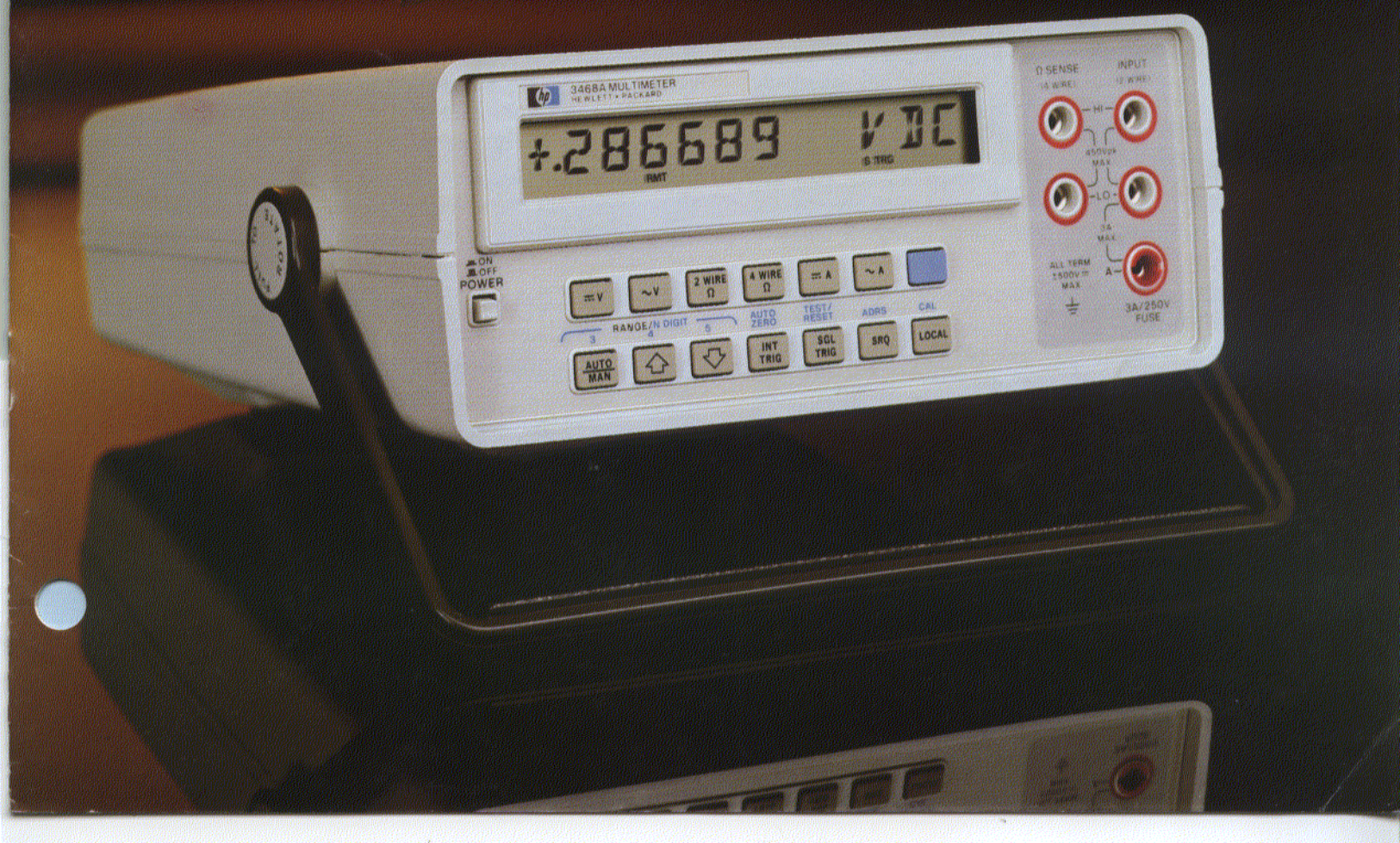
HEWLETT PACKARD

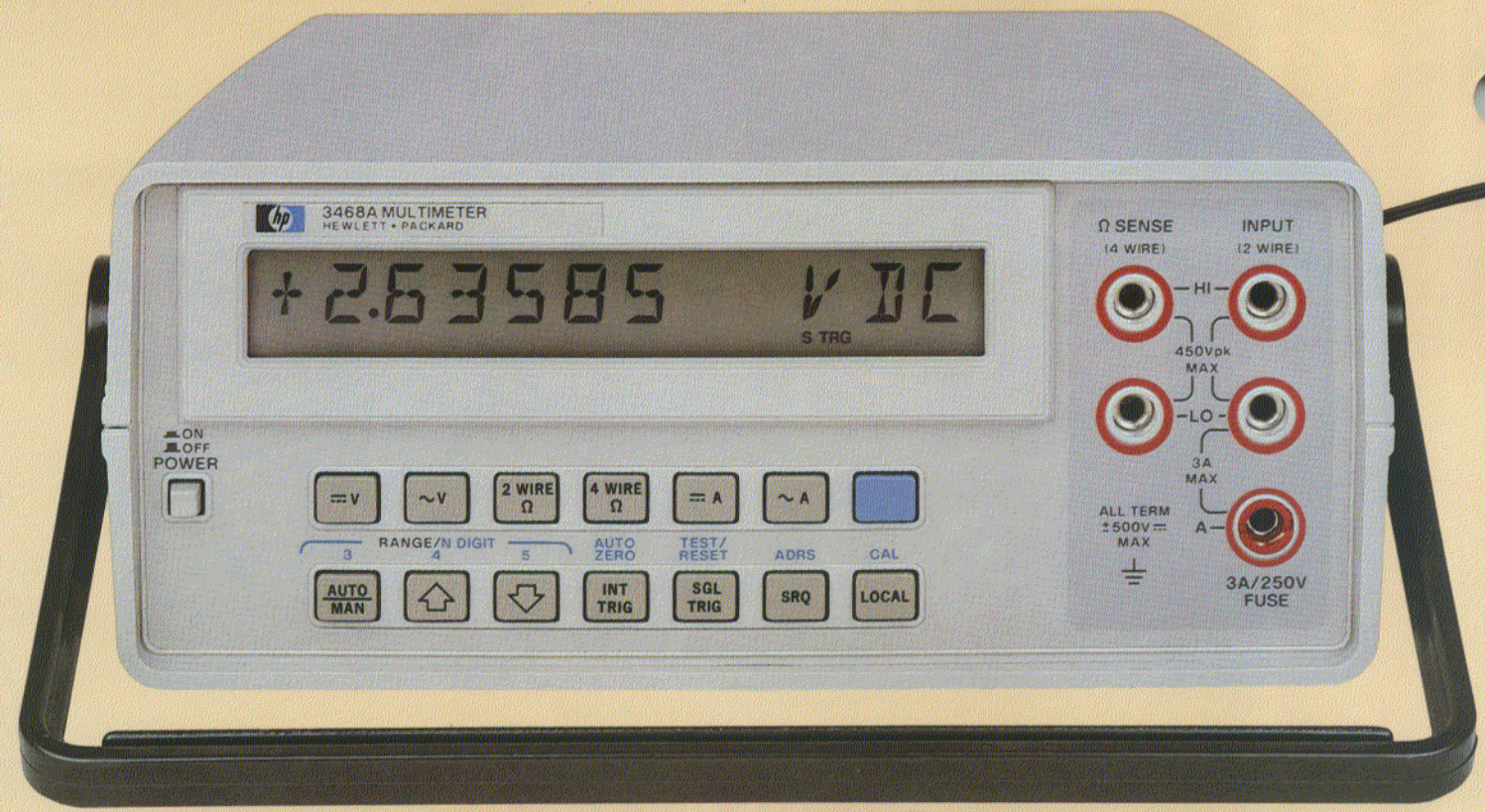
3468A Multimeter

Technical Data November 1981

low-cost bench automation with the new HP-IL interface

HP-IL





- 5½ to 3½ digits
- five functions
- HP-IL* programmable
- electronic calibration

