OPERATING INSTRUCTIONS

AVOMETER Model 8

Mark 5

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AVOMETER MODEL 8 Mark 5

Met dank aan A.R.A. van Rossum

Ned. Ver. v. Historie v/d Radio

TRADE MARKS
The Trade Marks *AVO* and *AVOMETER* are the exclusive property of Avo Limited.

SWITCH TRANSIT POSITION
During transit the left-hand switch should be set to OFF. The right-hand switch should be set to D.C.

CONTENTS

SPECIFICATION

TABLE OF RANGES

DC Voltage	DC Current	AC Voltage	AC Current
3000V	10A	3000V	10A
1000V	1A	1000V	1A
600V	100mA	600V	100mA
300V	10mA	300V	10mA
100V	1mA	100V	
30V	300μA	30V	
10V	50μA	10V	
3V		3V	
100mV*			

*On the 50μA range

Resistance

0 to 2000Ω (20Ω centre scale) } all self-contained
0 to 200kΩ (2kΩ centre scale) } all self-contained
0 to 20MΩ (200kΩ centre scale) } all self-contained
0 to 200MΩ (2MΩ centre scale) with external voltage

ACCURACY

D.C. Voltage & Current Ranges ± 1% of f.s.d.
A.C. Voltage & Current Ranges (50Hz) ± 2% of f.s.d.

SENSITIVITY

D.C. Voltage Ranges 20,000Ω/V
A.C. Voltage Ranges 2,000Ω/V (above 10V)

FREQUENCY RESPONSE

Variation from reading at 50Hz, on A.C. voltage ranges up to 300V, is not greater than ±3%, between 15Hz and 15kHz

TEMPERATURE RANGE

Operation: − 5°C to +35°C
Storage: −40°C to +50°C

TEMPERATURE EFFECT

Variation due to temperature change, not greater than 0·15% per degree C

FLASH TEST

7kV proof

OVERLOAD PROTECTION

High speed electro-mechanical cut-out with a fuse on the two lower resistance ranges

RESPONSE TIME

Typically 1 second to full scale

SPECIFICATION

GENERAL DESCRIPTION

The *AVOMETER* is extremely simple to use, range selection in general being accomplished by means of two switch knobs. All tests, except those on the 3000V ranges make use of the pair of terminals at the base of the instrument. A clearly marked 5 in. (127mm) scale has uniformly divided graduations to match 100 and 300 scale markings and in addition, there is an ohms scale. An anti-parallax mirror permits readings of the knife edge pointer to be made with great precision.

The meter is supplied complete with a pair of special *AVO* leads. The remote ends of the leads are fitted with spring clips, which may be interchanged with the Avo Long Reach Safety Clips Mark 2 supplied with the instrument.

AVO Long Reach Safety Clips have been introduced to enable connections for test purposes to be made at what are normally inaccessible points on a chassis. Examination will show that they are completely insulated with the exception of the jaws at one end, which can be opened by compressing the stem into the body of the clip. Rigid connections to wiring can thus be made by this insulated device in complicated wiring systems where other types of larger clip could not be attached. or if fixed might cause short circuits. It should be noted that they are not suitable for high current.

REPLACEMENT BATTERIES

Ever Ready SP2 (or equivalents, Burgess 210 or 230, Ever Ready HP2, IEC R20, Leclanché R20S, Ray-O-Vac 13 or 3D, Varta 232)	Pt.No. 25511–013
AND	
Ever Ready B121 (or equivalents, Burgess U10, IEC 10F20, Leclanché 215G, Ray-O-Vac 208, Varta 71)	Pt. No. 25511–181
OR	
Ever Ready B154 (or equivalents, Burgess Y10, IEC 10F15, Leclanché GB15, Ray-O-Vac 220, Varta 74)	

REPLACEMENT ACCESSORIES

$1\frac{1}{4}$ inch Cartridge Fuse — 1A	
Plug-in Lead (Black)	Pt. No. 6220-003
plug-in Lead (Red)	Pt. No. 6220-004
Long Reach Safety Clip (Black)	Pt. No. 6220-008
Long Reach Safety Clip (Red)	Pt. No. 6220-009
Clip	Pt. No. 6120-003

A range of accessories is available to extend the normal ranges of measurement. These include dc voltage multipliers (up to 30kV), dc current shunts (100mV drop) and a multi-range current transformer. *See page 14.*

OPERATION

GENERAL

The meter is intended for use horizontally. Should it happen by any chance that the pointer is not on zero, it may be so set by means of the screw head on the panel.

