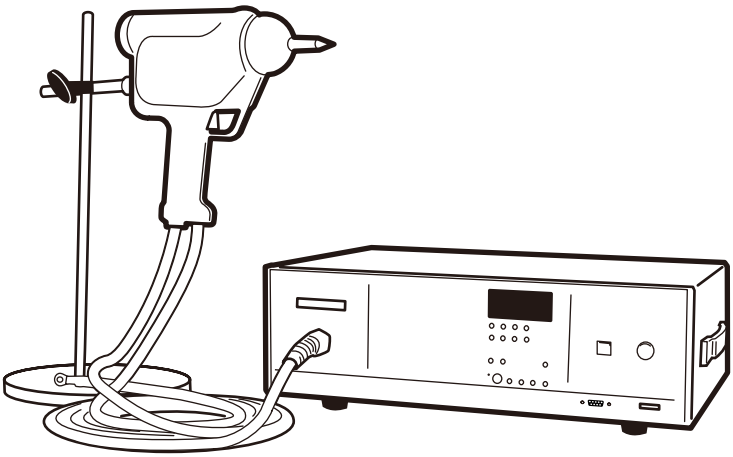
Part No. Z1-004-692, IB019862
Aug. 2014

OPERATION MANUAL

Electrostatic Discharge Simulator

KES4021A



DANGER

This instrument generates high voltage.

- Any incorrect handling may cause death.
- Read “Precautions for Safe Use” in this manual to prevent accident.
- Keep this manual near the instrument for easy access of the operator.

KIKUSUI

Use of Operation Manual

Please read through and understand this Operation Manual before operating the product. After reading, always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

If you find any incorrectly arranged or missing pages in this manual, they will be replaced. If the manual gets lost or soiled, a new copy can be provided for a fee. In either case, please contact Kikusui distributor/agent, and provide the “Kikusui Part No.” given on the cover.

This manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

Terms used in the manual

The instrument: all equipment, including the main unit and discharge gun

Main unit: entire panel operating unit, not including the discharge gun

Discharge gun: entire discharge gun, including the high-voltage cable

IEC 61000-4-2 Standard: IEC 61000-4-2 Ed.2.0 2008-12

ISO 10605 Standard: ISO 10605 Ed.2.0 2008-07

■ Applicable product firmware version

- KES4021A version 1.0 X or later

To check your firmware version, see 5.1 "Power on".

For inquiries concerning the product, please contact your Kikusui distributor or agent and provide your instrument's firmware version and serial number, located on the rear panel.

To the supervisor in charge of operation

- **If the operator does not read the language used in this manual, translate the manual into the appropriate language.**
- **Help the operator in understanding this manual before operation.**
- **Keep this manual near the instrument for easy access by the operator.**

For your own safety (to avoid electric shock)

Any of the following operations will result in a potentially fatal electric shock.

- **Touching the tip of the discharge gun while output is being generated from the instrument will result in electric shock.**
- **Touching the cup element of the discharge gun while output is being generated from the instrument will result in electric shock.**
- **Touching the Equipment Under Test (EUT) while output is being generated from the instrument will result in electric shock.**
- **Touching a component electrically connected to the EUT immediately after shutting down output will result in electric shock.**

Any of the following operations could result in a potentially fatal electric shock.

- **Operating the instrument without connecting a grounding wire may result in electric shock.**
- **Approaching a section electrically connected to the EUT while output is being generated from the instrument may result in electric shock.**
- **Approaching a section electrically connected to the EUT immediately after shutting down output may result in electric shock.**

Degraded service life of the high-voltage switch

The high-voltage switch to initiate discharge in the discharge gun is a consumable component. If the discharge gun is used under the following condition, the service life of the high-voltage switch may degrade significantly.

- **When the test voltage is set above the IEC TEST LEVEL.**
- **Used consecutively with the discharge interval set less than 1 second.***
- **Used in the test conditions other than the IEC and ISO standards.**
- **Used in combination with the optional C unit and discharge resistor.**

***The mechanical life of the high-voltage switch is 1,000,000 operations. The service life is approximately 14 hours (calculated value) if a test is performed using repetitive discharge (20 pulses/sec).**

⚠Safety Symbols

For the safe use and safe maintenance of this product, the following symbols are used throughout this manual and on the product. Understand the meanings of the symbols and observe the instructions they indicate (the choice of symbols used depends on the products).

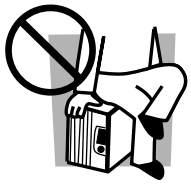
	Indicates that a high voltage (over 1000 V) is used here. Touching the part causes a possibly fatal electric shock. If physical contact is required by your work, start work only after you make sure that no voltage is output here.
DANGER	Indicates an imminently hazardous situation which, if ignored, will result in death or serious injury.
⚠WARNING	Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if ignored, may result in damage to the product and other property.
	Shows that the act indicated is prohibited.
	Is placed before the sign “DANGER,” “WARNING,” or “CAUTION” to emphasize these. When this symbol is marked on the product, see the relevant sections in this manual.
	Indicates a protective conductor terminal.
	Indicates a chassis (frame) terminal.

⚠ Safety Precautions

The following safety precautions are intended to avoid fire hazard, electric shock, and other accidents or failures. Please read and understand these precautions and ensure that all are properly observed.

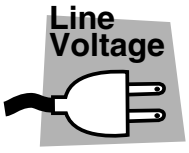
Users

- This product must be used only by qualified personnel who understand the contents of this Operation Manual.
- If this product is handled by unqualified personnel, personal injury may result. Ensure that the product is handled under the supervision of qualified personnel (i.e., those experienced in electrical applications).
- This product is neither designed nor manufactured for general home or consumer use.
- The product must not be operated by those with cardiac difficulties (including heart disease), women who are or may be pregnant, or those using medical devices such as pacemakers.



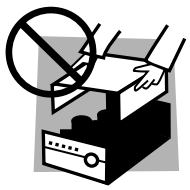
Purposes of use

- Do not use the instrument for any purpose other than ESD immunity tests on electric or electronic devices.
- Use of the instrument for purposes other than conducting ESD immunity tests could result in breakage.
- Use of the product in a manner not specified or described in this manual could impair the protective features of the product.



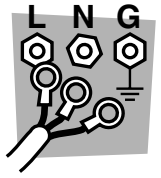
Input power

- Always use the product within the rated input line voltage range.
- To supply power, use the AC power cord provided. In some cases the provided power cord cannot be used, for example with certain products capable of switching among different input line voltages or products that can use either a 100 V or 200 V line (without switching). In such cases, use the appropriate power cord. For more information, see the relevant pages in this manual.
- This product is designed as an IEC Standards Overvoltage Category II device (equipment consuming energy supplied from a stationary facility).



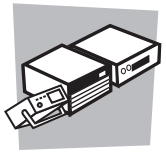
Cover

- Components inside the instrument may present physical hazards. Do not remove the external cover.



Grounding

- This product consists of Safety Class I equipment (equipment provided with a protective conductor terminal) as set forth in the IEC Standards. To prevent electric shock, always connect the protective conductor terminal of the product to electrical ground (safety ground) and install otherwise in compliance with the grounding requirements of the Electrical Codes and Regulations applicable in your area.



Installation

- This product is designed for indoor use. Only use it indoors.
- When installing products be sure to observe “2.2 "Precautions in Installation"” described in this manual.

Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Be sure the operation manual be included when the product is relocated.

Operation

- Check that there is no abnormality on the surface of the power cord, the discharge gun and the high-voltage cable. Be sure to unplug the power cord or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it immediately. Unplug the power cord or disconnect the power cord from the switchboard. Be careful not to allow the product to be used before it is completely repaired.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.

Maintenance and checking

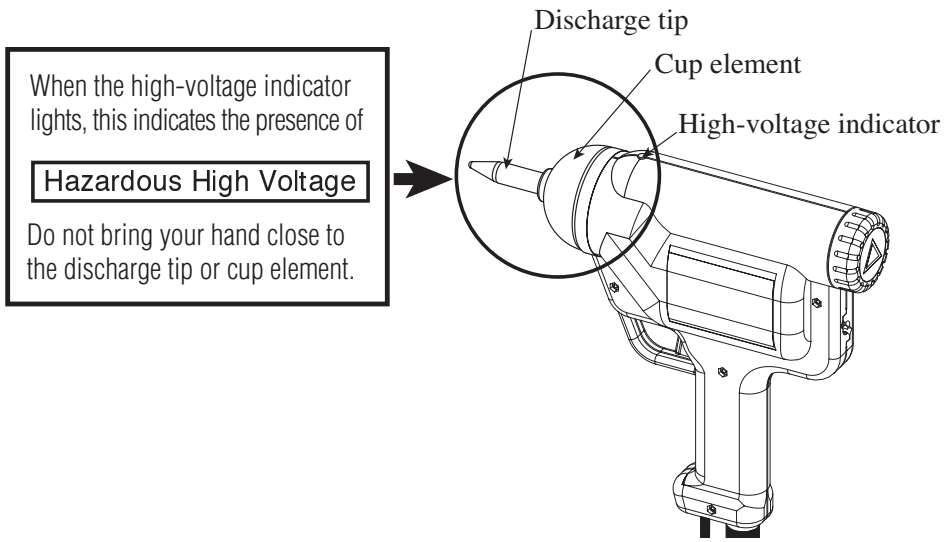
- To avoid electric shock, be absolutely sure to unplug the power cord or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact Kikusui distributor/agent.

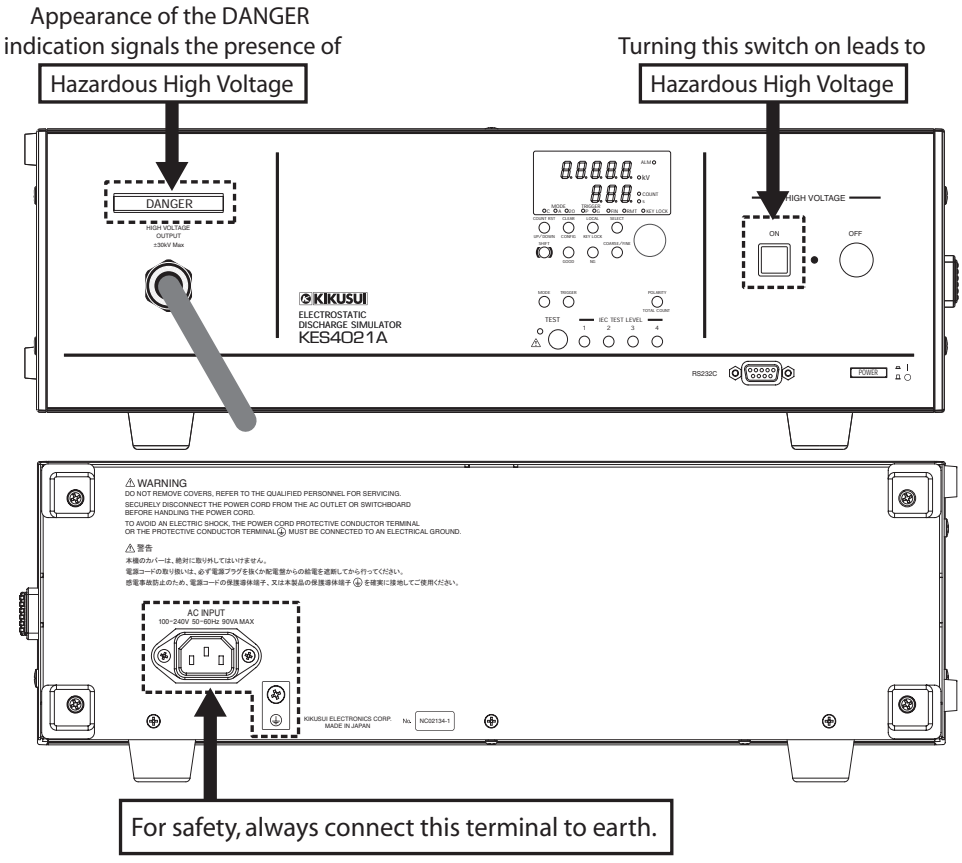
Discharge gun

- When using the discharge gun, always ensure that you have read and understood Chapter 3 "Precautions for Safe Use".



Front and rear panels

- Before using the instrument, ensure that you have read and understood Chapter 3 "Precautions for Safe Use".



Contents

Chapter 1 Outline

Provides a general outline and describes the features of the instrument.

1.1 Outline

Electrostatic discharge is a commonly occurring phenomenon. Invasion of an arc current or electromagnetic wave produced by this discharge in an electronic circuit may cause malfunction or circuit damage. This is a significant concern today given the widespread use of semiconductors in electric and electronic devices. Accordingly, a number of methods of testing for resistance to electrostatic discharge, as well as standards relating to such resistance have been established.

This instrument is used to perform immunity testing on electric and electronic devices subject to electrostatic discharges. It is capable of performing testing conforming to IEC 61000-4-2 Standards.

1.2 Features

■ Testing according to the IEC 61000-4-2 Standards

The instrument complies with the IEC 61000-4-2 Ed.2.0 2008-12.

IEC/ISO-compliant model conform to the ISO 10605 Ed. 2.0 2008-07 standard for the electrostatic discharge testing of automotive electronics.

■ Up to ±30 kV output

Maximum test voltage is ±30 kV. This allows you to conduct preliminary testing or allowance testing. The instrument can perform contact discharge or air discharge.

■ Operability

The design of the main unit control panel places prime importance on operability. For example, the user may select from among various test levels.

1.3 Options

For information about options, contact your Kikusui agent or distributor.

CR Units and Discharge Tips for the ISO 10605 Standards

We offer discharge tips and CR units. A CR unit consist of an energy storage capacitor and a discharge resistor.

■ CR units

Calibration is necessary if you want to change the CR unit that is included as standard, and perform testing based on standards such as IEC 61000-4-2 and ISO 10605. To have your KES4021A calibrated, contact your Kikusui distributor or agent.

