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Ion Systems

Charged Plate Monitor

Model 210

Manual

19-0210-M Version 1

Contents

1

Description

1.1 Model 210 Charged Plate Monitor

The Model 210 Charged Plate Monitor (CPM) is an easy to use, self-contained instrument for testing ionizer performance. In track mode, the CPM displays the voltage and polarity of ions arriving at the isolated plate. In peak voltage mode, the CPM records the largest positive or negative voltage registered on the plate. Offset mode measures long-term average balance.

An analog output signal allows information to be captured by a chart recorder or other device. An internal timer measures discharge time, the time required for ionization equipment to discharge a preset plate voltage of ±1 or 5 KV down to 50, 100 or 500 V. Two LED bar graphs simultaneously display positive and negative voltages, and plate voltage and timer readings appear on LED displays. The plate of the CPM is isolated from the rest of the instrument ensuring a low rate of charge leakage and a high level of accuracy. The Model 210 CPM makes all measurements described in Ionization Standard ANSI EOS/ESD S3.1 - 1991 of the ESD Association.

The following sections (1.2 and 1.3) describe the features on the front and rear panels of the Model 210 CPM.

1.2 Front Panel Functions

Item	Function
Power	An illuminated push button switch powers the unit on and off.
Level	A two position rotary switch determines the voltage of the internal plate charging source.
Plate Voltage Meter	A LED meter continuously displays the voltage present on the isolated plate.
Zero	A momentary switch that grounds the isolated plate.
Zero Set Control	Used with the Zero switch to set the Plate Voltage Meter to zero.
Charge	Two momentary switches that connect the positive or negative internal charging source to the isolated plate.
Mode	A four position rotary switch determines the display function of the Plate Voltage Meter.
Mode/Track	The meter display shows the voltage present on the isolated plate.
Mode/+Peak	The meter display shows the largest positive voltage registered on the plate since the last reset.
Mode/- Peak	The meter display shows the largest negative voltage registered on the plate since the last reset.
Mode/Offset	The meter display shows the long term average voltage on the plate. Allow at least 15 minutes for an accurate reading.
Peak Reset	A momentary switch which resets the peak voltage detection interval, or resets the offset voltage to zero in Offset Mode.
Balance Meter	Two, 10 segment, LED bar graph displays provide a visual indication of the plate voltage. The red display indicates positive and the green display indicates negative plate voltage.
Balance Voltage	A three position rotary switch that determines the scale (maximum 50, 100, or 250 V) for the segments of the Balance Meter displays.

High	A single LED for each polarity indicates that the voltage on the plate is at least 15% higher than the maximum of the Balance Meter bar graph display.
Discharge Time	Times 0-1999.9 seconds indicated on 5 ½ digit LED display.
Stop Level	A four position rotary switch that determines the stop level control voltage for the timer. In the OFF position, the display is turned off. When set, the Timer will run when the absolute value of the plate voltage exceeds the selected stop level of 50, 100 or 500 volts. When the plate voltage drops below the stop level, the Timer will stop and display the elapsed time.
Timer Reset	A momentary switch resets the timer and display. Depress the switch to set the Timer and display to “000.0”.

1.3 Rear Panel Functions

Item	Function
Power Cord	Supplies power to the Model 210 CPM and grounds the chassis. Connect only to properly grounded receptacle. See POWER REQUIREMENTS for input voltage information.
Fuse	2 Amp AGC type
Output Connectors	Two BNC type connectors provide analog outputs of 0-5 volts corresponding to a plate voltage of 0-5000 volts. The plate voltage polarity corresponds to the polarity of this analog output voltage. The PLATE OUTPUT always corresponds to the plate voltage. The METER OUTPUT always corresponds to the Plate Voltage Meter reading and will change depending on the setting of the Mode Switch and Level Switch.
Ground Terminal	A binding post is provided for attaching an external ground wire.

2 Installation and Operation

2.1 Unpacking and Inspection

Upon receipt of this instrument, inspect the package and report any shipping damage directly to the shipper. As you unpack the instrument, inspect it carefully for any damage that may have occurred during shipping. Do not apply power to a damaged unit.

2.2 Power Requirements

Caution

The use of improper input voltage may result in poor performance or damage to the unit.

