Time Domain Reflectometers
TDR2000/3 - TDR 2000/3P - CFL535G
TDR2010

User Guide
Safety warnings must be observed during use

NOTE - THE INSTRUMENT MUST ONLY BE USED BY SUITABLY TRAINED AND COMPETENT PERSONS

Users of this equipment and/or their employers are reminded that National Health and Safety Legislation requires them to carry out valid risk assessments of all works so as to identify potential sources of danger and risk.

Please refer to the full list of safety warnings for further information. This was supplied in the box your instrument arrived in or can also be found on the support CD and is downloadable from the Megger website.

**CAT II**
Measurement category II: Equipment connected between the electrical outlets and the user’s equipment.

**CAT III**
Measurement category III: Equipment connected between the distribution panel and the electrical outlets.

**CAT IV**
Measurement category IV: Equipment connected between the origin of the low-voltage mains supply and the distribution panel.

Battery information

This instrument runs on a Lithium Ion battery which should be maintained to maximise health, reliability and longevity. There are a few simple things that you can do to help maintain your battery health and power potential.

1. **Allow your battery to charge fully before using the instrument.** Fully charging the battery before use will ensure it can perform at peak performance and make maintaining performance easier.

2. **Keep your battery charged up whenever possible while in use.** A Li-Ion battery prefers frequent top-ups and should never be left in a flat state for extended periods as this can cause permanent damage.

3. **When not in use remove the battery from the instrument.** A Li-Ion battery starts losing power as soon as connected to a drain. Removing from the instrument will ensure health is maintained.

4. **Maintain a charge during storage.** If your battery is to be stored for extended periods maintain a charge of 40%, allowing for some discharge and maintaining the protection circuit.

5. **Store your battery in a cool, dry place.** Li-ion batteries can get stressed when exposed to heat which can reduce its life. Do not store above 30°C (86°F) for extended periods.

**WEEE Directive**

The crossed out wheeled bin symbol placed on Megger products is a reminder not to dispose of the product at the end of its life with general waste.

Megger is registered in the UK as a Producer of Electrical and Electronic Equipment. The Registration No is WEE/HE0146QT

For further information about disposal of the product consult your local Megger company or distributor or visit your local Megger website.

**Battery Disposal**

The crossed out wheeled bin symbol placed on the batteries is a reminder not to dispose of them with general waste at the end of their life.

This product contains the following batteries Li-ion rechargeable battery. They are located under the battery cover at the rear of the instrument.

They can be safely removed by following the instructions in the battery replacement section of this guide.

Spent Li-ion batteries packs are classified as Industrial Batteries. For disposal in the UK contact Megger Ltd. For disposal of batteries in other parts of the EU contact your local Megger branch or distributor.

Megger is registered in the UK as a producer of batteries.

The Registration number is BPRN00142.

For Further information see www.megger.com
**Connectivity**

- **Used for PC connectivity**
- **Lift cover for access – avoid stressing**
- **Power lead dependant on region**

The main connectivity is made via standard 4 mm test leads plugged into the dual channel ports.

**F-Type**

Using the supplied adapter, connectivity can also be made to the dual F-type ports. Other standard push-on adapters also fit.
Accessories

- **6231-652**
  - Single miniature clip lead set 4mm

- **6231-654**
  - Dual miniature clip lead set 4mm

- **1002-015**
  - Single Fused test leads

- **1002-136**
  - Dual Fused test leads

- **6231-655**
  - Bed of Nails Test Leads (1 Pair)

- **6231-653**
  - Bed of Nails Test Leads (2 Pairs)

- **1003-352**
  - Mains Charger

- **1002-552**
  - Replacement Battery

- **1003-218**
  - Terminal adaptor kit
There are various mounting and carrying options for the TDR20xx series to ensure the user can position their instrument securely and efficiently.
Mode
The TDR20xx series can be set up to work for several different applications. This will allow the user to specify how the instrument receives, processes and displays test readings. The testing options for each mode are shown on the line adjacent to the icon for the specific mode.

Selecting Mode
Change mode Press to select Use cursor keys

Choosing a mode
Single Channel mode Choose T1 or T2 Press key indicated to change

Dual Channel mode Choose T1-T2, T2-T1, T1&T2 Press key indicated to change

Crosstalk Choose T1 or T2 Press key indicated to change
Load saved trace  Choose T1-M, T2-M, M  Press key indicated to change

Intermittent mode  Choose T1 or T2  Press key indicated to change
General functions are available from the main screen and be accessed using the left and right navigation keys and appropriate selection buttons.

The instrument is also able to save and preview traces, enabling the user to maintain a database of information for downloading to a PC to create reports or to use in other custom applications.

