Tan Delta Diagnostics

TD30/TD60/TD90
TD60-MC/TD90-MC /TD120-MC

User Manual

ENGLISH

DHV0091 Rev00

HV Diagnostics, Inc
North and South America

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Portable TanDelta Measurement System

Table of Contents

1 Foreword

The TD unit is an easy to use, single piece, Digital Signal Processor based, field portable, fully automatic VLF (Very Low Frequency) high voltage measurement instrument developed for the high potential measuring of the insulation dielectrics of various types of electrical apparatus.

Purpose

This operating manual serves to ensure the proper and safe use of the TD test instrument.

1.1 Regarding this Document

Target User

This operating manual is designed to inform various user groups. The scope and depth of the information provided may not be appropriate for all users. However, it is important that all users familiarize themselves with this document in full. The following is a guideline indicating the most significant information as a function of the user's responsibilities.

User	Responsibilities	Focus
TD Operator	• To connect the equipment • To carry out manual or pre-programmed test sequences • To verify validity of TD application • To adjust instrument settings • To program automatic test sequences in accordance with particular testing standards	**All** Sections Particular focus on all **safety** messages
Procurement, Management	• To assure that the workplace is safe and has all required equipment • To assure that TD operators are qualified technicians • To assure that operators fulfil their responsibilities	Particular focus on **safety** messages and information regarding **general** product description.

Safekeeping

NOTICE

This manual should always be on hand when using the TD test instrument

1.2 Documentation Conventions

The following explains the **symbols**, and **safety messages** found in this document. The employment of safety symbols and signal words are according to the American National Standards Institute standard ANSI Z535.6 "Product Safety Signs and Labels".

Safety Messages

Danger

DANGER

Indicates a hazardous situation which if not avoided will result in death or serious injury

Warning

WARNING

Indicates a hazardous situation which if not avoided could result in death or serious injury.

Caution

CAUTION

Indicates a hazardous situation which if not avoided could result in minor or moderate injury.

Notice

NOTICE

Indicates suggested practices to protect equipment and property.

Symbols

Yellow triangle, framed in black: Used to indicate a potential hazard.
Only used in conjunction with description of the possible hazard!
Detailed symbol may correspond to this specific hazard.

Red outlined circle with red diagonal line: Used to indicate forbidden practices.
The described handling practice must not be carried out!

Blue circle with white exclamation mark: Used to indicate recommended precautionary measures or a situation that can lead to property damage.

1.3 Legal Considerations

Warranty

HV Diagnostics provides a one-year warranty from the original purchase date of instrument for all necessary parts and labor. This warranty is void in the event of abuse, incorrect operation or use, unauthorized modification or repairs, or failure to perform the specified maintenance as indicated in this operation manual. This warranty does not include normal consumable items such as lamps, paper rolls, printer ribbons, batteries or other auxiliary items.

This warranty and our liability are limited to replacing or repairing defective equipment, at our discretion. Equipment that is returned to HV Diagnostics must be packed in original packaging. All shipped items must be prepaid and insured. No other warranties are expressed or implied.

Contact Information

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Your opinion matters!

Your comments and suggestions are of value. We are dedicated to supporting your needs. Offering you optimal documentation is part of our promise of quality.

Improvement suggestions regarding this manual may be sent to:

sales@hvdiagnostics.com

Thank you for your feedback!

2 Safety

Safety is **priority**! Respect all **safety information**; only use the HVA for **appropriate applications** and ensure that operators possess the required **operator qualifications and training.**

2.1 General Safety

NOTICE

Operation Manual

Before carrying out any high voltage test with this instrument, read this Operating Manual in its entirety.

2.2 Safety Precautions and Prerequisites

- All equipment to be high potential tested must be de-energized and properly isolated from all power sources. All equipment grounds must remain in place.
- All high potential test equipment cable connections must be clean and secure. Separate equipment ground connections should be used. Ground integrity must be maintained at all times.
- Avoid testing alone – always have someone available who is able to render First Aid and resuscitation if required.
- Do not install substitute parts or make unauthorized modifications to the test instrument or its accessories as this may introduce additional risks and unknown hazards. To ensure that all safety features in the instrument are maintained, it is strongly recommended that all repairs and modifications be performed by HV Diagnostics or one of their authorized repair service centers.
- Before using this test instrument, please read through the operating manual in its entirety. Make sure you clarify any points that you feel unsure or uncertain about before using the instrument. Make sure you are knowledgeable about the proper application, safety, potential hazards involved, and procedures in using the test instrument. The awareness for safety is an integral part of the job, and it cannot be over emphasized. ***Safety is the responsibility of the user/operator.***
- All personnel operating the high potential test equipment must wear high voltage gloves. Verify the class rating/voltage of all protective devices (e.g. rubber blankets) to ensure proper protection.
- Use suitable barriers, barricades, or warnings to keep persons not directly involved with the work away from test activities. Personnel must be notified to prevent other workers, as well as the general public, from entering the high potential test area.
- Vacuum bottles must only be high potential tested with AC. Dangerous X-rays can possibly be produced when vacuum bottles are high potential tested above their rating with DC.

- Since some electrical apparatus such as cables are essentially capacitors, they can hold a charge after being exposed to a high potential test. These electrical apparatus must therefore remain grounded for sufficient time to drain off any remaining charge. Never assume that a piece of equipment that has been high potential tested is safe to handle without using the necessary safety equipment and grounding procedures. Always treat exposed connectors and conductors as potential electric shock hazards.
- All auxiliary electrical apparatus such as switchgear, surge arresters, etc. must be isolated from the test source and device under test (DUT).
- The test leads must always be disconnected from the device under test (DUT) before attempting to disconnect from the test equipment. The ground connections must be the first made and the last removed. Any interruption of the grounding connection may create an electric shock hazard.
- The visual signals of the TD are designed to be easily distinguished even under bright sunlight to avoid incorrect readings. Always keep at least 6 feet / 2 meters distance when looking directly at the LED signals. Avoid long direct exposure of eyes to the signals especially under dark conditions.

NOTICE

LED signal

The LED signal colors on the TD system indicate a TD value / range or equipment status condition. These LED lights signals in no way indicate the presence or absence of high voltage and the TD should be considered energized at all times when connected to a potential voltage source like a HVA test system.

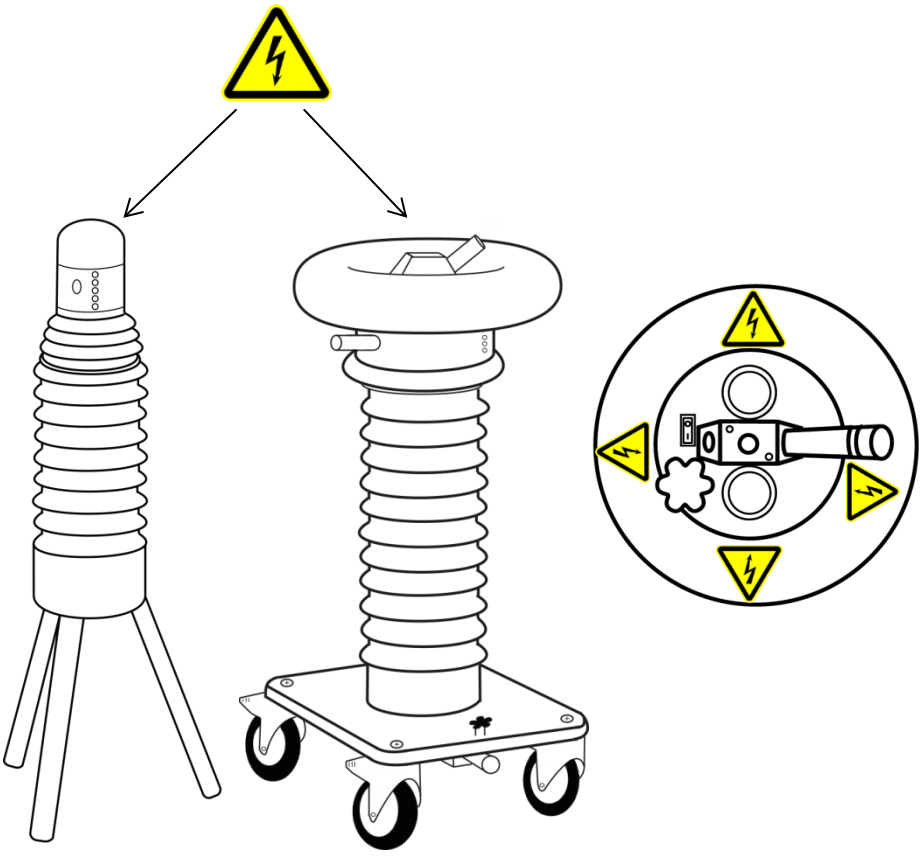
2.3 Work Safety

DANGER

Electric Shock Hazard

Never assume that equipment is safe to handle without using the necessary safety equipment and grounding procedures.

- All procedures must comply with local safety regulations
- Always treat exposed connectors and conductors as potential electric shock hazards.
- DUT must be earthed, de-energized and isolated from all power sources.
- All auxiliary electrical apparatus such as switchgear, surge arresters etc. must be isolated from the test power source and the DUT.
- All cables and connectors must be inspected for damage before use. Damaged equipment must not be used.
- Earth connections must be made first and removed last!
- DUT must be discharged and earthed before disconnecting the test lead.
- Avoid testing alone. In the event of an emergency another person's presence may be essential.



