Model 8 mk6
AVOMETER

SAFETY IN THE USE OF ELECTRICAL EQUIPMENT

It should be understood that any use of electricity inherently involves some degree of safety hazard.

Whilst every effort is made by responsible manufacturers to reduce the hazard, it still rests with the user to play his part in ensuring his own safety.

The best way to achieve this is:-

Understand the equipment you are proposing to use and its ratings.

Understand the application to which the equipment is to be put.

Ensure that all reasonable safety procedures are followed.

Take no chances, nor short cuts, in safety procedures

See also the notes for this particular instrument in the paragraph headed 'WARNING' on page 10, also the 'PRECAUTION NOTES' and the paragraph on 'MEASUREMENT IN HIGH FAULT ENERGY SITUATIONS' on pages 10 and 12.

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TRANSIT POSITION FOR SWITCHES

During transit and when not in use the left-hand switch should be set to 'off' and the right-hand switch should be set to 'DC ⎓'.

GENERAL DESCRIPTION

DESIGN AND CONSTRUCTION

The Model 8mk6 instrument comprises a moulded front panel on which are mounted the whole of the switching apparatus, the movement and other components. 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.

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

RANGE CONTROLS

The left-hand switch provides all the d.c. current and voltage ranges and the right-hand switch the a.c. current and voltage ranges and also the resistance ranges. These switches are electrically interlocked so that readings can only be made after a.c. or d.c. measurement and range has been selected. Resistance tests require the left-hand switch to be set to 'Ω' and the right-hand one to the desired range.

The ranges are marked on the front panel and arrow heads indicate the actual range selected. The current ranges are indicated by a red arc and the voltage ranges by a grey arc. Resistance ranges have a black arc. 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 10 k' to supplement it. Each resistance range has its own zero adjustment control.

In addition a 200 megohm range, marked 'ins' is available, using an external d.c. voltage source (see page 14).

THE MOVEMENT

The meter movement in the Model 8mk6 is a robust AVO centre pole movement type ACP1, fitted with spring mounted jewelled bearings. The meter has a full scale deflection of 37, 5 μA. 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 plate scale has three calibrated scales. One is for resistance measurement and is marked 0 to 2000 ohms, the second is for current and voltage (both a.c. and d.c.) and is marked 0 to 10 with 100 divisions whilst the third scale calibrated 0 to 3 has 60 divisions and is used for a.c. and d.c. current and voltage measurements.

CUT-OUT

The sensitive cut-out, with very positive latching action is triggered by the meter movement when overloaded, i.e. when the pointer deflects rapidly to

beyond the full scale position. The cut-out is reset by a push-button on the front of the meter.

The 'off' position on the left-hand switch selects heavy damping of the meter movement for transit purposes.

METER REVERSAL

If a d.c. quantity is measured with a polarity in the opposite sense to that assumed by the connection of the red and black test leads, the meter pointer will try to deflect to the left. Operation of the 'Rev MC' self-latching push-button enables a correct reading on the scale to be made by reversing the direction of the meter deflection.

BATTERY AND FUSE COMPARTMENT

A special compartment to contain the batteries (to supply power for resistance measurements) and fuse is moulded into the rear of the case, and has a lockable cover.

RANGE EXTENSION

To enhance the use and measuring capabilities of the instrument, many accessories are available, (see page 8).

The Model 8mk6 is a general purpose, multi-range, portable meter for measurement of voltage, current and resistance. The 20 000 Ω/V sensitivity matches the data given in most service manuals for electronic equipment.

The instrument is suitable for general fault finding work, installation and commissioning work and for use in the laboratory, in both the electrical and electronic fields.

SPECIFICATION

Ranges	d.c. voltage	100 mV* 3 V 10 V 30 V 100 V 300 V 600 V 1000 V
	a.c. voltage	3 V 10 V 30 V 100 V 300 V 600 V 1000 V
	d.c. current	50 μA 300 μA 1 mA 10 mA 100 mA 1 A 10 A
	a.c. current	10 mA 100 mA 1 A 10 A
	resistance	0-2 kΩ 0-200 kΩ 0-20 MΩ
	decibels	—10 dB to +55 dB using a.c. voltage scale
	insulation resistance	up to 200 MΩ using ohms scale and external 150 V d.c. supply
		*Select 50 μA d.c. range
Accuracy at 20 °C	d.c.	± 1% of full scale deflection
	a.c.	± 2% of full scale deflection at 50 Hz
	resistance	± 5% of reading at centre scale
Sensitivity	d.c.	20 000 Ω/volt all ranges
	a.c.	100 Ω/volt-3 volt range
		1000 Ω/volt-10 volt range
		2000 Ω/volt-30 volt range and upwards
Voltage Drop at Terminals	d.c.	from 100 mV at 50 μA to 750 mV at 10 A
	a.c.	less than 450 mV at 10 A
Frequency Response		For voltage ranges from 10 V to 300 V, the change in reading due to a change in frequency is not greater than ± 3% over the range 15 Hz to 15 kHz. This is in addition to the accuracy figure specified for 50 Hz.
Response Time		Typically 1 second to full scale
Magnetic Field Effect		Variation due to external magnetic fields is within the limits of BS89 1970
Lead Resistance		0,01 Ω per lead (approx.) for standard AVO test leads.

Temperature Range	operation storage	— 5 °C to + 35 °C — 40 °C to + 50 °C
Temperature Effect		Variation due to temperature change, not greater than 0,15% per degree C
Flash Test		7 kV a.c. r.m.s.
Overload Protection		High speed electro-mechanical cut-out with fuse on the two lower resistance ranges
Fuse		1 A ceramic cartridge 32 x 6 mm
Batteries		one 1,5 V cell IEC R20 type (e.g. Ever-Ready type R20B – was SP2) one 15 V battery IEC 10F15 (e.g. Ever-Ready type B154 or BLR 154) using adaptor part no. 5210-064 supplied, or IEC 10F20 (e.g. Ever-Ready type B121) without adaptor.
Dimensions		192 x 167 x 115 mm (7 9/16 x 6 9/16 x 4½ in) (excluding handles and lugs)
Weight		2,2 kg (4¾ lb) approximately with batteries and leads.

ACCESSORIES

SUPPLIED WITH THE INSTRUMENT

	Part no.
one 1,2 m (3 ft 11 in) long plug-in test lead, black	6220-003
one 1,2 m (3 ft 11 in) long plug-in test lead, red	6220-004
a pair of long reach safety clips, (one red, one black)	6220-007
a pair of standard bulldog clips	6120-003
one 1,5 V battery (Ever-Ready R20B - was SP2)	25511-013
one 15 V battery (Ever-Ready B154 or BLR 154)	25511-182
obe battery adaptor	5210-064
spare fuse 1 A ceramic cartridge 32 x 6 mm (pack of five)	6120-299
operating instruction book	6171-046

AVAILABLE AS AN OPTIONAL EXTRA

	Part no.
1,8 m (6 ft) hook-ended test lead, black	6220-090
1,8 m (6 ft) hook-ended test lead, red	6220-091
3,05 m (10 ft) hook-ended test lead, black	6220-092
3,05 m (10 ft) hook-ended test lead, red	6220-093
1,2 m (3 ft 11 in) test lead set, hook-ended, including prods and clips	6120-452
1,2 m (3 ft 11 in) test lead set, side entry 4 mm plug, including prods and clips	6120-453
1,37 m (4 ft 6 in) test lead, 4 mm plug and fused prod (440 V a.c. max. 500 mA fuse), black	6120-107
1,37 m (4 ft 6 in) test lead, 4 mm plug and fused prod (440 V a.c. max. 500 mA fuse), red	6120-108
light-weight test lead set, (recommended 50 V max. a.c./d.c., max. current 7 A a.c./d.c.)	6380-015
light-weight safety test lead set including retractable prod	6110-243
standard prod, red	6120-012
standard prod, black	6120-013
standard leather case	6320-002
ever-ready leather case	6320-052
ever-ready synthetic case	6320-060
voltage converter VC1-85 (replaces the 15 V battery)	6210-072

