INSTRUCTION MANUAL

W/I AUTO TESTER

MODEL 860A

KIKUSUI ELECTRONICS CORPORATION

TABLE OF CONTENTS

1. GENERAL

Model 860A W/I Auto Tester is a combination of an automatic withstanding voltage tester and an automatic insulation resistance tester, and it is capable of performing withstanding voltage test and insulation resistance test in one continuous process.

As for the withstanding voltage tester, the instrument can provide a maximum output voltage of 5 kV and an output wattage of 500 VA, and can be used for withstanding voltage test in compliance with JIS Electrical Appliance Control Ordinance, UL·CSA, and other major electrical standards and ordinances. As for the insulation resistance tester, the instrument has two ranges of 500V/250MΩ and 1000V/500MΩ.

When in either test mode, the instrument can perform a GO-NOGO judgement function. For insulation resistance test, the instrument is incorporated with a window comparator and is capable of automatic GO-NOGO judgement of the insulation resistance of the tested object including open circuiting of the test leadwires and imperfect contacting of connections, simply by presetting a high limit reference value. The instrument also has a remote TEST/RESET control function and other auxiliary functions which greatly contribute for labor economization in withstanding voltage and insulation resistance tests of components and devices.

The instrument, which deals with a high voltage, has been designed with full attention to the safety of the operator.

2. SPECIFICATIONS

☐ Withstanding Voltage Tester

Test voltage

Application voltage:	0 - 2.5 kV AC and 0 - 5 kV AC (two ranges)
Wattage rating:	500 VA (5 kV, 100 mA, up to 30 minutes of continuous operation, with 100 V line power)
Waveform:	AC line waveform
Voltage regulation:	Better than 20% at 5 kV output (for maximum rated load to no load, with 100 V line power)

Output voltmeter

Type of meter:	JIS Class 1
Scales:	2.5 kV range and 5 kV range, linear scales
Indication:	Mean-value response, effective-value scale graduation
Provision:	Zero-turn-on switch provided

Output cut off by leak current detection

Ranges:	0.5/1/2/5/10/100 mA (six ranges)
Setting accuracy:	±5%
Detection method:	Current is integrated, compared with the limit reference value, and calibrated in terms of rms value of sine wave.

Note: For NG detection for output terminal shorting at 100 mA range, an output voltage of 800 V or over is required.

Test time and test method

Test time: 0.5 - 10 sec. (can be set with timer)

Test method: Automatic test or manual test

Test result judgement (GO-NOGO judgement)

When a leak current larger than the set value is detected, the output is instantaneously cut out and an NG alarm signal is generated.

NG alarm:
- o Lamp
- o Buzzer
- o Make-contact signal (100 V AC, 1 A or 30 V DC, 1A)

Leak current measuring terminals

The current that flows in the tested object can be measured by connecting a milliammeter to these terminals.

☐ Insulation Resistance Tester

Measuring voltages and measuring ranges

500 V DC, negative polarity; 0.2 MΩ - 250 MΩ (center value 5 MΩ)

1000 V DC, negative polarity; 0.5 MΩ - 500 MΩ (center value 10 MΩ)

Measuring accuracy

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

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

(at 25°C ±10°C)

Accuracy of measuring voltage

When terminals are open: +5%, -0% of nominal voltage

At center of scale: 95% or more of nominal voltage

Test method and test time

Test method: Automatic or manual

Test time: 0.5 - 10 sec. (can be set with timer)

Test result judgement (GO-NOGO judgement)

Judgement system: Window comparator system
(High/low limit setting system)

Limit value setting: Can be set at any point within effective measuring range

Judging accuracy

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

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

(at 25°C ±10°C)

Judging time: Approx. 0.3 sec.

NOGO judgement alarm

When NOGO judgement is done, the output is instantaneously cut off and an NG alarm signal is generated.

NG alarm:
- o Lamp
- o Buzzer
- o Make contact signal (100 V AC, 1 A or 30 V DC, 1 A)

Note: The 1st effective measuring range is a range of 1/2 to 1/1000 of the maximum value of the effective measuring range. Other measuring ranges fall into the category of the 2nd effective measuring range.

☐ Overall Specifications

Types of tests

Automatic test: Withstanding voltage test and insulation resistance test are performed as set at the instrument front panel.

Single test: Either one of the two types of tests is performed.

Output signals

TEST ON signals: Delivered during the period the test is performed.

- o Lamp
- o Make-contact signal (100 V AC, 1 A or 30 V DC, 1 A)

GOOD signal: Delivered after the test is done (in about 50 msec).

- o Lamp
- o Buzzer
- o Make contact signal (100 V AC, 1 A or 30 V DC, 1 A)

Remote control

The test/reset operation can be remote-controlled in the following cases:

- o When the remote control box (option) is used
- o When the high voltage test probe (option) is used.
- o When make-contact signal control is done with an external relay or other device
- o When low active control is done with logic elements

The input conditions of this instrument are as follows:

High level input voltage:	11 - 15 V
Low level input voltage:	0 - 5 V
Low level sweep-out current:	1 mA

*: Since the internal gate is pulled up with a resistor, a state equivalent to the high level input is obtained when the input terminals are made open.

Ambient temperature and himidity

Specification range: 5 to 35°C (41 to 95°F), 20 to 80% RH

Operable range: 0 to 40°C (32 to 104°F), 20 to 80% RH

Power requirements: 100 V ±10%, 50/60 Hz AC

Power consumption

No load (reset state): Approx. 15 VA

Full load (5 kV, 100 mA): Approx. 680 VA

Insulation resistance: 30 MΩ or over (500 V DC)

Withstanding voltage: 1000 V AC, 1 minute

Dimensions: 497 W × 280 H × 370 D mm
(19.57 W× 11.02 H × 14.57 D in.)

(Maximum dimensions): 500 W × 295 H × 410 D mm
(19.69 W × 11.61 H × 16.14 D in.)

Weight: Approx. 33 kg (73 lb.)

Accessories: Test leads (HTL-1.5A) ..... 1 set

Instruction manual ..... 1 copy

Options:

- Model 913A Remote Control Box

  Used being connected to the panel DIN connector, for remote control of test and reset operations.

- Model 914A Remote Control Box

  The test is turned on only when test buttons are pressed with both hands. Used when extra high operation safety is required.

- HTL-3W High Voltage Test Lead

  Test lead wire, approx. 3 m (9.8 ft) long

o HTP-1.5A High Voltage Test Probe

High voltage test probe designed for high operating safety and operability. Cable length approx. 1.5 m (4.9 ft).

3. PRECAUTIONS BEFORE USE

3.1 Unpacking and Inspection

The instrument is shipped after being fully adjusted and inspected at the factory. Upon receiving the instrument, immediately unpack it and check for any sign of damage caused while in transportation. If any damage is found, immediately notify the bearer or, if malfunctioning is found, notify the dealer.

3.2 Precautions for Operation

☐ Model 860A W/I Auto Tester has been designed with full attention to safety because this instrument handles a high voltage. Yet, as the instrument provides as high voltage as 5 kV to the external circuit, serious hazards are unavoidable unless the instrument is handled correctly. Be sure to observe the following when operating the instrument.