DANGER

Authorized Personnel Only

The test area must be secured to keep non-qualified personnel off the premises!

- Signs must warn all persons of the high voltage test area.
- Only qualified electrical technicians should have access to the test area.
- Other persons must be accompanied by qualified electrical technicians and must be informed of the risks involved.

NOTICE

Equipment Handling

DUT must have clean connections.

Test instruments must only be repaired or modified by authorized HV Diagnostics' personnel.

NOTICE

If required according to local safety regulations

Wear high voltage gloves when handling high voltage cables and equipment.

Appropriate Applications

The **TD** provides the testing and commissioning engineer/technician with a versatile high voltage tan delta measuring system suitable for testing medium voltage electrical insulation systems such as cables (including: XLPE, PE, EPR, PILC, etc.), capacitors, switchgear, transformers, rotating machines, insulators and bushings.

Tan Delta testing enables the cable test engineer to detect insulation defects before the cable fails in service. The **TD** is a versatile tan delta measuring system that is directly connected to the HVA series of VLF test systems from HV Diagnostics. The tan delta test results of the test object can now be easily measured and recorded and the results stored on a standard PC or Laptop for analysis, trending or quality control. This enables the cable engineer to now make tan delta testing a routine maintenance test.

The TD is a battery powered system that is directly connected to the HVA series of VLF test systems. Standard “C” size alkaline or rechargeable battery cells that are commonly available will last up to 10 hours of continuous operation.

The TD is supplied with a terminated output cable to plug directly into the HVA test system and is supplied complete with operating software which gives a complete picture of the tan delta measurement together with a real time display of the output voltage and current. The data transmission to standard notebook PC or PDA that is Bluetooth® enabled, thus eliminating a direct connection between the TD and the data collection device.

DUT Type	Examples
Cables	• Extruded cables (e.g. XLPE) • Laminated cables (e.g. PILC) • Insulated cables • Cable jacket / sheath
Other highly capacitive loads	• Generators • Switchgear • Transformers • Rotating machines • Insulators • Bushings

NOTICE

Other Applications

Before proceeding, contact HV Diagnostics to validate appropriate use!

2.4 Operator Qualifications

TD operators must be **qualified electrical technicians!** Proof of necessary qualifications for working in high voltage domain is mandatory. It is highly recommended that operators have completed an emergency rescue training program.

3 General Description

3.1 Technical Specifications

Characteristic		TD30[1]	TD60[1]	TD60-MC[1]
Article Number		700 003	706 003	706 003MC
Name		TD30 Tan Delta System	TD60 Tan-Delta System	TD60 Tan-Delta System with MC
Input Voltage		2 type “C“ alkaline cells or NiMH batteries		2 type “D“ alkaline cells or NiMH batteries
Operating Voltage	Sinusoidal	1 – 23 kV rms	1 – 44kV rms	
	Frequency	0.1 Hz 0.01 to 0.09 Hz[2]		
Voltage measurement	Resolution	0.1 kv rms		
	Accuracy	1% of reading		
Current measurement	Resolution	1×10^{-5}		
	Accuracy	$\pm 1 \times 10^{-4}$		
Load range	Standard	500 pF to 10µF		
Weight		7 lbs/ 3 kg	11 lbs/ 5 kg (without cable)	31.25 lbs/ 14.2 kg (without cable)
Dimensions (Length x Diameter)		9.5” x 3.5”/ 240mm x 85mm	18” x 5”/ 450mm x 120mm	11.8” x 25.2” x 11”/ L 300 x H 640 x W 280 mm
Computer includes		Bluetooth		
Delivery includes		HV connection cable, transport case, Bluetooth™ Dongle, Earth cable, TD Control Center Software, Operating manual, Dell Netbook		Transport case, Bluetooth™ Dongle, Earth cable, TD Control Center Software, Operating manual, Dell Netbook
Standards		EMV: IEC6100-4-2, IEC6100-4-4, EN55077; Safety: EN60950, EN50191, EN61010-1		
Environmental Conditions		Storage: -13°F to +158°F/ -25°C to +70°C , Operating:+23°F to +113°F/ -5°C to +45°C Humidity: max. 80% R.H. (non-condensing)		

Characteristic		TD90[1]	TD90-MC[1]	TD120-MC[1]
Article Number		709 003	709 003MC	712 003MC
Name		TD90 Tan-Delta System	TD90 Tan-Delta System 64kVrms with MC	TD120 Tan Delta System 85kVrms with MC
Input Voltage		2 type “C“ alkaline cells or NiMH batteries	2 type “D“ alkaline cells or NiMH batteries	
Operating Voltage	Sinusoidal	1 – 64kV rms		1 – 85 kV rms
	Frequency	0.1 Hz 0.01 to 0.09 Hz[2]		
Voltage measurement	Resolution	0.1 kv rms		
	Accuracy	1% of reading		
Current measurement	Resolution	1×10^{-5}		
	Accuracy	$\pm 1 \times 10^{-4}$		
Load range	Standard	500 pF to 10µF		
Weight		24 lbs/ 11 kg (without cable)	35.27 lbs/ 16 kg (without cable)	35.27 lbs/ 16 kg (without cable)
Dimensions (Length x Diameter)		26” x 5”/ 660mm x 120mm	11.8” x 31” x 11”/ L 300 x H 790 x W 276 mm	11.8” x 31” x 11”/ L 300 x H 790 x W 276 mm
Computer includes		Bluetooth		
Delivery includes		HV connection cable, transport case, Bluetooth™ Dongle, Earth cable, TD Control Center Software, Operating manual, Dell Netbook	Transport case, Bluetooth™ Dongle, Earth cable, TD Control Center Software, Operating manual, Dell Netbook	
Standards		EMV: IEC6100-4-2, IEC6100-4-4, EN55077; Safety: EN60950, EN50191, EN61010-1		
Environmental Conditions		Storage: -13°F to +158°F/ -25°C to +70°C , Operating:+23°F to +113°F/ -5°C to +45°C Humidity: max. 80% R.H. (non-condensing)		

[1] Technical Specifications are subject to change. HV Diagnostics reserves the right to modify values in accordance with future HVA development.

[2] in combination with locator set (not in scope of supply)

3.2 Design Features

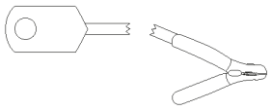
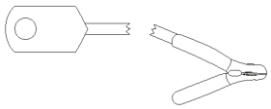
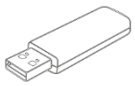
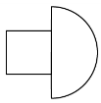
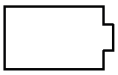
To assure that the workplace is safe and that operators can fulfil their responsibilities with ease, the TD provides the following features.

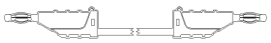
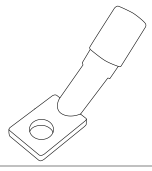
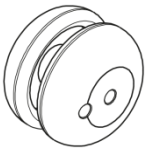
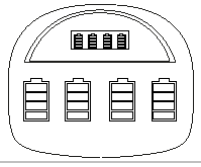
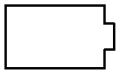
- Lightweight, portable, battery powered unit
- Solid state air insulated design
- Suitable for use with the HVA VLF test systems.
- Test results are easily stored via Notebook Computer or PocketPC via wireless Bluetooth® connection.
- Supplied complete with TD communication and analysis software – TD Control Center.
- Real-time display of actual output waveform.
- Power Save (Sleep) function (1 hour of inactivity), automatic wakeup on reapplication of high voltage. One-Click reconnect in Control Center after Sleep

3.3 Materials

Shipment Content – TD-MC units (TD60-MC/TD90-MC/TD120-MC)

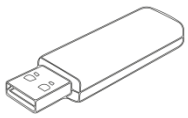
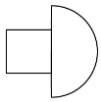
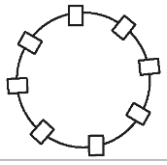
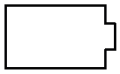
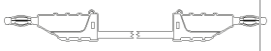
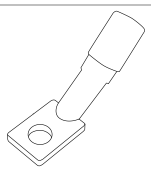
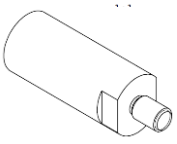
Items included upon delivery of the TD are listed below. The * marking specifies items that are country specific. For inquiries, please contact HV Diagnostics.

