NoiseKen

Electrostatic Discharge Simulator

ESS-S3011A
ESS-B3011A
GT-30RA (Discharge Gun)

www.noiseken.com

ESD Simulator

ESS-S3011A & GT-30RA

Smart model equipped high function & extendibility

EMC test equipment to evaluate the resistibility of electronic equipments when energy charged on a human body or object is discharged to the electronic equipment. This can be available for evaluating malfunctions or functions declines of electronic equipment against the ESD.
Programmable simulator to ease some complicated tests. The output voltage is up to 30kV and performable IEC61000-4-2 & ISO 10605 Standardscompliant tests.

*Probe stand for the discharge gun is option.

- **“3 pre-checking function” to make sure the more confirmable test**
- **“CR constant indicator” to make sure the correct unit attachment**
- **One-touch exchange of gun head and CR unit realized**
- **“Ten-key & Rotary knob” to ease the setting.**
- **“Infra-red Remote Controller” to realize the setting remotely from the generator (Standard attached).**
- **“Discharge Detecting Function” to realize the air-discharge confirmation.**
- **“Lightest discharge gun in the market” to lighten the continuous operation (Excluding the cable and connector)**
- **“White LED Irradiator” to facilitate the visualization of the discharging areas.**
- **“ Control Software” to enable the test result reporting and control with PC.**

* The software is scheduled to be downloaded freely from our web-site (The connection cable is necessary in addition).
* C (Capacitor) and R (Resistor) for the discharge gun is one-body unit.
* ISO 10605 compliant test can be realized with the optional parts in addition.

Feature

More insurable test realized ! “3 pre-checking function” built-in

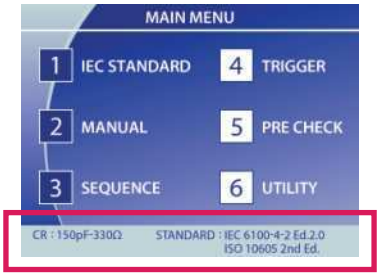
[Check 1] Check high voltage output Confirm error to the set value.
[Check 2] Check withstanding voltage
Confirm whether withstanding voltage is normal or defective
The output and defectiveness are checked upon insertion of the discharge gun to the attached gun holder.
[Check 3] Check discharge relay operation
Confirm whether the relay is exhausted or still available.
Confirmable by touch of the discharge gun to the check terminal on the generator and discharge.

Photo of the operation

“CR constant indicator” to make sure the correct unit attachment.

Whether the gun head corresponds to IEC or ISO ?

What values are the charge capacitor and discharge resistor ?

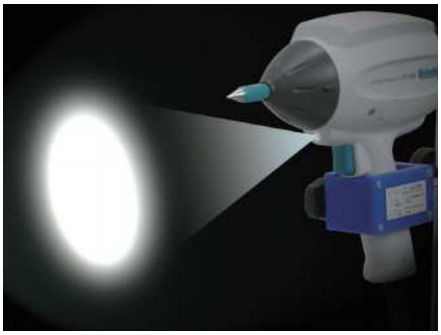


Indicated on the display of the generator

ESS-S3011A & GT-30RA

Lighter and more user-friendly discharge gun

The discharge gun has been renewed completely to materialize a considerable Weight reduction and best gravity balance.
Human load in the operation can be remarkably reduced comparing to the previous model. Please realize it on-hand actually.
Also, an event of air discharge can be visualized with LED light on the body in this new discharge gun although the previous one has to be confirmed only with human eyes. In addition, various functions are added like one-touch exchange of CR unit, LED irradiator to shine the discharging points, etc.

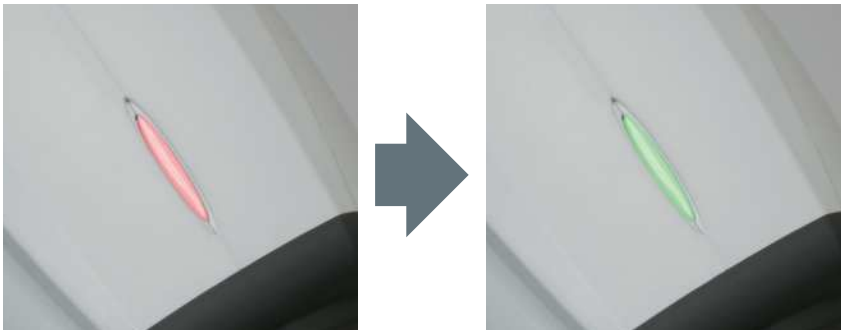


LED irradiator built-in to shine the discharging points

One-touch exchangeable CR unit

Easily exchangeable gun head

More light and comfortable handling



LED irradiator to visualize the discharge
(Change the color from red to green upon the discharge)

"Infra-red Remote Controller" standard attached to realize the setting remotely from the generator

- Start/Stop
- Polarity change
- Voltage Up / Down
- Air/Contact discharge change
- Gun trigger function
  Count reset
  Sequence change
  F key assignment
  etc.

Most of the operation can be controlled by the remote controller.

ESS-S3011A & GT-30RA

ISO 10605 standard compliant discharge gun package available

Options for ISO 10605 Standard compliant test

Model	Name
12-00009A	Discharge tip (GT-30R series Spherical 30mm)
03-00072A	Gun head to GT-30R series for constant 2kΩ test
06-00074B	CR unit (150pF - 2kΩ) to GT-30R series
06-00076B	CR unit (330pF - 2kΩ) to GT-30R series
06-00075B	CR unit (330pF - 330Ω) to GT-30R series

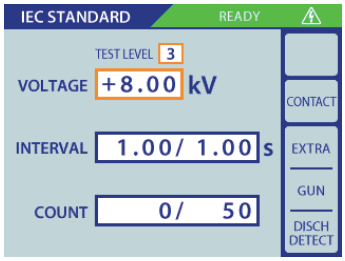
Gun head
for constant 2kΩ test

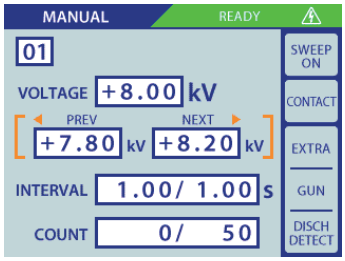
CR unit

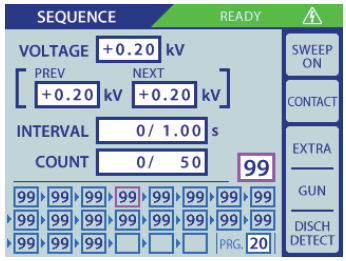
Discharge tip
(Spherical 30mm)

High visibility LCD panel and operatability

Reviewed the past operatability so that more easy and optimal operation can be realized.
In " 1 IEC STANDARD" in MAIN MENU, since the test levels are preset, the test parameters can be set easily only with selection of the test level. In " 2 MANUAL", voltage and number of times of the test can be selected and also the set conditions can be recorded. Sweeping discharges can be set as well. In " 3 SEQUENCE", the set conditions in MANUAL can be recalled for combining them so as to realize the arbitrary sequential tests. In addition, varied functions like setting for gun trigger, automated ESD eliminator, etc. are equipped.







