KE-TDR20
CABLE FAULT LOCATOR

Time Domain Reflectometer
Cable Fault Locator for Balanced Pairs up to 32 km

KE-TDR20 is identical to ETDR-10

If you have any questions to the operating and using this device, contact following address:

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CONTENTS

1 INTRODUCTION 1-2
1.1 Principles of Operation 1-2
1.2 Application 1-2
2 MAIN FEATURES 2-1
2.1 Measuring Modes 2-1
2.2 Arrangement of Front Panel 2-2
2.3 Controls 2-2
2.4 LED indicators 2-4
2.5 Connectors 2-4
2.6 Display Arrangement 2-5
3 OPERATING INSTRUCTIONS 3-1
3.1 Start up. 3-1
3.2 The Operator's Name 3-1
3.3 Settings before Measurement 3-2
3.4 Test of a Single Pair 3-4
3.5 Location of Cross Talk Points 3-6
3.6 Comparison of Two Pairs 3-6
4 MEMORY OPERATIONS 4-1
4.1 Storage to Memory 4-1
4.2 Recall from Memory 4-2
4.3 Deletion of Records 4-3
4.4 Comparison with Memory 4-4
5 BATTERY MANAGER 5-1
5.1 Battery Charging Modes 5-1
5.2 Charging Mode Selection 5-2
6 SETTINGS 6-1
7 PC SOFTWARE FOR DATA TRANSFER 7-1
8 APPLICATION GUIDE 8-1
8.1 General Hints 8-1
8.2 Typical Waveforms 8-2
8.3 Obtaining the Missing V/2 8-6
9 SOFTWARE UPGRADE 9-1
10 SPECIFICATIONS 10-1

1 INTRODUCTION

1.1 Principles of Operation

The KE-TDR20 is a Cable fault locator utilizing the radar principle. A measuring pulse is transmitted down a cable. When that pulse reaches the end of the cable or a fault along the cable, a certain part or all the pulse energy is reflected back to the instrument.
The KE-TDR20 measures the time taken by the pulse to travel down the cable, see the problem, and reflect back. Than converts this time to distance and displays the information as a waveform. Distance to fault is displayed on the screen after the cursor is positioned to the start of the reflected fault pulse.

The displayed waveform shows all impedance discontinuities along the cable. The amplitude of any reflection is determined by the degree of the impedance change.

1.2 Application

The KE-TDR20 can be used, among other fault conditions, to locate several cabling problems, including:

- Broken conductors
- Shorted conductors
- Water damage
- Sheath fault
- Loose connectors
- Crimps
- Splits and resplits
- Taps
- Capacitance networks
- Unwanted loading coils
- Change of cable type

In addition, the KE-TDR20 can also be used to ascertain shipping damage of cable reels and for inventory management.
The KE-TDR20 is a hand-held small size instrument powered from an internal rechargeable battery pack. When connected to the mains adapter supplied, the battery is automatically charged. The displayed trace can be transferred to PC via USB interface. PC program is provided.

2 MAIN FEATURES

2.1 Measuring Modes

Test of a single pair

L1 Transmission and reception of the test pulses over L1
This is the most frequently used basic mode of operation.

L2 The same as the L1 mode above but L2 is used instead of L1

Long time measurement

L1 LONG TIME
L1 mode measurements are repeatedly done for a long time. All the obtained waveforms are displayed together and so the intermittent faults are to be seen.

L2 LONG TIME
The same as L1 LONG TIME but L2 is used instead of L1

Location of cross talk points

XTALK One of the pairs is connected to the L1 sockets and the other one to the L2 sockets. The measuring pulse is transmitted via L2 and the reflected pulses are received via L1. This mode is typically used for locating splits and resplits.

Comparison between two pairs

L1&L2 this mode is the combination of the L1 and L2 modes. Two waveforms are simultaneously displayed.

L1- L2 In this mode, the difference between two waveforms is displayed. The typical use of this mode is to find close in faults, because the balance between two cables may be better than between one cable and the internal balance control.

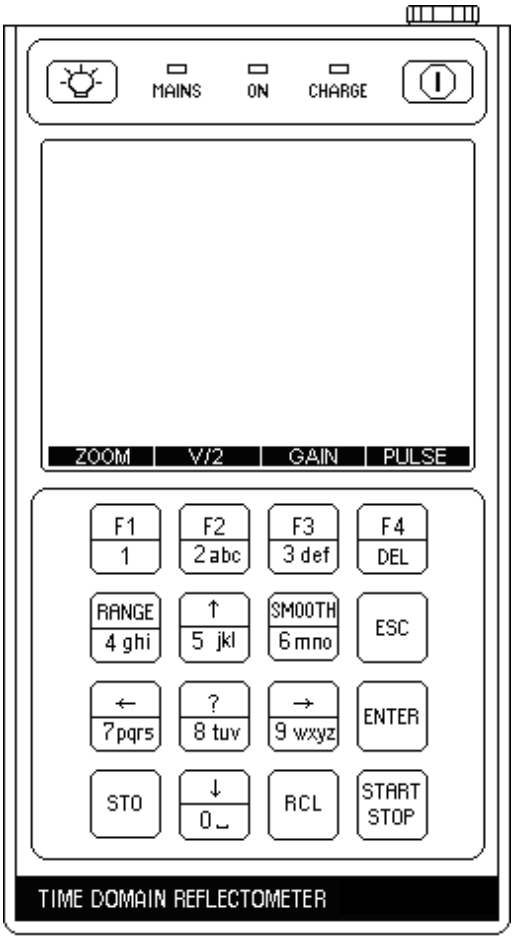
Comparison with memory

A waveform stored in memory can be used for comparison of the cable conditions before and after a critical period, or a repair job.

L1 & MEMORY
In this mode, two waveforms are simultaneously displayed.