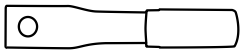
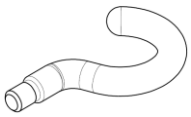
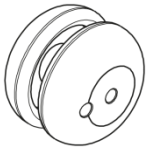
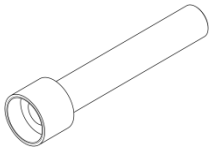
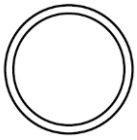
Art. No.	Item	Description	TD60-MC	TD90-MC	TD120-MC
HVD0075	TD Manual HV Diagnostics		1	1	1
709 526	Grounding cable transparent 6mm² 10m with 600A clamp			1	
712 576	Grounding cable 10mm² MC contact - clamp 4m				2
709 550	TD Connecting cable TD-DUT 0.70m/ 2.3ft		1	1	1
709 551	TD Connecting cable TD-DUT 1.60m/ 5.25ft		1	1	1
709 580	Clamp 600A red with MC contact 14mm		1	1	1
700 199	USB Pen Flash Drive HV Diagnostics		1	1	1
700 053	USB Bluetooth Dongle		1	1	1
700 006	Rechargeable Battery Size D		1	2	2

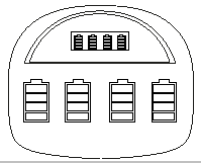
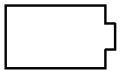
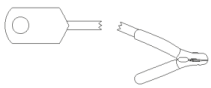
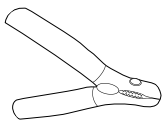
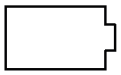
700 027	Measuring lead MFK15/1/100/ red		1	1	1
700 022	Alligator Clip 4mm connector red		1	1	1
700 105	Angle Bracket Connector 14mm		1	1	1
700 209	MC socket connection for corona shield		1	1	1
700 050	Corona Shield 2 parts		2	2	2
700 009	Battery Charger		1	1	1
706 220	Battery, 1.5V Size D		2	2	2
709 033	TD90-MC transport Case with Inlays			1	1
709 031	TD60-MC transport Case with Inlays;		1		

Shipment Content – TD – units (TD30/TD60/TD90)

Items included upon delivery of the TD are listed below. The * marking specifies items that are country specific. For inquiries, please contact HV Diagnostics.

Art. No.	Item	Description	TD30	TD60	TD90
HVD0075	TD Manual HV Diagnostics		1	1	1
700 199	USB Pen Flash Drive HV Diagnostics		1	1	1
700 053	USB Bluetooth Dongle		1	1	1
700 093	Extra Lid for Battery Compartment		1	1	1
700 300	Ni-MH Size C Battery		2	2	2
700 027	Measuring lead MFK15/1/100/ red		1	1	1
700 022	Alligator clip 4mm connector red		1	1	1
700 105	Angle Bracket Connector 14mm				1
709 208	USB Adapter Neutrik with Adapter				1

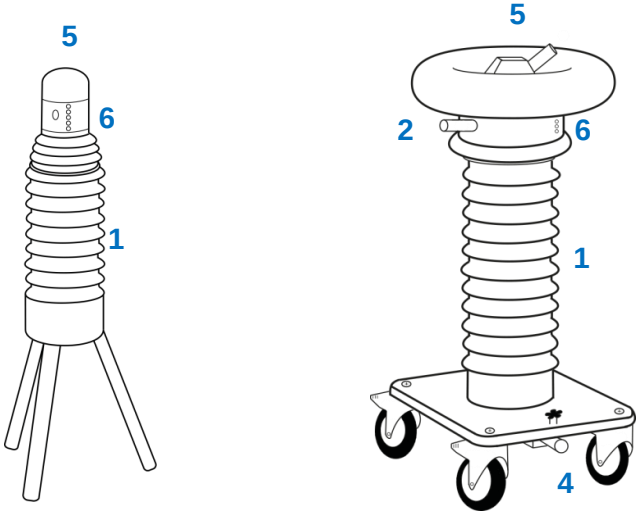
Art. No.	Item	Description	TD30	TD60	TD90
700 209	MC socket connection for corona shield				1
700 050	TD30 Hook		2		
	TD Head Inserts		3	3	3
700 050	Corona Shield 2 parts		2	2	2
700 086	HV Plug Protection Cap		1		
706 113	TD60 Cradle			1	
700 182	TD Foot base		3	3	
700 183	TD Feet upper part		3	3	
700 188	TD30 Cradle		1		
700 022	O-Ring 69 x 1.5 mm		1	1	1

Art. No.	Item	Description	TD30	TD60	TD90
700 009	Battery Charger Powerline 5 LCD		1		1
700 023	Battery 1.5V Size C		2		2
709 526	Grounding cable transparent 6mm² 10m with 600A clamp				1
709 548	TD90 Cable 100kV/10m/Plug-Plug				1
709 550	TD Connecting cable TD-charge 0.70m/ 2.3ft				1
709 551	TD Connecting cable TD-charge 1.60m/ 5.25ft				1
709 580	Clamp 600A red with MC contact 14mm				1
700 023	Battery 1.5V Size C				2
706 053	TD60 Set transport case with Inlays			1	
700 013	TD30 Set transport case with Inlays		1		

Art. No.	Item	Description	TD30	TD60	TD90
709 026	TD90 Set transport case with Inlays				1

4 Design and Construction

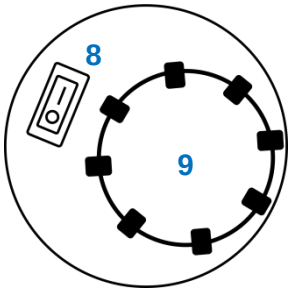
4.1 TD/TD-MC Hardware Description



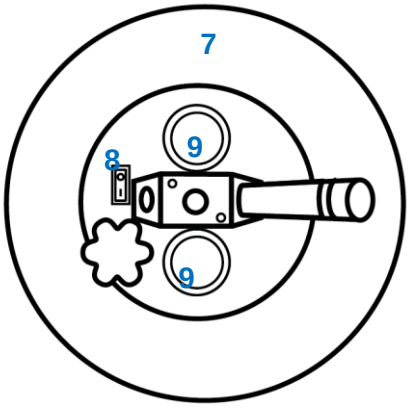
1	TD System Housing	The TD System housing/enclosure. Note the TD will assume a potentially dangerous high potential / voltage during testing and measurement. Always keep the housing isolated and clear of any ground during testing. Depending on the application, the 3-Pod “Sputnik” Stand which is supplied can be used to ensure proper isolation.
2	TD-MC HV Input	Input for the high voltage – Connection for the standard HVA test lead (connection to HVA)
3	High Voltage Plug HVA	Plug directly into HVA HV output plug socket.
4	Ground/Earth Cable	Ground connection for load / station ground. Always connect this cable to a station ground. Do not use this cable to “ground” the Device Under Test without a suitable connection to a safe station / earth ground.
5	Aluminum Head	Aluminum Head covering the main ON/OFF switch and the battery housing. TD: This head also incorporates an 8mm metric thread, which assists in providing a number of different connection options to the DUT. Unscrew head cap section to remove from the rest of the housing to turn ON/OFF the system or to replace the batteries. To re-install the head cap section, carefully screw on the cap, taking care not to cross thread the connection. TD-MC: On top of the TD-MC units there is also the output of the TD-MC unit, or rather the connection for the DUT. As well as input of unit it is a 14mm socket.
6	LED and Bluetooth® RF	5 LEDs showing operation status information. Do not cover this

		area.

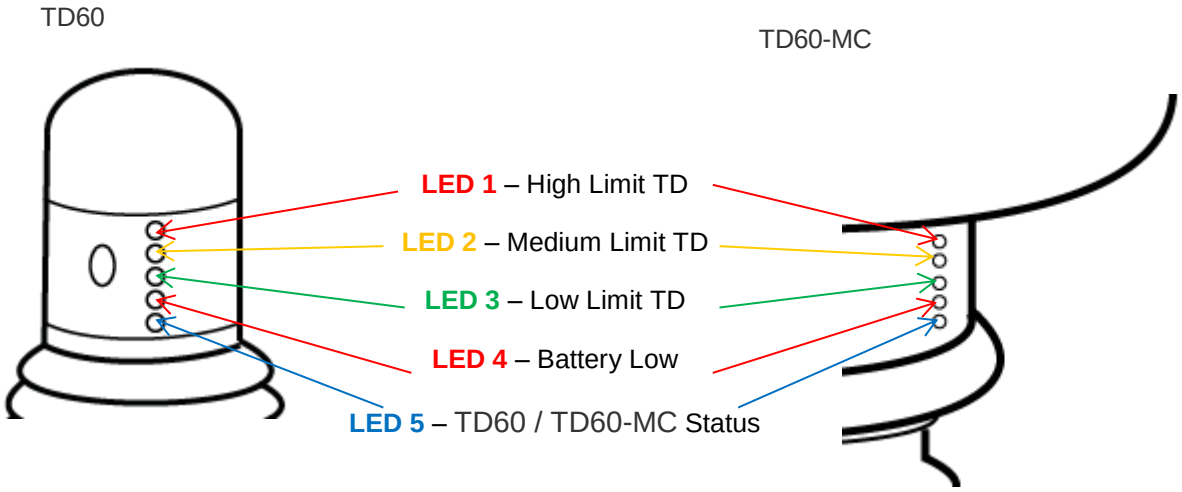
TD60



TD60-MC



7	TD system control	By removing the aluminum head cap the main switch and the battery housing can be accessed.
8	Main Switch	Switch for powering up or shutting down the TD system. It is advisable to turn off the system to conserve battery life if the system is not planned to be used for an extended period of time. The TD system incorporates an automatic power save sleep mode, which shuts down the system after no voltage (<1kV) has being sensed for 60 minutes or more. In this mode the main switch has to be set to 0 (off) for about 2 minutes and then on again to wake up the system manually, or you can reapply voltage with the HVA which will also wake up the unit.
9	Battery Compartment	Just unscrew the lid of the compartment to change the battery. TD-MC ➔ battery Size D TD ➔ battery Size C



LED 1	Signal High TD (RED)	A flashing signal here indicates a TD level that is higher than the HIGH TD setting. If setup correctly, this will normally indicate a poor TD result. Flashing will occur simultaneously with the status LED signal. The TD HIGH limit can be set using the TD Control Center PC Software.
LED 2	Signal Medium TD (YELLOW)	A flashing signal here indicates a TD level that is lower than the HIGH limit and higher than the LOW limit. If setup correctly, this will normally indicate a mediocre (medium) condition. The limits of the TD value can be set using the TD Control Center PC Software.
LED 3	Signal Low TD (GREEN)	A flashing signal here indicates a TD level that is lower than the LOW limit. If setup correctly, this will normally indicate a good TD result. The limit of the TD value can be set using the TD Control Center PC Software.
LED 4	Signal Battery Low (RED)	Battery Low signal. Permanently ON if battery voltage drops below critical limit. If battery condition is OK then this light will not be ON.
LED 5	Signal Status (BLUE)	Flashing status signal showing active operation of the system.

