FLUKE networks

TS®54 TDR
TS®53 PRO

Test Sets

Users Guide

PN 3836384
August 2011, Rev. 1, 12/11

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Each Fluke Networks product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period for the mainframe is 3 years and begins on the date of purchase. Parts, accessories, product repairs and services are warranted for 90 days, unless otherwise stated. Ni-Cad, Ni-MH and Li-Ion batteries, cables or other peripherals are all considered parts or accessories. The warranty extends only to the original buyer or end user customer of a Fluke Networks authorized reseller, and does not apply to any product which, in Fluke Networks' opinion, has been misused, abused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke Networks warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke Networks does not warrant that software will be error free or operate without interruption.

Fluke Networks authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke Networks. Warranty support is available only if product is purchased through a Fluke Networks authorized sales outlet or Buyer has paid the applicable international price. Fluke Networks reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke Networks warranty obligation is limited, at Fluke Networks option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke Networks authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke Networks authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB destination). Fluke Networks assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB destination). If Fluke Networks determines that failure was caused by neglect, misuse, contamination, alteration, accident or abnormal condition of operation or handling, or normal wear and tear of mechanical components, Fluke Networks will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping point).

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. FLUKE NETWORKS SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

4/04-3

Fluke Networks
PO Box 777
Everett, WA 98206-0777
USA

Contents

Title Page

TS®54 TDR/TS®53 PRO
Professional Series Test Sets

Overview of Features

The TS54 TDR and TS53 PRO Professional Series Test Sets are analog test telephones used by installers, repair technicians and other authorized personnel to test copper wire, voice subscriber lines.

Today, many subscriber lines support data services. The data services are in the same distribution facilities as voice services. It is not always easy to tell the difference between data and voice services. The test sets use unique, patented circuitry that reduces the possibility of disruptions to digital data services if you accidentally connect the test set to a data line.

The TS54 TDR includes a time domain reflectometer that lets you measure the length of cables and the distance to the first open or short on cables as long as 3,000 ft (914 m).

The test sets include these features and functions:

- Liquid crystal display with backlight
- TDR measures cable length and locates opens and shorts (TS54 TDR only)
- Line voltage / Loop current test
- Optional headset
- Caller ID
- DataSafe™ protection in Monitor mode
- Data detection and lockout in Talk mode
- Data lockout override
- DTMF digit grabbing
- High impedance in Monitor mode
- High voltage protection
- SmartTone™ toner function (TS54 TDR only)
- Last number redial up to 23 digits
- Visual ANAC mode
- Microphone mute
- Pause key
- Reverse polarity indication
- Two-way speakerphone
- Receive-only loud speaker mode
- Speed dialing for nine 23-digit numbers
- Tone and pulse dialing
- Hook flash
- Low battery indication
- Field-replaceable belt clips, battery, and test leads
- Weatherproof case
- High-contrast keys are easy to read even when dirty
- Keys glow in the dark
- High voltage lockout in Talk mode

Registration

Registering your product with Fluke Networks gives you access to valuable information on product updates, troubleshooting tips, and other support services. To register, fill out the online registration form on the Fluke Networks website at **www.flukenetworks.com/registration**.

Contacting Fluke Networks

www.flukenetworks.com
support@flukenetworks.com
+1-425-446-4519

- Australia: 61 (2) 8850-3333 or 61 (3) 9329 0244
- Beijing: 86 (10) 6512-3435
- Brazil: 11 3759 7600
- Canada: 1-800-363-5853
- Europe: +31-(0) 40 2675 600
- Hong Kong: 852 2721-3228
- Japan: 03-6714-3117
- Korea: 82 2 539-6311
- Singapore: 65-6799-5566
- Taiwan: (886) 2-227-83199
- Anywhere in the world: +1-425-446-4519

Visit the Fluke Networks website for a complete list of phone numbers.

Safety Information

The following IEC symbols are used either on the test set or in the manual:

⚠	**Warning: Risk of personal injury. See the manual for details.** **Caution: Risk of damage or destruction to equipment or software. See the manual for details.**
⚠	**Warning: Risk of electric shock.**
	Conforms to relevant Australian EMC requirements.
C US	**Conforms to relevant Canadian and US standards.**
CE	**Conforms to European Union directives.**
⧈	**Double Insulated - does not require connection to earth ground.**
	Do not put products containing circuit boards into the garbage. Dispose of circuit boards in accordance with local regulations.

⚠ Warning ⚠

To avoid possible fire, electric shock, or personal injury:

- **Do not use the test set if it is damaged. Before you use the test set, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.**
- **Do not use around explosive gases or vapors, or in a damp or wet environment when hazardous voltage is present.**
- **Do not connect the test set to lines that have more than 140 V dc.**
- **The test set meets IEC Measurement Category I. CAT I equipment is designed to protect against transients in equipment on circuits not directly connected to MAINS. Under no circumstances should the test leads of the test set be connected to any CAT II, CAT III, or CAT IV rated circuit.**
- **Do not use test leads if they are damaged. Examine the test leads for exposed metal and damage to the insulation. Make sure the wear indicator on the cords does not show. The wear indicator is the white layer below the outer, braided layer. Verify the continuity of the test leads. To replace the test leads, see page 31.**
- **Do not connect the test set to voltages higher than the maximum specified by the Measurement Category (CAT) rating of the lowest-rated individual component of the test set, test leads, or accessory.**
- **Use only accessories that are approved by Fluke Networks.**
- **Use only a 9 V battery, correctly installed, to supply power to the test set.**
- **Do not touch the exposed metal of the test clips.**

- **If this product is used in a manner not specified by the manufacturer, the protection provided by the product may be impaired.**
- **To prevent unreliable test results, replace the battery as soon as the battery icon shows no bars.**
- **Before you remove the battery door, disconnect the test leads from the line.**

Physical Characteristics

Housing

See Figure 1.

The test set housing is made of high-impact plastic. The test set provides rugged service and withstands the rough handling and shocks associated with field use. The housing permits operation in bad weather, such as heavy rain or dust storms.

Belt Clip

See Figure 1.

The belt clip has a spring-loaded clip that assures a secure connection to belt loops and D-rings. You can replace the belt clip in the field. See "Replacing the Belt Clip" on page 30.

Test Leads

See Figure 1.

The test set has field-replaceable test leads. Test leads that show damage or abrasion should be replaced before you use the test set. See "Replacing the Test Leads" on page 31

Several different configurations of test leads are available. See "Accessories" on page 32 for model numbers.

Battery

⚠Warning⚠

Use caution when handling batteries. Do not let the terminals short together. Dispose of batteries properly to ensure terminals cannot short. Disposal may be restricted by local laws.

Note

If the test set does not operate properly, first replace the battery and try it again before you send the test set to Fluke Networks for repair.

A 9 V alkaline battery must be installed for the test set to operate. Do not use a rechargeable battery.

When the battery icon on the display shows no bars, replace the battery immediately. See "Replacing the Battery" on page 29.

Speaker and Speakerphone Microphone

See Figure 1.

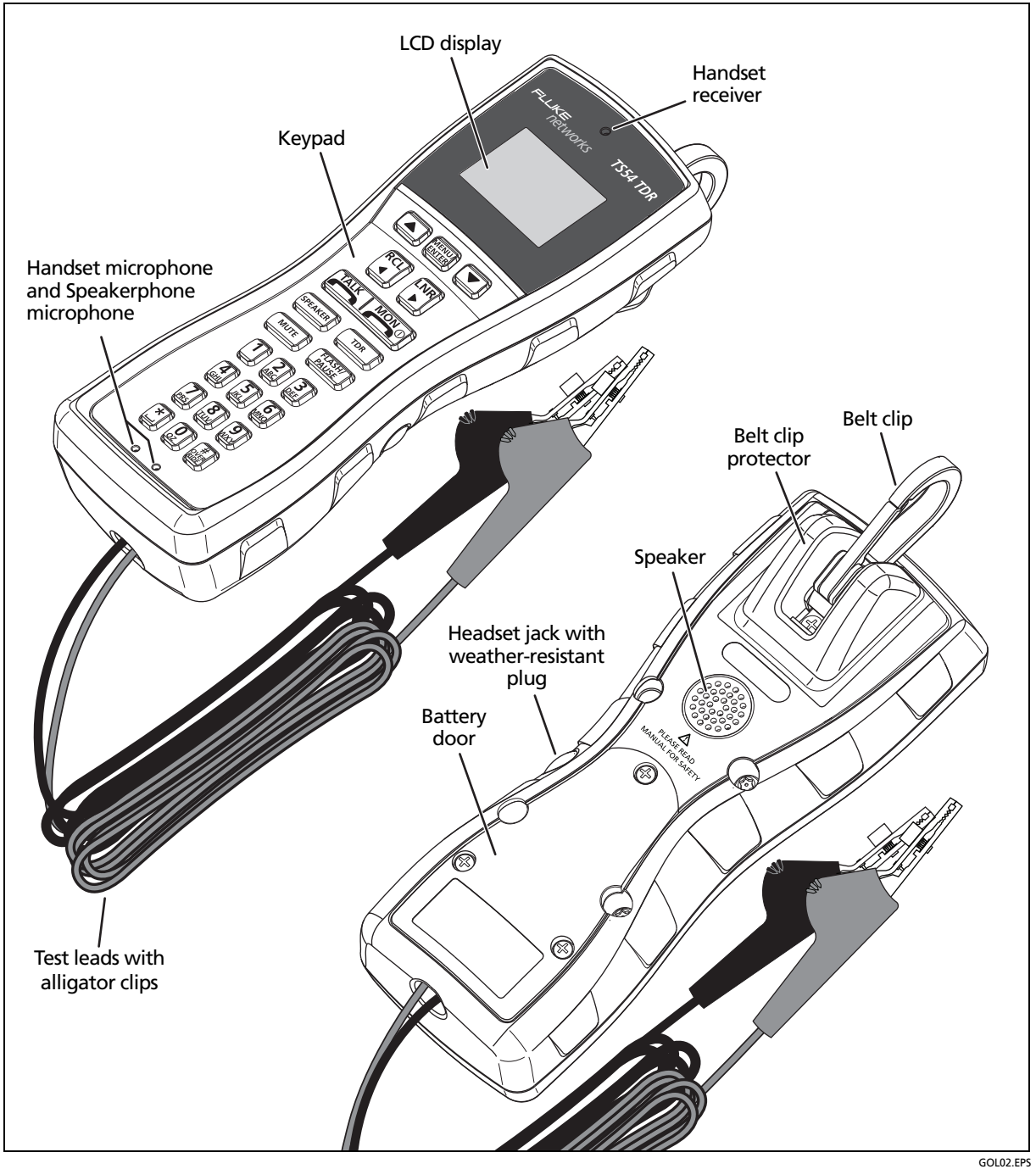
The speaker is on the back of the test set. The speakerphone microphone is below the keypad. To turn on the speaker, press SPEAKER. See page 9.

