VACUUM TUBE VOLTMETER

INSTRUCTION MANUAL

MODEL 175

DIVISION OF DYNASCAN CORPORATION

1801 W. Belle Plaine Ave. Chicago, Illinois 60613

SPECIFICATIONS

DC VOLTMETER, ELECTRONIC:

7 Ranges	0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale.
Input Resistance	11 Megohms (1 Megohm in probe).
Sensitivity	7⅓ Megohms-per-volt on 1.5 volt range.
Circuit	Balanced bridge using twin triode.
Accuracy	±3% full scale.

AC VOLTMETER, ELECTRONIC:

7 Ranges (R.M.S.)	0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale.
7 Ranges (Peak-to-peak)	0-4, 14, 40, 140, 400, 1400, 4000 volts.
Frequency Response (5V Range)	±1 db 40 CPS to 4 MC (600 ohms source).
Accuracy	±5% full scale.
DB Scale	—6 to +16db, +4 to +26db, +14 to +36db, +24 to +46 db, +34 to +56db, +44 to +66db (0.775 volts into 600 ohm line on 0-5 volts AC scale = 0db).

OHMMETER, ELECTRONIC:

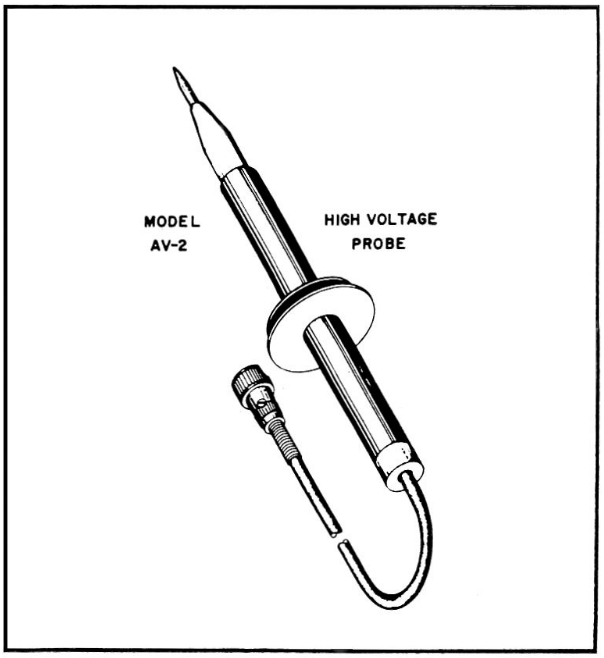
7 Ranges	0-1000 (x1), 10,000 (x10), 100,000 (x100), 1 meg (x1000), 10 meg (x10K), 100 meg (x100K), 1000 meg (x1 meg). 10 ohms center scale on Rx1.
	Battery not required for ohmmeter.

METER	4½" 400 μA movement, plastic case.
MULTIPLIERS	1% precision type.
TUBES	12AU7, twin triode bridge, 6AL5, twin diode, peak-to-peak rectifier.
POWER REQUIREMENTS	105-125 volts 50-60 cycle AC.

INTRODUCTION

Your VTVM is an unusually versatile, rugged, all-purpose meter for radio, TV and experimental electronic work.

The meter employs a balanced vacuum tube bridge circuit for all voltage and resistance measurements which assures maximum sensitivity and stability.



The Model AV-2 High Voltage Multiplier Probe has been developed as an Accessory item (available at your favorite distributor) to extend all DC voltage ranges of your VTVM by a factor of 100.

Heavy wall plastic handle and head, and safety-type connector insures maximum operator safety. In addition, two oversized flashover guards protect the operator's hands from leakage at the test point on the prod head.

One of the most useful applications of the AV-2 High Voltage Probe is the measurement of 2nd anode voltage in TV sets.

CIRCUIT DESCRIPTION

This VTVM has been designed for use by television and radio service technicians, engineers, students and anyone engaged in electronics activities. It may be used for measuring voltages, and resistances in TV and radio work, laboratory research and in any application where the rapid, accurate measurement of electrical functions is required.

