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2257 North Penn Road
Hatfield, PA 19440

Telephone (215) 822-2171
Telex 846130

INSTRUCTION MANUAL

MODEL EA-1

ELECTROSTATIC ANALYZER

PART NUMBER 4001400

SERIAL NUMBER 0153

Return to Jim HENNESSY

1-B81-RL

XZ9403

5200076
Rev. A

HIGH VOLTAGE SAFETY

The Electrostatic Analyzer contains two high voltage power supplies which provide charging of the test plate. The output of power supplies is about 6000 volts of each polarity. The H.V. power supplies load down at a rate of 1 kv per 1 microampere of current. Therefore, the maximum short circuit current at the power supplies is about 6 microamperes. This is well below the generally accepted maximum harmless current of 5 milliamperes. The exposed plate is connected to the H.V. power supplies through an 80 megohm resistor providing a further measure of safety. Both of the H.V. power supplies become energized when the CHARGE/GROUND switch on the remote control is set to the CHARGE position and the CHG/GND-ISOLATE button is depressed. At any other time, including when the remote control cable is disconnected from the unit, the H.V. power supplies are inoperative.

TABLE OF CONTENTS

		Page #
1	Description	1 - 1
2	Features	2 - 1
3	Specifications	3 - 1
4	Operating Instructions	4 - 1
	4.1 Introduction	4 - 1
	4.2 Function of the Front Panel Controls and Adjustments	4 - 1
	4.3 Function of the Remote Control	4 - 3
	4.4 Performance Test	4 - 5
	4.5 Operation with Hewlett Packard Model 7015B X-Y Recorder	4 - 7
5	Routine Calibration and Maintenance	5 - 1
	5.1 Equipment	5 - 1
	5.2 Electrostatic Fieldmeter Calibration	5 - 1
	5.3 Cleaning of Insulator Standoffs and High Voltage Relays	5 - 4
6	Service and Repairs	6 - 1
7	Appendix	7 - 1
	7.1 Table of Accessories	7 - 1
	7.2 Bibliography	7 - 1

IMPORTANT

THIS INSTRUMENT CONTAINS DELICATE COMPONENTS AND CAN BE DAMAGED BY STRONG PHYSICAL SHOCKS OR VIBRATIONS

1. DESCRIPTION

The Electrostatic Analyzer is a sophisticated multipurpose research instrument designed to evaluate the performance of ionization equipment such as room air ionization systems, ionized air blowers, guns, and nozzles. It can be used to evaluate static-protective floor and work surfaces, conductive containers, antistatic garments and wrist straps, as well as monitor potentials on the human body. It can also be used in determining the capacitance of large objects. As an educational aid, the analyzer graphically demonstrates phenomena of static electricity such as charging by induction, electrostatic decay and etc.

The Analyzer consists of a 6 inch square stainless steel plate whose potential is monitored by an electrostatic fieldmeter probe. (see FIG. 1.1). The plate is connected to a high voltage relay which is normally open, isolating the plate. When the relay is closed the plate is connected to an internal high voltage power supply for charging the plate to a known voltage (adjustable up to 6000 volts). Current limiting resistor provides short circuit protection against shock from the plate. A digital display indicates the voltage present on the plate. The external connector allows for connection of an X-Y recorder for recording the monitored data. The same connector provides a signal of synchronization which starts the recorder the moment the plate becomes isolated. Once the plate is charged and then isolated, its charge will decay at a rate depending on the density of airborne ions and the humidity level in the test area. The decay can be timed or recorded so the ionizing efficiency of various static control systems may be compared.

The Analyzer can also monitor the balance of ions by measuring the voltage produced on the plate as well as the presence of electric fields which would charge the plate by induction. For monitoring purposes, the plate is left uncharged and isolated.

All functions of the monitor are controlled via manual remote control which allows you to take measurements in various locations and distances.

