

# Megger<sup>®</sup>

# Megger<sup>®</sup>

**Megger Limited**  
Archcliffe Road  
Dover, Kent CT17 9EN  
England  
T +44 (0)1 304 502101  
F +44 (0)1 304 207342

**Megger**  
4271 Bronze Way,  
Dallas, TX 75237-1019  
USA  
T +1 800 723 2861  
T +1 214 333 3201  
F +1 214 331 7399

**Megger**  
Z.A. Du Buisson de la Couldre  
23 rue Eugène Henaff 78190  
Trappes, France  
T +33 (0) 1 30.16.08.90  
F +33 (0) 1 34.61.23.77

## **MFT1735**

### **User guide addendum**

#### **Other technical sales offices**

Toronto Canada, Sydney Australia, Mumbai India, Madrid Spain and the Kingdom of Bahrain.  
Megger products are distributed in 146 countries worldwide.

**This instrument is manufactured in the United Kingdom.**

**The company reserves the right to change the specification or design without prior notice.**

**Megger is a registered trademark**

**Part No. 2005-290**

**MFT1735\_ad\_en\_V02**

**[www.megger.com](http://www.megger.com)**

The word 'Megger' is a registered trademark

Operation of the MFT1735 is identical to the MFT1730 except for the following section on Earth Testing.

For Safety Warnings refer to the printed Quick Start Guide.

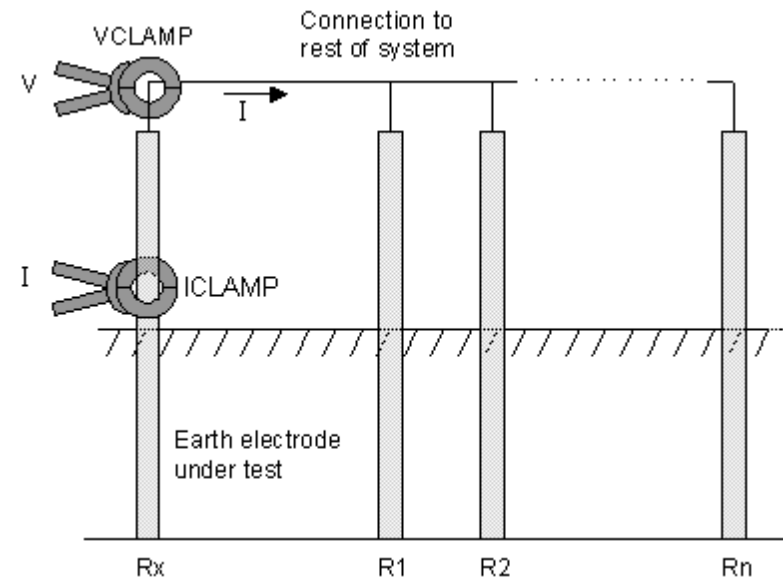
For all other operating instructions, refer to the MFT1730 sections within the full User Guide on the included CD.

**F.3 Principle of operation (two-clamp stake-less resistance measurement)**

In this example, the electrode under test is connected to a network of other electrodes. It is either impractical or unsafe to disconnect an individual electrode for testing. Also, there might be insufficient space to perform a classic three-terminal resistance measurement. The stake-less test method using both VCLAMP and ICLAMP can be used to obtain a measurement for the electrode under test.

A defined test voltage is injected into the system using the VCLAMP, inducing a current, I, to flow and be measured by the ICLAMP. The model shown in Figure 7 can be simplified to the resistance of the electrode under test,  $R_x$  and the resistance of the other electrodes in parallel, i.e.  $R_1 \parallel R_2 \parallel \dots \parallel R_n$ .

Therefore, the current induced by the test voltage is  $I=V/[R_x+(R_1 \parallel R_2 \parallel \dots \parallel R_n)]$ . It follows that as the resistance of the other electrodes in parallel approaches zero, then the resistance measured, approaches the value of the electrode under test.

