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AC LOW OHM TESTER (EARTH CONTINUITY TESTER)

TOS6100

OPERATION MANUAL



Part No. Z1-212-120, IB001133

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Power Requirements of this Product

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

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

Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

Input fuse

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

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

AC power cable

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

WARNING

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

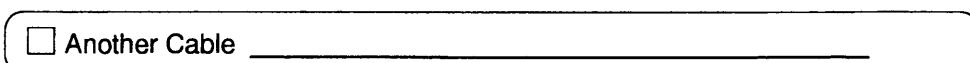
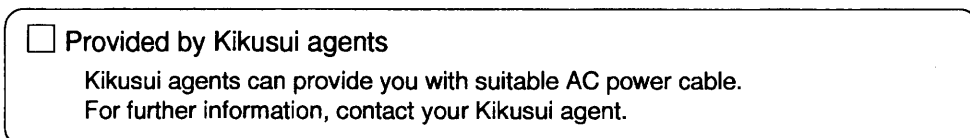
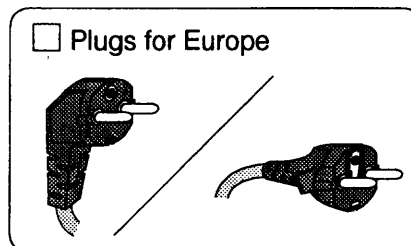
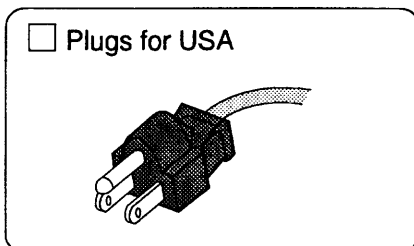
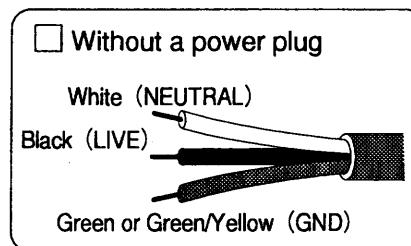
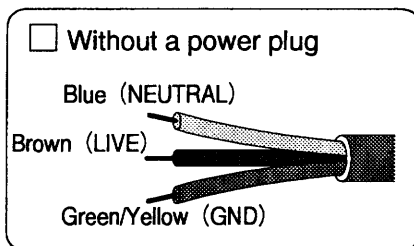


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1. GENERAL DESCRIPTION

The TOS6100 is an AC low ohm tester (earth continuity tester) conforming to such safety regulations as IEC, BS, VDE, AS, and JIS, and it is used for the earth connection low resistance test on the Class I electric devices.

The TOS6100 can be used for most of regulations because its test current can be set freely within the range from 3A to 30A. As to the measurement range, 0.1 Ω range or 0.5 Ω range can be selected (when 0.1 Ω range is selected, the resistance of 0 - 0.12 Ω can be measured; when 0.5 Ω range is selected, 0 - 0.6 Ω can be measured.) Since this instrument has such additional functions as PASS-FAIL judgment function, subtraction function, and test current monitoring function, it can be used for the tests requiring various conditions.

Further, the TOS6100 can greatly contribute to test automatization and labor economization because it can output various signals such as "TEST", "PASS", "FAIL", and "READY" and its start/stop operation can be remote-controlled.

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2. SPECIFICATIONS

Resistance measurement range		0 - 0.12Ω/0 - 0.6Ω Two ranges
	Accuracy	3 - 5A: ±10% f.s 5 - 30A: ± 5% f.s
Test current		3 - 30A AC Adjusted by dial on panel
	Output	Maximum current: 30A AC Maximum voltage: 8V AC These values are obtained when the line voltage is the center value of each input voltage range. Note: These values cannot be obtained at the same time.
Output ammeter	Scale	0 - 30A AC
	Accuracy	±5% f.s
	Indication	Mean-value response, effective-value scale graduation
PASS-FAIL judgment function	Judgment method	<ul style="list-style-type: none"> ○ If the measured value is greater than the reference value, FAIL judgment is made, FAIL alarm is output, and output is cut off. ○ If no errors are found during a predetermined period of time, PASS judgment is made and a PASS signal is output.
	Reference value setting range	The reference value can be set within the range from 5% to 100% of the measurement range.
	Accuracy of judgment	3 - 5A: ±15% f.s for reference value 5 - 30A: ±10% f.s
Subtraction function		<ul style="list-style-type: none"> ○ A predetermined value can be subtracted from the measured value, and the result of subtraction can be displayed. ○ The result of subtraction can be compared with a PASS-FAIL judgment reference value, and the result of comparison can be used for the PASS-FAIL judgment.

Subtraction function (cont'd)			
	Subtraction range	0 - 0.1Ω	
	Subtraction error	Less than ±5% of full scale (Added to measurement accuracy or PASS-FAIL judgment accuracy)	
Test current monitoring function		<ul style="list-style-type: none"> ○ The test current can be monitored during test. ○ If the test current goes out of the allowable range (approximately ±10% of the monitoring reference value), a WARNING alarm is raised. ○ The monitoring reference value can be set freely within the range from 3 A to 30A. ○ The user can choose whether to continue or stop the test when the alarm is raised. 	
Test time		0.5 seconds to 10 minutes (with 4-range timer)	
Remote control	Start/stop operation	<ul style="list-style-type: none"> ○ Low active control ○ Input conditions <ul style="list-style-type: none"> - High level input voltage: 11 - 15V - Low level input voltage: 0 - 4V - Low level sweepout current: 2 mA or less - Input signal time width: 20 ms minimum <p>Note: The input terminal is pulled up to the +15V power source by a resistor. Opening of the input terminal is equivalent to input of high level voltage.</p>	
Signal output	Signal type	Condition for signal output	Signal description
	TEST	In the testing period	Make-contact signal and lamp
	PASS	Approx. 50ms when judged PASS	Make-contact signal, lamp, and buzzer