Electrostatic Analyzer

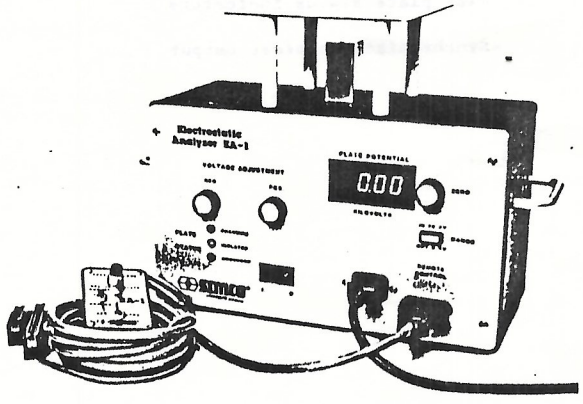


Figure 1.1 Electrostatic Analyzer

2. FEATURES

-Measures static charge decay

-Monitors ion flow imbalance

-Built-in power supplies

-Digital readout with high accuracy

-Remote control of all functions

-Test plate status indicators

-Synchronized recorder output



3. SPECIFICATIONS

Power:
120 VAC, 50/60 Hz., 0.2 amps
Fuse: 1/2 amp
Control Functions:
GROUND/CHARGE, ISOLATE, POLARITY

Plate Capacitance to Ground:
17 Picofarads

Plate Impedance to Ground:
(when Isolated)
more than 10^{12} ohms

Plate Charging Source:
Internal Positive and Negative Adjustable Power Supplies. 6,000 volts max. output.

Meter:
Non-Contact electrostatic fieldmeter, chopper-stabilized type

Display:
3-1/2 digit DPM

Meter Ranges:
0-1.999 kV, 19.99 kV

Accuracy:
5% of full scale

Meter Response Time:
100 Milliseconds

Recorder Output:
0-1 volts full scale: available at recorder connector. Polarity corresponds to plate polarity.

Size:
10-1/2" H x 12" W x 4" D

Weight:
12.5 lbs

Mounting:
1/4" - 20 NC standard tripod mounting thread provided in bottom of instrument case.

4. OPERATING INSTRUCTIONS

4.1 INTRODUCTION

This section describes: 1) Function of the front panel controls, selectors, indicators and connectors. 2) Function of the Remote Control. 3) Operation of the Analyzer with Hewlett Packard Model 7015B X-Y Recorder.

4.2 FUNCTION OF THE FRONT PANEL CONTROLS AND ADJUSTMENTS

The following is a general description of the Analyzer control indicators and connectors. This description will familiarize you with their function and FIG. 4.1 illustrates their location.

(1) PLATE POTENTIAL - LED display of the plate potential (in kilovolts).

(2) ZERO - Potentiometer for zeroing the meter.

(3) RANGE - Selects the meter display range. 20kV when the pushbutton is in and 2kV when it is out.

(4) POWER - Switch and built-in indicator, switch applies power to the instrument and the indicator illuminates to indicate the power is on.

(5) AC LINE RECEPTACLE - accepts molded grounding connector, 120 volts AC, 60 Hz.

(6) FUNCTION CONTROL - 9-pin D-SUB Connector for applying signals from the Remote Control. Also provides output signals for the X-Y Recorder.

(7) PLATE STATUS - Three LEDS which indicate the status of the plate,

CHARGING - red LED indicates that the plate is connected to a HV power supply.
ISOLATED - yellow LED indicates that the plate is electrically floating.
GROUND - green LED indicates that the plate is grounded through a 1 G ohm resistor.

(8) VOLTAGE ADJUSTMENT - Two controls which adjust voltage output from the HV power supplies to the plate.

POSITIVE - controls positive output;
NEGATIVE - controls negative output.