Connection to a properly grounded circuit is necessary for correct operation of the CPM. This equipment has a 3 prong grounding type plug that automatically grounds the chassis when connected to a properly grounded power receptacle. This plug will only fit into a grounding type outlet. Do not alter the plug in any way.

Be sure the proper power is available before plugging in the CPM. Three models available are for 100, 120 and 230 V input, and the input voltage is indicated on the rear panel label. The use of improper input voltage may result in damage to the CPM that is not covered by the product warranty.

If fuse replacement is necessary, the fuse is a 2 AMP AGC type, Ion part number #28-1415. Remove power from the unit before replacing the fuse.

The Model 210 CPM is ready to operate as received. Read the operating instructions in this manual before applying power to the unit.

2.3 Placement and Powerup

Place the Model 210 CPM at a location at which discharge times are to be measured or induced electrostatic potentials are to be monitored.

1. Plug in the CPM and turn on the power. Place the Mode switch in the Track position. For best results allow approximately five to fifteen minutes of warm-up time before proceeding.
2. For discharge time measurement or plate voltage monitoring, select the desired Level (1 or 5 KV) and Stop Level voltage (50, 100, or 500 volts) using the appropriate switches.
3. After the warm-up time has elapsed, depress and hold the Zero switch. At the same time, set the reading of the Plate Voltage Meter to zero volts using the Zero Set control. After setting the control in the desired position, release the Zero switch. The zero setting can be verified and corrected at any time using this procedure. Be sure the Mode switch is set to Track to “zero” the CPM.

2.4 Discharge Time Measurement

To perform a discharge time measurement set the Mode switch to track and choose the Stop Level. The EOS/ESD standard measures discharge time from 1000 to 100 volts. Press and release the Timer Reset switch and the desired Charge switch at the same time. The Plate Voltage Meter will indicate the selected plate voltage and the Timer will start automatically. The Charge switches and the Timer Reset switch have been located to allow their simultaneous operation.

The plate voltage will begin to decay from its starting level at a rate determined by environmental factors such as air ionization level and air flow. The Timer will stop automatically when the plate voltage drops below the level selected by the Stop Level Selector switch. The Timer display will now indicate the discharge time of the charged plate. The timer will resume counting if the plate voltage rises above the Stop Level voltage.

2.5 Monitoring Electrostatic Potential

To monitor electrostatic potentials in a selected area, place the 210 CPM in an appropriate location and set the Mode switch to track. Operate the Timer Reset switch so that the Timer display reads “000.0”. The Plate Voltage Meter will now indicate voltages on the isolated plate caused by electrostatic fields as well as the presence of air ionization. You may also use this method to check the balance of an ionizer or ionization system.

The Timer will run only when the voltage induced on the plate exceeds the voltage set by the Stop Level Selector switch.

While monitoring, it may be useful to determine the peak levels of the voltage on the plate and the long term average balance of the air ionization. This may be done using the +Peak, -Peak, and Offset positions of the Mode switch. Remember to operate the Peak Reset switch at the start of each measurement. In the Offset position it is necessary to wait at least 15 minutes to obtain an accurate measurement. Note: the CPM will not “zero” in Peak or Offset Mode.

2.6 Adjustment Procedures

The Model 210 CPM may be used to perform general evaluation and adjustment procedures with Ion 5000 series ionizers and room systems, particularly Model 5184(e) and Model 5511 emitters. Procedures for other ionization equipment may vary. Consult the equipment manual or manufacturer for additional information.

2.6.1 Room System Adjustment Procedure

Contact Ion Technical Support with any questions regarding the following instructions.

In sequenced bipolar ionization (pulse mode), positive and negative ions are released sequentially during on-times from emitters. During off-times, no ions are released, allowing the dispersion of existing ions. In steady state DC mode, both positive and negative ions are constantly produced. The goal of the adjustment procedure is to regulate ion delivery, so that equal numbers of positive and negative ions arrive at the work surface to neutralize any existing static charge.

