



OPERATING AND SERVICE MANUAL

MODEL 3438A DIGITAL MULTIMETER

Serial Numbers 1717A00330 and Greater

IMPORTANT NOTICE

Any changes made in instruments manufactured after this printing will be found in a "Manual Changes" supplement, supplied with this manual. Be sure to examine this supplement, if one exists for this manual, for any changes which apply to your instrument and record these changes in the manual.

WARNING

To help minimize the possibility of electrical fire or shock hazards, do not expose this instrument to rain or excessive moisture.

Manual Part No. 03438-90001

Microfiche Part No. 03438-90051

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P.O. Box 301, Loveland, Colorado, 80537 U.S.A.

Printed: February 1978

HEWLETT  PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except that in the case of certain components, if any, listed in Section I of this operating manual, the warranty shall be for the specified period. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the proper preventive maintenance procedures as listed in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. **NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.**

If this product is sold as part of a Hewlett-Packard integrated instrument system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains general information concerning the -hp- Model 3438A Multimeter. Included is an instrument description, specifications, information about instrument and manual identification, option and accessory information, and safety considerations.

1-3. DESCRIPTION.

1-4. The -hp- Model 3438A is an HP—IB compatible, 3½ digit, five function, autoranging multimeter. The functions are AC and DC Voltage, AC and DC Current and Ohms. All five functions have manually selectable ranges. AC and DC Voltage and Ohms functions may also be automatically ranged by depressing the AUTO pushbutton.

1-5. The 3438A enables the user to set up a low cost data gathering system utilizing the HP—IB. Voltage (ac or dc), Current (ac or dc) and resistance information can be transferred on the HP—IB to Printers, Calculators, and Computers for data storage or *hard copy* printouts.

1-6. Throughout the remainder of this manual, the -hp- Model 3438A Multimeter will be referred to as Multimeter.

1-7. SPECIFICATIONS.

1-8. Specifications for the Multimeter are listed in Table 1-1. These specifications are the performance standards or limits to which the Multimeter can be tested. Any changes in these specifications due to manufacturing changes, design or traceability to the National Bureau of Standards will be covered by an errata or change sheet. These specifications supersede any prior published specifications. Supplemental information in Table 1-2 is provided to describe general operating characteristics.

1-9. INSTRUMENT AND MANUAL IDENTIFICATION.

1-10. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of

instruments. The last section (suffix) identifies a particular instrument within the series. A letter between the prefix and the suffix identifies the country in which the instrument was manufactured. The manual is kept up-to-date at all times by means of a change sheet which is supplied with the manual. If the serial number of your instrument differs from the one on the title page of this manual, refer to the change sheet supplied with the manual. All correspondence with Hewlett-Packard should include the complete serial number.

1-11. OPTIONS.

1-12. Table 1-3 lists the options available for the Multimeter.

1-13. The option label affixed to the rear of the Multimeter identifies the line voltage for which the instrument is wired. This operating voltage can be changed by following the procedure outlined in Section V (Power Requirement Modification Instructions). If the line voltage option is changed, the option label should also be corrected to reflect the new configuration.

1-14. ACCESSORIES.

1-15. The accessories available for use with the Multimeter are listed in Table 1-4.

1-16. SAFETY CONSIDERATIONS.



1-17. This Operating and Service Manual contains cautions and warnings alerting the user to hazardous operating and maintenance conditions. This information is flagged by a caution or warning heading and/or the symbol . The  symbol appears on the front panel and is an international symbol meaning "refer to the Operating and Service Manual". This symbol flags important operating instructions located in Section III. To ensure the safety of the operating and maintenance personnel and retain the operating condition of the instrument, these instructions must be adhered to.

Table 1-1. Specifications.

DC VOLTMETER													
	<table border="1"> <thead> <tr> <th>Ranges</th> <th>Max Display</th> </tr> </thead> <tbody> <tr> <td>± 200 mV</td> <td>± 199.9 mV</td> </tr> <tr> <td>± 2 V</td> <td>± 1.999 V</td> </tr> <tr> <td>± 20 V</td> <td>± 19.99 V</td> </tr> <tr> <td>± 200 V</td> <td>± 199.9 V</td> </tr> <tr> <td>± 1200 V</td> <td>± 1199 V</td> </tr> </tbody> </table>	Ranges	Max Display	± 200 mV	± 199.9 mV	± 2 V	± 1.999 V	± 20 V	± 19.99 V	± 200 V	± 199.9 V	± 1200 V	± 1199 V
Ranges	Max Display												
± 200 mV	± 199.9 mV												
± 2 V	± 1.999 V												
± 20 V	± 19.99 V												
± 200 V	± 199.9 V												
± 1200 V	± 1199 V												
Maximum Input: 1200 V (dc + peak ac).													
Ranging: Automatic or manual.													
Sensitivity: 100 μ V on 200 mV range.													
Polarity: Automatically sensed and displayed.													
Accuracy: 1 Year 15° to 30°C @ 95% RH.													
	<table border="1"> <thead> <tr> <th>Range</th> <th>Specifications</th> </tr> </thead> <tbody> <tr> <td>200 mV</td> <td>± (0.1% of reading + 2 digits)</td> </tr> <tr> <td>2 V to 1200 V</td> <td>± (0.1% of reading + 1 digit)</td> </tr> </tbody> </table>	Range	Specifications	200 mV	± (0.1% of reading + 2 digits)	2 V to 1200 V	± (0.1% of reading + 1 digit)						
Range	Specifications												
200 mV	± (0.1% of reading + 2 digits)												
2 V to 1200 V	± (0.1% of reading + 1 digit)												
Temperature Coefficient: 0° - 15°C and 30° - 55°C ± (.018% reading + 0.1 digit) / °C													
Input Resistance: 10 meg Ω ± 1%.													
Input Type: Floating 500 V max COM to ground.													
Normal Mode Rejection: 40 dB at 50 Hz and 60 Hz ± .1 Hz.													
Effective Common Mode Rejection: With 1 k Ω unbalance is > 120 dB at 50/60 Hz ± 0.1%.													
Response Time: < 0.7 seconds to within 1 digit of final value on any range. Add 1 second for each range change.													
AC VOLTMETER													
AC Converter: Avg. Responding rms calibrated.													
	<table border="1"> <thead> <tr> <th>Ranges</th> <th>Max Display</th> </tr> </thead> <tbody> <tr> <td>200 mV</td> <td>199.9 mV</td> </tr> <tr> <td>2 V</td> <td>1.999 V</td> </tr> <tr> <td>20 V</td> <td>19.99 V</td> </tr> <tr> <td>200 V</td> <td>199.9 V</td> </tr> <tr> <td>1200 V</td> <td>1199 V</td> </tr> </tbody> </table>	Ranges	Max Display	200 mV	199.9 mV	2 V	1.999 V	20 V	19.99 V	200 V	199.9 V	1200 V	1199 V
Ranges	Max Display												
200 mV	199.9 mV												
2 V	1.999 V												
20 V	19.99 V												
200 V	199.9 V												
1200 V	1199 V												
Maximum Input: 1700 V (dc + peak ac), 10 ⁷ volt - Hz max.													
Ranging: Automatic or manual.													
Sensitivity: 100 μ V on 200 mV range.													
Accuracy: 1 year, 15° to 30°C @ 95% RH.													
Minimum Reading: 20 digits.													
	<table border="1"> <tbody> <tr> <td>30 Hz - 50 Hz</td> <td>± (1.5% of reading ± 3 digits)</td> </tr> <tr> <td>50 Hz - 20 kHz</td> <td>± (0.3% of reading ± 3 digits)</td> </tr> <tr> <td>20 kHz - 100 kHz</td> <td>± (1.5% of reading ± 10 digits)</td> </tr> </tbody> </table>	30 Hz - 50 Hz	± (1.5% of reading ± 3 digits)	50 Hz - 20 kHz	± (0.3% of reading ± 3 digits)	20 kHz - 100 kHz	± (1.5% of reading ± 10 digits)						
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50 Hz - 20 kHz	± (0.3% of reading ± 3 digits)												
20 kHz - 100 kHz	± (1.5% of reading ± 10 digits)												
Temperature Coefficient: 0° - 15°C and 30° - 55°C ± (0.04% of reading + 0.2 digits) / °C.													
DC AMMETER													
	<table border="1"> <thead> <tr> <th>Ranges</th> <th>Max Display</th> </tr> </thead> <tbody> <tr> <td>± 200 μA</td> <td>± 199.9 μA</td> </tr> <tr> <td>± 2 mA</td> <td>± 1.999 mA</td> </tr> <tr> <td>± 20 mA</td> <td>± 19.99 mA</td> </tr> <tr> <td>± 200 mA</td> <td>± 199.9 mA</td> </tr> <tr> <td>± 2000 mA</td> <td>± 1999 mA</td> </tr> </tbody> </table>	Ranges	Max Display	± 200 μ A	± 199.9 μ A	± 2 mA	± 1.999 mA	± 20 mA	± 19.99 mA	± 200 mA	± 199.9 mA	± 2000 mA	± 1999 mA
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± 20 mA	± 19.99 mA												
± 200 mA	± 199.9 mA												
± 2000 mA	± 1999 mA												
Maximum Input: 2A from < 250 V source.													
Protection: 2A/250 V fuse (normal blow).													
Ranging: Manual only.													
Sensitivity: 100 nA on 200 μ A range.													
Polarity: Automatically sensed and displayed.													
Accuracy: 1 year, 15 to 30°C @ 95% RH.													
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2000 mA	± (0.6% of reading + 2 digits)												
Temperature Coefficient: 0 - 15°C and 30 - 55°C ± (.028% of reading + 0.1 digits) / °C.													
Voltage Burden:													
	<table border="1"> <thead> <tr> <th>Range</th> <th>Max Burden at Full Scale</th> </tr> </thead> <tbody> <tr> <td>200 μA to 20 mA</td> <td>< 220 mV</td> </tr> <tr> <td>200 mA</td> <td>< 240 mV</td> </tr> <tr> <td>2000 mA</td> <td>< 400 mV</td> </tr> </tbody> </table>	Range	Max Burden at Full Scale	200 μ A to 20 mA	< 220 mV	200 mA	< 240 mV	2000 mA	< 400 mV				
Range	Max Burden at Full Scale												
200 μ A to 20 mA	< 220 mV												
200 mA	< 240 mV												
2000 mA	< 400 mV												
Input Type: Floating 500 V max COM to ground.													
Response Time: 0.7 seconds on any range to within 1 digit of final value.													
AC AMMETER													
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200 mA	199.9 mA												
2000 mA	1999 mA												
Maximum Input: 2A from < 250 V source.													
Protection: 2A/250 V fuse (normal blow).													
Ranging: Manual only.													
Sensitivity: 100 nA on 200 μ A range.													
Accuracy: With display of \geq 20 digits. 1 year 15 to 30°C 95% RH.													