Specification

Parameter	Specification
Polarity	Positive / Negative
Output voltage	0.20kV ～ 30.0kV±5% (30.5kVmax) ～10.0kV : 0.01kV step ～30.0kV : 0.1kV step
Repetition cycle	0.05s ～ 600s±10% / Manual Set step : 0.01s (0.05 ～ 9.99s), 0.10s (10.0 ～ 600.0s)
No. of time of discharge	1～60,000 times, Preset 1 time step or continuous preset
Discharge mode	Contact discharge / Air discharge
Radiation level mode	NORMAL mode / EXTRA mode
Trigger mode	Gun trigger / Main trigger / External trigger
Operation panel	Color LCD / Push-buttons (Partially lighting)
Gun holder	Standard attached (to hold the discharge gun Model GT-30RA)
Radiation mode select switch	Extra / Normal switching function built-in
Discharge detection	Discharge detection function in air-discharge equipped
Pre-checking function	Following 3 steps function equipped (by user operation. Not the calibration but just checking) SETP1 : High voltage output checking STEP2 : Withstanding voltage checking STEP3 : Discharge relay operation checking
CR & Gun head checking	CR constant and gun head recognizable (with an indicator to prevent the wrong combination)

Parameter	Specification
"IEC STANDARD" test mode	Contact discharge mode : 2.0kV, 4.0kV, 6.0kV and 8.0kV step Air discharge mode : 2.0kV, 4.0kV, 8.0kV and 15.0kV step
"MANUAL" test mode	Contact / Air discharge mode, Arbitrary setting during 0.2kV～30.0kV Sweeping function built-in, Recordable up to 99 units
"SEQUENCE" test mode	Enables to operate units set in MANUAL mode continuously. Max. 22 steps / 1 program and the programs recordable up to 20.
Warning lamp	Lighting at voltage output from the generator. Blinking at electro-static discharging
Charge capacitor / resistor	150pF±10%, 330Ω±10%(Built-in CR unit for discharge gun GT-30RA)
Charge resistor in generator	10MΩ(Totally 53Ω in combination with 43MΩ in discharge gun)*
AUX connector	D-SUB 15pins female connector (for connecting to patolight, automated ESD eliminator, external interlock input, external trigger input terminal)
Optical communication	Optical connector (serial interface) for connecting to PC connector
Power supply / consumption	AC100V～AC240V 50Hz / 60Hz ±10% 75VA
Dimensions	Generator : (W)392mm X (H)312mm X (D)295.3mm (gun holder included) Discharge gun : (W)83.3mm X (H)217.2mm X (D)229.3mm
Weight	Generator : approx. 7.5kg Discharge gun : approx. 800 g (cable and connector excluded)

* The constant depends on combination with CR unit for the discharge gun

ESD Simulator

ESS-B3011A & GT-30RA

Cost-oriented Basic models

Cost-oriented basic model ESD Simulator the light Weight discharge gun attachable.
The output voltage can be selected max. 30kV.
And compliant to both EN/IEC61000-4-2 Standard and ISO10605 Standard.

- **"Pre-checking function" taking the confirmable test into the account**
- **"CR constant checking function" (No indicator) to make the correct unit attachment sure"**
- **"Discharge Detecting Function" to realize the air-discharge confirmation.**
- **"Lightest Discharge Gun in the market" to lighten the continual operation"**
- **"White LED Irradiator" to facilitate the visualization of the discharging area.**
- **One-touch exchange of gun head and CR unit realized**

*** ISO 10605 compliant test performable with addition of the gun head and CR units (only with ESS-B3011A)**

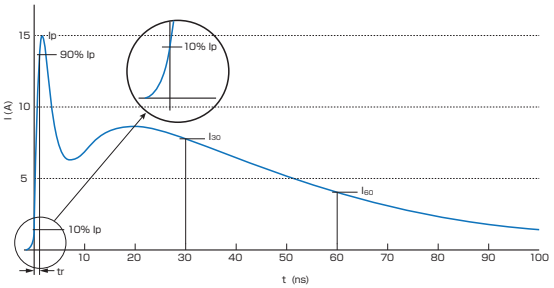
*Probe stand for the discharge gun is option.

Specification

Parameter	Specification
Modell	ESS-B3011A
Output voltage	0.20kV～30.0kV±5%(30.5kVmax)
Polarity	Positive / Negative
Repetition cycle	0.05s～9.99s±10%, 0.01s step / Manual
No. of time of discharge	1～999 times, Preset 1 time step or continuous preset
Discharge mode	Contact discharge / Air discharge
Trigger mode	Gun trigger / Main trigger
Operation panel	Indicator : 5X7 Dot matrix LED / Operation : Push buttons (Partially lighting)
Radiation mode select switch	Extra / Normal switching function built-in
Discharge detection	Discharge detection function in air-discharge equipped.
Pre-checking function	High voltage output checking function (by user operation. Not the calibration but just checking)
CR & Gun head checking	CR constant and gun head recognizable (to prevent the wrong combination without indicator)
IEC LEVEL Switching function	Contact discharge mode : 2.0kV, 4.0kV, 6.0kV and 8.0kV step Air discharge mode : 2.0kV, 4.0kV, 8.0kV and 15.0kV step
Warning lamp	Lighting at voltage output from the generator. Blinking at electro-static discharging
Charge capacitor / resistor	150pF±10%, 330Ω±10% (Built-in CR unit for discharge gun GT-30RA)
Charge resistor in generator	10MΩ (Totally 53Ω in combination with 43MΩ in discharge gun)*
Power supply / consumption	AC100V～AC240V ±10% 50Hz / 60Hz 62VA
Dimensions	Generator : (W)270mm X (H)263mm X (D)200mm Discharge gun : (W)83.3mm X (H)217.2mm X (D)229.3mm
Weight	Generator : Approx. 4.8kg Discharge gun : Approx. 800g (excluding cable and connector)

* Remote control function not built-in.
* The constant depends on combination with CR unit for the discharge gun

Discharge output waveform (IEC Standard)



Test environment (Table-top type / Floor-standing type)

ESS-801 / 801GL

Feature

ESD test environment in conformance with EN/IEC61000-4-2 Standard.
Two types for EUT are available, table-top type and floor-standing type so that the environments can support the tests along EUT figures. Since the table is made of wood, influence to the test result should be small (quantitable test result can be expected since the discharge can be realized in state high frequency electromagnetic field is less lost) and the high reproducibility can be expected and realized. Also, versatilely utilized for another tests like impulse noise immunity test, etc.

- **ESD test environments in conformance with EN/IEC61000-4-2 standard**
- **High reproducible tests can be performed**
- **Can be verstatilely utilized for another tests**

Test setup example with ESS-801
* Contents in the set referred to following specification

Specification

ESS-801 (Table-top type)

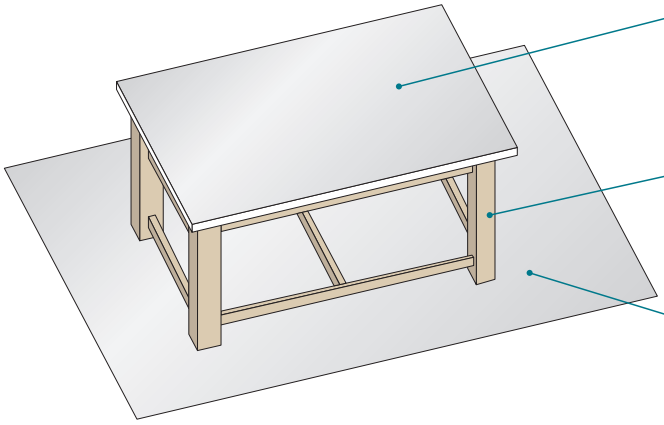
Item	Model	Dimensions	Q'ty
Test table	03-00039A	(W) 1600x(H)800x (D) 800mm	1 set
Vertical coupling plate	03-00005A	(W) 500x(H)500x (t) 1.5mm	1 set
Ground plane	03-00007A	(W) 1800x(D)1000x (t) 1.5mm	3 pcs.
Insulating sheet	03-00004A	(W) 1450x(D)650x (t) 0.5mm	1 pc.
Discharge resistance cable	05-00054B	2m cable equipped with 470kΩX 2 pcs.	2 pcs.
Horizontal coupling plate	03-00020A	(W) 1600x(D)800x (t) 1.5mm	1 pc.

