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3M

Advanced Systems Tester 900AST Series

Instruction Manual

March 2005
78-8135-2559-5-E

Table of Contents

Out of the Box

What you will find when you unpack the shipping box:

- 3M™ Advanced Systems Tester 900AST Series
- Carrying case
- Battery holder and batteries
- Multimeter test leads (red/black pair, blue/yellow pair, green)
- TDR test leads (two each, coaxial with adapters-not assembled)
- Instruction manual
- Warranty card

The 900AST tester comes in a sturdy nylon carrying case and should be used in the case to provide extra protection from shock and the environment.

The battery holder holds six "AA" standard alkaline batteries and should be installed prior to using the unit. Please see the Care and Maintenance section for battery installation instructions. Always initiate a self-calibration (see Toolbox – Self Calibrate for instructions) after installing new batteries.

The 900AST tester comes with two types of test leads – five single-conductor test leads (red, black, green, yellow, and blue) for most DMM (digital multi meter) functions and two special coaxial test leads for precision TDR measurements.

For operational information, refer to this manual or the 900AST tester "Help" screens. For Technical Service, Warranty or Repair questions call 800 426 8688 (US and Canada) or contact your local 3M Representative.

Front Panel

Screen

The 900AST tester screen is a high resolution graphical LCD (Liquid Crystal Display) for viewing text and graphics. The screen format is similar to the following for most functions.

```
┌──────────────────────────────┐
│ FCN  Function Name         🔋 │
│ ICON                         │
│ ◄───────────────┐    Battery │
│                 │      State │
│                 │            │
│ ◄──────►  ┌──────────┐       │
│           │  Result  │       │
│           └──────────┘       │
│ ◄──────────────┐             │
│   Test Leads   │             │
│                              │
│     Function Controls        │
└──────────────────────────────┘
```
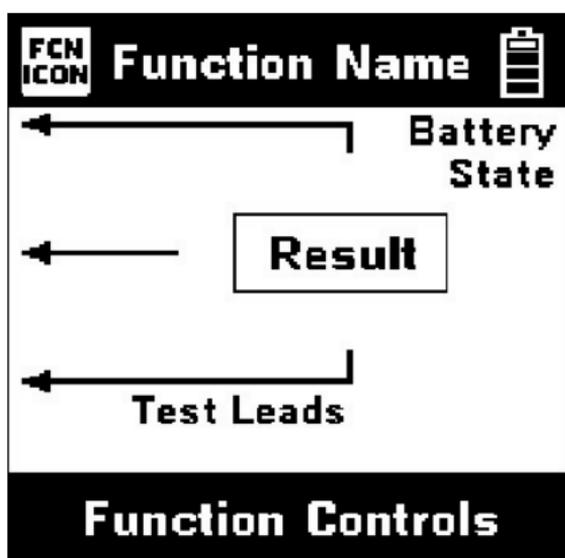
Test Leads

The test lead icons are shown on each of the measurement screens. Each lead points to a color dot on the front label that corresponds to the actual test lead and test jack to be used. For TDR applications using the special coaxial TDR test lead(s), the test lead icons indicate which test jacks (also denoted by colors) to use.

Keypad

The 900AST tester keypad has twelve yellow and red "Control Keys" and nine blue "Function Keys". Additional blue keys on the keypad are reserved for future expansion and have no designation or current function.

Control Keys

Use the red and yellow keys to control the setup and control of the 900AST tester and its functions. The active control keys for each function are shown at the bottom of the corresponding 900AST screen.

Use the [Return] key to return to a previous step in a function.

Use the [Contrast] key to adjust the contrast or to turn the backlight on or off.

Use the [Save] key for storing TDR traces.

Use the [On/Off] key to turn the 900AST power on or off (also see "Power Down Timeout").

Use the [Tab] key to select between different options.

Use the [Setup] key to change the setup of a function.

Use the [Help] key to get context sensitive help with any screen or function.

Use the [Enter] key to accept changes or move to the next step in a function.

Use the [Up] and [Down] keys to scroll to different menu options or insert/delete characters when editing.

Use the [Left] and [Right] keys to move between different options or move the TDR cursor.

Edit

Use the following keys when creating record ID's for stored TDR traces:

Use [Ins] to insert a space to the left of the cursor.

Use [Del] to delete the character above the cursor.

Use [Save] to add a 'dash' in a record name or a minus sign when entering sub-zero temperature.

Function Keys

Use the blue keys to select the different tests in the 900AST tester. The blue keys become number or letter keys when editing.

Use the [Voltage] key to measure DC or AC voltage.

Use the [Load] key to measure the current through a simulated load lamp.

Use the [Resistance] key to measure resistance and access the 'Soak Test' and 'Contact Resistance' functions.

Use the [Toolbox] key to access: Self Calibration, Stored Results, Special Resistance, and the Ohms to Distance Calculator.

Use the [Capacitance] key to measure the capacitance of a component or circuit.

Use the [Tone] key to send interrupted tone for circuit identification.

Use the [RFL] key to find the distance to a resistance fault between two conductors or a conductor and ground.

This key is used for editing only.

Use the [TDR] key to activate the Time Domain Reflectometer.

Use the [Auto] key to activate automatic TDR trace analysis.

Welcome Screen

This is the screen that you see when you first turn on the 900AST tester. It shows the model name and series, unit serial number, software version, and the selected country. The battery symbol in the upper right-hand corner of the display gives an indication of the approximate battery capacity. Each bar represents one-quarter of the full capacity.

Press 🔲 to go to the general Setup screen from the Welcome screen.
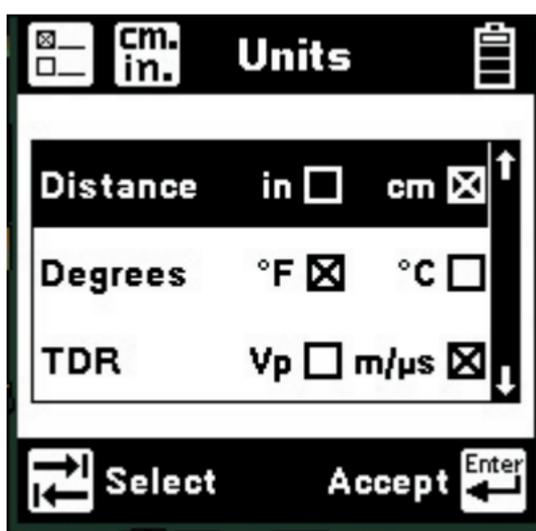
System Setup
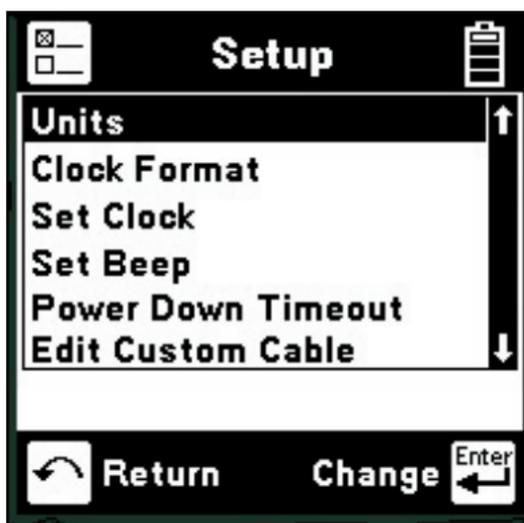
Use the ⬆ and ⬇ keys to highlight a menu item: units, clock format, set clock, set beep, power down timeout, or edit/create custom cables. Press the Enter key to select the highlighted item.

Use ⟲ to return to Welcome Screen without making changes.

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Units

Use the Units setup to change the units of measurement for the 900AST tester.

Use the ⬆ and ⬇ keys to highlight the desired option. Use the ⇄ key to select the parameter for each unit of measurement.

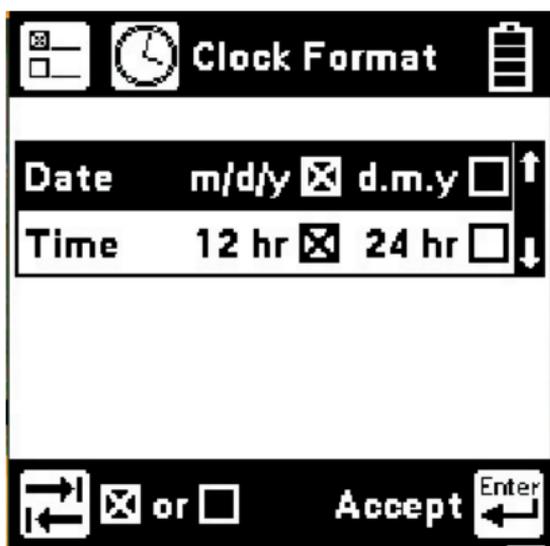**Distance:** Inches or Centimeters. This affects all distances displayed in the 900AST tester.

Degrees: Fahrenheit or Centigrade. This affects all temperatures used or displayed in the tester.

TDR: Vp (Velocity of Propagation) or m/μs (Meters per Microsecond). This affects the conductor velocity factor used by the TDR function. Vp is normally represented as a fraction of the speed of light and has a value less than one.

Use the ⏎ key to accept any changes and return. Use the ↺ key to return to the Welcome Screen without making changes.

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Clock Format

Use the Clock Format setup to change the format of the clock. The clock is used for the time and date stamps in stored results.

Use the $\left[\begin{smallmatrix}Ins\\\uparrow\end{smallmatrix}\right]$ and $\left[\begin{smallmatrix}Del\\\downarrow\end{smallmatrix}\right]$ keys to highlight either the date or time. Use the $\left[\rightleftarrows\right]$ key to select the format parameter:

Date: m/d/y (month/day/year) or d.m.y (day.month. year) The m/d/y format is used in the US and Canada. The d.m.y format is used in most other countries.

Time: 12 hours or 24 hours: This affects the number of hours displayed in the clock. The 12 hour clock (with a.m. and p.m.) is used in the US and Canada. The 24 hour clock format is used in military services and most other countries.

Use $\left[\begin{smallmatrix}Enter\\\hookleftarrow\end{smallmatrix}\right]$ to accept the changes and return. Use $\left[\curvearrowleft\right]$ to return to the Welcome Screen without making changes.

Set Clock

Use the Set Clock setup to change the date and time.

Use the 🔄 key to select date, time, or a.m./p.m. Use the ← and → keys to select the digit to change. Use the Blue keys to enter the values. Use the ↑ and ↓ keys to select a.m. or p.m. Use ⏎ to accept the changes and return. Press ⟳ to return to the Welcome Screen without making changes.