L1 - MEMORY
In this mode, the difference between two waveforms is displayed

2.2 Arrangement of Front Panel



2.3 Controls

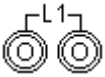
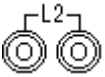
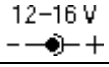
	Switches the KE-TDR20 on and off. The instrument has an automatic switch-off feature. The switch-off takes place automatically in a preset time after the latest keystroke.
	This key can be used to control brightness
BALANCE 	Rotary control used to minimize the transmitted pulse at the start of the waveform for near end measurements, in lack of a reference cable.

F1 1	This key can be used: to enter 1 or to select measuring mode or parameter
F2 2 abc	This key can be used: to enter 2 or a b c letters and to select measuring mode or parameter
F3 3 def	This key can be used: to enter 3 or d e f letters and to select measuring mode or parameter
F4 DEL	This key is intended to select measuring mode or parameter; or to delete a character when editing a name
RANGE 4 ghi	This key can be used: to enter 4 or g h i letters and having it pressed, the measuring range can be modified by the ↑ ↓ keys
↑ 5 jkl	This key can be used: to enter 5 or j k l letters or to select an option
SMOOTH 6 mno	This key can be used: to enter 6 or m n o letters and having it pressed the smoothing function can be called.
ESC	This key can be used for canceling something or returning to the previous state
← 7 pqrs	This key can be used: to enter 7 or p q r s letters or to move the cursor left
? 8 tuv	This key can be used: to enter 8 or t u v letters or to call the help function
→ 9 wxyz	This key can be used: to enter 9 or w x y z letters or to move the cursor right
ENTER	That key can be used to enter a parameter. Pressing it a vertical marker line can be placed to the position of cursor.
STO	Press it to recall the **STORE** menu for selecting the required option (Waveform, setup, V/2).
↓ 0	This key can be used: to enter 0 or to select an option
RCL	Press it to recall the **RECALL** menu for selecting the required option (Waveform, Setup, V/2, Standard cables)
START STOP	This key can be used to start/stop the measurement

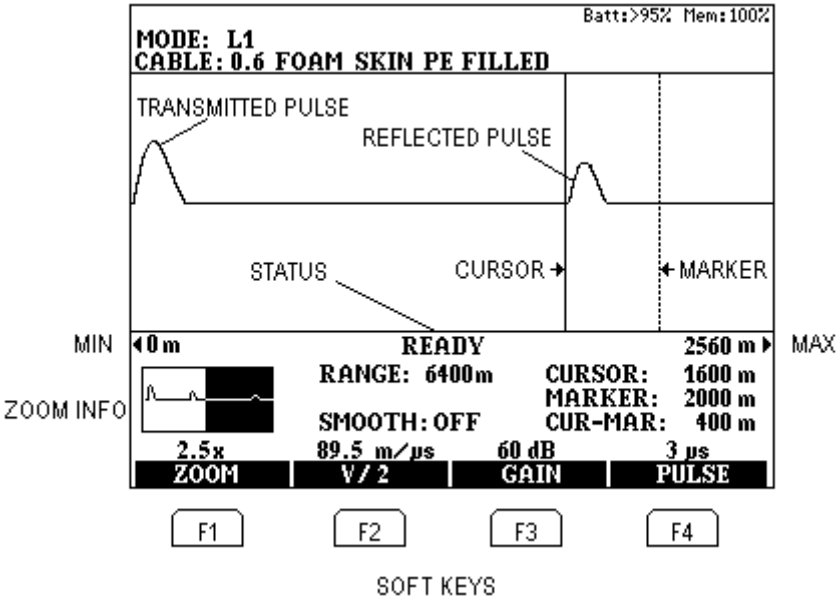
2.4 LED indicators

	Charge indicator
	Switch on indicator
	Mains indicator indicating the presence of power supplied by the mains adapter or car battery.

2.5 Connectors

	Two 4 mm sockets to which the cable under test should be connected.
	Two 4 mm sockets to which a second cable under test should be connected.
	USB 1.1 socket for PC connection
	2.1/5.5 mm coaxial connector for connecting an external 12-16 V mains adapter or car battery cable.

2.6 Display Arrangement

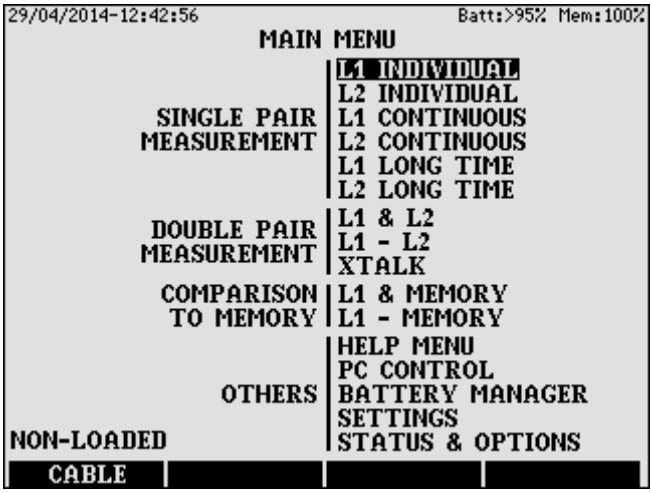


MODE	Shows the selected operation mode
CABLE	Shows the selected cable type
RANGE	Shows the nominal value of the measurement range
ZOOM INFO	Shows information about the non visible part of trace if ZOOM is on
ZOOM (F1)	Shows the amount of expansion if ZOOM is on
V/2 (F2)	Shows the V/2 value
GAIN (F3)	Shows the gain from 0 to 90 dB
PULSE (F4)	Shows the selected pulse width
MIN	Shows the distance at the left edge of the display (Zero if ZOOM is off)
MAX	Shows the distance at the right edge of the display (Equal to the measurement range if the ZOOM is off)
CURSOR	Shows the position of the cursor in meters (Red)
MARKER	Shows the position of the marker in meters (Green)
CUR-MAR	Shows the distance between cursor and marker
STATUS	Shows the actual status of measurement like READY, MEAS, etc.
SMOOTH	Distance dependent amplitude display function

3 OPERATING INSTRUCTIONS

3.1 Start up.

Switch the instrument on.
First the opening display appears.
2 seconds later, self-test indication and the **MAIN MENU** appears showing the percentage of the battery level



Basically, the user should follow the instructions appearing at the bottom of each display in all measurement modes!

