

The logo consists of the letters 'HVZI' in a large, bold, grey, 3D-style font. The letters are set against a background image of a control panel. On the left, there is a 'CURRENT METER' with a dial and labels 'X100', 'X10', 'X1', and '250'. In the center, there is a red 'STOP' button and a label 'OUTPUT ADJUST'. On the right, there is a digital display showing '0.00'. A registered trademark symbol (®) is located to the right of the letter 'I'.

HVZI®

HIGH VOLTAGE, INC.
VERY LOW FREQUENCY AC HIPOT TEST SETS
VLF SERIES AND E-SERIES PRODUCT CATALOG

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For further information and to see our complete product line, please visit www.hvinc.com

VERY LOW FREQUENCY AC HIPOT TESTERS - DELIVERING SEAMLESS CABLE TESTING EFFICIENCY

HVI is the world's source for VLF hipot test sets with units in over 100 countries and proudly made in the USA. The High Voltage Inc. line of portable and affordable VLF hipots are designed to AC field test highly capacitive loads, particularly cables and rotating machinery. High Voltage Inc. offers a full line of VLF AC Hipots from 30 kVac to 200 kVac peak. Some models can test up to 50 μF of load or approximately 50 miles of cable, and the largest of generators or motors. VLF is used for AC withstand testing and as a voltage source for Tan Delta and Partial Discharge Diagnostic Testing. HVI offers both its original, patented, long proven oil filled power supply models with analog controls and its all new solid state computer and microprocessor controlled design with wireless communication.

SINCE 1998, HVI has produced the most economical, rugged, and reliable VLF products available. Our electro-mechanical control and our oil filled HV power supply designs are extremely dependable, and easy to service in the field if necessary. The HVI design has a proven record with well over 2000 units in service worldwide.

SINCE 2010, HVI has produced the E-Series generation of VLF AC hipots using an air-cooled, solid state design with microprocessor control. High end features include user programmable test profiles/ sequences, wireless communications to a user supplied PC, data retrieval and manual or automatic load based output frequency selection. The supplied E-Link PC software offers wireless remote operation, custom report generation, and test data export to .csv. Wireless communication between an E-Series VLF and the optional TD-65E Tan Delta Bridge, and/or user supplied PC is achieved via the XBee protocol which offers more reliability than Bluetooth.



CE

VLF-30CM(F)

Very Low Frequency General Info

What is VLF?

VLF stands for Very Low Frequency. HVI VLF products provide sinusoidal AC voltage but at 0.1 Hz - 0.01 Hz, compared to the 50/60 Hz output of conventional AC test sets. It is still an AC voltage with sinusoidal polarity reversals every half cycle. The VLF instrument is used to provide a simple pass/ fail withstand test. VLF instruments can be used as the voltage source for performing off-line Partial Discharge and Tan Delta cable diagnostic testing, both available from HVI.

Why VLF?

VLF test sets are used to field test high capacitance loads such as cables and motors/generators. The lower the frequency of an AC source, the lower the current and power required to energize a capacitive load. At 0.1 Hz, it requires 600 times less power to test a cable than at 60 Hz. The HVI VLF instruments permit users to field test long cables and large generators with a portable and affordable test set. A 100 lb VLF instrument can do the job of a multi-ton 60 Hz AC test set. AC Cable testing can be done with HVI VLF products in a practical, economical, and easy to use package.

When and Where Is VLF Used – Cable & Rotating Machinery

The principal use of VLF is testing medium and high voltage shield power cables. A long cable may have many microfarads of capacitance therefore, VLF technology is used to verify the insulation integrity of a cable. If the cable can't withstand 2-3 times normal voltage, it is not healthy and an in-service failure is likely. Defects in the cable insulation big enough to be excited by the VLF voltage applied will grow to failure during a Withstand Test. Find the fault, make the repair or replacement and be left with a healthier cable. Some of the world standards that define VLF testing are IEEE 400, 400.2, & 433, VDE 0276, CENELEC HD 620/621, SANA 10198, NEN 3620 and IEC 60502-2.

VLF is also very useful for testing large rotating machinery, since it provides a portable and affordable method of field-testing coils and is sanctioned by the IEEE 433-2009 standard.



Benefits of using HVI VLF AC Hipots

- Portable and affordable
- All models feature a true sinewave output
- Waveform is independent of load capacitance between 0.01 μF and maximum load for VLF Series
- E-Series VLF units have no minimum load
- Highest load ratings available
- Highest voltage models available, 30 to 200kV peak
- Simple and easy operation
- AC testing does not degrade good cable insulation
- Harmful space charges are not injected into the cable insulation
- No traveling waves are generated
- BNC scope output for waveform viewing
- Rugged and reliable designs less prone to failure from transients

Two Design Choices

Original patented, electro-mechanical, transformer designs and the latest solid-state microprocessor-controlled designs, both are available from HVI.

