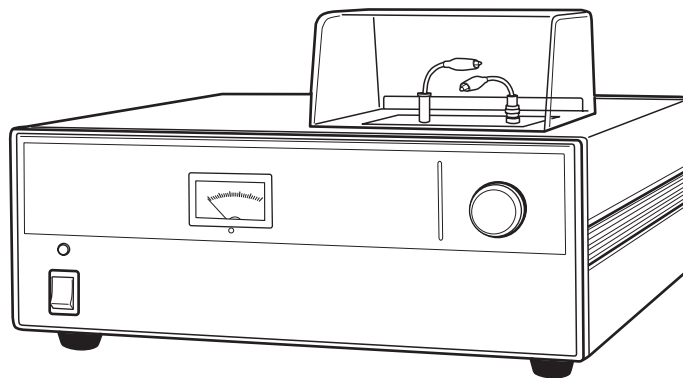# OPERATION MANUAL

Partial Discharge Tester

KPD2050

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.

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.

(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,

and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____ A, _____ VAC, and _____ .

⚠ **WARNING** • To avoid electrical shock, always disconnect the power cord or turn off the switch on the switchboard before attempting to check or replace the fuse.

 • Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.
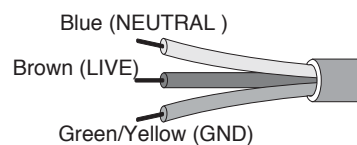

☐ Power cord

The product is provided with power cords described below. If the cord has no power plug, attach a power plug or crimp-style terminals to the cord in accordance with the wire colors specified in the drawing.

⚠ **WARNING** • The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

☐ **Without a power plug**

Blue (NEUTRAL)
Brown (LIVE)
Green/Yellow (GND)

☐ **Without a power plug**

White (NEUTRAL)
Black (LIVE)
Green or Green/Yellow (GND)
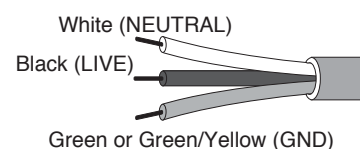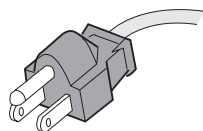
☐ **Plugs for USA**

☐ **Plugs for Europe**
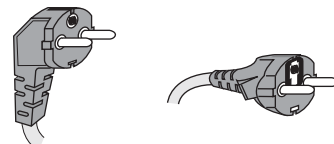
☐ **Provided by Kikusui distributor/agent**
Kikusui agents can provide you with suitable power cord.
For further information, contact Kikusui distributor/agent.

⚠ 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).

|	
⚡ OR ⚡	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 must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly.

Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)
- This product is not designed or manufactured for general home or consumer use.
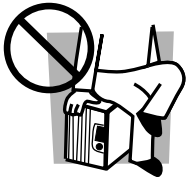
Purposes of use

- Do not use the product for purposes other than those described in the operation manual.
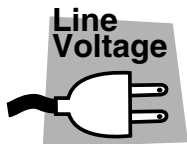
Input power

- Use the product with the specified input power voltage.
- For applying power, use the power cord provided. Note that the provided power cord is not use with some products that can switch among different input power voltages or use 100 V and 200 V without switching between them. In such a case, use an appropriate power cord.
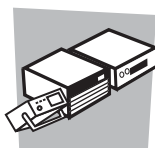
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.

Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover.

Installation

- When installing products be sure to observe "1.2 Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When connecting the power cord to a switchboard, be sure work is performed by a qualified and licensed electrician or is conducted under the direction of such a person.
- When installing products with casters, be sure to lock the casters.

Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

Operation

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the power cord. 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.
- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact Kikusui distributor/agent.

Maintenance and checking

- To avoid electrical 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.

Arrangement of This Manual

This Operation Manual is made up of the following sections.

Preface

Provides a brief descriptions of the product and specifies its features.

Chapter 1 Setup

This chapter describes the proper procedures for unpacking, installation, and connecting to a PC.

Chapter 2 Installing Software

This chapter describes the installation of Software Applications for PDTester.

Chapter 3 Basic Operation

This chapter describes basic test procedures for the partial discharge tester KPD2050.

Chapter 4 EN 50178-Compliant Partial Discharge Testing

This chapter describes partial discharge testing, as prescribed in the EN 50178 standard.

Chapter 5 PDTester Application Reference

This chapter gives a detailed description of PDTester Application functions.

Chapter 6 Part Names and Functions

This chapter provides the names and functions of switches, connectors, and other panel items.

Read this chapter to learn the meanings of the alert marks ⚠ indicated on the panels of the unit.

Chapter 7 Maintenance and Calibration

This chapter describes proper tester maintenance and calibration. To maintain the tester's original performance for extended periods, perform periodic maintenance, checks, and calibration.

Chapter 8 Specifications

This chapter provides the electrical and mechanical specifications for the KPD2050 tester and the functionality specifications for PDTester Application.

Appendix

Provides measurement methods and measured data.

Contents

Chapter 6   Part Names and Functions   6-1

Chapter 7   Maintenance and Calibration   7-1

Chapter 8   Specifications   8-1

Preface

About This Operation Manual

■ About the notation used in this manual

This manual describes the KPD2050 partial discharge testers as follows:

- **Description of the whole tester, including hardware and software**

  KPD2050 partial discharge tester or tester

- **Description of hardware only**

  KPD2050 tester

- **Description of software only**

  Software Applications for PDTester or PDTester Application

NOTE
- The PDTester Application runs under Windows. This manual assumes basic familiarity with Windows. For more information on Windows, please refer to your Windows documentation.

■ About the version of applicable products

This Operating Manual applies to version 1.0x of Software Applications for PDTester.

Product Overview

The KPD2050 partial discharge testers were developed to test the insulation of electronic components. The testers perform this testing by picking up the movement of electrical charge in insulators resulting from the partial discharge phenomenon. The testers are especially well-suited for testing performed in the research and development of small electronic parts.

The partial discharge testing method used by these testers conforms to the specifications for "Electronic equipment for use in power installations" in the EN 50178:1997 standard.

These testers are capable of generating a maximum AC voltage of 5 kV. But the amount of power generally applied to the device under test (DUT) is usually below that for conventional withstanding voltage testers, because these testers have a 1M (current-limiting resistor) in the high voltage generation area. Thus, even when dielectric breakdown occurs, the testers sidestep secondary breakdowns, such as burning caused by arc discharge. If the insulation conditions can be detected before a dielectric breakdown, it is also possible to conduct testing without destroying the DUT.

The testers gauge partial discharge by determining the quantity of electrical charge resulting from partial discharge and the number of discharge pulses. The quantity of electrical charge caused by partial discharge is determined by measuring the maximum quantity of partial discharge over every interval of the applied AC voltage waveform (20 ms or 16.7 ms).

The testing package is divided into hardware (the KPD2050 tester), which generates the test voltage, and software (Software Applications for PDTester), which controls the hardware. The KPD2050 tester is connected to a PC-installed general-purpose A/D (DAQ) board and is controlled by the Windows Software Applications for PDTester. Measurement data can be exported to Microsoft Excel (97/2000/2002), and the exported data can be freely manipulated in Excel for graphing or statistical examination.

Features

- **Low-distortion application voltage**

The voltage wave applied to the DUT is a circuit-generated low-distortion sine wave, power-amplified with a power amplifier applying regulated AC power supply technology and voltage-multiplied through a high-voltage transformer. Use of stable, quality voltage waveforms assures that measurement results are undistorted by power line waveform distortions.

- **Programmable voltage application patterns**

You can program the generation pattern of the voltage to be applied to the DUT. The testers can measure the amount of generated partial discharge by automatically shifting the application voltage, a function useful in examining voltage characteristics of partial discharge quantity.

- **Measurement capability even for single-occurrence partial discharge**

Since partial discharge occurs randomly, the testers measure this random partial discharge continuously, allowing them to capture even single-occurrence partial discharges.

- **Output of three analog monitoring signals**

The testers can output analog monitoring signals, for confirmation of partial discharge phenomenon, to an oscilloscope for waveform observation. Three monitoring signals are provided: test voltage, partial discharge current, and the quantity of electrical charge caused by partial discharge.

- **Protective function**

To protect the DUT from destruction, the testers have protective functions that limit the quantity of electrical charge and other parameters.

- -

DESCRIPTION • Partial discharge

Partial discharge is a phenomenon that occurs during insulator failure, generally in cases where voltage applied to an insulator is not distributed equally. Such unequal voltage distribution within the insulator is referred to as a non-uniform electric field, which often results in the concentration of the electric field at points where insulation capacity is poor, resulting in small discharge at such points. This kind of discharge is called partial discharge since it occurs only partially, not resulting in the complete passage of the electrical charge from electrode to electrode.

When a high voltage is continually applied to an insulator, even if one partial discharge does not lead to a short circuit, multiple partial discharges can produce a dielectric breakdown at points where the partial discharges occur, resulting in a discharge (an arc discharge) that leads to a short circuit. Additionally, partial discharge occurrence in air produces ozone and nitrogen oxide, which can further promote the deterioration of the insulator.

Non-uniform electric fields often result from inconsistencies, air bubbles formed in insulators (void) and other defects within the insulators themselves, or from the contours of the electrode or insulators.

Partial discharge occurs randomly, with the same discharge phenomenon often not reproducible even under identical test conditions. This is a trait common to all discharge phenomena, not just partial discharges.

When a voltage is applied to an insulator, a rising quantity of electrical charge resulting from partial discharge is often a precursor of dielectric breakdown.

- Partial discharge testing under the EN 50178:1997 standard

EN 50178 is now widely used as a European standard for industrial equipment, in the place of DIN VDE0160, a safety standard long used in the past. EN 50178 provides an effective design standard for European CE compliance of products that "Low Voltage" Directive is applied.

The EN 50178 standard is scheduled to take effect in August 2003, after a transition period. This standard contains a wide variety of requirements. It is different from DIN VDE0160 in that the former requires partial discharge testing of enhanced insulating components.

Under the EN 50178 standard, several new enhanced insulating components have been added as items that require partial discharge testing. These include insulating transformers, switches, electrical components, connectors, and terminal blocks. Partial discharge testing is required in a type test of these items.

Partial discharge testing required by EN 50178 aims to ensure that there is no partial discharge at or above the rated insulation voltage times 1.25. In this sense, this testing is quite different from withstanding voltage tests and insulation resistance tests.

- -

Minimum Requirements for Running the Tester

To use the tester, you'll need the following minimum hardware and software:

- An IBM-PC/AT compatible personal computer with a Pentium 166 MHz or greater microprocessor
- Microsoft Windows 2000/XP Professional
- At least 32 MB RAM (64 MB or more recommended)
- VGA or better display adaptor and color monitor
- At least 20 MB of hard disk space (100 MB or more recommended for data storage)
- 3.5" FD drive (1.44 MB)
- CD-ROM drive
- Mouse and other pointing devices supported by Windows
- Microsoft Excel 97/2000/2002 (required for data analysis)

Options

- **Rack-mount brackets**

The following optional brackets are available for rack mounting.
    BH3M-TOS (metric rack conforming to JIS Standards)
    BH4-TOS (inch rack conforming to EIA Standards)

⚠ **WARNING** • When rack-installing the KPD2050 tester, provide sufficient space above the tester to connect the DUT to the test leads.

- **Attachment**

In addition to the supplied test leads with the product, we can manufacture an attachment to connect the DUT after consultation.

For more information on optional accessories, contact Kikusui distributor/agent.

Chapter 1 Setup

This chapter describes the proper procedures for unpacking, installation, and connecting to a PC.

1.1　Unpacking Inspection

When unpacking, make sure no parts are missing or damaged.

If you find missing or damaged parts, contact Kikusui distributor/agent.

NOTE
• We recommend saving the packing materials in case the product needs to be moved later.

[91-82-1402]

☐ Black test lead
[for LOW side]
(1)

[91-82-1402]

☐ Red test lead
[for HIGH VOLTAGE side]
(1)

[89-04-0070]

☐ Cable for standard electrical charge generator
(1)

[SA-6007-XX]

☐ Setup disk
CD-ROM
(1: PDTester Application)

[SA-5130-01]

☐ Calibration data disk
3.5" FD
(1: Calibration Data Disk)

[Z1-002-462]

☐ Operatinon Manual
(1)

[85-AA-0004]

Different types of power cords are provided, according to the range preset before shipping for the line voltage.

☐ Power cord
(1)

[UA-1297-01]

☐ Calibration capacitor box
(1)

[97-09-2050] (PCMCIA)
[97-09-2070] (PCI)

☐ A/D (DAQ) board of the type specified in your purchase order
(1)

[96-01-0140]
(Core)

[91-82-1404] (PCMCIA)
[91-82-1405] (PCI)

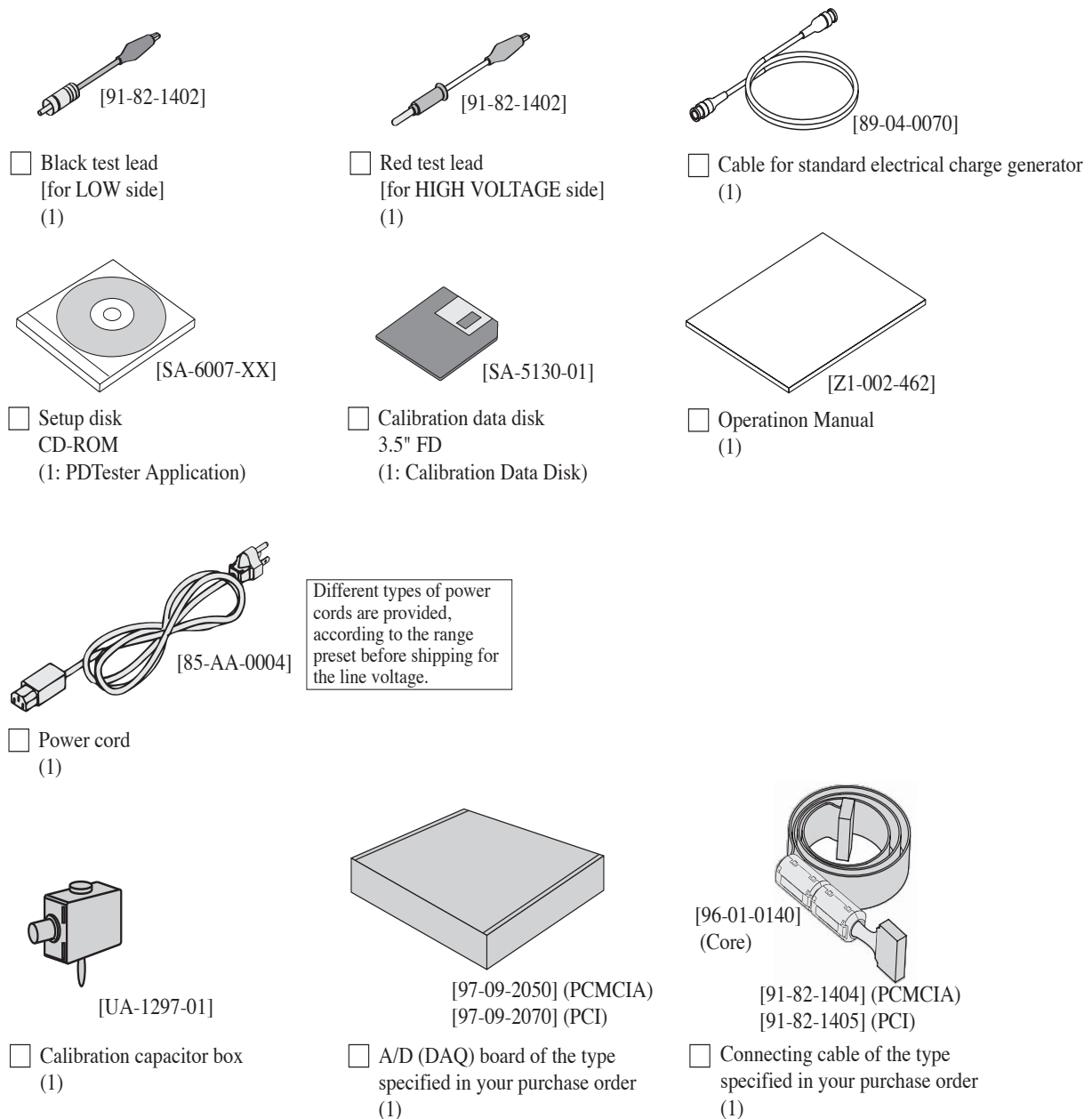☐ Connecting cable of the type specified in your purchase order
(1)

Fig. 1-1　　List of accessories

1.2　Precautions for Installation

Observe the following precautions when installing the tester:

■ Do not use the tester where flammable fumes are present.

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

■ Avoid locations exposed to high temperatures or direct sunlight.

Do not locate the tester near a heater or in areas subject to drastic temperature shifts.

Operating temperature range: 23 ℃ ± 5 ℃

Storage temperature range: -10 ℃ to +60 ℃

■ Avoid locations of high humidity.

Do not place the tester in high-humidity locations: near a boiler, humidifier, water supply, etc.

Operating humidity range: 20 % to 80 % [RH] (no condensation permitted)

Storage humidity range: 10 % to 80 % [RH] (no condensation permitted)

Condensation may occur even within the given operating humidity range. Do not use the tester until such condensation has completely dried.

■ Do not use or store the tester in a corrosive atmosphere.

Do not install the tester in an atmosphere containing sulfuric acid mist or other corrosive substances. Failure to observe this precaution may lead to corroded conductors and imperfect contact with connectors, malfunction or failure, or fire.

■ Do not locate the tester in dusty locations.

Dirt and dust on the tester can lead to electric shocks and fire.

■ Do not use the tester in an area with poor ventilation.

Provide sufficient space around the tester.

■ Avoid placing objects on the tester.

Heavy objects placed on the tester can lead to malfunction.

■ Avoid installing the tester on non-level surfaces or in locations subject to vibrations.

The tester can fall down, causing damage and injury.

■ Do not use the tester in locations affected by strong magnetic or electric fields.

Place the tester at least 1 meter away from the PC monitor.

1.3   Precautions for Moving

To transport the tester to the installation site, observe the following precautions:

■ Turn off the POWER switch.

Electric shocks and damage can occur if the tester is transported with the POWER switch turned on.

■ Remove all connected wires.

Cable disconnection and injury from falling can occur if the tester is carried with the cables connected.

■ When transporting the product, be sure to use the original packing materials.

Transportation without using the original packing materials can cause damage from vibration or from a fall in transit. If you need packing materials, contact Kikusui distributor/agent.

1.4   Connecting the Test Leads

Connect the supplied test leads with the product to the OUTPUT terminals at the top of the tester. Connect the red test lead to the HIGH VOLTAGE terminal and the black test lead to the LOW terminal, ensuring they are securely connected.

NOTE
• If you're using a dedicated attachment instead of the supplied test leads, please refer to the operating manual for the attachment.

⚠ WARNING • Use only the supplied test leads or a dedicated attachment.

Connect the red test lead to
the HIGH VOLTAGE terminal.

Connect the black test
lead to the LOW terminal.

HIGH
VOLTAGE

LOW

OUTPUT
MAX 5kV

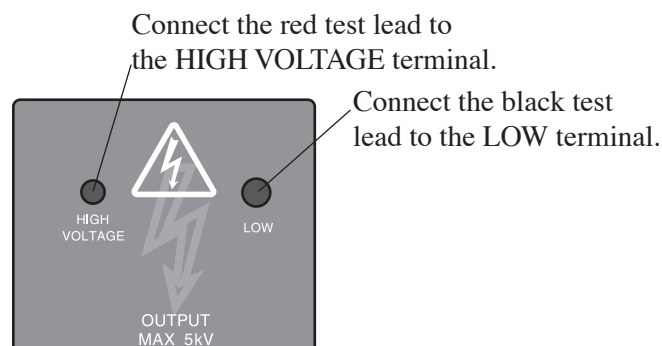Fig. 1-2   OUTPUT terminals on the top panel of the KPD2050 tester

1.5   Connecting the Power Cord

Two line voltage ranges are available for this tester, as shown in Table 1-1. Note, however, that the rated voltage of the power cord included with the product is different for 100 V system and 200 V system. If you are to use a product that is set up for 100 V system line voltage with a 200 V system line voltage, or vice versa, use the appropriate power cord.

⚠ WARNING • The power cord with a three-contact plug shown in Fig. 1-3 (included with a product set up for 100 V system line voltage) has a rated voltage of 125 VAC. If you are to use this product with a 200 V system line voltage, replace this cord with the appropriate power cord.

⚠ CAUTION • To prevent malfunction, be sure to use this product within the given input voltage range.

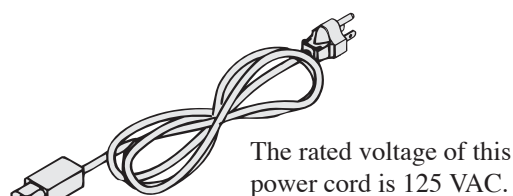The rated voltage of this power cord is 125 VAC.

Fig. 1-3   Power cord

To connect the power cord, take the following steps:

1.   Check that the AC supply voltage is within given the line voltage range.

2.   Connect the power cord to the AC INPUT connector on the rear panel.

3.   Plug in the power cord.

Table1-1   Selecting line voltage

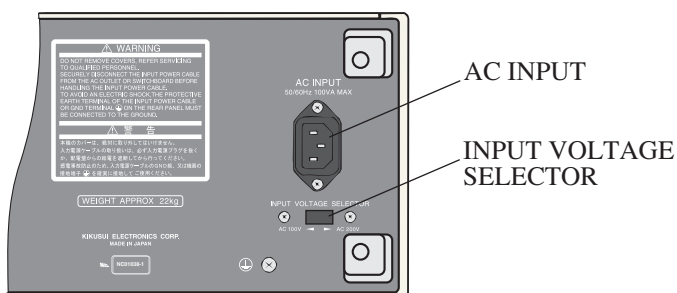| Display on INPUT VOLTAGE SELECTOR	Input voltage range
AC100 V	90 V - 110 V (50/60 Hz)
AC200 V	180 V - 220 V (50/60 Hz)

AC INPUT

INPUT VOLTAGE SELECTOR
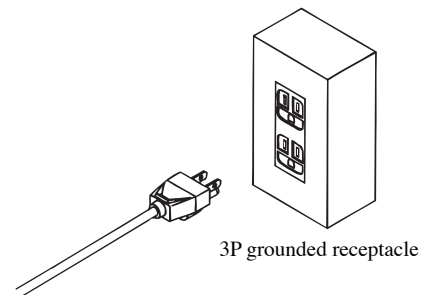
Fig. 1-4   Rear panel of the KPD2050 tester

1.6   Grounding

⚠ WARNING • Failure to provide adequate grounding may lead to electric shock.
• Connect the grounding terminal to an electrical ground (safety ground).

