



Time Domain Reflectometer

User's Guide



We set the standards.

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CSI Doc No. 101013-001 Rev. A

Warranty

ComSonics, Inc. warrants this product to be free of material and workmanship defects for a period of one (1) year from the original date of shipment.

Remedies provided under Warranty are exclusive and in lieu of all other warranties express or implied. The liability to ComSonics is limited to product repair or replacement at the discretion of ComSonics. ComSonics shall not be held liable for any incidental or consequential damages.

The following are not covered by this warranty:

- 1) Parts or components not supplied by ComSonics, or parts or components that have been modified.
- 2) Any product or part failure that results from accident, abuse, misuse, neglect, or unauthorized repairs or modifications by individuals other than ComSonics personnel.
- 3) Failures caused by use of this product in extreme climates or moisture conditions.
- 4) Batteries and Battery Packs.

Technical Support

ComSonics maintains a Technical Support Service for customer convenience. Should the need arise, a Technical Support Representative can be reached by Phone (1-800-336-9681, 1-540-434-5965), Fax (1-540-432-9794), or Email (tech-support@comsonics.com).

Return Information

Products returned for repair, calibration, etc., must be safely packed. Please enclose information on the reason for return. Ship the material prepaid.

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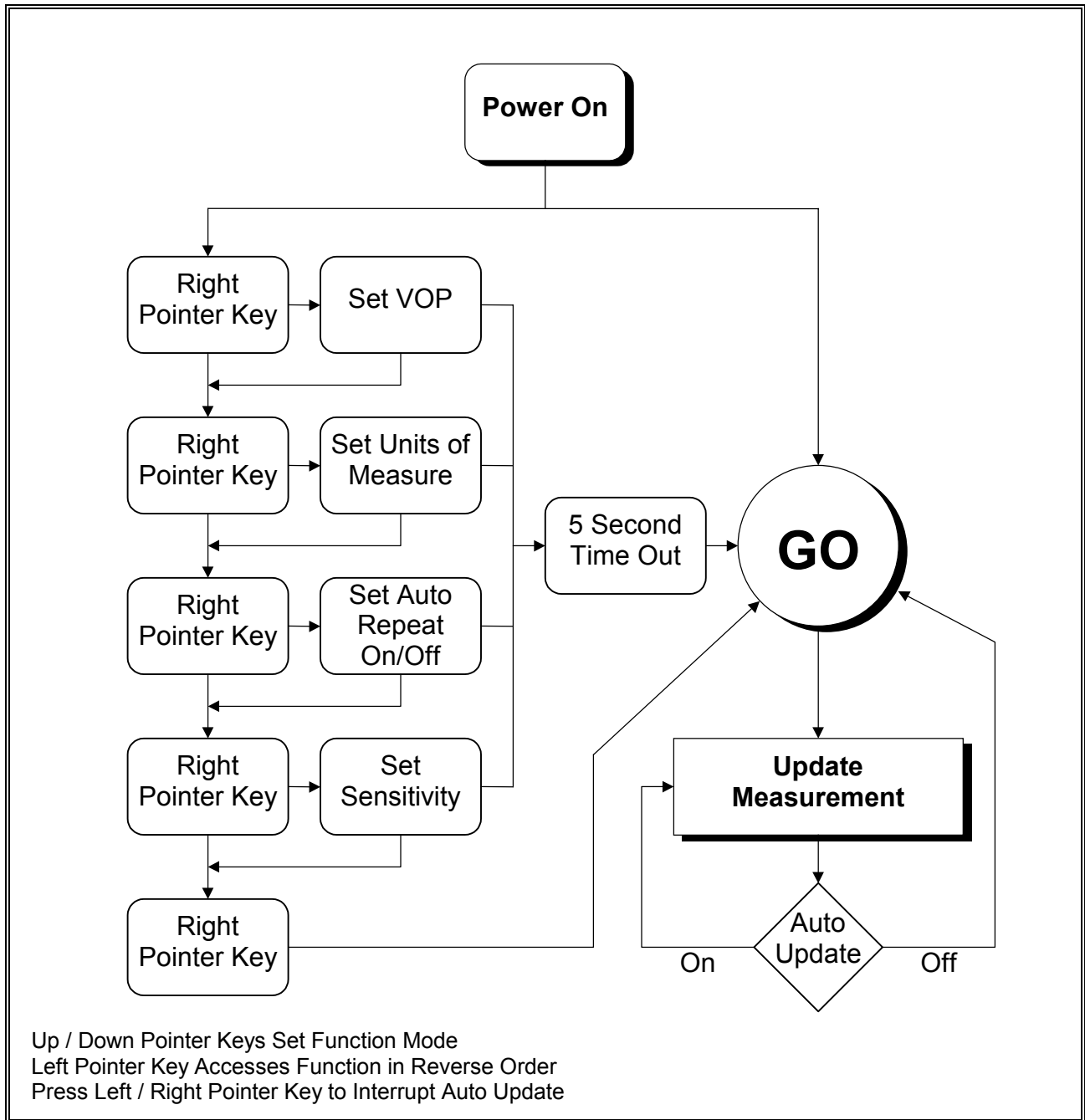
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Operations Navigator