In most cases, the measuring, setting and editing modes are selected by the menu-driven operation system. For selection use the vertical cursor keys and then press **ENTER.**
The various cable and test parameters can be selected with the function keys: **F1** to **F4**. To return back to the previous display, press **ESC.**
Measurements can be started or stopped with the **START/STOP** key.

3.2 The Operator's Name

The name of operator should be given before starting a measurement.

- Enter the **MAIN MENU/GENERAL SETTING** option
- Enter the **OPERATOR'S NAME** option
- Enter the name as it is usual at mobile phones.
  (The last character can be deleted with the **DEL** key.)

3.3 Settings before Measurement

The cables to be tested can be included into two groups:

- Non loaded cables
- Loaded cables containing load coils

Cable group selection
The measuring ranges and the test methods are different for the two groups therefore the first task to select the proper cable group with the **CABLE (F1)** key of **MAIN MENU**. (Default is non loaded cable)

Measuring mode selection
Select the wanted measuring mode in the **MAIN MENU** with the ↑↓ keys and press **ENTER.** Having the mode selected the measuring display appears belonging to the selected mode.

Setting the Propagation Velocity
After mode selection the next step is to set the appropriate velocity factor. The propagation velocity of electromagnetic waves in cable depends on:

- The permittivity (ε) of insulation material of cable.
- The presence and inductance of load coils.

The following units are regularly used to characterize a cable:
Half Propagation Velocity (V/2) m/μs
Velocity of Propagation (VOP) %

The definition of VOP:

$$VOP = \frac{\text{WAVE VELOCITY IN CABLE}}{\text{LIGHT VELOCITY IN SPACE}} \times 100\,\%$$

To change the unit of propagation velocity:

- Enter the **GENERAL SETTINGS** option of the **MAIN MENU**
- Select the **PV UNIT** option and press **ENTER**

The propagation velocity range:

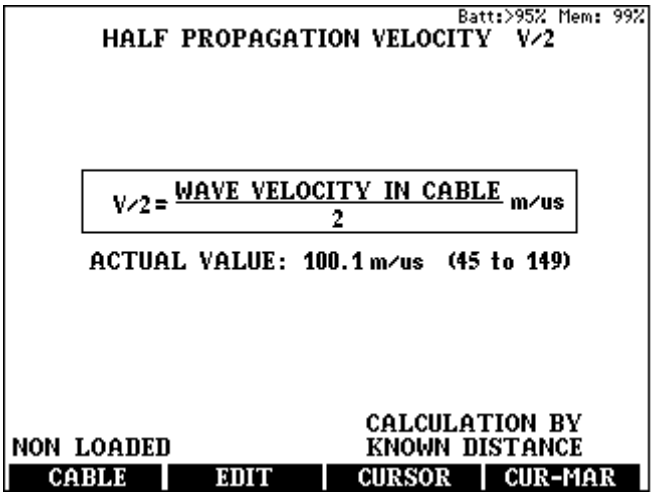
- For non loaded cables: V/2=45 to 149 m/μs (VOP=30 to 99 %)
- For loaded cables: V/2=1.2 to 30 m/μs (VOP=0.8 to 20 %)

The V/2 or VOP value of the most frequently used cable types can be recalled from the cable library of KE-TDR20 as follows:

- Press the **RCL** key and when the RCL display appears
- Call the cable library by pressing the **CABLE (F4)** key
- Select the required cable type with the ↑↓ keys
- Press **ENTER**

The V/2 or VOP value can be given directly. For example in case of V/2:

- Press the **V/2** key and the following display appears with the actual and acceptable value range on it:



- If you want to change the cable group from **NON LOADED** to
- **LOADED** or reversal press the **CABLE (F1)** key
- Press the **EDIT (F2)** key
- Type in the required new value
- Press **ENTER**

(If the propagation velocity is not known, see section 8.3)

Setting the Measuring Range

After setting the V/2 value the next step is to select the shortest range covering the full cable length.

- Press the **RANGE** key
- Select the required range with the ↑↓ keys

3.4 Test of a Single Pair

Steps of Measurement

After setting the mode, range and propagation velocity, the measurement can be started by pressing the **START/STOP** key. The measurement is running repeatedly until a following **START/STOP** keystroke.

- In **L1**and **L2** measuring modes the last waveform is displayed. To save battery life, the measurement is automatically stopped after one-minute elapsed time.
- In **L1 LONG TIME** and **L2 LONG TIME** modes all the obtained waveforms are displayed together showing the intermittent faults. In these modes there is no time out.

Balance Adjustment
Adjust the rotary **BALANCE** control to minimize the transmit pulse at the start of waveform. (In the **XTALK** and **L1-L2** modes, the balance control is not effective.)

Gain Adjustment
Because of the attenuation of the cable under test, the amplitude of the reflected pulse will decrease as the distance to the reflection location increases. To obtain suitable reflected pulse amplitude, the gain should be set as follows:

- Press the **GAIN (F3)** key
- Select the required gain with the ↑↓ keys

The gain can be adjusted between 0 and 90 dB in 6 dB steps

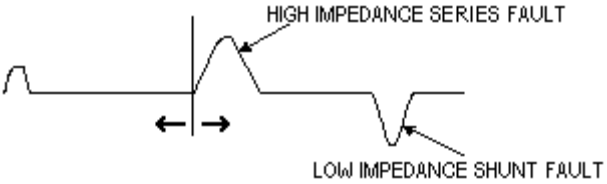
Setting Transmit Pulse Width (optional)
The pulse width is automatically changed with measuring range.
However, in the case of high cable attenuation, a better reading may sometimes be obtained by using a wider pulse. Therefore, if required, the pulse width can be changed as follows:

- Press the **PULSE (F4)** key
- Select the required width by the ↑↓ keys

Waveform Evaluation

Reading Distance to Fault

After the measurement process is terminated, move the cursor with the horizontal cursor keys to the start point of the reflected pulse.