(1) Be sure to connect securely the GND terminal to a good grounding earth line. If grounding is imperfect, the instrument casing can be charged to the high voltage of the instrument when the output is shorted to the ground line or power line and hazards can be caused to the operator when he touches the instrument.

(2) The connection method of the test leadwire of the GND side is shown in Figure 3.1. Be sure to check for that this leadwire is not open, each time the instrument is used. Also be sure to connect at first the GND terminal to the ground line of the measured object. If it is not securely connected, the measured object becomes a floated state and a dangerously high voltage may be built up in the measured object.

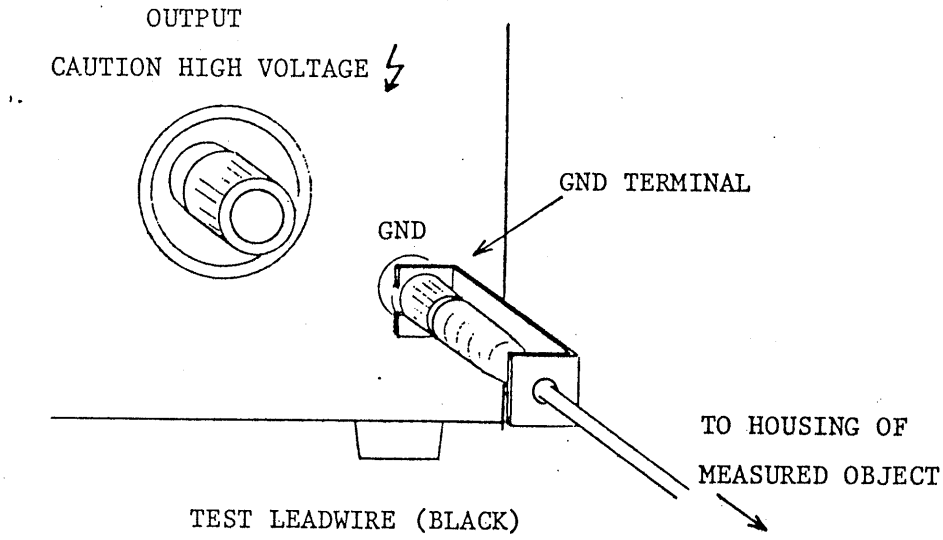


Figure 3.1

(3) Be sure to wear gloves whenever operating this instrument, in order to guard against electric shock hazards.

(4) Before turning on the power switch, make it sure that the TEST VOLTAGE dial is in the counterclockwise extreme position ("0" position).

(5) Except when test is being done, turn the TEST VOLTAGE dial to the counterclockwise extreme position ("0" position). Also, press the RESET (HV OFF) button for the sake of safety. Be sure to turn off the power switch each time the instrument is not used even for a short period of time or when the operator leaves the instrument.

(6) Before changing the voltage RANGE switch, make it sure that the instrument is in the reset state and the TEST VOLTAGE dial is turned to the counterclockwise extreme position ("0" position).

(7) Never touch the tested object, leadwires or the output terminals when the instrument is in the TEST ON state and the test voltage is being delivered.

(8) Before touching the test leadwires or output terminal, be sure to check the following:

(a) The output voltmeter indication is zero.

(b) The TEST ON lamp is off.

Also short the high voltage OUTPUT terminal to the GND terminal with the test leadwire of the GND terminal side.

(9) Do not short the output to the ground line or AC power line, lest the instrument housing should be charged up to a hazardously high voltage. It is permissible, however, to short the high voltage OUTPUT terminal to the GND terminal when the instrument housing is grounded to an earth line.

(10) In case of an emergency, immediately turn off the POWER switch and disconnect the AC power cord from the AC line receptacle.

(11) When the TEST ON lamp has failed and does not turn on, immediately replace it or contact Kikusui's agent in your area.

(12) When the instrument is remote controlled, the high voltage output is turned on and off with an external signal. When operated in this mode, be extremely careful so that the high voltage output is not turned on inadvertently.

☐ To operate the instrument in good conditions for a long time, pay attention to the following:

(1) When in the no-load state, the maximum output voltage of the instrument becomes higher than 5 kV. An output voltage higher than 5 kV may be produced also when the AC line voltage has surged up. Operate the instrument with an output voltage not higher than 5 kV, whenever possible.

(2) The heat dissipation capacity of the transformer of this instrument is for one-half of the rated output, from the viewpoints of size, weight and cost. Therefore, continuous operation when set at the 100-mA leak current range must not exceed 30 minutes (at ambient temperature 40°C (104°F)). If more test time is required, pause the instrument for the same period that it has been used and, then, resume operation. This requirement does not apply when the leak current range is 10 mA or less.

(3) This instrument operates normally with an AC power line voltage range of 100 V ±10%. If the AC line voltage is not within this range, the instrument operation becomes unstable and damage may be caused to the instrument. When the AC line voltage in your area is not within this range, step it up or down into this range using an appropriate device.

(4) Do not use or store the instrument in direct sunlight, in high temperature or humidity, or in dusty atmosphere.

☐ This instrument employs a high voltage output transformer of 500 VA. Therefore, a large input power current (several tens amperes) may flow for several tens milliseconds before the NG signal is detected and the output current is cut off when an overcurrent has flowed in the load being tested. Pay attention to the AC line capacity taking also into consideration the other instruments and devices connected to the same AC power line.

