SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The -hp- Model 3480A or 3480B Digital Voltmeter in combination with one of the plug in units available makes measurements with four-digit resolution, and up to 50% overrange capability on most ranges and functions. The display includes a fifth digit "1" for overrange measurements. Polarity selection and display are automatic. Most controls, such as range, function, filter and sample rate selection are contained in the plug-in unit. The following functions and ranges are available in the various plug-in units:

Plug-in Unit	Function and Range
Model 3481A Buffer Amplifier	DC Volts 10 V range
Model 3482A DC Range Unit	DC Volts 100 mV thru 1000 V ranges
Model 3484A Multifunction Unit	DC Volts 100 mV thru 1000 V ranges AC Volts (optional) 1 V thru 1000 V ranges Ohms (optional) 100 Ω thru 10 MΩ ranges
Model 3485A Scanning Unit (10, 20, 30, 40 or 50 channels)	DC Volts 100 mV thru 10 V ranges

1-3. The Model 3480A is a bench model instrument, while the Model 3480B is designed to facilitate rack mounting. The electrical performance of the two models is identical. Throughout this manual, the term 3480A/B will be used when no distinction between instruments is made. Any information that applies to one instrument only will be clearly indicated.

1-4. SPECIFICATIONS.

1-5. Complete specifications for the Model 3480A/B Digital Voltmeter in combination with the various plug-in units are given in Table 1-1.

1-6. OPTIONS.

1-7. Sample/Hold Option 001.

1-8. The Sample/Hold option for the 3480A/B permits accurate scanning of changing input voltage. In addition, the Sample/Hold feature may be used for digitizing low-frequency waveforms, for peak readings, response time measurements, or transient analysis. Any of the available 3480 series plug-in units may be used in an instrument equipped with this option.

1-9. BCD Output Option 003.

1-10. Option 003 provides eight columns of 1-2-4-8 BCD output information, "1" state positive. In addition, a print command signal, a printer holdoff line and positive and negative voltage references are provided. An external trigger connection is also available through the rear panel BCD output connector. Output ground is common with 3480A/B input low. This option may be installed either at the factory or in the field. For field installation, it may be purchased as an accessory, Model 11147A. Option 003 cannot be used with the 3485A plug-in unit.

1-11. Isolated BCD Output 004.

1-12. Option 004 provides the same eight columns of BCD output information as Option 003, in isolated form. All signals at the output connector are isolated from the Model 3480A/B circuits. Isolated signals are referenced to chassis (power line) ground. Option 004 may be installed at the factory only.

1-13. Data Storage Option 005.

1-14. When the 3480A/B is equipped with Data Storage Option 005, up to 50 complete readings may be entered into Data Storage at a rate of 1 reading per millisecond. The output of these stored readings may be governed by an external device. Data Storage is ideal for use with a digital recorder where readings may be taken at high speed, stored, then printed at 10 to 20 lines per second.

1-15. Each stored reading includes all information generated by the 3480A/B including input voltage magnitude, range, function, polarity and overload. The number of readings stored is selectable up to 50, in steps of 10. When stored readings are read out, two additional digits are added to identify the reading number.

1-16. All Data Storage output lines are isolated from the 3480A/B input terminals; consequently, when Data Storage is disabled, the output of the 3480A/B becomes identical to that of Isolated BCD Option 004.

1-17. Ratio Option 002 or H11.

1-18. The Model 3480A/B equipped with the ratio option is capable of making three-terminal ratio measurements, using either a +10 V or +100 V external reference. The

reference input LOW is connected to the unknown input LOW. The front panel display is proportional to the input voltage divided by the reference voltage. The ratio option must be installed at the factory.

1-19. ACCESSORIES SUPPLIED.

1-20. Accessories supplied with the 3480A/B include two printed circuit extender boards, -hp- Part No. 5060-6033, and a rack mount kit (3480B only). A 50-pin mating connector for the BCD output, -hp- Part No. 1251-0086, is supplied with Options 003 and 004. A remote control connector for the Sample/Hold option, -hp- Part No. 1251-1757, is supplied with Option 001.

1-21. ACCESSORIES AVAILABLE.

1-22. A Plug-in Extender Cable, -hp- 11148A, is available for servicing plug-in units with the 3480A (not required for 3480B). This cable permits operation of the plug-in unit outside the instrument.