NOTICE

LED Test during Start-up

After Power On and during system startup/wake mode the TD unit performs a LED test to make sure that all of the LED signals work and performs a quick self-check

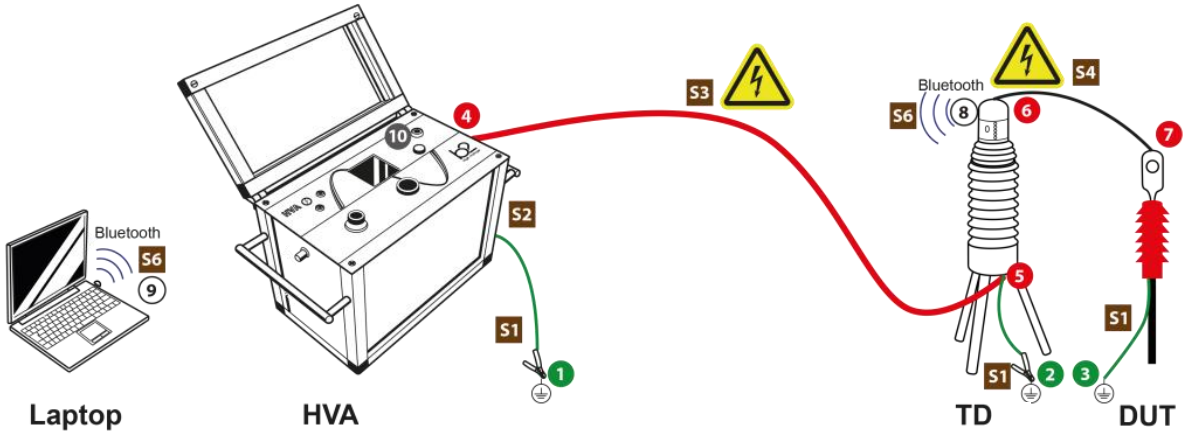
5 Connection Up to the TD / TD-MC Instrument

Safe operation requires strict adherence to the recommended grounding procedures. The TD measurement system hook-up to a cable or other electrical apparatus requires three connections. It is important that these connections are made correctly, securely and in the correct sequence. The TD / TD-MC is a measurement device and it and the DUT (Device under Test) are energized by the HVA VLF high voltage power source. The TD / TD-MC does not generate any High Voltage, but it does operate at the voltage applied to it by the HVA HV power supply. Therefore always treat the TD / TD-MC as the same voltage potential as HVA power supply “feeding” it. In addition make sure that all safety precautions and requirements are adhered to for the HVA test instrument – see HVA instruction manual.

The **Ground Cable** of the TD / TD-MC should be connected to the station ground. In the case of a cable this can be the concentric neutral / ground shield / ground wire. The cable ground must be connected to the station ground for testing purposes and SHOULD NOT be isolated from ground.

The **HV Test Lead** is a coaxial conductor made up of the center high voltage conductor and an outside Shield Return that should remain at ground potential. The return shield is internally connected to ground in the HVA via this HV plug and a separately grounded connection inside of the TD system. Connect the HV Test lead of the TD / TD-MC to the HVA test instrument by screwing in the HV plug. Make sure the plug is securely screwed into the HV socket and then connect the TD / TD-MC system to the DUT using one of the versatile connectors. The connection of the TD / TD-MC system to the DUT should be the last connection made before a test is commenced and it should be the first one removed after a test has been performed and it should be independently verified that there is no longer voltage present at the TD / TD-MC.

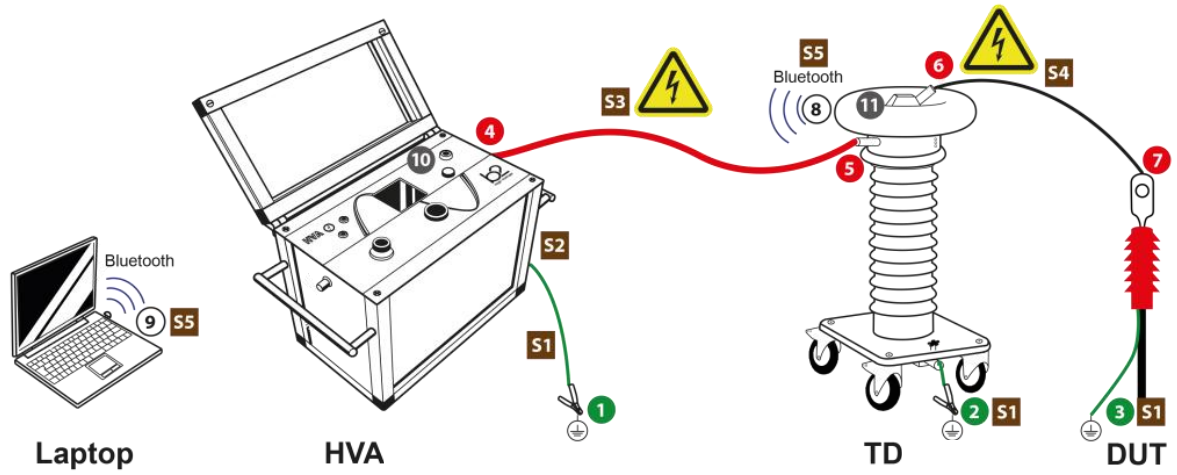
5.1 TD Cable Connection



Step	Procedure
S1	Connect Grounding Cable • Connect grounding cable to the HVA grounding connector (1) • Connect grounding cable to the TD grounding connector (5) • Connect grounding cable to the DUT grounding connector (3)
S2	Connect Power Supply Cable • Connect the power supply cable to the HVA power supply plug
S3	Connect HV Test Lead • Screw the HV test lead, which is connected to the TD (5), into the HVA HV output connector (4)
S4	• Connect the TD (6) with the DUT (7)
S5	• Check that all cables are attached securely.
S6	• Connect the HVA / TD (8) with the Laptop via Bluetooth
S7	• Turn the key switch (10) to the “ON” position.
S8	The HVA system automatically boots • Start-up default screen appears “Start Test” screen

5.2 TD60-MC Cable Connection

TD60-MC Standard Connection



Step	Procedure
S1	Connect Grounding Cable • Connect grounding cable to the HVA grounding connector (1) • Connect grounding cable to the TD grounding connector (5) • Connect grounding cable to the DUT grounding connector (3)
S2	Connect Power Supply Cable • Connect the power supply cable to the HVA power supply plug
S3	Connect HV Test Lead • Screw the HV test lead, which is connected to the TD-MC (5), into the HVA HV output connector (4)
S4	• Connect the TD-MC (6) with the DUT (7)
S5	• Check that all cables are attached securely.
S6	• Connect the HVA/TD (8) with the Laptop via Bluetooth
S7	• Turn the key switch (10) to the “ON” position.
S8	The HVA system automatically boots • Start-up default screen appears “Start Test” screen

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6 Software TD Control Center

The TD system is delivered with a set of Windows based software tools that are packaged into a software package called the TD Control Center. This software connects, records, analyzes, and reports the test results from the TD /TD-MC test instrument.

Before doing any TD measurements, please make sure the PC or Notebook that you are using is correctly setup and configured for Bluetooth® communication and has the necessary hardware installed. A Bluetooth dongle is supplied with the TD system and this can be installed by the user into the USB port of a computer. However some PC's and Handhelds come with integrated built-in Bluetooth® capability and the supplied Bluetooth® Dongle with the TD / TD-MC will normally not be required under these circumstances. In a case where Bluetooth® is already available or integrated into a PC, follow the user manual for that device to correctly configure the Bluetooth® for communication purposes.
See also the "TD System Bluetooth Setup Manual".

For Bluetooth® connection setup using the supplied Bluetooth® dongle – please refer to Appendix A.

Description of Elements of the Main Screen:

System Information, Title Bar

The Title Bar shows connection status information like the serial of the TD / TD-MC system that is paired to the current PC.

Information Selection Tabs

Use these Tabs to switch between the various information you want to view.

Phase A-C: Show detailed TD measurement information of Phase A, B, or C. If the corresponding Phase under "Currently Measured" is selected all new measurements will automatically be inserted under the selected tab.

Wave View: If a measurement is in progress, this tab shows a slightly delayed real-time display of the data acquired by the TD measurement system. Voltage and Current are shown. These values are not to scale. The graph is updated after each finished waveform period.

