electro-tech systems, inc.

Charged Device Model Test Fixture

ETS Model 9903

Operating Manual

D00779 Revision B

Table of Contents

I. Important Safety Information

SAFETY INSTRUCTIONS

The equipment described in this Manual is designed and manufactured to operate according to defined procedures and within defined design limits. Any misuse may result in electric shock, fire, injury, or damage. For safe operation, the following rules must be observed for installation, use, and maintenance. **Read the following safety instructions before operating the instrument.**

CAUTION

DO NOT TOUCH OR COME IN CONTACT WITH THE EQUIPMENT WHILE IN USE. Voltages used in the equipment may cause serious discomfort, injury, or death. CDM testing, by definition, involves hazardous voltage and unenclosed wiring. Power down and discharge all circuitry before contact.

DO NOT OPERATE WITH COVERS OR PANELS REMOVED. Voltages inside the equipment may pose a further threat of serious discomfort, injury, or death.

DO NOT OPERATE IN THE PRESENCE OF A PACEMAKER OR OTHER MEDICAL OR LIFE-SUSTAINING ELECTRONICS. The equipment produces high-voltage discharges which may cause malfunction of nearby electronic circuits.

DO NOT OPERATE WITH SUSPECTED EQUIPMENT FAILURES. If any odor or smoke becomes apparent turn off the equipment and unplug it immediately. Failure to do so may result in electrical shock, fire, explosion, or permanent damage to the equipment. Contact the factory for maintenance instructions.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE: Operating the equipment in the presence of flammable gases or fumes **constitutes a definite safety hazard** and may cause explosion or fire. For equipment designed to operate in such environments the proper safety devices must be used such as dry air or inert gas purge, intrinsically safe barriers and/or explosion-proof enclosures.

DO NOT USE IN ANY MANNER NOT SPECIFIED OR APPROVED BY THE MANUFACTURER: Unapproved use may result in damage to the equipment or present an electrical shock or fire hazard.

II. Description of Contents

Included in the standard Model 4406 package:

Item	Qty.	Description
CDM Arbor Fixture	1	See Figure 2.1
DUT Holding Fixture	1	See Figure 2.2
Spring-loaded pin type J	1	round tip for pad terminals
Spring-loaded pin type G	1	cup tip for DIP style legs
Spring-loaded pin type B	1	point tip for very small contact points
Verification module A	1	Precision 6.8pF calibration disc
Verification Module B	1	Precision 55pF calibration disc
Charging lead	1	8” banana plug to mini-grabber

The Model 9903 Charged Device Test Fixture shown in Figure 2.1 is a completely integrated unit that provides the means of performing both direct charge and field induced CDM tests.

Figure 2.1: Model 9903 Charged Device Model Test Fixture

The Model 9903 CDM Test Fixture shown in Figure 2.1 consists of a magnetic stainless steel field induction plate/ground plane and a control module that controls the charging and grounding function. It contains the upper ground plane, spring-loaded discharge pin and the discharge button.

The internal control electronics time the charge and discharge function of the field induction plate and DUT. This enables the DUT to be charged and discharged multiple times at the same polarity. In addition, the module contains a precision current sensing circuit for measuring the discharge current. The entire assembly is mounted on an arbor press fixture for performing the test.

The adjustable DUT holding fixture shown in Figure 2.2 holds devices up to 2.5 x 2.5" (64x64mm). The fixture itself has magnets to help align the desired pins with the discharge electrode.

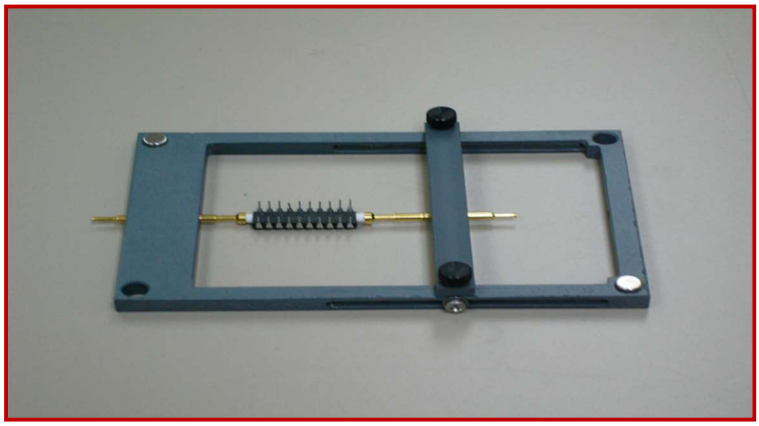
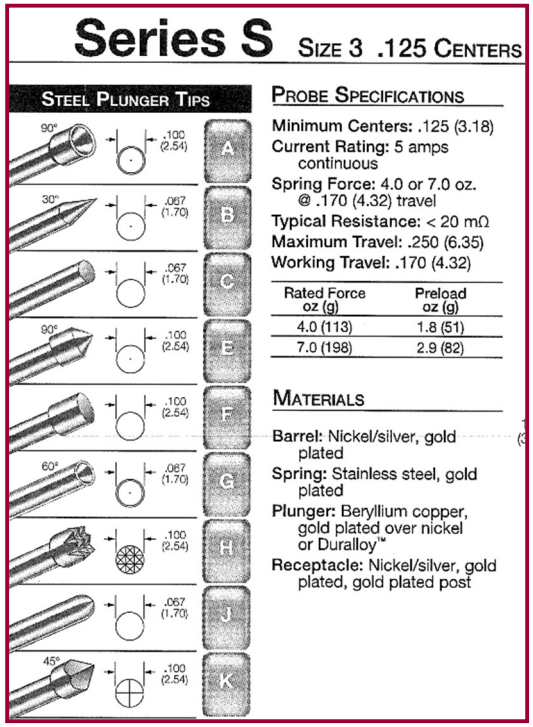


Figure 2.2: DUT Holding Fixture

The spring-loaded pins (Interconnect Devices Series S, Size 3) shown in Figure 2.3 are interchangeable. Three types are provided.



