AN3353
Application note

IEC 61000-4-2 standard testing

Introduction

This Application note is addressed to technical engineers and designers to explain how STMicroelectronics protection devices are tested according to IEC 61000-4-2 standard.

This standard, describing testing and measurements techniques for electrostatic discharge immunity, is dedicated to electrical and electronic equipment, and the way to apply it to standalone electronics components may not be obvious.

Market environment

The IEC 61000-4-2 standard is commonly used to certify equipment such as mobile phones, computers and any sensitive electronic equipment. Each of these devices has to be protected against electrostatic discharges using components able to clamp and resist the high voltages generated and defined by each standard level. The robustness of these devices has to be checked and guaranteed.

Frequently asked questions

This document provides responses to the following:

1. Contact discharge or air discharge method?
2. What about the IEC 61000-4-2 test bench?
3. How do we test ESD in air discharge?
4. How do we test ESD in contact discharge?
5. How do we measure the clamping voltage?

1 Contact discharge or air discharge?

According to the standard, contact discharge is the preferred test method. Air discharge shall be used when contact discharge cannot be applied. Contact discharge is more dedicated to conductive surfaces and air discharge to insulating surfaces. In case of air discharge, the current level and rise time are less reproducible and more related to environmental conditions (humidity, speed of the tip approach etc.).

However, STMicroelectronics protection devices are always specified according to the two test methods, and the specified levels are most of the time the maximum standard levels. That is to say 8 kV for contact discharge and 15 kV for air discharge (level 4 of the standard).

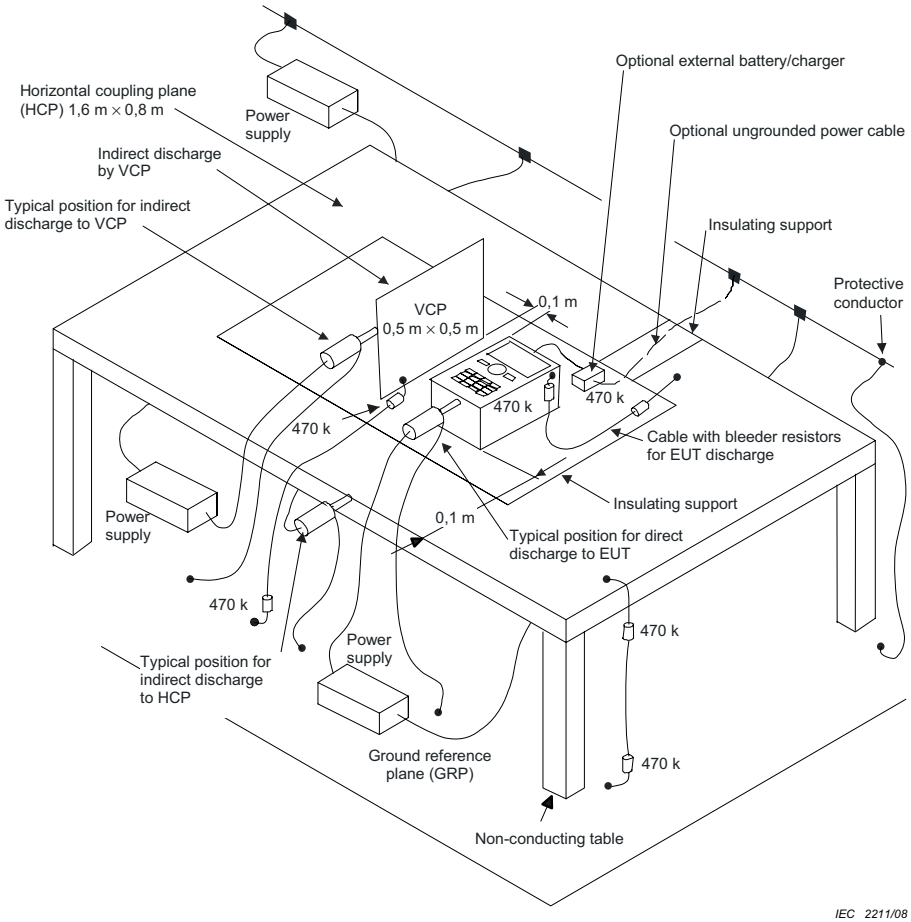
Note: The clamping voltage waveforms of our protection devices given in the datasheets are measured at 8kV in contact discharge. This test condition gives the worst case clamping voltage response because the rate of rise of the current gets its highest value (around 45 A/ns). (See Section 5: Clamping voltage measurement.)

2 Test benches

2.1 IEC 61000-4-2 test bench

Figure 1 shows the test bench recommended by IEC 61000-4-2 standard for ungrounded equipment (mobile phones for example). This is the setup we adapted for our standalone protection devices.