- CR32-KES: 330 pF/330 Ω
- CR33-KES: 150 pF/2 kΩ
- CR34-KES: 330 pF/2 kΩ

■ Discharge Tips

- AT32-KES: air discharge tip (2 kΩ)
- CT32-KES: contact discharge tip (2 kΩ)
- ST31-KES: sphere discharge tip (330 Ω)
- ST32-KES: sphere discharge tip (2 kΩ)

C units / Discharge resistors

IEC61000-4-2 specifies the combination of a 150-pF energy storage capacitor and a 330-W discharge resistor. These options are used to test other combinations.

C units
EC21-KES: 150 pF
EC22-KES: 100 pF
EC23-KES: 200 pF

Discharge resistors	
DR21-KES: 330 Ω	DR29-KES: 1.5 kΩ
DR22-KES: 100 Ω	DR30-KES: 2 kΩ
DR23-KES: 150 Ω	DR31-KES: 5 kΩ
DR24-KES: 200 Ω	DR32-KES: 10 kΩ
DR25-KES: 300 Ω	DR33-KES: 10 Ω
DR26-KES: 400 Ω	
DR27-KES: 500 Ω	
DR28-KES: 1 kΩ	

1.4 Electrostatic discharge immunity testing environment

IEC61000-4-2 defines electrostatic discharge immunity testing apparatus based on the characteristics of the EUT. These options can be combined to create an apparatus for performing electrostatic discharge immunity testing that is appropriate for the EUT.

■ Ground reference plate (GP21-KES)

Three aluminum plates are joined together to create the ground reference plane whose dimensions are 1800 mm x 2700 mm x 1.6 mm. The size of each aluminum plate is 1800 mm x 900 mm.

■ Horizontal coupling plane (ZC21-KES)

The horizontal coupling plane measures 1600 mm x 800 mm and is a metal plate with the same thickness and material as the ground reference plane.

■ Vertical coupling plane (VC21-KES or VC22-KES)

The vertical coupling plane is used to perform indirect discharge testing. The vertical coupling plane measures 500 mm x 500 mm and is a metal plate with the same thickness and material as the ground reference plane.

- VC21-KES Tabletop type
- VC22-KES Floor-standing type

■ Resistance cable (CL21-KES)

This cable is used to connect the horizontal or vertical coupling plane to the ground reference plane. A 470-k¾ resistor is attached to each end.

■ Insulation sheet (IS21-KES)

This 0.5-mm-thick sheet is used to electrically isolate the horizontal coupling plane from the EUT.

■ Testing table (TT21-KES)

This table is used to test EUTs that are designed to be used on a tabletop. It is a wooden table that is 800 mm in height whose tabletop measures 1600 mm x 800 mm.

■ Insulation pallet (IP21-KES)

This 10-cm-thick pallet is placed on the ground reference plane to insulate the EUT from the ground reference plane.

■ Discharge gun stand (GS21-KES)

This stand is used to hold the discharge gun.

Dimensions: 402 mm x 200 mm

Weight: Approx. 3 kg.

2

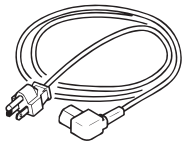
Chapter 2 Installation and Preparation for Use

Describes the preliminary procedures for use of the KES4021A, starting with unpacking.

2.1 Unpacking Check

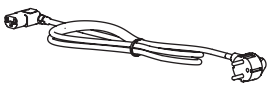
Upon receiving the product, make sure that you have all the necessary accessories and that neither the product nor any accessory has been damaged during transport.

In the event that any part is damaged or missing, contact your Kikusui distributor or agent.



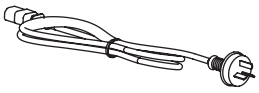
PLUG: NEMA5-15
[85-AA-0003]

OR



PLUG: CEE7/7
[85-AA-0005]

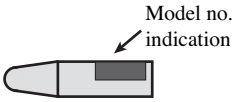
OR



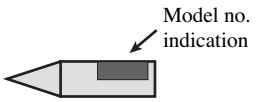
PLUG: GB1002
[85-10-0790]

☐ Power Cord (1 pc.)

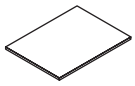
The power cord that is provided varies depending on the destination for the product at the factory-shipment.



☐ Air discharge tip
(330 Ω) [AT31-KES]

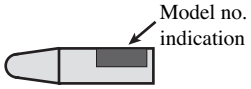


☐ Contact discharge tip (330 Ω)
(with protective cap)
[CT31-KES]

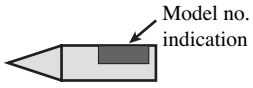


☐ Operation Manual (1 copy)
[Z1-004-692]

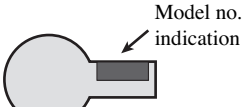
IEC/ISO-compliant model only



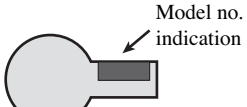
☐ Air discharge tip
(2 kΩ) [AT32-KES]



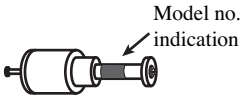
☐ Contact discharge tip (2 kΩ)
(with protective cap)
[CT32-KES]



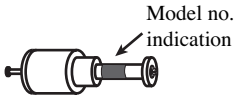
☐ Sphere discharge tip
(330 Ω) [ST31-KES]



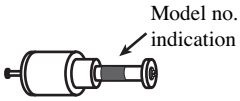
☐ Sphere discharge tip
(2 kΩ) [ST32-KES]



☐ CR unit
(330 pF/330 Ω)
[CR32-KES]



☐ CR unit
(150 pF/2 kΩ)
[CR33-KES]



☐ CR unit
(330 pF/2 kΩ)
[CR34-KES]

Fig.2-1 Accessories

The CR31-KES unit (that consists of a 150-pF energy storage capacitor and a 330-¾ discharge resistor) is built into the discharge gun.

NOTE

- We recommend that you save all packing materials for use in the event the product is to be transported at a later time.

2.2 Precautions in Installation

Be sure to observe the following precautions when installing the product.

■ Do not use the instrument in a flammable atmosphere.

To prevent explosion or fire, do not use the instrument near combustible materials such as alcohol or thinner, or in an atmosphere containing similar vapors.

■ Avoid locations subject to high temperatures or exposed to direct sunlight.

Do not place the instrument near a heater or in areas subject to drastic temperature fluctuations.

Operating temperature range:	+10 °C to +40 °C (+50 °F to +104 °F)
Storage temperature range:	-5 °C to +70 °C (+23°F to 158 °F)

■ Avoid humid locations.

Do not place the instrument in a high-humidity location such as near a boiler, humidifier, or water supply.

Specification-assured humidity range:	10% to 80% RH (with no condensation)
Storage humidity range:	10% to 80% RH (with no condensation)

Condensation may occur even within the specification-assured humidity range. In such case, do not begin using the instrument until it is completely dry.

■ The serviceable altitude limit is 1300 m above sea level.

■ Always use the instrument indoors.

The product is designed for safe indoor use.

■ Provide sufficient space around the power plug.

Do not insert the power plug into an electrical outlet that would cause difficulty in insertion or do not locate an object near the plug that would make plug insertion/ extraction difficult.

■ Always connect the protective conductor terminal to electrical ground (safety ground).

This product consists of Safety Class I equipment (equipment provided with a protective conductor terminal) as set forth in the IEC Standards. To prevent electric shock, always connect the protective conductor terminal of the product to electrical ground (safety ground) and install otherwise in compliance with the grounding requirements of the Electrical Codes and Regulations applicable in your area.

■ Do not install the instrument in a corrosive atmosphere.

Do not install the instrument in a corrosive atmosphere; e.g., one containing sulfuric acid mist or similar substances, as doing so may cause corrosion of conductors or improper connector contacts in the instrument, resulting in malfunction or failure that could lead to fire.

■ Do not place the instrument in a dusty environment.

Dirt and dust in the instrument may result in electric shock or fire.

■ Do not use the instrument in areas of poor ventilation.

Provide sufficient space around the instrument to ensure that air circulates around the product.

■ Do not place any object on the instrument.

In particular, heavy objects placed on the instrument could lead to equipment failure.

■ Do not install the instrument on a tilted surface or in a location subject to vibration.

Failure to observe this precaution may cause the instrument to fall, resulting in damage or injury.

■ Do not use the instrument in locations affected by strong magnetic or electric fields or in locations exposed to waveform distortion or input power noise.

Placing the product in such a location may result in malfunction.

■ Do not use the instrument in the vicinity of any medical, electronic, or communication equipment other than the EUT.

As this product generates powerful electromagnetic noise, it is recommended that it be used in a shielded enclosure. Moreover, use the instrument at a sufficient distance from devices such as medical, electric, electronic, or communication equipment that may malfunction under such circumstances.

■ Do not place any object near the instrument that could result in injury to the operator in the event of contact.

If the operator accidentally receives a high voltage generated by the instrument, he or she is likely to have a spontaneous reflex that includes rapid withdrawal of the arm or body.

To avoid secondary injuries such as collisions, falls, etc. caused by such reflexes (in addition to any direct damage caused by the electric shock), conduct testing in a clean and uncluttered location.

■ Do not conduct testing in the event of a hazardous situation caused by short-circuiting of the power supply to the EUT.

If the EUT is broken, in some cases there is a short circuit in the power supply. Take the necessary measures to ensure that no hazardous state will result even in these cases.

It is recommended that an isolation transformer be used for the AC power supply used in the test environment, in order to isolate the supply from other power systems.

■ Conduct testing in accordance with the testing environment determined by the relevant standards.

The standards specify testing environment conditions such as the size of the ground reference plane, distance from the wall, use of a horizontal coupling plane, and use of the vertical coupling plane. Consult the relevant standards.

2.3 Precautions in Moving

When moving or transporting this product to an installation site, observe the following precautions.

■ Turn the power switch off.

Moving the instrument with the power on may result in electric shock or damage.

■ Hold the instrument with both hands when moving, exercising care not to drop the discharge gun.

Remove the discharge tip from the discharge gun.

Disconnect the discharge return cable from the ground reference plane.

■ Disconnect all connected wiring.

Moving the instrument with the cables connected may cause a break in the cables or cause the instrument to fall, resulting in injury.

■ When transporting the product, always use the dedicated packing materials.

If the dedicated packing materials are not used, the instrument could fall or could be subject to vibration during transportation, resulting in breakage.

■ Always keep this manual with the instrument.

2.4 Preparing the Discharge Gun

⚠WARNING

- When the power switch is on, do not check the CR unit or attach a discharge tip to the discharge gun.
- Before checking the CR unit, turn the power switch off and wait for more than 1 minute to avoid risk of electric shock.
- Exercise care not to drop the discharge gun. Use of a discharge gun that has been dropped could pose a risk of electric shock.
- Before conducting testing, clean the discharge gun's cup element (red component) to maintain proper insulation. For instructions on cleaning, see 7.1, "Cleaning."

CR units and discharge tips can distinguish discharge resistor value with the color of the model display label.

330 ¾ discharge resistors: Purple

2 k¾ discharge resistors: Green

CR Unit

The CR unit consists of an energy storage capacitor to initiate electrostatic discharge and a discharge resistor that limits the discharge current.

⚠WARNING

- Removing the CR unit cap while power is on causes the alarm buzzer to sound, to warn of the risk of electric shock. Always turn the power switch off before removing the CR unit cap.

NOTE

- Do not remove the CR unit's internal discharge resistor. If you do so, the generated waveform is no longer guaranteed.

Procedure to check the constant values indicated on the label:

1. Turn the power switch off.
2. Leave the main unit and discharge gun stand for more than 1 minute to allow voltage to discharge naturally to a safe level.
3. Remove the CR unit cap and then disconnect the CR unit from the discharge gun.
4. Check that capacitor indication is 150 pF (for the standard unit) and that the discharge resistance indication is 330 Ω (for the standard unit).
5. Reattach the CR unit to the discharge gun.
6. Securely attach the CR unit cap to the discharge gun.

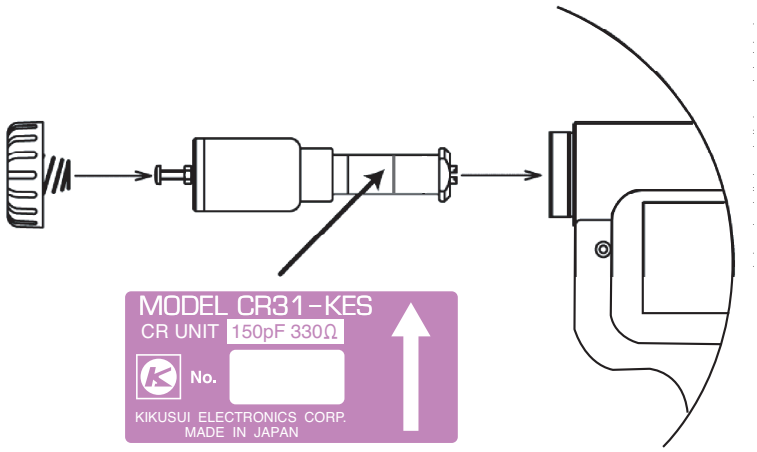
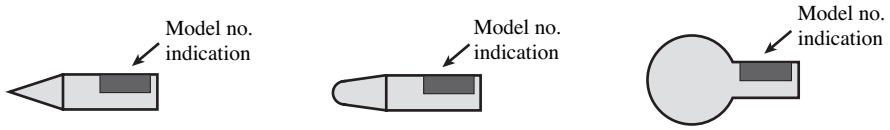


Fig. 2-2 Checking the CR Unit Constant Values

Discharge Tips

Discharge tips are metallic electrodes used to discharge static electricity to the EUT. There are three types of discharge tips (contact discharge tip, air discharge tip, and sphere discharge tip), according to the testing objective.



Contact discharge tip

Air discharge tip

Sphere discharge tip (IEC/ISO-compliant model only)

Fig. 2-3 Discharge Tips

⚠ WARNING

- Before replacing the discharge tip, turn the power switch off and wait for more than 1 minute to avoid risk of electric shock.
- The contact discharge tip is sharp. Attach the provided protective cap to the discharge tip at all times other than during testing. (Note that because the protective cap is made of vinyl, application of strong force from the end may cause the discharge tip to penetrate the cap, which could result in injury.)

