Very Low Frequency
AC Technology – VLF

Cable & Motor/Generator
High Voltage Withstand
& Diagnostic Testing

High Voltage, Inc.
Copake, NY USA
VLF leader since 1997
Very Low Frequency AC Testers

AC testing of Cables, Motors & Generators is now easier than ever.

Since the introduction of the High Voltage, Inc. line of portable and affordable VLF hipots, there is a practical method of AC field testing 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 with models that can test up to 50 μF of load, cables over 50 miles in length and the largest of generators or motors. Use VLF for AC Withstand stress tests and/or 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-micro controlled wireless design. Both have diagnostic accessories available.

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 if necessary, more easily field serviced than the electronic designs. The HVI design has a proven record with well over 2000 units in service worldwide. 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. HVI now also offers the latest in solid state design VLF units that offer many benefits, like automatic programmable control and wireless communications.

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. A sine wave producing VLF is required to perform these tests. Keep all options open by choosing a sine wave design, like the HVI VLF.

The HVI VLF technology is protected under U.S. Patent # 6,169,406
Why Buy HVI VLF Products?

- **HVI Design - Portable, Affordable, Rugged, Reliable, & Long Proven**
- **HVI Support & Service – Best Customer Support, Ship from Stock, Instant Factory Help**
  Quick Service Turn Around, Repair & Cal. Locations Worldwide, Reps in over 90 countries

**What is VLF?**

VLF stands for Very Low Frequency. A VLF hipot is an AC output high voltage instrument. 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 go/no-go, or pass/fail, withstand test. Also, VLF instruments can be used as the voltage source for performing off-line Partial Discharge and Tan Delta cable diagnostic testing, both from HVI.

**Why VLF?**

VLF test sets are used to field test high capacitance loads like cables and motors/generators. The lower the frequency of an AC source, the lower the current and power required to apply a voltage to a capacitive load like a cable. At 0.1Hz, 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 60Hz AC test set. Cables should be tested with AC voltage. With the HVI VLF products, it can be done with 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 shielded power cables. A long cable may have many microfarads of capacitance. To AC high voltage test this cable requires the use of VLF technology. An AC voltage test is the best way to verify the AC integrity of a cable. If a cable can’t hold 2 – 3 times normal voltage, it is not healthy and an in-service failure is likely. Use the VLF to cause defects to fail during the test. Find the fault, make the repair or replacement, and be left with a better cable. It is especially valuable for verifying a cable after installation or repair: far better than using a DC hipot, 5kV megohmmeter, hot stick adaptor, or soak test, none of which provide meaningful information about a cables ability to withstand several times normal AC voltage. IEEE 400, 400.2, & 433, VDE 0276, CENELEC HD 620/621, SANA 10198, NEN 3620 and IEC 60502-2 standards all define VLF testing.

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.

**Partial Discharge & Tan Delta**

**VLF Cable Diagnostic Testing**

The VLF hipot alone provides a withstand, or proof test. It can also be used as the voltage source for off-line Partial Discharge and Tan Delta cable diagnostic testing. HVI can serve the needs of the industry for cable and generator testing better than any other. Contact HVI for additional information on other cable testing methods and products available.

For more information on VLF testing, visit www.hvinc.com

**Benefits of 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
- Highest load ratings available
- Highest voltage models available
- 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 design less prone to failure from transients

**Two Design Choices**

Patented original, electro-mechanical, transformer designs and the latest solid state computer controlled designs available from HVI.
VLF-30CM(F)  
**Best for testing 5 kV - 15 kV cables**

Our smallest VLF model, the VLF-30CM approaches the size and cost of a DC hipot and is designed for quick & easy short-run cable testing. It can test up to 0.4 μF of load, about 4000 feet (1200 m) of a typical 15 kV class cable. Small, light, inexpensive, and easy to use. Now there’s no reason not to use VLF.

