

# IEC61000-4-2 Ed.2 Test Standard

## 1. General

The international immunity test standard which applies to electronic equipment against ESD generated directly from a human body or near metal objects in condition chemical fibers carpets or clothings are used in low humidity relatively. This standard assumes cases an charged human body discharges to electronic equipment and testing with the circuit to simulate current waveform generated in such conditions

## 2. Test Level

### Test level range for the ESD

The levels as below.

Level	Test voltage (contact discharge)	Test voltage (air discharge)
1	2kV	2kV
2	4kV	4kV
3	6kV	8kV
4	8kV	15kV
X	Special	Special

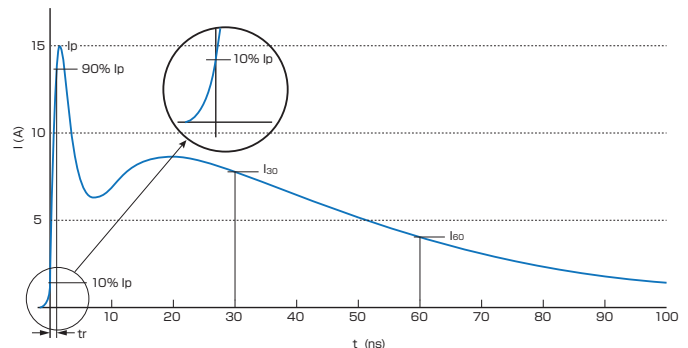
\* X can be any level determined by consent between the EUT manufacturer and the simulator supplier

## 3. Test Generator and Waveform Verification

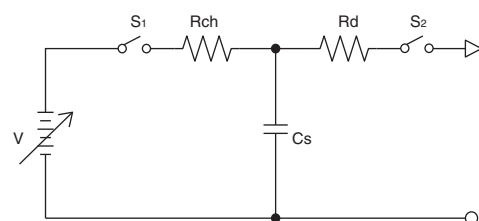
### Generator specification

The generator must satisfy following specification.

Energy accumulation capacity	150pF (typical)
Discharge resistance	330Ω (typical)
Output voltage	8kV / Contact discharge, 15kV / Air discharge
Tolerance of output voltage	±5%
Polarity of output voltage	Positive and negative (Switching available)
Hold time	>= 5sec.
Discharge mode of operation	Single discharges (Discharge interval >=1 sec)
Waveform of discharge current	See right figure



Discharge current waveform and its characteristics



Capacitance  $C_s$  : 150pF  
Discharge resistance  $R_d$  : 330

Simplified diagram of the ESD generator

### Generator characteristics

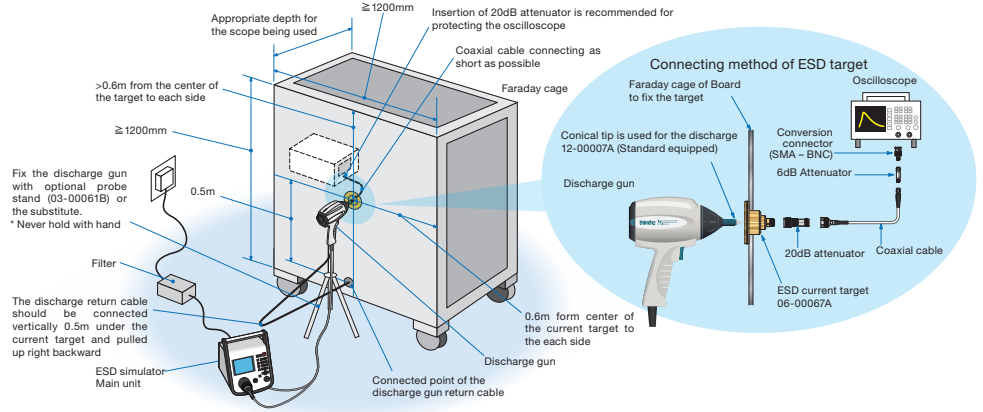
The characteristics in following table must be verified in order to compare the tests results even among different generators

