CROPICO-TEST

TYPE CF6

OPERATING INSTRUCITONS

The Cropico-Test is supplied complete with all necessary dry batteries ready for immediate use.

Before taking any measurements, it is necessary to switch on and zero the null detector.

(a) Set detector centre knob to zero 1, wait a few minutes and adjust zero 1 control to bring the detector pointer to a null point (centre scale).

(b) Switch to zero 2, and adjust the zero 2 control to bring the pointer to centre.

(c) Switch to null – this is the operational position.

(d) If these controls fail to operate, replace the battery.

Use as a Wheatstone Bridge

When used as a Wheatstone Bridge, the practical measuring range is 1 ohm to 10 megohms. To ascertain the best range to use for maximum resolution, see fig. 1. Bear in mind that when measuring low values the lead resistance can be significant, in which case the resistance of the leads can be measured on the bridge and subtracted from the measured value. Due to the high sensitivity of the electronic null detector, the 9-volt battery supplied with the bridge should be adequate for the range of the bridge.

(1) Connect the test resistor or cable to the terminals X1 and X2. Make sure that the wires are clean and the terminals are tight. Assume the usual situation, that the value of the resistance to be measured is unknown, proceed as follows:

(2) Set the detector sensitivity control near its minimum and the M.V.R. switch to position R.

(3) Set the measuring dials to maximum and the range switch on the lowest range.

(4) Press the battery and detector keys. If the detector is deflected to the right set the range switch to the next higher range and press the keys.

(5) Repeat until a deflection to the left is obtained, then adjust the dials until a balance is obtained increasing the detector sensitivity as necessary.

(6) At balance, no movement of the pointer should be detected as the detector key is pressed or released whilst the battery key is held down.

(7) The value of Rx is the dial setting multiplied by the range.

(8) When the detector is deflected to the right, the dial setting should be increased and vice versa.

(9) When measuring conductors which are inductive or capacitive as in the case of cables, always press the battery key first and release the detector key before the battery key.

Typical Operating Conditions Wheatstone Bridge

TEST RESISTOR RX	RANGE X By	VARIABLE ARM SETTING	RESOLUTION WITH INTERNAL DETECTOR
0.1 ohms	0.001	100	1.0%
0.5 ohms	0.001	500	0.2%
1.0 ohms	0.001	1,000	0.1%
5.0 ohms	0.001	5,000	0.04%
10 ohms	0.001	10,000	0.04%
50 ohms	0.010	5,000	0.02%
100 ohms	0.010	10,000	0.01%
500 ohms	0.100	5,000	0.02%
1,000 ohms	0.100	10,000	0.01%
5,000 ohms	1.000	5,000	0.02%
10,000 ohms	1.000	10,000	0.01%
50,000 ohms	10.000	5,000	0.02%
100,000 ohms	10.000	10,000	0.01%
500,000 ohms	100.000	1,000	0.02%

Fig.1

Null Detector

The internal electronic null detector is internally connected to two 4mm. sockets on the instrument panel, and when used with the bridge is connected by links to two 4mm. sockets, also on the instrument panel. Thus it is possible to use the detector with other measuring system, or connect another possibly more sensitive detector to the bridge.

a) To use the bridge with a more sensitive null detector, remove the two links and connect to the two 4mm. sockets marked ***Bridge.***

b) To use the detector with another system, remove the links and connect to the two 4mm. sockets marked ***Detector.***

External Power Supply

When an external power supply of a higher voltage than that supplied with the bridge is required due to a high resistance earth when taking measurements using one of the loop systems, connect the external battery in place of the one supplied to the terminals marked Batt. +, -. The maximum external voltage is 50 dc. This should be adequate due to the high sensitivity of the null detector.

Use as a Resistance Box

The r-dial measuring arm of the bridge can be used as a resistance box. Connect to the terminals marked R and X2. The total available resistance is 10,110 ohms; the smallest subdivision is 1 ohm. The residual resistance is 0.01 ohm. The M.V.R. switch must be in the position R or V not M. Do not press the BATT or DET keys.

Cable Testing Fault Location

Tracing an earthed conductor in a multi-core cable.

(1) Set the X1000 dial to the ∞ position

(2) Connect the "E" terminal to earth.

(3) Connect a test lead and prod to terminal X1.

(4) Set M.V.R. switch to V.

(5) Set range switch to X1 and sensitivity control to MIN.

