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SENCORE

DVM36

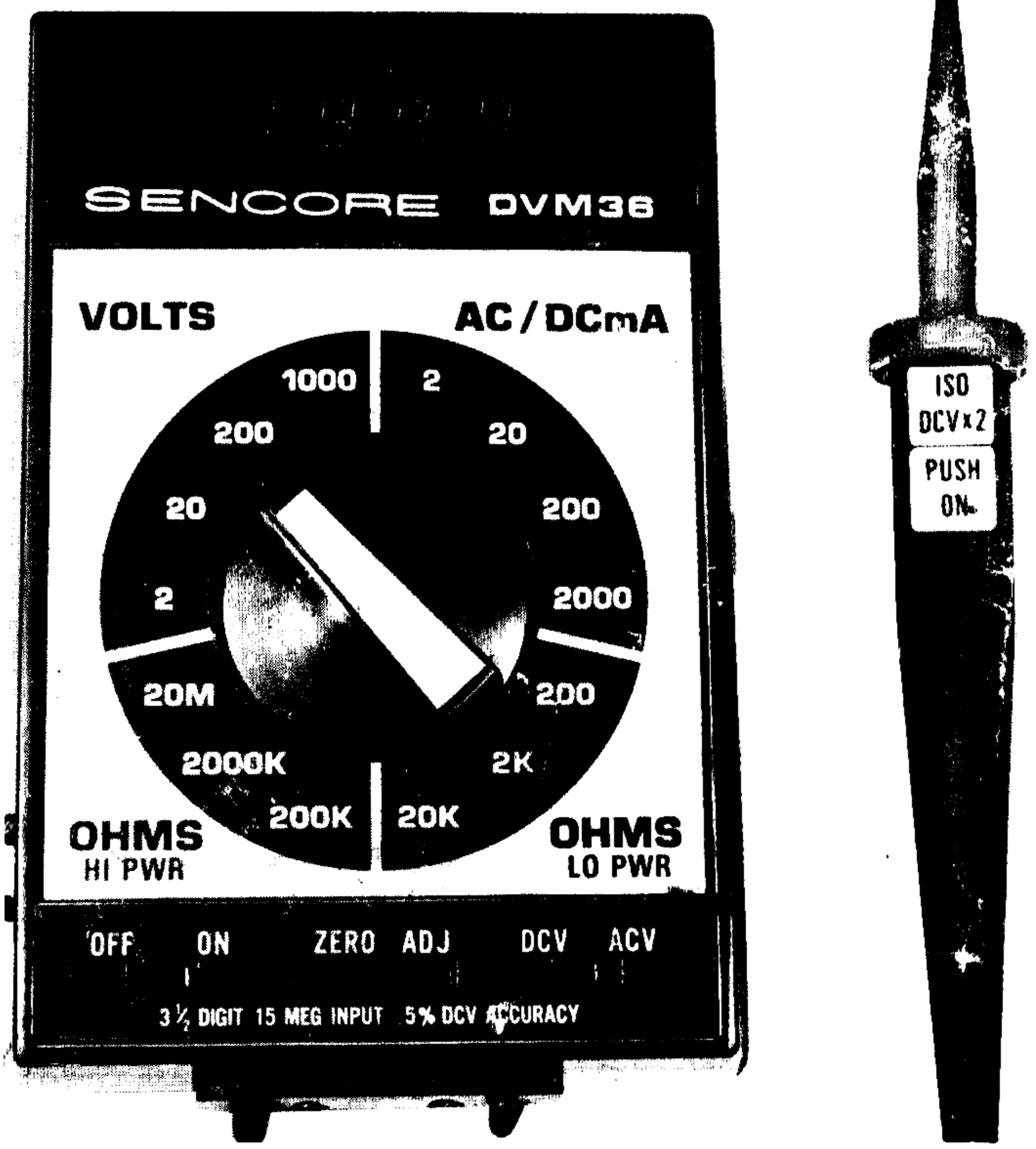
DIGITAL MULTIMETER

OPERATION AND MAINTAINANCE

MANUAL

DVM36
DIGITAL MULTIMETER

OPERATION, APPLICATION AND MAINTENANCE MANUAL



SENCORE

THE ALL AMERICAN LINE OF HIGH QUALITY TEST EQUIPMENT

SENCORE SAFETY REMINDERS

Every precaution has been taken in the design of your instrument to insure that it is as safe as possible. However, safe operation depends on you, the operator.

There is always a danger present when testing electronic equipment. Unexpected high voltages can be present at unusual locations in defective equipment. Become familiar with the equipment you're working with, and observe the following safety precautions.

1. Never exceed the limits of this instrument as given in the specifications section, and the additional special warnings in this manual.

2. A severe shock hazard can result if the chassis of the equipment being serviced is tied to the "hot" side of the AC line. An isolation transformer should always be used with this equipment. Also, be sure that the top of the workbench and the floor underneath it are dry and made of non-conductive material.

3. Remove the circuit power before making connections to high voltage points. If this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket and stand on an insulated floor mat to reduce the possibility of shock.

4. Discharge filter capacitors before connecting test leads to them.

5. Be sure your equipment is in good order. Broken or frayed test leads can be extremely dangerous and can expose you to dangerous voltages.

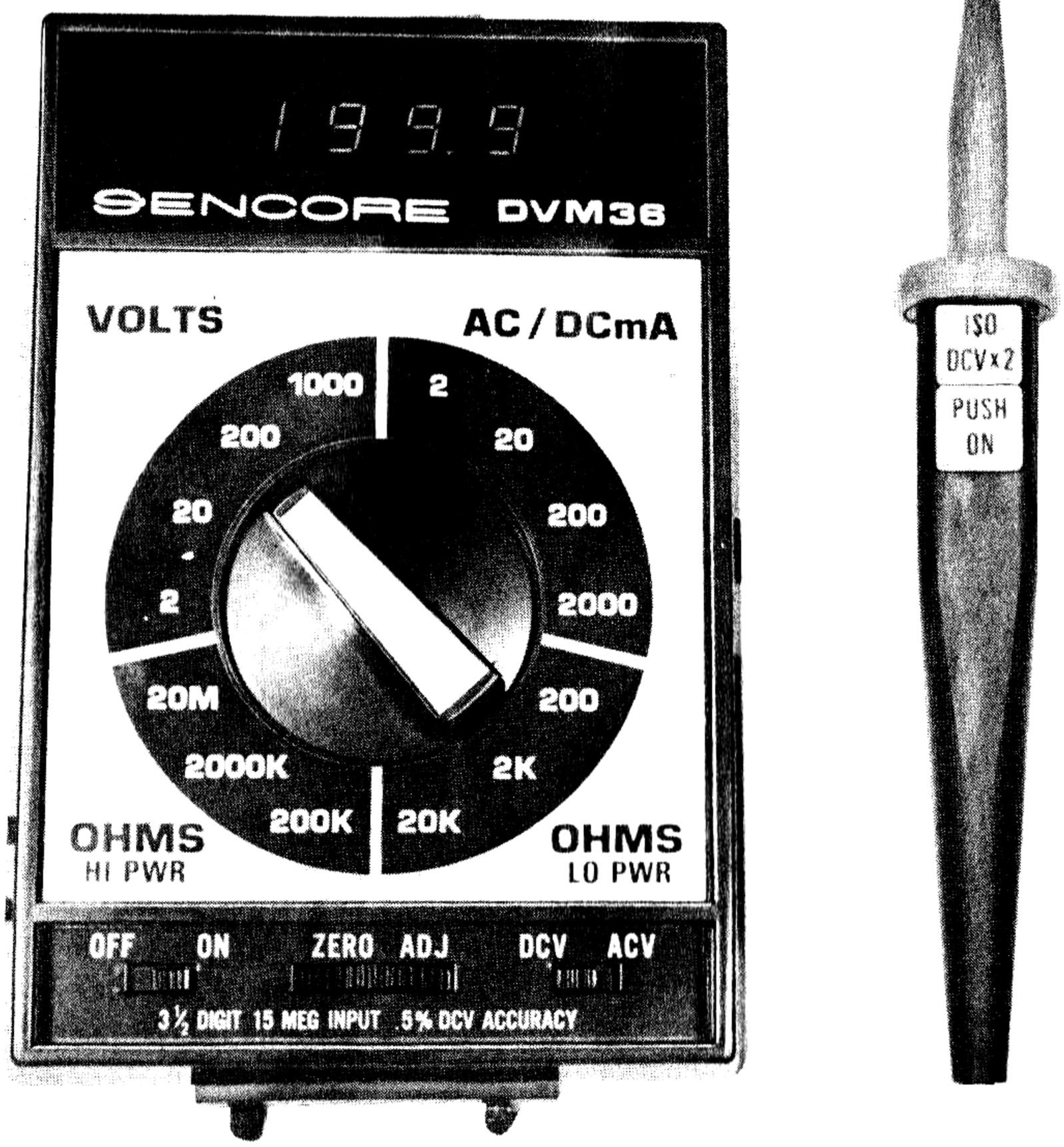
6. Remove the test leads immediately after the test has been completed to reduce the possibility of shock.

7. Do not work alone when working on hazardous circuits. Always have another person close by in case of an accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltages.

DVM36

DIGITAL MULTIMETER

OPERATION, APPLICATION AND MAINTENANCE MANUAL



SENCORE

3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

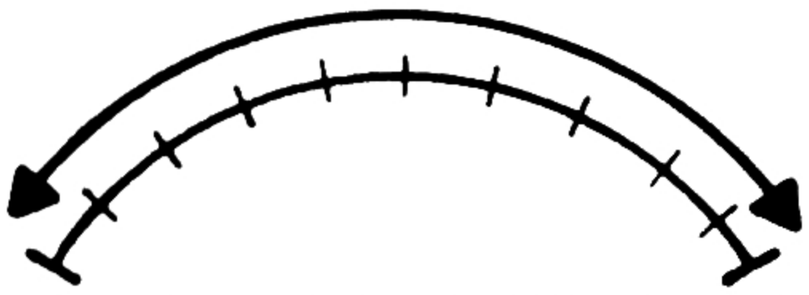
FAMILIARIZATION

" HOW TO GET THE MOST FROM YOUR DVM36 "

PLAY THE CASSETTE TRAINING TAPE SUPPLIED WITH THE DVM36, AND FOLLOW THE DIAGRAMS BELOW.

