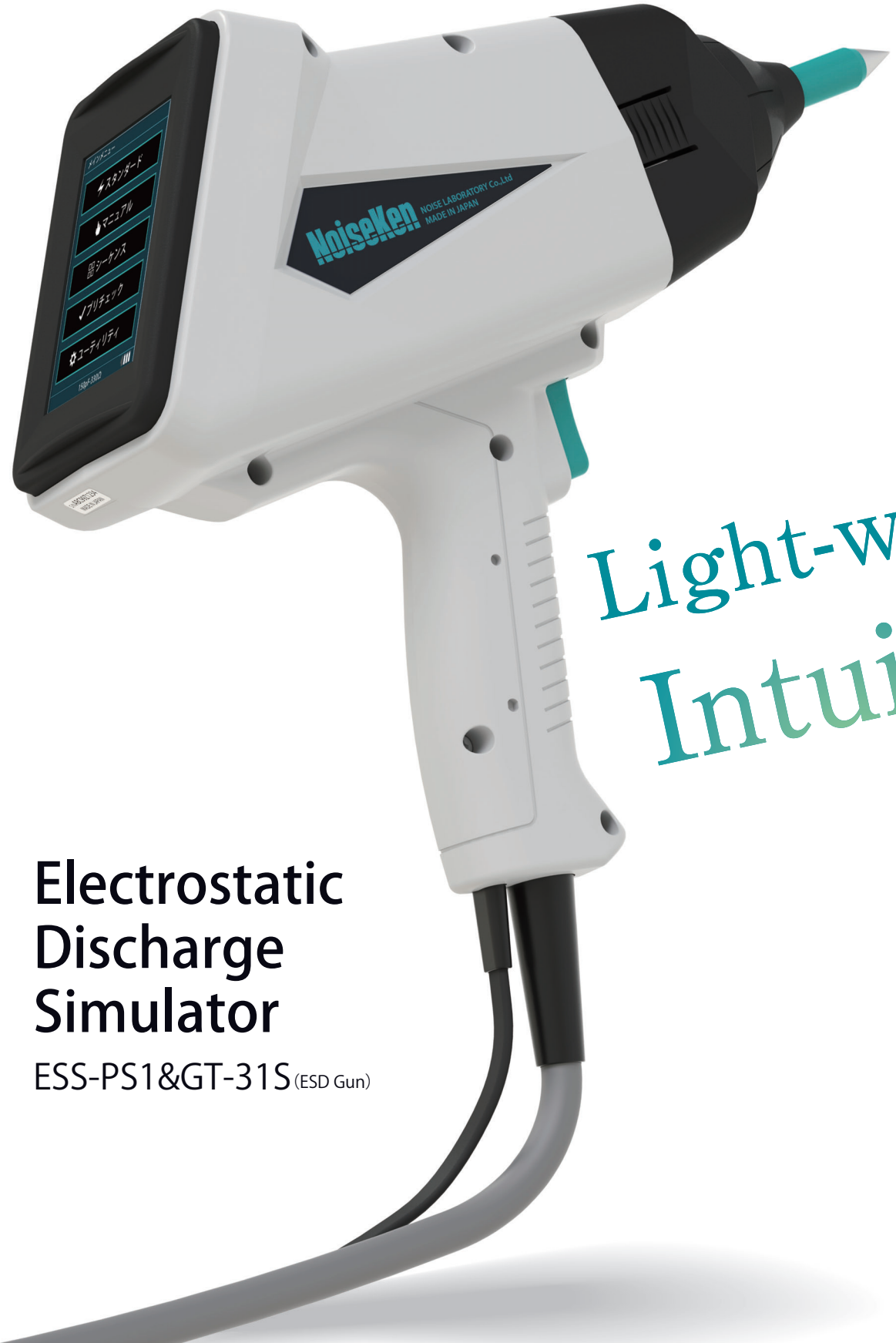
NoiseKen

www.noiseken.com




Light-weight

Intuitive

# Electrostatic Discharge Simulator

ESS-PS1&GT-31S (ESD Gun)

Electrostatic Discharge Simulator

# ESS-PS1 & GT-31S

## Make electrostatic discharge testing easier !

Electrostatic discharges caused by a charged human body approaching an electronic device's operation panel, button switches, or enclosure generate high-voltage, high-frequency noise that can cause electronic devices to malfunction. Electrostatic discharge simulator is used to simulate such electrostatic discharge phenomena and evaluate the resistance of electronic equipment to electrostatic discharge.

IEC 61000-4-2 / ISO 10605
Standards compliant testing

### Touch panel on discharge gun
### Intuitive operation menu

Easy-to-understand intuitive design. The display language can be switched between English and Japanese, and in "Standard Mode," test conditions for IEC and ISO standards can be easily set.


Manual mode "allows free setting of test voltage, application frequency, etc.


Sequence test mode - load the saved test conditions in sequence and combine for automatic testing

**Big screen**
**25% bigger**
**than other ESD Guns**


**Light-weight**
**13% lighter**
**than other ESD Guns**

### The main unit is battery powered
### Convenient to carry!

Superior portability makes it effective for testing mobility equipment, large medical equipment, office equipment, etc.

**Light-weight**
**51% lighter**
**than other ESD Guns**

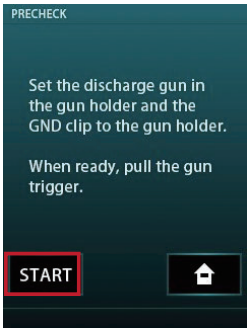
ESS-PS1 & GT-31S

# More reliable and secure testing!

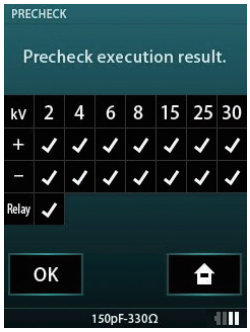
NoiseKen Original Function

When performing electrostatic discharge testing, do you ever feel unsure as to whether the test is being carried out correctly? With the three pre-check functions (high voltage power supply output check / insulation failure check / discharge relay operation check) provided in our simulator, such concerns can be eliminated. Before starting a test, the simulator can easily check for any abnormalities, making the test more reliable and secure.

Set the discharge gun in the gun holder




Start the Pre-Check

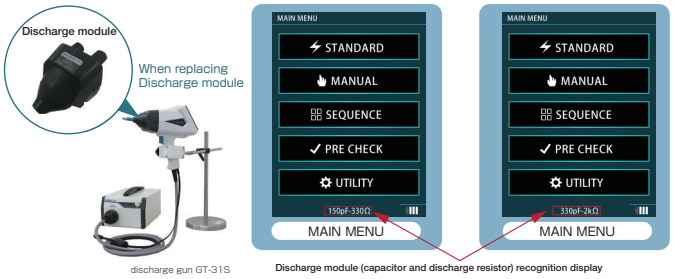



Pre-Check Complete

## Eliminate mis-attachment

### Equipped with discharge module identification function

Equipped with an automatic recognition function to identify the type of discharge module installed in the discharge gun. Automatic recognition of installed discharge modules reduces installation errors.




| Discharge Module | Display | Operational restriction |
|---|---|---|
| Not attached | Not attached | START is not possible |
| 150pF-330Ω | 150pF-330Ω | None |
| 330pF-330Ω | 330pF-330Ω | None |
| 150pF-2kΩ | 150pF-2kΩ | None |
| 330pF-2kΩ | 330pF-2kΩ | None |
| C value disregarded-0 Ω | 0Ω | None |
| Others (30kV enabled unit) | Other | None |
| Other (20kV MAX unit) | Other (20kV MAX) | MAX 20 kV |

## Features

- Complies with IEC 61000-4-2 / ISO 10605 standards.
- The discharge gun is equipped with a touch panel for improved operability.
- Battery operation improves portability and makes testing of large equipment more convenient.
- Equipped with a pre-check function (pre-start inspection) to ensure testing is carried out properly.
- Uses a discharge module in which the discharge cup and CR unit are integrated.
- Equipped with automatic discharge module recognition function helping to reduce mis-attachment.
- Equipped with a discharge detection function that notifies the user of discharge detection.
  *Air discharge mode only.
- Remote control from PC via optical communication is also possible.
  * Please consult with our sales representative.

The ISO 10605 test can be performed by using the accessory set for GT-31S (MODEL: GT-ISOSET-A).

# ESS-PS1 & GT-31S

## Specifications

### Main Unit ESS-PS1

| Parameter | Specification |
|---|---|
| Output voltage | 0.20kV - 30.0kV (30.5kV max), 0.20kV - 10.00kV: 0.01kV step setting, 10.0kV - 30.0kV: 0.1kV step setting |
| Output polarity | Positive/Negative |
| Repetition cycle | 0.05s - 600.0s±10%, 0.05s - 9.99s: 0.01s step setting, 10.0s - 600.0s: 0.1s step setting |
| Discharge number of times | 1 - 60000 times, 1 time step setting, or continuous |
| Discharge mode | Contact discharge, air discharge |
| Test mode | IEC test mode - Contact discharge: 2.0kV, 4.0kV, 6.0kV, 8.0kV Air discharge: 2.0kV, 4.0kV, 8.0kV, 15.0kV |
| | ISO test mode - Test voltage: 2.0kV, 4.0kV, 6.0kV, 8.0kV, 15kV, 20kV, 25kV |
| | Manual test mode - Contact and air discharge mode 0.20kV - 30.5kV, Arbitrary setting,<br>Sweep function available. *99 test units memory |
| | Sequence test mode - Max. 6 steps per sequence program. *20 sequence programs memory |
| Trigger settings | Trigger switch or external trigger |
| Gun stand | Gun stand for the GT-31S discharge gun *included as standard equipment |
| Discharge detection | Detects discharges in air discharge mode |
| Pre-check function<br>(pre-start inspection) | Check 1: Check the output voltage of the built-in high-voltage power supply and the dielectric strength of the simulator<br>Check 2: High voltage output and dielectric strength check<br>Check 3: Discharge relay operation check |
| Discharge Module detection | Recognition and display of various discharge modules |
| AUX connector | D-SUB 15-pin female connector Connection of warning light (MODEL: 11-00014B) and automatic ESD Elimination probe (MODEL: 01-00013B) External trigger input and external interlock input |
| Optical Communication Connectors | PC-communication optical connector (serial interface) |
| Power Supply and Power Consumption | AC100V - 240V ±10%, 50Hz to 60Hz / Battery |
| Operating temperature | +15℃ -+35℃ |
| Operating humidity | 20%RH - 60%RH * No condensation |
| Dimensions | Main unit: (W)1800 x (D)270 x (H)124mm * Protrusions not included |
| Mass | Main unit: 3.0 kg *excluding AC adapter for charging |