Both positive and negative calibration controls are used. This feature insures that the same degree of accuracy is obtained when measuring voltages of either polarity.

The 400 microampere meter movement is connected in the cathode circuit of a 12AU7 twin triode in a balanced bridge arrangement. The zero adjust control sets up a balance between the two triodes such that with zero voltage applied to the first grid, the potentials on each cathode are equal. This being true, there will be no voltage drop or difference in potential across the meter, and consequently the meter will read zero. With a voltage applied to the first grid, the balanced condition is upset, causing a difference in the potentials on the two cathodes and consequently across the meter. The meter will then indicate. The relationship between the test voltage applied to the first grid and the current through the meter is linear and therefore the meter is calibrated with a linear scale. One of the advantages of a vacuum tube voltmeter circuit is that the voltages to be measured are applied to the tube and not directly to the meter. Since the amount of current a vacuum tube can draw is limited, the meter movement is electronically protected.

The maximum test voltage which is applied directly to the 12AU7 is approximately 1.5 volts. A voltage divider network having a total resistance of 10 megohms reduces voltages higher than 1.5 volts. An additional isolating resistance of 1 megohm, located in the test probe, is used in the DC position. This makes it possible to make measurements in circuits carrying R-F with a minimum disturbance of these circuits.

For AC measurements, a 6AL5 duo-diode is used to rectify the test voltages to provide a DC voltage proportional to the applied AC. The DC voltage is then applied through the voltage divider network to the input grid of the 12AU7 balanced bridge circuit causing the meter to indicate as previously described. The 6AL5 is connected as a half-wave doubler which will respond to the peak-to-peak value of applied AC test voltages. The AC voltage scales are calibrated to read both RMS and peak-to-peak values. The 0-1.5VAC (RMS) ONLY and 0-5.0VAC (RMS) ONLY scales have been especially calibrated to improve the accuracy of the meter on these low ranges. Stray pickup reduces the accuracy of any highly sensitive VTVM on the lower AC ranges. Therefore, with this special scale, you have an added feature of improved accuracy (on the low AC range) that many other instruments do not have. In the 0-1.5, 0-5, 0-50, and 0-150 volt ranges, the full AC voltage being measured is applied to the 6AL5 rectifier. A voltage divider network reduces the applied voltage on the 0-500, and 0-1500 volt ranges to limit the voltage applied to the 6AL5 to a safe level. When the instrument is used properly, it is not possible to apply in excess of 150 volts to the 6AL5. When measuring any unknown voltage, always make it a habit to start on the highest range, and then switch down to a more appropriate range. THIS IS IMPORTANT! THE 6AL5 WILL INVARIABLY BE RUINED IF VOLTAGES IN EXCESS OF 400 VOLTS ARE ACCIDENTALLY APPLIED WHILE THE RANGE SWITCH IS SET ON THE 0-150 VOLT POSITION OR LOWER.

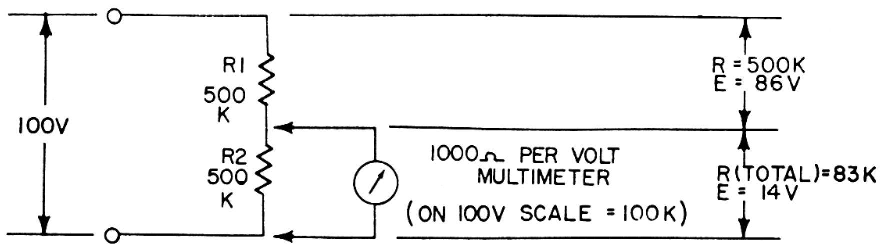
The AC Balance control is used to compensate for the "contact potential" developed on the 6AL5. A diode tube with its filament heated, will conduct a minute amount even though no voltages are being applied to plate or cathode. This current flows from cathode to plate of the diode, through the external resistors to ground and back to the cathode. The voltage developed across the resistors will be negative with respect to ground and is known as the "contact potential." To offset this negative voltage, an equal positive voltage is taken from the power supply and fed into the circuit. The amount of "bucking" voltage is controlled by the AC Balance control. This minimizes movement of the pointer when switching from one low AC range to another. The AC calibrate control is used to obtain the correct meter deflection for the AC voltage being measured.

