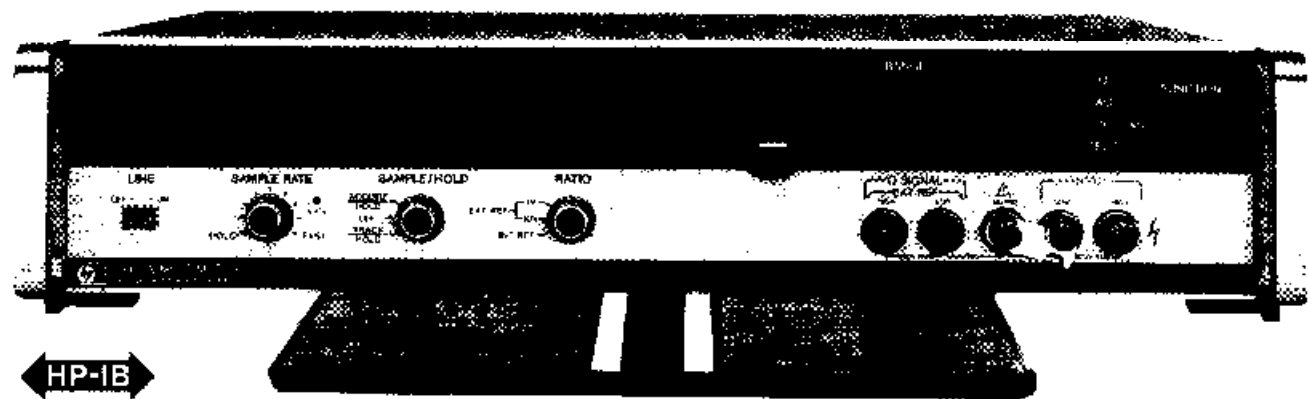


# DIGITAL VOLTMETERS

Five-digit digital multimeter with self-test

Model 3490A



## Description

Hewlett-Packard's Model 3490A Multimeter is a five-digit integrating digital voltmeter. The basic instrument measures dc voltages, ac voltages, and resistances. Additional measurement capability is achieved by the addition of low cost options.

HP's 3490A uses a dual slope integrating technique and is fully guarded, providing excellent noise immunity at five readings per second on all dc ranges. Ranging is automatic over all ranges on all functions. DC measurements can be made with 1  $\mu$ V resolution on the 100 mV range. AC voltage measurements can be made from 20 Hz to 250 kHz in four ranges. The 1 V range provides 10  $\mu$ V of ac voltage resolution. Ohms measurements can be made, utilizing the four-wire conversion technique which eliminates errors due to test lead resistances. Six ranges of ohms, including a 100 $\Omega$  range, are provided. All functions and ranges include 20% overranging except the 1000 V range.

## Display

The 3490A uses Hewlett-Packard's light emitting diodes (LED's). These display digits are the seven segment type. The extremely high reliability of this LED display assures maximum life.

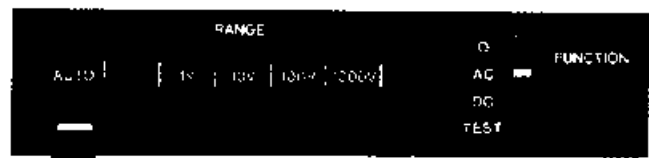
## Self-test

At the flip of a switch, Hewlett-Packard's 3490A Digital Multimeter sequences itself through 10 tests that check timing signals and autoranging circuits, validate the performance of most logic-circuit IC's and check the six-digit LED display. These tests, and six others provided by six additional front-panel switches, cut calibration costs and ensure the DMM is ready to make accurate measurements.



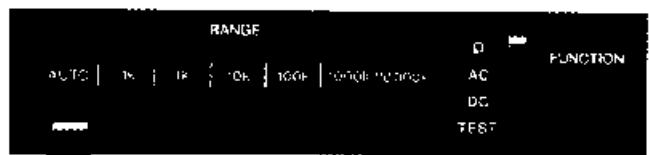
## DC functions

The standard 3490A includes five ranges of dc measurement capability from 100 mV to 1000 V. Measurements are made from the front panel at a precise five readings/s, and at slower rates, using digitally controlled sample rate selector. High input resistance,  $>10^{10}\Omega$  on 100 mV, 1 V, and 10 V range, assures accurate measurement of high impedance sources.