Rugged Oil Filled HV Sections with Electro-mechanical Controls

The HVI VLF design offers the best of everything, with manual, easy to use controls but also sophisticated data collection. Electric utilities and industrials have long recognized the benefit of our technology. HVI knows how to build long lasting field test equipment. Models range from 30kV peak to 200kV peak. HVI also manufactures specialty models with very high load rating for testing extremely long lengths of cables commonly found in windfarm, solar, or subsea applications.

HVI also offers the latest in solid state design VLF units that offer many benefits, like automatic programmable controls, wireless communication and report generation. See our VLF E-Series for more details.

Original Patented Transformer Based Design*

- | | |
|----------------|--|
| • VLF-30CM | 0-30 kVac, 0.1 Hz, load rated to 0.4 μF |
| • VLF-4022CM | 0-44 kVac, 0.1 Hz - 0.02 Hz, load rated to 5.5 μF |
| • VLF-50CMF | 0-50 kVac, 0.1 Hz - 0.01 Hz, load rated to 50 μF |
| • VLF-6022CM | 0-62 kVac, 0.1 Hz - 0.02 Hz, load rated to 5.5 μF |
| • VLF-65CMF | 0-65 kVac, 0.1 Hz - 0.01 Hz, load rated to 22 μF |
| • VLF-90CMF | 0-90 kVac, 0.1 Hz - 0.02 Hz, load rated to 2.75 μF |
| • VLF-12011CMF | 0-120 kVac, 0.1 Hz - 0.01 Hz, load rated to 5.5 μF |
| • VLF-140CMF | 0-140 kVac, 0.1 Hz - 0.02 Hz, load rated to 7.5 μF |
| • VLF-200CMF | 0-200 kVac, 0.1 Hz - 0.02 Hz, load rated to 3.75 μF |

***values are peak voltage**

Features and Benefits

- Sine wave output at 0.1, 0.05 and 0.02 Hz frequencies standard. Some offered with 0.01Hz
- Continuously adjustable output voltage
- Continuous duty rating
- Fixed thermal circuit breaker overload
- “Zero Start” and External Interlock provision
- Single-range voltmeter
- Single -range Current/Capacitance meter
- VLF-30CM comes as single-piece design
- VLF-4022CM, VLF-6022CM, VLF-90CMF come as Two-piece portable design
- VLF-50CMF, VLF-65CMF, and VLF-120CMF come on 4 wheel push cart
- Transit protected meter prevents damage between test sites
- Ground stick provided for increased operator safety. Can be used to safely connect the unit and the test load to ground before and after test

High Voltage Section Configurations



Cable Output

Shielded output cables are standard on models rated 120kV peak and below.



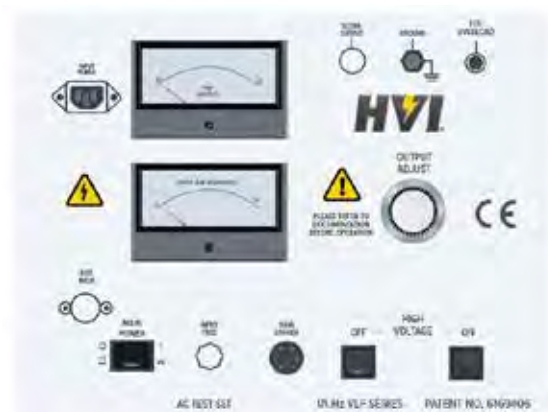
Toroidal Output

Toroidal dish on oil filled porcelain bushing.

Controls and Configuration

VLF-30CM

- Sine wave output at 0.1Hz
- Continuously adjustable output voltage
- Fixed thermal circuit breaker overload
- Single-range center “0” voltmeter
- Single -range Current meter
- Transit protected meter prevents damage between test sites
- Zero start safety interlock
- External interlock provisions



VLF-4022CM

- Sine wave output at 0.1Hz, 0.05Hz, and 0.02Hz
- Continuously adjustable output voltage
- Fixed thermal circuit breaker overload
- Single-range center “0” voltmeter
- Single -range Current/Capacitance meter
- Transit protected meter prevents damage between test sites
- Zero start safety interlock
- External interlock provisions