Graph TD vs. Voltage:
Graphical display of the TD test results as a function of applied voltage. The values of all three phases can be viewed and compared. The diagram is completely auto-scaling and extracts the mean TD value from the most recent voltage block for a particular phase.

Current TD Value

This field shows the currently measured TD value or the last value if measurement has stopped. Helpful if not in Phase-View, so the current TD value can always be observed.

Report Phase Detail

Each Phase Measurement Report consists of a header which includes the TD / TD-MC serial number it was acquired from, and the filename that it was stored under.

Report Block Header

For every detected voltage change during measurement the system automatically creates a new block in the corresponding Phase Tab. Each Block starts with a header, which gives information like the Start Time of the measurement and the updated mean values of this block.

The “Change Phase” Button enables the user to move a selected block to another Phase or to completely remove it from the Report. This is useful if phase test data was mistakenly recorded under the incorrect phase number. This can happen if the user starts a measurement under one phase but does not change the “Currently Measured Phase Selection”. Then the whole block can be easily moved after the full measurement block has been completed.

Report Block Measurements

This grid shows the detailed individual test measurements for each distinct voltage. Each column is described with units in the grid header row.

Test Report File Functions – Load, Save, Print …

Use these buttons to Load, Save, and Print a test report.

The Print function can also be used to create PDF document reports if a PDF Writer or a similar PDF Printer Driver is installed.

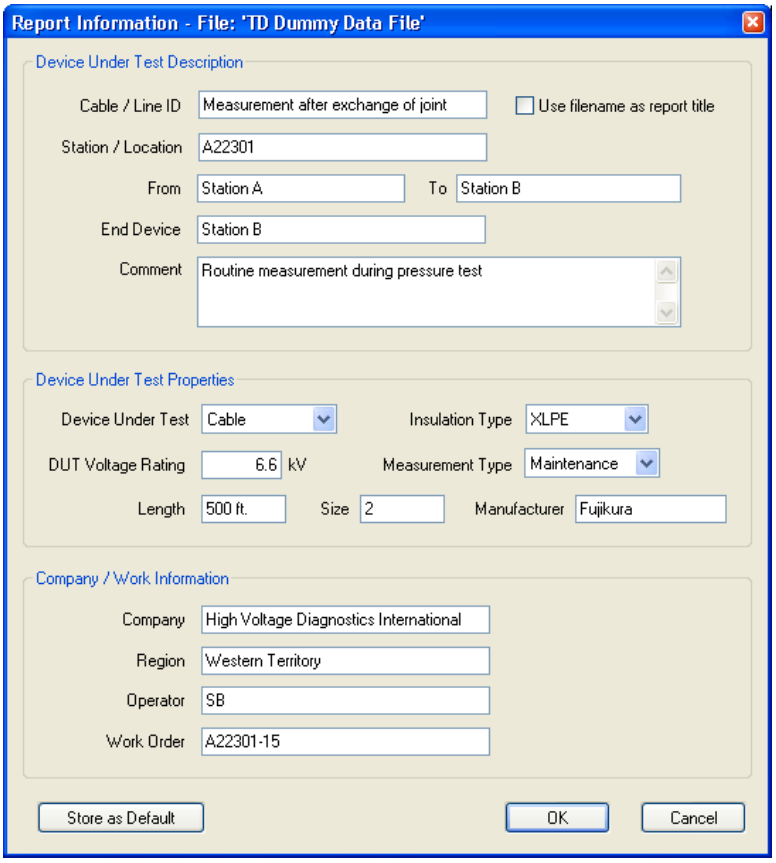
Report Specific Functions

Clear Report

Clear the current active report test data. Be sure to save your test data before you clear a test report. This function is useful if you want to start a new test and want to “clean” the test sheet.

Edit Report Information

This Form enables the user to save detailed information with the report data.



Cable/Line ID (if cable as DUT is selected)

The user can enter a unique identifier for the Device Under Test (DUT). This Text will also be used (by default) as the title for this Report on the Summary and Printout.

Store As Default

The user can store certain fields that are not likely to change from one test to another as default start-up fields. These fields are then easily and automatically inserted into any new test reports.
Fields stored: Station, Company, Region and Operator

Use filename as report title

If this box is checked, the report filename will be used as the report title instead of the Cable/Line ID field.

Currently Measuring…… Phase Selection

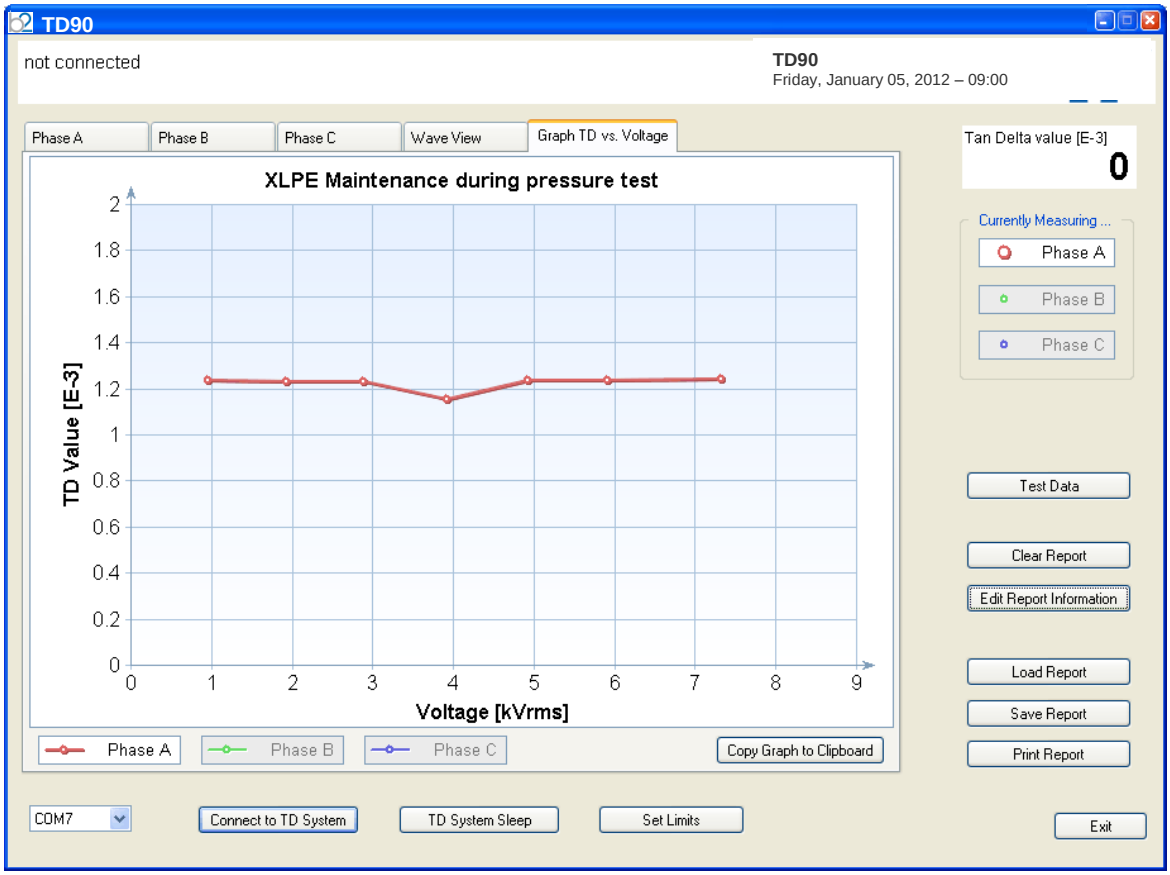
The phase that is currently being tested by the TD / TD-MC needs to be selected.

All new measurement data will be put into the corresponding report phase section (tab).

If the operator changes the phase during an active TD / TD-MC measurement, the change will only occur when the current TD / TD-MC voltage block is finished to avoid splitting up of the respective TD / TD-MC measurement data block. The block “under the wrong” phase tab can then be moved to the correct phase section using the “Change Phase” button in the block header at a later stage.

Graphical View / Diagram

This screen provides a graphical diagram of the Mean TD / TD-MC measurement data versus the applied test voltage.
The values of all three phases can be viewed and compared. The graph automatically scales and draws the mean TD / TD-MC values for each voltage block.



Phase Selection for Diagram View

Toggle ON/OFF the various phases to display / block out the relevant phase information.

Copy Graph to Clipboard

Use this function to make a copy the currently shown TD diagram into the Windows Clipboard. It can then be easily put into many other applications (like Word, Excel) by selecting Paste in the target program.

6.1 Bluetooth® Setup and Configuration Procedure

A Bluetooth USB dongle is shipped with every TD / TD-MC system. This dongle is tested to work with the TD unit and can be used if your Computer/Notebook has no built in integrated Bluetooth Hardware. Since there are various ways to use and configure Bluetooth under Windows operating systems, the following procedures are provided to setup and use Bluetooth wireless TD measurement system. You will need Administrator Privileges to install the drivers on certain secure networks.