TDR Tech

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Specifications

<i>typical distance</i>	10 to 2000 feet (3 to 600 meters); maximum usable distance dependent upon cable type
<i>accuracy</i>	$\pm 1\%$ or ± 3 feet (± 1 meter) whichever is greater
<i>significant fault</i>	electrical short circuit (0 ohms) or electrical open circuit (infinite ohms)
<i>no-fault condition</i>	more than 50% or less than 200% of nominal impedance
<i>resolution</i>	1 foot / 0.1 meter
<i>auto sensitivity mode</i>	normal mode for significant fault location
<i>manual sensitivity mode</i>	settings 1 through 4, allow experienced user to identify non-short circuit and non-open circuit faults
<i>units of measure</i>	feet or meters
<i>VOP range</i>	50% to 99%, in 1% increments
<i>display</i>	LCD, custom
<i>backlight</i>	key press On/Off, auto time-out
<i>user interface</i>	membrane keypad
<i>size</i>	7.7" high x 3.5" wide x 2.3" deep (195.6 x 88.9 x 58.4 mm)
<i>weight</i>	1 pound, 1 oz (.48kg.)
<i>operating temperature</i>	0°F ~ 120°F (-18°C ~ 49°C)
<i>storage temperature</i>	-20°F ~ 150°F (-29°C ~ 66°C)
<i>humidity</i>	weather resistant (withstands total immersion into 1 foot of water for 30 minutes without intrusion)
<i>shock and vibration</i>	withstand a 4 foot drop to hard surface
<i>power</i>	rechargeable battery pack, NiMH auto power down

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1 Introducing the TDR Tech

The TDR Tech Time Domain Reflectometer detects the presence of shorts, opens, and 'major' impedance variations in metallic coaxial signal cables.

The TDR Tech is a compact, self-contained, hand held instrument featuring:

- Simple operation
- Direct readout of distance
- Compact 7" x 3.5" x 2" size
- Rechargeable NiMH battery pack, wall charger included
- Ring for lanyard
- Easy to change standard F type input connector
- Optional BNC type input connector
- Optional Soft Case

To use the TDR Tech, simply power it on and connect the input to the cable to be tested. The screen displays the current VOP (velocity of propagation) setting. Setup functions are provided for the user to set the following test conditions.

- ◇ Velocity of propagation for cable to be tested
- ◇ Feet or meters for the distance display
- ◇ Manual or auto-repeat update mode
- ◇ Sensitivity level

