AVTMTDR3090
Rev 2
Dec 2012

INSTRUCTION MANUAL
Digital Time Domain Reflectometer

Models
T3090, T3090 SX, T3090 T & T3090 SXT

CE

HIGH VOLTAGE EQUIPMENT
Read this entire manual before operating.

M

Valley Forge Corporate Center
2621 Van Buren Avenue
Norristown, PA 19403-2329
U.S.A.

610-676-8500

www.megger.com

INSTRUCTION MANUAL
Digital Time Domain Reflectometer

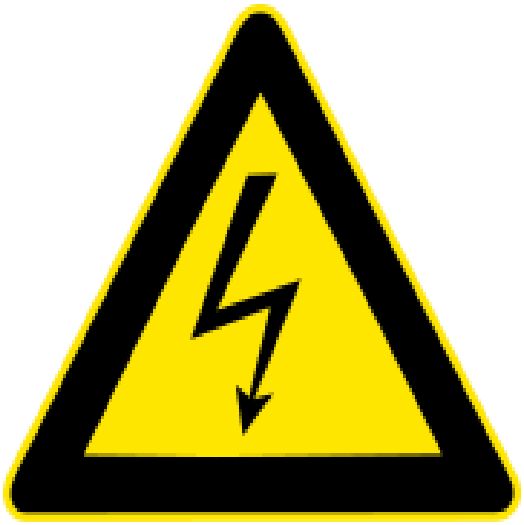
Models
T3090, T3090 SX, T3090 T & T3090 SXT

The information presented in this manual is believed to be adequate for the intended use of the product. The products described herein should not be used for purposes other than as specified herein. Specifications are subject to change without notice.

WARRANTY

Products supplied by Megger are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned for repair must be shipped prepaid and insured. Contact your local MEGGER representative for instructions and a return authorization (RA) number. Please indicate all pertinent information, including problem symptoms. Also specify the serial number and the catalog number of the unit. This warranty does not include batteries, lamps or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.

Local Megger Offices		
Australia	**Canada**	**France**
Megger Pty Limited Unit 1, 11-21 Underwood Road Homebush NSW 2140 T: +61 (0)2 9397 5900 F:+61 (0)2 9397 5911	110 Milner Avenue Unit 1 Scarborough Ontario M1S 3R2 Canada T: 1 416 298 6770 F: 416 298 0848	23 rue Eugène Henaff ZA du Buisson de la Couldre 78190 TRAPPES T: 01 30 16 08 90 F: 01 34 61 23 77
Germany	**India**	**Kingdom of Bahrain**
SebaKMT/Megger Germany Dr. Herbert-Iann Str. 6 96148 Baunach, Germany T: +49 (0)9544-680 F: +49 900 9544 2273 sales@sebakmt.com www.sebakmt.com	Megger (India) Pvt Limited 501 Crystal Paradise Mall Off. Veera Desai Road Andheri (W) Mumbai 400053 T: +91 22 26740468 F: +91 22 26740465	P.O. Box 15777 Office 81, Building 298 Road 3306, Block 333 Manama Kingdom of Bahrain. T: +973 177 40 620 F: + 973 177 20 975 mesales@megger.com
Kingdom of Saudi Arabia	**South Africa**	**Sweden**
PO Box 1168 Khobar 31952 T: +966 3889 4407 F: +966 3889 4077 mesales@megger.com	PO Box 22300 Glen Ashley 4022 Durban South Africa T: +27 (031) 5646578 F:+27 (031) 5637990	Megger Sweden AB Eldarvägen 4 Box 2970 SE-187 29 TÄBY SWEDEN T: +46 8 510 195 00 F: +46 8 510 195 95
Switzerland	**United Kingdom (Dover)**	
Megger Schweiz AG Ob. Haselweg 630 5727 Oberkulm Aargau T: +41 62 768 20 30 F: +41 62 768 20 33	Megger Limited Archcliffe Road Dover CT17 9EN T: 01304 502101 F: 01304 207342	
United States (Dallas)	**United States (Valley Forge)**	**United States (College Station)**
4271 Bronze Way, Dallas, Texas 75237-1019 USA T: 1-800-723-2861 F: 1-214-331-7399	Valley Forge Corporate Centre 2621 Van Buren Avenue Norristown, PA 19403 USA T: 610 676 8500 F: 610-676-8610	4064 State Highway 6 South College Station, TX 77845 USA T: 979-690-7925 F: 979-690-0276



Safety

Voltages of greater than 50 V applied across dry unbroken human skin are capable of producing heart fibrillation if they produce electric currents in body tissues which happen to pass through the chest area.[citation needed] The electrocution danger is mostly determined by the low conductivity of dry human skin. If skin is wet, or if there are wounds, or if the voltage is applied to electrodes which penetrate the skin, then even voltage sources below 40 V can be lethal if contacted. Additionally research has shown that where the skin has been compromised, very small voltage of up to 3V can kill.

Accidental contact with high voltage supplying sufficient energy will usually result in severe injury or death. This can occur as a person's body provides a path for current flow causing tissue damage and heart failure. Other injuries can include burns from the arc generated by the accidental contact. These can be especially dangerous if the victim's airways are affected. Injuries may also be suffered as a result of the physical forces exerted as people may fall from height or be thrown a considerable distance.

M

Table of Contents

INTRODUCTION

The Digital Time Domain Reflectometer T 3090 is a very compact, portable TDR for fault locating on primary / secondary power cables. All essential components of the unit are mounted in a durable, compact, water protected, portable carrying case.

The unit will operate on AC voltage (90-240V / 50-60 Hz). The AC, Signal and Trigger cables are water protected and located on the backside of the unit.

UPON RECEIPT OF YOUR DELIVERY

Prior to operation, check for loosened hardware or damage incurred during transit. If these conditions are found, a safety hazard could exist, DO NOT attempt to operate equipment.

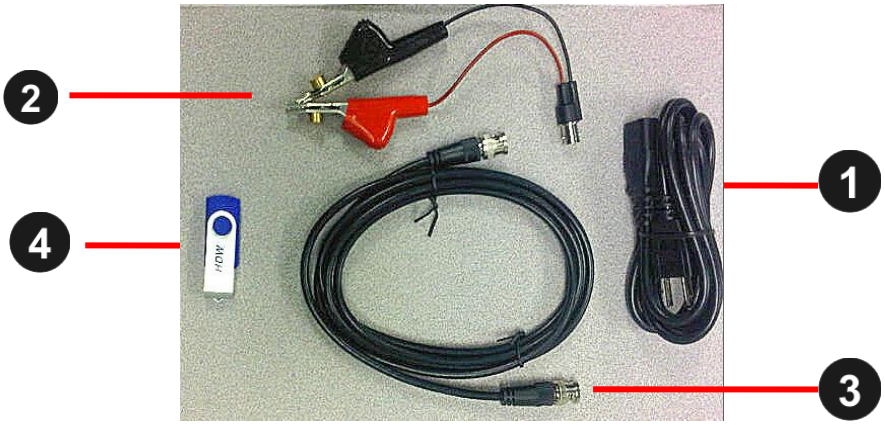
Please contact Megger as soon as possible.

Please check your delivery against:

a) your order
b) our advice note
c) the item delivered, and
d) the parts list

Any shortages must be reported immediately.

The T3090 TDR is shipped complete with the following accessories:



Element	Description
1	AC Power Cord
2	Alligator / BNC Splitter
3	Coax Extension Cable
4	USB Memory Stick
Not shown	2 Velcro strips to secure TDR enclosure to base

M

STANDARD MANUAL CONVENTIONS

This manual uses the following conventions:

Bold indicates emphasis or a heading.

NOTE: *is used to set off important information from the rest of the text.*

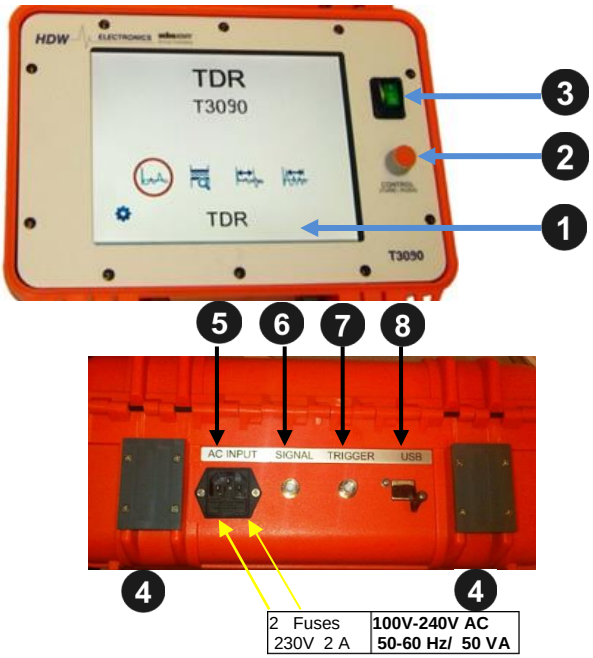
F **A WARNING symbol alerts you to a hazard that may result in equipment damage, personal injury, or death. Carefully read the instructions provided and follow all safety precautions.**

G **A CAUTION symbol alerts you that the system may not operate as expected if instructions are not followed.**

1

Getting to know your TDR

CONTROLS & CONNECTIONS



1. Display:
2. Rotary Knob – Control Knob (turn & click)
3. ON / OFF" button
4. Ventilation Slots
5. AC power connector
6. Signal Port
7. "Coax connectors for Trigger, ICE and TDR-Signal
8. USB Port

2

Getting Started

NOTE: Typically the TDR has been set-up in the factory for use with the specific fault locating system for **primary cables**, which it has been purchased for. There may be reasons why the user must go through this process again. MEGGER encourages user to call the factory in order to assist with this process, which can be done within 30 minutes.

