



**VLF-E
SERIES**

E-Series Operators Manual

VLF-34E, VLF-65E

VLF hipots
and

TD-65E

Tan delta transducer

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Warning! This equipment is intended to be used near energized high voltage equipment. Failure to follow the instructions could result in injury or death. Read this manual carefully and completely prior to using this unit.



Warning! Proper grounding of the test equipment must be done prior to connecting this unit to a power source

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Introduction

SECTION

1

VLF is a very low frequency sinusoidal ac voltage that is used to perform testing on shielded power cables, and other large capacitive test loads.

VLF testing of shielded power cables is defined by IEEE-400.2 "IEEE Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) (less than 1 Hz)". There are International Standards that also apply for cable testing and for testing rotating machinery (IEEE-433).

The E-Link software and the included XBee communications dongle allow the user to program tests and control the VLF wirelessly with a PC and easily transfer the data from the test set for further analysis and final report generation.

High Voltage, Inc was the first company in the world to produce a field portable sine – wave output VLF tester which the market rapidly adopted for power cable testing. We remain the only VLF manufacturer in the US and are proud to offer you high quality test equipment with the latest features and our second-to-none customer and product support.

Precautions

The system is intended to be used near energized high voltage equipment and operated only by qualified and properly trained personnel. When performing any work near high voltage equipment, proper safety precautions, such as insulated gloves and insulated overshoes, should be taken. When this equipment is operated near energized facilities, it is essential that all safety procedures, as generally accepted within the electric utility industry or mandated by your company, be strictly observed. No instruction or procedure contained in this manual is intended to specify, modify, or supersede any industry or company mandated safety practices.

What's in the Box?

No.	Name	Description
1.	VLF	VLF-34E or VL-65E Test instrument. (See following section for Description of Controls)
2.	Ground Stick with 20 ft. of ground wire	
3.	Green/Yellow Lead with Green Boot	10' lead for grounding VLF instrument
5.	20ft. HV Output Lead	20' cable for connecting the VLF to the test object.
6.	Input Line Cords	2 - IEC cord sets are provided for 120V and 220V operation
7.	Safety Ground Lead "Y" Assembly	Use to ground the two phases not being tested
8.	Manual	This manual
9.	Bag	Logo Accessory bag
10.	Enable Key	
11.	USB Flash Drive	Contains PC software, firmware and manual(s)
12.	X-Stick	For PC communications to VLF

Description of Controls

No.	Name	Description
1.	Input Fuse	Fuse for Line Power Input. Replace with 5A (VLF-34E), 8A (VLF-65E, 240V) or 15A (VLF-65E, 120V) fast-blow type only
2.	Line Power Input	IEC C14 Inlet connector
3.	Line LED	Indicates input power is present.
2.	User Display	QVGA (320x240) LCD display.
3.	USB Data	A-type USB port for saving test data to USB flash drive media
4.	Accept Button	Selects options highlighted by encoder wheel
5.	Encoder wheel	Rotating encoder knob highlights menu options. Pushing the knob selects menu items the same as the Accept Button
6.	Display buttons	Select on screen menu items
7.	Disable Button	Shut down test in progress
8.	HV Status LED	Green = voltage on DUT (Device Under Test) is less than 250 Volts Yellow = Caution High Voltage is about to be applied Red = High Voltage present on DUT
9.	Enable Key	Safety key for instrument. Key must be inserted and rotated to 'I' position in order to energize HV output for testing.
10.	USB port	B-type USB port. This port is primarily used for firmware upgrades using a USB printer (A-to-B) type cable.
11.	External Interface	Removable terminal block for external interlock and indicator light tree connections. External Interlock terminals must be jumped when not used. Light tree connections are dry contact with a single common (120VAC, 60VDC max)
12.	Antenna Output	SMA output with stub antenna for remote operation of VLF/TD



Setting up the VLF

Select the Advanced button from the front panel to perform the operations listed below

Setting the date and time

Setting the date-time format

USA or International

Setting the Unit Display

Sets the display of Voltage and Current to either peak or RMS.

Serial Coms

Erase Tests

The E-series instrument can hold ~100 tests in its internal memory

PANID

Preparing the VLF for testing

SECTION**2**

The setup procedures of this equipment have been minimized by careful consideration of the operator during design. The **VLF-34E** and **VLF-65E** single-piece construction and light weight lends itself to convenient portability for AC testing in the field.

Select a location for the unit that will allow easy viewing of the control panel at a safe distance from the test object (within 20 ft.) on a level area.

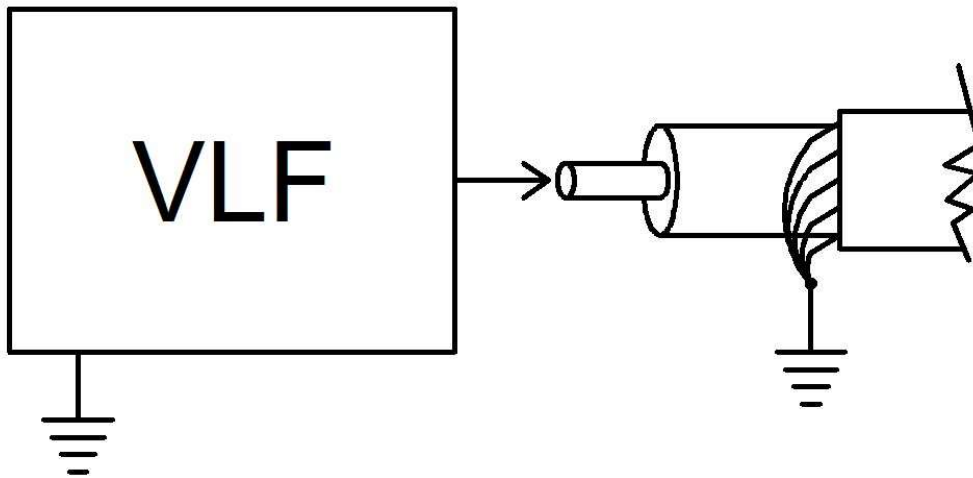
Note: The mains outlet that is utilized to power this equipment must be within 3 meters of the device, and shall be easily accessible and easily disconnected.

1. **Be sure that main power switch is off.**
2. **Secure a ground test lead to the ground stud on the right side of the case**

–CAUTION –

**No switches or Disconnect devices in the earth conductor.
Disconnection of the protective earth conductor, will impair the protection
provided by the system**

3. **Choose the 120V input power cord or wire the 230v input power cord to a grounding-type plug rated for the required voltage and power compatible to the local power receptacles.**
4. **If a generator is being used as a mains source HVI highly recommend pure-sine inverters such as Honda EU-series or equivalent.**
5. **Connect the input line cord (maximum length 3 meters) to mains outlet.**
6. **Connect the safety ground stick to a solid earth ground.**
7. **Check and clean if required the ends of the High Voltage cable and then Insert the output cable into the High voltage output dry-well (check and clean if required) and stretch out the cable for later connection to the test cable or load.**
8. **Insert the EXT INTLK plug into the socket.** The plug may also be wired to a normally open contact of a safety switch for added protection.



- IMPORTANT NOTE -

DO NOT BLOCK THE COOLING VENTILATION OPENINGS

The setup of the VLF Test Set does not address the need for proper safety grounding of the load (test sample or cable). The grounding requirements vary for different types of tests. Please consult the local electrical codes where applicable or reference the guidelines for grounding found under OPERATING THE EQUIPMENT.

Connecting to the load

This section provides step-by-step instruction for various test methods. Many facilities have their own in-house test procedures, and this manual is not to supersede these. The purpose of this section is to explain the capabilities of this test set in real-world applications. **Only trained personnel should attempt to operate this equipment.**

Dangerous voltages and currents are produced during the testing of cables, only trained individuals should operate this type of equipment and access to the test area must be restricted during testing to avoid endangering others.

<p>OPERATING THIS EQUIPMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE PROTECTION PROVIDED BY THIS EQUIPMENT</p>

When testing cables, either single or three phase, there are certain extra steps that must be observed to ensure safe operation.

AC Testing of High Voltage Cables

1. Ensure that all the steps listed in preparing the VLF for testing have been accomplished. Take special note to ground the test set to a solid earth ground.

<p><i>Caution!!</i></p>

<p><i>Before making any cable connections, ensure that the cable being tested has been properly identified, de-energized, and grounded!</i></p>

2. Make sure that all insulators, stress cones, and pot heads are clean and free of moisture. This will prevent flashover and minimize leakage.

Note: Be aware that any lightning arrestor or transient suppressing device must be disconnected if the clamping voltage is below the test voltage being performed. Failure to clear these devices from the cable may result in a false failure indication of the test cable.

3. Isolate the far end of the conductors under test for the test voltage; that may mean separating some of the conductors in a multi-conductor cable from each other *and* their shields.

The shields of all cables must be securely tied to ground at the nearest end of the cable.

4. Any conductors or wires in the cable or the vicinity not being tested must be grounded to avoid a buildup of charge and possible shock hazard.
5. Voltage must be applied according to specifications from the cable manufacturer or any other applicable test standards
6. Prior to connecting anything to the test sample, be sure the test sample is identified, de-energized and grounded until ready to test.
7. Connect the input power cable to a **grounded**, 50/60 Hz source as noted in preparing the VLF for testing. **If a generator is being used as a mains source HVI highly recommend pure-sine inverters such as Honda EU-series or equivalent.**
8. Connect the output lead to the test sample. Be sure that there is enough clearance to grounded objects for the expected test voltage. The minimum clearance in air is 10 kV ac/inch.
9. **Clear the test area of unauthorized personnel and use safety barricades to warn others of potential danger during the high voltage test.**
10. **Insert the EXT INTLK plug into the socket.** The plug may also be wired to a normally open contact of a safety switch for added protection.
11. Turn on the **MAIN POWER** switch near input power receptacle.



***** CAUTION *****

**POTENTIALLY LETHAL
VOLTAGES MAY BE PRESENT**

**STORED ENERGY LEVELS IN THE CABLE GREATLY
INCREASE THE RISK OF FATAL INJURY IF CONTACT
IS MADE WITH THE LOAD WHILE AT ANY VOLTAGE.**

Testing the load (New Test)

Setup a new test by pressing the button to the right of 'New Test Setup' in the screen below.

