

DIGITAL OHMMETER TYPE D04A

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IMPORTANT NOTE

Instruments are delivered ready for immediate use; no extras are required.

Supplied Accessories: One set of test leads
 One mains cord
 One copy of Operating Instructions (English)

When unpacked, inspect for physical damage and report any defects immediately in writing, retaining packaging materials for inspection. Before placing into service, ensure mains voltage is correct, instruments are normally supplied for 240V 50Hz. Other voltages may also be selected according to the chart in section 5, (Maintenance). Be sure to also change the fuse to the correct type.

1. Safety

Digital Ohmmeter type D04A is designated Safety Class I as defined in the EN61010.

This apparatus has been designed and tested in accordance with EN61010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The present instruction manual contains some information and warnings that have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

If this apparatus is to be connected to a fixed installation, before any other connection is made, the protective earth terminal shall be connected to a protective conductor.

Before switching on the apparatus, make sure that it is set to the voltage of the power supply. The mains plug shall only be inserted in a socket outlet provided with protective earth contact. The protective action must not be negated by the use of an extension lead without a protective conductor.

WARNING!

Any interruption of the protective conductor inside or outside the apparatus, or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

When the apparatus is connected to its mains supply, terminals may be live, and the opening of covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.

The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement maintenance or repair.

Any adjustment, maintenance and repair of the opened apparatus under voltage shall be avoided as far as possible, and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved

Make sure that only fuses with the required rate current and of the specified type are used for replacement. The use of makeshift fuses, and the short-circuiting of fuse holders are prohibited.

Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation and returned to our factory or Agent for rectification.

2. Introduction

The DO4A is an accurate bench/portable digital ohmmeter for the measurement of resistance in the range $10\mu\Omega$ to 4000Ω . It offers you the four terminal resistance measurement method to eliminate the effect of lead resistance. The measured values are displayed on a 4 digit LCD display; an overflow of the selected range is also indicated.

Display range 4000

Simple push button selection of the range required ensures the DO4A may be easily used by unskilled personnel, error and status warnings are illuminated when appropriate. The utmost care has been used to ensure that the ohmmeter will withstand an accidental mains voltage applied to the measuring terminals, but it is not recommended that voltage should be applied.

3. Measuring Principle

The measurement is true 4 terminal, using the Kelvin principle. A stable current is produced across the resistance to be measured via the C terminals, and the voltage drop across the Rx is measured at the P terminals. This potential drop is then compared against the voltage drop across internal standards, the ratio of these is then converted to the resistance value of Rx and displayed in ohms on the digital display. High accuracy and long term stability is achieved by using our own manufactured internal resistance standards.

4. Case Design

The case is ruggedly constructed and is a painted aluminium shell with a strong internal sub-frame. The front panel is a reverse printed polycarbonate overlay with clear and unambiguous text. The case is painted anthracite grey, and the tilt handle means that the instrument can be positioned for easy viewing.

5. Maintenance

Normally no maintenance is required other than cleaning with a moist cloth. Avoid aggressive detergents or solvents.



CAUTION: Before any maintenance, repair or exchange of parts or fuses, the instrument must be disconnected from the mains supply and all power sources. In the event of a fault occurring, the instrument should be returned to our factory or Agent. A mains fuse is fitted to the mains inlet socket on the rear panel, and should be replaced if necessary.



CAUTION: Disconnect mains lead and all connecting leads, before removing fuse holder. Replace only with correct fuse type ie. according to the following chart

Line Voltage Selection	Range VAC 47-63Hz	Fuse (250V) IEC 127 5 x 20 mm.	Fuse (250V) UL198 G 0.25"X1.25"
100V 120V	87-110V 104-132V	630mA (T)	800mA Slo-Blo
220V 240V	191-242V 209-264V	315mA (T)	400mA Slo-Blo
Maximum Input Power : 20VA			

The input circuits are protected by a 2 AMP fuse located on a holder on the main printed circuit board. Access is gained by removing the top cover. Only replace with the correct fuse type as below.

2A	550V rms	Type A1
BS 88 : PART 2 !		

6. Battery Charging

The DO4A has a built-in sealed lead acid battery, which is fully charged when delivered. This type of battery has advantages over other types of rechargeable batteries; it is more tolerant to erratic charging cycles thus giving a better service life.

The battery charger is built in and the instrument may be connected to 100/120/220 or 240 volts supply. The appropriate voltage setting must be selected on the inlet socket and the correct fuse inserted. The LINE LED will illuminate on the front panel to indicate when the mains supply is connected.

