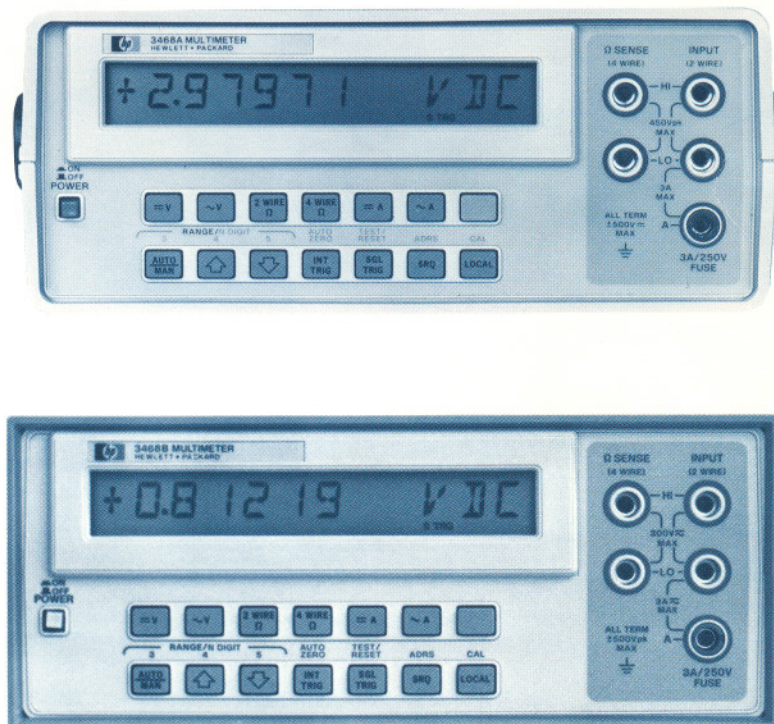


# DIGITAL MULTIMETER

3468A/B





# SECTION I

## GENERAL INFORMATION

### WARNING

*The information in this manual is for the use of Service Trained Personnel. To avoid electrical shock, do not perform any procedures in the manual or do any servicing to the 3468A/B unless you are qualified to do so.*

#### 1-1. INTRODUCTION

1-2. The information in this manual is for the Installation, Operation, Performance, Calibration, and Service of the 3468A/B Digital Multimeter. The manual is designed for the use of Service Trained Personnel. Other users should refer to the Operators Manual. This manual is separated into the following sections.

#### 1-3. Section I, General Information

1-4. A short description of the manual and introduction to the 3468A/B is in Section I. The section also lists instrument specifications and accessories.

#### 1-5. Section II, Installation Procedures

1-6. This section explains how the 3468A/B is prepared for use and includes power requirements, line voltage selection, etc. The section also explains how to connect the multimeter for remote operation.

#### 1-7. Section III, Operation

1-8. The condensed operating instructions of the 3468A/B, for the use of Service trained Personnel, is in this section. For more complete instructions, refer to the Operators Manual.

#### 1-9. Section IV, Performance Test and Calibration

1-10. The 3468A/B's Performance Test and Calibration Procedures are in Section IV. The Required Equipment Table and an abbreviated specification table are also included.

#### 1-11. Section V, Replaceable Parts

1-12. Section V lists the replaceable parts of the 3468A/B. It also includes pictures and illustrations of chassis and mechanical parts.

#### 1-13. Section VI, Backdating

1-14. This section has information for adapting the manual to 3468A/B's with serial numbers below the ones shown on the title page.

#### 1-15. Section VII, Service

1-16. The 3468A/B's Troubleshooting Procedures, Theory Of Operation, and Schematics are in Section VII. The troubleshooting information is in the form of Service Groups which are symptoms oriented (i.e., what is the failure). The complete theory of operation is in Service Group F and the Schematics are in Service Group G (last group).

#### 1-17. Appendix A

1-18. The appendix has a condensed description of the HP-IL (Hewlett-Packard Interface Loop).

#### 1-19. DESCRIPTION

1-20. The -hp- Model 3468A/B is a versatile multimeter with dc and ac volts, dc and ac current, and resistance measurement capabilities. The multimeter is excellent for bench use, and since it is remotely programmable, it can be used in measurement systems: A feature of the instrument is that the reading can be displayed in either 5 1/2, 4 1/2, or 3 1/2 digits. Other features are Autozero (for good stability), and an AlphaNumeric Liquid Crystal Display.

1-21. Another excellent feature is Electronic Calibration. No mechanical adjustments are necessary to calibrate the 3468A/B.

