HVA Family

HVA28 | HVA34-1 | HVA45

and corresponding TD models

ENGLISH
Rev.6.0

Ultra-compact, universal

VLF High Voltage Testing Set with Tan Delta

Firmware V2

HV Diagnostics, Inc.
271 Rope Mill Pkwy, Ste 2
Woodstock, GA 30188
USA

T +1 (678) 445 2555
F +1 (678) 445 2557

www.hvdiagnostics.com
sales@hvdiagnostics.com

Table of Contents

1 Introduction

Purpose

The purpose of this manual is to ensure the proper and safe use of the HVA28, HVA28TD, HVA34-1, HVA34TD-1, HVA45 and HVA45TD testing instruments.

1.1 About this Document

Devices

This document applies to all the corresponding HVA smart VLF units.
HVA refers to HVA28, HVA28TD, HVA34-1, HVA34TD-1, HVA45 and HVA45TD.

Target Users

This user 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
HVA operator	• Connecting the equipment • Carrying out manual or pre-programmed test sequences • Verifying the validity of a HVA application • Adjusting instrument settings • Programming automatic test sequences in accordance with particular testing standards	**All** sections Particular focus on all **safety** messages
Procurement, management	• Assuring that the workplace is safe and has all required equipment • Assuring that HVA operators are qualified technicians • Assuring that operators fulfil their responsibilities	Particular focus on **safety** messages and information regarding general product description.

Safety

NOTICE

This manual should always be on hand when using the HVA testing instruments.

1.2 Documentation Conventions

This chapter explains the symbols and safety messages in this document. Safety symbols and signal words are used in accordance with 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.

Safety Messages

A detailed symbol, 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 a specific hazard.

Circle outlined in red with red diagonal line: Used to indicate forbidden practices.
The practice described 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 warrenty from the original purchase date of the instrument on all necessary parts and labor. This warranty is void in the event of abuse, incorrect operation or use, unauthorized modifications or event of abuse, incorrect operation or use, unauthorized modification or repairs, or failure to perform the specified maintenance as indicated in this user 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, Inc. must be packed in original packaging. All shipped items must be prepaid and insured. No other warranties are expressed or implied.

Contact Information

HV Diagnostics, Inc.
271 Rope Mill Pkwy, Ste 2
Woodstock, GA 30188
USA
T: +1 (678) 445-2555
F: +1 (678) 445-2557
www.hvdiagnostics.com
sales@hvdiagnostics.com

Copyright

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

2.1 General Safety

NOTICE

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

2.2 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.
- Device Under Test (DUT) must be grounded, 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.
- Ground connections must be made first and removed last.
- DUT must be discharged and grounded 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.

WARNING

Radiation Hazard
Testing vacuum bottles, above their rated voltage, with DC can produce dangerous X-rays.

NOTICE

Equipment Handling
DUT must have clean connections.
Testing 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.

WARNING

This is a Class A product. In a domestic environment, this product may cause technical interference, in which case the user may be required to take adequate measures.

2.3 Appropriate Applications

The HVA testing instruments are designed to perform high voltage insulation testing of various types of highly capacitive loads.

Appropriate DUTs

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

Appropriate measurements

Measurement	Examples
Test	• Capacitance • Resistance • Dielectric breakdown voltage • RMS current • Applied voltage • Tan Delta

NOTICE

Other Applications

Before proceeding, contact HV Diagnostics to validate appropriate use!

2.3 Operator Qualifications

HVA 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

Description	HVA28TD[1]	HVA28[1]
Part Number	702 003	702 001
Input Supply Voltage	100 - 240 V 50/60 Hz (400 VA)	
Input Supply Power	400 VA	
Output Voltage [Max.]	VLF Sinusoidal: 0 - 30 kV_{peak}, 21 kV_{rms} DC: ± 0 - 28 kV VLF square wave: 28 kV Resolution: 0.1 kV, Accuracy: ± 1 %	
Output Current	0 - 20 mA, Accuracy: ± 1 %, Resolution: 1 µA	
Resistance Range	0.1 MΩ - 5 GΩ	
Output Frequency	0.01 - 0.1 Hz in steps of 0.01 Hz (default 0.1 Hz) – Automatic Frequency Optimization	
Output Load	0.5 µF @ 0.1 Hz @ 20 kV_{rms} 5.0 µF @ 0.01 Hz @ 20 kV_{rms} 10.0 µF Maximum Capacitance![2]	
Sheath Test	Max. Test Voltage: 10 kV | Trip Current: 0.1 mA - 5.0 mA	
Sheath Fault Location[3]	Max. Test Voltage: 10 kV | Pulse/Period: 1:3 / 4 s, 1:5 / 4 s, 1:5 / 6 s, 1:9 / 6 s	
Metering	Voltage and Current (true rms and/or peak), Capacitance, Resistance, Time, Flashover Voltage	
Tan Delta Measurement	Accuracy ± 1 x 10^{-4}	Optional
Output Duty	Continuous! No thermal limitation on operating time.	
Test Modes	Manual & Automatic	
Output Modes	AC (VLF) Symmetrical and Load-Independent across full range, DC (plus or negative polarity), Burn-/Fault Condition or Fault Trip Mode, Jacket/Sheath Testing	
Safety	50 Hz - 12 kV Feedback Protection / Dual Discharge System (internal)	
Computer Interfaces	Bluetooth and USB	
Record Storage	Built-in Memory: up to 50 reports, 50 Test Sequences USB Flash Drive: Unlimited	
PC Software	“HVA Control Center” and “TD Control Center” (Windows Compatible)	
Weight	14 kg/ 31 lbs	
Dimensions	430 mm x 240 mm x 340 mm/ 17” x 9.5” x 13.4”	
Environment	Storage Temperature: -25°C to 70°C (-13°F to 158°F) Operating Temperature: -20°C to 55°C (-4°F to 131°F) Humidity: 5-70 % non-condensing;	

[1] technical specifications are subject to change. HV Diagnostics Inc reserves the right to modify values in accordance with future HVA development.
[2] at lower frequency and voltage
[3] in combination with locating device (not in scope of delivery)

Description	HVA34TD-1[1]	HVA34-1[1]
Part Number	735 003	735 001
Input Supply Voltage	100 - 240 V 50/60 Hz	
Input Supply Power	1.2 kVA	
Output Voltage [Max.]	VLF Sinusoidal: 0 - 34 kV_{peak}, 24 kV_{rms} DC: ± 0 - 34 kV VLF square wave: 34 kV Resolution: 0.1 kV, Accuracy: ± 1 %	
Output Current	0 - 60 mA, Accuracy: ± 1 %, Resolution: 1 µA	
Resistance Range	0.1 MΩ - 5 GΩ	
Output Frequency	0.01 - 0.1 Hz in steps of 0.01 Hz (default 0.1 Hz) – Automatic Frequency Optimization	
Output Load	1.5 µF @ 0.1 Hz @ 24 kV_{rms} 2.8 µF @ 0.1 Hz @ 18 kV_{rms} 10.0 µF Maximum Capacitance![2]	
Sheath Test	Max. Test Voltage: 10 kV | Trip Current: 0.1 mA - 5.0 mA	
Sheath Fault Location[3]	Max. Test Voltage: 10 kV | Pulse/Period: 1:3 / 4 s, 1:5 / 4 s, 1:5 / 6 s, 1:9 / 6 s	
Metering	Voltage and Current (True rms and / or peak), Capacitance, Resistance, Time, Flashover Voltage	
Tan Delta Measurement	Accuracy ± 1 x 10^{-4}	Optional
Output Duty	Continuous! No thermal limitation on operating time.	
Test Modes	Manual & Automatic	
Output Modes	AC (VLF) Symmetrical and Load-Independent across full range, DC (plus or negative polarity), Burn-/Fault Condition or Fault Trip Mode, Jacket/Sheath Testing	
Safety	50 Hz-12 kV Feedback Protection / Dual Discharge Device (internal)	
Computer Interfaces	Bluetooth and USB	
Record Storage	Built-in memory: up to 50 reports, 50 test sequences USB flash drive: unlimited	
PC Software	“HVA Control Center” and “TD Control Center” (Windows Compatible)	
Weight	39 kg/ 86 lbs	
Dimensions	500 mm x 305 mm x 457 mm/ 19.7” x 12” x 18”	
Environment	Storage Temperature: -25°C to 70°C (-13°F to 158°F) Operating Temperature: -20°C to 55°C (-4°F to 131°F) Humidity: 5-70 % non-condensing;	

[1] technical specifications are subject to change. HV Diagnostics Inc reserves the right to modify values in accordance with future HVA development.
[2] at lower frequency and voltage
[3] in combination with locating device (not in scope of delivery)

Description	HVA45TD[1]	HVA45[1]
Part Number	745 003	745 001
Input Supply Voltage	100 - 240 V 50/60 Hz	
Input Supply Power	1.2 kVA	
Output Voltage [Max.]	VLF Sinusoidal: 0 - 45 kV_{peak}, 32 kV_{rms} DC: ± 0-45 kV VLF square wave: 45 kV Resolution: 0.1 kV, Accuracy: ± 1%	
Output Current	0-60 mA, Accuracy: ± 1%, Resolution: 1 µA	
Resistance Range	0.1 MΩ - 5 GΩ	
Output Frequency	0.01-0.1 Hz in steps of 0.01 Hz (default 0.1 Hz) – Automatic Frequency Optimization	
Output Load	1 µF @ 0.1 Hz @ 32 kV_{rms} 10.0 µF @ 0.01 Hz @ 32 kV_{rms} 10.0 µF Maximum Capacitance![2]	
Sheath Test	Max. Test Voltage: 10 kV | Trip Current: 0.1 mA - 5.0 mA	
Sheath Fault Location[3]	Max. Test Voltage: 10 kV | Pulse/Period: 1:3 / 4 s, 1:5 / 4 s, 1:5 / 6 s, 1:9 / 6 s	
Metering	Voltage and Current (true rms and / or peak), Capacitance, Resistance, Time, Flashover Voltage	
Tan Delta Measurement	Accuracy ± 1 x 10^{-4}	Optional
Output Duty	Continuous! No thermal limitation on operating time.	
Test Modes	Manual & Automatic	
Output Modes	AC (VLF) Symmetrical and Load-Independent across full range, DC (plus or negative polarity), Burn-/Fault Condition or Fault Trip Mode, Jacket/Sheath Testing	
Safety	50 Hz-12 kV Feedback Protection / Dual Discharge Device (internal)	
Computer Interfaces	Bluetooth and USB	
Record Storage	Built-in Memory: up to 50 reports, 50 Test Sequences USB Flash Drive: Unlimited	
PC Software	"HVA Control Center" and "TD Control Center" (Windows Compatible)	
Weight	39 kg/ 86 lbs	
Dimensions	500 mm x 305 mm x 457 mm/ 19.7" x 12" x 18"	
Environment	Storage Temperature: -25°C to 70°C (-13°F to 158°F) Operating Temperature: -20°C to 55°C (-4°F to 131°F) Humidity: 5-70 % non-condensing;	

[1] technical specifications are subject to change. HV Diagnostics Inc reserves the right to modify values in accordance with future HVA development.
[2] at lower frequency and voltage
[3] in combination with locating device (not in scope of delivery)

3.2 Design Features

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

Feature	Purpose	Advantage
Optimized frequency selection/automatic load measurement	• To test capacitive loads • No instrument restart necessary	• Facilitates testing • Limits number of connections to the DUT • No Manual Switching
Fully automatic test sequences	• To test according to IEEE or other standards	• Facilitates complex testing • Facilitates test repetition
Real time display	• To instantly indicate output voltage	• Facilitates testing
Load-independent output	• To display true symmetrical sine and square waveforms	• Facilitates testing
Built-in memory	• To save test sequences • To save test reports	• Facilitates test repetition • Facilitates documentation
Arc management	• To provide short-circuit protection • To allow for fault conditioning	• Limits test interruptions commonly encountered when using conventional HV testing instruments that immediately trip on arc detection
Automatic load measurement	• To limit connections to the DUT	• Facilitates testing
Intelligent design	• To avoid moving parts and need for lubrication	• Reduces maintenance • Improves instrument durability and reliability
Instrument lock - key switch	• To prevent unauthorized use	• Improves safety
Local and remote emergency off switches	• To shut down operations in emergency situation	• Improves safety
Fully integrated discharge and transient circuit	• To ground the DUT after testing • To protect the unit from transient overvoltages	• Improves safety • Protects instrument
Initial load clearance test at reduced voltages	• To check automatically for shorts or grounds, during load measurement, before test initiation	• Improves safety
Return voltage indication	• To monitor external high voltage greater than 100 V (AC or DC)	• Improves safety

Feature	Purpose	Advantage
Discharge status indication	• To indicate when DUT is not fully discharged red LED light (71) flashes when residual voltage is greater than 100 V	• Improves safety during normal disconnection procedures
USB	• To store test reports • To upload test sequences	• Facilitates documentation • Facilitates test repetition
Bluetooth	• To send test reports • To upload test sequences	• Facilitates documentation • Facilitates test repetition
IP67 (with closed lid)	• To avoid damage during transport or storage • To protect instrument from water	• Protects instrument • Improves functionality

3.3 External Interlock and Control

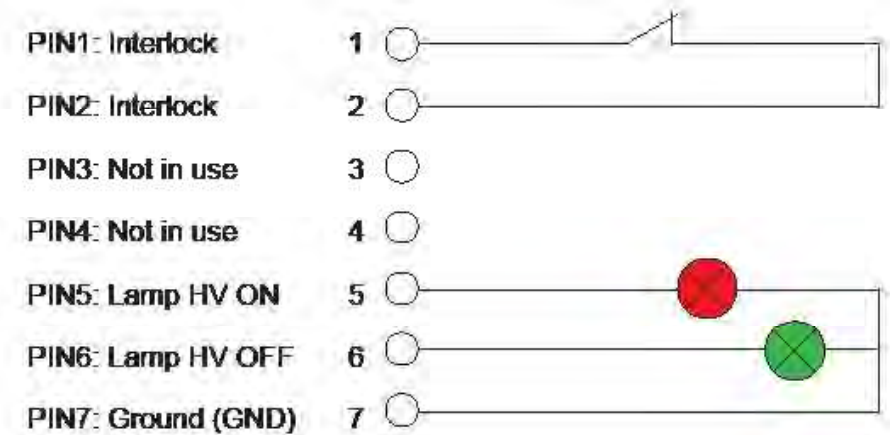
(only applicable for HVA34-1, HVA34TD-1, HVA45 and HVA45TD)

NOTICE

Equipment Not Included
Cables for remote control and external lamps are not in scope of delivery!

Cable requirements:
- Twisted pair; rating: 600 V;
- Dimensions: 18 gauge or 1 mm²
- 2-pole to 5-pole cable

External lamp requirements:
- Data: 12 V, max 1.2 W
- Recommended colors: red, green



3.4 Materials

Scope of Delivery

Items included with delivery of the HVA are listed below. For inquiries, please contact HV Diagnostics. Please note that the items depend on availability and delivery terms.

Standard Accessories

The following items are included in all HVA deliveries.

Part Nr.	Item	Image	pcs	Part Nr.	Item	Image	pcs
700 505	Grounding Cable 8 AWG/ 6mm^2; 13ft/ 4m long		1	700 907	Power On key Spare key for key switch		1
	Mains cable		1	700 199	HVD USB flash drive		1
	HVA Smart VLF User Manual		1		PC Software on USB Flash Drive		1

HVA28 Accessories

The following items are included in the HVA28 deliveries.

Art. Nr.	Item	Image	pcs	Art. Nr.	Item	Image	pcs
700 501	HVA28 HV cable		1	700 086	HV protection plug for HVA28/TD		1
	HVA28 / TD transport box		1		HVA28/TD accessory bag		1
	HVA28/TD strap for Case						

HVA28TD Accessories

The following items are includes in the HVA28TD deliveries.

Part Nr.	Item	Image	pcs	Part Nr.	Item	Image	pcs
702 501	HVA28TD HV cable		1	700 086	HV protection plug for HVA28/TD		1
	HVA28 / TD transport box		1		HVA28/TD accessory bag		1
	HVA28/TD strap for Case		1	702 509	Connection for exter-nal guard and cable shield		2
	Measuring lead black		1		Alligator clamp 4 mm black connector		2
700 050	Two-part corona shield		2				

HVA34-1 / HVA45 Accessories

The following items are included in the HVA34-1 and HVA45 deliveries.

Part Nr.	Item	Image	pcs	Part Nr.	Item	Image	pcs
765 501	HVA45/TD HV cable 100 kV/5 m/MC14 mm		1		HVA34-1/TD Transport Box		1
	Accessory bag for HVA45 and HVA34-1		1				

HVA34TD-1 / HVA45TD Accessories

The following items are included in the HVA34TD-1 and HVA45TD deliveries.

Part Nr.	Item	Image	pcs	Part Nr.	Item	Image	pcs
765 501	HVA45/TD HV cable 100 kV/5 m/MC14 mm		1		HVA45/TD Transport Box		1
	Accessory bag for HVA45 and HVA34-1		1	702 509	Connection External Guard - cable shield		2
	Measuring lead black		1		Alligator clamp 4 mm connector black		2
700 050	Two-part corona shield		2	702 509	HVA45TD Guard connection DUT		2

[1] *The HV cable is not PD free. For measuremts in combination with a PD system you need a PD-free cable.*

4 Design and Construction

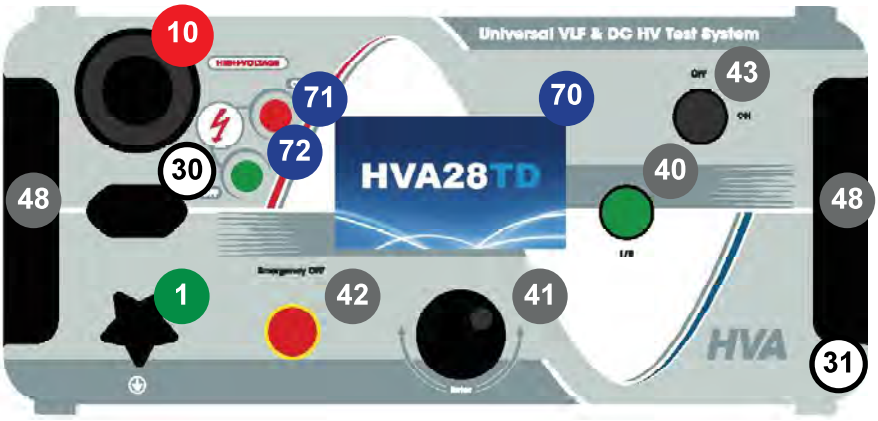
4.1 Control Elements

Front Panel

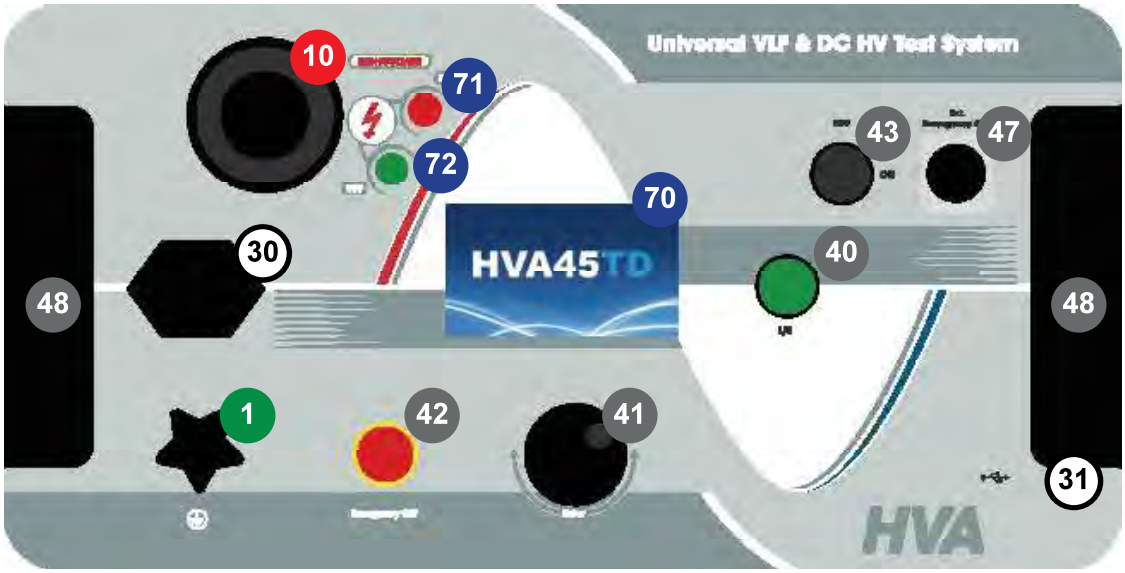
All HVA control and connection components are located on the front panel.

