



# ***AVOMETER Model 10***

OPERATING  
INSTRUCTIONS 



## AVO LIMITED

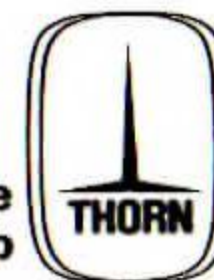
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A Member of the  
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# SAFETY IN THE USE OF ELECTRICAL EQUIPMENT

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

Various safety regulations and recommendations are in existence, and new ones are being formulated, in an attempt to reduce the extent of such hazard. This is achieved principally by defining, as far as possible, the levels of voltage and current above which there is significant hazard; by establishing certain principles in the design of equipment and by recommending specific visual warnings of any residual hazard, to be placed on the equipment.

We, in common with other responsible manufacturers, take all reasonable steps to ensure that our products comply with relevant approved safety standards. However, it must be emphasised

that certain types of electrical testing essentially involve the use of voltages and currents above the limits defined as 'safe' values. For example insulation testing and flash testing generally require the use of high voltages well above the safe limit and it may not always be possible to restrict the currents available from the test equipment to within the defined safe values.

It is recommended that the user of electrical equipment of any sort should always ensure that he understands, in detail, the equipment's characteristics so that he is aware of the degree of safety hazard which may be involved.

# SAFETY IN THE USE OF ELECTRICAL EQUIPMENT

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**Whilst every effort is made by responsible manufacturers to reduce the hazards and to warn of any hazard remaining, 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.**

The equipment described in this handbook has been examined, both in design and manufacture, to ensure that safety hazards are minimised.

Any known remaining hazards are explained in the paragraphs headed 'WARNING' on page 5 and 'PRECAUTIONS' on page 10.

If for some specific application, it is found that the information provided is not adequate, then please contact the manufacturer for further details and assistance.

# INSTRUMENT REPAIRS AND SPARES

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The manufacturer's joint service and spares organisation for AVO instruments

## **LONDON INSTRUMENT REPAIR CENTRE**

### **Spares & Repairs**

Archcliffe Road,  
Dover,  
Kent. CT17 9EN  
England  
Tel: Dover (0304) 202620  
Telex: 96283 (LIRC)

### **London Collection Depot**

Cunnington Street,  
Acton Lane Works,  
Chiswick,  
London W4 5HJ  
Tel: 01-995 9212  
Telex: 22583 LIRC

Instruments may be delivered to either address  
Trade Reception counters are provided. Spare  
parts should be ordered from the Dover Unit.

### **Approved Repair Companies**

A number of independent instrument repair  
companies in the U.K. have been approved for  
repair work on AVOMETER instruments, using  
genuine AVO spares. Their names and addresses

are listed on the Avo Warranty Booklet, supplied  
with each new instrument.

### **Overseas**

Instrument owners outside Great Britain should  
consult the Appointed AVO Distributor/Agent  
for their country regarding spares 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 AVO Warranty Booklet supplied  
with each new instrument.

If returning an instrument to Britain for repair,  
it should be sent, freight pre-paid, to L.I.R.C.  
AT DOVER (not to the Chiswick Unit). A copy  
of the invoice and of the Packing Note should be  
sent simultaneously by airmail to L.I.R.C. at  
Dover to expedite clearance through 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.**

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## **WARNING**

For maximum user safety, care should be taken to ensure that when measuring voltages, the instrument should not be switched to either the current or resistance range.

The lead set may be stowed in the special compartment in the instrument lid.

Ensure that the batteries and battery cover are fitted before using the instrument.

