OPERATION MANUAL

TH5201/5201A

Withstanding Voltage Tester

If you turn on the power of the tester simply after taking the tester out of the package, test is not available because the interlock function is activated. Refer to the "Interlock function" section in this manual for more information and operate the tester properly using the interlock function.

Make sure the operating personnel have read the manual carefully and fully understand the contents before using the tester. Keep this manual near the tester for easy access by the operator.

While the tester is delivering the high test voltage, never touch the following areas, otherwise, you will run the risk of electric hazard, even death.

1. **The output terminal**
2. **The test leads connected to the output terminal.**
3. **The Device Under Test (DUT)**
4. **Any part electrically connected to the output terminal.**
5. **Any part electrically connected to the output terminal immediately after a DC output has been cut off.**

Also, electric shock or accident may occur in the following cases:

1. **The tester is operated without grounding.**
2. **The gloves against electrical shock are not used.**
3. **Approach any part connected to the output terminal while the power of the tester is turned on.**
4. **Approach any part connected to the output terminal immediately after the power of tester has been turned off in the DC test mode.**

Chapter 1 General Introduction

1.1 Overview

The TH5201/TH5201A/TH5201B/TH5201C is a tester for carrying out withstanding voltage tests on electronic devices and electronic parts.

TH5201/TH5201B is capable of carrying out both AC tests and DC tests;

TH5201A/TH5201C is only capable of carrying out AC tests;

WARNING!

This tester is equipped with various safety features to protect the operator from hazards. However, when the tester is in use, high voltage is applied to the DUT. Accidently touching the DUT, test leads, probes, and output terminals may cause electric shock.

1.2 Features

1.2.1 Transformer capacity

Model	Transformer Capacity
TH5201 / TH5201A	500 VA

1.2.2 A color VFD display

The tester is equipped with a large color VFD display. With its wide viewing angle and high intensity, it displays information clearly. Various information including test conditions, instrument status, measurement values, and result of Pass/Fail judgment can be indicated with different colors and different size of characters.

1.2.3 An analog voltmeter and a digital voltmeter

The tester is equipped with an analog voltmeter and a digital voltmeter. The analog voltmeter can provide an instant response of the voltage while the digital one can provide a more accurate readout. So you can perform the test quickly and accurately.

1.2.4 A digital ammeter

The tester is equipped with a digital ammeter for measuring the current that flows through the DUT.

1.2.5 A danger lamp

The tester is equipped with a triangular danger lamp. This lamp lights when electric charge is remaining on the output terminal, warning you of a possible electric shock hazard.

1.2.6 A safer high voltage output terminal

The lead insertion portion of the high voltage output terminal is structured with a restriction for safer connection.

1.2.7 PASS/FAIL judgment

The tester generates a FAIL signal when the measured current that flows through the DUT is greater than the preset upper cutoff current or when it is less than the preset lower cutoff current. The LOWER FAIL detection function contributes to the test reliability by detecting open-circuits and bad contacts. The tester has a separate indicator and signal output for each type of failure. This allows you to immediately find out whether the failure is a withstanding voltage failure or an open-circuit/bad-contact failure.

1.2.8 A RS-232C interface for outputting data

The test data and results can be outputted to a PC through the RS-232C interface.

1.2.9 A DC-DC converter for DC test voltage

The tester has a DC to DC converter which generates a quality test voltage of high stability and less ripples.

1.2.10 Rational layouts of keys and switches

For the adjustment of the pass/fail judgment limit current and timer, dedicated increment/decrement keys are provided. These keys and buttons, together with the large VFD display are laid out rationally and will help you conduct your tests accurately and efficiently.

1.2.11 Remote control function

The tester has functions for remote START/STOP control operation. That is, it has a 5-pin connector on its front panel and a 25-pin Amphenol connector on its rear panel. The remote control function, together with the state signal function, will help you conduct efficient automatic labor-saving tests.

1.2.12 Nonvolatile memory function

When you turn the tester OFF, the tester stores the lately used test conditions in its nonvolatile memory. When you turn the tester ON the next time, the tester recalls the stored information and restores the test conditions lately used before you turned OFF the power last time.

1.2.13 Interlock function

The tester has an interlock function that shuts down the output voltage in synchronization with the external mechanism. When this function is activated, the output is shut down and keeps tests from being executed. The interlock function operates even if there is open-circuit or bad contact with the interlock signal lines, thereby enhancing the operation safety.

1.2.14 Key-lock function

The tester has a key-lock function to disable all keys (except the START/STOP buttons) to avoid inadvertent key operation by the operator or an unauthorized person. This improves the reliability of tests.

1.2.15 Noise resisting circuits

The built-in circuits of the tester are designed to resist noise efficiently, thereby enhancing the operation stability.

1.2.16 Automatic discharge function (only for TH5201 / TH5201B)

When the DC test output voltage is turned off, the output circuit is automatically discharged, thereby discharging the charge in the DUT. This feature, together with the DANGER lamp, enhances the test

operation safety.

1.2.17 State signals

The tester delivers seven state signals (HV-ON, TEST, PASS, U-FAIL, L-FAIL, READY, and PROTECTION) through its 25-pin Amphenol connector on the rear panel. With the remote control function, these signals can be used for efficient automatic labor-saving tests.

1.2.18 Dimensions and weight

The tester is compact and light as shown below.

Model	Dimensions	Weight
TH5201 / TH5201A	320mm (W)×132mm (H)×300mm (D)	14 kg

1.2.19 Tests complying with major industrial standards

The tester can carry out withstanding voltage tests on electronic devices and electronic parts in compliance with JIS, UL, CSA, BS, and other major electrical standards.

Chapter 2 Preparation and Installation

2.1 Checking the product

When you receive the product, check all accessories according to the list below. If the contents are incomplete, please contact us or our agent.

Item	Quantity
Power cord	1 pcs
High voltage test leads	1 set
25-pin Amphenol connector plug	1 pcs
Operation Manual	1 copy

2.2 Precautions about installation location

2.2.1 Do not operate the tester in a flammable atmosphere.

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

2.2.2 Do not use the tester in the locations with high temperature or direct sunlight.

Do not place the tester near a heater or in areas subject to huge temperature changes.

Operating temperature range: 0 ℃ ~ 40 ℃

Storage temperature range: -20 ℃ ~ 70 ℃

2.2.3 Do not place the tester in humid environments.

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

Operating humidity range: ≤ 80%RH (no condensation)

Storage humidity range: ≤ 90%RH (no condensation)

2.2.4 Do not place the tester in a corrosive atmosphere.

Do not place the tester in a corrosive atmosphere or in environments containing sulfuric acid mist etc. This may cause corrosion of various conductors and bad contacts of connectors inside the tester leading to malfunction and failure, or in a worse case, a fire.

2.2.5 Do not place the tester in a dusty location.

Accumulation of dust can lead to electric shock or fire.

2.2.6 Do not place the tester in the location where ventilation is poor.

Make sure there is adequate space around the tester so that air can circulate around it.

2.2.7 Do not place anything on top of the tester.

Placing heavy object on top of the tester can cause failures.

2.2.8 Do not place the tester on an inclined surface or location subject to vibrations.

The tester may fall or tip over causing damages and injuries.

2.2.9 Do not place the tester in a location where strong magnetic or electric fields are present or where serious distortion and noise are present with the power supply.

2.2.10 Do not use the tester near highly sensitive instruments or transceivers

Do not operate the tester near highly sensitive measuring instruments such as communication receivers, because the tester may interfere with such devices.

Above 3 kV test voltage, the tester may produce corona discharge between its test lead clips which will generate a significant amount of broadband RF emission. To minimize this effect, separate the alligator clips and leads away from each other and from conductive surfaces, especially sharp metal edges.

2.2.11 Make sure there is adequate space around the power plug

Do not insert the power plug to an outlet where access to the plug is poor.

2.3 Precautions when moving the tester

2.3.1 Remove all connected wires

Moving the tester with connected wires may break the wires and you could run the risk of injuries when the tester is falling over.

2.3.2 Turn off the Power switch

You may run the risk of electric shock hazard or the tester could be damaged if you move the tester with the power ON.

2.3.3 The original packing materials should be used when the tester is transported.

If you don’t use the original packing materials, the tester could be damaged as a result of vibration or falling over during transportation.

2.4 AC line requirements

The AC line requirements of the tester are as below:

Rated voltage	Voltage tolerance	Rated frequency
125V	±10% of rated voltage	50/60 Hz

2.5 Connecting the power cord

1) Make sure that the AC power supply is within the input line voltage range of the tester.
2) Check and make sure that the POWER switch is turned OFF.
3) Connect the power cord to the AC LINE receptacle on the rear panel.

4) Insert the power plug to a grounded power outlet.

2.6 Grounding

Make sure to ground the tester for your safety.
Use either method to ground the tester described as follows:

1) Connect the power cable to a three-wire power outlet with proper grounding.

2) Connect the grounding terminal on the rear panel to the earth ground.

WARNING!

1. Electric shock may occur, if the tester is not grounded properly.
2. Make sure that the protective ground terminal is connected to an appropriate earth ground.
3. Malfunction may occur due to external noise, or the noise of the tester may become large if the protective ground is defeated.

Chapter 3 Operation Precautions

3.1 Preparation before test

3.1.1 Wearing insulation gloves

When operating the tester, make sure to wear a pair of insulation gloves in order to protect yourself from electronic shock hazard.

3.1.2 Grounding the tester

Ground securely the protective grounding terminal on the rear panel of the tester. If the safety grounding is defeated, the tester chassis can be charged to a very high voltage that can cause electric shock or death.

3.2 Warnings and cautions for operating

3.2.1 TEST VOLTAGE control knob position

Before turning on the tester, turn the TEST VOLTAGE control knob counterclockwise to make sure that the TEST VOLTAGE control knob is at the “0” position.

3.2.2 Connecting the Low Test Lead first

Perform the following steps to connect the low test lead:

1) Check and make sure that the low test lead is not broken.
2) Connect the low test lead before the high test lead is connected and make sure that it is securely connected between the LOW terminal of the tester and the corresponding terminal of the DUT.

3.2.3 Connecting the High Test Lead

Make sure that the low test lead is well connected before you try to connect the high test lead. Perform the following steps to connect the high test lead:

1) Press the STOP key.
2) Check and make sure that the output voltmeter reading is “0”
3) Make sure that the DANGER lamp is OFF.
4) Connect the high test lead to the HIGH VOLTAGE output terminal of the tester.
5) Connect the tester leads to the DUT with the low output lead first and then high output lead.

3.2.4 Before Changing Test Parameters

Press the STOP button and turn the TEST VOLTAGE control knob counterclockwise and make sure that the TEST VOLTAGE control knob is at the “0” position. Then you can change the test parameters now.

3.2.5 Precautions for Pausing Tests

When you pause a test, make sure to turn the TEST VOLTAGE control knob to the “0”position and press the STOP button. If you are not going to continue the test soon or if you are going to leaving the

test area, make sure to turn OFF the power supply.

3.2.6 Items Charged Up to Dangerous High Voltages

While the test is in progress, touching a section charged with high voltage near the DUT, test lead, probe, or output terminal is dangerous.

3.3 Warning for turning off the power

3.3.1 Check Items after Turning OFF the Power

If you have to touch the DUT, test leads, probes, and output terminals for re-connection or other reasons, make sure that the following two conditions are fulfilled:

1) The output voltmeter indicates “0.”
2) The DANGER lamp has turned OFF.

When you have just tested the DUT with the DC voltage, the DUT could remain charged at a high test voltage.

3.3.2 Residual High Voltages (TH5201 Only)

When you perform a test with the DC voltage, the DUT, test leads, probes, and output terminals and their vicinities are charged up to high voltages. Even after you turn off the DC output, these voltages remain there for a period which depends on the conditions of the test. Within this period, never touch the DUT, test leads, probes, or output terminals or their vicinities to avoid electric shock.

When touching a section charged with high voltage, make sure that the following two conditions is fulfilled:

1) The output voltmeter indicates “0.”
2) The DANGER lamp has turned OFF.

3.3.3 Checking the Discharge

The discharging time varies depending on the capacitance of the DUT and the test voltage delivered by the tester. An internal circuit is designed to discharge the residual high voltage of its output circuit when the output is turned off. Do not remove the DUT from the tester during a test. If you do so, a high residual voltage will remain for a long time.

3.4 Warning for remote control

Be careful when operating the tester in a remote control mode in which the dangerous high test voltage will be turned ON/OFF remotely.

1) Make sure that the test setup does not output voltage inadvertently (TEST state).
2) Make sure that no one can touch the DUT, test leads, probes, output terminals and their vicinities when high voltage is being delivered (TEST state).

3.5 Limited operating conditions

3.5.1 Test voltage must be less than or equal to 5 kV

The maximum output voltage of the tester can be higher than 5 kV when there is no load, or due to AC line voltage fluctuation. Anyway make sure that the output voltage is less than or equal to 5 kV.

3.5.2 Give enough time for the tester to cool down

1. During an AC test

When the upper cutoff current is higher than 50 mA, give at least same pause time with test time for the tester to cool down. Do not test continuously more than 30 minutes. Doing so may destroy the high voltage transformer because of overheat. For upper cutoff current which is less than 50mA, you don't have this time limit and can test continuously.

2. During a DC test (TH5201 only)

When operating the tester, provide pause time as shown in the table below. If you operate the tester beyond these time limits, the high voltage generator will be overheated and the protective circuit will be triggered to force the tester to enter the PROTECTION state ("PROTECTION" is lit). If this happens, stop the test operation until the tester cools down and then resume the test again. As the tester is cooled down, the PROTECTION display will be turned off and the tester resumes its normal operating state.