The basic steps of the adjustment procedure for a room system are:

1. Choose 5 or 6 diverse emitter locations to obtain sample measurements.
2. Optimize controller settings for desired average balance voltage swing and discharge times for all sampled emitters.
3. Where necessary, adjust an emitter's output settings to obtain the desired balance voltage swing and discharge time at an individual location.
4. When choosing the sample measurement locations, consider the following variables which significantly affect system performance; distance from the emitter points to the work surface, rate of air flow, and proximity to grounds, i.e. large metal objects which will attract ions and reduce the number of ions available in the air. Select 5 or 6 emitter locations which differ in these considerations, and are representative of your environment. Set up the CPM on a tripod or workbench directly underneath the emitter. Adjust the height of the isolated plate to the appropriate work level height (36"- 43" is typical). See . Using an anemometer, measure the air flow at the CPM plate. Record the air flow along with the measurements obtained at each sample location.

For room systems, controller models 5084, 5084e, and 5580 can power up to 80 emitters and have adjustable on-time, off-time and ion emission output. For small environments or flow hoods, the Model 5024 controller can power up to 4 ionizers and Model 5024e and 5520 controllers can power up to 20 ionizers. Models 5024, 5024e, and 5520 offer adjustable on-time and ion emission output.

5. Beginning with the recommended settings in Table 1, adjust the controller timing settings until the desired average balance voltage swing and discharge times are obtained. Note that the desired balance and discharge time will depend on the sensitivity of your product to electrostatic related problems. Choose values which meet the static charge protection needs of your environment. A peak swing voltage range of ±100 to ±150 V for wafer fabrication environments is common. This range decreases for products more sensitive to electrostatic related problems and increases for less sensitive products.

Controller model	Ceiling height	On time	Off time	Output
5084(e)	9 feet	3 sec	1 sec	50%
	12 feet	4 sec	1.5 sec	50%
5024(e)	9 feet	4 sec	N/A	50%
	12 feet	6 sec	N/A	50%
5520/5580	9 feet	3 sec	1 sec	50%
	12 feet	4 sec	1.5 sec	50%

Table 1. Initial Controller Settings for room systems (final settings will vary)

6. Voltage swing refers to the range of the CPM plate voltage reading between the positive and negative peak readings at the sample locations. For a desired swing of 150 volts, the average of the sample positive peak readings should be 150 V, and the

average of the sample negative peak readings should be -150 V. Additionally, the sum of all peak voltage readings, i.e. offset voltage, should approach zero. Open areas tend to have larger voltage swing ranges than areas near grounds, therefore each sample locations may not display the desired swing. After the desired average balance swing is obtained by adjusting the system controller, individual locations can be “fine-tuned” using the controls on the emitter.

7. Press and hold the Charge switch of the desired polarity. The Plate Voltage Meter will now indicate the voltage of the plate charging source. The voltage will be 1000 volts or 5000 volts, ±5%, as selected by the Level switch. Release the Charge switch and recheck the zero setting as described in Step 4.

8. To measure swing and balance, turn on the CPM and set the Plate Charging Level and Timer Stop Level. Set the CPM Mode to Track. Adjust the Plate Voltage Meter to zero. Watch the plate voltage meter and note the largest positive and negative voltages. An alternate method is to set the Mode switch to + Peak, note the value, and then - Peak and note the value. Be sure to use the Peak Reset switch between each reading. Perform these steps for all sample locations.

9. Adjust the timing settings on the controller to achieve the desired balance readings. In general, a decrease in cycle time causes a decrease in the output voltage swing which results in an increase in discharge time. Allow at least one minute after each adjustment for the CPM reading to reflect the adjustment.

In the same manner as balance voltage, discharge time may be optimized by adjusting the timing setting. Make discharge time and balance adjustments at the same time, because there is an interaction between them. Typical discharge time directly below a ceiling mounted emitter at 36” work height with 100 fpm air flow is approximately 30 seconds. Optimum discharge times will also vary according to your application requirements.

10. After the timing settings on the controller have been set to achieve the desired swing and discharge times for the sample locations, do not alter the settings. Record the initial controller settings and sample locations with the air flow measurement.

Ionization at individual locations can be adjusted using the individual output settings on the Model 5184(e) Emitter.

