

portable

VLF HIPOT INSTRUMENTS

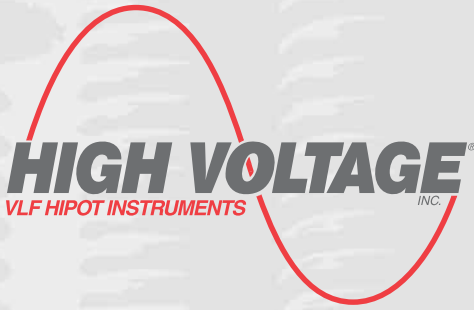
*ac testing of
cables and
electrical apparatus
is now easier
than ever*



affordable

HIGH VOLTAGE[®]
VLF HIPOT INSTRUMENTS INC.

www.hvinc.com



CONTENTS

Introduction 2

VLF Applications 3

 Cable 3

 Rotating Machinery 4

VLF Overview 4

VLF Benefits 4

Models Available 5

 VLF-25CM 5

 VLF-4022CM 5

 VLF-6022CM 6

 VLF Control Panel 6

 VLF Connection 6

 VLF-12011CM 7

 VLF-50CM 7

 VLF-65CM 7

Other High Voltage Products ... 8

Very Low Frequency AC Hipots

AC testing of cables and electrical apparatus is now easier than ever.

With the introduction of the High Voltage, Inc. line of portable and affordable VLF hipots, there is now a practical method of field-testing various loads, particularly cables and rotating machinery. High Voltage, Inc. offers a full line of VLF AC Hipots from 25 kVac to 200 kVac with models that can test up to 50 μ F of load, cables from 150 feet to 90 miles in length and the largest of generators/motors. Use VLF for AC stress tests and/or our Tan Delta unit with our VLF as the voltage source for cable diagnostics.



VLF-6022CM



The HVI VLF Advantages:

- Smallest
- Lightest
- Easiest to use
- Most economical
- True sine wave output
- Highest load ratings
- Variable frequency
0.1 — 0.01 Hz

VLF Applications

Cable

SHIELDED POWER CABLE is the most common application for VLF testing, as long cable runs can have a high capacitance. An AC stress test using VLF is the best means to verify cable integrity. It is a go/no-go test: the cable is good and holds the test voltage, or it fails. If failure occurs, find the fault, fix it, and be left with a good cable.

Because of the damage DC voltage causes to solid dielectric insulation and due to its limited ability to expose many types of defects, most have quit DC testing or reduced the test voltages to levels that provide little information about the cable condition. A cable is designed for and carries AC voltage; it should be tested with AC voltage. The High Voltage, Inc. VLF AC Hipots enable users to AC field test cable with an affordable and portable test set. For cable testing, below are three application areas where VLF is mostly used:

1. Post Cable Installation And/Or Repair

You just installed or repaired a cable: now what? How do you know if the materials are good or if installation deficiencies exist? There is only one sure and easy way to know: **VLF it!** The best way to expose defects in a cable is to AC hipot it using VLF technology. After any cable is installed or repaired, it should be VLF tested to ensure the integrity of the insulation, splices, joints, etc. A 15 kVdc hipot test, a megohm test, or a 24 hour soak test tell little about the quality of the installation or repair. The cable's already down: VLF it before reenergizing. If the cable can't hold 2 – 3 times normal voltage

for the IEEE prescribed 15+ minutes, find out now while you're there to make the repairs. With the majority of failures due to deficiencies or installation damage, a VLF test is a must to guarantee the cable's integrity. It's quick, easy, and sure.

For utilities or industrials that use outside contractors for cable installation, require them to VLF hipot the cables before concluding their work. Without doing so, shortly after the cable work is done failures may begin to occur due to installation errors and/or damage. Then it's your problem. After each cable length is installed – **VLF it!**

2. System Wide Proactive Cable Testing

A VLF should be used to routinely test important cable runs: feeders, substation cables, substation getaways, cables to critical customers, certain URD locations, etc. Even transmission level cables can be VLF tested using our 120 kVac and 200 kVac models. If a cable can't hold 2 to 3 times normal voltage, find out when it's convenient. Allow the VLF to break down the defect, locate the fault, make the repair, and be left with a good cable. It's simple, fast, economical, and conclusive.