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# SPECIFICATION

## TABLE OF RANGES

### Voltage Ranges

DC Range	Internal Impedance	AC Range	Internal Impedance	Scale/ Range Multiplier
1500V	30M $\Omega$	1500V	3M $\Omega$	0-15/x100
600V	12M $\Omega$	600V	1,2M $\Omega$	0-6 /x100
300V	6M $\Omega$	300V	600k $\Omega$	0-30/x10
150V	3M $\Omega$	150V	300k $\Omega$	0-15/x10
60V	1,2M $\Omega$	60V	120k $\Omega$	0-6 /x10
30V	600k $\Omega$			0-30/x1
15V	300k $\Omega$	15V	10k $\Omega$	0-15/x1
6V	120k $\Omega$	6V	400 $\Omega$	0-6 /x1
1,5V	30k $\Omega$	1,5V	100 $\Omega$	0-15/x0,1
600mV	12k $\Omega$			0-6 /x100
150mV*	2,5k $\Omega$			0-15/x10

\*On the 60 $\mu$ A  
range

# SPECIFICATION

## Current Ranges

DC Range	Typical Voltage Drop*	AC Range	Typical Voltage Drop*	Scale/ Range Multiplier
6A	750mV	6A	320mV	0-6 /x1
1,5A	495mV	1,5A	155mV	0-15/x0,1
600mA	435mV	600mA	85mV	0-6 /x100
60mA	405mV	60mA	85mV	0-6 /x10
15mA	400mV	15mA	110mV	0-15/x1
1,5mA	395mV	1,5mA	535mV	0-15/x0,1
150µA	300mV			0-15/x10
60µA	150mV			0-6 /x10

\* Measured at the input sockets

## Resistance Ranges

Range	Span	Maximum test current/voltage	Scale/ Range Multiplier
$\Omega \times 1$	0 to 2k $\Omega$ (20 $\Omega$ centre scale)	75mA/1,5V	0-2k $\Omega$ /x1
$\Omega \times 100$	0 to 200k $\Omega$ (2k $\Omega$ centre scale)	750µA/1,5V	0-2k $\Omega$ /x100
$\Omega \times 10k$	0 to 20M $\Omega$ (200k $\Omega$ centre)	75µA/15V	0-2k $\Omega$ /x10 000



# SPECIFICATION

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## ACCURACY

### Limits of Error

DC Voltage and Current ranges  
AC Voltage and Current ranges  
Resistance ranges

The instrument complies with the international specification IEC 51.

The following values apply when the meter is used in its horizontal working position, at a temperature of 20°C.

±1,5% of f.s.d.  
±2,5% of f.s.d. (50Hz sinewave)  
±5% of indication between 2 and 200 markings on resistance scale  
±1,5% of scale length for the remainder of the scale

(Some batteries may have a very high resistance which will affect the accuracy. If this is suspected, change the batteries)

### Frequency Effect

With sinewave input, the change from the 50Hz reading on the 60V range resulting from a change in frequency is not greater than ±2,5% over the range 20Hz to 20kHz.

### Temperature Effect

The variation from a reading at 20°C resulting from a temperature change is not greater than ±0,15% per deg. C over the operating range.

## TEMPERATURE RANGE

Operation	0°C to +40°C
Storage	-40°C to +55°C

# SPECIFICATION

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## LEAD RESISTANCE

25m $\Omega$  per lead

## SAFETY REQUIREMENTS

Complies with all the main requirements of IEC 414.

## FLASH TEST VOLTAGE

5kV a.c. r.m.s.

## OVERLOAD PROTECTION

Power assisted mechanical cut-out using 15V battery, or VC1-10 voltage converter when fitted. Additional fuse protection on all ranges.

## FUSE

20mm x 5mm ceramic cartridge. 6,3A 250V. IEC 127, Sheet 1.

## BATTERIES

One 1,5V cell, IEC R20 (SP2, 212LP, 2LP, U2MJ)

One 15V battery, IEC 10F20 (B121, U10, 215G, 71) or IEC 10F15 (B154, GB15, 74, 504) (Voltage Converter VC1-10 is available at extra cost to replace the 15V battery)

## DIMENSIONS

Instrument only  
With protective cover

185 x 147 x 87mm (7,3 x 5,8 x 3,4 in)

185 X 150 x 106mm (7,3 x 5,9 x 4,2 in)

## WEIGHT

1,5kg (approx)

# OPERATION

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## PRECAUTIONS

USE EXTREME CARE WHEN MEASURING VOLTAGES ABOVE 50V.

AVOID CONNECTING THE METER TO A LIVE CIRCUIT WHENEVER POSSIBLE.

ENSURE THE CIRCUIT IS NOT LIVE BEFORE MAKING RESISTANCE MEASUREMENTS.