1-23. A "Y" cable for use with 3480A/B Option 005 Data Storage and an -hp- 5055A Digital Recorder is available as -hp- 11181A Data Storage Cable. This cable is terminated at one end by a 100-pin Data Storage connector. The BCD lines are terminated with a 50-pin connector for use with a digital recorder, and the remote control lines are unterminated.

1-24. The -hp- 11146A Interface Kit is available to link the 3480A/B with the -hp- 2114/2115/2116 Computer. The 3480A/B must be equipped with Option 004 Isolated BCD for use with this interface kit. In addition, if remote control of range and function is desired, the plug-in unit must have Isolated Remote Control.

1-25. The -hp- Model 2070A Data Logger combines a Model 3480A (using any of the plug-in units) and a Model 5055A Digital Recorder in one unit for convenient operation and installation.

1-26. INSTRUMENT AND MANUAL IDENTIFICATION.

1-27. Instrument identification by serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix. Some instruments have a letter separating the two sections of the serial number, indicating the country in which the instrument was manufactured.

1-28. If the four-digit prefix of the serial number of your instrument is lower than the prefix shown on the title page of this manual, backdating information located in Appendix C will define the differences between your instrument and the 3480A/B described in this manual. No change sheet supplement will be supplied for this manual. Any change information has already been integrated into the manual by page revisions. Revised pages are so designated in the lower corner of the page. You may obtain subsequent revisions by returning the questionaire in the front of this manual.

Table 1-1. Specifications.

DC VOLTAGE

Ranges:

3481A	3482A and 3484A	3485A
10 V range only	100 mV 1000 mV 10 V 100 V 1000 V	100 mV 1000 mV 10 V

Overrange: 50 % on all ranges, ± 1200 V max input (peak). (± 50 V peak for 3485A).

Range Selection: manual, automatic or remote.

Automatic Ranging: upranges at 140 % of range; downranges at 10 % of range.

Accuracy (90 days, 25° C ± 5° C, < 95 % relative humidity):

3481A: ± (0.01 % of reading + 0.01 % of range).

3482A and 3484A:
100 mV range: ± (0.01 % of reading + 0.02 % of range).
All other ranges: ± (0.01 % of reading + 0.01 % of range).

3485A:
100 mV range: ± (0.01 % of reading + 0.04 % of range).
1000 mV and 10 V ranges: ± (0.01 % of reading + 0.01 % of range).

Sample/Hold Option 001:
Delay off: does not degrade accuracy of plug-in.
Delay on: add ± 0.02 % of reading to 100 mV range for any plug-in.

Temperature Coefficient (0° C to 55° C):

3481A: ± (0.001 % of reading + 0.0003 % of range)/° C.

3482A, 3484A and 3485A:
100 mV range, Filter Out: ± (0.001 % of reading + 0.0005 % of range)/° C.
100 mV range, Filter A or B: ± (0.001 % of reading + 0.0015 % of range)/° C.
All other ranges, with or without filter: ± (0.001 % of reading + 0.0005 % of range)/° C.

Input Resistance:

3481A: $> 10^{10}$ Ω.

3482A and 3484A:
100 mV, 1000 mV and 10 V ranges: $> 10^{10}$ Ω.
100 V and 1000 V ranges: 10 MΩ ± 0.1 %.

3485A (25° C, < 95 % RH): $> 10^{7}$ Ω.

Effective Common-Mode Rejection: (ECMR is the ratio of the peak common-mode voltage to the resultant error in reading with 1 kΩ unbalance in either lead).

3481A, 3482A and 3484A: > 80 dB, dc to 60 Hz.

3485A:
DC: > 80 dB.
AC (50 - 60 Hz):
Filter Out: > 70 dB.
Filter In: > 105 dB.

Normal-Mode Rejection: (NMR is the ratio of the peak normal-mode signal to the resultant error in reading).

	Filter Position	50 Hz	60 Hz and above
3482A and 3484A:	Out	0 dB	0 dB
	A	> 27 dB	> 30 dB
	B	> 77 dB	> 80 dB
3485A:	Out	0 dB	0 dB
	In	> 27 dB	> 30 dB

OHMS
3484A only, Option 042

Ranges:

100 Ω
1000 Ω
10 kΩ
100 kΩ
1000 kΩ
10 MΩ

Overrange: 50 % on all ranges.