The displayed value of the cursor shows the distance to fault. Remember to deduct the length of the test leads.

Waveform Expansion (ZOOM)

The waveform can be shown in more detail around the cursor line by using the **ZOOM** facility. The amount of horizontal expansion can be selected as follows:

- Using the ← → keys move the cursor to the point around which you want to expand the waveform
- Press the **ZOOM (F1)** key
- Select the required ZOOM value with the ↑↓ keys

On the down left corner of the display there is a “ZOOM INFO” showing information about the non visible part of trace if the ZOOM is on

Use of Marker

The marker appears as a vertical green line and can be placed to any selected point of the waveform. Displayed are the position of marker and the cursor, further the true distance from marker to cursor.

To measure the distance between any two points, the marker should be used as follows:

- Move the cursor to the point from which the distance is to be measured (e.g. reflection from a known point or from the change of the cable type), and set the marker by pressing **ENTER**.
- Move the cursor to the point to which the distance measurement is to be carried out.

The distance between these points is directly shown by the display.

The Smoothing Function
Because of the attenuation losses, the reflection from a fault long way down the cable may be much smaller than a regular reflection from a nearby discontinuity. The amplitude display of near reflections can be reduced by the smoothing function as follows:

- Press the **SMOOTH** key
- Select the required reduction with the ↑↓ keys

3.5 Location of Cross Talk Points

The measurement
In XTALK mode one of the pairs is connected to the L1 sockets, and the other one to the L2 sockets. The measuring pulse is transmitted on L2 socket the reflected pulses are received on L1. This mode is typically used for locating splits and resplits. The steps of measurement are similar for the L1 and L2 modes.
(The **BALANCE** control is not operational in this mode.)

3.6 Comparison of Two Pairs

The comparison is used to identify the differences between a known good cable and a faulty one. There are two methods of comparison:

- L1 & L2 mode
- L1 - L2 mode

Comparison in the L1 & L2 mode
In the L1 & L2 mode, two waveforms are simultaneously displayed, one for L1 and the other for L2. (L2 is blue)
The steps of measurement are similar to the L1 and L2 modes.
For the evaluation of the two waveforms the **CURSOR**, **MARKER** and **ZOOM** facilities are available. Using the ↑ and ↓ keys, the L2 waveform can be vertically shifted.

Comparison in the L1 - L2 mode
In this mode, the difference between the L1 and the L2 waveform is displayed. Using this method, the reflections caused by the common features of the two cables can be separated from reflections caused by cable faults. This method is a convenient way to find close-in faults, as two similar cables may balance each other more accurately than one cable and the internal BALANCE control. (The **BALANCE** control is not operational.) The steps of measurement and the waveform evaluation are the same as the L1 & L2 mode.

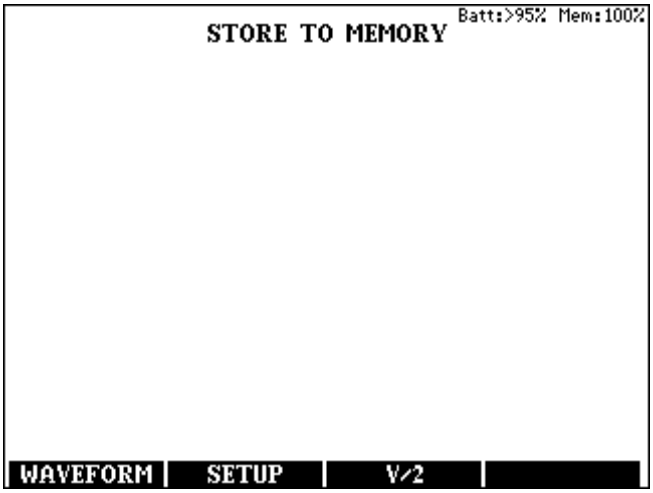
4 MEMORY OPERATIONS

4.1 Storage to Memory

- Obtain a waveform
- Press **STO**

Doing so the **STORE TO MEMORY** display appears offering three options to store:

- Storage of **WAVEFORM**
- Storage of **SETUP**
- Storage of **V/2**



- Select the wanted option by pressing the **F1**, **F2** or **F3** key
- Type in the name of record
- Press **ENTER**.

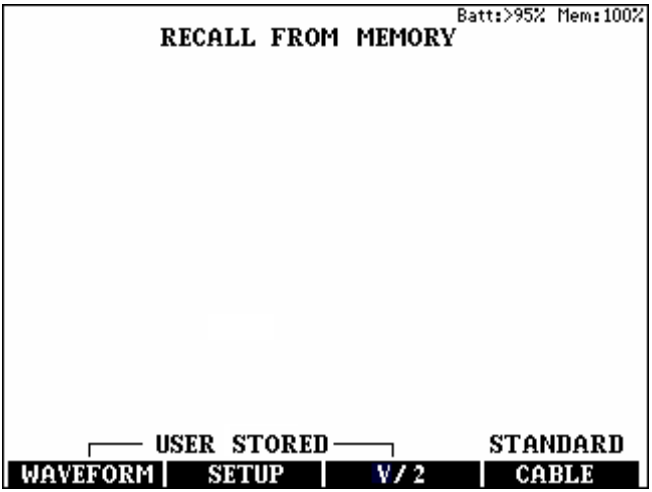
Notices

1. Waveform obtained in all modes can be saved and recalled except the two MEMORY modes.
2. Waveforms are stored together with the main parameters of the measurement. (**RANGE, GAIN, V/2, PULSE**)

4.2 Recall from Memory

Press **RCL** and the **RECALL FROM MEMORY** display appears offering four options to recall:

- Recall of user stored **WAVEFORM**
- Recall of user stored **SETUP** (RANGE, GAIN, V/2 and PULSE)
- Recall of user stored **V/2**
- Recall of standard **CABLE** parameters



- Select the wanted option by pressing the **F1**, **F2, F3** or **F4** key
  Then the list of records belonging to the selected option appears
- Select the required record with the ↑↓ keys
- Press **ENTER**

