

HP Memory Project - Bertcha Bench

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Bertcha's Bench on 11/27/2007

Low resistance measurement of various connectors.

HP 4328A Milliohmmeter

Below are two pages from the 4328A manual giving the main specifications of the instrument used for this bench.

[HP 4328A General Information](#)

SECTION I GENERAL INFORMATION

1-1. DESCRIPTION

1-2. The Model 4328A Milliohmmeter (Fig. 1-1) is a portable instrument designed to measure low resistance with speed and accuracy. Covering a resistance range of .001 Ω to 100 Ω , the instrument uses a Kelvin Bridge method to obtain high sensitivity. Although the 4 terminal method is used to insure accuracy, only 2 probes placed on each end of the sample are used in the actual measurement.

1-3. To avoid measurement errors due to thermal emfs, contact potential differences and electrolytic polarization, the measurement utilizes a 1kHz signal, and is insensitive to d. c. errors.

1-4. In the measurement of contact resistance of components used in low level signal circuits, switches, relays and connectors, the measurement voltage applied should be less than 20mV peak so that thin insulating films are protected from breakdown. With the 4328A, voltage across samples is less than 200 μ V peak on any range (when proper range setting used), and a maximum voltage of 20mV if incorrect range settings are used.

1-5. The 4328A can be used to measure heat-sensitive

samples because the power dissipation in samples is very low. Voltage applied to samples is automatically limited to permit safe measurement of fuses and explosives.

1-6. A unique phase discriminator in the meter circuit insures accurate measurement of samples with series reactance up to twice full scale resistance.

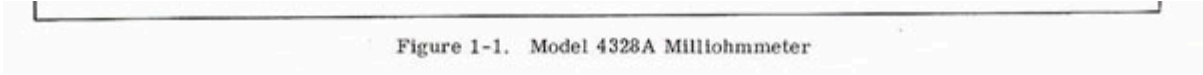
1-7. 150V superimposed dc bias may be present on samples during measurement. Thus, direct measurement of incremental resistance of back biased diodes may be performed, permitting use of the 4328A in the design of semiconductor circuitry.

1-8. Complete specifications of the Model 4328A are given in Table 1-1.

1-9. ACCESSORIES FURNISHED

1-10. Model 16005A Clip-type probe, 16006A Pin-type probe and 16007A/B Test Leads are furnished; these probes or test leads may be "mixed or matched" in any configuration determined by the form of the sample to be measured. Also detachable power cord is supplied with the Model 4328A Milliohmmeter.





HP 4328A Specifications

Section I
Paragraphs 1-11 to 1-14

1-11. INSTRUMENT IDENTIFICATION

1-12. Hewlett-Packard uses a two-section nine-character (0000A00000) or eight-character (000-00000 or 000A00000) serial number. The first three or four digits (serial prefix) identify a series of instrument; the last five digits identify a particular instrument in that series. A letter placed between the two sections identifies the country where the instrument was manufactured. The serial number appears on a plate located on the rear panel. All correspondence with Hewlett-Packard Sales/Service Offices with regard to an instrument should refer to the complete serial number.

1-13. MANUAL CHANGES

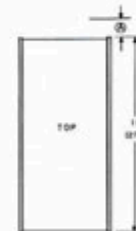
1-14. This manual provides operating and service information for the HP Model 4328A a portable instru-