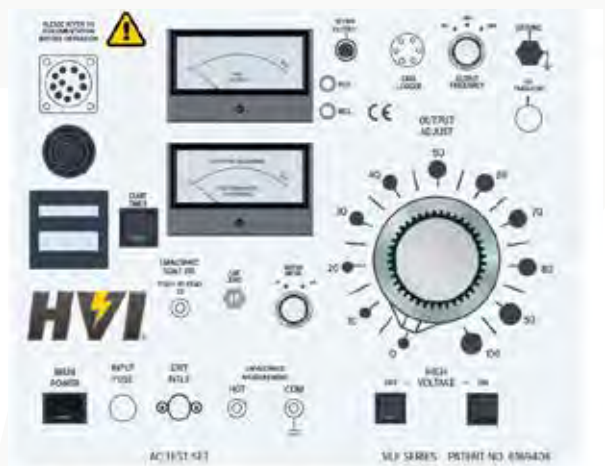
VLF-50CMF, VLF-65CMF, and VLF-12011CMF

- Sine wave output at 0.1Hz, 0.05Hz, 0.02Hz, and 0.01Hz
- Continuously adjustable output voltage
- Fixed thermal circuit breaker overload
- Single-range voltmeter with polarity indication
- Single -range Current/Capacitance meter
- Transit protected meter prevents damage between test sites
- Built in test duration timer with alarm
- Zero start safety interlock
- External interlock provisions



VLF-6022CM and VLF-90CMF

- Sine wave output at 0.1Hz, 0.05Hz, and 0.02Hz
- Continuously adjustable output voltage
- Fixed thermal circuit breaker overload
- Single-range voltmeter with polarity indication
- Single -range Current/Capacitance meter
- Transit protected meter prevents damage between test sites
- Built in test duration timer with alarm
- Zero start safety interlock
- External interlock provisions



VLF-140CMF and VLF-200CMF

- Sine wave output at 0.1Hz, 0.05Hz, and 0.02Hz
- Continuously adjustable output voltage
- Fixed thermal circuit breaker overload
- Single-range voltmeter with polarity indication
- Single -range Current/Capacitance meter
- Transit protected meter prevents damage between test sites
- Built in test duration timer with alarm
- Built in ADL-1 Automatic Data Logger for Voltage and Current vs Time test data
- Zero start safety interlock
- External interlock provisions



VLF Series Specifications

All HVI VLF designs produce a sine wave output that meets the requirements of world standards, permitting it to be used as a voltage source for Tan Delta and Partial Discharge diagnostic testing.

All HVI equipment is built and serviced in the USA at HVI. All products and parts are kept in stock and quick turnaround is guaranteed.



VLF Series Specifications



VLF-30CM



VLF-4022CM

	VLF-30CM	VLF-4022CM
Input:	120 Vac, 7A, 50/60 Hz (VLF-30CM) 230 Vac, 3A, 50/60 Hz (VLF-30CMF)	120 Vac, 10A, 50/60 Hz (VLF-4022CM) 230 Vac, 6A, 50/60 Hz (VLF-4022CMF)
Output:	Sinusoidal 0 - 30 kVac peak, 0.1Hz frequency	Sinusoidal 0 - 44 kVac peak, 0.1, 0.05, and 0.02 Hz frequency
Duty:	Continuous	Continuous
Max Test Capacitance:	0.4 μ F @ 0.1 Hz Minimum capacitance to achieve full output- .005 μ F	1.1 μ F @ 0.1 Hz, 2.2 μ F @ 0.05 Hz, 5.5 μ F @ 0.02 Hz Minimum capacitance to achieve full output- .01 μ F
Voltmeter:	3.5 in. Analog, Center Zero, -30 - 0 - +30 kV peak, +/- 2% Accuracy	3.5 in. Analog, Center Zero, -45 - 0 - +45 kV peak, 2% Full-scale Accuracy
Current Meter:	3.5 inch Analog, 0 - 50mA peak, +/- 2% Accuracy	3.5 inch Analog, 0 - 100mA peak, 5 - 0 uF, +/- 5% Accuracy
Size & Weight:	14.25 x 11.25 x 21.75in., 85lb. 362 x 286 x 552mm, 39kg	Control: 22 x 11.25 x 15 in., 50 lb. 559 x 286 x 387 mm, 23 kg HV Section: 14.5 x 10.5 x 19 in., 72 lb. 368 x 267 x 483 mm, 33 kg
Output Termination:	20ft. RG8U shielded XLPE cable with Alligator Clamp	20ft. RG8U shielded XLPE cable with Alligator Clamp
Scope of Supply:	20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate	Accessory bag, 10ft. interconnect cable, 20ft. green/yellow ground lead, 20ft. red test lead, 20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate

VLF Series Specifications



VLF-50CMF



VLF-6022CM

	VLF-50CMF	VLF-6022CM
Input:	230Vac +/- 10%, 30A peak, 25A avg, 50/60Hz Sinusoidal power required for full output	120 Vac, 15A, 50/60 Hz (VLF-6022CM) 230 Vac, 8A, 50/60 Hz (VLF-6022CMF)
Output:	Sinusoidal 0 - 50 kVac peak, 0.1, 0.05, 0.02 and 0.01 Hz frequency	Sinusoidal 0 - 62 kVac peak, 0.1, 0.05, and 0.02 Hz frequency
Duty:	Continuous	Continuous
Max Test Capacitance:	5.0 μ F @ 0.1 Hz, 10.0 μ F @ 0.05 Hz, 25.0 μ F @ 0.02 Hz, 50.0 μ F @ 0.01 Hz Minimum capacitance to achieve full output- .01 μ F	1.1 μ F @ 0.1 Hz, 2.2 μ F @ 0.05 Hz, 5.5 μ f @ 0.02 Hz Minimum capacitance to achieve full output- .01 μ F
Voltmeter:	3.5 in. Analog, 0 - 60 kV peak, 2% Full-scale Accuracy	3.5 in. Analog, 0 - 65 kV peak, 2% Full-scale Accuracy
Current Meter:	3.5 inch Analog, 0 - 200mA peak, 6 - 0 uF, +/- 5% Accuracy	3.5 inch Analog, 0 - 100mA peak, 5 - 0 uF, +/- 5% Accuracy
Size & Weight:	Complete Trolley: 28 x 60 x 51in., 775lb. 711 x 1524 x 1295mm, 352kg	Control: 26 x 13 x 16 in., 75 lb. 660 x 330 x 406 mm, 34 kg HV Section: 15 x 11 x 21.5 in., 120 lb. 381 x 280 x 546 mm, 54 kg
Output Termination:	100ft. shielded EPR cable on reel with MC connector and vicegrip adapter	20ft. shielded EPR cable with Alligator Clamps
Scope of Supply:	4 wheel trolley, interconnect cables, 100ft. ground lead on reel, 20ft. red test lead, 20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate	10ft. interconnect cables, 20ft. green/ yellow ground lead, 20ft. red test lead, 20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate



VLF-65CMF



VLF-90CMF

VLF-65CMF

VLF-90CMF

Input: 230Vac +/- 10%, 30A peak, 20A avg, 50/60Hz
Sinusoidal power required for full output

230Vac +/- 10%, 15A peak, 50/60Hz
Sinusoidal power required for full output

Output: Sinusoidal 0 - 65 kVac peak, 0.1, 0.05, 0.02
and 0.01 Hz frequency

Sinusoidal 0 - 90 kVac peak, 0.1, 0.05,
and 0.02 Hz frequency

Duty: Continuous

Continuous

Max Test Capacitance: 2.2µF @ 0.1 Hz, 4.4µF @ 0.05 Hz, 11µF @ 0.02
Hz, 22µF @ 0.01 Hz
Minimum capacitance to achieve full
output- .01µF

0.55µF @ 0.1 Hz, 1.1µF @ 0.05 Hz, 2.75µF
@ 0.02 Hz
Minimum capacitance to achieve full
output- .01µF

Voltmeter: 3.5 in. Analog, 0 - 75 kV peak,
2% Full-scale Accuracy

3.5 in. Analog, 0 - 100 kV peak,
2% Full-scale Accuracy

Current Meter: 3.5 inch Analog, 0 - 200mA peak, 6 - 0 uF,
+/- 5% Accoracy

3.5 inch Analog, 0 - 100mA peak, 5 - 0 uF,
+/- 5% Accoracy

Size & Weight: Complete Trolley: 28 x 60 x 51in., 775lb.
762 x 1524 x 1295mm, 309kg

Control: 26 x 13 x 16in., 75lb.
660 x 330 x 406 mm, 34 kg
HV Tank: 15 x 21 x 29 in., 293 lb.
381 x 533 x 686 mm, 133 kg

Output Termination: 100ft. shielded EPR cable on reel with
MC connector and vicegrip adapter

20ft. shielded EPR cable with Alligator
Clamps

Scope of Supply: 4 wheel trolley, 10ft. interconnect cables,
100ft. ground lead on reel, 20ft. red test lead,
20ft. black test lead, safety ground stick,
external interlock plug, operations manual,
calibration certificate

10ft. interconnect cables, 20ft. green/
yellow ground lead, 20ft. red test lead,
20ft. black test lead, safety ground stick,
external interlock plug, operations manual,
calibration. Optional Handcart
HC-VLF90 shown above.