Signal output (cont'd)	FAIL	Continuous when judged FAIL	Make-contact signal, lamp, and buzzer
	WARNING	Refer to section on test current monitoring function	Make-contact signal and lamp
	READY	In the ready mode	Make-contact signal
	MONITOR	Always output	0 - 10V DC
<p>Notes: (1) The rating of the contact is 1A at 100V AC or 1A at 30V DC.</p> <p>(2) The loudness of buzzer for PASS signal and that for FAIL alarm can be adjusted by the same dial.</p> <p>(3) The MONITOR output signal is a DC voltage signal which represents the reading of the ohmmeter. The scale of this signal is as follows:</p> <p style="padding-left: 40px;">0.5Ω range: 10V/0.5Ω</p> <p style="padding-left: 40px;">0.1Ω range: 10V/0.1Ω</p> <p>The absolute value of the error of the above output voltage is 5% of the output value or 50 mV, whichever larger.</p>			
Ambient conditions	Specification temperature and humidity	5 - 35°C/20 - 85% r.h	
	Operating temperature and humidity	0 - 40°C/20 - 90% r.h	
	Storage temperature and humidity	-20 - 70°C, 90% r.h or less	
EMC	*1 *2	Comply with the following standards European community Requirements (89/336/EEC) EN55011 Radiated Emissions Class A Conducted Emissions Class A EN50082-1 IEC801-2 Electro-static Discharge IEC801-3 Radiated Susceptibility IEC801-4 Fast Burst Transient	

3. PRECAUTIONS BEFORE USE

3.1 Unpacking and Inspection

The Tester is shipped from the factory after full mechanical and electrical test and inspection to confirm its correct operation and guarantee its quality. Immediately after receiving the Tester, inspect it for any damages that may have been caused during transportation.

Should any damages be found, notify the dealer.

3.2 Precautions for Operation

- (1) The Tester can be used in the voltage ranges listed in the table below. Select the appropriate voltage range by the voltage selecting plug on the rear panel.

Before connecting the AC power cord, confirm that the setting of the voltage selection plug matches the actual AC line voltage.

When changing the voltage range, change the fuse also according to the table below.

If the Tester is not used within the allowable voltage range, incorrect operation or failure may occur.

Plug position	Center voltage	Voltage range	Fuse
A	100V	90 - 110V	3A (S.B)
B	115V	104 - 125V	
C	215V	194 - 236V	1.6A (S.B)
D	230V	207 - 250V	

- (2) When the Tester is in the test-on state, do not connect/disconnect the tested object to/from the Tester because the spark caused by the connection/disconnection may burn the surface of the tested object. Be sure to turn off the output before the connection/disconnection.

- (3) The value of test current is determined by the TEST CURRENT dial and resistance of the tested object. Therefore, if the amount of the current to flow is unknown because the resistance of the tested object is undefined, turn the TEST CURRENT dial counterclockwise fully (up to the "0" position), press the START button, and select the proper test current by slowly turning the dial clockwise.

Be sure to set the test current to less than 30A. If a test is executed with the test current exceeding 30A, the fuse may blow out.

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

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4. INSTRUCTIONS

4.1 Description of Front Panel

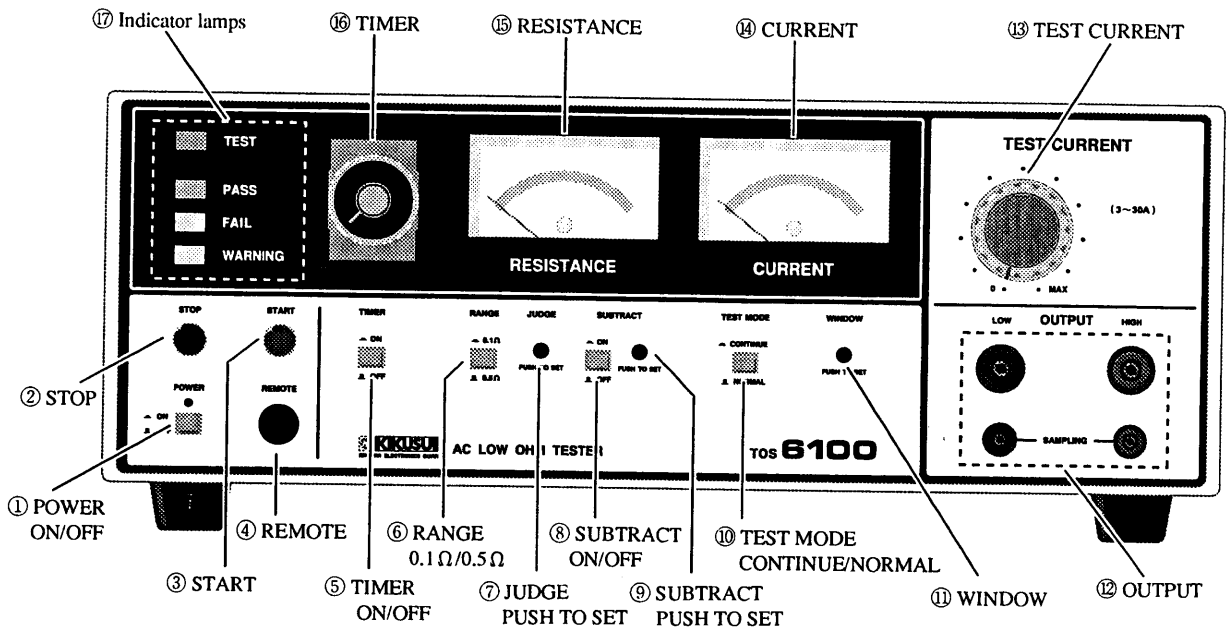


Figure 4.1

① POWER (ON/OFF)

Power switch and power-on indication lamp. Before turning on the power, be sure to read Section 3.2 "Precautions for Operation."

