HIGH VOLTAGE
VLF HIPOT INSTRUMENTS

VLF-12011CMF

SERIES

Safety, Operation, and Procedure Instructions for the VLF Series of AC Hipots

Please Refer to Documentation Before Operation

Danger- Lethal Voltages:

Equipment to be used by trained personnel only

This Operator Manual contains instructions for the operation of a High Voltage power source. The operator of this equipment must use good judgement and follow all safety precautions noted in this guide to ensure the protection of himself and others in close proximity to the test area. Failure to follow the instructions could result in injury or death. Proper grounding of the test set must be done prior to connecting this unit to a power source.

VLF Operator Manual

HIGH VOLTAGE
VLF HIPOT INSTRUMENTS

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Very Low Frequency (VLF) AC High Voltage Testing - Operators Manual Addendum

Instrument Summary

This instrument is a Very Low Frequency AC high voltage test system – a VLF hipot. It is an AC hipot whose frequency output is 0.1 Hz or lower, compared to the 50/60 Hz of a conventional AC hipot. The lower the frequency, the lower the current and power it takes to test a capacitive load like a cable. At 0.1Hz, it takes 600 times less current and power, compared to 60Hz, to apply an AC voltage to a cable or some other high capacitance load.

At 0.1Hz frequency output, one full cycle of the sine wave takes 10 seconds, 20 seconds at 0.05Hz, and 50 seconds at 0.02Hz. Even though each cycle of the waveform can take 10 seconds or longer, it is still alternating current – AC – and is sinusoidal.

This is not a DC hipot and it does not operate in the same manner. When the voltage output is raised, the voltage will climb to its peak and then descend back to zero. The output polarity of the set reverses (a solenoid switch can be heard) and then climbs again in the opposite polarity. This rise and fall of the voltage is obvious on the voltmeter and is normal. The current meter will also rise and fall as the cable charges and discharges every half cycle. Unlike DC, there are no leakage currents to read. This is a go/no-go, or pass/fail, AC stress test. The load under test either withstands the test voltage and passes, or it breaks down and fails.

Important note: Use the VLF test set properly. Test at the proper test voltage and time duration. Abbreviated tests or tests at reduced voltage levels should not be performed. An improper test may aggravate cable defects that may cause cable failure later in service. The proper test voltage and time duration are essential to allow the VLF to do its job.

Helpful Notes to Users

Peak Voltage: The Voltmeter on the VLF test set measures the Peak voltage. It is the peak output voltage that is used during VLF testing. If your test specification indicates a test voltage in RMS, multiply by 1.414 to obtain the peak value for the test. The IEEE400.2 chart indicating test voltages for different cable ratings shows both rms and peak. All other AC hipoting using 50/60 Hz instruments is measured by the rms voltage, not VLF testing, so make sure this issue is addressed.

Output Frequency: All VLF sets are rated by the uF of load they can test at a given frequency. The lower the frequency, the higher the capacitance, or the longer the cable, can be tested. Always use the highest frequency possible. Testing should be performed at 0.1Hz, unless the capacitance of the load is too high for the uF rating of the set at 0.1 Hz. It may be necessary to reduce the frequency to 0.05, 0.02, or 0.01 Hz depending on the capacitance of the load. The load capacitance can be measured using the capacitance meter of the VLF or be calculated, if the capacitance per foot or meter is known. Example: At 0.1Hz, 1 – 2 miles of cable can be tested, depending on size.

Test Duration: The recommended test duration is 30 minutes as a minimum. In the body of this manual are reprints from the IEEE400.2 standard discussing this issue and additional information on the subject. The longer the test duration the better, as minor defects that triggered into partial discharge due to the test voltage will have time to grow through to failure during the test. The duration indicated in the standard is based on using a frequency of 0.1Hz. If lower frequencies are used, the test time must be extended. Rather than 30+ minutes at 0.1Hz, perhaps 60 minutes should be used at 0.05 and 0.02Hz.

Cable Failure Indication: When the cable fails, the thermal Overload on the front panel will pop up. Also, the Voltage and Current meters will read erratically as the cable arcs. It may take several cycles of the voltage rising to the arc-over voltage of the fault to cause the thermal overload to warm up enough to trip.

Know Your Test Equipment – Read the Operators Manual

Table of Contents

About the Operator Manual

Important

This Operator Manual describes the features and safe operation of a High Voltage AC Test Set. The instructions are intended to be clear and simple, but the operator must be trained and qualified according to the customer's established procedures for the use of this type of equipment.

This Operator Manual is organized to provide information on the VLF-12011CMF in steps that familiarize the new operator with the entire scope of operation of this test set.

Section 1: Specifications and Controls.

Section 2: Setup and Operation.

Section 3: Performing Special Operations.

The Functions, Features, and Specifications of the VLF Series of AC Hipots are also discussed in the VLF Brochure available from High Voltage, Inc.

SECTION

1

General Information

This section familiarizes the operator with the features and specifications of the

VLF Series of Very Low Frequency AC Hipots manufactured by HIGH VOLTAGE, INC.

Features and Specifications

The VLF-12011CMF hipot test set provides true sine wave AC output voltage for the test of high voltage cables and other capacitive loads.

Standard features of the VLF-12011CMF AC Hipot

- Sine wave output, 0.1, .05, .02 and .01Hz frequencies standard.
- Continuously adjustable output voltage
- Continuous duty rating
- Fixed primary overload
- "Zero Start" and External Interlock provision
- Single-range voltmeter
- Single range current meter with capacitance measuring scale for determining best test frequency
- Dual operating mode- Hipot/Burn for either hipotting with an overload or burning with current limiting
- Three piece design, mounted on one Trolley.
- Transit protected meter prevents damage between test sites in vehicle mounted installations
- 20 ft. interconnect cables with grounds
- 100 ft. shielded X-Ray output cable AND 100 ft. Ground an Cable Reel

- Hook type output connector
- Alligator clip type output connector
- External Energy Dissipation Resistor
- 14" Safety Grounding Hook with 20ft. lead.

WARNING

DO NOT OPERATE THE VLF HIPOT SET IF THE HIGH VOLTAGE TANK IS 5° OR MORE FROM LEVEL.

IF THE UNIT IS OPERATED OUT OF LEVEL, OVERHEATING AND INTERNAL ARCING MAY OCCUR.

DO NOT STORE OR TRANSPORT VLF HIGH VOLTAGE SECTION

ON IT'S SIDE

Operating Environment

Indoor/Outdoor-fair weather

Altitude: 100% of rating;Sea-level, up to 5000ft.(approx.1500M). The output power is de-rated 10% above 5000 ft. altitude, 20% above 12,000 ft.(approx. 3600M), and 30% above 15,000 ft.(approx. 4500M)

Storage Temperature: -20°C to 70°C(-4°F to 158°F)

Operating Temperature: -5°C to 45°C(22°F to 113°F) Output power is de-rated linearly by 15% from 30 to 45°C ambient.

Maximum Relative Humidity: 80% up to 31°C(88°F), decreasing linearly to 50% at 40°C(104°F)

Mains supply fluctuation: +/-10% of rated voltage

Installation: Category II

Pollution: Degree 2

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ON IT'S SIDE

Safety Symbol Identification

Warning! Please refer to documentation before operation

Protective Earth Terminal

Warning: Hazardous Voltage

MODEL VLF AC HIPOT SPECIFICATIONS

	VLF-12011CMF(120 kV,1.1 μF)
Input	230V +/-10%, 50/60 Hz, single phase, 30 A . Sinusoidal Power Required for full output
Output	Sinusoidal 0-120 kVac peak, 0.1, .05, .02 and .01 Hz frequency
Duty	Continuous
Test Capacitance	.55μF @ .1 Hz, 1.1μF @ .05 Hz, 2.2 μF @ .02 Hz , 5.5μF@.01 Hz Minimum capacitance to achieve full output- .01μF
Kilovoltmeter	3.5 in. , 0-120 PEAK KILOVOLTS 2% FS Accuracy
Current/uF Meter	3.5 in. , 0-100 PEAK MILLIAMPS, /5-0 uF 5% FS Accuracy
Remote Control Size Power Section Size High Voltage Tank size	17w x 11d x 9.5 high 20w x 14d x 27 high 26w x 26d x 22high
Control Case Wt. Power Section Wt. HV Tank Wt.	20 lbs. (9kg) 160 lbs. (73kg) 390 lbs. (177kg) 855 lbs. (388g) on Platform Truck with 100ft. Cable Reel Assembly
Interconnect cable length Output cable length	20 ft.(STANDARD) Shielded X-Ray 100 ft.(STANDARD)

Table 1 *VLF-12011CMF Specifications*.

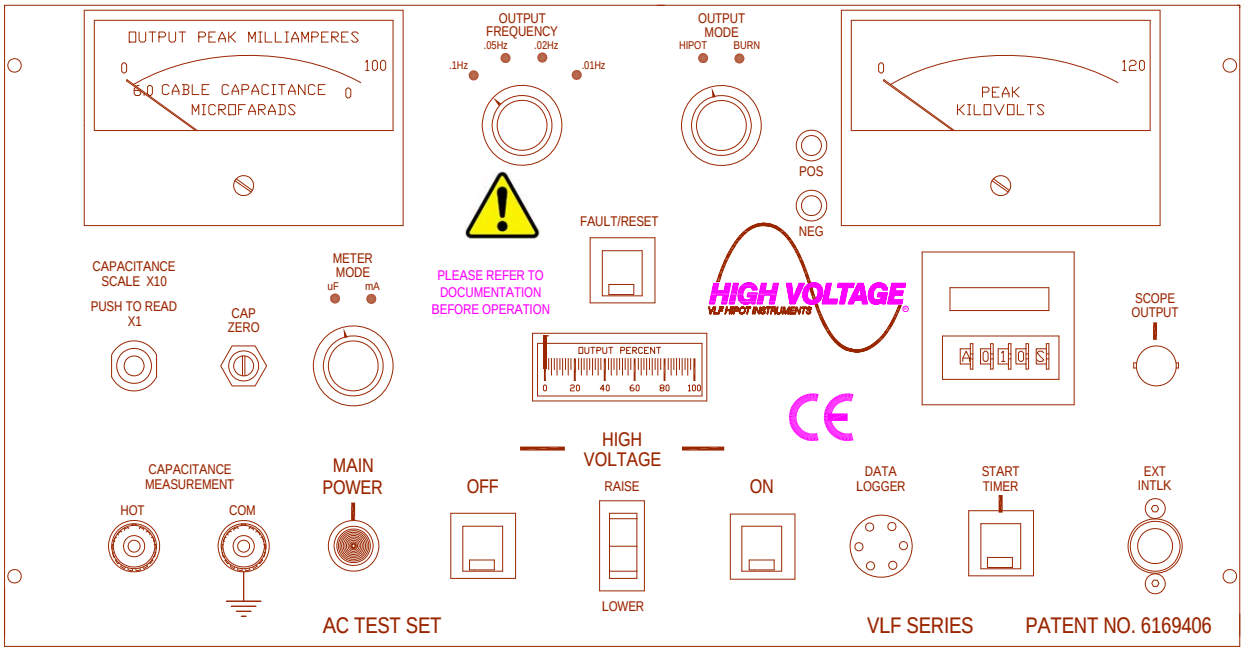

Figure 1 *VLF Series front panel controls.*

MAIN POWER

The MAIN POWER neon lamp will light when the main power circuit breaker is on in the power section and voltage is available to the input terminals.

