Heavy Duty Avometer Mk. 5

THE HEAVY DUTY AVOMETER Mk. 5

INSTRUCTION MANUAL

AVO LTD

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TABLE OF RANGES

D.C. Voltage	D.C. Current	A.C. Voltage	A.C. Current
10V	10mA*	10V	10mA
25V	100mA	25V	100mA
250V	1A	250V	1A
1000V	10A	1000V	10A

*With 'Range Switch' in this position, a 100mV range is obtainable by adjustment of the 'Sensitivity Switch'.

RESISTANCE

0– 500 Ω 125 Ω mid-scale
0–50000 Ω 1250 Ω mid-scale

SENSITIVITY

D.C. Voltage Ranges 1000 Ω/V – 1mA f.s.d.
A.C. Voltage Ranges 10V only 200 Ω/V – 5mA f.s.d.
All other a.c. voltage ranges 500 Ω/V 2mA f.s.d.

THE HEAVY DUTY AVOMETER Mk. 5

OPERATING INSTRUCTIONS

Introduction

This instrument has been designed and developed as a result of many requests received for a robust portable instrument for use under difficult conditions. The ranges have been carefully selected and the controls simplified to assist the operator.

It is manufactured to the high standards which have resulted in AVO instruments being regarded as a standard of reliability and accuracy wherever they are used.

Description

The instrument is supplied complete with a pair of rubber covered leads, long reach safety clips Mk. 2 and a pair of square ended clips.

The plug in leads are designed to facilitate easy connection to the instrument terminals. The remote ends of these are terminated with sockets which enable the long reach safety clips Mk. 2 or the square ended clips to be inserted as required.

Range switching is carried out using a single switch knob, providing a total of 18 ranges for the measurement of a.c./d.c. current and voltage and resistance.

Facilities are incorporated which enable standard Avo shunts (100mV) and the Avo Resistance Range Extension Unit to be used; full details are given later in this Instruction Manual.

The metal handle not only serves as a means for carrying, but can be utilised to tilt and support the instrument when in use. An anti-parallax mirror incorporated in the scale plate is of great assistance when making accurate readings. The instrument is protected against reasonable overloads by a mechanical cut-out.

Design and Construction

The moulded front panel is used to support the meter movement, range switch, associated shunt, multiplier resistors, and other component parts.

The range switch is of a generous and robust design, its silver plated contacts being arranged to make before break on adjacent positions. The case of the instrument which is of a similar material to the front panel, includes a compartment which houses the 1·5V cell used for resistance measurements.

Controls

Range Switch—Main control for selection of the appropriate range situated on the front panel.

Movement Mechanical Zero Adjuster—Screwdriver adjustment adjacent to the range switch.

Adjust Ohms—Small knurled knob on left of panel for electrical zeroing of the meter on the resistance ranges.

Reset Control—Small knurled knob on right of panel to manually reset the mechanical cut-out if it has operated.

Sensitivity Switch—Situated between the terminals, this is used to select the sensitivity when using d.c. shunts and the Resistance Range Extension Unit. The method of use is explained later in this Instruction Manual. When switched to a position other than 'NORMAL', a red flag becomes visible at the top of the scale plate.

NOTE:

This switch must always be in the 'NORMAL' position, except when accessories are used with the instrument, i.e., shunts and R.R.E.U.

Accuracy

For the greatest accuracy, the instrument should be used with the scale plate in a horizontal position (or slightly tilted as referred to in the foregoing). The accuracy of indication is within the limits laid down in Section 6 of the British Standard Specification 89:1954 for 3·25 in. (8·23cm.) scale length industrial portable instruments, and is as follows:—

D.C. Voltage and Current Ranges ± 1·75 per cent of f.s.d. between 10 per cent and full scale deflection.

A.C. Voltage and Current (25–2000~) ± 2·25 per cent of f.s.d. between 25 per cent and full scale deflection.

Audio frequency voltages and currents can be measured quite successfully because although the limits of accuracy are not claimed above 2 Kc/s, the meter is reasonably accurate up to 10 Kc/s.

Due to the nature of the resistance scale it is impossible to quote accuracy for the whole range; as a guide however, readings will be within ± 5 per cent of indication around mid-scale increasing to ± 10 per cent of indication at deflections corresponding to 10 per cent and 90 per cent of the arc traversed by the pointer.

Scaling

Two basic scales are provided, each approximately 3·25 in. (8·23cm.) long, the outer being for resistance only is scaled 0–500 Ω, the first calibration being at 0·5 Ω.

The inner scale (50 divisions) is for all voltage and current measurements and is marked 0–100 and 0–250.

