exists some of the current flowing along the cable will be directed into the fault, producing a variation in the magnetic field around the cable. This change in direction and reduction in the null to maximum difference can be a good indication of the location of the fault. A similar method may be used to locate core to sheath faults, where no current would flow to earth; just connect the oscillator between the sheath and the shorted core.

Note that when using Search Coil 3A, any change of field direction or strength could also result from the cable changing depth or direction or splitting; use an electrostatic method to confirm as detailed in section 9.2.

9.2 Electrostatic Method

The soil around a ruptured cable conducts the signal back to the oscillator's earthed terminal (figure 10), detecting this can locate the fault. Probe 5B and your feet can be used to detect the electric field, the maximum normally being directly above the fault. Having already identified the route and approximate location of the fault as in section 9.1, stand with feet together above the suspected fault, press the tip of Probe 5B into the ground an equal distance to either side of the cable route. Move your feet back and forth and side to side. When an equal maximum signal is detected either side of the cable, your feet are directly above the earth fault (figure 11). The greater the distance between the probe and your feet, the more sensitive the system. Therefore the accuracy of this method can be improved if the Probe 5B is taped to the end of a short insulating pole (e.g. wooden broom handle). **Keep hold of the exposed metal body of the connector at the Amplifier, to maintain a good earth reference.**

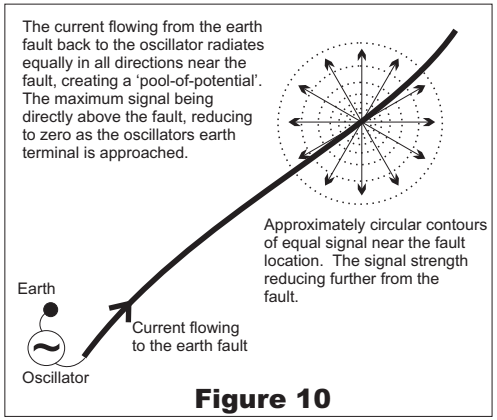

Figure 10

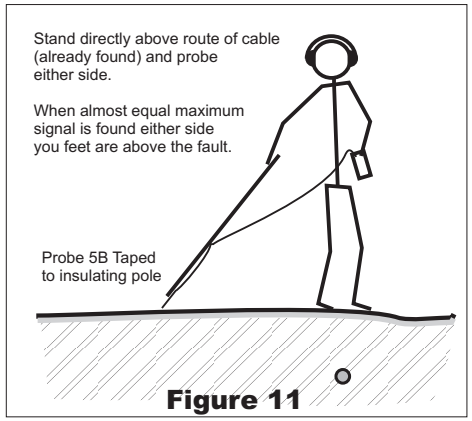

Figure 11

Note: you may have a Locator 6A, this can still be used with Amplifier 109K in a similar way to earlier models of Amplifier 109.

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Part No.: 52059082 Iss 1, 01/11