Level	Indicated voltage	1 <sup>st</sup> peak current of discharge ( $\pm 15\%$ ) $I_p$	Rise time ( $\pm 25\%$ )	Current ( $\pm 30\%$ ) at 30ns	Current ( $\pm 30\%$ ) at 60ns
1	2kV	7.5A	0.8ns	4A	2A
2	4kV	15A	0.8ns	8A	4A
3	6kV	22.5A	0.8ns	12A	6A
4	8kV	30A	0.8ns	16A	8A

## IEC61000-4-2 Ed.2 Test Standard

### ■ Waveform verification of ESD Generator

Measure the waveform with an oscilloscope whose band width is 2GHz or more upon use of Faraday cage and the current target. Attach the discharge electrode directly to the current target and operate the generator with the contact discharge mode.



\* It is recommended that insertion of approx. 20dB attenuator for protecting the measurement equipment although it is not specified in IEC Standard.

## 4. Test setup

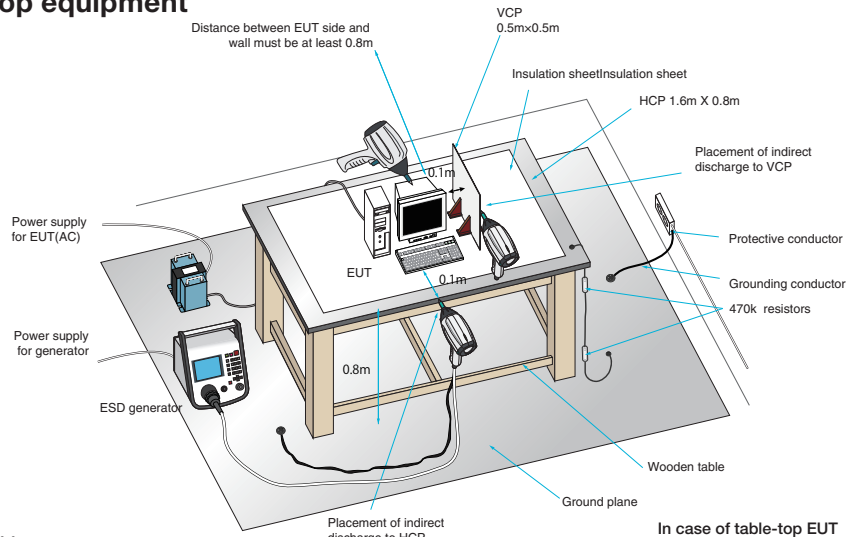
### ■ Example of test set-up for table-top equipment

The direct discharge test is electrostatic direct discharge to EUT and examine the influence.

Put a wooden table whose height is 0.8m on the ground plane and place horizontal coupling plate (HCP 1.6m × 0.8m).

Connect the HCP with resistor 470kΩ × 2 to the ground plane and lay a insulation sheet between the HCP and the EUT.

The indirect discharge test is electrostatic discharge to the HCP and vertical coupling plate (VCP 0.5m × 0.5m) and examine the influence of EUT. Connect the VCP with resistor 470kΩ × 2 to the ground plane as well.

