AC DIELECTRIC TEST SET MANUAL
CASCADE TYPE

Model Number 6CP200/100-10

Version 4.3

Phenix Technologies, Inc.
A Division of Doble Engineering
75 Speicher Drive
Accident, Maryland 21520

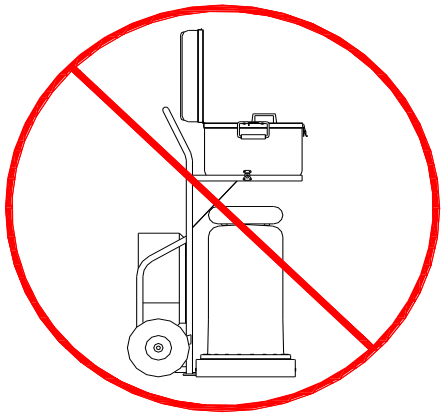
REV:1/11/23 SHB

TABLE OF CONTENTS

DANGER / WARNINGS

WARNING !!

WARNING !



DO NOT OPERATE THE TEST SET
WITHOUT REMOVING HIGH-VOLTAGE
TRANSFORMER FROM THE CART.

THE HIGH-VOLTAGE TRANSFORMER
MUST BE POSITIONED A SAFE DISTANCE
FROM PERSONNEL AND OTHER OBJECTS.

DANGER

Grounding of this unit is necessary for the safe operation of this equipment. Disconnect inputs before ungrounding this equipment

GENERAL SAFETY PRECAUTIONS

This equipment can produce POTENTIALLY LETHAL VOLTAGES!
Improper operation or test practices may result in injury or death to the operator or surrounding personnel.

The operation of High Voltage test equipment should only be performed by personnel familiar with HIGH VOLTAGE testing and safety procedures. The operator of this equipment must be aware of all hazards associated with High Voltage testing. The operator is responsible for himself and others in close proximity of the testing area.

Some General Safety Practices for working with High Voltage Test Equipment have been listed below for your reference.

- **Get familiar with your instrument before performing an actual test**
- **Know your work area, check that all circuits are de-energized and locked out.**
- **Never work alone; always work with another qualified worker.**
- **Mark off entire work area with barriers and warning tape.**
- **Make all personnel aware of your testing activities.**
- **Be aware of dangerous conditions that may arise from energizing a test specimen.**
- **Never modify test equipment, modifications to equipment could introduce an unknown hazard or hinder a designed-in safety feature.**
- **DO NOT operate damaged equipment. Remove power, and do not use the equipment until safe operation can be verified by service-trained personnel.**

Phenix Technologies, Inc. assumes no liability for unsafe or improper use of test equipment.

TECHNICAL SPECIFICATIONS

Input

220-240 volts, single phase, 50/60 Hz, 25 amperes

Output Rating

Series Connection:	200 kilovolts, 50 milliamperes 5 minutes ON / 15 minutes OFF @ 10 kVA
Parallel Connection:	100 kilovolts, 100 milliamperes 5 minutes ON / 15 minutes OFF @ 10 kVA
Single Cylinder:	100 kilovolts, 50 milliamperes 5 minutes ON / 15 minutes OFF @ 5 kVA

Type of Cooling

ONAN (Oil / Air Natural Convection)

Operating Ambient Temperature

10 – 40 degrees C

Output Termination

High Voltage Electrode

Metering

Output Voltmeter:	Display:	3 ½ digit LCD
	Accuracy:	± (0.8% of Reading + 0.2% of Range) + LSD (10-100% of Range)
	Ranges:	0 to 100kV / 200 kV
	Type:	Peak/(Square root of 2)
Output Currentmeter:	Display:	3 ½ digit LCD
	Accuracy:	± (0.8% of Reading + 0.2% of Range) + LSD (10-100% of Range)
	Ranges:	0 to 200µA / 2mA / 20mA / 200mA
	Type:	True RMS

Sizes and Weights

Control/Regulator Section:	21.25” (540mm) W x 16.75" (426mm) D x 13.75" (350mm) H; 220 V – 52 lbs (24 Kg)
High Voltage Cylinder (2):	16" (406mm) W x 16" (406mm) D; X 30” (762mm) H; 178 lbs. (81 kg)
High Voltage Divider:	9" (229mm) W x 9" (229mm) D; X 43” (1092mm) H; 40 lbs. (18 kg)

Additional Equipment

Cart (2):	22.5” (572mm) W x 29.25” (743mm) D x 50” (1270mm) H; 61 lbs. (27.7 kg)
Cables:	20 lbs. (9.1 kg)
Total Unit Weight:	220V – 309 lbs. (140.2 Kg)

SECTION 2: UNCRATING PROCEDURE

GENERAL PROCEDURE

1. Exercise care in removing shipping materials to avoid injury to personnel or damage to the unit. Items in this shipment are large and heavy. Phenix Technologies recommends that 2 persons be assigned to this task.

2. Perform visual inspection to determine if unit was damaged during shipment. If there are any signs of physical damage (such as dents, scratches, oil leaks), contact the factory before proceeding.

For questions or information regarding operation of the Test Set, please refer to the appropriate sections of this manual. Further information is also available from:

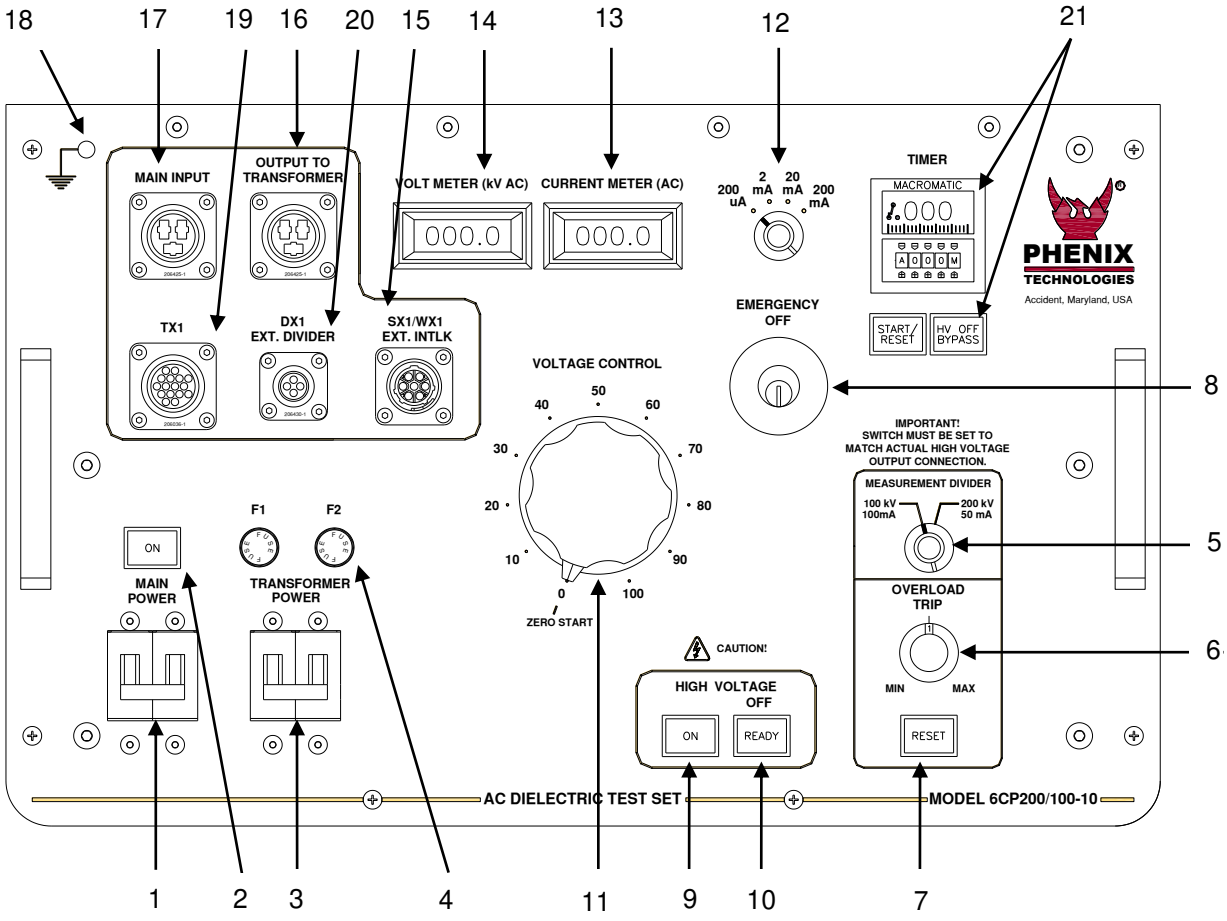
Phenix Technologies' Service Department
75 Speicher Drive
Accident, Maryland 21520