Cable and Pair Tracing Using the Tester 132K

Incorporating the Amplifier 109K User's Guide

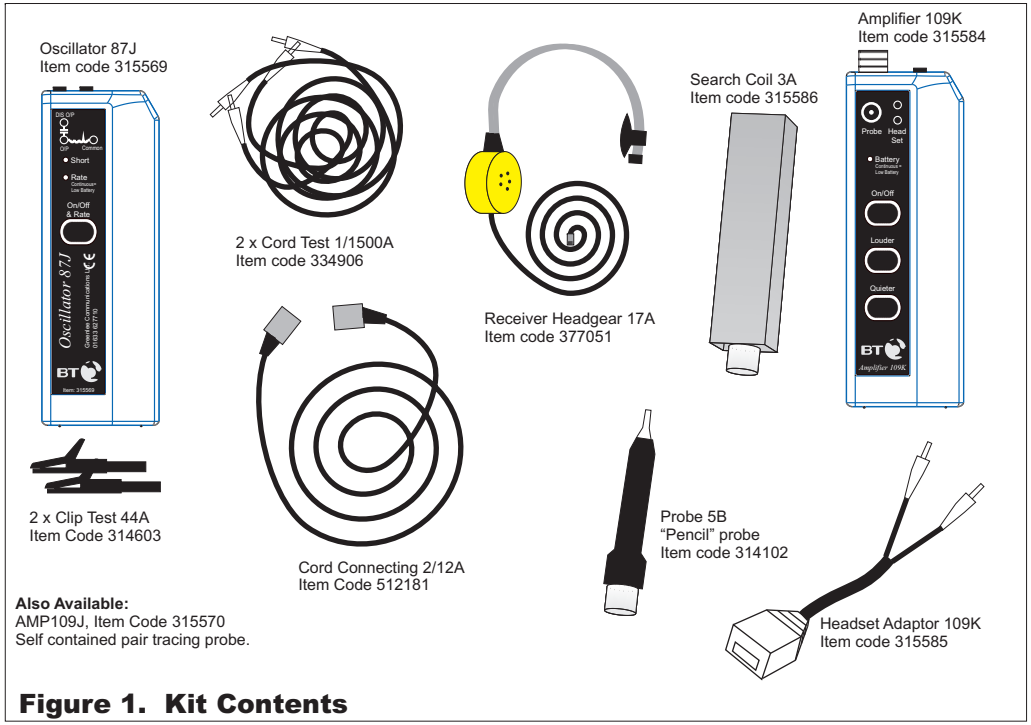


Figure 1. Kit Contents

1. Introduction

The Tester 132K can be used for telecommunications pair and cable identification. In different configurations it can be used for cable and pair identification, cable route tracing both underground and overhead and also for locating some faults, e.g. disconnection or earth faults, before excavation.

2. Battery

2.1 Installation

The Amplifier 109K and Oscillator 87J each require 4, AA (LR6) alkaline cells. Unscrew the two captive screws retaining the battery cover. Remove the cover from the unit, then remove the old cells. Replace the cells as shown in the battery compartment. Check that the rubber seal is clean and in place. Replace the cover, being careful not to over-tighten the screws.

2.2 Performance

As the battery voltage drops the red LED will light continuously and the Oscillator 87J tone becomes continuous. At least two hours of battery life remain from the first indication. However, the battery should be replaced at the first opportunity.

In the Amplifier 109K, a further check is made at switch on; if the battery voltage has dropped below a level where reliable operation may no longer be possible, the unit will switch off automatically after lighting the LED.

3. Amplifier 109K

3.1 Operation

The Amplifier 109K only operates with a headset connected[1]**.** To switch on, press the 'On/Off' button for about half a second, when you see the LED light[2], release the button. While operating normally, the LED will flash slowly. To switch off, press the 'On/Off' button, again for about half a second. If the headset is disconnected, Amplifier 109K will switch off after about five minutes.

The unit always starts with a medium gain when switched on. Adjust the gain as required by pressing the 'Louder' and 'Quieter' buttons. Short presses allow the gain to be adjusted in small steps, during longer presses the gain will be rapidly 'swept' up[3] or down. Use the lowest setting required to hear the signal being traced.

Caution: Avoid exposure to loud signals for more than a few seconds; always lower the gain (by pressing 'Quieter') as you approach the signal. When used with Receiver Headgear 17A the peak output level is limited. However, exposure to the maximum level (e.g. tip contact with wire) should be minimised.

Notes:
1 - The use of a Headset Adaptor 109K allows the Amplifier 109K to be a water-resistant product.
2 - If the button is pressed for too long the unit will switch off again; just in case the button gets pressed in your tool-bag.
3 - During operation at the louder settings you may hear a faint click each time the LED switches on or off; this is due to the proximity of the LED and amplifier circuit but it is quiet and should not interfere with your work.

3.2 Compatibility

The Amplifier 109K will work with any version of the Oscillator 87 (see separate instruction for details of Oscillator 87J). Use Cord Connecting 2/12A to attach the Search Coil 3A or Search Coil 2B, Probe 4B, Probe 5B and Locator 6A

3.3 Principles of Operation

The Oscillator 87 supplies a 1kHz tone which can be pulsed at various rates for easy recognition. When the oscillator is connected across the A and B wires of a pair, surrounding electric and magnetic fields are set up along the length of the pair. The induction into other pairs balances itself out giving negligible crosstalk. One field or the other can be detected when the capacitive probe (Probe 5B for electric fields) or inductive probe (Search Coil 3A for magnetic fields) is held close to the pair. The detected signal is then amplified and output to the earpiece of the headgear.

The Search Coil 3A detects the magnetic field set up by the flow of current in each 7 (similar to section 4), to the wires which are shorted (if possible not a twisted pair). Using Search Coil 3A, follow the signal along the cable as in section 4 (the higher the fault resistance, the weaker the signal). When you are above the fault the signal detected may rise in strength then suddenly drop. The shorted pair may then be identified within a joint by progressively dividing the cable bundle, in a way similar to normal pair tracing but using Search Coil 3A to home in on the pair carrying the signal. See also the section 6, detailing Identifying Pairs that are shorted.