Series S SIZE 3 .125 CENTERS

STEEL PLUNGER TIPS

90° .100 (2.54) A
30° .067 (1.70) B
.067 (1.70) C
90° .100 (2.54) E
.100 (2.54) F
60° .067 (1.70) G
.100 (2.54) H
.067 (1.70) J
45° .100 (2.54) K

PROBE SPECIFICATIONS

Minimum Centers: .125 (3.18)
Current Rating: 5 amps continuous
Spring Force: 4.0 or 7.0 oz. @ .170 (4.32) travel
Typical Resistance: < 20 mΩ
Maximum Travel: .250 (6.35)
Working Travel: .170 (4.32)

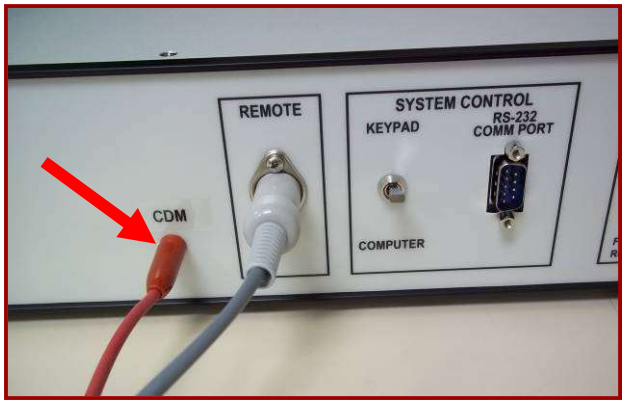
Rated Force oz (g)	Preload oz (g)
4.0 (113)	1.8 (51)
7.0 (198)	2.9 (82)

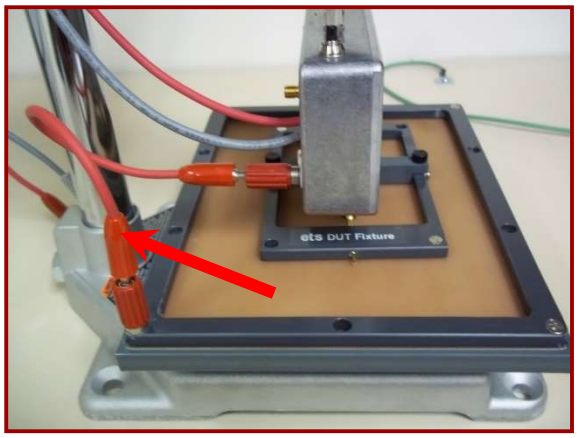
MATERIALS

Barrel: Nickel/silver, gold plated
Spring: Stainless steel, gold plated
Plunger: Beryllium copper, gold plated over nickel or Duralloy™
Receptacle: Nickel/silver, gold plated, gold plated post

Figure 2.3: Spring-loaded pin configurations

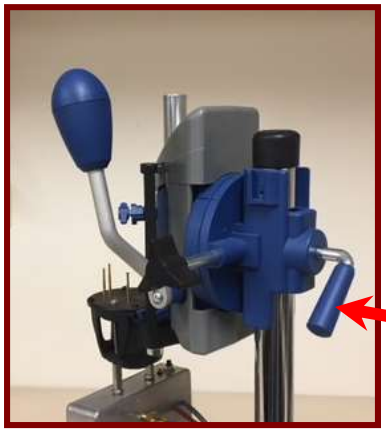
III. Set-Up Guide

	**Step 1 – Connect the HV cable to 9910** Plug the red 0.080” pin plug from the CDM Test fixture into the CDM 0.080 pin jack on the Simulator OUTPUT panel. This provides the voltage to the induction plate or to the device depending on the type of test.
	**Step 2 – Connect the power cable to 9910** Connect the 3-pin power plug into the REMOTE DIN connector located on the rear panel. This provides the power to operate the charge and discharge relays.
	**Step 3 - Connect the 9903 coaxial cable to the oscilloscope.** The scope input must be set to 50 Ohms. The scope also must be set to scale 10:1 since ETS provided RF cable has a 20 dB attenuator.



Step 4. Set up for Field-Induced testing.

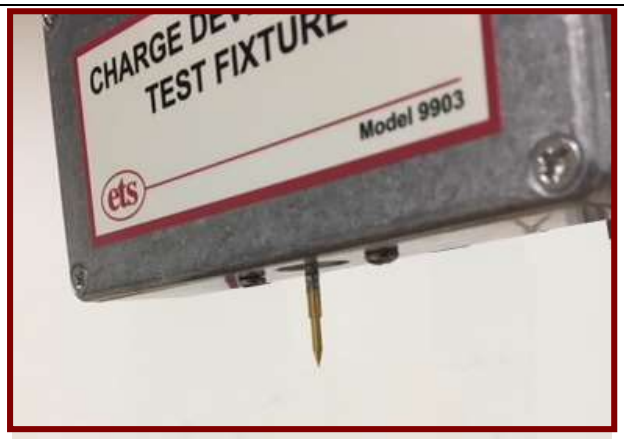
plug the red banana-banana cable into the red banana jack on the rear of the control module and the red banana jack on the plate as shown in Figure 3.0-3.



Lever

Step 5. Raise Test Head.

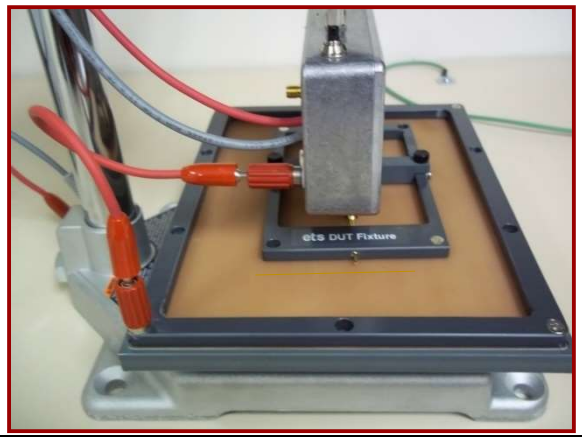
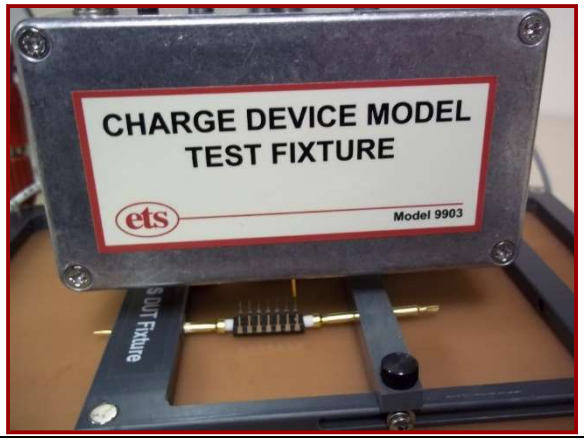
To change pins, raise the test head to the top by loosening the lever on the rear.

