1.4.2 Controls and Input Connections

(i)	Facility Selector:	Selects desired facility, i.e., OHMS, A.C., etc.
(ii)	Range Selector:	Selects desired range, i.e., 1.5V., 5V., etc.
(iii)	ZERO ADJ.	Positions the meter needle to "0", or "-0+" (the latter when the facility selector is set to "+" VOLTS position, and the instrument is used for centre-zero indication).
(iv)	OHMS ADJ.	Positions the meter needle at the extreme right-hand mark of the ohms scale when the facility selector is set to OHMS position.
(v)	VOLTS, A.C.-D.C. Connector:	Input terminal for "Active" side of voltages to be measured.
(vi)	"+" mA.-OHMS:	Positive input terminal for current readings. Also associated with ohms facility.
(vii)	-mA. EARTH.	"-" terminal for current readings; earthed for other facilities. Second terminal for ohms measurement.

1.4.3 Electrical Characteristics

(a) D.C. Voltmeter

Sensitivity: (on 1.5V. range)	7.3 M.ohms/volt
Accuracy: (all ranges)	± 3% of full scale deflection (F.S.D.)

(b) Milliammeter

Accuracy on all ranges:	± 3% of F.S.D.

(c) A.C. Voltmeter

Input resistance and capacitance (with direct probe and cable): 1.5V., 5V., 50V., and 150V.:-	0.83 M.ohm, in parallel with 90 uuF.
500V. range:-	1.3 M.ohm in parallel with 85 uuF.
1,500V. range:-	1.5 M.ohm in parallel with 85 uuF.

Frequency Response (using direct probe and cable):-

Source Impedance	Freq. Range	Response
100 ohm	30 cycles to 2.5 Mc.	+ 1 db at 2.5 Mc.
1000 ohm	30 cycles to 500 kc.	+ 1 db at 500 kc.
5000 ohm	30 cycles to 270 kc.	- 1 db at 270 kc.
10,000 ohm	30 cycles to 80 kc.	- 1 db at 80 kc.

Frequency Response (using crystal diode probe type 2R56020):-	Within ± 1 db from 50 kc. to 250 Mc.

Accuracy:-

1.5V., 5V., 15V., 50V., 150V., and 500V.	± 5% of F.S.D. at 50 cycles.

(d) Maximum Input Voltages

Pure D.C. (i.e., without A.C. components):-

Using D.C. probe 1R56020	1,500V.
Using High Voltage probe 2R56020	30,000V.

A.C. Voltages (i.e., without D.C. components):-

R.M.S. sinusoidal	1,500V.
Peak-to-peak sinusoidal	4,200V.
Peak-to-peak Complex waveforms	2,100V.

Sum of D.C. and A.C. peak-to-peak voltage inputs:-

When measuring A.C. component:-	2,100V.
D.C. component:-	1,500V.

(e) Meter Sensitivity

200 uA. for F.S.D.

(f) Mains Supply and Power Consumption

Mains Input:-	240V., 50-60 cycle, single-phase.
Power Consumption:-	5.5W. approximately.

1.5 Probes and Cables used with Voltohmyst A56010

Refer to fig. 8 (Drg. 56010D7) at the rear of this book.

1.5.1 Cables and Probes Supplied with the Instrument

The instrument is normally supplied fitted with three probes (ohms probe, direct probe type R56020, and D.C. probe type 1R56020), together with an earth cable which is fitted with an alligator clip.

The ohms probe and direct probe are each connected to individual cables, and are thus used alone for the measurement of resistance and A.C. voltages respectively; the circuit is completed in each case via the earth cable and clip.

The D.C. probe, however, consists of an extension piece which fits over the direct probe and clamps into place on the latter. The whole is then used for measurement of D.C. voltages.

1.5.2 Probes Not Normally Supplied with the Instrument (available on separate order)

(a) Crystal Diode Probe type 2R56020

This probe consists of an extension piece similar to the D.C. probe, with a clip attached to the side, and contains a small diode rectifier element, coupling capacitor and isolating resistor. (Refer to the insert on the circuit diagram Drg. 5601002).