## AC functions

Four ranges of ac measurements are provided. The average ac value is accurately detected, and the rms value is displayed with five digits of resolution. Full autoranging, wide frequency response, and 20% overranging are designed-in features to permit easy operation.



## Ohms

Six ohms ranges are standard, and all ranges provide true four-wire ohms measurement capability. Maximum current through the unknown is approximately 1 mA. Over voltage protection for ohms sensing terminals insures maximum protection against inadvertent application of a high voltage to ohms terminals. Over-voltage protection is provided to 250 V and fuse protection to 1000 V.

### Serviceability

HP's 3490A has been "designed for serviceability." Inside, the 3490's low parts density provides easy access for servicing. Test points and jumpers are keyed to detailed diagnostics.

Several diagnostic aids are available to further minimize 3490A repair time. A service video tape, Accessory No. 11128A, will demonstrate use of self-test and front panel symptoms to isolate failures. The 11126A accessory provides a set of IC reference boards with most of the 3490A logic IC's for use with HP 10529A Logic Comparator. Using these boards with the Logic Comparator, a faulty IC can be isolated in seconds without removing it from the circuit. Also, a spare parts set, Accessory No. 11127A, containing most critical components of the 3490A, will be available.

### Options

#### Systems applications

Model 3490A offers built-in flexibility for systems applications. HP's 3490A offers both HP-IB interface and a bit parallel (BCD coded) interface. This combination provides the necessary versatility to configure the lowest cost instrument system.

#### Ratio, opt 080

DC/DC and AC/DC three-wire ratio measurements can be conveniently added to the 3490A. This capability offers both auto-polarity and a selection of two reference ranges. The 1 V and 10 V ranges are specified from 10% to 120% of selected range. Ratio function is not programmable.

#### 50 Hz operation, opt 050

Maximum noise immunity is achieved when power line frequency is harmonically related to the sample period of the integrating DMM. Option 050 will maximize normal and common mode rejection for 50 Hz power line frequency, and Option 060 will provide this rejection for 60 Hz.

#### Sample/hold, option 040 and 045

Sample/hold provides HP's 3490A with extra and unique measurement capability.

The Sample/hold option has two modes of operation to solve difficult measurement problems.

Track and hold: in this mode, input voltage is held instantly upon receiving an external command. This mode is useful in digitization of repetitive or transient waveforms.

Acquire and hold: in this mode, a known delay is inserted to permit the input amplifier to settle to a specified accuracy. This is useful in measuring pulse height or any similar step input.

#### Digital output, opt 021 and remote control, opt 022

These options provide digital control and data output in the parallel BCD code of 8-4-2-1, either negative or positive true logic. Selection is accomplished by positioning an internal switch. The remote control option provides complete control of all functions, ranges, and external trigger commands. The digital output option provides nine columns of information which includes function, polarity, data, and range. These options may be purchased separately to meet specific application requirements. Either of these options require Option 020 Systems Expand.

### BCD/remote

Both Option 021 and 022 require Option 020, BCD/Remote Expand. This option provides the required internal and external connectors to permit user installation of Digital Output, Opt 021 and/or Remote Control, Opt 022 and should be ordered as an initial option on HP's 3490A. This option includes rear terminals in parallel (switchable front/rear terminals are available as a special - H19).

#### HP-IB (character serial bit parallel) data input/output, opt 030

The data control and data output option permits HP Model 3490A to operate on a single data/control bus with up to 14 other instruments. This serial code is an eight-bit byte typically using an ASCII-type coding. A unique "talker/listener" address structure makes the system's hardware more economical and associated software much simpler. The HP-IB is compatible with Hewlett-Packard Model 9800 Series calculators as well as Hewlett-Packard computers.

### Specifications

#### DC voltage ranges

**Full range display:**  $\pm 1.00000$  V,  $\pm 1.00000$  V,  $\pm 10.0000$  V,  $\pm 100.000$  V,  $\pm 1000.00$  V.

**Overrange:** 20% on all ranges except 1000 V range.

**Range selection:** manual, automatic, or remote (optional).

#### DC voltage performance

**Accuracy:**  $\pm$ (% of reading + % of range).

		0.1 V Range		1 V to 1000 V Range	
		% rdg.	% rng.	% rdg.	% rng.
24 hrs	(23°C $\pm$ 1°C)	$\pm$ (0.005 + 0.001)		$\pm$ (0.004 + 0.001)	
30 days	(23°C $\pm$ 5°C)	$\pm$ (0.01 + 0.005)		$\pm$ (0.008 + 0.002)	
90 days	(23°C $\pm$ 5°C)	$\pm$ (0.01 + 0.005)		$\pm$ (0.01 + 0.002)	
6 months	(23°C $\pm$ 5°C)	$\pm$ (0.013 + 0.005)		$\pm$ (0.013 + 0.002)	
1 year	(23°C $\pm$ 5°C)	$\pm$ (0.015 + 0.005)		$\pm$ (0.015 + 0.002)	

**DC voltage input characteristics:** fully guarded with 140 dB ECMR at dc and 60 Hz  $\pm$ 0.1% with 1 k $\Omega$  imbalance between guard and low.