⚠ CAUTION

- Do not drop or apply strong force to the discharge tip. Otherwise it may break or the generated waveform may be deformed.

Procedure for attaching a discharge tip to the discharge gun:

1. Turn the power switch off.
2. Leave the main unit and discharge gun for more than 1 minute to allow voltage to discharge naturally to a safe level.
3. Attach the selected discharge tip to the discharge gun securely. Turn the discharge tip clockwise (when viewing the discharge gun cup element from the front) to secure it to the gun.

Discharge Return Cable

This cable is used as a discharge current return line.

Connecting procedure:

1. Turn the power switch off.
2. Leave the main unit and discharge gun for more than 1 minute to allow voltage to discharge naturally to a safe level.
3. Connect the discharge return cable of the discharge gun securely to the ground reference plane.

⚠WARNING • Improper connection of the discharge return cable to the ground reference plane may result in electric shock.

2.5 Connecting the Power Cord

This product is designed as an IEC Standards Overvoltage Category II device (equipment consuming energy supplied from a stationary facility).

NOTE

- To connect to the AC power line, use the accessory power cord.
  If the accessory power cord cannot be used because of its rated voltage or plug shape,have a qualified engineer replace it with an appropriate power cord of 3 m or shorter. If it is difficult to procure the power cord, contact your Kikusui distributor or agent.
- A power cord with a plug can be used to disconnect this product from the AC power line in an emergency. To disconnect the plug from the outlet at any time, connect the plug to an outlet within your reach and keep sufficient space around the outlet.
- Do not use the accessory power cord to operate another device.

Procedure for connecting the power cord:

1. Check that the AC power to be supplied meets the nominal input rating of the instrument.

   Nominal input ratings: 100 V to 240 V AC, 50/60 Hz

   The voltage that can be input may be any nominal voltage in the range of 100 V to 240 V AC at a nominal frequency of 50 Hz or 60 Hz.
2. Confirm that the power switch is off.
3. Connect the AC power cord to the AC INPUT connector on the instrument's rear panel.
4. Connect the other end of the AC power cord to an electrical outlet.

2.6 Grounding

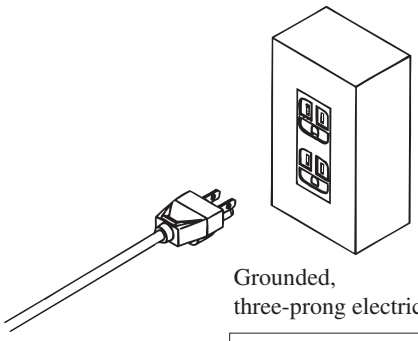
⚠ WARNING • This product consists of Safety Class I equipment (equipment provided with a protective conductor terminal) as set forth in the IEC Standards. To prevent electric shock, always connect the protective conductor terminal of the product to electrical ground (safety ground) and install otherwise in compliance with the grounding requirements of the Electrical Codes and Regulations applicable in your area.

⚠ CAUTION • If no ground is provided, malfunction may result due to external noise; the instrument may also generate significant noise.

Never use the instrument without first grounding it.

There are two methods of grounding the product. Ground the instrument properly in accordance with one of these methods:

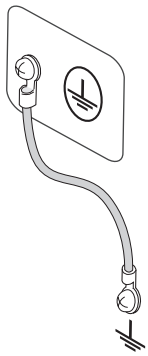
- Connect the power plug to a grounded, three-prong electrical outlet.



Grounded,
three-prong electrical outlet

The type of power cord provided will differ depending on the nominal service voltage range set upon shipment.

- Connect the protective conductor terminal on the rear panel to an electrical ground (safety ground) or otherwise in compliance with the grounding requirements of the Electrical Codes and Regulations applicable in your area.
  The selection and preparation of wire materials and installation of wire should be performed by an authorized electrical engineer. Connect to an electrical ground (safety ground) securely using the appropriate tool.



Ground to an electrical ground (safety ground) or otherwise in compliance with the grounding requirements of the Electrical Codes and Regulations applicable in your area.

Fig. 2-4 Grounding Methods

Chapter 3 Precautions for Safe Use

Describes the precautions to prevent accidents involving personal injury or death.

⚠ WARNING • This instrument supplies voltage as high as 30 kV to the exterior; improper operation could result in a fatal accident. To prevent such an accident, observe the precautions described here and use the instrument with the utmost attention to safety verification.

List of items to be described in this chapter

The numbers below reflect the section numbers in this chapter.

3.1 Check Prior to Daily Operation

High-voltage Cable

- Check that the cable covering is free of deterioration and damage (including the discharge return cable).
- Check that there is no displacement of any outer sheath or looseness in the HIGH VOLTAGE OUTPUT section or at the base of the discharge gun.

Discharge Gun High-voltage Section

- Check that there are no cracks in the discharge gun and no loose screws.

⚠WARNING • A maximum voltage of 30 kV is applied to the discharge gun; any abnormality in the discharge gun or high-voltage cable may pose a risk of electric shock. In such case, turn the power switch off immediately and unplug the power cord from the electrical outlet.

CR Unit Cap

Check that the cap is securely tightened.

⚠WARNING • Removing the CR unit cap while power is on causes the alarm buzzer to sound to warn of the risk of electric shock. Always turn the power switch off before removing the CR unit cap.

To maximize the duration of instrument performance, observe the following:

1. Always perform the check procedure before beginning daily operation.
2. Conduct periodic calibration (annually or twice a year).
3. Do not generate voltages higher than required.
4. Do not perform an unnecessary number of discharges.

NOTE

- The high-voltage switch to initiate discharge in the discharge gun is a consumable component. Its service life is affected by method of use, output voltage, and other factors. Note that discharging voltages higher than required or switching the voltage polarity will shorten the life of the main unit and/or discharge gun.

3.2 Precautions During Operation

⚠ WARNING

- The instrument features components generating voltages as high as 30 kV; these components are exposed for functional purposes. Do not bring your hand close to these components when high voltage is applied.
- During and after testing, the EUT and some of the metal parts present in the testing environment are charged in addition to the instrument. During testing, do not touch any part other than the ground reference plane. Also, even after completion of testing, metal components not electrically connected to the ground reference plane are also charged. Do not touch these components until the electricity has fully discharged.
- Never attempt to apply discharge to any part other than the EUT, vertical coupling plane, horizontal coupling plane, or ground reference plane.
- If you encounter any problem with this instrument, turn the power switch off and unplug the power cord from the electrical outlet. Turn the device on again only after resolving the cause of such abnormality and checking safety thoroughly.
- Before conducting testing, clean the discharge gun's cup element (red component) to maintain proper insulation. For instructions on the cleaning procedure, see 7.1, "Cleaning."
- In the event of fire, explosion, or electric shock during testing, turn the instrument's power switch off and unplug the power cord from the electrical outlet.
- High voltage may remain in the CR unit, posing a risk of electric shock. When replacing the CR unit, first release all electrical charge from the energy storage capacitor.
- To release all electrical charge, set the voltage to "0" kV and connect the discharge tip to GND to initiate discharge two to three times. After discharge, turn the POWER switch off.

⚠ CAUTION

- Use of the instrument in a manner not specified or otherwise described in this manual could impair the protective functions of the product.
- Do not drop the discharge gun, CR unit, or discharge tips. If any of these are dropped, contact your Kikusui agent or distributor to arrange an inspection of the dropped component.

3.2.1 Hazardous Points of the Discharge Gun

⚠WARNING • Do not bring your hand close to the discharge tip or cup element if the high-voltage indicator is lit; this indicates a risk of electric shock.

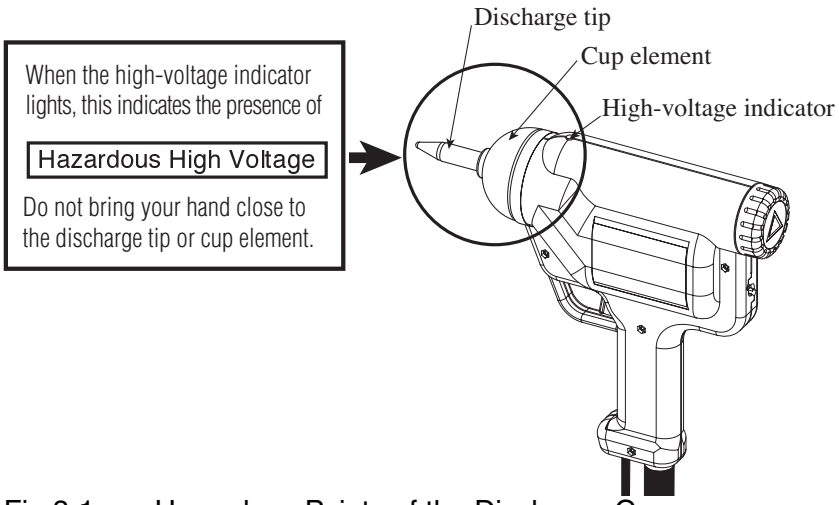


Fig.3-1 Hazardous Points of the Discharge Gun

⚠WARNING
- Appearance of the DANGER indication signals the presence of hazardous high voltage.
- Pressing the HIGH VOLTAGE ON switch presents a risk of exposure to hazardous high voltage.

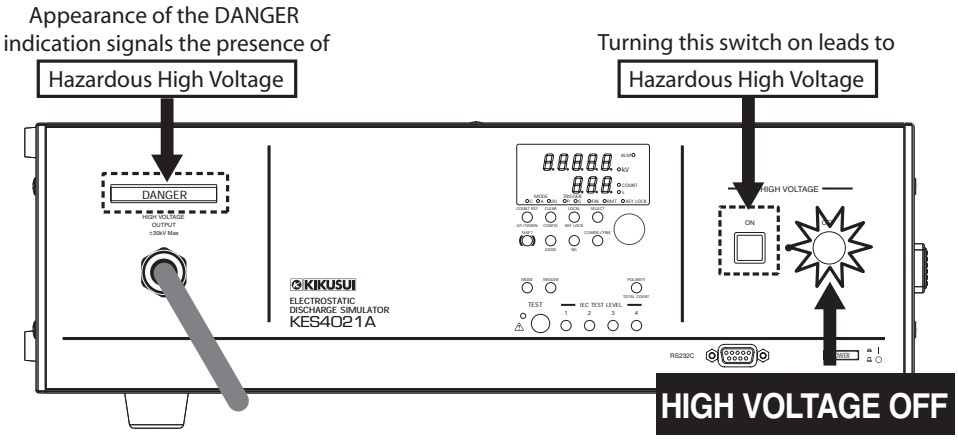


Fig. 3-2 Monitoring the Presence of Hazardous High Voltages

3.2.2 Interrupting a Test

■ Shutting down the high voltage source

Except during testing, press the HIGH VOLTAGE OFF switch to shut down the high voltage source. If the instrument will not be used for some time or the operator leaves the instrument, ensure that the power switch is off.

■ EUT is charged at high voltage

In testing using the instrument, the EUT and other components are charged at high voltages. It takes some time for the EUT and other parts to discharge even after the test has been interrupted. To avoid electric shock, never touch the EUT or other components until a safe period has elapsed following interruption of the test.

3.3 Prohibited Actions

■ Repeated powering on and off

Once you have turned the power switch off, wait for more than 10 seconds before turning it on again. In particular, do not turn the power switch on and off repeatedly while output is being generated. In some cases failure to observe this precaution will disable the instrument's protective functions, posing a danger.

Except for in cases of emergency, do not turn the power switch off while output is being generated.

■ Discharge to equipment other than the EUT

This poses a risk of electric shock. Do not initiate discharge to any devices other than the EUT. Failure to observe this precaution may cause the instrument or other devices to malfunction, due to the absence of a discharge current return line.

3.4 Steps to Be Taken in the Event of an Emergency

In the event of an emergency such as electric shock or burning of the EUT due to abnormality in the instrument, EUT, or other devices, take the following steps:

⚠WARNING
- In the event of danger, turn the power switch off and unplug the power cord from the electrical outlet immediately. This shuts down the instrument's high voltage source, stopping discharge.
- Types of dangers or abnormalities:
  - Electric shock
  - EUT breakage
  - Malfunction of equipment other than the EUT
  - Continuous sounding of the instrument's buzzer
  - Error in the instrument voltage setting
  - Abnormal noise from the discharge gun or instrument interior
- Record the problem and contact your Kikusui distributor or agent.

■ Turning Power on Again

Procedure to be taken in the event of a hazard in equipment other than the instrument:

1. Eliminate the source of the hazard.
2. Take suitable safety precautions.
3. Turn the power switch on.

Chapter 4 Part Names and Their Functions

Presents the names of controls and describes their functions, introduces the display unit, and provides additional related information.