The probe has application in the measurement of R.M.S. values of sinusoidal waveforms in the range 50 kc. to 250 Mc. The R.M.S. values are read on the D.C. scale of the voltohmyst, and the peak values may then be obtained by multiplying by 1.414.

The probe may be used in the presence of D.C. voltages as high as 250V.

The specification is as follows:-

Frequency Response:- ± 1 db from 50 kc. to 250 Mc.

Input Capacitance:- 1.75 uuF. (approx.)

Input Resistance.

Frequency	Resistance
50 kc.	370,000 ohms
100 kc.	360,000 ohms
1 Mc.	312,000 ohms
10 Mc.	283,000 ohms
100 Mc.	90,000 ohms
220 Mc.	6,000 ohms

Maximum Input Voltages

R.F. Voltages	20V. R.M.S. 28V. peak.
D.C. Voltage	250V.

Voltohmyst Meter Indication

Sinusoidal Waveforms:	R.M.S. values read off the D.C.-R.M.S. scales.
Complex Waveforms:-	Peak values of approximately 1.414 of indicated R.M.S. value for the positive portion of the cycle.

Method of Use

(i) Fit the probe (type 2R56020) over the tip of the direct probe. Set the facility selector on the voltohmyst to "-" VOLTS position and the range selector to an appropriate scale.

(ii) Connect the clip to the earth side of the voltage source and apply the probe to the other side.

(b) High Voltage Probe type 3R56020

This probe consists of a cable and hollow-moulded piece containing a dropping resistor capable of extending the D.C. range of the instrument to 0-30,000V., and is indispensable in television and heavy-duty industrial work.

The maximum input voltage usable with the probe is 30,000V., and since the probe effectively provides the D.C. ranges of the instrument with a multiplying factor of 100, the range selector may be set as required, and a direct reading obtained. Note that the total input resistance of the voltohmyst when using the high voltage probe is in the vicinity of 1100 M.ohms, providing a valuable facility when working in high impedance circuits with poor regulation.

Method of Use

Remove the direct probe and cable from the instrument and fit the high voltage probe and cable in its place. Set the facility selector to "+" or "-" VOLTS as required, and the range selector to a position considerably higher than the estimated value of voltage source. More accurate readings may be made with successive settings of the range selector after taking the first trial measurement.

IMPORTANT:

The probe is provided with an earthed guard ring in front of the hand-piece, and it is important that the operator's hand be behind this guard ring at all times, so that in the event of a flash-over occurring, current will pass only to the latter.

2. METHOD OF USE

2.1 Warning Notes

(i) DO NOT USE THIS INSTRUMENT FOR THE MEASUREMENT OF A.C. AT POWER OUTLETS, ETC., WHERE THE ACTIVE LEAD CANNOT BE DISTINGUISHED.

(The frame of the instrument is earthed via the 3-core mains cable, and application of the test prods in incorrect polarity would therefore short-circuit the supply.)

WHEN MEASURING ANY OTHER A.C. OR D.C. VOLTAGE IN WHICH ONE SIDE IS EARTHED, BE CAREFUL TO APPLY THE EARTHY PROD TO THE EARTHED SIDE OF THE VOLTAGE.

(ii) Before taking any voltage measurements, refer to the maximum input voltage ratings given in para. 1.4.3. On no account should these values be exceeded.

(iii) Do not connect the EARTH cable to a point of high potential. (The connector to which this cable is attached is connected to the instrument case when measuring volts.) Reversal of D.C. polarity is obtained by switching between "+" and "-" VOLTS positions on the facility switch.

(iv) When measuring the resistance of certain devices such as thermocouples, meters, etc., a higher range than R x 1 or R x 10 should be used, because on these lower ranges the instrument applies up to 1.5V. (depending on the resistance of the device being measured) in series with the external circuit, and could cause damage to the thermocouple or meter.

(v) Exercise care when using the instrument as a milliammeter. The electronic protection devices incorporated for voltage applications are switched out of circuit when the facility selector is set to "mA." position.

(vi) Exercise extreme care when working on equipment in which high voltages appear. Where possible it is advisable to follow the precautions listed below.

(a) Remove the power from the equipment under test before connecting the instrument.