The leads fitted with Long Reach Safety Clips Mark 2 or clips, as required, should be connected to the lower pair of meter terminals in all cases except when measuring voltages over 1000V.

When measuring current or voltage, ensure that the instrument is set to match the type of source to be measured (either ac or dc) and then choose a suitable range before connecting up to the circuit under test. When in doubt, always switch to the highest range and work downwards, there being no necessity to disconnect the leads as the switch position is changed.

Do not, however, switch off by rotating either of the knobs to a blank position.

The instrument is flash tested at 7000V ac but should the meter be used with accessories on circuits in excess of 3000V, it should be kept at the low potential end of the circuit (near earth potential). If this procedure cannot be adopted other suitable safeguards must be applied.

CURRENT MEASUREMENT

To measure current, the instrument should be set to a suitable ac or dc range and then connected in series with the apparatus to be tested.

Generally speaking, the power absorbed in the instrument is negligible, but in cases of low voltage, heavy current circuits, the inclusion of a meter may reduce the current appreciably below the value which would otherwise prevail. The voltage drop at the meter terminals is 400mV on the 10A dc range dropping to 100mV on the 50 microamp range. In the case of ac ranges it is less than 450mV on all ranges. Standard meter leads have a resistance of 0.02 ohm per pair. Care should be taken to ensure that the circuit is 'dead' before breaking into it to make current measurements.

VOLTAGE MEASUREMENT

When measuring voltage, it is necessary to set the appropriate range of 'ac' or 'dc' and connect the leads across the source of voltage to be measured. If the expected magnitude of the voltage is within the range of the meter, but its actual value is unknown, set the instrument to its highest range, connect up and if below 1000V, rotate the appr priate selector switch, decreasing the ranges step by st until the most suitable range has been selected. If the voltage should exceed 1000V, the instrument should be set to measure 1000V as described above, but the positive lead should be transferred to the appropriate 3000V terminal

OPERATION

Great care must be exercised when making connections to a live circuit and the procedure should be entirely avoided if possible.

When measuring high ac and dc voltages (say above 800V) unless the common negative terminal is either earthy or connected to earth, errors will be introduced if the instrument is touched during a reading.

On dc ranges, the meter consumes only 50 microamps at full scale deflection, this sensitivity corresponding to 20,000Ω/V. In the case of ac ranges above 10V, full scale deflection is obtained with a consumption of 0.5mA (2000Ω/V). The 10V range is 1000Ω/V. The 3V ac range consumes 10mA at full scale deflection. The meter maintains a high degree of accuracy for audio frequency tests up to 15kHz on ranges up to 300V ac. Whilst discussing the problem of measuring voltage, it would be well to draw attention to the fact that in certain circuits where the current is limited because of the presence of a resistance between the source and the point at which a measurement is to be made, it is possible for the actual voltage to be higher normally than when the meter is connected. All current consuming voltmeters, however sensitive, draw current to varying degrees from the circuit under test, thus causing a higher volts drop in the resistances mentioned and thereby causing the voltage to fall at the point of measurement.

Owing to the high sensitivity of the Model 8 on dc ranges, this effect is unlikely to be of importance except in a very few instances. A practical example of where it might be taken into account is in the measurement of e.h.t. voltage on a television set or the tapping on a potential divider, where the resistances are so high as to be comparable with the resistance of the meter on the range in use. It is generally possible to use a meter on a higher range than absolutely necessary and in such a case the higher meter resistance causes less disturbance than would otherwise be the case. At the same time adequate pointer deflection for reasonable accuracy should be attained.

When it is essential to obtain an accurate indication of the voltage developed across a high resistor it is sometimes preferable to insert the meter in series with it and to measure the current flowing. The reading given upon the meter, in milliamps, multiplied by the value of the resistance in thousands of ohms, will give the developed voltage.

RESISTANCE MEASUREMENT

There are three self-contained ranges covering from 1 ohm to 20 megohms and provision is also made for upward extension of these limits. The self-contained ranges make use of the usual series circuit and successive ranges are on 100:1 ratio, which permits of very wide coverage with three ranges.

OPERATION

On resistance ranges, the meter must not merely start from its normal instrument zero, but must have, in addition, a resistance zero corresponding to the full scale deflection of the meter. Before carrying out tests for resistance, a check and, if necessary, adjustment should be carried out to ensure that when the leads are joined together the meter actually indicates zero ohms irrespective of the condition of the battery (within the limits of adjustment). The method of adjustment is described later.