② STOP

Press this button for terminating a test. Also press it for stopping FAIL alarm or WARNING alarm. When this button is pressed, the Tester is set in ready state.

③ START

Press this button for starting a test. Press it when the Tester is in ready state, and the TEST lamp ⑰ goes on to indicate that the Tester is in test-on state.

④ REMOTE

Use this connector for connecting the optional Remote Control Box (RC01-TOS) or Low Resistance Test Probe (LTP-2) when the start/stop operation of the Tester is to be remote-controlled, or use it for receiving a control signal from other instrument. Before remote-controlling the Tester, be sure to read Section 4.3 "Remote Control."

⑤ TIMER (ON/OFF)

Use this switch for choosing whether to use timer or not.

⑥ RANGE (0.1 Ω /0.5 Ω)

Use this switch for selecting a range for ohmmeter (0.1 Ω range or 0.5 Ω range).

⑦ JUDGE (PUSH TO SET)

Pre-set resistor with push switch for setting the reference value for PASS-FAIL judgment. When this switch is pressed, the PASS-FAIL judgment reference value is indicated by the ohmmeter ⑮. The reference value can be changed by turning this switch while pressing it.

⑧ SUBTRACT (ON/OFF)

Use this switch for choosing whether to use the subtraction function or not. When this switch is set to the position of OFF, the subtraction function is ineffective and the measured value is indicated by the ohmmeter as it is. When it is set to the position of ON, the result of subtracting a predetermined value from the measured value is indicated by the ohmmeter.

⑨ SUBTRACT (PUSH TO SET)

Pre-set resistor with push switch for determining subtracter. When this switch is pressed, the current value of subtracter is indicated by the ohmmeter ⑮. To change the value of subtracter, turn this switch while pressing it. The value of subtracter can be set within the range from 0Ω to 0.1Ω whether the ohmmeter is in 0.1Ω range or in 0.5Ω range.

⑩ TEST MODE (CONTINUE/NORMAL)

Use this switch for choosing whether to stop or continue test when a WARNING alarm is raised by the test current monitoring function. If this switch is set to the position of NORMAL, the WARNING alarm is raised and test is stopped when the value of test current becomes greater or smaller than the reference value specified by WINDOW ⑪ by approximately 10%. If this switch is set to the position of CONTINUE, the test is continued even when the WARNING alarm is raised. Also, set this switch to the position of CONTINUE when specifying the value of test current.

⑪ WINDOW

Pre-set resistor with push switch for specifying the reference value for test current monitoring function. When this switch is pressed, the present reference value is indicated by ammeter ⑭. To change the reference value, turn this switch while pressing it. By setting the reference value to the test current value specified by regulation, the actual test current can be monitored. That is, when the actual test current value becomes greater or smaller than the reference value by approximately 10% of it, a WARNING alarm is raised.

⑫ OUTPUT

Use these terminals for connecting the object to be tested. The two big terminals are the terminals for current, and the two small terminals are the voltage sampling terminals for measuring resistance by 4-terminal measurement method.

⑬ TEST CURRENT

Use this dial for setting the test current. When value of the resistance of the object to be tested is unknown, turn this dial counterclockwise fully (up to the "0" position) and press the START button ③. Then, select the proper test current by slowly turning this dial clockwise.

⑭ CURRENT

Ammeter to indicate the amount of current that flows through the tested object. This ammeter also indicates the test current monitoring reference value.

⑮ RESISTANCE

Ohmmeter to indicate the measured resistance value. When the SUBTRACT switch ⑧ is ON, this ohmmeter indicates the result of subtracting a predetermined value (subtractor) from the measured value. Also, this ohmmeter can indicate the subtractor value and PASS-FAIL judgment reference value.

⑯ TIMER

Use this timer for setting the period of test time.

See Section 4.3 "Switching Timer Ranges" for the method of setting the test time period.

⑰ Indicator lamps

TEST: Indicates that the Tester is in the test-on state.

PASS: Indicates the test result. If the result of PASS-FAIL judgment is PASS, this lamp is turned on for approximately 50 ms. The PASS judgment is not made when the timer is not used.

FAIL: Indicates the test result. If the result of PASS-FAIL judgment is FAIL, this lamp is turned on continuously. To turn it off, press the STOP button ②.

WARNING: This lamp is turned on when the value of test current becomes greater or smaller than the reference value by approximately 10% of it during test (the reference value is predetermined by WINDOW ①). If the TEST MODE switch ⑩ is set to NORMAL, the test is stopped and this lamp is kept on till the STOP button ② is pressed. If the TEST MODE switch is set to CONTINUE, this lamp is turned off automatically when the difference between the test current value and reference value returns to the range of $\pm 10\%$ of the reference value.