(b) Discharge large capacitors before making adjustments.

(c) Check for breaks in the insulation wiring.

(d) Disconnect test leads immediately a test is completed.

(e) Where practicable, use only one hand to make an adjustment or measurement; keep the other away from any part of the equipment or earth point.

(f) Work in the presence of a second person who can render assistance in the case of accident.

2.2 Setting Up Procedure

(i) THE 1.5V. CELL USED ON THE OHMS FACILITY IS NOT NORMALLY FITTED IN THE INSTRUMENT WHEN SUPPLIED. TO FIT THIS CELL, REMOVE THE INSTRUMENT FROM ITS CASE BY UNDOING THE FRONT COVER SCREWS, FIT THE CELL INTO THE APPROPRIATE CLAMP (UPPER RIGHT, WHEN VIEWED FROM THE FRONT), AND SOLDER/CONNECT (DEPENDING ON THE TYPE OF BATTERY USED) THE RED AND BLACK LEADS TO THE POSITIVE (CENTRE) AND NEGATIVE (CELL CASE) POLES RESPECTIVELY.

(ii) Identify the EARTH and OHMS cable and the Direct Probe (refer to Fig. 8) and connect respectively to EARTH, OHMS and VOLTS (A.C.-D.C.) connectors on the front panel.

(iii) Check the mechanical zero of the meter, and if necessary, re-adjust. Plug into the mains and switch on. Allow a short warm-up period. Set facility selector to "+" VOLTS position.

(v) Turn the ZERO ADJ. control until the meter needle coincides with the left-hand "0" on the scale. Check the adjustment by now setting the facility switch to "-" VOLTS position. If the meter needle moves from "0", again make an adjustment to the ZERO ADJ. control. If necessary, make alternate adjustments to the facility switch and ZERO ADJ. control until a setting is obtained which allows the facility switch to be set to either "+" or "-" VOLTS without affecting the needle.

(v) Set the facility selector to the OHMS POSITION. The needle should be deflected to approximately full scale. Turn the OHMS ADJ. control until the needle coincides with the right-hand edge of the OHMS scale.

The instrument is now ready for use.

2.3 D.C. Voltage Measurement (using D.C. and Direct Probes)

Use the D.C. probe (type 1R56020, indicated on Fig. 8) in conjunction with the direct probe R56020 for all D.C. voltage measurements. Fit the probe piece over the tip of the direct probe and clip into place.

(i) Set the facility selector to "+" VOLTS or "-" VOLTS as required (refer to warning note (iii) in 2.1).

(ii) Connect the EARTH cable to earth or low side of the voltage source under measurement.

(iii) Set the range selector to a position considerably higher than that at first required. Use the probe as a conventional multimeter test prod. Switch to progressively lower settings of the range selector to obtain more readable deflections.

Read direct from the appropriate scales.

2.4 Centre-zero Readings

The centre-zero facility allows observations of positive or negative excursions in D.C. voltages without the necessity of re-setting the facility selector to "-" or "+" VOLTS, as the case may be.

(i) Set the facility selector to "+" VOLTS.

(ii) Turn the ZERO ADJ. control until the meter needle coincides with the centre "0" of the scale.

(iii) Set the range selector to a position at least double the voltage to be measured.

(iv) Take several test readings, re-setting the range selector for more convenient readings.

2.5 A.C. Voltage Measurement (With Direct probe alone)

Use the direct probe (type R56020) alone. Low values of R.M.S. (below 1.5V.) and peak-to-peak (below 4.2V.) should be read on the separate LO-A.C. scales.

Higher voltages should be read on the "D.C. or R.M.S." scale graduated to 1.5, in association with the appropriate multiplying factor given by the range selector. Peak-to-peak values can be read simultaneously with the R.M.S. values.

(i) Set the facility selector to A.C. VOLTS position and if necessary, adjust the ZERO ADJ. control to make the needle coincide with the left-hand "0" of the scale.

(ii) Set the range selector to a position considerably higher than that at first required. Use the probe as a conventional test prod. Switch to progressively lower settings of the range selector to obtain more convenient readings. Read direct from the appropriate scales.