ESS-801GL (Floor-standing type)

Item	Model	Dimensions	Q'ty
Insulating support	03-00024A	(W) 1200x(H)1200x (t) 100mm	1 pc.
Floor-standing vertical coupling plate	03-00034A	(W) 540x(H)1540x (D) 500mm	1 pc.
Ground plane	03-00007A	(W) 1800x(H)1000x (t) 1.5mm	3 pcs.
Discharge resistance cable	05-00054B	2m cable equipped with 470kΩX 2 pcs	1 pc.

Vertical coupling plate for ESS-801GL

■Option



Horizontal Coupling Plate (HCP) MODEL : 03-00020A

Metal plate to be placed onto the table in case of the testing to table top devices.
W1600 × D800 × t1.5mm × 1 pc.(Made of aluminum)

Test Table MODEL : 03-00039A

Wooden table to be used for the test to devices under test (DUT).
W1600 × H800 × D800mm

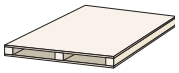
Ground Reference Plane (GRP) MODEL : 03-00007A

Ground plane to be placed just under the wooden table.
W1800 × D1000 × t1.5mm × 3 pcs. in 1 set (Made of aluminum)

Discharge resistance cable MODEL : 05-00054B

Cable to be used for eliminating the ESD on DUT and connect between HCP and GRP
470kΩ × 2 pcs./1 set.

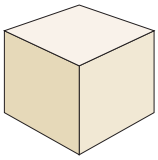
Insulating support MODEL : 03-00024A



When doing the electrostatic discharge test to floor-standing equipment, to be used for floating the equipment 10cm higher than the ground reference plane.
Size : W 1200 × D 1200 × H 100mm
Material : Wooden
Withstanding loads : 500kg

Option

Cubic Insulating Block100 MODEL : 03-00029A



Used for floating EUT 10cm upper than the ground plane in case of testing to floor-standing EUT
Size : W100 × D100 × H100mm
Material : Wood
Withstanding loads: 500kg

Automated ESD Eliminator MODEL : 01-00013B

Enable to eliminate electric charge which has been charged to EUT automatically with connection to ESS-S3011A

●Available model : ESS-S3011A

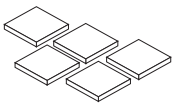
Probe Stand MODEL : 03-00108A

A probe stand used to fix the discharge gun for ESD Simulator. (Excluded from IEC standard) Because of the articulated type, the discharge gun fixes in any direction.

Item	Specification
Dimensions	(H)380mm, Pedestal diameter 160mm
Weight	approx. 4.1 kg
Range of movement	Vertical: 150mm, Swing angle: 130 °

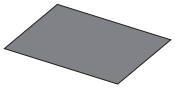
●Available discharge gun : GT-30R series

Insulating Block MODEL : 03-00054A



Blocks to float (isolate) wirings of DUT from GRP.
W300 × D300 × H50mm, 5 pcs. in 1 set

Conductive Mat (for ISO Standard) MODEL : 03-00055A



Mat to be laid out in between DUT and GRP for the ESD susceptibility test in the packaging and handling.
Surface resistance 10^7 $10^9\Omega$
W1000 × D500 × t2mm

ESD Elimination Brush MODEL : 05-00125A

Brush to eliminate the electrification on EUT / DUT before starting the test.

Conversion Adaptor for Probe Stand MODEL : 03-00074A

Adaptor for connecting between probe stand PS-806 or 03-00022B and discharge gun GT-30R series.

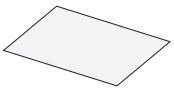
●Available discharge gun : GT-30R series

Free Arm Gun Stand MODEL : 03-00022B

Enable to move discharge gun vertically and horizontally to arbitrary desirable discharging point.
(Out of ISO Standard)

●Corresponding discharge gun : GT-30R series
* Conversion adaptor model 03-00074A is necessary in addition for the attachment to GT-30R series

Insulating Support MODEL : 03-00066A



Sheet to be laid out in between DUT and GRP for the test to automotive electronics devices.
W1450 × D650 × t2mm

Aluminum Plate for Test MODEL : 03-00053A

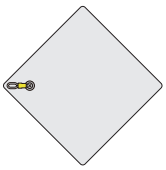
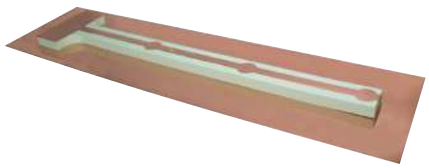


Plate to be laid out under tires for the vehicle test
W500 × D500 × t1.5mm

Ground Cable (for ISO Standard) MODEL : 05-00104A

Cable to be used for grounding connection required in ISO 10605 (2001). L2000 × W50mm
* Not required in ISO 10605 Ed.2 (2008)

Coupling Plate for ISO 10605 Annex F MODEL : 03-00065A



Coupling plate used for the optional test in ISO 10605 Ed.2 (2008). It consists of a coupling plate (made of copper) and an insulation block.
* Ground reference plane is not included.

Option

CR Unit M

CR unit for ESD gun GT-30R series

●Available discharge gun : GT-30R series

*** Please contact us when the other CR constant is required than the right description.**
*** The unit size depends on the capacitor constant.**

Model	CR constant
06-00073B	150pF-330Ω
06-00074B	150pF-2kΩ
06-00075B	330pF-330Ω
06-00076B	330pF-2kΩ
06-00077B	500pF-0Ω
06-00078B	150pF-500Ω
06-00079B	100pF-1.5kΩ
06-00080B	200pF-0Ω

Model	CR constant
06-00081B	150pF-150Ω
06-00082B	500pF-500Ω
06-00083B	500pF-5kΩ
06-00084B	250pF-100Ω
06-00085B	200pF-100Ω
06-00086B	250pF-0Ω

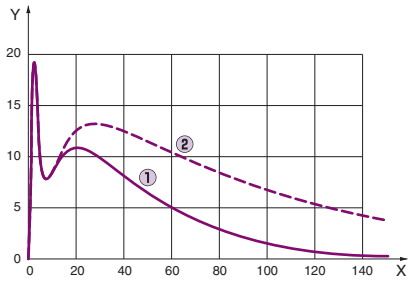
● For ISO10605 compliant test

●GT-30R3302KA package contents

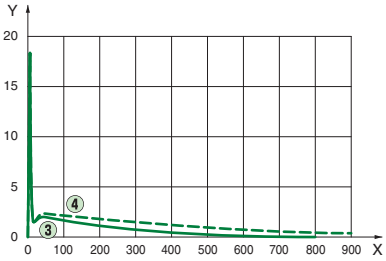
GT-30R series	gun body
03-00071A	gun head
03-00072A	gun head
06-00073B	150pF-330 ohm CR unit
06-00074B	150pF-2K ohm CR unit
06-00075B	330pF-330 ohm CR unit
06-00076B	330pF-2K ohm CR unit
12-00007A	conical tip
12-00008A	round tip
12-00009A	spherical tip