Range Selection: manual, automatic or remote.

Automatic Ranging: upranges at 140 % of range; downranges at 10 % of range.

Accuracy (90 days, 25° C, ± 5° C, < 95 % relative humidity):

100 Ω range: ± (0.02 % of reading + 0.05 % of range).

1000 Ω through 1000 kΩ ranges: ± (0.01 % of reading + 0.01 % of range).

10 MΩ range: ± (0.1 % of reading + 0.01 % of range).

Temperature Coefficient (0° C to 55° C):

100 Ω through 100 kΩ ranges: ± (0.0015 % of reading + 0.0005 % of range)/° C.

1000 kΩ and 10 MΩ ranges: ± (0.0035 % of reading + 0.0005 % of range)/° C.

TRUE RMS AC VOLTAGE
3484A only, Option 043

Ranges:

100 mV
1000 mV
10 V
100 V
1000 V

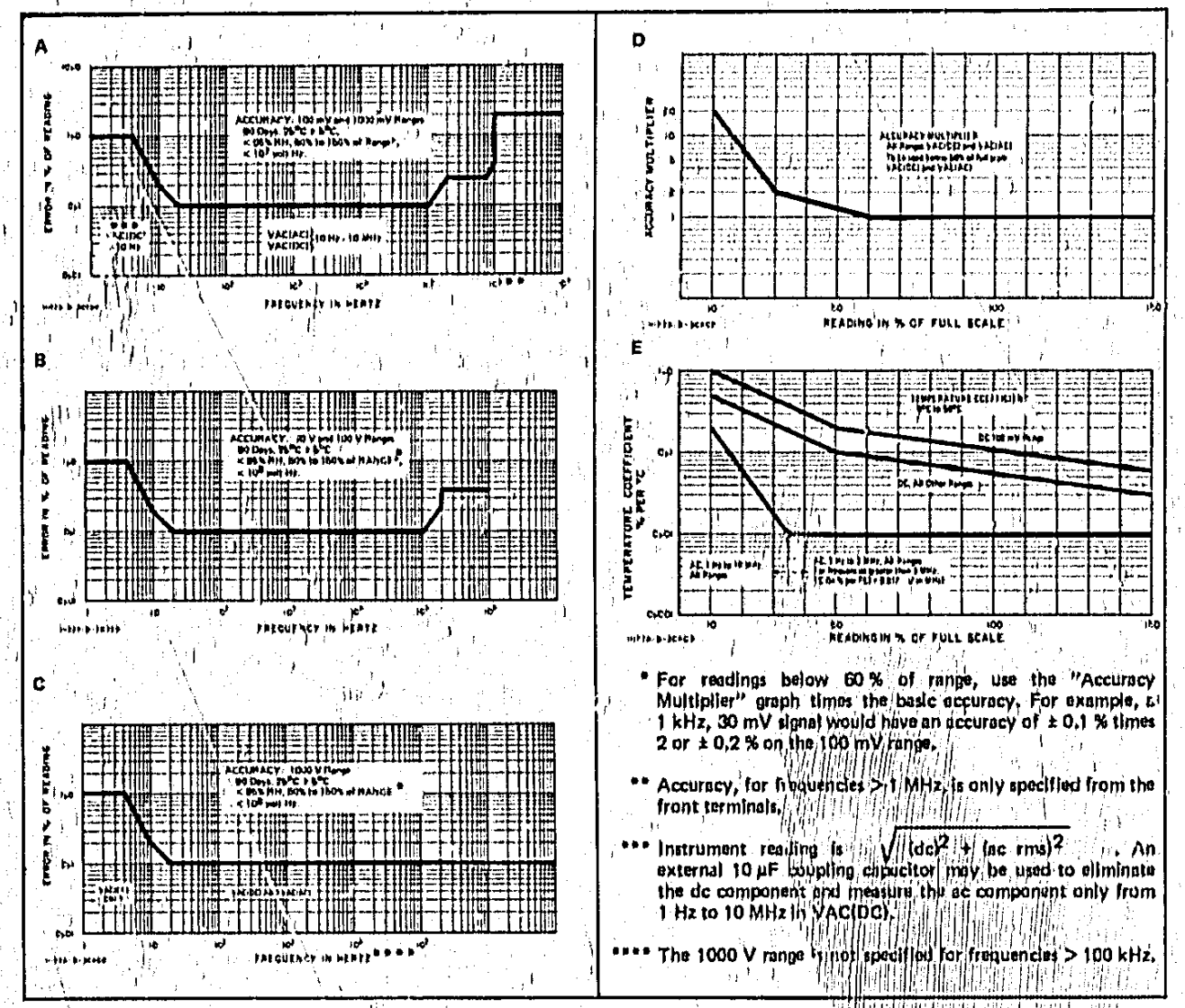
Overrange: 50 % on all ranges, 1500 V peak input.