Location	Description
Front Panel	• Test controls and emergency shutdown • HV status information • Cable and power source connections • Air vent • USB

HVA28/HVA28TD Front panel



HVA34-1/HVA34TD-1/HVA45/HV45TD Front panel



Nr.	Name	Description
1	Grounding Connector	Serves as connection point from HVA to ground. **Unit must be grounded at all times!**
10	HV Output Connector	Serves as connection point from the HVA to the HV test lead. To connect: Screw the HV test lead into the HV output connector (until a click can be heard) and tighten.
30	Power Supply Plug	Serves as connection point from the HVA to the100V-240V, 50/60 Hz power source.
31	Communication Port	Serves as connection point from the HVA to a USB device.
40	HV Switch [On/Off] Button	Activates high voltage. To activate HV output: Press within 10 seconds after “Start” - *see 5.3 Automatic Test Mode on page 54*
41	Navigation Knob	Enables user to select options and functions shown on display - *see 5.3 Automatic Test Mode on page 54* - To scroll selection up or down: Rotate - To enter selection: Click (push in)
42	Emergency OFF Button	Activates emergency shutdown. Device operation is only possible if the Emergency OFF button is deactivated. - To activate Emergency OFF: Press down/in - To deactivate Emergency OFF: Release latch and rotate
43	Key Switch [On/Off]	Locks the unit to prevent unauthorized use. - To disable unit: Remove key from the OFF Position - To reactivate unit: Replace key and turn to ON Position.
47	Remote Control Indication and Interlock Plug	Provides interlock for the remote switch (i.e. interlock). Can be connected to a remote emergency off switch, a gate, foot pedal or a main switch.
48	Air Vent	Air inlet for cooling of electronic elements.
49	Air Vent	Air outlet for cooling of electronic elements.
70	Display Screen	Displays menu, options and status information.
71	Red LED	Indicates HV status. Red light indicates: - High Voltage is ON (possible DANGER) - DUT is not discharged (residual voltage > 100 V)
72	Green LED	Indicates HV status. Green light indicates: - High Voltage is OFF

4.2 User Interface

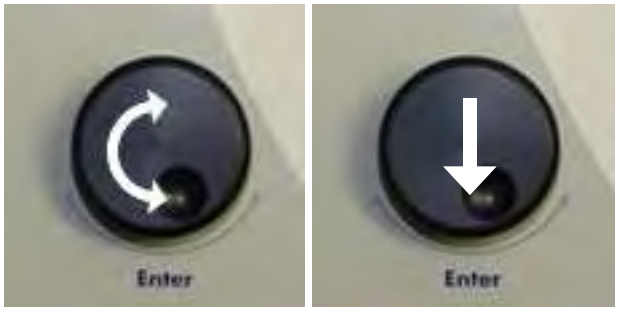
4.2.1 Main Screen

Element	Picture	Description
Title		After activating the unit, display shows “Main Menu”
Unit		Indicates model of unit
Date and Time		Indicates day, date and time
USB		Indicates if USB is enabled (green) or disabled (red)
Bluetooth		Indicates if Bluetooth is enabled (green) or disabled (red)
Scroll button		If active, scroll up or down the screen
Up & Down Arrows		Use to navigate up and down in activated control boxes.
Control Box Selected		Control box is selected, press “Enter” to activate/ change/ edit
Button Selected		Button is selected. Press “Enter” to activate

4.2.2 Display Navigation

The navigation knob (41) enables the user to select or change options shown on the HVA display screen (70).

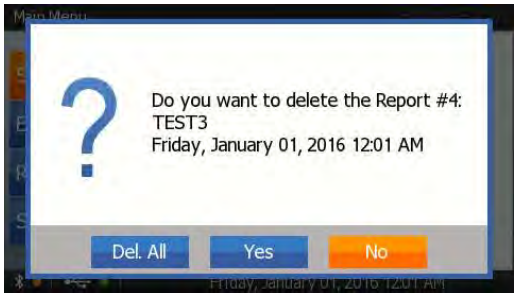
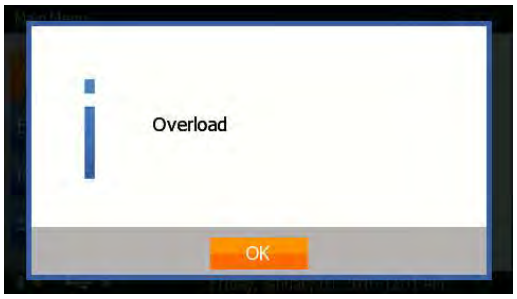
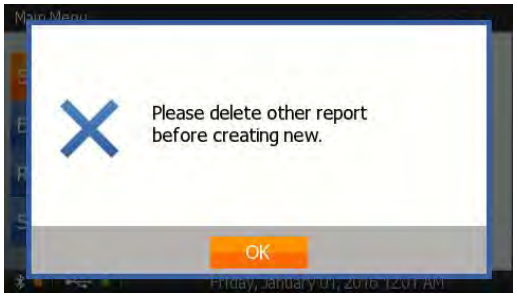
Rotate **Push in / Click**



- To move to another item in a menu list or to any other field possible on the screen currently displayed, rotate the knob.
- To scroll through options or to change the value displayed in an active field, rotate the knob.
- To select marked option or to accept set value, push in/click.

4.2.3 Information and Warning Messages

Situation	Procedure
Information 	This screen gives an information. Press “OK” to confirm.

Situation	Procedure
Question 	This screen indicates a user interaction/ question. Consider the information on the screen and make your choice by selecting “Yes” or “No”.
Warning 	This screen shows a warning. Press “OK” to confirm.
Error 	This screen indicates an error. The operation in progress could not be finished successfully. Please consider the information and decide if further action is necessary. Press “OK” to confirm.

4.2.4 Keyboard functions

To enter information for some steps in the settings sequences and reports, the operator is required to enter a user-selected name.
Possible entries are:

- A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
- - + ‘ 0+ - ‘space’ _ ( ) # @ - + * / \ ! ? = : , ; “ % ° < > | & [ ]
- 0 1 2 3 4 5 6 7 8 9

Situation	Procedure
Activate Naming 	To select characters, rotate knob 41 then push in/click. Press and hold the “Enter” button for auto-repeat.
Activate Symbols  	To select characters, rotate knob 41 then push in/click For special characters, press the button .?!.
Delete 	To delete characters, select the backspace symbol ← and press Enter. Press and hold “Enter” for auto-repeat.

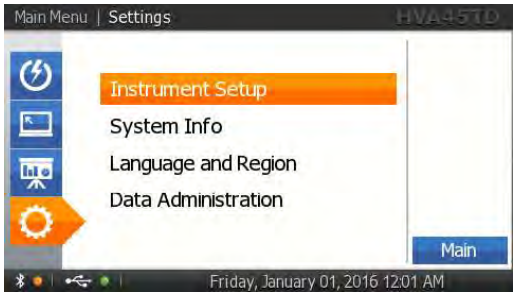
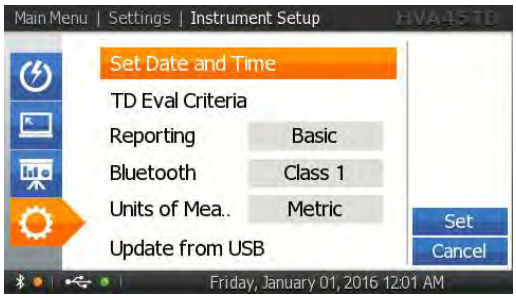
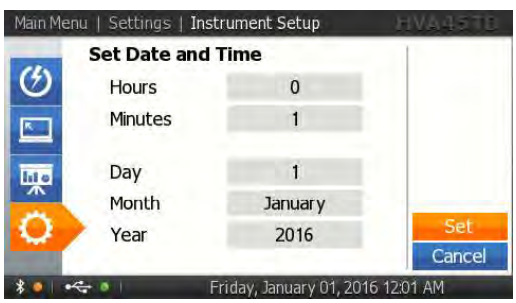
Situation	Procedure
Cancel Changes 	To cancel your changes in the text field, select the cancel symbol and press “Enter”.
Save Changes 	To save your changes in the text field, select the OK symbol and press “Enter”.

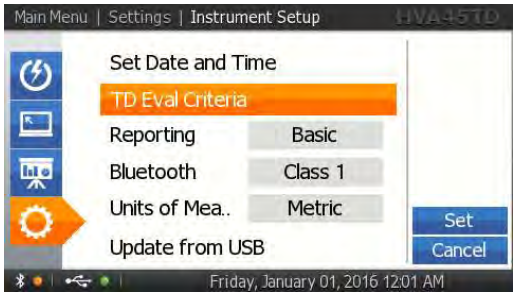
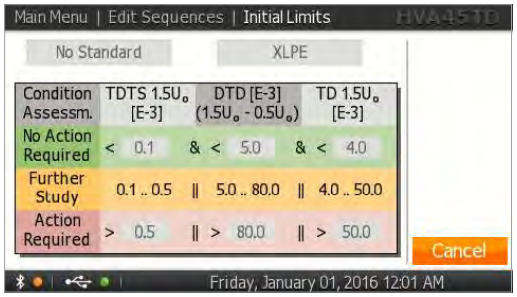
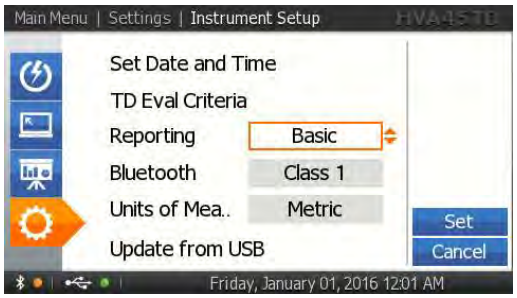
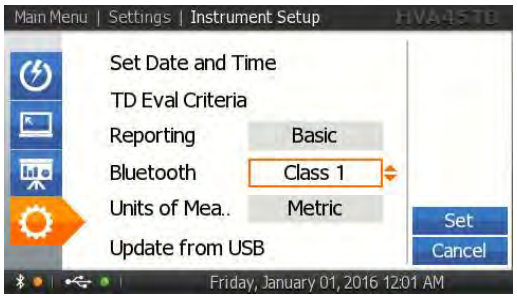
4.3 Instrument Setup

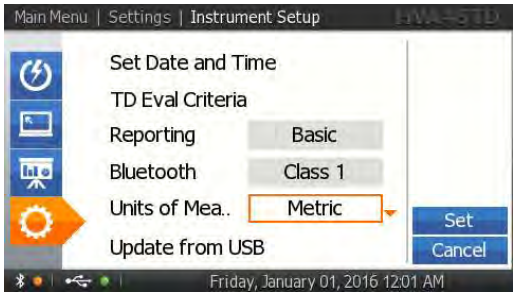
The instrument setup must be made prior to the HVA’s first use. Settings can be modified anytime. You will find the selection option Instrument Setup in the main menu under Settings.

4.3.1 Setup

Steps IS1-IS8 describe how to **setup the instrument.**

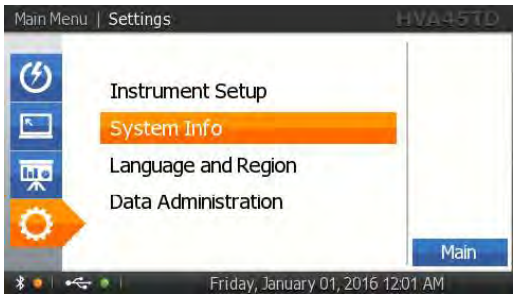
Step	Procedure (Instrument Setup)
IS1: Settings 	Select “Settings”.
IS2: Instrument Setup 	Select “Instrument Setup”.
IS3: Set Date and Time  	Select “Set Date and Time” from the “Instrument Settings” menu to arrive at the appropriate screen and set date and time.

Step	Procedure (Instrument Setup)
IS4: Initial Limits  	Use these settings to edit default limits for Tan Delta measurements depending on the insulation of the Device Under Test (DUT). These limits are also used for Monitored Withstand Tests (MWT).
IS5: Reporting 	Select the appropriate reporting type: Disabled/Basic Reporting/Extended Reporting Basic Reporting only states the DUT type and a title, whereas Extended Reporting provides detailed information.
IS6: Bluetooth 	Depending on the Bluetooth setting (Class 1/2/3/Disabled), the device selects the corresponding RF transmission power. Class 1 is the highest; Class 3 is the lowest.

Step	Procedure (Instrument Setup)
IS7: Units 	Select Metric or Imperial units. When "Imperial" is selected, the temperature unit is also set to °F. This choice has no impact on the best results.
IS8: Update from USB 	This function is used when installing updates and for transferring information from the PC software to the unit via USB. Insert the USB flash drive before selecting this function.

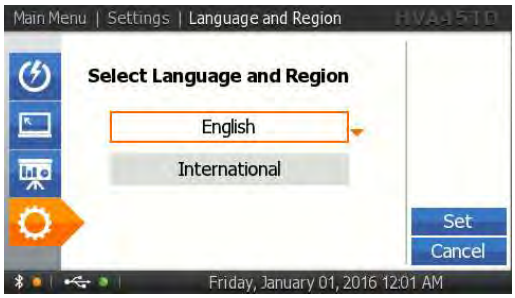
4.3.2 System Information

Steps SI1-SI3 describe the information provided in **System Information**.

Step	Procedure (System Information)
SI1: Settings 	Select “Settings”.
SI2: System Information 	Select “System Info”.
SI3: System Information 	“System Information” displays HVA characteristics. This information cannot be modified by the operator: • Software versions • Serial number of the HVA • Nickname (to alter via PC software) • Bluetooth MAC address • Date of last calibration • Temperature

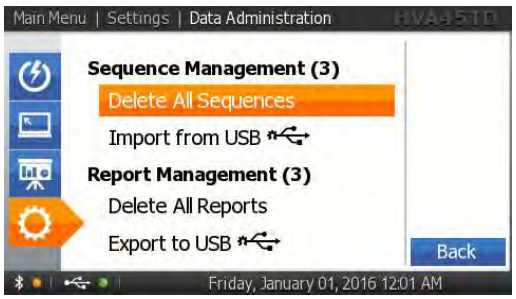
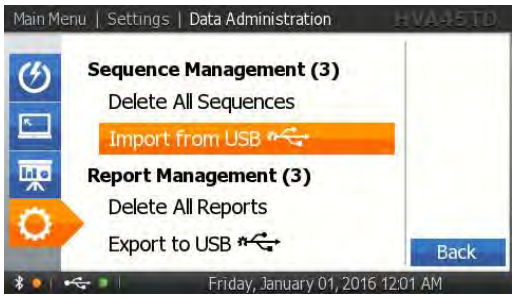
4.3.3 Language and Region

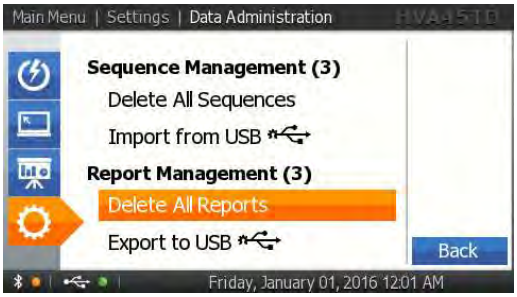
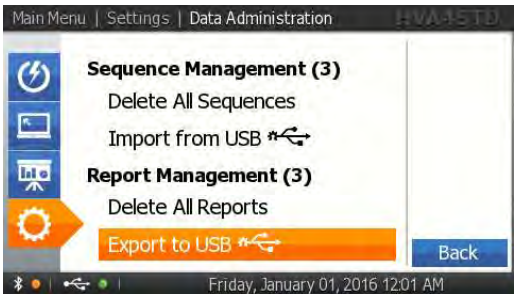
Steps L1-L4 describe how to **Set Language and Region**.

Step	Procedure (Language and Region)
L1: Settings 	Select “Settings”
L2: System Information 	Select “Language and Region”.
L3: Language 	Choose language. Select from different options depending on the firmware version.
L4: Region 	Choose region: Select from different options depending on the firmware version. Based on the region setting, the unit selects the corresponding date/time format and other localized information. The language and region can be set independently.

4.4.1 Sequence and Report Management

Steps SRM1–SRM6 describe how to **Manage Sequences and Reports**.

Step	Procedure (Sequences and reports)
SRM1: Settings 	Select “Settings”.
SRM2: Settings 	Select “Sequence and Report Management”.
SRM3: Delete All Sequences 	To delete all sequences, select “Delete all Sequences”. Note: Test Sequences are automatic sequences that can be setup by the user. They determine voltages, steps and duration of a test sequence. They are not test reports!
SRM4: Import from USB 	To import sequences from a USB flash drive, select “Import from USB”. Refer to the PC software user manual for further information about file formats.

Step	Procedure (Sequences and reports)
SRM5: Delete All Reports 	To delete all reports, select “Delete all Reports”. Note: Once reports are deleted, they cannot be recovered- so take care. It is recommended to download them to a USB Flash Drive or Laptop/ PC first before deleting off instrument.
SRM6: Export Reports 	To export the stored reports on the unit, insert a USB flash drive and select this function. All reports will be automatically written in multiple file formats (HTML/XML/PC software database). The reports will remain on the unit and may be deleted manually.

4.5 Operation Modes

Described below are the various HVA operation modes.
Test Modes, Output Modes (Waveform), Arc Management Modes, and Data Transfer Modes.

Test Modes

The HVA can be operated in Manual or Automatic Mode. For detailed procedure, *see 5.2 Manual Test Mode on page 40*, and *see 5.3 Automatic Test Mode on page 54*.

Test mode	Characteristics
Manual	Designed to facilitate rapid testing. Test parameters of the last selected manual test appear as the default settings. • Test parameters can be changed before activating a test. • Test types: VLF, VLF TD, DC, ST, SFL, VB

Automatic	Designed for testing with a predefined configuration in order to satisfy specific requirements (e.g. IEEE or IEC standards). • The test sequence must be configured and saved before testing. • Test types: VLF, VLF TD, DC, ST, VB

Output Modes

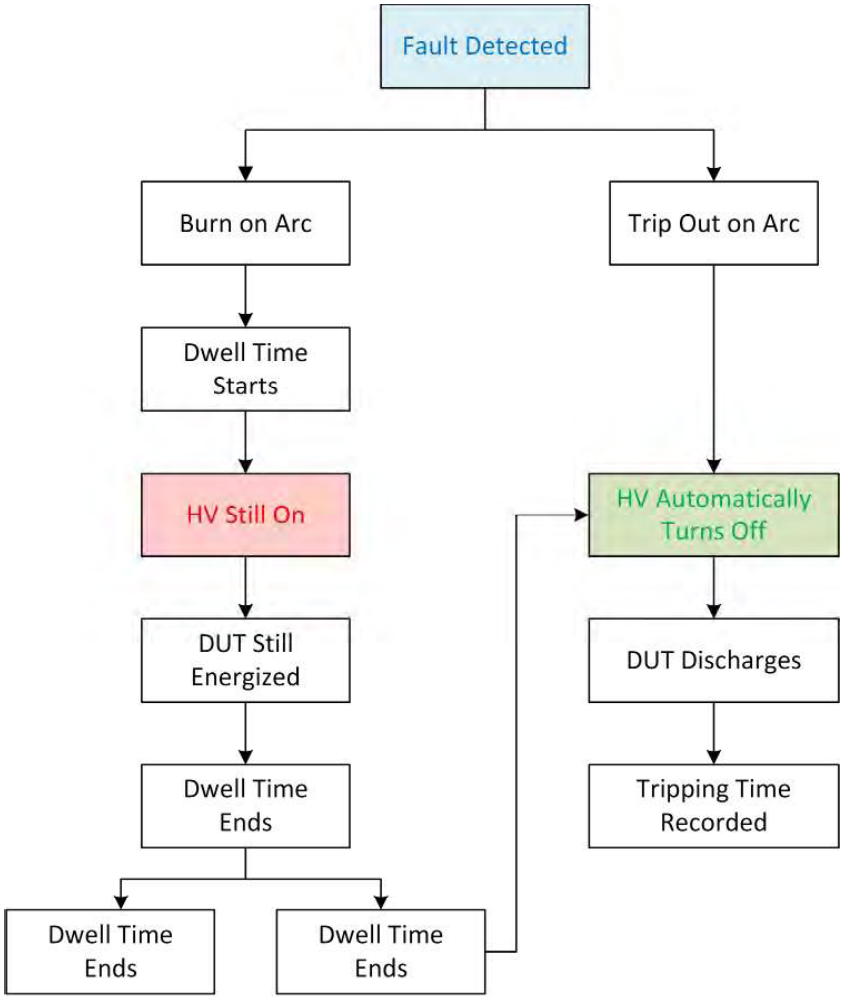
The HVA can carry out HV testing in the following output modes:

Output mode	Characteristics
DC [- /+]	Single-polarity output. DUT is polarized (negative/positive) with respect to ground. • Not recommended for testing extruded cables (e.g. XLPE/ EPR cables). • Measured value: dielectric loss of the DUT (including leakage current across terminations) • DC - : Most commonly used DC Output Mode
VLF Withstand Test (VLF) Sine Wave or Square Wave	• Suitable for testing extruded cables (e.g. XLPE/ EPR cables) and other DUTs. • Measured values shown as RMS.
VLF Tan Delta Measurement (VLF TD) Sine Wave	• Measures the Tan Delta value of the DUT according to selectable standards and/or custom limits • A Sine Wave will be applied. • Measured values shown as RMS, TD E-3.
Vacuum Bottle Testing (VB)	• Not suitable for testing with DC above DUT voltage rating (X-ray hazard) • Possible in Manual and Automatic Test modes. • Trip current and rise rate are user-defined. • Measured value: peak voltage
Sheath Test (ST)	• Suitable for sheath test • Duration is user-defined • Max test voltage: 10 kV

Sheath Fault Location Mode (SFL)	• Suitable for sheath fault location • Duration is user defined • Pulse is user defined • (1:3 / 4 s, 1:5 / 4 s, 1:5 / 6 s, 1:9 / 6 s) i.e. “1:3” is 1 second Pulse On and 3 seconds Off, Period of 4 seconds

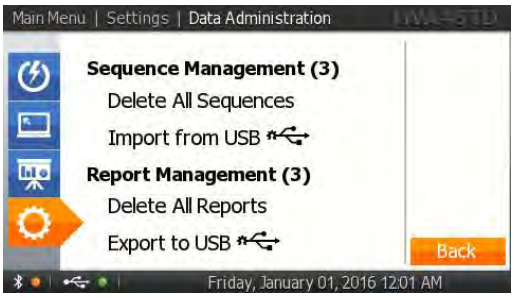
Arc Management Modes

If a fault is detected during an HV test, the arc management mode determines how the failure is managed. The “Burn on Arc” mode will condition the fault whereas the “Trip out on Arc” mode will immediately switch off the HV.