(6) Prod each of the conductors in turn with the lead connected to X1.

(7) On touching an earthed conductor, the detector will move to the left, note that it will give full scale deflection on MIN sensitivity with a 50 kilohm earth connection.

(8) To take a reading, the BATT. and DET keys must be pressed.

Simple Insulation Testing

As this test set incorporates a sensitive null detector and 9 volt battery it can, of course, be used for determining insulation resistance. The results will be very approximate as the battery voltage is not stabilised.

(1) Connect the test object RX, to the X1 and E terminals.

(2) Set detector sensitivity control to Max.

(3) 9 volt battery connected to battery terminals.

(4) Set M.V.R. switch to "V".

(5) Press BATT and DET keys.

Range	**Value of RX for detector full scale deflection**
X1,000	50 Megohms
X1	25 Megohms
X0.1	5 Megohms
X0.01	0.5 Megohms

Tips and Hints – Loop Tests

(1) Always use as one wire of the loop a wire that is identical to the faulty wire, i.e. a wire in the same cable. This means they will have identical lengths, and errors will be minimised. A good wire should have a high insulation to earth and other wires in the cable.

(2) Do not rely on wire resistance obtained from wire tables. Use the methods and formula which determine the resistance to the fault as a fraction of the total length of the loop of the faulty wire.

(3) Always make good clean connections to the test set and at the distant end of the loop.

(4) Multiple faults when taking loop tests are very nearly impossible to identify, as a balance on the bridge cannot be obtained. Make tests from both ends.

(5) High resistance faults to earth, or disappearing earth faults can be difficult to trace. The use of higher battery volts on the bridge and taking a quick reading will sometimes help.

(6) Use the Murray Loop for locating faults in low resistance loops. Note that lead resistance forms part of R1 and R2 and can be significant.

(7) When only one good conductor, which is of a different length and size to the fault conductor is available, make a Murray Loop Test at each end of the cable.

(8) Use the Varley Loop for fault location in high resistance loops. For best location the bridge ratio should be as low as possible.

(9) In some faults, thermal emfs are present at the cable connections which make it advisable to reverse the battery connections. Make measurements with normal and reverse polarities and take the mean of the readings.

(10) The two ratios 1/9 and ¼ make an easy calculation of Varley Loop measurements.

Viz:

1/4 Ratio $$R1 = \frac{R + \text{Dial Setting}}{5}$$

1/9 Ratio $$R1 = \frac{R + \text{Dial Setting}}{10}$$

Measurement of Cable Loop Resistance

Use the CROPICO-TEST as a Wheatstone Bridge with two conductors connected to the terminals X1 and X2 and joined at the distance end. The loop resistance can be measured.

Measurement of Conductor Resistance

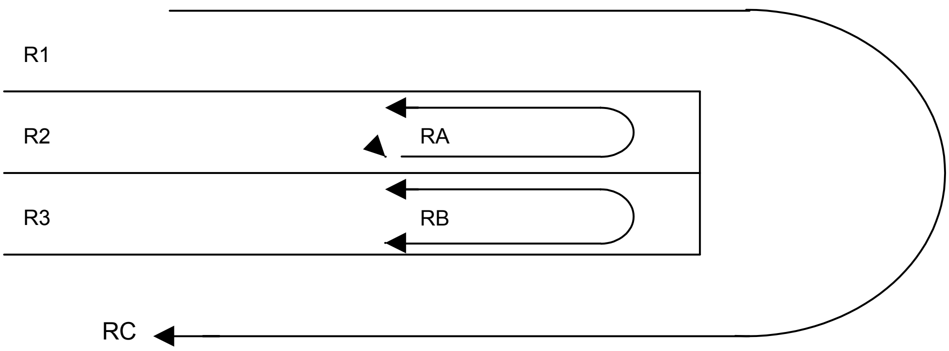


Fig. 2

Using three conductors connected together at their distant end, their individual resistance can be determined as follows:

The test set is used as a Wheatstone Bridge. Name the conductors R1, R2 and R3 and the loops RA, RB and RC.

$RA = R1 + R2$, $RB = R2 + R3$ $RC = R1 + R3$

$$R1 = \frac{RA+RC-RB}{2} \qquad R2- = \frac{RA+RB-RC}{2} \qquad R3 = \frac{RB+RC-RA}{2}$$

Loop Tests

Can be carried out for the location of either a ground or a short-circuit fault, provided that a sound cable runs along with the grounded cable, or with the two cables (or cores in a multi-core cable), which are short-circuited.

