



CDS

SERIES

---

## Safety, Operation, and Procedure Instructions for the CDS Series of Capacitor Discharge/ Hipot Cable Fault Locators

### **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.

# Operator Manual

---



© HIGH VOLTAGE, INC.  
31 County Route 7A  
Copake, N.Y. 12516  
Phone 518/329-3275 • Fax 518/329-3271  
<http://www.hvinc.com>

# Table of Contents

About the Operator Manual	1
SECTION 1	
General Information	2
Theory of Operation	2
Features and Specifications	3,4
Controls and Indicators	6,7
SECTION 2	
Setting up the Equipment	8
Operating the Equipment	9-17
Hipot / Burn Mode	9-11
Capacitor Discharge Fault Locating (Thumping)	12-14
Capacitor Discharge Fault Locating (TDR)	15-17
Blank Page for Notes	18
SECTION 3	
Performing Special Operations	19
Miscellaneous	19
Return Material	20
Warranty	21,22

# 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

## WARNING

**DO NOT OPERATE THE CDS 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.

## About the Operator Manual

### Important

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

This Operator Manual is organized to provide information on the **CDS Series** 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 CDS Series of Capacitor Discharge/Hipot Cable Fault Locators are also discussed in the CDS Brochure available from High Voltage, Inc.

## General Information

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

**CDS Series of Capacitor Discharge/Hipot Cable Fault Locators** manufactured by **HIGH VOLTAGE, INC.**

Operation of this unit with standard TDR fault locating devices is possible using the internal Arc Reflection Filter.

## Theory of Operation

With the use of buried underground cables in primary feed electrical installations, it is necessary to locate faults and repair the cable the cable as quickly as possible to restore power to affected areas. The **CDS Series of Capacitor Discharge/Hipot Cable Fault Locators** uses an energy storage capacitor to provide a pulse of energy to create an audible sound at the fault location for tracing. HVI CDS series fault locators all have built in Arc reflection filters for use with most TDR's (RADAR) on the market at thump voltages up to 25 kV.

## Features and Specifications

The CDS Series of cable fault locating test sets provide continuously adjustable output voltages for the test and location of faults in primary cables. The constant energy design provides the maximum energy at the lowest voltage to quicken fault location while not overstressing the cables and terminations.

Standard features of the CDS Series of Capacitor Discharge/Hipot Fault Locator

- Continuously adjustable output voltage
- "Zero Start" Interlock provision
- Single range volt meter
- Single range current meter
- Single-cycle or continuous Capacitor Discharge operation
- Adjustable discharge timing, 6- 10 seconds
- Motorized Output Voltage Tap Switch
- Manually operated Coupler Switch with Radar and Direct position
- Two internal discharge solenoids, one for the output cable, one for the internal capacitor bank
- One piece design
- Transit protected meters prevent meter damage between test sites
- Shielded high voltage output cables included on all models.
- 4 AWG Braided ground cable for secure ground connection

## OPTIONS AVAILABLE

- Storage Reel system available for Output and Ground Cables
- CDS-36 available with 3.2kJ discharge capacitor



## CDS MODEL SPECIFICATIONS

See last page of parts list for  
Specifications

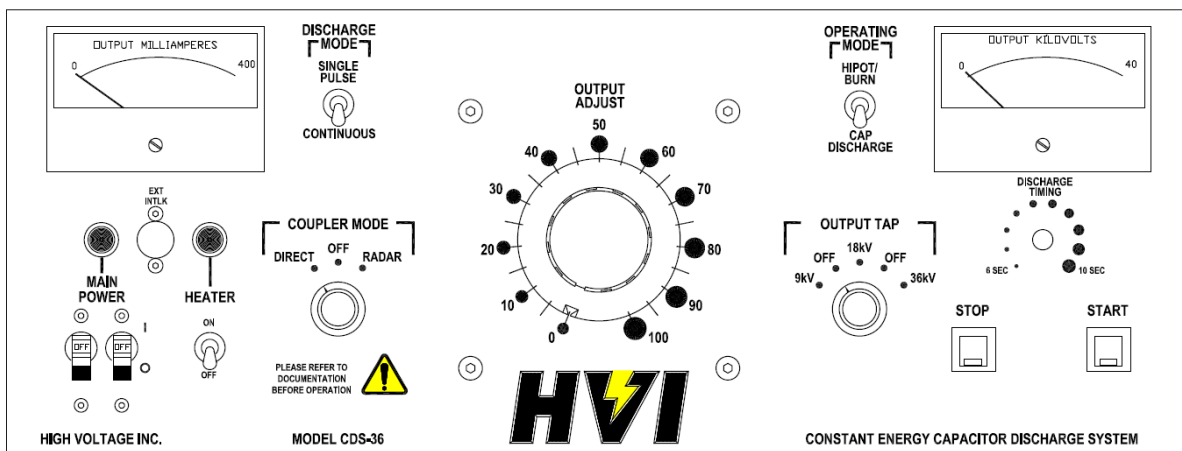


Figure 1 CDS36U Series front panel controls.