#### 1-22. SPECIFICATIONS

1-23. Specifications of the 3468A/B are the performance characteristics of the multimeter which are certified. The specifications are listed in Table 1-1 and Table 4-1 (in Section IV). They are the performance standards or limits against which the multimeter can be tested.

#### 1-24. INSTRUMENT AND MANUAL IDENTIFICATION

1-25. Instrument Identification is by a serial number located on the multimeter's rear panel. Hewlett-Packard uses a two-part serial number with the first part (prefix) identifying a series of instruments and the second part (suffix) identifies a particular instrument within a series. An -hp- assigned alpha character between the prefix and



**Table 1-1. Specifications**

## DC VOLTAGE

### Input Characteristics:

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

### Input Resistance:

.3V, 3V ranges:  $> 10^{10}\Omega$   
 30V, 300V ranges:  $10M\Omega \pm 1\%$

### Maximum Input Voltage: (non-destructive)

Hi to Lo: 301 Vrms or 450V peak  
 Hi or Lo to Earth Ground:  $\pm 500V$  peak

### Measurement Accuracy:

$\pm$  (% of reading + number of counts)  
 Auto-zero ON

### 5½ Digit Mode:

Range	Cal. Temp. $\pm 1^\circ C$		Cal. Temp. $\pm 5^\circ C$	
	24 Hours	90 Day	1 Year	
.3V	0.005 + 4	0.009 + 5	0.02 + 5	
3V	0.0035 + 2	0.007 + 2	0.018 + 2	
30V	0.005 + 3	0.009 + 3	0.02 + 3	
300V	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.

The Cal. Temp. (Calibration Temperature) is the temperature of the environment where the 3468A/B was calibrated. Calibration should be performed with the temperature of the environment between  $20^\circ C$  and  $30^\circ C$ .

### Auto-Zero Off:

(5½ digit) for a stable environment ( $\pm 1^\circ C$ ), for  $< 24$  hrs., add 11 counts to accuracy specification for .3V and 30V ranges, 3 counts for 3V and 300V ranges. For 4½ or 3½ digits, multiply counts by 0.1.

### Temperature Coefficient:

$0^\circ C$  to (Cal. Temp.  $- 5^\circ C$ ), (Cal. Temp.  $+ 5^\circ C$ ) to  $55^\circ C$   
 5½ digit display, auto-zero ON  
 $\pm$  (% of reading + number of counts)/ $^\circ C$

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

### Noise Rejection:

In dB, with  $1k\Omega$  imbalance in Lo lead. AC rejection for 50, 60Hz  $\pm 0.1\%$ . 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

### Maximum Reading Rates: (readings/sec)

First reading is correct within .1 count of final value, when on correct range, triggered coincident with step input.

The reading rates are dependent on the speed of the controller being used.

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

### Maximum Reading Rate with 41CV:

2 readings/sec

### Display Rate: (readings/sec)

For 50 or 60 Hz operation.

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

## Resistance (2-wire $\Omega$ , 4-wire $\Omega$ )

### Input Characteristics:

Range	Maximum Reading (5½ Digit)	Resolution		
		5½ Digit	4½ Digit	3½ Digit
300 $\Omega$	301.000 $\Omega$	1m $\Omega$	10m $\Omega$	100m $\Omega$
3 k $\Omega$	3.01000 k $\Omega$	10m $\Omega$	100m $\Omega$	1 $\Omega$
30 k $\Omega$	30.1000 k $\Omega$	100m $\Omega$	1 $\Omega$	10 $\Omega$
300 k $\Omega$	301.000 k $\Omega$	1 $\Omega$	10 $\Omega$	100 $\Omega$
3M $\Omega$	3.01000M $\Omega$	10 $\Omega$	100 $\Omega$	1 k $\Omega$
30M $\Omega$	30.1000M $\Omega$	100 $\Omega$	1 k $\Omega$	10 k $\Omega$

### Input Protection: (non-destructive)

Hi source to Lo source:  $\pm 350V$  peak  
 Hi sense to Lo sense:  $\pm 350V$  peak  
 Hi or Lo to Earth Ground:  $\pm 500V$  peak

### Measurement Accuracy:

$\pm$  (% of reading + number of counts)  
 Auto-zero ON. 4-wire ohms.