9. Earth Fault Location

When a cable has been damaged such that a connection to earth is made (e.g. rupture of a direct buried cable) the following methods may be used to locate the fault. Connect the oscillator between earth and one or more wires that are known to have an earth fault, as in figure 8.

9.1 Inductive Method

Using Search Coil 3A, follow the route of the cable as described in section 7; you can move quickly until you have nearly reached the distance indicated by other means (e.g. Ohmmeter 18C). As the earth fault is approached, the difference between the null and maximum signals either side will become less pronounced and as the fault is passed the signal identified either side of the null will decrease, or even disappear altogether.

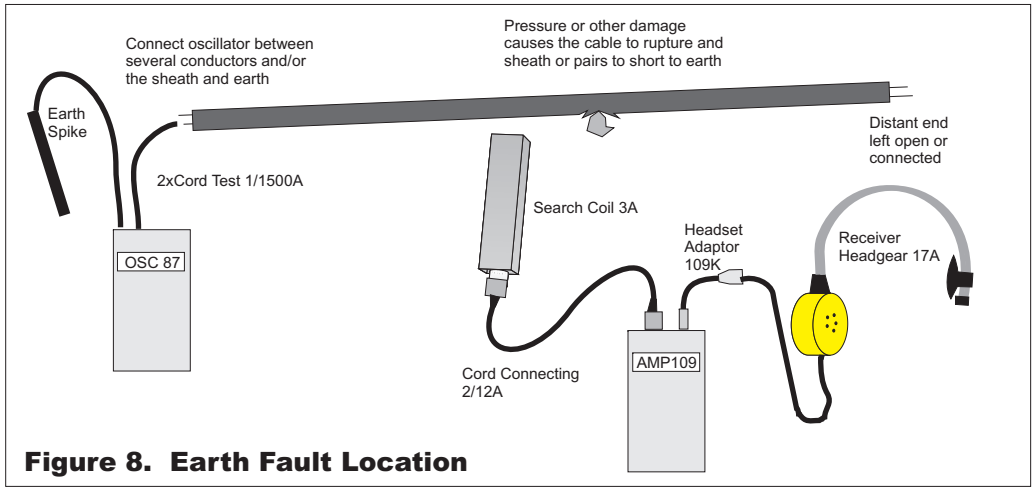


Figure 8. Earth Fault Location

Alternately hold the search coil horizontally (see figure 9), when it points along the route of the cable there should be a null in the received signal and a maximum in the received signal when it points across the direction of the cable. Where an earth fault