For measuring resistances, a 1.5 volt DC supply is connected through a series of multiplier resistances and the external resistance to be measured. This forms a voltage divider circuit consisting of the 1.5 volt supply in series with one or more multiplier resistors, and the resistance under test. The voltage across the unknown resistor is then proportional to its resistance. This voltage is supplied to the input grid of the 12AU7 balanced bridge circuit which produces an ohmmeter scale reading proportional to the unknown resistance.

In the "off" position the meter movement is automatically shorted to prevent damage in transit.

Using The VTVM

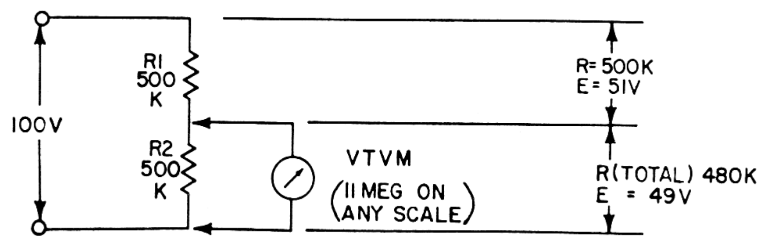
The greatest of the many advantages offered by the VTVM is its high input impedance. This feature makes possible the measurement of voltages in high impedance circuits such as oscillator grid circuits and AGC networks with a much higher degree of accuracy. As a simple illustrative example of this, we have shown in Figure 1A two 500K resistors connected in series across a 100 volt source of voltage. A simple knowledge of basic fundamentals makes it obvious here that the voltage drop across each resistor will be 50 volts. Measuring the voltage across either resistor with a 1000 ohm-per-volt non-electronic type instrument on the 0-100 volt scale however, we obtain a reading of only about 14 volts. Why the discrepancy? The answer is fairly simple. As shown in Figure 1A the meter on the 100 volt scale can be considered a resistor of 100K, which is connected in parallel with the 500K resistor. A few simple calculations involving Ohm's Law will readily show the total resistance of the parallel circuit to be 83K, resulting in a redistribution of the voltage drops around the entire circuit such



R(TOTAL) (METER IN PARALLEL WITH R2) $= \frac{500K \times 100K}{500K + 100K} = 83K$

VOLTAGE ACROSS R2 AND METER $= \frac{83}{500 + 83} \times 100 = 14$ VOLTS (APPROX.)

FIGURE 1A



R(TOTAL) (METER IN PARALLEL WITH R2) $= \frac{.5MEG \times 11\,MEG}{.5MEG + 11\,MEG} = .48MEG = 480K$

VOLTAGE ACROSS R2 AND METER $= \frac{480}{500+480} \times 100 = 49$ VOLTS

FIGURE 1B

that now the first 500K resistor has approximately 86 volts across it, and the other 500K resistor in parallel with the meter has approximately 14 volts across it. The low resistance meter is thus said to be loading or changing the impedance of the circuit to which it is connected. Consider now the case of the VTVM. As shown in Figure 1B we have a total of 11 megohms connected in parallel with the 500K resistor, and the total resistance of our parallel network is now approximately 480K, resulting in the voltage across the meter and resistor dropping only to 49 volts or a mere 2% lower than the actual operating voltage. Thus it can readily be seen, more accurate readings can only be obtained with a high-impedance instrument such as the VTVM.