Maximum continuous test time under DC mode

Environment temperature T(℃)	Upper cutoff current Ic (mA)	Pause time (Test time = Tt)	Max. continuous Test time
T≤30℃	6 < Ic ≤ 11	≥ 5 × Tt	≤ 30 s
	6 < Ic ≤ 11	≥ 10 × Tt	≤ 60 s
	3 < Ic ≤ 6	≥ 4 × Tt	≤ 120 s
	1 < Ic ≤ 3	≥ 2 × Tt	≤ 120 s
	Ic ≤ 1	Not required	Continuous
30℃<T≤35℃	6 < Ic ≤ 11	≥10×Tt	≤15 s
	6 < Ic ≤ 11	≥4×Tt	≤30 s
	3 < Ic ≤ 6	≥2×Tt	≤60 s
	1 < Ic ≤ 3	≥2×Tt	≤120 s
	Ic ≤ 1	Not required	Continuous
35℃<T≤40℃	1 < Ic ≤ 3	≥10×Tt	≤15 s
	Ic ≤ 1	Not required	Continuous

3.5.3 Operate within the range of ±10% of the rated line voltage

The tester operates normally within ±10% of the rated line voltage. Outside this voltage range, the tester may not operate normally and in very serious case it might be damaged. If the actual AC line voltage is not within this range, convert it into this range before the tester is connected.

3.5.4 Do not operate the tester under direct sunlight or in high temperature, high humidity, or dusty atmosphere.

3.5.5 The capacity requirement of the AC line voltage

The tester has a high voltage output transformer of 500 VA and will draw a large AC input current (several tens of Amperes) under the following cases:

1) Several tens of milliseconds before the tester detects a failure in the DUT.
2) Several tens of milliseconds when starting up the tester.

WARNING!

Make sure the capacity of the AC line is adequate for the tester and other devices connected to the same line. Do not connect the tester to an AC line with a over-current cutoff protector. If the AC line is cut off, the tester may generate an extremely high surge voltage in its output circuit. This is very dangerous.

3.6 Other precautions

3.6.1 Inhibitions

1) Inhibition of rapid ON/OFF operations

Turn on the tester only several seconds or longer after turning it off. Do not keep turning ON/OFF the power switch rapidly. If you do so, the protective circuits of the tester may fail to function properly. Turn OFF the power switch only after cutting off the output voltage except emergency cases.

2) Inhibition of Shorting to Earth Ground

When the high test voltage lead is shorted to a nearby AC line or devices which are connected to an earth ground, the tester chassis can be charged up to a hazardous high voltage.

Make sure the protective grounding terminal of the tester is connected to an earth ground. If this has been done correctly, then the tester will not be damaged and its chassis will not be charged up to a high voltage even if the HIGH output terminal is shorted to the LOW output terminal.

3.6.2 Emergent Measures

In case of an emergency (such as an electric shock accident or burning of the DUT), take the following measures:

1) Turn OFF the POWER switch of the tester immediately.
2) Disconnect the power cord of the tester from the AC line receptacle.

3.6.3 Breakdown

1) Do not Use broken testers

   If the tester behaves as indicated below, the tester may have broken down. The tester may be in an extremely dangerous state in which the high voltage cannot be shut down. If such behavior is observed, immediately turn OFF the POWER switch and disconnect the power cord from the AC line receptacle. Don't attempt to repair the tester by yourself.

   - ◆ The DANGER lamp does not turn OFF even you press the STOP button.
   - ◆ The DANGER lamp turns OFF but the pointer of the voltmeter is deflected indicating that the output voltage is being delivered.

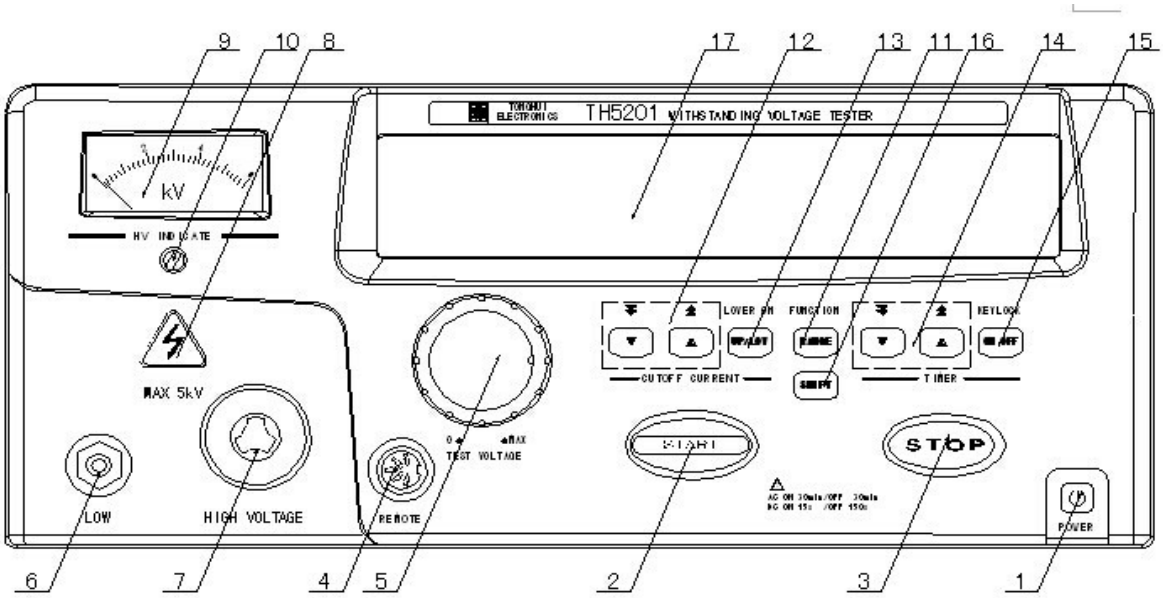
   In other cases in which the tester is not operating properly, it is possible that the output voltage is

delivered unexpectedly. Stop using the tester immediately for service.

2) DANGER Lamp
   If the DANGER lamp works abnormally due to a failure of the lamp itself or other causes, this may lead to a potential electric shock hazard. Immediately stop using the tester for service.

Chapter 4 Description of Panel Items

4.1 Description of the front panel



1. POWER switch

The POWER switch turns ON/OFF the AC power of the tester. When you turn ON the POWER switch, the tester automatically resumes the test conditions that have been used last time before you turned OFF the POWER switch.

Turn ON the POWER switch while holding down the SHIFT key, you can reset the test conditions to the factory default setup as shown in the following table and the last stored test conditions will be lost.

Factory default test conditions

Item	Default
Upper cutoff current	0.2 mA
Lower cutoff current	0.1 mA
Lower pass/fail judgment	OFF
Test time	0.5 s
Timer function	ON
Key lock function	OFF
Talk mode	0
Voltage mode and range	AC, 2.5 kV

The tester will not save the changed test conditions until a complete test has been performed or the STOP button has been pressed after you have changed the test conditions.

Normally, when you turn ON the POWER switch, the tester enters the READY state (“READY” is lit). However, the “READY” lamp will not light up in the following cases:

- The tester is in the PROTECTION state, because the interlock pins of the SIGNAL I/O connector on the rear panel are open. In this case, connect the interlock pins first, and then exit the PROTECTION state by pressing the STOP button. Now you can start your test.
- The tester is in the PROTECTION state, because the high voltage generating section is overheated during a DC test (TH5201 only). In this case, wait until the overheated section is fully cooled down first, and then exit the PROTECTION state by pressing the STOP button. Now you can resume your test again.
- The current unit “mA” keeps blinking, if the lower cutoff current limit is higher than the upper cutoff current limit and at the same time the lower pass/fail judgment function is ON. In this case, you can either change the upper/lower cutoff current settings or just turn OFF the lower pass/fail judgment function to solve this problem. When the READY lamp lights and unit “mA” stops blinking, the tester is now ready for test.

2. START button

If you press the START button when the tester is in the READY state (“READY” is lit), the tester will perform a test with parameters displayed on the screen.

If the “REMOTE” message is displayed, the remote start control through the REMOTE CONTROL connector or the SIGNAL I/O connector is enabled, while the START button on the front panel is disabled.

If the MOMENTARY test mode is selected, the high voltage will be outputted only when you hold down the START button.

WARNING!

For your safety, never try to remote-control the tester from both the REMOTE CONTROL connector and the SIGNAL I/O connector simultaneously.

3. STOP button

The STOP button is used to stop a test and reset the tester. When you press this button, the tester will behave like this:

- **Clear the TEST status (“TEST” is lit)**
  1) Turn off the high voltage output with the highest priority.
  2) Start the discharge function if the test is in DC mode.
  3) Turn off the “DANGER” lamp until there is no residual test voltage in the output circuit.
  4) Turn off the “TEST” display message on the screen.
  5) Turn off the TEST signal and the HV-ON signal in the SIGNAL I/O connector.
- **Clear the PASS status (“PASS” is lit)**
  1) Turn off the “PASS” display message on the screen.
  2) Turn off the PASS signal in the SIGNAL I/O connector.
- **Clear the FAIL status (“FAIL” is lit)**
  1) Turn off the “UPPER FAIL” or the “LOWER FAIL” message.
  2) Turn off the U_FAIL or L_FAIL signal in the SIGNAL I/O connector.
- **Clear the PROTECTION status (“PROTECTION” is lit)**

1) Turn off the “PROTECTION” message.
2) Turn off the PROTECTION signal in the SIGNAL I/O connector.

The PROTECTION status can’t be cleared by pressing the STOP button if the interlock pins of the SIGNAL I/O connector are still open or if the overheated voltage generation section has not been fully cooled down during a DC test (TH5201/TH5201B only).

- **5. Clear the READY status (“READY” is lit)**

1) Turn off the “READY” message.
2) Turn off the READY signal in the SIGNAL I/O connector.

Normally, when you release the STOP button, the tester enters the READY state (“READY” is lit). In the following cases, however, the tester will not enter the READY state.

1) The cause of PROTECTION status remains un-eliminated.
   - The interlock pins of the SIGNAL I/O connector are still open.
   - The high voltage generation section is still overheated during a DC test.
2) The test voltage remains charged. The DANGER lamp remains lighted even though the “TEST” message is off.
3) A period of approximately 0.5 seconds elapses after releasing the STOP button, when the DOUBLE ACTION test mode is selected. If the DOUBLE ACTION test mode is selected, the tester will enter the READY state when you release the STOP button. But the tester will automatically exit the READY state after around 0.5 seconds.
4) The STOP button is released while the START button is pressed.

[redacted]

If the FAIL MODE is selected, FAIL status or the PROTECTION status can only be cleared by pressing the STOP button from the front panel.

4. REMOTE connector

A remote control box (TH9000) or a HV test probe can be connected to the REMOTE connector to START/STOP the tester.

When a remote control device is connected, the tester detects and enters the REMOTE mode automatically. When the tester enters the REMOTE mode, “REMOTE” message will be displayed and the START button on the front panel is disabled. In this case, the tester will enter the PROTECTION status (“PROTECTION” is lit) and the high voltage output is cut off. The STOP operation can be done by either the STOP button on the front panel or by the connected remote control device.

As soon as the remote control device is unplugged, the “REMOTE” message disappears and the START button is enabled again. The tester will enter the PROTECTION status (“PROTECTION” is lit) and the high voltage output is cut off.

WARNING!

1. Use the optional HV test probe only when test voltage is less than 4 kV AC or 5 kV DC.
2. If you want to control the START/STOP operation using a device other than one of the optional devices of the tester, use the SIGNAL I/O connector on the rear panel instead of the REMOTE CONTROL connector on the front panel.
3. Do not remote-control the tester simultaneously from both the REMOTE CONTROL connector and the SIGNAL I/O connector.

5. TEST VOLTAGE control knob

The TEST VOLTAGE control knob is used to adjust the test voltage. When you turn the TEST VOLTAGE control knob clockwise from the “0” position, the test voltage increases.

1) *Make sure to turn the TEST VOLTAGE control knob fully counterclockwise to its “0” position whenever you are not performing a test.*
2) *When the TEST VOLTAGE control knob is set to the fully clockwise position (“MAX” position) without load connected, the output voltage in the DC mode may be higher than the test voltage range you’ve selected with the RANGE key. In the AC mode, the output voltage may be even higher due to the AC line voltage fluctuation. Although higher voltages may be available, be sure to operate the tester within the voltage ranges.*

6. LOW terminal

This terminal is the low terminal of the tester output. This terminal is directly connected to the tester chassis.

7. HIGH VOLTAGE terminal

This terminal is the high terminal of the tester output. The high output voltage is delivered between this terminal and the LOW terminal.

WARNING!

Never touch the HIGH VOLTAGE terminal during the test when the DANGER lamp lights and the “TEST” message displays.

8. DANGER lamp

This red lamp illuminates to tell you that the high test voltage is being delivered. It remains illuminated as long as the test voltage remains in the output circuit.

WARNING!

When the DANGER lamp is illuminating, never touch the HIGH VOLTAGE terminal, test leads, DUT, or other charged objects.

9. Analog voltmeter

The analog voltmeter indicates directly the output terminal voltage.

10. Zero adjustment of analog voltmeter

This is the mechanical zero adjustment of the analog voltmeter. Before making a zero adjustment, be sure to turn off the POWER switch first.

11. RANGE key

Press the RANGE key to toggle between 2.5kV and 5kV voltage range. Press the RANGE key with the SHIFT key holding down to toggle between DC and AC voltage mode. (TH5201A has no DC voltage mode).