### Discharge Gun GT-31S

| Parameter | Specification |
|---|---|
| Output voltage | 0.20kV - 30.5kV |
| Output polarity | Positive/Negative |
| Holding time | 5 seconds or more |
| Control panel | Color LCD touch panel (resistive film type) |
| Operating temperature | +15℃ -+35℃ |
| Operating humidity | 20%RH - 60%RH * No condensation |
| Dimensions | (W)90 x (D)236.2 x (H)246mm * Excluding discharge tip |
| Mass | 1.5 kg * including cables, excluding connectors |

### Battery

| Parameter | Specification |
|---|---|
| Battery type | Rechargeable lithium-ion battery |
| Rated voltage | DC 14.4V |
| Rated capacity | 3.40 Ah |
| Charging time<br>(reference value) | 3 hours (ambient temperature 25° C) |
| Continuous use time (reference value) | Approx. 7 hours *Depends on usage conditions |

### AC Adapter

| Parameter | Specification |
|---|---|
| Input Rating | AC100V ～ AC240V±10% 50Hz ～ 60Hz / 1.7A |
| Rated voltage | DC19.0V / 3.42A |
| Dimensions | (W)95 x (D)25.4 x (H)50mm * Cable and connector not included |
| Mass | 270g |

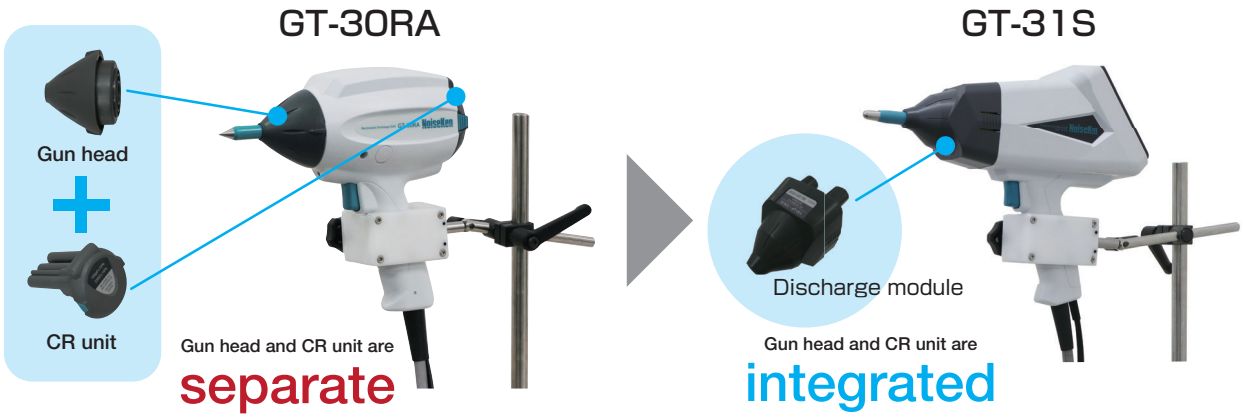
# Accessories

## Discharge module (CR for GT-31S)

**Conventional discharge guns had a CR unit and a discharge cup attached, but in the GT-31S discharge gun, the CR unit and the discharge cup are integrated in 1 piece as a discharge module.**
**By replacing the discharge module, testing to IEC 61000-4-2 and ISO 10605 standards is possible.**

| MODEL | Product Name | Constant | Remarks |
|---|---|---|---|
| 06-00100A | CR for GT-31S ( 150pF-330 ) | 150pF-330Ω | IEC 61000-4-2 Ed.2 & Ed.3<br>ISO 10605 Ed.2 & Ed.3 |
| 06-00101A | CR for GT-31S ( 150pF-2k ) | 150pF-2kΩ | ISO 10605 Ed.1/2/3 |
| 06-00102A | CR for GT-31S ( 330pF-330 ) | 330pF-330Ω | ISO 10605 Ed.2 & Ed.3 |
| 06-00103A | CR for GT-31S ( 330pF-2 ) | 330pF-2kΩ | ISO 10605 Ed.1/2/3 |
| 06-00104A | CR for 12-00010A and GT-31S (150pF-330) | 150pF-330Ω | CR for Micro-gap Discharge Tip 12-00010A |
| 06-00105A | CR for GT-31S ( 500pF-0 ) | 500pF-0Ω | |
| 06-00106A | CR for GT-31S ( 150pF-500 ) | 150pF-500Ω | |
| 06-00107A | CR for GT-31S ( 100pF-1.5k ) | 100pF-1.5kΩ | |
| 06-00108A | CR for GT-31S ( 200pF-0 ) | 200pF-0Ω | |
| 06-00109A | CR for GT-31S ( 150pF-150 ) | 150pF-150Ω | |
| 06-00115A | Fast Rise Time CR for GT-31S (150pF-330) | 150pF-330Ω | |
| 06-G1262 | CR for GT-31S ( 200pF-50Ω ) | 200pF-50Ω | Discharge module for wearable devices |

**06-00100A is included in the discharge gun GT-31S package**
**Please inquire separately for discharge modules (CR for GT-31S) other than the listed constants.**




# For ISO 10605 testing

**The ISO 10605 test can be conducted using the accessory set for the GT-31S.**

| MODEL | Product Name | Set Contents |
|---|---|---|
| GT-ISOSET-A | Accessory set for GT-31S | 06-00101A / 06-00102A / 06-00103A / 12-00009A Quantity: 1 each<br>12-00009A is a discharge tip (sphere type) |

ESS-PS1 & GT-31S


GT-ISOSET-A

Accessories

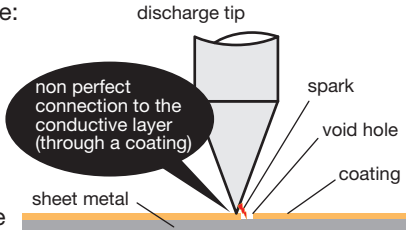
## Micro gap discharge tip MODEL: 12-00010A

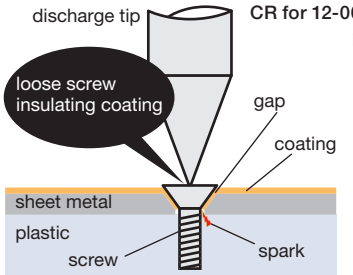
# Enabling a more stringent evaluation for the real world ESD immunity

CR for 12-00010A and GT-31(150pF-330Ω)
Model : 06-00104A

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-standardized 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

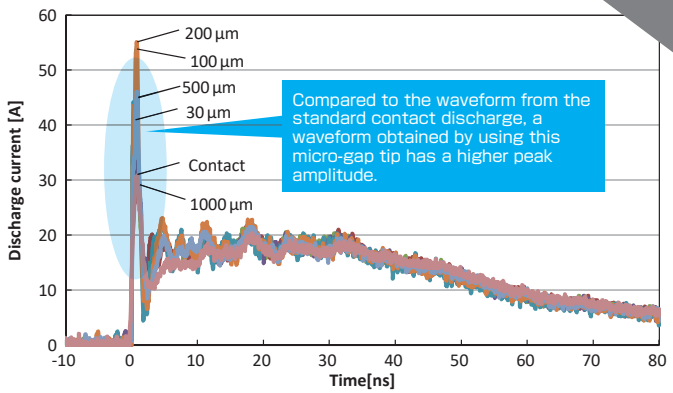


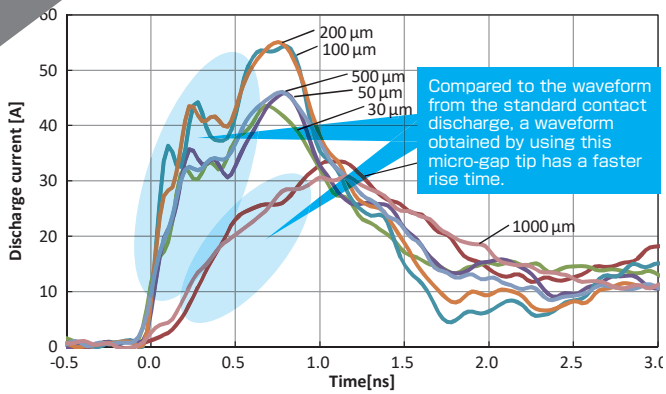

enlarged photo of the micro-gap

## Simulated field events

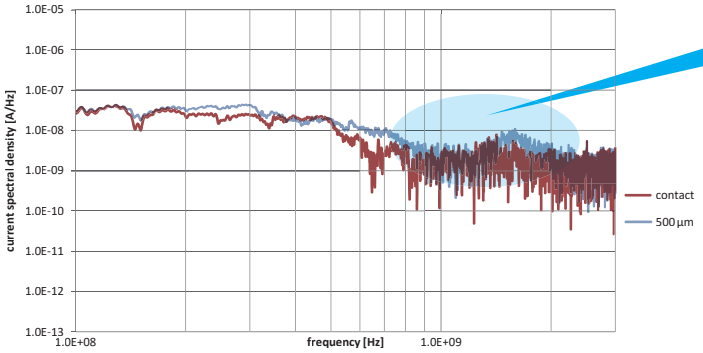
■ Output waveform (reference)




entire waveform

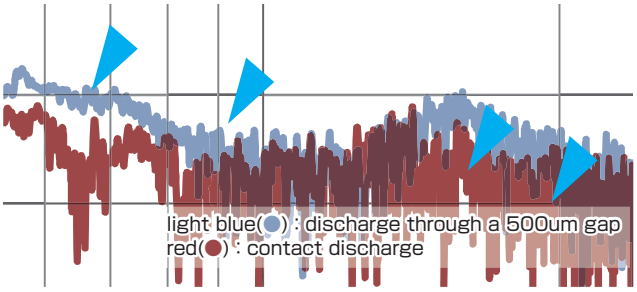



waveform leading edge




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 band

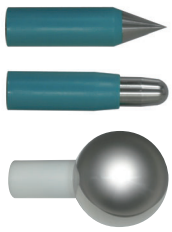
■ Other compatible discharge guns

TC-815S, 815R, 815ISO, 815-330, 815-2K, 815S-330, GT-30R series (the Gun Head 03-00103A required)

*This product cannot be used for the air discharge testing

# Accessories

## Discharge tips MODEL: 12-00007A / 8A / 9A



Tip of discharge gun.
Discharge tip (conical): 12-00007A
Discharge tip (round): 12-00008A
Discharge tip (sphere type 30mm): 12-00009A

## Discharge gun stand MODEL: 03-00127A

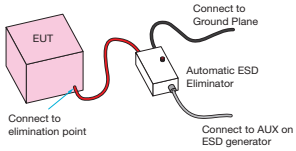
A stand to fix the discharge gun for testing.
Also used during the pre-check (pre-start inspection).
03-00127A is included in the main unit ESS-PS1 package.

