BIDDLE CFL800E

Bridge Time Domain Reflectometer

COMPLIES WITH IEC/EN 61010-1

BIDDLE®

User Guide

Contents

Symbols used on the instrument

Caution: Refer to accompanying notes

Equipment protected throughout by Double or reinforced Insulation

Instrument flash tested to 3.7 kV r.m.s. for 1 min.

Equipment complies with current EU Directives

SAFETY WARNINGS

This instrument primary use is for testing telecomm cables and so it meets the safety requirements of IEC 60950 third Edition (1999-04). It also meets the safety requirements of IEC 61010 parts 1 and 2 but without a category of installation as the instrument must not be directly connected to an energised Mains Supply. The instrument is designed for used on de-energised circuits, however, when used with telecomm cables, it may, in normal use, be subject to telecomm network voltages up to TNV-3 as defined by IEC-60950. Do not exceed the limits of this tester. If it is to be used in situations where hazardous live voltages may be encountered then an additional blocking filter must be used to isolate the instrument.

CAUTION (Risk of electric shock)

Although this tester does not generate any hazardous voltages, circuits to which it can be connected could be dangerous due to electric shock hazard or due to arcing (initiated by short circuit). While every effort has been made by the manufacturer to reduce the hazard, the user must assume responsibility for ensuring his, or her, own safety.

- **Never** connect the instrument to circuits that may be hazardous live.
- The instrument should **not** be used if any part of it is damaged.
- Test leads, probes and crocodile clips must be in good order, clean and with no broken or cracked insulation.
- Check that **all** lead connections are correct before making a test.
- Disconnect the test leads before accessing the battery compartment.
- Refer to operating instructions for further explanation and precautions.
- **Safety Warnings** and **Precautions** must be read and understood before the instrument is used. They must be observed during use.

NOTE

THE INSTRUMENTS MUST ONLY BE USED BY SUITABLY TRAINED AND COMPETENT PERSONS.

2.0 INTRODUCTION

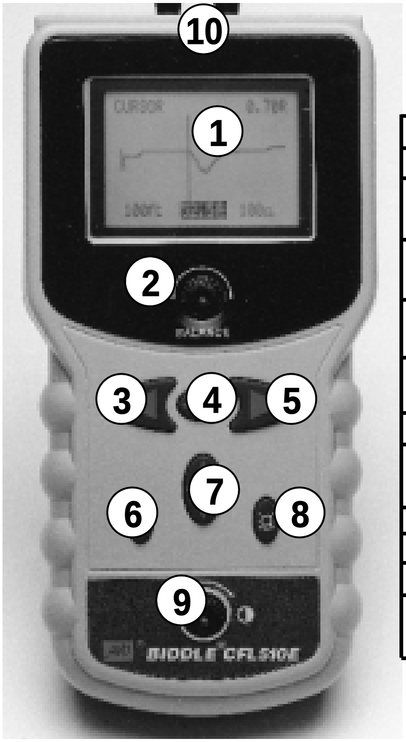
Thank you for purchasing this quality AVO product. Before attempting use of your new instrument please take the time to read this user guide, ultimately this will save you time, advise you of any precautions you need to take and could prevent damage to yourself and the instrument.

The BIDDLE CFL800E is an advanced instrument capable of identifying a wide range of cable faults. It incorporates an Insulation Tester, a DC Voltmeter, Time Domain Reflectometer (TDR) and a Digital Bridge to allow for the accurate location of short and open faults on a cable.

The Voltmeter measures a DC voltage to ± 250 V and can verify if a telecomm cable has a Telecomm Network Voltage (TNV) present on it.

The TDR has a range of 10 m to 3000 m. It transmits a narrow pulse of electrical energy along a pair of conductors within a cable and times how long any reflections of the pulse take to get back. By knowing how fast these pulses travel through a given cable, the measured time can be converted to a distance to fault. The reflections are caused by impedance changes within the cable that are significantly different from the characteristic impedance of the cable. A partial to full short circuit will have a negative going reflection whereas a partial to full open circuit will have a positive going pulse. If the change in impedance is less significant, the ability to discern the cable feature accurately using the TDR technique alone can be difficult and so the BIDDLE CFL800E provides a Digital Bridge for this occasion.

The Digital Bridge can measure the insulation resistance up to 200 MΩ (insulation test), the loop resistance up to 2 kΩ (2-wire loop test) and the series leg resistance of up to 1 kΩ (3-wire loop test). Where a fault causes the insulation resistances to lie below 20 MΩ, the fault position can be determined (AUTO test) relative to the meter end and also relative to the far end where a loop has been made by fitting a strap between the wire under test and one or two return wires. In the case of a single return wire (2-wire test method), the position of the strap is assumed to be at the position of half the total loop resistance. If two return wires can be used (3-wire test method) the position of the strap will be known to greater accuracy and will be independent of the resistance of either of the return wires.