#### Maximum input voltage:

**0.1 V to 1000 V ranges:**  $\pm$ 1500 V peak.

**Guard to chassis:**  $\pm$ 500 V peak.

**Guard to low:**  $\pm$ 200 V peak.

#### Input resistance:

**0.1 V to 10 V ranges:**  $> 2 \times 10^{10} \Omega$  (<70% R.H.).

**100 V and 1000 V ranges:** 10 M $\Omega$   $\pm$ 0.15%.

**Maximum reading rate:** 5 readings/s.

**Normal mode rejection ratio:** 50 Hz  $\pm$ 0.1%; 60 Hz  $\pm$ 0.1%;  $> 50$  dB.

#### Notes:

- On the 1000 V range, add 0.04 ppm/volt to the % of reading specification.
- Thermal EMF's generated external to the DVM may be compensated to achieve the % of range accuracy specified by utilizing the rear panel zero adjust provided in the 3490A.

#### AC voltage ranges

**Full range display:** 1.00000 V, 10.0000 V, 100.000 V, 1000.00 V.

**Overrange:** 20% on all ranges except 1000 V range.

**Range selection:** manual, automatic, or remote (optional).

## DIGITAL VOLTMETERS

## Model 3490A (cont.)

## AC voltage performance

Accuracy:  $\pm$ (% of reading + % of range):

		20 Hz - 50 Hz	50 Hz - 100 kHz	100 kHz - 250 kHz
24 hrs	(23°C $\pm$ 1°C)	$\pm$ (0.32 + 0.05)	$\pm$ (0.09 + 0.025)	$\pm$ (0.7 + 0.06)
30 days	(23°C $\pm$ 5°C)	$\pm$ (0.35 + 0.05)	$\pm$ (0.1 + 0.025)	$\pm$ (0.75 + 0.06)
90 days	(23°C $\pm$ 5°C)	$\pm$ (0.35 + 0.05)	+ (0.1 + 0.025)	$\pm$ (0.75 + 0.06)
6 months	(23°C $\pm$ 5°C)	$\pm$ (0.40 + 0.06)	$\pm$ (0.1 + 0.03)	+ (0.75 + 0.07)
1 year	(23°C $\pm$ 5°C)	$\pm$ (0.45 + 0.07)	$\pm$ (0.12 + 0.035)	$\pm$ (0.75 + 0.08)

## AC voltage input impedance

Without rear terminals: 2 M $\Omega$   $\pm$ 1% shunted by <65 pF.With rear terminals: 2 M $\Omega$   $\pm$ 1% shunted by <90 pF.

AC voltage maximum reading rate: 1 reading/s.

AC voltage response time: &lt;1 s to within rated accuracy for a step input applied coincident with encode trigger.

AC maximum input voltage: 1000 V rms; +1500 V peak.

## Notes:

- Guard must be connected to low.
- On the 1000 V range, add 0.01 ppm/(volt-kHz).
- Frequencies >100 kHz specified on 1 V and 10 V ranges only.
- Specifications are for input levels above 1/100th of full scale.

## Ohms ranges

Full range display: .100000 k $\Omega$ , 1.00000 k $\Omega$ , 10.0000 k $\Omega$ , 100.000 k $\Omega$ , 1000.00 k $\Omega$ , 10000.0 k $\Omega$ .

Overrange: 20% on all ranges.

Range selection: manual, automatic, or remote (optional).

## Ohms performance

Accuracy:  $\pm$ (% of reading + % of range).

Note: Thermal EMF's generated external to the DVM may be compensated to achieve the % of range accuracy specified by utilizing the rear panel zero adjust provided in HP's 3490A.