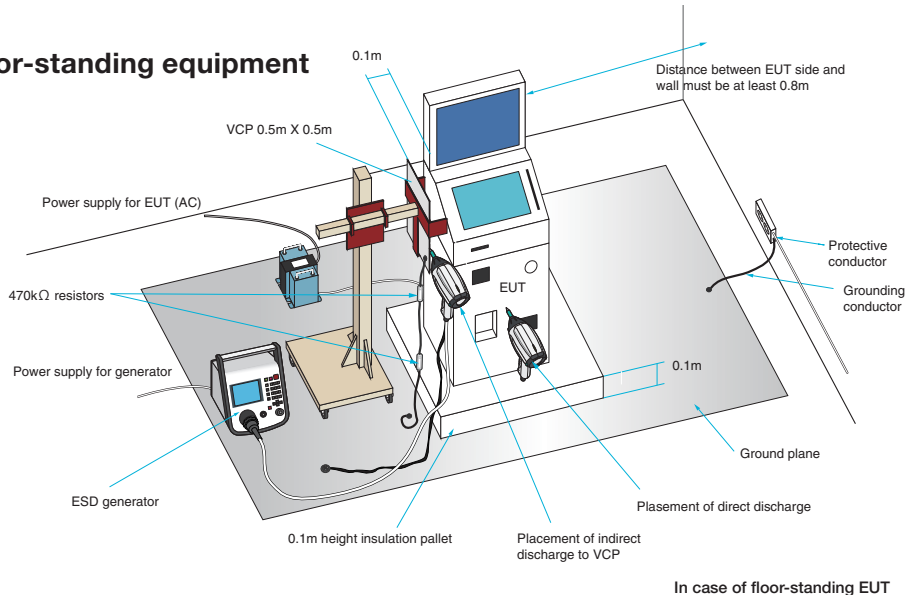


\* The isolation transformer for EUT is not specified in IEC Standard.

### ■ Example of test set-up for floor-standing equipment

Put an insulation pallet whose height is 0.1m onto the ground plane and place EUT on the pallet for the direct discharge test.

The indirect discharge test is electrostatic discharge to the VCP and examine the influence of EUT. Connect the VCP with resistor 470kΩ × 2 to the ground plane as well.



\* Float cables from the ground plane with 0.5mm thickness insulation sheet.  
\* Keep GND cable of the discharge gun ≧ 0.2m from any conductive parts other than the ground plane

\* The isolation transformer for EUT is not specified in IEC Standard.

## IEC61000-4-2 Test Standard

## 5. Test Procedure

### ■ Climatic and Other Environmental Conditions

It is necessary to leave equipment which are brought in from different climatic conditions fully before performing the test. Also, in order to stabilize the discharging condition certainly, it is necessary to fix the climatic conditions in the test room.

Fulfillment of the conditions listed in following table must be required to perform testing in conformance with IEC61000-4-2.

Ambient temperature	15°C to 35°C
Relative humidity	30% to 60%
Atmospheric pressure	86 kPa (860 mbar) to 106 kPa (1060 mbar)
Electromagnetic conditions	Level not to affect the test result

### ■ Test Procedure

Direct discharge test : Contact discharge (at 1 second interval) and air discharge

Indirect discharge test : Discharge to VCP and HCP

At least 10 single discharges shall be applied at 1 second or longer interval in both positive and negative polarities.

\* A preliminary test which discharges 20 times or more per second may be done in order to select the points to which single discharges should be applied.

## 6. Evaluation of Test Results and Test Report

The tests results are classified into following 4 patterns according to specifications of EUT and operating conditions.

- 1) Normal operation within the tolerance of the specification
- 2) Temporary degradation or loss in the operation or the function which is able to be recovered by a self-recovery function
- 3) Temporary degradation or loss in the operation or the function which needs to be recovered by user intervention or reset in the system.
- 4) Damage of the system (parts) or software, and unrecoverable degradation in the function due to loss of the data.

Generally, as far as the EUT is immune to the ESD during testing and it satisfies the functional requirements according to the product specification after testing, the test result can be perceived as "Pass"

The test report shall contain the test conditions and the result.

Notes: This test procedure and test set-up are extracted from IEC61000-4-2 (2009) and JIS C 61000-4-2 standard sed.2.0 (2005) Standard for applying to our products. Please go through the Standards if the more details are required.

# ISO 10605 Ed. Test Standard

## 1. General

Electrostatic discharges which are generated both in vehicles and while we get on and off there can be factors to cause malfunction of the electrical devices and components. Nowadays, more attention has been paid, as vehicles install more and more electronic devices and components. This Standard provides that static electricity is discharged to the electronic devices or equipment from the charged human body and tests are simulated by electrical circuit to reproduce the electric current waveform at the discharge.

In addition to procedures for the immunity tests and evaluations in state that the electronic devices or equipment work while the vehicle is driving, also, the Standard provides tests procedures to evaluate the immunity of the each module against simulated human discharges during the assembly process or in servicing.

## 2. Test level

The following tests levels are reference. The categories are classified according to functional importance of the electronics devices/components.