DC Voltage Measurements

To measure DC voltages with the VTVM, connect the common lead to the common B—, or "ground" side of the voltage to be measured. This is the chassis in most instances although in many transformerless sets, the chassis is isolated from the electrical circuitry and the common or B— side must be determined from the schematic diagram. Set the function switch to —DC or +DC as required, and set the range switch to a range greater than the voltage to be measured, if known. If not known, set to the highest, (0-1500 volt) range. Set the AC-OHMS, DC switch on the test probe to the DC position, then touch the probe to the voltage point to be measured. If the reading obtained is less than ⅓ full scale (500 volts when on the 0-1500 volt range) move the range switch to the next lower position. (0-500 volt range in above mentioned instance.) For greatest accuracy, always select the range which permits you to obtain a reading nearest full scale deflection without having the pointer go off scale. Use only the scales marked DC-AC (RMS) for reading DC voltages. The scales marked "1.5VAC (RMS) ONLY" and "5.0VAC (RMS) ONLY" are for AC measurements and the top DC-AC (RMS) scales calibrated 0-15 and 0-50 are the ones to be used for measuring DC voltages in the 0-1.5 and 0-5 volt ranges respectively.

You will notice that your VTVM has a convenient center scale zero position for certain special applications such as balancing FM discriminator circuits. You may use this center scale zero feature when the range switch is on either the +DC or —DC position by simply adjusting the ZERO ADJ. control to bring the pointer to the center scale marking.

AC Voltage Measurements

To measure AC voltages with the VTVM, connect the common lead to one side of the voltage to be measured, set the function switch to AC, and the range switch to a range greater than the voltage to be measured, if known. If not known, set to the highest (0-1500 volt) range. Set the AC-OHMS, DC switch on the test probe to the "AC-OHMS" position, then touch the probe to the other side of the voltage to be measured. If the reading obtained is less than ⅓ full scale (500 volts when on the 0-1500 volt range) move the range swich to the next lower position. (0-500 volt range in above mentioned instance.) For greatest accuracy, always select the range which permits you to obtain a reading nearest full scale deflection without having the pointer go off scale. It is important to remember that 1500 volts is the highest AC voltage that can be measured with your VTVM. The scales of the meter are calibrated to read both RMS and peak-to-peak voltages. For convenience there is provided on the meter scale plate an RMS to P-P table. Read the RMS values on the scales marked "DC-AC (RMS)", and the peak-to-peak values on the scales directly beneath marked "P-P". Peak-to-peak voltages are equal to 2.83 times the RMS values of sine-wave voltages and the scales are so calibrated that when a voltage of 10 volts RMS for example is applied to the instrument, the meter pointer will indicate 10 volts on the 0-15 volt scale, and 28.3 volts on the 0-40 P-P scale directly below. This direct-reading feature provides a simplified, time-saving means of obtaining peak-to-peak values of sine waves simultaneously with the RMS readings. It eliminates the need for calculating or transposing from one scale to another. Use the scale marked "1.5VAC (RMS) ONLY" and "0-5.0VAC (RMS) ONLY" for AC voltages that fall within these ranges. For measurements in the 0-15, 0-150, and 0-1500 volt ranges, use the DC-AC (RMS) scale calibrated 0-15, and read the scale as follows:

0-15:	Read Directly.
0-150:	Multiply all readings by 10.
0-1500:	Multiply all readings by 100.

Similarly, use the scale marked "0-50 DC-AC (RMS)" for 0-50 and 0-500 volt ranges.

Note that the "DC-AC (RMS)" scales are correct for AC voltages only when sine-wave voltages are being measured. The peak-to-peak scales can be used for both peak-to-peak of sine and non-sine (complex) voltages such as are measured in TV receivers.

This VTVM is a highly sensitive electronic AC voltmeter, and since the human body picks up AC voltage radiations when near any sources of such radiation such as power lines, the meter will indicate this pickup, and consequently reduce the accuracy of the voltage measurement. Therefore for utmost accuracy when measuring low voltages in high impedance circuits the user should avoid holding the test probe in his hand. A good practice is to use an alligator clip or wire hook of some kind on the end of the probe tip to clip to the voltage point, so that the hands may be removed entirely from the probe while reading the test voltage.