THE METER WILL CONTINUE TO OPERATE AFTER THE FUSE HAS RUPTURED. THE READING IS NOT ACCURATE. CHECK THE FUSE BEFORE PROCEEDING WITH MEASUREMENTS.

IF IN DOUBT ABOUT THE CORRECT RANGE, SELECT THE HIGHEST AND WORK DOWNWARDS.

## GENERAL

The meter is intended for horizontal use.

Before taking measurements, ensure that the pointer is at zero. If necessary it may be set by the screw-driver slot in the front panel.

During transit the range selection knob should be set to 'OFF'. In this position the meter movement is heavily damped.

## VOLTAGE AND CURRENT MEASUREMENTS

- (a) Set the function switch to  $\text{---} +/\Omega$  (DC) or  $\sim$  (AC).
- (b) Set the range selector switch to the appropriate range. If the value is unknown, set to the highest range and decrease the range until an adequate pointer deflection is obtained.
- (c) For voltage measurements, connect the meter across the source of voltage to be measured. For current measurements, connect the meter in series with the circuit under test.
- (d) If polarity reversal is required, rotate the function switch to  $\text{---} -$ . This obviates the need for lead reversal.
- (e) The measured value can be obtained from the combination of the indicated value and the range in use. (See Table of Ranges.)

# OPERATION

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## RESISTANCE MEASUREMENTS

- (a) Ensure that the circuit is not live, and that all capacitors have been discharged.
- (b) Set the function switch to  $\Omega$ .
- (c) Set the range selector switch to an appropriate resistance range.
- (d) Short together the test leads and adjust the Ohms Zero knob for meter full scale deflection (zero ohms). If it is not possible to obtain a zero ohms setting, firstly check the fuse, then the batteries.
- (e) Connect the test leads across the unknown resistor.
- (f) The measured value can be obtained from the combination of the indicated value and the range in use (See Table of Ranges)

# OPERATION

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## OVERLOAD PROTECTION

This instrument has been designed to withstand the accidental application of up to 250V rms to any range for up to 10 seconds. On most occasions the cut-out will operate. This will cause the cut-out knob in the front panel to spring out from its normal position level with the panel. The overload condition should first be rectified **WITH THE METER DISCONNECTED FROM THE CIRCUIT**. The cut-out knob should then be depressed and the meter will again be ready for use.

On some ranges the fuse may rupture if severe overloads are applied. A high value resistor is connected across the fuse-holder. This is a safety precaution to prevent the user from incorrectly assuming that a circuit is "dead" after the meter fuse has blown. Noticeably incorrect readings will be obtained. For example, an input of 240V ac will give a reading of 160V on the 300V ac range. The fuse should be checked and, if necessary, replaced before further measurements are made.

The power-assisted cut-out relies on the 15V battery (or VC1-10 converter) for its operation. If the  $\Omega \times 10k$  range operates satisfactorily, then so will the assisted cut-out. If there is no battery or converter in the instrument, or the battery is in a poor condition, the cut-out mechanism will no longer be power assisted. Some degree of protection will be afforded by the mechanical cut-out, which relies only on the movement of the pointer for its operation, and the fuse provides protection on some ranges. It is thus advisable to check the condition of the battery regularly, particularly after long periods of disuse. To do this, switch to the  $\Omega \times 10k$  range, short together the leads and adjust the Ohms Zero knob for full scale deflection. If this can not be achieved the 15V battery should be replaced, or if the VC1-10 converter is fitted, the 1.5V cell should be changed.

# OPERATION

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## BATTERY REPLACEMENT

The batteries are situated beneath the rear cover. Turn the screw on the back of the instrument to "0", and remove the back plate. TAKE CARE TO OBSERVE THE CORRECT POLARITY WHEN INSERTING NEW BATTERIES. A voltage converter, type VC1-10, is available to replace the 15V battery. If the meter is going to stand unused for several months the batteries should be removed.

## FUSE REPLACEMENT

The fuse is located in the positive socket in the front panel. Use the key provided to remove the socket from the front. The fuse will then be accessible.

Two replacement fuses are located beneath the rear cover.

