

# INSTRUCTION MANUAL

## Tracker Pro

(Model V3)

**Time Domain Reflectometer (TDR)  
for metal cable faultfinding and troubleshooting  
as well as  
for district heating pipelines troubleshooting and monitoring**



## DISTRIBUTOR IN THE EU:

**TESTERON**

ul. Nowy Rynek 6  
62-002 Suchy Las, Poland

tel +48 61 6521235  
cell phone. +48 724 565157  
e-mail: [biuro@testeron.pl](mailto:biuro@testeron.pl)

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# 1. General Information

## 1.1 Introduction

The Tracker Pro is a multipurpose metallic time domain reflectometer (TDR). It is a cable fault locator designed to quickly and easily diagnose metallic cables. The Tracker Pro combines the latest technology and user-friendly operation, creating a versatile and accurate TDR. It uses square pulse widths with very fast rising and falling edges. This unique capability creates high frequencies that allow for the most accurate reading of small faults in the cable even at very short distances less than 1m from the source of the test pulse. At the same time, a combination of available testing pulse widths allows the user to test cable networks and district heating pipelines on long distances up to 16km on coax cables or 19km on alarm systems of pipelines.

The Tracker Pro is a product of Springbok Instruments, USA, whose founders created RiserBond over two decades ago - a world known brand of metallic TDRs. As compared to all existing TDRs, Springbok Instruments introduces some revolutionary new features as standard: a high resolution color touch LCD screen and the Tracker Store - a unique system of storing measurement data, each file being a full waveform with all the available pulse widths regardless of what is on screen.



## 1.2 Tracker Pro's Key-Features

- the most modern TDR technology based on high frequency energy test pulses
- locates faults (cable impedance discontinuities) for most of metallic cable types
- long testing range up to 16km on coax cables or 19km on district heating pipelines
- detects faults at very short distances - less than 1m with a 5ns pulse width
- high resolution large color touch LCD screen
- Auto-Search mode for ease of operation
- three measurement cursors and multiple marking system
- intuitive interface combined with accurate diagnose & locating of multiple events on a cable
- unique „one-touch storage of all pulse width” Tracker Store System for 60 cable tests
- IFD mode (Intermittent Fault Detection)
- Bluetooth 4 and USB connectivity to tablets and smartphones
- splash proof USB connection and Tracker View PC software at standard delivery
- updates of the Tracker Pro's operating system & Tracker View PC software via internet for free
- increased operating time of the internal battery exceeding 9 hours in standard conditions
- rugged and field tested case

## 1.3 Tracker Pro's Typical Field Applications

Typical field applications for Tracker Pro TDR include:

- coax cable TV troubleshooting
- telecom copper cable faultfinding
- railway automation cables troubleshooting
- LV power cable faultfinding
- district heating network troubleshooting
- and many more....



## 1.4 Theory of Operation

Tracker Pro was successfully introduced to the world market over 5 years ago. It is a reflectometer designed to detect and analyze faults on metal cables. It belongs to the group of measurement devices called TDR (Time Domain Reflectometer). Using time domain reflectometry, or cable radar, the TDR transmits a signal down the cable. Impedance discontinuities along the length of the cable reflect some or all of the signal energy back to the instrument. These reflections are measured and displayed on the Tracker Pro's color LCD touch screen as both a waveform and a numeric distance to the fault.

If the pulse reaches an impedance discontinuity, part or all of the pulse energy is reflected back to the instrument. If the cable is an open circuit, the reflected pulse will be in-phase (upward reflection) with the output pulse. If the cable is a short circuit, the reflected pulse will be out-of-phase (downward reflection) with the output pulse. In either case, a substantial amount of energy will be reflected. If it were possible to have a cable with no loss, all of the signal energy would be reflected. The incident and the reflected signals would look identical. Inductive faults and reflections from an impedance higher than the characteristic impedance will be in-phase, or upward. Capacitive faults and reflections from a lower impedance are out-of-phase, or downward.

The Tracker Pro displays the cable under test as a digitized waveform with a numeric distance readout on the touchscreen display. The digitized waveform enables the operator to view the signature of the cable in great detail. An impedance mismatch (opens, shorts or faults of less severity) can be identified and distances to the faults determined. The Tracker Pro will test all types of metallic paired cables for opens, shorts and impedance mismatch.

### Square Pulses

The Tracker Pro uses square pulse widths with very fast rising and falling edges. This unique capability creates high frequencies that allow for the most accurate reading of small faults in the cable. Due to high frequency energy of the pulses, the minimum effective test range of the first 2nsec pulse is less than 0,5m! The combination of available testing pulse widths for the instrument allows the user to test cable networks and district heating pipelines on long distances up to 16km on coax cables or 19km on alarm systems of pipelines.

## 1.5 Safety Information

### WARNINGS:

- Review all safety precautions before using.
- Do not operate this instrument near flammable gases or fumes!
- Do not modify any part or accessory of this instrument.
- If the unit is damaged, do not use.
- To avoid electric shock, do not remove covers or any parts of the enclosure!

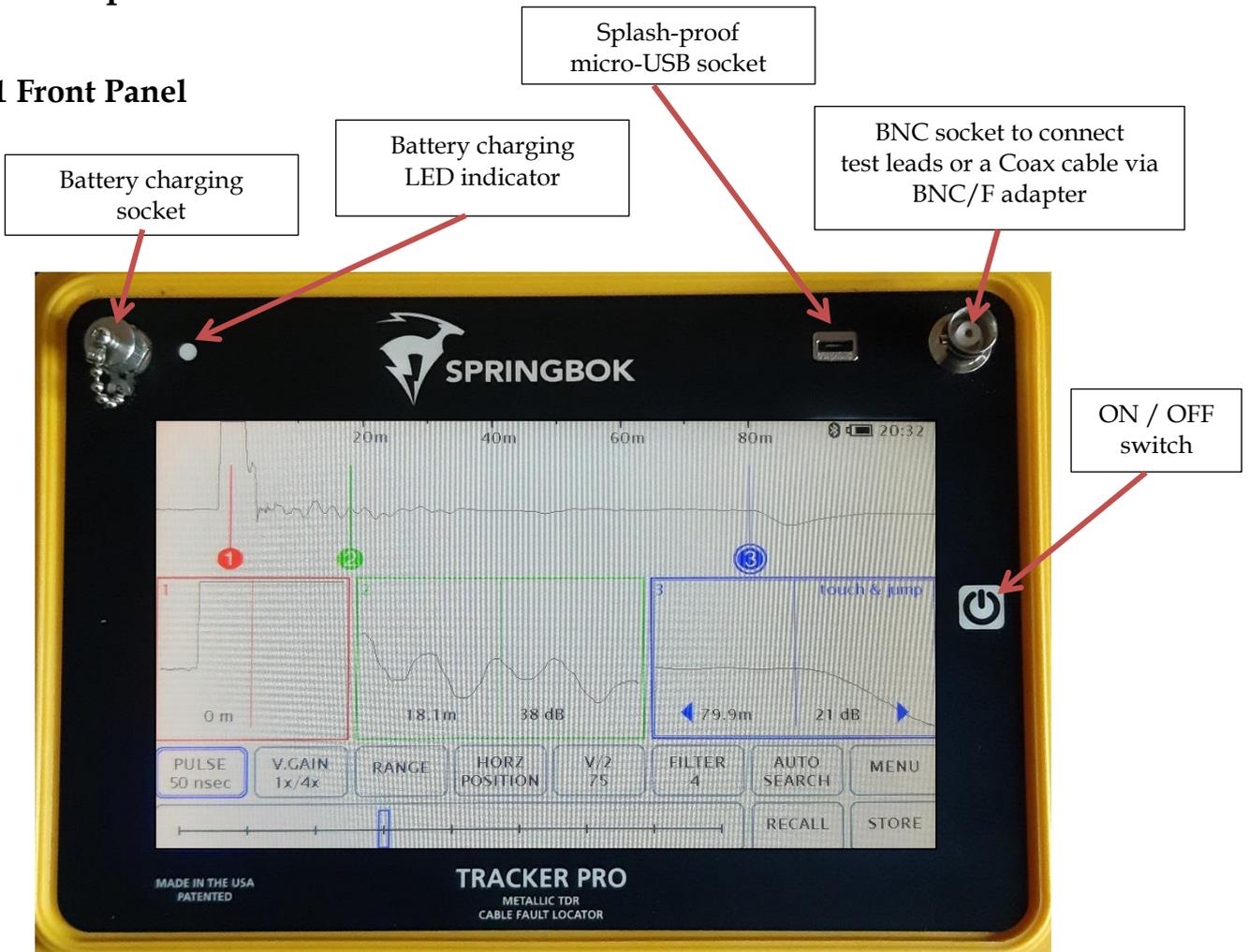
### CAUTION:

As with most electronic equipment, care should be taken not to expose the equipment to extreme temperatures or humidity. Store the instrument indoors during extreme hot or extreme cold temperatures to insure that your Tracker Pro will be ready to use. If the instrument is stored overnight in a service vehicle, be certain the instrument is brought to specified operating temperatures before using.

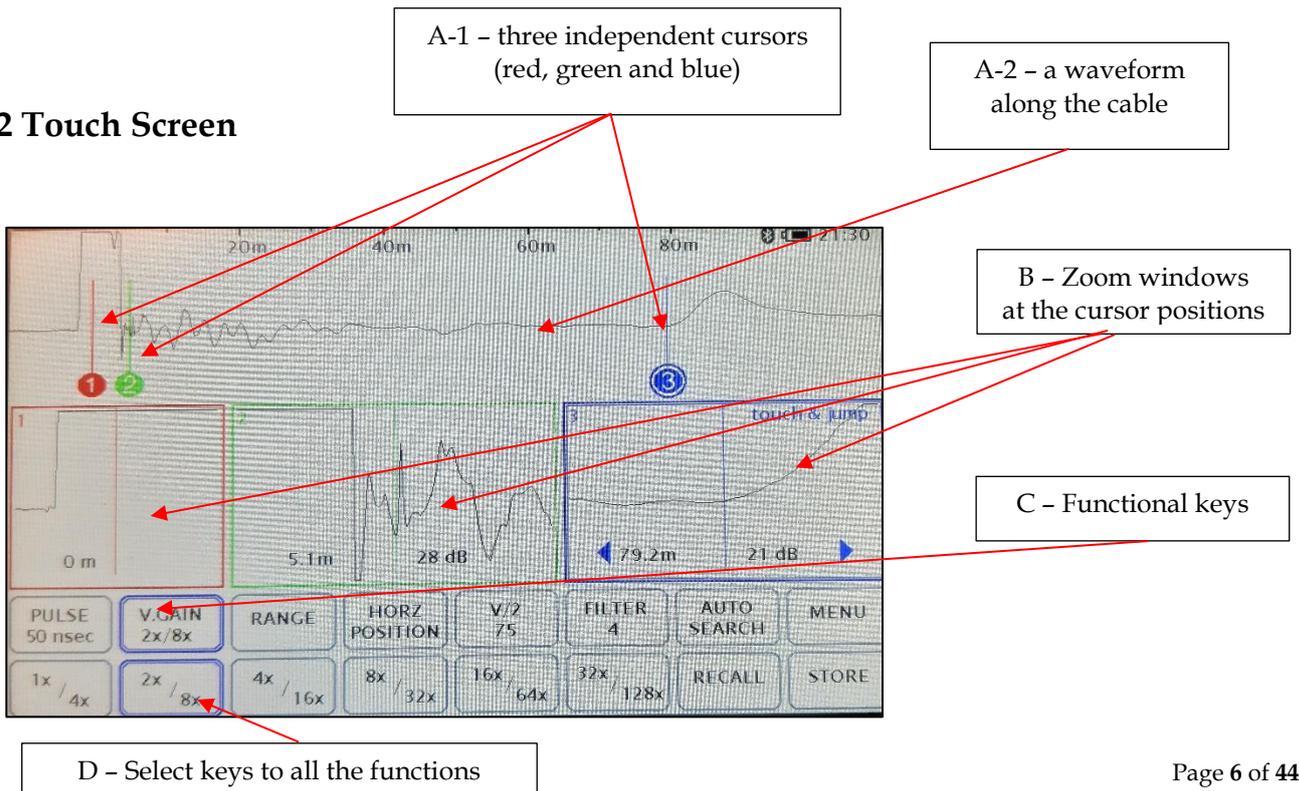


## 2. Description

### 2.1 Front Panel



### 2.2 Touch Screen



The Tracker Pro touch screen consist of four main parts:

- A. A graphical presentation of a waveform along the cable that shows any impedance mismatch of the tested network (reflections of the test pulse), two independent cursors marked in red and blue and a distance marker at the upper part.
- B. Three ZOOM windows – one for each of the cursor which help to position the given cursor correctly at the place of the fault (green and blue cursors) or at the start of testing pulse (red cursor).
- C. The tool bar of functional keys that enable to:
  - chose the proper pulse width to perform the cable test (PULSE)
  - chose the level of Vertical Gain (V.GAIN)
  - chose the proper test range (RANGE)
  - adjust horizontal position of the graph (HORZ POSITION)
  - chose the proper VOP setting (VOP)
  - chose the proper Filter setting (FILTER)
  - activate the function of Auto-Search (AUTO-SEARCH)
  - store the measurement into the instrument’s internal memory (STORE)
  - recall of the recorded measurement from the instrument’s internal memory (RECALL)
  - enter the instrument’s MENU
- D. Select keys to choose specific values of the required function

## 2.3 Intuitive Ease of Use

Due to modern technologies used, including a touch screen LCD of high mechanical resistance, the Tracker Pro is a friendly to use test-and-measure instrument. Its intuitive ease of use combined with professional faultfinding reliability can be experienced in the toughest site conditions.

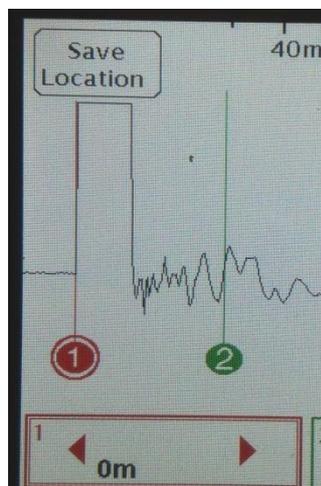
## 2.4 Touch & Jump

1. Select a cursor to adjust by touching anywhere inside the zoom window
2. Touch along the main waveform to move the cursor to the desired location
3. Fine tune the location of the cursor by touching the arrows inside the zoom window to move the cursor left and right.

Note: The red cursor is the reference and it is to be set up either at the beginning of the initial pulse (start of the testing pulse from the instrument) or at the leading edge of the reflection from the point where the crocodile clips of a test leads are connected to the cable under test).

Position of the red cursor can be stored, e.g. if the user wants to work in the mode of “Cancel test lead length”.

1. Select the red cursor to adjust by touching anywhere inside the red zoom window.
2. Touch along the main waveform to move the cursor to the desired location.
3. Press “Save Location” button
4. The instrument will remember the position of the red cursor at the next switch on of the device.



## 2.5 Return Loss

The green or blue ZOOM windows automatically display the distance between the red and the green or blue cursor positions. At the same time, the Return Loss value is displayed there in [dB].

In general, **Return Loss** is the loss of power in the signal returned (reflected from any impedance mismatch in a transmission line).