⚠Warning

Never hold the speaker against your ear when it is on, or when turning it on or off. Sounds emitted by the speaker can be loud enough to damage your hearing.

Note

The speaker uses a lot of battery power. The battery lasts longer if the speaker is used in moderation.



GOL02.EPS

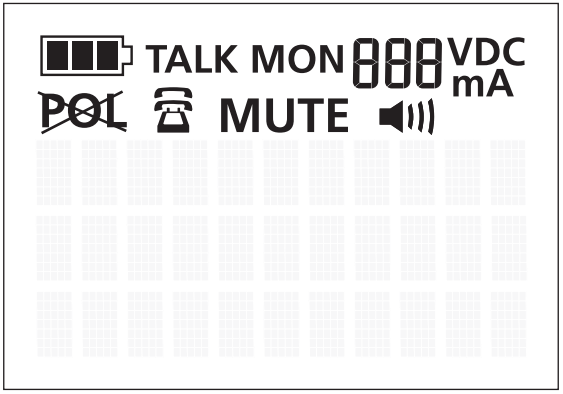
Figure 1. Physical Characteristics (TS54 TDR shown)

Display and Keypad

See Tables 1 and 2.

The test sets have an LCD display and a keypad that are recessed into the housing. The recessed bezel protects the keypad and helps prevent accidental key presses.

Table 1. Display Icons



GOL03.EPS

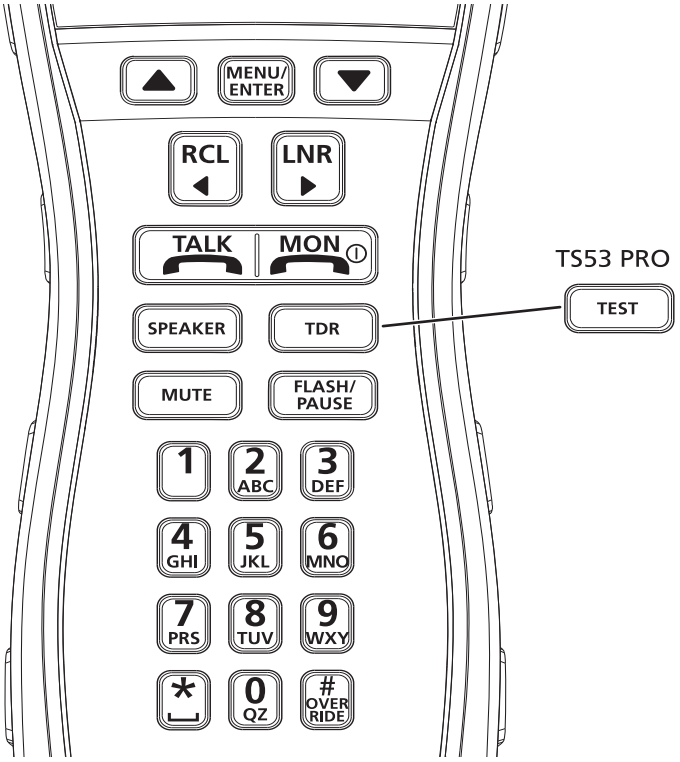
	When the 9 V battery is nearly discharged, no bars are shown on the battery icon on the display. Replace the battery immediately when this occurs. See "Replacing the Battery" on page 29.
TALK	Shows when the test set is in Talk mode. See "Talk Mode" on page 12.
MON	Shows when the test set is in Monitor mode. See "Monitor Mode" on page 11.
VDC mA	When the test set is on-hook, it measures the dc voltage (4 V dc to 140 V dc) at the test leads. Normal line voltage across Tip and Ring is between 42 V dc and 54 V dc. When the test set is off-hook, the display shows the dc loop current (0 mA to 100 mA) that the test set draws from the line. Normal loop current is above 23 mA. If the loop current is too low, the telephone line you are testing may not be able to supply enough current to power the customer's telephone devices and you may want to perform some additional testing on that line. These tests let you quickly see if the line has the correct Central Office battery voltage or the correct loop current. Voltage below 4 V dc is too low for the test set to go off-hook. **⚠ Warning ⚠** **Voltage above 140 V dc is possibly dangerous to you and the test set. See "High Voltage Lockout Operation" on page 14.**

-continued-

Table 1. Display Icons (continued)

POL	The polarity icon shows when the polarity of the dc voltage across the line's Tip and Ring wires is reversed. If you connect the red clip to a more positive voltage than the black clip (reverse polarity), POL shows on the display. If you connect the red clip to a more negative voltage than its black test lead, the icon does not show. The test set operates correctly if the polarity is reversed.
☎ ☎	☎ shows when the test set is in Monitor mode (on-hook). ☎ shows when the test set is in Talk mode and connected to an active telephone line (off-hook). The icon alternates between on-hook and off-hook when a call comes in.
MUTE	The **MUTE** icon shows when the test set is in mute mode. See the description of the MUTE key on page 8.
🔈	The speaker icon shows when the speaker is on. To turn the speaker on or off, press SPEAKER. See the description of the SPEAKER key on page 9. The speaker stays on until you turn it off or until the test set turns off.
)))	The high-volume icon shows when the volume for the handset or speakerphone is set to a level of 5 or more. At lower levels, the icon does not show. In Monitor mode, this icon shows when you select the high-volume level (level 8). To adjust the volume of the speaker that is on, press ▲ ▼.

Table 2. Keys



GOL15.EPS

1 2 ABC 3 DEF 4 GHI 5 JKL 6 MNO 7 PRS 8 TUV 9 WXY * ␣ 0 QZ # OVER RIDE	Use the numeric keypad to dial telephone numbers and select some functions. The numeric keypad has 12 standard dialing keys including the star (*) and the pound (#) keys. To make the test set go off-hook when there is data on the line, press #. See "Data Lockout Override" on page 14.

-continued-

Table 2. Keys (continued)

MUTE	The MUTE key operates only when the test set is off-hook. When you use the test set as a handset, you can press MUTE to turn off the handset's microphone. This is useful in noisy environments such as near heavy traffic. With the mute on, ambient noise is not picked up by the test set's microphone and therefore not transmitted to the receiver. When the mute is on, it is easier to hear the person at the other end of the line and easier to hear static or noise on the line. To turn on the microphone, press MUTE again. TS54 TDR and TS53 PRO only: When the test set is off-hook and is in Speakerphone mode, you can press MUTE to turn off the speakerphone's microphone and temporarily put the test set into a Receive-Only Loud Speaker mode. This is a better mode for troubleshooting because it prevents the speaker from cutting out when a medium to loud noise occurs in your vicinity. To turn on the speakerphone microphone, press MUTE again. You can set the Receive-Only Loud Speaker mode to be default mode (see "Make Receive-Only Loud Speaker Mode the Default" on page 22). In this mode, the MUTE key has no effect. When the test set is muted, **MUTE** shows on the display.
FLASH/ PAUSE	This is key has two functions. It performs the "flash" function when the test set is in Talk mode. It performs the "pause" function when the test set is in Monitor mode. The flash function is not available in Monitor mode and the pause function is not available in Talk mode. If the test set is in Talk mode and is off-hook and you press FLASH/ PAUSE, the test set generates a flash signal. The default flash duration is 500 ms. To change the duration, see "Hook Flash Duration" on page 22. The pause function is available when you enter numbers into the speed-dialing memory. If you press FLASH/ PAUSE, a 4 second pause is inserted into the number you are entering. See "Putting a Pause in a Stored Number" on page 15. To change the duration, see "Pause Duration" on page 22.
TDR (TS54 TDR)	On the TS54 TDR test set in Monitor mode, press TDR to do the TDR test. The TDR test measures the distance to the first short or open on the cable. See "Using the TDR (TS54 TDR)" on page 17. The TDR key does not operate in Talk mode.
TEST (TS53 PRO)	On the TS53 PRO test sets press TEST while in Monitor mode to do a test for data on the line. See "Test for Data on the Line (TS53 PRO)" on page 12. The TEST key does not operate in Talk mode.