3.0 USER CONTROLS AND DISPLAY:

The controls of the CFL800E have been arranged such that the instrument is easy to use and easy to learn how to use. The precise function of each control depends on the current mode selected and is detailed as follows: Figure 1 –The CFL800E Controls

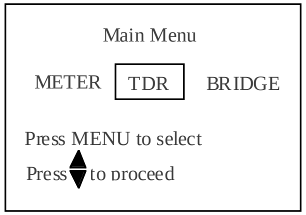
#	Name	Main Menu	Voltmeter	Bridge	TDR
1	Display-128 x 64 pixel	Shows current settings or measurement results relevant to the selected mode.			
2	TX Null - Rotating dial	-	-	-	Analogue control to minimise O/P pulse.
3	Cursor Left - Uni-directional push button	-	-	Reduce selected value	Moves cursor left/reduces selected value
4	Menu - Bi-directional push button	Moves menu cursor left or right	Selects E to A or E to B V and can select EXIT	Menu left/right ctrl and option selector	Clockwise/anti-clockwise option selector.
5	Cursor Right - Uni-directional push button	-	-	Increase selected value	Moves cursor right/increases selected value
6	Power On/Off	Turns the instrument On/OFF			
7	Gain - Bi-directional push button	Proceeds with selected Menu option	Proceed with EXIT selection	Proceeds with selected Menu option	Increases/decreases gain setting, confirm EXIT.
8	Backlight	Turns the instrument backlight On/Off			
9	Contrast	Analogue control to correct the display contrast for extremes of temperature			
10	O/P Sockets	Labelled E, A, B & C, they are designed for the leads supplied with the CFL			
11	Battery Cover	This is on the back of the instrument and provides the user with access to the batteries. The cover must not be removed while the instrument is on or connected to a cable. this instrument must not be operated with the cover open.			

Figure 1 - The CFL800E Controls

4.0 OPERATION

When the instrument is first turned on, the screen displays the following:

Figure 3 - The Main Menu Display

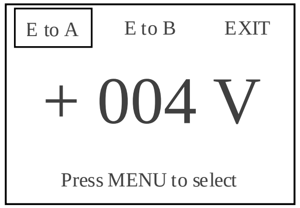


Use the MENU key (see #4 table 1) to highlight the instrument function you want and then use the Gain key (see #7 table 1) to select that mode.

5.0 METER

When this mode is selected, the instrument displays a DC Voltmeter on the display as shown below:

Figure 4 – The Voltmeter Display



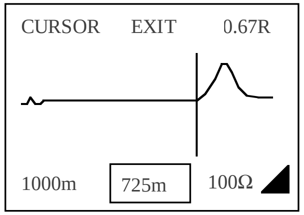
Use the MENU key (see #4 above) to automatically select the displayed DC voltage, either E to A Volts or E to B Volts and to highlight the exit option. Then use the Gain key (see #7 above) to confirm exit from the Voltmeter Mode.

Use the black, red and green leads of the four loose test leads and connect each to their associated socket. The DC voltage measurement is make between the black and red terminals (E to A) or the black and green terminals (E to B). If there is any possibility of connecting to a low-impedance source, e.g. Mains Supply, then this must be verified to be de-energised by using a correctly rated volt-meter, before testing with the CFL800E.

This is a DC Voltmeter ONLY intended for use on a positive earth telecom system and can measure up to ± 250 V. This voltmeter must not be connected to an energised mains supply, the Mains Blocking Filter (see the Specification) can not be used with the meter as it will prevent its correct operation. The minimum source impedance for a DC voltage source is 1.5 Ω.

6.0 TDR

Figure 5 - The TDR Display



6.1 OPERATING INSTRUCTIONS

When the TDR mode is selected from the Main Menu, the TDR display (figure 5) is shown. Use the TDR leads provided (the pair of leads welded together) and connect into terminals A & B. The display shows the current trace reading from the TDR leads and the information along the screen's perimeter is the option settings for the instrument (see later). The title of the currently highlighted option is displayed in the top left of the screen. The User selects the current option using the MENU button (see #4, table 1) to select from CURSOR position, RANGE, EXIT, VF, VF Units and CURSOR position Units. To change a highlighted option use the CURSOR LEFT and CURSOR RIGHT keys (#3 & #5, table 1) to decrement / increment the current living process. The only exceptions to this are the EXIT command confirm with the Up/Down Gain key (#6, table 1) and GAIN control that normally selects the gain from one of four levels.

Ensure the test leads are firmly fitted into the sockets of the instrument. Connect the test lead to the cable under test. If working on live power cables a blocking filter must be used to isolate the instrument from the live line.

The CFL will then display a trace. The instrument will have powered up, set to the last used range and velocity factor. If these settings are different for the cable under test (C.U.T) then use the menu and cursor keys to set the correct values. With the Gain, set it at the lowest level required to easily identify the cable feature, e.g. an open or closed circuit, and move the cursor to the very beginning of the reflection. This is done by using the Menu key to set the instrument into Cursor mode and then using the left and right cursor keys to set the cursor position. The distance is then directly read from the display. The distance calculation is performed using the current velocity factor. If this velocity factor is not correct, the displayed distance will be incorrect.

