DC power supplies, simulating real-life loading patterns, with a minimum of programming commands.

Buffer measurement data: Voltage, current, and power measurements can be buffered for later readback to the computer, reducing computer interaction.

Control measurement speed vs. accuracy: Decrease the number of measurement samples to achieve greater measurement speed, or increase the number of samples to achieve higher measurement accuracy. You can optimize your measurements for each test.

Control rising and falling slew rates separately: Reduce rate of loading change when necessary for DUT stability or to simulate real life conditions, but otherwise change load values at maximum rate.

Increase System Flexibility... for both present and future requirements

Most power supply and battery charger test systems designed today need to test a variety of products and/or assemblies. In the future, additional products or assemblies may be needed. A flexible family of electronic loads makes present system design and future growth much easier.

Test low voltage power supplies: The N3300A series electronic loads operate with full stability down to zero volts. Many other electronic loads available today have been found to become unstable in the operating region below one volt. When designing power supply test platforms, the trend towards lower voltage requirements should be taken into account. Refer to the specification and supplemental characteristic tables for details of lower voltage operating characteristics.

Choose DC load connection method: Automatic test systems need consistency and reliability. Option UJ1 8 mm screw connectors provide a simple screw onto which your wires, terminated with insulated ring terminals, may be securely mounted. This optional connector is specifically designed for test systems. Wires may exit the plastic cover in any direction, and multiple wires may be placed on each screw terminal for easy parallel load connections. Up to AWG 4 wire may be used.

Applications which require repeated connections/disconections are better suited to the standard connector. The standard connector accepts an unterminated wire, and may be hand-tightened. This connector is specifically designed for bench applications and short-term automated tests.

More detailed specifications at **www.agilent.com/find/N3300**

Multiple-Input: 150 W to 600 W (Continued)

Design a system to test a variety of products: This series consists of 2 mainframes and 5 modules. The N3300A mainframe is full rack width. It has 6 slots. The N3301A mainframe is half rack width. It has 2 slots. Any assortment of the 5 different modules can be configured into these mainframes, up to the slot capacity. The N3302A (150 watts), N3303A (250 watts), N3307A (250 watts) and N3304A (300 watts) each require one slot. The N3305A (500 watts) and the N3306A (600 watts) each require 2 slots. The electronic load can be configured to supply exactly what you need now, and this modular design also allows for easy future reconfiguration.

Test high current power supplies: Electronic load modules can be operated in parallel to provide addition current sinking capability.

Control the electronic load how you want to: GPIB, RS232, and manual use of the front panel all provide complete control of these electronic loads. There are also analog programming and monitoring ports for those applications that utilize non-standard interfaces, require custom waveforms, or utilize process control signals. Custom waveforms can also be created by downloading a "List" of load parameters. In addition, there is a built-in transient generator, which operates in all modes.

Quickly create powerful and consistent software: All Agilent Technologies electronic loads use the SCPI (Standard Commands for Programmable Instruments) command set. This makes learning the commands easy, because they are the same format as all other SCPI instruments. The resulting code is virtually self-documenting, and therefore easier to troubleshoot and modify in the future. *Plug-n-Play* drivers are also available to help you to integrate the loads into your standard software packages.

Make Measurements Easily and Accurately

The 16-bit voltage, current and power measurement system provides both accuracy and convenience. The alternative is using a dmm (digital multimeter) and MUX (multiplexer) along with a precision current shunt and a lot of extra wiring. Avoiding this complexity increases system reliability and makes the system easier to design and support. Current measurements in particular are more consistently accurate using the electronic load's internal system, because the wiring associated with an external precision current shunt may pick up noise.

Measure with all load modules simultaneously: Testing multiple-output DC power supplies and DC-DC converters can be very time consuming if each output must be tested sequentially. If measurements are being made through a MUX using one DMM, this is what will happen. Using the built-in measurement capabilities of the N3300A electronic loads, all outputs can be measured simultaneously. Alternatively, multiple single output power sources can be tested simultaneously.

Measure voltage and current simultaneously: The N3300A measurement system has individual but linked current and voltage measurement systems. This means that voltage and current measurements are taken exactly simultaneously, which gives a true picture of the power supply under test's output at a particular moment in time. Some other electronic loads which feature internal measurement systems actually take current and voltage measurements sequentially, and therefore do not give as accurate a picture of momentary power.

Observe transient behavior using waveform digitization: Transient response and other dynamic tests often require an oscilloscope. The N3300A has a flexible waveform digitizer with a 4096 data point buffer for voltage and a 4096 data point buffer for current. Under many circumstances, this internal digitizer will be adequate for power supply test needs. Current and voltage are digitized simultaneously, and the sampling rate and sample window are programmable. Some analysis functions are provided, including RMS, max and min.

More detailed specifications at **www.agilent.com/find/N3300**

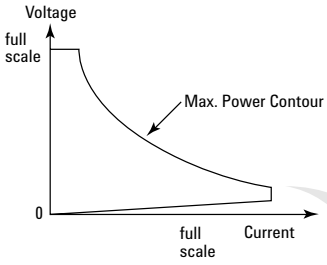
Multiple-Input: 150 W to 600 W (Continued)

Table A-1 Specifications

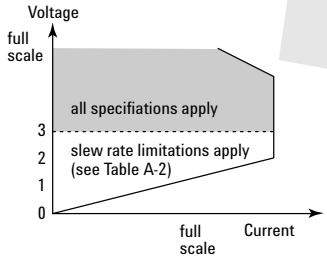
Table A-1 lists the specifications for the different load models. Specifications indicate warranted performance in the 25°C ±5°C region of the operating temperature range. Specifications apply to normal and transient modes unless otherwise noted.

Input Characteristic

Operating Contour



Derated Current Detail



Notes

1 Maximum continuous power available is derated linearly from 100% of maximum at 40°C, to 75% of maximum at 55°C.

2 Specification is ± (% of reading + fixed offset). Measurement is 1000 samples. Specification may degrade when the unit is subject to an RF field of 3 V/meter, the unit is subject to line spikes of 500 V, or an 8 kV electrostatic discharge.

3 DC current accuracy specifications apply 30 seconds after input current is applied.

	N3302A	N3303A	N3304A	N3305A	N3306A	N3307A
Input ratings						
Current	0 - 30 A	0 - 10 A	0 - 60 A	0 - 60 A	0 - 120 A	0 - 30 A
Voltage	0 - 60 V	0 - 240 V	0 - 60 V	0 - 150 V	0 - 60 V	0 - 150 V
Maximum Power @ 40°C[1]	150 W	250 W	300 W	500 W	600 W	250 W
Specified current @ low voltage operation						
2.0 V	30 A	10 A	60 A	60 A	120 A	30 A
1.5 V	22.5 A	7.5 A	45 A	45 A	90 A	22.5 A
1.0 V	15 A	5 A	30 A	30 A	60 A	15 A
0.5 V	7.5 A	2.5 A	15 A	15 A	30 A	7.5 A
0 V	0 A	0 A	0 A	0 A	0 A	0 A
Typical minimum operating voltage @ full scale current	Table A-1 states that maximum current is available down to 2 volts. Typically, however under normal operating conditions, the load can sink the maximum current down to the following voltages:					
	1.2 V	1.2 V	1.2 V	1.4 V	1.4 V	1.4 V
Constant current mode[2]						
Low Range/High Range	3 A/30 A	1 A/10 A	6 A/60 A	6 A/60 A	12 A/120 A	3 A/30 A
Regulation	10 mA	8 mA	10 mA	10 mA	10 mA	10 mA
Low Range Accuracy 0.1% +	5 mA	4 mA	7.5 mA	7.5 mA	15 mA	7.5 mA
High Range Accuracy 0.1% +	10 mA	7.5 mA	15 mA	15 mA	37.5 mA	15 mA
Constant voltage mode[2]						
Low Range/High Range	6 V/60 V	24 V/240 V	6 V/60 V	15 V/150 V	6 V/60 V	15 V/150 V
Regulation	5 mV	10 mV	10 mV	10 mV	20 mV	10 mV
Low Range Accuracy 0.1% +	3 mV	10 mV	3 mV	10 mV	3 mV	10 mV
High Range Accuracy 0.1% +	8 mV	40 mV	8 mV	20 mV	8 mV	20 mV
Constant resistance mode[2]						
Range 1 (I >10% of current rating)	0.067-4 Ω	0.2-48 Ω	0.033-2 Ω	0.033-5 Ω	0.017-1 Ω	0.067-10 Ω
Range 2 (I >1% of current rating)	3.6-40 Ω	44-480 Ω	1.8-20 Ω	4.5-50 Ω	0.9-10 Ω	9-100 Ω
Range 3 (I >0.1% of current rating)	36-400 Ω	440-4800 Ω	18-200 Ω	45-500 Ω	9-100 Ω	90-1000 Ω
Range 4 (I >0.01% of current rating)	360-2000 Ω	4400-12000 Ω	180-2000 Ω	450-2500 Ω	90-1000 Ω	900-2500 Ω
Transient generator						
Frequency Range	0.25 Hz-10 kHz	0.25 Hz-10 kHz	0.25 Hz-10 kHz	0.25 Hz-10 kHz	0.25 Hz 10 kHz	0.25 Hz-10 kHz
Pulse Width	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%	50 µs ±1% to 4 seconds ±1%
Current measurement[2]						
Low Range/High Range	3 A/30 A	1 A/10 A	6 A/60 A	6 A/60 A	12 A/120 A	3 A/30 A
Low Range Accuracy[3] 0.05% +	3 mA	2.5 mA	5 mA	5 mA	10 mA	3 mA
High Range Accuracy[3] 0.05% +	6 mA	5 mA	10 mA	10 mA	20 mA	6 mA
Voltage measurement[2]						
Low Range/High Range	6 V/60 V	24 V/240 V	6 V/60 V	15 V/150 V	6 V/60 V	15 V/150 V
Low Range Accuracy 0.05% +	3 mV	10 mV	3 mV	8 mV	3 mV	8 mV
High Range Accuracy 0.05% +	8 mV	20 mV	8 mV	16 mV	8 mV	16 mV
Power measurement[2]						
Accuracy 0.1% +	0.5 W	1.2 W	0.5 W	1.5 W	1.2 W	0.5 W

More detailed specifications at **www.agilent.com/find/N3300**

Multiple-Input: 150 W to 600 W (Continued)

Table A-2 Supplemental Characteristics

Table A-2 lists the supplemental characteristics, which are not warranted but are descriptions of typical performance determined either by design or type testing.

Notes

1 Slew rate bands are the ranges of programmable slew rates available. When you program a slew rate value outside the indicated bands, the electronic load will automatically adjust the slew rate to fit within the band that is closest to the programmed value. It is not necessary to specify the band, only the slew rate itself.

Below 3 volts, the maximum bandwidth of the electronic load is reduced by a factor of ten to one. For example, in the current range for Model N3302A, the maximum slew rate is specified as 2.5 MA/s, below 3 volts the maximum slew rate would be 250 kA/s. Any slew rate programmed between 2.5 MA/s and 250 kA/s would produce a slew rate of 250 k/s. Slew rates programmed slower than 250 kA/s would still correctly reflect their programmed value. Note that if you are using transient mode to generate a high frequency pulse train, a reduced slew rate might cause the load to never reach the upper programmed value before beginning the transition to the lower programmed value. So even though the transient mode is still operational at lower voltages, a fast pulse train with large transitions may not be achievable.

		N3302A	N3303A	N3304A	N3305A	N3306A	N3307A
Programming Resolution							
Constant current mode		0.05 mA/ 0.5 mA	0.02 mA/ 0.2 mA	0.1 mA/ 1 mA	0.1 mA/ 1 mA	0.2 mA/ 2 mA	0.05 mA/ 0.5 mA
Constant voltage mode		0.1 mV/1 mV	0.4 mV/4 mV	0.1 mV/1 mV	0.25 mV/2.5 mV	0.1 mV/1 mV	0.25 mV/2.5 mV
Constant resistance mode		0.07/0.7/ 7/70 mΩ	0.82/8.2/ 82 mΩ	0.035/0.35/ 3.5/35 mΩ	0.085/0.85/ 8.5/85 mΩ	0.0175/0.175/ 1.75/17.5 mΩ	0.17/1.7/ 17/170 mΩ
Readback resolution							
Current		0.05 mA/ 0.5 mA	0.02 mA/ 0.2 mA	0.1 mA/ 1 mA	0.1 mA/ 1 mA	0.2 mA/ 2 mA	0.05 mA/ 0.5 mA
Voltage		0.1 mV/ 1 mV	0.4 mV/ 4 mV	0.1 mV/ 1 mV	0.25 mV/ 2.5 mV	0.1 mV/ 1 mV	0.25 mV/ 2.5 mV
Programmable slew rate[1]							
Current Ranges	Slow band	500 A/s - 25 kA/s	167 A/s - 8330 A/s	1 kA/s - 50 kA/s	1 kA/s - 50 kA/s	2 kA/s - 100 kA/s	500 A/s - 25 kA/s
	Fast band ≥3 V	50 kA/s - 2.5 MA/s	16.7 kA/s - 833 kA/s	100 kA/s - 5 MA/s	100 kA/s - 5 MA/s	200 kA/s - 10 MA/s	50 kA/s - 2.5 MA/s
	Fast band <3 V	50 kA/s - 250 kA/s	16.7 kA/s - 83.3 kA/s	100 kA/s - 500 kA/s	100 kA/s - 500 kA/s	200 kA/s - 1 MA/s	50 kA/s - 250 kA/s
Voltage Ranges	Slow band	1 kV/s - 50 kV/s	4 kV/s - 200 kV/s	1 kV/s - 50 kV/s	2.5 kV/s - 125 kV/s	1 kV/s - 50 kV/s	2.5 kV/s - 125 kV/s
	Fast band ≥3 V	100 kV/s - 500 kV/s	400 kV/s - 2 MV/s	100 kV/s - 500 kV/s	250 kV/s - 1.25 MV/s	100 kV/s - 500 kV/s	250 kV/s - 1.25 MV/s
	Fast band <3 V	100 kV/s - 50 kV/s	400 kV/s - 200 kV/s	100 kV/s - 50 kV/s	250 kV/s - 125 kV/s	100 kV/s - 50 kV/s	250 kV/s - 125 kV/s
Resistance Range 1	Slow band	44 Ω/s - 1125 Ω/s	540 Ω/s - 13.5 kΩ/s	22 Ω/s - 560 Ω/s	55 Ω/s - 1400 Ω/s	11 Ω/s - 280 Ω/s	110 Ω/s - 2800 Ω/s
	Fast band ≥3 V	2250 Ω/s - 34 kΩ/s	27 kΩ/s - 408 kΩ/s	1120 Ω/s - 17 kΩ/s	2800 Ω/s - 42.5 kΩ/s	560 Ω/s - 8.5 kΩ/s	5600 Ω/s - 85 kΩ/s
	Fast band <3 V	2250 Ω/s - 3.4 kΩ/s	27 kΩ/s - 40.8 kΩ/s	1120 Ω/s - 1.7 kΩ/s	2800 Ω/s - 4.25 kΩ/s	560 Ω/s - 850 Ω/s	5600 Ω/s - 8.5 kΩ/s
Resistance Range 2	Slow band	440 Ω/s - 11.25 kΩ/s	5.4 kΩ/s - 135 kΩ/s	220 Ω/s - 5600 Ω/s	550 Ω/s - 14 kΩ/s	110 Ω/s - 2800 Ω/s	1.1 kΩ/s - 28 kΩ/s
	Fast band ≥3 V	22.5 kΩ/s - 340 kΩ/s	270 kΩ/s - 4.08 MΩ/s	11.2 kΩ/s - 170 kΩ/s	28 kΩ/s - 425 kΩ/s	5600 Ω/s - 85 kΩ/s	56 kΩ/s - 850 kΩ/s
	Fast band <3 V	22.5 kΩ/s - 34 kΩ/s	270 kΩ/s - 408 kΩ/s	11.2 kΩ/s - 17 kΩ/s	28 kΩ/s - 42.5 kΩ/s	5600 Ω/s - 8.5 kΩ/s	56 kΩ/s - 85 kΩ/s
Resistance Range 3	Slow band	4.4 kΩ/s - 112.5 kΩ/s	54 kΩ/s - 1.35 MΩ/s	2.2 kΩ/s - 56 kΩ/s	5.5 kΩ/s - 140 kΩ/s	1.1 kΩ/s - 28 kΩ/s	11 kΩ/s - 280 kΩ/s
	Fast band ≥3 V	225 kΩ/s - 3.4 MΩ/s	2.7 MΩ/s - 40.8 MΩ/s	112 kΩ/s - 1.7 MΩ/s	280 kΩ/s - 4.25 MΩ/s	56 kΩ/s - 850 kΩ/s	560 kΩ/s - 8.5 MΩ/s
	Fast band <3 V	225 kΩ/s - 340 kΩ/s	2.7 MΩ/s - 4.08 MΩ/s	112 kΩ/s - 170 kΩ/s	280 kΩ/s - 425 kΩ/s	56 kΩ/s - 85 kΩ/s	560 kΩ/s - 850 kΩ/s
Resistance Range 4	Slow band	44 kΩ/s - 1.125 MΩ/s	540 kΩ/s - 13.5 MΩ/s	22 kΩ/s - 560 kΩ/s	55 kΩ/s - 1.4 MΩ/s	11 kΩ/s - 280 kΩ/s	110 kΩ/s - 2.8 MΩ/s
	Fast band ≥3 V	2.25 MΩ/s - 34 MΩ/s	27 MΩ/s - 408 MΩ/s	1.12 MΩ/s - 17 MΩ/s	2.8 MΩ/s - 42.5 MΩ/s	560 kΩ/s - 8.5 MΩ/s	5.6 MΩ/s - 85 MΩ/s
	Fast band <3 V	2.25 MΩ/s - 3.4 MΩ/s	27 MΩ/s - 40.8 MΩ/s	1.12 MΩ/s - 1.7 MΩ/s	2.8 MΩ/s - 4.25 MΩ/s	560 kΩ/s - 850 kΩ/s	5.6 MΩ/s - 8.5 MΩ/s

Multiple-Input: 150 W to 600 W (Continued)

Table A-2 (Continued) Supplemental Characteristics

Table A-2 lists the supplemental characteristics, which are not warranted but are descriptions of typical performance determined either by design or type testing.

Notes
2 Applies to all ranges.

	N3302A	N3303A	N3304A	N3305A	N3306A	N3307A
Programmable short	66 mΩ max.	200 mΩ max.	33 mΩ max.	33 mΩ max.	17 mΩ max.	33 mΩ max.
	40 mΩ typical	100 mΩ typical	20 mΩ typical	25 mΩ typical	12 mΩ typical	20 mΩ typical
Programmable open	≥20 kΩ	≥80 kΩ	≥20 kΩ	≥20 kΩ	≥20 kΩ	≥80 kΩ
Command processing time						
Using discrete commands	3 ms	3 ms	3 ms	3 ms	3 ms	3 ms
Using List commands	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms
List dwell characteristics						
Range	0 - 10 s	0 - 10 s	0 - 10 s	0 - 10 s	0 - 10 s	0 - 10 s
Resolution	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms
Accuracy	5 ms	5 ms	5 ms	5 ms	5 ms	5 ms
Measurement time						
1000 samples (default)	20 ms (with specified measurement accuracy)	20 ms (with specified measurement accuracy)	20 ms (with specified measurement accuracy)	20 ms (with specified measurement accuracy)	20 ms (with specified measurement accuracy)	20 ms (with specified measurement accuracy)
200 samples	10 ms (with <6% additional fixed offset)	10 ms (with <6% additional fixed offset)	10 ms (with <6% additional fixed offset)	10 ms (with <6% additional fixed offset)	10 ms (with <6% additional fixed offset)	10 ms (with <6% additional fixed offset)
100 samples	9 ms (with <10% additional fixed offset)	9 ms (with <10% additional fixed offset)	9 ms (with <10% additional fixed offset)	9 ms (with <10% additional fixed offset)	9 ms (with <10% additional fixed offset)	9 ms (with <10% additional fixed offset)
20 points	7 ms (with <30% additional fixed offset)	7 ms (with <30% additional fixed offset)	7 ms (with <30% additional fixed offset)	7 ms (with <30% additional fixed offset)	7 ms (with <30% additional fixed offset)	7 ms (with <30% additional fixed offset)
<20 points	7 ms (with >30% additional fixed offset)	7 ms (with >30% additional fixed offset)	7 ms (with >30% additional fixed offset)	7 ms (with >30% additional fixed offset)	7 ms (with >30% additional fixed offset)	7 ms (with >30% additional fixed offset)
Ripple and noise (20 Hz - 10 MHz)						
Current (rms/peak to peak)	2 mA/20 mA	1 mA/10 mA	4 mA/40 mA	4 mA/40 mA	6 mA/60 mA	2 mA/20 mA
Voltage (rms)	5 mV_{rms}	12 mV_{rms}	6 mV_{rms}	10 mV_{rms}	8 mV_{rms}	10 mV_{rms}
External analog programming						
Voltage Programming Accuracy[2]	0.5% + 12 mV	0.5% + 48 mV	0.5% + 12 mV	0.5% + 30 mV	0.5% + 12 mV	0.5% + 30 mV
Current Programming Accuracy[2]	0.25% + 4.5 mA	0.25% + 1.5 mA	0.25% + 9 mA	0.25% + 9 mA	0.25% + 18 mA	0.25% + 4.5 mA
External monitor ports						
Voltage Monitor Accuracy	0.25% + 12 mV	0.25% + 48 mV	0.25% + 12 mV	0.25% + 30 mV	0.25% + 12 mV	0.25% + 30 mV
Current Monitor Accuracy	0.1% + 4.5 mA	0.1% + 1.5 mA	0.1% + 9 mA	0.1% + 9 mA	0.1% + 18 mA	0.1% + 4.5 mA

Multiple-Input: 150 W to 600 W (Continued)

Table A-3 Supplemental Characteristics

	N3300A	N3301A
Operating temperature range	0°C to 55°C	0°C to 55°C
Input ratings		
Operating range	100 - 250 Vac 48 - 63 Hz	100 - 250 Vac 48 - 63 Hz
Input Current	4.2 A @ 100 - 127 Vac 2.2 A @ 200 - 250 Vac	2.3 A @ 100 - 250 Vac
Input VA	440 VA	230 VA
Inrush Current	38 A	18 A @ 115 Vac 36 A @ 230 Vac

Application Notes:

Agilent AN 372-1 Power Supply Testing
(AN 372-1)
5952-4190

Agilent AN 372-2 Battery Testing
(AN 372-2)
5952-4191

Increasing DC Power Supply Test System Throughput with Agilent Technologies N3300A DC Electronic Loads
5980-0233E

Agilent Zero Volt Electronic Load
5968-6360E

Making Fuel Cell AC Impedance Measurements Utilizing Agilent N3300A Series Electronic Loads
5988-5358EN

Supplemental Characteristics for all model numbers

Analog Programming Bandwidth:
10 kHz (-3 db frequency) in CC mode only

Analog Programming Voltage:
Voltage: 0 - 10 V
Current: 0 - 10 V

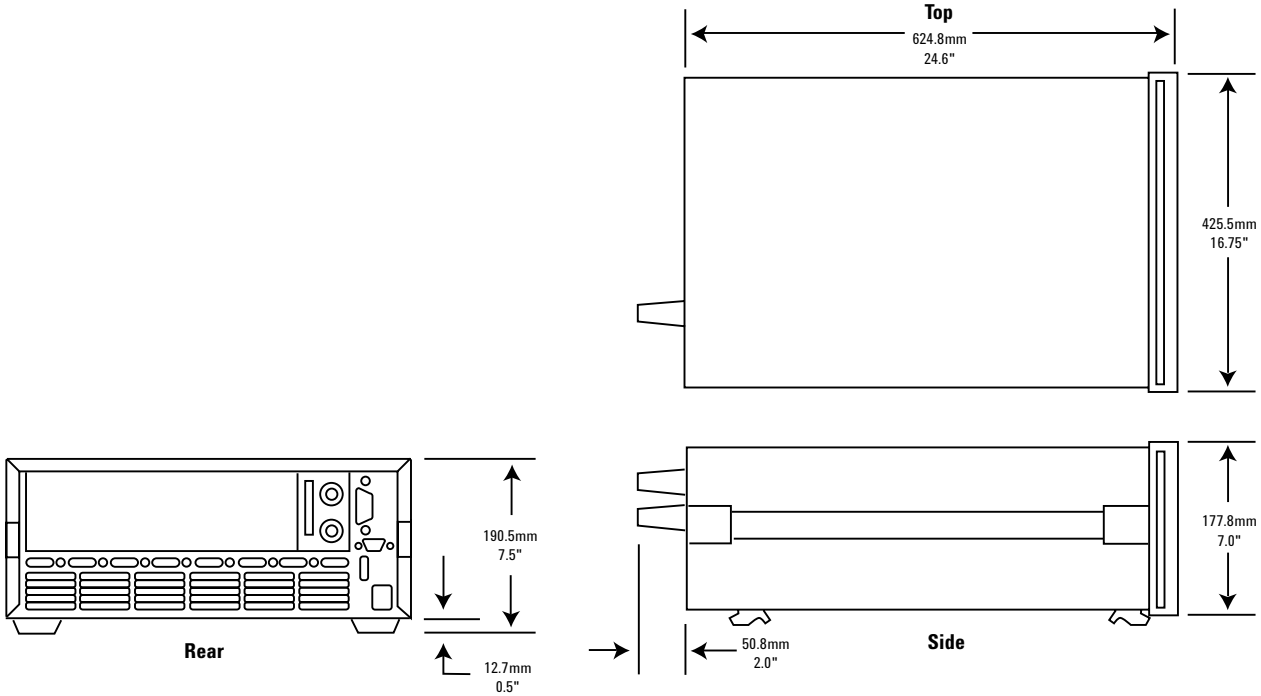
Analog Monitor Ports:
Voltage: 0 - 10 V
Current: 0 - 10 V

Remote Sensing:
5 V DC between sense and load input

Digital/Trigger Inputs
Vil = 0.9 V max at Iil = -1 mA
Vih - 3.15 V min
(pull-up resistor on input)

Digital/Trigger Outputs
Vol = 0.72 V max at Iol = 1 mA
Voh = 4.4 V min at Ioh = -20 µA

Agilent Models: N3300A



More detailed specifications at **www.agilent.com/find/N3300**

Multiple-Input: 150 W to 600 W (Continued)

Software Driver:
VXI*Plug&Play*

Net Weight:
N3300A: 13.2 kg (29 lb); N3301A: 7.3 kg (16 lb); N3302A, N3303A or N3304A: 2.7 kg (6 lb); N3305A or N3306A: 4.6 kg (10 lb), N3307A 2.7 kg (6 lb)

Shipping Weight:
N3300A: 17 kg (38 lb); N3301A: 9.1 kg (20 lb) N3302A, N3303A, or N3304A: 4.1 kg (9 lb) N3305A or N3306A: 6.8 kg (15 lb), N3307A 4.1 kg (9 lb)

Warranty: One year

Ordering Information

Opt. UJG: Standard finger twist connector

Opt. UJ1: 8 mm screw terminal connector (available on all load modules N3302A-N3307A)

Opt. 800: Rack-mount kit for two N3301A Mainframes mounted side-by-side (p/n 5061-9694 and 5062-3978).

Opt. 908: Rack-mount kit (Two p/n 5062-3974C for a N3300A, or p/n 5062-3960 for one N3301A). For the N3301A, the kit includes a blank filler panel.

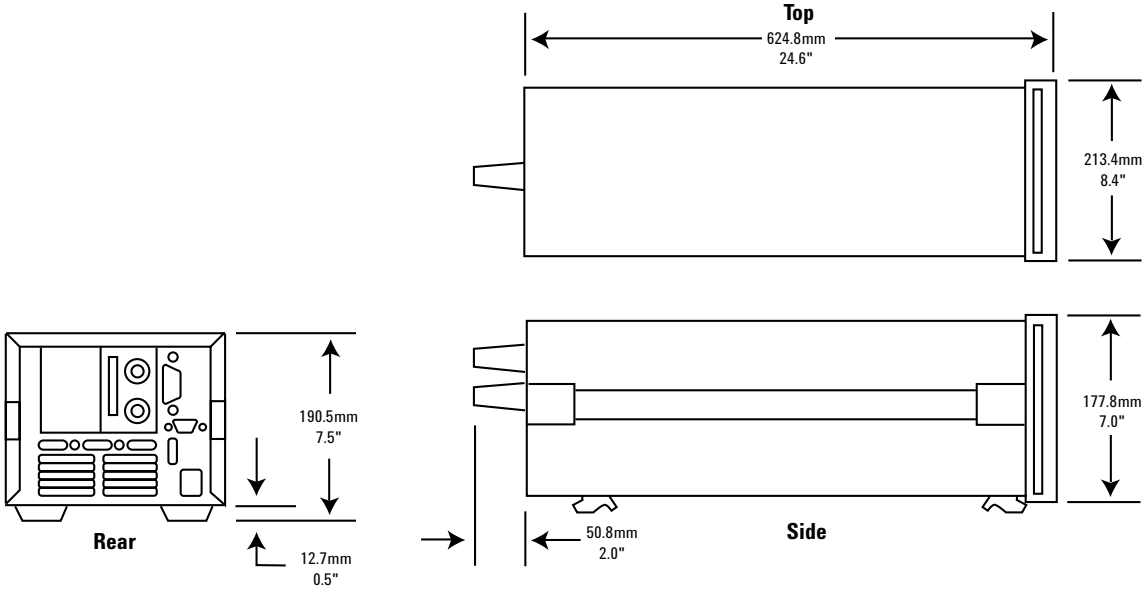
Opt. 909: Rack-mount kit with handles for N3300A (Two p/n 5062-3975 and 5063-9219)

Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 0B0 Full documentation on CD-ROM only

Agilent Models: N3301A



More detailed specifications at **www.agilent.com/find/N3300**

6060B and 6063B

Single-Input
250 W to 300 W

Cost-effective for single input applications

Convenient optional front panel input connection

The 6060B and 6063B each provides one load input. This is more convenient for single input applications than a mainframe product.

These electronic loads are particularly suited for the lab bench. Entering commands manually using the front panel keypad is simpler because the channel does not need to be specified, as in a mainframe configuration. The keypad entry is further simplified because these products do not have the downloadable LIST feature of the N3300A Series, which helps to maximize production throughput. Extensive protection is included to help protect your valuable prototypes under test. This includes overvoltage, overcurrent, overtemperature, overpower, and reverse polarity.

These loads are suitable for manufacturing test systems where maximizing speed is not critical. They use industry standard SCPI instructions, and also have VXI*Plug&Play* drivers to simplify system design. For the greatest speed and accuracy in programming and measurement, see the N3300A Series of DC electronic loads.

Specifications	6060B	6063B
Amperes	0 to 60 A	0 to 10 A
Volts	3 to 60 V	3 to 240 V
Maximum power (at 40° C)	300 W	250 W
Constant current mode		
Ranges	0 to 6 A, 0 to 60 A	0 to 1 A, 0 to 10 A
Accuracy	0.1% ±75 mA	0.15% ±10 mA
Regulation	10 mA	8 mA
Constant voltage mode		
Accuracy	0.1% ±50 mV	0.12% ±120 mV
Regulation (w/remote sense)	10 mV	10 mV
Constant resistance mode	0.033 to 1.0 Ω	0.20 to 24.0 Ω
Ranges	1 to 1,000 Ω 10 to 10,000 Ω	24 to 10,000 Ω 240 to 50,000 Ω
Accuracy	1 Ω: 0.8% ±8 mΩ (with ≥6 A at input) 1 KΩ: 0.3% ±8 mS (with ≥6 V at input) 10 KΩ: 0.3% ±8 mS (with ≥6 V at input)	24 Ω: 0.8% ±200 mΩ (with ≥1 A at input) 10 KΩ/: 0.3% ±0.3 mS (with ≥24 V at input) 50 KΩ: 0.3% ±0.3 mS (with ≥24 V at input)
Transient generator		
Frequency range Accuracy	0.25 Hz to 10 kHz 3%	0.25 Hz to 10 kHz 3%
Duty cycle range Accuracy	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 6% of setting ±2%
Current level high range Accuracy	60-A range: 0.1% ±350 mA	10-A range: 0.18% ±50 mA
Current level low range Accuracy	6-A range: 0.1% ±80 mA	1-A range: 0.18% ±13 mA
Voltage level Voltage level accuracy	3 to 60 V 0.1% ±300 mV	3 to 240 V 0.15% ±1.1 V
Readback specifications		
Current readback accuracy Voltage readback accuracy	0.05% ±65 mA ±(0.05% + 45 mV)	0.12% ±10 mA ±(0.1% + 150 mV)
Ripple and noise (20-Hz to 10-MHz noise) Current Voltage	 4 mA rms 40 mA peak-to-peak 6 mV rms	 1 mA rms 10 mA peak-to-peak 6 mV rms

More detailed specifications at **www.agilent.com/find/6060**

Single-Input: 250 W to 300 W (Continued)

Notes:

1. Operating temperature range is 0° to 55°C. All specifications apply for 25°C ±5°C, except as noted.
2. Maximum continuous power available is derated linearly from 40°C to 75% of maximum at 55°C.
3. DC current accuracy specifications apply 30 seconds after input is applied.

Specifications	6060B	6063B
Supplemental Characteristics	(Non-warranted characteristics determined by design that are useful in applying the product)	
Constant current mode	60-A range: 16 mA	10-A range: 2.6 mA
Resolution	6-A range: 1.6 mA	1-A range: 0.26 mA
Temperature coefficient	100 ppm/°C ±5 mA/°C	150 ppm/°C ±1 mA/°C
Constant voltage mode		
Resolution	16 mV	64 mV
Temperature coefficient	100 ppm/°C ±5 mV/°C	120 ppm/°C ±10 mV/°C
Constant resistance mode Resolution	1 Ω : 0.27 mΩ 1 KΩ: 0.27 mS 10 KΩ: 0.027 mS	24 Ω: 6 mΩ 10 KΩ: 0.011 mS 50 KΩ: 0.001 mS
Temperature coefficient	1 Ω: 800 ppm/°C ±0.4 mΩ/°C 1 KΩ: 300 ppm/°C ±0.6 mS/°C 10 KΩ: 300 ppm/°C ±0.6 mS/°C	24 Ω: 800 ppm/°C ±10 mΩ/°C 10 KΩ: 300 ppm/°C ±0.03 mS/°C 50 KΩ: 300 ppm/°C ±0.03 mS/°C
Transient generator		
Frequency range Resolution	0.25 Hz to 10 kHz 4% or less	0.25 Hz to 10 kHz 4% or less
Duty cycle range Resolution	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 4%	3 to 97% (0.25 Hz to 1 kHz) 6 to 94% (1 to 10 kHz) 4%
Current level high range Resolution	60-A range: 260 mA	10-A range: 43 mA
Current level low range Resolution	6-A range: 26 mA	1-A range: 4 mA
Current temperature coefficient	100 ppm/°C ±7 mA/°C	180 ppm/°C ±1.2 mA/°C
Voltage level resolution	260 mV	1 V
Voltage temperature coefficient	150 ppm/°C ±5 mV/°C	120 ppm/°C ±10 mV/°C
Programmable slew rate	60-A range: 1 A/ms to 5 A/µs 6-A range: 0.1 A/ms to 0.5 A/µs	10-A range: 0.17 A/ms to 0.83 A/µs 1-A range: 17 A/ms to 83 A/ms
Rise/fall time	12 µs to 8 ms	16 µs to 8 ms
Analog programming bandwidth	10 kHz (–3 dB frequency)	10 kHz (–3 dB frequency)
Analog programming accuracy		
Current (low range)	4.5% ±75 mA	3% ±8 mA
Current (high range)	4.5% ±250 mA	3% ±20 mA
Temperature coefficient	100 ppm/°C ±6 mA/°C	150 ppm/°C ±1 mA/°C
Voltage	0.8% ±200 mV	0.5% ±150 mV
Temperature coefficient	100 ppm/°C ±1 mV/°C	120 ppm/°C ±10 mV/°C
Analog programming voltage	0 to 10 V	0 to 10 V
Readback specifications	17 mA (via GPIB)	2.7 mA (via GPIB)
Current readback resolution	20 mA (front panel)	10 mA (front panel)
Temperature coefficient	50 ppm/°C ±5 mA/°C	100 ppm/°C ±1 mA/°C
Voltage readback resolution	17 mV (via GPIB) 20 mV (front panel)	67 mV (via GPIB) 100 mV (front panel)
Temperature coefficient	50 ppm/°C ±1.2 mV/°C	100 ppm/°C ±8 mV/°C

More detailed specifications at **www.agilent.com/find/6060**

Single-Input: 250 W to 300 W (Continued)

Notes:

1. Operating temperature range is 0° to 55°C. All specifications apply for 25°C ±5°C, except as noted.
2. Maximum continuous power available is derated linearly from 40°C to 75% of maximum at 55°C.
3. DC current accuracy specifications apply 30 seconds after input is applied.

Specifications	**6060B**	**6063B**
Supplemental Characteristics (Continued)	(Non-warranted characteristics determined by design that are useful in applying the product)	
Analog monitor accuracy		
Current monitor (0 to 10 V out)	4% ±85 mA	3% ±10 mA
Temperature coefficient	50 ppm/°C ±6 mA/°C	100 ppm/°C ±1 mA/°C
Voltage monitor (0 to 10 V out)	0.25% ±40 mV	0.4% ±240 mV
Temperature coefficient	50 ppm/°C ±0.2 mV/°C	70 ppm/°C ±1.2 mV/°C
Remote sensing	5-Vdc maximum between sense and load input	5-Vdc maximum between sense and load input
Minimum operating voltage (at full rated current)	2 volts (1.2 V typical)	2 volts (1.2 V typical)
Programmable short	0.033 Ω (0.020 Ω typical)	0.20 Ω (0.10 Ω typical)
Programmable open (typical)	20 kΩ	80 kΩ
Drift (over 8-hour interval)		
Current	0.03% ±10 mA	0.03% ±15 mA
Voltage	0.01% ±10 mV	0.01% ±20 mV
DC isolation voltage	±240 Vdc, between any input and chassis ground	±240 Vdc, between any input and chassis ground
Digital inputs	V_{IL} = 0.9 V max at I_{IL} = –1 mA / V_{IH} = 3.15 V min (pull-up resistor on input)	V_{IL} = 0.9 V max at I_{IL} = –1 mA / V_{IH} = 3.15 V min (pull-up resistor on input)
Digital outputs	V_{OL} = 0.72 V max at I_{OL} = 1 mA / V_{OH} = 4.4 V min at I_{OH} = –20 µA	V_{OL} = 0.72 V max at I_{OL} = 1 mA / V_{OH} = 4.4 V min at I_{OH} = –20 µA
Net weight (approx.)	6.12 kg (13.5 lb)	6.12 kg (13.5 lb)
Shipping weight	8.16 kg (18 lb)	8.16 kg (18 lb)

Single-Input: 250 W to 300 W (Continued)

Application Notes:

Agilent AN 372-1 Power Supply Testing
(AN 372-1)
5952-4190

Agilent AN 372-2 Battery Testing
(AN 372-2)
5952-4191

Pulsed Characterization of Power Semiconductors Using Electronic Loads
(AN 1246)
5091-7636E

Supplemental Characteristics for all model numbers

Software Driver:
VXI*Plug&Play*

Weight: 6.12 kg (13.5 lb) net; 8.16 kg (18 lb) shipping

Size: 425.5 mm W x 88.1 mm H x 396 mm D (16.75 in x 3.5 in x 13.7 in)

Warranty: One year

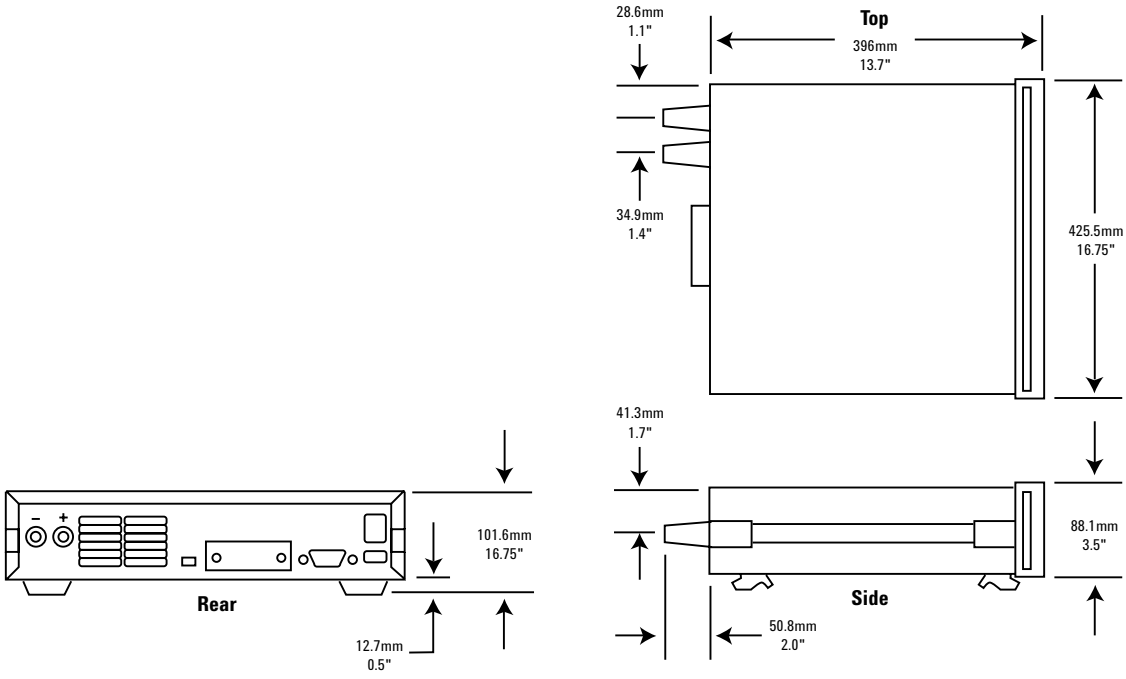
Ordering Information

Opt 020 Front Panel DC Input Connectors
Opt 100 87 to 106 Vac, 47 to 66 Hz input (for Japan only)
Opt 120 104-127 Vac, 47 to 66 Hz
Opt 220 191 to 233 Vac, 47 to 66 Hz input
Opt 240 209 to 250 Vac, 47 to 66 Hz input
* **Opt 908** Rack-mount Kit (p/n 5062-3974C)
* **Opt 909** Rack-mount Kit with Handles (p/n 5063-9219)
Opt 0L1 Full documentation on CD-ROM, and printed standard documentation package
Opt 0L2 Extra copy of standard printed documentation package
Opt 0B0 Full documentation on CD-ROM only
Opt 0B3 Service Manual
* Support rails required

Accessories

E3663AC Support rails for Agilent rack cabinets

Agilent Models: 6060B, 6063B



More detailed specifications at **www.agilent.com/find/6060**

AC Power Source/Analyzers...

an integrated AC power solution

Agilent AC Power Source/ Analyzers provide a complete AC test solution. As AC sources, they combine the capabilities of a power amplifier and an arbitrary waveform generator. This allows you to simulate normal waveforms and many types of distorted power waveforms. The built-in power analyzer combines the capabilities of a multimeter, oscilloscope, harmonic analyzer and power analyzer. These instruments may also be used to produce DC power, either alone or as a DC offset to an AC waveform.

AC Power Source/Analyzers
375-1750 VA

6811B, 6812B, 6813B

Provides a complete AC and DC power and measurement solution

Protect valuable DUTs with extensive protection features

Easy to use Graphical User Interface (GUI)

The Complete AC Power Test Solution

Since your product will have to operate in the real world of unpredictable AC power, you need to design and verify its correct operation under a wide range of AC power inputs. Brownouts, dropouts, sags, and other irregularities are not unusual in many communities today. Agilent AC sources have the features needed to easily accomplish this test goal either in an R&D environment or on the manufacturing test floor. If you plan to sell your products in a worldwide market, you will also need to test them at the line voltages and frequencies that they will eventually operate at. There is also additional testing needed to meet regulatory requirements for sale into some countries.

Agilent AC sources offer a complete solution for AC power testing, helping you to simplify this important task. These instruments combine the features of a power amplifier and arbitrary waveform generator to give you the ability to do all of the tests that you need. There are many standard preprogrammed waveforms, or you can use the transient generation system to simulate sophisticated and repeatable AC line disturbances. DC power can also be generated, either as a DC offset or as a pure DC signal.

Powerful Built-in Measurement Capabilities

Agilent AC sources have extensive 16-bit precision measurement capabilities which would normally require a number of complex measurement instruments, including a DMM (digital multimeter), oscilloscope, power analyzer, and harmonic analyzer. The precision measurements include:

- rms, DC, AC + DC voltage and current
- peak voltage and current
- real, apparent, and reactive power
- harmonic analysis of voltage and current waveforms providing amplitude and phase up to the 50th harmonic
- THD (total harmonic distortion)
- Triggered acquisition of digitized voltage and current

Using the measurement capabilities of an Agilent AC source simplifies your test setups and helps you obtain accurate data quickly.

Dual Power Analyzer Option 020

The powerful built-in power meter/analyzer in Agilent AC sources provides everything that you need to make AC measurements at the AC input to your DUT. For many test scenarios, this is the extent of the AC analysis required.

Some test scenarios, however, require AC measurements to be made at both the AC input and the AC output of the DUT. Option 020 provides an additional power analyzer, complete with a precision current shunt, which can be connected anywhere you need it. This second analyzer can even be used for tests where the AC source is not providing power, thus expanding the usefulness of this instrument to many more test configurations. The additional analyzer is equivalent in specifications and capabilities to the standard analyzer.