**Input:**
- 120 volts, 60 Hz, 5 A peak, 2.5 A average
- or 230 volts, 50/60 Hz, 3 A peak, 2A average (F suffix)

**Output:**
- 0 – 30 kVac peak, 0.1 Hz, sinusoidal

**Duty:**
- Continuous

**Load Rating:**
- 0.4 μF

**Metering:**
- Voltmeter: -30 kVac – 0 – +30 kVac
- Charging Current meter: 0 – 50 mA peak

**HV Cable Output:**
- Shielded EPR output cable - 20 ft. (6 m)

**Size & Weight:**
- 381 mm w x 292 mm d x 559 mm h, 39 kg
  (42 kg - F version)

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VLF-4022CM(F)  
**Two piece portability for field testing 25 kV & 35 kV cables**

This model, with its 44 kVac peak output, is suitable for all testing of 25 kV cable and Maintenance testing on 35 kV cable. Its high load capacity enables it to test up to approximately 10 miles of cable (at .02 Hz), 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 – 44 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: Center Zero -45 – 0 – +45 kVac peak
- Charging Current meter: 0 – 100 mA peak
- Load capacitance meter: 0 – 6 Microfarads

**Cable Lengths:**
- Shielded RG/8U output cable - 20 ft. (6 m)
- Interconnect cable - 10 ft. (3 m)

**Size & Weight:**
- Controls: 22” w x 11.25” d x 15.25” h, 50 lbs.
  559 mm w x 286 mm d x 387 mm h, 23 kg
- HV Tank: 14.5” w x 10.5” d x 19” h, 72 lbs.
  368 mm w x 267 mm d x 483 mm h, 33 kg

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VLF-6022CM(F)  
**Two piece portability for testing up to 35 kV cable systems - Wind Farms**

This model, with its 62 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 (at .02 Hz), 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:**
- 0-62 kVac peak, 0.1 Hz - 0.02 Hz Continuous

**Load Rating:**
- 1.1 μF @ 0.1 Hz, 2.2 μF @ 0.05 Hz, & 5.5 μF @ 0.02 Hz

**Metering:**
- Voltmeter: 0 – 65 kVac peak
- Charging Current meter: 0 – 100 mA peak
- Load capacitance meter: 0 – 6 Microfarads
- Settable test duration timer

**Cable Lengths:**
- Shielded EPR output cable - 20 ft. (6 m)
- Interconnect cable - 10 ft. (3 m)

**Size & Weight:**
- Controls: 26” w x 13” d x 16” h, 75 lbs.
  660 mm w x 330 mm d x 406 mm h, 34 kg
- HV Tank: 15” w x 10.25” d x 21.5” h, 120 lbs.
  381 mm w x 260 mm d x 546 mm h, 54 kg

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All HVI VLF models are labeled and metered for peak voltage, not rms. When testing, use the peak voltage values given in your specification.
The VLF-50CMF is the highest power VLF unit we offer. It is rated for 5 μF at 0.1 Hz and can increase its output to 50 μF at 0.01 Hz, capable of testing up to 50 miles of 15 kV and 25 kV cable. It is ideal for very long cable runs, like long feeders, wind farm applications, submarine cables, and others. It comes as pictured, including cable reels with 100’ of high voltage and ground cable.

<table>
<thead>
<tr>
<th>Input</th>
<th>230V +/-10%, 50/60 Hz, single phase, 30 A peak, 25 A avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>Sinusoidal 0 – 50 kVac peak, 0.1/.05/.02 and .01 Hz frequency</td>
</tr>
<tr>
<td>Duty</td>
<td>Continuous</td>
</tr>
<tr>
<td>Test Capacitance</td>
<td>5.0 μF @ .1 Hz, 10.0 μF @ .05 Hz, 25.0 μF @ .02 Hz, 50.0 μF @ .01 Hz</td>
</tr>
<tr>
<td>Kilovoltmeter:</td>
<td>3.5 in., 0 – 60 kVac peak 2% FS Accuracy</td>
</tr>
<tr>
<td>Current Load:</td>
<td>3.5 in., 0 – 200 mAac peak 5% FS Accuracy</td>
</tr>
<tr>
<td>Capacitance Meter:</td>
<td>0 – 6 μF with x1 &amp; x10 ranges</td>
</tr>
<tr>
<td>Sizes:</td>
<td>Controls: 17” w x 11” d x 9.5” h, 20 lbs.</td>
</tr>
<tr>
<td></td>
<td>Power Section: 20” w x 14” d x 27” h, 160 lbs.</td>
</tr>
<tr>
<td></td>
<td>432 mm w x 280 mm d x 241 mm h, 9 kg</td>
</tr>
<tr>
<td></td>
<td>508 mm w x 356 mm d x 686 mm h, 73 kg</td>
</tr>
<tr>
<td></td>
<td>HV Tank size: 13.5” w x 19” d x 23” h, 310 lbs.</td>
</tr>
<tr>
<td></td>
<td>343 mm w x 483 mm d x 584 mm h, 141 kg</td>
</tr>
<tr>
<td></td>
<td>Complete Trolley: 28” w x 60” d x 51” h, 775 lbs</td>
</tr>
<tr>
<td></td>
<td>711 mm w x 1524 mm d x 1295 mm h, 352 kg</td>
</tr>
<tr>
<td>Output cable length:</td>
<td>Shielded X-Ray/Ground on reels - 100 ft. (30 m)</td>
</tr>
</tbody>
</table>