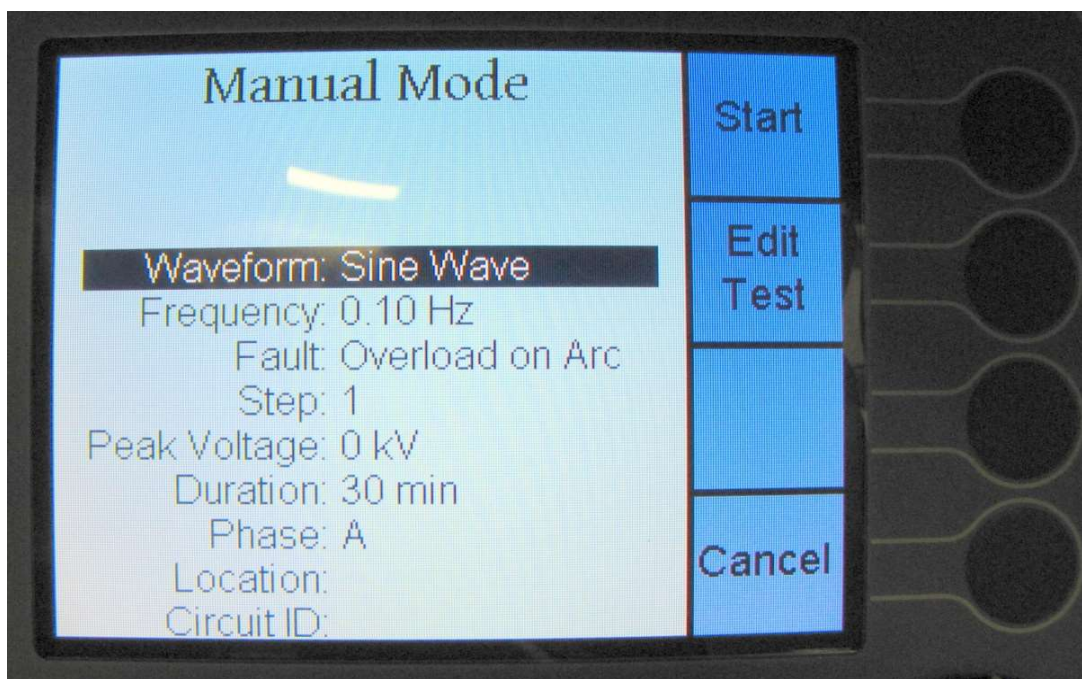
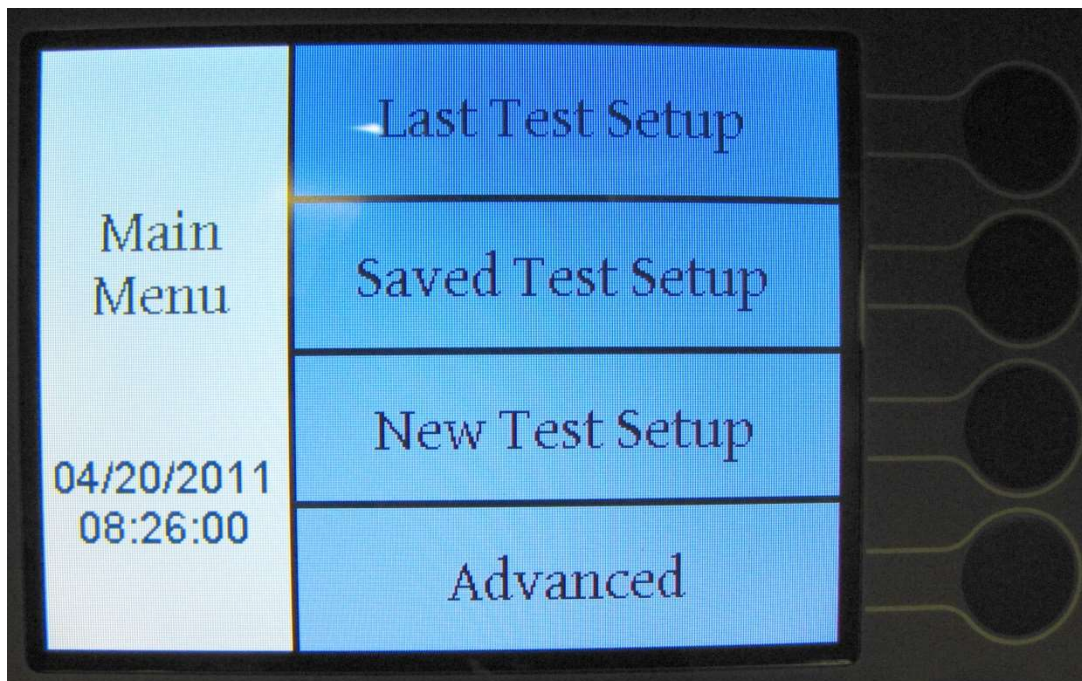


Figure 1 - Manual Mode

Setting up the Test

Setup fields for tests are shown in Figure 4 above. Each field has several options that may be viewed by pressing the encoder knob or the Accept button.

Manual Mode setup options are:

Waveform: Sine Wave

Square Wave

DC Positive

DC Negative

Frequency: Auto

0.1 – 0.01 Hz

Step: 1-5

Voltage: 0-34 kV (VLF-34E), 0-65kV (VLF-65E) in 0.1kV increments

Duration: 1, 2,3,4,5,15,30,60 min

Phase A, B, C

Location: (entered from alphanumeric display)

Circuit ID: (entered from alphanumeric display)

Once your test is set to your parameters, press Start (top right button). After the Start button is pressed the screen will turn yellow, the settings for the first step will appear on the screen and a countdown timer will give you 10 secs in which to confirm that you wish to start the test. Press Start again and the test will begin.



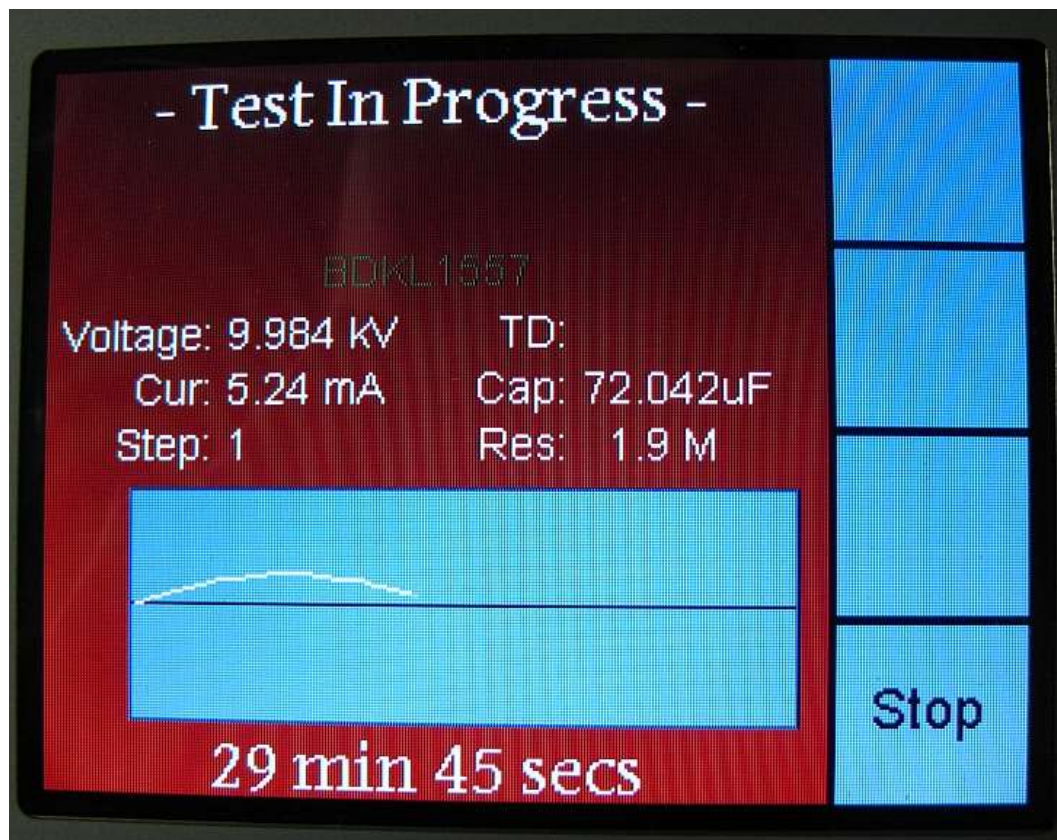


Figure 2 - Test in Progress

Remote Operation with E-link

In addition to testing in Standalone Mode using the VLF, testing may also be executed in Remote Mode using the E-link application software running on a suitable laptop or other PC.

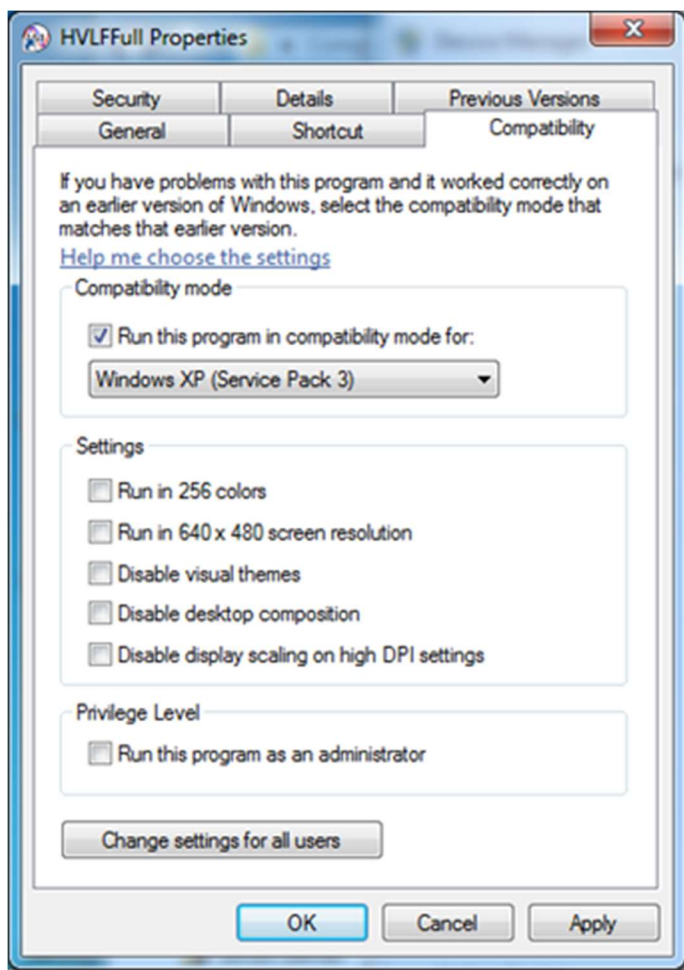
System Requirements:

- Windows-compatible Hardware
- 500 MHz or faster processor
- At least 512MB of RAM
- Windows XP, Vista, Windows 7, Windows 8

Installing E-link:

E-link can be installed to any PC/laptop directly from the HV Flash drive provided with unit:

- Insert the HVI USB jump drive
- Navigate to the E-link zip file
- Double-click the .zip file
- Double-click the setup.exe file
- Follow the prompts to install the application
- After application installs, right-click on the E-link icon and select Properties
- Select the Compatibility tab and check the 'run this program in compatibility mode' box for Windows XP (Service Pack 3) as shown below



Testing with E-link:

As with Standalone Mode, testing may either be done by manually entering test parameters (up to 5 independent voltage steps) or by loading and running a Profile or Sequence. In addition to being able to run batches of tests more expediently than in Standalone Mode, the E-link application also has rich report generating features as well as being able to export test data to MS Excel or MS Access for entry into a larger database.