To enable partial cable faults to be identified, the gain of the instrument can be adjusted. With the gain at minimum the end of the cable should be seen on the trace, if a minor fault is suspected then increase the gain until the fault is more visible.

NOTE: The test lead length is automatically removed to give a direct reading of the cable length, therefore the test leads supplied with the instrument must always be used.

6.2 TX NULL

Without TX Null (#2, table 1) the transmitted pulse would be visible at the beginning of the trace, swamping any reflections within the pulse length (the dead zone). The balancing circuit attempts to match the characteristic impedance of the cable under test to produce an equivalent pulse. Subtracting this equivalent pulse from the transmitted pulse effectively removes the dead zone and allows cable features much closer in to be detected.

NOTE: In many cases, it will be impossible to completely null the transmitted pulse.

6.3 VELOCITY FACTOR

The velocity factor is the scalar that is used to convert the measured time interval into an actual length of cable. It can be displayed in one of two ways: a ratio of the transmitted pulse speed to the speed of light, or as a distance per microsecond. When it is displayed as the distance per µs (either m/µs or ft/µs) the velocity factor will be indicated as half the speed of the pulse in the cable. This is because the pulse in fact has to go along the cable to the cable feature and back again which is twice the distance to the feature.

If the exact length of a piece of cable of the same type as the C.U.T is known and the reflection from the cable end is visible then a more accurate value for the velocity factor can be determined:

1. Locate the reflection caused by the end of the known length of cable with the instrument set on the shortest possible range to see the end of the cable.
2. Locate the start of this reflection as described in the Operation section of this manual.
3. Adjust the velocity factor until the correct cable length is shown.

The measurement of the distance to the fault can now be made with more confidence that the measurement will be correct. The ability of the instrument to accurately measure the distance to a cable feature relies on the velocity factor being correct; any errors in the velocity factor are directly proportional to distance measurement errors. Please refer to the Quick Reference Guide for a table of typical Velocity Factors.

6.4 PULSE WIDTHS

The CFL800E pulse widths range from 8 ns to 3 µs to overcome signal attenuation and enable the instrument to see further down a length of cable. In distance terms for the size of the transmitted pulse, this represents a transmitted pulse from as small as 1.5m to 600m! (This assumes a velocity factor of 0.67.) Without TX Null, this would be an enormous dead zone, but with the instrument correctly balanced, faults can be seen well within the pulse width.

As the measured distance is taken at the start of the reflected pulse, the size of the pulse width does not affect the accuracy of the measurement. However, if the first feature does not give a complete reflection such that the instrument can see beyond it to a second feature, the ability to discern between features is affected by the pulse widths. If there are multiple features, the instrument can only fully discern between them if the features are more than the pulse width apart. Hence, for discerning multiple features, the instrument should be used with the shortest range, and so smallest pulse width, that can see both features (refer to the pulse width table in the specification).

6.5 TECHNIQUES FOR TDR USE

To improve on the accuracy of the measurement and the ability to discern faults, numerous techniques can be used, depending on the situation encountered. Here are a few for your information:

6.5.1 Test the cable from both ends

When fault finding a cable it is good practice to shoot the cable from both ends. Particularly in the case of open circuit faults, the true end of the cable is not visible. Thus, it is harder to estimate whether the answer that is obtained is realistic. If the measurement is made from both ends, then the combined answer should add up to the expected length of the cable. Even in the case when the true end of the cable is still visible, the reflections after the fault may be too obscure to analyse clearly. In this case, measurement from both ends yields a clearer picture as well as improved accuracy.

It is also good practice to follow the cable route with a cable tracer, as not all cable runs will be straight. It can save a great deal of time if the exact route of the cable is known as faults will usually be found at points were human intervention has occurred, junction boxes splices etc.

6.5.2 Reflections caused by Mismatches

On very short faults, when there is a mismatch between the test lead impedance and the cable under test a proportion of the reflected wave from cable fault "bounces" off this impedance mismatch. This reflection generates an apparent second fault at double the first fault’s distance. If there is sufficient energy left in the wave a third and fourth reflection can occur. The problem is more evident on 50 Ω and 25 Ω cables (i.e. power distribution cables) as the impedance mismatch is greater and the signal attenuation is less. This will show on the screen as multiple, equidistant faults of diminishing amplitude.

6.5.3 Bridge Taps

Bridge taps occur when another pair of conductors is connected to a pair in the main cable to form a branch or party line. At the branch or bridge junction, a short circuit type fault will occur due to the characteristic impedance halving at that point. If a pair of conductors has a large number of taps, then the waveform displayed will be difficult to evaluate if specific knowledge of the cable network is lacking.

