

**INSTRUCTION MANUAL
FOR THE
ELECTROSTATIC DISCHARGE SIMULATOR
MODEL EDS-200**

ELECTRO-METRICS

A PENRIL COMPANY

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(NOVEMBER 1985)

*****>>> WARNING <<<*****

HIGH VOLTAGES of up to 30 kV are present during the operation of this instrument. Always exercise extreme caution and care when operating the unit. Serious injury or death could result from improper setup and operation. Always operate the equipment in accordance with the instructions contained within this manual.

*****>>> WARNING <<<*****

MAY BE HAZARDOUS TO PACE-MAKER WEARERS

===== NOTE =====

The instrument contains no user serviceable components. Return unit to the factory for repair, servicing, or calibration. Warranty void if control unit or probes are opened.

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SECTION I INTRODUCTION AND SPECIFICATIONS

1.1 INTRODUCTION

This manual contains the instructions for operation of the ELECTRO-METRICS Model EDS-200 ELECTROSTATIC DISCHARGE SIMULATOR.

1.2 EDS-200 ELECTROSTATIC DISCHARGE SIMULATOR

The EDS-200 Electrostatic Discharge Simulator is designed to simulate in a known and repeatable manner the effects produced by static electricity discharging into electronic equipment from human beings and inanimate objects. An example of this phenomenon is the sparking which occurs after a person walks across a woolen or nylon carpet in winter and then touches a metal doorknob or table. This resultant spark is the discharge of up to 30 000 volts of static electricity built up on the person's body from the friction of their shoes on the carpet.

Accurate and repeatable simulation of these "static electricity" events is extremely important in the design, development, and manufacture of electronic equipment. If a computer is susceptible to "operator induced" ESD, its response may be anything from an error in computation or data storage to a complete failure caused by component burnout. If an assembler in a factory causes an ESD event, the sensitive components (e.g. transistors, integrated circuits, etc) being handled may be damaged, and the resultant damage may not be discovered until later in the manufacturing process. Only by having an accurate and repeatable simulation of these and other types of ESD events can a manufacturer be assured that its products, whether they are semiconductor devices, computers, or home entertainment equipment, will withstand their everyday operating environment.

1.3 UNPACKING

1.3.1 Remove the instrument carefully from the shipping carton and examine thoroughly for shipping damage. If there is any damage, replace the instrument in the shipping carton and immediately inform ELECTRO-METRICS and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

1.3.2 Check the contents of the carton against the shipping slip to verify that all components and accessory items ordered are present. Notify ELECTRO-METRICS immediately if any items are missing.

1.4 ELECTRONIC SHIPPING DAMAGE

Before leaving the factory, this instrument was subjected to a complete operational check. However, it is possible that electronic damage may have occurred in transit. It is desirable, therefore, to check the operation of the instrument as soon as possible after unpacking.

To do so, perform the checkout procedure in Section 2.6.2. If the instrument does not perform as per these instructions, inform the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT, (518) 843-2600, giving the information required in Paragraph 1.3.1.

1.5 INSTALLATION

1.5.1 The EDS-200 is completely portable and can be utilized anywhere a 115 VAC power source is available. No unit setup and assembly is required for normal operational use. Refer to Section 3.4 for information on test setups and procedures.

1.6 INSTRUMENT SPECIFICATIONS

The electrical and general specifications for the EDS-200 Electrostatic Discharge Simulator are given in TABLE 1.1.

1.7 MECHANICAL CONSTRUCTION

The EDS-200 is an enclosed modular assembly whose outer shell functions as the chassis-carrying case for the instrument. All components and subassemblies are secured to the EDS-200 front panel which in turn is secured into a formed metal chassis. A removable cover, with handle, fits onto the chassis to protect the instrument from dust and damage while in transit.

TABLE 1.1
EDS-200 SPECIFICATIONS

The EDS-200 ELECTROSTATIC DISCHARGE SIMULATOR consist of the following:

- a. Control Unit
- b. One or more Discharge Units

CONTROL UNIT

- a. Variable High Voltage Output up to 25 kV (standard), 30 kV (optional).
- b. High Voltage Output Monitor: 3 1/2 digit LED.
- c. Pulse Counter: 3 digit LED.
- d. Three (3) modes of operation:
 1. STOP ON COUNT: select from 1 to 999 pulses.
 2. STOP ON TIMER: 5 seconds to 5 minutes.
 3. FREE RUNNING: until manually stopped.
- e. Adjustable PULSE RATE: 1 to 30 Hz.
- f. START/RESET and STOP controls.¹⁰
- g. Selector Switch for PULSED or DC Discharge Units.
- h. For use with PULSED Discharge Units only:
 1. SINGLE PULSE Switch.
 2. TRIGGER SELECTOR Switch: External or Internal.
 3. TTL Level Trigger Input.

PULSED DISCHARGE UNITS

General Features:

- a. Operates with tip in short circuit with equipment under test.
- b. Eliminates spark discharge.
- c. Repeatable fast rise time (1 ns per kV).
- d. Waveform not affected by:
 1. Corona
 2. Spark formation
 3. Multi-channelling
 4. Humidity
- e. Standard resistance: 150 ohms.
- f. Standard capacitance: 150 pF.

NOTE: Other values of capacitance and resistance are available on request.

MODEL P-5

Voltage Range: 0.5 to 5 kV.
Type: Pulse.
Case: Round, metal case electrically "grounded".
Trigger Cable Connector: BNC
Monitor Cable Connector: BNC
High Voltage Connector: Single pin, male.

TABLE 1.1 (Cont'd)
EDS-200 SPECIFICATIONS

MODEL P-8

Voltage Range: 1.5 to 8 kV.
Type: Pulse.
Case: Round, metal case electrically "grounded".
Trigger Cable Connector: BNC
Monitor Cable Connector: BNC
High Voltage Connector: Single pin, male.

MODEL P-25

Voltage Range: 7 to 25 kV.
Type: Pulse.
Case: Round, metal case electrically "grounded".
Trigger Cable Connector: BNC
Monitor Cable Connector: BNC
High Voltage Connector: Single pin, male.

MODEL P-30

Voltage Range: 7 to 30 kV.
Type: Pulse.
Case: Round, metal case electrically "grounded".
Trigger Cable Connector: BNC
Monitor Cable Connector: BNC
High Voltage Connector: Single pin, male.

DC DISCHARGE UNITS

General Features:

- a. High Voltage DC on tip until discharge occurs.
- b. Discharge controlled by electric field between tip and ground.
- c. Fast risetime (1 ns per kV).
- d. Output Voltage Polarity:
 - Standard: positive.
 - Optional: negative, factory installation only.

MODEL D-25

Voltage Range: 1 to 25 kV.
Type: DC.
Case: Round, metal case electrically "grounded".
Monitor Cable Connector: BNC
High Voltage Connector: Single pin, male.

MODEL D-30

Voltage Range: 1 to 30 kV.
Type: DC.

TABLE 1.1 (Cont'd)
EDS-200 SPECIFICATIONS

Case: Round, metal case electrically "grounded".
Monitor Cable Connector: BNC
High Voltage Connector: Single pin, male.