VLF Series Specifications



VLF-12011CMF



VLF-140CMF

VLF-12011CMF

VLF-140CMF

Input:	230Vac +/- 10%, 30A peak, 50/60Hz Sinusoidal power required for full output	230Vac, 80A peak, 50/60Hz Sinusoidal power required for full output
Output:	Sinusoidal 0 - 120 kVac peak, 0.1, 0.05, 0.02 and 0.01 Hz frequency	Sinusoidal 0 - 140 kVac peak, 0.1, 0.05, 0.02 Hz frequency
Duty:	Continuous	Continuous
Max Test Capacitance:	0.55 μ F @ 0.1 Hz, 1.1 μ F @ 0.05 Hz, 2.2 μ F @ 0.02 Hz, 5.5 μ F @ 0.0 1Hz Minimum capacitance to achieve full output- .01 μ F	1.5 μ F @ 0.1 Hz, 3 μ F @ 0.05 Hz, 7.5 μ F @ 0.02 Hz Minimum capacitance to achieve full output- 0.005 μ F
Voltmeter:	3.5 in. Analog, 0 - 120 kV peak, 2% Full-scale Accuracy	3.5 in. Analog, 0 - 150 kV peak, 2% Full-scale Accuracy
Current Meter:	3.5 inch Analog, 0 - 100mA peak, 5 - 0 uF, +/- 5% Accuracy	3.5 inch Analog, 0 - 200mA peak, 5 - 0 uF, +/- 5% Accuracy
Size & Weight:	Complete Trolley: 30 x 60 x 51in., 853lb. 762 x 1524 x 1295mm, 388kg	Control: 23 x 30 x 62 in., 750 lb. 584 x 762 x 1575 mm, 340 kg HV Tank: 61 x 37 x 61 in., 2555 lb. 1550 x 940 x 1550 mm, 1160 kg
Output Termination:	100ft, shielded EPR cable on reel. External limit resistor and alligator clamp.	Oil Filled Porcelain Apparatus Bushing, 250kV BIL Rating
Scope of Supply:	4 wheel trolley, interconnect cables, 100ft. ground lead on reel, 20ft. red test lead, 20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate	Interconnect cables, 100ft ground lead on reel, data logger built in, 20ft. red test lead, 20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate



VLF-200CMF

VLF-200CMF

Input: 230Vac, 80A peak, 50/60Hz
Sinusoidal power required for full output

Output: Sinusoidal 0 - 200 kVac peak, 0.1, 0.05, 0.02 Hz frequency

Duty: Continuous

Max Test Capacitance: 0.75 μ F @ 0.1 Hz, 1.5 μ F @ 0.05 Hz, 3.75 μ F @ 0.02 Hz
Minimum capacitance to achieve full output- 0.005 μ F

Voltmeter: 3.5 in. Analog, 0 - 200 kV peak, 2% Full-scale Accuracy

Current Meter: 3.5 inch Analog, 0 - 200mA peak, 5 - 0 uF, +/- 5% Accuracy

Size & Weight:

Control:	23 x 30 x 62in., 750lb. 584 x 762 x 1575 mm, 340 kg
HV Tank:	59 x 37 x 87 in., 3300 lb. 1500 x 940 x 2210 mm, 1497 kg

Output Termination: Oil Filled Porcelain Apparatus Bushing, 350kV BIL Rating

Scope of Supply: Interconnect cables, 100ft ground lead on reel, data logger built in, 20ft. red test lead, 20ft. black test lead, safety ground stick, external interlock plug, operations manual, calibration certificate

VLF E-SERIES MODERN SOLID-STATE VLF HIPOTS WITH MICROPROCESSOR CONTROL AND WIRELESS COMMUNICATION CAPABILITY

The E-Series VLF Test Sets from HVI are the newest generation of VLF hipots that use a dry-type, air cooled, solid-state design with microprocessor control. Better design equals better results!

The test programming, numerous output functions, wireless communications, and data retrieval are intuitive and easy to learn. They are lightweight, portable, affordable, and built for the rigors of field use, like all HVI products. The use of the XBee protocol over Bluetooth has the benefit of stronger signal connection allowing a longer communication distance, less signal interference from other common wireless devices, and works in more signal-sensitive areas which translates to less dropped connections while testing. Models range from 34 kVac peak to 65kV peak meeting world standards for Acceptance Testing up to 35 kV class cable. Its sine wave output is suitable for using optional Tan Delta or Partial Discharge measurement systems, like the HVI TD-65E Tan Delta System. HVI E-Series VLF and accessories are everything needed to perform diagnostic and withstand testing of cables rated to 35kV.