Owing to the nature of the scale, it is not easy to define the accuracy, but it should be within 3% of the reading about centre scale, increasing up to about 10% of the indication around deflections corresponding to 10% and 90% of full scale deflection.

Resistance tests should never be carried out on components which are already carrying current.

On three ranges which utilise the internal source of voltage, it should be remembered that a positive potential appears at the negative terminal of the instrument when set for resistance tests. This fact may be important because the resistance of some components varies according to the direction of the current through them and readings therefore, depend upon the direction in which the test voltage is applied, quite apart from its magnitude. Such cases include electrolytic capacitors and rectifiers.

When measuring the leakage resistance of an electrolytic capacitor, the negative lead from the meter should be connected to the positive terminal of the capacitor and the ohms x 10k range employed.

Before making resistance tests the pointer should be adjusted to zero in the following sequence:

1. Set the left hand switch at Ω.
2. Join the leads together.
3. On the Ω x 1 range adjust zero by means of the knob marked Ω x 1.
4. On the Ω x 100 range adjust zero by means of the knob marked Ω x 100.
5. On the Ω x 10k range adjust zero by means of the knob marked Ω x 10k.

To test a resistance, set the right-hand switch at the range required, the leads being connected across the unknown component.

Resistance is read directly on the Ω x 1 range but readings should be multiplied by 100 and 10,000 on the Ω x 100 and Ω x 10k ranges respectively.

If on joining the leads together it is impossible to obt. zero ohms setting, or if furthermore the pointer position will not remain constant, but falls steadily, the internal battery or cell concerned should be replaced. It is important that a discharged unit should not be left in the instrument, since the electrolyte might seep through and cause damage to the meter. If it is impossible to obtain readings on the Ω x 1 and Ω x 100 ranges, the 1A fuse located in the battery box should be checked.

NOTE: It can so happen that a 15V battery may age in such a manner that although it indicates a potential of 15V, its internal resistance has increased so much that some loss of accuracy can occur on the high resistance range (Ω x 10k). If the battery has been in use for some time, or if errors are suspected on the high resistance range, it is worthwhile removing the battery and checking its short circuit current on the 100mA dc range. If the battery fails to give a reading greater than 25mA it should be discarded.

INSULATION RESISTANCE MEASUREMENT

High resistance measurements may be made using an external dc voltage of the order of 130/160V. The left-hand switch should be set at Ω with the right-hand switch at INS and the meter leads should be connected to the battery. The pointer should be brought to zero on the ohms scale by means of the adjuster marked Ω x 10k. To test, connect the unknown resistance in series with the meter and its value will be that shown on the ohms scale multiplied by 100,000. Resistances up to 200 megohms can, therefore, be read on this range.