PHYSICAL CHARACTERISTICS EDS-200

Height: 203 mm (8") with cover
 127 mm (5") without cover
Depth: 406 mm (16")
Width: 229 mm (9")
Weight: Approx. 9 kg (20 lbs)

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SECTION II OPERATING INSTRUCTIONS

2.1 GENERAL

This section provides information and instructions for the operation of the Model EDS-200 Electrostatic Discharge Simulator.

***** CAUTION *****

READ ALL INFORMATION IN THIS SECTION BEFORE ATTEMPTING OPERATION. IMPROPER OPERATION MAY CAUSE COSTLY DAMAGE TO THE INSTRUMENT OR SERIOUS INJURY TO THE OPERATOR.

2.2 OPERATIONAL PRECAUTIONS

2.2.1 AC POWER SOURCE

The standard EDS-200 operates from an AC power source of 120 VAC $\pm 10\%$ 50/60 Hz.

For optional 220 VAC $\pm 10\%$ 50/60 Hz operation, the EDS-200 must be either ordered with 220 VAC from the factory or be returned for modification to this option. The EDS-200 DOES NOT CONTAIN A POWER SOURCE SWITCH for switching between two or more AC power sources.

Operation from an AC power source other than the one specified could cause extensive damage to the circuitry.

2.2.2 HIGH VOLTAGE PRECAUTIONS

Always observe the following precautions when working around high voltage:

- a. When the EDS-200 is turned "ON", keep hands and other extremities away from the IIPS of the Discharge Units.
- b. NEVER turn "ON" the Control Module without a Discharge Unit connected.
- c. Turn "OFF" the Control Module when not in use.

2.3 CONTROL FUNCTIONS

All controls for operating the EDS-200 Electrostatic Discharge Simulator are located on the front panel of the Control Unit. The location of each individual control and indicator is shown in Figure 2.1 and described in the following paragraphs.

2.3.1 HIGH VOLTAGE CONTROL

The HV Control is used to adjust the output level of the discharge voltage. The discharge voltage range is determined by the Discharge Unit connected to the Control Unit.

2.3.1.1 DISCHARGE VOLTAGE MONITOR

A three and one half digit LED Meter which indicates the peak discharge voltage level.

2.3.2 PULSED/DC SELECTOR SWITCH

Two position slide switch which selects either the PULSED or DC mode of operation for the Control Unit corresponding to the Discharge Unit being used.

NOTE: 1. A Pulsed Discharge Unit cannot be used in the DC mode and a DC Discharge Unit cannot be used in the PULSED mode.

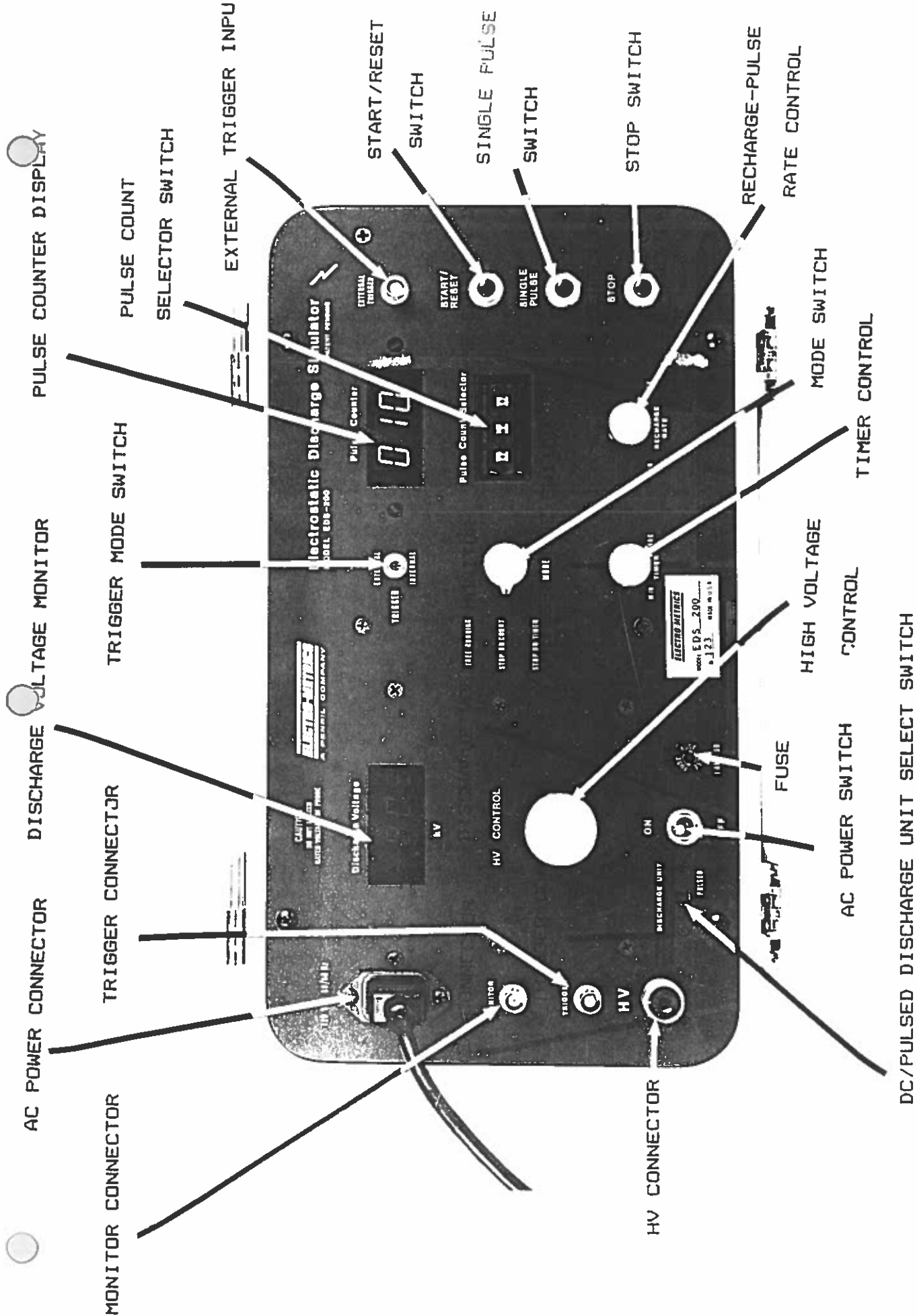


FIGURE 2.1
EDS-200 CONTROL UNIT FRONT PANEL
(2-2)

2. If the DC mode of operation is selected, the following will occur:

The trigger circuitry will be disabled and disconnected from the TRIGGER Connector.

2.3.3 POWER SWITCH

Two position switch which controls the AC power to the Control Unit.

2.3.4 MODE CONTROL SWITCH

Three position switch which selects one of three modes of Discharge Unit operation: FREE RUNNING, STOP ON COUNT, STOP ON TIME.

2.3.4.1 FREE RUNNING

In this position, the Discharge Unit will operate continuously after the START/RESET Switch is pushed. To halt the operation of the unit, the STOP Switch must be pushed.