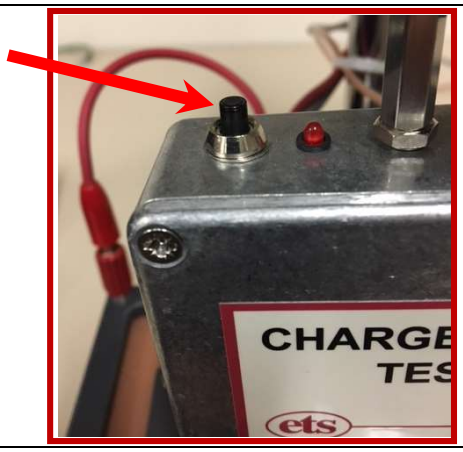
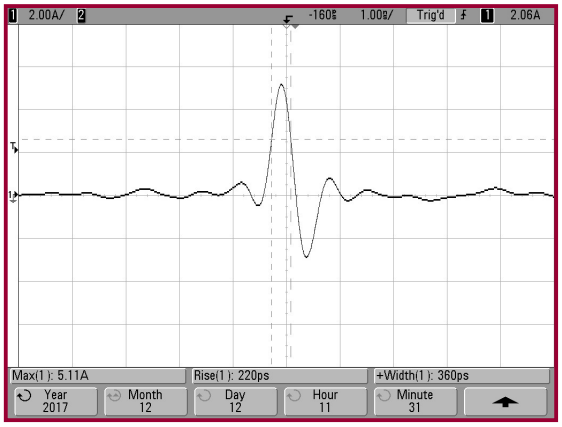


Step 6. Install Spring-Loaded Pin.

Replace or change the pin. Then move the test head back to a position where the pin tip is approximately 0.25” (6mm) above the device under test. Tighten lever.

IV. Quick Start Guide

	**Step 1 – Verify Setup** Ensure all cables are connected and the system is set up as described in the previous section.
	**Step 2 -** Place the DUT either in the holding fixture or directly onto the plate. Align the spring-loaded pin to the DUT pin to be discharged.
	**Step 3 -** Lower the module. Verify the alignment to the center of the pin under test. Touch the spring-loaded pin to the DUT pin to initially ground the pin. **Do Not Push the Discharge Button Yet.**

	**Step 4**. Set the voltage to the desired level
	**Step 5.** Depress the Discharge button for 2 seconds, then quickly use the main lever to lower the test head enabling the spring-loaded pin to discharge the DUT. The discharge waveform will be displayed on the scope. **Continue to hold the lever down until the red LED indicator goes out.**
	**Step 6.** Proceed with the test plan. Allow at least 4 seconds after each discharge before the next charge.

V. Operating Instructions

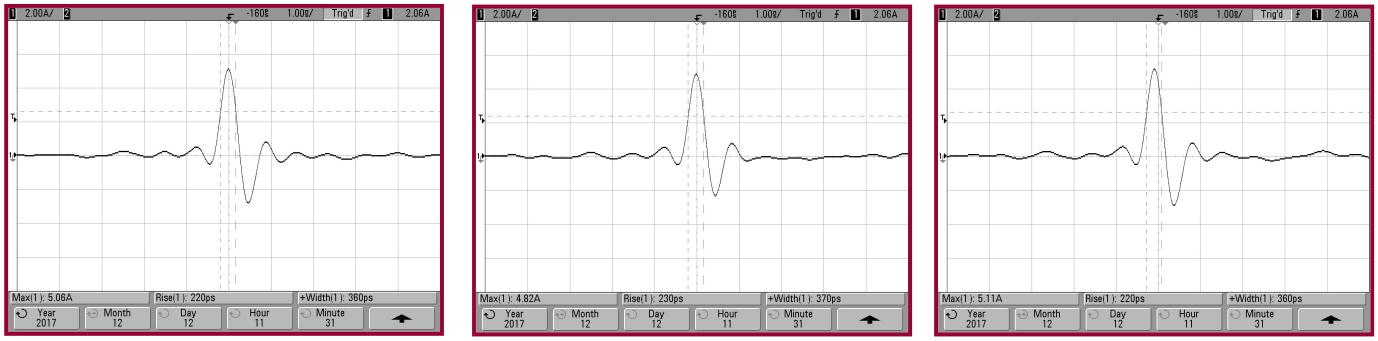
A. Waveform Verification

The Model 9903 produces verification waveforms that meet all the requirements specified in the test standards referenced above. Due to the nature of CDM Model, there are small deviations of the Ip (peak current). The new Standard suggests collection of at least ten successive waveforms during the set discharges and using the average as the final result to determine that the CDM waveforms measured with the specified verification modules will meet individual requirements.

