OPERATION MANUAL

WITHSTANDING VOLTAGE
AND INSULATION TESTER
MODEL 871

Second Edition

WARNINGS against HIGH VOLTAGE
o *This tester generates high voltage.* o *Any incorrect handling may cause death.* o *Read Section 3 "WARNINGS" in this manual to prevent accident.* o *This manual should be placed within the reach of the operator so that he may read it whenever necessary.*

KIKUSUI ELECTRONICS CORPORATION

— To supervisor in charge of operation —

(1) If the operator does not read the language used in this manual, translate the manual into appropriate language.

(2) Help the operator in understanding this manual before operation.

(3) Keep this manual near the tester for easy access of the operator.

— Receiving inspection —

Prior to the shipment from our factory, the tester has been subjected to electric- and mechanical-testing and guaranteed of satisfactory quality and performance. Nevertheless, you are kindly requested to make an acceptance inspection to see if the tester has any in-transit damage. Should there be any, please inform our local dealer of such a damage.

— For your own safety (How to avoid electrification) —

(1) While the tester is generating the output, do not touch the following areas, or else, you will be electrified, and run the risk of death by electric shock.

- *the output terminal*
- *the test lead-wire connected to the output terminal*
- *the Device Under Test (D.U.T.)*
- *any part of the tester, which is electrically connected to the output terminal, and*
- *the same part as above immediately after the output has been cut off. (in case of insulation resistance test)*

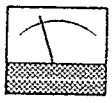
(2) Also, electric shock or accident may arise in the following cases:

- *the tester being operated without grounding.*
- *if the gloves for electrical job are not used.*
- *approach to any part connected to the output terminal while the power of the tester is turned on.*
- *the same action as above immediately after the power of tester has been turned off. (in case of insulation resistance test)*

ATTENTION

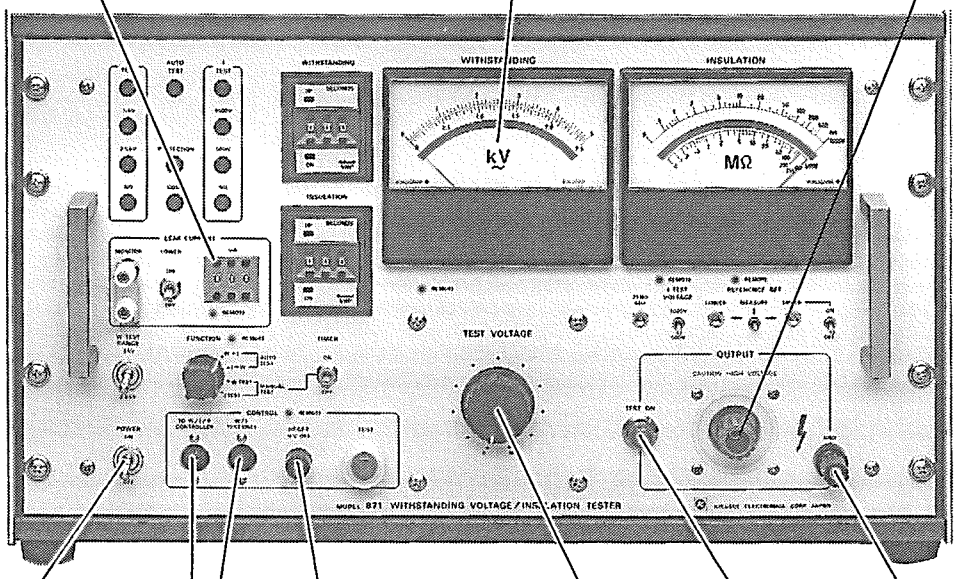
Pay attention to the following instructions and those warnings given in the Section 3 "WARNINGS" as well.

Before changing the value on the LEAK CURRENT switch, pay good attention to the setting on the peripheral device.



Swinging of the indicator means "high voltage warning"

High-voltage output terminal dangerous



Turn on the POWER switch while the TEST VOLTAGE dial is at "0" position.

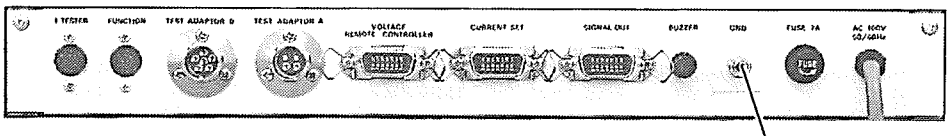
Be sure to push the RESET button before changing the test condition.

TEST VOLTAGE dial should be at "0" position except during the testing.

Connect with the lead wire on GND side.

Read Instruction Manual Page 38 before remote operation.

If the lamp comes on, it warns "high voltage"



The rear-side of the tester casing and the protective grounding terminal shall be connected to the earth, using the applicable tool.

On Power Supply Source, it is requested to replace the related places in the instruction manual with the following items.

(Please apply the item of ✓ mark.)

☐ Power Supply Voltage: to _ _ _ _ _ V AC

☐ Line Fuse: to _ _ _ _ _ A

☐ Power Cable: to 3-core cable (See Fig. 1 for the colors.)

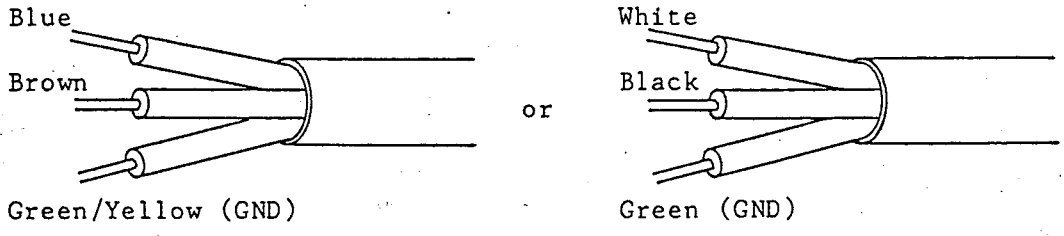


Fig. 1

Please be advised beforehand that the above matter may cause some alteration against explanation or circuit diagram in the instruction manual.

* AC Plug: In case of Line Voltage 125V AC or more, AC Plug is in principle taken off and delivered, in view of the safety.
(AC Plug on 3-core cable is taken off in regardless of input voltages.)

Before using the instrument, it is requested to fix a suitable plug for the voltage used.

TABLE OF CONTENTS

1. OUTLINE OF THE 871 SYSTEM

The 871 System is compriesd of instruments and devices as shown in Figure 1.1 and is able to perform very efficiently the three types of tests, namely, withstanding voltage test, insulation resistance test, and low resistance test.

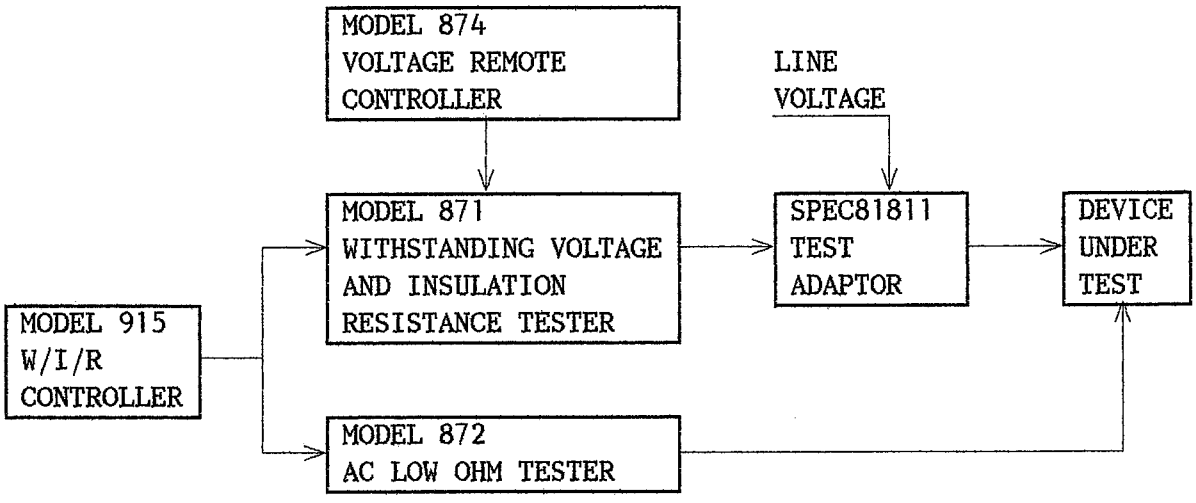


Figure 1.1 A Full Line Up of the 871 System

Advantageous features of the 871 System are as follows:

- ☐ A combination of Model 871 W/I Tester, Model 872 AC Low Ohm Tester and Model 915 W/I/R Controller allows efficient and automatic tests of withstanding voltage, insulation resistance, and low resistance.

- ☐ The SPEC81811 Test Adaptor allows automatic switchover between the AC line voltage and the test voltage to be applied to the device under test.

- ☐ Model 874 Voltage Remote Controller allows accurate remote control of the test voltage and presetting of up to four channels of test voltages.

- ☐ The 871 System provides the various remote control functions, allowing sequence control of withstanding voltage and insulation resistance tests, thereby greatly contributing to test labor economization.
  (Specific sequence controllers are available from Kikusui. Please consult your Kikusui agent.)

Model 871 W/I Tester plays a nucleus role in the 871 System. The 871 Tester is able to carry out both withstanding voltage test and insulation resistance test within a single continuous test cycle.

As a withstanding voltage tester, the 871 Tester is capable of providing an output voltage of up to 5 kV with output wattage 500 VA. This capability is sufficient for test complying with UL, CSA, and BS, as well as with JIS (Japanese Industrial Standard) and Japanese Electric Appliance Control Ordinance.
As an insulation resistance tester, the 871 Tester has two ranges, namely, 500V/250MΩ range and 1000V/500MΩ range.

The 871 Tester is able to make a GO/NOGO judgement for both withstanding voltage test and insulation resistance test. Operating as an withstanding voltage tester, the 871 Tester can make a NOGO judgement when the detected leakage current is larger than a preset GO/NOGO judgement reference value and also when it is smaller than one-tenth of the reference value. When operating as an insulation reference tester, the 871 Tester allows to preset both high and low limit reference values rendering a feature of window comparator which can, to a certain level, contribute for discrimination of test setup failures (such as open test leadwires or imperfect contacting of test leadwires).

Many of the functions of the 871 Tester can be remote-controlled.
Moreover, the 871 Tester is incorporated with the various features which greatly facilitates automatic tests. Thus, the 871 Tester can realize a substantial test labor economization.

Although many safety features are incorporated in the 871 Tester, a deadly accident may occur when the operator touches the device under test (D.U.T) or the probe.

Safety guards around D.U.T. should be considered for safe operation.
Also, other precaution, which deemed necessary for the tester and the devices, shall be maintained under positive control.

2. SPECIFICATIONS

☐ Withstanding Voltage Tester

Test Voltage

Applied voltage:	0 - 2.5 kV AC and 0 - 5 kV AC (two ranges)
Wattage rating:	500 VA (5 kV, 100mA, 30 minutes continuous operation, with 100 V line voltage)
Waveform:	AC line waveform
Voltage regulation:	Better than 20% (for maximum rated load to no load, with 100 V line voltage, at 5 kV output)
Switching:	With zero-start type switch

Output Voltmeter

Scales:	2.5 kV FS and 5 kV FS, two ranges linear scales
Class of meter:	JIS Class 1
Accuracy:	±3% FS or better
Indication:	Mean-value response, effective-value scale graduation

Judgement of Test Result (GO-NOGO judgement. Output cutoff by leakage current detection)

Judgement:

- o Window comparator system
- o NG judgement when leakage current larger than high limit reference value is detected.
- o NG judgement also when leakage current smaller than 1/10 of the set value is detected.

- When NG judgement is made, output is cutoff and NG alarm is generated.

Limit current reference value: (LEAK CURRENT) — 1 - 100 mA can be covered with digital switch

Accuracy of judgement:

- ±5% of high limit reference value
- ±(20% + 20 μA) of low limit reference value (1/10 set value).

Detection method: — Absolute value of leakage current is integrated, compared with the limit reference value, and calibrated in terms of rms value of sine wave.

(Note) When making an NG judgement test with the output terminals shorted, a certain level of no-load output voltage is needed due to the internal resistance of the output circuit.
For output terminal shorting at 100 mA range, an output voltage of 800 V or over is required.

Test time: — 1 - 999 seconds (with digital timer)
For SINGLE test, a TIMER-OFF switch is provided

Terminals: — Terminals for monitoring of leakage current

(Note) When an AC voltage is applied to a capacitive load, the output voltage may become higher than that when in no load due to the capacitance component of load. Especially when the load (specimen) is of a voltage-dependent capacitance type (such as ceramic capacitors), the voltage waveform may be distorted.