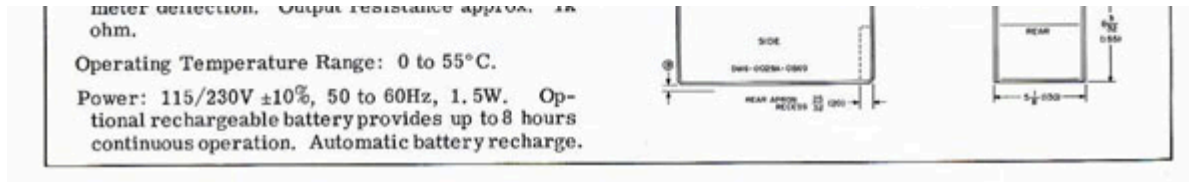
ment for measurement of low resistances. Information in this manual applies directly to instruments (as manufactured) with serial numbers prefixed by the three digits indicated on the title page. If the serial prefix of the instrument is above that on the title page, a "Manual Change" sheet supplied will describe changes which will adapt this manual to provide correct coverage. Technical correction (if any) due to known errors in print are called Errata and are shown on the change sheet. And if the serial prefix or number of the instrument is below that on the title page, see SECTION VII MANUAL CHANGES AND OPTIONS. For information on manual coverage of any HP instrument, contact the nearest HP Sales/Service Office (addresses are listed at the rear of this manual).

Table 1-1. Specifications

Resistance Range: 0.001 to 100 ohms in a 1, 3, 10 sequence.	Weight: 7 lbs (3.2kg)																																				
Resolution: max. resolution 0.02 on 0-1 scale. 0.05 on 0-3 scale.	Accessories Furnished: 16005A Clip-type Probes 16006A Pin-type Probes 16007A Test Lead 16007B Test Lead Detachable Power Cord 16143A Probe Cable																																				
Accuracy: $\pm 2\%$ of full scale. Accuracy is unaffected by series reactance of samples with magnitude of up to 2 times full-scale resistance value.	Accessories Available: 5060-0797 Rack Adapter Frame (holds three instruments the size of the 4328A. 16459A Carrying Case 11056A Handle Kit																																				
Measuring Frequency: 1000Hz \pm 100Hz	Combining Cases: 1051A 11 - 1/4 in. (286mm) deep 1052A 16 - 3/8 in. (416mm) deep The combining cases accept the 1/3 -module HP instruments for bench use or rack mounting. See 1051A data sheet for detail.																																				
Voltage across sample: 200 μ V peak at full scale.	Options: 001: Rechargeable battery installed, provides up to 8 hours continuous operating.																																				
Maximum voltage across sample: 20mV peak in any case.	Dimensions:																																				
Measuring current and power dissipation in sample.																																					
<table border="1"> <thead> <tr> <th>Range (ohms)</th> <th>* Applied Current (mA)</th> <th>** Maximum Dissipation in Samples (μW)</th> </tr> </thead> <tbody> <tr><td>0.001</td><td>150</td><td>23</td></tr> <tr><td>0.003</td><td>50</td><td>8</td></tr> <tr><td>0.01</td><td>15</td><td>2.3</td></tr> <tr><td>0.03</td><td>5</td><td>0.8</td></tr> <tr><td>0.1</td><td>1.5</td><td>0.23</td></tr> <tr><td>0.3</td><td>0.5</td><td>0.08</td></tr> <tr><td>1</td><td>0.15</td><td>0.023</td></tr> <tr><td>3</td><td>0.05</td><td>0.008</td></tr> <tr><td>10</td><td>0.015</td><td>0.0023</td></tr> <tr><td>30</td><td>0.005</td><td>0.0008</td></tr> <tr><td>100</td><td>0.0015</td><td>0.00023</td></tr> </tbody> </table>	Range (ohms)	* Applied Current (mA)	** Maximum Dissipation in Samples (μ W)	0.001	150	23	0.003	50	8	0.01	15	2.3	0.03	5	0.8	0.1	1.5	0.23	0.3	0.5	0.08	1	0.15	0.023	3	0.05	0.008	10	0.015	0.0023	30	0.005	0.0008	100	0.0015	0.00023	
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10	0.015	0.0023																																			
30	0.005	0.0008																																			
100	0.0015	0.00023																																			
* Constant for each range.																																					
** Proportional to meter deflection, full scale values given.																																					
Superimposed DC: 150V dc maximum may be superimposed on samples from an external source.																																					
Recorder Output: 0.1V dc output at full scale																																					

NOTE:
DIMENSIONS IN INCHES AND (MILLIMETERS).
① FOR TOTAL LENGTH INCLUDING KNOBS, ADD 25/32" (208)
② FOR HEIGHT INCLUDING FEET, ADD 7/16" (111)





HP 4328A Milliohmmeter - At Work

Four Wires input probes shorten.

