ESD Open Forum

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Question: Why doesn't the ANSI/ESDA CDM-5.3.1 document provide current values for the higher capacitance verification module (30pF) for the 3.0GHz and 1.0 GHz BW measurements? The tables in the standard do not provide these data or give guidance as to what the data should be. Should we expect any linearity?

Answer: You are correct, the standard does not provide values at all voltage levels for the higher capacitance module, and the reasons are many. However, data does exist, but it was collected at one test lab only. The WG's plan is to collect fresh data, using several test labs including both manufacturers and users of the CDM tester. The good news is that like the small capacitance (4pF) data (see table below for 3.0 GHz BW measurements), the current values for the larger module are linear from 125V to 2000 V. This Round Robin data will then be analyzed and used in the next revision of the document.

Requirements for the 3.0 gigahertz BW measurement:

Charge voltage Volts ± 5%	Symbol	4 pF Verification module Amperes ± 20%	30 pF Verification module Amperes ± 20%
125	Ip_1	1.9	
250	Ip_1	3.75	
500	Ip_1	7.5	18.00
1000	Ip_1	15.0	
1500	Ip_1	22.5	
2000	Ip_1	30.00	

For the 1.0 GHz BW measurement, data also exists for the 30 pF module, and as is the case for the 3.0GHz data, only one data point is available. However, a graph (not included here) of Current versus Voltage (x-axis) is linear from 125 V to 2000V. This 1 GHz BW data was collected using a splitter to take the current from the CDM tester to 2 scopes; one was a 3.0GHz BW scope, and the 2nd, a 1.0GHz BW scope. Hence both Scopes saw the same CDM event each time a data set was collected. This correlates well with the linearity shown in the table below for the smaller module.

Requirements for 1.0 GHz BW measurement:

Charge Voltage Volts ± 5%	Symbol	4 pF +/- 5% Verification Module Amperes ± 20 %	30 pF +/-5% 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	

The linearity is to be expected even though there is a natural variance in each air arc discharge. The waveform Verification Modules used to collect the current data are made up of gold-plated or nickel-plated etched copper disks on single sided insulative circuit board material. The circuit board material can be FR-4 or RF-35. Each disk is etched in the center of a square of the insulative material. The capacitance is always measured with the non-metalized non-disc side of the verification modules in intimate contact with the metal surface of the grounded field charging plate in the CDM tester. We have found the RF-35 material, which is made up of a ceramic-filled polymeric substrate, to have much ***lower moisture***

adsorption rate than the FR-4 material, so the Rf-35 is preferred, but it is optional to use either one. .

It is to be noted that if the user plans to build their own module, then changes to the materials dielectric constant will change the required dimensions (shown in the standard) if the specified capacitances are to be maintained. The physical dimensions given in the standard are meant to be a guide only. The final capacitance of the verification modules are to be measured using the specified capacitance meter.

References:

1. *ANSI/ESD STM-5.3.1-Charged Device Model (CDM)--Component Level*, ESD Association, Rome, NY.
2. Henry et al. "Charged Device Model Metrology", EOS/ESD Symposium, 1996, EOS-18. p167. www.esda.org.

About the author

This article was prepared on behalf of the ESD Association by Dr. Leo G. Henry, an IEEE Senior member. He is a member of the ESDA's Board of Directors, and serves as Vice President. He is chair of the Device Design Certification Program and is also chair/facilitator for the ESDA's Device Testing Standard Committee (WG-5.0) that has several subgroups (HBM, CDM, MM, HMM, TLU and TLP). Dr. Henry is presently the Chief Engineer at ESD/TLP Consultants LLC, located in Silicon Valley, Fremont, CA. LeoG earned B.S. and M.S. degrees in Physics from the University of the West Indies, and M.S. & PhD degrees in Materials Science & Engineering from U.C. Berkeley, CA, USA. He can be reached at 510-657-5252 (office) or 510-708-5252 (Mobile) and at leogesd@pacbell.net or leogesd@ieee.org.

About the ESD Association

Founded in 1982, the ESD Association is a not for profit, professional organization dedicated to furthering the technology and understanding of electrostatic discharge. The Association sponsors educational programs, develops ESD standards, holds an annual technical symposium, and fosters

the exchange of technical information among its members and others. Additional information may be obtained by contacting the ESD Association, 7900 Turin Rd., Bldg. 3, Rome, NY 13440-2069 USA. Phone: 315-339-6937. Fax: 315-339-6793. Email: info@esda.org. Website: http://www.esda.org.