4.1 Front Panel

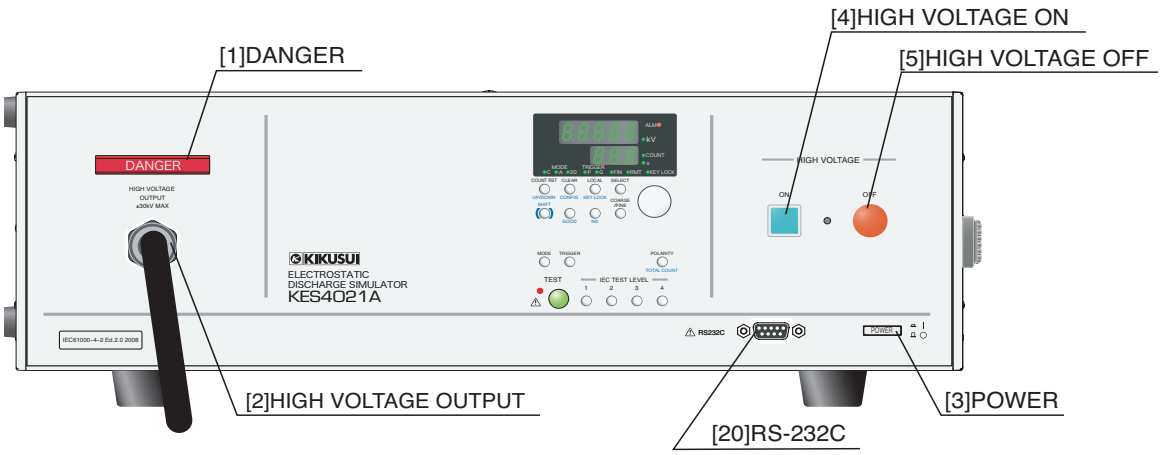


Fig. 4-1 Front Panel (Entire View)

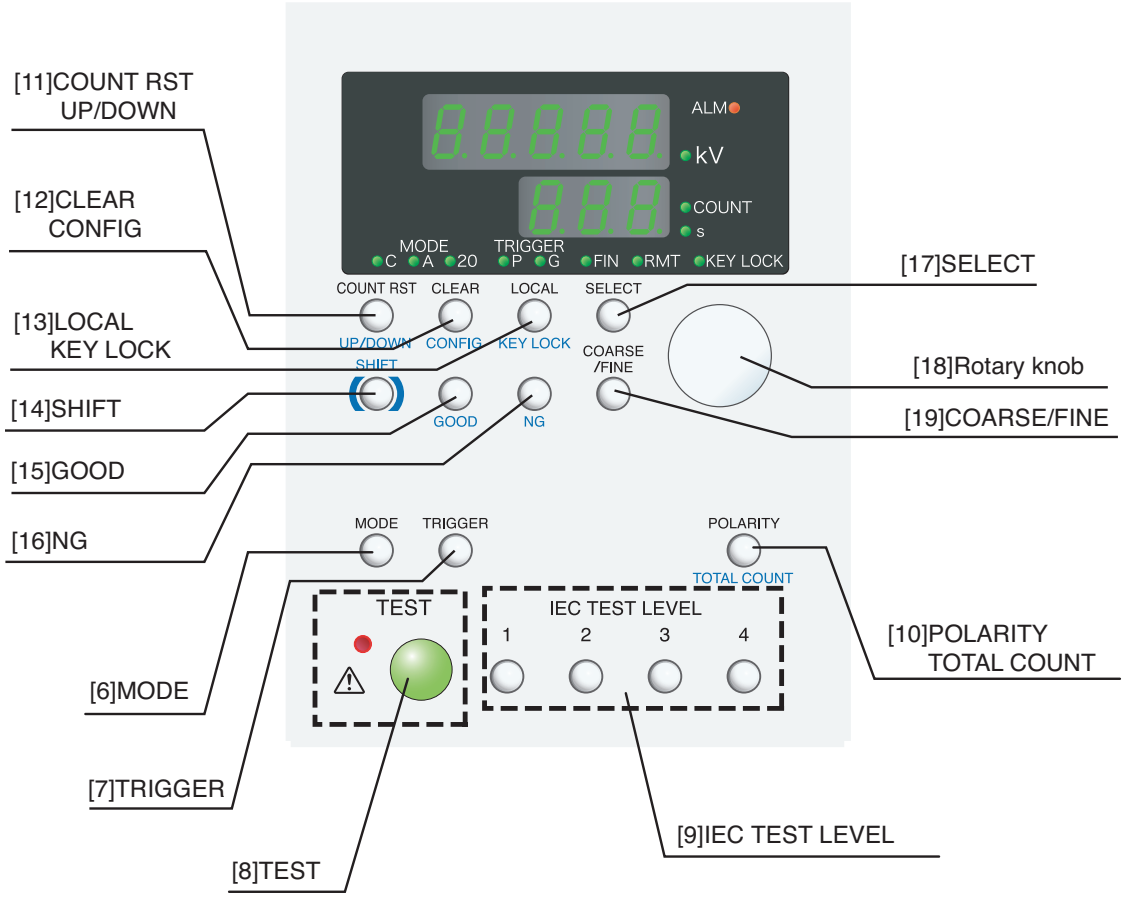


Fig. 4-2 Front Panel (Enlarged Control Section)

NOTE

- Pressing a key with the SHIFT key held down activates the function indicated in blue on the lower part of the key.
- In the manual, the operation of pressing a key with the SHIFT key held down is represented as "SHIFT + (indication in the upper part of the key)."

[1] DANGER indication

This indication lights when the HIGH VOLTAGE ON switch is pressed, indicating that high voltage power is being output or is in standby. When the HIGH VOLTAGE OFF switch is pressed, the indication goes off and high voltage power is shut down.

⚠WARNING

- While the DANGER indication is lit, do not touch or bring your hand close to any parts other than the discharge gun's grip or the EUT in order to avoid electric shock.

[2] HIGH VOLTAGE OUTPUT

This is the high-voltage output section. The high-voltage cable to the discharge gun is connected to this section. Do not exert force by pulling on the high-voltage cable. The cable is fastened to the interior chassis and cannot be removed.

[3] POWER switch

This is the instrument's power switch. Pressing this switch alternately turns power on and off. If this switch is pressed with the SHIFT key held down, the instrument is started with the factory settings.

[4] HIGH VOLTAGE ON switch

When this switch is pressed, the instrument enters the state in which high voltage power can be generated. In this case, the DANGER indication lights.

[5] HIGH VOLTAGE OFF switch

When this switch is pressed, output of high voltage power is shut down. This causes the DANGER indication to go off.

[6] MODE key

Used to switch the discharge mode. Each time this key is pressed, the discharge mode is switched, lighting the relevant mode LED.

C: contact discharge mode (single discharge)

A: air discharge mode (single discharge)

20: contact discharge mode (repetitive discharges, 20 pulses/sec.)

Fig. 4-3 Mode Indication Change

[7] TRIGGER key

Selects the method of initiating discharge. This allows you to select between the trigger switch and the TEST key.

"P" LED is lit: TEST key is selected.

"G" LED is lit: Trigger switch is selected.

[8] TEST key

Pressing this key alternately starts and stops testing. When testing starts, the TEST LED lights. This key is enabled only when the TRIGGER key has been used to select "P" (front panel).

[9] IEC TEST LEVEL (1, 2, 3, 4) keys

These are illuminated switches for selecting the IEC 61000-4-2 Standards test level. The switch corresponding to the selected level lights. Test levels cannot be changed during testing.

[10] POLARITY/TOTAL COUNT key

POLARITY

Switches the polarity of high voltage power. The voltage display section shows the "-" symbol only when high voltage power has negative polarity. At power on, high voltage power has positive polarity. Polarity cannot be changed during testing.

TOTAL COUNT

Pressing this key with the SHIFT key held down (SHIFT + POLARITY) displays the number of times the discharge gun's internal high-voltage switch has been used. Press this key again with the SHIFT key held down (SHIFT + POLARITY) to return to previous display.

[11] COUNT RST/UP/DOWN key

COUNT RST

This is a count indication reset switch. When the key is pressed, counter indication is reset to the initial set value.

UP/DOWN

Pressing this key with the SHIFT key held down (SHIFT + COUNT RST) enables selection between increment/decrement indication on the discharge counter.

The display unit presents a "count" indication status, allowing you to select "uP" (increments) or "dn" (decrements).

After setting, press this key again with the SHIFT key held down (SHIFT + COUNT RST) to return to the previous display.

[12] CLEAR/CONFIG key

CLEAR

When this key is pressed, the alarm is reset.

CONFIG

Pressing this key with the SHIFT key held down (SHIFT + CLEAR) activates CONFIG setup. Press this key again with the SHIFT key held down (SHIFT + CLEAR) to exit CONFIG setup.

In CONFIG setup, use the SELECT key to modify a given setting item. The selected setting item can then be changed using the rotary knob.

[13] LOCAL/KEY LOCK key

LOCAL

This key does not have an associated function.

KEY LOCK

Pressing this key with the SHIFT key held down (SHIFT + LOCAL) toggles between locked and unlocked status. For details the key lock function, see 5.3.2, “Use of the Key Lock Function”

[14] SHIFT key

When a key is pressed with the SHIFT key held down, the function indicated in blue on the lower part of the key is activated. Pressing a key without the SHIFT key activates the function indicated on the upper part of the key.

[15] GOOD key

This key does not have an associated function.

[16] NG key

This key does not have an associated function.

[17] SELECT key

Pressing this key changes the setting item from COUNT (discharge count) to kV (test voltage) to “s” (discharge interval), in succession.

The instrument displays test voltage in the upper part of the display unit and indicates the number of discharges or discharge interval in the lower part.

During testing, you can use this key to switch between discharge count and discharge interval displays.

[18] Rotary knob

Use this knob to set or select a variety of numerical values.

[19] COARSE/FINE key

This is the setting-digit selector switch for test voltage, allowing you to set the test-voltage setting resolution to COARSE (1 kV) or FINE (10 V). Pressing this key causes the voltage display to toggle between a steadily lit (10 V) and a blinking (1 kV) decimal point.

[20] RS-232C connector

The functionality of serial communications hardware is not disclosed. Under normal usage, there may be cases where the computer malfunctions during discharge testing. If you wish to perform communication or control via a personal computer (PC), contact your Kikusui distributor or agent.

4.2 Display Unit

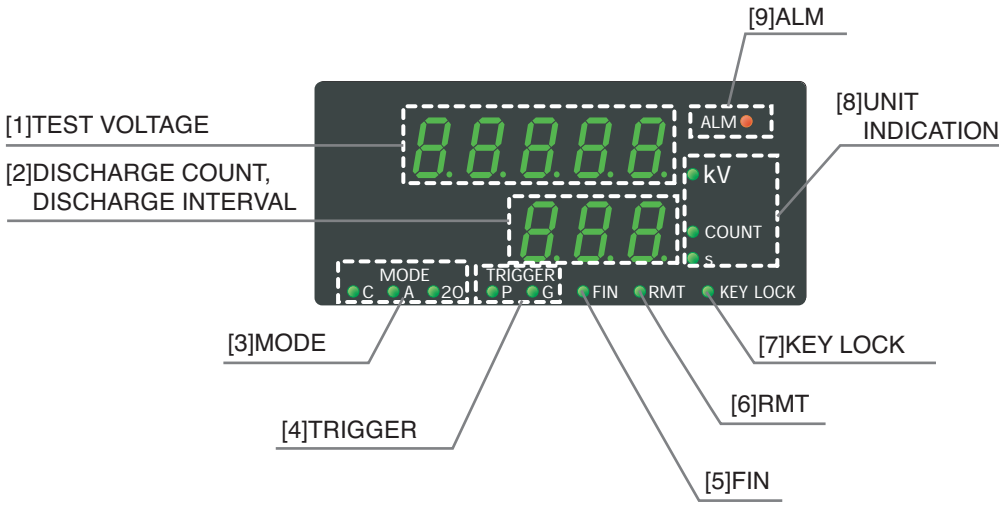


Fig. 4-4 Display Unit

[1] Test voltage

This area displays test voltage. In CONFIG setup, it displays a given setting item.

[2] Discharge count, discharge interval

This area displays the number of discharges or discharge interval. In CONFIG setup, this displays the set value.

[3] MODE (C, A, 20)

This area indicates the results of mode selection by the MODE key.

C: contact discharge mode (single discharge)

A: air discharge mode (single discharge)

20: contact discharge mode (repetitive discharge, 20 pulses/sec.)

[4] TRIGGER (P, G)

This area indicates the results of selection by the TRIGGER key.

"P" is lit: TEST key is enabled.

"G" is lit: Trigger switch is enabled.

[5] FIN

This indicator lights when the set number of discharges is complete.

[6] RMT

There is no function associated with this indicator. It is always inactive.

[7] KEY LOCK

Lights in key-locked status.

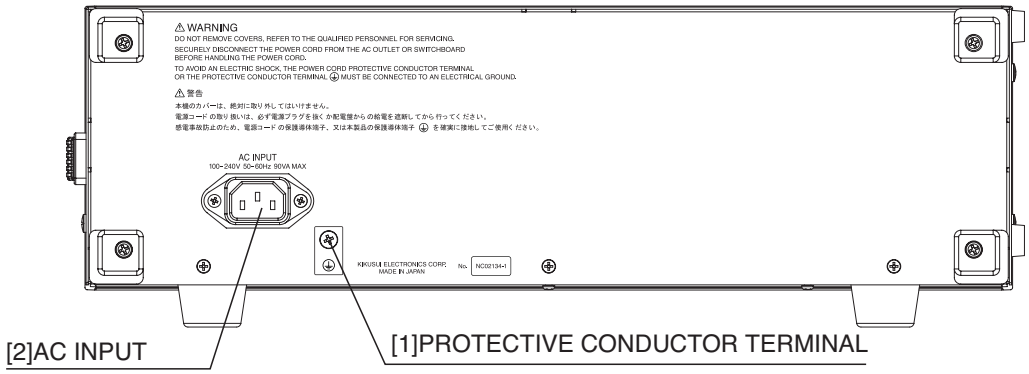
[8] kV, COUNT, s (unit indication)

The relevant LED from among “kV” (test voltage), COUNT (discharge count) and “s” (discharge interval) lights.

[9] ALM

Lights if the discharge gun’s CR unit cap is not securely tightened. (An alarm also sounds.)

4.3 Rear Panel



[1] Protective conductor terminal

This terminal is used to ground the instrument to earth.

For safety, always ground this terminal to an electrical ground (safety ground) or otherwise in compliance with the grounding requirements of the Electrical Codes and Regulations applicable in your area. For details on grounding, see 2.6, “Grounding.”

[2] AC INPUT connector

This is the instrument’s AC INPUT connector. Connect the power cord to this connector. For details on connection of the power cord, see 2.5, “Connecting the Power Cord.”