Set Beep

Use the Set Beep setup to turn the key beeps on or off.
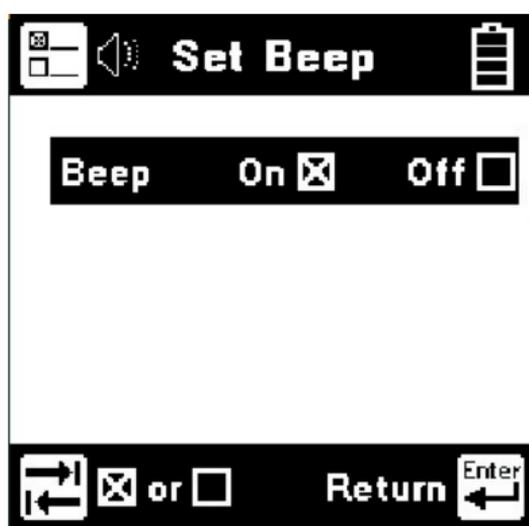
Use the 🔄 key to toggle between on or off. Use the ⏎ key to return.

Power Down Timeout

To change the power down timeout, press the [⊞] key from the startup screen, then select Power Down Timeout. Use the [↑ Ins] and [↓ Del] arrow keys to select the desired timeout period, then press the [Enter] key to set that period as the default. After a period of inactivity equal to the default period, the unit will beep, then automatically power down to preserve battery life.

Edit Custom Cable

This function allows you to create custom cable types for specific applications.
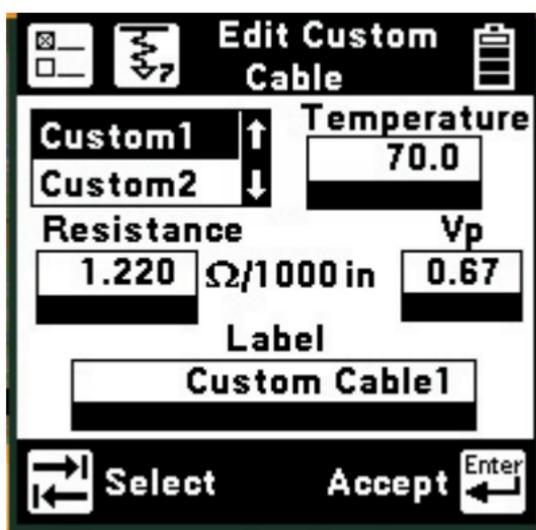
Select one of the six available customizable cables (Custom 1 through Custom 6) to edit. Use the [⇄] key to move between temperature, resistance, velocity factor, and the label field. Use the [←] and [→]

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keys to select a digit or character to change. Use the Blue keys to enter values or characters. Use the $\left[\begin{smallmatrix}\text{Ins}\\\uparrow\end{smallmatrix}\right]$ and $\left[\begin{smallmatrix}\text{Del}\\\downarrow\end{smallmatrix}\right]$ keys to insert and delete values and characters. Use $\left[\begin{smallmatrix}\text{Enter}\\\hookleftarrow\end{smallmatrix}\right]$ to accept any changes and return. Use $\left[\curvearrowleft\right]$ to return to the Setup menu without making changes.

Completing the Label field is optional. This is used for reference (i.e. "tail harness") and can contain up to fourteen characters and digits. The label only appears on this screen. To use one of the custom cables in an application (RFL, TDR), select the desired cable (Custom 1 through Custom 6) in the wire gauge menu of the application.

Note: Velocity of Propagation (Vp) is the rate at which electrical signals travel through a conductor. Vp is expressed as a fraction of the speed of light, so it is always less than 1. Meters per microsecond (m/µs) is an alternate way to specify cable velocity factor. Consult your aircraft wire specifications to obtain the correct velocity factor for the conductors that you wish to test.
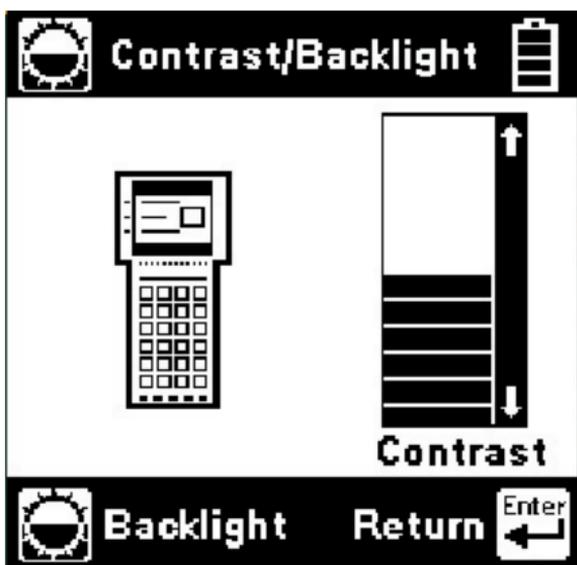
Controls

Contrast/Backlight

Press the [☼] key to display the contrast screen. Use the [↑] and [↓] keys to adjust the contrast. Press the [☼] key again to turn the backlight on or off. **Please note that use of the backlight decreases available battery capacity.** Use the [Enter] key to return.

Help

Press the [?] key at any time on any screen to get context sensitive help with the present function.
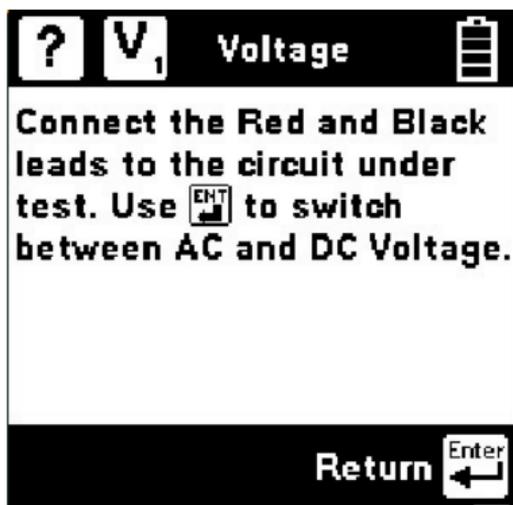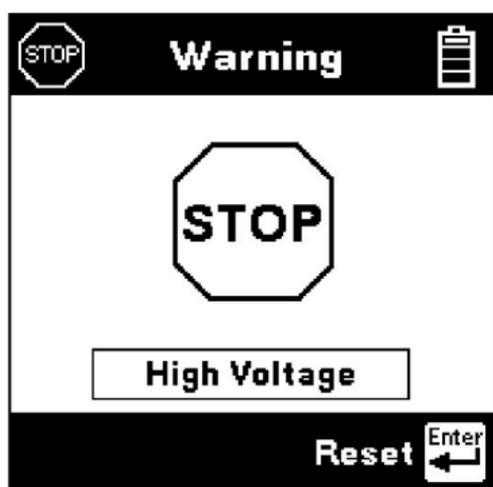

Press the [Enter] key to return to the previous screen.

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High Voltage

This screen indicates that a high voltage (120 VAC/VDC or greater) has been detected between the test leads when the 900 AST tester is not in the Voltage Mode. The 900AST tester has opened an internal relay to protect itself from damage. Use standard customer safety practices for disconnecting the test leads since a high voltage is present.
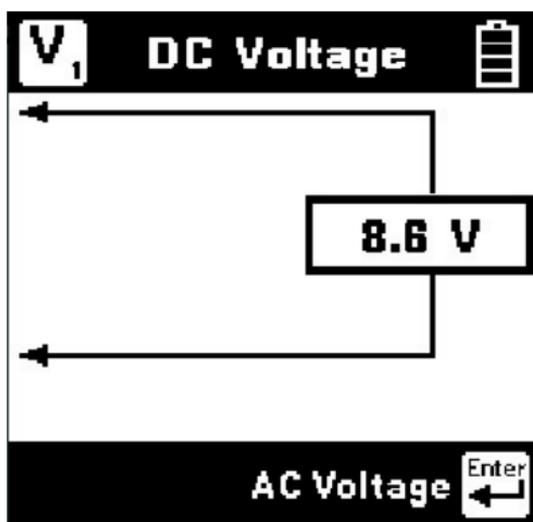
STOP / Warning

STOP

High Voltage

Reset Enter

Press the Enter key to restart the 900AST tester.

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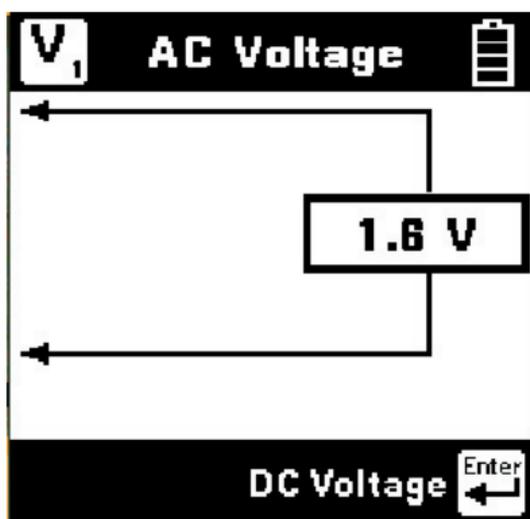
Functions

$$V_1$$

Voltage

This function measures and displays the DC or AC voltage between the Red and Black test leads. The readings are 'live' and will vary with the voltage being measured.

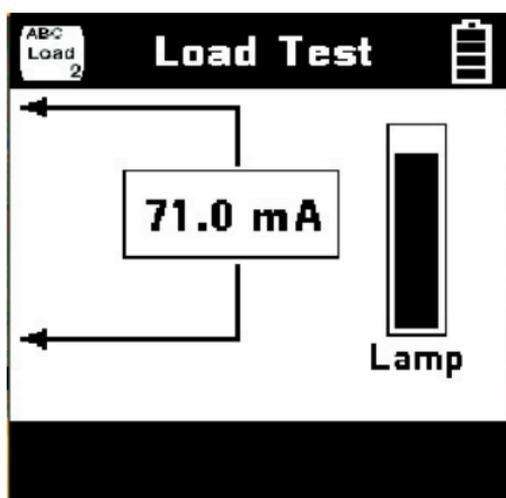The 900AST tester initially measures DC voltage. Press the [Enter] key to switch from DC to AC voltage measurement.