## ESD elimination brush MODEL: 05-00125A

This brush is used to remove electrical charges accumulated on equipment when conducting ESD tests.
Dimensions: (W)250 x (D)15 x (H)60mm
Weight: Approx. 160g *Cable not included

## Automatic ESD Eliminator MODEL: 01-00013B

Connected to ESS-PS1 ESD Simulator to automatically perform static elimination to remove charges from equipment charged by the application of static electricity.
Dimensions: (W)85 x (D)150 x (H)60mm
Mass: 1.1 kg




## Free Arm Probe Stand MODEL: 03-00022B

Probe stand to move and fix the discharge gun of ESD Simulator to a desired position, up and down, left or right.

*Not standardized in the Standard
When using discharge gun GT-31S, stand conversion adapter MODEL: 03-00131A is separately required.

| Parameter | Specification |
|---|---|
| Dimensions | (W)200 x (D)68 x (H)750mm<br>* When stored |
| Mass | 5kg |

## Probe stand for GT Guns MODEL: 03-00130A

Used to fix a discharge gun during ESD testing. The articulated type allows the discharge gun to be oriented and fixed in any desired direction.

*Not standardized in the Standard
Probe stand exclusively for use with the GT-31S discharge gun.

| Parameter | Specification |
|---|---|
| Dimensions | Height: 380mm<br>Base diameter: 160mm |
| Mass | 4.1kg |
| Motion range | Vertical: 150mm Pivot angle: 130° |

## Stand conversion adapter MODEL: 03-00131A

Adapter for mounting the discharge gun GT-31S on a free arm probe stand.

## OPTICAL INTERFACE BOX MODEL : 07-00022A

Used to operate the ESD Simulator remotely from a PC.
Includes 5m USB-to-optical conversion fiber-optic cable.

## AUX Connector Junction Box MODEL: 05-00052A

Used for connection of multiple auxiliary accessories such as warning light, automatic ESD eliminator, external triggers and others.

## Warning light MODEL: 11-00014B

This warning light can be used with the ESS-PS1 static tester. Flashes during the test alerting the surrounding people.

## AC adapter MODEL: 17-00007A

AC adapter for the ESS-PS1 ESD Simulator.
17-00007A is included in the ESS-PS1 package.

# Accessories

## Faraday cage MODEL: FC-300

Faraday cage for checking current waveforms as defined in the IEC 61000-4-2 / ISO 10605 standards. Easy to move with the attached casters.

| Parameter | Specification |
|---|---|
| Dimensions | (W)848×(D)765×(H)1757mm |
| Mass | Approx. 75kg |
| Power supply | AC100V 50Hz/60Hz±10%* |

* Other power supply voltages (220V,etc) available per request.

RGP for FC-300 MODEL: 03-00138A
**(W)1225×(D)1680×(T)1.5mm**

* FC-300 is a Faraday cage compliant with IEC 61000-4-2 Ed.3. FC-300 does not include RGP for FC-300 (03-00138A), GND cable holding stand (03-00129A), or discharge gun fixing base (03-000128A).

## Discharge gun mount MODEL: 03-00128A

Jig for fixing the discharge gun during waveform verification using a Faraday cage and ESD current target mounting board (03-00052B/03-00118A).

Compatible guns: GT-31S, GT-30R(A), TC-815R, TC-815S

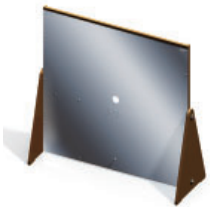
## ESD current target MODEL: 06-00094A

Load resistor required by the IEC 61000-4-2 standard. Used for measurement of the electrostatic discharge current waveform.

| Parameter | Specification |
|---|---|
| Max. applied voltage (pulse) | 30kV MAX |
| Input Resistance | 2.04 Ω |
| Output impedance | 2.04 Ω |
| Insertion loss (S21) | 300kHz - 1GHz: within ±0.5dB<br>1 GHz - 4 GHz: within ±1.2 dB |
| Output connector | SMA type |
| Dimensions | 70φ×35mm |
| Mass | 480g |

Included items: Attenuator MODEL: 00-00022A 2 pcs.
Coaxial cable MODEL: 02-00157A 1 pc.
*Conversion connector MODEL: 02-00133A is not included.

## Target mounting board (1.2m x 1.2m) MODEL: 03-00052B



Mounting board for fixing the ESD current target 06-00094A for measuring discharge current waveform.
Dimensions: 1200mm x 1200mm

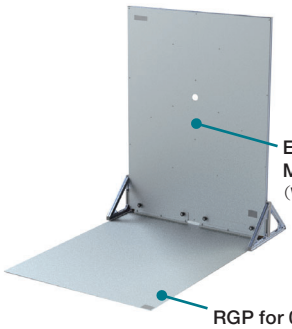
## Attenuator MODEL: 00-00022A

20dB SMA type attenuator for protection of measurement equipment.
*Included in the 06-00094A package.

## Conversion connector MODEL: 02-00133A

SMA to BNC conversion connector.

## ESD current target mounting plate MODEL: 03-00118A

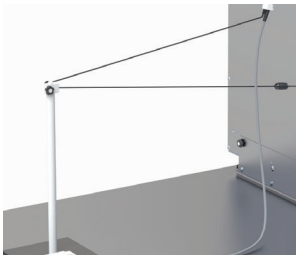


A board and dedicated ground plane for mounting current target in a discharge current waveform measurement environment.

ESD current target mounting board
MODEL: 03-00118A
**(W)1275×(D)560×(H)1636mm**

RGP for 03-00118A MODEL: 03-00119A
**(W)1210×(D)1660×(T)1.5mm(Excluding positioning block)**

## GND cable positioner MODEL: 03-00129A

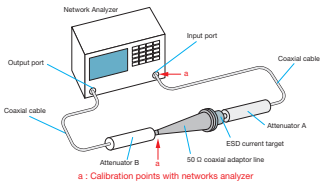


A stand for pulling the ground cable of a discharge gun when observing the ESD discharge current waveform.

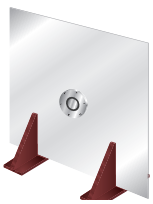
(H)700mm

## ESD Current Target Calibration Set MODEL: 06-00068B

Adapter for calibrating ESD current target 06-00094A/06-00067A.
Not compatible with 06-00001A.
* Current target MODEL: 06-00094A is not included.




## Load resistor mounting board MODEL: 03-00027A

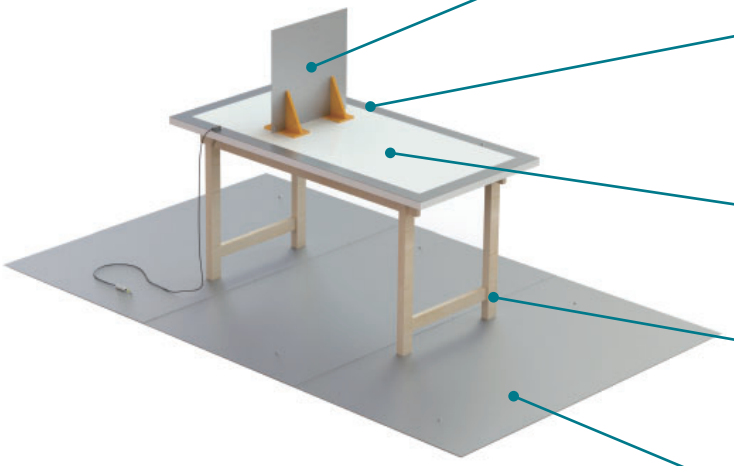


Mounting board for fixing the ESD current target 06-00094A for measuring discharge current waveform.
Dimensions: 600mm x 600mm

## Coaxial cable MODEL: 02-000157A

Coaxial cable for high frequency. Used to connect ESD current target to oscilloscope.
Length: 1m
*Included in the 06-00094A package.

# Accessories



*Set products are also available. For details, please refer to p.13: Test Environment (Table-top type and floor-standing type) ESS-801 / 801GL.

## Vertical coupling plane MODEL: 03-00005A

Vertical coupling plane for use in table-top type test environments.
Dimensions: (W)500 x (D)500 x (t)1.5mm
Material: Aluminium * Support base and center adapter included.

## Horizontal coupling plane MODEL: 03-00020A

A metal plate to be placed on a test table in a table-top test environment.
Dimensions: (W)1600 x (D)800 x (t)1.5 mm Mass: 5.2 kg
Material: Aluminium
ISO 10605 Ed.3 defines the horizontal coupling plane as the ground plane.