Data Transfer Modes

The HVA's built-in memory can save up to 50 reports and 50 test sequences. Furthermore, an unlimited number of reports and sequences can be stored when the HVA is connected to the PC software or by using a USB flash drive.

Configuration	Characteristic
USB	All reports saved in the HVA memory can be transferred to a USB flash drive: 
Bluetooth	If the HVA is connected to the HV Control Center, reports and sequences can be downloaded from the HVA using the corresponding functions. See software manual for further information.

5 Test Procedure

DANGER

Electric Shock Hazard

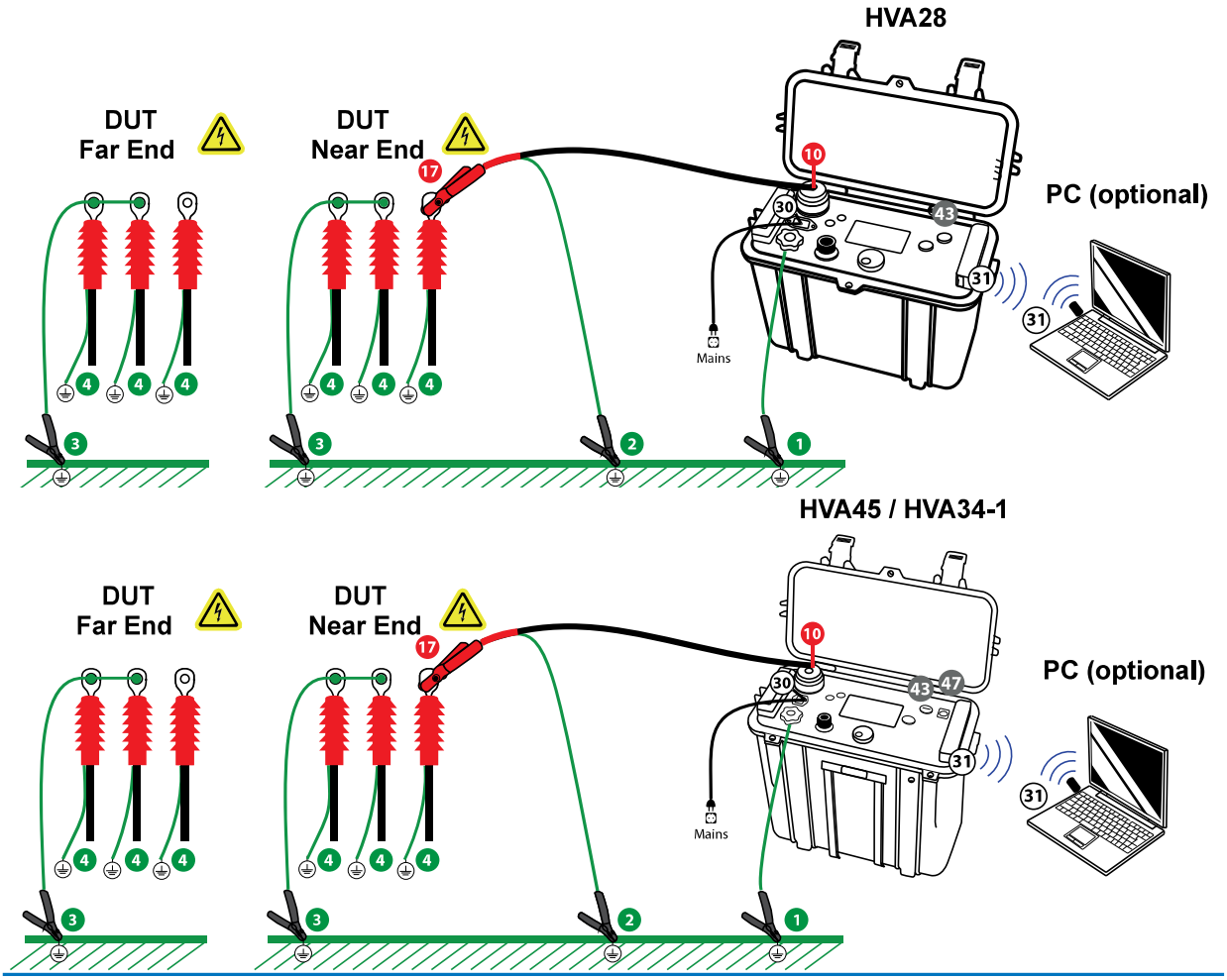
All procedures must comply with local safety regulations.

- Before operating the HVA, equipment set-up procedure must be completed!
- Cables must be connected in the proper sequence!
- Before turning on the power supply and before activating the HVA, verify that all system elements are properly grounded!
- Ensure DUT is completely isolated from all potential external energization sources.
- Ensure adequate clearances.

5.1 Equipment Setup

Steps S1-S8 describe the equipment setup procedure. When carrying out multiple tests, the ground and power supply connections must always remain intact. The HV test lead must be reconnected before each subsequent test (i.e. repeat procedure from step S3). **Do not forget to ground the instrument!**

5.1.1 Connection Diagram: VLF Withstand Test

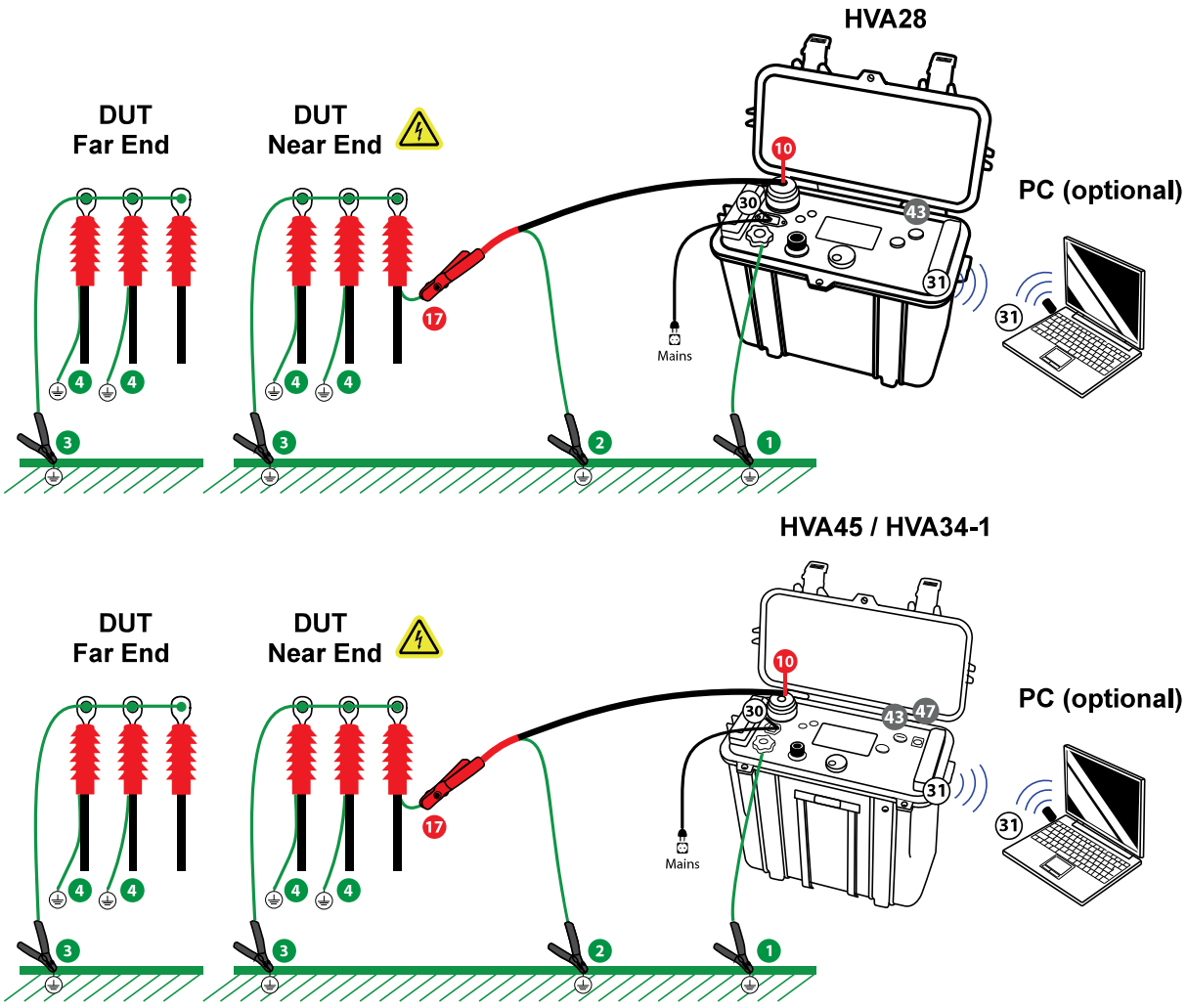


NOTICE

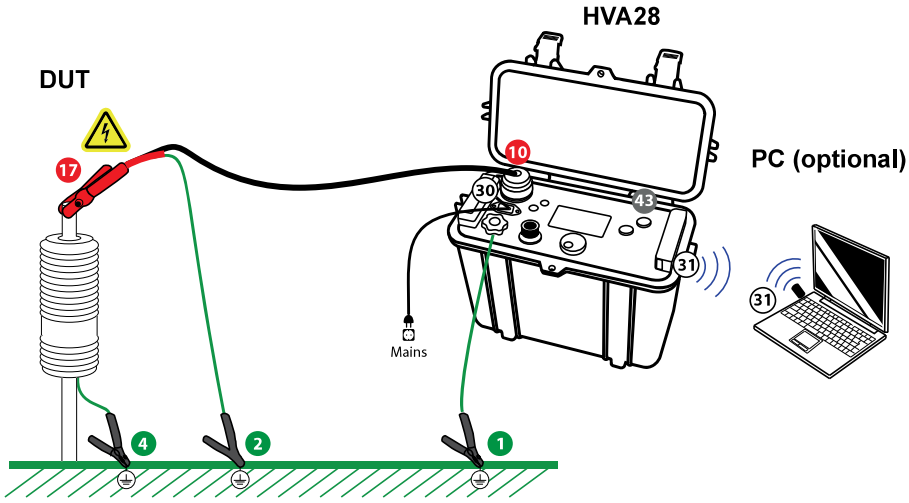
Establish secure grounding via connection 1, 3, and 4.
Connect HVA main ground lead first 1 and remove last!
Instrument is not grounded by connection 2
Note: Make sure DUT Cable Shield is grounded.

Step	Procedure	Art. Nr.
S1	Connect all grounding cables • Discharge and ground the DUT complying with local safety regulations. • Connect grounding cable to the HVA grounding connector 1. • Prepare grounding for measurement 3 4.	700 505
S2	• Connect power supply 30.	
S3	Connect all HV cable connections. • Screw the HV test lead into the HVA HV output connector 10. • Ground the HV cable shield 2. • Connect the other end of the HV test lead to the DUT conductor 17.	700 501
S4	Verify connections. • Check that all cables are attached securely.	
S5	Configure interlock plug (only for HVA45/TD and HVA34-1/TD). • Verify that the HV emergency adapter is connected 47. If operating with remote controls (optional): • Connect external lamps or remote switches (*see 3.3 External Interlock and Control on page 14)*	
S6	Configure communication port. For USB data transfer mode, insert USB flash drive 31. (Optional at this stage)	700 199
S7	Turn key switch 43 to “ON” position.	700 907
S8	The HVA system automatically boots. • Start-up default screen appears. Select appropriate option from default screen and proceed to appropriate section for further instructions: • *see 5.2 Manual Test Mode on page 40* or • *see 5.3 Automatic Test Mode on page 54*	

5.1.3 Connection Diagram: Sheath Test and Sheath Fault Location



5.1.4 Connection Diagram: Vacuum Bottle Test



NOTICE

Establish secure grounding via connection 1, 3, and 4.
Connect HVA main ground lead first 1 and remove last!
Instrument is not grounded by connection 2.
Note: Make sure DUT Cable Shield is grounded.

Step	Procedure	Art. Nr.
S1	Connect all grounding cables • Discharge and ground the DUT complying with local safety regulations. • Connect grounding cable to the HVA grounding connector 1. • Prepare grounding for measurement 3 4.	705 505
S2	• Connect power supply 30.	
S3	Connect all HV cable connections. • Screw the HV test lead into the HVA HV output connector 10. • Ground the HV cable shield 2 to base of Vacuum Bottle (VB) DUT. • Connect the other end of the HV test lead to the other side of VB DUT 17.	700 501
S4	Verify connections. • Check that all cables are attached securely.	
S5	Configure interlock plug. • Verify that the HV emergency adapter is connected 47. If operating with remote controls (optional): • Connect external lamps or remote switches (*see 3.3 External Interlock and Control on page 14*)	

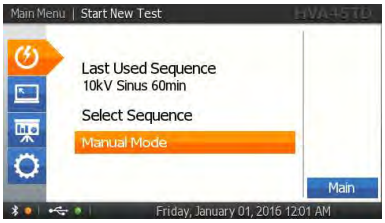
S6	Configure communication port. For USB data transfer mode, insert USB flash drive ㉛.	700 199
S7	Turn key switch ㊸ to “ON” position.	700 907
S8	The HVA system automatically boots. • Startup default screen appears Select appropriate option from default screen and proceed to appropriate section for further instructions: • *see 5.2 Manual Test Mode on page 40* or • *see 5.3 Automatic Test Mode on page 54*	

5.2 Manual Test Mode

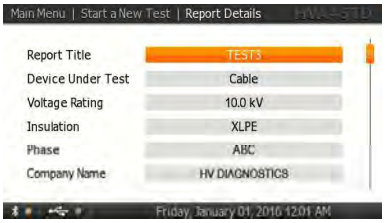
This HVA test mode facilitates easy and efficient testing. Select “Start New Test” from the Main Menu, then “Manual Mode”. Depending on the Instrument Settings the unit also reports for Manual Mode.

Main Menu

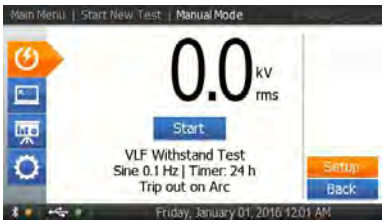
Manual Mode

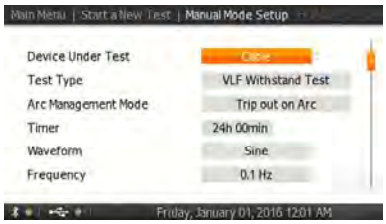


Report Details



Setup



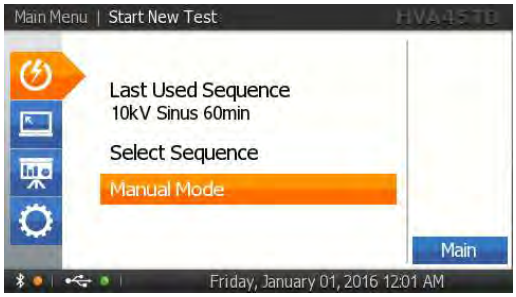
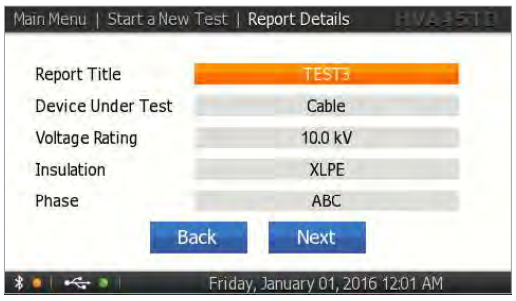


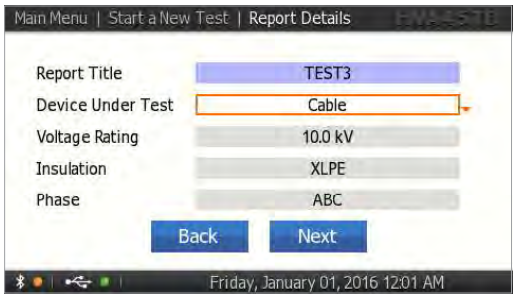
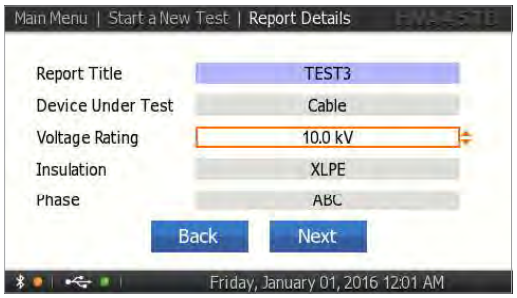
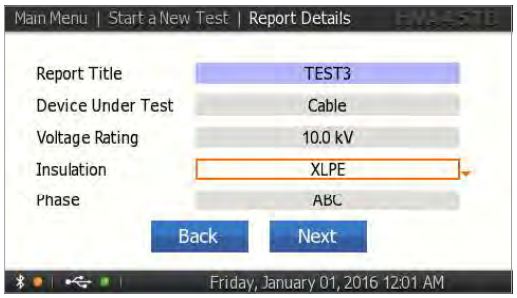
Modify Test Voltage

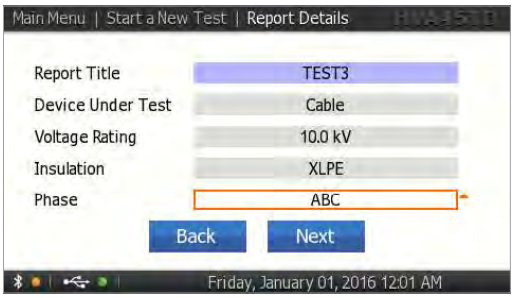
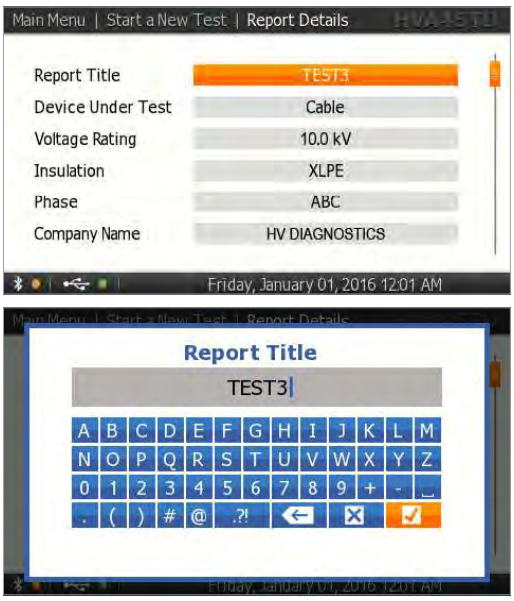
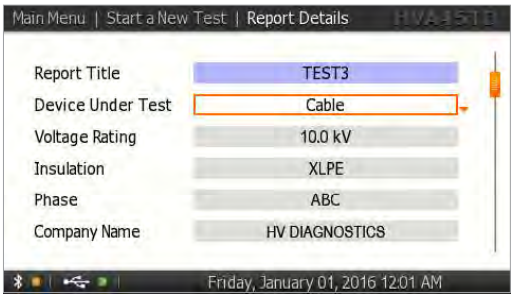
Start Test

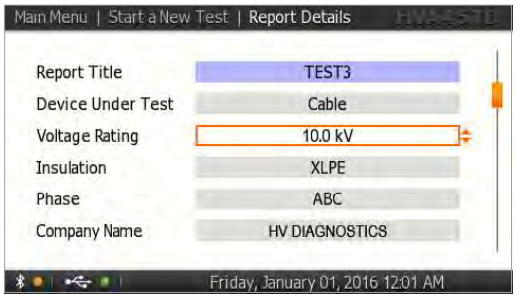
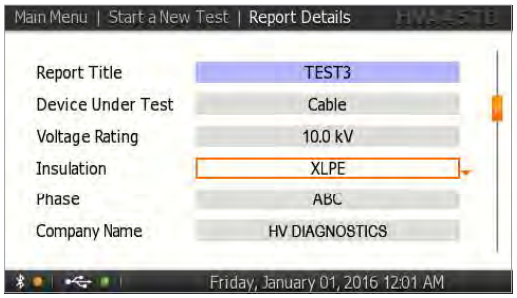
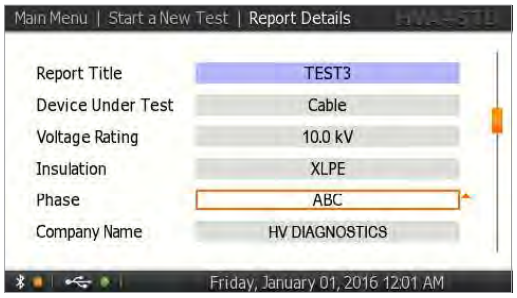
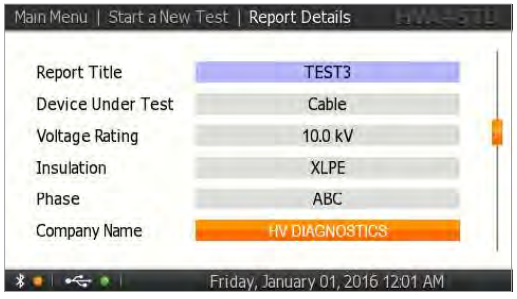
5.2.1 Setting Report Details

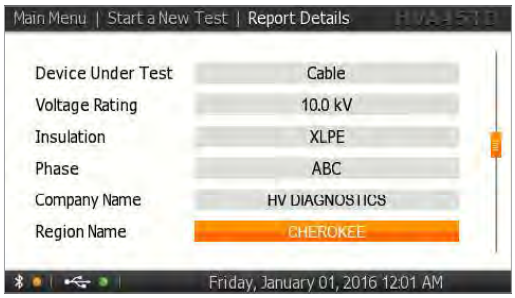
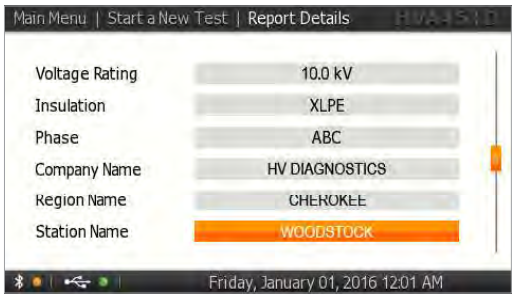
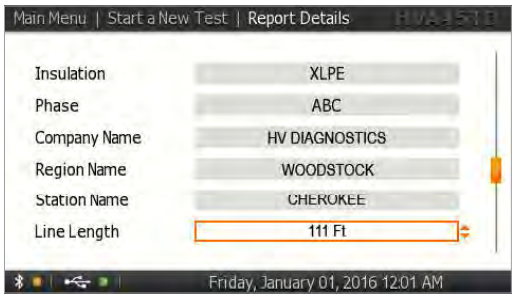
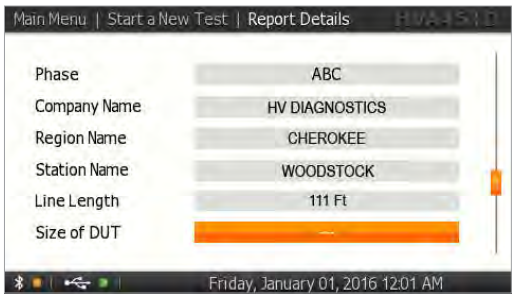
Steps RS1-RS14 describe how to set report details.