### Navigation
- Use cursor keys
- Use soft keys to select

### Range
- 10, 25, 50, 100, 200, 400 m, 1, 2, 4, 8, 16, 20 km
- 30, 75, 150, 300, 600, 1200, 3000, 6000, 12000, 24000, 48000 ft
  (30 km 98,000 ft VP 0.99)

The currently selected range is shown at top right of the screen.

### Operational state
The current operational state is shown at the top left of the screen and identifies the current operational setting for the chosen screen. Icons displayed are specific to the function.

- Current operational state. Currently in Automatic operation
- Current operational state. Currently in Setup operation
- Change current state using the appropriate button
**Setup**

The user has the ability to change various settings for the live trace ranging from the velocity factor to the gain applied to the trace. These settings can be accessed via the setup icon.

**Accessing Setup**

Press to select

Automatic mode

Manul mode

**Adjusting the Setup Options**

**Velocity Factor**

Use the up and down cursors to set the Velocity Factor to match the cable under test

**Impedance**

Use the up and down cursors to adjust the impedance for the cable under test

*Only available in manual operation (see page 13)*

**Gain**

Use the up and down cursors to alter the gain to adjust visible disturbances on trace

*Only available in manual operation (see page 13)
**Setup**

**Pulse width**
Use the up and down cursors to change the instrument pulse width

*Only available in manual operation (see page 13)*

**Cable Range**
Use the up and down cursors to change the length of the cable under test

---

**Saving Current Trace**

**Save**
**Preview**
**Selected trace displayed**

---

**Manage Memory**
Use cursor keys
Selecting the tick saves the results to the selected memory location and the bin deletes the result from the selected memory location.
Trace Tagging

Trace Tagging is only available on the TDR2010 model.

This function is activated when choosing a memory location to save a trace to.

Use the navigation buttons to select a letter and the soft keys to action.

You can also press the OK button to accept the selection.

Press the hand icon to add the currently selected character.

Press the shift icon to change the keyboard to the extended characters.

Press the backspace icon to delete the last character.

Once all characters have been chosen, press the save icon to complete the save process.

You can edit a current trace tag either when you save a trace, or when you are choosing a trace for a memory mode function.

Once you enter edit mode, simply use the technique for new trace tags in the previous section.

When you have finished editing, press the save icon to complete the edit and save your changes.
**Zoom**

The zoom capabilities are limited by the range chosen and only zoom modes suitable for the chosen ranges are displayed.
### Advanced

The TDR20xx series has two methods of operation. Both options allow the user to set operational parameters. In Manual operation the user has full control over the settings in use for the cable under test. In Automatic operation the TDR sets the appropriate impedance to the cable and suggests gain and pulse width settings. Expert Function allows auto detection of faults on the live traces.

### Manual and Automatic operation

<table>
<thead>
<tr>
<th>Mode</th>
<th>Operation</th>
<th>Settings Available</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manual</strong></td>
<td>Adjustable in this mode</td>
<td></td>
</tr>
<tr>
<td><strong>Automatic</strong></td>
<td>Adjustable in this mode</td>
<td></td>
</tr>
</tbody>
</table>

**Auto Find**

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto find</td>
<td>Press for next disturbance</td>
</tr>
<tr>
<td>Cursor snap to disturbance</td>
<td></td>
</tr>
</tbody>
</table>
**Battery**

The TDR20xx series has built in intelligent charge management technology so that the battery never overheats and maximum charge rate is maintained, meaning a longer battery life is possible.

### Battery information

<table>
<thead>
<tr>
<th>Battery state</th>
<th>Capacity</th>
<th>Typical life remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image1.png" alt="Battery icon" /></td>
<td>0% 25% 50% 75% 100%</td>
</tr>
<tr>
<td></td>
<td><img src="image2.png" alt="Battery icon" /></td>
<td>0 hrs 3 hrs 6 hrs 9 hrs 12 hrs</td>
</tr>
<tr>
<td></td>
<td><img src="image3.png" alt="Battery icon" /></td>
<td></td>
</tr>
</tbody>
</table>

- **Battery state**: Charging
- **Capacity**: 50% 75% 100%
- **Typical life remaining**: 0 hrs 3 hrs 6 hrs 9 hrs 12 hrs

### Warnings

- ![Battery icon](image4.png)

### Charging

- ![Battery icon](image5.png)

### Charging paused

- ![Battery icon](image6.png)

### Charged

- ![Battery icon](image7.png)
Results

The cursor lines on the TDR20xx series allow the user to identify disturbances at strategic points to determine distances and positions of potential faults on the trace.

Cursors and measurements

Cursor choice
Press to select
Swap between cursors

Cursor movement
C1-C2 Trace 1
(Single Trace Mode)
C3-C4 Trace 2
(Dual Trace Mode)

Use cursor keys
Cursor position on trace

Distance measurement
Distance to cursor
Delta measurement
When in the Setup screen, access can be made to a selection of user tools. Within the tools function the user can change basic settings and locate current instrument setup information.