3020 high voltage probe 30 kV d.c. max.	6220-039
30 A d.c. shunt	6310-586
100 A d.c. shunt	6310-595
300 A d.c. shunt	6310-591
600 A d.c. shunt	6310-589
1000 A d.c. shunt (1 minute max. time limit)	6310-592
multi-range, 6 ratio a.c. current transformer, max. 600 A	6330-259
100 A/1000 A a.c./d.c. current clamp MCC1	6110-246
resistance range extension unit 0-5 Ω and 0-200 MΩ	6320-098
multimeter temperature probes:-	
with rechargeable battery (complete with charger)	
MTP1 immersion type	6110-202
MTP2 surface type	6210-109
with replaceable battery	
MTP3 immersion type	6110-248
MTP4 surface type	6110-247

WARNING

1. Ensure that when measuring voltages the instrument is not switched to any of the current or resistance ranges.
2. Use extreme care when measuring voltages above 50 V.
3. Avoid connecting the test leads to a 'live' circuit whenever possible.
4. When making current measurements ensure that the circuit is not 'live' before opening it in order to connect the test leads.
5. Before making resistance measurements ensure that the circuit is completely de-energized.
6. Do not leave the instrument exposed to direct heat from the sun for long periods. Instruments used in dusty atmospheres should be stripped and cleaned periodically.
7. Ensure that the test leads are in good condition with no damage to the insulation.
8. Do not switch off by rotating either of the range selection knobs to a blank position.
9. 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 peak wave form and although these peaks are only of a few milli-seconds duration, they may, never-the-less, damage the instrument diodes.

GENERAL PRECAUTIONARY NOTES

Establishing that a circuit is de-energized before making connection for current and resistance may be achieved by (i) checking that the appropriate switches are off and (ii) testing, with the instrument set to a voltage range, to see that there is no potential present.

When measuring current or voltage, ensure that the instrument is set to either 'AC ~' or 'DC ⎓' as appropriate, and switch to a suitable range before making connections to the circuit under test. When in doubt always switch to the highest range and work downwards, there is no necessity to disconnect the leads as the switch position is changed. Do not, however, switch off by turning to a blank position.

The instrument is flash tested at 7 kV a.c., but if it is used, with accessories, on circuits operating at voltages in excess of 1 kV, it should be kept at the low potential end of the circuit, (near earth potential), or other suitable safe-guards must be applied.

The instrument is intended for use horizontally. The meter pointer should rest over the zero position on the top scale, when there is nothing connected to the terminals. If it does not adjustment may be made using the slotted screw head on the front panel.

NON SINUSOIDAL WAVEFORMS

In as much as rectifier moving coil instruments give readings on a.c. 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, near square wave-shapes producing high readings and peaky ones, low readings.

POLARITY REVERSE CONTROL

If d.c. voltage is required both positive and negative with respect to a reference point, or the direction of current flow is reversed, in order to simplify the matter of lead alteration, a polarity reverse push-button marked 'Rev MC' is provided. It should be noted that the polarity indicated at the terminals is for normal use and does not apply when the 'Rev MC' button is in the raised position. The button is a self latching type and must be pressed to release for reversal of meter movement direction.

OVERLOAD PROTECTION

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, and imparts to the user a feeling of confidence.

If an overload is applied to the meter, either forward or in reverse, the 'Cut-Out' button springs up from its normal position in the front panel, to the raised position, thus breaking the main circuit and the red portion of the button will now be extended. This button has only to be depressed its full amount to render the instrument ready for use again. It is important to note that the cut-out should never be reset when the instrument is connected to an external circuit, and the fault which has caused the overload should be rectified before the meter is reconnected.

Although the overload mechanism gives almost complete protection to the meter, it cannot be guaranteed to completely fulfill 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. Additional protection is provided on

resistance ranges by a 1 A fuse connected in the circuit on the 'Ω x 1' and 'Ω x 100' resistance ranges.

MEASUREMENT IN HIGH FAULT ENERGY SITUATIONS

Particular care must be taken with all testing equipment when making measurements in high fault energy situations, e.g. main power distribution systems.

Always ensure the correct range is selected before connecting the instrument to the circuit under test.

Fused test leads, fitted with High Rupture Capacity fuses, can be used to increase user safety in the event of incorrect range selection. It is most important, when fused leads are used, that the continuity of the test leads be checked before every measurement. This may be performed as follows: select the lowest resistance range; connect the test leads to the instrument and short together the test prods or clips; check that the resistance is low.

Suitable test leads with fused prods can be obtained as optional accessories, part nos. 6120-107 and 6120-108.

VOLTAGE MEASUREMENT

When measuring voltage, it is necessary to set the appropriate switch to 'AC ∿' or 'DC ⎓' as required and to select the required range (on the other switch). Connect the test leads to the circuit to be measured.

If the value of the voltage is unknown, set the instrument to its highest range, connect the test leads and decrease the range step by step until the most suitable one has been found. The readings are taken from the 0-3 or 0-10 scale and multiplied by the appropriate factor i.e. 10, 100 or 1000.

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

On d.c. ranges, the meter consumes only 50 microamps at full scale deflection corresponding to 20 000 Ω/V. In the case of the a.c. ranges above 10 V, full scale deflection is obtained with a consumption of 0,5 mA (2000 Ω/V). The 10 V a.c. range is 1000 Ω/V and therefore consumes 1 mA at full scale deflection. The 3 V a.c. range consumes 10 mA at full scale deflection (100 Ω/V.) The meter maintains a high degree of accuracy for audio frequency tests up to 15 kHz on ranges up to 300 V a.c.

All current consuming voltmeters, however sensitive, draw current to varying degrees from the circuit under test, thus causing the voltage to fall at the point of measurement. Owing to the high sensitivity of the

Model 8mk6 d.c. ranges, this effect is unlikely to be of importance except in a very few instances. It might affect the measurement of e.h.t. voltage on a television set or the tapping on a potential 'divider', where the resistances are comparable with the resistance of the instrument on the range in use. It is generally possible to use an instrument on a higher range than absolutely necessary where the higher instrument resistance causes less disturbance. 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 value resistor it is sometimes preferable to insert the instrument in series with it and to measure the current flowing. The reading in milliamps, multiplied by the value of the resistance in thousands of ohms, will give the developed voltage.

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

CURRENT MEASUREMENT

To measure current the instrument should be switched to 'AC ∿' or 'DC ⎓' as appropriate and a suitable a.c. or d.c. range set by the other switch. Connect the instrument in series with the circuit under test, do this only when that circuit is switched off.

The voltage drop at the meter terminals is approx. 750 mV on the 10 A d.c. range at full load reducing to 100 mV on the 50 μA range at full load. In the case of a.c. it is less than 450 mV on all ranges. Standard meter leads have a resistance of 0,02 ohm per pair.

RESISTANCE MEASUREMENT

There are three self-contained ranges covering resistances from 1 Ω to 20 MΩ. A resistance range extension unit is available as an optional extra. (part no. 6320-098).

On resistance ranges the meter must have, in addition to the normal instrument mechanical zero, a resistance zero corresponding to the full scale deflection of the meter. Before carrying out tests of resistance, a check should be made to ensure that the instrument actually indicates zero ohms irrespective of the condition of the battery (within the limits of adjustment described later).

The accuracy should be within ± 5% of the reading about centre scale, increasing up to about ± 10% of the reading around deflections corresponding to 10% and 90% of full scale.