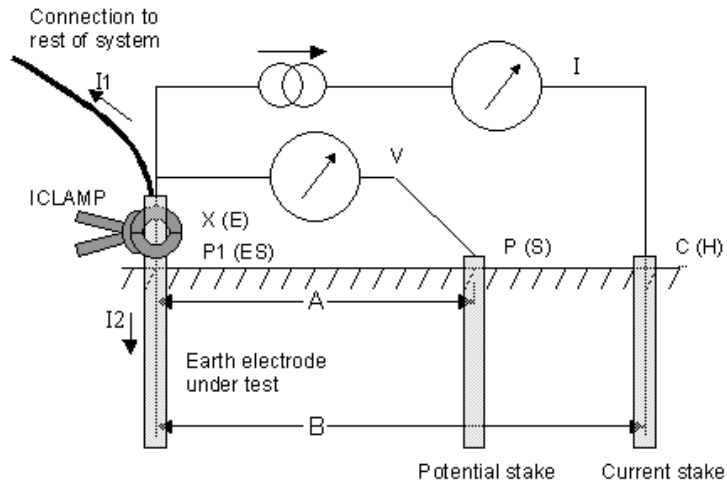


Schematic for two-clamp stake-less resistance measurement

## F.2 Principle of operation (three-terminal resistance measurement using ART)

The classic three-terminal test method has a disadvantage, namely that the electrode under test must be disconnected from the system it is supposed to protect in the event of a power system fault. The reason for this is that the injected test current will take all possible routes to ground and not all of it will necessarily flow through the electrode under test. In this case, the instrument will make a reading of the entire earthing network, not just the individual electrode.

By using a current transducer (the Megger ICLAMP) to measure the current flowing through the electrode under test as a fraction of the total test current injected, the instrument can determine the individual resistance. This arrangement is shown below:



Schematic for three-terminal resistance measurement using

In this configuration, the injected test current  $I$  splits along two paths into  $I_1$  (flowing into the connected earthing system) and  $I_2$  (flowing into the electrode under test, i.e.  $I=I_1+I_2$ ). The resistance of the electrode under test is calculated as  $R=V/I_2$  or  $R=V/(I-I_1)$ . The current transducer (ICLAMP) measures  $I_2$  and feeds this value back to the instrument.

## 9. Earth resistance measurement

The Megger MFT1735 offers a unique solution to the measurement of earth or ground electrode (rod) supporting 2 and 3 wire measurements:

The MFT1735 can use an optional current clamp (ICLAMP) to measure electrode (rod) resistance without disconnection, leaving the installation earthing system intact (Attached Rod Technique, ART). Additionally, the MFT1735 can drive an optional voltage-inducing clamp (VCLAMP) which, in conjunction with the ICLAMP, can be used to make stake-less measurements of the earthing system.

For the principles of Earth resistance testing go to Appendix F

### 9.1 Connection terminals

The terminal references used on the MFT are:



The terminal colours correspond to the Earth test lead set, **not the standard test leads** shipped with the MFT1700.

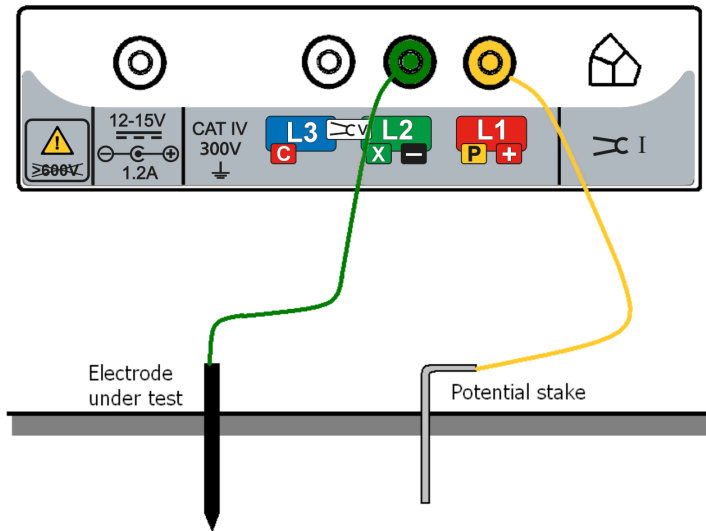
### MFT1735 Connection panel

#### 9.2 Touch voltage limit

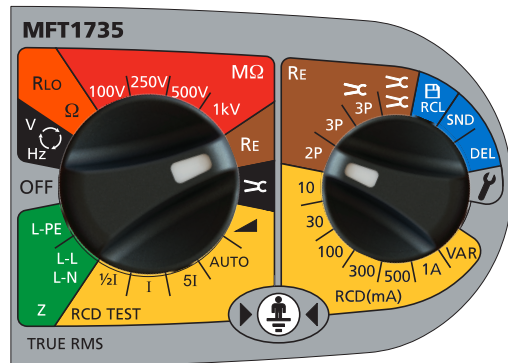
Adjust the touch voltage limit to 25V or 50V depending on location. (Refer to section 10 in the MFT1730 User Guide)

### 9.3 Making a measurement - Two terminal resistance measurement

1. Connect the instrument as shown below.



2. Set the rotary selector switch to the **2P** position.



3. Press and release the **TEST** button.

The instrument will perform pre-measurement check, the status of which will be indicated on the display.

The two-terminal resistance reading will be displayed

**Note:** The test voltage used to make the two-terminal resistance reading is a.c. and may not be suitable for continuity testing according to some local regulations.