Step	**Procedure** (Set Manual Test Parameters)
RS1: Start New Test 	Select “Start Test”.
RS2: Start Manual Mode 	Select “Manual Mode”.
Basic Report	
RS3.1.01: Report Details - Basic Report Title  	For naming “Report Title” *see 7.3 Report Naming Instructions on page 85*

Step	**Procedure** (Set Manual Test Parameters)
RS3.1.02: Report details - Basic DUT 	Set Device Under Test (DUT): • Cable • Motor • Generator • Transformer • Switchgear • Vacuum Bottle • Other
RS3.1.03: Report Details - Basic Voltage Rating 	Set voltage rating: • 0 - 50 kV **This is the characteristic rating of the DUT and does NOT refer to the test voltage!**
RS3.1.04: Report Details - Basic Insulation (only for cable) 	Set insulation: • XLPE • TRXLPE • PILC • EPR • EPR (Carbon Filled- Black) • EPR (Mineral- Pink) • EPR (Dischare Resistant- Brown) • PE • PVC • HYBR

Step	**Procedure** (Set Manual Test Parameters)
RS3.1.05: Report Details - Basic Phase 	Set phase: • A • B • C • AB • AC • BC • ABC
Extended Report	
RS3.2.01: Report Details - Extended Report Title 	For naming reports *see 7.3 Report Naming Instructions on page 85.*
RS3.2.02: Report Details - Extended DUT 	Set Device Under Test: • Cable • Motor • Generator • Transformer • Switchgear • Vacuum Bottle • Other

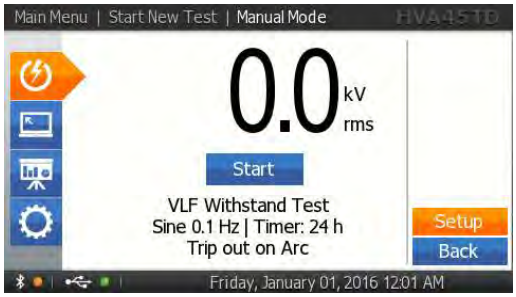
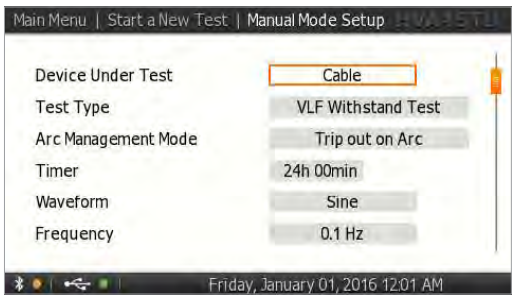
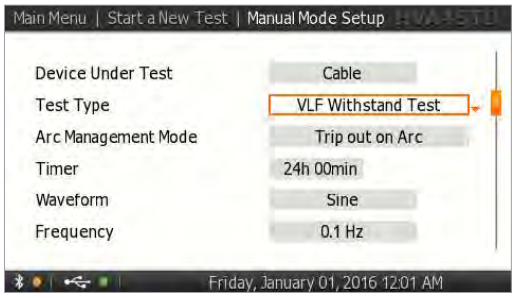
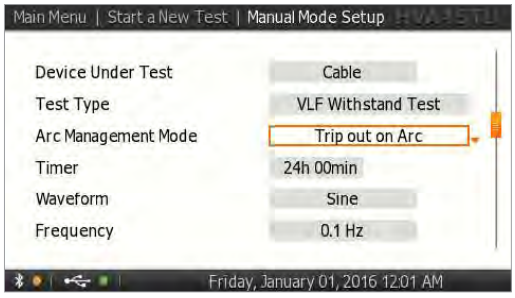
Step	**Procedure** (Set Manual Test Parameters)
RS3.2.03: Report Details - Extended Voltage Rating 	Set voltage rating: • 0 - 50 kV **This is the characteristic rating of the DUT and does NOT refer to the test voltage!**
RS3.2.04: Report Details - Extended Insulation (only for cable) 	Set insulation: • XLPE • TRXLPE • PILC • EPR • EPR (Carbon Filled- Black) • EPR (Mineral- Pink) • EPR (Discharge Resistant- Brown) • PE • PVC • HYBR
RS3.2.05: Report Details - Extended Phase 	Set phase: • A • B • C • AB • AC • BC • ABC
RS3.2.06: Report Details - Extended Company Name 	For instructions on how to edit the company name, see *7.3 Report Naming Instructions on page 84*

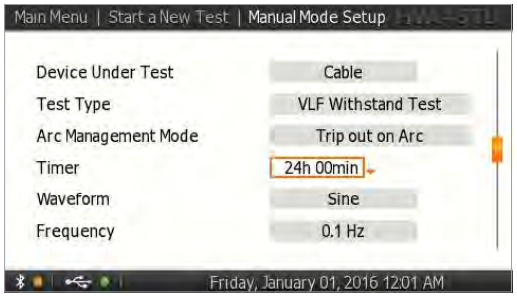
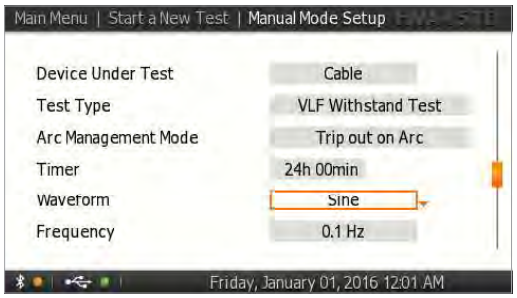
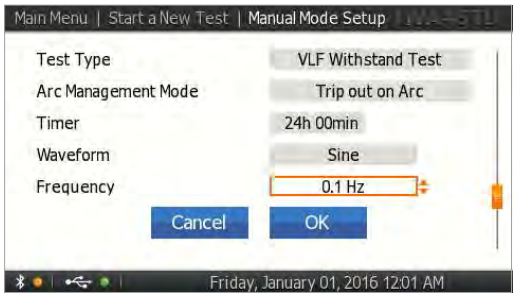
Step	**Procedure** (Set Manual Test Parameters)
RS3.2.07: Report Details - Extended Region Name 	For instructions on how to edit the region name, *see 7.3 Report Naming Instructions on page 85*
RS3.2.08: Report Details - Extended Station Name 	For instructions on how to edit the station name, *see 7.3 Report Naming Instructions on page 85*
RS3.2.09: Report Details - Extended Line Length 	For instructions on how to edit the line length, *see 7.3 Report Naming Instructions on page 85*
RS3.2.10: Report Details - Extended Size of DUT 	For instructions on how to edit the size of DUT, *see 7.3 Report Naming Instructions on page 85*

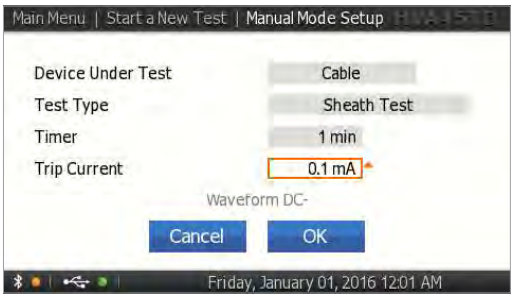
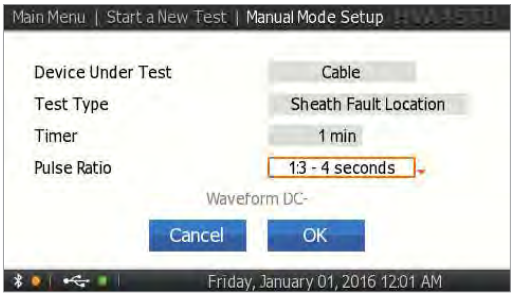
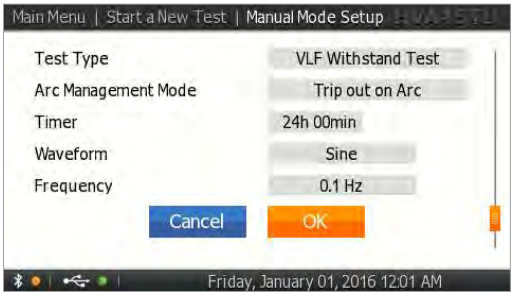
Step	**Procedure** (Set Manual Test Parameters)
RS3.2.11: Report Details - Ext Manufacturer Name 	For instructions on how to edit the manufacturer name, *see 7.3 Report Naming Instructions on page 85*
RS3.2.12: Report Details - Extended Work Order 	For instructions on how to edit the work order, *see 7.2 Report Activation on page 84*
RS3.2.13: Report Details - Extended Operator Name 	For instructions on how to edit the operator name, *see 7.2 Report Activation on page 84*
RS3.2.14: Finish 	Set report details: By pressing “Next”, you will store the report details in the non-volatile memory. They will be used as default values for the next test.

5.2.2 Manual Test Parameters

Steps MS1-MS10 describe how to set **Manual Test Parameters**.

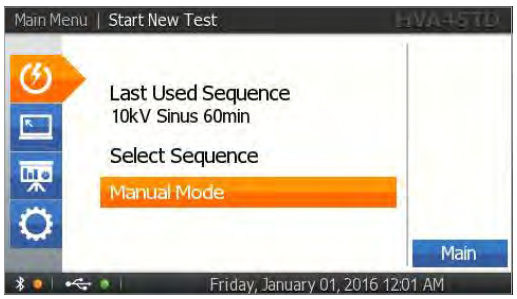
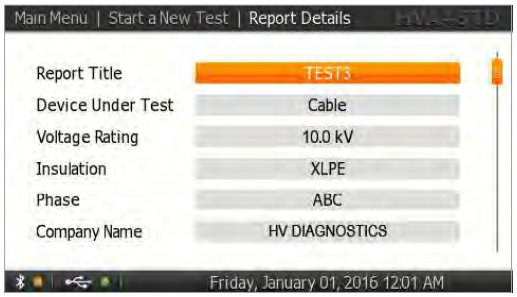
Step	**Procedure** (Manual Test Parameters)
MS1: Setup 	To set the waveform, frequency, or test duration, select “Setup” in the menu. These settings will be remembered for the next test.
MS2: DUT Setup 	Select DUT: Select the corresponding Device Under Test.
MS3: SETUP Test Type 	Select one of the following output modes: • VLF Withstand Test • VLF Tan Delta Test • DC Test • Sheath Test • Sheath Fault Location • Vacuum Bottle
MS4: SETUP Arc Management Mode 	Select one of the following: • Trip out on Arc • Burn on Arc If you have selected “Burn on Arc”, make sure that the appropriate dwell time is selected.

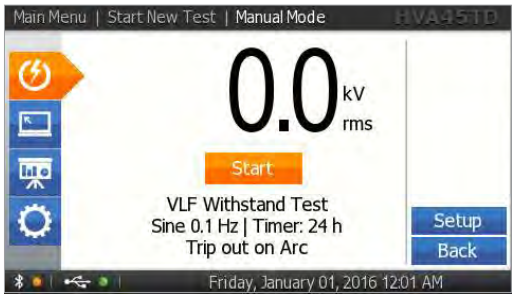
Step	**Procedure** (Manual Test Parameters)
MS5: Timer 	Select the duration time of the test: • Min. test duration: 1 minute • Max. test duration: 24 hours
MS6: Waveform Not applicable for VLF Tan Delta Testing, Sheath Testing, Sheath Fault Location, or Vacuum Bottle Testing 	Depending on the selected test type, choose: • Sine Wave • Square Wave • DC • DC+ • DC-
MS7: Frequency Not applicable for DC Testing, Sheath Testing, Sheath Fault Location, or Vacuum Bottle Testing 	Set the frequency to as close to 0.1 Hz as possible. • 0.1 Hz/Auto: recommended setting that automatically maintains the frequency as close to 0.1 Hz as possible.

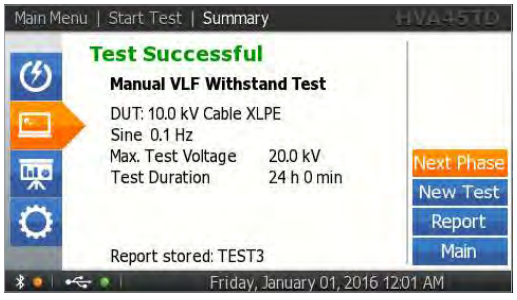
Step	**Procedure** (Manual Test Parameters)
MS8: Trip Current Applicable for Sheath Testing, Vacuum Bottle Testing 	Set trip current and testing time: • 0.1-5.0 mA • Time: 1 min-10 min
MS9: Pulse/Period Not applicable for DC Testing, Sheath Fault Location 	Set pulse/period and testing time: • 1:3 / 4 s • 1:5 / 4 s • 1:5 / 6 s • 1:9 / 6 s i.e. “1:3/ 4 s”= 1 second On, 3 seconds Off, 4 seconds period
MS10: Preset Test Voltage (Optional- voltage can be set once test has been initiated!) 	Entering the test voltage before activating the manual mode test by pressing “Start” is optional. In manual mode, the voltage can be set once the test has been initiated! To set the test voltage before activating the manual mode test by pressing “Start”, rotate the navigation knob 41 until the voltage field is selected. The dot in upper right hand corner indicates that the test voltage is in pre-set mode. To modify the value, rotate navigation knob 41 To accept the value, push in knob 41. The dot in upper right hand disappears indicating that the test voltage is set. The value will also be updated if the knob is not rotated for 2 seconds.

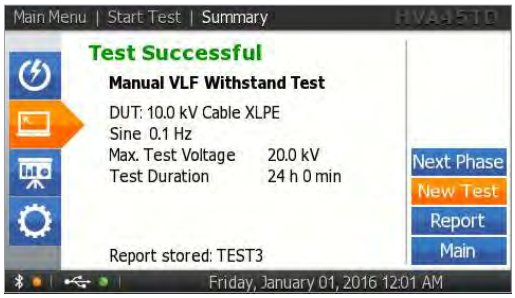
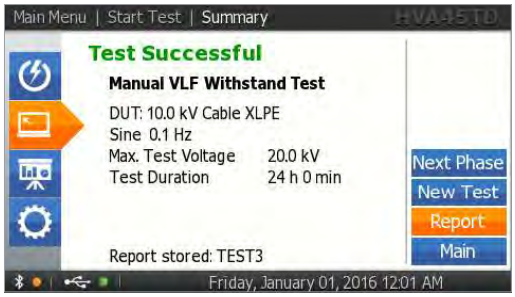
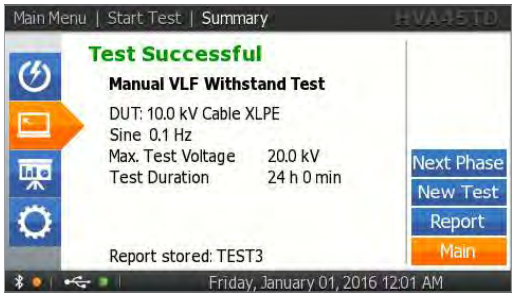
5.2.3 Running a Manual Test

Steps MR1-MR10 describe how to run a test in manual mode.

Step	**Procedure** (Run a Manual Test)
MR1: Start New Test 	Select “Start Test”.
MR2: Start Manual Mode 	Select “Manual Mode”.
MR3: Report Details – Basic or Extended  	Define specifications for reporting.

Step	**Procedure** (Run a Manual Test)
MR4: START Test 	Start the test when the test parameters displayed on the “Manual Test” screen are correct. Rotate the navigation knob (41) until the “START” field is highlighted. To run the test, push in the knob (41).
MR5: Report Settings 	Select “Start Test”.
MR6: HV Activation 	Once the activation screen appears, press the HV switch (40) within 10 seconds. If the HV switch is not activated within 10 seconds, the “Manual Mode” screen will reappear.

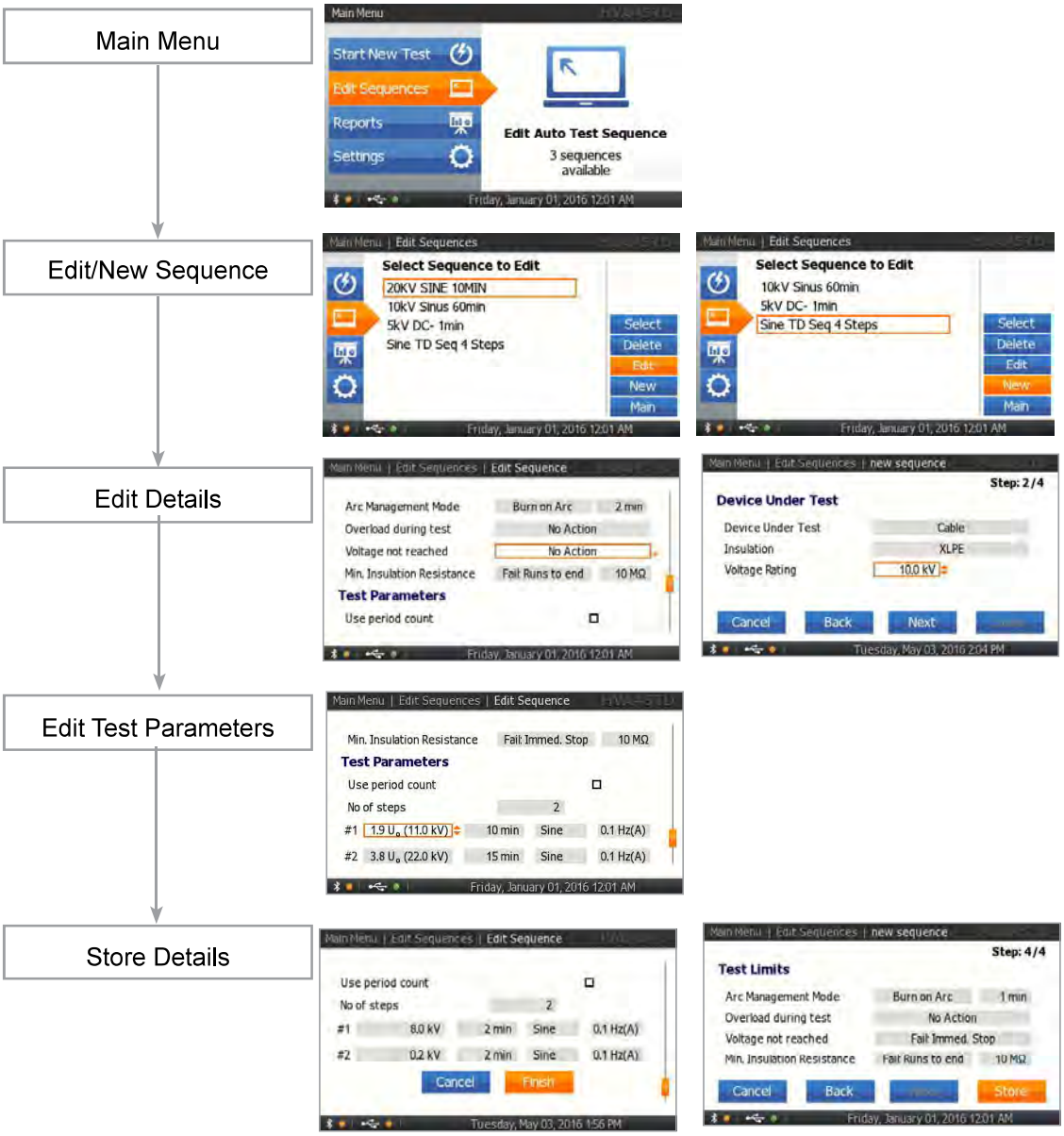
Step	**Procedure** (Run a Manual Test)
MR7: Test Startup 	"Startup" appears on the screen to indicate that the HVA is initializing the test.
MR8: Set Test Voltage (if not preset in step MS8) 	Rotate the navigation knob 41 to modify the voltage value.
MR9: Test 	Test begins automatically. The timer value indicates the remaining testing time. The bottom line of the screen displays the preset values.
MR10-1: Test End - New Phase 	Display indicates end of manual test. For testing the next phase, select the "Next Phase" button and push in/click the navigation knob 41. "Test Successful" means the instrument did not trip out or detect an arc during the test. The user still needs to interpret the test results.