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

**Resistance (2-wire  $\Omega$ , 4-wire  $\Omega$ ) (Cont'd)**

**5½ Digit Mode:**

Range	Cal. Temp. $\pm 1^{\circ}\text{C}$	Cal. Temp. $\pm 5^{\circ}\text{C}$	
	24 Hours	90 Day	1 Year
300 $\Omega$	0.0045 + 4	0.012 + 5	0.017 + 5
3k – 300k $\Omega$	0.0035 + 2	0.011 + 2	0.016 + 2
3M $\Omega$	0.0052 + 2	0.011 + 2	0.016 + 2
30M $\Omega$	0.036 + 2	0.066 + 2	0.078 + 2

**2-Wire Ohms Accuracy:**

Same as 4-wire ohms, except add a maximum of 100m $\Omega$  offset.

**Auto-Zero Off:**

(5½ digit) for a stable environment ( $\pm 1^{\circ}\text{C}$ ), for < 24 hrs., add 11 counts to accuracy specification for 300 $\Omega$  range 3 counts for 3k $\Omega$  through 300k $\Omega$  ranges, 8 counts for 3M $\Omega$  range, and 33 counts for 30M $\Omega$  range.

**Temperature Coefficient:**

0 $^{\circ}\text{C}$  to (Cal. Temp.  $- 5^{\circ}\text{C}$ ), (Cal. Temp.  $+ 5^{\circ}\text{C}$ ) to 55 $^{\circ}\text{C}$   
5½ digit display, auto-zero ON  
 $\pm$  (% of reading + number of counts)/ $^{\circ}\text{C}$

Range	Temperature Coefficient
300 $\Omega$	0.0009 + 0.5
3k – 300k $\Omega$	0.0009 + 0.05
3M $\Omega$	0.0021 + 0.05
30M $\Omega$	0.021 + 0.05

**Current Through Unknown:**

Range:	300 $\Omega$	3k $\Omega$	30k $\Omega$	300k $\Omega$	3M $\Omega$	30M $\Omega$
Current:	1mA	1mA	100 $\mu\text{A}$	10 $\mu$	1 $\mu$	100nA

**Maximum Open Circuit Voltage:**

6.5V

**Maximum Reading Rates:**

Same as dc volts, except for 3M $\Omega$  and 30M $\Omega$  ranges. For 3M $\Omega$  range, add 20ms; for 30M $\Omega$  range, add 200ms per reading.

**AC VOLTAGE (true rms responding)**

**Input Characteristics:**

Range	Maximum Reading (5½ Digit)	Resolution		
		5½ Digit	4½ Digit	3½ Digit
.3V	.301000V	1 $\mu\text{V}$	10 $\mu\text{V}$	100 $\mu\text{V}$
3V	3.01000V	10 $\mu\text{V}$	100 $\mu\text{V}$	1mV
30V	30.1000V	100 $\mu\text{V}$	1mV	10mV
300V	301.000V	1mV	10mV	100mV

**Input Impedance:**

1M $\Omega \pm 1\%$  shunted by < 60pF

**Maximum Input Voltage: (non-destructive)**

Hi to Lo: 301Vrms or 450V peak  
Hi or Lo to Earth Ground:  $\pm 500\text{V}$  peak

**Measurement Accuracy:**

$\pm$  (% of reading + number of counts)  
Auto-zero ON. 5½ digit display. Accuracy is specified for sine-wave inputs only, > 10% of full scale.  
1 Year, Cal. Temp.  $\pm 5^{\circ}\text{C}$

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

**Auto-Zero Off:**

(5½ digits) for a stable environment ( $\pm 1^{\circ}\text{C}$ ), for < 24 hrs., add 10 counts to accuracy specifications for all ranges.

**Temperature Coefficient:**

0 $^{\circ}\text{C}$  to (Cal. Temp.  $- 5^{\circ}\text{C}$ ), (Cal. Temp.  $+ 5^{\circ}\text{C}$ ) to 55 $^{\circ}\text{C}$ ,  
5½ digit display, auto-zero ON.  
For frequencies < 20kHz,  $\pm$  (0.016% of reading + 10 counts)/ $^{\circ}\text{C}$   
For frequencies > 20kHz,  $\pm$  (0.04% of reading + 10 counts)/ $^{\circ}\text{C}$

**Crest Factor:**

> 4:1 at full scale.

**Common Mode Rejection:**

With 1k $\Omega$  imbalance in Lo lead, > 70dB, dc to 60Hz.