2kΩ gun head

Spherical (φ30mm) discharge tip



Energy storage capacitor / Discharge resistor values		1st discharge peak current	t_1 Current	t_2 Current
150pF/330Ω	①	3.75A/kV±10%	2A/kV±30% (t_1=30ns)	1A/kV±30% (t_2=60ns)
330pF/330Ω	②	3.75A/kV±10%	2A/kV±30% (t_1=65ns)	1A/kV±30% (t_2=130ns)
Energy storage capacitor / Discharge resistor values		1st discharge peak current	t_1 Current	t_2 Current
150pF/2kΩ	③	3.75A/kV +30%-0%	0.275A/kV±30% (t_1=180ns)	0.15A/kV±50% (t_2=360ns)
330pF/2kΩ	④	3.75A/kV+30%-0%	0.275A/kV±30% (t_1=400ns)	0.15A/kV±50% (t_2=800ns)



Gun Head MODEL : 03-00071A / 03-00072A

Gun head to be changed according to Standard compliant test. 2 kinds for the test with 330Ω(03-00071A) and 2kΩ (03-00072) are lined up.

●Available discharge gun : GT-30R series

Fast Rise Time Adaptor MODEL : 03-00073A

Fast Rise Time Adaptor MODEL : 03-00073A
Realize faster rise time of the discharge current than IEC61000-4-2 standard value (0.6-1.0ns) around 0.2-0.3ns with attachment to the discharge gun.

●Available discharge gun : GT-30R series

Discharge Tip MODEL : 12-00007A / 8A / 9A

Discharge tips on the gun.
Conical (12-00007A) and Round (12-00008A) are standard equipped with GT-30R series.
The all 3 tips are standard equipped with GT-30R series.

●Available discharge gun : GT-30R series

Impulsive Electric Field Adoptor MODEL : 03-00068A

Adaptor for simulating static induction as one of noise inductive mode.with attachment to the discharge gun (Not standardized in IEC)

●Available discharge gun : GT-30R series

Option

Impulsive Magnetic Field Adaptor MODEL : 03-00069A

Adaptor for simulating electro-magnetic induction as one of noise inductive mode.with attach-ment to the discharge gun (Not standardized in IEC)

- Available discharge gun : GT-30R series

Magnetic Field Adapter MODEL : 03-00070A

Magnetic field adapter for Ford standard.
Connected to GT-30R series discharge gun, it generates transient magnetic fields.

- Available discharge gun : GT-30R series

Item	Specification
Loop coil diameter	155m
Dimensions	168mm(loop outer diameter) 300mm(length) 12.7mm(thickness of the loop)

Extension cable for GT-30R MODEL : 05-00047B

Extension cable in connection between ESD simulator main unit and its discharge gun. The length is 3m
* not compliant with the IEC standard

- Available discharge gun :GT-30R series

Gun Holder MODEL : 03-00075A

Holder for discharge gun during the test.
Also, can be the pre-checking fixture in combina-tion between ESS-S3011A and GT-30R series.

- Available discharge gun : GT-30R series

Specialized Case for Discharge Gun MODEL : 09-00006A

Specialized Case for putting the discharge gun, CR units and the other related fixtures and carrying them out.

- Available discharge gun : GT-30R series

Warning Lamp MODEL : 11-00014A

Caution is alerted with its blinking while the HV circuit is on.

- Available model : ESS-S3011A

* The connection is done with DSUB connector.

AUX Connector Junction Box MODEL : 05-00052A

Enable to connect warning lamp, automated ESD eliminator and external trigger simultaneously

- Available model : ESS-S3011A

Optical USB Module MODEL : 07-00022A

Optical conversion adaptor Used for remote control with PC. 5m of optical fiber cable with USB interface attached.

- Available model : ESS-S3011A

Optical RS232 Module MODEL : 07-00017A

Optical conversion adaptor used for remote control with PC.
5m of optical fiber cable with RS232 interface attached.

- Available model : ESS-S3011A

Option

Faraday cage MODEL : FC-200

Farady cage which is defined in IIEC61000-4-2 Standard and ISO 10605 Ed.2 Standard
to verify the discharge current waveform. Easy to move with casters equipped to the bottom.

Item	Specification
Power supply	AC100V 50Hz/60Hz 3P inlet Equipped with over-current protective breaker
Opening Dimensions on door	(W) 410mm X (H) 618mm
Dimensions / Weight	(W)670mm x (H)1612mm x (D) 1509mm Approx. 65kg. 3p outlet X 2 15A MAX

Load Resistor Mounting Board MODEL : 03-00052B

The board to fix the load resistor (MODEL NO. 06-00067A ESD current target) for measuring the discharge current waveform defined in IEC61000-4-2 Standard and ISO 10605 Ed.2 Standard
Dimensions : 1.2m X 1.2m

Coaxial Cable MODEL : 02-00132A

High frequency responsible cable to connect ESD target And oscilloscope
BNC-SMA connector (02-00133A) is also available as an option

GND Cable Positioner MODEL : 03-00060A

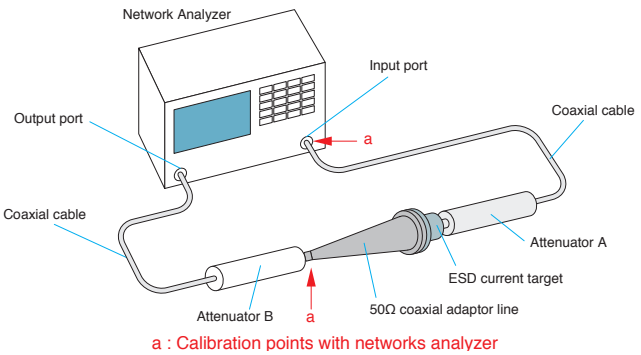
Stand to pull and fix the ground cable of discharge gun 0.5m backward at the middle of the cable when calibrating the ESD current.

ESD Current Target Calibration Set MODEL : 06-00068A

Set to calibrate the ESD target (06-00067A) in conformance with IEC61000-4-2 Ed.2.0 (2008).