2.3.4.2 STOP ON COUNT

In this position, the number of discharges is determined by the setting of the PULSE COUNT SELECTOR Switch. The Discharge Unit will be turned off when the PULSE COUNTER Display reaches the number of pulses set by the PULSE COUNT SELECTOR Switch.

2.3.4.3 STOP ON TIME

In this position, the duration of Discharge Unit operation is determined by the TIMER CONTROL setting.

2.3.5 TIMER CONTROL

The TIMER CONTROL sets the duration of Discharge Unit operation in the STOP ON TIME position of the MODE Switch. The control can vary the operating time between 5 and 300 seconds (approx.) before turning off the Discharge Unit.

2.3.6 PULSE COUNT SELECTOR SWITCH

A three-section thumb wheel switch which determines the number of discharges in the STOP ON COUNT position of the MODE Switch. The pulse count can be varied from 1 to 999 discharges, with the Discharge Unit being turned off when the selected count is reached.

2.3.6.1 PULSE COUNTER DISPLAY

A three digit LED readout which records the number of trigger pulses sent to the PULSED Discharge Unit. The display is reset to zero (000) when the START/RESET Switch is pushed and counts until the Discharge Unit stops pulsing. The count is cumulative from each RESET point up to a total of 999 before starting over again from zero (000).

2.3.7 RECHARGE (PULSE) RATE CONTROL

The RECHARGE RATE Control determines the trigger pulse rate and thus the application of the high voltage to the PULSED Discharge Unit. The pulse rate is adjustable from 1 to 30 Hz.

2.3.8 TRIGGER SWITCH

Two position switch which selects between two modes of trigger operation: INTERNAL or EXTERNAL.

2.3.8.1 INTERNAL

In this position of the TRIGGER Switch, the PULSED Discharge Unit is pulsed from an internal trigger circuit with the pulse rate determined by the RECHARGE RATE Control setting.

2.3.8.2 EXTERNAL

In this position of the TRIGGER Switch, the PULSED Discharge Unit is pulsed from an external trigger source. Since the internal trigger circuitry is disabled, the PULSED Discharge Unit will not operate without the external trigger.

NOTE: The external trigger source must be buffered to drive a 20 mA TTL level signal, not to exceed 5 V. The minimum time between trigger signals is 50 msec.

2.3.9 START/RESET SWITCH

A pushbutton switch which resets the PULSE COUNTER DISPLAY to zero (000) and starts operation of the Discharge Unit in all modes.

2.3.10 SINGLE PULSE SWITCH

A pushbutton switch which provides the Discharge Unit with a single pulse mode capability.

2.3.11 STOP SWITCH

A pushbutton switch which turns off the high voltage to the Discharge Unit in all modes of operation.

2.4 FRONT PANEL CONNECTORS

2.4.1 POWER INPUT CONNECTOR

A combined power connector and AC line filter which connects the EDS-200 to the AC power source.

2.4.2 MONITOR CONNECTOR (BNC)

A BNC connector which supplies the low voltage reference to drive the DISCHARGE VOLTAGE MONITOR.

2.4.3 TRIGGER CONNECTOR (BNC)

BNC output connector which supplies the trigger pulse to the Pulsed Discharge Units.

2.4.4 HIGH VOLTAGE CONNECTOR

An insulated connector which supplies the high voltage input to the Discharge Unit.

2.4.5 EXTERNAL TRIGGER CONNECTOR (BNC)

A BNC connector for the external trigger input when operating in the external trigger mode.

2.5 POWER REQUIREMENTS

The EDS-200 operates from an AC power source of 105-130 VAC, 50/60 Hz.

2.5.1 FUSE SPECIFICATION

1.0 A SLO-BLO.

2.6 OPERATING PROCEDURE

2.6.1 INITIAL SETUP

- a. Unlatch the cover. Remove the power cord and the Discharge Unit, if installed and required for the test to be performed.

NOTE: Normally the cover of the EDS-200 contains one Discharge Unit secured to a mounting bracket using a knurled thumbscrew. A total of six Discharge Units are available for use with the EDS-200 Control Unit.

Refer to Section I Table 1.1 for a complete listing of all Discharge Unit specifications.

b. Connect the Discharge Unit chosen to the Control Unit using one of the two methods given below:

(1) PULSED DISCHARGE UNITS:

(a) Connect the High Voltage Cable to the HV Connector on the Control Unit.

(b) Connect the Monitor and Trigger cables to their respective connectors on the Control Unit.

(2) DC DISCHARGE UNITS:

(a) Connect the High Voltage Cable to the HV Connector on the Control Unit.

(b) Connect the Monitor cable to the Monitor Connector on the Control Unit.

2.6.2 PRE-OPERATIONAL CHECKOUT

***** CAUTION *****

DO NOT OPERATE THE DISCHARGE UNITS ABOVE THE VOLTAGE RATINGS INDICATED FOR EACH UNIT AS THIS COULD DAMAGE THE DISCHARGE UNIT. BELOW THE MINIMUM VOLTAGE RATING INDICATED, THE DISCHARGE UNIT WILL NOT OPERATE RELIABLY.

2.6.2.1 CHECKOUT USING PULSED DISCHARGE UNIT

a. Set the Control Module controls as follows:

AC POWER SWITCH.....OFF
MODE SWITCH.....STOP ON COUNT
PULSED/DC SWITCH.....PULSED
HV CONTROL.....FULL CCW
RECHARGE RATE CONTROL.....FULL CCW

***** CAUTION *****

(1) THE HV CONTROL SHOULD ALWAYS BE SET FULLY COUNTERCLOCKWISE (CCW) BEFORE THE CONTROL MODULE IS TURNED ON TO PREVENT SHOCK AND POSSIBLE INJURY.

(2) NEVER OPERATE THE EDS-200 CONTROL UNIT WITH THE DISCHARGE UNIT SELECT SWITCH IN THE "PULSED" POSITION WITHOUT A PULSED DISCHARGE UNIT CONNECTED. THIS WILL DAMAGE THE CONTROL UNIT CIRCUITRY. THIS DAMAGE IS NOT INSTANTANEOUS BUT WILL OCCUR AFTER SEVERAL MINUTES OF OPERATION.

- b. Connect the AC power cord to a 115 VAC power source.
- c. Attach the ground strap of the Discharge Unit to the test object. Place the tip of the Pulsed Discharge Unit in direct contact with the test object.
- d. Set the AC POWER Switch to ON, the LED displays should light.

***** CAUTION *****

NEVER TURN ON OR OPERATE THE CONTROL UNIT WITHOUT A DISCHARGE UNIT CONNECTED. TO DO SO COULD DAMAGE OR DESTROY THE CONTROL UNIT CIRCUITRY.

- e. Set the PULSE COUNT SELECTOR to a number between 001 and 999, e.g. 85.
- f. Using the HV CONTROL, set the DISCHARGE VOLTAGE MONITOR at 25% of the rated voltage level of the Discharge Unit selected.
- g. Push the START/RESET Switch, the PULSE COUNTER should reset to 000 with the HV circuitry activated. The Discharge Unit should discharge for the number of pulses selected in Step e. The unit should stop when the PULSE COUNTER reaches the number indicated.
- h. Set the MODE Switch to FREE RUNNING and push the START/RESET Switch. The Discharge Unit should pulse continuously with the PULSE COUNTER incrementing one count for each pulse. Rotate the RECHARGE RATE Control CW, the pulse rate should increase.
- i. Push the STOP Switch, the Discharge Unit should stop pulsing.
- j. Set the MODE Switch to STOP ON TIME and the TIMER CONTROL FULL CCW.
- k. Push the START/RESET Switch, the Discharge Unit should pulse (discharge) for approximately five (5) seconds before turning off.