Automate Your Bench Measurements

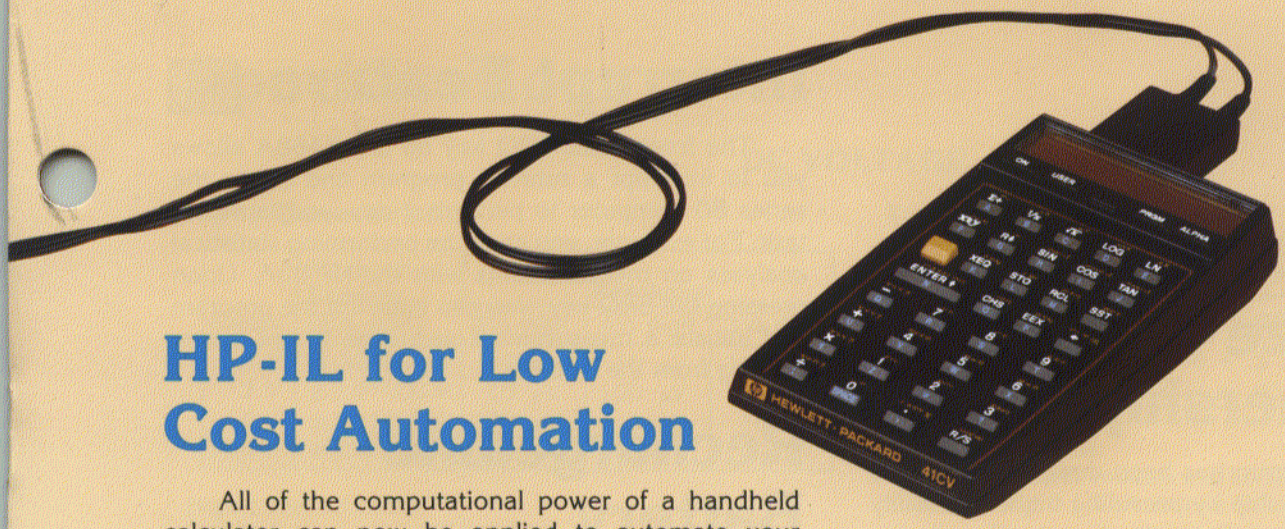
Now, you can combine the bench measurements of a high performance digital multimeter with the advanced computational power of an HP handheld calculator. The HP 3468A is an autoranging, 3½ to 5½ digit, five function dmm with 1 μV sensitivity to solve your most precise bench applications. Equipped with a new two-wire serial interface known as HP-IL (Hewlett-Packard Interface Loop), the 3468A can be controlled with HP handheld calculators such as the 41C/CV.

The 3468A can be completely calibrated electronically without any adjustments, providing you with an easy and simple calibration procedure for a lower cost of ownership.

* HP-IL is Hewlett-Packard's new two-wire serial interface for small, low cost, battery-operable systems.

Analyzing measurements on IC samples.

Testing design of PH meters.



HP-IL for Low Cost Automation

All of the computational power of a handheld calculator can now be applied to automate your measurements. The 3468A is fully programmable with HP-IL, a new two-wire serial interface and the HP 41C/CV calculators or the more powerful HP series 80 desktop computers. The 41C/CV are powerful programmable calculators that can expand to 2,000 lines of program memory.

With the power of a programmable calculator and the 3468A, you can easily develop software that analyzes and stores data for your specific application. For example, if you need to measure temperature, use the 41C/CV to linearize your transducer device and display the results in degrees C or degrees F right on the display of the 3468A. With a simple 41C/CV program, you can have the 3468A display in dBm referenced to any impedance for audio and telecommunications applications. For applications such as resistor tolerance or performance testing of a device, the 41C/CV can easily be programmed to get data from the 3468A and perform a % error calculation, then display the results in percent on the 3468A. The documentation and Operator's and Programming manuals provided with the HP-IL devices let you get started with your system right away.

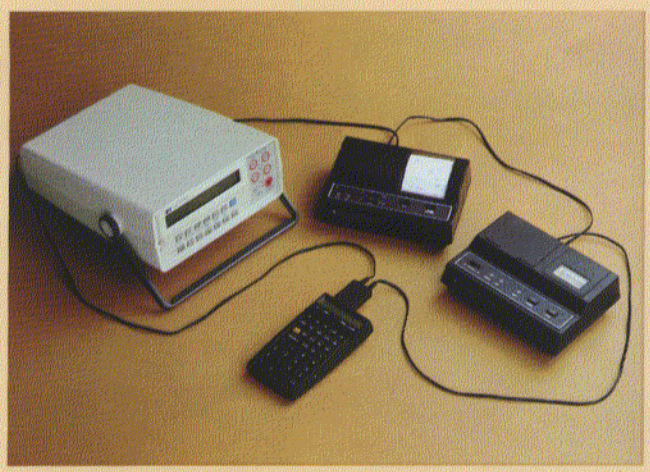
Peripheral equipment, including a printer and cassette drive, are available to further expand your system to provide data recording and mass storage.