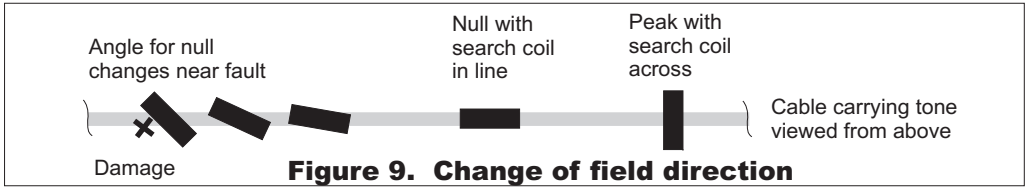


Figure 9. Change of field direction

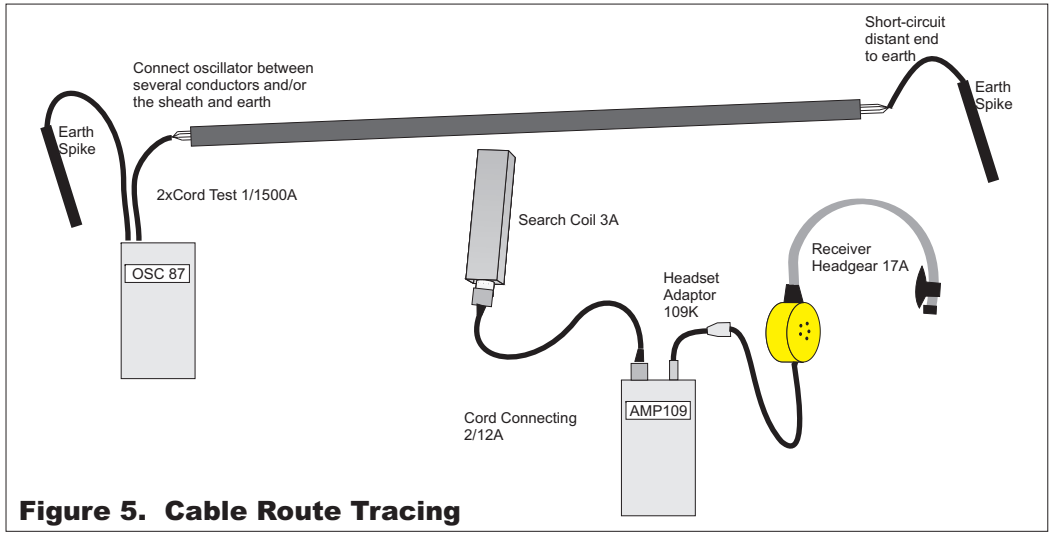


Figure 5. Cable Route Tracing

With the search coil held pointing directly at the cable, there will be null in the received signal, see figure 6a. As the search coil is moved to either side of the cable, or rotated so that it is horizontal, the signal will increase. The maximum signal will be received when the search coil is horizontal and across the cable, see figure 6b.

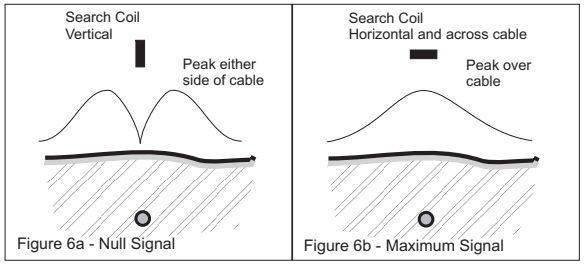


Figure 6a - Null Signal

Figure 6b - Maximum Signal

8. Short Circuit Location

Where a cable has been damaged resulting in the wires of a pair or pairs becoming shorted, the location of such a fault can be identified. Connect the oscillator as in figure

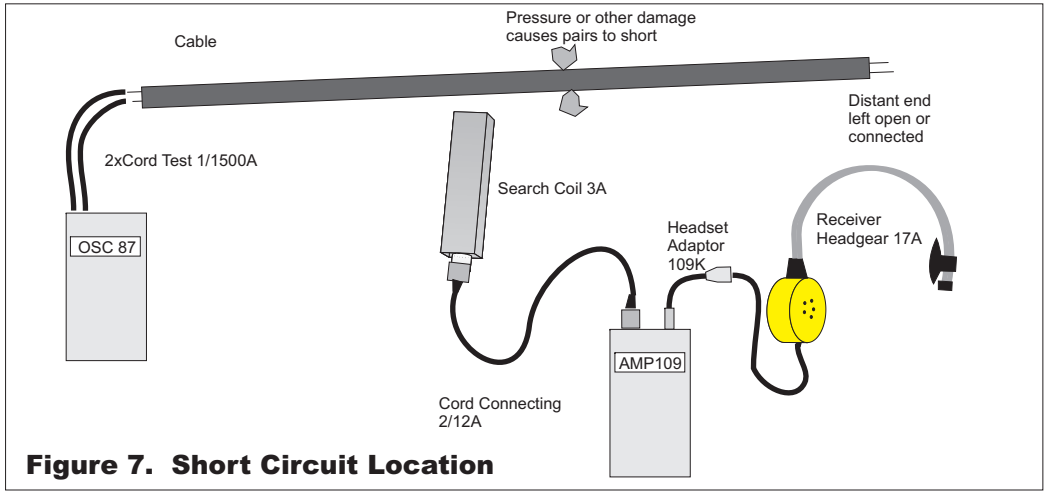


Figure 7. Short Circuit Location

wire of the pair, the currents in the two wires being in opposite directions. To obtain a strong magnetic field the pair should be short-circuited at the far end so that maximum current will flow. As the metal sheath, barrier foil or conductors do not shield the magnetic field to any great extent, the tone may be detected outside the cable. However, steel armouring wires or tapes may reduce the field outside the cable.

The Probe 5B (pencil probe) detects the electric field resulting from the voltage across the pair, each wire having opposite polarity. To obtain a strong electric field the pair should be open-circuited at the far end so that maximum voltage is present. The electric field (i.e. the difference in the alternating potential between the two wires) decreases as a short circuit is approached. The loudest signal will be heard when the probe is held close to one wire of the pair or when the metallic probe tip touches one of the conductors. The metal sheath or barrier foil, used in some cables, forms a screen to the electric field, as to some extent do the conductors of surrounding pairs. For this reason the pencil probe is not generally effective outside the cable sheath.