2.6.2.2 CHECKOUT USING DC DISCHARGE UNIT

- a. Set the Control Module controls as follows:
AC POWER SWITCH.....OFF
MODE SWITCH.....STOP ON COUNT
PULSED/DC SWITCH.....DC
HV CONTROL.....FULL CCW
RECHARGE RATE CONTROL.....FULL CCW

***** CAUTION *****

(1) THE HV CONTROL SHOULD ALWAYS BE SET FULLY COUNTERCLOCKWISE (CCW) BEFORE THE CONTROL MODULE IS TURNED ON TO PREVENT SHOCK AND POSSIBLE INJURY.

(2) NEVER OPERATE THE EDS-200 CONTROL UNIT WITH THE DISCHARGE UNIT SELECT SWITCH IN THE "PULSED" POSITION WITHOUT A PULSED DISCHARGE UNIT CONNECTED. THIS WILL DAMAGE THE CONTROL UNIT CIRCUITRY. THIS DAMAGE IS NOT INSTANTANEOUS BUT WILL OCCUR AFTER SEVERAL MINUTES OF OPERATION.

- b. Connect the AC power cord to a 115 VAC power source.
- c. Attach the ground strap on the Discharge Unit to the test object.

- d. Set the AC POWER Switch to ON, the LED displays should light.

***** CAUTION *****

NEVER TURN ON OR OPERATE THE CONTROL MODULE WITHOUT A DISCHARGE UNIT CONNECTED. TO DO SO COULD DAMAGE OR DESTROY THE CONTROL MODULE CIRCUITRY.

- e. Set the PULSE COUNT SELECTOR to a number between 001 and 999, e.g. 25.
- f. Rotate the HV CONTROL clockwise (CW), a voltage indication between 0.2 and 5 kV may appear on the DISCHARGE VOLTAGE MONITOR. This due to leakage around the high voltage transformer. If a voltage indication greater than 5 kV is present during this step, consult Electro-Metrics for further assistance. Return the HV CONTROL to a fully CCW position.
- g. Push the START/RESET Switch, the PULSE COUNTER should reset to 000. Using the HV CONTROL, set the DISCHARGE VOLTAGE MONITOR at 25% of the rated voltage level of the Discharge Unit selected.
- h. The Discharge Unit should discharge each time the dielectric strength of the air gap between the probe tip and the test object is broken down, for the number of pulses selected in Step e. The unit should stop when the PULSE COUNTER reaches the number indicated.
- i. Set the MODE Switch to FREE RUNNING and push the START/RESET Switch. The Discharge Unit should discharge each time the tip is held near the test object. Each time the unit discharges, the PULSE COUNTER should increment one count per discharge. Rotate the RECHARGE RATE Control CW, the discharge rate should increase.
- j. Push the STOP Switch, the Discharge Unit should stop and turn off.
- k. Set the MODE Switch to STOP ON TIME and the TIMER CONTROL FULL CCW.
- l. Push the START/RESET Switch, the Discharge Unit should discharge for approximately five (5) seconds before turning off.

2.6.3 TEST METHODS

Refer to Section III for complete information on Electrostatic Discharge testing methods plus equipment and personal safety when working with high voltage EDS simulators.

SECTION III
ELECTROSTATIC DISCHARGE TEST METHODS

3.1 INTRODUCTION

This section provides information on Electrostatic Discharge testing methods plus personnel and equipment safety when working with and around the EDS-200 simulator.

3.2 SAFETY PROCEDURES

*****>>> WARNING <<<*****

- a. THE ESD TEST DISCHARGE MAY BE HAZARDOUS TO PACE-MAKER WEARERS.
- b. PERSONNEL WITH PACE-MAKERS, HEART PROBLEMS, NERVOUS DISORDERS, AND SIMILAR PROBLEMS SHOULD NOT BE ALLOWED TO OPERATE THE EDS-200 OR OTHER ESD SIMULATORS OR BE PRESENT WHEN ESD TESTING IS OCCURRING.

The EDS-200 Electrostatic Discharge Simulator is a high voltage instrument producing voltage levels up to 30 kV. The energy level of this voltage is below that which is considered a lethal level* for a normal healthy person but even this lower energy level* can, at the minimum, give a very unpleasant shock to the user. Operating and working around any high voltage instrument or device requires a high degree of responsibility, care, and common sense. Extreme caution and care should always be exercised when working with these (or any other) high voltage and energy levels since under some circumstances--environmental conditions, health of operator, etc--even these levels can be fatal. Moreover, even a healthy person can be startled by a static discharge and accidentally injure him/herself.

3.2.1 SAFETY PRECAUTIONS TO OBSERVE

The following safety precautions should always be observed when using the EDS-200 to perform Electrostatic Discharge testing.

3.2.1.1 TEST AREA/EQUIPMENT UNDER TEST PRECAUTIONS

- a. The test area and equipment under test should be kept isolated and separate from other test, operating, and administrative areas.
- b. The test area should be clearly marked with the appropriate WARNING and CAUTION signs denoting that high voltage testing is being conducted.
- c. The number of personnel in the High Voltage test area should be limited to that which is required to perform the testing. The greater the number of people in the test area, the greater the probability of the occurrence of accidents and other undesired incidents.

* Usually much less than 0.15 joule.

- d. The equipment under test should be properly grounded, unless the procedure being following states otherwise, to protect the test personnel and the EDS-200. In addition, the equipment under test should be clearly marked as such.

3.2.1.2 EDS-200 PRECAUTIONS AND USAGE

- a. Always verify that the EDS-200 is returned to ground, unless the procedure being followed states otherwise, to protect the operator, EDS-200, and other equipment in the area.
- b. Never perform ESD testing near other equipment or machinery. ESD discharges can effect electronically controlled and/or computer controlled equipment, medical equipment such as pacemakers, and many other electron. devices. These discharges may possibly cause malfunctions, breakdowns, and (in the extreme) life-threatening problems.
- c. NEVER turn "ON" the Control Module without a Discharge Unit connected.
- d. Turn "OFF" the Control Module when not in use.
- e. Do not operate the discharge units above the voltage ratings indicated for each unit as this could damage the discharge unit. Below the voltage rating indicated, the discharge unit will not operate reliably.
- f. The HV Control should always be set FULLY COUNTERCLOCKWISE (CCW) before the Control Module is turned on to prevent SHOCK and POSSIBLE INJURY.
- g. Never turn on or operate the Control Unit without a Discharge Unit connected. To do so could damage or destroy the Control Unit circuitry.
- h. Before performing any work or checks on the equipment under test or the EDS-200, always push the STOP Switch to stop operation of the EDS-200 (regardless of the EDS-200 operating mode) plus turn off and remove the high voltage from the Discharge Unit.