Press the [Enter] key again to switch back from the AC to the DC voltage measurement.
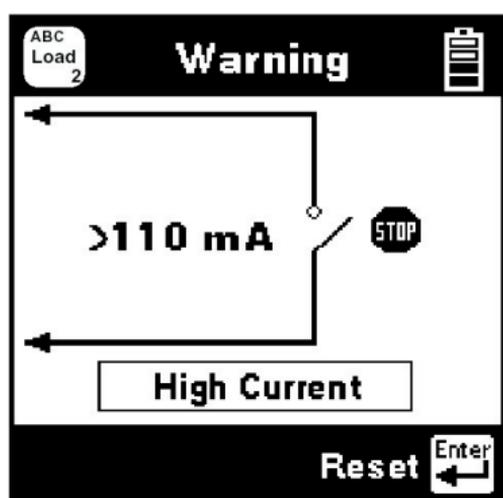
17

ABC
Load
2
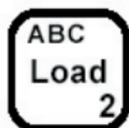
Load Test

This function measures the DC current flowing through a simulated load lamp inside the 900AST tester. Connect the Red lead to the conductor under test and the Black lead to a return or ground. The 900AST tester will continuously display the current passing through the load as well as a bar graph representing the approximate level of load lamp illumination.

```
ABC
Load     Load Test          🔋
2

  ┌──────────────────┐  ┌───┐
  ◄─┐                 │  │███│
    │                 │  │███│
    │   ┌─────────┐   │  │███│
    │   │ 71.0 mA │   │  │███│
    │   └─────────┘   │  │███│
    │                 │  │███│
  ◄─┘                 │  └───┘
                           Lamp
```

If the current in the load is greater than 110 mA, the following 'Current Warning' screen is displayed.

```
ABC
Load      Warning          🔋
2

  ◄─┐           ┌──────┐
    │           ○      │  🛑
    │  >110 mA  ╱      │  STOP
    │                 │
  ◄─┘                 │
    ┌──────────────┐
    │ High Current │
    └──────────────┘
                   Reset ⏎
                        Enter
```

This screen indicates that a high current has been detected between the test leads and that the 900AST tester has opened an internal relay to protect itself from damage. Use standard safety practices for disconnecting the test leads. Press the ⏎ key to restart the 900AST tester. Fix problems before restarting the 'Load' measurement.
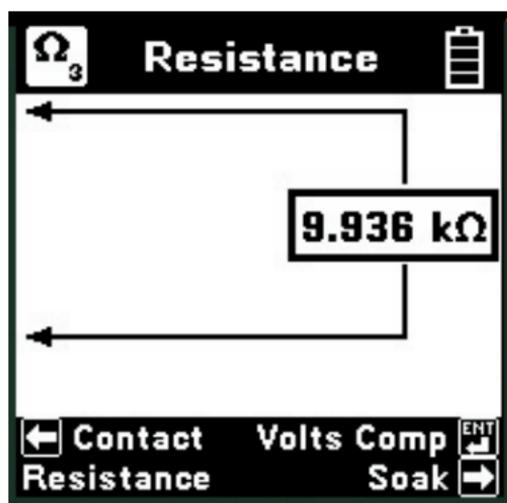
Resistance

This function measures the resistance between the Red and Black test leads. It is also the entry point for accessing the Soak Test and Contact Resistance measurements.
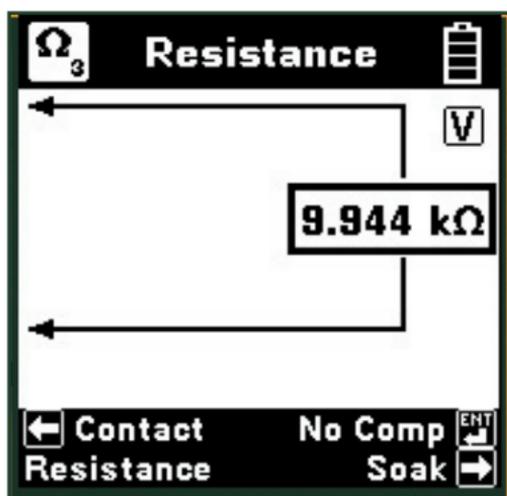

The "V" in the upper right corner of the screen indicates that the resistance measurement is compensating for any foreign voltage on the line. Press the [Enter] key to remove the voltage compensation. Use this mode only if you have first determined there is no DC voltage on the conductor (by using the Voltage function). The non-compensated measurement is slightly faster, but it is not as accurate if there is voltage on the conductor.

The resistance measurement can be affected by moisture on the test lead contacts or their access points. For the most accurate measurement make sure that these areas are dry.

Soak Test

Use the Soak Test function to continuously measure the non-compensated insulation resistance of a conductor to another conductor, shield, or ground. This is useful in detecting time varying faults such as corrosive bridges.
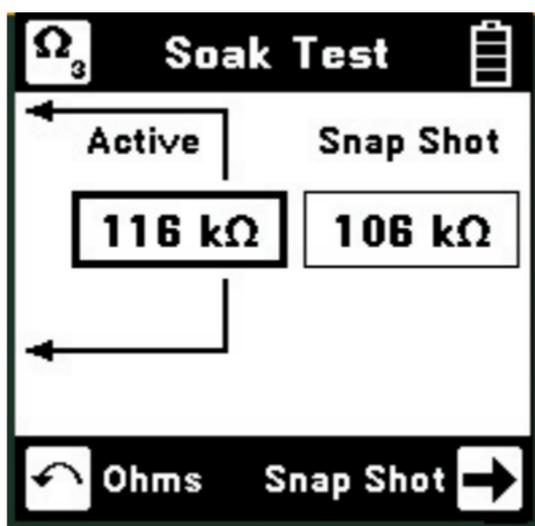
Press the $\boxed{\rightarrow}$ key to access the Soak test from the Resistance screen. Connect the Red lead to the conductor under test and the Black lead to the fault reference (usually ground). Use the $\boxed{\rightarrow}$ key to save the active resistance to the "Snap Shot" area. This measurement will not be accurate if there is foreign voltage on the conductor.

Use the $\boxed{\curvearrowleft}$ key to return to the Resistance measurement.
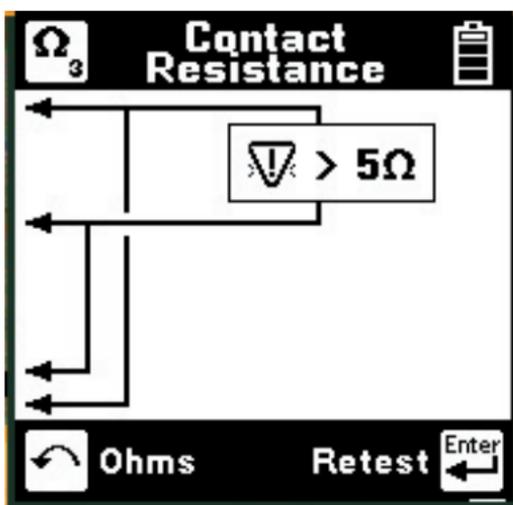
Contact Resistance

This is a precision resistance measurement for applications requiring limited range and high accuracy. The Contact Resistance function measures the resistance between the Red/Blue and Green/Yellow leads.
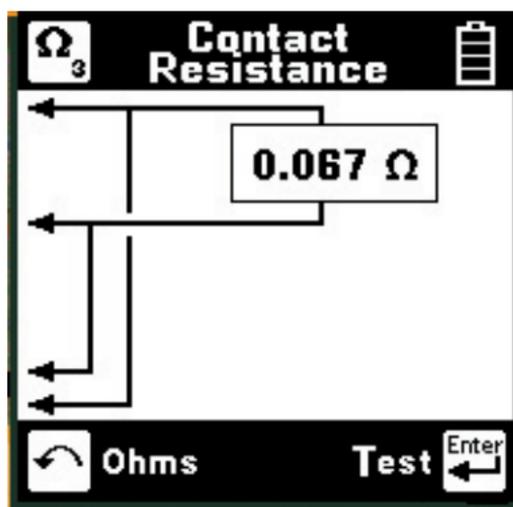
Connect the Red and Blue test leads to one side of the circuit and the Green and Yellow test leads to the other side. Press the ⏎ key when you are ready to measure. The Contact Resistance measurement may take a few seconds to settle and display a result. **This measurement is not continuous.** To retest, press the ⏎ key again.

If the Contact Resistance is greater than 5 ohms, the test returns immediately with an over-range indicator.

Check all test leads and repeat the test. To retest, press the ⏎ key again. Use the ⤺ key to return to the Resistance measurement.

Toolbox

The "Toolbox" menu contains a selection of special functions. Use the [↑] and [↓] keys to move to a desired function, then press the [Enter] key to accept the choice.

```
 ⚒₄    Toolbox      🔋

 ┌─────────────────────┐
 │ Self-Calibrate     ↑│
 │ Stored Results      │
 │ Special Resistance  │
 │ Ohms/Distance       │
 │ Maintenance        ↓│
 └─────────────────────┘

              Accept Enter
```

Note: The last item in the Toolbox menu (Maintenance) is reserved for use only during Factory setup and service of the 900AST tester.

Self-Calibration

Use this function to calibrate the 900AST tester anytime the outside temperature changes by more than 35°F (20°C). Calibrate the 900AST tester at the same temperature at which it will be used.

Note: Initiate a self-calibration prior to the very first use of your 900AST tester.

You will see the following screen as soon as you select Self-Calibration from the Toolbox.

Short the test leads together, then press ⏎ to continue.

The screen shows "Self-Calibration Complete" when the calibration is done, or "Self-Calibration Failed" if the calibration fails. In this last case, check the test lead connections and try again.
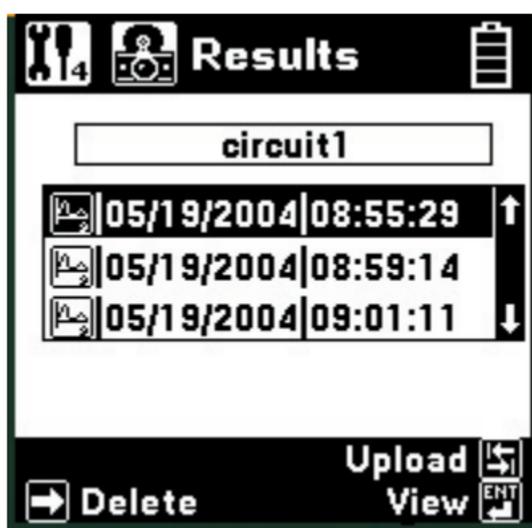
Stored Results

Use this function to view previously stored records. If no results have been stored, "No Results Stored" will be visible on the screen. If one or more sets of test results have been stored, the ID number for each will be displayed.

Use the $\left[\begin{smallmatrix}\mathsf{Ins}\\\uparrow\end{smallmatrix}\right]$ and $\left[\begin{smallmatrix}\mathsf{Del}\\\downarrow\end{smallmatrix}\right]$ keys to highlight the desired stored record. Press the $\left[\begin{smallmatrix}\mathsf{Enter}\\\leftarrow\end{smallmatrix}\right]$ key to select the highlighted record and display the stored results list for that record number by type, date, and time.