More detailed specifications at **www.agilent.com/find/6800**

AC Power Source/Analyzers: 375-1750 VA (Continued)

Using the dual power analyzer option instead of an additional power analyzer instrument externally is more than just convenient. Measurements on all four measurement channels (AC source output voltage and current, and dual power analyzer voltage and current inputs) are inherently synchronized with the AC source output waveform. This precision would be difficult to achieve using separate measurement instruments.

Examples Dual Power Analyzer Applications

- Complete testing of uninterruptible power sources (UPS)
- Efficiency testing of DC power supplies
- Efficiency testing of AC power sources
- Efficiency testing of transformers
- Safety testing of transformers
- Line disturbance and brownout testing of DC power supplies
- Line disturbance and brownout testing of AC power sources
- Sleep mode current monitoring
- Independent power analyzer

Sleep Mode Current Monitoring

Many electronic products have power-saving or sleep modes. In this mode, the device draws only enough power to be able to recognize a "wake-up" signal, and then execute a smooth "wake-up". The power drawn in this mode is a critical parameter, and the ability to accurately monitor it is important.

The accessory precision current shunt that is supplied with option 020 is mounted in such a way to make it easy for you to replace it with a precision resistor of your choice. By doing this, you can configure the system to accurately monitor extremely low currents. This provides an easy way for you to profile the current draw in all modes of your product's operation. Since Agilent 6811B-6813B AC sources produce DC power as well as AC power, portable battery operated products can also be tested with this configuration.

UPS (uninterruptible power source) Testing

The Dual Power Analyzer Option provides many important benefits for UPS testing. Since the key to correct UPS operation is having the output react properly to changes on the input, being able to monitor the output relative to the input simplifies testing. For example, commands are available to enable calculation of UPS transfer time, and the phase difference between the UPS input and output voltage. Agilent AC sources also have programmable output impedance, enabling the UPS designer to verify product stability over a wide range of AC line impedance.

Free Graphical User Interface (GUI)

When you need to run a variety of tests, study the results carefully, and then run more tests with slightly varied conditions, writing computer programs using the extensive SCPI command set may seem burdensome. This is when you should download the latest copy of the Free Agilent AC Source Graphical User Interface from www.agilent.com.

The Agilent AC source GUI makes it quick and easy to set the output of your Agilent AC source, be it from a stored waveform or with a waveform that you create using your mouse. The GUI also allows you to see the output of the AC source in graphical form, save the results, or dump them directly into a Microsoft Excel file.

Microsoft Excel Link

The direct Excel link feature was recently added to meet the current needs of R&D engineers. It makes it easy to keep the results of many tests, and makes them easily retrievable. With it, the test records resulting from changing conditions can be kept in one place and easily compared.

Access to raw data often helps in fully understanding test results. For example, small local peaks may not be evident in processed data. V, I and phase results from harmonic measurements are particularly susceptible to not showing the complete story in a graphical representation.

AC Power Source/Analyzers: 375-1750 VA (Continued)

Microsoft Excel offers a wide variety of data manipulation and graphical capabilities that can help an engineer gain the fullest understanding from the test data.

Test Suite for Avionics Equipment
Agilent AC sources are well suited for testing equipment intended for use in the avionics industry which operate at nominally 400 Hz. One of the special requirements that many manufacturers in this industry must concern themselves with is testing to meet RTCA DO-160 standards. These standards involve both AC and DC immunity tests. The Agilent AC source GUI includes a section devoted to these tests. By using this tool, you can quickly step through the required set-ups with confidence.

Extensive protection to prevent load damage

In addition to overcurrent, overvoltage, overpower and overtemperature protection, the 6800 series offers output disconnect relays and remote inhibit capability (quickly disabling the output of the AC source via a TTL signal) to protect the device under test.

The 6800 series is backed by a three-year warranty and Agilent's worldwide network of support and service centers.

Application info

The 6800 series can help you test and improve your products. You can easily perform:

1. Static testing–generating and measuring voltage, frequency, and line current for meeting worldwide specifications.
2. Dynamic testing–generating AC line transients for limit testing and design verification.
3. Specialty testing–measuring current harmonic content and creating custom AC power waveforms (such as a combined AC + DC signal to simulate a telephone ring).
4. Precompliance regulatory testing–measuring current harmonics, voltage fluctuations and flicker emissions and generating voltage and frequency disturbances and interharmonics to determine product immunity.

Development engineers and test professionals in a wide variety of industries use AC power source/analyzers. Here are a few examples:

Avionics
Instrumentation, ATE test stations

Computer Products
Computers, Monitors, Peripherals

Consumer Products
Home appliances, Audio and video equipment, Heating/cooling controls

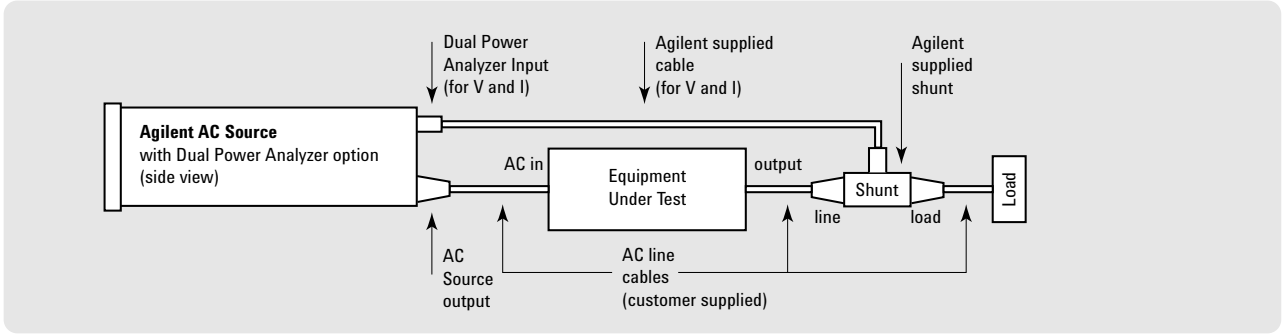
Electrical Products
Relays, Transformers, Power components, Fire alarms

Lighting Products
Electronic ballasts, Compact flourescent bulbs, Timers

Motors
AC motors, Electronic controllers

Power Products
AC/DC adapters, AC/DC power supplies, PBX power supplies, Uninterruptible power supplies

Telecom Products
RF amplifiers, CATV devices, MUX's, routers, switches

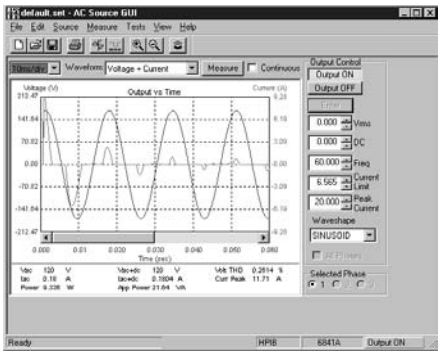


Test configuration of efficiency measurement using an Agilent AC source with the 020 Dual Power Analyzer Option.

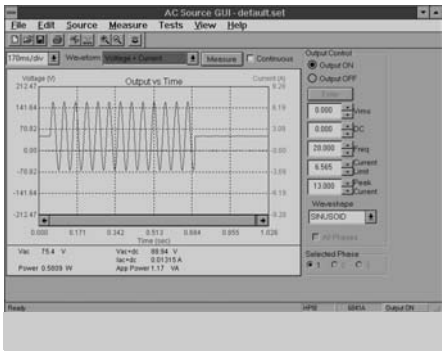
More detailed specifications at **www.agilent.com/find/6800**

AC Power Source/Analyzers: 375-1750 VA (Continued)

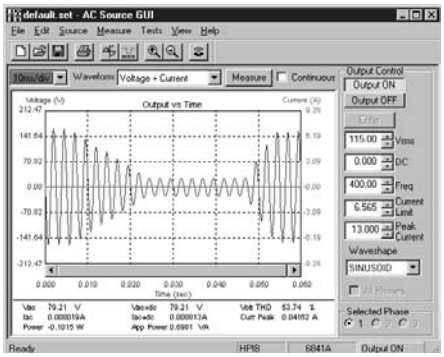
AC Source Graphical User Interface



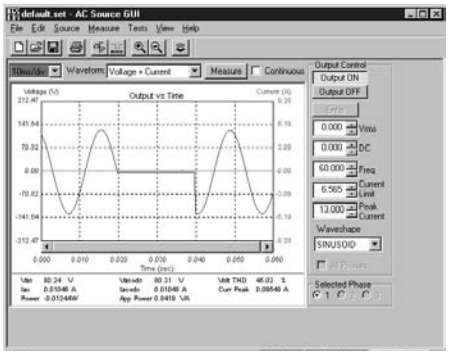
Inrush Current Measurement



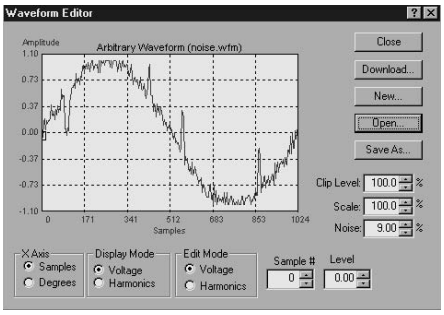
Ringer Voltage (DC + AC) Generation



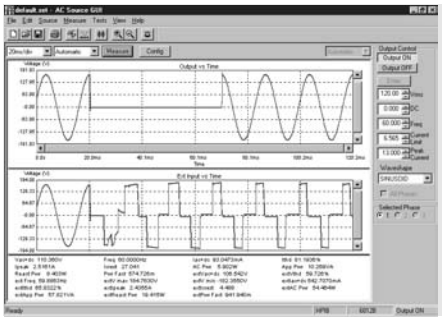
Voltage Slew Control (Brownout)



One cycle AC Mains Dropout



User Defined Waveform: Noise with Spikes



Testing of UPS Input and Output using Dual Power Analyzer Option 020

More detailed specifications at **www.agilent.com/find/6800**

AC Power Source/Analyzers: 375-1750 VA (Continued)

For a sine wave with a resistive load at 0° to 40° C, within an output frequency range of 45 Hz to 1000 Hz, and in AC coupled mode after a 30 minute warm-up unless otherwise noted.

Notes:

1 Product may be operated between DC and 45 Hz subject to certain deratings. Measurements may be extended to 4.5 Hz at full accuracy only by selecting a digitization rate of 250 µ seconds per point. Frequency content of the measured signal must be limited to 4 k Hz or less to avoid aliasing effects.

Specifications (at 0˚ to 55˚C unless otherwise specified)	**6811B**	**6812B**	**6813B**
Number of phases	1	1	1
Output ratings (Maximum)			
Power	375 VA	750 VA	1750 VA
rms voltage	300 V	300 V	300 V
rms current	3.25 A	6.5 A	13 A
Repetitive & non-repetitive peak current	40 A	40 A	80 A
Crest factor	12	6	6
Load Power factor capability	0 to 1	0 to 1	0 to 1
DC power	285 W	575 W	1350 W
DC voltage	±425 V	±425 V	±425 V
DC current	2.5 A	5.0 A	10.0 A
Output frequency range[1]	DC; 45 Hz to 1 kHz	DC; 45 Hz to 1 kHz	DC; 45 Hz to 1 kHz
Constant voltage ripple and noise (20 kHz to 10 MHz)	-60 dB (relative to full scale)	-60 dB (relative to full scale)	-60 dB (relative to full scale)
Line regulation (% of full scale)	0.1%	0.1%	0.1%
Load regulation (% of full scale)	0.5%	0.5%	0.5%
Maximum total harmonic distortion	0.25% at 50/60 Hz 1% worst case 45 to 1 kHz	0.25% at 50/60 Hz 1% worst case 45 to 1 kHz	0.25% at 50/60 Hz 1% worst case 45 to 1 kHz
Programming accuracy	(25° ± 5°C)		
RMS voltage (% of output + offset)	0.15% + 0.3 V (45 - 100Hz) 0.5% + 0.3 V (>100 - 500 Hz) 1% + 0.3 V (> 500 - 1000 Hz)	0.15% + 0.3 V (45 - 100Hz) 0.5% + 0.3 V (>100 - 500 Hz) 1% + 0.3 V (> 500 - 1000 Hz)	0.15% + 0.3 V (45 - 100Hz) 0.5% + 0.3 V (>100 - 500 Hz) 1% + 0.3 V (> 500 - 1000 Hz)
DC voltage	0.1% + 0.5 V	0.1% + 0.5 V	0.5% + 0.3 V
Frequency	0.01% + 10µHz	0.01% + 10µHz	0.01% + 10µHz

More detailed specifications at **www.agilent.com/find/6800**

AC Power Source/Analyzers: 375-1750 VA (Continued)

For a sine wave with a resistive load at 0° to 40° C, within an output frequency range of 45 Hz to 1000 Hz, and in AC coupled mode after a 30 minute warm-up unless otherwise noted.

Notes:

1 Product may be operated between DC and 45 Hz subject to certain deratings. Measurements may be extended to 4.5 Hz at full accuracy only by selecting a digitization rate of 250 µ seconds per point. Frequency content of the measured signal must be limited to 4 k Hz or less to avoid aliasing effects.

2 Select low measurement range for improved accuracy (10:1) for lower power measurements.

Specifications (at 0˚ to 55˚C unless otherwise specified)	**6811B**	**6812B**	**6813B**
Measurement Accuracy	(25°C ±55°C)		
Rms. voltage (45 - 100 Hz)	0.03% + 100 mV[1]	0.03% + 100 mV[1]	0.03% + 100 mV[1]
DC voltage	0.05% + 150 mV[1]	0.05% + 150 mV[1]	0.05% + 150 mV[1]
RMS current (45 - 100 Hz)[2]			
high range	0.05% + 10 mA	0.05% + 10 mA	0.05% + 10 mA
low range	0.05% + 1.5 mA	0.05% + 1.5 mA	0.05% + 1.5 mA
Power (VA) (45-100 Hz)[2]	0.1% + 1.5 VA +	0.1% + 1.5 VA +	0.1% + 1.5 VA +
high range	12 mVA/V	12 mVA/V	12 mVA/V
low range	0.1% + 1.5 VA + 1.2 mVA/V	0.1 % + 1.5 VA + 1.2 mVA/V	0.1% + 1.5 VA + 1.2 mVA/V
Power (watts) (45-100 Hz)[2]	0.1% + 0.3 W +	0.1% + 0.3 W +	0.1% + 0.3 W +
high range	12 mW/V	12 mW/V	12 mW/V
low range	0.1% + 0.3 W + 1.2 mW/V	0.1% + 0.3 W + 1.2 mW/V	0.1% + 0.3 W + 1.2 mW/V
Frequency	0.01% + 0.01 Hz	0.01% + 0.01 Hz	0.01% + 0.01 Hz
Power factor	0.01	0.01	0.01
Current magnitude Fundamental	0.03% + 1.5 mA	0.03% + 1.5 mA	0.03% + 1.5 mA
Low range Harmonics 2-49	0.03% + 1 mA + 0.2%/kHz	0.03% + 1 mA + 0.2%/kHz	0.03% + 1 mA + 0.2%/kHz
Current magnitude Fundamental	0.05% + 5 mA	0.05% + 5 mA	0.05% + 5 mA
High range Harmonics 2-49	0.05% + 3 mA + 0.2%/kHz	0.05% + 3 mA + 0.2%/kHz	0.05% + 3 mA + 0.2%/kHz
Supplemental Characteristics	(Non-warranted characteristics determined by design that are useful in applying the product)		
Average programming accuracy (% of output + offset) rms current	1.2% + 50 mA	1.2% + 50 mA	1.2% + 50 mA
Average programming resolution			
rms voltage	125 mV	125 mV	125 mV
DC voltage	250 mV	250 mV	250 mV
Overvoltage programming (OVP)	2 V peak	2 V peak	2 V peak
rms current	2 mA	4 mA	4 mA
peak current	12.5 mA	25 mA	25 mA
output frequency	10 µHz	10 µHz	10 µHz
phase	N/A	N/A	N/A

More detailed specifications at **www.agilent.com/find/6800**

AC Power Source/Analyzers: 375-1750 VA (Continued)

For a sine wave with a resistive load at 0° to 40° C, within an output frequency range of 45 Hz to 1000 Hz, and in AC coupled mode after a 30 minute warm-up unless otherwise noted.

AC Input Ratings notes:

1 Measured at low line

2 Measured at high line

Application Notes:

Agilent 6800 Series AC Power Source/Analyzer
5963-7044E

Testing Uninterruptible Power Supplies Using Agilent 6800 Series AC Power Source/Analyzers,
5967-6056E

Simplify your Avionics Testing with a 400 Hz Single Phase Power Source that includes a Built-in 26 V reference signal
5989-3700EN

Software Driver:
VXI*Plug&Play*

Warranty: One year

Specifications (at 0° to 55°C unless otherwise specified)	**6811B**	**6812B**	**6813B**
Supplemental Characteristics (Continued)	(Non-warranted characteristics determined by design that are useful in applying the product)		
Average measurement resolution			
rms voltage	10 mV	10 mV	10 mV
rms current	2 mA	2 mA	2 mA
Programmable output impedance			
resistance	0-1 Ω	0-1 Ω	0-1 Ω
inductance	20 µh - 1 mh	20 µh - 1 mh	20 µh - 1 mh
Remote sense capability	Up to 1 Vrms can be dropped across each load lead.	Up to 1 Vrms can be dropped across each load lead.	Up to 1 Vrms can be dropped across each load lead.
Isolation to ground	300 Vrms/425 Vdc	300 Vrms/425 Vdc	300 Vrms/425 Vdc
Net weight	28.2 kg (62 lb)	28.2 kg (62 lb)	32.7 kg (72 lb)
Shipping weight	31.8 kg (70 lb)	31.8 kg (70 lb)	36.4 kg (80 lb)
Dimensions	See drawings on page 105		
AC Input Ratings			
Voltage range (Vac) *default factory setting	87 to 106 Vac *104 to 127 Vac 174 to 220 Vac 191 to 254 Vac	87 to 106 Vac *104 to 127 Vac 174 to 220 Vac 191 to 254 Vac	174 to 220 Vac *191 to 254 Vac
Maximum input current (rms)[1]	12 A (100 Vac) 10 A (120 Vac) 7.5 A (200/208 Vac) 6.5 A (230 Vac)	28 A (100 Vac) 24 A (120 Vac) 15 A (200/208 Vac) 13 A (230 Vac)	22 A (200/208 Vac) 20 A (230 Vac)
Input power (max)[2]	1000 VA/700 W	2500 VA/1400 W	3800 VA/2600 W
Input frequency	47 to 63 Hz	47 to 63 Hz	47 to 63 Hz

AC Power Source/Analyzers: 375-1750 VA (Continued)

Ordering Information

Opt 019 2000 VA AC Power source/ analyzer (6813B only)

Opt 020 Dual power analyzer option (6813B only)

Opt 026 26 Volt, 0.1A auxiliary 45 to 100 Hz only reference output (6812B only)

Opt 0B0 Full documentation on CD-ROM only

Opt 0L1 Full documentation on CD-ROM, and/with printed standard documentation package

Opt 0L2 Extra copy of standard printed documentation package

Opt 1CM Rack-mount Kit, p/n 5062-3977 (quantity 2) (support rails required)

Opt 1CP Rack-mount Kit with Handles, p/n 5062-3983 (support rails required) 6811B, 6812B, 6813B only

Support rails, p/n 12679B, required when rack mounting the 6811B, 6812B, and 6813B Opt 1CM and Opt 1CP. E3664AC non Agilent rack. E3663AS for Agilent rack.

Opt 100 (6811B and 6812B only) 87 to 106 Vac (100 Vac nominal), 47-63 Hz, Japan only

Opt 120 104-127 Vac (120 Vac nominal), 47-63 Hz

Opt 200 (6813B only) 174-220 Vac (200 Vac nominal), 47-63 Hz, Japan only

Opt 208 (6811B and 6812B only) 174 to 220 Vac (208 Vac nominal), 47-63 Hz

Opt 230 191 to 254 Vac (230 Vac nominal), 24-63 Hz

Opt 831 12 AWG, 200 to 240 Vac, unterminated (6812B, 6813B only)

Opt 832 4 mm^2 wire size, unterminated (6813B only)

Opt 833 1.5 mm^2 wire size, 200 to 240 Vac, unterminated (6812B only)

Opt 834 10 AWG, 100 to 120 Vac, unterminated (6812B only)

Opt 841 Line Cord with NEMA L6-20P; 20 A 250 V Plug (6812B only)

Opt 842 Line Cord with IEC 309; 32 A 220 V plug (6813B only)

Opt 844 Line Cord with NEMA L6-30P; 30 A 250 V Locking Plug (6813B only)

Opt 845 Line Cord with IEC 309; 16 A 220 V Plug (6812B only)

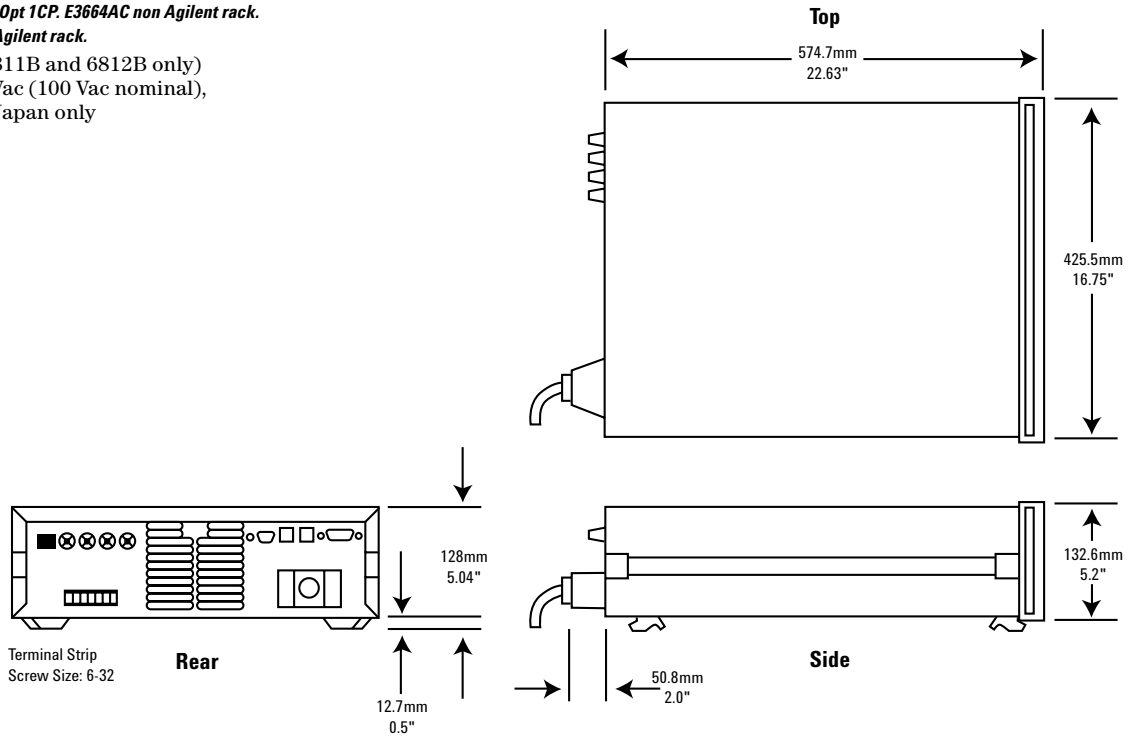
Opt 846 Line Cord with NEMA L6-30P; 30 A 120 V Plug (6812B only)

Opt 847 Line Cord with CEE 7/7; 16 A 220 V Plug (6812B only)

Opt 848 Line Cord with BS 546; 15 A 240 V Plug (6812B only)

See the AC line voltage and cord section, for more details on line cords.

Agilent Models: 6811B, 6812B, 6813B



More detailed specifications at **www.agilent.com/find/6800**

Choosing AC Line Voltage and Cord Options for your Agilent Power Products

DC Power Supplies, DC Electronic Loads, and AC Sources

4 Easy Steps for Choosing Line Cord Options

Choosing AC Line Voltage and Cord Options for your Power Product

Power distribution systems, regulations, and connection techniques vary greatly among geographic regions as a result of local AC electrical standards. Most Agilent products, including power products which draw less than 500 watts of power from the AC line, can be readily adjusted to accept different line voltages or frequencies.

Line voltage and frequency for certain Power Products may not be field changeable. Choosing the correct voltage option for these products requires care. This is especially true for higher power products.

Step 1

Go to the tables. Find the model number and the correct line cord option of the product you are ordering.

Line cords for low power products

Step 2

If your model # requires a 900 series line cord, the correct one will automatically be shipped for the destination country on the purchase order. DONE!

Line cords for high power products

Step 3

If your model number requires an 800 series line cord, determine if there is a line cord with plug that matches your outlet receptacle. If not, choose the appropriate unterminated line cord.

Step 4

Add the option number for the appropriate line cord to your purchase order. DONE!

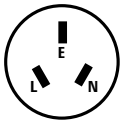
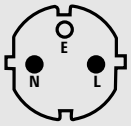
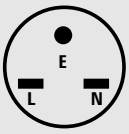
For more detailed specifications see the product manual at **www.agilent.com/find/power**

Low Power Products

For lower power products, a universal receptacle on the rear panel accepts a wide range of line cords to meet local regulatory requirements. The tables containing the 900 series line cords show a range of standard line cords that Agilent offers, with option numbers and part numbers.

Part numbers are needed to order a line cord separately.

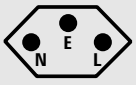
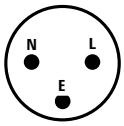
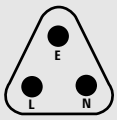
For products which use the 900 series line cords, the appropriate type is automatically selected at time of shipment, based on the country to which the product is being shipped. If you plan to use your power products in a different country or region than the country to which the product is being shipped, you will need to specify the appropriate line voltage and line cord options on your order, so that we can provide the appropriate configuration. Contact your local Agilent Field Engineer for assistance.

Cord Options	900	901	902	903	904
Product/Family					
	United Kingdom	Australia New Zealand	Europe Korea	United States Canada	United States Canada
6033A, 38A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698
6060B, 63B	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698
6541A - 45A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698
6551A - 55A	8120-1351	8120-5412	8120-5413	8120-5337	8120-5421
6611C - 14C	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
6621A - 6629A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698
6631B - 34B	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
6641A - 45A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698
6651A - 55A	8120-1351	8120-5412	8120-5413	8120-5337	8120-5421
6811B	8120-1351	8120-5412	8120-1689	8120-5337	8120-5421
66309B/D	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
66311B	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
66319B/D	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
66321B/D	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
66332A	8120-8705	8120-1369	8120-1689	8120-4383	8120-0698
E3610 - 17A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698
E3620A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698
E3630A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698
E3631 - 34A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698
E3640 - 49A	8120-1351	8120-1369	8120-8768	8120-8767	8120-0698
E4350B, 51B	8120-1351	8120-5412	8120-5413	8120-5337	8120-5421
N5741A - 52A	8120-1351	N/A	8120-1689	8120-4383	N/A
N6700B, N6701A - 02A N6710B, N6711A, 12A	8120-1351	8120-1369	8120-1689	8120-4383[1]	8120-0698
N3300A, 31A	8120-1351	8120-1369	8120-1689	8120-4383	8120-0698

L = Line or Active Conductor (also called "live" or "hot")
N = Neutral or identified Conductor
E = Earth or Safety Ground

[1] For models N6702A and N6712A: Using 100-120 Vac limits total output power to 600 W. 200-240 Vac line is required to permit full 1200 W operation

For more detailed specifications see the product manual at **www.agilent.com/find/power**

Cord Options	906	912	917	918	919
Product/Family					
	Switzerland	Denmark	South Africa India	Japan	Israel
6033A, 38A	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6060B, 63B	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6541A - 45A	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6551A - 55A	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
6611C - 14C	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6621A - 6629A	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6631B - 34B	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6641A - 45A	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
6651A - 55A	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
6811B	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
66309B/D	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66311B	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66319B/D	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66321B/D	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
66332A	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800
E3610 - 17A	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3620A	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3630A	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3631 - 34A	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E3640 - 49A	8120-2104	8120-2956	8120-4211	8120-4753	8120-5181
E4350B, 51B	8120-2104	8120-2956	8120-5414	8120-5342	8120-6800
N5741A - 52A	N/A	N/A	N/A	8120-4753	N/A
N6700B, N6701A - 02A N6710B, N6711A, 12A	8120-1351	8120-1369	8120-1689	8120-4383[1]	8120-0698
N3300A, 31A	8120-2104	8120-2956	8120-4211	8120-4753	8120-6800

L = Line or Active Conductor (also called "live" or "hot")
N = Neutral or identified Conductor
E = Earth or Safety Ground

[1] For models N6702A and N6712A: Using 100-120 Vac limits total output power to 600 W. 200-240 Vac line is required to permit full 1200 W operation

For more detailed specifications see the product manual at **www.agilent.com/find/power**

Choosing AC Line Voltage and Cord Options for your Agilent Power Products

DC Power Supplies, DC Electronic Loads, and AC Sources (Continued)

Cord Options	920	921	922	927
Product/Family				
	Argentina	Chile	China	Brazil Thailand
6033A, 38A	8120-6869	8120-6980	8120-8376	8120-8871
6060B, 63B	8120-6869	8120-6980	8120-8376	8120-8871
6541A - 45A	8120-6869	8120-6980	8120-8376	8120-8871
6551A - 55A	8120-6869	8120-6980	8120-8376	8120-8871
6611C - 14C	8120-6869	8120-6980	8120-8376	8120-8871
6621A - 6629A	8120-6869	8120-6980	8120-8376	8120-8871
6631B - 34B	8120-6869	8120-6980	8120-8376	8120-8871
6641A - 45A	8120-6869	8120-6980	8120-8376	8120-8871
6651A - 55A	8120-6869	8120-6980	8120-8376	8120-8871
6811B	8120-6869	8120-6980	8120-8376	8120-8871
66309B/D	8120-6869	8120-6980	8120-8376	8120-8871
66311B	8120-6869	8120-6980	8120-8376	8120-8871
66319B/D	8120-6869	8120-6980	8120-8376	8120-8871
66321B/D	8120-6869	8120-6980	8120-8376	8120-8871
66332A	8120-6869	8120-6980	8120-8376	8120-8871
E3610 - 17A	8120-6869	8120-6980	8120-8376	8120-8871
E3620A	8120-6869	8120-6980	8120-8376	8120-8871
E3630A	8120-6869	8120-6980	8120-8376	8120-8871
E3631 - 34A	8120-6869	8120-6980	8120-8376	8120-8871
E3640 - 49A	8120-6869	8120-6980	8120-8376	8120-8871
E4350B, 51B	8120-6869	8120-6980	8120-8376	8120-8871
N5741A - 52A	N/A	N/A	8120-8376	N/A
N6700B, N6701A - 02A N6710B, N6711A, 12A	8120-6869	8120-6980	8120-8376	8120-8871
N3300A, 31A	8120-6869	8120-6980	8120-8376	8120-8871

L = Line or Active Conductor (also called "live" or "hot")
N = Neutral or identified Conductor
E = Earth or Safety Ground

For more detailed specifications see the product manual at **www.agilent.com/find/power**

High Power Products

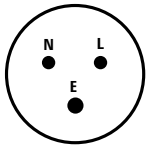
There are several factors which limit the amount of power which can be readily drawn from a normal branch circuit. For example, in the U.S., the typical 115/120 Vac branch circuit has a circuit breaker rated for 15 A. For industrial applications, 20 A service is commonly available.

Linear power supplies with outputs over 500 watts and switching supplies rated over 750 watts will generally exceed the capability of a 15 A branch circuit. Connecting power products above these power levels will require installing either a higher voltage or higher current service. Some practical examples are:

- standard line voltage for 2KW products such as the 667XA is 230 Vac; they can not be powered off a 120 Vac line
- the 1KW 601XA and 603XA products cannot be powered off a standard 15 A/120 Vac circuit; they can operate off a 30 A/ 120 Vac service, or they can be configured for 208/240 Vac operation

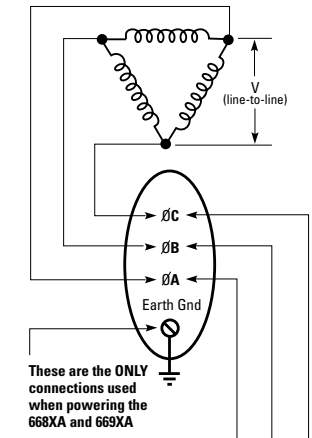
Agilent offers a range of 800 series line cords for many higher power products to mate with the wall receptacles commonly specified for these higher power services. Refer to the tables to determine if there is a 800 series line cord for your product with a plug that meets the local requirements. If not, you must order an unterminated line cord.

Cord Options	831	832	833	834
Product/Family	**No Plug #12AWG**	**No Plug 4 mm²**	**No Plug 1.5mm²**	**No Plug #10AWG**
6030A, 31A, 32A, 35A	8120-5573	N/A	8120-5568	8120-5566
6571A - 75A	8120-5488	8120-5490	N/A	8120-5545
6671A - 75A	8120-5488	8120-5490	N/A	8120-5545
6812B	8120-5573	N/A	8120-5568	8120-5566
6813B	8120-5573	8120-6502	N/A	8120-5566
66000A	8120-5573	N/A	8120-5568	8120-5566
E4356A	8120-5488	8120-5490	N/A	8120-5545

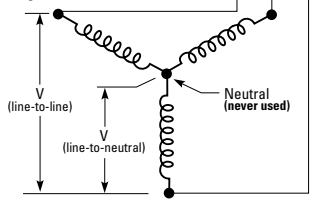
Cord Options	861	862	841	842
Product/Family	**No Plug (AWG)** N/S America, (AWG wire)	**No Plug (Metric)** Asia, Europe, Harmonized (metric wire)	 **NEMA 6-20P #12AWG** N/S America Japan	 **IEC 309 32-A 4mm²** Europe Korea
6030A, 31A, 32A, 35A	N/A	N/A	8120-5572	N/A
6571A - 75A	N/A	N/A	N/A	8120-5489
6671A - 75A	N/A	N/A	N/A	8120-5489
6680A - 84A	8121-6203	8120-6204	N/A	N/A
6690A - 92A	8121-0694	8121-0695	N/A	N/A
6812B	N/A	N/A	8120-5572	N/A
6813B	N/A	N/A	N/A	8120-6506
66000A	N/A	N/A	8120-5572	N/A
E4356A	N/A	N/A	N/A	8120-5489
N5761A-72A	8121-1330	8121-1331	N/A	N/A

Often, higher power products (over 1 kW) are hardwired, i.e. connected directly to a breaker panel or distribution box. The line cord may also be hard wired to the back of the power supply where a universal receptacle is impractical. Typically, a local electrician should be consulted to determine the best alternative to connect a high power product to the AC line.

Delta

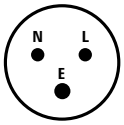
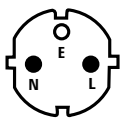


Wye



In a wye system

$$V_{(line\text{-}to\text{-}neutral)} = \frac{V_{(line\text{-}to\text{-}line)}}{\sqrt{3}}$$

Cord Options	844	845	846	847	848
Product/Family					
	NEMA L6-30P #10AWG N/S America Japan	**IEC 309 16-A 1.5 mm²** Denmark Switzerland Austria, China	**NEMA L5-30P #10AWG** N. America	**CEE 7/7 16-A 1.5 mm²** Europe Korea	**BS 546 15-A 1.5 mm²** India South Africa
6030A, 31A, 32A, 35A	N/A	8120-5570	8120-5565	8120-5567	8120-5569
6571A - 75A	8120-5546	N/A	N/A	N/A	N/A
6671A - 75A	8120-5546	N/A	N/A	N/A	N/A
6812B	N/A	8120-5570	8120-5565	8120-5567	8120-5569
6813B	8120-6507	N/A	N/A	N/A	N/A
66000A	N/A	8120-5570	8120-5565	8120-5567	8120-5569
E4356A	8120-5546	N/A	N/A	N/A	N/A

Note:
The countries or regions indicated here are for general guidance only. Local electrical codes governing wire size, wire type (AWG or metric) and plug type should be consulted to determine which of these available line cords/plugs is correct in your country to make proper connection to your AC mains. Please consult a qualified, licensed electrician for more information.

Products with 3-Phase Inputs
Some of the higher power products exceed the capability of a single phase line. Agilent offers several power products which require 3-phase inputs, including the 5 kW 668XA and 6.6 kW 669XA DC source family. For 3-phase power distribution up to the building, there are two different distribution systems in wide use: delta, predominantly used in the US; and wye predominantly used in Europe. However, for service inside the building, the 5 wire wye is the predominant configuration. Products which are delta loads, are compatible with either delta or wye. Agilent 3-phase products are delta loads.

In selecting the correct operating voltage for 3-phase products you need to distinguish between the line-to-line and the line-to-neutral voltages. The line-to-line voltage is the square root of 3 x the line-to-neutral voltage. It is the line-to-line voltage that is used to specify the input voltage to be applied to Agilent power products.

Power Products Applications Information

10 Most frequently asked questions about using DC power products

1

How do I put the power supply in the constant current mode?

The power supply cannot be "put" into the constant current mode. The output settings of the power supply combined with the ohmic value of the particular load determine whether or not the power supply is in constant current.

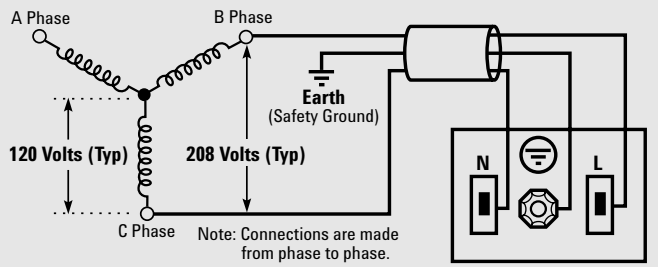
ie: The power supply inherently resides in the constant voltage mode. If the output voltage were set to 24 volts and a 6 Ω load were placed across the output terminals, Ohm's Law would require that 4 amps would flow (24 V/6 Ω). This presumes that the constant current setting of the power supply were set to a value greater than 4 amps; lets say 5 amps. Now, if the 6 Ω load were replaced by a 2 Ω load, Ohm's Law would suggest that 12 amps (24 V/ 2 Ω) would flow. However, the power supply is set to go into constant current at 5 amps. Therefore, the actual output voltage would be 10 volts (2 Ω x 5 A). The power supply will now remain in constant current for values of load = 0 Ω ≤ R < 4.8 Ω. Once the ohmic value of the load becomes greater than 4.8 Ω (24 V/5 A), the power supply will again revert to constant voltage operation at the value of 24 volts.

2

I have 208 vac, 3ϕ phase power; can it be used to operate a product requiring 208 V single phase?

Yes, see below.

657xA/667xA Connection to a 3-phase line



Assume V (nominal) = 208 Vac
208V @ 8% low = 191V
208V @ 12% high = 233V
• (Instrument operates between 191 & 250 Vac) instrument will not operate on a 120 Vac line

Instrument requires an ac input voltage in the window 191-250 Vac

3

Why are the required Watts and VA so different?

Watts is a scalar quantity which is frequently used to measure system efficiency. It is the energy supplied by the utility company over a given period of time and is commonly referred to as power. Except for heavy industrial users, the utility company only bills users for the watts consumed. Watts are directly convertible into mechanical work or BTUs (British Thermal Units) of heat. Wasted power is paid for a second time in terms of additional loading on the user's air-conditioning system. Mathematically, it is a scalar quantity resulting from the vector product of two vector quantities (volts and amps). It is NOT the simple algebraic product of the rms volts times rms current.

VA on the other hand IS the scalar quantity resulting from multiplying the magnitudes (rms) of the vector

quantities (volts and amps). This resulting quantity will never be smaller than the watts demanded by an instrument. Uninformed users incorrectly use VA to assess the device's over-all efficiency and power demands. VA is most frequently and correctly used by electricians to determine proper AC mains conductor gage and circuit breaker sizing.

4

How much cooling do I need for my power supply?

Users frequently rack power supplies into an enclosure to supply power to some remotely located external load. Under these conditions, to properly determine the cooling requirements, the systems integrator needs thermal data from the manufacturer for the specific enclosure in question. This data is generally in the form of a curve which relates the rise of the enclosure's internal air temperature to the amount of power (or BTU's) dissipated within the enclosure.

The difference between the maximum power demanded by the external load, and the AC power demanded by the power supply to support the load's needs, is the power dumped into the internal air of the enclosure. Using this number and data for the enclosure, the internal rise can be determined. The internal rise added to the external ambient temperature will determine the temperature of the environment for the power supply. This must be within the ratings of the product or premature failure will occur.

A valuable conversion factor between Watts and BTU's is listed below:

1 BTU/Hr = 0.293 Watt

The N57xxA family draws cooling air from the outside of the rack. Thus, the air temperature is equal to that of the room's environment. Heated, cooling air is then exhausted into the inside of the rack. As a result, these instruments will not properly cool if the inside of the rack is "pressurized". The static air pressure within the rack must be equal to or less than the air pressure in the room's ambient.

5

Can Agilent power supplies sink current?

Yes! Sinking, or downprogramming, is the ability of a power supply to pull current into the positive power terminal. Sinking is necessary to discharge the power supply's own output capacitor, or the capacitors that are part of an external load.

Sinking is particularly important, for example, in printed circuit board test systems. The relays in test board systems typically must be switched only when the power supplies have discharged to zero volts, to avoid arcing and burn-out of the relay contacts. Sinking allows the power supply outputs to go to zero quickly, thus providing faster test times, an important factor for reducing overall test cost.

The value of the sink current is fixed and is not programmable, with the exception of the 6630 series, where sink current is set to the same value that is programmed for source current.

In general, sinking is provided to improve a power supply's transition time from a higher to a lower constant voltage operating level, and is not intended to be a steady-state operating condition.

Other models not listed here do not have high powered down programmers. Instead, they are capable of discharging the power supply output capacitors but not sinking current from the device under test.

Series	Current Sinking Capability
6620 Multiple Output	110% of source current rating
6630 100 Watt	110% of source current rating
6030 Autorangers	50 W/actual output voltage in volts or actual voltage in volts/0.05 ohms, whichever is less
6640 200 Watt	25% of source current rating
6650 500 Watt	20% of source current rating
6750/6760 50/100 Watt	Dynamically controlled to maximize output down-programming speed. 7 W continuous dissipation, 300 W peak.

Series	Current Sinking Capability
6670 2000 Watt	50 W/actual output voltage in volts or actual output voltage in volts/ 0.05 ohms, whichever is less
6680 5000 Watt	50 W/actual output voltage in volts or actual output voltage in volts/0.05 ohms, whichever is less
6690 6600 Watt	50 W/actual output voltage in volts or actual output voltage in volts/0.05 ohms, whichever is less

6

I want to put a microswitch on the safety cover over my UUT so that lifting the cover will program my ATE power supplies to zero volts and protect the operator from harm. Do Agilent power supplies have this capability?

Yes, many Agilent power supplies have a feature called "Remote Inhibit" (RI).

When connected to the RI input on the rear of the power supply, a contact closure or TTL low signal causes the output of the supply to shutdown and be programmed to zero volts. The power supply can also be set to generate a service request (SRQ) via the GPIB in the event that RI is pulled low.

7

Can I use Agilent Electronic Loads in series and in parallel?

Agilent electronic loads are designed to be operated in parallel for more current, but NOT in series for more voltage. Loads are fully protected against damage from current overloads, but will be damaged by voltage above the maximum voltage rating.

8

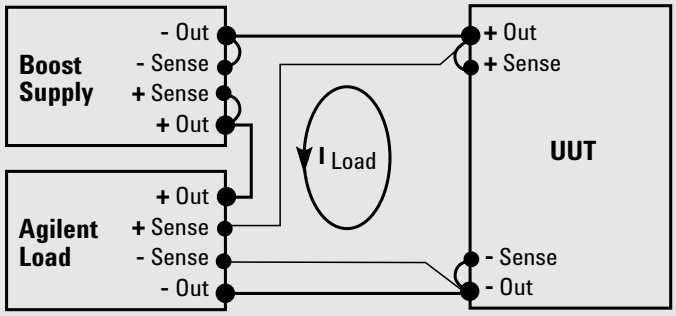
I must test a 1 volt power supply using a constant current load and I want to use Agilent Electronic Loads. But the Agilent load meets all of its dynamic specs with no derating on down to 3 volts. Below 2 volts, the Agilent load current must be linearly derated. What can I do?

Use a boost supply in series with the UUT. The load will now meet all its specs with no derating, because it always operates above 3 volts. (see the illustration below)

The boost supply can be a low-cost fixed output 3 V or 5 V supply with a current rating at least as high as the maximum peak load current needed. The 6641A (8 V, 20 A), 6651A (8 V, 50 A), 6671A (8 V, 220 A), or 6681A (8 V, 580 A) are all excellent choices.

The voltage setting of a programmable boost supply should be set to 3 volts, and the current limit set to full scale.

Select a boost power supply with low p-p ripple and noise. The constant current load will compensate for low-frequency p-p ripple and noise below a few kHz, but high frequency ripple and noise from the boost will appear across the UUT.



9

Why are Agilent's Electronic Loads constant resistance resolution speced in ohms on the low resistance range, but in mSiemens on the two higher ranges?

In general, Agilent's Electronic Loads are not a conventional "resistor". The loads consist of IC's, capacitors, resistors, FETs, etc. They were designed with two major circuits, a cv and cc circuit. These circuits are used to simulate resistance on the two upper ranges.