❶ RESOLUTION AND ACCURACY

100 DIVISIONS



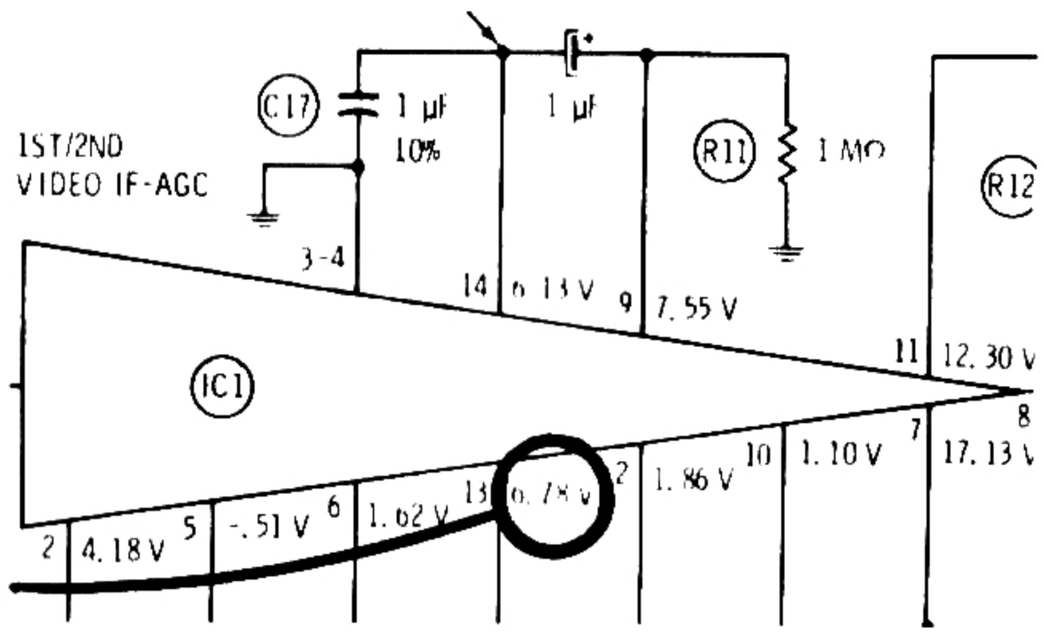
STANDARD METER SCALE
CAN BE READ ACCURATELY
1 PART IN 100

2000 DIVISIONS



3½–DIGIT DVM WILL READ TO
1 PART IN 2000

❷

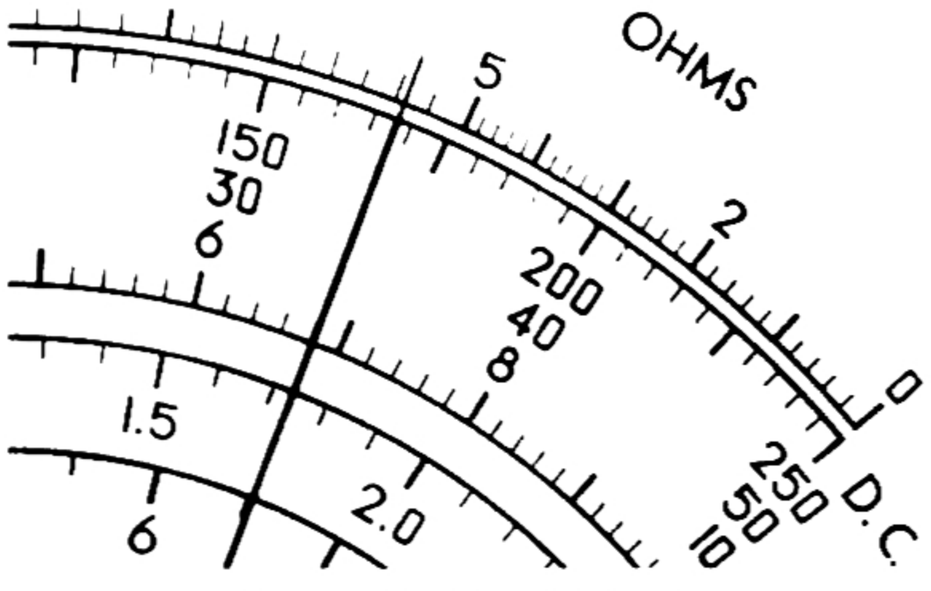


6.78 VOLTS

SOLID STATE EQUIPMENT REQUIRES DIGITAL ACCURACY

Quasar Chassis C19TS
Sams Photo Fact 1478-2

❸ ACTUAL SIZE METER READINGS

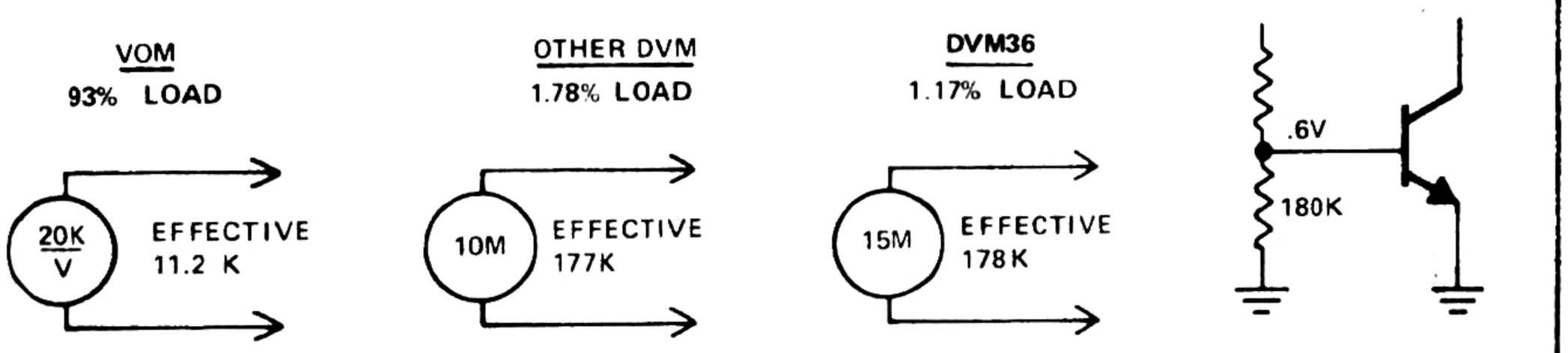


POPULAR VOM



3½ DIGIT DVM36

4 CIRCUIT LOADING



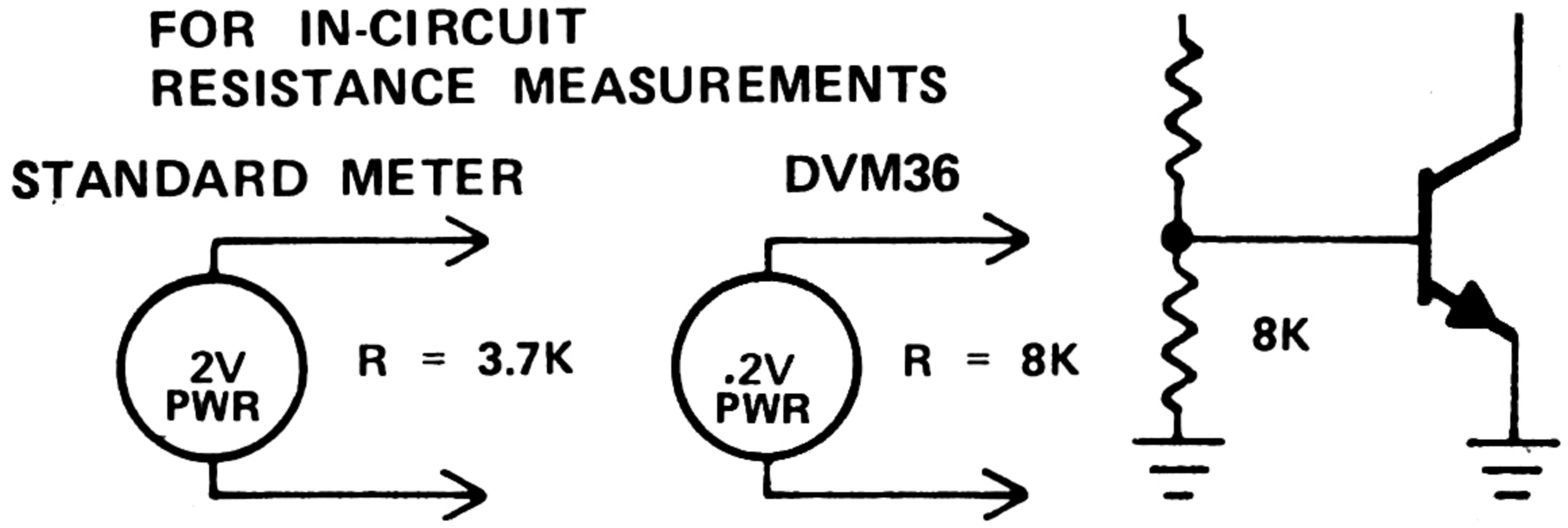
5 ACCURACY SPECS

	OTHER DVM 100V RANGE	DVM36 20V RANGE
	.5% FULL SCALE = .50V	
10V MEASURED	.5% READING = .05V	.5% READING = .05
MAXIMUM ERROR =	.55V	.05V

COMPARE

6 LO POWER OHMS

FOR IN-CIRCUIT RESISTANCE MEASUREMENTS



7 HI POWER OHMS

FOR DIODE, TRANSISTOR, IC TESTING

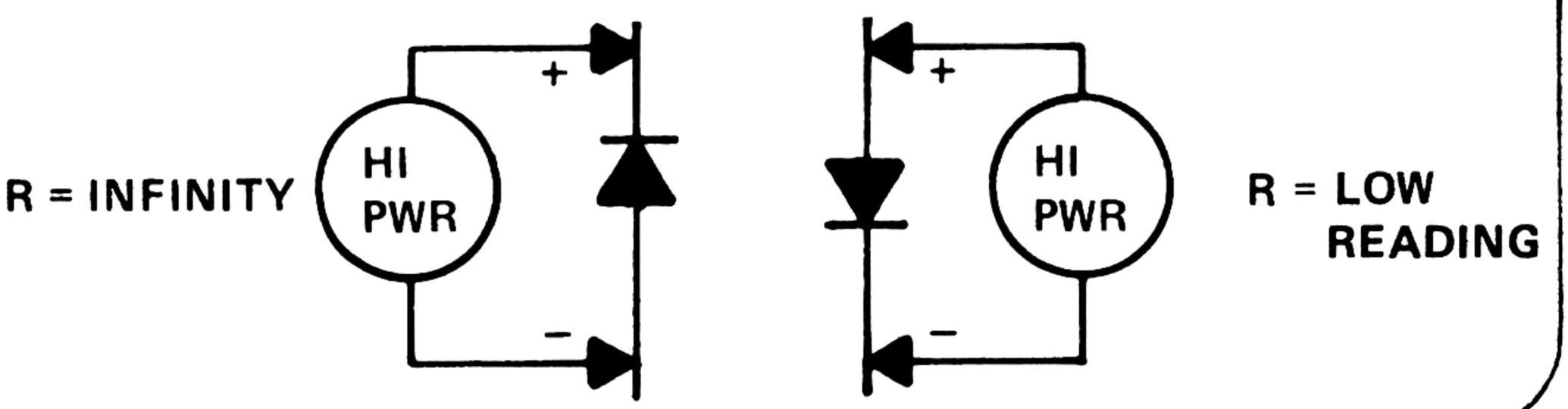


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INTRODUCTION AND GENERAL DESCRIPTION

INTRODUCTION

For many years the VOM multimeter has been the standard instrument for electronic measurements, and it has served well in field applications requiring portability and for all-around general purpose use. With the advent of the transistor, however, the VOM found limited application because high circuit loading altered normal circuit operation, and the meter movements were not sensitive enough for the low voltage readings required.

To answer the need for accurate solid state measurements, the FET multimeter was developed, offering a constant high input impedance, greater low range sensitivity, and higher accuracy. But the new generation of integrated circuits has now placed even greater demands upon these multimeters. Solid state and IC circuits have become widespread, appearing in literally thousands of applications -- from automobile ignition systems and household appliances, to home entertainment products, industrial control systems, and computers everywhere. These circuits now demand reading accuracies beyond what the pointer-type meter is capable of delivering. The analog meter has become "old fashioned."

Of course, the AC-powered, laboratory digital multimeter answered these requirements for high accuracy and resolution, high input impedance, and low level sensitivity, but they are not enough for field applications. Adding an accessory battery pack to a lab DVM is still a long way from the compact meter in the hand, and much more expensive.

The electronic technician today needs a compact "pocket portable" digital multimeter that includes the digital's resolution, sensitivity, and overload protection in a tough, compact, and durable case that is designed to be portable -- and at an analog price. Sencore engineering has accomplished this with the DVM36 3 1/2-digit Portable Digital Multimeter.

The DMV36 has up to twenty times more accuracy than analogs with .5% digital accuracy and 15 Megohm input impedance. It measures more -- down to 1 mV and up 2000 VDC -- for expanded field capabilities. It's tougher -- burnout proof to 1000 Volts on all functions and ranges, and drop-proof for less downtime and replacement costs. Finally, long battery life is assured with the exclusive "Push to Test" Remote Power switch in the probe, which turns the battery power on only while the measurement is being made.

The Sencore DVM36 offers portable speed, accuracy, and convenience for today's technician, plus it is backed by the exclusive Sencore 100% Made Right Lifetime Guarantee against factory workmanship errors.

SPECIFICATIONS

Note: Accuracies are expressed as percentage of reading ± specified number of digits for the given range. All specifications are from full scale to 1/10th full scale.

DC VOLTAGE

RANGES:	0 to ±2, 20, 200, 1000 Volts
ACCURACY:	±0.5% of reading ±1 digit
RESOLUTION:	1 mV on 2V range
INPUT IMPEDANCE:	15 Megohm shunted by less than 60 pF (30 Megohm using isolation resistor)
RESPONSE TIME:	2 sec max.
POLARITY:	Automatic: negative sign indicator
ISOLATION:	Built-in 15 Megohm 1% Isolation resistor in probe. Can also be used for X2 multiplication extending ranges to 4, 40, 400, 2000 Volts. Isolation Accuracy: 2% .
AC REJECTION:	-40 dB at 60 Hz
MAX INPUT PROTECTION:	1000 Volts (DC + peak) any range. Internal diode plus back-up fuse protection. Fuse in probe tip.

AC VOLTAGE

RANGES:	0 to 2, 20, 200, 1000 Volts
ACCURACY:	±1.0% of reading ±2 digits at 50-60 Hz
RESOLUTION:	1 mV on 2V range
INPUT IMPEDANCE:	15 Megohm shunted by less than 60 pF
RESPONSE TIME:	2 sec. max
FREQUENCY RESPONSE:	40Hz to 1000Hz, ±5% reading ±1 digit
AC CONVERSION:	RMS reading, average detecting
MAX INPUT PROTECTION:	1000 Volts (peak + DC) any range. Internal diode plus back-up fuse protection. Fuse in probe tip.

AC/DC CURRENT

Total average sum of AC and DC current is indicated.

RANGES:	0 to ±2, 20, 200, 2000 mA
ACCURACY:	DC: ±1% of reading ±1 digit AC: ±1.5% of reading ±2 digits
RESOLUTION:	1 uA on 2 mA range

VOLTAGE BURDEN:	200 mV, except 1V on 2000 mA range.
SHUNT RESISTANCE:	100, 10, 1 .1 ohms for ranges above.
RESPONSE TIME:	2 sec max.
POLARITY:	Automatic: negative sign indicator
MAX INPUT PROTECTION:	Diode and 2A fuse protection of shunt resistors. Fuse in probe tip.

RESISTANCE

RANGES:	0 to 200, 2K, 20K ohms (Low Power): 200K, 2000K, 20 Megohm (High Power)
ACCURACY:	±1% of reading ±2 digits, except: 200 ohm range: ±1.0% of reading ±2 digits from Full to 1/4 scale, ±2.0% of reading ±2 digits from 1/4 to 1/10 scale. 20 Megohm range: ±2.0% of reading ±2 digits.
RESOLUTION:	.1 ohm on 200 ohm range
MAX VOLTAGE APPLIED:	Low Power: 200 mV max. High Power: 2V max.
MAX CURRENT THRU UNKNOWN R:	2 mA, 200 uA, 20 uA, 10 uA, 1 uA, 100 nA for ranges above.
RESPONSE TIME:	2 sec max.
MAX INPUT PROTECTION:	1000 Volts (DC +peak) all ranges, except 500 Volts (DC +peak) on 20 Megohm range. Diode and fuse protection of Low Power ranges. Fuse protection of High Power ranges. Fuse in probe tip.

GENERAL

DISPLAY:	3 1/2 digit, 7-segment, 0.3" red L.E.D.
INDICATORS:	Automatic negative sign Automatic decimal Automatic overrange (as blinking display with "1" on, "888" blinking)
A/D CONVERSION:	Single slope method
SAMPLE RATE:	2 samples per second
FUSE:	2A fast blow, 3AG-type, located in probe tip

ELECTRICAL:	All solid state circuitry, including CMOS LSI.
MECHANICAL:	Drop-proof Cycolac® case, completely insulated.
SIZE:	6'' x 4'' x 1 1/4'' (15.2 x 10.2 x 3.2 cm) HWD
WEIGHT:	1.1 lb. (.5 Kg) including batteries
POWER:	Batteries: 6-AA 1½ Volt alkaline cells (Eveready No. E91 or equivalent). Rechargeable: PA202 Power Adapter used with 6-AA 1 1/2 Volt NiCad rechargeable cells (GE No. GC1 or equivalent). AC Line: 105-130 VAC, 50/60 Hz when used with PA202 Power Adapter and batteries installed for filtering.
SUPPLIED ACCESSORIES:	39G96 Touch-On Probe with Isolation "DCV X2'' switch and "Push to Test'' Remote Power switch, attached to case. Manual Schematic and Parts List Familiarization Instruction Tape
OPTIONAL ACCESSORIES:	HP200 50KV High Voltage Probe PA202 Power Adapter

"Specifications and design subject to change without notice.''

CONTROLS

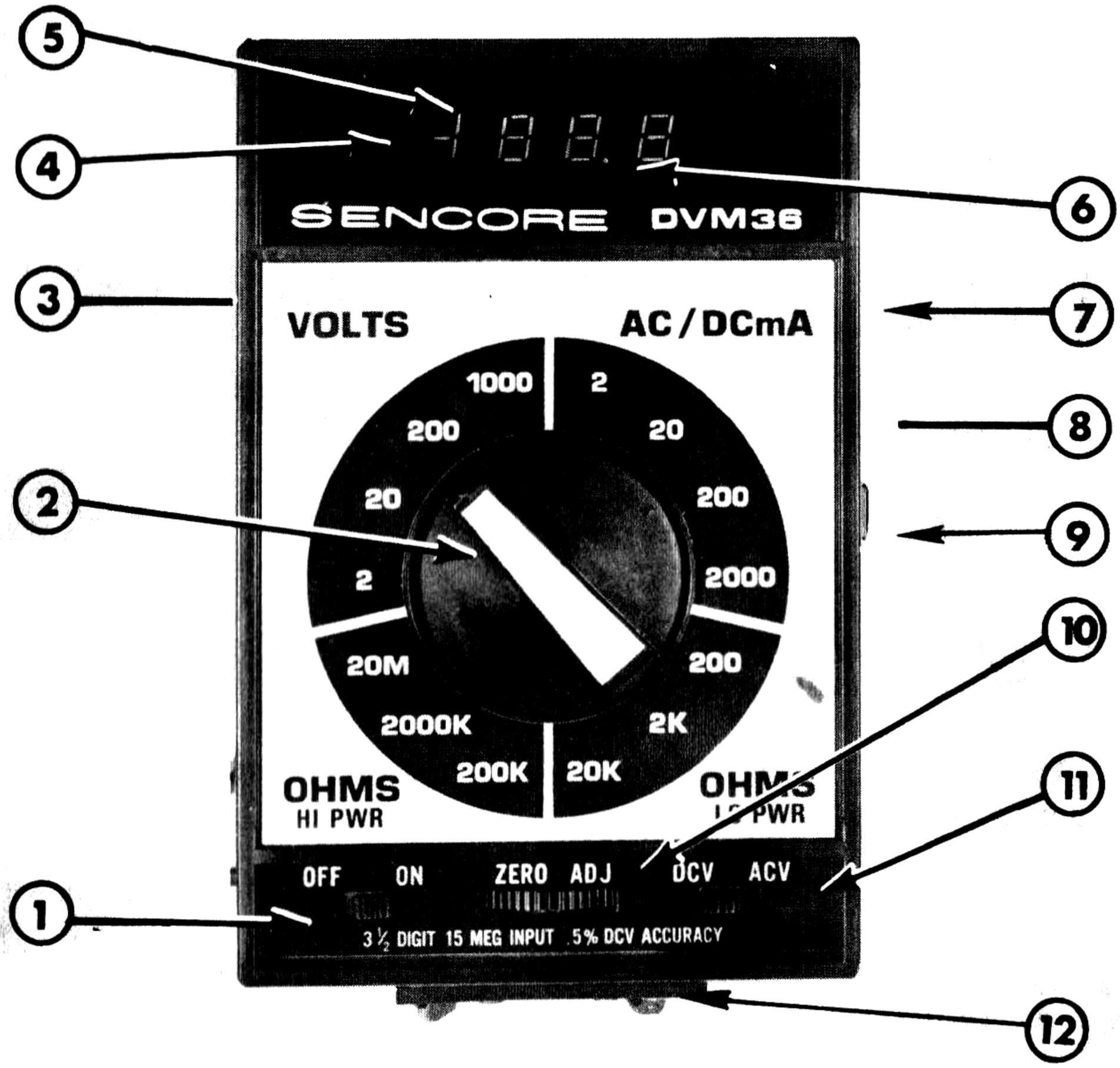
1. POWER SWITCH: Applies power to the instrument.