Communication Parameters for Bluetooth Setup (Advanced Users)

- Bluetooth v1.1 compliant
- Serial Port Profile, only this profile and the corresponding outbound COM port needed
- COM 3 to COM30 are supported
- Secure and unsecure communication and pairing supported
- Passkey used is “welcome”, all lowercase, (for pairing this is also the PIN-code)

To install the communication three steps have to be done

- **Step 1**: Installation of Bluetooth driver support on your computer (if not already built-in)
- **Step 2**: Configure Bluetooth support (Initial usage, only has to be done once)
- **Step 3-A/B**: Setting up the TD Communication Port
  A: With use of External Dongle or B: Windows Supported Hardware
  There are 2 different ways to set up a communication port, one is with Windows directly supported, and one is using the external dongle. See below which procedure to use with your computer.

Check Bluetooth Hardware

First check if your computer has a built in Bluetooth communications hardware like most of the newer Notebooks have. Normally they are already configured to use Bluetooth.
In this case you will not need to use the external USB dongle nor should you install the Bluetooth driver CD supplied.

If you are not sure if Bluetooth is installed and running please check with your system administrator to verify if Bluetooth is supported on your computer system.
Installed drivers show a white on blue B-Icon in the system tray on the right bottom side of the desktop (Taskbar). Some Notebooks have separate pushbuttons to switch it on/off.

If Bluetooth is already supported you can go directly to Step 3-B Setting up TD Communication (Windows supported). If your system uses a different driver than shown in this manual, use the above mentioned parameters to set up Communication.

Step 1 Installation of Bluetooth support on your computer

If your computer does not have a built in or existing Bluetooth Hardware you can use the Bluetooth Dongle and CD which is shipped with your TD System. This dongle has been tested to work with the TD unit and has a range of approximately 50 feet / 15 meters.

WARNING

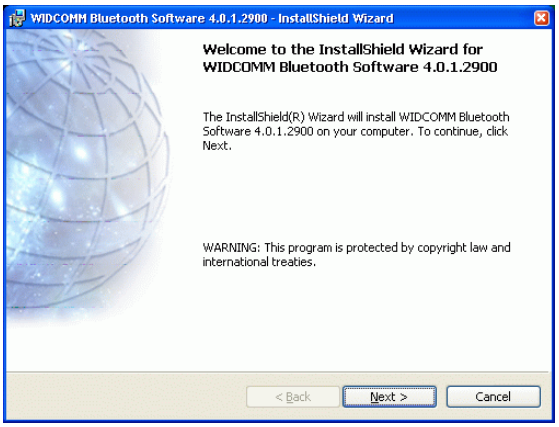
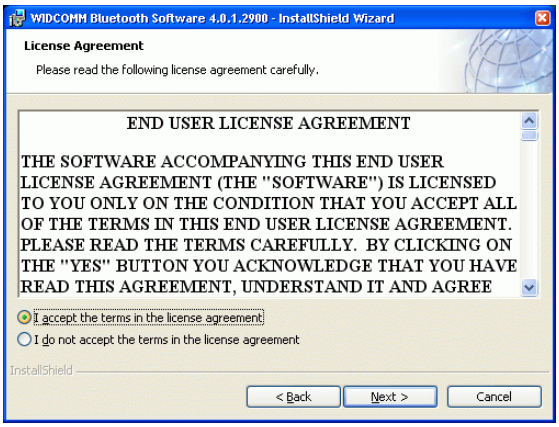
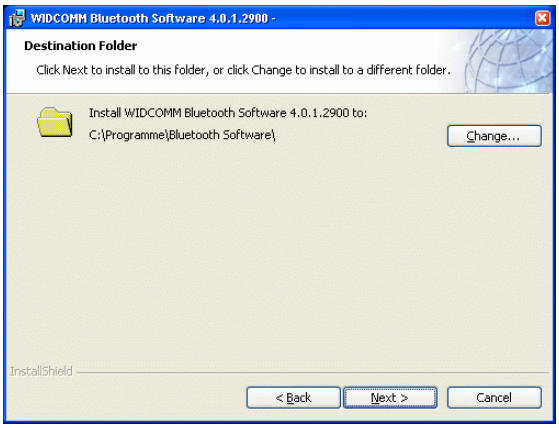
Installation Bluetooth Dongle

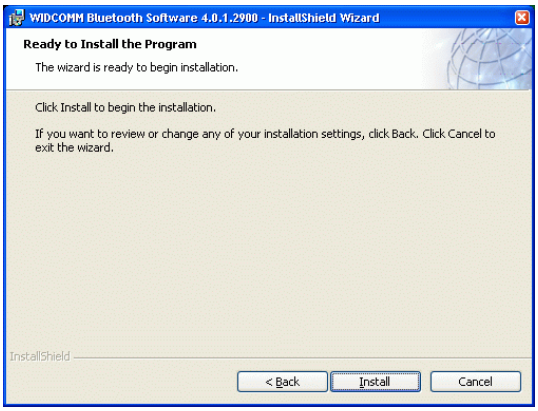
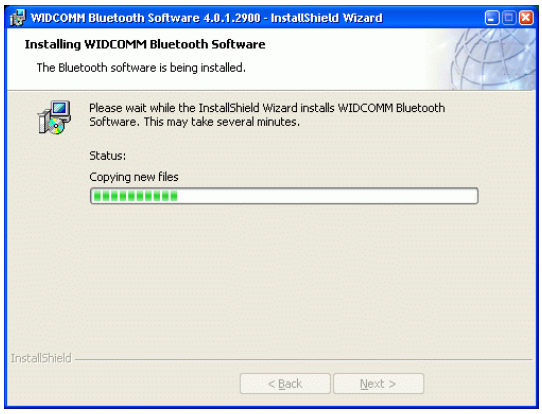
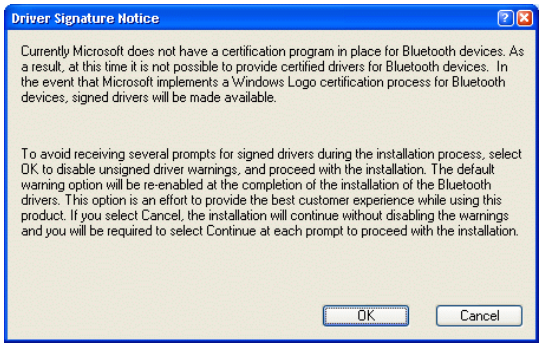
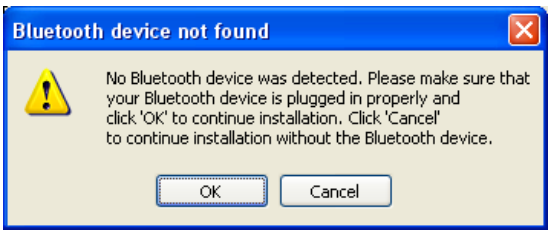
Do not install the Bluetooth Dongle before you begin installing the drivers as described.

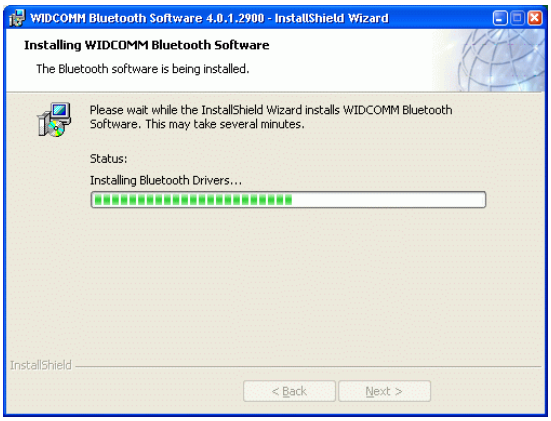
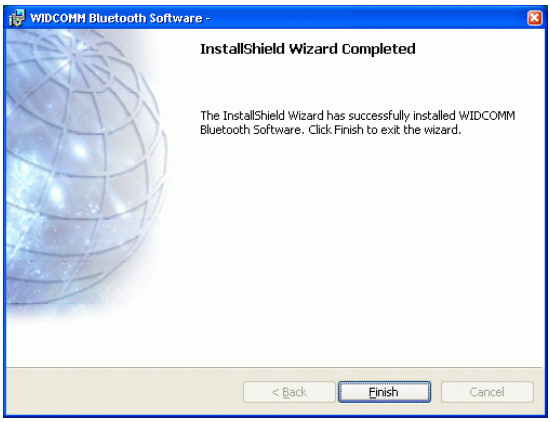
Start Installation

Start the installation process by inserting the driver CD supplied.
The Setup should start automatically, if not locate the CD/DVD drive on “My Computer” and start Setup.exe in the driver folder.
Due to possible technologically changes in drivers and the Windows operating system, certain messages shown below may vary slightly to what you may find on your computer.

Steps **IB1 – IB9** describe how to **Install the Bluetooth Software**

Step	Procedure (Installation Bluetooth Software)
IB1: Setup Start 	Driver Setup Start Screen
IHV DIAGNOSTICS: Accept License 	Accept License agreement
IB3: Choose Destination 	Choose Driver Software Destination. We suggest using the defaults.

Step	Procedure (Installation Bluetooth Software)
IB3: Start Installation 	Begin Installation.
IB5: Installation starts 	Installation has started
IB6: Accept Driver 	Press OK to accept this driver
IB7: find Bluetooth 	The driver now needs to have the Bluetooth dongle inserted. Plug the dongle into a free USB port. The windows Hardware Installation will now run and some further information windows will appear. Please wait until the Hardware Detection has finished. This screen will then disappear automatically.