2.6.2 Flow hoods and Mini-environment Adjustment Procedure

1. Optimize controller settings for desired average balance voltage swing and discharge times for all AeroBars or Emitters.
2. Where necessary, adjust AeroBar or Emitter output settings to obtain desired balance voltage swing and discharge time at individual locations.
3. The adjustment procedure for small environments is the same as that above. The recommended initial Model 5024(e) controller settings are listed in Table 2. With the ionizer mounted in a flow hood 24" above work height, an average balance voltage swing of 25 - 50 volts is common. Choose a balance swing which meets the requirements of your application.

5024(e)	Air Flow	On-Time	Output
Small Environments	50 - 100 fpm	0.5 - 1 sec	50%

Table 2. Recommended Initial 5024(e) Settings (Final Settings will vary)

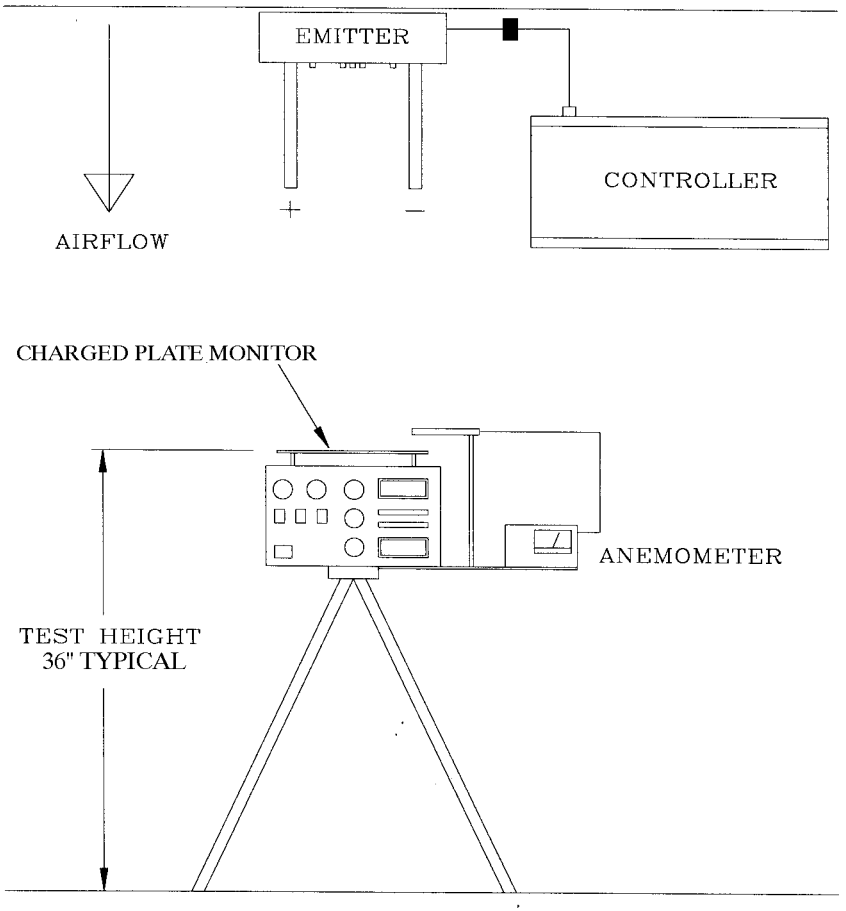

Figure 1. Test Setup

3
Maintenance

- 3.1 Cleaning
- 3.2 Test Procedure
- 3.3 Calibration

3.1 Cleaning

Caution

These instructions are for use by qualified personnel only. To avoid personal injury or damage to the equipment, do not perform any maintenance other than that contained in these instructions.

There are no user-serviceable parts inside the CPM. Any unauthorized service will void the warranty and may result in additional repair charges.

The exterior finish and isolated plate of the Model 210 CPM may be cleaned as necessary to maintain appearance. Other cleaning procedures should only be carried out when the performance of the instrument indicates a need for them.

Required Cleaning Materials

- Solution of 50% de-ionized water and 50% isopropyl alcohol (IPA) or Ion Emitter Point Cleaner #22-1000
- Cleanroom-compatible cloth or wipe
- Cleanroom-approved swab (foam is not recommended)

3.1.1 Case and Plate Cleaning

Using a cloth moistened with isopropyl alcohol, wipe the exterior of the instrument and the plate turning the cloth frequently. Once the exterior is clean, allow the instrument to dry thoroughly before applying power.