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

Specifications	
Current Range 200 μ A Thru 200 mA \pm 2000 mA	\pm (2% of reading) \pm 4 digits
	\pm (1.2% of reading) \pm 4 digits
Frequency of Input Signal 30 Hz 50 Hz 10 kHz	\pm (1.7% of reading) \pm 4 digits
	\pm (0.9% of reading) \pm 4 digits

Temperature Coefficient: 0 - 15°C and 30 - 55°C
 \pm (0.05% of reading + 0.2 digits) /°C.

Voltage Burden:

200 μ A to 20 mA	< 220 mV rms
200 mA range	< 240 mV rms
2000 mA range	< 400 mV rms

Input Type: Floating 500 V max COM to ground.

Response Time: 1.6 seconds on any range to within 3 digits of final value.

OHMMETER

Ranges	Max Display
20 Ω	19.99 Ω
200 Ω	199.9 Ω
2 k Ω	1.999 k Ω
20 k Ω	19.99 k Ω
200 k Ω	199.9 k Ω
2000 k Ω	1999 k Ω
20 M Ω	19.99M Ω

Input Protection: 250 V rms.

Ranging: Automatic, or manual.

Sensitivity: 10 milliohm on 20 Ω range.

Accuracy: 1 year 15 to 30°C at 95% RH.

Range	Specification
20 Ω	\pm (0.5% of reading + 10 digits)
200 Ω to 2 M Ω	\pm (0.2% of reading + 2 digits)
20 M Ω	\pm (0.8% of reading + 2 digits)

Temperature Coefficient: 0 - 15°C and 30 - 55°C.

Range	Specifications
20 Ω to 2M Ω	\pm (0.04% of reading + 0.2 digits) /°C
20 M Ω	\pm (.18% of reading + 0.2 digits) /°C

Configuration: 2 wire.

Open Circuit Voltage: < 5 V max.

Current through unknown:

Range	20 Ω	200 Ω	2k Ω	20k Ω	200k Ω	2M Ω	20M Ω
Current	5mA	5mA	500 μ A	50 μ A	5 μ A	500nA	50nA

Response Time: 0.8 seconds to within 1 digit of final value. Add 0.8 seconds for each range change.

In accordance with IEEE-488-1975, the 3438A Multimeter meets the following Interface Function Specifications.

Interface Function	Description	3438A Capability
SH1	Source handshake	Yes
AH1	Acceptor handshake	Yes
T7	Talker (basic talker, talk only mode, unaddress-to-talk if addressed-to-listen)	Yes
L4	Listener (basic listener, unaddress-to-listen if addressed-to-talk)	Yes
E1	Open collector Bus driver	Yes
DT1	Device trigger	Yes
RL2	Remote/Local	Yes
LL0	Local lock-out	No
SRQ	Service Request	No
PP0	Parallel poll	No
DC0	Device clear	No
CO	Controller	No

Table 1-2. General Information.

GENERAL:	
Display: 7 segment RED 0.3 inch high LED's. Function and range annunciation.	Humidity: 0 - 95% RH at 40°C.
Reading rate: 2.4 - 4.7/sec. depending on input level.	Power: AC line; 48 - 440 Hz 86-106 V Opt. 100 104-127 V Opt. 115 190-233 V Opt. 210 208-250 V Opt. 230
A-D Conversion: Dual slope.	Total Instrument Power Dissipated: 12 watts
Integration time: 100 msec.	Configuration: 3438A Std, Rack and Stack case, ac line power only. Rack mount kit not included.
Ranging: Automatic or manual in ac V, dc V and ohms. Manual only in ac and dc current.	Dimensions: 20.96 cm (8 1/4") wide x 8.57 cm (3 3/8") high x 31.12 cm (12 1/4 in.)
Storage Temperature: (-40 to +75)°C;	Weight: 2.87 kg (6 lbs. 5 oz.)
Operating Temperature: (0 to 55)°C.	

Table 1-3. Options.

Standard	Rack mount case. AC line operation only.
Option 100	86 - 106 Vac 48 - 440 Hz 12 Watts
Option 115	104 - 127 Vac 48 - 440 Hz 12 Watts
Option 210	190 - 233 Vac 48 - 440 Hz 12 Watts
Option 230	208 - 250 Vac 48 - 440 Hz 12 Watts
Option 908	Rack Mount Kit -hp Part Number 5061-0054.
Option 910	An additional Operating and Service Manual.

Table 1-4. Accessories.

11002A	Test leads (dual banana to dual alligator).
11003A	Test leads dual banana to probe and alligator.
11096B	RF Probe 10 kHz to 700 MHz, use only 10 V and 100 V dc ranges.
5061-0054	Rack adapter kit including 1/2 module filler panel.
34110A	Soft vinyl carrying/operating case.
34111A	High voltage probe, 40 kV dc
34112A	Touch - Hold, input probe.
11067A	Test lead kit.
11000 A	Test leads, dual banana on both ends
10631 A	1M (39.37") HP-IB Cables
10631 B	2M (78.74") HP-IB Cables
10631 C	4M (157.48") HP-IB Cables

SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions for the installation and shipping of the Multimeter. Included are initial inspection procedures, power and grounding requirements, environmental information, and instructions for repackaging the instrument for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of marks or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Electrical performance should be tested using the performance test outlined in Section V. If there is damage or deficiency, see the warranty inside the front of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Multimeter can be operated from any one of the ac power sources listed in Table 1-2. Before connecting the instrument to ac power, verify that the ac power source matches the power requirement of the instrument as marked on the option label affixed to the rear of the instrument. If the instrument is incompatible with the available power source, refer to Section V for Power Requirement Modification instructions.

2-7. ENVIRONMENTAL REQUIREMENTS.

2-8. The Multimeter will meet the specifications listed in Table 1-1 when the operating temperature is within the range of + 15°C to + 30°C. The instrument can be operated where the ambient temperature is within the range of 0°C to + 40°C and the relative humidity is less than 95%.

WARNING

To prevent potential electrical or fire hazard, do not expose equipment to rain or moisture.

2-9. INSTRUMENT MOUNTING.