CAUTION

Certain basic rules for safe operating procedure should always be observed when making voltage measurements. When handling the test probe, touch only the insulated housing. Never touch the exposd or tip portion. The metal chassis of the unit is connected to the ground side of the internal circuit, and for proper operation, the common or ground lead of the instrument should always be connected to the ground, common, or B— side of the equipment being tested. A certain amount of danger is always present when working on electrical equipment and therefore, the user is cautioned to always familiarize himself as much as possible with the equipment to be tested, before any work is performed. It should be kept in mind that high voltages often appear at unexpected points in defective equipment.

When testing high voltage circuits, develop the habit of keeping one hand in your pocket to minimize the hazard of accidental shock. It is also important to have a properly insulated floor or floor covering to stand on while taking measurements. Be particularly careful to avoid contacting nearby objects which could provide a ground return path. A good practice is to remove operating power before connecting test leads.

Resistance Measurements

To measure resistance with the VTVM, set the function switch to the "Ω" position, and the range switch to a position that will result in the meter pointer reading as near to midscale as possible. Set the AC-Ω, DC switch on the test probe to the AC-Ω position, then attach the common alligator clip to the probe tip and set the meter pointer to ZERO on the ohms scale by rotating the "ZERO ADJ." control. Then disconnect the alligator clip from the probe tip and use the "OHMS ADJ." control to set the meter pointer to exactly full scale, marked "∞" (infinity). Connect the common test lead alligator clip to one side of the resistance to be measured, and the probe tip to the other side. Read the resistance on the ohms scale, and multiply by the proper factor for the range being used.

Using The Decibel (Db) Scale

Since the human ear responds in a logarithmic manner to variations in sound intensity and not linearly—that is, when the amount of sound is doubled, the ear responds to it so that we sense only a slight increase in loudness rather than a doubled increase, a unit of measure based on logarithms called the "bel" was adopted. The bel corresponds very nearly to the human ear response variations. Normally, signal levels are given in tenths of a bel, or decibels, because this unit represents the smallest variation in sound intensity the ear can detect. Various manufacturers use a variety of signal levels as a standard for zero db. The Db scale uses .001 watt (1 milliwatt) into a 600 ohm line as zero db. This corresponds to 0.775 volts AC on the 0-5 volt scale. From this figure, a conversion chart may be made so that readings on the Db scale may be obtained on any of the various AC voltage ranges, except the "1.5V RMS ONLY" scale. This scale is not calibrated for use with the Db scale.

CONVERSION CHART FOR Db (DECIBEL) SCALE

AC VOLTAGE RANGE	Db (DECIBEL) SCALE
0—5 VOLTS	Read db directly.
0—15 VOLTS	Add 10 db to reading.
0—50 VOLTS	Add 20 db to reading.
0—150 VOLTS	Add 30 db to reading.
0—500 VOLTS	Add 40 db to reading.
0—1500 VOLTS	Add 50 db to reading.

Since the decibel represents a voltage ratio, it may be used as such without specifying the reference level. Therefore, for example, a response curve may be plotted for an amplifier by injecting a signal of variable frequency and constant amplitude, with the VTVM connected to the output. Adjust the signal input at some reference frequency, such as 400 cycles, for a convenient indication on the VTVM. (Zero db for example.) As the input frequency is varied, the ouput variation may be observed in db above and below the reference frequency level.