2. FUNCTION/RANGE SELECTOR: Selects both desired function and range.

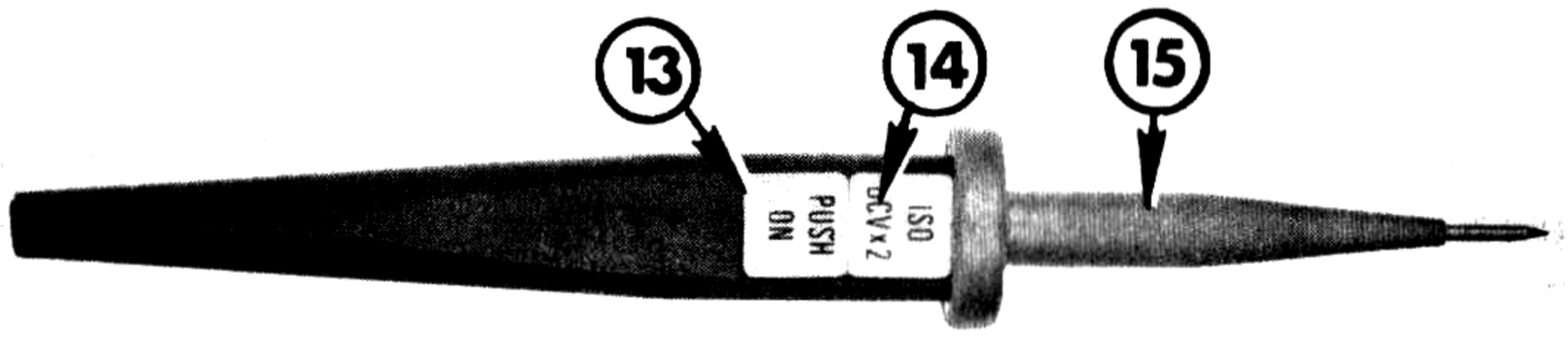
3. BATTERY COMPARTMENT: (on back of case) for 6 - "AA" size alkaline or NiCad batteries.

4. "—" NEGATIVE SIGN INDICATOR: Lights when the display reading is negative potential, with respect to black lead potential.

5. DISPLAY READOUT: Bright 3-digit 7-segment light emitting diode (L.E.D.) numerals.



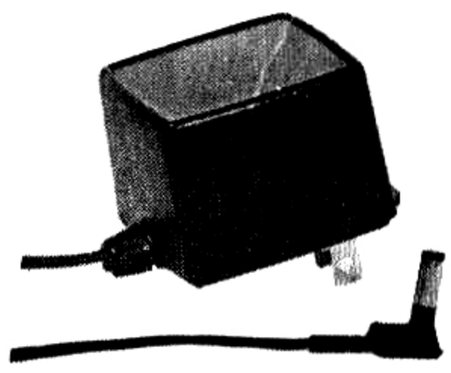
DVM35 DIGITAL MULTIMETER



39G96 TOUCH-ON PROBE



HP200 HIGH VOLTAGE PROBE



PA202 POWER ADAPTER

6. DECIMAL INDICATORS: Automatically positioned for direct display readout. (No decimal lights on "1000" or "2000" ranges)

7. HI-IMPACT CYCOLAC ® CASE: Completely insulated two piece case for rugged field use.

8. TILT STAND: (On back of case) Raises display for easy viewing on bench.

9. POWER ADAPTER JACK: (On side of case) For plug-in PA202 Power Adapter for rechargeable or AC Line operation, and checking battery condition.

10. ZERO ADJUST: Adjusts zero "000" readout.

11. DCV/ACV VOLTAGE SELECTOR: Selects DC or AC reading for FUNCTION/RANGE voltage positions.

12. TEST LEADS: 39G96 Touch-On Probe and common test lead permanently attached to case.

13. "PUSH TO TEST" REMOTE POWER SWITCH: Applies power to the instrument during measurement when pressed. (Can be bypassed by POWER SWITCH on front panel for continuous operation.)

14. "ISO DCV X2" ISOLATION SWITCH: Connects 15 megohm resistor in series with test lead for isolation or DCV X2 expand when pressed.

15. PROBE TIP AND PROTECTION FUSE: Unscrews for replacement of 2A 3AG protection fuse. Sharp probe tip for positive contact.

16. HP200 50KV HIGH VOLTAGE PROBE: (Optional) Slips over probe to extend DC Voltage range to 50KV. Multiplies all DC voltage readings by 100.

17. PA202 POWER ADAPTER: (Optional) Plugs into POWER ADAPTER JACK for AC Line or rechargeable battery operation.

OPERATION

INTRODUCTION

To get maximum effectiveness from your DVM36, you should become thoroughly familiar with its operation and applications before putting the instrument to use. Play the Familiarization Instruction Tape supplied with the instrument, then read through the step-by-step instructions in this Operation Section and the Applications Section following, for common DVM applications and uses.

Observe all safety precautions listed inside the front cover and throughout the manual to insure continued usefullness with the DVM36.

OVERLOAD PROTECTION

The DVM36 is a completely protected digital multimeter, eliminating most downtime because of accidental overloads. Built-in circuit overload protection reduces time-consuming fuse replacement for most common errors. Additional fuse protection prevents damage from extreme overloads. All functions and ranges are protected, as follows (as measured without depressing X2 button).

OVERLOAD PROTECTION LIMITS

FUNCTION	OVERLOAD LIMIT	PROTECTION
DC, AC Voltage	1000V (DC + peak)	Diode, Hi Input Impedance, 2A Fuse
DC, AC Current	2A RMS	Diode, 2A Fuse
Resistance		
200, 2000, 20K ranges	1000V (peak + DC)	Diode, 2A Fuse
200K range	1000V (peak + DC)	Neon lamp, 2A Fuse
2M range	1000V (peak + DC)	2A Fuse
20M range	500V (peak + DC)	2A Fuse

The protection will generally handle an overload long enough for corrective action to be taken. With any overload the display will indicate a flashing "1888" overrange condition. Remove the probe from the test point, select the proper function and/or range, and then make the test again.

Always start at the highest range when measuring unknown voltages. Switch down to the range giving the greatest resolution once the approximate value is known.

CAUTION: DO NOT EXCEED THE OVERLOAD LIMITS. To do so may cause damage to the instrument and possible hazards to the operator. The warranty is invalid if an instrument shows indications of overload. Be especially careful in television high voltage and output sections.

OVERRANGE INDICATION

If the actual measured value on any range or function is above the maximum value of the selected range (such as measuring 24 Volts on the 20 Volt range), the DVM36 will display a blinking "1888" to indicate the overrange condition. The "1" will remain on, while the three "8" digits will flash. Step up to the next higher range until a normal reading is obtained. Infinity resistance (open circuit) will always show as overrange on any OHMS range.

The overrange indication also serves as a "lamp test" to illuminate all the L.E.D. display segments as a check for any possible "burned out" elements.



Fig. 5 — Flashing Overrange Indication

PREPARING FOR MEASUREMENT

1. Be sure the batteries are installed properly (see BATTERY INSTALLATION) and have adequate power (see BATTERY TEST).
2. The DVM36 power may be turned on either of two ways:
   a. Slide the POWER SWITCH on the front panel to the ON position for continuous measuring.
   b. Press the "Push to Test" REMOTE POWER SWITCH on the probe during measurement to save battery power when making intermittent measurements. The REMOTE POWER switch is bypassed by the front panel switch when the latter is used.

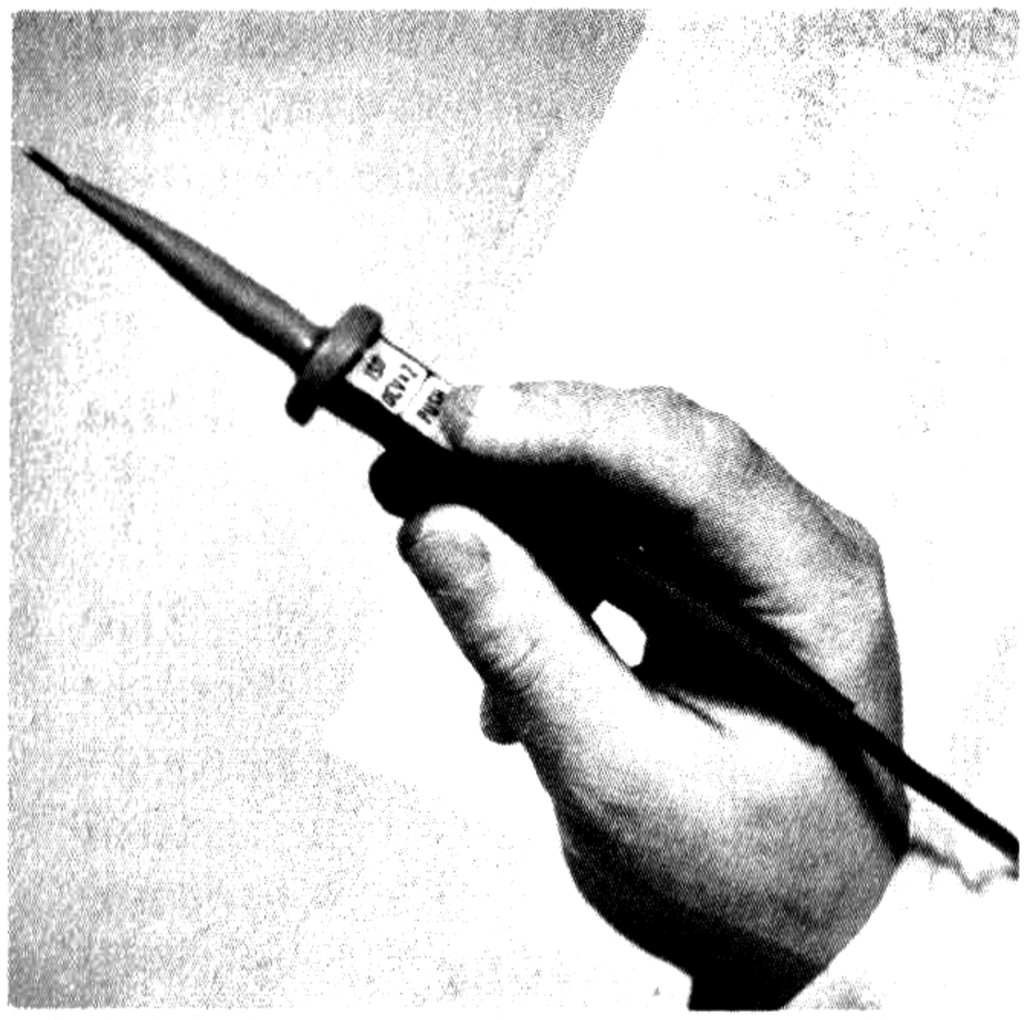


Fig. 6 — Pressing the remote power switch to turn unit on.

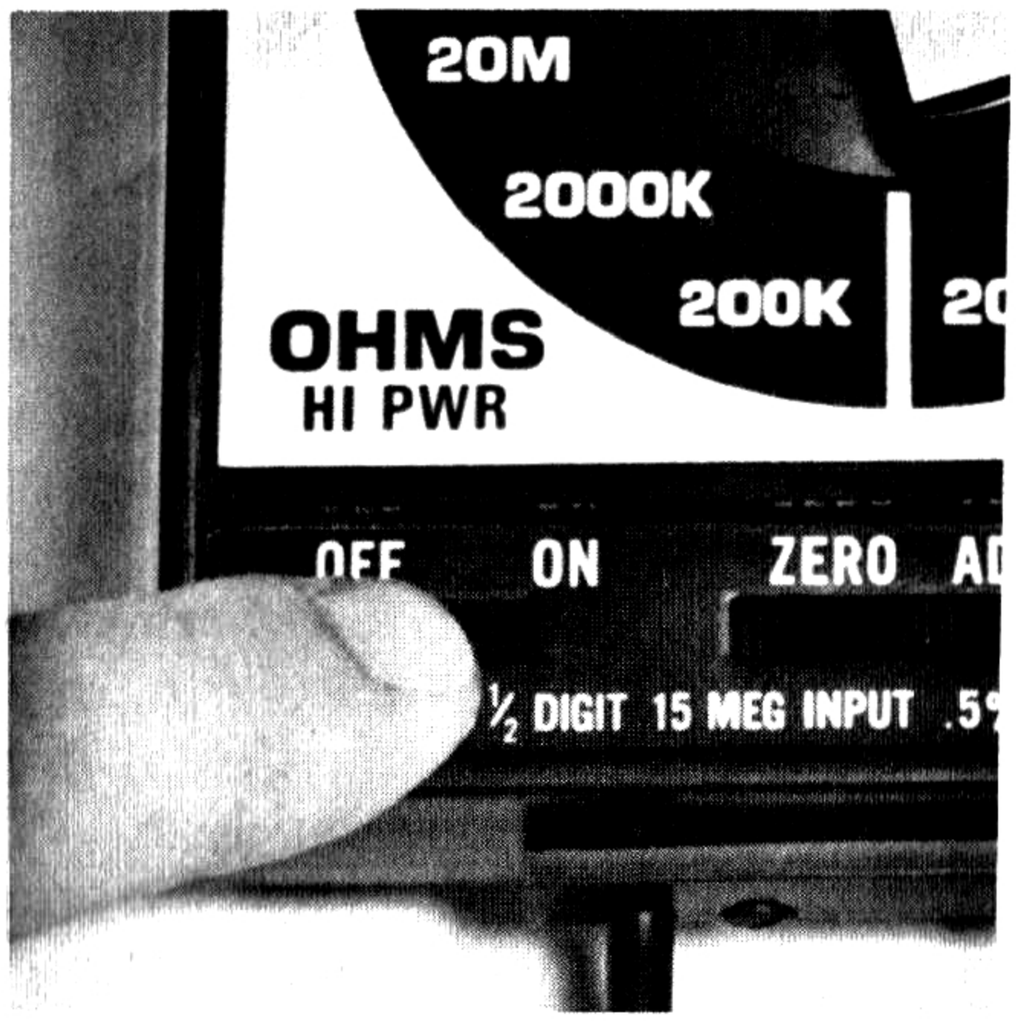


Fig. 7 — Using power switch to turn unit on.

3. Rotate the FUNCTION/RANGE selector knob to the desired function section.
4. With the test leads shorted, the display should read "000". If not, adjust the ZERO ADJUST control until a "-000" reading is obtained, then turn the control slightly until the negative sign just blinks on and off, or just stays on. It is important that the zeroing be properly set since any readings will be changed by an improper zero offset.

NOTE: Under certain conditions, the last digit may alternate from "0" to "1", and is a normal action when the test leads are shorted together. The negative polarity sign may show on DC Voltage, Current, or the Ohms functions, but will not appear on AC Voltage. For this reason, the best zero position will be obtained on the DCV function, although zeroing on Current or Ohms should produce similar results.

5. Develop the practice of returning the FUNCTION/RANGE selector knob to the 1000 VDC position after testing is completed to prevent accidental overloads to the meter.