Notices

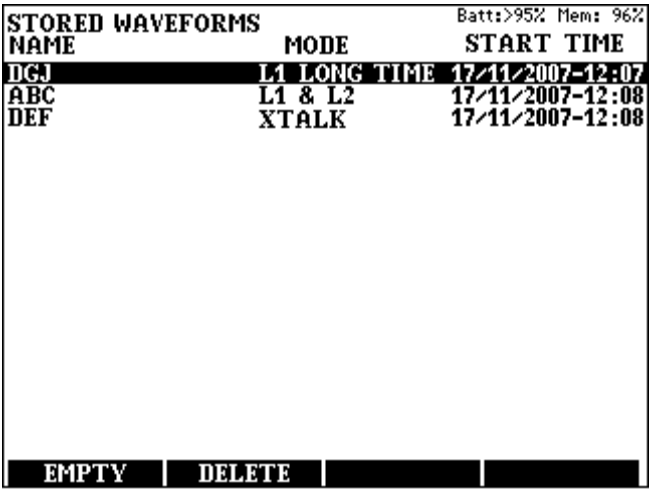
1. Recalling a waveform, the actual main parameters will be overwritten by the memory because they are stored together with the waveform. The name of the memory location from which the waveform was recalled is shown on the display. Starting a new measurement or modifying any parameter (except zoom), the waveform and the memory number indication disappear.
2. Recalling a setup the actual main parameters will be overwritten by the memory and the actual waveform will be cleared.

4.3 Deletion of Records

Press **RCL** and the **RECALL FROM MEMORY** display appears offering four options

- Select one of the user stored options **F1**, **F2** or **F3** key
  Then the list of records belonging to the selected option appears

For example:



Using the appropriate keys one of the records or the whole record block can be deleted. For safety reasons before deleting a record or record block a picture appears asking for confirmation.

Deleting one record

- Select the record to be deleted with the ↑↓ keys
- Press **DELETE (F2)**

If you are sure:

- Press **YES (F3)**

Deleting the whole record block

- Press **EMPTY (F1)**

If you are sure:

- Press **YES (F3)**

Pressing YES the record or record block will be deleted!

4.4 Comparison with Memory

Waveforms stored in memory can be used for comparison of the cable conditions before and after a critical period, or before and after a repair job. **The stored waveform and the recently obtained waveform can only be compared if the main parameters are the same**. As the main parameters are stored together with the waveform, the actual measurement must be performed with the stored settings (V/2, RANGE, PULSE WIDTH, GAIN). Accordingly, in this mode, the controls of the above mentioned parameters are not operational. There are two methods of comparison:

Comparison in the L1 & MEMORY mode

In this mode, the stored and the actually obtained waveforms are displayed together (the stored waveform is blue).
Measurement steps:

- Enter the **L1 & MEMORY** option of **MAIN MENU** The list of stored waveforms is now displayed.
- Select the memory location containing the stored waveform to be used for comparison and press **ENTER**.
- Start the measurement by pressing the **START/STOP** key.

For evaluation, the CURSOR, MARKER and ZOOM facilities can be used as in the single pair investigation. The vertical position of the stored Waveform can be shifted with the ↑ ↓ keys.

Comparison in the L1 - MEMORY mode

In this mode, the difference between the obtained and the stored Waveform is displayed. Measurement steps:

- Enter the **L1 - MEMORY** option of **MAIN MENU.** The list of stored waveforms is now displayed.
- Select the memory location containing the stored waveform to be used for comparison and press **ENTER**.
- Start the measurement by pressing the **START/STOP** key.

For evaluation, the CURSOR, MARKER and ZOOM facilities can be used as in the single pair investigation

5 BATTERY MANAGER

5.1 Battery Charging Modes

The life of the battery depends on the proper way of charging and discharging. DO NOT CHARGE THE BATTERIES WHEN THE AMBIENT TEMPERATURE IS BELOW +0^{o}C OR OVER +45^{o}C.

Manufacturers usually supply the batteries in the discharged state. Their full capacity may only be reached by two or three repeated charge and discharge cycles. During regular use of the KE-TDR20, the battery should be, from time to time, discharged before charging. The KE-TDR20 is equipped with a processor controlled automatic charger-discharger circuit offering three selectable charging methods:

- Normal charging
- Fast charging
- Regenerating charging

Normal charging (max. 14 hours)

The instrument can be used during this charging process. When the mains adapter is connected, the batteries are automatically charged with a low charging current. The **CHARGE** indicator LED is lighted while the charging is in progress. When full charge is reached, the charger is automatically switched off, and the **CHARGE** indicator LED goes out.

Fast charging (Approx 3.5 hours)

When the relatively high current (0.5 C) fast charging is on, the **CHARGE** indicator LED is blinking, and the instrument is automatically switched off. Reaching the full charge, the **CHARGE** indicator LED goes out, and the instrument stays in the switched off state.

Switching the instrument on during charging:

- Information can be obtained about the current battery level and the charging time left
- The process can be aborted by pressing the **ABORT (F3)** key. (In this case, the KE-TDR20 initiates a normal charging process automatically.)

Regenerating charge process (max. 6. 5 hours)

The instrument can't be used during this two-phase process either. The battery is first discharged (max. 3 hours), and following this, charged by the fast charging process (max. 3.5 hours).

- During the first phase, **DISCHARGING** message is displayed.
- At the beginning of the second phase, the instrument is automatically switched off, and the charge indicator LED is blinking.

Switching the instrument on during charging:

- Information can be obtained about the actual battery level and the charging time left
- The process can be aborted by pressing the **ABORT (F3)** key. (In this case, the KE-TDR20 initiates a normal charging process.)