EXT.INTLK (EXTERNAL INTERLOCK)

The Ext. Intlk. connector is provided to allow for a normally open safety interlock switch to control the energizing of the high voltage output.

FAULT/RESET

The FAULT/RESET pushbutton illuminates when the primary current in the power section has exceeded the maximum limit. Its delayed trip allows for the short term overload of the variable transformer while still providing proper protection. Depressing the pushbutton resets the circuit.

HIGH VOLTAGE ON/OFF

The HIGH VOLTAGE ON (OFF) pushbuttons activate (de-activate) the high voltage power circuits. The LED indicators provide long life positive indication of the circuit status. The RED (ON) LED lights when high voltage is energized, the GREEN (OFF) LED lights when the high voltage is de-energized.

HIGH VOLTAGE- RAISE/LOWER

The RAISE/LOWER control adjusts the output voltage by raising or lowering the motorized output control variable transformer. The OUTPUT PERCENT meter above the RAISE/LOWER control indicates the relative position of the variable transformer with respect to the output voltage. An automatic return to zero function at time of high voltage off ensures energizing of high voltage at zero. The control must be at ZERO (0) to energize the high voltage circuits. The output control must always be returned to zero at the completion of testing, prior to de-energizing the output , allow the unit to cycle for 60 seconds to assure full discharge of the capacitance in the load.

VOLTMETER

The KILOVOLT METER allows for accurate output voltage readings. 1-% precision resistors minimize the need for re-calibration due to aging shift. See Voltmeter Re-calibration in Section 3 for details on calibration.

CURRENT/CAPACITANCE METER

The CURRENT/CAPACITANCE METER allows for output current readings. The CURRENT meter portion of this circuit is for observing the charge and discharge currents in the cable load. 1-% precision resistors minimize the need for re-calibration due to aging shift. The CAPACITANCE scale on this meter is for measuring the load cable capacitance prior to test to determine the best operating frequency for that particular cable run.

SCOPE OUPUT

The SCOPE OUTPUT allows for accurate output voltage monitoring. This connector can be fed into an oscilloscope for the looking at the actual output wave shape. The peak voltage representing 50 kVac is 5 volts peak.

OUTPUT FREQUENCY

The OUTPUT FREQUENCY switch adjusts between calibrated frequencies for testing loads larger than normal .By allowing slower frequencies the output waveshape is maintained. Output frequency choices are .1 Hz for .55 μF, .05 Hz for 1.1 μF, .02 Hz for 2.2 μF, and .01 for 5.5μF load capacitance.

OUTPUT MODE

The OUTPUT MODE is for choosing the operating mode of the overloads. When this control is in the HIPOT mode, the overload will trip in case of an arc. When in the BURN mode, the overload is still active. But, if an arc occurs, a reactor is switched into the primary line to limit primary current to the maximum rating for the unit allowing the faulted cable to be burned to a low impedance fault. After a short is burned into the cable, conventional fault locating techniques can be employed.

START TIMER

The START TIMER switch starts the dwell timer on the front panel to time test duration. The timer can only be started when high voltage is energized. The timer is reset only after the high voltage is off and the START TIMER pushbutton is depressed.

Operation of the Timer In the VLF Hipot

The Dwell Timer included in our VLF Series of AC Hipots will function as an end of test alarm only. The timer will start upon initiation of the high voltage. The timing function will count up to the preset value. Upon reaching the dwell time, an alarm will sound indicating the need to return the Output Control to zero. Turn off the high voltage, as noted later in the Operating Manual, by allowing the output discharge solenoids and polarity solenoids to cycle at least ten more seconds (one full cycle).

To set the timer.

1) Press 'Mode'. When 'Timing Range' appears. Press '1' pushbutton. When desired range appears move to next step.

2) Press 'Mode'. When 'UP/Down Count' appears, press '1' to choose 'UP or 'DOWN'.

3) Press 'Mode''. When 'Output Mode' appears, press '1' until Mode 'A' appears.

This setup should be retained in the timers memory. To change the time in the future see step 1.

METER MODE

The METER MODE switch configures the current metering circuit for capacitance measuring or for output current measurement.

CAPACITANCE (PUSH TO READ X1) PUSHBUTTON

The PUSH TO READ X1 pushbutton changes the scale of the CAPACITANCE metering. The modified Wheatstone Bridge incorporated in this circuit indicates x10 readings without depressing the PUSH TO READ X1 pushbutton. *When in the x10 scale and the reading is below 6 μF, the PUSH TO READ X1 should be depressed to get an accurate load capacitance measurement.*

CAP ZERO

This potentiometer is for zeroing the capacitance range at full scale prior to measuring the cable capacitance.

CAPACITANCE MEASUREMENT POSTS

These posts are for connecting the cable to the capacitance measuring circuit. The HOT post is for the cable center conductor, the COM post is for the cable's grounded shield. Be sure the cable is de-energized before connecting this low voltage circuit or damage will result. The resulting capacitance measurement on the cable will identify the best operating frequency for that particular cable run. A frequency table is provided in the section OPERATING THE EQUIPMENT.

List of included components with the VLF Hipot

- ☐ Ext. Intlk. jumper plug
- ☐ 100 ft. long output X-Ray cable (Standard)
- ☐ 100 FT. Ground Lead
- ☐ 10 ft. interconnect cable with grounds power section to HV tank. (Standard)
- ☐ 20 ft. interconnect cable power section to control box(Standard)
- ☐ 6 ft. BNC to BNC coax cable -scope to panel interconnect
- ☐ 20 ft. red and black test leads for capacitance measurement
- ☐ External energy (current limit) dissipation resistor
- ☐ Safety Ground Hook with 20 ft. lead

WARNING

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DO NOT STORE OR TRANSPORT VLF HIGH VOLTAGE SECTION

ON IT'S SIDE

SECTION 2

SETTING UP THE EQUIPMENT

The setup of this equipment has been minimized by consideration of the operator during design. The VLF-12011CMF three-piece construction on a roll around platform truck relieves the usual installation and mobility obstacles for AC testing in the field or in a sub-station.

Select a level location for the high voltage unit that will allow easy hook-up to the test cable. The cooling and filter assembly of the VLF series will not operate properly if the high voltage tank is placed on uneven ground. A maximum angle for correct operation is 5°. Blocking the tank to a level condition is acceptable.

1. Be sure that all the controls are off, in their de-energized or fully counterclockwise position.

2. Secure ground leads to the high voltage tank brass stud, and the power section brass stud. *The Ground leads should be of sufficient ampacity to carry any expected fault currents from the load cable*.

3. Secure the interconnect cables from the power section to both the control and the high voltage tank. These connections are likely done once upon receipt, the correct mating is as follows:

   RC J1 to PS J1

   RC J2(BNC) to PS J2(BNC)

   RC J3(BNC) to PS J3(BNC)

   RC J4 to PS J4

   PS J5 to T J1(power)

   PS J6 to T J2(cooling)

   RC= Remote Control, PS = Power Section, T = Tank

   All Connections must be made to operate this unit.

4. **Insert the coaxial output cable into the high voltage output connector on the tank.** Tighten the clamping nut securely. The free hanging lead from the center of the cable reel assembly connects to the high voltage tank.

   Note: The Output Cable from the cable reel *must* be uncoiled to the desired length *before* the connection to the high voltage tank is made.

5. **Extend the GROUND CABLE on the reel to desired length**. Clamp the working end to the test cable shield and STATION GROUND. Clamp the reel end of the ground cable to the GROUND clamp on the trolley, at the base of the reel.

6. **Insert the EXT INTLK plug into the socket on the control panel.** The plug may also be wired to a normally open contact of a safety switch for added protection.

7. **Wire the input power terminal block to power as specified in Table 1, VLF-12011CMF specifications. Power wire should be rated for 30 Amps.**

Operation of the Timer In the VLF

The Dwell Timer included in our VLF Series of AC Hipots will function as an end of test alarm only. The timer will start upon initiation of the high voltage and depression of the START TIMER pushbutton. The timing function will count up to the preset value. Upon reaching the dwell time, an alarm will sound indicating the need to return the Output Control to zero and turn off the high voltage, as noted in the Operating Manual, by allowing the output discharge solenoids and polarity solenoids to cycle at least ten more seconds (one full cycle).

The timer supplied will be settable from .1 second to 10 hour increments. The timer will reset when the high voltage turns off by depressing the START TIMER pushbutton.

The setup of the VLF AC Test Set does not address the need for proper safety grounding of the test cable load. The identification and disconnecting of cables from service and the subsequent verification of the cables being de-energized may vary for different types of tests or setups. Please consult the local codes where applicable or reference the guidelines provided by your employer for maximum safety.