Solid State with Microprocessor Controls



VLF-34E

0-34 kVac, 0.1 Hz - 0.01 Hz, load rated to 5.0 μ F



VLF-65E

0-65 kVac, 0.1 Hz - 0.01 Hz load rated to 10.0 μ F

Features and Benefits

- Multiple output modes:
 - Sine wave – 0.1Hz to 0.01Hz, 0 – max voltage
 - Square wave - 0.1Hz to 0.01Hz, 0 – max voltage
 - DC + or - to max voltage
- Output Frequency, 0.1Hz to 0.01Hz in 0.01Hz increments
- Voltage metering can be set to meter in kV peak or kV RMS
- Current metering can be set to meter in mA peak or mA RMS
- Calculates Capacitance, Resistance, Flashover voltage, Time to Failure
- 20' Shielded output cables and test leads
- Test results saved in internal memory
- No Bluetooth, the XBee protocol offers a more robust and reliable wireless connection
- Upload data to PC via USB Flash Drive or wirelessly via the XBee Protocol
- E-Link software included! Allows for:
 - Remote control of the VLF wirelessly via the XBee Protocol
 - Creation of custom test reports
 - Creation of custom test profiles and test sequences
 - Export results to .csv file
- PC Not required for testing, even while using the TD-65E Tan Delta accessory

High Voltage Section Configurations



Cable Output

Shielded output cables are standard on models rated 65kV peak and below.

Controls and Configuration

VLF-34E and VLF-65E

- Large LCD with easy menu driven interface
- Large rotary encoder for easy menu navigation even while wearing gloves
- LCD shows wave form, voltage, current, capacitance (where applicable), and resistance (where applicable)
- Run a manually programmed test or choose from a previously programmed test profile
- USB port for data upload via USB flash drive
- PC Not required for testing, even while using the TD-65E Tan Delta accessory
- Same controls and E-Link software used on all VLF E-Series models



VLF E-Series E-Link Software

High End Remote Control and report generation software

HVI customers are providing a lot of positive feedback about E-Link, the new software that makes local and remote control of HVI's VLF and TD cable test system easier than ever before.

Local Mode

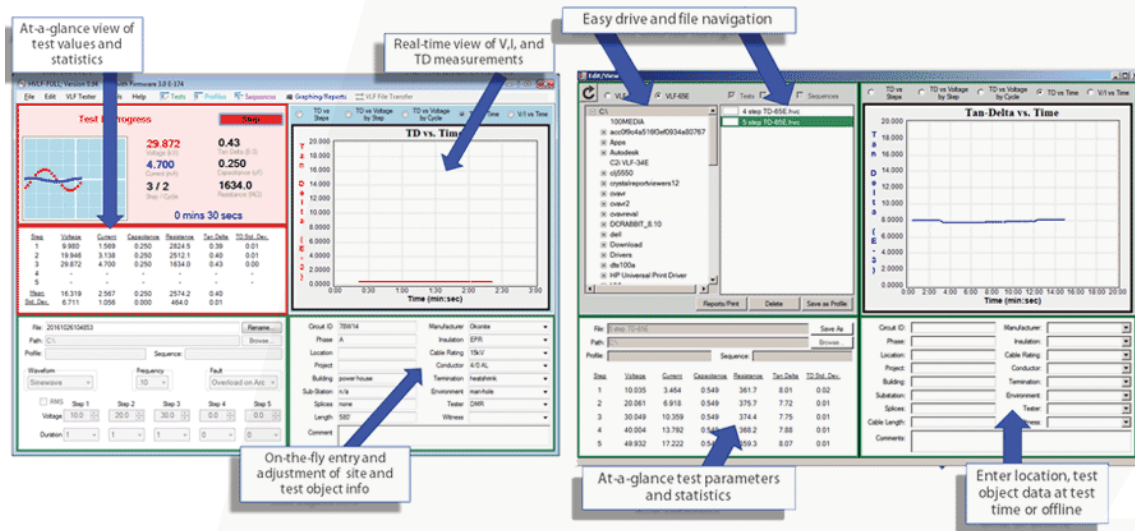
The local mode of operation logs test data to the internal memory of the VLF unit or to a removable USB flash drive. The logged data can be transferred from the VLF unit to the included PC application software for evaluation and reporting with a USB drive or an XBee wireless connection.

Remote Mode

The remote mode of operation uses a laptop PC to wirelessly connect to the E-Series VLF. Once connected, the E-Link PC software application allows the user to input or change the test parameters, view the live test data, save the logged data directly to the PC, and upload custom test profiles or sequences of test profiles.