First, it is necessary to understand why there is a difference in the way in which the ranges are specified (mohms or mS). The constant resistance (CR) mode in the load actually operates using either the constant current (CC) or constant voltage (CV) circuits inside the load. The lowest CR range uses the CV regulating circuits, while the two higher ranges use the CC regulating circuits. It is because of these differences in the circuits used to regulate the load input that the specifications need to be different.

When the CV circuits are used, the load can be viewed as many resistors, all the same value (the resolution), in series to produce the desired resistance. Then, changing the resistance is like changing the number of discrete resistors in series. Therefore, the resolution is the value of one of these series resistors, and putting resistors in series changes the resistance measured in ohms. For the N3302A, the "discrete resistor" or resolution that can be programmed is 0.54 mohms in the 2 ohm range.

When the CC circuits are used, the load can be viewed as many resistors, all the same value (the resolution), in parallel to produce the desired resistance. Then, changing the resistance is like changing the number of discrete resistors in parallel. Therefore, the resolution is the value of one of these parallel resistors, and putting resistors in parallel changes the conductance measured in siemens. For the 60501B, the "discrete resistor" or resolution that can be programmed is 0.14 mS (=7.14 kohms).

For example, in the 2 kohm range, you can program the load input from 2 ohms to 2 kohms (0.5 S to 0.5 mS) with a resolution of 0.14 mS. This would be the equivalent of starting with about 3568 7.143 kohm resistors in parallel with each other, and in parallel with a 2 kohm resistor, and removing one at a time until you had only the 2 kohm resistor left.

Note that the resolution of the conductance is constant at 0.14 mS, however, the resolution of the total parallel resistance is not constant. It depends on how many resistors you have in parallel.

If you have two 7.143 kohm resistors in parallel and remove one, the resolution looks like 3571.5 ohms. If you have 3568 7.143 kohm resistors in parallel and remove one, the resolution looks like (7143/3567) - (7143/3568) = 0.561 mohms. But the conductance resolution is constant at 0.14 mS.

10

Can Agilent power supplies be programmed from 0 to full output voltage using a 0 to 10 V signal source?

Yes, many Agilent power supplies feature remote voltage programming or analog programming capability. However, there is a potential danger in analog programming any power supply, especially a high voltage supply. If the 0 to 10 V programming source is a typical, non-isolated, low-cost, digital-to-analog converter (DAC), it is probably grounded through its digital inputs and/or through the computer's internal power supplies, which are grounded through the computer's power cord. It's easy to overlook this, and the mistake can be very expensive.

If the DAC is non-isolated (or isolated only up to 42 V above ground) and one of the output terminals of the power supply is grounded, either directly or through the UUT, the output capacitor of the power supply can discharge through the computer backplane, motherboard, and the I/O common through the computer power cord ground. The resulting high current may even last long enough to vaporize the thin ground tracks on some or all of the printed circuit boards in the PC.

Be sure the programming source is electrically isolated, is operated from isolated power supplies, and is rated for floating voltages up to the full output voltage of the programmed supply. This is necessary so no one is hurt, and no equipment is damaged, no matter which output terminal of the power supply or UUT is grounded.

For additional questions and answers visit our web site at www.agilent.com/find/answers

AC Power and Load Connections

A modern stabilized DC power supply is a versatile high performance instrument capable of delivering a constant or controlled output reliably and with little attention. But to take full advantage of the performance characteristics designed into a supply, certain basic precautions must be observed when connecting it for use on the lab bench or installing it in a system. Factors such as wire ratings, system grounding techniques, and the particular way that AC input, DC output, and remote error sensing connections are made can contribute materially to obtaining the stable, low noise output expected by the user. Careful attention to the following guidelines can help to ensure the trouble free operation of your Agilent power supply.

AC Power Input Connections

Wire Rating

RULE 1. When connecting AC power to a power supply, always use a wire size rated to carry at least the maximum power supply input current.

If a long cable is involved, make an additional check to determine whether a still larger wire size might be required to retain a sufficiently low impedance from the service outlet to the power supply input terminals. As a general guideline, input cables should be of sufficient size to ensure that the voltage drop at maximum rated power supply input current will not exceed 1% of the nominal line voltage.

Continuity

RULE 2. Maintain the continuity of the AC, acc, and grounding wires from the AC power outlet to the power supply input terminals without an accidental interchange.

Interchanging the AC and grounding wires may result in the power supply chassis being elevated to an AC potential equal to the input line voltage. If the chassis is grounded elsewhere, the result may be no worse than some blown fuses. But if the chassis is not grounded, the result could be a potentially lethal shock hazard. Confirm that the chassis is grounded by the grounding wire.

Transformers

RULE 3. If an autotransformer or an isolation transformer is connected between the AC power source and the power supply input terminals, it should be rated for at least 200% of the maximum rms current required by the power supply.

The transformer must have a higher rating than would be suggested by the supply's rms input current because a power supply input circuit does not draw current continuously. Input current peaks can cause a smaller transformer to saturate, resulting in failure of the supply to meet its specifications at full output.

RULE 4. Be sure to connect the common terminal of an autotransformer to the acc (and not the AC) terminals of both the power supply and the input power line.

If acc is not connected to the common terminal of the autotransformer, the power supply's input acc terminal will have a higher than normal AC voltage connected to it, contributing to a shock hazard and, in some instances, a greater output ripple.

AC Line Regulator

RULE 5. Do not use an AC line regulator at the input to a regulated power supply without first checking with the power supply manufacturer.

Some regulators tend to increase the impedance of the line in a resonant fashion and can cause power supplies to malfunction, particularly if they use SCR or switching regulators or preregulators. Moreover, since the control action of many line voltage regulators is accompanied by a change in the output waveshape, their advantage in providing a constant rms input to a power supply is small. In fact these changes in waveshape are often just as disruptive in causing power supply output changes as the original line voltage amplitude changes would have been.

Load and Remote Error Sensing Connections

Making Load Connections to One Power Supply

The simplest and most common example of improper load wiring is shown in Figure 1. The voltage at each load depends on the current drawn by the other loads and the voltage drops they cause in some portion of the load leads. Since most load currents vary with time, an interaction among the loads results. This interaction can sometimes be ignored, but in most applications the resulting noise, pulse coupling, or tendency toward inter-load oscillation is unacceptable. The following thirteen steps describe a recommended procedure for connecting the load wiring, grounding the system in a manner that avoids troublesome ground loops, and making connections for remote error sensing.

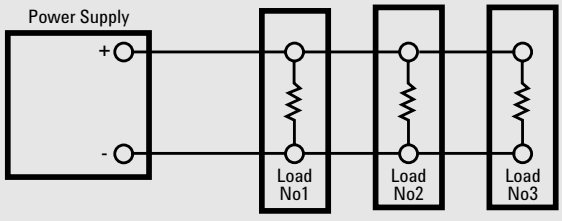


Figure 1
Improper load connections

STEP 1. Select a load wire size that, as an absolute minimum, is heavy enough to carry the power supply output current that would flow if the load terminals were short-circuited.

This is the minimum, however. Impedance and coupling considerations usually dictate the use of load wires larger than would be required just to satisfy current rating requirements. In general, the power supply performance degradation seen at the load terminals becomes significant when the wire size and length result in a load wire impedance comparable to or greater than the effective output impedance of the power supply. Refer to a copper wire resistance table to see if a larger wire size might have to be used to attain an impedance comparable to or smaller than the output impedance of the power supply.

If multiple loads are supplied from a pair of DC distribution terminals not located at the power supply terminals, it is necessary to consider separately the mutual impedance of the wires connecting the power supply to the distribution terminals and the additional impedance of the wires to each individual load. The mutual impedance presents an opportunity for a variation of one load current to cause a DC voltage variation at another load. Fortunately this mutual impedance can be effectively reduced at DC and at low frequencies by using remote error sensing, as will be described later.

Connect the Load Wiring

STEP 2. Designate a single pair of terminals as the positive and negative DC distribution terminals.

These two terminals might be the power supply output terminals, the load terminals, or a separate pair of terminals established expressly for distribution. If the power supply is a short distance from the load and remote sensing will not be used, locate the DC distribution terminals as near as possible to the power supply output terminals. Using the power supply output terminals themselves as the distribution terminals results in optimum performance.

If remote sensing is to be used, locate the DC distribution terminals as near as possible to the load terminals. Later in the procedure, sensing leads will be connected from the power supply sensing terminals to the DC distribution terminals as shown in Fig. 2.

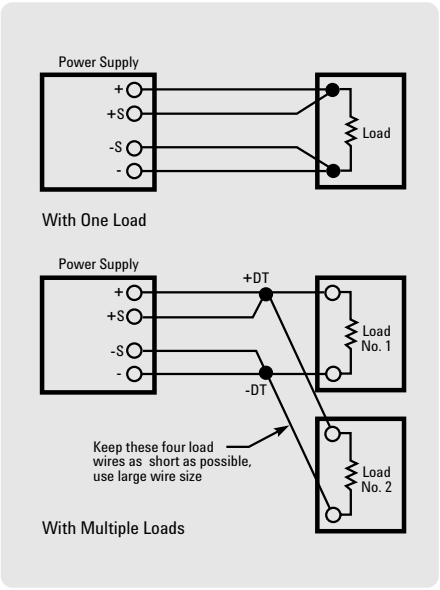


Figure 2
Location of DC Distribution Terminals with Remote Sensing (Distribution Terminals are Shown Solid)

STEP 3. Connect one pair of wires directly from the power supply output terminals to the DC distribution terminals, and connect a separate pair of wires from the distribution terminals to each load.

There should be no direct connection from one load to another except by way of the DC distribution terminals. (Although for clarity the diagrams show the load and sensing leads as straight lines, some immunity against pick-up from stray magnetic fields can be obtained by twisting each pair of load leads and shielding all sensing leads.)

Decouple Multiple Loads

STEP 4. If required, connect a local decoupling capacitor across each pair of distribution and load terminals.

Load decoupling capacitors are often needed when multiple loads draw pulse currents with short rise times. To reduce high frequency mutual coupling effects under these circumstances, capacitors must be connected directly across the load and distribution terminals. The capacitors used for decoupling must be selected to have a high frequency impedance that is lower than the impedance of the wires connected to the same load, and their connecting leads must be kept as short as possible to minimize impedance.

Grounding the System

Since no two ground points have exactly the same potential, the idealized concept of a single ground potential is a snare and a delusion. In many cases the potential difference is small, but a difference in two ground potentials of even a fraction of a volt could cause amperes of current to flow through a complete ground loop. (Ground loop is a term used to describe any conducting path formed by two separate connections to ground). Ground loops can cause serious interference problems when voltages developed by these currents are coupled into sensitive signal circuits.

To avoid ground loop problems, there must be only one ground return point in a power supply system. (A power supply system includes the power supply, all of its loads, and all other power supplies connected to the same loads). The selection of the best ground return point depends on the nature and complexity of the DC wiring. In large systems, practical problems frequently tend to force compromises with the ideal grounding concept. For example, a rack mounted system consisting of separately mounted power supplies and loads generally has multiple ground connections. Each instrument usually has its own chassis tied to the third grounding wire of its power cord, and the rack is often connected by a separate wire

to ground. With the instrument panels fastened to the rack frame, circulating ground currents are inevitable. However, as long as these ground currents are confined to the ground system and do not flow through any portion of the power supply DC distribution wiring, their effect on system performance is usually negligible. To repeat, separating the DC distribution circuits from any conductive paths in common with ground currents will in general reduce or eliminate ground loop problems. The only way to avoid such common paths is to connect the DC distribution system to ground with only one wire. Figure 3 illustrates this concept: DC and signal currents circulate within the DC system, while ground loop currents circulate within the ground system. Steps, 5, 6, and 7 make specific recommendations for avoiding ground loop problems.

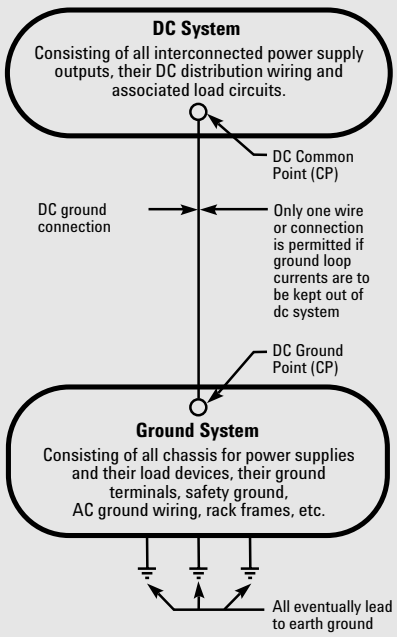


Figure 3
Isolating Ground Loop Paths from the DC system

Select the DC Common Point

STEP 5. Designate one of the DC distribution terminals as the DC common point. There should be only one DC common point in a DC system. If the supply is to be used as a positive source, then the negative DC distribution terminal is the DC common point. If it is to be a negative source, then the positive DC distribution terminal is the DC common point. Here are some additional suggestions for selecting the best DC common point for five different classes of loads:

a. Single Isolated Load.
A single isolated load exists when a power supply is connected to only one load and the load circuit has no internal connections to the chassis or ground. If the power supply output terminals are to be used as the DC distribution terminals, then the DC common point will be either the positive or negative power supply output terminal (Fig. 4A). If remote sensing is to be used and the load terminals will serve as the distribution terminals, then either the positive or negative load terminal will be the DC common point (Fig. 4B).

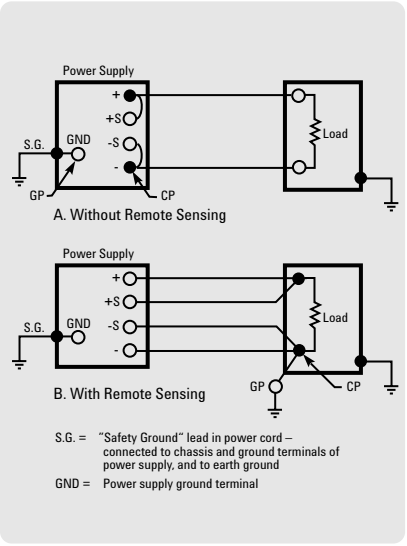


Figure 4
Preferred Ground Connections for a Single Isolated Load

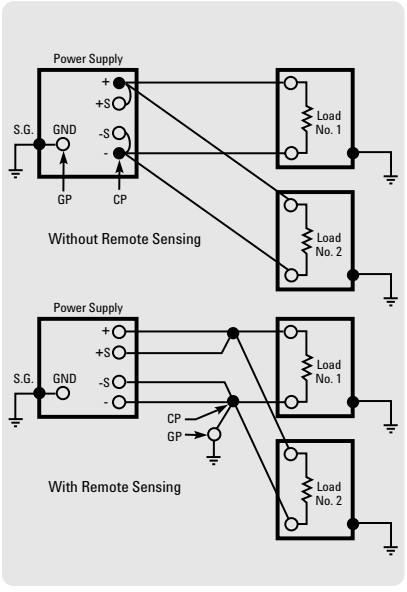


Figure 5
Preferred Ground Connections for Multiple Ungrounded Loads

b. Multiple Ungrounded Loads.
This alternative applies when separate pairs of load leads connect two or more loads and none of the load circuits has an internal connection to chassis or ground (Fig. 5). Use the positive or negative DC distribution terminal as the DC common point.

c. Single Grounded Load.
When a power supply is connected to a single load that has a necessary internal connection to chassis or ground as in Fig. 6, or when a supply is connected to multiple loads only one of which has a necessary internal connection to chassis or ground as in Fig. 7, the load terminals of the grounded load must be designated the DC distribution terminals, and the grounded load terminal is necessarily the DC common point.

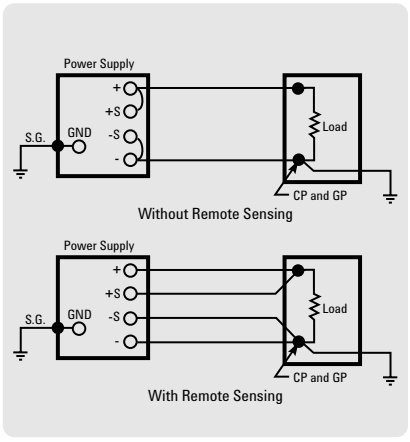


Figure 6
Preferred Ground Connections for a Single Grounded Load

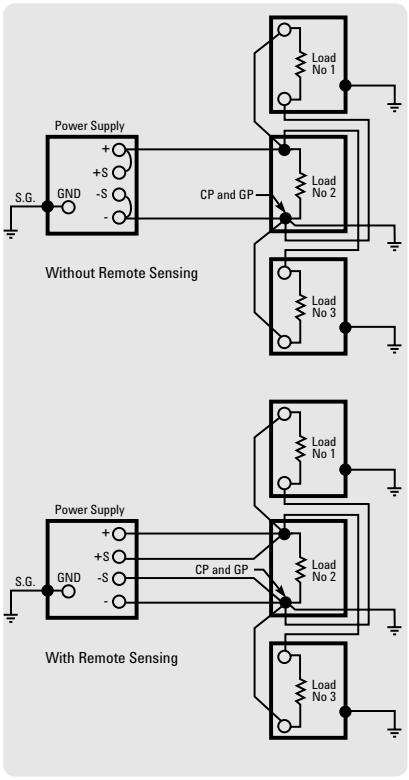


Figure 7
Preferred Ground Connections for Multiple Loads, Only One of Which is Grounded Internally

d. Multiple Loads, Two or More of Which are Individually Grounded.
This undesirable situation must be eliminated if at all possible. Ground loop currents circulating through the DC and load wiring cannot be avoided so long as separate loads connected to the same power supply or DC system have separate ground returns as shown in Fig. 8.

One possible solution is to break the ground connection in all of the loads and then select the DC common point using the multiple ungrounded load alternative as in (b) above. Another would be to break the ground connection in all but one of the loads and select the DC common point as in alternative (c). If there are two or more loads with ground connections that cannot be removed and the system is susceptible to ground loop problems, then the only satisfactory solution is to increase the number of power supplies and to operate each grounded load from a separate supply. Each combination of power supply and grounded load would be treated as in alternative (c).

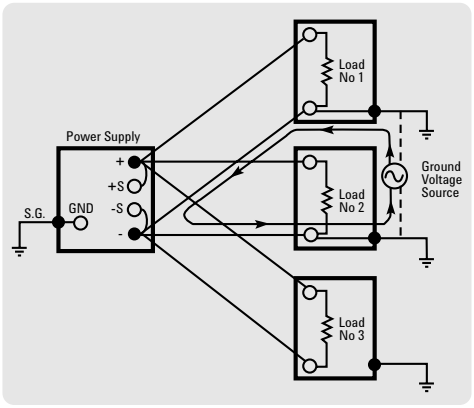


Figure 8
Improperly Connected DC Distribution System with Two Grounded Loads forming a Ground Loop

e. Load System Floated at a DC Potential Above Ground.
It is sometimes necessary to operate the power supply output at a fixed voltage above or below ground potential. The usual procedure in these circumstances is to designate a DC common point using whichever of the preceding four alternatives is appropriate, just as though conductive grounding were to be used. Then connect this DC common point to the DC ground point through a 1 microfarad capacitor as shown in Figure 9.

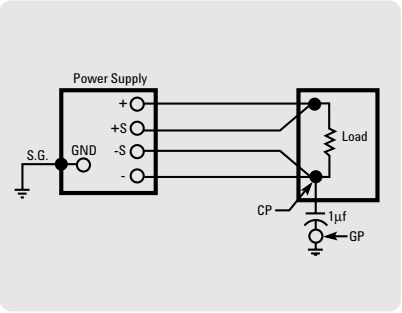


Figure 9
Floating a Load System at a DC Potential Above Ground

Select the DC Ground Point

STEP 6. Designate the terminal that is connected to ground as the DC ground point.

The DC ground point can be any single terminal, existing or added, that is conductively connected to the ground of the building wiring system and then eventually to earth ground.

STEP 7. Connect the DC common point to the DC ground point, making certain there is only one conductive path between these two points.

Make this connection as shown in Figures 4, 5, 6, or 7. Make the connection as short as possible and use a wire size such that the total impedance from the DC common point to the DC ground point is not large compared with the impedance from the ground point to earth ground. Flat braided leads are sometimes used to further reduce the high frequency component of the ground lead impedance.

Making Remote Error Sensing Connections

Normally a power supply operating in the constant voltage mode achieves its optimum line and load regulation, its lowest output impedance, drift, and PARD, and its fastest transient recovery performance at the power supply output terminals. If the load is separated from the output terminals by any lead length (as in Fig. 10), some of these performance characteristics will be degraded at the load terminals-usually by an amount proportional to the impedance of the load leads compared with the output impedance of the power supply.

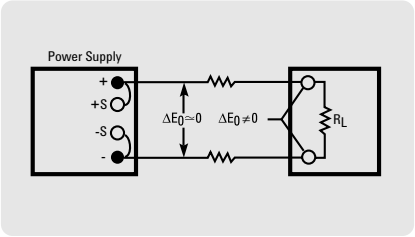


Figure 10
Load Voltage Variations Caused by Load Lead Voltage Drops when Remote Error Sensing is not Used

With remote error sensing, a feature included in nearly all Agilent power supplies, it is possible to connect the input of the voltage feedback amplifier directly to the load terminals so that the regulator performs its function with respect to the load terminals rather than with respect to the power supply output terminals. Thus, the voltage at the power supply output terminals shifts by whatever amount is necessary to compensate for the voltage drop in the load leads, thereby maintaining the voltage at the load terminals constant (Fig. 11).

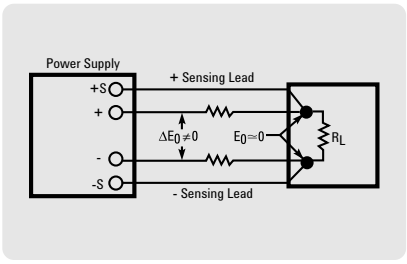


Figure 11
Regulated Power Supply with Remote Error Sensing.

Making the Sensing Connections

STEP 8. Remove the jumper connections between the power supply sensing and output terminals, and connect the power supply sensing terminals to the DC distribution terminals as shown in Fig. 12.

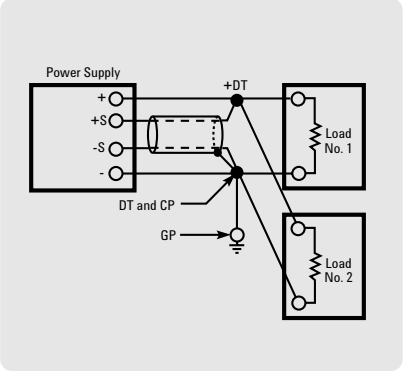


Figure 12
Properly Grounded Power Supply System with Remote Error Sensing

Use an insulated shielded pair for the sensing leads. Do not use the shield as one of the sensing conductors.

STEP 9. Connect one end of the sensing lead shield to the DC common point and leave the other end unconnected.

In nearly all cases this method of connecting the sensing shield minimizes ripple at the DC distribution terminals.

Protect Against Open Sensing Leads Step

STEP 10. Avoid the possibility of an open remote sensing path, either on a long-term or a transient basis.

Opening a sensing lead causes the power supply output voltage to increase. Protective circuits in the supply provide some load protection by limiting the amount of the increase, but eliminating all switch, relay, or connector contacts from the remote sensing path helps to minimize the possibility of any loss of regulation due to this cause.

Check the Load Wire Rating

STEP 11. Verify that the voltage drop in the load leads does not exceed the capabilities of the remote sensing circuit.

Most well regulated power supplies have an upper limit to the load lead voltage drop around which remote sensing can be connected without losing regulation. This maximum voltage drop is typically 0.5, 1, or 2 volts, and may apply to the positive, the negative, or both the positive and negative output leads. See the instruction manual for the exact load lead voltage drop limitations of a particular power supply.

Remember too, that any voltage drop lost in the load leads reduces the maximum voltage available for use at the load. Either of these limitations sometimes dictates the use of a larger wire size than would be required by wire current rating or impedance considerations.

Check for Power Supply Oscillation

STEP 12. Verify that the power supply does not oscillate when remote sensing is connected.

Although DC and low frequency performance are improved by remote sensing, phase shifts associated with long load and sensing leads can affect the stability of the feedback loop seriously enough to cause oscillation. This problem can frequently be corrected by readjusting a "transient recovery" or "loop stability" control inside the supply if the circuit includes one; follow the adjustment procedure in the manual. Another remedy that is often effective is to disconnect the output capacitor inside the power supply (some models have a rear panel jumper that can be removed for this purpose) and to connect a similar capacitor across the DC distribution terminals.

Check for Proper Current Limit Operation

STEP 13. Check that the operating point of the current limit circuit has not been affected by the remote sensing connections.

With some power supply designs, the resistance of one of the output conductors adds to the resistance used for current limit monitoring when remote sensing is used. This reduces the threshold value at which current limiting begins and makes readjustment of the current limit

circuit necessary. To determine whether connecting remote sensing has changed the current limit setting, turn off the supply, short terminal -S to -OUT and +S to +OUT at the power supply, and check whether the current limit value differs from the value without these terminals shorted. If it does differ significantly, the current limit control needs readjustment.

Making Load Connections to Two or More Power Supplies in the Same System

The following four rules must also be observed in extending the preceding techniques to systems containing two or more power supplies.

DC Distribution Terminals

RULE 1. There must be only one point of connection between the DC outputs of any two power supplies in the multiple power supply system. This point must be designated as one of the two DC distribution terminals for those two power supplies.

Thus there are always exactly (N+1) DC distribution terminals in any system, where N is the number of power supplies. (This is true unless parallel supplies share the same distribution terminals, or supplies are connected in series with no other connections to their intermediate terminals).

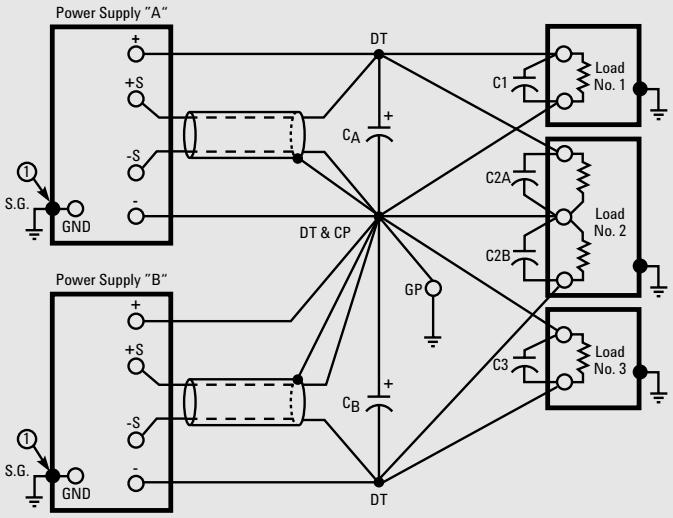


Figure 13
A Properly Connected Multiple Power Supply System

DC Common Point

RULE 2. One of the (N+1) DC distribution terminals must be designated as the DC common point for the system.

There can be only one DC common point allowed in a system.

DC Ground Point

RULE 3. There must be only one DC ground point in a multiple power supply system.

This rules out the possibility of connecting two grounded loads in the same system.

RULE 4. There must be only one conductive path between the system DC common point and the system DC ground point.

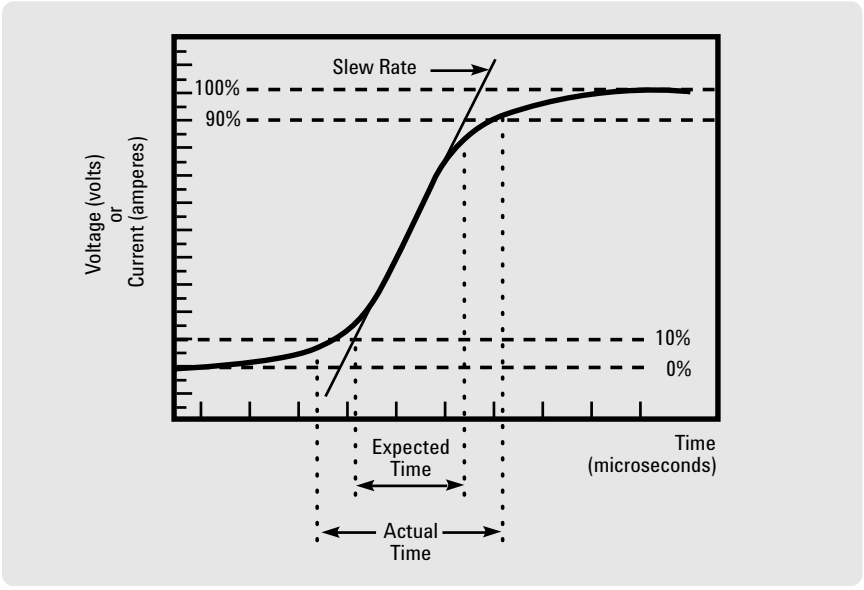
This rule is repeated from Step 7 above as a reminder because of the far greater number of possible paths to ground in a multiple power supply system. Figure 13 shows an example of a properly connected and grounded multiple power supply system.

Power Products Terms

AC input current: the maximum current into the power supply or electronic load. The current specified is worst case (low line voltage, full output).

Actual transition time: for an electronic load, either the total slew time (voltage or current change divided by slew rate - time) or the minimum transition time, whichever is longer.

Auto-parallel operation: a master-slave connection of the outputs of two or more supplies or the inputs of two or more electronic loads used for obtaining a current rating greater than can be obtained from a single load or supply. Only supplies that have the same voltage and current ratings should be paralleled.



Risetime Transition Limitation

Ambient temperature: the temperature of the air immediately surrounding the power supply or electronic load.

Analog programming: controlling the output voltage and/or current with an analog signal. This signal could be a voltage, current or resistance. This is similar to using the power supply as an amplifier.

Autoranging power supply: a power supply that can provide maximum rated power over a wide and continuous range of voltage and current settings.

Auto-series operation: a master-slave connection of the outputs of two or more supplies used for obtaining a voltage greater than can be obtained from one supply. Only supplies that have the same voltage and current ratings should be connected in series.

Auto-tracking operation: a master-slave connection of two or more supplies each of which has one of its output terminals in common with one of the output terminals of all of the other supplies.

Command processing time: the average time required for a power supply output voltage, or electronic load input voltage or current, to begin to change following receipt of a voltage or current set command over GPIB. This is effectively the time it takes for the power supply or electronic load to interpret the voltage set command and initiate a response.

Common mode noise: the current flowing from either output terminal (+ and –) through the power supply to chassis ground.

Compliance voltage: the output voltage of a power supply operating in the constant-current mode.

Constant-current (CC) mode: a power supply that stabilizes output current with respect to changes in load impedance. Thus, for a change in load resistance, the output current remains constant while the output voltage changes by whatever amount necessary to accomplish this.

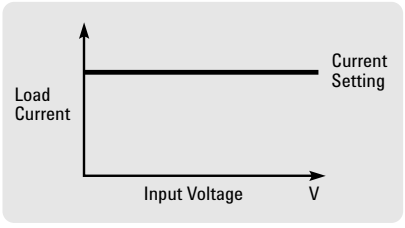
Power Products Terms (Continued)

Constant-current/voltage/resistance mode electronic load: an electronic load that can operate in one of the following ways:

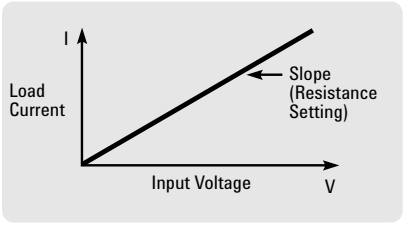
CC= ratio of voltage to current in accordance with the programmed value regardless of the input voltage

CV= ratio of voltage to current in accordance with the programmed value regardless of the input current

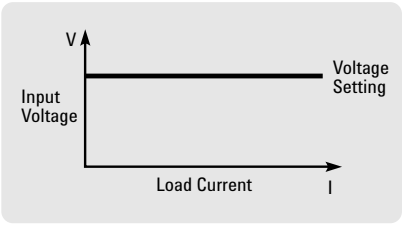
CR= ratio of voltage to current while maintaining the programmed resistance value



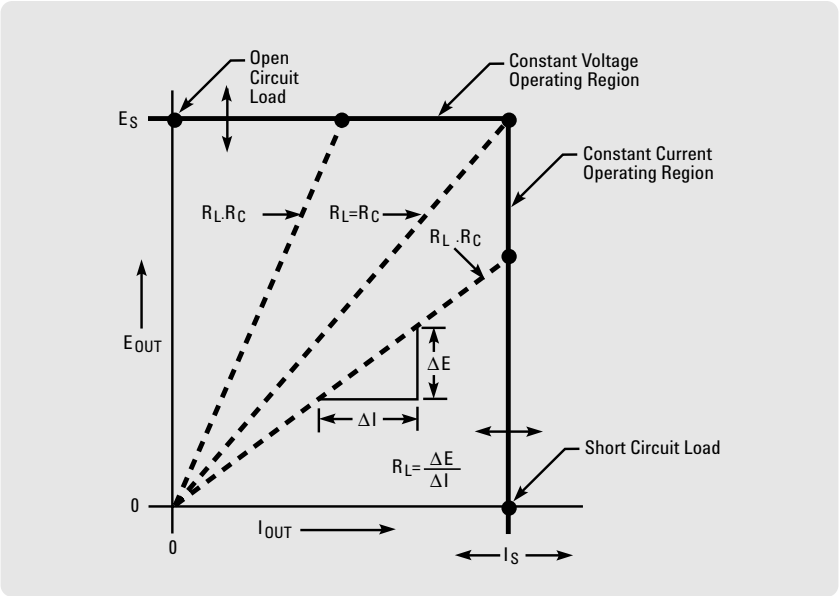
Constant-Current Mode



Constant-Resistance Mode



Constant-Voltage Mode



Constant-Voltage/Constant-Current Output Characteristics

Constant-current/voltage/resistance regulation: the change in the steady-state value of the stabilized electronic load input voltage, current, or resistance resulting from a full scale source change, with all other influence quantities held constant.

Constant-voltage (CV) mode: a power supply that stabilizes output voltage with respect to changes in influence quantities. Thus, for a change in load resistance, the output voltage remains constant while the output current changes by whatever amount necessary to accomplish this.

Constant-voltage/constant current (CV/CC) power supply: a power supply that operates as a constant-voltage power supply or a constant-current power supply, depending on load conditions. The supply acts as a constant-voltage source for comparatively large values of load resistance and as a constant-current source for comparatively small values of load resistance.

Power Products Terms (Continued)

Constant-voltage/current limiting (CV/CL) power supply: a power supply similar to a constant-voltage/constant-current supply except that at comparatively small values of load resistance, its output current is limited instead of being stabilized.

Crest factor: the ratio of the zero-to-peak value to the rms value of a waveform. This term is often used to specify the maximum peak amplitude that an AC power supply can source (relative to its maximum rms rating) without distortion.

Crowbar: see overvoltage protection.

Current limiting: the action, under overload or short-circuit conditions, of limiting the output current of a constant-voltage supply to some predetermined maximum value (fixed or adjustable) and automatically restoring the output voltage to its normal value when the overload or short circuit is removed. There are three types of current limiting:

- by constant-voltage/constant-current crossover
- by decreasing the output voltage as the current increases
- by decreasing both voltage and current as the load resistance decreases.

DFI: a TTL compatible output signal that can be used as an alarm and automatically initiates an action for multiple power supply or electronic load shutdown. The DFI signal is commonly connected to RI of the next supply. (See RI)

Downprogramming: the ability of a power supply to discharge its output capacitors independently of load. The use of an active down programming device can reduce the fall time of the output voltage.

Drift: the maximum change of a power supply output or load input voltage or current during an 8-hour period following a 30-minute warmup, with all influence and control quantities maintained constant during the warm-up time and the period of drift measurement. Drift includes both periodic and random deviations over the bandwidth from zero frequency (DC) to a specified upper frequency limit.

Efficiency: expressed in percent, efficiency is the total output power of the supply divided by the active input power. Unless otherwise specified, Agilent measures efficiency at maximum rated output power and at worst case conditions of the AC line voltage.

Electromagnetic interference (EMI): any type of electromagnetic energy that could degrade the performance of electrical equipment. The EMI generated by a power supply can be propagated either by conduction (via the input and output leads) or bt radiation from the units' case. The terms "noise" and "radio-frequency interference" (RFI) are sometimes used in the same context.

Electronic Load: an active device which absorbs power. Loads are used for the testing of the power producing products.

Foldback: immediate shutdown of the power supply output when a crossover between constant voltage and constant current mode occurs. Both the voltage and current levels are reduced (folded back).

Harmonics: the occurrence of this type of distortion is based upon the mathematical principle that all periodic waveforms are made up of a series of sine waves. As a result, harmonic distortion is produced at frequencies that are integer multiples of the fundamental or desired signal frequency. When viewed in the frequency domain, harmonics have an amplitude (often expressed in db), frequency, and phase characteristic relative to the fundamental.

Isolation: the maximum voltage (including output voltage) either output terminal may be floated from earth ground.

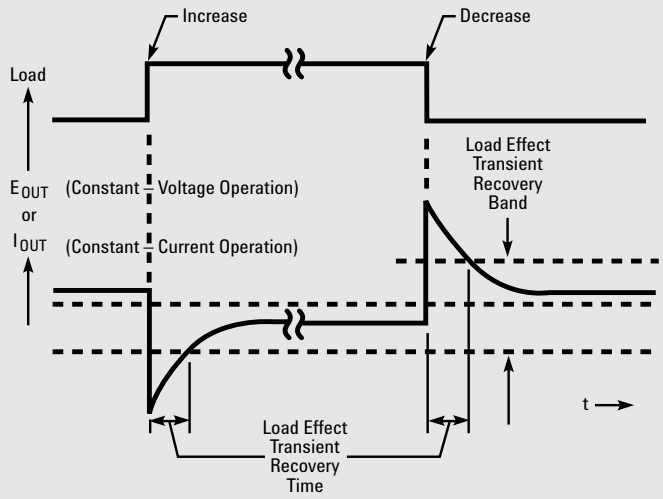
Load cross regulation: the affect on one output of a multiple output power supply when another output is programmed from zero to full rated current.

Power Products Terms (Continued)

Load Effect: also known as "load regulation". Load effect is the change in the steady-state value of the stabilized output voltage or current resulting from a full-load change in the load current of a constant-voltage supply or the load voltage of a constant-current supply, with all other influence quantities maintained constant.

Load effect transient recovery time: the time interval between a specified step change in the load current of a constant-voltage supply (usually a full-load or 5-amp change, whichever is smaller) or in the load voltage of a constant-current supply and the instant when the stabilized output quantity returns to and stays within a specified transient recovery band.

Master-slave operation: a method of interconnecting two or more supplies or electronic loads such that one of them (the master) serves to control the others (the slaves). The outputs of the slave supplies or inputs of the slave electronic loads always remain equal to or proportional to the output of the master. The outputs of the master supply and of one or more slaves may be connected in series, in parallel, or with just their negative or positive output terminals in common. (See also "complementary tracking"). The inputs of the master electronic load and one or more slaves may be connected in parallel only.



Load Effect Transient Recovery Waveforms

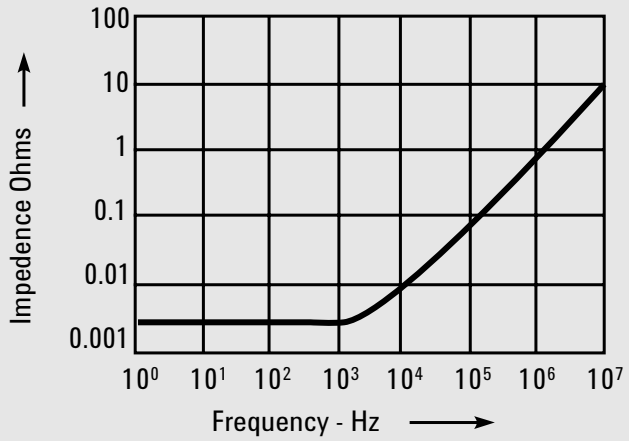
Minimum transition time: the shortest possible time in which an electronic load input can change from one level to another. This is determined by the small signal bandwidth of the load.

Modulation: analog programming of the output voltage and/or current. The output programming response time determines the maximum slew rate at which the power supplies output can be programmed.

Nominal value: the value that exists "in name only"; not the actual value. For example, in the case of a power supply with a calibrated output control, the nominal value is the value indicated by the control setting. For a supply with a fixed output, the nominal output is the output indicated on the nameplate. The nominal value of a 120-volt ±10% line voltage is 120 volts.

"One-Box": a power supply that can be controlled by direct connection to a computer (with no additional programmers) and that can provide measured data to a computer without external voltmeters or ammeters.

Power Products Terms (Continued)



Typical Output Impedence of a Constant Voltage Power Supply

Output Impedance: at any frequency of load change, ΔEout/ΔIout. Strictly speaking, the definition applies only for a sinusoidal load disturbance, unless the measurement is made at zero frequency (DC). The output impedance of an ideal constant voltage power supply would be zero at all frequencies, while the output impedance for an ideal constant current power supply would be infinite at all frequencies.

Overcurrent protection: protection of the power supply, electronic load and/or connected equipment against excessive output current.

Overvoltage protection: protection of the power supply, electronic load and/or connected equipment against excessive output voltage. Overvoltage protection is usually by means of a crowbar protection circuit, which rapidly places a low resistance shunt across the supply's output terminals to reduce output voltage to a low value if a predetermined voltage is exceeded. A supply equipped with an overvoltage crowbar must also be protected by a means for limiting or interrupting the output current.

Peak-to-peak noise: is the range between maximum and minimum noise level. Sometimes called noise "spikes." Peak-to-peak noise is typically low in energy and does not show up in a RMS measurement, 20-20 Mhz.

Phase angle: specifies the time domain phase relationship between two sine waves. The unit of phase angle is the degree, with one cycle corresponding to 360 degrees of phase.

Programming speed: the maximum time required for the programmed output voltage or current to change from a specified initial value (usually zero or maximum output) to a value within a specified tolerance band of a specified newly programmed value (for most models 99.9% or 0.1% of maximum output, respectively) following the onset of a step change in an analog programming signal, or the gating of a digital signal.

Readback: the ability of a power supply or electronic load to measure its actual output voltage and/or current, and provide the reading to a computer.

Remote sensing: remote sensing, or remote error sensing, is a means by which a power supply or electronic load monitors the stabilized voltage directly at the load or source respectively, using extra sensing leads. The resulting circuit action compensates for voltage drops up to a specified limit in the load leads.

Resolution: for a bench supply, the smallest change in output voltage or current that can be obtained using the front panel controls. For a system supply or electronic load, the smallest change that can be obtained using either the front panel controls, or a computer.

Reverse voltage protection: protection of the power supply or electronic load against reverse voltage applied at the outputor input terminals.

Power Products Terms (Continued)

RI (discrete fault indicator/remote inhibit): a rear-panel port that can be used to disable the power supply output independently of the GPIB. This port can also be used to chain multiple power supplies together such that an emergency shutdown of one output automatically signals the other supplies to disable their outputs.

Ripple and Noise (dB): a term often used to specify rms or peak AC source noise relative to the maximum rms or peak output rating. The specification is calculated as follows: dB = 20 Log (Vnoise/Vrating).

Rms (or effective) amplitude or noise: an average signal or noise level based on energy content. The root mean square (rms) content is often called the AC component.

SCPI (Standard Commands for Programmable Instruments): is a programming language for controlling instrument functions over the GPIB (IEEE 488) instrument bus. The same SCPI commands and parameters control the same functions in different classes of instruments.

Serial link: a means by which up to 16 power supplies with this feature can share one GPIB primary address. The power supplies can be connected with cables similar to U.S. modular telephone cables. They are independently controlled using GPIB secondary addressing.

Series regulation: power supplies designed with this topology have fast programming speeds and low noise. Also referred to as a "linear" topology.

Slave operation: see "master-slave operation".

Slew rate: for any given electronic load input transition, the change in current or voltage over time.

Source effect: also known as "line regulation", source effect is the change in the steady-state value of the stabilized output or input voltage or current resulting from any change in the AC source voltage within its specified range, with all other influence quantities maintained constant. Source effect may be measured at any output or input voltage and current within rating.

Specifications: describe the power supply or electronic load warranted performance.

Supplemental characteristics: give typical but nonwarranted performance parameters.

Switching regulation supplies: power supplies designed with this topology are efficient and can have laboratory-grade specifications.

Temperature effect coefficient: the maximum steady-state change in a power supply's output voltage or current or electronic load's input voltage or current per degree Celsius following a change in the ambient temperature within specified limits, with all other influence quantities maintained constant.

Total harmonic distortion: the ratio of the rms sum of the harmonic components to the rms value of a periodic waveform. This is typically expressed as a percent or in decibels (dB).

Voltage limiting: the action of limiting the output voltage of a constant-current supply to some predetermined maximum value (fixed or adjustable) and automatically restoring the output current to its normal value when the load conditions are restored to normal. There are two types of voltage limiting:

- by constant voltage/constant current crossover
- by decreasing the output current as the voltage increases

Warm-up time: the time interval from when a power supply or electronic load is turned on until its output complies with all performance specifications.