Model	Voltage mode	Voltage range
TH5201	AC	2.5kV
		5.0kV
	DC	2.5kV
		5.0kV
TH5201A	AC	2.5kV
		5.0kV

The RANGE key is only enabled when the tester is in the READY status ("READY" is lit); it will be disabled during test status ("TEST" is lit) or when the tester is delivering the result of PASS/FAIL judgment ("PASS" or "FAIL" is lit).

Before pressing the RANGE key, make sure that the TEST VOLTAGE control knob is at the fully counterclockwise position ("0" position).

12. CUTOFF CURRENT ▲▼ keys

These keys are used to increase or decrease the cutoff current limits for PASS/FAIL judgment. The keys are only enabled when the tester is in the READY status ("READY" is lit) and the "KEYLOCK" message is OFF. These keys will be disabled during the TEST status ("TEST" is lit) or when the tester is delivering the result of PASS/FAIL judgment (when "PASS" or "FAIL" lights). There are two cutoff currents, upper cutoff current and lower cutoff current. You can select a cutoff current by pressing the UP/LOW key and increase or decrease the selected cutoff current with these keys. If you press either key alone, the increment/decrement resolution follows the basic resolution shown below. If you press it with the SHIFT key holding down, the increment/ decrement resolution will be ten times that of the basic resolution.

If you press and hold down the key, the current limit increases/decreases continuously.

Cutoff Current ▲	Press this key to increase the cutoff current limit. The current limit value will be shown by the digital ammeter.
Cutoff current ▼	Press this key to decrease the cutoff current limit. The current limit value will be shown by the digital ammeter.

UPPER/LOWER Cutoff Current Range	Resolution	Display format
0.1 mA ~ 9.9 mA	0.1 mA	X.X mA
10 mA ~ 110 mA	1 mA	XXX mA

[redacted]

Because the UPPER and LOWER cutoff currents can be set separately, it is possible that the LOWER current limit is higher than the UPPER current limit. If this happens and the "LOWER ON" is enabled, blinking "mA" with off "READY" message reminds you to change the current setup or simply turn off the LOWER ON function. The "READY" message illuminates again if the LOWER cutoff current is lower

than the UPPER cutoff current or if LOWER ON function is turned off.

13. CUTOFF CURRENT UP/LOW key

Press this key to toggle the display between the upper and the lower cutoff currents. Press this key while holding down the SHIFT key to turn on/off the LOWER ON function. The key is enabled when the tester is in the READY status (“READY” is lit) and the “KEYLOCK” function is off. It will be disabled during the test status (“TEST” is lit) or when the tester is delivering the “PASS” or “FAI”L result (when “PASS” or “FAIL” is lit).

1) When the UP/LOW key is pressed alone.
   Each time you press the key, the upper or lower cutoff current will be displayed along with its corresponding “UPPER” or “LOWER” message. The “UPPER” message indicates that the upper cutoff current is displayed on the CURRENT readout, and you can change the value with the ▲ or ▼ key. The “LOWER” message indicates that the lower cutoff current is displayed on the CURRENT readout, and you can change the value with the ▲ or ▼ key.
2) When the UP/LOW key is pressed while holding down the SHIFT key.
   Each time you press the key, the “LOWER ON” message appears or disappears indicating that the lower pass/fail judgment function has been enabled or disabled. This LOWER ON function will be valid for both AC and DC voltage modes.

14. TIMER ▲▼ keys

These keys are used to increase/decrease the test time. The keys are enabled only when the tester is in the READY status (“READY” is lit) and the “KEYLOCK” function is off. These keys will be disabled in the test status (“TEST” is lit) or when the tester is delivering the “PASS” or “FAI”L result (when “PASS” or “FAIL” is lit).

If you press either key alone, the resolution of increment/decrement follows the basic resolution shown below. If you press it while holding down the SHIFT key, the resolution of increment/decrement will be ten times the basic resolution. If you hold down the key, the timer increases/decreases continuously.

TIMER ▲ key	Press this key to increase the test period. The TIMER value will be shown on the TIME display.
TIMER ▼ key	Press this key to decrease the test period. The TIMER value will be shown on the TIME display.

Test time range	Resolution	Display format
0.1 s ~ 99.9 s	0.1 s	XX.X s
100 s ~ 999 s	1 s	XXX s

15. TIMER ON/OFF key

Press the ON/OFF key to turn ON/OFF the timer function. Press the key while holding down the SHIFT key to toggle the key lock function.

1) When the ON/OFF key is pressed alone.
   Each time you press the key, the TIMER function is toggled.
   When the TIMER function is on, the test will be terminated as soon as the displayed time of the timer counts down to zero. Remained counting down time will be displayed on the TIME display.
   When the TIMER function is off, the test will not be terminated by the timer. Elapsed test time will

be displayed on the TIME display.

The ON/OFF key is valid only when the tester is in the READY status (“READY” is lit) and the “KEYLOCK” function is off. The key will be disabled when the tester is in the test state (“TEST” is lit) or when the tester is delivering the PASS/FAIL result (When “PASS” or “FAIL” is lit).

2) When ON/OFF key is pressed while holding down the SHIFT key.

Press the ON/OFF key while holding down the SHIFT key to toggle the key lock function on/off. When key lock function is on, the “KEYLOCK” message will be displayed. When key lock function is off, the “KEYLOCK” message disappears. When the key lock function is ON, the following key operations will be disabled.

- CUTOFF CURRENT ▲▼keys
- CUTOFF CURRENT UP/LOW key
- TIMER ▲▼ keys
- TIMER ON/OFF key
- RANGE key

Therefore, the following conditions can be protected from inadvertent or unauthorized change.

- Upper cutoff current
- Lower cutoff current
- ON/OFF of lower pass/fail judgment function
- Test time
- ON/OFF of timer function

You can lock or unlock the keys at anytime in any status.

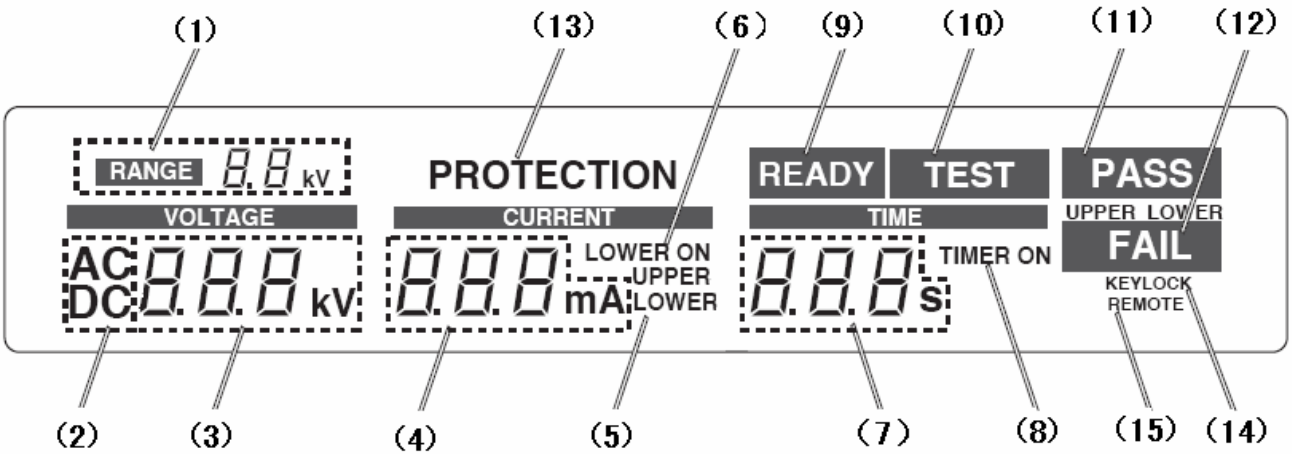
16. SHIFT key

1) Press the POWER switch while holding down the SHIFT key to restore the factory default setup.
2) Press the CUTOFF CURRENT ▲ key while holding down the SHIFT key to increase the limit value with a resolution ten times the basic resolution.
3) Press the CUTOFF CURRENT ▼ key while holding down the SHIFT key to decrease the limit value with a resolution ten times the basic resolution.
4) Press the UP/LOW key while holding down the SHIFT key to toggle the lower pass/fail judgment function ON or OFF.
5) Press the TIMER ▲ key while holding down the SHIFT key to increase the time value with a resolution ten times the basic resolution.
6) Press the TIMER▼ key while holding down the SHIFT key to decrease the time value with a resolution ten times the basic resolution.
7) Press the ON/OFF key while holding down the SHIFT key to toggle the key lock function ON or OFF.

17. Vacuum fluorescent display

The vacuum fluorescent display indicates test conditions, test results, and other items.

4.2 Description of the VFD



1. TEST VOLTAGE RANGE message

This 7-segment 2-digit message indicates the current test voltage range selected with the RANGE key. The 5 kV and 2.5 kV test voltage ranges are available.

The RANGE key will be disabled when the tester is in the test state (“TEST” is lit) or when the tester is delivering the PASS/FAIL result (When “PASS” or “FAIL” is lit).

2. AC/DC test mode message

This message indicates whether the current test voltage mode selected with the SHIFT+RANGE key. AC or DC test voltage modes are available.

1) The TH5201A has the AC test mode only.
2) The SHIFT+RANGE key will be disabled when tester is in the test state (“TEST” is lit) or when the tester is delivering the PASS/FAIL result (When “PASS” or “FAIL” is lit).

3. VOLTAGE readout (digital voltmeter)

The VOLTAGE readout (digital voltmeter) displays a 7-segment 3-digit output voltage. It continuously monitors the voltage on the output terminal. For model TH5201, the digital voltmeter works as either an AC voltmeter or a DC voltmeter according to different AC or DC voltage mode.

Measuring ranges, resolutions and display formats

Measuring range		Resolution	Display format
5kV AC range	0kV to 6.5kV	27.77 V	X.XX kV
2.5kV AC range	0kV to 3.25kV	13.88 V	X.XX kV
5kV DC range	0kV to 6.0kV	25.00 V	X.XX kV
2.5kV DC range	0kV to 3.0kV	12.50 V	X.XX kV

4. CURRENT readout (digital ammeter)

When the tester is in the test state (“TEST” is lit), the CURRENT readout displays the measured output current; when the tester is in other states than the test state, the CURRENT readout displays the preset

upper or lower cutoff current.

Press the UP/LOW key to switch the display between the upper cutoff current and lower cutoff current when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off. The upper cutoff current displays with “UPPER” message on, and the lower cutoff current displays with the “LOWER” message on.

You can increase/decrease the upper or lower cutoff current with the ▼or▲ key when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off. If you press the SHIFT+▼or SHIFT+▲ key, the increment/decrement rate will be multiplied by 10.)

If the lower cutoff current is higher than the upper cutoff current and the lower pass/ fail judgment function is ON, “mA” (unit of current) blinks and the “READY” message disappears to alert you to that the current setting is illogical and the test cannot be done. When the lower cutoff current is set lower than the higher cutoff current or when the lower pass/fail judgment function is turned OFF, the “mA” automatically stops blinking and the tester resumes the READY state. For model TH5201/TH5201B, the upper/lower cutoff currents for both AC and DC modes can be preset separately.

1) Displayed items

READY state		**TEST state**
When “UPPER is lit”	When “LOWER” is lit	Measured current
Upper cutoff current	Lower cutoff current	

2) Setup ranges

Model	**DC mode test**	**AC mode test**
	Upper/Lower cutoff current range	Upper/Lower cutoff current range
TH5201	0.1mA ~ 11mA	0.1mA ~ 110mA
TH5201A	Not available	

3) Setup resolutions and display formats

Upper/Lower cutoff current range	**Resolution**	**Display format**
0.1mA ~ 9.9mA	0.1mA	X.X
10mA ~ 110mA	1mA	XXX

5. UPPER message

This “UPPER” message is displayed along with the upper cutoff current. Press the UP/ LOW key to toggle between the “UPPER” and “LOW” message when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off.

During a test state (“TEST” is lit), both “UPPER” and “LOWER” messages will disappear, and the ammeter displays the measured current.

6. LOWER message

This “LOWER” message is displayed along with the lower cutoff current. Press the UP/ LOW key to toggle between the “UPPER” and “LOW” message when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off.

During a test state (“TEST” is lit), both “UPPER” and “LOWER” messages will disappear, and the ammeter displays the measured current.

7. LOWER ON message

This “LOWER ON” message lights when the lower pass/fail judgment function is ON. You can toggle the LOWER ON function ON or OFF by pressing the SHIFT+UP/LOW key when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off.

You still can display and change the lower cutoff current when the lower pass/fail is turned off. For

model TH5201, this LOWER ON setup applies to both AC and DC test modes.

8. Timer

When the tester is in the test state (“TEST” is lit), the TIME display displays the remaining or elapsed test time as a 3-digit 7-segment readout.

You can increase/decrease the time setup by pressing the ▼or▲ key when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off. You can increase/decrease the time setup with a 10 times rate by pressing SHIFT+▼ or SHIFT+▲ key.

When the timer function is ON (“TIMER ON” is lit), the counting down time will be displayed. The test will be terminated when preset time is up. If the timer function is off (“TIMER ON” is off), the elapsed time will be displayed as test continues. The test will not be terminated when preset time is up.

