# FOUR TERMINAL RESISTANCE BRIDGE
## (KELVIN BRIDGE)

# TYPE KB3

# SPECIFICATION

| Test Object Rx | Range Selector Position x BY | Accuracy | Resolution as seen on null detector |
|---|---|---|---|
| 1,000 Ω | 100 | ± 1 Ω | 1 Ω |
| 500 Ω | 100 | | 1 Ω |
| 100 Ω | 100 | | 1 Ω |
| 100 Ω | 10 | ± 100 mΩ | 100 mΩ |
| 50 Ω | 10 | | 100 mΩ |
| 10 Ω | 19 | | 100 mΩ |
| 10 Ω | 1 | ± 10 mΩ | 10 mΩ |
| 5 Ω | 1 | | 10 mΩ |
| 1 Ω | 1 | | 10 mΩ |
| 1 Ω | 0.1 | ± 1 mΩ | 1 mΩ |
| 0.5 Ω | 0.1 | | 1 mΩ |
| 0.1 Ω | 0.1 | | 1 mΩ |
| 0.1 Ω | 0.01 | ± 200 μΩ | 200 μΩ |
| 0.05 Ω | 0.01 | | 100 μΩ |
| 0.01 Ω | 0.01 | | 100 μΩ |
| 10 mΩ | 0.001 | ± 50 μΩ | 50 μΩ |
| 5 mΩ | 0.001 | ± 30 μΩ | 30 μΩ |
| 1 mΩ | 0.001 | ± 20 μΩ | 10 μΩ |
| 500 μΩ | 0.001 | ± 10 μΩ | 10 μΩ |
| 100 μΩ | 0.001 | ± 10 μΩ | 10 μΩ |
| 50 μΩ | 0.001 | — | 10 μΩ |
| 10 μΩ | 0.001 | — | 10 μΩ |

Coils: “Manganin” non-inductive

Switches: “CROPICO” type SP1

Batteries: Bridge 1 x Alkaline – Manganese Dioxide Size D Ever Ready R20
Detector 1X Leclanché 26.5 x 17.5 x 48.4mm Ever Ready Type PP3

Terminals: Insulated will accept 4 mm banana plug or spade tags

Test Leads: The bridge is supplied with four test leads 1 metre in length terminated with banana plugs. For connection to the test object crocodile clips test prods and two combined potential and current probes are provided (see fig. 2). These probes will accept rods up to a diameter of 5mm

Case: “Melamine” moulded

Weight: 6.5 kg

Size: 330 x 240 x 200mm

Method of Operation: Rx = Range selector position x dial reading

(3) Noise < 2μV.

(4) Battery Every Ready PP3 current consumption 2.5mA

# FOUR TERMINAL RESISTANCE BRIDGE TYPE KB3

## Operating Instructions

### INTRODUCTION

Instruments are delivered ready for immediate use fitted with batteries and complete with a set of test leads. No extras are required. When unpacked, inspect for physical damage and report any defects immediately in writing, retaining packaging materials for inspection.

### FOUR TERMIANL RESISTANCE MEASUREMENT

This is a Kelvin (Thomson) resistance bridge for the measurement of resistance in the range of a few microhms to 1,110 ohms.

The incorporation of a d.c. electronic null detector of high sensitivity, ensures a low bridge current, and makes possible operation by means of one single dry battery.

This is a four terminal bridge which operates on the null balance principle, it has three 11 position measuring dials having resistance values of 10 x 100, 10 x 10 and 10 x 1 ohms. The dials are numbered 0 to 9 with an "X" in position 10. Six internal standards with vales of 0.1, 1, 10, 100, 1,000 and 10,000 ohms are selected by a single range switch.

### OHMMETER CONNECTIONS

(a) Connect the black leads to the $C_1$ and $P_1$ 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. 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) Figs. 1, 2, 3 and 4 illustrate 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.

### NULL DETECTOR

(1) Solid state with three cascaded differentially connected stages to give zero stability with change of temperature and battery voltage.

(2) Zero drift with temperature 1$\mu$V per degree C.