Data Acquisition/Switch Instruments

Selection Guide	L4400 Series Switch & Control Instruments	34970A Data Acquisition Switch Unit	34980A Multifunction Switch/Measure Unit
Number of Available slots & modules	7 standalone instruments	3 slots & 8 modules	8 slots & 19 modules
Available Module Functionality			
Integrated DMM	N/A	6 1/2 digit	6 1/2 digit
Max Scan Speed	100 ch/sec	250 ch/s	1000 ch/s
Max 2-wire Mux Channels	40	60	560
Max 2-wire Matrix Crosspoints	64	96	1024
Max Voltage	300 V	300 V	300 V
Max Switching Current	5 A	1 A	5 A
Max Counter/Totalizer Frequency	10 MHz	100 KHz	10 MHz
Max Digital I/O Channels	64 ch	48 ch	510 ch
Max Analog Outputs	4 ch	6 ch	32 ch
Max RF Frequency	custom	2 GHz	3 GHz
Max Microwave Frequency	custom	N/A	20 GHz, custom
Breadboard (for custom circuits)			available
Web Interface (via web browser)	yes		yes
Connectivity	LAN, optional GPIB IntuiLink SW	GPIB, RS-232, Optional USB w/ 82357A BenchLink Data Logger SW	LAN, USB, GPIB IntuiLink SW

More detailed specifications at **www.agilent.com/find/dataacquisition**

L4400 Series LXI Switching and Control Instruments

Features switching, digital I/O, analog outputs and counter functionality in compact, self-contained LXI instruments

Agilent Open

- LXI class C compliant
- Small, 1U, half-rack size
- Built-in Ethernet connectivity
- Full-featured graphical Web interface
- Standard Dsub connectors for flexible connection options
- Software drivers for most common programming environments

The Agilent L4400 Series LXI instruments are high-performance LXI class C compliant instruments that encompass all benefits of LXI with an Ethernet connection, instrument Web server, standard software drivers and more. With their small size and Ethernet connectivity, these instruments are easily placed anywhere on the network.

Summary of L4400 Series LXI Instruments

offers a broad range of functionality to meet a wide variety of application needs in design verification, automated test and data acquisition.

Low Frequency Switching

		Max Volts	Max Current	Scan Ch/s
L4421A	40 Channel Armature Mux	± 300 V	1 A	100
L4433A	Dual 4x8 Reed Matrix	± 150 V	0.5 A	500
L4437A	28 Channel Form C	300 V	1 A	N/A
	4 Channel Form A	30 VDC/250 VAC	5 A	N/A

RF and Microwave Switching

L4445A Microwave Switch/Attenuator Driver	Drive up to 64 external switch coils; 32 SPDT switches, 8 multiport switches, 8 attenuators, or custom combination

System Measurement and Control

L4450A 64-Bit Digital I/O with Memory and Counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V with handshaking protocols and 128 kB pattern memory. Two 10 MHz frequency counters and programmable clock output
L4451A 4-Channel Isolated D/A Converter with Memory	Output DCV up to ± 16 V or DC current up to ± 20 mA, Output waveforms w/200 kHz update rate and 16 bit resolution. 500 k memory for waveforms. Four independent D/A converters.
L4452A Multifunction Module	Four 8-bit digital I/O channels, 2 Channel ± 12 V analog outputs, 100 kHz gated totalizer

More detailed specifications at **www.agilent.com/find/L4400**

L4400 Series LXI Switching and Control Instruments
(Continued)

Ethernet connectivity enables simple connection to the network and remote access to your measurements
You can set up a private network to filter out unwanted LAN traffic and speed up the I/O throughput, or take advantage of the remote capabilities and distribute your tests worldwide.

Use the built-in graphical web interface for remote access and control of your instruments via a Java-enabled web browser
Monitor, troubleshoot, or debug your application remotely. The web interface includes features that allow you to view and modify instrument setup, setup and initiate scans or switch sequences, and get status reports on relay counts, firmware revisions and more.

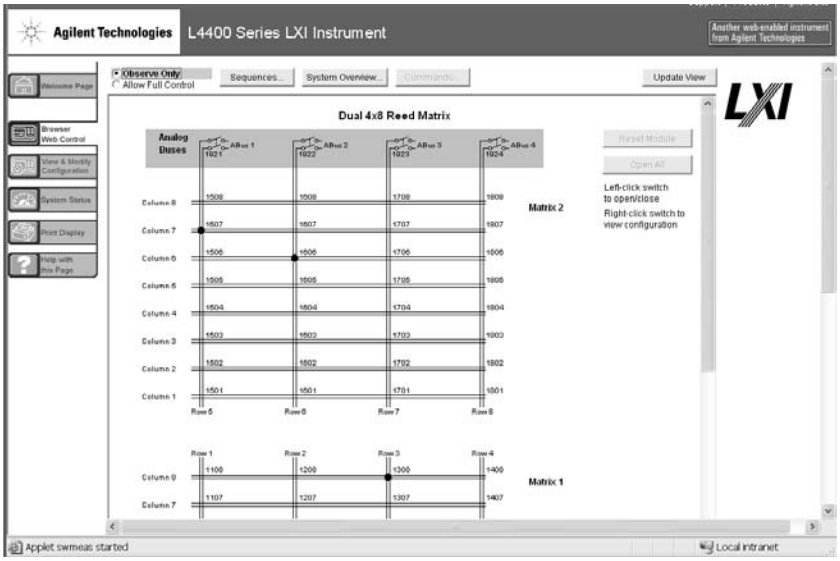


Figure 1. L4433A Dual 4 x 8 matrix web interface

System connections you can trust
The L4400 series instruments come with standard Dsub connectors for simple, reliable connection options that include quick disconnect terminal blocks, cables and connector kits.

Software drivers and connection tools to work in your environment
The Agilent IO Libraries Suite makes it easy for you to configure and integrate instruments into your system — even if your system includes instruments from other vendors. Additionally, these instruments include IVI and LabVIEW software drivers making it easy to program in the most popular programming environments including Agilent VEE and T&M Toolkit, National Instruments LabVIEW and LabWindows, and Microsoft programming languages.

Agilent's family of LXI instruments offer versatility
In addition to the L4400 Series LXI instruments, Agilent offers the 34980A Switch/Measure unit for high-density systems. So whether you need a full-blown switching system with high-density switching, measurement and system control, or just a few channels of switching, Agilent's family of LXI switch/measure instruments have great versatility so you can choose what you need and easily add to it when your requirements change.

See the L4400 and 34980A specific datasheets for more product information and ordering details.

L4400 Series LXI Switching and Control Instruments
(Continued)

L4421A 40-Channel Armature Multiplexer

- 40 2-wire latching armature relays
- Thermocouple reference junction for temperature measurements (reqs ext DMM)
- Relay counter
- Scan up to 100 ch/s
- 300 V, 1 A switch; 2 A carry current

The L4421A is a versatile multiplexer for general purpose scanning. The low thermal offset characteristics and built-in thermocouple reference on the terminal block, make it ideal for temperature measurements with an external DMM. The dense, multi-function switching with 100 ch/s scan rates addresses a broad spectrum of data acquisition, design verification and functional test applications.

Four additional fused inputs (44 channels total) can route up to 1 A of current to an external DMM, allowing for AC and DC current measurements without the need for external shunt resistors.

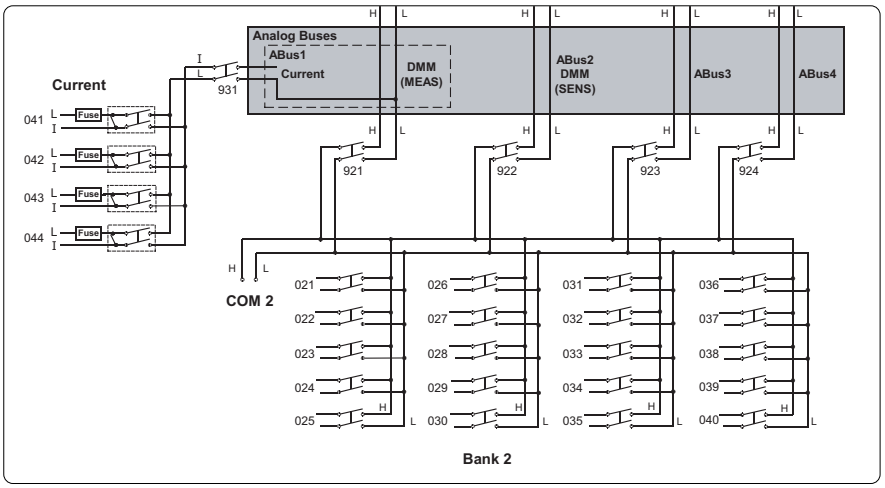


Figure 2. L4421A 40-channel armature multiplexer with low thermal offset (bank 2)

Specifications and Characteristics

Channels/Configurations:
40 2-wire
20 4-wire
4-current (1.5 A fused)

Switch Type:
Armature Latching

Input Characteristics (per channel)

Max Volts: (DC, AC RMS) ±300 V

Max Current: (DC, AC RMS)
Switch Current: 1 A
Carry Current: 2 A

Power (W, VA): 60 W

Volt-Hertz Limit: 10^8

General Specifications

Offset Voltage: < 3 µV

Initial Closed Channel Resistance:
< 1.5 Ω

DC Isolation (ch-ch, ch-earth): > 10 GΩ

T/C cold junction accuracy: < 0.8°C

AC Characteristics

Bandwidth at Terminal Block: 45 MHz

Crosstalk at Terminal Block (ch-ch):

300 kHz	75 dB
1 MHz	75 dB
20 MHz	50 dB
45 MHz	40 dB

Capacitance at Terminal Block:

HI-LO	150 pF
LO – earth	150 pF

General Characteristics

Relay Life: typical
No Load: 100 M
10 V, 100 mA: 10 M
Rated Load: 100 k

Scanning Speeds: 100 ch/s

Open/Close Time: typical 4 ms/4 ms

Analog Bus Connection: Yes

Ordering Information

L4421A 40-chan Armature Multiplexer

Connection Options

34921T Terminal block with temp reference

Y1135A 1.5 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1136A 3 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1139A Solder cup connector kit with female 50-pin Dsub

Y1160A Rack mount kit for two L4400 series instruments

More detailed specifications at **www.agilent.com/find/L4400**

L4400 Series LXI Switching and Control Instruments
(Continued)

L4433A Dual/Quad 4 x 8 Reed Matrix

- Configure as Dual 4x8, 8x8, or 4x16 2-wire matrix
- 64 2-wire or 128 1-wire cross-points
- High speed reed relays
- Analog bus connection
- Relay counter
- ±150 V peak, 0.5 A switch, 1.5 A carry current

The L4433A is a full cross-point matrix that offers a flexible connection path between your devices and your test equipment. Each cross-point in the matrix switch has two wires—a high and a low for the measurement or the matrix can be configured as a 1-wire matrix, increasing the number of crosspoints to 128. The L4433A also has in-rush resistors on each column for added protection. Expand your matrix using the analog bus connector to create a larger matrix, or easily connect to an external measurement device like a DMM.

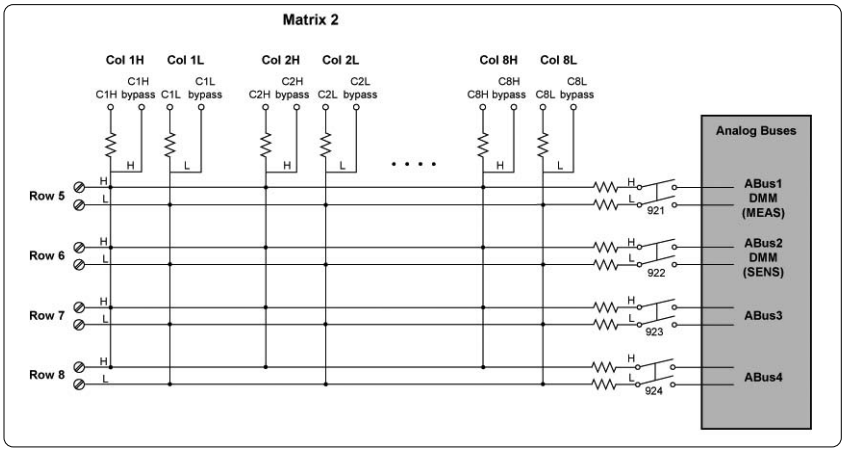


Figure 3. L4433A Dual/Quad 4 x 8 Reed Matrix

Specifications and Characteristics

Channels/Configurations:
dual 4x8, 8x8, 4x16, 2-wire
quad 4x8, 1-wire

Switch Type:
Reed non-latching

Input Characteristics (per channel)

Max Volts: ±150 V peak

Max Current: (DC, AC RMS)[1]
Switch Current: 0.5 A/0.05 A
Carry Current: 1.5 A/0.05 A

Power (W, VA): 10 W

Volt-Hertz Limit: 10^8

General Specifications

Offset Voltage:
< 50 µV, 2-wire
< 100 µV 1 wire

Initial Closed Channel Resistance:[1]
< 1.5 Ω/200 Ω

DC Isolation (ch-ch, ch-earth): > 10 GΩ

AC Characteristics

Bandwidth at Terminal Block:
30 MHz/4 MHz, 2-wire[1]
2 MHz 1-wire

Crosstalk at Terminal Block (ch-ch):

300 kHz	65 dB
1 MHz	65 dB
20 MHz	40 dB

Capacitance at Terminal Block:

HI-LO	80 pF
LO – earth	75 pF

General Characteristics

Relay Life: typical
No Load: 1000 M
10 V, 100 mA: 10 M
Rated Load: 10 k

Open/Close Time: typical 0.5 ms/0.5 ms

Analog Bus Connection: Yes

Ordering Information

L4433A Dual/Quad 4x8 Reed Matrix

Connection Options

34933T Terminal block for discrete wiring

Y1135A 1.5 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1136A 3 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1139A Solder cup connector kit with female 50-pin Dsub

Y1160A Rack mount kit for two L4400 series instruments

[1] Shown with input resistor bypassed and with 100 Ω input protection resistor. Bypassing input resistors will reduce the life of the relays.

More detailed specifications at **www.agilent.com/find/L4400**

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4437A 32-chan Form A/Form C General Purpose Switch

- 28 Form C channels up to 1 A, 60 W
- 4 Form A channels up to 5 A, 150 W
- Armature latching relays
- Relay counter
- Temperature sensor for overheating conditions
- Simultaneous channel switching

The L4437A has 32 general purpose switches that can be used to cycle power to products under test, control status lights, and to actuate external power relays and solenoids.

This product has 28 independent single-pole, double-throw (Form C) 1 A relays and 4 single-pole, single-throw (Form A) 5 A relays. The 28 Form C channels have 300 V, 1 A contacts and can handle up to 60 W. The form A channels are 30 VDC/250 VAC, 5 A contacts and can handle up to 150 W, enough for many power line-switching applications. These switches are made of latching armature relays where multiple channels can be closed at the same time. Additionally, for switching reactive loads, the optional terminal blocks have pads for snubbing circuits.

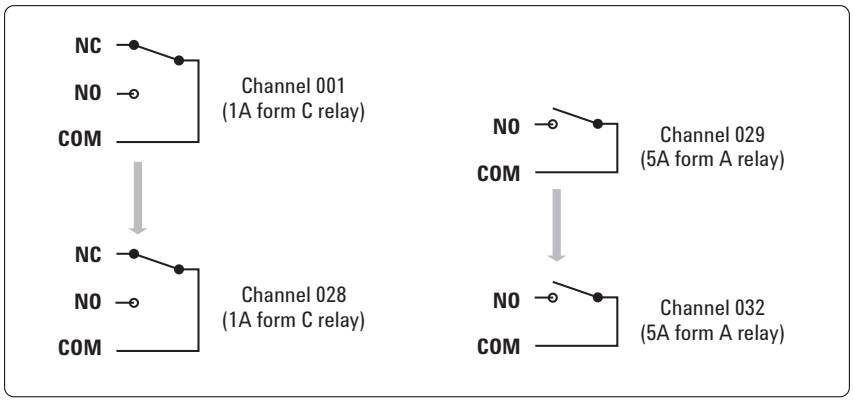


Figure 4. L4437A 32-Chan General Purpose Switch

Specifications and Characteristics

Channels/Configurations:
28 Form C
4 Form A

Switch Type:
Armature Latching

Input Characteristics (per channel)

Max Volts: (DC, AC RMS)
Form C - 300 V
Form A - 30 VDC/250 VAC

Max Current: (DC, AC RMS)
Form C - 1 A switch (2 A carry)
Form A - 5 A switch (8 A carry)

Power (W, VA):
Form C - 60 W
Form A - 150 W

Volt-Hertz Limit: 10^8

General Specifications

Offset Voltage: < 3 µV

Initial Closed Channel Resistance:
Form C - 125 mΩ
Form A - 50 mΩ

DC Isolation (ch-ch, ch-earth): > 10 GΩ

AC Characteristics

Bandwidth at Terminal Block: 10 MHz

Channel Isolation at Terminal Block (ch-ch):

100 kHz	55 dB
1 MHz	35 dB
10 MHz	15 dB

Capacitance at Terminal Block:
Ch-Ch - Form C 12 pF/Form A 10 pF
Ch-earth - Form C 21 pF/Form A 18 pF

General Characteristics

Relay Life: no load/rated
Form C – 100 M/100 k
Form A – 50 M/30 k

Open/Close Time:
Form C – 4 ms/4 ms
Form A – 10 ms/10 ms

Initial/Reset Relay State:
Form C – maintains state
Form A – user configurable

Analog Bus Connection: No

Ordering Information

L4437A 32 Channel Form C/Form A General Purpose Switch

Connection Options

34937T Terminal block for discrete wiring

Y1135A 1.5 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1136A 3 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1139A Solder cup connector kit with female 50-pin Dsub

Y1160A Rack mount kit for two L4400 series instruments

More detailed specifications at **www.agilent.com/find/L4400**

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4445A Microwave Switch/ Attenuator Driver

- Control of most popular microwave switches and attenuators
- Expandable with 34945EXT
- Distribution boards allow for easy wiring
- Switch read-back capabilities
- External power option for simultaneous switching

The L4445A allows you to control switches, attenuators and other devices close to your device under test. The L4445A combined with the 34945EXT provides the power and control signals to drive up to 64 switch coils—that's 32 standard SPDT switches. The L4445A can be extended by adding additional 34945EXT extenders.

The following microwave switches and attenuators are supported with the Y1150A-Y1155A distribution boards:

- N181x series SPDT switches
- 8762/3/4 series SPDT switches (screw terminals)
- 87104x/106x multiport switches
- 87406x series matrix switches
- 87204x/206x series
- 87222x transfer switches
- 849x series attenuators
- 8490x series attenuators
- Screw terminal connections for other devices including the N9397A/C

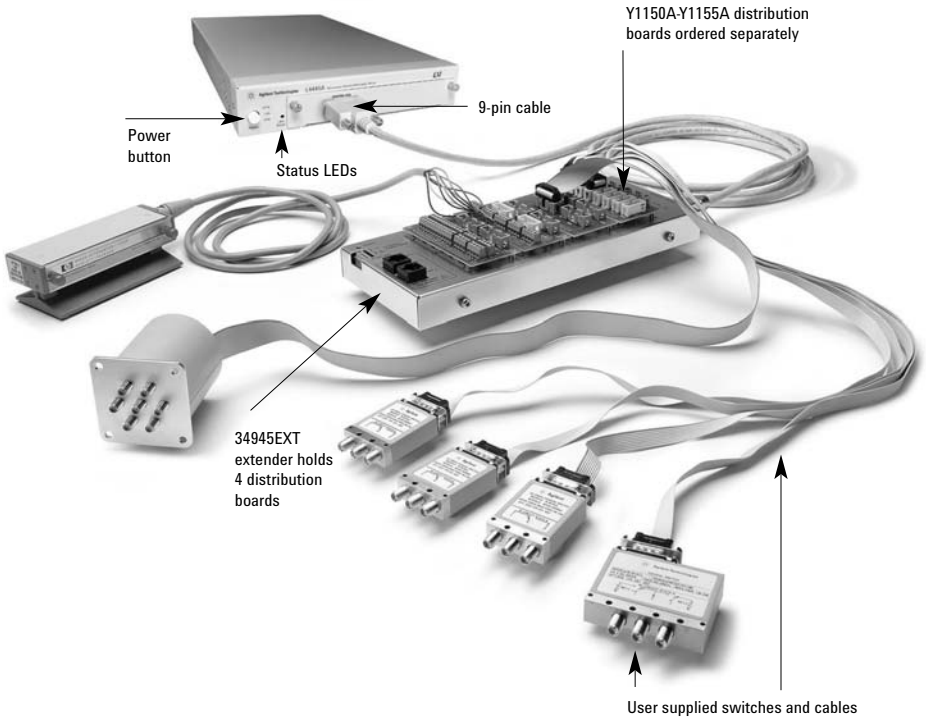


Figure 5. L4445 Microwave Switch/Attenuator Driver with 34945EXT

More detailed specifications at **www.agilent.com/find/L4400**

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4445A Microwave Switch/ Attenuator Driver
(Continued)

Specifications and Characteristics

34945EXT Switch Drive

64 channels, Low Side Drive Mode
Driver Off voltage (max): 30 V
Driver Off Leakage Current: 500 µA
Driver On Current (max): 600 mA
Driver On Voltage (max): 0.5 V @ 600 mA

64 channels, TTL drive mode
Hi output voltage: 3 V @ I_{out} = 2 mA
Lo Output Voltage: 0.4 V @ I_{in} = 20 mA
Lo Input Current: 20 mA

34945EXT position indicator sense inputs
Channels: 64
Lo Input Voltage (max): 0.8 V
Hi Input Voltage (min): 2.5 V
Input resistance: > 100 kΩ @ $V_{in} \leq 5$ V
> 20 kΩ @ $V_{in} > 5$ V
Maximum Input Voltage: 30 V

34945EXT switch drive power supply (34945EXT powered by L4445A)
Voltage: 24 V nominal
(external power supply required for switches needing different voltages)
Current: 100 mA continuous + 200 mA (15 ms pulse, 25% duty cycle)

34945EXT external power connection
Voltage Range: 4.75 V to 30 V
Current limit: 2 A

LED indicator (Current mode divers)
Channels: 64
Supply Voltage: 5 V nominal
LED Drive Current:
5 mA nominal (prog 1-20 mA)
Driver Compliance Voltage: 0.8 V

Maximum 8 34945Ext's per L4445A

Ordering Information

L4445A Microwave Switch/Attenuator driver (requires 34945EXT extender)

Accessories

Y1150A distribution board for 8 N181x SPDT switches

Y1151A distribution board for two 87104x/106x multiport or 87406B matrix switches

Y1152A distribution board for one 87204x/206x or 87606B switch and two N181x switches

Y1153A distribution board for two 84904/5/6/7/8 or 8494/5/6 step attenuators

Y1154A distribution board for two 87222 transfer switches and six N181x SPDT switches

Y1155A distribution board w/generic screw terminals for driving 16 switch coils

Y1157A 9- to 10-pin cable kit for Y1150A, Y1152A, Y1154A - supplies to build 4 cables

Y1158A 10- to 10/10- to-14-pin cable kit for Y1153A, Y1154A - supplies to build 2 cables

Y1159A 16- to 16-pin cable kit for Y1150A/51A/52A/53A/54A/55A supplies to build 2 cables

Y1160A Rack mount kit for two L4400 series instruments

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4450A 64-Bit Digital I/O with Memory and Counter

- 64 bi-directional digital I/O bits with programmable polarity
- Variable threshold from 0 V to 5 V
- Handshaking protocols
- Source/sink current up to 24 mA
- 128 kB pattern memory
- Two 10 MHz counter channels
- 20 MHz divide-by-n clock

The high-speed L4450A digital I/O can be used to simulate or detect digital patterns. It has 64-bits of digital I/O with handshaking, pattern memory; two 10 MHz counters with gate functions; and a programmable clock output.

The 64 bi-directional lines are configured as eight 8-bit channels. Each 8-bit channel has programmable polarity and thresholds up to 5 V. The 128 k of memory is useful for simulating and capturing digital patterns up to 10 MHz. The configurable handshaking protocols can be used for a wide variety of applications.

The two counter channels can be used to count events, frequency, period, duty cycle, pulse width and totalize.

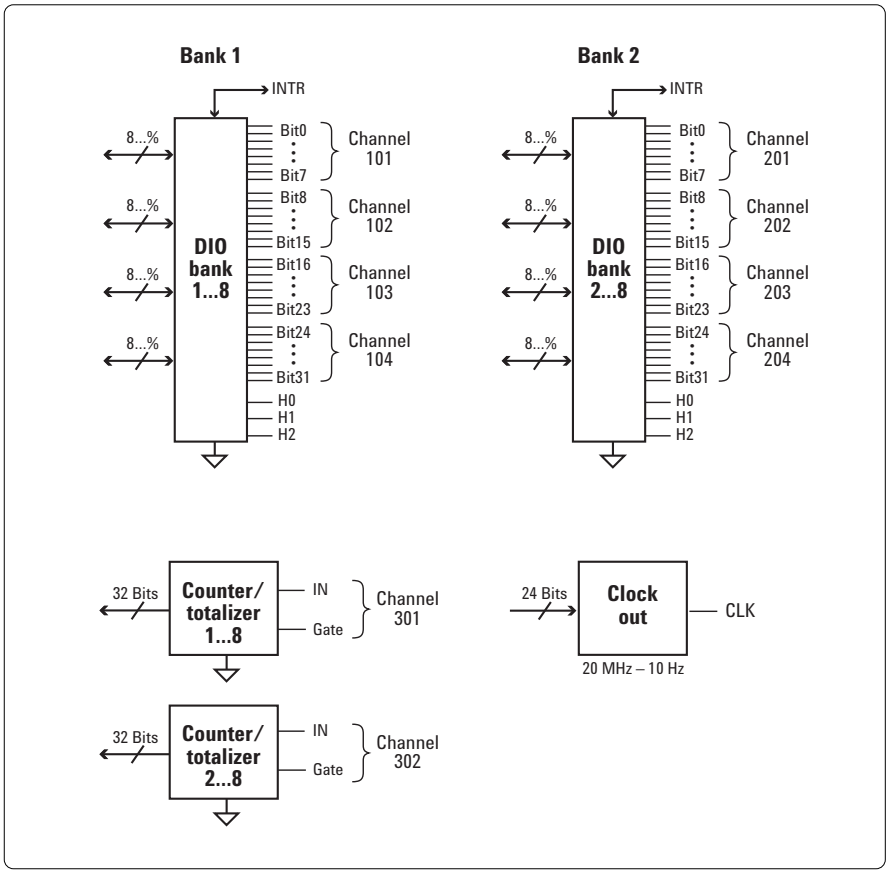


Figure 6. L4450A 64-bit digital I/O

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4450A 64-Bit Digital I/O with Memory and Counter
(Continued)

Specifications and Characteristics

Digital Input/Output Characteristics

Eight 8-bit channels:
8 bits wide, input or output, non-isolated

V_{in}: 0 V – 5 V
V_{out}: 1.65 V – 5 V
I_{out} (max): 24 mA
Frequency (max): 10 MHz
I_{Load} (max): 400 mA
tr + tf (typ): 6 ns

Handshake Lines

V_{in}: 0 V– 5 V
V_{out}: 1.65 V– 5 V
I_{out} (max): 24 mA
Frequency (max): 10 MHz

Counter Function Characteristics

Maximum Freq: 10 MHz (max)
50% duty cycle
V_{in}: 0 V– 5 V

Totalizer Function Characteristics

Maximum Count:
2^32 – 1 (4,294,967,296)
Max Input Freq:
10 MHz (max), rising or falling edge programmable
V_{in}: 0 V– 5 V
Gate Input: 0 V – 5 V

System Clock Generator Characteristics

Frequency:
20 MHz – 10 Hz configurable divide-by-n 24-bits, programmable on/off
V_{out}: 1.65 V – 5 V
Accuracy: 100 ppm

Ordering Information

L4450A 64-bit Digital I/O with memory and counter

Connection Options

34950T Terminal block for discrete wiring

Y1137A 1.5 m 78-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1138A 3 m 78-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1142A Solder cup connector kit with male 78-pin Dsub

Y1160A Rack mount kit for two L4400 series instruments

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4451A 4-Channel Isolated D/A Converter with Memory

- Four isolated analog outputs
- Outputs up to ±16 V or ±20 mA DC
- 16-bits of resolution
- 500 k memory
- 200 kHz update rate
- Default standard waveforms

The Agilent L4451A has four isolated analog channels that are useful to source bias voltages to your device under test, to control your analog programmable power supplies, or use the outputs as setpoints for your control systems. You can use the standard waveforms provided or create your own using over 500,000 points. These points can be dynamically allocated among one or more channels and output as a point-to-point arb.

The four independent, isolated channels can output DC voltage up to ±16 V or DC current up to ±20 mA with 16 bits of resolution. The gain and offset can be adjusted on-the-fly. And since these are isolated channels, they can be stacked to create waveforms with higher output voltages.

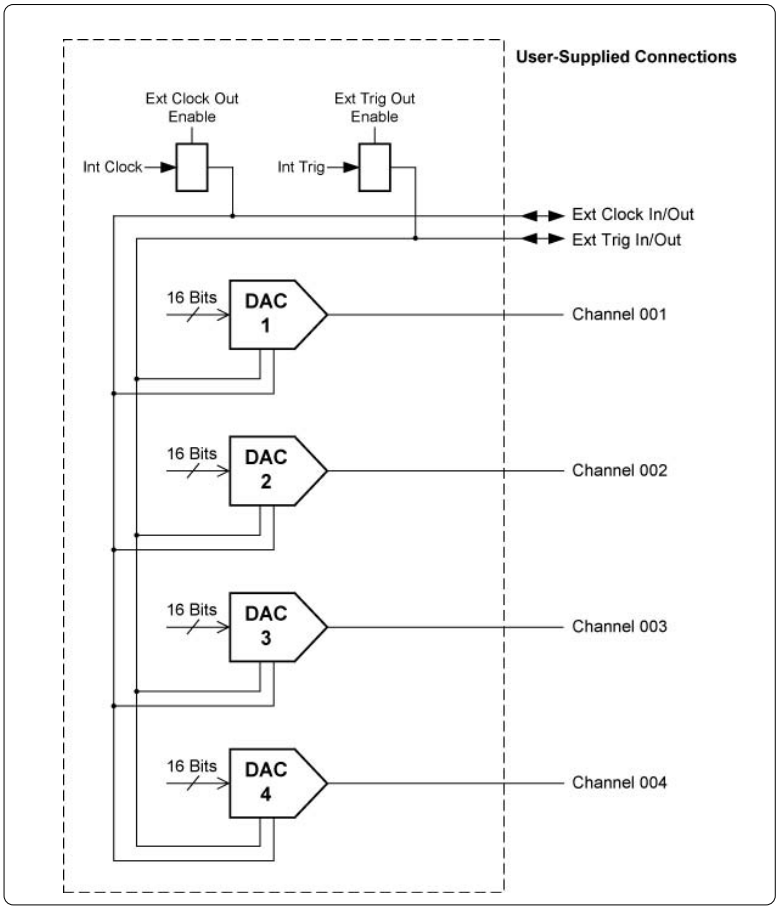


Figure 7. L4451A 4-channel isolated D/A converter

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4451A 4-Channel Isolated D/A Converter with Memory
(Continued)

Specifications and Characteristics

Output Specifications

Maximum Update Rate: 200 kHz point-to-point

Monotonic: to 16 bits

Isolation: > 80 VDC/AC peak (chan-to-chassis or chan-to-chan)

Synchronization: Software commands or external trigger

Internal/External CLK Accuracy: 100 ppm

AC Accuracy: Not specified

DC Voltage

Amplitude: ±16 V up to 10 mA

Resolution: 16-bit = 500 µV

Amplitude Accuracy (DC): ±(0.05% + 3.0 mV)

Ripple and Noise: < 2 mVrms, 20 Hz to 250 kHz into 10 kΩ load

Settling Time: 40 µs (-full scale to +full scale step, single channel, to rated accuracy)

Output Impedance: < 1 Ω with the load sensed

DC Current

Range: ±20 mA

Resolution: 16-bit = 630 nA

Accuracy: ±(% value + amps) (temperature within ±5°C of Tcal or *Cal?) 90-day: ±(0.09% + 5.0 µA)

Ripple and Noise: < 2 µArms, 20 Hz to 250 kHz into 250 Ω

Compliance Voltage: ±12 V

Max Open Circuit Voltage: < ±22 V

Phase-locking I/O Trigger Characteristics

Trigger Input

Input Level: TTL compatible (3.3 V logic, 5 V tolerant)

Slope: Rising or falling, selectable

Pulse Width: > 100 ns

Input Impedance: > 10 kΩ, DC coupled

Trigger Output

Level: TTL compatible into 1 kΩ (3.3 V logic)

Output Impedance: 50 Ω typical

Clock Input

Input Level: TTL compatible (3.3 V logic, 5 V tolerant)

Input Impedance: > 10 kΩ, DC

Maximum Rate: 10 MHz

Clock Output

Level: TTL compatible Into 1 kΩ (3.3 V logic)

Output Impedance: 50 Ω typical

Maximum Rate: 10 MHz

Accuracy: ±100 ppm

Ordering Information

L4451A 4-Channel Isolated D/A Converter with Memory

Connection Options

34951T Terminal block for discrete wiring

Y1135A 1.5 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1136A 3 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1141A Solder cup connector kit with male 50-pin Dsub

Y1160A Rack mount kit for two L4400 series instruments

L4400 Series LXI Switching and Control Instruments
(Continued)

Agilent L4452A Multifunction with Digital I/O, D/A, Totalizer

- 32-bits of digital I/O up to 42 V
- 100 kHz gated totalizer
- Two ±12 V analog outputs with 1 mV of resolution

The L4452A is a multifunction instrument that combines four 8-bit channels of digital input and output, a 100 kHz gated totalizer, and two ±12 V analog outputs all on a single earth-referenced module.

The digital I/O supports output levels up to 42 V. These channels can be used with an external power supply to control external devices or to sense limit switch and digital bus status with no complex hand-shake modes.

The analog outputs can output up to ±12 V or 10 mA DC with 1 mV of resolution. They can be used to source bias voltages to your device under test, to control your analog programmable power supplies, or use the outputs as set points for your control systems.

The totalizer inputs can be used to count events and can be included in a scan. Alarm limits for the digital and event counter inputs are evaluated continuously, capturing and logging alarm conditions even between scans.

Specifications and Characteristics

Digital input/output characteristics

Four 8-bit Channels, 8-bits Wide: Input or output, non-isolated

$V_{in}(L)$: < 0.8 V (TTL)

$V_{in}(H)$: > 2.0 V (TTL)

$V_{out}(L)$: < 0.8 V @ I_{out} = -400 mA

$V_{out}(H)$: > 2.4 V @ I_{out} = 1 mA

$V_{in}(H)$ max: < 42 V with external open drain pull-up

Alarm: Maskable pattern match or state change

Speed: 4 ms (max) alarm sampling latency

Read/Write Speed: 95/s

Totalize Input Characteristics

Max Count: 2^{26} - 1

Totalize Input: 100 kHz (max) rising or falling edge, programmable

Signal Level: 1 Vp-p (min) 42 Vpk (max)

Threshold: 0 V or TTL

Gate Input: TTL-Hi, TTL-Lo, or none

Count Reset: Manual or read + reset

Read Speed: 85 rdgs/s

Analog Output Characteristics

DAC 1, 2: ±12 V, non-isolated

Resolution: 1 mV

I_{out}: 10 mA max

Settling Time: 1 ms to 0.01% of output

Accuracy: ±(% of output + mV) 1 year (0.25% + 20 mV)

Temp. Coefficient: ±(0.015% + 1 mV)/°C

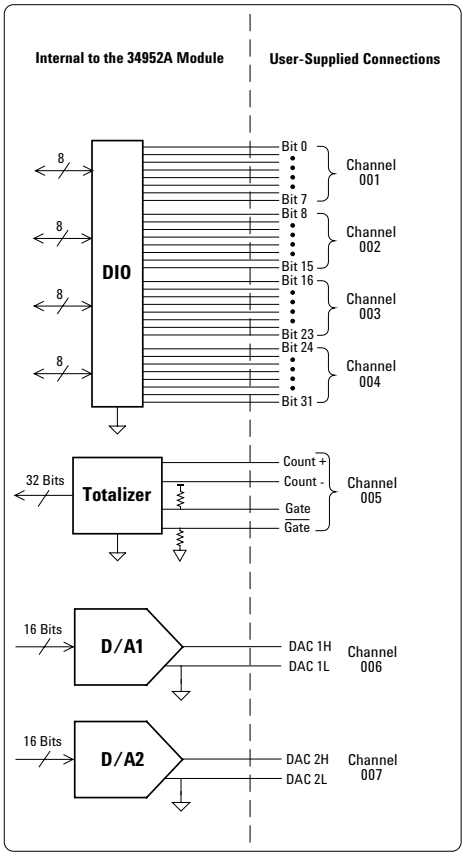


Figure 8. L4452A Multifunction with Digital I/O, D/A, totalizer

Ordering Information

L4452A Multifunction instrument with digital I/O, D/A converters and totalizer

Connection Options

34952T Terminal block for discrete wiring

Y1135A 1.5 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1136A 3 m 50-pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1141A Solder cup connector kit with female 50-pin Dsub

Y1160A Rack mount kit for two L4400 series instruments

More detailed specifications at **www.agilent.com/find/L4400**

L4400 Series LXI Switching and Control Instruments
(Continued)

L4400 General Specifications

L4400 General Specifications

Power Supply:
Universal 100 V to 240 V ±10%

Power Line Frequency:
50 Hz to 60 Hz ±10% automatically sensed

Power Consumption: 15 VA

Operating Environment:
Full accuracy for 0°C to 55°C
Full accuracy to 80% R.H. at 40°C

Pollution Degree: 1 of IEC 61010-1

Storage Environment:
-40°C to 70°C

Approximate Dimensions:
(H x W x L) 40.9 x 212.3 x 379.3 mm
1.61 x 8.36 x 14.93 in

Approximate Weight: 3.9 kg, 8.6 lbs.

Safety:
Conforms to CSA, UL/IEC/EN 61010-1

EMC: Conforms to IEC/EN 61326-1, CISPR 11

Warranty: 1 year

Software

Agilent connectivity software included:
Agilent I/O Libraries Suite 14 or greater (E2094N)

Minimum System Requirements:

PC hardware
Intel Pentium
100 MHz, 64 MB RAM,
210 MB disk space

Display
800x600, 256 colors, CD-ROM drive

Operating system
Windows® 98 SE/NT/2000/XP

Computer Interfaces:
Standard LAN 10BaseT/100BaseTx
Optional IEEE 488.2 GPIB

Software Driver Support for Programming Languages:

Software drivers

- IVI-C and IVI-COM for Windows NT®/2000/XP
- LabVIEW

Compatible with programming tools and environments

- Agilent: VEE Pro, T&M Toolkit (reqs Visual Studio.NET)
- National Instruments: TestStand, Measurement Studio, LabWindows/CVI, LabVIEW, Switch Executive
- Microsoft: Visual Studio.NET®, C/C++, Visual Basic 6®

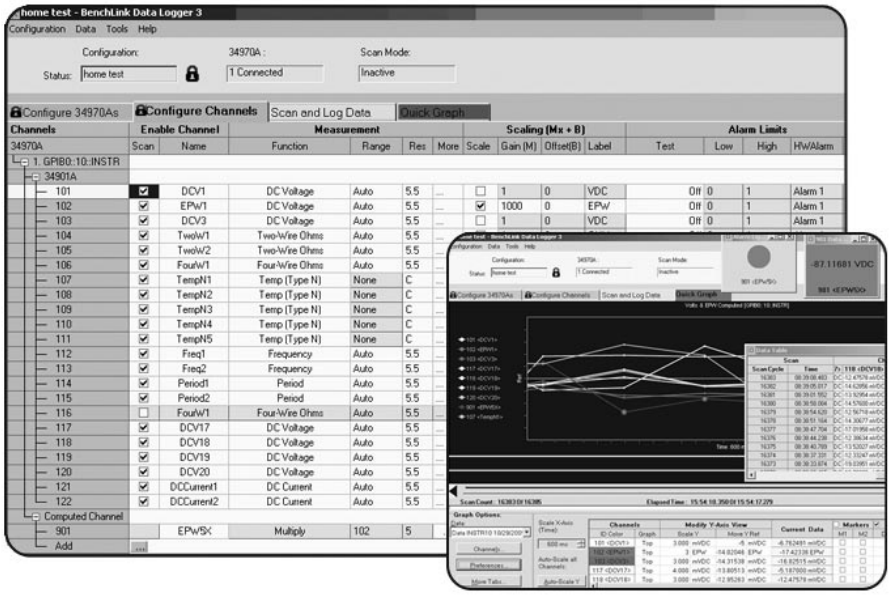
34970A

Low-Cost Data Acquisition/Switch
34970A

- 3-slot data acquisition and switching mainframe
- 6½-digit (22 bit) internal DMM
- 11 built-in measurement functions
- 8 switch and control plug-in modules
- BenchLink data logger software included

34970A Data Acquisition/Switch Unit

The Agilent 34970A is a high performance, low-cost data acquisition and switching mainframe ideal for data logging, data acquisition, and general-purpose switching and control applications. It consists of a half-rack mainframe with an internal 6½ digit (22 bit) digital multimeter. Three module slots are built into the rear of the unit to accept a combination of switch and control modules. Whether you need a few channels of simple data logging or a hundred channels of ATE performance, the 34970A meets your data acquisition needs at a price that meets your budget.



Measurements You Can Trust

The 34970A incorporates the measurement engine from our best-selling benchtop digital multimeter (DMM). You get the benefit of proven Agilent performance, universal inputs with built-in signal conditioning, and modular flexibility, all in a low-cost, compact data acquisition package. The 34970A features 6½ digits (22 bits) of resolution, 0.004% basic dcV accuracy, and ultra-low reading noise. Combine that with scan rates of up to 250 channels/sec, and you've got the speed and accuracy you need to get the job done.

Custom Configurations That Grow With You

Three module slots and eight switch and control modules allow you to customize the 34970A to meet your unique requirements. Buy only what you need, and add more modules later as your application grows. Measure up to 120 inputs with a single half-rack instrument.

More detailed specifications at **www.agilent.com/find/34970A**

Low-Cost Data Acquisition/Switch 34970A (Continued)

Free BenchLink Software Simplifies Your Data Gathering

If you want PC-based data logging capabilities, but don't want to spend hours programming, BenchLink Data Logger is the answer. Use it to set up your test, acquire and archive measurement data, and perform real-time display and analysis of the incoming measurements.

A familiar spreadsheet environment makes it easy to configure and control your tests. A rich set of colorful graphics provides many options for displaying your data – all with point-and-click ease. Set up multiple graphics using strip charts, histograms, or individual channel results and more. Also use Agilent BenchLink Data Logger to easily move data to other applications for further analysis, or for inclusion in your presentations and reports.

Powerful Flexibility

The 34970A's unique design allows per-channel configurability for maximum flexibility and quick, easy setup. The internal autoranging DMM measures 11 different functions directly, eliminating the need for expensive external signal conditioning. Temperature conversion routines are built-in to display raw thermocouple, RTD, or thermistor inputs in degrees C, F, or Kelvin. Use Mx+B scaling to convert linear transducer outputs directly into engineering units. You can even set high/low alarm limits to warn you of out-of-tolerance conditions.

Applications

Data Logging

Configured with the 34901A 20-channel relay multiplexer, the 34970A becomes a rugged, low-cost data logger that's ideal for quick tests in the lab or in the field. An intuitive front panel with self-guiding menus and a bright, easy-to-read vacuum fluorescent display make standalone set-up fast and easy. All readings are automatically time stamped and stored in a 50,000 reading memory – enough memory to hold a week's worth of data (20 channels scanned every five minutes). The non-volatile memory holds your data even after power is removed, so you can use the 34970A to collect data at a remote location for later uploading to a PC. The system configuration is also held in non-volatile memory, so in the event of a power failure the unit automatically resumes scanning when power is returned. And for PC-based testing, Agilent BenchLink Data Logger software is included to simplify your test configurations, data analysis and data management.

Automated Testing

For automated test and benchtop automation applications, the 34970A's three slots and choice of eight plug-in switch and control modules allow easy customization. The $6\frac{1}{2}$-digit internal DMM brings you the power and performance of a world-class standalone DMM, but in a fraction of the space and at a fraction of the cost. Software drivers that support Agilent VEE and National Instruments LabVIEW™ are available to make an easy integration of the 34970A into your test system. Standard RS-232 and GPIB interfaces and SCPI programming language make integration even easier. Our proprietary relay maintenance system automatically counts and stores every individual switch closure to help you predict relay end-of-life and avoid costly production line downtime.

Module Overview

Up to three modules, in any combination, can be inserted into a single mainframe. The 34970A's internal DMM connections are accessible only through the 34901A, 34902A, and 34908A multiplexers.