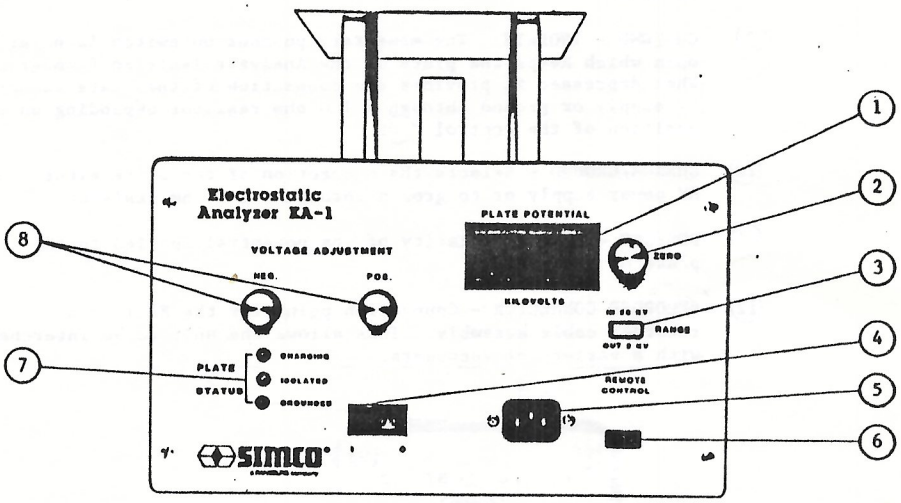


FIG. 4.1. Electrostatic Analyzer
Front Panel Controls, Indicators and Connectors.

4.3 FUNCTION OF THE REMOTE CONTROL

The following is a general description of the Remote Control and its connectors. This description will familiarize you with their function. Remote Control consists of a control box, (FIG.4.2), a D-SUB Connector for connection to the front panel of the Analyzer and a recorder connector for connection to an X-Y Recorder.

(9) CHG/GND - ISOLATE - The momentary pushbutton switch is normally open which keeps the plate of the Analyzer isolated from ground. When depressed it provides the connection of the plate either to a HV supply or ground through a 1 G ohm resistor depending on the position of the control (10).

(10) CHARGE/GROUND - Selects the connection of the plate either to a HV power supply or to ground through a 1 G ohm resistor.

(11) POS/NEG - Selects polarity of the potential applied to the plate of Analyzer.

(12) RECORDER CONNECTOR - Connection point for the EA-1 to X-Y recorder cable assembly. This allows the unit to be interchanged with a variety of recorders.

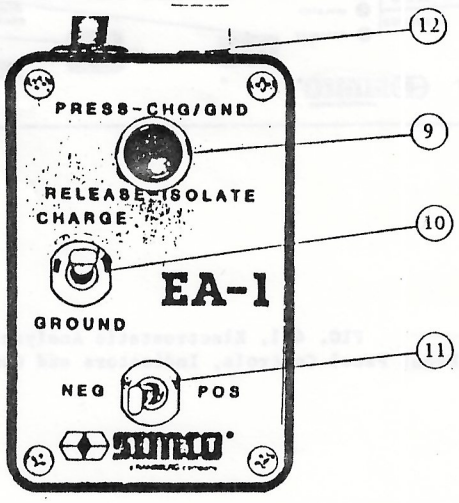


FIG. 4.2 Remote Control Face Panel.

4.3.1 Cable Assembly EA-1 to X-Y Recorder (Fig. 4.2.1)

13 Recorder Connector - This is a standard connector as used on modular telephones. It plugs into the remote control.

14 Cable - This is standard modular telephone cable (4 conductor, 7 strand, #26 AWG). Each wire carries a specific signal to the recorder:

A. Red - Meter output. Provides an output from the EA-1 meter that is proportional to the voltage on the plate:

Range	Output	Plate
2kV	.1V	/ 200V
20kV	.1V	/ 2kV

When used in conjunction with a .1V/inch setting this will yield:

Range	
2kV	200V/inch
20kV	2kV/inch

B. Green - Meter ground. Provides a ground reference from the EA-1 meter.

C. Black - Ground to start. Provides a connection with ground to synchronize the start of the recorder with the isolation of the EA-1 plate.