Step	**Procedure** (Run a Manual Test)
MR10-2: Test End - New Test 	Display indicates end of manual test. For starting a new test, select “Next Test” button and push in/click the navigation knob 41.
MR10-3: Test End - Report 	Display indicates end of manual test. If you wish to view the corresponding report, select the “Report” button and push in/click the navigation knob 41.
MR10-4: Test End - Main 	Display indicates end of manual test. For going back to the main menu, select the “Main” button and push in/click the navigation knob 41.

5.3 Automatic Test Mode

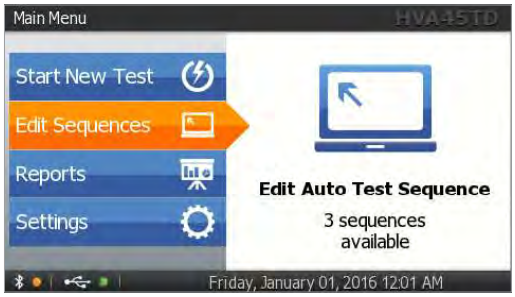
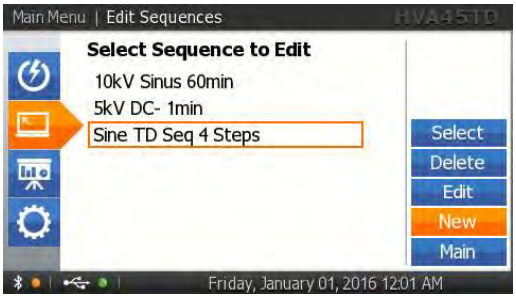
This HVA test mode facilitates sytisfying specific requirements (e.g. IEEE, IEC Standards) when testing. The test sequence can be configured, modified and saved at anytime before testing.

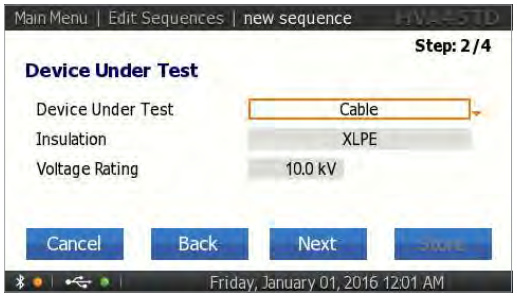
5.3.1 Configuring Automatic Testing Sequence - Overview

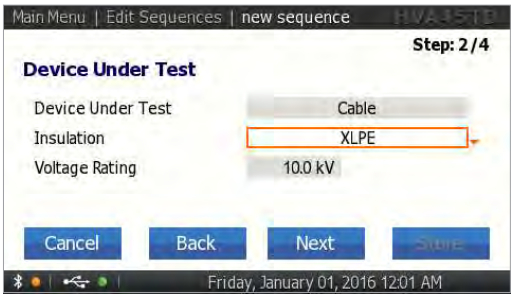
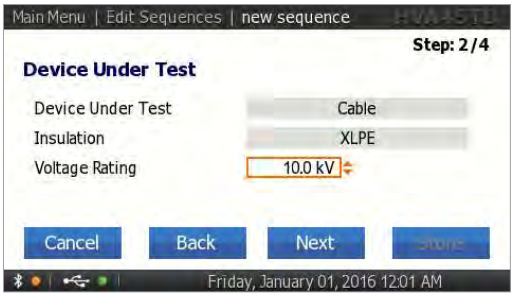
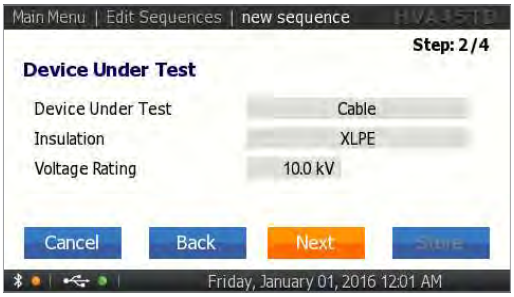


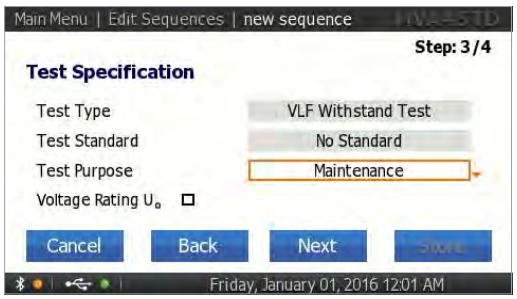
5.3.2 Configuring Auto Test Sequence on the HVA Unit

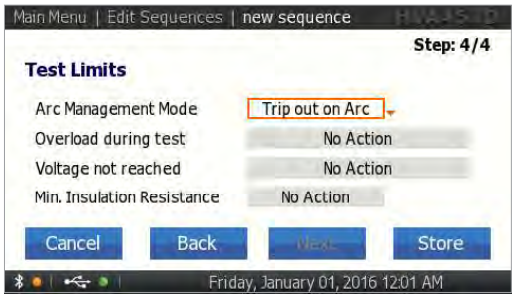
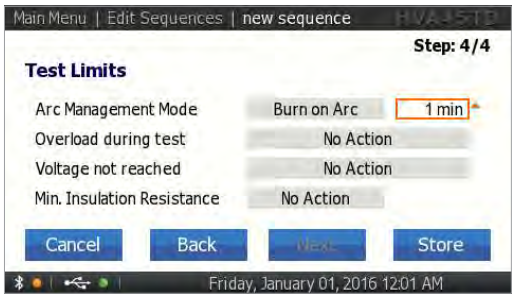
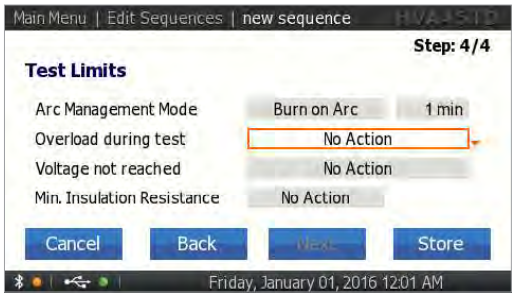
Steps NS1-NS19 describe how to configure a test sequence.

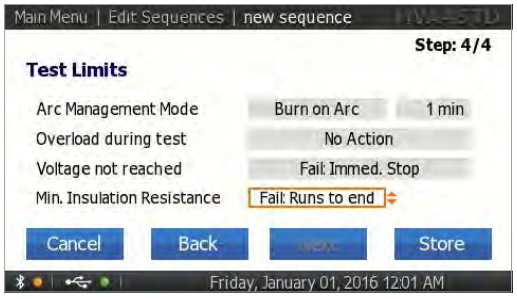
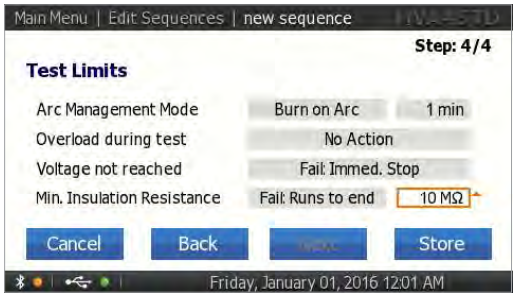
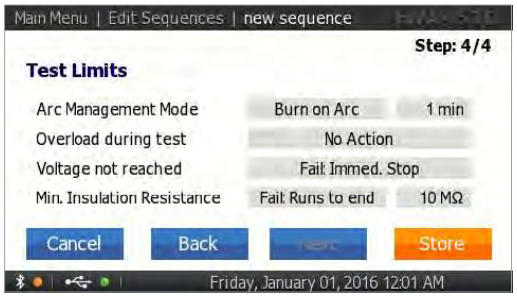
Step	**Procedure** (Configure Auto Test Sequence)
NS01: Edit Sequences 	Select “Edit Sequences”.
NS02: EDIT or NEW? 	The “Edit Sequences” menu displays the sequences already stored in memory. To create a new sequence, select the “New” option on the right-hand side of the screen.
NS03: Title  	For entering a title for the test sequence, activate the keyboard and type the title.

Step	**Procedure** (Configure Auto Test Sequence)
NS04: Work Order 	For entering a work order number, activate the keybord. For instructions, *see 7.3 Report Naming Instructions on page 84*
NS05: Next Step 	Press “Next” to continue.
NS06: DUT 	Set DUT: • Cable • Motor • Generator • Transformer • Switchgear • Vacuum bottle • Other

Step	**Procedure** (Configure Auto Test Sequence)
NS07: Insulation 	Set insulation: • XLPE • TRXLPE • PILC • EPR • EPR (Carbon Filled- Black) • EPR (Mineral- Pink) • EPR (Discharge Resistant- Brown) • PE • PVC • HYBR • Other
NS08: Voltage Rating 	Set voltage rating: • 0-50 kV **This is the characteristic rating of the DUT and does NOT refer to the test voltage!**
NS09: Next Step 	Press “Next” to continue.
NS10: Test Type 	Select one of the following test types: • VLF Withstand Test • VLF Tan Delta Test • DC Test • Sheath Test The test type depends on the DUT type or guide.

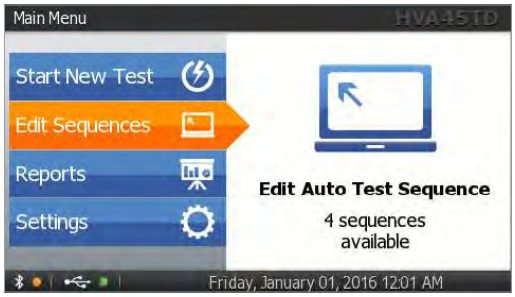
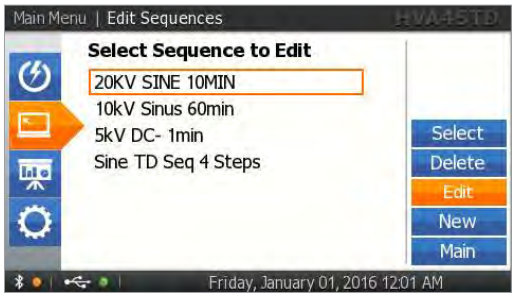
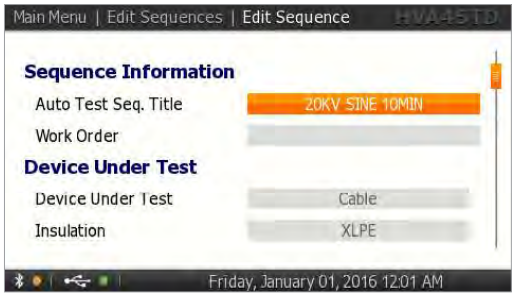
Step	**Procedure** (Configure Auto Test Sequence)
NS11: Test Standard 	Set the test standard: • IEEE400.2-2013 • HD620 • No guide Guide: If you select a test standard (guide), some of the parameters are locked. e.g. IEEE 400.2 -> no DC Test possible
NS12: Test Purpose 	Select one of the following test propose: • Maintenance • Acceptance • Installation
NS13: U_0  	Select this check box if you want to refer to the voltage rating U_0 for definition of the test step voltage. Depending on the DUT type, determine whether to use a three-phase calculation or a one-phase calculation of U_0. U_0 is defined as the phase to ground RMS voltage of a cable.

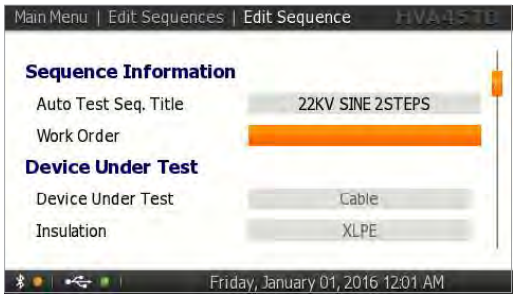
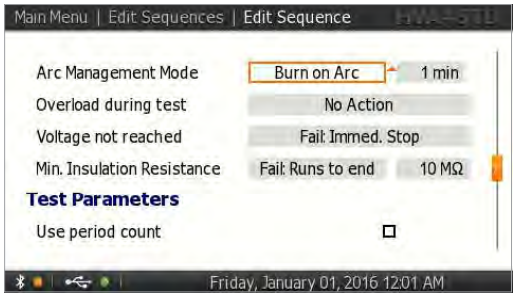
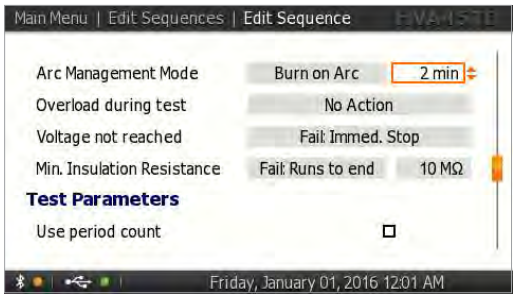
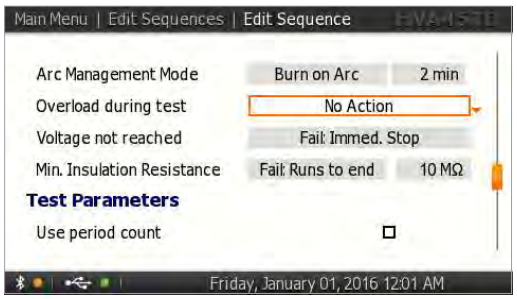
Step	**Procedure** (Configure Auto Test Sequence)
NS14: Next Step 	Press “Next” to continue.
NS15: Arc Management Mode Only applicable for VLF Withstand Testing  	Select one of the following arc management modes: • Trip out on Arc • Burn on Arc Fix the dwell time: • Min. dwell time: 1 min • Max. dwell time: 5 min
NS16: Overload during test 	Set action to be taken in case of overload: • No Action (default) • Fail: Runs to end • Fail. Immed. Stop

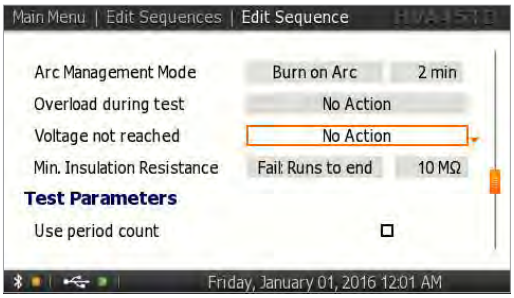
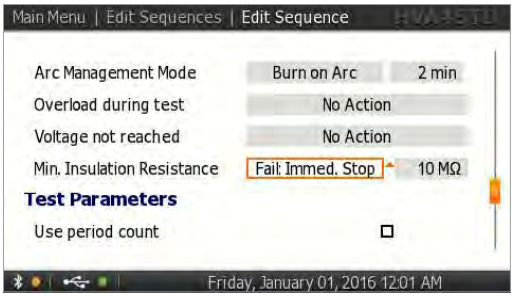
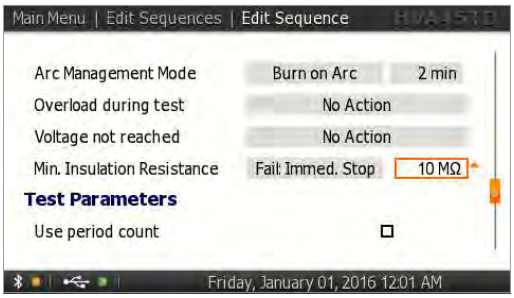
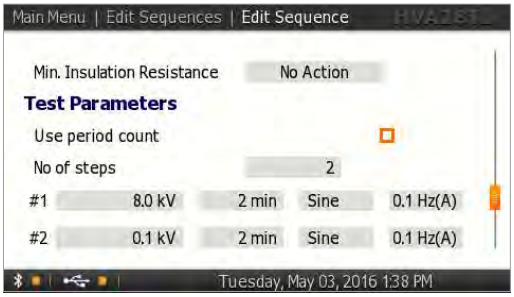
Step	**Procedure** (Configure Auto Test Sequence)
NS17: Voltage not reached 	Set action to be taken in case voltage is not reached: • No Action (default) • Fail: Runs to end • Fail. Immed. Stop
NS18: Min. Insulation Resistance 	Set action to be taken in case minimum insulation resistance is reached: • No Action (default) • Fail: Runs to end • Fail. Immed. Stop
	
NS19: Store 	To store the sequence, press the “Store” button.

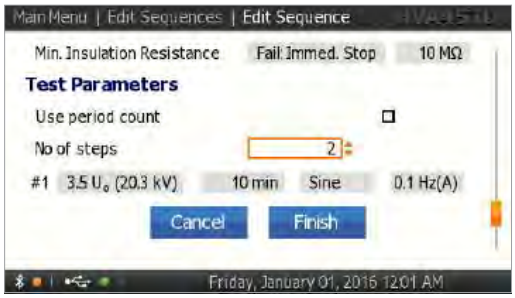
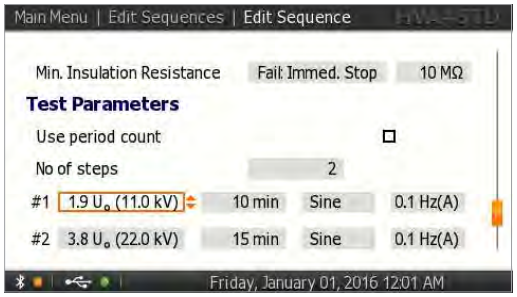
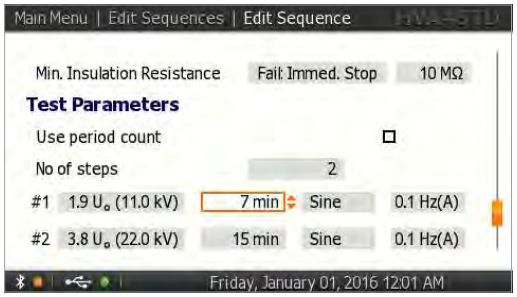
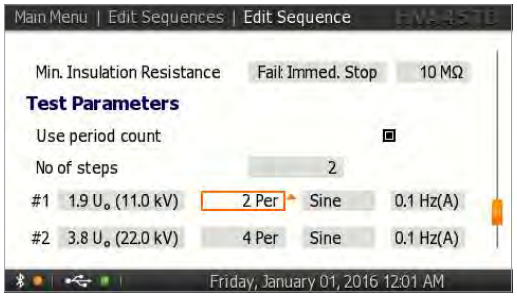
5.3.3 Configuring an Auto Test Sequence on the HVA Unit

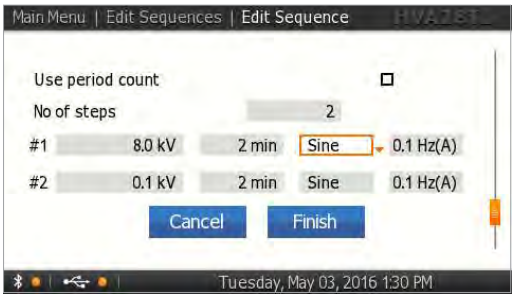
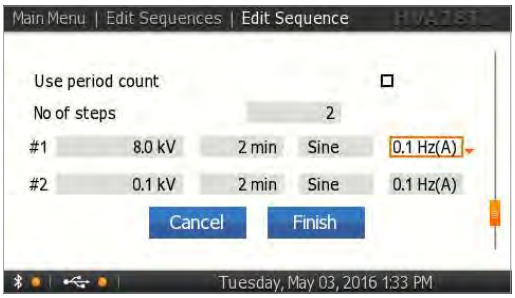
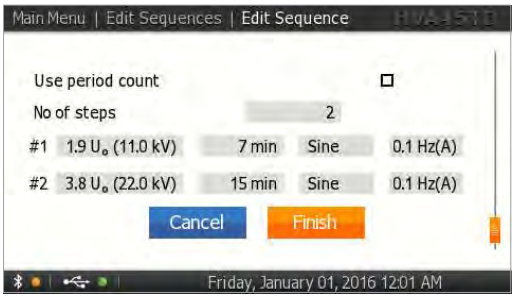
Steps AS1-AS15 describe how to configure a test sequence.

Step	**Procedure** (Configure Automatic Sequence)
AS01: Edit Sequences 	Select “Edit Sequences”.
AS02: Edit or New 	The “Edit Sequences” menu displays the sequences already stored in memory. To modify an existing sequence, select the corresponding sequence from the list and select the “EDIT” option on the list. To create a new sequence, select the “New” option on the right-hand side of the screen.
AS03: Title  	For entering a test sequence title, activate the keyboard and type the title.