The VLF-65CMF is a higher power model designed to test very long cables rated up to 35kV. It offers the complete controls package including Cable Burn mode. Its cable reels provide 100’ (30m) of HV and ground.

<table>
<thead>
<tr>
<th>Input</th>
<th>230 V, 50/60 Hz, 30A peak, 25A average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>0 – 65 kVac peak, 0.1/0.05/0.02/0.01 Hz sinusoidal</td>
</tr>
<tr>
<td>Duty</td>
<td>Continuous</td>
</tr>
<tr>
<td>Load Rating:</td>
<td>2.2 μF @ 0.1 Hz, 4.4 μF @ 0.05 Hz</td>
</tr>
<tr>
<td></td>
<td>11 μF @ 0.02 Hz &amp; 22 μF @ 0.01 Hz</td>
</tr>
<tr>
<td>Kilovoltmeter:</td>
<td>Voltmeter: 0-75 kVac peak</td>
</tr>
<tr>
<td>Current Load:</td>
<td>Charging Current Meter: 0 – 200 mA peak</td>
</tr>
<tr>
<td>Capacitance Meter:</td>
<td>Load capacitance meter: 0 – 6 microfarads</td>
</tr>
<tr>
<td>sizes &amp; Weight:</td>
<td>User programmable test duration timer</td>
</tr>
<tr>
<td>Controls:</td>
<td>Shielded EPR output cable – 100 ft. (30m)</td>
</tr>
<tr>
<td>Power Section:</td>
<td>Ground cable 100 ft. (30m)</td>
</tr>
<tr>
<td>HV Tank:</td>
<td>15” w x 18” d x 22” h, 215 lbs.</td>
</tr>
<tr>
<td>Overall:</td>
<td>381 mm w x 457 mm d x 559 mm h, 98 kg</td>
</tr>
<tr>
<td>on Skid:</td>
<td>762 mm w x 1524 mm d x 1295 mm h, 320 kg</td>
</tr>
</tbody>
</table>

The VLF-90CMF is the highest power VLF unit we offer. It is rated for 5 μF at 0.1 Hz and can increase its output to 50 μF at 0.01 Hz, capable of testing up to 50 miles of 15 kV and 25 kV cable. It is ideal for very long cable runs, like long feeders, wind farm applications, submarine cables, and others. It comes as pictured, including cable reels with 100’ of high voltage and ground cable.

<table>
<thead>
<tr>
<th>Input</th>
<th>230 V, 50/60 Hz, 20A peak, 15A average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>0 – 90 kVac peak, 0.1/0.05/0.02 Hz sinusoidal</td>
</tr>
<tr>
<td>Duty</td>
<td>Continuous</td>
</tr>
<tr>
<td>Load:</td>
<td>55 μF @ 0.1 Hz, 1.1 μF @ 0.05 Hz, 2.75 μF @ 0.02 Hz</td>
</tr>
<tr>
<td>Kilovoltmeter:</td>
<td>Voltmeter: 0 – 100 kVac peak</td>
</tr>
<tr>
<td>Current Load:</td>
<td>Charging Current Meter: 0 – 200 mA peak</td>
</tr>
<tr>
<td>Capacitance Meter:</td>
<td>Load capacitance: 0 – 6 microfarads</td>
</tr>
<tr>
<td>sizes &amp; Weight:</td>
<td>User programmable test duration timer</td>
</tr>
<tr>
<td>Controls:</td>
<td>Shielded EPR output cable – 20 ft. (6m)</td>
</tr>
<tr>
<td>HV Tank:</td>
<td>Interconnect cable - 10 ft. (3m)</td>
</tr>
<tr>
<td>Sizes &amp; Weights:</td>
<td>Controls: 28” w x 13” d x 16” h, 75 lbs.</td>
</tr>
<tr>
<td>Ground cable:</td>
<td>660 mm w x 330 mm d x 406 mm h, 34 kg</td>
</tr>
<tr>
<td>Power Section:</td>
<td>15” w x 21” d x 29” h, 293 lbs.</td>
</tr>
<tr>
<td>HV Tank:</td>
<td>381 mm w x 533 mm d x 737 mm h, 133 kg</td>
</tr>
</tbody>
</table>