WARNING

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DO NOT STORE OR TRANSPORT VLF HIGH VOLTAGE SECTION

ON IT'S SIDE

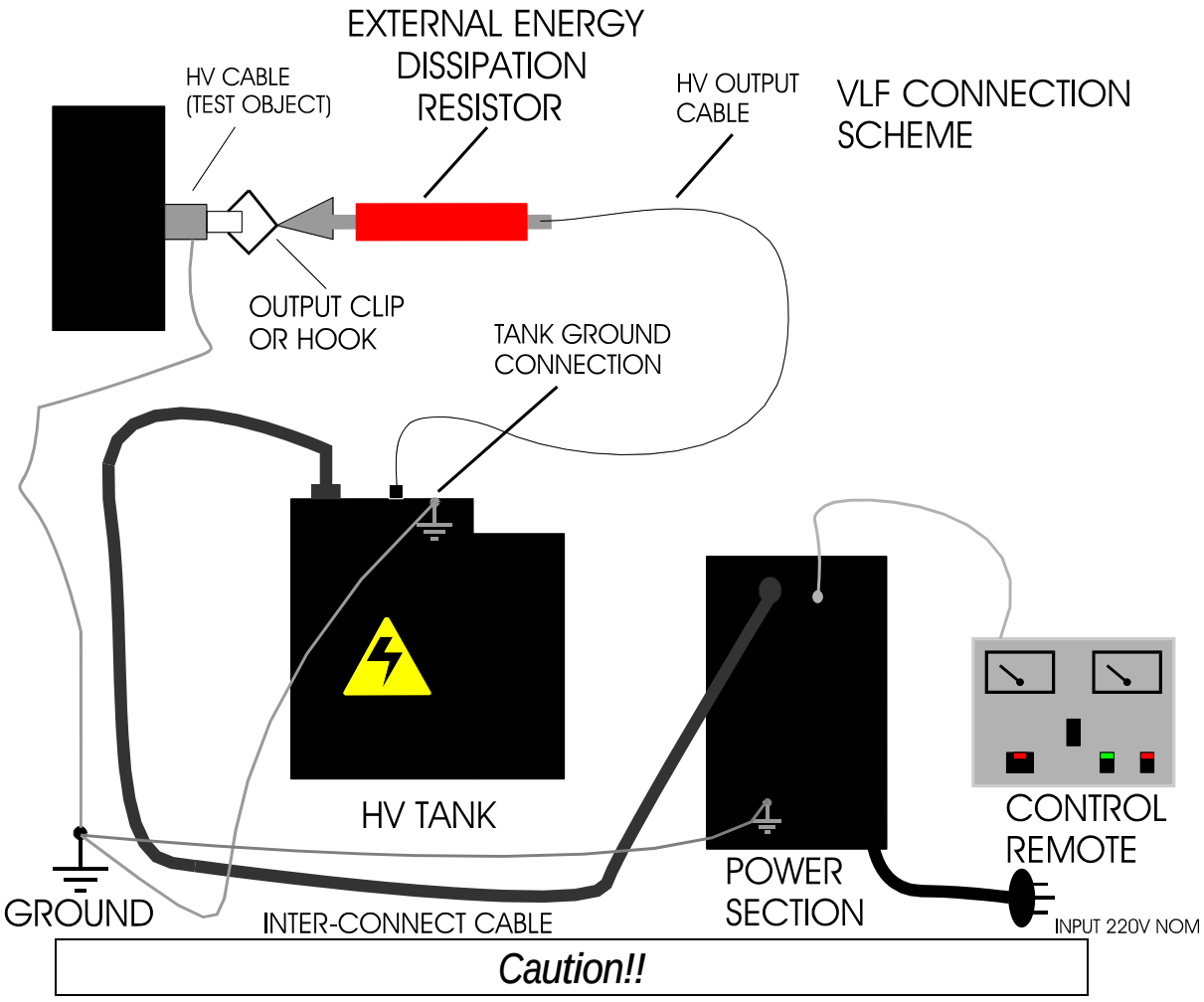
Operating the Equipment

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 supercede these. The purpose of this section is to explain the capabilities of this test set in real-world applications.

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

AC Cable Insulation Testing

1. Ensure that all the steps listed in Setting up the Equipment have been accomplished. Take special note to ground the power section and the high voltage tank to a solid earth ground.



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

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

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.

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.

7. First, the cable capacitance must be measured to determine the best operating frequency. Place the control near the cable being tested.

8. Connect the input power terminal block to a grounded 230 v (+/-10%), 50/60 Hz source. A generator is an acceptable power source.

9. Turn on the main circuit breaker. The MAIN POWER light will illuminate at both the power section and the control.

10. Operate the METER MODE to μF position. Adjust the CAP ZERO for full scale deflection (ZERO) on the meter.

11. Connect the HOT post to the center conductor of the test cable. Connect the COM post to the grounded shield of the test cable. Read the CAPACITANCE scale(x10).

12. If the reading is below 6.0μF (about 6 divisions on x10 multiplier) depress the x1 pushbutton. Then following table provides operating frequency versus capacitance.

Capacitance	Frequency
.55μF or less	.1 Hz
1.1μF or less	.05Hz
2.2μF or less	.02Hz
5.5 μF or less	.01Hz

13. An oscilloscope (optional) can be connected to the SCOPE OUTPUT on the control for wave shape monitoring. The oscilloscope should be properly grounded and the input should be set to 1 volt/ division, the time base should be 5 seconds/division and the trigger should be set to roll display to view the wave shape. An oscilloscope with signal memory display is best used for this application. A BNC to BNC shielded jumper should be used for connection between the SCOPE OUTPUT and the oscilloscope. A digital meter can be used to monitor this connector. The voltage feedback calibration for this connector is 1 volt for 10 kV of output.

CAUTION

POTENTIALLY LETHAL VOLTAGES MAY BE PRESENT

14. Connect the output lead of the cable reel to the test sample through the External Energy Dissipation Resistor using the flexible alligator clip for the connection. 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.

15. Place the OUTPUT MODE in the HIPOT position

16. With the OUTPUT control at zero (zero start interlock engaged), depress the HV ON pushbutton. The HV ON light will glow. At this time the pump and fan on the high voltage section will also energize. ***If this is the first test at this location, leave the output control at zero and allow the pump to circulate oil for 5 minutes prior to raising the output voltage and starting the test. This will purge air from the cooling system.***

17. Increase the output by operating the HIGH VOLTAGE control to the RAISE position until the desired output voltage is reached. Raising the output too fast with large capacitive loads may trip the output overload. Observe the OUTPUT PERCENT meter to rough in

the set voltage. Please recognize that the output cycle is: 100 seconds for a full sine wave @.01 Hz, 50 seconds fro a full sine wave @ .02 Hz, 20 seconds for a full sine wave @ .05 Hz, and 10 seconds for a full sine wave @ .1 Hz. . To set the output voltage you may need more than one cycle to read the output accurately.

18. Maintain the output voltage for the test time specified in your standard procedures.

19. After the test is complete, depress the HIGH VOLTAGE control in LOWER position, allowing the load to return to zero and the unit to cycle for about 60 more seconds prior to depressing the HV OFF pushbutton. Allowing the unit to cycle for some time allows for the complete discharge of the load and avoiding the normal self recharge that capacitive loads will exhibit.

20. If the test sample fails during the test, the overload circuit will de-energize the high voltage. Should an overload occur, the normal sine wave cycle is interrupted and the load may bleed down much more slowly than when the unit is cycling normally. Depress the FAULT/RESET pushbutton to resume testing.,

21. Prior to removing the output cable from the load, observe that the output voltmeter is at zero, and then use a GROUND STICK to positively ground the test sample.

Note: Be sure to disconnect the output cable from the high voltage tank *before* coiling the output cable onto the cable reel assembly.

WARNING

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DO NOT STORE OR TRANSPORT VLF HIGH VOLTAGE SECTION

ON IT'S SIDE

Using the BURN MODE on AC Cables

1. Ensure that all the steps listed in Setting up the Equipment have been accomplished. Take special note to ground the power section and the high voltage tank 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!***

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

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.

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.

7. First, the cable capacitance must be measured to determine the best operating frequency. Place the control near the cable being tested.

8. Connect the input power terminal block to a grounded 230 v (+/-10%), 50/60 Hz source. A generator is an acceptable power source.

9. Turn on the main circuit breaker. The MAIN POWER light will illuminate at both the power section and the control.

10. Operate the METER MODE to μF position. Adjust the CAP ZERO for full scale deflection (ZERO) on the meter.

11. Connect the HOT post to the center conductor of the test cable. Connect the COM post to the grounded shield of the test cable. Read the CAPACITANCE scale(x10).

12. If the reading is below 6.0μF (about 6 divisions on x10 multiplier) depress the x1 pushbutton. Then following table provides operating frequency versus capacitance.

Capacitance	Frequency
.55μF or less	.1 Hz
1.1μF or less	.05Hz
2.2μF or less	.02Hz
5.5 μF or less	.01Hz

CAUTION

POTENTIALLY LETHAL VOLTAGES MAY BE PRESENT

13. Connect the output lead from the cable reel to the test sample through the External Energy Dissipation Resistor. 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.

14. Place the OUTPUT MODE in the BURN position

15. With the OUTPUT control at zero (zero start interlock engaged), depress the HV ON pushbutton. The HV ON light will glow. At this time the pump and fan on the high voltage section will also energize. ***If this is the first test at this location, leave the output control at zero and allow the pump to circulate oil for 5 minutes prior to raising the output voltage and starting the test. This will purge air from the cooling system***

16. Increase the output by operating the HIGH VOLTAGE control to the RAISE position until full output voltage is reached. Observe the OUTPUT PERCENT meter to rough in the set voltage. Please recognize that the output cycle is: 100 seconds for a full sine wave @.01 Hz, 50 seconds fro a full sine wave @ .02 Hz, 20 seconds for a full sine wave @ .05 Hz, and 10 seconds for a full sine wave @ .1 Hz. . To set the output voltage you may need more than one cycle to read the output accurately.

17. When the load faults, the BURN reactor is switched into the primary of the high voltage tank. This reactor will limit the fault current to the maximum rating for the test set. The fault current will flow only while the VLF output is above ground. As the output reaches zero and changes polarity, the fault current will extinguish. The fault current will

re-initiate when the output voltage has reached the fault break-over voltage in the next half of the output wave.