Display Results

Use the $\left(\uparrow\right)$ and $\left(\downarrow\right)$ keys to highlight the desired stored result. Press the $\left(\text{Enter}\right)$ key to view the data for the highlighted selection.
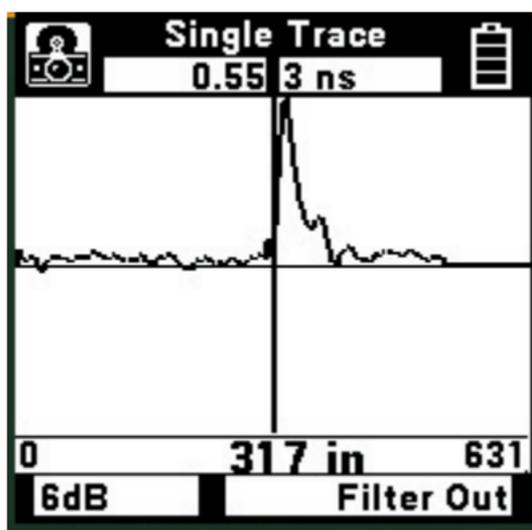
Use the $\left(\rightarrow\right)$ key to delete the selected result. Use the $\left(\rightleftarrows\right)$ key to upload the selected stored test result to a PC.

Delete Results

Press the ➡ key to display the Delete screen.

Press the [Enter] key to delete all saved results. Press the ⟳ key to delete the saved results of the selected ID. Press the ⟲ key to return to the main Results screen.

Upload Results

Press the ⟳ key to display the Upload screen.

Press the [Enter] key to upload all of the saved results. Press the ⟳ key to upload the results of the selected ID. Press the ⟲ key to return to the main Results screen.

Uploading the test results to a PC requires an IR adapter (see 'Care and Maintenance'). Both USB and serial ports are supported. The 3M communications software package PC Link_900AST is also required. Contact the 3M Repair Center at 800-426-8688 (Option 2) to order the IR adapter. Contact the 3M Technical Support Hotline at 800-426-8688 (Option 3) to obtain PC Link_900AST.

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Special Resistance

The Special Resistance function measures whether a pair of conductors are electrically equal in resistance. Use this function to measure the loop resistance between the Red and Green test leads, the resistance of each conductor connected to the Red and Green test leads, and the difference in resistance between the two conductors.
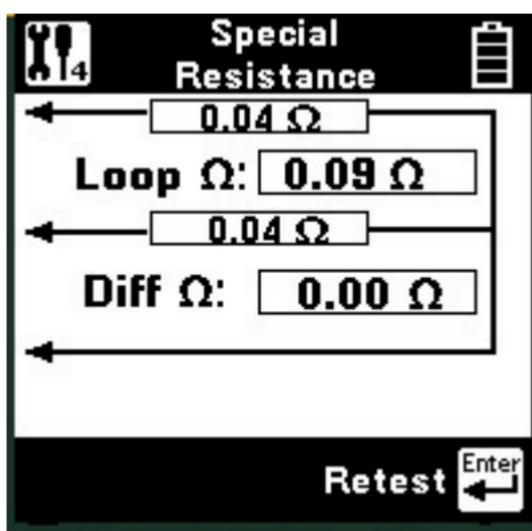
Connect the Red lead to one conductor of the pair and the Green lead to the other conductor. Connect the Black lead to a reference wire. Note that the "reference wire" can be a separate wire, ground, or the shield of the cable. **Short the other end of the two conductors to each other and to the reference wire.**
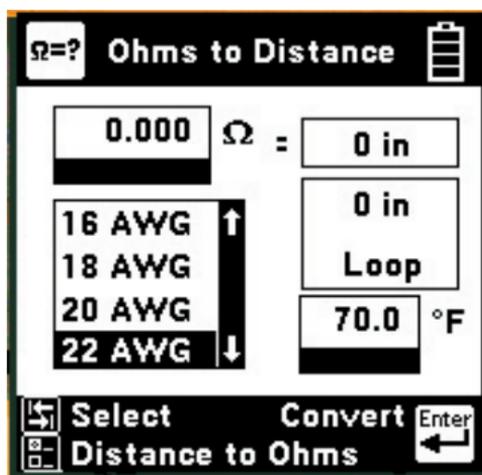
Press the $\boxed{\text{Enter}}$ key to start the test.

After the 900AST tester displays the results, press the $\boxed{\text{Enter}}$ key to repeat the test. Special Resistance is not a continuous test.

Use the $\boxed{\curvearrowleft}$ key to return to the Toolbox.

Ohms/Distance

Use this function to convert Ohms to Distance based on temperature and wire gauge.

If you have just run a resistance measurement, the Ohms field will be automatically populated with the last value measured. Otherwise, enter the Ohms value using the keypad and then press the ⇄ key to select gauge or temperature. If you select "gauge," press the ↑ and ↓ keys to select the desired gauge. If you select "temperature," enter the value of the desired temperature using the keypad.

Press Enter when you are ready to convert from Ohms to Distance. The screen shows the total conductor length, and half the length (if you are measuring the distance to the end of a shorted pair).
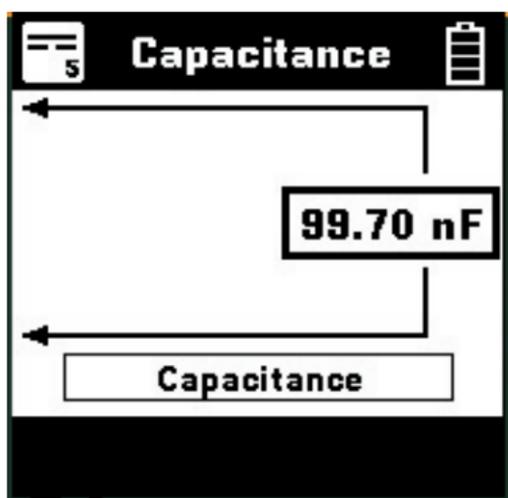
Press the 🔢 key to enter Distance instead of Ohms. All control keys work the same as above when entering distance.
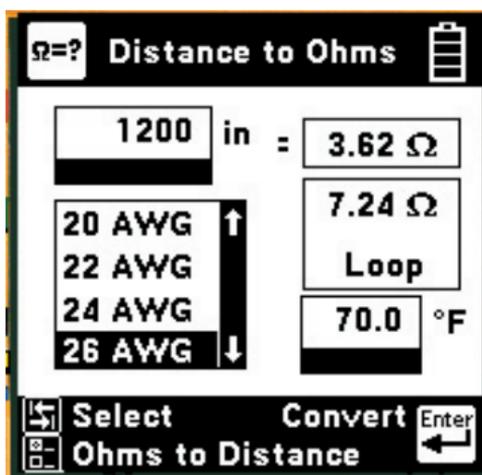
Capacitance

This function measures the capacitance of a circuit or component. Connect the Red lead to one side of the circuit and the Black lead to the other side. The capacitance is measured continuously.

If the capacitance cannot be measured, the display indicates '***'. Press ⟲ to exit.

Tone

Use this function to send an interrupted ID tone on a pair of conductors or between a conductor and ground for identification using a tone probe (not supplied with the 900AST tester). Connect the Red and Black test leads to the conductors under test. Press $\boxed{\text{Enter}}$ to start sending the ID tone.

The volume of the tone heard in the 900AST tester speaker may be adjusted. Press the $\boxed{\uparrow}$ and $\boxed{\downarrow}$ keys to adjust the volume. Use $\boxed{\text{Enter}}$ to stop sending.

*Note: The volume control does not affect the level of the tone sent on the circuit.*

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Press the 🔲 key from the Tone screen to change the ID tone. Use the keypad to change the frequency. The frequency range is 200 to 1000 Hz. The output level is fixed at 8 volts peak to peak.

**RFL
(Resistance Fault Locate)**

Use this function to locate a Resistance Fault on a pair of conductors or between a single conductor and ground
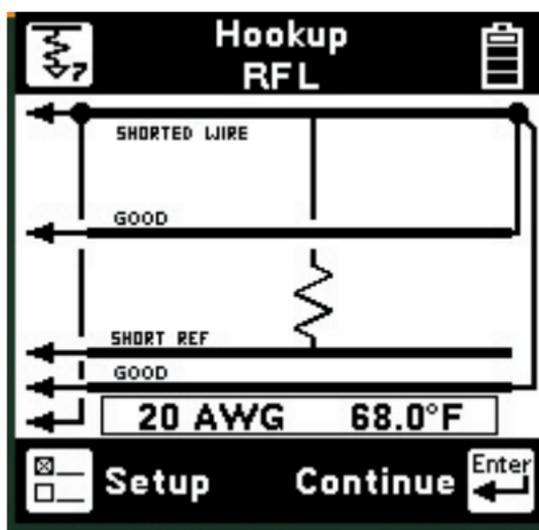
First, use the Resistance function to determine the faulted conductor and to find a separate good pair of conductors (with no faults) in the same cable. If you prefer, you can run a pair of wires to the end of the faulted wire to serve as the 'separate good pair'.

Once you identify the wires, short ('Strap') the far-end of the faulted conductor to the two conductors of the separate good pair. Press the key.

The hookup screen will show the last selected wire gauge and temperature. Use the key to change the gauge, temperature or enter a known distance to the Strap.
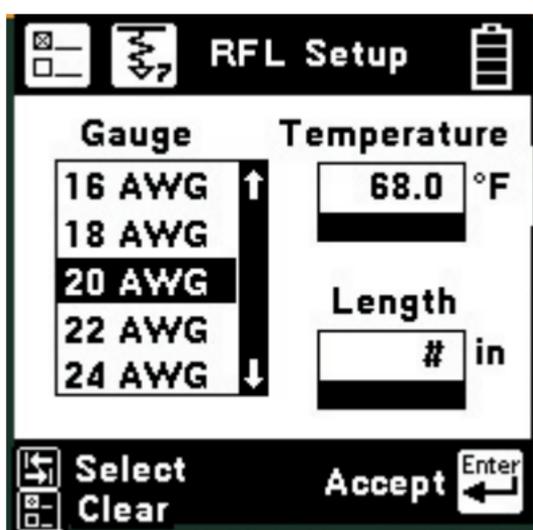
Note: Either the temperature or length (distance to Strap) must be selected as unknown. Press the ⊞ key to clear one of these fields. The cleared field will be indicated by a '#'.

Connect the Red and Blue test leads to the faulted wire. Connect the Black Lead to the reference. (The reference is the return path for the fault and can be the shield or another wire in the cable.) Connect the Green and Yellow test leads to the separate good pair.

Press the ⏎ key after you make the above connections. If no errors in the hook-up are detected, the 900AST tester will begin the measurement and go to the results screen.
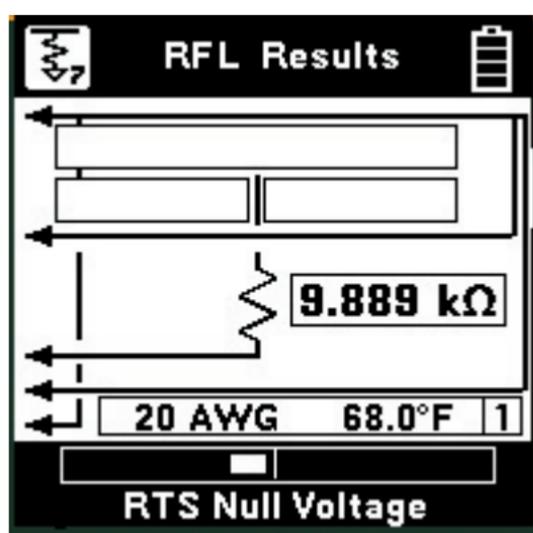
During the measurement a bar graph of the measurement null voltage for Resistance to Strap (RTS) and then Resistance to Fault (RTF) will be visible at the bottom of the screen.