1) Displayed items

Display items		
When in READY state	When in TEST state	
	“TIMER ON” appears	“TIMER ON” disappears
Preset time	Remaining time	Elapsed time

2) Setup ranges, resolutions, and display formats

Setup range	**Resolution**	**Display format**
0.5s ~ 99.9s, OFF	0.1 s	XX.X
100s ~ 999s, OFF	1 s	XXX

9. TIMER ON message

TIMER ON message will be displayed when timer function is on. Press the ON/OFF key to toggle the TIMER function on or off when the tester is in the READY state (“READY” is lit) and the “KEYLOCK” function is off. For model TH5201/TH5201B, the setup for the timer function applies to both AC and DC test modes.

10. READY message

This “READ” message tells you that the tester is ready for a test. Press the START button when this message is displayed, the tester will start a test operation using the displayed test parameters on the screen.

11. TEST message

This “TEST” message in red tells you that the tester is in the TEST state, and a high voltage is being delivered on the test terminals. To end this state, press the STOP button.

12. PASS message

This “PASS” message in green will be displayed when the preset time is up and the result of pass/fail judgment is PASS. The “PASS” message will not be displayed if the TIMER is off or if a test is terminated by pressing the STOP button.

Normally, the “PASS” message will be turned off after displaying for approximately 0.2 seconds. But if the PASS HOLD test mode is selected, this message will be displayed until the STOP button is pressed.

13. FAIL messages

1) UPPER FAIL message
   This “UPPER FAIL” message will be displayed when the leakage current that flows through the DUT is greater than the preset upper cutoff current. To clear the message, press the STOP button.
2) LOWER FAIL message
   This “LOWER FAIL” message will be displayed when the leakage current that flows through the DUT is less than the preset lower cutoff current. To clear the message, press the STOP button.

14. PROTECTION message

This “PROTECTION” message in yellow will be displayed when one of the following causes exists. In the PROTECTION state, output voltage will be cut off. To clear the PROTECTION state, eliminate the causes first and then press the STOP button.

1) The plug is connected to or removed from the REMOTE CONTROL connector.
2) The status of the REMOTE ENABLE signal pins of the SIGNAL I/O connector has changed.
3) The INTERLOCK signal pins of the SIGNAL I/O connector are open.
4) The high voltage generation circuit of the DC test section (TH5201 only) is overheated.

15. KEYLOCK message

This “KEYLOCK” message will be displayed when the key lock function is ON. The key lock function disables the following key operations:

1) CUTOFF CURRENT ▼▲ keys
2) CUTOFF CURRENT UP/LOW key
3) TIMER ▼▲ keys
4) TIMER ON/OFF key

Thus, the following test conditions are protected.

1) Upper cutoff current
2) Lower cutoff current
3) ON/OFF of lower pass/fail judgment
4) Test time
5) ON/OFF of timer function

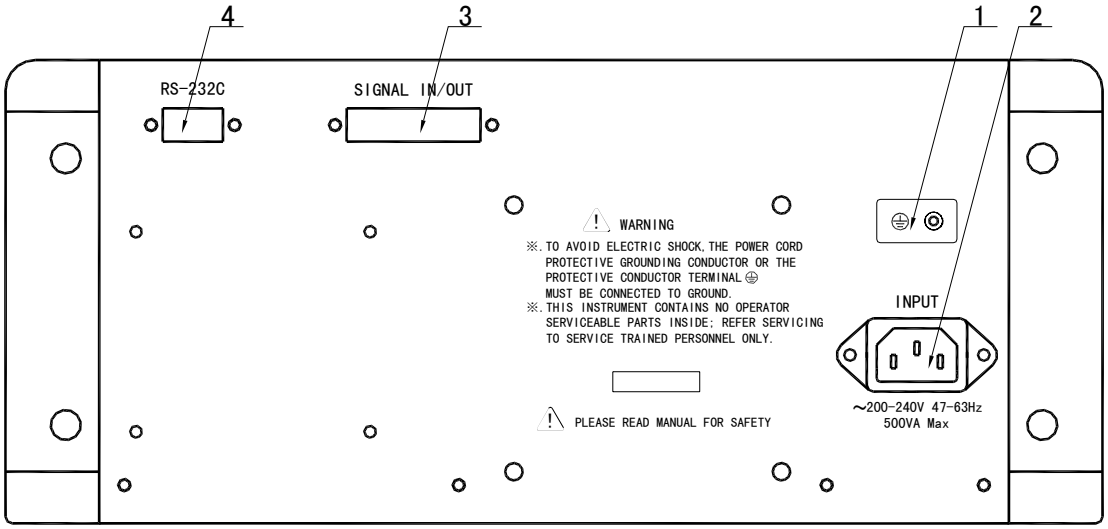
The key-lock function can be turned ON or OFF at any time by pressing the SHIFT+ON/ OFF keys.

16. REMOTE message

This “REMOTE” message will be displayed when the tester is remote-controlled by the REMOTE CONTROL connector or the SIGNAL I/O connector.

This message will also be displayed when a REMOTE command is received from the RS-232C interface. When this message appears, the START key will be disabled.

4.3 Description of the Rear Panel



1. Protective ground terminal

This terminal can be used to ground the tester. For your safety, make sure that the tester is grounded before operation.

2. AC LINE receptacle

The AC LINE receptacle used for the AC input power.

3. SIGNAL I/O connector

The SIGNAL I/O connector is a 25-pin Amphenol connector for the interlock input signal, remote control signal for test start/stop, and status output signal.

4. RS-232C connector

This connector is used to connect a RS-232C cable. Measured values and test results can be output to an external device such as a PC or serial printer. Commands can be sent by a PC to control the tester.

Chapter 5 Preparation before test

5.1 Initial Setup

5.1.1 Table below shows the initial setup (factory default setup)

Factory default setup data

Item	Setup
Upper cutoff current	0.2 mA
Lower cutoff current	0.1 mA
Lower pass/fail adjustment	OFF
Test time	0.5s
Timer function	ON
Key lock function	OFF
Talk mode	0

5.1.2 Initializing Test Setup Data

The set of setups shown above are saved in the internal non-volatile memory of the tester and will not be changed when the POWER switch is turned OFF.

Perform following steps to restore the factory default values:

1) Make sure that the POWER switch is turned OFF.
2) Make sure that the power cord is correctly connected.
3) Turn on the POWER switch while holding down the SHIFT key. The VFD will start illuminating, indicating that power has been turned ON.
4) Release both SHIFT key and POWER switch. The default version number, model name and talk mode will be displayed for several seconds.
5) If nothing is displayed after one minute, perform the procedure from the beginning again.

5.2 Checking the Tester Operation

The tester will not output high voltage until the PROTECTION state (“PROTECTION” is lit) is eliminated by connecting the interlock pins.

Perform following the procedures to make sure the tester works normally before using it.

1) Make sure that the POWER switch is OFF.
2) Make sure that the VOLTAGE control knob is in its zero position.
3) Make sure that the 25-pin Amphenol plug is not connected to the SIGNAL I/O connector on the rear panel of the tester.
4) Make sure that the power cord is correctly connected.
5) Turn on the POWER switch while holding down the SHIFT key to restore the factory default setup. The version number, model name, and talk mode number will be displayed for several seconds.
6) Make sure that the “PROTECTION” is displayed.
7) Turn OFF the POWER switch.
8) Connect the 25-pin Amphenol connector to the SIGNAL I/O connector.

9) Turn the POWER switch ON again after one minute.
10) Make sure that the tester is in the READY state (“READY” is lit).

5.3 Checking the tester before operation

Check and adjust following items of the tester before starting test operation.

5.3.1 Zero adjustment of the analog voltmeter

Before turning ON the POWER switch, check and make sure that the pointer of the analog voltmeter indicates the “0” position. If the pointer of the analog voltmeter does not indicate the “0” position, you need to adjust it with a small screwdriver.

5.3.2 Interlock function

Before start operating the tester, make sure that the test system is protected with an appropriate interlock function.

5.3.3 Tester in PROTECTION state

If the tester is in the PROTECTION state (“PROTECTION” message is displayed), the tester will not start the test operation and deliver the test voltage when you press the START button. To reset from the PROTECTION state, eliminate the cause that has driven the tester into the PROTECTION state and then press the STOP button. Possible causes that drive the tester into the PROTECTION state are as follows:

1) An accessory device is connected to or disconnected from the REMOTE CONTROL connector.
2) The state of the REMOTE ENABLE input signal pins of the SIGNAL I/O connector is changed.
3) The INTERLOCK input signal pins of the SIGNAL I/O connector are open.
4) The high DC voltage generation section is overheated (TH5201only).

Chapter 6 Test Procedures

6.1 ACW Test Procedure

Set the test conditions for the DUT according to the available ranges below:

Test voltage	Upper cutoff current	Lower cutoff current	Test time
0 kV to 5 kV	0.1 mA to 110 mA	0.1 mA to 110 mA, OFF	0.5 s to 999 s, OFF

1. Select an AC Voltage Range

Press SHIFT+RANGE key to select AC voltage mode, “AC” message will be displayed. Press RANGE key to select an AC test voltage range from 5 kV or 2.5 kV, the current range message will be displayed.

1) Before changing the range, make sure that the TEST VOLTAGE control knob is at the fully counterclockwise position (“0” position).

2) During the TEST period (“TEST” message is lit.), the RANGE key will be disabled.

2. Set the Upper Cutoff Current

If the leakage current that flows through the DUT is larger than the upper cutoff current limit, the DUT will be judged as UPPER FAIL. Perform the following procedure to set the upper cutoff current for pass/fail judgment.

1) Select the upper cutoff current parameter by pressing the UP/LOW key. The “UPPER” message will be displayed together with the preset upper limit current value.
2) Press the ▲ or ▼ key to increase/decrease the preset upper cutoff current value within the range from 0.1 mA to 110 mA.
3) Press SHIFT +▲or SHIFT+▼ keys to adjust the upper current limit with a ten times speed.

Resolution and format for different current range

UPPER cutoff current range	Resolution	Display format
0.1 mA ~ 9.9 mA	0.1 mA	X.X mA
10 mA ~ 110 mA	1 mA	XXX mA

1) The ▲ and ▼ keys are enabled when the tester is in the READY state (“READY” message is lit) and the “KEYLOCK” massage is OFF. The ▲ and ▼ keys will be disabled when in the test state (“TEST” message appears) or when the tester is delivering the result of PASS/FAIL judgment (when the “PASS” message or the “FAIL” message is displayed).

2) Because the upper and lower cutoff currents can be set separately, it is possible that the lower cutoff current is higher than the upper cutoff current. If this happens and the pass/fail judgment function for the lower cutoff current is ON. Blinking unit “mA” with “READY” message off reminds you to change the cutoff limits. The READY state resumes and the blinking “mA” stops when the

lower cutoff current is lower than the upper cutoff current or when the pass/fail judgment function for the lower cutoff current is turned OFF.

3. Set the Lower Cutoff Current

If the leakage current that flows through the DUT is less than the lower cutoff current limit, the DUT will be judged as LOWER FAIL.

If you know the possible lowest leakage current for a DUT, you can set the lower cutoff current slightly less than the lowest leakage current. Then you can discriminate DUT whose leakage currents are abnormally low and prevent open-circuit of the test leads at the same time. This will enhance the reliability of test. If this lower cutoff limit is inconvenient for your test, you can turn OFF the lower pass/fail judgment function.

Perform following procedure to set the lower cutoff current:

1) Select the lower cutoff current parameter by pressing the UP/LOW key. The “LOWER” message will be displayed together with the preset lower limit current value.
2) Press the ▲ or ▼ key to increase/decrease the preset lower cutoff current value within the range from 0.1 mA to 110 mA.
3) Press SHIFT +▲or SHIFT+▼ keys to adjust the lower current limit with a ten times speed.
4) Press SHIFT+ UP/LOW keys to turn on/off the lower limit for PASS/FAIL judgment. “LOWER ON” message will be displayed when the lower limit judgment function is turned on.

Resolution and format for different current range

LOWER cutoff current range	Resolution	Display format
0.1 mA to 9.9 mA	0.1 mA	X.X mA
10 mA to110 mA	1 mA	XXX mA

[redacted]

1) The ▲ and ▼ keys are enabled when the tester is in the READY state (“READY” message is lit) and the “KEYLOCK” massage is OFF. The ▲ and ▼ keys will be disabled when in the test state (“TEST” message appears) or when the tester is delivering the result of PASS/FAIL judgment (when the “PASS” message or the “FAIL” message is displayed).

2) Because the upper and lower cutoff currents can be set separately, it is possible that the lower cutoff current is higher than the upper cutoff current. If this happens and the pass/fail judgment function for the lower cutoff current is ON. Blinking unit “mA” with “READY” message off reminds you to change the cutoff limits. The READY state resumes and the blinking “mA” stops when the lower cutoff current is lower than the upper cutoff current or when the pass/fail judgment function for the lower cutoff current is turned OFF.

3) When a test is done with a high AC voltage, the output current that flows may be higher than the preset lower cutoff current due to the stray capacitance of the output circuit even no DUT is connected. So the test will give a PASS judgment instead of a FAIL one which you have normally expected. You have to consider the various factors that may affect the reliability of judgment. Make sure that the preset lower cutoff current is larger than the open-circuit leakage current, if you want to use the lower cutoff current for judgment. Before starting tests, disconnect the DUT and be certain that the FAIL judgment is correctly given.

4. Set the Test Time

The test time is valid only when the TIMER function is turned on ("TIMER ON" message is lit). The tester delivers the high test voltage during this test period of time. If no FAIL judgment happens, the tester will give a PASS judgment when this period of test time elapses. If FAIL judgment happens, the tester will terminate the current test immediately. You can turn OFF the timer function if you don't need it.

