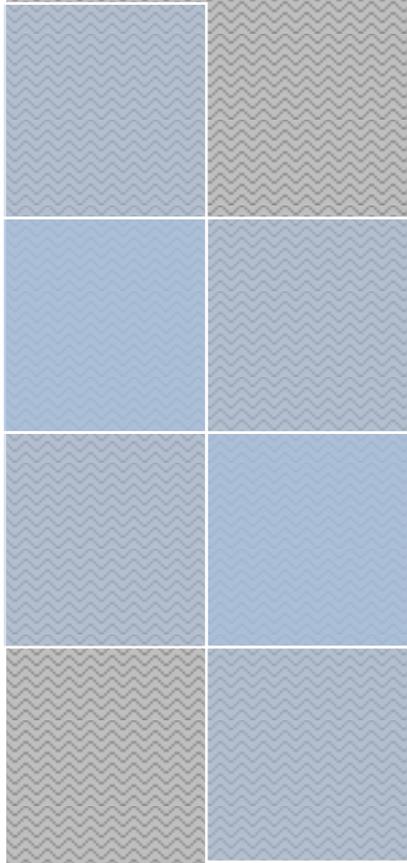


TDR Pulse Echo

Basic step-by-step guide



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- **Its uses:**

The pulse echo can, if used properly, can be a very good tool to find damage within a cable. Depending on the type of cable fault it can be extremely accurate. Disses and shorts are easier to find than minor damage which may be picked up by an initial earth fault and not actually a cable fault, such as a nick in the cable outer sheath and water ingress.

The operator should be familiar with the equipment and its use and be as accurate as possible. If the cable is on the surface then being a few metres out on the trace would not be as important as if it was in troughing or buried as this would involve more lifting of lids or extra digging.

These instructions are based on the Bicotest TDR basic model. Other models have more functions but they are generally not needed.

Also the TDR will only work on cables with two or more cores, providing at least one of those cores is in working condition (no fault). If you don't know the VOP (see page three), and need to work out the VOP in the method explained below but the cable has no working cores, due to a dis, then the TDR will only show that dis without a proper distance. However most locs have other cables going to the same loc, so you could work out the VOP using spare cores of another cable, but it should be noted that the other cable may not take the same route or have the same length due to coiled up spare in the loc bottom.

- **How does it work?**

The TDR (Time Domain Reflectometer) also known as a pulse echo tester or radar cable test set provides a visual indication of a cable fault on many different types of cable. The echo transmitted is reflected back from the damage and gives a reading on where that damage is located.

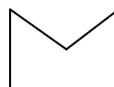
A cursor on the screen is moved to show the distance of the damage in metres (or feet depending on the model used).

The type of fault can be determined by the waveform on the screen, this is explained later.