2-10. The Multimeter is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument. The front of the instrument may be elevated for convenience of operating and viewing by extending the tilt stand. The plastic feet are shaped to permit placing the instrument on top of other System II half or full module Hewlett-Packard instruments.

2-11. HEWLETT—PACKARD INTERFACE BUS (HP—IB).

2-12. Figure 2-1 illustrates the rear panel HP—IB connector, along with a brief description of each signal line.

2-13. Interface Cable Length.

2-14. The maximum accumulative length of an HP—IB cable in any system must not exceed more than 2 meters of cable per device (up to 15 devices) or 20 meters, whichever is less.

2-15. REPACKAGING FOR SHIPMENT.

2-16. The following paragraphs contain a general guide for repackaging the instrument for shipment. Refer to Paragraph 2-17 if the original container is to be used, 2-18 if it is not. If you have any questions, contact your nearest -hp- Sales and Service Office. (See Appendix A for office locations.)

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and full serial number.

2-17. Place instrument in original container with appropriate packing material and seal well with strong tape or metal bands. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

2-18. If original container is not to be used, proceed as follows:

- a. Wrap instrument in heavy paper or plastic before placing in an inner container.
- b. Place packing material around all sides of instrument and protect front panel with cardboard strips.
- c. Place instrument and inner container in a heavy carton or wooden box and seal well with strong tape or metal bands.

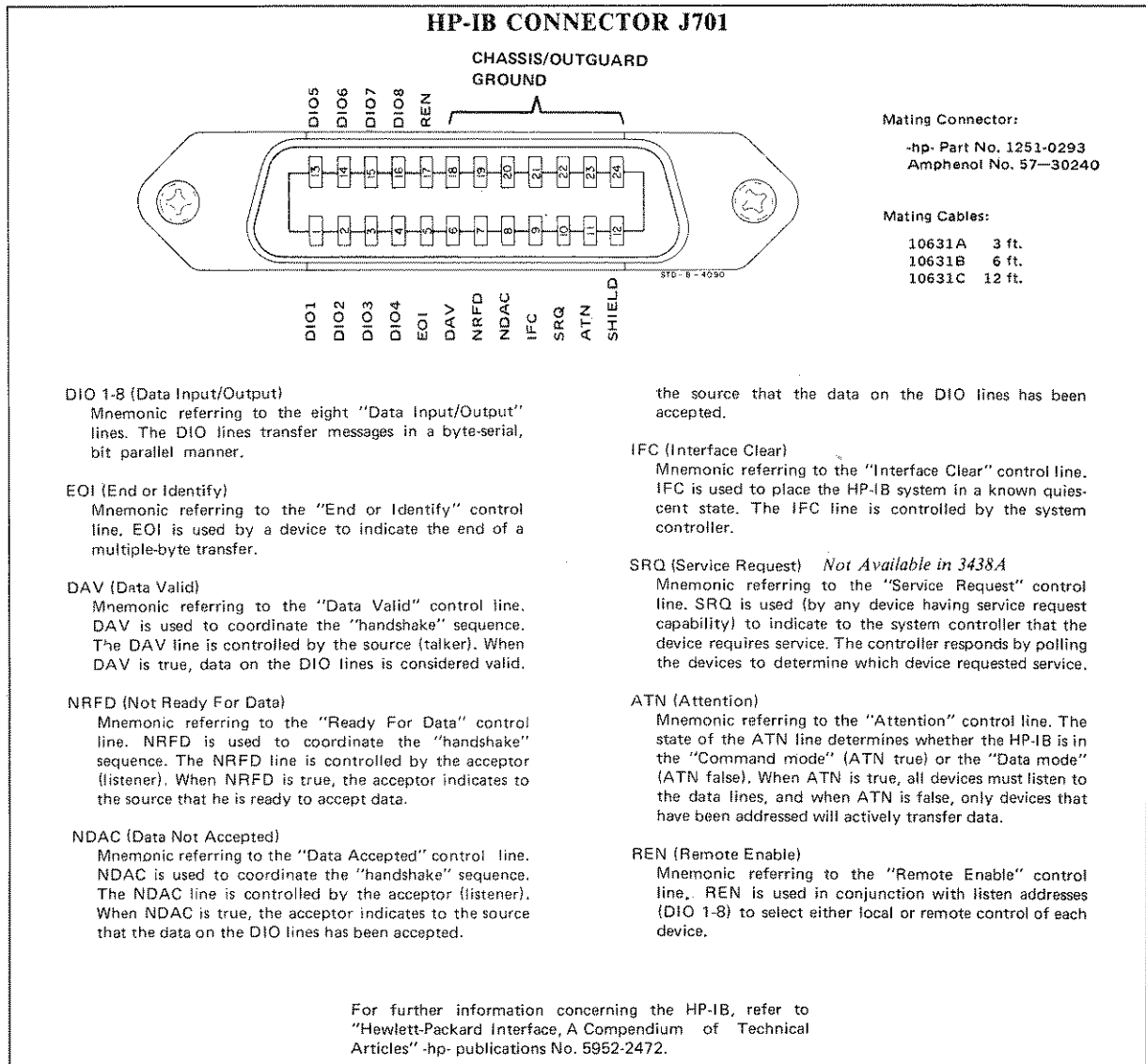


Figure 2-1. Hewlett-Packard Interface Bus Connector.

2-19. POWER CORDS AND RECEPTACLES.

2-20. Figure 2-2 illustrates the plug cap configurations that are available to provide ac power to the Multimeter. The -hp- part number shown directly below each plug cap drawing is the part number for the power cord set equipped with the appropriate mating plug for that receptacle. The appropriate power cord should be provided with each instrument. However, if a different power cord set is required, notify the nearest -hp- Sales and Service Office and a replacement cord will be provided. The instrument ac power input receptacle and cord set appliance coupler meet the safety specifications set by the International Commission on Rules for the Approval of Electrical Equipment (CEE 22).

2-2

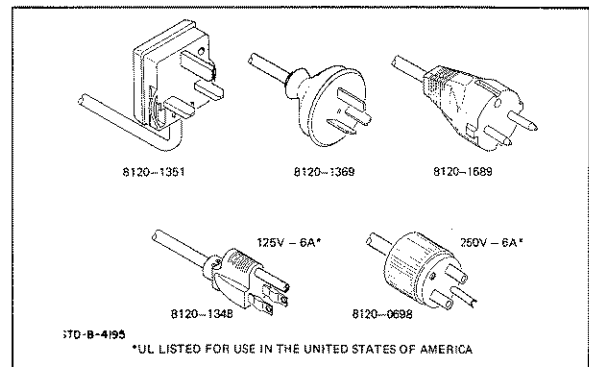


Figure 2-2. Power Receptacles.

SECTION III OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains instructions for operating the Multimeter. Measurements of ac and dc voltage, ac and dc current, and ohms are discussed. Sample applications will be given in this section to demonstrate the use of the HP-1B. A description of the controls and connectors is given in Figure 3-3.

WARNING

To prevent potential electrical or fire hazard, do not expose the Multimeter or its accessories to rain or moisture.

3-3. AC Operation.

3-4. Before connecting the Multimeter to ac power, verify that the ac power source matches the power requirements the Multimeter as marked on the option label affixed to the rear of the instrument. If the instrument is incompatible with the available power source, refer to Section V of this manual for power requirement modification instructions. After this verification, connect the proper ac power to the instrument and press the ON button. The instrument is ready for use.

3-5. Overload/Overrange/Improper Function Indication.

3-6. Figure 3-1 shows the display indication during overload, overrange, or an improper switch setting.



Figure 3-1. Overload Indication.

3-7. Table 3-1 lists improper switch combinations.

Table 3-1. Improper Switch Combinations.

Function	Range		
V		MΩ	
		20	
~V	mV, Ω	MΩ	
	20	20	
mA	mV, Ω	MΩ	Auto
	20	20	
~mA	mV, Ω	MΩ	Auto
	20	20	

3-8. Auto.

3-9. Depressing the AUTO switch with acV, dcV or k Ω function selected sets the Multimeter in an automatic ranging mode. In this mode the Multimeter will *uprange* if the display increases above (+) or (-) 119999 and *downrange* if the display decreases below (+) or (-) 11800. These numerical autoranging points are irrespective of decimal placement. The difference between the two autoranging points is called *autoranging Hysteresis*. Figure 3-2 shows the autoranging points for dc voltage measurements from 0 to 1200 V dc. Autoranging in other Multimeter functions is similar.