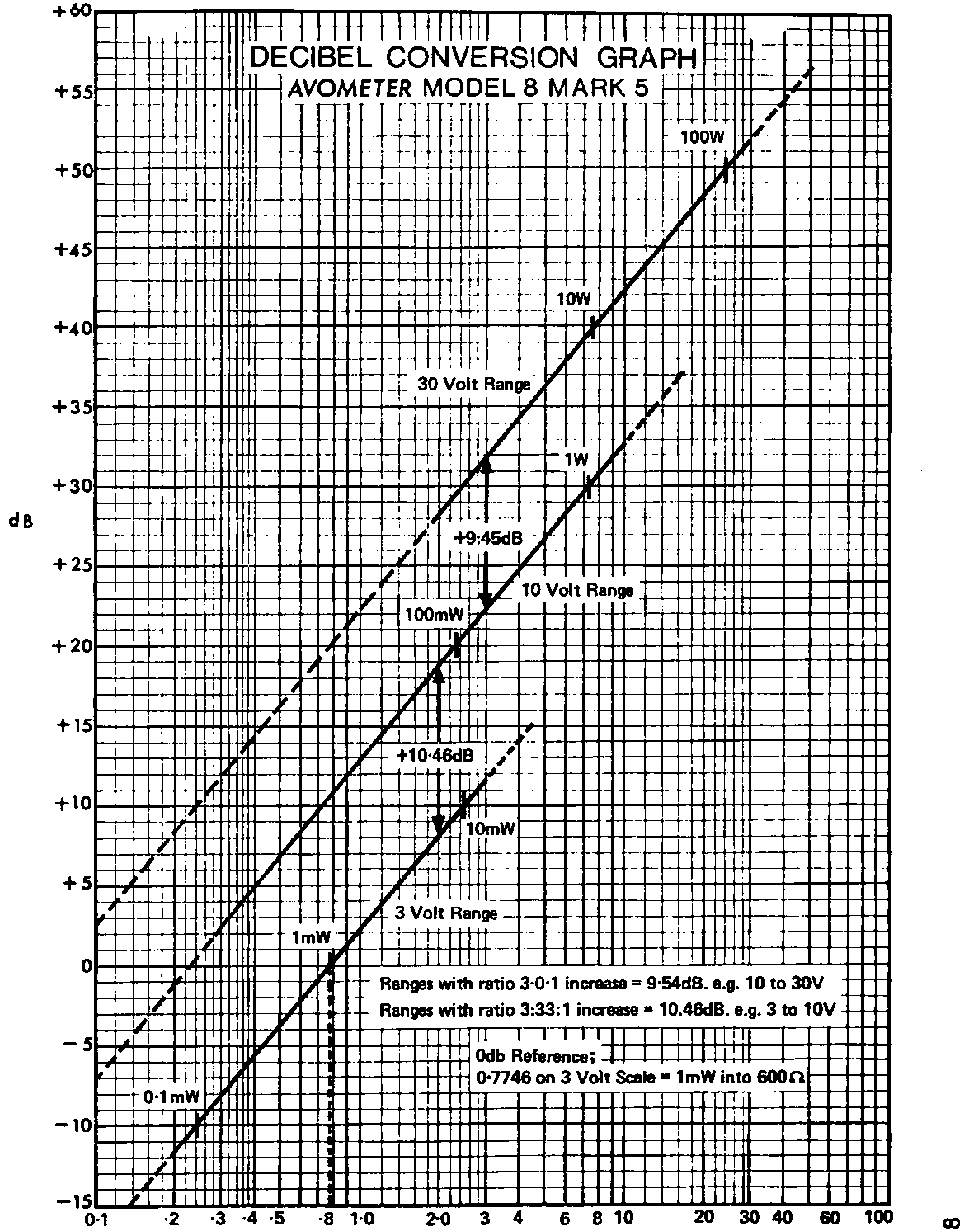
DECIBEL MEASUREMENTS

The graph on Page 8 can be used to determine the dB values corresponding to r.m.s. voltage values across a 600 ohm resistive load. A dB value is defined as the number of decibels above or below a reference level of 1mW in 600 ohms at 1kHz. Zero dB, therefore, would indicate a power level of 1mW; 10dB, 10mW, 20dB, 100mW. Because dB are defined with respect to a 600 ohm load, power levels correspond to voltage levels. Decibels can be measured in terms of r.m.s. voltages across a 600 ohm resistive load. For example, 0.775V r.m.s. indicates 0dB and 7.75V r.m.s. indicates 20dB. Whilst these measurements must be made with a sine waveform to avoid waveform error, any frequency may be used within the range of the Model 8 Mark 5. The decibel and ear response curves have their closest correlation at 1kHz.

Power levels can be read along the top of the graph. If the r.m.s. voltage is measured across a resistive load other than 600 ohms the correction factor given below must be added algebraically to the dB values read from the graph. The following formula should be used for determining the correction factor.

$$\text{Correction Factor} = 10 \log_{10} \frac{600}{10R}$$

where R is the load in ohms. If R is greater than 600 ohms the Correction Factor is negative.


DECIBEL CONVERSION GRAPH
AVOMETER MODEL 8 MARK 5
100W
10W
30 Volt Range
1W
+9·45dB
10 Volt Range
100mW
+10·46dB
10mW
3 Volt Range
1mW
Ranges with ratio 3·0·1 increase = 9·54dB. e.g. 10 to 30V
Ranges with ratio 3:33:1 increase = 10.46dB. e.g. 3 to 10V
0db Reference;
0·7746 on 3 Volt Scale = 1mW into 600Ω
0·1mW
dB
+60
+55
+50
+45
+40
+35
+30
+25
+20
+15
+10
+5
0
−5
−10
−15
0·1
·2
·3
·4
·5
·8
1·0
2·0
3
4
6
8
10
20
30
40
60
100
∞

POLARITY REVERSE CONTROL

If dc voltage is required both positive and negative to a reference point, or the direction of current flow may be reversed. In order to simplify the matter of lead alteration, a polarity reverse press button (REV. M.C.) is provided. It should be noted that the polarity marked on the terminals is for normal use and does not apply when the red section of the REV. M.C. button can be seen.