Perform following procedure to set the test time:

1) Press the ▲or▼ key to adjust the test time. Press the SHIFT+▲ or SHIFT+▼ keys to adjust the time at a ten times speed. The test time will be displayed on the TIME display.
2) Press the ON/OFF key to turn on/off the timer function. "TIMER ON" message appears when timer function is turned on.

Resolutions and display formats for different range

Test period range	Resolution	Display format
0.5 s ~ 99.9 s	0.1 s	XX.X s
100 s ~ 999 s	1 s	XXX s

[redacted]

1) Test time and pause period are limited according to different upper cutoff currents. "ON 30min" on the front panel shows a maximum test time and "OFF 30min" shows a minimum pause period.

2) The ON/OFF key is enabled when the tester is in the READY state ("READY" message is lit) and the "KEYLOCK" message is OFF. The ON/OFF key will be disabled in the test state ("TEST" message is lit.) or when the tester is delivering the result of PASS/FAIL judgment ("PASS" message or "FAIL" message appears).

3) The timer function is turned on with the "TIMER ON" message displayed. When the timer function is turned off, the tester will not terminate its test even when the preset test period elapses and no PASS judgment will be given.

4) If your test specification requires that the test period for the DUT must not be shorter than the specified test period even by a very short period, increase the preset test period just by one digit.

5. Set the Test Voltage

The test voltage will be delivered and applied to a DUT in the test state.

[redacted]

A stable AC power supply is needed in order to get a stable test voltage, because the output voltage will be affected directly by fluctuations of the AC power supply according to its voltage generation circuit.

Perform following procedure to set the test voltage:

1) Turn OFF the lower pass/fail judgment function by pressing the UP/ LOW key while holding down the SHIFT key. The "LOWER ON" message will disappear.
2) Turn OFF the timer function by pressing the ON/OFF key. The "TIMER ON" message will disappear.
3) Make sure that the TEST VOLTAGE control knob is in the "0" position (fully counterclockwise) and

that the tester is in the READY state (“READY” message appears). Press the START button.

4) Monitor the output voltage on the analog voltmeter or digital VOLTAGE readout and raise the output voltage to your desired voltage by turning gradually the TEST VOLTAGE control knob clockwise.
5) Press the STOP button to cut off the output voltage.
6) Turn ON the timer function by pressing the ON/OFF key. The “TIMER ON” message will appear.
7) If you need the lower pass/fail judgment function, press the UP/ LOW key while holding down the SHIFT key to turn the lower pass/fail judgment function. The “LOWER ON” message will appear.

6. Connect the DUT

Perform following procedure to connect the DUT to the test terminals:

1) Make sure that the analog voltmeter indicates “0” volt.
2) Make sure that the DANGER lamp has turned OFF.
3) Make sure that the “READY” message has appeared.
4) Connect the low test lead to the LOW terminal.
5) Connect the high test lead to the HIGH VOLTAGE terminal.
6) To check that the high output voltage is not being delivered, short-circuit the low test lead and high test lead.
7) Connect the low test lead to the DUT first.
8) Connect the high test lead to the DUT.

7. Execute a Test

Test condition setup example:

Test voltage range	2.5kVAC
Test voltage	1.1kV
Upper cutoff current	11mA
Lower judgment function	OFF
Test time	9.2s

The messages displayed in the READY state will be as shown below.

1) Test Procedure

To start the test, press the START button when the tester is in the READY state (“READY” message appears). The following actions will take place:

- The DANGER lamp lights up.
- The H.V ON signal of the SIGNAL I/O connector is turned ON
- The “TEST” message appears.
- The TEST signal of the SIGNAL I/O connector is turned ON.
- The test voltage is delivered between the HIGH VOLTAGE terminal and the LOW terminal.
- The analog voltmeter indicates the test voltage. (The voltmeter indicates the voltage even when the tester is not in the test state.)
- The VOLTAGE readout displays the test voltage. (The readout displays the voltage even when the tester is not in the TEST state.)
- The CURRENT readout displays the measured output current.

- The TIME display shows the remaining test time or the elapsed test time.

The test voltage is 1.1kV AC, the measured output current is 1.1mA, and remaining time is 4.2s as shown in the following figure.

[redacted]

1) The tester will not start if it is in the PROTECTION state.

2) The tester will not start if a STOP signal is being applied.

2) If the test result is PASS

When the timer is turned on, if the measured current is within the preset current limit, the tester will give a PASS judgment as the preset time elapses. If the test result is PASS, the following actions will take place:

- The tester terminates the test and cuts off the test voltage.
- The “TEST” message disappears.
- The TEST signal of the SIGNAL I/O connector is turned OFF.
- The DANGER lamp turns OFF. (It does not go out as long as a residual voltage remains in the output circuit)
- The H.V ON signal of the SIGNAL I/O connector is turned OFF. (It will not turn off as long as a residual voltage remains in the output circuit.)
- The “PASS” message appears.
- The buzzer sounds.
- The PASS signal of the SIGNAL I/O connector is turned ON.

The VFD will be shown as follows:

- The “PASS” message disappears after 0.2second when PASS HOLD is off.
- The buzzer stops.
- The PASS signal of the SIGNAL I/O connector is turned OFF.
- The tester returns to the READY state automatically.

The tester will fail to return to the READY state in any of the following cases:

1) *When the PASS HOLD mode is turned on. In this case the PASS state will be held until STOP button is pressed.*
2) *As long as the cause of the PROTECTION status remains.*
3) *When the STOP button remains pressed (including the STOP button of the remote control box).*
4) *When the START button remains pressed (including the START button of the remote control box).*

3) If the timer is set to OFF

If the timer function is OFF and the "TIMER ON" message is OFF, the test will not terminate automatically. You must manually stop the test by pressing the STOP key. In this case the tester will not give the PASS judgment and the following actions will take place when STOP button is pressed:

- The tester terminates the test and cuts off the test voltage.
- The "TEST" message disappears.
- The TEST signal of the SIGNAL I/O connector is turned OFF.
- The DANGER lamp turns OFF. (It does not go out as long as a residual test voltage remains in the output circuit.)
- The H.V ON signal of the SIGNAL I/O connector is turned OFF. (It is not turned off as long as a residual test voltage remains in the output circuit.)

4) If the test result is FAIL

If the leakage current measured during the test is beyond the limits shown below, the tester will give a FAIL judgment and cut off the test voltage.

When the measured current is larger than the upper cutoff current: the "UPPER FAIL" message will be displayed as shown below:

When the measured current is less than the lower cutoff current and the lower pass/fail judgment function is ON, "LOWER FAIL" message will appear. The VFD will be shown as follows:

When test is terminated with a FAIL judgment, the following actions will take place:

- The tester terminates the test and cuts off the test voltage.
- The “TEST” message disappears.
- The TEST signal of the SIGNAL I/O connector is turned OFF.
- The DANGER lamp turns OFF. (It does not go out as long as a residual test voltage remains in the output circuit.)
- The H.V ON signal of the SIGNAL I/O connector is turned OFF. (It is not turned off as long as a residual test voltage remains in the output circuit.)
- The “UPPER FAIL” or “LOWER FAIL” message appears.
- Turn on the U FAIL signal or L FAIL signal of the SIGNAL I/O connector.
- The buzzer sounds.
- The FAIL judgment will not reset automatically. To reset it, press the STOP button.

5) Repeat the test

The tester will return to the READY state automatically after approximately 0.2 second with PASS message and sound on. When the READY message is displayed, you can repeat the test simply by pressing the START button. The same applies also when the tester is controlled remotely.

[redacted]

The tester will fail to return to the READY state in any of the following cases:

1) *When the PASS HOLD mode is turned on. In this case the PASS state will be held until STOP button is pressed.*
2) *As long as the cause of the PROTECTION status remains.*
3) *When the STOP button remains pressed (including the STOP button of the remote control box).*
4) *When the START button remains pressed (including the START button of the remote control box).*
5) *When the test is terminated with a FAIL judgment, press the STOP button to reset the tester to the READY state. The same applies also when the tester is controlled remotely.*

6.2 DCW Test Procedure (TH5201)

Set the test conditions for the DUT according to the available ranges below:

Test voltage	Upper cutoff current	Lower cutoff current	Test time
0 to 5 kV	0.1 mA to 11 mA	0.1 mA to 11 mA, OFF	0.5 s to 999 s, OFF

1. Select a DC Test Voltage Range

Press SHIFT+RANGE key to select DC voltage mode, “DC” message will be displayed. Press RANGE key to select an DC test voltage range from 5 kV or 2.5 kV, the current range message will be displayed.

[redacted]

1) *Before changing the range, make sure that the TEST VOLTAGE control knob is at the fully counterclockwise position (“0” position).*
2) *During the TEST period (“TEST” message is lit.), the RANGE key will be disabled.*

2. Set the Upper Cutoff Current

If the leakage current that flows through the DUT is larger than the upper cutoff current limit, the DUT will be judged as UPPER FAIL. Perform the following procedure to set the upper cutoff current for pass/fail judgment.

1) Select the upper cutoff current parameter by pressing the UP/LOW key. The “UPPER” message will be displayed together with the preset upper limit current value.
2) Press the ▲ or ▼ key to increase/decrease the preset upper cutoff current value within the range from 0.1mA to 11mA.
3) Press SHIFT +▲or SHIFT+▼ keys to adjust the upper current limit with a ten times speed.

Resolution and format for different current range

UPPER cutoff current range	Resolution	Display format
0.1 mA to 9.9 mA	0.1 mA	X.X mA
10 mA to 11 mA	1 mA	XXX mA

[redacted]

1) Test time and pause period are limited according to different upper cutoff currents. “ON 15s” on the front panel shows a maximum test time and “OFF 150s” shows a minimum pause period.

2) The ▲ and ▼ keys are enabled when the tester is in the READY state (“READY” message is lit) and the “KEYLOCK” massage is OFF. The ▲ and ▼ keys will be disabled in the TEST state (“TEST” message appears) or when the tester is delivering the result of PASS/FAIL judgment (when the “PASS” message or the “FAIL” message is displayed).

3) Because the upper and lower cutoff currents can be set separately, it is possible that the lower cutoff current is higher than the upper cutoff current. If this happens and the pass/fail judgment function for the lower cutoff current is ON. Blinking unit “mA” with “READY” message off reminds you to change the cutoff limits. The READY state resumes and the blinking “mA” stops when the lower cutoff current is lower than the upper cutoff current or when the pass/fail judgment function for the lower cutoff current is turned OFF.

3. Set the Lower Cutoff Current

If the leakage current that flows through the DUT is less than the lower cutoff current limit, the DUT will be judged as LOWER FAIL.

If you know the possible lowest leakage current for a DUT, you can set the lower cutoff current slightly less than the lowest leakage current. Then you can discriminate DUT whose leakage currents are abnormally low and prevent open-circuit of the test leads at the same time. This will enhance the reliability of test. If this lower cutoff limit is inconvenient for your test, you can turn OFF the lower pass/fail judgment function.

Perform following procedure to set the lower cutoff current:

1) Select the lower cutoff current parameter by pressing the UP/LOW key. The “LOWER” message will be displayed together with the preset lower limit current value.
2) Press the ▲ or ▼ key to increase/decrease the preset lower cutoff current value within the range from 0.1 mA to 11 mA.
3) Press SHIFT +▲or SHIFT+▼ keys to adjust the lower current limit with a ten times speed.
4) Press SHIFT+ UP/LOW keys to turn on/off the lower limit for PASS/FAIL judgment. “LOWER ON”

message will be displayed when the lower limit judgment function is turned on.

Resolution and format for different current range

LOWER cutoff current range	Resolution	Display format
0.1 mA to 9.9 mA	0.1 mA	X.X mA
10 mA to 11mA	1 mA	XXX mA

[redacted]

1) The ▲ and ▼ keys are enabled when the tester is in the READY state ("READY" message is lit) and the "KEYLOCK" massage is OFF. The ▲ and ▼ keys will be disabled when in the test state ("TEST" message appears) or when the tester is delivering the result of PASS/FAIL judgment (when the "PASS" message or the "FAIL" message is displayed).

2) Because the upper and lower cutoff currents can be set separately, it is possible that the lower cutoff current is higher than the upper cutoff current. If this happens and the pass/fail judgment function for the lower cutoff current is ON. Blinking unit "mA" with "READY" message off reminds you to change the cutoff limits. The READY state resumes and the blinking "mA" stops when the lower cutoff current is lower than the upper cutoff current or when the pass/fail judgment function for the lower cutoff current is turned OFF.

3) When a test is done with a high AC voltage, the output current that flows may be higher than the preset lower cutoff current due to the stray capacitance of the output circuit even no DUT is connected. So the test will give a PASS judgment instead of a FAIL one which you have normally expected. You have to consider the various factors that may affect the reliability of judgment. Make sure that the preset lower cutoff current is larger than the open-circuit leakage current, if you want to use the lower cutoff current for judgment. Before starting tests, disconnect the DUT and be certain that the FAIL judgment is correctly given.

4. Set the Test Time

The test time is valid only when the TIMER function is turned on ("TIMER ON" message is lit). The tester delivers the high test voltage during this test period of time. If no FAIL judgment happens, the tester will give a PASS judgment when this period of test time elapses. If FAIL judgment happens, the tester will terminate the current test immediately. You can turn OFF the timer function if you don't need it.

Perform following procedure to set the test time:

1) Press the ▲or▼ key to adjust the test time. Press the SHIFT+▲ or SHIFT+▼ keys to adjust the time at a ten times speed. The test time will be displayed on the TIME display.
2) Press the ON/OFF key to turn on/off the timer function. "TIMER ON" message appears when timer function is turned on.