- **Initial power up:**

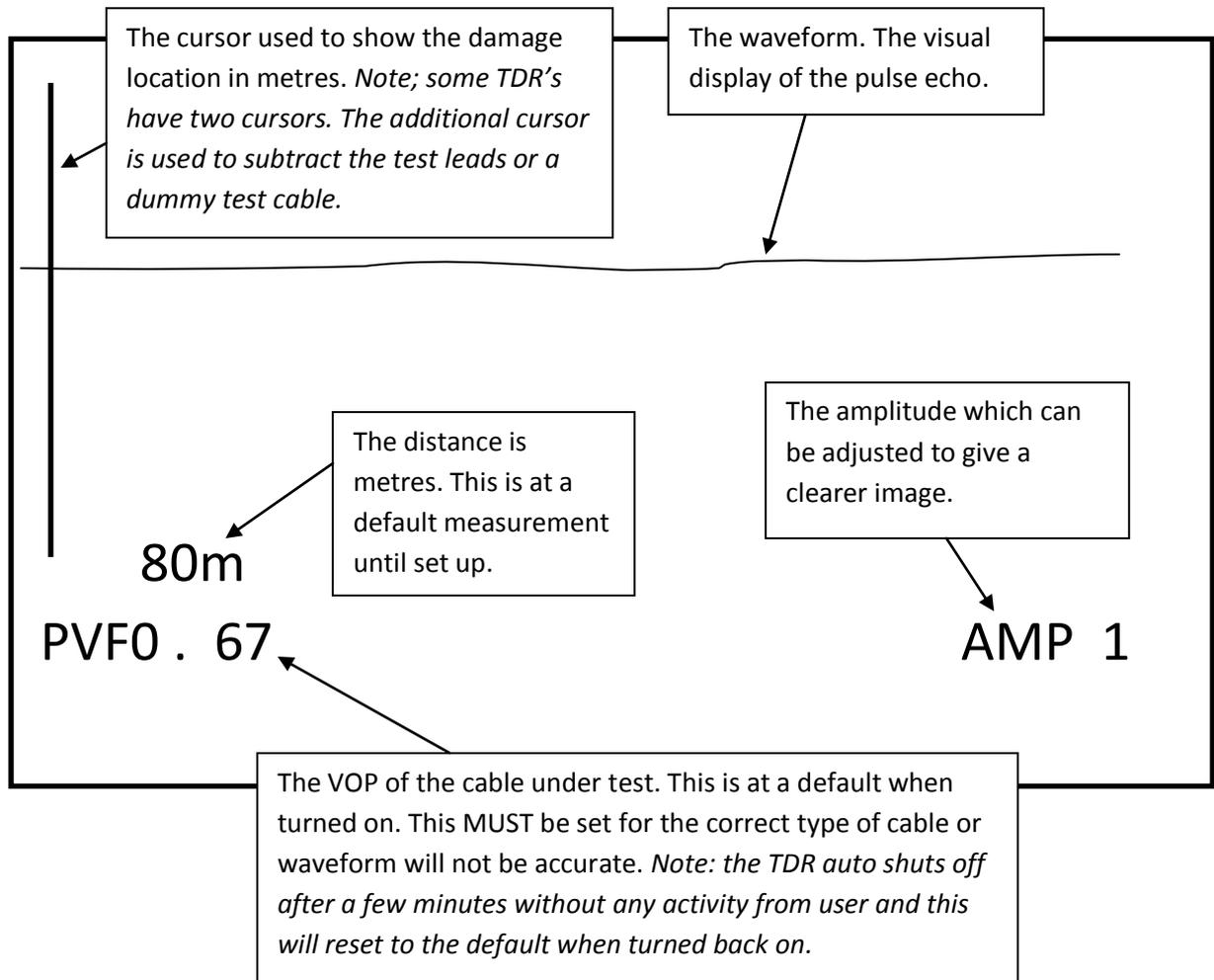
Before you connect the TDR you **MUST** make sure the circuit to be tested is **free from voltage** (this means an intentional voltage and not a natural source from earth) or the TDR will be damaged. A blocking filter can be used if a circuit with voltage was to be tested.

Also before you connect the TDR to a cable, turn down and click off the balance rotary switch. The balance switch is denoted by this symbol:



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Before you connect the TDR, turn it on and the display should look like this;



- **Adjusting the VOP:**

Connect the test leads to the L1 sockets and then to the cores under test. The L2 sockets are used to compare one set of cores to another, but this is explained in the instruction manual with the TDR.

The waveform will be quite different from the one above which is because the echo is now being sent down the cable.

The next step is to adjust the VOP (velocity of propagation) or the 'Dielectric'.

This is very important and different cable properties affect the echo and if not selected correctly it will show an inaccurate reading by a difference of several metres.

If you know the VOP use the DIEL + or – buttons to adjust it. *Note: some top-of-the-range TDR's have a menu and you can select the different types of cables.*

If you do not know the VOP you can determine it by following one of these methods;

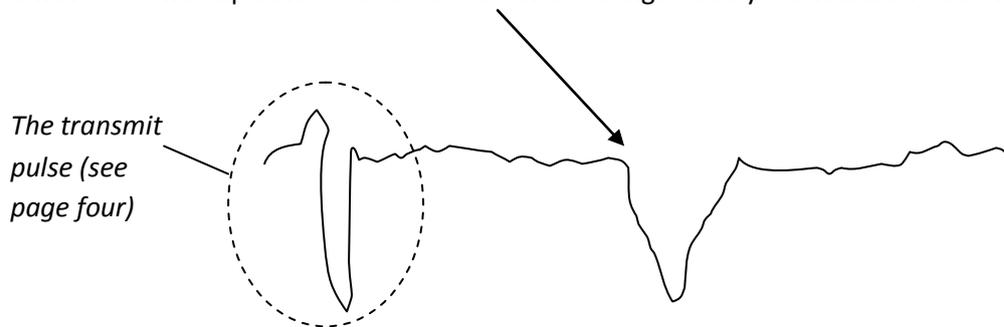
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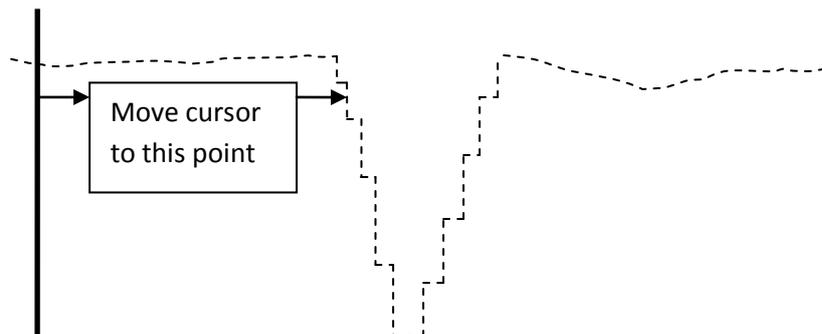
- **Adjusting the VOP continued:**

Have an assistant go to the other location case where the cable is terminated and short out the cores under test. It may be best to do this on any spare working cores if available as the fault you are looking for may affect the result.