Table 2. Keys (continued)

SPEAKER	The speaker key turns the speaker on the back of the test set on and off. It operates in both Talk and Monitor modes. When the speaker is on, shows on the display. In Monitor mode when you use the test set as a handset, press SPEAKER to turn on the speaker so you can monitor a line while you work at a distance from the test set. To adjust the volume, press ▲ ▼. In Monitor mode, the speaker has a high volume (8 bars) and a low volume (4 bars). When you turn off the test set, it saves the volume setting. When the test set is off-hook and you use it as a handset, press SPEAKER to turn on the speakerphone. The handset microphone and receiver turn off and the speakerphone microphone and speaker turn on. You can use this mode for hands-free conversation. In Talk mode, the speaker has 8 volume levels. When you turn on the test set and put it in Talk mode, the speaker is set to the volume level specified in the Settings menu. To adjust the volume, press ▲ ▼. The level you set also changes the level in the Settings menu. You can also set the test set to operate only in Receive-Only Loud Speaker mode (see "Make Receive-Only Loud Speaker Mode the Default" on page 22). In this mode, if the test set is off-hook and you use it as a handset, pressing SPEAKER turns on the speaker, but not the speakerphone microphone. Receive-Only Loud Speaker mode lets you listen to the line, hands-free. The speaker stays on until you turn it off or until the test set turns off.
TALK | MON	To turn on the test set, press MON. To switch between Monitor mode and Talk mode, press TALK or MON. To turn off the test set, hold down MON for 3 seconds. See "How to Use the Monitor and Talk Modes" on page 11.
RCL	The RCL key recalls telephone numbers. See "Program Speed Dialing Numbers" on page 15.
LNR	The LNR key redials the last number dialed. See "Last Number Redial (LNR)" on page 14.
▲ ▼	Press ▲ ▼ to adjust the volume of the active speaker in Monitor and Talk modes. The ▲ ▼ keys change the volume of received signals. They do not change the volume of transmitted signals. In Monitor mode, the ▲ ▼ keys toggle the test set between high (8 bars) and low (4 bars) volume for the ring tone and the speaker. When you change the volume, `Monitor Volume` shows and a bar graph shows the volume setting. shows on the display when you select high volume. When you turn off the test set, it saves the volume setting. In Talk mode when the test set is off-hook, press ▲ or ▼ to change the volume for the speaker that is on. Each speaker has 8 volume levels. When you change the volume, the display shows `Handset Volume` or `Spkr Volume`, and a bar graph shows the volume level. When you select a high level (5 or more bars), shows on the display. The volume levels you select also show in the Settings menu and are saved when you turn off the test set. In the Settings menu, use ▲ and ▼ to scroll through the menu.

-continued-

Table 2. Keys (continued)

MENU/ ENTER	The MENU/ ENTER key lets you access these phone numbers, settings, and tests: • Call PhnBk: A phonebook of nine stored numbers for the speed dialing function. See "Dialing and Storing Numbers in Memory" on page 14, "Program Speed Dialing Numbers" on page 15, and "Dialing a Number with the Speed Dial Function" on page 16. The number in memory location 9 is the numbers for the ANAC function. See "Visual ANAC Mode" on page 17. • Call Log: A list of phone numbers for the last 10 calls that the test set made or received. See "Dialing a Number from the Call Log" on page 16. • Digit Grab: Shows you the digits dialed by another device. See "DTMF Digit Grabbing" on page 16. • SmartTone: Lets you use an inductive probe to find telephone lines. See "Using the Toner (TS54 TDR)" on page 19. • Edit PhnBk: Lets you edit numbers in the phonebook. See "Program Speed Dialing Numbers" on page 15. • TDR (TS54 TDR): Lets you change the Line Verification and VOP settings for the TDR. See "Line Verification" on page 18 and "VOP" on page 18. • Settings: Lets you change settings for the backlight timeout (page 23), handset and speaker volume (page 24), tone/pulse mode (page 22), pause duration (page 22), flash duration (page 22), default mode for the speakerphone (page 22), and the test set timeout (page 23). You can also reset the test set to factory defaults (page 25).

How to Turn the Test Set On and Off

To turn on the test set, press MON. To turn off the test set, hold down MON for 3 seconds. To set the time period for the automatic shut-off function, see "Test Set Timeout"on page 23.

How to Use the Monitor and Talk Modes

The test set has two basic modes of operation: Talk mode and Monitor mode. Talk mode is used for off-hook operations (such as dialing verification, automatic number identification, and audio quality verification). Monitor mode is for audio monitoring of the Tip and Ring pair while on-hook. In Monitor mode, the test set has a high input impedance. This reduces the possibility of disruptions to conversations or data while you monitor the line

⚠Warning

When testing circuits that are close to a battery source, clipping onto a line may cause loud pops in the receiver. Holding the receiver tightly against your ear may cause acoustic shock. The test set is designed to rest comfortably on the shoulder with some space between the receiver and the ear. It should be used in this position when working close to a battery source.

Shorting the Tip and Ring leads together while connected to a data line will disrupt data on the line.

Monitor Mode

To put the test set in Monitor mode, press MON.

In Monitor mode, the test set is always on-hook. The test set draws no direct current from the line and it transmits no signals to the line. In this mode, the test set has a high ac input impedance. This reduces the possibility of disruptions to conversations or data while you monitor the line. You can use either the handset receiver or the speaker to monitor a line.

To use the speaker to monitor the line, press SPEAKER. This disables the handset receiver and sends all audio signals to the speaker. Two volume levels are available: normal (🔈) and high (🔊). Press ▲ ▼ to toggle the volume level. Press SPEAKER again to turn off the speaker and monitor signals through the handset receiver.

In the Monitor mode, the test set is typically used for one or more of the following procedures:

- Verification that a line is idle when looking for a line to borrow
- Listening for noise on the line
- Hunting for tracer tones
- Measuring the dc voltage on the line

Caller ID

The display shows the Caller ID (CID) after the first ring while in Monitor mode. CID shows these messages:

- The incoming phone number and the name of the caller, if available
- `Blocked ID` (if CID is blocked by the originating device)
- `Line error` (CID data is incomplete)
- `Unknown ID` (CID is not available)

Caller ID for Call Waiting

If you are on a call, and another call comes in, the caller ID function for the second call operates similar to the caller ID function for the original call.

Test for Data on the Line (TS53 PRO)

On the TS53 PRO test set, press TEST while in Monitor mode to do a test for data on the line. If data is present, the display shows `Data Present On Line`. If data is not present, it shows `No Data Present On Line`.

If you press TALK when data is present, the TS53 PRO test set does a data lockout. See "Data Lockout Operation" on page 13.

Talk Mode

To select Talk mode, press TALK. The test set performs a brief test for high-speed data and it looks for talk battery on the line. If high-speed data is detected, the test set generates an audio alarm and remains on-hook. If high-speed data is not detected and talk battery is present, the test set goes off-hook. When off-hook, the test set operates like a standard telephone and is typically used to verify the proper operation of a voice telephone line or to establish temporary communications on a “borrowed pair”.

Low Voltage Lockout

If you press TALK and the test set sees 4 V or less, it shows `Low Voltage Lock Out`, and will not go off-hook.

Originating a Call

1 Press MON.

2 Connect the test leads to the Tip and Ring of a subscriber loop.

3 Monitor (listen to) the line to verify that it is idle.

4 If the line is not idle, disconnect the test set from the line.

5 If the line is idle, press TALK. The test set automatically tests for high-speed data.

6 If data is detected, the test set will not go off-hook and `Data Detect Lockout` shows on the display. Try another line.

7 If there is no data on the line and talk battery is present, the test set goes off-hook and draws dial tone.

Note

The test set will not go off-hook if the line voltage exceeds 140 V dc.

8 Dial the desired number.

Note

If you mis-dial the number, press MON, press TALK then enter the number again.

Disconnecting a Call

To disconnect a call, press MON or remove the test leads from the line.

Answering a Call

1 If a ringing signal is received, press TALK. The test set automatically tests for high-speed data on the line.

2 If there is no data and talk battery is present, the test set goes off-hook.

Note

The test set will not go off-hook if the line voltage exceeds 140 V dc. See "High Voltage Lockout Operation" on page 14.

3 If the test set detects data, it not go off-hook and it shows `Data Detect Lockout` on the display. See the sections, "Data Lockout Override" on page 14 and "Data Safe Practices" on page 13.

4 To go off-hook with data present, press #. See "Data Lockout Override" on page 14.

Data Lockout Operation

With the increase in high capacity data lines in the distribution system comes the greater risk of disrupting data services when working on analog lines. The test set is designed to be used by Outside Plant and Central Office technicians to perform their normal duties while greatly reducing the possibility of accidentally disrupting data service.

Accidentally going off-hook on a data line while searching for talk battery or dial tone on an unmarked terminal block or cable splice could bring down a high-capacity data line. To prevent this, the test set provides an automatic data lockout function. When you put the test set in Talk mode then connect it to a Tip and Ring pair, it automatically tests the line for high-speed data (data signals that are above the human audio range) before going off-hook. If the test set detects data, it locks out and does not go off-hook. A warning beep sounds, and `Data Detect Lockout` shows on the display.

When the test set is locked out, it remains on-hook, it does not draw direct current from the line, and it presents a high ac impedance to the line to reduce the possibility of disruptions to data. The test set can detect and protect high frequency data services.

Ground Start

Ground start lines are typically found on PBX installations. To activate an idle, ground-start telephone line, do the following:

1 Press MON, and connect the test leads to Tip and Ring of the ground start line. With a third wire, temporarily short the Tip side of the line to earth ground. A wire with an alligator clip at each end is often used for this. Do not allow clips to short network connections.

2 With the short to earth ground in place, press TALK. When dial tone is received, remove the third wire from earth. The circuit is now ready for dialing.

Data Safe Practices

Always monitor the line for an audible signal before attempting to go off-hook to draw dial tone. The data detect circuitry on the test set is designed to detect data signals above the human audio range. To detect data signals within the human audio range, such as produced by voiceband modems and subrate DDS transceivers, you must listen to the line using the test set's audio monitoring capability. If you hear the hiss of a voice band modem or low frequency data transceiver, do not press TALK. If you press TALK, the test set will not lock out because it does not detect low frequency data.

It will go off-hook and will interfere with the voice band modem or data transceiver. To avoid this, try another line or wait until the line is idle.

Data detection is a two part process. The first part requires listening to the line for audible data traffic in Monitor mode as described above. If the line is quiet, then the second part is to use the test set's data detect capability to determine if there is data above the human audio range on the line. This can be done as follows:

1 Press TALK.

The test set automatically performs a brief test for high-speed data. If there is data on the line, the test set locks out, (remains on-hook), a warning beep sounds, and `Data Detect Lockout` is shown on the display. If there is no data on the line, the test set goes off-hook.