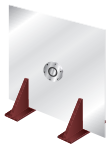
Adaptor (06-00068A)

A photo of 06-00067A ESD target and 06-00068A adaptor connected faced to face



a : Calibration points with networks analyzer

Load Resistor Mounting Board MODEL : 03-00027A



The board to fix the load resistor (MODEL NO. 06-00067A ESD current target) for measuring the discharge current waveform defined in IEC61000-4-2 Standard and ISO 10605 Ed.2 Standard. (not conforming to the standard strictly but simply)
Dimensions : 0.6m X 0.6m

ESD Current Target MODEL : 06-00067A

Load resistor to measure, verify and calibrate ESD current waveform defined in IEC61000-4-2 Standard and ISO 10605 Ed.2 Standard

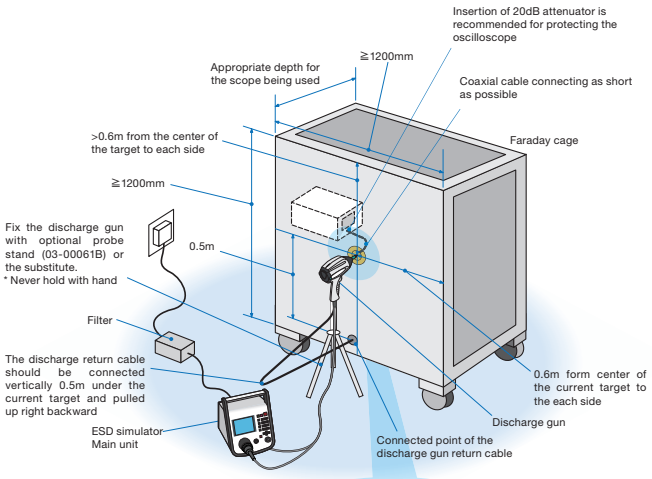
Parameter	Specification
300kHz-1GHz	±0.5dB
1GHz-4GHz	±1.2dB
Maximum applied voltage	15kV
Conversion ratio	2V/1A (50Ω termination)
Weight	Approx. 400g

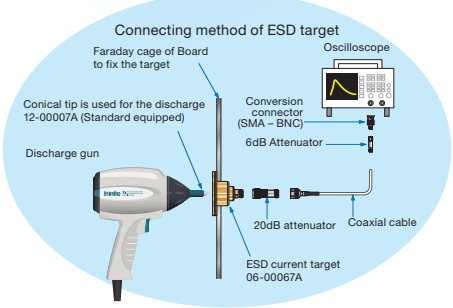
Discharge Gun Mount MODEL : 03-00061B

Fixture to load and fix the discharge gun to be Farady cage (FC-200) or load resistor mounting board (03-00052B)

Attenuator MODEL : 00-00010A / 00-00011A

Attenuator to protect measurement equipment for ESD current waveform.
00-00010A : Attenuation ratio 6dB / SMA connector
00-00011A : Attenuation ratio 20dB / N connector





Option

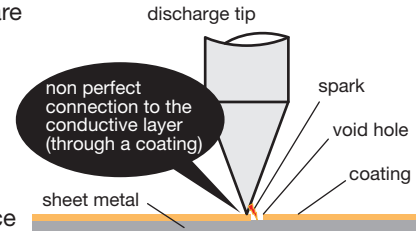
Micro-gap Discharge Tip **MODEL : 12-00010A**

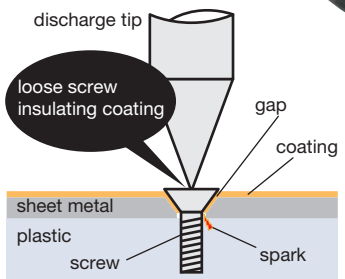
Enabling a more stringent evaluation for the real world ESD immunity

dedicated cup
Model : 03-00103A

Connected to the NoiseKen ESD gun, this tip allows for a waveform with higher peak amplitude and a faster rise time. It is a common view that ESD immunity testing is the most challenging and passing the standard test does not always assure real world immunity. This tip is helpful for more extensive testing against non-standard-ized field events

- Events you can simulate are
  - Loose screws
  - Poor insulation coating
  - Poor electrical connection between components and others which cause secondary discharges within a very close distance

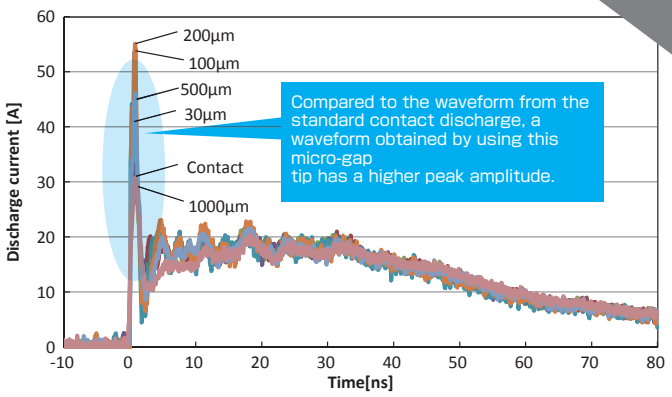




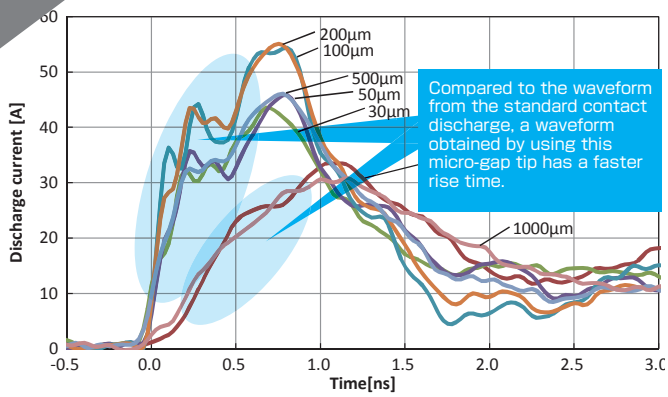
enlarged photo
of the micro-gap

Simulated field events

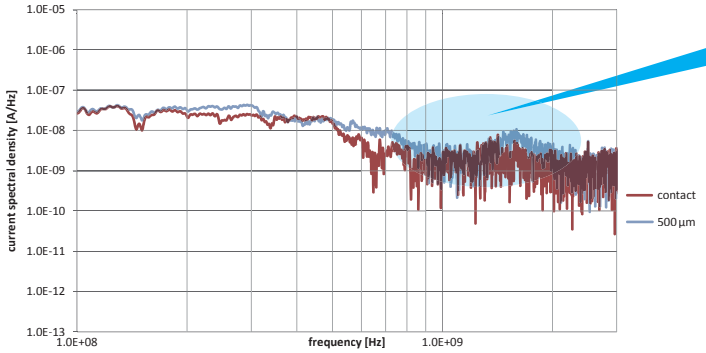
■ Output waveform (reference)



entire waveform

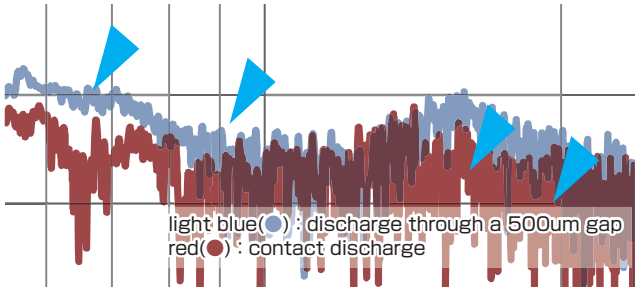


waveform leading edge



discharge current energy spectral density

Compared to the contact discharge, discharge through a micro-gap contains a higher level of noises over the higher side of the spectrum



Testing with energy rich pulses for the GHz region

■ Compatible discharge gun

TC-815S, 815R, 815ISO, 815-330, 815-2K, 815S-330, GT-30Rseries (the dedicated cup 03-00103A required)