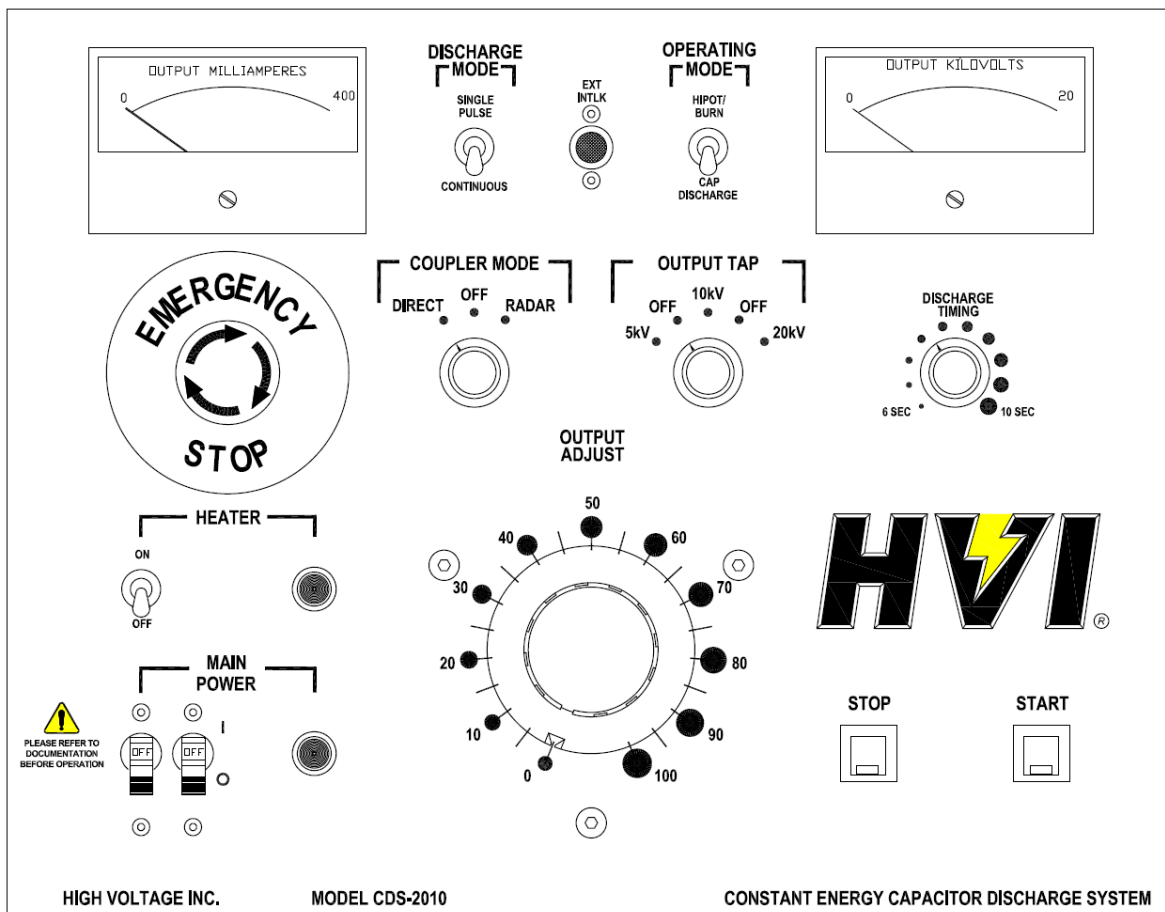


Figure 2 CDS20U Series front panel controls.

## MAIN POWER

The **MAIN POWER** circuit breaker provides the power to the control and power circuits. The **MAIN POWER** pilot light will light when the power is on and voltage is available through the input line cord. The power supplied to the input line cord must be from a **grounded** source rated to match the input power specifications noted in Table-1.

## HEATER

The **HEATER** circuit provides assistance in keeping the internal components from accumulating moisture in damp environments. The pilot light will illuminate when the circuit is powered.

## START/STOP

The **START/STOP** pushbuttons activate (de-activate) the high voltage power circuits. The LED indicators provide long life positive indication of the circuit status. The **RED (START)** LED lights when high voltage is energized, the **GREEN (STOP)** LED lights when the high voltage is de-energized.