Resolutions and display formats for different range

Test period range	Resolution	Display format
0.5 s ~ 99.9 s	0.1 s	XX.X s
100 s ~ 999 s	1 s	XXX s

1) Test time and pause period are limited according to different upper cutoff currents. "ON 15s" on the front panel shows a maximum test time and "OFF 150s" shows a minimum pause period.

2) The ON/OFF key is enabled when the tester is in the READY state ("READY" message is lit) and the "KEYLOCK" message is OFF. The ON/OFF key will be disabled in the test state ("TEST" message is lit.) or when the tester is delivering the result of PASS/FAIL judgment ("PASS" message or "FAIL" message appears).

3) The timer function is turned on with the "TIMER ON" message displayed. When the timer function is turned off, the tester will not terminate its test even when the preset test period elapses and no PASS judgment will be given.

4) If your test specification requires that the test period for the DUT must not be shorter than the specified test period even by a very short period, increase the preset test period just by one digit.

5. Set the Test Voltage

The test voltage will be delivered and applied to a DUT in the test state.

Perform following procedure to set the test voltage:

1) Turn OFF the lower pass/fail judgment function by pressing the UP/ LOW key while holding down the SHIFT key. The "LOWER ON" message will disappear.
2) Turn OFF the timer function by pressing the ON/OFF key. The "TIMER ON" message will disappear.
3) Make sure that the TEST VOLTAGE control knob is in the "0" position (fully counterclockwise) and that the tester is in the READY state ("READY" message appears). Press the START button.
4) Monitor the output voltage on the analog voltmeter or digital VOLTAGE readout and raise the output voltage to your desired voltage by turning gradually the TEST VOLTAGE control knob clockwise.
5) Press the STOP button to cut off the output voltage.
6) Turn ON the timer function by pressing the ON/OFF key. The "TIMER ON" message will appear.
7) If you need the lower pass/fail judgment function, press the UP/ LOW key while holding down the SHIFT key to turn the lower pass/fail judgment function. The "LOWER ON" message will appear.

6. Connect the DUT

Perform following procedure to connect the DUT to the test terminals:

1) Make sure that the analog voltmeter indicates "0" volt.
2) Make sure that the DANGER lamp has turned OFF.
3) Make sure that the "READY" message has appeared.
4) Connect the low test lead to the LOW terminal.
5) Connect the high test lead to the HIGH VOLTAGE terminal.
6) To check that the high output voltage is not being delivered, short the low test lead and high test lead.
7) Connect the low test lead to the DUT first.
8) Connect the high test lead to the DUT.

7. Execute a Test

Test condition setup example:

Test voltage range	2.5kV DC
Test voltage	1.1kV
Upper cutoff current	11mA
Lower judgment function	OFF
Test time	0.5s

The messages displayed in the READY state will be as shown below.

1) Test Procedure

To start the test, press the START key when the tester is in the READY state ("READY" message appears). The following actions will take place:

- The DANGER lamp lights up.
- The H.V ON signal of the SIGNAL I/O connector is turned ON
- The "TEST" message appears.
- The TEST signal of the SIGNAL I/O connector is turned ON.
- The test voltage is delivered between the HIGH VOLTAGE terminal and the LOW terminal.
- The analog voltmeter indicates the test voltage. (The voltmeter indicates the voltage even when the tester is not in the test state.)
- The VOLTAGE readout displays the test voltage. (The readout displays the voltage even when the tester is not in the TEST state.)
- The CURRENT readout displays the measured output current.
- The TIME display shows the remaining test time or the elapsed test time.

The test voltage is 1.1kV DC, the measured output current is 1.10mA, the remaining test time is 0.2s as shown in the following figure.

[redacted]

1) The tester will not start if it is in the PROTECTION state.

2) The tester will not start if a STOP signal is being applied.

2) If the test result is PASS

When the timer is turned on, if the measured current is within the preset current limit, the tester will give a PASS judgment as the preset time elapses. If the test result is PASS, the following actions will take place:

- The tester terminates the test and cuts off the test voltage.
- The “TEST” message disappears.
- The TEST signal of the SIGNAL I/O connector is turned OFF.
- The DANGER lamp turns OFF. (It does not go out as long as a residual voltage remains in the output circuit)
- The H.V ON signal of the SIGNAL I/O connector is turned OFF. (It will not turn off as long as a residual voltage remains in the output circuit.)
- The “PASS” message appears.
- The buzzer sounds.
- The PASS signal of the SIGNAL I/O connector is turned ON.

The VFD will be shown as follows:

- The “PASS” message disappears after 0.2second when PASS HOLD is off.
- The buzzer stops.
- The PASS signal of the SIGNAL I/O connector is turned OFF.
- The tester returns to the READY state automatically.

[redacted]

The tester will fail to return to the READY state in any of the following cases:

1) *When the PASS HOLD mode is turned on. In this case the PASS state will be held until STOP button is pressed.*
2) *As long as the cause of the PROTECTION status remains.*
3) *When the STOP button remains pressed (including the STOP button of the remote control box).*
4) *When the START button remains pressed (including the START button of the remote control box).*

3) If the timer functions is set to OFF

If the timer function is OFF and the “TIMER ON” message is OFF, the test will not terminate automatically. You must manually stop the test by pressing the STOP key. In this case the tester will not give the PASS judgment and the following actions will take place when STOP button is pressed:

- The tester terminates the test and cuts off the test voltage.
- The “TEST” message disappears.
- The TEST signal of the SIGNAL I/O connector is turned OFF.
- The DANGER lamp turns OFF. (It does not go out as long as a residual test voltage remains

in the output circuit.)

- The H.V ON signal of the SIGNAL I/O connector is turned OFF. (It is not turned off as long as a residual test voltage remains in the output circuit.)

4) If the test result is FAIL

If the leakage current measured during the test is beyond the limits shown below, the tester will give a FAIL judgment and cut off the test voltage.

When the measured current is larger than the upper cutoff current: the "UPPER FAIL" message will be displayed as shown below:

When the measured current is less than the lower cutoff current and the lower pass/fail judgment function is ON, "LOWER FAIL" message will appear. The VFD will be shown as follows:

When test is terminated with a FAIL judgment, the following actions will take place:

- The tester terminates the test and cuts off the test voltage.
- The "TEST" message disappears.
- The TEST signal of the SIGNAL I/O connector is turned OFF.
- The DANGER lamp turns OFF. (It does not go out as long as a residual test voltage remains in the output circuit.)
- The H.V ON signal of the SIGNAL I/O connector is turned OFF. (It is not turned off as long as a residual test voltage remains in the output circuit.)
- The "UPPER FAIL" or "LOWER FAIL" message appears.
- Turn on the U FAIL signal or L FAIL signal of the SIGNAL I/O connector.
- The buzzer sounds.
- The FAIL judgment will not reset automatically. To reset it, press the STOP button.

5) Repeat the test

The tester will return to the READY state automatically after approximately 0.2 second with PASS message and sound on. When the READY message is displayed, you can repeat the test simply by pressing the START button. The same applies also when the tester is controlled remotely.

The tester will fail to return to the READY state in any of the following cases:

1) *When the PASS HOLD mode is turned on. In this case the PASS state will be held until STOP button is pressed.*
2) *As long as the cause of the PROTECTION status remains.*
3) *When the STOP button remains pressed (including the STOP button of the remote control box).*
4) *When the START button remains pressed (including the START button of the remote control box).*
5) *When the test is terminated with a FAIL judgment, press the STOP button to reset the tester to the READY state. The same applies also when the tester is controlled remotely.*

6.3 Remote Control

WARNING!

The dangerous high voltage will be turned on/off remotely when the tester is in the remote control mode. Provide means to make sure that nobody will have the change to touch the DUT, test leads, probes, output terminals and their vicinities in the TEST state. If safety can't be assured, do not attempt to control the tester remotely.

The dangerous high voltage will be turned on/off remotely when the tester is in the remote control mode. Provide means to make sure that nobody will have the change to touch the DUT, test leads, probes, output terminals and their vicinities in the TEST state. If safety can't be assured, do not attempt to control the tester remotely.

6.3.1 Remote Control through the REMOTE Connector

The REMOTE connector is used to turn the high voltage ON/OFF according to the signals received from the optional remote control box (TH9000) or a high voltage test probe.

Control procedure:

1) Turn OFF the POWER switch.
2) Connect the optional device with a 5-pin DIN cable to the REMOTE connector on the front panel.
3) Turn ON the POWER switch. "REMOTE" message tells you that remote function is enabled. Now you can use the START or STOP button from the connected remote control device to start or stop a test. You can still stop a test by pressing the STOP button from the front panel, but you can't start a test by pressing the START button from the front panel in remote control mode.

Resume panel control procedure:

1) Turn OFF the POWER switch.
2) Remove the 5-pin DIN cable from the REMOTE connector on the front panel.
3) Turn ON the POWER switch. The "REMOTE" message disappears and the START key on the panel is enabled.

1) If you connect or remove the REMOTE connector while the POWER switch is turned ON, the tester will enter the PROTECTION state ("PROTECTION" is lit), and the high voltage output will be shut down. However, if the forced stop switch on the remote control box or HV test probe is ON, the tester will not enter the PROTECTION state when the plug is inserted or removed with the POWER on.

2) Do not remote-control the tester from both REMOTE CONTROL connector and SIGNAL I/O connector simultaneously.

3) If the FAIL MODE is selected, the FAIL and PROTECTION messages will not be remotely reset by applying a remote STOP signal. They must be reset with the STOP button on the front panel.

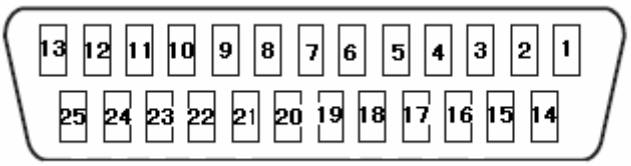
6.3.2 Remote Control through the SIGNAL I/O Connector

The 25-pin SIGNAL I/O connector has three functions as listed below.

1) Set the test modes, four test modes are available:
   - DOUBLE ACTIONS
   - PASS HOLD
   - MOMENTARY
   - FAIL-MODE
2) Turn ON/OFF the high voltage from a control device other than the optional remote control devices.
3) Output the tester status with different signals.

Specifications of the SIGNAL I/O signals

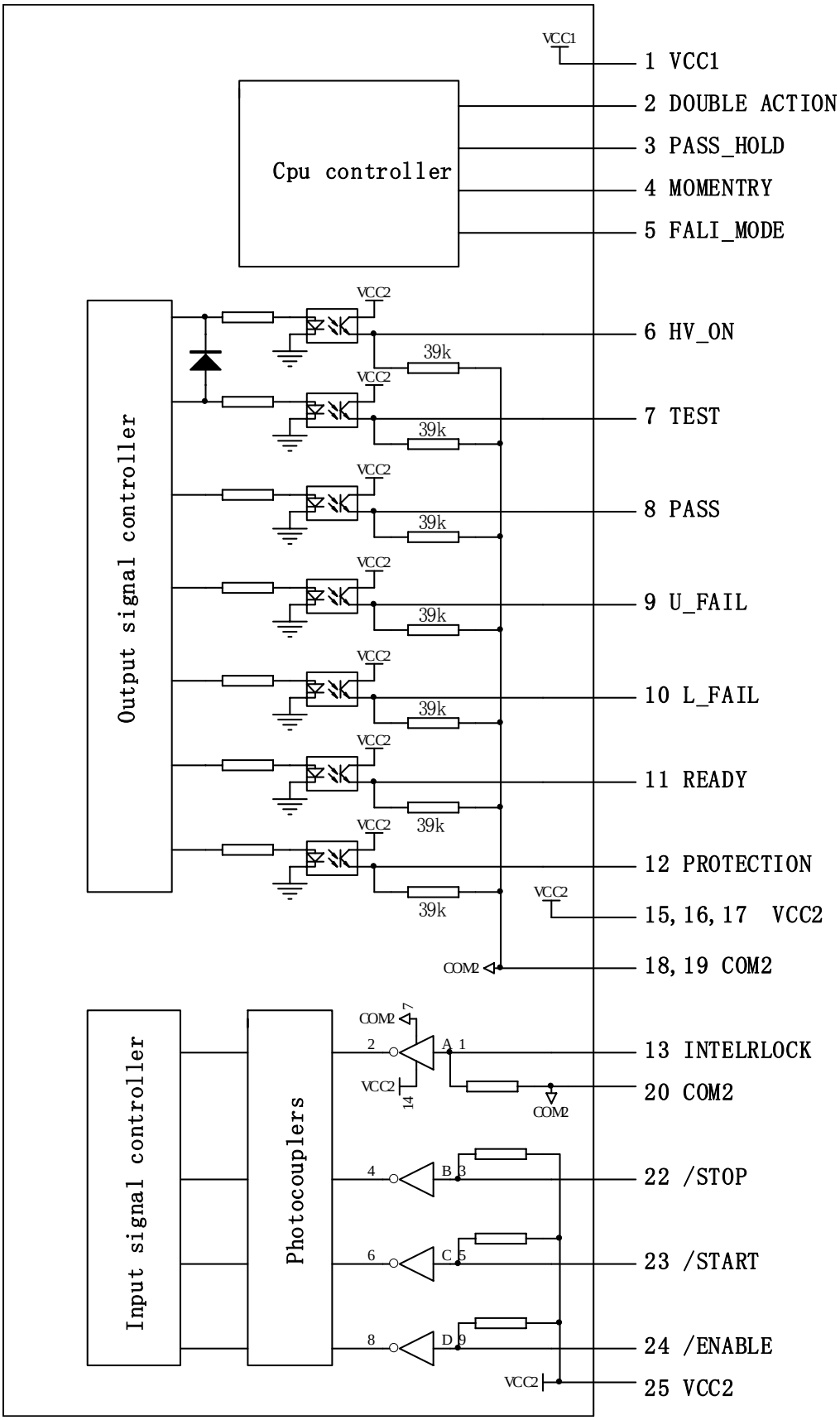
Item		Specifications
Input signals	High-level input voltage	7V to 15V
	Low-level input voltage	0V to 1V
	Input time width	Minimum 5 ms
Output signals	High-level output voltage	11V to 15V
	Low-level output voltage	0V to 1V
	Max. output current	5 mA per signal