Reading the Scale Plate

Due to the limited space available on the scale plate, and to assist in good readability, it is not possible to provide individual scales for each switch position. It is, therefore, necessary for the operator to use the most convenient basic scale, and to multiply or divide the reading obtained by a factor of 10 or 100 where necessary. For example, on the 100mA and 250V a.c. and d.c. range, the scales calibrated 0–100 and 0–250 are direct, whereas on the 10mA and 10V ranges, the 0-100 scale is used and readings obtained divided by 10. For the 1000V range, the 0-100 scale is used and this time readings are multiplied by 10; the remaining ranges are dealt with in a similar manner.

OPERATION OF THE INSTRUMENT

General Information

For greatest accuracy, use the instrument face upwards or partly tilted as previously mentioned. If necessary, set the pointer to the left hand zero by means of the MECHANICAL ZERO ADJUSTER adjacent to the range switch.

NOTE:

The instrument must not be connected to any external circuit etc., during zeroing.

The leads should be connected, red to the positive (red) terminal, and black to the negative (black) terminal, the remote ends being terminated with clips or Prodclips as required.

Ensure that SENSITIVITY SWITCH is in the 'NORMAL' position unless external accessories are being used.

Set the RANGE SWITCH to the correct position for the type of measurement to be made before connecting the leads to the circuit. Should any doubt exist as to the magnitude of the voltage or current to be measured, always switch to the highest range, and then progressively to lower ranges until a suitable deflection is obtained. Under these conditions it is not necessary to break the circuit when switching ranges.

WARNING

Except in the case of low-voltage circuits, it is dangerous to make connections to 'live' apparatus. The user is advised wherever possible to make a habit of connecting the instrument with power supplies switched off.

Resetting the Overload Cut-out

If the instrument is overloaded and the cut-out trips, disconnect the leads immediately and then reset the cut-out. Before continuing tests, ascertain the cause of the overload, and take appropriate action.

Should the cut-out trip, an indication is given by a red marker which becomes visible through a hole in the centre of the scale plate. To reset the cut-out rotate the spring-loaded 'RE-SET' control on the front panel in a clockwise direction through approximately 45°, and then release it; the red marker will then be replaced by a white one indicating that the instrument is ready for further use.

A.C. and D.C. Voltage Measurement

When measuring voltage, select the appropriate range and connect the leads across the source to be measured, observing polarity for d.c. measurements.

On d.c. ranges the sensitivity of the instrument is 1000 Ω per volt, i.e., a current of 1mA is required to give full scale deflection.

The sensitivity on a.c. ranges is 500 Ω per volt, i.e., 2mA f.s.d., with the exception of the 10V a.c. range which is 200 Ω per volt, i.e., 5mA for f.s.d.

A.C. and D.C. Current Measurement

Select the appropriate a.c. or d.c. current range, and connect the instrument in series with the circuit to be tested, observing polarity for d.c. measurements; the total current flowing in the circuit will then pass through the instrument.

To measure currents in excess of 10A, it is necessary to use an external shunt for d.c., and a current transformer for a.c. measurements. Details of these accessories are included in the section headed 'Accessories and Their Use'.

Resistance and Continuity

Before carrying out resistance or continuity tests, the ohms zero must be checked and adjusted if necessary. This is carried out by switching to the resistance range required, joining the two leads together, and adjusting the pointer to the ohms zero (full scale deflection) by means of the 'ADJUST Ω' control.

If the condition of the internal cell has deteriorated due to use, or age, it may not be possible to adjust the pointer to zero, or even if this can be accomplished, the pointer indication may gradually fall. In such a case the 1·5V cell (Every Ready Type U2—Avo Part No. 12379-9) which is housed in a compartment on the under side of the instrument should be removed and replaced by a similar cell, inserted in the same direction (the small centrally positioned contact on the cell toward the spring contact marked '+'). The ohms zero should then be adjusted as described above.

To measure resistance connect the two leads across the component to be tested. It is most important when measuring the resistance of a component or circuit to ensure that no current is flowing from a source other than the cell in the instrument, and that no other resistive components are in parallel with it. Should doubt exist, it is advisable to disconnect one end of the component to be measured from its associated circuit.

Although most components are substantially constant as regards resistance, some vary considerably with temperature, e.g., lamps, etc., so that resistance tests only indicate continuity, and the readings obtained cannot be used to calculate wattage. The resistance of other devices, such as rectifiers, varies according to the voltage applied and the direction of current. When such tests have to be made using the resistance ranges, it should be noted that the polarity which appears at the meter terminals will be reversed from that shown on the panel (i.e., the positive terminal has a negative potential).