Tests, Profiles and Sequences:

Test files contain all the data of a particular test. This includes voltage, current and (when used with the TD-65E) loss angle (tan delta) data. It also includes test setup parameters such as step voltages, step durations, frequency, arc-fault response mode, output type (VLF, DC or sinewave) as well as numerous fields for cable location, cable type, project name etc. These test setup parameters are also known as

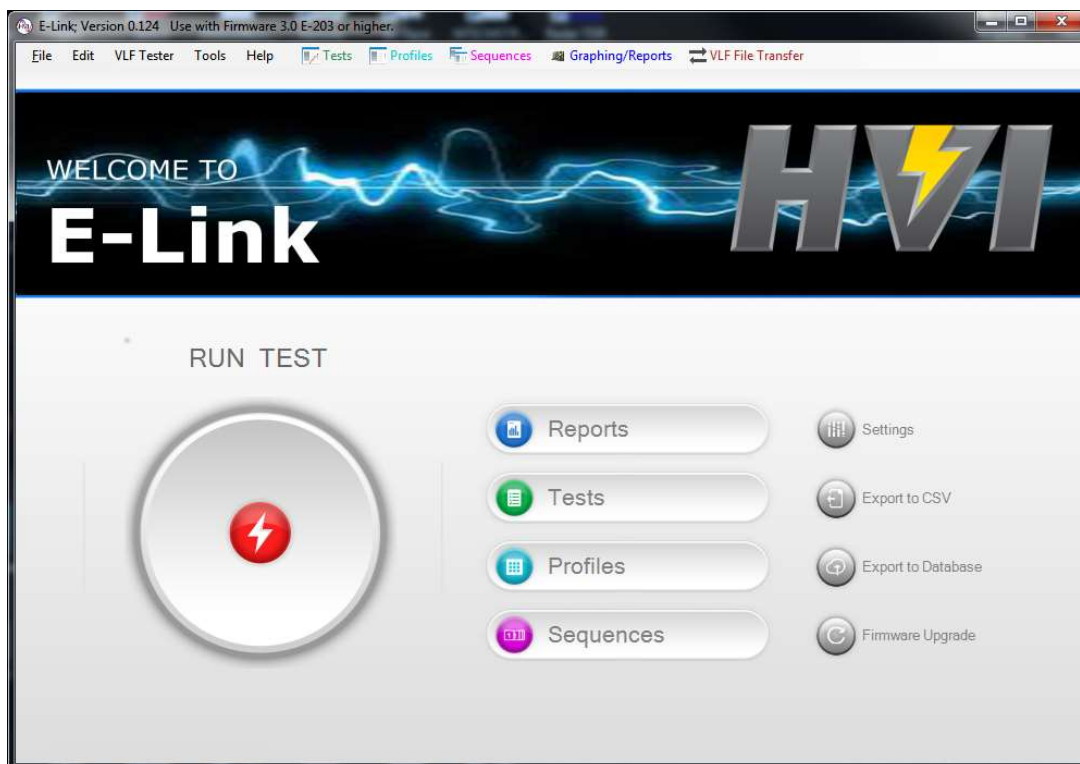
Profiles and can be created ahead of time to save data entry time in the field where the same test will be repeated on different phases and locations during the day. Multiple Profiles can be grouped together into Sequences to allow more than 5 voltage steps or more than 60 min step durations.

File Naming and Location

E-link automatically names all test files unless the user gives them a name of their choosing. The default filenames are year+month+day+hour+minute+second and have a .hvc file extension. A test run on July 4, 2015 at 2:10:06PM would then have a default filename of: 20150704141006.hvc. The files are stored in the default file location specified under the Options Screen (Settings->Folders->Export Folders ->location for Input Files). This default is also the location for any Profiles or Sequences created.

E-link Main Screen

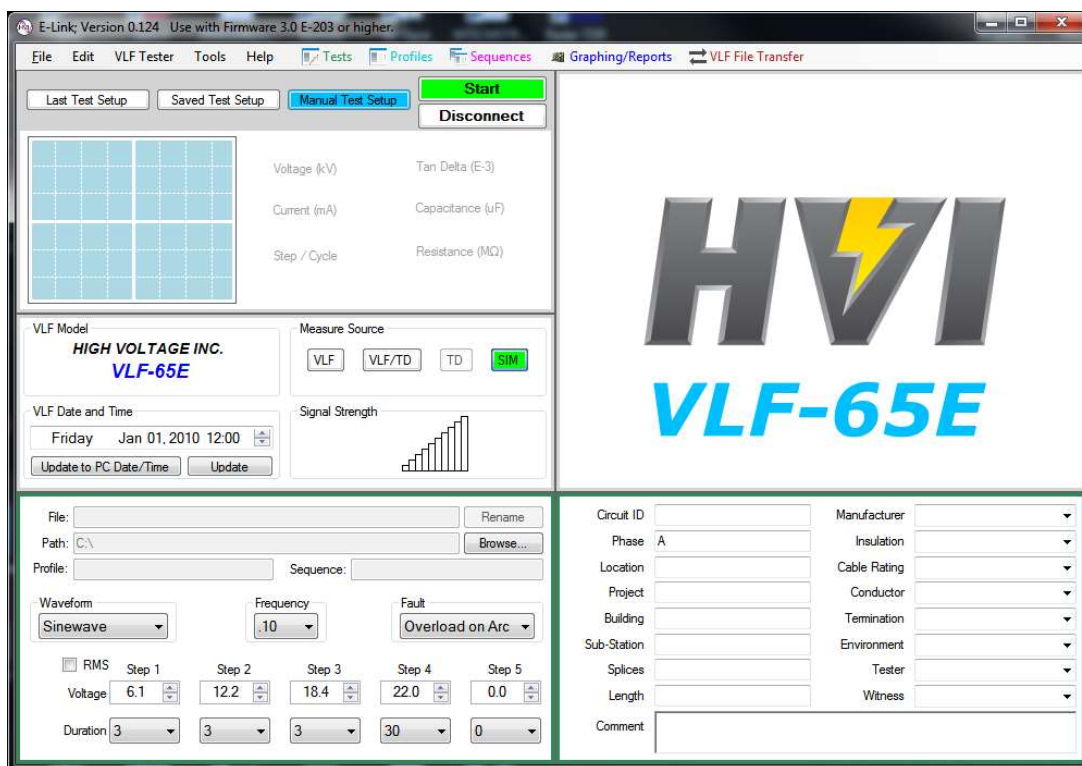
Double-click the E-link icon created on the Desktop. The E-link Main screen shown below should appear and shows all the options.



Setting up Default File Locations

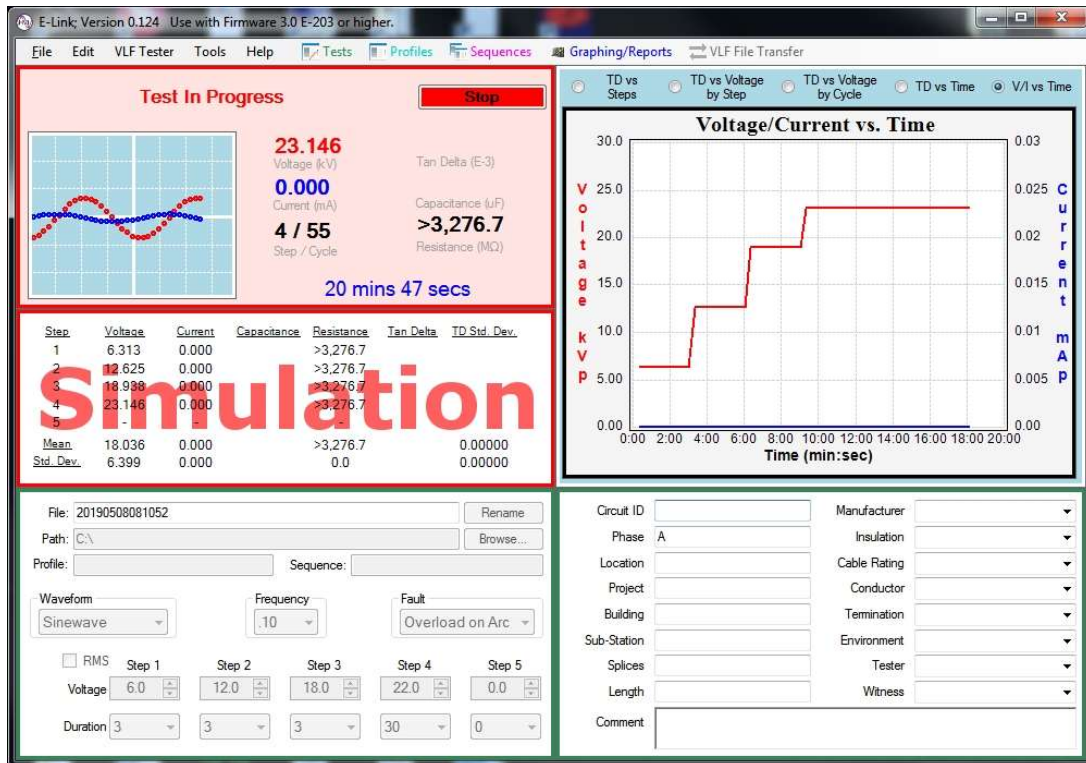
Running a Test

- Powerup the VLF if you haven't already.
- From the Main Screen, Select the Run Test icon – the screen below should appear.
- The Run Test screen contains the following windows:
 - o Oscilloscope Readout for live display of VLF voltage, current, tan delta, capacitance and resistance
 - o Logging Display of tan delta v. time, KV or step, or voltage and current v. time
 - o Status Screen w/ measurement source and signal strength indicators. VLF date and time (and synchronizing to PC date and time) may be done from this screen as well.
 - o Test File screen allows the user to set the step voltages, frequency, duration, fault behavior and filename as with Manual Mode on the VLF.
 - o Circuit Information Screen allows the entry of additional information for the test such as circuit ID, Location, cable length etc.