## OUTPUT ADJUST

The **OUTPUT ADJUST** control variable transformer sets the output voltage. The 0-100% markings on the knob indicate the low to high setting. 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.

## VOLTMETER

The **KILOVOLT METER** indicates the output voltage. 1-% precision resistors minimize the need for re-calibration due to aging shift.

## CURRENT METER

The **CURRENT METER** provides output current readings for the **HIPOT/BURN** function and capacitor charge current in **CAPACITOR DISCHARGE** mode.

## CAPACITOR DISCHARGE MODE

The **CAPACITOR DISCHARGE MODE** switch presets the control circuits for a single pulse (for use with TDR) or allows the circuit to run continuously in pulse mode.

## DISCHARGE TIMING

The **DISCHARGE TIMING** adjustment sets the control circuits for timing of the discharge in the continuous thump pulse mode.

## OPERATING MODE

The **OPERATING MODE** switch controls the connection of the capacitor discharge bank and capacitor discharge solenoids. The **HIPOT** position is used for high voltage testing without the energy discharge capacitors in the circuit. The **HIPOT** mode also connects a current limiting reactor for burning down cables and limit follow through current in a fault. The **CAPACITOR DISCHARGE** mode for fault locating cable connects the capacitor bank into the high voltage circuit and enables the discharge solenoids.

## COUPLER MODE

The **COUPLER MODE** switch is used to connect the internal radar coupler into the output circuit. The **COUPLER MODE** must be in either **RADAR** (*thump voltages up to 25 kV*) or **DIRECT** position or the high voltage cannot be energized. If the switch is operated to another position when the high voltage is energized, the output will turn off. **NOTE:** The **COUPLER MODE** switch is only active in **CAPACITOR DISCHARGE** operating mode.

## OUTPUT TAP

The **OUTPUT TAP** switch provides maximum output voltage selection while configuring the discharge capacitor bank for the output voltage selected. The use of this switch provides a constant energy for capacitor discharge even at lower output voltages. When in any one of the **OFF** positions, the high voltage cannot be energized. If the switch is operated during testing, the output will de-energize. When changing tap positions allow 20 seconds for the motorized switch to achieve final position.

## EXT INTLK

The **EXT INTLK** external interlock socket provides a safety interlock to disable the high voltage control circuits. A normally closed switch from a test cage or foot switch can be wired to this connector to provide access control or electrical lockout ability. The circuit is within the 120Vac control circuit.

Note regarding the use of MC connectors:

The MC connector requires the operator to push IN before pulling OUT when disconnecting.

## SETTING UP THE EQUIPMENT

The setup of this equipment has been minimized by careful consideration for the operator during design. The CDS Series' one-piece FIELD PORTABLE construction makes this the preferred unit for fault locating.

1. **Select a location** for the unit that will allow easy viewing of the meters at a safe distance from the test cable.

### ***Caution!!***

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

2. **Be sure that all the controls are off**, in their de-energized or fully counterclockwise position.
3. **Unspool the cables onto the ground.** Separate the input line cord, ground lead and output cables from each other.
4. **Secure the ground test lead to the cabinet.** The Ground stud on the rear panel of the unit **must** be used for that purpose. A 4 AWG braided copper lead has been provided for the ground connection. Proper grounds are essential when fault locating with a capacitor discharge device. Connect the ground lead cable clamp to the station ground of the cable being tested.

## 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.

### *DC Insulation Testing of Cables in the Hipot/Burn Mode*

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

1. Ensure that all the steps listed in **Setting up the Equipment** have been accomplished. Take special note to ground the unit to a solid earth ground using the supplied 4 AWG braided copper lead. Connect the ground lead cable clamp to the station ground of the cable being tested.

#### ***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.

***The shields of all cables must be securely tied to ground at the nearest end of the cable.***

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. **Connect the RETURN clamp** to the neutral or shield of the cable being tested.
6. **Connect the HV lead clamp** to the center conductor of the cable being tested.

**Note:** If an output cable reel is being used, connect the high voltage MC connector to the center plug on the reel. The MC connector requires the operator to push IN before pulling

**OUT to disconnect.** Connect the return ring terminal to the brass return stud on the reel. Make all load test connections to the cable from the reel leads as noted in steps 5 and 6.