Reading The Meter Scales

The voltage markings on the RANGE switch indicate the full scale reading. The DC-AC (RMS) scales are marked 0-15 and 0-50 with calibrated P-P scales beneath marked 0-40 and 0-140 respectively. The 1.5VAC (RMS) ONLY and 5.0VAC (RMS) ONLY scales are marked 0-1.5 and 0-5.0 with P-P scales beneath marked 0-4 and 0-14 respectively. These scales are only used for measuring AC voltages within the 0-5.0 volt range and are always read directly. That is, when the pointer is indicating .5 on the top section of the 0-1.5 volt range the voltage is .5 volts RMS, or 1.37 volts peak-to-peak. To read DC voltages with the RANGE switch set to "1.5V" or "5V", use the DC-AC (RMS) scale marked 0-15 or 0-50 respectively and move the decimal point one place to the left. In this case for example a reading of "8" on the top section of the 15V scale would represent a voltage of .8 volts DC. On the 0-15 volt range, use the DC-AC (RMS) scale marked 0-15 for both AC and DC voltages. On the 0-50 volt range, use the DC-AC (RMS) scale marked 0-50 for both AC and DC voltages and read directly. For example, a reading of "30" on the top section would represent a voltage of 30 volts DC or AC (RMS), and 85 volts peak-to-peak. On the 0-150 volt range, use the DC-AC (RMS) scale marked 0-15 and move the decimal point one place to the right (or add one zero to the reading). For example, a reading of "8" on the top section would represent a voltage of 80 volts DC or AC (RMS), and 225 volts peak-to-peak. On the 0-500 volt range, use the DC-AC (RMS) scale marked 0-50 and move the decimal point one place to the right. For example, a reading of "30" on the top section would represent a voltage of 300 volts DC or AC (RMS), and 850 volts peak-to-peak. On the 0-1500 volt range, use the DC-AC (RMS) scale marked 0-15, and move the decimal point two places to the right, or add two zeros to the reading. For example, a reading of "8" on the top section would represent a voltage of 800 volts DC or AC (RMS), and 2250 volts peak-to-peak.

The OHMS scale is read directly when the RANGE switch is in the Rx1 position only. For the other ranges, add the proper number of zeros to the reading obtained. Add one zero on the Rx10 position, two zeros on the Rx100 position, three zeros on the Rx1000 position, four zeros on the Rx10000 position, five zeros on the Rx100K position, and six zeros on the Rx1 MEG position. On the Rx1 MEG position, the scale can also be considered to read directly in megohms.

CALIBRATION PROCEDURE

The calibration controls are located on the chassis of your VTVM, see Fig. 2. The instrument must be removed from the case to permit you to use these controls.

Calibration should be rechecked if any parts are replaced, especially tubes.

NOTE: The accuracy of the instrument depends on the accuracy of the standard voltage source used. For D.C. calibration a mercury cell battery provides an extremely accurate voltage, 1.354 volts under no drain conditions.