2 If there is no data on the line, you can now dial a number.

When going from pair to pair searching for tracer tone or dial tone, it is best to connect the test set to Tip and Ring of the pairs. Avoid the practice, either in Talk or Monitor mode, of clipping one lead of the test set to ground, and using the other lead to search for tracer tone or dial tone on a block. This may create an electrical imbalance on a data line that will disrupt service. Once you find the voice line you are searching for then it is OK to test Tip to ground or Ring to ground on that line.

Be careful not to short the test leads together when connecting to a data line (or any line for that matter), as this could bring down the service.

Put the test set in Monitor mode when you use other instruments to troubleshoot a line.

Data Lockout Override

Normally, when the test set detects data, it means the operator has accidentally connected to a high-speed data line and should immediately disconnect from the line to avoid disrupting the data service.

But in some cases the operator must go off-hook on a specific line even though the test set indicates that the line is a data line.

The following are scenarios where the operator may wish to override a data lockout:

- When there is false data detection due to RF pickup on a line that is near an AM radio broadcast antenna. The RF induced in the line may appear to be data.
- When performing a ground start, the test set may lock out in Talk mode. This is because ground start lines are unbalanced before startup and thus are prone to picking up a lot of noise which may appear to be data to the test set. If this occurs, use the override function to go off-hook on a ground start line.

Telephone lines near AM radio broadcast facilities pick up the RF signals from the broadcast antennas. Normally this is not a problem for the test set. If the line is well balanced, the test set will not see the RF signal because it is a common mode (longitudinal) signal. But if the line is unbalanced, part of the RF signal will be converted to a differential (metallic) signal. If the signal amplitude is high enough, it may be detected as high-speed data by the test set. If you know for sure you are on such a line, use the override function to go off-hook.

You can override the data lockout only in TALK mode. To activate the override, press [#]. If dc voltage is present, the test set goes off-hook. To go back on-hook, unclip the test set's test leads from the line or put the test set into Monitor mode.

High Voltage Lockout Operation

⚠Warning⚠

Voltage above 140 V dc, is possibly dangerous to you and the test set. If the test set shows voltage above 140 V dc, carefully remove the test leads from the line. Be sure to hold the clips by their insulated boots and do not touch the metal parts of the clips. Do not touch the clips together while they are connected to a line that has high voltage.

The TS54 TDR and TS53 PRO are designed for use by Outside Plant and Central Office technicians in environments where analog voice lines co-exist with lines that carry high dc voltage.

Accidentally going off-hook on a line carrying a high dc voltage can damage the power supply feeding the line. To prevent this, the test set has an automatic, high-voltage lockout function. When a test set is in Talk mode and is connected to a Tip and Ring pair, it measures the voltage on the line before going off-hook. If the measured voltage exceeds 140 V dc, the test set locks out and does not go off-hook. The display shows LOCKOUT HI VDC.

In the event of a high voltage lockout, press MON, and carefully remove the test set leads from the line.

Dialing and Storing Numbers in Memory

Last Number Redial (LNR)

To redial the last number you dialed since you turned on the test set, go off-hook then press [LNR].

If the test set goes off-hook, and you press any dialing key, the LNR memory is deleted and the key is stored as the first digit in LNR memory.

The dialing keys that are stored in LNR memory are [1] [2 ABC] [3 DEF] [4 GHI] [5 JKL] [6 MNO] [7 PRS] [8 TUV] [9 WXY] [# OVER MODE] [*]. The star ([# OVER MODE]) and pound ([*]) keys are not redialed when the test set is in pulse dialing mode even if the redial memory includes them.

Program Speed Dialing Numbers

The test set has nine memory locations for speed dial numbers. Each location stores up to 23 digits. If you try to enter more than 23 digits, only the first 23 are stored. To put a pause in a number, press FLASH/PAUSE.

To store a speed dialing number:

1 Press MON.

2 Press MENU/ENTER.

3 Press ▼ to put the flashing cursor next to Edit PhnBk, then press MENU/ENTER.

4 Use ▲ ▼ to put the flashing cursor next to a name or phone number you want to edit.

5 To use the keypad to edit the name and number:

- To enter characters in a name, repeatedly press the digit key that has the character you want until the letter shows on the display. Wait until the flashing cursor moves to the right, then enter the next character.
- To move the cursor to the left or right, press RCL or LNR.
- To change a character, put the cursor on the character then enter a different one.
- To enter a space in a name, press *.
- If you entered an incorrect name or number or you want to delete all the characters, press MUTE, then enter the name or number again.
- To enter a pause in a number, press FLASH/PAUSE.
- To save your changes before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.
- To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

Notes

The location of the number in the phonebook is the recall number. For example, the first number in the phonebook has the recall number "1".

You cannot edit the name "ANAC" in speed dial location 9. The test set uses that location for a phone number for an Automatic Number Announcement Circuit. Dialing a number from speed dial location 9 automatically puts the test set into Visual ANAC mode and the test set is automatically muted. If a visual response is not available, an audible response is given. Use one of the other speed dial locations (1-8) if you always want an audible response. See "Visual ANAC Mode" on page 17.

Putting a Pause in a Stored Number

Note

Each time the FLASH/PAUSE key is pressed, it counts as one dialing digit.

In some situations, you need a pause between the digits of the number you dial. For example, to dial out through a PBX, you dial 9, wait for the PBX to connect to an outside line, then dial the remaining digits. The pause function lets you put a pause between the digits in a speed-dial number so that you do not need to dial the number manually.

For example, if you enter "9 FLASH/PAUSE 2 3 4 5 6 7 8" into a speed dial memory location, then recall that number, the test set dials a 9, then waits for the pause duration of 4 seconds. This gives the PBX time to connect to an outside line. Then, the test set dials the remaining digits "2345678". If you need a delay longer than 4 seconds, press FLASH/PAUSE more than once when you enter the number into memory. For example, if you press FLASH/PAUSE twice, you get a pause of 8 seconds. Each pause shows as a comma in the number.

The default duration is 4 seconds. You can change the duration in the Settings menu. See "Pause Duration" on page 22.

Storing the Number You are Calling

After you dial a number, you can save it in one of the memory locations for the speed dialing function:

1 Connect the test set to a working telephone line.

2 Press TALK, then dial the number.

3 Press MENU/ENTER, then press the number key (1 through 9 WXY) to select a memory location.

Dialing a Number with the Speed Dial Function

1 Connect the test set to a working telephone line.

2 Press TALK.

3 When the test set goes off-hook, press RCL then the number key (1 through 9 WXY) for the memory location. For example, to dial the number stored in location 5, press RCL and then 5 JKL. The test set shows and automatically dials the number.

Dialing a Number from the Phone Book

1 Connect the test set to a working telephone line.

2 Press MENU/ENTER twice to see the CALL PHNBK.

3 Press ▲ or ▼ to put the flashing cursor next to the name for the number you want to dial.

4 Press TALK. The test set goes off-hook, then dials the number.

Dialing a Number from the Call Log

The call log is a list of phone numbers for the last 10 calls that the test set made or received. If you make or receive a call from the same number more than one time, the number shows only one time in the list.

To dial a number from the call log:

1 Connect the test set to a working telephone line.

2 Press MENU/ENTER, press ▼ to put the flashing cursor next to Call Log, then press MENU/ENTER again.

3 Press ▲ or ▼ to put the flashing cursor next to the number you want to dial.

4 Press TALK. The test set goes off-hook, then dials the number.

DTMF Digit Grabbing

The test set lets you capture DTMF (Dual-Tone Multi-Frequency) tones generated on a telephone line. This feature is useful when you suspect that the customer's equipment is not generating proper DTMF signals.

The test set detects tones for 0 through 9, *, and #.

To use the Digit Grabbing mode:

1 Connect the test set to the Tip and Ring of the line that is connected to the customer equipment.

2 Press MON.

3 Press MENU/ENTER, press ▼ to put the flashing cursor next to Digit Grab, then press MENU/ENTER.

4 Put the equipment into tone dialing mode, then take it off-hook.

5 Dial a number on the equipment. The number shows on the test set display.

6 Verify that the number on the display is the same as the number you dialed.

7 To exit Digit Grabbing mode, press MENU/ENTER, or press TALK then MON, or turn off the test set then turn it on again.

Visual ANAC Mode

Note

Visual ANAC mode is for service provider use only. Visual ANAC is not available in all regions.

A visual Automatic Number Announcement Circuit (ANAC) gives the DTMF tones of the telephone number of the line. In visual ANAC mode, the test set automatically goes into mute mode and shows the number on its display. If the test set is not in visual ANAC mode, the ANAC speaks the number with a digitized voice.

To get a visual response from an ANAC:

1 Connect the test set to a working telephone line.

2 Press TALK.

3 Press RCL #. The display shows `Dial ANAC`.

4 Dial the ANAC number.

After you dial the ANAC number and get a response, the phone number of the line pair that the test set is connected to is shown on the display. If the ANAC response is more than 10 digits, the display shows the last 10 digits. If the ANAC does not support visual ANAC mode, it speaks the number with a digitized voice.

If you do not press RCL # before you dial the ANAC number, the ANAC gives a digitized voice response.

You can also use the speed dial function to get a visual ANAC response. If you put the ANAC number into location 9 in the Call Phonebook, the test set goes into visual ANAC mode and dials the ANAC number when you press RCL 9.

If you always want a digitized voice response when you use speed dial for an ANAC number, put the number in one of the other speed dial locations (1-8).

Using the TDR (TS54 TDR)

The TDR lets you measure the length of cables and the distance to the first open or short on cables as long as 3,000 ft (914 m). See ""Time Domain Reflectometry (TDR) Technology (TS54 TDR)" on page 25 for information on how the TDR operates.

Note

The TDR operates only on cables that have two conductors.

To use the TDR:

1 Optional: Change the length units, turn on the Line Verification function, and set the velocity of propagation to the correct value for the cable. See "How to Change the Length Units", "Line Verification", and ""VOP" below.