The results at the top of the screen indicate the "Distance to Strap". The results on the second line indicate the "Distance to Fault" and the "Distance, Strap to Fault".

The screen shows the fault resistance beside the resistor symbol. The wire gauge and temperature are displayed above the bottom bar.

If the Yield Sign [⚠] shows beside the results, this indicates a possible marginal result (due to noise or other external conditions).

Press [⇄] to show readings in Ohms instead of distance. Press again to return to distance. Press [Enter] to repeat the fault locate on the same conductor(s) or the [↺] key to test a new circuit. Press [⊟] to change the Gauge or Temperature.

If there is a problem with the connection, you will see the "RFL Error" screen.

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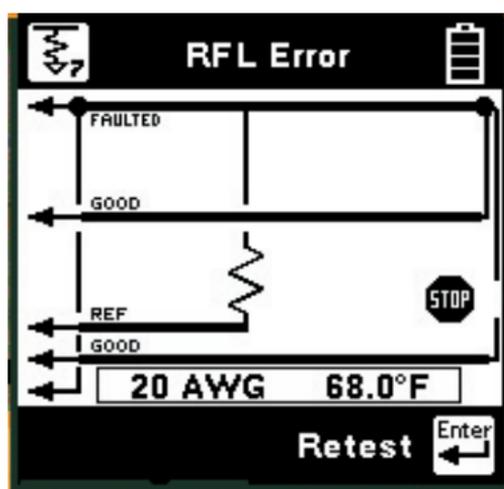
There are four main problems leading to the "RFL Error" screen:

1. The fault is greater than 5 M ohms.
2. The Blue lead is not connected.
3. The Green strap connection is missing or bad.
4. The Yellow strap connection is missing or bad.

The screen will show the combination of errors that have been detected. In the case shown above, the Yellow lead is not connected. Correct the errors and press the [Enter] key to repeat the hookup test.

RFL Setup

Use RFL Setup to change wire gauge and/or the temperature or to enter a known Distance to Strap (length). Press the [▣-] key to display the current settings.
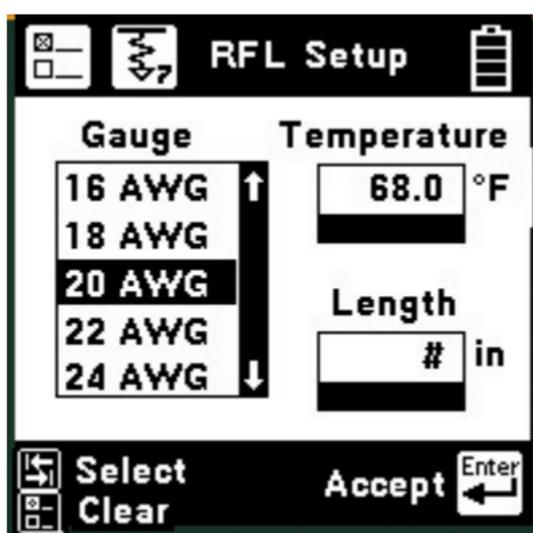
Press the ⟨⇄⟩ key to select either the wire gauge menu, the temperature, or the length (Distance to Strap) for editing. If you select the wire gauge menu, press the ⟨↑⟩ and ⟨↓⟩ keys to select the desired gauge. If you choose temperature or length, enter the new value using the blue numeric keys. Either the Temperature or Length must be specified as unknown. Use the ⟨⊟⟩ key to specify a field as unknown. The '#' sign will appear in the cleared field.

Note: Always enter the temperature of the wire itself, not the ambient temperature.

Press the ⟨Enter⟩ key to accept the changes and return to the previous screen. Press the ⟨↩⟩ key to return without saving the changes. Press the ⟨Enter⟩ key again to return to the hookup screen.

Other RFL Errors

If the RFL measurement terminates due to a time-out, a "Yield Sign" will be displayed next to the DSTF or RSTF. This indicates that the results may not be accurate. This could be caused by excessive noise on the circuit.

If the temperature is known and the specified conductor length is greater than the measured distance to strap, then the calculated unknown lengths would be negative. This will cause a "Yield Sign" to be displayed to the left of the setup boxes and "***" to be displayed in the "Distance to Fault" and "Distance Strap to Fault" boxes

If the red and green clips are reversed, the "Resistance to Fault" calculation may return a negative value. This will cause a "Yield Sign" to be displayed next to the DSTF or RSTF result and "***" in the DTF and DSTF boxes.
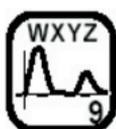
TDR

A Time Domain Reflectometer (TDR) sends an electrical pulse on a conductor or circuit and measures the distance to "events" (usually caused by some change in the conductor) based on input about the electrical properties of the conductor.

Note: For best operation, use the special coaxial TDR test leads supplied with your 900AST tester to perform TDR measurements. BNC to 20AWG wire adapters are provided for customization of the coaxial TDR leads to the target environment. The TDR test leads plug into the Red/Black and Blue/ Yellow test jacks on the 900AST tester depending on the desired operation.

TDR Setup

The TDR features a setup function that allows you to enter input about the electrical properties of the target conductor or circuit. From the TDR Menu, press the key to enter the TDR Setup.
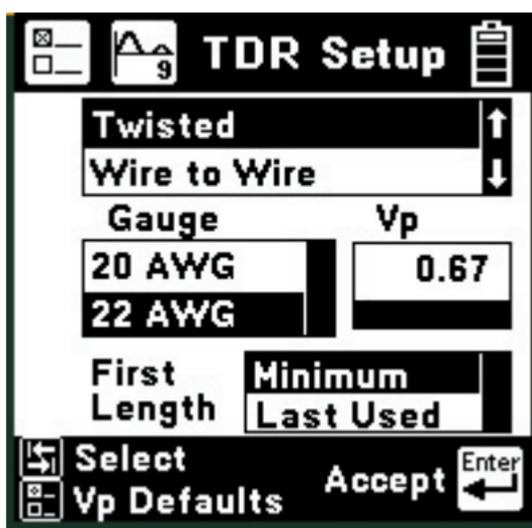

Press the to move between setup parameters. Use the and keys to select wire type (including custom cables), gauge, and 'minimum possible' or 'last used' initial measurement length setting. Use the and keys and Blue numeric keys to change the velocity factor for the selected wire type.

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Note: Editing the velocity factor may cause the TDR to read inaccurately. The 900 AST tester maintains modified Vp settings in internal memory. Press the ▣– key in the TDR Setup screen to restore original default Vp settings for all wire types.

TDR Menu

There are six possible modes in which to use the TDR.

- Use Single Trace to view a single conductor or circuit.
- Use Dual Trace to view two separate conductors or circuits at the same time.
- Use Differential to view the difference between two conductors or circuits.
- Use Crosstalk to view the electrical coupling between two conductors or circuits.
- Use Memory to compare a "live" trace with a trace stored in memory.
- Use Peak to display a history of maximum and minimum values with the live trace.
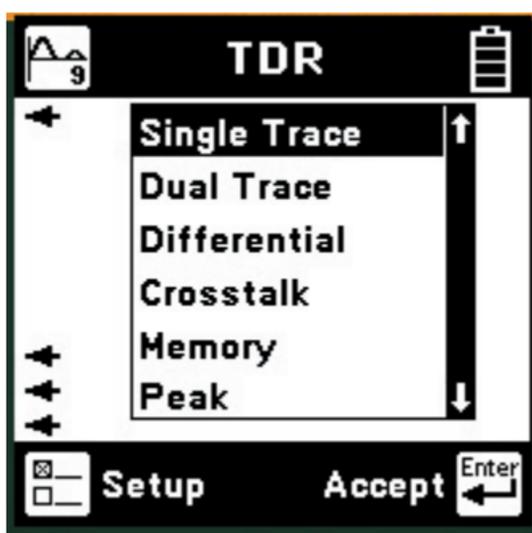
Press the ⬆ or ⬇ keys to move to the desired mode. Press the ⏎ key to accept the choice and start the measurement.

Single Trace
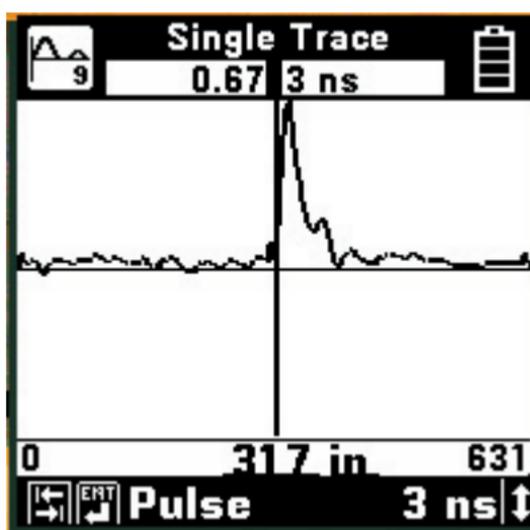
Insert the supplied coaxial TDR test lead into the Red and Black test jacks on the 900AST tester. Connect one TDR test lead to a single conductor or one side of a pair under test. Test lead polarity is not important for TDR measurements. If a single conductor circuit is being tested, connect the other TDR test lead to another de-energized conductor near the conductor under test. TDR pulses occur at such a high frequency that an adjacent conductor can serve effectively as a 'return' for the pulse. Ground or cable shield can also be used for the return if desired, but this often results in a very "noisy" trace and is not recommended. If a pair of conductors is being tested, place the other test lead on the second conductor of the pair. Single Trace is used to view events on a single circuit at a time.

Dual Trace
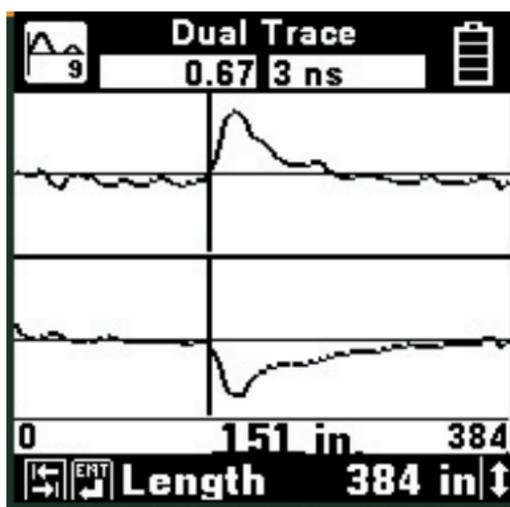
Connect the TDR test leads (Red and Black jacks) to the circuit under test. Connect the second TDR test lead set (Blue and Yellow jacks) to the reference circuit.