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

On the three ranges which utilize the internal source of voltage, a positive potential appears at the black common (negative) terminal of the instrument when

set for resistance tests. 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 black (negative) lead from the instrument should be connected to the positive terminal of the capacitor and the ohms 'x 10 k' range employed.

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

1. Set the left hand switch at Ω.
2. Connect the test leads to the instrument and join them 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 10 k' range adjust zero by means of the knob marked 'Ω x 10 k'

To measure 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 10 k' ranges respectively.

If on joining the leads together it is impossible to obtain a zero ohms setting or, if the pointer will not remain stationary but falls steadily, the internal battery or cell concerned should be replaced. It is important that an exhausted battery should not be left in the instrument, since it might cause damage by leaking electrolyte. If it is impossible to obtain readings on the 'Ω x 1' and 'Ω x 100' ranges, the 1 A fuse located in the battery compartment should be checked.

NOTE: A 15 V battery may age in such a manner that although it indicates a potential of 15 V, its internal resistance has increased so much that some loss of accuracy can occur on the high resistance range ('Ω x 10 k'). If errors are suspected on the high resistance range, remove the battery and check its short circuit current on the 100 mA d.c. range. If the reading is below 15 mA it should be discarded. Do not short circuit for more than two seconds.

INSULATION RESISTANCE MEASUREMENT

High resistance measurements may be made using an external d.c. voltage of approximately 150 V. The left-hand switch should be set at 'Ω' with the right hand switch at 'ins', then the instrument test leads

should be connected to the d.c. voltage source. The pointer should be brought to zero on the ohms scale by means of the adjuster knob marked 'Ω x 10 k'.

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. Resistance up to 200 megohms can therefore be read on this range.

DECIBEL MEASUREMENT

The graph on page 16 can be used to determine the dB values corresponding to r.m.s. voltage values across a 600 ohm resistaive load. A dB value is defined as the number of decibels above or below a reference level of 1 mW in 600 ohms at 1 kHz. Zero dB, therefore, would indicate a power level of 1 mW; 10 dB, 10 mW; 20 dB, 100 mW etc. 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, 0,775 V r.m.s. indicates 0 dB and 7,75 V r.m.s. indicates 20 dB. 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 8mk6. The decibel and ear response curves have their closest correlation at 1 kHz.

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.

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

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

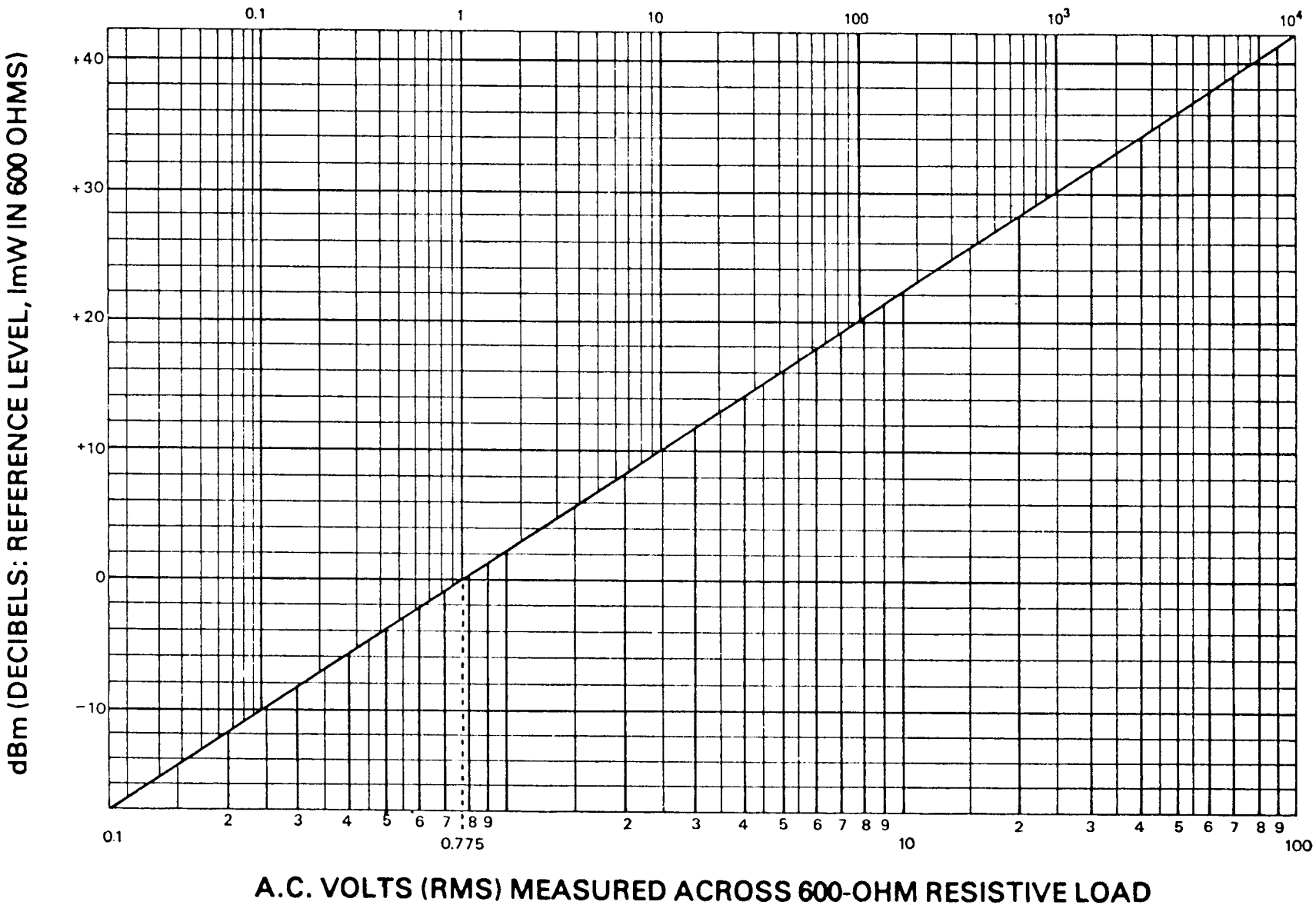
FITTING AND REPLACEMENT OF BATTERIES AND FUSE

The compartment containing the batteries and fuse is in the rear of the case above the instruction plate. The compartment cover is removed by turning the ¼ turn fastner at the top until the slot is vertical (i.e. at the 'O' position) and lifting off. The 15 V battery, 1,5 V cell, 1 A ceramic fuse and spare fuse all push into easily accessible clips.

When fitting the 15 V battery and 1,5 V cell they must be inserted the right way round to ensure the correct polarity. The '+' and '—' are marked on the case moulding. (Refer to the specification page 7 for the correct type of replacement for battery, cell and fuse).

The battery and cell should be examined from time to time to ensure that the electrolyte is not leaking. If the instrument is to remain unused for a long period of time, batteries should be removed and stored separately.

Decibel Conversion Graph



USING RANGE EXTENSION ACCESSORIES

HIGH VOLTAGE MEASUREMENT

A 30 kV Probe (model 3020 part no. 6220-039) is available for use in series with the meter set to its 1000 V d.c. range, readings being made on the 0-3 scale by multiplying the result by 10 000 V or on the 0-10 scale by multiplying the result by 3000 V. It is most important to ensure that the instrument is kept in the earthy end of the circuit and the probe connected to either the red (positive) or black (common negative) terminal, whichever is to be at the higher potential.

With this method of connection, to get forward pointer indication with the instrument earthy, is essential. Do not use the moving coil reverse button when measuring voltages above 1 kV.

A special lead is provided with the probe for connection to the high potential point.

Caution: It is recommended that neither the instrument or the test leads are handled whilst high voltage tests are in progress, and that the probe itself is held between the shields, by one hand only.