Step	Procedure (Installation Bluetooth Software)
IB8: Installation Bluetooth Driver 	Installation of Bluetooth support on your Computer. Other information messages may appear. Please wait until the Installation completes.
IB9: Installation Finished 	Installation of Bluetooth support finished. The above mentioned white on Blue “B”-Bluetooth icon now appears in the system tray.

Step 2 Configure Bluetooth Support (First Time Users)

After successful driver installation, a white on blue Bluetooth icon appears in the system tray on the right bottom side of your desktop and a new Icon, “My Bluetooth Places”, appears on your desktop:

Configure Bluetooth Support using external dongle

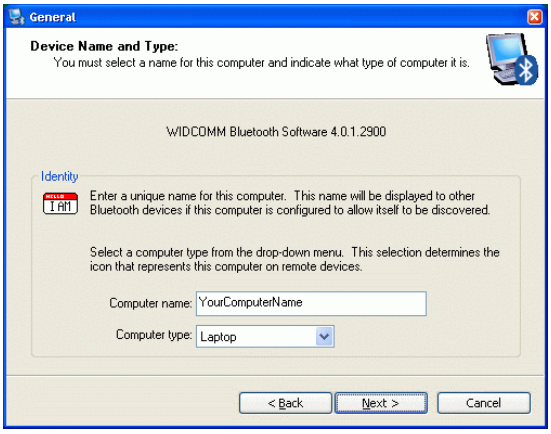
Please follow this instruction to set up a communication port to the TD system if you are using the external dongle with the above mentioned driver (not Windows built in support).

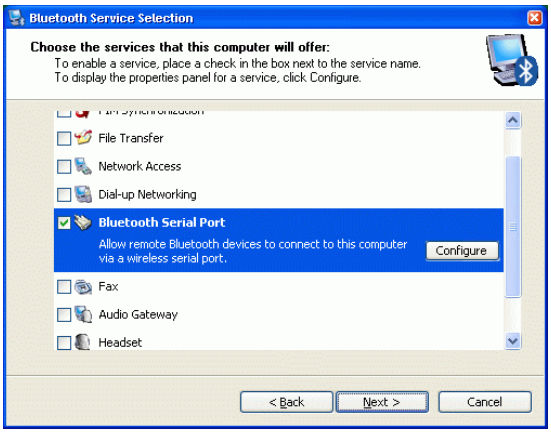
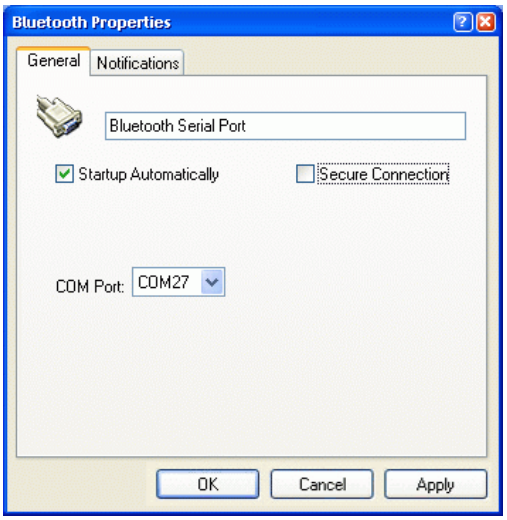
First usage configuration

After the new installation of the Bluetooth support on your computer, you have to configure the type of service your computer uses.

Double click on the Bluetooth icon in the system tray or the “My Bluetooth Places” icon on your desktop to bring up the configuration wizard:

Steps **CB1 – CB9** describe **the Bluetooth Software configuration.**

Step	**Procedure** (Bluetooth Software configuration)
CB1: Bluetooth Configuration 	Initial Bluetooth configuration (only has to be done once)
CHV DIAGNOSTICS: Computer Title 	Type in the name and type of your computer.
CB3: Configuration starts 	Start Configuration

Step	Procedure (Bluetooth Software configuration)
CB4: Bluetooth services 	Check or uncheck those Bluetooth services you want to use.
CB5: Bluetooth Serial Port Configuration 	Bluetooth Serial Port Configuration. Leave as suggested. Take note of the serial port number.
CB6: Bluetooth Configuration Access 	Press Skip to tell the system that you will connect to the TD system at a later stage.

Step	Procedure (Bluetooth Software configuration)
CB7: Bluetooth Configuration Finished  	Finished Initial Setup of Bluetooth Support.

Step 3-A: Setting up a TD Communication Port (External Dongle)

After installation and configuration of the Bluetooth drivers and hardware dongle, an icon called “My Bluetooth Places” gives you access to all Bluetooth specific properties and configurations.

All configured devices are listed under the “My Bluetooth Places”.

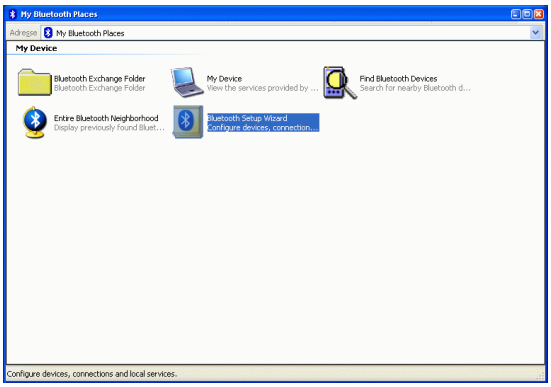
Switch on the TD system

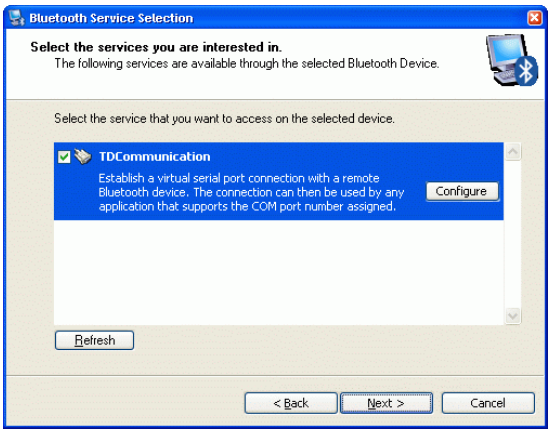
Before connecting, reset the TD System by switching the main power switch off and then ON again.
Make sure the TD system is within 50 foot / 15 meters of the connecting computer. Since the Bluetooth RF signals can be affected by other wireless systems and obstructions such as WLAN or other RF devices, try moving the TD system closer to your computer if you cannot get a “pairing” connection from following the procedure below.

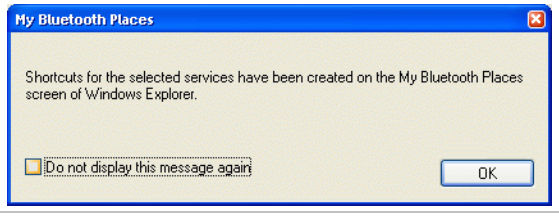
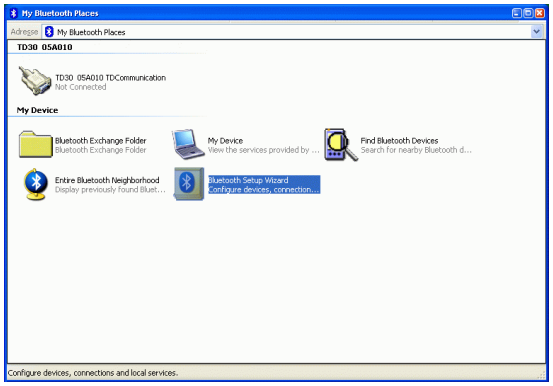
Setup the Communication Port to connect to the TD / TD-MC

Start to set up a communication port to the TD system by double-clicking on the “My Bluetooth Places” icon.

Steps **CB1 – CB9** describe how to **connect a TD-Unit (external Dongle).**

Step	Procedure (Connection with a TD-Unit)
VT1: Bluetooth Setup Wizzard 	My Bluetooth Places: Select Bluetooth Setup Wizard to connect to TD system.
VT2: Select Bluetooth Device 	Select “I want to find a specific Bluetooth device …” to find the TD system
VT3: Selection TD Device 	All available Bluetooth devices are listed. TD systems are shown with the last 6 digits of the Serial number. Select the TD unit you want to connect to.

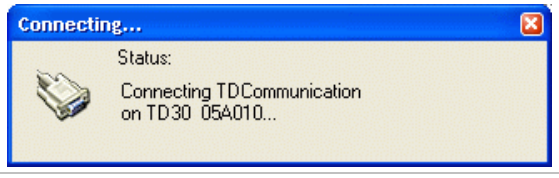
Step	Procedure (Connection with a TD-Unit)
VT4: Bluetooth Pairing Procedure 	Pair the device. Type in the PIN code “welcome” and press “Initiate Pairing”. A message “No Com port available” may be appear. Just quit with ok.
VT5: TD Communication 	Check the “TDCommunication” service to use. A message to configure the port will appear.
VT6: Bluetooth Properties 	Leave default setting for this port. Make note of it. You can use either Secure or Unsecured Connection.