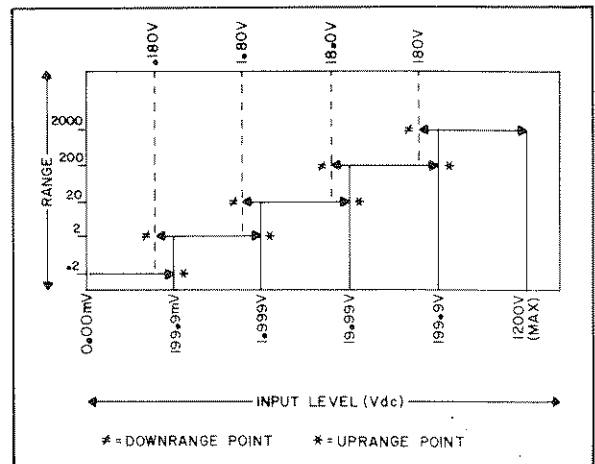


Figure 3-2. Multimeter Autoranging.

3-10. To release the AUTO switch depress one of the MANUAL RANGE switches.

3-11. Input Terminals.

3-12. Input Selector Switch. The Input Selector Switch (front panel) is used to select front or rear input terminals. In the FRONT position, the V Ω, COM, and A input terminals are internally connected to enable the user to make voltage, current, and resistance measurements from the front panel. With the Input Selector switch set to REAR, the V Ω and COM input terminals on the rear panel are connected to allow the user to make voltage and resistance measurements.

NOTE

There is no current measuring capability from the rear input terminals.

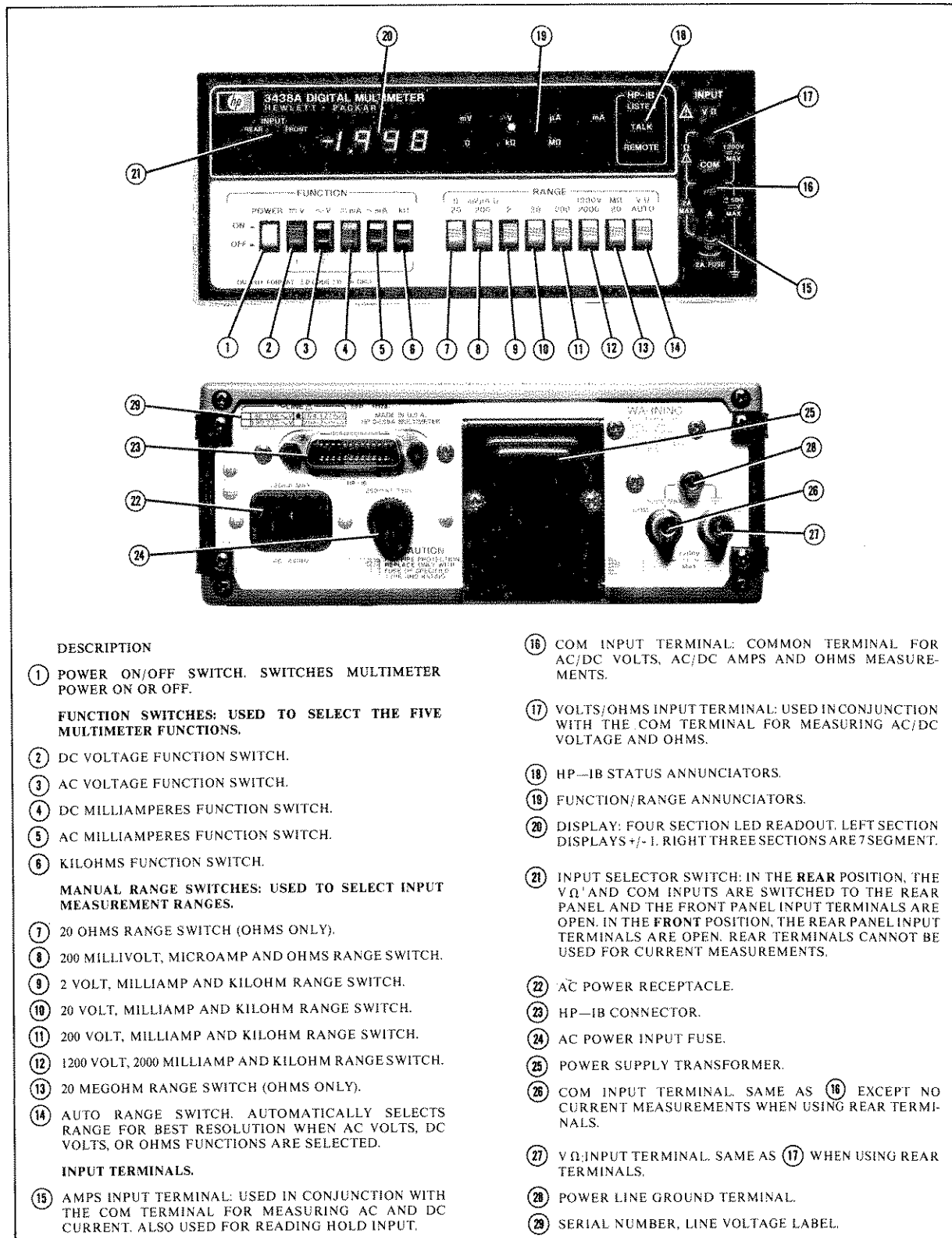


Figure 3-3. Front and Rear Panel Descriptions.

CAUTION

To avoid possible damage to the Multimeter, do not change the position of the Input Selector switch while voltage is connected to the front or rear input terminals.

3-13. V Ω (Volts/Ohms). The V Ω terminal (front or rear panel) is the *high* terminal for ac and dc voltage measurements. For ohms measurements, it is the positive (+) terminal.

3-14. COM (Common). The COM terminal is used for all five Multimeter functions. It is the negative (-) terminal for ohms measurements and it is the *low* terminal for ac and dc voltage and current measurements. The rear panel COM terminal is only used for voltage and resistance measurements.

CAUTION

To avoid possible damage to the Multimeter circuitry, the voltage between COM and (earth ground) must not exceed plus or minus 500 V dc.

3-15. A (Amps). The A terminal is the *high* terminal for ac and dc amps measurements. There is a 2 amp input protection fuse in series with this terminal.

CAUTION

The current function is protected by a fuse of 250 V rating. To avoid damage to the Multimeter, current sources having open circuit voltages greater than 250 V (dc + peak ac) must not be connected to the A (amps) input terminal.

3-16. DC Voltage Measurements (Front or Rear Input Terminals).

CAUTION

To avoid possible damage to the Multimeter circuitry, the dc input voltage must not exceed 1200 V (dc + peak ac).

3-17. Procedure.

- Depress $\text{---} \text{V}$ (dc volts).
- Depress proper manual range (200 mV to 1200 V) or depress AUTO for automatic range selection.
- Connect test leads from the Multimeter V Ω (high) and COM (low) terminals to the voltage under test as shown in Figure 3-4.

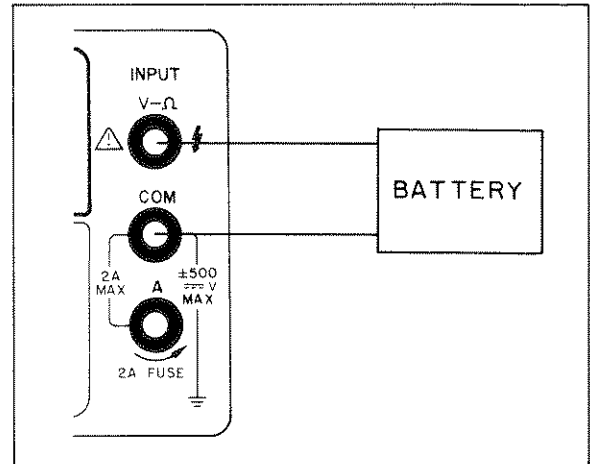


Figure 3-4. DC Voltage Measurements.

3-18. AC Voltage Measurements (Front or Rear Input Terminals).

CAUTION

To avoid possible damage to the Multimeter circuitry, the ac input voltage must not exceed 1700 V (dc + peak ac).

3-19. Procedure.

- Depress $\sim \text{V}$ (ac volts).
- Depress proper manual range (200 mV to 1200 V) or depress AUTO for automatic range selection.
- Connect test leads from the Multimeter V Ω (high) and COM (low) terminals to the voltage under test as shown in Figure 3-5.