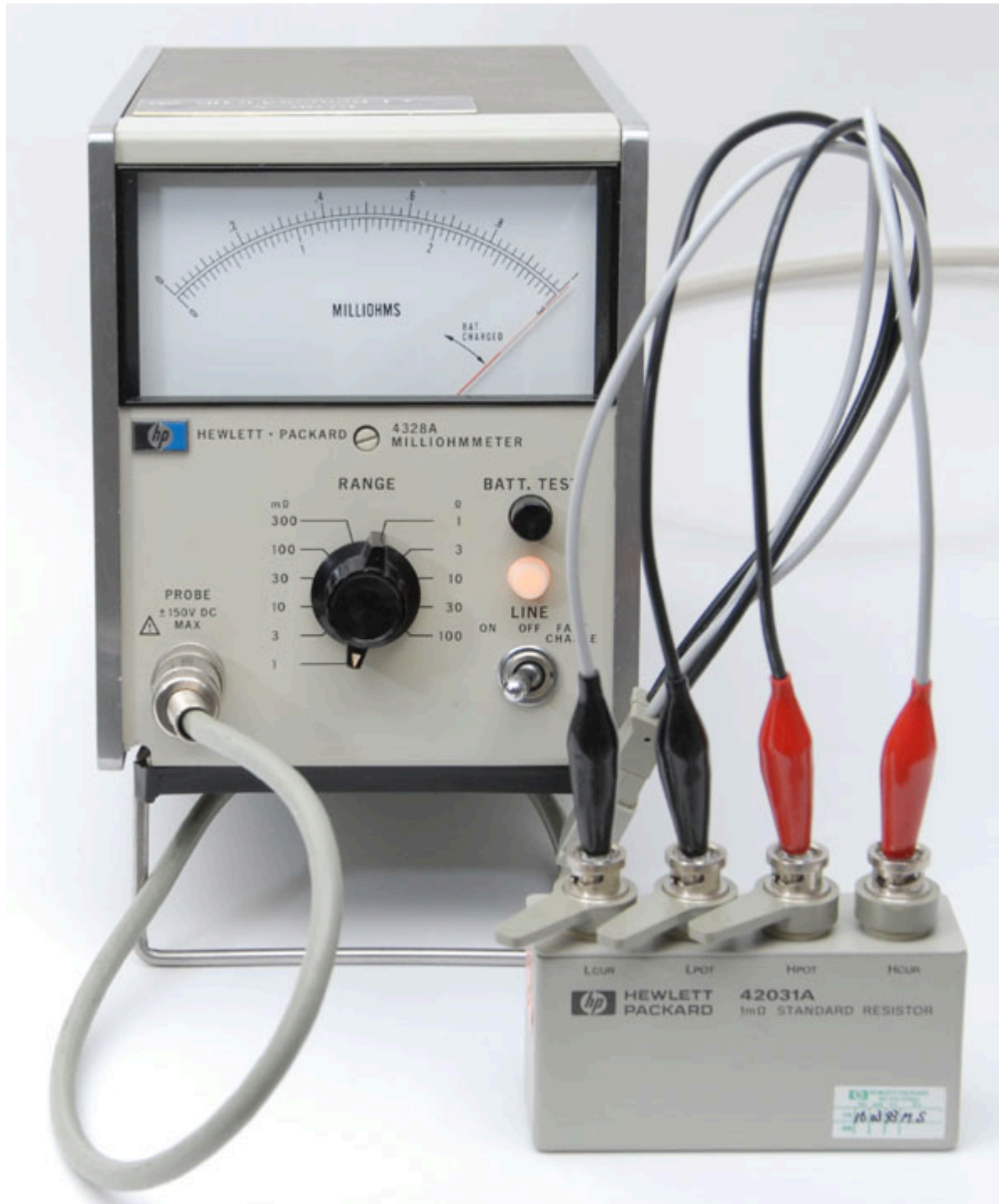
HP 4328A Zero Set



HP 4328A Milliohmmeter - Calibration Verification

Measuring a 1 milliohm Standard resistor on the 4328A lower range (1milliohm full scale)