## Insulation sheet MODEL: 03-00004A

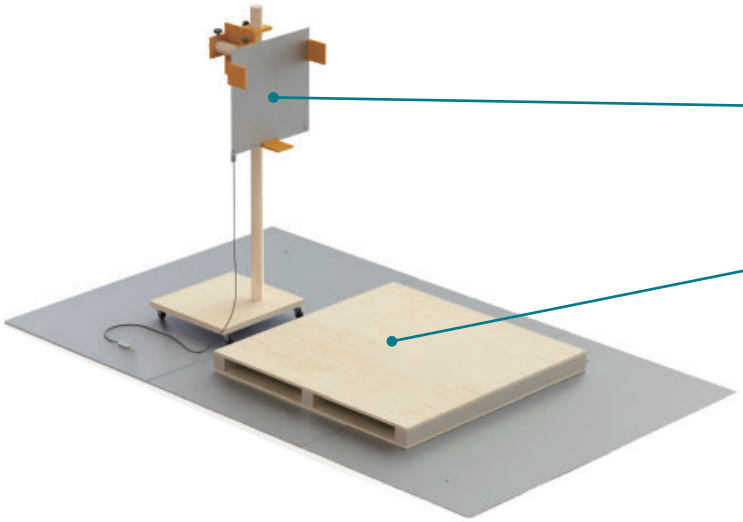
Insulation sheet for use in table-top type test environment.
Dimensions: (W)1450 x (D)650 x (t)0.5mm
Material: vinyl chloride

## Test Table MODEL: 03-00039A

(W)1600×(D)800×(H)800mm Mass: 22kg
Load capacity: 100 kg

## Ground plane MODEL: 03-00007A

Metal plate to be placed under wooden table.
Dimensions of 1 sheet: (W)1800 x (D)1000 x (t)1.5mm Mass: 7.2 kg (1 sheet)
Quantity: 3 sheet/set Material: Aluminium
In ISO 10605 Ed.3, the horizontal coupling plane is used as a ground plane, so it is not required.



*Set products are also available. For details, please refer to p.13: Test Environment (Table-top type and floor-standing type) ESS-801 / 801GL.

## Floor-standing vertical coupling plane MODEL: 03-00034A

Vertical coupling plane for use in floor-standing test environment.
Dimensions: (W)540 x (D)500 x (H)1538mm
Material: Aluminium * Support base and center adapter included.

## Insulation support MODEL: 03-00024A

Insulating support for use in floor-standing test environment. Used to float equipment 10 cm when conducting ESD testing.
Dimensions: (W)1200 x (D)1200 x (H)10 mm Mass: 22 kg
Load capacity: 500 kg

## Cubic insulating block 100 MODEL: 03-00029A

A cubic insulating block for use in a floor-standing test environment. Used to float equipment 10 cm when conducting ESD testing.
Dimensions: (W)100 x (D)100 x (H)100mm
Quantity: 4 pcs/1 set

## Discharge resistance cable (1.5m) MODEL: 05-00182A

Discharge resistor cable connecting between the horizontal coupling plane and the ground plane.
Length: 1.5m * Includes 2pcs of 470kΩ resistors.
* IEC 61000-4-2 Ed.2/Ed.3, ISO 10605 Ed.2/Ed.3 compliant

The photo is for illustrative purposes only.

## Discharge resistance cable (3m) MODEL: 05-00183A

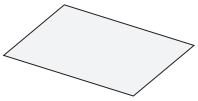
Discharge resistor cable connecting between the vertical coupling plane and the ground plane.
Length: 3m * Includes 2 x 470kΩ.
* IEC 61000-4-2 Ed.2/Ed.3, ISO 10605 Ed.2/Ed.3 compliant

The photo is for illustrative purposes only.

## Insulation block MODEL: 03-00054A

Insulation blocks are used to raise (insulate) wiring from equipment above the ground plane.
Dimensions: (W)300 x (D)300 x (H)50mm
Quantity: 5 sheets/set
ISO 10605 ed.3 compliant

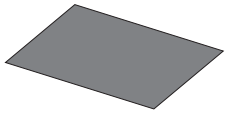
## Insulation support MODEL: 03-00066A



This sheet is placed between the equipment and the ground plane when performing electrostatic testing of in-vehicle electronic equipment.
Dimensions: (W)1450 x (D)650 x (t)2mm
Material: PVC (polyvinyl chloride) transparent
ISO 10605 ed.2 compliant

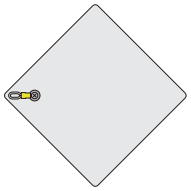
# Accessories

## Static dissipative mat for ISO 10605 MODEL: 03-00055A



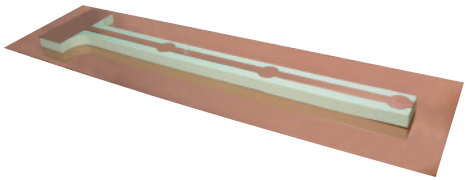
A mat placed between the equipment and the ground plane during packaging and handling ESD susceptibility testing.
Dimensions : (W)1000 x (D)1000 x (t)2mm

## Aluminium plate for testing MODEL: 03-00053A



A metal plate that is placed under the tire when performing ESD testing on an actual vehicle.
Dimensions: (W)500 x (D)500 x (t)1.5mm

## Field Coupling Plane MODEL: 03-00065A



A set of coupling part (made of copper) and insulating block as specified in ISO 10605.
The dimensions of the electric field coupling surface vary depending on the size of the EUT.
**Customization available, please consult our sales representative.*
**Ground plane not included.*

## Impulsive Electric Field Adaptor for GT-31S MODEL: 03-00135A

Adaptor for simulating electrostatic induction, an inductive mode of noise, and is used in combination with an ESD Simulator and a discharge gun.

## Impulsive Magnetic Field Adaptor for GT-31S MODEL: 03-00136A

Adaptor for simulating magnetic field induction, an inductive mode of noise, and is used in combination with an electrostatic tester and a discharge gun.

## Magnetic field loop adaptor for GT-31S MODEL: 03-00137A

A magnetic field loop adaptor, in accordance with U.S. Ford standard, used in combination with an electrostatic tester and a discharge gun.

## Storage case for GT-31S MODEL: 09-00011A

Case for storing the GT-31S discharge gun.
Can also store the GT-31S accessory set (GT-ISOSET-A) for performing testing complying with ISO Standard.

## ESS-PS1/GT-31S storage case MODEL: CASE-ESSPS1

This case can store the ESS-PS1 static tester and the GT-31S discharge gun.
Can also store the GT-31S accessory set (GT-ISOSET-A) for performing testing complying with ISO Standard.

## Accessories

### ESD voltage meter MODEL: 18-00086B

# For measuring the hold time and output voltage of electrostatic testers

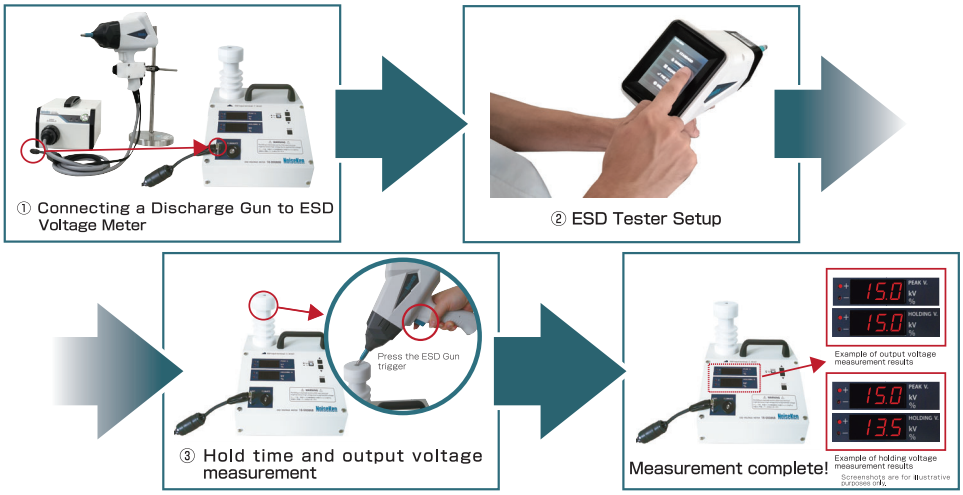
The ESD voltage meter MODEL: 18-00086B is a device that can measure the voltage holding time (holding voltage after 5 seconds) and output voltage, which are the tester specifications during the air discharge test in IEC 61000-4-2.
The measured voltage is displayed on a 7-segment LED with peak and holding voltage values.

- Easily measure the Hold Time, the tester specification for air-discharge testing.
- Measure the output voltage from ±2kV to 30kV.
- Monitor the measured voltage waveform by connecting to an oscilloscope.
- Compact, lightweight and easy to carry.

## Easy measurement of tester specifications for the Air Discharge testing !

### Hold time measurement function

IEC 61000-4-2 standard specifies the voltage "Hold Time" as a tester specification related to the Air discharge testing. The Hold Time is defined as "the time interval during which the output voltage decreases by 10% or less due to leakage before the discharge" and is required to be "at least 5 seconds". By using this product, the voltage "hold time" can be easily measured. Also, the output voltage specified in the IEC 61000-4-2 Standard can be easily measured without using a high-voltage probe or voltmeter.




■ Measuring Holding Voltage

① Connect the alligator clip on the end of the GND cable of the discharge gun to the GND terminal of the ESD voltage meter .

② Set the electrostatic tester to Air Discharge mode and the output voltage: set to the voltage set a the ESD voltage meter.

③ Press the【START】switch on the electrostatic tester to charge the discharge gun, then make contact of the discharge tip of the ESD GUN to the GND terminal of the ESD voltage meter. After eliminating the high voltage, press the trigger switch on the discharge gun while keeping the discharge tip in contact with the ESD input terminal of the ESD voltage meter.

【Example of measurement results】
When the holding voltage value is displayed in【HOLDING V.】in kV display mode. *Percentage (%) display mode is also available.





【PEAK V.】displays the Peak Voltage using the peak hold function.
【HOLDING V.】displays the holding voltage value and the reduction rate every second.

# Accessories

■ Measuring output voltage

① Connect the alligator clip on the end of the GND cable of the discharge gun to the GND terminal of the ESD voltage meter .

② Set the electrostatic tester to Contact Discharge mode and the output voltage: set to the voltage set at the ESD voltage meter, the discharge interval: 0.05s, discharge count: 100 times or more.

③ Press the【START】switch on the electrostatic tester to charge the discharge gun, then make contact of the discharge tip of the ESD GUN to the GND terminal of the ESD voltage meter. After eliminating the high voltage, press the trigger switch on the discharge gun while keeping the discharge tip in contact with the ESD input terminal of the ESD voltage meter.

【Example of measurement results】
When the Holding Voltage value is displayed in [HOLDING V.]
*kV display mode only.


* for illustrative purposes only.