Typical connections for primary fault locating applications:
Connect the AC power cord to the TDR and plug it into a 120/230VAC outlet provided by the fault locating system.

Typically the Signal and Trigger Cables form the fault locating system or the filter are connected to the respective BNC ports on the back side of the T3090 (if an internal trigger was ordered as an option, only the signal cable gets connected).

Typical connections for secondary fault locating applications:

Connect the AC Power cord to the TDR and plug it in a 120V /230V outlet or connect it to a 120V /230V "pigtail" and clip its lead between ***one*** hot leg and the neutral.

Take the Coax extension cable and connect one end to the signal port at the TDR and its other end to the alligator / BNC splitter.

NOTE: Do not connect TDR to hot primary or hot secondary cables!

Power ON / OFF

Push toggle switch **3** to turn unit on (light will come on).After the initial boot-up, the Main menu will appear. The unit has a wide voltage input power supply from 100-240VAC.

M

The Function of the Rotary Knob / Controller Knob

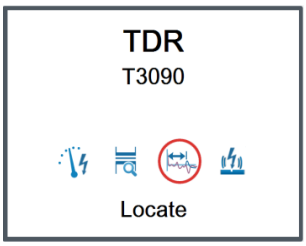
Control Knob **2***:* *"Turn" & "Click" & "Turn"*

***Turning* Control Knob**	Selects function.
***Clicking* Control Knob**	Activates Selected Function and puts a **red** circle around the icon.
Turning* Control Knob *in the activated state	Changes the numeric value of the activated function, if function allows.

Set-up of Default Parameters and Customer Selectable Parameters

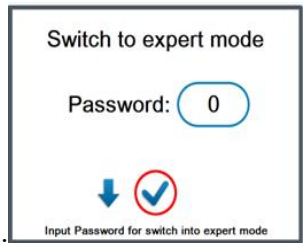
Please verify before its first use that theT3090 has been properly set up. In order to perform this task, the T3090 must be in the "Expert Style Menu" (see more details in Section 3 of the instruction manual regarding "Menu Style").

If the T3090 is in the EXPERT style menu , the**cog wheel** ⚙ symbol in the lower left corner of screen will be visible, if not go to EXPERT Style, pls see below



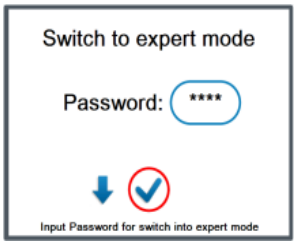
"Quick-Steps" Style Menu No "Cog Wheel ⚙ " symbol visible in the main screen

1. Push on any icon for a couple seconds to activate password screen, zero will show.

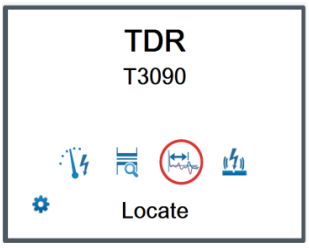


2. Click the rotary knob. Zero changes to *.

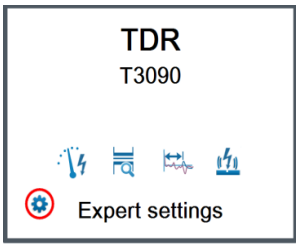
3. Click 3 more times. That will enter a total of 4 zeros = factory preset password. The "Cog Wheel ⚙ " symbol will be always visible in lower left corner of the main screen



NOTE:	*In the 'Expert Style Menu' the "Cog Wheel" is always in the lower left corner if the*



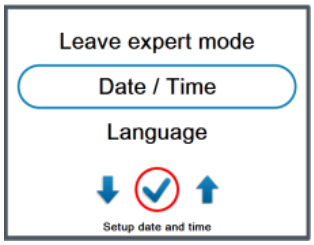
4. Turn the Rotary Knob and select the ⚙ symbol (now highlighted by a red circle). The "Expert Settings" are now available. Click on the Cog Wheel to access *Default* Setting. Turn rotary knob to *red circled* cog wheel.



5. Click on the "Cog Wheel". A drop down menu for the *Default* and customer selectable & accessible System Settings & Parameters becomes available

DATE /TIME

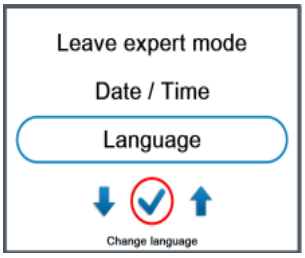
Click and turn the rotary knob, to the date and time settings. Click on Date/Time. Fill in the appropriate information



Important: the Auto Save feature saves **complete fault traces** by the *date* and *time* (complete means the combination of LV and HV trace when performing arc reflection or the HV trace when performing ICE).

LANGUAGE

Click on the Language icon and scroll through. Select the appropriate language. Then, click on the language of choice.



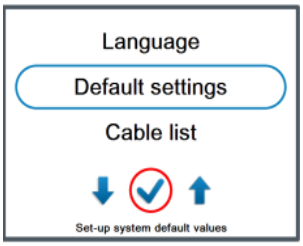
NOTE:	*When selecting the Thumper model for the STEP-by-STEP style menu of Operation, try to match the language to the one selected above if availbale.*

DEFAULT SETTINGS

The default settings ***define 5 or 6 parameters***, which must be set up in order for the TDR to function properly.

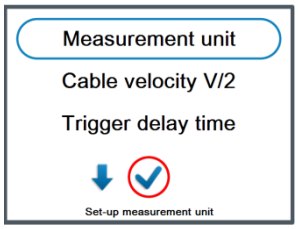
1. measurement unit (ft, m, time)
2. **cable velocity** (when ft, m in above setting, velocity will be v/2)
3. **trigger delay time** *
4. **measurement start**

5. **set-up start marker**

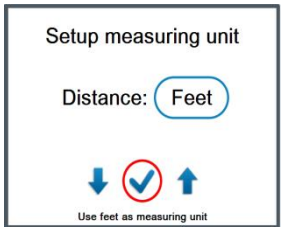


1. To setup the defualt settings, Click on the Select "Default settings" icon.

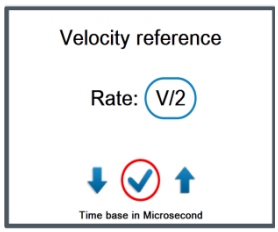
Measurement Unit



Select Measurement Unit.



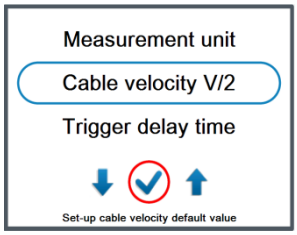
Select Feet or Meters.



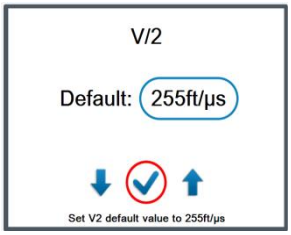
Select Rate.

How do you return to the default setting screen so the operator can select Cable Velocity?

Cable velocity V/2

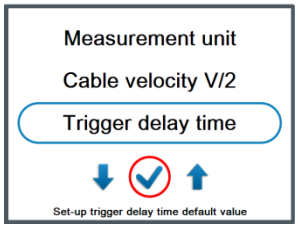


Select Cable velocity V/2.



Select the appropriate velocity. How do you return to the default setting screen so the operator can select Trigger Delay time

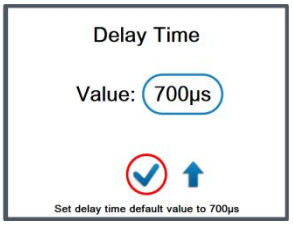
Trigger delay time



Delay time: the time between releasing the HV surge and the time to release the TDR pulse. The delay time allows the flash-over voltage to build up an arc before the measurement takes place. If the delay time is too short, Flash-over & resulting arc is not stable & TDR reflections may not be clear or nonexistent.

If the delay time is too long, the arc extinguishes before the TDR pulse reaches the fault, no reflection of the TDR pulse, no fault detected.

Trigger delay values: *SG15/25, SPG32 [700µsec] Units with M219 filter [1.3msec]*

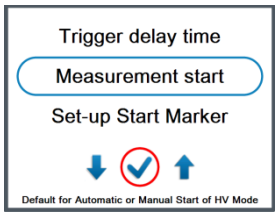


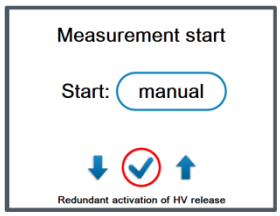
Select the appropriate delay time.