3.2.1.3 PERSONNEL PRECAUTIONS

- a. When the EDS-200 is turned "ON", keep hands and other extremities away from the TIPS of the Discharge Units.
- b. THE ESD TEST DISCHARGE MAY BE HAZARDOUS TO PACE-MAKER WEARERS.
- c. Personnel with pace-makers, heart problems, nervous disorders, and similar problems should not be allowed to operate the EDS-200 or other ESD simulators or be present when ESD testing is occurring.
- d. Personnel should remain clear of the equipment under test when ESD testing is occurring. Only one person should operate the EDS-200, or any other simulator, at one time.
- e. A flashing red light and/or other similar warning device should be installed and activated to warn other personnel that high voltage testing is occurring.
- f. For the safety of all personnel and equipment, ESD and high voltage testing should be done in an area that is isolated--separate room, warning signs and signals--and if possible shielded from other sections of your company.
- g. If any deviation from standard operating conditions occurs--in sound, equipment indications, etc--STOP TESTING

and INVESTIGATE before continuing the testing. This is good common sense and practice when doing any high voltage work.

3.2.2 SUMMARY

Always exercise extreme caution and care when working around and on ESD simulators and other high voltage equipment.

>>>>REMEMBER<<<<

CAREFUL, CAUTIOUS, AND CORRECT is better than DARING, DASHING, AND DEAD. "HIGH VOLTAGE" CAN KILL, RESPECT IT AND LIVE.

3 USING THE EDS-200

3.3.1 INTRODUCTION

As described previously, the EDS-200 comprises a Control Unit with one or more Discharge Units. The Control Unit sets the operating parameters for the EDS-200 while the Discharge Units set the high voltage operating range. There are two types of Discharge Units, DC and PULSED, with each series offering ranges up to 30 kV.

The "DC" Discharge Unit will charge up to the voltage selected by the Control Unit and hold the voltage at the tip until a discharge occurs. The discharge occurs when the dielectric, in most cases air, cannot hold-off the electric field between the Discharge Unit tip and the object under test. The DC Discharge Unit comes with a round tip to minimize corona current losses.

The "PULSED" Discharge Unit uses a series of internal high voltage switches to produce a consistent waveform. The tip remains at ground potential until it is triggered by the Control Unit in accordance with the settings established by the operator. The proper method of testing is to place the tip of the Discharge Unit in direct contact with the object under test, i.e. short circuited. The PULSED Discharge Unit comes with a pointed tip to facilitate direct contact with the unit under test.

For both types of Discharge Units, the Control Unit monitors and indicates the voltage directly at the Discharge Unit tip output capacitors. This eliminates any extrapolation errors.

While the "DC" Discharge Unit offers exact replication of an ESD event, it also has the same statistical variation and degradation of the waveform as allowed by spark type discharge. These deviations are the result of corona (charge leakage due to electric fields created by the Discharge Unit and the unit under test prior to discharge), unpredictable resistive phase time delay of the spark channel plus other factors such as multi-channeling of the spark.

The "PULSED" Discharge Unit does not suffer from these waveform modifiers since all of the above mentioned deviations are a result of the spark formation. The "PULSED" unit reliably replicates the waveform every time it is triggered since it switches the high voltage internally and is operated in a short circuit mode.

NOTE: Dielectric (voltage hold-off) strength is a function of geometry and the time that the voltage has been

present. This is the reason why the "PULSED" unit may appear to have a shorter spark than the "DC" unit when allowed to operate with a gap (not recommended). For this reason, when performing tests on insulated equipment and testing for hold-off voltage, the "DC" unit is preferred (as explained later in this section).

3.3.2 EDS-200 OPERATION-MODES/STATES

After determining the type of ESD testing to be performed, select the Discharge Unit required and set the DISCHARGE UNIT SELECT Switch (located next to the POWER Switch) on the Control Unit for the Discharge Unit being used.

***** CAUTION *****

NEVER OPERATE THE EDS-200 CONTROL UNIT WITH THE DISCHARGE UNIT SELECT SWITCH IN THE "PULSED" POSITION WITHOUT A PULSED DISCHARGE UNIT CONNECTED. THIS WILL DAMAGE THE CONTROL UNIT CIRCUITRY. THIS DAMAGE IS NOT INSTANT-ANEOUS BUT WILL OCCUR AFTER SEVERAL MINUTES OF OPERATION.

3.3.2.1 CONTROL UNIT OPERATION

The EDS-200 Control Unit controls and sets the state and mode of EDS operation. At any instant the Control Unit is in either of two states: stopped or operate. The operator can switch states by either pushing the START/RESET Switch to put the Control Unit in the operate state or by pushing the STOP Switch to put the Control Unit in the stopped state.

The operator can select one of three modes of Control Unit operation using the MODE Switch: FREE RUN, STOP ON COUNT, STOP ON TIME.

- a. FREE RUN: In this mode the Control Unit will operate as controlled by the operator indefinitely. When the PULSE COUNTER display exceeds 999, it rolls to 000 and continues.
- b. STOP ON COUNT: In this mode the Control Unit will go to the stopped state when the PULSE COUNTER display indicates the same number as set by the operator using the PULSE COUNT SELECTOR thumb wheel switches. For the DC Discharge Unit, this means that the high voltage is turned off while for the PULSED Discharge Unit, the triggering is stopped. It is equivalent to pushing the STOP Switch manually.
- c. STOP ON TIME: This mode is similar to FREE RUN except that a time limit has been established for the operate state. The time limit starts when the START/RESET Switch is pushed and expires after the time set by the operator using the TIMER CONTROL is reached. The range is 5 to 300 seconds. When the time limit expires, the Control Unit goes into the stopped state.

3.3.2.2 OPERATION WITH DC DISCHARGE UNIT

Connect the DC unit to the Control Unit, set the DISCHARGE UNIT SELECT Switch to the DC position. Turn on the Control Unit

and push the START/RESET Switch to activate the high voltage. This safety feature prevents accidental high voltage being present at the tip of the Discharge Unit when turning on the Control Unit.

Operation of the EDS-200 using a DC Discharge Unit:

- a. Push the START/RESET Switch and dial the desired voltage without causing a discharge. Keep the tip of the Discharge Unit away from any object to which it may discharge.
- b. Begin testing by approaching the unit under test with the round tip pointing towards the desired discharge spot.
- c. When the discharge occurs, immediately back off from the unit under test and wait a few moments prior to the next approach. This wait is controlled by the RECHARGE RATE Control on the Control Unit and is between 0.1 seconds (MIN-FULL CCW) and 1.0 second (MAX-FULL CW).
- d. To turn off the high voltage, push the STOP Switch at any time. The SINGLE PULSE Switch does not operate for a DC unit; however, the same result can be obtained by the setting the PULSE COUNT SELECTOR thumbwheel switch to 001 and the MODE Switch to STOP ON COUNT.
- e. Everytime a discharge is made, the PULSE COUNTER display will increment one count. The display can be reset to 000 at any time by pushing the START/RESET Switch.

3.3.2.3 OPERATION WITH PULSED DISCHARGE UNIT

Connect the PULSED unit to the Control Unit and set the DISCHARGE UNIT SELECT Switch to the PULSED position.