Charging is automatically controlled with built-in protection circuits eliminating the possibility of over-charging or deep discharging the battery. The display will flash 8888 when the battery requires recharging. The DO4A will operate at full accuracy whilst charging and therefore can be used whilst permanently connected to the mains supply

Battery

The internal battery is a sealed lead acid type. Care should be taken when disposing of it and it may be returned to Cropico for safe disposal.

Any regulations and directions applying to the disposal of such material must be applied.

Do not dispose of battery in fire.

Do not short circuit

Do not crush, puncture, open, dismantle or otherwise mechanically interfere with the battery.

7. Technical Data

Digital Display	4 digit, LCD 15 mm height with automatic decimal point units and error warning lamps
Working temperature	0...+40°C rel. humidity max. 65%
Calibration temperature	20°C
Storage temperature	-20°C ... +50°C
Mains connection	100/120/220/240V + 10 - 13% 47-63 Hz
Warm-up time	Approx. 30 mins.
Size (mm.)	215 x 88 x 250 (WHD), ½ 19" rack 2U high
Mass	3.5 Kgs.

Measurement

Resistance	True four terminal measurement with fixed dc measuring currents.
Measuring time	Approx. 0.5 seconds
Auto-zero	Permits the automatic zero of amplifiers eliminating errors due to thermal emf

Range	Resolution	Typical Current	Accuracy @ 20 C ±5 C, 1 year	Temperature Coefficient/ C
4 kΩ	1 Ω	100 μA	±(0.05% Rdg +0.02% FS)	30 ppm Rdg + 1 ppm FS
400 Ω	100 mΩ	1 mA	±(0.05% Rdg +0.02% FS)	30 ppm Rdg + 1 ppm FS
40 Ω	10 mΩ	10 mA	±(0.05% Rdg +0.02% FS)	30 ppm Rdg + 1 ppm FS
4 Ω	1 mΩ	10 mA	±(0.05% Rdg +0.03% FS)	30 ppm Rdg + 4 ppm FS
400mΩ	100 μΩ	10 mA	±(0.05% Rdg +0.05% FS)	30 ppm Rdg +25 ppm FS
40mΩ	10 μΩ	100 mA	±(0.05% Rdg +0.05% FS)	30 ppm Rdg +25 ppm FS

8. Description of Controls



Fig. 8-1 Description of Controls

8.1 Auto-zero

For measurements where thermal emf can cause a large measuring zero error, it is possible to cancel this using the auto-zero button. First connect the potential leads to the sample to be measured in the usual way, then connect the C & C1 terminals together at the sample.

Press the auto-zero, the LED will illuminate and the zero offset will be measured and stored as an offset. Reconnect the current leads in the normal measurement configuration and the resistance reading will be displayed with the zero offset eliminated. The LED will stay lit to warn that an offset is stored. This offset and lamp will be cancelled if the range is changed or the instrument switched off. A maximum of ± 100 digits can be offset.

Range Selection:

The 6 ranges may be selected manually by simply pressing the desired range button. The selected range will be indicated by an LED; over-range will be indicated by the display reading - - - -.

Error & Status Lamps

These LEDs will light to indicate the instrument status.

- | | | |
|----------|---|--|
| LINE | : | Mains supply is connected to the instrument. |
| CAL | : | Calibration mode has been initialised by the rear key switch and the instrument is in calibration mode. |
| O/C LEAD | : | One of the measuring leads is open circuit, to high resistance, or not connected to test sample correctly. The internal protection fuse is open circuit. |

9. Methods of Measurement

9.1 Ohmmeter Connections

The Digital Ohmmeter type DO4A employs a four-wire method of measurement, ie. it is necessary to make four connections to the resistor under test. The instrument is supplied with four leads; two for the potential connections which are made across the test resistor at the points between which the resistance is to be determined, and two for the current connections which connects the test resistor to the supply circuit.

- a) Connect the black leads to the C1 and P1 terminals, and the red leads to terminals C and P. It is immaterial which leads of the pair goes to the P or C terminals.
- b) Clip on to the resistor under test fig. 9.1. Cleanliness is important and if the sample is not clean, a rub with an abrasive paper to remove oxides is recommended.
- c) It is not always possible to use the combined current and potential clips, in which case test leads with spade tags or special test fixtures may have to be made for the user to suit particular applications.
- d) Fig. 8.3 illustrates connections to various types of test resistors.
- e) When measuring 4 terminal resistance standards, do not use the combined current and potential probes, make four separate connections to the current and potential terminals.