⚠ CAUTION • Failure to provide sufficient grounding may result in malfunctions due to external noise or increased signal noise.

To ensure safety, always ground the tester. The KPD2050 tester functions by detecting minute signals. Proper grounding makes the tester less vulnerable to the effects of external electromagnetic interference.

The following two grounding methods are available to ground the tester. Choose one of them to perform appropriate grounding.

1. Connect the power cord to the 3P grounded receptacle.

3P grounded receptacle

2. Connect the ⏚ terminal on the rear panel (protective conductor terminal) to the grounding (GND) terminal.

The protective conductor terminal has an M4 screw and lock washer. Attach the lock washer to the rear panel side of the KPD2050 tester.

Electrical ground
(Safety ground)
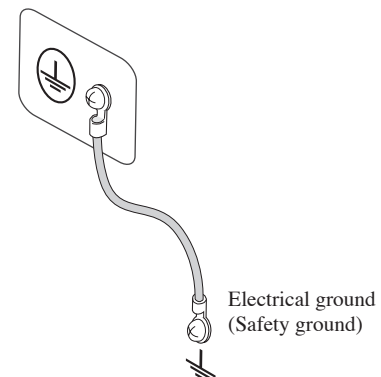
1.7   Installing the A/D (DAQ) Board

Install National Instruments' A/D (DAQ) board on the computer.

For installation, see the manual included with the A/D (DAQ) board.

⚠ **CAUTION**   • Before installing the A/D (DAQ) board, turn off the POWER switches for both the KPD2050 tester and the PC.

---

1. Install the A/D (DAQ) board in the PC.

2. Using the connecting cable, join the connector on the A/D (DAQ) board and the PC I/O connector on the rear panel of the KPD2050 tester.
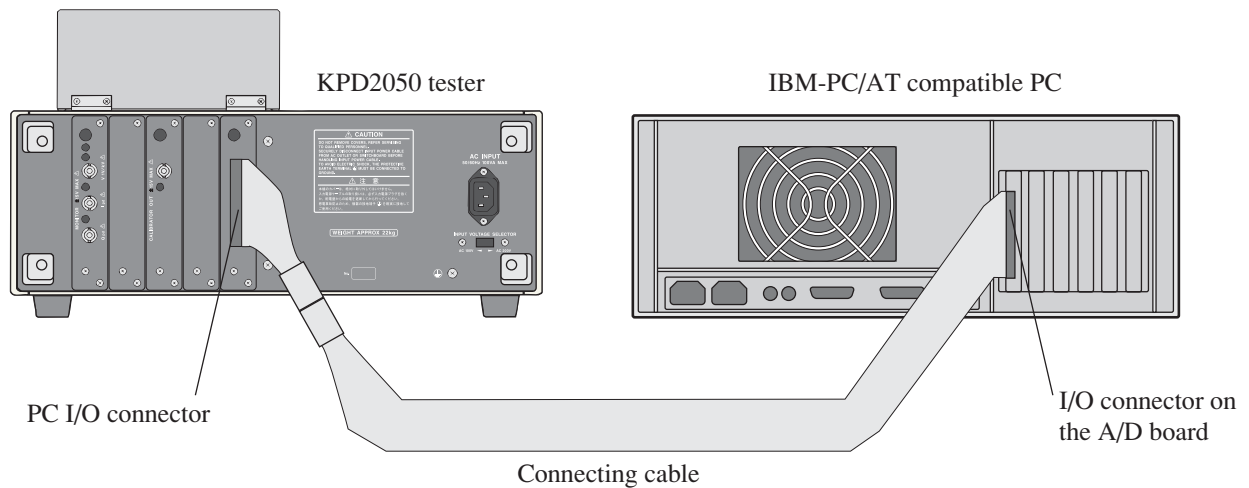

KPD2050 tester   IBM-PC/AT compatible PC

PC I/O connector   I/O connector on the A/D board

Connecting cable

Fig. 1-5   Example of A/D (DAQ) board connection

2

Chapter 2 Installing Software

This chapter describes the installation of Software Applications for PDTester.

To use Software Applications for PDTester (hereafter referred to as the "PDTester Application"), it is necessary to install Data Acquisition Driver Software (NI-DAQ), which is the driver software for National Instruments' A/D (DAQ) board. Then install the PDTester Application.

To install PDTester Application, use the setup program found on the program disk.

- -

NOTE
• Place the accompanying setup disk in the CD-ROM drive. Then, the Applications for PDTester Ver 1.0 "Readme" file opens automatically. Using this "Readme" file, you can install the two software programs. Depending on the system environment, however, installation may fail from this "Readme" file. In this case, install the programs in accordance with "2.1 Installing NI-DAQ" and "2.2 Installing the PDTester Application".

- -

2.1 Installing NI-DAQ

■ Preparation

1. Find the setup disk included with the product.

   The setup disk is the CD-ROM marked "Application for PDTester."

■ Installing

2. Start Windows.

   The first time the A/D (DAQ) board is installed, installation of the driver may automatically commence right after Windows startup. Even in this case, follow the next steps.

3. Place the accompanying setup disk in the CD-ROM drive.

4. From the [NI-DAQ6.9.3] folder in the CD-ROM, run Setup.exe.

5. Follow the instructions on the screen.

2.2 Installing the PDTester Application

■ Preparation

1. Find the setup disk and the calibration data disk included with the product.

   The setup disk is the CD-ROM marked "Application for PDTester."

   The calibration data disk is the 3.5" FD marked "Calibration Data Disk."

2. Confirm that the serial numbers on the Calibration Data Disk (3.5" FD) label (indicated on its rear) and for the KPD2050 tester (indicated on the rear panel) match.

NOTE • The Calibration Data Disk (3.5" FD) contains factory calibration data saved when the KPD2050 tester was shipped. For proper measurements, the serial number on the disk must match that of the KPD2050 tester. If these numbers don't match, please contact Kikusui distributor/agent.

■ Installing

3. Start Windows.

4. Place the accompanying setup disk in the CD-ROM drive.

5. From the "Disk1" folder in the "Application for PDTester" folder in the setup disk, run Setup.exe.

6. The following screen should appear:

   The below screen (version display) may differ somewhat from the screen you see.
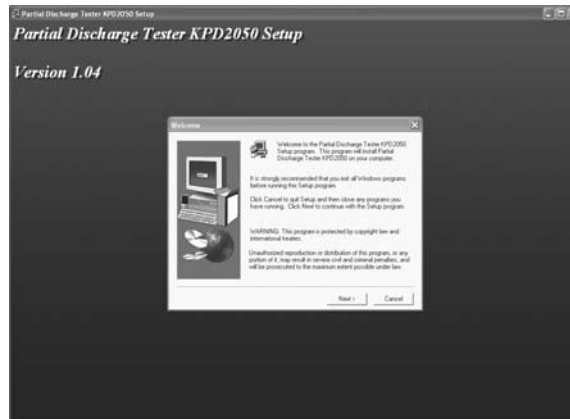

Fig.2-1   Partial Discharge setup screen

7. Click the [Next] button, then follow the screen prompts.

8. When installation is complete, a [Kikusui Partial Discharge Tester KPD2050] folder is created in the [Program] folder under the [Start] menu.

   The folder contains the following three applications:
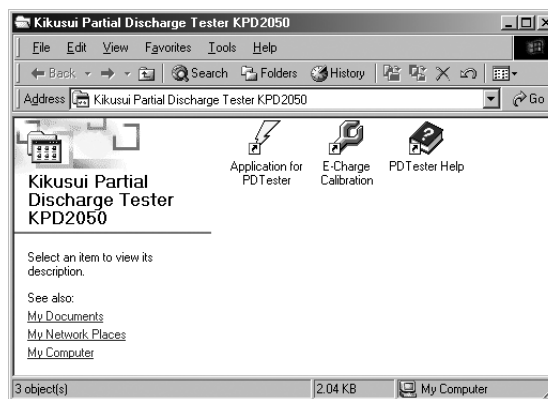

Fig. 2-2   Kikusui Partial Discharge Tester folder

Application for PDTester

      Controls the KPD2050 tester

PDTester Help

      Displays online help for Application for PDTester

E-Charge Calibration

      Calibrates the tester's electrical charge measurement function

2.3 Installing Calibration Data Only

On receiving a request for periodic calibration, we will calibrate, then send, the KPD2050 tester and the disk saved new calibration data after completing calibrations. This new calibration data must be installed on the PC to prevent inaccurate measurements resulting from operations based on outdated calibration data.

Calibration data must be reinstalled if it is corrupted or lost. In such cases, the PDTester Application issues a message that calibration data is abnormal.

The calibration data will be automatically installed when you install the PDTester Application. However, it may also be installed independently.

The calibration data file contained on the Calibration Data Disk (3.5" FD) is uncompressed; simply copy it to the hard disk to complete installation.

To install the calibration data only, follow these procedures:

1. Insert the Calibration Data Disk (3.5" FD) into drive "A."

2. From the [Start] button, select the [Programs] folder, and then [Windows Explorer].

3. Copy all files on the Calibration Data Disk (3.5" FD) to the [Partial Discharge Tester KPD2050] folder in the [Kikusui] folder in [Program Files].

2.4 Uninstalling the PDTester Application

To remove the PDTester Application from the PC, follow the procedure given below:

1. From the [Start] button, select [Settings], and then the [Control Panel] folder.

2. Open the [Add/Remove Programs] icon in the [Control Panel] folder and select the "Kikusui Partial Discharge Tester KPD2050."

3. Follow the prompts that appear on screen.

3

Chapter 3 Basic Operation

This chapter describes basic test procedures for the partial discharge tester KPD2050.

This chapter is meant to illustrate basic functions and omits some application functions. For more information on the PDTester Application, please refer to "Chapter 5 PDTester Application Reference".

⚠ **WARNING** • The partial discharge tester KPD2050 outputs a maximum voltage of 5 kV. Although the hardware and software are equipped with safety features, improper operation may lead to personnel injury or death. Always follow the procedures described in the Operation Manual.

3.1   Turning on Power

This section describes the procedures for supplying power to the KPD2050 tester.

NOTE
- After starting OS (Windows) on the PC, turn on the KPD2050 tester.
- If the KPD2050 tester is turned on before the PC is started, some PCs fail to recognize the A/D (DAQ) board. In this case, an error message appears as soon as the software included with the product is started, rendering it unable to conduct a test. This problem most likely happens when the PC is not fully compatible with the A/D (DAQ) board.
- If the PDTester Application has started before you turn on the KPD2050 tester, shut down the software. Testing does not start if the KPD2050 tester is turned on after the PDTester Application.

1. Confirm that the KPD2050 tester POWER switch is off.

2. Confirm that the KPD2050 tester and PC are properly connected.

3. Confirm that power cord is connected properly.

4. Confirm that the EMERGENCY STOP switch on the front panel has not been pressed.

   (If it has been, release it by turning the knob clockwise.)

5. Turn on the POWER switch.

   The green lamp for the POWER switch lights, indicating that power is supplied properly.

6. Confirm that the AC TEST VOLTAGE meter on the front panel is pointing to "0."

3.2 Starting the PDTester Application

■ Before starting

Before starting the PDTester Application, close all Windows applications, including the screen saver and power management applications.

Since the PDTester Application acquires data from the KPD2050 tester in real time, concurrently running applications including the screen saver and power management applications may render accurate data collection impossible. For more information, refer to "5.1 Precautions for Using the PDTester Application"

NOTE
• Never start, exit or run software application in the background during testing.

■ Starting procedure

1. From the [Start] menu, select [Programs], then the [Kikusui Applications for PDTester].

2. After a brief pause, the PDTester Application initial screen appears.

NOTE
• During this pause, the PDTester Application checks the connection between the KPD2050 tester and the PC. If the following message appears, confirm that the KPD2050 tester and PC are connected properly and that the KPD2050 tester POWER switch is on. Then click the [Retry] button.
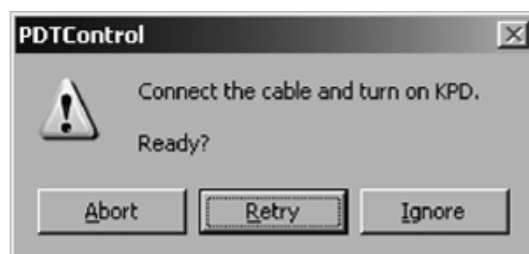
Fig.3-1   Confirming the connection

If you press the [Ignore] button to start PDTester Application and then secure the cable or turn on the POWER switch, the test won't be carried out. The PDTester Application checks for the presence of the KPD2050 tester when starting.

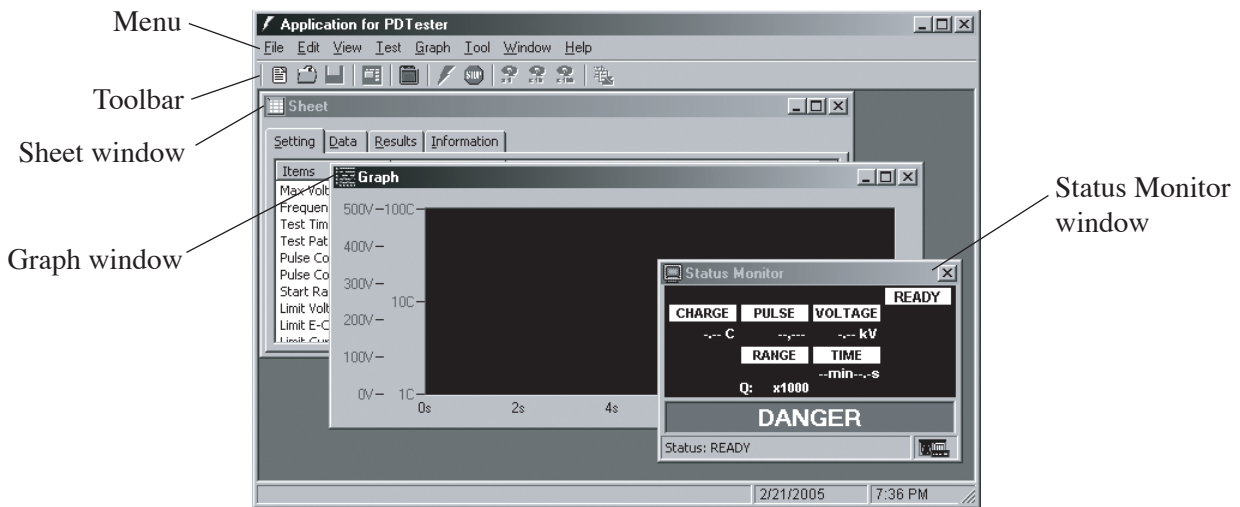3. When the PDTester Application starts, the following screen appears.

Menu

Toolbar

Sheet window

Graph window

Status Monitor
window

Fig. 3-2   Screen appearing immediately after startup

NOTE • After starting the PDTester Application, do not turn off the KPD2050 tester POWER switch. If the KPD2050 tester POWER switch is turned off, you must restart the PDTester Application to get it to recognize the tester.

Calibration confirmation message

When you use the tester for the first time after purchase, or if no charge calibration (see "3.4 Charge Calibration") has been made for over a day, the following message appears as soon as the PDTester Application starts.
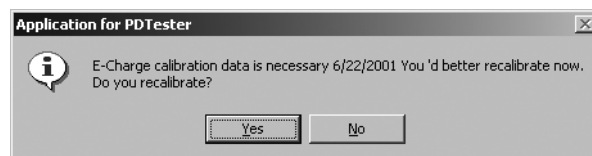

Fig. 3-3   Confirming start of calibration

To start calibration, click [Yes] button. To disregard calibration, click [No] button.

3.3 Connecting the DUT

■ Checking safety

⚠ WARNING • Before touching the OUTPUT terminals of the KPD2050 tester, always take the following steps to confirm that the terminals are free of voltage.

1. Confirm that the electric shock caution lamp below the OUTPUT terminals is off.

   As a high-voltage alert, the electric shock caution lamp is lit red while the tester outputs high voltage.

The ⚡ lamp must be off.
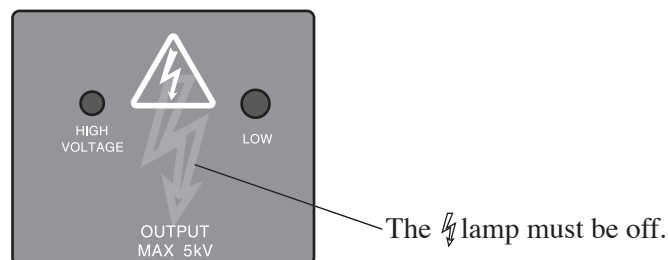
Fig. 3-4   Checking the Electric Shock Caution lamp

2. Confirm that the AC TEST VOLTAGE meter pointer on the KPD2050 tester indicates "0."
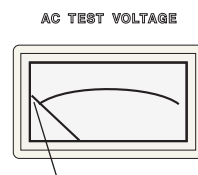
The pointer must indicate "0."

Fig. 3-5   Checking the meter reading

3. Confirm that the status indicator for the Status Monitor window shows "READY" and the DANGER bar is indicated in dark red.
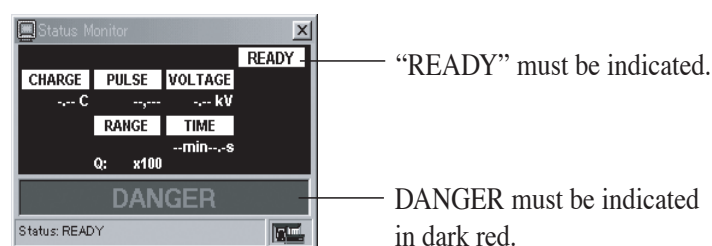

"READY" must be indicated.

DANGER must be indicated in dark red.

Fig. 3-6   Checking the status monitor

■ Connection

NOTE

• This procedure describes a connection using the test leads provided with the product. If you use a dedicated attachment instead, please refer to the operation manual for the attachment.

---

4. Open the safety cover.

5. Connect the DUT to the test leads supplied with the product.

   Situate the test lead (on the high-voltage side) as far as possible from the chassis and the safety cover. This minimizes the risk of partial discharge caused by these components.

⚠ CAUTION • Firmly connect the DUT.

---

6. Close the safety cover.

   If the safety cover is open, the guard function is activated to disable testing.

⚠ WARNING • Never block the hole that detects opening/closing of the safety cover to carry out the test with the cover opened. Doing so will expose dangerous high-voltage-applied components.

This projection detects open/close status for the safety cover.

Fig. 3-7   Checking the "open/closed" status of the safety cover

3.4   Charge Calibration

Under any of the following conditions, calibration is required to use the charge measuring function of the tester effectively. In this manual, this calibration is called "charge calibration."

Table 3-1   Conditions requiring charge calibration

1.	Before the first test of the day.
2.	When the type of device under test (DUT) has been changed.
3.	When a DUT has been replaced with another one that differs in capacitance by more than 10 %, even if both DUTs are of the same type.
4.	To conduct extremely precise measurement.
5.	When the ambient temperature has changed by more than 5 ℃ following the last charge calibration.

Charge calibration procedure

The following shows the steps to be taken with the test lead connected:

1.   From the HIGH VOLTAGE terminal, remove the red test lead, and insert the capacitor box into the terminal.

Capacitor box
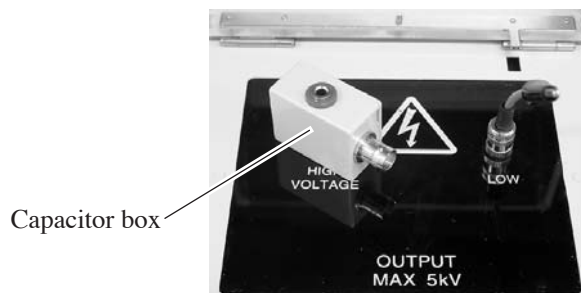
Fig. 3-8   Installing the capacitor box

2.   Using the BNC-BNC cable, connect the capacitor box to the CALIBRATOR OUT terminal.

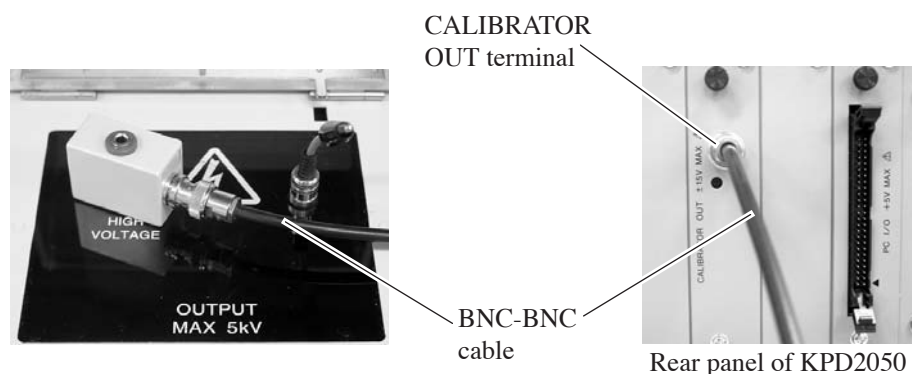CALIBRATOR OUT terminal

BNC-BNC cable

Rear panel of KPD2050

Fig. 3-9   Connecting the BNC-BNC cable

3. Insert the red test lead in the top of capacitor box.
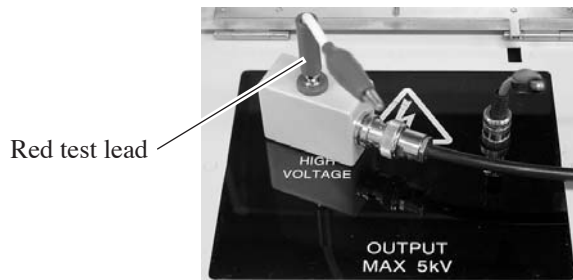

Red test lead

Fig. 3-10   Inserting the red test lead

4. Between the red and black test leads, connect a DUT.

5. Close the safety cover.

Guide the BNC-BNC cable along the groove at the side of the safety cover.
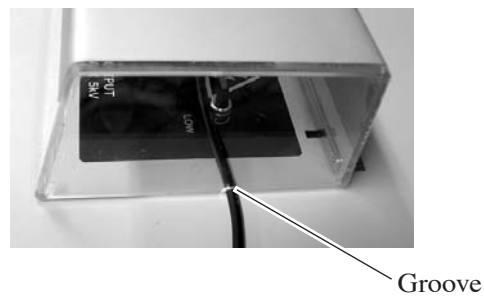

Groove

Fig. 3-11   Guiding the cable along the groove

6. On the PDTester Application, from the [Tool] menu, select [Charge calibration...].

The E-Charge Calibration program starts and displays a new screen.