One normally associates the employment of high currents when measuring resistance with a Kelvin type bridge. This is due to the fact that in the past current sensitive galvanometers have been employed as null detectors and high currents were necessary to obtain the resolution required. Now that the electronic d.c. null detector is in common usage it is possible to manufacture Kelvin bridges with higher resistive components than hitherto, thus considerably reducing the bridge current. In consequence of this the "CROPICO" bridge type KB3 is suitable for use with temperature sensing devices such as themistors and resistance thermometers.

| Using the leads supplied, which have a resistance of 0.02 ohm, you will see that the errors due to lead resistance will be negligible | | |
|---|---|---|
| Rx | Range Selector position Multiply By | Error due to Lead Resistance |
| 100 ohms | 100 | 0.02 ohm |
| 10 ohms | 100 | 0.02 ohm |
| 0.01 ohm | 0.001 | 0.2 microhm |
| 0.001 ohm | 0.001 | 0.02 microhm |
| 0.0001 ohm | 0.001 | 0.2 microhm |

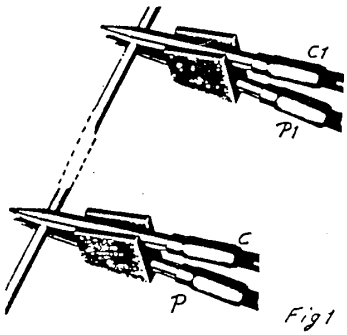
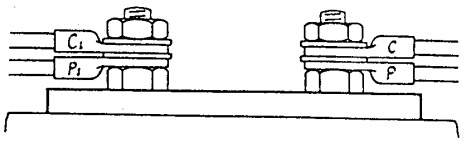
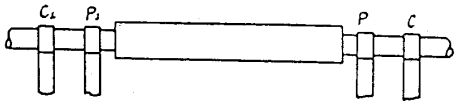