6.5.4 Load Coils

Load coils are used on telephone lines to increase the line inductance, so improving the transmission characteristics of long lines. The inductive load coils appear as open circuits to a cable fault locator. To test beyond the coils, a new test site further upstream has to be chosen.

6.6 TDR APPLICATION NOTES

The CFL800E is intended for use on de-energised circuits only. For operator safety the instrument is double insulated, it also incorporates safety terminals. For complete list of the Safety Standards adhered to, please refer to the specification (8.1). Please refer to the enclosed Quick Reference Guide for a list of typical waveforms relating to various cable features.

6.6.1 Metallic Shorts

These are caused by metallic contact between two conductors of a cable pair. This produces a strong downward pulse. See the Application Card supplied with the CFL800E.

6.6.2 Sheath Shorts

These are caused by a conductor in a cable making metallic contact with the metallic sheath of the cable. To locate a sheath short, disconnect the sheath from earth and then connect one terminal to the sheath. Connect the other terminal to each conductor in turn until you locate the shorting conductor.

6.6.3 Crossed Conductors

When multiple twisted pair circuits pass through the same junction box, there is a possibility crossing conductors from adjacent pairs. This produces waveforms similar to metallic shorts but with reduced amplitude. A crossed conductor can be located from either adjacent pair but is more pronounced if the CFL800E is connected across both crossed conductors.

6.6.4 Metallic Open Circuits

This is caused when one or both conductors of a pair are disconnected or broken and produces a strong upward fault pulse.

6.6.5 Resistive joints or Splices

These are caused by poor joints or the joining of two cables at a junction box. They produce upward going fault pulses whose amplitude depends on the quality of the joint.

6.6.8 Water Ingress Faults

When a cable's sheath is damaged, water can soak into the cable and contaminate the insulation medium. The affect this contamination has is to cause a drop in cable impedance at the start of the water ingress (downward pulse) and a corresponding increase in cable impedance at the end of the ingress (upward pulse). If the contamination is gradual then the impedance change is also gradual and so the pulses shape more extended and rounded. If the whole cable is contaminated then the fault can be difficult to locate, as there is no impedance change.

6.7 TDR SPECIFICATION

Except where otherwise stated, this specification applies at an ambient temperature of 20°C.

General Ranges: 30ft, 100ft, 300ft, 1000ft, 3000ft, 10000ft and Auto (10m, 30m, 100m, 300m, 1000m, 3000m)

Accuracy: ±1% of range ± pixel at 0.67VF

[Note- The measurement accuracy is for the indicated cursor position only and is conditional on the velocity factor being correct.]

Resolution: 1% of range

Output pulse: 5 volts peak to peak into open circuit. Pulse widths determined by range

Range	30ft	100ft	300ft	1000ft	3000ft	10000ft
Pulse width	8ns	30ns	100ns	300ns	1000ns	3000ns

Gain: Set for each range with four user selectable steps.

Velocity Factor: Variable from 0.30 to 0.99 in steps of 0.01

Output impedance:100 Ω

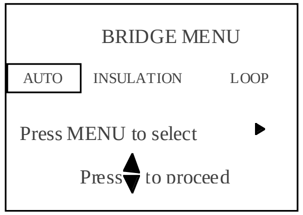
TX Null: An internal circuit can simulate a line with impedance in the range 0 Ω to120 Ω to enable the displayed transmitted pulse to be nullified.

Update Rate: Once a second for 5 minutes after last key-press.

7.0 INSTRUCTIONS FOR BRIDGE USE

When the bridge is selected from the Main Menu, the Bridge Menu is displayed as follows:

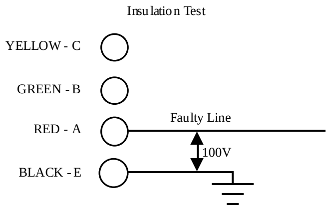
Figure 6 - The Bridge Menu

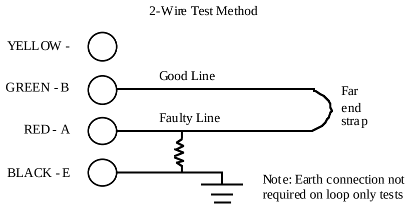


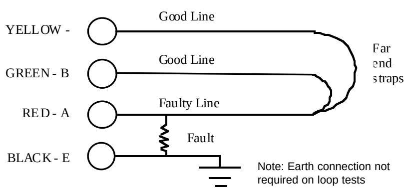
The Bridge Menu has four options: AUTO / INSULATION / LOOP / EXIT. Use the Menu key (#4, table 1) to highlight the required selection and then the Up / Down Gain key (#7, table 1) to proceed with the selection. The right facing triangle next to "select" indicates that another menu option (the EXIT option) is off-screen to the right and requires pressing right when LOOP is highlighted. At this point, INSULATION / LOOP / EXIT will be the visible menus with a left facing triangle next to "Press MENU" indicating that another menu is now available to the left.