Range Selection: manual, automatic or remote.

Automatic Ranging: upranges at 140 % of range; downranges at 10 % of range.

Accuracy (90 days, 25° C ± 5° C, < 95 % relative humidity): as specified by graphs A through E.

Table 1-1. Specifications (Cont'd).



* For readings below 60 % of range, use the "Accuracy Multiplier" graph times the basic accuracy. For example, at 1 kHz, 30 mV signal would have an accuracy of ± 0,1 % times 2 or ± 0,2 % on the 100 mV range.

** Accuracy, for frequencies > 1 MHz, is only specified from the front terminals.

*** Instrument reading is $\sqrt{(dc)^2 + (ac\ rms)^2}$. An external 10 µF coupling capacitor may be used to eliminate the dc component and measure the ac component only from 1 Hz to 10 MHz in VAC(DC).

**** The 1000 V range is not specified for frequencies > 100 kHz.

Table 1-2. Typical Operating Characteristics.

DC VOLTAGE

Response Time: (Time required to read within 1 count of final reading when triggered coincident with application of a step input voltage.)

3481A: 1 ms.

3482A and 3484A:
Filter Out: 1 ms.
Filter A: 200 ms.
Filter B: 1 s.

3485A:
Filter Out: 1 ms.
Filter In: 250 ms.

Filter Selection: manual or remote.

Reading Period: 950 µs.

Reading Rate (without range change):

3481A, 3482A and 3484A:
Manual: reading may be initiated manually with front panel pushbutton.
Internal: 1 to ≥25 per second with front panel control.
External: 0 to 1000 per second with external trigger.

3485A scanning and reading rate:
Manual: readings may be initiated manually on any one channel with front panel self-latching Monitor pushbutton at a fixed 3 readings per second.
Internal: readings may be automatically initiated in the Single Scan or Continuous Scan modes at any one of six Channel Delays. Speed ranges from 1 channel per second to 1000 channels per second. With Filter In, a minimum delay of 250 ms is used.
External: 0 to 1000 channels per second with external trigger.

Table 1-2. Typical Operating Characteristics (Cont'd).

3485A Channel Delay: Six delays; 1 s, 500 ms, 250 ms, 125 ms, 62 ms and None. The reading is taken after the selected Channel Delay. In None, the speed is limited mainly by the reading period (1 ms).

Maximum Input Voltages:

3481A, 3482A and 3484A:
Between High and Low terminals: ± 1200 V peak.
Between Low and Guard terminals: ± 200 V peak.
Between Guard and Chassis: ± 500 V peak.

3485A:
High to Low: ± 50 V peak.
Low to Guard: ± 50 V peak.
Guard to Chassis: ± 50 V peak.

Maximum 3485A Operating Voltage (for rated accuracy):

High to Low: ± 15 V dc.

Low to Guard: ± 10 V peak.

Guard to Chassis: ± 50 V peak.

The algebraic sum of all voltages in a path between any Low and any High must not exceed ± 15 V peak.

The maximum algebraic voltage difference between any Low and any other Low must not exceed ± 15 V peak.

Zero Offset (3482A and 3484A):

Voltage stability (at constant temperature): < 10 μV/week.

Voltage temperature coefficient (0° C to 55° C): < ± 1 μV/° C.

Current (25° C ± 5° C): < ± 10 pA.

Current temperature coefficient (0° C to 55° C): < ± 1 pA/° C.

Noise: < 40 μV peak to peak (unfiltered). Peak to peak noise is less than 40 μV 95 % of the time since the noise amplitude approximates a Gaussian distribution where the standard deviation (which is also the rms value) = 10 μV.

OHMS
3484A Option 042

Response Time: (Time required to read within 1 count of final reading when triggered coincident with application of input.)

100 Ω through 100 kΩ ranges (no filtering): 1 ms.