4. OPERATION INSTRUCTIONS

4.1 Description of Front Panel

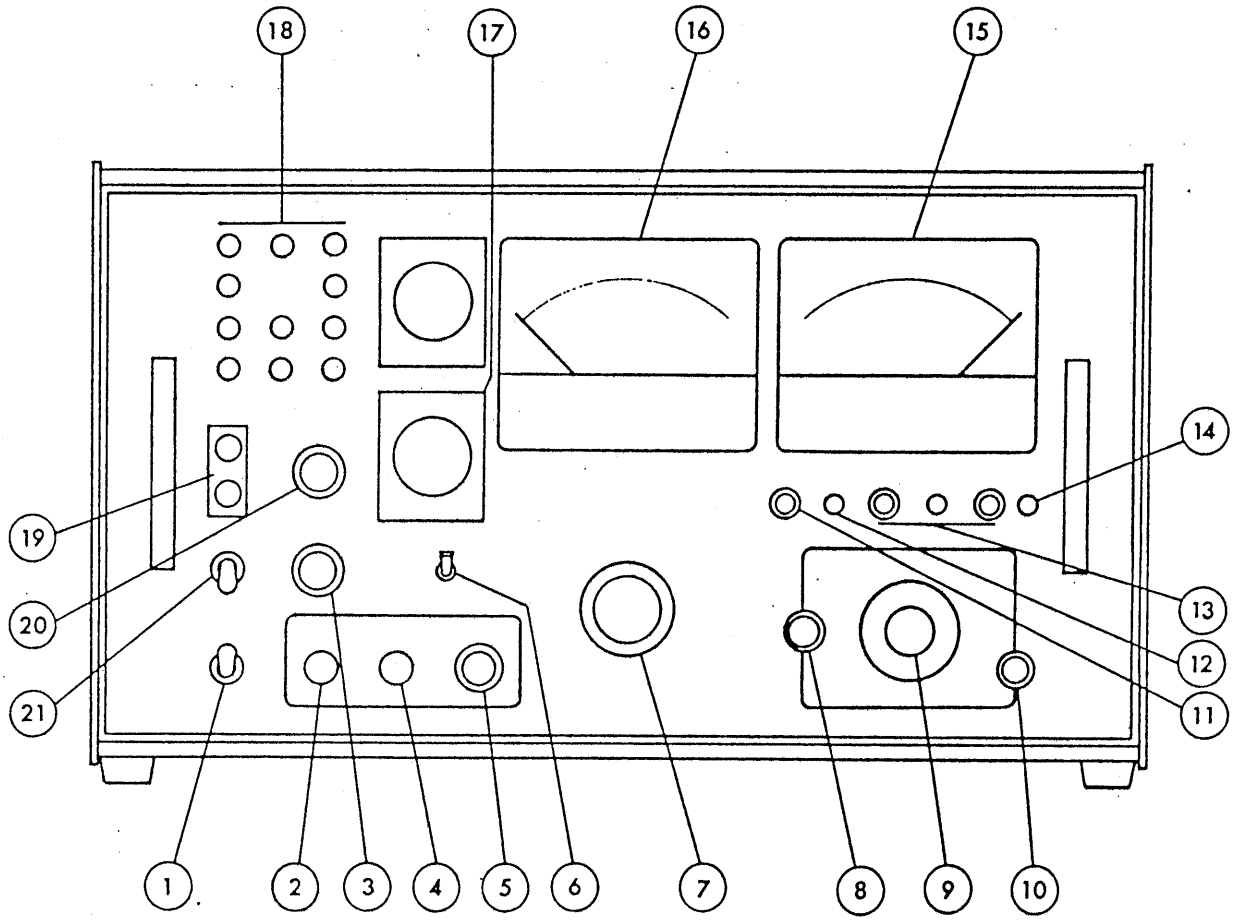


Figure 4.1

(1) POWER (ON/OFF) switch:

Main power switch of instrument. Before turning on this switch, be sure to read Section 3.2 "Precautions for Operation."

② REMOTE CONTROL connector:

When the instrument is remote controlled, the cable of the remote control box is connected to this connector.

③ FUNCTION selector switch:

When in the automatic test mode, this switch is used to set the order of withstanding voltage test and insulation resistance test. When in the automatic test mode, this switch is used to select either one of the two types of tests.

④ RESET button (HV OFF):

To cut off the HV output when in test operation, press this button. This button is used also to reset the NG alarm state or the PROTECTION state.

⑤ TEST button:

As you press this button when the instrument is in the reset state, ⑧ TEST ON lamp lights and the test as selected by ③ FUNCTION selector switch is performed by delivering to the output terminal the test voltage corresponding to the type of test selected.

⑥ TIMER ON/OFF switch:

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

⑦ TEST VOLTAGE dial:

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

⑧ TEST ON lamp:

This red lamp indicates that the test voltage can be delivered to the OUTPUT terminal or the test voltage is being delivered.

⑨ OUTPUT terminal:

The hot line of the test voltage.

⑩ GND terminal:

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

⑪ ZERO ADJ control:

Semi-fixed potentiometer for electrical zero adjustment of insulation resistance meter.

⑫ I TEST VOLTAGE (1000V/500V) selector switch:

Switch to select a test voltage for insulation resistance test.

⑬ REFERENCE SET switch:

This switch is for setting of GO-NOTO judgement reference value for insulation resistance test. Normally, the switch is set in its center position and the measured resistance is indicated by ⑮ ohmmeter. When the switch is thrown to the left-hand position, the low-limit reference value for GO-NOGO judgement is indicated; when it is thrown to the right-hand position, the high-limit reference value is indicated. Reference value setting is done with the semi-fixed potentiometers at right and left of the switch.

⑭ UPPER ON/OFF selector switch:

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

⑮ Ohmmeter:

Indicates the resistance measured in insulation resistance test.

⑯ Voltmeter:

Indicates the output voltage (test voltage) when in withstanding voltage test.

⑰ Timers:

For test time setting, mutually independently for withstanding voltage test and insulation resistance test.

⑱ Indicator lamps:

- o AUTO TEST: Identifies between automatic test and single test. This lamp turns on when in the automatic test mode. When in the single test mode, either the W TEST lamp or the I TEST lamp turns on.
- o W TEST: Turns on when in the withstanding voltage test mode.
- o 5kV/2.5kV: Indicate the output voltage range being used for the withstanding voltage test.
- o I TEST: Turns on when in the insulation resistance test mode.

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

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

- o PROTECTION: When in any of the following cases, this lamp lights and the output is cut off.

  (1) When (21) RANGE switch of the withstanding voltage tester is changed.

  (2) When (12) I TEST VOLTAGE (1000V/500V) selector switch is changed.

  (3) When (2) REMOTE CONTROL connector is disconnected and then connected. (However, this lamp does not light when a connector which meets the requirements of reset condition is connected.)

  (4) After turning on the power switch, when it is turned off and then (within a short period of time) it is turned on again.

  (5) When both withstanding voltage test and insulation resistance test occurred at the same time due to failure of the instrument.

When this lamp is on, the instrument is in the PROTECTION state and it does not perform any test operation even if you press the TEST button. In such a case, press once the RESET button and then press the TEST button. If the lamp does not go off even when you have pressed the RESET button, the most probable cause is the abnormal state of Item (5) above. Immediately stop using the instrument.

⑲ CURRENT MONITOR terminals:

The leak current can be directly monitored by disconnecting the shorting bar from these terminals and connecting a milliammeter between them. The milliammeter should be capable of measuring the current set by ⑳ LEAK CURRENT dial. The upper terminal is connected to the instrument chassis. Be sure to connect the shorting bar when the current is not measured.

⑳ LEAK CURRENT dial:

Sets the reference value for leak current detection. The value can be set at 0.5, 1, 2, 5, 10 or 100 mA. If a leak current larger than the set value flows in the tested object, judgement is done to be NG and the output is instantaneously cut off. The dial should be set at a value corresponding to the requirement of the tested object.

㉑ RANGE (5kV/2.5kV) switch:

Selects the test voltage range (5 kV range or 2.5 kV range).