Report Generation

E-Link's menu-driven reports feature allows the user to quickly generate custom test reports that include header information input by the user, company logos, and graphs/tables of the logged data. E-Link can also export data in .csv or a Microsoft Access compatible format for more detailed reporting or database input.



Features and Benefits

- Easy installation—just run the setup program
- Local and remote operation
- Easy test setup via the VLF front panel or PC software
- Programmable test profiles
- XBee wireless—higher connection sustainability, longer range for remote VLF and TD testing
- Advanced data capture capabilities
- Intuitive VLF and TD report templates
- E-Link software and firmware comes standard with all E-Series VLF Test Sets
- TD average and standard deviation continuously updated for easy evaluation
- PC not required for withstand or TD testing
- Data stored automatically in VLF memory with optional backups to USB and PC

VLF E-Series Specifications

All HVI VLF designs produce a sine wave output that meets the requirements of world standards, permitting it to be used as a voltage source for Tan Delta and Partial Discharge diagnostic testing.

All HVI equipment is built and serviced in the USA. All products and parts are kept in stock and quick turnaround is guaranteed.

VLF E-Series Specifications



VLF-34E



VLF-65E

	VLF-34E	VLF-65E
Input:	100 - 265Vac, 50/60Hz, 5A max	100 - 265Vac, 50/60Hz, 20A 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	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	Continuous
Load Rating:	0.5uF@0.1Hz@34kVp, 5.0uF@0.01Hz@34kVp, calculated 1.7kVp*uF*Hz uF rating increases at lower voltages, Ex: 0.77uF@0.1Hz@22kVp	1.0uF@0.1Hz@ 65kVp, 10.0uF@0.01Hz@ 65kVp, calculated 6.5kVp*uF*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	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	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	Fault on Arc and Burn on Arc
Memory:	Internal: 50 test records External (USB Drive): Limited by media capacity	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)	External USB (Firmware Upgrade Only) XBee 802.15.4 (wireless, ~30ft range)
PC Software:	E-Link remote control and report generation software included	E-Link remote control and report generation software included
Size and Weight:	19.7 x 12 x 18in., 45lb. 500 x 305 x 457mm, 21kg	22 x 15.5 x 26in., 150lb. 559 x 394 x 660mm, 68kg
Output Termination:	20ft. RG8U shielded XLPE cable with Alligator Clamp	20ft. shielded EPR cable with Alligator Clamp
Scope of Supply:	Accessory bag, 20ft. ground lead, safety ground stick, external interlock plug, mainpower key, XBee USB antenna, USB flash drive with E-Link software and electronic operations manual, paper operations manual, calibration certificate	

VLF AC Withstand Testing of Cables

Testing Methodology

When VLF Withstand testing cable, the proper test voltage and time duration are critical for the success of the test. A defect that is big enough to be excited by the applied voltage will grow to failure during the test. Lesser defects are not affected. They remain dormant and are not aggravated by the test voltage. The information and data that follows is taken directly from the IEEE 400.2-2013 Standard.

IEEE Std. 400.2-2013

IEEE Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) (less than 1 Hz)

Table 3 - VLF withstand test voltages for sinusoidal and cosine-rectangular waveforms (see note 1)

WAVEFORM	Cable system rating (phase to phase) [kV]	Installation (phase to ground)		Acceptance (phase to ground)		Maintenance ² (phase to ground) (see Note 2)	
		[kV RMS]	[kV PEAK]	[kV RMS]	[kV PEAK]	[kV RMS]	[kV PEAK]
Sinusoidal	5	9	13	10	14	7	10
	8	11	16	13	18	10	14
	15	19	27	21	30	16	22
	20	24 (Note 3)	34 (Note 3)	26	37	20	28
	25	29 (Note 3)	41 (Note 3)	32	45	24 (Note 3)	34 (Note 3)
	28	32	45	36 (Note 3)	51 (Note 3)	27	38
	30	34	48	38	54	29 (Note 3)	41
	35	39	55	44	62	33	47
	46	51	72	57	81	43	61
	69	75	106	84	119	63	89

VLF ac voltage testing methods utilize ac signals at frequencies in the range of 0.01 Hz to 1 Hz. The most commonly used, commercially available VLF ac voltage test frequency is 0.1 Hz. VLF ac test voltages with cosine- rectangular and the sinusoidal wave shapes are most commonly used. While other wave shapes are available for testing of cable systems, recommended test voltage levels have not been established.

NOTE 1 If the operating voltage is a voltage class lower than the rated voltage of the cable, it is recommended that the maintenance test voltages should be those corresponding to the operating voltage class.

NOTE 2 The maintenance voltage is about 75% of the acceptance test voltage magnitude.