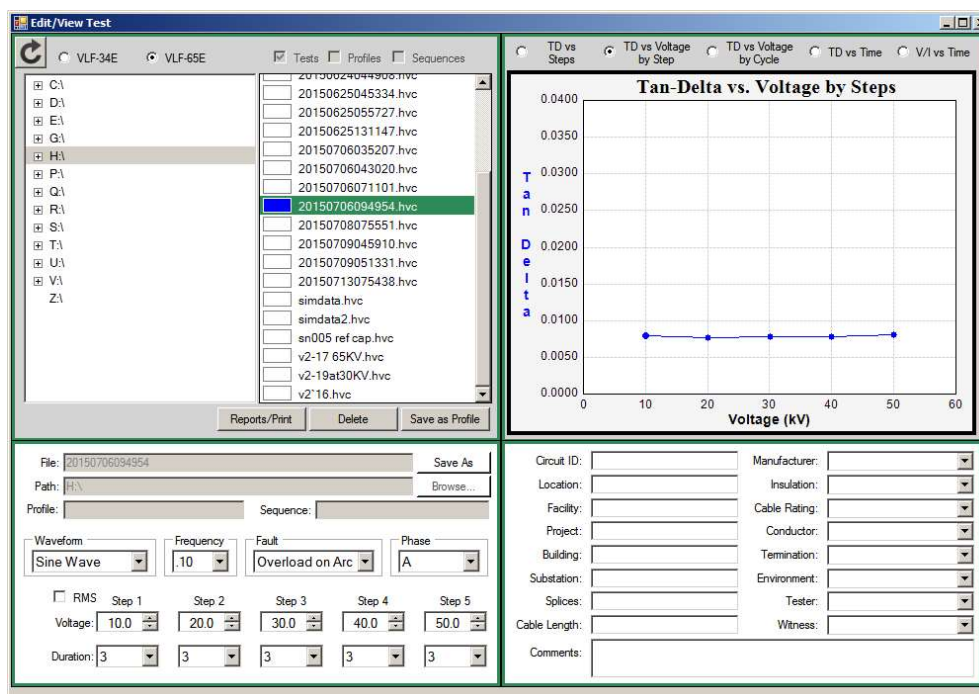
- Enter the test parameters in the Test File Screen. If you do not wish to use all 5 steps, just leave the unused ones with a '0' Duration. You can either enter a descriptive file name in the File window at this time or leave the field blank and an automatic file name based on the date and time will be created automatically.
- You are ready to start testing. Double check your test setup and safety procedures before proceeding to the next step!

- Press 'Start' in the upper right hand corner of the Oscilloscope Readout window. A 10 second countdown timer will appear and you must press Start again before this time elapses to start the test.
- After pressing start a second time, the test should begin and the Oscilloscope Readout screen will begin to update both the graphical (voltage and current) and numeric (voltage, current, step, tan delta, capacitance and resistance) displays. The Status Screen is also replaced with the Statistics Screen showing moving average data for voltage, current, capacitance, resistance and tan delta and moving standard deviation data for tan delta for each test step. The Logging Display also begins to populate with tan delta data. The radio buttons above the Display can be used to select viewing of tan delta v. time, voltage or step or voltage and current v. time



Viewing a Test

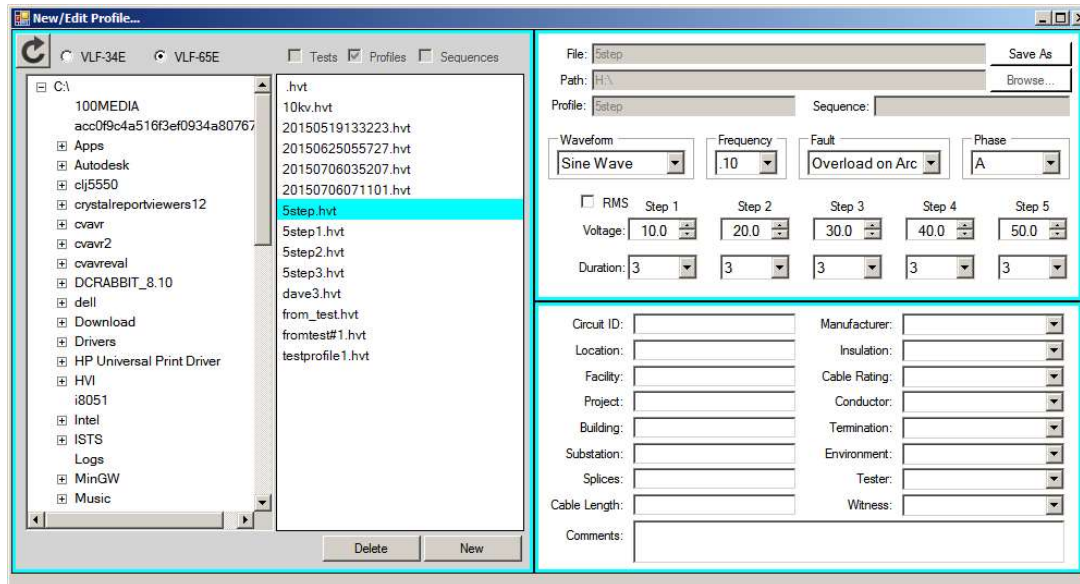
- From the E-link Main Screen, select the Test icon.
- The Edit/View Test screen has the following sections:
 - o Directory Window: select the directory where you want to look for Test files
 - o File Window: all available test files within the selected directory
 - o Graphic Display Window: display test results in tan delta v. step, voltage, cycle or time or voltage and current v. time
 - o Profile Parameter Window: Displays the parameters of the selected test
 - o Circuit Information Screen: Displays additional information for the test such as circuit ID, Location, cable length etc.
- Navigate to the directory where you wish to view the test file
- Select anywhere in the name of the file to display the test. Multiple tests may be displayed by clicking on the empty box to the left of the file name. The box will change color to indicate the selected color for that test and then more tests may be clicked. Each test is automatically assigned a new color for easy identification on the same screen.
- You can save a previously unnamed test as a profile for future reuse by clicking the Save as Profile button. The default Profile file name will be the same as the test unless overwritten by the user.



Creating a Profile

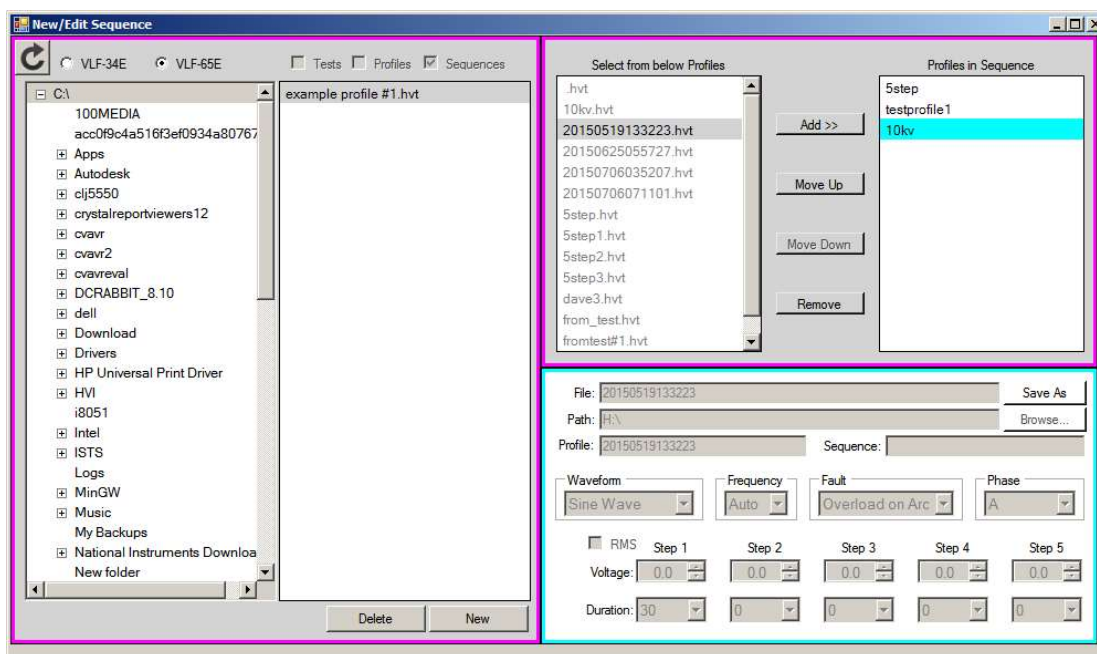
From the Main Screen, click Profiles to create (or edit) a Profile. The Directory and File Windows in this window will only show profiles (.hvt file extension) – not tests (.hvc file extension). To create a New Profile:

- Click the 'New' button, select a file name for the new Profile and populate the voltage and duration fields in the Parameters screen
- Alternatively, if you only want to slightly modify an existing Profile, select the Profile, click the Save As box and rename to a different name. Then select the new name and edit only those Profile parameters you wish to change



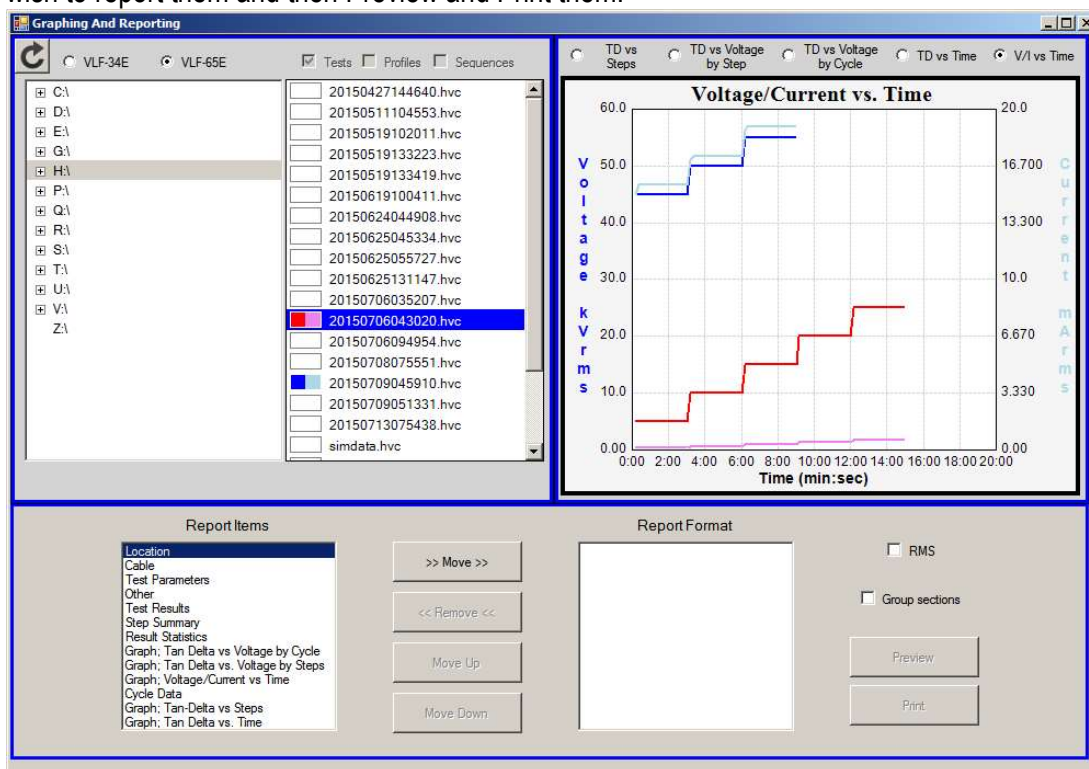
Creating a Sequence

From the Main Screen, select the Profiles icon to create or edit a Profile. As with creating profiles, the File Window will show all Sequences in the default directory (see [File Naming and Location](#) above). The Sequence Selection window to the right shows all available Profiles (again in the default directory) available for addition (or removal) from the Sequence. To create a new Sequence, click the new button and assign the new sequence a name. Then use the 'Add >>' button to copy Profiles from the left-hand screen to the Sequence list on the right. Order of the Profiles within the sequence can then be adjusted if necessary using the Move up or Move Down buttons.