□ Insulation Resistance Tester

Measuring Voltages: 500 V and 1000 V (two ranges), DC, negative polarity

Effective Measuring Ranges

500 V range: 0.2 to 250 MΩ

1000 V range: 0.5 to 500 MΩ

Values at Center of Scale

500 V range: 5 MΩ

1000 V range: 10 MΩ

Accuracy

1st effective measuring range: ±5% of the indicated value

2nd effective measuring range: ±10% of the indicated value

Note 1: At 25°C ± 10°C

Note 2: The 1st effective measuring range is from 1/1000 to 1/2 of the maximum effective scale value. The 2nd effective measuring range is from the above to the maximum effective scale value.

Measuring terminal voltage

When output terminals are open: +5%, -0% of rated measuring voltage

When at center of scale: 95% or more of rated measuring voltage

Judgement of Test Result (GO-NOGO judgement)

Judgement:

- Window comparator system (mutually independent settings of high limit and low limit)
- NG judgement when measured resistance is smaller than the low limit reference value.
- NG judgement when measured resistance is larger than the high limit reference value.
- When NG judgement is made, output is cut-off and NG alarm is generated.

Limit reference value setting range: Low and high limit reference values can be set at any points whthin the effective measuring range of the Tester.

Accuracy of judgement

1st effective measuring range: ±10% of set value

2nd effective measuring range: ±15% of set value

Note: At 25°C ± 10°C

Waiting-time for judgement: Approx. 0.3 sec

Test Time: 1 - 999 seconds (with digital timer)
For SINGLE test, a TIMER-OFF switch is provided.

☐ Overall Specifications

Types of Tests

AUTO test: Both withstanding voltage test and insulation resistance test are automatically executed as preset on front panel of tester.

SINGLE test: Either withstanding voltage test or insulation resistance test as selected is executed mutually independently.

Remote-controllable Items

(1) Test/Reset function

(2) Setting and execution of SINGLE test (withstanding voltage test or insulation resistance test)

(3) Setting of output voltage for withstanding voltage test when Model 874 Voltage Remote Controller (optional) is used in conjunction

(4) Setting of reference leak current for withstanding voltage test, with BCD codes

(5) Selecting an insulation resistance test voltage (500 V or 1000 V)

(6) Setting of GO-NOGO judgement reference value for insulation resistance test, with external DC voltage signal. (For the voltage signal, the tester provides a supply voltage of approximately -15 V.)

Note 1: To accomplish the remote control operation for items (1), (2), (4) or (5), the corresponding pin of the remote control connector must be driven to the LOW ACTIVE status in one of the following methods:

- By connecting the corresponding pin to the common line with a make-contact (such as of a relay or a switch)

- By connecting the corresponding pin to the common line with a logic circuit.

The conditions of input for the equipment are as follows:

HI level input voltage: 11 - 15 V
LO level input voltage: 0 - 4 V
LO level sweep out current: 1 mA or less

Note 2: When the function of (2) is used, the SPEC 81811 Test Adaptor and Model 915 W/I/R Controller cannot be used.

Output Signals

TEST ON signal:	Delivered during entire test-on period. Make-contact signal and lamp (Note ①)
GOOD signal:	Delivered when GOOD judgement is made, for approximately 50 msec. Make-contact signal, lamp and buzzer (Notes ①, ②)
W/NG alarm:	Delivered continuously when NG judgement of withstanding voltage test is made. Make-contact signal, lamp and buzzer (Notes ①, ②)
I/NG alarm:	Delivered continuously when NG judgement of insulation resistance test is made. Make-contact signal, lamp and buzzer (Notes ①, ②)
Leak current value of withstanding voltage testing:	Delivered during W test-on period. (Note ③)
Insulation resistance value of Insulation resistance testing:	Delivered during I test-on period. (Note ④)

Notes: ① The rating of the contact is 100 V AC, 1 A, or 30 V DC, 1 A.

② Loudness of the buzzer is adjustable with a knob in common for the GOOD signal and NG alarm.

③ This signal is a DC voltage signal which represents the mean value of the leak current. The scale of the signal differs depending on whether the leak current detect reference value is set at not greater than 10 mA or it is set at not less than 11 mA as follows:

When reference is 0 - 10 mA: Scale is 10 V/10 mA.

When reference is 11 - 100 mA: Scale is 10 V/100 mA.

④ This signal is a DC voltage signal which represents the reading of the ohmmeter on the front panel of the tester. The scale of the signal is 10 V/0 Ω.

The accuracies of the above-mentioned DC voltage signals are 5% of reading or 50 mV, whichever larger.

Ambient Temperature and Humidity

Specification range:	5 to 35°C, 20 to 80% RH
Operable range:	0 to 40°C, 20 to 80% RH

Power Requirements

Line voltage:	100 V ±10%, 50/60 Hz AC (This model can correspond to nominal voltages 110V, 115V, 120V, 220V, 230V and 240V respectively, subject to prior modification.)

Power consumption

When no load (RESET state):	Approx. 10 VA
When with rated load: (5 kV, 100 mA)	Approx. 620 VA
Insulation resistance:	30 MΩ or more, with 500 V DC
Withstanding voltage:	1000 V AC, 1 minute

Dimensions:	497 W × 280 H × 370 D mm
Including extrusions:	500 W × 295 H × 410 D mm
Weight:	Approx. 33 kg (Approx. 4kg increase when in line voltage modified)
Accessories:	○ HTL-1.5W High Voltage Test Leadwires, 1 set ○ 5p DIN cable, 1 ○ 8p DIN cable, 2 ○ 14P Amphenol plug, 1 ○ Operation manual, 1 copy
Options:	○ Model 872 AC Low Ohm Tester ○ Model 915 W/I/R Controller ○ Model 874 Voltage Remote Controller ○ SPEC 81811 Test Adaptor ○ Model 913A Remote Control Box ○ Model 914A Remote Control Box ○ HTP-1.5A High Voltage Test Probe ○ HTL-3W High Voltage Test Leadwires, ○ Model 9202 Warning Light Unit ○ Model 9203 Buzzer Unit

3. WARNINGS

The tester supplies high voltage up to 5kV to the outside connection. Thus any incorrect handling of the tester may bring the risk of death to the operator. For safe operation of the tester, strictly observe the following instructions.

1. Electrification

Be sure to wear a pair of rubber gloves for electrical job, before operating the tester, to prevent electric shock.

2. Grounding:

The protective grounding terminal, on the rear of the tester casing, shall be positively grounded using the applicable tool.

If not properly grounded, the casing of this tester is charged with high voltage when the power is short-circuited to the ground or conveyer or any devices connected to the ground or to the commercial power line (Note i). It is very risky that anyone who touches the casing under such a condition will be subject electric shock.

(Note i) Generally a commercial power line means a line leading to the AC cord socket of the tester, from which the rated power is supplied into the tester.

This manual also covers the power supply line from a private power generator.

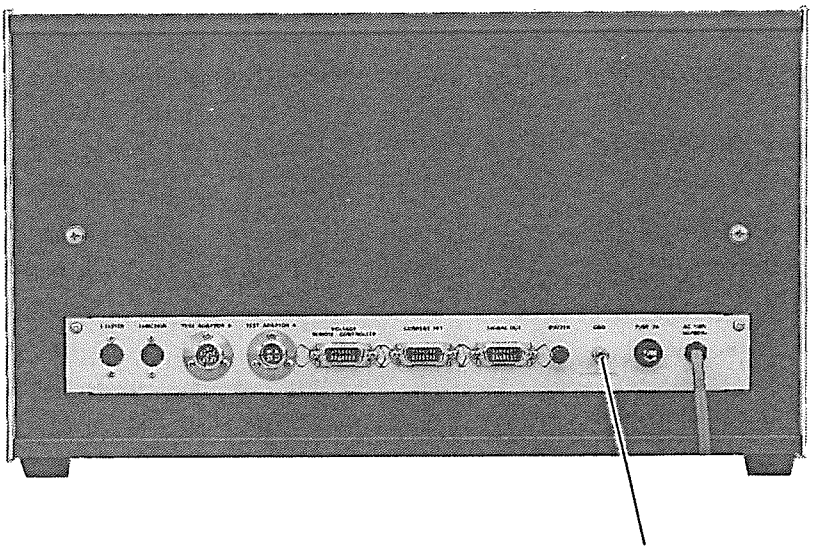


Figure 3.1 Rear of Casing, Model 871 Protective grounding terminal

3. Connecting of test lead-wire on GND side:

Figure 3.2 shows the connection of the test lead-wire on GND side. Every time the tester is used, check if the lead wire is not damaged or disconnected.
The lead-wire connection to the D.U.T. shall be made from GND side. If the connection is incomplete, it is hazardous that the entire D.U.T. may be charged with high voltage.

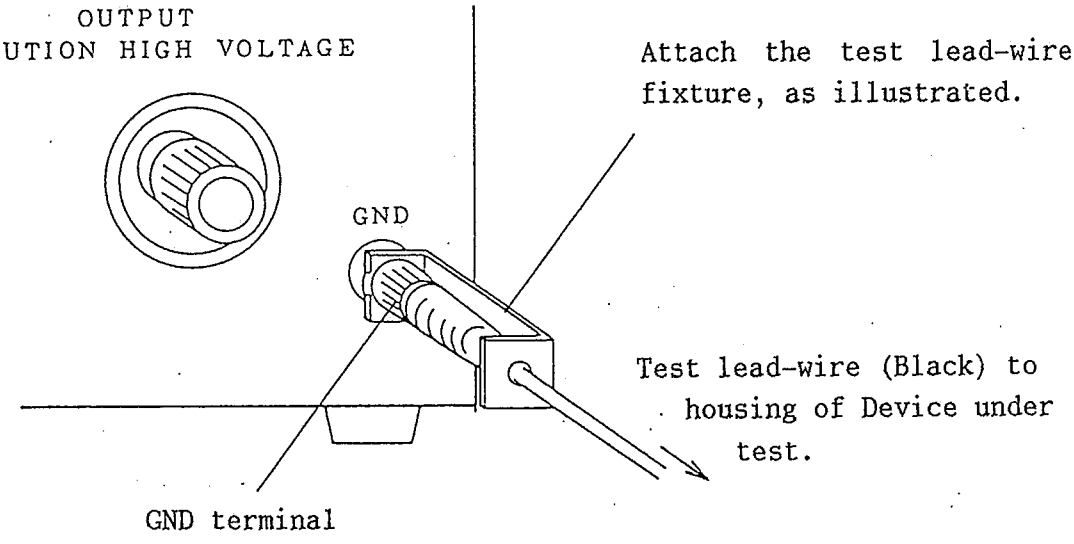


Figure 3.2

4. Connection of test lead-wire on high-voltage output side:

After connecting the lead-wire on GND side, take the following procedure.

- Push the RESET button.
- Confirm if the indicator of the output voltmeter is at "0".
- Confirm if the TEST ON lamp has been off.
- Short the high-voltage output terminal with the GND test lead-wire once, and confirm that no high voltage is output.
- Connect the high-voltage test lead-wire with the high-voltage output terminal.
- Lastly, connect the GND test lead-wire and then the high-voltage output test lead-wire to the D.U.T.

5. Power source switch:

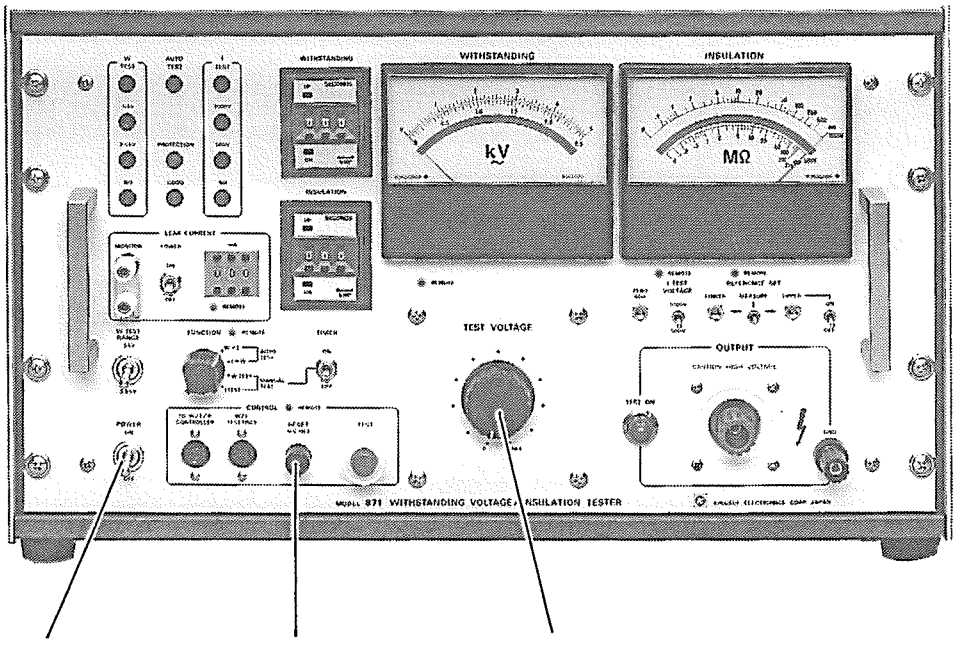
The power switch shall be turned on after confirming that the TEST VOLTAGE dial has been turned to the extreme left ("0" position).