OVERLOAD PROTECTION

Apart from the ability to do its job, one of the most attractive features of the instrument is the provision of an automatic cut-out which gives a very high degree of overload protection to the whole of the instrument. The incorporation of this device will be found to be of particular value when conducting experimental work, for it imparts to the user the feeling of mental ease and confidence. When conducting experimental work with conventional moving coil meters, these can easily be ruined by inadvertantly applied overloads, whereas the *AVOMETER* is so well protected that it can withstand considerable mishandling.

If an overload is applied to the meter, the cut-out knob springs from its normal position in the panel, thus breaking the main circuit. When the circuit is broken the red portion of the cut-out knob will show. This knob has only to be depressed to render the instrument again ready for use. It is important to note that the cut-out should never be reset when the instrument is connected to an external circuit, whilst the fault which has caused the overload should be rectified before the meter is reconnected.

The mechanism is brought into operation by the moving coil coming into contact with a trigger just beyond its full-scale position. There is, in addition, a second trigger at the zero end, so that the cut-out is tripped if the meter is overloaded in reverse. Although the overload mechanism gives almost complete protection to the meter, it cannot be guaranteed to fulfil completely its function in the very worst cases of misuse, such as the mains being connected across the meter when set to a current range. It should be noted that mechanical shock to the instrument will sometimes trip the cut-out mechanism. The cut-out should be re-set using direct pressure on the button with the instrument lying face upwards. Additional protection is provided on resistance ranges by a fuse connected in the Ω x 1 and Ωx100 ranges.

WARNING *Special care must be taken when using the instrument to service television receivers or other apparatus employing capacitors of large capacitance, for the inclusion of such components in a circuit may mean that very heavy peak currents may flow when the apparatus is switched on. Such surges produce a peaky wave form and although these peaks are only of a few milli-seconds duration, they may, never-the-less, damage the instrument diodes.*

EHT MEASUREMENT

Using the Combined 10kV/30kV Multiplier

A combined 10kV and 30kV dc multiplier is available for use with the instrument .The Multiplier should be connected to the *AVOMETER* set to the 10V dc range. It is recommended that the meter is kept as near earth potential as possible and the Multiplier used at the high potential end, e.g. when measuring an e.h.t. voltage when the negative line is earthy, the Multiplier should be connected between the point of positive potential and the positive terminal of the meter. In addition, the low potential end of the meter must be connected to the low potential of the supply being measured using the low potential lead provided. A cap is provided which should always be in position over the high voltage terminal not in use.

It is recommended that neither the meter, multiplier nor leads are handled whilst high voltage tests are in progress. Protection is provided by a resistor connected permanently across the multiplier terminals thus preventing the full voltage being present should the meter be disconnected.

General Note: When measuring high ac and dc voltages (say above 800V) unless the common negative terminal is either earthy or connected to earth, errors will be introduced if the instrument is touched during a reading.

Using the 30kV Probe Multiplier

A 30kV dc Multiplier is available for use in series with the meter set to its 1000V dc range, readings being made direct in kV on the 0-100 scale and multiplied by 300. It is most important to ensure that the meter is kept in the earthy end of the circuit and the multiplier connected to either the positive or negative terminal whichever is at high potential. This method of connection to get forward pointer indication with the meter earthy is recommended as we do not think it desirable to use the moving coil reverse button when measuring high voltage.

In general, we recommend that neither the meter, multiplier nor leads are handled whilst high voltage tests are in progress and a special lead is provided with the multiplier for connection to the high potential point.

HEAVY AC CURRENT MEASUREMENT

AC Currents between 10A and 600A may be measured by use of the *AVO* Multi-range Current Transformer (Pt. No. 45869). Full operating instructions for its use are packed with the optional accessory.

HEAVY DC CURRENT MEASUREMENT

D.C. currents between 10A and 600A may be measured by use of the appropriate *AVO* DC Shunt accessory.

30 Amp	Pt. No. 6220-015
100 Amp	Pt. No. 6220-016
300 Amp	Pt. No. 6220-017
600 Amp	Pt. No. 6220-018

When used with the *AVOMETER* 8 Mk 5, all these shunts produce a voltage drop of 100mV when passing current at their maximum rating.