More detailed specifications at **www.agilent.com/find/34970A**

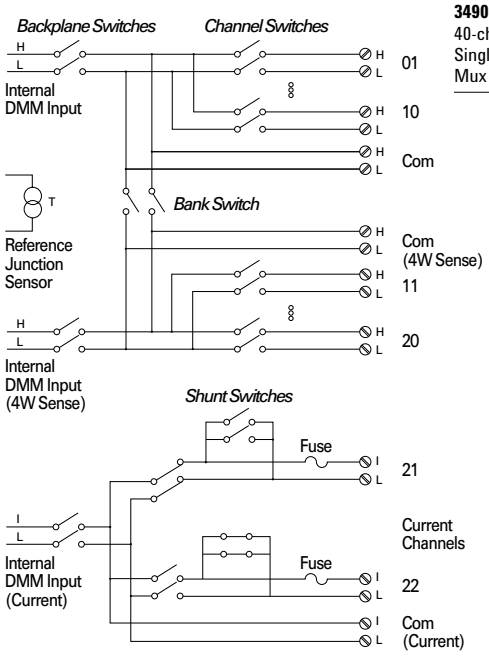
Low-Cost Data Acquisition/Switch 34970A (Continued)

Module Specifications

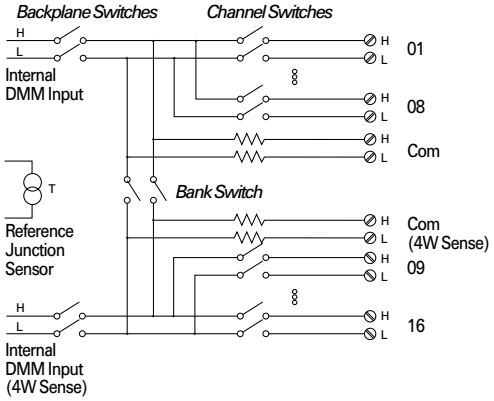
Switching
For test applications that don't require the built-in measurements of the 34970A, the unit can be ordered without the internal DMM. This provides an ultra low-cost solution for routing test signals to and from your device-under-test and assorted instruments, including external DMMs, scopes, counters and power supplies. Plus, you can add the DMM later if your needs change.

Module Description	Type	Connects to Internal DMM	Speed (ch./sec.)	Maximum Input			Offset Voltage	Bandwidth	Comments
				Voltage	Current	Power			
34901A 20-ch. Multiplexer	2-wire armature (4-wire selectable)	Yes	60	300 V	1 A	50 W	<3 µV	10 MHz	2 current channels (22 ch. Total) Built-in cold junction reference
34902A 16-ch. Multiplexer	2-wire reed (4-wire selectable)	Yes	250	300 V	50 mA	2 W	<6 µV	10 MHz	Built-in cold junction reference
34903A 20-ch. Actuator/GP Switch	SPDT/ form C	No	120	300 V	1 A	50 W	<3 µV	10 MHz	–
34904A 4 x 8 Matrix	2-wire armature	No	120	300 V	1 A	50 W	<3 µV	10 MHz	Full crosspoint
34905A Dual 1:4 RF Mux, 50 Ω	Common Low (unterminated)	No	60	42 V	0.7 A	20 W	<6 µV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
34906A Dual 1:4 RF Mux, 75 Ω	Common Low (unterminated)	No	60	42 V	0.7 A	20 W	<6 µV	2 GHz	1 GHz through provided BNC-to-SMB adapter cables
34907A Multifunction Module	Two 8-bit digital I/O ports	No	–	42 V	400 mA	–	–	–	Open drain Gated; selectable input threshold
	26-bit event counter	–	–	42 V	–	–	–	100 kHz	16-bit, earth referenced
	Two analog outputs	–	–	± 12 V	10 mA	–	–	DC	
34908A 40-ch. Single-ended Mux	1-wire armature (common low)	Yes	60	300 V	1 A	50 W	<3 µV	10 MHz	No 4-wire measurements built-in cold juction reference

34901A 20-Channel general purpose multiplexer



34902A 16-Channel multiplexer (2/4-wire) module for 34970A



More detailed specifications at **www.agilent.com/find/34970A**

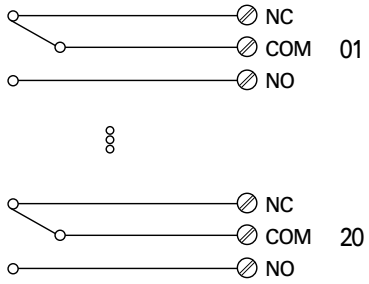
Low-Cost Data Acquisition/Switch 34970A (Continued)

Accuracy Specifications[1]

±(% of reading + % of range)

Includes measurement error, switching error and transducer conversion error

34903A 20-Channel Actuator/GP switch module for 34970A



Function	Range[2]	Frequency, etc.	1 Year[2] 23°C ± 5°C
DC Voltage	100.0000 mV	–	0.0050 + 0.0040
	1.000000 V	–	0.0040 + 0.0007
	10.00000 V	–	0.0035 + 0.0005
	100.0000 V	–	0.0045 + 0.0006
	300.000 V	–	0.0045 + 0.0030
True RMS AC Voltage[3]	100.0000 mV to 100.0000 V	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.35 + 0.04
		10 Hz – 20 kHz	0.06 + 0.04
		20 kHz – 50 kHz	0.12 + 0.05
		50 kHz – 100 kHz	0.60 + 0.08
		100 kHz – 300 kHz[4]	4.00 + 0.50
	300.0000 V	3 Hz – 5 Hz	1.00 + 0.08
		5 Hz – 10 Hz	0.35 + 0.08
		10 Hz – 20 kHz	0.06 + 0.08
		20 kHz – 50 kHz	0.12 + 0.12
		50 kHz – 100 kHz	0.60 + 0.20
		100 kHz – 300 kHz[4]	4.00 + 1.25
Resistance[5]	100.0000 Ω	1 mA current source	0.010 + 0.004
	1.000000 kΩ	1 mA	0.010 + 0.001
	10.00000 kΩ	100 µA	0.010 + 0.001
	100.0000 kΩ	10 µA	0.010 + 0.001
	1.000000 MΩ	5.0 µA	0.010 + 0.001
	10.00000 MΩ	500 nA	0.040 + 0.001
	100.0000 MΩ	500 nA 10 MΩ	0.800 + 0.010
Frequency and Period[6]	100 mV to 300 V	3 Hz – 5 Hz	0.10
		5 Hz – 10 Hz	0.05
		10 Hz – 40 Hz	0.03
		40 Hz – 300 kHz	0.01
DC Current (34901A only)	10.00000 mA	<0.1 V burden	0.050 + 0.020
	100.0000 mA	<0.6 V	0.050 + 0.005
	1.000000 A	<2 V	0.100 + 0.010
True RMS AC Current (34901A only)	10.00000 mA to 1.00000 A	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.30 + 0.04
		10 Hz – 5 Hz	0.10 + 0.04
	100.0000 mA[7]	3 Hz – 5 Hz	1.00 + 0.5
		5 Hz – 10 Hz	0.30 + 0.5
		10 Hz – 5 kHz	0.10 + 0.5

Temperature	Type	1-Year Accuracy[8]	
Thermocouple[9]	B	1100°C to 1820°C	1.2°C
	E	-150°C + 1000°C	1.0°C
	J	-150°C + 1200°C	1.0°C
	K	-100°C + 1200°C	1.0°C
	N	-100°C + 1300°C	1.0°C
	R	300°C + 1760°C	1.2°C
	S	400°C + 1760°C	1.2°C
	T	-100°C + 400°C	1.0°C
RTD	R_0 from 49 Ω to 2.1 kΩ	-200°C + 600°C	0.06°C
Thermistor	2.2 k, 5 k and 10 k	-80°C to 150°C	0.08°C

See manual or datasheet for more information

1 Specifications are for 1-hour warm-up and 6 ½ digits, slow AC filter.

2 20% over range on all ranges except 300 Vdc and AC ranges and 1 A DC and AC current ranges.

3 For sinewave input >5% of range. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range additional error.

4 Typically 30% of reading error at 1 MHz, limited to 1 x 10^8 V Hz.

5 Specifications are for 4-wire ohms function or 2-wire ohms using scaling to remove the offset. Without scaling, add 4 Ω additional error in 2-wire ohms function.

6 Input >100 mV. For 10 mV inputs, multiply % of reading error x 10.

7 Specified only for inputs >10 mA.

8 For total measurement accuracy, add temperature probe error.

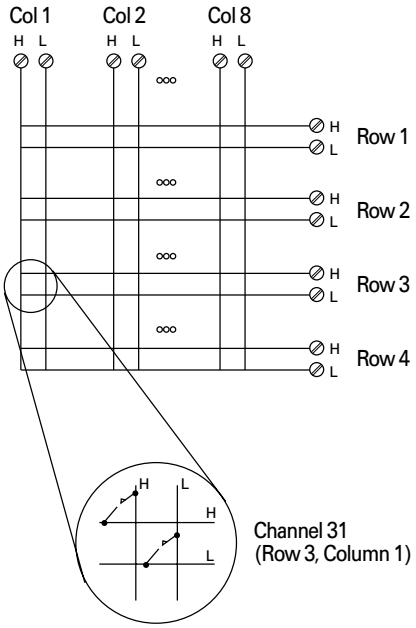
9 Thermocouple specifications not guaranteed when 34907 module is present

More detailed specifications at **www.agilent.com/find/34970A**

Low-Cost Data Acquisition/Switch 34970A (Continued)

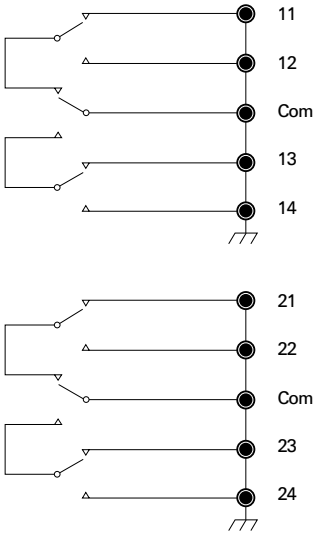
Measurement Characteristics

34904A 4x8 Two-wire matrix module for 34970A



34905A 50 Ω 2 GHz Dual 1:4 Rf MUX, 50 ohm module for 34970A

34906A 75 Ω 2 GHz Dual 1:4 Rf MUX, 75 ohm module for 34970A



DC Voltage	Measurement Method	Continuously integrating multi-slope III A-D Converter
	A-D Linearity	0.0002% of reading + 0.0001% of range
	Input Resistance	
	100 mV, 1 V, 10 V ranges	Selectable 10 MΩ or >10.000 MΩ
	100 V, 300 V ranges	10 MΩ ± 1%
	Input Bias Current	<30 pA at 25°C
	Input Protection	300 V all ranges
True RMS AC Voltage	Measurement Method	AC coupled True RMS – measures the AC component of the input with up to 300 Vdc of bias on any range
	Crest Factor	Maximum of 5:1 at full scale
	Additional Crest Factor Errors (non-sinewave)	Crest Factor 1–2 0.05% of reading Crest Factor 2–3 0.15% of reading Crest Factor 3–4 0.30% of reading Crest Factor 4–5 0.40% of reading
	Input Impedance	1 MΩ ± 2% in parallel with 150 pF
	Input Protection	300 Vrms all ranges
Resistance	Measurement Method	Selectable 4-wire or 2-wire Ohms Current source referenced to LO input
	Offset Compensation	Selectable on 100 Ω, 1 kΩ, 10 kΩ ranges
	Maximum Lead Resistance	10% of range per lead for 100 Ω and 1 kΩ ranges 1 kΩ on all other ranges
	Input Protection	300 V on all ranges
Frequency and Period	Measurement Method	Reciprocal counting technique
	Voltage Ranges	Same as AC voltage function
	Gate Time	1 s, 100 ms, or 10 ms
	Measurement Timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit
DC Current	Shunt Resistance	5 Ω for 10 mA, 100 mA; 0.1 Ω for 1 A
	Input Protection	1 A 250 V fuse on 34901A module
True RMS AC Current	Measurement Method	Direct coupled to the fuse and shunt, AC coupled True RMS measurement (measures the AC component ony)
	Shunt Resistance	5 Ω for 10 mA; 0.1 Ω for 100 mA, 1 A
	Input Protection	1 A 250 V fuse on 34901A module
Thermocouple	Conversion Conformity	ITS-90 based software routines
	Reference Junction Type	Internal, Fixed, or External
	Open Thermocouple Check	Selectable per channel, Open >5 kΩ
Thermistor		44004, 44007, 44006 series
RTD		α = 0.00385 (DIN) and α = 0.00391
Measurement Noise Rejection 60 (50) Hz[1]	DC CMRR	140 dB
	AC CMRR	70 dB
	Integration Time	**Normal Mode Rejection**[2]
	200 plc/3.33 s (4 s)	110 dB[3]
	100 plc/1.67 s (2 s)	105 dB[3]
	20 plc/334 ms (400 ms)	100 dB[3]
	10 plc/167 ms (200 ms)	95 dB
	2 plc/33.3 ms (40 ms)	90 dB
	1 plc/16.7 ms (20 ms)	60 dB
	<1 plc	0 dB

1 For 1 KΩ unbalance in LO lead

2 For power line frequency ±0.1%

3 For power line frequency ±1% use 80 dB or ±3% use 60 dB

More detailed specifications at **www.agilent.com/find/34970A**

Low-Cost Data Acquisition/Switch 34970A (Continued)

Operating Characteristics[4]

Single Channel Measurement Rates[5]

Function	Resolution[9]	Reading/s
dcV, 2-wire Resistance	6½ digits (10 plc)	6 (5)
	5½ digits (1 plc)	57 (47)
	4½ digits (0.02 plc)	490
Thermocouple	0.1°C (1 plc)	49 (47)
	(0.02 plc)	280
RTD, Thermistor	0.01°C (10 plc)	6 (5)
	0.1°C (1 plc)	47 (47)
	1°C (0.02 plc)	280
acV	6½ Slow (3 Hz)	0.14
	6½ Med (20 Hz)	1
	6½ Fast (200 Hz)	8
	6½[6]	100
Frequency, Period	6½ digits (1s gate)	1
	5½ digits (100 ms)	9
	4½ digits (10 ms)	70

System Speeds[7]		Channel/s
INTO Memory	Single Channel dcV	490
	34902A scanning dcV	250
	34907A scanning digital in	250
	34902A scanning dcV with scaling and 1 alarm fail	220
	34907A scanning totalize	170
	34902A scanning temperature	160
	34902A scanning acV	100
	34902A scanning dcV/Ohms on alternate channels	90
	34901A/34908A scanning dcV	60
INTO and OUT of Memory to GPIB or RS-232 (init/fetch)	34902A scanning dcV	180
	34902A scanning dcV with timestamp	150
OUT of Memory to GPIB[10]	Readings	800
	Readings with timestamp	450
	Readings with all format options ON	310
OUT of Memory to RS-232	Readings	600
	Readings with timestamp	320
	Readings with all format options ON	230
DIRECT to GPIB or RS-232	Single channel dcV	440
	34902A scanning dcV	200
	Single channel MEAS DCV10/MEAS DCV 1	25
	Single channel MEAS DCV/MEAS OHMS	12

4 Reading speeds for 60 Hz and (50 Hz) operation

5 For fixed function and range, readings to memory, scaling and alarms off, AZERO OFF

6 Maximum limit with default settling delays defeated

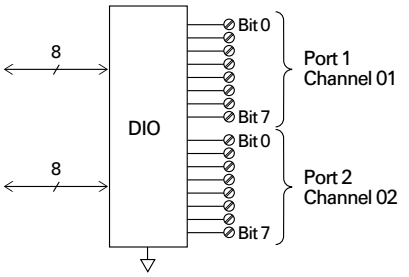
7 Speeds are for 4½ digits, delay Ø, display off, autozero off, using 115 kbaud RS-232 setting

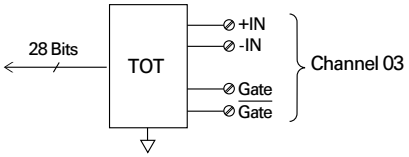
8 Isolation voltage (ch-ch, ch-earth) 300 Vdc, AC rms

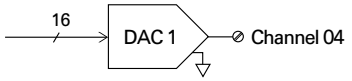
9 6½ digits = 22 bits, 5½ digits = 18 bits, 4½ digits = 15 bits

10 Add 50 uV error for 34923/24/33.

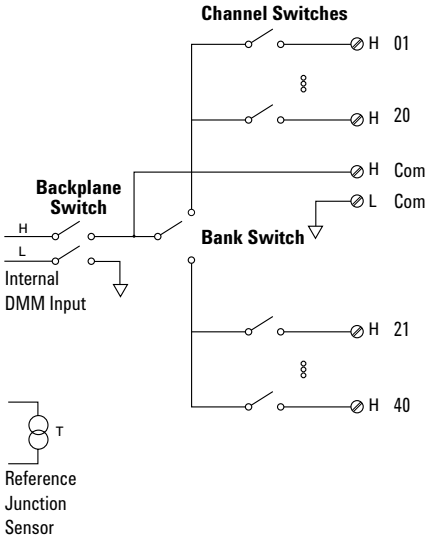
34907A Multifunction module for 34970A







34908A 40-Channel single-ended multiplexer module for 34970A



More detailed specifications at **www.agilent.com/find/34970A**

Low-Cost Data Acquisition/Switch 34970A (Continued)

System Characteristics

Scanning Inputs	Analog	34901A, 34902A, and 34908A multiplexer channels
	Digital	34907A digital in and totalize
	Scan List	Scans channels in ascending order
Triggering	Source	Interval, external, button press, software, or on monitor channel alarm
	Scan count	1 to 50,000 or continuous
	Scan interval	0 to 99 hours; 1 ms step size
	Channel delay	0 to 60 seconds per channel; 1 ms step size
	External trig delay	<300 µs. With monitor on <200 ms
	External trig jitter	<2 ms
Alarms	Analog inputs	Hi, Lo, or HI + Lo evaluated each scan
	Digital inputs	34907A digital in: maskable pattern match or state change 34907A totalize: Hi limit only
	Monitor channel	Alarm evaluated each reading
	Alarm outputs	4 TTL compatible; selectable TTL logic Hi or Lo on fail
	Latency	5 ms (typical)
Memory (Battery backed, 4 year typical life[1])	Readings	50,000 with timestamp; Readable during scan
	States	5 instrument states with user label
	Alarm queue	Up to 20 events with channel number, reading, and timestamp
System Features	Per-channel math	Individual Mx + B scaling and Min/Max/Average calculated real time
	Power fail recovery	Resumes scanning automatically
	Relay maintenance	Counts each relay closure and stores on module. User resettable.
	Real time clock	Battery-backed, 4 year typical life[1]
General Specifications	Power supply	100 V/120 V/220 V/240 V ±10%
	Power line frequency	45 Hz to 66 Hz automatically sensed
	Power consumption	12 W (25 VA peak)
	Operating environment	Full accuracy for 0°C to 55°C Full accuracy to 80% R.H. at 40°C
	Storage environment	-40°C to 70°C[1]
	Weight	Net: 3.6 kg (8.0 lbs)
	Safety	Conforms to CSA, UL-1244, IEC 1010 Cat 1
	RFI and ESD	CISPR 11, IEC 801/2/3/4

Software
Agilent BenchLink Data Logger
(not included with Option 001)

System Requirements[2]	Operating System	Windows 98SE, NT® 4.0 SP6a, 2000 SP4, XP SP2, Adobe® Acrobat® Reader V5.0 or higher (to view documentation) Microsoft® Internet Explorer V6.0 or higher (required when using Windows NT)
	Controller	Recommended Pentium® 4, 800 MHz or greater, Min: Pentium III, 500 MHz
	RAM	Recommended 256 MB or greater, Min 128 MB
	Disk Space	Recommend 200 MB, Min 100 MB
	Display	800 x 600 resolution, 256 colors
Computer Interfaces[3]	GPIB	Agilent and National Instruments PCI-GPIB
	LAN-to-GPIB	E5810A
	USB-to-GPIB	82357A
		RS-232 (Serial Port) PC COM 1-4

1 Storage at temperature above 40°C will decrease battery life

2 Software provided on CD-ROM and includes utility to create floppy disks for installation

3 Interface and driver must be purchased and installed separately

More detailed specifications at **www.agilent.com/find/34970A**

Low-Cost Data Acquisition/Switch 34970A (Continued)

Ordering Information

34970A Data Acquisition/Switch Unit
Includes internal 6½ digit DMM, operating and service manuals, test report, power cord, and Quick Start package (includes Agilent Benchlink Data Logger software, RS-232 cable, thermocouple, and screwdriver). Modules are purchased separately and are required to operate.

- **34970A-001** Delete Internal DMM
  Same as above but deletes DMM and quick start package
  Order 34970-80010 to retrofit DMM at a later time
- **34970A-1CM** Rackmount Kit
- **34970A-0B0** Delete Manual Set

34901A 20-Channel Armature Multiplexer

34902A 16-Channel Reed Multiplexer

34903A 20-Channel Actuator/ General Purpose Switch

34904A 4 x 8 Two-Wire Matrix Switch

34905A Dual 4-Channel RF Multiplexer, 50 Ohms (Includes (10) SMB-to-BNC(f) 50 Ω adapter cables)

34906A Dual 4-Channel RF Multiplexer, 75 Ohms (Includes (10) SMB-to-BNC(f) 75 Ω adapter cables)

34907A Multifunction Module

34908A 40-Channel Single-Ended Multiplexer

Accessories

34161A Accessory Pouch

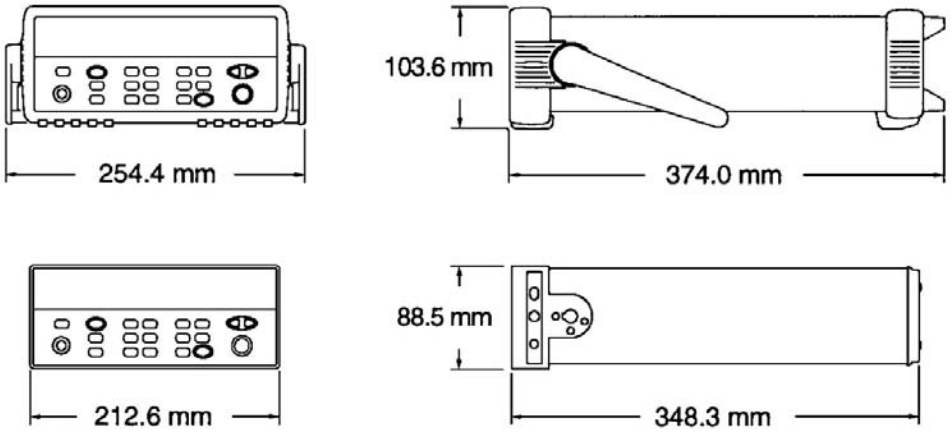
34131A Hard Carrying Case

E5810A LAN/GPIB Gateway

82357A USB to GPIB Converter

34970-80010 DMM Field Installation Kit (Fully calibrated with Test Report and Quick Start Kit)

Agilent Model: Bench Dimensions 34970A



More detailed specifications at **www.agilent.com/find/34970A**

34980A

Multifunction Switch/Measure
Mainframe and Modules 34980A

- 8-slot mainframe with 19 mix-and-match plug-in modules
- Up to 560 2-wire multiplexer channels or 1024 matrix cross-points
- Optional built-in 6½ digit DMM
- LAN, USB 2.0, and GPIB connectivity
- Built in graphical interface
- LXI class C compliant

Agilent Open

High-performance Unit Provides Low-cost Alternative to PXI/VXI Switch & Measurement Platforms

If you use automated test equipment for design validation or manufacturing, you now have a cost-effective alternative to PXI and VXI based test-system platforms. The 34980A multifunction switch/measure unit provides comparable functionality that is much easier to use than PXI and VXI and costs less. The 34980A helps you lower your cost of test and accelerate your test-system integration and development.

The 34980A handles system switching up to 20 GHz and provides basic measurements and system control. It also offers DMM measurements, counter/totalizer functionality, digital I/O with pattern capabilities, and analog outputs with basic waveforms – all in one low-cost, compact box. And with its standard connectors, software drivers, computer-standard I/O, and Web browser interface, the 34980A easily integrates into electronic functional test and data acquisition systems.

Flexible Switching, Measurements, and System Control

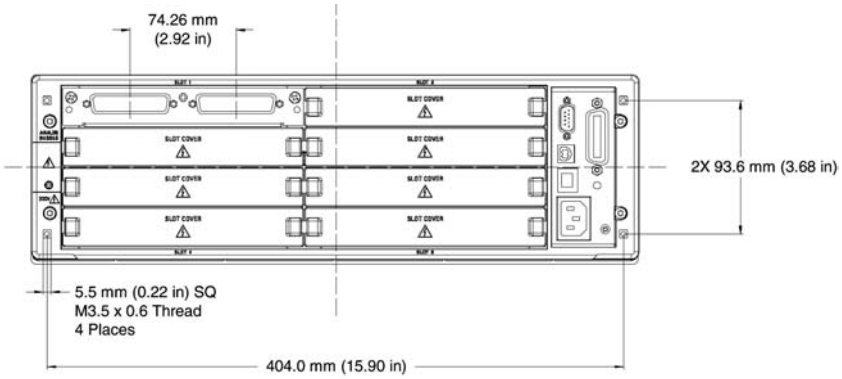
The 34980A accommodates up to 8 plug-in modules to give you the flexibility you need. Choose from 19 different modules to define your own configuration. You can buy what you need now and add to it or reconfigure it as your requirements change.

Whether you are measuring temperature, AC or DC voltage, resistance, frequency, current, or custom measurements, the 34980A offers the functionality you need in a single box. Switch in different measurements with high-performance signal switching – no external signal conditioning is required. Choose between different switch types and topologies with frequency ranges from DC to 20 GHz. The 34980A offers high-density multiplexers for scanning multiple channels, matrices for connecting multiple points at one time, and general purpose switches for simple control and high power needs.

The 34980A also offers flexible choices for system control. You can control external devices such as microwave switches, attenuators, solenoids, and power relays. Or use the digital inputs to sense limit-switch and digital-bus status.

The rugged instrument comes with a variety of system-ready features:

- Web browser interface shows settings at a glance and provides remote access and control
- Self-guiding front panel to configure, troubleshoot or view data
- Low EMI and efficient system cooling
- Heavy-duty cabling and connection options
- Rack mount options
- Relay counters help predict end-of-life



More detailed specifications at **www.agilent.com/find/34980A**

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

- In-rack calibration for reduced maintenance time
- DMM measurement accuracies include the switch for simple calculations

Make system connections easily and quickly with simple, reliable connection options:

- Built-in Ethernet, USB 2.0, and GPIB connectivity
- Low-cost, standard 50- or 78-pin Dsub connectors and cables
- Detachable terminal blocks with strain relief
- Mass interconnect solutions

The 34980A also has easier signal routing using four 2-wire internal analog buses. You can route your measurements directly to the internal DMM, or you can connect to external instruments through the analog bus connector on the rear of the mainframe. And since you have four 2-wire buses, you can dedicate one bus for use with the internal DMM and use the other three buses for module extensions or additional signal routing between modules, reducing your wiring needs.

Measurements You Can Trust
Get proven performance from Agilent instruments, with the resolution, repeatability, speed, and accuracy you've come to expect.

The 34980A offers built-in signal conditioning and modular flexibility. When you use it with the internal DMM, you can configure each channel independently for the measurements you choose. It includes a variety of features that give you confidence in your measurements:

- 6½ digits of resolution with .004% of accuracy with DC voltage measurements
- Alarms per channel – high limit, low limit, or both
- Math functions – use Mx+B for custom linear conversions and converting raw inputs
- Built-in thermocouple reference for temperature measurements (34921T)
- Time-stamped readings

The integrated DMM is mounted inside the mainframe and does not consume any of the eight user-available slots and gives you the flexibility to measure 11 types of inputs:

- Temperature with thermocouples, RTDs, or thermistors (with 34921A)
- DC and AC voltage
- 2- and 4-wire resistance
- Frequency and period
- DC and AC current

Standard Interfaces Take the Hassle Out of Connecting to your PC

Standard Ethernet, USB and GPIB
Standard interfaces are included in every mainframe. Use one of the interfaces that is already available in your computer, or if you prefer, GPIB is still available.

Remote Access and Control
The built-in Web browser interface provides remote access and control of the instrument via a Java-enabled browser such as Internet Explorer. Using the Web interface, you can set up, troubleshoot, and maintain your system remotely.

- View and modify instrument setup
- Open, close, or monitor switches
- Send SCPI commands
- Define and execute switch sequences
- View error queue
- Get status reports on relay counts

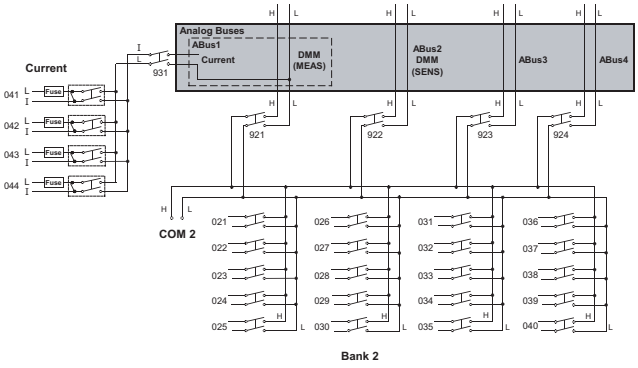
Works With your Choice of Software
You can save time and preserve your software and hardware investments. Program directly with SCPI, or use IVI or LabVIEW software drivers that provide compatibility with the most popular development environments and tools.

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

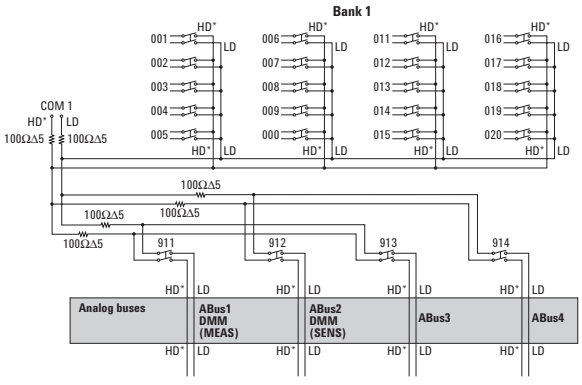
Modules at a Glance
The 34980A mainframe holds up to eight plug-in modules. Mix and match them to create a custom system to meet your switching and system control needs. You can easily add or replace modules as your needs change.

Low Frequency Switch Models	Description	Max Volts	Max Current	BW (MHz)	Scan ch/sec	Thermal offset	Comments
34921A	40-channel armature multiplexer w/low thermal offset	± 300 V	1 A	45 MHz	100	<3 µV	Temperature reference 4 current channels Config as 2- or 4-wire
34922A	70-channel armature multiplexer	± 300 V	1 A	25 MHz	100	<3 µV	Config as 2- or 4-wire
34923A	40/80-channel reed multiplexer	± 150 V	0.5 A	45 MHz	500	<50 µV	Config as 1-, 2- or 4-wire
34924A	70-channel reed multiplexer	± 150 V	0.5 A	25 MHz	500	<50 µV	Config as 2- or 4-wire
34925A	40/80-channel optically isolated FET multiplexer	± 80 V	0.05 A	1 MHz	1000	<3 µV	Config as 1-, 2- or 4-wire
34931A	Dual 4x8 armature matrix	± 300 V	1 A	30 MHz	100	<3 µV	Backplane expandable
34932A	Dual 4x16 armature matrix	± 300 V	1 A	30 MHz	100	<50 µV	Backplane expandable
34933A	Dual/Quad 4x8 reed matrix	± 150 V	0.5 A	30 MHz	500	<3 µV	Backplane expandable Config as 1- or 2-wire
34937A	28-channel Form C and 4-channel Form A	300 V 250 VAC	1 A 5 A	10 MHz	N/A	<3 µV <3 µV	N/A N/A
34938A	20-channel 5-amp Form A	250 VAC	5 A	1 MHz	N/A	<3 µV	N/A

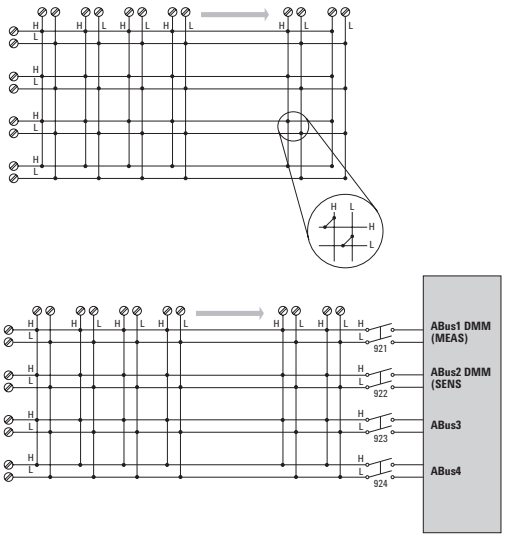
34921A 40-Channel armature multiplexer for 34980A



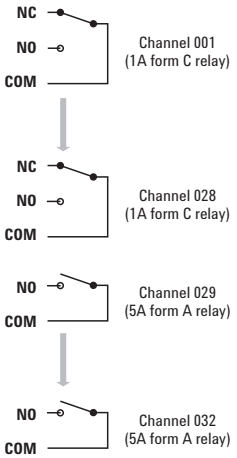
34923A 40/80 channel dual multiplexer for 34980A



34932A Dual 4x16 Armature Matrix for 34980A



34937A 32-Channel Form C/Form A General Purpose Switch for 34980A



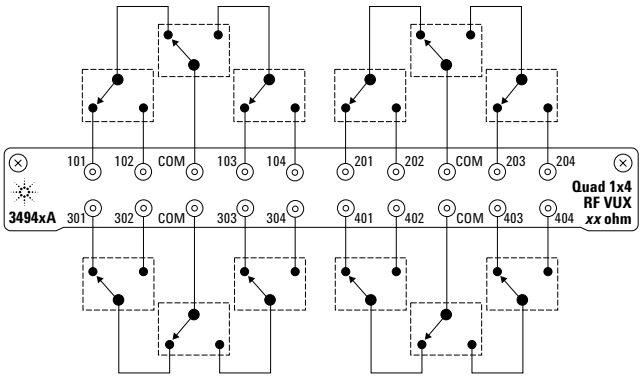
More detailed specifications at **www.agilent.com/find/34980A**

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

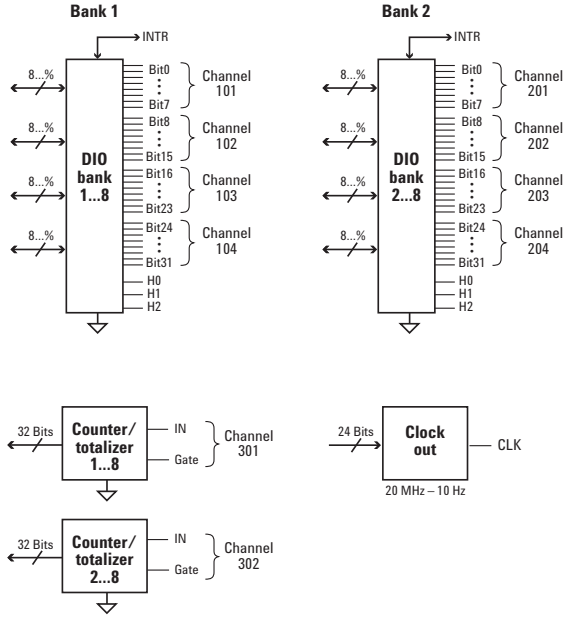
RF and Microwave Models	Description	Insertion Loss	Isolation	Freq Range	VSWR	Input Impedance	Comments
34941A	Quad 1x4 50 ohm 3 GHz RF multiplexer	0.6 dB	>58 dB	3 GHz	<1.25	50 Ω	@ 1 GHz
34942A	Quad 1x4 75 ohm 1.5 GHz RF multiplexer	0.6 dB	>60 dB	1.5 GHz	<1.35	75 Ω	@ 1 GHz
34945A/ 34945EXT	Microwave switch/ attenuator driver	Can drive up to 64 external switch coils; 32 SPDT switches, 8 multiport switches, 8 attenuators, or your own combination. Expand with additional 34945EXTs.					
34946A	Dual 1x2 SPDT terminated microwave switch	<0.42 dB <0.69 dB	>85 dB >67 dB	4 GHz or 20 GHz	<1.15 <1.30	50 Ω	@ 4 GHz @ 20 GHz
34947A	Triple 1x2 SPDT unterminated microwave switch	<0.42 dB <0.69 dB	>85 dB >67 dB	4 GHz 20 GHz	<1.15 <1.30	50 Ω	@ 4 GHz @ 20 GHz

System Control Modules	Description	Specifications
34950A	64-bit digital I/O with memory and counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V, with handshaking protocols and pattern memory. Two 10-MHz frequency counter and programmable clock output to 20 MHz,
34951A	4-channel isolated D/A converter with waveform memory	Output DC voltage up to ±16 V or DC current up to ±20 mA. Output waveforms with a 200 kHz update rate and 16 bits of resolution. Use on-board memory to create point-to-point waveforms with more than 500,000 points.
34952A	Multifunction module with 32-bit DIO, 2-ch D/A and totalizer	Four 8-bit digital I/O channels, two ±12 V analog outputs, and a 100-kHz gated totalizer.
34959A	Breadboard module	Create your own custom designs with access to the +12 V and +5 V supplies, 16 GPIO ports and 28 relay drive lines.

34941A Quad 1x4 50 ohm 3 GHz multiplexer module for 34980A



34950A 64-bit digital I/O with memory and counter for 34980A



More detailed specifications at **www.agilent.com/find/34980A**

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

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

Includes measurement error, switching error and transducer conversion error

Function	Range[2]	Frequency, etc.	1 Year[2] Tcal ± 1°C
DC Voltage (with 34921A/22A/25A/ 31A/32A)[10]	100.0000 mV	–	0.0050 + 0.0040
	1.000000 V	–	0.0040 + 0.0007
	10.00000 V	–	0.0035 + 0.0005
	100.0000 V	–	0.0045 + 0.0006
	300.000 V	–	0.0045 + 0.0030
True RMS AC Voltage[3]	100.0000 mV to 100.0000 V	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.35 + 0.04
		10 Hz – 20 kHz	0.06 + 0.04
		20 kHz – 50 kHz	0.12 + 0.05
		50 kHz – 100 kHz	0.60 + 0.08
		100 kHz – 300 kHz[5]	4.00 + 0.50
	300.0000 V	3 Hz – 5 Hz	1.00 + 0.08
		5 Hz – 10 Hz	0.35 + 0.08
		10 Hz – 20 kHz	0.06 + 0.08
		20 kHz – 50 kHz	0.12 + 0.12
		50 kHz – 100 kHz	0.60 + 0.20
		100 kHz – 300 kHz[6]	4.00 + 1.25
Resistance[7]	100.0000 Ω	1 mA	0.010 + 0.004
	1.000000 kΩ	1 mA	0.010 + 0.001
	10.00000 kΩ	100 µA	0.010 + 0.001
	100.0000 kΩ	10 µA	0.010 + 0.001
	1.000000 MΩ	5.0 µA	0.010 + 0.001
	10.00000 MΩ	500 nA	0.040 + 0.001
	100.0000 MΩ	500 nA 10 MΩ	0.800 + 0.010
Frequency and Period[8]	100 mV to 300 V	3 Hz – 5 Hz	0.10
		5 Hz – 10 Hz	0.05
		10 Hz – 40 Hz	0.03
		40 Hz – 300 kHz	0.01
DC Current (34921A only)	10.00000 mA	<0.1 V burden	0.050 + 0.020
	100.0000 mA	<0.6 V	0.050 + 0.005
	1.000000 A	<2 V	0.100 + 0.010
True RMS AC Current (34921A only)	10.00000 mA and[5] 1.0 A	3 Hz – 5 Hz	1.00 + 0.04
		5 Hz – 10 Hz	0.30 + 0.04
		10 Hz – 5 Hz	0.10 + 0.04
	100.0000 mA[9]	3 Hz – 5 Hz	1.00 + 0.5
		5 Hz – 10 Hz	0.30 + 0.5
		10 Hz – 5 kHz	0.10 + 0.5

1 One hour warm-up and a fixed configuration with slow AC filter, sine wave input, and 6½ digits. Temperature within ± 5°C of temperature at calibration (Tcal between 18-28°C).

2 90 minute warm-up and a fixed configuration and 6½ digits. Temperature within ± 1°C of temperature at calibration (Tcal between 18-28°C).

3 Relative to calibration standards

4 20% over range on all ranges except 300 VDC and AC ranges and 1 ADC and AC current ranges

5 For sine wave input > 5% of range. For inputs from 1% to 5% of range and < 50 kHz add 0.1% of range additional error. For AC filter slow.

6 Typically 30% of reading error at 1 MHz, limited to 1 x 108 volt-hertz

7 For 4-wire ohms or 2-wire ohms using scaling to remove offset. Add 4 ohms additional error to 2-wire ohms function without scaling. 34923/24/25/33 have series resistance that may limit low 2-wire ohm measurements.

8 Input > 100 mV. For 10 mV inputs multiply % of reading error x 10. For 1 sec aperture (6½ digits).

9 Specified only for inputs > 10 mA. For AC filter slow.

10 Add 50 µV error for 34923/24/33

More detailed specifications at **www.agilent.com/find/34980A**

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

Temperature Measurement Accuracy[1]
±(% of reading + % of range)

Temperature 1-Year accuracy	Type	Best Range[1]	
Thermocouple (34921A only, includes cold junction accuracy on terminal block)	B	1100°C to 1820°C	1.2°C
	E	-150°C to 1000°C	1.0°C
	J	-150°C to 1200°C	1.0°C
	K	-100°C to 1200°C	1.0°C
	N	-100°C to 1300°C	1.0°C
	R	300°C to 1760°C	1.2°C
	S	400°C to 1760°C	1.2°C
	T	-100°C to 400°C	1.0°C
RTD	R_0 from 49 Ω to 2.1 kΩ	-200°C to 600°C	0.06°C
Thermistor	2.2 k, 5 k and 10 k	-80°C to 150°C	0.08°C

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

Operating Characteristics
Single Channel Measurement Rates[1,2]

Function	Resolution	Reading/s
DCV	4½ digits (0.02 plc)	3000
	5½ digits (1 plc)	59
	8½ digits (10 plc)	6
2-wire Resistance	4½ digits (0.02 plc)	2000
	5½ digits (1 plc)	58
	8½ digits (10 plc)	6
Thermocouple	(0.02 plc)	2000
	0.1°C (1 plc)	59
RTD, Thermistor	1°C (0.02 plc)	1900
	0.1°C (1 plc)	58
	0.01°C (10 plc)	6
ACV	6½ Fast (200 Hz)	350
	6½ Med (20 Hz)	350
	6½ Slow (3 Hz)	300
Frequency, Period	4½ digits (10 ms)	70
	5½ digits (100 ms)	9
	6½ digits (1 s gate)	1

1 Reading speeds for 60 Hz: autozero OFF

2 For fixed function and range, readings to memory, scaling and alrams off, autozero OFF

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

Measurement Characteristics

DC Voltage	Measurement Method	Continuously integrating multi-slope III A-D Converter
	A-D Linearity	0.0002% of reading + 0.0001% of range on 10 v range
	Input Resistance 100 mV, 1 V, 10 V ranges 100 V, 300 V ranges	 Selectable 10 MΩ or >10.000 MΩ 10 MΩ ± 1%
	Input Bias Current Input Protection	<50 pA at 25°C 300 V all ranges
True RMS AC Voltage	Measurement Method	AC coupled True RMS – measures the AC component of the input with up to 300 Vdc of bias on any range
	Crest Factor	Maximum of 5:1 at full scale
	Additional Crest Factor Errors (non-sinewave)	 Crest Factor 1–2 0.05% of reading Crest Factor 2–3 0.15% of reading Crest Factor 3–4 0.30% of reading Crest Factor 4–5 0.40% of reading
	Input Impedance Input Protection	1 MΩ ± 2% in parallel with 150 pF 300 Vrms all ranges
Resistance	Measurement Method Current source	Selectable 4-wire or 2-wire Ohms referenced to LO input
	Offset Compensation Maximum Lead Resistance	Selectable on 100 Ω, 1 kΩ, 10 kΩ ranges 10% of range per lead for 100 Ω and 1 kΩ ranges 1 kΩ on all other ranges
	Input Protection	300 V on all ranges

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

Measurement Characteristics (Continued)

Frequency and Period	Measurement Method	Reciprocal counting technique
	Voltage Ranges	Same as AC voltage function
	Gate Time	1 s, 100 ms, or 10 ms
	Measurement Timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit
DC Current	Shunt Resistance	5 Ω for 10 mA, 100 mA; 0.1 Ω for 1 A
	Input Protection	1 A 250 V fuse on 34921A module
True RMS AC Current	Measurement Method	Direct coupled to the fuse and shunt, AC coupled True RMS measurement (measures the AC component ony)
	Shunt Resistance	5 Ω for 10 mA; 0.1 Ω for 100 mA, 1 A
	Input Protection	1 A 250 V fuse on 34921A module
Thermocouple	Conversion	ITS-90 software compensation
	Reference Junction Type	Internal, Fixed, or External
	Open Thermocouple Check	Selectable per channel, Open >5 kΩ
Thermistor		44004, 44007, 44006 series
RTD		α = 0.00385 (DIN) and α = 0.00392
Measurement Noise Rejection 60 (50) Hz[1]	DC CMRR	140 dB
	AC CMRR	70 dB
	Integration Time	**Normal Mode Rejection**[2]
	200 plc/3.33 s (4 s)	105 dB[3]
	100 plc/1.67 s (2 s)	100 dB[3]
	20 plc/333 ms (400 ms)	95 dB[3]
	10 plc/167 ms (200 ms)	90 dB
	2 plc/33.3 ms (40 ms)	85 dB
	1 plc/16.7 ms (20 ms)	60 dB
	<1 plc	0 dB

1 For 1 KΩ unbalance in LO lead
2 For power line frequency ±0.08%
3 For power line frequency ±1% use 75 dB or ±2.5% use 60 dB

System Characteristics

Scanning Inputs	Analog	34921A -34922A, 34923A, 34924A, and 34925A multiplexer channels
	Digital	34950A/52A digital in and totalize
Scan Triggering	Source	Interval, external, button press, software, or on monitor channel alarm
	Scan count	1 to 50,000 or continuous
	Scan interval	0 to 99 hours; 1 ms step size
	Channel delay	0 to 60 seconds per channel; 1 ms step size
	External trig delay	<2 ms, With monitor on <200 ms
	External trig jitter	<2 ms

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

System Characteristics

Alarms	Analog inputs	Hi, Lo, or HI + Lo evaluated each scan	
	Digital inputs	34950A/52A digital in maskable pattern match or state change 34950A/52A frequency and totalize, Hi limit only	
	Monitor channel	Alarm evaluated each reading	
	Alarm outputs	4 TTL compatible; selectable TTL logic Hi or Lo on fail	
	Latency	5 ms (typical)	
Memory	Type	Volatile	
	Readings	500,000 with timestamp; Readable during scan	
	States	5 instrument states with user label	
	Alarm queue	Up to 20 events with channel number, reading, and timestamp	
System Features	Per-channel math	Individual Mx + B scaling and calculated real time	
	Min/Max/Average		
	Power fail recovery	Save switch states	
	Relay maintenance	Counts each relay closure and stores on module. User resettable.	
	Real time clock	Battery-backed, 20 year typical life	
General Specifications	Power supply	Universal 100 V to 240 V ±10%	
	Power line frequency	50-60 Hz ±10% automatically sensed	
	Power consumption	150 VA	
	Operating environment	Full accuracy 0°C to 55°C Full accuracy to 80% R.H. at 40°C IEC 60664-1 pollution degree 1	
	Storage environment	-40°C to 70°C[1]	
	Mainframe dimensions	133 x 426 x 341 mm (5.25" x 18.8" x 14") Full rack, 3 units high	
	Mainframe Weight	8.6 kg (19.6 lbs)	
	Module dimensions	280H x 170 W x 27D mm (11" x 6.7" x 1")	
	Safety	Conforms to CSA, UL/IEC/EN 61010-1	
	EMC	Conforms to IEC/EN 61326-1, CISPR 11	
	Warranty	1year	
Software	Agilent connectivity software included		Agilent IO Libraries Suite 14.2 (E2094N)
	Minimum system requirements (IO) libraries and drivers	PC hardware	Intel Pentium100 MHz, 84 MByte RAM 210 MByte disk space Display 800 x 600, 256 colors, CD-ROM Drive
		Operating System	Windows® 98 SE/NT/2000/XP
	Computer Interfaces		Standard LAN 10 BaseT/100 BaseTx Standard USB 2.0 IEEE400 2 GPIB
	Software driver support for programming languages	Software drivers	IVI-C and IVI-COM for Windows NT/2000/XP LabVIEW
	Compatible with programming tools and environments		Agilent VEE Pro, Agilent T&M Tool kit (requires Visual Studio.NET) National Instuments Test Stand, Measurement Studio, LabWindows/CVI LabVIEW, Switch Executive Microwoft Visual Studio.NET, C/C++ Visual Basic 6

1 Storage at temperature above 40°C will decrease battery life
2 Load IO libraries version M for Windows NT Support

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

Ordering Information

34980A Multifunction switch/measure mainframe comes with "DMM" option standard. The mainframe holds up to 8 plug-in modules.