WARNING

Under normal conditions the internal cell will operate satisfactorily for a very long period but it should, nevertheless, be examined from time to time, since a discharged cell may develop a leak and thus damage the instrument. If it is anticipated that the instrument will not be used for any length of time, it is strongly advised that the cell be removed.

ACCESSORIES AND THEIR USE

In order that the ranges of the instrument, which are already wide may be extended still further, Avo Limited produce a range of accessories. *These are illustrated in Fig. 1, and their use explained below.*

Item a. **D.C. Current Shunts:** The shunt should be connected by means of its two main terminals in series with the circuit in which the current is to be measured. Set the meter to the 10mA d.c. range and adjust the 'SENSITIVITY' switch (between terminals) to the 10mA d.c. - 100mV position; the meter should then be connected to the two small studs protruding from the ends of the shunt, taking care to observe polarity. The full scale meter reading will now correspond to the rating of the shunt.
The following shunts can be supplied:—50A, 100A, 200A, 400A.

Item b. **A.C. Current Transformers:** To extend the a.c. current ranges, it is necessary to use an AVO Current Transformer. It should be connected in series with the circuit under test by means of the two large (primary) terminals, and with the meter set to the 100mA a.c. range, connect the leads to the small (secondary) terminals. The full scale reading will now correspond to the rating of the current transformer.
Current transformers can be supplied with the following ratings:—50A, 100A, 200A, 400A.
A dual type, suitable for measuring 50A and 200A, is also available.

WARNING

To prevent the build-up of high potentials, it is essential

that the secondary winding is terminated with the instrument switched to the 100mA a.c. range before the power is switched on.

Item c. **Resistance Range Extension Unit:** This unit makes it possible to measure resistance from 1 Ω down to 0·01 Ω on the uniformly divided 0–100 scale. Resistance values indicated are, therefore, expressed as a percentage of 1 Ω.
To use the unit adopt the following procedure:

(i) Set the range switch to 10mA d.c. and the 'SENSITIVITY' switch to its 'VARIABLE SENSITIVITY' position.

(ii) Connect the unknown resistor between the terminals on the unit marked '+' and 'R'. This completes the circuit of the internal cell.

(iii) Connect the meter leads to the terminals marked 'R' and '—', and using the 'ADJUST Ω' control, set the pointer to read full scale deflection, i.e., 100 on 0–100 scale.

(iv) Transfer the meter leads to the terminals marked '+' and 'R', the reading obtained on the 0–100 scale is the value of the resistor under test as a percentage of 1 ohm.

NOTE:

(i) *On completion of a test disconnect the meter and tested resistor from the unit to avoid discharging the internal cell. This cell should be checked periodically and replaced when discharged.*

(ii) *Always reset the 'SENSITIVITY' switch on the meter to the 'NORMAL' position.*

Item d. **Ever Ready Carrying Case:** This illustration shows the specially designed 'ever-ready' leather case which can be supplied for the Heavy Duty Avometer Mk. 5 if required. This enables the instrument to be used whilst protected by the leather case.

Servicing

The instrument has been carefully designed and manufactured under ideal conditions to the rigid standards for which Avo Limited are universally renowned, but should it be necessary to return the instrument to the Company for repair, pack it carefully and enclose full details of the fault you have found, for the information of our Service Department engineers.

RANGE SWITCH S.1A

Position	Range	Switch	Range
1	1000V a.c.	10	1A d.c.
2	250V a.c.	11	100mA d.c.
3	25V a.c.	12	10mA d.c.
4	10V a.c.	13	500Ω
5	10mA a.c.	14	50KΩ
6	100mA a.c.	15	10V d.c.
7	1A a.c.	16	25V d.c.
8	10A a.c.	17	250V d.c.
9	10A d.c.	18	1000V d.c.

SENSITIVITY SWITCH S.2A

Position	Range
1	10mA d.c. = 100mV
2	NORMAL
3	Variable Sensitivity

COMPONENT LIST

Circuit Ref.	Description	Remarks
R.1 R.2 R.3 R.4	750KΩ +0·75 per cent —0·25 per cent 220KΩ ±0·5 per cent	740KΩ + supplementary resistor
R.5	15KΩ	Wire wound bobbin
R.6	9940Ω	Wound bobbin
R.7	1189Ω	Wound bobbin
R.8.	1[illegible]Ω	Wound bobbin
R.10	26·7Ω	
R.11	6·3Ω	
R.12	13·5Ω	
R.13	1·35Ω	
R.14	0·135Ω	
R.15	0·015Ω	
R.16	0·6Ω	
R.17	45Ω	Adjust to suit movement
R.18	198Ω	
R.19	11·59KΩ	
R.20 R.21 R.22	112·5KΩ +0·75 per cent —0·25 per cent	
R.23 R.24	375KΩ +0·75 per cent —0·25 per cent	2X 184KΩ + supplementary
R.25	1620Ω	Wound bobbin
T.1	Transformer	
M.1	Meter movement 600μA	100Ω together with R.17
B.1	1·5V cell	Every Ready Type U2
CO.1	Mechanical cut-out	
REC.1	5mA Bridge Rectifier	
S.1A	Range Switch	
S.1B	Leaf Switch—part of range switch	Closed on a.c. ranges
S.1C	Leaf Switch—part of range switch	Closed on Ω×1 range
S.2A	Sensitivity Switch	For use with accessories