		0.1 k $\Omega$		1 k $\Omega$ - 100 k $\Omega$		1000 k $\Omega$		10,000 k $\Omega$	
		% rdg.	% rng.	% rdg.	% rng.	% rdg.	% rng.	% rdg.	% rng.
24 hrs	(23°C $\pm$ 1°C)	$\pm$ (0.006 + 0.001)		$\pm$ (0.005 + 0.001)		$\pm$ (0.007 + 0.001)		$\pm$ (0.025 + 0.001)	
30 days	(23°C $\pm$ 5°C)	$\pm$ (0.012 + 0.005)		$\pm$ (0.010 + 0.002)		$\pm$ (0.012 + 0.002)		$\pm$ (0.035 + 0.002)	
90 days	(23°C $\pm$ 5°C)	$\pm$ (0.012 + 0.005)		$\pm$ (0.012 + 0.002)		$\pm$ (0.015 + 0.002)		$\pm$ (0.035 + 0.002)	
6 months	(23°C $\pm$ 5°C)	$\pm$ (0.015 + 0.005)		$\pm$ (0.015 + 0.002)		$\pm$ (0.020 + 0.002)		$\pm$ (0.040 + 0.002)	
1 year	(23°C $\pm$ 5°C)	$\pm$ (0.018 + 0.005)		$\pm$ (0.018 + 0.002)		$\pm$ (0.025 + 0.002)		$\pm$ (0.050 + 0.002)	

## Ohms terminal characteristics

Maximum voltage generated across unknown: 20 V for overload; 13 V for valid reading.

## Ohms current thru unknown:

0.1 k $\Omega$  to 10 k $\Omega$  range: 1 mA.100 k $\Omega$  to 1000 k $\Omega$  range: 10  $\mu$ A.10,000 k $\Omega$  range: 1  $\mu$ A.

## Ohms overload protection:

Nondestructive: 250 V rms.

Fuse destructive:  $\pm$ 1000 V peak.

## Ohms maximum reading rate:

0.1 k $\Omega$  to 100 k $\Omega$  range: 5 readings/s.1000 k $\Omega$  range: 4 readings/s.10,000 k $\Omega$  range: 2 readings/s.

## General

## Data output (BCD), option 021

Data output is 1-2-4-8 TTL output which is compatible with HP 562A, 5050B, and 5055A Digital Recorders. Either high true or low true logic code can be selected with an internal switch.

Storage temperature: -40°C to +75°C.

## Remote control, option 022

The remote control option uses a low true logic (BCD type) code. Required voltage levels for input signal and output signal levels are listed below.

## BCD and remote terminals:

	High Level	Low Level
DVM Inputs	+3.9 V $\pm$ 1.5 V, 100 $\mu$ A max	+0.3 V $\pm$ 0.3 V, 2 mA max
DVM Outputs	+3.9 V $\pm$ 1.5 V, 400 $\mu$ A max	+0.3 V $\pm$ 0.3 V, 15 mA max

Operating temperature: 0°C to 50°C.

Warm-up time: one hour warm-up required to meet all specifications on the 0.1 V range and the 0.1 k $\Omega$  range. Thirty minutes warm-up required to meet all other specifications.

Humidity range: &lt;95% R.H., 0°C to 40°C.

Power: 100 V, 120 V, 220 V, 240 V +5%, -10%, 48 Hz to 400 Hz line operation  $\leq$ 60 VA with all options.Dimensions: 425.4 mm wide, 85.7 mm high, 466.7 mm deep (16 5/8"  $\times$  3 3/8"  $\times$  18 3/8").

Weight: net, 9.38 kg (20 lb 11 oz). Shipping, 11.79 kg (26 lb).

## Options

Options	Price
020: BCD/remote expand, includes rear terminals in parallel	\$236
021: BCD* — full parallel, 1-2-4-8 code	\$295
022: Remote* — full parallel, 1-2-4-8 code	\$202
030: HP-IB remote control and data output	\$1045
040: Sample-and-hold*	\$525
045: Sample-and-hold (without Opt. 020 or 030)	\$550
050 or 060: 50 Hz or 60 Hz operation	N/C
080: Three-wire ratio	\$236
Rack mounting kit furnished.	

## Model number and name

3490A Digital Multimeter (includes ac, dc, & ohms)	\$1985
Opt 050 Noise Rejection for 50 Hz	N/C
Opt 060 Noise Rejection for 60 Hz	N/C

\*These options require BCD/Remote Expand Option 020 or HP-IB Opt 030.

Note: Rack mounting requires supplies on rear of instrument.