In the event that the instrument was used in a corrosive environment or the plate has been physically damaged, extra-fine steel wool may be used to polish the surface and edges of the isolated plate. Take care in only using steel wool after the plate has been removed from the instrument.

3.1.2 Teflon Insulator Cleaning

The Teflon insulator should be cleaned only if the following conditions are met:

- The 210 CPM is isolated from any source of air ionization in an environment with 40% relative humidity or less.
- The plate discharges more than 10% in 5 minutes. Use the Charge switch to charge the plate and observe the discharge.

To clean the Teflon insulator:

1. Remove the four screws securing the stainless steel plate to the Teflon insulators, not the top cover screws. (Do not open the case as this will void the warranty.)
2. Clean the insulators with a clean cloth soaked in isopropyl alcohol. It is important not to touch the insulators at any time with the fingers as natural skin oils will contaminate the insulators. Wearing latex gloves is recommended.
3. Allow the insulators to dry thoroughly. Note that this may take as long as 3 hours. You may speed the process by gently warming the insulators.
4. Taking care not to touch the Teflon insulators with your fingers, reinstall the stainless steel plate.

Check the plate discharge as in steps 2 and 3 above.

3.1.3 Electrostatic Probe Cleaning

1. Apply power to the CPM and allow a five minute warm-up time.
2. Connect a clip lead from the isolated plate to the case and adjust the Plate Voltage Meter to zero using the Zero Set control.
3. The Plate Voltage Meter should continue to read within a few volts of zero. If the reading continually shifts by large amounts, contact Ion Technical Support to determine if the instrument requires service. Electrostatic probe cleaning may only be performed by Ion or an authorized facility.

3.2 Test Procedures

Table 3 outlines a list of recommended test equipment required to complete the test procedures.

Instrument	Minimum Requirements
DC Voltmeter (Meter 1)	0-10 VDC scale with 1% of full scale accuracy. 3½ digit readout.
Voltmeter (Meter 2)	0-5000 VDC with 1% of full scale accuracy. 4½ digit readout. High impedance DC 200GΩ minimum input impedance.
Voltage Source	Output current limited to 1 mA.

Table 3. Recommended Test Equipment

he test procedures described below will assure that the operation of the Model 210 CPM is within the published specifications. Before proceeding, you should be familiar with the controls and features of the instrument.

3.2.1 Electrostatic Fieldmeter Test

Caution

This test involves the presence of exposed high voltage.

1. Connect the 0-10 VDC voltmeter (meter 1) to the rear panel output connector labeled “J1- Plate Voltage”.
2. Connect the 0-5000 VDC high impedance voltmeter (meter 2) to the isolated plate. Ground the voltmeter to the CPM case.
3. Set the CPM to zero. Set the Level switch to 1 KV.
4. Meter 1 should read 0 ±4 mV. The Plate Voltage Meter reading should be 000 ±4 volts.
5. Connect a voltage source to the isolated plate and adjust it to +1000 volts as shown on meter 2. Meter 1 should show a

reading of 1.000 volts ±20 mv. The reading on the Plate Voltage Meter of the CPM should be 1000 ±20 volts.

Caution

Do not attempt to zero the CPM with the voltage source attached.

6. Disconnect the voltage source. Repeat steps 3 and 4 with the Level switch set to 5 KV. The Plate Voltage Meter reading should be 0000 ±4 volts.
7. Repeat step 5 with the voltage source set to +5000 volts. Meter 1 should read 5.000 volts ±100 mV and the Plate Voltage Meter should read 5000 ±100 volts.

3.2.2 Timer Stop Level Test

1. After performing the Electrostatic Fieldmeter Test, remove all the test equipment and ground the isolated plate to the case using a suitable clip lead.
2. Operate the Timer Reset switch so that the Timer display reads “000.0”.
3. Set the Stop Level Selector switch to 50 volts.
4. Use the Zero Set control to vary the voltage as shown on the Plate Voltage Meter. Increase the magnitude of the voltage until the Timer starts. Decrease the magnitude of the voltage until the Timer stops. The Timer should stop when the voltage is less than 50 ±5 volts of either polarity.
5. Set the Stop Level Selector switch to 100 volts. Verify Timer operation as in Step 4 at 100 ±5 volts for each polarity.
6. Set the Stop Level Selector switch to 500 volts. Remove the ground from the isolated plate and attach the 0-5000 volt source of the appropriate polarity. Verify Timer operation at 500 ±25 volts for each polarity.