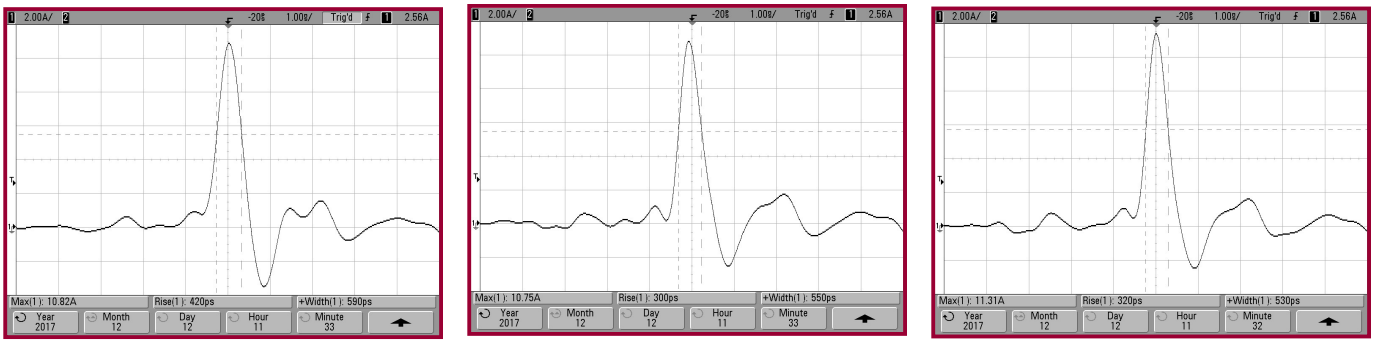
The CDM waveforms can be measured using the supplied the 6.8 pF and the 55 pF verification modules. The measurement procedure is the same for both modules. Typical waveforms over 3 discharges obtained with the Model 9903 CDM Test Fixture using the Field Induced charging method are shown in Figure 5.1 and the Direct Charging method in Figure 3.05b. Low amplitude can usually be compensated for by increasing the charging voltage since it is typically affected by losses caused by leakage, parasitic capacitance, verification module characteristics humidity etc. during charging. In addition, air discharge can easily result in a 20% variation in peak amplitude.

The actual resistance of the radial 1 Ohm resistor varies. The 5% variation should be factored in when measuring the actual peak current levels.

Performing direct discharge measurements with the charging probe connected will also affect the waveform by adding additional parasitic capacitance. The Model 9903 Probe contains a 15 megOhm resistor at the wire end of the 5” minigrabber.



ANSI/ESDA/JEDEC JS-002-2014, 6.8pF Disc @ 500V



ANSI/ESDA/JEDEC JS-002-2014, 55pF Disc @ 500V

Figure 5.1: Typical Field Induced Model verification waveforms

CDM Characteristic Waveform and Parameters of The Joint Standard ANSI/ESDA/JEDEC JS-002-2014 are shown in Figure 5.2.

Table 1. CDM Waveform Characteristics for a 1 GHz Bandwidth Oscilloscope

1 GHz BW Oscilloscope		Test Condition									
		TC 125		TC 250		TC 500		TC 750		TC 1000	
Verification Module	Sym.	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Peak Current (A)	Ip	1.0-1.6	1.9-3.2	2.1-3.1	4.2-6.3	4.4-5.9	9.1-12.3	6.6-8.9	13.7-18.5	8.8-11.9	18.3-24.7
Rise time (ps)	Tr	<350	<450	<350	<450	<350	<450	<350	<450	<350	<450
Full width at half maximum (ps)	FWHM	325-725	500-1000	325-725	500-1000	325-725	500-1000	325-725	500-1000	325-725	500-1000
Undershoot (A, max. 2nd peak)	Ip_2	<70% Ip	<50% Ip	<70% Ip	<50% Ip	<70% Ip	<50% Ip	<70% Ip	<50% Ip	<70% Ip	<50% Ip

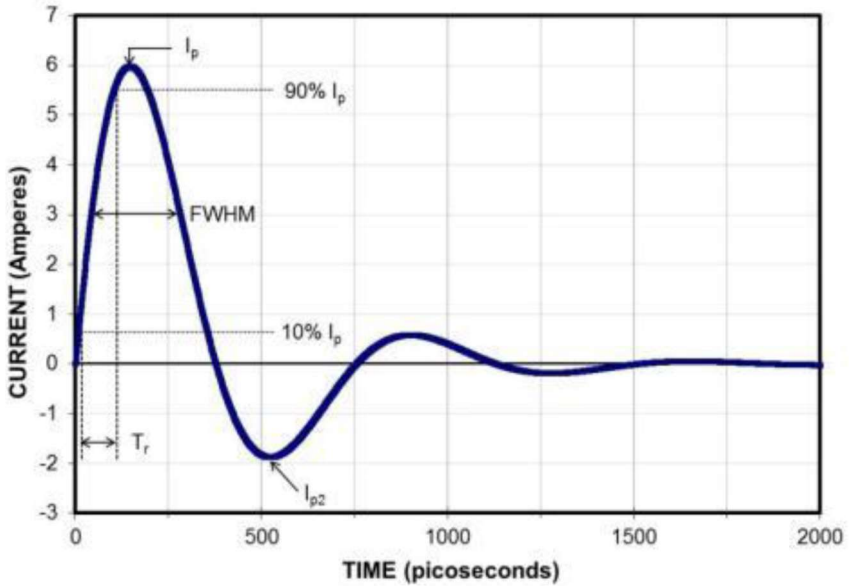


Figure 5.2: ANSI/ESDA/JEDEC JS-002-2014 Waveform requirements

CDM Characteristic Waveform and Parameters (for reference only) of The EDS22-C101E and ANSI/ESD-STM5.3.1 are shown in Figure 5.3.

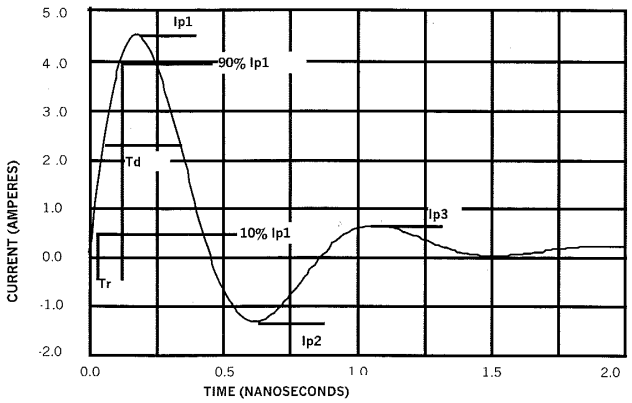


Figure 2: CDM ESD waveform for the standard verification modules using the one gigahertz bandwidth measurement system

Requirements for one gigahertz:

Charge Voltage Volts ± 5%	Symbol	4 pF Verification Module Amperes ± 20 %	30 pF Verification Module Amperes ± 20%
125	Ip_1	1.13	
250	Ip_1	2.25	
500	Ip_1	4.50	14.00
1000	Ip_1	9.00	
1500	Ip_1	13.50	
2000	Ip_1	18.00	

Parameter	Symbol	4 pF Verification Module All Voltages	30 pF Verification Module 500 V only
Rise Time	t_r (ps)	<400 ps	<400 ps
Full width at Half Height	t_d (ps)	<600 ps	<1000 ps
Max 2nd peak	Ip_2	<50% Ip_1	<50% Ip_1
Max 3rd peak	Ip_3	<25% Ip_1	<25% Ip_1

Note 14: For the positive polarity: Ip2 is the second peak, the undershoot negative peak; Ip3 is the third peak, the overshoot positive peak. For the negative polarity: Ip2 is the second peak, the overshoot positive peak; Ip3 is the third peak, the undershoot positive peak.

a. ANSI/ESD-STM5.3.1

Table 3 — CDM waveform characteristics

		Test Number			
		#1	#2	#3	#4
Standard test module		**Small**	**Small**	**Large**	**Large**
Test voltage (V)		500 (± 5%)	1000 (± 5%)	200 (± 5%)	500 (± 5%)
Peak current magnitude (A)	Ip	5.75 (± 15%)	11.5 (± 15%)	4.5 (± 15%)	11.5 (± 15%)
Rise time (ps)	tr	<400	<400	-	-
Full width at half height (ns)	Td	1.0 ± 0.5	1.0 ± 0.5	-	-
Undershoot (A, max.)	U-	<50% Ip	<50% Ip	<50% Ip	<50% Ip
Overshoot	U+	<25% Ip	<25% Ip	<25% Ip	<25% Ip

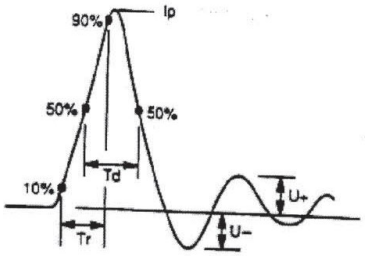


Figure 2 — CDM current waveform

b. JESD22-C101E

Figure 5.3: ANSI/ESD-STM5.3.1 and JESD22-C101E Waveform requirements

Verification Test Procedure

1. Verify that the Test Fixture is configured for Field Induced Measurements per Section III.
2. Adjust the height of the Press test head so that the bottom of electronics housing (ground plane) is approximately 0.5” (12mm) above the induction plate using the lever located on the rear of the test head.

   Place one of the verification modules in intimate contact with the surface of the field induction plate. It should be centered under the Discharge Electrode spring-loaded pin as shown in Figure 5.4.
3. Set the Model 910 or 9910 to 500V. (For the Model 910 the plug-in CDM Adapter limits the voltage to just the low range of 2000V. For the Model 9910, select the CDM function. This limits the voltage to 1000V. **Under no circumstances should the Model 9903 be operated above 2000V. This will destroy the timing relays.**) Depress and release the Charge button on the Fixture module. The red CHARGE LED will light for approximately 2 seconds. While the LED is on, quickly lower the module enabling the spring-loaded pin to contact the disc to discharge it. **MAINTAIN CONTACT WITH THE DISC FOR 2 SECONDS AFTER THE LED TURNS OFF.** This allows the disc to remain grounded while the induction plate returns to ground. Repeat at least 2 more times (**wait 5 to 10 seconds between calibration discharges**). The waveforms for the 6.8pF and 55pF discs will look similar those shown in Figure 5.1. Record and save the data.

   If this procedure is not followed, the disc will not charge for the next test. This timing sequence is critical for the field induced measurement. Subsequent measurements at the same polarity can then be performed. If the sequence is broken first lower the test head **WITHOUT DEPRESSING THE CHARGE BUTTON ON THE MODULE** in order to ground the disc then repeat the measurement.
4. Repeat the above procedure for measurements at –500V.
5. Other voltage levels can be used.

Refer to the respective specifications for more procedure details.

Figure 5.4: Verification module alignment

B. Device Testing

1. Raise the discharge module and place the DUT either in the holding fixture or directly onto the plate. Verify that the spring-loaded pin is correctly inserted.

2. Visually align the spring-loaded pin to the DUT pin to be discharged as shown in Figure 5.5.

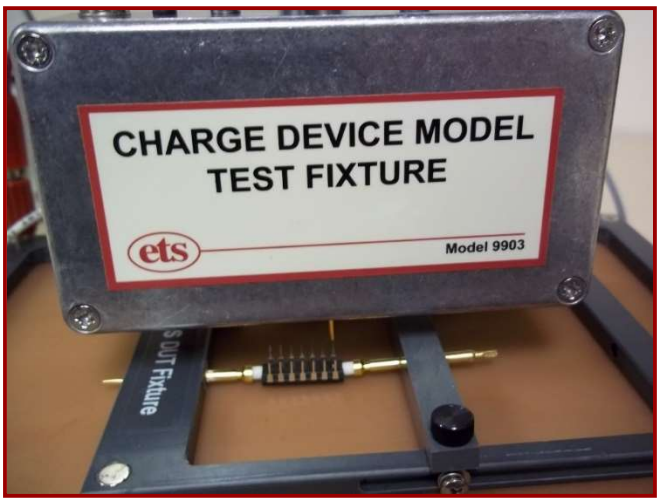


Figure 5.5: DUT/Discharge pin alignment

3. Lower the module carefully until the spring-loaded pin touches the device pin. This verifies the alignment and initially grounds the pin. **Do Not Push the Discharge Button.**

4. If not already set then set the voltage to the desired level.

5. **For Field Induced charging,** depress the Discharge button momentarily, then quickly lower the test head enabling the spring-loaded pin to discharge the DUT. The discharge waveform will be displayed on the scope. **Continue to hold the lever down until the red LED indicator goes out.**

6. For each component, apply 3 positive and 3 negative discharges to each pin. Observe the discharge on the oscilloscope. Allow at least several seconds between charge/discharge cycles

C. Testing Hints

The recommended stress levels are slightly different between the JEDEC and ANSI/ESD specifications as listed in the table below.