The circuit under test is displayed at the top of the screen. The reference circuit is displayed at the bottom of the screen. Any changes in the control parameters affect both traces. It is not possible to control each trace independently.

Dual Trace is used to compare two circuits at the same time (usually a faulted and a good circuit).

Differential and Crosstalk

Use the Differential mode to display only the difference between two circuits (usually a 'good' circuit and a circuit under test).
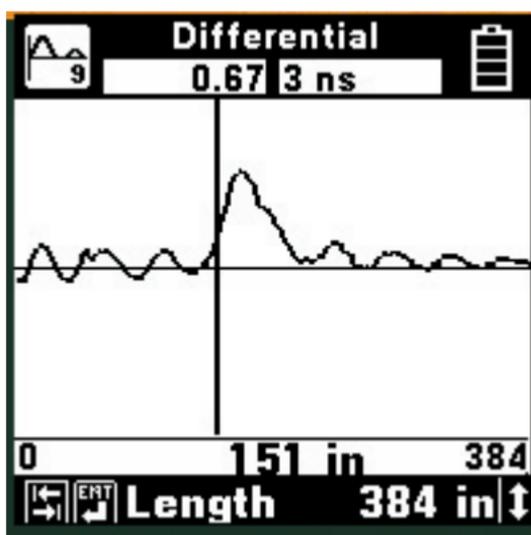
Use the Crosstalk mode to display the amplitude and location of signals that "cross" from one conductor to the other. This could be caused by two wires with high frequency signals running together for long distances and coupling their electrical signals.
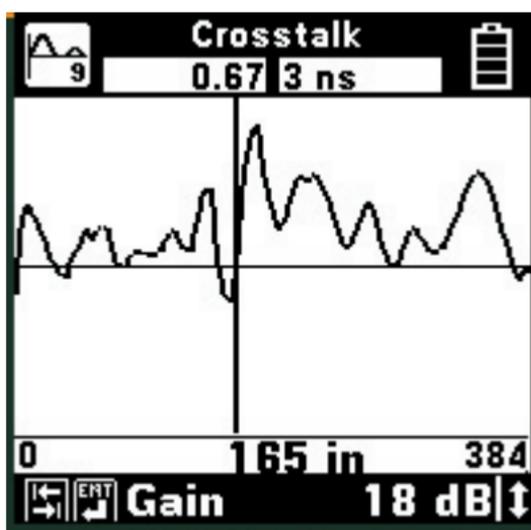
For both Differential and Crosstalk, connect the Red/Black TDR test leads to the circuit under test and connect the Blue/Yellow TDR test leads to the reference circuit.

Memory

Connect the Red/Black TDR test leads to the circuit under test. Memory mode is used to compare a circuit under test to a stored trace in memory. The first screen in memory mode will show a list of the ID numbers for all stored TDR traces. Use the $\boxed{\uparrow}$ and $\boxed{\downarrow}$ keys to highlight the desired stored result.
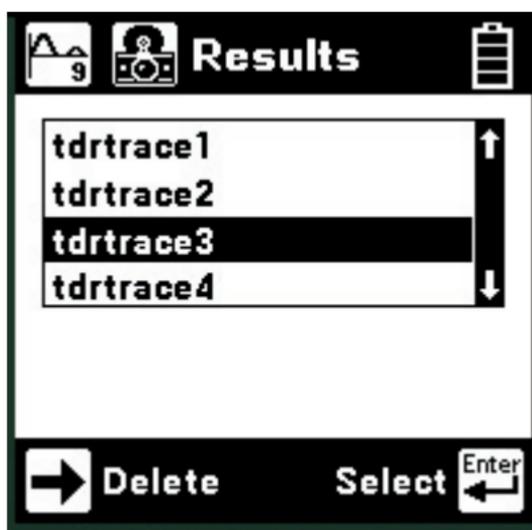
Press the $\boxed{\text{Enter}}$ key to select the highlighted result and display the stored results list for that ID number by type (TDR), date and time.

You can delete individual stored results by pressing the $\boxed{\rightarrow}$ key.

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Use the $\left[\begin{smallmatrix} \text{Ins} \\ \uparrow \end{smallmatrix}\right]$ and $\left[\begin{smallmatrix} \text{Del} \\ \downarrow \end{smallmatrix}\right]$ keys to highlight the desired stored result. Press the $\left[\begin{smallmatrix} \text{Enter} \\ \leftarrow \end{smallmatrix}\right]$ key to display the stored trace on the bottom of the TDR screen and the "live" trace on the top.

You may move the cursor by using the $\left[\leftarrow\right]$ and $\left[\rightarrow\right]$ keys. The control settings for the stored trace can be viewed by pressing the $\left[\begin{smallmatrix} \rightleftarrows \end{smallmatrix}\right]$ or $\left[\begin{smallmatrix} \text{Enter} \\ \leftarrow \end{smallmatrix}\right]$ keys but the settings cannot be changed.
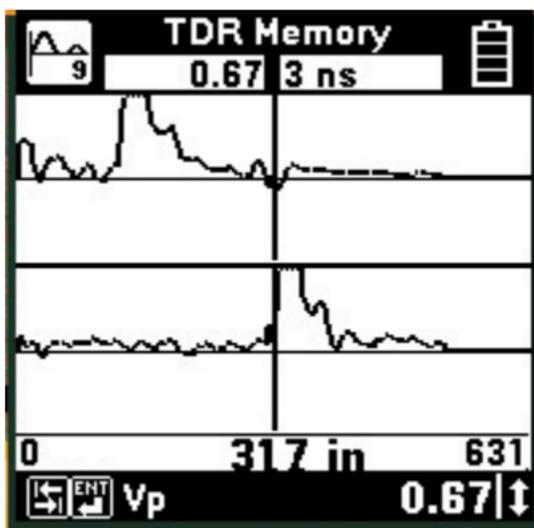
The TDR Memory function includes a Difference ('Diff') control, accessible from the memory screen by pressing the $\left[\begin{smallmatrix} \rightleftarrows \end{smallmatrix}\right]$ key. The default is Difference Control OFF. Use the $\left[\begin{smallmatrix} \text{Ins} \\ \uparrow \end{smallmatrix}\right]$ or $\left[\begin{smallmatrix} \text{Del} \\ \downarrow \end{smallmatrix}\right]$ arrow key to turn the Difference Control ON. Diff combines the live trace with the stored trace to show the difference in the two readings.
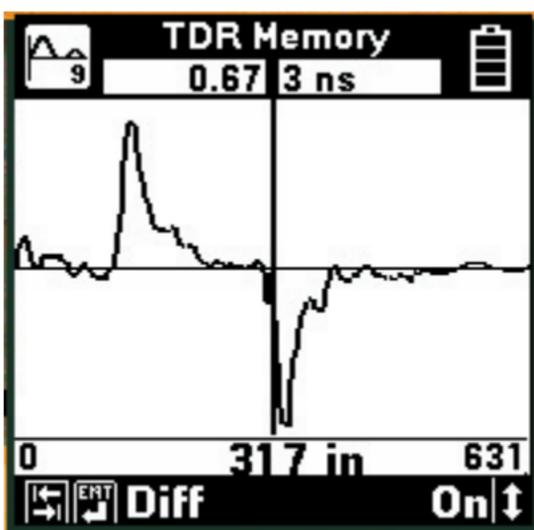
The TDR Memory screen defaults to the control settings that were active when the stored trace was saved using the "TDR Save" function.

Peak

Use the TDR Peak mode to capture events that may be intermittent. This mode continuously detects and displays the maximum and minimum traces that occur from the time that the mode is first selected. The 'live' trace is also displayed continuously. As a new maximum or minimum trace is detected, it will replace the previous one on the display.
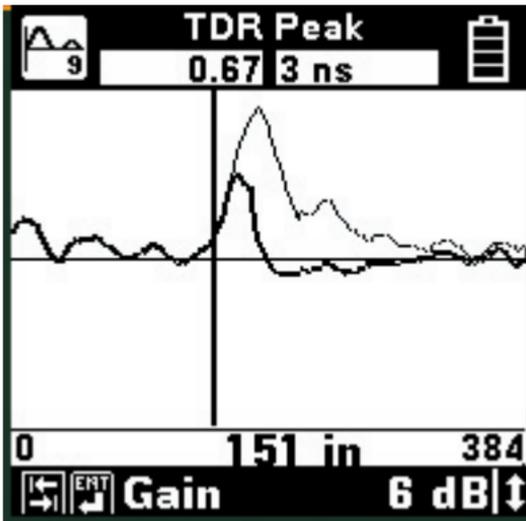
If the circuit being tested is stable (no intermittent faults), then the minimum, maximum and "live" traces should appear as a single trace.

If any of the control values are changed, the peak histories will be erased and new values will begin to display.

TDR Controls

The controls described below are valid for all modes, except for the Memory mode. The 900AST tester displays the controls and other parameters at the bottom of the screen.

```
0          125 in        384
🔄🔁 Length        384 in ↕
```

Use the [⇥] and [⏎] key to move forward or backward through the TDR controls. Use the [⬆] and [⬇] key to change the parameters for the control selected.

Individual controls and their parameters are described as follows:

Length

192" (16 ft), 384" (32 ft), 624" (52 ft), 1320" (110 ft), 2640" (220 ft), 3840" (320 ft), 5760" (480 ft), 15360" (1280 ft)

```
🔄🔁 Length    384 in ↕
```

Length allows you to set the distance (or span) from the left side of the screen to the right side. The left side of the screen is at the end of the test leads, and the right side is the farthest distance that can be displayed with the selected length.

Note: The length ranges are nominal and based on a Vp of 0.67. If you change the Vp or select a conductor type that has a Vp other than 0.67, the distance indicator at the right side of the display will have a different value than the nominal length. It will represent the actual distance displayed across the horizontal axis of the screen for the selected Vp.

Filter

Out, In

```
🔄🔁 Filter    is Out ↕
```

Filter allows you to switch in a filter to remove noise. You should use the filter if you see noise on the display. Note that switching in the filter may make it difficult to detect small events on the cable.

Vp (Velocity of Propagation)

0.10 to 0.99

| 🔄📲 Vp | 0.67↕ |

Vp allows you to adjust the velocity factor ("propagation velocity") of the conductor or pair. Different conductors have different values of Vp. To get the most accurate distance, Vp should be set to the exact value for the conductor being tested. The 900AST tester Setup Menu pre-selects Vp values based on the type of circuit being tested. The propagation velocity is shown in the left-side box at the top of the TDR screen.

Pulse Width

3 ns, 5 ns, 34 ns

| 🔄📲 Pulse | 5 ns↕ |
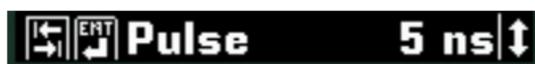
Pulse Width allows you to select the width of the pulse sent out on the circuit. The 900AST tester automatically chooses the best pulse width for each length selected. Note that you can change the pulse width independent of the length.