**Maximum Reading Rates: (readings/sec)**

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

For 50 or 60Hz 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	$\pm 3.01000\text{A}$	10 $\mu\text{A}$	100 $\mu\text{A}$	1mA

**Maximum Input: (non-destructive)**

3A from < 250V source; fuse protected

**Measurement Accuracy:**

$\pm$  (% of reading + number of counts)  
Auto-zero ON. 5½ digit display.

Range	Cal. Temp. $\pm 5^{\circ}\text{C}$	
	90 Days	1 Year
3A, < 1A input	0.14 + 6	0.17 + 6
3A, > 1A input	1.0 + 30	1.0 + 30



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

## DC CURRENT (Cont'd)

### Auto-Zero Off:

(5½ digit) for a stable environment ( $\pm 1^{\circ}\text{C}$ ), for < 24 hrs., add 11 counts to accuracy specification for 5½ digit mode.

### Temperature Coefficient:

0°C to (Cal. Temp.  $- 5^{\circ}\text{C}$ ), (Cal. Temp.  $+ 5^{\circ}\text{C}$ ) to 55°C  
5½ digit display, auto-zero ON  
 $\pm (0.012 \text{ of reading} + 0.5 \text{ counts})/^{\circ}\text{C}$

### Maximum Burden at Full Scale:

1V

### 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
.3A	.301000A	1µA	10µA	100µA
3A	3.01000A	10µA	100µA	1mA

### Maximum Input: (non-destructive)

3A from < 250V source; fuse protected

### Measurement Accuracy:

$\pm$  (% of reading + number of counts)  
Auto-zero ON. 5½ digit display. Accuracy specified for sine-wave inputs only > 10% of full scale.  
1 YEAR, CAL. TEMP.  $\pm 5^{\circ}\text{C}$

Frequency	Ranges	
	300mA	3A
20Hz – 50Hz	1.77 + 163	2.5 + 163
50Hz – 1kHz	1.1 + 163	1.8 + 163
1kHz – 10kHz	1.0 + 163	1.7 + 163
10kHz – 20kHz	1.14 + 163	1.84 + 163

### Auto-zero Off:

(5½ digits) for a stable environment ( $\pm 1^{\circ}\text{C}$ ), for < 24 hrs., add 10 counts to accuracy specification.

### Temperature Coefficient:

0°C to (Cal. Temp.  $- 5^{\circ}\text{C}$ ), (Cal. Temp.  $+ 5^{\circ}\text{C}$ ) to 55°C.  
5½ digits, auto-zero ON.  
 $\pm (0.021\% \text{ of reading} + 10 \text{ counts})/^{\circ}\text{C}$

### Maximum Burden at Full Scale:

1V

### 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:

$- 40^{\circ}\text{C}$  to  $75^{\circ}\text{C}$   
except for battery option,  $- 40^{\circ}\text{C}$  to  $+ 65^{\circ}\text{C}$

### Warm-up Time:

1 hr. to meet all specifications.

### Integration Time:

Number of Digits	Line Frequency	
	50Hz	60Hz
5½	200ms	166.7ms
4½	20ms	16.67ms
3½	2ms	2ms

### Power:

AC Line 48 – 440Hz; 86 – 250V, (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:

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

### Weight:

3468A/B - 2.1 kg (4.63 lbs.)  
3468A/B with Option 001 - 3.1 kg (6.83 lbs.)

suffix identifies the country in which the 3468A/B was manufactured.

1-26. This manual applies to instruments with the serial number identified on the title page. Updating of the manual is accomplished either by a change sheet or revised manual.

### 1-27. OPTIONS

1-28. The following options are available for the 3468A/B.

- Option 001: add Rechargeable Battery Pack
- Option 315: set for 100V, 50Hz Power Source
- Option 316: set for 100V, 60Hz Power Source
- Option 325: set for 120V, 50Hz Power Source
- Option 326: set for 120V, 60Hz Power Source
- Option 335: set for 220V, 50Hz Power Source
- Option 336: set for 220V, 60Hz Power Source
- Option 345: set for 240V, 50Hz Power Source
- Option 346: set for 240V, 60Hz Power Source

Option 910: additional set of Operators and Service Manuals

### 1-29. ACCESSORIES AVAILABLE

1-30. The following is a list of available accessories for the 3468A/B.

Accessory No.	Description
10023A	Temperature Probe
11000A	Test leads, dual banana both ends
11002A	Test leads, dual banana to dual alligator
11003A	Test leads, dual banana to probe and alligator
11096B	RF Probe
34111A	High Voltage Probe
34118A	Test Leads, dual banana to probes with safety guard rings
82167A	HP-IL Cable (2 each)