DC VOLTAGE MEASUREMENT

1. Make the initial set-up as explained in PREPARING FOR MEASUREMENT.

2. Slide the DCV/ACV switch to the DCV position.

3. Rotate the FUNCTION/RANGE selector to the VOLTS area, and the range desired. If the value of the voltage is unknown, start with the 1000 Volt range and work down to the range required for a satisfactory reading.

4. Connect the common lead to the ground or common point of the circuit in which the measurements are to be made.

5. Touch the Test Probe to the voltage point to be measured. The DVM36 will automatically determine the polarity and display the "—" negative sign for voltages that are negative with respect to the black common lead. The readout will show the actual voltage with the decimal automatically positioned. If the voltage is over the range selected, the overrange of a flashing "1888" will be displayed.

EXTENDING DC VOLTAGE RANGE TO 2000 VOLTS

The 1000 Volt range can be extended to 2000 Volts for high voltage measurements, such as the Boost voltages in television receivers. The "DCV X2" button on the probe places a 15 Megohm resistor in series with the 15 Megohm input impedance of the DVM36. This action reduces the input to the DVM to one half the actual measured voltage. Multiply the reading obtained by two for the actual measured value.

1. When measuring voltages between 1000 and 2000 Volts, select the 1000 Volt DC range and press the "DCV X2" switch on the probe.

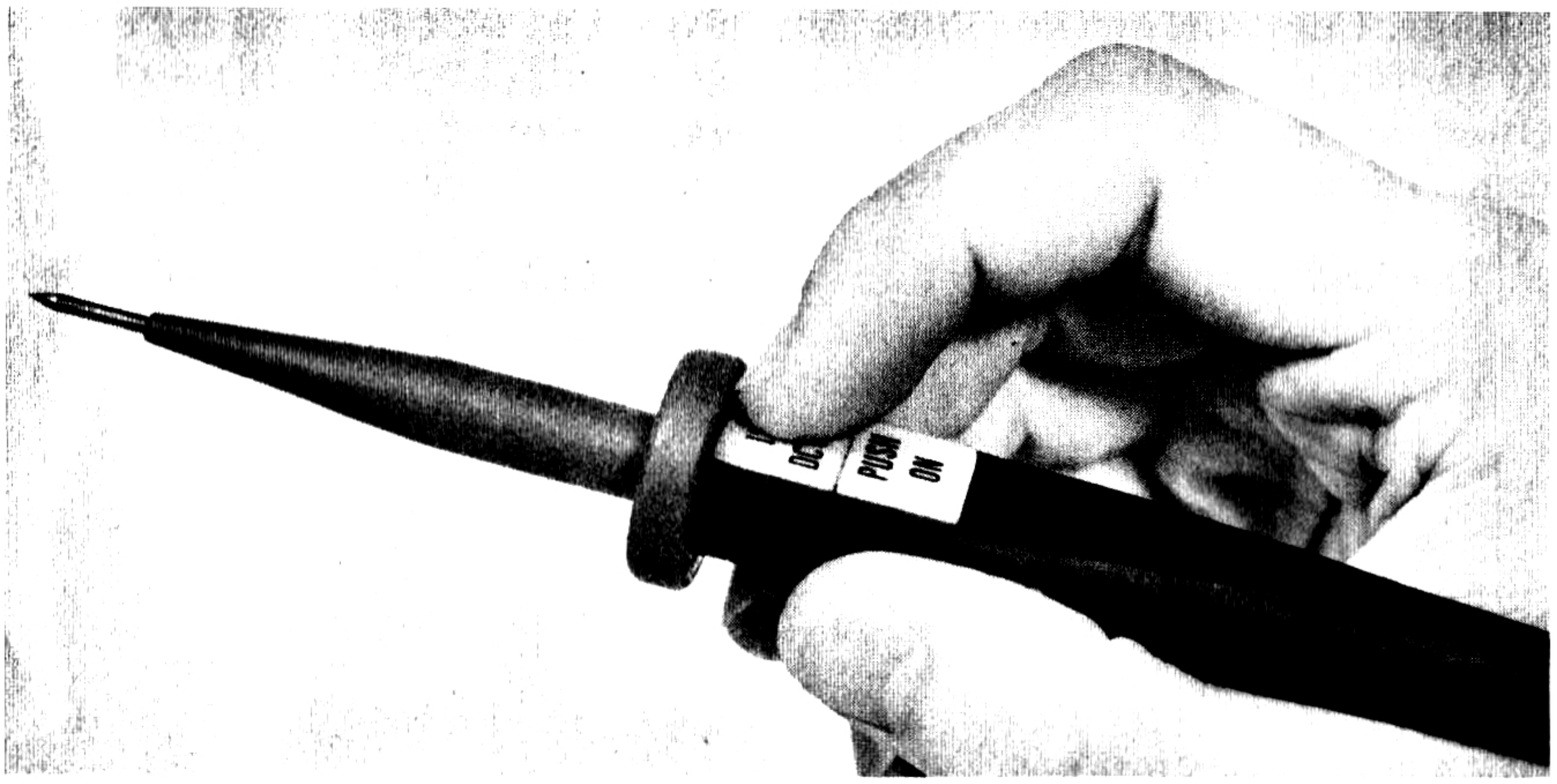


Fig. 8 — Pressing "ISO DCV X2" switch for extended DC voltage measurements.

2. Measure the voltage while holding the switch in position.

3. Multiply the indicated reading by two for the actual voltage measured.

> **WARNING: Be sure the "DCV X2" button is continuously pressed when making these measurements, since the input protection of the DVM36 is limited to 1000 Volts.**

AC VOLTAGE MEASUREMENT

1. Make the initial set-up as explained in PREPARING FOR MEASUREMENT.

2. Slide the DCV/ACV switch to the ACV position.

3. Rotate the FUNCTION/RANGE switch to the VOLTS area, and the range desired. If the value of the voltage is unknown, start with the 1000V range, and work down to the range required for a satisfactory reading.

4. Connect the common lead to the ground or common point of the circuit in which the measurements are to be made.

5. Touch the Test Probe to the voltage point to be measured. The Display readout will show the actual voltage with the decimal automatically positioned. If the voltage is over the range selected, the overrange indication of a flashing "1888" will be displayed. The "DCV X2" button should not be used for AC measurements.

> **NOTE: The AC converter detects the AC average value, but displays the RMS value, for a pure sine wave. Readings obtained for non-sinusidal waveforms may not be the true RMS value.**

AC/DC CURRENT MEASUREMENTS

1. Make the initial set-up as explained in PREPARING FOR MEASUREMENT.
2. Rotate the FUNCTION/RANGE selector to the AC/DC mA area, and the range desired. Note that 2000 mA equals two Amps. If the value of the current is unknown, start with the 2000 mA range and work down to the range required for a satisfactory reading. The DCV/ACV switch has no effect on the measurement, but should be placed in "DCV" position when measuring DC current, or "ACV"

position when measuring AC current. The proper polarity indication will be obtained on DC, and blanked on AC current.

3. Before connecting the instrument to read current, always REMOVE POWER from the equipment in which current is to be measured.

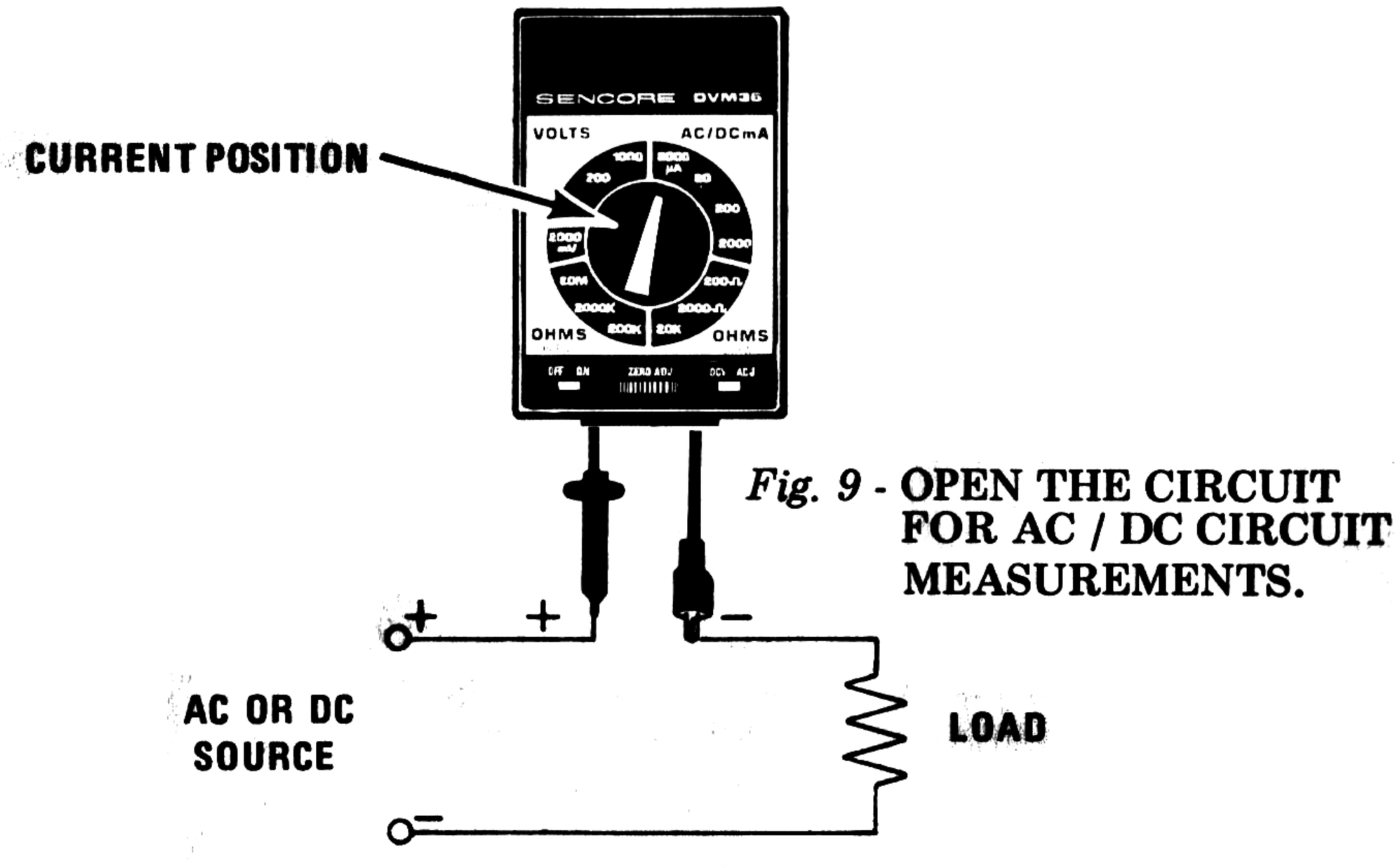


Fig. 9 - **OPEN THE CIRCUIT FOR AC / DC CIRCUIT MEASUREMENTS.**

4. Always connect the DVM leads in series with the circuit to measure current. Break the circuit between the power source and the load, then connect the test leads to each terminal of the open circuit. The display will automatically indicate current with respect to the black lead.
5. The average of the sum of the AC and DC currents is indicated.
6. The life of the switch contacts can be prolonged if switching high currents is avoided. When using the high current ranges, turn the power off in the circuit being measured before switching the DVM range.

SELECTING HI OR LOW POWER OHMS

The Lo Power Ohms function allows in-circuit resistance measurements in solid state circuits. Most multimeters use a 1.5 Volt, or greater, maximum source voltage at the test leads. This voltage causes semiconductor components to conduct, giving erroneous resistance readings. Lo Power Ohms uses a much lower source voltage (.2 Volts max) that has minimal forward junction conduction. The need for switching the test leads to obtain the correct reverse bias reading is thus eliminated.

Select the Lo Power Ohms ranges when making low value resistance measurements of less than 20K ohms in-circuit. Hi Power Ohms is for higher value resistance measurements. The current through unknown resistances is always maintained at low levels to prevent damage to delicate solid state components.

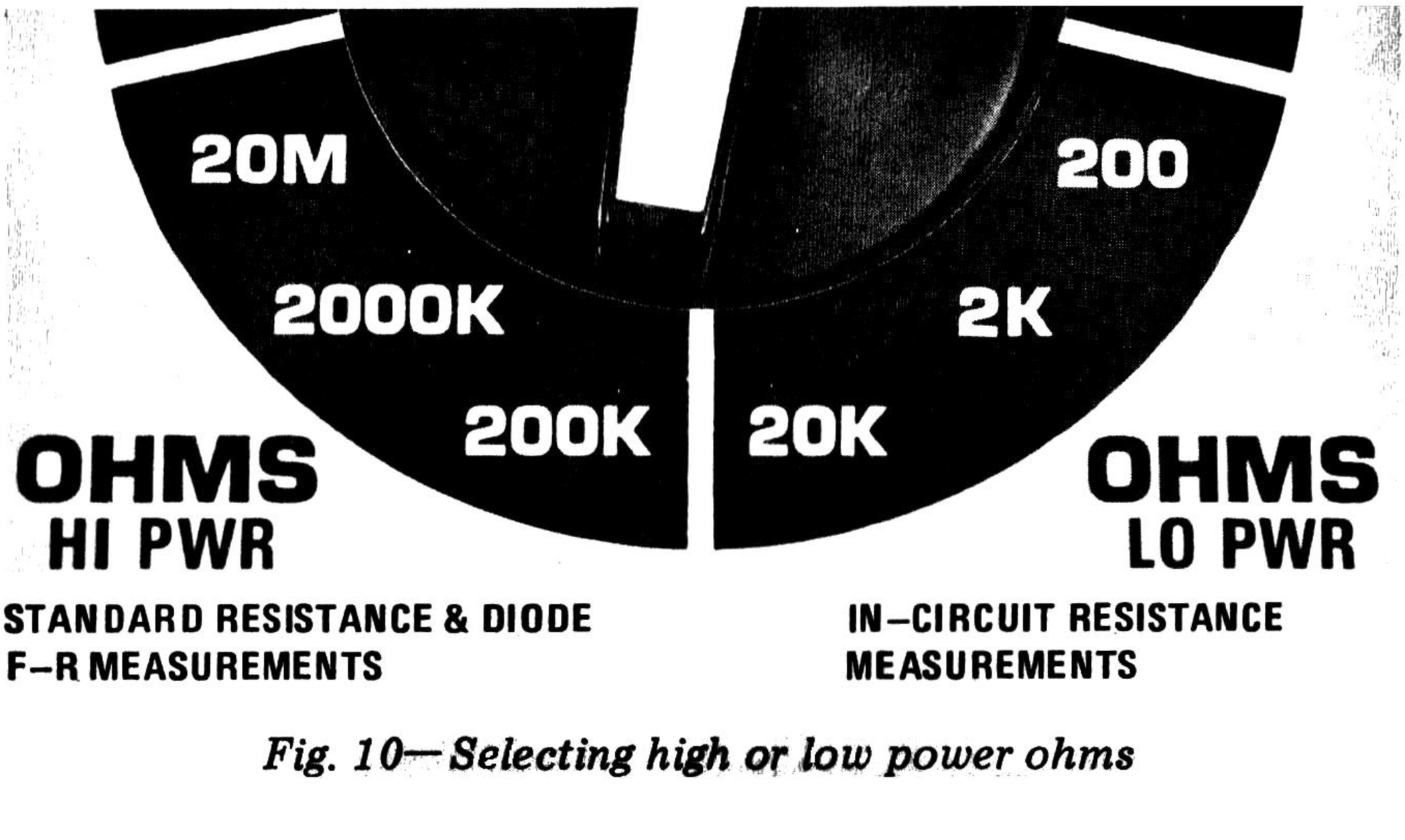


Fig. 10—Selecting high or low power ohms

RESISTANCE MEASUREMENT

1. Make the initial set-up as explained in PREPARING FOR MEASUREMENT.

2. Rotate the FUNCTION/RANGE switch to the OHMS area; and the range desired. Note that the three lower ranges are LO PWR, and the three higher ranges are HI PWR only, (see SELECTING HI OR LO POWER OHMS). The display will indicate infinity resistance overrange (blinking "1888") with no input, or open circuit.