Note that a delay will occur between the removal of the test prods from the source voltage and the return of the meter needle to zero when measuring A.C. voltage.

This delay is caused by the effects of circuit constants within the instrument, such constants having been chosen to enable more accurate measurements of pulse waveforms having low repetition rate.

2.6 Resistance Measurement

2.6.1 Normal Measurement of Resistance up to 1000 M. ohm

(i) Refer to Warning Note (iv) of 2.1.

(ii) Ensure that there is no voltage present in the circuit in which the instrument is to be used.

(iii) Set the facility selector to OHMS position.

(iv) Set the range selector to a convenient position (R x 1000 being suitable) and check that the meter needle is reading full scale. Make any necessary adjustment to the OHMS ADJ. control.

IF ONE END OF THE RESISTANCE TO BE MEASURED IS EARTHED, OBSERVE THIS POLARITY WHEN USING THE OHMS PROBE AND EARTH CABLE RESPECTIVELY. CONNECT THE LATTER TO THE EARTHED END OF THE RESISTOR, AND APPLY THE PROBE TO THE OTHER.

(v) Multiply the reading on the ohms scale by the factor against the position of the range selector.

2.6.2 High Resistance (insulation) Measurement

The instrument has application as a high resistance (above 1,000 M. ohms) test unit when used in conjunction with an external D.C. voltage (between 20V. and 500V.), in a circuit as indicated in Fig. 4 below.

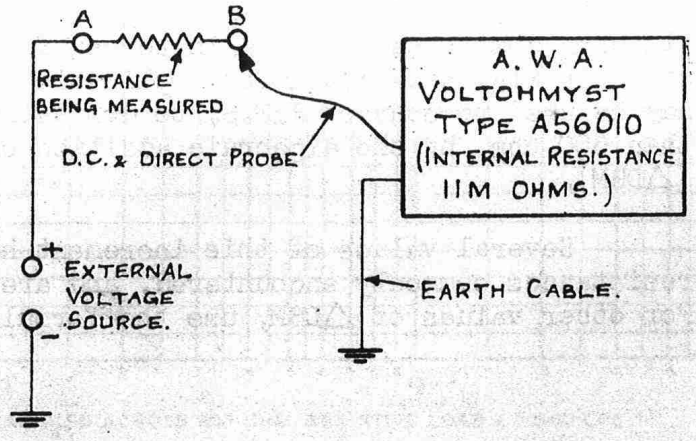

Fig. 4 Circuit for Measurement of Resistance Values above 1000 M. ohms

(i) Set the facility selector to "+" VOLTS, and measure the volts at point "A". Let this applied voltage be "V".

(ii) Measure the voltage at point "B". Let this voltage be "v".

(iii) Calculate the unknown resistance from:-

$$R(\text{in M. ohms}) = \frac{11\ (V-v)}{v}$$

2.7 Current Measurement

(i) Set the facility switch to "mA." position.

Observe the warning note (v) of 2.1.

(ii) Use the instrument as a conventional milliammeter.

Connect the OHMS cable in the "+" side. Set the range selector to a considerably higher position than that at first required, then make progressive adjustments for more convenient readings. Read direct from the appropriate scale.

2.8 Measurement and Calculation of dbm

The chart given in Fig. 5 can be used in conjunction with the instrument to determine dbm values corresponding to R.M.S. A.C.-voltage values across a 600-ohm load. The dbm is defined as the number of decibels above or below a reference level of 1 milliwatt in 600 ohms at 1000 cycles. Accordingly, 0 dbm indicates a power of 1 mW.; 10 dbm, 10 mW.; 20 dbm, 100 mW. etc.

Since dbm are defined with respect to a 600-ohm circuit, the power levels in these circuits correspond to voltage values, thus allowing dbm to be measured in terms of R.M.S. voltages. The chart given in Fig. 5 is drawn for application to 600 ohm circuits, but may be used to convert R.M.S. to dbm values in load resistances other than 600 ohm, by the algebraic addition of a suitable increment (ΔDBM).

Several values of this increment have been worked out for resistances commonly encountered, and are given in the table below. For other values of ΔDBM, use the formula given in equation (i).