4.4 Discharge Gun

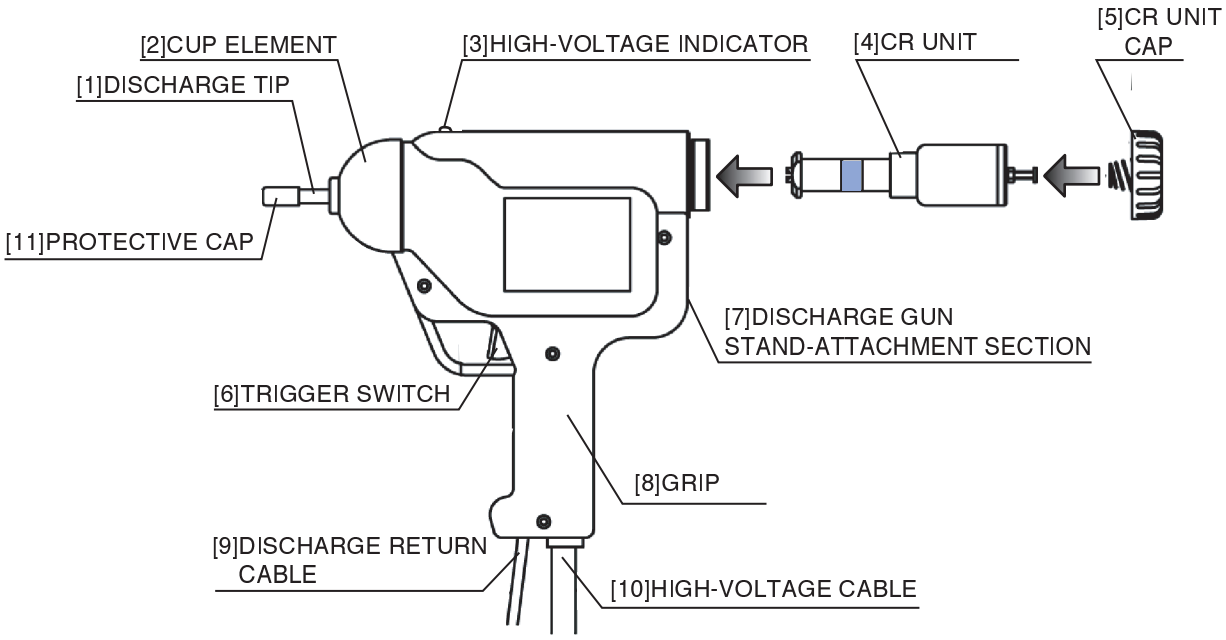


Fig. 4-5 Discharge Gun

⚠WARNING

- Observe the following precautions against the risk of high-voltage electric shock.
  - Do not bring your hand close to the discharge tip or cup element during testing.
  - When replacing the discharge tip, turn the POWER switch off, wait for a minimum of 1 minute, and then replace.
- The contact discharge tip is sharp, in accordance with the standards, and can cause injury. When the discharge gun is not in use, attach the provided protective cap to the discharge tip. (Note that because the protective cap is made of vinyl, application of strong force from the end may cause the discharge tip to penetrate the cap, which could result in injury.)

[1] Discharge tip

This element initiates discharge to the EUT. Two discharge tips are available: a contact discharge tip and an air discharge tip.

[2] Cup element

This section forms the discharge current waveform, and could be electrically charged at high voltages. During testing, do not touch or bring your hand close to any area other than the grip itself.

[3] High-voltage indicator

Lights when the HIGH VOLTAGE ON switch is pressed. Do not touch or bring your hand close to the discharge tip or cup element while this indicator is lit.

[4] CR unit

The unit inserted into the discharge gun, consisting of an energy storage capacitor and a discharge resistor. (In accordance with IEC 61000-4-2 Standards, the energy storage capacitor has a capacity of 150 pF and the discharge resistor has a capacity of 330 Ω. For testing in accordance with standards other than the IEC 61000-4-2 Standards, replace this CR unit with the appropriate optional CR unit.)

[5] CR unit cap

Loosen this cap to replace the CR unit in the discharge gun. Turning the cap counterclockwise enables removal of the CR unit.

⚠WARNING

- High voltage may remain in the CR unit, posing a risk of electric shock. When replacing the CR unit, first release all electrical charge from the energy storage capacitor.
- To release all electrical charge, set the voltage to "0" kV and connect the discharge tip to GND to initiate discharge two to three times. After discharge, turn the POWER switch off.
- Removing the CR unit cap while power is on causes the alarm buzzer to sound, warning of risk of electric shock. Always turn the POWER switch off before removing the CR unit cap.

---

[6] Trigger switch

When this switch is pulled, testing starts. This switch is enabled when "G" (discharge gun) is selected using the TRIGGER key.

While this switch is pulled in contact discharge mode, the discharge gun repeats the discharge action at the set discharge interval until the set number of discharges is reached.

In air discharge mode, discharge is initiated each time the trigger switch is pulled, and the number of trigger actions is counted.

[7] Discharge gun stand-attachment section

This component is used to attach an optional discharge gun stand.

[8] Grip

Grip this part to hold the discharge gun. When the POWER switch is on, some of the remaining components are charged at high voltages. Do not bring your hand close to any component other than the grip.

[9] Discharge return cable

This cable is used as a discharge-current return line. Do not use in a coiled or bundled arrangement.

[10] High-voltage cable

This is a composite cable combining shielded-type high-voltage wires and signal wire. Do not use in a coiled or bundled arrangement.

[11] Protective cap

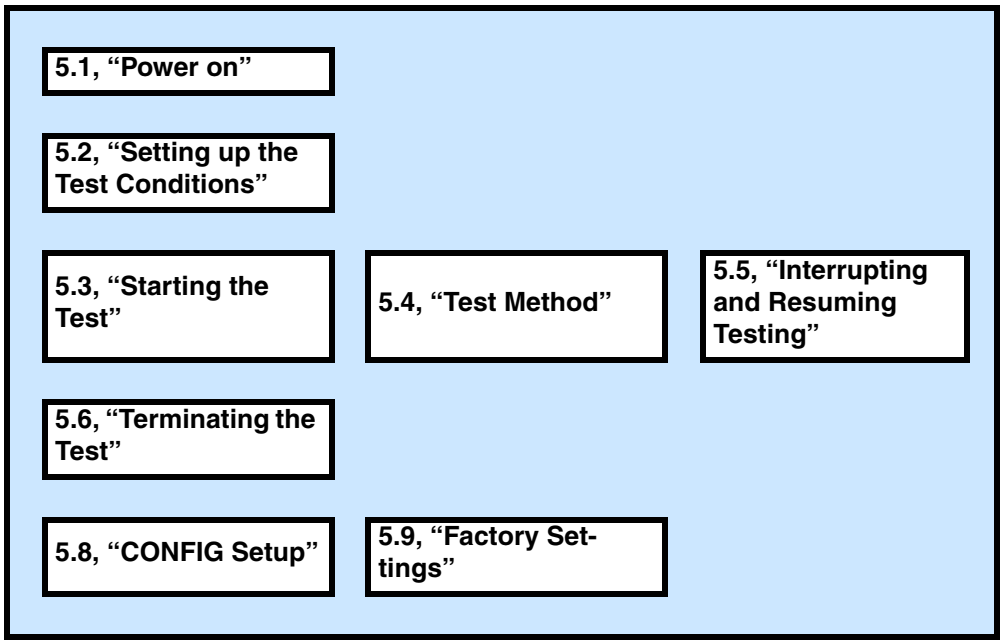
This is a protective cap for the contact discharge tip. The contact discharge tip has a sharp edge. If the discharge gun is not in use, attach the protective cap to the discharge tip. (Note that because the protective cap is made of vinyl, application of strong force from the end may cause the discharge tip to penetrate the cap, which could result in injury.)

Chapter 5 Operation Method

Describes the basic method of operation, concentrating on the functions of the respective components. For more information on the electrostatic discharge immunity tests, see the IEC 61000-4-2 Standards.

List of items to be described in this chapter

The numbers show the corresponding section numbers in this chapter. Operations are carried out in the order shown, from top to bottom.



⚠WARNING

- The instrument features components generating voltages as high as 30 kV; these components are exposed for functional purposes. Do not bring your hand close to these components when high voltage is applied.
- During and after testing, the EUT and some of the metal parts present in the testing environment are charged in addition to the instrument. During testing, do not touch any part other than the ground reference plane. Also, even after completion of testing, metal components not electrically connected to the ground reference plane are also charged. Do not touch these components until the electricity has fully discharged.
- Never attempt to apply discharge to any part other than the EUT, vertical coupling plane, horizontal coupling plane, or ground reference plane.
- If you encounter any problem with this instrument, turn the power switch off and unplug the power cord from the electrical outlet. Turn the device on again only after resolving the cause of such abnormality and checking safety thoroughly.
- Before conducting testing, clean the discharge gun’s cup element (red component) to maintain proper insulation. For instructions on the cleaning procedure, see 7.1, “Cleaning.”
- In the event of fire, explosion, or electric shock during testing, turn the instrument’s power switch off and unplug the power cord from the electrical outlet.
- High voltage may remain in the CR unit, posing a risk of electric shock. When replacing the CR unit, first release all electrical charge from the energy storage capacitor.

- To release all electrical charge, set the voltage to “0” kV and connect the discharge tip to GND to initiate discharge two to three times. After discharge, turn the POWER switch off.

5.1 Power on

Ensure that you have read and understood chapter 2, “Installation and Preparation for Use,” and chapter 3, “Precautions for Safe Use.”

Power-on procedure:

1. Turn the POWER switch on (|).

   All LEDs on the front panel light immediately after turning the POWER switch on. Subsequently the instrument displays the abbreviated model name in the upper part of the display unit and the firmware version in the lower part.

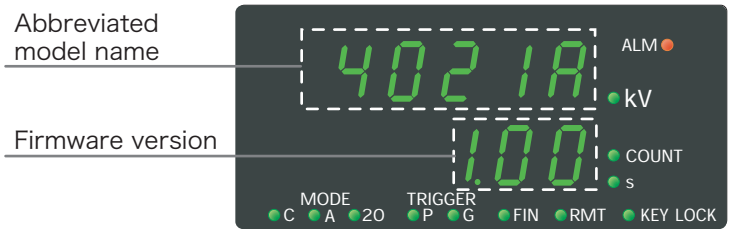


Fig.5-1 Abbreviated Model and Firmware Version

After displaying the abbreviated model and firmware version, the instrument starts up with the factory settings. If panel settings have been made in CONFIG setup and saved, the instrument starts up with the saved setting information. See 5.7, “CONFIG Setup,” for details on the CONFIG setup and 5.8, “Factory Settings,” for details on the factory settings.

Shutdown procedure:

1. Press the HIGH VOLTAGE OFF switch.
2. Set the test voltage to “0” kV.
3. Connect the discharge tip to GND and initiate discharge two to three times.
4. Turn the POWER switch off (O).

NOTE

- Ensure that there is an interval of 10 seconds between off and on operations of the POWER switch. Do not turn the POWER switch on and off unnecessarily. Failure to observe this precaution may result in damage to the instrument.

5.2 Setting up the Test Conditions

5.2.1 Selecting the Discharge Mode

⚠ CAUTION
- The high-voltage switch to initiate discharge in the discharge gun is a consumable component. If the discharge gun is used under the following condition, the service life of the high-voltage switch may degrade significantly.
- When the test voltage is set above the IEC TEST LEVEL.
- Used consecutively with the discharge interval set less than 1 second.*
- Used in the test conditions other than the IEC and ISO standards.
- Used in combination with the optional C unit and discharge resistor.

*The mechanical life of the high-voltage switch is 1,000,000 operations. The service life is approximately 14 hours (calculated value) if a test is performed using repetitive discharge (20 pulses/sec).

Selection procedure:

1. Press the MODE key to select the discharge mode.

   Pressing this key toggles between discharge modes, lighting the LED of the selected mode.

   C: contact discharge mode (single discharge)

   A: air discharge mode (single discharge)

   20: contact discharge mode (repetitive discharges, 20 pulses/sec.)

Fig. 5-2 Mode Indication Change

The discharge gun must be provided with the appropriate discharge tip in accordance with the discharge mode (contact discharge or air discharge). For more information, see 2.4, “Preparing the Discharge Gun.”

5.2.2 Setting the Number of Discharges

NOTE
- Set an appropriate number of discharges, bearing in mind that the electrostatic discharge immunity test applies electrical stress to the EUT.

Setting procedure:

1. Press the SELECT key to choose COUNT.
2. Using the rotary knob, set the number of discharges.

   Turning the rotary knob clockwise increases the number of discharges, while turning it counterclockwise decreases the number of discharges. If “---” is set, continuous discharge mode is in effect.

   Setting range: 1 to 999 times

   The IEC 61000-4-2 Standards stipulate 10 discharges to a given location.

Discharge count-changing procedure:

1. Press the HIGH VOLTAGE OFF switch.
   The instrument enters standby status.
2. Press the SELECT key to choose COUNT.
3. Using the rotary knob, set the number of discharges.

Discharge counter's increment/decrement indication setting:

1. Press the UP/DOWN (SELECT + COUNT RST) key.
2. Using the rotary knob, set to "uP" (increments) or "dn" (decrements).
3. Press the UP/DOWN (SHIFT + COUNT RST) key again.
   The previous display reappears.

5.2.3 Setting the Discharge Interval

Setting of the discharge interval is possible when contact discharge mode has been selected.

1. Press the SELECT key to choose "s."
2. Using the rotary knob, set the discharge interval.
   Turning the knob clockwise increases the discharge interval; turning it counter-clockwise decreases the discharge interval.
   Setting range: 0.1 to 99.9 seconds
   The IEC 61000-4-2 Standards stipulate a discharge interval of 1 second.

5.2.4 Setting the Test Voltage (Test Level)

■ For IEC 61000-4-2 Standards Test Level 1, 2, 3, and 4

Setting procedure:

1. Press the POLARITY key to select the polarity.
   The selected polarity is indicated (only the negative "-" symbol is shown, with negative polarity). At power on, positive polarity applies. If the polarity panel setting has been set and saved in CONFIG setup, the instrument starts up with the saved polarity.
2. Using the IEC TEST LVEL 1, 2, 3, and 4 keys, select the test level.
   The selected key lights. Note that the test voltage changes depending on the selected discharge mode. See 5.2.1 for details on selection of the discharge mode.

NOTE

- After the trigger switch is pulled or the TEST key is pressed, entry using the IEC TEST LVEL 1, 2, 3, or 4 key will no longer be accepted.