6. Change of test condition:

Change-over of the switches on the panel shall be made after confirming that the RESET button has been pushed in and that the TEST VOLTAGE dial has been turned to the extreme left ("0" position).

7. Suspension of testing:

Except under testing, the TEST VOLTAGE dial shall be turned to the extreme left("0" position).
Also, push the RESET button (H.V OFF) to ensure safety.
The Power switch shall be turned off if the tester is not used for some time or the operator is to leave from the tester.



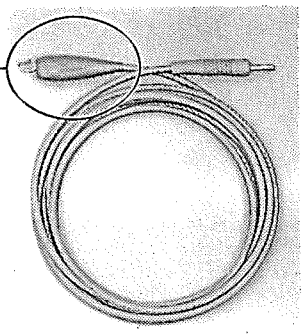
Power switch | RESET button (H.V OFF) | TEST VOLTAGE dial

Figure 3.3

8. Critical areas of the tester under operation:

It is dangerous to touch such high voltage areas as the D.U.T., and the test lead-wide, probe and output terminal while the tester is under operation.

Never touch this area!



NEVER touch the alligator of the test lead-wire and the vinyl-cover of the clip because they are NOT insulation proof.

Figure 3.4

— Warning after the output has been cut off —

9. Confirmation on completion of testing:

You may touch the D.U.T. and the high-voltage areas (test lead-wire, probe or output terminal) for correction of the wiring or any other purpose provided that the following confirmation has been made;
- the indication of output voltage is at "0", and
- the TEST ON lamp has been turned off.

In the case of insulation resistance test, D.U.T. is charged after testing. Therefore, a paticular attention must be paid to the succeeding paragraphs, 4-10 and 4-11.

— Cautions in electric charging in insulation resistance test —

10. Electric charging:

In case of insulation resistanse test, the D.U.T. and the capacitor, test lead-wire, probe and output terminal, embodied in the tester, are charged with high voltage.
And it takes some time to discharge such an electric charge after the power has been cut off.
Accordingly, you should not touch such areas to prevent electric shock for a while after the power has been turned off.

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11. Confirmation on discharge of electric charge:

The time required to discharge electric charge depends on the characteristic of the D.U.T. and the test voltage.
Suppose that the high-voltage areas such as the D.U.T and the test lead-wire are an equivalent circuit and that it can be expressed as a capacity of 0.01μF and a parallel resistance of 100MΩ, then the time required to attenuate the voltage of the D.U.T. down to 30V will be about 3.5 sec. at the test voltage of 1000V, and about 2.8 sec. at 500V.

If the time constant of the D.U.T. is known, the attenuation time down to 30V, after the power has been cut off, of the D.U.T. can be determined by multiplying the attenuation time given above with such a time constant.

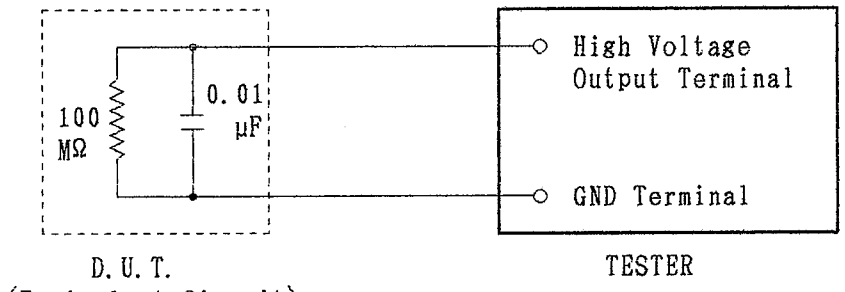

Figure 3.5

12. Remote controll of tester:

In the case this tester is to be remote controlled, the application of high voltage to the tester will be controlled by an external signal.
Take the following safety precautions to prevent accident. Also, shall be maintained the safety precaution under positive control.

- NOT to permit unexpected output of high voltage from the tester (that is, to prevent this tester from being put in TEST ON condition).
- NOT to permit operator and any other come into contact with D.U.T. test lead-wire, probe, output terminal, etc. while the tester is generating high test voltage.

13. Re-turn on of POWER switch:

Once the Power switch of the tester has been turned off, leave at least several seconds before it is turned on again. Do not repeat ON-OFF switching of the Power switch particularly when the tester is generating the output voltage. In such a case, the safety protection of the tester may not

work properly, and the operater is endangered.
The power switch shall not be turned off while the tester is generating the output voltage except in the case of emergency.

14. Connection or disconnection of connector

Before connecting or disconnecting the connectors from the front and rear panels of this tester, cut off the power supply and turn the test voltage knob to extreme left ("0" position).

Caution: Mis-connection of such connectors may arise the tester to be put in TEST ON condition.

15. Precautions in using Model 874 (Option)

This tester can be controlled by Model 874 (Optional, output voltage controller). In using this tester in combination with Model 874, also read Section 3 "WARNINGS" of Model 874 Operation Manual.

When Model 874 is out of use, pay attention to the preset conditions in Model 874, in changing the test conditions in this tester. Pay special care to change of preset value on the leak current switch. Because high voltage may possibly be output depending on preset conditions in Model 874.

16. Other precautions:

Do not short-circuit the tester output with the ground or a conveyer or any device connected to the ground, or with the comercial power-line around tester location. Such a short-circuit may cause high-voltage charging on the tester casing, which is very dangerous.
However, such a risky condition will not arise if only the casing has been grounded, in which case the casing will not be electrically charged nor will cause the damage on the tester even when the GND terminal has been short-circuited with the high-voltage terminal.
The protective grounding terminal shall be positively grounded using applicable tool.

— In case of Emergency —

17. Emergency handling:

In the case of any accident such as an electric shock or burn-down of the D.U.T. resulting from the failure of the tester or D.U.T., take the following actions promptly;
- cut off the POWER switch, and
- pull out the plug of AC cord from the socket of the power source.

It does not make any difference whichever action of the above two is taken first, but be sure to take the two actions.

— Trouble-shooting —

18. In case of trouble:

In the following cases of trouble, it is very hazardous that the power of the tester may not be cut off while the tester continues to generate high voltage:
- TEST ON lamp keeps on lighting even when the RESET button has been pushed.
- TEST ON lamp is turned off but the indicator of the output voltmeter continues swinging.

The immediate action to take, in the above cases, is to pull out the plug of AC cord from the the socket of the power source, and suspend the operation of the tester.
Thereafter, entrust us with the trouble-shooting and repair of your defective tester.
If the tester shows any irregular performance, it is possible that a high voltage may be output irrespective of the operator's will.
Suspend the operation of the tester immediately.

19. Fade out of TEST ON lamp:

In the case the TEST ON lamp has been faded out, it may cause erroneous operation of the tester, which in turn give rise to dangerous electrification.
Please entrust us with the repair of such a defective tester.

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◆◆ Attention for Trouble-Free Operation ◆◆

(1) The max. output voltage of this tester reaches higher than 5kV under no-load condition, and even higher voltage in proportion to the power-supply fluctuation. But be sure to operate the tester at a lower voltage than the specified 5kV.

(2) The heat dissipation capacity of the high-voltage transformer, embodied in the tester, is designed to be a half of the rated output, taking into consideration of the size, weight and cost.
Accordingly, if the test is to be conducted at the LEAK CURRENT of 100mA, leave a suspension time longer than the test duration.
Incidentally, the max. allowable test duration is 30 minutes at ambient temperature of 40°C (104°F) or lower.

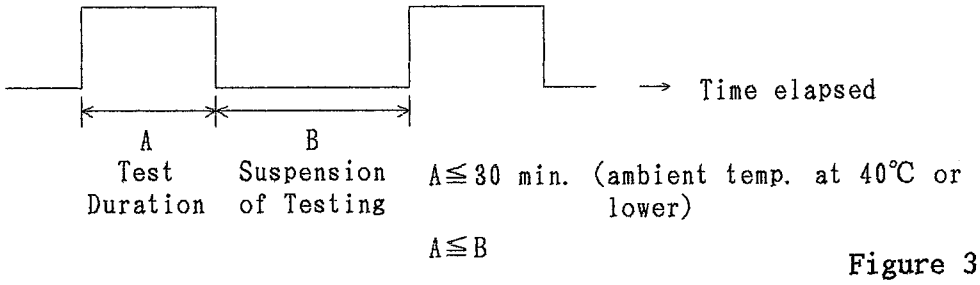

Figure 3.6

The above timing is not applicable if the tester is used at the LEAK CURRENT setting of 70mA or lower.

(3) This tester can be properly used with the input power supply of nominal input voltage ±10%, but its operation becomes incomplete outside of this range and leads to possible failures.
It is thus important to adjust the power supply within the range of nominal input voltage ±10% by any proper means.

(4) The operation and storage of the tester under exposure to the direct sunshine, high temperature and humidity or dusty environment should be avoided.

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(5) This tester is incorporated with a transformer of high output voltage up to 500VA.

A considerably large current (in scores of amperes) may flow through the commercial power line, which is connected with the tester in the following two cases:

- In the duration of scores of milli-sec., in which the tester detects that a D.U.T. has failed the testing.

- At an instant when the test is executed.

Also it is important to determine the capacities of the power line and of any electronic device connected to the same line, taking into consideration of such a large current.

4. OPERATION INSTRUCTIONS

4.1 Description of Front Panel

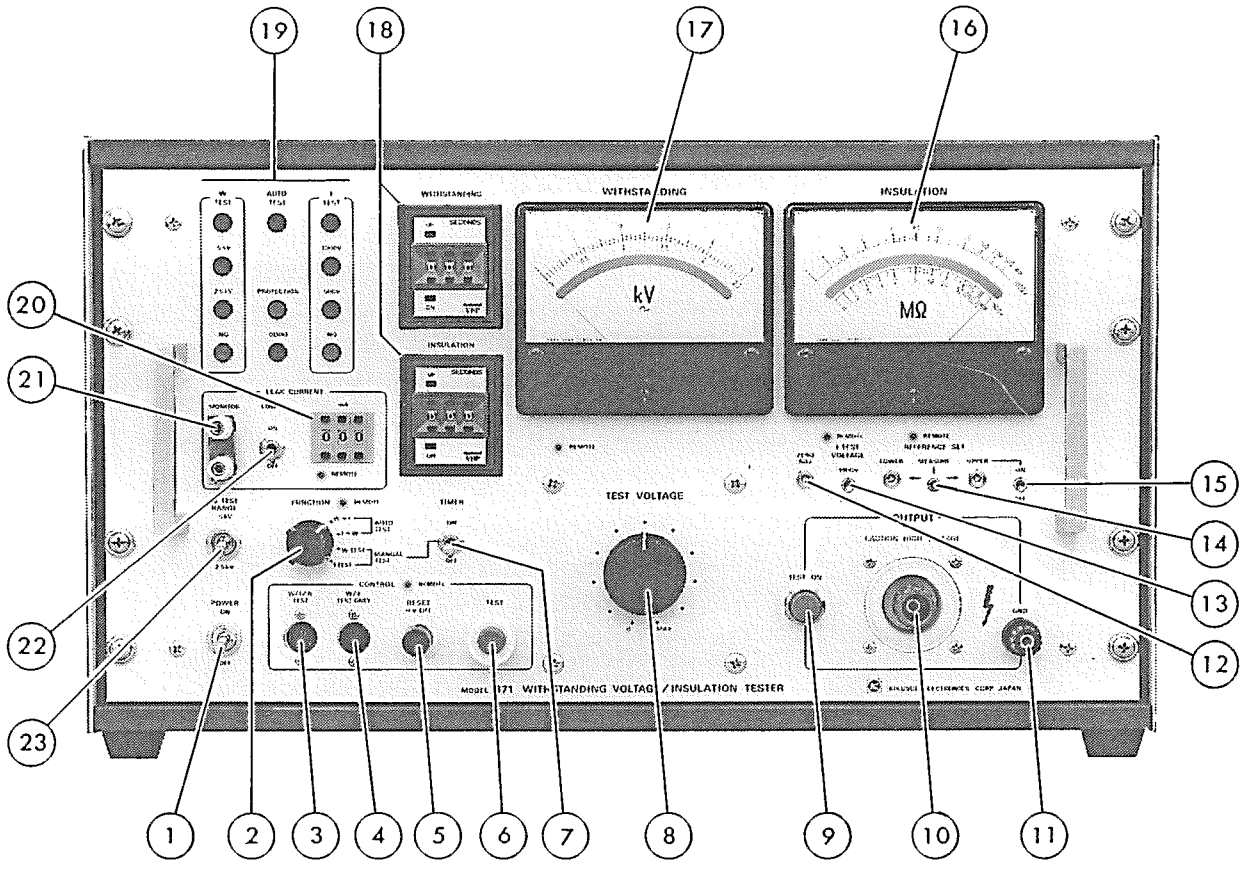

Figure 4.1

① Power ON/OFF switch:

Main power switch of Tester. Before turning on the switch, be sure to read Section 3 "WARNIGS."