Adjustable settings include Volume, Standby, Units of measure, NVP formats, Colour scheme, Brightness and Language.

Preferences
- Use cursor keys
- Up/Down to select
- Left/Right to change

Help
- Use cursor keys
- Function information

Custom
- Press to select
- Left/Right to select
- Up/Down to change
Colour Schemes

Press the preferences icon to access the system preferences screen.

There are a number of colour schemes available as standard, plus additional custom schemes where you can set your own.

Use the left and right navigation buttons to change the current scheme.

You can use the current scheme as a basis for a custom scheme by pressing the custom scheme pallet icon.

From here you can change any of seven elements that make up all screens.

Use the left and right navigation buttons to choose an element.

Use the up and down navigation buttons to change the colour for the chosen element.

Once finished setting your colours, press either the custom 1 or custom 2 icons to save that scheme. The scheme currently stored in that custom slot will be overwritten.

After saving your custom scheme, press the back button to return to the main screen.
## Glossary

### Appendix A

<table>
<thead>
<tr>
<th>Function</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Single Channel mode" /></td>
<td><img src="image" alt="Delete" /></td>
<td><img src="image" alt="Preferences" /></td>
</tr>
<tr>
<td><img src="image" alt="Dual Channel mode" /></td>
<td><img src="image" alt="Accept" /></td>
<td><img src="image" alt="Colour scheme" /></td>
</tr>
<tr>
<td><img src="image" alt="Intermittent mode" /></td>
<td><img src="image" alt="Preview" /></td>
<td><img src="image" alt="Help" /></td>
</tr>
<tr>
<td><img src="image" alt="Crosstalk" /></td>
<td><img src="image" alt="Mode" /></td>
<td><img src="image" alt="Velocity Factor" /></td>
</tr>
<tr>
<td><img src="image" alt="Save" /></td>
<td><img src="image" alt="C1-C2" /></td>
<td><img src="image" alt="Impedance" /></td>
</tr>
<tr>
<td><img src="image" alt="Load saved trace" /></td>
<td><img src="image" alt="Tools" /></td>
<td><img src="image" alt="AutoFind function" /></td>
</tr>
<tr>
<td><img src="image" alt="Gain" /></td>
<td><img src="image" alt="AUTO" /></td>
<td><img src="image" alt="Pulse width" /></td>
</tr>
<tr>
<td><img src="image" alt="Press for next fault" /></td>
<td><img src="image" alt="MAN" /></td>
<td><img src="image" alt="Range" /></td>
</tr>
<tr>
<td><img src="image" alt="Zoom function" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

www.megger.com
## TroubleShooting

### Appendix B

<table>
<thead>
<tr>
<th>Fault</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solution</strong></td>
<td></td>
</tr>
<tr>
<td>Instrument won't turn on</td>
<td>Battery not charged up</td>
</tr>
<tr>
<td>Plug in charger and charge for 6 hours</td>
<td></td>
</tr>
<tr>
<td>Instrument won't charge</td>
<td>Battery not functioning (error message)</td>
</tr>
<tr>
<td>Contact your local Megger dealer for a replacement battery</td>
<td></td>
</tr>
<tr>
<td>Instrument won't charge</td>
<td>Charger not functioning (LED)</td>
</tr>
<tr>
<td>Contact your local Megger dealer for a replacement charger</td>
<td></td>
</tr>
<tr>
<td>Instrument keeps turning itself off</td>
<td>Battery not sufficiently charged</td>
</tr>
<tr>
<td>Plug in charger and charge for 6 hours</td>
<td></td>
</tr>
<tr>
<td>Instrument keeps turning itself off</td>
<td>Standby set too low</td>
</tr>
<tr>
<td>Access user settings and change standby time</td>
<td></td>
</tr>
<tr>
<td>Display not visible</td>
<td>Colour settings incorrect</td>
</tr>
<tr>
<td>Access user settings and change colours</td>
<td></td>
</tr>
<tr>
<td>Display not visible</td>
<td>Instrument in power save mode</td>
</tr>
<tr>
<td>Press standby button to return to display</td>
<td></td>
</tr>
<tr>
<td>Distance to fault is inaccurate</td>
<td>Incorrectly set Velocity Factor</td>
</tr>
<tr>
<td>Check VF value for the cable under test and change settings</td>
<td></td>
</tr>
<tr>
<td>Can't set Velocity Factor</td>
<td>Cable Velocity Factor unknown</td>
</tr>
<tr>
<td>Test a known length of cable to determine Velocity Factor</td>
<td></td>
</tr>
<tr>
<td>VF, Impedance, Gain, Pulse inaccessible</td>
<td>Instrument set to Automatic</td>
</tr>
<tr>
<td>Press the escape button and then change to manual</td>
<td></td>
</tr>
<tr>
<td>Instrument keeps ticking</td>
<td>Dual input function chosen</td>
</tr>
<tr>
<td>Ticking is normal due to relays switching input</td>
<td></td>
</tr>
</tbody>
</table>