The waveform will dip down to show a short which is signified by the waveform below;



Next, using a measuring wheel, wheel out the cable as near as you can to the exact route. Once this is done, move the cursor to the short on the waveform to where it just starts to dip. The cursor should be placed on the first longest dotted line (see figure below). You may have to use the zoom and amplitude to achieve a closer view, as in the example waveform below, see the next pages for this.



Now adjust the DIEL + or - to adjust the PVFO display until the measurement in metres matches that what was wheeled out. For example your assistant wheeled out 256m of cable. Adjust the DIEL (*) so the display changes to 256m (**) or the very closest to that.

Note: be sure to subtract the test leads (2 metres) and also any coiled up cable (if any) in the bottom of the locs from the wheeled out measurement.



PVFO . 54* Note: railway signalling cable is normally 54, but always check.

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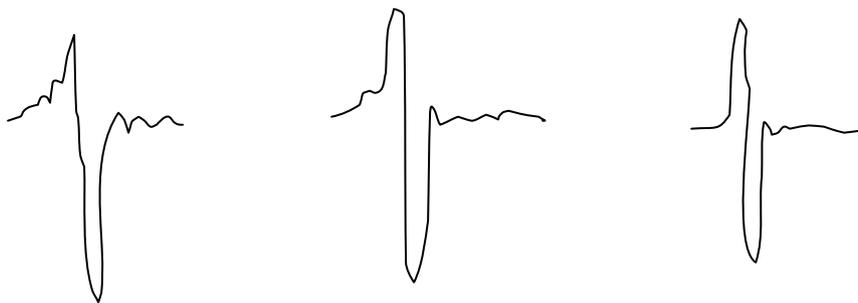
- **Adjusting the balance:**

When the TDR is connected to the cable under test, you will notice a sharp reflection at the start of the waveform, this is normal, as this is called the 'transmit pulse'.

The waveform after the transmit pulse may also be all over the place and not as clear in the example in page three.

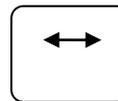
To make this clearer and readable, you can adjust the balance, zoom and amplitude as follows.

Using the balance rotary switch as mentioned on page one, turn it clockwise. The transmit pulse will start to go straighter at the beginning as below left. Keep adjusting until it's as straight as possible as in the right hand side example. You may also see the main waveform balance out too.



- **Adjusting the zoom:**

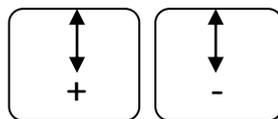
Adjusting the zoom by using the zoom button:



This will zoom in on the waveform and will make it more clearer.

- **Adjusting the amplitude:**

The amplitude buttons:



This will make the waveform more clearer to put the cursor on the first longest dotted line at a fault blip. The word AMP 1 will be replaced by AMP 2, then AMP 3 etc.

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The TDR is now set up and ready to test the faulty cable.

Have the assistant remove the test strap at the other end if applicable.

The waveform will now give the proper reading and reveal any damage. Note: the trace will carry on past the fault as it sees the rest of the cable as infinity.

Making sure the VOP, balance, zoom and amplitude are all set up, and the cursor is moved to the first longest dotted line, the fault is displayed in metres. The cable can now be inspected for damage.

Because of the unknown possible coils either in the location case bottom or in the troughing etc, it is advisable to inspect the cable a few metres either side to eliminate the extra cable.

Examples of traces are shown below;



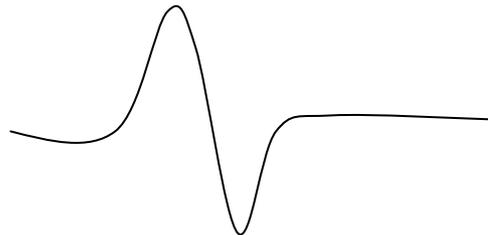
Open circuit (dis)



Short circuit



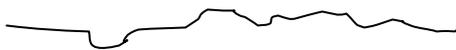
Cross (smaller forms may also be a joint or earth fault)



Splice/joint



Split and re-split



Water ingress/minor damage

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Use this page to make any notes (it is intentionally blank).