

An Introduction to Device-Level ESD Testing Standards

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Electrostatic discharge (ESD) can stop a design in its tracks. Although ESD protection is important for [several applications](#), it can be especially crucial for smaller designs like mobile devices. [ESD](#) poses little threat of harm to the user, but a small amount of static electricity can ruin semiconductors.

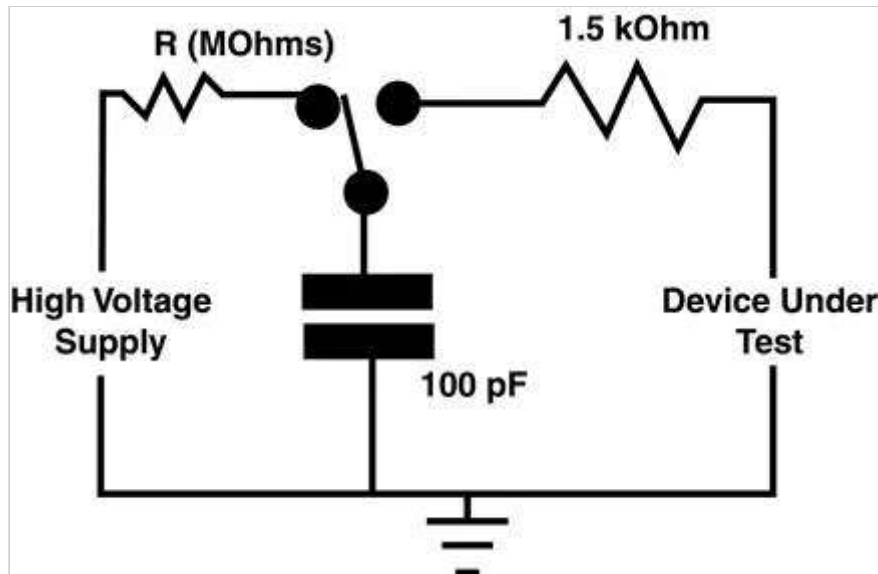
To avoid these malfunctions in manufactured devices, standardized ESD tests were made. These tests were designed to reproduce as many situations that cause ESD events as possible and are divided into different standards based on the ESD event that the test is simulating. These standards are further divided into sensitivity classification levels based on the amount of voltage that runs through the device being tested.

In this article, we'll get familiar with the common device-level testing models for electrosensitive-devices.

Human Body Model (HBM) Testing

The Human Body Model test is the oldest and most commonly conducted method. An HBM test simulates the electrical discharge caused by a person with some residual charge built up from something like dragging their feet across carpet and then touching a component with their fingertip.

The test is modeled by a 100pF capacitor discharging through a switching component and a 1.5kW series resistor into the component.



A typical HBM circuit. Courtesy of the [EOS/ESD Association](#)