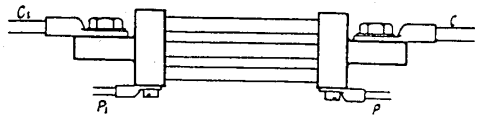
Fig 1



Connections to Stud Terminals Fig 2



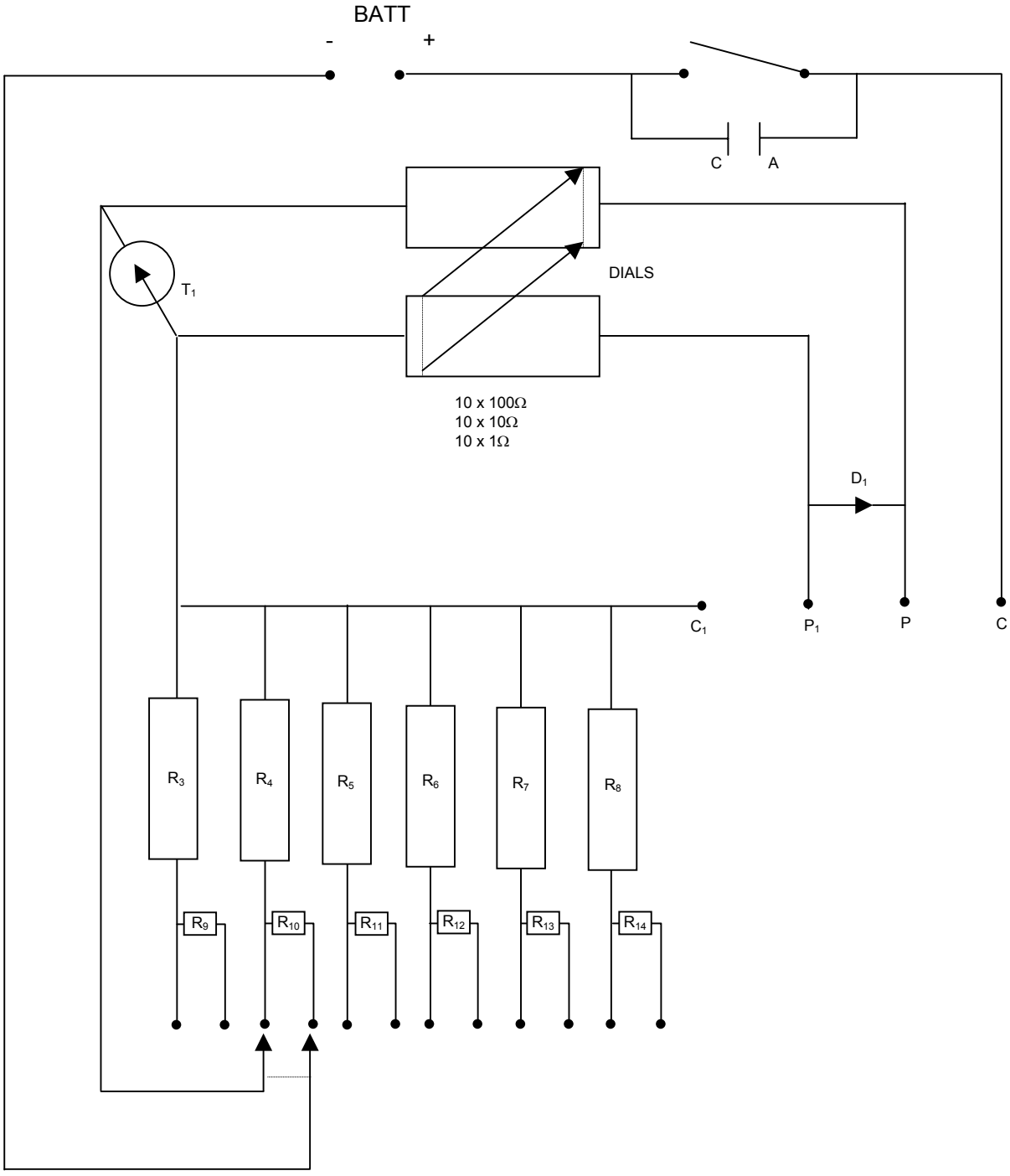
Connections to Cable Joint Fig 3



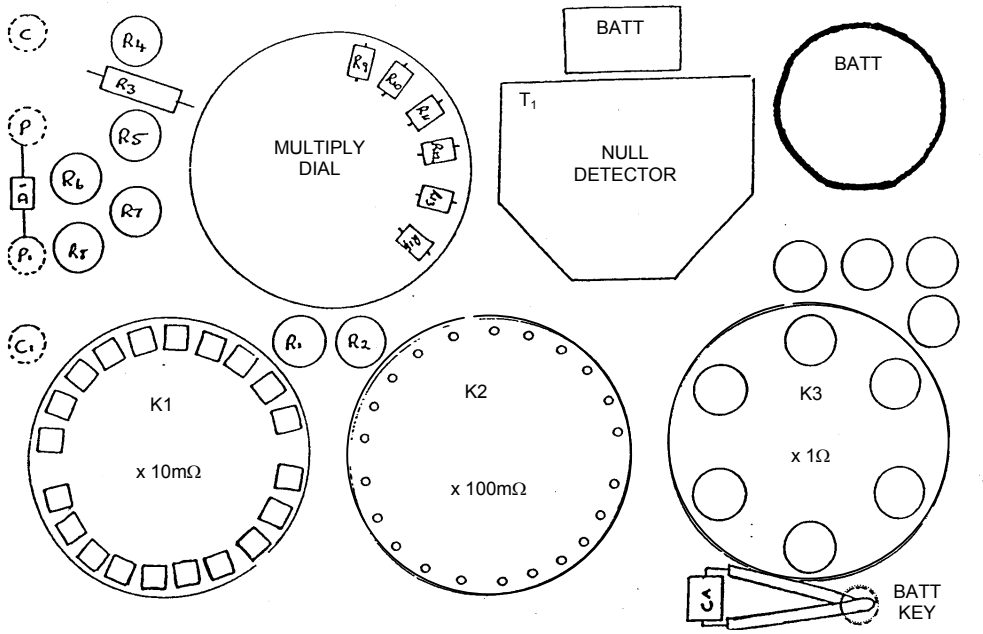
Connections to Current Shunt Fig 4

| Range Selector Multiply by | Range Full Scale Ohms | Resolution | Current Rx |
|---|---|---|---|
| 100 | 1,110 | 1 ohm | 35 microamps |
| 10 | 111 | 0.1 ohm | 0.3milliamps |
| 1 | 11.1 | 0.01 ohm | 1.5milliamps |
| 0.1 | 1.11 | 1 milliohm | 15 milliamps |
| 0.01 | 0.111 | 100 microhm | 60 milliamps |
| 0.001 | 0.0111 | 10 microhm | 300 milliamps |

# CIRCUIT DIAGRAM TYPE KB3



## CIRCUIT LAYOUT TYPE KB3




## COMPONENTS LIST
## TYPE KB3

| | | |
|---|---|---|
| D1 | 1N5404 | |
| CA | 0.01μF | 630V dc ±20% |
| R1 | 10K ohms | CROPICO MANGANIN COIL |
| R2 | 10K ohms | CROPICO MANGANIN COIL |
| R3 | 0.1 ohm | CROPICO MANGANIN COIL |
| R4 | 1 ohm | CROPICO MANGANIN COIL |
| R5 | 10 ohm | CROPICO MANGANIN COIL |
| R6 | 100 ohm | CROPICO MANGANIN COIL |
| R7 | 1K ohm | CROPICO MANGANIN COIL |
| R8 | 10K ohm | CROPICO MANGANIN COIL |
| R9 | 3.3 ohm | METAL FILM 0.5W ± 1% |
| R10 | 18 ohm | METAL FILM 0.5W ± 1% |
| R11 | 100 ohm | METAL FILM 0.5W ± 1% |
| R12 | 820 ohm | METAL FILM 0.5W ± 1% |
| R13 | 3.9K ohm | METAL FILM 0.5W ± 1% |
| R14 | 22K ohm | CARBON FILM 0.25W + 1% |
| T1 | NULL DETECTOR | |
| K1 | 20 x 1 ohm | CROPICO MANAGININ COIL |
| K2 | 20 x 10 ohm | CROPICO MANAGININ COIL |
| K3 | 20 x 100 ohm | CROPICO MANAGININ COIL |

# MAINTENANCE

Due to the robust construction of this instrument, very little maintenance should be required. Nevertheless, if it is used in dusty or dirty conditions, the switches and contacts should be cleaned once a year. Proceed as follows:

(1) Remove all the knobs from the instrument. The large 42mm. Diameter knobs are secured by 2BA socket set screws, which can be loosened with a 3/32" hexagon key. Slotted 4BA set screws secure all the small knobs.

(2) Remove the 6 wood screws around the edge of the panel, carefully take the instrument out of its case.

(3) Remove the detector battery cover panel (2 screws), underneath this panel there are two screws which secure the detector to the top panel. Remove these, the null detector will then be loose, but still connected to the bridge by 2 leads.

(4) Take off the top panel by removing the 4 large screws (one on each corner of the panel). The switches are then exposed.

(5) Remove any dust that may have got into the instrument.

(6) To clean the ratio and 3 dial measuring arm switches, use a piece of lint-free cloth wrapped around a small screwdriver; clean the contact surfaces of all the stud contacts and centre return contact. If this is not sufficient, dampen the cloth with either methylated spirit or carbon tetrachloride and clean them again. Lightly lubricate all the cleaned contacts with a good quality contact grease or oil. Use only enough grease to lightly cover the switch studs.

(7) Detector and battery key contacts are silver and may not need any attention. If they appear to be dirty, wipe over with a lint-free cloth, being careful not to distort the contact arms. ***Do not grease***.

(8) Reversing the dismantling procedure, re-assemble the instrument.

(9) Note that any servicing should only be carried out by competent technicians, and care must be exercised not to damage the resistors when the instrument is out of its box. We have our own Service Department, and instruments can be returned to us for service and repair for which we offer a first-class service at reasonable cost.

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