【PEAK V.】displays the Peak Voltage using the peak hold function.
【HOLDING V.】displays the holding voltage value and the reduction rate every second.

## Specifications

| Parameter | Functions / Performance |
|---|---|
| Input polarity | Positive/Negative |
| Input voltage | ±2kV - 30kV *Voltage value set at the electrostatic tester |
| Voltage display accuracy (voltage display mode) | Within ±5% *for DC input |
| Display | Voltage value: 7-segment LED 4 digits. Polarity: LED |
| Buzzer | built-in |
| Monitor output | BNC connector Approx. 1/10,000 (Approx. 3V output at 30kV input).<br>Output accuracy: ±20% of indicated voltage value |
| GND Terminal | Conductive to the GND of the product housing |
| Elimination terminal | Conductive to the GND of the product housing |
| Input resistance | 1TΩ±20% |
| Voltage divider ratio | Approx. 1/3,333 |
| Check voltage setting range | 2.0kV, 4.0kV, 8.0kV, 15.0kV, 20.0kV, 25.0kV, 30.0kV * Input voltage threshold is 1/2 of the set check voltage value |
| Hold time setting range | 5.0 - 30.0 sec. |
| Power supply | AC100V～240V±10% 50Hz／60Hz |
| Power consumption | 13VA |
| Operating temperature range | +15℃ - +35℃ |
| Operating humidity range | 30%RH to 60%RH (no condensation) |
| External dimensions | (W)220mm x (H)256.5mm x (D)230mm (excluding protrusions) |
| Mass | Approx. 2kg |

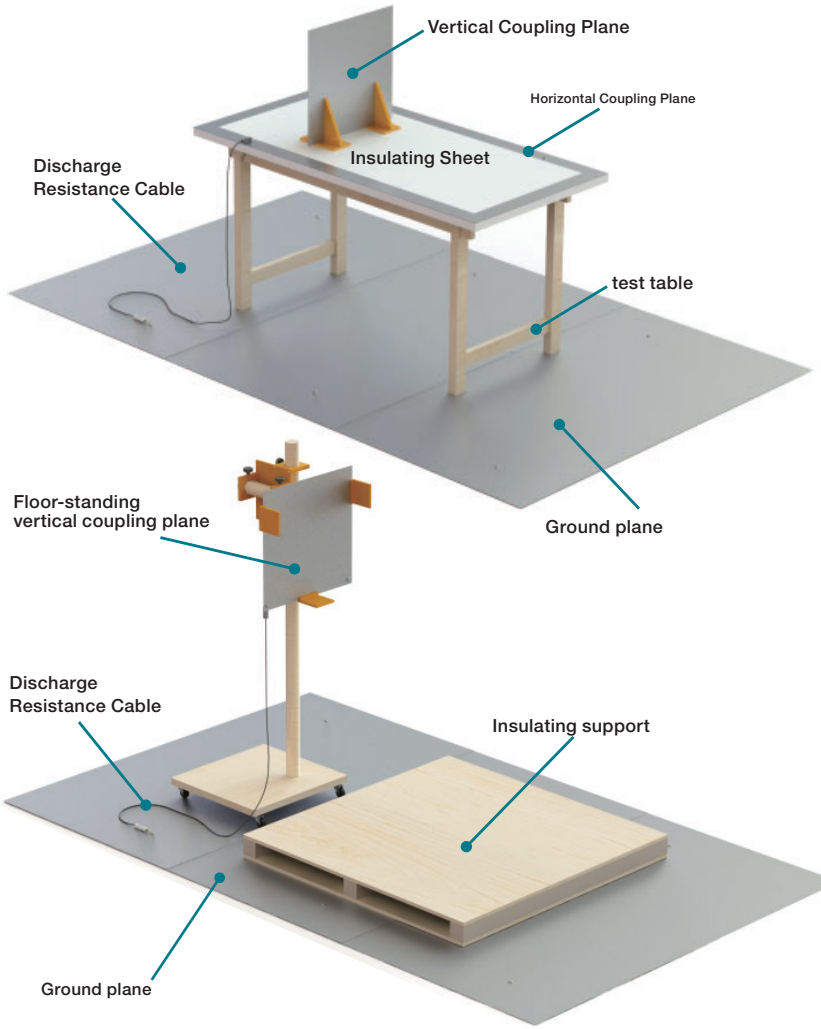
Test environment (Table-top type and Floor-standing type)

# ESS-801 / 801GL

## Features

The electrostatic test environment conforms to the IEC 61000-4-2 standard, and two types, table type and floor-standing type, support a wide range of testing environments.
The test table is made of wood, which minimizes the influence on the test (high-frequency electromagnetic fields can be applied to the specimen without loss, resulting in excellent quantitativity) and allows for highly reproducible testing.
It is also versatile for other tests such as impulse noise testing.

- This is an electrostatic discharge immunity test environment that complies with the IEC 61000-4-2 standard.
- There are two types of test environments: one for tabletop equipment and the other for floor-standing equipment.
- It can be used not only for EN/IEC 61000-4-2, but also for other EMC tests such as impulse tests.




## Specifications

### Test Environment Set (Table-top type) MODEL: ESS-801

| Product Name | Model | Dimensions | Remarks |
|---|---|---|---|
| Test table | 03-00039A | (W)1600×(D)800×(H)800mm | Mass:22 kg Load capacity:100 kg |
| Insulating Sheet | 03-00004A | (W)1450×(D)650×(t)0.5mm | Material: Vinyl chloride |
| Vertical Coupling Plane | 03-00005A | (W)500×(D)500×(t)1.5mm | Material: Aluminium *Supporting base and center adapter included |
| Ground plane | 03-00007A | (W)1800×(D)1000×(t)1.5mm | Material: Aluminium * size of 1 sheet (1 set = 3 sheets) |
| Horizontal coupling plane | 03-00020A | (W)1600×(D)800×(t)1.5mm | Material: Aluminium |
| Discharge Resistance Cable | 05-00182A | Length: 1.5m | 470kΩ×2 *for Horizontal Coupling Plane |
| Discharge Resistance Cable | 05-00183A | Length: 3m | 470kΩ×2 *for Vertical Coupling Plane |

### Test Environment Set (Floor-standing type) MODEL: ESS-801GL

| Product Name | Model | Dimensions | Remarks |
|---|---|---|---|
| Insulating support | 03-00024A | (W)1200×(D)1200×(H)10mm | Mass: 22 kg Load capacity: 500 kg |
| Ground plane | 03-00007A | (W)1800×(D)1000×(t)1.5mm | Material: Aluminium * size of 1 sheet (1 set = 3 sheets) |
| Floor-standing vertical coupling plane | 03-00034A | (W)540×(D)500×(H)1538mm | Material: Aluminium *Supporting base and center adapter included |
| Discharge Resistance Cable | 05-00183A | Length: 3 m | 470kΩ×2 |

# IEC 61000-4-2 Ed.3 Standard Overview

## 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 when charged human body discharges to electronic equipment and testing with the circuit to simulate current waveform generated in such conditions.

## 2. Test Levels

### Test level values for ESD

The test levels for ESD are shown below. Air discharge is tested at all test levels up to the specified test level, and contact discharge and indirect discharge tests are tested at the specified test level.

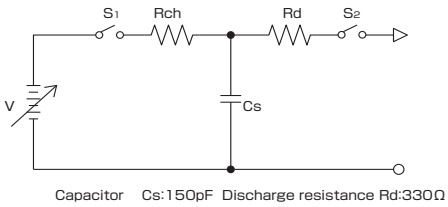
| Level | Test voltage | |
|---|---|---|
| | Contact Discharge | Air discharge |
| 1 | 2kV | 2kV |
| 2 | 4kV | 4kV |
| 3 | 6kV | 8kV |
| 4 | 8kV | 15kV |

## 3. Verification of test generators and waveforms

### Generator specification

The generator must satisfy following specification.

| Parameter | Values |
|---|---|
| Output voltage | Contact discharge: 2kV to 8kV<br>Air discharge: 2kV to 15kV |
| Output voltage tolerance | ±5% |
| Output voltage polarity | Positive and negative |
| Holding time | 5 seconds or more |
| Discharge Mode | single-shot discharge |




Simplified diagram of the ESD generator

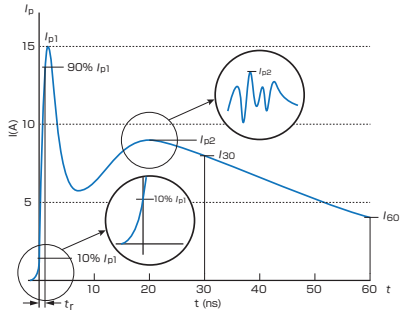
### Generator characteristics

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

| Level | | Indicated voltage | 1st peak current $I_{p1}$ (±15%) | Rise time $t_r$ (±25%) | Second peak current $I_{p2}$ (−20%/+40%)* | Current value at 30ns $I_{30}$ (±30%) | Current value at 60ns $I_{60}$ (±30%) |
|---|---|---|---|---|---|---|---|
| Contact Discharge | Air discharge | | | | | | |
| 1 | 1 | 2 kV | 7.5 A | 0.8 ns | 4.5 A | 4.0 A | 2.0 A |
| 2 | 2 | 4 kV | 15.0 A | 0.8 ns | 9.0 A | 8.0 A | 4.0 A |
| 3 | --- | 6 kV | 22.5 A | 0.8 ns | 13.5 A | 12.0 A | 6.0 A |
| 4 | 3 | 8 kV | 30.0 A | 0.8 ns | 18.0 A | 16.0 A | 8.0 A |
| --- | 4 | 15 kV | 56.3 A | 0.8 ns | 33.8 A | 30.0 A | 15.0 A |

Discharge current waveform and its characteristics

* $I_{p2}$ is the maximum value in the 10ns to 40ns interval




Discharge current waveform of contact discharge at 4kV

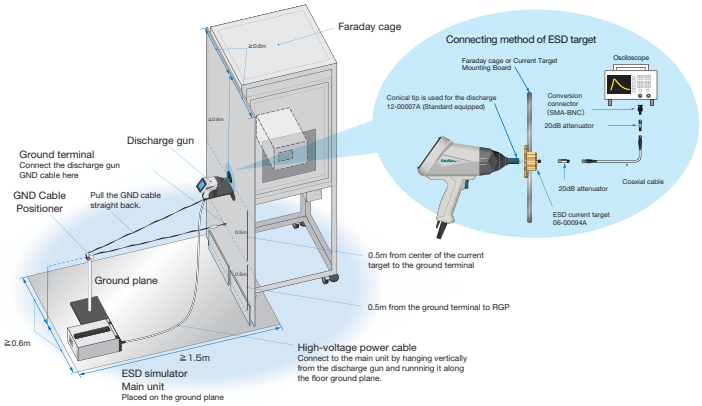
Contact discharge and air discharge are shown in the level column of the discharge current waveform parameter, and the discharge current waveform regulations apply to contact discharge as well as air discharge.