2 Press MON.

3 Connect the test leads to the cable.

4 Press TDR.

Below are examples of TDR test results:

`TDR Results Short at 1267 ft`	There is a short across the two conductors 1267 feet from the test set.
`TDR Results Open at 2433 ft`	The cable is 2433 feet long, or there is an open in one or both of the conductors 2433 feet from the test set.
`TDR Voltage Detect Lockout`	There is data or voltage on the line. The TDR does not operate on an active line.

How to Change the Length Units

The TDR shows length measurements in feet or meters. To change the unit of measurement:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to TDR, then press MENU/ENTER again.

3 Press ▼ to put the flashing cursor next to Units, then press MENU/ENTER.

4 Press LNR or RCL to select feet (ft) or meters (m).

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

Line Verification

The Line Verification function does tests for data and voltage on the line when you press TDR. If the test set senses data or voltage, it gives these responses:

- Data Detect LOCK OUT: There is data on the line.
- If there is voltage on the line, but no dial tone, the display shows a voltage measurement
- Active Telephone Line: There is a dial tone on the line and there is no ANAC number stored in memory location 9.
- If there is a dial tone on the line and an ANAC number in memory location 9, the test set automatically dials the ANAC number and shows the telephone number for the line. This helps you identify the line so that you can make it inactive before you do the TDR test again. Or, the number can show you that you are connected to the wrong line.

If Line Verification is off, and there is data or voltage on the line, the display shows TDR Voltage Detect Lockout.

To turn on the Line Verification function:

1 Press MENU/ENTER.

2 Press ▲ to put the flashing cursor next to TDR, then press MENU/ENTER.

3 Press ▼ to put the flashing cursor next to Line Verif, then press MENU/ENTER to select Line Verif.

4 Press RCL or LNR to select On or Off.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

VOP

To get the most accurate measurements of the length of a cable or the distance to a fault, set the velocity of propagation to the correct value for the cable.

See "Velocity of Propagation (VOP)" on page 24.

Using the TDR on Multi-Wire Cables

In a multi-wire cable, such as 4 wire telephone cable, 8 wire CAT-5 cable, 12-2 with ground ac wire, or several THHN wires inside a conduit, a short can exist between any of the conductors, including a shield or the conduit. To detect the short, you must connect the test set to the wires that are shorted. This means that to fully test a multi-wire cable, you must test every wire against every other wire including the shields and conduits.

While a quick way to test many conductors against conduit or shield length is to connect all the conductors to one clip lead and the shield to the other lead, this will reduce the impedance of the cable, and measurements may fall below the test set's range. It is more reliable to test the wires individually.

If the TDR Shows Unusual or Unstable Length Measurements

Devices connected to the line can make the TDR show unusual or unstable measurements. Such devices include bridge taps, inactive telephone equipment, and transformers.

Using the Toner (TS54 TDR)

The toner helps you identify wire pairs and find cables in bundles, at patch panels, or behind walls. The toner puts a signal on a wire pair, then you use an optional, inductive probe to find the signal. The toner has five different tones.

The SmartTone function helps you make sure you correctly identify a wire pair. When you put a short on the correct pair, the tone changes.

Notes

The toner does not operate on wire pairs that have DC or AC voltage or on pairs that are terminated.

The toner can cause interference on adjacent wire pairs. To minimize problems with services on those pairs, complete your work with the toner quickly.

The toner uses a lot of battery power. To preserve the life of the battery, turn off the toner when you do not use it.

Finding a Cable

To find a cable:

1. Turn on the test set.
2. Connect the test set to one end of the cable (see Figure 2).

   For twisted pair wire, connect the red test lead to a wire in the cable. Connect the black test lead to another wire in the cable. If possible, connect to a wire that is in a different wire pair, or connect to ground. This increases the strength of the toner signal emitted from the cable.
3. Make sure that the test set shows 0 VDC.
4. Press MENU/ENTER, press ▼ to put the flashing cursor next to `SmartTone`, press MENU/ENTER, then press MENU/ENTER again to turn on the toner.

   If there is voltage on the line, the display shows `SmartTone Volt Detect Lock Out`, and toner will not operate.
5. Use a tone probe to find the place where the tone is the loudest.
6. To make sure you have found the correct cable, put a short momentarily across a wire pair in the cable (Figure 4). If the tone changes, you have found the correct cable.

   To turn off the toner, press MENU/ENTER or MON.

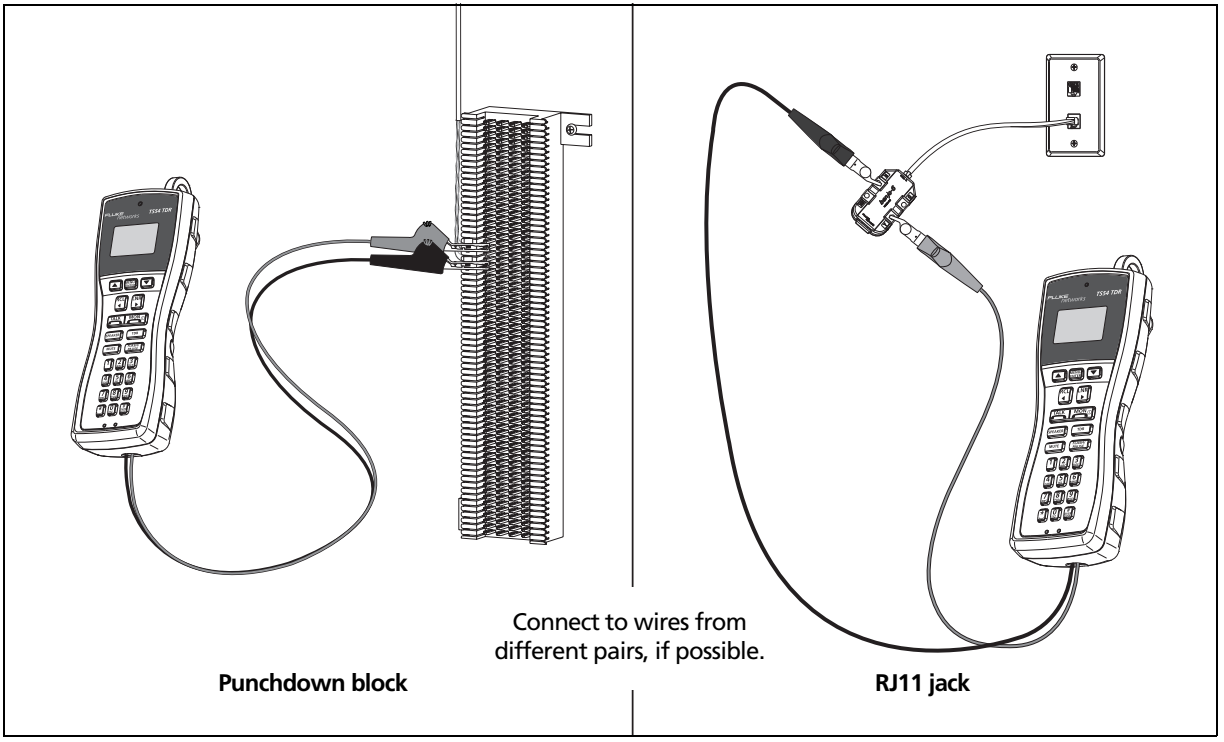


Figure 2. How to Make Connections for the Toner (TS54 TDR)

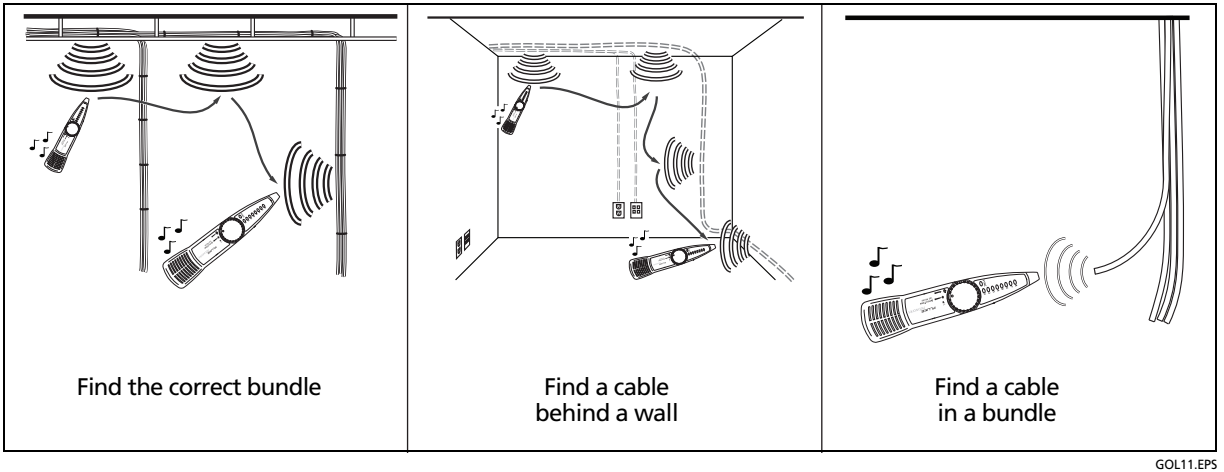


Figure 3. How to Use a Tone Probe to Find a Cable

Using the SmartTone Function

To use the SmartTone function to identify a wire pair:

1 Turn on the test set, then connect it to a wire pair in the cable.

2 Make sure that the test set shows 0 VDC.

3 Press MENU/ENTER, press ▼ to put the flashing cursor next to SmartTone, then press MENU/ENTER, then press MENU/ENTER again to turn on the toner.