3. REMOVE POWER from the equipment in which the measurement is to be made and DISCHARGE the electrolytic capacitors.

4. Connect the test leads across the resistance to be measured. If the resistance value exceeds the range selected, the overrange indication of a blinking "1888" reading will be present.

BATTERY INSTALLATION

To install the batteries, remove the cover to the battery compartment on the back of the DVM36 by removing the single captive screw in the bat-

tery compartment cover. Install six "AA" size batteries, observing the correct polarity as indicated in the compartment. Small tabs in the compartment help prevent installing the batteries improperly. Do not force a battery that does not seem to fit, but recheck the battery polarity. Replace the battery compartment cover, and tighten the screw.

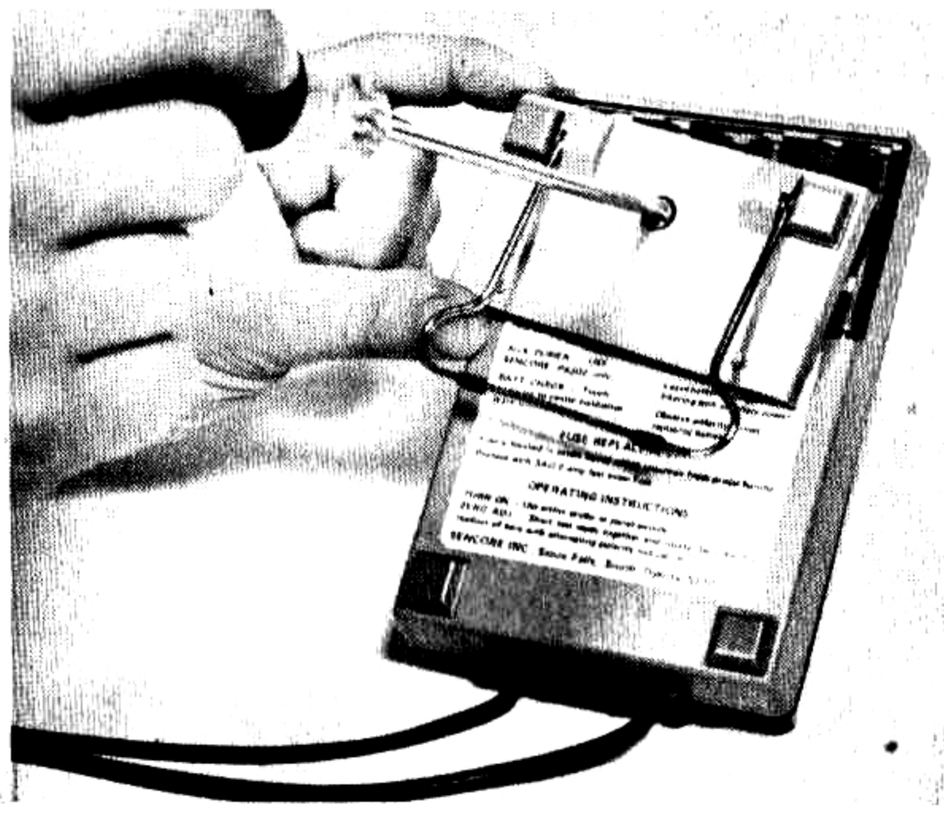


Fig. 11— Removing battery compartment cover.

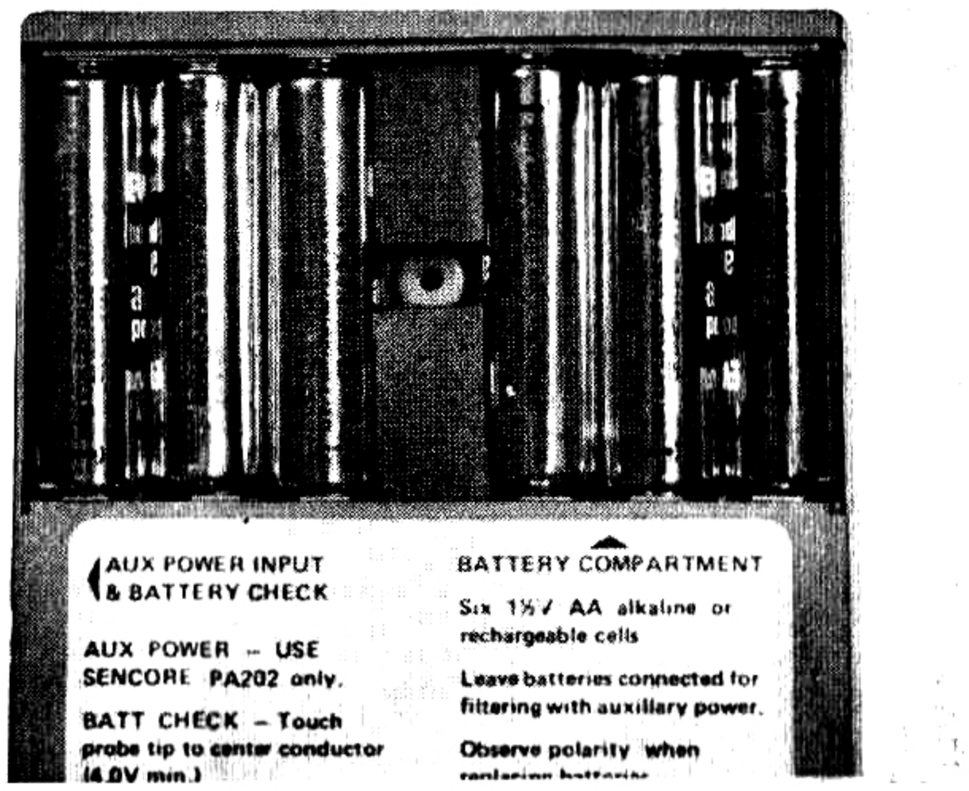


Fig. 12— Correct battery installation.

For longer battery life and stable operation, use only 1.5 Volt "AA" size sealed alkaline or nickel cadmium rechargeable batteries.

NOTE: Batteries must be installed in the DVM36 for proper filtering when the PA202 Power Adapter is used. See USING THE POWER ADAPTER section.

"AA"–SIZE ALKALINE BATTERIES				
NEDA	MALLORY	EVEREADY	BURGESS	RCA
15A	MN1500	E91	AL9	VS1334

NI-CAD RECHARGEABLE BATTERIES			
BURGESS	EVEREADY	GE	MALLORY
CD6	CH500	GC-1	Zm9

If the instrument is not going to be used for a period of time (one month or longer), remove the batteries before storing the instrument. Corrosion and damage from battery leakage may result to the spring contacts and battery compartment during prolonged storage periods. Service required due to such damage is not covered by the guarantee.

BATTERY TEST

Proper measuring operation and accuracy can be maintained only with adequate battery power level. The battery voltage may be tested by

measuring the DC Voltage at the center pin in the Power Adapter Jack. A reading of less than 4.1 Volts on the 20 VDC range indicates that the batteries should be replaced, or recharged.

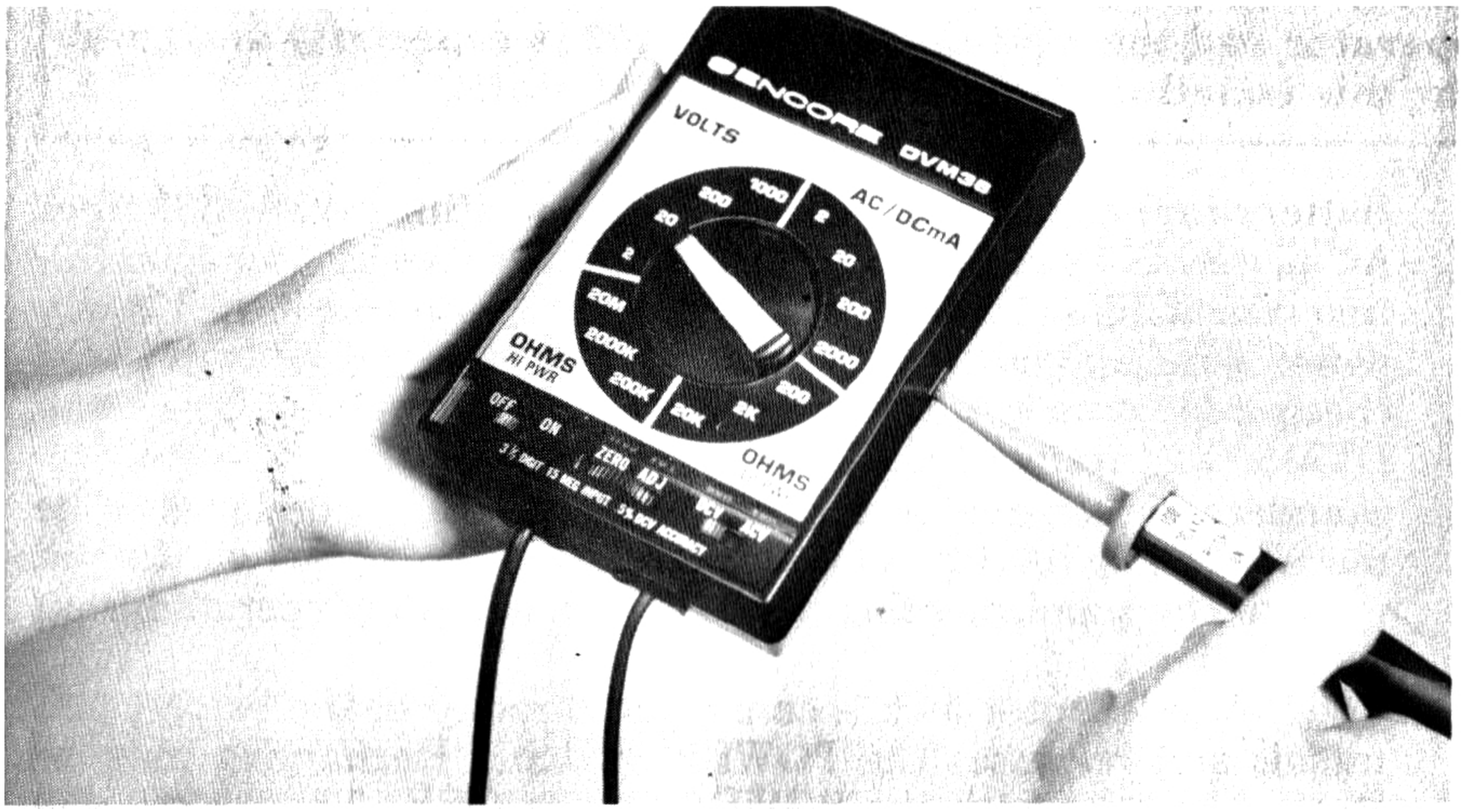


Fig. 13— Battery test at power adapter jack.

USING THE POWER ADAPTER

The Sencore PA202 Power Adapter can be used to operate the DVM36 from 105-130 VAC 50/60 Hz power, or used to recharge nickel cadmium rechargeable batteries. The PA202 is an optional accessory that may be purchased at your Sencore Full Line Distributor, or from a Sencore Sales and Service Center listed in the back cover.

1. Plug the PA202 into any 105-130 VAC, 50/60 Hz outlet. Insert the small plug into the Power Adapter Jack on the side of the DVM36.



Fig. 14— Installing the PA202 power adapter.

WARNING: Use only the Sencore PA202 Power Adapter with the DVM36. Similar-looking "tape recorder" power accessories do not have adequate isolation from the AC line to be used safely with the DVM36, and can cause a shock hazard to the operator and the equipment. The PA202 is especially designed for this isolation and protection to 1000 Volts.

2. Batteries are required for filtering when operating the DVM36 from AC power. See BATTERY INSTALLATION section for installation instructions. The PA202 is designed to supplement the battery power when operating from the AC line. The batteries must be charged for proper operation, since the PA202 will not power the DVM36 and recharge the batteries simultaneously.
3. Standard carbon-zinc or alkaline batteries are not designed to be recharged. The PA202 will not recharge these types, but will extend their life by supplementing the battery power when operated from the AC line.
4. The Power Adapter Jack is connected directly to the battery terminals and bypasses the POWER switch. Recharging may be done overnight with the POWER switch OFF. The PA202 will not be damaged if left in the AC outlet and not connected to the DVM36.
5. Always disconnect the PA202 from the DVM36 when measuring voltages above 1000 Volts to avoid a possible shock hazard in the event the ground lead becomes disconnected during the measurement.

FUSE REPLACEMENT

The fuse protection for the DVM36 is contained in the red tip section of the probe. Unscrew the red section from the black handle portion. The 2 Amp 3AG fast blow fuse is then readily available

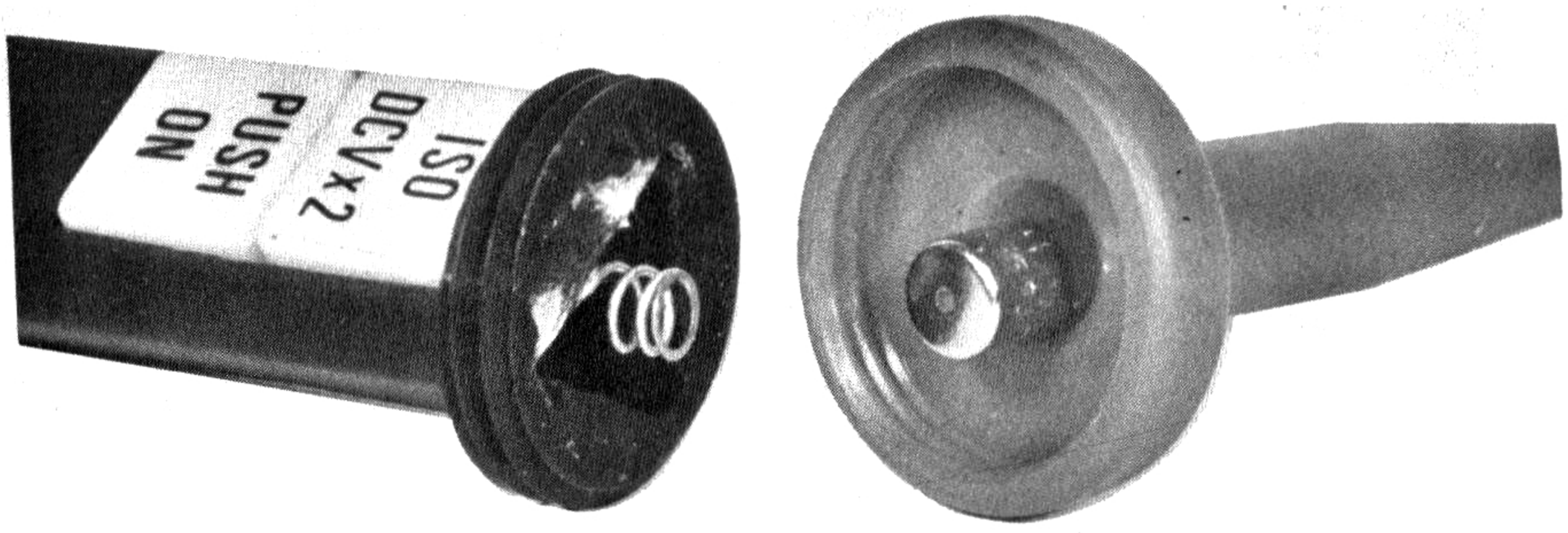


Fig. 15— DVM36 fuse location in probe.

for replacement. Be sure the red tip section is securely tightened after replacing the fuse. A simple check is to short the leads together and check for a zero ohms reading. Inadequate spring contact may cause intermittent readings.