On this screen, you must check the warm-up status. To obtain accurate calibration results, the KPD2050 tester requires at least 30 minutes to warm up (to have power supplied).

If at least 30 minutes have passed since the POWER switch on the tester was turned on, check [Yes], and then click [Next] button.

Otherwise, check [No] and then click [Start] button. Time consumed is displayed. Warm-up completes in 30 minutes. To suspend warm-up, click [Stop] button.

- -

NOTE   • If, after checking [No], you click [Start] button, the PDTester Application only measures time, and performs no operation on the KPD2050 tester.

- -
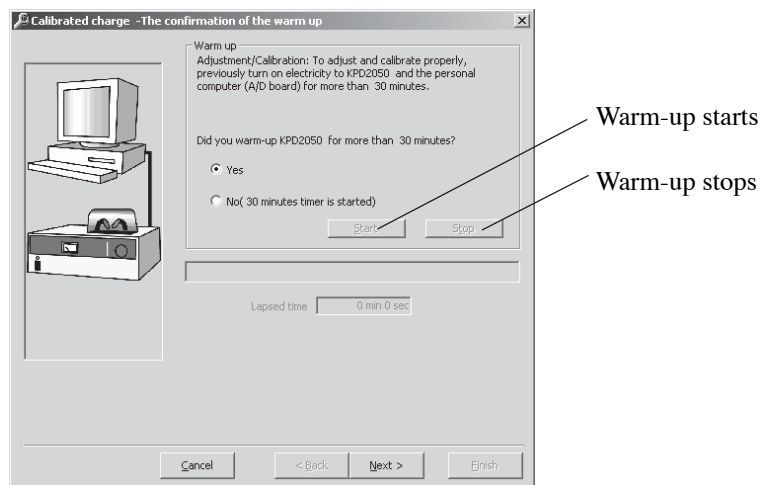
Fig. 3-12   Checking the warm-up status

Warm-up starts

Warm-up stops

7. Check [Yes] and click [Next] button.

A new screen appears for you to enter the temperature and humidity at charge calibration and operator information.

Be sure to enter the operator name. Otherwise, a message screen appears and prevents you from going on to the next page.
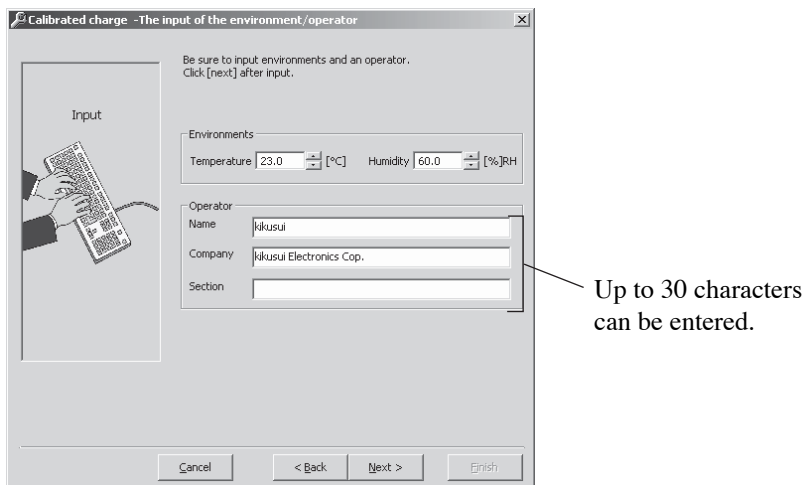
Fig. 3-13   Entering environmental parameters and operator name

Up to 30 characters can be entered.

8. Enter the environmental parameters and the name of the operator. Then click [Next] button.

The charge calibration execution screen appears.

To print the previous calibration data, click [Print] button.

Charge calibration starts
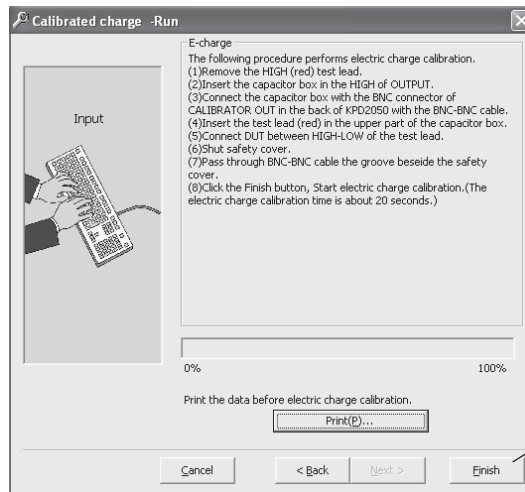
Fig. 3-14   Executing charge calibration

9. Click [Finish] button.

Charge calibration takes about 20 seconds. On completion of charge calibration, the next message appears.

To print the new calibration data, check [Print Data after Charge Calibration] and click [OK] button.

For an example of data printouts, see the Appendix to this manual.

Fig. 3-15   Ending the charge calibration wizard

10. On completion of charge calibration, open the safety cover, and remove the BNC-BNC cable from the capacitor box.

11. Remove the capacitor box from the HIGH VOLTAGE terminal, and insert the red test lead to the terminal.

The above steps complete charge calibration. Now the tester is ready to start a test.

• If the following error message appears during charge calibration, ask Kikusui distributor/agent for periodic calibration service.
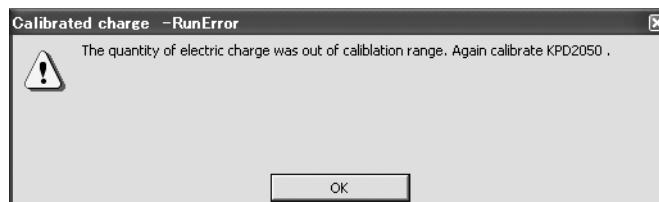
Fig. 3-16   Charge calibration error

DESCRIPTION • Charge calibration

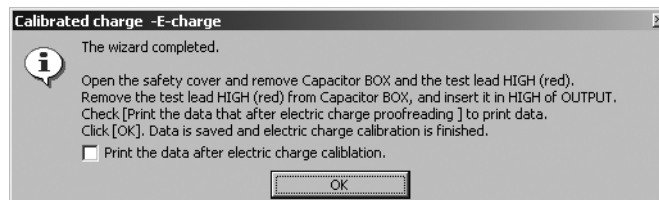The tester retains data obtained in periodic calibration (the first calibration is conducted before delivery) until the next periodic calibration.

In charge calibration, the data obtained is compared with this periodic calibration data. Unless an error message appears during calibration, the charge calibration data is rewritten. The rewritten data is retained until the next charge calibration. Note, however, that even in the next charge calibration, the data obtained in periodic calibration is used as the basis for comparison. If an error message appears, conduct periodic calibration.

3.5 Setting New Test Conditions

Before performing a test, set test conditions such as application voltage, frequency, and measurement ranges. These parameters can then be saved to a file for later use. This section describes procedures for creating a file for new test conditions.

■ Opening the [Test Setting...] dialog

1. Select [New Test Setting...] from the [File] menu.

2. The [Test Setting...] dialog appears, showing the [Output] page for voltage settings.
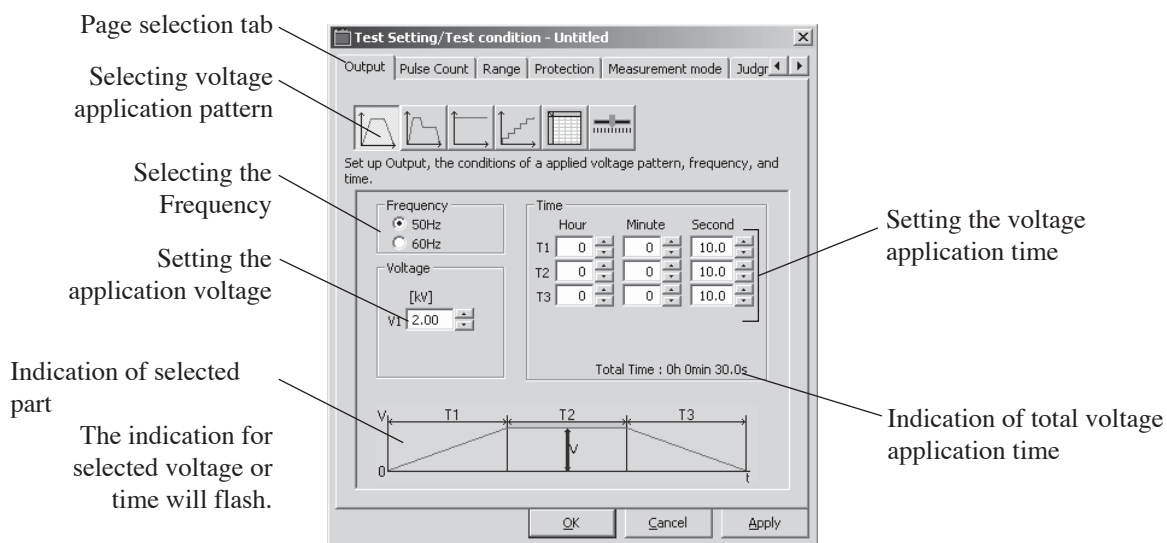
Fig. 3-17   Output page

■ Setting the test voltage

3. Set the application pattern of the test voltage.

    To select a voltage application pattern, click the Pattern select button from those representing the six available application patterns. This procedure uses the [Ramp] value set by default. This pattern allows increase and decrease ramp to be set to the test voltage.

4. Set the test voltage frequency.

    To select the frequency, click the [Frequency] radio button. This procedure uses the [50 Hz] default value.

5. Set the application voltage.

Application voltage can be set by typing a value into the [Volt] box of [Output], or by using the Up/Down button to the right of the box. For this procedure, type "2." When you place the cursor in the [Volt] box, the "V" in the selected part indication will flash.

⚠ **CAUTION** • This example uses a setting of 2 kV. Set the voltage appropriate for the DUT.

NOTE • If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can't be set as the application voltage. If a value entered in the application voltage setting box reverts to the previous value, open the [Protection] page.

6. Set test time.

You can set the test time by typing a value in the [Time] box, or by using the Up/Down button to the right of the box. In this procedure, type "10" in each [Second] box of [T1], [T2], and [T3]. When you place the cursor in a [Time] box, the corresponding "T" in the selected part indication will flash. The total figure for the tests times entered will be indicated in [Total Time].

■ Setting pulse measurements

7. Click [Pulse Count].

This page is used to set items related to measurement of current pulses. In this procedure, set [Count method] to "Minus [-]" and [Threshold Level] to "50 %."
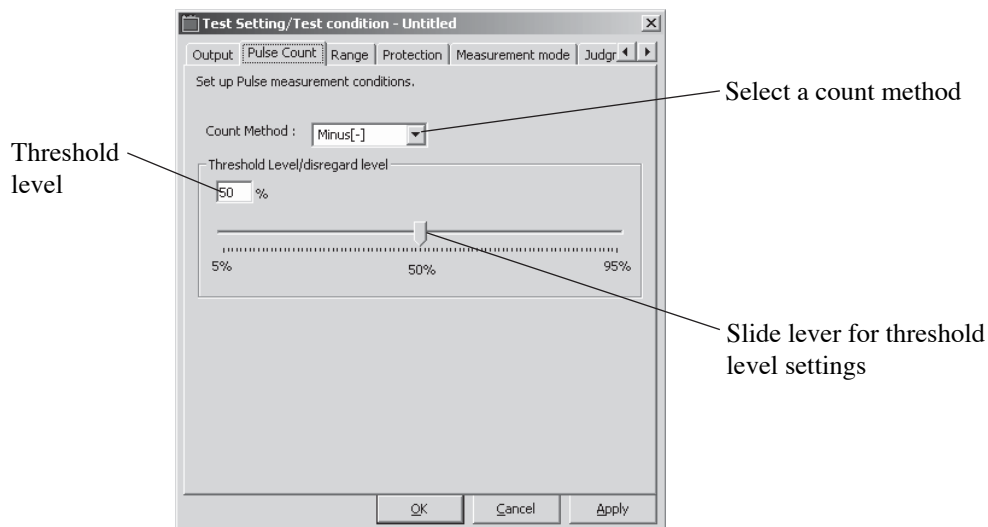
Fig. 3-18   Pulse Count page

■ Setting measurement ranges

8. Click [Range].

    This page is used to set items related to measurement ranges. In this procedure, the range will be set to "10.0 pC."

    On this page, you can set only the charge measurement range. The other items cannot be set.

Select a charge measurement range
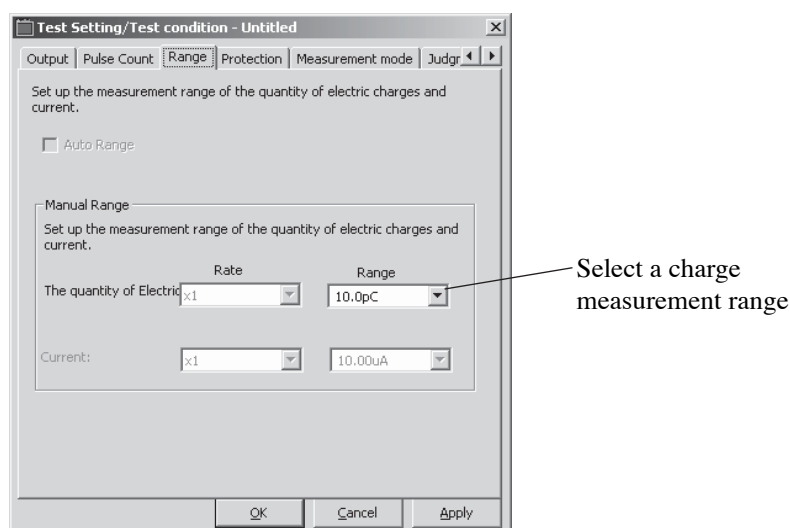
Fig. 3-19   Range page

■ Setting limit values

9. Click [Protection].

    This page is used to set items related to the protection of the DUT. In this procedure, only the voltage will be protected. Check "Voltage" and enter "2.2" in the setting box to set to "2.2 kV."

⚠ CAUTION • Since the application voltage has been set to 2 kV in step 5, the voltage limit value is also set to 2.2 kV. If you have set an application voltage other than 2 kV in step 5, use that voltage with a margin as the limit value.

NOTE • If the [Voltage] checkbox is checked (voltage protection is on), a value exceeding the voltage limit can't be set as the application voltage.

DESCRIPTION • This guard function is activated by the PDTester Application. The PDTester Application checks whether acquired measured values exceed limit values, and halts a test if any are exceeded by the appropriate limit. Acquired data is captured by the PC every 15 cycles; the PDTester Application makes a judgement of the measured values 15 cycles (300 ms for 50 Hz, or 250 ms for 60 Hz) after the KPD2050 tester.

Setting the voltage limit value
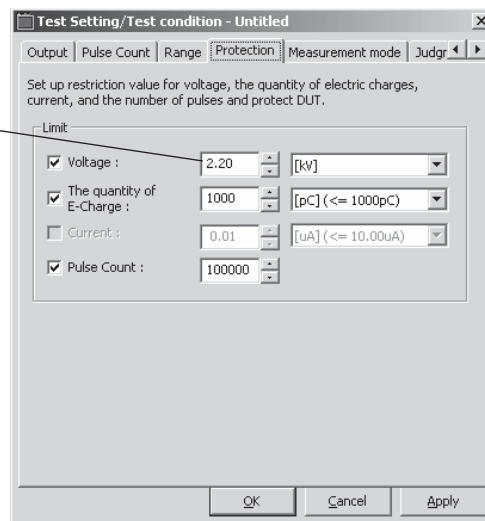
Fig. 3-20   Protection page

■ Setting the measurement mode

10. Click [Measure].

This page is used to set the charge threshold value for measuring the brake down voltage and discharge disappearance voltage. In this procedure, there is no special entry.

■ Setting judgment conditions

11. Click [Judgment].

This page is used to set the conditions for the judgment function of the tester. In this procedure no special entry is made.

■ Saving test information

12. Click [Information].

This page saves information for the DUT, and operator information to a file. No additional information needs to be entered for this procedure.

■ Transferring the set conditions

13. Transfer the test conditions data set up to step 12 to the KPD2050 tester by pressing the [OK] button for the [Test Setting...] dialog.

This causes "Test Setting Data Transferring..." to appear in the status bar at the lower portion of the PDTester Application screen and closes the [Test Setting...] dialog.

■ Creating a test conditions file

14. Select [Save Test Setting...] from the [File] menu.

This opens the [Save as] dialog. Enter a file name and click the [Save] button. The extension ".kpd" is automatically assigned to the file name.

3.6   Performing a Test

In this section, perform a test under the test conditions specified in "3.5, Setting New Test Conditions."

⚠ **CAUTION**
- If you need to abort the test immediately due to a test error, press the KPD2050 tester EMERGENCY STOP switch.
- You can also abort the test with the [Stop] command in the PDTester Application [Test] menu. This method requires somewhat more time, since it is performed by software.

■ Inspection before performing the test

1. Confirm that the safety cover is closed.

2. Confirm that the EMERGENCY STOP switch on the front panel is not pressed.

   The EMERGENCY STOP switch will be locked while pressed. To cancel the lock, turn the switch knob clockwise.

■ Performing the test

3. Select [Run] from the [Test] menu.

4. When the following confirmation screen appears, click [OK].
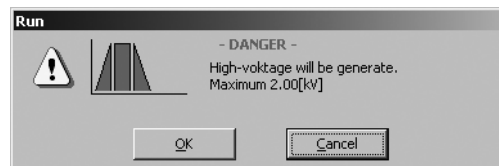
Fig. 3-21   Executing a test

When the test starts:

- The status indication for the Status Monitor window changes from "READY" to "TEST," and the DANGER bar changes to bright red.
- On the Graph window, the graphs for voltage, and electrical charge are drawn with time.
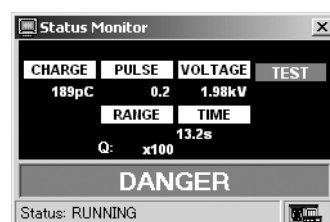
Fig. 3-22   Testing in progress

If the test is aborted:

- If the test is aborted during the test, the status indication for the Status Monitor window changes from "TEST" to "ALARM", and the reason for aborted testing is indicated. The following screen shows the status at which the test has been aborted when the KPD2050 tester EMERGENCY STOP switch was pressed.
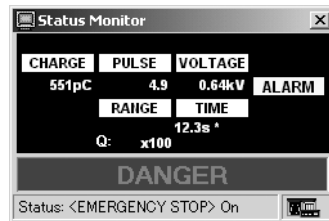
Fig. 3-23   Testing suspended

When the test completes:

- When the set test time has passed, the status indicator for the Status Monitor window changes from "TEST" to "PASS", and the DANGER bar changes to dark red.
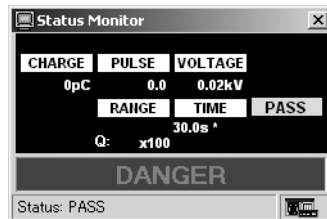
Fig. 3-24   Testing ended

- Wait while acquired data is processed internally. "Acquisition Data Transferring..." appears in the status bar at the lower portion of the PDTester Application screen. Processing time depends on the amount of data acquired.
- New data and test conditions are embedded in the Sheet window.
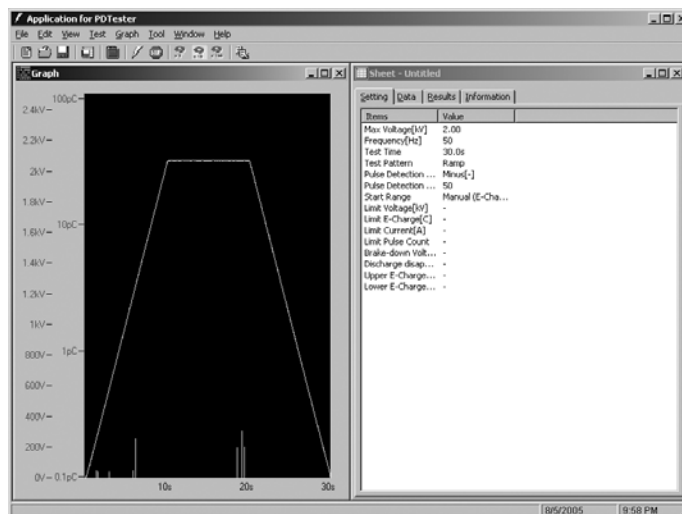
Fig. 3-25   Screen displayed at completion of testing

3.7　Exporting Acquired Data to Excel

Acquired data and the test information entered in the [Information] page of the [Test Setting...] dialog are embedded in the cells of the Sheet window. Data in this Sheet window can be exported to Excel (97/2000/2002) worksheets for data analysis.

- -

NOTE
- While the PDTester Application permits data in the Sheet window to be saved to text files having extension '.csv,' it can't open such files. Such text files must be opened from within Excel.
- Graphs drawn in the Graph window can't be saved as files. If you wish to save it, copy and paste the screen data to the clipboard, then paste to another document.

  To copy screen data to the clipboard, press the [Print Screen] key while holding down the [Alt] key. (Key indications vary from PC to PC.) To paste, use the [Paste] command in the application's [Edit] menu. (Specific menu and command item descriptions vary from application to application.)
- Graphs are printed by using the [Print] command under the [File] menu.