18. Maintain the BURN mode voltage until the cable has sufficiently burned to a low impedance fault, as indicated on the unit Kilovoltmeter and conventional fault locating techniques can be used. Most cable fault locators must operate from 10 - 36kVdc.

19. After the test is complete, depress the HIGH VOLTAGE control in LOWER position, allowing the load to return to zero and the unit to cycle for about 60 more seconds prior to depressing the HV OFF pushbutton. Allowing the unit to cycle for some time allows for the complete discharge of the load and avoiding the normal self-recharge that capacitive loads will exhibit.

20. Prior to removing the output cable from the load, observe that the output voltmeter is at zero, and then use a GROUND STICK to positively ground the test sample.

WARNING

DO NOT OPERATE THE VLF HIPOT SET IF THE HIGH VOLTAGE TANK IS 5° OR MORE FROM LEVEL.

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ON IT'S SIDE

Recommended VLF Test Voltage Levels A-and Durations

With much of the world abandoning DC testing of solid dielectric cable, VLF AC hipots are becoming widely used. Since an AC test is a proof (or withstand) test on a go/no-go (or pass/fail) basis, the test voltage is applied for a set duration. The cable being tested either holds the test voltage or fails. The question arises, and there is and has been much debate, as to the proper test voltage and the time length of the test. There are differing recommendations and standards in existence that define voltage level and duration. Here we will attempt to summarize what exists and offer recommendations.

5.1 General VLF testing

5.1.1 VLF test parameters

During a VLF test an electrical tree at the site of an insulation defect is forced to penetrate the insulation. Inception of an electrical tree and channel growth time are functions of test signal frequency and amplitude. For an electrical tree to completely penetrate the insulation during the test duration, VLF test voltage levels and testing time durations have been established for the two most commonly used test signals, the cosine-rectangular and the sinusoidal wave shapes.

The voltage levels (installation and acceptance) are based on most-used practices world-wide of between 2 Uo and 3 Uo, where Uo is the rated voltage for cables rated between 5 kV and 35 kV. The maintenance test level is about 80% of the Acceptance test level. One can reduce the test voltage another 20% if more test cycles are applied (Bach [B2]; Baur, Mohaupt, and Schlick [B5]; Krefter [B16]).

Table 4 and Table 5 list voltage levels for VLF withstand testing of shielded power cable systems using cosine-rectangular and sinusoidal waveforms (Bach [B2]; Eager et al. [B7]; Krefter [B16]; Moh [B17]. For a sinusoidal waveform the rms is 0.707 of the peak value if the distortion is less than 5%.

VLF test voltage for sinusoidal waveform (see Note 1)

Waveform Sinusoidal	Cable System Rating (Phase to Phase) [kV]	Installation (Phase to Ground)		Acceptance (Phase to Ground)		Maintenance (Phase to Ground)	
		[kV rms]	[kV peak]	[kV rms]	[kV peak]	[kV rms]	[kV peak]
	5	9	13	10	14	7	10
	8	11	16	13	18	10	14
	15	19	27	21	30	16	22
	20	24	34	26	37	20	28
	25	29	41	32	45	24	34
	28	32	45	36	51	27	38
	30	34	48	38	54	29	41
	35	39	55	44	62	33	47
	46	51	72	57	81	43	61
	69	75	106	84	119	63	89

NOTES

1—For sinusoidal VLF the voltages are given in both rms and peak values. For a sinusoidal waveform the rms is 0.707 of the peak value if the distortion is less than 5%.

2—The results of field tests on over 15000 XLPE cable circuits tested showed that ~68% of the recorded failures occurred within 12 minutes, ~89% within 30 minutes, ~95% after 45 minutes, and 100% after 60 minutes (Moh [B17]). **The recommended testing time varies between 15 and 60 minutes, although the data in Moh** [B17] **suggest a testing time of 30 minutes.** The actual testing time and voltage may be defined by the supplier and user and depend on the testing philosophy, cable system, insulation condition, how frequently the test is conducted, and the selected test method. Testing databases or Eager et al. [B7] may be consulted when choosing a preferred testing time. When a VLF test is interrupted, it is recommended that the testing timer be reset to the original time when the VLF test is restarted.

3—For a 0.1 Hz VLF test voltage, the suggested maintenance voltage duration is 15 minutes (Eager et al. [B7]).

VLF testing methods utilize AC signals at **frequencies in the range of 0.01 Hz to 1 Hz**. The most commonly used, commercially available **VLF test frequency is 0.1 Hz**. Other commercially available frequencies are in the range of 0.0001 Hz to 1 Hz. These frequencies may be useful for diagnosing cable systems where the length of the cable system exceeds the limitations of the test system at 0.1 Hz, although there is evidence that testing below 0.1 Hz may increase the risk of failure in service following the test in Moh [B17]. The internal impedance of the test set can limit the available charging current, preventing the cable under test from reaching the required test voltage. Testing databases; Eager et al. [B7]; or Baur, Mohaupt, and Schlick [B5] may be consulted when selecting an initial test voltage level and testing time duration for a particular cable length.

Typical Recommendations

[It comes down to engineering compromises. One can test for an hour (which is too long for many users in this country) and catch all defects, or test for 25 – 30 minutes and be satisfied that the great majority of defects were grown to failure and be willing to live with a 2 – 3% in-service failure rate over the next few years on cables that passed the VLF test. Even at 3%, the in-service failure rate would be less by multiples than if the cable was never tested or tested with DC voltage.

In addition to the years of European and North American research, an extensive review of VLF testing performed in Japan by Furukawa Electric indicated that if a cable passes a VLF test at 3Vo for 15 minutes, there is a 97% chance that the cable will not fail in service for at least three years. This data is consistent with other users experiences.]

The goal is to test for a long enough time and at a high enough voltage to grow existing insulation defects thru to failure but not aggravate minor defects that would not have resulted in an in-service failure in the next 5 – 10 years. The test duration is 30 minutes at a voltage of 2.5 - 3Vo at 0.1 Hz. Very important in VLF testing is that should a failure occur, the cable must be retested following the repair. Once the cable holds voltage for the full duration, one can be satisfied that 95+% of the cables tested will not contain any further defects that will result in in-service failures in the next few years.

Other data and knowledge of the cables tested is helpful. For instance, if a cable fails twice during a VLF test, both times the insulation and not accessories, then you may want to consider not continuing the test if it is known that the cable is very old and it or like cables have a history of high failure rate. Maybe stop testing, rather than cause multiple failures, and mark that cable for replacement soon. If the failures are to the accessories, then keep testing, as the VLF is a great splice checker for material problems and/or workmanship.

All of the above numbers apply to VLF testing at 0.1Hz. If lower frequencies are used, the test duration should be longer. At 0.1Hz, the period of the sine wave is 10 seconds with a peak voltage applied every 5 seconds. At 0.05 Hz, a peak voltage is applied every 10 seconds. We suggest that if using 0.05 Hz the test time be doubled and perhaps tripled if using lower frequencies. Lower test frequencies are sometimes necessary for testing highly capacitive loads; very long cables. (Most HVI models are powerful enough to allow testing all three phases at once.)

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SECTION 3

PERFORMING SPECIAL OPERATIONS

The following section contains information on the care and upkeep of your new VLF SERIES AC Hipot. There are some notes on troubleshooting and service, which will save much time and money over the life of the unit.

Meter Re-calibration

The VLF SERIES of AC hipots uses precision metal film resistors for measurement and calibration of the voltmeter. The use of these resistors in both the high voltage tank and the metering circuits has minimized circuit drift due to aging and temperature. But, a potentiometer (R4) on the voltmeter PCB can be used to correct for movement changes from the aging of the meter.

The certification of meters on a yearly basis is recommended to ensure accurate test results.

Voltmeter Re-calibration

1. Locate the unit in a position that will allow easy reading of the meters.
2. Remove the panel screws and support the panel vertically to gain access to the calibration pot on the back of the voltmeter.
3. Zero the meter movement using the zero adjustment below the scale window.
4. Perform the steps in **Setting up the Equipment** at the start of SECTION 2. Be sure to ground power section and high voltage tank to a solid earth ground prior to connecting the unit to input power.
5. Connect the output cable to a calibrated reference meter with ability to read to the full output voltage of the unit. Be sure to ground the low side of the meter.

6. Raise the output to one half scale on the unit meter. Adjust R4 as required.

7. Check calibration at both half and full scale. If the customer facility calibration certification requires more points of reference, follow those procedures instead of these.

Current Meter Re-calibration

1. Locate the unit in a position that will allow easy reading of the meters.

2. Remove the panel screws and support the panel vertically to gain access to the calibration pot on the back of the front panel near the current meter..

3. Zero the meter movement using the zero adjustment below the scale window.

4. Perform the steps in Setting up the Equipment at the start of SECTION 2. Be sure to ground power section and high voltage tank to a solid earth ground prior to connecting the unit to input power.

5. Connect the output cable to a calibrated reference meter with ability to read to the full output current of the unit. A series limiting resistor should be used to allow adjusting the current in controllable increments. Be sure to ground the low side of the meter.

6. Raise the output current to one half scale on the unit meter. Adjust R6, located on the base of the control as required.

7. Check calibration at both half and full scale. If the customer facility calibration certification requires more points of reference, follow those procedures instead of these.

Miscellaneous

Oil Insulated High Voltage Tanks

The oil-filled tanks in all the VLF SERIES of hipots are field serviceable. The only requirement is that the tank must be oil filled under vacuum at re-assembly. The parts to service the tank are available from HIGH VOLTAGE, INC. at the address noted on the inside front cover of this manual.

The oil level in the tank should be .50 - .75 inches from the lid when the oil temperature is 20°C.

Weekly Maintenance Schedule

Weekly maintenance must be developed for each individual customer and their particular needs. The typical regular maintenance items are:

1) Keep output cable insulation and HV tank well clean. Use a clean cloth and mild solvent oil (like WD40) to remove dirt and carbon marking from use.

2) Watch for accumulation of dust or foreign matter in the cooling ports on the HV tank. Clean with a damp cloth as necessary.
3) Watch for loose clamps on the interconnect cable. Tighten as necessary.