4.2 Description of Rear Panel

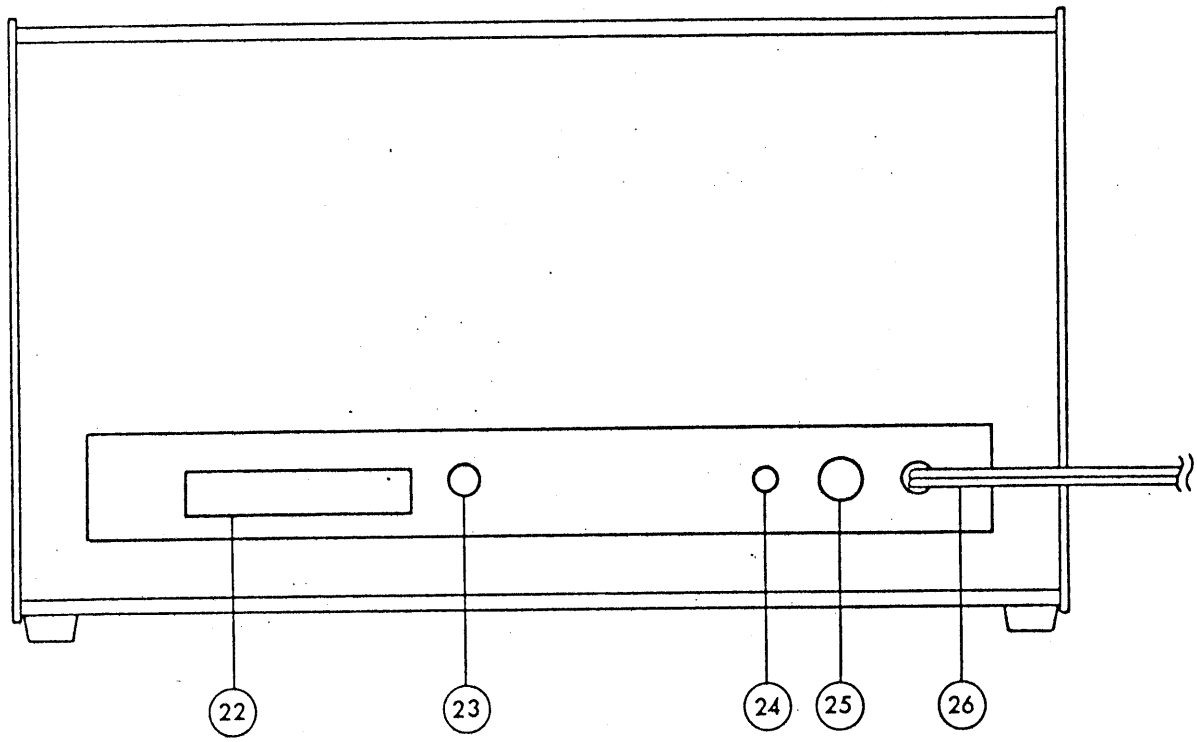


Figure 4.2

(22) Signal output terminals:

Provide various make-contact signals (each contact is made when its signal is generated and it is broken when its circuit is reset). The contact rating is 100 V AC, 1 A or 30 V DC, 1 A.

o GOOD signal:

The GOOD signal is generated if no NG signal is generated until the end of the automatic test or the single test. This terminal is for this GOOD signal. While the NG signal lasts continuously, the GOOD signal lasts only for

about 50 msec. The GOOD signal is not generated when the single test is done without using the timer.

- o I/NG signal:

  This terminal delivers the NG alarm signal for the insulation resistance test.

- o W/NG signal:

  This terminal is for the NG alarm signal for the withstanding voltage test.

- o TEST ON signal:

  This terminal is for the signal to indicate that the test is being performed.

(23) BUZZER loudness control:

Controls the loudness of sound of the buzzer which sounds continuously for an NG alarm or only for about 50 msec for a GOOD judgement signal.

(24) GND terminal:

To ground the instrument to an earth ground.

(25) Fuse:

Fuse of the AC power line (7 ampers)

(26) AC power cord

4.3 Operating Procedures

☐ Procedure Before Test

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

(2) After thoroughly reading and noting the items of Subsection 3.2 "Precautions for Operation," turn on ① POWER switch.

(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.

☐ Single Withstanding Voltage Test

(1) Selecting the withstanding voltage test:

Set ③ FUNCTION selector switch in the MANUAL W TEST position. The W TEST indicator lamp will light.

(2) Selecting the test voltage range:

Select the required test voltage range (2.5 kV or 5 kV) with ㉑ RANGE switch. The corresponding indicator lamp will light.

(3) Setting the leak current limit reference value:

With ⑳ LEAK CURRENT dial, set the leak current limit reference value as required by the tested object.

(4) Setting the test time:

Set the test time as required by the tested object, with the WITHSTANDING knob of ⑰ TIMERS.

(5) Setting the test voltage:

Set ⑥ TIMER ON/OFF switch in the OFF state, press the RESET button, check that ⑦ TEST VOLTAGE dial is at the counterclockwise extreme position, and then press the TEST button. Gradually turn clockwise ⑦ TEST VOLTAGE dial to set the required test voltage. Press the RESET button to cut off the output and then set ⑥ TIMER ON/OFF switch in the ON state.

(6) Connecting the tested object:

After making sure that the output voltmeter and the TEST ON lamp are in the below-mentioned states, short the high voltage OUTPUT terminal to the GND terminal with the test leadwire of the GND terminal. Next, connect the test leadwire of the GND terminal to the tested object. Then, connect the test leadwire of the high voltage side to the tested object.

- o The output voltmeter indication is "0".
- o ⑧ TEST ON lamp is off.

(7) Test procedure:

(a) If the PROTECTION one of ⑱ indicator lamps is on, press the RESET button to reset the instrument. Then press the TEST button to start the test operation. If the instrument has already been in the reset state, press directly the TEST button to start the test operation.

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

(c) When a leak current larger than the limit value set by (20) LEAK CURRENT dial has flowed, the NG judgment is done and the output is instantaneously cut off and the NG alarm signals with a lamp, buzzer and make-contact are generated. Different from the case of the GOOD signal, the NG alarm signals continue until the instrument is reset or the PROTECTION condition is applied. To reset the NG alarm signals, press the RESET button.

(8) Fully manual test without using the timer

(a) The timer of the instrument is for 10 seconds maximum. When a test time longer than this is needed, apply the test voltage without using the timer. When test is done with (20) LEAK CURRENT RANGE 100 mA setting, however, a continuous test of up to 30 minutes can be done.

(b) Set (6) TIMER ON/OFF switch to the OFF position.

(c) Connect the tested object to the output terminal of the instrument as is the case for the Single Withstanding Voltage Test.

(d) Check that (7) TEST VOLTAGE dial is at the counter-clockwise extreme position and then press the TEST button. (8) TEST ON lamp will light to indicate that the test voltage is ready to apply. Gradually turn clockwise (7) TEST VOLTAGE dial until the necessary test voltage is obtained. When the required test time has elapsed, press the RESET button. The output voltage will be cut off and the test will end. In this case the GOOD signal is not generated.

(e) If the NG alarm signal is generated in the above test, the instrument operations are the same with that when the test is done using the timer.

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

If the instrument is in the reset state, the test voltage as set by (7) TEST VOLTAGE dial is delivered to the output terminal simply by pressing the TEST button. If the instrument is generating the NG alarm signal or is in the PROTECTION state, press the RESET button to reset the instrument. If the GOOD judgment is done at the end of the test, the auto reset circuit operates and the instrument is automatically reset.

☐ Single Insulation Resistance Test

(1) Setting for insulation resistance test:

Select the MANUAL I TEST mode with (3) FUNCTION selector switch. The I TEST indicator lamp will light.

(2) Zero ohm adjustment:

Set (6) TIMER ON/OFF switch to the OFF position, short the high voltage terminal to the GND terminal, press the RESET button and then press the TEST button. The ohmmeter pointer will indicate a position near the zero scale position. Adjust the pointer accurately to the zero scale position by means of (11) ZERO ADJ semi-fixed potentiometer.

(3) Setting the test voltage:

Set the test voltage as required by the tested object, by means of (12) I TEST VOLTAGE 1000V/500V switch.