Level	JESD Level V	ANSI/ESD Level V
1	100	125
2	200	250
3	500	500
4	1000	1000
5	2000	1500
6	-	2000

VI. Maintenance & Calibration

The Model 9903 Charged Device Model Test Fixture, like all precision electronic instruments, should be returned to the factory once a year for calibration. However, due to heavy use or having been moved to another location the instrument may require some minor adjustments in the interim.

VII. Warranty

Electro-Tech Systems, Inc. warrants its equipment, accessories and parts of its manufacture to be and remain free from defects in material and workmanship for a period of one (1) year from date of invoice. ETS will, at its discretion either replace or repair without charge, F.O.B. Glenside, similar equipment or a similar part to replace any equipment or part of its manufacture which, within the above stated time, is proved to have been defective at the time it was sold. All equipment claimed defective must be returned properly identified to the Seller (or presented to one of its agents for inspection). This warranty only applies to equipment operated in accordance with Seller's operating instructions.

Seller's warranty with respect to those parts of the equipment that are purchased from other manufacturers shall be subject only to that manufacturer's warranty.

The Seller's liability hereunder is expressly limited to repairing or replacing any parts of the equipment manufactured by the manufacturer and found to have been defective. The Seller shall not be liable for damage resulting or claimed to result from any cause whatsoever.

This warranty becomes null and void should the equipment, or any part thereof, be abused or modified by the customer of if used in any application other than that for which it was intended. This warranty to replace or repair is the only warranty, either expressed or implied or provided by law, and is in lieu of all other warranties. The Seller denies any other promise, guarantee, or warranty with respect to the equipment or accessories and, in particular, as to its or their suitability for the purposes of the buyer or its or their performance, either quantitatively or qualitatively or as to the products that it may produce. The buyer is expected to expressly waive rights to any warranty other than that stated herein.

ETS must be notified before any equipment is returned for repair. ETS will issue an RMA (Return Material Authorization) number for return of equipment.

Equipment should be shipped prepaid and insured in the original packaging. If the original packaging is not available, the equipment must be packed in a sufficiently large box (or boxes if applicable) of double wall construction with substantial packing around all sides. The RMA number, description of the problem along with the contact name and telephone number must be included in formal paperwork and enclosed with the instrument. Round trip freight and related charges are the owner's responsibility.

WARNING

WOODEN CRATES MUST NOT BE USED. PACKAGING OF DELICATE INSTRUMENTS IN WOODEN CRATES SUBSTANTIALLY INCREASES THE CONTENT'S SUSCEPTIBILITY TO SHOCK DAMAGE. DO NOT PLACE INSTRUMENTS OR ACCESSORIES INSIDE OTHER INSTRUMENTS OR CHAMBERS. ELECTRO-TECH SYSTEMS, INC. WILL NOT ASSUME RESPONSIBILITY FOR ADDITIONAL COST OF REPAIR DUE TO DAMAGE INCURRED DURING SHIPMENT AS A RESULT OF POOR PACKAGING.

Appendix A - CDM Testing Background

The rapid advancement in the electronics industry during the past decade has placed an increasing importance on the understanding of electrostatics and its effect on electronic devices and systems. Electrostatic discharge (ESD) is a common cause of microelectronic circuit failure. Many devices can be seriously damaged or destroyed by an electrostatic discharge below 20 Volts. The sensitivity to ESD of other components has also become evident through use, testing and failure analysis. The trend in technology towards greater complexity, increased packaging density and hence thinner dielectrics between active elements result in parts becoming even more sensitive to ESD.

Failure mechanisms of electrical and electronic parts due to ESD typically include thermal breakdown, metallization melt and bulk breakdown that are power dependent; dielectric breakdown, metallization to metallization arc over, surface breakdown and surface inversion that are voltage dependent.

ESD can also induce latent failure mechanisms in both MOS structures and bipolar junctions in both discrete devices and microcircuits. This latent failure mechanism results in performance degradation and eventually a failure.

Personnel are prime sources of ESD for damaging electrical and electronic parts. Electrostatic charges generated by rubbing or separating materials are readily transmitted to a person's conductive sweat layer charging that person. When a person handles or comes in close proximity to an ESD sensitive part, that part can then be damaged from a direct discharge by touching the part or by subjecting the part to an electrostatic field.

However, another type of discharge that is far more severe than the discharge from a person touching a device is the Charged Device Model (CDM). This occurs when the device itself becomes charged then touches ground a very fast rise time discharge can occur.

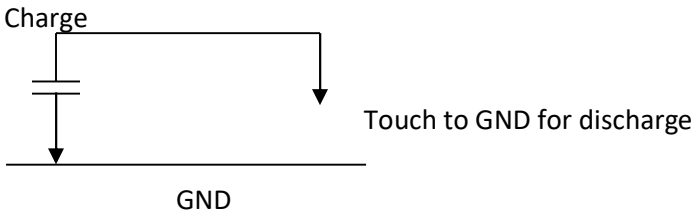


Figure A.1: Basic Charge Device Model equivalent circuit

The CDM discharge is a function of the device capacitance that may be as low as a few picofarads or can be as high as several hundred picofarads. This variation has a significant affect on the severity of the discharge. Small component packages may not be able to hold sufficient charge to meet specified discharge levels.

CDM Testing Process

The Charged Device Model test, as defined in Standards ANSI/ESDA/JEDEC JS-002-2014 (Joint Standards of EDS22-C101E, ANSI/ESD-STM5.3.1 and AEC-Q101-005) describes a test procedure where a component is slowly charged to a given voltage and then discharged directly to ground through one of the device leads. The CDM test permits either field induced or direct charge/discharge protocol.

To create a CDM the Device Under Test (DUT) is charged as if it was the capacitor and then discharged by grounding the desired pin manually by lowering a grounded spring loaded pin to the desired lead. Two different charging methods are specified.

The Field Induced Model charging method raises the DUT potential indirectly by induction and then the desired pin is grounded to generate the CDM discharge. The potential is raised by applying voltage to the field-charging electrode shown in Figure A.2.