Component test – Example severity levels for direct contact discharge and direct air discharge (Function performance status)

Test severity level	Direct contact discharge			Direct air discharge.		
	Category 1	Category 2	Category 3	Category 1	Category 2	Category 3
Level 4	±8kV	±8kV	±15kV	±15kV	±15kV	±25kV
Level 3	±6kV	±8kV	±8kV	±8kV	±8kV	±15kV
Level 2	±4kV	±4kV	±6kV	±4kV	±6kV	±8kV
Level 1	±2kV	±2kV	±4kV	±2kV	±4kV	±6kV

Component test – Example severity levels for indirect contact discharge (Function performance status)

Test severity level	Direct contact discharge		
	Category 1	Category 2	Category 3
Level 4	±8kV	±15kV	±20kV
Level 3	±6kV	±8kV	±15kV
Level 2	±4kV	±4kV	±8kV
Level 1	±2kV	±2kV	±4kV

Vehicle test – Example severity levels for contact discharge and air discharge (Test points accessible only from inside vehicle)

Test severity level	Contacts discharge			Air discharge		
	Category 1	Category 2	Category 3	Category 1	Category 2	Category 3
Level 4	±6kV	±8kV	±8kV	±8kV	±15kV	±15kV
Level 3	±4kV	±4kV	±6kV	±6kV	±8kV	±8kV
Level 2	±2kV	±2kV	±2kV	±4kV	±4kV	±6kV
Level 1	–	–	–	±2kV	±2kV	±4kV

Vehicle test – Example severity levels for contact discharge and air discharge (Test points accessible only from outside vehicle)

Test severity level	Contacts discharge			Air discharge		
	Category 1	Category 2	Category 3	Category 1	Category 2	Category 3
Level 4	±6kV	±8kV	±8kV	±15kV	±15kV	±25kV
Level 3	±4kV	±6kV	±6kV	±8kV	±8kV	±15kV
Level 2	±2kV	±4kV	±4kV	±4kV	±6kV	±8kV
Level 1	–	–	±2kV	±2kV	±4kV	±6kV

## 3. Specification of generator and verification of output waveform

### ■ Specification of ESD simulator

Following specification must be satisfied with the simulator for the test.

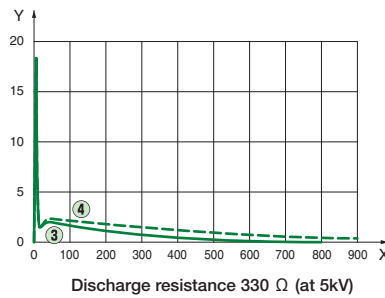
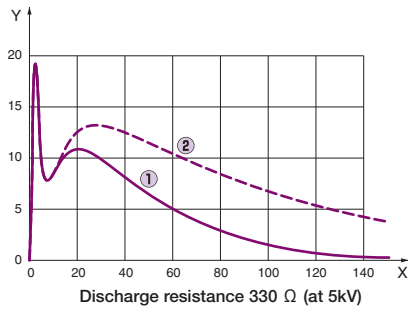
Parameter	Specification
Output voltage . Contact discharge-(kV)	2kV 15kV
Output voltages - Air discharge-(kV)	2kV 25kV
Output voltages accuracy (%)	≤5%
Polarity	Positive and negative
Rise time of short circuit current in contact discharge mode(10 % to 90 %)	0.7ns 1ns
Holding time	≥5s
Storage capacitances(pF)	150pF, 330pF
Discharge resistances(Ω)	2kΩ, 330Ω

## Testing Summary according to ISO 10605 Ed.2 Standard

### Contact discharge mode current specifications

Following discharges characteristics should be verified.