7. Connect the input power cord to a grounded power source (see specifications for input voltage and frequency). If the distance to a power source is greater than the cord provided, a **grounded** extension cord of sufficient ampacity will work.
8. Operate the **MAIN POWER** circuit breaker to energize the control circuits. *(Check emergency stop button is out and for External Interlock plug or safety switch if applicable.)*
9. Place the **OPERATING MODE** switch in the **HIPOT/BURN** position.
10. Voltage must be applied according to specifications from the cable manufacturer or any other applicable test standards.
11. Choose the appropriate **OUTPUT TAP** (9/18/36 kVdc, 5/10/20 kVdc) for the cable being tested. When changing tap positions the switch must be in position to energize high voltage, allow 20 seconds for the motorized switch to achieve final position.
12. Be sure to place the **COUPLER MODE** switch in the **DIRECT** position.

\* \* \* CAUTION \* \* \*

## POTENTIALLY LETHAL VOLTAGES MAY BE PRESENT

---

13. With the **OUTPUT ADJUST** at zero (zero start interlock engaged), depress the **START** pushbutton. The **START** light will glow.
14. Increase the output by rotating the **OUTPUT** control slowly clockwise until the desired output voltage is reached.
15. Maintain the output voltage for the test time specified in your standard procedures. Leakage current may be read on the current meter at this time. Should the test cable arc or fail, the output will collapse to a lower value and the current meter reading will increase.
16. Burning of the cable for THUMPING can be accomplished at this time by allowing the fault to burn until the output voltage is at the desired thumping voltage.

17. At completion of test or operation, the depress the **STOP** pushbutton, the output cable load will be discharged through an internal discharge resistor. Turn off the **MAIN POWER** circuit breaker.
18. Always use a GROUND HOOK to ground the cable(s) prior to disconnecting the output cable.



## *Capacitor Discharge Fault Locating (thumping)*

### *High Voltage Cables*

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

1. Ensure that all the steps listed in **Setting up the Equipment** have been accomplished. Take special note to ground the unit to a solid earth ground using the supplied 4 AWG braided copper lead. Connect the ground lead cable clamp to the station ground of the cable being tested.

#### ***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 in areas other than the fault site.

***The shields of all cables must be securely tied to ground at the nearest end of the cable.***

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. **Connect the RETURN clamp** to the neutral or shield of the cable being tested.
6. **Connect the HV lead clamp** to the center conductor of the cable being tested.

**Note:** If an output cable reel is being used, connect the high voltage MC connector to the center plug on the reel. The MC connector requires the operator to push IN before pulling OUT to disconnect. Connect the return ring terminal to the brass return stud on the reel. Make all load test connections to the cable from the reel leads as noted in steps 5 and 6.

7. Connect the input power cord to a grounded power source (see specifications for input voltage and frequency). If the distance to a power source is greater than the cord provided, a grounded extension cord of sufficient ampacity will work.
8. Operate the **MAIN POWER** circuit breaker to energize the control circuits. *(Check emergency stop button is out and for External Interlock plug or switch if applicable.)*
9. Place the **OPERATING MODE** switch in the **CAP DISCHARGE** position.
10. Voltage must be applied according to specifications from the cable manufacturer or any other applicable test standards.
11. Choose the appropriate **OUTPUT TAP** voltage (9/18/36 kVdc, 5/10/20 kVdc) for the cable fault being tested. When changing tap positions the switch must be in position to energize high voltage, allow 20 seconds for the motorized switch to achieve final position.
12. Assure that the **COUPLER MODE** switch is in the **DIRECT** position.
13. Choose the discharge timing (6-10 seconds). This adjustment can be re-adjusted during test if desired.
14. Place the **CAPACITOR DISCHARGE MODE** in **CONTINUOUS** position.

\* \* \* CAUTION \* \* \*

POTENTIALLY LETHAL VOLTAGES  
MAY BE PRESENT

---

**STORED ENERGY LEVELS IN THE CABLE  
GREATLY INCREASE THE RISK OF FATAL  
INJURY IF CONTACT IS MADE WITH THE LOAD  
WHILE AT ANY VOLTAGE.**

15. With the **OUTPUT ADJUST** at zero (zero start interlock engaged), depress the **START** pushbutton. The **START** light will glow.
16. Increase the output by rotating the **OUTPUT ADJUST** slowly clockwise until the desired Capacitor Discharge (Thumping) voltage is reached. The **OUTPUT ADJUST** percentage markings will provide a good guide to the level the output will reach. The cable fault will break

over ('Thump') at the fault location and acoustical devices can be used to pinpoint the resulting sound.

17. Upon locating the failure point, depress the **STOP** pushbutton to interrupt the test cycling.
18. At completion of test or operation, the depress the **STOP** pushbutton, the internal capacitor(s) and output cable load will be discharged through two internal discharge resistors. Turn off the **MAIN POWER** circuit breaker.
19. Always use a GROUND HOOK to ground the cable(s) prior to disconnecting the output cable.