7. Remove the 0-5000 V source and ground the plate. For each setting of the Balance Range switch (50, 100, or 250 volts) determine that the number of lit segments of the Bargraph Display agrees with the voltage on the Plate Voltage Meter. Check the operation of the High LED for each polarity. Use the Zero Set control as in Step 4 to vary the voltage shown on the Plate Voltage Meter.
8. Place the Mode switch in the +PEAK or -PEAK position. Verify that the Plate Voltage Meter will indicate and hold the corresponding voltage peak. The peak voltage should decay at a rate less than 1 V/Sec. Use the Zero Set control as in Step 4 to vary the voltage shown on the Plate Voltage Meter.

3.3 Calibration

An annual factory calibration of the CPM is recommended to ensure accurate performance. Calibration may only be performed by Ion or an authorized facility. Contact Ion Technical Support for information.

4

Specifications

Charged Plate	
Isolation	Self-discharge <10% in 5 minutes with 40% relative humidity and ambient ionization levels <200 ions/cc
Capacitance	20 pf ±2 pf. No circuitry is attached to the plate, resulting in zero stray capacitance.
Charging	Internal power supplies for each polarity, current limited by 1GΩ resistor
Voltage Measurement	Non-contacting electrostatic fieldmeter
Dimensions	6" x 6" (15.2 x 15.2 cm), isolated by Teflon® insulators
Plate Voltage Function	
Controls	TRACK monitors actual plate voltage; +PEAK/-PEAK monitors peak plate voltage; OFFSET monitors long-term average balance
Display	4 ½ digits, 0.4" (1 cm) digit height, least significant digit indicates 1 V
Accuracy	±2% chopper stabilized (accuracy unaffected be air ionization)

Plate Charging Function	
Controls	LEVEL switch selects either 1 or 5 KV charging voltage; ZERO switch grounds the isolated plate; ZERO SET used with ZERO switch sets the plate voltage to zero; two charge switches connect the positive and negative internal charging source to the isolated plate.
Balance Meter Function	
Controls	Full-scale level can be set to 50, 100 or 250 V for each polarity.
Display	10-segment LED bar graph for each polarity; Separate LED indicates over-range.
Discharge Time Function	
Controls	STOP LEVEL can be set to 50, 100, or 500 V for both polarities; TIMER RESET sets timer to zero.
Display	5 ½ digits, 0.4" (1 cm) digit height, least significant digit indicates 0.1 seconds
Accuracy	Crystal-controlled
General	
Input	120 VAC +10%; 50 or 60 Hz; 25 watts; fuse protected; 230 VAC model available
Recorder Output	0 to 10 V available at rear panel BNC connector, corresponding to plate polarity; connects to a variety of external recorders, scale 1 mV = 1 V
Dimensions	6"H x 9"W x 10"D (15.2 x 22.9 x 25.4 cm)
Weight	7.5 lbs. (3.4 kg)

5

Warranty and Service

Ion provides a limited warranty for the Model 210 Charged Plate Monitor. New products manufactured or sold by Ion are guaranteed to be free from defects in material or workmanship for a period of two (2) years from date of initial shipment. Ion's liability under its new product warranty is limited to servicing (evaluating, repairing, or replacing) any unit returned to Ion that has not been subjected to misuse, neglect, lack of routine maintenance, repair, alteration, or accident. In no event shall Ion be liable for collateral or consequential damages.

To obtain service under this warranty, please contact Ion Technical Support.

About MKS, Ion Systems

Ion develops, manufactures, and markets system solutions to manage electrostatic charge. As the world's largest provider of electrostatics management products and services, Ion improves its customers' business results by providing a total solution to their electrostatic discharge and electromagnetic interference challenges. Ion is a wholly-owned subsidiary of MKS Instruments, and is located in Alameda, California. For more information about Ion visit www.ion.com or call 800-367-2452. Ion is ISO 9001 and ANSI ESD S20.20 - 1999 certified.

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