Table5-1 Test Voltages at Test Levels 1, 2, 3, and 4 by Discharge Mode

IEC TEST LEVEL keys	Test Voltages and Discharge Modes	
	C/20 (contact discharge mode)	A (air discharge mode)
1	2 kV	2 kV
2	4 kV	4 kV
3	6 kV	8 kV
4	8 kV	15 kV

Increasing/decreasing the test voltage slightly in the vicinity of test levels 1, 2, 3, or 4

NOTE

- Turning the rotary knob when one of the IEC TEST LEVEL 1, 2, 3, or 4 keys has been selected cancels the given selection. This feature is useful if you wish to increase or decrease test voltage slightly in the vicinity of test levels 1, 2, 3, or 4.

■ For Test Levels Other Than IEC 61000-4-2 Standards Test Levels 1, 2, 3, and 4

The following describes a case in which the test level is other than test level 1, 2, 3, or 4.

Setting procedure:

1. Press the POLARITY key to select the polarity.

   The selected polarity is indicated (only the negative "-" symbol is shown, with negative polarity). At power on, positive polarity applies. If the polarity panel setting has been set and saved in CONFIG setup, the instrument starts up with the saved polarity.

2. Press the SELECT key to choose "kV."

3. Using the COARSE/FINE key, select the voltage-setting operation digit.

   The setting resolution is 1 kV in COARSE mode, while it is 10 V in FINE mode. Pressing the key causes the voltage display to toggle between a blinking (1 kV) and a steadily lit (10 V) decimal point.

4. Set the voltage using the rotary knob.

   The set value is indicated on the instrument's display unit.

   In this case, if one of the IEC TEST LEVEL 1, 2, 3, or 4 keys has been selected, that selection will be canceled.

Table 5-2 Test Voltage for Test Levels Other Than Test Levels 1, 2, 3, and 4 by Discharge Mode

IEC TEST LEVEL keys	Test Voltages and Discharge Modes	
	C/20 (contact discharge mode)	A (air discharge mode)
Selection is canceled.	0.5 kV to 30 kV (specification-assured range)	

5.3 Starting the Test

⚠ WARNING

- The instrument features components generating voltages as high as 30 kV; these components are exposed for functional purposes. Do not bring your hand close to these components when high voltage is applied.
- During and after testing, the EUT and some of the metal parts present in the testing environment are charged in addition to the instrument. During testing, do not touch any part other than the ground reference plane. Also, even after completion of testing, metal components not electrically connected to the ground reference plane are also charged. Do not touch these components until the electricity has fully discharged.
- Never attempt to apply discharge to any part other than the EUT, vertical coupling plane, horizontal coupling plane, or ground reference plane.

5.3.1 Turning On High Voltage Power

For safety, high voltage is not immediately output when the HIGH VOLTAGE ON switch is turned on in order to prevent electric shock when not testing. At this stage, high voltage power is in standby status. Charge to the energy storage capacitor is started only after the trigger switch is pulled or the TEST key is pressed. Charging requires approx. 0.3 seconds after initiation of the test.

"On" procedure:

1. Press the HIGH VOLTAGE ON switch.

   This causes the DANGER indication to appear and the discharge gun's high voltage indicator to light; the high voltage source enters standby status.

5.3.2 Use of the Key Lock Function

This function prevents inadvertent front panel operation during testing. There are two types of key lock operations as follows:

Key lock in the condition where the HIGH VOLTAGE ON switch is pressed:

Only the following keys and switch related to test execution can be used. Normally, the key lock function is used in this condition.

- The TEST key, and KEY LOCK key
- The HIGH VOLTAGE OFF switch

Key lock in the condition where the HIGH VOLTAGE ON switch is not pressed:

Only the following keys can be used, and tests cannot be performed.

- The CLEAR key, and KEY LOCK key

5.3.3 Initiating Discharge

Discharge is initiated by pulling the trigger switch or pressing the TEST key. After the trigger switch has been pulled or the TEST key has been pressed, the discharge recurs at the set discharge interval.

Initiating procedure:

1. Select "P" or "G" using the TRIGGER key.

   Pressing this key toggles between the "P" (front panel) and "G" (discharge gun) selections.

2. When the TRIGGER key has been used to select "P," press the TEST key. The TEST LED lights and discharge begins.

3. When the TRIGGER key has been used to select "G," activate the trigger switch. Discharge begins.

NOTE

- The initial discharge is delayed by approx. 0.3 seconds after the trigger switch is pulled or the TEST key is pressed.

5.4 Test Method

The IEC 61000-4-2 Standards specifications address contact discharge and air discharge. This section describes the operation methods for each discharge test.

Contact discharge may consist of direct discharge or indirect discharge. In direct discharge the end of the discharge tip is brought into contact with the EUT. Indirect discharge is applied to the vertical or horizontal coupling plane located near the EUT.

If insulation painting is specified for the EUT, conduct air discharge testing only.

For more information on each discharge test, see the IEC 61000-4-2 Standards.

5.4.1 Contact Discharge Test

Two testing methods are available; one in which the discharge gun is held by the grip and another in which the discharge gun is fixed to the optional gun stand.

Testing procedure (discharge gun is held by the grip):

1. Check that the discharge gun is equipped with the contact discharge tip.

   For details on replacing the discharge tip, see 2.4, "Preparing the Discharge Gun."

2. Using the MODE key, select “C” (contact discharge mode).

   The “C” LED on the instrument’s display unit lights.

3. Select “G” (discharge gun) using the TRIGGER key.

   The “G” LED on the instrument’s display unit lights.

4. Select COUNT using the SELECT key and set the number of discharges using the rotary knob.

5. Select “s” using the SELECT key and set the discharge interval using the rotary knob.

■ With adoption of an IEC 61000-4-2 Standards test level

6. Select the desired test level from among the IEC TEST LEVEL 1, 2, 3, and 4 keys. Then proceed to step 7.

■ Without adoption of an IEC 61000-4-2 Standards test level

6. Select “kV” using the SELECT key and set the discharge voltage using the rotary knob.

7. Press the HIGH VOLTAGE ON switch.

   The DANGER indication lights.

8. Bring the contact discharge tip into contact with the EUT or the vertical or horizontal coupling plane.

9. Pull the trigger switch.

   Discharge is initiated and continues at the set discharge interval until the set number of discharges is complete.

   When the set number of discharges has been reached, the FIN LED lights and the buzzer sounds.

10. To conduct testing again, pull the trigger switch.

■ Preliminary test (to shorten the discharge interval)

Perform steps 1 to 10 as noted, with the exception of the following modified steps.

2. Select “20” using the MODE key.

   The “20” LED on the instrument’s display unit lights. In this case, the discharge interval is fixed at 0.05 seconds and discharge thus takes place 20 times per second.

5. Do not use the SELECT key.

   The discharge interval is fixed.

⚠ WARNING • To prevent electric shock, do not bring your hand close to any part other than the discharge gun’s grip or the EUT.

Testing procedure (with the discharge gun fixed to the gun stand):

1. Check that the discharge gun is equipped with the contact discharge tip.
   For details on replacing the discharge tip, see 2.4, "Preparing the Discharge Gun."
2. Fix the discharge gun to the optional discharge gun stand.
3. Using the MODE key, select "C" (contact discharge mode).
   The "C" LED on the instrument's display unit lights.
4. Using the TRIGGER key, select "P" (front panel).
   The "P" LED on the instrument's display unit lights.
5. Select COUNT using the SELECT key, and set the number of discharges using the rotary knob.
6. Select "s" using the SELECT key, and set the discharge interval using the rotary knob.

■ With adoption of an IEC 61000-4-2 Standards test level

7. Select the desired test level from among the IEC TEST LEVEL 1, 2, 3, and 4 keys. Then proceed to step 8.

■ Without adoption of an IEC 61000-4-2 Standards test level

7. Select "kV" using the SELECT key and set the discharge voltage using the rotary knob.
8. Press the HIGH VOLTAGE ON switch.
   The DANGER indication lights.
9. Bring the contact discharge tip into contact with the EUT or the vertical or horizontal coupling plane.
10. Press the TEST key.
    The TEST LED lights and discharge is initiated.
    The discharge continues at the set discharge interval until the set number of discharges is complete.
    When the set number of discharges has been reached, the FIN LED lights and the buzzer sounds.
11. To conduct testing again, press the TEST key.

■ Preliminary test (to shorten the discharge interval)

Perform steps 1 to 11 as noted, with the exception of the following modified steps.

3. Select "20" using the MODE key.
   The "20" LED on the instrument's display unit lights. In this case, the discharge interval is fixed at 0.05 seconds and discharge thus takes place 20 times per second.
6. Do not use the SELECT key.
   The discharge interval is fixed.

⚠WARNING • To prevent electric shock, do not bring your hand close to any part other than the discharge gun's grip or the EUT.

5.4.2 Air Discharge Test

Bring the contact discharge tip toward the EUT, with the discharge gun held by the grip. Air discharge is initiated during this movement.

Testing procedure:

1. Check that the discharge gun is equipped with the air discharge tip.
   For details on replacing the discharge tip, see 2.4, "Preparing the Discharge Gun."
2. Using the MODE key, select "A" (air discharge mode).
   The "A" LED lights on the instrument's display unit.
3. Select "G" (discharge gun) using the TRIGGER key.
   The "G" LED lights on the instrument's display unit.
4. Select COUNT using the SELECT key and set the number of discharges using the rotary knob.

■ With adoption of an IEC 61000-4-2 Standards test level

5. Select the desired test level from among the IEC TEST LEVEL 1, 2, 3, and 4 keys. Then proceed to step 6.

■ Without adoption of an IEC 61000-4-2 Standards test level

5. Select "kV" using the SELECT key and set the test voltage using the rotary knob.
6. Press the HIGH VOLTAGE ON switch.
   The DANGER indication lights.
7. Pulling the trigger switch, bring the contact discharge tip toward the EUT as quickly as possible and then into contact with the EUT.
   Air discharge is initiated during the approach to the EUT.
8. Immediately after air discharge has been initiated, release the trigger switch (trigger switch OFF).
9. Separate the discharge gun's discharge tip from the EUT.
   The number of trigger switch off/on operations is calculated to determine the number of discharges.
10. Repeat steps 7 to 9 until the set number of discharges is reached.
    When the set number of discharges has been reached, the FIN LED lights and the buzzer sounds.
11. To conduct testing again, activate the trigger switch.
    The number of discharges reverts to the set initial value, and you can re-start the test.

⚠ CAUTION
- Exercise care not to damage the EUT mechanically when approaching the EUT with the discharge tip and when bringing the tip into contact with the EUT.

5.5 Interrupting and Resuming Testing

■ Interrupting a Test

1. Release the trigger switch or press the TEST key to turn the switch off.

■ Resuming a Test

Two methods are available: you can resume a test by continuing from the elapsed number of discharges at interruption or you can restart a test from the beginning.

If a test is interrupted, the discharge count indication stops at the elapsed value prior to interruption.

Continuation:

1. Pull the trigger switch or press the TEST key.
   The test resumes from the prior number of discharges.

Restart:

1. Press the COUNT RST key and check that the test count indication is reset to the initial set value.
2. Pull the trigger switch or press the TEST key.

5.6 Terminating the Test

When the test is completed, follow the procedure below.

The operator must not leave the test site without performing the termination procedure.

⚠WARNING

- The contact discharge tip has a sharp edge. When the discharge gun is not in use, attach the provided protective cap to the discharge tip.

Termination procedure:

1. Press the HIGH VOLTAGE OFF switch.
2. Set the test voltage to “0” kV.
3. Connect the discharge tip to the GND and initiate discharge two to three times.
4. Turn the POWER switch off (O).
5. Ensure that the vicinity of the test location is neat, clean, and uncluttered.

5.7 Displaying the number of times the high-voltage discharge switch has been used

Press the POLARITY key with the SHIFT key held down (SHIFT + POLARITY) to display the number of times that the discharge gun's internal high-voltage discharge switch (TOTAL COUNT) has been used. Use this as a reference for replacing the discharge gun. Press the POLARITY key again with the SHIFT key held down to return to previous display

The unit for the upper display area is 100000 times. The unit for the lower area is 1 time. Add the values in the upper and lower display areas to get the total number of times that the switch has been used.

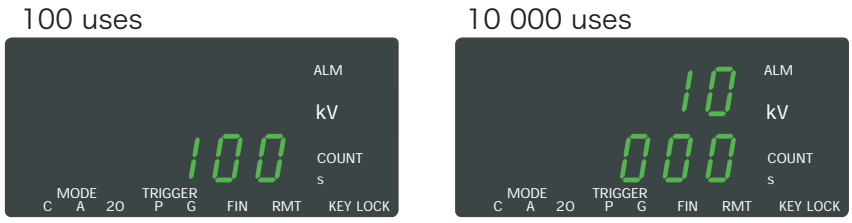


Fig. 5-3 Displaying the number of times the switch has been used

The mechanical life of the high-voltage switch is 1000000 uses. The mechanical life is approximately 1000000 uses when performing the IEC 61000-4-2 standard's level 4 test. If the voltage is twice the value that is used in this test, the mechanical life is reduced to approximately 1/4th of the expected value.

The number of times that the high-voltage switch has been used is cleared when you change the KES4021A's backup battery.

5.8 CONFIG Setup

The following information is to be set.

Setting information

- Power on panel settings (test voltage, number of discharges, discharge interval, discharge mode, trigger, test voltage polarity, and discharge count indication) Current panel settings can be saved. To modify a setting, change it and then perform CONFIG setup.
- Brightness of display LEDs
- Buzzer volume (upon alarm and other buzzer events)
- Discharge gun trigger mode

NOTE

- The functionality of serial communications hardware is not disclosed. Under normal usage, there may be cases where the computer malfunctions during discharge testing. If you wish to perform communication or control via a personal computer (PC), contact your Kikusui distributor or agent.