Operation of the EDS-200 using a PULSED Discharge Unit:

- a. Turn on the Control Unit, select the desired voltage level, and place the tip of the Discharge Unit directly against the unit under test.
- b. Push the START/RESET Switch, the Control Unit will now provide a repetitive trigger signal to the Discharge Unit. The trigger rate may varied from 1 to 30 Hz using the RECHARGE-PULSE RATE CONTROL.
- c. Another mode of controlling the trigger signal is using the SINGLE PULSE Switch. The single pulse function operate only after the STOP Switch has been pushed and/or before the START/RESET Switch has been pushed.
- d. To stop the triggering of the Discharge Unit, for any mode of operation, simply push the STOP Switch.
- e. Everytime a trigger pulse is sent to the Discharge Unit, the PULSE COUNTER display will increment one count. This will occur regardless of whether the Discharge Unit is connected to the unit under test or not. The display can be reset to 000 at any time by pushing the START/RESET Switch.
- f. If the operator desires to have the Control Unit in the stopped mode and the PULSE COUNTER display set to 000, this can be accomplished by pushing the START/RESET Switch and then the STOP Switch.

3.4 ESD TESTING METHODS

Both types of Discharge Units produce a fast risetime ESD waveform when triggered. There are basically four methods of performing ESD testing: Current Injection Mode, EMI Exposure, Electrostatic, and Dielectric Hold-Off. Each will be explained using the EDS-200.

3.4.1 CURRENT INJECTION

PURPOSE: To produce a direct discharge to the equipment under test.

DISCHARGE UNIT REQUIRED: PULSED or DC. PULSED unit is preferred since it will produce more accurate and reliable data.

The discharge areas/spots/contact points chosen are usually the ones most susceptible to ESD such as corners, slits, knobs, switches, controls, cable entry areas, etc. The result is that the radiation emitted internally to the equipment under test can cause:

- a. A hard failure, equipment ceases to function.
- b. An operator-correctable soft failure, equipment has an apparent malfunction (example: computer-controlled machine miss a sequence) which is corrected by operator re-issuing commands to unit under test.
- c. Self-correctable or transparent soft failure. Equipment has a minor malfunction (example: computer-controlled machine misses a command but when the sequence is repeated functions correctly) but causes no lasting effect on equipment operation.

Either the DC or PULSED configuration can be used, although the PULSED Discharge Unit will produce more accurate and reliable data.

The PULSED unit resistor tip is placed in direct contact with the unit under test, while the DC unit is allowed to discharge into the unit under test with the resistor tip approximately 1 mm away. The placement of the ground strap is a controversial topic, but in general, minimizing the length and placing it near the discharge spot/point will cause the discharge to have a faster rise time increasing the high frequency spectral content. For small systems such as personal computers it is recommended that the ground strap be placed at the power cord entry ground point.

The DISCHARGE VOLTAGE MONITOR indicates the voltage level of the charge on the Discharge Unit tip before triggering occurs.

3.4.2 EMI EXPOSURE

PURPOSE: To create an intense EM field that emanates through the equipment under test and produces failures of the type mentioned in 3.4.1 above.

DISCHARGE UNIT REQUIRED: PULSED unit only.

This test is limited to use with the PULSED Discharge Unit only. An antenna, comprising either a square plate or loop, is used as the load of the Discharge Unit. The tests consist of two types:

- a. "E" FIELD TESTING which uses the 12-inch (305 mm) and 8-inch (203 mm) square plates to radiate an electric field at the equipment under test. The plate is fastened onto the Discharge Unit using the tip to secure it in place. The ground return is from one corner of the plate to the ground return on the Discharge Unit. Refer to Figure 3.1 for an illustration of this setup.
- b. "H" FIELD TESTING which uses the 4-inch (102 mm) and 6.75-inch (171.5 mm) loops to radiate a magnetic field at the

equipment under test. One end of the loop is fastened onto the Discharge Unit using the tip to secure it in place, while the other end of the loop is secured to the ground return of the Discharge Unit. Refer to Figure 3.2 for an illustration of this setup.

The smaller of the two loops and plates is used to limit the radiation to a fixed area of the equipment under test, while the larger of the two loops and plates is used for radiation of the entire equipment under test.

3.4.3 ELECTROSTATIC

PURPOSE: To test the equipment under test for the effects of the high voltage electric field lines.

DISCHARGE UNIT REQUIRED: DC unit only.

This test is typically applied to small equipment, such as calculators and portable plastic cased instrumentation, to check its ability to withstand the effects of high voltage electric fields. The electric field stress across internal modules, pc boards, and circuitry of the device under test (DUT) will be divided in inverse proportion to the capacitance amongst these internal parts. This electric field stress may alter the logic state of high input impedance circuits. The method of testing is to touch the ball tip of the DC Discharge to the case of the equipment under test at specific points of interest and noting the results. The ground return is usually connected to the power input ground return connector. The DC Discharge Unit is used here since a high voltage field is desired rather than the results of a discharge.

If the case of the device under test is entirely non-conducting the E-Field Radiating Plate may be used (with its ground strap disconnected) as one plate of a capacitor. A metal surface under or behind the DUT and connected to the DC Discharge Unit ground return functions as the other plate.

3.4.4 DIELECTRIC HOLD-OFF

PURPOSE: To test the ability of insulating materials to hold off high voltage.

DISCHARGE UNIT REQUIRED: DC unit only.

This test is used to test the ability of insulating material (such as plastics) used for enclosures, display panels, and touch film panel to hold off high voltage. The method of testing is to touch the insulating material with the ball tip and move it around. The ground return is normally connected to one end of/or behind the material under test. The DC Discharge Unit is used here since a high voltage potential is required rather than a continuous discharge into the material. The E-Field Radiating Plate may be used as a backing electrode for this test.



FIGURE 3.1
“E” FIELD TEST SETUP
(3-8)



FIGURE 3.2
“H” FIELD TEST SETUP

(3-9)

SECTION IV ACCESSORY DATA

4.1 INTRODUCTION

This section contains information and data on accessory items which are available for use with the EDS-200 ELECTROSTATIC DISCHARGE SIMULATOR.

4.2 ANTENNAS

- a. EF-1000 "E" FIELD DISCHARGE PLATES
8 inch (203 mm) and 12 inch (305 mm) square plates for use in radiating an electric field during EMI EXPOSURE TESTING.
- b. ML-1000 "H" FIELD DISCHARGE LOOPS
4 inch (102 mm) and 6.75 inch (171.5 mm) loops for use in radiating a magnetic field during EMI EXPOSURE TESTING.