The equipment enables cables and pairs to be identified quickly in all local networks regardless of length and sizes of cables used, providing these are in good condition. Results can be unreliable with wet cables or where the pair is subject to short circuits, contacts or disconnects. However, an introduction to pinpointing some of these faults, is included below.

4. Identifying Cables

When using Oscillator 87J, connect the A (Common terminal) and B (O/P terminal) wires of one pair, this minimises crosstalk to other circuits, see figure 2. Ideally you should short the far end of the pair (without this, little current will flow and the final few hundred metres will be difficult to identify). Use the Search Coil 3A connected to the Amplifier 109K by a Cord Connecting 2/12A.

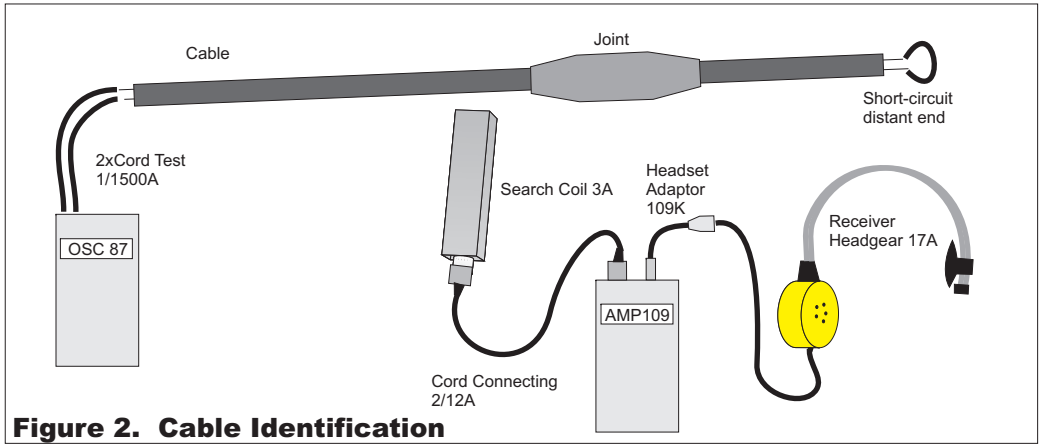


Figure 2. Cable Identification

With the Search Coil 3A pointing towards the cable a distinct maximum tone should be identifiable. The strength of the signal will vary as the search coil is moved along the cable; this is because the magnetic field strength varies as the pair of wires cross and as they move around the bundle within the cable.

An identifiable tone should be found outside the sheath of the cable, but where the wires of the pair are further separated, for example in a joint there will be a much louder signal.

If the pair has a high resistance connection or one wire is disconnected somewhere along its length, the signal may not fade completely but may be heard faintly beyond the fault. Normally a cable can be identified under these conditions particularly when the far end is short-circuited, but if the results are uncertain, a good pair may be connected in parallel with the faulty one to aid tracing. When two or more cables are lying in a bundle, care should be taken that the required cable has been positively identified.

Note: If a loud 50Hz hum is heard this may indicate a nearby electricity supply cable!

5. Identifying Split Pairs

Where a pair is suspected as being split at some joint along its length this may be located using the oscillator and amplifier as described in section 4. The signal detected in the leg of the cable where the signal is split between two pairs will be much greater than when passing down a single pair.

6. Identifying Pairs

Connect the Oscillator 87J between the A (Common) and B (O/P) wires of one pair, see figure 3. If you suspect the pair has a short circuit it is better to connect between the oscillator terminals “Common” and “DIS O/P” which places a capacitor in series with one wire. Use the Probe 5B connected to the Amplifier 109K by a Cord Connecting 2/12A. The probe tip should be placed amongst the pairs.