Figure 1. Extract from IEC 61000-4-2 standard: recommended ESD test bencht[(a)]



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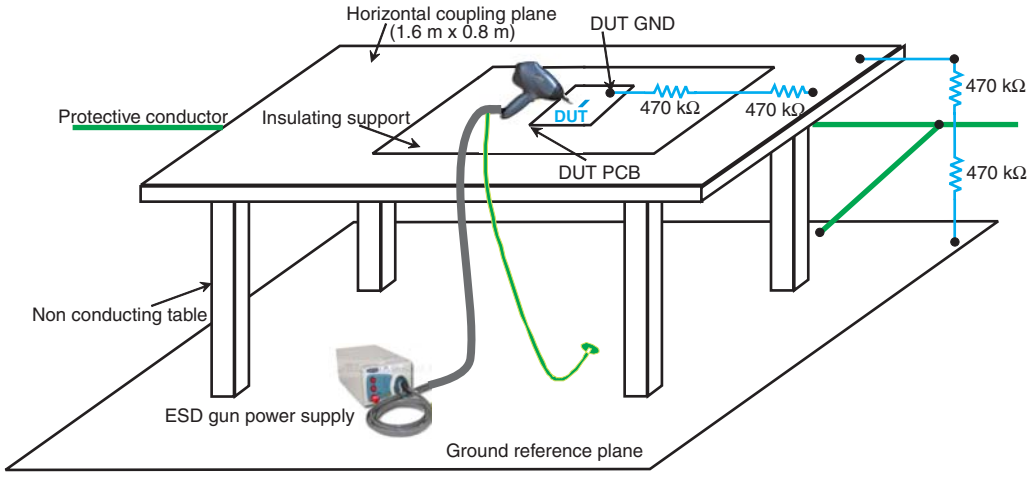
2.2 STMicroelectronics test bench

STMicroelectronics test bench is described in *Figure 2*. All the dimensions (height, materials, insulator thickness etc.) and ground connections are in accordance with the standard (*Figure 1*).

The ESD gun is mounted on a stand with a slide arm in order to move it up to the device under test especially during air discharge conditions.

Figure 2. ESD test bench for STMicroelectronics protection devices

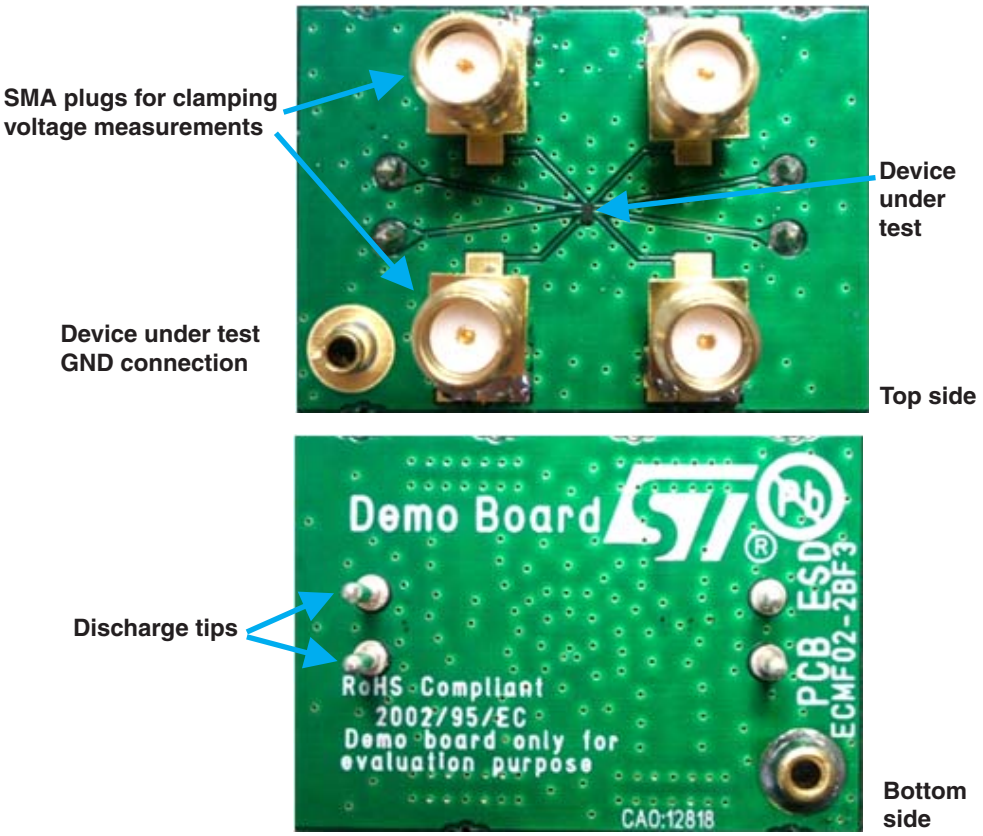


ESD Generator NSG438 TESEQ
ESD IEC6100-4-2 environment ESS-801 NOISEKEN

Our device is soldered on a dedicated PCB as shown in *Figure 3*. A 2 mm female banana plug is connected to the ground plane of the PCB. This plug, through the bleeder resistors (2 x 470 kΩ), links the horizontal coupling plane to the PCB ground plane.