How do you return to the default setting screen so the operator can select Trigger Delay time

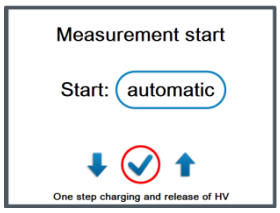
Measurement Start

Measurement start defines how a HV test is started, automatic or manual and relates to how the HV is released.





MANUAL means that after PUSH GREEN BUTTON for HV-O", the unit will go to a pre-set voltage, but ***will not*** release the shot unless the operator manually releases the shot individually.



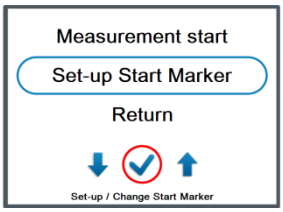
AUTOMATIC means that pushing "PUSH GREEN BUTTON for HV-ON" the unit will go to a preset voltage, and once reached, ***releases*** the shot without any additional intervention by the operator.

NOTE: AUTOMATIC is typical for North American Market.

How do you return to the default setting screen so the operator can select Trigger Delay time

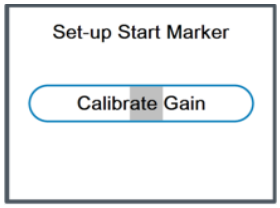
Set-up Start Marker

Set-up Start Marker positions the Start Marker at the end of the actual test lead and its physical end.

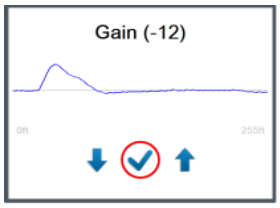


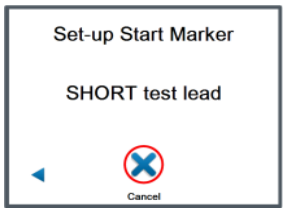
Select Set-up Start Marker.

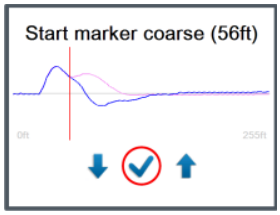
First: A TDR reflection measurement is taken with the ends of the HV test lead open. Press Knob to continue.



Then the gain setting is adjusted (typical -12) and confirmed and a copy of the trace is frozen.

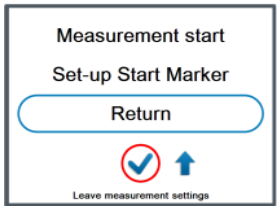






A second trace is recorded with the ends of the HV test lead shorted to each other, which will show a significant change.

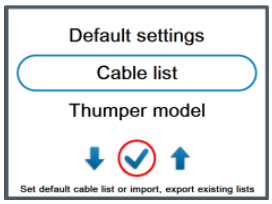
The marker is automatically placed on the position where both traces start to split.



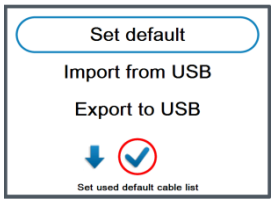
If required, the marker can be **manually adjusted.** This setting of the start marker will be stored after being prompted as the default and **should only be changed if the length of the test lead is changed.**

Cable list

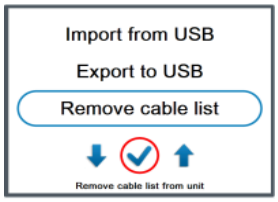
By means of the Cable list one can quickly set the appropriate propagation velocity during a reflection measurement by selecting the correct velocity form the list based on voltage class, insulation thickness & wire size:



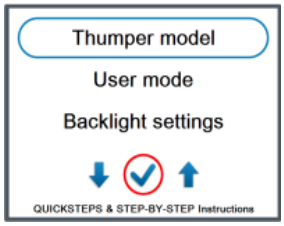
The Cable list can be set as the default list, exported or imported, or removed altogether. The cable list can be edited (Chapter 8) and imported (XML file) according to specific preferences and then shared among multiple units.

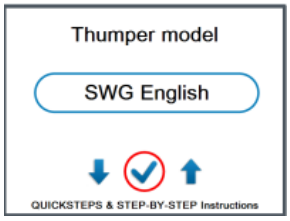


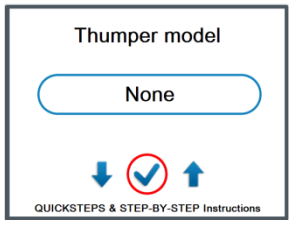
If a specific cable is not on the list, select the closest cable (in terms of XLPE, EPR, PILC voltage class and conductor size). However, if the cable is commonly used by a customer, its velocity should be determined and added to the cable list (see Chapter 8, Utility Menus, for details).

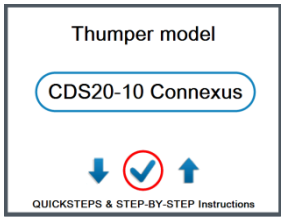


Thumper Model Selection & Effect on Step-by-Step Instructions









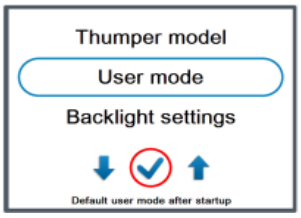
If the customer prefers to use the **Step-by-Step Style Menu** to operate a specific thumper system in combination with the T3090, he must select the specific thumper model from the drop down menu "Thumper Model" (in the example SWG).

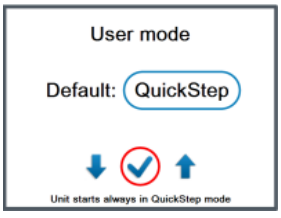
For all Megger thumper models the Step-by-Step Style menus have been generated, **at least** for Arc Reflection and Direct Thump Mode, for competitive thumper systems they can be generated together with the customer for a nominal fee (example CDS20-10 Connexus).

NOTE: If "NONE" is selected for the Thumper Model, the "Quick-Steps Style Menu" and the "EXPERT Style Menu" are available, but none of the Step-by-Step style menus are available!

User mode

User mode allows the operator to select the default style menu which is active after switching unit on (after start-up). It is recommended to set to QUICK STEPS.



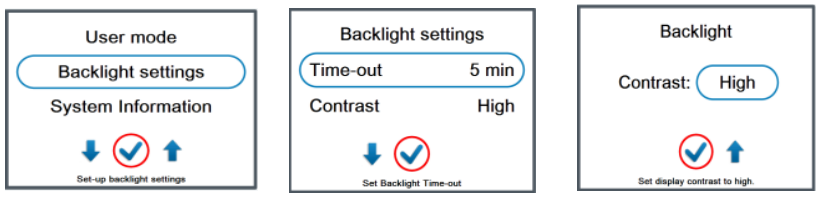


This will always make the QUICK STEPS Style & STEP-by-STEP Style menus available to the user without a password (Step-by-Step only if specific).

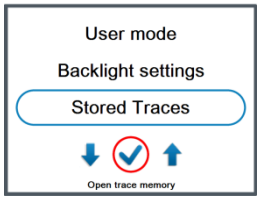
NOTE:	*If set to **Last**, the unit will start up in the style menu, which had been **active before** the last shut down; if this had been e.g. "Expert Style Menu", then the T3090 will start in the "Expert Style menu", enabling an user without the proven credentials as an expert user, to access and modify features in both the "Expert Style Menu" and the "Expert Settings", possibly effecting the proper operation of the T3090.*

Backlight settings

Both features are typically important **if the TDR is part of a battery operated system**; the **time out feature** displays the number of minutes of inactivity after which the system is automatically shut down. It is suggested to use the settings as shown.



Stored Traces

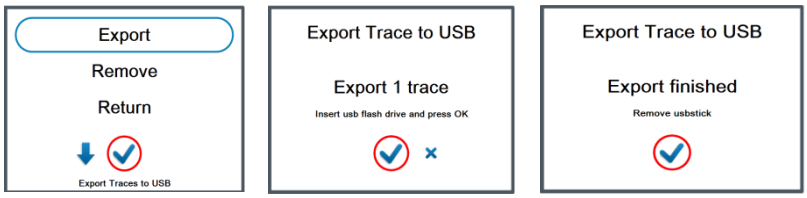


Stored Traces will either *Export or Remove* **ALL** traces which have been stored in the internal memory.

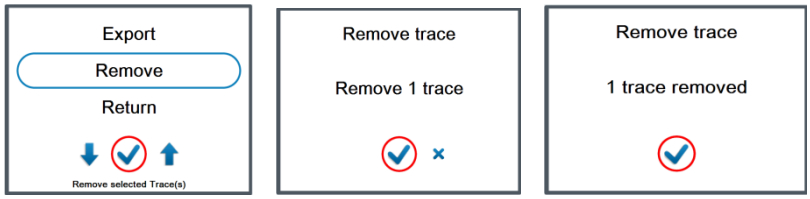
NOTE:	*The Stored Traces icon **only** shows up in the drop down menu **if at least 1 trace** has been stored.*

NOTE:	*The T3090 will automatically store each* complete set of fault traces = LV trace plus HV trace. *An **LV trace** can also be stored by itself if the **save trace** feature is used, which is described in the section **Customize TDR Features**.*

Exporting traces **requires a USB flash drive** plugged into the USB port 8. The traces are written into the **Etray Traces folder** which is automatically created. The data can be viewed in any regular web browser by opening the *index.html* file which is also located in the *Etray Traces* folder.