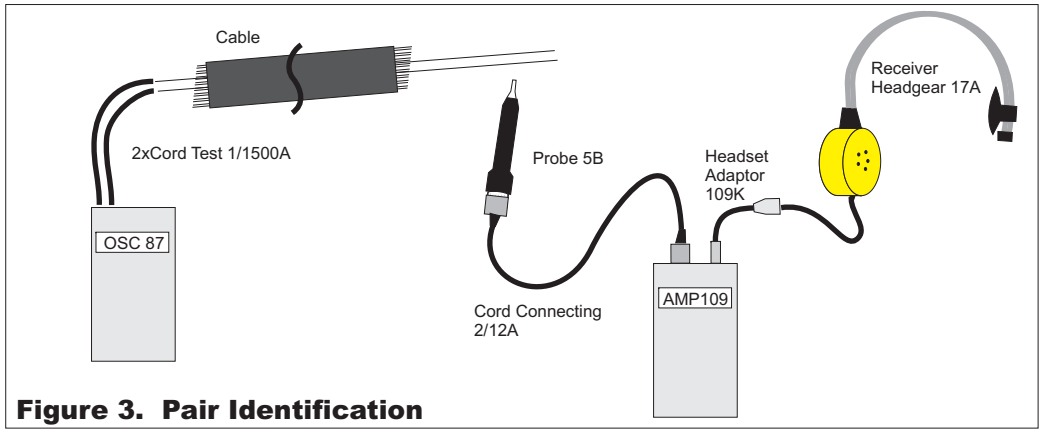


Figure 3. Pair Identification

If the required pair appears at the joint, a faint tone will be heard and its position should then be found by selecting a section of the joint having the loudest tone. Groups of pairs and finally individual pairs should be eliminated by selection until one pair is found to have the loudest tone. During this process the amplifier gain should be set to give the minimum signal, otherwise the weak tone induced into other pairs may cause confusion.

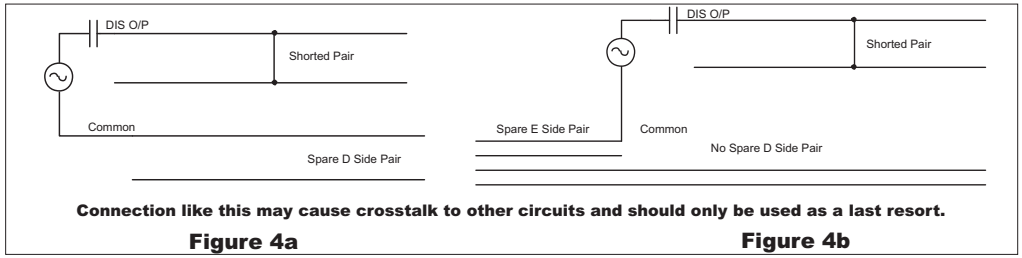
Placing the probe tip alongside the pair gives a strong signal except where the wires cross. Here there should be a noticeable null. Move the probe back and forth along the wire to confirm this.

To positively identify the pair, place the probe tip between the two wires of the pair; a null in the signal should be found when the probe tip is centred between the wires. If the ends of the pair are available, shorting both to the probe tip should result in very little output. If a stronger signal is still heard then, this may be the incorrect pair, the pair may be split at an earlier joint or one leg is disconnected or has a high resistance fault. You will also hear a small signal if using the “DIS O/P” of the oscillator as this adds an imbalance equivalent to about 160 ohms.

The Probe 5B can also be used to follow overhead lines or dropwires, though you may need extension cords and poles. If a fault is approached the output level will change (up or down), sometimes the change can be very small.
Caution: Be very careful to avoid overhead power lines.

When attempting to trace up to and beyond a short circuit, use of the “DIS O/P” output of the oscillator adds a small imbalance to the output. Then, at and beyond the short circuit, there will be a small signal detectable. If you cannot detect the small signal present when using this method, the Search Coil 3A may be used to detect the magnetic field resulting from the current flowing to the short circuit, but probably not beyond it. The other advantage of using the “DIS O/P” of the oscillator is that once the short circuit fault is cleared it can be tested using the 95V insulation test range of Ohmmeter 18C or SA9083 (do not use the 500V range with the oscillator connected as its capacitor is rated at 200V).

Where it is necessary to trace a shorted pair, connect the oscillator between one line of the shorted pair and one line of another D side pair (figure 4a), or if there are no spare D side pairs, between one line of the shorted pair and one line of a spare E side pair (figure 4b).



Connection like this may cause crosstalk to other circuits and should only be used as a last resort.

Figure 4a **Figure 4b**

7. Cable Route Tracing

Connect the “O/P” terminal of the Oscillator 87J to several spare pairs and/or the foil barrier of the cable and the “Common” terminal of the oscillator to earth, see figure 5. Where possible, earth the distant end of the cable (otherwise the final few hundred metres will be progressively difficult to follow). This will induce maximum current in the cable allowing it to be traced at a far greater range. This method should be used only where absolutely necessary as connection of the oscillator in this way may result in crosstalk to other pairs in the cable.