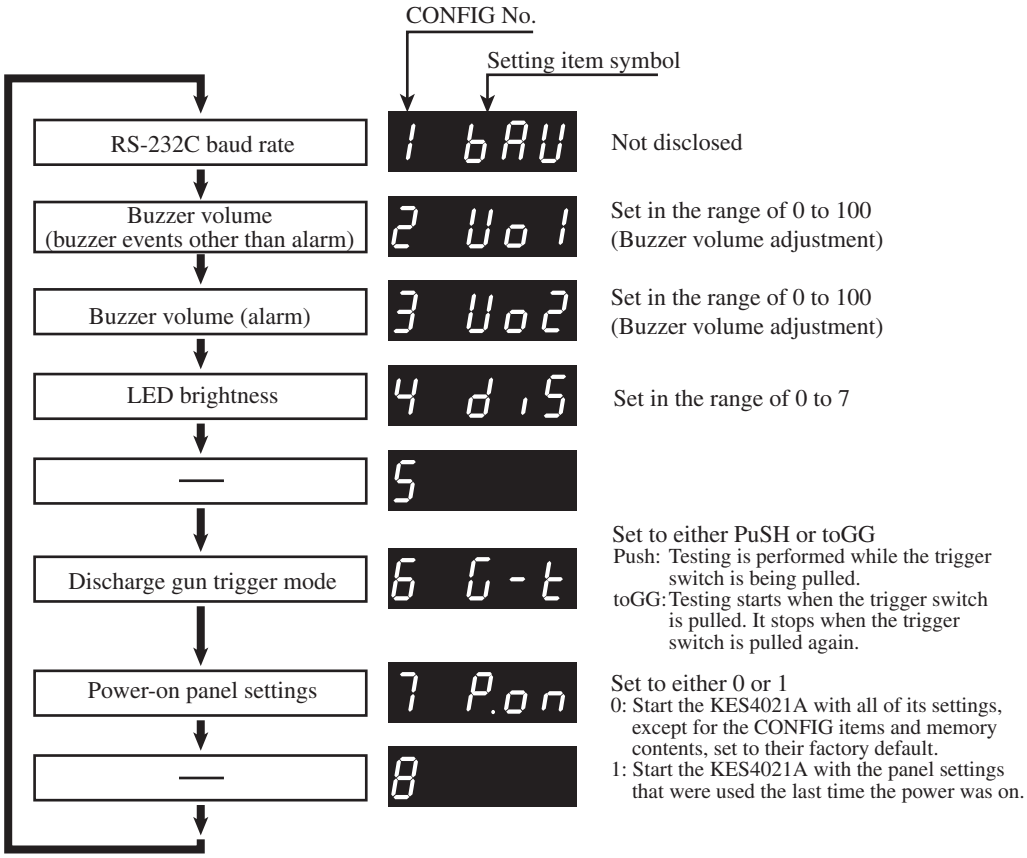


Fig. 5-4 CONFIG Setup

Setting procedure:

1. Press the CLEAR key with the SHIFT key held down (SHIFT + CLEAR).
   The instrument enters CONFIG setup.

2. Select the desired setting item (CONFIG No.) using the SELECT key.
   The set value is indicated by the instrument's display unit LED.
3. Set the value using the rotary knob.
   The set value is indicated by the instrument's display unit LED.
4. Select the next setting item (CONFIG No.), again using the SELECT key.
5. Set the value using the rotary knob.
6. Repeat the above steps to set up CONFIG No.2 to CONFIG No.4, CONFIG No.6 and CONFIG No.7.
   For details on the set values, see Fig. 5-4. Note that CONFIG No.1 settings is not disclosed.
7. Press the CLEAR key again with the SHIFT key held down (SHIFT + CLEAR).
   This allows you to exit CONFIG setup.

5.9 Factory Settings

NOTE
- Reverting to factory settings resets the panel settings made and saved in CONFIG setup.

Setting procedure:

1. Turn the POWER switch on with the SHIFT key held down.
   The instrument displays the abbreviated model name in the upper part of the display unit and the firmware version in the lower part.

   Next, "ini" appears momentarily, as all panel settings are reset to the factory settings shown below.

Setting Information

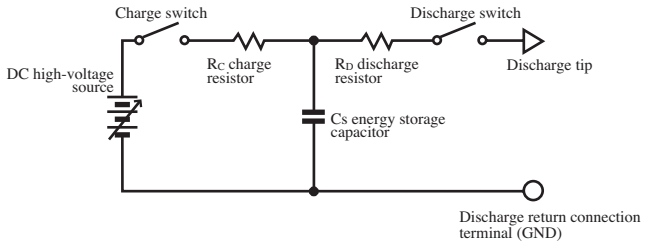
Setting Items		Set values
Panel setting	Test voltage (kV)	2.00
	Number of discharges (COUNT)	10
	Discharge interval (s)	1.0
	Discharge mode (MODE)	Contact discharge
	Trigger (TRIGGER)	Discharge gun
	Test voltage polarity (POLARITY)	Positive (no "+" symbol displayed)
	Discharge count indication (UP/DOWN)	Increment
Brightness of display LEDs		7
Buzzer volume	Non-alarm buzzer events	30
	Alarm buzzer events	30
Discharge gun trigger mode		PuSH

6

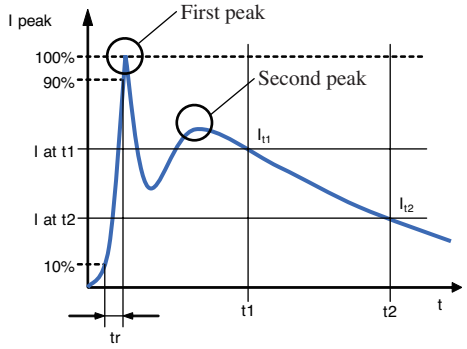
Chapter 6 Principle of Discharge

Explains the principle behind initiation of the discharge and the waveform.

6.1 Overview of the Principle of Discharge



The charge and discharge switches are operated alternately. When the charge switch is on, output from the DC high-voltage source charges Cs via Rc. After charging is complete, turning off the charge switch and then turning on the discharge switch causes the electrical charge stored in the Cs to be discharged to the EUT via Rd.



The discharge waveform is defined by current and is determined by the discharge switch and distribution capacity (Cd).*1 This distribution capacity principally affects the first peak. “Cd + Cs” primarily affects the waveform of the second and subsequent peaks.

The length and shape of the discharge return cable connected to the discharge return connection terminal (GND) also affect characteristics.

The current waveform generated from the electrostatic testing device is required to be observed properly complied with the measuring environment standard (described in the IEC 61000-4-2 or ISO 10605). For details, see 7.4, "Calibration".

*1. Distribution capacity (Cd) is formed between the generator and the EUT, ground reference plane, and coupling planes. This capacity is distributed over the entire system and changes depending on the conditions. Thus, this value cannot be shown in the circuit diagram.

Chapter 7 Maintenance

Describes the maintenance, inspection, and calibration of the instrument.

7.1 Cleaning

⚠WARNING • Before cleaning, always turn the POWER switch off and unplug the power cord from the electrical outlet.

If the main unit or discharge gun becomes soiled, clean the surfaces by wiping gently with a soft cloth moistened with a water-diluted neutral detergent solution.

- In particular, clean the discharge gun's cup element (red component) periodically to maintain proper insulation.
- After cleaning, let the main unit and/or discharge gun dry sufficiently before use.

⚠CAUTION • Do not use volatile solvents such as thinner or benzine. Use of an organic solvent could result in surface discoloration, erasure of printed characters, illegible display, etc.

7.2 Inspection

⚠WARNING • Rupture in the covering, a broken wire, or any other defect in the power cord could result in electric shock or a fire hazard. In such cases, discontinue use of the instrument immediately.

Power cord

- Check that there is no rupture in the covering, looseness in the plug, or cracks.

Discharge Gun High-voltage Section

- Check that there are no cracks in the discharge gun and no loose screws.

High-voltage cable

- Check that the cable covering is free of deterioration and that the plug is not damaged (including the discharge return cable).
- Check that there is no displacement of any outer sheath or looseness in the HIGH VOLTAGE OUTPUT section or at the base of the discharge gun.

■ High-voltage cable checking procedure

Procedure for checking that the high-voltage cable is not broken:

1. Set the test voltage to 2 kV in the testing procedure in 5.4.2, “Air Discharge Test.”
2. Bring the air discharge tip toward the end terminal of the discharge return cable.
3. Check that discharge occurs during the approach to the end terminal.
   The high-voltage cable is normal if discharges occur.

⚠WARNING
- If no discharge occurs, the high-voltage cable may be broken. In this case, stop using the instrument immediately and contact your Kikusui distributor or agent to request repair.
- Internal inspection requires disassembly of the discharge gun or opening of the main unit's cover, and voltages as high as 30 kV are generated inside the instrument. It is recommended that internal inspection be left to our service personnel to avoid hazard to the user. For replacement, please contact your Kikusui distributor or agent.

7.3 Maintenance

It is recommended that the instrument be overhauled regularly, including internal inspection and cleaning. We recommend that this maintenance be left to our service personnel.

7.3.1 Maintenance of Discharge gun

The high-voltage switch for waveform output installed in the discharge gun may become damaged depending on the method of use or frequency of discharge. In the event of abnormal switch noise in operation or apparent variation in output waveform, it is recommended that the discharge gun be inspected or calibrated.

⚠CAUTION
- The high-voltage switch to initiate discharge in the discharge gun is a consumable component. If the discharge gun is used under the following condition, the service life of the high-voltage switch may degrade significantly.
- When the test voltage is set above the IEC TEST LEVEL.
- Used consecutively with the discharge interval set less than 1 second.*
- Used in the test conditions other than the IEC and ISO standards.
- Used in combination with the optional C unit and discharge resistor.

*The mechanical life of the high-voltage switch is 1,000,000 operations. The service life is approximately 14 hours (calculated value) if a test is performed using repetitive discharge (20 pulses/sec).

7.3.2 Backup battery replacement

The KES4021A uses a lithium battery for total count backup. When the battery is low, the KES4021A cannot store total count. (Battery life varies depending on the environment.)

We recommend that the battery be replaced once every three years. You can also have the KES4021A inspected and cleaned at the same time. You must open the cover to replace the backup battery. For battery replacement, contact your Kikusui distributor or agent.

7.3.3 Maintenance Parts

We offer the following maintenance parts.

Contact discharge tip (CT31-KES, CT32-KES)
Air discharge tip (AT31-KES, AT32-KES)
Sphere discharge tip (ST31-KES, ST32-KES)
CR unit 150 pF/330 Ω (CR31-KES)
CR unit 330 pF/330 Ω (CR32-KES)
CR unit 150 pF/2 kΩ (CR33-KES)
CR unit 330 pF/2 kΩ (CR34-KES)

NOTE

- If the standard CR unit provided with the product is replaced with a different CR unit in maintenance, the instrument must be calibrated.

For more information, please contact your Kikusui distributor or agent.

7.4 Calibration

This instrument was calibrated prior to factory shipment. However, it is recommended that the product be periodically calibrated (once or twice a year) to maintain performance.

To change an IEC-compliant KES4021A to an IEC/ISO-compliant model, you must purchase options and have the KES4021A calibrated.

The current waveform generated from the electrostatic testing device is required to be observed properly complied with the measuring environment standard (described in the IEC 61000-4-2, ISO 10605)

⚠CAUTION

- This instrument generates voltages as high as 30 kV. Thus, it is recommended that instrument calibration be left to our service personnel to avoid hazard to the user.

■ IEC standard compliant model

The instrument is calibrated for the combination of main unit, discharge gun, standard CR unit (CR31-KES), and contact discharge tip (CT31-KES) installed in the gun.

Use of a CR unit other than the standard CR unit (CR31-KES) does not meet the IEC 61000-4-2 Standards. In this case, the instrument is out of the scope of calibration. However, it is possible to calibrate only sections relating to the instrument's performance.

■ IEC/ISO-compliant model

The instrument is calibrated for the combination of main unit, discharge gun, standard CR unit (CR31-KES, CR32-KES, CR33-KES, and CR34-KES), and contact discharge tip (CT31-KES and CT32-KES) installed in the gun.

Proper measuring environment

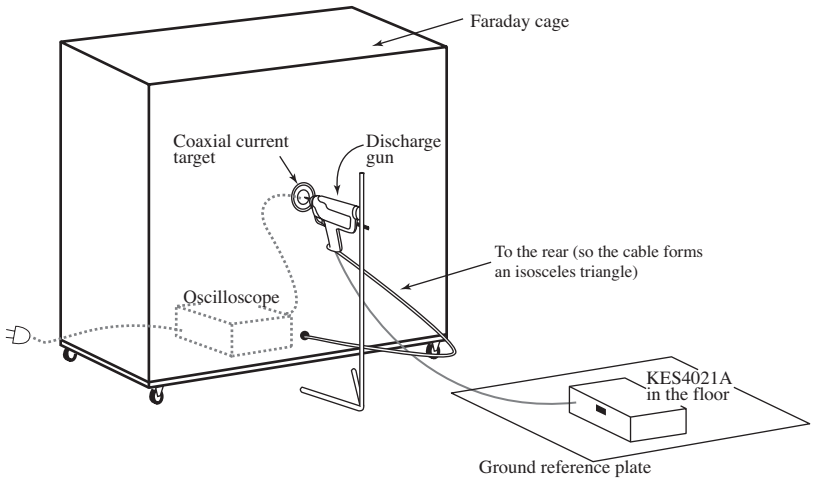
This section uses an example to explain the proper measuring environment that is based on the IEC 61000-4-2 standard. For the detail of IEC standard, please refer to the IEC 61000-4-2 Ed.2.0 2008-12. For the detail of ISO 10605 standard, please refer to the ISO 10605 Ed.2.0 2008-07.

■ Observing the waveform of discharge current

The following equipments are required for observing the waveform of discharge current.

- Coaxial current target (will be provided through a special order)
- Faraday cage (Front area: A square with each side 1.2 m in length or greater; will be provided through a special order)
- Oscilloscope (Required higher than 2 GHz (ISO standard: higher than 1 GHz) of the frequency bandwidth)

The following configuration is an example.