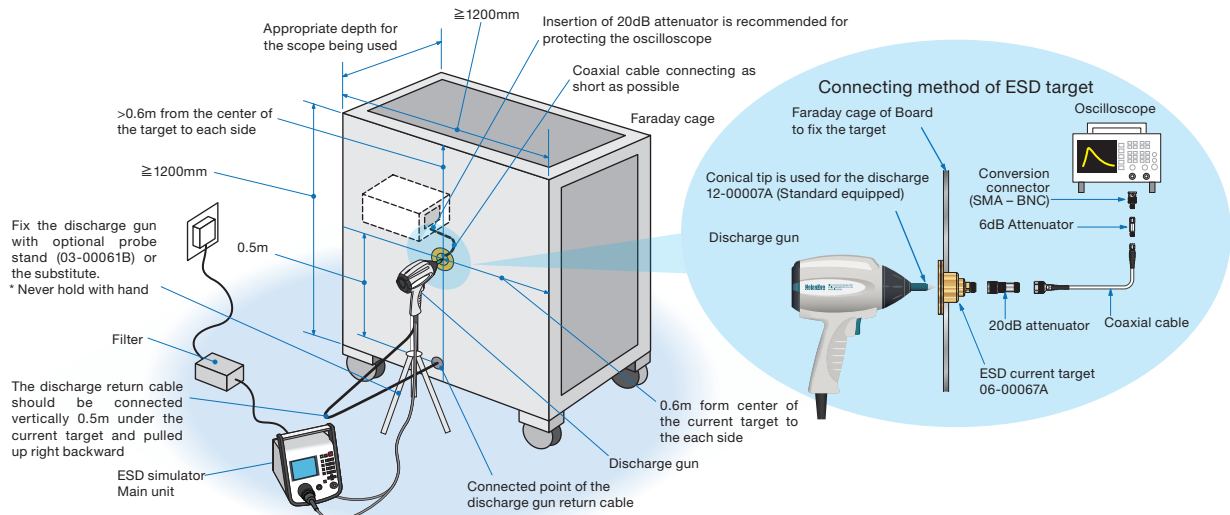
Typical capacitance / resistance values	Peak current / charge voltage	Current at T1 / Charge voltage	Current at T2 / Charge voltage
① 150pF/330Ω	3.75A/kV ±10%	2A/kV ±30% (t1=30ns)	1A/kV ±30% (t2=60ns)
② 330pF/330Ω		2A/kV ±30% (t1=65ns)	1A/kV ±30% (t2=130ns)
③ 150pF/2kΩ	3.75A/kV +30% -0%	0.275A/kV±30% (t1=180ns)	0.15A/kV±50% (t2=360ns)
④ 330pF/2kΩ		0.275A/kV±30% (t1=400ns)	0.15A/kV±50% (t2=800ns)



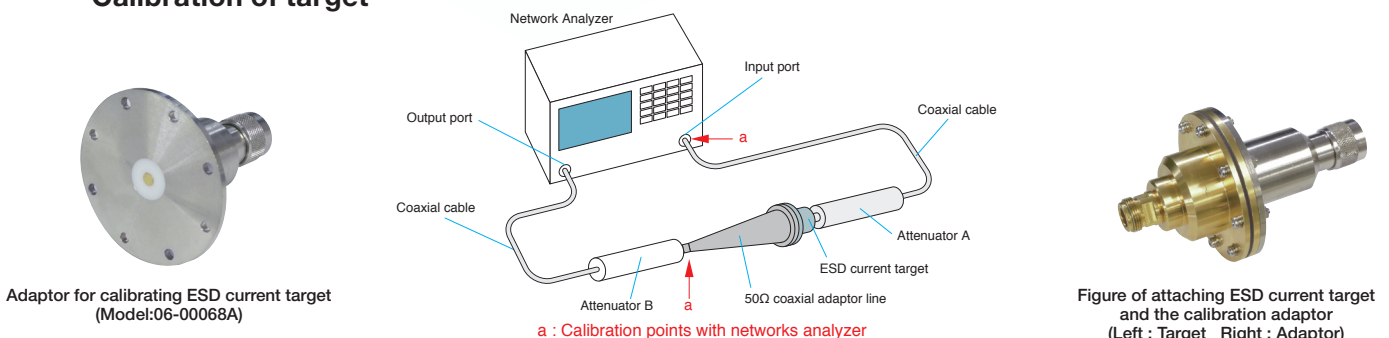
### Verification of output current waveform

The waveform shall be verified with an oscilloscope whose bandwidth is 1GHz or more in a Faraday cage or with a 1.2m x 1.2m metallic board mounting an ESD current target in the center of the cage or the board. The discharge electrode (Discharge tip of the gun) shall be touched onto the target and the discharge mode shall be set at the contact discharge mode.

The discharge return cable shall be turned up the center of the length and connected to vertically 0.5m under the target on surface of the Faraday cage or board.