Modules		Description	Module Connectors	Optional Terminal Blocks, Cables, Connector Kits
Multiplexer Modules	**34921A**	40-channel armature multiplexer w/low thermal offset (order 34921T for temp reference)	2-50 pin Dsub, Male	3492xT Terminal block with screw connectors
	34923A	40/80-channel reed multiplexer		Y1135A – 1.5 m 50 pin M/F Dsub cable
	34925A	40/80-channel optically isolated FET multiplexer		Y1136A – 3 m 50 pin M/F Dsub cable Y1139A – 50 pin female solder cup connector kit
	34922A	70-channel armature multiplexer	2-78 pin Dsub, Male	3492xT Terminal block with solder connectors Y1137A – 1.5 m 78 pin M/F Dsub cable
	34924A	70-channel reed multiplexer		Y1138A – 3 m 78 pin M/F Dsub cable Y1140A – 78 pin female solder cup connector kit
Matrix Modules	**34931A**	Dual 4X8 armature matrix	2-50 pin Dsub, Male	3493xT Terminal block with screw connectors
	34932A	Dual 4x16 armature matrix		Y1135A – 1.5 m 50 pin M/F Dsub cable
	34933A	Dual/quad 4x8 reed matrix		Y1136A – 3 m 50 pin M/F Dsub cable Y1139A – 50 pin female solder cup connector kit
General Purpose/ Actuator Modules	**34937A**	32-channel Form C/Form A General purpose switch	2-50 pin Dsub, Male	3493xT Terminal block with screw connectors Y1135A – 1.5 m 50 pin M/F Dsub cable
	34938A	20-channel 5-amp Form A switch		Y1136A – 3 m 50 pin M/F Dsub cable Y1139A – 50 pin female solder cup connector kit
RF & Microwave Modules	**34941A**	Quad 1x4 50-ohm 3 GHz RF multiplexer	10-SMA	Requires standard 50 ohm SMA RF cables, adapaters
	34942A	Quad 1x4 75-ohm 1.5 GHz RF multiplexer	10-Mini SMB	Requires mini 75 ohm SMB RF cables, adapters
	34945A	Microwave switch/ attenuator driver	N/A	Requires 34945EXT and optional Y1150A-Y1155A distribution boards
	34946A	Dual 1x2 SPDT terminated microwave switch Option 004: 4 GHz switches installed Option 020: 20 GHz switches installed	SMA	Requires standard 50 ohm SMA cables and adapters
	34947A	Triple 1x2 SPDT unterminated microwave switch Option 004: 4 GHz switches installed Option 020: 20 GHz switches installed	SMA	Requires standard 50 ohm SMA cables and adapters
System Measurement & Control Modules	**34950A**	64-bit digital I/O with memory and counter	2-78 pin Dsub, Female	3495xT Terminal block with screw connectors Y1137A – 1.5 m 78 pin M/F Dsub cable Y1138A – 3 m 78 pin M/F Dsub cable Y1142A – 78 pin male solder cup connector kit
	34951A	4-channel isolated D/A converter with waveform memory (DMM option required for calibration)	1-50 pin Dsub, Female	3495xT Terminal block with screw connectors Y1135A – 1.5 m 50 pin M/F Dsub cable Y1136A – 3 m 50 pin M/F Dsub cable Y1141A – 50 pin female solder cup connector kit
	34952A	Multifunction module with 32-bit DIO, 2-ch D/A and totalizer		
	34959A	Breadboard module	26 & 40 pin internal ribbon cable connections	Any terminal block can be used assuming 50 or 78 pin Dsub is used

More detailed specifications at **www.agilent.com/find/34980A**

Multifunction Switch/Measure
Mainframe and Modules 34980A (Continued)

Ordering Information

Accessories

Y1130A Rackmount kit for 34980A, forward or reverse mount (reverse mount requires E3664A rail kit) Order E3663AC rail kit for forward rack mount

Y1131A Verification and diagnostic tools for 34980A mainframe and modules

Y1132A Module extender for 34980A

Cables[1]
(used for direct cable connection to module. Some modules require 2 cables)

Y1135A 1.5 m 50 pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1136A 3 m 50 pin Dsub, M/F twisted pair with outer shield cable – 300 V

Y1137A 1.5 m 78 pin Dsub , M/F twisted pair with outer shield cable – 300 V

Y1138A 3 m 78 pin Dsub, M/F twisted pair with outer shield cable – 300 V

Connector Kits[1]
(used to build custom cables)

Y1139A Solder cup connector kit for 34921/23/25/31/32/33/37/38 – 50 pin Dsub female – 125 V

Y1140A Solder cup connector kit for 34922/34924 – 78 pin Dsub female – 60 V

Y1141A Solder cup connector kit for 34951, 34952 – 50 pin Dsub male – 125 V

Y1142A Solder cup connector kit for the 34950A – 78 pin Dsub male – 60 V

[1] Module specifications include terminal block. Performance may be degraded when using cables or connector kits.

34945A Accessories
(distribution boards required for control of external switch)

34945EXT External driver for 34945A, one required for each 64 coils – holds 4 distribution boards

Y1150A 34945A distribution boards for 8 N181x SPDT switches

Y1151A 34945A distribution board for two 87104x/106x multiport or 87406B matrix switches

Y1152A 34945A distribution board for one 87204x/206x or 87606B switch and 2 N181x switches

Y1153A 34945A distribution board for two 84904/5/6/7/8 or 8494/5/6 step attenuators

Y1154A 34945A distribution board for two 87222 transfer switches and 6 N181x SPDT switches

Y1155A 34945A distribution board w/generic screw terminals for driving 16 switch coils

Y1157A 9-to-10 pin cable kit for Y1150A, Y1152A, Y1154A - supplies to build 4 cables

Y1158A 10-to-10/10-to-14 pin cable kit for Y1153A, Y1154A - supplies to build 2 cables

Y1159A 16-to-16 pin cable kit for Y1150A/51A/52A/53A/54A/55A supplies to build 2 cables

Thermocouples/Thermistors

34307A 10 pack of J type thermocouples

34308A 5 pack of 10 k thermistors

What Ships with a 34980A

5061-0701	LAN Cross Over Cable
E2094-60003	I/O Library Suite CD
34980-906xx	Firmware Update Flyer
8710-0059	Screwdriver
34980-13601	Product CD Manual Set

Digital Multimeters, Voltmeters

Product Comparison	34405A	34401A	34410A/ 34411A	34420A	3458A	34970A w/ 34901A
Type	DMM 5 -Digit	DMM $6\frac{1}{2}$ -Digit	DMM $6\frac{1}{2}$ -Digit	Nanovolt / micro-ohm meter $7\frac{1}{2}$ -Digit	DMM $8\frac{1}{2}$ -Digit	Data Logger/ Scanning DMM $6\frac{1}{2}$ -Digit
Basic Measurements	DC & AC voltage, DC & AC current, 2-wire resistance, frequency	DC & AC voltage, DC & AC current, 2-& 4-wire resistance, frequency & period	DC & AC voltage, DC & AC current, 2-& 4-wire resistance, frequency & period	DC voltage, 2-& 4-wire resistance, low power resistance, ratio	DC & AC voltage, DC & AC current, 2-& 4-wire resistance, frequency & period	DC & AC voltage, DC & AC current, 2-& 4-wire resistance, frequency & period
Additional Measurements	continuity, diode test, capacitance	continuity, diode test	continuity, diode test, capacitance, data logger, and waveform capture	2 channels - ratio and difference	3 modes of true RMS, Digitizing	Scanning 20 to 60 2-wire channels
Temperature	Thermistor	N/A	Thermistor, RTD	Direct SPRT, RTD, Thermistor, Thermocouple	Thermistor, RTD	Thermocouple, RTD, Thermistor
dcV Accuracy[1] ±(% of reading + % of range)	0.025 + 0.005	0.0035 + 0.0005	0.0030 + 0.0005	0.003 + 0.0004	0.0008 + 0.000005 (.0004 + .000005)[2]	0.0035 + 0.0005
Math Functions	Null, min/max, dBm, dB, limit test, hold	Null, statistics, dBm, dB, limit test	Null, statistics, dBm, dB, limit test	Null, statistics, dBm, dB, limit, scale, offset, filter, moving avg. filter	Null, statistics, dBm, dB, limit test, scale, offset, filter, % error	Null, statistics, limit test, scale, offset
Connectivity	USB 2.0	GPIB, RS232, Optional USB w/82357A Includes IntuiLink SW	GPIB, USB 2.0 and LAN LXI class C standard Includes IntuiLink SW and LXI Web browser	GPIB, RS232, Optional USB w/82357A Includes IntuiLink SW	GPIB, Optional USB w/ 82357A Includes BenchLink Data Logger SW	GPIB, RS232, Optional USB w/82357A

1 dcV accuracy; 1yr, 10 V range

2 dcV accuracy with optional high stability reference (option 3458-002)

More detailed specifications at **www.agilent.com/find/DMM**

5½-Digit Low-Cost Multimeter
34405A

NEW 34405A

Agilent Open

Agilent 34405A 5½-Digit Low-Cost DMM

- 120,000 counts resolution
- 16 built-in measurement functions including temperature and capacitance
- 0.025% 1-year DC voltage accuracy
- USB 2.0
- SCPI compatible
- Agilent IO Libraries Suite and DMM IntuiLink connectivity software included

Affordable and Feature-Rich Measurement Tool

The 34405A is the latest addition to Agilent's DMM family, and it offers you another choice for making electronics measurements. The 34405A provides a broad range of measurement functions and features such as DC voltage, DC current, true-RMS AC voltage and AC current, 2-wire resistance, frequency, diode test and continuity measurement functions, all designed to meet your general industrial needs. Further evidence of its true value is its ability to measure capacitance from 1,000 pF to 10,000 µF.

With its six built-in math operations – Null, dBm, dB, MinMax, Limit and Hold – the Agilent 34405A improves your efficiency and accuracy.

Quick Connect to PC with USB 2.0 Interface

If you need to control your DMM and take preset measurements through a PC, use the built-in USB 2.0 interface, which provides an easy and robust connection between the PC and the DMM. Compliant with the TMC-488.2 standard, the USB interface works seamlessly with Agilent connectivity software, and it can be controlled remotely with industry-standard SCPI commands or through DMM IntuiLink connectivity software. IVI-COM and LabVIEW drivers are included to ensure easy integration with different programming environments.

Bright Display, High Reading Speed and Configuration Storage

When higher productivity and throughput are a priority, the Agilent 34405A VFD dual display allows you to take multiple measurements and display them simultaneously on the front panel. For speed-critical applications, the Agilent 34405A can take up to 19 readings/s at 4.5 digits direct to a PC. You also can configure and store complete instrument setups and recall them anytime from any one of four built-in storing states.

Rugged and Reliable

The 34405A was designed and tested according to major safety and regulatory standards. Its shock-absorbing bumpers prevent physical damage from your day-to-day use.

More detailed specifications at **www.agilent.com/find/34405A**

5½-Digit Multimeter 34405A (Continued)

Operating Characteristics

Function	Digits	Reading Speed[1]	System Speed			
			Function Change (S)[2]	Range Change (S)[3]	Auto Range (S)[4]	Reading Speed Over USB (S)[5]
DCV, DCI	5 1/2 4 1/2	15/s 70/s	0.6	0.7	2.2	8/s 19/s
ACV, ACI	5 1/2 4 1/2	2.5/s	5.0	2.2	6.1	1/s
Frequency	5 1/2 4 1/2	2/s	7.0	2.5	6.1	1/s

1 Reading rate of the A/D converter

2 Time to change from 2-wire resistance to this specified function and to take at least one reading in 4.5-digit mode using the SCPI "FUNC" and "READ?" commands

3 Time to change one range to the next higher range and to take at least one reading in 4.5-digit mode using the SCPI "FUNC" and "READ?" commands

4 Time to automatically change one range and to take at least one reading in 4.5-digit mode using SCPI "CONF AUTO" and "READ?" commands

5 Number of measurements per second that can be read through USB using SCPI "READ?" command

Measurement Characteristics

DC Voltage

Measurement Method:
Sigma delta A-to-D converter

Input Resistance:
10 MΩ ± 2% range (typical)

Input Protection:
1000 V on all ranges

Resistance

Measurement Method:
2-wire ohms

Open-Circuit Voltage:
Limited to < 5 V

Input Protection:
1000 V on all ranges

DC Current

Shunt Resistance:
0.1 Ω to 10 Ω for 10 mA to 1.2 A ranges
0.01 Ω for 12 A range

Input Protection:
Front panel fuse for I terminal;
Internal 15 A, fuse for 12 A terminal

Continuity/Diode Test

Measurement Method:
Uses ± 0.2% constant current source, < 5 V open circuit voltage

Response Time:
70 samples/s with audible tone

Continuity Threshold: 10 Ω fixed

Input Protection: 1000 V

DC Characteristics[1]

Function	Range[2]	Test Current or Burden Voltage	Input Impedence[3]	Accuracy ± (% of Reading + % of Range)	
				1 Year 23°C ± 5°C	Temp. Coefficient 0°C - 18°C 28°C - 55°C
Voltage	100.000 mV	—	10.0 MΩ ± 2%	0.025+0.008	0.0015+0.0005
	1.00000 V	—	10.0 MΩ ± 2%	0.025+0.006	0.0010+0.0005
	10.0000 V	—	10.1 MΩ ± 2%	0.025+0.005	0.0020+0.0005
	100.00 V	—	10.1 MΩ ± 2%	0.025+0.005	0.0020+0.0005
	1000.0 V	—	10.0 MΩ ± 2%	0.025+0.005	0.0015+0.0005
Resistance	100.000 Ω	1.0 mA	—	0.05+0.008[4]	0.0060+0.0008
	1.00000 kΩ	0.83 mA	—	0.05+0.005[4]	0.0060+0.0005
	10.0000 kΩ	100 µA	—	0.05+0.006[4]	0.0060+0.0005
	100.000 kΩ	10.0 µA	—	0.05+0.007	0.0060+0.0005
	1.00000 MΩ	900 nA	—	0.06+0.007	0.0060+0.0005
	10.0000 MΩ	205 nA	—	0.25+0.005	0.0250+0.0005
	100.000 MΩ	205 nA || 10 MΩ	—	2.00+0.005	0.3000+0.0005
Current	10.0000 mA	< 0.2 V	—	0.05+0.015	0.0055+0.0005
	100.000 mA	< 0.2 V	—	0.05+0.005	0.0055+0.0005
	1.00000 A	< 0.5 V	—	0.20+0.007	0.0100+0.0005
	10.0000 A	< 0.6 V	—	0.25+0.007	0.0150+0.0005
Continuity	1000 Ω	0.83 mA	—	0.05+0.005	0.0050+0.0005
Diode Test[5]	1.0000 V	0.83 mA	—	0.05+0.005	0.0050+0.0005

1 Specifications are for 30 minutes warm-up, 5 1/2 digit resolution and calibration temperature 18°C to 28°C.

2 20% over range on all ranges except 1000 VDC

3 Input impedence is in parallel with capacitance < 120 pF

4 Specifications are for 2-wire ohms using Math Null. Without Math Null, add 0.2 Ω additional error.

5 Specifications are for the voltage measured at the input terminals only.

More detailed specifications at **www.agilent.com/find/34405A**

5½-Digit Multimeter 34405A (Continued)

Temperature

Measurement Method:
2-wire ohms measurement of 5 kΩ thermistor sensor (YSI 4407) with computer conversion auto-ranging measurement, no manual range selection

Input Protection: 1000 V

Measurement Noise Rejection

CMRR (Common Mode Rejection):
For 1 kΩ unbalance LO lead
DC 120 dB
AC 70 dB

NMR (Nomal Mode Rejection):
For 60 Hz (50 Hz) ± 0.1%
5 1/2 digits 65 dB (55 dB);
4 1/2 digits 0 dB

AC Voltage

Measurement Method:
AC coupled true-rms – measure the AC component with up to 400 VDC bias any range

Crest Factor:
Maximum 5:1 at full scale

Input Impedance:
1 MΩ ± 2% in parallel with < 100 pF of all ranges

Input Protection:
750 Vrms on all ranges

AC Characteristics[1]

Function	Range[2]	Frequency	Accuracy ± (% of Reading + % of Range) 1 Year 23°C ± 5°C	Accuracy ± (% of Reading + % of Range) Temp. Coefficient 0°C - 18°C 28°C - 55°C
True RMS AC Voltage[3]	100.000 mV	20 Hz - 45 Hz	1.0+0.1	0.02+0.02
		45 Hz - 10 kHz	0.2+0.1	0.02+0.02
		10 kHz - 30 kHz	1.5+0.3	0.05+0.02
		30 kHz - 100 kHz[4]	5.0+0.3	0.10+0.02
	1.00000 V to 750.00 V	20 Hz - 45 Hz	1.0+0.1[5]	0.02+0.02
		45 Hz - 10 kHz	0.2+0.1	0.02+0.02
		10 kHz - 30 kHz	1.0+0.1	0.05+0.02
		30 kHz - 100 kHz[4]	3.0+0.2[6]	0.10+0.02
True-RMS[7]	10.0000 mA	20 Hz - 45 Hz	1.5+0.1	0.02+0.02
	100.000 mA	45 Hz - 1 kHz	0.5+0.1	0.02+0.02
	10.0000 A	1 kHz - 10 kHz[8]	2.0+0.2	0.02+0.02
Frequency[9]	100 mV to 750 V	< 2 Hz	0.18+0.003	0.005
		< 20 Hz	0.04+0.003	0.005
		20 Hz ~ 100 kHz[10]	0.02+0.003	0.005
		100 kHz ~ 300 kHz[11]	0.02+0.003	0.005
	10 mA to 10 A	< 2 Hz	0.18+0.003	0.005
		< 20 Hz	0.04+0.003	0.005
		20 Hz ~ 10 kHz[11]	0.02+0.003	0.005

Temperature and Capacitance Characteristics[1]

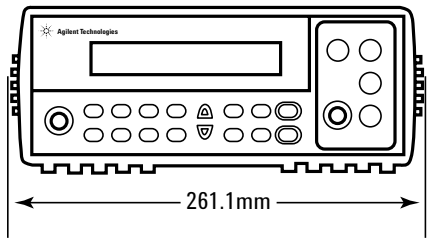
Function	Range	Test Current, Etc.	Accuracy ± (% of Reading + % of Range) 1 Year 23°C ± 5°C	Accuracy ± (% of Reading + % of Range) Temp. Coefficient 0°C - 18°C 28°C - 55°C
Temperature	-80.0° C - 150°C	5 kΩ thermistor probe	Probe accuracy + 0.2 °C	0.002 °C
	-110.0° F - 300.0°F	5 kΩ thermistor probe	Probe accuracy + 0.4 °F	0.0036°F
Capacitance	1.000 nF	0.75 µA	2.0+0.8	0.02+0.001
	10.00 nF	0.75 µA	1.0+0.5	0.02+0.001
	100.0 nF	8.3 µA	1.0+0.5	0.02+0.001
	1.000 µF - 100.0 µF	83 µA	1.0+0.5	0.02+0.001
	1000 µF	0.83 mA	1.0+0.5	0.02+0.001
	10,000 µF	0.83 mA	2.0+0.5	0.02+0.001

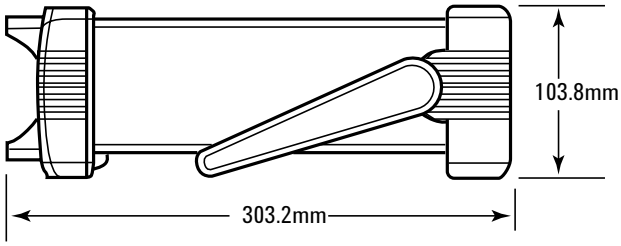
1 Specifications are for 30 minutes warm-up, 5 1/2 digit resolution and calibration temperature 18 °C - 28 °C.
2 20% over range on all range except 750 Vac
3 Specifications are for sinewave inputs > 5% of range. Maximum crest factor: 3 at full scale.
4 Additional error to be added as frequency > 30 kHz and signal input < 10% of range
30 kHz ~ 100 kHz: 0.003% of full scale per kHz
5 For input < 200 Vrms
6 For input < 300 Vrms
7 For 12 A terminal, 10 A DC or AC rms continuous, > 10 A DC or AC rms for 30 seconds on and 30 seconds off
8 For 1 A and 10 A ranges, the frequency is verified for less than 5 kHz.
9 Specifications are for half-hour warm-up, using 0.1 second aperture. The frequency can be measured up to 1 MHz as 0.5 V signal to 100 mV/1 V ranges.
10 For 20 Hz ~ 10 kHz, the sensitivity is AC input current from 10% to 120% of range except where noted.
11 For 100 kHz ~ 300 kHz, the sensitivity will be 12% ~ 120% of range except 750 V range.

More detailed specifications at **www.agilent.com/find/34405A**

5½-Digit Multimeter 34405A (Continued)

Agilent Model: Systems Dimensions 34405A





AC Current

Measurement Method:
DC coupled to the fuse and current shunt, AC coupled true rms measurement (measure the AC component only)

Shunt Resistance:
0.1 Ω to 10 Ω for 10 mA to 1.2 A range
0.01 Ω for 12 A range

Input Protection:
Externally accessible
1.5-A, 250-V fuse for 1 terminal
Internal replaceable
15-A, 500-V fuse for 12 A terminal

Frequency

Measurement Method:
Reciprocal counting technique
AC-coupled input using AC voltage function

Signal Level:
10% of range to full scale
input on all ranges
Auto or manual range selection

Gate Time:
0.1 second or 1 period of the input signal, whichever is longer

Input Protection:
750 Vrms on all ranges

Math Functions

Null, dBm, dB, Min/Max/Avg, Hold, Limit Test

Triggering and Memory

Single trigger, 1 reading memory

Remote Interface

USB 2.0 full speed, USBTMC class device (GPIB over USB)

Programming Language

SCPI, IEEE-488.1, IEEE-488.2

General Specifications

Power Supply:
100 V/120 V(127 V) /
220 V (230 V) / 240 V ± 10%
AC line frequency 45 Hz - 66 Hz and (360 Hz - 440 Hz, 100/120 V operation)

Power Consumption
16 VA maximum, <11 W average

Operating Enviroment
Full accuracy at 0°C to 55°C
Full accuracy to 80% RH at 30°C (non-condensing)
Altitude up to 3000 meters

Storage Compliance Temperature
-40°C to 70°C

Safety Compliance
Certified by CSA for IEC/EN/CSA/UL 61010-1 2nd Edition

Measurement Category:
CAT II, 300 V: CAT I 1000 VDC, 750 Vrms, 2500 Vpk transient over voltages
Pollution degree 2

EMC Compliance
Certified to IEC/EN 61326: 2002, CISPR 11, for Group 1, Class A

Shock and Vibration
Tested to IEC/EN 60086-2

Dimension (H x W x D):
Rack: 88.5 mm x 212.6 mm x 272.3 mm
Bench: 103.8 mm x 261.1 mm x 303.2 mm

Weight: 3.75 kg, 8.27 lb

Warm up Time: 30 minutes

Warranty: 1 year

More detailed specifications at **www.agilent.com/find/34405A**

34401A

Low-Cost 6½-Digit Multimeter
34401A

- 12 measurement functions
- 1000 V maximum input
- 35 ppm basic dcV accuracy (1-year)
- 1000 readings per second direct to GPIB
- GPIB and RS-232 standard
- 512-reading memory
- 3 Hz to 300 kHz AC bandwidth
- IntuiLink Connectivity Software included

34401A Digital Multimeter
The 34401A digital multimeter establishes a new price/performance standard by offering such features as 6½ digits of reolution, 1000 readings per second, and 15 ppm basic DC accuracy at a surprisingly affordable price. The 34401A has been designed for superior performance while providing the flexibility to meet both your present and future needs.

Great Bench Performance
The clear, logical front panel of the 34401A allows you to easily select all primary measurement functions. Traditional "bench" functions, such as continuity and diode test, are included. Math functions, such as NULL, dB, dBm, limit test, and min/max/avg are easily selected. A simple menu scheme gives you access to powerful advanced features, such as the ability to store up to 512 readings in internal memory. Measurement results are displayed on a bright, high-visibility readout. A rugged case ensures survival even under the toughest conditions, and the optional accessory pouch makes it easy to pack up and go with the 34401A.

Superior Performance in Your System
The 34401A can take up to 1000 readings per second, including GPIB bus transfer in ASCII format. Both GPIB and RS-232 are standard, letting you select the interface that best meets your needs. 34401A responds to three different command languages. It accepts SCPI commands (Standard Commands for Programmable Instruments), which ensures present and future compatibility. Drivers are also available for both National Instruments Labview and Agilent's VEE software.

IntuiLink Software, included with your 34401A, allows you to transfer your measurement data and images into Microsoft Excel or Microsoft Word with little or no programming. You can specify the meter setup and take a single reading or log data to the Excel spreadsheet in specific time intervals. Programmers can use the ActiveX components to control the DMM using SCPI commands. To find out more about IntuiLink, visit **www.agilent.com/find/intuilink**

Application Information

Optimizing System Design for Rapid Development, Fast Execution and Re-use
Application Note 1481
5989-0154EN

Techniques to Minimize Overall Test Time When Using a DMM and Switch System
Application Note 1479
5989-0150EN

Making High Accuracy Temperature Measurements with the 3499A/B/C Switch and the 34401A Digital Multimeter
Application Note 1460
5988-9550EN

Digital Multimeter Measurement Errors Series System Cabling Errors and DC Voltage Measurement Errors in Digital Multimeters
Application Note AN 1389-1
5988-5511EN

Digital Multimeter Measurement Errors Series Resistance; DC Current; AC Current; and Frequency and Period Measurement Errors in Digital Multimeters
Application Note AN 1389-2
5988-5512EN

More detailed specifications at **www.agilent.com/find/34401A**

Low-Cost 6½-Digit Multimeter 34401A (Continued)

Low Cost 6 ½ Digital Multimeter
– Abbreviated Technical Specifications

General Specifications:

Power: 100/120/220/240V, ±10%

Power Line Frequency: 45 to 66 Hz, 360 to 440 Hz

Power Consumption: 25 VA peak (10 W average)

Operating Environment: 0 to 55°C, full accuracy to 80% RH, 40°C

Storage Environment: -40°C to 70°C

Size: 88.5 mm H x 212.6 mm W x 348.3 mm D (4 in x 8.5 in x 14 in)

Weight: Net 3.6 kg (8.0 lb); shipping 5.9 kg (13 lb)

Safety: Designed to UL-1244, IEC-348, CSA

Order Information:

34401A Multimeter
- **34401A-1CM** Rackmount Kit
- **34401A-A6J** ANSI Z540 Compliant Calibration

34161A Accessory Pouch

34171A Input Terminal Connector (sold in pairs)

34172A Input Calibration Short (sold in pairs)

34131A Hard Transit Case

DC Voltage Input Characteristics

Range	Maximum Reading (6 ½ digits)	Resolution in Digits			Input Resistance
		6 ½	5 ½	4 ½	
100 mV	120.0000	100 µV	1 µV	10 µV	10 MΩ or >10 GΩ
1 V	1.200006	1 µV	10 µV	100 µV	10 MΩ or >10 GΩ
10 V	12.00000	10 µV	100 µV	1 mV	10 MΩ or >10 GΩ
100 V	120.0000	100 µV	1 mV	10 mV	10 MΩ
1000 V	1050.000	1 mV	10 mV	100 mV	10 MΩ

Input Protection: >1000 V on all ranges

Measurement Accuracy: ±(% of reading + % of range)

Range	24 Hour 23°C ± 1°C	90 Day 23°C ± 1°C	1 Year 23°C ± 1°C
100 mV	0.0030 + 0.0030	0.0040 + 0.0035	0.0050 + 0.0035
1 V	0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007
10 V	0.0015 + 0.0004	0.0020 + 0.0005	0.0035 + 0.0005
100 V	0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006
1000 V	0.0020 + 0.0006	0.0035 + 0.0010	0.0045 + 0.0010

Maximum Reading Rate: (readings/s)

Power Line Frequency	Resolution in Digits		
	6 ½	5 ½	4 ½
60 Hz	6	300	1000
50 Hz	6	300	1000

AC Voltage (true rms) Measurement Accuracy: ±(% of reading + % of range); 1 year, 23°C + 5°C

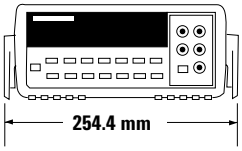
Frequency	Ranges 100 mV	Ranges 1, 10, 100, 750 V
3 to 5 Hz	1.00 + 0.04	1.00 + 0.03
5 to 10 Hz	0.35 + 0.04	0.35 + 0.03
10 Hz to 20 kHz	0.06 + 0.04	0.06 + 0.03
20 to 50 kHz	0.12 + 0.04	0.12 + 0.05
50 to 100 kHz	0.60 + 0.08	0.60 + 0.08
100 to 300 kHz*	4.00 + 0.50	4.00 + 0.50

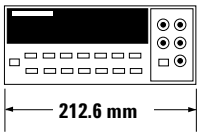
*Typically 30% of reading error at 1 MHz

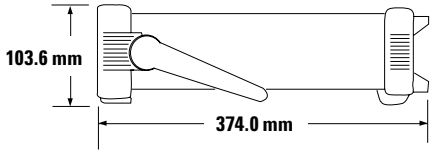
More detailed specifications at **www.agilent.com/find/34401A**

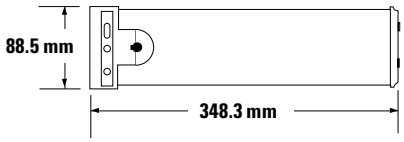
Low-Cost 6½-Digit Multimeter 34401A (Continued)

Low Cost 6 ½ Digital Multimeter
– Abbreviated Technical Specifications (Continued)









Resistance: (2-wire Ω, 4-wire Ω)Input Characteristics

Range	Maximum Reading (6 ½ digits)	Resolution in Digits		
		6 ½	5 ½	4 ½
100Ω	120.0000	100 µΩ	1 mΩ	10 mΩ
1 kΩ	1.200000	1 mΩ	10 mΩ	100 mΩ
10 kΩ	12.00000	10 mΩ	100 mΩ	1Ω
100 kΩ	120.0000	100 mΩ	1Ω	10 Ω
1 MΩ	1.200000	1 µ	10 Ω	100Ω
10 MΩ	12.00000	10 µ	100 Ω	1 kΩ
100 MΩ	120.0000	100 µ	1 kΩ	10 Ω

Input Protection: >1000 V on all ranges

Measurement Accuracy: ±(% of reading + % of range) Specs are for 4-wire Ω or 2-wire Ω using Math Null

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C	Shunt Resistance
100 Ω	0.0030 + 0.0030	0.008 + 0.004	0.010 + 0.004	1 mA
1 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	1 mA
10 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	100 µA
100 kΩ	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	10 µA
1 MΩ	0.0020 + 0.001	0.008 + 0.001	0.010 + 0.001	5.0 µA
10 MΩ	0.0150 + 0.001	0.020 + 0.001	0.040 + 0.001	500 nA
100 MΩ	0.3000 + 0.010	0.800 + 0.010	0.800 + 0.010	500 nA*

Maximum Reading Rate: Same as dcV

DC Current Measurement Accuracy: ±(% of reading + % of range)

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C	Shunt Resistance
10 mA	0.005 + 0.010	0.030 + 0.020	0.050 + 0.020	500 Ω
100 mA	0.010 + 0.004	0.030 + 0.005	0.050 + 0.005	5.0 Ω
1 A	0.050 + 0.006	0.080 + 0.010	0.100 + 0.010	0.1 Ω
3 A	0.100 + 0.020	0.120 + 0.020	0.120 + 0.020	0.1 Ω

Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse
Maximum Reading Rate: Same as dcV

AC Current (true rms): Measurement Accuracy: ±(% of reading + % range); 1 year, 23°C ± 5°C

Frequency	Ranges 1 A	Ranges 3 A
3 to 5 Hz	1.00 + 0.04	1.10 + 0.06
5 to 10 Hz	0.30 + 0.04	0.35 + 0.06
10 Hz to 5 kHz	0.10 + 0.04	0.15 + 0.06

Input Protection: Externally accessible 3 A 250 V fuse; internal 7 A 500 V fuse
Maximum Reading Rate: Same as dcV

More detailed specifications at **www.agilent.com/find/34401A**

NEW 34410A and 34411A

6½-Digit High Performance Multimeters
34410A and 34411A

Agilent Open

Agilent 34410A 6½-Digit High-Performance DMM

- 10,000 readings/s @ 5½ digits direct to PC
- 1,000 readings/s @ 6½ digits direct to PC
- 30 PPM 1 year Basic DC accuracy
- LAN, USB & GPIB standard
- DCV, ACV, DCI, ACI, 2-wire and 4-wire Resistance, Frequency, Period, Continuity, and Diode Test
- Capacitance & Temperature measurements
- Expanded measurement ranges
- Data logger with 50 k reading Non-volatile memory
- LXI class C compliant

Agilent 34411A 6½-Digit Enhanced-Performance DMM

All the features of the 34410A, plus:

- 50,000 readings/s @ 4½ digits direct to PC
- 1 Million reading memory
- Analog level triggering
- Programmable Pre/Post triggering
- LXI class C compliant

The Best Just Got Better

The Agilent 34410A and 34411A 6½-Digit DMMs represent the latest generation of multimeters from Agilent Technologies. Building on the success of the industry-standard Agilent 34401A, these new meters offer improved accuracy, expanded measurement capability, dramatically improved measurement speed and throughput, and modern computer interfaces including LAN and USB. The dual display offers both dual measurement capabilities and ease of use when setting up and configuring the DMM. Improvements have been made in every facet of the 34401A to make the best even better, whether you use it on the bench or in a system.

Dramatic Speed Improvements

Whether it's raw reading speed or fast system throughput, the 34410A sets a new benchmark in performance. Using a new A/D technology, the 34410A achieves an impressive 10,000 readings a second at 5½ digits, and can stream readings to your computer at this same speed! Triggering is fast and precise, with both trigger latency and trigger jitter less than 1 µs, while bus query response is less than 500 µs. ACV measurements are faster as well thanks to a digital measurement technique that additionally improves accuracy at high and low frequencies. For even greater reading speeds, select the 34411A, which achieves 50,000 DCV readings a second at 4½ digits.

Enhanced Measurement Performance

The 34410A and 34411A offer Temperature and Capacitance capabilities, in addition to those measurements you have come to expect, such as DCV, ACV, DCI, ACI, 2-wire and 4-wire Resistance, Frequency, Period, Continuity and Diode Test. You also get Offset Compensated Ohms, allowing you to accurately measure resistance in the presence of voltages. Measurement ranges have been expanded as well; for example, DC and AC Current Ranges now go down to 100 µA, resulting in 100 pA resolution. Real-time math and statistics are included, and a peak-detect capability allows you to capture peaks as short as 20 µs.

Even Greater Performance with the 34411A

The 34411A has all the features of the 34410A, plus additional performance that makes it even more powerful. With the ability to make 50,000 readings per second at 4½ digits, Analog Level Triggering, programmable Pre- and Post- Trigger and 1 million readings of volatile memory in addition to 50,000 reading of non-volatile memory, you now have the ability to capture low-frequency waveforms, characterize device performance and transfer results for analysis on your computer.

More detailed specifications at **www.agilent.com/find/34410A**

6½-Digit Multimeters 34410A–34411A (Continued)

Measurement Characteristics

DC Voltage

Measurement Method:
Continuously integrating multi-slope IV A/D converter

Linearity:
0.0002% of reading + (10 V range) + 0.001% of range

Input Resistance:
0.1 V, 1 V, 10 V range
10 MΩ or > 10 GΩ
100 V, 1000 V range
10 MΩ ±1%
Input Bias Current: < 30 pA at 25°C
Input Protection: 1000 V
DC CMRR: 140 dB[1]

True RMS AC Voltage

Measurement Method:
AC-coupled True RMS measurement. Digital sampling with anti-alias filter.

Crest Factor:
No additional error for crest factors <10. Limited by peak input and 300 kHz bandwidth.

Peak Input:
300% of range or 1100 Vpk

Overload Ranging:
Will select higher range if peak input overload is detected during auto range. Overload is reported in manual ranging.

AC CMR: 70 dB[2]

Maximum Input:
400 Vdc, 1100 Vpk

Input Impedance:
1 MΩ ± 2% in parallel with < 150 pF

Input Protection:
750 Vrms all ranges

[1] For 1 kΩ unbalanced in LO lead, ± 500 V peak maximum

[2] For 1 kΩ unbalanced in LO lead and < 60 Hz, ± 500 V peak maximum

Resistance

Measurement Method:
Selectable 2-wire or 4-wire. Current source referenced to LO input.

Offset Compensation:
Selectable on the 100 Ω, 1 kΩ, and 10 kΩ ranges

Max. Lead Resistance (4-wire):
10% of range per lead for 100 Ω, 1 kΩ. 1 kΩ per lead on all other ranges.

Input Protection:
1000 V on all ranges

DC Current

Current Shunt:
200 Ω for 100 µA, 1 mA
2 Ω for 10 mA, 100 mA
0.1 Ω for 1 A, 3 A

Input Protection:
3 A, 250 V fuse

True RMS AC Current

Measurement Method:
AC-coupled True RMS measurement. Directly coupled to the fuse and shunt. Digital sampling with anti-alias filter.

Current Shunt:
200 Ω for 100 µA, 1 mA
2 Ω for 10 mA, 100 mA
0.1 Ω for 1 A, 3 A

Maximum Input:
The peak value of the DC + AC current must be <300% of range. The RMS current must be <3 A including the DC current content.

Input Protection:
3 A, 250 V fuse

Frequency and Period

Measurement Method:
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 Vrms all ranges

Capacitance

Measurement Method:
Current input with measurement of resulting ramp.

Connection Type:
2-wire

Temperature

Thermistor:
2.2 kΩ, 5 kΩ, and 10 kΩ

RTD:
α = 0.00385,
R_0 from 49 Ω to 2.1 kΩ

Continuity/Diode Test

Response Time:
300 samples/sec with audible tone

Continuity Threshold:
Fixed at 10 Ω

Operating Characteristics-
Maximum readindgs/second

	Digits		
Function[3]	4.5	5.5	6.5
DCV	50 k[4]	10 k	1 k
2-wire Ω	25 k[4]	3 k	60(50)
DCI	3 k	60(50)	60(50)
ACV	500	500	150
ACI	500	150	150
Frequency	450	90	10
Period	450	90	10

[3] Maximum rate for DCV, DCI, and resistance functions (using zero settling delay, autozero off, manual range)

[4] 34411A only

More detailed specifications at **www.agilent.com/find/34410A**

6½-Digit Multimeters 34410A–34411A (Continued)

Triggering and Memory

Reading Hold Sensitivity:
1% of reading

Samples per Trigger:
1 to 50,000 (34410A)
1 to 1,000,000 (34411A)

Trigger Delay:
0 to 3600 sec (20 µs step size)

External Trigger:
Programmable edge,
Low-power TTL compatible
Delay: < 1 µs
Jitter: < 1 µs
Max rate: up to 5,000/sec
Min Pulsewidth: 1 µs

Voltmeter Complete:
3 V Logic output, 2 µs pulse with programmable edge

Nonvolatile Memory:
50,000 readings

Volatile Memory:
50,000 readings (34410A)
1,000,000 readings (34411A)

Sample Timer:
Range: Up to 3600 sec
(20 µs step size)
Jitter: <100 ns

General Specifications

Power Supply:
100 V/120 V/220 V/240 V ±10%

Power Line Frequency:
45 Hz to 66 Hz and 360 Hz to 440 Hz, automatically sensed at power-on

Power Consumption:
25 VA peak (16 W average)

Operating Environment:
Full accuracy for 0°C to 55°C,
95% R.H. at 40°C Non-condensing

Storage Temperature:
-40°C to 70°C

Weight: 3.72 kg (8.2 lbs)

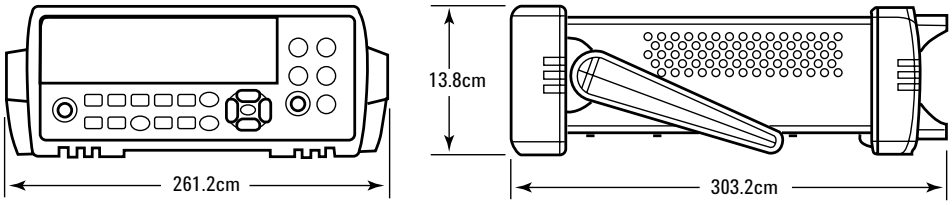
Safety:
IEC 61010-1, EN 61010-1,
UL 61010-1, CAN/CSA-C22.2
No. 61010-1, Refer to Declarations of Conformity for current revisions.
Measurement CAT II 300V, CAT I 1000V. Pollution Degree 2

EMC:
IEC 61326, EN 61326, CISPR 11, ICES-001, AS/NZS 2064.1, Refer to Declaration of Conformity for current revisions.