If more diagnostic testing is desired, a Tan Delta system can be used with our VLF to measure the loss angle of the insulation, providing clues to the cable's overall insulation integrity.

3. Cable Fault Burning

The most effective method of "burning" down cable faults, to decrease their impedance to aid in

fault-finding, is to use a VLF unit. To burn down cable faults using DC hipots or low current rated thumpers takes a long time. Cable faults can be burned down or conditioned in just minutes with a VLF unit. The VLF unit raises its voltage to the point of the cable breakdown. When the cable arcs at the fault location, all the stored energy in the cable plus the VLF current is discharged into the fault. The energy behind the discharge can be thousands of joules, depending on the charge built up in the cable. This rapidly reduces the cable fault impedance to near zero. Aiding this process is the fact that the VLF reverses polarity every half cycle. This alternating negative and positive discharge causes rapid carbonization of the insulation and near immediate reduction of fault impedance.



Rotating machinery

SEVERAL TESTS on large motors and generators require AC voltage. For this application, there are two choices: series resonant units or VLF. Series resonant units have been used for decades. However, even though SR units are far smaller than line frequency power supplies, they are quite heavy, require a high input power, and are not portable. The alternative is to use a VLF Hipot. Rather than a heavy series resonant system, one can use a 150 lb. VLF unit. It's very portable, requiring only a conventional 120 volt source and conforms to the IEEE 433 Standard for AC testing rotating machinery.

(Series resonant units were developed and patented decades ago by Stan Peschel, the founder of High Voltage, Inc. As with his series resonant technology, his VLF products have once again revolutionized the cable and generator testing industry.)

Other possible applications include the testing of transformers, bushings, full reel cable, insulated conductor aerial feeder cable, and other high capacitance loads that require high voltage AC testing.

Some large transformers are high in capacitance, requiring the use of large, heavy, high kVA rated AC hipots when performing AC stress tests. Rather than use 50/60 Hz or series resonant units, a far smaller, lighter, less expensive, and less power consuming VLF unit can be used. For the use of the High Voltage, Inc. VLF products, a load capacitance of at least 0.01 μF is required.

VLF Overview

What is VLF?

VLF stands for Very Low Frequency and is generally considered to be 0.1 Hz and lower. The HVI VLF AC Hipots output a true sinusoidal AC voltage at 0.1 Hz or lower, rather than at 50 or 60 Hz. It is still AC voltage, only at a lower frequency. HVI VLF units offer frequencies as low as 0.01 Hz.

Where is VLF Used?

VLF is used whenever a high capacitance load must be tested with AC voltage, usually in field service applications where far larger and heavier series resonant AC systems are not practical. Typical loads are cables, generators & motors, insulators, bushings, transformers, and any other high capacitance load requiring AC proof testing.

Why VLF?

A long cable or large generator has a high capacitance. To test a cable at 60 Hz, it takes a high power, large, heavy, and expensive power supply: not practical for field use. Our VLF products are sine wave output, AC hipots, only at a lower frequency. With the introduction of our VLF hipots, utilities and others can finally field test cable with AC voltage using a small, lightweight, economical unit.

- 600 times less power required for cable testing at 0.1 Hz than at 60 Hz, 6000 times less when 0.01 Hz is used.
- 500 times less power required for cable testing at 0.1 Hz than at 50 Hz, 5000 times less when 0.01 Hz is used.
- Approximately 10 times smaller than a comparable series resonant system with a Q of 40.

How to VLF?

A VLF hipot is simple to operate and VLF testing is easy to perform. It's just an AC hipot but at a lower frequency. AC hipots have been used for decades to test various types of equipment. Now they can be used for field testing cable, rotating machinery, and other loads. The load is connected to the HV output and the grounded return of the VLF unit. The test voltage is applied for the required duration. The load under test either holds the voltage and passes or fails. It is a go/no-go test.

What Standards Apply?