### Calibration of target

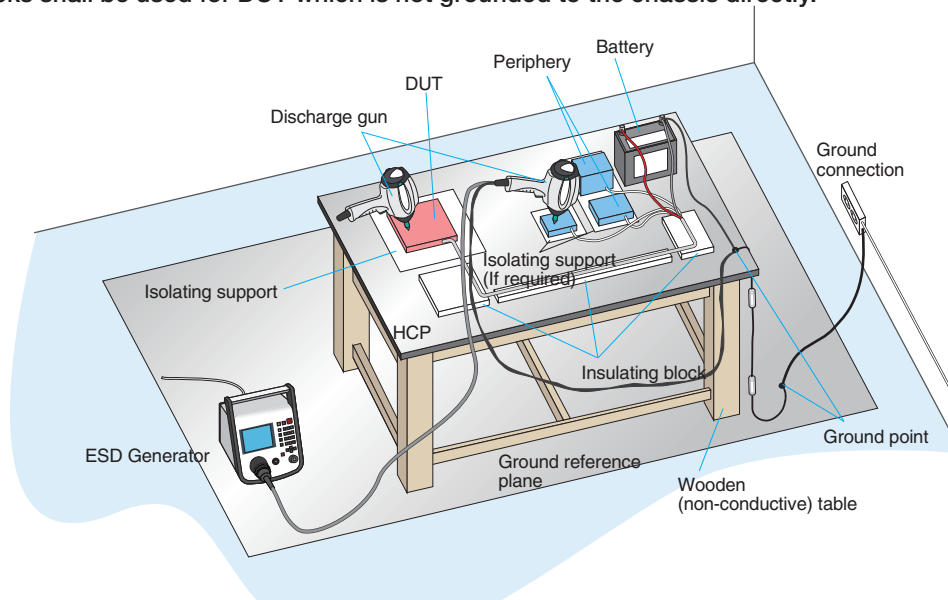


## Testing Summary according to ISO 10605 Ed.2 Standard

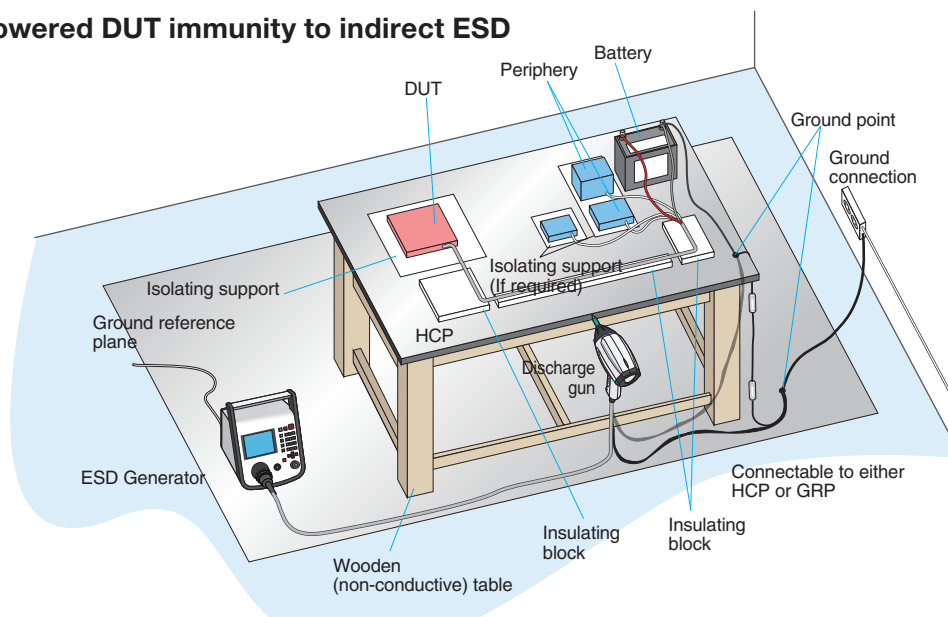
### 4. Test setup and test procedure

#### ■ For testing powered DUT immunity to direct ESD - Contact discharge and air discharge

- Capacitance shall be selected to 150 pF (In case for components accessible from outside vehicle) or 330 pF (In case for components accessible from inside vehicle) and resistance shall be 330Ω.
- The test level shall be two or more.
- At least 3 discharges shall be applied both to the positive and negative polarities with the interval not less than 1s. The time intervals between successive single discharges in the indirect discharge shall be longer than 50 ms and the number of the test shall be >50 times.
- In the contact discharge, it shall be done to wherever human finger may touch.
- In the air discharge, the speed of approach should be between 0.1 m/s and 0.5 m/s and the discharge tip is held perpendicular to the surface of the DUT when possible; if not possible, an angle of at least 45° to the surface of the DUT is preferred.