NOTE: Depending upon internal construction and different manufacturing characteristics, proper amperage fuses may have a variety of resistances. Since the protection fuse is in series with the current shunts and the ohms measuring circuit, a high resistance-type fuse will alter the DVM's reading accuracy in these functions. A simple check for this characteristic is to note if there is any zero shift between a DC Voltage range and the 200 ohm range with the leads shorted. A correct low resistance fuse will not cause a change in the reading.

WARNING: Use the proper type fuse for replacement only. Damage may occur to the instrument if an improper fuse is used. Use only "fast blow" types. Warranty is invalid if an instrument shows signs of improper fuse use.

FUSE TYPE = 2 Amp 3AG Fast Blow

APPLICATIONS

INTRODUCTION

The DVM36's applications can be extended beyond the standard voltage, current, and resistance measurements and operations that are only a part of the DVM's daily work. This section describes how to expand the versatility of the DVM36, and how to use the optional accessories available.

CONNECTING COMMON ABOVE GROUND

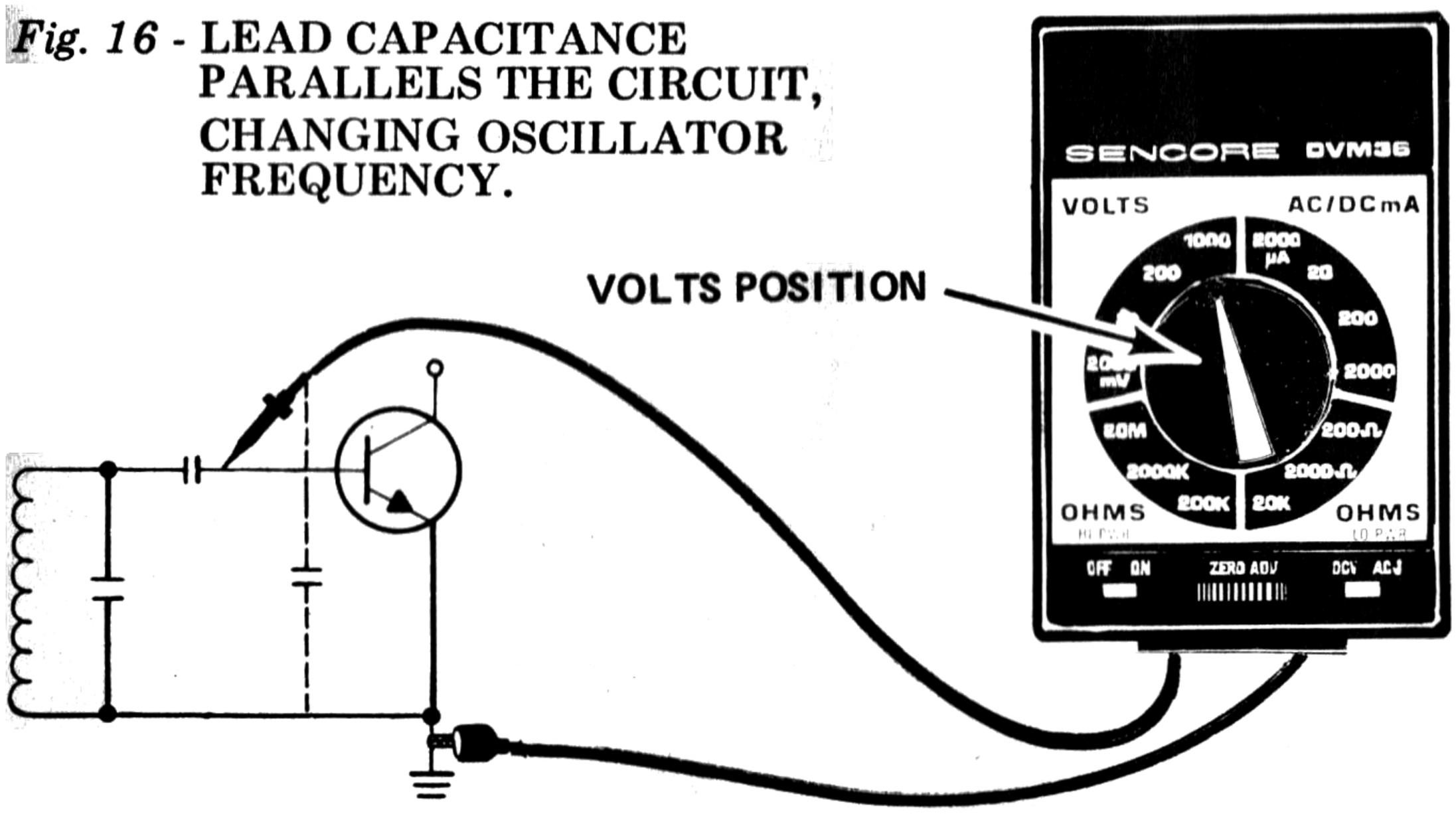
The DVM36 may be operated with the common (—) lead connected to a potential up to 1000 Volts (DC + peak) above chassis ground. To prevent a safety hazard to the operator and damage to the equipment, this value must not be exceeded.

> **WARNING: Do not connect the DVM36 common (—) lead to any voltage of more than 1000 Volts (DC + peak) above chassis ground.**

DC VOLTAGE MEASUREMENTS WITH ISOLATION

DC voltage measurements made in high frequency or low signal level circuits may disrupt normal circuit operation, and cause erroneous and misleading readings. Consider the high frequency oscillator circuit shown in Figure 16 where the DVM test lead is connected across the resonant circuit. The test lead capacitance parallels the circuit capacitance, possibly changing the oscillator frequency enough to stop the circuit operation.

Fig. 16 **- LEAD CAPACITANCE PARALLELS THE CIRCUIT, CHANGING OSCILLATOR FREQUENCY.**



The "ISO DCV X2" Isolation switch in the probe connects a 15 Megohm resistor in the probe in series with the lead. This resistor effectively isolates the DVM input capacitance from the circuit by terminating the probe at the tip. Normal circuit operation and accurate measurements can be maintained.

NOTE: Use of the Probe Isolation resistor will eliminate this large error, and will reduce the DC voltage reading to 1/2 the measured value, since the isolation resistor is in series with the DVM input impedance. Isolation should be used when normal testing results in an erroneous reading. This will maintain accuracy of the instrument readings when isolation is not needed.

When isolation is required, press the "ISO DCV X2" Probe switch, and proceed as described in the DC VOLTAGE MEASUREMENT section. Double the indicated reading for the actual voltage being measured.

INCREASING INPUT IMPEDANCE

The 15 Megohm input impedance of the DVM36 is high enough to prevent it from loading most circuits. As a general rule, the input impedance should always be at least ten times that of the circuit being measured. The DVM36 will measure voltages in circuits up to 1.5 Megohms without appreciable circuit loading. In comparison, other DVMs or VTVMs are limited to 1 Megohm circuits without loading. VOMs are extremely limited, causing loading errors in circuits of over 3000 ohms impedance.

If it desired to measure the voltage in an extremely high impedance circuit, use the optional HP200 50 KV High Voltage Probe as an isolation resistor. This probe will drop all DC voltage readings by a factor of 100. The input impedance is increased by 100 times, giving a total input impedance of 1500 Megohms.

The HP200 converts the 2 volt range to a 200 volt full scale range. This range allows resolution of .1 volts with the extremely high input impedance. The 1% resistor used in the HP200, combined with the .5% accuracy of the DVM36, will still provide good accuracy for such readings.

Slip the HP200 PROBE over the Test Probe making sure the probe tip is secured in the HP200; Select the range desired and proceed as described in the DC VOLTAGE MEASUREMENT section. Multiply the readout by 100 to obtain the measured voltage.

HIGH VOLTAGE MEASUREMENTS

WARNING! Do not measure over 2000 Volts directly with the DVM36 test leads. Severe damage to the DVM36 and equipment, and possible shock hazard to the operator, may result. Make high voltage measurements with the Sencore No. HP200 50KV High Voltage Probe only.

The Sencore HP200 50 KV High Voltage Probe must be used with the DVM36 for high voltage measurements above 2000 Volts DC. This probe extends the DC Voltage capability of the DVM36 to 50 KV DC. The probe acts as a voltage dropping resistor that reduces the voltage at the DVM36 input to 1/100th of the measured potential. The DVM36 readout must be multiplied by 100 to obtain the value of the voltage to be measured, within 2% accuracy.

NOTE: READ THIS SECTION ENTIRELY BEFORE PROCEEDING WITH THE TEST.

1. REMOVE POWER from the equipment in which the high voltage is to be measured. Disconnect the PA202 from the DVM36.
2. Plug the DVM36 Probe into the back of the HP200 HV Probe. Be sure that the probe tip is securely seated.
3. Turn on the DVM36 front panel POWER SWITCH. Rotate the FUNCTION/RANGE knob to the 1000 VOLTS position, and select the DCV position of the DCV/ACV switch.



Fig. 17-- Installing HP200 High Voltage Probe

4. SECURELY ATTACH the black common lead from the DVM36 to the ground, chassis, or common point of the high voltage circuit to be measured, so that this lead cannot become detached during the high voltage measurement.

CAUTION! If the common lead becomes detached during the measurement, a SEVERE SHOCK HAZARD will be present. DO NOT TOUCH the DVM36 or the HV Probe! Immediately REMOVE POWER from the equipment in which the high voltage is present. Then remove the HV Probe from the equipment. Damage to the DVM36 may have resulted, since it would effectively be at the high voltage potential.

5. Connect the high voltage probe to the high voltage point to be measured, so that the probe DOES NOT have to be held in the hand during measurement.

CAUTION: If the HV Probe MUST be held on the high voltage point during measurement, be sure to keep one hand in your pocket and stand on dry, insulated material. Hold the probe ONLY BY THE BLACK HANDLE portion.

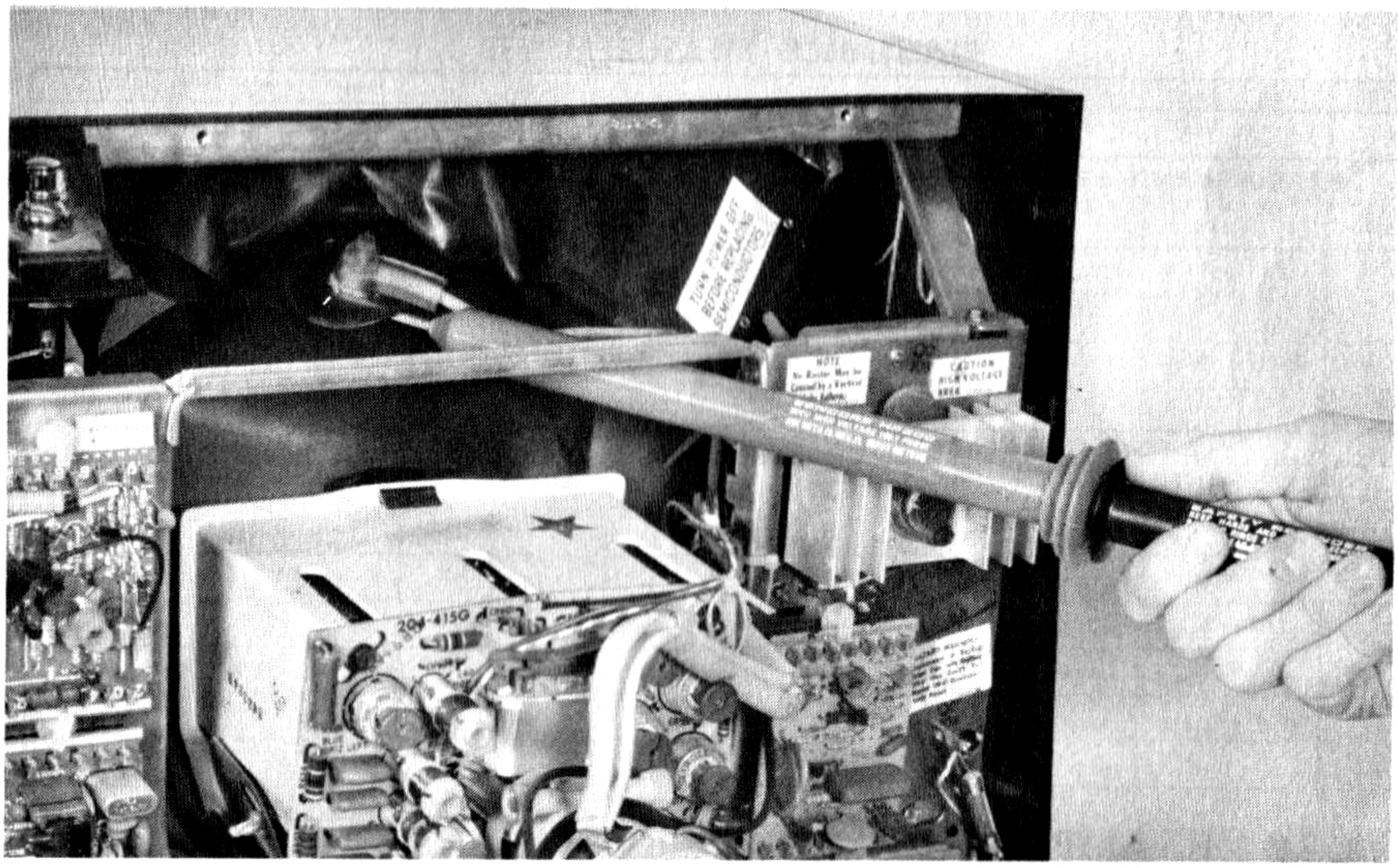


Fig. 18-- Measuring High Voltage

6. Apply power to the equipment in which the high voltage to be measured is present.

7. Multiply the readout by 100 to obtain the value of the high voltage being measured, or simply add two zeros to the reading. For example, if the readout is 300, multiply 300 x 100 for the value of 30,000 Volts being measured.

NOTE:
The DCV X2 switch should not be used when using the HP200.

8. REMOVE POWER from the equipment being measured and detach the HV Probe and common lead.

USING SERVICE LITERATURE RESISTANCE TABLES

Many types of servicing literature include resistance charts showing the resistance paths to ground from key test points. These charts can be helpful in locating defective solid state devices. However, it is necessary to determine whether the chart was prepared with a Hi or Lo Power meter.

Generally, if no special reference is made, the Hi Power function of the DVM36 should obtain the same readings. If the chart refers to a source voltage of less than .2 Volts, the Lo Power Ohms function should be used.