D. Yellow - Positive pulse to start. Provides a connection with a 1 mf capacitor in series with a 100 ohm resistor that has been charged to +5V. This will apply a positive pulse, the waveform dependent on the input impedance of the recorder circuitry. The pulse is suitable to start TTL control recorders.

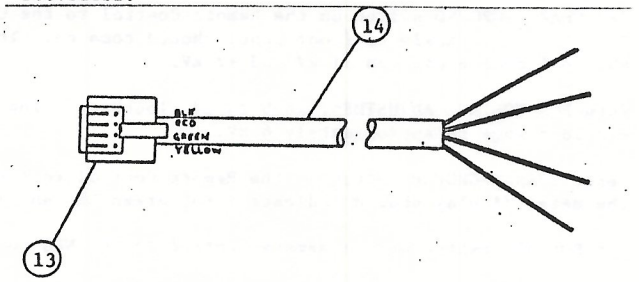


FIG. 4.2.1 Cable Assembly EA-1 to X-Y Recorder

4.4 PERFORMANCE TEST

IMPORTANT: STATIC CHARGE COULD BE GENERATED ON TEFLON* STANDOFFS SUPPORTING THE PLATE. PLACE THE INSTRUMENT INTO IONIZED AIR FLOW PRIOR TO ANY TESTING TO AVOID ERRORS.

4.4.1 Plug the instrument's power cord into an AC three-wire receptacle with true ground.

4.4.2 Connect D-SUB Connector of the Remote Control to the connector on the front panel of the Analyzer.

4.4.3 Turn the POWER switch on. Built-in switch indicator light, PLATE STATUS yellow LED and meter's LED display should come on.

4.4.4 Depress and release the RANGE pushbutton switch. The position of decimal point in the display should change.

4.4.5 Depress the RANGE switch again.

4.4.6 Turn both VOLTAGE ADJUSTMENT knobs fully counter clockwise.

4.4.7 Set POS-NEG switch on the remote control to the POS position.

4.4.8 Set CHARGE-GROUND switch on the remote control to the GROUND position.

4.4.9 Depress and hold CHG/GND - ISOLATE pushbutton switch on the remote control. Green LED on the Analyzer front panel should come on.

Steps 4.4.10 through 4.4.16 must be performed with CHG/GND - ISOLATE pushbutton depressed.

4.4.10 Adjust ZERO knob on the Analyzer until meter reads zero.

4.4.11 Set CHARGE-GROUND switch on the Remote Control to the CHARGE position. Red LED on the Analyzer front panel should come on. The meter display should indicate between +1 kV and +2 kV.

4.4.12 Turn POS VOLTAGE ADJUSTMENT knob fully clockwise. The meter display should change to approximately 6 kV.

4.4.13 Reset CHARGE-GROUND switch on the Remote Control to the GROUND position. The meter display should indicate zero, green LED should come on.

4.4.14 Set POS-NEG switch on the Remote Control to the NEG position.

*Trademark - E. I. Dupont

4.4.15 Return CHARGE-GROUND switch to the CHARGE position. Red LED on the front panel of the Analyzer should come on. The meter display should indicate about between -1 kV and -2 kV.

4.4.16 Turn NEG VOLTAGE ADJUSTMENT knob fully clockwise. The meter display should change to approximately -6 kV.

4.4.17 Release CHG/GND - ISOLATE pushbutton.

4.4.18 The instrument is now ready for operation.

NOTE: Meeting performance test requirements indicates proper operation of the instrument.

4.5 Operation with Hewlett-Packard Model 7015B X-Y Recorder

IMPORTANT: THIS INSTRUMENT CONTAINS DELICATE PARTS AND CAN BE DAMAGED BY SHOCKS OR STRONG VIBRATIONS.