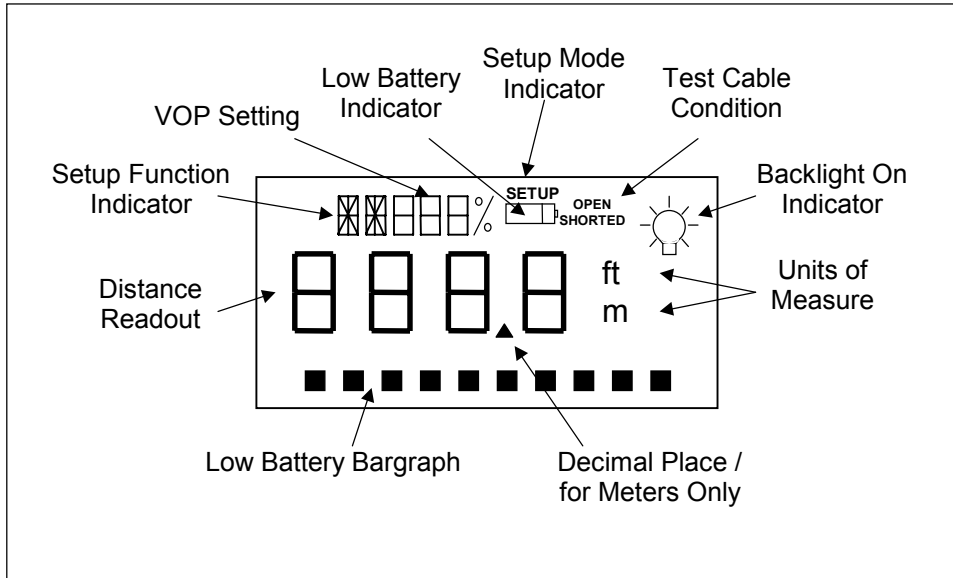
When all settings are correct, press the **GO** key to start a measurement. Auto-update mode does not require the **GO** key to be pressed to start measurements.

TDR Tech functions by sending a high-speed electromagnetic pulse down the connected end of the cable and then detects for reflected energy, if any, from the other end of the cable. Pressing the **GO** key sends the pulse in manual update mode. In auto-update mode, the TDR Tech continually repeats the cycle of sending a test pulse, detecting for reflected energy, and displaying the results. If no fault is detected, **OK** is displayed with four bold dashes in the center of the screen. A distance measurement is displayed with **OPEN** if the cable has an unterminated end or **SHORT** if the cable has a short circuit. The TDR Tech can also detect if the cable is powered, displaying **POC** (power on cable) in the upper left of the screen. Remove power from the cable before continuing the test.

By combining ruggedness for field use with simplicity of operation, the TDR Tech provides fast, accurate cable fault detection technology.

1.1 TDR Tech Display

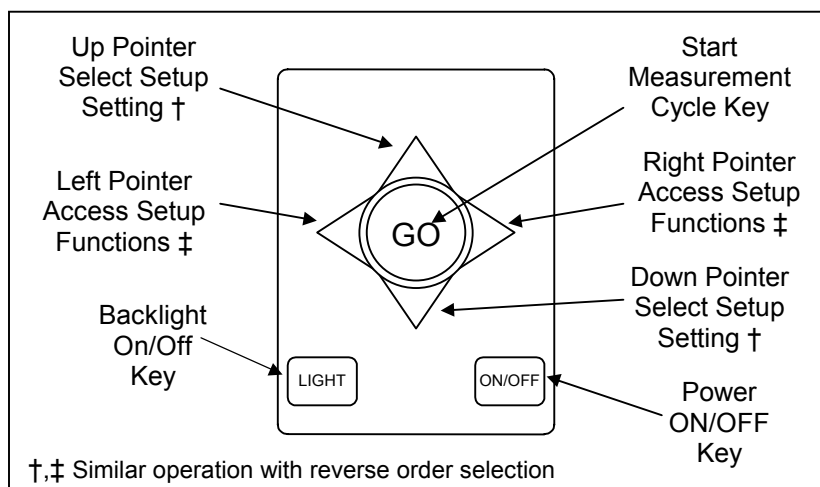
The TDR Tech utilizes a liquid crystal display (LCD), with backlight, containing characters and symbols labeled in the diagram below.



The above diagram is for user reference, as all elements shown are not simultaneously visible.

1.2 TDR Tech Keypad

The TDR Tech keypad is simple to use, with test session setup needing less than five keys and measurement updates with only one key press (in manual update mode).



1.3 Calibration

Each TDR Tech is carefully characterized at the factory before shipment. Internal circuitry aging and normal field handling may cause slight inaccuracies to occur. To confirm original accuracy we recommend that each unit be returned to the factory or to a factory authorized calibration facility at intervals not to exceed one year.

It is advisable to keep the original shipping container for use when returning the unit for annual recalibration.