HEAVY CURRENT MEASUREMENT

(a) a.c.
Currents between 10 A and 600 A may be measured by using the special multi-range Current Transformer (part no. 6330-259) connected to the instrument terminals with the appropriate range selected. Full instructions for its use are supplied with the transformer.

(b) d.c.
Currents between 10 A and 1000 A may be measured by use of the appropriate shunt accessory, (for part nos. see Accessories page 8).

When used with the Model 8mk6, the shunts produce a voltage drop of 100 mV while passing current at their maximum rating.

The shunt should be connected with its two main terminals in series with the circuit to be measured. The instrument set to its 50 μA (100 mV) d.c. position should then be connected to the two small studs on the shunt end blocks. The instrument when so set, consumes only 50 μA 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.

(c) Current Clamp MCC1
Currents up to 1000 A a.c. or d.c. may be measured using the multimeter current clamp

MCC1, (part no. 6110-246). The advantage of this accessory is that because it is operated like a clamp meter the circuit in which the current has to be measured is not broken, as is the case for conventional methods of measurement.

The current clamp uses the Hall effect principle and there is a choice of either a 100 A or 1000 A range, sensitivity being ± 1 V at 100 A or 100 A as appropriate. The red and black connectors on the clamp lead plug into the corresponding terminals on the Model 8mk6 which itself is set to the 3 V a.c. or d.c. range.

Full instructions for its use are supplied with the current clamp. It should be noted that only maximum deflection of ⅓ of f.s.d. will be obtained because the 3 V range is used. Readings on the 0-3 scale are multiplied by 100 A or 1000 A in accordance with the range selected on the clamp.

RESISTANCE RANGE EXTENSION UNIT

A unit is available (part no. 6320-098) to add two further resistance measuring ranges to the Model 8mk6, namely 0-5 Ω and 0-200 MΩ.

The instrument set to the 50 μA range, is connected to the terminals marked 'METER' on the unit and the resistance to be measured is connected to the terminals marked 'RESISTANCE'. Press the desired resistance range button, then press the F.S.D. button and adjust the F.S.D. control on the unit to obtain a full scale reading on the meter. Repeat this process for each resistance measurement. Release the F.S.D. button and the meter reading will correspond to the resistance value being measured. For the 0-5 Ω range, take the reading from the 0-10 Ω linear scale and divide by 2. For the high resistance range read from the 'Ω' scale and multiply by 100 000. Always press the 'off' button at the end of a test to conserve battery power. Full instructions are given on the plate at the rear of the resistance unit.

TEMPERATURE MEASUREMENT

The Model 8mk6 may be adapted to measure temperature by using one of a range of multimeter temperature probes available (see Accessories page 9).

The right hand switch on the instrument is set to the 'DC ⎓' position and the left hand switch to the appropriate range for the probe being used. The MTP1 and MTP2 have a sensitivity of 1 μA/°C and the MTP3 and MTP4 have a sensitivity of 1 mV/°C. Therefore, for the MTP1 and MTP2 set the switch to the 50 μA or 300 μA position (or 1 mA if necessary) and for the MTP3 and MTP4 set it to the 100 mV (50 μA) or 3 V position (on this latter range deflection will be limited by the max. temperature of the probe).

Connect the probe leads to the red and black instrument terminals matching the colours to give the correct polarity. For negative temperatures the 'Rev MC' button may be used to give an 'on scale' reading.

To obtain a temperature measurement, apply the probe tip to the item under test and press the push-button on the probe handle. The readings for MTP1 and MTP2 probes are taken on the 0-10 scale for a 50 μA switch setting and the result multiplied by 5 °C, or on the 0-3 Ω scale for a 300 μA switch setting and the result multiplied by 100 °C. The readings for the MTP3 and MTP4 probes are taken on the 0-10 scale for a 100 mV switch setting and the result multiplied by 10 °C, or on the 0-3 scale for a 3 V switch setting and the result multiplied by 3000 °C.

If the light emitting diode on the probe handle illuminates during measurement the probe battery needs to be recharged or replaced. An instruction sheet is supplied with each temperature probe.

ATTENTION

1. S'assurer, avant toute mesure de tension, que l'appareil n'est pas commuté sur une gamme d'intensité ou de résistance.
2. Etre très prudent lors de la mesure de tension supérieure à 50 V.
3. Eviter, dans la mesure du possible, de raccorder les cordons d'essai à un circuit sous tension.
4. En cas de mesure d'intensité, s'assurer avant interruption du circuit, pour raccordement des cordons d'essai, que celui-ci est hors tension.
5. Avant d'effectuer les mesures de résistance, s'assurer que le circuit est absolument hors tension.
6. Eviter une exposition prolongée de l'appareil à la chaleur solaire. Par ailleurs, ouvrir et nettoyer périodiquement tous appareils utilisés dans des zones poussiéreuses.
7. S'assurer du bon état des cordons, et que leur matière isolante n'a pas été endommagée.
8. Ne pas arrêter l'appareil sur une position non repérée des commutateurs de sélection de gamme.
9. Prendre des précautions lorsque l'on utilise l'appareil à la vérification des redresseurs utilisés en télévision, ou aux essais sur des équipements intégrant des condensateurs de forte capacité. Les forts courants crête transitoires pouvant apparaitre risquent d'endommager les diodes de l'appareil.

PRECAUTIONS D'EMPLOI GENERALES

1. Position des commutateurs pour le transport de l'appareil
   - Commutateur de gauche sur "OFF" (Arrêt)
   - Commutateur de droite sur "DC ⎓"
2. Avant d'effectuer les liaisons pour mesures de courant ou résistance, s'assurer que le circuit en essai est hors tension à l'aide de l'appareil réglé sur une gamme de tension.
3. S'assurer que les fonctions et gammes correctes ont été choisies. En cas de doute sur la gamme à utiliser, commencer par la plus élevée. De toute facon, ne pas placer les commutateurs sur une position non repérée.
4. Quand l'appareil est utilisé avec ses accessoires sur des circuits présentant des tensions supérieures à 1 kV, relier l'appareil au point de potentiel bas (potentiel terre) du circuit.
5. Utiliser l'appareil en position horizontale. Avant de brancher ses cordons, ajuster le zéro mécanique sur l'échelle supérieure, par la vis de réglage, à tête fendue, placée en dessous du galvanomètre.

FORMES D'ONDES NON SINUSOIDALES

L'appareil indique la valeur efficace des signaux alternatifs. Bien que la mesure soit moyenne, le facteur de forme 1,11 a été inclus dans l'étalonnage simulant une forme d'onde sinusoidale. Des

distorsions importantes de formes d'onde n'affectent pas la précision de facon significative. Des distorsions trop fortes peuvent provoquer quelques erreurs (ex: lectures trop élevées pour ondes carrées, lectures trop faibles pour ondes crête).

INVERSION DE POLARITE

Si l'aiguille se déplace vers la gauche, une lecture sur l'échelle peut toutefois être obtenue en pressant le bouton 'Rev MC' (inversion de polarité) qui se place alors en position haute quand on le relache. En utilisation normale, ce bouton doit être en position bloquée basse.

PROTECTION CONTRE LES SURCHARGES

L'appareil est protégé contre les surcharges (sauf si celles-ci sont trop importantes) par un disjoncteur automatique. Quand une surcharge est appliquée, le disjoncteurse déclenche. Couper alors le circuit et débrancher l'appareil avant de réenclencher le disjoncteur en enfoncant son bouton de commande. Eliminer la cause de la surcharge avant de rebrancher l'appareil.

Les gammes 'Ω x 1' et 'Ω x 100' ont une protection supplémentaire par fusible 1 Amp.