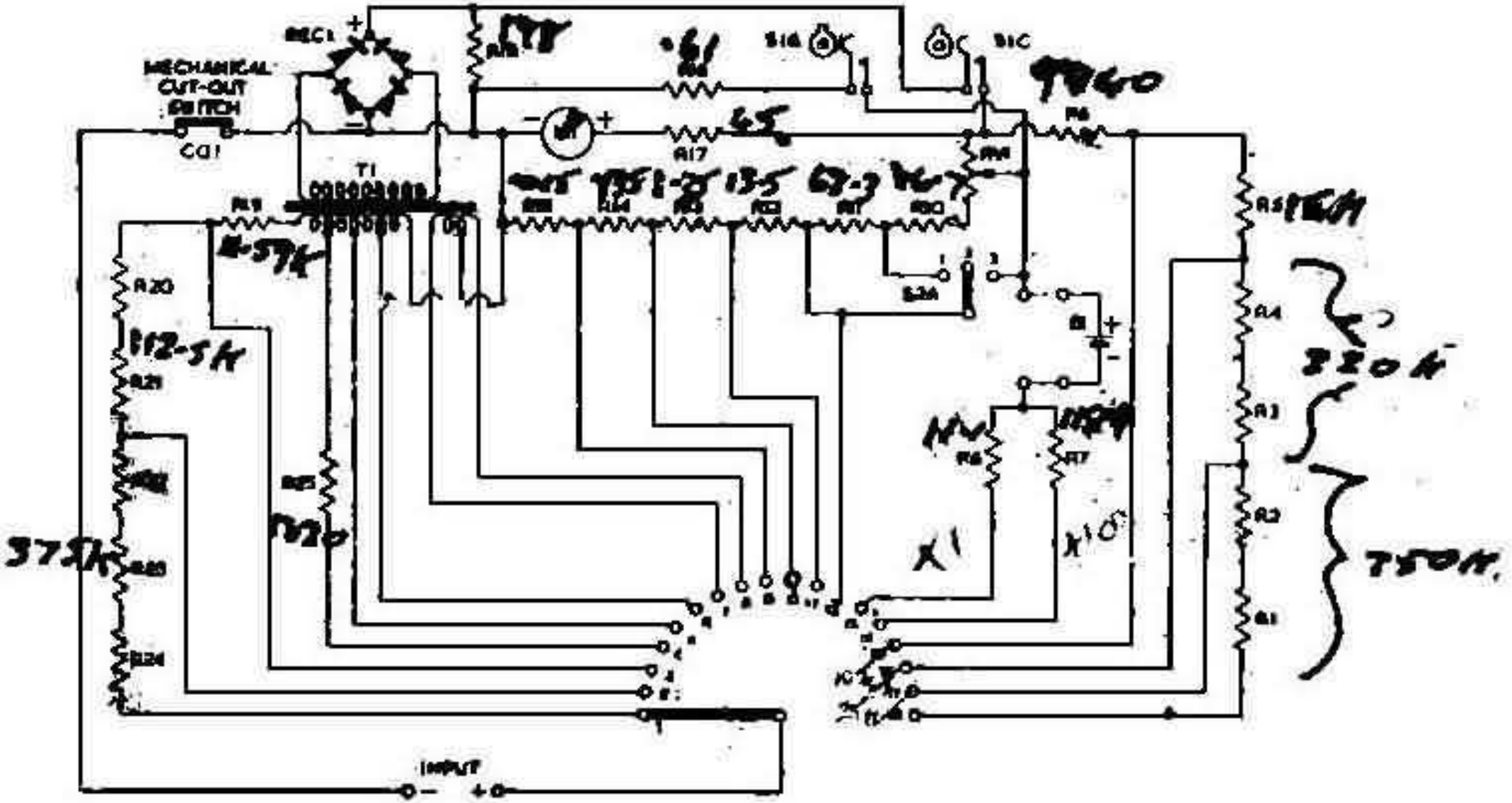

Fig. 2—Circuit Diagram of the Instrument