- Cable: IEEE 400.2/D5, IEEE 400-1991, VDE DIN 0276-620 and VDE DIN 0276-621
- CENELEC HD 620, HD 621
- Rotating Machinery: IEEE 433

Benefits of HVI VLF AC Hipots

For more information on VLF testing, download our VLF FAQ from our website: www.hvinc.com

- Smallest, lightest, most economical of all available
- All models feature true sinewave output
- Waveform is independent of load capacitance between 0.01 μF and maximum load
- Highest load ratings available
- Highest voltage models available
- Simple, easy operation
- AC testing does not degrade cable insulation
- Harmful space charges are not injected into the cable insulation
- No traveling waves are generated during testing
- BNC scope output for waveform viewing

Models Available

High Voltage, Inc. offers many models in our VLF Series of products. The following table summarizes the various models available.

VLF-25CM	0-25 kVac, 0.1 Hz, load rated to 0.4 μ F
VLF-4022CM	0-40 kVac, 0.1 Hz - 0.02 Hz, load rated to 5.5 μ F
VLF-50CM	0-50 kVac, 0.1 Hz - 0.01 Hz, load rated to 50 μ F
VLF-6022CM	0-60 kVac, 0.1 Hz - 0.02 Hz, load rated to 5.5 μ F
VLF-65CM	0-65 kVac, 0.1 Hz - 0.01 Hz, load rated to 22 μ F
VLF-12011CM	0-120 kVac, 0.1 Hz - 0.01 Hz, load rated to 5.5 μ F
VLF-200CM	0-200 kVac, 0.1 Hz - 0.01 Hz, load rated to 5.5 μ F



Compared to others, this model has simplified controls.



VLF-25CM

Our smallest VLF model, the VLF-25CM approaches the size and cost of a DC hipot and is designed for quick & easy short-run URD cable testing. It can test up to 0.4 μ F of load, or approximately 4000 feet of a typical 15 kV class cable. Small, light, inexpensive. Now there is no reason not to use VLF.

Input:	120 volts, 60 Hz, 5 A peak, 2.5 A average or 230 volts, 50/60 Hz, 3A peak, 2A average (F suffix)
Output:	0 – 25 kVac peak, 0.1 Hz, sinusoidal
Duty:	Continuous
Load Rating:	0.4 μ F
Metering:	Voltmeter: Center Zero 25–0–25 kVac peak Charging Current meter: 0–50 mA peak
HV Cable Output:	Shielded RG-58/U output cable 20 ft.
Size & Weight:	13.5" w x 10.5" d x 19.25" h, 73 lbs. 343 mm w x 267 mm d x 489 mm h, 33 kg



VLF-4022CM

This model, with its 40 kVac peak output, is suitable for testing cables rated up to 25 kV. Its high load capacity enables it to test up to approximately 10 miles of cable, depending on type. This model includes a charging current and load capacitance meter, and a center zero peak kilovolt output meter.



Input:	120 volts, 60 Hz, 10 A peak, 5 A average or 230 volts, 50/60 Hz, 6 A peak, 2.5 A average (F suffix)
Output:	0 – 40 kVac peak, 0.1/0.05/0.02 Hz sinusoidal
Duty:	Continuous
Load Rating:	1.1 μ F @ 0.1 Hz, 2.2 μ F @ 0.05 Hz, & 5.5 μ F @ 0.02 Hz
Metering:	Voltmeter: Center Zero 40–0–40 kVac peak Charging Current meter: 0–100 mA peak Load capacitance meter: 0–6 Microfarads
Cable Lengths:	Shielded RG-8/U output cable 20 ft. Interconnect cable 10 ft.
Size & Weight:	Controls: 19" w x 11" d x 15.5" h, 50 lbs. 483 mm w x 279 mm d x 394 mm h, 23 kg HV Tank: 13.5" w x 8.5" d x 19" h, 72 lbs. 343 mm w x 216 mm d x 483 mm h, 33 kg



VLF-6022CM

This model, with its 60 kVac peak output, is suitable for testing cables rated up to 35 kV. Its high load capacity enables it to test up to approximately 10 miles of cable, depending on type. This model includes an enhanced features package: a charging current and load capacitance meter, test dwell timer, and polarity indicating lights.