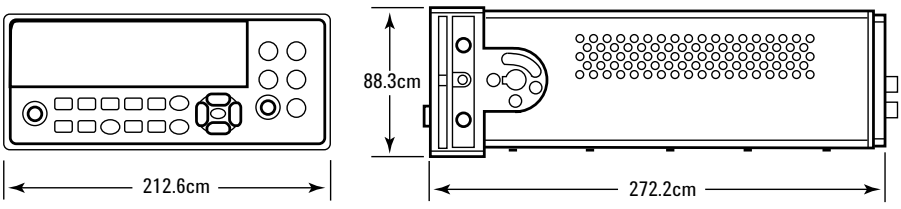
Vibration & Shock:
MIL-T-28800E, Type III, Class 5 (Sine Only)

Warranty: 1 year

Agilent Model: Bench Dimensions 34410A, 34411A



Agilent Model: Systems Dimensions 34410A, 34411A



More detailed specifications at **www.agilent.com/find/34410A**

6½-Digit Multimeters 34410A–34411A (Continued)

Specifications ± (% of reading + % of range)	Range[3]	Frequency, Test Current or Burden Voltage	24 Hour[2] Tcal ± 1°C	90 Day Tcal ± 1°C	1 Year Tcal ± 5°C	Temp.Coef. 0°C to (Tcal - 5°C) (Tcal + 5°C) to 55°C
DC Voltage	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[4]		0.0020 + 0.0006	0.0035 + 0.0006	0.0040 + 0.0006	0.0005 + 0.0001
True RMS AC Voltage[5]	100.0000 mV to 750.000 V	3 Hz – 5 Hz	0.50 + 0.02	0.50 + 0.03	0.50 + 0.03	0.010 + 0.003
		5 Hz – 10 Hz	0.10 + 0.02	0.10 + 0.03	0.10 + 0.03	0.008 + 0.003
		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
Resistance[6]	100.0000 Ω	1 mA	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 nA||10 MΩ**	**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 µA	0.0020 + 0.0010	0.010 + 0.001	0.012 + 0.001	0.0010 + 0.0002
	10.00000 MΩ	500 µA	0.0100 + 0.0010	0.030 + 0.001	0.040 + 0.001	0.0030 + 0.0004
	100.0000 MΩ	500 nA	0.200 + 0.001	0.600 + 0.001	0.800 + 0.001	0.1000 + 0.0001
	1.000000 GΩ	500 nA||10 MΩ	2.000 + 0.001	6.000 + 0.001	8.000 + 0.001	1.0000 + 0.0001
DC Current	100.0000 µA	< 0.03 V	0.010 + 0.020	0.040 + 0.025	0.050 + 0.025	0.0020 + 0.0030
	1.000000 mA	**< 0.30 V**	**0.007 + 0.006**	**0.030 + 0.006**	**0.050 + 0.006**	**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	< 0.30 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
	3.000000 A	< 2.0 V	0.100 + 0.020	0.120 + 0.020	0.150 + 0.020	0.0050 + 0.0020
True RMS AC Current[7]	100.0000 µA to 3.000000 A	3 Hz – 5 kHz	0.10 + 0.04	0.10 + 0.04	0.10 + 0.04	0.015 + 0.006
		5 kHz – 10 kHz	0.20 + 0.04	0.20 + 0.04	0.20 + 0.04	0.030 + 0.006
Frequency or Period	100 mV to 750 V	3 Hz – 5 Hz	0.070 + 0.000	0.070 + 0.000	0.070 + 0.000	0.005 + 0.000
		5 Hz – 10 Hz	0.040 + 0.000	0.040 + 0.000	0.040 + 0.000	0.005 + 0.000
		10 Hz – 40 Hz	0.020 + 0.000	0.020 + 0.000	0.020 + 0.000	0.001 + 0.000
		40 Hz – 300 kHz	**0.005 + 0.000**	**0.006 + 0.000**	**0.007 + 0.000**	**0.001 + 0.000**
Capacitance[8]	1.0000 nF	500	0.50 + 0.50	0.50 + 0.50	0.50 + 0.50	0.05 + 0.50
	10.000 nF	1 nA	0.40 + 0.10	0.40 + 0.10	0.40 + 0.10	0.05 + 0.10
	100.00 nF	10 µA	0.40 + 0.10	0.40 + 0.10	0.40 + 0.10	0.01 + 0.10
	1.0000 µF	10 µA	0.40 + 0.10	0.40 + 0.10	0.40 + 0.10	0.01 + 0.10
	10.000 µF	100 µA	0.40 + 0.10	0.40 + 0.10	0.40 + 0.10	0.01 + 0.10

More detailed specifications at **www.agilent.com/find/34410A**

6½-Digit Multimeters 34410A–34411A (Continued)

Specifications

± (% of reading + % of range)

	Range[3]	Frequency, Test Current or Burden Voltage	24 Hour[2] Tcal ± 1°C	90 Day Tcal ± 1°C	1 Year Tcal ± 5°C	Temp.Coef. 0°C to (Tcal - 5°C) (Tcal + 5°C) to 55°C
Temperature[9]						
RTD	-200°C to 600°C		0.06°C	0.06°C	0.06°C	0.003°C
Thermistor	-80°C to 150°C		0.08°C	0.08°C	0.08°C	0.002°C
Continuity	1000.0	1 mA	0.002 + 0.010	0.008 + 0.020	0.010 + 0.020	0.0010 + 0.0020
Diode Test[10]	1.0000 V	1 mA	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 100 PLC.

2 Relative to calibration standards.

3 20% overrange on all ranges, except DCV 1000 V, ranges, ACV 750 V, DCI and ACI 3 A ranges.

4 For each additional volt over ± 500 add 0.02 mV of error.

5 Specifications are for sinewave input > 0.3% of range and > 1 m Vrms. Add 30 uV error for frequencies below 1 kHz. 750 VAC range limited to 8 x 10^7 Volts-Hz. For each additional volt over 300 Vrms add 0.7 mVrms of error.

6 Specifications are for 4-wire resistance measurements, or 2-wire using Math Null. Without Math Null, add 0.2 ohms additional error in 2-wire resistance measurements.

7 Specifications are for sinewave input >1% of range and >10 µArms. Frequencies > 5 kHz are typical for 1.0 A and 3.0 A ranges.

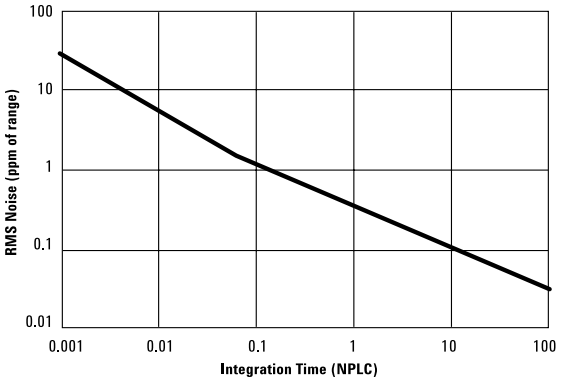
8 Specifications are for 1-hour warm-up using Math Null. Additional errors may occur for non-film capacitors.

9 For total measurement accuracy, add temperature probe error.

10 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.

A-to D Converter Noise Performance



Integration Time (NPLC)	Resolution (ppm of range)[1]	Normal Mode Rejection (dB)[12]	Readings/ Second[4]
0.001[5]	30	0	50,000
0.002[5]	15	0	25,000
0.006	6	0	10,000
0.02	3	0	3,000
0.06	1.5	0	1,000
0.2	0.7	0	300
1	0.3	55	60 (50)
2	0.2	110[3]	30 (25)
10	0.1	110[3]	6 (5)
100	0.03	110[3]	0.6 (0.5)

1 Resolution is defined as the typical DCV 10 V range RMS noise. Auto-zero on for NPLC ≥ 1. See manual for additional noise characteristics.

2 Normal mode rejection for power line frequency ± 0.1%.

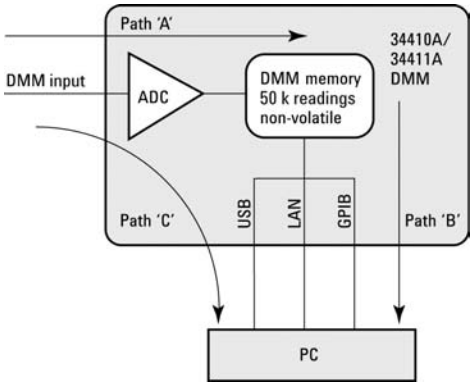
3 For power-line frequency ± 1% 75 dB and for ± 3% 55 dB.

4 Maximum rate with auto-zero off for 60 Hz and (50 Hz) operation.

5 Only available for the 34411A.

More detailed specifications at **www.agilent.com/find/34410A**

6½-Digit Multimeters 34410A–34411A (Continued)



DMM memory to PC (Maximum reading rate out of memory)[1] Drawing, - Path B

Reading Format	GPIB Readings/sec	USB 2.0 Readings/sec	LAN (VXI-11) Readings/sec	LAN (Sockets) Readings/sec
ASCII	2,850	2,000	4,800	4,000
32-bit Binary	89,000	265,000	110,000	270,000
64-bit Binary	47,000	154,000	60,000	160,000

Direct I/O Measurements single reading - measure and IO time[1] Drawing – Path C

Function	Resolution (NPLC)	GPIB msec	USB 2.0 msec	LAN (VXI-11) msec	LAN (Sockets) msec	Maximum Reading Rate into Memory or to Direct I/O (Readings/secs) Drawing – Path A or C
DCV/2-wire Resistance	0.006 (0.001)	34.0	34.6	5.0	34.5	10,000 (50,000)
ACV/ Frequency	Fast Filter 1 ms Gate	10.0	10.0	10.0	10.0	500

1 1/2 scale input signal, immediate trigger, trigger delay 0, auto-zero off, auto-range off, no math, null off, 60 Hz line frequency, null off.Specifications are for 34410A or (34411A). See manual for performance on other functions.

System Performance

	Function Change (msec)[1]	Range Change (msec)[2]	Auto-range (msec)[3]	Max. External Trigger Rate	Max. Internal Trigger Rate[4]
DCV/ 2-wire Resistance	22	5.5	7.5	5,000/s	10,000/s (50,000/s)
ACV/Frequency	37	6.5	19	500/s	500/s

1 Time to change from 2-wire Resistance to this specified function, or dcv DCV to 2-wire Resistance using the SCPI " (FUNC " '----" command)
2 Time to change from one range to the next higher range, ≤10 V, ≤10 MΩ
3 Time to automatically change one range and be ready for the new measurement, ≤10 V, ≤10 MΩ, ≤10 V, ≤10 Mohm
4 Specifications are for 34410A or (34411A).

More detailed specifications at **www.agilent.com/find/34410A**

34420A

Nanovolt/Micro-ohm Meter
34420A

- 7½ digit resolution
- 1.3 nV rms noise/8 nVp-p
- 100 pV, 100 nΩ sensitivity
- Two-channel programmable voltage input; difference and ratio functions
- 1 mV to 100 V ranges
- SCPI and Keithley 181 languages
- Direct SPRT, RTD, Thermistor, and thermocouple temperature measurements
- IntuiLink Connectivity Software included

34420A Nanovolt/Micro-ohm Meter
The Agilent 34420A sets a price/performance standard in low-level measurement capability. The noise performance of the 34420A nanovolt/micro-ohm meter is more than an order of magnitude better than that previously available from Hewlett-Packard.

Accurate, Repeatable Low-Level Measurements
A shielded copper pin screw-down connector, a 7½ digit A/D, converter 2 ppm basic DC accuracy, and a new measurement algorithm that gives 100 dB normal mode rejection without front-end filtering result in measurement capability you can depend on to make accurate and repeatable low-level measurements. Low noise input amplifiers and a highly-tuned input protection scheme bring reading noise down to 8 nVp-p. Longer integration times improve noise performance even further.

Math Functions Enhance Capabilities
Math functions such as NULL, STATS, and SCALE ease the capture of minimum and maximum readings, provide averages and standard deviation, scale your measurement results, and ultimately makes it easier for you to characterize your input signal. The 34420A can also store up to 1024 readings in internal memory.

Agilent IntuiLink: Easy Data Access
The Included Agilent IntuiLink software allows your captured data to be put to work easily, using PC applications such as Microsoft Excel or Microsoft Word, to analyze, interpret, display, print, and document the data you get from the 34420A. To find out more about IntuiLink, visit **www.agilent.com/find/intuilink**

Unprecedented Functionality
Two input channels allow voltage measurements to be made independently, or they can be mathematically combined to make difference and ratio measurements. Ohms measurements combine the low-noise input circuits with a highly-stable current source to provide outstanding low-resistance measurements. Offset compensation is employed to eliminate the effects of stray thermal EMFs that would otherwise result in measurement error. Low power ohms and a low-voltage resistance measurement capability allow repeatable measurements to be made where a low voltage (20 mV) is required to avoid oxidation punch-through. A wide range of temperature measurement capabilities are also built in, providing support for SPRT, thermocouple, RTD, and thermistor temperature sensors.

Built-in Versatility
You will find that the 34420A will fit equally well into your bench or your system applications. Designed with the bench user in mind, operation of the 34420A from the front panel is straightforward and intuitive. For system applications, the 34420A includes both GPIB and RS-232 interfaces standard, and uses Standard Commands for Programmable Instrumentation (SCPI). This ensures both present and future compatibility. The 34420A also responds to commands for the Keithley 181 nanovoltmeter.

More detailed specifications at **www.agilent.com/find/34420A**

Nanovolt/Micro-ohm Meter 34420A (Continued)

Abbreviated Technical Specifications

Accuracy Specifications:
± (% of reading + % of range)

Temperature

SPRT: ITS-90 calibrated temperature within the range of -190° to +660°C

RTD: Type Á = 0.00385 and Á = 0.00392. R_0 from 4.9 Ω to 2.1 KΩ. ITS-90 (IEC 751) Callendar-Van Dusen conversion

Thermistor: 5 KΩ

Thermocouple: ITS-90 conversions of type B, E, J, K, N, R, S, T

Chart Out (Analog Out)

Resolution: 16 bits

Maximum Output: ±3 V

Span and Offset: Adjustable

Filter (Analog or Digital or Both)

Analog: Low pass 2 pole @13 Hz, available for dcV on 1 mV, 10 mV, 100 mV ranges

Digital: Moving average filter. 10 (fast), 50 (medium) or 100 (slow) reading averages

Math Functions

NULL (Channel 1 dcV, Channel 2 dcV, Difference, Resistance, Temperature)

STATS (Min/max/avg, peak-peak, standard deviation, number of readings)

SCALE (Allows linear scaling as Y=MX + B)

CHART NULL (Establishes zero for rear-panel output)

Application Information

Digital Multimeter Measurement Errors Series System Cabling Errors and DC Voltage Measurement Errors in Digital Multimeters
Application Note AN 1389-1
5988-5511EN

Digital Multimeter Measurement Errors Series Resistance; DC Current; AC Current; and Frequency and Period Measurement Errors in Digital Multimeters.
Application Note AN 1389-2
5988-5512EN

DC Voltage[1] – 7½ digits Resolution all Ranges

Range	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 mV	0.0025 + 0.0020	0.0040 + 0.0020	0.0050 + 0.0020
10 mV	0.0025 + 0.0002	0.0040 + 0.0002	0.0050 + 0.0003
100 mV	0.0015 + 0.0003	0.0030 + 0.0004	0.0040 + 0.0004
1 V	0.0010 + 0.0003	0.0025 + 0.0004	0.0035 + 0.0004
10 V	0.0002 + 0.0001	0.0020 + 0.0004	0.0030 + 0.0004
100 V	0.0010 + 0.0004	0.0025 + 0.0005	0.0035 + 0.0005

DCV1/DCV2 (ratio): Ratio error in % = channel 1 accuracy in % + channel 2 accuracy in %
DCV1-2 (difference): Differnce error = channel 1 (% reading + % range) + channel 2 (% reading + % range)

DC Voltage Noise Specifications[2]

Range	2-Minute rms Noise	2 – Minute p-p Noise	24-Hour p-p Noise
1 mV	1.3 nV RMS	8 nV p-p	12 nV p-p
10 mV	1.5 nV RMS	10 nV p-p	14 nV p-p
100 mV	10 nV RMS	65 nV p-p	80 nV p-p
1 V	100 nV RMS	650 nV p-p	800 nV p-p
10 V	450 nV RMS	3 µV p-p	3.7 µV p-p
100 V	11 µV RMS	75 µV p-p	90 µV p-p

DC Voltage: **Input Resistance:** 10 MΩ ± 1% (100 V range)
>10 GΩ ± (1 mV through 10 V range)

Input Protection: 150 V peak to Channel 1 LO

Resistance[3] – 7½ digits Resolution all Ranges

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 kΩ	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 kΩ	100 µA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 kΩ	10 µA	0.0015 + 0.0003	0.0040 + 0.0004	0.0060 + 0.0004
1 MΩ	5 µA	0.0015 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

1 Specifications are for channel 1 or channel 2 (100 V range on channel 1 only), after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with filters off.

2 After a 2-hour warm-up ±1°C, 6.5 digits (10 NPLC) with analog filter off digital filter medium (50 readings). 2 minute rms and 24-hour noise typical.

3 All resistance specifications are for channel 1 only, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC) with filters off, for 4-wire Ω or 2-wire Ω using Null.

4 For 25 ΩSPRT with triple-point of water check within last 4 hours. With no triple-point of water check, add 0.013°C for 24-hour, 0.035°C for 90-day, and 0.055°C for 1-year specifications.

5 For fixed reference junction. Add 0.3°C for external reference junction, add 2.0°C for internal reference junction.

More detailed specifications at **www.agilent.com/find/34420A**

Nanovolt/Micro-ohm Meter 34420A (Continued)

Abbreviated Technical Specifications

Accuracy Specifications:
± (% of reading + % of range)

General Specifications

Front-Panel Connection: Shielded, low-thermal, copper contacts

Interface: GPIB and RS-232 standard

Languages: SCPI-1994 (IEEE-488.2), Keithley 181

Ordering Information

34420A Nanovolt/Micro-Ohm Meter Includes low-thermal input cable (34102A), low-thermal shorting plug (34103A), operating and service manuals, quick reference guide, test report with calibration sticker, 2.3 ml bottle of contact cleaner, and power cord.

34420A-1CM Rackmount Kit

34420A-A6J ANSI Z540 Compliant Calibration

Accessories

34102A Low-Thermal Input Cable (four-conductor with copper spade lugs)

34103A Low-Thermal Shorting Plug

34104A Low-Thermal Input Connector

34161A Accessory Pouch

34131A Hard Transit Case

Low Power Resistance[3] – $7\frac{1}{2}$ digits Resolution all Ranges

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
1 Ω	10 mA	0.0015 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
10 Ω	10 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
100 Ω	1 mA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
1 kΩ	100 µA	0.0015 + 0.0002	0.0040 + 0.0002	0.0060 + 0.0002
10 kΩ	10 µA	0.0015 + 0.0004	0.0040 + 0.0004	0.0060 + 0.0004
100 kΩ	5 µA	0.0015 + 0.0012	0.0040 + 0.0015	0.0060 + 0.0015
1 MΩ	5 µA	0.0020 + 0.0003	0.0050 + 0.0004	0.0070 + 0.0004

Voltage Limited Resistance[3]: Voltage limit selectable: 20 mV, 100 mV, or 500 mV

Range	Test Current	24-Hour 23°C ± 1°C	90-Day 23°C ± 5°C	1-Year 23°C ± 5°C
10 Ω	1 mA	0.0020 + 0.0002	0.0050 + 0.0002	0.0070 + 0.0002
100 Ω	100 µA	0.0025 + 0.0002	0.0040 + 0.0002	0.0070 + 0.0002

Temperature: 0.001°C Resolution

Probe Type	Accuracy
SPRT[4]	SPRT probe accuracy +0.003°C
RTD	RTD probe accuracy +0.05°C
Thermistor	Thermistor probe accuracy +0.1°C
Thermocouple[5]	Thermocouple probe accuracy +0.2°C

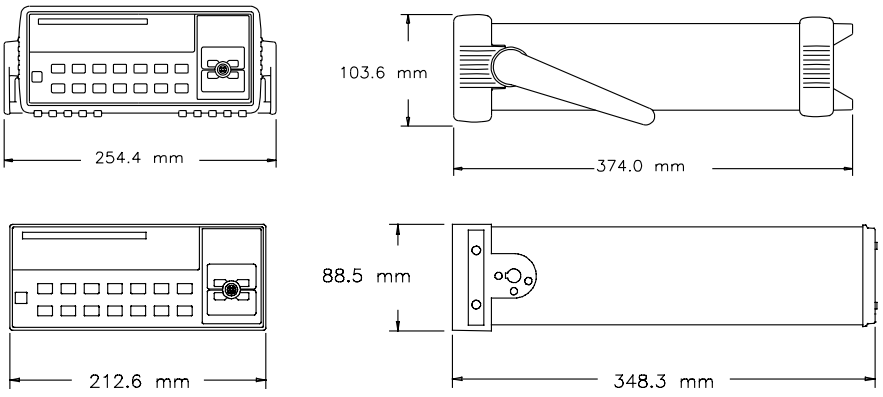
1 Specifications are for channel 1 or channel 2 (100 V range on channel 1 only), after 2-hour warm-up, resolution at 7.5 digits (100 NPLC), with filters off.

2 After a 2-hour warm-up ±1°C, 6.5 digits (10 NPLC) with analog filter off digital filter medium (50 readings). 2 minute rms and 24-hour noise typical.

3 All resistance specifications are for channel 1 only, after 2-hour warm-up, resolution at 7.5 digits (100 NPLC) with filters off, for 4-wire Ω or 2-wire Ω using Null.

4 For 25 ΩSPRT with triple-point of water check within last 4 hours. With no triple-point of water check, add 0.013°C for 24-hour, 0.035°C for 90-day, and 0.055°C for 1-year specifications.

5 For fixed reference junction. Add 0.3°C for external reference junction, add 2.0°C for internal reference junction.



More detailed specifications at **www.agilent.com/find/34420A**

8½-Digit Multimeter
3458A

3458A

8½ digit resolution
100,000 reading/s (4½ digits)
8 ppm (4 ppm optional) voltage stability – 1 year
To 1000 V input range

Abbreviated Technical Specifications

3458A Multimeter

The Agilent 3458A multimeter shatters long-standing performance

barriers of speed and accuracy on the production test floor, in research and development, and in the calibration lab. The 3458A is the fastest, most flexible, and most accurate multimeter offered by Agilent Technologies. In your system or on the bench, the 3458A saves you time and money with unprecedented test-system throughput and accuracy, seven-function measurement flexibility, and low cost of ownership.

Select a rate of 100,000 reading per second for maximal test throughput. Or achieve highest levels of precision with up to 81.2 digits of measurement resolution and 0.1 part per million transfer accuracy. Add to this the 3458A's simplicity of operation, and you have the ideal multimeter for your most demanding applications.

High-Test System Throughput

Faster Testing

- Up to 100,000 readings/s
- Internal test setups >340/s
- Programmable integration times from 500 ns to 1 s

Greater Test Yield

- More accuracy for tighter test margins
- Up to 8½ digits resolution

Longer Uptime

- Two-source (10 V, 10 kΩ) calibration, including AC
- Self-adjusting, self-verifying auto-calibration for all functions and ranges, including AC

High-Resolution Digitizing

Greater Waveform Resolution and Accuracy

- 16 to 24-bits resolution
- 100,000 to 0.2 sample/s
- 12 MHz bandwidth
- Timing resolution to 10 ns
- Less than 100 ps time jitter
- Over 75,000 reading internal memory

Calibration Lab Precision

Superb Transfer Measurements

- 8½ digits resolution
- 0.1 ppm DC volts linearity
- 0.1 ppm DC volts transfer capability
- 0.01 ppm rms internal noise

Extraordinary Accuracy

- 0.6 ppm for 24 hours in DC volts
- 2.2 ppm for 24 hours in Ω
- 100 ppm mid-band AC volts
- 8 ppm (4 ppm optional) per year voltage reference stability

3458A Multimeter Performance Features

DC Volts

- 5 ranges: 0.1 V to 1000 V
- 8½ to 4½ digits resolution
- Up to 100,000 readings/s (4½ digits)
- Maximum sensitivity: 10 nV
- 0.6 ppm 24-hour accuracy
- 8 ppm (4 ppm optional)/year voltage reference stability

Resistance

- 9 ranges: 10 Ω to 1 GΩ
- 2-wire and 4-wire Ω with offset compensation
- Up to 50,000 readings/second (5½ digits)
- Maximum sensitivity: 10 μΩ
- 2.2 ppm 24-hour accuracy

AC Volts

- 6 ranges: 10 mV to 1000 V
- 1 Hz to 10 MHz bandwidth
- Up to 50 readings/s with all readings to specified accuracy
- Choice of sampling or analog true rms techniques
- 100 ppm best accuracy

More detailed specifications at **www.agilent.com/find/multimeters**

8½-Digit Multimeter 3458A (Continued)

Abbreviated Technical Specifications

DC Current

- 8 ranges: 100 nA to 1 A
- Up to 1,350 readings/s (5½ digits)
- Maximum sensitivity: 1 pA
- 14 ppm 24-hour accuracy

AC Current

- 5 ranges: 100 µA to 1 A
- 10 Hz to 100 kHz bandwidth
- Up to 50 readings/second
- 500 ppm 24-hour accuracy

Frequency and Period

- Voltage or current ranges
- Frequency: 1 Hz to 10 MHz
- Period: 100 ns to 1 second
- 0.01% accuracy
- AC or DC coupled

Throughput

Maximum Reading Rates

- 100,000 readings/s at 4½ digits (16 bits)
- 50,000 readings/s at 5½ digits
- 6,000 readings/s at 6½ digits
- 60 readings/s at 7½ digits
- 6 readings/s at 8½ digits

Measurement System Speed

- 100,000 readings/s over GPIB or with internal memory
- 110 autoranges/s
- 340 function or range changes/s
- Postprocessed math from internal memory

Math Functions

The 3458A performs the following math functions on measurements: null, scale, offset, rms filter, single pole filter, thermistor linearization, db, dbm, % error, pass/fail LIMIT TESTING, and statistics. Two math functions may be used at one time.

DC Voltage

Range	Full Scale	Maximum Resolution	1-Year* Accuracy	Transfer Accuracy 10 min., tref ±0.5°C	Input Impedence
			ppm of reading + ppm of range		
100 mV	120.00000	10 nV	9(5) + 3	0.5 + 0.5	>10 GΩ
1 V	1.20000000	10 nV	8(4) + 0.3	0.3 + 0.1	>10 GΩ
10 V	12.0000000	100 nV	8(4) + 0.05	0.05 + 0.05	>10 GΩ
100 V	120.000000	1 µV	10(6) + 0.3	0.5 + 0.1	10 MΩ ± 1%
1000 V	1050.00000	10 µV	10(6) + 0.1	1.5 + 0.05	10 MΩ ± 1%

One-year specifications for NPLC 100 within 24 hours and ±1°C of last ACAL, Tcal ±5°C, MATH NULL, fixed range. Add 2 ppm of reading additional error for Agilent factory traceability of 10 V DC to US NIST. Traceability error is the absolute error relative to National Standards associated with the source of last external calibration. Transfer specifications for NPLC 100, following 4-hour warm-up. Full scale to 10% of full scale. Measurements on the 1000 V range are within 5% of the initial measurement value and following measurement settling. Tref is the starting ambient temperature. Measurements are made on a fixed range using accepted metrology practices.
*High stability (Option 002) ppm of reading in parentheses.

Noise Rejection (dB)[1]

	AC NMR[2]	AC ECMR	DC ECMR
NPLC <1	0	90	140
NPLC ≥ 1	60	150	140
NPLC ≥ 10	60	150	140
NPLC ≥ 100	60	160	140
NPLC = 1000	75	170	140

1 Applies for 1 kΩ unbalance in the LO lead and ±0.1% of the line frequency currently set for LFREQ.

2 For line frequency ±1%, ACNMR is 40 dB for NPLC ≥1, or 55 dB for NPLC ≥100.
For line frequency ±5%, ACNMR is 30 dB for NPLC ≥100.

DC Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±300 V pk
Guard to earth	±500 V pk	±1000 V pk

$8\frac{1}{2}$-Digit Multimeter 3458A (Continued)

Abbreviated Technical Specifications (Continued)

Application Information:

Notes Digital Multimeter Measurement Errors Series System Cabling Errors and DC Voltage Measurement Errors in Digital Multimeters
Application Note AN 1389-1
5988-5511EN

Digital Multimeter Measurement Errors Series Resistance; DC Current; AC Current; and Frequency and Period Measurement Errors in Digital Multimeters.
Application Note AN 1389-2
5988-5512EN

Digital Multimeter Measurement Errors Series AC Voltage Measurement Errors in Digital Multimeters
Application Note AN 1389-3
5988-5513EN

General Specifications

Operating Temperature: 0°C to 55°C

Warmup Time: Four hours to all specifications except where noted

Humidity Range:
95% RH, 0°C to 40°C

Storage Temperature:
–40°C to +75°C

Power: 100/120 V, 220/240 V ± 10%, 48 to 66 Hz, 360 to 420 Hz automatically sensed. Fused at 1.5 A @115 V or 0.5 A @230 V. <30 W, < 80 VA (peak).

Size: 88.9 mm H x 425.5 mm W x 502.9 mm D (3.5 in x 16.75 in x 19.8 in)

Weight: Net, 12 kg (26.5 lb); shipping, 14.8 kg (32.5 lb)

Ordering Information

3458A Multimeter (with GPIB, 20 KB reading memory, and 8 ppm stability)

3458A-001 Extended Reading Memory (expands total to 148 KB)

3458A-002 High-Stability (4 ppm/year) Reference

3458A-A6J ANSI Z540 Compliant Calibration

3458A-907 Front-handle Kit

3458A-908 Rack Flange Kit

3458A-909 Rack Flange Kit (with handles)

True rms AC Voltage (Synchronous Subsampled Mode)

Range	Full Scale	Maximum Resolution	Accuracy* 24 Hour – 2 Year 40 Hz to 1 kHz % of reading + % of range	Input Impedance
10 mV	12.00000	10 nV	0.02 + 0.011	1 MΩ ± 15% with <140 pf
100 mV	120.00000	10 nV	0.007 + 0.002	1 MΩ ± 15% with <140 pf
1 V	1.2000000	100 nV	0.007 + 0.002	1 MΩ ± 15% with <140 pf
10 V	12.000000	1 µV	0.007 + 0.002	1 MΩ ± 2% with <140 pf
100 V	120.00000	10 µV	0.02 + 0.002	1 MΩ ± 2% with <140 pf
1000 V	700.0000	100 µV	0.04 + 0.002	1 MΩ± 2% with <140 pf

* Specifications apply for full scale to 10% of full scale, DC <10% of AC, sine-wave input, crest factor of 1.4. Within 24 hours and ±1°C of last ACAL. Peak (AC+DC) input limited to 5 x full scale for all ranges. Add 2 ppm of reading additional error for Agilent factory traceability of 10 Vdc to US NIST.

AC Maximum Input

	Rated Input	Nondestructive
HI to LO	±1000 V pk	±1200 V pk
LO to guard	±200 V pk	±350 V pk
Guard to earth	±500 V pk	±1000 V pk
Volt-Hz product	1 x 10*	-

Resistance

Range	Full Scale	Maximum Resolution	Current Source	1-Year Accuracy* (4-wire Ω) ppm of rdg+ppm of range
10 Ω	12.00000	10 µΩ	10 mA	15 + 5
100 Ω	120.00000	10 µΩ	1 mA	12 + 5
1 kΩ	1.2000000	100 µΩ	1 mA	10 + 0.5
10 kΩ	12.000000	1 mΩ	100 µA	10 + 0.5
100 kΩ	120.00000	10 mΩ	50 µA	10 + 0.5
1 MΩ	1.2000000	100 mΩ	5 µA	15 + 2
10 MΩ	12.000000	1 Ω	500 nA	50 + 10
100 MΩ	120.00000	10 Ω	500 nA	500 + 10
1 GΩ	1.2000000	100 Ω	500 nA	0.5% + 10

Memory

	Standard Readings	Bytes	Option 001 Readings	Bytes
Reading Storage (16 bit)	10,240	20 k	+65,536	+128 k
Non-volatile, for Subprograms and/or State Storage	–	14 k	–	–

More detailed specifications at **www.agilent.com/find/multimeters**

Frequency Counters

Selection Guide	Model	Frequency range (optional range)	Frequency resolution	Best Sensitivity	Time Interval resolution (single-shot LSD)	Additional features
Two channel frequency counters w/time interval[1]	53131A	225 MHz (3, 5, 12.4 GHz)	10 digits/s	20 mVrms	500 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization
	53132A	225 MHz (3, 5, 12.4 GHz)	12 digits/s	20 mVrms	150 ps	GPIB standard, full math, statistics, limit testing, auto pulse characterization
Single channel frequency counter	53181A	225 MHz (1.5, 3, 5, 12.4 GHz)	10 digits/s	20 mVrms		GPIB standard, full math, statistics, limit testing
CW Microwave counters	53150A	20 GHz	1 Hz	-30 dBm		GPIB standard, battery optional, Simultaneous power measurement
	53151A	26.5 GHz	1 Hz	-30 dBm		GPIB standard, battery optional, Simultaneous power measurement
	53152A	46 GHz	1 Hz	-30 dBm		GPIB standard, battery optional, Simultaneous power measurement
CW Microwave counters/ power meter/DVMs	53147A	20 GHz	1 Hz	-30 dBm		GPIB and DVM standard, battery optional,-70 dBm to +20 dBm true power meter
	53148A	26.5 GHz	1 Hz	-30 dBm		GPIB standard, battery optional, -70 dBm to +20 dBm true power meter
	53149A	46 GHz	1 Hz	-30 dBm		GPIB standard, battery optional, -70 dBm to +20 dBm true power meter

[1] Channel 2 can be used to make frequency, period, ratio, and voltage measurements - measurements on channel 1 and channel 2 are made sequentially.

Additional frequency counters

Agilent also offers frequency counters for VXI and the popular 34980A and 34970A data acquisition mainframes. More information is available for these counters on the Agilent website.

Connectivity

Agilent provides IntuiLink a free software application for your PC. IntuiLink allows you to easily transfer measurement data and images into familiar PC applications like Microsoft Office Excel and Word. IntuiLink can be downloaded free of charge at www.agilent.com/find/intuilink IntuiLink supports the 53131A, 53132A and the 53181A. Agilent offers the 82357A USB to GPIB converter making it easy to connect your counter to a PC using USB.

More detailed specifications at **www.agilent.com/find/frequencycounters**


53131A


53132A


53181A

Frequency Counters
53131A, 53132A, and 53181A

225 MHz bandwidth (optional 1.5, 3, 5, or 12.4 GHz)

10- or 12-digit/s resolution

GPIB interface and IntuiLink connectivity software standard

Data transfer rate of up to 200 fully formatted measurements / second

Abbreviated technical specifications

A family of frequency counters to meet your needs

Agilent Technologies 53131A, 53132A and 53181A frequency counters give you fast, precise frequency measurements at an affordable price. These counters feature an intuitive user interface and one-button access to frequently used functions so you can make accurate measurements quickly and easily. Real-time digital signal processing technology is used to analyze data while simultaneously taking new readings, speeding measurement throughput.

This series of counters offers built-in statistics and math functions so you can scale measurements and simultaneously measure and track average, min/max and standard deviation. Automated limit testing lets you set upper and lower limits for any measurement. The analog display mode lets you see at a glance whether a measurement is within pass/fail limits. The counters flag out-of-limit conditions and can generate an output signal to trigger external devices when a limit is exceeded. For quick access to frequently used tests, a single keystroke recalls up to 20 different stored front-panel set-ups.

	53131A	53132A	53181A
Type	Two channel, universal[1]	Two channel, universal[1]	One channel RF
Measurements	Frequency, frequency ratio, time interval, period, rise/fall time, positive/negative pulse width, duty cycle, phase, totalize, peak voltage, time interval average, time interval delay		Frequency, frequency ratio (with optional second channel 2), period, peak voltage
Analysis	Automatic limit testing, math (scale and offset), statistics (minimum, maximum, mean, standard deviation)		
Frequency range (optional channel)	DC to 225 MHz (3, 5 or 12.4 GHz)	DC to 225 MHz (3, 5 or 12.4 GHz)	DC to 225 MHz (1.5, 3, 5 or 12.4 GHz)
Resolution (frequency, time interval)	10 digits/s, 500 ps	12 digits/s, 150 ps	10 digits/s, N/A
Measurement speed	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB	Up to 200 meas/s over GPIB
Voltage range & sensitivity (Sinusoid)			
DC to 100 MHz	20 mVrms to ± 5 Vac +DC	20 mVrms to ± 5 Vac +DC	20 mVrms to ± 5 Vac +DC
100 to 200 MHz	30 mVrms to ± 5 Vac +DC	30 mVrms to ± 5 Vac +DC	30 mVrms to ± 5 Vac +DC
200 to 225 MHz	40 mVrms to ± 5 Vac +DC	40 mVrms to ± 5 Vac +DC	40 mVrms to ± 5 Vac +DC
With Optional Channel	75 mVrms to ± 5 Vac +DC	75 mVrms to ± 5 Vac +DC	75 mVrms to ± 5 Vac +DC
Input Conditioning	(Independently selectable on CH 1 & 2)	(Independently selectable on CH 1 & 2)	(Independently selectable on CH 1)
Impedance coupling	1 MΩ or 50 Ω, AC or DC	1 MΩ or 50 Ω, AC or DC	1 MΩ or 50 Ω, AC or DC
Low pass filter	100 kHz or none	100 kHz or none	100 kHz or none
Attenuation	x1 or x10	x1 or x10	x1 or x10
External timebase reference Input	1, 5, 10 MHz	10 MHz	1, 5, 10 MHz
Trigger	CH 1 & CH 2	CH 1 & CH 2	CH 1
	Trigger on rising/falling edge; set level as a percent of signal level or voltage; Sensitivity can be set as LOW, MED, HIGH		
Gating and arming	Auto, manual (set gate time or number of digits of resolution); external, delay (expanded on 53132A)		
Interfaces	GPIB (IEEE 488.1 and 488.2) with SCPI-compatible language; talk only RS-232		
Power	AC line selection is automatic 100 to 120 VAC ± 10% at 50, 60, or 400 Hz ± 10% 220 to 240 VAC ± 10% at 50, 60 Hz ± 10%		
Net weight/size	3 kg (6.5 lbs.) 88.5mm H x 212.6mm W x 348.3mm D (3.54 in x 8.50 in x 13.932 in)		

[1] Channel 2 can only be used to make frequency, period, ratio, and voltage measurements - measurements on channel 1 and channel 2 are made sequentially.

More detailed specifications at **www.agilent.com/find/frequencycounters**

Frequency Counters 53131A, 53132A, and 53181A (Continued)

Standard and optional high stability timebases

	Standard (0° to 50°C)	Medium Oven Option 001	High Oven Option 010	Ultra High Oven Option 012
Temperature stability (referenced to 25° C)	$< 5 \times 10^{-6}$	$< 2 \times 10^{-7}$	$< 2.5 \times 10^{-9}$	$< 2.5 \times 10^{-9}$
Aging Rate (after 30 days)				
Per Day:		$< 4 \times 10^{-8}$	$< 5 \times 10^{-10}$	$< 1 \times 10^{-10}$
Per Month:	$< 3 \times 10^{-7}$	$< 2 \times 10^{-7}$	$< 1.5 \times 10^{-8}$	$< 3 \times 10^{-9}$
Per Year:				$< 2 \times 10^{-8}$
Turn-on stability vs. time (30 minutes)		$< 2 \times 10^{-7}$ (Referenced to 2 hours)	$< 5 \times 10^{-9}$ (Referenced to 24 hours)	$< 5 \times 10^{-9}$ (Referenced to 24 hours)
Calibration	Manual Adjust	Electronic	Electronic	Electronic

Note: that power to the time base is maintained when the counter is placed in standby via the front panel switch. The internal fan will continue to operate when in standby to maintain long-term measurement reliability.

Agilent 53131A Universal Counter
The two-channel 53131A counter offers a bandwidth of 225 MHz with a resolution of 10 digits per second when measuring frequency or period. Time interval measurements may also be made with a resolution of 500 ps. An optional third channel can be added to any counter to provide frequency measurements up to 3 GHz, 5 GHz, or 12.4 GHz.

Agilent 53132A Universal Counter
For applications requiring higher resolution, the 53132A offers the same features and functions as the 53131A, with up to 12 digits per second frequency resolution and 150 ps time interval resolution. If more accuracy is required, a choice of optional timebases may be added to any of the counters. In addition, the 53132A offers advanced arming modes for time interval measurements.

Agilent 53181A RF Counter
Optimized for RF applications, the single-channel 10 digits per second. 53181A measures frequency, period and peak voltage. A digit-blanking function easily eliminates unnecessary digits when you want to read measurements quickly. For higher frequency measurements, choose an optional second channel. A self-guided menu makes this counter exceptionally easy to use.

Connectivity
For computer-controlled systems applications, each counter includes a standard GPIB interface with full SCPI-compatible programmability and a data transfer rate of up to 200 fully formatted measurements per second. Measurements can be transferred via USB with an optional 82357A GPIB to USB converter. The standard RS-232 talk-only interface provides printer support or data transfer to a computer through a terminal-emulation program.

IntuiLink, free PC connectivity software allows you to easily transfer measurement data and images into familiar PC applications like Microsoft Office Excel and Word, with little or no programming. Use the following link for additional and downloading instructions.
www.agilent.com/find/intuilink

Optional High Frequency Channels	Frequency range	Connector	Coupling	Power range and sensitivity	Damage level
Option 015[1] 1.5 GHz Channel	100 MHz to 1.5 GHz	BNC	AC	-27 dBm to +19 dBm	5 Vrms
Optional 030 3.0 GHz Channel	100 MHz to 3.0 GHz	BNC	AC	-27 dBm to +19 dBm (100 MHz to 2.7 GHz)	5 Vrms
				-21 dBm to +13 dBm (2.7 GHz to 3 GHz)	
Optional 050 5.0 GHz Channel	200 MHz to 5.0 GHz	Type-N	AC	-23 dBm to +13 dBm	25 dBm
Optional 124 12.4 GHz Channel	200 MHz to 12.4 GHz	Type-N	AC	-23 dBm to +13 dBm	25 dBm

[1] Option 015 is available only for the 53181A

More detailed specifications at **www.agilent.com/find/frequencycounters**

Frequency Counters 53131A, 53132A, and 53181A (Continued)

Drivers

53131A/53132A/53181A:
IntuiLink Connectivity Software

Application Notes:

8 Hints for Making Better RF Counter Measurements
This brochure focuses on making better RF counter measurements by understanding the effects of counter architecture; recognizing the difference between resolution and accuracy, and scheduling calibration to match performance needs.
5967-6038E

Find a video demo, specifications calculator and more at **www.agilent.com/find/frequencycounters**

Configure a counter that is right for your application

Start by selecting a counter, either the 53131A, 53132A, or 53181A. Don't know which one to choose? Check out our most popular 53131A. Then choose the timebase that is the best fit for your application. Optional timebases improve stability due to changes in temperature or time and provide the convenience of electronic calibration. Finally, an optional RF channel can be added to measure signals up to 12.4 GHz – opt 030, a 3 GHz RF channel is a common choice.

Ordering Information

Agilent 53131A
Universal Counter, 10 digit/s

Agilent 53132A
Universal Counter, 12 digit/s

Agilent 53181A
RF Counter, 10 digit/s

Option 001 Medium stability timebase

Option 010 High stability timebase

Option 012 Ultra stability timebase

Option 015 1.5 GHz Ch. w/BNC connector

Option 030 3.0 GHz Ch. w/BNC connector

Option 050 5.0 GHz Ch. w/Type-N connector

Option 124 12.4 GHz Ch. w/Type-N connector

[1] Option 015 is available only for the 53131A

Option 060 Adds parallel 225 MHz channel(s) to rear panel

Option 061 Adds parallel 225 MHz channel(s) to rear panel and moves option 030 to rear panel.

Option 062 Adds parallel 225 MHz channel(s) to rear panel, opt 050 or opt 124 remain on front panel.

Option 1CM Rack mount kit

82357A Optional USB Interface

Microwave Frequency Counter
w/power meter, 53140 Series

53147A - 53149A

A choice of frequency counter ranges up to 46 GHz

A true power meter to meet your "laboratory-accuracy" requirements

A DC DVM to assist with antenna alignment and telecom power supply measurements

GPIB and RS232 standard

Abbreviated technical data

Simplify design and verification of point-to-point microwave links
Whether you are designing or verifying cell-site to base-station links, business-to-business communication links, digital radio links (along railroads, pipelines or power lines) or even satellite ground stations, designing and verifying microwave links typically requires three pieces of equipment. These are a CW microwave counter, a true power meter and a DC DVM.

Save ATE rack space and budget dollars by combining three instruments into one
For measurements used in microwave component and assembly testing, the compact, three-in-one 53140 series reduces the need for expensive ATE rack space. The 53140 series comes ATE-ready with both GPIB and RS-232 SCPI programmable interfaces. A rack mount kit is optional.

CW microwave counter up to 46 GHz
Choose the frequency range you need. The 53140 series has three ranges; 20 GHz, 26.5 GHz and 46 GHz. The ultra-wideband microwave input covers from 50 MHz up to the maximum frequency. This reduces the need for channel

Input characteristics		Agilent 53147A	Agilent 53148A	Agilent 53149A
Frequency range	**Channel 1** Normal mode Low pass filter enabled	 10 Hz - 125 MHz 10 Hz - 50 kHz	 10 Hz - 125 MHz 10 Hz - 50 kHz	 10 Hz - 125 MHz 10 Hz - 50 kHz
	Channel 2	50 MHz - 20 GHz	50 MHz - 26.5 GHz	50 MHz - 46.0 GHz
Sensitivity	**Channel 1** 10-30 Hz 30 Hz-125 MHz	 40 mV 25 mV	 40 mV 25 mV	 40 mV 25 mV
	Channel 2 50-250 MHz 0.25-12.4 GHz 12.4-18 GHz 18-20 GHz 20-26.5 GHz 26.5-40 GHz 40-46 GHz	 –20 dBm –33 dBm –33 dBm –29 dBm N/A N/A N/A	 –20 dBm –33 dBm –33 dBm –29 dBm –25 dBM N/A N/A	 –20 dBm –33 dBm –30 dBm –27 dBm –27 dBm –23 dBm –17 dBm
Maximum input	**Channel 1**	2 Vrms	2 Vrms	2 Vrms
	Channel 2 50 MHz - 2 GHz 2-46 GHz	 +5 dBm +13 dBm	 +5 dBm +13 dBm	 +5 dBm +13 dBm
Damage level	**Channel 1**	120 V_{pk} (DC + AC) linearly derated to 5 Vrms at 125 MHz	120 V_{pk} (DC + AC) linearly derated to 5 Vrms at 125 MHz	120 V_{pk} (DC + AC) linearly derated to 5 Vrms at 125 MHz
	Channel 2	+27 dBm	+27 dBm	+27 dBm
Impedance (Nominal)	**Channel 1**	1 MΩ / 60 pF	1 MΩ / 60 pF	1 MΩ / 60 pF
	Channel 2	50 Ω	50 Ω	50 Ω
Connector	**Channel 1**	BNC female	BNC female	BNC female
	Channel 2	SMA/APC-3.5 compatible female	SMA/APC-3.5 compatible female	2.92 mm removable, SMA/APC-3.5 compatible female
SWR (typical)	**Channel 2** 50-250 MHz 0.25-10 GHz 10-20 GHz 20-26.5 GHz 26.5-46 GHz	 1.5:1 2.0:1 3.0:1 N/A N/A	 1.5:1 2.0:1 3.0:1 3.0:1 N/A	 1.5:1 2.0:1 3.0:1 2.5:1 2.5:1

More detailed specifications at **www.agilent.com/find/microwavecounters**

Microwave Frequency Counter
w/power meter, 53140 Series (Continued)

Abbreviated technical data

switching. You don't have to wait for resolution that is not needed, as the resolution is selectable from 1 Hz to 1 MHz. For better measurement accuracy over time and temperature, an optional oven timebase is available.