**Basically, the lower the value of RL, the more severe the fault.**

The dBRL value is usually expressed as a ratio in decibels (dB) and it is calculated and displayed to the TDR user via the equation:

$$RL \text{ (dB)} = 20\log_{10}(V_o/V_r)$$

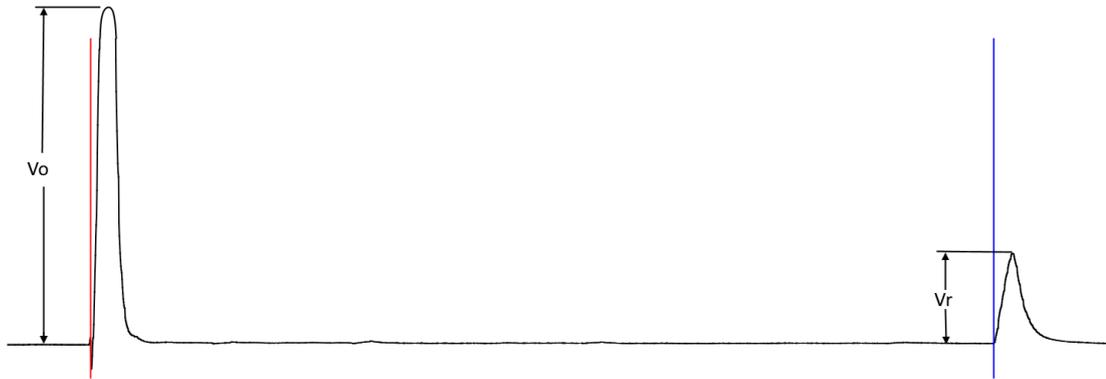
where:

$RL$ (dB) is the return loss in dB

$V_o$  is the transmitted signal amplitude in Volts

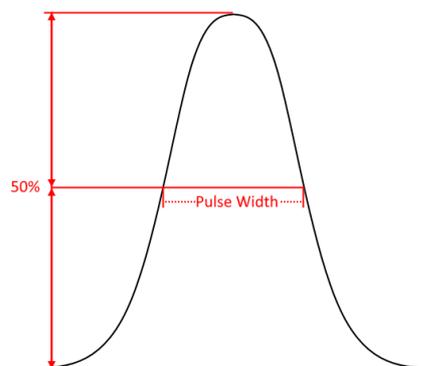
$V_r$  is the reflected signal amplitude in Volts recorded at the TDR.

See Figure below for the visual TDR representation of these values.



In an ideal world where flawless transmission cables are used, the amount of reflected signal would match the transmitted signal amplitude resulting in a dBRL reading of 0dB. Actual cables will have a given amount of attenuation per kilometer that is also dependent on the fundamental frequency of the pulse that is transmitted by the TDR. The higher the frequency (or inversely the lower the pulse width), the greater the attenuation over distance will be. Additionally, this means that the shown dBRL value is a combination of the fault on the cable and the cable attenuation.

Pulse Width	Fundamental Frequency
2ns	250MHz
5ns	100MHz
20ns	25MHz
50ns	10MHz
100ns	5MHz
300ns	1.67MHz
500ns	1MHz
1000ns	500KHz
2000ns	250KHz



## 2.6 Pulse

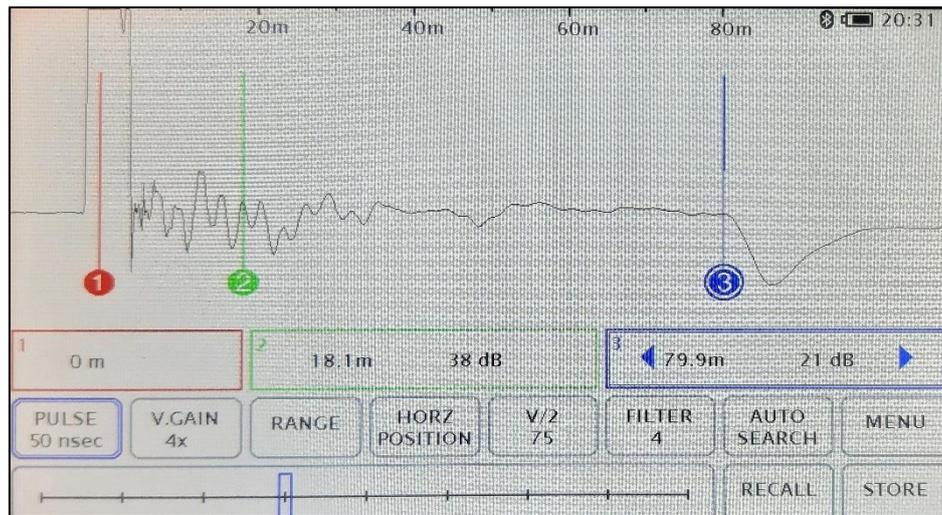
Tracker Pro V3 has 9 available testing pulse widths:

2 nsec, 5 nsec, 20 nsec, 50 nsec, 100 nsec, 300ns, 500 nsec, 1000ns and 2000ns .

**NOTE:** **2 nsec pulse width of the Tracker Pro corresponds to the pulse width of less than 0,5 nsec that is generated in any other known TDRs from other manufacturers.**

The default pulse width for the Tracker Pro is 2 nsec. In order to change it, press the PULSE key and choose the desired pulse width value on the slide bar below (press the screen on the correct position that corresponds to the required pulse width). The choice made is presented in a pulse width key, eg. PULSE 50 nsec

**NOTE:** Always start the fault finding procedure in the shortest pulse width available, as the fault may be only a short distance away. Use the Range and Vertical Gain controls to locate fault. If the fault is not located, adjust to the next larger pulse width and retest.



## 2.7 Vertical Gain

The Vertical Gain control increases or decreases the vertical amplitude of the waveform display. Increasing the vertical gain of the waveform display allows the user to see smaller reflections or minor faults on the cable signature.

Tracker Pro has 6 available levels of Vertical Gain control:

1x/4x, 2x/8x, 4x/16x, 8x/32x, 16x/64x and 32x/128x

After the instrument switch on, a default level of Vertical Gain is applied - 1x/4x.

1. In order to change the Vertical Gain, press the V.GAIN key.
2. Select the required level of Gain by choosing the right key . 1x/4x, 2x/8x, 4x/16x, 8x/32x, 16x/64x or 32x/128x

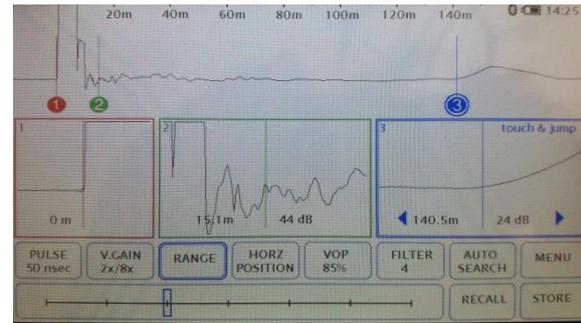
The default value of the Vertical Gain can be set by the user - just go to MENU and select the required value of the Vertical Gain at the "Settings" screen.

## 2.8 Range

Range, or horizontal zoom, expands and contracts the waveform from the left side. These are different preset range levels with the first being the small, seeing up to 20 meters, and last- the largest, seeing up to 4,000 meters down the cable. Once the proper range has been selected the cursor zoom windows can be used to see specific areas in the cable with finer detail.

The default value of the Range can be set by the user - just go to MENU-Settings and set-up the appropriate position of the slide bar

1. In order to change the testing Range, press the RANGE key.
2. Adjust the required Range by the use of a slide bar.



## 2.9 Horizontal Position

The horizontal position arrows can be used to scan to the left and right on the cable without changing the range level. You can use it to view the whole length of the tested network at the chosen pulsewidth in search of unusual reflections that could be actual faults or expected regular points. The arrows can be held down to continuously scan along the cable to the desired location.

## 2.10 VOP (Velocity of Propagation)

The speed of light in a vacuum is 300,000 kilometers per second. This speed is represented by the number 1(100%). A coaxial cable with a VOP of .85 would transmit a signal at 85% of the speed of light.

### 2.10.1 Determine VOP

The VOP number of a cable is determined by the dielectric material that separates the two conductors. In a coaxial cable, the foam separating the center conductor and the outer sheath is the material determining the VOP. In twisted pair, the VOP number is determined by the spacing between conductors and the insulation that separates them.

The VOP of a cable can change with temperature, age and humidity. It can also vary from one manufacturer and/or cable family and from one run to another. Even new cable can vary as much as +/-3%.

There are several ways to determine the correct VOP. The first is to simply refer to the VOP card provided with the instrument. Second, consult the manufacturer for the correct VOP of that specific cable. A third way is to actually determine the VOP from a known cable length:

1. Measure a known cable length, the longer the cable, the more accurate the VOP will be.
2. Correctly place the cursors of the TDR on the output pulse and the reflected pulse (end) of the cable.
3. Change the VOP setting until the "Distance Between Cursors" displays the known length.

### 2.10.2 Reducing VOP Error

When trying to pinpoint a fault, the most common technique used to reduce VOP error is to test the faulty cable from both ends.

1. Determine the path of the cable and, therefore, its length
2. Test both ends of the cable to a common point on the cable (fault) with VOP readings
  - If the sum of the two readings is more than the known cable length, reduce the VOP setting and retest
  - If the sum of the two readings is less than the known cable length, increase the VOP setting and retest
3. Continue this method until the sum of the two readings equal the known length of the cable
4. The result will be the correct length readings.

### 2.10.3 Set up VOP for the Actual Cable Test

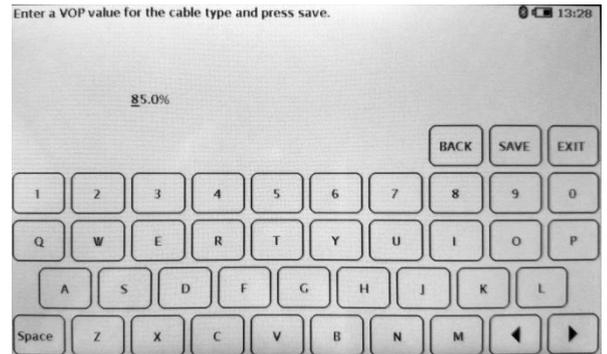
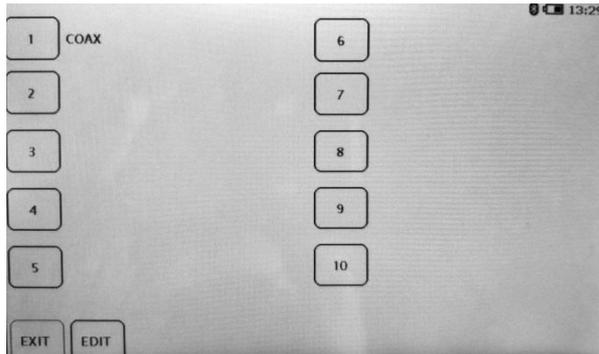
After the instrument switch on, a default value of VOP is applied, e.g. 85%

1. In order to change the VOP, press the VOP key.
2. Select the required value VOP by pressing up or down arrows on the screen

The default value of the VOP can be set by the user - just press the key "Save Start VOP" and the actually displayed VOP value will be the default value with the next switch on of the instrument.

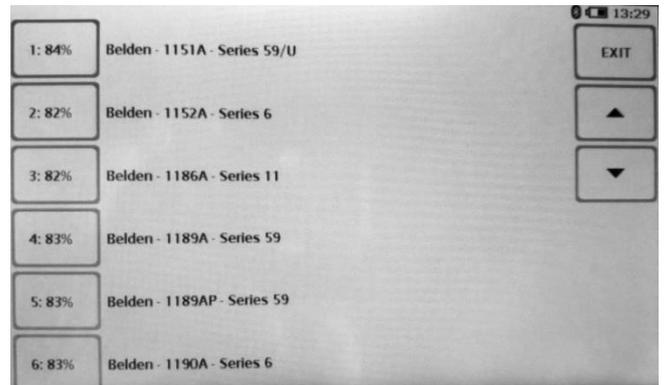
You can also use the feature "Favorites" - the user can store 10 favorite of the most frequently used VOP values in the memory of the instrument.

1. Press VOP key
2. Press "Custom VOP List" key
3. A screen with 10 numbered boxes, „EDIT" and "EXIT" keys will be displayed.
4. Press „EDIT" key in order to determine where you want to store the preferred VOP value.
5. A screen with a keypad will be displayed.
6. Write down the name of your preferred VOP value and press "NEXT" key.
7. Write down the desired VOP value and press "SAVE" key.
8. You can edit the favorite VOP value any time or leave the screen by pressing „EXIT" key.



You can also use the feature "STD Cables" - the user can select the VOP value from the pre-stored list of the most commonly cables used in the US.

1. Press VOP key
2. Press "STD Cables" key
3. Select the desired cable type and press „EXIT"



## 2.11 Filters

The filtering option is used for various types of interference.

1. Press FILTER
2. Select the required Filter value by choosing the right key . 1x, 2x, 4x, 8x, x16, 32x or 64x
3. The 8x filter will be the most accurate as it takes the average of the most waveforms.

Signals such as power (50 to 400 Hz), audio (100 Hz to 20,000 Hz), data (50 Hz to 10MHz), and RF (500 kHz to 1GHz) can all affect a TDR differently. Therefore, a TDR with only one type of filtering system may work well in one application but not in another.

The Tracker Pro has 7 available levels of Filter control: 1x, 2x, 4x, 8x, x16, 32x or 64x.

Please, note, the higher filtering value, the slower the response of the waveform on dynamic changes in the cable under test - e.g. performing shorts of opens at the end of the cable in order to confirm the correct location of the cable end. Using the filter value No. 4 will enable to see the waveform going down and up in real time, whereas any higher filter value will result in the delay of the waveform movement.

The default value of the Filters can be set by the user - just go to MENU and select the required value of the Startup Filter Level at Settings.

## 2.12 Auto-Search

The Auto-Search function is used for a quick test of the cable or for automatic search mode of the most severe fault along the tested cable.

1. Press AUTO SEARCH.
2. The blue cursor moves to the largest impedance mismatch.
3. Markers are placed at possible events along the cable. The markers can be deleted by pressing the key "Erase markers"

When the end of the cable is disconnected from the cable plant, the largest reflection will be the end of the cable and therefore cursor No. 3 will move to the end. If not disconnected, the blue cursor will move to the largest impedance mismatch on the cable line.

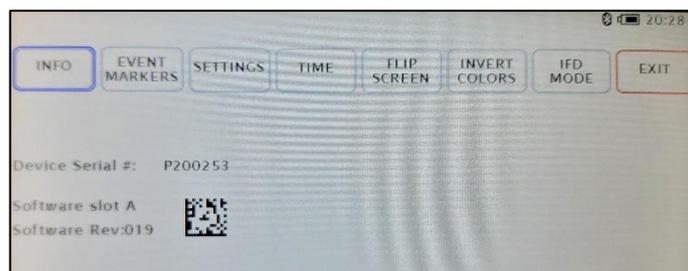
**NOTE:** The Auto-Search mode is working properly in a variety of different conditions but you just cannot assume it works perfect in all of the situations. It's only just a helping tool to the user.

**NOTE:** If you pressed the Auto-Search key on the Tracker Pro and the blue cursor pointed the place at the leading edge of the pulse reflection from the point where the crocodile clips of test leads had been connected to the cable under test, it DOES NOT mean there are no faults along this cable!

## 2.13 Menu

By pressing the MENU key, the user can enter the menu of the instrument including:

- a) INFO page that presents information on the instrument serial number, actual software revision and bar code containing serial No. info.
- b) Event Markers (adjusting Auto Search Marker sensitivity)
- c) SETTINGS mode (LCD screen brightness, distance measure units, VOP format, auto shut-off, Start-up Vertical Gain, Start up Filter level and Active or Hidden ZOOM Windows)
- d) TIME mode (adjusting the Time and Date)
- e) FLIP SCREEN mode (flip of the screen by 180 degrees)
- f) INVERT COLORS mode (invert of screen colors)
- g) IFD Mode (Intermittent Fault Detection)



### 2.13.1 Internal Software Revision

The procedure of updating Tracker Pro firmware can be done only from a PC via the TrackerView application. The TrackerView application is free of charge and can be downloaded from the manufacturer's website. The whole updating procedure is very easy and can be done by the user free of charge over the internet.

### 2.13.2 Event Markers

Allows the user to adjust the sensitivity of the Auto Search event markers.