Fig. 8.2 Combined current and potential probes

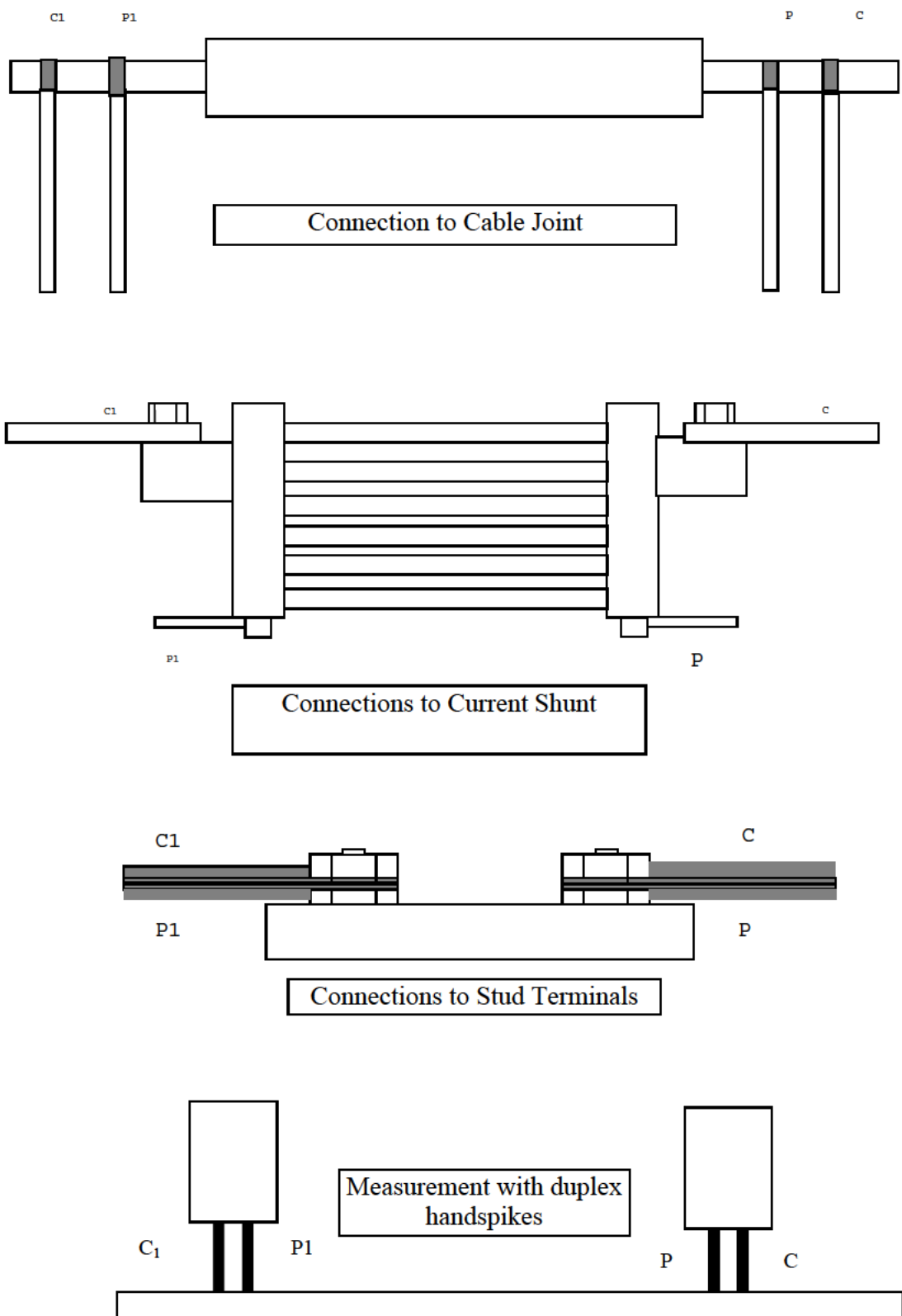


Fig. 8.3 Various types of resistors

10. Power Up

When the DO4A is first switched on, a lamp test is automatically performed, all display segments are illuminated followed by each LED lighting in sequence. The microprocessor checks for correct internal operation and indicates "P" if all tests pass O.K. At the same time the software version will be displayed and held for approximately 2 seconds. The display will typically read "P 1.1". Should the internal checks indicate an error, then the display will read "HELP". To rectify this, see section 13.

The DO4A will perform an automatic zero sequence and finally sets to the following default start up mode ready for use. The measuring range $4K\Omega$ selected, auto-zero lamp out.

11. Measurement

Connect the resistance to be measured (Rx) to the measuring terminals in accordance with the diagram on the instrument panel. Select the range required. The green LED lamp will light to indicate which buttons are active.

CAUTION: Do not auto-zero when Rx is connected for measurement. This will store a large offset made up of resistance and thermal emf and displayed values will be invalid.