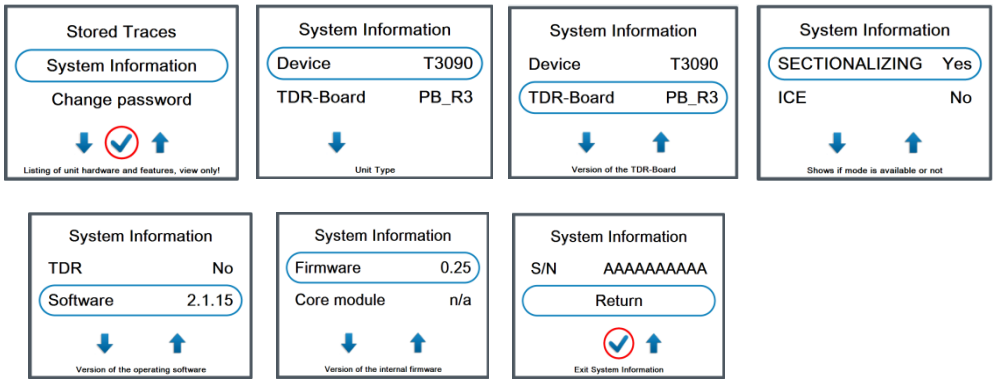


OR



SYSTEM INFORMATION

IMPORTANT: Displays the detailed hardware and software configuration, as well as the serial number of the unit. This is a **View Only** screen, which is based on the factory setting. All possible screens are shown below.



NOTE: *Sectionalizing will say YES or NO or COMED (COMED version) depending on what customer ordered.*

As mentioned above, all System Information screens are "view only"; they can be very helpful for the customer to determine the exact configuration of the TDR before calling the Help/Service Line for MEGGER / SebaKMT.

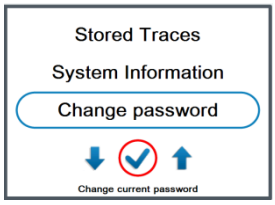
CHANGE PASSWORD

Access to **change** the password, is **required** to enter in the **Expert Style Menu** and the **Expert Settings**.

NOTE:	*Factory sets temporary Password as "0000"; if the password is changed by customer, it is recommended to keep a record of the new password.*

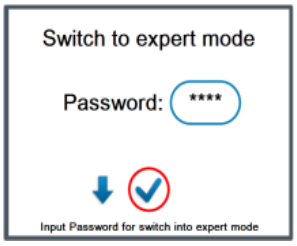
To change the password:

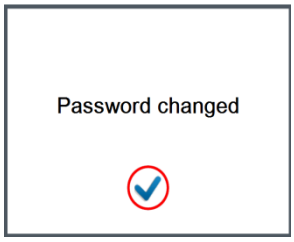
1. Select Change password.



2. Click the rotary knob. Zero changes to *.

3. Click 3 more times. That will enter a total of 4 zeros = factory preset password.





3

TDR Operation

Explanation of 3 style menus to operate TDR

The T3090 is the only TDR in the market to offer 3 “Menu Styles” for its operation to its user: "***QUICK STEPS***", "***EXPERT***" and ***"STEP-by-STEP"*** style menus of operation

"***QUICK STEPS***", and "***EXPERT***" style menus allow the user to custom configure the TDR feature as he / she sees them fit best the skill levels in their organization.

"STEP-by-STEP" style menu, is hard-scripted to emulate a conventional specific fault locating system, and therefore does not allow for any custom configuration of TDR features

"STEP-by-STEP" is typically intended for the "casual & inexperienced" operator, it provides all necessary steps in the operation of a specific fault locating system from connecting the tests leads, pre-locating, pin-pointing the fault, operating the Hipot or Burner.

NOTE:	*"STEP-by-STEP" can be easily recognized by its symbol of 2 side-by-side feet.*

The purpose of this "3 layer" approach is as follows: ***Show only*** what is ***absolutely necessary***.

"simple option / extended option" vs. “disabled option”:

If the "simple option" or "extended option" icons are *not* activated, the feature has been "disabled". A feature ***should*** be marked "***disabled***", if it can be reasonably assumed that its availability and application by an ***inexperienced*** operator ***could or would*** render the TDR useless as the consequence of an

incorrect choice and combination of TDR settings and their values (e.g. pulse width, gain, etc.).

"simple option" vs. "extended option":

A feature that is quite ***commonly used should*** be marked "***simple option***", conversely a feature, which is ***hardly ever used***, but could be beneficial to have in very rare instances, would be marked "***extended option***", which "hides" it, but still makes it available within the same menu level if needed.

4

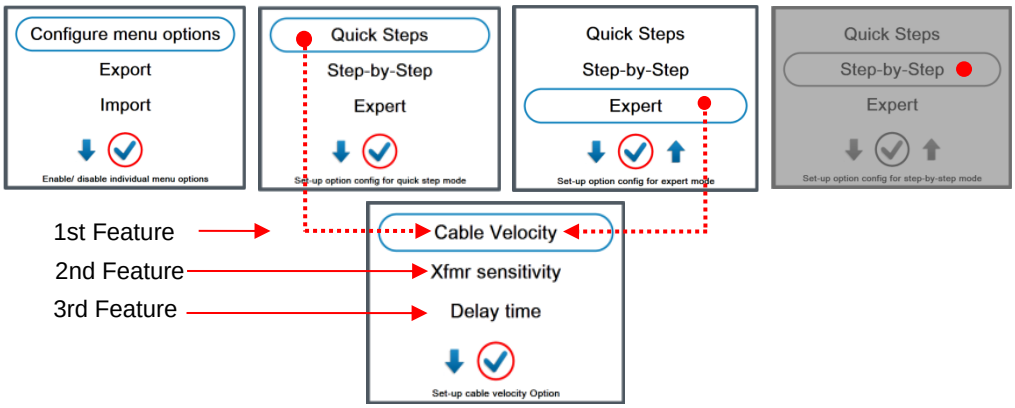
Customize TDR Features

Set-up for specific Menu Style

By clicking on "Configure Menu Options" the 3 style menus become visible and allow you to configure the 20 (18) available TDR features.

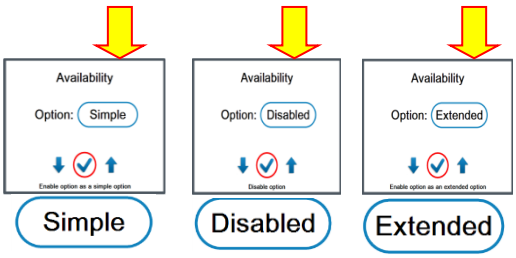
SIMPLE -, EXTENDED - , DISABLED Options

Follow the chart below to access the style menu required.



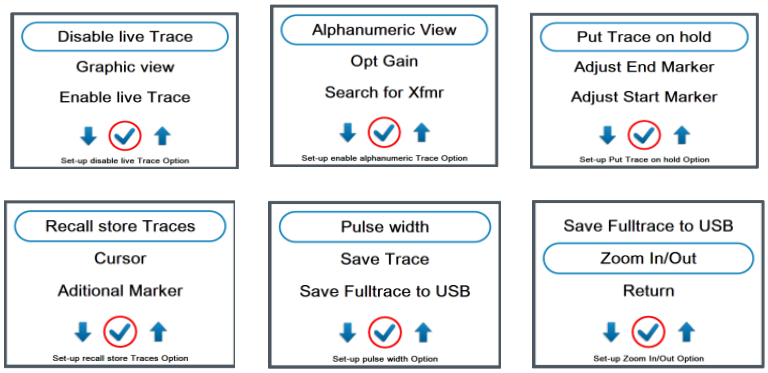
Quick Steps Style

By clicking on Quick Steps a new screen with the 1st feature Cable Velocity opens up,which by turning the control knob will show ***3 choices*** for the **availabilty** of this feature in the **Quick-Steps Style** menu.



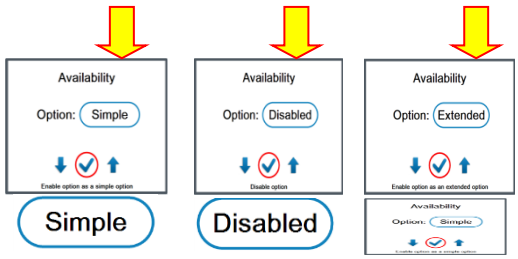
After a decision amongst the 3 choices has been made for the 1st feature, the 2nd feature "Xfmr sensitivity" is selected and the same process is applied to it; this process is repeated till a choice has been set up for the last feature "***Zoom In/Out***" *(all screens are shown below).*

The entire process for the "***Quick Steps***" style menu is finished by selecting "return" and clicking on it .