4.2 Description of Rear Panel

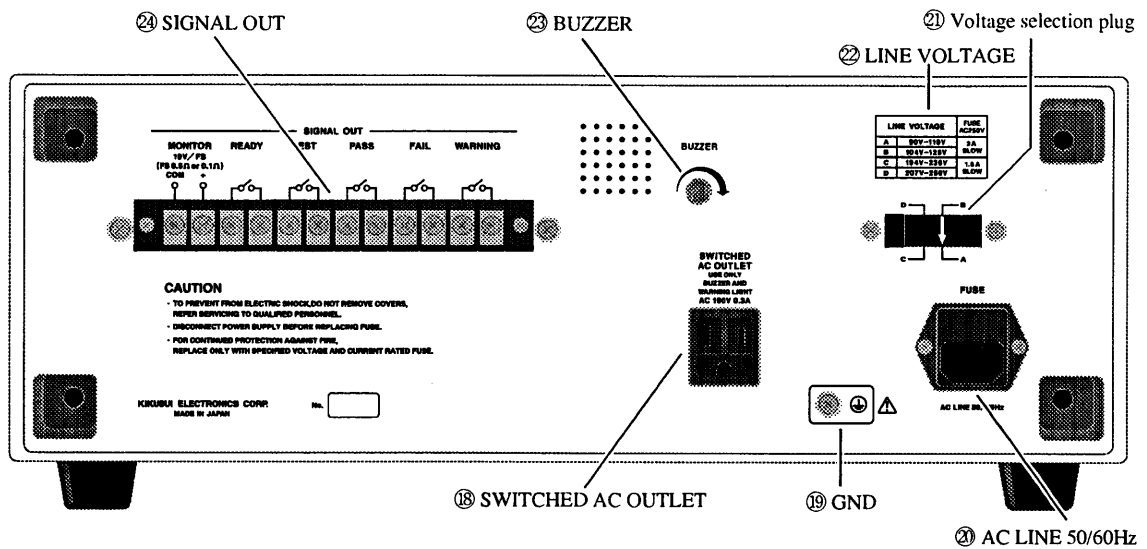


Figure 4.2

⑱ SWITCHED AC OUTLET

This outlet outputs 100V AC as the power source for the optional Model 9202 Warning Light Unit or Model 9203 Buzzer Unit. On/off of this output is interlocked with on/off of the POWER switch on front panel. Since this outlet is provided only for the above mentioned units, it must not be used as the power source of other electronic instruments.

Note: The Tester operates in one of the four line voltage ranges, but this outlet outputs approximately 100V regardless of the line voltage range selected by the voltage selection plug.

⑲ GND

Use this terminal for grounding the Tester. Be sure to fasten the earth cord tightly to this terminal by a tool.

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⑳ AC LINE 50/60 Hz

Three-pin power inlet with a fuse holder. Use the power cable set supplied with the Tester, and use the proper fuse that matches the line voltage as indicated by Table ㉒. To replace the fuse, disconnect the cable and remove the fuse holder by wrenching the claw open with a screwdriver.

㉑ Voltage selection plug

Set the arrow mark on this plug to the line voltage to be used according to Table ㉒.

㉒ LINE VOLTAGE

This table lists the ranges of the line voltage that can be used for the Tester and the fuse ratings that correspond to the line voltage ranges.

㉓ BUZZER

Use this dial for adjusting the loudness of the FAIL/PASS buzzer.

㉔ SIGNAL OUT

These terminals output various contact signals and ohmmeter monitor signal. Five type of contact signals, namely, READY, TEST, PASS, FAIL, and WARNING, are output. The ohmmeter monitor signal is a DC voltage signal that represents the measured resistance value. See Section 4.3 "Signal Output" for details.

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4.3 Operation Procedures

Before Starting Test

- (1) Before turning on the POWER switch, confirm that the pointers of ohmmeter and ammeter are set to the "0" position of the respective scales. If they are not set to the "0" position bring them to that position by the "0" adjusters in the center of the respective meters. If the Tester is already powered on, turn off the POWER switch and check the positions of the pointers.
- (2) After reading Section 3.2 "Precautions for Operation" thoroughly, turn on the POWER switch and manipulate the Tester in the procedures explained below.
- (3) When the POWER switch is turned on or off, the pointers of ohmmeter and ammeter may tremble irregularly, but this does not mean abnormal indication.

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Function Setting Procedures

Before starting the actual test, set functions according to the regulation, but before setting the functions in procedures (1) to (7) below, preset the switches and the pre-set resistors with push switches as follows:

Name	Preset
⑤ TIMER (ON/OFF)	OFF
⑥ RANGE (0.1Ω/0.5Ω)	0.5Ω
⑦ JUDGE (PUSH TO SET)	Center
⑧ SUBTRACT (ON/OFF)	OFF
⑨ SUBTRACT (PUSH TO SET)	Turn counterclockwise to utmost limit
⑩ TEST MODE (CONTINUE/NORMAL)	CONTINUE
⑪ WINDOW (PUSH TO SET)	Turn counterclockwise to utmost limit
⑬ TEST CURRENT	Turn counterclockwise to utmost limit ("0" position)

(1) Setting ohmmeter range

Set the range of ohmmeter by RANGE (0.1Ω/0.5Ω) switch.

Select the range that matches the PASS-FAIL judgment reference value specified by regulation or the estimated resistance value of the object to be tested.

(2) Setting PASS-FAIL judgment function

To use the PASS-FAIL judgment function, set the PASS-FAIL judgment reference value by the JUDGE pre-set resistor with push switch.

If the measured value is greater than the reference value set by the JUDGE pre-set resistor, the Tester makes a FAIL judgment, cuts of the output immediately, and raises a FAIL alarm (lamp/buzzer/make-contact signal).

Set the reference value in the following procedure:

- a. Push the pre-set resistor by a screwdriver for adjustment or similar tool.

- b. The present PASS-FAIL judgment reference value is indicated by the ohmmeter. The ohmmeter range specified by Step (1) is effective.
- c. To change the present reference value to the new value that conforms to the regulation, turn the pre-set resistor while pressing it.
- d. To check the newly set reference value, press the pre-set resistor by a screwdriver for adjustment or similar tool. When the pre-set resistor is pressed, the reference value is indicated on the ohmmeter.