② FUNCTION selector switch:

When in the automatic test mode, the switch is used to set the order of withstanding voltage test and insulation resistance test. When in the single test mode, the switch is used to select either one of the two types of tests.
When the FUNCTION REMOTE lamp at upper right of the switch is illuminating, the test functions of the Tester are remote-controlled by the signals fed through the FUNCTION connector at the rear of the Tester irrespective of local settings of the Tester panel switches and controls.

③ W/I/R TEST connector:

The connector is used to hook up the W/I/R Controller to the Tester when it is operated in conjunction with a Low Ohm Tester.

④ W/I TEST ONLY connector:

The connector is used to hook up a Remote Control Box (Model 913A or 914A) or other control equipment to remote-control the test/reset function of the Tester.

⑤ RESET H.V OFF button:

To cutoff the H.V output when in test operation, press the button. The button is used also to reset from the NG alarm state or the PROTECTION state.

⑥ TEST button:

As you press the button when the Tester is in the RESET state, the TEST ON lamp illuminates and the test as selected by the FUNCTION selector switch is performed by delivering to the output terminal the test voltage corresponding to the type of test selected.

When the FUNCTION REMOTE lamp or the CONTROL REMOTE lamp above the RESET button is illuminating, the test/reset function of the Tester is remote-controlled and the TEST button remains disabled.

⑦ TIMER ON/OFF switch:

This switch selects whether the timer is to be used or not when in the single test mode.

⑧ TEST VOLTAGE dial:

The dial controls the output voltage for withstanding voltage test. The "0" position is for minimum output and the voltage increases as this dial is turned clockwise.

Note: When Model 874 Remote Controller is hooked up to the Tester and the TEST VOLTAGE REMOTE lamp at upper left of the TEST VOLTAGE dial of the Tester is illuminating, the dial is disabled and the test voltage is controlled from the Remote Controller. At the instant the control mode is changed from

the remote to the local, however, the dial is enabled and the Tester delivers a test voltage corresponding to the setting of the dial. Therefore, be sure to set the dial at the fully counterclockwise position ("0" position) even when in the remote control mode.

⑨ TEST ON lamp:

The lamp (red) indicates that the test voltage is ready to be delivered to the output terminal or that it is being delivered.

⑩ OUTPUT terminal:

The hot line of the test voltage.

⑪ GND terminal:

The ground line of the test voltage. Electrically, the line is connected to the Tester chassis.

⑫ ZERO ADJ control:

The potentiometer for electrical zero adjustment of insulation resistance meter.

⑬ I TEST VOLTAGE 500V/1000V selector switch:

The switch selects a test voltage for insulation resistance test. When the I TEST VOLTAGE REMOTE lamp above the switch is illuminating, the switch is disabled and 500V/1000V selection is remote controlled.

⑭ REFERENCE SET switch:

The switch is for setting a GO-NOGO judgement reference value for insulation resistance test. Normally, the switch is set in its center position, the ohmmeter indicates the value of measuring resistance.
When the switch is thrown to the left-hand position, the ohmmeter indicates the low limit reference value for GO-NOGO judgement; when the switch is thrown to the right-hand position, the ohmmeter indicates the high limit reference value. The limit reference values are adjustable with the potentiometers located at right and left of the switches.

When the REFERENCE SET REMOTE lamp above the switch is illuminating, the potentiometers are disabled and the limit reference values are remote-controlled with external DC signals.

⑮ UPPER ON/OFF switch:

The switch selects whether the high-limit GO-NOGO judgement in the insulation resistance test is to be done or not.

⑯ Ohmmeter:

Indicates the resistance measured in insulation resistance test.

⑰ Voltmeter:

Indicates the output voltage for withstanding voltage test.
Directly measures the voltage of the high voltage output terminal.

⑱ Timer:

Presets the insulation resistance and withstanding voltage test period.

⑲ Indicator lamps:

- o AUTO TEST: Identifies between automatic test and single test. The lamp illuminates when in the automatic test mode. When in the single test mode, either the W TEST lamp or the I TEST lamp illuminates.

  When the FUNCTION REMOTE lamp is illuminating, the W TEST lamp or the I TEST lamp illuminates only during the period the withstanding voltage test or insulation resistance test is performed.

- o W TEST: Illuminates when in the withstanding voltage test mode.
  If the Tester is set in the manual single test mode, the lamp illuminates when withstanding voltage test is selected.
  If the Tester is set in the automatic test mode or if the FUNCTION REMOTE lamp is illuminating, the W TEST lamp illuminates only during the period the withstanding voltage test is performed.

- 2.5kV/5kV: Indicate the output voltage range being used for withstanding voltage test.
  The lamps indicate whether the 2.5 kV range or the 5 kV range is selected for the withstanding voltage test.

  Neither of them illuminates, however, when the TEST VOLTAGE REMOTE lamp is illuminating to indicate that the output voltage of the Tester is remote-controlled by Model 874 Remote Controller.

- I TEST: Illuminates when in the insulation resistance test mode.
  If the tester is set in the manual single test mode, the lamp illuminates when the insulation resistance test is selected. If the tester is set in the automatic test mode or if the FUNCTION REMOTE lamp is illuminating, the I TEST lamp illuminates only during the period the insulation resistance test is performed.

- 500V/1000V: Indicate the test voltage being used for insulation resistance test.

- GOOD/NG: Indicate the test result. If the result of GO-NOGO judgement is GOOD, the GOOD lamp illuminates; if it is NG, the NG lamp illuminates. The NG lamp illuminates continuously; the GOOD lamp illuminates only for about 50 msec. When no timer is used in the single test mode, the GOOD judgement is not done.

- PROTECTION: When in any of the following cases, the protective circuit trips, the output is cutoff and the lamp illuminates.

  (1) When the FUNCTION switch is changed.

  (2) When the RANGE 2.5kV/5kV switch of withstanding voltage tester is changed.

  (3) When the TEST VOLTAGE 500V/1000V switch of insulation resistance tester is changed.

  (4) When control of insulation resistance test voltage setting (1000 V or 500 V) is changed from local to remote or from remote to local.

(5) (If the W/I/R Controller is used in conjunction with the Tester) When the connection from the Tester (the W/I/R TEST connector) to the controller is broken.

(6) When the W/I TEST ONLY connector of the tester is connected to or disconnected from the objective device (such as a Remote Control Box). (This is not true when the objective device satisfied the required reset conditions.)

(7) (If test adaptors are used in conjunction with the Tester) When the B connector alone of the TEST ADAPTOR A/B connectors on the Tester rear panel is connected to the odjective device.

(8) (If test adaptors are used in conjunction with the Tester) When an emergency signal is generated on the test adaptor side.

(9) (If the LEAK CURRENT [mA] digital switch of the tester is set at not greater than 20 mA) When Model 874 Remote Controller is connected to or disconnected from the Tester.

(10) (If Model 874 Remote Controller is used in conjunction with the Tester) When the LEAK CURRENT [mA] switch is changed from setting for a value not greater than 20 mA to that not less than 21 mA, or from the latter to the former.

(11) (If Model 874 Remote Controller is used in conjunction with the Tester) When a protect signal is generated on the remote controller side.

(12) When the mode of controlling the setting of leakage current reference value is changed from local to remote or from remote to local.

(13) When an objective controller is connected to or disconnected from the FUNCTION connector on the Tester rear panel.

(14) When the POWER switch is turned on again immediately after turning it off.

(15) When both withstanding voltage tester and insulation resistance tester are operated at the same time due to a failure of the Tester.

When the PROTECTION lamp is illuminating, the test function is disabled and no test voltage is delivered regardless of pressing of the TEST button or application of a test control signal. To enable the test function to resume the test, press the RESET button. If the PROTECTION lamp does not go off even when the RESET button is pressed, check that the connectors are securely connected and then press the RESET button again.

For details of the reasons for the cases of (8) and (11), refer to the instruction manual for the Test Adaptor and that for the Remote Controller. If the PROTECTION lamp does not go off even when the RESET is pressed due to other reasons than those of the cases of (8) and (11), a probable cause is that of the case of (15). If this is the case, immediately stop using the Tester.

⑳ LEAK CURRENT [mA] digital switch:

The switch is used to set a leakage current detection reference value, within a range of 1 - 100 mA. If the D.U.T. draws a current larger than the reference value, the Tester immediately judges the D.U.T. to be NG, cuts off the output voltage, and generates an NG signal.

Select a reference value as required for the device under test. Note, however, that the maximum reated output current of the Tester is 100 mA. Do not select any reference value higher than 100 mA.

When the LEAK CURRENT REMOTE lamp below the digital switch is illuminating, the digital switch is disabled and the reference value can be remote-controlled with an external signal.

In use of this tester in combination with Model 874, the output voltage setting in this tester and that in Model 874 change automatically according to the preset value on the leak current switch. It is danger to change at random the setting on the leak current switch. When such change is reqired, therefore, read the instruc-

tions in Para. 15 on page 16 and Model 874 Operation Manual.

㉑ MONITOR terminals:

The terminals for direct monitoring of the leakage current, by removing the shorting bar from between them and connecting in its stead and ammeter whose full scale well covers the value set by the LEAK CURRENT switch.
The upper terminal is connected to the chassis ground.

Be sure to connect the terminals with the shorting bar whenever the leakage current is not monitored.

㉒ LOWER ON/OFF switch:

The Tester is able to make an NG judgemnt also when the leakage current in withstanding voltage test is less than the lower limit value (1/10 of the upper limit value selected with the LEAK CURRENT [mA] switch). The LOWER ON/OFF switch enables or disables this function.

㉓ W TEST RANGE 2.5kV/5kV switch:

The switch selects either the 2.5 kV or 5 kV range for withstanding voltage test. The switch is linked to the output voltmeter to change its ranges.

When the Tester is controlled with Model 874 Remote Controller, the W TEST RANGE switch is disabled and the output voltage of the Tester is dictated by the controller, although the voltmeter range change function of the switch remains enabled.

4.2 Description of Rear Panel

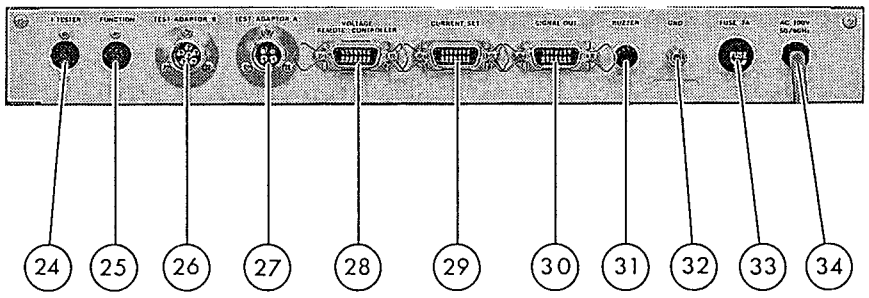

Figure 4.2

㉔ I TESTER connector:

The connector accepts remote control signals to select an insulation resistance test voltage (500 V or 1000 V) and to set a GO-NOGO judgement reference value.

㉕ FUNCTION connector:

The connector accepts remote control signals for setting and execution of withstanding voltage test and insulation resistance test when in the remote control mode disabling the local function switch.

㉖ ㉗ TEST ADAPTOR A/B connectors:

The connectors accept SPEC 81811 Test Adaptors.

㉘ VOLTAGE REMOTE CONTROLLER connector:

The connector accepts Model 874 Remote Controller to control the Tester output voltage for withstanding voltage test.

㉙ CURRENT SET connector:

The connector accepts the BCD signal with which to set the leakage current reference value for withstanding voltage test.

㉚ SIGNAL OUT connector:

The connector delivers the output signals of the Tester.

㉛ BUZZER control:

Controls the loudness of buzzer of an NG or GOOD judgement.

㉜ Protectiv GND terminal:

To ground the Tester to an earth line.