4.5.1 Locate the Analyzer at the location where you wish to study ionization, or mount the ionized air blower so that the air flow is directed to the test plate.

4.5.2 Plug the instrument's power cord into an AC three-wire receptacle with true ground.

4.5.3 Turn the POWER switch of the Analyzer on.

4.5.4 Remove the connector cover from the bottom panel of the X-Y Recorder as shown in FIG. 4.3.

4.5.5 Connect the dual card edge connector of the Remote Control to the Remote Signal and Control Connection of the X-Y Recorder (FIG. 4.4).

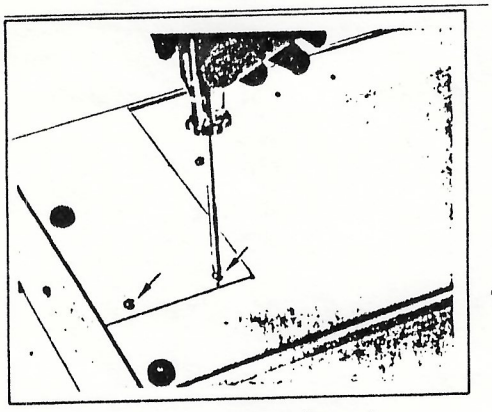


Figure 4.3 Connector Cover Removal

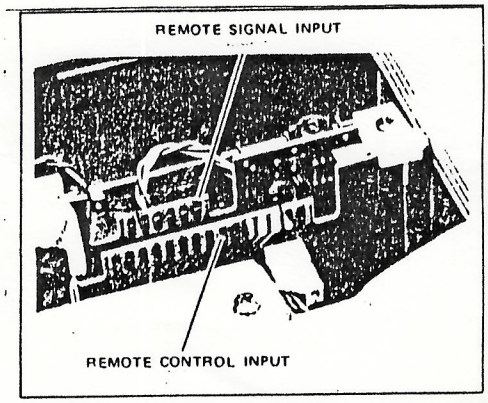


Figure 4.4 Model 7015B Remote Signal and Control Connections

4.5.6 Press the LINE pushbutton (pos.1) to energize the recorder.

4.5.7 The power ON indicator will light.

4.5.8 Place chart paper on the recorder platen and press the CHART HOLD button (pos.2).

4.5.9 Install the pen.

4.5.10 Depress pushbutton 12 indicating .1 V/in.

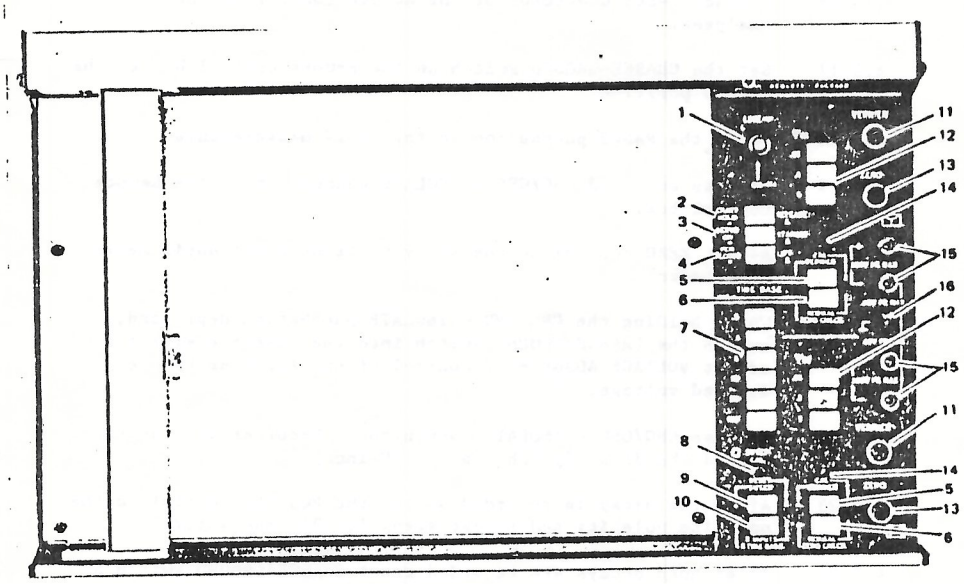


Figure 4.5 Model 7015B Front-panel Controls, Indicators and Connectors

4.5.11 Select the sweep time by pressing the appropriate pushbutton beside the desired SEC/IN indication (pos.7).

4.5.12 To activate the recorder servo system, press SERVO ON pushbutton (pos.3).

4.5.13 Press X TIME BASE pushbutton (pos.10).

4.5.14 Lower the pen and set zero by using Y-ZERO and X-ZERO knobs (pos.13) while pressing in ZERO CHECK buttons (pos.6).

4.5.15 Lift the pen.

4.5.16 Connect D-SUB Connector of the Remote Control to the Analyzer.

4.5.17 Set the CHARGE-GROUND switch on the Remote Control box to the GROUND position.

4.5.18 Press the RANGE pushbutton in for 20 kV measurements.

4.5.19 Depress and hold CHG/GND - ISOLATE pushbutton on the Remote Control box.

4.5.20 Adjust ZERO control on the Analyzer front panel until meter shows zero.