1. Press the Menu button
2. Press Event Markers
3. Press the selected value of the Auto Search Marker Sensitivity (level 1 - the smallest events up to level 5 - the largest events along the cable length)
4. Press EXIT to leave the Menu screen

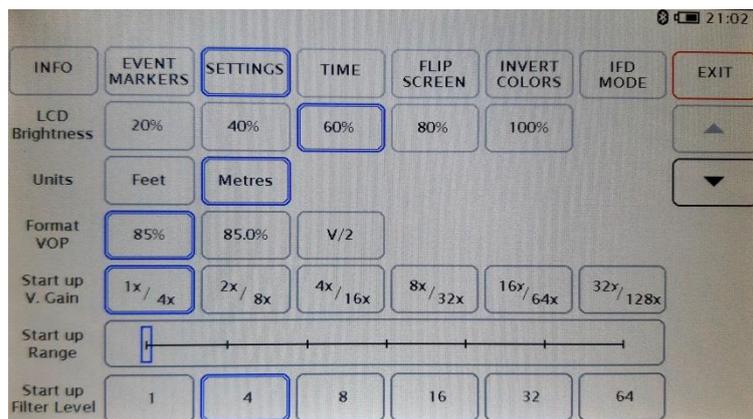
### 2.13.3 Settings

We can set up a few working parameters of the Tracker Pro in the MENU. This will set up the chosen values as default ones for the switch on of the instrument.

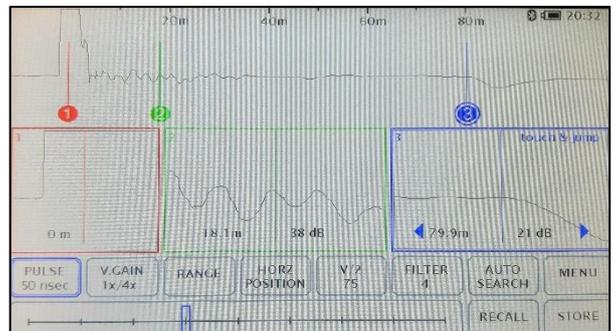
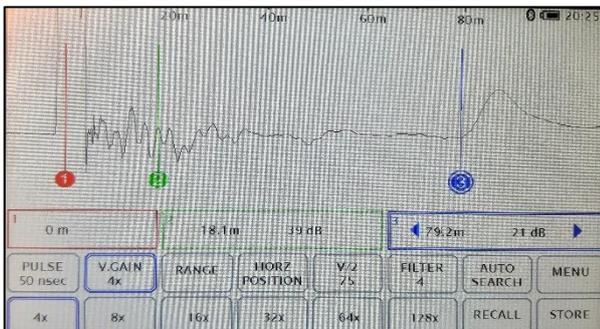
1. Press MENU key
2. In order to select the desired LCD screen brightness, (LCD Brightness), chose one of available option: 20%, 40%, 60%, 80% or 100%

**NOTE: The higher LCD brightness value used, the faster internal battery drainage time!**

3. In order to select the desired distance measure units (Units), chose either „Feet” or „Meters”
4. In order to select the desired VOP format (VOP Format), chose either 85% or 85.5%):
5. In order to select the desired level of Range, set up the appropriate position of the slide bar
6. In order to select the start-up value of the Vertical Gain (Start-up V. Gain), chose one of the values: 1x/4x, 2x/8x, 4x/16x, 8x/32x
7. In order to select the start-up value of the Filter level, chose one of the values: 1, 4, 8, 16, 32, 64



8. In order to select the option of hidden or active ZOOM windows (Zoom Windows), go to the second page of the Menu by pressing the “down arrow” and select either „Active” or „Hidden”.



Main screen of the instrument:

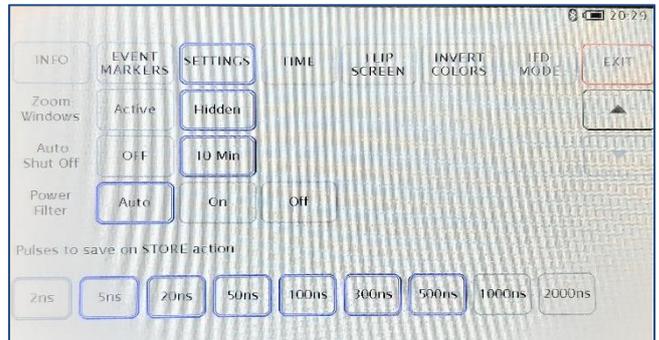
- left – Zoom Windows hidden

- right – Zoom Windows active

9. In order to select the option of automatic shut off (Auto Shut Off), go to the second page of the Menu by pressing the “down arrow” and chose either “OFF” (no automatic shut off) or “10Min” (automatic shut off after 10 minutes without touching the screen)
10. In order to control filtering option for incoming power lines interference “Filter 50Hz”, go to the second page of the “Setting” Menu by pressing the “down arrow” and chose either “ON” (filters on), or “OFF” (filters off) or “Auto Filter” (activating 50Hz filters when the unwanted 50Hz signal is detected by the instrument).

11. In order to declare which selection of pulse widths will be saved on STORE action, please click on the desired values until they are highlighted in blue frames.

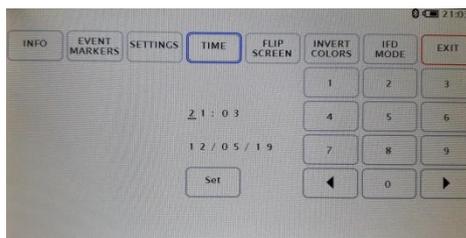
Please, note, all the Tracker series TDRs have the unique „one-touch storage of all pulse widths” feature as standard. The Tracker Pro V3 Model is the only one in which the user decides if all the available pulse widths are being saved for future analysis or only the declared selection of them will be available after the instrument is disconnected from the tested network.



12. Press EXIT to leave the Menu screen

### 2.13.4 Adjusting the Time and Date

1. Press MENU.
2. In the menu window, press TIME.
3. Using the number keypad enter the current time & date (NOTE: This device uses military time format).
4. Use the arrows to move left and right.
5. When the desired time and date is entered press SET.
6. Press EXIT to close the menu window and return to the main screen.



### 2.13.5 Flip Screen

Allows to invert the orientation of the display. This can be useful if you wish to hang the Tracker Pro from the handle or prop it on its back.

1. Press MENU key
2. In the menu window, press FLIP SCREEN key
3. Press EXIT to close the menu window and return to the main screen.

### 2.13.6 Reverse colors

Allows the user to choose either a white or a black background.

1. Press MENU key
2. In the menu window, press INVERT COLORS key



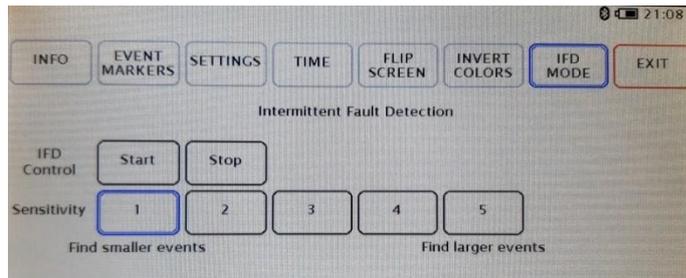
Press EXIT to close the menu window and return to the main screen

### 2.13.7 IFD Mode (Intermittent Fault Detection)

One of the problems on cables that is difficult to diagnose is the so-called “intermittent fault”. The fault of this type often appears after heavy rains or windstorms and it is usually a series of high resistance faults. The Tracker Pro TDR mode of IFD enables to pre-locate these type of faults regardless if they are shorts or opens.

In order to use the IFD mode efficiently, you need to:

1. Connect the Tracker Pro TDR across two cores of a cable that have been suspected of having problem with intermittent fault.
2. Adjust all the on-screen parameters of the waveform in order to see details you need (set up Pulse, Range and Vertical Gain).
3. Press “Mode” key on the main Menu
4. Press „IFD” key.



5. Select the desired sensitivity of the IFD testing on the level between 1 and 5
6. Activate the IFD testing on the cable that the TDR is connected to by pressing „START” key
7. Leave the main Menu by pressing „EXIT” key.

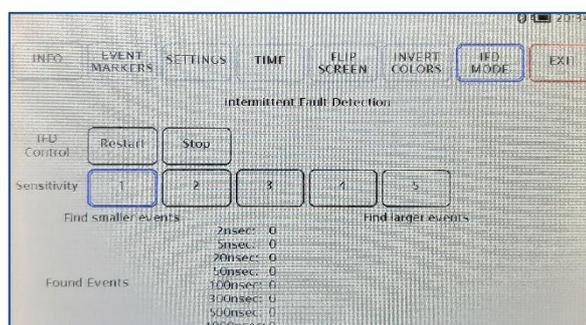
When you have activated the IFD mode, the TDR will record a baseline of the currently connected cable on the pulse width that has been chosen by the user. It will then look for faults that deviate from that baseline waveform. Any fault detected will be recorded as a red line overlayed on the base line (the more events found, the more red lines). The IFD mode of Tracker Pro will record up to 500 faults that occur on the currently activated pulse width. The actual number of the events (faults) that have been recorded will be presented on the upper part of the screen, e.g. “IFD: 189/500”.



**NOTE:** The Tracker Pro TDR enables you to record intermittent faults on the cable only on individual pulse widths such as 2 nsec, 5 nsec, 20 nsec, 50 nsec, 100 nsec, 300ns, 500 nsec, 1000ns and 2000ns.

When you switch a new pulse width it will record a new baseline waveform and continue to record red lines of appearing faults. It will keep recording any faults that it sees on each pulse width up-to 500 total faults.

More detailed IFD data of the total number events (faults) recorded for the declared pulse widths will be presented on the IFD Mode Control screen. Just press “Menu” key followed by pressing “IFD Mode” key



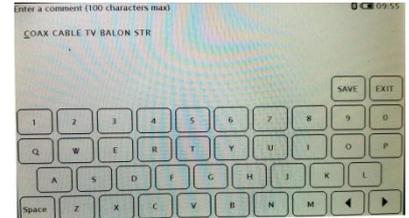
Press the “Exit” key to come back to IFD recording mode

**NOTE: Do NOT exit IFD mode at his stage in order not to lose your measurement data!**

When you have finished your IFD mode session on all the required pulse widths, you can store the waveform as you normally do - just press “STORE” key on the main screen. All pulse widths will then be recorded and all of the faults will also be recorded. All the intermittent faults recorded can be then recalled and can also be viewed on the Tracker Pro display or transferred for viewing on the TrackerView PC application.

When viewing a recalled IFD waveform you can add comments to the file recorded. The user can do it any time until the record is deleted or overwritten.

1. Press RECALL
2. Select the desired waveform form the Memory Content screen
3. Press “Comment”
4. Key in the text you wish to save
5. Touch “Save” to store the comments with the waveform
6. Touch “Exit” to discard
7. Press GO LIVE to leave the area of internal memory of the TDR



**NOTE:** Any comment that has been entered by the user will be visible for the procedure of transferring the data to a PC (data transfer screen). The comment will be transferred with the file and the user can find it in the Comment area on the TrackerView screen while viewing the waveform on a PC.

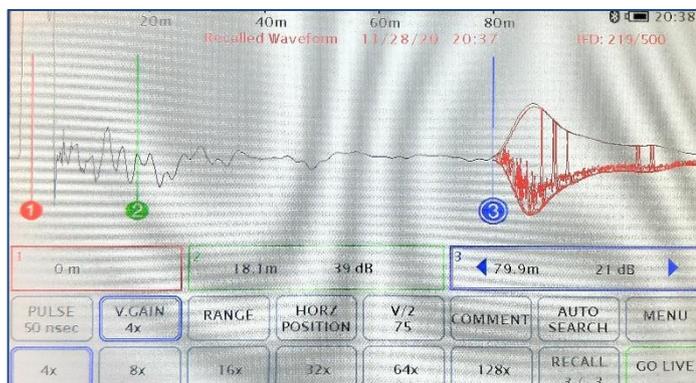
In order to exit from the IFD mode

1. Press “Mode” key on the main Menu
2. Press „IFD” key.
3. Press „STOP” key

You can also start another IFT testing session by pressing “RESTART” key on this screen.

**Recall of IFD data from the Tracker Pro’s memory**

The stored IFD data will be presented as a baseline of the tested cable at the pulse width that has been chosen by the user including overlaid red lines of the events/faults that have been recorded during IFD testing. You can analyze such IFD data when you open the file from the memory screen on the Tracker Pro. Please, note you can see the IFD data only on the pulse widths that have been previously declared during the IFD testing stage, the waveform at other pulse widths will display the base line only.



**NOTE:** Due to its nature, IFD testing can take some time. In order not to lose the measurement data due to the internal battery run time level, please, make sure you control the charging status of the battery. You can always activate IFD mode with the charging procedure on (the active use of the TDR during the charging procedure from the 230 V AC mains or from the external power generator).

## 2.14 Internal Memory

### 2.14.1 Storing of Waveforms

1. Connect the cable under test to Tracker Pro
2. Press STORE
3. Wait a moment, until the icon returns to the word STORE, for Tracker Pro to save the cable at all pulse widths.
4. When storing, the button will show the word "Storing" and the indication of the memory cell where the measurement is actually being stored, e.g. "6/10" plus a "progress bar" of the storing operation. When finished storing the button will return to showing the word "Store". After storing, you can disconnect the cable and work remotely or download to your PC or a mobile device.
5. The Tracker Pro is able to store up to 60 waveforms. Once 60 waveforms have been stored the Tracker TDR will start replacing the oldest waveform with the newest.

**Please, note, all the Tracker series TDRs have the unique „one-touch storage of all pulse widths” feature as standard. This means that the instrument will save all pulse widths available for the model used regardless of what is actually seen on the screen. Each file is approximately 1 MB.**

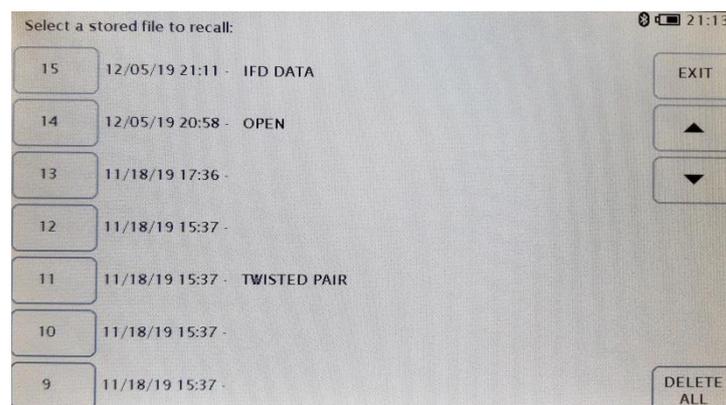
**The Tracker Pro V3 Model is the only one in which the user decides if all the available pulse widths are being saved for future analysis or only the declared selection of them will be available after the instrument is disconnected from the tested network.**

### 2.14.2 Saved Waveforms

All the measurement data recorded into the Tracker Pro’s internal memory can be recalled at any time for some more careful or advanced analysis. You can view the whole trace of the testing pulse along the cable at all available pulse widths no matter how was the setting of the screen at the time of storing. Each file can be transferred to a PC with the use of the USB cable for further analysis, printing or with the purpose of using it as a Template/Reference waveform to be compared with some other waveforms recorded on the same section of a cable later on. It can also be transferred to a mobile device such as tables or smartphone with the use of Bluetooth communication or a micro-USB cable (only Android powered devices) with the purpose of, e.g. sending the measurement data to an office for urgent comparison with the Template/Reference waveform of to a customer in a PDF format

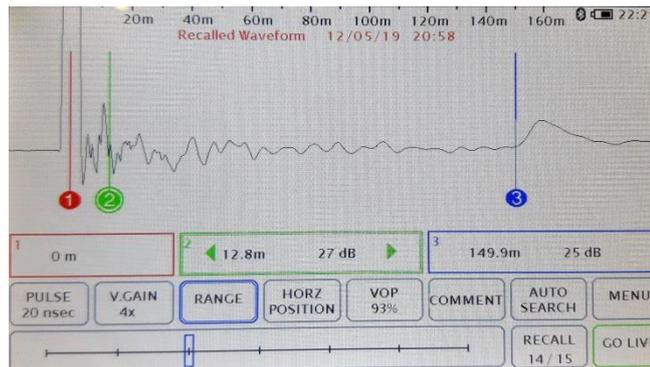
### 2.14.3 Procedure of Viewing Saved Waveforms

1. Press RECALL in order to open the Memory Content screen



2. Select the desired waveform – each of them can be identified by a number of the memory cell where the measurement has been actually stored, date and time of storing and description of the file (only if the user has entered such description)
3. On the right side of the screen, the user can see the Exit button (coming back to the main screen), arrows to scroll the memory content screen up and down and the Delete All button to initiate the 3-step procedure of erasing the instrument’s measurement data memory.