SIGNAL I/O connector Pin layout

SIGNAL I/O pin assignments

Pin No.	SIGNAL	I/O	Output condition and signal description
1	VCC1	O	Internal +5V output
2	DOUBLE ACTION	I	DOUBLE ACTION function input pin
3	PASS HOLD	I	PASS HOLD function input pin
4	MOMENTARY	I	MOMENTARY function input pin
5	FAIL MODE	I	FAIL MODE function input pin
6	HV ON	O	Assert while high voltage is delivered.
7	TEST	O	Assert while the test is in progress
8	PASS	O	Assert for about 0.2 s when PASS is given. Assert continuously when PASS HOLD is enabled.
9	U-FAIL	O	Assert continuously when a current above the upper cutoff current is detected and a FAIL result is given.
10	L-FAIL	O	Assert continuously when a current below the lower cutoff current is detected and a FAIL result is given.
11	READY	O	Assert when tester is ready.
12	PROTECTION	O	Assert when the tester is in the PROTECTION state.
14	-	-	Not used
15,16,17	VCC2	O	Isolated output voltage ,+12V
18,19	COM2	O	Isolated common
13	INTERLOCK	I	Interlock signal input pin
21	-	-	Not used
20	COM2	O	Isolated common
21		-	Not used
22	/STOP	I	Stop signal input pin
23	/START	I	Start signal input pin
24	/ENABLE	I	Remote control enable signal input pin
25	VCC2	O	Isolated output voltage ,+12V



Schematic circuit diagram of the SIGNAL I/O Connector

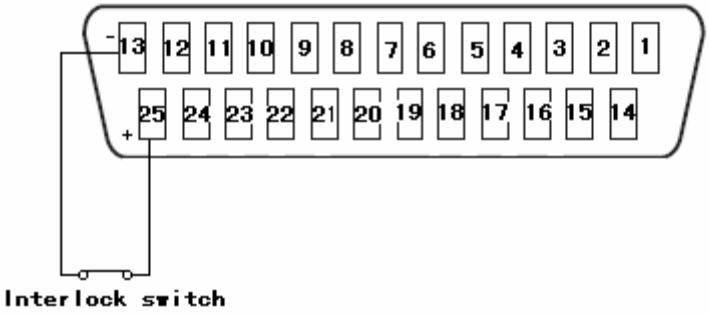
6.3.3 Interlock Function

The tester has an interlock function for safety purpose. When the interlock circuit is open circuit, the tester enters the PROTECTION state ("PROTECTION" message appears). In this PROTECTION state, the tester will cut off the high test voltage, and disable the local and remote START/STOP operation at the same time.

Using the interlock function

Pin 13 and Pin 25 of the SIGNAL I/O connector are the input pins for the interlock function. The interlock function is enabled when pin 13 and pin 25 is open; the interlock function is released when pin 13 and pin 25 is shorted. To clear the PROTECTION state caused by the interlock function, connect pin 13 and pin 25 and then press the STOP button or apply a remote-controlled STOP signal.

Reference circuit for interlock function



WARNING!

If you turn on the power of the tester without the 25-pin Amphenol plug accessory simply after taking the tester out of the package, the interlock function will be activated and the tester will not start operating.

A 25-pin Amphenol plug with pin 13 and pin 25 connected are supplied as an accessory to the tester. Use this plug only to release the protection temporarily. When the tester is actually installed, use the interlock function as much as possible to provide a safe working environment. When the withstanding voltage test is performed, here are some of the effective safety measures:

1) Provide a cover for the DUT to prevent electric shock.
2) Shut down the output voltage in synchronization with the opening of the cover.
3) Build a safety fence around the working area and shut down the output in synchronization with the door.

6.3.4 Start/Stop Control

Pins 22, 23, and 24 of the SIGNAL I/O connector are used to control start/ stop remotely.

Control procedure

1) Set the control enable signal (ENABLE) to low level by short pin 24(ENABLE) and pin 20(COM). This will disable the START button on the front panel. However, you can still stop the test by pressing STOP button on the panel or asserting the stop input signal (STOP).
2) Set the start signal (START) to low level by shorting the pin 23(START) to pin 20 (COM). This will start a test.
3) Set the stop signal (STOP) to low level by shorting the pin 22(STOP) to pin 20 (COM). This will stop the proceeding test.
4) Set the control enable signal (ENABLE) to high level by opening the pin 23(ENABLE) and pin 20(COM). The “REMOTE” message disappears, the START button on the front panel is enabled, and the start signal of the SIGNAL I/O connector is disabled.

[redacted]

1) Keep the control signal wires away from the HV test leads and DUT at least 500 mm. Never short the HV test lead to the signal wires. Doing so may damage the internal circuits of the tester permanently.

2) When the remote control enable signal (ENABLE) changes its state, the tester enters the PROTECTION state (“PROTECTION” is lit) at once. Press the STOP button or assert the stop signal to release the protection state.

3) Do not remote-control the tester simultaneously from both REMOTE CONTROL connector and SIGNAL I/O connector.

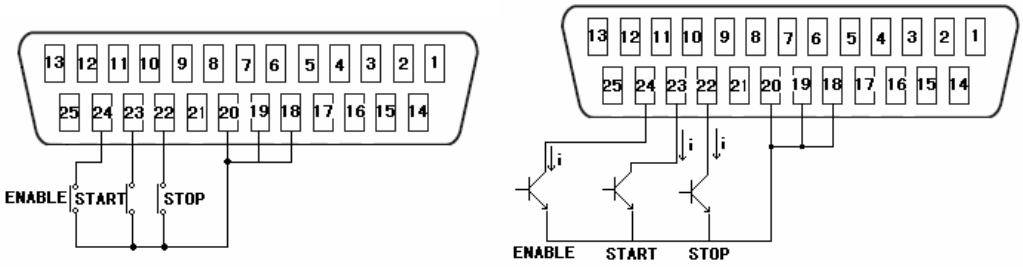
4) If the FAIL MODE is selected, the FAIL state and PROTECTION state cannot be remotely reset by asserting a remote STOP signal. You have to use the STOP button on the front panel.

5) The input pins are pulled up to +15 V by internal resistors. Open input pin means a high level signal.

6) The internal control circuit of the tester has been designed to resist noise interference from the tester itself and its peripheral devices. However, shielded wires are recommended to connect the pins of the SIGNAL I/O connector.

7) Use a shielded 25-pin Amphenol connector, shielded cables, and external circuits fixed with a shielded casing and connect the chassis of the tester to the shield. This will isolate the SIGNAL I/O circuits from the external environments and enhance the ability against noise.

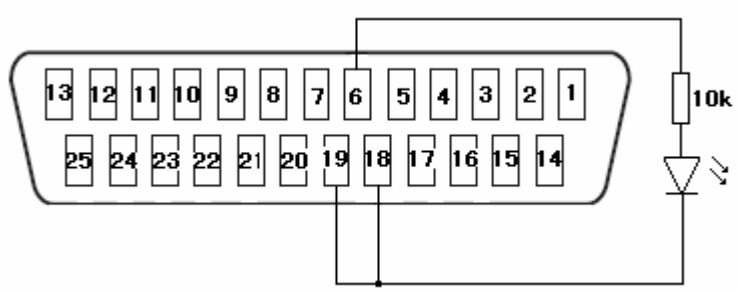
Reference start/stop circuit when contact devices or transistors are used.



6.3.5 Output Signal

The tester state can be output through pin 6 to pin 12 of the SIGNAL I/O connector. Construct the circuit by referring to the pin assignments given in Table-SIGNAL I/O pin assignments.

Reference circuit for signal output:



HV_ON signal output

[redacted]

1) *Keep the control signal wires away from the HV test leads and DUT at least 500 mm. Never short the HV test lead to the signal wires. Doing so may damage the internal circuits of the tester permanently.*
2) *The common lines of output signal circuit and input signal circuit of the SIGNAL I/O connector are connected.*
3) *When you drive an inductive load (such as a relay), make sure a diode in parallel with the coil of the load is connected.*
4) *The open-collector circuit elements and board can be damaged if the output circuit is shorted. It is recommended to use a fuse in the output circuit.*
5) *The internal control circuit of the tester has been designed to resist noise interference from the tester itself and its peripheral devices. However, shielded wires are recommended to connect the pins of the SIGNAL I/O connector.*
6) *Use a shielded 25-pin Amphenol connector, shielded cables, and external circuits fixed with a shielded casing and connect the chassis of the tester to the shield. This will isolate the SIGNAL I/O circuits from the external environments and enhance the ability against noise.*

6.4 Special Test Modes

The special TEST MODE can be set from pins 1 to 5 of the SIGNAL I/O connector. You may select two or more test modes in combination. The tester reads the test mode settings when POWER switch is turned ON. So, once you have changed the settings, remember to restart the tester again to enable the mode settings.

6.4.1 DOUBLE ACTION Test mode

Enable the DOUBLEACTION mode by shorting pin 2 to pin 1 (VCC1). In DOUBLEACTION mode, the tester will not be started unless you press the START button within approximately 0.5 seconds after STOP button is released. This function is useful to enhance the operation safety. This function is also applicable in the remote control mode.

6.4.2 PASS HOLD test mode

Enable PASS HOLD mode by shorting the pin 3 to pin 1 (VCC1). In PASS HOLD mode, the tester will not return to the READY state 0.2s after the PASS judgment is made. You need to press the STOP button or assert a remote STOP signal to clear the PASS message and return to READY state.

6.4.3 MOMENTARY test mode

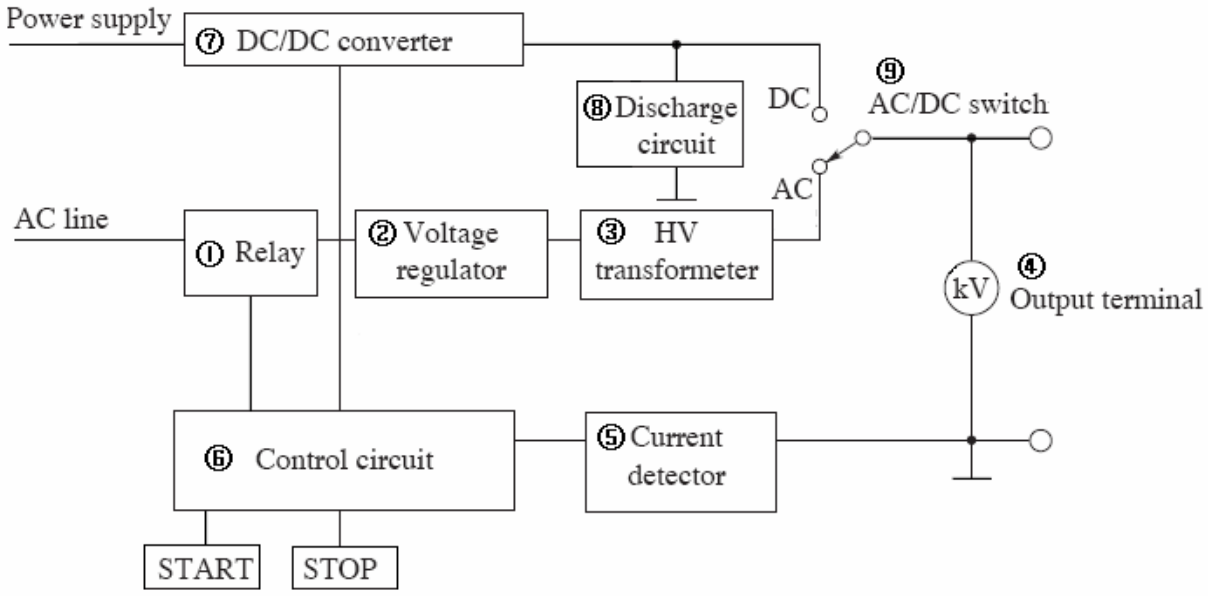
Enable MOMENTARY mode by shorting the pin 4 to pin 1 (VCC1). In MOMENTARY test mode, the test will be executed only when START button is holding down and the test will be terminated as soon as the START button is released. This function is helpful to enhance the test safety. This function is also applicable in the remote control mode.

6.4.4 FAIL MODE test mode

Enable FAIL MODE by shorting pin 5 to pin 1 (VCC1). In FAIL MODE, the tester will not be reset from the FAIL or PROTECTION state by a STOP signal applied from the remote control circuit. To reset the tester, you must press the STOP button on the front panel. You may use this function in order to reconfirm the FAIL or PROTECTION state when you are making tests with the optional HV test probe.