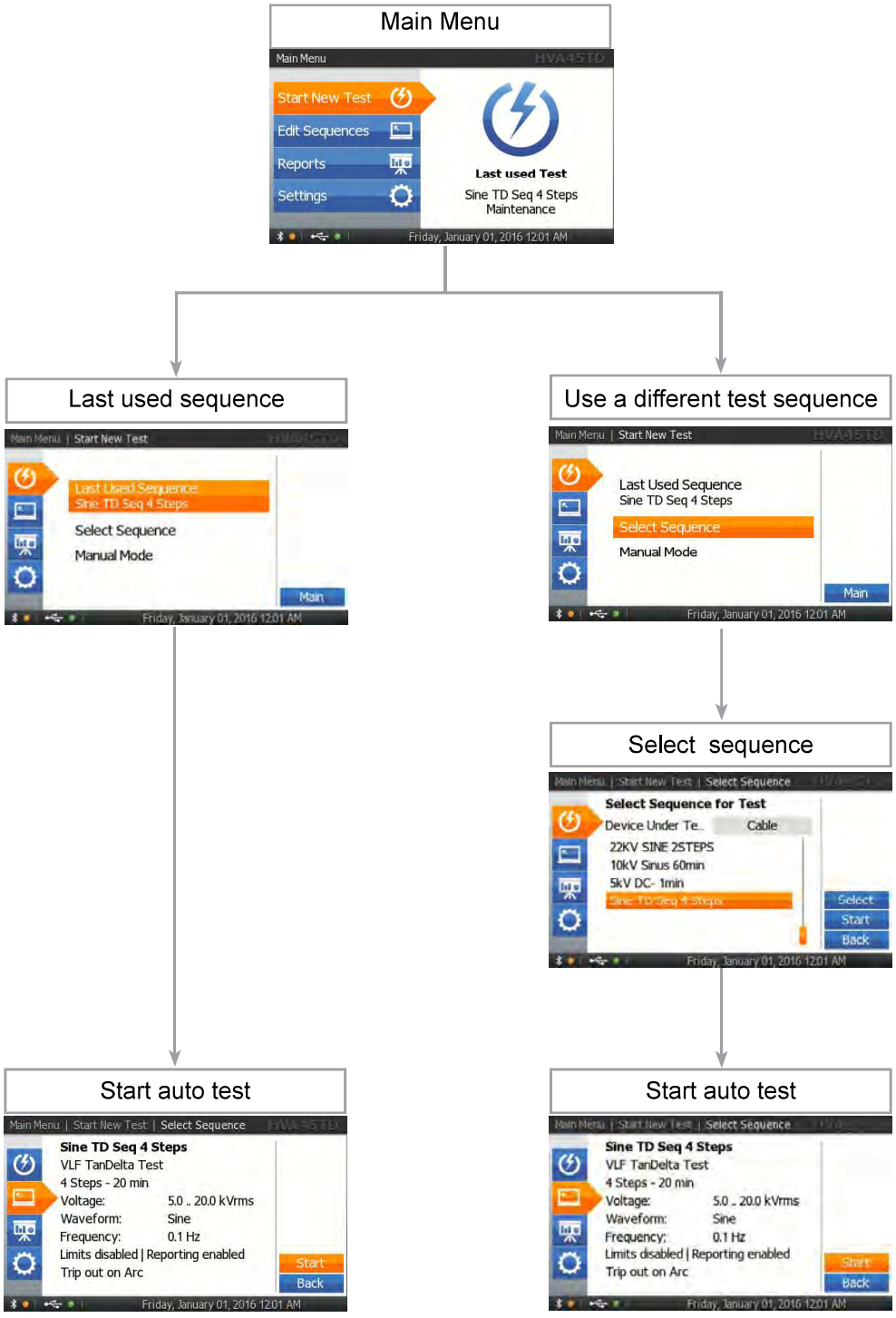
Step	**Procedure** (Configure Automatic Sequence)
AS04: Work Order 	For entering a work order number, activate the keyboard and type the number.
AS05: Arc Management Mode  	If “Burn on Arc” is activated, you can set the duration of burning.
AS06: Overload during test 	Set action to be taken in case of overload: • No Action (default) • Fail: Runs to end • Fail. Immed. Stop

Step	**Procedure** (Configure Automatic Sequence)
AS07: Voltage not reached 	Set action to be taken in case voltage is not reached: • No Action (default) • Fail: Runs to end • Fail. Immed. Stop
AS08: Min. Insulation Resistance  	Set action to be taken in case minimum insulation resistance is reached: • No Action (default) • Fail: Runs to end • Fail. Immed. Stop
AS09: Test Parameters – Use period count 	Set period count: • Time • Cycle Periods

Step	**Procedure** (Configure Automatic Sequence)
AS10: Test Parameters – Voltage Steps 	Specify the number of voltage steps to be applied to the DUT. • Min. voltage levels: 1 Step • Max. voltage levels: 15 Steps
AS11: Test Parameters – Test Voltage 	Specify test voltage for each step.
AS12: Test Parameters – Duration  	Specify the test duration for each step: • Min.: 1 Cycle Period • Max.: 500 Cycle Periods T = 1/f The testing time depends on the frequency chosen. Note: When selecting Auto, the frequency can differ from the expected value.

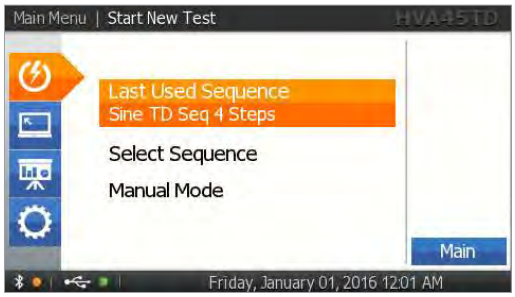
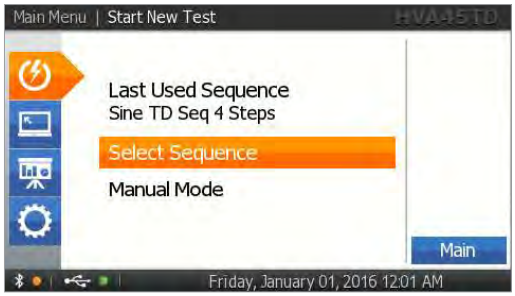
Step	**Procedure** (Configure Automatic Sequence)
AS13: Test Parameters – Waveform 	Select one of the following output modes: VLF Withstand Test • Sine Wave • Square Wave VLF Tan Delta Test • Sine Wave DC Test • DC+ • DC- DC Test • DC - Vacuum Bottle Test
AS14: Test Parameters – Frequency 	Set the frequency to as close to 0.1Hz as possible. • 0.1 Hz/Auto: Recommended setting that automatically maintains the frequency as close to 0.1 Hz as possible.
AS15: Store 	To store the sequence, press “Finish” button.

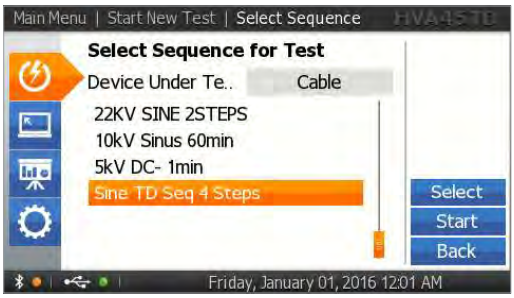
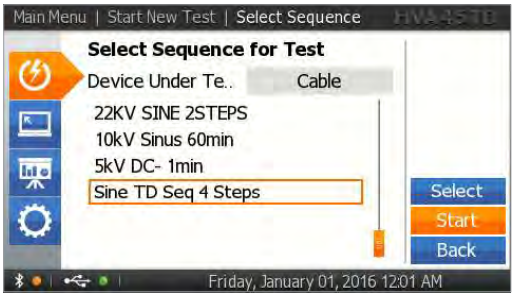
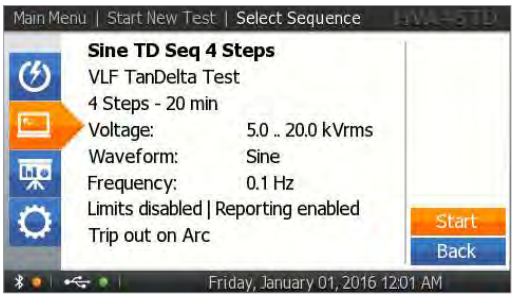
5.3.4 Running an Automatic Test - Overview

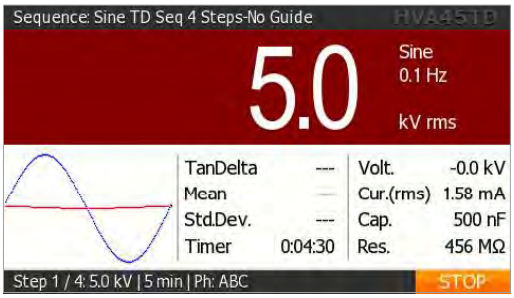
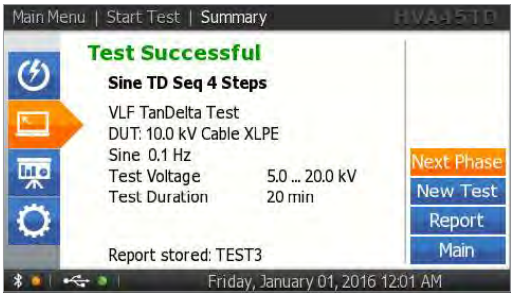


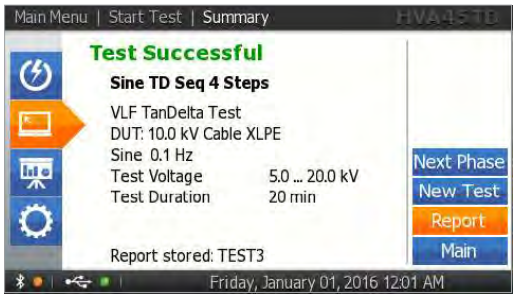
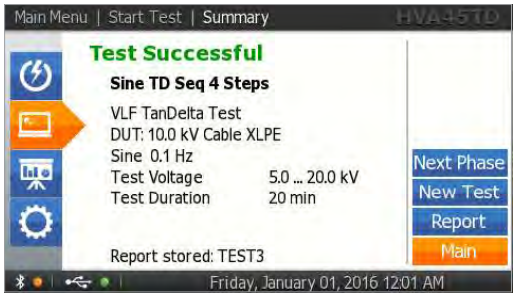
5.3.4.1 Running an automatic test - Detailed Steps

Steps AR1-AR10.4 describe how to run a test in the Automatic Mode.

Step	**Procedure** (Running Automatic Mode)
AR1: Use Last used Test or Start New Test 	Select “Start Test”.
AR2: Choose Test 	To repeat the previous test sequence: • Select “Last Used Sequence” from the “Main Menu” • Skip steps AR3-AR5: Select Sequence
AR3: Select Sequence 	Select one of the sequences.
AR4: Reporting Settings 	For more details, *see 5.2.1 Setting Report Details on page 41*

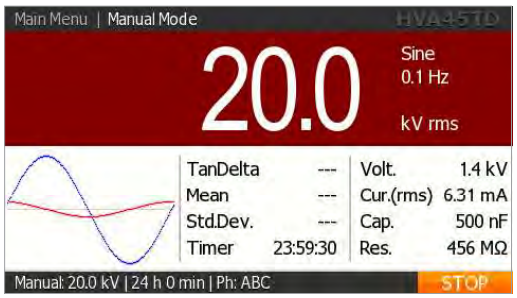
Step	**Procedure** (Running Automatic Mode)
AR5: Select Sequence  	All information about the selected sequence is displayed. Press the “Start” button to see a summary of the sequence.
AR6: Sequence Summary 	The summary of the selected sequence is displayed. To start the test, press the “Start” button.
AR7: HV Activation 	Once the activation screen appears, press the HV switch (40) within 10 seconds. If the HV switch is not activated within 10 seconds, the “Manual Mode” screen will reappear.

Step	**Procedure** (Running Automatic Mode)
AR8: Test Start Up 	"Startup" appears on the screen to indicate that the HVA is initializing test.
AR9: Test 	Test begins automatically. The timer value indicates the remaining testing time. The bottom line of the screen display the preset values
AR10.1: Test End – New Phase 	Display indicates end of automatic test. For testing the next phase, select the "Next Phase" button and push in/click the navigation knob (41).
AR10.2: Test End – New Test 	Display indicates end of automatic test. For starting a new test, select "Next Test" button and push in/click the navigation knob (41).

Step	**Procedure** (Running Automatic Mode)
AR10.3: Test End Report 	Display indicates end of automatic test. If you wish to view the corresponding report, select the “Report” button and push in/click the navigation knob 41.
AR10.4: Test End Main 	Display indicates end of automatic test. For going back to the main menu, select the “Main” button and push in/click the navigation knob 41.

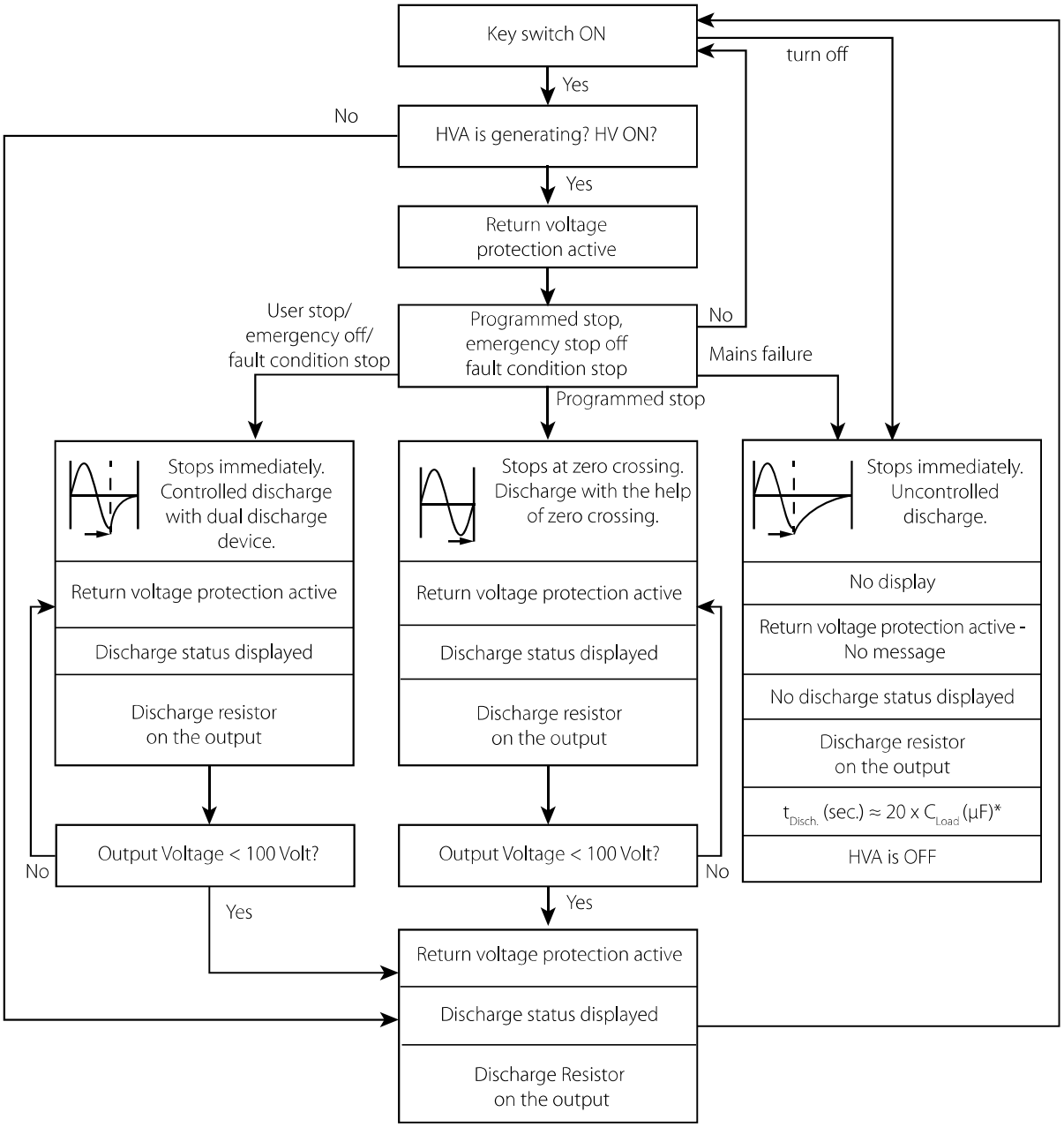
5.4 Interrupting a Test

Once a test has started, it can be interrupted at any time. It is recommended to select the appropriate interruption method to each situation

Step	**Procedure** (Interrupting a Test)
Routine STOP (Non-emergency) 	When a test is in progress, “Stop” is highlighted on the display screen. To interrupt the test, push in/click the navigation knob 41 • HVA software deactivates HV. • Test stops.

Alternative 	When a test is in progress, press the HV switch 40 to deactivate high voltage. • HVA hardware deactivates HV. • Test stops.
Emergency Stop 	In an emergency situation, press the emergency off button 40 to shutdown the system. • HVA hardware deactivates HV. • Test stops.

5.5 Discharge Status



* Discharge time approximation: $t_{Discharge}$ (sec.) ≈ 20 $\frac{s}{\mu F}$ x C_L (µF)
Example: Load capacitance C_L = 1.2 µF.. $t_{Discharge}$ ≈ 20 x 1.2 = 24 sec.
This is an approximation only and does not replace the safety rules.

6 Tan Delta

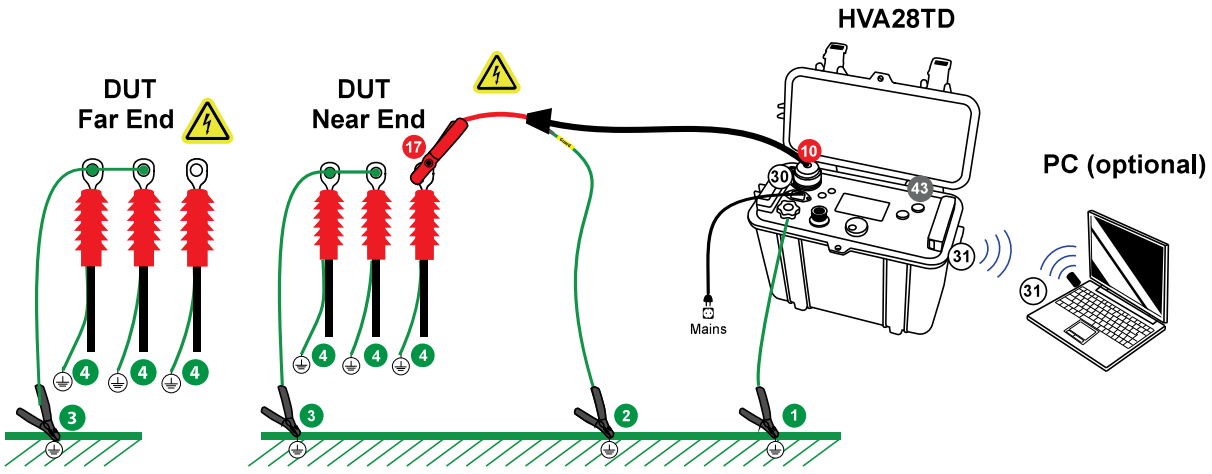
6.1 Application

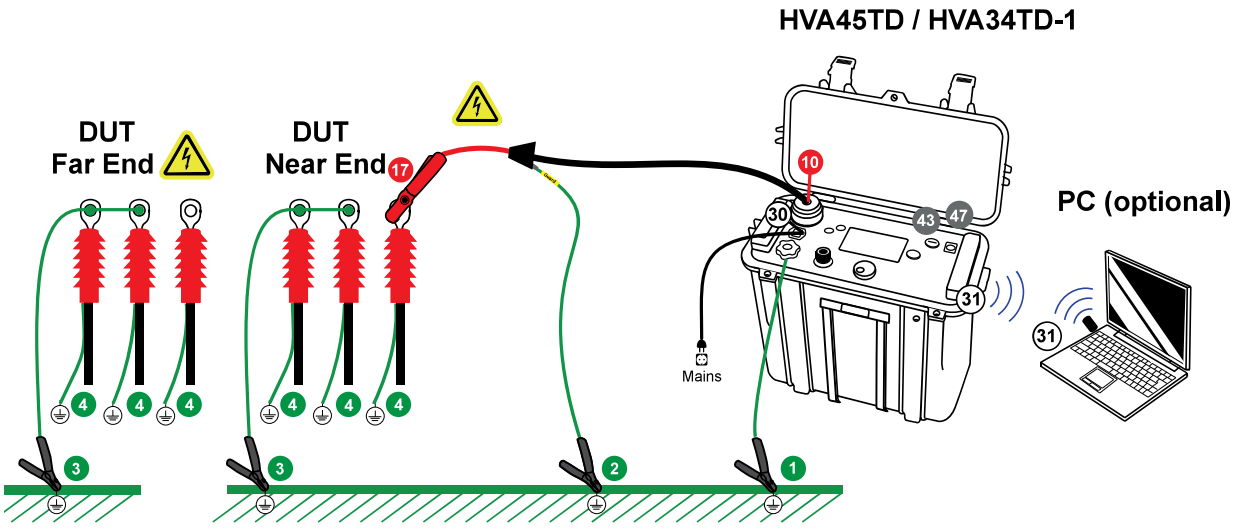
The HVA-TD Series of VLF test instruments incorporates an integrated Tan Delta measuring system. The Tan Delta Diagnostic Measuring System is suitable for testing medium-voltage electrical insulation systems such as cables (including XLPE, PE, EPR, PILC, etc.), capacitors, switchgear, transformers, rotating machines, insulators and bushings. Tan Delta testing enables the cable test engineer to detect insulation defects before the cable fails in service. The Tan Delta test results of the test object can be easily measured, recorded and displayed on the screen. The results can be easily stored via USB flash drive, Bluetooth synchronization or internal memory.

Suitable PC software (HV and TD Control Center) is included in the scope of delivery. With this PC software test results can easily be 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 or acceptance test.