- Insulating blocks shall be used for DUT which is not grounded to the chassis directly.



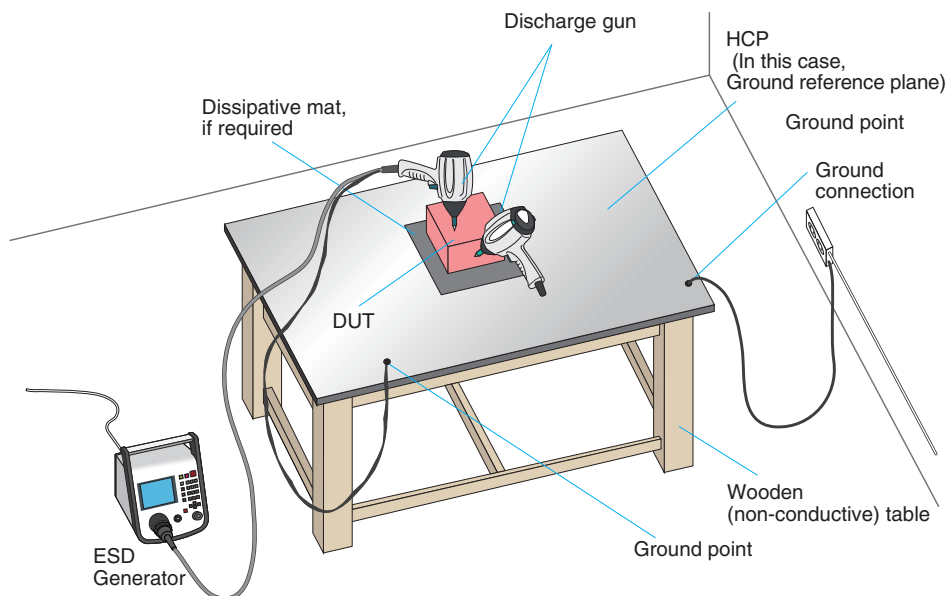
#### ■ For testing powered DUT immunity to indirect ESD



## Testing Summary according to ISO 10605 Ed.2 Standard

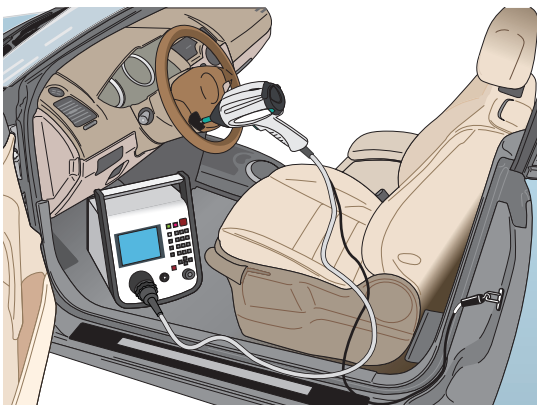
### ■ For testing (unpowered) packaging and handling ESD sensitivity

- Capacitance shall be selected to 150 pF (Although the resistance value is not provided, it is recommended to perform the tests supposing both resistance when the DUT may be directly accessible by human body ( $2k\Omega$ ) and it may be accessible by a metal object a human hold ( $330\Omega$ ))
- The test level shall be two or more.
- At least 3 discharges shall be applied both to the positive and negative polarities with the interval not less than 1s.
- In the contact discharge, it shall be done to wherever human finger may touch.
- Charge build-up should be eliminated by briefly connecting a bleeder wire with high resistance ( $>1M\Omega$ ) after the discharge and the DUT shall be turned on. Afterwards, normal operation of it shall be confirmed.