7.1 CONNECTIVITY

When you use the CFL800E in bridge mode all four of the terminals can be used; the exact configuration required depends on the test in progress according to the following diagrams:







The 2-wire test method assumes that the Good Line and the Faulty Line are of the same gauge wire and approximately equal in length. Then the assumption that the strap is at half the total loop distance is valid. However, it is preferable to use a second return wire if possible to make use of the 3-wire testing method. Each of the Good Lines can be of different resistances and lengths compared with the Faulty Line. This can allow for a direct measurement of the resistance (and hence distance) to the strap without making any assumptions and so can give a more accurate fault position.

7.2 Auto Test

The Auto Test automatically runs through a series of tests to calculate the resistance to a fault. These calculations and measurements are based on the bridge principle given that the location of the fault will be the point of the lowest insulation resistance. Hence, by measuring the insulation resistance, the loop resistance (in 2-wire mode) or leg resistances of the faulty wire (in 3-wire mode), the instrument can then inject current through the fault resistance to measure and derive the following:

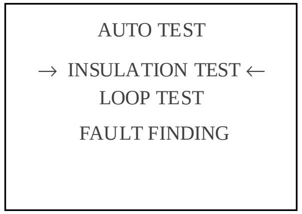
Resistance to Fault (RTF)
Resistance to Strap (RTS)
Resistance of the Strap to Fault (STF)

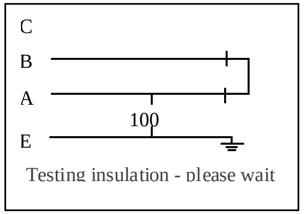
From this resistance, and by knowing some other conversion factors – the gauge of wire and its temperature – the distance to fault can be calculated and displayed as:

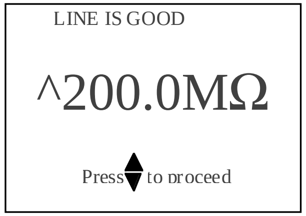
Distance to Fault (DTF)
Distance to Strap (DTS)
Distance of the Strap to Fault (STF)

7.2.1. Auto test – Insulation

When Auto is selected, the screen briefly indicates the sequence of tests that is to be run before starting the insulation test. Then while the insulation test is taking place, the screen indicates between which terminals the insulation test is performed (E to A).







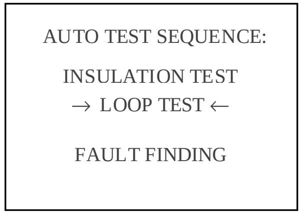
The result of the insulation test is then displayed as an insulation resistance (Re) – see the bridge specification for the measurement resolution and increments.

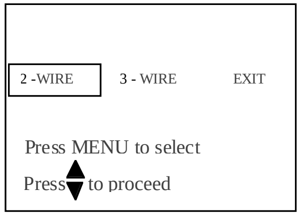
If Re <1 MΩ **- LINE IS BAD** If 1 MΩ <Re <10 MΩ**- LINE IS FAIR** If Re >10 MΩ **- LINE IS GOOD**

NOTE: If the insulation resistance >20 MΩ, then the instrument can not locate the fault during the fault finding test.

7.2.2. Auto test – Loop

By pressing the Up / Down Gain key to proceed (#7, table1) the test sequence then switches to the loop test where a 2 or 3-wire test for both the loop test and the fault finding can be selected. See section 7.1 for connection requirements. For the 2-wire testing method, the measurement is of the total loop resistance and the RTS is assumed half of that resistance. For the 3-wire testing method, the two good wires allow for the resistance of the faulty wire (RTF + STF) to be measured directly and so no such assumptions are made. The use of the 3-wire test method is strongly recommended.





When the type of test is selected, again the screen will indicate between which terminals the loop resistance is measured. Alternatively, pressing EXIT will return you to the Bridge Menu.

With the loop test, the auto sequence is used to verify that any loop resistances are < 2 kΩ. This is the A-B loop only on the 2-wire test and A-B and A-C loops on the 3-wire test.

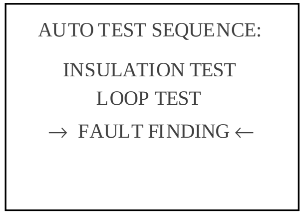
If this is not the case then an error message: **A – (B/C) STRAP OPEN OR LINE TOO LONG** is displayed. You will then be prompted to return to the Bridge Menu.

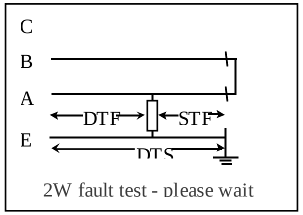
NOTE – the loop resistance result is not given as the fault finding test will use the result to derive its readings.