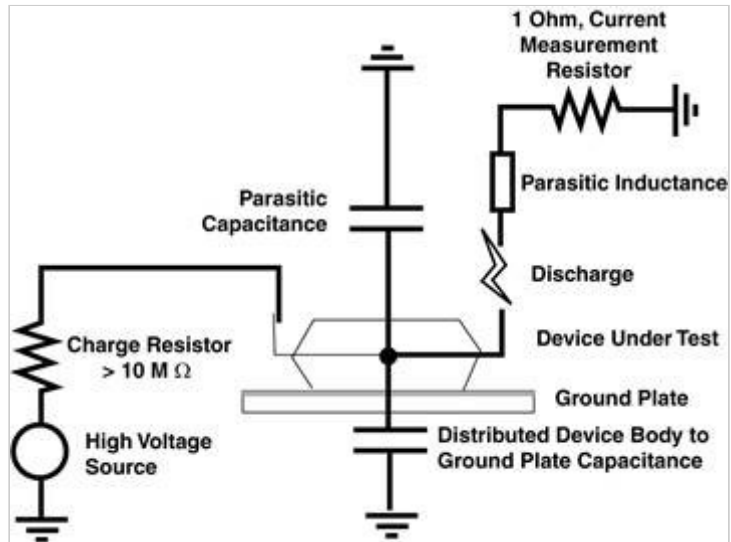
HBM Sensitivity Classification Levels

Class	Voltage Range
Class 0	< 250 volts
Class 1A	250 volts to < 500 volts
Class 1B	500 volts to < 1,000 volts
Class 1C	1000 volts to < 2,000 volts
Class 2	2000 volts to < 4,000 volts
Class 3A	4000 volts to < 8000 volts
Class 3B	\geq 8000 volts

Charged Device Model (CDM) Testing

A CDM test concerns a device building charge by making friction with a conductive surface and coming into contact with a grounded conductor. These are most common in automated manufacturing environments. An example of a CDM event would be a device sliding around a feeder in an assembly line. Without CDM testing, many devices would be destroyed before their construction is complete.

A CMD test involves placing a device on a field plate with its leads' point up, charging it, and then discharging it.



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A typical CDM test. Courtesy of the [EOS/ESD Association](#)

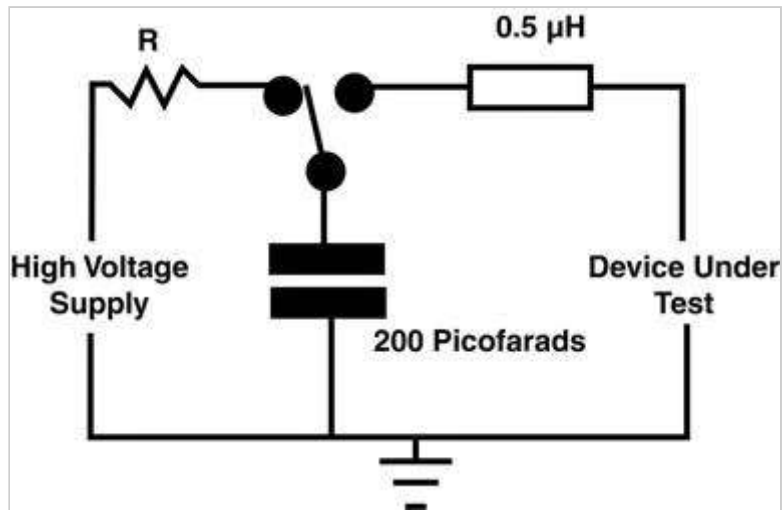
CDM Sensitivity Classification Levels

Class	Voltage Range
Class C1	<125 volts
Class C2	125 volts to < 250 volts
Class C3	250 volts to < 500 volts
Class C4	500 volts to < 1,000 volts
Class C5	1,000 volts to < 1,500 volts
Class C6	1,500 volts to < 2,000 volts
Class C7	=>2,000 volts

Machine Model (MM) Testing

An MM test simulates a device coming into contact with a metallic item like a tool or loose cables. MM testing is far less common than HBM testing because the circumstances that the circuits simulate are more extreme and less likely to occur.

A common ESD model for an MM test is a 200pF capacitor discharged directly into a component with no DC resistor in series with the output circuitry.



A typical MM circuit. Courtesy of the [EOS/ESD Association](#)

MM Sensitivity Classification Levels

Class	Voltage Range
Class M1	< 100 volts
Class M2	100 volts to < 200 volts
Class M3	200 volts to < 400 volts
Class M4	> or = 400 volts

Component-Level ESD Testing

Like consumer devices, components also need to be tested for possible ESD events. The shrinking of integrated circuits allows for smaller product designs and, like with their consumer-end counterparts, the risk of an ESD event increases as semiconductor size decreases.

Over time, chip makers have had to place more and more emphasis on [ESD protection](#). There are also many [devices made especially for ESD protection](#), such as [transient voltage suppressors](#) and ESD protection diodes.

If you'd like to learn more about ESD protection, check out this webinar on [protecting portable applications from ESD, EMI, and surge](#).

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