The Shunt should be connected by means of its two main terminals in series with the circuit to be measured. The meter set to its 50μA (100mV) dc position should then be connected to the two small studs on the shunt end blocks. The *AVOMETER* when so set, consumes only 50μA at full scale deflection, a value which is negligible in comparison with the full scale current of the shunt. The millivolt drop across the shunt is directly proportional to any current which may flow through it and since the deflection on the meter is directly proportional to the millivolt drop across the terminals, the instrument indicates correctly over its entire scale length.

NON-SINE WAVEFORMS

In as much as rectifier moving coil instruments give readings on 'ac' proportional to the mean and not the r.m.s. value of the waveform with which they are presented, they depend for their accuracy, not only upon their initial calibration, but also upon the maintenance of a sinusoidal waveform. Since the form factor (r.m.s. value divided by mean value) of a sine wave is 1.11, this has been taken into account in calibrating the meter, which does, therefore, indicate r.m.s. values on the assumption that the normal sine wave will be encountered. Generally speaking, considerable waveform distortion can occur without appreciably affecting the form factor and resulting accuracy of measurement, but the user should recognise the possibility of some error when using distorted waveforms, squarish waveshapes producing high readings and peaky ones, low readings.

DESIGN FEATURES

LIMITS OF ACCURACY

The instrument will produce its highest accuracy when used face upwards, in which position it has been calibrated.

In the case of voltage measurements, successive ranges have been chosen to obviate the need for taking readings on very small deflections.

DC Voltage ±1% of full scale value
DC Current ±1% of full scale value
***AC Voltage** (50Hz) ± 2% of full scale value
AC Current (50Hz) ± 2% of full scale value
Resistance 3% of reading at centre scale

*The instrument is calibrated for use at 50Hz but the change in readings, due to variation in frequency (between 15Hz and 15kHz) should not exceed 3% on ac current ranges or on ac voltage ranges up to 300V.

DESIGN AND CONSTRUCTION

The instrument consists of a moulded panel on the inside of which are mounted the whole of the switching apparatus, resistors, shunts, transformer, rectifier etc. together with the movement. A carrying strap is fixed to moulded lugs on the rear case. The front panel is fitted into this case with a dust proof joint. The main switching is accomplished automatically by means of two knobs which indicate on the panel the range in use. These switches are of generous and robust design, the contacts being arranged to 'make' before 'break' on adjacent ranges; a feature which provides a factor of safety in use.

When the instrument is set for operation on dc the moving coil is associated with a universal shunt and series multipliers, whilst on ac, diodes and a transformer are also introduced.

DESIGN FEATURES

RANGE CONTROLS

The left-hand knob provides all the dc current and voltage ranges (except 3000V) and the right-hand knob the ac ranges (except 3000V) and also the resistance ranges. These knobs are electrically interlocked so that dc readings can only be made after the right-hand switch has been set to dc and the left-hand switch to the range selected, ac readings call for the left-hand switch to be set for ac and the right-hand switch at the range required. Resistance tests require the left-hand switch to be set to Ω and the right-hand one to the desired range.

The main ranges are marked on the panel around the switches and arrow heads on the knobs indicate the actual range selected. The 3000V ac and dc ranges are available by means of the two special terminals so marked.

Wide coverage in resistance has been achieved by having a fundamental range as marked on the scale, together with ranges of x 100 and x 10k to supplement it.

In addition a 200 megohm range marked INS is available, using an external dc voltage source (See Page 7).

THE MOVEMENT

The meter movement in the Model 8 Mark 5 is a robust *AVO* centre pole movement type ACP1, fitted with spring mounted jewelled bearings and impregnated coil. The meter has a full scale deflection of 37.5μA. A knife edge pointer enables very fine readings to be taken, whilst the whole movement is balanced and damped so that the pointer quickly comes to rest.

SCALING

The scale plate has three main sets of markings. One is for resistance measurement and is marked 0 to 2000 ohms, the second is for current and voltage (both ac and dc) and is marked 0 to 10 with divisions approximately 1¼mm apart. The third scale calibrated 0 to 30 has 30 divisions and is used for current and voltage measurements.

ACCESSORIES

A range of accessories is available to extend the normal ranges of measurement. These include dc voltage multipliers (up to 30kV dc), dc current shunts (100mV drop) and a current transformer.