RESISTANCE MEASUREMENTS

ITEM	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12	PIN 13	PIN 14
V101	FIL	7000 Ω↑	13 K Ω↑	45 K Ω↑	45 K Ω↑	7000 Ω↑	13 K Ω↑	NC	60 MΩ	NC	7000 Ω↑	13 K Ω↑	50 K Ω↑	FIL
MEASUREMENTS BELOW TAKEN WITH METER HAVING .08V MAX BETWEEN PROBE TIPS														
IC301	INF	INF	0 Ω	0 Ω	1100 Ω	4800 Ω	9000 Ω	INF	5600 Ω	5600 Ω	INF	10 K Ω	6500 Ω	150 K Ω
IC701	5000 Ω	39 K Ω▲	390 Ω	9000 Ω▲	0 Ω	10 K Ω	6800 Ω	2200 Ω	70 K Ω	INF ●	4000 Ω	4000 Ω	4000 Ω	1500 Ω
													PIN 15 7500 Ω	PIN 16 4000 Ω
IC702	4200 Ω	24 K Ω	2600 Ω	INF	0 Ω	7000 Ω	5000 Ω	10 MΩ●	10 MΩ●	40 MΩ●	5000 Ω	7300 Ω	4000 Ω	2500 Ω
													PIN 15 2500 Ω	PIN 16 INF

ITEM	E	B	C		ITEM	E	B	C		ITEM	E	B	C	
Q202	INF	5000 Ω	900 Ω		Q311	1000 Ω	1000 Ω	480 Ω		Q701	4000 Ω	10 K Ω	600 Ω	
Q203	680 Ω	5000 Ω	INF		Q312	100 Ω	1100 Ω	INF ●		Q702	0 Ω	3300 Ω	4800 Ω	
Q204	3500 Ω	3600 Ω	560 Ω		Q313	236 Ω	10 K Ω	20 K Ω▲		Q703	12 Ω	4800 Ω	1800 Ω	
Q301	1650 Ω	3000 Ω	560 Ω		Q501	5600 Ω	50 K Ω	45 K Ω		Q704	330 Ω	800 Ω	0 Ω	
Q302	1950 Ω	5000 Ω	580 Ω		Q502	0 Ω	68 K Ω	24 K Ω		Q705	660 Ω	1800 Ω	INF ●	
Q303	100 Ω	1900 Ω	1400 Ω		Q503	300 K Ω	320 K Ω	INF ●		Q706	660 Ω	1800 Ω	INF ●	
Q304	0 Ω	10 K Ω	680 Ω		Q504	A INF ●	K 0 Ω	G 4500 Ω		Q707	660 Ω	1800 Ω	INF ●	

Fig. 19 - **EXAMPLE OF RESISTANCE TABLE USING LOW POWER OHMS.**

Courtesy Howard W. Sams & Co., Inc.

CHECKING TRANSISTORS AND DIODES

Front-to-back ratios of diode and transistor junctions can be measured using the DVM36 HI POWER OHMS function. Normal reverse junction bias will indicate as a blinking overrange on any range. With forward junction bias, the DVM36 will not show the "zero" reading typical of pointer-type analog meters on this test. The DVM36 will instead indicate the approximate voltage drop across the junction.

This reading (ignoring the decimal position) can be used to determine the type of junction material. Silicon will generally show as "600" or more (.6 Volt), and germanium will give a reading of about "300" (.3 Volt).

These readings will depend upon the particular ohms range (drive current) used. All the currents are limited to a very low level and will not damage solid state components.

For determining polarity, the DVM36 Probe is positive, and the test lead negative.

NULL DETECTOR

The DVM36 can be used as a high resolution null detector to indicate small voltage changes in bridge circuits, potentiometers, difference amplifiers, etc. The wide range of the ZERO ADJUST control allows adjusting the normal circuit voltage indication to a "000" reading. Any variations from the normal voltage reading are then directly indicated by polarity and the amount of voltage change.

READING THE DISPLAY IN DIRECT SUNLIGHT

If the DVM36 display is exposed to direct sunlight, or other intense light conditions, it will appear to indicate "8888" because of reflected light on the L.E.D. segments. Simply shade the readouts for viewing under these lighting conditions.

CIRCUIT DESCRIPTION

INTRODUCTION

This section describes the theory of operation and the circuits of the DVM36. These will be helpful in learning how your DVM36 operates and will serve as a guide to the calibration and maintenance of the instrument.

FUNCTIONAL DESCRIPTION AND BLOCK DIAGRAM

Three main circuit functions must be performed by the DVM36 on each measurement for it to be viewed as the digital display. The Signal Processor changes the input signals to a DC voltage absolute value (0 to +2000mV) that is suitable for the Analog-to-Digital (A/D) Converter. The A/D Converter produces the digital coding that operates the Display section to produce the digital readout.

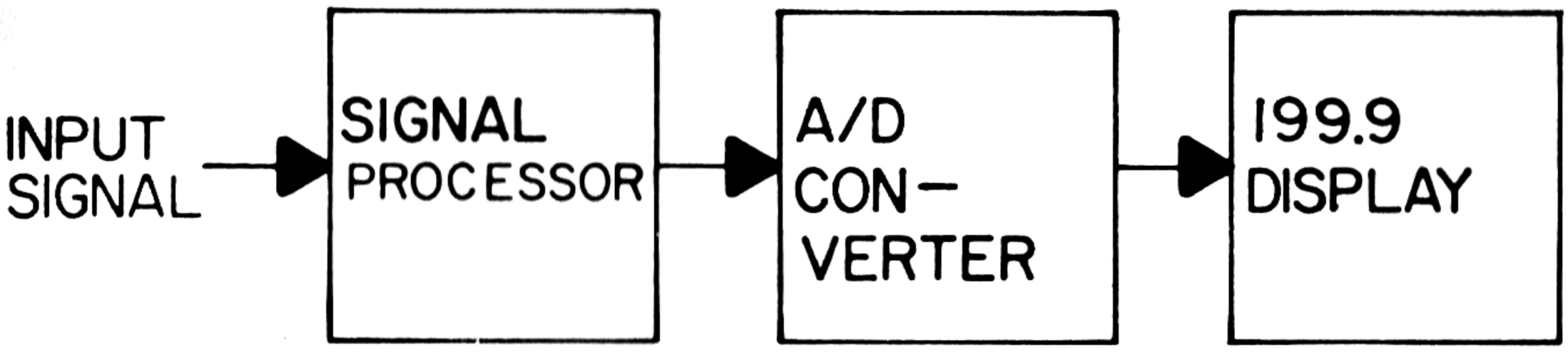


Fig. 20 - **DVM36 FUNCTION DIAGRAM**

The Signal Processor changes the input signal to a 0 to +2000mV DC input that is required by the A/D Converter. DC voltages and currents are converted to the proper level by the voltage dividers and current shunts. Negative voltages and currents are inverted to produce the positive absolute value input. The negative going portion of each AC cycle is also inverted to produce a positive, pulsating DC signal that is averaged for input to the A/D Converter. A DC output voltage that is proportional to an unknown resistance is produced by the High and Low Power Ohms circuits.

The A/D Converter section uses the single slope method to change the absolute value input voltage to the digitally coded outputs that will give the proper display readout of the measured signal. The Comparator receives inputs from the Integrator and the Absolute Value circuits and produces the latch pulse that is fed to the A/D converter chip. The number of clock counts at that instant is converted to binary coded data (BCD) for the display circuits.

The display section decodes the BCD output to a decimal output and presents the information on seven segment L.E.D. readouts. The Display, Polarity, and Decimal Driver circuits accomplish the complete decoding process. The result is an extremely accurate and clearly readable presentation of the measured signal.

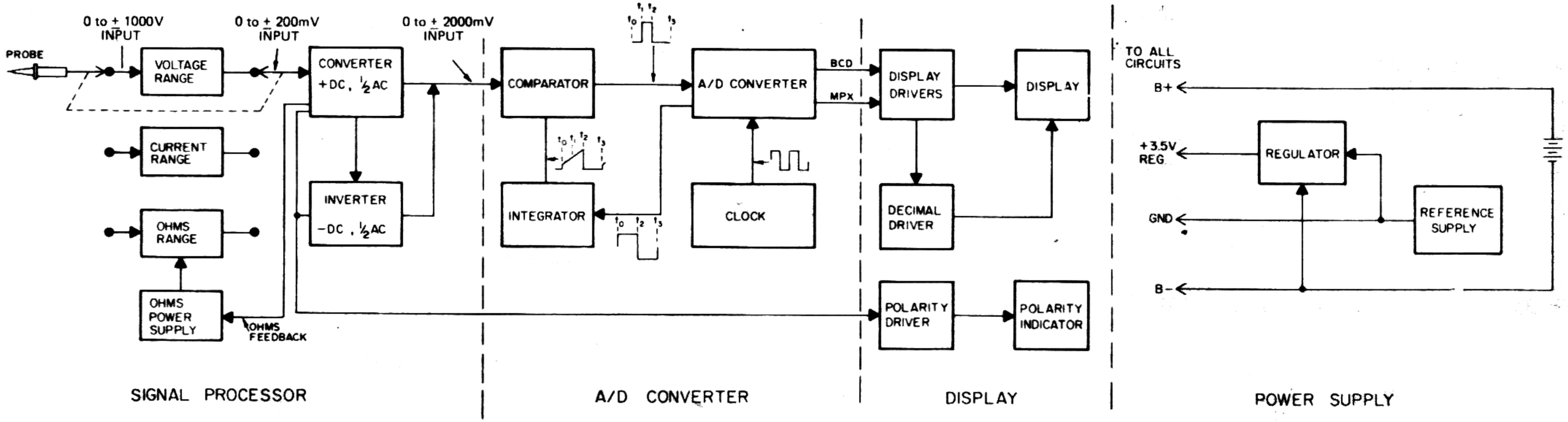


***Fig.21* - DVM36 BLOCK DIAGRAM**

The Power Supply develops a Reference source 3 volts above negative battery voltage, and a regulated voltage 3.5V above the reference potential. For convenience, the reference source potential is called circuit ground, or common. The regulated outputs (- 3V and +3.5V) are generally used in the measurement circuits where high stability is required, while the unregulated outputs (battery terminals) are used to drive the displays.

All circuit functions, except the Display and Decimal Drivers, A/D Converter chip, and Clock, are mounted on the Analog PC board. These components are always prefixed with a 100 number in the circuit reference. The remaining circuits are on the Digital PC board, and the components are prefixed by a 200 number.

THEORY OF OPERATION

The process of converting an analog voltage input to an equivalent digital readout is performed by changing the input voltage relationship to a time relationship. The measured signal (whether AC or DC voltage, current, or ohms) is processed to an absolute value voltage of 0 to +1999 mV. The A/D Converter matches this voltage to a corresponding number of clock counts, from 0 to 1999.

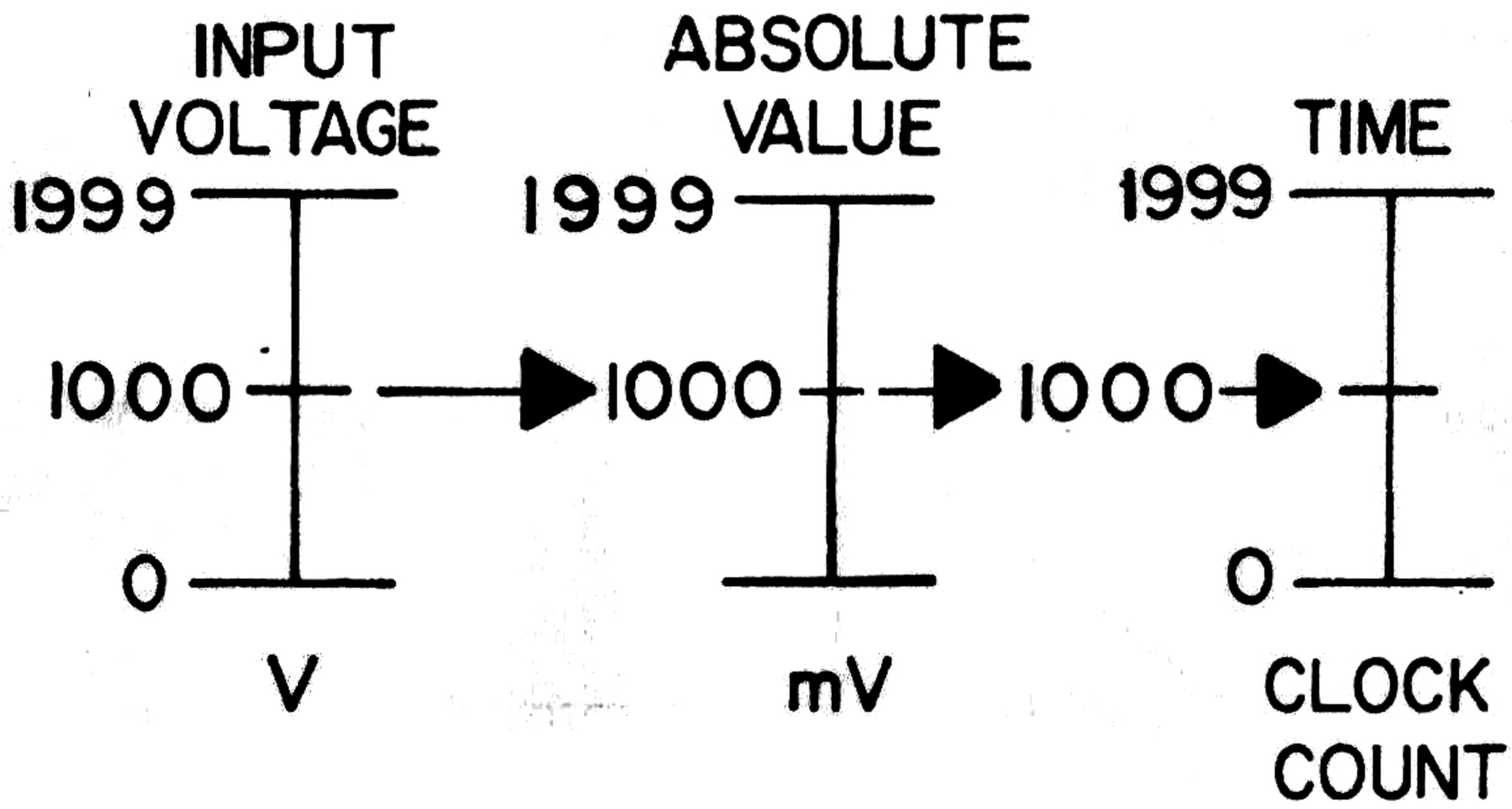


Fig. 22 - ANALOG TO DIGITAL CONVERSION

For example, a measured voltage of 1000 Volts is reduced to a +1000 mV absolute value input. This corresponds to 1000 counts of the clock pulses. Therefore, "1000" is displayed on the readout.

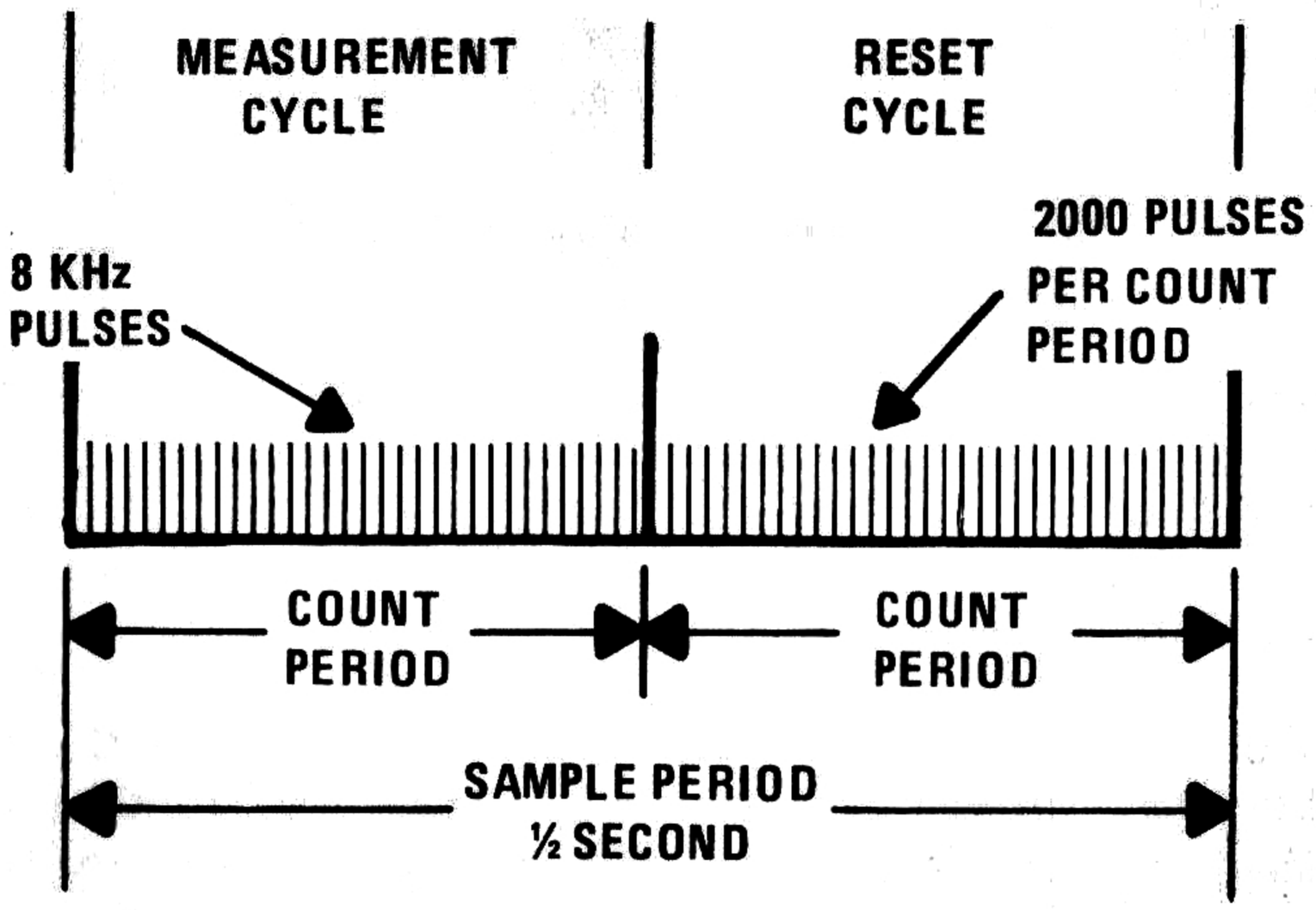


Fig. 23 - DVM36 CLOCK

The DVM36 Converter uses the single slope method of converting the analog input to the BCD digital coding for the display circuits. IC202 continually receives a 8KHz signal from the Clock. These 8KHz pulses are counted to two 2000-count periods for each sample period. The first count period is used as the measurement cycle while the second count period is used for the reset cycle.