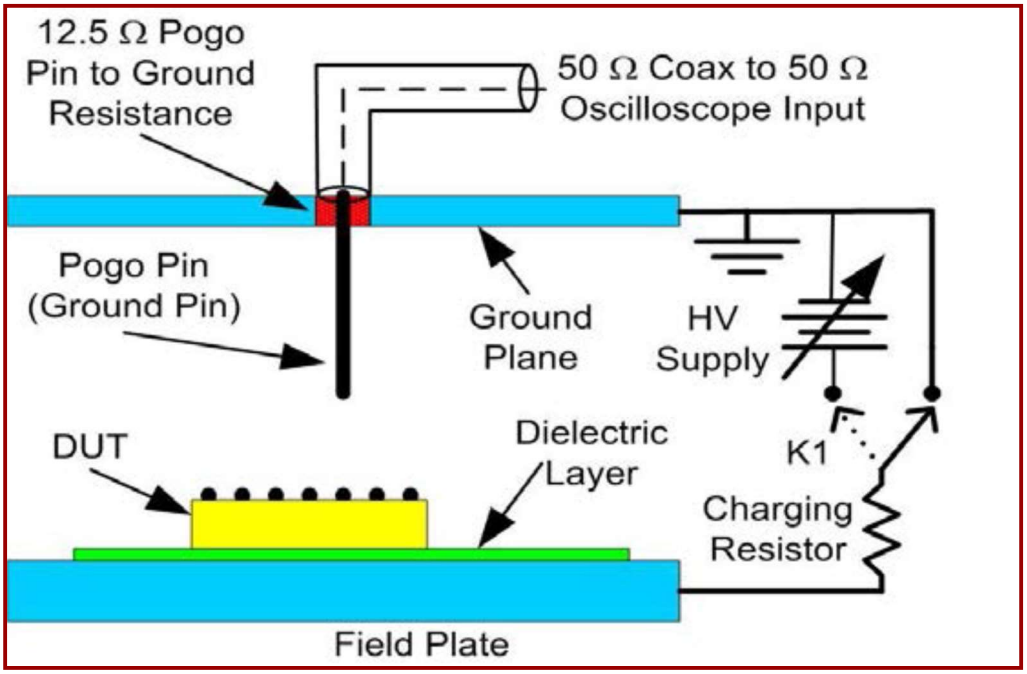


Figure A.2: Field Induced Charged Device Model

Tests that are performed using Direct Charging by placing the device on a grounded surface with or without a dielectric isolator. One or more pins are charged directly through at least a 100 MegOhm resistor. The Models 910 and 9910 incorporate a 400 MegOhm series resistor in the charging circuit. The respective pin is then discharged directly to ground. Discharge rise times are in the picosecond range.

The Model 9903 in conjunction with either the ETS Model 910 with CDM modification or the Model 9910 enables the user to perform both Field Induced and Direct Charge tests.

Appendix B - Use of the 9903 with the ETS Model 910

NOTE: The Model 910 must be modified by the factory to provide CDM testing.

Connect the CDM Test Fixture to the Model 910 as shown in Figure B.1.

Figure B.1: Model 9903 with Model 910

1. Plug the CDM Charging Module into the CAPACITOR location on the Simulator OUTPUT panel. This provides the voltage to the induction plate or to the device depending on the type of test.

2. Plug the red 0.080" pin plug from the CDM Test fixture into the CDM plug-in module.

3. Connect the 3-pin power plug into the REMOTE DIN connector located on the rear panel. This provides the power to operate the charge and discharge relays.

4. Connect the coaxial cable to the oscilloscope. **The scope input must be set to 50 Ohms. The scope also must be set to scale 10:1 since ETS provided RF cable has a 20 dB attenuator.**

Appendix C - Direct Discharge testing with the 9903

NOTE: The Direct Discharge Method is not required by JS-002-2014.

The direct discharge method is no longer required by the Joint Standard JS-002-2014. It is only applicable to older Standards.

Select the CDM Direct Charge test method

Selection of Model 9903 charging method is accomplished by a jumper wire. To configure the Test Fixture for Direct Charge testing, the jumper wire connects the plate to the ground connector that is also located on the rear of the module. Plug the red banana-banana cable into the GND jack on the rear of the control module and the red banana jack on the plate as shown in Figure C.1.

In this configuration, an 8" (203mm) charging lead with a 5" (127mm) minigrabber is connected to the voltage output. .

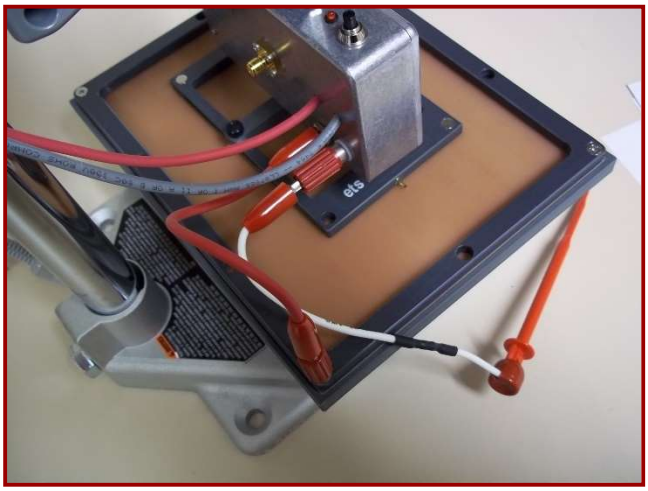


Figure C.1: Direct Charge connections

Direct Charge Measurement Procedure

1. Verify that the Test Fixture is configured for Direct Charge Measurements.
2. Adjust the height of the Press test head so that the bottom of electronics housing (ground plane) is approximately 0.5" (12mm) above the induction plate using the lever located on the rear of the test head.
3. The 6.8pF calibration disc and the 55pF calibration disc specified in ANSI/ESDA/JEDEC JS-002 are used for verification. Place one of the verification modules in intimate contact with the surface of the field induction plate. It should be centered under the Discharge Electrode spring-loaded pin as shown in Figure C.2.