Yearly Maintenance Schedule

Yearly Maintenance schedules must be developed for each individual customer and their particular needs. The typical required yearly maintenance items are:

1) Calibration verification.
2) Thorough cleaning of the control and cooling section of the high voltage tank.
3) Replacing the oil filter if necessary. Approximately every 2000 hours of use.
4) Replace the thermal overload on the panel if the set has been used to burn or condition cables for fault locating.

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.

REPLACEMENT PARTS ORDERING

To order replacement parts, first refer to the Parts List for the product in question. Every part is issued a part number. It will be necessary for this part number and the product model and serial number to be provided. When calling High Voltage, Inc. request the Service Department.

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,

[Section 9.c.ii. continued on page 2]

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 subect 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]

ISO 9001 : 2008

HIGH VOLTAGE INC.

VLF HIPOT INSTRUMENTS

PRODUCT SUMMARY

Advanced test equipment for high voltage proof and preventive maintenance testing of electrical apparatus +1.518.329.3275 | sales@hvinc.com | web: www.hvinc.com

DC Hipot/Megohmmeter Test Sets

Two Testers in One

80 kVdc
10 mA

100 kVdc
10 mA

**Top DC
Bucket Truck Tester

600 kVDC @ 5mA

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

300 kVac
7 kVA

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

Bucket Truck Tester

** Top AC
Great for other
AC applications

Oil Dielectric Testing

Standard & Micro Controlled

60 kVac & 100 kVac models

60 kVac
.5/2/3 kV/sec
Digital Display

60 kVac
Fully Programmable
Panel Printer

Very Low Frequency AC Technology

Cables & Motors/Generators

0.1 – 0.01 Hz up to 200 kVac

VLF

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.

62 kVac peak - sine wave
0.1 – 0.01 Hz to 5.5 uF
Wind Farm Model

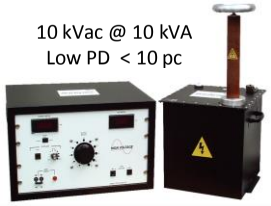
** **New Solid State Design**
34 kV peak - sine wave
0.1 – 0.01 Hz to 7 uF

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

AC Testing of High Capacitance Loads – up to 300 kVac

100 kVac
10 kVA
PD <10 pc

5 kVac @ 1 A
Motor Testing



10 kVac @ 10 kVA
Low 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

VLF - TD
* Pair *

TD-34E
0-34 kV

TDB-60 0 - 60 kVac

TD/PD Meas.
40 – 200 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 *

HVI Products 10/2015

HVI – Excellence in Design, Manufacturing, & Support **Made in the USA** *The World's Source for Field & Factory HV Test Equipment*

Parts List VLF-12011CMF (230V 50/60 Hz)

REF.	QTY	HVI#	DESCRIPTION
			Power Section-VLF-12011CM
			Part No: VLF-1066S
B1	1	17-020	FAN, 4.75 INCH, 115V 50/60Hz
	2	17-036	FAN GUARD, NEWARK # 92N4685
B2	1	24-140	MOTOR, DC GEAR, 3.46 RPM, 24 Vdc, COLMAN # DDQE-7001-771
C1	1	03-075	CAPACITOR, ELECTROLYTIC, RADIAL LEADS, 4700µF, 50Vdc, MOUSER # 140-XRL50V4700
C2	1	03-060	CAPACITOR, ELECTROLYTIC, RADIAL LEADS, 100µF, 50Vdc, MOUSER # 140-XRL50V100
C3	1	03-092	CAPACITOR, CERAMIC DISC, 0.1µF, 50Vdc
C4	1	03-130	CAPACITOR, ac OVAL CAN, 4µF, 440 Vac
C4,5	2	03-188	CAPACITOR, CERAMIC DISC, .01µF, 3kV
CAB	1		CABINET, TANK MOUNT, HVI # CSE-0011D REV A
CB1	1	06-127	CIRCUIT BREAKER, 30A , 250Vac , 2 POLE, AIRPAX # UPGH66-1-72-303-01
CT1	1	T-080	CURRENT TRANSFORMER, HVI # 080
F1,2	2	06-032	FUSE, 5A, 250V, SLO-BLO, MDA-5
F3	1	06-031	FUSE, 5A, 250V, AGC-5
	3	06-010	FUSE HOLDER, MOUSER # 504-4405
J1	1	07-062	CONNECTOR, BULKHEAD, CIRCULAR, 17 PIN, AMPHENOL # 97-3102A-20-29S
J2	1	07-312	CONNECTOR, BULKHEAD, CIRCULAR PLASTIC, 4 PIN, AMP # 206061-1
	4	07-302	CONNECTOR, PIN, AMP#1-66103-5
J3,4	2	07-206	CONNECTOR, COAX BNC, AMPHENOL # 1094/U
J5	1	07-052	CONNECTOR, BULKHEAD, CIRCULAR, 14 PIN, AMPHENOL # 97-3102A-20-27S
J6	1	07-308	CONNECTOR, BULKHEAD, CIRCULAR PLASTIC, 4 PIN, AMP # 206430-1
	4	07-304	CONNECTOR, SOCKET, AMP#1-66105-6
K1	1	11-154	CONTACTOR, 3PST , 30A, 120 Vac COIL, SQUARE-D # DPA-33V02, WWG # 5B118
L1	1	T160	LINE REACTOR, 230 V, 4kVA, HVI # 160
LF1	1	03-912	LINE FILTER, 250V, 30A
MOT. CONT.	1	24-130	MOTOR CONTROL BOARD, DC DRIVER, # KBIC-120
	1	24-135	HORSE POWER RESISTOR, # 9835
MOV1-3	3	06-216	METAL OXIDE VARISTOR, # V275LA40B
NE1	1	15-114	NEON LAMP, #NE2
P1	1	07-068	CONNECTOR, CABLE, CIRCULAR, 17 PIN, AMPHENOL # 97-3108B-20-29P
	1	07-082	CONNECTOR CLAMP, AMPHENOL # AN3057-12
P2	1	07-310	CONNECTOR, CABLE, CIRCULAR PLASTIC, 4 PIN, AMP # 206060-1
	1	07-314	CONNECTOR, CLAMP, AMP # 206062-1
	4	07-304	CONNECTOR, SOCKET, AMP#1-66105-6
P5	1	07-056	CONNECTOR, CABLE, CIRCULAR, 14 PIN, AMPHENOL # 97-3108B-20-27P
	1	07-082	CONNECTOR CLAMP, AMPHENOL # AN3057-12
P6	1	07-306	CONNECTOR, CABLE, CIRCULAR PLASTIC, 4 PIN, AMP # 206429-1
	1	07-314	CONNECTOR, CLAMP, AMP # 206062-1
	4	07-302	CONNECTOR, PIN, AMP#1-66103-5
SG1	1	06-213	SPARK GAP, 230V, CP CLARE # CG230L

PCB-038			**ARC DETECTOR OVERLOAD/BURN ADJUST**
C1	1	03-040	CAPACITOR, ELECTROLYTIC, RADIAL LEADS, 1µF, 50Vdc, MOUSER # 140-XRL50V1.0
D1,2	2	04-415	DIODE, FULL WAVE BRIDGE, 1.5A, 1kVdc, MOUSER # 583-RB157
J1	1	07-136	CONNECTOR, HEADER, 8 PIN, .1" SPACING, MOLEX # 22-23-2081
J2	1	07-134	CONNECTOR, HEADER 7 PIN, .1" SPACNG, MOLEX # 22-23-2071
P1	1	07-120	CONNECTOR, CABLE, 8 PIN, .1" SPACNG, MOLEX # 22-23-2071
P2	1	07-118	CONNECTOR, HEADER 7 PIN, .1" SPACNG, MOLEX # 22-23-2071
	15	07-103	CRIMP TERMINALS, MOLEX # 08-50-0108
PCB	1	14-038	PRINTED CIRCUIT BOARD, HVI # PCB-038
R1-3	3	01-220	RESISTOR, METAL FILM, 1/2W, 200 OHM, 1%
R4	1	01-150	RESISTOR, METAL FILM, .25W, 100K, 1%
R5	1	01-124	RESISTOR, METAL FILM, .25W, 24.9K, 1%
R6	1	02-110	RESISTOR, POTENTIOMETER, 0.5W, 10K, 25T, MOUSER # 72-T93YB-10K
R7	1	01-100	RESISTOR, METAL FILM, .25W, 10K, 1%
SG1	1	06-205	SPARK GAP, 90V , CP CLARE # CG90L
SG2	1	06-213	SPARK GAP, 230V, CP CLARE # CG230L
RY1,2	2	11-110	RELAY, PCB MOUNT, SPDT, 24 Vdc COIL, P&B # T70L5D131-24

PCB-013SB			**ADJUSTABLE AC/DC OVERLOAD (SCHEMATIC # PCB-013SB)**
C1	1	03-060	CAPACITOR, ELECTROLYTIC, 100µF, 50V
C2	1	03-092	CAPACITOR, POLYESTER FILM, 0.1µF, 50V
C3	1	03-045	CAPACITOR, ELECTROLYTIC, 4.7µF, 50V
C4	1	03-085	CAPACITOR, CERAMIC, .01, 50V
D1	1	04-415	DIODE, FULL WAVE BRIDGE, 1.5A, 1kVdc, MOUSER # 583-RB157
D2-5	4	04-010	DIODE, SWITCHING, 1N4148
D6	1	04-025	DIODE, SWITCHING, 1N4007
J1	1	07-140	CONNECTOR, HEADER, 14 PIN, .1" SPACING, MOLEX # 22-23-2141
LED1	1	15-120	LIGHT EMITTING DIODE, WATER CLEAR, RED
MOV1	1	06-207	METAL OXIDE VARISTOR, # V130LA10A
P1	1	07-124	CONNECTOR, TERMINAL HOUSING, 14 CIRCUIT, .1" SPACING, MOLEX #22-01-3147
	14	07-103	CRIMP TERMINALS, MOLEX # 08-50-0108
PCB	1	14-013	PRINTED CIRCUIT BOARD, HVI # PCB-013
Q1	1	05-345	SEMICONDUCTOR, VOLTAGE REGULATOR, 15 V POS, .5 A, # 7815CP
Q2	1	05-310	SEMICONDUCTOR, TRANSISTOR, PNP , #TIP42
R1,2,4,7	4	01-150	RESISTOR, METAL FILM, .25W, 100K, 1%
R3	1	01-162	RESISTOR, METAL FILM, .25W, 300K, 1%
R5	1	01-060	RESISTOR, METAL FILM, .25W, 1K, 1%
R6	1	01-100	RESISTOR, METAL FILM, .25W, 10K, 1%
T1	1	25-319	TRANSFORMER, STEP-DOWN, MAGNETEK # VPP28-180
U1	1	05-235	INTEGRATED CIRCUIT, OP-AMP, # CA3140E
xU1	1	05-265	SOCKET, IC, 8 PIN DIP
PL1	1	15-130	PILOT LIGHT, 250V, NEON, WHITE, IDI # 1051QC4