㉝ Fuse:

Fuse of the AC power line

Nominal voltage	Fuse
100 V, 110 V 115 V, 120 V	7 A
200 V, 220 V 230 V, 240 V	4 A

㉞ AC XXXV 50Hz/60Hz

The AC input power cord of the Tester.

4.3 Operating Procedures

4.3.1 Procedure Before Test

(1) Before turning on the POWER switch, check that the voltmeter is indicating the "0" scale position and the ohmmeter is indicating the "∞" scale position. If the meters are not indicating these positions adjust them to these positions with their mechanical zero at their centers.
If the Tester power is on, turn it off and then check the meters.

(2) Before turning on the POWER switch, thoroughly read and note the items of Section 3 "WARNINGS."

(3) When the POWER switch is turned on or off, the ohmmeter pointer may deflect irregulary. This is only transiential and is not an abnormal indication.

4.3.2 Single Withstanding Voltage Test

(1) Selecting the withstanding voltage test mode:

Select the MANUAL W TEST mode with the FUNCTION selector switches, and set the LOWER ON/OFF switch to the OFF state. The W TEST indicator lamp will illuminate.

(2) Selecting a test voltage range:

Select the required test voltage range (2.5 kV or 5 kV) with the RANGE 2.5 kV/5 kV switches. The corresponding indicator lamp will illuminate.

(3) Setting the high limit reference value of leakage current:

With the LEAK CURRENT switches, set the high limit reference value (upper reference value) of leakage current of the device under test as required.

(4) Setting the GO-NOGO judgement reference values for withstanding voltage test:

The GO-NOGO judgement by the Tester is done in a window comparator system such that the GOOD judgement is made only when the measured leakage current is between the high and low limit reference values.
The NG judgement can be made not only when the measured value is larger than the high limit reference value but also when it is smaller than the low limit reference value (1/10 of the high limit reference value).

The window comparator system is especially advantageous when the leakage currents of the device under test are predicted to be substantially ununifrom. To test such device under test, the high limit reference value may be set at a value slightly larger than the predicted highest value and the low limit reference value may be set at a value slightly smaller than the predicted lowest value, and the test may be done in the window comparator system. When this is done, device under test of exceptionally small leakage currents can be identified and open-circuiting of leadwires and imperfect contacting also can be detected, thereby substantially facilitating the withstanding voltage test.

Tests with low limit judgements for low leakage currents will be inconvenient when setting the test voltage in the no-load state or when the device under test draw almost no current. In such cases, set the LOWER ON/OFF switch to the OFF state to disable the low limit judgement function.

(5) Setting the test time:

Set the test time with the timer as requered by the device under test.

(6) Setting the test voltage:

Set the TIMER ON/OFF switch to the OFF state.
Press the RESET button, and check that the TEST VOLTAGE dial is at fully counterclockwise position and press the TEST button.
Adjust the test voltage by gradually turning clockwise the TEST VOLTAGE dial and reading the voltage on the voltmeter. Then, cutoff the output by pressing the RESET bytton. Next, set the TIMER ON/OFF switch to the ON state.

(7) Connecting the device under test:

First of all, make sure that the output voltmeter indication is zero and the TEST ON lamp is not illuminating.
Next, connect the GND test leadwire to the GND terminal of the Tester. With that test leadwire, short the high voltage output terminal to the GND terminal to make sure that no high voltage is being delivered to the output terminal.
Then, connect the high voltage test leadwire (hot line) to the output terminal. Connect the GND leadwire to the device under test first and the high voltage test leadwire (hot line) to the device under test next.

(8) Test procedure:

(a) If the PROTECTION indicator lamp is illuminating, press the RESET button to reset the Tester. If the Tester is already in the RESET state, test can be immediately started simply by pressing the TEST button.

(b) When the period set by the timer has elapsed, the test voltage is cutoff and GOOD judgement is made and the GOOD signal is generated in the forms of lamp and buzzer and make-contact signal for about 50 msec.

(c) When a leakage current larger than the high limit reference value set by the LEAK CURRENT switches has flowed, the NG judgement is made and the output is instantaneously cutoff and the NG alarm with the lamp, buzzer and make-contact are generated.
Different from the case of the GOOD signal, the NG alarm continue until the Tester is reset or the PROTECTION condition is effected. To reset from the NG state, press the RESET button.

(d) To abort the test being executed (to cutoff the output) for any reason, press the RESET button.

(9) Single test without using the timer

(a) The timer of the Tester is for 999 sec maximum. When a test time longer than this is needed, perform the test without using the timer. However, note that, when the LEAK CURRENT switches are set for 100 mA, the continuous operation time rating of the Tester is up to 30 minutes.
The above item is not applicable if the tester is use at LEAK CURRENT setting of 70 mA or lower.

(b) Set the TIMER ON/OFF switch to the OFF state.

(c) Connect the device under test to the output terminals of the Tester as descrebed in Step (7).

(d) Check that the TEST VOLTAGE dial is set at the fully counterclockwise position and then press the TEST button. The TEST ON lamp will illuminate to indicate that the test voltage is ready to be applied to the device under test. Gradually turn clockwise the TEST VOLTAGE dial until the necessary test voltage is obtained.

When the required test time has elapsed or when a condition calling for aborting the test has occurred, press the RESET button to cutoff the output voltage. In this case the GOOD signal is not generated.

(e) When an NG alarm is generated in the above test, operation is identical with that when the test is made using the timer.

(10) Re-application of test voltage (retest):

If the Tester is in the RESET state, the test voltage as set by the TEST VOLTAGE dial can be delivered again to the output terminal simply by pressing the TEST button. If the Tester is generating an NG alarm or is in the PROTECTION state, press the RESET button to reset the Tester.

If a GOOD judgement is made at the end of the test, the auto reset circuit operates and the Tester is automatically reset.

4.3.3 Single Insulation Resistance Test

(1) Selecting the insulation resistance test mode:

Select the MANUAL I TEST mode with the FUNCTION selector switches. The I TEST indicator lamp will illuminate.

(2) Zero-ohm adjustment:

Check that the TIMER ON/OFF switch is in the OFF state. With the high voltage OUTPUT terminal shorted to the GND terminal, press the RESET button and then the TEST button. The ohmmeter will indicate approximately zero ohms. Precisely adjust the ohmmeter to zero ohms with the ZERO ADJ control potentiometer.

(3) Selecting a test voltage:

Select the required test voltage (500 V or 1000 V) with the I TEST VOLTAGE 500V/1000V selector switches.

(4) Setting the GO-NOGO judgement reference value for insulation resistance test:

(a) The GO-NOGO judgement by the Tester is done in a window comparator system such that the GOOD judgement is made only when the measured insulation resistance is between the high and low limit reference values. The NG judgement is made not only when the measured value is lower than the low limit reference value but also when it is higher than the high limit reference value.

The window comparator system is especially advantageous when the insulation resistances of the device under test are predicted to be substantially ununiform. To test such device under test, the high limit reference value may be set at a value slightly higher than the predicted highest value of the device under test and the test may be made in the window comparator system. When this is done, device under test of exceptionally high insulation resistances can be identified and open-circuiting of leadwires and imperfect contacting also can be detected, thereby attaining still better insulation resistance test.

(b) With the REFERENCE SET switches set in the regular state (center position), the ohmmeter indicates the measured resistance when in the insulation resistance test.

When not in the insulation resistance test, the ohmmeter indicates the ∞ position.

(c) Turn on the REFERENCE SET switch to left, and the ohmmeter will indicate the low limit reference value. Next, turn on the REFERENCE SET switch to right, and the ohmmeter will indicate the high limit reference value.

(d) The high and low limit reference values can be set with the potentiometers located at right and left of the switches.
Set the values as required by the device under test.

(e) For some types of tests, it may be undesirable to perform high limit judgement. In such cases, set the UPPER ON/OFF switch in the OFF state.

When the low limit judgement is not required, turn the low limit reference value setting potentiometer so that the ohmmeter pointer for the low limit reference value indicates a position lower than the zero ohm scale position.

(5) Setting the test time:

Set the TIMER ON/OFF switch to the ON state. Set the test time of INSULATION as required by the device under test.

(6) Connecting the device under test:

Connect the device under test to the Tester in the same manner as in the case of withstanding voltage test.

(7) Test procedure:

(a) If the PROTECTION indicator lamp is illuminating, press the RESET button to reset the Tester. If the Tester is already in the RESET state, test can be immediately started simply by pressing the TEST button.

(b) If the device under test satisfies the conditions of GOOD judgement set for GO-NOGO judgement in Step (4), the ohmmeter will indicates the measured resistance value. When the preset time has elapsed, the test voltage is cutoff, the divice under test is judged to be good, and the Tester will generate GOOD signals with the lamp, buzzer and make-contact for approximately 50 msec.

(c) If the device under test does not meet the above-mentioned test conditions, the NG judgement is made and the output is instantaneously cutoff and the NG alarm is generated.
The alarm is with the lamp and make-contact which are different from those for the withstanding voltage test and with the buzzer which is used in common for the withstanding voltage test. To reset the alarm, press the RESET button.

(8) Test without using the timer:

Set the TIMER ON/OFF switch to the OFF state. When this is done, insulation resistance test can be done irrespective of the timer as is the case for withstanding voltage test. If the Tester is in the RESET state, the test will start as you press the TEST button. As you press the RESET button, the output voltage is cutoff and the test ends.

(9) Re-application of test voltage (retest):

The re-application method of the test voltage is the same as that of the case of the withstanding voltage test.

(10) Checking discharge from D.U.T.

In case of this mode (Single Insulation Resistance Test), D.U.T is charged after testing. Be sure to check discharge from D.U.T. Read the instruction given on page 14 - 15, items 10 and 11 for the detail.

4.3.4 Automatic Test

(1) Selecting a test sequence

The Tester is capable of performing a withstanding voltage test and an insulation resistance test sequentially. Sequence is selectable for "W → I" or "I → W" with the FUNCTION switches. When the Tester is set for this mode, the AUTO lamp illuminates. (Letter "W" stands for withstanding voltage test and letter "I" for insulation resistance tests.)

(2) Setting the test conditions:

Set the test voltages of withstanding voltage test or insulation resistance test, leakage current detection reference values, test time, and insulation resistance judgement reference values as in the case for the single-item tests.

(3) Connectings the device under test:

Connect the device under test to the output terminal of the Tester as in the case for the single-item tests.

(4) Test procedure:

(a) Set the Tester in the RESET state and then press the TEST button. The Tester will automatically perform the two types of tests.

(b) When the test is over without the NG judgement, the GOOD signals are generated at the end of the test. The signals are the same as those of the single test.

When the withstanding voltage test or insulation resistance test is over with NG judgement, the output voltage is instantaneously cutoff, the NG alarm is generated, and the test is end.
The signals are the same as those of the single test.

(5) To abort the test:

To abort the test being performed, press the RESET button. The output voltage will be instantaneously cutoff and the Tester will be reset.

(6) Re-application of test voltage (retest):

When the test is over with the GOOD judgement, the Tester generates the GOOD signals for approximately 50 msec and then resets itself. The next test can be started simply by pressing the TEST button. When the Tester has generated the NG alarms, reset once the Tester and then press the TEST button.

(7) Checking discharge from D.U.T.

In case of "W → I" test mode, D.U.T is charged after testing. Be sure to check discharge from D.U.T. Read the instruction given on page 14 - 15, items 10 and 11 for the detail.

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4.3.5 Remote Control

(A) General Notes for Remote Control

> Many of the functions of the Tester can be remote-controlled.
> Be extremely careful when using this method because the high voltage is on/off -controlled with an external signal. Pay attention so that the high test voltage is not generated inadvertently. Also, provide full measures to ensure that nobody is contacted with the high voltage areas (D.U.T. test lead-wire, probe or output terminal etc.) when the test voltage is being delivered.
> When these measures are unavailable, do not use the follwing remote control method.

For details of remote control of the following two items, refer to respective instruction manuals. For hook-up connections of units for remote control, see Figure 7.1.

(a) To control the Tester output voltage with Model 874 Remote Controller.

(b) To control alternately the Tester and the Low Resistance Tester with Model 915 W/I/R Controller.

To remote-control the other items than the above-mentioned two items, drive the corresponding pin of the corresponding connector to the low active state in one of the two methods mentioned below. The same applies also when controlling other units of the 871 system.

(a) Connect the corresponding connector pin to the common line using a make-contact (a relay or a switch).

(b) Connect the corresponding connector pin to the common line using a logic citcuit. The conditions of the input connector pins are as follows:

High level input voltage:	11 - 15 V
Low level input voltage:	0 - 4 V
Low level sweep out current:	1 mA or less

Each of the input terminal pins is pulled up to +15 V with an internal resistor and, as the input circuit is made open, it becomes the same as that a high level input signal is applied.