(4) Setting the GO-NOGO judgment reference value:

(a) The GO-NOGO judgment of this instrument is done in such window comparator system that the GOOD judgment is done only when the measured value is between the high and low limit reference values. The NG judgment is done 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 in such case that the insulation resistances of tested objects are predicted to be substantially ununiform. To test such objects, the high limit reference value may be set at a value slightly higher than the predicted highest value of the objects and the test may be done in the window comparator system. When this is done, objects of exceptionally high insulation resistances can be identified and open-circuiting of leadwires and imperfect contacting also can be detected, thereby attaining still better withstanding voltage test and insulation resistance test.

(b) Normally, (13) REFERENCE SET switch is set in its center position. When the switch is in this state and the insulation resistance test is done, the measured value is indicated by the ohmmeter. When in other test than the insulation resistance test, the ohmmeter pointer remains at the infinitive resistance position.

(c) If (13) REFERENCE SET switch is thrown to the left hand position, the ohmmeter indicates the low limit reference value; if it is thrown to the right hand position, the ohmmeter indicates the high limit reference value.

(d) The high and low limit reference values can be set with the semi-fixed potentiometers located at right and left of (13) REFERENCE SET switch. Set the values as required by the tested objects.

(e) For some types of tests, it may be undesirable to perform high limit judgment. In such cases, set (14) UPPER ON/OFF switch in the OFF state.

When the low limit judgment is not required, turn the low limit reference value setting semi-fixed 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 (6) TIME ON/OFF switch in the ON state. Set the test time as required by the tested object (within a range of 0.5 to 10 seconds) with (17) INSULATION timer.

(6) Connecting the tested object:

Connect to the instrument the object to be tested, in the same manner as in the case of withstanding voltage test.

(7) Test procedure;

(a) If (18) PROTECTION indicator lamp is on, press the RESET button to reset the instrument. If the instrument has already been in the reset state, the test can be immediately started simply by pressing the TEST button.

(b) If the tested object satisfies the conditions of GOOD judgment set for GO-NOGO test in Item (4), (15) ohmmeter will indicates the measured resistance. When the preset time has elapsed, the test voltage is cut off, the

tested object is judged to be good, and the instrument will generate the GOOD signals with the lamp, buzzer and make-contact for approximately 50 msec.

(c) If the tested object does not meet the above-mentioned test conditions, the NG judgment is done and the output is instantaneously cut off and the NG alarm signals are generated. The alarm signals are 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 signals, press the RESET button.

(8) Fully manual test without using the timer:

Set (6) TIMER ON/OFF switch to the OFF state. When this is done, the insulation resistance test can be done irrespective of the timer as is the case for the withstanding voltage test. If the instrument 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 cut off and the test ends.

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

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

☐ Automatic Test

(1) Automatic withstanding voltage and insulation resistance tests:

This instrument is capable of performing the withstanding voltage test and insulation resistance test continuedly. Selection for which one of the two tests is to be done first can be made with (3) FUNCTION selector switch by setting it to the "W → I" or to the "I → W" position. When

in the automatic test mode, ⑱ AUTO indicator lamp will light. Letter "W" stands for the withstanding voltage test and letter "I" for the insulation resistance test.

(2) Setting the test conditions:

Set the test voltage, current detection reference value, test time, and insulation resistance judgment reference values as is the case for the single test.

(3) Connecting the tested object:

Connect the tested object to the output terminal of the instrument as is the case for the single test.

(4) Test procedure:

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

(b) If the tested object meets all the test conditions, the GOOD signals are generated at the end of the test. The signals are the same with those for the single test.

If the tested object does not meet any of the test conditions, the output voltage is instantaneously cut off and the NG signals are generated. The signals are the same with those for the single test.

(5) To interrupt the test:

To interrupt the test being performed, press the RESET button. The output voltage will be instantaneously cut off and the instrument will be reset.

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

When the test is over with the GOOD judgment, the instrument generates the GOOD signals for approximately 50 msec and then resets itself. The next test can be resumed simply by pressing the TEST button. When the instrument has generated the NG signals, set once the instrument in the reset state and then press the TEST button.

☐ Remote Control

This instrument can be remote-controlled with the remote control box (option). As the plug of the remote control cable is connected to (2) REMOTE CONTROL connector on the instrument front panel, the internal circuit is automatically switched to the remote operation mode. In this case, the TEST button on the instrument front panel becomes idle, although the reset operation can be done either at the instrument front panel or at the remote control box.

It also is possible to remote-control the instrument without using the remote control box. This method is explained below. 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 the operator's body is not contacted with the output terminal or the test lead-wire when the test voltage is being delivered. When these measures are unavailable, do not use the following remote control method.

(a) By controlling the TEST and RESET contacts shown in Figure 4.3, the test voltage can be on-off controlled in the same manner as done at the instrument front panel.

(b) In the case of the setup shown in Figure 4.4, the test voltage is turned on when the switch is thrown to the NO Position, and instrument is forcefully reset when the switch is returned to the NC position.

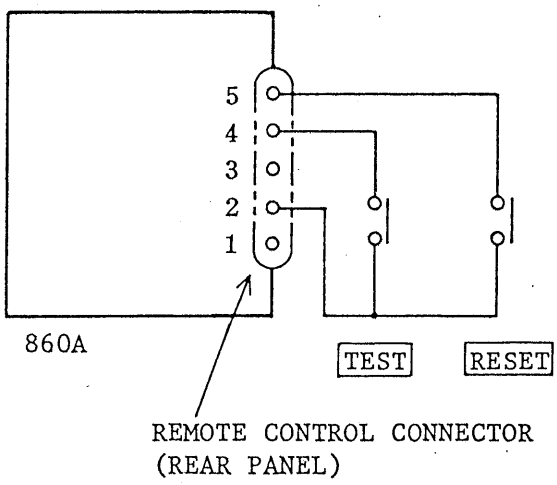


Figure 4.3

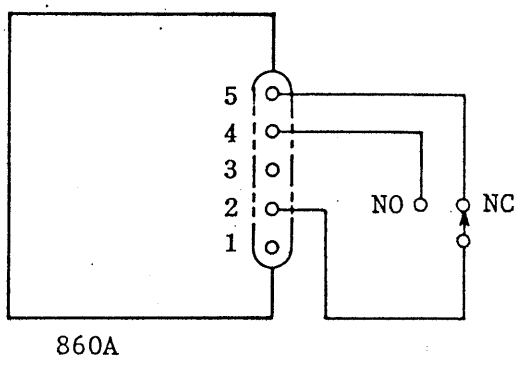


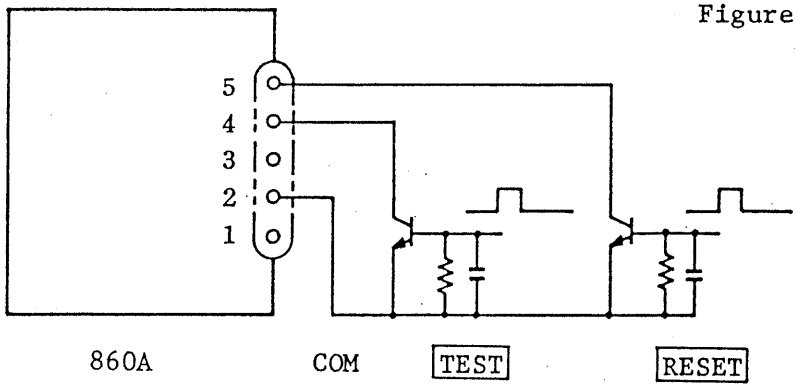
Figure 4.4

(c) Logical elements or transistors may be used instead of the switches in Figure 4.3. The signal status for such operation is shown in Figure 4.5. The input conditions of this instrument for such operation are as follows:

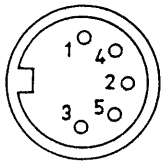
- o High level input voltage: 11 - 15 V
- o Low level input voltage: 0 - 5 V
- o Low level sweep out current: 1 mA

The internal gate is pulled up to +15 V with resistors. Pay attention to the withstanding voltage rating of the transistors used.