Generating Reports

From the Main Screen select the Reports icon. The directory and File Windows allow selection of the test (or tests) you wish to include in the report. After the tests have been selected, use the Move>>, Move Up, Move Down and Remove buttons to populate the Report Format list with the Report Items in the order you wish to report them and then Preview and Print them.



Exporting Data

To export test files (.hvc file extension) to MS Excel or MS Access select the Export to Excel or Export to Database icons from the Main Screen. Either option will generate a standard Windows dialog box allowing you to navigate to and select the file you wish to convert. After selecting the file, click 'OK' and another dialog box will prompt you for the location of the output file. Exporting to Excel will create a .csv file type and Exporting to Database will create a .mdb file type.

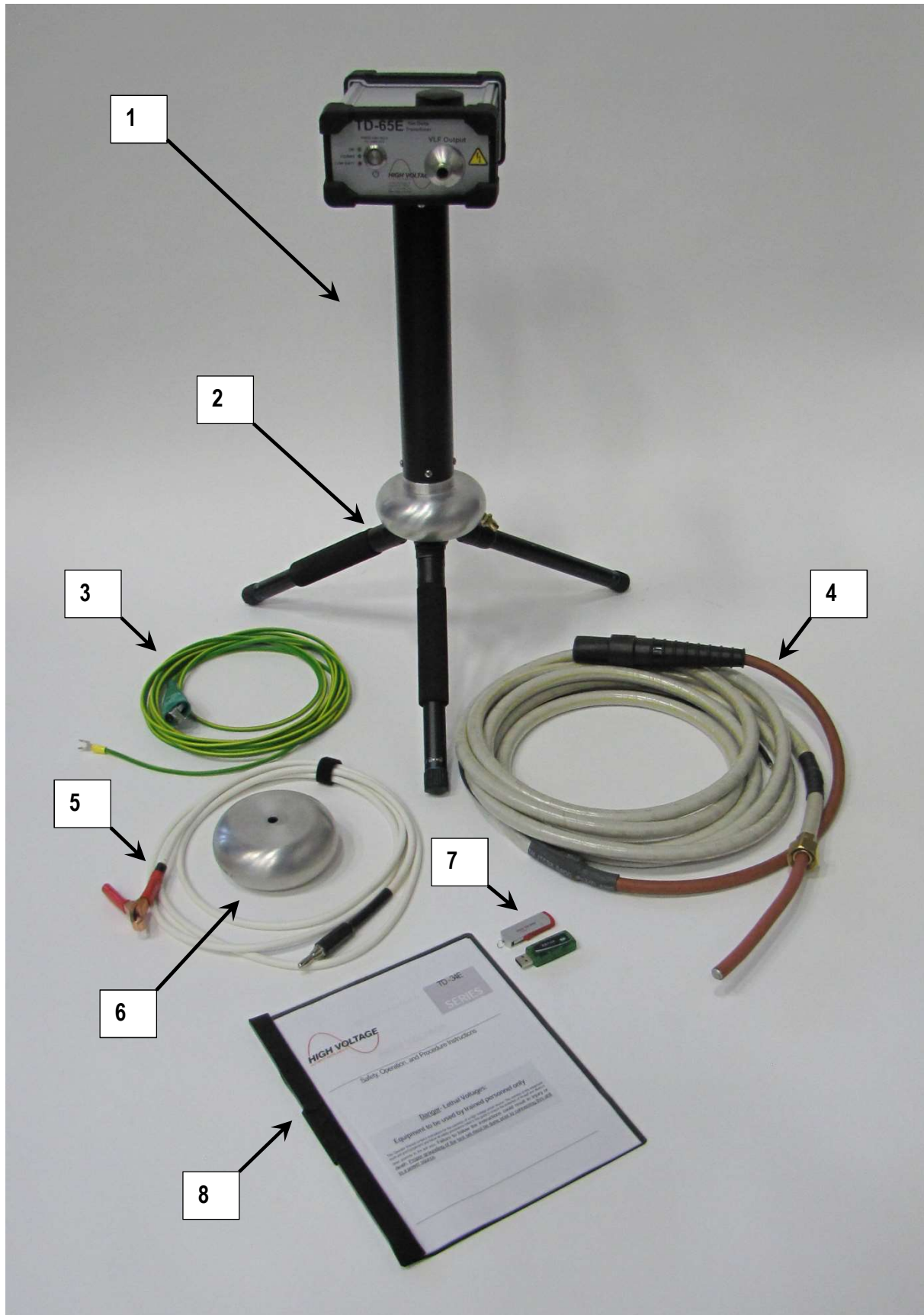
Introduction to the TD-65E

The TD-65E is a tan delta (or $\tan \delta$, loss angle, dissipation factor) transducer - a non-destructive diagnostic testing tool used to assess the condition of cable system insulation. It is designed to be used in conjunction with the HVI E series VLF power source. It is equipped with a wireless interface to communicate with the VLF.

SECTION**4**

What's in the Box?

No.	Name	Description
1	TD-65E transducer	Test instrument. See following section for Description of Controls
2	Tripod	Provides a stable base for TD-65E. Legs may be extended for additional height/compensate for uneven terrain.
3	Ground cable	10' lead for grounding tan delta instrument
4	High voltage Cable	20' long shielded cable for connecting the VLF to the TD-65E
5	Silicone wire	10' unshielded wire for connecting the Device under test to the tan delta transducer.
6	2x 5" spinning	Accessory for use in corona suppression at the connection to the test object.
7	USB Flash Drive	Contains E-link PC application software
8	Operators Manual	



Description of Controls

The controls for the instrument are identified in Figure 3 and described below.

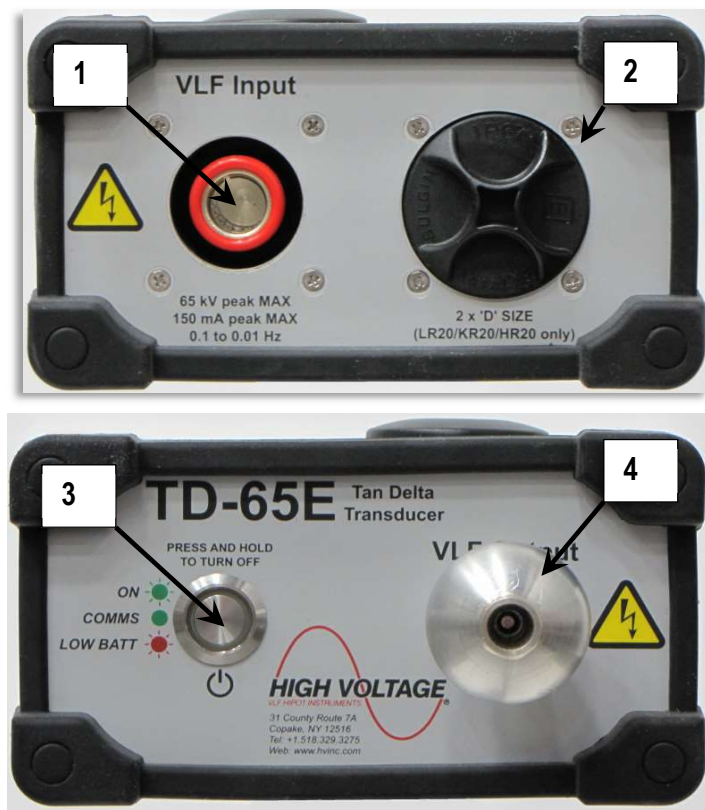


Figure 3

No.	Name	Description
1.	VLF Input	14mm MC socket connector for input from VLF unit using supplied VLF input cable
2.	Battery Compartment	Instrument power. Use 2 D cells only. Secondary cells of NiCad and NiMH may be used but may have shorter life than primary (alkaline) types. Battery positives should face outwards (towards battery lid)
3.	Power/Indicator Button	Press for 1 second to energize instrument. Holding for >3 seconds will power down instrument. Indicator LED will flash green until communications are established with the VLF unit at which point it will light green continuously. Flashing red indicates low battery state of charge (~2 hours test time left)

4. VLF Output Output connection to test object

SECTION

5

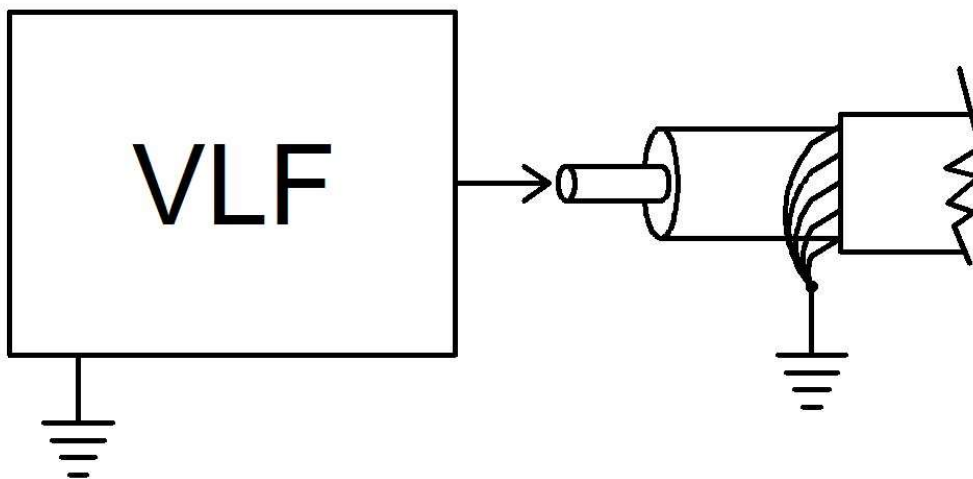
Setting Up the TD-65E

The setup of this equipment has been minimized by careful consideration of the operator during design. The **TD-65E** single-piece construction and light weight lends itself to convenient portability for AC testing in the field.