Note 1: If the PASS-FAIL judgment need not be made, turn the pre-set resistor clockwise to the utmost limit.

Note 2: The PASS-FAIL judgment reference value is determined by the range of ohmmeter and angle of pointer. Therefore, when the range of ohmmeter is changed, the previous reference value becomes invalid and the present angle of pointer gives a different reference value based on the new range.

(3) Setting subtraction function

The subtraction function subtracts a predetermined value (subtrahend) from the measured value and indicates the result on the ohmmeter. This function is useful for the two-terminal measurement in which the residual resistance need be cancelled.

Set the subtrahend in the following procedure:

- a. Set the SUBTRACT ON/OFF switch to the position of ON.
- b. Press the pre-set resistor with push switch on the right side of the ON/OFF switch by a screwdriver for adjustment or similar tool.
- c. The ohmmeter indicates the present value of subtrahend. The ohmmeter range specified by Step (1) is effective.
- d. Change the present value to the desired value by turning the pre-set resistor while pressing it.

- e. Just to check the presently set subtrahend, simply press the pre-set resistor by a screwdriver for adjustment or similar tool; the value of subtrahend is indicated on the ohmmeter regardless of the setting of the SUBTRACT ON/OFF switch.

Note 1: The allowable range of subtrahend is 0Ω to 0.1Ω regardless of the range of ohmmeter.

Note 2: If the subtrahend is greater than the measured value (actual resistance of tested object), the ohmmeter indicates "0".

Note 3: When the subtraction function is used with the PASS-FAIL judgment function, the result of subtraction is compared with the PASS-FAIL judgment reference value.

Note 4: The value of subtrahend is determined by the range of ohmmeter and angle of pointer. Therefore, when the range of ohmmeter is changed, the previous value of subtrahend becomes invalid and the present angle of pointer gives a different value based on the new range.

(4) Setting test current monitoring function

By using this function, the user can check the test current which may go out of the proper range because of the fluctuations of the resistance of tested objects.

If the value of test current goes out of the range of 90% to 110% of the monitoring reference value (same as the test current value specified by regulation) during test, the Tester raises a WARNING alarm to notify that the test current is improper. The WARNING alarm is expressed by a lamp and a make-contact signal.

Set the monitoring reference value in the following procedure:

- a. Press the WINDOW pre-set resistor with push switch by a screwdriver for adjustment or similar tool.
- b. The ammeter indicates the present monitoring reference value.

- c. Change the present value to the required value (test current value specified by regulation) by turning the pre-set resistor while pressing it.
- d. Just to check the presently set reference value, simply press the pre-set resistor by a screwdriver for adjustment or similar tool; then, the reference value is indicated on the ammeter.

The user can choose whether to stop or continue the test when the WARNING alarm is raised. See Step (7) "Setting TEST MODE" for details.

(5) Setting test current

Set the test current by the TEST CURRENT dial in the following procedure:

- a. Connect the object to be tested to the Tester firmly. See the section of "Connecting object to be tested" for details.
- b. Confirm that the TEST CURRENT dial has been turned counterclockwise to the utmost limit ("0" position).
- c. Press the START button. At this time, the TEST and WARNING indicator lamps are turned on.
- d. Turn the TEST CURRENT dial gradually clockwise, watching the indication on the ammeter.
- e. Set the test current according to the regulation. When the value of the test current enters the range of 90% to 110% of the monitoring reference value set in Step (4), the WARNING lamp goes off.
- f. Press the STOP button to set the Tester in ready state.

Note: Even if the TEST CURRENT dial is set to the same position, the test current value may change depending on the resistance of the tested object. If the resistance fluctuates greatly, the test current must be set for each object.

Ref: Relationship between test current and measurement accuracy.

The Tester obtains the value of resistance by dividing the measured value of voltage by the value of current. Therefore, the result of the calculation does not fluctuate greatly even if the value of test current changes. In other words, the correct value of resistance can be obtained even if the value of test current is changed by the fluctuation of resistance or line voltage.

(6) Setting TEST MODE

The user can choose whether to stop or continue the test when a WARNING alarm is raised by the test current monitoring function. To stop the test, set the TEST MODE switch to the position of NORMAL; to continue the test, set it to the position of CONTINUE.

The Tester raises a WARNING alarm when the value of test current gets out of the range of 90% to 110% of the monitoring reference value set in Step (4). If this alarm is raised when the TEST MODE switch is at the position of NORMAL, the Tester stops the test immediately, remains in the alarm state, and notifies that the value of test current is improper. To release the Tester from this state, press the STOP button. The TEST MODE switch should be set to the position of NORMAL when many objects having similar resistance (little fluctuation of resistance) are to be tested.

If the TEST MODE switch is set to the position of CONTINUE, the test is continued even when the WARNING alarm is raised. The WARNING alarm stops automatically when the value of test current returns to the proper range (90% to 110% of monitoring reference value). The PASS-FAIL judgment function is effective even when the WARNING alarm is given.

The TEST MODE switch should be set to this position when the test does not require the monitoring of test current or when the proper test current is searched for in the initial stage.

(7) Setting timer

When the timer is to be used, set the TIMER switch to the position of ON; when the timer is not to be used, set it to the position of OFF.

To set the test time period, use the timer above the TIMER switch.

See the section of "Switching Timer Ranges" for the method of setting the test time period.