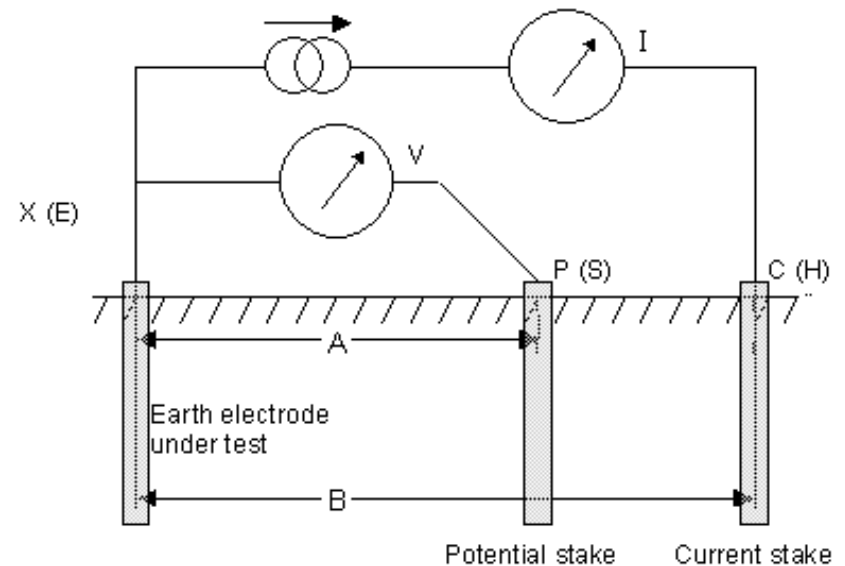
### Appendix F – Earth resistance testing – Basic principles

#### F.1 Principle of operation (three-terminal resistance measurement)

The classic “fall of potential” test is used to accurately measure the resistance of an earth electrode using auxiliary stakes driven into the soil, which form a circuit for the test current injection and voltage measurement as used for the two-terminal method.

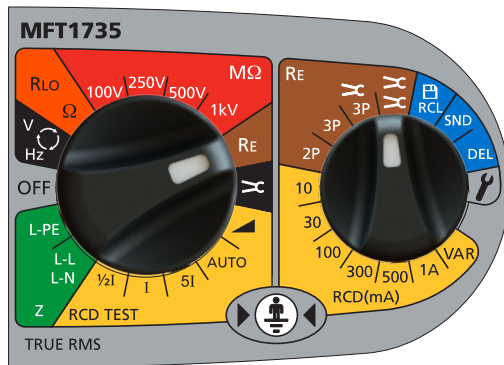
The MFT injects an a.c. current of known magnitude into the system under test and measures the voltage developed across it as shown in Figure 4. The system resistance is a simple ratio as per Ohm's Law. In this case, the potential stake is moved by fixed increments in a straight line between the electrode under test and the current stake. At each location, the resistance is calculated as  $R=V/I$ . A graph of resistance versus potential stake position is plotted and the resistance of the electrode under test is taken to be the point at which the curve is flattest.

Empirical testing has shown that with suitably positioned stakes, this method can be shortened by placing the potential stake at a distance of approximately 62% between the electrode under test and the current stake, i.e. at  $A = 0.62 \times B$ .



Schematic for three-terminal resistance measurement

5. Ensure a minimum separation of 100 mm between the ICLAMP and VCLAMP.
6. Set the rotary selector switch to the  $\Omega$  position.



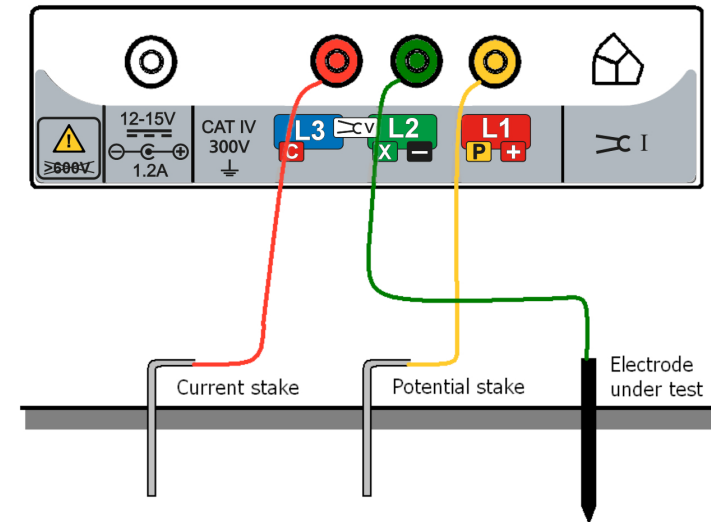
7. Press and release the **TEST** button. The instrument will perform pre-measurement checks, the status of which will be indicated on the display.
8. The stake-less resistance reading will be displayed.