4.3 IM-30 WAVEFORM MONITOR

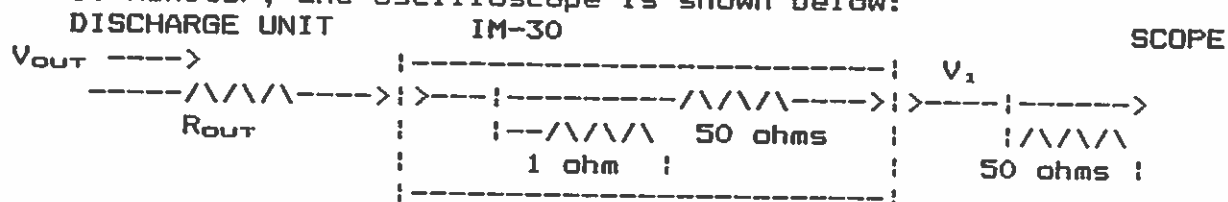
The IM-30 Current Monitor is designed to monitor the current waveform produced by the discharge units used with the ELECTRO-METRICS MODEL EDS-200 ELECTROSTATIC DISCHARGE SIMULATOR. An oscilloscope with a minimum bandwidth of 100 MHz and an input impedance of 50-ohms is required to display the waveform data obtained by the monitor, whose output connector is a BNC FEMALE.

To use the IM-30 Current Monitor, perform the following:

- a. PULSED DISCHARGED UNITS
 1. Connect the monitor to the oscilloscope using a coaxial cable. Refer to Page 4-2 for oscilloscope specifications and settings.
 2. Connect the ground strap provided with the monitor to the case of the discharge unit.
 3. Place the tip of the pulsed discharge unit selected in direct contact with the center of the flat circular plate on the monitor.
 4. A waveform will appear on the oscilloscope display, when the discharge unit is operating and pulsing, equivalent to the current waveform produced by the discharge unit¹.
- b. DC DISCHARGE UNITS
 1. Same as Step a-1.
 2. Same as Step a-2.
 3. With the DC discharge unit selected, turned on, and operating, move the tip towards the flat circular plate of the monitor. At some given distance from the monitor, depending on the voltage level selected and environmental conditions, a discharge will occur from the tip to the monitor.
 4. A waveform will appear on the oscilloscope display equivalent to the current waveform produced by the DC discharge unit.

NOTE: 1. Depending on the beam intensity of the oscilloscope selected, a single shot event may or may not be easily seen. In such a case, a storage oscilloscope may be required.

An equivalent circuit corresponding to the discharge unit, IM-30 Monitor, and oscilloscope is shown below:



$$V_{out} = (2V_1/1 \text{ ohm})(R+1) \quad 2V_1R/1 \text{ ohm}$$

OSCILLOSCOPE SPECIFICATIONS AND SETTINGS

As noted on Page 4-1, an oscilloscope with a minimum bandwidth of 100 MHz and an input impedance of 50-ohms is required to display the waveform obtained by the monitor. In general, the wider the bandwidth of an oscilloscope, the faster its response time. For this application note, we shall define an oscilloscope with a bandwidth equal to or less than 200 MHz as "slow" and with a bandwidth greater than 200 MHz as "fast".

If a "slow" oscilloscope is used as the monitor display, the waveform will be relatively "clean" but there will be a loss of amplitude level. This is due to the inability of the oscilloscope to respond to a fast rising waveform.

If a "fast" oscilloscope is used as the monitor display, the waveform will have less amplitude loss than the "slow" oscilloscope, but may have ringing and spiking due to impedance mismatching and inductive losses in the system.

OSCILLOSCOPE SETTINGS

TIME BASE SETTINGS:

In order to observe at least 5 time constants, the time base must be set as follows:

SERIES RESISTANCE @ 150 pF	WAVEFORM DURATION (5 Time-Constants)	SUGGESTED TIME BASE SETTING
150 ohms	112 ns	20 ns/div
500 ohms	375 ns	50 ns/div
1000 ohms	750 ns	100 ns/div

AMPLITUDE SETTINGS:

In order to observe the correct amplitude indication, set the amplitude as follows:

SERIES RESISTANCE @ 150 pF	AMPLITUDE V ₁ @ V _{OUT} = 10 kV	AMPLITUDE LEVEL PER DIVISION SETTING
150 ohms	33.3 V	5 V/div
500 ohms	20.0 V	5 V/div
1000 ohms	10.0 V	2 V/div

4.4 ADDITIONAL ACCESSORIES

a. RESISTOR ADD-ON-TIPS

Contact Electro-Metrics for information on obtaining the resistor values required. Standard resistor value is 150 ohms with standard capacitance value of 150 pF for the probe.

b. TRIPOD

To mount probe on during EMI EXPOSURE and similar testing.

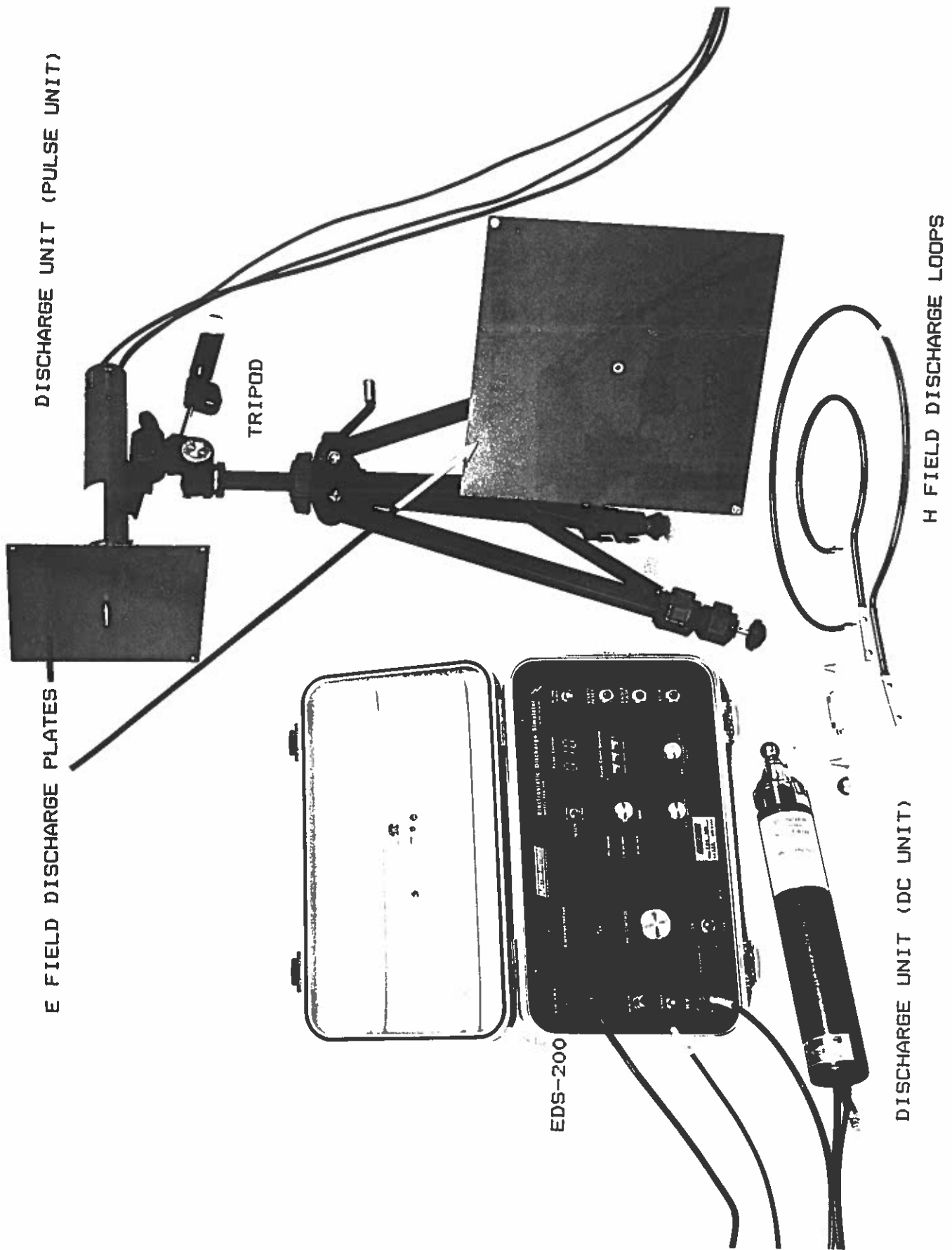
c. IMM-30

International Electrotechnical Commission (IEC) mounting bracket for EDS testing using the IM-30 Current Monitor.