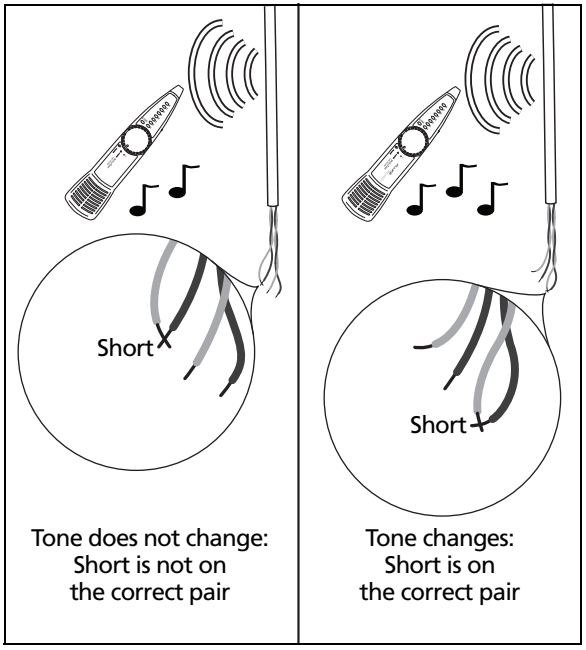
If there is voltage on the line, the display shows SmartTone Volt Detect Lock Out, and toner will not operate.

4 At the other end of the cable, use a tone probe to find the wire pair that has the loudest tone.

5 To make sure you have found the correct pair, put a short momentarily across the wire pair (Figure 4). If the tone changes, you have found the correct pair.

Notes

You cannot hear the tone on the test set.



GOL12.EPS

Figure 4. How to Use the SmartTone Function (TS54 TDR)

Configuring Your Test Set

The test set stores all settings in non-volatile memory. The settings do not change if you change the battery.

How to Select Tone or Pulse Mode

1 Press [MENU/ENTER].

2 Press [▲] to put the flashing cursor next to Settings, then press [MENU/ENTER].

3 Press [▼] to put the flashing cursor next to Tone/Pulse, then press [MENU/ENTER].

4 Press [RCL] or [LNR] to select Tone or Pulse.

5 To save your selection before you exit or go back to the main menu, press [MENU/ENTER]. The display shows Saved.

To go back to the previous menu, press [MON]. Or, press [▲] or [▼] until Back shows, then press [MENU/ENTER].

Hook Flash Duration

When the test set is off-hook, and you press [FLASH/PAUSE], a timed interruption of the loop current occurs. Some PBX setups or telephone office switches use this signal to put a call on hold or to activate a special function. Each key press generates one flash.

You can select durations of 100 ms to 1000 ms in increments of 100 ms. The default is 500 ms.

To set the flash duration:

1 Press [MON].

2 Press [MENU/ENTER], press [▲] to put the flashing cursor next to Settings, then press [MENU/ENTER] again.

3 Press [▲] to put the flashing cursor next to Flash Time, then press [MENU/ENTER].

4 Press [RCL] or [LNR] to change the time period.

5 To save your selection before you exit or go back to the main menu, press [MENU/ENTER]. The display shows Saved.

To go back to the previous menu, press [MON]. Or, press [▲] or [▼] until Back shows, then press [MENU/ENTER].

Pause Duration

When you enter numbers into the speed-dialing memory, you can press [FLASH/PAUSE] to include pauses between digits. The default pause duration is 4 seconds. You can select durations of 1 second to 8 seconds.

To set the pause duration:

1 Press [MON].

2 Press [MENU/ENTER], press [▲] to put the flashing cursor next to Settings, then press [MENU/ENTER] again.

3 Press [▲] to put the flashing cursor next to Pause Time, then press [MENU/ENTER].

4 Press [LNR] or [RCL] to change the time period.

5 To save your selection before you exit or go back to the main menu, press [MENU/ENTER]. The display shows Saved.

To go back to the previous menu, press [MON]. Or, press [▲] or [▼] until Back shows, then press [MENU/ENTER].

Make Receive-Only Loud Speaker Mode the Default

If a test set has factory defaults, and you put it in the off-hook mode and press [SPEAKER], the Speakerphone turns on. If you then press [MUTE], the Receive-Only Loud Speaker is enabled temporarily. When the Receive-Only Loud Speaker is enabled, the speakerphone microphone turns off and the test set can only receive audio signals – it cannot transmit any audio signals. Receive-only is preferred when your main concern is to listen to the line and you do not want ambient noise such as caused by a passing car to switch the Speakerphone into transmit mode.

If you frequently have two-way conversations, then you probably want the Speakerphone to be the default mode for the speaker. If you mostly listen when the speaker is on, then you may want the Receive-Only Loud Speaker to be the default mode for the speaker.

To set Receive-Only Loud Speaker as the default mode for the speaker:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to Settings, then press MENU/ENTER again.

3 Press ▼ to put the flashing cursor next to Spkr Phone, then press MENU/ENTER.

4 Press ▼ to put the flashing cursor next to ReceivOnly, then press MENU/ENTER.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

To turn on the speakerphone microphone, do the steps above again, but select Two-Way for the SPKRPHONE setting.

Display Backlight Timeout

To extend the battery life, keep the display backlight off when you do not need it. You can set a timer to automatically turn off the backlight when you do not press a key for a specified period of time. Or, you can set the backlight to be off all the time.

You can set the backlight timer to 30 or 60 seconds. The default is 60 seconds.

To turn on the backlight after it automatically turns off, press *.

To turn off the backlight or change the timeout period:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to Settings, then press MENU/ENTER again.

3 Press MENU/ENTER to select Bklt Time.

4 Press RCL or LNR to change the time period or select Off.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

Test Set Timeout

The test set turns off after a specified period of inactivity. The default is 2 minutes. The timer starts again when you press a key or when the test set is in Monitor mode and receives a call.

To change the test set timeout period:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to Settings, then press MENU/ENTER again.

3 Press ▲ to put the flashing cursor next to AutoShutoff, then press MENU/ENTER.

4 Press RCL or LNR to change the time period.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

Speaker and Handset Receiver Volume for Talk Mode

In Talk mode, you can press ▲ ▼ to adjust the volume of the speaker or handset receiver when they are on, or you can set the volume levels in the Settings menu:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to Settings, then press MENU/ENTER again.

3 Press ▼ to put the flashing cursor next to Handset Vol or Spkr Vol, then press MENU/ENTER.

4 Press RCL or LNR to change the volume.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

Note

In Talk mode, when the handset receiver or the speaker is on and you press ▲ ▼ to adjust the volume, the level you select also changes the level in the Settings menu. In Monitor mode, the ▲ ▼ keys change the volume levels for the ringtone and speaker, but do not change the levels in the Settings menu.

Velocity of Propagation (VOP)

The test set uses the VOP value to calculate length for the TDR function. See "Time Domain Reflectometry (TDR) Technology (TS54 TDR)" on page 25.

You can set the VOP to a known value, or you can use the test set to find the VOP for a known length of cable.

Note

The default VOP value of 66 is satisfactory for most applications. See "VOP Variations" on page 27.

To set the VOP to a known value:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to TDR, then press MENU/ENTER again.

3 Press ▼ to put the flashing cursor next to VOP Setting, then press MENU/ENTER. to select VOP.

4 Use the numeric keypad to change the VOP value. For example, to enter a VOP of 71, press 7 PRS 1.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▼ to select Back, then press MENU/ENTER.

To find the VOP of a known length of cable, change the VOP setting until the test set shows the correct length:

1 Connect the test set to a known length of cable. The cable must be 200 feet (60 meters) or longer.

2 Press TDR. The test set shows the length of the cable.

3 Press MENU/ENTER, press ▲ to put the flashing cursor next to TDR, press MENU/ENTER again, press ▼ to put the flashing cursor next to VOP Setting, then press MENU/ENTER again.

4 Press RCL or LNR to change the VOP setting, then press MENU/ENTER. If you increase or decrease the VOP by 1, the length measurement increases or decreases by approximately 1.5%.

5 Do steps 2 through 4 again, until the length measurement is correct.

Factory Defaults

You can set all programmable features to their original, factory settings. This function does not delete stored telephone numbers. The defaults are:

- Backlight timer: 30 seconds
- Power-down timeout: 2 minutes
- Hook flash duration: 500 ms
- Pause time: 4 seconds
- Speaker timeout: 2 minutes
- Speakerphone microphone: on
- Handset volume: level 4
- Speaker volume: level 4
- Tone/Pulse: tone
- Receive-Only Loud Speaker mode: disabled
- DTMF Digit Grabbing: off
- Velocity of propagation: 66

To restore factory defaults:

1 Press MON.

2 Press MENU/ENTER, press ▲ to put the flashing cursor next to Settings, then press MENU/ENTER again.

3 Press ▲ to put the flashing cursor next to FactDfaults, then press MENU/ENTER.

4 Press RCL or LNR to select Yes.

5 To save your selection before you exit or go back to the main menu, press MENU/ENTER. The display shows Saved.

To go back to the previous menu, press MON. Or, press ▲ or ▼ until Back shows, then press MENU/ENTER.

Time Domain Reflectometry (TDR) Technology (TS54 TDR)

A time domain reflectometer senses reflections of electrical signals on a cable and shows where the reflections occur on the cable. Because faults such as shorts and opens cause reflections, a TDR can show you the location of faults on a cable.

The TDR sends a pulse down the two conductors in a cable. When the pulse goes across a change in the impedance of the conductors, some of the energy of the pulse is reflected back to the test set. Changes in impedance are caused by changes in the physical relationship between the two conductors. For example, an open, a short, or a change in the distance between the conductors causes a change in impedance.

The test set measures the time from when it sent the pulse to when it received the reflection. Then, it uses this time and the speed of the signal in the cable to calculate the distance to the change in impedance:

$$\text{Distance in feet} = \left(\frac{\text{Time}}{2}\right) \text{X VOP X } 983571088$$

VOP (velocity of propagation) is the ratio of the speed of a signal in the cable to the speed of light. Typically, the speed of a signal in a cable is between 60 % and 80 % the speed of light.

The test set also looks at the polarity of the reflected pulse (Figure 5). If the impedance of the cable increased, the polarity of the reflection is the same as the pulse from the test set. This occurs if there is an open on the cable. If the impedance decreased, the polarity of the reflection is opposite. This occurs if there is a short on the cable.