REG ASM			**SINE WAVE REGULATOR ASSEMBLY**
C1	1	03-130	CAPACITOR, ac OVAL CAN, 4µF, 440 Vac
B1	1	24-205	MOTOR, 11 RPM, 90VDC, WWGRAINGER # 4Z535
D1-5	5	04-025	DIODE, 1N4007
D6	1	04-415	DIODE, FULL WAVE BRIDGE, 1.5A, 1kVdc, MOUSER # 583-RB157
F1	1	06-021	FUSE, 1A, 250V, AGC-1
	1	06-010	FUSE HOLDER, MOUSER # 504-4405
RY1	1	11-114	RELAY, LATCHING, DPDT, 24 Vdc COIL, P&B # S89R11DBD1-24
RY2-6	5	11-112	RELAY, DPDT, 24 Vdc COIL, MIDTEX # 25862C200
S1-5	5	10-321	SWITCH,MAGNETIC REED SENSOR, HAMLIN #59025-010
T1	1		TRANSFORMER, VARIABLE, SUPERIOR TYPE 236
	1		FACE CAM, HEART PATTERN, HVI # VLF-1022D REV A
	1		SWITCH PLATE, HVI # VLF-1249D
	1		BASE PLATE, HVI # VLF-1250D
	1		BEARING/HUB, HVI # VLF-1027D
	1	10-320	MAGNET, REED SWITCH ACTUATOR, HAMLIN #57025-000

RY1-5,7,8	7	11-112	RELAY, DPDT, 24 Vdc COIL, MIDTEX # 25862C200
RY6	1	11-166	RELAY, SOLID STATE, 250V, 40A, 3-32 Vdc CONTROL, MOUSER #518-1140
S1,2	2	10-104	SWITCH, SNAP ACTION, CHERRY #D44LR1RA, WWG# 6X293
T1	1	25-118	TRANSFORMER, VARIABLE, SUPERIOR TYPE 236
T1R1	1	02-205	POTENTIOMETER, 10K, 2W (POSITION INDICATOR)
T2	1	T-138A	TRANSFORMER, AUTO STEP-DOWN, 230/115/24, HVI # 138A
TB1	1	08-890	TERMINAL BLOCK, 5 POS., 30A, CINCH # 5-142
TB2	1	08-902	TERMINAL BLOCK, 18POS., 20A, CINCH # 18-141
VR1	1	05-345	VOLTAGE REGULATOR, 15V, .5A, TO-220 , MOUSER # 511-L78M15CV
MISC. CABLES	1 SET		CABLE, INTERCONNECT, 16/14 COND / 4 COND, 20 ft., POWER SECTION TO HV
	1 SET		CABLE, INTERCONNECT, 18/18 COND / 4 COND, 20 ft., POWER SECTION TO CONTROL
	2		CABLE, COAX, RG58/U, BNC-BNC, 20 ft., POWER SECTION TO CONTROL
	2		TEST LEAD, (1) RED, (1) BLACK, 20 FT., CAPACITANCE MEASURING LEADS.
	1		CABLE, BNC-BNC, RG58/U, 6 ft.

REMOTE CONTROL VLF-12011CM

Part No. VLF-1065S

AL	1	16-010	ALARM, SONALERT, 24-110 Vac/dc, SONALERT # SC110
BP1	1	08-845	BINDING POST, RED, # BP-10R
BP2	1	08-848	BINDING POST, GREEN, # BP-10DG
C1	1	03-105	CAPACITOR, METALIZED POLYPROPYLENE, 0.22µF, 250v
CAB	1	32-013	CABINET, PORTABLE. METALLIC GRAY, BUD #2142
D1-6	6	04-025	DIODE, 1N4007A
J1	1	07-064	CONNECTOR, CABLE, CIRCULAR, 17 PIN, AMPHENOL # 97-3102A-20-29P
J2	1	07-308	CONNECTOR, BULKHEAD, CIRCULAR PLASTIC, 4 PIN, AMP # 206430-1
	4	07-304	CONNECTOR, SOCKET, AMP#1-66105-6
J3-5	3	07-206	CONNECTOR, BNC, AMPHENOL # UG-1094A/U
J6	1	07-440	CONNECTOR, BULKHEAD, 2 SOCKET, CINCH # S302AB
LED1	1	15-120	LIGHT EMMITTING DIODE, RED WATER CLEAR, MOUSER # 35CA004
LED2	1	15-122	LIGHT EMMITTING DIODE, GREEN WATER CLEAR, MOUSER # 35CA005
M1	1	13-316	METER, ANALOG, 100 µA MOVEMENT, SCALED 0-120 PEAK KILOVOLTS
M2	1	13-321	METER, ANALOG, 100 µA MOVEMENT, SCALED 0-100 PEAK MILLIAMPERES/6.0-0uF
M3	1	13-330	METER, ANALOG, EDGEWISE, 100 µA MOVEMENT, SCALED 0-100 OUTPUT PERCENT
MOV1	1	06-210	METAL OXIDE VARISTOR, # V250LA20A
P1	1	07-066	CONNECTOR, CABLE, CIRCULAR, 17 PIN, AMPHENOL # 97-3108B-20-29S
	1	07-082	CONNECTOR, CABLE CLAMP, AMPHENOL #97-3057-12
P2	1	07-310	CONNECTOR, CABLE, CIRCULAR, AMP# 206060-1
	1	07-314	CONNECTOR, CABLE CLAMP, AMP#206062-1
	4	07-304	CONNECTOR, SOCKET PIN, AMP#1-66105-6
P6	1	07-442	CONNECTOR, CABLE, 2 CIRCUIT, CINCH# P302CCT
PL1	1	15-130	PILOT LIGHT, 250V, NEON, WHITE, IDI # 1051QC4

PCB-001-VLF12	1		PRINTED CIRCUIT BOARD, HVI # 001 VOLTMETER BOARD
C1	1	03-070	CAPACITOR, ELECTROLYTIC, RADIAL LEADS, 1000µF, 50 Vdc, MOUSER # 140-XRL50V1000
D1	1	04-025	DIODE, 1N4007A
D2	1	04-415	DIODE, FULL WAVE BRIDGE, 1.5A, 1kVdc, MOUSER # 583-RB157
J1	1	07-136	CONNECTOR, HEADER, 8 PIN, .1" SPACING, MOLEX # 22-23-2081
PCB	1	14-001	PRINTED CIRCUIT BOARD, HVI #PCB-001
R1	1	01-154	RESISTOR, METAL FILM, 0.25W, 200K, 1%
R2	1	01-156	RESISTOR, METAL FILM, 0.25W, 249K, 1%
R3	1	01-086	RESISTOR, METAL FILM, 0.25W, 4.02K, 1%
R4	1	02-016	RESISTOR, POTENTIOMETER, 0.25W, 5K, MOUSER # 569-25PR-5K
R5,6	2	01-310	RESISTOR, CARBON FILM, 1W, 1K, 5%
RY1	1	11-110	RELAY, PCB MOUNT, SPDT, 24 Vdc COIL, P&B # T70L5D131-24

PCB-030			**CURRENT METER PCB**
C1	1	03-095	CAPACITOR, METALLIZED POLYESTER FILM, 4.7 µF, 100 Vdc, MOUSER # 1430-1475
C2	1	03-090	CAPACITOR, METALLIZED POLYESTER FILM, 0.1 µF, 100 Vdc, MOUSER # 1430-1104
D1,2	2	04-025	DIODE, 1N4007A
D3,4	2	04-415	DIODE, FULL WAVE BRIDGE, 1.5A, 1kVdc, MOUSER # 583-RB157
J1	1	07-136	CONNECTOR, HEADER, 8 PIN, .1" SPACING, MOLEX # 22-23-2081
P1	1	07-120	CONNECTOR, CABLE, 8 PIN, .1" SPACING, MOLEX # 22-01-2087
J2	1	07-140	CONNECTOR, HEADER, 14 PIN, .1" SPACING, MOLEX # 22-23-2141
P2	1	07-124	CONNECTOR, CABLE, 14 PIN, .1" SPACING, MOLEX # 22-01-2147
	22	07-104	CONNECTOR PINS, .1" SPACING, MOLEX # 08-50-0114
PCB	1	14-030	PRINTED CIRCUIT BOARD, HVI #PCB-030
R1	1	01-154	RESISTOR, METAL FILM, 0.25W, 200K, 1%
R2	1	02-120	RESISTOR, POTENTIOMETER, 0.50 W, 1M, 20T, MOUSER # 72-T93YB-1M
R3	1	01-482	RESISTOR, WIREWOUND, 25 W, 22Ω, 1%, MOUSER # 71-RH25-22
R4	1	01-370	RESISTOR, WIREWOUND, 5.0 W, 250Ω, 1%, MOUSER # 71-RS5-250
R5	1	01-368	RESISTOR, WIREWOUND, 5.0 W, 200Ω, 1%, MOUSER # 71-RS5-200
R6	1	01-144	RESISTOR, METAL FILM, 0.25W, 62K, 1%
R7-9	3	01-310	RESISTOR, CARBON FILM, 1W, 1K, 5%
RY1,2	2	11-110	RELAY, PCB MOUNT, SPDT, 24 Vdc COIL, P&B # T7NS5D1-24