Murray/Varley Loop Short Circuit Fault

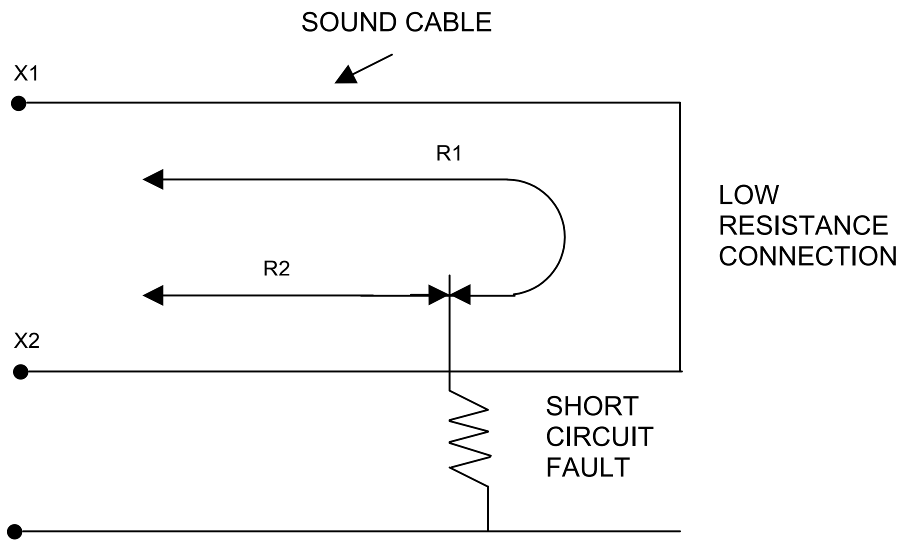


Fig. 3

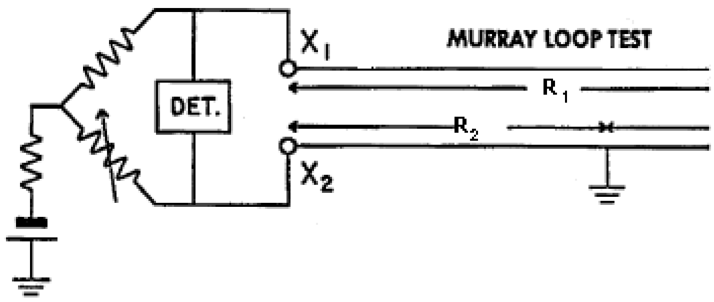
(a) Connect the sound cable R1 to X1.
(b) Connect the short-circuited cable R2 to X2.
(c) Connect the R1 an dR2 together at the distant end.
(d) Connect the other short-circuited cable to test set terminal E.
(e) Measure the loop resistance R1 + R2 = R

Murray Loop

The Murray Loop test is used for locating faults in low resistance loops, such as short lengths of communications and power cables. Fig. 4 shows the connections for an earth fault and Fig. 3 for a short circuit fault. The Murray Loop test is a ration test in which

$$\frac{R1}{R2} = \frac{\text{M Ratio}}{\text{Dial Setting}}$$

As the four measuring dials have a total resistance of 10 kilohms, best sensitivity and accuracy is realised with a dial setting between 1 and 10 kilohms, using the M1000 ration. See the chart for typical operating conditions



Use the Wheatstone Bridge to measure loop resistance (R_1 + R_2) as R ohms. With the selector switch in M position and using M ratios.

At balance

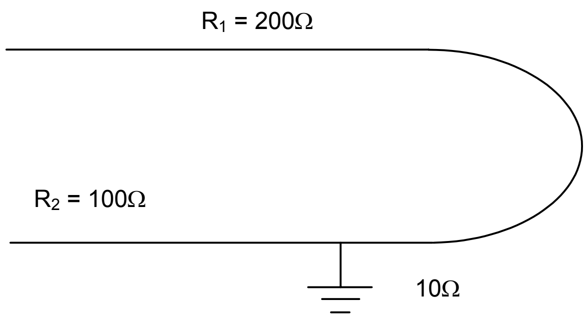
$$\text{Resistance of } R_1 = \frac{\text{R x M Ratio}}{\text{M Ration + Dial Setting}} \text{ ohms}$$

$$\text{Resistance of } R_2 = \frac{\text{R x Dial Setting}}{\text{M Ration + Dial Setting}} \text{ ohms}$$

Fig. 4

Note: in this test the detector movement is reversed.

example 1.