ACCESSORIES

AVO part Numbers

TEST LEADS

1 metre (approx. 42in.) with 4mm plug end*	Pt. No. 6220-003/4 (pair)
1.8 metres (approx. 72in.) with hook end	Pt. No. 209130/Q/R (pair)
3 metres (approx. 120in.) with hook end	Pt. No. 20913L/M (pair)

TEST PRODS

Long reach safety clips (red and black)*	Pt. No. 6220-007 (pair)
Standard *AVO* prods (red and black)	Pt. No. 6120-012/3 (pair)

TEST CLIPS

Bulldog clip**	Pt. No. 6120-003 (each)
Insulated clips	Pt. No. 14319 C/D (pair)

CURRENT SHUNTS

30 amp	100mV *AVO* 8 mk5 only	Pt. No. 6220-015
100 Amp		Pt. No. 6220-016
300 Amp		Pt. No. 6220-017
600 Amp		Pt. No. 6220-018

CURRENT TRANSFORMER

AVO Multirange transformer for a.c. currents up to 600A	Pt. No. 45869

VOLTAGE MULTIPLIERS

10/30 kV d.c. box type	Pt. No. 6310-094
30 kV d.c. probe type	Pt. No. 6220-039

CARRYING CASES

Standard leather case	Pt. No. 6320-002
Ever-ready leather case	Pt. No. 6320-010

**These accessories are included with each new AVOMETER* 8

SERVICING YOUR *AVOMETER*

REPLACEMENT OF BATTERIES and FUSE

By turning the ¼ turn fastener on the back of the instrument until the slot is vertical the 15V battery, 1.5V cell, 1A fuse and spare fuse are easily accessible. The batteries should be examined from time to time to ensure that the electrolyte is not leaking and damaging the instrument. The condition will generally occur only when the cells are nearly exhausted.

If it is known that the meter is going to stand unused for several months, it is preferable that these batteries should be removed to prevent possible damage.

When replacing batteries the 1.5V cell and the 15V battery must be inserted with the poles to match the markings of polarity inside the battery box.

Suitable replacement batteries are listed on Page 3.

PLUG-IN TYPE LEADS

…n ordering replacements, the full description and Part numbers should be quoted.

If these part numbers for Test Leads are not quoted, the older type (with hook terminations) will automatically be supplied.

AVO REPAIRS DEPARTMENT

Due to the high operational standards maintained throughout our organisation and the close limits within which we work, breakdowns are comparatively rare and can often be traced to transit damage or careless handling, for which the company cannot be held responsible. If however, your instrument should require servicing or a calibration check, we at *AVO* have the knowledge and equipment to repair your instrument to the highest possible standard. For those customers who feel they have the necessary skill and equipment to carry out their own servicing requirements. spares are available from Avo Limited. To obtain the correct spares item, identify the component required and state its position on the instrument. Where applicable state the circuit reference number. Should you at any time have to return your instrument to the Company for repair, pack it carefully and enclose a note informing our engineers of the faults which you have found. Customers outside the U.K. should contact the *AVO* representative for their territory.

TABLE OF COMPONENTS

R1	19.4Ω	R21	4MΩ
R2	2.16kΩ	R22	6MΩ
R3	77kΩ	R23	8MΩ
R4	180kΩ	R24	40MΩ
R5	1.8MΩ	R25	4MΩ
R6	7kΩ*	R26	20kΩ
R7	500Ω*	R27	Movement swamp
R8	3200Ω*		
R9	0.04Ω (Printed Shunt)	R28	5kΩ*
R10	0.36Ω (Printed Shunt)	R29, R30	889Ω
R11	3.6Ω (Printed Shunt)	RV1	15kΩ
R12	36Ω	RV2	15kΩ
R13	360Ω	RV3	18kΩ
R14	933.3Ω		
R15	6.667kΩ	D1, D2	OA95
R16	58kΩ	C1	220pF
R17	140kΩ	C2	0·015μF
R18	400kΩ	C3	470pF
R19	600kΩ		
R20	800kΩ	B1	1.5V
		B2	15V

* Adjusted on calibration.

CIRCUIT DIAGRAM (later version)

ADJUST ON CALIBRATION
R6 Ω 800R
R7 Ω 500R
R8 Ω 5K
R28 Ω 5K
R27 Ω 1k6

*On earlier versions there was no C4 and C2 value was 0,015µF ±10%.

†On earlier versions RV1, RV2 and RV3 were 18kΩ.

Avo Limited

Dover, Kent, England
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Telex:
96283 (Measurement Dv

Cables:
Measurement Dover

Thorn Measurement Control
and Automation Division.

Part No. 6170-144

Printed in England. B.Pr. 10B

UNIVERSAL AVOMETER

MODEL 8

WORKING INSTRUCTIONS.