- -

1.　From the [Edit] menu, select [To Excel].

   This starts Excel if it isn't already running, and the data is exported to a series of new Excel worksheets (PDTester Report 1 of PDTester Book 1, PDTester Report 2 of PDTester Book 1, and so on).

2.　From the [File] menu, select [Save as] to save the Books.

⚠ CAUTION
- Precautions for the [To Excel] command

  If you close all open Books and then exit Excel after executing the [To Excel] command, a fatal error will occur in Excel that may require restarting the PC.

  After executing the [To Excel] command, save the Books and exit Excel with at least one Book left open.

4

Chapter 4   EN 50178-Compliant Partial Discharge Testing

This chapter describes partial discharge testing, as prescribed in the EN 50178 standard.

In light of more stringent requirements expected in the future in the standard and for easier and more efficient testing, a substitute testing method is also provided in this chapter.

4.1 Preparation for Testing

Before starting a test, determine the applied voltage and limit values.

1. Determine the rated voltage for the partial discharge test.

   Using an oscilloscope, measure the maximum cyclic peak voltages in two insulated circuits used in steady state with a DUT. The sum of these values is the rated voltage for the partial discharge test.

2. Determine the limit value of the discharge disappearance voltage.

$$\text{Limit value of discharge disappearance voltage} = \frac{\text{Rated voltage for partial discharge test} \times 1.25}{\sqrt{2}} \approx \text{Rated voltage for partial discharge test} \times 0.884 \text{ Vrms}$$

3. Determine the maximum applied voltage for the partial discharge test.

$$\text{Maximum applied voltage} = \frac{\text{Rated insulation voltage of the DUT} \times 1.875}{\sqrt{2}} \approx \text{Rated insulation voltage of the DUT} \times 1.326 \text{ Vrms}$$

4.2 Inspection

EN 50178 requires inspection of all relevant items, including environmental features, to be conducted before starting a test.

NOTE
- The EN 50178 standard calls this inspection "calibration." This term is confusing, because we use the term "periodic calibration" for measuring instruments and the term "charge calibration" for this tester in this manual. The term "calibration" used in the standard means "inspection" rather than "calibration" in the true sense of the word. For this reason, we use "inspection" to describe the "calibration" prescribed in the standard.

Inspection procedure

1. Check that the temperature and humidity are near 23 °C and 50 %.

   EN 50178 recommends testing at this temperature and humidity.

2. Provide a capacitor that has almost the same impedance as the DUT and is free from partial discharge at the maximum testing voltage.

   If such capacitors are not available, provide a DUT proven to be free from partial discharge. If no such DUTs are available, do not use any DUTs.

3. Using the capacitor as a DUT, conduct charge calibration.

   For charge calibration, see "3.4 Charge Calibration"

4. On completion of charge calibration, start a test under the testing conditions provided in Table 4-1, with the capacitor as a DUT.

   The template file for these testing conditions (EN50178 InspectTest.kpd) is provided in the [Partial Discharge Tester KPD2050] - [Condition Files] folder. To use this template, enter the maximum applied voltage and other information.

Table 4-1   Testing conditions for inspection

Page	Item	Setting
Output	Pattern	Lamp
	Frequency	50 Hz
	Voltage	Maximum applied voltage (the value determined in "Preparation for Testing")
	Time T1	10 seconds
	Time T2	2 seconds
	Time T3	10 seconds
Pulse count	All items	Set a value.
Range	Electric charge	100 pC range
Protection	All items	Uncheck.
Measurement mode	Brake down voltage	10 pC: [pC] (≤100.0 pC)
	Discharge disappearance voltage	10 pC: [pC] (≤100.0 pC)
Judgment: Voltage judgment	Voltage judgement	Uncheck.
Judgment: Electric charge/Judgment time	Upper limit	5 pC: [pC] (≤100.0 pC)
	Lower limit	Uncheck.
	Beginning	Uncheck.
	End	Uncheck.
Information	All items	Set a value.

5.   On completion of the test, check that the maximum partial discharge is 5 pC or less.

When the status monitor displays "PASS," inspection is complete.

- -

NOTE   • After the test, if the status monitor does not display "PASS," repeat the test after checking the following.

- • Check that the test lead and the DUT are not touching the safety cover and the metal part of the upper cover. If they are in contact, remove the test lead and the DUT from the covers.
- • Check that the DUT and the acrylic board in the safety cover are free from dust or stains. If they are not, clean them.
- • Check that the KPD2050 tester is securely grounded. If not, ground the tester properly.
- • If the temperature and humidity deviate markedly from 23 ℃ or 50 %, adjust the environment, using an air conditioner or by other means.
- • Check the area for noise-generating devices or other objects. If there are any, remove them.
- • Check the area for noise-generating devices sharing the same power line. If any, remove them or use separate power lines for the tester and the other device.
- • Repeat the test a few times.

- -

4.3 Testing

1. Initiate testing under the conditions listed in Table 4-2.

   The template file for these testing conditions (EN50178 StandardTest.kpd) is provided in the [Partial Discharge Tester KPD2050] - [Condition Files] folder. To use this template, enter the maximum applied voltage and other information.

   Complete step 2 through step 5 within 1 minute.

Table4-2   Testing conditions for compliance with EN 50178

Page	Item	Setting
Output	Pattern	Manual
	Frequency	50 Hz
	Time	1 minute
Pulse count	All items	Set a value.
Range	Electric charge	100 pC range
Protection	Voltage	Maximum applied voltage
	Other items	Uncheck.
Measurement mode	Brake down voltage	10 pC: [pC] (≤100.0 pC)
	Discharge disappearance voltage	10 pC: [pC] (≤100.0 pC)
Judgment	All items	Uncheck.
Information	All items	Set a value.

2. With the slider, slowly raise the voltage above 0 kV.

3. If partial discharge exceeds 10 pC as the voltage increases, temporarily stop raising the voltage, and read the voltage on the status monitor.

   This value is the brake down voltage.

4. Resume raising the voltage until it exceeds the starting voltage by 10 %.

   Be sure not to let the voltage exceed the maximum applied voltage.

5. Then, slowly lower the voltage to 0 kV.

6. On completion of the test, check the data page on the Sheet window to confirm the voltage at which the electric charge exceeded 10 pC for the last time.

   This voltage is the discharge disappearance voltage. The test is successful if the discharge disappearance voltage is at or above its limit.

   If the actual voltage exceeds the maximum applied voltage, the test is suspended by the protection function. The test is successful if partial discharge has not exceeded 10 pC before suspension.

4.4　Substitute Test

Tests under EN 50178 require a great deal of manual work. This paragraph proposes a simpler substitute testing method. This substitute demands stricter testing conditions, but it reduces testing time for DUTs that exhibit sufficient insulation capacity.

1. Reviewing the testing method provided in the preceding paragraph, estimate the brake down voltage.

2. Initiate testing under the conditions listed in Table 4-3.

   The template file for these testing conditions (EN50178 SubstituteTest.kpd) is provided in the [Partial Discharge Tester KPD2050] - [Condition Files] folder. To use this template, enter the maximum applied voltage, the discharge disappearance voltage limit, and other information.

Table4-3　　Test conditions for alternative testing method

Page	Item	Setting
Output	Pattern	Lamp
	Frequency	50 Hz
	Voltage	Estimated brake down voltage x 1.15
	Time T1	10 seconds
	Time T2	2 seconds
	Time T3	10 seconds
Pulse count	All items	Set a value.
Range	Electric charge	100 pC range
Protection	Voltage	Maximum applied voltage
	Other items	Uncheck.
Measurement mode	Brake down voltage	10 pC: [pC] (≤100.0 pC)
	Discharge disappearance voltage	10 pC: [pC] (≤100.0 pC)
Judgment: Voltage judgment	Brake down voltage	Uncheck.
	Discharge disappearance voltage	Limit value of discharge disappearance voltage
Judgment: Electric charge/Judgment time	All items	Uncheck.
Information	All items	Set a value.

3. On completion of the test, check the Results page on the Sheet window to make sure that the starting voltage did not exceed 90 % of the voltage applied during the test.

   If the starting voltage did exceed 90 % of the applied voltage, raise the applied voltage by 5 % and repeat the test.

4. If, on completion of step 3 above, "PASS" is displayed on the status monitor, the test is successful.

Chapter 5   PDTester Application Reference

This chapter gives a detailed description of PDTester Application functions.

If the PDTester Application displays an error message during tester operation, refer to "5.4 Error Messages", in this chapter.

5.1 Precautions for Using the PDTester Application

The following gives some general precautions for using the PDTester Application. Never perform any of the following actions during testing, since doing so may impair the capability of the PDTester Application to acquire data correctly.

1. Running other application software
2. Running a resident program
3. Running Power Management
4. Running the screen saver
5. Changing the display size of the PDTester Application Graph window
   (Processing is faster with smaller display sizes.)

5.2   Menus and Toolbar

This section describes the PDTester Application menus and Toolbar.
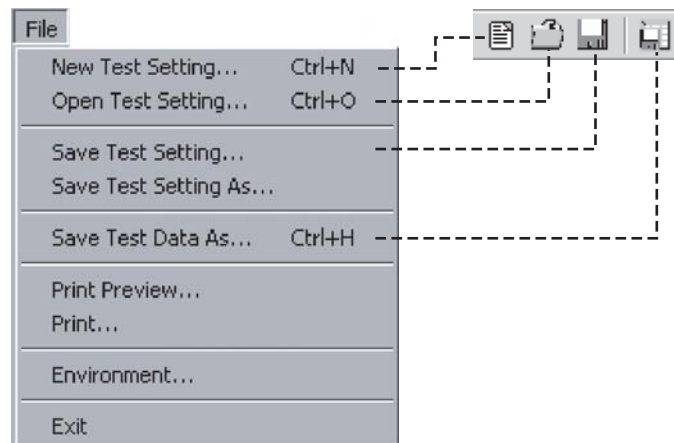
5.2.1   File menu

Fig.5-1   File menu

■ New Test Setting...

Opens a new [Test Setting] dialog.

■ Open Test Setting...

Reads test condition data from the existing test conditions file (*.kpd) to open the [Test Setting] dialog.

■ Save Test Setting...

Saves test condition data. The test condition data file is about 3 kB.

■ Save Test Setting As...

Saves test condition data to a new file. Use this command to edit test condition data and save under another file name.

■ Save Test Data As...

Saves Test data (test conditions and acquired data) as a new text file (extension: .csv). Test data are saved as files having a maximum size of about 165 kB. The PDTester Application can't open text files (extension: .csv).

NOTE
- The PDTester Application assumes that acquired data will be pasted to and analyzed in Microsoft Excel (97/2000/2002) worksheets. Thus, it's also assumed that Test data will be saved in Excel; Test data saved by the PDTester Application are found in CSV format only.

- Test data may be saved to a text file using the [Save Test Data As...] command, then opened by spreadsheet software such Excel. However, such files will not retain their layouts, as will data pasted to Excel worksheets using the [To Excel] command.
- Graphs drawn in the Graph window can't be saved as files. To save, capture a copy of screen data and paste to another document.
- When the [Automatically Save Sheet] checkbox is checked on the [File] page of [Options...] in the [Text] menu, Sheet data is automatically saved whenever a test finishes.

■ Print Preview...

Print Preview enables you to view your document on the screen exactly as it will be printed.

■ Print...

Prints graphs of the test results and testing conditions.

■ Environment...

Used to enter the ambient temperature and humidity. The values entered here are displayed on the [Information] page of the Sheet window.
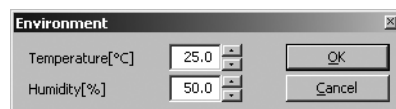

Fig. 5-2   Environment window

■ Exit

Exits the PDTester Application. Note that you can't exit the PDTester Application while a test is being performed.

5.2.2 Edit menu

Fig. 5-3   Edit menu

■ To Excel

Transfers Test data (test conditions and acquired data) to Excel (97/2000/2002) worksheets. The command automatically launches Excel and sequentially exports Test data to worksheets named 'PDTester Report 1' of 'PDTester Book1', 'PDTester Report 2' of 'PDTester Book1', and so on.

When saving Test data, create a new file name. Excel Test files are generally a maximum of 270 kB per sheet.

⚠ **CAUTION** • Precautions for using the [To Excel] command

If you close all open Books and then exit Excel after executing the [To Excel] command, a fatal error will occur in Excel that may require restarting the PC.

After executing the [To Excel] command, save the Books and exit Excel with at least one Book left open.
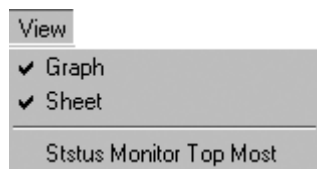

5.2.3 View menu

Fig. 5-4   View menu

■ Graph

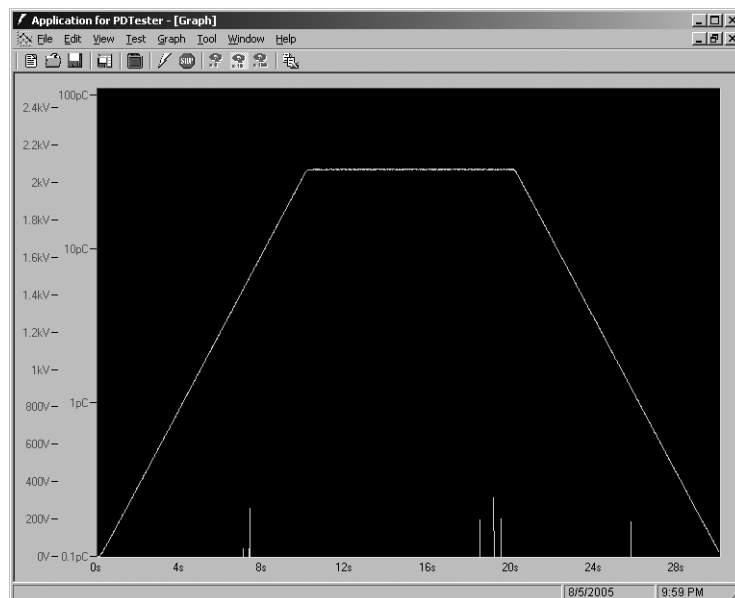Toggles display/non-display for the Graph window.

Fig. 5-5   Graph window

The Graph window displays the collected data in graph form. Graphs are shown in different colors, as follows:

Green: Applied voltage, Blue: Electric charge

On the [Graph] menu, you can alter the way the graph is displayed. For details, see "5.2.5 Graph menu".

NOTE
- A graph drawn on the Graph window in the screen can't be saved as a file. To save graph data, copy the screen data to the clipboard, then paste into another document.

  To copy screen data to the clipboard, press the [PrintScreen] key while holding down the [Alt] key. (Key indications vary from PC to PC.) To paste, use the [Paste] command under the [Edit] menu. (Menu and command particulars vary with applications.)

■ Sheet

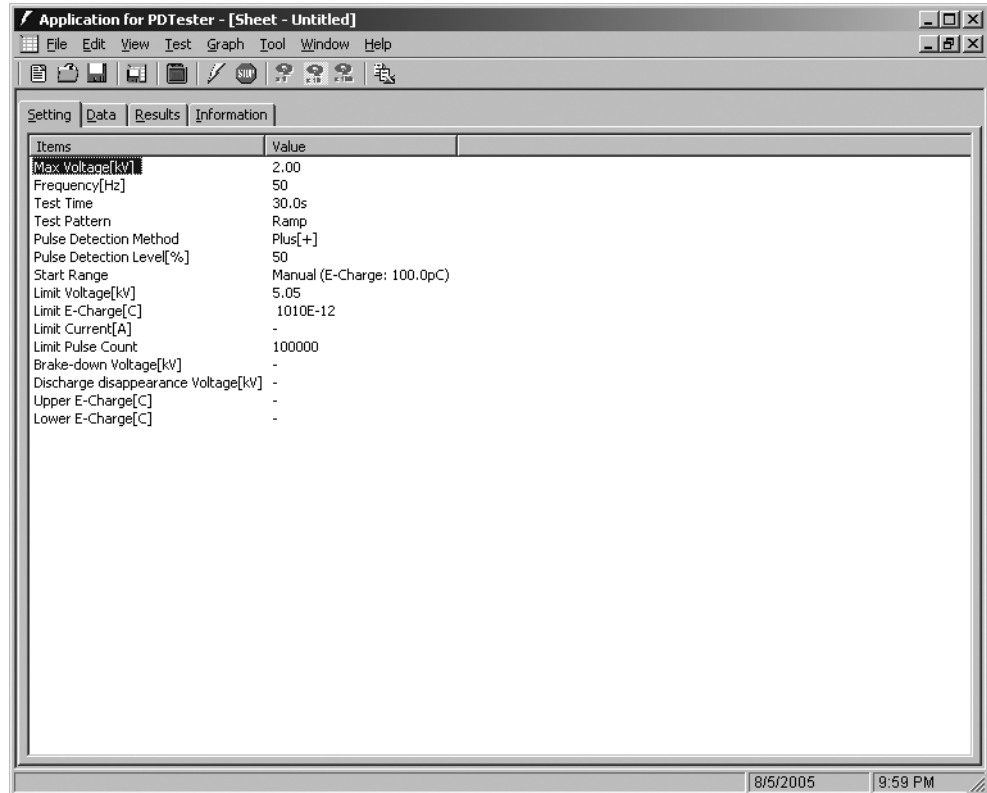Used to select the display/non-display status of the Sheet window.

Fig. 5-6　　Sheet window

The Sheet window has four pages - [Setting], [Data], [Results], and [Information].

- -

NOTE
- The PDTester Application can save data in the Sheet window to text files having extension ".csv," but can't open such files. Such text files must be opened from within Excel (97/2000/2002).
- If the [Automatically Save Sheet] checkbox is checked on the [File] page of [Options...] in the [Text] menu, Sheet data is automatically saved whenever a test is complete.
- For the electrical charge on the [Data] page, inconclusive data may be indicated by "ERROR."

- -

■ Status Monitor Top Most

Used to place the Status Monitor window in front of the other windows. The relocation of the window is linked with the movement of the icon at the bottom right of the Status Monitor window. For details, see "5.3 Status Monitor".
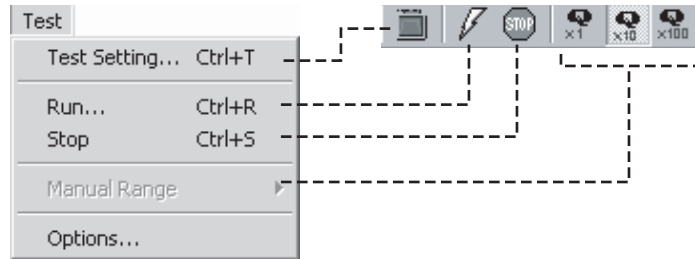
5.2.4   Test menu

Fig. 5-7   Test menu

■ Test Setting...

Opens the [Test Setting] dialog for the latest test conditions exported to the KPD2050 tester.

This dialog box has seven pages - Output, Pulse Count, Range, Protection, Measure, Judgment, and Information.

The PDTester Application retains in memory the latest test condition data exported to the KPD2050 tester. Even when the PDTester Application is terminated and restarted, the [Test Setting...] command allows the [Test Setting] dialog for the most recently exported test condition data to be opened.
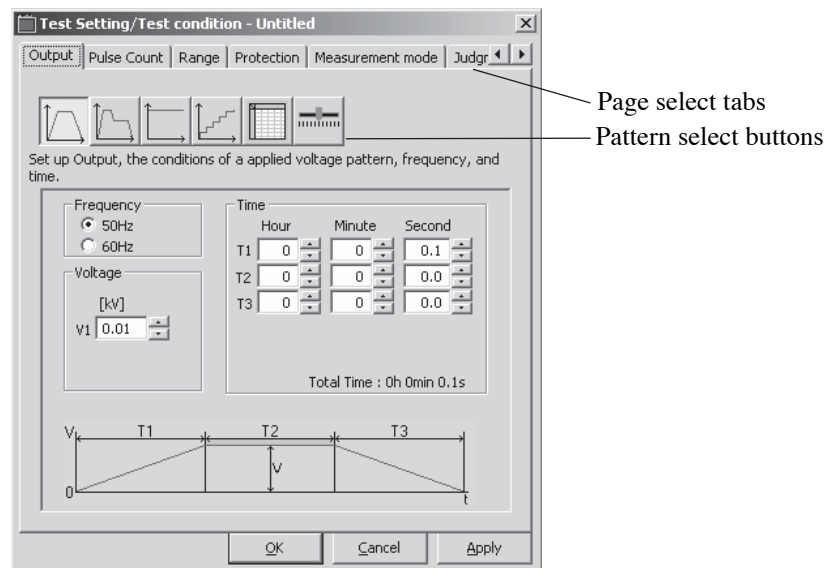

Fig. 5-8   Test setting dialog box

[OK] button

Transfers test conditions data to the KPD2050 tester and closes the [Test Setting] dialog.

[Cancel] button

Closes the [Test Setting] dialog without transferring test conditions data to the KPD2050 tester.

[Apply] button

Transfers test condition data to the KPD2050 tester. The [Test Setting] dialog is not closed.

NOTE • Testing can't be performed with the [Test Setting] dialog open.
• Even when test conditions are changed in the [Test Setting] dialog, test condition data will not be reflected in the next test unless exported to the KPD2050 tester.

◆**Output page**

This page is used to set items related to test voltage, such as a voltage application pattern, frequency, voltage, and time.

NOTE • If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can't be set as the application voltage. If a value entered in the application voltage setting box reverts to the previous value, open the [Protection] page.

Pattern

Sets the test voltage application pattern. The following six patterns are provided. To select a pattern, click a Pattern Select button.