The recalled waveform contains information on the date and time when it was stored. The information in red is displayed at the upper part of the screen



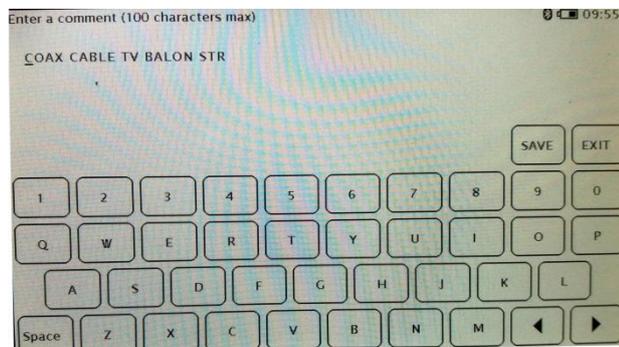
At this time, you can change the parameters of the presented waveform such as the pulse width, vertical gain, range and VOP. You can move all the 3 cursors and measure distances to multiple events on the cable.

**NOTE:** While viewing the recalled waveforms, the key RECALL has changed into GO LIVE. Pressing this key results in leaving the area of internal memory of the TDR and going back to the live waveform under test (if any testing is actually being done).

#### 2.14.4 Editing Comments

When viewing a recalled waveform you can add comments to each of the recorded measurements. The user can do it any time until the record is deleted or overwritten.

8. Press RECALL
9. Select the desired waveform from the Memory Content screen
10. Press "Comment"
11. Key in the text you wish to save
12. Touch "Save" to store the comments with the waveform
13. Touch "Exit" to discard
14. Press GO LIVE to leave the area of internal memory of the TDR



**NOTE:** Any comment that has been entered by the user will be visible for the procedure of transferring the data to a PC (data transfer screen). The comment will be transferred with the file and the user can find it in the Comment area on the TrackerView screen while viewing the waveform on a PC.

#### 2.14.5 Deleting of Waveforms from the TDR

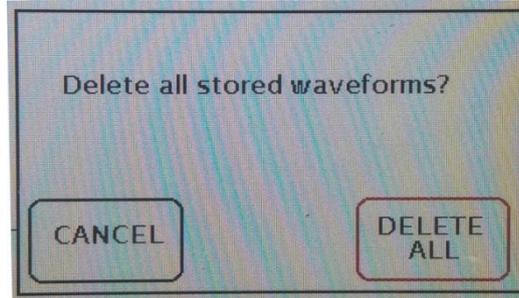
The user can clear the internal memory of the Tracker Pro, e.g. before going out for a series of cable tests that require storing a large number of measurements. Deleting all the recorded files in such a case would ease identification of the newly recorded data.

**NOTE:** **DELETING ALL feature of the Tracker Pro is IRREVERSIBLE!**

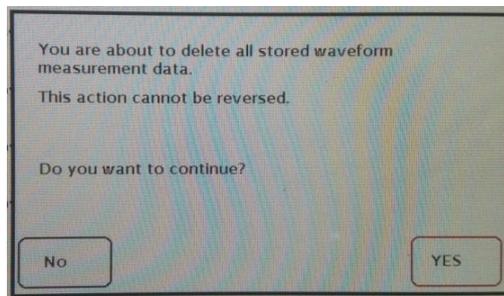
However, the procedure goes in 3 steps and the user is receiving clear warnings before the measurement data are actually and irreversibly lost.

The actual procedure of clearing the Tracker Pro's memory is the following:

1. Press RECALL if you are on the main screen
2. Press Delete All on the Memory Content screen (right-hand corner of the screen)
3. Select the desired option: „DELETE ALL“ (clear all the internal memory) or „CANCEL“ (to stop the deleting procedure).



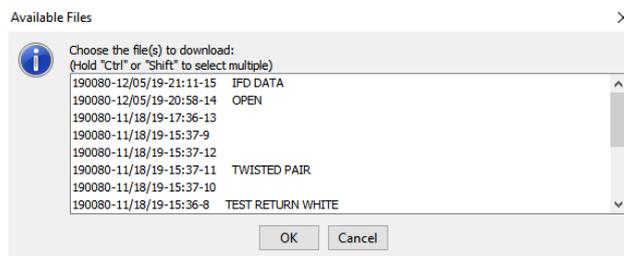
4. If you have pressed DELETE ALL, the next step is to confirm your wish to continue the procedure of deleting all the measurement data by pressing YES or you pressing NO (to stop the deleting procedure).



**NOTE:** Finalizing the DELETE ALL procedure for the Tracker Pro results in deleting all measurement data that have been recorded so far in the internal memory of the instrument. As soon as the DELETE ALL procedure is completed, the key RECALL on the main screen is inactive as there are no waveforms in the instrument's memory.

#### 2.14.6 Downloading of Saved Waveforms into a PC

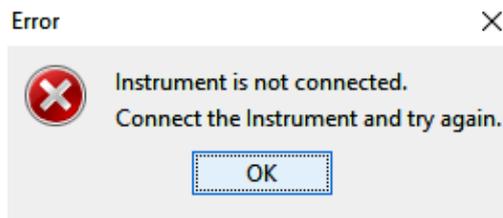
1. Connect Tracker Pro to your PC using a USB cable.
2. On your PC, open the "Tracker View" application.
3. Turn on the Tracker Pro.
4. Select "Download from Instrument" option by pressing the key in the right-up corner of the screen.
5. Select the file or files to download.
6. A progress bar will close when the download is complete and the file has been moved to your Tracker View folder on your PC.



**NOTE:** If you download a single file from your Tracker Pro, the waveform will be displayed on the PC screen and the file will be automatically stored on your PC (a default folder is TrackerView). If you download more than one file at the same time, all the selected files will be stored on your PC (a default folder is TrackerView) but none of them will be displayed on the PC screen after the data transfer.

**NOTE:** All the files are being transferred to a PC in a "raw format", that is, without the proper values of Pulse or Range, even if the user has set up those values on the Tracker Pro screen.

**NOTE:** In case of any problems with communication between the Tracker Pro TDR and the PC, an Error message will appear:



### 2.14.7 Downloading of Saved Waveforms into a Mobile Device

1. Open the Tracker View App on your iPhone or Android device.
2. Turn on the Tracker Pro (must have Bluetooth, not available on all models)
3. Touch "Download" on your smart device.
4. The smart device is scanning for the TDR (no other devices can be paired such as headphones).
5. Select the TDR by touching the serial number displaying on your smart phone device and touch "Connect".
6. Select the waveform you wish to download and touch "Download". A progress bar will display the waveform.

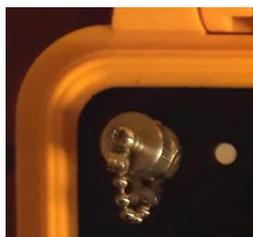


## 3. Charging the Batteries

The Tracker Pro is powered by a rechargeable battery pack contained within the instrument.

When the battery supply has been depleted and the batteries need to be recharged, plug the external battery charger into the front panel charger socket and into any common AC outlet. The front panel green LED will light to indicate the batteries are being charged. The LED indicator will stay illuminated while the charger is plugged in.

The Tracker Pro will operate while being charged as long as the battery level indicator is above a quarter charge. Allow at least 5 hours charging time for the batteries to cycle from a completely discharged state to a fully charged state.



## 4. Examples of Waveforms

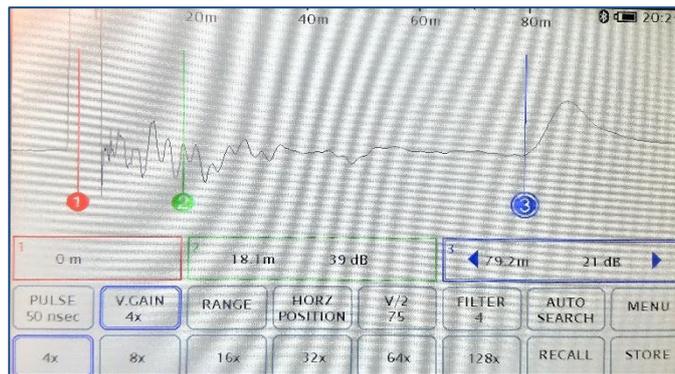
A great variety of waveforms may be encountered. This is due to the various applications and electrical and environmental characteristic differences found in the wide variety of cables that exist today.

Remember: The reflection of a fault or component will look different on a short length of cable than it will on a long length of cable.

Various industries, cable types, and components produce many different waveforms. The TDR's pulse width, range, and vertical gain settings all affect how a waveform will appear. Practice testing various known cable segments, with and without components. Become familiar with how each segment looks prior to any problem.

### Open

If the cable is an open circuit, the reflected pulse will be in-phase (upward reflection) with the output pulse - full amount of test pulse energy will be reflected. On the picture below, the blue cursor marks the position of this open circuit of a high impedance.

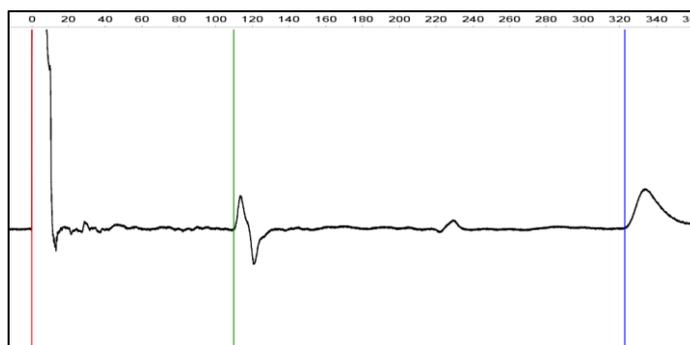


### Short

If the cable is a short circuit, the reflected pulse will be out-of-phase (downward reflection) with the output pulse. On the picture below, the blue cursor marks the position of this shorted circuit of a very low impedance. Since this is a metallic short of two copper cores, the full amount of test pulse energy will be reflected and there will be no reflection from the end of the cable.

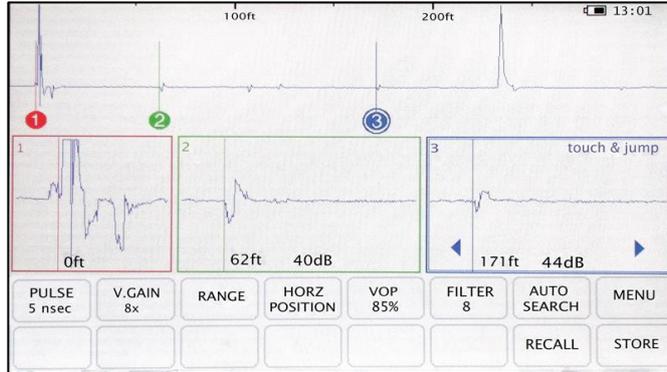


**Joint** A typical picture of a joint along the cable, the green cursor is on the joint (an upward reflection immediately followed by a downward reflection). The blue cursor marks the end of the cable. The below picture comes from the TrackerView application for PC.



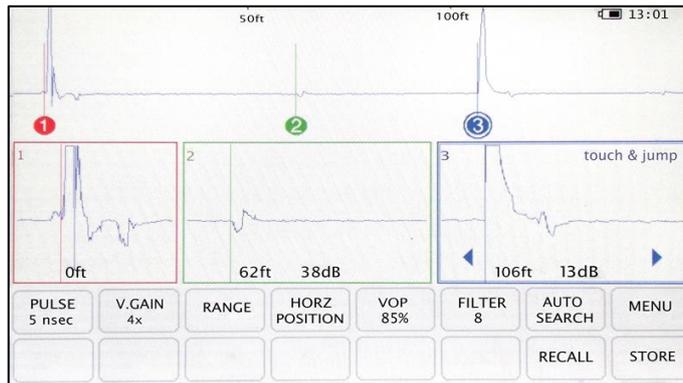
**One Extender**

An extender will show a signature with a low impedance (green cursor) with a high impedance immediately following (blue cursor).



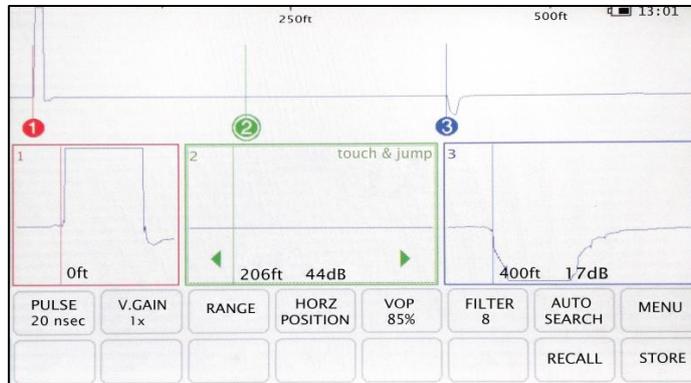
**Multiple Extenders**

The Tracker TDR has the capability to see more than one extender on a coaxial cable. The farther away the extender the higher the dB level.



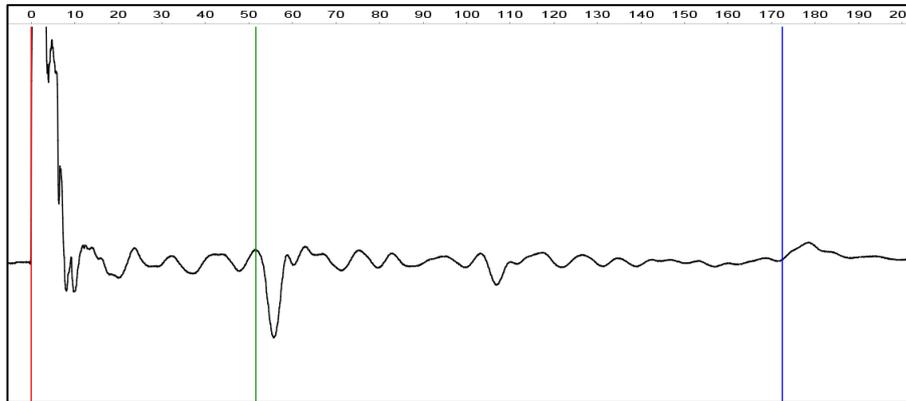
**Shooting From Both Ends**

When using two TDRs (one at each end of the same cable) the cable is displayed as a short.



**Wet joint at district heating pipeline system**

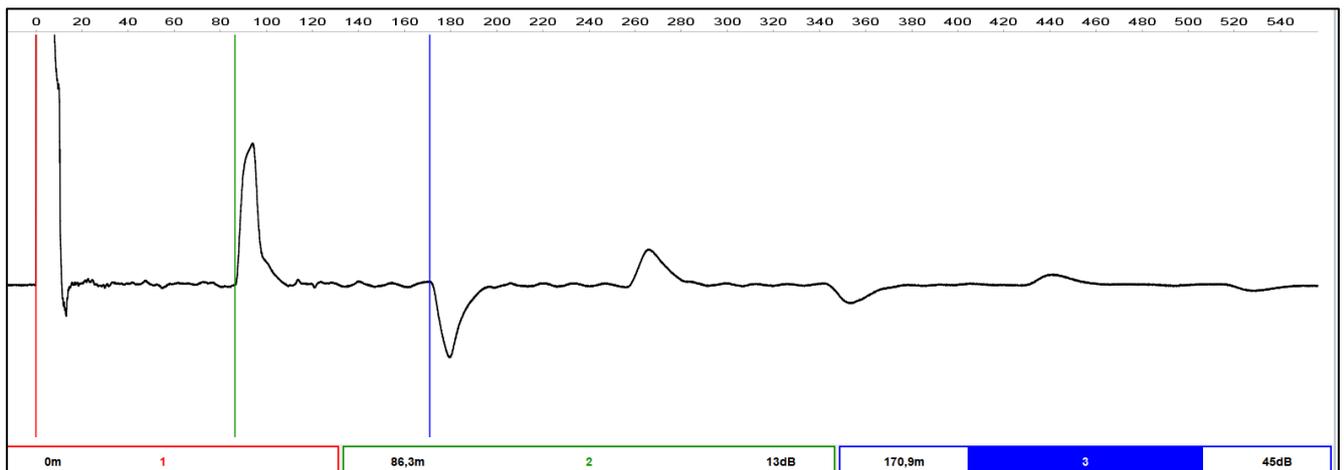
A typical picture of a wet joint that was found on a district heating pipeline system. The resistance of the fault was 8 kHz which is marked by the green cursor (a short in the loop). The blue cursor is set at the end of the tested loop – the severity of the pipeline fault is not critical (small amount of humidity at a small area) so the testing pulse was able to pass the problem area and was reflected at the end of the loop. The below picture comes from the TrackerView application for PC.