6.2 Equipment Setup

6.2.1 Connection Diagram: VLF withstand test with Tan Delta





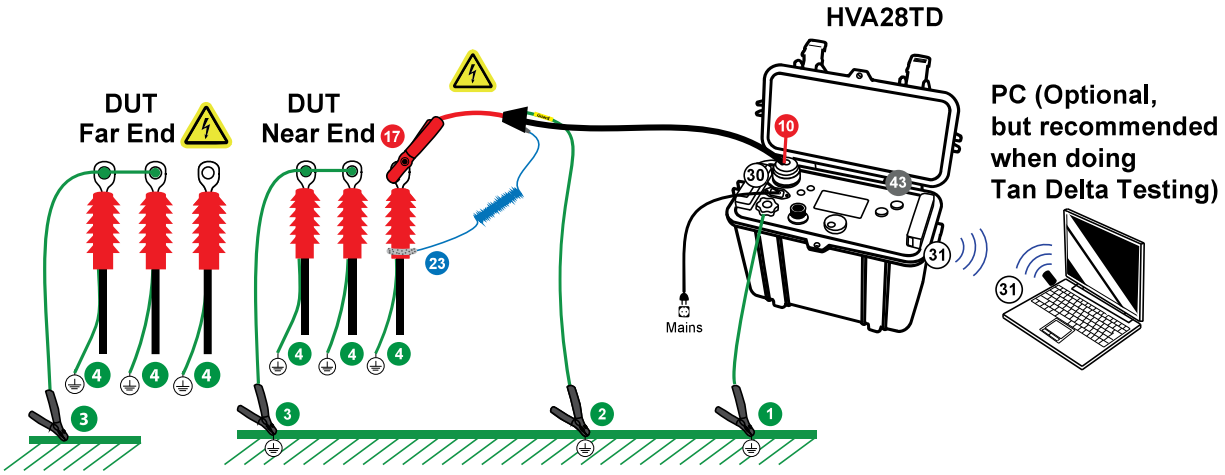
NOTICE

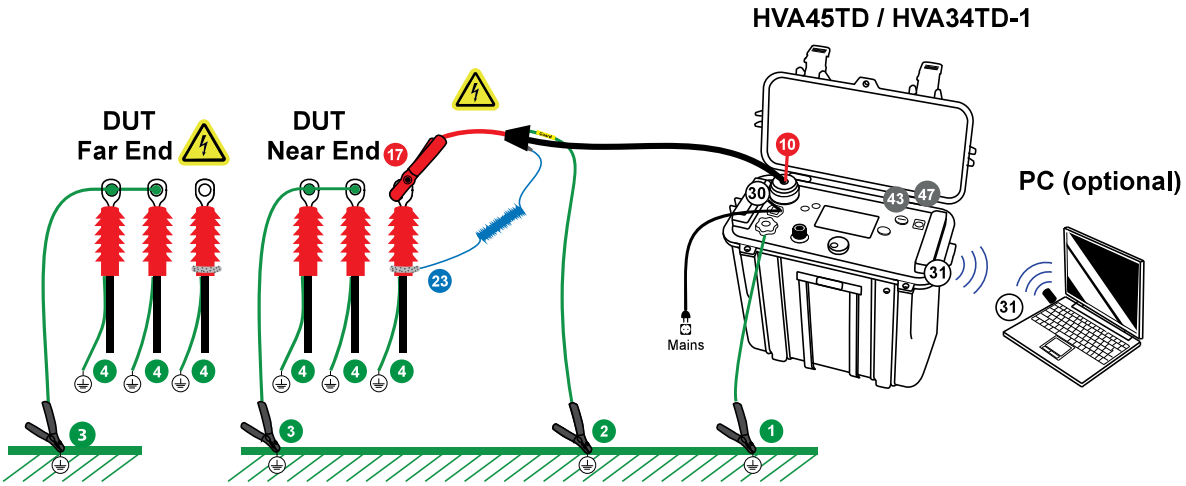
Establish secure grounding via connection 1, 3, and 4.
Connect HVA main ground lead first 1 and remove last!
Instrument is not grounded by connection 2.
Note: Make sure DUT Cable Shield is grounded.

Step	Procedure	Art. Nr.
S1	Connect all grounding cables • Discharge and ground the DUT complying with local safety regulations. • Connect grounding cable to the HVA grounding connector 1. • Prepare grounding for measurement 3 4.	700 505
S2	• Connect power supply 30.	
S3	Connect all HV cable connections. • Screw the HV test lead into the HVA HV output connector 10. • Ground the HV cable shield 2. • Connect the other end of the HV test lead to the DUT conductor 17.	702 502
S4	Verify connections. • Check that all cables are attached securely.	
S5	Ensure interlock plug (only for HVA45TD and HVA34TD-1) is plugged in. • Verify that the HV emergency adapter is connected 47. If operating with the remote controls interface (optional): • Connect external lamps or remote switches (*see 3.3 External Interlock and Control on page 14*)	
S6	Configure communication port. For USB data transfer mode, insert USB flash drive 31. (Optional)	700 199

S7	Turn key switch 43 to “ON” position.	700 907
S8	The HVA system automatically boots. • Start-up default screen appears. Select appropriate option from default screen and proceed to appropriate section for further instructions: • *see 6.3.1 Running a Manual Test with Tan Delta on page 79*	

6.2.2 Connection Diagram: VLF Withstand Test with Tan Delta Using Guarding



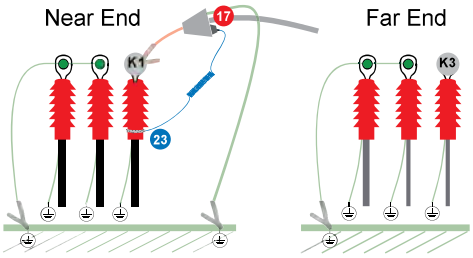


NOTICE

Establish secure grounding via connection 1, 3, and 4.
Connect HVA main ground lead first 1 and remove last!
Instrument is not grounded by connection 2.
Note: Make sure DUT Cable Shield is grounded.

Step	Procedure	Art. Nr.
S1	Connect all grounding cables • Discharge and ground the DUT complying with local safety regulations. • Connect grounding cable to the HVA grounding connector 1. • Prepare grounding for measurement 3 4.	700 505
S2	• Connect power supply 30.	
S3	Connect all HV cable connections. • Screw the HV test lead into the HVA HV output connector 10. • Ground the HV cable shield 2. Note: this does not ground the instrument! • Connect the other end of the HV test lead to the DUT conductor 17.	702 502
S4	Connect guard connection. • Connect guard connection from HV test lead to cable termination 23. • Make sure there is no connection between the cable shield and the guard. • The Guard is a Low Voltage Guard, it should be installed close to the ground of the termination on the insulated section of the termination. • If you are unsure of where to place the Guard, in many cases it is best to not use it.	702 502 702 509
S5	Verify connections. • Check that all cables are attached securely.	
S6	Configure interlock plug (only for HVA45TD and HVA34TD-1). • Verify that the HV emergency adapter is connected 47. If operating with remote controls (optional): • Connect external lamps or remote switches (*see 3.3 External Interlock and Control on page 14*)	
S7	Configure communication port. For USB data transfer mode, insert USB flash drive 31.	700 199
S8	Turn key switch 43 to “ON” position.	700 907
S9	The HVA system automatically boots. • Startup default screen appears Select appropriate option from default screen and proceed to appropriate section for further instructions: • *see 6.3.1 Running a Manual Test with Tan Delta on page 79*	

6.2.2.1 Option with corona shield

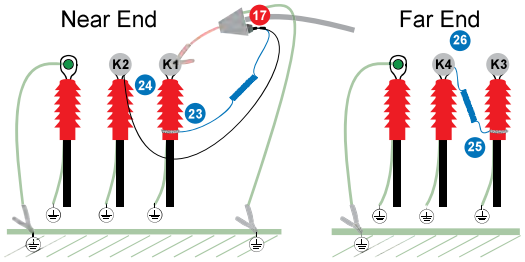


NOTICE

For voltages from 15 kV we recommend the use of corona shields for TD diagnostics.
Follow the introduction VLF withstand test with Tan Delta and guard *see 6.2.2 Connection Diagram: VLF withstand test with Tan Delta and guard on page 75.* **And replace S4 with OS1 to OS5 and continue with S5.**

Step	Procedure	Art. Nr.
Connections on near end:		
S1	Mount corona shield to the DUT. • Mount the corona shield at the phase to be tested K1.	700 050
S2	Fix the hook and loop fastener. • Fix the hook an loop fastener at the termination 23.	702 509
S3	Connect the guard connection cable: • Connect the cable at the 4 mm socket jack at the HV test lead 17. • Connect the other end of the cable at the conducting hook and loop fastener 23.	702 509
Connections on far end:		
S4	Mount corona shield to the DUT. • Mount corona shield on the same phase K2 at the far end.	700 050

6.2.2.2 Option with corona shield guard on far end



NOTICE

For very short cables with a capacitance below 100 m we recommend use of the guard on the far end as well as on the near end. This is possible for 3 phase systems or systems where you have a second connection from Far End to Near End.
Follow the introduction VLF withstand test with Tan Delta and guard *see 6.2.2 Connection Diagram: VLF withstand test with Tan Delta and guard on page 75.* **And replace S4 with OSG1 to OSG7 and continue with S5.**

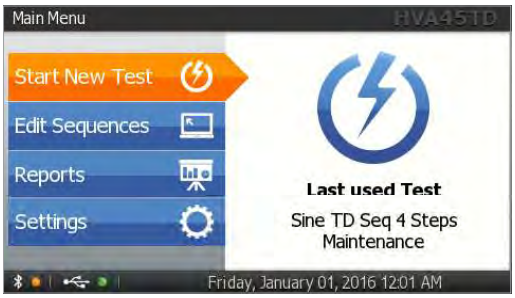
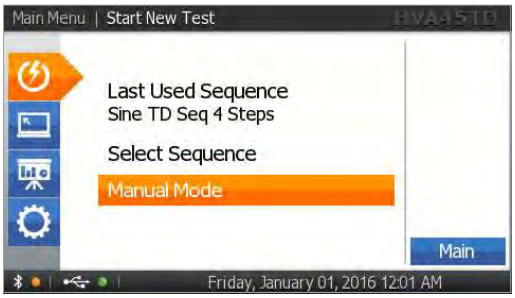
Step	Procedure	Art. Nr.
Connections on near end:		
S1	Mount corona shield to the DUT. • Mount the corona shield at the phase to be tested K1. • Mount the corona shield on a second phase K2 .	700 050
S2	Fix the external connection guard. • Fix the hook an loop fastener at the termination 23.	702 509
S3	Connect the guard connection cable: • Connect the cable at the 4 mm socket jack at the HV test lead 17. • Connect the other end of the cable at the conducting external connection guard 23.	702 509
S4	Connect the leakage current guard cable. • Connect the cable at the 4mm socket jack at the corona shield 24. • Connect the other end of the cable at the 4mm socket jack at the HV test lead 17.	
Connections on far end:		
S5	Mount corona shield to the DUT. • Mount corona shields on the same phases on far end K3 and K4.	700 050
S6	Fix the conducting external connection guard for leakage current detection. • Fix the external connection guard at the termination to the phase which will be tested 25.	702 509

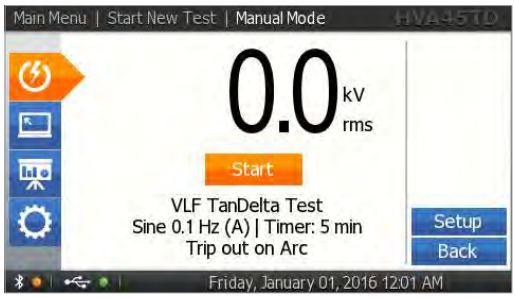
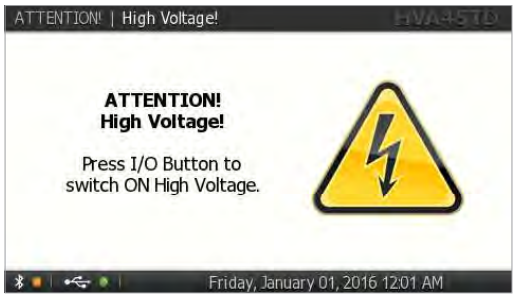
S7	Connect the guard connection cable. • Connect the cable at the conducting external connection guard 25. • Connect the other end of the cable with the 4 mm socket jack at the corona shield 26.	702 509

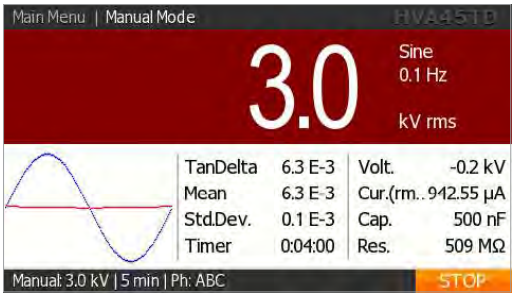
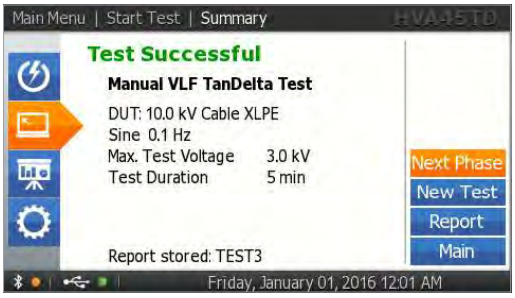
6.3 Tan Delta Test

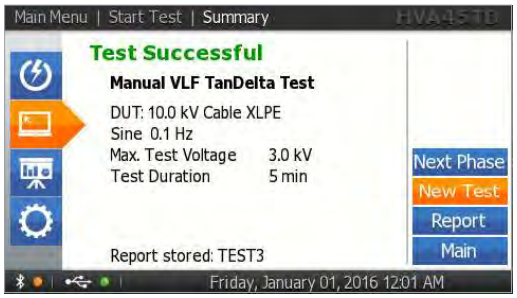
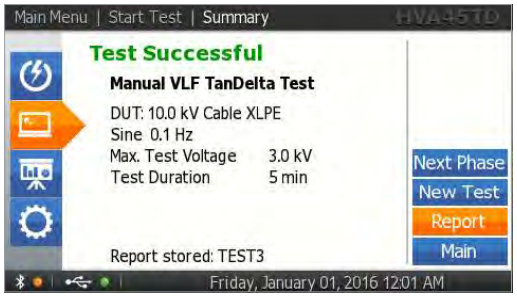
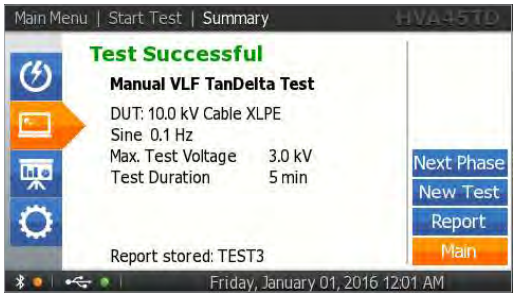
6.3.1 Running a Manual Test with Tan Delta

Steps TD1-TD9 describe how to run a test in manual mode with Tan Delta.

Step	**Procedure** (Manual TD Test)
TD1: Start New Test 	Select “Start Test”.
TD2: Start Manual Mode 	Select “Manual Mode”.

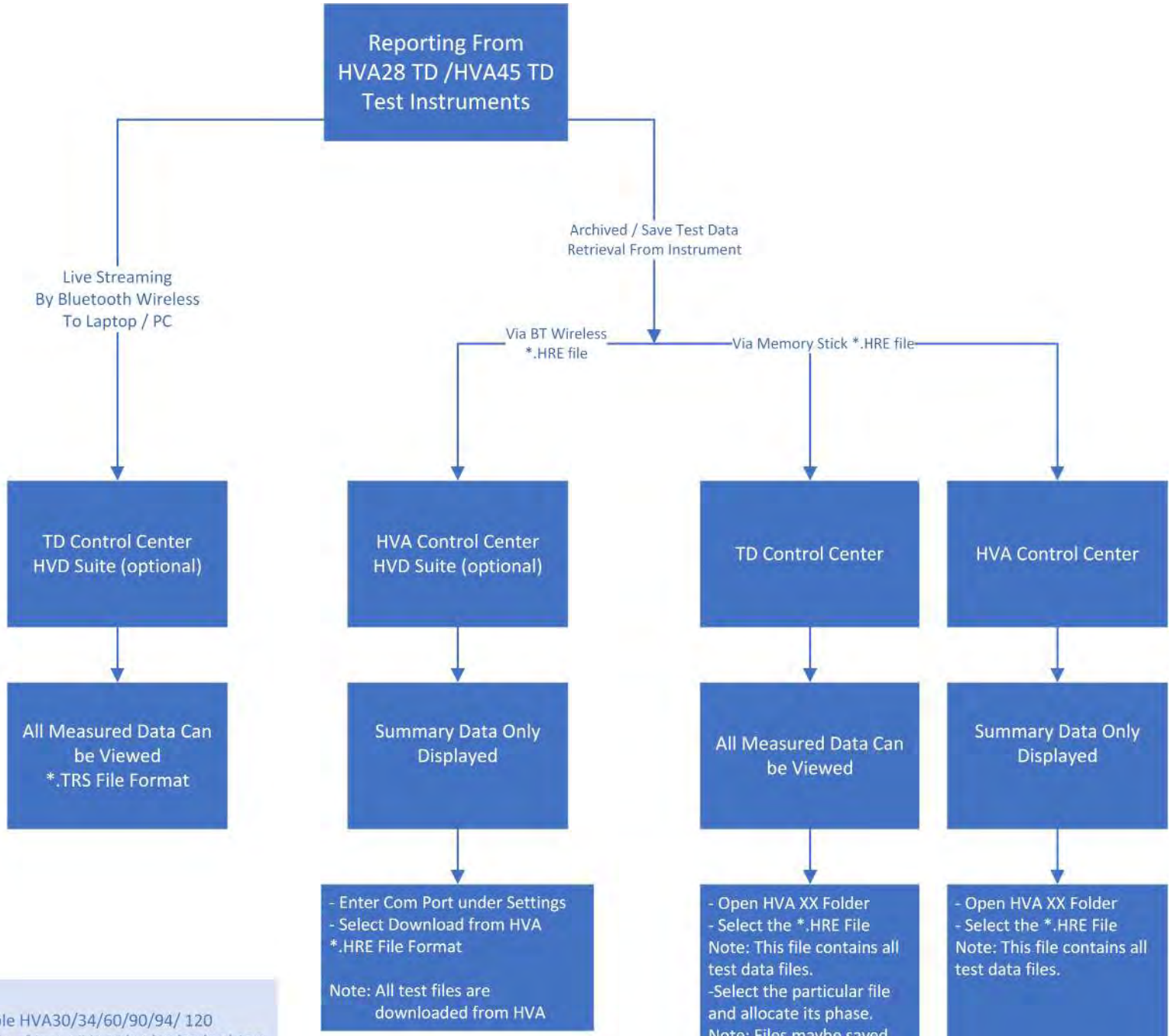
Step	**Procedure** (Manual TD Test)
TD3: Report Details – Basic or Extended  	Define specifications for the report.
TD4: Start Test 	Start the test when the test parameters displayed on the “Manual Test” screen are correct. Rotate the navigation knob until the “Start” field is highlighted. To run the test, push in the knob.
TD5: HV Activation 	Once the activation screen appears, press the HV switch (40) within 10 seconds. If the HV switch is not activated within 10 seconds, the “Manual Mode” screen will reappear.

Step	**Procedure** (Manual TD Test)
TD6: Test Startup 	Startup appears on the screen to indicate that the HVA is initializing the test.
TD7: Set Test Voltage (if not pre-set in step MS 8) 	Rotate the navigation knob 40 to modify the voltage value.
TD8: Test 	Test begins automatically. The bottom of the screen indicates elapsed time T: lapsed time / total test duration
TD9.1: Test End 	Display indicates end of manual test. For testing the next phase, select the “Next Phase” button and push in/click the navigation knob 41. Note: “Test Successful” means simply that the test set did not trip out prematurely due to an arc or overload. The user still needs to evaluate the Test Results.

Step	**Procedure** (Manual TD Test)
AR9.2: Test End – New Test 	Display indicates end of manual test. For starting a new test, select “Next Test” button and push in/click the navigation knob (41).
AR9.3: Test End Report 	Display indicates end of manual test. If you wish to view the corresponding report, select the “Report” button and push in/click the navigation knob (41).
AR9.4: Test End Main 	Display indicates end of manual test. For going back to the main menu, select the “Main” button and push in/click the navigation knob (41).

6.4 PC Software

The HVA system is delivered with a set of Windows-based software tools in an integrated software package (HV and TD Control Centers). This software connects, records, analyzes and reports the test results from the HVA testing instruments.
The following flowchart describes the options to download and view the test data from the instruments.



*.hrs if using Serial RS232 cable HVA30/34/60/90/94/ 120
*.hrd if using Black box on side of Inst. HVA30/34/60/90/94/ 120
*.hre if using USB Stick from Instrument. HVA28TD/45TD/34TD
Ensure you have an empty Mem Stick

7 Reporting

7.1 Report Type

The HVA can generate two report types: “Basic” or “Extended”. Reporting can also be disabled. *See 4.3 Instrument Setup on page 24*

Report Information	Basic	Extended	Disabled
Report Title	✔	✔	
Device Under Test	✔	✔	
Voltage Rating	✔	✔	
Insulation	✔	✔	
Phase	✔	✔	
Company Name		✔	
Region Name		✔	
Station Name		✔	
Line Length		✔	
Size of DUT		✔	
Manufacturer Name		✔	
Work Order		✔	
Operator Name		✔	

7.2 Report Activation

Reporting Types can be activated or deactivated in “Instrument Settings”. *See 4.3 Instrument Setup on page 24*
If reporting is set to “Disabled”, no report will be produced.