4.5.21 While holding the CHG/GND - ISOLATE pushbutton depressed, switch the CHARGE-GROUND switch into the CHARGE position and adjust VOLTAGE ADJUSTMENT control of the Analyzer to the desired voltage.

4.5.22 Release CHG/GND - ISOLATE pushbutton. Recorder will start to record the decay (graph scale 2 kV/inch).

4.5.23 After the decay is recorded switch the POS-NEG control to the opposite polarity and repeat steps 4.5.21, and 4.5.22.

4.5.24 After both decays are recorded reset CHARGE-GROUND switch on the Remote Control box to the GROUND position.

4.5.25 Release RANGE pushbutton on the front panel of the Analyzer.

4.5.26 Depress CHG/GND - ISOLATE pushbutton of the Remote Control.

4.5.27 Rezero the meter.

4.5.28 Release the above pushbutton and record the potential of the plate (graph scale 200 V/inch) for an ion balance check.

Electrostatic Analyzer

4.5.29 After test is completed release SERVO-ON and CHART HOLD pushbuttons of the recorder.

4.5.30 Remove the chart.

4.5.31 Turn off the recorder.

4.5.32 Turn off the Analyzer.

4.6 Examples of charts obtained with the Electrostatic Analyzer.

4.6.1 Decay Test (see Fig. 4.6.1).

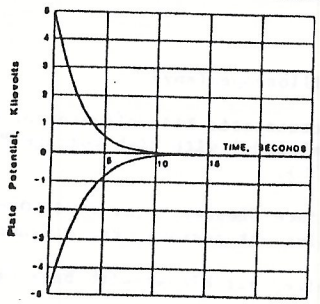


Fig. 4.6.1 Typical decay curves obtained with Electrostatic Analyzer

4.6.2 Ion Flow Imbalance Test (Fig. 4.6.2).

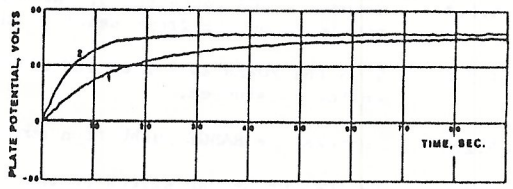


Fig. 4.6.2 Typical ion flow imbalance chart

5. ROUTINE CALIBRATION AND MAINTENANCE

Routine calibration and maintenance should only be performed after the checks in the Performance Test (section 4.4) have indicated a need for adjustments of the instrument. It will be necessary to remove the instrument's back cover to perform some of these procedures. The cover can be removed after removing four screws located at the corners of the back panel.

In order to identify various adjustments and controls discussed in this section, refer to Figure 5.1.