True power meter with a wide selection of sensors
The 53140 series true power meter provides laboratory instrument. Obtain 0.01 dB resolution and 0.02 dB basic instrument accuracy.

DC DVM for AGC and power supply measurements
A ±50 Vdc DVM monitors the microwave receiver's AGC circuitry for assistance during antenna alignment. The DVM can also check the -48 Vdc power supplies typically found at telecom sites.

Advanced instrument features that help make the job easier
The Agilent 53140 series has the features you expect in a precision laboratory instrument. Relative readings for both frequency and power measurements show deviations from nominal values. Offset reading allows indirect measurement of either final frequency or power values or both. Averaging smoothes out rapidly changing measurement displays for ease of viewing.

Input characteristics		Agilent 53147A	Agilent 53148A	Agilent 53149A
Coupling	**Channel 1**	AC	AC	AC
	Channel 2	AC	AC	AC
Acquisition time (1 MHz FM rate)	**Channel 1**	N/A	N/A	N/A
	Channel 2 (FM Auto/ FM Off)	150 ms/125 ms	150 ms/125 ms	165 ms/140 ms
Resolution	**Channel 1/ Channel 2**	1 Hz to 1 MHz	1 Hz to 1 MHz	1 Hz to 1 MHz
Emissions ("kickback noise")	**Channel 1**	N/A	N/A	N/A
	Channel 2 (measuring/ no input)	–40 dBm / <–70 dBm	–40 dBm / <–70 dBm	–40 dBm / <–70 dBm
Residual stability* *Counter and source tied to same timebase	**Channel 1**	N/A	N/A	N/A
	Channel 2	0.6 LSD rms	0.8 LSD rms	1.25 LSD rms
Accuracy	**Channel 1/ Channel 2**	±1 LSD ±residual stability ± timebase error x frequency	±1 LSD ±residual stability ± timebase error x frequency	±1 LSD ±residual stability ± timebase error x frequency
Measurement time	**Channel 1**	1/Resolution + 30 ms	1/Resolution + 30 ms	1/Resolution + 30 ms
	Channel 2	1/Resolution + acquisition time + 30 ms	1/Resolution + acquisition time + 30 ms	1/Resolution + acquisition time + 30 ms
FM tolerance	**Channel 1**	N/A	N/A	N/A
	Channel 2 (FM Auto)	20 MHz p-p max @ 10 MHz rate	20 MHz p-p max @ 10 MHz rate	20 MHz p-p max to 26.5 GHz, 12 MHz p-p max above 26.5 GHz @ 10 MHz rate
	(FM Off)	1 MHz p-p @ 10 MHz rate	1 MHz p-p @ 10 MHz rate	1 MHz p-p @ 10 MHz rate
Power Meter Specifications	**Frequency range**	100 kHz to 50 GHz, sensor dependent.		
	Power range	-70 to +44 dBm, sensor dependent.		
	Power sensors supported	8480 series		
	Resolution	0.01 dB in log mode, 0.1% of full scale in linear mode.		
	Display units	**Absolute** dBm or Watts, **Relative** dB or %		
	Accuracy	**Instrumentation** ±0.02 dB or ± 0.5%. Add power sensor linearity specification for overall system accuracy.		
		Zero set (digital setting capability of zero) Sensor dependent		
	Power reference	**Power output** 1.00 mW. Factory set to ± 0.7%, traceable to NIST.		
		Accuracy ±1.2% worst case (± 0.9 RSS) for one year.		
		Frequency 50 MHz (nominal)		
		Connector N (f)		
DVM Specifications	**Function**	DC Volts		
	Range	±50 Vdc		
	Resolution	2 mV		
	Accuracy	±0.25% of reading ±10 mV		
	Display	Replaces frequency display when DVM is activated		

More detailed specifications at **www.agilent.com/find/microwavecounters**

Microwave Frequency Counter
w/power meter, 53140 Series (Continued)

Internal timebase stability		TCXO Standard	Oven Option 001
Frequency		10 MHz	10 MHz
External Input		1, 2, 5, 10 MHz	1, 2, 5, 10 MHz
Aging rate	Per Day	–	$< 5 \times 10^{-10}$
	Per Month	$< 1 \times 10^{-7}$	$< 1.5 \times 10^{-8}$
Short term	(1 sec. avg. time)	$< 1 \times 10^{-9}$	$< 2 \times 10^{-10}$
Line variation	(±10%)	$< 1 \times 10^{-7}$	$< 1 \times 10^{-10}$
Warm-up		–	$< 1 \times 10^{-8}$ within 5 min. after turn-on at 25°C
Temperature stability	(0-55°C)	$< 1 \times 10^{-6}$	$< 3 \times 10^{-9}$

General information

Save and recall: Up to 9 complete instrument setups may be saved and later recalled. These setups are retained when power is removed.

Sample rate: User-selectable
Fast (nominally 20 ms between readings), Medium (nominally 250 ms between readings), Slow (nominally 1 s between readings) and Hold.

Size: 330mm W x 156 mm H x 376 mm

Operating temperature: 0-55°C
With battery option: 0-40°C

Weight: 4.5 kg without battery option, 6.6 kg with battery option

Warranty: 1 year

Ordering Information

Agilent 53147A
20 GHz Counter/Power Meter/DVM

Agilent 53148A
26.5 GHz Counter/Power Meter/

Agilent 53149A
46 GHz Counter/Power Meter/DVM

Option 001 Oven timebase

Option 002 Battery and DC input

Option 007 Soft carrying case

Option 1CM Rack mounting kit

Power Sensors

8481B 25 W Power Sensor, 18 GHz

8482B 25 W Power Sensor, 4.2 GHz

8481H 3 W Power Sensor, 18 GHz

8482H 3 W Power Sensor, 4.2 GHz

8485D 100 mW Power Sensor, 26.5 GHz

8485D-033 100 mW Power Sensor, 33 GHz

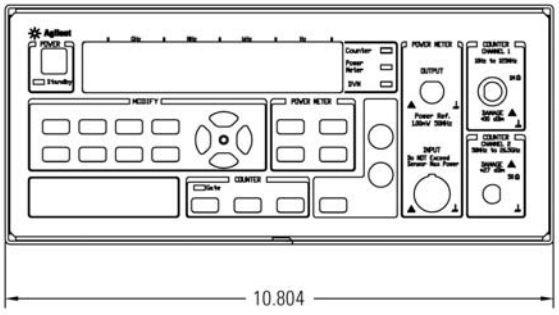
8481A 100 mW Power Sensor, 18 GHz

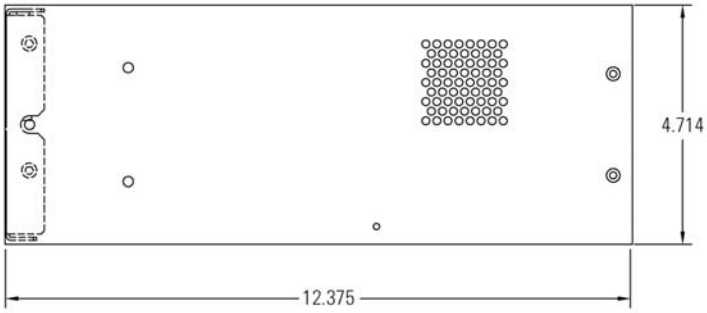
8482A 100 mW Power Sensor, 4.2 GHz

8487A 100 mW Power Sensor, 50 GHz

Application Information

4 Hints for Making Better Microwave Counter Measurements
This Product Note provides four pertinent hints for making better microwave counter measurements, describes the advantages of using a microwave counter, and deals with the unique measurement problems created by the advancement in counter technology.
5967-6195E





More detailed specifications at **www.agilent.com/find/microwavecounters**

Microwave CW Frequency Counter
53150 Series

53150A - 53152A

Ultrawide range, single input (from 50 MHz up to 46 GHz)
Simultaneous power and measurement with analog indicator
GPIB and RS-232 standard
Lightweight and rugged
Optional battery

Abbreviated technical data

Convenience, portability and outstanding performance
The innovative designs of the Agilent 53150 Series microwave counters offer an uncluttered, feature laden front panel. These designs present no-compromise performance and quality in a surprisingly small, light, battery operated product.

The convenience of a single microwave input
The Agilent 53150 Series has an advanced sampler that integrates a separate zero bias Schottky diode for the accurate measurement of input power. This allows measurement of both frequency and power with a single connection. No compromise in frequency coverage is required for this capability. The ultrawideband microwave input covers the entire RF and microwave spectrum, from intermediate frequencies IFs) of 50 MHz to millimeter waves.

The power measurement accuracy and repeatability of these counters rivals power meters with diode sensors.

Input characteristics		Agilent 53150A	Agilent 53151A	Agilent 53152A
Frequency range	**Channel 1** Normal mode Low pass filter enabled	 10 Hz - 125 MHz 10 Hz - 50 kHz	 10 Hz - 125 MHz 10 Hz - 50 kHz	 10 Hz - 125 MHz 10 Hz - 50 kHz
	Channel 2	50 MHz - 20 GHz	50 MHz - 26.5 GHz	50 MHz - 46.0 GHz
Sensitivity	**Channel 1** 10-30 Hz 30 Hz-125 MHz	 40 mV 25 mV	 40 mV 25 mV	 40 mV 25 mV
	Channel 2 50-250 MHz 0.25-12.4 GHz 12.4-18 GHz 18-20 GHz 20-26.5 GHz 26.5-40 GHz 40-46 GHz	 –20 dBm –33 dBm –33 dBm –29 dBm N/A N/A N/A	 –20 dBm –33 dBm –33 dBm –29 dBm –25 dBm N/A N/A	 –20 dBm –33 dBm –30 dBm –27 dBm –27 dBm –23 dBm –17 dBm
Maximum input	**Channel 1**	2 Vrms	2 Vrms	2 Vrms
	Channel 2 50 MHz - 2 GHz 2-46 GHz	 +5 dBm +13 dBm	 +5 dBm +13 dBm	 +5 dBm +13 dBm
Damage level	**Channel 1 / Channel 2**	120 V (DC + AC pk) linearly derated to 5 Vrms at 125 MHz +27 dBm	120 V (DC + AC pk) linearly derated to 5 Vrms at 125 MHz +27 dBm	120 V (DC + AC pk) linearly derated to 5 Vrms at 125 MHz +27 dBm
Impedance (Nominal)	**Channel 1**	1 MΩ / 60 pF	1 MΩ / 60 pF	1 MΩ / 60 pF
	Channel 2	50 Ω	50 Ω	50 Ω
Connector	**Channel 1**	BNC female	BNC female	BNC female
	Channel 2	SMA or APC-3.5 compatible female	SMA or APC-3.5 compatible female	2.92 mm removable, SMA or APC-3.5 compatible female
SWR	**Channel 2** 50-250 MHz 0.25-10 GHz 10-20 GHz 20-26.5 GHz 26.5-46 GHz	 1.5:1 typical 2.0:1 typical 3.0:1 typical N/A N/A	 1.5:1 typical 2.0:1 typical 3.0:1 typical 3.0:1 typical N/A	 1.5:1 typical 2.0:1 typical 3.0:1 typical 2.5:1 typical 2.5:1 typical

More detailed specifications at **www.agilent.com/find/microwavecounters**

Microwave CW Frequency Counter
53150 Series (Continued)

Abbreviated technical data

Field tough but ready for bench-top or ATE applications
The Agilent 53150 Series is as comfortable in the field as in the laboratory. The rugged case with an integrated tilting handle can tolerate the vibration and shock expected in field use. The backlit LCD display ensures visibility in all environments, from dark to full sunlight, at distances exceeding 15 feet.

If AC power is unavailable, the internal, replaceable camcorder batteries provide at least 2.5 hours of continuous operation. The unit can also be powered from an external 11-18 Vdc source.

For benchtop and ATE applications, the Agilent 53150 Series delivers full functionality and high measurement speed. The fully programmable RS-232 interface and high speed GPIB interface are standard features.

General information

Save and recall: Up to 9 complete instrument setups may be saved and later recalled. These setups are retained when power is removed.

Sample rate: User-selectable
Fast (nominally 20 ms between readings), Medium (nominally 250 ms between readings), Slow (nominally 1 s between readings) and Hold.

Size: 213 mm W x 88.5 mm H x 300 mm

Operating temperature: 0-55°C
With battery option: 0-40°C

Weight: 4 kg without battery option, 6.4 kg with battery option

Warranty: 1 year

Programming: GPIB (IEEE-488.1-1987, IEEE 488.2-1987) or RS-232C

Language: SCPI-1992.0 (Standard Commands for Programmable Instruments)

RS-232C rates: User-selectable 2400 19200 baud

Input characteristics		Agilent 53150A	Agilent 53151A	Agilent 53152A
Coupling	**Channel 1**	AC	AC	AC
	Channel 2	AC	AC	AC
Acquisition time (1 MHz FM rate)	**Channel 1**	N/A	N/A	N/A
	Channel 2 (FM Auto/FM Off)	125 ms/100 ms	125 ms/100 ms	140 ms/115 ms
Resolution	**Channel 1/ Channel 2**	1 Hz to 1 MHz	1 Hz to 1 MHz	1 Hz to 1 MHz
Emissions ("kickback noise")	**Channel 1**	N/A	N/A	N/A
	Channel 2 (measuring/ no input)	–40 dBm / <–70 dBm	–40 dBm / <–70 dBm	–40 dBm / <–70 dBm
Residual stability*	**Channel 1**	N/A	N/A	N/A
	Channel 2 *Counter and source tied to same timebase	0.6 LSD rms	0.8 LSD rms	1.25 LSD rms
Accuracy	**Channel 1/ Channel 2**	±1 LSD ± timebase error x frequency	±1 LSD ± timebase error x frequency	±1 LSD ± timebase error x frequency
Measurement time	**Channel 1**	1/Resolution + 20 ms	1/Resolution + 20 ms	1/Resolution + 20 ms
	Channel 2	1/Resolution + acquisition time + 20 ms	1/Resolution + acquisition time + 20 ms	1/Resolution + acquisition time + 20 ms
FM tolerance	**Channel 1**	N/A	N/A	N/A
	Channel 2 (FM Auto) (FM Off)	20 MHz p-p max @ 10 MHz rate 1 MHz p-p @ 10 MHz rate	20 MHz p-p max @ 10 MHz rate 1 MHz p-p @ 10 MHz rate	20 MHz p-p max to 26.5 GHz, 12 MHz p-p max above 26.5 GHz @ 10 MHz rate 1 MHz p-p @ 10 MHz rate
Power measurement	**Channel 1**	N/A	N/A	N/A
	Channel 2	N/A	N/A	N/A
	Range	Counter sensitivity to +7 dBm	Counter sensitivity to +7 dBm	Counter sensitivity to +7 dBm
	Accuracy at input connector** (0 dBm to –20 dBm) 0.05-12.4 GHz 12.4-20 GHz 26.5-46 GHz	 ±1.5 dB ±1.5 dB N/A N/A	 ±1.5 dB ±1.5 dB ±2.0 dB N/A	 ±1.0 dB ±1.5 dB ±1.5 dB ±2.0 dB
	Resolution	0.01 dB	0.01 dB	0.01 dB
	Display	dBm or milliwatts/ microwatts	dBm or milliwatts/ microwatts	dBm or milliwatts/ microwatts

More detailed specifications at **www.agilent.com/find/microwavecounters**

Microwave CW Frequency Counter
53150 Series (Continued)

Internal timebase stability		TCXO Standard	Oven Option 001
Frequency		10 MHz	10 MHz
External Input		1, 2, 5, 10 MHz	1, 2, 5, 10 MHz
Aging rate	Per Day	–	$< 5 \times 10^{-10}$
	Per Month	$< 1 \times 10^{-7}$	$< 1.5 \times 10^{-8}$
Short term	(1 sec. avg. time)	$< 1 \times 10^{-9}$	$< 2 \times 10^{-10}$
Line variation	(±10%)	$< 1 \times 10^{-7}$	$< 1 \times 10^{-10}$
Warm-up		–	$< 1 \times 10^{-8}$ within 5 min.after turn-on at 25°C
Temperature stability	(0-55°C)	$< 1 \times 10^{-6}$	$< 3 \times 10^{-9}$

Power supply:

AC: 90-132 Vac; 47.5-66 Hz or 360-440 216-264 Vac; 47.5-66 Hz line selection: automatic power requirements: 75 VA max. (25 W typ.)

DC (Option 002 only): 11-18 Vdc; 2A

Battery (Option 002):

Type: VHS camcorder, lead acid (2

Charge Time: 8 hours in unit

Capacity: 2.5 hours min. at 25°C

Ordering Information

Agilent 53150A
Microwave frequency counter, 20 GHz

Agilent 53151A
Microwave frequency counter, 26.5 GHz

Agilent 53152A
Microwave frequency counter, 46 GHz

Options

Opt 001 Oven Timebase

Opt 002 Battery and DC input

Accessories

Battery charger 53150-60217

Spare battery 53150-80010

DC Power input cable 53150-60214

Application Information

4 Hints for Making Better Microwave Counter Measurements
This Product Note provides four pertinent hints for making better microwave counter measurements, describes the advantages of using a microwave counter, and deals with the unique measurement problems created by the advancement in counter technology.
5967-6195E

Drivers

None

Function/Arbitrary Waveform Generators

Selection Guide	33220A Function/Arbitrary Waveform Generator, 20 MHz	33250A Function/Arbitrary Waveform Generator, 80 MHz
Frequency range (sine, square)	1 µHz to 20 MHz	1 µHz to 80 MHz
Standard waveforms	Sine, square, pulse, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, DC volts	Sine, square, pulse, triangle, ramp, noise, sin(x)/x, exponential rise and fall, cardiac, DC volts
Arbitrary waveforms	2 to 64 K-points	1 to 64 K-points
Sample rate	50 MSa/s	200 MSa/s
Modulation	AM, FM, PM, FSK, PWM, sweep and burst (all internal/external)	AM, FM, FSK, burst (all internal/external)
Sweep	Linear or logarithmic; up or down	Linear or logarithmic; up or down
External clock reference	Optional External lock range: 10 MHz ± 500 Hz Internal frequency: 10 MHz	Standard External lock range: 10 MHz ± 35 kHz Internal frequency: 10 MHz
Connectivity (Intuilink Software included)	GPIB, USB, LAN	GPIB, RS-232, Optional USB w/82357A

More detailed specifications at **www.agilent.com/find/power**

33220A

Function/Arbitrary Waveform Generator
33220A 20 MHz

20 MHz Sine and Square waveforms
Ramp, Triangle, Noise, and DC waveforms
5 MHz pulse with variable edge-time
14-bit, 50 MSa/s, 64 K-point Arbitrary waveforms
AM, FM, PM, FSK, and PWM modulation types
Linear & logarithmic sweeps and burst operation
LXI class C compliant

Agilent Open

Uncompromising performance for functions and waveforms
The Agilent Technologies 33220A Function/Arbitrary Waveform Generator uses direct digital synthesis (DDS) techniques to create a stable, accurate output signal for clean, low distortion sine waves. It also gives you square waves with fast rise and fall times up to 20 MHz and linear ramp waves up to 200 kHz.

Pulse generation
The 33220A can generate variable-edge-time pulses up to 5 MHz. With variable period, pulse width, and amplitude the 33220A is ideally suited to a wide variety of applications requiring a flexible pulse signal.

Custom waveform generation
Use the 33220A to generate complex custom waveforms. With 14-bit resolution, and a sampling rate of 50 MSa/s, the 33220A gives you the flexibility to create the waveforms you need. It also lets you store up to four waveforms in nonvolatile memory.

Specifications
(at 0° to 55°C unless otherwise specified)

Waveforms	**Standard**	Sine, Square, Ramp, Triangle, Pulse, Noise, DC		
	Built-in arbitrary	Exponential rise, Exponential fall, Negative ramp, Sin(x)/x, Cardiac		
Waveform Characteristics	**Sine**	Frequency Range	1 µHz to 20 MHz	
		Amplitude Flatness[1, 2]	**(relative to 1 kHz)**	
			< 100 kHz	0.1 dB
			100 kHz to 5 MHz	0.15 dB
			5 MHz to 20 MHz	0.3 dB
		Harmonic distortion[2, 3]	**< 1 V_{PP}**	**≥ 1 V_{PP}**
		DC to 20 kHz	-70 dBc	-70 dBc
		20 kHz to 100 kHz	-65 dBc	-60 dBc
		100 kHz to 1 MHz	-50 dBc	-45 dBc
		1 MHz to 20 MHz	-40 dBc	-35 dBc
		Spurious (non-harmonic)[2, 4]		
		DC to 1 MHz	-70 dBc	
		1 MHz to 20 MHz	-70 dBc + 6 dB/octave	
	Square	**Frequency range**	1 µHz to 20 MHz	
		Rise/Fall time	< 13 ns	
		Overshoot	< 2%	
		Variable duty cycle	20% to 80% (to 10 MHz) 40% to 60% (to 20 MHz)	
	Ramp, Triangle	Frequency range	1 µHz to 200 kHz	
		Linearity	< 0.1% of peak output	
		Variable Symmetry	0.0% to 100.0%	
	Pulse	Frequency range	500 µHz to 5 MHz	
		Pulse width (period ≤ 10s)	20 ns minimum, 10 ns resolution	
		Variable edge time	< 13 ns to 100 ns	
	Noise	Bandwidth	10 MHz typical	
	Arbitrary	Frequency range	1 µHz to 6 MHz	
		Waveform length	2 to 64 K points	
		Amplitude resolution	14 bits (including sign)	
		Sample rate	50 MSa/s	
		Non-volatile memory	four waveforms	

More detailed specifications at **www.agilent.com/find/33220A**

Function/Arbitrary Waveform Generator
33220A 20 MHz (Continued)

Specifications
(at 0° to 55°C unless otherwise specified)

Easy-to-use functionality
Front-panel operation of the 33220A is straight-forward and user friendly. You can access all major functions with a single key or two. The knob or numeric keypad can be used to adjust frequency, amplitude, offset, and other parameters. You can even enter voltage values directly in V_{pp}, V_{rms}, dBm, or as high and low levels. Timing parameters can be entered in Hertz (Hz) or seconds.

Internal AM, FM, PM, FSK, and PWM modulation make it easy to modulate waveforms without the need for a separate modulation source. Linear and logarithmic sweeps are also built in, with sweep rates selectable from 1 ms to 500 s. Burst mode operation allows for a user-selected number of cycles per period of time. GPIB, LAN, and USB interfaces are all standard, plus you get full programmability using SCPI commands.

External frequency reference (Option 001)
The 33220A external frequency reference lets you synchronize to an external 10 MHz clock, to another 33220A, or to an Agilent 33250A. Phase adjustments can be made from the front panel or via a computer interface, allowing precise phase calibration and adjustment.

Common Characteristics	**Frequency**	Resolution	1 µHz
	Amplitude	Range	10 mV_{PP} to 10 V_{PP} into 50 Ω 20 mV_{PP} to 20 V_{PP} into open circuit
		Accuracy[1, 2] (at 1 kHz)	± 1% of setting ± 1 mV_{PP}
		Units	V_{PP}, Vrms, dBm
		Resolution	4 digits
	DC Offset	Range (peak AC + DC)	± 5 V into 50 Ω ± 10 V into open circuit
		Accuracy[1, 2]	± 2% of offset setting ± 0.5% of amplitude ± 2 mV
		Resolution	4 digits
	Main Output	Impedance	50 Ω typical
		Isolation	42 Vpk maximum to earth
		Protection	Short-circuit protected, overload automatically disables main output
	Internal Frequency Reference	Accuracy[5]	± 10 ppm in 90 days ± 20 ppm in 1 year
	External Frequency Reference (Option 001)	Rear Panel Input	Lock Range 10 MHz ± 500 Hz
			Level 100 mV_{PP} to 5 V_{PP}
			Impedance 1 kΩ typical, AC coupled
			Lock Time < 2 seconds
		Rear Panel Output	Frequency 10 MHz
			Level 632 mV_{PP} (0 dBm), typical
			Impedance 50 Ω typical, AC coupled
		Phase Offset	Range + 360° to - 360°
			Resolution 0.001°
			Accuracy 20 ns
Modulation	**AM, FM, FSK**	Carrier waveforms	Sine, Square, Ramp, Arb
		Source	Internal/External
		Internal modulation	Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
		Depth	0.0% to 120.0%
	PM	Carrier waveforms	Sine, Square, Ramp, Arb
		Source	Internal/External
		Internal modulation	Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
		Deviation	0.0 to 360.0 degrees
	External Modulation Input[6] (for AM, FM, PM, PWM)	Voltage range	± 5 V full scale
		Input impedance	5 kΩ typical
		Bandwidth	DC to 20 kHz

More detailed specifications at **www.agilent.com/find/33220A**

Function/Arbitrary Waveform Generator
33220A 20 MHz (Continued)

Specifications
(at 0° to 55°C unless otherwise specified)

Sweep	**Waveforms**	Sine, Square, Ramp, Arb
	Type	Linear or Logarithmic
	Direction	Up or Down
	Sweep time	1 ms to 500 s
	Trigger	Single, External, or Internal
	Marker	falling edge of sync signal (programmable frequency)
Burst[7]	**Waveforms**	Sine, Square, Ramp, Triangle, Pulse, Noise, Arb
	Type	Counted (1 to 50,000 cycles), Infinite, Gated
	Start/Stop Phase	-360° to +360°
	Internal Period	1 µs to 500 s
	Gate Source	External trigger
	Trigger source	Single, External or Internal
General	**Power Supply**	CAT II 100 - 240 V @ 50/60 Hz (-5%, +10%) 100 - 120 V @ 400 Hz (±10%)
	Power Consumption	50 VA max
	Operating Temperature	0°C to 55°C
	Interface	USB, GPIB, and LAN standard
	Language	SCPI - 1993, IEEE-488.2
	Dimensions Bench top Rack mount	**(W x H x D)** 261.1 mm x 103.8 mm x 303.2 mm 212.8 mm x 88.3 mm x 272.3 mm
	Weight	3.4 kg (7.5 lbs)
	Warranty	1 year

Connectivity
The Agilent IntuiLink Arbitrary Waveform software allows you to easily create, edit, and download complex waveforms using the waveform editor. Or you can capture a waveform using IntuiLink for Oscilloscope and send it to the 33220A for output. To find out more about IntuiLink, visit **www.agilent.com/find/intuilink.**

Software Driver:
- SCPI
- VXI*Plug&Play*
- IVI.com

Ordering Information
Agilent 33220A
20 MHz Function/Arbitrary Wavefrom Generator

Accessories included
Operating manual, service manual, quick reference guide, IntuiLink waveform editor software, test data, USB cable, and power cord.

Options

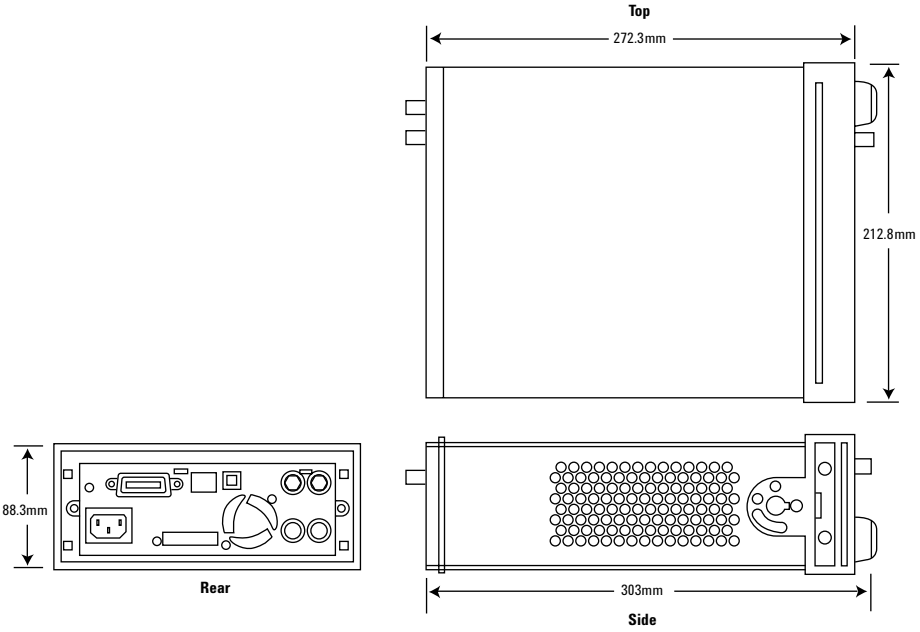
Opt. 001	External frequency reference
Opt. 0B0	Delete manual
Opt. 1CM	Rackmount kit (also sold as Agilent 34190A)
Opt. A6J	ANSI Z540 calibration

Other Accessories

34131A	Carrying case
34161A	Accessory pouch
34190A	Rackmount kit

Footnotes:
1. add 1/10th of output amplitude and offset spec per °C for operation outside the range of 18°C to 28°C
2. Autorange enabled
3. DC offset set to 0 V
4. spurious output at low amplitude is –75 dBm typical
5. add 1 ppm/°C average for operation outside the range of 18°C to 28°C
6. FSK uses trigger input (1 MHz maximum)
7. Sine and square waveforms above 6 MHz are allowed only with an "infinite" burst count

Agilent Model: 33220A



More detailed specifications at **www.agilent.com/find/33220A**

33250A

Function/Arbitrary Waveform Generator
33250A 80 MHz

80 MHz sine and square waveforms
Ramp, triangle noise and other waveforms
50 MHz pulse waveforms with variable edge time
12-bit, 200 MSa/s, 64K-point deep arbitrary waveform
AM, FM, PM, FSK linear & logarithmic sweeps and burst

Standard Waveforms

The Agilent Technologies 33250A Function/Arbitrary Waveform Generator uses direct digital-synthesis techniques to create a stable, accurate output on all waveforms, down to 1 µHz frequency resolution. The benefits are apparent in every signal you produce, from the sine wave frequency accuracy to the fast rise/fall times of square waves, to the ramp linearity.

Front-panel operation of the 33250A is straightforward and user friendly. The knob or numeric keypad can be used to adjust frequency, amplitude and offset. You can even enter voltage values directly in Vpp, Vrms, dBm, or high/low levels. Timing parameters can be entered in hertz (Hz) or seconds.

Custom Waveform Generation

Why settle for a basic function generator when you can get arbitrary waveforms at no extra cost? With the 33250A, you can generate arbitrary waveforms with 12-bit vertical resolution, 64K memory depth, and a sample rate of 200 MSa/s. You can also store up to four 64K-deep arbitrary waveforms in non-volatile memory with user-defined names to help you find the right waveform when you need it most.

Specifications
(at 0° to 55°C unless otherwise specified)

Waveforms	**Standard**	sine, square, pulse, ramp, noise, sin(x)/x, exponential rise, exponential fall, cardiac, DC volts		
	Arbitrary	Waveform length	1 to 64K points	
		Amplitude resolution	12 bits (including sign)	
		Repetition rate	1 µHz to 25 MHz	
		Sample rate	200 MSa/s	
		Filter bandwidth	50 MHz	
		Non-vol. memory	Four (4) 64K waveforms	
Frequency Characteristics	**Sine**	1 µHz to 80 MHz		
	Square	1 µHz to 80 MHz		
	Pulse	500 µHz to 50 MHz		
	Arb	1 µHz to 25 MHz		
	Ramp	1 µHz to 1 MHz		
	White noise	50 MHz bandwidth		
	Resolution	1 µHz; except pulse, 5 digits		
	Accuracy (1 year)	2 ppm, 18°C to 28°C 3 ppm, 0°C to 55°C		
Sinewave Spectral Purity	**Harmonic distortion**		**≤ 3 Vpp**[1]	**> 3 Vpp**
		DC to 1 MHz	-60 dBc	-55 dBc
		1 to 5 MHz	-57 dBc	-45 dBc
		5 to 80 MHz	-37 dBc	-30 dBc
	Spurious (non-harmonic)[2]			
		DC to 1 MHz	-60 dBc	
		1 to 20 MHz	-50 dBc	
		20 to 80 MHz	-50 dBc + 6 dBc/octave	
Signal Characteristics	**Squarewave**	Rise/Fall time	< 8 ns	
		Overshoot	< 5%	
		Asymmetry	1% of period + 1 ns	
	Pulse	Period	20.00 ns to 2000.0 s	
		Pulse width	8.0 ns to 1999.9 s	
		Variable edge time	5.00 ns to 1.00 ms	

More detailed specifications at **www.agilent.com/find/33250A**

Function/Arbitrary Waveform Generator
33250A 80 MHz (Continued)

Pulse Generation
The 33250A can generate simple pulses up to 50 MHz. With variable edge time, pulse width and voltage level, the 33250A is ideally suited to a wide variety of pulse applications.

Built-in Versatility
AM, FM and FSK capabilities make it easy to modulate waveforms with or without a separate source. Linear or logarithmic sweeps can be performed with a programmable frequency marker signal. Programmable burst count and gating allow you to further customize your signal.

Color Graphical Display
The unique design of the 33250A combines a low-profile instrument with the benefits of a color graphical display. Now you can display multiple waveform parameters at the same time. The graphical interface also allows you to modify arbitrary waveforms quickly and easily.

Timebase Stability and Clock Reference
The 33250A TCXO timebase gives you frequency accuracy of 2 ppm for your most demanding applications. The external clock reference input/output lets you synchronize to an external 10 MHz clock, to another 33250A, or to an Agilent 33220A. Phase adjustments can be made from the front panel or via a computer interface, allowing precise phase calibration and adjustment.

Specifications
(at 0° to 55°C unless otherwise specified)

Signal Characteristics (Continued)	**Ramp**	Linearity	< 0.1% of peak output	
		Symmetry	0.0% - 100.0%	
	Arb	Min. edge time	< 10 ns	
		Linearity	< 0.1% of peak output	
		Settling time	< 50 ns to 0.5% of final value	
Output Characteristics	**Amplitude** (into 50 Ω)		10 mVpp to 10 Vpp	
		Accuracy (at 1 kHz, >10 mVpp, Autorange)	± 1% of setting ± 1 mVpp	
		Flatness (sinewave relative to 1 kHz, Autorange)	< 10 MHz 10 to 50 MHz 50 to 80 MHz	± 1% (0.1 dB) ± 2% (0.2 dB) ± 5% (0.4 dB)
		Units	Vpp, Vrms, dBm, high and low level	
		Resolution	0.1 mV or 4 digits	
	Offset (into 50 Ω)		± 5 Vpk AC + DC	
		Accuracy	1% of setting + 2 mV + 0.5% of amplitude	
	Waveform Output	Impedance	50 Ω typical (fixed)	
			>10 MΩ (output disabled)	
		Isolation	42 Vpk maximum to earth	
		Protection	short-circuit protected; overload automatically disables main output	
Modulation	**AM, FM**	Carrier waveforms	sine, square, ramp, and arb	
		Mod. waveforms	sine, square, ramp, noise, and arb	
		Mod. frequency	2 mHz to 20 kHz	
		Source	internal/external	
	FSK	Carrier waveforms	sine, square, ramp, and arb	
		Mod. waveform	50% duty cycle square	
		Internal rate	2 mHz to 1 MHz	
		Frequency range	1 µHz to 80 MHz	
		Source	internal/external	
	External Modulation Input	Voltage range	± 5 V full scale	
		Input impedance	10 kΩ	
		Frequency	DC to 20 kHz	
Burst	**Waveforms**	sine, square, ramp, pulse, arb, and noise		
	Frequency	1 µHz to 80 MHz[3]		
	Burst count	1 to 1,000,000 cycles or infinite		
Sweep	**Waveforms**	sine, square, ramp, and arb		
	Type	linear and logarithmic		
	Direction	up or down		

More detailed specifications at **www.agilent.com/find/33250A**

Function/Arbitrary Waveform Generator
33250A 80 MHz (Continued)

Specifications
(at 0° to 55°C unless otherwise specified)

Connectivity
For system applications, both GPIB and RS-232 interfaces are standard, and support full programmability using SCPI commands.

The included Agilent IntuiLink software allows you to easily create, edit, and download complex waveforms using the intuiLink Arbitrary Waveform Editor. Or you can capture a waveform using IntuiLink oscilloscope or DMM and send it to the 33250A for output. For programmers, ActiveX components can be used to control the instrument using SCPI commands. IntuiLink provides the tools to easily create, download, and manage wave-forms for your 33250A.

Software Driver:
- SCPI
- VXI*Plug&Play*
- IVI.com

Ordering Information
Agilent 33250A
80 MHz Function/Arbitrary Wavefrom Generator

Accessories included
Operating manual, service manual, quick reference guide, IntuiLink waveform editor software, test data, RS-232 cable, and power cord.

Options

Opt. 0B0	Delete manual
Opt. 1CM	Rackmount kit (also sold as Agilent 34190A)
Opt. A6J	ANSI Z540 calibration

Other Accessories

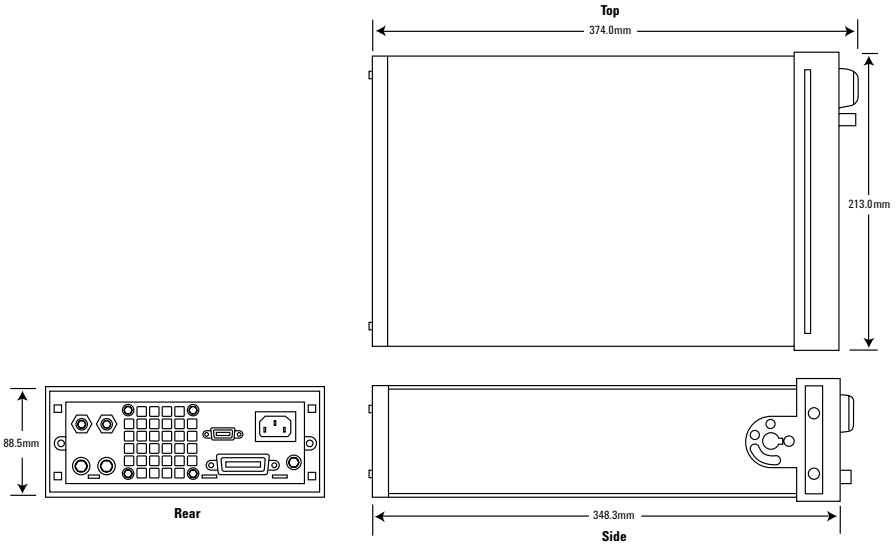
82357A	Optional USB
34131A	Carrying case
34161A	Accessory pouch
34190A	Rackmount kit*

* For racking two 33250As side-by-side, order the following items: Lock-link kit (p/n 5061-9694), Flange kit (p/n 5063-9212)

System Characteristics			
Clock Reference	**Phase Offset**	Range	-360° to +360°
		Resolution	0.001°
	External Reference Input	Lock range	10 MHz ± 35 kHz
		Level	100 mVpp to 5 Vpp
		Impedance	1 kΩ nominal, AC coupled
		Lock time	< 2 s
	Internal Reference Output	Frequency	10 MHz
		Level	632 mVpp (0 dbm), nominal
		Impedance	50 Ω nominal, AC coupled
Sync Output	**Level**	TTL compatible into > 1 kΩ	
	Impedance	50 Ω nominal	
General	**Power supply**	100-240 V, 50-60 Hz 100-127 V, 50-400 Hz	
	Power consumption	140 VA	
	Operating temp.	0°C to 55°C	
	Stored states	4 named user configurations	
	Interface	IEEE-488 and RS-232 std.	
	Language	SCPI-1997, IEEE-488.2	
	Dimensions	(WxHxD)	
		Bench top	254 x 104 x 374 mm
		Rackmount	213 x 89 x 348 mm
	Weight	4.6 kg	
	Warranty	1 year	

Notes:
1 Harmonic distortion at low amplitudes is limited by a -70 dBm floor
2 Spurious noise at low amplitudes is limited by a -75 dBm floor
3 Sine and square waveforms above 25 MHz only with infinite burst count

Agilent Model: 33250A



More detailed specifications at **www.agilent.com/find/33250A**

VXI Instruments, 3499 Switch Solutions and Connectivity Products

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Agilent provides more full-featured VXI instrument modules than any other industry-wide open standard architecture. Instruments include C-size and B-size mainframes, multimeters, counters, power meters, digitizers, arbitrary waveform generators, switches, and interfaces. VXI is an ideal solution for systems that require extensive switching with other high-performance instruments - Agilent offers large channel count multiplexers, matrix, and RF switches. You can get complete details including specifics and price at: **www.agilent.com/find/vxi**
For new system development Agilent offers the 34980A a lower cost solution.

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Agilent offers a complete line of cards and converters for GPIB, USB, RS232, and LAN. Software solutions allow you to quickly connect to any instrument from any vendor, and then combine graphical and textual programming tools to measure, test, and analyze data. Agilent's software applications include VEE Pro, T&M Toolkit, IO Libraries Suite, and IntuiLink. Our software products are part of the Agilent Open family of products featuring open software, system-ready instruments and PC-standard I/O. Agilent Open products give you the freedom to choose the right tools for your test solution and the assurance that they will all work together, every time.
For complete details see **www.agilent.com/find/connectivity**

Agilent's 3499 Series Switch Solutions
Agilent's 3499 Series of switches provide a scalable solution with a choice of three mainframes and over 30 switch modules. Switch signals from DC to light- wave, along with RF, 1000 V, or 8 A of current. All mainframe configurations of the 3499 can scan at rates up to 350 channels per second or open/close 200 channels in less than 0.1 second. Programmable control is provided via either RS-232 or GPIB.
For complete details see **www.agilent.com/find/3499**
For new system development Agilent offers the 34980A a lower cost solution.

34980A A Lower Cost Switch Measure Solution
The 34980A is an 8-slot mainframe that has an optional built-in DMM and your choice of 19 plug-in modules including switching from DC 20 GHz, digital I/O, D/A converters, and counters. It's ideal for medium to high-density switching and can be more cost effective than the 34970A in some applications. Complete product details for the 34980A can be found at **www.agilent.com/find/34980A**

Agilent Model Number Index

More detailed specifications at **www.agilent.com/find/power**

Agilent Model Number Index (Continued)

More detailed specifications at **www.agilent.com/find/power**

Agilent Replacement Guide

Index for Obsolete Agilent System and Bench Products

* These products are closest in ratings to the discontinued model, but are not identical. Refer to the catalog for the features and specifications of the suggested alternative products.

Obsolete Model Number	Closest Alternatives*	Obsolete Model Number	Closest Alternatives*
6002A	664xA	**6266B**	6543A
6010A	6030A	**6267B**	6553A
6011A	6031A	**6268B**	6574A
6012B	6032A	**6269B**	6573A
6015A	6035A	**6271B**	6544A
6023A	6033A	**6274B**	6574A
6024A	6038A	**6281A**	E3614A
6028A	6038A	**6282A**	6542A
6034A	6038A	**6284A**	E3615A
6050A	N3300A	**6286A**	6542A
6051A	N3301A	**6289A**	E3616A
6200B	E3616A	**6291A**	6543A
6201B	E3616A	**6294A**	E3617A
6202B	E3616A	**6296A**	6544A
6203B	E3614A	**6299A**	6634B or (2) E3617A
6204B	E2617A	**6384A**	6542A
6205C	(2) E3611A	**6427B**	6552A
6206C	E3617A	**6428B**	6011A
6211A	E3612A	**6433B**	6012B
6212C	E3612A	**6434B**	6012B
6213A	E3610A	**6438B**	6544A, 6634B
6214C	E3610A	**6439B**	6012B
6215A	E3611A	**6448B**	6015A
6216C	E3611A	**6453B**	(2) 6572A
6217A	E3612A	**6456B**	(2) 6572A
6218C	E3612A	**6459A**	(2) 6573A
6220B	E3617A	**6464C**	(2) 6681A
6224B	6453A	**6466C**	(2) 6681A
6226B	6544A	**6612B**	6612C
6227B	(2) E3616A	**6632A**	6632B
6228B	(2) E3617A	**6633A**	6633B
6234A	E3620A	**6634A**	6634B
6235A	E3630A	**6814A/B**	6813B
6236B	E3630A	**6834A/B**	6813B
6237B	E3611A and E3620A	**60501B**	N3302A
6253A	(2) E3615A	**60502B**	N3304A
6255A	(2) E3616A	**60503B**	N3303A
6256B	E6552A	**60504B**	N3306A
6259B	6572A	**60507B**	N3305A
6260B	6572A	**66111A**	66311B
6261B	6573A	**66311A**	66311B
6263B	6542A	**66311D**	66321D
6264B	6552A	**E4350A**	E4350B
6265B	6554A		

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