High Performance

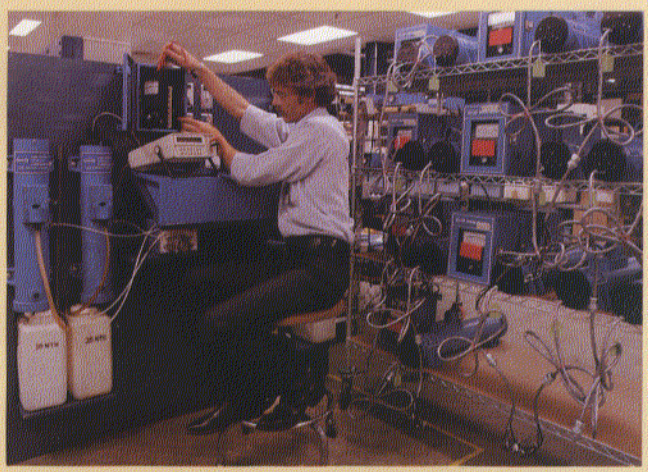
The 3468A lets you measure dc volts, True RMS ac volts, 2- and 4-wire ohms, and current with 3½, 4½ or 5½ digit resolution. You can measure dc and True RMS ac voltage from 0.3 volt full-scale range with 1 μV sensitivity up to 300 volts. This wide dynamic range enables you to detect low level signals and reduces the amount of signal conditioning necessary. Either 2- or 4-wire ohms measurements can be selected with a maximum range of 30 megaohms down to a 1 milliohm sensitivity on the 300 Ω range. You can use 4-wire ohms for reducing errors caused by lead resistance or use 2-wire ohms for convenience. Both dc and True RMS ac current capability is provided up to 3A.

All functions on the 3468A incorporate a fast autoranging to provide answers quickly and accurately.

The 3468A uses an integrating analog to digital conversion technique to give you high noise rejection for your bench measurements. By allowing you to select a display of 3½, 4½ or 5½ digits, you get flexibility in choosing speed or noise rejection.



HP-IL system configuration.

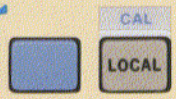


Precision measurements in production.

Minimize Your Cost of Ownership

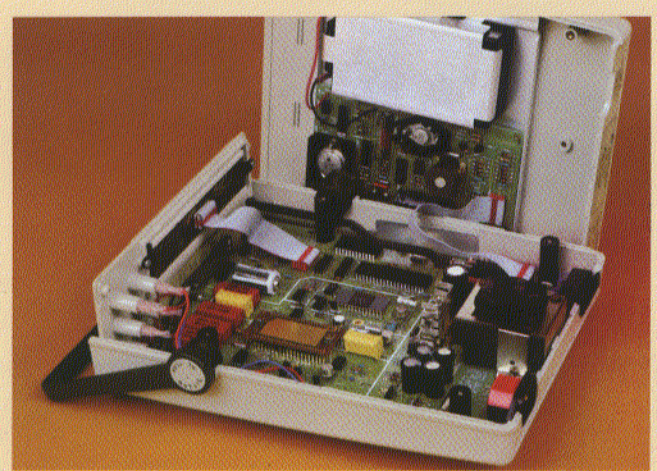
The 3468A dmm has been designed to reduce your cost of ownership by providing higher reliability and easier calibration. Reliability has significantly improved through a design and manufacturing philosophy with uncompromising reliability and quality goals.

Fast Electronic Calibration



Complete calibration of the 3468A is done electronically, either manually from the front panel or remotely in an automatic calibration system. There are no internal adjustments. Complete calibration of all functions is done without removal of the instrument's covers, thus saving valuable time and reducing cost. The calibration procedure for the 3468A involves connecting a calibration standard to the input, then pressing three keystrokes to store one calibration constant in CMOS RAM for each range and function. When the 3468A makes a measurement, each reading is corrected according to the calibration constants that have been stored. The internal CMOS RAM used in the 3468A is powered by a lithium battery to create a nonvolatile memory capable of holding the calibration constants for more than ten years.

Now, you can own a high performance dmm with a high reliability and fast electronic calibration to minimize your cost of ownership.



No internal adjustments for fast calibration.