The standards specify that triggers be set to 10% of the first peak current value. Depending on the oscilloscope that is used, triggers may occur again on signals that are not the main discharge (such as charge noise). If these unwanted triggers occur, use the oscilloscope's hold-off function (set the hold-off time to approximately 40 ms), and observe the signal.

Confirm the output voltage

The IEC61000-4-2 standard is required for the following output voltage.

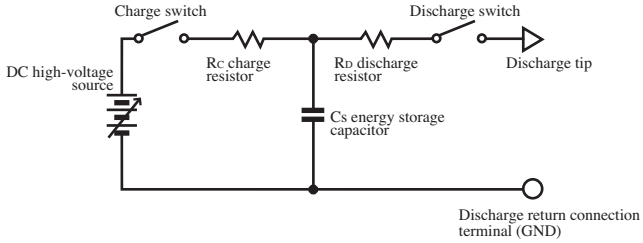
At contact discharge: 8 kV or higher

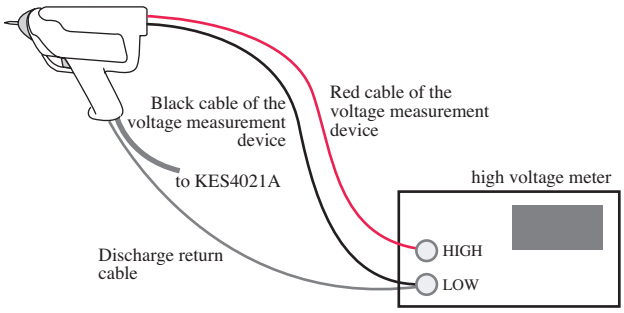
At air discharge: 15 kV or higher

For measuring of the output voltage, the custom-designed voltage measurement device (Model SPEC80562 : manufactured by Kikusui) is required.

The standards specify that measurements be performed at the discharge gun's discharge tip. However, the KES4021A is designed to prioritize the single discharges that are required by the standards, so measurements cannot be performed at the discharge tip.

The following describes the outline of the electrostatic testing device and an example of measuring environment for the output voltage using the custom-designed voltage measurement device Model SPEC80562.





7.5 Malfunctions and Causes

The following describes some of the effects of possible malfunctions encountered during use of the instrument, together with appropriate remedies. Here we note some typical effects and possible check items for each; simply review to find the applicable item. In general many of these effects can be resolved without difficulty.

When you find the applicable item, perform the corresponding remedy. If this does not resolve or improve the problem or if you cannot find the relevant item, contact your Kikusui distributor or agent.

Symptom1: Nothing appears on the display unit when the POWER switch is turned on.

Check item		Possible causes	Remedies
Location and condition of the item concerned	Check results		
Check to determine whether the rated input voltage (AC) is applied to the instrument.	No	The power cord is broken. The power cord has been improperly connected to the AC INPUT connector on the rear panel.	Check to ensure that the power cord is not damaged and that the power cord has been securely connected to the AC INPUT connector.
	Yes	Defective	Unplug the power cord from the electrical outlet. Stop using the instrument immediately and contact your Kikusui distributor or agent to request repair.

Symptom2: No test voltage is output.

Check item		Possible causes	Remedies
Location and condition of the item concerned	Check results		
Check to determine whether the rated input voltage (AC) is applied to the instrument.	No	Supplied voltage drop	Use the instrument within the nominal input ratings.
	Yes	The CR unit cap has not been tightened securely.	Tighten the CR unit cap securely.
Check to determine whether the buzzer is sounding and the ALM indication is lit.	Yes	The CR unit cap has not been tightened securely.	Tighten the CR unit cap securely.

Symptom3: No key can be operated.

Check item		Possible causes	Remedies
Location and condition of the item concerned	Check results		
Check to determine whether key-locked mode has been activated.	Yes	Key lock has been activated.	Cancel the key lock function.
	No	Defective	Stop using the instrument immediately and contact your Kikusui distributor or agent to request repair.

Symptom4: Alarm occurred.

Check item		Possible causes	Remedies
Location and condition of the item concerned	Check results		
Check if “Gun Err” is displayed on the main unit’s display unit.	Yes	The CR unit’s cap has not been tightened securely.	Tighten the CR unit cap securely.
	No	Defective	Stop using the instrument immediately and contact your Kikusui distributor or agent to request repair.

Chapter 8 Specifications

Contains the specifications of the instrument.

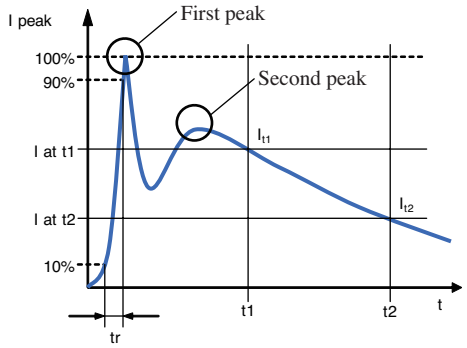
8.1 Specifications

Discharge Current Waveform

Meets the waveform parameter requirements indicated in the IEC 61000-4-2 Ed.2.0 2008-12 standard (using the waveform monitoring apparatus specified in Annex B of the IEC 61000-4-2 Ed.2.0 2008-12 standard).

Each item and numerical values are in accordance with the IEC 61000-4-2 Standard.

At an ambient temperature/humidity range of 15°C to 35°C/ 30% to 60%RH (with no condensation).



IEC-compliant model (150 pF/330 ¾ (CR31-KES))

Test level	1	2	3	4
Charge voltage	2 kV	4 kV	6 kV	8 kV
1st peak current*1	7.5 A	15 A	22.5 A	30 A
	±10 %			
Rise time*2 (tr)	0.8 ns			
	+25 %, -12.5 %			
Current value at 30 ns (It1)	4 A	8 A	12 A	16 A
	±30 %			
Current value at 60 ns (It2)	2 A	4 A	6 A	8 A
	±30 %			

*1. Defined in accordance with ISO standards. The accuracy is defined as ±15 % in the IEC standard.

*2. Defined in accordance with ISO standards. The accuracy is defined as ±25 % in the IEC standard.

IEC/ISO-compliant model
(ISO-standard waveforms produced by the 150 pF/330 ¾ CR unit (CR31-KES) is defined according to the specifications of IEC-compliant model.)

CR unit	330 pF/ 330¾ (CR32-KES)	150 pF/ 2 k¾ (CR33-KES)	330 pF/2 k¾ (CR34-KES)
1st peak current*1	3.75 A/kV		
	±10 %	+30 %, -0 %	
Rise time (tr)*1	0.7 ns to 1.0 ns (from 10 % to 90 %)		
Current value at t1 (It1)*1	2 A/kV (t1: 65 ns)	0.275 A/kV (t1: 180 ns)	0.275 A/kV (t1: 400 ns)
	±30 %		
Current value at t2 (It2)*1	1 A/kV (t2: 130 ns)	0.15 A/kV (t2: 360 ns)	0.15 A/kV (t2: 800 ns)
	±30 %	±50 %	

*1. Defined according to IEC test level.

Functions and Performance

Item		Function and performance
Discharge method		Air discharge and contact discharge
Test voltage[*1]	Setting range	0 to 30.50 kV
	Specification-assured range	0.5 to 30 kV
	Setting accuracy	±5 % (2 kV or more)
		± (5 % + 5 digits) (less than 2 kV)
	Setting resolution	0.01 kV
	Output polarity	Positive and negative
Energy storage capacitor[*2]		150 pF ± 10 % 330 pF ± 10 %[*3]
Discharge resistor[*4]		330 Ω ± 10 % 2 k¾ ± 10 %[*3]
Charge resistor		50 MΩ[*5]
Repetitive discharges	Discharge interval	0.05 s and 0.1 s to 99.9 s ± (2% + 1 ms)
	Number of discharges	1 to 999 times, and 0 (infinite)
Discharge current waveform		Conforming to IEC 61000-4-2 Standard
Trigger selection		Trigger switch and TEST key
Communication functions		RS-232C[*6]

*1. Voltage across the energy storage capacitor
*2. CR unit singly
*3. IEC/ISO-compliant model only
*4. Resistor singly
*5. Nominal value
*6. Option

Safety Functions

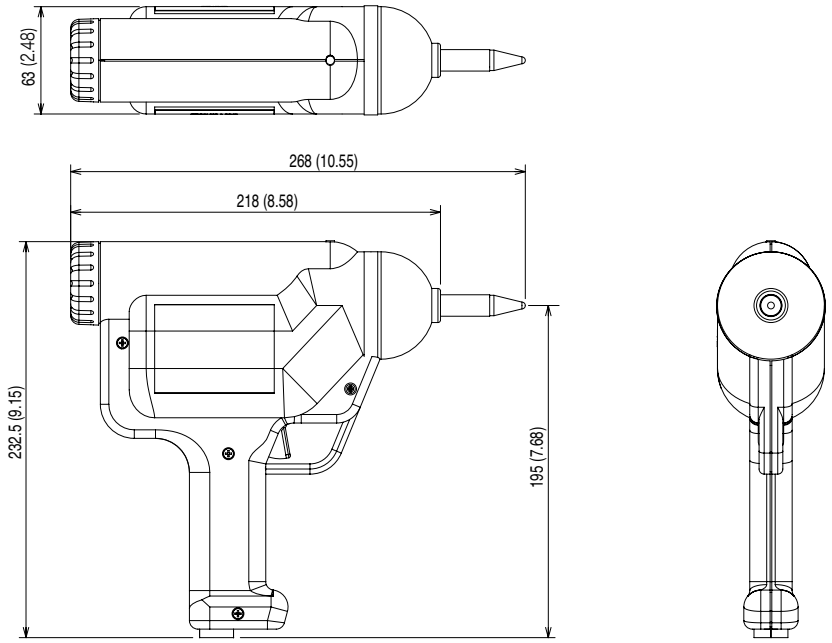
Item	Function
DANGER indicator	Lights up when the internal high-voltage source is on.
High-voltage indicator (discharge gun)	Lights up when the internal high-voltage source is on.
High-voltage shutdown function	Shuts down the high-voltage source if the CR unit cap of the discharge gun is not properly tightened.
Protective cap	Contact discharge tip protective cap
Charge system	The high-voltage source is off in standby status. High-voltage power is output approx. 0.3 s before initiation of discharge.

General Specifications

Item		Functions and performance
Nominal input ratings		100 V to 240 V AC, 50/60 Hz
Power consumption		90 VAmax
Inrush current		100 A
Operating temperature range		10 °C to 40 °C (50 °F to 104 °F)
Operating humidity range		10% to 80% RH (with no condensation)
Storage temperature range		-5 °C to 70 °C (23 °F to 158 °F)
Storage humidity range		10% to 80% RH (with no condensation)
Usage location		Indoors
Altitude limit		1300 m above sea level
Insulation resistance	Primary side ⇔ chassis	30 MΩ or more at 500 V DC
Withstand voltage	Primary side ⇔ chassis	1500 V AC for 1 minute, with no abnormality.
Earth continuity	Ground pin of AC inlet ⇔ chassis	25 A AC, 0.1 ¾ or less
Outer dimensions	Discharge gun	See the outline drawing.*1
	Main unit	See the outline drawing.
Weight	Discharge gun	Approx. 1.5 kg (3.31 lb)*2
	Main unit	Approx. 8 kg (17.64 lb)
Backup battery life		Approx. 3 years
Accessories	Power cord	1 pc.
	CR unit*3	CR32-KES*4: 1 unit CR33-KES*5: 1 unit CR34-KES*5: 1 unit
	Air discharge tip	AT31-KES*3: 1 pc. AT32-KES*5: 1 pc.
	Contact discharge tip	CT31-KES*3: 1 pc. (with protective cap) CT32-KES*5: 1 pc. (with protective cap)
	Sphere discharge tip*5	ST31-KES: 1 pc. ST32-KES: 1 pc
	Operation Manual	1 copy

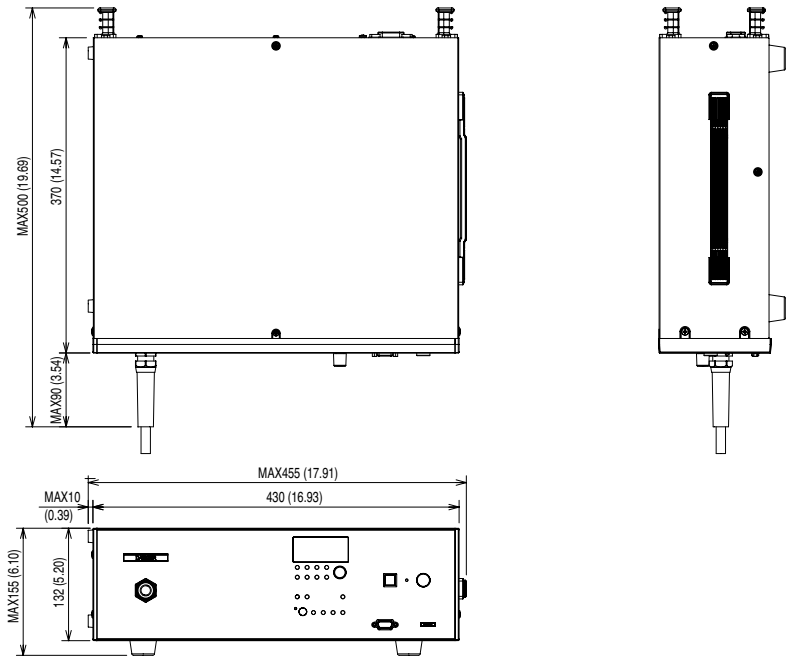
*1. The length of the high-voltage cable is approx. 2.5 m.
*2. Including the high-voltage cable.
*3. The CR unit (CR31-KES, Complies with the IEC 61000-4-2 standard) is built into the discharge gun.
*4. Complies with the IEC 61000-4-2 Standard.
*5. Complies with the ISO 10605 standard and is included with IEC/ISO-compliant model.

8.2 Outer Dimensions



Units: mm (inch)

Fig. 8-1 Outline Drawing of Discharge Gun



Units: mm (inch)

Fig. 8-2 Outline Drawing of Main Unit

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