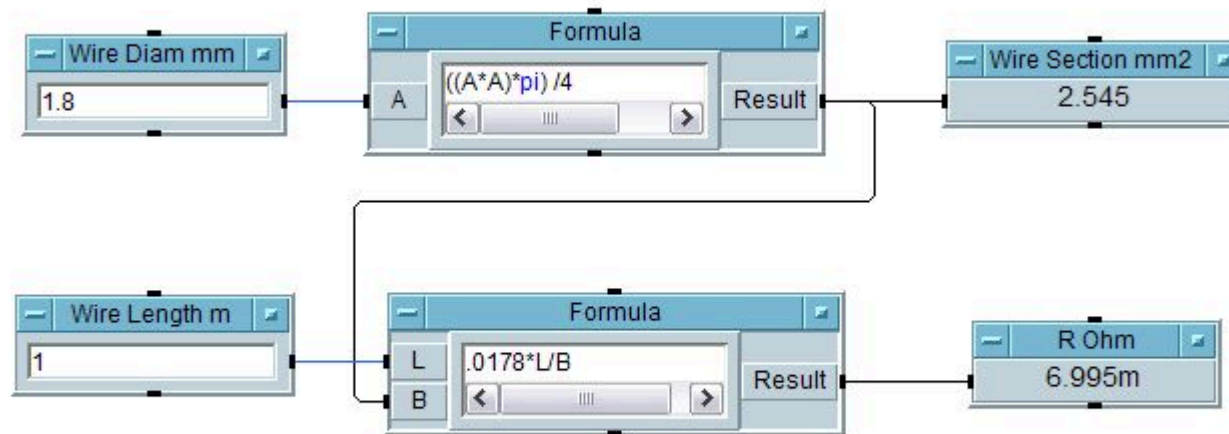
HP 4328A Calibration



HP 4328A Milliohmmeter - Test 1

Measuring a 1 meter length of 25 mm² copper wire sample. The measured wire diameter is 1.8 mm. According to the following calculation the theoretical value would be 7 milliohms.

HP-Vee Calculation of a 1 meter, 1.8 mm section, copper wire



HP 4328A Milliohmmeter - Test 1

Measuring a 1 meter length of 25 mm² copper wire sample. The measured value is 7.4 milliohms. Note that the instrument range switch is on the 10 milliohm full scale position.

Measured Value of a 1 meter, 1.8 mm section, copper wire = 7.4 milliohms



Measuring the submitted Samples:

Measurements will be made in the order shown below :

Connector Samples



Connector Sample A = 430 micro-ohm



Connector Sample B = 1.5 milli-ohm
Notice that Range is 3 milliohm FS



Connector Sample C = 625 micro-ohm



Connector Sample D = 860 micro-ohm



Connector Sample E = 18 milli-ohm
Notice that Range is 30 milliohm FS !



Summary:

Connector Samples



Final Notes

- Sample A = 0.43 mOhm
- Sample B = 1.5 mOhm
- Sample C = 0.62 mOhm
- Sample D = 0.86 mOhm
- Sample E = 18 mOhm

These measured values are the sum of the contact resistance plus the resistance of the length of material between each end of the contact. If only the contact resistance is to be considered, an approximate value of 200 micro-Ohm could be subtracted from every measured values. As shown on the picture on the right this is the residual resistance of a 2cm length of 25 mm² copper wire, which is itself the approximative length of each tested connector, except connector A. Connector A is only 1cm long, and its diameter is such that the residual resistance of the sample can be considered to be null...

Non mais !



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