1.4 About VOP and Measurements

The velocity of propagation (VOP) is the speed a signal travels through a cable relative to the speed of light in a vacuum. Practical cable designs have a VOP between 0.60 and 0.95. Signals travel slower through a 0.60 VOP cable than a 0.95 VOP cable.

The TDR measures the time difference between the transmitted pulse and the reflected pulse, applies a VOP factor and displays a distance reading. The VOP setting must be correct for the TDR to properly calculate distance. Refer to the cable manufacturers' VOP specifications for the setting to use.

Similar cable types may have different VOP specifications and batches of the same cable type may have a slightly different VOP. To be certain of a cable's VOP, measure out a length of at least 100 feet and test with the TDR, adjusting the VOP setting until the display is equal to the measured length. Also the TDR may display slightly different readings if the cable is rolled up or laid out straight. Be sure to test the cable from both ends, as inconsistencies throughout the cable can cause readings to be different.

The TDR can not detect a fault within ten feet of its end of the cable. To measure faults that are less than ten feet from the TDR, add a twenty-foot length of cable between the TDR and the cable under test. The added length of cable should have a VOP similar to the cable under test. Be sure to consider the length of the added cable in any fault readings.

2 Setup and Measurements

2.1 Making a Measurement

Before starting a new test session with the TDR Tech follow these steps:

1. Power on unit (hold the ON key until unit emits a 'beep' sound, about two seconds).
2. Set velocity of propagation (VOP) for test cable: range 50 to 99%.
3. Set units of measure: feet (f) or meters (m).
4. Set reading updates for: manual or auto-repeat.
5. Set sensitivity for: auto or manual setting 1, 2, 3, or 4.
6. Connect cable to be tested.
7. Press GO key, if set for manual reading updates.
8. Observe the measurement results.

STEP 1
Power On

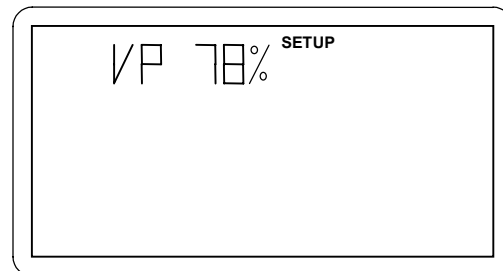
Press the ON/OFF key (hold for two seconds). If all function settings are known to be proper for the cable to be tested, go to Step 6.



Press for two seconds to power on.

STEP 2
Set VOP

Press the right pointer key to access the VOP mode. SETUP and VP will illuminate on the display. Within five (5) seconds, press the up pointer key to increase or the down pointer key to decrease the VOP setting for the cable to be tested.

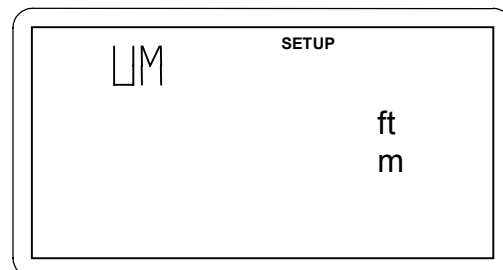


VP - velocity of propagation

Note: All setup modes will time out in five (5) seconds.
Setup selections are 'remembered' and do not require setup for each use.

STEP 3
Set Units of Measure

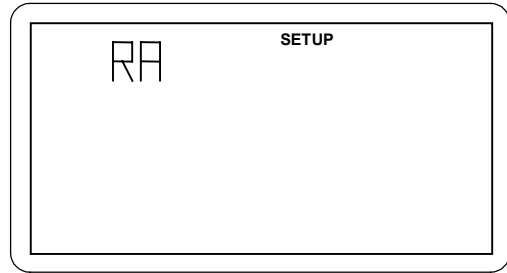
Press the right pointer key (press it twice if the unit has timed out) to access the units of measure mode. SETUP and UM or UF will illuminate on the display. Within five (5) seconds, press the up or the down pointer key to cycle through the feet or meters selection.