Let loop resistance R1 + R2 = 300Ω
Measure using Murray (M) setting
M Ratio – 1000
Dial Setting = 500

$$\text{The Resistance } R_1 = \frac{\text{R x MRatio}}{\text{MRatio + Dial Setting}} = \frac{300 \text{ x } 1000}{1000 + 500} = \frac{300000}{1500} = 200\Omega$$

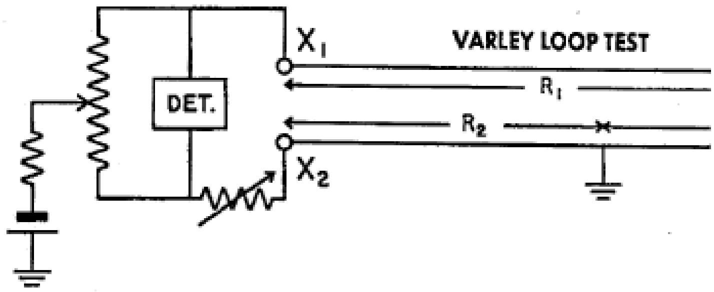
$$\text{The Resistance of R2} = \frac{\text{R x Dial Setting}}{\text{M Ratio + Setting}} = \frac{300 \text{ x } 500}{1000 = 500} = \frac{150000}{150} = 100\Omega$$

Varley Loop

This loop test is for fault location in high resistance loops. It differs from the Murray circuit in the sense that a portion of the loop is made up by the 4-dial measuring are in the test set. To obtain satisfactory fault location, the bridge ratio dial should be as low as possible.

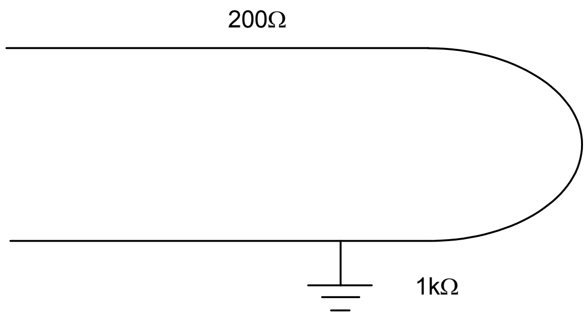
$$\text{Ratio} = \frac{R1}{R2 + \text{Dial Setting}}$$

The dials have a minimum value of 1 ohm, therefore R2 can be determined to an accuracy of 1 ohm on the XX1 ratio, and 0.1 ohm on the X0.1 ratio etc.



Use the Wheatstone Bridge to measure loop resistance (R1 + R2) as R ohms. With the selector switch in V position and using a ratio setting between.001 and 1000.

example 2.



Let Loop Resistance R = R1 + R2 = 300Ω
Measure using Varley (V) Setting
Ratio = 0.1
Dial Setting = 1900Ω

$$\text{The Resistance R1} = \frac{\text{Ratio Setting (R + Dial Setting)}}{\text{Ratio Setting + 1}} = \frac{0.1\,(300 + 1900)}{0.1 + 1} = \frac{220}{1.1} = 200\Omega$$

$$\text{The Resistance R2} = \frac{\text{R – (Ratio x Dial Setting)}}{\text{Ratio Setting + 1}} = \frac{300 - (0.1 \times 1900)}{0.1 + 1} = \frac{110}{1.1} = 100\Omega$$

Typical Operating Conditions Murray and Varley Loop Tests

The resistance of the bridge at the battery terminals when used to measure low resistance loops is a minimum of 1,000 ohms. It increases with earth and loop resistance. The sensitivity of the bridge balance is proportional to the battery current, and decreases with increased loop and earth resistance. The following tables give detector sensitivity figures with zero earth resistance for Murray and Varley loops. An earth resistance of 1 kilohm will approximately halve the sensitivity shown and 10 kilohm will reduce it by 90%. The figures have been taken with 9 volts on the bridge and zero earth resistance. The resolution figures indicate sensitivity using the internal null detector expressed as mm. deflection against ohms.