Figure C.2: Verification module alignment

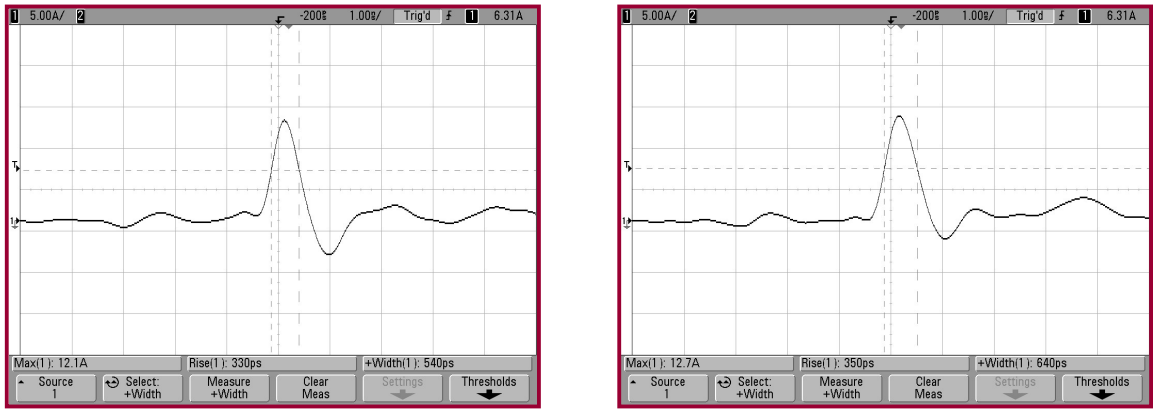
4. Set the ESD Discharge Simulator to 500V. (For the Model 9910 select the CDM function.)

   Touch with minigrabber contact: Depress the Charge button on the Fixture module. While the LED is on, touch the probe to the disc. Then quickly lower the module enabling the spring-loaded pin to contact the disc to discharge it. **MAINTAIN CONTACT WITH THE DISC for approximately 2 seconds.** This allows the disc to remain grounded ensuring total discharge.

   Maintain probe contact to the disc: Depress the Charge button on the Fixture module. While the LED is on, quickly lower the module enabling the spring-loaded pin to contact the disc to discharge it. **MAINTAIN CONTACT WITH THE DISC for approximately 2 seconds.** This allows the disc to remain grounded ensuring total discharge. A 15 megOhm resistor in the probe minimizes the parasitic capacitance effects of the probe.

   Repeat the measurement at least 2 more times. The waveforms for the 6.8pF and 55pF discs will look similar those shown in Figure C.3. Record and save the data.

5. Repeat the above procedure for measurements at –500V.



a. Touch and remove

Probe remains connected

Figure C.3: Typical Direct Charge waveforms for 55pF disc.

Other voltage levels can be used. The recommended stress levels are slightly different between the JEDEC and ANSI/ESD specifications as listed in the table below.

Level	JESD Level V	ANSI/ESD Level V
1	100	125
2	200	250
3	500	500
4	1000	1000
5	2000	1500
6	-	2000

Test Procedure

1. Place the DUT either in the holding fixture or directly onto the plate.
2. Align the spring-loaded pin to the DUT pin to be discharged as shown in Figure C.4.

3. Lower the module to both verify the alignment and to initially ground the pin. **Do Not Push the Discharge Button.**
4. If not already set then set the voltage to the desired level.
5. **For Direct Charging,** either touch the minigrabber probe to the desired pin or connect it to the pin:

   Touch with minigrabber contact: Depress the Charge button on the Fixture module. While the LED is on, touch the probe to the disc. Then quickly lower the module enabling the spring-loaded pin to contact the disc to discharge it. **MAINTAIN CONTACT WITH THE DISC for approximately 2 seconds.** This allows the disc to remain grounded ensuring total discharge.

   Maintain probe contact to the disc: Depress the Charge button on the Fixture module. While the LED is on, quickly lower the module enabling the spring-loaded pin to contact the disc to discharge it. **MAINTAIN CONTACT WITH THE DISC for approximately 2 seconds.** This allows the disc to remain grounded ensuring total discharge.
6. For each component, apply 3 positive and 3 negative discharges to each pin. Observe the discharge on the oscilloscope. Allow at least several seconds between charge/discharge cycles.

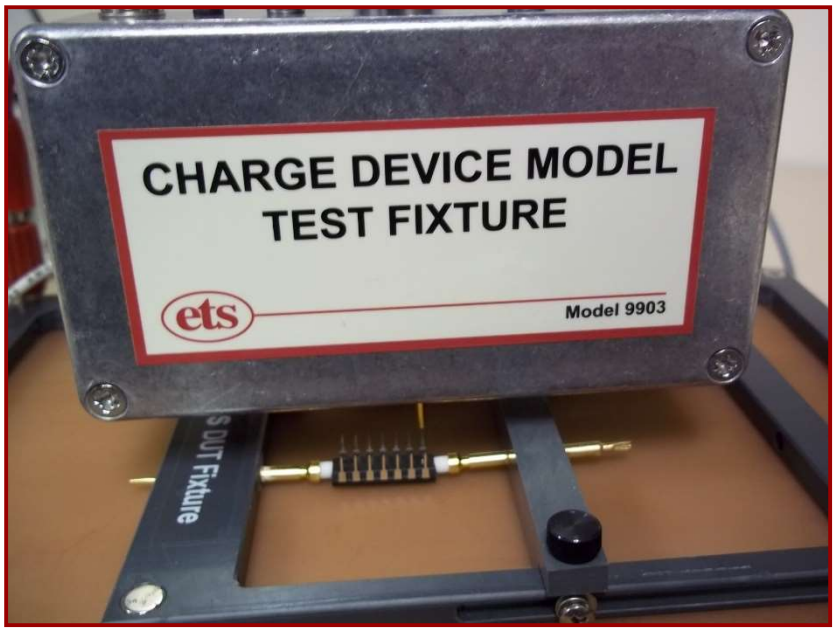


Figure C.4: DUT/Discharge pin alignment