Phone 1 (301) 746-8118
Fax 1 (301) 895-5570
E-mail: info@phenixtech.com

SECTION 3: CONTROLS AND INDICATORS

Control Panel

Figure 3-1



Descriptions are keyed to Figure 3-1

1. **Main Power Circuit Breaker.** Turns main power of unit on and off and provides input overload protection.

2. **Main Power Indicator.** Lights when unit is powered on.

3. **Transformer Power Circuit Breaker**.

4. **F1, F2 Control Power Fuse**.

5. **Measurement Divider Switch**. Selects proper overload and voltmeter circuitry for the HV output terminal being used. Match switch setting to output being used on HV transformer.

6. **Overcurrent Trip**. Use for presetting desired Overcurrent trip setting. Range approximately 10-110% of rated current.

7. **Reset**. Will light when Overcurrent Trip setting is exceeded. Push to reset. Lamp must be extinguished for HV ON.

CONTROLS AND INDICATORS

Control Panel (Cont'd)

8. **Emergency Off switch. Press to i**mmediately shut off all power.

9. **High Voltage On Switch and Indicator Lamp**. Turns on output voltage when Ready indicator is illuminated.

10. **High Voltage Off Switch and Ready Indicator Lamp**. Turns HV off, indicator shows when all conditions are met to turn H.V. ON. (External Interlock closed, Reset Lamp off, Emergency Off Button pulled up, Voltage Control at Zero).

11. **Voltage Control**. Adjusts Output Voltage and must be set at zero to turn High Voltage on.

12. **Currentmeter Range Selector**.

13. **Output Currentmeter**.

14. **Output Voltmeter.**

NOTE: 200kV voltmeter range is calibrated at 80% of range. 100kV range may not be accurate above 100% of range.

1. **SX1**/**WX1**: For security and warning circuits.

    - SX connection provides for user connection of external interlock or auxiliary safety control device such as emergency off switch, gate switch, foot switch, dead man switch, etc. Included plug has shorting jumper installed to complete circuit. Jumper must be removed, and cable connected to user supplied device by user in order to use this provision. Only non-energized switch or dry relay contact devices may be used. This is a 120VAC circuit that must remain closed for high voltage to be active.

    - WX connection provides for user connection of an external warning device such as a warning light, bell or other alarm device. 120VAC is on contacts when high voltage is energized.

15. **Output to Transformer.** High Voltage transformer power connection.

16. **Main Input.** Main input cable connects here.

17. **Ground Terminal.**

18. **TX1**. Provided interconnect cable is connected here and to the same designation connector on the high voltage unit. This is the metering and return connection. **Do not attempt to operate high voltage unit without this cable connected at both ends**

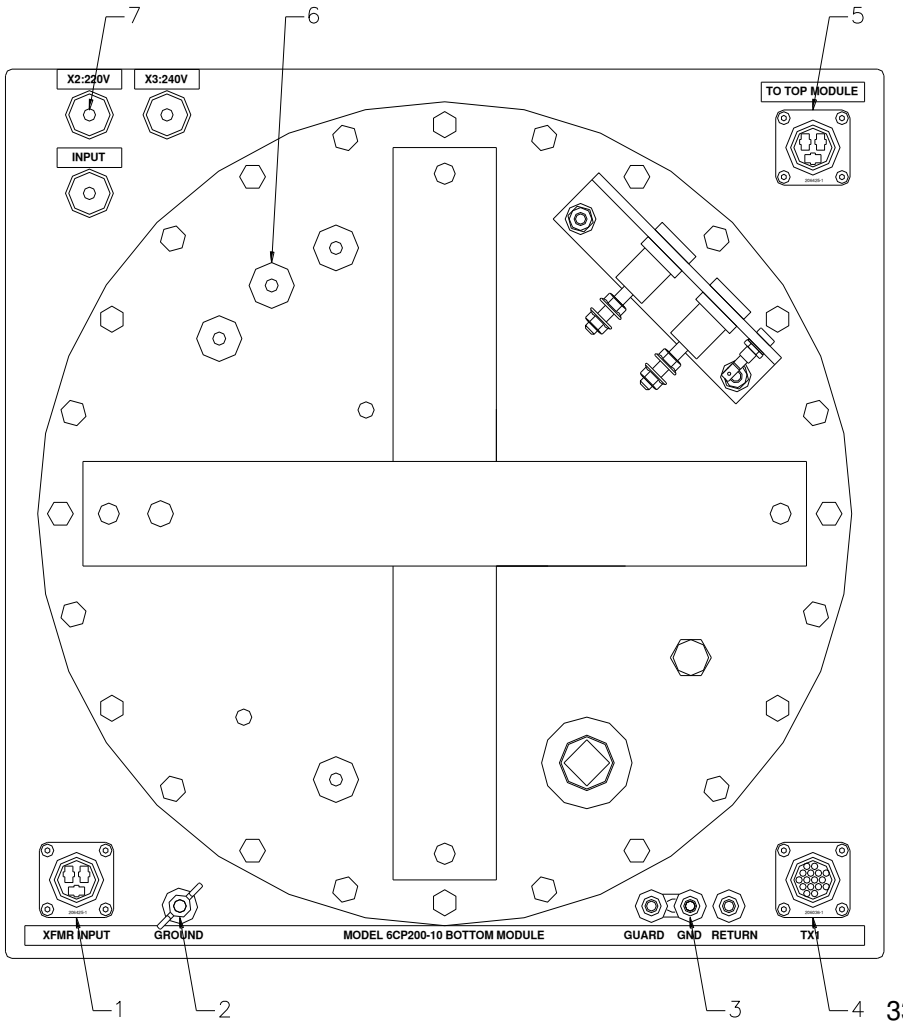
19. **DX1**. Signal/Metering cable between HV Divider and controls connects here.

20. **Timer** Press START/RESET to start the timer after test voltage has been reached. Press START/RESET again to reset timer to the original setting. Press HV OFF BYPASS to allow high voltage to remain on after the timer has expired. Test time can be set using the buttons on the face of the timer.

CONTROLS AND INDICATORS

High Voltage Transformer

Figure 3-2



Descriptions are keyed to Figure 3-2

1. **Power Connector.** Connect the Power Cable from Output to Transformer connector on control box at this point.

2. **High Voltage Ground Point.** A ground cable from facility ground or earth ground must be connected here.

3. **Ground/Guard/Return Circuit.** Select current to be read on currentmeter. Care must be taken to ensure that test specimen can be isolated from ground before using this option.

4. **TX1 Connector.** Signal/Metering cable connects from here to TX1 on control box.

5. **Power Connector.** Connect power cable from this point to multilamm style connectors on Top Module.

6. **Lundeys.** Provide sealed air-to-oil interface for connections.