Chapter 7 Operating Theory

7.1 Block Diagrams



1. **Relay**
   The relay turns ON/OFF the line power supply of the voltage regulator used for AC withstanding voltage test. A solid-state zero-turn-on circuit is used to turn on/off the relay. This circuit minimizes the transient pulse voltage caused when the relay is turned on or off.
2. **Voltage regulator**
   An autotransformer is used to control the output voltage.
3. **High voltage transformer**
   The transformer with a ratio of 1:12.5 or 1:25 transfers the regulator voltage to the high output voltage: 0 kV to 2.5 kV or 0 kV to 5 kV.
4. **Voltmeter**
   The voltmeter indicates the output voltage.
5. **Current detector**
   The current detector measures the leakage current. It consists of an absolute-value circuit, current detecting resistors, and an integrating circuit.
6. **Control circuit**
   The circuit controls whole operation of the tester, including voltage measurement, current measurement, pass/fail judgment, test time management, and test sequence control.
7. **DC/DC converter**
   The converter provides a stable high voltage for the DC test mode. The test voltage is positive. Its rating is 5 kV, 10 mA when the AC line voltage is at its nominal level.
8. **Discharge circuit**
   In the DC test mode, the test leads, probe, DUT and other items connected to the output circuit can be charged up to the high DC test voltage. Even after the test is over and the test voltage is cut off, these

items can remain in the charged state for a period of time. The discharge circuit is used to rapidly discharge the charges stored in these items. The circuit consists of a high voltage relay and a discharge resistor. The discharge resistance is 125 kΩ. When the output voltage is cut off, the discharge circuit will automatically discharge the internal output circuit of the tester, test leads, probe, and DUT.

9. AC/DC switching circuit

This circuit is used to switch between AC and DC test voltage. The circuit includes two high voltage relays and a control circuit.

7.2 Zero-turn-on Switch

If a relay with normal mechanical contacts is used to turn on/off the primary high voltage transformer, a high transient impulse voltage may be produced. This high transient impulse voltage will be applied to the DUT and a good DUT may be misjudged or damaged. The zero-turn-on switch, which employs a solid-state switching circuit, turns on and off the power line at approximately 0 volt level, thereby reducing transient overshoots effectively.

7.3 Delay Time for Pass/Fail Judgment in DC Mode

When a DUT with larger capacitance is tested, the DUT will draw a larger charge current at the beginning. In order to avoid the influence of the charge current, the pass/fail judgment will be made after approximately 0.3 second.

7.4 Automatic Discharge Function

In the DC test mode, the test leads, probe, DUT and other items connected to the output circuit can be charged up to the high DC test voltage. Even after the test is over and the test voltage is cut off, these items can remain in the charged state for a period of time. The discharge circuit is used to rapidly discharge the charges stored in these items. When the output voltage is cut off, the discharge circuit will automatically discharge the internal output circuit of the tester, test leads, probe, and DUT.

Chapter 8 RS-232C Interface

8.1 Connecting the Cable

1) Turn OFF the tester and the device to be connected.
2) Connect a RS-232C cable to the 9-pin RS-232C interface on the rear panel.

8.2 RS-232C Specifications

Item	Specifications
Transmission mode	Start-stop synchronization, half-duplex
Baud rate	9600 bps
Data bits	8 bits
Handshaking	None
Stop bits	1 bit
Parity	None
Terminal character	When sending: CR+LF When receiving: CR, LF, or CR+LF

8.3 Communication Method

1) The tester receives the commands from the PC and replies for inquiries.
2) One response is always replied for one inquiry. Commands cannot be sent continuously. Confirm the response before sending the next command.

8.4 Talk Mode

8.4.1 Description of the talk modes

Mode	Description	
0	The tester responds only when a command is received (default setting).	
1	The tester sends the test state automatically once a test is started or finished.	
	Start response	<START>
	End response	<PROTECT>, <PASS>, <U_FAIL>, <L_FAIL>, or <STOP>
2	The tester sends the tester state, preset settings and measurement results automatically once a test is started or finished.	
	Start response	a) Upper cutoff current and Lower cutoff current (only when LOWER ON is on.). b) Preset test time (only when timer is on.) c) <START>AC or <START>DC
	End response	a) Max. measured voltage b) Max. measured current, c) Actual test time d) <PROTECT>, <PASS>, <U_FAIL>, <L_FAIL>, or <STOP>
3	The operation is the same as talk mode 2, except an LF terminal code is inserted between tests.	

8.4.2 Examples for different talk modes

Step	Talk mode1	Talk mode 2	Talk mode 3
Start of test 1	<START>	8.0mA,2.5s<START>AC	8.0mA,2.5s<START>AC
End of test 1	<PASS>	930V,0.3mA,2.5s<PASS>	930V,0.3mA,2.5s<PASS>+LF
Start of test 2	<START>	8.0mA,2.5s<START>AC	8.0mA,2.5s<START>AC
End of test 2	<U_FAIL>	930V,10.0mA,0.5s<U_FAIL>	930V,10.0mA,0.5s<U_FAIL>+LF
…	…	…	…

8.4.3 Setup the talk mode from the front panel

Perform following steps to setup the talk mode:

1) Turn off the POWER switch.
2) Turn on the POWER switch while holding down the special key for different talk mode.

Talk mode	Special key
0	None
1	Cutoff current ▼ key
2	Cutoff current ▲ key
3	Cutoff current UP/LOW key

3) Release the special key and the POWER switch. Current talk mode number will be displayed for

several seconds in the voltage range area.

4) Check and make sure that the talk mode number displayed is what you need.

8.5 Before operating the RS-232C

8.5.1 When the tester is set to special test modes

When DOUBLE ACTION or MOMENTARY test mode is selected, the tester will not start even when a START command is received. Turn off the DOUBLE ACTION or MOMENTARY test mode first.

8.5.2 Releasing the PROTECTION state

The PROTECTION state cannot be released with the STOP command. Refer to section 5.3.3 for how to release the PROTECTION state.

8.5.3 Test start operation and REMOTE message

No.	Combination of remote control sources			Start function		REMOTE message
	REMOTE connector	SIGNAL I/O connector	RS-232C REMOTE	START Button	Enabled remote source	
1	Disconnected	Disconnected	Disconnected	Enabled	None	OFF
2	Connected	Disconnected	Disconnected	Disabled	REMOTE connector	ON
3	Disconnected	Connected	Disconnected	Disabled	SIGNAL I/O connector	ON
4	Disconnected	Disconnected	Connected	Disabled	RS-232C REMOTE	ON
5	Connected	Connected	Disconnected	Disabled	REMOTE connector and SIGNAL I/O connector	ON
6	Disconnected	Connected	Connected	Disabled	SIGNAL I/O connector	ON
7	Connected	Disconnected	Connected	Disabled	REMOTE connector	ON
8	Connected	Connected	Connected	Disabled	REMOTE connector and SIGNAL I/O connector	ON

8.6 Command and response reference

This section describes all the commands and responses.

- Uppercase or lowercase is ignored in commands. Responses will be returned in uppercase.
- The response for command error is ERROR.
- The command inside the parentheses is the abbreviation.

8.6.1 *IDN?

This query returns the information of manufacturer, model name and ROM version of the tester.

Response example:

TONGHUI (CHANGZHOU) ELECTRONIC CO., LTD, TH5201, 1.00

8.6.2 *RST

This command resets only the talk mode of RS232C interface to mode 0. This command will not

change the preset parameters or test conditions.

Response:

OK

8.6.3 STATUS? (STAT?)

This query returns the tester's state.

Possible responses:

PROTECTION	When the tester is in the PROTECTION state and PROTECTION lights.
TEST	When the tester is in the TEST state and TEST message lights.
READY	When the tester is in the TEST state and TEST message lights.
PASS	When a PASS result is given after a test and PASS message lights.
U_FAIL	When the upper limit is defeated in a test and UPPER FAIL message lights.
L_FAIL	When the lower limit is defeated in a test and LOWER FAIL message lights.
ELSE	When the tester is in a state other than above states listed.

8.6.4 MODE?

This query returns the timer ON/OFF state, the lower cutoff current ON/OFF state, the voltage mode, and the voltage range.

Response examples:

TIMEON, LOWEON, VOLTAC, RANG2.5

TIMEOFF, LOWEOFF, VOLTDC, RANG5.0

8.6.5 MEASURE? (MEAS?)

This query returns the measured results and state of the tester.

Response when test is in process:

The query returns the measured voltage, current and actual elapsed test time regardless of timer's on/off state.

Response when test is not in process:

The tester returns the measured results of the latest test including the maximum measured voltage, maximum measured current, actual elapsed test time regardless of timer's on/off state, and one of the following states:

PROTECT	When the tester is in the PROTECTION state.
PASS	When the judgment result is PASS.
U_FAIL	When the judgment result is U_FAIL.
L_FAIL	When the judgment result is L_FAIL.
STOP	When the latest test is terminated by pressing STOP key.
P_ON	When no test has been finished after power on.

8.6.6 TMODE (TMOD)

This command sets the talk mode of RS232C interface.

Command syntax:

TMODE0	sets the talk mode to mode 0.
TMODE1	sets the talk mode to mode 1.
TMODE2	sets the talk mode to mode 2
TMODE3	sets the talk mode to mode 3.

Response:

OK

8.6.7 TMODE? (TMOD?)

This query returns the talk mode setting.

Responses for different talk modes:

TMODE0 When current talk mode is Mode 0.

TMODE1 When current talk mode is Mode 1.

TMODE2 When current talk mode is Mode 2.

TMODE3 When current talk mode is Mode 3.

8.6.8 REMOTE

This command enables the START command through the RS-232C (RS-232C REMOTE mode). The "REMOTE" message will be displayed on the screen.

Response:

OK

8.6.9 LOCAL

This command disables the START command through the RS-232C(RS-232C LOCAL mode). The "REMOTE" message on the screen turns OFF.

Response:

OK

8.6.10 START

This command initiates a test.

Response:

OK When the START command is accepted when the tester is in RS-232C REMOTE mode.

ERROR When the START command is defeated when the tester is in RS-232C LOCAL mode.

8.6.11 STOP

This command stops the current test.

Response:

OK

Chapter 9 Maintenance

9.1 Instruction for Cleaning

To prevent electrical shock, disconnect the power cable from the receptacle before cleaning. Use a dry cloth or a cloth slightly dipped in water to clean the casing. Don't attempt to clean the tester internally.

9.2 Inspection

1) **AC Power Cable**
   Check for possible tears of the cable coating, looseness and fracture of the plug and breakage of the cable.
2) **HV Test Leads**
   Check the lead for possible tears and breakage.

WARNING!

Tears and breakage of the power cable or HV test lead may lead to electric shock and fire. In such case, stop using the tester immediately.

9.3 Maintenance

WARNING!

To replace the broken components, you need to move the cover of the tester. Component replacement must be made by qualified maintenance personnel.

1) **High voltage relay**
   The high voltage relay of the internal discharge circuit is a consumable component. The life expectancy of the high voltage relay is around 200,000 times.
2) **Cooling fan**(TH5201 only)
   The cooling fan is also a consumable component. The life expectancy of the cooling fan is around 30000 hours.

9.4 Calibration

Periodic calibration is needed to ensure the measurement accuracy and optimum operation. How often you calibrate the tester depends on the operating and environmental conditions.

WARNING!

The tester delivers a dangerous high voltage up to 5kV. Don't try to calibrate the tester by yourself.

Please contact us or qualified agency.

Chapter 10 SPECIFICATIONS

10.1 Basic Performance

Item		TH5201	TH5201A
Output voltage		AC/DC: 0kV to 2.5kV / 0kV to 5kV	AC: 0kV to 2.5kV / 0kV to 5kV
AC	Output rating	TH5201/TH5201A: 500VA/5kV, 100mA	
	Waveform	AC line voltage waveform	
	Voltage regulation	≤15% from rated load to empty load	
	Switching	Zero crossing start switch	
DC	Output rating	50W/5kV, 10mA	---
	Ripple	At 5kV, empty load: 50 Vp-p typical	---
		At 5kV, rated load: 100Vp-p typical	---
	Voltage regulation	≤3% from rated load to empty load	---
Analog Voltmeter	Scale	5kV	
	Class	2.5	
	Accuracy	±5% of full scale	
Digital Voltmeter	Scale	5kV	
	Accuracy	±1.5% of full scale	
	AC response	rms value display, 600 ms response time	
Ammeter	Accuracy	±(5%×upper cutoff current+20uA)	
	AC response	rms value display, 450 ms response time	

10.2 Interface and Other Functions

Item	TH5201/TH5201A	
REMOTE Connector	REMOTE connector (5-pin, on the front panel)	To control the tester from an optional remote control box TH9000 or a high voltage test probe.
SIGNAL I/O Connector	SIGNAL I/O connector (25-pin, on the rear panel)	Setup the special test modes: DOUBLE-ACTION, PASS-HOLD, MONENTARY, and FAIL-MODE.
		Output the state signals: HV-ON, TEST, PASS, U-FAIL, L-FAIL, READY and PROTECTION.
		Remote control the tester with control signals: STOP, START, and ENABLE.
RS-232C Interface	9-pin connector on the rear panel (conforms to EIA-232-D)	
	Transmission mode	Start /Stop synchronization, half-duplex
	Baud rate	9600 bps
	Data bits	8 bits
	Stop bits	1 bit
	Parity bits	None

10.3 General Specifications

Item	TH5201/TH5201A
Operating environment	0℃ to 40℃, ≤80% RH
Storage environment	-20℃ to 70℃, ≤90% RH
AC line power	110V±10%; 50/60Hz
Insulation resistance	≥30MΩ under 500VDC
Withstanding voltage	1500VAC(1s),between AC line and chassis
Earth continuity	≤0.1Ω at 25A AC
Dimensions	320 (W) × 132 (H) × 300 (D) mm
Weight	Approx. 14kg

10.4 Accessories

Item	Quantity	Remarks
Power cord	1	5 kV, 1.5m
High voltage test leads	1 set	
25-pin Amphenol plug	1	Assembly type
Operation manual	1	