**“Ghost” reflections along the cable**

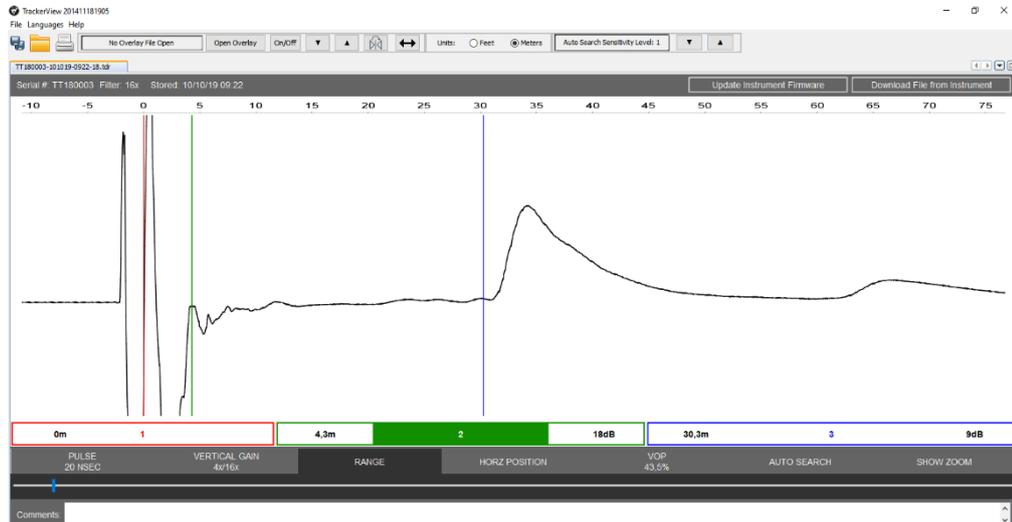
It happens quite often that a series of “ghost reflections” can be seen on the waveform. They are signatures that appear on the TDR trace but they do not correspond to any actual splice or “true” problem with the cable. They are just anomalies that have to be ignored in the process of analyzing the waveform. The picture below presents an open circuit at the distance of 86.3m which is marked by the green cursor. The blue cursor and following “ups and downs” of the TDR trace are only “ghost reflections”. The truth is that the whole energy of the testing pulse was reflected at the open circuit and what you can see on the right from the green cursor it’s a series of anomalies of the waveform only and not faults of the cable.

A practical hint how to make sure a given reflection can be recognized as a “ghost reflection”: it’s usually a double distance from the source of a testing pulse as compared to the main reflection that stops the pulse to travel onwards and it’s usually in a reverse phase to it. The “ghost reflections” that follow, copy the same pattern. The below picture comes from the TrackerView application for PC.



## 5. TrackerView PC Application to Tracker series TDRs

TrackerView application for PC is a standard part of delivery while purchasing of Tracker series TDRs. The software can be used for deeper analysis of waveforms on a larger screen, printing test reports, and archiving measuring data – both for future reference and for comparing historical data with current measurements in the process of monitoring of various types of networks. The TrackerView application is very easy to use – its layout is basically the same as for the Tracker series TDR screen and its functionality reflects the TDR’s everyday use plus it gives some extra features.



### 5.1 Availability of TrackerView application

The TrackerView PC application is free of charge. It is delivered to every new user of a Tracker series TDR either on a CD or as an option of a free download from the manufacturer’s website:

<http://springbokinstruments.com/sand/downloads-2/>

e.g. TrackerView 2.54 for Windows (where 2.54 is the current revision of the software available)

**NOTE:** TrackerView application for mobile devices such as tablets or smartphones can be downloaded directly as a mobile application from APP Store (Apple related devices) or Google Play (Android operating system). You just write down “Springbok Instruments” in the Search window.

TrackerView application for mobile devices can be also downloaded from the manufacturer’s website:

<http://springbokinstruments.com/sand/downloads-2/>

e.g. TrackerView for iPad & iPhone

or

TrackerView for Android

**NOTE:** Mobile TrackerView Apps are free of charge.

### 5.2 The screen layout

After switching on of the TrackerView Pc Application, you can see seven sections of the screen:

- Upper Tool Bar
- Info Bar + Communication
- Distance scale
- Waveform and Cursors
- Zoom windows (precise cursor placement)
- Main Control Panel
- Comments box

## 5.2.1 Upper Tool Bar

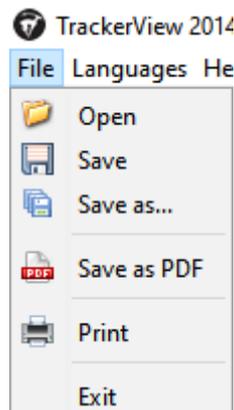
In the upper part of the screen, there is a tool bar for operating a few functions such as:

- opening, closing, saving, saving as, saving as PDF file related to files of recorded measurement data
- printing of recorded waveforms
- searching for available updates of the software
- choosing languages available for the screen operations
- operating Overlay function of comparing waveforms on the screen
- settings of Units for distance and controlling sensitivity level of Auto-Search feature



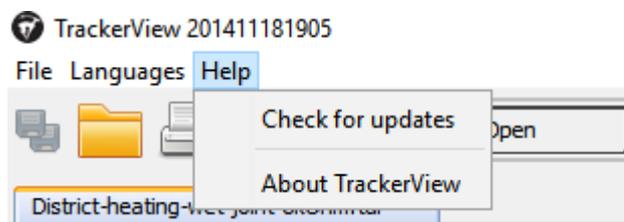
When you click on „File”, you get access to a context menu where you can:

- „Open” – open a file originally recorded on a Tracker series TDR and then transferred to the PC
- „Save” – save the file currently being viewed on the screen into a dedicated folder of the PC
- „Save as...” – save the current file with a different name into a chosen folder of the PC
- „Save as PDF” - save the current file in a PDF format into a chosen folder of the PC
- „Print” – print the current picture of waveform being viewed on the screen on the printer attached to the PC as well as some basic information on the file (file name, serial No. of the TDR, date of its original recording) and the waveform setting on the screen (testing pulse, level of VOP and Vertical gain)
- „Exit” - close the TrackerView application



When you click on „Help” you get access to a context menu where you can:

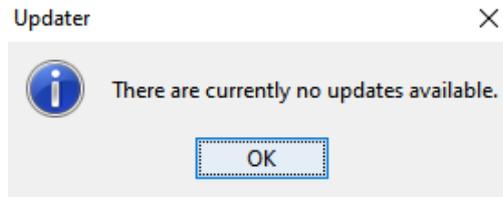
- „Check for updates” – check if there are any new updates available for TrackerView application
- „About TrackerView” – check the current software revision of TrackerView application being used



When you click on „Help” and then on “Check for updates”, the PC will start searching for new updates available for TrackerView application by communicating with the manufacturer’s database over the internet.



If there are currently NO updates available in the manufacturer’s database, that is „more current version than the one having been installed on the PC actually used”, the user will receive a message:



Periodically, when the user opens the TrackerView application, an interrogation window might open with a message:

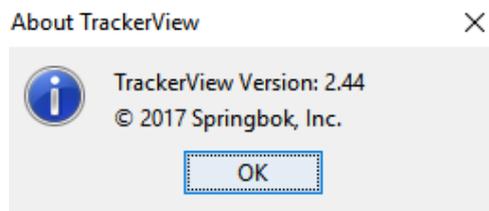
**“It has been 30 days since the last time TrackerView has checked for an update. Do you want to check for updates?”**

When the user confirms the wish to check the updates available, the PC will start searching for new updates available for TrackerView application by communicating with the manufacturer’s database over the internet. If the new update is found, the user will be asked for confirmation to install the new software revision. Then, the update will be downloaded and the user will receive a message:

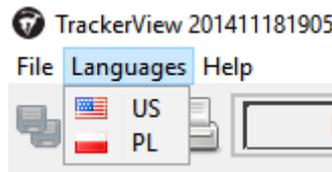
**“A new update is ready to install. Restart TrackerView to complete installation”**

**NOTE: New updates can be downloaded if the PC actually used by the user has access to internet.**

When you click on „Help” and then on „About TrackerView”, you will receive information on the current version of the TrackerView software that has been installed on the PC in use.

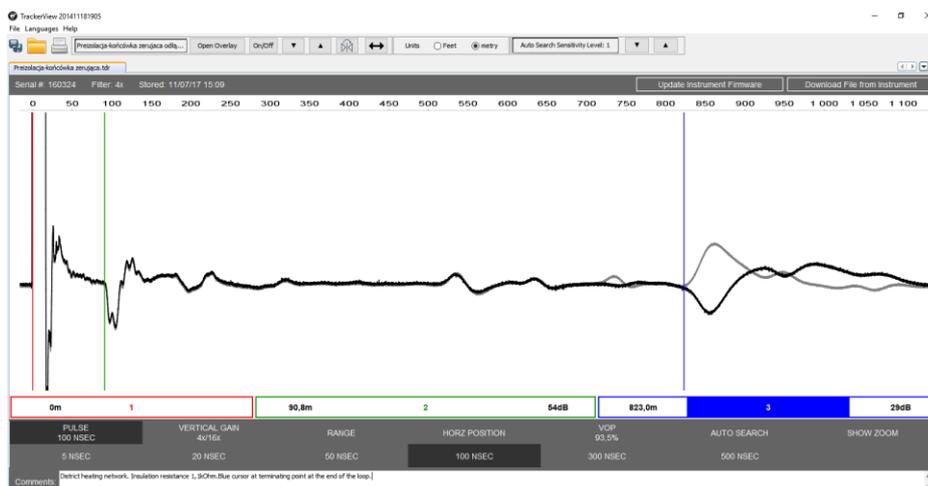


When you click on „Languages”, you can change the language of all the screen operations.



## 5.2.2 Comparing waveforms - OVERLAY

The upper Toolbar is also the place where all the controls for comparing waveforms are located. The Overlay feature enables you to compare two different waveforms on the screen, e. g. you can compare a “template” (or “reference”) waveform recorded on a given section of the network with a waveform recorded on the same section but in the time when the insulation resistance parameters of the network clearly show a problem with the line. When you compare such two waveforms (overlay one onto the other), it’s very likely you will find out the fault of the network in the place where the two graphs split .



Procedure of comparing waveforms:

1. Open the file including the „template” (reference) waveform
2. Click on „Open Overlay” in order to open the second file including a waveform to be compared with the “template waveform”
3. Using the functions of the Control Panel such as “pulse”, “vertical gain”, “range” or “VOP”, adjust the picture of the waveforms to the optimum state you think they can be analyzed (both waveforms will react at the same time to the changes of control parameters)
4. Use the „up” and „down” arrows to shift the waveforms, that is to move away from each other or to bring closer in order to see more details (only the overlay waveform is actually moving)
5. Use the On/Off switch to close and then open the overlay waveform again in order to see more details
6. When you click on „Open Overlay” again, you can open another file with a waveform to be compared with the “template waveform”. Since only one waveform can be overlay onto the “template waveform”, this means the former overlay waveform will be automatically closed.

### 5.2.3 „Mirror Horizontal” Feature

It can happen, especially when quite a long section of the network is to be tested, that a fault at the distant end is difficult to analyze due to a low energy of the testing pulse having been left. In such a case, it is recommended to do a TDR test from both ends (provided that access to the far end is available). Using “Mirror Horizontal” feature, we can compare such two recorded waveforms on one screen and make sure where the actual fault is located.



In order to complete the procedure of correct interpretation of such fault analysis, the user needs to use one more feature – „Drag Overlay Waveform”. You just click on the „Drag Overlay Waveform” icon on the Upper Tool Bar and then use the mouse to drag the overlay waveform left or right until you get the expected results.



**Note:** Both features: „Mirror Horizontal” and „Drag Overlay Waveform” are active only when you overlay waveforms (compare two graphs on the screen).

## 5.2.4 Info + Communication Control Bar

Just below the Upper Tool Bar, you will find the Info + Communication Control Bar.



On the left side of the screen, you will find four types of information:

- the name of a file that is actually opened on the screen
- a serial number of the TDR on which the file has been originally recorded
- the level of TDR filters at which the file has been originally recorded
- date and time when the file has been originally recorded into the TDR's memory (military format of date – month/day/year and military format of time, e.g. 18:20)

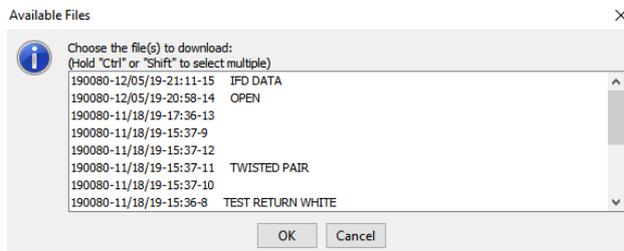
On the left side of the screen, you will find two controls for communication with a Tracker series TDR:

- Update Instrument Firmware
- Download File from Instrument

## 5.2.5 Download File from Instrument

„Download File from Instrument” feature enables the user to download all the files available in a Tracker series TDR's memory. The files can be easily downloaded into TrackerView PC application and then they can be used for deeper analysis of waveforms on a larger screen, printing test reports, and archiving measuring data – both for future reference and for comparing historical data with current measurements in the process of monitoring of various types of networks.

1. Connect the Tracker series TDR to your PC using a USB cable.
2. On your PC, open the Tracker View application.
3. Turn on the TDR.
4. Select “Download from Instrument” option of the TrackerView application by pressing the key in the right-up corner of the screen.
5. Select the file or files to download on the dialog window.
6. A progress bar will close when the download is complete and the file has been transferred to the Tracker View folder on your PC.

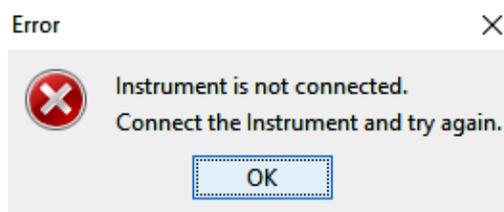


**NOTE:** If you download a single file from your Tracker series TDR, the waveform will be displayed on the PC screen and the file will be automatically stored on your PC (a default folder is TrackerView). If you download more than one file at the same time, all the selected files will be stored on your PC (a default folder is TrackerView) but none of them will be displayed on the PC screen after the data transfer.

**NOTE:** All the files are being transferred to a PC in a “raw format”, that is, without the proper values of Pulse or Range, even if the user has set up those values on the TDR screen.