1. Ramp
2. Ramp with initial voltage
3. Constant
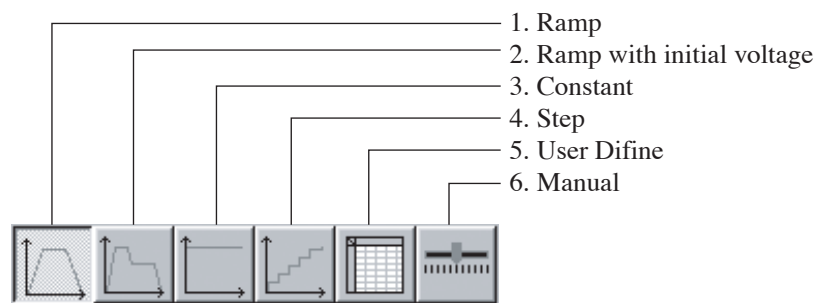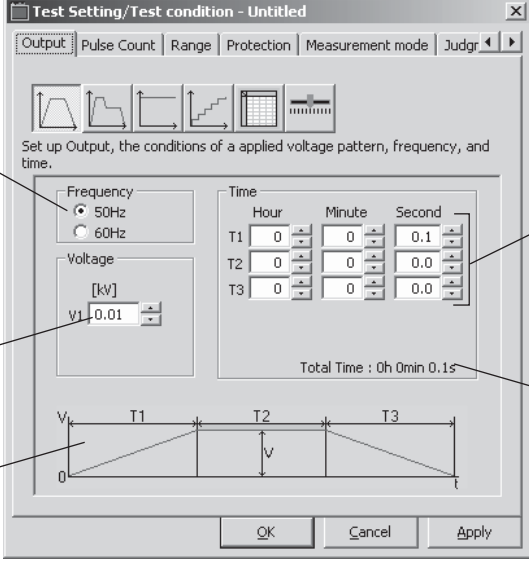4. Step
5. User Difine
6. Manual

Fig. 5-9   Pattern select buttons

1. Ramp

This pattern sets increase and decrease ramps for voltage application.

Setting the frequency of the application voltage
  This applies to six individual patterns.

Setting the application voltage
  Setting range:
  0.01 kV to 5.05 kV (*1)

Indication of selected part
  The selected portion of the selected voltage or time will flash.

Setting the voltage application time
  Setting range:
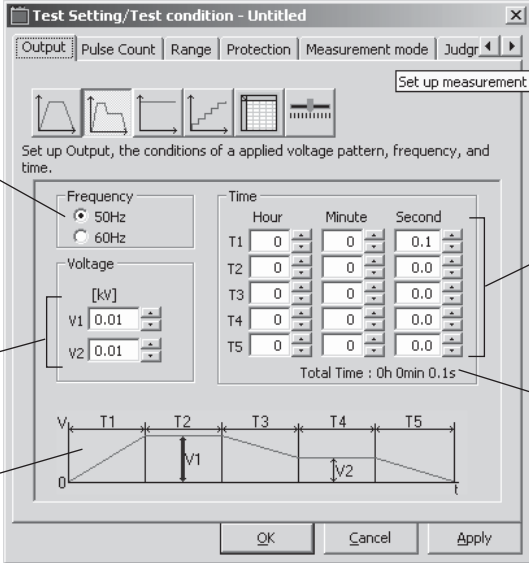 0.1 s to 500 hr for total of T1, T2, and T3

Indication of total voltage application time

*1: If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can't be set as the application voltage.

Fig. 5-10   Output - Ramp pattern page

2. Ramp With Initial Voltage

This pattern sets two voltages with increase and decrease ramps.

Setting the frequency of the application voltage
  This applies to six individual patterns.

Setting the application voltages
  Setting range:
  0.01 kV to 5.05 kV (*1)

Indication of selected part
  The selected portion of the selected voltage or time will flash.

Setting the voltage application time
  Setting range:
  0.1 s to 500 hr for total of T1 to T5

Indication of total voltage application time

*1: If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can't be set as an application voltage.

Fig. 5-11   Output - Ramp with Internal Voltage pattern page

3. Constant

This pattern applies constant voltage for a set time.

Setting the frequency of the application voltage
  This applies to six individual patterns.

Setting the application voltages
  Setting range:
  0.01 kV to 5.05 kV (*1)

Indication of selected part
  The selected portion of the selected voltage or time will flash.
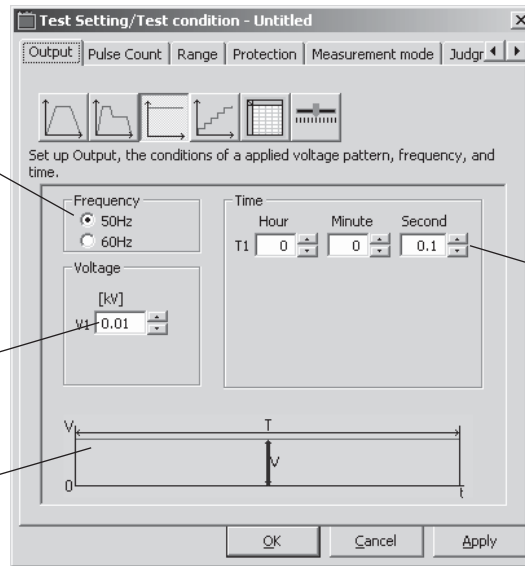
Setting the voltage application time
  Setting range:
  0.1 s to 500 hr

*1: If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can't be set as an application voltage.

Fig. 5-12   Output - Constant pattern page

4. Step

This pattern sets the starting and end voltages and applies voltage in steps between the start and end points. The number of steps is automatically calculated from the starting voltage (V1) and end voltage (V2).
    Total steps = V2/V1 (N) (fractional values are rounded up)
    Note the maximum number of steps of 97.

Setting the frequency of the application voltage
  This applies to six individual patterns.

Setting the application voltage
  Setting range:
  0.01 kV to 5.05 kV (*1)

  V1: starting voltage
  V2: end voltage

Indication of selected part
  The selected portion of the selected voltage or time will flash.

Setting the voltage application time per step
  Setting range:
  0.1 s to 500 hr

Indication of total voltage application time

Indication of total number of step
  Maximum number of steps: 97

*1: If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can t be set as the application voltage.

Fig. 5-13   Output - Step pattern page

5. User Define

This allows the user to set any test voltage application pattern. Voltage, time, and Ramp/Step can be set on a pre-step basis for up to 50 steps.

Ramps or steps can be set by simply entering their first letter.

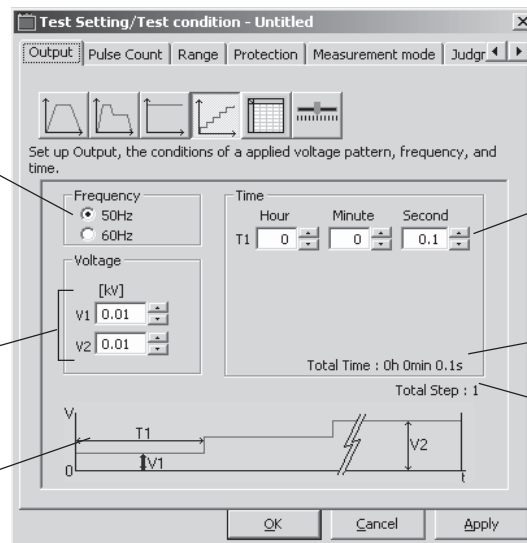Setting the application voltages
  Setting range:
  0.01 kV to 5.05 kV (*1)

Step number:
  1 to 50

Setting the frequency of the application voltage
  This applies to six individual patterns.

Setting the voltage application time
  Setting range:
  0.1 s to 500 hr for total of all steps

Setting the ramps and steps
  Ramp: Enter R or r.
  Step: Enter S or s.

Indication of total voltage application time

*1: If the [Voltage] checkbox in the [Protection] page is checked (voltage protection is on), a value exceeding the voltage limit can't be set as an application voltage.

Fig. 5-14   Output - User Define pattern page

The settings in the screen above become as shown below when expressed in a pattern.
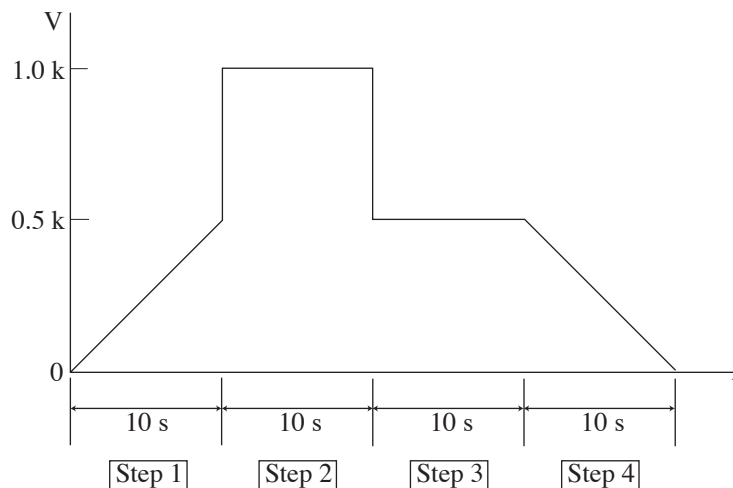
Fig. 5-15   Setting a voltage application pattern: an example

Step 1: Increases voltage from 0 to 0.5 kV in 10 seconds.
Step 2: Increases to 1 kV, then maintains that voltage for 10 seconds.
Step 3: Decreases to 0.5 kV, then maintains that voltage for 10 seconds.
Step 4: Decreases voltage from 0.5 kV to 0 in 10 seconds.
Step 5 and after: Invalid since time settings are 0 [h], 0 [m], and 0 [s].

6. Manual

This pattern sets the voltage application time only and allows a tester to change a voltage value manually during testing.

Setting the frequency of the application voltage
This applies to six individual patterns.

Setting the voltage application time
Setting range:
0.1 s to 500 hr
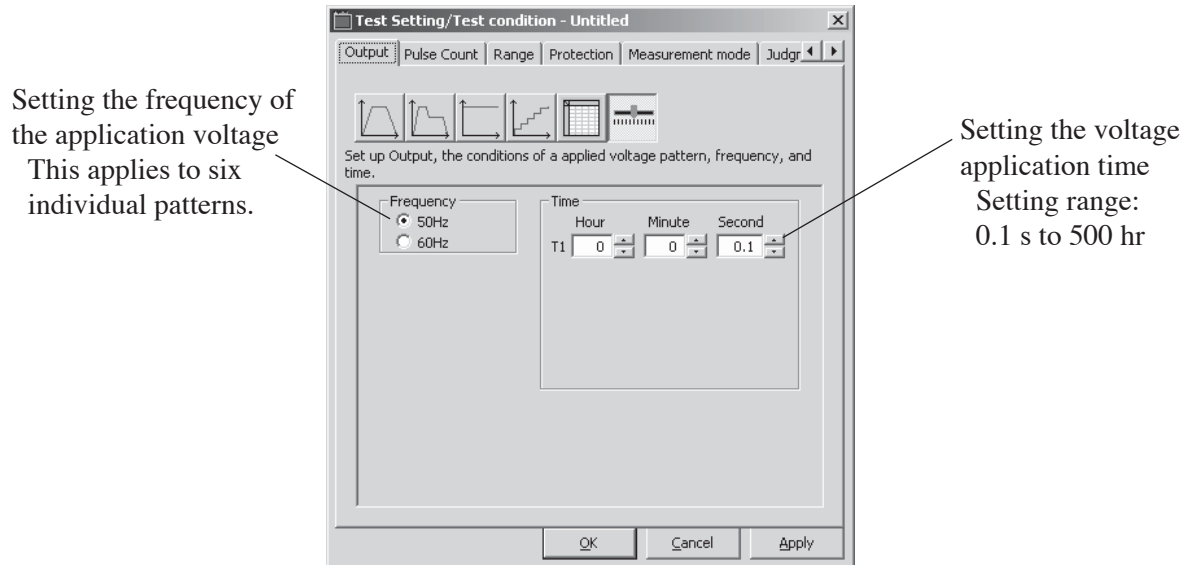
Fig. 5-16   Output Manual pattern page

⚠ CAUTION   • Performing testing with the Manual pattern allows for the possibility of applying excessive voltage. Check the [Voltage] checkbox in the [Protection] page to set a voltage limit value.

◆ Pulse Count page

This page is used to set measurement conditions for current pulse.

Count Method

Specifies the polarity of current pulses to be measured. Select one of the three types.

Threshold

This is a threshold level that determines whether pulse count is measured. To set a threshold, enter a value into the setting box or drag the slide bar to a desired position.

Setting the
threshold
  Setting range:
  5% to 95%

Slide lever
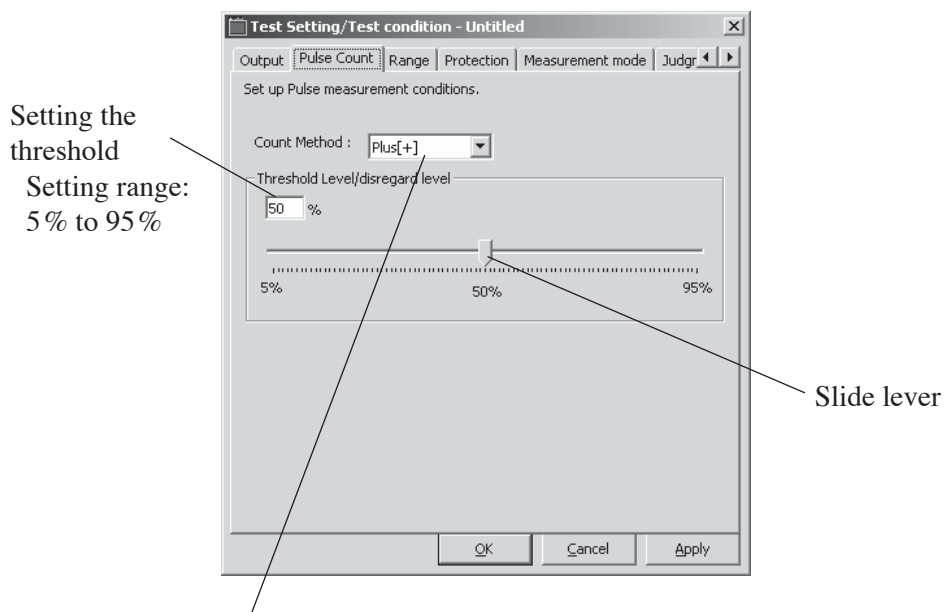
Setting the pulse measurement methods
  Plus [+]: Measures positive pulses only.
  Minus [-]: Measures negative pulses only.
  Bipolar [+-]: Measures both positive and negative pulses.

Fig. 5-17   Pulse Count page

◆ Range page

Used to set the measurement range of electric charge.

When the measurement exceeds the preset range, "Over" is displayed on the RANGE of the Status Monitor window. If "Over" status continues for a given period of time, the test is suspended.

Setting the charge
measurement range
  Set range:
   10 pC, 100 pC, 1000 pC

Fig. 5-18   Range page

◆ Protection page

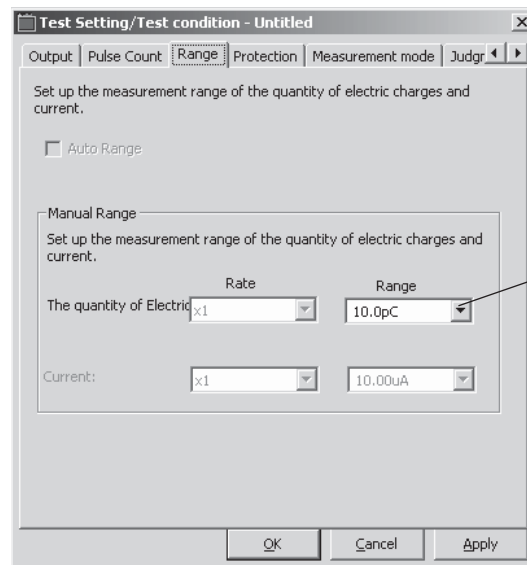This page is used to set a limit value for voltage, electrical charge, and pulse count to protect the DUT. If the measured value exceeds a limit value, the test is halted.

⚠ **CAUTION** • For [Limit], all checkboxes are checked by default, with setting boxes containing maximum settable values. To protect the DUT, always set values appropriate for the DUT.

- -

NOTE • If the [Voltage] checkbox is checked (voltage protection is on), a value exceeding the voltage limit can't be set as the application voltage.

DESCRIPTION • This guard function is activated by the PDTester Application. The PDTester Application checks whether acquired measured values exceed the limit values, and halts testing if it detects such occurrences. The data acquired is captured by the PC every 15 cycles; the PDTester Application makes a judgment for measured values 15 cycles (300 ms for 50 Hz, or 250 ms for 60 Hz) after the KPD2050 tester.

- -
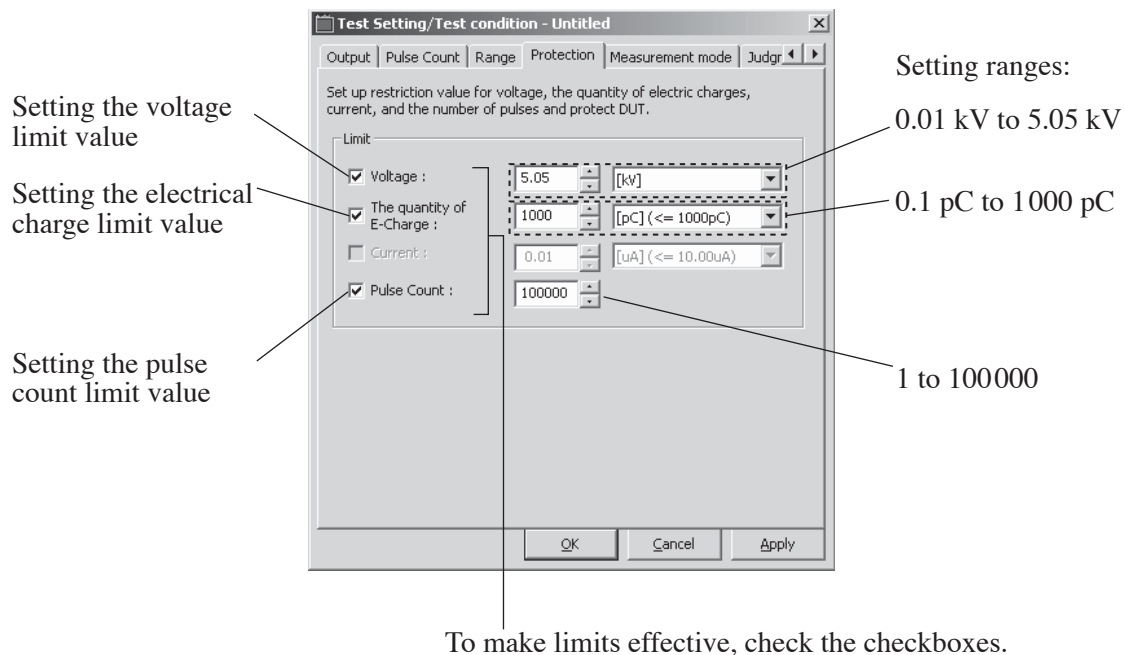

Fig. 5-19   Protection page

◆ Measurement Mode page

Used to set the electric charge level for measurement of the brake down voltage and discharge disappearance voltage.

- -

DESCRIPTION · Brake down voltage

To determine the brake down voltage, first set a charge level (represented by "x [pC]" in Fig. 5-21). The brake down voltage is the voltage applied when the set charge is measured for the first time in the test.

· Discharge disappearance voltage

To determine the discharge disappearance voltage, first set the charge level (represented by "y [pC]" in Fig. 5-21). The discharge disappearance voltage is the voltage applied when the set charge is measured for the last time in the test.

- -
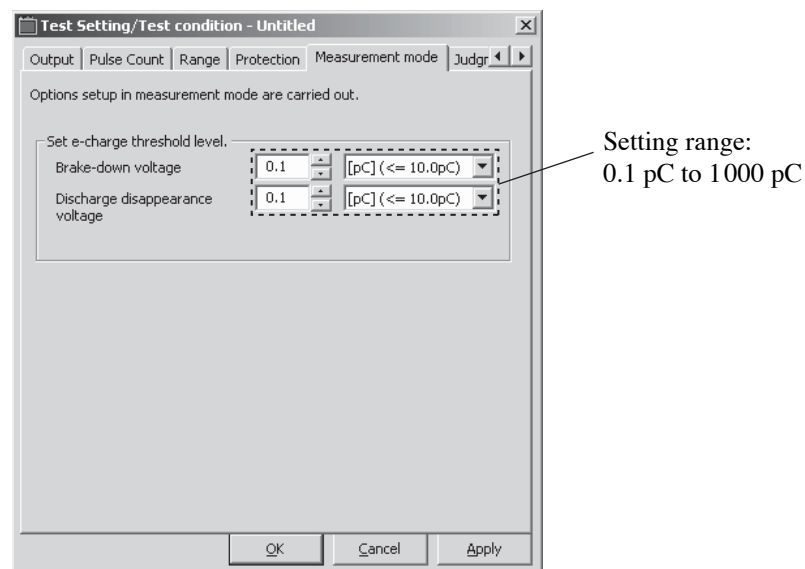

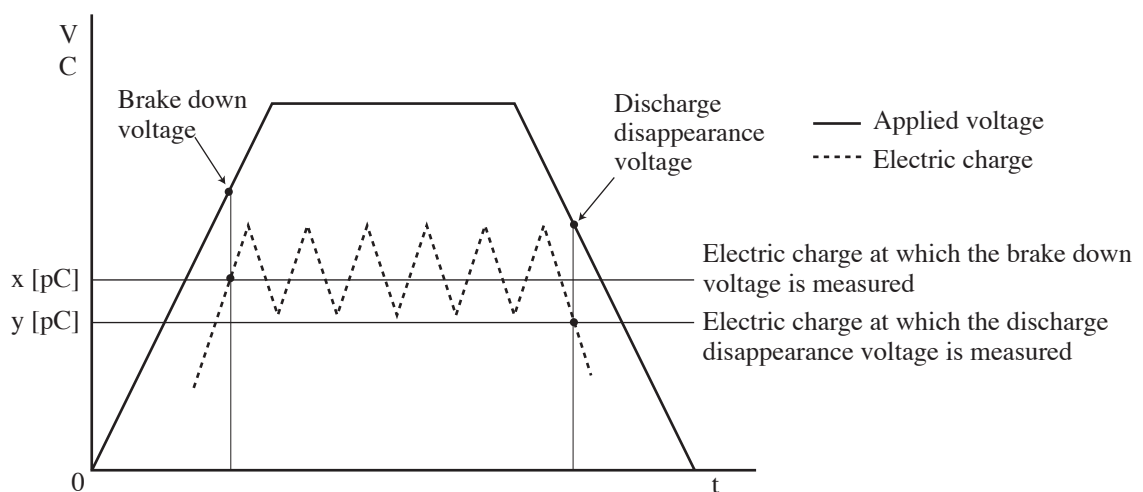Fig. 5-20   Measurement Mode page

Fig. 5-21   Brake down voltage and discharge disappearance voltage

◆ Judgment page

Used to set the judgment functions. When more than one judgment condition is set, judgment is made on the AND basis.