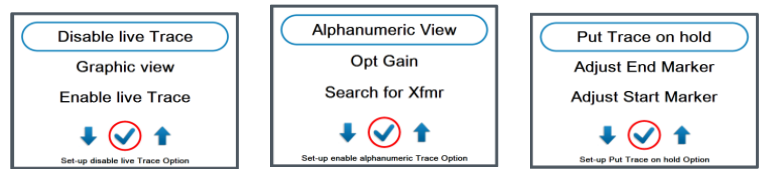
Expert Style

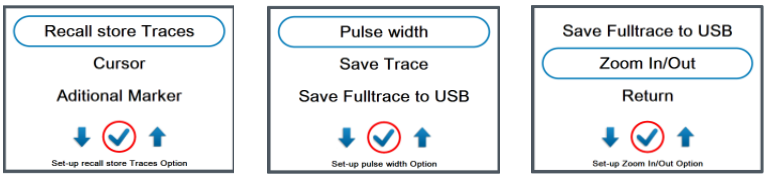
By clicking on Expert a new screen with the 1st feature Cable Velocity opens up,which by turning the control knob will show ***3 choices*** for the **availabilty** of this feature in the **Expert Style** menu.



After a decision amongst the 3 choices has been made for the 1st feature, the 2nd feature "Xfmr sensitivity" is selected and the same process is applied to it; this process is repeated till a choice has been set up for the last feature "***Zoom In/Out***" *(all screens are shown below).*

The entire process for the "***Expert***" style menu is finished by selecting "return" and clicking on it .



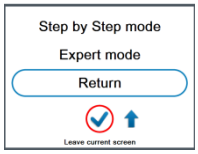


NOTE:	*On newer software versions there are 18 features (Opt Gain & Save Full trace to USB are removed*

Export & Import Feature for TDR feature configuration

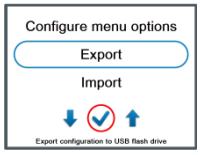
After completing the selection for all features for the EXPERT style menu,

1. click return and the following screen will appear.



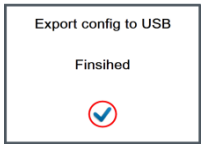
2. Click return again and the EXPORT / IMPORT feature can be selected.

It allows you to copy all feature selections for both the QUICK-STEPS and the EXPERT style menus to a USB flash drive (EXPORT) and then to import that very selection via the USB flash drive and to another unit (helpful tool) when customer has multiple units

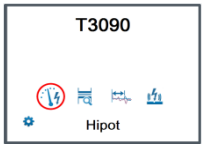


3. If the rotary knob is turned from the checkmark ✓ to the circled X ⊗, this submenu is left and the screen IMPORT-EXPORT (see above) returns.

4. After selecting IMPORT or EXPORT follow the instructions and click till the FINISHED message appears.

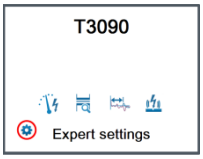


5. After clicking the checkmark in the FINISHED screen, click on RETURN on the following screen and then again on the next screen till the MAIN screen appears.



MAIN screen

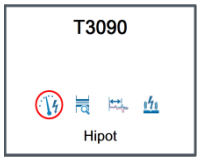
6. Turn Rotary knob to the cog wheel in the lower left corner and click on it.



This will access the scroll down menu in the EXPERT mode, click on Leave expert mode.

The MAIN screen reappears, now **in the QUICK STEPS mode** (no cogwheel visible, see also page 7 for detailed description).

After setting all default values and customizing the configuration for the TDR features in both the EXPERT and QUICK-STEPS style menus, the T3090 is now prepared to be used for cable fault locating.



List of Customer selectable TDR features

FEATURE	Description	Simple Option	Extended Option	Disabled Option
Cable Velocity	Specific for each cable: can be looked up in cable list, should be as close as possible	X		
Xfmr Sensitivity*****	Allows to decrease sensitivity for transformer identification	X		
Delay Time (Trigger Delay)	Adjust time to synchronize HV shot and TDR shot			X
Disable live Trace	If live trace is disabled the TDR must be “fired” after each adjustment to get an updated trace			X
Graphic view	The TDR trace is shown in graphic form to show the impedance changes			X
Enable live Trace	Only required if live trace can be disabled			X
Alphanumeric View	Mo impedance changes are shown, only the alphanumeric values for the cable end and the fault			X
Opt Gain	Service Only			
Search for Xfmr*	Allows to include or exclude the search for transformers			X
Gain	Adjusts the trace amplification			X
Trace on hold	Allows to store multiple traces on same screen (phase comparison)			X
Adjust End Marker	Allows to adjust end marker by hand override automatic)	X		
Adjust Start Marker	Allows the adjustment of the start marker; should be always adjusted as part of the set-up process			X
Recall Stored Traces	Allows to recall previously stored traces for comparison			X
Cursor	Allows to adjust cursor (typically the fault marker) by hand (override automatic)	X		
Additional Marker	Allows to position additional marker(s) to identify accessories, e.g. splices , transformers			X

Pulse Width	Manual adjustment of the pulse width, is normally done automatically as a function of the active cable length			X
Save Trace	Allows to save any single trace;			X
Save Full Trace to USB	Service Only			
Zoom In/Out	Allows to look at a section of cable with greater resolution			X
* If TDR has been ordered with optional sectionalizing software				

Recommended SELECTION for ***QUICK-STEPS*** have been highlighted in yellow.

Recommended SELECTION for ***EXPERT:*** Based on the explanations provided for each feature it is recommended for the customer to make his/her own choice what should be a "simple", an "extended" and a "disabled" feature. If the skill set of the expert operators meets a high standard, then no features should be disabled.

5

QUICK-STEPS and EXPERT Style Menus

General Introduction to QUICK-STEPS & EXPERT Style Menus

When the T3090 is operated in these 2 menu styles, and the choice of the thumper model has been set to "NONE", it will operate like any other stand-alone TDR when performing fault locating. The thumper system is operated independently from the TDR.

NOTE:	*Using the QUICK-STEPS menu style requires the operator to be familiar with the operation of the thumper system*

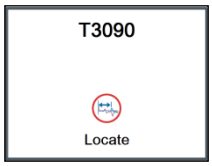
Using the EXPERT menu style requires the operator to be *familiar with both* the operation of the *thumper system as well as the TDR*

The QUICK-STEPS style menu allows moving very quickly through the TDR, and is typically used when no TDR adjustments are expected to become necessary (e.g. URD fault locating), it still re- quires the knowledge to operate the thumper and ***is not intended*** for the casual user who is not familiar with the specific thumper.

In QUICK-STEPS the number of available TDR features is limited to a bare minimum in order to not confuse the operator; essentially he will follow the red circled steps and typically makes no TDR adjustments (may be the velocity, if not working on a typical URD cable). The EXPERT style menu functions are very similar, except the operator has access to select from a list of 18 TDR features. They allow him / her to "tune" the TDR to the best possible trace image, which is sometimes required on difficult to find faults, but require an understanding of the TDR features.

QUICK-STEPS style menu for ARM Fault Locating

The T3090 can be ordered either with a ***single*** or ***up to 4*** fault locating method. The T3090 with **LOCATE**, which stands for ARM fault locating, represents its *most basic version* (left).

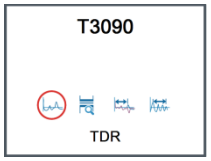


ARM Method

Basic T3090

Configuration

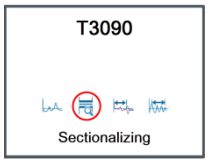
NAZFTA Market



TDR Method

Typical in Europe

Typical in MED/FE

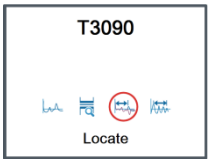


SECTIONALIZING Method

Typical; in NAFTA

URD Trouble

Shooting in MV Hoops

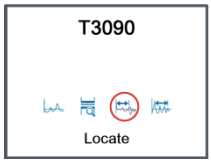


ARM Method

Worldwide

State of the Art

Method for Solid Dielectric Cables



SURGE PULSE (ICE) Method

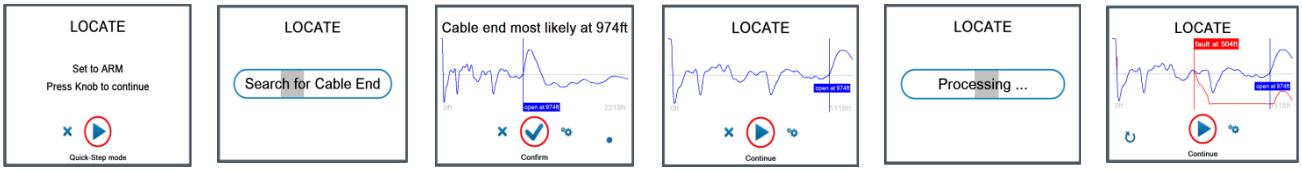
Typical in Europe

Typical in MED/FE

Excellent for PILC & long cables

If any of the other fault locating methods, ***TDR, Sectionalizing, Surge Pulse***, are available to the user, they what?????

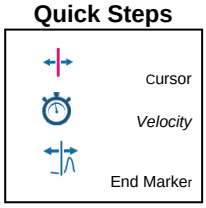
Typical ***QUICK-STEPS*** ARM fault locating process, if user follows ***automatic sequence*** without making adjustments, follow ***red arrow,*** if user wants to ***override automatic*** & ***adjusts manually*** the TDR features, follow ***blue arrow.***

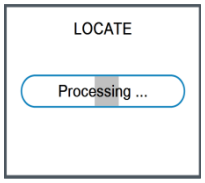


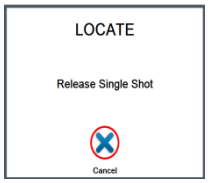
Accepting the results from the QUICK-STEP's, ***no user*** TDR interaction required.