CONTROLS AND INDICATORS

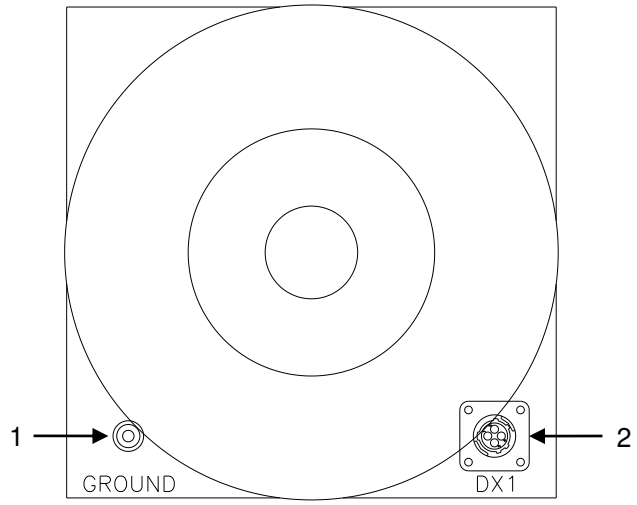
High Voltage Transformer (cont'd)

7. **Input Voltage Select.** This jumper is used to select the input voltage in single cylinder and series operation. In parallel operation, the Top Module connection must match this jumper position.

8. **High Voltage Electrode.** (not shown) Provides connection point for HV output, and provides corona shielding for lundeys and cylinder edge.

High Voltage Divider

Figure 3-3



High Voltage Divider

1. **Ground Stud:** Connection from ground divider.

2. **DX1:** Metering connection between high voltage divider and control/regulator box.

SECTION 4: INITIAL SET-UP / MECHANICAL

MECHANICAL SETUP

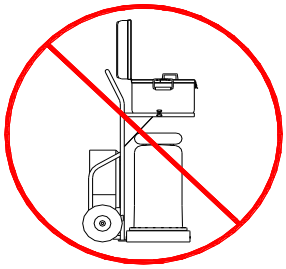
A. Designate an area suitable for electrical testing. The area must provide sufficient mechanical and electrical clearances to perform the test.

B. The test site surface must be strong enough to support the weight of the unit. The approximate weight of each cylinder is available from the respective nameplate. The surface must also be level to prevent the unit from excessively tilting.

NOTICE: *If the unit is being used for PD testing a shielded room and/or grounded floor may be necessary to achieve desired background noise levels. The shielding solution must be installed prior to installing the test set.*

C. Place the test set into position in desired configuration. This test set can be operated in three different configurations, single cylinder, parallel, and series. Reference MREF-012.

WARNING !



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Single Cylinder Configuration
Place only main high voltage cylinder in position for testing and remove the hand cart from the testing area. Install the two-tiered electrode on the cylinder. The secondary high voltage cylinder is not used.

Parallel Configuration
Place both high voltage cylinders in position for testing and remove the hand cart from the testing area. The cylinders should be placed close together (1-2 feet). Install the two-tiered electrode on the main cylinder and the single tiered electrode on the secondary cylinder.

Series Configuration
Place the main high voltage cylinder in position for testing. Remove the base of the second-high voltage cylinder by removing the bolts at the bottom of the cylinder. Place the second cylinder on top of the main cylinder. The cylinder can only be placed one way. Studs keep it from being rotated incorrectly. Identify correct placement before placing. *CAUTION: The cylinders are very heavy. It is recommended to use a lift or multiple personnel to place the cylinder.* Install the two-tiered electrode on the top of the stacked cylinders.

D. Place high voltage divider a short distance from the high voltage cylinders 3-6 feet.

E. Clean all high voltage components to remove all contamination from the component surface. This cleaning must include the high voltage cables.

INITIAL SET-UP / MECHANICAL

GENERAL ELECTRICAL SETUP

Reference the system overview diagram for this section.

A. Use low inductance braid or copper foil for grounding of the unit. Use conductors of sufficient size (amperage rating greater than or equal to the rated input current) for making all ground connections. Connect the facility ground, control box, and high voltage divider to the high voltage transformer ground stud. Ground in a “star” configuration, making the high voltage transformer ground stud the center point of the star. DO NOT "daisy chain” the grounding from one cylinder to the next!

B. Connect external security interlock circuit (SX1). The security circuit can be used with footswitches, dead man switches, etc. If integrating into an existing security interlock circuit, the jumpers on the provided plug must be disconnected. The external security circuit then connects to the jumpers. The external security circuit must consist of a closed loop of dry contacts; an open circuit prevents the high voltage output from being energized. The voltage on the external interlock circuit may vary depending on the model of the unit. Reference unit schematics to see what voltage is used.

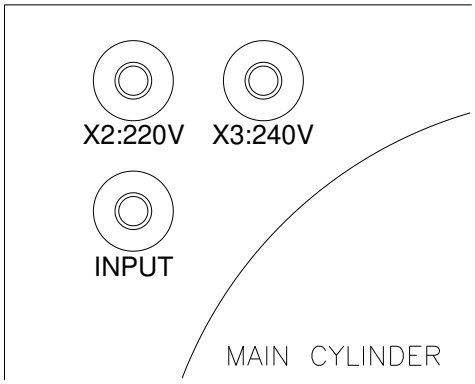
Security circuit accessories are available from Phenix Technologies. Contact Phenix Technologies for more information.

C. Connect external warning circuit (WX1) (If equipped). The external warning circuit is an optional circuit that can be used to power alarms, flashing lights, etc. The circuit will be powered depending on unit state. The warning circuit options, and connection type may vary depending on unit model. Reference unit schematics to see warning circuit connection configuration.

Warning circuit accessories are available from Phenix Technologies. Contact Phenix Technologies for more information.

D. Connect the divider metering cable between the high voltage divider and the control box.

E. Connect voltage selector jumper on base of main high voltage cylinder.
If facility power is 220-230V, connect jumper between INPUT and X2.
If facility power is 240V, connect a jumper between INPUT and X3.
Reference figure below.



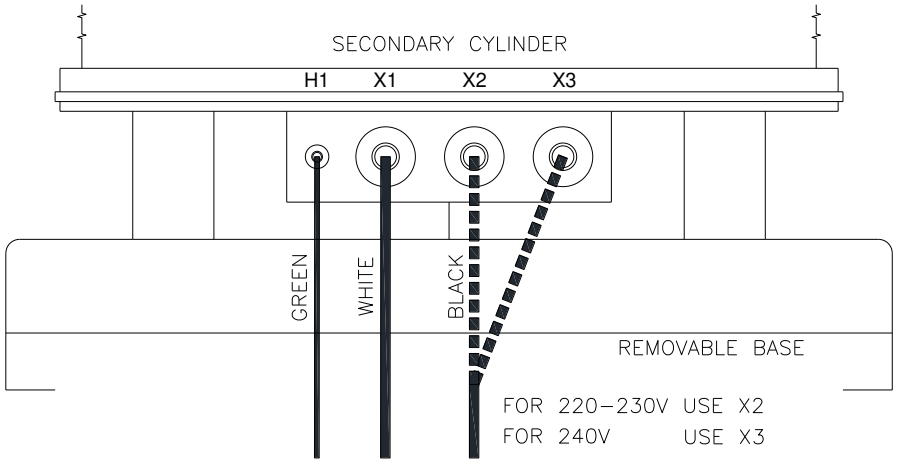
INITIAL SET-UP / MECHANICAL

GENERAL ELECTRICAL SETUP (Cont'd)

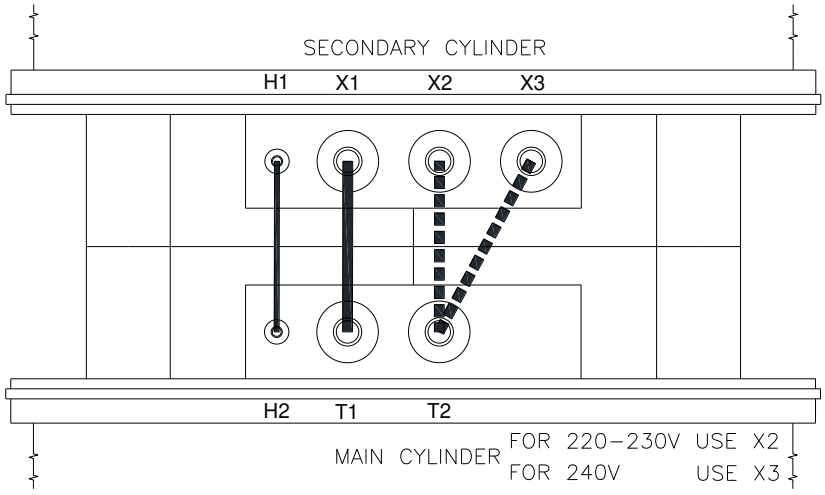
F. This test set can be operated in three different configurations, single cylinder, parallel, and series.