The judgment function works only when no data is decimated.

NOTE • Data are decimated under the following conditions:

• Applied voltage frequency: 50 Hz, Testing time: 81.9 s or more.

• Applied voltage frequency: 60 Hz, Testing time: 68.25 s or more.
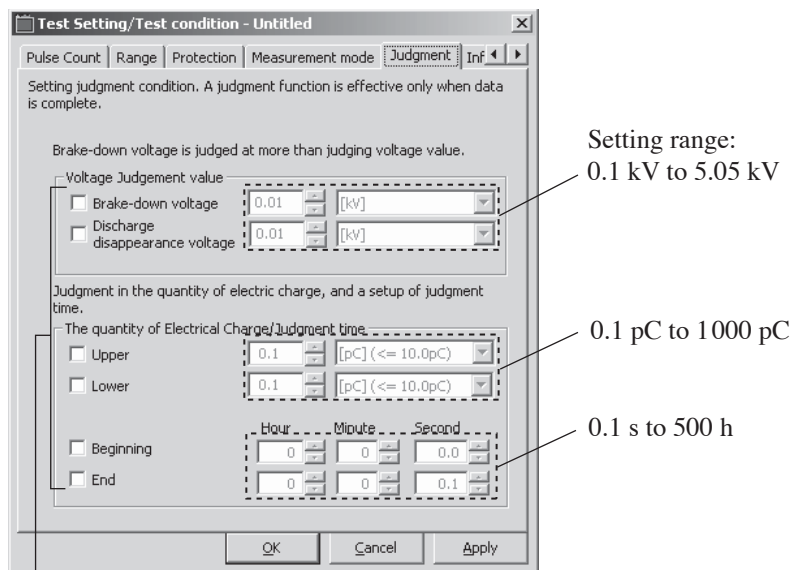
Fig. 5-22   Judgment page

Judgment at an brake down voltage (electric charge) exceeding the voltage judgment value

To determine the PASS/FAIL status, comparison is made between the voltage judgment values set here and the brake down voltage and discharge disappearance voltage that are obtained from the electric charge set on the [Measure] page.

Judging the brake down voltage

If the brake down voltage is the voltage judgment value or more, the test passes (PASS). If it is less than the voltage judgment value, the test fails (FAIL). See Fig. 5-23.

Judging the discharge disappearance voltage

If the discharge disappearance voltage is the voltage judgment value or more, the test passes (PASS). If it is less than the voltage judgment value, the test fails (FAIL).
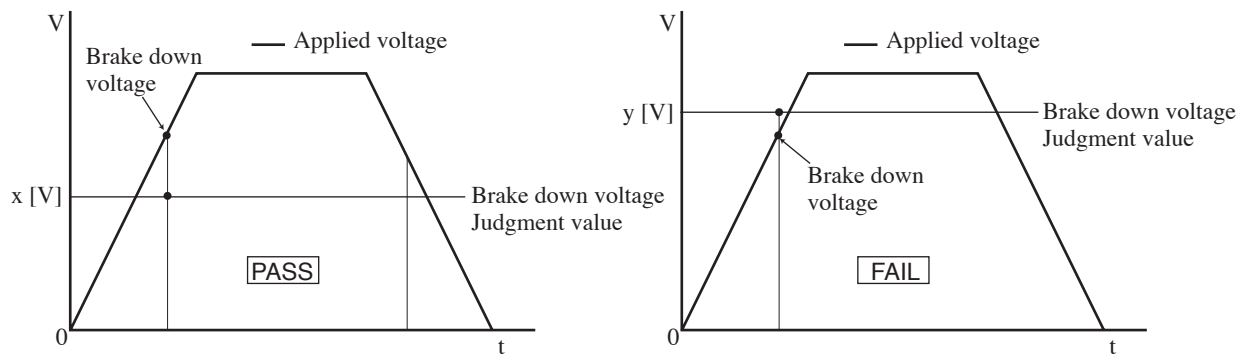
Fig. 5-23   Judgment by voltage (for brake down voltage)

Judgment by electric charge and settings for judgment time

PASS/FAIL judgment is made using the preset amount of electric charge as a threshold. By setting the start and end times for judgment, you can specify the time during which judgment is made.

Upper

If any electric-charge data point exceeds the threshold, the test fails (FAIL). If all data points remain below the threshold, the test passes (PASS).

Lower

If at least five data points exceed the threshold, the test passes (PASS). If only four or fewer data points exceed the threshold, the test fails (FAIL).
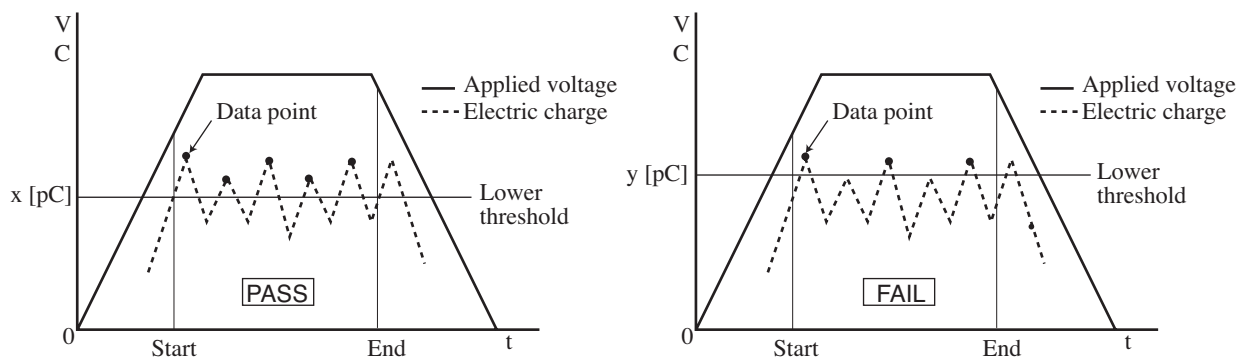
Fig. 5-24   Judgment by electric charge (with the lower threshold and judgment time set)

◆ Information Page

This page is used to record information on the device under test (DUT) and the operator. Enter information when necessary. Information entered here is embedded in the Test Data file (.csv, .xls)

The following shows the maximum number of characters for the Text box.

Fig. 5-25   Information Page

■ Run...

This command starts a test. Before the test actually begins, the following confirmation screen appears.

NOTE
• When [Run with...] checkbox has been checked in the [Protection] page of [Options...] in the [Test] menu, the [OK] button (for manual, the [Run] button) can't be clicked unless the checked key is depressed.
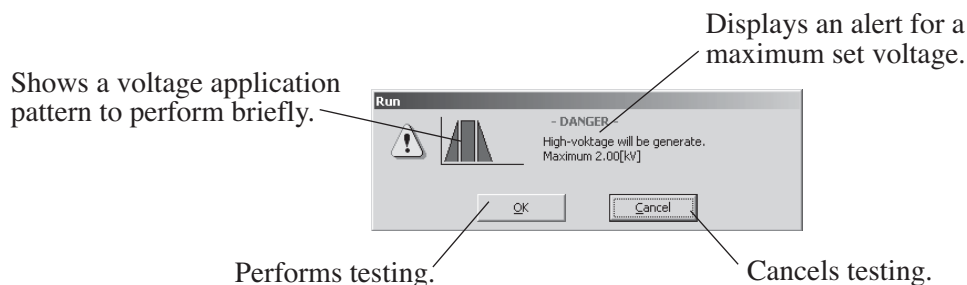
Fig. 5-26   Run confirmation screen

When the voltage application pattern in the [Output] page of the [Test Setting] dialog is set to [Manual] in order to execute the [Run] command, the following screen appears.

Select the voltage range and drag the slide lever to a desired position during testing. This allows you to apply any voltage within the set range. Note that when the [Voltage] checkbox in the [Protection] page has been checked (voltage protection is on), a voltage exceeding the voltage limit value can't be applied.
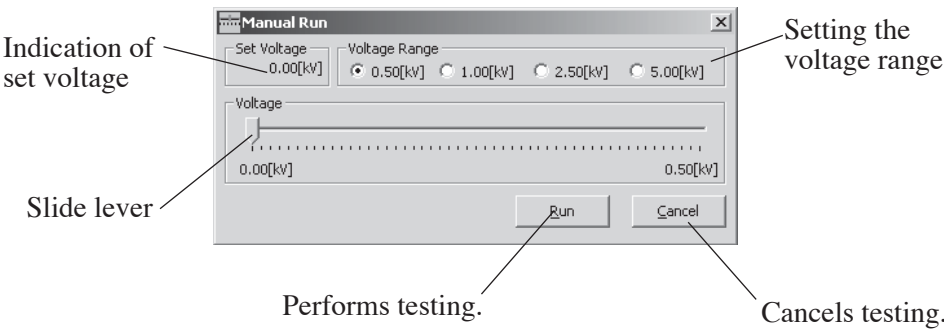
Fig. 5-27   Manual Run screen

■ **Stop**

This command aborts testing.

⚠ **CAUTION** • This feature aborts testing through software, which takes longer than using the EMERGENCY STOP switch on the KPD2050 tester. If you want to halt testing immediately, use the EMERGENCY STOP switch.

■ **Manual Range**

Used to switch charge-measurement ranges during a test.

To switch measurement ranges, on the submenu or the tool bar, select a new range from among the Range buttons.
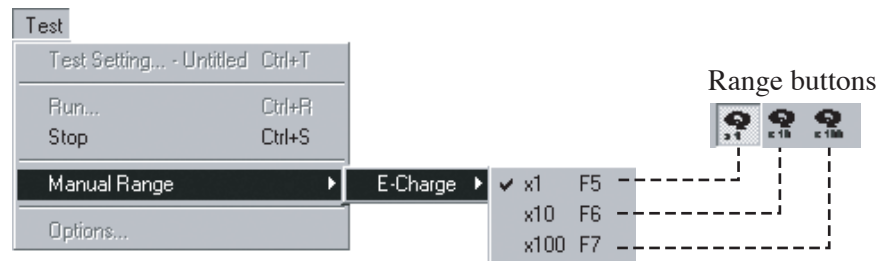
Fig. 5-28   Manual Range submenu

■ Options...

This command sets items for operation and functions of the PDTester Application.
This dialog box has four pages - Protection, Measurement, File, and DAQ.

Page Selection tab

Saves the settings and
closes the option dialog.

Closes the option dialog without
saving the settings.
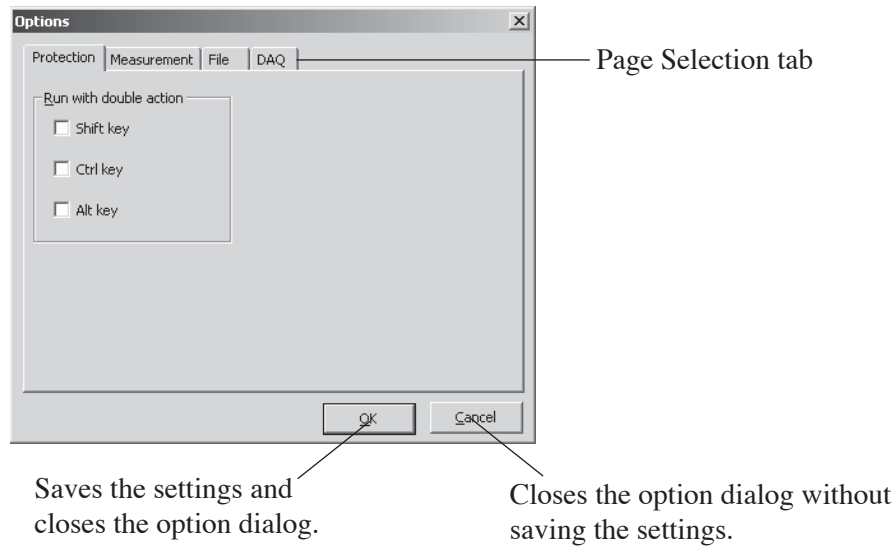
Fig. 5-29   Option dialog

◆Protection page

Run with...

When each checkbox under this item is checked, the [OK] button can't be clicked
on the test running screen unless the checked key is depressed. This item allows the
[Shift], [Ctrl], or [Alt] key to be specified individually, or in combination. This func-
tion is not applied on the Manual Run screen.

Protection of test running
   The [OK] button can't be
   clicked unless the checked
   key is depressed.
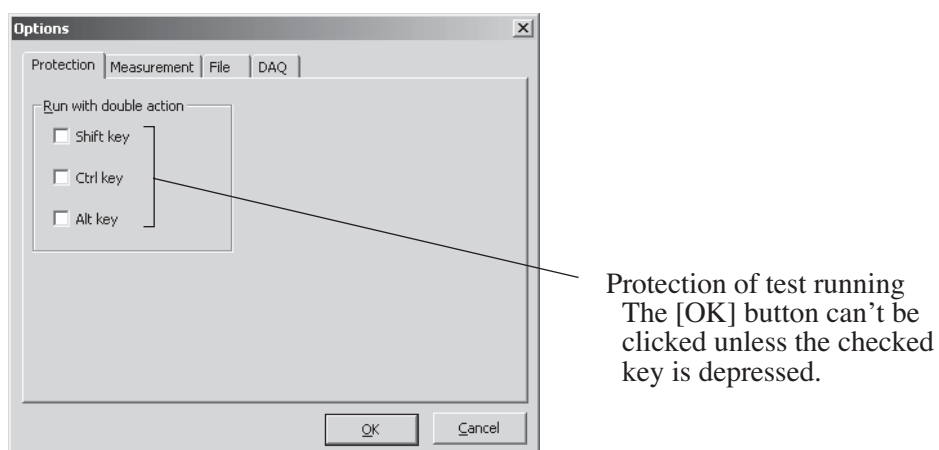
Fig. 5-30   Protection page

◆Measurement page

After DAQ Over Write Error

Used to set if a test is stopped or restarted in the event of DAQ overwrite error during testing.

- -

NOTE
- When the PDTester Application handles data from the A/D board, the A/D board overwrites the next data set with previous data if data processing does not complete before next data acquisition starts. This results in a DAQ overwrite error.

  If this error occurs, check whether "5.1 Precautions for Using the PDTester Application", have been observed.

- -

Priority

Sets priority of operations during testing. Under normal circumstances, select LOW (the default setting).

- -

NOTE
- If a DAQ overwrite error occurs even all "5.1 Precautions for Using the PDTester Application", try selecting 'High.' This gives operations related to measurement highest priority during testing. Note that the reaction of operations unrelated to measurement, such as menu selection, becomes slower.

- If a DAQ overwrite error still occurs frequently even after selecting 'High,' increase your PC's memory capacity, or use a PC equipped with a more powerful CPU.

- -
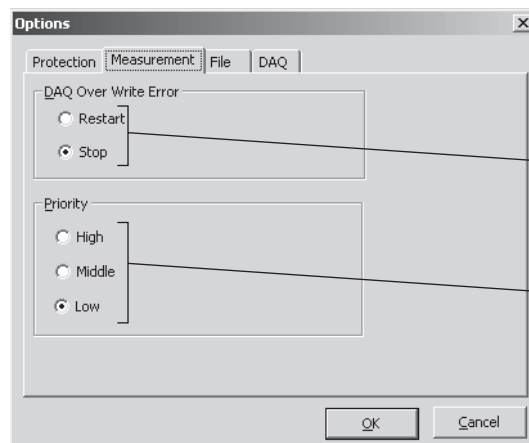
Sets the action to take in the event of a DAQ overwrite error.

Sets priority of operations during testing.

Fig. 5-31   Measurement page

◆ File page

Automatically Save Sheet

When this checkbox is checked, Sheet data is automatically saved as a new text file (extension: .csv) each time a test is complete. The file name is the time at which the data is saved, as indicated below.

Folder

Specifies the folder in which a text file is saved. Select another directory by pressing the [Browse...] button.

Browse...

Selects the folder in which a text file is saved and pastes it to [Folder].

Sets whether Test data is saved automatically.

Specifies a folder in which a file is saved.

Selects the folder in which the file is saved.
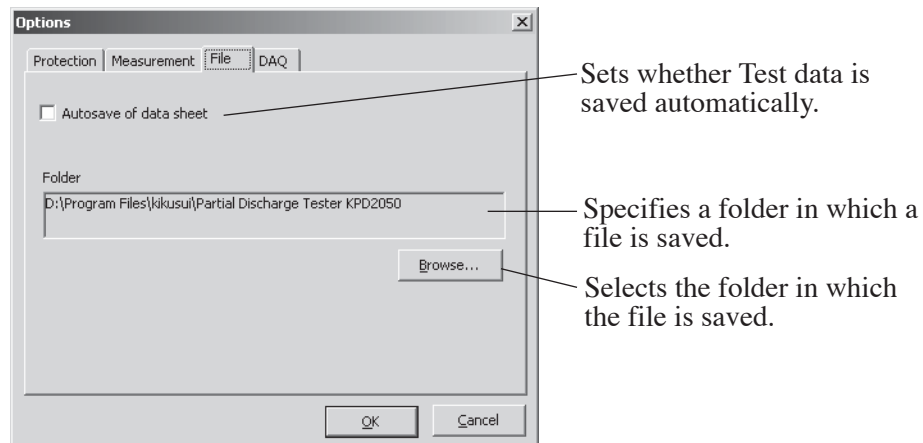
File name automatically assigned

XX XXX XX_XX XX XX .CSV

Year Month Day Hour Minute Second

Example: At 13:31:25 in Jun 25, 2001
01Jun25_133125.CSV

Fig. 5-32   File page

Pressing the [Browse...] button brings up the following screen. Select a folder in which you wish to save a file and press the [OK] button. This causes the directory of the selected folder to be pasted to the box.

Fig. 5-33   Select folder

◆DAQ page

DAQ Driver Version

Displays the A/D (DAQ) board device driver version.
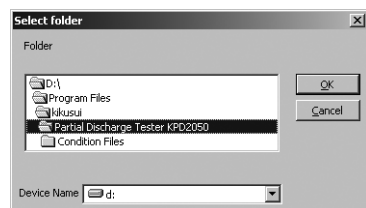
DAQ Board Type

Displays the model name of the A/D (DAQ) board in use.

The following two boards may be used with the testers.

PCI-1200 and DAQCard-1200

If a board other than these is installed, 'No support DAQ Board' appears. If no board is installed, 'Nothing DAQ Board' is displayed.

DAQ Serial Number

Shows the serial number of the A/D (DAQ) board. (For PCI-1200 only)

Device Number

This number must match the device number of the A/D (DAQ) board in use in order for the PDTester Application to control the A/D (DAQ) board. Under normal circumstances, set it to '1.'
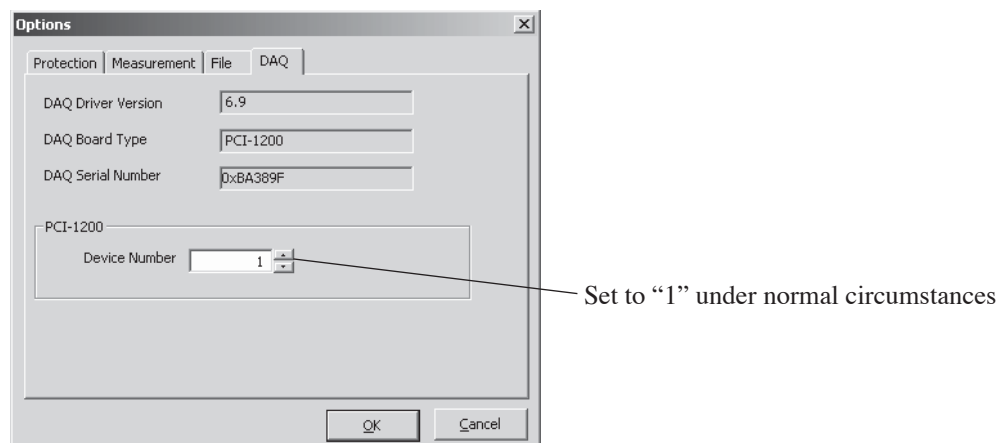
Fig. 5-34   DAQ page

To check the A/D (DAQ) board device number

NOTE • The procedure given below uses the software supplied with the A/D (DAQ) board. The following description applies to version 6.9. The screen status or certain operations may differ for other versions.

For details, see the manual for your A/D (DAQ) board.

---

1. On the desktop, click [Measurement & Automation.]

2. From the [Measurement & Automation] folder, select the [Device and Interfaces] folder, and check the device number.

The device number is set to "1" by default.
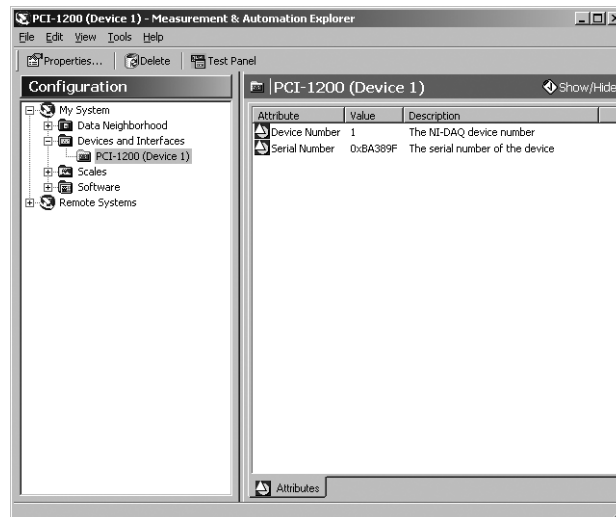
Fig. 5-35   Checking the device number

5.2.5 Graph menu
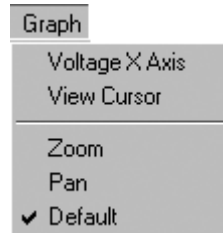
Fig. 5-36   Graph menu

■ Voltage X Axis

Displays the voltage on the x-axis.
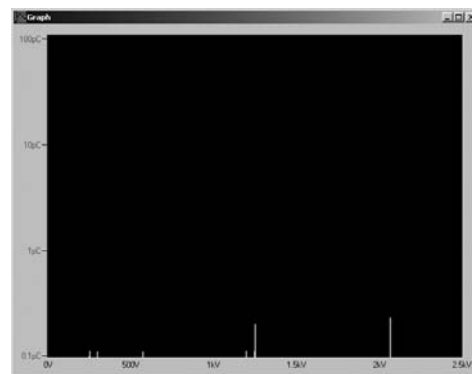
Fig. 5-37   Displaying the voltage on the x-axis

■ View Cursor

Displays a cursor on the graph. By default, the cursor is set to the origin. Drag the cross mark with the mouse to display the cursor point reading on the bottom left of the window.