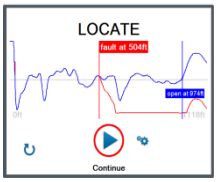
If you ***want to modify*** the automatic cable end result from QUICK-STEP's, you can make the required adjustment by turning the rotary control knob to the ⚙ symbol manually adjusting the end marker; in this position the user can also select any feature, which has been made available in the QUICK-STEPS menu according to Para 4.1., page 13 and Para 4.3, page 15 (*the example shows 3 selected features*).

Selected TDR Features in Quick Steps





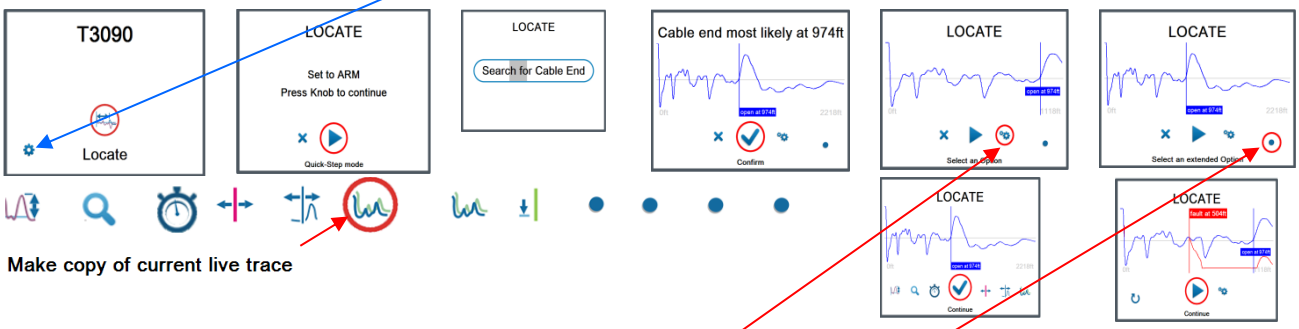




EXPERT style menu for ARM Fault Locating

Follow para 2.2., page 7 to change from QUICK-STEPS to EXPERT menu style.

The "cog wheel" ⚙ symbol in the lower left hand corner indicates that the EXPERT menu style is active.



Make copy of current live trace

Example: being activated

Selected as "*SIMPLE*" options in TDR Feature Menu

Selected as "*EXTENDED*" options in TDR Feature Menu

6

STEP-by-STEP Style Menu

"STEP-by-STEP" is typically intended for the "casual & inexperienced" operator, it provides all necessary steps in the operation of a specific fault locating system, which can comprise a number of different operating modes depending on the particular fault locating System. The STEP-by-STEP style menu will explain every step necessary to operate the system, starting from connecting the test leads.

After selecting the operating mode on the main screen and confirming it by c licking on the control knob, the "***Step-by-Step***" mode symbol becomes visible and must be selected by turning the rotary knob onto it and confirming it.

As previously described under Para 2.2., page 8, the user must select a specific Thumper Model in order to activate the STEP-by-STEP menu that explains each step of the operation of that particular Thumper model when used in a number of different operating modes. Some of the STEP-by-STEP menus are also available in other languages (see list).

M

List of Fault locating Systems with available Step-by-Step Style Menus

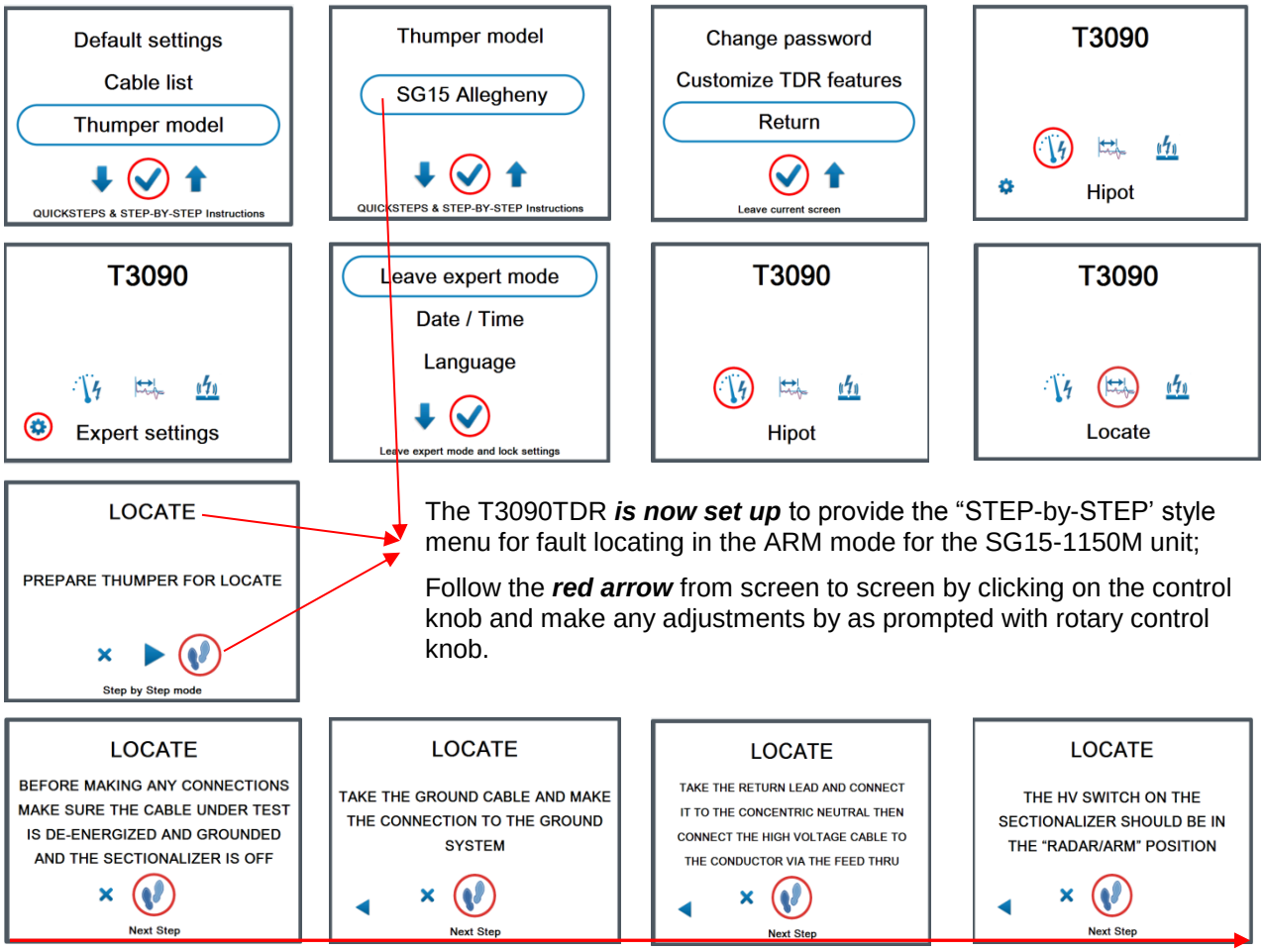
Thumper Model / ARM Filter	None	Operation Modes	Comments
With M219 Filter	T19-1 English	LOCATE, PINPOINT	English only
Integrated Filter	SG15.40-1000	LOCATE, PINPOINT	English only
Integrated Filter	SG25 English	LOCATE, PINPOINT, Hipot	
Integrated Filter	SG25 Chinese	LOCATE, PINPOINT, Hipot	Model with Chinese Step-by-Step
Integrated Filter	SG15 English	LOCATE, PINPOINT, Hipot	
Integrated Filter	SG15 Allegheny	LOCATE, PINPOINT, Hipot	Preferred/ English
Integrated Filter	SG15 Spanish	LOCATE, PINPOINT, Hipot	Only model with Spanish Step-by-Step
Integrated Filter	SG15 Chinese	LOCATE, PINPOINT, Hipot	Model with Chinese Step-by-Step
With M219 Filter	SWG English	LOCATE, PINPOINT, Hipot, BURN	English only
Integrated Filter	Hipotronics 5100	LOCATE, PINPOINT	English only
Integrated Filter	CDS20-10 Connexus	LOCATE, PINPOINT, Hipot	English only

LOCATE "Arc Reflection Method" (ARM®) using STEP-by-STEP

ARM® is today's state of the art method to locate faults in XLPE and EPR distribution and transmission type cables. ***When the T3090*** is used with an ARM capable fault locating system (Surge Generator plus ARM Filter, either integrated or stand-alone) ***for the first time***, it is recommended to make use the of STEP-by-STEP style menu. It is available for all Megger systems plus a number of competitive systems.