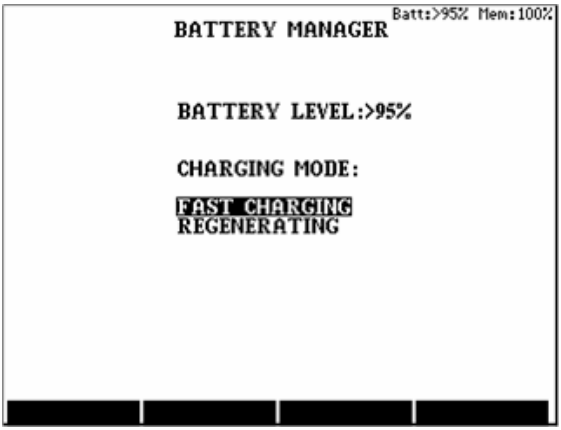
At the end of the initial charging process, the indicator LED goes out and the instrument stays switched off.

TO MAXIMIZE BATTERY LIFE, A MONTHLY REGENERATING CHARGING PROCESS IS RECOMMENDED.

5.2 Charging Mode Selection

The normal charging mode is the default mode. The other two charging modes can be selected and started by the **BATTERY MANAGER** submenu as follows:

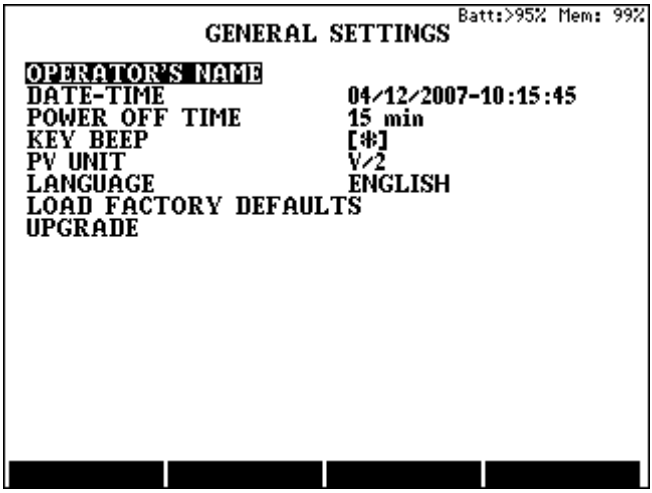
- Enter the **BATTERY MANAGER** option of **MAIN MENU**.
- Pressing **ENTER** the following display appears:



The wanted charging mode can then be selected, and started by using the appropriate keys.

6 SETTINGS

- Enter the **GENERAL SETTINGS** option of **MAIN MENU**.
- Pressing **ENTER** the following display appears:



The way of setting

- Select the item to be modified with the ↑ ↓ keys.
- Press **ENTER**
- Do the modification and press **ENTER** again

7 PC SOFTWARE FOR DATA TRANSFER

PC software is available for KE-TDR20 with the following functions.

- The displayed waveform or any of the stored waveforms can be transferred from the KE-TDR20 to the PC for post-processing or creating archives.
- Waveforms stored in the PC can be downloaded into the memory of the KE-TDR20

The steps of data transfer:

- Interconnect the KE-TDR20 with the PC
- Enter the **PC TRANSFER** option of **MAIN MENU**

Pressing the **ENTER** key the control is handed over to the PC.

The PC software contains the description of the data transfer process.

8 APPLICATION GUIDE

8.1 General Hints

Reflections can be classified to fall into two groups:

- Regular reflections
- Reflections from faults (irregular reflections)

Regular reflections

Even faultless pairs may produce reflections caused by inherent discontinuities such as joints or cable type changes.

Reflections from faults

A faulty pair produces regular reflections and, in addition, reflections from the fault. Because of the attenuation losses, the reflection from a fault long way down the cable may be much smaller than a regular reflection from a nearby discontinuity.

A suitable method to distinguish regular and irregular reflections is to compare the faulty cable with a good one. By using the L1-L2 method, the regular reflections caused by the common features of the two pairs will be canceled but the reflections due to faults will remain unchanged.

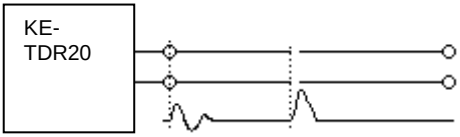
In telephone cables there are several pairs of conductors. The physical length of the pairs depends on their position in the cable. The length is increasing with the distance of the layer from the center. Consequently, the physical length of pairs can be longer than the cable length, and the propagation velocity (V/2) may be different for different layers. Therefore, in case of comparative tests, the two pairs compared should be in the same layer.

If there is more than one fault, the first one may reflect so much from the pulse energy that the subsequent fault may not be seen. Therefore, having located and eliminated the first fault, the cable section following the fault should be tested again.

8.2 Typical Waveforms

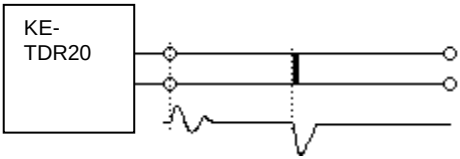
Open circuit (series faults)

The reflection is a positive (upward going) pulse. No reflected pulse from the far end.



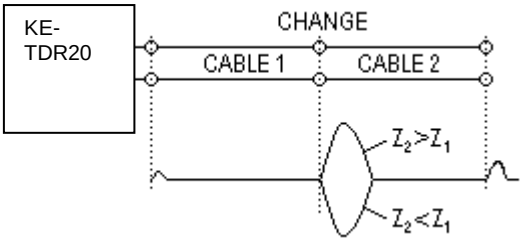
Short circuit (shunt fault)

The reflection is a negative (downward going) pulse. No reflected pulse from the far end.



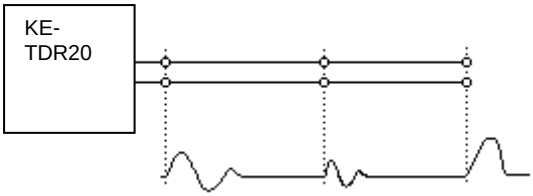
Change of cable type (mismatch)

The amplitudes of the reflected pulses are determined by the degree of impedance changes.