MESURES SUR LES CIRCUITS A DEFAUTS HAUTE ENERGIE

Les mesures sur les circuits risquant de présenter des défauts développant une énergie importante nécessitent un renforcement des précautions d'emploi. Toujours vérifier que la gamme correcte a été choisie avant de relier l'appareil au circuit.

Des cordons d'essai à fusible à haut pouvoir de coupure peuvent être fournis pour augmenter la sécurité dans le cas de choix de gamme incorrecte. Ces cordons doivent être vérifiés avant chaque mesure, sur la gamme résistance, après avoir courtcircuité leurs extrémités. La valeur de résistance lue doit être faible.

MESURE DE TENSION

Placer le commutateur approprié sur 'AC ~' ou 'DC ⎓' suivant le type de tension à mesurer. Choisir la gamme désirée sur l'autre commutateur, et relier les cordons au circuit en essai. Les lectures sont effectuées sur les échelles 0-3 ou 0-10, suivant la gamme choisie, et multipliées par le facteur nécessaire 10, 100 ou 1000.

Pour la mesure de tensions alternatives ou continues élevées (soit au dessus de 800 V.), si la borne négative commune n'est pas mise à la terre, des erreurs de mesures seront introduites si on touche l'appareil pendant un essai.

Quand il est essentiel d'obtenir une indication précise de la tension aux bornes d'une résistance de valeur élevée, il est parfois préférable d'insérer l'appareil en série avec la résistance et de mesurer le courant qui circule. La lecture en milliampères, multipliée par la valeur de la résistance en milliers d'ohms, fournit la tension développée.

MESURE DE COURANT

Placer le commutateur approprié sur 'AC ∿' ou 'DC ⎓' suivant le type de courant à mesurer. Choisir la gamme adéquate sur l'autre commutateur et insérer l'appareil en série dans le circuit en essai, après avoir mis préalablement le circuit hors tension. Les lectures sont effectuées sur les échelles 0-3 ou 0-10 suivant la gamme choisie et multipliées par le facteur approprié, soit 10, 100 ou 1000.

MESURE DE RESISTANCE

Les mesures ne doivent pas être effectuées sur des résistances dans lesquelles circule un courant.

Les trois gammes de résistance ont une source de tension interne (le potentiel positif se trouve sur la borne commune (négatif) noire). Il est à remarquer que la résistance de certains composants varie suivant le sens dans lequel le courant circule, aussi le résultat de la mesure peut changer en fonction du sens dans lequel la tension de mesure est appliquée.

Lors de la mesure de résistance de fuite de condensateurs électrolytiques, le cordon noir (négatif) doit être relié à l'extrémité positive du composant. D'autre part, utiliser la gamme 'Ω x 10 k'.

Avant d'effectuer des mesures de résistance, il faut effectuer un réglage du zéro comme suit:

1. Mettre le commutateur de gauche sur 'Ω'.
2. Relier les cordons à l'appareil et court circuiter leurs autres extrémités.
3. Placer le commutateur de droite sur la gamme choisie et amener l'aiguille au zéro de l'échelle résistance en tournant le bouton marqué 'Ω x 1', 'Ω x 100' ou 'Ω x 10 k' approprié.

   S'il n'est pas possible de régler le zéro, remplacer la pile. Pour effectuer une mesure, placer les cordons aux bornes de la résistance, et effectuer une lecture sur l'échelle résistance, multiplier ensuite cette valeur par le coefficient approprié 1, 100 ou 10 000. Si l'on ne peut faire de mesure sur les gammes 'Ω x 1' et 'Ω x 100', vérifier le fusible 1 Amp.

MESURE DE RESISTANCE D'ISOLEMENT

Des mesures de résistance de valeur élevée peuvant être effectuées en utilisant une source de tension externe continue d'environ 150 V. Le commutateur de gauche est placé sur la position 'Ω' et le commutateur de droite sur 'INS' (Isolement).

Les cordons de mesure sont alors reliés à la source de tension. L'aiguille doit être amenée au zéro de l'échelle au moyen du bouton marqué 'Ω x 10 k'.

Pour faire une mesure, placer la résistance en série avec le multimètre, la valeur lue devra être multipliée par 100 000. On peut ainsi, sur cette gamme, mesurer des résistances jusqu'à 200 MΩ.

MESURE DE DECIBELS

Le graphique de la page 16 est utilisé pour déterminer les valeurs en dB correspondant aux valeurs de tension efficace aux bornes d'une charge résistive de 600 Ω. Les dB étant définis par rapport à une charge de 600 Ω, les niveaux de puissance correspondent aux niveaux de tension. Les décibels peuvent être mesurés en terme de tension efficace aux bornes d'une charge résistive de 600 Ω. Les niveaux de puissance peuvent être lus en haut du graphique. Si la tension est mesurée aux bornes d'une résistance différente de 600 Ω, un facteur de correction, obtenu par la formule cidessous, doit être ajouté algébriquement à la valeur en dB obtenue sur la graphe:

$$\text{Facteur de correction} = 10 \log_{10} \frac{600}{R}$$

où R est la charge résistive en Ohms.

REMPLACEMENT DES PILES ET FUSIBLE

Le compartiment de logement piles-fusible est situé à l'arrière de l'appareil, juste au-dessus de la plaquette mode d'emploi. Retirer le couvercle en tournant son système d'attache d'un quart de tour jusqu'à ce que sa fente soit verticale.

Lors de la mise en place des piles, bien respecter les polarités gravées dans le boitier.

Les piles doivent être examinées de temps en temps pour vérifier que l'electrolyte ne fuit pas. Si l'appareil ne doit pas être utilisé pendant un temps prolongé, les piles doivent être retirées et rangées séparément.

BETRIEBSANWEISUNG

ACHTUNG!

1. Bei der Messung von Spannung darauf achten, daß das Gerät nicht auf den Strom-oder Widerstandsbereich geschaltet ist.
2. Bei der Messung von Spannungen über 50 V ist größte sorgfalt geboten.
3. Nach Möglichkeit das Anlegen der Testkabel an unter Spannung stehende Schaltungen vermeiden.
4. Bei der Durchführung von Strommessungen sicherstellen, daß die Schaltung nicht unter Spannung steht, wenn sie zum Anlegen der Testkabel geöffnet wird.
5. Vor der Durchführung von Widerstandsmessungen sicherstellen, daß die Schaltung völlig stromlos ist.
6. Das Gerät niemals längere Zeit direkter Wärme durch Sonneneinstrahlung aussetzen. In staubiger Umgebung eingesetzte Geräte sind regelmäßig zu zerlegen und zu reinigen.
7. Die Testkabel müssen in gutem Zustand sein; die Isolierung darf nicht beschädigt sein.
8. Das Gerät nicht durch Drehen eines Bereichswählers auf eine Blindstellung schalten.
9. Vorsicht beim Verwenden des Gerätes für Servicearbeiten an Fernsehgleichrichtern und Geräten mit großen Kondensatoren! Bei möglichen Entaldungen können die kurzzeitigen hohen Stromspitzen die Dioden des Meßgeräts beschädigen.

ALLGEMEINE VORSICHTSMASSNAHMEN

1. Transportstellung der Schalter: Schalter auf der linken Seite auf 'Aus' (off), Schalter auf der rechen Seite auf 'DC ⎓'.
2. Vor dem Herstellen der Anschlüsse für Strom-und Widerstandsmessung prüfen, ob die Schaltung abgeschaltet ist, und sie mit einem auf Spannungsbereich gestellten Gerät testen.
3. Sicherstellen, daß 'AC ∿' oder 'DC ⎓' und der korrekte Bereich wie erforderlich gewählt wurden. Im Zweifelsfalle erst den höchsten Bereich wählen und dann nach Bedarf herunterschalten. Das Gerat jedoch nicht durch Drehen der Bereichswähler auf eine Blindstellung schalten!
4. Bei Verwendung des Geräts an Teilen in Schaltungen von mehr als 1 kV ist das Gerät an dem Ende der Schaltung mit dem niedrigen Potential (Erdpotential) einzusetzen.
5. Das Gerät waagerecht verwenden. Wenn nichts an die Klemmen angeschlossen ist, den Zeiger am mechanischen Nullpunkt (Schlitzschraube) in der Frontplatte auf der oberen Skala in die Nullstellung bringen.