7.2.3. Auto test – Fault Finding

The Auto test sequence then moves to the Fault Finding phase where the Bridge principle will be used to locate the fault. Here, the resistance to fault can be derived by using the digital bridge and making use of the loop resistance calculated in the step above. The insulation resistance is assumed to be at its lowest at the fault location and so is used to inject current into the bridge circuit at that point. However, if the insulation resistance at the fault is too high, (>20 MΩ), there will be insufficient current drive into the digital bridge circuit to be able to resolve the reading accurately. If this is the case, an error message: **FAULT RESISTANCE OUT OF RANGE** will be given.

Having measured the fault resistance and knowing the loop resistance or leg resistance (2- or 3-wire mode) then the RTS and STF can be derived. When testing in 2-wire mode, selected during the Loop Test detailed in 7.2.2 above and shown below, the RTS is assumed to be half the loop resistance. If the measured RTF indicates that the fault is on leg B, then the error message: **FAULT NOT FOUND IN LINE ‘A’, WIRES MAY BE CROSSED** is displayed.

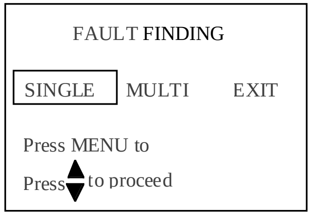


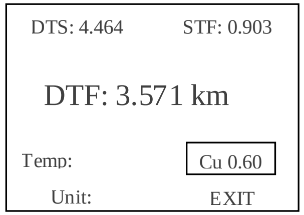


If the reading is within range, you will be asked if the cable under test is made up of one type of wire along its length (SINGLE) or multiple sections with different types of wire (MULTI).

Single

If SINGLE is selected, this then generates the result of the distance to fault, distance to strap and the strap to fault distance using the calculated resistances scaled by the Ω/m of the gauge and type of wire selected. (See the section on calculated factors for more information).
From the display you can modify the temperature or selected wire gauge or can display the result in m, ft or Ω. Simply select the required parameter with the MENU key (#4, table1) and alter with the cursor keys (#3 & #5, table 1).

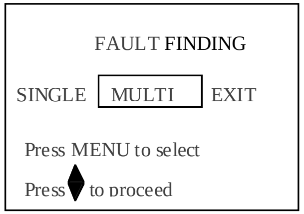


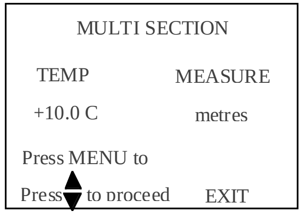


If the gauge of the cable under test is not included in the built in table, you can define your own gauge of wire by specifying its resistance per metre (or ft). This must be within the range 0.01000 Ω/m to 0.32500 Ω/m (0.10000 Ω/ft to 0.00300 Ω/ft) or a warning of ABOVE MAX OF or BELOW MIN OF the selected range is displayed.. To do this, select the wire gauge parameter (as shown above) and step through the available options until "USER GA" is displayed. Select this with the Up / Down gain key (#7, table 1). You can now define the resistance per metre of the cable by selecting the digit using the Menu keys (#4, table 1) and changing the value of each digit using the cursor keys (#3 & #5, table 1). Press the Up / Down gain key to return to the results screen.

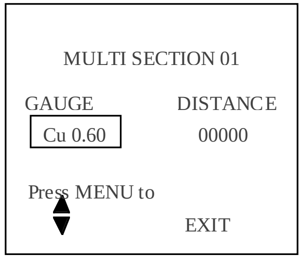
Multi

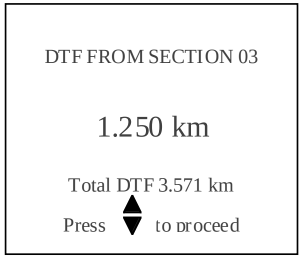
If a multi section cable is selected then before the instrument can generate the results, you have to instruct it what gauges are used in each section and the length of each section.





The first screen allows the temperature and measured variables to be set. Note: on selecting feet, the temperature is automatically set to Fahrenheit. For each section, use the Menu key (#4, table1) to highlight the required parameter and the cursor keys (#3 & #4, table 1) to change the selected value. The distance parameter can be changed digit by digit. When the details for that multi section are complete, press the Up / Down Gain key (#7, table 1) to proceed. If the fault is calculated to be within this section then the distance to fault from the beginning of this section and the overall distance to fault will be displayed. If, however, the fault is not in this section, then you will be prompted to enter the details of the next section of cable. This will continue until the section containing the fault is entered or you select Exit.





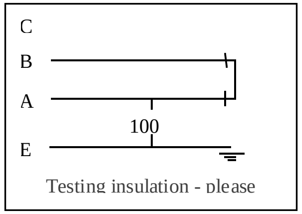
NOTE: Only metres or feet are selectable (not Ω) and the user-defined gauge is not availablein multi section.

If the distance reads "00000 ft" when you proceed to the next section or the derived resistance for that length of the indicated gauge is < 10 Ω then the error message: **GAUGE / DISTANCE U/R** is displayed. Similarly, if the derived resistance is > 1000 Ω for 2-wire and 2000 Ω for 3-wire, then the error message: **GAUGE / DISTANCE / O/R** is displayed. If the entered distance is greater than 65535 m or ft, then the error message: **ABOVE MAX OF 65535** is displayed.