### Note:

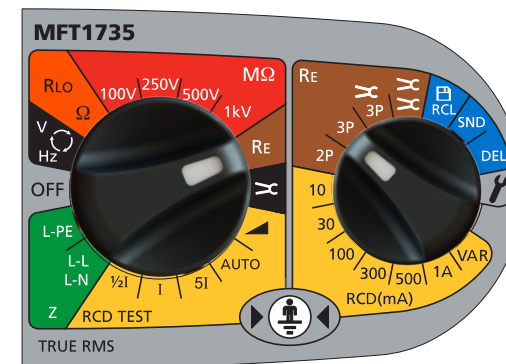
- Ensure that the VCLAMP and ICLAMP jaw mating surfaces are free of dust and contamination and that they contact completely when the VCLAMP and ICLAMP are closed.
- Currents carried by conductors in close proximity to the VCLAMP and ICLAMP may affect calibration and reduce the accuracy of measurements made.
- If the VCLAMP opens at any time after the **TEST** button is pressed, the test will be aborted.

## 9.4 Making a measurement – Three terminal resistance measurement

1. Connect the instrument as below.



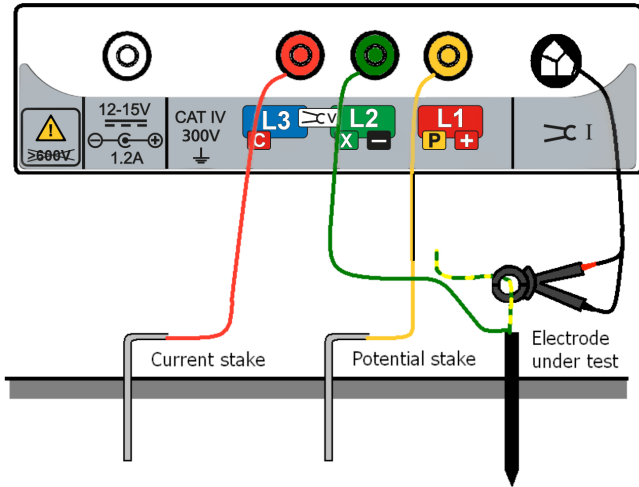
2. Set the rotary selector switch to the **3P** position.




3. Press and release the **TEST** button.

The instrument will perform pre-measurement check, the status of which will be indicated on the display. The three-terminal resistance reading will be displayed

**9.5 Making a measurement – Three terminal resistance measurement using ART**



1. Connect the instrument as BELOW. Close  the ICLAMP around the conductor under test.



2. Set the rotary selector switch to the **3P** position.
3. Press and release the **TEST** button [by holding the **TEST** button, the resistance measurement will be continually updated].

The instrument will perform pre-measurement checks, the status of which will be indicated on the display.

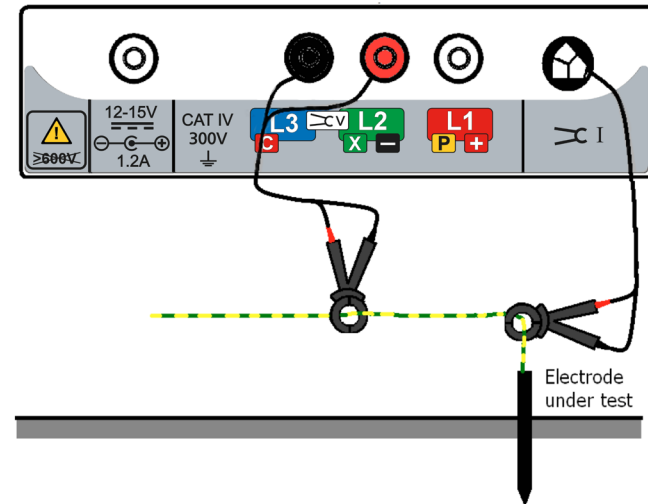
The three-terminal resistance reading using ART will be displayed

**Note:**

- Ensure that the ICLAMP jaw mating surfaces are free of dust and contamination and that they contact completely when the ICLAMP is closed.
- Currents carried by conductors in close proximity to the ICLAMP may affect calibration and reduce the accuracy of measurements made.
- $R_e/R_s$  ratio must be less than 100, where  $R_e$  = Earth resistance,  $R_s$  = Shunt resistance

**9.6 Two-clamp stake-less measurement**

Before making a stake-less measurement, please follow the procedures contained in the sections on ICLAMP calibration.



1. Ensure the rotary selector switch is in the **OFF** position.

**Instrument connection for two-clamp stake-less measurement**

2. Connect the instrument as shown above.
3. Close the ICLAMP around the conductor under test. Ensure the arrow on the side of the jaw is pointing in the same direction as the arrow on the VCLAMP.
4. Close the VCLAMP around the conductor under test. Ensure the arrow on the side of the jaw is pointing in the same direction as the arrow on the ICLAMP.

(If one of the clamps is reversed, the main display shows 'Err' momentarily with 'REV' on the auxiliary display together with the V clamp symbols).