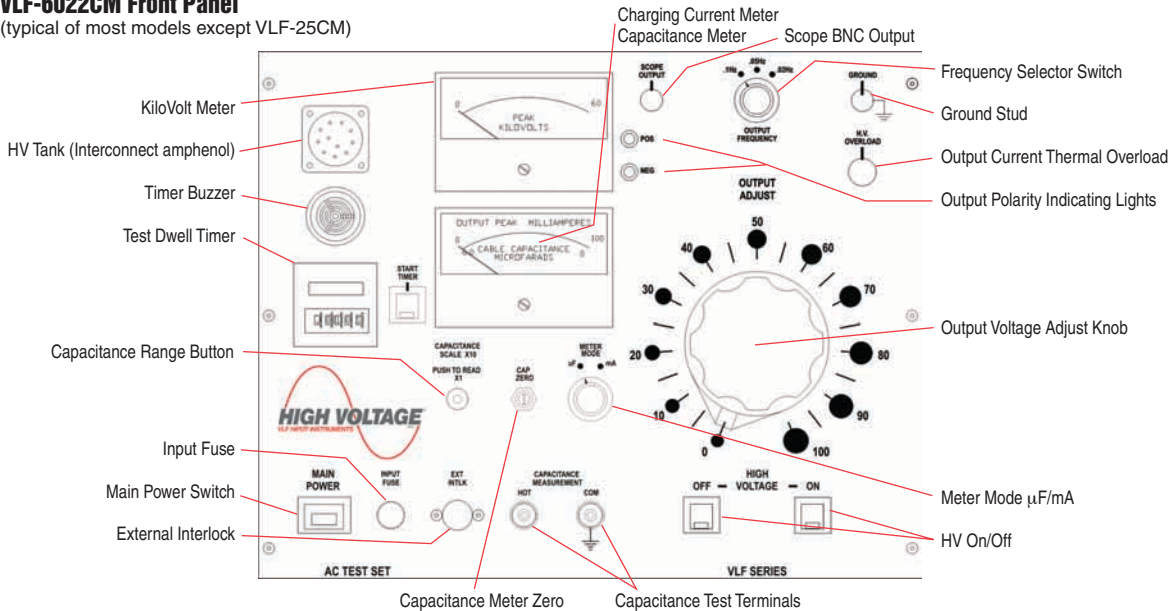


Input:	120 volts, 60 Hz, 15 A peak, 7.5 A average or 230 volts, 50/60 Hz, 8 A peak, 4 A average (F suffix)
Output:	0 – 60 kVac peak, 0.1/0.05/0.02 Hz sinusoidal
Duty:	Continuous
Load Rating:	1.1 μF @ 0.1 Hz, 2.2 μF @ 0.05 Hz, & 5.5 μF @ 0.02 Hz
Metering:	Voltmeter: 0–60 kVac peak Charging Current meter: 0–100 mA peak Load capacitance meter: 0–6 Microfarads
Timer:	Settable test duration timer
Cable Lengths:	Shielded x-ray output cable 20 ft. Interconnect cable 10 ft.
Size & Weight:	Controls: 19" w x 11" d x 15.5" h, 55 lbs. 483 mm w x 274 mm d x 394 mm h, 25 kg HV Tank: 14.5" w x 10.25" d x 21.5" h, 100 lbs. 368 mm w x 260 mm d x 546 mm h, 45 kg

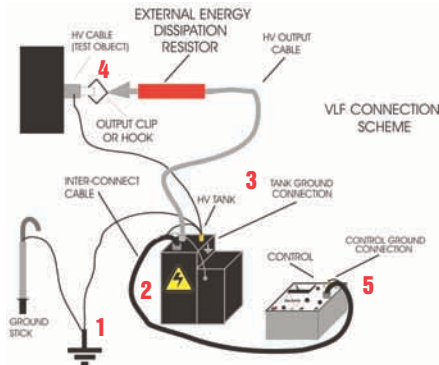


VLF-6022CM Front Panel

(typical of most models except VLF-25CM)