Pressing the Up / Down Gain key (#7, table1) at this point will return you to the Bridge Menu.

7.3 INSULATION TEST

From the Bridge Menu, if the Insulation test option is selected the insulation resistance between terminals E and A will be measured with a 100 V insulation test. The insulation voltage level is selected to prevent the accidental operation of telecom surge arresters that may be fitted to the line under test. This can be done as a stand-alone operation to help identify which cables may have a fault on them – then the AUTO test can be used to help locate that fault. The test is self repeating approximately once every three seconds to allow for a number of cables to be tested consecutively. See section 7.1 for connection requirements.

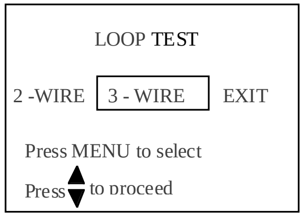


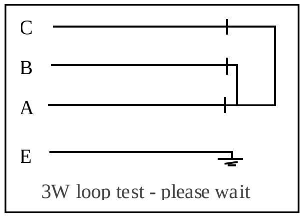
On selecting exit, you will be returned to the Bridge Menu.

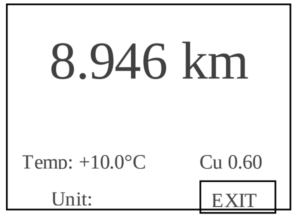
7.4 LOOP TEST

From the Bridge Menu, a Loop test can be selected for a qualitative test on a telecom cable to determine if the line will provide reasonable performance. If the loop resistance is too great, it could indicate that the line is incapable of supplying the 20 mA current required to power telecomm equipment or too long and therefore too much signal degradation to support Digital Communications.

On selecting this mode, you will be asked to select a 2- or 3-wire mode and on that selection, the screen will indicate the wiring configuration required between the terminals. See section 7.1 for connection requirements. If any loop resistance is greater than 2 kΩ than an error message will be displayed, else the test result will be displayed. If a 2-wire test is selected, the reading will be that of the complete loop between A and B terminals. If a 3-wire test is selected, the reading will be series leg resistance of the faulty wire (RTF + STF) with an error message if either loop A-B or loop A-C is > 2 kΩ. The parameters and viewable results are very similar between the loop test and the auto test SINGLE section display and the same







parameters are adjustable by the same means. See section 7.2.3 for more details.
On selecting EXIT, you will be returned to the Bridge Menu.

7.5 CALCULATED FACTORS FOR BRIDGE MEASUREMENTS

7.5.1 Wire Gauges

For a temperature of 68°F, wire gauges given in AWG.

AWG 16	–	249.37 ft/Ω
AWG 19	–	124.24 ft/Ω
AWG 22	–	61.75 ft/Ω
AWG 24	–	38.54 ft/Ω
AWG 26	–	24.00 ft/Ω

7.5.2 Temperature Compensation Factor
0.391%/°C - Applied to all wires regardless of type

7.5.3 Metres to feet conversion 3.281 ft / m

7.6 BRIDGE SPECIFICATION

Except where otherwise stated, this specification applies at an ambient temperature of 20°C

Loop and Fault tests, with results displayed in resistance:	0 to 190 Ω in steps of 0.1 Ω 190 Ω to 2000 Ω in steps of 1 Ω

Standard Conductor Gauges

Copper:	0.32, 0.4, 0.5, 0.6, 0.63, 0.9 & 1.27mm
Aluminium:	0.5, 0.6, 0.7 & 0.8mm

User Definable Gauge entered as Ω/m or Ω/ft

Accuracy of Fault Reading: (Km, W, Kft)	±0.2% ±1 digit from 0 Ω to 1 MΩ ±0.2% ±3 digits from 1 MΩ to 5 MΩ ±0.2% ±6 digits from 5 MΩ to 10 MΩ
Accuracy of Loop Reading:	±0.2% of reading ±1 digit (on Ω)
Insulation Accuracy:	±2% of reading ±1 digit
Insulation Range:	0 to 19 MΩ in steps of 0.01 MΩ 19 MΩ to 200 MΩ in steps of 0.1 MΩ
Voltage to line:	100 V DC ±20%. The output is current limited (100 µA) so as the load drops below 1 MΩ, the voltage to line will approach 0 V as the load approaches 0 Ω.
Current to line:	100 µA DC nominal

8.0 GENERAL SPECIFICATION

This specification applies to the instrument as a whole.