Use a shorter pulse width to give better resolution of events. A shorter pulse will not go as far on the circuit. Use a longer pulse to see farther on the conductor. Note that the resolution of a longer pulse will not be as good as a shorter pulse.

The pulse width is shown in the right-side box at the top of the TDR screen.

Gain

0dB, 6dB, 12dB, 18dB, 24dB

🔁🔲 **Gain**   **0 dB↕**

Gain allows you to control the size of the trace represented on the TDR. Higher gain will make events look taller on the screen and is helpful for finding small faults. The gain settings are referenced to dB levels, so +6dB is twice as much gain.

Move Cursor

Always place the cursor to the left side of an event to mark its location. Use the ← and → arrow keys to move the cursor across the screen. The distance from the 900AST tester to the cursor is always shown in the center of the distance bar. **The 900AST tester TDR function automatically compensates for the length of the special TDR test leads. Zero distance is at the very end of the test lead where it contacts the target circuit under test.**

The "Start" and "Stop" numbers shown in the distance bar are the distances represented at the left and right side of the screen.

If you move the cursor to the right side of the screen, the screen will "pan" to the right. If you move the cursor to the left side of the screen (and the start distance is greater than 0 feet), the screen will "pan" to the left.

If the cursor is moved to a position on the TDR trace that is out of viewing range (above the top of the screen or below the bottom), the trace is shifted up or down to bring it into view. The x-axis (horizontal) will not move. The vertical offset will be maintained until the cursor is moved to another point that is out of viewing range or until one of the display controls is changed.

Event Recognition

Events are the "dips" and "peaks" seen on the screen caused by faults or changes (such as an open circuit or short) on the conductor or pair.

Target Contact

The first peak or dip on the screen is usually the "target contact" which occurs at the point where the 900AST tester connects to the circuit under test. Since impedances of the different types of conductors vary significantly, the initial event caused by the 100-ohm TDR launch circuit contacting the target can usually be ignored. Remember that distance zero (0") begins at the end of the test leads for the TDR function.
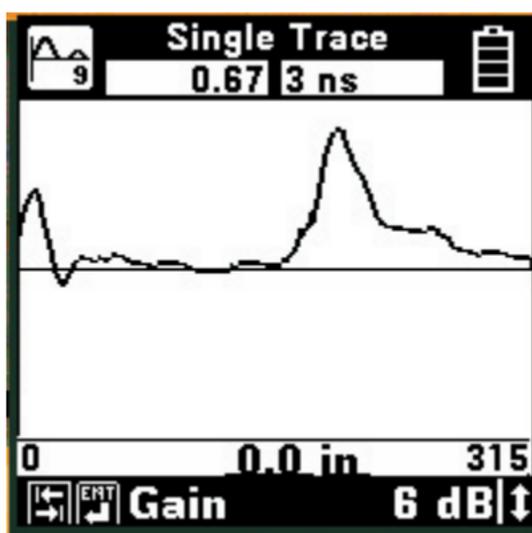
Open Circuit

Any open circuit will show up as a peak on the screen. A complete open will be the tallest peak you will see. You cannot see events past a complete open. A partial open circuit (caused by situations such as corroded or poorly crimped splices) will appear as a lower amplitude peak on the screen.
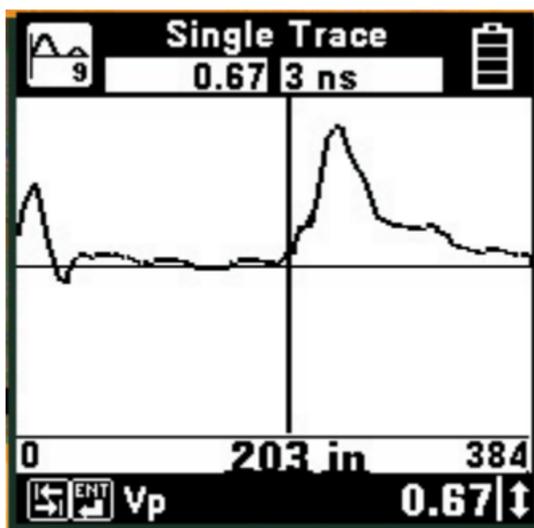
Short Circuit

A short circuit (or zero-Ohm resistance fault) will show up as the lowest dip on the screen. You cannot see events past a short circuit.

Resistance Fault
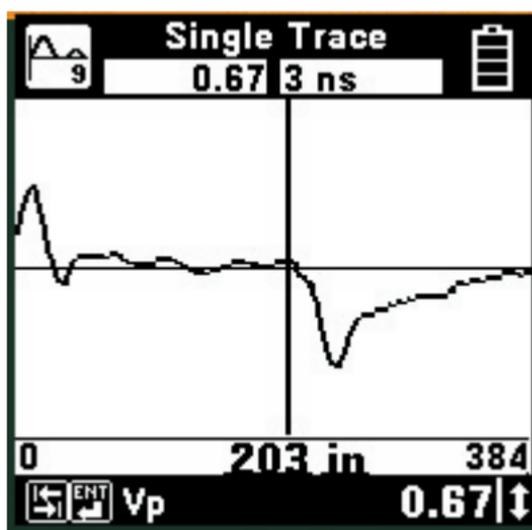
A resistance fault will show as a dip on screen. The lower the value of resistance (or the closer to a zero-ohm short), the lower the dip.

Bridge Tap

A bridge tap is a wire that has one or more wires branching off of the main wire. The beginning of the bridge tap will look like a resistance fault and an open. (A dip followed by a peak.) The distance between the two events is the length of the bridge tap. The start of a bridge tap looks like a resistance fault. Use the 900AST tester Resistance function to measure the resistance on the conductors. If there is no resistance, and you see a dip followed by a peak, you might suspect a bridge tap.

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TDR Save

Approximately 200 TDR screenshots can be saved. The percentage of remaining memory for results storage is shown in the box at the top of the "Save Results" screen. You can save only the active "Single Trace" TDR screen. First, select the TDR control parameters so the screen displays the trace as desired. Press the 🔲 key. The 900AST tester will display the Save Results screen as follows:

The date and time displayed is the 900AST tester "system clock." See the "Set Clock" section of this manual for further information on setting the clock and the format of the date and time.

Use the blue keys to enter an alphanumeric ID. The ID may have up to twelve digits. Because there are not enough keys for all twenty-six letters, each of the number keys (except "1") also functions as letter keys for ID entry. Whether a number or letter is entered depends on how many times the key is pressed. As an example, if the Ohms key is pressed once, the number "3" will be displayed. If the same key is pressed twice, the letter "d" will be displayed, three times for the letter "e" and four times for the letter "f". When the desired number or letter is displayed, press any other key to insert the next number or letter. This will cause the previously entered characters to move to the left making room for the new character. **If the same key needs to be used multiple times in a row (i.e. to enter the**

sequence 'ABC2'), press the $\left[\begin{smallmatrix}\text{Ins}\\\uparrow\end{smallmatrix}\right]$ arrow to insert multiple spaces to the left of the cursor. Use the $\left[\leftarrow\right]$ arrow to position the cursor under the first space and enter the first character, and then use the $\left[\rightarrow\right]$ arrow to move the cursor under the next space. Insert the next character and use the $\left[\rightarrow\right]$ cursor again to position the cursor to the next position. Continue entering numbers or letters in this manner until all have been entered. If you enter more than 12 characters, the first entered character will be discarded. To change or delete any of the characters that have been entered, use the $\left[\rightarrow\right]$ or $\left[\leftarrow\right]$ key to move the cursor under the letter to be changed or deleted. To delete the character, press the $\left[\begin{smallmatrix}\text{Del}\\\downarrow\end{smallmatrix}\right]$ key. To change the character, press the key of the new character once (for a number) or several times (for a letter). Once the ID has been entered, press the $\left[\begin{smallmatrix}\text{Enter}\\\leftarrow\end{smallmatrix}\right]$ key to save the current TDR trace information.

$\boxed{\begin{smallmatrix}\text{Auto}\\0\end{smallmatrix}}$ **Auto TDR**

Use the Auto TDR function to have the 900AST tester analyze and interpret a TDR trace.
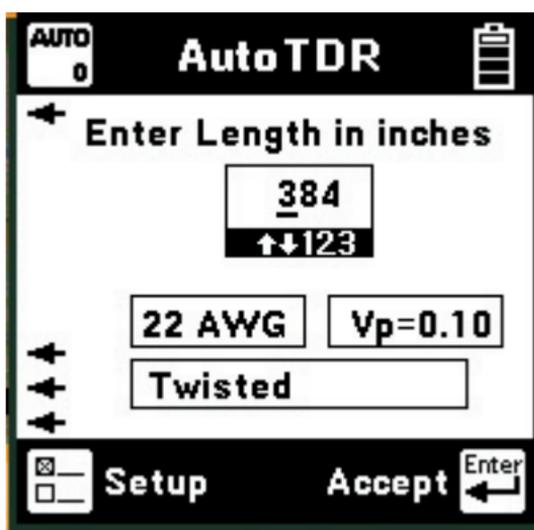
The Auto TDR function requires information about the circuit being analyzed. Use the $\left[\begin{smallmatrix}\text{Ins}\\\uparrow\end{smallmatrix}\right]$ and $\left[\begin{smallmatrix}\text{Del}\\\downarrow\end{smallmatrix}\right]$ keys and the Blue numeric keys to enter the length of cable to analyze. If you suspect a fault at a particular location, enter a value longer than the distance to the suspected fault in order to guarantee that the fault

will be captured on the trace. The currently selected wire type, gauge, and Vp are indicated. If you press the $\boxed{\text{Auto}}$ key while in TDR mode, the TDR wire parameters are imported into Auto TDR directly. To change these parameters, press the $\boxed{\text{紐-}}$ key to enter the Auto TDR Setup.
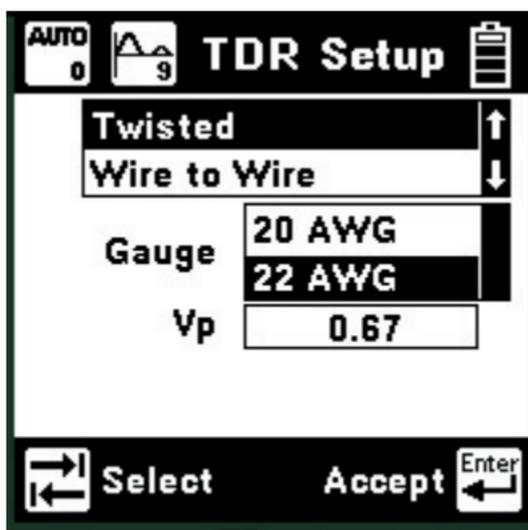
Press the $\boxed{\leftrightarrows}$ key to move between fields. Use the $\boxed{\text{Ins} \uparrow}$ and $\boxed{\text{Del} \downarrow}$ keys to select a choice within a parameter field.