*This product cannot be used for the air discharge testing

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

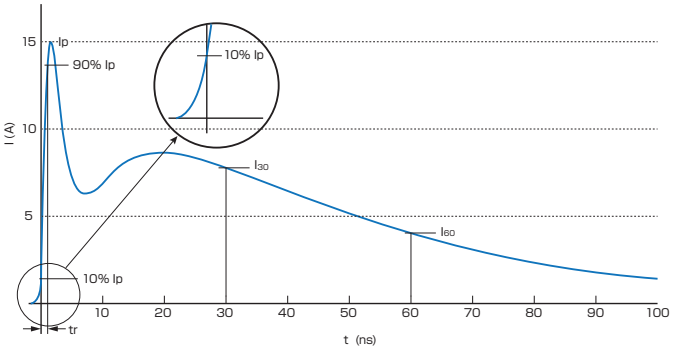
*** X can be any level determined by consent between the EUT manuracturer and the simulator supplier**

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

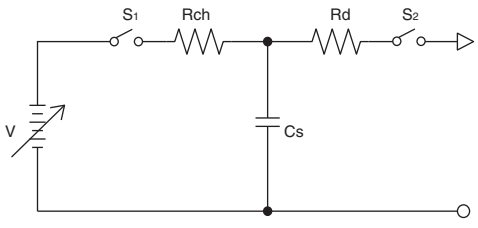


Discharge current waveform and its characteristics

Generator characteristics

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

Level	Indicated voltage	1st peak current of discharge (±15%) Ip	Rise time (±25%)	Current (±30%) at 30ns	Current (±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



Capacitance Cs : 150pF
Discharge resistance Rd : 330

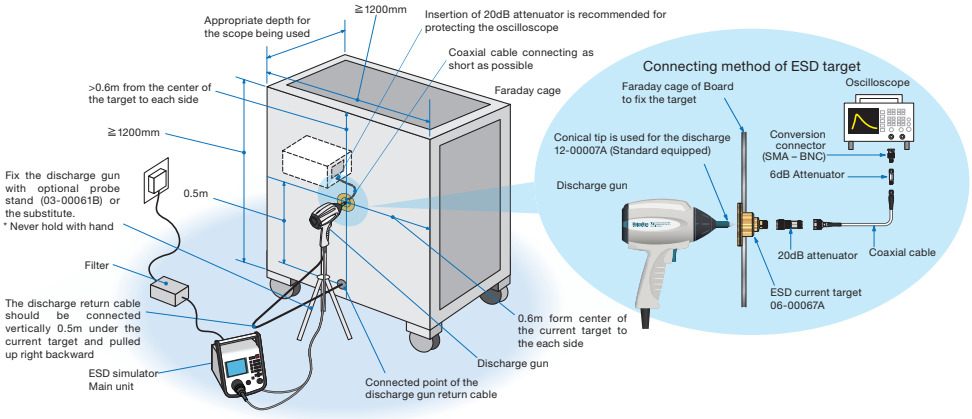
Simplified diagram of the ESD generator

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.

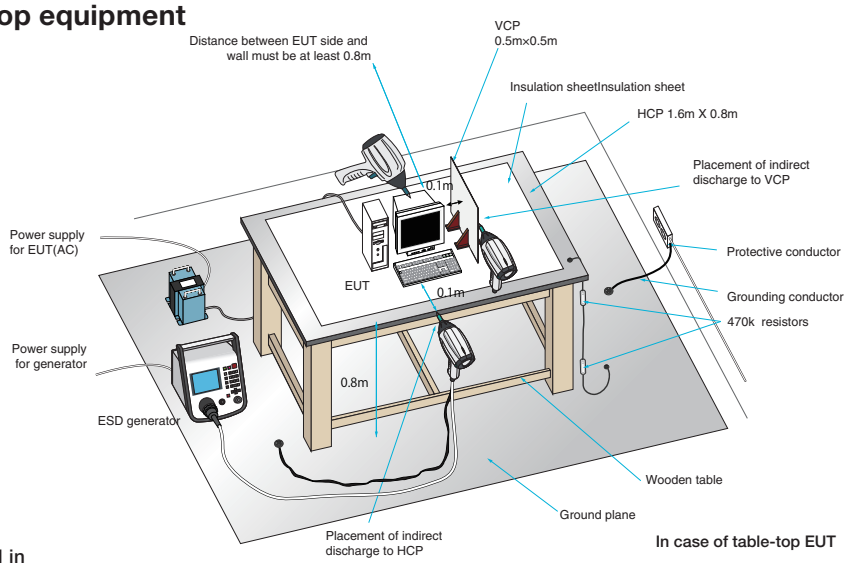


4. Test setup

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.



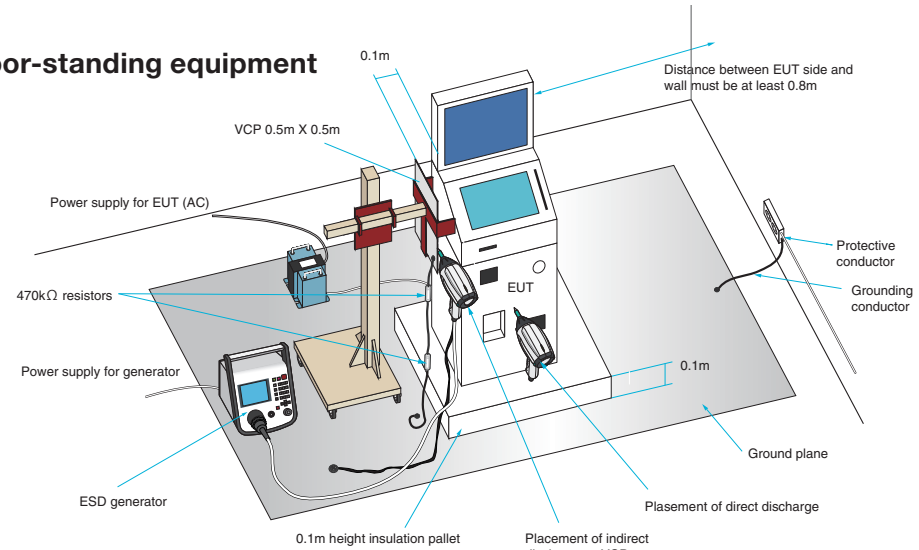
In case of table-top EUT

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.



In case of floor-standing EUT

床置き機器の場合

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	15ºC to 35ºC
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 standardsed.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)

	Direct contact discharge			Direct air discharge.		
Test severity level	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)

	Direct contact discharge		
Test severity level	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)

	Contacts discharge			Air discharge		
Test severity level	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)

	Contacts discharge			Air discharge		
Test severity level	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.