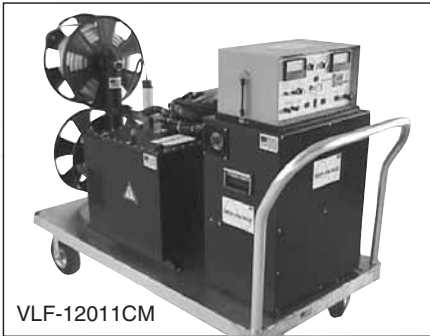


VLF Connection



Set-up and Test Procedure

- 1 Ground all components
 - 2 Interconnect VLF controller with HV tank
 - 3 Insert HV output cable into HV tank well
 - 4 Connect HV output cable to load
 - 5 Plug VLF into power source
- Turn on VLF
- Turn up voltage. Wait for end of test
- If cable fails during test, make repair
- Resume test until cable holds voltage



VLF-12011CM

VLF-12011CM, VLF-50CM and VLF-65CM

The **VLF-12011CM** with its 120 kVac peak output, is suitable for testing 69 kV cables at 3 times line to ground voltage and 1.5 times normal on 138 kV cable. Its high load capacity enables it to test up to approximately 10 miles of cable, depending on type.

The **VLF-50CM** is suitable for testing long lengths of cables rated up to 35kV at 2.5 times the line to ground voltage. The high load capacity enables testing cables up to 90 miles in length, depending on type. The **VLF-65CM** is capable of testing approximately 50 miles of 35kV class cable. The appearance and configuration of the VLF-50CM and VLF-65CM is similar to the VLF-12011CM.

These models are capable of “burning” down cable faults to decrease the fault breakdown voltage to permit the use of conventional, lower voltage fault locators (thumpers). When operating in BURN mode, the output automatically “current limits” during a fault. When the fault occurs, the energy stored in the cable discharges across the fault while the VLF continues to provide burn current until the finish of the half cycle (to the zero crossing). On the next half cycle, the process repeats itself. Through continual arcing and burning of the fault, the impedance is quickly reduced, significantly reducing fault locating time.

	VLF-12011CM
Input:	230 volts, 50/60 Hz, 30A peak, 25 A average
Output:	0 – 120 kVac peak, 0.1/0.05/0.02/0.01 Hz sinusoidal
Duty:	Continuous
Load Rating:	0.55 μ F @ 0.1 Hz, 1.1 μ F @ 0.05 Hz 2.75 μ F @ 0.02 Hz & 5.5 μ F @ 0.01 Hz
Metering:	Voltmeter: 0–120 kVac peak Charging Current meter: 0–100 mA peak Load capacitance meter: 0–6 Microfarads
Timer:	User programmable test duration timer
Cable Lengths:	Shielded x-ray output cable 100 ft. Interconnect cable 20 ft.
Size & Weight:	Controls: 17" w x 11" d x 9.5" h, 20 lbs. 432 mm w x 280 mm d x 241 mm h, 9 kg Regulator: 20" w x 14" d x 27" h, 160 lbs. 508 mm w x 356 mm d x 686 mm h, 73 kg HV Tank: 26" w x 20" d x 22" h, 390 lbs. 660 mm w x 508 mm d x 559 mm h, 177 kg



	VLF-50CM
Input:	230 volts, 50/60 Hz, 30A peak, 25 A average
Output:	0 – 50 kVac peak, 0.1/0.05/0.02/0.01 Hz sinusoidal
Duty:	Continuous
Load Rating:	5 μ F @ 0.1 Hz, 10 μ F @ 0.05 Hz 25 μ F @ 0.02 Hz & 50 μ F @ 0.01 Hz
Metering:	Voltmeter: 0–60 kVac peak Charging Current meter: 0–200 mA peak Load capacitance meter: 0–6 Microfarads
Timer:	User programmable test duration timer
Cable Lengths:	Shielded x-ray output cable 20 ft. Interconnect cable 20 ft.
Size & Weight:	Controls: 17" w x 11" d x 9.5" h, 20 lbs. 432 mm w x 280 mm d x 241 mm h, 9 kg Regulator: 20" w x 14" d x 27" h, 185 lbs. 508 mm w x 356 mm d x 686 mm h, 84 kg HV Tank: 13.5" w x 19" d x 23" h, 200 lbs. 343 mm w x 483 mm d x 584 mm h, 91 kg