UM units of measure in meters
UF units of measure in feet

STEP 4
Set Manual or
Automatic
Update

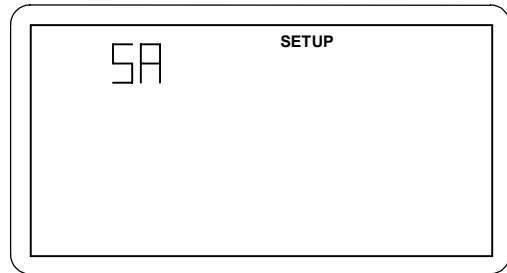
Press the right pointer key (press it three times if the unit has timed out) to access the readings mode. **SETUP** and **RM** or **RA** will illuminate on the display. Within five (5) seconds, press the up or the down pointer key to cycle through the readings-manual or readings-automatic selection. Manual requires the user to press the **GO** key for each reading and automatic continuously updates the reading.



RM - reading manually updated by pressing the GO key.
RA - reading automatically updated

STEP 5
Set Sensitivity

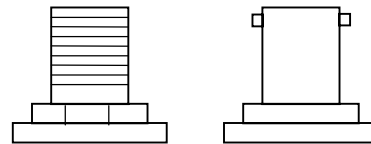
Press the right pointer key (press it four times if the unit has timed out) to access the sensitivity mode. **SETUP** and **SA**, **SM1**, **SM2**, **SM3**, or **SM4** will illuminate on the display. Within five (5) seconds, press the up or the down pointer key to cycle through the sensitivity selections. **SA** is automatic and readings will be reported with an **OPEN**, **SHORTED**, or **OK** message on the display.



SA automatic sensitivity mode
SM1 manual sensitivity setting one
SM2 manual sensitivity setting two
SM3 manual sensitivity setting three
SM4 manual sensitivity setting four
See Section 2.2 on using the manual sensitivity settings.

STEP 6
Connect Test
Cable

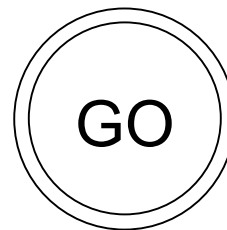
Install a connector on the cable to be tested. Connect to TDR Tech input connector. For best results, make sure the far end of the cable is open, disconnected from all equipment.



F connector standard / BNC optional

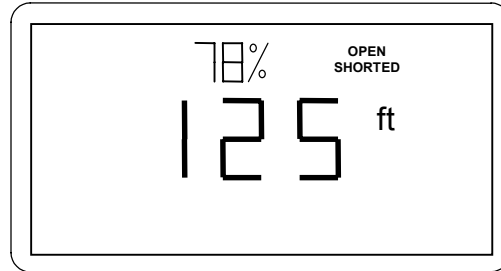
STEP 7
Start
Measurement

Press the **GO** key to initiate a measurement. Small segments will cycle across the display during the measurement time. The fault distance reading is displayed until the **GO** key is pressed again. If auto-update **RA** was selected, step 7 is not necessary.

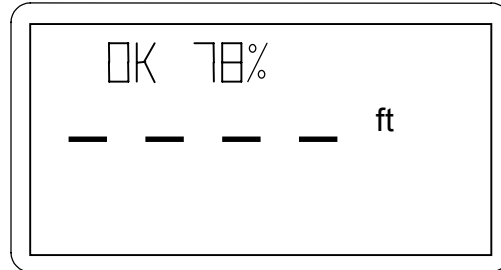


STEP 8
Reading
Displayed

The fault distance reading is displayed in the measurement units selected. The fault condition detected is displayed as OPEN or SHORTED.



If no fault was detected, OK is displayed.



2.2 Using the Sensitivity Selections

The automatic sensitivity mode SA is designed for the basic application of a TDR, measuring an unknown length of cable. For testing, it is best to have the cable electrically open at the far end but the cable may be manually shorted for identification purposes. Open and short conditions provide the TDR with the strongest reflected signals and more accurate results. In either case, the TDR is measuring for a simple open or short condition. A condition falling between open and short will most likely be reported as OK. Use the automatic mode for basic tests, such as, testing rolls of new cable.

An improperly terminated or damaged cable will reflect less signal level back to a TDR than a completely open or shorted cable. A properly terminated cable in good condition will reflect no signal level back to a TDR.