Figure 4.5



(d) Note that the layout of pins of the REMOTE CONTROL connector is as per DIN standard and is not in the due order of number progression, as shown in Figure 4.6.



Layout of connector pins as viewed from outside

Figure 4.6

☐ Contact Signal Outputs

(1) This instrument provides four types of make-contact signals for external use as follows:

- o GOOD signal: This signal is generated when the GOOD judgment is done at the end of a single test or at the end of the latter one of automatic tests. The signal lasts for approximately 50 msec.
- o I/NG signal: This signal is generated when the NG judgment is done when in the insulation resistance test. This signal continues until the next reset signal is applied or the PROTECTION signal is generated.
- o W/NG signal: This signal is generated when the NG judgment is done when in the withstanding voltage test. The conditions of resetting the signal are the same as above.
- o TEST ON signal: This signal is generated and remains on for the entire period of either the single test or the automatic test.

(2) The contact signals are only with contacts and without any power sources. Therefore, they cannot drive any loads which have no power.

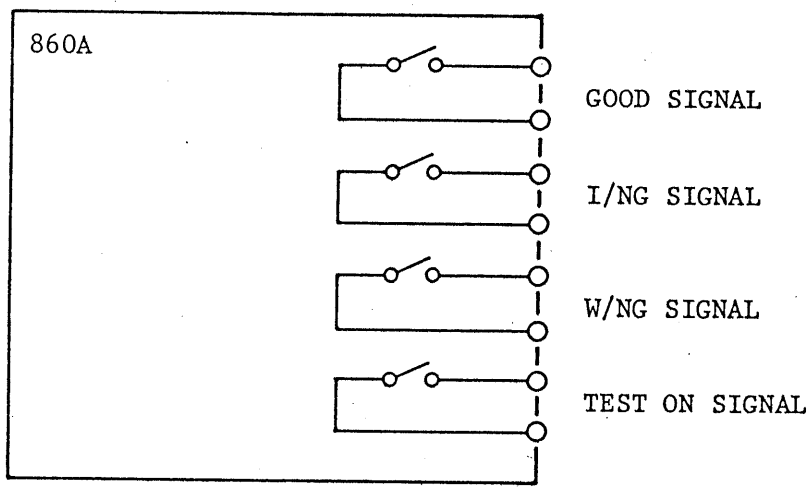


Figure 4.7

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 this instruments are of the make-contact type and their rating is 100 V AC, 1 A or 30 V DC, 1 A.

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

(a) To drive a buzzer with the NG signal:

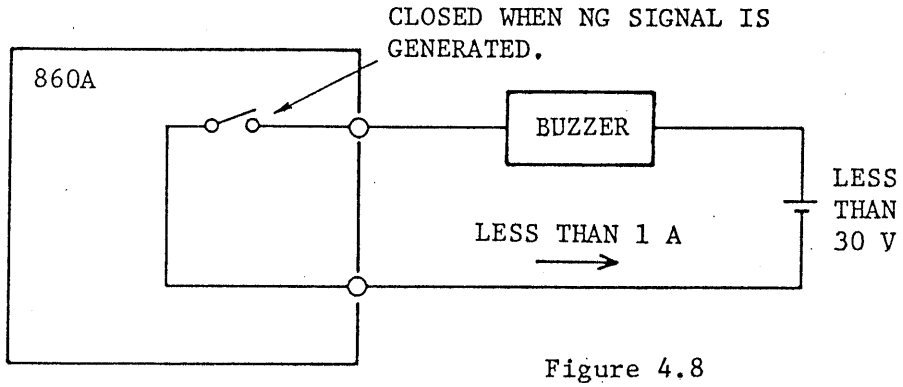


Figure 4.8

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

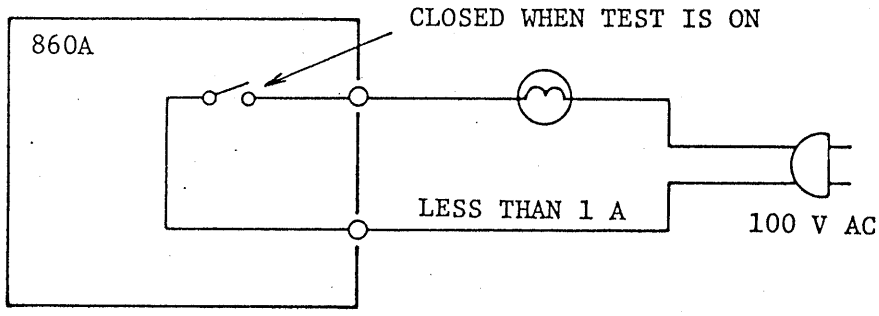


Figure 4.9

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

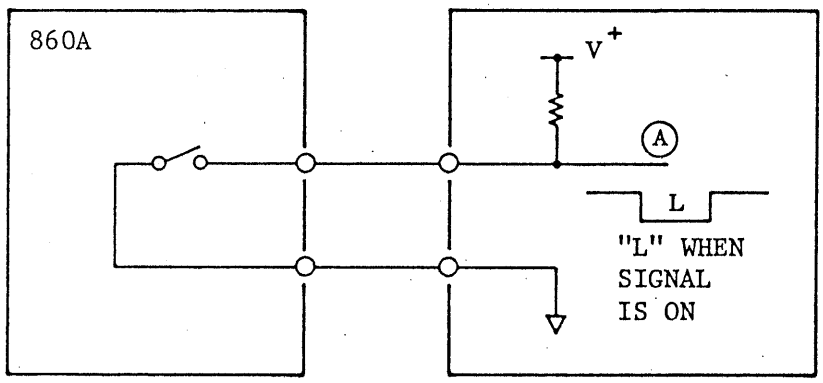


Figure 4.10

In the above illustration, an "L" level signal is obtained at point Ⓐ when the contact output signal is on. However, since the signal obtained at point Ⓐ 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.