1000 kΩ range (Filter A): 200 ms.

10 MΩ range (Filter A): 2 s.

NOTE: Due to noise generated in the unknown resistance, filtering may be required for quiet readings with inputs > 100 kΩ. Response times with filtering are proportionally less than those shown for inputs below full scale.

Reading Period: 950 μs.

Reading Rate (without range change):

Manual: reading may be initiated manually with front panel pushbutton.

Internal: 1 to ≥ 25 per second with front panel control.

External: 0 to 1000 per second with external trigger.

Autorange Time per Range Change:

Filter Out: 4 ms.

Filter A: 200 ms.

Filter B: 1 s.

Voltage across Unknown Input: 1 V at full scale, all ranges.

Current through Unknown Input:

100 Ω range: 10 mA.

1000 Ω range: 1 mA.

10 kΩ range: 100 μA.

100 kΩ range: 10 μA.

1000 kΩ range: 1 μA.

10 MΩ range: 100 nA.

Overload Protection: ± 75 V peak maximum input, all ranges.

TRUE RMS AC VOLTAGE
3484A Option 043

Response:

VAC(AC) function: responds to true rms value of ac coupled input signal.

VAC(DC) function: responds to true rms value of dc and ac input signal. Reading is $\sqrt{(dc)^2 + (ac\ rms)^2}$. An external 10 μF coupling capacitor may be used to eliminate the dc component and measure ac component only from 1 Hz to 10 MHz.

Function selection: manual or remote.

Response Time (without range change):

VAC(AC): 1 second to within 10 counts of final reading (input change from 10 % to 100 % of range) or 20 counts of final reading (input change from 100 % to 10 % of range).

VAC(DC): 15 seconds to within 10 counts of final reading.

Reading Rate:

Manual: reading may be initiated manually with front panel pushbutton.

Internal: 1 to ≥ 25 per second with front panel control.

External: 0 to 1000 per second with external trigger.

Autorange Time per Range Change:

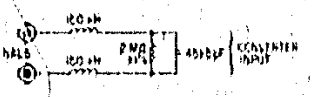
VAC(AC): 1 second.

VAC(DC): 3 seconds.

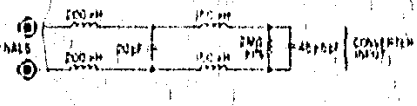
Table 1-2. Typical Operating Characteristics (Cont'd).

Input Impedance:

Front terminals



Rear terminals



Crest Factor: 7:1 at full scale, derated linearly from 35 Hz to 2.2:1 at 5 Hz.

Maximum Input Voltage:

VAC(AC): 1500 V peak ac, 100 V dc (10 V dc max on 100 mV range); dc + ac = 1500 V max.

VAC(DC): 1000 V rms; dc + ac = 1500 V max.

SAMPLE/HOLD
3480A/B Option 001

Acquisition Time: (Time to respond to a plus or minus full-range step input to within ± 0.01 % of final value.)

Range	3481A	3482A, 3484A	3485A
100 mV		100 µs	100 µs
1000 mV		70 µs	70 µs
10 V	25 µs	70 µs	60 µs
100 V		70 µs	
1000 V		70 µs	

Maximum ΔV/ΔT: 8 % of range per µs, Sample/Hold enabled.

Aperature Time: (Time from command to the Sample/Hold option to take a reading to when the signal is actually held.)

100 ns ± 20 ns.

NOTE: A delay of 105 µs ± 20 µs may be added prior to aperature time by using Delay On or by triggering through External Trigger (normal trigger).

Modes of Operation: (Selected manually on rear panel, or remotely.)

Sample-and-Hold:
- On: Sample/Hold enabled.
- Off: Normal 3480 operation.
- Remote: Remote control.

Delay:
- On: 105 µs delay added before Hold.
- Off: No delay.
- Remote: Remote control of delay.

Measuring Speed: Same as DC Voltage measuring speed.

Analog Output: Sample/Hold output for use with an oscilloscope for the measurement and display of repetitive waveforms. Output is 1 V ± 2 % for full-range input; source resistance 1 kΩ ± 2 %.

GENERAL

Power: 115 V or 230 V ± 10 %, 40 Hz to 440 Hz, 60 VA max including any plug-in or options.

Operating Temperature: 0° C to 55° C.

Storage Temperature: -40° C to +75° C.