Single Cylinder Configuration
Connect the metering and power interconnect cables between the control box and the main high voltage cylinder.

Parallel Configuration
Connect the metering and power interconnect cables between the control box and the main high voltage cylinder. Connect a ground lead from the main high voltage cylinder to the base of the secondary cylinder. Connect the paralleling power cables between the base of the main high voltage cylinder and the secondary cylinder connections. Connect the green wire to H1 and the white wire to X1. If facility power is 220-230V, connect the black wire to X2. If facility power is 240V, connect to X3. Reference figure below. Finally, jumper together the electrodes of the high voltage cylinders and the high voltage divider.



Series Configuration
Connect metering and power interconnect cables between the control box and the main high voltage cylinder. Attach jumpers between the main and secondary high voltage cylinders. Connect jumpers between H2 and H1, T1 and X1, and T2 and X2 or X3. If facility power is 220-230V, connect jumper to X2. If facility power is 240V connect jumper to X3. Reference figure below.



INITIAL SET-UP / MECHANICAL

GENERAL ELECTRICAL SETUP (Cont'd)

G. Connect the test specimen's "low side" to the return, guard, or ground connection. Depending on unit type, the connections may vary. See the Current Meter Setup part of this section for more details on connections.

H. Connect the test specimen to the output termination of the high voltage transformer. Ensure that connection is applicable for test type and level, and that the connection has sufficient safety clearances for voltage rating.

I. Connect the main input power cable from the facility power connection to the control box. Ensure that facility circuit is rated for the unit power requirements.

INITIAL SET-UP / MECHANICAL

GROUND-GUARD-RETURN CONNECTIONS

The base of the High Voltage transformer contains a currentmeter feature useful in measurement of different current sources. (Refer to Figure (3-1.)

1. **Return Mode (Standard Mode)**

   The standard configuration is set up to measure the current from the high potential side of the unit under test to ground. This configuration **must** be used if it is not possible to isolate the low voltage side of the object under test from ground.

   This measures the output current flowing from the high voltage output through the unit under test to ground **and** the current meter then senses the return current from ground to the "RTN" terminal of the high voltage transformer.

   The low potential side of the unit under test is connected directly to ground. **The binding post Jumper Clip is installed between the Ground ("GND") and the Return ("RTN") posts on the base of the H. V. Transformer.**

2. **Guard Mode**

   For test objects that can be fully isolated from ground it may be desirable to use the Guard Mode. In this mode **only current passing through the test object will be displayed on the current meter.** This will be especially important if very small currents are to be observed.

   In this mode the current path does not flow directly to ground from the low potential side of the unit under test but flows through the currentmeter first and then to ground.

   For Guard Mode operation, connect the low potential side of the unit under test directly to the Return post ("RTN") and **connect the jumper clip between the Guard ("GRD") and Ground ("GND") posts** that are located on the base of the HV Transformer.

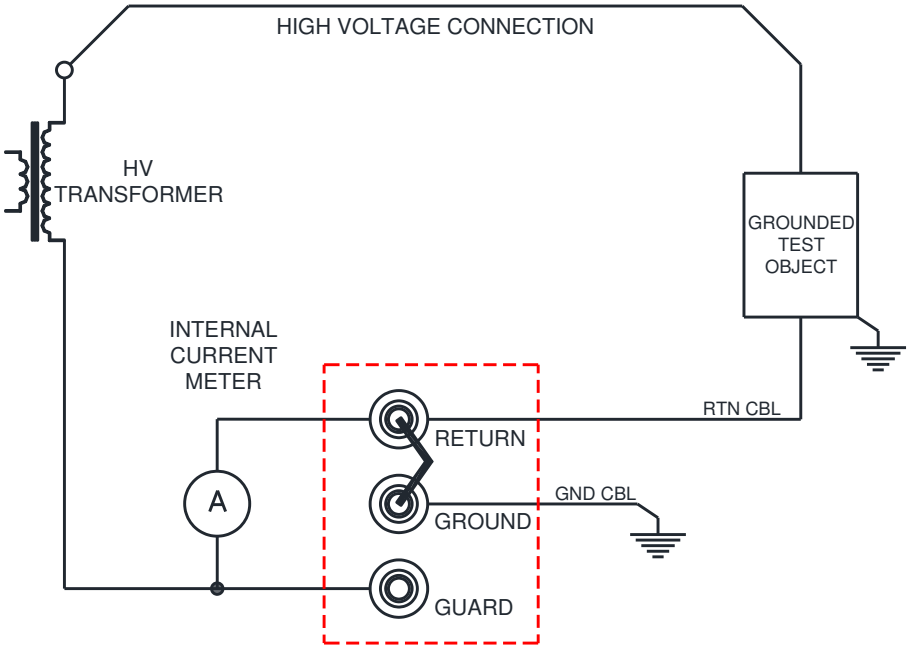
   (NOTE: Ensure the Ground ("GND") post is grounded.)

CAUTION

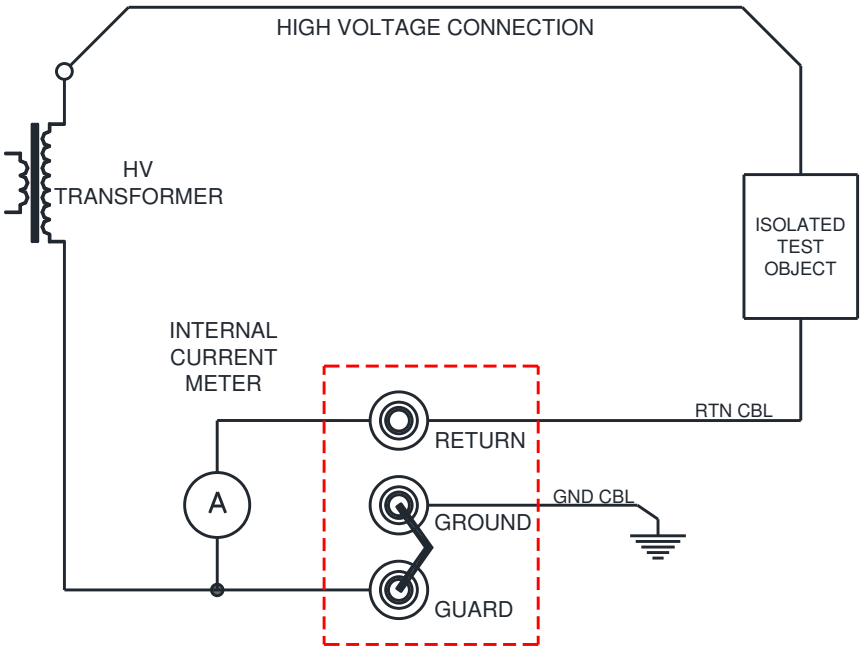
If the test specimen is not fully isolated from ground, the current meter will either not work, or will not display accurate current readings, and this mode should not be used.

INITIAL SET-UP / MECHANICAL

RETURN / STANDARD MODE



GUARD MODE



SECTION 5: OPERATIONAL VERIFICATION PROCEDURE

WARNING:

This equipment should only be used by personnel familiar with High Voltage testing and safety procedures.