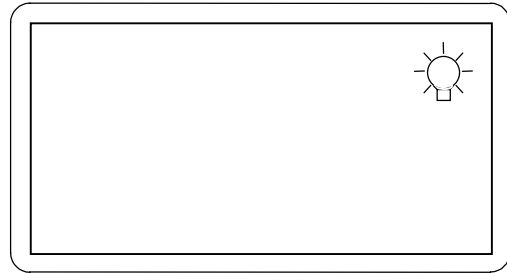
A damaged cable or bad splice (not completely open or shorted) can be diagnosed utilizing the manual sensitivity selections to fine tune the TDR's discrimination of open / short / OK conditions. Manual sensitivity selections are SM1 through SM4, with SM4 the most sensitive setting. In the manual mode, an open or a short indication does not necessarily mean a completely open or shorted condition. It just indicates the impedance at the fault is higher or lower than the nominal impedance of the cable.

Start with the sensitivity set to SM1 and the far end of the cable open. The distance reading should be the full cable length with an OPEN indication. Next set the sensitivity to SM2 and note the reading. A measurement of less than full distance with either a shorted or open condition indicates the position of the fault. If the reading with the sensitivity set to SM2 was the full cable length, then change the setting to SM3 and retest. If the reading is still the full length, set the sensitivity to SM4 and retest.

3 Miscellaneous

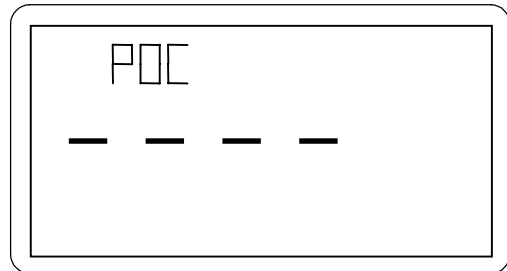
3.1 Other Keys

Light Key Press the LIGHT key to illuminate the display. A light bulb symbol appears on the upper right of the display. The backlight operation is automatically suspended after 10 seconds. Press any key to re-activate the backlight. Press the LIGHT key while the light bulb symbol is visible to turn off the backlight.

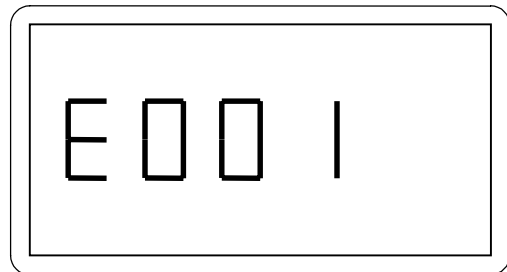


3.2 Messages

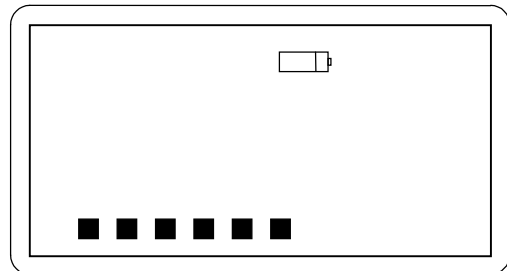
POC The TDR Tech will display POC (power on cable) when a test cable carrying power is connected to it. No measurements will be made until the power is removed from the test cable.



E___ An internal error or fault condition will be reported on the display by an E followed by a code. The TDR Tech must be returned to the factory if this message appears.



Low Battery A battery symbol appears on the screen when battery level is low. The bargraph at bottom of the screen monitors the remaining life of the battery. The TDR Tech will power off when the battery level becomes too low.



3.3 Battery Charging

The hand held TDR Tech model is powered by a nickel-metal hydride battery pack and requires periodic charging to maintain performance. The best time to charge the unit is just after the battery symbol appears. Otherwise, charge the battery prior to expected usage schedules, especially when extended use is expected.

The factory supplied charger will fully charge a low condition battery pack in approximately sixteen (16) hours. The required charge period may vary somewhat with power line and environmental conditions.

The charger's contact end consists of a plastic housing, with flanges on both sides, and two spring-loaded prongs. It fits into the slot on the bottom edge of the TDR Tech, which has contacts corresponding to the charger prongs.

To engage the contacts properly, hold the TDR Tech keypad side up, place the charger connector so the flanges fit into the corresponding grooves in the TDR Tech case, and push the charger connector into place. When the connector is completely inserted, the prongs will be in contact with TDR Tech's points. Power the charger to begin charging the battery.