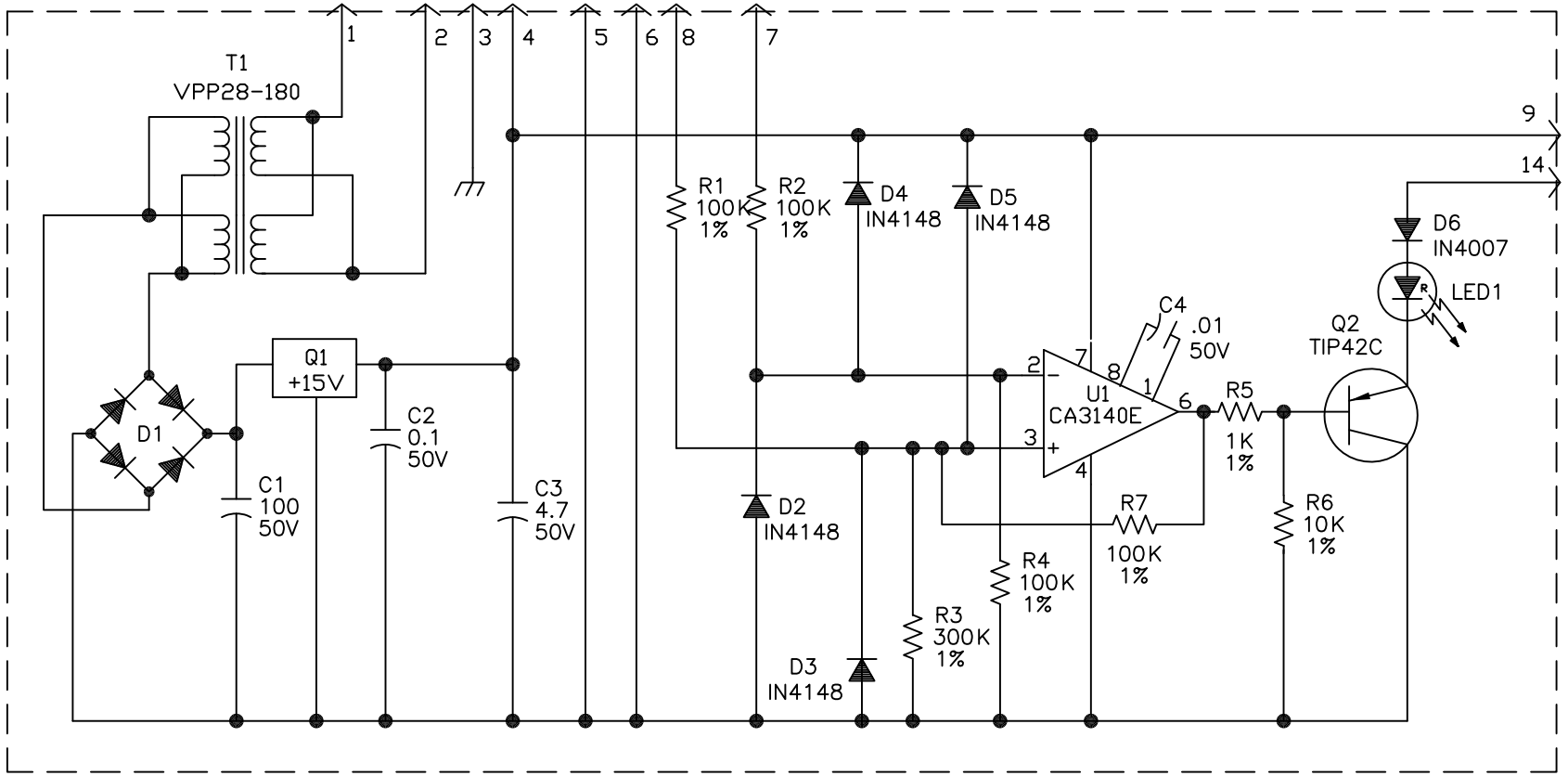
R1	1	01-096	RESISTOR, METAL FILM, .25W, 7.5K, 1%
R2	1	01-130	RESISTOR, METAL FILM, .25W, 30K, 1%
R3	1	01-090	RESISTOR, METAL FILM, .25W, 4.99K, 1%
R4,5	2	02-106	RESISTOR, POTENTIOMETER, 0.5 W, 5K, 25T, MOUSER # 594-64Y502
R6	1	02-206	RESISTOR, POTENTIOMETER, 2.0 W, 50K, 1T
R7	2	01-3991	RESISTOR, METAL FILM, 10W, 20Ω, 1%, NEWARK #03F5296
RY1,2	2	11-112	RELAY, DPDT, 24 Vdc COIL, MIDTEX # 25862C200
S1,8	2	10-514	SWITCH, ROTARY, 6 POL., 2 POS., NON-SHORTING, MOUSER # 10YX062
S2,4	2	10-218	SWITCH, PB, MOM., 125 Vac, 15A, SPDT, RED LED, MICROSWITCH # AML22CBC2AA
S3	1	10-222	SWITCH, PB, MOM., 125 Vac, 15A, SPDT, GRN LED, MICROSWITCH # AML22CBS2AA
S6	1	10-220	SWITCH, PB, MOM., 125 Vac, 15A, SPDT, YEL LED, MICROSWITCH # AML22CBJ2AA
	4	10-252	SWITCH, PB COVER, BLACK, MICROSWITCH # AML52-C10K
S5	1	10-404	SWITCH, SPRING LOADED ROCKER, EATON ARROW-HART #1506-11E, NEWARK# 95F4248
S7	1	10-206	SWITCH, PB, MOM, NC, BLACK, T&B # MSPF-101B, NEWARK # 11F402
S9	1	10-506	SWITCH, ROTARY, 3 POL., 4 POS., NON-SHORTING, MOUSER # 10YX034
T1	1	25-306	TRANSFORMER, STEP-DOWN, 115/24V C.T. @ 1 AMP, 50/60 Hz, STANCOR # TGC25-24
TM	1	16-06P	TIMER, DIGITAL, OMRON # H5CX-L8D
		16-066P	TIMER PANEL MOUNT ADAPTOR
		16-066S	TIMER SOCKET
	1		PANEL, CONTROL, HV # VLF-1063D REV D
	1	08-898	TERMINAL BLOCK, 15 AMP, 15 POS., CINCH # 15-140
	3	23-119	KNOB, SKIRTED, POINTER, ALCO # PKD-70B-1/4

HV TANK VLF-12011CM

Part No: VLF-1058S

CR1-4	4	04-230	DIODE, HIGH VOLTAGE X-RAY STRING, 200 kVdc, 220 mA, EDAL # B1552
J1	1	07-050	CONNECTOR, BULKHEAD, CIRCULAR, 14 PIN, AMPHENOL # 97-3102E-20-27P
J2	1	07-312	CONNECTOR, BULKHEAD, CIRCULAR, 4 PIN, AMP # 206061-1
	4	07-302	CONNECTOR PINS, AMP # 1-66103-5
P1	1	07-054	CONNECTOR, CABLE, CIRCULAR, 14 PIN, AMPHENOL # 97-3108B-20-27S
	1	07-082	CONNECTOR, CABLE CLAMP, AMPHENOL #97-3057-12
P2	1	07-310	CONNECTOR, CABLE, CIRCULAR, 4 PIN, AMP # 206060-1
	1	07-314	CONNECTOR, CLAMP, AMP # 206062-1
	4	07-304	CONNECTOR SOCKETS, AMP # 1-66105-6
R1	10	01-470	RESISTOR, WIRE WOUND, 20W, 25K, 5%, DALE #HLW-20-A1Z-25K
R2-5	20	01-478	RESISTOR, WIREWOUND, 20W, 100K, 10%, DALE # HLW-20-A1Z-100K
R6,7	8	01-430	RESISTOR, METAL FILM, 12.5W, 250K, 10%, EBG # SSP52-250K
R8-10	8	01-434	RESISTOR, METAL FILM, 12.5W, 750K, 10%, EBG # SSP52-750K
R11	3	01-442	RESISTOR, METAL FILM, 12.5W, 125M, 1%, EBG # SSX103-125M
R12	2	01-402	RESISTOR, WIREWOUND, 1K, 10W
S1			SWITCH ASSEMBLY, POLARITY, 120 kVac PEAK
SOL1-4	4	12-210	SOLENOID, GUARDIAN # 11HD-C-24D
R1-12	24	01-356	RESISTOR, METAL FILM, 4.6W, 100M, 1%, EBG # SSX39-100M
SOL1-4	4	12-210	SOLENOID, GUARDIAN # 11HD-C-24D
T1	1	T150B	TRANSFORMER, HIGH VOLTAGE, HVI # 150-REV B
	1	34-075	TANK AND HEADER ASSEMBLY, HV # TNK-0018D REV F
	1	33-066S	COOLING SHROUD, HVI # TNK-0046D
	1	17-335	FILTER, PARKER # 12AT03CN15BBLI
	1	17-120	COOLING RADIATOR, NAPA # 660-3334
M1	1	17-020	FAN, 4.75 " MUFFIN
M2	1	17-320	PUMP, LITTLE GIANT # 3-MD-MT-HC
	1	10-752	THERMAL SWITCH, NC,175ºF
MISC. ACC.	1	33-076	PLATFORM TRUCK, 30” WIDE, 60” LONG, 1200lb. CAPACITY, 8” PNEUMATIC WHEELS
	1	87-274	ASSEMBLY, DOUBLE CABLE REEL, WITH 100 ft. HIGH VOLTAGE OUTPUT AND 100 ft. GROUND LEAD, VLF-120
	1	88-004	OUTPUT FLEX CLIP ASSEMBLY
	1	33-006	OUTPUT HOOK ASSEMBLY
	1	R126	RESISTOR, LIMIT, 20 KΩ, 120kVdc, HVI # 126