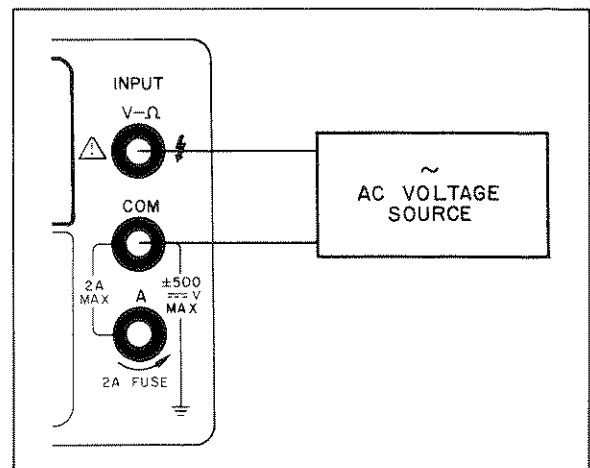


Figure 3-5. AC Voltage Measurement.

3-20. DC Current Measurements.

The current function is protected by a fuse of 250 V rating. To avoid damage to the Multimeter, current sources having open circuit voltages greater than 250 V (dc + peak ac) must not be connected to the A (amps) input terminal.

3-21. Procedure:

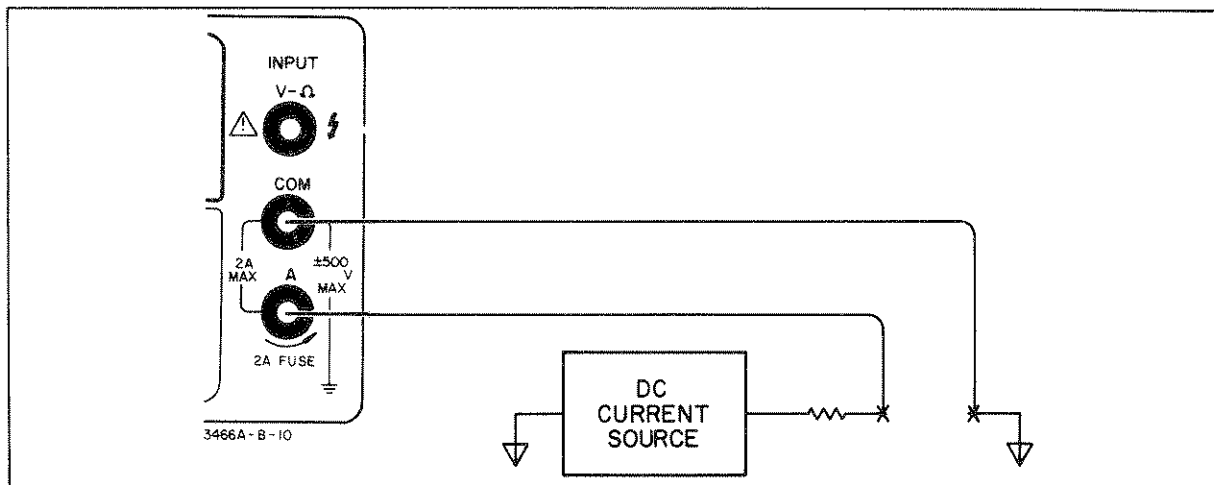
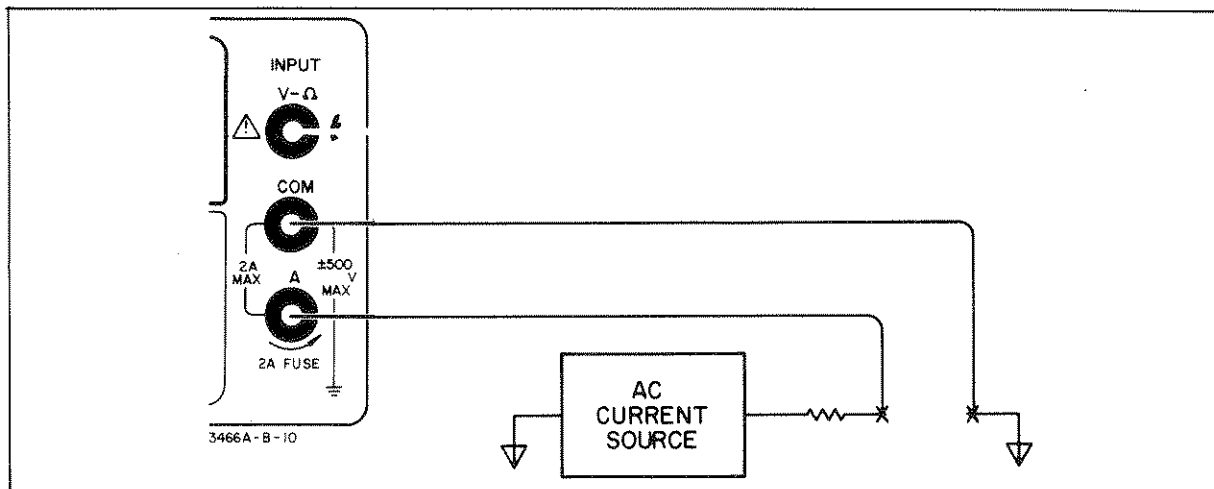
- a. Depress === mA (dc milliamperes).
- b. Depress proper manual range (200 μA to 2000 mA).
- c. Connect test leads from the Multimeter A and COM terminals in series with the current under test as shown in Figure 3-6.

3-22. AC Current Measurements.

The current function is protected by a fuse of 250 V rating. To avoid damage to the Multimeter, current sources having open circuit voltages greater than 250 V (dc + peak ac) must not be connected to the A (amps) input terminal.

3-23. Procedure:

- a. Depress \sim mA (ac milliamperes).
- b. Depress proper manual range (200 μ to 2000 mA).
- c. Connect test leads from the Multimeter A and COM terminals in series with the current under test as shown in Figure 3-7.

**Figure 3-6. DC Current Measurements.****Figure 3-7. AC Current Measurements.**

3-24. Resistance Measurements (Front or Rear Input Terminals).

3-25. Procedure:

- a. Depress k Ω (kilohms).
- b. Depress proper manual range or Auto for automatic range selection (20 Ω to 20 M Ω).
- c. Connect test leads from the Multimeter V Ω (=) and COM (-) terminals to the resistance under test as shown in Figure 3-8.

NOTE

When making resistance measurements using the lower ohms ranges, consideration should be given to the resistance of the test leads. This potential measurement error can be eliminated by measuring the lead resistance and subtracting it from the combined resistance value of the test leads and the resistance under test.

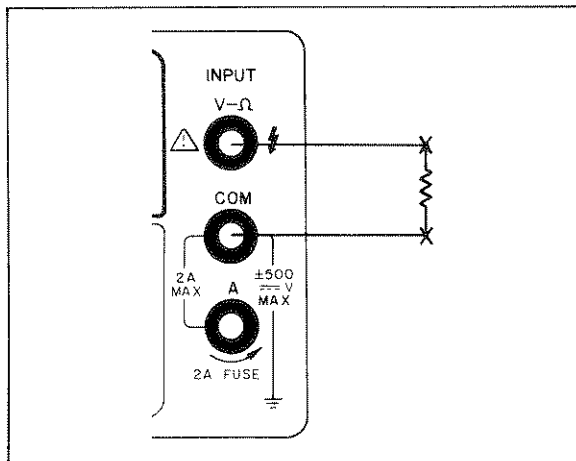


Figure 3-8. Resistance Measurement.

3-26. HP-IB APPLICATIONS.

3-27. Examples of typical HP-IB System operations using the 3438A Multimeter are given to aid the user in setting up his own system. There are two usable HP-IB modes of operation:

- a. Talk Only.
- b. Addressed To Talk.

Both modes will be discussed in the following paragraphs.

3-28. Data Output Format.

3-29. The Data Output Format and Function Codes are shown in Figure 3-9.

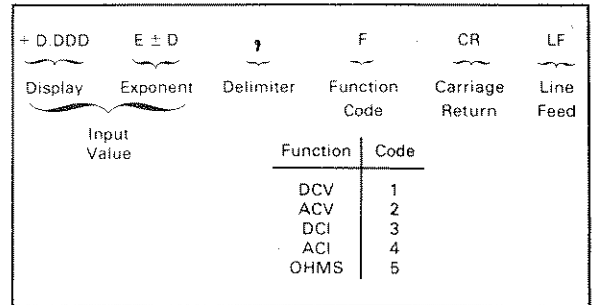


Figure 3-9. Data Output Format and Function Codes.

3-30. The Data Output Format is a fixed length of 13 characters. The Display and Exponent portion combine to relate the actual input value.