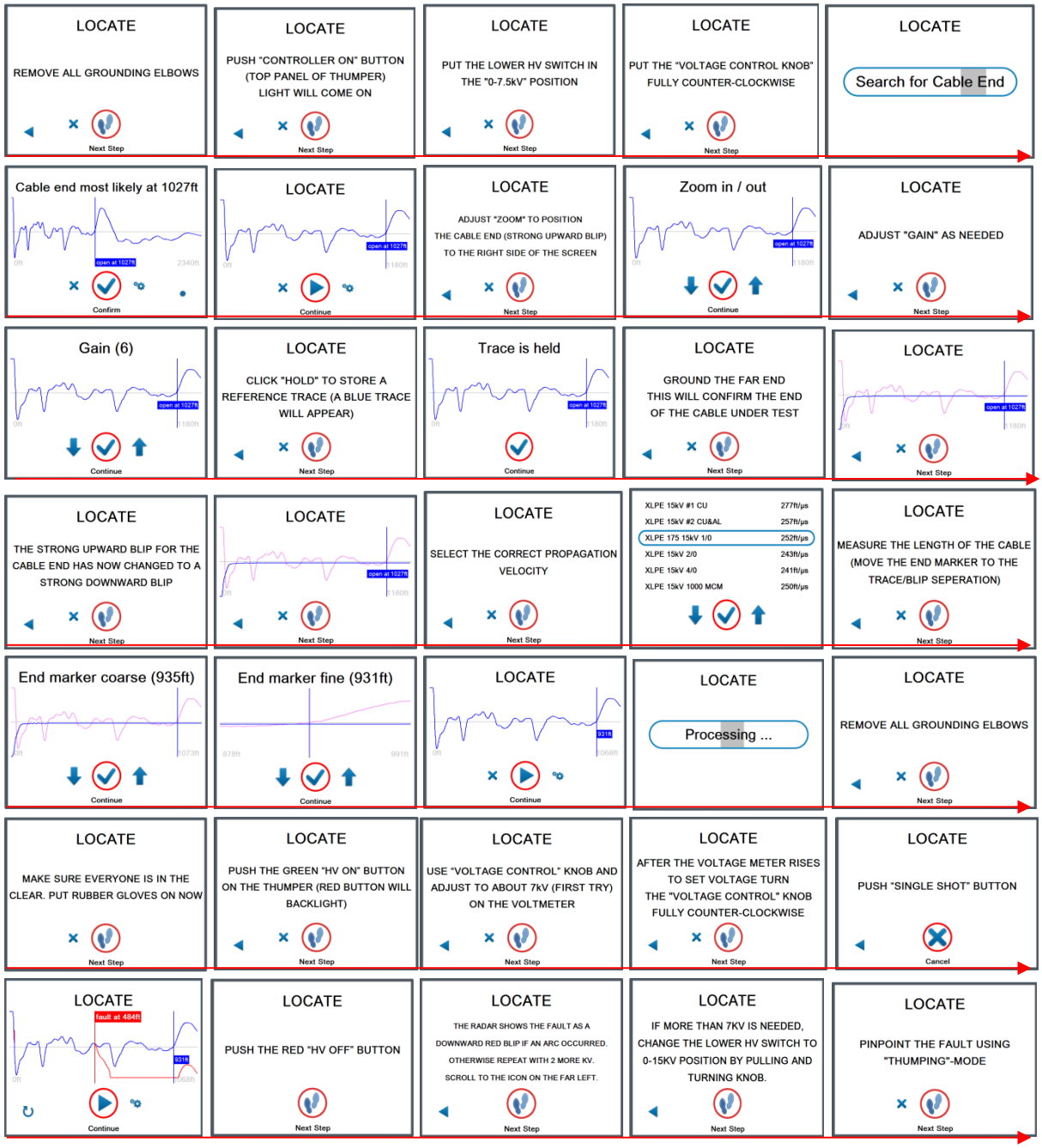
> ***NOTE:*** *If no STEP-by-STEP is available or the operator prefers to not display it on the TDR screen, NONE must be selected as described under Para 2.2., page 8. If a STEP-by-STEP is selected, it should be selected for the same language as selected under the Default Settings under Para 2.2., page, provided it is available in that language, otherwise the operator might select the English files.*

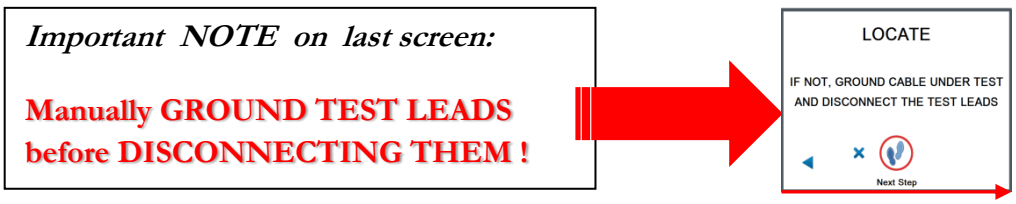
> ***NOTE:*** *In the following illustration the SG15 Allegheny Thumper Model is used*



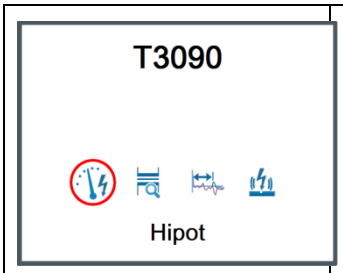
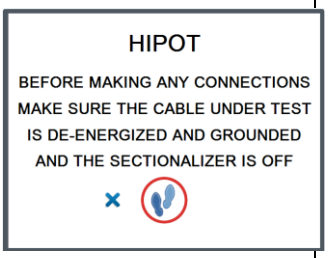
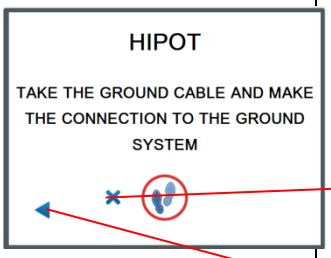
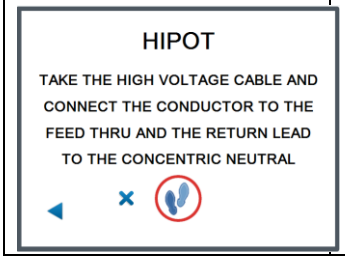
The T3090TDR ***is now set up*** to provide the "STEP-by-STEP' style menu for fault locating in the ARM mode for the SG15-1150M unit;

Follow the ***red arrow*** from screen to screen by clicking on the control knob and make any adjustments by as prompted with rotary control knob.