1. Make sure that Main Power Circuit Breaker on the Control Panel is in OFF position. Ground output of high voltage unit.

2. Connect high voltage cylinders for series operation. (See drawing #7632110)

3. Make sure that all electrical connections have been properly made between the Controls and High Voltage Unit, and Divider, including grounds. Remove Ground from HV Transformer output. There is NO connection to the high voltage output at this time (except high voltage divider). There must be adequate clearance from the High Voltage Unit to allow voltage to be raised safely.

4. Connect Main Input Power Cable to Controls and to Power Source. Switch the Main Power Circuit Breaker on the Control Panel to On position. Main Power indicator lamp should illuminate. Check that the Emergency Off button is pulled up, Voltage Control is at Zero, Reset Lamp is Off, and EXT INTLK CKT is complete or has shorting jumper in place. HV Off lamp should be illuminated.

5. Press HV On switch. Indicator lamp should illuminate. Press the HV Off switch. HV On indicator lamp should extinguish and HV Off / Ready lamp should illuminate.

   NOTE: The following conditions **must be** met before High Voltage will engage: External Interlock loop must be closed, Emergency Off switch must be closed (mushroom button up), Overload Reset Lamp must be off, and Voltage Control at Zero.

6. Set Measurement Divider Switch to 100 kV / 100 mA

7. Press the HV On switch.

8. Manually raise the Voltage Control dial on the Control Panel to approximately fifty percent (50%). Voltmeter should indicate voltage change and show approximately 95 to 105 kV.

   NOTE: 100kV voltmeter range is calibrated at 80% of range. The 100kV range may not be accurate above 100% of range.

9. Select 200 kV / 50 mA on Measurement Divider Selector Switch. At 50% on Voltage Control Dial, voltmeter should read approximately 95 to 105 kV.

10. Return Voltage Control to Zero. Press HV Off switch.

11. Turn Main Power Circuit Breaker off and connect a short between the 200kV High Voltage Output and Ground. Measurement Divider Switch is to be set at 200 kV / 50 mA.

12. Set Overcurrent Trip to low (1) setting.

13. Turn Main Power Circuit Breaker on. Press HV On switch and slowly raise voltage with the dial on the Control Panel. Output Current Meter will indicate, and at approximately 10% of output current rating, the High Voltage will trip off and the Overcurrent Indicator Lamp will illuminate. With the front panel Overload Selector Switch set at 200 kV/50 mA, the trip point should be at approximately 5 mA.

14. Return Voltage Control to zero. Press HV Off Switch. Turn off Main Power Circuit breaker.

OPERATIONAL VERIFICATION PROCEDURE

15. Connect high voltage cylinders for parallel operation. (See drawing #7632110.)

16. Move short from 200 kV output to 100 kV output and ground. Repeat step 13. Unit should trip off at approximately 10 mA.

    CAUTION: Do not attempt to check 110% level of current trip under shorted output conditions. Rated output currents are only available through a capacitive load of sufficient value. Shorted current values should never exceed 50% of rated currents for the High Voltage Tap being used. If desired to test at 110% of current rating, the output must be connected to a High Voltage load appropriate to the rated voltage and current of the test set.

17. Return Voltage Control to Zero. Press HV Off switch. Turn Off Main Power Circuit Breaker on Controls.

END OF OPERATIONAL VERIFICATION TEST!

GENERAL TEST PROCEDURE

1. Make sure that Main Power Circuit Breaker on the Control Panel is in the Off position.

2. Make sure that all electrical connections have been properly and securely made, and that the test specimen is properly connected to the High Voltage Transformer (refer to Initial Set-up Procedures). Make sure that all personnel are clear of danger and that test area is clearly marked.

3. Connect Input Cable to Controls and to Power Source. Switch the Main Power Circuit Breaker on the Control Panel to the ON position.

4. Set Measurement Divider switch to the position that matches the High Voltage output being used.

5. Set Overload Trip dial to desired trip-out level.

   NOTE: In setting this device, it is important to consider the capacitive current that the sample under test will require. Set the dial to a high enough value to preclude false failure indications. If this value is not known, it is recommended that the dial be left in a higher setting.

6. Press the HV On switch. (**NOTE:** The following conditions must be met before High Voltage will engage: Security Circuit Loop must be closed, Emergency Off Switch must be closed (mushroom button up), Overload Reset Lamp must be off, Voltage Control at Zero Start, and Ready lamp illuminated.)

7. Raise the manual Voltage Control knob on the Control Panel until desired test voltage level is reached. Keep voltage at desired level for required duration. Record data if desired.

8. After completion of the test, manually return the Output Voltage to zero or its lowest level via the Voltage Control knob.

9. Press HV Off momentary switch.

10. If during the test a failure should occur or if the Overcurrent Trip setting is exceeded, the High Voltage will automatically shut off. In order to regain High Voltage, press the Reset pushbutton and return the Voltage Control knob to Zero.

SECTION 6: CALIBRATION

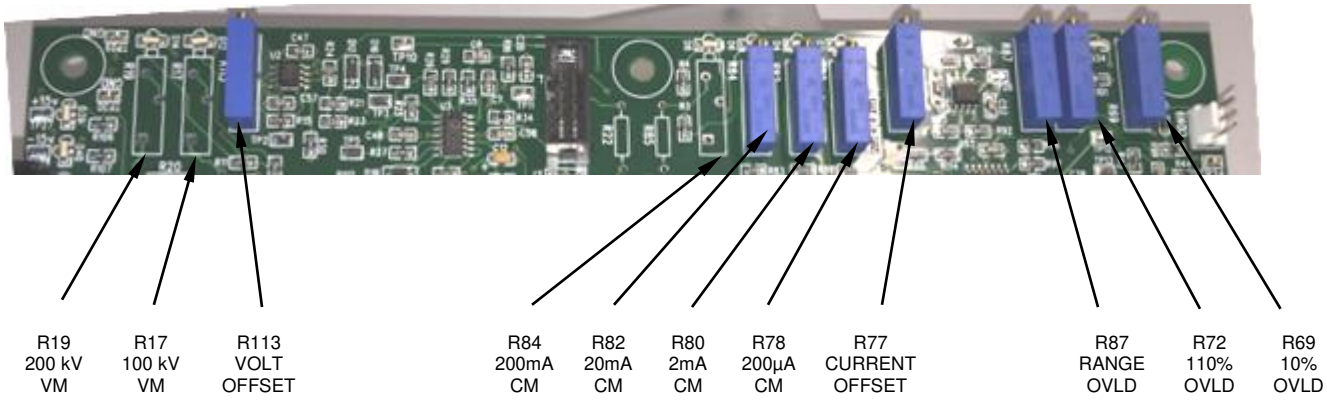
WARNING:
Calibration should only be done by persons familiar with High Voltage testing and safety procedures.

All calibrations have been done at the factory. Periodic calibration of the output voltmeter and output currentmeter should be done annually.

NOTE: Refer to Electrical Diagram Section for schematics pertaining to the model number of your test set.

Locating the Calibration Adjustments

The calibration points are shown in the following diagram.



1. **Output Voltmeter.**

   Connect a precision high voltage voltmeter across the output to ground on 100 kV output, with Measurement Divider switch set to 100 kV. Raise the output to approximately 80% of the output rating. Adjust the reading on the panel meter (M2) by means of potentiometer R17 to a corresponding reading. Repeat procedure with precision high voltage voltmeter connected between the 200 kV output and ground with the Measurement Divider switch set to 200 kV. Adjust R19 to match precision voltmeter at 80% of output rating.

2. **Output Currentmeter**

   It is necessary to connect adequately rated High Voltage loads (isolated from ground) to the high voltage unit that will allow each full range current to be drawn at approximately 15% or higher output voltage. This allows sufficient resolution to adjust current levels. All ranges can be calibrated from 100 kV parallel output**.**

   Place Binding Post Configuration in GUARD MODE. (Jumper clip is installed between “GRD” and “GND” posts.)