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



QTY	DESCRIPTION	PART NO.	MAT'L OR NOTE	ITEM
	SCHEMATIC PRINTED CIRCUIT VLF/BURN DETECTOR/ENABLE			

HIGH VOLTAGE

MAT'L		NEXT ASSY	MODEL NO.	PCB-013/BURN
FINISH		UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES DO NOT SCALE DWG TOLERANCES	DRAWN JHW 3/99	DWG NO. PCB-013SB REV. A
		FRACTIONS ±1/64 DECIMALS ±.010 ANGLES 30'	ENGINEER JHW 3/99	SCALE NA SHT 1 OF 1
			APPROVED JHW 3/99	

pcb013sbRa

02/11/99

SCHEMATIC
VLF -120CMF
W/ DATA LOGGER
REMOTE CONTROL

HIGH VOLTAGE LABORATORIES

QTY	DESCRIPTION	PART NO.	MAT'L OR NOTE	ITEM

MODEL NO. VLF-120CMF

MAT'L	NEXT ASSY		
–			
–			
FINISH	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES DO NOT SCALE DWG TOLERANCES		
–	FRACTIONS ±1/64	DECIMALS ±.010	ANGLES 30'

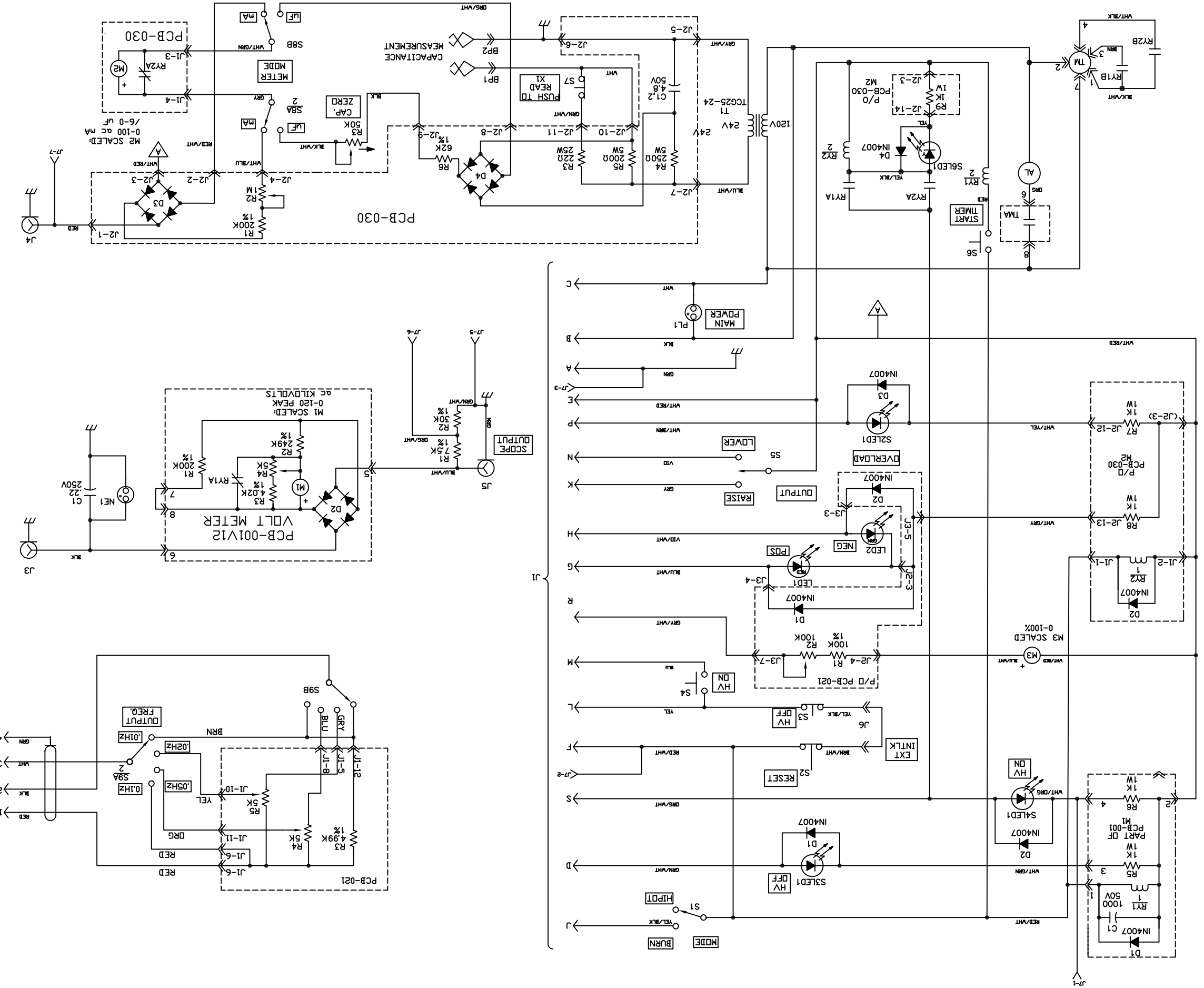
	DRAWN	DATE
	CHECKED	JHW 5/99
	APPROVED	JHW 5/99
	SCALE NA	SHT 1 OF 1

DWG NO. VLF-1065S REV. L

05/30/12

vlf1065R

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	K	REMOVE R7 (NOW ON DATA LOGGER SUB	09/10	BDO



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

INPUT POWER
230V
50/60 Hz
30 A

TB1 CB1 30A LF1 40A LINE FILTER

MAIN POWER

A LINE

B LINE

PL1

FAN B1

RY1A

K1 3

K1B

D2-5= 1N5408

F3 5A

D2-5

C1 4700 50V

T2 #138-A

115V 4A

24V 2A

F1 5A SB

F2 5A SB

C4 .01 3kV

C5 .01 3kV

L2

F1 1A

MOTOR CONTROL BD

L1 P3 P1 P2

TB2

C1 4 440V

MOV3 V275

T1 TYPE 236

K1A

T1 TYPE 236

CT1 #080 2T

L1 #160

RY6A

C4 4 440V

MOV1 V275

MOV2 V275

B1

B2

SINE WAVE REGULATOR ASM

J1 J2 J3 J4 J5 J6

RY1B

RY2B RY3B RY4B RY5B

C2 100 50V

VR1 T1R1 10K P/O T1 ASM

C3 0.1 50V

RY2A RY3A RY4A

RY2 1 RY3 2 RY4 1 RY5 1 RY6 1 RY7 2 RY8 1

S1 U.L.

S1 Z.S.

S2 L.L.

S2 15° S3 30° S4 45° S5 60°

D1 IN4007

RY5A

K1C

NE1

PCB-038
FIXED PEAK O.L.

R1-3 (FA) 200Ω 1% IN PARA

RY7B

SG1 90V

PCB-013SB
VLF/BURN DETECTOR

RY7A RY8A

PCB-038
BURN ADJUST
SET FOR 90mA

R5 24.9K 1%

R6 10K

R7 10K 1%

R4 100K 1%

C1 1 50V

D2

SG2 230V

QTY	DESCRIPTION	PART NO.	MAT'L OR NOTE	ITEM
	SCHEMATIC VLF-120CM AC HIPOT/BURNER POWER SECTION			

HIGH VOLTAGE

NEXT ASSY

MODEL NO. VLF-12011CM

MAT'L –

FINISH –

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES DO NOT SCALE DWG TOLERANCES

FRACTIONS ±1/64 | DECIMALS ±.010 | ANGLES 30'

DRAWN JHW 5/99 | CHECKED JHW 5/99 | APPROVED JHW 5/99

DWG NO. VLF-1066S | REV. 1

SCALE NA | SHT 1 OF 1

vlf1066sRI 12/03/08

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

INPUT
230 VAC
50/60 Hz

X1
X2
A
D
B
C
BLK
WHT
F
S

T1
#150-REV B

CR1-4

CR1-4=
EDAL#B1552

S1 POLARITY SWITCH

SOL1A
SOL2A
SOL3A
SOL4A

R1 100M 4.6W 2 SER
R2 100M 4.6W 2 SER
R3 100M 4.6W 2 SER
R4 100M 4.6W 2 SER
R5 100M 4.6W 2 SER
R6 100M 4.6W 2 SER
R7 100M 4.6W 2 SER
R8 100M 4.6W 2 SER
R9 100M 4.6W 2 SER
R10 100M 4.6W 2 SER
R11 100M 4.6W 2 SER
R12 100M 4.6W 2 SER

HIGH VOLTAGE TANK

R1
25K
20W
10 IN SER

R11
125M
12.5W, 1%
3 IN SER

HV OUTPUT
0-120kVac,
PEAK
.1/.05/.02/.01 Hz FREQ.

R2	R3	R4	R5	R6	R7	R8	R9	R10
100K 20W 5 IN SER	100K 20W 5 IN SER	100K 20W 5 IN SER	100K 20W 5 IN SER	250K 12.5W 4 IN SER	250K 12.5W 4 IN SER	750K 12.5W 3 IN SER	750K 12.5W 3 IN SER	750K 12.5W 2 IN SER

SOL1A,B
SOL2A,B
SOL3A,B
SOL4A-C

L RETURN WHT/GRY

N GND GRN

R12
1K
10W
2 IN PARA

H SOL1 WHT/BRN
I SOL2 WHT/RED
J SOL3 WHT/ORG
K SOL4 WHT/YEL

SOL1 24Vdc 15°
SOL2 24Vdc 30°
SOL3 24Vdc 45°
SOL4 24Vdc 60°

E SOL COM WHT/GRN

SOL1 24Vdc NEG
SOL4 24Vdc NEG
SOL2 24Vdc POS
SOL3 24Vdc POS
PART OF S1

G NEG BLKWHT

F POS RED/WHT

M VM WHT/VIO

J2
1
2
3
4
175°
FAN
PUMP
M1
M2

COOLING
SHROUD
ASM

QTY	DESCRIPTION	PART NO.	MAT'L OR NOTE	ITEM
	SCHEMATIC VLF-120CM HIGH VOLTAGE TANK			

MAT'L –
–
FINISH –
–

NEXT ASSY

MODEL NO. VLF-120CM TANK

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
DO NOT SCALE DWG
TOLERANCES

FRACTIONS ±1/64 | DECIMALS ±.010 | ANGLES 30°

DRAWN	DATE	DWG NO.	REV.
JHW	1/99	VLF-1058S	E
CHECKED JHW	1/99		
APPROVED JHW	1/99	SCALE NA	SHT 1 OF 1

vlf1058sRe
12/11/03