NICHTSINUSFÖRMIGE WELLENFORMEN

Das Gerät zeigt die Effektivwerte von Wechselströmen an; obwohl die tatsächliche Messung einen Mittelwert darstellt, ist der Formfaktor von 1,11 in der Eichung enthalten. Hierbei wird eine

sinusförmige Wellenform angenommen. Eine beträchtliche Wellenformverzerrung kann auftreten, ohne daß die Genauigkeit wesentlich beeinträchtigt wird. Einige Fehler können allerdings infolge schwerer Sinuswellenverzerrung auftreten; so erzeugen z.B Rechteckwellenformen hohe Ablesungen und spitzenhaltige Wellen niedrige Anzeigen.

POLARITÄTSUMKEHR-SCHALTER

Wenn der Meßgerätzeiger nach links ausschlägt, kann man eine Ablesung auf der Skala erhalten, indem man die Taste 'Rev MC' drückt (selbsthaltende Taste). Die Taste geht dann in die angegebene Stellung, bei der die Polarität umgekehrt von den Klemmen ist. Für normalen Gebrauch muß sich die Taste in der unteren Stellung befinden.

ÜBERLASTSCHUTZ

Das Gerät ist durch einen automatischen Ausschalter gegen Überlast geschützt (wenn diese nicht überaus hoch ist. Wenn eine Überlast angelegt wird, springt die 'Ausschalt'-Taste (Cut-Out) aus der Normalstellung und unterbricht so den Schaltkreis. Die Schaltung dann abschalten, das Gerät abtrennen und durch Drücken der 'Asschalt'-Taste (Cut-Out) wieder rückstellen. Vor dem Wiederanschließen des Meßgeräts die Ursache für die Überlast beseitigen.

In den Widerstandsbereichen 'Ω x 1' und 'Ω x 100' ist ein zusätzlicher Schutz durch eine 1-A-Sicherung vorgesehen.

MESSUNGEN BEI HOHEN FEHLERSTRÖMEN

Bei der Durchführung von Messungen bei hohen Fehlerströmen ist sorgfältig vorzugehen. Stets darauf achten, daß vor dem Anschließen des Geräts an den Schaltkreis der richtige Meßbereich gewählt wird!

Für erhöhte Sicherheit im Falle unrichtiger Bereichswahl stehen abgesicherte Testkabel zur Verfügung, die mit Hochleistungssicherungen versehen sind. Vor jeder Messung sind diese Kabel durch Kurzschließen der Enden im Widerstandsbereich zu testen. Der Widerstand muß niedrig sein.

SPANNUNGSMESSUNG

Den entsprechenden Shalter je nach dem zu messenden Spannungstyp auf 'AC ∿' bzw. 'DC ⎓' (d.h. Wechsel-oder Gleichspannung) stellen. Mit dem anderen Schalter den erforderlichen Bereich wählen und die Testkabel an die zu messende Schaltung legen. Die Anzeigen werden – je nach dem gewählten Bereich – von der 0-3- bzw. 0-10-Skala abgelesen und mit dem erforderlichen Faktor, d.h. 10, 100 oder 1000, multipliziert.
Bei der Messung hoher Wechsel-und Gleichspannungen (etwa über 800 V) stellensich

Fehler ein, wenn das Gerät dabei berührt wird. Dies laßt sich vermeiden, indem man die gemeinsame negative Klemme an Erdpotential legt.

Wenn das Ergebnis einer genauen Anzeige der an einem hochohmigen Widerstand entstehenden Spannung wesentlich ist, empfiehlt sich manchmal das Anschließen des Gerätes in Serie mit dem Widerstand und die Messung des Stromflusses. Die Ablesung ist in Milliampere, multipliziert mit dem Wert des Widerstands in Ohm, woraus sich die anstehende Spannung ergibt.

STROMMESSUNG

Den entsprechenden Schalter je nach dem zu messenden Stromtyp auf 'AC ∿' bzw. 'DC ⎓' (d.h. Wechsel- oder Gleichstrom) stellen. Mit dem anderen Schalter den erforderlichen Bereich wählen und das Gerät in Serie an die zu messende Schaltung legen. Dies darf jedoch erst erfolgen, nachdem der zu messende Schaltkreis abgeschaltet ist! Die Werte werden je nach dem gewählten Bereich von der 0-3- bzw. 0-10-Skala abgelesen und mit dem entsprechenden Faktor, d.h. 10, 100 oder 1000 multipliziert.

WIDERSTANDSMESSUNG

Widerstandsprüfungen dürfen neimals an Teilen vorgenommen werden, die bereits Strom führen!

Die drei Widerstandsbereiche arbeiten mit einer internen Spannungsquelle, die ein positives Potential an der schwarzen, gemeinsamen (negativen) Klemme abgibt. Es ist zu beachten, daß der Widerstand bei einigen Bauteilen je nach der Richtung des durchfliesenden Stromes variiert und daß die Ablesungen daher von der Polung der Testspannung abhängen.

Bei der Messung des Leckwiderstands eines Elektrolytkondensators ist das schwarze (negative) Kabel vom Gerät an die positive Klemme des Kondensators anzulegen und der Bereich 'Ω x 10 k' zu wählen.

Vor der Durchführung von Widerstandsprüfungen ist der Zeiger in der folgenden Reihenfolge auf Null des Widerstandsbereichs zu stellen:

1. Den Shalter auf der linken Seite auf 'Ω' stellen.
2. Die Testkabel an das Gerät anschließen und miteinander verbinden.
3. Deb Schalter auf der rachten Seite auf den erforderlichen Bereich einstellen und den Meßgerätezeiger auf der 'Ω'-Skala in die Null-Stellung bringen, indem man jeweils den mit 'Ω x 1', 'Ω x 100' bzw. 'Ω x 10 k' bezeichneten Knopf nach Bedarf einstellt. Sollte es nicht

möglich sein, Null einzustellen, ist die interne Batterie auszuwechseln. Zur Durchführung einer Messung die Testkabel an den Widerstand legen, die Anzeige von der Widerstandsskala ablesen und das Ergebnis mit dem entsprechenden Faktor 1, 100 oder 10 000

multiplizieren. Wenn es unmöglich ist, eine Ablesung in den Bereichen 'Ω x 1' und 'Ω x 100' zu erhalten, ist die 1-A-Sicherung zu prüfen.

MESSUNG DES ISOLATIONSWIDERSTANDS

Hochohmmessungen lassen sich unter Verwendung einer externen Gleichspannung von ca. 150 V ausführen. Der Schalter auf der linken Seite ist auf 'Ω' und der rechte Shalter auf 'ins' zu stellen; dann die Testkabel des Meßgeräts an die Gleichspannungsquelle legen. Den Zeiger mit dem mit 'Ω x 10 k' markierten Einstellknopf auf der Ohm-Skala auf Null stellen.

Zum Testen den unbekannten Widerstand mit dem Meßgerät in Serie schalten. Der auf der Ohm-Skala angezeigte Wert ist dann mit 100 000 zu multiplizieren. Auf diese Weise lassen sich in diesem Bereich Widerstände bis 200 Megaohm messen.