   Connect a precision ammeter between the low potential side of the appropriate high voltage load and the ground post. Select the 200 uA meter range. Raise the output to approximately 80% of the range rating. Adjust the reading on the panel meter (M1) by means of potentiometer R78 to a corresponding reading. Repeat for 2 mA, 20 mA and 200 mA ranges adjusting R80, R82 and R84, respectively. (High Voltage load will need to change when changing range).

   NOTE: An optional method is to use current injection between RTN and GND (Guard Mode).
   Do not turn High Voltage on for this method!

CALIBRATION

3. **Overcurrent**

   This calibration should not need adjustment (factory adjusted). If the Overcurrent Circuit is out of calibration, perform the following steps. To recalibrate the Overcurrent Circuit with the High Voltage Unit it will be necessary to connect a 4 nanofarad capacitor rated at 100 kVAC or higher to the 100 kV /100 mA output of the High Voltage Unit. If the capacitor is isolated from ground at the low potential end, the low potential end can be connected to the RTN post. The Guard Post Jumper may be connected to GRD (Guard Mode). If the low potential end of the capacitor is grounded, the Ground Post Jumper must be connected to RTN post.

   a. Set front panel Measurement Divider switch to 100 kV/100mA. When current trip dial is set to minimum (1) current trip level should be approx. 10 mA. When dial is set to maximum (11) trip level should be approx. 110 mA.

   b. Set the Overload Trip potentiometer (R15) on the front panel to "1" and the Current Range switch to 200 mA.

   c. Turn on HV On and adjust the output current slowly until 10% of rated current is displayed on the current meter (10 mA).

   d. Adjust potentiometer R69 until the Reset lamp illuminates and high voltage is shut off.

   e. Set the Overcurrent Trip potentiometer (R15) on the front panel to "11."

   f. Turn on HV On and adjust the output current slowly until 110% of rated current is displayed on meter (110 mA).

   g. Adjust potentiometer R72 until the Reset Lamp illuminates and high voltage is shut off.

   h. Repeat steps "b" through "g" if necessary, until both settings are calibrated

4. **Range Overcurrent.** R235 sets an overcurrent for the ranges and should be set to trip at approximately 112% of full range current on medium range setting with current trip potentiometer set at “11.”

5. **Voltage offset adjustment (R113):**
   The voltage offset should be done with the voltage output lead connected to board ground. This typically can be done by connecting the output to the guard terminal. Once connected, the offset should be adjusted until the output meter reads nearest to zero. This offset adjustment should be done before adjustments to the voltage ranges are made. Test point T10 may also be used to make this adjustment.

6. **Current offset adjustment (R77):**
   The current offset should be done with the current input connected to board ground. This typically can be done by placing a jumper from the guard to the return terminal. Once jumped, the offset should be adjusted until the output meter reads nearest to zero. This offset adjustment should be done before adjustments to the current ranges are made. Test point T37 may also be used to make this adjustment.

SECTION 7: TROUBLESHOOTING

General

If the controls do not operate properly after having been used according to the instructions, the following process may help.

- Check main facility input power to the test set.
- Check all control and switch settings.
- Check indicating lamps. (Spare lamps are available through Phenix Technologies.)
- Check Fuse F1 and F2
- Check operation of main power circuit breaker (CB1). Main Power lamp should be on.
- Check Transformer Power circuit breaker.
- Check all plug connections, internal and external, on the test set.

Specific Problems

1. **High voltage cannot be turned on?**

   - Emergency OFF has been pressed – pull switch button up.
   - External interlock is open (SX1).
   - Voltage Control dial is not in zero start position.
   - Protection circuit (Overload Trip) is not Reset.
   - Transformer Power circuit breaker is off or faulty.
   - Faulty HV On or Off switch.
   - Faulty relay contacts.

2. **Voltage control inoperable?**

   - Transformer Power circuit breaker faulty.
   - Problem with power cable between Controls and High Voltage Unit.
   - High voltage is not on (K1 or K3 not energized or see number 1 above).
   - Faulty regulator T1.
   - Faulty step-up transformer in high voltage unit. (T301).

3. **Overload Trip inoperable?**

   - Improper sensitivity (adjust Current Trip (R15) on front panel).
   - Defective U13.
   - Check the +15 volts DC and -15 volts DC regulator (U16, U17).
   - Check LP4 (RESET) and relay K7 on PCB 1387.

TROUBLESHOOTING

SPECIFIC PROBLEMS (Cont'd)

4. **Currentmeter inoperable?**

- Binding post jumper clip installed between ground and guard with a grounded test object.
- Connection between currentmeter and high voltage test specimen return connected improperly.
- Meter damaged
- Faulty TX1 interconnect cable.
- Damaged or inoperative range switch or wiring.
- Faulty Circuit on PCB1387.

5. **Voltmeter inoperable?**

- Faulty DX1 interconnect cable.
- Meter damaged.
- No high voltage present at transformer output.
- Damaged or inoperative Measurement Divider Switch.
- Faulty circuit on PCB1387.

6. **No output voltage from high voltage section?**

- No input to voltage regulator section, possible problems with K9 on PCB 1387 or K3, regulator (T1), or with Transformer Power circuit breaker.
- Internal connection broken.
- High voltage winding of T301 or T302 short circuited.
- Refer also to 1 and 2 above.

SECTION 8: MECHANICAL MAINTENANCE

General

No solution or chemical stronger than an ordinary household cleaner should be applied to the cabinet area of this unit. Care must be used when cleaning the meter faces and console panel. Abrasives may remove printing and descriptive titles. When cleaning, always disconnect unit from power source. Never attempt to clean inside the unit as the cleaning solution may cause damage to the electronic components.

High Voltage Transformer

Surface

All surfaces are finished with heavy duty paints and will provide adequate protection against the elements in normal use. It is recommended that the finish be wiped down for longer life and for proper electrical operation of the unit. Also inspect all fabrication joints for oil leakage. If a leak is found, check hardware for tightness or consult Phenix Technologies Service Department.

Control Box / Regulator Section

At least once every year, the control assembly should be removed for inspection of the regulator assembly and other parts. If dust and dirt are present, cleaning with a dry brush and air hose should be sufficient. Inspect the voltage regulator contact surfaces for any signs of burning or wear. The brushes are the carbon type and are constructed to provide a 1/8" wide contact point. If they are worn down to be nearing approximately) 1/32" at the wider part of the brush, they should be replaced.

The only other mechanical maintenance needed on the control box is that it be kept clean.

Transformer Oil Maintenance

At time intervals, ranging from six months to one year, the oil purity (see next page) should be checked in the high voltage transformer to verify its reliability. If the transformer is subject to adverse weather conditions or an oil leak develops, the oil purity should be checked regularly.

SECTION 9: CHECKING OIL PURITY

NOTE: Typical test data for the oil used by Phenix Technologies are provided at the end of this section.

1. The most reliable means of determining the purity of the oil in the field is to test the dielectric strength. Test sets for this purpose available on the market differ in design, particularly in the shape of the electrodes and the test container. Tests on samples from the same oil carried out with electrodes of different types give different breakdown values for the same distance between the electrodes. Oil test values should therefore always be accompanied by information about the type of test gap used. The most common types of test gaps are:

   a. Cylinder gap.
   b. Spheres, 12.5 m in diameter.
   c. Flat discs, 25 mm in diameter.
   d. Segments of spheres, 35 mm in diameter, radius of sphere 25 mm.

Phenix employs for field testing Gap C, flat discs, which is per ASTM specification D-877.

2. Regardless of which type of test gap is used, it is important that container and electrodes be well cleaned and dried before oil filling. Cleaning should be done per the instructions with the oil testing equipment.

3. Sample the oil at the top of the transformer. Phenix recommends a minimum test level of 30 kV when using the ASTM D-877 test procedure. If the oil tests lower than this, consult the Phenix Technologies Service Department for recommendations.