1. Remove the tripod from the TD-65E carry case and open the tripod legs. The tripod has two stop positions on the legs and it is recommended to use the low angle position for maximum stability.
2. Remove the TD-65E transducer from the carrying case and insert its base into the tripod. Tighten the tripod knob firmly to secure the transducer into the tripod.
3. Select a location for the VLF unit that will allow easy viewing of its control panel at a safe distance from the test object (within 20 ft.) on a level area. Location should be within 3 meters of an easily accessible and easily disconnected mains outlet and not block the side ventilation louvers of the VLF unit.
4. Place the TD-65E between the VLF unit and the Test Object
5. Be sure that main power switch on the front panel is off.
6. Secure a ground test lead to the ground stud on the right side of the case
7. Wire the input power cord to a grounding-type plug rated for the required voltage and power compatible to the local power receptacles.
8. Connect the input line cord (maximum length 3 meters) to mains outlet.
9. Connect the safety ground stick to a solid earth ground.
10. Insert one end of the VLF input cable into the High voltage output dry-well on the right side of the case and firmly tighten the brass collar nut to secure the cable in the well.
11. Insert the other end of the VLF Input Cable into the VLF input of the TD-65E. While holding the body of the TD-65, push the rubber boot of the cable until the shoulder of the rubber boot bottoms out against the body of the TD-65 or until a slightly audible click is heard. Test that the connection is locked by pulling back on the boot. The connector should stop when the shoulder of the boot is ~1/8" away from the body. If the connector pulls free repeat this step until it full engages. **To disconnect** the Input Cable, push the boot forward until the shoulder hits the body of the TD-65E or until the click is felt and then pull back quickly and the connector should release.

12. Attach the shield ground (ring lug) of the VLF Input Cable to the brass ground stud of the TD-65E. Attach the Fork lug end of the TD-65E Grounding Cable to the same stud and tighten firmly using the wing nut on the stud.
13. Plug the VLF Output Cable into the jack on the VLF Output of the TD-65E.
14. Connect the other (battery clamp) end of the VLF Output Cable to the Test Object. Connection to Test Object should have very little slack to prevent movement of the cable under voltage, so coil up any excess cable and secure using the provided Velcro strip.
15. Insert the EXT INTLK plug into the socket on the right side of front panel. The plug may also be wired to a normally open contact of a safety switch for added protection.

–CAUTION –
No switches or Disconnect devices in the earth conductor.
Disconnection of the protective earth conductor, will impair the protection
provided by the system



The setup of the VLF AC Test Set does not address the need for proper safety grounding of the load (test sample or cable). The grounding requirements vary for different types of tests. Please consult the local electrical codes where applicable or reference the guidelines for grounding found under **OPERATING THE EQUIPMENT**.

Operating the TD-65E

The TD-65E may be used in either Standalone (connected to the VLF unit) or in Remote (connected thru the VLF unit to a PC running E-link) mode. When running in Standalone Mode all test configurations must be made thru the VLF unit's LCD display and encoder wheel. In Remote Mode these adjustments are made using E-link with the PC display, mouse and keyboard. Whether in Standalone or Remote Mode, the VLF unit must be configured to use external (TD-65E) tan delta measurement.

Configuring the VLF unit for tan delta measurement

To configure the VLF for external tan delta measurement:

- 1.) Power up the VLF
- 2.) Press the 'Advanced' button on the VLF main screen.
- 3.) Using the scroll knob, scroll down to the 'Meas. Source' option and push downward on the scroll knob to select the option.
- 4.) Scroll down to the 'TD-65E' option and push downward on the encoder to select the option.
- 5.) Press the 'Done' button to confirm the change.

Note: this configuration is non-volatile and will persist after the VLF is powered down. If you wish to return to VLF-only operation, the above sequence must be repeated, selecting the 'VLF' (instead of 'TD-65E') option under 'Meas. Source'.

Operating in Standalone Mode

This section provides step-by-step instruction on various test methods. Many facilities have their own in-house test procedures, and this manual is not to supersede these. The purpose of this section is to explain the capabilities of this test set in real-world applications. ***Only trained personnel should attempt to operate this equipment.***

Dangerous voltages and currents are produced during the testing of cables, only trained individuals should operate this type of equipment and access to the test area must be restricted during testing to avoid endangering others.

**OPERATING THIS EQUIPMENT IN A MANNER NOT SPECIFIED BY THE
MANUFACTURER MAY IMPAIR THE PROTECTION PROVIDED BY THIS EQUIPMENT**

When testing cables, either single or three phase, there are certain extra steps that must be observed to ensure safe operation.

AC Testing of High Voltage Cables

12. Ensure that all the steps listed in [Setting up the Equipment](#) have been accomplished. Take special note to ground the test set to a solid earth ground.

Caution!!

Before making any cable connections, ensure that the cable being tested has been properly identified, de-energized, and grounded!

13. Make sure that all insulators, stress cones, and pot heads are clean and free of moisture. This will prevent flashover and minimize leakage.

Note: Be aware that any lightning arrestor or transient suppressing device must be disconnected if the clamping voltage is below the test voltage being performed. Failure to clear these devices from the cable may result in a false failure indication of the test cable.

14. Isolate the far end of the conductors under test for the test voltage; that may mean separating some of the conductors in a multi-conductor cable from each other *and* their shields.

The shields of all cables must be securely tied to ground at the nearest end of the cable.

15. Any conductors or wires in the cable or the vicinity not being tested must be grounded to avoid a buildup of charge and possible shock hazard.
16. Voltage must be applied according to specifications from the cable manufacturer or any other applicable test standards
17. Prior to connecting anything to the test sample, be sure the test sample is identified, de-energized and grounded until ready to test.
18. Connect the input power cable to a **grounded**, 50/60 Hz source as noted in **SETTING UP THE EQUIPMENT**. A generator is an acceptable power source.
19. Connect the TD-65E output lead to the test sample. Be sure that there is enough clearance to grounded objects for the expected test voltage. The minimum clearance in air is 10 kV ac/inch.

20. Clear the test area of unauthorized personnel and use safety barricades to warn others of potential danger during the high voltage test.
21. Turn on the **MAIN POWER** switch near input power receptacle.



***** CAUTION *****

**POTENTIALLY LETHAL
VOLTAGES MAY BE PRESENT**

**STORED ENERGY LEVELS IN THE CABLE GREATLY
INCREASE THE RISK OF FATAL INJURY IF CONTACT
IS MADE WITH THE LOAD WHILE AT ANY VOLTAGE.**

VLF-34E Specifications

Input	100 - 265Vac, 50/60Hz, 5A max
Output	VLF Sinewave: 0 - 34kVPeak (24kVrms), resolution: ± 0.1 kV VLF Square wave: 0 - 34kVPeak, resolution: ± 0.1 kV DC: ± 0 - 34kV (Proof Test, Sheath Test), resolution: ± 0.1 kV
Duty	Continuous
Load Rating	0.5uF @ 0.1Hz @ 34kVp, 5.0uF @ 0.01Hz @ 34kVp, calculated $1.7\text{kVp} \cdot \text{uF} \cdot \text{Hz}$. uF rating increases at lower voltages, Ex: 0.77uF @ 0.1Hz @ 22kVp
Frequency	0.01 to 0.1Hz in 0.01Hz Increments, auto-frequency detect
Metering	5.7" Color LCD display Voltage (kVp/kVrms): $\pm 1\%$ accuracy, 0.001kV resolution Current (mA _p /mA _{rms}): $\pm 1\%$ accuracy, 0.001mA resolution Calculated: Capacitance, Resistance, Flashover Voltage, and Time to Failure
Fault Response	Fault on Arc and Burn on Arc
Memory	Internal: 50 test records/External (USB Drive): Limited by media capacity
PC Interface	External USB (Firmware Upgrade Only)/XBee 802.15.4 (wireless, ~30ft range)
PC Software	E-Link remote control and report generation software
Cable Lengths	20'/6m flexible x-ray, 20'/6m test leads #10, ground hook, line cord
Size	19.7"/500mm x 12"/305mm x 18"/457mm
Weight	45 lbs., 21 kg
Storage Temp.	-20°C - 70°C (-4°F - 158°F)
Operating Temp.	-5°C - 45°C (-22°F - 113°F). (Output power derates linearly to 15% from 30°C -
Operating Humidity	80% non-condensing to 31°C, linear decrease to 50% non-condensing at 40°C
Operating Altitude	Rated power: 0 – 5000', derated 10%: >5000', derated 20%: >12,000', derated 30%: >15,000'

VLF-65E Specifications

Input	100 – 265Vac, 50/60Hz, 20A max
Output	VLF Sinewave: 0 – 65kVPeak (46kVrms), resolution: ± 0.1 kV VLF Square wave: 0 – 65kVPeak, resolution: ± 0.1 kV DC: ± 0 – 65kV (Proof Test, Sheath Test), resolution: ± 0.1 kV
Duty	Continuous
Load Rating	1.0uF @ 0.1hZ @ 65kVp, 10.0uF @ 0.01Hz @ 65kVp, calculated $6.5\text{kVp} \cdot \text{uF} \cdot \text{Hz}$ uF rating increases at lower voltages, Ex: 1.4uF @ 0.1Hz @ 47kVp
Frequency	0.01 to 0.1Hz in 0.01Hz Increments, auto-frequency detect
Metering	5.7" Color LCD display Voltage (kVp/kVrms): $\pm 1\%$ accuracy, 0.001kV resolution Current (mA/mArms): $\pm 1\%$ accuracy, 0.001mA resolution Calculated: Capacitance, Resistance, Flashover Voltage, and Time to Failure
Fault Response	Fault on Arc and Burn on Arc
Memory	Internal: 50 test records/External (USB Drive): Limited by media capacity
PC Interface	External USB (Firmware Upgrade Only)/Xbee 802.15.4 (wireless, ~30ft range)
PC Software	E-Link remote control and report generation software
Cable Lengths	20'/6m flexible x-ray, 20'/6m test leads #10, ground hook, line cord
Size	22"/559mm x 15.5"/394mm x 26"/660mm
Weight	150 lbs., 68 kg
Storage Temp.	-20°C - 70°C (-4°F - 158°F)
Operating Temp.	-5°C - 45°C (-22°F - 113°F). (Output power derates linearly to 15% from 30°C - 45°C)
Operating	80% non-condensing to 31°C, linear decrease to 50% non-condensing at 40°C
Operating Altitude	Rated power: 0 – 5000', derated 10%: >5000', derated 20%: >12,000', derated 30%:

TD-65E Specifications

Features & Operations		Specifications
Voltage Measurement	Range	1 – 65KV peak/1- 38KV rms
	Accuracy & Resolution	1% & 0.1KV peak
Current Measurement	Range	150mA peak/106mA rms
Tan d measurements	Frequency Range	0.1 Hz – 0.01Hz
	Load range	5nF – 10uF
	Accuracy & Resolution	1.0 x10 ⁻⁴ & 1x10 ⁻⁵
Communications	Type	Xbee 802.15.4 (2.4GHz)
	Range (indoor/outdoor)	100'(30m)/1000'(300m)
Power Input	type	2 x "D" cells (Alkaline or NiMH)
	Battery life	>16 hours
Dimensions	TD transducer	6"x8"x18" (152x203x457mm)
	TD transducer case	24.76" x 19.57" x 13.9" (62.9 x 49.7 x 35.3 cm)
Weight	TD transducer	10 lbs.(4.5kg)
	TD transducer + case	40 lbs. (18.1kg)
Input voltage connection	Type	Multicontact IB14AR-N (14mm socket)
Output voltage connection	Type	1/4-20 stud w/ accessories
Equipment ground connection	Type	1/4-20 stud w/ wingnut
Environmental	Operating temp	-10°C to 50°C
	Storage Temp	-25°C to 65°C
	Humidity	80% to 31°C(88°F)

Service Instructions

If factory service is required or desired, contact High Voltage, Inc. for return instructions.

Provide High Voltage, Inc. with the serial number, nature of the problem or service desired, return address, your name, and where you can be reached should the factory need to contact you.

Pack the equipment appropriately to prevent damage during shipment. It is suggested that the packaging material the unit is shipped in from the factory be retained for use in shipping the unit to the factory should the need arise.

Troubleshooting

Power Management features: The TD-65E has two internal timers that will automatically power down the unit to save battery charge. The first is an Unconnected Timeout that will power down the TD-65E if the unit is powered up but left unconnected (i.e. a VLF-65E configured for TD operation but not turned on) for over 10 minutes. The second is an Idle Timeout that will power down the unit if the TD-65E is connected to a VLF-65E but a test has not been initiated for more than 30 minutes.

Changing the PANID: The XBEE wireless interface used by the TD-65E has a large range and will conflict with other HVI XBEE products (VLF-34E, TD-34E, other PC's running E-link) if used in close proximity. In these instances, either the conflicting devices must be turned off or the Private Area Network ID (PANID) must be changed in order to allow simultaneous operation of all devices. Please consult the factory for instructions on how to do this.

Warranty

TERMS AND CONDITIONS AND LIMITED WARRANTY

Rev. 102113

High Voltage, Inc., 31 County Route 7A, Copake, NY USA 12516
Phone: (518) 329-3275 Fax (518) 329-3271 E-mail: factory@hvinc.com

THESE TERMS AND CONDITIONS OF SALE AND LIMITED WARRANTY OF HIGH VOLTAGE, INC. ("High Voltage") SHALL BE GOVERNED BY AND CONSTRUED ACCORDING TO THE INTERNAL LAWS OF THE STATE OF NEW YORK, USA, WITHOUT GIVING EFFECT TO ITS CONFLICT OF LAWS PROVISIONS. THE RIGHTS AND OBLIGATIONS OF ALL PARTIES AND ALL PERSONS OR ENTITIES CLAIMING HEREUNDER SHALL NOT BE GOVERNED BY THE PROVISIONS OF THE 1980 U.N. CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS.

1. **ACCEPTANCE.** All orders become effective only when accepted by High Voltage's written order acknowledgment at Copake, New York, USA. Unless modified in writing by an authorized representative of High Voltage, or modified in High Voltage's Quotation or order Acknowledgment, these Terms and Conditions and Limited Warranty shall solely control Purchaser's order. High Voltage expressly rejects any additional or different provisions, terms or conditions proposed by Purchaser at any time.

2. **SCHEDULING.** High Voltage's shipping date specified in High Voltage's quotation or purchase order acknowledgment is approximate and High Voltage shall use reasonable commercial efforts to effect timely shipment. Furthermore, High Voltage shall not be liable for any delay in the performance of orders or contracts or in the delivery or shipment of goods or for any damages suffered by Purchaser by reason of such delay when such delay is, directly or indirectly, caused by, or in any manner arising from Purchaser's fault, fires, floods, accidents, riots, acts of God, war, governmental interference or, embargoes, strikes, labor difficulties, shortage of labor, fuel, power, materials or supplies, transportation delays, or any other cause or causes (whether or not similar in nature to any of these hereinbefore specified) beyond the control of High Voltage.

3. **CANCELLATIONS.** Prior to shipment, Purchaser may request cancellation or delayed delivery of an order or part thereof, but such shall be conditioned upon written consent of High Voltage and upon payment to High Voltage of cancellation or delayed delivery charges to be determined by High Voltage.

4. **SALE AND DELIVERY.** Unless otherwise agreed in writing, sale and delivery of the goods hereunder shall be made EXW or FCA (Incoterms® 2010) at High Voltage's option, High Voltage's dock at Copake, New York, USA, at which time all risk of loss or damage shall pass to Purchaser. All shipments and packaging shall be made in the manner determined by High Voltage, unless otherwise requested by Purchaser, in which case any resultant additional changes and expenses shall be paid by Purchaser.

5. **TAXES.** Any and all sales, use, excise and similar taxes, and duty and all other charges levied or imposed by governmental authority, foreign and domestic, upon any goods sold or contracted to be sold shall be paid by Purchaser and added to the purchase price unless appropriate tax exemption certificates are supplied to High Voltage in form satisfactory to High Voltage.

6. PAYMENTS.

a. All payments shall be in US Dollars without discount unless otherwise specified in High Voltage's order acknowledgment. Credit card payments are accepted only if specified in High Voltage's order acknowledgment.

b. Terms of payment are net thirty (30) days from date of invoice, unless otherwise agreed by High Voltage in its order acknowledgment. Delinquent payments are subject to a service charge on the unpaid balance from invoice date

equal to the lower of 1-1/2% per month or the maximum rate permitted by law until all amounts are paid in full. If the financial responsibility of Purchaser becomes unsatisfactory to High Voltage for any reason, or if Purchaser has been in default to High Voltage under any order, High Voltage may require full payment in cash before shipment of goods.

c. If Purchaser so requests and makes arrangements prior to shipment which meet High Voltage's full satisfaction, High Voltage in its discretion may accept irrevocable letters of credit in its favor issued by a United States bank which is satisfactory to High Voltage.

7. **INFRINGEMENT, ETC.** On goods manufactured to Purchaser's specifications, Purchaser shall and does indemnify and hold High Voltage harmless against any claims, damages, liabilities, costs and expenses (including attorneys' fees) arising out of or resulting from actual or alleged infringement of patent, copyright, trademark or other proprietary rights, or claim of unfair trade or unfair competition arising from or occasioned by the use, possession, sale or delivery of any such goods sold by High Voltage.

8. **REPRODUCTION RIGHTS.** Drawings, specifications, reports, photographs and other data relating to all orders and all proprietary rights and interests therein and the subject matter thereof shall be and remain the property of High Voltage. Purchaser agrees that it shall not use High Voltage's drawings, specifications or other materials covered by this order, or any similar article from any other source, or reproduce the same or otherwise appropriate them, without the prior written authorization of High Voltage.

9. LIMITED WARRANTY.

a. High Voltage warrants to the original Purchaser of any new goods that the goods are free from defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment by High Voltage. The obligation of High Voltage under this Limited Warranty is limited, in High Voltage's exclusive option, to repair, replace with new or reconditioned parts or issue credit for goods, parts or materials which prove to be defective. Costs incurred by Purchaser for labor or other expenses to repair or replace such goods, parts and/or materials shall be the sole responsibility of Purchaser. High Voltage shall not be responsible for any damage or lack of performance resulting from: (i) defects due to accident, negligence, alteration, modification, faulty installation, abuse or misuse, whether by Purchaser, Purchaser's agents or employees, or by others than High Voltage (ii) attempted or actual dismantling, disassembly, service or repair by any person, firm or corporation not specifically authorized in writing by High Voltage, or (iii) defects caused by or due to handling by carrier, or incurred during shipment, transshipment or other move.

b. High Voltage expressly disclaims any warranty whatsoever of (i) consumables, and of (ii) parts, components, software (including but not limited to object code and source code and software user instructions), accessories, and materials not prepared, compiled or manufactured by High Voltage, and Purchaser must deal directly with such other supplier. High Voltage may elect to assist Purchaser in settling such claim against such other supplier, but any such assistance shall not prejudice High Voltage's position as to its own liability.

c. Compliance with the following Limited Warranty Claim Procedure is a condition precedent to the obligation of High Voltage under this Limited Warranty:

i. Purchaser must notify High Voltage in writing as soon as is reasonably

possible, but within the applicable warranty period, of any alleged defect in material, workmanship, or operation of any goods covered under this Limited Warranty. Such notice must describe in detail the defect, any and all defective parts, and the alleged cause of the defect. No goods may be returned to High Voltage without High Voltage's prior written permission, which permission may be withheld by High Voltage in its sole discretion.

ii. At the exclusive option of High Voltage, Purchaser may be directed in writing to dismantle the goods at the Purchaser's cost and expense and ship the goods prepaid to High Voltage (refer to "Returns" Section 10 for provisions regarding the return of any goods to High Voltage). If High Voltage elects to inspect the goods at Purchaser's site, and to repair, replace, or ship the defective goods to High Voltage's factory, Purchaser, at its own cost and expense, shall provide the facilities for such work as needed to inspect and evaluate and possibly repair/replace the goods. If inspection discloses that the defect is not one for which High Voltage is liable, then Purchaser shall promptly reimburse High Voltage for all expenses incurred.

iii. Upon receipt of the defective goods, or following access to the same, High Voltage shall inspect and evaluate the goods and determine the validity of Purchaser's claim.

iv. The validity of any warranty claim, Purchaser's compliance with the Limited Warranty and Limited Warranty Claim Procedure, and the obligation to replace, repair, or issue credit for any goods are solely and exclusively to be determined by High Voltage and any determination shall be final and binding.

d. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, STATUTORY OR EXPRESSED OR IMPLIED ON THE PART OF HIGH VOLTAGE, INCLUDING THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT; FURTHERMORE, HIGH VOLTAGE MAKES NO WARRANTY REGARDING NON-INTERRUPTION OF USE OR SOFTWARE FREEDOM FROM BUGS. HIGH VOLTAGE NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON, FIRM, OR CORPORATION TO ASSUME ANY LIABILITY OR OBLIGATION IN CONNECTION WITH THIS SALE OR LIMITED WARRANTY ON HIGH VOLTAGE'S BEHALF AND PURCHASER ACKNOWLEDGES THAT NO REPRESENTATION EXCEPT THOSE MADE HEREIN HAS BEEN MADE TO PURCHASER.