If there is more than one fault on the cable, the test set shows the distance to the nearest fault.

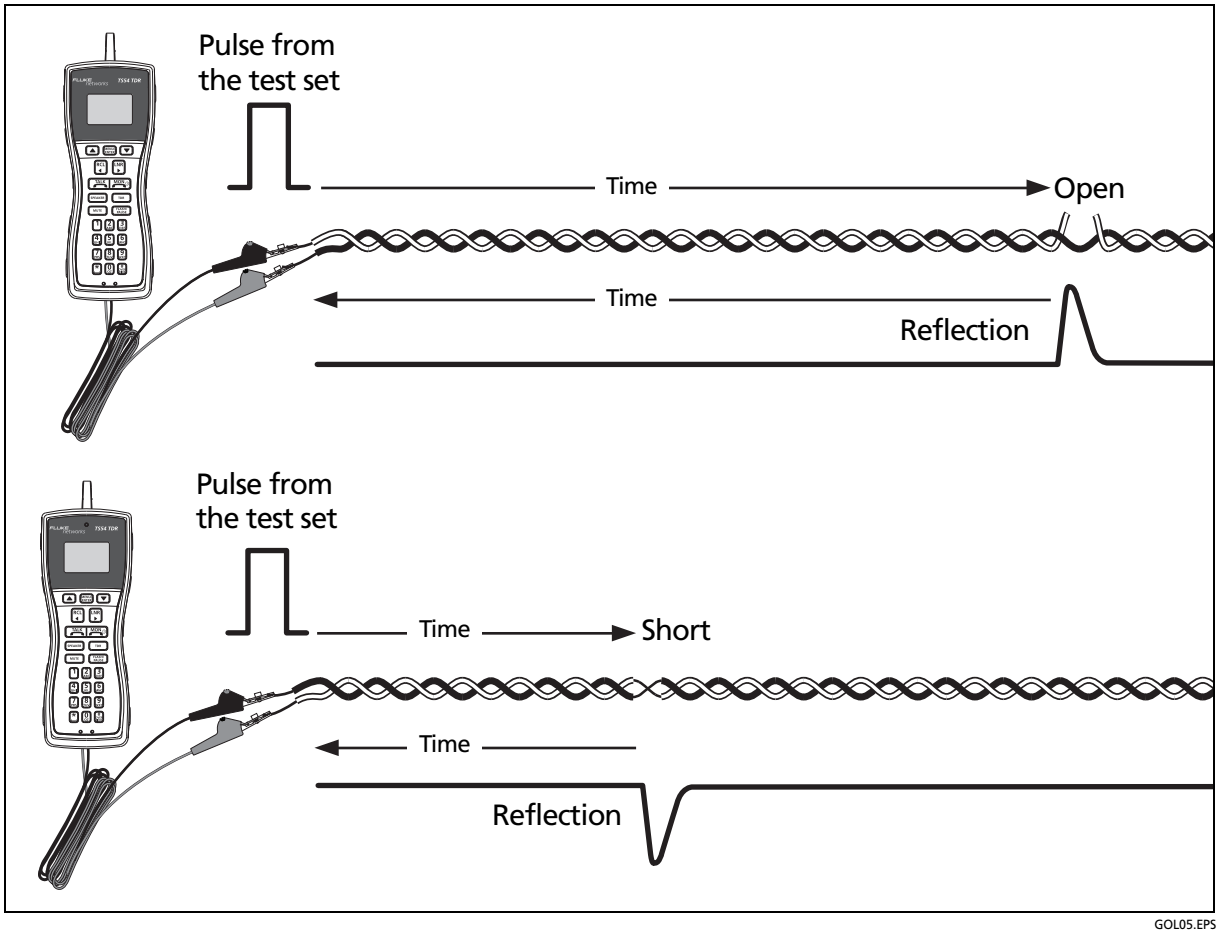


Figure 5. Signal Reflections from an Open and a Short

VOP Variations

Typically, cable manufacturers do not tightly control the VOP of cables. The VOP of the same type of cable from different boxes or from different manufacturers can have large variations. Because the test set uses VOP to calculate length, the accuracy of the length values depends on the accuracy of the VOP setting.

For most applications, a length value that is calculated with an incorrect VOP value is accurate enough to help you find a fault on the cable. For example, opens often occur at junction boxes. If the test set shows an open at 80 feet (25 meters), and you see a junction box at 70 feet (20 meters), you would first examine the wires at the junction box.

But for some applications, such as when you measure the remaining cable in a box, you must use a more accurate VOP value. Tables 3 and 4 show VOP values for specific cables and for other types of cable.

Note

The VOP values in Tables 3 and 4 are for unspooled, uninstalled cable. The VOP of a cable can change if the cable is on a spool or is installed near other cables.

Because the space and material between the conductors can also change the VOP, length values that the test set calculates with the values in Tables 3 and 4 can change as much as ±5 feet (±2 meters) for cables that are the maximum length.

Table 3. VOP Values and Maximum Length for Specifically Identified Cables

VOP	Maximum Length	Cable
64	**2000 ft (610 m)**	Lucent 1024 006ABE 6/24 W1000, 6 pair CAT3 (Blue-White)
63	**1500 ft (460 m)**	BICC General Aerial Service Wire (ASW) 2/22, 2 Pair Drop Wire
61	**2000 ft (610 m)**	Superior Essex, 4 pair CAT3 Plenum (not pair dependent)
60	**1500 ft (460 m)**	BICC General, 24 AWG CMX Outdoor CMR Station Wire
58	**1000 ft (300 m)**	BICC General cross-connect 24 AWG twisted pair on original spool
66	**2500 ft (770 m)**	Berk-Tek, CAT5 (Orange-White)
68	**2500 ft (770 m)**	Superior-Essex Cobra CAT5 CMR (Orange-White)
72	**2500 ft (770 m)**	Superior-Essex Cobra CAT5 CMP (Orange-White)
67	**500 ft (150 m)**	Belden 88760 2 wire shielded 18 AWG, Red-Black
68	**500 ft (150 m)**	Belden 88760 2 wire shielded 18 AWG, Red/Black-Shield
57	**500 ft (150 m)**	BICC General, E22025, Red-Black

Table 4. VOP Values for Other Cables

VOP	Cable Type
68	Twisted Pair, Gel Filled 19 AWG
64	Twisted Pair, Gel Filled 22 AWG
62	Twisted Pair, Gel Filled 24 AWG
60	Twisted Pair, Gel Filled 26 AWG
68	Twisted Pair, Paper 22 AWG
66	Twisted Pair, Paper 24 AWG
65	Twisted Pair, Paper 26 AWG
72	Twisted Pair, PIC 19 AWG
67	Twisted Pair, PIC 22 AWG
66	Twisted Pair, PIC 24 AWG
64	Twisted Pair, PIC 26 AWG

Frequently Asked Questions

Q: How do I calibrate the test set?

A: The test set does not need calibration.

Q: Why are length measurements sometimes incorrect?

A: The accuracy of the length measurement depends on the VOP value. For accurate measurements, the VOP must be correct for the cable that you measure. See "VOP Variations" on page 27.

Q: Can this test set measure the length of single-conductor wires such as THHN?

A: No. The test set measures the length of only cables that have two conductors, and you must connect the test leads to the conductors at the same end of the cable.

Q: On multi-conductor cables with a short between two of the conductors, I sometimes read an open at twice the known length of the cable.

A: If the cable has more than two conductors, and a short exists at the far end between one of the conductors you are connected to and a conductor you are not connected to, the displayed length will be the sum of the lengths of the conductors joined by the short.

Q: When testing a set of wires that go into a conduit, I sometimes get a reading of 0 or 1. Why?

A: If there is more than a foot or so of wires that are physically separated before they enter the close confinement of the conduit, this will look to the test set like an open at the start of the cable. Remember that TS54 reports the FIRST failure that it finds. Try bringing the two wires of the pair closer together for the path from the TS54 to the entry to the conduit.

Q: How does the test set react to a speaker or a transformer at the end of a cable?

A: A speaker or a transformer is a large coil of wire. This usually causes the length reading to be larger than that of the cable alone. A moderate power speaker adds 500 feet (150 meters) to the length reading. Some combinations of speakers and transformers connected to the cable can make the test set give incorrect results, such as a length reading that is too long or too short.

Maintenance

⚠ Warning ⚠

Disconnect the test set's alligator clips from any metallic connections before performing any maintenance. Read all instructions completely and understand possible hazards to end user if repairs are not performed properly.

Batteries are hazardous to handle. Do not allow the terminals to be shorted together. Severe burns or explosion can result if not handled properly. Dispose of the battery properly to ensure contacts cannot short. Disposal may be restricted by local laws.

Cleaning

For general cleaning, wipe the case, front panel keys, and lens using a soft cloth slightly dampened with water or a non-abrasive mild cleaning solution that does not harm plastics.

⚠ Caution

Do not use CRC Cable Clean® or any chlorinated solvent or aromatic hydrocarbons on the test set. Doing so will damage the test set.

If the Test Set Gets Wet

If moisture gets inside the test set, let the test set dry at normal room temperature for 24 hours.

If the Test Set Stops Operating

If the test set stops operating, remove the 9 V battery as described in the next section, wait at least 40 seconds, then replace the battery. This resets the test set. Use the same battery if you know it is good or use a new battery if you are not sure. If it still does not operate, contact Fluke Networks Technical Support.

Replacing the Battery

See Figure 6.

⚠ Warning ⚠

To prevent unreliable test results, replace the battery as soon as the battery icon shows no bars.

Before you remove the battery door, disconnect the test leads from the line.

Use only a 9 V battery, correctly installed, to supply power to the test set.

Do not use the test set without the battery door installed.