If action is required, it is recommended to replace the oil with new oil. Alternately, the oil can be removed and re-purified, then replaced. Either action then requires that the High Voltage Unit be processed in a vacuum chamber after refilling to remove any air and moisture.

NOTE: If air has been injected into the oil, it is recommended that a period of two days be allowed after completion of oil filling until energizing to allow the oil to absorb any occluded air or gas in the insulation.

4. Oil Specifications

Transformer oil is a high quality insulating oil specially refined and formulated to meet the exacting requirements of major electrical equipment manufacturers and users. It also meets Federal Specification VV-I-530a.

High quality mineral-based transformer oil is recommended as the insulating and cooling medium for oil-immersed transformers. It is also recommended for arc-forming apparatus such as switches, circuit breakers, tap changers, reclosers, and fuses. General Characteristics of transformer oil include:

a. High Dielectric Strength:

Transformer Oil has high electrical insulating values as shown by their dielectric strengths of over 30,000 volts.

b. Excellent Oxidation Stability:

Excellent oxidation stability and high resistance to sludging provide protection, particularly where high temperatures are likely to be encountered. These products are specially refined to ensure long time service with a minimum of maintenance.

CHECKING OIL PURITY

c. Freedom From Contaminants:

Absence of organic acids, corrosive sulfur, and other foreign materials, which might affect metals or insulation, ensures long life for the oil as well as the electrical units.

d. High Interfacial Tension:

High interfacial tension shows the absence of soluble polar contaminants. Refinery sealed containers assure maintenance of purity in transit.

e. Good Heat Transfer Properties:

Good circulation and rapid transfer of heat from the coils to the cooling fins are assured by low viscosities at all operating temperatures.

Specifications

(Typical Test Data for Transformer Oil)

TEST	METHOD	UNITS	SPECIFICATION
Moisture	ASTM D1533	Mg/kg	35 max
Color	ASTM D1500	ASTM	0.5 max
DDF (Power Factor) @100ºC	ASTM D924	0.3 max	0.3 max
Breakdown voltage (2mm gap)	ASTM D1816	kV	35 min
Inhibitor Content	ASTM D2668	%w/w	0.30 max
Interfacial tension	ASTM D971	dynes/cm	40 min
Density @15ºC	ASTM D1298	g/ml	0.91 max
Viscosity @ 100ºC	ASTM D445	cSt	3.0 max
Viscosity @ 40ºC	ASTM D445	cSt	12.0 max
Viscosity @ 0ºC	ASTM D445	cSt	76.0 max
Refractive Index	ASTM 1218	Units	
Carbon N%	ASTM D2140	%	
Carbon A%	ASTM D2140	%	
Carbon P%	ASTM D2140	%	
Corrosive Sulfur	ASTM D1275B		Noncorrosive
PCBs – Detection Unit 1 mg/kg	ASTM D4059	mg/kg	Not Detected
Flash Point	ASTM D92	0ºC	145 min

SECTION 10: TRANSPORTING / STORAGE OF EQUIPMENT

In some instances, there is a requirement for transporting the equipment from one location to another for on-site field testing. If such conditions prevail, the following precautions should be adhered to.

1. **Control Box / Regulator Section**

   Anchor sufficiently to prevent movement during shipment, and cover with a canvas or other protective covering to prevent damage during transport.

2. **Interconnect Cables**

   Cover the connectors, both male and female ends, to prevent foreign matter from entering.

3. **High Voltage Transformer**

   Anchor sufficiently to prevent movement during transport, and cover with a canvas or other protective covering to prevent damages during transport. Prior to operation, all insulating materials should be cleaned. Protective caps should be in place on connectors.

STORAGE OF EQUIPMENT

If the equipment will be stored for a prolonged period, the following precautions are recommended.

1. The equipment should be covered and kept in a warm, dry environment (95% maximum humidity, 5 to 50 degrees C).

2. If the high voltage transformer is to be stored outdoors, it should be completely covered to prevent damage from environmental conditions.

3. In no case should the control box be stored outdoors

4. Prior to placing the equipment back into operation, all aspects of the maintenance schedule should be strictly adhered to.

SECTION 11: CIRCUIT DIAGRAM SYMBOLS

CIRCUIT DIAGRAM SYMBOLS
SYMBOLES POUR SCHEMA DE CIRCUIT
SYMBOLE ZU SCHEMA

REF	SYMBOL	DESCRIPTION	DESCRIPTION	BEMENKUNG
A		Amplifier	Unite d'amplificateur	Verstärker
ARSR		Surge Arrestor	Parafoudre	Ueberspannungsableiter
C		Capacitor	Condensateur	Kondensator
BSHG		Bushing	Tranversée	Durchfuehoung
C		Electrolytic Capacitor	Condensateur électrol	Eleckrolytik kondensator
F		Fuse	Fusible	Sicherung
CT		Current Transfomer	Transformateur de Courant	Stromtransformer
CB		Circuit Breaker	Interrupteur	Unterbrecher
K		Relay, Contactor	Relais, Contacteur	Relais, Schütz
L		Inductor	Self	Drossel, Spule
MOT		Motor	Moteur	Motor
MOV		Movistor	Parafoudre	Movistor
NE		Neon	Parafoudre	Ueberspannungsableiter
LP		Lamp, Indicator	Lampe	Meldeleuchte
R		Resistor	Resistance	Widerstand
R		Variable Resisitor	Resistance Variable	Widerstand
T		Transformer	Transformateur	Transformer
TB		Terminal Block	Borne	Lösbare Klemme
X		Connector	Prise de Courant	Steckverbindung
K		Relay Contact Normally Open	Contact Normalement Ouvert	Schlierskontakt
K		Relay Contact Normally Closed	Contact Normalement Fermé	Oeffnungskontakt
K		Changeover Contact	Contact de Changement	Umschaltkontakt
		Shielded Wire	Cable blindé	Abgeschirmetes Kabel
TR		Transistor	Transisteur	Transistor
M		Analog Meter	Insrument Analogue	Analog Meter
D		Diode	Diode	Diode
Z		Zener	Diode Zener	Zener
SCR		Thyristor	Thyristor	Thyristor
SW		Normally Open Maintained Switch	Interrupteur Normalement Maintenu Ouvert	Schrittschalter (Schliesser)
SW		Normally Closed Maintained Switch	Interrupteur Normalement Maintenu Fermé	Schrittshalter (Oeffner)
SW		Normally Closed Momentary Switch	Interrupteur Normalement Fermé Momentanement	Druckschalter (Oeffner)
SW		Normally Open Momentary Switch	Interrupteur Normalement Ouvert Momentanement	Druckschalter (Schliesser)
DP		Current Overload Device	Dispositif De Sûr Intensité	UeberstromschutzEinheit

SECTION 12: ELECTRICAL DIAGRAMS

Drawing Number	Description
9602110	6CP200-10 System Diagram
7612110	Control and Regulator Schematic
7632110	HV Transformer Schematic
7662110	HV Divider Schematic
MREF-012	200kV Switchgear Test Set Assembly Details

SECTION 13: PARTS ORDERING INFORMATION

Replacement parts are available from Phenix Technologies, Inc.

Changes to Phenix Technologies' products are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest technical improvements developed in our Engineering Department. It is, therefore, important when ordering parts to include the serial number of the unit as well as the part number of the replacement part.

When your purchase order is received at our office, a representative of Phenix Technologies will contact you to confirm the current price of the part being ordered. If a part you order has been replaced with a new or improved part, an Applications Engineer will contact you concerning any change in part number.

Send orders for replacement parts to:

Replacement Parts Department
Phenix Technologies, Inc.
75 Speicher Drive
Accident, Maryland 21520

Ph: (301) 746-8118
Fax: (301) 895-
E-mail: info@phenixtech.com

SECTION 14: RECOMMENDED SPARE PARTS

Phenix Technologies recommends that the customer purchase and stock the following parts for normal maintenance of the unit. The recommended quantity should be sufficient to support the unit during normal operation.