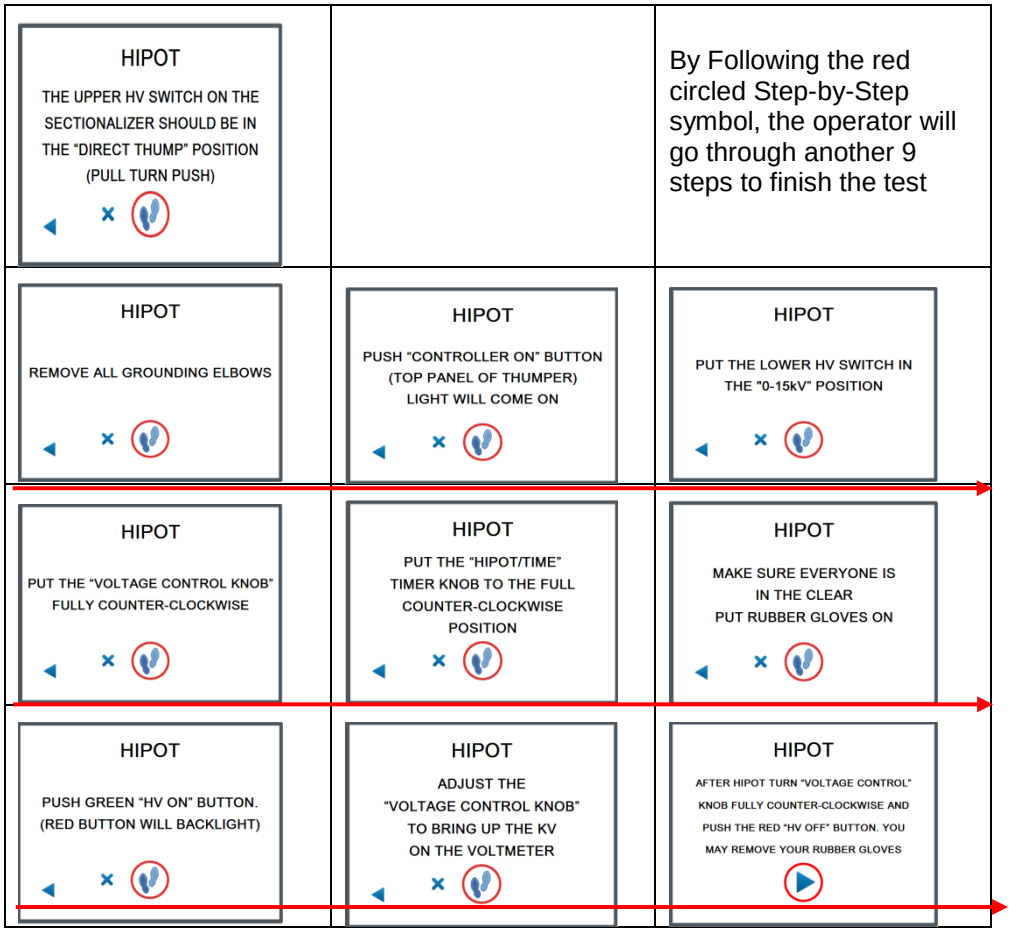

LOCATE
REMOVE ALL GROUNDING ELBOWS
Next Step
LOCATE
PUSH "CONTROLLER ON" BUTTON (TOP PANEL OF THUMPER) LIGHT WILL COME ON
Next Step
LOCATE
PUT THE LOWER HV SWITCH IN THE "0-7.5kV" POSITION
Next Step
LOCATE
PUT THE "VOLTAGE CONTROL KNOB" FULLY COUNTER-CLOCKWISE
Next Step
LOCATE
Search for Cable End
Cable end most likely at 1027ft
Confirm
LOCATE
Continue
LOCATE
ADJUST "ZOOM" TO POSITION THE CABLE END (STRONG UPWARD BLIP) TO THE RIGHT SIDE OF THE SCREEN
Next Step
Zoom in / out
Continue
LOCATE
ADJUST "GAIN" AS NEEDED
Next Step
Gain (6)
Continue
LOCATE
CLICK "HOLD" TO STORE A REFERENCE TRACE (A BLUE TRACE WILL APPEAR)
Next Step
Trace is held
Continue
LOCATE
GROUND THE FAR END THIS WILL CONFIRM THE END OF THE CABLE UNDER TEST
Next Step
LOCATE
Next Step
LOCATE
THE STRONG UPWARD BLIP FOR THE CABLE END HAS NOW CHANGED TO A STRONG DOWNWARD BLIP
Next Step
LOCATE
Next Step
LOCATE
SELECT THE CORRECT PROPAGATION VELOCITY
Next Step
XLPE 15kV #1 CU 277ft/µs
XLPE 15kV #2 CU&AL 257ft/µs
XLPE 175 15kV 1/0 252ft/µs
XLPE 15kV 2/0 243ft/µs
XLPE 15kV 4/0 241ft/µs
XLPE 15kV 1000 MCM 250ft/µs
LOCATE
MEASURE THE LENGTH OF THE CABLE (MOVE THE END MARKER TO THE TRACE/BLIP SEPERATION)
Next Step
End marker coarse (935ft)
Continue
End marker fine (931ft)
Continue
LOCATE
Continue
LOCATE
Processing ...
LOCATE
REMOVE ALL GROUNDING ELBOWS
Next Step
LOCATE
MAKE SURE EVERYONE IS IN THE CLEAR. PUT RUBBER GLOVES ON NOW
Next Step
LOCATE
PUSH THE GREEN "HV ON" BUTTON ON THE THUMPER (RED BUTTON WILL BACKLIGHT)
Next Step
LOCATE
USE "VOLTAGE CONTROL" KNOB AND ADJUST TO ABOUT 7kV (FIRST TRY) ON THE VOLTMETER
Next Step
LOCATE
AFTER THE VOLTAGE METER RISES TO SET VOLTAGE TURN THE "VOLTAGE CONTROL" KNOB FULLY COUNTER-CLOCKWISE
Next Step
LOCATE
PUSH "SINGLE SHOT" BUTTON
Cancel
LOCATE
fault at 484ft
Continue
LOCATE
PUSH THE RED "HV OFF" BUTTON
Next Step
LOCATE
THE RADAR SHOWS THE FAULT AS A DOWNWARD RED BLIP IF AN ARC OCCURRED. OTHERWISE REPEAT WITH 2 MORE KV. SCROLL TO THE ICON ON THE FAR LEFT.
Next Step
LOCATE
IF MORE THAN 7KV IS NEEDED, CHANGE THE LOWER HV SWITCH TO 0-15KV POSITION BY PULLING AND TURNING KNOB.
Next Step
LOCATE
PINPOINT THE FAULT USING "THUMPING"-MODE
Next Step


Important NOTE on last screen:
Manually GROUND TEST LEADS
before DISCONNECTING THEM !
LOCATE
IF NOT, GROUND CABLE UNDER TEST AND DISCONNECT THE TEST LEADS
Next Step

Performing a Hipot Test with the SG-15 Allegheny Menu (English) in the "STEP-by-STEP" style menu

		Go to main screen, select QUICK- STEPS style menu and click on HIPOT icon *NOTE: going through the Hipot procedure will test if cable will hold voltage or is faulted*
		 Follow the red circled Step-by-Step symbol, the user is provided with one instruction at the time and will successfully finish the Hipot procedure.
		Follow the red circled Step-by-Step symbol Explanation of other symbols on screen: By turning the Rotary Knob to the x position and clicking on it, the user will exit the Hipot procedure and go back to the main screen By turning the Rotary Knob to the far left check mark and clicking on it, the user will be taken back to the previous step
		Follow the red circled Step-by-Step symbol

M


HIPOT
THE UPPER HV SWITCH ON THE SECTIONALIZER SHOULD BE IN THE "DIRECT THUMP" POSITION (PULL TURN PUSH)
By Following the red circled Step-by-Step symbol, the operator will go through another 9 steps to finish the test
HIPOT
REMOVE ALL GROUNDING ELBOWS
HIPOT
PUSH "CONTROLLER ON" BUTTON (TOP PANEL OF THUMPER) LIGHT WILL COME ON
HIPOT
PUT THE LOWER HV SWITCH IN THE "0-15kV" POSITION
HIPOT
PUT THE "VOLTAGE CONTROL KNOB" FULLY COUNTER-CLOCKWISE
HIPOT
PUT THE "HIPOT/TIME" TIMER KNOB TO THE FULL COUNTER-CLOCKWISE POSITION
HIPOT
MAKE SURE EVERYONE IS IN THE CLEAR
PUT RUBBER GLOVES ON
HIPOT
PUSH GREEN "HV ON" BUTTON. (RED BUTTON WILL BACKLIGHT)
HIPOT
ADJUST THE "VOLTAGE CONTROL KNOB" TO BRING UP THE KV ON THE VOLTMETER
HIPOT
AFTER HIPOT TURN "VOLTAGE CONTROL" KNOB FULLY COUNTER-CLOCKWISE AND PUSH THE RED "HV OFF" BUTTON. YOU MAY REMOVE YOUR RUBBER GLOVES

7

UTILITY MENU

Software Upgrade

When a software update becomes available, the customer will receive on request a USB memory stick in order to perform the update.

Update Procedure:

1. Before powering unit up, insert USB stick
2. Power unit up
3. After booting up screen will ask, if you want to update Software, please acknowledge
4. Unit will go automatic software loading, and when finished asked to reboot unit and remove USB stick. Power unit off and wait 20 seconds, then reboot. Unit, which will then go through the update cycle (depending on the age of the old version this might take several minutes).
5. The default values are typically not affected by the upgrade, but it is recommended to verify them, especially the setting of the start marker and trigger delay.

8

Technical Specifications T3090, T3090 T, T3090 SX, T3090 SX-T

Using radar to pre-locate faults will save time and reduce cable damage. The **T 3090** is designed to be most user-friendly radar on the market! Advanced features include One Button Operation, Automatic Gain and a Large Color Screen. The T 3090 will automatically 'read' the cable end and display the fault distance with a single thump. Our interactive ***'Step-By-Step Easy Mode'*** will help train (or re-train) the occasional user ***while on the job!*** The optional '**Sectionalizing Mode**** will quickly sectionalize faults in loops or radial systems.

Measuring Range (ft, m , m sec or NVA)	Continuously from 0 ft to 25,000 ft X Models 0 ft to 100,000 ft***
Fault Locating Methods:	ARM® (HV Arc Reflection Mode) Surge Pulse (optional, T 3090 SX models) Sectionalizing (optional, T3090T models) LV TDR (use for secondary fault locating)
Pulse Width:	Automatic with range selection or manual 50 ns, 100 ns, 200 ns, 500 ns, 1µs, 2 µs, 5 µs, 10 µs
Pulse Shape:	special pulse shape for high resolution
Sampling Rate:	100 MHz
Accuracy:	<= 2.5 feet depending on displayed range
Screen:	High Brite 1200 nits 10.4" diagonal VGA Color TFT LC-Display,
Velocity of propagation:	Via cable menu or manual between 140 ft/µs ... 492 ft/µs (also in m/µs)
Display Choices:	live trace always visible, stored reference & fault trace Up to 10 superimposed traces visible on display for comparison
Weight / Dimensions:	17lbs, 11" x 15" x 6"
Operator Menu Styles:	
Quick Steps® Style Menu	Automatic fault distance location Automatic "short" or "open" assessment

M

Step-by-Step Easy Style Menu	Unique real time on screen tutorial for : *fault locating – hipot – pinpointing – burning for all MEGGER & some competitor's thumpers*
Expert Style Menu	NOTE: *user can custom configure and pass -word protect the specific TDR features available in each of the 3 menu styles (22), depending on the experience & skill level of the operator*
Optional Fault locating Programs	
Sectionalizing:	Automatic sectionalizing in loops, identifying cable fault between 2 closest transformers
Surge Pulse:	fault locating with TDR as transient recorder
Convenient Features:	
PC Communication:	Upgrade & Up & Download via USB Port
Power Requirements:	115 V / 230 V, 50 / 60 Hz
Operating Temperature:	-5 F to 105 F (-20 °C + 40 °C)

*ARM® is a Trademark of MEGGER Electronics, Inc.
Quick Steps® is applied for Trademark by MEGGER Electronics, Inc.
** Sectionalizing, Patent No.US 6,683,459 B2
*** Available 06/2012