During the measurement cycle, the Integrator generates a linear ramp from 0 to +2000mVDC. The Comparator circuit compares this

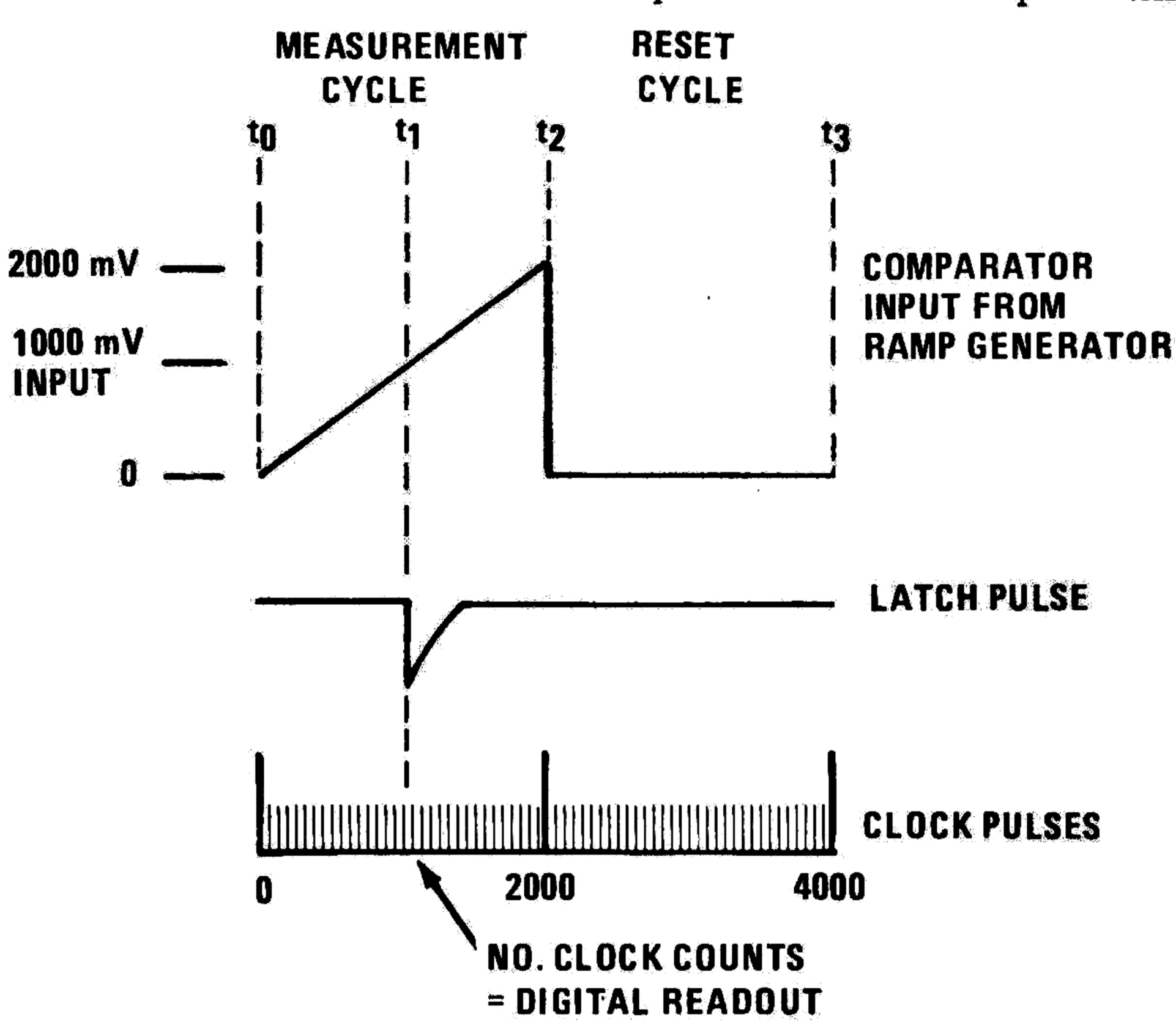


Fig. 24 - DVM36 Analog to Digital Conversion

ramp voltage with the absolute value input from the Signal Processor section. When the two inputs are equal, an output pulse is produced by the Comparator that is fed to the latch input of the A/D Converter chip. The ramp integrator is discharged during the reset cycle and readied for the next measurement cycle.

The A/D Converter starts counting Clock pulses when the ramp is started. When the latch pulse is received from the Comparator, the count at that instant (from 0 to1999) is remembered by the A/D Converter chip, and then presented to the Display circuits during the display cycle.

COMPLETE CIRCUIT DESCRIPTION

The complete circuit description for the DVM36, with simplified circuit diagrams, is available for a minimal $3.00 handling charge from the Sencore Field Engineering Department, 3200 Sencore Drive, Sioux Falls, South Dakota 57107.

MAINTENANCE AND SERVICE

INTRODUCTION

This Maintenance and Service section will help you to maintain the DVM36 within published specifications and assure years of useful application.

The schematic, parts location diagrams, and parts list are included as a separate sheet to this manual. The exclusive color-coded "Signal Tracer" schematic has the key signal paths marked for fast identification and recognition of supply voltages, function paths, and circuit waveforms. The color coding simplifies and speeds understanding of the circuit functions and pinpoints signal locations that otherwise would be "lost in the woods."

Warranty information is printed on the back of the Quality Assurance tag attached to the instrument. Factory Service information is located inside the back cover of this manual.

BATTERY / FUSE REPLACEMENT

See page 17 for battery replacement instructions.
See page 20 for fuse replacement instructions.

ACCESS/DISASSEMBLY

To gain access to the interior of the DVM36, proceed as follows:

1. Remove the battery compartment door by unscrewing the single captive screw in it.
2. Remove the batteries.
3. Remove the two screws in the retaining clip at the bottom of the DVM36, and pull it away from the case. The test leads feed through this clip.
4. Remove the two screws in the battery compartment. Unsolder the two leads to the contact clips. Pull the rear case panel away from the front case panel.
5. Grasp the lower PC board and the front case panel and pull them apart. The Function/Range knob is held by tension and will fall away. All components and calibration controls are now exposed.
6. To operate the instrument for testing, the batteries may be reinstalled in the battery compartment and jumper leads connected from the battery clips to the red (+) and black (-) wires on the circuit board.
7. For reassembly, simply reverse the steps above.

CLEANING

The front panel and case may be cleaned with a mild solution of detergent and water. Use a soft cloth when cleaning the display lens to prevent scratching.

CALIBRATION PROCEDURE

The calibration procedure should be performed at regular intervals (six months recommended) to restore DVM36 performance to the original factory specifications.

The test standards for calibration and performance tests are listed below.

EQUIPMENT	SPECIFICATIONS
Frequency Counter	To measure 8KHz ± 2Hz
DC Voltage Source	10mV to 1000V ± 0.2%
Resistor	900 ohm ± 0.1%

The DVM36 should be calibrated under the following environmental conditions:

Temperature	20°-25° C (72°-77° F)
Humidity	50-70%

Proceed as follows for the calibration procedure.

1. Check the Reference Supply voltage by measuring the common lead potential with respect to the negative battery terminal. Set the Reference Adjust R120 for a reference voltage of 2.95 ± .05 volts.
2. Check the Regulated B+ Supply voltage test point with respect to the negative battery terminal. This should be at least 6.40 to 6.60 Volts.
3. With the leads shorted, zero the meter Zero Adjust control R124 so that the negative polarity sign just blinks on and off, or just stays on.
4. Measure the Clock frequency at the Clock Test Point. Adjust the Clock control R147 for 8000 Hz ±100 Hz.
5. With the Function/Range selector in the 2V DC position and a +1.000 Volt input, adjust DCV Cal R134 for +1.000 Volt ±2 counts. When the test leads are reversed, the reading should be -1.000 Volt ±2 counts. Recheck for the +1.000 reading and balance R134 for equal readouts with both positive and negative inputs.
6. Use a -.200 Volt input on the same range, and adjust the Linearity control R136 for a reading of -.200 Volt ±2 counts. R136 and R134

interact, so repeat steps 5 and 6 as needed for proper readout limits.

7. Turn the Function/Range Selector switch to the 20K ohm position. Measure the 10K ohm precision resistor and adjust Ohms Cal R130 for a reading of 10.00 K ohm ±2 counts.
8. This completes the calibration adjustments required for the DVM36. Additional performance tests may be completed as desired on all ranges and functions. Compare the resulting readings with the maximum accuracy limits given in the SPECIFICATIONS section.

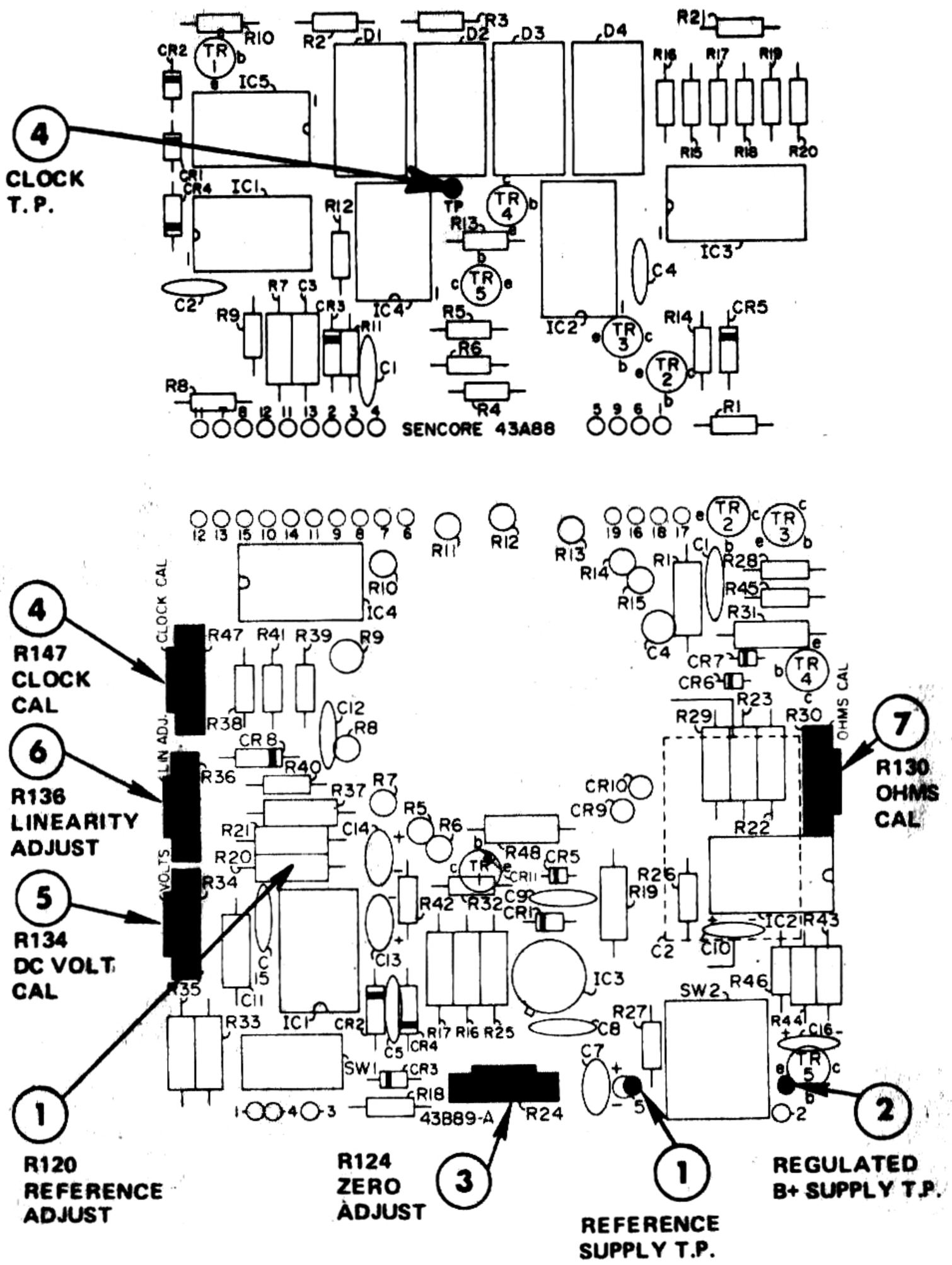


***Fig. 25* - CALIBRATION CONTROL LOCATION DIAGRAM**

SERVICE AND WARRANTY

You have just purchased one of the finest Portable Digital Multimeters on the market today. The Sencore DVM36 has been inspected and tested twice at the factory and has passed a rugged use test by our Quality Assurance Department to insure the best quality instrument to you. If something should happen, the DVM36 is covered by the exclusive 100% Made Right Lifetime Guarantee as explained on the warranty policy enclosed with your instrument.

Sencore has six factory-owned Regional Sales and Service Centers to serve you. Instruments to be serviced should be returned to the nearest Regional Center by UPS if possible. Parcel Post should be used only as a last resort. Instruments should be packed with the original packing materials or equivalent, and double boxed to insure safe arrival. The display carton is not an acceptable shipping container. When returning an instrument for service, be sure to state the nature of the problem to insure faster service.

If you wish to repair your own DVM36, we have included a schematic and parts list. Any of these parts may be ordered directly from the Regional Center nearest you.

We reserve the right to examine defective components before an in-warranty replacement is issued.

SENCORE REGIONAL SALES AND SERVICE CENTERS:

Sencore East Central
4105 Duke Street
Alexandria, VA 22304
(703) 751-3556

Sencore Central
2711 B Curtiss Street
Downers Grove, IL 60515
(312) 852-6800

Sencore Western Coast
833 Mahler Road
Burlingame, CA 94010
(415) 697-5854

Sencore West
3200 Sencore Drive
Sioux Falls, SD 57107
(605) 339-0100

Sencore Southeastern
2459 Roosevelt Hwy. Suite B-3
College Park, GA 30337
(404) 768-0606

Sencore Northeastern
1237 Central Avenue
Albany, NY 12205
(518) 459-6040



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