DEZIBEL-MESSUNG

An Hand des Diagramms auf Seite 16 lassen sich die dB-Werte bestimmen, die den Effektivspannungswerten an einer ohmschen Last von 600 Ω entsprechen. Da die dB in bezug auf eine Last von 600 Ω festgelegt sind, entsprechen die Leistungspegel den Spannungspegeln. Die Dezibel können in Form von Effektivspannungen an einer ohmschen Last von 600 Ω gemessen werden. Die Tests können daher unter Verwendung der Wechselspannungsbereiche durchgeführt werden. Die jeweiligen Leistungspegel lassen sich oben auf dem Diagramm ablesen. Wenn die Effektivspannung an einem Widerstand gemessen wird, der nicht 600 Ω hat, ist ein aus der nachstehenden Formel erhaltener Korrekturfaktor dem aus dem Diagramm entnommenen dB-Wert algebraisch zuzurechnen.

$$\text{Korrekturfaktor} = 10 \log_{10} \frac{600}{R}$$

R = Lastwiderstand in Ohm

EINSETZEN UND AUSWECHSELN VON BATTERIEN UND SICHERUNG

Das Fach mit den Batterien und der Sicherung befindet auf der Rückseite des Gerätes oberhalb des Anweisungsschildes. Zum Abnehmen des Deckels die Befestigungsvorrichtung um eine Viertelumdrehung drehen, bis der Schlitz waagerecht ist. Der Deckel kann nun abgehoben werden.

Beim Einsetzen der Batterien darauf achten, daß sie entsprechend der Polaritätsmarkierungen am Gehäuse richtig eingelegt werden.

Die Batterien Sind gelegentlich auf Elektrolytlecks zu prüfen, Soll das Gerät über längere Zeit nicht verwendet werden, sind die Batterien herauszunehmen und getrennt aufzubewähren.

INSTRUCCIONES DE USO

ADVERTENCIAS

1. Cuando se miden voltajes, asegurar que el instrumento no esté conectado a las gamas de resistencia o corriente.
2. Hay que adoptar una precaución extrema cuando se miden tensiones por encima de los 50 V.
3. Siempre que sea posible debe evitarse la conexión de los conductores de prueba en circuitos energizados.
4. Cuando se hacen mediciones de corriente, asegurar que el circuito no esté energizado antes de abrirlo con el fin de conectar los conductores de prueba.
5. Antes de efectuar mediciones de resistencia, asegurar que el circuito esté completamente desenergizado.
6. No dejar el instrumento expuesto al calor directo del sol durante largos períodos de tiempo. Los instrumentos usados en condiciones de trabajo polvorientas deben ser desarmados y limpiados periódicamente.
7. Cerciorarse de que los conductores de prueba estén en buen estado y que no esté dañado su aislamiento.
8. No efectuar la desconexión girando cualquiera de los botones de selección de gama hasta una posición en blanco.
9. Ha de tenerse gran cuidado cuando se usa el instrumento para poner en servicio rectificadores de televisión y aparatos que utilicen grandes capacitores. Las potentes corrientes instantáneas máximas que pueden surgir podrían causar desperfectos en los diodes del instrumento.

NOTAS DE PRECAUCION GENERAL

1. Posiciones de tránsito para los conmutadores: el de la izquierda en "off" (desconectado), y el de la derecha en "DC ⎓" (c.c.).
2. Antes de efectuar las conexiones para realizar las mediciones de corriente y resistencia, comprobar que el circuito esté desconectado y probarlo con el instrumento regulado en una gama de voltaje.
3. Cerciorarse que estén seleccionados según convenga "AC ∿" (c.a.) o "DC ⎓" (c.c.), así como la gama correcta. Si se tienen dudas, seleccionar la gama más alta y conmutar descendiendo según convenga. No efectuar la desconexión seleccionando hasta una posición en blanco.
4. Cuando se usa con accesorios en circuitos que trabajen a más de 1 kV, mantener el instrumento en el extremo de potencial bajo (potencial de tierra) del circuito.
5. Usar el instrumento de manera horizontal. Sin nada conectado en los terminales, regular la aguja en la posición cero de la escala superior, usando el ajustador del cero mecánico (cabeza de tornillo ranurada) incluido en el panel frontal.

FORMAS DE ONDA NO SINUSOIDALES

El instrumento indica los valores eficaces (RMS) de las cantidades de c.a. y, si bien la medición actual en una media, se ha incluido en la calibración el factor de forma 1,11. Esto presupone una forma de onda sinusoidal. Puede surgir una distorsión considerable de forma de onda sin que afecte de manera apreciable la precisión. Algunos errores pueden ocurrir debido a una intensa distorsión de ondas sinusoidales, e.g. las formas de onda cuadradas producen unas lecturas elevadas, mientras que las formas de onda en pico reflejan lecturas bajas.

REGULACION DE INVERSION DE LA POLARIDAD

Si la aguja del contador se desvía hacia la izquierda, puede obtenerse una lectura en la escala pulsando el botón "Rev MC" (de tipo autoenclavable), tras lo cual se desplazará hasta la posición alzada. Cuando está en la posición alzada, la polaridad no es como la indicada por los terminales. En uso normal, el botón debe estar en la posición "bajada".

PROTECCION CONTRA LAS SOBRECARGAS

El instrumento está protegido contra las sobrecargas (a menos que sean sumamente excesivas) mediante un disyuntor automático. Cuando surge una sobrecarga, el botón "disyuntor" salta de su posición normal interrumpiendo así el circuito. Poner en desconexión el circuito y desconectar el instrumento antes de reposicionar el botón "disyuntor" al apretarlo hacia abajo. Eliminar la causa de la sobrecarga antes de volver a conectar el instrumento.

En las gamas de resistencia de "Ω x 1" y "Ω x 100", se incluye protección adicional mediante un fusible de 1 A.

MEDICION EN ENERGIA DE ALTA PERDIDA

Debe tenerse cuidado cuando se hacen mediciones en situaciones de energía de alta pérdida. Cerciorarse siempre de que se selecciona la gama correcta antes de conectar el instrumento al circuito.

Para los casos de selección de gama incorrecta, se ofrecen conductores de prueba provistos de fusibles de gran capacidad de ruptura, los cuales aumentan la seguridad. Estos conductores deben ser comprobados antes de efectuar todas las mediciones haciendo una prueba en la gama de resistencia con los extremos cortocircuitados conjuntamente. La resistencia deberá ser baja.

MEDICION DE VOLTAJES

Seleccionar el conmutador apropiado en "AC ∿" o "DC ⎓", de acuerdo con el tipo de voltaje que se esté midiendo. Seleccionar la gama requerida en el otro conmutador y conectar los conductores de prueba en el circuito que se va a medir. Las lecturas se toman de la escala de 0-3 ó 0-10, de acuerdo con la gama seleccionada, tras lo cual son multiplicadas por el factor necesario i.e. 10, 100 ó 1000.

Cuando se miden voltajes elevados de c.a. y c.c. (digamos por encima de los 800 V), a menos que el terminal negativo esté conectado a masa o a tierra, se introducirán errores si se toca el instrumento durante una medición.

Cuando es esencial obtener una indicación precisa del voltaje desarrollado a través de un resistor de alto valor resulta a veces preferible insertar el instrumento en serie con el resistor, y medir la corriente que fluye. La lectura en miliamperímetros, multiplicada por el valor de la resistencia en miles de ohmios, nos facilitará el voltaje desarrollado.

MEDICION DE CORRIENTE

Seleccionar el conmutador apropiado en "AC ∿" o "DC ⎓", de acuerdo con el tipo de corriente que se va a medir. Seleccionar la gama requerida en el otro conmutador y conectar el instrumento en serie con el circuito que se está probando. Esto debe hacerse solamente cuando dicho circuito esté desconectado. Las lecturas son tomadas de la escala 0-3 ó 0-10, de acuerdo con la gama seleccionada, tras lo cual son multiplicadas por el factor apropiado i.e. 10, 100 ó 1000.