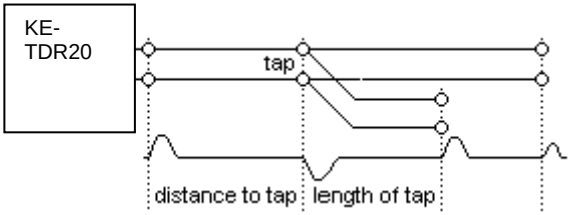
Joints (splices)

The joints produce ‘S’ shaped reflections.



Taps (tee joints)

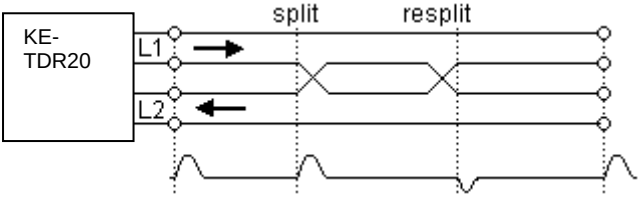
A tap produces two pulses, one at the beginning and the other at the end of the tap.



The troubleshooting may be difficult if the tested pair is tapped at many points. In this case, the test should be progressively done with moving from tap to tap.

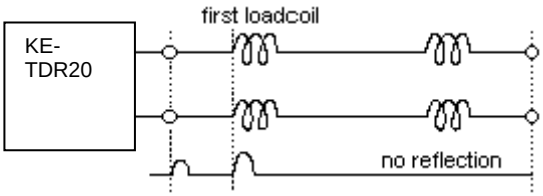
Splits and resplits

Splits and resplits produce cross talk.



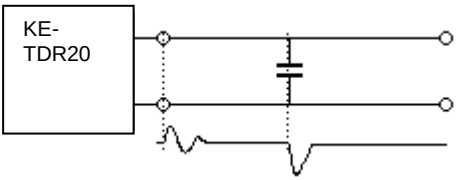
Load coils

Load coils produce positive (upward going) reflections. Generally, TDR's can not 'see' beyond the first loading coil. For fault location beyond the loading coil, the KE-TDR20 should be connected to another point following the coil.



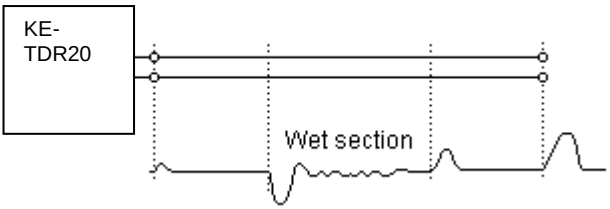
Capacitance network

The reflection is negative (downward going pulse).



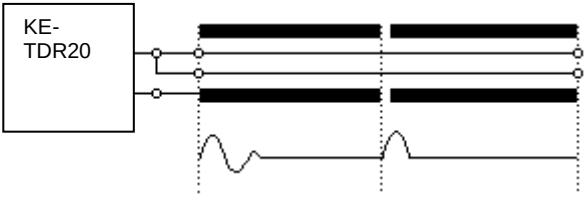
Wet section

The presence of water causes a capacitance increase. Therefore, there are two pulses: one from the beginning, the other from the end of the wet section.



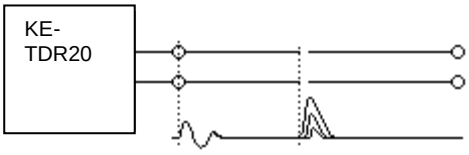
Open sheath

If the metallic sheath of the cable is broken, the position of the break can be located by connecting the test leads to the shield and to as many conductors as possible.



Loose contacts

The loose contacts can be detected in LONG TIME modes. In these modes measurements are repeatedly done for a long time. All the obtained waveforms are displayed together and so the intermittent faults are to be seen.



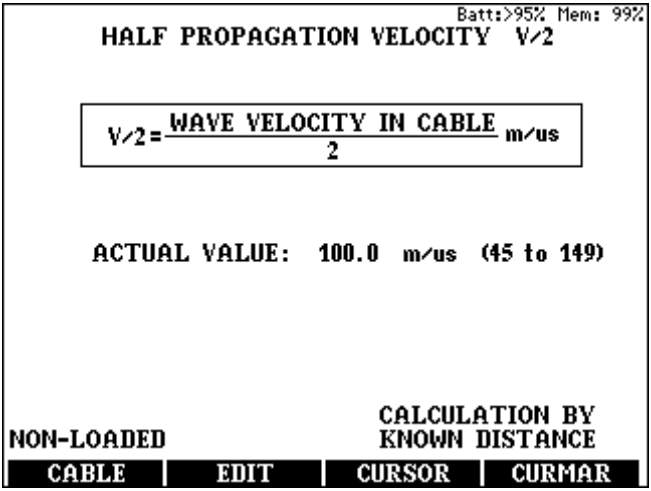
8.3 Obtaining the Missing V/2

The V/2 value can be determined in following cases:

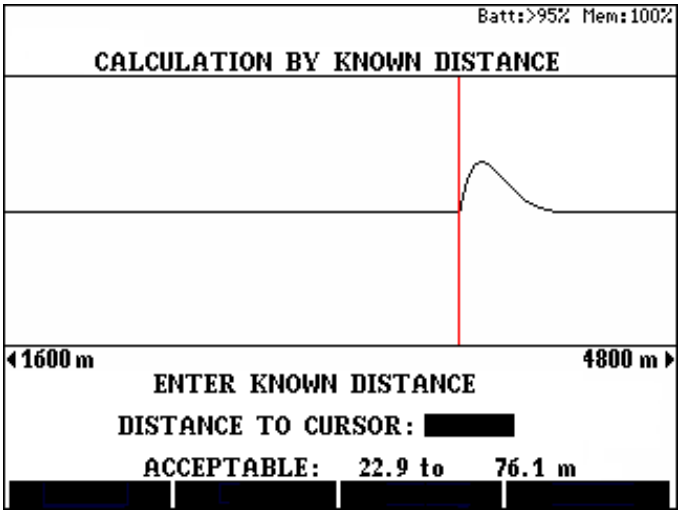
- the length of the cable or the distance to a known point is known. (eg. join box, change of cable-type etc.)
- a sample of the same cable is available with a known length
- the distance between two points is known.