Note: Vp is not an adjustable field in the Auto TDR Setup. To change the Vp of a given wire type, use the TDR Setup.

Use the $\boxed{\text{Enter}}$ key to accept any changes and return. Use the $\boxed{\curvearrowleft}$ key to return to the Auto TDR screen without making changes.

When the correct information is displayed on the Auto TDR screen, press the $\boxed{\text{Enter}}$ key to start the analysis. The 900AST performs DC parametric tests to determine if the conductor or cable is shorted, open circuited, or has a resistance fault.

Note: Resistance faults are very difficult to detect using TDR techniques. If a resistance fault is detected, the 900AST tester prompts you to consider using the RFL (Resistance Fault Locate) function as shown below.

If this screen is displayed, press the ⊞ key to go directly to the RFL function or the ⏎ key to continue with Auto TDR. Press the ⟲ key to exit the Auto TDR function.

The Auto TDR function completes a TDR trace for the selected length and analyzes the response.
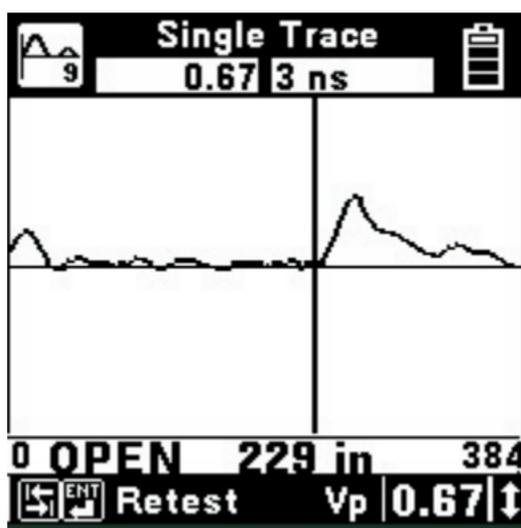
Note: Auto TDR operates from a captured trace. The trace is not 'live' as in the standard TDR mode. Changes made to the circuit after the Auto TDR analysis starts will not be detected or displayed. Vp can be adjusted while in this mode by using the ↑ and ↓ keys.

If the Auto TDR detects an open circuit, the cursor is positioned at the location of the open circuit and OPEN is displayed below the trace. If the Auto TDR detects a short circuit or low resistance fault, the cursor is positioned at the location of the short circuit and SHORT is displayed below the trace.

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If the most significant event is the target contact, the Auto TDR positions the cursor at the target contact point (zero distance) and displays OPEN or SHORT below the trace.
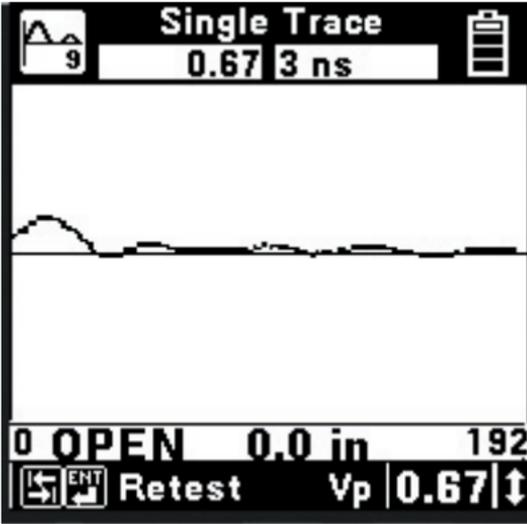
This usually means that there was no fault found in the selected length. If further analysis is needed, enter a longer length and retest.

If multiple events are detected, the Auto TDR places the cursor at the most significant event and attempts to classify it. Light cursor marks are placed at less significant event locations. In the example below, the Auto TDR correctly locates an open circuit at the end of the cable.
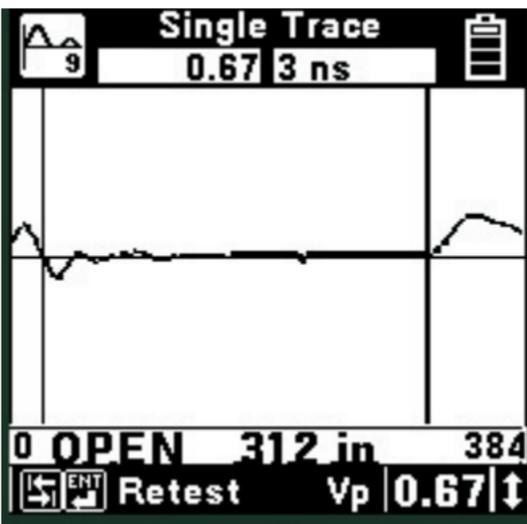
Press the ⇄ key to move the cursor to the other events detected.
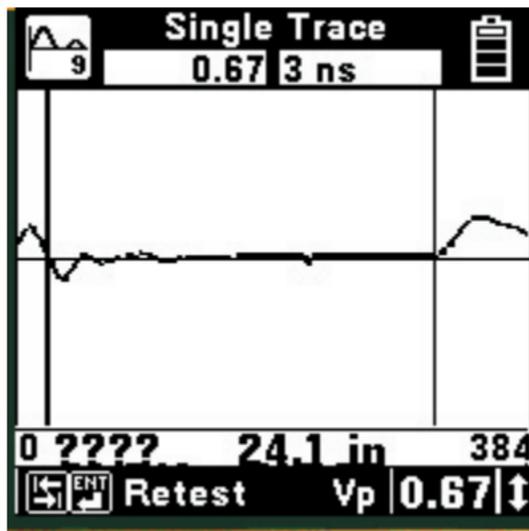
In this case the low impedance anomaly at 24 inches is detected but not classified. The Auto TDR displays **'????'** below the trace.

Care and Maintenance

Battery Holder

The plastic battery holder that comes with the 900AST tester uses six "AA" alkaline batteries. Typical lifetime of the alkaline battery pack is twenty hours of normal use (or less if you use the backlight frequently or work in very cold weather).

To change the batteries:

1) Loosen the six screws on the battery compartment door and remove the door.

2) Remove the battery pack from the unit and unplug the battery connector.

3) Install six fresh alkaline cells in the pack per the orientation embossed on the battery holder. **WARNING: Do not reverse any batteries or install improperly in pack.**

4) Reattach the battery holder plug and insert the battery holder in the compartment.

5) Replace the battery compartment door and retighten screws.

Caution: Batteries may explode, leak or catch fire if exposed to high temperatures or fire. Recycle or dispose of properly. To prevent injuries or burns, do not allow metal objects to contact or short circuit the battery terminals.

Level of Charge

The battery icon in the upper right of the display indicates the battery charge. Four black bars in the icon indicate full charge. Zero black bars indicate the battery pack is very low and the batteries should be changed.

IR Port

The IR Port on the top of the 900AST tester is used for uploading TDR traces to a personal computer. A special IR adapter cable is available for interfacing with a laptop or PC. 3M provides a program (PC Link_900AST) for saving/viewing/printing files on a personal computer.

Test Leads

The 900AST tester comes with a Red/Black test lead pair, a Blue/Yellow test lead pair, a separate Green test lead, and a pair of special, coaxial TDR test cables.
The Red/Black and Green test leads are used for most multimeter-type measurements. The Blue/Yellow lead pair is used for RFL and Contact Resistance. The coaxial test leads are used only for TDR. Keep the test leads clean and dry at all times to insure best accuracy of the measurements. Use soap and water to clean them if necessary.

Replacement Items

You may order any of the following replacement items from 3M. Contact 3M customer service at 800 426 8688 for more information.

Accessory	3M Part Number
Red/Black Test Lead	80-6113-1243-2
Blue/Yellow Test Lead	80-6113-1244-0
Green Test Lead	80-6113-1245-7
TDR Test Lead	80-6113-1242-4
Cable, BNC to 2MM Plug, 93 Ohm	80-6113-1240-8
Adapter, BNC to 20AWG	80-6113-1241-6
Carrying Case	80-6113-1238-2
Holder, Alkaline Battery	80-6108-6472-2
PC IR Adapter (serial port)	80-6109-9197-0
PC IR Adapter (USB port)	80-6113-1480-0

3M™ Advanced Systems Tester 900AST Series

Repair

Many apparent failures with the 900AST tester can be corrected by simple procedures.

Symptom	Cause	Solution
Unit does not turn on	Discharged battery pack	Replace batteries
Screen goes blank	Battery voltage low	Replace batteries
Dark lines across screen	Battery voltage low	Replace batteries
Error messages	Battery voltage low	Replace batteries
Inaccurate results	Battery voltage low	Replace batteries
No results	Test lead broken Improper connections	Replace test lead See on-screen hookups
Resistance <999 MOhm with test leads open	Test leads dirty	Clean test leads
Error messages during Self-Calibration	Test leads not shorted properly when prompted Test leads broken	Check connections Check test leads

If the above solutions do not fix the problem, the 900AST tester may need repair.

Please make a note of the conditions when the failure occurred and record any error messages that may have appeared on the screen, then call 3M Repair Service at 800-426-8688 and select option 2 (in the US or Canada), or call your local 3M representative in other countries for further details on repair service.

Physical Specifications

Size:	4.6x10.3x3"
Weight:	4.0 lbs with batteries, test leads, and soft case
Operating Temp:	0 to 140°F
Storage Temp:	-40 to 165°F
Humidity:	0 to 95% non-condensing

Electrical Specifications

Function	Range	Accuracy
DC Voltage:	0 to 99.9 V	1% ± 0.5 V
	100 to 300 V	3%
AC Voltage:	0 to 99.9 V	1% ± 0.5 V
	100 to 250 V	3%
Ohms (resistance):	0 to 9999 Ω	1% ± 5 Ω
with foreign voltage	0 to 9999 Ω	1% ± 50 Ω
	10 K to 99.9 KΩ	1%
	100 KΩ to 999 KΩ	3%
	1 M to 9.9 MΩ	3%
	10 M to 99 MΩ	5%
	100 M to 990 MΩ	10%
Contact Resistance:	0 to 5 Ω	0.1%±/- 0.01 Ω
Special Resistance:	0 to 25 Ω	1% of Loop Resistance ± 0.01 Ω
Capacitance:	10 nF to 9.9 uF	10%
ID Tone:	200 to 1000 Hz fixed level interrupted	± 1 Hz
RFL:		
Fault range:	0 to 5 MΩ (0 to 500 KΩ for specified accuracy)	
Resistance to fault:	0 to 15 Ω	0.1% of RTS +/- 0.01 Ω
TDR:		
Pulse Width:	3 ns, 5 ns, 34 ns	fixed values
Ranges:	192", 384", 624", 1320", 2640", 3840", 5760", 15360"	2% of range
Velocity of Propagation:	0.10 to 0.99	----
Modes:	Single, Dual, Differential,Crosstalk, Memory, Peak	----

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