3.4 Battery Replacement

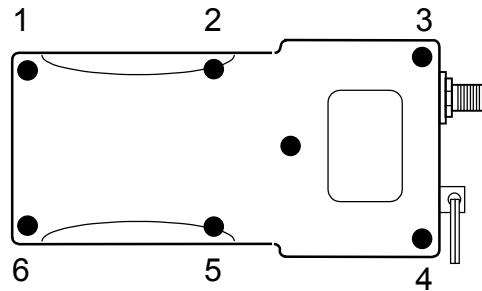
The efficiency of a rechargeable battery decreases with use and age. Eventually the battery pack in the TDR Tech will need to be replaced. Care must be taken when replacing the battery to maintain the waterproof seal. The following procedures are provided for proper battery pack replacement.

1. Place the TDR Tech on a static controlled work surface with the keypad side down.
2. Remove six (6) Phillips head screws from the corners and sides of the case back.
3. Hold the front and back parts of the case together and place the unit with the keypad side up.
4. Gently lift the front of the case and place to one side. The battery is mounted to the case back by a metal bar.
5. Note the routing of the battery harness and any padding material. Remove the screws holding the metal bar over the battery and remove the bar.
6. Unplug the battery's two-pin Methode connector and remove the battery. Discard properly.
7. Place the new battery in position and connect its two-pin Methode connector. **Be sure to insert the connector properly; the connector should not have to be forced on.**
8. Route the battery harness as noted, place any padding needed, and install the metal bar over the battery.

9. Place and align the case front over the case back. Make sure none of the internal cables are pinched between the rubber pads and the TDR Tech's internal parts.
10. Hold the front and back parts of the case together and place the unit with the keypad side down.
11. Replace the case screws and tighten as described below.

To Close the Unit:

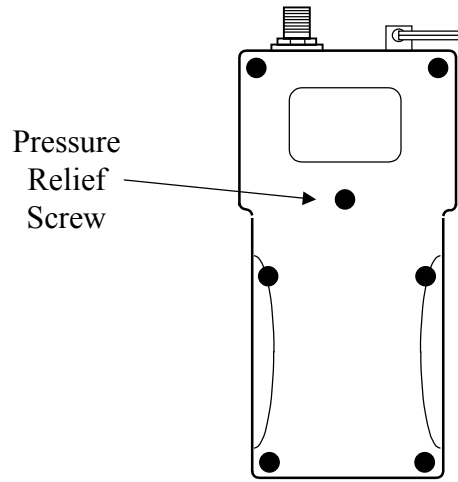
1. Loosely reinstall the screws. Tighten to 2 inch pounds in this order; 2, 3, 4, 1, 6.
2. Once all screws are in place, tighten them to a final torque of 4 inch pounds in 3, 4, 2, 5, 1, 6 order.
3. Take care NOT to pinch the battery harness.



3.5 Pressure Relief Port

The TDR Tech case is sealed against water. Because of this seal, taking the TDR Tech to extremes of air pressure (e.g., from sea level to a very high elevation) may cause air pockets within the keypad. To alleviate this, the case is fitted with a pressure relief port: a Phillips screw directly below the label on the case back.

Loosen the screw a few turns and wait five minutes for the air pressure within the unit to equalize. Then re-tighten the screw.



!! Forgetting to tighten the screw will reduce the effectiveness of the water seal. !!

3.6 European Community Declaration of Compliance



Manufacturer: ComSonics, Inc.
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Tel. # 540-434-5965

Product: TDR Tech

Models: 100921-001

ComSonics, Inc. of Harrisonburg, Virginia, USA, hereby declares that the above-referenced product, to which this declaration relates, is in conformity with the provisions of:

Council Directive 89/336/EEC (May 3, 1989), on Electromagnetic Compatibility, as amended by Council Directive 92/31/EEC (April 28, 1992), and

Council Directive 73/23/EEC (February 19, 1973), on Low Voltage.

The Technical File required by these directives, including the original of this Declaration of Conformity, are maintained at the corporate headquarters of ComSonics, Inc. (as listed above) and within the European Community at ComTec Cable Accessories, Ltd., Over Industrial Park, Over, Cambridge CB4 5QE, United Kingdom.