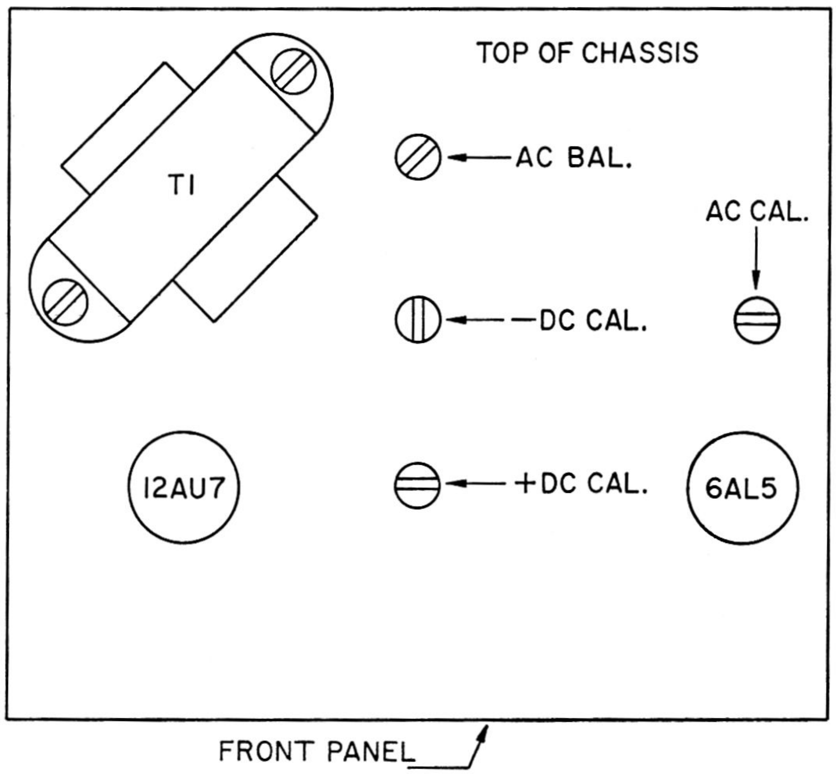


Figure 2

1. Check the mechanical zero adjustment of the meter before attempting to calibrate your instrument. Disconnect the VTVM line cord from the AC power outlet. Place the VTVM in an upright position and using a screwdriver, adjust the plastic screw on the meter face until the pointer coincides with the '0' calibrations on the left end of the meter scale.

2. Plug your VTVM line cord into 120 volt AC outlet and turn the function switch to "+ DC" position. Allow VTVM to warm up for one hour. (Minimum of 8 hours when tubes are replaced.) While it is warming, set switch on probe to the AC-Ohms position and short probe and common lead together.

3. Set range switch to 1.5 volts position. Adjust "ZERO ADJ" control on front panel for minimum shift as Function Switch is switched back and forth between "+ DC" and "— DC" positions.

4. Set Function Switch to "AC" position. Adjust "AC Bal" control (on chassis) until minimum or no shift is noted on meter when shifting between "AC", "+ DC" and "— DC" positions of the Function Switch.

5. Repeat steps 3 and 4 as necessary to obtain absolute minimum shift between functions.

6. Separate Probe from common lead. Set the VTVM Function Switch to "AC" position. Set the Range Switch to 150 volts position. Connect Probe and common lead to an accurately known AC Voltage Source of 100 to 150 volts. Adjust "AC CAL" control until meter reading on VTVM agrees with the source.

   CAUTION: If AC power line is going to be used for calibrating AC scales on your VTVM, use extreme care as you connect the leads and make adjustment.

7. Set slide switch on Probe to "DC" position, set Function Switch to "+ DC" position and Range Switch to 1.5V position. Recheck *Zero* adjustment with the inputs leads connected together. Connect Probe to positive side of a new 1.5 volt battery and the common lead to negative side. Adjust the "+ DC CAL" control until meter needle rests exactly at the red line to the right of the end of the 1.5V DC scale. If mercury 1.354 volts cell is used as a calibrating DC source adjust the "+ DC CAL" control until meter needle reads 1.35 volts.

8. Remove Probe and common lead from battery. Set Function Switch to "— DC" position. Recheck *Zero* adjustment with the input leads connected together. Connect Probe to negative side of battery and common to positive side. Proceed as in step No. 7 except adjust "— DC CAL" control on the chassis. Disconnect test leads from battery.

9. Set Function Switch "OHMS" position. Set Slide Switch on Probe to "AC-OHMS" position. Short Probe tip and common lead together and adjust '"ZERO ADJ" control (on panel) until meter lines up with "0" mark on end of OHM scale.

10. Separate Probe tip from common lead and adjust "OHMS ADJ" control (on panel) until meter needle is at "∞" mark on OHM scale.

11. Repeat steps 9 and 10 as necessary. (When "ZERO ADJ" and "OHMS ADJ" controls are set properly, meter needle will swing from "∞" of ohms scale to "0" of ohms scale as Probe and common lead are touched to each other and back to "∞" as they are separated, without operator touching either of the panel controls.)

12. Check each *OHM* Range of meter, usng standard 1% resistors of approximately mid-scale value.

MAINTENANCE SUGGESTIONS

Your VTVM is capable of fulfilling continuous daily service requirements over a period of several years. However, in order for the user to fully realize these capabilities, the same degree of care in operation and maintenance should be accorded your instrument that would be given any fine piece of equipment.