Interrupt Feature

The front panel SRQ key on the 3468A allows you to interrupt a running program and cause the series 80 computer to perform a new programming task. For example, you could be performing statistical analyses on measurements with the HP 85A. Upon pressing the SRQ key, you can interrupt the program and initiate a measurement sequence to get a new reading from the 3468A.

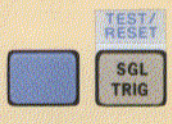
Rechargeable Battery

The optional battery pack includes a rechargeable battery and the battery charger circuitry for up to five hours of continuous portable measurements. Now, you can have a completely portable system with the 3468A and other HP-IL devices that are battery powered.

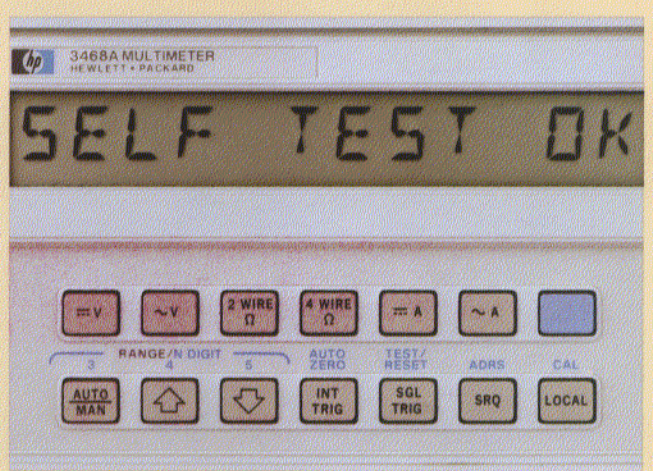
A Smart Display

The 3468A dmm uses an easy-to-read, liquid crystal display that provides measurement units as part of the reading for unambiguous answers. The annunciators below the reading show instrument status and status of the HP-IL interface. With the HP-IL interface you can display words or messages for prompting or displaying answers in user units such as degrees or RPM.

Self-Test



The built-in self-test feature in the 3468A assures you that the instrument is functioning properly. A comprehensive check of both analog and digital circuits is performed while activating all display segments. A message is then displayed, indicating proper operation of the 3468A.



Self-test verifies proper operation.

Specifications

DC VOLTAGE

Input Characteristics:

Range	Maximum Reading (5½ digit)	Resolution		
		5½ digit	4½ digit	3½ digit
.3 V	±.301000 V	1 μV	10 μV	100 μV
3 V	±3.01000 V	10 μV	100 μV	1 mV
30 V	±30.1000 V	100 μV	1 mV	10 mV
300 V	±301.000 V	1 mV	10 mV	100 mV

Input Resistance:
.3 V, 3 V ranges: $>10^{10}\Omega$
30 V, 300 V ranges: 10 MΩ ± 1%

Maximum Input Voltage: (non-destructive)
Hi to Lo: 301 Vrms or 450 V peak
Hi or Lo to Earth Ground: ±500 V peak

Measurement Accuracy:
±(% of reading + number of counts)
Auto zero ON.

5½ DIGIT MODE:

Range	T_{Cal}* ±1°C 24 Hour	T_{Cal}* ±5°C	
		90 Day	1 Year
.3 V	0.005 + 4	0.009 + 5	0.02 + 5
3 V	0.0035 + 2	0.007 + 2	0.018 + 2
30 V	0.005 + 3	0.009 + 3	0.02 + 3
300 V	0.0055 + 2	0.009 + 2	0.02 + 2

4½ AND 3½ DIGIT MODE:
Accuracy is the same as 5½ digit mode for % of reading; use 1 count for number of counts.

*T_{Cal} is the temperature of the environment where the 3468A was calibrated. Calibration should be performed with the temperature of the environment between 20°C and 30°C.

Auto Zero Off:
(5½ digits) For a stable environment (±1°C) for <24 hrs., add 11 counts to accuracy specification for .3 V and 30 V ranges, 3 counts for 3 V and 300 V ranges.

Temperature Coefficient:
0° to 55°C, 5½ digits, auto zero ON.
±(% of reading + number of counts)/°C

Range	Temperature Coefficient
.3 V, 30 V	0.0008 + .5
3 V, 300 V	0.0007 + .05

Noise Rejection:
In dB, with 1 kΩ imbalance in Lo lead. AC rejection for 50, 60 Hz ±0.1%. Auto zero ON.