**NOTE:** The procedure of transferring files DOES NOT delete the original files from the TDR's memory.

**NOTE:** In case of any problems with communication between the Tracker series TDR and the PC, an Error message will appear:

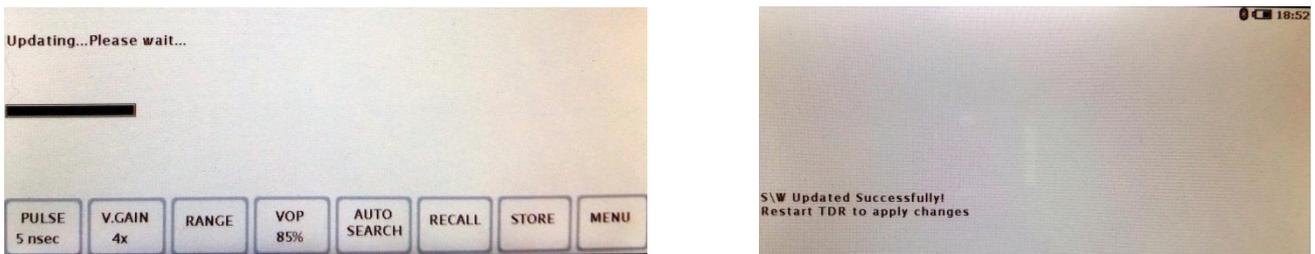


## 5.2.6 Update Instrument Firmware

The procedure of updating Tracker series TDR firmware can be done only from a PC via the TrackerView application. The procedure requires connection to internet as any update is controlled by the Springbok Instruments database of users.

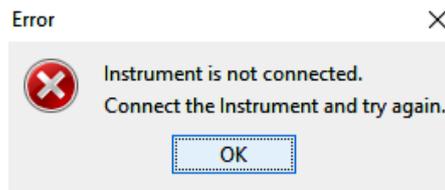
1. Press the Tracker series TDR's MENU and check the software revision No.
2. Connect Tracker series TDR to your PC using a USB cable.
3. On your PC, open the Tracker View application.
4. Select "Update Instrument Firmware" and wait a few seconds for the instrument's reaction.
5. Switch the TDR off and on again in order to install the new firmware.
6. Press MENU and check if the new software revision No. has been installed.

Please note: If the user initiates the procedure of updating the Tracker series TDR's internal software, the whole procedure of update will have to take place even if there is no new update of the Tracker series TDR internal software available at this time.



A typical Tracker series TDR screen during the update procedure.

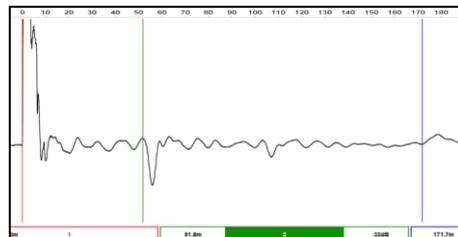
**Note:** In case of any problems with communication between the Tracker TDR and the PC, an Error message will appear:



**Note:** In case of any problems with the update to the Tracker series TDR installation, please contact your equipment dealer or authorized Springbok repair service.

## 5.2.7 Distance Scale

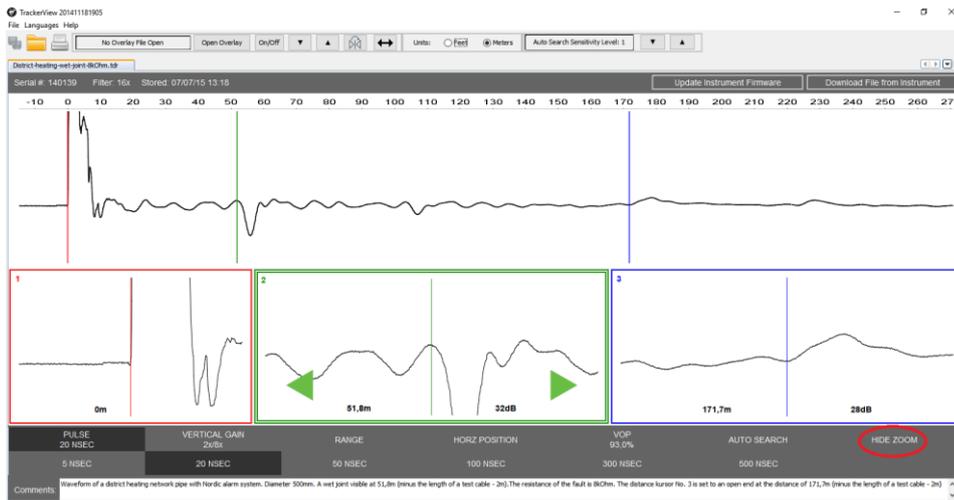
Just below Info + Communication Control Bar, you will find „Distance Scale” that helps to control distances at which you expect to find some regular points on the waveform such as any known splices or joints. In this way, the user gets the reference points as compared to the actual faults. The „Distance Scale” helps also to estimate which level of the Range should be used while viewing the waveform.



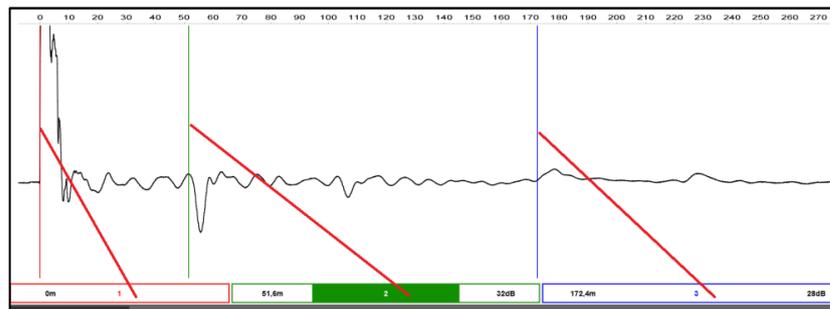
## 5.2.8 Waveform and Cursors

When you open the TrackerView application and open any measurement data file, the main screen is similar to the Tracker series TDR's screen. You can see two distinct sections - 1) the picture of a waveform over a certain distance and 2) cursor Zoom windows. When you click on "Hide Zoom", you can analyze the waveform on a much bigger part of the screen.

Please, note, if you work on the Show Zoom mode, you can fine tune the location of the cursor by touching the arrows inside the zoom window to move the cursor left and right. It's definitely more precise way of positioning the cursors. The biggest part of the screen is for presenting of waveforms (graphical presentations of the testing pulse reflections along the network under test) together with three color cursors.



When you open a file including TDR measurement data, you can see a waveform and three color cursors. The first **red cursor** is automatically set up at the beginning of the first pulse reflection going up – this is the place where the testing pulse leaves the instrument. It might be the case that the user of a TDR set up the first **red cursor** of the instrument a little further along the tested network in order to cancel test lead length – this will be continued on the TrackerView screen until the user decides to change the position of the cursors. The remaining **green cursor** and **blue cursor** will be set up by the user on the reflections of the testing pulse that are suspected to be faults.



The user should first click the mouse on a cursor Zoom window (or cursor distance window in a show zoom mode) in order to choose which cursor is to be set up. Then, the given cursor can be placed on the screen with the use of the mouse. When you set up the second **green cursor** or the third **blue cursor** on the chosen place of the waveform, you will find two values in the cursor Zoom window (or cursor distance window in a hide zoom mode) – the distance between the given cursor and the first **red cursor** in [m] (most commonly being the place of fault) and return loss in [dB] indicating severity of the fault (the lower the value the more severe the fault). The **red cursor** is then the reference cursor and all the distances calculated by the software are based on the principle – the given distance is between the second **green cursor** and the **red cursor** or the third **blue cursor** and the **red cursor**.

NOTE: The general principle of cursor placement is always the same – the cursor is placed on the beginning of a rising or falling slope of the graph or, when you compare two waveforms, in the position when they split (read: significantly differ). However, it is the user that decides where the cursor is going to be placed. This is the user that decides if the cursor having been placed indicates the point of a fault or it's just a regular joint or other impedance mismatch characteristic for the given section of the network under test.

### 5.2.9 Main Control Panel

The bottom part of the screen contains Main Control Panel. This is the control center where a waveform can be adjusted to get the best picture on which the user can analyze the graph in order to find a fault.



**NOTE:** The function keys are NOT active when there is no measurement data file opened

### A. Choose the pulsewidth (testing pulse)

Click on the function key first in order to choose the desired control function. Then, choose the desired value on the bar below.

„Pulse: 100ns” – indicates the actual testing pulse used.

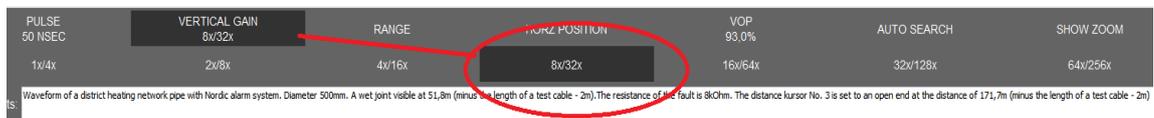


**NOTE:** TrackerView application allows you to adjust the waveform originally recorded on a Tracker series TDR in a full scope of test pulses available for the Tracker system.

### B. Choose the Vertical Gain value

Click on the function key first in order to choose the desired control function. Then, choose the desired value on the bar below.

Vertical Gain 8x/32x indicates the actual value of the graph amplitude presented on the screen.



### C. Choose the Range of the waveform displayed on the screen

Click on the function key first in order to choose the desired control function. Then, choose the desired value on the bar below.



The Range feature allows the user to expand or shrink the picture of the waveform viewed on the screen. The maximum Range No. 6 enables the user to see the maximum distance of the tested network but it depends on the VOP value used by the user.

Please, note, adjusting the Range value does not change the setting of the testing Pulse. In order to analyze the waveform properly and not to miss any vital details along the tested network, you have to adjust both pulse width used (enough energy of the pulse to reach certain distance) and range value (the current section of the tested network presented on the screen) at the same time.

### D. Choose the HORZ Position function

This function helps you to adjust horizontal position of the graph to the left or right without changing the Range function setting. You can use it to view the whole length of the tested network at the chosen pulse width in search of unusual reflections that could be actual faults or expected regular points.



### E. Choose VOP value

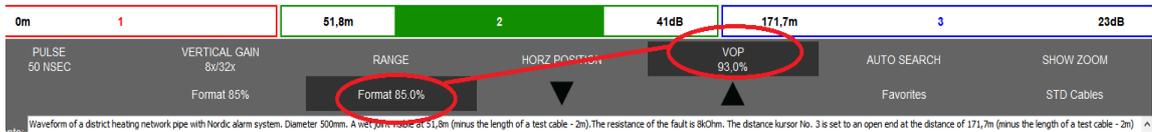
Click on the function key first in order to choose the desired control function. Then, choose the desired value of additional function on the bar below.

„VOP: 93,0 %” indicates the actual value of the VOP (Velocity Of Propagation) that is used for the fault analysis of the given network type.

Use up or down arrows to adjust the desired VOP characteristic for the given network type.

For the VOP setting, you can use three additional functions:

1. You can choose „**Format**” of the VOP parameter being used as an integer rounded up, e.g. 93% or a decimal number, e.g. 93,0%



Click on the VOP function key, then on the Format key (either Format 85% or Format 85,0%) and finally use the up or down arrows to adjust the desired VOP characteristic for the given network type

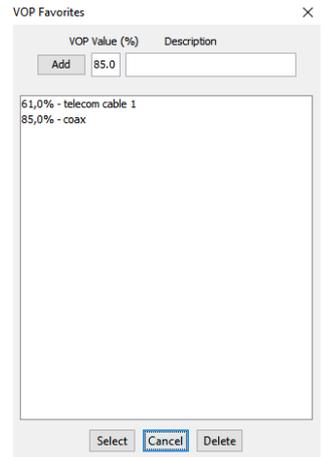
2. You can choose the option “**Favorites**” in order to spare some time on manual adjusting of the desired VOP and to create a list of pre-defined VOP values of the most frequently network types being tested by the user.



Click on the VOP function key, then on the “Favorites” key, choose the pre-defined value and press “Select”.

**Editing the „Favorites” list of VOP values:**

- write down a short description of the network
- write down the desired value of the VOP for the given network
- Note: decimals are separated by a „dot” and not by a „coma”
- click on “Add” key

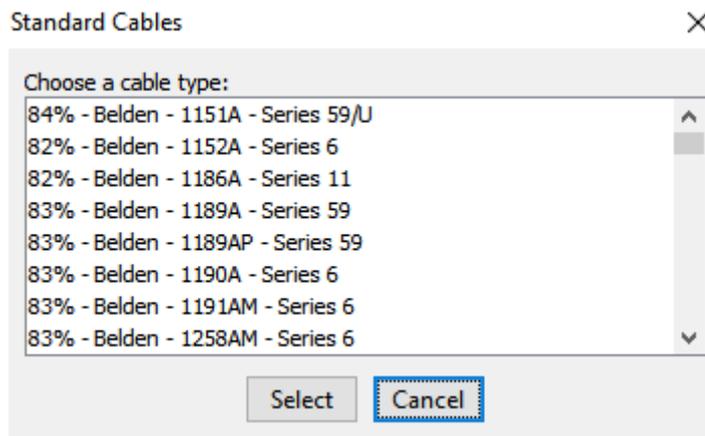


All the pre-defined values and their descriptions can be edited or deleted any time – you just need to select the desired entry and click on “Delete” or correct the description or VOP value itself.

3. You can choose „**STD Cables**” option in order to use a pre-defined list of VOP values for most commonly cables used on the US market



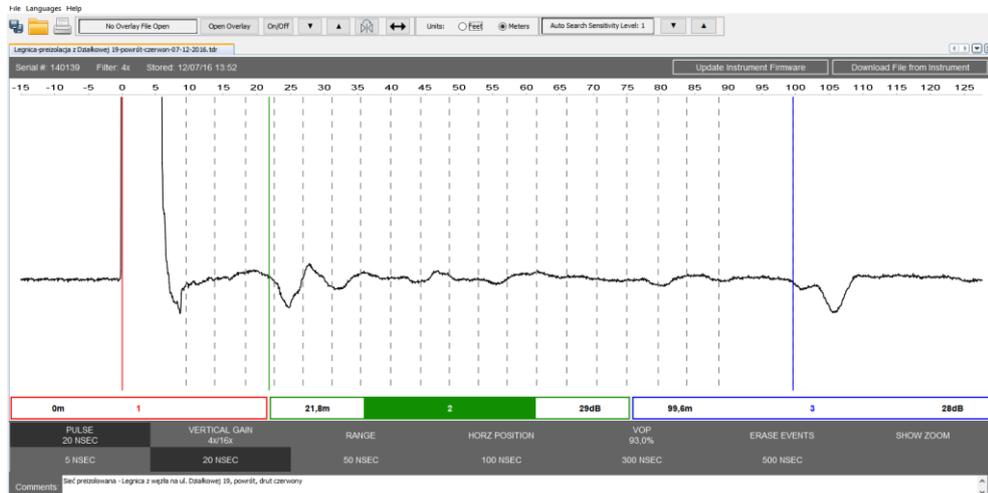
The „**Standard Cable**” window contains a list of some 65 different cable types with its names and appropriate VOP value declared by their manufacturers. Just click on the VOP function key, then on the “STD Cables” key, choose the pre-defined value and press “Select”.



## F. Choose the Auto-Search function

The **Auto-Search** function is used to analyze the waveform in a quick way at an automatic search mode of the most severe fault along the tested network.

1. Click on the AUTO SEARCH key.
2. The **blue cursor** moves automatically to the largest impedance mismatch.
3. Markers are placed at possible events along the tested network. The markers can be deleted by pressing the key "Erase markers"



While testing a cable - when the end of the cable is disconnected from the cable plant, the largest reflection will be the end of the cable and therefore cursor No. 3 will move to the end. If not disconnected, the blue cursor will move to the largest impedance mismatch on the cable line.

**NOTE:** The Auto-Search mode is working properly in a variety of different conditions but you just cannot assume it works perfect in all of the situations. It's only just a helping tool to the user.

**NOTE:** If you pressed the Auto-Search key and the blue cursor was moved to the place at the leading edge of the pulse reflection from the point where the crocodile clips of the test leads had been connected to the network under test, it DOES NOT mean there are no other faults along this network!

You can find „Auto-Search Sensitivity Level” key in the Upper Tool Bar of the screen. By clicking on the arrows on the left of this key, you can adjust the level of sensitivity used for the „Auto-Search” mode, where Level 1 means “automatic search for less severe faults” and Level 5 means “automatic search for more severe faults”.