5.1 Equipment

5.1.1 Oscilloscope (any).

5.1.2 Electrostatic Kilovoltmeter or Electrometer (Keithly Model 610C) with High Voltage Probe (Keithly Model 6103C).

5.1.3 Surface Cleaner Spray (CRC CO contact cleaner or equivalent residue free cleaner).

5.1.4 Ionized air blower with balanced output.

5.2 Electrostatic Fieldmeter Calibration

5.2.1 Expose the standoffs to an ionized air flow for 10 seconds.

5.2.2 With the instrument off, connect the electrostatic kilovoltmeter or high voltage probe to the test plate.

5.2.3 Connect D-SUB Connector of the Remote Control to the connector on the front panel of the Analyzer.

5.2.4 Turn the POWER switch on and allow the Analyzer to warm up for 15 minutes.

5.2.5 Depress the RANGE pushbutton switch.

5.2.6 Set CHARGE-GROUND switch on the remote control to the GROUND position.

5.2.7 Depress and hold CHG/GND - ISOLATE pushbutton switch on the remote control.

5.2.8 Adjust ZERO knob on the Analyzer until meter reads zero.

5.2.9 Release CHG/GND - ISOLATE pushbutton.

5.2.10 Set POS-NEG switch on the remote control to the POS position.

5.2.11 Set CHARGE-GROUND switch on the Remote Control to the CHARGE position.

5.2.12 Depress and hold CHG/GND-ISOLATE pushbutton switch on the remote control.

5.2.13 Turn the appropriate VOLTAGE ADJUSTMENT knob until the Electrostatic Kilovoltmeter or Electrometer used for calibration indicates 5,000 volts.

5.2.14 Compare Analyzer meter reading.

5.2.15 Release CHG/GND-ISOLATE pushbutton switch.

5.2.16 Set POS-NEG switch on the Remote Control to the NEG position.

5.2.17 Repeat steps 5.2.12 through 5.2.17 for negative potential.

5.2.18 If based on results of this check, adjustment is required then;

5.2.19 Unplug the instrument and remove back cover.

5.2.20 Connect oscilloscope probe to oscilloscope terminal shown in Figure 5.1.

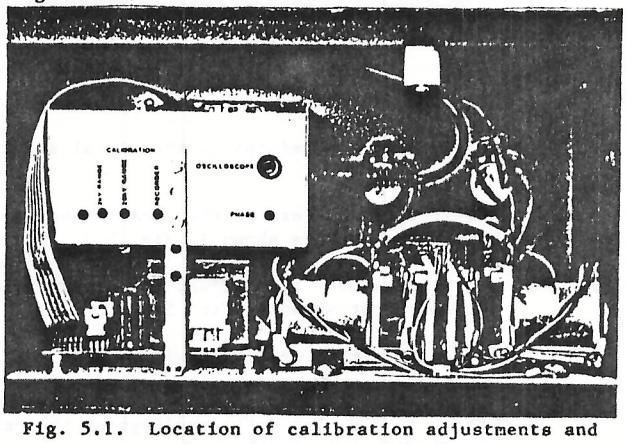


Fig. 5.1. Location of calibration adjustments and various components of Analyzer.

Electrostatic Analyzer

5.2.21 Plug the instrument into AC line and turn the power switch on.

CAUTION: While the instrument is plugged into an AC line and open for servicing a shock hazard is present, do not touch or contact parts other than those specified.