7.3 Report Naming Instructions

When entering report information, some steps require the operator to enter a user-selected name. Possible entries are:

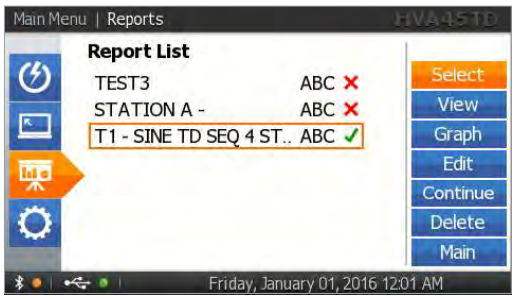
- A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
- - + ‘ 0+ - ‘space’ _ ( ) # @ - + * / \ ! ? = : , ; “ % ° < > | & [ ]
- 0 1 2 3 4 5 6 7 8 9

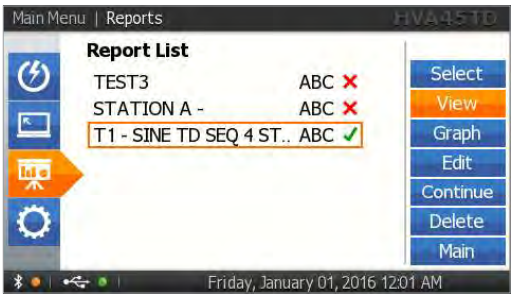
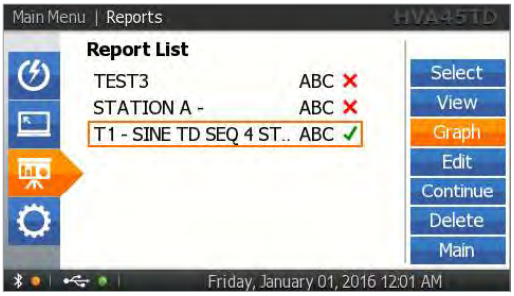
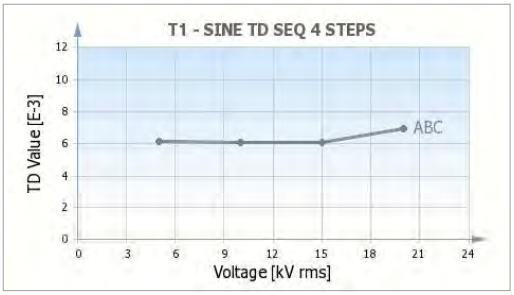
Step	Procedure
Activate Naming 	To select characters: rotate the knob 40, then push in/click.
  	To select characters: rotate the knob 40, then push in/click. For more characters, press the “.?!” button.

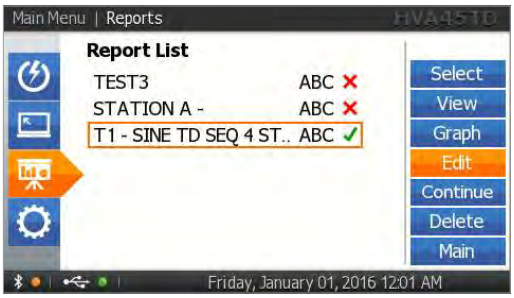
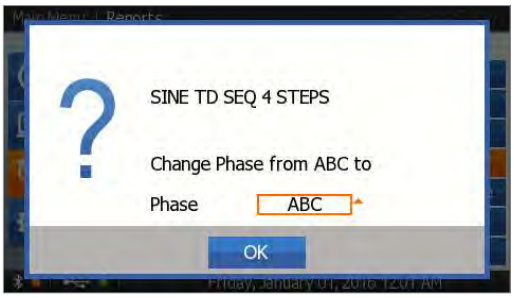
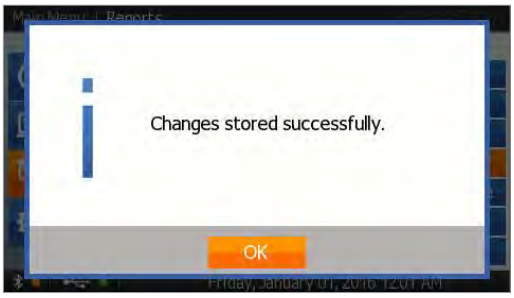
Step	Procedure
Delete 	To delete, rotate the knob 40 until reaching the ← button, then push in/click.
Exit without saving 	To exit without saving, rotate the knob 40 until reaching the ☒ button, then push in/click.
Confirm 	To confirm, rotate the knob 40 until reaching the ☑ button, then push in/click.

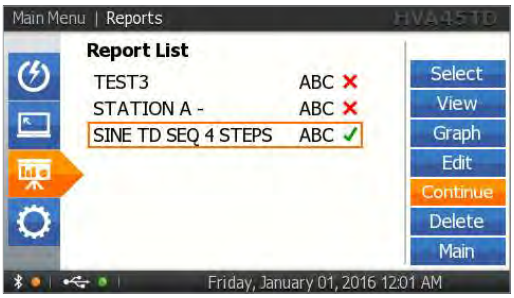
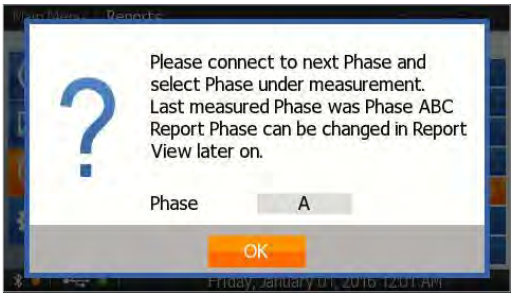
7.4 Manage Reports

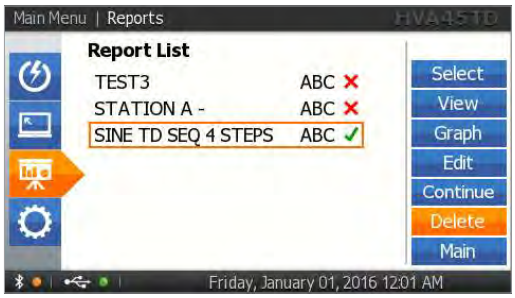
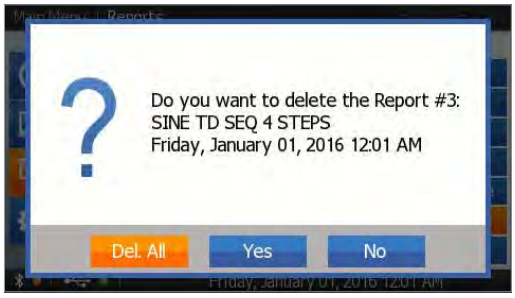
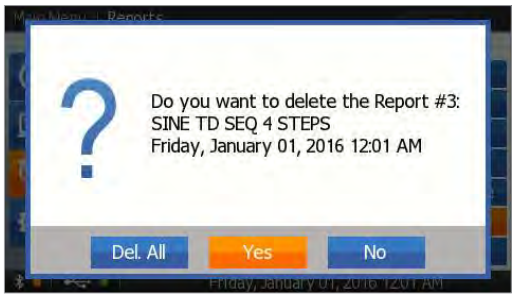
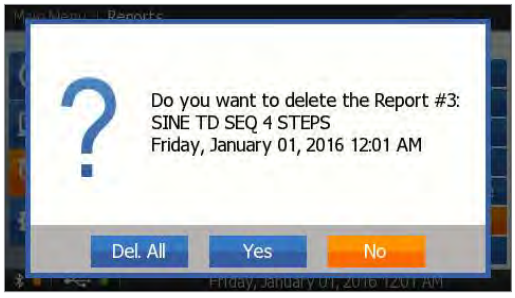
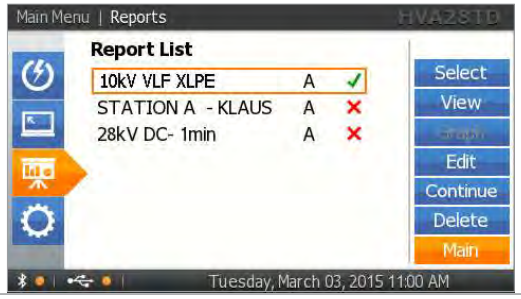
Reports can be viewed directly on the HVA display and/or can be exported on a USB Flash Drive or downloaded to HV Control Center/TD Control Center or HV Suite via Bluetooth.

Step	Procedure
Reports 	Open “Reports”.
Report List 	All reports are listed. “Graph” indicates if TD data are available to be displayed in graph form.
Choose Report 	Choose one of the reports.

Step	Procedure
View Report   	Select “View” for viewing the report on the HVA screen. The whole Report appears.
Graph   	Select “Graph” for viewing the TD Graph on the HVA screen. The whole Report appears. Only possible if you have the integrated TD System.

Step	Procedure
Edit Report     	Select “Edit” to change the name or phase of the report.

Step	Procedure
Continue Report  	Select “Continue” to continue a measurement. Select the phase to be tested. The phase last measured is indicated. To enter, push in/click “OK” with the navigation knob (40). This functionality allows you to start a measurement on a three-phase system at one time and finish it later.

Step	Procedure
Delete Report    	Select “Delete” to remove the corresponding report from the HVA.
Return to Main Menu 	Return to the main menu by pushing in/ clicking “Main” with the navigation knob (40).

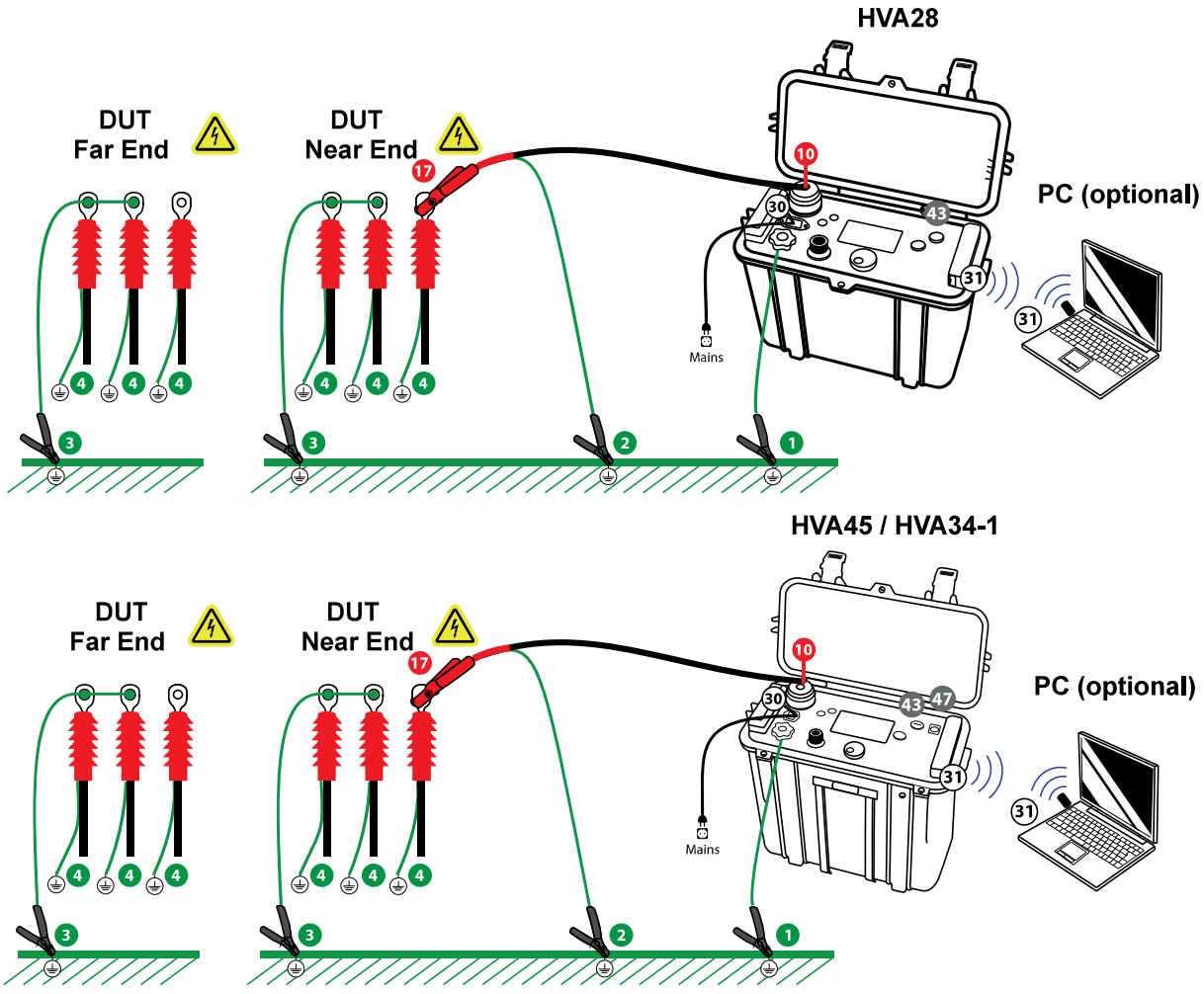
8 Disconnection Procedure

DANGER

Electric Shock Hazard
Never assume that equipment is safe to handle without using the necessary safety equipment and grounding procedures.
Disconnection procedures must comply with local safety regulations.

- Before disconnecting test lead, DUT must be discharged and grounded.
- Ground connections must be removed last!

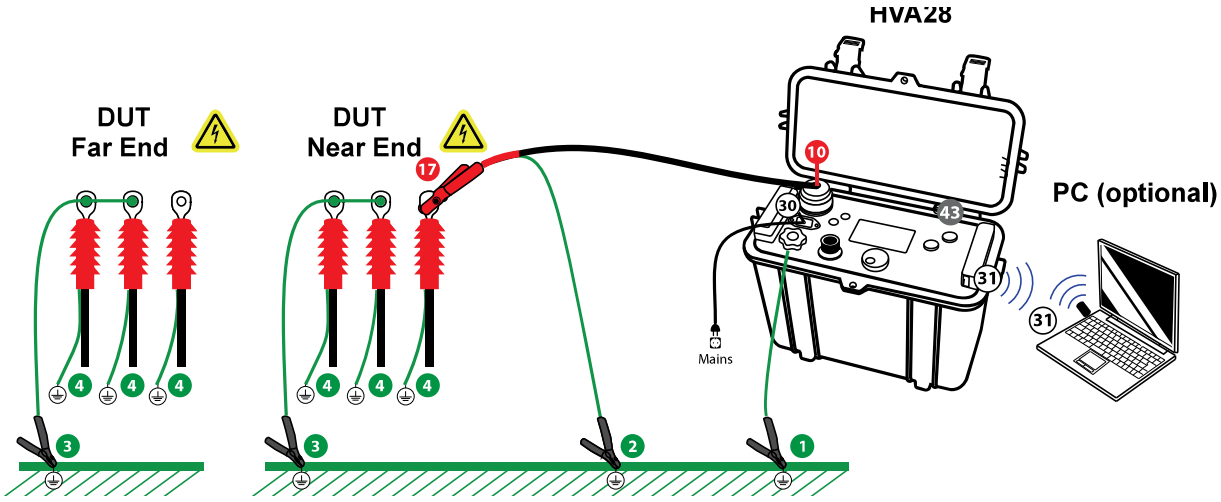
8.1 Disconnection Diagram - Normal Conditions

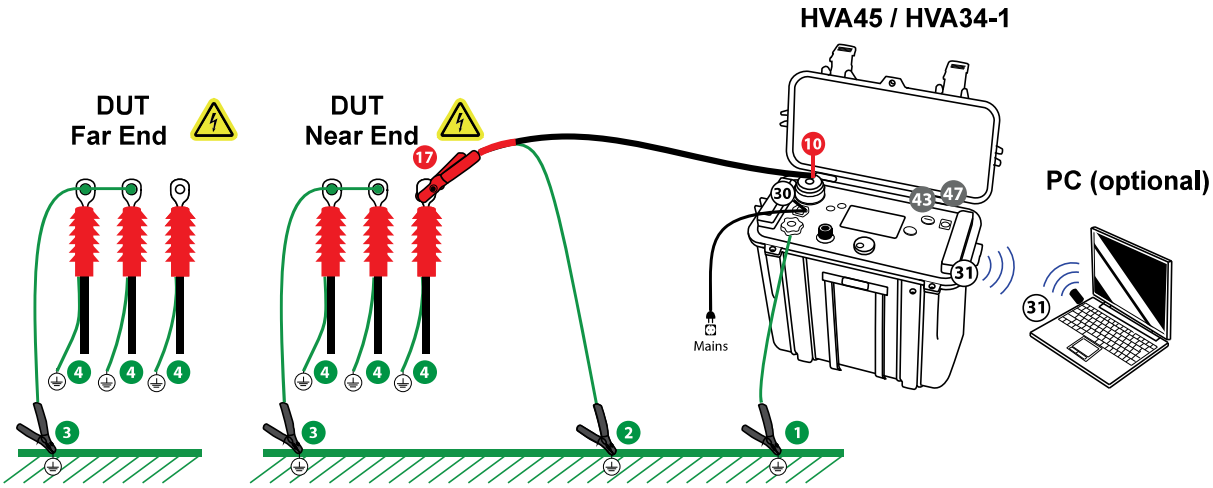


Steps D1-D7 describe the normal disconnection procedure.

Step	Procedure
D1	Once Test is completed. Press emergency off 42 Stop test according to *see 5.4 Interrupting a Test on page 70* and press emergency off button to lock against re-energise.
D2	Verify HV status. Wait until red LED 71 light turns off and green LED light turns on. (Red light indicates residual voltage > 100V)
D3	Manually and visually discharge and ground the DUT complying with local safety regulations and using an appropriate external device.
D4	To prevent unauthorized use: • Turn key switch 43 to the OFF position.
D5	Disconnect the Test Lead • Disconnect test lead from DUT 17. • Disconnect ground cable from the HV cable shield 2 • Unscrew HV test lead from HVA HV output connector 10
D6	• Disconnect power supply cable from power supply plug 30.
D7	Disconnect all grounding cables • Disconnect grounding cable form HVA grounding connector 1. • Disconnect grounding cable from DUT ground 3 4.

8.2 Disconnection Diagram - System Failure





Discharge stick

In the event of possible errors or failures due to a loss of power during testing, additional precautions are required. The HVA red LED light 71 does not indicate of less than 100V. To guarantee that the residual voltage has dissipated before removing the test lead, the DUT must be de-energized using a discharge stick.

Steps DSF1-DSF7 describe the disconnection procedure in case of system failure.

Step	**Procedure** (System failure disconnection)
DSF1	Switch HVA off • Press emergency off button 42 • Turn on key switch 43 to off position and remove key.
DSF2	• Verify correct functioning of discharge stick.
DSF3	Discharge and ground DUT complying with local safety regulations. • Discharge DUT using a discharge stick.
DSF4	Before disconnecting test lead, **wait** until residual voltage has dissipated. • Required wait time depends on the resistance of the discharge stick. • Rule of thumb: For standard discharge sticks, wait a minimum of 10 minutes.

DSF5	Disconnect the Test Lead • Disconnect test lead from DUT 17. • Disconnect ground cable from the HV cable shield 2 • Unscrew HV test lead from HVA HV output connector 10
DSF6	• Disconnect power supply cable from power supply plug 30.
DSF7	Disconnect all grounding cables • Disconnect grounding cable form HVA grounding connector 1. • Disconnect grounding cable from DUT ground 3 4.

9 Instrument Care

Cleaning

DANGER

Electric Shock Hazard
Never assume that equipment is safe to handle without using the necessary safety equipment and earthing procedures.
Disconnection procedures must comply with local safety regulations.

- Before disconnecting test lead, DUT must be discharged and grounded.
- Ground connections must be removed last!

HV CABLE

Clean the HV Cable connection points after use and before storing.

Maintenance and Repairs

NOTICE

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

Annual inspection by authorized HV Diagnostics staff is recommended.

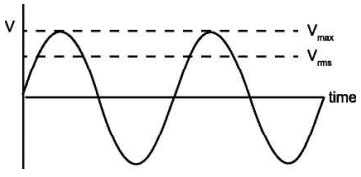
10 Accessories

Accessories are not included in the scope of standard delivery of the HVA. These items are available for order through HV Diagnostics. For orders, please contact HV Diagnostics.

Art. No.	Item	Description
706 221	PD60-2 Partial Discharge Fault Location System 60 kV_{rms} Standard	
706 223	PDTD60-2 PD Fault Location System with integrated Tan-Delta 60 kV_{rms}	
700 221	PD30-E Partial Discharge Fault Location System 30kV_{rms}	
	HV34-1 HVA45 HV cable PD free 75 kV, 5 m, MC14 mm incl.	
706 070-DS70	Discharge Stick 60 kV 1440 R 9 kJ	
712 070-DS140	Discharge Stick 30 kV 6000 R 4 kJ 750 mm	

11 Glossary and Abbreviations

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

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 up to 0.1 Hz. • Greatest allowable frequency depends on the test load and test voltage applied. • For loads greater than 0.5 µF, the instrument automatically reduces the frequency.
DUT	Device Under Test
Duty (continuous)	Load state in which the unit operates for an extended 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 1Hz = 1cycle / 1 second 0.1 Hz = 1cycle / 10 second , etc.
MWT	Monitored Withstand Test
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 Electrotechnical Vocabulary)
IEC	International Electrotechnical Commission
Peak value	Maximum Voltage = Vmax
RMS value	Root Mean Square Voltage • Vrms = Vmax / √2 

Term	Explanation
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).
SFL	Sheath Fault Location
ST	Sheath Test
TD	Tan Delta
TDTS	Tan Delta Time Stability (TD Temporal Stability)
DTD	Differential Tan Delta
VLF	Very Low Frequency • Typically between 0.01-0.1 Hz

12 Declaration of Conformity

The HVA28, HVA28TD, HVA34-1, HVA34-1TD, HVA45 and HVA45TD are CE certified and have 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