(1) Examples of low active control are shown in Figure 4.3 and 4.4.

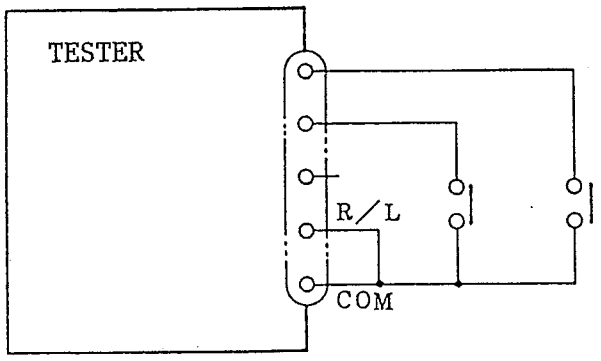


Figure 4.3 Remote Control with Contact Signals

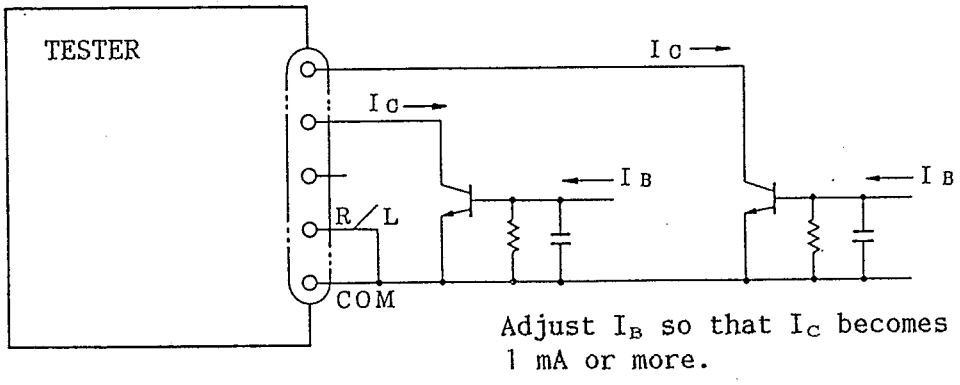
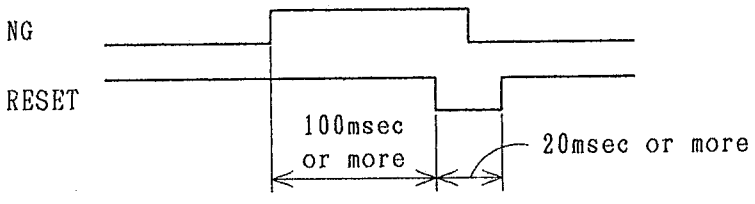


Figure 4.4 Remote Control with Transistor Circuits

Instead of the transistor circuits shown in Figure 4.4, photocoupler citcuits, open drain circuits or other logic circuits may be used. Note, however, that the input circuit is pulled up internally to +15V.

Note: The timing of the RESET signal for clearing the NG alarm is as follows.



(2) The Tester may generate a large noise when its output terminals delivering a high voltage is shorted due to load breakdown or other cause. Lest the electronic devices connected to the Tester should be erroneously driven by the noise, provide sufficient measures to protect them against noise.

(3) To change from the local control mode to the remote control mode, connect the corresponding R/L terminal to the common line. (The remote control methods of individual functions are described in Section (B).) When in the remote control mode, the local switches and controls are disabled and the Tester operation is controlled with external signals.

(B) Remote Control of Individual Functions

(1) To Control the Test/Reset Operation

The test/reset operation can be remote-controlled by driving the corresponding pins of the connector as shown in the below table. The connector can be used also to hookup Model 913A or 914A Remote Control Box and Model HTP-1.5A High Voltage Test Probe.

Connector Name: TEST/RESET CONTROL W/I TEST ONLY

Pin No.	Signal or Line Name	Input or Output	Signal level or Function
1	TEST ON signal	Output	+24 V signal is delivered through 1.5 kΩ resistor when test is on.
2	COM		
3	TEST/RESET R/L	Input	"L" level signal drives Tester into remote control mode.
4	TEST	Input	Application of "L" level signal is equivalent to pressing of TEST or RESET button.
5	RESET		

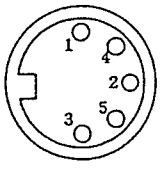


Figure 4.5 Layout of Connector Pins (as viewed facing the front panel)

(2) To Select Insulation Resistance Test Voltage (500 V/1000 V) and to Set GO-NOGO Judgement Reference Value

Connector Name: I TESTER

Pin No.	Signal or Line Name	Input or Output	Signal Level or Function
1	500 V/1000 V R/L	Input	"L" level signal for remote control of test voltage
2	1000 V	Input	"L" → 1000V, "H" → 500V
3	-15 V	Output	Power supply for remote setting (*), current rating 5 mA.
4	COM		
5			
6	REFERENCE R/L	Input	"L" level signal for remote setting of GO-NOGO judgement reference value
7	UPPER	Input	DC signal of 0 to approximately -6.8V for resistance infinitive to zero.
8	LOWER		

*: The -15 V supply can be used to control the GO-NOGO judgement reference value. Prepare a setup as shown in Figure 4.6. Throw the measured-value/reference-value selector switch on the front panel to right or left, and the ohmmeter will indicate the high-limit or low-limit reference value. The values are adjustable with the potentiometers shown in Figure 4.6. When no judgement for the high-limit is needed, make terminal 7 open; when no judgement for low limit is needed, make terminal 8 open.

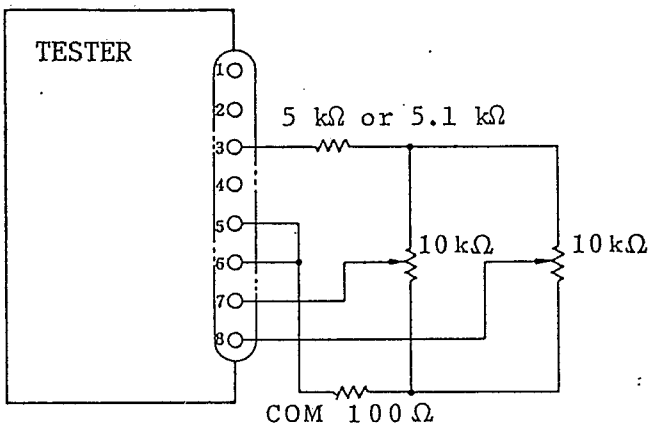


Figure 4.6

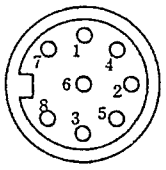


Figure 4.7 Layout of Connector Pins (as viewed facing the rear panel)

(3) To Set the Leakage Current Detect Reference Value for Withstanding Voltage Test

Connector Name: CURRENT SET

Pin No.	Signal or Line Name		Input or Output	Signal Level or Function
1	1	10^0 Column	Input	BCD signal
2	2			
3	4			
4	8			
5	1	10^1 Column		
6	2			
7	4			
8	8			
9	1	10^2 Clolumn		
10 11 12				NC (Not connected)
13	CURRENT SET R/L		Input	"L" level signal for remote setting mode
14	COM			

Note: Never set the reference value at higher than 100 mA.
For the connector pin layout, see Figure 4.8.

(4) To Select and Execute the Withstanding Voltage Test or the Insulation Resistance Test

Connector Name: FUNCTION

Pin No.	Signal or Line Name	Input or Output	Signal Level or Function
1	(P) U (NG) SIGNAL	Output	"H" level signal for PROTECTED or NG status (Note 1)
2	COM		
3	FUNCTION R/L	Input	"L" level signal for remote control
4	W.TEST	Input	To select the withstanding voltage test (Note 2)
5	RESET	Input	To reset the Tester (Note 3)
6	I.TEST	Input	To select the insulation resistance test (Note 4)
7	TIMER SIGNAL	Output	"H" level signal at the end of test (Note 5)
8	+24 V	Output	Supply voltage, reted current 50 mA

Remarks: The connector pin layout is identical with that shown in Figure 4.7

Note 1: The input impedance of the circuit connected to this pin must be 1 MΩ or more.
"H" level : 12 - 15 V; "L" level: 0 - 3 V.

Note 2: If the W.TEST pin is driven when the Tester is in the RESET mode, it executes the withstanding voltage test. The drive signal period must be 20 msec or more.

Note 3: If the RESET pin is driven, the tester is reset unconditionally. The drive signal period must be 20 msec or more.

Note 4: If the I.TEST pin is driven when the Tester is in the RESET mode, it executes the insulation resistance test. The drive signal period must be 20 msec or more.

Note 5: Regardless of setting of the TIMER ON/OFF switch, the test terminates when the period preset with the timer has elapsed.
The input impedance of the circuit connected to this pin must be 1 MΩ or more.
"H" level: 12 - 15 V; "L" level: 0 - 3 V

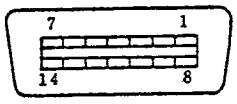


Figure 4.8 Layout of 14P Connector Pins
(as viewed facing the rear panel)

4.3.6 Output Signals

(1) The Tester delivers the following signals other than the lamp and buzzer signals.

Connector Name: SIGNAL OUT

Pin No.	Signal	Condition for Delivery	Type and Rating	
1, 2	TEST ON	Entire period during test is on	Make-contact signal Ratings: 100 V AC, 1 A 30 V DC, 1 A	
3, 4	GOOD	When test is over. Approx. 50 msec		
5, 6	W/NG	When NG judgement is made for withstanding voltage test. Continuous		
7, 8	I/NG	When NG judgement is made for insulation resistance test. Continuous		
9, 10			NC	
11, 12	CURRENT	For withstanding voltage test	0 to 10 V DC	Note 1
13, 14	MΩ	For insulation resistance test	0 to 10 V DC	

The layout of the connector pins is identical with that shown in Figure 4.8.
Note 1: Pins No. 12 and 14 are the COM lines and are of "L" level.

(2) This Tester provides four types of make contact signals for external use as follows:

① Contact signal conditions

- o TEST ON signal: This signal is generated and remains on for the entire period of either the single test or the automatic test.
- o GOOD signal: This signal is generated when a GOOD judgement is made at the end of a single test with the timer or at the end of the latter one of automatic tests. The signal lasts for approximately 50 msec.
- o W/NG alarm: This signal is generated when an NG judgement is made for the withstanding voltage test. This signal remains on until the next reset signalis applied (or the RESET button is pressed) or the PROTECTION signal is applied.
- o I/NG alarm: This signal is generated when an NG judgement is made for the insulation resistance test. The conditions for resetting the signal are the same as above.

② Contact signals

The contact signals are only with contacts and without any power sources as shown in Figure 4.9. Therefore, they cannot drive any loads which have no power.

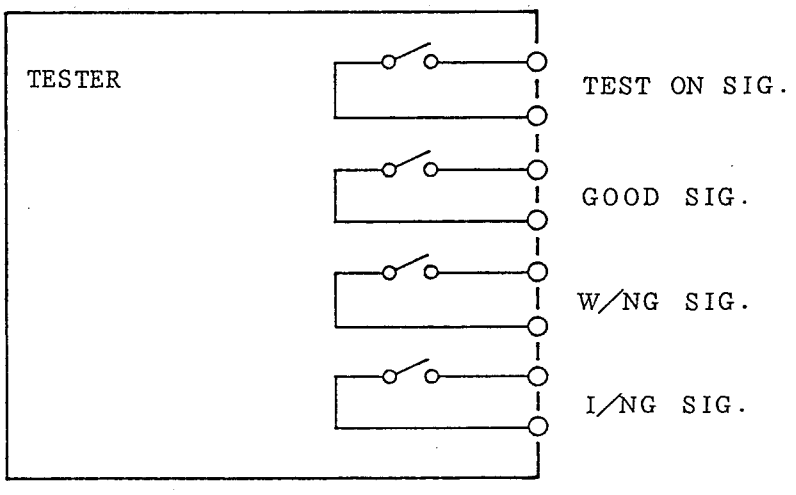


Figure 4.9

A contact which is closed when the signal is applied is called make contact, normally open contact, or form "a" contact. A contact which opens when the signal is applied is called break contact, normally closed contact, or form "b" contact.

The contacts of the Tester are of the make-contact type and their rating is 100 V AC, 1 A or 30 V DC, 1 A.
The withstanding voltage is 500 V AC 1 minute between the circuit and chassis.

③ Examples of use of these contacts are illustrated in the following.

(a) To drive a DC buzzer with an W/NG or I/NG alarms.