# IEC 61000-4-2 Ed.3 Standard Summary

## Waveform verification of ESD Generator

There are no changes to the regulations for current targets and oscilloscope bandwidths, etc. However, the setup for discharge current calibration has been changed, with the height of the current target fixed at 1 m and a floor ground plane required. To improve reproducibility, the high-voltage cable of the electrostatic tester should hang vertically from the discharge gun and be connected to the body of the tester along the floor ground plane, and the main unit of the electrostatic tester should also be installed on the ground plane.

* Insertion use of approx. 20 dB attenuator for protecting the measurement equipment is recommended, although it is not specified in the IEC Standard.




## 4. Test Setup

## Example test setup for table-top equipment

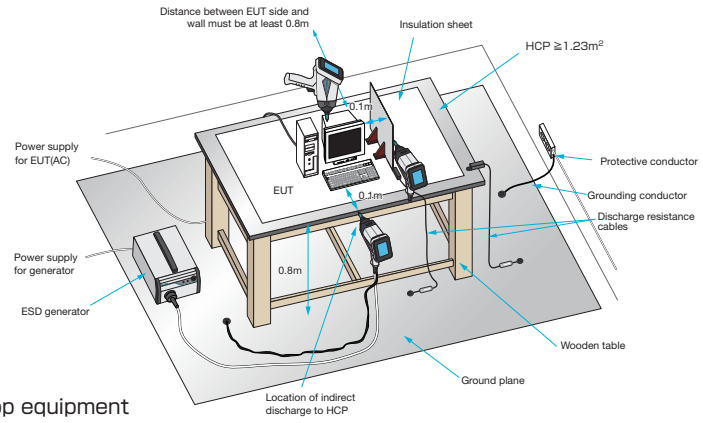
【Direct discharge test】
The direct discharge test is a test in which the EUT is directly discharged to verify the effect to the device. A wooden table 0.8 m high is placed on the ground plane and a horizontal coupling plane is placed on top of it. The horizontal coupling plane is connected to the ground plane with a discharge resistor cable. Place an insulating sheet between the horizontal coupling plane and the device.

【Indirect discharge test】
The indirect discharge test is a test in which the horizontal and vertical coupling planes are discharged to verify the effect to the EUT . In addition to the test environment for direct discharge testing, a vertical coupling plane ( 0.5 m x 0.5 m ) is used. The vertical coupling plane is also connected to the ground plane with a discharge resistor cable.

The cables of the equipment are floated off the horizontal coupling plane with 0.5 mm insulation sheet.

<Basic test setup>

(1) The distance between the 470 kΩ resistance of the discharge resistance cable and the terminals shall be within 0.1 m at both ends.
(2) The total length of the discharge resistance cable to the horizontal coupling plane shall not exceed 1.5 m.
(3) The total length of the discharge resistance cable to the vertical coupling plane shall not exceed 3 m.
(4) Auxiliary equipment can be installed inside or outside the test environment, and the connection cables of auxiliary equipment can be decoupled.
(5) Horizontal coupling plane regulations were changed from dimensional rules to area rules. Not only rectangular shape, but also square, round and other shapes are acceptable.




For table-top equipment

# IEC 61000-4-2 Ed.3 Standard Summary

## Example test setup for floor-standing equipment

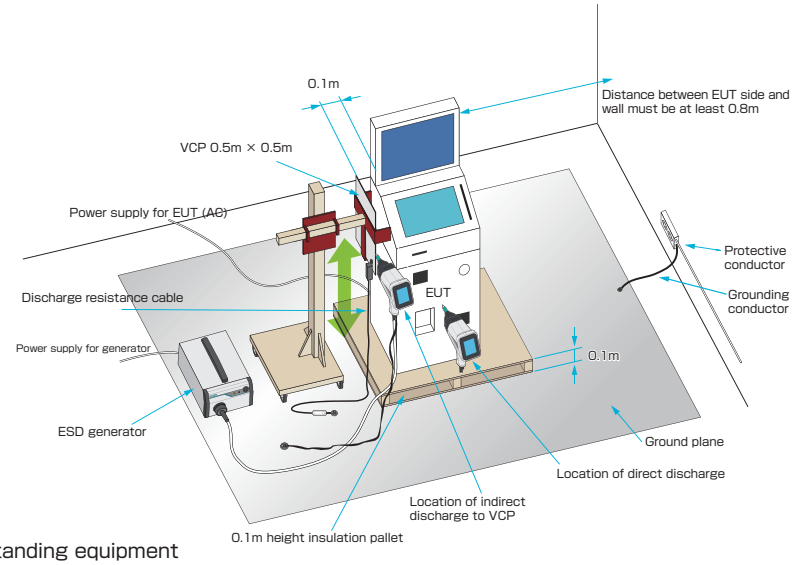
【Direct discharge test】
Place an insulating support 0.1 m high on the ground plane and place the EUT on top of it.

【Indirect discharge test】
A test to verify the effect to the EUT by application of the discharge to a vertical coupling plane. The vertical coupling plane is connected to the ground plane with a discharge resistor cable.

Equipment cables are floated off the ground plane with 0.5 mm insulation sheet.

<Basic test setup>

(1) The distance between the 470 kΩ resistance of the discharge resistance cable and the terminals shall be within 0.1 m at both ends.
(2) The total length of the discharge resistance cable to the vertical coupling plane shall not exceed 3 m.
(3) Auxiliary equipment can be installed inside or outside the test environment, and the connection cables of auxiliary equipment can be decoupled.




For floor-standing equipment

## Test Setup for table-top and floor-standing equipment *For Ungrounded Equipment

There are no changes to the basic test setup for testing ungrounded table-top and floor-standing devices, but ungrounded devices are defined as Class II devices as defined in IEC 62368-1.

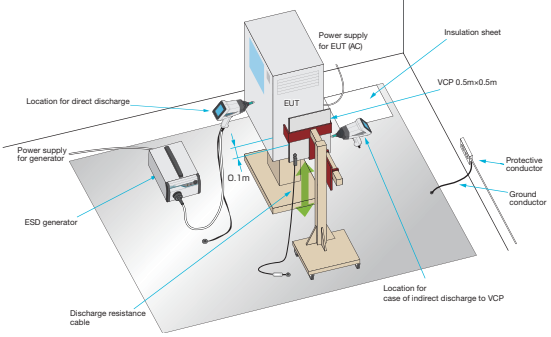
If the test results differ due to the connection of the discharge resistance cable to the EUT, disconnect the discharge resistance cable, apply ESD, then reconnect the cable and perform static elimination. The distance to the 470 kΩ resistance of the discharge resistance cable is within 0.1 m.

# IEC 61000-4-2 Ed.3 Standard Summary

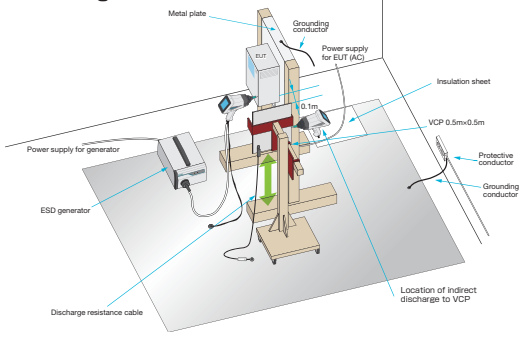
## Test setup for wall-mounted equipment

[For non-conductive surfaces] Place a 0.8 m high non-conductive support on top of the ground plane and place the device on top of it for testing.
[For conductive surfaces] The test is performed by mounting the device on a grounded metal wall with a distance of 0.8 m from the ground plane to the bottom of the device.
Other regulations are not significantly different from the test for floor-standing equipment.

If the mounting surface is a non-conductive wall

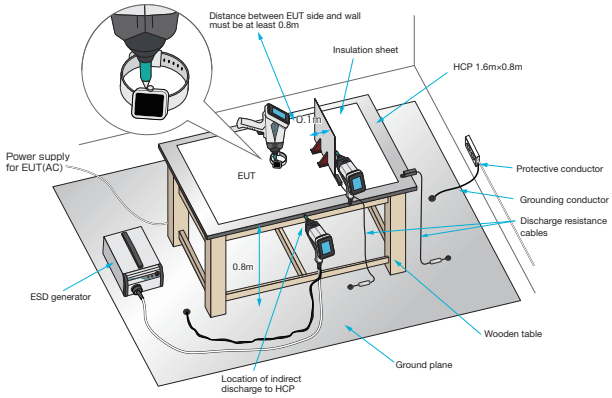



If the mounting surface is a conductive wall




## Test Setup for Wearable Devices

Test is conducted at the test setup of table-top equipment for ungrounded devices.
For additional experimental testing, the recommended charging capacitor and discharge resistor are 200 pF and 50 Ω, respectively, to reproduce the most severe discharge current conditions from a wearable device worn on the waist.