If the unit will be operated at an isolated site for an extended period or will be subjected to unusual stresses, a larger quantity of parts should be stocked as spares. In such a case, contact your Phenix Technologies' sales representative for a recommendation.

Current prices may be obtained by contacting the Parts Ordering Department at Phenix Technologies.

Part Name	Computer Number	Recommended Quantity
LCD Meter, KNS 3 ½ Digit DMO-66T	1506400	1
Limit Switch, 2HBA190-1 (SW7)	1866005	1
Switch, Mom., 1 Pole, 31-121.025 EAO (HV on, HV off, Reset)	1860120	1
Fuse, 1 A, 3AG (F1, F2)	1603601	2
Rotary Switch –4P, 2-6 Pos.	1863042	1
Relay (K3)	1705465	1
Led 24V White	1420163	3
Led 24V Red	1420162	1
Led 24V Green	1420161	1

SECTION 15: 6CP200/100-10 PARTS LIST

CONTROL/REGULATOR

Item	Part Number	Description	Quantity
CB1,CB2	1601332	2P CIRCUIT BREAKER	1
CON1	1151178	RECEPTACLE	1
CON1	1151183	HIGH CURRENT PINS, MALE	3
CON2	1151179	RECEPTACLE	1
CON2	1151185	HIGH CURRENT PINS, FEMALE	2
D1-D5	1780025	DIODE	5
DX1	1151152	RECEPTACLE,	1
DX1,SX1/WX1	1151174	CONTACT PINS, FEMALE	8
F1-2	1603601	FUSE	2
F1-2	1603920	FUSEHOLDER	2
K3	1705465	CONTACTOR	1
K3AUX	1701500	AUX CONTACTOR	1
LP1	1423300	SOCKET	1
LP1, LP4,SW10	1420163	WHITE LED LAMP	3
LP1,SW10,SW11	1422153	LENS CLEAR	1
SW2	1422150	RED LED LAMP	1
SW3	1420161	GREEN LED LAMP	1
M1-2	1506400	3 ½ DIGIT LCD	2
M1-2	31138800	METER INTERFACE BD	1
M1-2	1152152	CONNECTOR	4
M1-2	1079909	RIBBON CABLE	6 FT
MOV1 (220 V)	1606110	MOVISTOR	1
PCB1387	31138715	6CP200/100-10 CONTROL/METERING BD	1
R15	1761098	POTENTIOMETER	1
R15 -CAP	1355102	PEAKED CAP	1
R15 KNOB	1355101	KNOB	1
R15-DIAL	1355910	DIAL	1
R15-KNOB	1355905	KNOB	1
R16A-B	1710400	RESISTOR	2
SW10	1860265	SWITCH 2POLE	1
SW11	1860260	SWITCH 1POLE	1
SW2,3,4	1860120	SWITCH, 1 POLE	3
SW2	1422150	LENS, RED	1
SW3	1422151	LENS, GREEN	1
SW4	1422148	LENS, BLUE	1
SW5	1863042	SWITCH	1
SW5, SW9	1355310	KNOB	2
SW7	1866005	ROLLER SWITCH	1
SW8	1860900	LATCHING MUSHROOM BUTTON	1
SW8	1862905	SWITCH	1
SW9	1863048	SWITCH	1
SX1/WX1	1151147	RECEPTACLE	1
T1	1890239	VARIABLE AUTO TRANSFORMER	1
T2	1896017	CONTROL POWER TRANSFORMER	1
TIMER	1480120	PANEL MOUNT DIFITAL TIMER	1
TX1	1151158	RECEPTACLE	1
TX1	1151170	MALE PINS	7

CONTROL/REGULATOR

Item	Item	Item	Item
CBL INPUT	30110008	BK130 INPUT POWER CBL-30',10/3	1
CBL POWER INTER	30110007	BK130 PWR INTERCONNECT-20' 10/2	1
CBL TX1	30160001	ST-ST 6PR SHL'D CABLE ASSY - 20'	1
CBL DX1	30180006	DIVIDER INTERCONNECT CABLE 30'	1
CBL DX1	30180006	DIVIDER INTERCONNECT CABLE	1
CBL RTN	30080010	RTN CBL CLIP – HOOK LUG 30'	1
CBL GND 2	30080008	GROUND CBL CLIP – HOOK LUG 10'	1
CBL GND 1	30080019	GROUND CBL RING LUGS 30'	2
CBL GND 3	30080025	GROUND CBL RING LUG – HOOK LUG 30'	
CBL PARRALLEL	30110042	PWR CBL 10/3 30'	1
		GROUND CBL RING LUGS 10'	1
CBL JMP	30180007	HYPALON CBL 10'	3
		BLACK CBL 10'	1

HIGH VOLTAGE MODULES

BP GND	1351103	BINDING POST (GREEN)	1
BP GRD	1351104	BINDING POST (WHITE)	1
BP RTN	1351102	BINDING POST (RED)	1
BP SHORT	1351110	BINDING POST SHORTING BAR	1
CAPS	1151196	SEALING CAP	3
CON3	1151178	RECEPTACLE	1
CON3	1151183	HIGH CURRENT PINS, MALE	2
CON4	1151179	RECEPTACLE	1
CON4	1151184	FEMALE CONTACT PIN	1
CON4	1151185	HIGH CURRENT PINS, FEMALE	3
D501-4	1780066	TRANZORB	4
H1-2	1356214	MULTILAM JACK	2
H1-2	1356212	MULTILAM PLUG	2
MOV301-10 (220 V)	1606110	MOVISTOR	10
PCB 1070	1110700	PCB 1070	1
PCB 1223	1112232	PCB 1223	1
R505A-B	1740395	RESISTOR	2
R507	1722570	RESISTOR	1
R508	1722087	RESISTOR	1
R509	1720600	RESISTOR	1
R510	1740185	RESISTOR	1
SPG501-502	1605110	SPARK GAP	2
T301-302	3834-2690	PHENIX TRANSFORMER GO1-2690	2
TX1	1151158	RECEPTACLE	1
TX1	1151170	PINS, MALE	8
X1-3, T1-2	1356312	MULTILAMM PLUG	4
X1-3, T1-2	1356310	MULTILAMM SOCKET	8

HIGH VOLTAGE DIVIDER

C601-602	1090304	CAPACITOR	2
DX1	1151152	RECEPTACLE	1
DX1	1151175	CONTACT PINS, FEMALE	3
GROUND	1351103	BINDING POST GREEN	1
NE2	1609990	NEON LAMP	1
PCB 1282	31128204	PCB 1282	1
TB601	1156050	TERMINAL STRIP	1

SECTION 16: RETURNED MATERIAL

If for any reason it should become necessary to return this equipment to the factory, the Service Department of Phenix Technologies, Inc. must be given the following information:

Name Plate Information
Model Number
Serial Number
Reason for Return
Cause of Defect

If Phenix Technologies, Inc. deems return of the part appropriate; it will then issue an "Authorization for Return."

If return is not deemed advisable, other inspection arrangements will be made.

NOTE: Material received at this plant without the proper authorization shall be held as "Customer's Property" with no service until such time as the proper steps have been taken.

Your cooperation is requested in order to ensure prompt service.

SECTION 17: CUSTOMER COMMENTS/SUGGESTIONS

Phenix Technologies made significant efforts to ensure that the materials in this Operator's Manual are correct. If there are concerns or comments as you have used this information, Phenix Technologies appreciates any feedback.

Unit Serial Number:

Sect	Page(s)	Comment

Please return to Phenix Technologies, Engineering Department, 75 Speicher Drive, Accident, MD 21520 USA.

Phone: 1 (301) 746-8118, Fax 1 (301) 895-5570 or E-mail: info@phenixtech.com