



**MITTON**  
INSTRUMENTS

# **Instruction Manual**

**M1000**

**Micro-ohmmeter**

**Rev 00**

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## 1 Introduction

The M1000 is a portable micro-ohm measurement instrument designed to measure heavy current conductors and joints. It is a 4-terminal instrument which overcomes connection resistances of test leads and probes. The M1000 has been designed to work in electrically noisy HV environments.

The M1000 uses a combination of hardware and software filters combined with a reversing dc test current of up to 1 A to minimise electrolytic effects and noise in the test leads.

The M1000 has a simple two button interface for power and mode selection.

This manual describes the operation of the M1000 in its various modes.

## 2 Features

The M1000 front panel and operation is straightforward and as detailed in the next sections. P1, C1 are connected to one side of the joint of section of conductor under test. P2, C2 are connected to the other side. For short lengths of conductor and joints, keep P1 and P2 "inside" C1 and C2.



Figure 1: M1000

## **3 Operation**

Two different test modes are available: micro-ohms single shot, micro-ohms continuous. Single shot mode takes a single measurement.

The different operating modes are selected by sequential pressing of the Power button (after first powering on).

### **3.1 Probe Integrity Test**

At the commencement of each test, the M1000 verifies the integrity of the test leads and P1, P2, C1, C2 probe contact resistance, to ensure that measurements can be made.

The M1000 will auto-range should there be significant noise (eg 50 Hz) appearing on the P1, P2 connections. In the event of total input voltage (eg noise) exceeding  $\pm 13.75$  V peak, P1, P2 over-range check probes will appear after the initial probe test.

It is essential that P1, C1 and P2, C2 be independently connected to the conductor under test. This will eliminate any test probe contact resistance.

If there is no activity for 2 minutes the M1000 will automatically shut down to conserve the battery.

### **3.2 Micro-ohmmeter Measurement Mode**

The M1000 operates at a frequency of approximately 1.5 Hz. It can measure down to several micro-ohms and is suited to measuring the resistance of earth conductors, joints, connections, interconnection conductors (eg plant bonding) and also switch contacts.

Two separate operating modes are available. The first is one shot operation and the second is continuous operation should it not be practical to press the test button. Ensure good contact is being made with all connections otherwise measurement errors may result.

If the resistance measurement exceeds 200  $\Omega$ , "C1 + C2 probes high resistance" will be displayed.

### **3.3 Battery Charging**

The M1000 has an internal 11.1 V Li-ion battery with internal charge control. An external 15 Vdc 2 A supply (plug centre positive) is used to charge the battery. A charging icon and a low battery message will also show on the display. Full charge is approximately 12.6 V.

## **4 Field Testing**

This section describes some of the practical aspects of field testing.

### **4.1 Test Probes**

Recommended test probes are crocodile test clips or multimeter probes. The probes must make good electrical contact with the conductor under test.

### **4.2 Test Plugs**

The M1000 will accept 4 mm banana plugs and banana plugs should be used on the test cables. Good quality (gold plated if available) plugs should be used. Plugs and cables should be checked and if necessary repaired or changed should wear and tear, looseness or dirt become apparent.

## 4.3 Test Cables

Test cables and associated plugs should be thoroughly checked for integrity prior to any field testing.

Suggested cable is twin 0.75 mm<sup>2</sup> twin flexible, pvc insulated (eg speaker wire). P1, C1 can be short lengths (eg 1 m) and P2, C2 can be 25 m length to enable roaming throughout the switchyard. Another 1 m length can also be used for P2, C2 for joint tests.

Take care in switchyards not to pull the test cables in case they flick up into live equipment.

## 5 Four wire connection

This diagram shows the four wire connection method. Referring to figure 2 the resistance reported will be the resistance between the P1 and P2 test probes, C1 and C2 are connected using separate test clips and on the outer sides of P1 and P2.