Display	AC NMR	AC ECMR	DC CMR
5½ digits	80	150	140
4½ digits	59	130	140
3½ digits	0	70	140

Reading Rates: (readings/sec)

MAXIMUM READING RATE WITH HP 85A:

Line Frequency	Auto Zero	Resolution		
		3½ digits	4½ digits	5½ digits
60 Hz	Off	32	21	3.7
	On	25	13.4	2
50 Hz	Off	32	19	3.1
	On	25	12	1.7

MAXIMUM READING RATE WITH 41CV:
2 readings/sec
First reading is correct when triggered coincident with step input.

Display Rate: (readings/sec)

	5½ Digits	4½ or 3½ Digits
Auto Zero Off	4	4
Auto Zero On	2	4

For 50 or 60 Hz operation

Easily develop software for HP-IL systems.

Portable HP-IL system for data gathering.

RESISTANCE (2-wire Ω, 4-wire Ω)

Input Characteristics:

Range	Maximum Reading (5½ digit)	Resolution		
		5½ digit	4½ digit	3½ digit
300 Ω	301.000 Ω	1 mΩ	10 mΩ	100 mΩ
3 kΩ	3.01000 kΩ	10 mΩ	100 mΩ	1 Ω
30 kΩ	30.1000 kΩ	100 mΩ	1 Ω	10 Ω
300 kΩ	301.000 kΩ	1 Ω	10 Ω	100 Ω
3 MΩ	3.01000 MΩ	10 Ω	100 Ω	1 kΩ
30 MΩ	30.1000 MΩ	100 Ω	1 kΩ	10 kΩ

Input Protection: (non-destructive)
Hi source to Lo source: ±350 V peak
Hi sense to Lo sense: ±350 V peak
Hi or Lo to Earth Ground: ±500 V peak

Measurement Accuracy:
±(% of reading + number of counts)
Auto zero ON. 5½ digit display. 4-wire ohms.

Range	T_{Cal} ±1°C	T_{Cal} ±5°C	
	24 Hour	90 Day	1 Year
300 Ω	0.004 + 4	0.012 + 4	0.017 + 5
3 kΩ–300 kΩ	0.004 + 2	0.011 + 2	0.016 + 2
3 MΩ	0.005 + 2	0.011 + 2	0.016 + 2
30 MΩ	0.036 + 2	0.066 + 2	0.078 + 2

2-WIRE OHMS ACCURACY: Same as 4-wire ohms, except add a maximum of 100 mΩ offset

Auto Zero Off:
(5½ digits) For a stable environment (±1°C) for <24 hrs., add 11 counts to accuracy specification for 300 Ω range, 3 counts for 3 kΩ through 300 kΩ ranges, 8 counts for 3 MΩ range, and 33 counts for 30 MΩ range.

Temperature Coefficient:
0° to 55°C, 5½ digits, auto zero ON.
±(% of reading + number of counts)/°C

Range	Temperature Coefficient
300 Ω	0.0009 + 0.5
3 kΩ–300 kΩ	0.0009 + 0.05
3 MΩ	0.0021 + 0.05
30 MΩ	0.021 + 0.05

Current Through Unknown:

Range	300 Ω	3 kΩ	30 kΩ	300 kΩ	3 MΩ	30 MΩ
Current	1 mA	1 mA	100 μA	10 μA	1 μA	100 nA

Maximum Open Circuit Voltage: 6.5 V

Maximum Reading Rates:
Same as dc volts except for 3 MΩ and 30 MΩ ranges. For 3 MΩ range, add 20 ms; for 30 MΩ range, add 200 ms per reading.

AC VOLTAGE (true rms responding)

Input Characteristics:

Range	Maximum Reading (5½ Digit)	Resolution		
		5½ Digit	4½ Digit	3½ Digit
.3 V	.301000 V	1 μV	10 μV	100 μV
3 V	3.01000 V	10 μV	100 μV	1 mV
30 V	30.1000 V	100 μV	1 mV	10 mV
300 V	301.000 V	1 mV	10 mV	100 mV

Input Impedance: 1 MΩ ± 1% shunted by <60 pF

Maximum Input Voltage: (non-destructive)
Hi to Lo: 301 Vrms or 450 V peak
Hi or Lo to Earth Ground: ±500 V peak

Measurement Accuracy:
±(% of reading + number of counts)
Auto zero ON. 5½ digit display. Accuracy is specified for sinewave inputs only, >10% of full scale.