d. IEC GROUND STRAP

2 m grounding strap which meets the test setup requirements stated in IEC Publication 801-2.





DISCHARGE UNIT (PULSE UNIT)

E FIELD DISCHARGE PLATES

TRIPOD

EDS-200

DISCHARGE UNIT (DC UNIT)

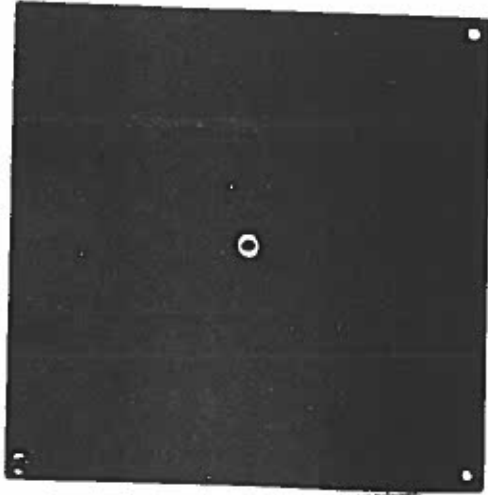
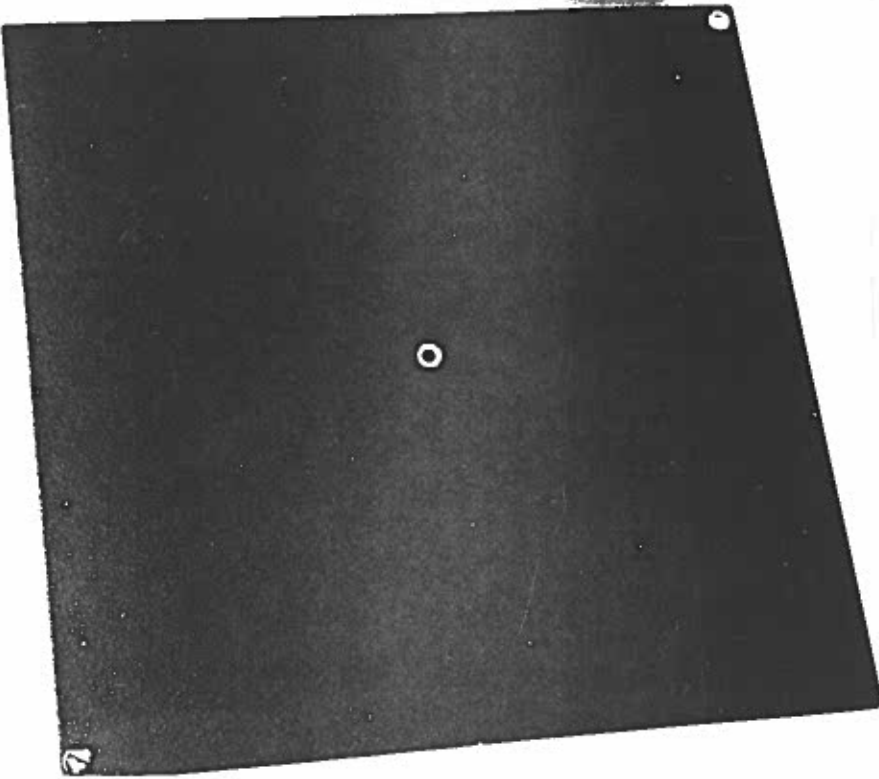
H FIELD DISCHARGE LOOPS

FIGURE 4.1
EDS-200 AND ACCESSORIES
(4-4)

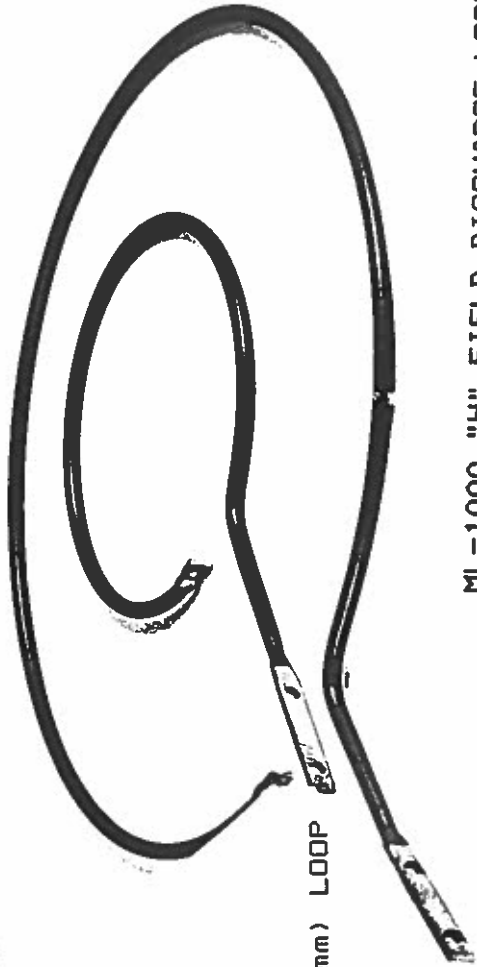
EF-1000 "E" FIELD DISCHARGE PLATE

12" (305 mm) PLATE

8" (203 mm) PLATE



4" (102 mm) LOOP



6.75" (172 mm) LOOP

ML-1000 "H" FIELD DISCHARGE LOOPS

FIGURE 4.2
EDS-200 ANTENNAS
(4-5)

NOTE: THESE ANTENNAS ARE USED ONLY WITH A PULSED DISCHARGE UNIT.

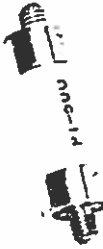
DC DISCHARGE UNIT

RE BEFO
MAY
PAGE
DO
SERV
WARRIN
DANGER
HIGH
VOLTAGE

BALL TIPS DC UNITS



RESISTOR ADD-ON-TIP



POINTED-TIPS PULSED UNITS



RESISTOR ADD-ON-TIP



PULSE DISCHARGE UNIT



1 DIRECT TO DISCHARGE UNIT

2 USE WITH RESISTOR TIPS

FIGURE 4.3
CLOSE-UP DISCHARGE UNIT TIP ACCESSORIES
(4-6)