MEDICION DE RESISTENCIA

Las pruebas de resistencia no se deberán realizar nunca en componentes que estén ya portando corriente.

Las tres gamas de resistencia usan una fuente de voltaje interior que brinda un potencial positivo en el terminal común negro (negativo). Deberá observarse que con algunos componentes, la resistencia varía de acuerdo con la dirección de la corriente que pasa a través de ellos, y que las lecturas por lo tanto dependerán de la dirección en la cual es aplicado el voltaje de prueba.

Cuando se mide la resistencia de fuga de un capacitor electrolítico, el conductor negro (negativo) del instrumento debe conectarse al terminal positivo del capacitor y emplearse la gama de "Ω x 10 k".

Antes de efectuar pruebas de resistencia, la aguja deberá ajustarse en la gama de resistencia cero en la secuencia siguiente:

1. Seleccionar en "Ω" el conmutador de la izquierda.
2. Conectar los dos conductores en el instrumento y unirlos.
3. Seleccionar el conmutador de la izquierda en la gama requerida y ajustar la aguja del contador en la posición cero de la escala "Ω", regulando según convenga el botón marcado "Ω x 1", "Ω x 100" ó "Ω x 10 k". Si no es posible regular en cero recambiar la bateria interior. Para efectuar una medición, conectar los conductores de prueba a través de la resistencia y tomar la lectura en la escala de la resistencia multiplicando el resultado por al factor apropiado

1, 100 ó 10 000. Si no es posible obtener una lectura en las gamas "Ω x 1" y "Ω x 100", verificar el fusible 1 A.

MEDICION DE RESISTENCIA AL AISLAMIENTO

Pueden llevarse a cabo mediciones de alta resistencia usando un voltaje de c.c. exterior de aproximadamente 150 V. El conmutador izquierdo debe estar seleccionado en "Ω", con el conmutador derecho en "ins", Los conductores de prueba del instrumento deben estar conectados en la fuente del voltaje de c.c. La aguja deberá ponerse en el cero de la escala de ohmios mediante el botón ajustador marcado "Ω x 10 k".

Para efectuar la prueba, conectar la resistencia desconocida en serie con el contador, siendo su valor mostrado en la escala de ohmios multiplicado por 100 000. Podrán así pues registrarse en esta gama resistencias hasta de 200 megaohmios.

MEDICION DE DECIBELIOS

El gráfico incluido en la página16 puede usarse para determinar los valores dB correspondientes a los valores de voltaje eficaces (RMS) a través de una carga resistiva de 600 ohmios. Debido a que los dB son definidos con arreglo a una carga de 600 ohmios, los niveles de energía corresponden a niveles de voltaje. Los decibelios pueden ser medidos con arreglo a voltajes RMS a través de una carga resistiva de 600 ohmios. Las pruebas se efectúan, así pues, usando las gamas de voltaje de c.a. Los niveles de energía pueden leerse a lo largo de la parte superior del gráfico. Si el voltaje RMS es medido a través de una resistencia que no sea la de 600 ohmios, habrá de añadirse algebraicamente un factor de corrección obtenido de la fórmula siguiente al valor de dB obtenido del gráfico.

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

por cuanto R es la resistencia de la carga en ohmios.

INSTALACION Y RECAMBIO DE BATERIAS Y FUSIBLE

El alojamiento que contiene las baterías y el fusible está situado en la parte posterior de la caja encima de la placa de instrucciones, Quitar la tapa girando ¼ de vuelta el sujetador hasta que la ranura quede vertical, tras lo cual se levanta para sacarla.

Cuando se instalan baterías cerciorarse de que se insertan correctamente según lo indican las marcas de polaridad incluidas en la moldura de la envuelta.

Las baterías habrán de inspeccionarse de vez en cuando, para asegurarse que no se fugue el electrólito, Si el instrumento va a permanecer inactivo durante largo tiempo, las baterías deberán quitarse y guardarse separadamente.

INSTRUMENT REPAIRS AND SPARE PARTS

Approved Repair Companies

A number of independent instrument repair companies in the U.K. have been approved for repair work on most AVOMETER instruments, using genuine AVO spare parts. Their names and addresses are listed in the Warranty Booklet supplied with each new instrument.

Overseas

Instrument owners outside Great Britain should consult the Appointed Distributor/Agent for their country regarding spare parts and repair facilities. The Distributor/Agent will advise on the best course of action to take. Names and addresses of Overseas Distributors/Agents are given in the Warranty Booklet supplied with each new instrument.

If returning an instrument to Britain for repair, it should be sent. freight pre-paid, to the Parts and Service Centre at the address shown opposite. A copy of the Invoice and of the Packing Note should be sent simultaneously by airmail to expedite clearance through the U.K. Customs.

A repair estimate showing return freight and other charges will be submitted to the sender, if required, before work on the instrument commences.

NEW AVO INSTRUMENTS ARE GUARANTEED FOR 12 MONTHS FROM THE DATE OF PURCHASE BY THE USER.

COMPONENTS LIST

R1	Resistor	18,4 Ω	printed resistor
R2	Resistor	2,16 kΩ ± 0,3%	¼ W
R3	Resistor	51 kΩ ± 0,3%	½ W
R4	Resistor	177 kΩ ± 0,5%	½ W
R5	Resistor	1,8 MΩ ± 1%	¼ W
R6	Resistor	800 Ω	(thick film) A.O.C.*
R7	Resistor	500 Ω	(thick film) A.O.C.*
R8	Resistor	5 kΩ	(thick film) A.O.C.*
R9	Resistor	0,04 Ω	printed shunt
R10	Resistor	0,36 Ω	
R11	Resistor	3,6 Ω	
R12	Resistor	36 Ω ± 0,3%	¼ W
R13	Resistor	360 Ω ± 0,3%	¼ W
R14	Resistor	933,3 Ω ± 0,3%	¼ W
R15	Resistor	6,667 kΩ ± 0,3%	¼ W
R16	Resistor	58 kΩ ± 0,3%	¼ W
R17	Resistor	140 kΩ ± 0,3%	¼ W
R18	Resistor	400 kΩ ± 0,3%	¼ W
R19	Resistor	600 kΩ ± 0,3%	¼ W
R20	Resistor	800 kΩ ± 0,3%	¼ W
R21	Resistor	4 MΩ ± 0,3%	½ W
R22	Resistor	6 MΩ ± 0,3%	½ W
R23	Resistor	8 MΩ ± 0,3%	½ W
R24	Resistor	18 kΩ ± 2%	½ W
R25	Resistor	889 Ω ± 3%	¼ W
R26	Resistor	889 Ω ± 3%	¼ W
R27	Resistor	1,6 kΩ	(thick film) A.O.C.*
R28	Resistor	5 kΩ	(thick film) A.O.C.*

*Adjusted on calibration

R29	Resistor	270 Ω ± 2%	½ W
R30	Resistor	8,2 kΩ ± 5%	½ W
R31	Potentiometer	18 kΩ	
R32	Potentiometer	18 kΩ	
R33	Potentiometer	18 kΩ	
C1	Capacitor	220 pF ± 5%	160 V
C2	Capacitor	10 nF ± 10%	400 V
C3	Capacitor	470 pF ± 5%	680 V
C4	Capacitor	2,2 nF $^{+\ 80\%}_{-\ 20\%}$	select on test
C5	Capacitor	2,2 nF $^{+\ 80\%}_{-\ 20\%}$	select on test
C6	Capacitor	15 pF ± 10%	500 V
D1	Diode	OA 95	
D2	Diode	OA 95	

CIRCUIT DIAGRAM