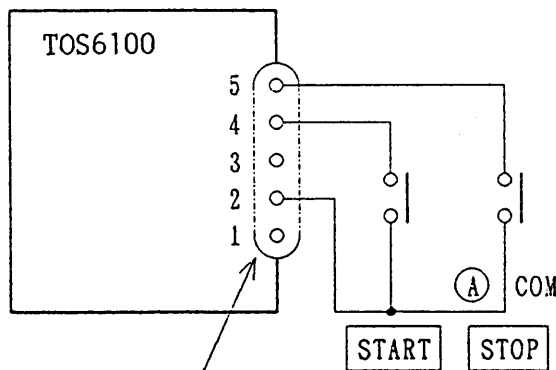
Test Method

- (1) Confirm that the object to be tested is connected to the Tester firmly. See the section of "Connecting the Object to be tested" for the method of connecting the object.
- (2) Start the test by pressing START button.
- (3) If the WARNING alarm is raised at this time, the test current must be adjusted because it is greatly different from the monitoring reference value. Set the TEST MODE switch to the position of CONTINUE and adjust the value of test current to the reference value.
- (4) If the timer is used, the test is terminated when the time specified by the timer has elapsed and the Tester makes PASS judgment and outputs PASS signal at the termination of the test. The PASS signal is output for approximately 50 ms in the forms of lamp, buzzer, and make-contact signal.
- (5) If the timer is not used, terminate the test by pressing. STOP button when a desired period of time has elapsed or when the termination is required.
- (6) Replace the tested object with a new object to be tested, and press the START button again. Repeat this operation for all the objects to be tested.
- (7) If, during the test, the measured value is judged to be greater than the PASS-FAIL judgment reference value specified by the JUDGE pre-set resistor, the Tester makes FAIL judgment, cuts off the output immediately, and issues FAIL alarm. The FAIL alarm is issued in the forms of lamp, buzzer, and make-contact signal. Differing from the PASS signal, the FAIL alarm keeps being issued till it is stopped by the pressing of STOP button.

Remote Control

(1) The start/stop operation of the Tester can be remote-controlled by using an optional Remote Control Box. When the plug of connection cable is inserted into the REMOTE socket on the front panel, the start/stop operation can be controlled both from the panel and from the Remote Control Box. The start/stop operation of the Tester can be controlled not only by the Remote Control Box but also by other devices as explained in the following paragraphs:

- ① If the start and stop contacts are controlled as shown in Figure 4.3, the start/stop operation can be controlled in the same way as it is controlled on the panel.
- ② In the example shown in Figure 4.4, the Tester is set in the test-on state when the contact is set to the NO side, and the output is cut off forcibly when the contact is set to the NC side.



REMOTE control connector

Figure 4.3

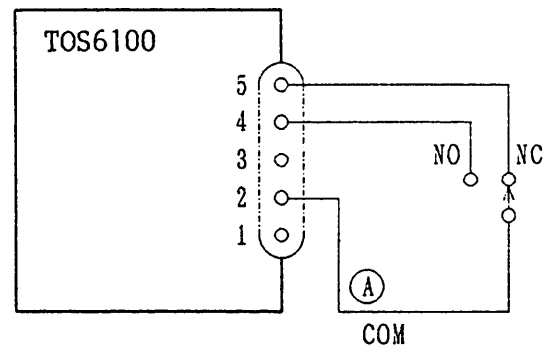


Figure 4.4

- ③ The contacts in Figure 4.3 can be replaced with logical elements, transistors, FETs, or photocouplers. Figure 4.5 shows an example of using photocouplers. In this case, the input conditions for the Tester are as follows:

- High level input voltage: 11 - 15 V
- Low level input voltage: 0 - 4 V
- Low level sweepout current: 2 mA or less
- Input time width: 20 ms minimum

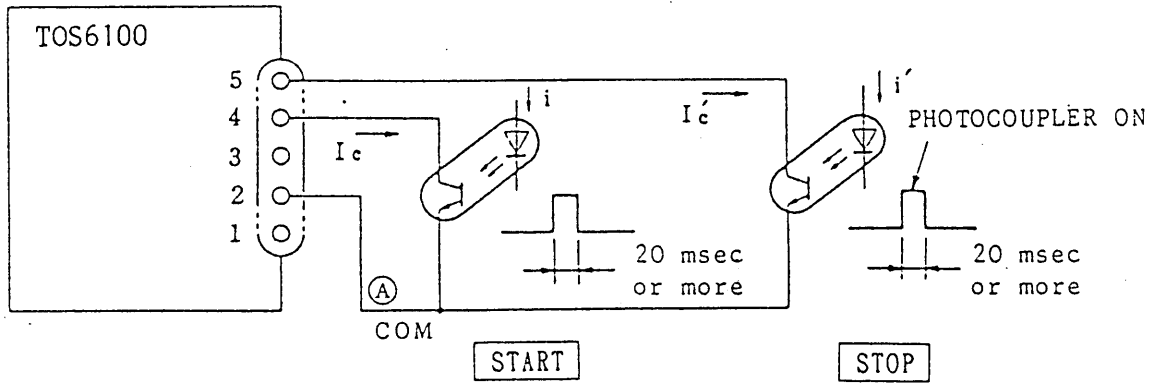
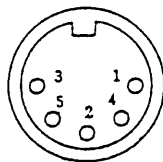


Figure 4.5

Note 1: Each gate is pulled up to +15V. Opening of input terminal is equivalent to the input of high level voltage.

Note 2: Set i and i' to the values that make the values of I_c and I_c' greater than 2 mA.