A rounded discharge tip is connected to the pin to test. Depending on the device, one or more tips can exist. These tips are soldered on the bottom side of the PCB such that they act as a shield for the clamping voltage measurement by means of the SMA plugs added in the top side of the PCB.

Figure 3. Test PCB example



3 Air discharge test

The rounded ESD gun dedicated to air test is used. The voltage generator is set to the desired level and the ESD gun moved with the slide arm towards the PCB probe tip until a spark appears and then further until the ESD gun tip touches the PCB discharge tip. This action is repeated ten times minimum, in positive and negative polarities.

4 Contact discharge test

The sharp tip ESD gun dedicated to contact test is used. Contact is maintained with the PCB discharge tip by locking the slide arm. The generator is set to the desired voltage and ten discharges minimum are applied in positive and negative polarities to the device under test.

5 Clamping voltage measurement

As we say in *Section 1: Contact discharge or air discharge?*, the clamping voltage measurement is done in contact mode at ±8 kV. The ground return of the ESD gun is connected directly to the GND test PCB, as well as the reference of the oscilloscope.

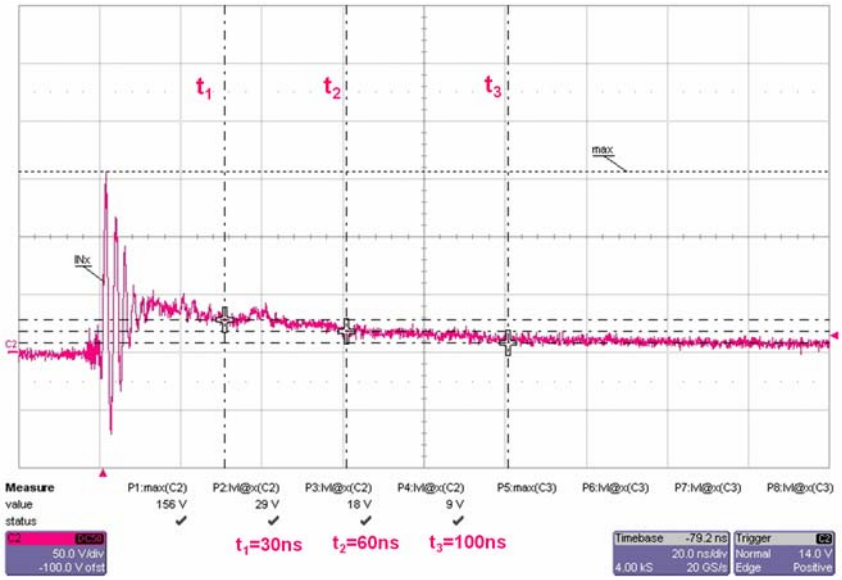
A 3 GHz analog bandwidth oscilloscope is used (2 GHz minimum is recommended by the standard). Its sample rate is 20 giga samples per second and the time base is set to 20 ns/div. The vertical amplifier input impedance is set to 50 Ω.

A 50 Ω coaxial cable is connected to the SMA where the clamping voltage is measured (*Figure 3*). Depending on the device and the test conditions, the clamping voltage can vary between several volts up to around two hundred volts. So attenuators are inserted at the end of the cable at the channel oscilloscope input. Two -20 dB attenuators in series give an attenuation ratio of 100.

A clamping voltage waveform example is shown in *Figure 4*. On the waveform, we find the typical clamping voltage at three different times after the beginning of the surge: t = 30 ns, t = 60 ns and t = 100 ns. The typical peak voltage is also noted.

According to the JESD210 Jedec standard, a limiting resistor can be added in series with the measurement cable. In this case, its value is specified.

Figure 4. Clamping voltage waveform example



6 Conclusion

This document describes how STMicroelectronics protection and filtering devices are tested to guarantee their capability to withstand the IEC 61000-4-2 levels (contact or air discharge).

When these components are mounted in a product to protect some of its fragile parts, the behavior of this component, tested in the same conditions will be more predictable. The wave shape of the clamping voltage given in worst case test conditions indicates the magnitude of remaining voltage that the protected equipment can meet.

7 Revision history

Table 1. Document revision history

Date	Revision	Changes
24-Jun-2011	1	Initial release.