**VLF-50CMF High $\mu$F rating available: 5 $\mu$F - 50 $\mu$F @ 0.1 Hz - 0.01 Hz**

**VLF-65CMF Ideal for long 35 kV cable runs at Wind Farms**

**VLF-90CMF 90 kVac voltage output yet still portable**
VLF-12011CMF  69 kV Cable Withstand & 115 kV Cable Diagnostics

The VLF-12011CMF provides a 120kVac peak output voltage, suitable for VLF hipot testing 69 kV cable and as a voltage source for partial discharge and tan delta testing of 115 kV cable. In addition to the standard controls described, this model also contains a Cable Burn mode. Cable reels provide 100’ (30m) of HV and ground cable.

Input: 230 volts, 50/60 Hz, 30 A peak, 25 A average
Output: 0 – 120 kVac peak, 0.1/0.05/0.02/0.01 Hz sinusoidal
Duty: Continuous
Load Rating: .55 µF @ 0.1 Hz, 1.1 µF @ 0.05 Hz, 2.75 µF @ 0.02 Hz, 5.5 µF @ 0.01 Hz
Metering: Voltmeter: 0 – 200 kV peak
Charging Current Meter: 0 – 100 mA peak
Load capacitance meter: 0 – 6 microfarads
User programmable test duration timer

Cable Lengths: Shielded EPR output cable 100 ft. (30m)
Ground cable 100 ft. (30m)
Sizes & Weight: Controls: 17” w x 11” d x 9.5” h, 20 lbs.
Regulator: 20” w x 14” d x 27” h, 160 lbs.
HV Tank: 26” w x 20” d x 22” h, 390 lbs.
Overall: 30” w x 60” d x 51” h, 853 lbs.

VT33(F)  VLF & Fault Locator Combo  2 tools in 1 box

The VT33 is the worlds only combination VLF hipot and cable fault locator, or thumper. It is the complete tool for AC testing and fault locating cables rated up to 25kV. It offers a 33 kVac peak VLF output, VLF Cable Burn mode, and a 760 joule discharge output. It is fully TDR/radar ready.

Input: VT33: 120 V, 60 Hz, 10 A
VT33F: 230 V, 50/60 Hz, 5 A

VLF Hipot Output: 0 – 33 kVac peak @ 0.1 Hz
Load Capability: 1 µF – more than one mile (1.6 km) of 15 kV & 25 kV cable
Discharge Output: 0 – 13 kVdc @ 760 joules
Discharge Rate: Every 8 seconds
VLF Burner: Arcs cable every few seconds using cable energy to burn.
TDR Interface: Arc Reflection & Current Impulse
Size & Weight: 28” w x 26”d x 44” h, 245 lbs.
1499 cm w x 635 mm d x 1118 mm h, 1678 kg
Cable Outputs: 50’ (15 m) shielded HV cable & ground
The “E” Series VLF Models  Solid State Design - Fully Automated w/PC App - Wireless

The “E” Series of VLF products offer the latest in electronic design, with fully automated and programmable operation, data collection and reporting, and Tan Delta ready, all wirelessly controlled via custom software. There is no better VLF available. The two models shown below each have an optional HVI designed Tan Delta measurement accessory and Partial Discharge detection options are available from HVI and from others.