- ④ To prevent the system from operating erroneously because of noise, photocouplers (as shown in Figure 4.5) or relays (as shown in Figure 4.3) are recommended as the devices to be connected to the Tester. The Tester is designed to operate correctly even if noise may be generated by the Tester itself or by its peripheral equipments, but take measures against the noise that may cause erroneous operation of the devices connected to the Tester.
- ⑤ The pins of the remote control socket are allocated according to the DIN regulation, and they are not arranged in the ascending order of their numbers. Figure 4.6 shows the pin allocation.



Layout of connector pins as viewed from panel surface

Figure 4.6

Signal Output

(1) In addition to the lamp and buzzer signals, the Tester outputs the following signals:

	Signal name	Condition for signal output	Signal description
①	TEST	Output during entire test period	Make-contact signal Ratings: 1A at 100V AC 1A at 30V DC
②	PASS	Output for 50 ms approx. when test is terminated	
③	FAIL	Output continuously when FAIL judgment is made	
④	WARNING	When the test current is out of proper range	
⑤	READY	Output when the Tester is in ready state	
⑥	MONITOR	Always output	0 - 10V DC

① TEST

This signal is output when the Tester is in test-on state.

② PASS

This signal is output when the Tester makes PASS judgment by the PASS-FAIL judgment function. That is, it is output when a test is terminated because the time specified by timer has elapsed. It is output for approximately 50 ms.

③ FAIL

This signal is output when the Tester makes FAIL judgment by the PASS-FAIL judgment function. It keeps being output till the STOP signal is input (or till the STOP button is pressed).

④ WARNING

This signal is output by the test current monitoring function when the value of test current goes out of the range of 90% to 110% of the reference value during test.

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If the TEST MODE switch is set to the position of NORMAL, it keeps being output till the STOP signal is input (or till the STOP button is pressed). If the TEST MODE switch is set to the position of CONTINUE, it stops automatically when the value of test current returns to the above range.

⑤ READY

This signal is output continuously when the Tester is in ready state (the state that allows a test to be started at any time).

If a START signal is input (or the START button is pressed) when the READY signal is being output, the Tester enters the test-on state.

⑥ MONITOR

This signal is a DC voltage signal output in proportion to the angle of the pointer of ohmmeter on front panel. The scales are as follows:

0.5 Ω range: 10V/0.5 Ω

0.1 Ω range: 10V/0.1 Ω

Note that the absolute value of the error of the above output voltage is 5% of the output value or 50 mV, whichever larger.

Note: See "Status Timing Chart" in this section for the output condition and timing of each signal.

(2) Contact signals

- ① As Figure 4.7 shows, the contact signals simply open or close contacts when they are output. Since their circuits do not have any power sources, they cannot drive the loads that do not have power sources.

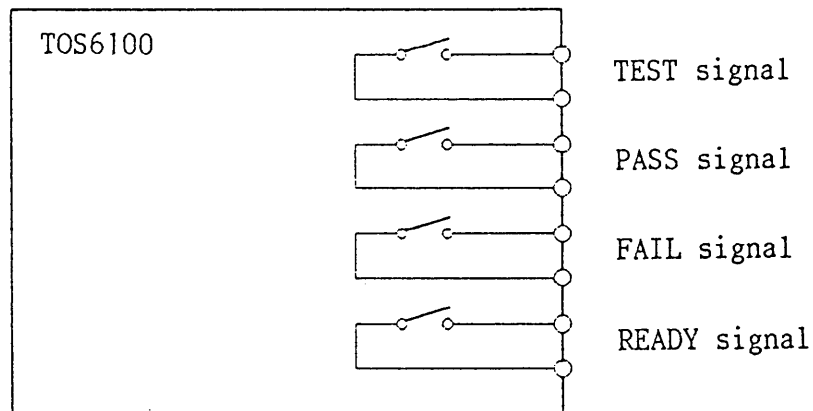


Figure 4.7

The contact signal which closes the contact when it is output is called make-contact, normally open contact, or form "a" contact signal. The contact signal which opens the contact when it is output is called break-contact, normally close contact, or form "b" contact signal.

The Tester outputs make-contact signals, and their rating is 1A at 100V AC or 1A at 30V DC. The withstand voltage between the circuit and shassis is 500V AC/1 minute.

- ② The following illustrations are the example circuits in which the contact signals are used:

- To drive DC buzzer by FAIL signal

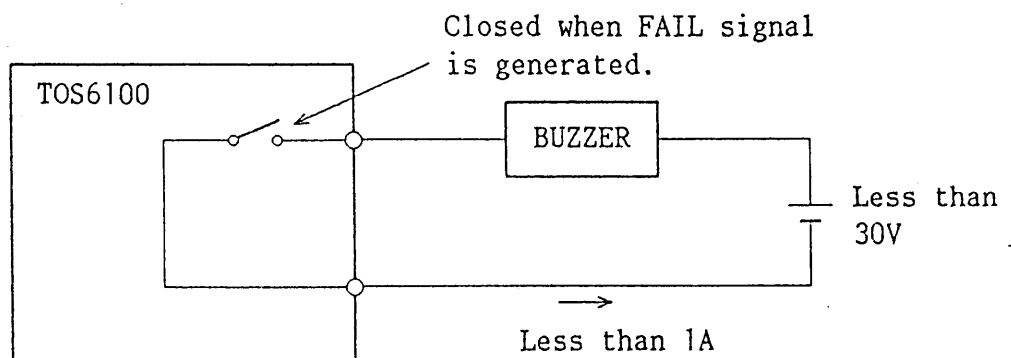


Figure 4.8

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- To drive lamp by TEST signal