1 Year, T_{Cal} ±5°C.

Frequency	Ranges		
	.3 V	3 V, 30 V	300 V
20–50 Hz	1.14 + 163	1.14 + 102	1.18 + 102
50–100 Hz	0.46 + 163	0.46 + 103	0.5 + 102
100 Hz–20 kHz	0.29 + 163	0.26 + 102	0.33 + 102
20–50 kHz	0.56 + 247	0.41 + 180	0.55 + 180
50–100 kHz	1.74 + 882	1.05 + 825	1.26 + 825
100 k–300 kHz	10.1 + 3720 (30 V range only)		

Auto Zero Off:
(5½ digits) For a stable environment (±1°C) for <24 hrs., add 10 counts to accuracy specification for all ranges.

Temperature Coefficient:
0° to 55°C, 5½ digits, auto zero ON.
For frequencies <20 kHz, ±(0.016% of reading + 10 counts)/°C
For frequencies >20 kHz, ±(0.04% of reading + 10 counts)/°C

Crest Factor:
>4:1 at full scale

Common Mode Rejection:
With 1 kΩ imbalance in Lo lead, >70 dB, dc to 60 Hz

Maximum Reading Rates:
First reading is correct within 70 counts of final value when triggered coincident with step input. Add 0.6 seconds for each range change.

REMOTE CONTROL AND DISPLAY RATE:
For 50 or 60 Hz operation, auto zero ON or OFF.
3½ or 4½ digits: 1.4 readings/sec
5½ digits: 1.0 readings/sec

DC CURRENT

Input Characteristics:

Range	Maximum Reading (5½ digit)	Resolution		
		5½ digit	4½ digit	3½ digit
3A	±3.01000 A	10 μA	100 μA	1 mA

Maximum Input: (non-destructive)
3A from <250 V source; fuse protected

Measurement Accuracy:
±(% of reading + number of counts)
Auto zero ON. 5½ digit display.

Range	T_{Cal} ±5°C	
	90 Days	1 Year
3 A, <1 A input	0.14 + 6	0.17 + 6
3 A, >1 A input	1.0 + 30	1.0 + 30

Auto Zero Off:
(5½ digits) For a stable environment (±1°C) for <24 hrs., add 11 counts to accuracy specification.

Temperature Coefficient:
0° to 55°C, 5½ digits, auto zero ON.
±(0.012 of reading + 0.5 counts)/°C

Maximum Burden at Full Scale:
1 V

Maximum Reading Rates:
Same as dc volts

AC CURRENT (true rms responding)

Input Characteristics:

Range	Maximum Reading (5½ digit)	Resolution		
		5½ digit	4½ digit	3½ digit
.3 A	.301000 A	1 μA	10 μA	100 μA
3 A	3.01000 A	10 μA	100 μA	1 mA

Maximum Input: (non-destructive)
3A from <250 V source; fuse protected

Measurement Accuracy:
±(% of reading + number of counts)
Auto zero ON. 5½ digit display. Accuracy specified for sinewave inputs only, >10% of full scale.

1 Year, T_{Cal} ±5°C

Frequency	Ranges	
	.3 A	3 A
20–50 Hz	1.77 + 163	2.5 + 163
50–1 kHz	1.1 + 163	1.8 + 163
1 k–10 kHz	1.0 + 163	1.7 + 163
10 k–20 kHz	1.14 + 163	1.84 + 163

Auto Zero Off:
(5½ digits) For a stable environment (±1°C) for <24 hrs., add 10 counts to accuracy specification.

Temperature Coefficient:
0° to 55°C, 5½ digits, auto zero ON.
±(0.021% of reading + 10 counts)/°C

Maximum Burden at Full Scale:
1 V

Crest Factor:
>4:1 at full scale

Maximum Reading Rates:
Same as ac volts

GENERAL INFORMATION

Operating Temperature: 0 to 55°C

Humidity Range: 95% R.H., 0 to 40°C

Storage Temperature: –40°C to 75°C; except for battery option, –40°C to +65°C

Warm-up Time: 1 hr. to meet all specifications

Integration Time:

Number of Digits	Line Frequency	
	50 Hz	60 Hz
5½	200 ms	166.7 ms
4½	20 ms	16.67 ms
3½	1.667ms	1.667 ms

Power: AC Line 48–440 Hz; 86–250 V, (see configuration)

Battery: (Option 001) Rechargeable lead-acid; minimum continuous operation for 5 hours at 25°C; recharge time is 16 hours with 3468A off and 36 hours with 3468A on.