Example:

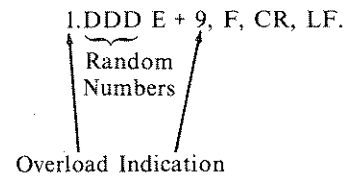
If the Multimeter display reading was + 17.90 V in the dcV function, the output format would be:



NOTE

There is no leading zero suppression.

3-31. Overload Indication. The output format for an Overload Indication is:



The leading 1 and the + 9 exponent signifies an overload indication.

3-32. Talk Only Mode.

3-33. The Talk Only Mode is used in an HP-IB system without a controller. The Address Switches AS6 and AS7, which are located on the A3 Logic board (remove top cover), must be set as shown in Figure 3-10 for this mode. AS1 through AS5 may be set in any position.

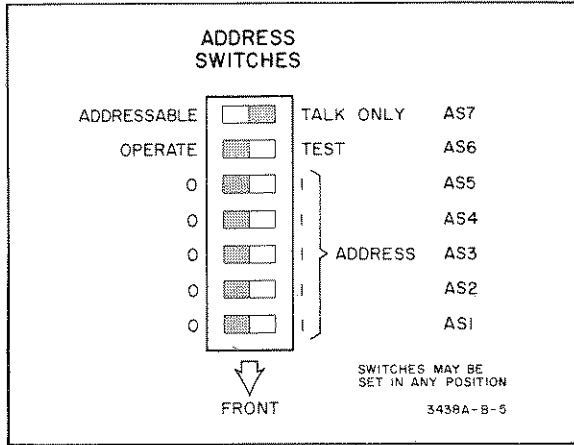


Figure 3-10. Talk Only Switch Settings.

3-34. In the Talk Only mode with no other devices connected to the Multimeter, the Multimeter inputs are sampled continuously at a rate of 2.4—4.7/sec determined by the exact input level. Data is output at the HP—IB terminal as fast as it is obtained. Refer to Table 3-2.

Table 3-2. Output Delays.

Bus Commands	Time Required
Group Execute Trigger (GET)	≤ 1 msec
Dual Slope Conversion	≤ 300 msec
Multimeter Output Availability	≤ 9 msec
GET thru Output Availability*	≤ 310 ms
Time to Output Data to the HP—IB	≤ 900 μs + Listener delay
Time to Accept Data from the HP—IB	310 μs/character; 100 μs/character typical

*After 100 ms Auto Zero

3-35. With other devices connected to the Multimeter via the HP—IB, the output data rate is determined by the slowest Listener. The following application shows a simple data logging system using the -hp- Model 3438A Multimeter and the -hp- Model 5150A Thermal Printer.

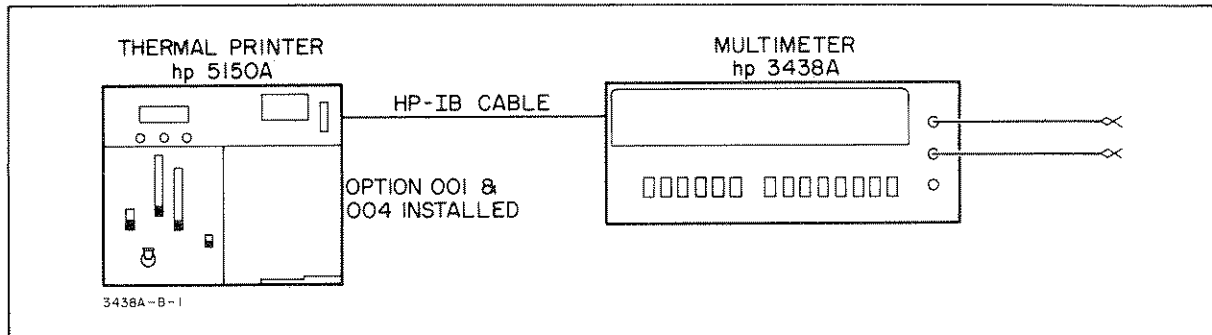


Figure 3-11. Talk Only Data Logger.

3-36. Procedure:

- With both instruments OFF, connect the HP—IB cable between them.
- Set Printer to LISTENING (back panel).
- Set Printer PRINT COMMAND switch to LF (line feed).
- Set the Printer front panel to the desired Print Interval.

NOTE

If the selected print interval is less than the Multimeter output rate, the actual print interval will be equal to the Multimeter sample period.

- Set the PRINT TIME switch to Sep Line (separate line).
- Set the Multimeter Address Switch to Talk Only/Operate as shown in Figure 3-10.

g. Select the desired Multimeter Function and Range and connect the Multimeter to the unknown voltage, current, or resistance.

h. Switch both instruments ON and set the printer clock time (front panel). The Multimeter TALK annunciator light should be ON.

3-37. This system will print the Multimeter data and the Printer clock time. Any HP—IB compatible LISTENER can be used in place of the -hp- Model 5150A Printer for this system.

3-38. If Option 003 is installed in the 5150A Printer, as many as thirteen 3438A Multimeters can be scanned on one HP—IB data logger system.

3-39. Addressable to Talk Mode.

3-40. The Addressable to Talk Mode is used in a system with a controller such as a calculator or computer.

3-41. The Talk Address is user selectable by the internal Address switches AS1 through AS5. The Multimeter is shipped with address select code 23 as shown in Figure 3-12. This switch is binary coded, i.e., AS5 has weighting of $2^5 = 16$, AS4 has weighting of $2^4 = 8$, etc.

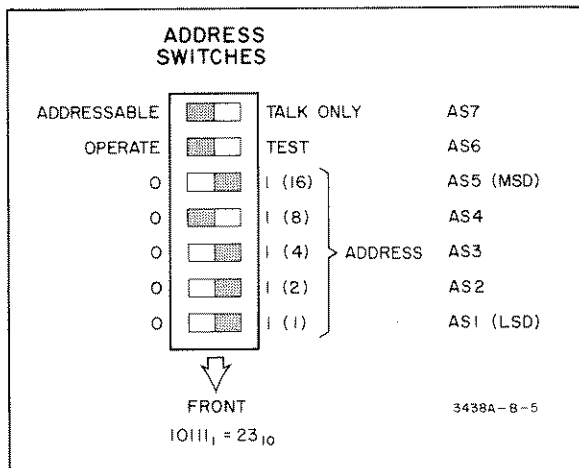


Figure 3-12. Address Select Code.

3-42. Sample Applications using three different -hp- calculators (9815A, 9825A, and 9830A) will be shown in the following examples. In each of these examples, the Multimeter is set to the Addressable to Talk Mode.

3-43. -hp- 9815A Sample Application.
(See Figure 3-13. 9815A/HP-IB Application.)

3-44. -hp- 9825 Sample Application.
(See Figure 3-14. 9825/HP-IB Application.)

3-45. -hp- 9830 Sample Application.
(See Figure 3-15. 9830A/HP-IB Application.)

3-46. Option Decal.

3-47. the option decal is affixed to the rear of the Multimeter. An example is shown in Figure 3-16.

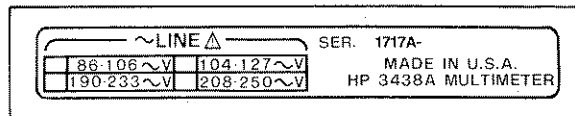


Figure 3-16. Option Decal.

3-48. Amps Input Fuse Replacement.

3-49. The amps input is protected by a 2A 250 V normal blow fuse, -hp- Part Number 2110-0002. This fuse is easily replaced using the following procedure:

- a. Insert a coin or wide bladed screwdriver into the slots of the A input terminal.
- b. Press the color ring in and rotate it counterclockwise 1/3 turn.
- c. Remove and replace the blown fuse.

3-50. Multimeter Cleaning.



Do not allow cleaning solvents, flux remover, or alcohol to come in contact with the Multimeter.

3-51. The Multimeter case and front panel should only be cleaned with a mild solution of soap and water and a soft cloth.

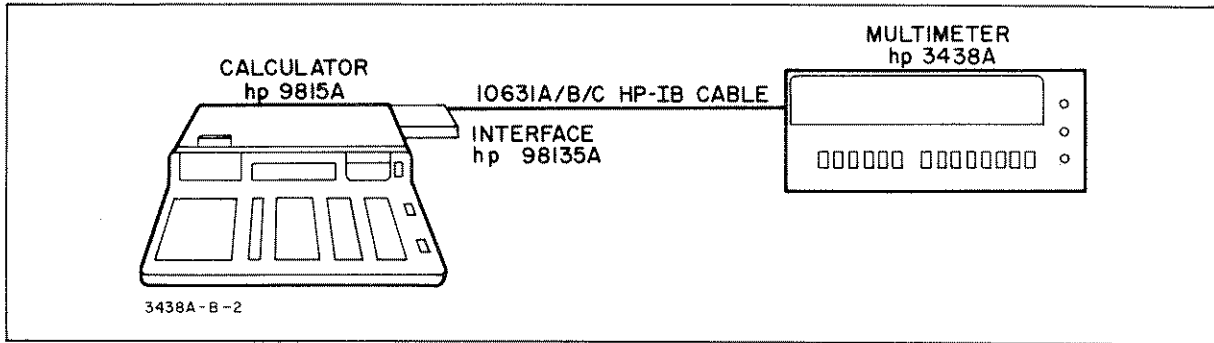


Figure 3-13. 9815A/HP-IB Application.