Procedure when the cable length or the distance to a known point is available

- Connect the cable to the L1 sockets and obtain a waveform in L1 mode by setting the appropriate measuring range and a V/2 value around 100 m/µs.
- Place the cursor to the start point of the pulse reflected from the known place. The displayed **CURSOR** position will be different from the distance to the known point
- Press the **V/2 (F2)** key and the following display appears:



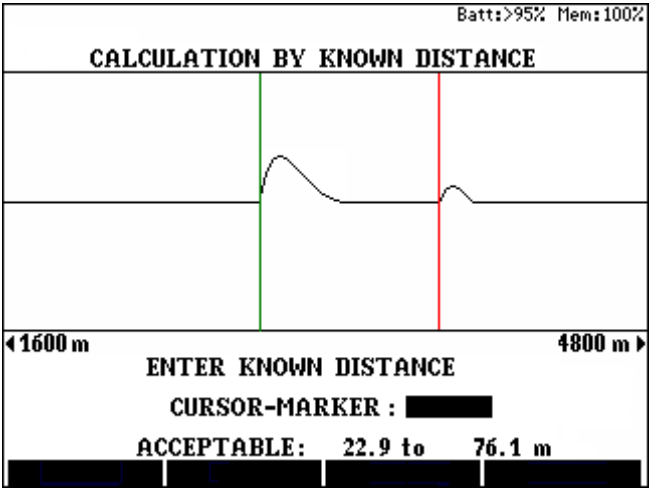
- Call the calculation by known distance page with the **CURSOR (F3)** key



- Using the numeric keys, type in the known distance (the length of the connecting lead should be added).
- Pressing the ENTER key, the proper V/2 value will be set automatically.

Procedure when the distance between two points is known

- Connect the cable to the L1 sockets and obtain a waveform in the L1 mode by setting the appropriate measuring range and a V/2 value around 100 m/µs.
- Place the cursor to the start point of the pulse reflected from the first known point, and set the marker by pressing **ENTER**
- Place the cursor to the starting point of the pulse reflected from the second known point
- Call the calculation by known distance page with the **CUR-MAR (F4)** key



- Using the numeric keys, type in the known distance
- Pressing the **ENTER** key, the proper V/2 value will be set automatically

9 SOFTWARE UPGRADE

The software of KE-TDR20 can be upgraded without disassembling the instrument. The new software version can be downloaded from a PC using the upgrade CD of manufacturer. This disk contains the description of the upgrade process.

10 SPECIFICATIONS

General Specifications

KE-TDR20 is identical to ETDR-10 from Elektronika, Hungary

Power supply:

Internal rechargeable NIMH battery pack

Operation time ..... approx. 8 hours (60 % duty time)

Charging (without taking the battery pack out)

From 230 V mains ..... with mains adapter

From 12 V car battery ..... with car adapter

Charging time ..... approx. 3 hours (Fast charging mode)

Display ..... 320 x 240 dot color LCD with backlight

Connectors

Connector for mains or 12V car adapter ..... 2.1/5.5 mm coaxial

L1 and L2 line connectors ..... 4 mm banana sockets

USB B ..... USB 1.1 device port to connect PC (Device driver provided)

Ambient temperature ranges

Operating ..... -10 to +50°C

Rel. humidity ..... 30% to 75% (<25g/m3)

Limits of operation ..... -10 to +50°C

Rel. humidity ..... 5% to 95% (<29g/m3)

Storage and transport ..... -20 to +70°C

Rel. humidity ..... 55% to 45% (<35g/m3)

Protection IP54

Dimensions ..... 200 x 100 x 40 mm

Weight (Including battery pack) ..... approx. 08 kg

User selectable languages ..... English, German, Russian

Measuring ranges (V/2=100 or V/2=10 for loaded cable)

			1 Px =
1.	For non loaded cable	16 m	5 cm
2.	For non loaded cable	32 m	10 cm
3.	For non loaded cable	64 m	20 cm
4.	For non loaded cable	160 m	50 cm
5.	For non loaded cable	320 m	100 cm
6.	For non loaded cable	640 m	2 m
7.	For non loaded cable	1600 m	5 m
8.	For non loaded cable	3200 m	10 m
9.	For all cables	6400 m	20 m
10.	For all cables	16000 m	50 m
11.	For all cables	32000 m	100 m

Maximum range depends on cable type and condition

Evaluation of results

With cursor and marker in meters

Zoom

Selectable ..... OFF, 2.5, 5

Resolution

with zoom ..... 0.06% of range
without zoom ..... 0.3% of range

Accuracy

Sampling ..... 0.01 m
Fault location ..... 0.2% of range

Propagation velocity

For non loaded cables
V/2 ..... 45 to 149 m/μs
VOP ..... 30 to 99 %
For loaded cables
V/2 ..... 1.2 to 30 m/μs
VOP ..... 0.8 to 20 %

Measuring modes

L1 or L2 INDIVIDUAL	One single measurement
L1 or L2 CONTINUOUS	Measurement with averaging
L1 or L2 LONG TIME	Location of intermittent faults
XTALK	Transmit on L2, Receiving on L1
L1 & L2 L1 – L2	Comparison of two pairs
L1 & MEMORY L1 - MEMORY	Comparison to memory

Pulse characteristics

Widths:
For non loaded cables ..... 3, 6, 10, 30, 60, 100, 300, 600 ns 1, 3, 6 µs
For loaded cables: ..... 330 µs
The provided pulse width automatically changed with range.
Amplitude: ..... peak to peak 1.3 to 12V into 120 Ohm
The pulse amplitude automatically changed with gain and width.

Line connection

Impedance .....120 Ohm balanced
Input protection ..... 350V RMS 50 Hz
500 V DC
Balance control ..... 50 to 270 Ohm

Gain control

Range .....0 to 90 dB
Steps.....6 dB/step

Memory locations

For waveforms..... 50
For setups..... 10
For user stored PVF values..... 10
For standard cable parameters 30