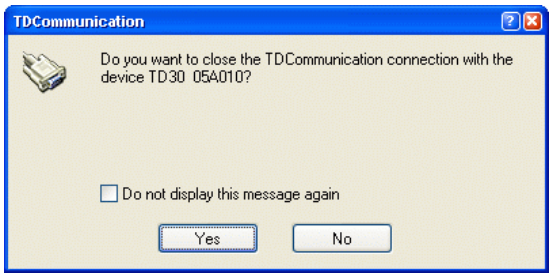
Step	Procedure (Connection with a TD-Unit)
VT7: Communication Port Setup 	Successful Setup of communication port!
VT8: TD Unit 	The TD system is now shown as an icon in “My Bluetooth Places”

Initial Connection to the TD unit (Establish and Test connection)

To establish the connection and to fix the settings of the COM-port you have to perform an initial connection to the TD unit. This is also verifies a correct setup.

Double click the TD System icon.

Step	Procedure (Initial Connection to TD)
Connect TD System 	Connecting to the TD System
Connection 	Established Connection! Read the information and note the COM-Port Number. This number is used by the TD Control Center to communicate with the TD unit.

Step	Procedure (Initial Connection to TD)
Close (disconnect) the Test connection 	Right click on the TD System icon and select Disconnect. It is also possible to switch off the TD system and the connection will automatically be closed.

WARNING

Installation finished!

The System is now configured and you can start working with the TD Control Center. You will use the given COM-Port number to set in the Control Center and press the connect button.

Step 3-B: Setting up a TD Communication Port (Windows Supported)

If your Windows operating System already supports your Bluetooth Hardware you can use the Windows Bluetooth System instead of a separate driver to set up the communication.

Windows shows you the Bluetooth icon in the System Tray on the right bottom side of your desktop. This gives you access to all Bluetooth specific properties and configurations.

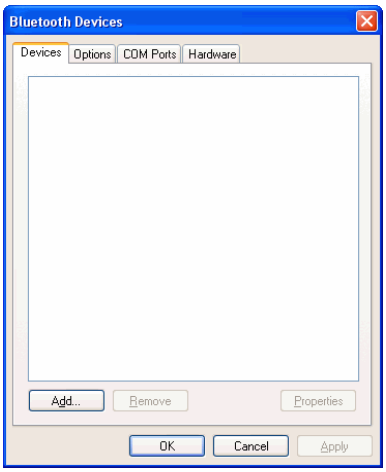
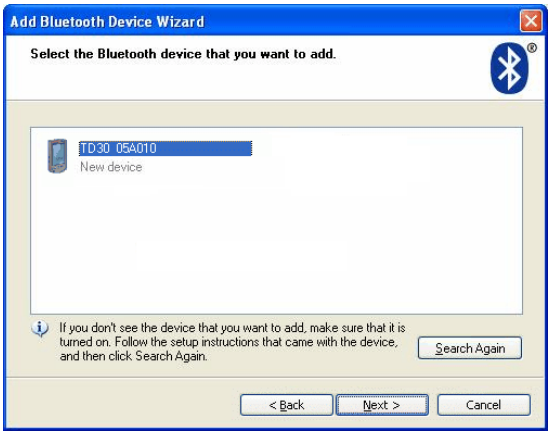
Switch on the TD system

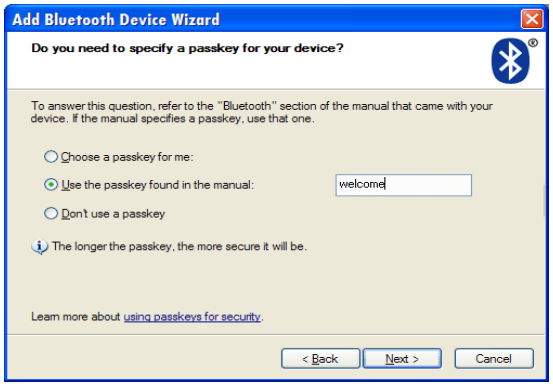
Before connecting, reset the TD System by switching the main power switch off and on.
Make sure the TD system is within the range of 50 feet / 15 meters to the computer. Internal integrated Bluetooth devices often have closer working ranges than external. So you maybe have to reduce the distance to get good connectivity.

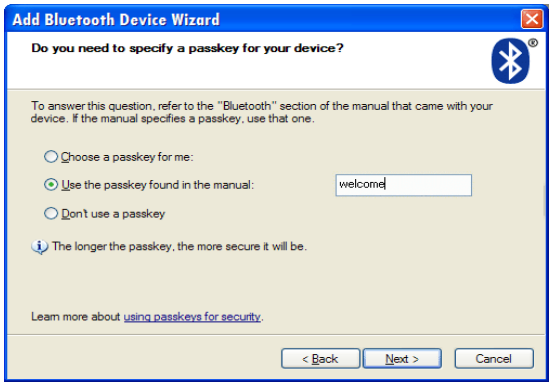
Setup the Communication Port

Start to set up and allocate a communication port to the TD system by double-clicking on the Bluetooth icon in the system tray.

Steps **KT1 – KT8** describe how to **connect a TD-Unit (Windows).**

Step	Procedure (Initial Connection with TD - Windows)
KT1: Bluetooth Device 	Bluetooth Devices, press Add to start.
KT2: Add Bluetooth Device 	Check Device is switched on and ready to discover
KT3: Select Bluetooth Device 	All available Bluetooth devices are listed. TD systems are shown with the last 6 digits of the Serial number. Select the TD unit you want to connect to.

Step	Procedure (Initial Connection with TD - Windows)
KT4: Specify a passkey 	Select “Use Passkey from documentation” and enter “welcome” to use as the key.
KT5: Install Drivers 	Windows connects to the TD System and installs the relevant drivers.
KT6: Finish Bluetooth Wizard 	Read the information and note the “outgoing/outbound” COM-Port Number. This number is used by the TD Control Center to communicate with the TD unit.

Step	Procedure (Initial Connection with TD - Windows)
KT4: Specify a passkey 	Select “Use Passkey from documentation” and enter “welcome” to use as the key.
KT4: Bluetooth Device is configured 	The System is now configured. You can start working with the TD Control Center. Use the given COM-Port number in the TD Control Center and press the connect button.

7 Instrument Care

Cleaning

DANGER

Electric Shock Hazard!

Only clean the instrument when turned off!

NOTICE

O-ring greasing!

Please always keep an eye on the O-ring (gasket) of the TD unit.
It should be lightly greased in in regular intervals. (Only the gasket ring!)

In the case the ring is brittle you should contact HV Diagnostics for a spare one.

Storage

CAUTION

Instrument Damage

Do not store the TD units outdoors!
Keep the TD units away from liquids!

HVA should be stored indoors in the following environmental conditions:

- Temperature: -25°C to 70°C (-13F to 158F)
- Humidity: 5-80% non-condensing

Maintenance and Repairs

NOTICE

Authorized personnel only!

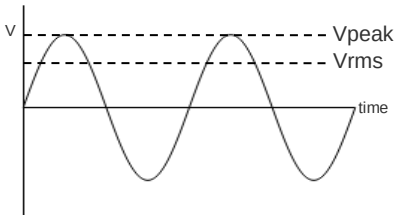
Repairs and maintenance should only be performed by authorized HV Diagnostics' personnel.

One yearly inspection by authorized HV Diagnostics personnel is recommended

8 Glossary and Abbreviations

The following explains abbreviations and selected terms used in this document in alphabetical order.

Term	Explanation
Arc	Self-maintained gas conduction for which most of the charge carriers are electrons supplied by primary‑electron emission (source: IEC)
Auto Adjust Frequency “0.1 Hz/Auto”	Mode that maximizes output frequency to highest allowable value • Greatest allowable frequency depends on the test load and test voltage applied • For loads greater than nominal load, the instrument automatically reduces the frequency
DUT	Device under Test
Duty (continuous)	Load state in which the unit operates for a long period. Continuous means: no limitation in operating time based on temperature limits
Fault	An unplanned occurrence or defect in an item which may result in one or more failures of the item itself or of other associated equipment (source: IEC)
Frequency[Hz]	Number of cycles per unit of time ; f=1/ Period (Time), units=Hz 1 Hz = 1cycle / 1 second 0.1 Hz = 1cycle / 10 second , etc.
Hipot	High potential (voltage)
HV	High Voltage: Voltage levels used in power distribution: • Medium Voltage: up to 36 kV • High Voltage: up to 110 kV • Extremely High Voltage: 220 kV, 380 kV or higher (according to IEC/International Electro technical Vocabulary)
IEC	International Electro technical Commission
Peak value	Maximum Voltage = V_{max}
RMS value	Root Mean Square voltage • $V_{rms} = V_{peak} / \sqrt{2}$ for Sinusoidal wave forms
To Short	Forcing the electric potential differences between two or more conductive parts to be equal to or close to zero (Infinite current flows in a short circuit)
To Trip	Opening the circuit (no current flows in open circuit)
VLF	Very Low Frequency • Typically between 0.01 -0.1 Hz



9 Declaration of Conformity

The TD / TD-MC is CE certified and has met the following requirements of the European Council:

Category	Standard
EMC	IEC61004-2 , ESD Level 4 (8/15kV) IEC61004-4 , Burst 4kV 5kHz EN55011
Safety	EN60950 EN50191 EN61010-1