www.megger.com
# Trouble Shooting

## Appendix B

<table>
<thead>
<tr>
<th>Fault</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument keeps ticking on single input</td>
<td>Incorrect connection to cable under test</td>
</tr>
<tr>
<td>End of cable not determined so unable to reach max range</td>
<td></td>
</tr>
<tr>
<td>Buttons not responding</td>
<td>Keypad error</td>
</tr>
<tr>
<td>Contact Megger for repair</td>
<td></td>
</tr>
<tr>
<td>Can’t see end of cable on trace</td>
<td>Wrong range chosen</td>
</tr>
<tr>
<td>From main screen press up navigation button to extend range</td>
<td></td>
</tr>
<tr>
<td>Can’t see fault I know is there</td>
<td>Gain set too low</td>
</tr>
<tr>
<td>In manual mode select and change gain with navigation buttons</td>
<td></td>
</tr>
<tr>
<td>The trace is very noisy</td>
<td>Gain set too high</td>
</tr>
<tr>
<td>In manual mode select and change gain with navigation buttons</td>
<td></td>
</tr>
<tr>
<td>No trace even though leads connected</td>
<td>Leads plugged in to wrong channel</td>
</tr>
<tr>
<td>Connect test leads to correct channel</td>
<td></td>
</tr>
<tr>
<td>Instrument not uploading/downloading</td>
<td>USB cable damaged or wrong type</td>
</tr>
<tr>
<td>Use only genuine Megger cable and check before connecting</td>
<td></td>
</tr>
<tr>
<td>Instrument won’t download data</td>
<td>No saved results on TDR</td>
</tr>
<tr>
<td>Take readings and save results before download</td>
<td></td>
</tr>
<tr>
<td>TraceXpert won’t load up</td>
<td>Incorrect or unstable installation</td>
</tr>
<tr>
<td>Obtain correct user rites if required and re-install TraceXpert</td>
<td></td>
</tr>
<tr>
<td>TraceXpert won’t install on PC</td>
<td>Incompatible operating system</td>
</tr>
<tr>
<td>TraceXpert is compatible with Windows XP, Vista, 7 and 8</td>
<td></td>
</tr>
</tbody>
</table>
Common fault traces

Appendix C

- Open conductor
- Shorted conductor
- Cable splice/joint
- T-joint
- Bridge tap
- Spilt/resplit
- Wet splice
- Water ingress
Specifications

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

General

Range
Up to 20000m with a minimum resolution of 0.1m

Accuracy
±1% of range ± 1 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

Input Protection
This instrument complies with IEC61010-1 to protect the user in the event of connection to live systems up to 150 V CAT IV. This instrument is designed for use on de-energised systems but fused leads must be used if the potential voltage between terminals could exceed 300 V

Output pulse
Up to 20 volts peak to peak into open circuit. Pulse widths determined by range and cable

Gain
Set for each range with user selectable steps (in Manual operating mode)

Velocity Factor
Variable from 0.2 to 0.99 in steps of 0.01

TX Null
Automatic mode

Power Down
User programmable auto power off timer 1, 5, 10 minutes or off

Batteries
Li-Ion rechargeable battery with 12 hours typical life

Safety
IEC61010-1 compliant for live systems, 150 V CAT IV or 300 V CAT III. EN60950-1, EN61010-3, UN38.3 and EN62133

EMC
Complies with Electromagnetic Compatibility Specifications BS EN 61326-1, B min. for all immunity tests

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

Case Dimensions
290 mm (11.4 inches) x 190 mm (7.5 inches) x 55 mm (2.2 inches)

Instrument weight
1.7 kg (3.8lbs)

Case material
ABS

Display
800 x 480 pixel WVGA colour graphics LCD, viewable in external environments, user selectable colour schemes

Connectors
Four 4mm-safety terminals and two F connectors. Other standard push on adapters will fit

Test leads

TDR2000/3, TDR2010
2 m 2 x 4 mm shrouded connector to miniature crocodile clips

TDR2000/3P
2 x 1.5 m fused leads

CFL535G
2 x Bed-of-Nails lead set

Environmental

Operational Temperature
-15°C to +50°C (5°F to 122°F)

Storage Temperature
-20°C to 70°C (-4°F to 158°F)

Charging Temperature
0°C to 40°C