## NON-SINE WAVEFORMS

Rectifier moving coil instruments give readings on ac proportional to the mean and not the rms value of the waveform with which they are presented. The accuracy of the ac measurements thus depends not only on the original calibration but also on the maintenance of a sinusoidal waveform. The form factor (rms value divided by mean value) of a sine-wave is 1,11 and this has been taken into account in calibrating the meter. Thus rms values are indicated for normal sine-wave inputs. Considerable waveform distortion can occur with only a small effect on the form factor and resulting accuracy, but with severely distorted waveforms some error will inevitably result. Waveforms which are more square will produce higher readings and those which are peaky will produce lower readings.

In the extreme case of highly peaked waveforms such as are encountered in television receivers or other apparatus employing high value capacitors, damage to the instrument diodes may occur. Special care should be taken when using this instrument to service such apparatus.

# ACCESSORIES

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## USE OF ACCESSORIES

### **30kV DC Probe** Part No. 6220-128

A 30kV dc probe is available for use in series with the meter set to its 1500V dc range. To obtain the correct measured value in kV, read the indicated value on the 0-30 scale.

CONNECT ONE OF THE INSTRUMENT TERMINALS DIRECTLY TO EARTH. SELECT THE RANGE AND CONNECT THE INSTRUMENT BEFORE APPLYING THE VOLTAGE. DO NOT TOUCH THE INSTRUMENT WHILE THE VOLTAGE IS APPLIED.

Full instructions for its use are provided with this optional accessory.

### **Multi-Range Current Transformer**

Part No. 6330-259

This accessory enables ac currents up to 600A to be measured in conjunction with the Model 10. Connections may be made to all the ac current ranges on the meter except the 6A range.

Full operating instructions for its use are provided with this optional accessory.

### **Voltage Converter, VCI-10** Part No. 6210-071

This is an AVO accessory which may replace the 15V battery in the rear compartment. It is powered by the 1,5V cell. Instructions for its use are supplied with this optional accessory.

As the successful operation of the cut-out depends on the 15V supply it is advisable to check this supply regularly, and to change the 1,5V cell if necessary. (See Overload Protection).

# ACCESSORIES

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## ACCESSORIES

### Supplied with instrument

Leads, prods, insulated clips  
Instruction booklet  
1,5V cell SP2  
15V battery B154  
Battery adaptor  
Two spare fuses  
Top cover with lead compartment  
Key to remove fuse

### Available at extra cost

30kV d.c. probe	Part No. 6220-128
Current transformer	6330-259
Miniature lead set	6320-134
VC1-10 Voltage Converter (to replace 15V battery)	6210-071
Carrying case — ever-ready leather	6320-136



# LIST OF COMPONENTS

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R1	330 $\Omega$	R24	180k $\Omega$	C1	33 $\mu$ F
R2	12k $\Omega$	R25	90k $\Omega$	C2	150pF
R3	0R0667	R26	18k $\Omega$	C3	4,7nF
R4	0R2000	R27	10k $\Omega$	C4	27nF
R5	0R4003	R28	18k $\Omega$ $\pm$ 5% 0,033W	C5	1nF
R6	6R003	R29	18k $\Omega$ variable resistor	C6	14pF (Part of p.c.b.)
R7	20R03	R30	889 $\Omega$	C7	220nF
R8	240R3	R31	889 $\Omega$	C8	220nF
R9	2,4k $\Omega$	R32	6,19k $\Omega$	D1	1N4148
R10	4k $\Omega$	R33	177k $\Omega$	D2	1N4148
R11	1,333k $\Omega$	R34	Movement swamp	D3	1N4148
R12	18,7 $\Omega$	R35	300k $\Omega$	D4	1N4148
R13	2,16k $\Omega$			D5	1N4148
R14	51k $\Omega$			D6	1N4148
R15	9,642k $\Omega$			D7	BZY88C15
R16	392,4 $\Omega$			D8	BZY88C15
R17	92,5 $\Omega$			TR1	BC184C
R18	18M $\Omega$			TR2	BC184C
R19	6M $\Omega$			B1	15V
R20	3M $\Omega$			B2	1,5V
R21	1,8M $\Omega$			FS1	6,3A
R22	600k $\Omega$				
R23	300k $\Omega$				