## 5. Test procedure

### Climatic and Other Environmental Conditions

It is necessary to let the equipment brought in from different climatic conditions to fully adjust to testing environment before performing the test. Also, in order to stabilize the discharging condition, it is necessary to control 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.

| Climatic conditions | |
|---|---|
| Parameter | official regulations |
| Ambient temperature | 15℃～35℃ |
| Relative humidity | 30% ～ 60% |
| Atmospheric pressure | 86 kPa (860 mbar) to 106 kPa (1060 mbar) * Values published by a meteorological observatory may be used. |
| Tests may be performed at relative humidity of 30% or less, but no further action is required if the EUT meets the specified performance criteria within these conditions, otherwise the test shall be performed within the relative humidity range described above. | |
| The electromagnetic conditions shall be such that the correct operation of the EUT is guaranteed in order not to affect the test results. | |

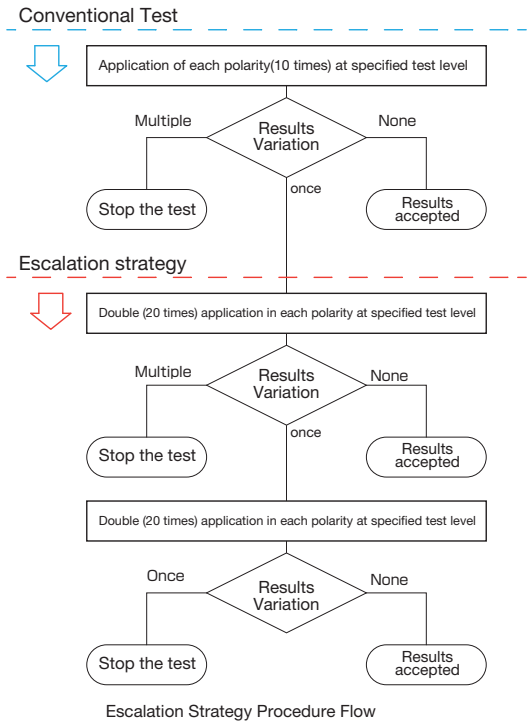
### Test Procedure

Direct discharge test: contact discharge (discharge at 1 second intervals) and air discharge (approach the EUT as quickly as possible).
Indirect discharge test: Applied to vertical and horizontal coupling planes.
Indirect discharge testing to the horizontal coupling plane targets the surface on which the EUT is normally installed, and testing of metal housings, especially EUTs with PE connections, is no longer necessary. Indirect discharge testing using a vertical coupling plane is performed on an accessible surface of the EUT.
The number of discharges is at least 10 discharges at 1 second intervals, both polarities.
*A preliminary test can be performed by discharging 20 times per second or more repeatedly in order to determine the discharge points.*

# IEC 61000-4-2 Ed.3 Standard Summary

## 6. Escalation strategy

If there are variations in the performance of the equipment during a direct discharge and it cannot be determined if the variations are due to the application of the discharge, an escalation strategy is applied.




Escalation Strategy Procedure Flow

If the device experiences a variation in performance during the application of a discharge and it is impossible to determine whether the variation is due to the application of the discharge, use the flowchart on the left as a guide. (Regulation)
Note: Not applicable if the application of the discharge allows the device to consistently perform the same operation and the test result can be determined.

If one variation occurs during 10 applications in the actual test, the result is accepted if 20 applications are made again and no variation occurs.

If one more variation occurs during the additional test, it will be accepted if no malfunction occurs after another 20 applications, and if multiple variations occur, it will be inapplicable.

## 7. Evaluation of Test Results and Test Report

### ■Test Results (Reference)

Test results are classified according to EUT specifications and operating conditions as follows:

Performance Criterion A: Normal operation within specifications
Performance Criterion B: Temporary degradation of function or performance that can self-recover.
Performance Criterion C: Temporary degradation of functionality or performance requiring operator intervention or system reboot.

### ■Test report

The following items are newly stipulated

- ○ Test level
- ○ The length of the discharge return cable
- ○ Performance criteria specified in the generic, product or product-family standard
- ○ Test setup
- ○ Diagram or photograph indicating the discharge points
- ○ Number of discharges per discharge point
- ○ HCP dimensions and shape, if used
- ○ Escalation strategy, if used

Note: This test method and connection method are excerpted from the IEC 61000-4-2 Ed.3 standard, and an example is shown using our product.
Please refer to the original Standard for detailed test methods.

# ISO 10605 Ed.3 Standard Overview

## 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 regulates 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, the Standard also regulates tests procedures to evaluate the immunity of the each module against simulated human discharges during the assembly process or in servicing.

## 2. Test levels

The following tests levels are for 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 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 level | Indirect 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 |

**Component test — Packaging and handling — Example severity levels —**

| Test level | Direct contact discharge | | | Direct air discharge | | |
|---|---|---|---|---|---|---|
| | Category 1 | Category 2 | Category 3 | Category 1 | Category 2 | Category 3 |
| Full function after test | ±1kV | ±2kV | ±4kV | ±8kV | ±15kV | ±25kV |

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

| Test level | Contact 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 level | Contact 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 | ±2kV | ±4kV | ±4kV | ±6kV | ±8kV |
| Level 1 | - | - | ±2kV | ±2kV | ±4kV | ±6kV |

# ISO 10605 Ed.3 Standard Overview

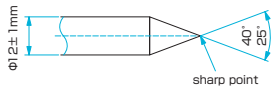
## 3. Specification of generator and verification of output waveform

### Specification of ESD simulator

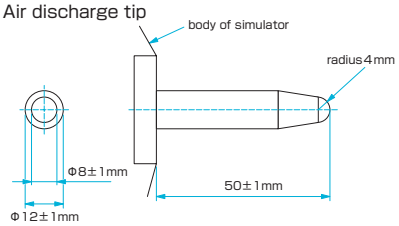
A simulator satisfying the following specifications must be used for the ESD Testing.

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

Contact discharge tip




Air discharge tip

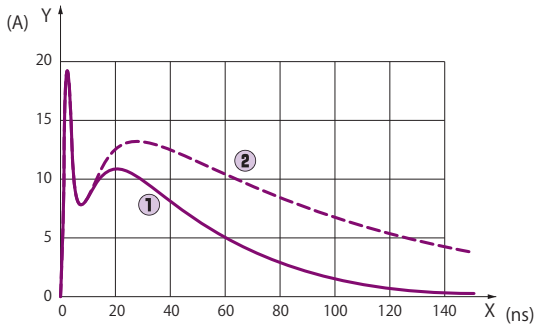



For air discharge at test voltages higher than 15 kV, a larger tip can be used to avoid pre-discharge.

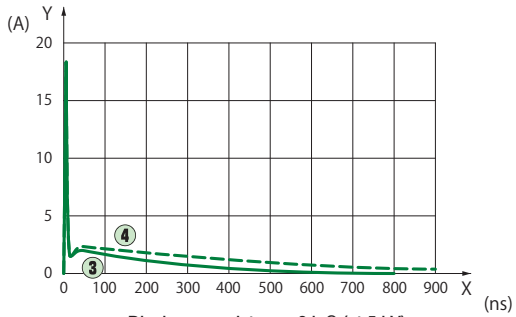
### ESD Simulator Characteristics (Contact discharge mode current specifications)

The following discharge characteristics must be verified.

| Capacitance / resistance | 1st peak current | Current at $t_1$ | Current at $t_2$ | Below Figure indication |
|---|---|---|---|---|
| 150pF/330Ω | 3.75A/kV ±10% | 2A/kV±30% ($t_1$=30ns) | 1A/kV ±30% ($t_2$=60ns) | ① |
| 330pF/330Ω | | 2A/kV±30% ($t_1$=65ns) | 1A/kV ±30% ($t_2$=130ns) | ② |
| 150pF/2kΩ | 3.75A/kV +30% − 0% | 0.275A/kV±30% ($t_1$=180ns) | 0.15A/kV±50% ($t_2$=360ns) | ③ |
| 330pF/2kΩ | | 0.275A/kV±30% ($t_1$=400ns) | 0.15A/kV±50% ($t_2$=800ns) | ④ |




Discharge resistance 330 Ω (at 5 kV)




Discharge resistance 2 k Ω (at 5 kV)

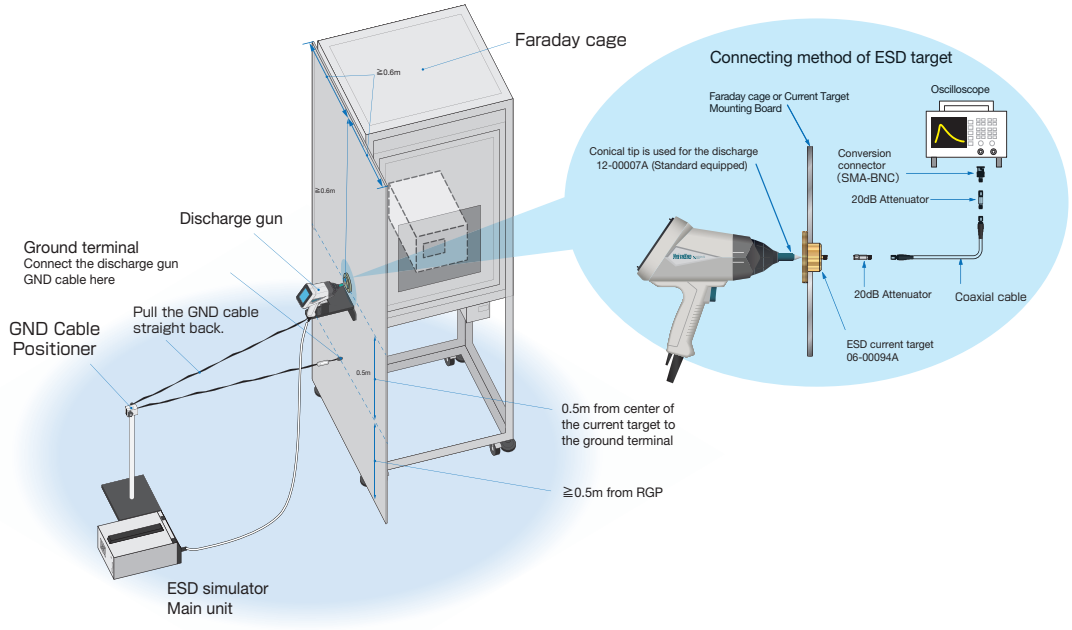
# ISO 10605 Ed.3 Standard Overview

## 4. Verification of test generators and waveforms

### Check output current waveform

The waveform shall be verified with an oscilloscope which bandwidth is 1 GHz or more in a Faraday cage or with a 1.2 m × 1.2 m 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 0.5 m under the target on surface of the Faraday cage or board..