	9815A PROGRAM #1	9815A PROGRAM #1 PRINTOUT
ENTER 3438A ADDRESS	<pre>0000 2 0001 3 0002 ENTER↑ 0003 CMD 5 0005 0 0006 B 0007 0008 ENDα</pre>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 2.430 01 1 </div> EXPLANATION 2.430 01 REPRESENT 2.43x10 ¹ = 24.3 V dc 1 = FUNCTION 1 (dc V)
GO TO REMOTE (REN)	<pre>0009 1 0010 STO R 0011 2 0012 0 0013 STO F 0014 FOR R+F 0015 PAUSE 0016 NEXT R 0017 2 0018 3 0019 ENTER↑ 0020 CMD 5 0022 0 0023 H 0024 ENDα</pre>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 2.220 01 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 2.030 01 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 1.800 01 1 </div>
PAUSE	<pre>0025 2 0026 3 0027 READX 5 0029 X=Y 0030 SCI 3 0032 PRINT 0033 X=Y 0034 FIX 0 0036 PRINT 0037 SPACE 0038 GOTO 0017 0040 END</pre>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 1.540 01 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 1.370 01 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 1.170 01 1 </div>
3438A ADDRESS		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 1.000 01 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 7.100 00 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 6.300 00 1 </div>
TRIGGER 3438A (GET)		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 4.000 00 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 2.900 00 1 </div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 1.100 00 1 </div>
INPUT AND PRINT 3438A DATA		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 10px;"> 0.000 00 1 </div>

9815A PROGRAM #2

```

0000 GOTO L01
0002 LBL
----- 02
0004 PRNTα
0006 -
0007 0
0008 .
0009 5
0010 1
0011 3
0012 E
0013 +
0014 1
0015 ,
0016 1
0017
0018
0019 ENDα
0020 RETURN
0021 LBL
----- 01
0023 2
0024 3
0025 ENTER↑
0026 CMD 5
0028 0
0029 B
0030
0031 ENDα
0032 1
0033 STO A
0034 2
0035 0
0036 STO F
0037 FOR A+F
0038 PAUSE
0039 NEXT A
    
```

```

0040 2
0041 3
0042 ENTER↑
0043 CMD 5
0045 0
0046 H
0047 ENDα
0048 2
0049 3
0050 ENTER↑
0051 1
0052 3
0053 ENTER↑
0054 1
0055 ENTER↑
0056 0
0057 INPUT 5
0059 6
0060 ENTER↑
0061 1
0062 3
0063 ENTER↑
0064 1
0065 ENTER↑
0066 0
0067 STR+α 5
0069 GOSUB L02
0071 1
0072 STO A
0073 2
0074 5
0075 STO F
0076 FOR A+F
0077 PAUSE
0078 NEXT A
0079 GOTO 0040
0081 END
    
```

9815 PROGRAM #2 PRINTOUT

38.2 mV dc

deV FUNCTION

```

+0.382E-1,1
+1.932E+0,1
+0.875E+1,1
+1.600E+1,1
+0.231E+2,1
+0.287E+2,1
+0.289E+2,1
    
```

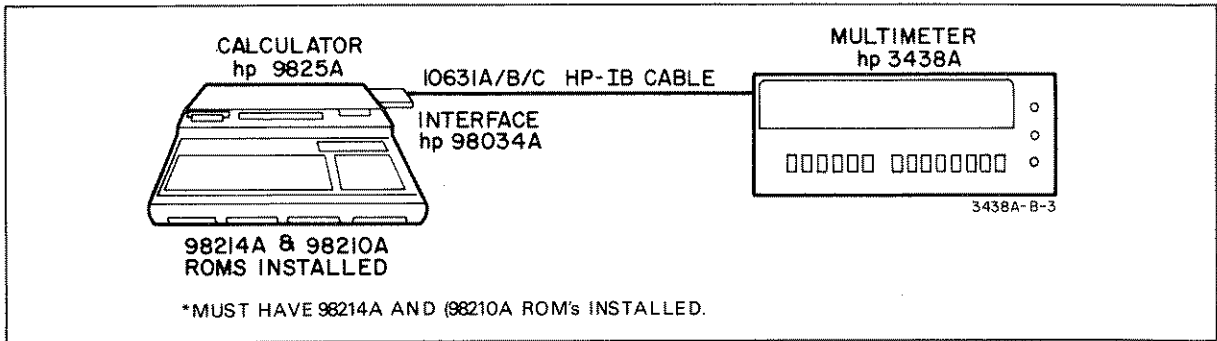
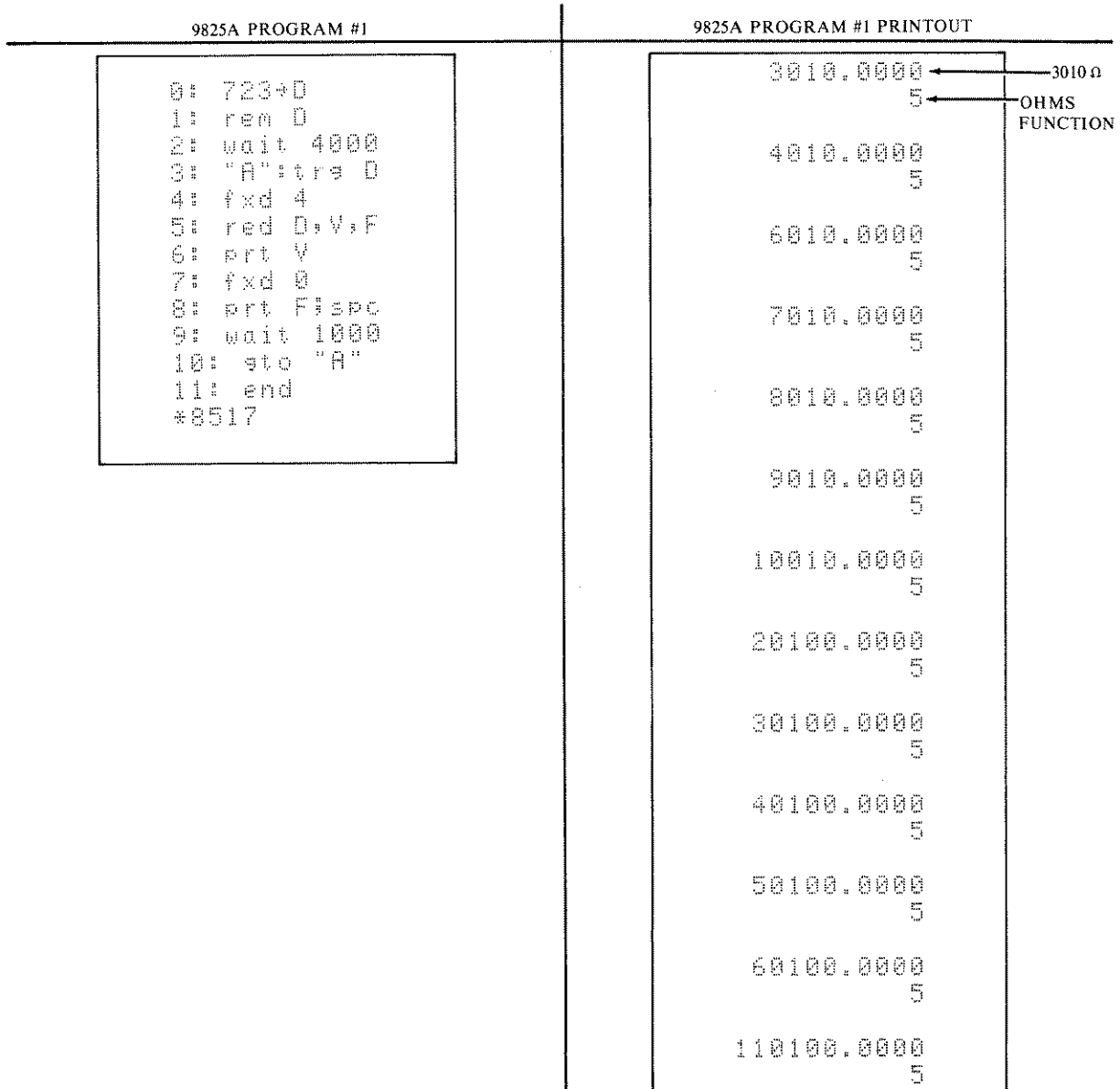


Figure 3-14. 9825/HP—IB Application.