Loop Resistance Ohms	R1 Ohms	R2 Ohms	Resolution mm. ohms	Ration	Dial Setting
10	0.10	9.90	1 = 0.0002	M 10	990
10	0.10	9.90	1 = 0.0002	M 100	9900
10	1.00	9.00	1 = 0.004	M 1000	9000
10	3.33	6.66	2 = 0.0016	M 1000	2000
100	0.10	99.90	1 = 0.0002	M 10	9990
100	1.00	99.00	1 = 0.0004	M 100	9900
100	10.00	90.00	1 = 0.001	M 1000	9000
100	33.30	66.60	20 = 0.015	M 1000	2000

Varley Loop

Loop Resistance Kilohms	R1 Ohms	R2 Ohms	Resolution mm. ohms	Ration	Dial Setting
1	550	450	30 = 1	X1	100
1	550	450	10 = 0.1	X0.1	5050
1	900	100	30 = 1	X1	800
1	900	100	5 = 0.1	X0.1	8900
1	100	900	1 = 0.01	X0.01	9100
1	100	900	1 = 0.1	X0.1	100
10	9000	1000	5 = 1	X1	8000
10	5500	4500	10 = 1	X1	1000
10	1000	9000	4 = 0.1	X0.1	1000
10	1700	8300	2 = 0.1	X0.1	8700
10	180	9820	2 = 0.02	X0.01	8180
10	100	9900	1 = 0.01	X0.01	100

Conversion from Resistance in ohms to length

Where both conductors are of uniform size and temperature, the conversion to length is easy as seen in the following example:-

If the length of each conductor is 2652 metres the length of the loop is:-

2 x 2652 metres = 5304.

If $\frac{R1}{R2} = 1.65$

The length of R2 = $\frac{5304}{1+1.65}$ = 2001.5 metres

Where conductors are known to be of a different diameter but the same length, the method of determining the resistance of each conductor is first used. If the loop resistance is 505.3 ohms, and one of the same length but 360.8 ohms using the loop test R1 = 314.7, R2 = 190.6

If the larger diameter wire is connected to X1, then the R1 measurement of 314.7 ohms has in it all the 144.5 ohms of wire to the far end termination, plus 170.2 ohms of the thinner wire from the far end to the fault.

The resistance to the fault from this end, R2 = 190.6 therefore the distance from this end to the fault

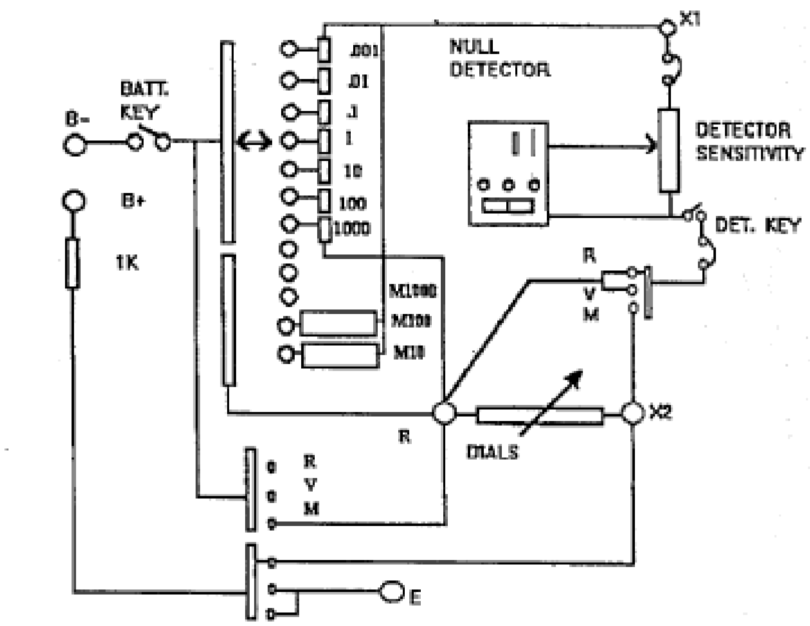
$$= \frac{190.6}{360.8} \times 2652 \text{ metres} = 1401 \text{ metres}$$

Commonly Used Cables

Approximate Resistance at 20°C

Note: The resistance of copper increases 0.4% for 1°C rise in temp.

Wire dia. In mm.	Ohms per km.	Metres per ohm
0.32	218.0	4.59
0.40	136.0	7.35
0.50	84.0	11.90
0.63	54.5	18.35
0.90	27.2	36.76



CROPICO-TEST TYPE CF6

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 4 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.

Additional Products From Cropico

DIGITAL OHMMETERS

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RESISTANCE STANDARDS

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