NOTE 3 Some existing test sets have a maximum voltage that is up to 5% below the values listed in the table. These test sets are acceptable to be used. However, there is a risk that the cable may be “undertested” due to a combination of lower test voltage and allowed uncertainty of the measuring circuit.

5.1 General VLF ac Withstand Voltage Testing

5.1.1 VLF ac withstand voltage test parameters

The purpose of a withstand test is to verify the integrity of the cable under test. If the cable under test has a defect big enough to be excited by the voltage applied, an electrical tree will initiate and grow through the insulation.

5.1 General VLF ac Withstand Voltage Testing (cont.)

Inception of an electrical tree and channel growth time are functions of several factors including test voltage, source frequency and amplitude, and the geometry of the defect. For an electrical tree from the tip of a needle in PE insulation in laboratory conditions to completely penetrate the insulation during the test duration, VLF ac voltage test levels and testing time durations have been established for the two most commonly used test voltage sources, the cosine-rectangular and the sinusoidal wave shapes. However, the time to failure will vary according to the type of insulation such as PE, paper, and rubber. Thus the electrical tree growth rate is not the same for all materials and defects.

The voltage levels (installation and acceptance) are based on the most used, worldwide practices of from $2U_0$ to $3U_0$, where U_0 is the rated rms phase to ground voltage, for cables rated between 5 kV and 69 kV. The maintenance test level is about 75% of the acceptance test level.

One can reduce the test voltage by another 20% if the voltage is applied for longer times (Bach [B2]; Baur, Mohaupt, and Schlick, [B6]; Krefter [B27]). Evidence (Hernandez-Mejía, et al. [B21]) indicates that increasing the voltage above $3U_0$ to compensate for reduced test cycles (time) does not replicate performance either on test or in service as compared to the lower voltage, longer time tests.

Table 3 lists voltage levels for VLF withstand testing of shielded power cable systems using cosine-rectangular and sinusoidal waveforms (Bach [B2]; Eager, et al. [B9]; Krefter [B27]; Moh [B28]). For a sinusoidal waveform the rms is 0.707 of the peak value, assuming the harmonic distortion is less than 5%. The rms and peak values of the cosine-rectangular waveform are assumed to be equal.

It should be noted that terminations may need to be added to avoid flashover for installation tests on cables rated above 35 kV.

Regarding the test times:

- The recommended minimum testing time for a simple withstand test on aged cable circuits is 30 min at 0.1 Hz (Goodwin, Oetjen, and Peschel [B13]). If a circuit is considered as important, e.g., feeder circuits, then consideration should be given to extending the testing time to 60 min at 0.1 Hz (Hampton, et al. [B19]).
- The recommended minimum testing time for an installation and/or acceptance withstand test on new cable circuits is 60 min at 0.1 Hz.
- A test time within the range 15–30 min may be considered if the monitored characteristic remains stable for at least 15 min and no failure occurs. It should be noted that the recommended test time for a withstand test is 30 min.

Summary: The intent of VLF Withstand Testing is to apply a sufficient test voltage for a long enough time to permit any defect big enough to be excited by the voltage applied to fail within the test duration. If a cable can't withstand the test voltage, let it fail and make the repair or replacement. If the cable passes, there is a high assurance that the cable should not fail in service for many years.

Diagnostic Testing: If a pass/fail AC Withstand test is not desired, there are several Diagnostic Tests available. Using the VLF as the voltage source, Tangent Delta (δ) measurements and Partial Discharge detection can be performed with accessories available from HVI.

Optional Accessories

VLF and E-Series



Hand and Foot Safety Interlock Switches

Dead man style safety switches that connect to the external interlock provisions on the front panel of the VLF AC Hipot Test Set. The switch must be depressed before "HV On" and remain depressed during the duration of the testing. Releasing the switch has the same effect as hitting "HV Off", turning off the high voltage circuit. Supplied with 12 foot lead.



Grounding Sticks

Safely confirm the device under test has been discharged and is at ground potential before handling after testing.



ADL-2

The ADL-2 is a data transmitter designed for our electro-mechanical VLF Series units. The data transmitter is installed in the front panel of the VLF unit and relays voltage, current, frequency and capacitance measurements to an app that is installed on a laptop. The app logs and records the data sent to it via the transmitter and allows for data visualization and reporting.



Reusable Shipping Center

Reusable hard shipping cases designed for safe transportation of your VLF Series AC Hipot. Available for the VLF-30CM, VLF-34E, VLF-65E and some control sections.



Handcart

Optional handcart for increased portability of larger 2 piece VLF Models. VLF-4022CM, VLF-6022CM, and VLF-90CMF.



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