10. **RETURNS.** No goods may be returned to High Voltage without High Voltage's prior written permission, which permission may be withheld by High Voltage in its sole discretion. Any request for return authorization must be in writing and include, as applicable, model number, serial number, part number, reason for return, alleged defect, and apparent cause of alleged defect. Except as specifically provided in Section 9 Limited Warranty, if High Voltage consents to return of goods: (a) all return shipments are to be via prepaid freight and with all other charges prepaid, (b) if goods are returned to High Voltage within sixty (60) days from the date of original shipment for reasons other than an error by High Voltage in filling the Purchaser's order, Purchaser shall only be entitled to receive a credit in an amount equal to the payment received by High Voltage for the goods minus (i) handling charges, and (ii) a restocking fee determined solely by High Voltage which shall not exceed twenty five percent (25%) of the invoiced amount, and (c) if goods are returned to High Voltage after sixty (60) days from the date of original shipment for reasons other than an error by High Voltage in filling the Purchaser's order, Purchaser shall only be entitled to receive a credit in the amount equal to the payment received by High Voltage for the goods minus (x) a handling fee, and (y) a restocking fee in excess of twenty five percent (25%) which shall be determined by High Voltage.

11. **SECURITY INTEREST.** In order to induce High Voltage to ship goods without full payment, Purchaser grants a security interest to High Voltage in any and all of Purchaser's right, title and interest in the goods, and Purchaser agrees to comply with any reasonable request of High Voltage to perfect such security interest. Purchaser hereby further authorizes High Voltage to perfect High Voltage's security interest in said goods and consents to filing one or more financing statements

without the signature of Purchaser.

12. **ARBITRATION.** Any controversy arising out of or relating to this document, or any breach thereof, including, without limitation, any claim that this document is voidable or void, shall be submitted to final and binding arbitration before, and in accordance with, the Commercial Rules of the American Arbitration Association then in effect, and judgment upon the award may be entered in any court have jurisdiction thereof; provided, however, that this clause shall not be construed to limit any rights which High Voltage may have to apply to any court of competent jurisdiction for equitable, injunctive or provisional relief. This arbitration provision shall be deemed self-executing, and in the event that either party fails to appear at any properly noticed arbitration proceeding, an award may be entered against such party notwithstanding said failure to appear. Such arbitration shall be conducted before a single arbitrator under the aegis of the American Arbitration Association in Columbia County, State of New York. The arbitrator shall have the authority to award expenses to the successful party.

13. **LIMITATION OF LIABILITY.** TO THE MAXIMUM EXTENT PERMITTED UNDER APPLICABLE LAW, AND NOTWITHSTANDING ANYTHING ELSE IN THIS DOCUMENT OR OTHERWISE, INCLUDING THAT HIGH VOLTAGE WAS WARNED THAT DAMAGES WOULD OCCUR OR WERE LIKELY TO OCCUR, HIGH VOLTAGE SHALL NOT BE LIABLE WITH RESPECT TO ANY SUBJECT MATTER OF THIS DOCUMENT UNDER ANY CONTRACT, NEGLIGENCE, STRICT LIABILITY OR OTHER LEGAL OR EQUITABLE THEORY FOR (i) ANY AMOUNTS IN EXCESS IN THE AMOUNT PAID TO HIGH VOLTAGE FOR THE PARTICULAR GOODS OR PART THEREOF WHICH GAVE RISE TO THE APPLICABLE CAUSE OF ACTION OR CLAIM, OR (ii) ANY INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOST PROFITS OR LOST OR CORRUPTED DATA, OR (iii) COST OF PROCUREMENT OF SUBSTITUTE GOODS, SOFTWARE, TECHNOLOGY OR SERVICES. HIGH VOLTAGE SHALL HAVE NO LIABILITY FOR ANY FAILURE OR DELAY DUE TO MATTERS BEYOND ITS REASONABLE CONTROL.

14. **SEVERABILITY.** These Terms and Conditions and Limited Warranty are the entire understanding between Purchaser and High Voltage with respect to the subject matter hereof and supersede all prior agreements, dealings and negotiations. No modification, alteration or amendment shall be effective unless made in writing and signed by a duly authorized representative of High Voltage. No waiver of any breach hereof shall be held to be a waiver of any other or subsequent breach. Nothing contained in this document shall be construed as requiring the commission of any act contrary to law. Whenever there is any conflict between any provision of this document and any present or future statute, ordinance or regulation contrary to which the parties have no legal right to contract, the latter shall prevail, but in such event the provision of this document thus affected shall be curtailed and limited only to the extent necessary to bring it within the requirements of the law. In the event that any part, article, section, paragraph, sentence or clause of this document shall be held to be indefinite, invalid or otherwise unenforceable, the entire document shall not fail on account thereof, and the balance of the document shall continue in full force and effect. If any arbitration tribunal or court of competent jurisdiction deems any provision hereof (other than for the payment of money) unreasonable, said arbitration tribunal or court may declare a reasonable modification thereof, and this document shall be valid and enforceable, and the parties hereto agree to be bound by and perform the same as thus modified.

15. **BASIS OF BARGAIN.** Each party recognizes and agrees that the warranty disclaimers and liability and remedy limitations in this document are material, bargained for bases of their agreement and that they have been taken into account and reflected in determining the respective obligations of the parties.

[End]

Returned Material

If for any reason it becomes necessary to return any equipment or materials to High Voltage, Inc., the Service Department of High Voltage, Inc. must be notified, and authorization received, prior to the shipment of the equipment. When notified, the following information must be provided:

MODEL:

SERIAL NO:

PART NO:

REASON FOR RETURN:

SUSPECTED DEFECT:

CAUSE OF DEFECT:

With the above information provided, High Voltage, Inc. will determine if the return of the equipment is appropriate. If deemed appropriate, a Return Authorization Number will be issued. At that time, the Purchaser will be instructed how to mark and return the equipment.

The above procedure must be adhered to in order to ensure prompt service. No equipment should be returned without the prior knowledge and authorization of High Voltage, Inc.

Revision History

Version	Comments
1.0	Initial Release
1.1	Removed X-stick from 'What's In The Box' (included w/ VLF)
1.2	Corrected VLF-34,65E metric dimensions
1.3	Added environmentals

[illegible]



THE WORLD'S SOURCE FOR HIGH VOLTAGE TEST EQUIPMENT

ADVANCED TEST EQUIPMENT FOR HIGH VOLTAGE PROOF AND PREVENTIVE MAINTENANCE TESTING OF ELECTRICAL APPARATUS

DC Hipot/Megohmmeter Test Sets



Two Testers in One

600 kVDC @ 5mA

80 kVdc
10 mA

100 kVdc
10 mA

**Top DC
Bucket Truck Tester

AC Hipots - Field Portable



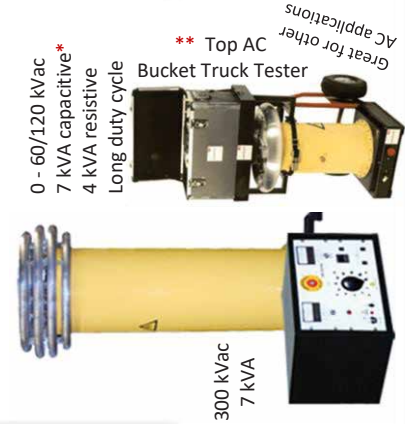
30 kVac @ 1 kVA

50 kVac @ 3 kVA
Cable Output **
Only 1 piece

100 kVac @ 3 kVA

Built for Field Use
Portable
Affordable
Rugged & Reliable
Easily Serviceable

Aerial Lift Test Sets - AC



0 - 60/120 kVac
7 kVA capacitive*
4 kVA resistive
Long duty cycle

300 kVac
7 kVA

Bucket Truck Tester
Great for other
AC applications
** Top AC

Oil Dielectric Testing



Standard & Micro Controlled
60 kVac & 100 kVac models

60 kVac
.5/2/3 kV/sec
Digital Display
Fully Programmable
Panel Printer

Very Low Frequency AC Technology

Cables & Motors/Generators
0.1 - 0.01 Hz up to 200 kVac

VLF Withstand
VLF TD & VLF PD



200 kVac peak - sine wave
0.1 - 0.02 Hz to 3.75 uF
90 kVac peak - sine wave
0.1 - 0.02 Hz to 2.75 uF
30 kVac
0.4 uF

Many more models avail.



** New Solid State Design
34 kV peak - sine wave
0.1 - 0.01 Hz to 7 uF

Wind Farm Model

50/60 Hz AC Dielectric Test Equipment: 5 kVA - 50 kVA

AC Testing of High Capacitance Loads - up to 300 kVac



5 kVac @ 1 A
Motor Testing

10 kVac @ 10 kVA
Low PD < 10 pc

100 kVac
10 kVA
PD < 10 pc

Concentric Neutral Resistance Tester

Ω-CHECK™



HV Dividers

150 kV AC/DC
300 kV AC/DC



VLF Diagnostic Cable Testing

Tan Delta & Partial Discharge



TDB-60 0 - 60 kVac

TD-34E
0-34 kV

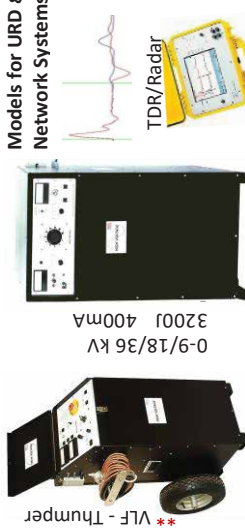
TD/34E
0-34 kV

TD/34E
0-34 kV

TD/34E
0-34 kV

Capacitor Discharge Systems - Thumpers

Three Full Joule Outputs - VLF/Thumper Combo



** VLF - Thumper

0-9/18/36 kV
3200J 400mA

Models for URD &
Network Systems

TDR/Radar

* Van Package *