5.2.22 Repeat steps 5.2.10 through 5.2.12.

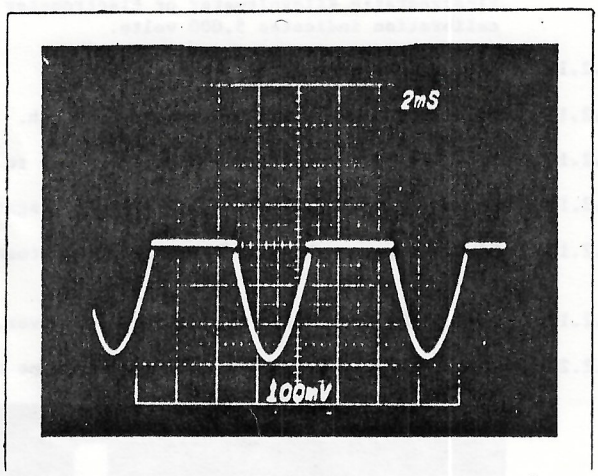


Fig. 5.2. Waveforms of the signal at terminal 1

5.2.23 Observe the picture on the oscilloscope screen. It should look like the one shown in Fig. 5.2..

5.2.24 If it does not, then adjust the picture with the PHASE trimming pot shown in Fig. 5.1.

5.2.25 Check the meter reading again.

5.2.26 Adjust the calibration with the 20 kV RANGE trimming pot shown in Fig. 5.1 until readings of the calibrating meter and analyzer meter are the same.

5.2.27 Release the RANGE pushbutton switch.

5.2.28 Repeat steps 5.2.6 through 5.2.12.

5.2.29 Adjust VOLTAGE ADJUSTMENT knob for an output below 2 kV indicated by the Electrostatic Kilovoltmeter or Electrometer used for calibration.

5.2.30 Compare Analyzer meter reading.

5.2.31 Release CHG/GND - ISOLATE pushbutton switch.

5.2.32 Set POS-NEG switch on the Remote Control to the NEG position.

5.2.33 Repeat steps 5.2.12 through 5.2.15 for negative potential.

5.2.34 If, based on results of this check, adjustment is required then,

5.2.35 Adjust the calibration with the 2 kV trimming pot shown in Fig. 5.1.

5.2.36 Adjustments of the recorder output can be accomplished with the RECORDER trimming pot.

5.2.37 Unplug the instrument from the AC line.

5.2.38 Disconnect the oscilloscope and high voltage probe from the analyzer.

5.2.39 Place back cover on unit and hold in position.

5.2.40 Install 4 screws to secure cover, screw them in until they make contact with the cover and tighten 1/2 TURN ONLY.

5.3 Cleaning of insulator standoffs and high voltage relays.

5.3.1 To prevent leakage current caused by contamination of Teflon standoffs and high voltage relay insulating material, it is advisable to clean them at 6 month intervals.

5.3.2 Unplug the instrument and remove back cover.

5.3.3 The following areas must be thoroughly sprayed with the surface cleaner spray (non-residue contact cleaner):

a. four exterior Teflon standoffs
b. one interior Teflon standoffs
c. all high voltage relay insulating material

5.3.4 As the surface cleaner evaporates it will leave a film of condensation. This can be dried with the application of warm air, otherwise wait 15 to 20 minutes to allow the condensation to dry before using the instrument.

5.3.5 Place back cover on unit and hold in position.

5.3.6 Install 4 screws to secure cover, screw them in until they make contact with the cover and tighten 1/2 TURN ONLY.

6. SERVICE AND REPAIRS

If an instrument is to be returned for repairs or recalibration, it should be packed carefully to prevent damage in shipment. A letter should accompany the instrument or be sent under separate cover, giving the model and serial number of the instrument and a brief description of the malfunction observed. Prior to returning the instrument, contact Simco for a return authorization number.

7. APPENDIX

7.1 Accessories

7.1.2 Remote Control - p/n 4101852, 1 (one)

7.1.3 Instruction Manual - p/n 5200076, 1 (one)

7.1.4 Carrying Case - p/n 4500067, 1 (one)

7.1.5 Wrist Strap - p/n 4001316, 1 (one)

7.1.6 Universal Cable Assembly EA-1 to X-Y Recorder - p/n 4102094 (one)

7.1.7 Cable Assembly EA-1 to H-P Model 7015B X-Y Recorder p/n 4101929 (one)

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