If, during measurement, any of the error messages should be displayed, then obviously the appropriate action should be taken. Whilst the input is protected against accidental application of mains voltage, single or 3-phase, care should be taken to avoid measuring on live circuits.

Over-range

The display will indicate - - - -.

Open Circuit Lead

O/C Lead will be displayed if the instrument detects that the lead resistance is too high. The C terminals are checked for compliance voltage. Measurement should not be made if this warning message is displayed. This warning will also be displayed if the internal protection fuse is open circuit.

Connections

When making good quality measurements, it is important to ensure that all measuring leads are in good condition, and less than 0.2 ohms resistance.

It should also be noted that some spade tags and crocodile clips can produce high thermal emfs when warmed, particularly nickel-plated brass types. This can cause problems when, for example, connecting too hot motor windings. The solution is to use plain copper or brass connections keeping them clean and oxide free.

12. Protection

Every effort has been made to protect the instrument against voltages being applied to the terminals. A large 6 Amp fuse is fitted internally to the C measuring line and a gas discharge tube, GDT, is across the C terminals. If voltages above approximately 90V are applied to the measuring terminals, the GDT will strike effectively shorting the C terminals through the 6 Amp protective fuse, which will interrupt the circuit.

The fuse fitted will interrupt up to 40,000 Amps. The P terminals are not fused and will withstand up to 460 Volts without damage to the instrument.

WARNING!

To replace the protection fuse, the top instrument panel should be removed, **but only after the mains supply and all input connections are removed**. The protection fuse is located on the main printed circuit board. Only replace with the correct fuse rating.

13. Calibration Process

WARNING! This should only be carried out by competent and trained personnel. The calibration is carried out from the front panel and no mechanical adjustments are necessary.

Equipment required - Milliohmmeter Test Standard type MTS2 or a set of Resistance standards 4m Ω , 40m Ω , 400m Ω , 4 Ω , and 400 Ω and 4k Ω . A calibration key is supplied with the instrument.

The DO4A is designed to eliminate all calibration. The factory adjusted internal standards are constructed to give long term stability and minimal drift. However, for those wishing to adjust the ohmmeter, proceed as follows.

The ohmmeter should be placed in a temperature controlled environment for at least 2 hours before calibration.

Select the 4mΩ range and connect a 4 milliohm Standard. This Standard should be within 0.01% or better of the nominal value. Press the CAL button and the DO4A will automatically measure the standard and store any calibration offsets.

With the Standard still connected, remove the C lead from the resistance and connect it to the C1 terminal. This effectively gives a zero value; press CAL again and the zero error is stored. Select the next range and appropriate full scale Standard and repeat the above procedure. All ranges should be calibrated in this way, ie. for both full scale and zero, the key being turned back to the run position and removed on completion.

NOTE: Should the calibration constants be corrupted, then the display will indicate **HELP**. To re-initialise the calibration memory, turn the calibration key to the CAL position, remove the top cover and press the red reset button on the main PCB. The instrument should be switched on, but the mains power supply **MUST BE DISCONNECTED** before removing the top cover.

After resetting the instrument, the full calibration procedure must be fully implemented to return the instrument to its full accuracy.

Repeated corruption of the memory and display of the HELP error message indicates a malfunction of the instrument, which should be returned to our Service facility for rectification.

A comprehensive repair and calibration service is available at our factory. When returning instruments, please ensure adequate packing to avoid damage in transit.

14. ACCESSORIES

14.1 LEADS The DO4A may be used with a variety of lead sets. The following are the available selection. Remember, if you do not see suitable leads for your application, please consult our customer help desk.

Ordering Code	Description
HS01-P	Duplex Handspikes with 2.5 metre lead length, current and potential spikes suitable for plate or Bussbar measurements.
HS02-P	Duplex Handspikes as a HS01-P but with 2.5 and 15 metre lead lengths
LS03-P	Large Kelvin clips with 3 metre lead length suitable for attaching to rods bars or cables up to 38mm diameter
LS04-P	As LS03-P but with lead lengths 3 and 15 metres
LS05	Executive lead set consisting of 4 x 1 metre leads with

	banana plugs, 4 x crocodile clips 4 x test prods and 4 x Kelvin clips (KC1) jaw opening 4mm
LS06-P	Kelvin lead set comprising of miniature Kelvin clips (KC2) with 1 meter leads attached terminated with banana plugs Jaw opening 6mm. Suitable for fine wires.

14.2 WIRE CLAMPS For the precise measurement of 1 meter cable samples we offer 2 wire clamp options.

Ordering Code	Description
C01	1 metre wire clamp with hardwood base suitable for cable diameters up to 25mm
C02	1 metre wire clamp with metal base and provision for temperature sensor suitable for wire cross section 1 to 1000mm