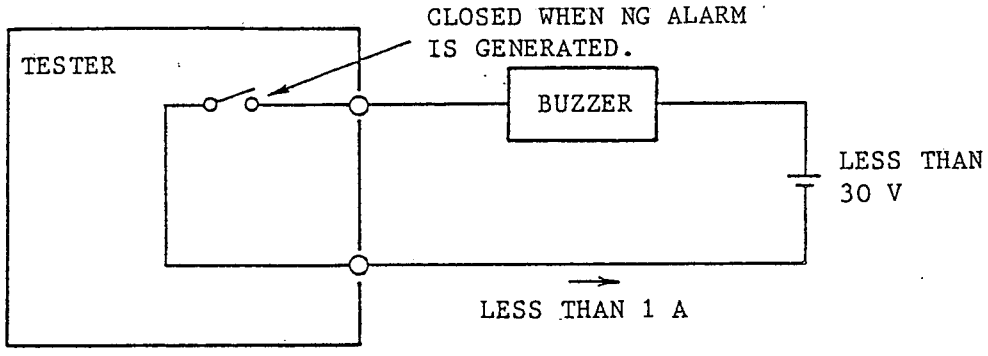


Figure 4.10

(b) To drive a lamp with the TEST ON signal:

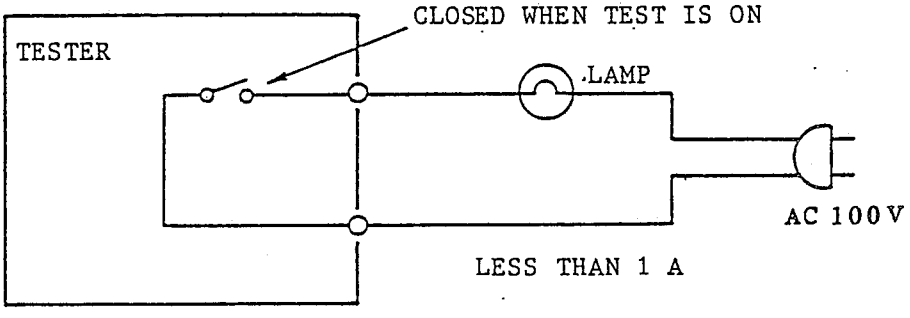


Figure 4.11

(c) To obtain an "L" level digital signal with the contact signal:

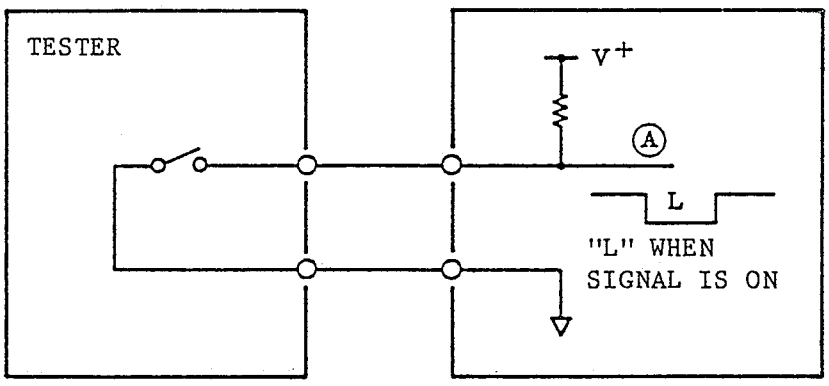


Figure 4.12

In the above illustration, an "L" level signal is obtained at point (A) when the contact output signal is on. However, since the signal obtained at point (A) include chattering, an appropriate chattering suppression provision should be incorporated depending on the nature of the circuit to be driven by this signal. In some cases, a noise suppression provision may be necessary.

(3) The Tester delivers a DC voltage signal (for the CURRENT signal) which represents the leakage current (average value) when in withstanding voltage test. The scale factor differs depending on whether the leakage current detect reference value is not greater than 10 mA or not less than 11 mA, as mentioned below. Although the signal represents the average value of the current, it is calibrated for rms value with a pure resistive load. The ripple factor of the signal is approximately 5%. Pins 11 and 12 are the "L" lines.

Current setting 0 - 10 mA: Scale factor 10 V/10 mA
Current setting 11 - 100 mA: Scale factor 10 V/100 mA

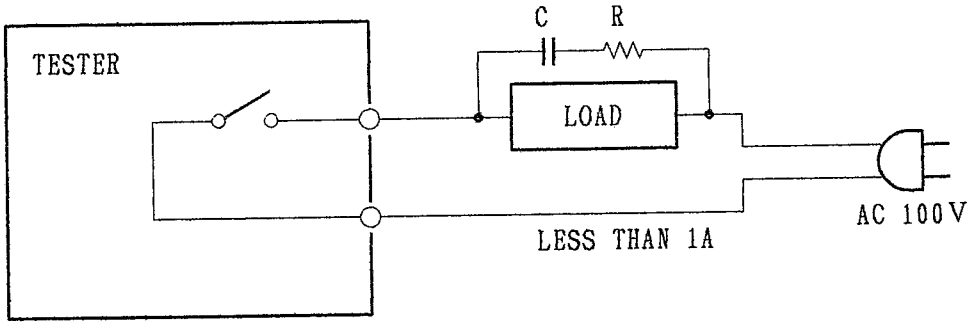
(4) The Tester delivers a DC voltage signal (for the MΩ signal) which is proportional to the ohmmeter reading. The relationship between the signal voltage and meter reading is 10 V/0 Ω.

(5) The accuracy (in absolute value) of the DC voltage signals of (3) and (4)is 5% of signal voltage reading or 50 mV, whichever larger.

(6) Precaution on using the contact signal

Before using this contact signal, provide a contact protection meausre (to absorb surge) suitable to the using method. Failure can not only cause malfunction of the circuit being connected later but also break the contact of the tester.

The figure 4.13 and 4.14 are the examples of the contact protection method recommended.

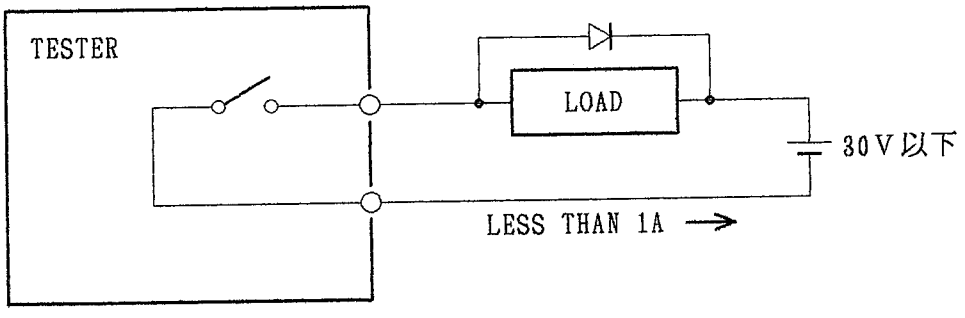


R : Approx. 100Ω 2W or over

C : Approx. 0.1μF AC 250V or higher

(The R and C are reference values only. Select proper values in accordance with the actual conditions.)

Figure 4.13



Diode

Reverse voltage 200V or higher

Foward current 1A or more

(The diode ratings are reference value only. Select proper values in accordance with the actual conditions.)

Figure 4.14

5. OPERATING PRINCIPLE

5.1 Block Diagram

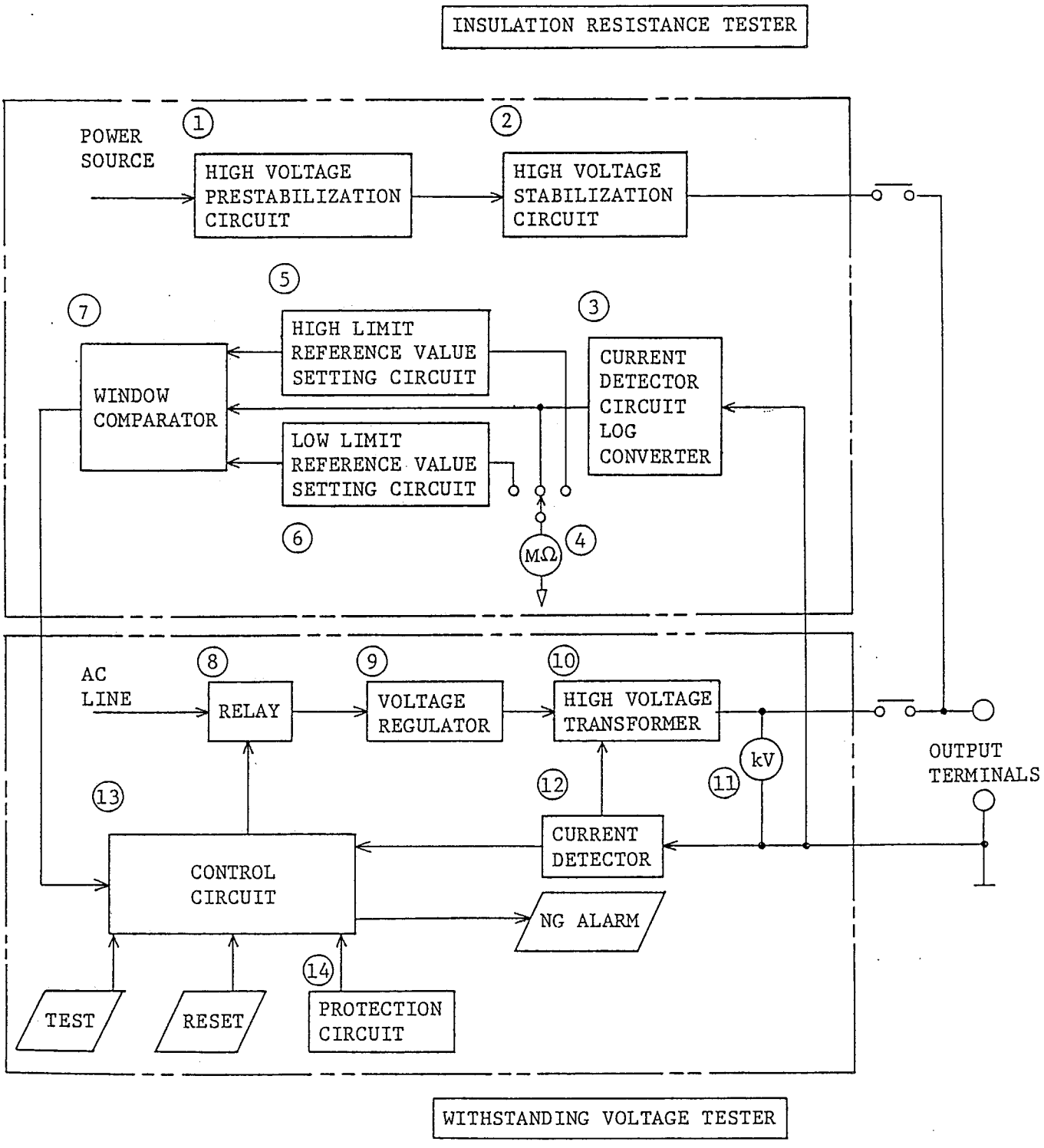


Figure 5.1

5.2 Descriptions of Individual Circuits

① High voltage prestabilization circuit:

In order to obtain the high voltage required for insulation resistance test, this circuit tripple-voltage rectifies the AC input power and roughly prestabilizes the DC output voltage at approximately 1150 V.

② High voltage stabilization circuit:

Stabilizes the above DC voltage more finely, in order to be applied as an insulation resistance test volatge to the device under test.
The test voltage is a negative voltage of nominal 1000 V or 500 V.

③ Current detector circuit with log converter:

The current which flows in the device under test varies ranging from less than 1 μA to several mA when shorted.
To detect and indicate this wide dynamic range current on the single range scale of the ohmmeter, this circuit has a log converter which converts the detected signal into a logarithmic signal. A highly accurate log converter is used in order to satisfy the specification accuracy.

④ Ohmmeter:

This meter is driven by the above logarithmic signal to indicate the insulation resistance of the device under test.

⑤ High limit reference value setting circuit:

Sets the high limit reference value for GO-NOGO judgement.
The value is adjustable with its potentiometer on the front panel.

⑥ Low limit reference value setting circuit:

Sets the low limit reference value for GO-NOGO judgement.
The value is adjustable with its potentiometer on the front panel.

⑦ Window comparator:

Generates a GOOD signal if the measured value is within the range between high and low limit reference values.
If not, generates an NG signal.

⑧ Relay:

On-off controls the power applied to the voltage regulator for withstanding voltage test. A solid-state zero-start type relay circuit is employed to minimize transiential spike voltages caused when the high voltage output is turned on or off.

⑨ Voltage regulator:

A slide transformer is used to control the output voltage.

⑩ High voltage transformer:

Boosts the voltage regulator output with a ratio of 1:25 or 1:50 into a high output voltage of 0 to 2.5 kV or 0 to 5 kV.
The rating is 5 kV, 100 mA (500 VA) when the AC line voltage is 100 V.