## Capacitor Discharge Fault Locating

### High Voltage Cables Using a TDR Device

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

**Please Note:** *The TDR will only operate in the TDR-RADAR MODE, it will not work in DIRECT MODE.*

1. Ensure that all the steps listed in **Setting up the Equipment** have been accomplished. Take special note to ground the unit to a solid earth ground using the supplied 4 AWG braided copper lead. **Connect the ground lead cable clamp to the station ground of the cable being tested.**
2. The TDR or Radar device should be plugged directly into the AC receptacle on the side panel of the CDS cabinet. The TDR signal input is connected to the BNC connector (on the control panel) marked **TDR SIGNAL**. The TDR trigger input (if on TDR) connects to the BNC marked **TDR TRIGGER**.
3. Operate the **COUPLER** switch to the **RADAR** position.

#### **Caution!!!**

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

4. Make sure that all insulators, stress cones, and pot heads are clean and free of moisture. This will prevent flashover in areas other than the fault site.

***The shields of all cables must be securely tied to ground at the nearest end of the cable.***

5. 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.
6. 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.
7. **Connect the RETURN clamp** to the neutral or shield of the cable being tested.
8. **Connect the HV lead clamp** to the center conductor of the cable being tested.

**Note:** If an output cable reel is being used, connect the high voltage MC connector to the center plug on the reel. The MC connector requires the operator to push IN before pulling OUT to disconnect. Connect the return ring terminal to the brass return stud on the reel. Make all load test connections to the cable from the reel leads as noted in steps 7 and 8.

9. Connect the input power cord to a grounded power source (see specifications for input voltage and frequency). If the distance to a power source is greater than the cord provided, a grounded extension cord of sufficient ampacity will work..
10. Operate the **MAIN POWER** circuit breaker to energize the control circuits. *(Check emergency stop button is out and for External Interlock plug or switch if applicable.)*
11. Voltage must be applied according to specifications from the cable manufacturer or any other applicable test standards.
12. Choose the appropriate **OUTPUT TAP** voltage (9/18/36 kVdc, 5/10/20 kVdc) for the cable fault being tested. When changing tap positions the switch must be in position to energize high voltage, allow 20 seconds for the motorized switch to achieve final position.
13. Place the **OPERATING MODE** switch in the **CAP DISCHARGE** position.
14. Make sure the **DISCHARGE MODE** switch is in the center position.
15. Set up the TDR in accordance with manufacturer's instructions. At this time you should see a low voltage trace on the screen and the TDR should be "armed".
16. With the **OUTPUT ADJUST** at zero (zero start interlock engaged), depress the **START** pushbutton. The **START** light will glow.
17. Increase the output by rotating the **OUTPUT ADJUST** slowly clockwise until the desired Capacitor Discharge (Thumping) voltage is reached. The **OUTPUT ADJUST** percentage markings will provide a good guide to the level the output will reach.
18. Push the **DISCHARGE MODE** switch upward to the single pulse position. The **CDS** will discharge one pulse. If the cable fault broke over, you should see a deflection on the TDR screen. If not, you may need to repeat this step at a higher voltage.
19. Once you have pre-located the fault with the TDR, put the coupler switch in **DIRECT MODE** and the discharge mode switch to the **CONTINUOUS** position. The cable fault will break over ('Thump') at the fault location and acoustical devices can be used to pinpoint the resulting sound. Refer to pages 13-15 for further instruction on thumping in direct mode.
20. Upon locating the failure point, depress the **STOP** pushbutton to interrupt the test cycling.

21. Always use a GROUND HOOK to ground the cable(s) prior to disconnecting the output cable.

THIS PAGE LEFT BLANK FOR APPLICATION NOTES

## PERFORMING SPECIAL OPERATIONS

The following section contains information on the care and upkeep of your new CDS SERIES of **Capacitor Discharge/Hipot Cable Fault Locators**. 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 CDS SERIES of fault locators use precision metal film resistors for measurement and calibration of the voltmeter and the current meter. The use of these resistors in both the high voltage tank and the metering circuits has minimized circuit drift due to aging and temperature.

If the current meter will not calibrate, the meter should be replaced once it has been determined the current sense resistor is not the cause.

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

### Miscellaneous

#### *Oil Insulated High Voltage Tanks*

Although not suggested for units in Warranty, the oil-filled tanks in all the CDS SERIES **Capacitor Discharge/Hipot Cable Fault Locators** are field serviceable. The only requirement is that the tank must be oil filled under vacuum at re-assembly if left out of the oil for longer than 2 hours. 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 .5 inches from the lid when the oil temperature is 20°C.



## 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.

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 subject 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]