5. OPERATING PRINCIPLE

5.1 Block Diagram

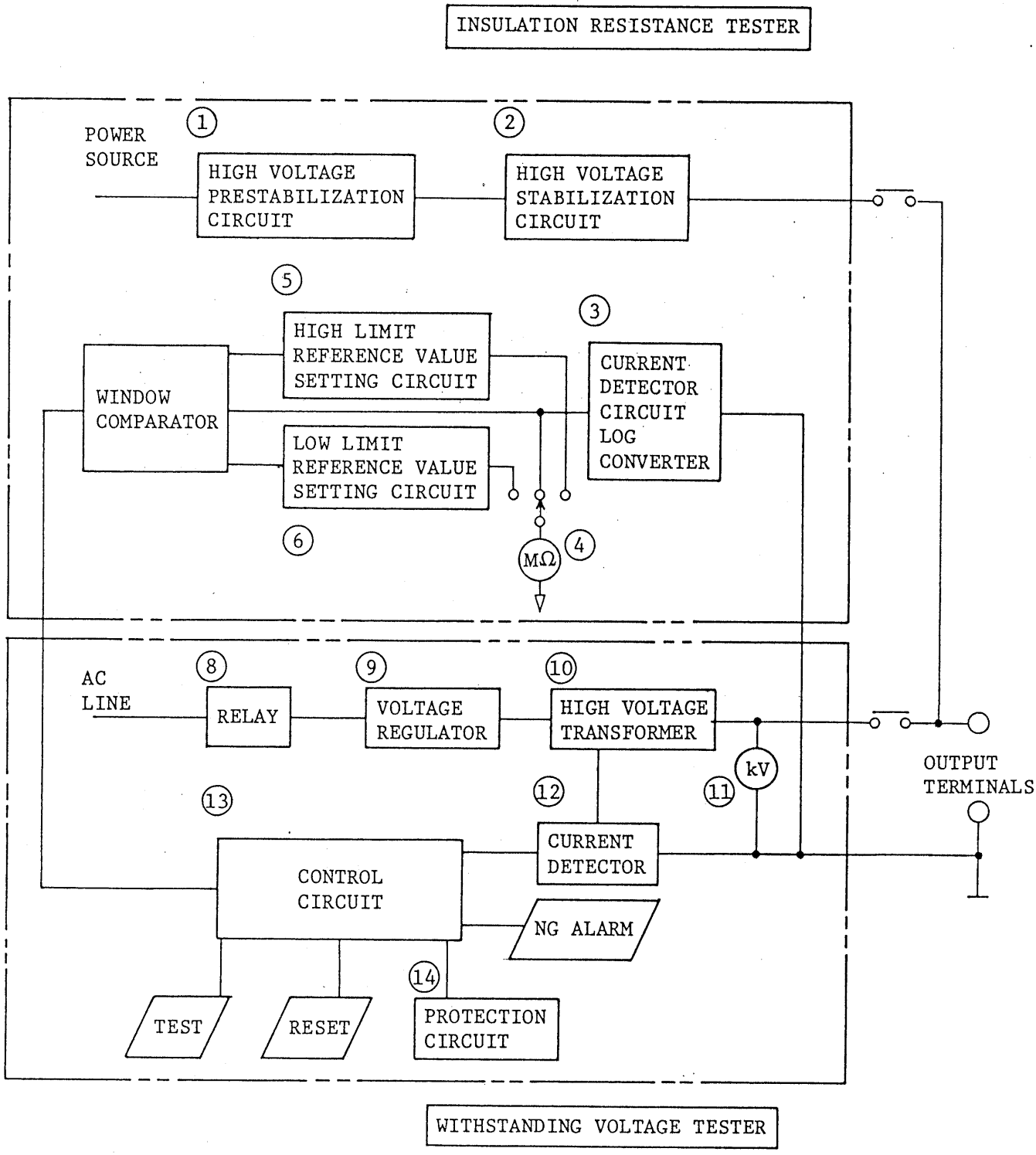


Figure 5.1

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 voltage to the object to be tested. 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 tested object varies ranging from less than 1 microampere to greater than several milliamperes. 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 tested object.

⑤ High limit reference value setting circuit:

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

⑥ Low limit reference value setting circuit:

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

⑦ Window comparator:

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

⑧ Relay:

On-off controls the power applied to the voltage regulator for withstanding voltage test. A solid-state zero-turn-on type relay circuit is employed to minimize transiential spike voltages caused when the power is turned on and 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 instrument. Fabricated in high-reliability logic circuits with CMOS IC.

⑭ Protection circuit:

Various protective features are incorporated for the safety of test.

5.3 Zero-turn-on 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 may be are produced, thereby applying an unjustifiedly high voltage to the tested object and causing a possibility of rejecting an acceptable tested object. The zero-turn-on switch, which employ a solid-state switching circuit, turns on and off the power line at approximately 0 volt level, thereby reducing transiential overshoots.

However, if the tested object is connected under the state that the test voltage is being delivered, spikes are produced at the instant of contacting and the effect of the use of the zero-turn-on switch is lost. It also is dangerous. Be sure to turn on or off the test voltage using the TEST and RESET buttons after the tested object is securely connected.

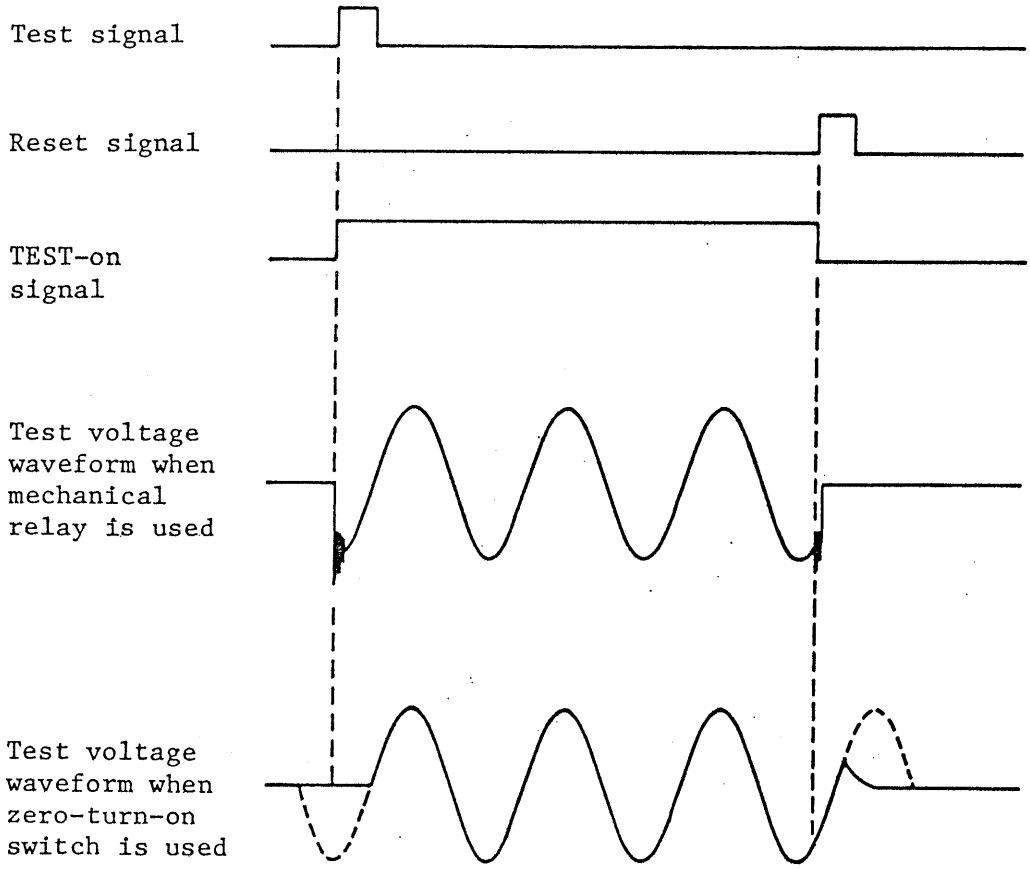


Figure 5.2

5.4 Regulation Provision of Instrument

In order to prevent hazards to the operator and damage to the tested object, excessive regulation of the instrument is suppressed by connecting a 5-ohm 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 100 mA 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 Judgment in Insulation Resistance Test

When a test voltage is applied to a tested object which has a larger capacitance, a larger charge current will flow at the initial short period and the resistance of the tested object may be indicated lower than the actual value. In order to eliminate such period from the GO-NOGO judgment period, a time delay 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 is lost. Be sure to set the timer at a period longer than 0.5 seconds.