Maximum Power: 13 VA

Size: 98.4 mm H x 238.1 mm W x 276.2 mm D (3.88 in H x 9.38 in W x 10.88 in D)

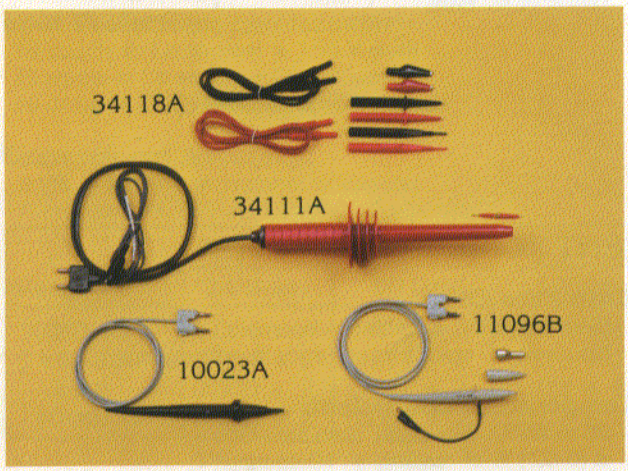
Weight:
3468 — 2,1 kg (4.63 lbs.)
3468A with Option 001 — 3,1 kg (6.83 lbs.)

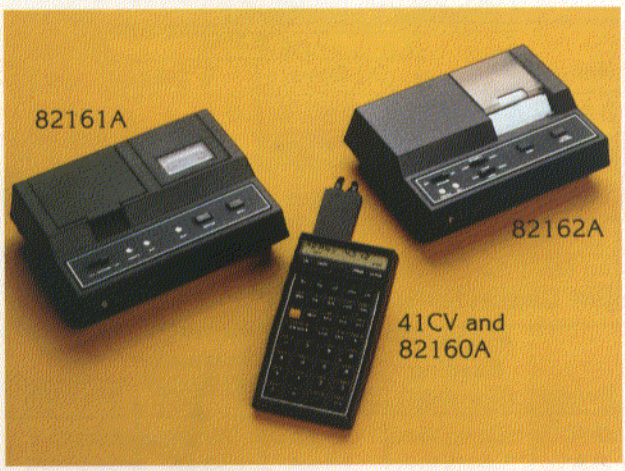
Accessories

Furnished: One pair of test probes

Available Accessories:
34118A Test Lead Kit
11096B RF Probe, detects AC Voltage up to 700 MHz
34111A High Voltage Probe, 1000 to 1 dc High Voltage Divider for up to 40 kVdc
10023A Temperature Probe
34110A Soft Vinyl Carrying/Operating Case

Available HP-IL Products:
41C Calculator
41CV Calculator
82160A HP-IL Interface Module
82161A Digital Cassette Drive
82162A HP-IL Thermal Printer/Plotter
82166A HP-IL Converter (GPIO) (2 each)
82167A HP-IL Cable (.5m)
82938A HP-IL Interface for HP Series 80 Computers





Ordering Information

Configuration:
Order one power and frequency option at no charge from below:
Option 315; 100 volts, 50 Hz
Option 316; 100 volts, 60 Hz
Option 325; 120 volts, 50 Hz
Option 326; 120 volts, 60 Hz
Option 335; 220 volts, 50 Hz
Option 336; 220 volts, 60 Hz
Option 345; 240 volts, 50 Hz
Option 346; 240 volts, 60 Hz

3468A dmm with HP-IL and Test Probes
3468A Option 001, add Rechargeable Battery Pack
3468A Option 910, extra Operating and Service Manual

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For more information, call your local HP Sales Office or nearest Regional Office: • Eastern (201) 265-5000; • Midwestern (312) 255-9800; • Southern (404) 955-1500; • Western (213) 970-7500; • Canadian (416) 678-9430. Ask the operator for instrument sales. Or write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. **In Europe:** Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box, CH 1217 Meyrin 2, Geneva, Switzerland. **In Japan:** Yokogawa-Hewlett-Packard Ltd., 29-21, Takaido-Higashi 3-chome, Suginami-ku, Tokyo 168.

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