⑪ Voltmeter:

Indicates the output voltage for withstanding voltage test.

⑫ Current detection circuit:

Consists of a current detecting resistor, a reference voltage generator circuit, and a comparator.

⑬ Control circuit:

Controls overall operations of the Tester.
Structured in high-reliability logic circuits with CMOS IC.

⑭ Protective circuits:

Various protective features are incorporated for the safety of test.
But be careful to operate.

5.3 Zero-start Switch

If a regular mechanical contact type relay is used for on-off operation of the primary circuit of the high voltage transformer, transiential spike voltages could be produced, thereby applying an unjustifiedly high voltage to the device under test (DUT) and causing a possibility of rejecting an acceptable DUT.

The zero-start switch, which employs a solid-state switching circuit, turns on and off the power line at approximately 0 volt level, thereby reducing transiential overshoots.

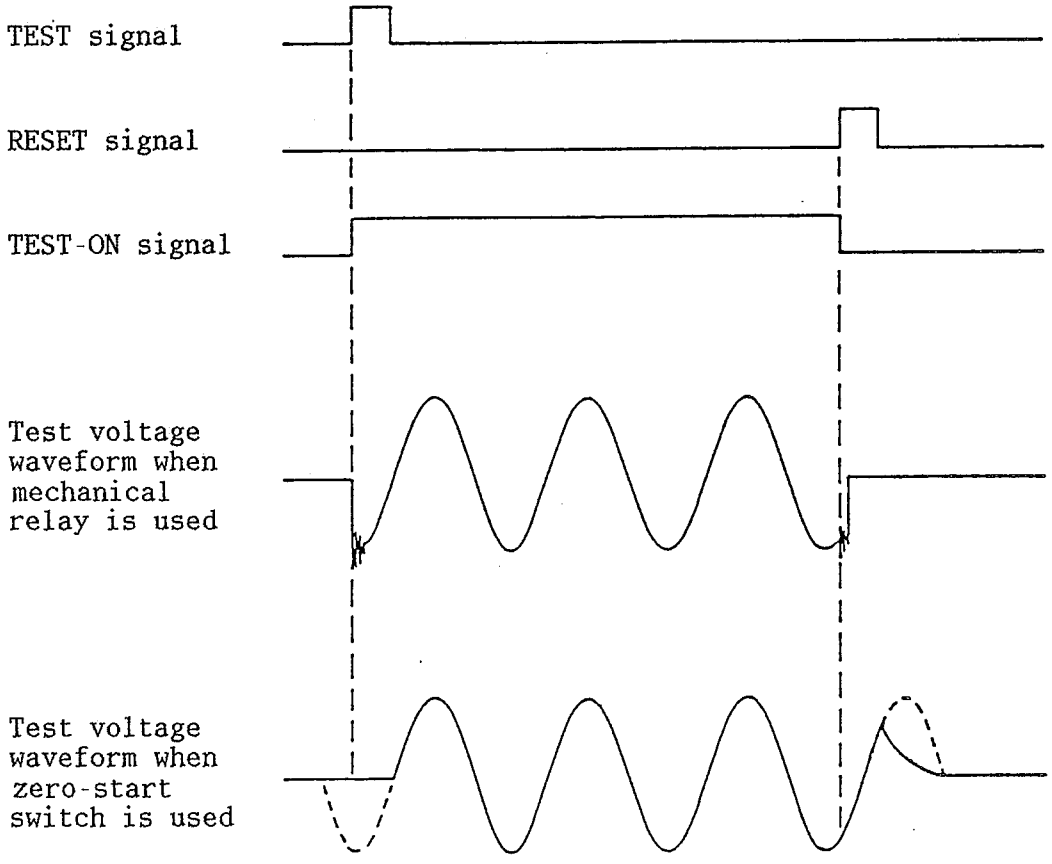


Figure 5.2

— *High-Voltage Test Probe and It's Usage Instruction* —

Two test probes, HTP-1.5A & HTP-3A, are available as optional.
A test probe shall be processed in the following sequence on completion of a testing;

1.) *turn off the switch of the probe, and then*

2.) *release the contact pin of the probe from the D.U.T. after comfirming the LED on probe has been OFF*

It is empharized that the probe shall NOT be processed in the reverse order (2.) & 1.)), or it will spoil the "zero" switching besides it is unsafe.

5.4 Regulation Provision of Instrument

In order to prevent hazards to the operator and damage to the DUT, excessive regulation of the Tester is suppressed by connecting a 5 Ω resistor in the primary circuit of the high voltage transformer at the 0.5 - 10 mA leak current range of the withstanding voltage tester. With this provision the instrument regulation is approximately 6% for 10 mA output to no load change when the output voltage is 5 kV.
At the 11 mA or more range, the above resistor is shorted by the relay and the instrument regulation becomes approximately 20% for full load (100 mA) to no load change when the output voltage is 5 kV.

5.5 Waiting-time for Judgement in Insulation Resistance Test

When a test voltage is applied to a DUT which has a larger capacitance, a larger charge current will flow at the initial short period and the resistance of the DUT may be indicated lower than the actual value.
In order to eliminate such period from the GO-NOGO judgement period, a timedelay provision is incorporated. The delay time is set at approximately 0.3 seconds. If the timer is set at a period shorter than 0.3 seconds, the effect of the above provision will be lost and a GOOD judgement may be made erroneously.
Be sure to set the timer for a period longer than 0.5 seconds.

6. OPTIONS

6.1 Options for System 871

☐ Model 872 AC Low Ohm Tester

The 872 has two measuring ranges, namely, 0 - 0.1 Ω (25 A) and 0 - 0.5 Ω (10A). Its output can be turned on or off with the TEST button.
It incorporates a GO-NOGO judgement function, remote control functions, and other convenient functions for test labor economization.

When used in conjunctions with Model 871 W/I Tester and Model 915 W/I/R Controller, the 872 can make up an integral system for withstanding voltage test, insulation resistance test, and low resistance test.

☐ Model 915 W/I/R Controller

The 915 controls the withstanding voltage test, insulation resistance test and low resistance test to be performed by Model 871 W/I Tester and Model 872 AC Low Ohm Tester as an integrated system. The 915 can also control individual tests of each of the testers.
The orders of withstanding voltage test and insulation resistance test, however, are as set by the 871 itself.

The integrated system is able to incorporate the various remote control functions and to deliver the various output signals, making up a highly efficient automatic test system.

☐ Model 874 Output Voltage Remote Controller

The 874 has a sine wave generator and a power amplifier, and provides the 871 Tester with a quality input power with which to control the 871 output voltage for withstanding voltage test. The output power rating when in this mode of operation is the maximum output volatge 5 kV and current 20 mA (within 5 seconds and requiring before each test a pause period which is 5 times of the run period). The output voltage can be preset for four points with three digital switches and one set of external signals. Any one of the four points can be selected as required.

The selection can be done with an external signal. Thus, the 874 greatly facilitates withstanding voltage test.
The output voltage setting accuracy is ±[(1% of setting) + 1 digit].

Continuously variable control of the output voltage also can be done with the potentioter on the front panel.

Combination of Model 871 and 874 enables ON/OFF of high voltage by remote-control. When using these together, read the respective Section 3 "WARNINGS" given in Model 871 and 874 Operation Manuals.

☐ SPEC 81811 Test Adaptor

The Test Adaptor plays a role of automatically switching between the 871 Tester output voltage and the AC line voltge to be applid to the load for withstanding for voltage test or insulation resistance test.
Thus, the Test Adaptor allows automatic W/I test of a device which normally is operating on an AC line power.

6.2 Other Options

This section covers devices which are available as optional items for the Tester.

☐ Model 913A Remote Control Box

For remote control of TEST and RESET operation

☐ Model 914A Remote Control Box

For remote control of TEST and RESET operation
With this control box, the test voltage is delivered only when the two test buttons are pressed simultaneously.

☐ Model HTP-1.5A High Voltage Test Probe

The High Voltage Test Probes are designed for high operation safety, yet maintaining good operabiliby. The test switch can be pressed only when the grip is squeezed, thereby preventing inadvertent turning on of the test voltage. When the test switch is released, the test voltage is cutoff unconditionally.

☐ Model HTL-3W High Voltage Test Leadwires

These leadwires are used for application of a high test voltage.
They are 3 meters long.

☐ Model 9202 Warning Light Unit

This unit indicates that the Tester is in the TEST ON state.
The unit is driven by the TEST ON signal (contact signal) of the Tester.

☐ Model 9203 Buzzer Unit

This buzzer unit is used to annunciate the NG state. It may be used when the loudness of annunciation only with the buzzer built in the Tester is insufficient. The 9203 is driven by the NG alarm (contact signal) of the Tester.

7. CONNECTIONS OF UNITS FOR FULL LINE UP

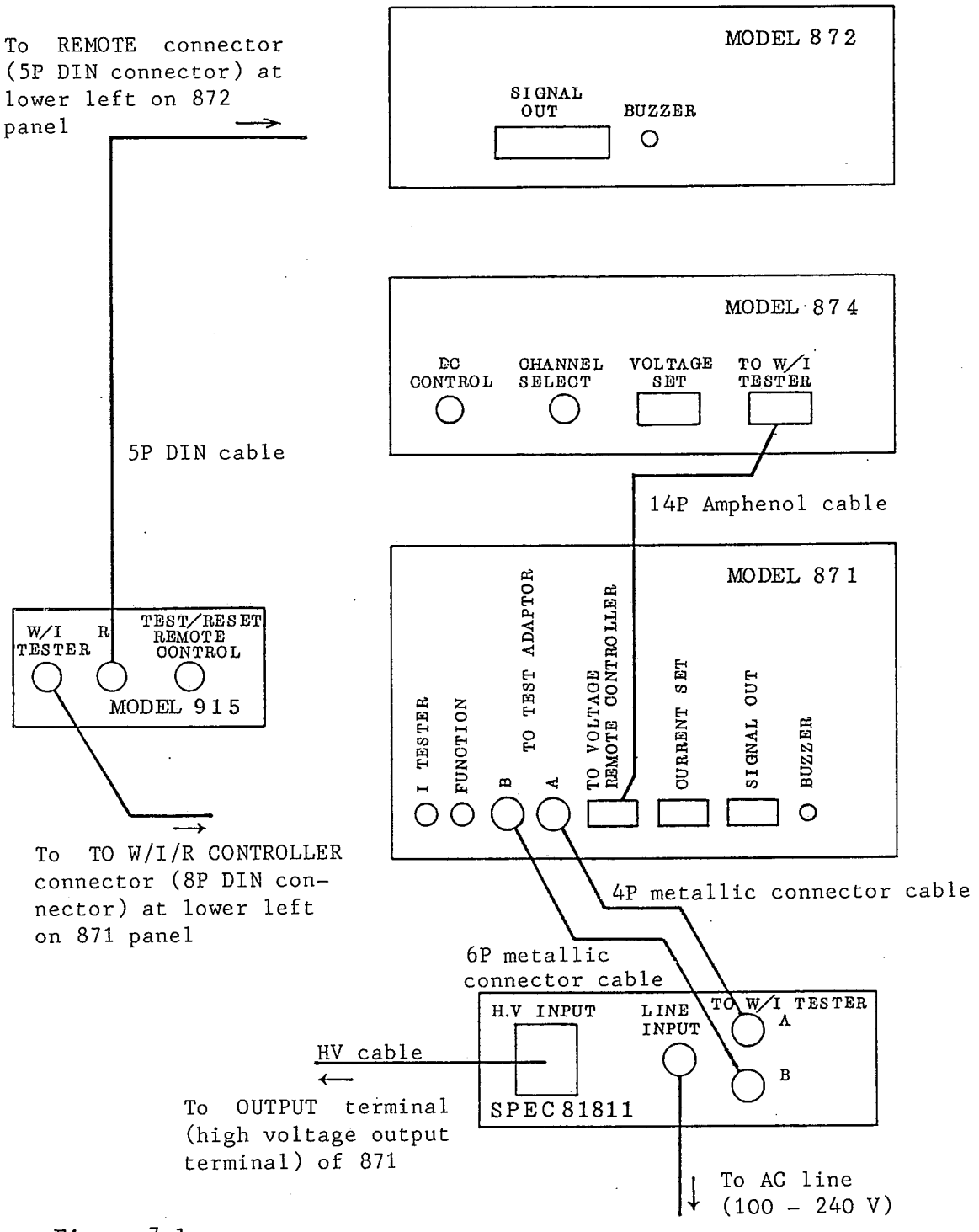


Figure 7.1

Note: The above illustration is only to indicate approximate locations of connectors. Layouts of marks may differ from the actual ones on the devices.