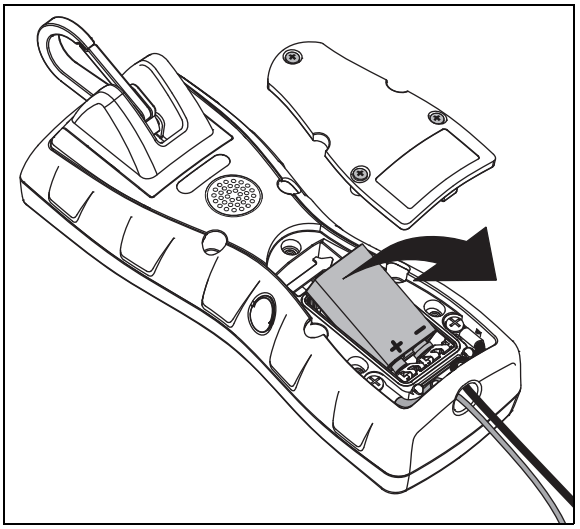
Use caution when handling batteries. Do not let the terminals short together. Dispose of batteries properly to ensure terminals cannot short. Disposal may be restricted by local laws.

⚠ Caution

Do not over tighten the screws. Torque the screws to a maximum of 0.904 N-m or 8 in-lb.

Note

The screws do not come out of the battery door.



GOL07.EPS

Figure 6. How to Replace the Battery

Replacing the Belt Clip

You can replace the belt clip if it is damaged. To order a replacement belt clip, contact your local Fluke Networks authorized distributor.

To replace the belt clip:

Refer to Figure 7.

1 Use a Phillips screwdriver to remove the two screws that attach the belt clip to the test set. Remove the belt clip.

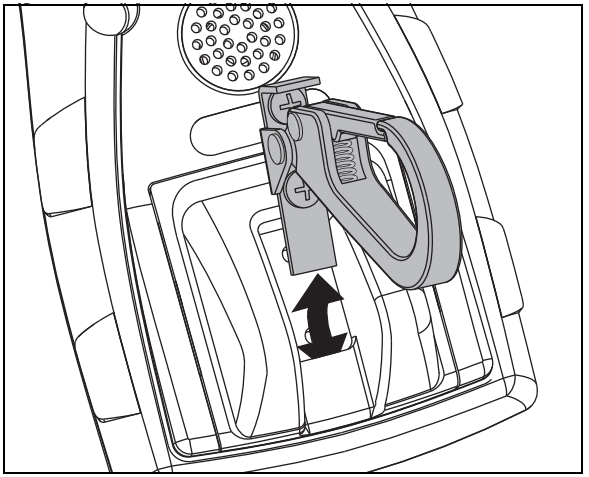
2 Put the screws into the plate on the new belt clip.

3 Put the end of the plate into the slot as shown in Figure 7 before you align the screws with the holes in the test set.

4 Tighten the screws.

⚠ Caution

Do not over-tighten the screws for the belt clip. If you do, you can cause damage to the screw holes.



GOL06.EPS

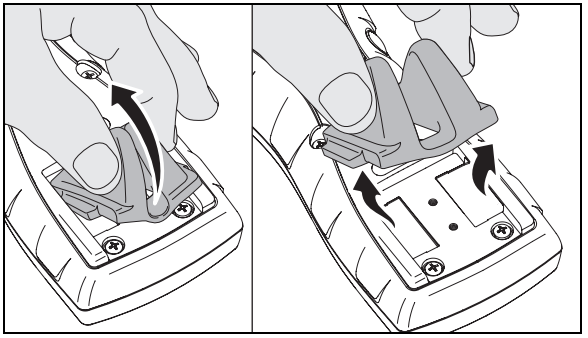
Figure 7. How to Remove and Install the Belt Clip

Replacing the Belt Clip Protector

The belt clip protector prevents damage to the belt clip if you drop the test set. You can replace the protector if it is damaged:

1 Remove the belt clip as described in the previous section.

2 Remove and install the protector as shown in Figure 8.



GOL09.EPS

Figure 8. How to Remove and Install the Belt Clip Protector

Replacing the Test Leads

You can replace a worn out or damaged test lead. To get a replacement test lead, contact your local Fluke Networks authorized distributor.

⚠ Warning ⚠

Read all instructions completely and understand possible hazards to end user if repairs are not performed properly.

Before you remove the battery door, disconnect the test leads from the line.

Install only test leads that are supplied by Fluke Networks for your model of the test set.

To remove and install the test leads:

⚠ Warning ⚠

Make sure you install all the screws and washers that you removed. Make sure that you tighten the screws. Missing or loose parts can make the test set dangerous to use.

When you install new test leads, be careful not to cause damage to the braided insulation around the cables.

Note

The screws do not come out of the battery door.

1 Use a Phillips screwdriver to loosen only the three screws on the battery door (Figure 6).

2 Remove the battery door and battery from the test set. (Figure 6)

3 Loosen the two screws that attach the test leads to the test set (Figure 9), then remove the two screws and washers.

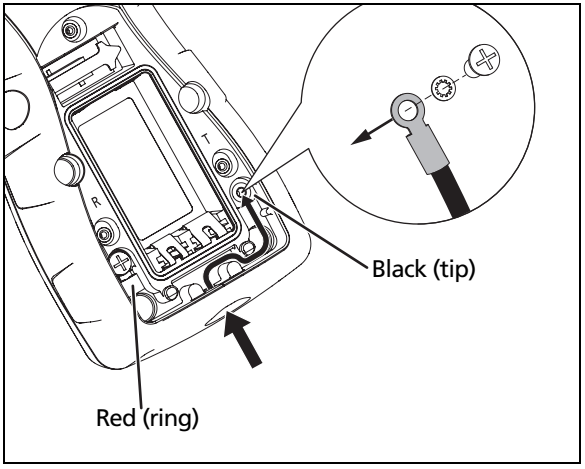
4 Lift the test lead cable out of the strain-relief channel, then pull out the cable through the hole in the housing.

5 Use alcohol and a swab to clean the battery compartment and the connections for the test leads.

6 Put the lug of the new test lead through the hole in the housing, then pull approximately 1 inch (25 mm) of cable through the hole. Push the cable down into the strain-relief channel.

7 Install the screw and washer to attach the lug to the test set. Figure 9 shows the correct installation for the lugs.

8 Install the battery and the battery door. Tighten the screws on the battery door to a maximum torque of 0.904 N-m or 8 in-lb.



GOLO8.eps

Figure 9. How to Remove and Install the Test Leads

Accessories

To order accessories, contact your local Fluke Networks distributor.

Description[1]	Fluke Networks Model Number
Belt clip	BELTCLIP-TS
Test leads with piercing-pin clips	TESTLEAD-PIERC-PIN
Test leads with a 346A plug for the central office[2]	TEST-LEAD-CO-346A
Test leads with angled bed-of-nails (ABN) and piercing-pin clips	TEST-LEAD-ABN-PPIN
Test leads with alligator clips	TEST-LEAD-ALIG-CLP
Test leads with an RJ11 plug, angled bed-of-nails (ABN), and piercing-pin clips	TESTLEAD-ABNPPRJ11
Test leads with a 4 mm banana plug and alligator clips	TEST-LEAD-BANA-CLP
Headset	HEADSET-TS
Hanger kit (magnetic and clip-on hangers for the test set)	TEST-SET-HANGER-TS

1. All accessories are for models TS54 TDR and TS53 PRO.
2. When you use these test leads, the TDR accuracy specifications do not apply.

Specifications

Electrical	
Current Range (Off-Hook)	10 mA to 100 mA
DC Resistance	
Off-Hook	150 Ω nominal
On-Hook	>3 MΩ
AC Impedance	
Off-Hook	600 Ω nominal; 300 Hz to 3400 Hz
On-Hook	>120 kΩ; 300 Hz to 3400 Hz
Headset impedance	32 Ω

Rotary Dial Output	
Pulsing Rate	10 pps ±1 pps
Break/Make Ratio	60/40
Interdigit Interval	>300 ms
Resistance During Break	>100 kΩ
DTMF Output	
Tone Frequency Error	±1.5 % maximum
Tone Level	-3 dBm combined (typical)
High versus Low Tone Difference	2 dB ± 2 dB

Memory Dialing	
Memory Capacity	9 speed dial memories plus one last number redial memory
Digit Capacity	23 digits per memory
PBX Pause Duration	User programmable; default of 4 seconds
Hook Flash Duration	User programmable; default of 500 ms
Automatic Shut Off Duration	User programmable; default of 2 minutes
Voltage Measurement	
Range	4 V dc to 140 V dc
Current Measurement	
Range	0 mA to 100 mA
TDR	
Range	3,000 feet (914 m)
Accuracy	±2 m ±5 %
SmartTone Toner	
Frequencies	Steady tone: 950 Hz Alternating tones: 950 Hz and 1480 Hz
Battery	9 V alkaline battery
Physical	
Dimensions	8.3 in x 3.2 in x 2.6 in (211 mm x 81 mm x 66 mm) (without belt clip)
Weight	1.16 lb (0.53 kg) (without belt clip
Water Resistance	The tester is rain and moisture resistant
Environmental	
Temperature Range	
Handset speech and dialing functions	-22°F to 140 °F (-30°C to 60°C)
LCD function	-13°F to 140°F (-25°C to 60°C)
Storage	-22°F to 150°F (-30°C to 66°C)
Altitude	To 10,000 ft. (3,000 m) max
Relative Humidity	95% to 30°C 75% to 40°C 45% to 50°C 30% to 60°C
Safety	
Regulatory Compliance	Complies with ANSI/ISA 82.02.01 (61010-1) 2004, CAN/CSA-C22.2 No. 61010-1-04, UL 61010-1 (2004) and IEC 61010-1:2010 for measurement Category I, 300 V dc Maximum, Pollution Degree 2
Maximum Transient Voltage	1500 V
EMC	Complies with EMC EN61326-1

Note

Specifications subject to change without notice.

Software Notice

This product uses freeRTOS v5.3.0 software. For more information on freeRTOS, go to **http://www.freertos.org.**

The software license statement and files that contain the binary and source code for freeRTOS v5.3.0 are on the CD supplied with this product.