8.1 ELECTRICAL

Input Protection:	The inputs will withstand 300 V d.c. or 300 V a.c. up to 60 Hz. with minimum source impedance of 1.5 Ω.
Voltage Test Accuracy:	±2% ±1 digit
Voltage Test Range:	0 – 250 V DC measured between terminals E to A or E to B, E being positive, minimum source impedance 1.5 Ω
Batteries:	Six LR6 (AA) type batteries, Manganese-alkali or nickel-cadmium or nickel-metal-hydride cells Nominal voltage: 9 V for Alkali of 7.2 V for NiCad. Low battery warning occurs at 6.5 V
Battery Consumption:	140 mA nominal, 180 mA with backlight
Safety:	The instrument meets the safety requirement of BS EN 61010-1: 1993 including Amendment 2: 1995-06. As its primary use is for Telecomm testing the instrument also adheres to IEC 60950, third edition: 1999-04 and is rated for use on TNV-3 circuits. If it is to be used in situations where hazardous live voltages may be encountered then an additional blocking filter must be used. Note that this will prevent the operation of the instrument in Bridge and Meter modes.
EMC:	In accordance with IEC61326 including Amendment No.1
Power Down:	Automatic after 5 minutes with no key-press.
Backlight:	Stays on for 1 minute when activated.

8.2 MECHANICAL

The instrument is designed for use indoors or outdoors and is rated to IP54.

Case Dimensions:	9.0 inches long	(230 mm)
	4.5 inches wide	(115 mm)
	2.5 inches deep	(63 mm)
Instrument weight	1.79lbs (0.815Kg)	
Case material:	ABS	
Connectors:	Four 4mm-safety terminals (E, A, B & C)	
Lead:	3.28ft (1 m)	
Display:	128 x 64 pixel Graphics LCD.	

8.3 ENVIRONMENTAL

Operational Temperature:	5°F to 122°F (-15°C to +50°C)
Operational Humidity:	95% at 104°F (40°C)
Storage Temperature:	-4°F to 158°F (-20°C to 70°C)

CARE AND MAINTENANCE

Other than replacing the batteries, the instrument has no user serviceable parts. In case of failure it should be returned to your supplier or an approved AVO INTERNATIONAL repair agent.

Cleaning the instrument should only be done by wiping with a clean cloth dampened with soapy water or Isopropyl Alcohol (IPA).

Included Accessories

Test & Carry case with strap	6420-128
Test Lead Set (TDR)	6231-653
Test Lead Set (Bridge)	6220-708
User Guide	6172-512

Optional Accessories

Blocking Filter	6220-669
EAN No.	5036175191811

REPAIR AND WARRANTY

The instrument contains static sensitive devices, and care must be taken in handling the printed circuit board. If an instrument's protection has been impaired it should not be used, but sent for repair by suitably trained and qualified personnel. The protection is likely to be impaired if for example; it shows visible damage; fails to perform the intended measurements; has been subjected to prolonged storage under unfavourable conditions, or has been subjected to severe transport stresses.

NEW INSTRUMENTS ARE GUARANTEED FOR 3 YEARS FROM THE DATE OF PURCHASE BY THE USER.

NOTE: Any unauthorized prior repair or adjustment will automatically invalidate the Warranty.

REPAIR AND SPARE PARTS

For service requirements for MEGGER Instruments contact:

AVO INTERNATIONAL	or	AVO INTERNATIONAL
Valley Forge		Archcliffe Road
Corporate Center		Dover Kent, CT17 9EN
2621 Van Buren Avenue		England
Norristown, PA 19403		Tel: +44 (0) 1304 502243
U.S.A.		Fax: +44 (0) 1304 207342
Tel: +1 (610) 676-8579		
Fax: +1 (610) 676-8625		

Or an approved repair company. Approved Repair Companies

A number of independent instrument repair companies have been authorised for repair work on most MEGGER instruments, using genuine MEGGER spare parts. Consult the Appointed Distributor/Agent regarding spare parts, repair facilities, and advice on the best course of action to take.

Returning an Instrument for Repair

If returning an instrument to the manufacturer for repair, it should be sent freight pre-paid to the appropriate address. A copy of the invoice and of the packing note should be sent simultaneously by airmail to expedite clearance through Customs. A repair estimate showing freight return and other charges will be submitted to the sender, if required, before work on the instrument commences.

AVO **INTERNATIONAL**

Archcliffe Road
Dover
Kent, CT17 9EN.
England.
Tel: +44 (0) 1304 502100
Fax: +44 (0) 1304 207342

PO Box 9007
Valley Forge
PA 19484-9007
U.S.A.
Tel: +1 (610) 676-8500
Fax: +1 (610) 676-8610
Fax: +1 (214) 337-3533

4271 Bronze Way
Dallas
TX 75237-1017
U.S.A.
Tel: +1 (800) 723-2861 (U.S.A. only)
Tel: +1 (214) 330-3255 (International)

MEGGER SARL
29 Allée de Villemomble
93340 Le Raincy
Paris, France
Tel: +33 (1) 43.02.37.54
Fax: +33 (1) 43.02.16.24

This instrument is manufactured in the United Kingdom.

Part No.6172-512 - Edition 3 - Printed in England - 06HH