Drag the cross mark with the cursor

Reading on the cursor point
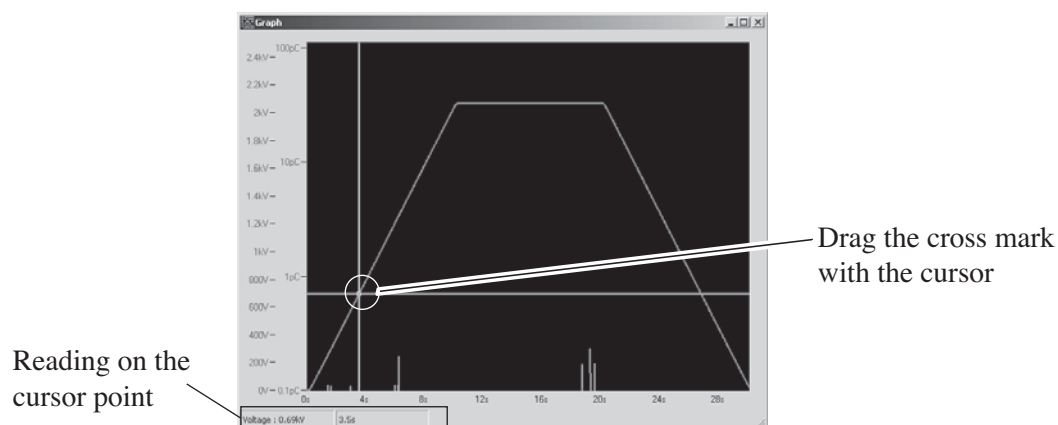
Fig. 5-38   Displaying a cursor

■ Zoom

Enlarges the dragged portion.

The portion within the
dotted line is enlarged.
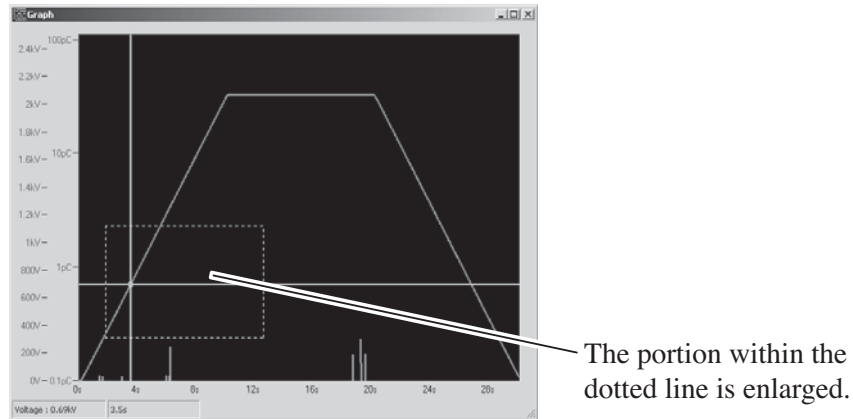
Fig. 5-39   Enlarging the display

■ Pan

The graph can be moved by dragging with the mouse.

Movable with the mouse
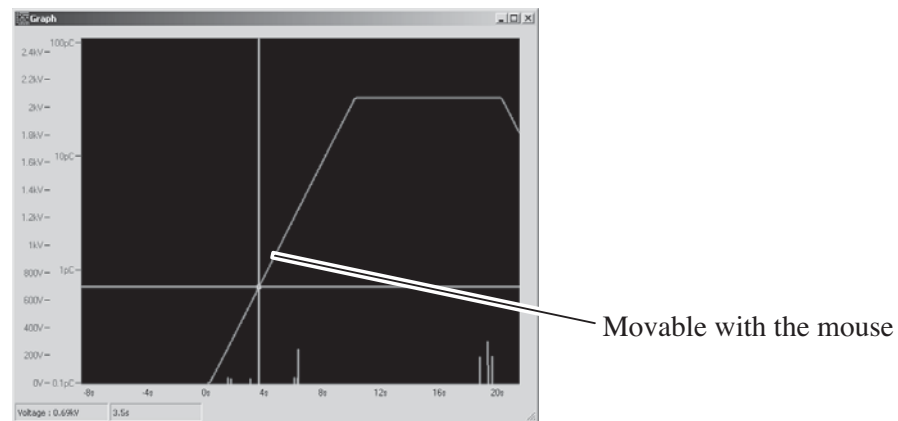
Fig. 5-40   Moving the graph

■ Default

The enlarged or moved graph can be returned to its original state.

5.2.6　Tool menu
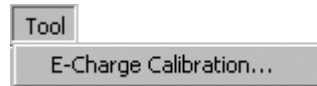
Fig. 5-41　Tool menu

■ Charge Calibration...

The E-Charge Calibration program is initiated to conduct charge calibration.

Under any of the following conditions, calibration is required to use the charge measuring function of the tester effectively.　In this manual, this calibration is called "charge calibration."

Table 5-1　Conditions requiring charge calibration

|	
1.	Before the first test of the day.
2.	When the type of device under test (DUT) has been changed.
3.	When a DUT has been replaced with another one that differs in capacitance by more than 10 %, even if both DUTs are of the same type.
4.	To conduct extremely precise measurement.
5.	When the ambient temperature has changed by more than 5 ºC following the last charge calibration.

For a description of the charge-calibration procedure, see "3.4 Charge Calibration".

- -

DESCRIPTION ● Charge calibration

The tester retains data obtained in periodic calibration (the first calibration is conducted before delivery) until the next periodic calibration.

In charge calibration, the data obtained is compared with this periodic calibration data.　Unless an error message appears during calibration, the charge calibration data is rewritten.　The rewritten data is retained until the next charge calibration. Note, however, that even in the next charge calibration, the data obtained in periodic calibration is used as the basis for comparison.　If an error message appears, conduct periodic calibration.

- -

5.2.7　Window menu
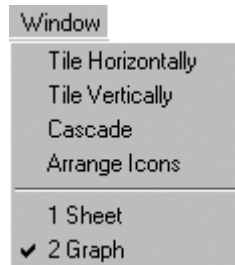
Fig. 5-42　Window menu

■ Tile Horizontally

Arranges displayed windows horizontally.

■ Tile Vertically

Arranges displayed windows vertically.

■ Cascade

Arranges displayed windows in cascaded form.

■ Arrange Icons

Arranges iconized windows.

5.2.8　Help menu
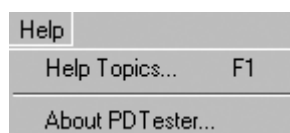
Fig. 5-43　Help menu

■ Help Topics...

Displays online help for the PDTester Application.

■ About PDTester...

Displays version information for the PDTester Application.

5.3   Status Monitor

This windows displays the status of a test currently being performed.
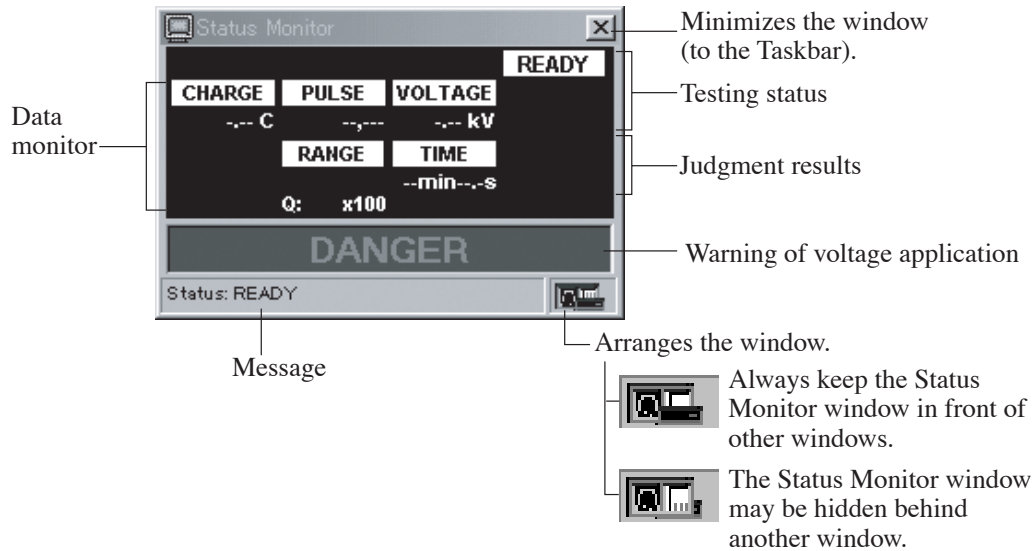
Fig. 5-44   Status Monitor window

■ Data Monitor

Displays measurement data, application voltage, and other values during testing. Displayed data is rewritten every 300 ms when test voltage frequency is 50 Hz, or every 250.5 ms when 60 Hz.

DESCRIPTION • Measurement data is acquired every 20 ms when test voltage frequency is 50 Hz and every 16.7 ms when 60 Hz. The PDTester Application displays the 15th data item in the data monitor area when acquiring 15 data items.

CHARGE

Displays the quantity of electrical charge.

PULSE

Displays the pulse count for the current.

VOLTAGE

Displays the application voltage.

RANGE

Q: indicates the measurement range for quantity of electrical charge.

TIME

Displays the time elapsed since the start of testing.

The time elapsed is expressed in "xx.x s" format for times less than 1 minute, in "xx min xx.x s" format for times of 1 min to 1 h, and in "xxx h xx min" format for times of 1 h or more.

■ Testing status

Indicates current testing status.

READY

Status in which testing may be performed

TEST

Status in which testing is performed

ALARM

Status in which testing has been aborted due to the cause indicated in the message

■ Judgment results

The judgment results are shown for the judgment conditions set on the [Judgment] page of the [Test Setting] dialog.

PASS

Indicates that the test has passed the judgment conditions.

- -

DESCRIPTION • Even if no settings are established for judgment conditions, "PASS" is displayed whenever the test ends without the occurrence of any alarm.

- -

FAIL

Indicates that the test has failed to pass the judgment conditions.

■ Alarm of voltage application

When testing is underway and the test voltage applied, the DANGER bar is indicated in bright red to call attention to high-voltage application.

■ Message

Displays test status or alarm information. See Table 5-2 for the details of status messages.

<p style="text-align:center">Table5-2   Status messages</p>

Message	Description
Status: READY	Status in which testing may be performed.
Status: RUNNING	Status in which testing is underway.
Status: ABORTED	The test has been halted with the [Stop] command.
Status: Over Voltage Protection	Application voltage has exceeded the voltage limit, tripping the guard function.
Status: Over Electrical Charge Protection	Quantity of electrical charge measured has exceeded the electrical charge limit, tripping the guard function.
Status: END (Warning:Restarted)	Measurement is complete, but data acquisition failed, with loss of data for 15 cycles or more.
Status: RUNNING (Warning:Restarted)	Measurement is underway, but data acquisition failed, with loss of data for 15 cycles or more.
Status: Over Pulse Count Protection	The number of pulses measured has exceeded the pulse count limit, tripping the guard function. If a test is aborted because measured data exceeds a limit value, open the [Protection] page in the [Test Setting] dialog to change the limit value or try unchecking the relevant checkbox.
Status: Over Range	Measured current or the quantity of electrical change measured has exceeded the corresponding measuring set range, disabling measurement. If a test aborts as a result of an Over Range, open the [Range] page from the [Test Setting] dialog and change the measurement range.
Status: <EMERGENCY STOP> On	The KPD2050 tester has halted for one of the following serious reasons: 1. The EMERGENCY STOP switch has been pressed. 2. The safety cover has been opened. 3. The protection circuit inside the KPD2050 tester has been activated by discharge. If the protection circuit inside the KPD2050 tester has been activated, the KPD2050 tester and PDTester Application must be restarted.
Status: Over Heat/Load Protection	The overheat or overload guard function of the KP2050 tester has been activated.
Status: Hardware Error	An error has been detected in the KPD2050 tester.
Status: Voltage Error Protection	Indicates a large difference between the set and application voltages.
Status: DAQ Over Write Error	Measurement data acquisition has failed, with loss of data for 15 cycles or more. Changing the priority of operations for the PDTester Application may prevent 'DAQ Over Write Error.' For more information, refer to the description given in the [Measurement] page of [Option...] in the [Test] menu.
Status: Measure Time Out Error	Measurement has exceeded the specified time by a significant margin. Check cable connections to the KPD2050 tester and other possible causes.
Status: Command Time Out Error	An error has occurred during serial data transfer to the KPD2050 tester.
Status: DAQ Error xxxxx	An error has originated with the A/D (DAQ) board or driver software, with 'xxxxx' representing an error number.

5.4   Error Messages

This section describes error messages displayed by the PDTester Application and corrective actions.

Table 5-3   Error messages and their remedies

Error message	Description	Remedy
1. Run-time error 'XX' : file can't be found. XXXXXXX	The A/D (DAQ) board's driver software (NI-DAQ) has not been installed.	Install the driver software supplied with the A/D (DAQ) board.
2. NI-DAQ Version ERROR!! (ver. 6.9 or later is needed.)	An older version of the A/D (DAQ) board driver software has been installed.	Install driver software of version number 6.9 or later.
3. The required DAQ board is not installed.	An A/D (DAQ) board required to run the PDTester Application has not been installed in the PC.	Install the A/D (DAQ) board in the PC, referring to "1.7, Installing the A/D (DAQ) Board."
	Different device numbers are used for the A/D (DAQ) board between the PDTester Application and the driver software (NI-DAQ).	From [Test], select [Options...] - [DAQ] page, and change the device number to the same number provided for the driver software (NI-DAQ).
4. Connect the cable and turn on the KPD.	PC and KPD2050 tester may not be connected properly, or power to the KPD2050 may have been cut off.	Confirm that the PC and KPD2050 tester are connected properly and that power for the KPD2050 tester is on.
5. Cannot Control	PDTester Application cannot control the KPD2050 tester.	Confirm that the PC and KPD2050 tester are connected properly, then try running the PDTester Application again.
6. Communication Error	Error occurred in communications with the KPD2050 tester.	Confirm that the PC and KPD2050 tester are connected properly, then try restarting the KPD2050 tester and the PDTester Application.
7. Cannot connect with KPD.	Error occurred in communications with the KPD2050 tester.	Confirm that the A/D (DAQ) board, PC, and KPD2050 tester are connected properly, then try restarting the KPD2050 tester and the PDTester Application.

If normal function can't be restored by taking the correctives steps given above, restart the tester and PC.

Chapter 6 Part Names and Functions

This chapter provides the names and functions of switches, connectors, and other panel items.

6.1 Front Panel
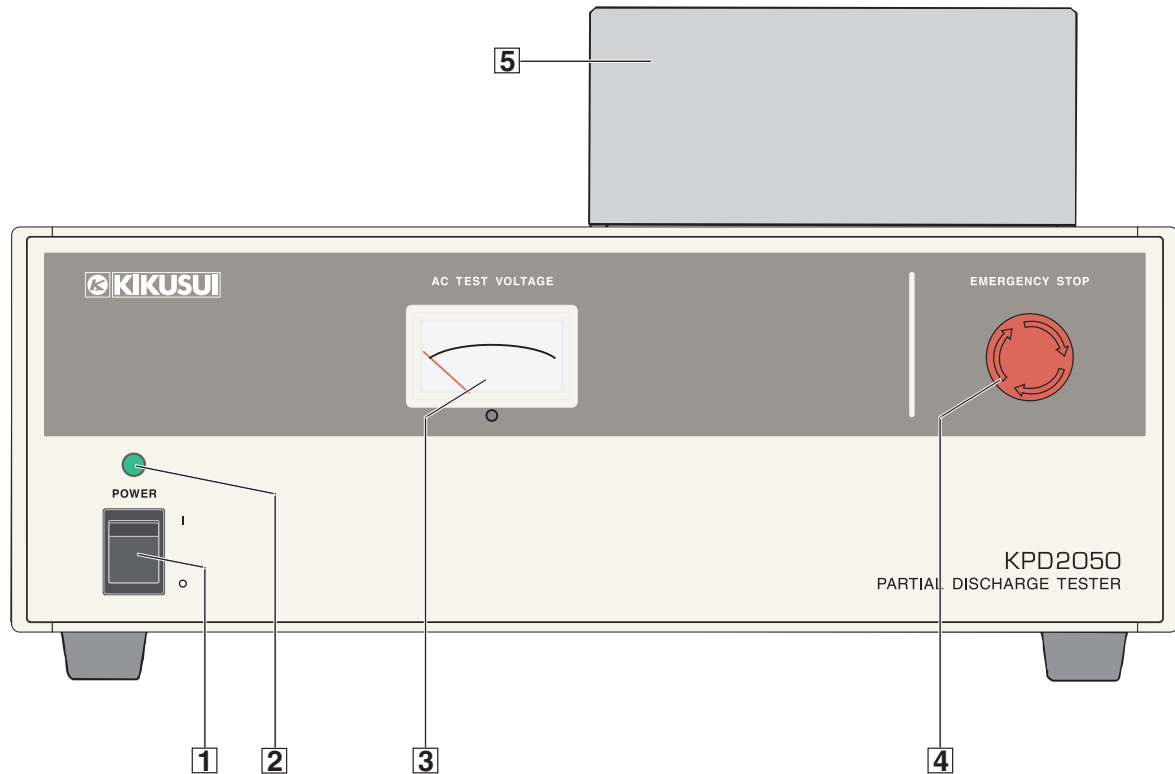
Fig.6-1   KPD2050 tester front panel

[1]   POWER

Turns on/off power for the KPD2050 tester. Tilting toward the "｜" side turns on power; tilting toward the "○" side turns off power.

[2]   POWER lamp

Lights up (in green) when power is supplied to the KPD2050 tester.

[3]   AC TEST VOLTAGE

This voltmeter indicates the voltage of the OUTPUT terminals.

A mechanical zero adjustment of the meter should be performed periodically. For information on adjusting the pointer to zero, see "7.2 Inspection".

⚠ WARNING
- Do not touch the OUTPUT terminals, test leads, or the DUT when the KPD2050 tester POWER switch is on and the AC TEST VOLTAGE meter pointer points to any value other than "0."
- Unless the meter pointer is properly zero-adjusted, the tester may not function properly.

• With PC power on and KPD2050 tester power off, the AC TEST VOLTAGE meter on the KPD2050 tester's front panel may indicate a few hundred volts. This is due to minute current flowing from the PC to the KPD2050 tester and does not indicate a problem. It does not indicate that the KPD2050 tester outputs a voltage.

[4] EMERGENCY STOP

This switch is used to halt a test immediately. Pressing the switch cuts off and locks the switch in the pressed position. Turn the switch knob clockwise to unlock it.

• When the EMERGENCY STOP switch is in its pressed (locked) state, the guard function disables testing.

• **EMERGENCY STOP switch**

While testing insulation conditions, you may want to test a part without damaging it. The EMERGENCY STOP switch is provided so that testing can be halted immediately if an electrical breakdown arises during testing, or if the operator senses an abnormality in the DUT during the course of testing.

This switch may also be used for dangerous situations occurring as a result of tester failure or from other causes. In such cases, you should also immediately turn off the POWER switch.

[5] Safety cover

Covers high-voltage-applied parts to prevent electric shock.

• If the safety cover is open, the guard function disables testing.

6.2   Output Terminals
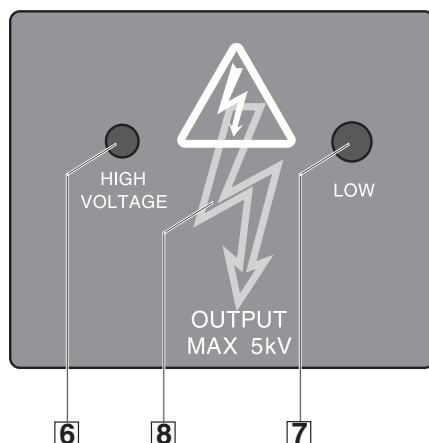
Fig. 6-2   KPD2050 Tester's Output Terminal Block

[6]   HIGH VOLTAGE

This output terminal is for high voltage. In calibration (charge calibration) of the electrical charge measurement function of the tester, the accompanying capacitor box is connected to this terminal.

[7]   LOW

This output terminal is for low voltage.

NOTE   • The tester's red high-voltage and black low-voltage output terminals are collectively called the OUTPUT terminals.

[8]   Electric shock caution lamp

Lights up in red when the tester outputs high voltage to alert you to high-voltage output.

⚠ WARNING   • Do not open the safety cover when the electric shock caution lamp is lit.