6. MAINTENANCE

Hazardously high voltage of a level of 5 kV is generated within this instrument. Never attempt to calibrate, check or repair the instrument by yourself. For such service, contact your Kikusui agent.

7. OPTIONS

The following options are available for this instrument.

7.1 Model 913A Remote Control Box

For remote control of test and reset operations.

Specifications

Functions

OPERATE switch:

The TEST button is effective only when this switch is ON. By turning OFF this switch, the output voltage is forcefully reset.

TEST button:

The test voltage is delivered as this button is pressed when the OPERATE switch is ON and the instrument is in the reset state.

RESET button:

This button is used to cut off the test voltage or to reset the NG alarm.

Dimensions: 150 (W) × 70 (H) × 40 (D) mm
(5.90 (W) 2.56 (H) 1.58 (D) in.)

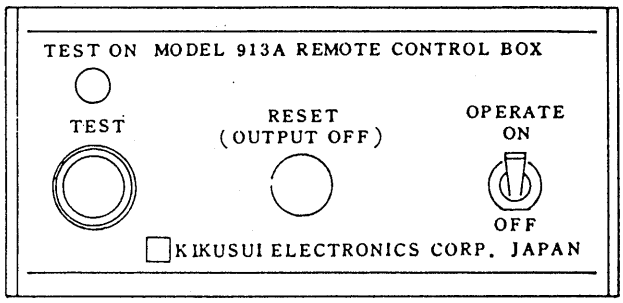


Figure 7.1

7.2 Model 914A Remote Control Box

With this control box, the test voltage is delivered only when the two test buttons are pressed simultaneously.

Specifications

Functions:

Has two TEST buttons and the output voltage is delivered only when the two buttons are pressed concurrently. Other functions are the same as those of Model 913A.

Dimensions: 280 (W) × 70 (H) × 40 (D) mm
(11.0 (W) 2.6 (H) 1.6 (D) in.)

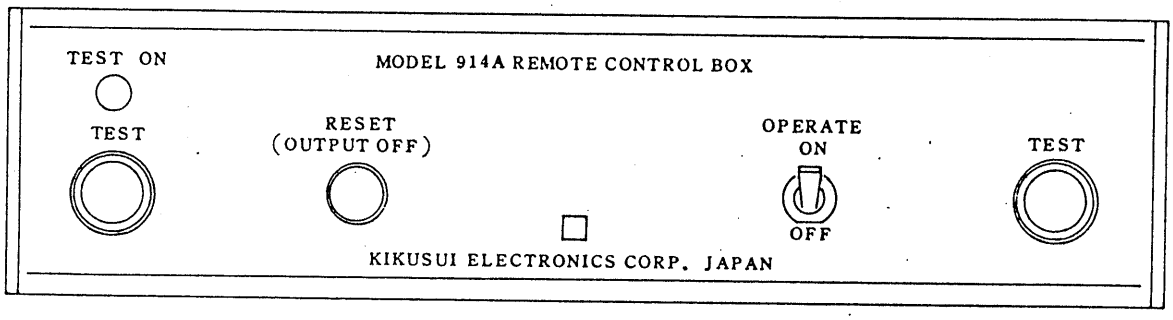


Figure 7.2

7.3 HTL-3W High Voltage Test Leadwire

A high voltage test leadwire approximately 3 m (4.9 ft.) long

7.4 HTP-1.5A High Voltage Test Probe

The HTP-1.5A is designed for high operation safety, yet maintaining good operability. The test switch can be pressed only after holding the grip, thereby preventing inadvertent turning on of the test voltage. When the test switch is released, the test voltage is reset forcefully.

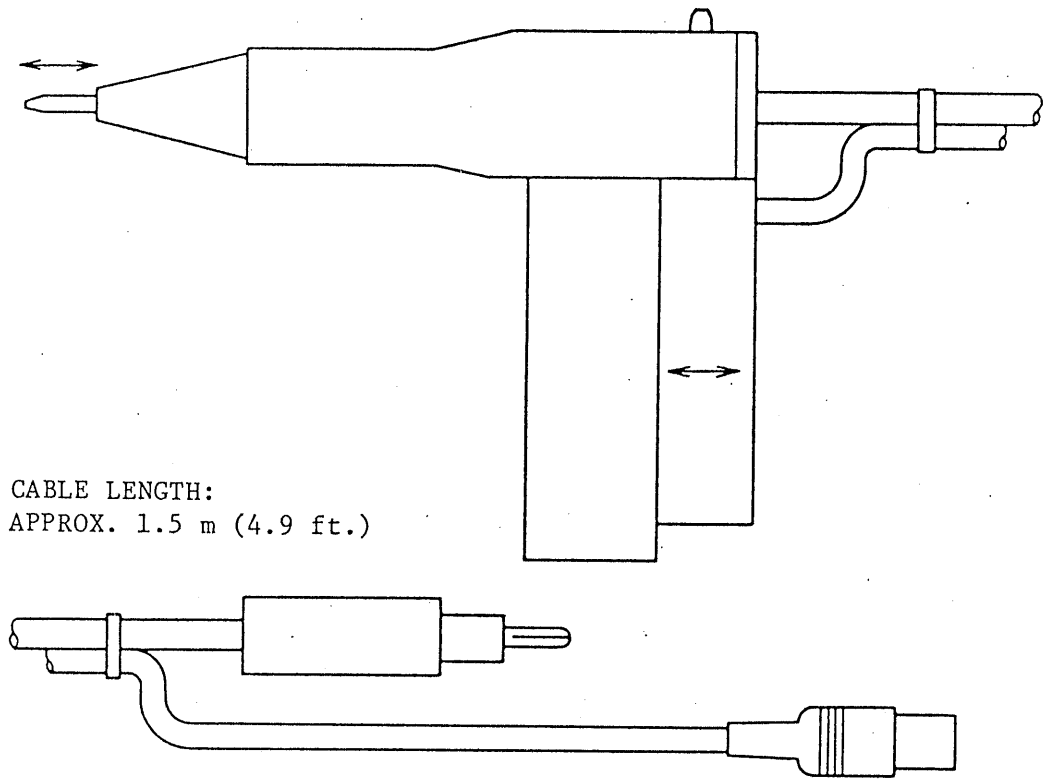


Figure 7.3