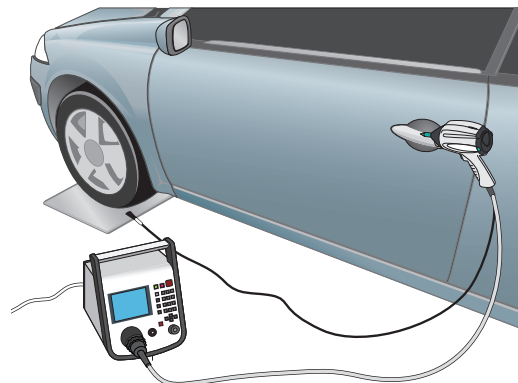


### ■ Vehicle test – Internal and external points

- Choose a generator capacitance of 330pF for areas that can easily be accessed only from the inside of the vehicle and resistance of  $330\Omega$  or  $2k\Omega$
- Choose a capacitance of 150 pF for points that can easily be touched only from the outside of the vehicle and resistance of  $330\Omega$  or  $2k\Omega$ .
- The ESD generator ground shall be connected to chassis like the seat-rail in case of the interior test or connected to a metallic plate under the wheel closest to the application point in case of the exterior test.
- Both the contact discharge and air discharge shall be done both for the internal and external.



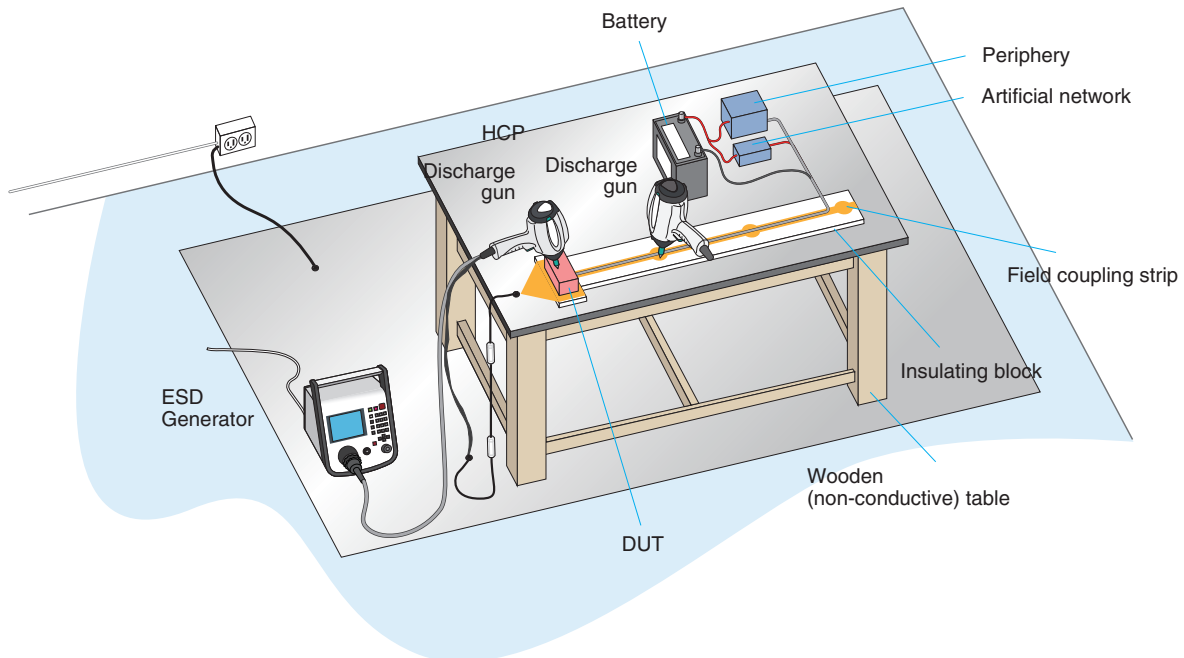
Internal test



External test

## Testing Summary according to ISO 10605 Ed.2 Standard

### ■ Optional test set-up and procedure for electronic modules (powered-up test) – Direct and indirect discharge



Notes: This test set-up is quoted from ISO10605 ed2.0 (2008) Standard.  
Please go through the Standard if the more details are required.



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