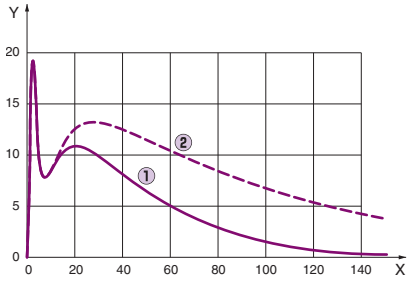
Parameter	Specification
Output voltage . Contact discharge-(kV)	2kV 15kV
Output voltages - Air discharge-(kV)	2kV 25kV
Output voltages accuracy (%)	≦5%
Polarity	Positive and negative
Rise time of short circuit current in contact discharge mode(10 % to 90 %)	0.7ns 1ns
Holding time	≧5s
Storage capacitances(pF)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

Testing Summary according to ISO 10605 Ed.2 Standard

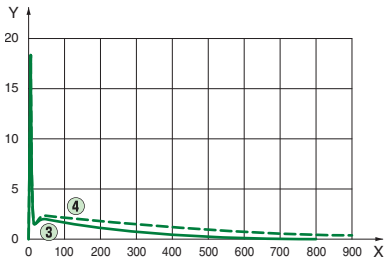
Contact discharge mode current specifications

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)



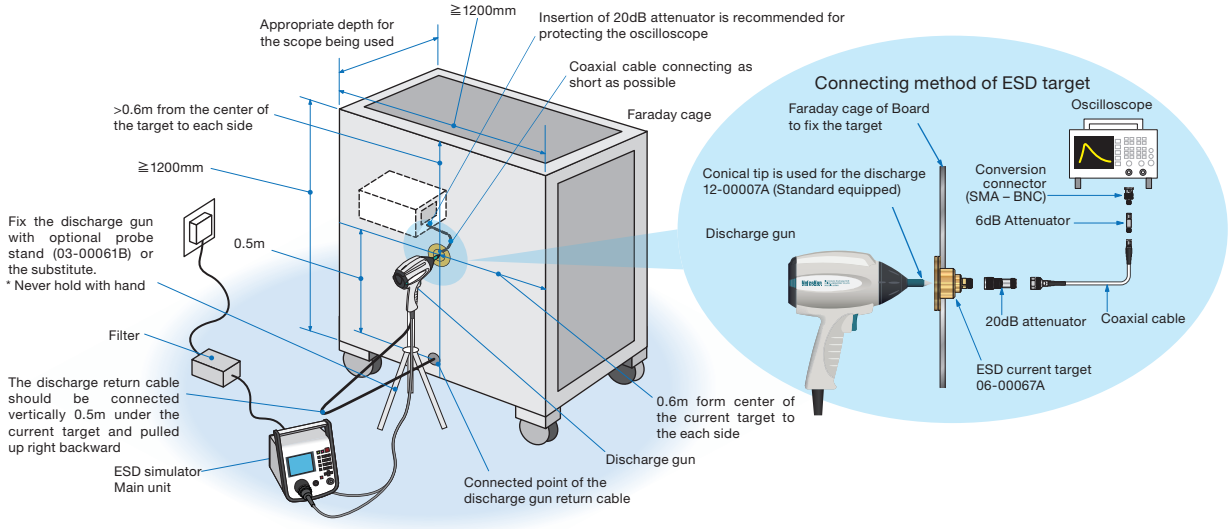
Discharge resistance 330 Ω (at 5kV)



Discharge resistance 330 Ω (at 5kV)

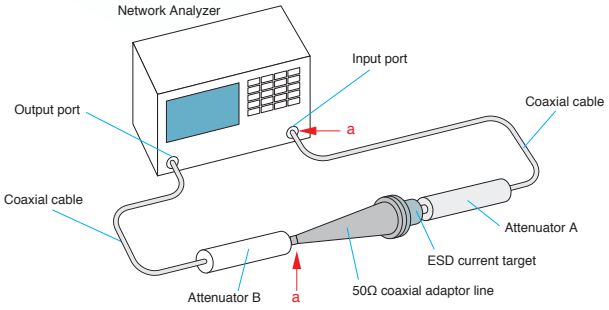
Verification of output current waveform

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


Adaptor for calibrating ESD current target
(Model:06-00068A)



a : Calibration points with networks analyzer

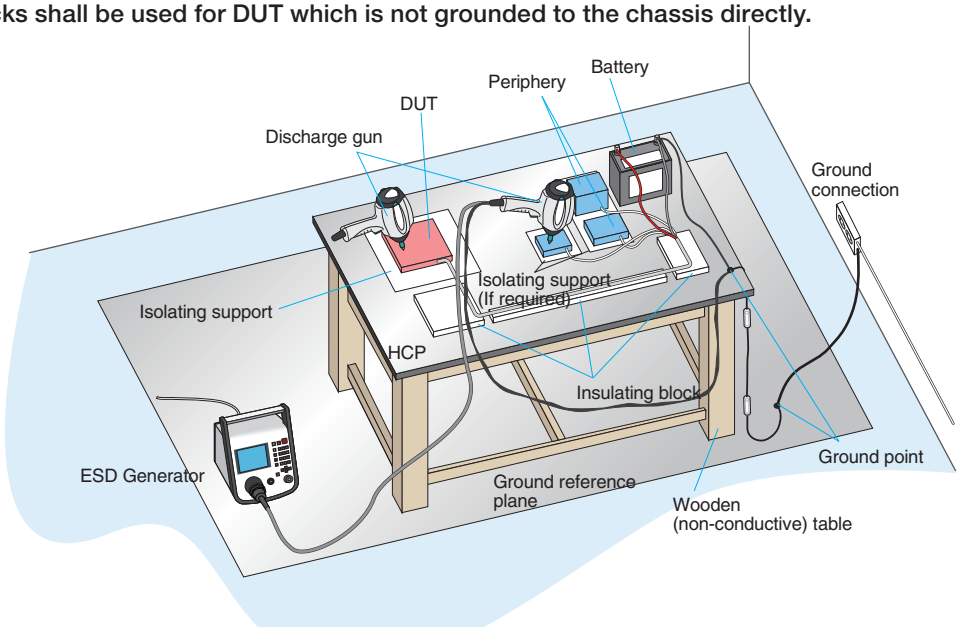

Figure of attaching ESD current target and the calibration adaptor
(Left : Target Right : Adaptor)

Testing Summary according to ISO 10605 Ed.2 Standard

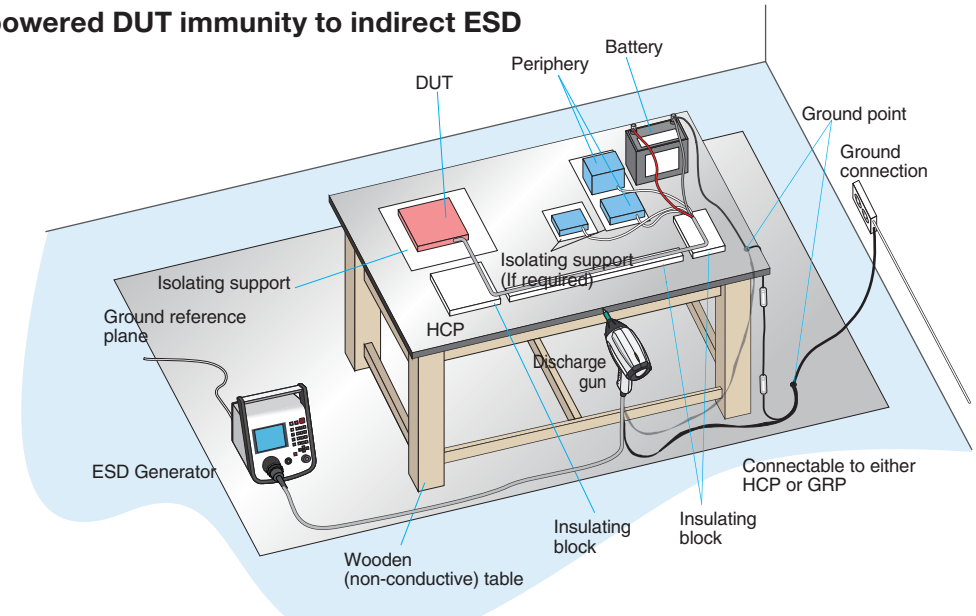
4. Test setup and test procedure

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.