The tubes used in this instrument should be checked periodically either by substitution or with a tube checker. Always make certain they are in good operating condition.

Should failure of the meter movement coil be suspected, the continuity may be checked with another ohmmeter if you first connect a 10K OHM limiting resistor in series with the ohmmeter test leads. Remember: — NEVER test meter coil continuity directly with another ohmmeter without using the limiting resistance. This can ruin the meter coil by forcing excessive current through it.

Do not attempt self-repair of the meter movement at any time. This will automatically void our standard warranty coverage of the meter.

The plastic meter cover may occasionally, through repeated polishing or cleaning, accumulate charges of static electricity. This will cause the pointer to deflect erratically regardless of whether the instrument is on or off. These static charges may easily be removed by using one of the commercially available anti-static solutions, or a solution of any good liquid detergent (of the type used for washing dishes) and water. Simply dip a clean, soft cloth in the solution and wipe the surface of the meter cover. The cover need not be removed for this operation.

Faulty operation of your VTVM may often be traced to the test leads, especially after being in use for several years, and therefore their maintenance should not be ignored. It is important that they be checked often and carefully for signs of trouble such as breakage, soldered connections developing resistance, the probe cable shield shorting to the inner conductor, etc.

Another frequent source of trouble arises from accidental improper usage of the VTVM, resulting in failure of one or more precision resistors in the multiplier strings. Symptoms of this difficulty may be slow, upscale drifting of the pointer, inability to obtain proper zero adjust action, and of course incorrect voltage or resistance readings. Keep in mind that patience and the exercise of proper precautionary measures in the use of your instrument are of the utmost importance in keeping troubles of this type at a minimum.

IN ALL CASES WHERE FAULTY OPERATION OF THE INSTRUMENT IS SUSPECTED, THE SERVICE DEPARTMENT OF DYNASCAN CORP. SHOULD FIRST BE CONSULTED. SHOULD THE SERVICE DEPARTMENT RECOMMEND RETURN OF THE INSTRUMENT TO THE FACTORY, THE COMPLETE INSTRUMENT SHOULD BE CAREFULLY PACKED IN A WELL PADDED, STRONG CORRUGATED SHIPPING CARTON AND ADDRESSED TO DYNASCAN'S SERVICE DEPARTMENT.

IMPORTANT NOTE: The original packing of the unit is admirably suited for this purpose.

IMPORTANT: If at any time this meter is to be returned to the factory for repair, a COMPLETE description of suspected faulty operation, as noted by the operator, MUST accompany the instrument. The more details submitted to the Service Department of Dynascan Corp., the more quickly and efficiently the instrument can be repaired and returned. It is very important that this description of suspected faulty operation be given in unusually exact detail due to the fact that in many cases, faulty operation can be traced to difficulties in other items of test equipment and/or improper analysis of results obtained.

ANY WRITTEN INQUIRIES TO THE FACTORY REGARDING YOUR METER MUST INCLUDE COMPLETE SERIAL NUMBER OF YOUR INSTRUMENT. IF YOU NEGLECT TO INCLUDE THE SERIAL NUMBER, IT WILL BE NECESSARY FOR THE FACTORY TO REQUEST THE NUMBER IN ORDER TO ANALYZE YOUR PROBLEM.

Your meter is a relatively critical and delicate instrument. Do not attempt any major repairs before consulting the Service Department of Dynascan Corporation.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the instruction manual for adjustments that may be applicable.
2. Check common electronic parts. Always check instruction manual for applicable adjustments after such replacement.
3. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of product from which removed and date of product purchase. These parts will be exchanged at no charge.
4. If the above mentioned procedures do not correct the difficulty, pack the product securely using the same packing arrangement as supplied by the manufacturer. A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred to the nearest B & K authorized communication service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to

Service Department

DYNASCAN CORPORATION

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