6.3   Rear Panel
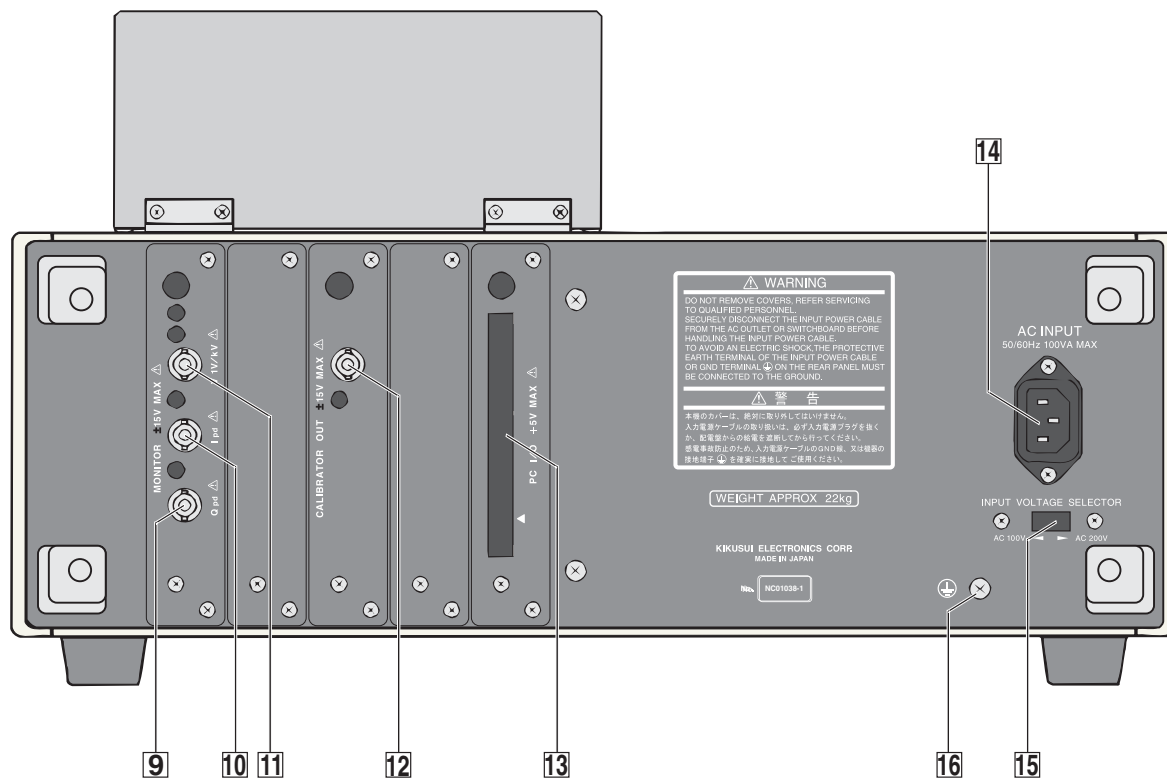
Fig. 6-3   KPD2050 Tester Rear Panel

[9]   Q pd

This is a signal output terminal for monitoring the quantity of electrical charge resulting from partial discharge using an oscilloscope or other instrument. The signal level changes with a combination of current and electrical charge measurement ranges. For more information, see "8.1 Performance".

[10] Ipd

This is a signal output terminal for monitoring partial discharge current using an oscilloscope or other instrument. For more information, see "8.1 Performance".

[11] V

This is a signal output terminal for monitoring test voltage using an oscilloscope or other instrument.

It outputs a voltage signal of 1 V/1 kV.

[12] CALIBRATOR OUT

This is an output terminal for the standard electrical charge generator. In calibration (charge calibration) of the electrical charge measurement function of the tester, this terminal is connected to the BNC terminal on the capacitor box with the accompanying cable for standard electrical charge generator.

[13] PC I/O

This connector is used to connect to an A/D (DAQ) board installed in the PC. Use the connecting cable applied to the A/D (DAQ) board.

[14] AC INPUT

This connector is for the power cord supplying power to the KPD2050 tester.

[15] INPUT VOLTAGE SELECTOR

This selector switch selects the input power voltage range. Select a voltage range suitable for the input power voltage. For more information, see "1.5 Connecting the Power Cord".

[16] Protective conductor terminal

Used to ground the tester.

⚠ WARNING • Always ground the tester. For more information, see "1.6 Grounding".

7

Chapter 7 Maintenance and Calibration

This chapter describes proper tester maintenance and calibration. To maintain the tester's original performance for extended periods, perform periodic maintenance, checks, and calibration.

7.1 Cleaning

⚠ **WARNING** • Before cleaning, always turn POWER off and unplug the power cord.

⚠ **CAUTION** • Do not use volatile solvents such as thinner and benzene. They may discolor the tester surface coating or remove printed characters.

■ Soiling on the panel surface or external cover

With a soft cloth dampened in a water-diluted neutral detergent, gently wipe the panel and cover.

■ Duston the OUTPUT terminals

Dust on the OUTPUT terminals may affect measurement results. Apply denatured alcohol to a soft cloth and gently wipe the terminal block.

7.2 Inspection

■ Power cord

Confirm that the insulation coating is free of damage and that the plug is attached securely and is free of cracks.

⚠ **WARNING** • Breaks in the insulation coating may lead to electric shock. If a break is found, immediately stop use of the tester.

To purchase accessories, contact Kikusui distributor/agent.

■ Test lead

Check for fractures in the cable shield, cracks, and looseness in the plugs, and disconnection in the leads.

The test lead may be subject to wear. For accessories, contact Kikusui distributor/agent.

■ Voltmeter's mechanical zero

Check the mechanical zero of the AC TEST VOLTAGE meter.

With the POWER switches off on the PC and the KPD2050, check that the pointer of the voltmeter indicates '0' when viewed from the right-front. If it does not indicate '0,' set the pointer to zero using the zero adjuster below the voltmeter.
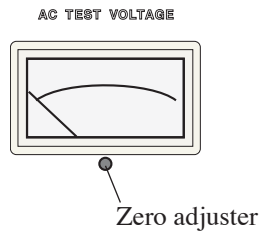
AC TEST VOLTAGE

Zero adjuster

Fig.7-1 Voltmeter's mechanical zero adjustment

- -

NOTE • When the PC's power is on and the KPD2050 tester's power supply is off, the AC TEST VOLTAGE meter on the KPD2050 tester's front panel may indicate a few hundred volts. This is due to a minute current flowing from the PC to the KPD2050 tester and does not indicate a problem. Under these circumstances, the KPD2050 tester does not output voltage.

- -

■ Electrical charge measurement function

Under any of the following conditions, calibration is required to use the charge measuring function of the tester effectively. In this manual, this calibration is called "charge calibration."

Table 7-1   Conditions requiring charge calibration

1.	Before the first test of the day.
2.	When the type of device under test (DUT) has been changed.
3.	When a DUT has been replaced with another one that differs in capacitance by more than 10 %, even if both DUTs are of the same type.
4.	To conduct extremely precise measurement.
5.	When the ambient temperature has changed by more than 5 ºC following the last charge calibration.

- -

DESCRIPTION • Charge calibration

The tester retains data obtained in periodic calibration (the first calibration is conducted before delivery) until the next periodic calibration.

In charge calibration, the data obtained is compared with this periodic calibration data. Unless an error message appears during calibration, the charge calibration data is rewritten. The rewritten data is retained until the next charge calibration. Note, however, that even in the next charge calibration, the data obtained in periodic calibration is used as the basis for comparison. If an error message appears, conduct periodic calibration.

- -

◆**Conducting charge calibration**

For a description of the charge-calibration procedure, see "3.4 Charge Calibration".

NOTE • The PDTester Application checks the date of the last charge calibration. If calibration has not been conducted for at least a day following the prior calibration, the following message appears. If this message appears right after starting the PDTester Application, conduct charge calibration.
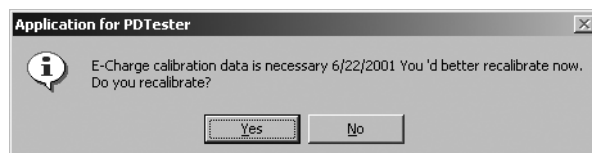
Fig. 7-2 Checking the implementation of charge calibration

Click the [Yes] button to carry on the charge calibration now, or the [No] button to carry it out later.

7.3 Periodic Calibration

The KPD2050 tester is factory-calibrated before shipment. Further calibration is necessary as the tester is used. We recommend recalibrating the KPD2050 tester every six months.

For periodic calibration, contact Kikusui distributor/agent.

NOTE • Because the testers carry out measurements using the A/D (DAQ) board, the board must also be calibrated.

• To ask Kikusui distributor/agent for calibration, present the following to the distributor/agent:

Table 7-2 Items to be presented for periodical calibration

1.	KPD2050 tester
2.	Calibration capacitor box
3.	A/D (DAQ) board
4.	Calibration data disk (3.5" FD labeled "Calibration Data Disk")

After calibration, Kikusui adds new calibration data to your disk, and you will be asked to install this new data on your PC. For details concerning this installation, see "2.3 Installing Calibration Data Only".

Chapter 8 Specifications

This chapter provides the electrical and mechanical specifications for the KPD2050 tester and the functionality specifications for PDTester Application.

8.1 Performance

Performance guarantee conditions

Warm-up time	30 minutes or more (*)
Electrostatic capacity of the DUT	1 000 pF or less
Daily calibration	Should be conducted before testing.

Test voltage output		
	Voltage range	0.01 kV to 5.0 kV AC
	Current limiting resistance	1 MΩ
	Coupling capacitor	1 000 pF
	Frequency	50 Hz or 60 Hz
Voltage measurement		
	Analog	Full scale	5 kV
		Instrument class	JIS class 2.5
		Accuracy	±5% of full scale (assuming no partial discharge occurs)
		Response	Average-based response/rms-value markings
	Digital	Full scale	5 kV
		Resolution	0.01 kV
		Accuracy	±1.5 % of full scale (assuming no partial discharge occurs)
		Response	Average-based response/rms-value markings
Electrical charge measurement		
	Full scale	10 pC, 100 pC, 1000 pC
	Resolution	0.1 pC (at range: 10 pC)
		0.1 pC (at range: 100 pC)
		1 pC (at range: 1000 pC)
	Accuracy	±1 pC (at range: 10 pC)
		±5% of full scale (at range: 100 pC, 1000 pC)
	Measurement intervals	Measurement is made for every cycle of application voltage; data is updated every 15 cycles.
Measurement of discharge pulse count		
	Threshold of pulse count	Variable in a range of 5 % to 95 % of the maximum peak current value in each range
	Measurement intervals	Every 15 cycles of application voltage

* More time may be required if the tester has been stored at temperatures lower than the recommended operating ambient temperature range, or if condensation has formed inside the tester.

Monitor output ([1])			
Voltage	Output	1 V/1 kV (load impedance of 1 MΩ or more)	
	Accuracy (Design value)	±0.1 V	
Partial discharge current	Output	Pulse-voltage waveform of peak voltage ±10 V	
Electrical charge	Output	10 V/10 pC (at range: 10 pC)	
		10 V/100 pC (at range: 100 pC)	
		10 V/1000 pC (at range: 1000 pC)	
	Full scale	10 V	
	Accuracy (Design value)	±1 V (at range: 10 pC, output: 10 V / 10 pC)	
		±0.5 V (at range: 100 pC, output: 10 V / 100 pC)	
		±0.5 V (at range: 1000 pC, output: 10 V / 1000 pC)	

*1. Monitor output is to monitor waveform on an oscilloscope. Load impedance should be used at 1 MΩ or greater.
The accuracy of the monitor output is not specified in the specifications, but is as follows in the design values. (The actual value varies according to the impedance of the DUT. The design value applies when the DUT has static capacity of 10 pF or less.)

8.2 General Specifications

Input voltage range	90 V to 110 V (input voltage range selector switch: 100 V AC) 180 V to 220 V (input voltage range selector switch: 200 V AC)
Power frequency	50 Hz/60 Hz
Apparent input power	100 VA or less
Insulation resistance	500 V DC, 30 MΩ or more (between input power (AC INPUT) and case)
Withstand voltage	1 500 V AC for one minute (between input power (AC INPUT) and case)
Operating ambient temperature and humidity range	23 ℃ ± 5 ℃, 20 % to 80 % [RH] (No condensation permitted)
Storage ambient temperature and humidity range	-10 ℃ to 60 ℃, 10 % to 80 % [RH] (No condensation permitted)
Dimensions	See the dimension diagram.
Weight	Approx. 22 kg
Accessories	Test lead, black (for LOW side)	1
	Test lead, red (for HIGH VOLTAGE side)	1
	Cable for standard charge generator	1
	Setup disk CD-ROM	1
	3.5" FD for calibration data	1
	Operation Manual	1
	Power cord (2 m)	1
	Calibration capacitor box	1
	A/D (DAQ) board	1
	Connecting cable	1

8.3 Functional Specifications (the PDTester Application)

Operating environment			
	PC		IBM PC/AT-compatible machine Processor of Pentium 166 MHz or greater At least 32 MB of RAM (64 MB or more recommended) VGA or better display adaptor and color monitor Hard disk (at least 20 MB; 100 MB or more recommended) 3.5" FD drive (1.44 MB) CD-ROM drive Microsoft mouse or compatible pointing device
	Operating system and specific application		Microsoft Windows 2000/XP Professional
Operating environment			
	A/D (DAQ) board		One of the following A/D (DAQ) boards must be installed according to the bus specifications of your computer: PCI bus: PCI-1200 (Type NB1 50p, 1m) PCMCIA bus: DAQCard-1200 (Type PR-50F, 1m)
			For A/D (DAQ), use driver software NI-DAQ version 6.9 or later (the A/D (DAQ) board, connecting cable, and driver software are made by National Instruments).
Setting function			
	Sequence	Pattern	6 types 1. Ramp, 2. Ramp with Initial Voltage, 3. Constant, 4. Step, 5. User Define, 6. Manual
		Voltage	0.01 kV to 5.05 kV (in 0.01 kV steps)
		Time	0 h 0 min 0.0 s to 500 h 0 min 0.0 s (in 0.1 s steps)
		Frequency	50 Hz/60 Hz
		Number of steps	1 to 50 steps (in User Defined sequence)
	Pulse count	Counting mode	+/-/±
		Threshold	5 % to 95 % (with respect to setting range)
	Range	Setting values	10 pC, 100 pC, 1000 pC
	Protection	Voltage	0.01 kV to 5.05 kV / release
		Electrical charge	0.1 pC to 1000 pC / release (in all ranges)
		Pulse count	1 to 100 000 / release

Measurement function			
	Items to be measured		1. Electrical charge 2. Voltage 3. Pulse count
	Measurement resolution		12 bits (resolution of A/D (DAQ) board)
	Measurement methods	Electrical Charge, and voltage	Double buffering method (15 cycles x 2)
		Pulse count	16-bit counter
	Acquired data	Data points	4096 points maximum
		Sampling method	Equal time sampling
		Sampling time	20 ms minimum (at 50 Hz), 16.7 ms minimum (at 60 Hz) (Depending on set measuring time)
	Display		1. Real-time graphing (sampling basis display) 2. Status monitoring
Others			
	Set conditions		Save and call up as files
	Converting measured data to files		1. Export to Excel97/2000/2002 (about 270 kB/sheet maximum) 2. Creation of CSV files (about 165 kB maximum)

8.4　Dimensions

430

149

MAX170

MAX225

MAX25

402

MAX460
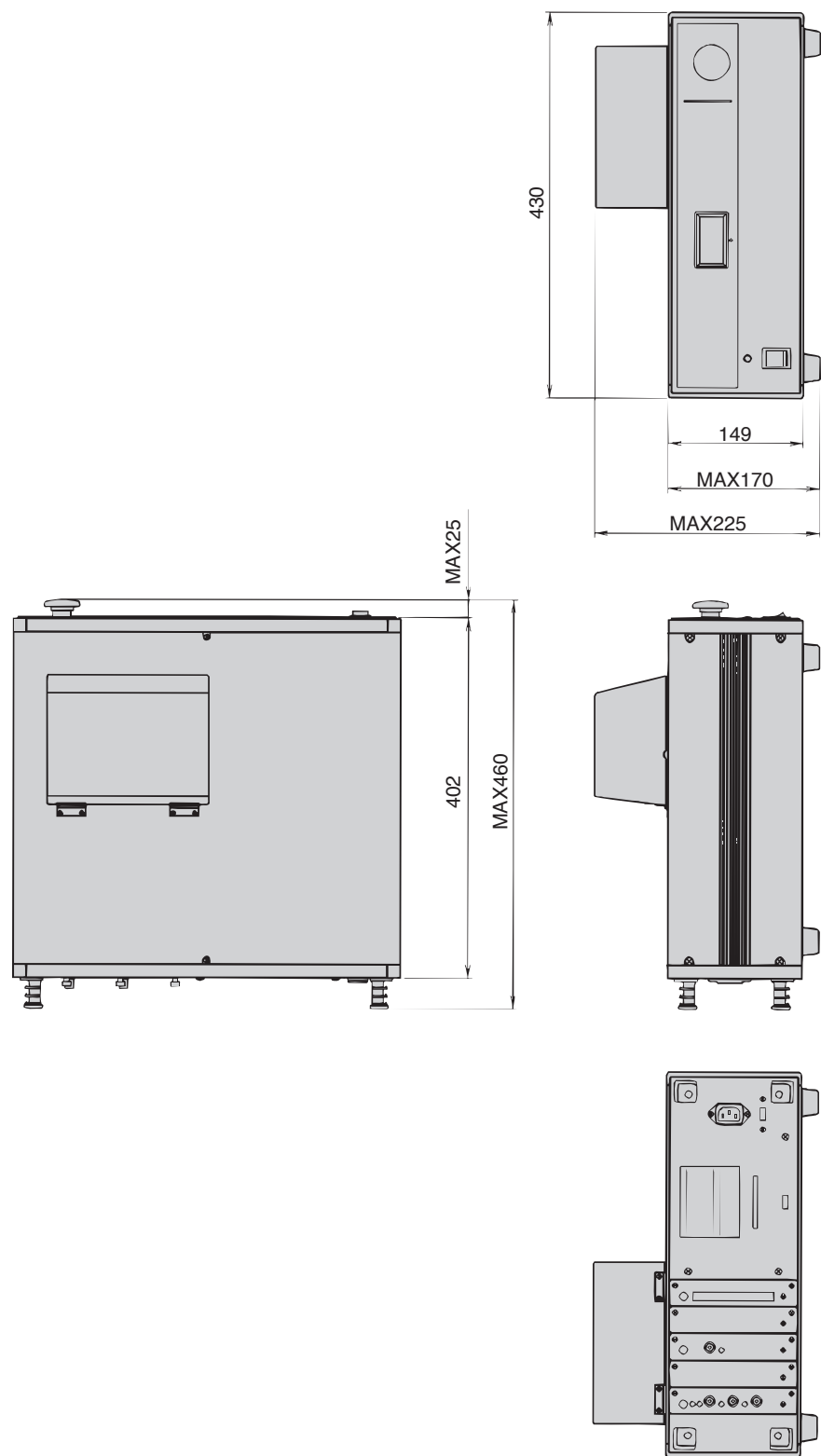
Unit: mm

Fig. 8-1　　Dimensions of KPD2050 tester

Appendix

Measurement Methods and Measured Data

■ Measurement methods

For analog quantities of electrical charge and application voltage, the A/D (DAQ) board acquires data at every cycle, while the PC captures at every 15 cycles. For pulse count, the hardware counter in the A/D (DAQ) board captures approximately at every 15 cycles, with the number of counts captured averaged by 15 cycles for treatment as single-cycle data.

Thus, data evaluation in the PC (conversion to graph form, protection function, and others) lags behind real-time by approximately 15 cycles (300 ms for 50 Hz or 250 ms for 60 Hz). Additionally, the numerical display on the monitoring screen shows 15th cycle data for those acquired in 15 cycles.

■ Measurement data

Measurement data can be stored in files holding a maximum of 4096 data items. For measurements extending over long hours, measured data will be stored in equal time intervals (decimating), allowing acquisition of a maximum of 4096 data items.

Example: • For a test of 1 minutes 20 seconds at 50 Hz: 4000 pieces of data acquired every cycle

• For a test of 2 minutes 30 seconds at 50 Hz: 3750 pieces of data acquired every two cycles

• For a test of 1 hour 30 minutes at 50 Hz: 3857 pieces of data acquired every 70 cycles

NOTE
• In decimation, the last data will be stored. For example, to store data every 70 cycles, the 70th data item is stored.
• Stored data is displayed in graphs.

Example of Printed Daily Calibration Data

```
Calibration Data <Partial Discharge Tester>              KIKUSUI ELECTRONICS CORP.
                                                         Date: 2001-06-22 18:25:21
=================================================================================
                            Instruments & Software
=================================================================================
Partial Discharge Tester     Calibration Board              Software
   Model Name: KPD2050           ID: 2050_X01                  PDTester: ver 1.00     (*1)
          S/N: 2050_X05        Date: 2001/04/27             PDT Utility: ver 1.10
     Revision: 2A

=================================================================================
                       Voltage Calibration Result (at 50Hz)
=================================================================================
     Name: Kikusui
     Date: 2001/06/22 18:14:52         Temperature: 24.1℃         Humidity:43.2%RH
     _____
Item                  Setting Value      Measuring Value    Accuracy         Result
                      (Input)            (Reading)
_____  _____    _____    _____       _____
Output                5.00[kV]           5.00[kV]           +/-1.0[%]         GO
Reading               5.00[kV]           5.00[kV]           +/-1.0[%]         GO
Monitor (BNC)         5.00[Vrms]         5.00[Vrms]         +/-0.1[V]         GO
Meter                 5.00[kV]           5.00[kV]           +/-5.0[%]         GO
_____

=================================================================================
                       Electrical Charge Calibration Result                          (*2)
=================================================================================
     Name: Kikusui
     Date: 2001/06/22 18:15:34         Temperature: 24.1℃         Humidity:43.2%RH
     _____
Item                  Setting Value      Measuring Value    Accuracy         Result
                      (Input)            (Reading)
_____  _____    _____    _____       _____
Reading(10.0pC)        9.0[pC]            9.0[pC]           +/-5.0[%]         GO
Reading(100.0pC)      91.0[pC]           91.0[pC]           +/-5.0[%]         GO
Reading(1000pC)       910[pC]            910[pC]            +/-5.0[%]         GO
Monitor Offset(BNC)   0.00[V]            0.00[V]            +/-0.5[V]         GO
Monitor FSL(BNC)      9.01[V]            9.01[V]            +/-0.5[V]         GO
_____

=================================================================================
                          E-Charge Calibration Result
=================================================================================
     Name: Kikusui
     Date: 2001/06/22 18:23:10         Temperature: 24.1℃         Humidity:43.2%RH
     _____         (*3)
Item                  Result             Item               Result
_____  _____    _____    _____
Reading(10.0pC)       GO                 -                  -
Reading(100.0pC)      GO                 -                  -
Reading(1000pC)       GO                 -                  -
_____
```

*1   Tester and software information
*2   Periodic calibration data (calibration data at shipment)
*3   Electrical charge calibration data

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V

W

Z

Partial Discharge Tester

KPD2050

OPERATION MANUAL