### 5.2.10 Full testing screen option

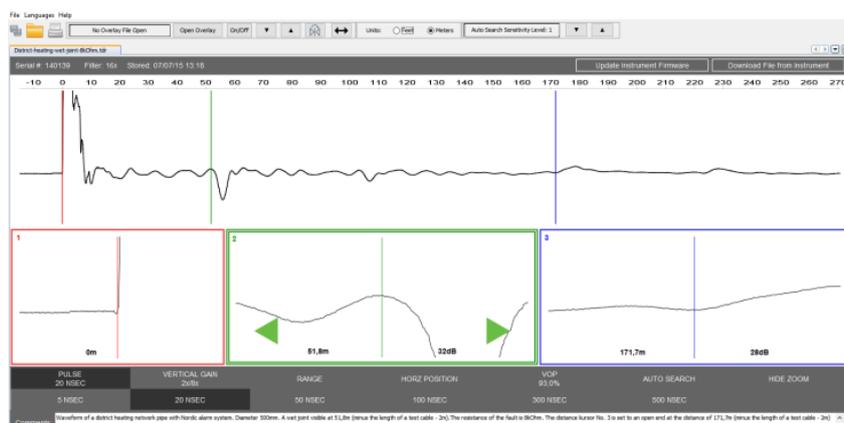
You can analyze the waveforms on two available types of screen:

- A. “Hide Zoom” mode
- B. “Show Zoom” mode

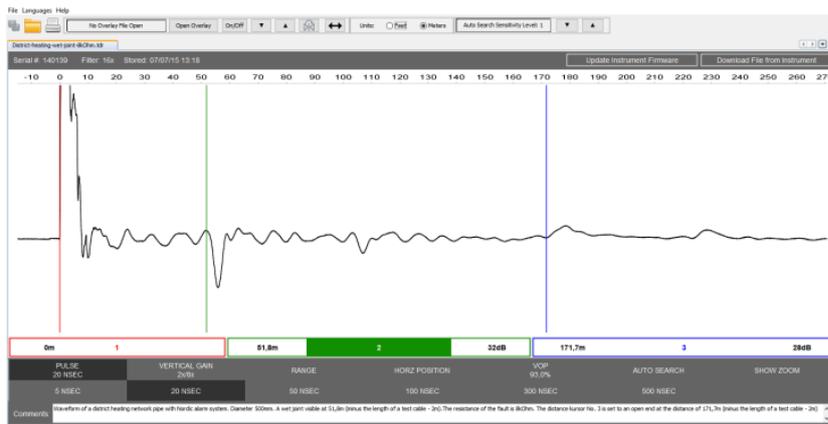
When you open the TrackerView application and open any measurement data file, the main screen is similar to the Tracker series TDR's screen.

You can see two distinct sections:

- 1) the picture of a waveform over a certain distance
- 2) cursor Zoom windows



However, when you click on “Hide Zoom”, you can analyze the waveform on a much bigger part of the screen as the cursor Zoom windows are minimized.



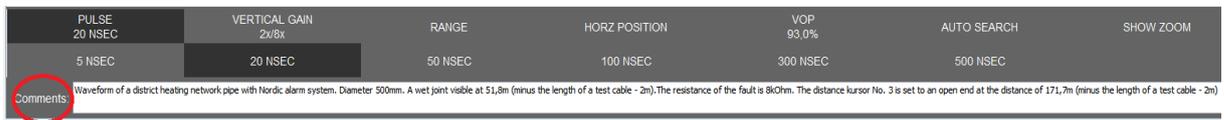
Please, note, if you work on the Show Zoom mode, you can fine tune the location of the cursor by touching the arrows inside the zoom window to move the cursor left and right. It’s definitely more precise way of positioning the cursors.

### 5.2.11 Comment Box

At the bottom part of the screen, you can find „**Comment**” box, where you can write down any kind of comments on the waveform presented on the screen or the situation the waveform was originally recorded on a Tracker series TDR.

Just click on the “Comment” box and use the PC keypad.

**NOTE:** If the waveform originally recorded on a Tracker series TDR included any comments entered by the user, they would be visible in the “Comment” box. They can be deleted or edited any time.



## 6. TrackerView Apps for tablets and smartphones

The TrackerView Apps for tablets and smartphones differs a little from the original TrackerView application for PC.

The main screen and a general division into screen sections is the same:

- **Upper Tool Bar**
- **Info Bar**
- **Distance scale**
- **Waveform and Cursors**
- **Zoom windows (precise cursor placement)**
- **Main Control Panel**
- **Comments box**

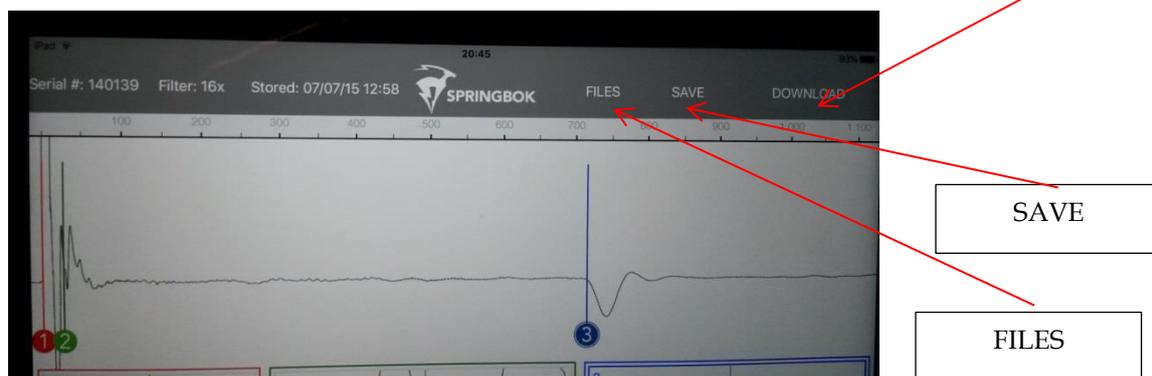
Note: Comment box is not visible on the screen until the user presses the Comment key



Note: The TrackerView Apps for tablets and smartphones DOES NOT have the OVERLAY feature (comparing waveforms on the screen)

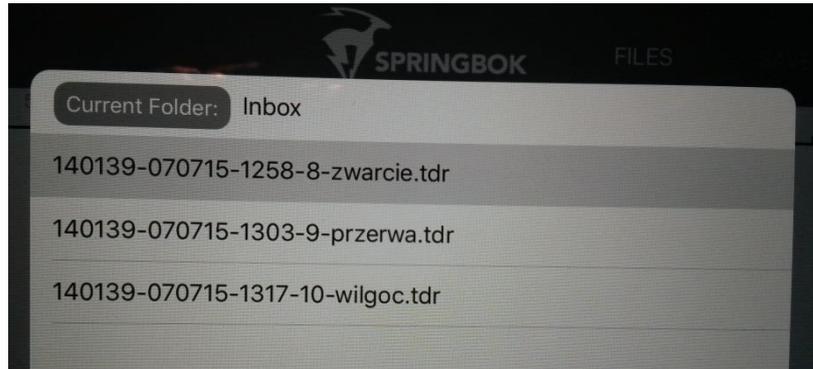
### 6.1 Upper Tool Bar

The Upper Tool Bar has only three controls to choose from:



## A. FILES

When you press the Files key, you get access to all the Tracker series TDR data files that were stored into memory of the mobile device. Just click on the file name, then on the Open key and you will have the selected waveform presented on the device screen.



## B. SAVE

When you press the Save key, you will store the modified version of the waveform on the screen into memory of the mobile device.

**NOTE:** All the files are being transferred from the Tracker series TDR to a mobile device in a “raw format”, that is, without the proper values of Pulse or Range, even if the user has set up those values on the TDR screen.

**NOTE:** The procedure of transferring files DOES NOT delete the original files from the TDR’s memory.

## C. DOWNLOAD

This is a Communication key. When you press the Download key, you can get connected to a Tracker series TDR in order to transfer files from its memory.

## 6.2 Info Screen

On the left side of the screen, you will find four types of information on the file being actually viewed:

- a serial number of the TDR on which the file has been originally recorded
- the level of TDR filters at which the file has been originally recorded
- date and time when the file has been originally recorded into the TDR’s memory (military format of date – month/day/year and military format of time, e.g. 18:20)



## 6.3 Distance Scale

Just below Info + Communication Control Bar, you will find „Distance Scale” that helps to control distances at which you expect to find some regular points on the waveform such as any known splices or joints. In this way, the user gets the reference points as compared to the actual faults. The „Distance Scale” helps also to estimate which level of the Range should be used while viewing the waveform.

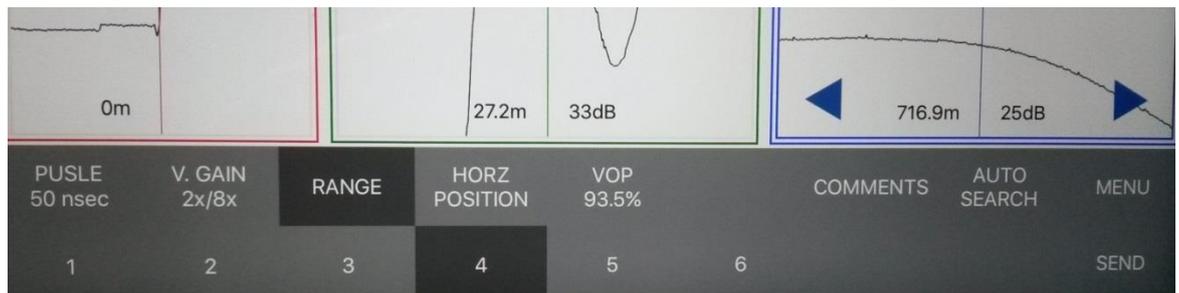
## 6.4 Waveform and Cursors

When you open a file including TDR measurement data, you can see a waveform and three color cursors. The first **red cursor** is automatically set up at the beginning of the first pulse reflection going up – this is the place where the testing pulse leaves the instrument. It might be the case that the user of a TDR set up the first **red cursor** of the instrument a little further along the tested network in order to cancel test lead length – this will be continued on the TrackerView screen until the user decides to change the position of the cursors. The remaining **green cursor** and **blue cursor** will be set up by the user on the reflections of the testing pulse that are suspected to be faults.

The user should first click the mouse on a cursor Zoom window (or cursor distance window in a show zoom mode) in order to choose which cursor is to be set up. Then, the given cursor can be placed on the screen with the use of the mouse. When you set up the second **green cursor** or the third **blue cursor** on the chosen place of the waveform, you will find two values in the cursor Zoom window (or cursor distance window in a hide zoom mode) – the distance between the given cursor and the first **red cursor** in [m] (most commonly being the place of fault) and return loss in [dB] indicating severity of the fault (the lower the value the more severe the fault). The **red cursor** is then the reference cursor and all the distances calculated by the software are based on the principle – the given distance is between the second **green cursor** and the **red cursor** or the third **blue cursor** and the **red cursor**.

NOTE: The general principle of cursor placement is always the same – the cursor is placed on the beginning of a rising or falling slope of the graph or, when you compare two waveforms, in the position when they split (read: significantly differ). However, it is the user that decides where the cursor is going to be placed. This is the user that decides if the cursor having been placed indicates the point of a fault or it's just a regular joint or other impedance mismatch characteristic for the given section of the network under test.

## 6.5 Control Panel



### A. Choose the pulsewidth (testing pulse)

Click on the function key first in order to choose the desired control function. Then, choose the desired value on the bar below.

„Pulse: 50ns” – indicates the actual testing pulse used.

NOTE: TrackerView application allows you to adjust the waveform originally recorded on a Tracker series TDR in a full scope of test pulses available for the Tracker system.

### B. Choose the Vertical Gain value

Click on the function key first in order to choose the desired control function. Then, choose the desired value on the bar below.

Vertical Gain 2x/8x indicates the actual value of the graph amplitude presented on the screen.

### C. Choose the Range of the waveform displayed on the screen

Click on the function key first in order to choose the desired control function. Then, choose the desired value on the bar below

The **Range** feature allows the user to expand or shrink the picture of the waveform viewed on the screen. The maximum Range No. 6 enables the user to see the maximum distance of the tested network but it depends on the VOP value used by the user.

Please, note, adjusting the Range value does not change the setting of the testing Pulse. In order to analyze the waveform properly and not to miss any vital details along the tested network, you have to adjust both pulse width used (enough energy of the pulse to reach certain distance) and range value (the current section of the tested network presented on the screen) at the same time.

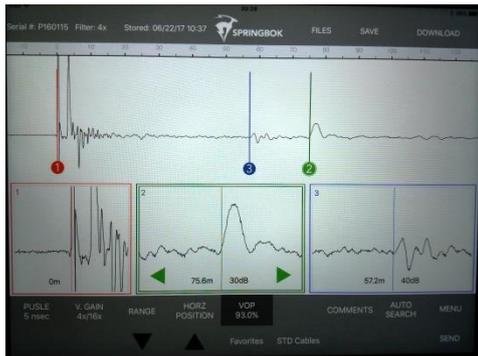
#### D. Choose the HORZ Position function

This function helps you to adjust horizontal position of the graph to the left or right without changing the Range function setting. You can use it to view the whole length of the tested network at the chosen pulse width in search of unusual reflections that could be actual faults or expected regular points.

#### E. Choose VOP value

Click on the function key first in order to choose the desired control function. Then, choose the desired value of additional function on the bar below.

„VOP: 93,0 % indicates the actual value of the VOP (Velocity Of Propagation) that is used for the fault analysis of the given network type.



Select a Cable Type
84.0% - Belden - 1151A - Series 59/U
82.0% - Belden - 1152A - Series 6
82.0% - Belden - 1186A - Series 11
83.0% - Belden - 1189A - Series 59
83.0% - Belden - 1189AP - Series 59
83.0% - Belden - 1190A - Series 6
83.0% - Belden - 1191AM - Series 6
83.0% - Belden - 1258AM - Series 6
83.0% - Belden - 1260AM - Series 6
83.0% - Belden - 1505AM - Series 59/U
82.0% - Belden - 1505F - Series 59/U
80.0% - Belden - 1523A - Series 11

Use up or down arrows to adjust the desired VOP characteristic for the given network type.

For the VOP setting, you can use two additional functions:

1. You can choose the option **“Favorites”** in order to spare some time on manual adjusting of the desired VOP and to create a list of pre-defined VOP values of the most frequently network types being tested by the user.

Click on the VOP function key, then on the **“Favorites”** key, choose the pre-defined value and press **“Select”**.

#### Editing the „Favorites” list of VOP values:

- write down a short description of the network
- write down the desired value of the VOP for the given network
- Note: decimals are separated by a „dot” and not by a „coma”
- click on **“Add”** key

All the pre-defined values and their descriptions can be edited or deleted any time – you just need to select the desired entry and click on **“Delete”** or correct the description or VOP value itself.

2. You can choose **„STD Cables”** option in order to use a pre-defined list of VOP values for most commonly cables used on the US market

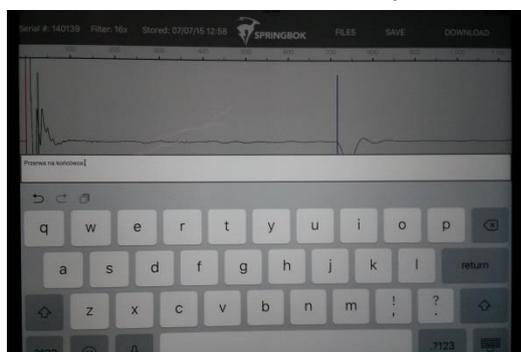
The **„Standard Cable”** window contains a list of some 65 different cable types with its names and appropriate VOP value declared by their manufacturers. Just click on the VOP function key, then on the **“STD Cables”** key, choose the pre-defined value and press **“Select”**.

#### E. Comment Box

At the **„Comment”** box, you can write down any kind of comments on the waveform presented on the screen or the situation the waveform was originally recorded on a Tracker series TDR.

Just click on the **“Comment”** box and use the mobile device’s keypad.

NOTE: If the waveform originally recorded on a Tracker series TDR included any comments entered by the user, they would be visible in the **“Comment”** box. They can be deleted or edited any time.



## F. AUTO SEARCH

The **Auto-Search** function is used to analyze the waveform in a quick way at an automatic search mode of the most severe fault along the tested network.