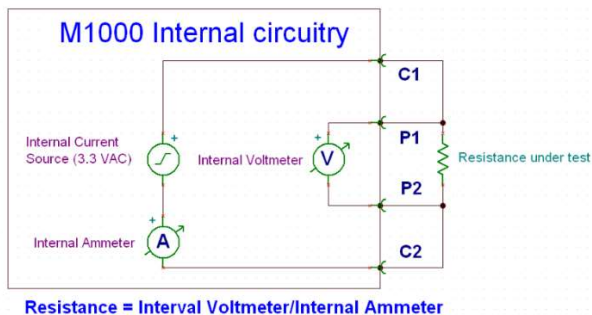


Figure 2: 4 wire connection

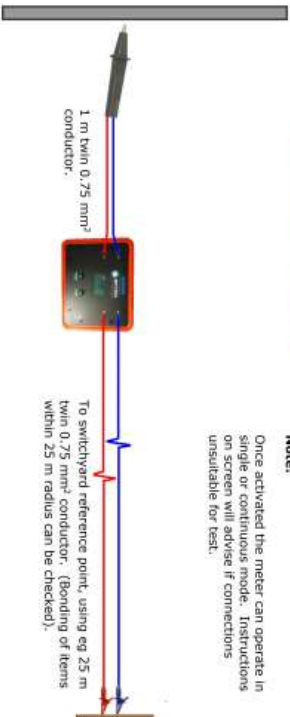
### Operation



- Connect P1, C1 & P2, C2 separately & individually to conductor or metalwork to eliminate contact resistance.
- Press Power to activate meter.
- Press Start to commence measurements.
- Press 2 sec to switch off.
- Clean metal surface prior to probe/clip connection (battery grinder).

### Note:

Once activated the meter can operate in single or continuous mode. Instructions on screen will advise if connections unsuitable for test.



Switchyard structure under test. Use dual connection (sq twin probe or two clips).

Test set-up for plant bonding tests. Choose convenient earth reference point in switchyard. For large switchyards several reference points may be required. Measure bonding resistance between consecutive reference points prior to relocating test leads.

Shorter cables may be used for joint testing.

### M1000 Description

Suitable for measuring resistance of operator in live switchyard joints, plant & structure bonding, contacts. Can operate in live switchyard where induced current may be present in earth grid conductors & metallic items. Low test current means lightweight, long test leads can be used. Measurement range 0  $\mu\Omega$  - 300  $\Omega$ . Test current 1 A reversing dc, 4-wire method.

Battery 11.1 V Li-Ion

P1, P2 = Voltage sensing  
C1, C2 = Current source

### Notes:

Prior to testing:

- Charge battery
- Check test lead integrity

### Warning:

When using long leads in switchyard avoid pulling in case of lead flick-up into live structure.



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## M1000 Micro-ohmmeter Operation

## 6 Specifications

### Range<sup>[1]</sup> ( $\mu\Omega$ ):

(The instrument is auto ranging)

0  $\mu\Omega$  - 999  $\mu\Omega$ , resolution 1  $\mu\Omega$

1.000 m $\Omega$  - 9.999 m $\Omega$ , resolution 1  $\mu\Omega$

10.00 m $\Omega$  - 99.99 m $\Omega$ , resolution 10  $\mu\Omega$

100.0 m $\Omega$  - 999.9 m $\Omega$ , resolution 100  $\mu\Omega$

1.000  $\Omega$  - 9.999  $\Omega$ , resolution 1m $\Omega$

10.00  $\Omega$  - 100.0  $\Omega$ , resolution 10m $\Omega$

100.0  $\Omega$  - 200.0  $\Omega$ , resolution 100m $\Omega$

**Accuracy:**  $\pm 0.5\%$  + 2 digits

**Operating temperature:** -5°C - 40°C

**Input impedance (P probes):** 220 k $\Omega$

**Output current (C probes):** +/- 1 A max

**Open circuit Output voltage (C probes):** +/-3.3 V max

**Test frequency:** 1.5 Hz

**Maximum input voltage (P probes)<sup>[2]</sup>:** +/- 13.75 V max

**Display:** LCD

**Power supply:** 11.1 V 4.4 Ahr Li-ion

**Battery life:** 12 hrs, charging time approx 4 hrs

**Weight:** 1 kg

**Dimensions:** 270 mm x 240 mm x 125 mm

[1] The instrument internally auto-ranges using 4 internal P probe voltage ranges (13.75 V, 1.375 V, 137.5 mV and 13.75 mV) and two internal current ranges (1 A and 100 mA)

[2] Maximum measurement range, the instrument will accept P probe voltages up to +/-50 V without damage

## 7 Contact Details

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