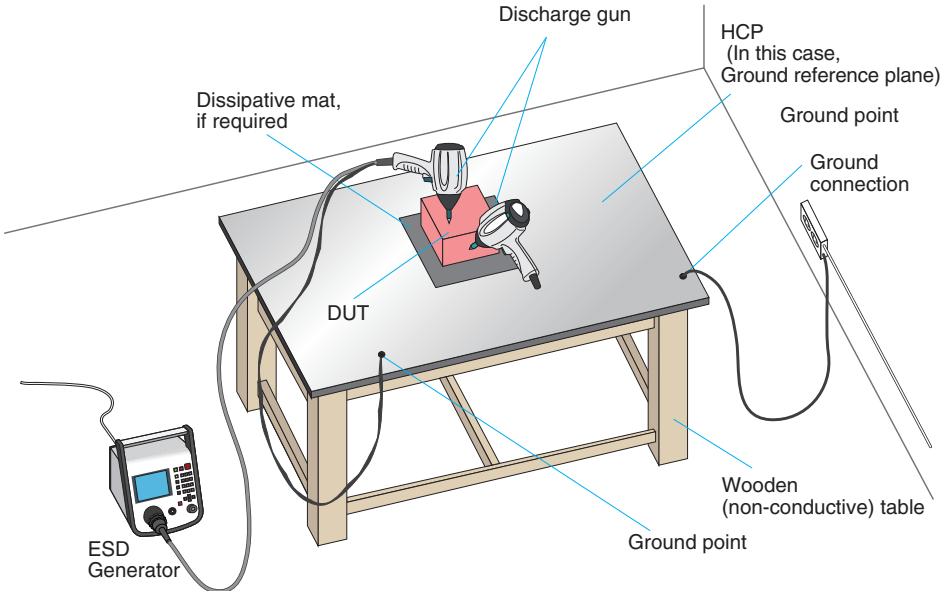
For testing powered DUT immunity to indirect ESD



Testing Summary according to ISO 10605 Ed.2 Standard

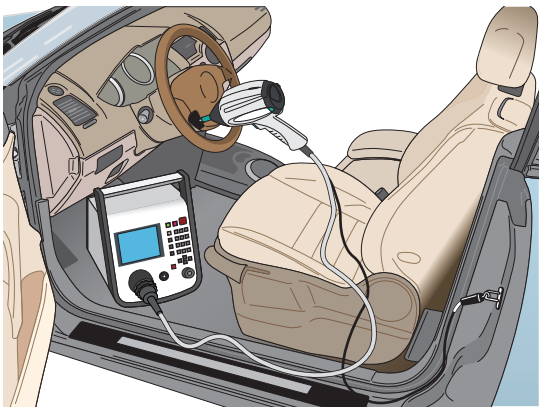
For testing (unpowered) packaging and handling ESD sensitivity

- 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 (2kΩ) and it may be accessible by a metal object a human hold (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.
- 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 (>1MΩ) after the discharge and the DUT shall be turned on. Afterwards, normal operation of it shall be confirmed.

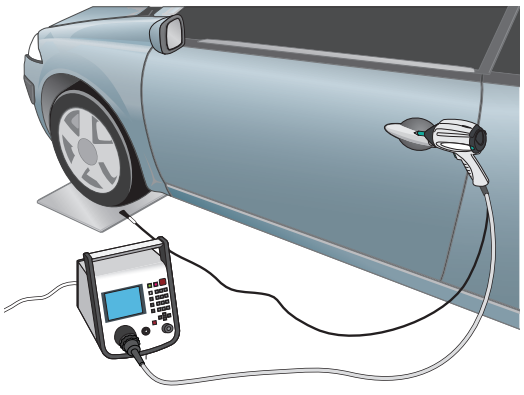


Vehicle test – Internal and external points

- Choose a generator capacitance of 330pF for areas that can easily be accessed only from the inside of the vehicle and resistance of 330Ω or 2 kΩ
- Choose a capacitance of 150 pF for points that can easily be touched only from the outside of the vehicle and resistance of 330Ω or 2 kΩ.
- 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.



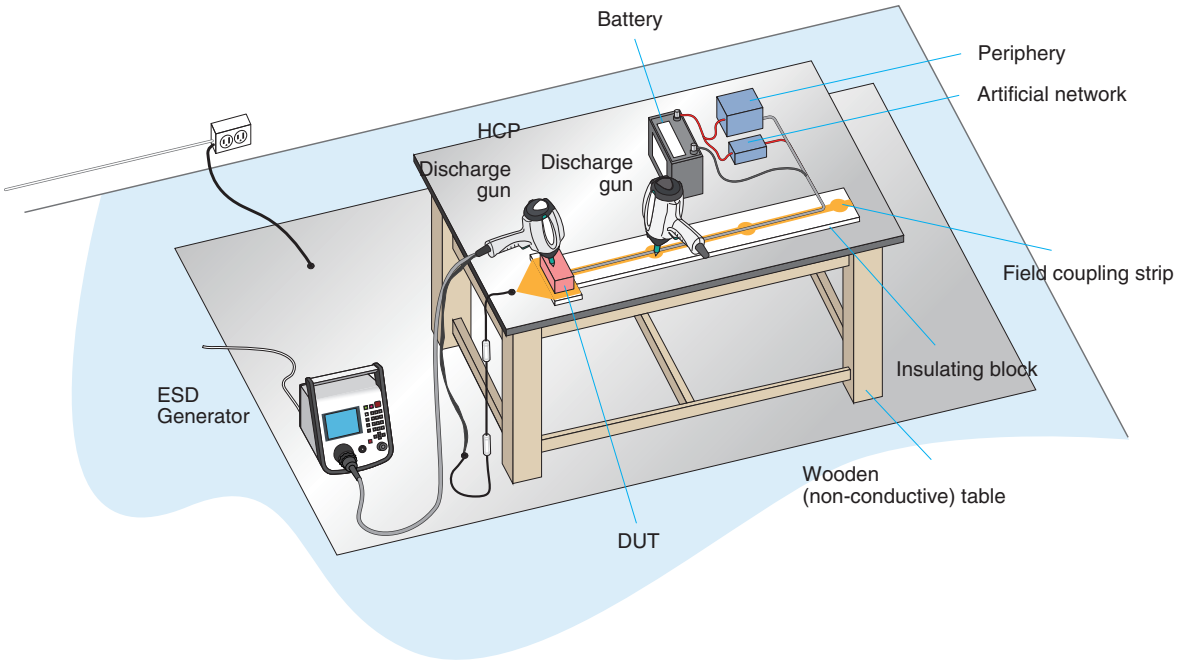
Internal test



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.

NoiseKen
NOISE LABORATORY

NOISE LABORATORY CO.,LTD **http://www.noiseken.com**

International Sales & Marketing Section
1-4-4 Chiyoda, Chuo-ku, Sagamihara City, Kanagawa Pref. 252-0237 Japan
TEL: +81-(0)42-712-2051 FAX: +81-(0)42-712-2050
E-mail : sales@noiseken.com

Authorized representative

2020-3K