9825A PROGRAM #2

```

0: dia D#[13]
1: 723→D
2: rem D
3: wait 4000
4: "A"↵↵↵ D
5: red D,D$
6: prt D$
7: wait 500
8: ato "A"
9: end
*18187
    
```

9825A PROGRAM #2 PRINTOUT

```

.22n → +0.0222E+1,5 ← OHMS
        +0.0222E+1,5 ← FUNCTION
        +0.0222E+1,5
        +0.0222E+1,5
        +0.0422E+1,5
        +0.9999E+5,5
100100 → +1.001E+5,5
100.1 k → +0.201E+6,5
        +0.201E+6,5
        +0.301E+6,5
        +0.301E+6,5
        +0.401E+6,5
        +0.501E+6,5
        +0.501E+6,5
        +0.601E+6,5
        +0.601E+6,5
        +0.952E+6,5
        +1.002E+6,5
        +1.002E+6,5
        +1.002E+6,5
        +0.400E+6,5
        +0.000E+1,5
        +0.025E+1,5
        +0.020E+1,5
        +0.020E+1,5
        +1.000E+4,5
        +1.001E+4,5
        +0.201E+5,5
        +0.301E+5,5
        +0.401E+5,5
        +0.501E+5,5
        +0.570E+5,5
        +0.601E+5,5
        +0.701E+5,5
        +1.001E+5,5
        +1.001E+5,5
        +1.001E+5,5
        +1.002E+5,5
OVERLOAD → +1.706E+9,5
            +1.739E+9,5
    
```

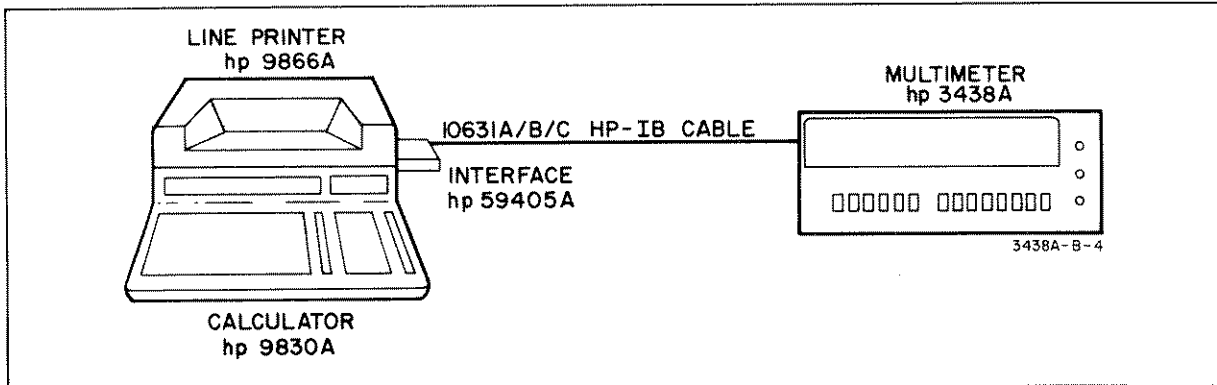
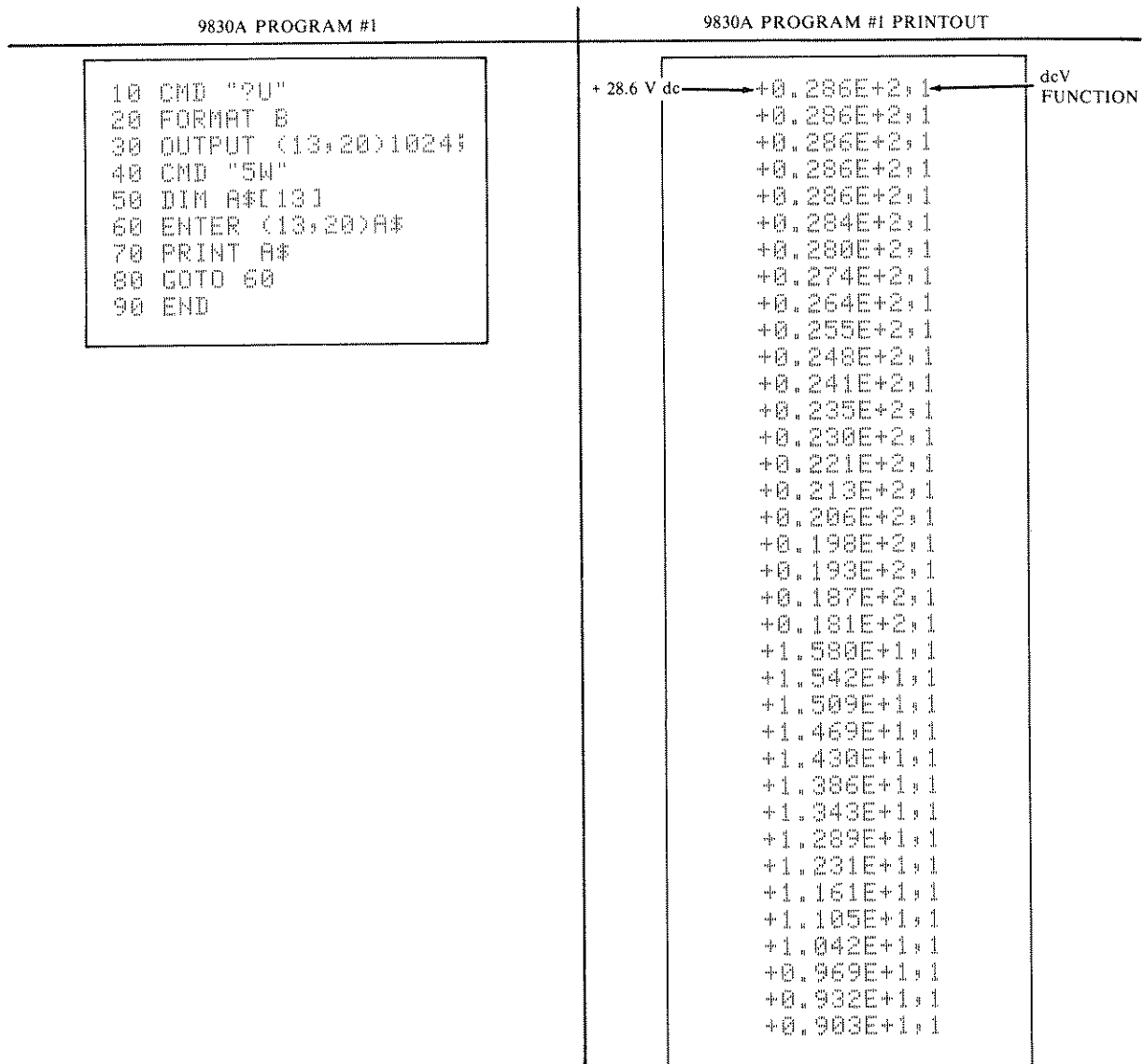


Figure 3-15. 9830A/HP-IB Applications.



9830A PROGRAM #2

9830A PROGRAM #2 PRINTOUT

```

10 CMD "?U"
20 FORMAT B
30 OUTPUT (13,20)1024;
40 CMD "5W"
50 DIM A#[13]
60 ENTER (13,20)A#
70 PRINT A#
80 WAIT 5000
90 GOTO 60
100 END
    
```

```

.46 Ω → +0.046E+1,5 ← OHMS FUNCTION
          +0.046E+1,5
          +0.046E+1,5
          +1.102E+1,5
          +0.204E+2,5
          +0.304E+2,5
          +0.404E+2,5
          +0.503E+2,5
          +0.604E+2,5
          +0.719E+2,5
          +0.803E+2,5
          +0.904E+2,5
          +1.011E+2,5
          +0.202E+3,5
          +0.302E+3,5
          +0.402E+3,5
          +0.502E+3,5
          +0.602E+3,5
          +0.701E+3,5
          +0.802E+3,5
          901 Ω → +0.901E+3,5
    
```

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