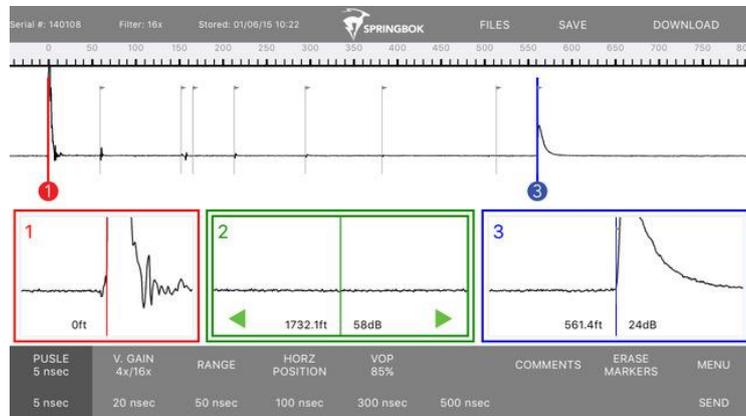
4. Click on the AUTO SEARCH key.
5. The **blue cursor** moves automatically to the largest impedance mismatch.

Markers are placed at possible events along the tested network. The markers can be deleted by pressing the key "Erase markers"

While testing a cable - when the end of the cable is disconnected from the cable plant, the largest reflection will be the end of the cable and therefore cursor No. 3 will move to the end. If not disconnected, the blue cursor will move to the largest impedance mismatch on the cable line.

**NOTE:** The Auto-Search mode is working properly in a variety of different conditions but you just cannot assume it works perfect in all of the situations. It's only just a helping tool to the user.

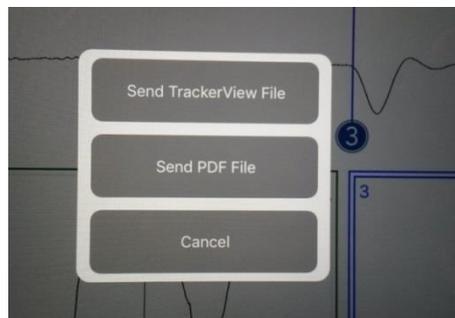
**NOTE:** If you pressed the Auto-Search key and the blue cursor was moved to the place at the leading edge of the pulse reflection from the point where the crocodile clips of the test leads had been connected to the network under test, it **DOES NOT** mean there are no other faults along this network!



You can find „**Auto-Search Sensitivity Level**” control option in the MENU at Settings. You can adjust the level of sensitivity used for the „Auto-Search” mode, where Level 1 means “automatic search for less severe faults” and Level 5 means “automatic search for more severe faults”.

## G. SEND

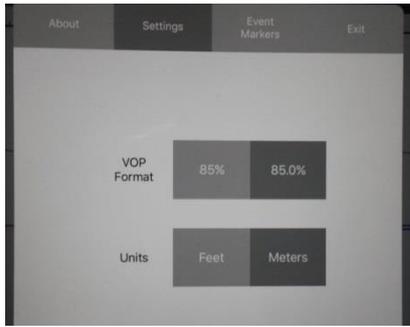
This function enables you to send single data files over email system configured on your mobile device. It can be either an original file containing measurement data in TrackerView format („Send TrackerView File”) or a modified form of the data in PDF format („Send PDF File”) that could be sent to those who do not have TrackerView application installed.



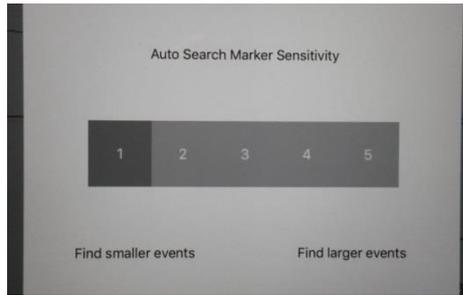
## H. MENU

You can enter Menu of the application by pressing the MENU key. In this way, you can get access to:

- information on the actual software revision (ABOUT)
- control panel of VOP format and distance units (SETTINGS)



- control panel of adjusting the level of sensitivity used for the „Auto-Search” mode

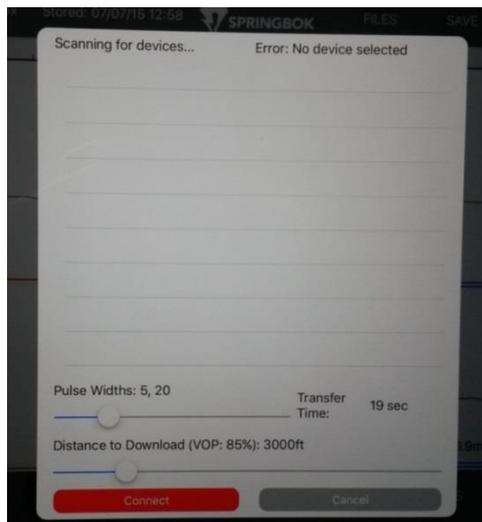


where Level 1 means “automatic search for less severe faults” and Level 5 means “automatic search for more severe faults”

## 6.6 Downloading of test data from the Tracker series TDR into a mobile device

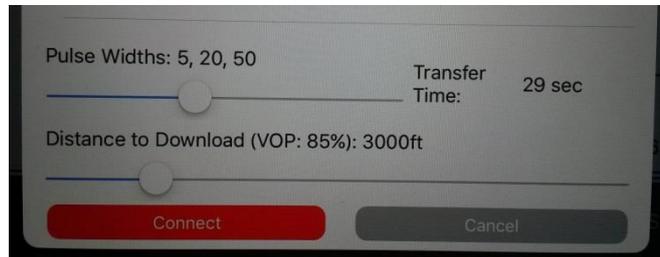
7. Open the Tracker View App on your iPhone/iPad or Android device.
8. Turn on the Tracker series TDR (must have Bluetooth, not available on all models)
9. Touch “Download” on your smart device.
10. The smart device is scanning for the TDR (no other devices can be paired such as headphones).
11. Select the TDR by touching the serial number displaying on your smart device and touch “Connect”.
12. Select the waveform you wish to download and touch “Download”. A progress bar will display the waveform.

If the Tracker series TDR you want to connect to is switched off or for some reason communication is not possible, the Tracker View Apps will open the screen containing the error warning: „Error: No device selected”



**NOTE:** Only single files can be transferred with the use of the TrackerView App. Before the actual file transfer, you can adjust certain parameters of the transfer. Due to limitations of Bluetooth communication, time necessary to transfer all of the measurement of a single file from the Tracker series TDR into a mobile device can be quite long. Since every single pulse width scan is being transferred separately, you can

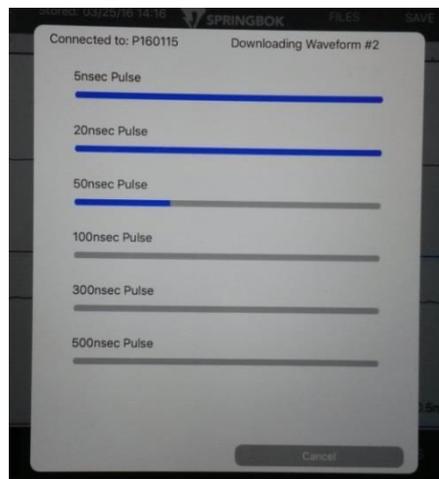
reduce the number of test pulse widths to transfer and, in this way, reduce the total transfer time. You can do the same with the maximum length of the network under test. For instance, the transfer of a file containing data of 5ns and 20ns pulse widths at the maximum distance of 900m will take 19 seconds. For comparison, the full scan of pulse widths up to 500ns at the maximum distance of 4,000m will take approximately 3 minutes. However, you should be careful in estimation what range of pulse widths and testing distance you need for data transfer, as it may turn out you will not see all the potential problems along the tested network.



„Pulse Widths” – actual testing pulse the user needs for testing the given network.

„Distance to Download” – maximum testing distance the user need to analyze on the given network

You can adjust the pulse widths and distance to download with the use of sliders and then press the connect key. If you do not specify any transfer parameters, only the pulse widths of 5ns and 20ns at the maximum distance of 900m will be transferred from the original file having been recorded on the TDR. Every single pulse width scan is being transferred separately.



The problem of a long data transfer time does not exist if you use an USB cable and a micro-USB adapter to connect the Tracker series TDR to your mobile device. However, not all of mobile devices can be used for such data file transfer.

**NOTE:** If you have a tablet or smartphone with Android operating system, you can use an USB cable to transfer files form the Tracker series TRD on such device. You can transfer single files only (it is not possible to select a few files to transfer at the same time) and the actual transfer time takes a few seconds.

**NOTE:** Some of the Android operated mobile devices „refuse to cooperate” when you try to connect them to a Tracker series TDR. This is the property of the given version of the Android operating system.

**NOTE:** All the files are being transferred to a PC in a “raw format”, that is, without the proper values of Pulse or Range, even if the user has set up those values on the TDR screen.

**NOTE:** The procedure of transferring files DOES NOT delete the original files from the TDR’s memory.

## 7. Maintenance

### 7.1 Cleaning

Remove dust from the outside of the instrument and connectors with a lint free cloth. Clean the instrument with a damp cloth, making sure the instrument is turned off and unplugged from the battery charger. Make sure the cloth is only damp to avoid getting water in the instrument.

**Note:** Do not use harsh chemicals or abrasive cleaners! Damage to the front panel overlay may result.

### 7.2 Periodic Inspection

The instrument and accessories are to be periodically inspected to make sure there is no damage, worn or missing parts or deformations in the enclosure. If the unit is regularly operated in harsh, dusty or wet environments, inspect after every use.

The instrument should be inspected and cleaned periodically. Inspect the front panel connectors for dirt, broken or deformed insulation and contacts. Clean or replace as necessary.

Inspect cable accessories for damaged insulation, bent or broken clips. Replace as necessary.

**Warning:** To avoid risk of electric shock, do not perform service of any type to the instrument or any accessory.

### 7.3 Instrument Disposal

This instrument is equipped with non-user serviceable Nickel Metal Hydride batteries. Should this instrument need to be disposed of, please consult your local regulations as to the standard disposal procedures.

## 8. Service and Warranty

There are no user serviceable parts on or in this instrument. It is recommended that service of any type, to the instrument or any accessories, be referred to Springbok Instruments or another authorized repair facility.

Tracker Pro manufactured by Springbok Instruments is the subject of a standard warranty procedure for a period of 12 months from the date of shipment from Springbok Instruments' factory or its designated distributor in the EU. The manufacturer declares that the Time Domain Reflectometer Model Tracker Pro shall be free from defects in material and workmanship that develop under normal use in accordance with Springbok Instruments operating instructions.

Items returned for warranty repair or replacement shall be shipped with a copy of the dated invoice, freight charges prepaid, to the European distributor of Springbok Instruments:

### TESTERON

ul. Nowy Rynek 6

62-002 Suchy Las, Poland

tel. +48 61 6521235

cell phone +48 724 565157

<http://www.testeron.pl/en>

email: [biuro@testeron.pl](mailto:biuro@testeron.pl)



This warranty will be void if products manufactured by Springbok Instruments are modified by the purchaser during the period of warranty without Springbok Instruments' written consent. This warranty is expressly made in lieu of all other warranties expressed or implied, including merchantability, whether arising by law, custom or conduct. The rights or remedies provided herein are exclusive in lieu of any other rights or remedies unless specifically stated in the purchase order for this equipment. This warranty covers repair or replacement of the purchased item only and does not cover any subsidiary damages to associated customer equipment. If the extended warranty is purchased, it does not apply to the battery pack.

## 9. Technical Data

### 9.1 Technical Specification

Distance Accuracy:	2-50 ns pulses – 0,5ns resolution, max distance 3,962 meters @ 85% VOP 100 - 500 ns pulses - 1 ns resolution, max distance or 7,930 m @ 85% VOP 1000 - 2000 ns pulses - 2 ns resolution, max distance 15,850 m @ 85% VOP)
Display:	7" LCD color touchscreen display (800 x 480)
Output Signal:	Pulse Widths: 2 nsec, 5 nsec, 20 nsec, 50 nsec, 100 nsec, 300ns, 500 nsec, 1000ns and 2000ns <i>Note, due to high frequency energy of the pulses, the min. effective test range of 2ns or 5nsec pulse is less than 1m!</i>
Power:	Battery: Internal, rechargeable, 8 cell 4200 mAh Nickel metal hydride
Charging source:	External 18VDC transformer, 1000mA
Operating time:	greater than 9 hours, continuous in standard brightness display mode
Horizontal Resolution:	3cm
Vertical Resolution:	14 bits at 193 dots
Internal Memory:	Store up to 60 multi-pulse waveforms files in the instrument's memory
Input Protection:	400 V (AC + DC) from DC to 400 Hz, decreasing to 10 V at 1 MHz
Filtering:	1x, 2x, 4x, 8x, x16, 32x, 64x
Vertical Gain:	1x/4x, 2x/8x, 4x/16x, 8x/32x, 16x/64x, 32x/128x
VOP Range:	40% - 99%
Connectivity:	USB port, internal Bluetooth 4.0 modem
Weight:	1,7 kg
Physical dimensions:	width 21,40 cm x depth 17,20 cm x height 9,80 cm
Operating temperature:	0° C - 50° C
Storage temperature:	-20° C - 60° C
Humidity:	95% maximum relative, non-condensing

### Scope of Delivery:

Tracker Pro TDR (V3 Model), BNC-Crocodile clip 2m test leads, mains charger, Tracker View PC software, micro-USB cable, 75 Ohm BNC - 50 Ohm F adapter, carry bag including shoulder strap, instruction manual



## 9.2 VOP Value Table for Different Types of Networks to be tested with the TDR

Cable type	Cable insulation type	VOP
<b>Power cables</b>	oil-saturated paper	50% - 56%
	cross-linked polyethylene	52% - 58%
	polyethylene	67%
	PTFE	71%
	pulp	72% - 0,88%
	air	94% - 98%
<b>Telecom copper cables</b>	polyethylene, ext. dia. 0,912mm	69%
	polyethylene, ext. dia. 0,643mm	68%
	polyethylene, ext. dia. 0,511mm	66%
	polyethylene, ext. dia. 0,404mm	65%
	jelly-filled, ext. dia. 0,912mm	68%
	jelly-filled, ext. dia. 0,643mm	65%
	jelly-filled, ext. dia. 0,511mm	64%
	jelly-filled, ext. dia. 0,404mm	63%
	pupl, ext. dia. 0,643mm	69%
	pulp, ext. dia. 0,511mm	68%
	pulp, ext. dia. 0,404mm	66%
<b>Cable TV</b>	QR PARA III	88%
	PARA I	82%
	T, TR	87%
	TX, TX10	89%
	RG6, RG11, RG59	82%
	Times Fiber RG-59	93%
	Dynafoam	90%
<b>Data transmission</b>	RG58	78%
	RG58U	76%
	UTP 26	64 %
	Thinnet	66% - 70 %
	Ethernet	77 %
	Token Ring	78 %
	Twinaxial	71 %
	Thicknet	77 %
	RG58/U	66 %
	Twisted Pair	64% - 66%
	U/UTP cat. 5e	67%
	U/UTP cat. 6	67%

**Troubleshooting and monitoring of district heating pipeline systems is performed at VOP = 90% to 93,5%**

The above VOP values for different types of cables are only a recommendation for the user of the Tracker TDR in order to make the cable test quicker and accurate. The best results can be achieved when the user applies the VOP determined on the basis of known length of the cable under test (which was described earlier in this Manual). However, it must be taken into account that the actual accuracy of the TDR type of measurement depends significantly on the user himself/herself – it's the user who finally positions the cursor on the waveform at the place of fault and the instruments only calculates the distance between the cursors.

**Please, remember:**

The VOP of a cable can change with temperature, age and humidity. It can also vary from one manufacturer and/or cable family and from one run to another. Even a new cable can vary as much as +/-3%. If a cable on a reel is tested, the actual length of the cable measured by any TDR at a given VOP can be lower than for a cable of the same length but having been placed in the ground horizontally.