IMPORTANT.

GENERAL.

To ensure accurate readings, the meter should be used face upwards.

If necessary, set the pointer to instrument zero by means of the screw on the face of the panel.

The lower pair of terminals should be used for all ranges on the switch knobs, the left-hand terminal being common for the 2500 V. ranges, also. When in doubt, always use the highest range and work downwards, there being no necessity to disconnect the supply.

Never switch off current or voltage by rotating either switch to a blank position.

The polarity shown at the terminals is correct for normal use, but a movement reversing switch marked "REV. M.C." is provided to facilitate certain tests.

The automatic overload cut-out, if tripped, interrupts the main circuit and except in cases of abnormal overload, it provides complete immunity from damage. If it operates, disconnect the leads from supply, reset the cut-out with the meter horizontal, and clear the fault before reconnecting the leads. Since mechanical shock may cause it to trip, handle the meter carefully.

If the meter is used on circuits in excess of 2500 V., it should be kept at the earthy end of the circuit or alternative precautions taken. The instrument itself has been tested at 6000 V., A.C., but special care should always be taken when testing high voltage circuits. Ensure that the leads are maintained in good condition.

The resistance of the leads is approximately 0·02 ohms per pair.

A copper oxide rectifier is incorporated for A.C. measurements, the calibration being correct for a sinusoidal input or for one of equivalent form factor (1·11).

The decibel scale may be used with any A.C. current or voltage range.

When comparing readings on different ranges, add 8 Dbs. to pointer indication for each increase of $2\frac{1}{2}$ times in the current or voltage range, alternatively 12 Dbs. for each increase of 4 times in the range.

D.C. CURRENT & VOLTAGE.

Set right-hand switch at "D.C." position, and left-hand switch at range required. For 2500 V. set range switch to 1000 V., but connect negative lead to appropriate 2500 V. terminal.

All D.C. voltage ranges are 20,000 ohms per volt. (50 μA. for full scale deflection).

On D.C. current ranges, a potential drop of approximately 0·5 V. occurs at the terminals at full load except for the 50 μA. range, which absorbs 125 mV.

A.C. CURRENT & VOLTAGE.

Set left-hand switch at "A.C." position and right-hand switch at range required. For 2500 V. set range switch to 1000 V., but connect negative lead to appropriate 2500 V. terminal.

Voltage ranges from 100 V. upwards are 1000 ohms per volt (1 mA. for full scale deflection). The 25 V., 10 V., and 2·5 V. ranges consume 4, 10 and 40 mA. respectively.

A.C. current ranges require approximately 0·2 V. at terminals for full scale deflection.

RESISTANCE.

Before testing, the pointer should be adjusted to zero in the following sequence:

(1) Set left-hand switch at "RESISTANCE."
(2) Join leads together.
(3) On the "Ω" range, adjust to zero by means of the knob marked "ZERO Ω."
(4) On the "Ω ÷ 100" range, adjust to zero by means of the knob marked "ZERO Ω ÷ 100".
(5) On the "Ω X 100" range, adjust to zero by means of the knob marked "ZERO Ω X 100".

To test a resistance, set the right-hand switch at the range required, the leads being connected across the unknown component. Resistance is read directly on the "Ω" range, but indications should be divided or multiplied by 100 on the other two ranges.

BATTERY REPLACEMENT.

When it is impossible to obtain satisfactory zero setting, the $1\frac{1}{2}$ V. cell should be replaced immediately in the case of the two lower ranges, and the 15 V. battery in the case of the high range.

EXTENSION OF RESISTANCE RANGES.

Set the switch at "INS" and apply a D.C. voltage between 130 V. and 160 V. Adjust pointer to zero by means of knob marked "ZERO Ω X 100". To test, connect unknown in series and multiply pointer indication by 1000.

This 200 megohm range is available also by means of the "Model 8 Resistance Range Extension Unit." This device which is complete with batteries can be used for tests down to 0·025 Ω in conjunction with meter switch when set to "L.R."

Instructions for use are attached to the Unit.

CURRENT & VOLTAGE ACCESSORIES.

D.C. Multiplier for 10 KV. (at 20,000 ohms per volt.)
A.C. Transformers for 50 A, 100 A, 200 A, and 400 A.
} Available from the Company

AVO LTD., AVOCET HOUSE, 92/96, VAUXHALL BRIDGE ROAD,
LONDON, S.W.1.