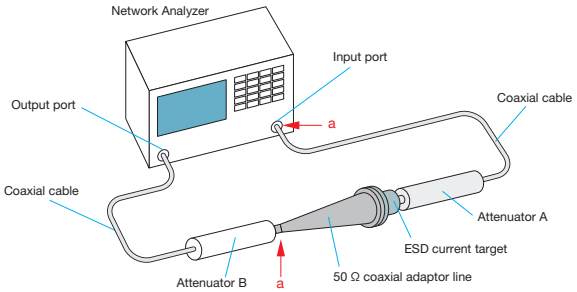



### Current Target calibration

The frequency characteristics of current waveform observation targets must be verified using a dedicated measurement jig.

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

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




a : Calibration points with networks analyzer

## 4. Test Setup

### Common Points:

- Ground plane: at least 1.6 x 0.8m in size, at least 0.2m larger than the DUT or peripherals during setup, and with a connection resistance of 2.5m Ω or less.
- Insulating block: height 50 ± 5mm. Extend 20mm beyond the test configuration on all sides.
- The DUT shall be connected to all peripheral devices required for functional testing of the DUT with the wire harness length of 1.7m (+0.3m - 0).
- All components should be at least 0.2 m apart from each other.
- Bundle the wire harness 0.1m away from the edge of the ground plane and secure it to the insulating block.
- The supply battery shall be on the test table, with the negative terminal of the battery directly connected to the GP.
- The test stand should be at least 0.1m away from other dielectric structures.
- For direct discharge, connect the electrostatic simulator's discharge return cable to the ground plane.
- Use discharge network of 150pF or 330pF depending on the EUT device location, and use 330 Ω or 2kΩ.
- The test should be conducted for two or more test levels.
- Insulating block should be used for electronic equipment that are not directly chassis-mounted.

### Component immunity test method (powered-up test) - Direct contact and air discharge -

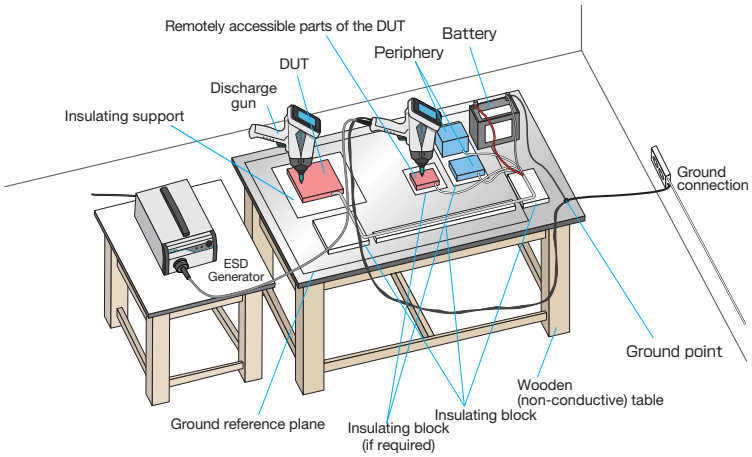
- Test at least 3 times with positive and negative polarity, separated by at least 1 second.
- Apply to every location available for human touch.
- Insulating block should be used for electronic equipment that are not directly chassis-mounted.

**【 Contact Discharge 】**

- The discharge electrode is brought into contact with the discharge point of the DUT before activating the discharge switch.
- For painted surfaces, if the coating is not an insulating coating, the pointed tip of the generator should penetrate the coating so as to make contact with the conducting substrate.
- The ESD discharge tip is held perpendicular to the surface of the DUT.

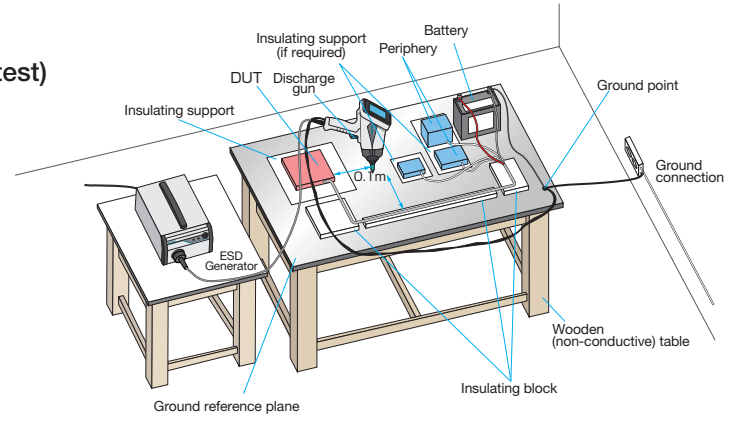
**【 Air Discharge 】**

- After operating the discharge switch, move the discharge electrode tip to the DUT as quickly as possible (0.1m/s to 0.5m/s) until it contacts the discharge point and apply voltage.
- If the conductive material is declared to be an insulating coating, perform air discharge.




### Component immunity test method (powered-up test) - Indirect Discharge -

- Apply discharge to the ground plane with contact discharge.
- Test 10 times or more at intervals of 1s or more.
- Apply to the ground plane at points on each side of the DUT.
- Position the DUT so that the nearest surface is 0.1 m away from the edge of the ground plane that receives the discharge.
- Apply at a position 0.1m from the DUT and harness.
- Select 330pF as the CR constant depending on the mounting position of the device, and use 330 Ω .



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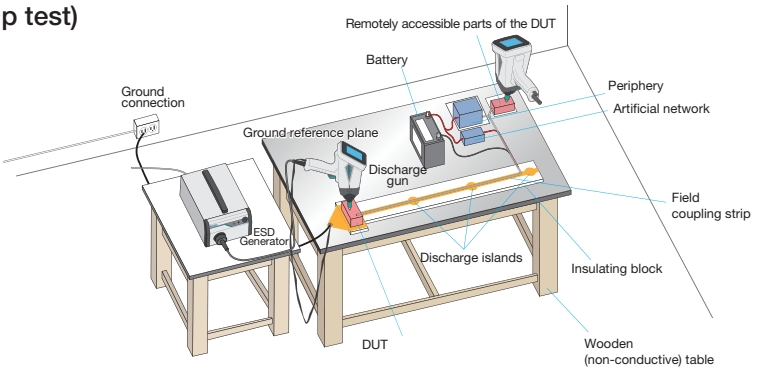
## Component immunity test method (powered-up test)

### - Indirect Discharge using FCP -

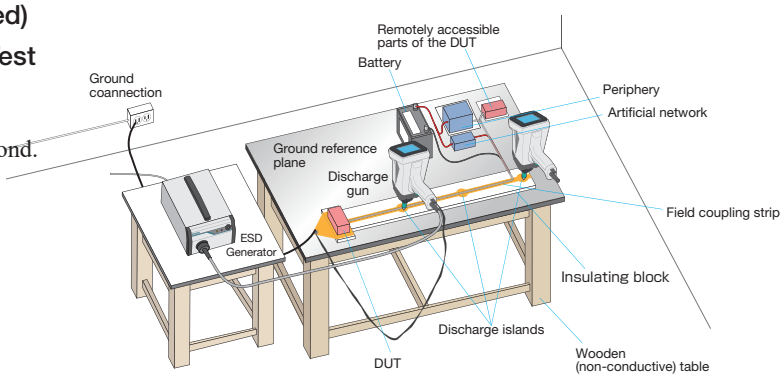
- Test at least 10 times with positive and negative polarity at intervals of for at least 1 second.
- The CR constant is selected to be 150pF or 330pF depending on the mounting position of the device, and 330 Ω is used.




## Component immunity test method (unpowered)

### - Packaging and Handling - ESD Sensitivity Test

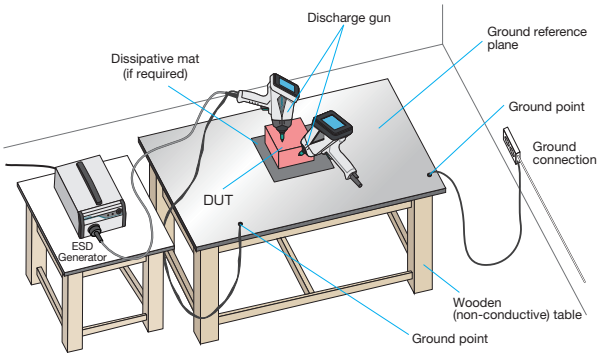
- Test at least 10 times with positive and negative polarity to each island, at intervals of for at least 1second.
- CR constant is 330 pF depending on the mounting position of the device, and 330 Ω is used.




## Component immunity test method (unpowered)

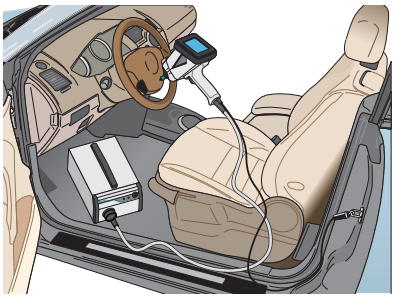
### - Packaging and Handling - ESD Sensitivity Test

- We recommend using a CR constant of 150 pF and conducting tests with resistances that simulate both direct human contact (2 k Ω ) and contact with a metallic object being held (330 Ω ).
- Conduct tests of two or more levels.
- At least 3 discharges shall be applied both to the positive and negative polarities with the interval not less than 1s.
- Contact discharge is applied to all areas touched by the hand.
- After applying the voltage, remove the static electricity from the DUT with a static elimination resistor of 1M Ω± 20%, then energize it and confirm that it operates normally.

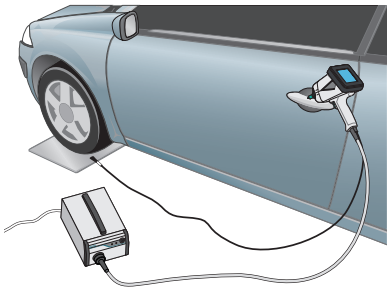



## Vehicle test – Internal and external points –

- Areas that can be easily touched by people inside the vehicle are tested with 330pF/330 Ω or 2k Ω .
- Areas that can be easily touched by people from outside the vehicle are tested with 150pF/330 Ω or 2k Ω .
- The ground wire connects to the chassis, such as the seat rail. During external testing connect to a nearby chassis or metal plate under the tire.
- Both the contact discharge and air discharge tests shall be done both for the internal and external tests.



Internal testing



External Testing

**Note: This test outline is based on the ISO10605 Ed.3 2023 Standard. Please refer to the original text of the Standard for detailed test methods, etc.**

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