	VLF-65CM
Input:	230 volts, 50/60 Hz, 30A peak, 20 A average
Output:	0 – 65 kVac peak, 0.1/0.05/0.02/0.01 Hz sinusoidal
Duty:	Continuous
Load Rating:	2.2 μ F @ 0.1 Hz, 4.4 μ F @ 0.05 Hz 11 μ F @ 0.02 Hz & 22 μ F @ 0.01 Hz
Metering:	Voltmeter: 0–75 kVac peak Charging Current meter: 0–200 mA peak Load capacitance meter: 0–6 Microfarads
Timer:	User programmable test duration timer
Cable Lengths:	Shielded x-ray output cable 20 ft. Interconnect cable 20 ft.
Size & Weight:	Controls: 17" w x 11" d x 9.5" h, 20 lbs. 432 mm w x 280 mm d x 241 mm h, 9 kg Regulator: 20" w x 14" d x 27" h, 160 lbs. 508 mm w x 356 mm d x 686 mm h, 73 kg HV Tank: 15" w x 18" d x 22" h, 215 lbs. 381 mm w x 457 mm d x 559 mm h, 98 kg



Other High Voltage, Inc. Products for Cable Testing

Capacitor Discharge Units – Thumpers

HVI produces some of the top thumpers available, with models from 20 kV to 100 kV, 1000 joules to 7500 joules, most offer three constant energy output taps and the highest burn current ratings in the industry. All models include internal arc reflection filters for connection to a radar unit, also available from HVI.

Model CDS-2010:

0 - 5/10/20 kV @ 1000J

Model CDS-3616:

0 - 9/18/36 kV @ 1600J

Model CDS-3632:

0 - 9/18/36 kV @ 3200J

Custom models up to 100 kV available



Very Low Frequency – Tan Delta

The Tan Delta system can be used to help determine the insulation quality of cables and other capacitive loads. It is used in conjunction with a Very Low Frequency AC Power Supply to measure the loss angle (Tan Delta) of the insulation. These measurements can be used to track the deterioration of service aged cable and establish baseline readings on new cable installations. Changes in Tan Delta measurements can indicate degradation of the insulation, which can be used to make engineering decisions about the service life of the cables.

How It Works

The Tan Delta is a bridge for use with a sinusoidal high voltage VLF power supply. High voltage is applied to the test specimen through the measuring unit. The control unit compares the phase angles of the voltage and current waveforms to give a loss angle of the insulation.

Features

- Frequency range up to 0.2Hz
- In line measurement of current and voltage
- Automatic readout of frequency and loss angle
- Automatically adjusts to VLF generator frequency
- Real time readout of loss angle
- Readout of high voltage, frequency & current in real time
- Connection to HV measurement module via fiber optics, eliminating high voltage safety hazards from the controller
- Audible indication when new reading is available
- Easy and quick set-up for field testing applications
- RS232 port for data storage

Applications

- Field testing HV service aged cables for degradation
- Aged cable replacement programs for HV cable networks
- Cable manufacturing for quality assurance
- Research on high voltage cable systems
- Commission / proof testing for new and repaired cables
- Can also be used for insulation condition monitoring of transformers, switchgear, bushings, etc.

Other Products from High Voltage, Inc.

AC Hipots



Only single piece, cable output 50 kVac unit available. Models available from 10kVac to 300kVac

Aerial Lift Tester



Highest power, fullest featured tester available. 0-60/120 kVac, 7kVA.



www.hvinc.com

HIGH VOLTAGE
VLF HIPOT INSTRUMENTS INC.

HIGH VOLTAGE, INC.

Factory: 31 Rt. 7A • P.O. Box 408 • Copake, NY 12516 • (518) 329-3275 • Fax: (518) 329-3271 • E-Mail: factory@hvinc.com • Web: www.hvinc.com

U.S. Sales: 1187 Coast Village Rd., Ste. 1-156 • Santa Barbara, CA 93108 • (805) 898-1533 • Fax: (805) 898-0662 • E-Mail: ussales@hvinc.com

Int'l. Sales & Corporate: 31 Rt. 7A • P.O. Box 408 • Copake, NY 12516 • (518) 329-3275 • Fax: (518) 329-3271 • E-Mail: sales@hvinc.com