VLF-34E

Typical Front Panel Controls  Electro-Mechanical Designed Models

0 – 34 kVac peak, Sinusoidal 0 – 65 kVac peak, Sinusoidal
0.5 μF – 5.0 μF, 0.1 Hz – 0.01 Hz 0.5 μF – 5.0 μF, 0.1 Hz – 0.01 Hz

Refer to the separate VLF-34E & VLF-65E brochures for details

Cable Diagnostic Testing Accessories for all HVI VLF Models

HVI offers the accessories used for performing VLF Tan Delta and VLF Partial Discharge diagnostic testing for cables and rotating machinery. Some of the models offered are designed and produced by HVI and some are from other vendors, designed to function with the HVI VLF products. Other vendors also offer these accessories that may be used with the HVI VLF designs. Models are available up to 200 kV peak. Consult HVI for more details and refer to separate literature for each item.

Tangent Delta (δ) or Loss Angle Measurement  Partial Discharge Detection and Location & Tan Delta Measurement

TD-34E 34 kVac peak  TDB-60 60 kVac peak (since 1999)
TD-65E 65 kVac peak  Shown is PDIX-70, 70 kV peak models to 200 kV available

HVI Founder & Inventor
Stanley G. Peschel (1930 – 2002)
Application Help and Field Test Scenes

Selecting a VLF Model
Considerations when selecting the right model: voltage, μF rating, μF rating at 0.1Hz, & control features.

Voltage: What is the cable voltage rating and what tests will be performed? Table from IEEE 400.2-2013.

<table>
<thead>
<tr>
<th>Cable Rating</th>
<th>Installation</th>
<th>Acceptance</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>phase to phase</td>
<td>phase to ground</td>
<td>phase to ground</td>
<td>phase to ground</td>
</tr>
<tr>
<td>kVrms</td>
<td>kVrms (kVpk)</td>
<td>kVrms (kVpk)</td>
<td>kVrms (kVpk)</td>
</tr>
<tr>
<td>5</td>
<td>9 (13)</td>
<td>10 (14)</td>
<td>7 (10)</td>
</tr>
<tr>
<td>8</td>
<td>11 (16)</td>
<td>13 (18)</td>
<td>10 (14)</td>
</tr>
<tr>
<td>15</td>
<td>19 (27)</td>
<td>21 (30)</td>
<td>16 (22)</td>
</tr>
<tr>
<td>25</td>
<td>29 (41)</td>
<td>32 (45)</td>
<td>24 (34)</td>
</tr>
<tr>
<td>35</td>
<td>39 (55)</td>
<td>44 (62)</td>
<td>33 (47)</td>
</tr>
<tr>
<td>46</td>
<td>51 (72)</td>
<td>57 (81)</td>
<td>43 (61)</td>
</tr>
<tr>
<td>69</td>
<td>75 (106)</td>
<td>84 (119)</td>
<td>63 (89)</td>
</tr>
</tbody>
</table>

μF Rating: VLF hipots are rated by the capacitance of the loads they can test. To select the right model, either the load capacitance must be known or the cable length if the μF/km, μF/ft, etc. is known.

μF Rating at 0.1 Hz: If the VLF is to be used as a voltage source for performing Tan Delta and Partial Discharge testing, the load rating at 0.1 Hz is important, as this is the frequency most used for these tests. In some cases, 0.05 Hz frequency can be used. If the VLF is to be used for hipoting, then any frequency can be used.

Control Features: Are the automated, laptop controlled, etc. features of the “E” Series necessary or are the basic manual controls of our original design adequate, saving money and gaining other benefits?

Comment: A fifth consideration could be the vendor? Where it is made and serviced, how available is it, how quick is the service turnaround, and what is the vendors reputation. All HVI products are Made in the USA and most are in stock.

Other Cable Test & Fault Locating Products

VLF Cable Testing & Fault Locating Van Ready Custom Packages
Instant & easy test van: HVI can mix and match products to deliver a custom made module to handle all your test and fault locating needs. Just drop it in your truck.

Can Include
- VLF Hipot
- Tan Delta
- Data Logger
- Thumper
- TDR/Radar
- UG Fault Finder
- Cable Reels
- DC Hipot
- and more

200 kV VLF van in service, high voltage out thru top.

Ω-CHECK® Concentric Neutral Resistance Tester & Substation Ground Cable Integrity Check

How good are your neutrals?

Wind Farm 35kV Cables are Ideal for VLF Withstand Testing

VLF Acceptance Test per IEEE 400.2-2013 All 3 phases @ 62 kVac for 60 minutes

Cable system is newly installed needing a VLF Withstand to find defects and faulty workmanship. Find the bad spots.