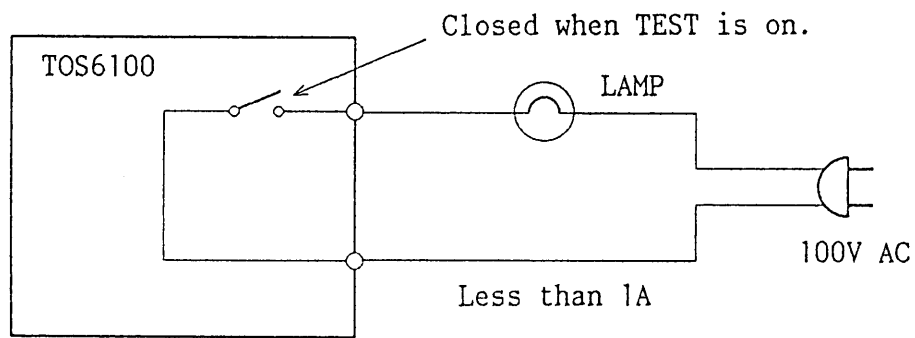


Figure 4.9

- To obtain "L" level of digital signal when contact signal is output

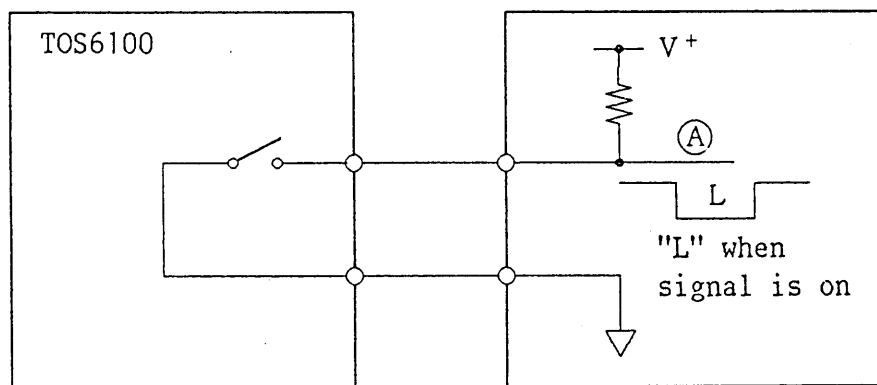


Figure 4.10

In the illustration of Figure 4.10, the signal is set to "L" level at point A when the contact signal is output. However, since the signal obtained at point A includes chattering of the contact, a chattering suppression circuit should be provided for the circuit to be driven by this signal. In some cases, a noise suppression circuit should be provided.

□ Connecting the Object to be tested

(1) Four-terminal measurement

To prevent the small resistance of lead wires and contact resistance at connection terminals from being included in the measured value of resistance, execute 4-terminal measurement by connecting the object to the Tester as shown in Figure 4.11. For the 4-terminal measurement, remove the short bars from the current terminals and voltage terminals. In this way, the resistance between A and B can be measured without being affected by the contact resistance (r_1 - r_8) and lead wire resistance (R_1 - R_4).

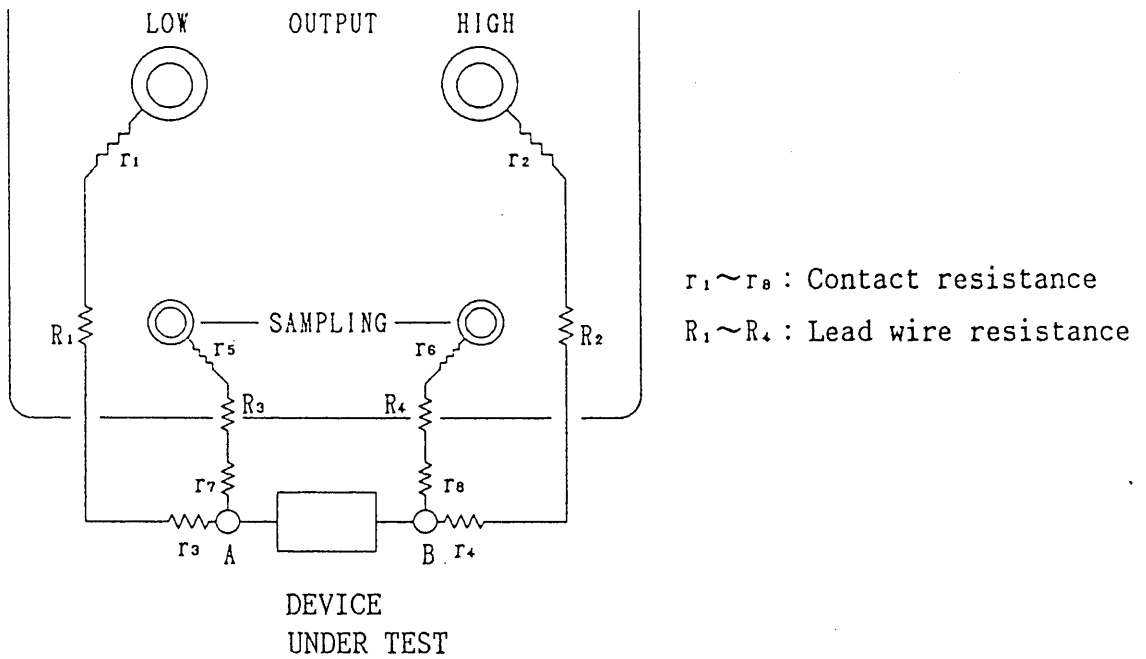


Figure 4.11

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(2) Two-terminal measurement

If the resistance of lead wires and contact resistance can be ignored, execute 2-terminal measurement by connecting each current terminal and voltage sampling terminal by the supplied short bars as shown in Figure 4.12. In this case, the lead wire resistance and contact resistance are included in the measured value of resistance, and this point must be fully noted.

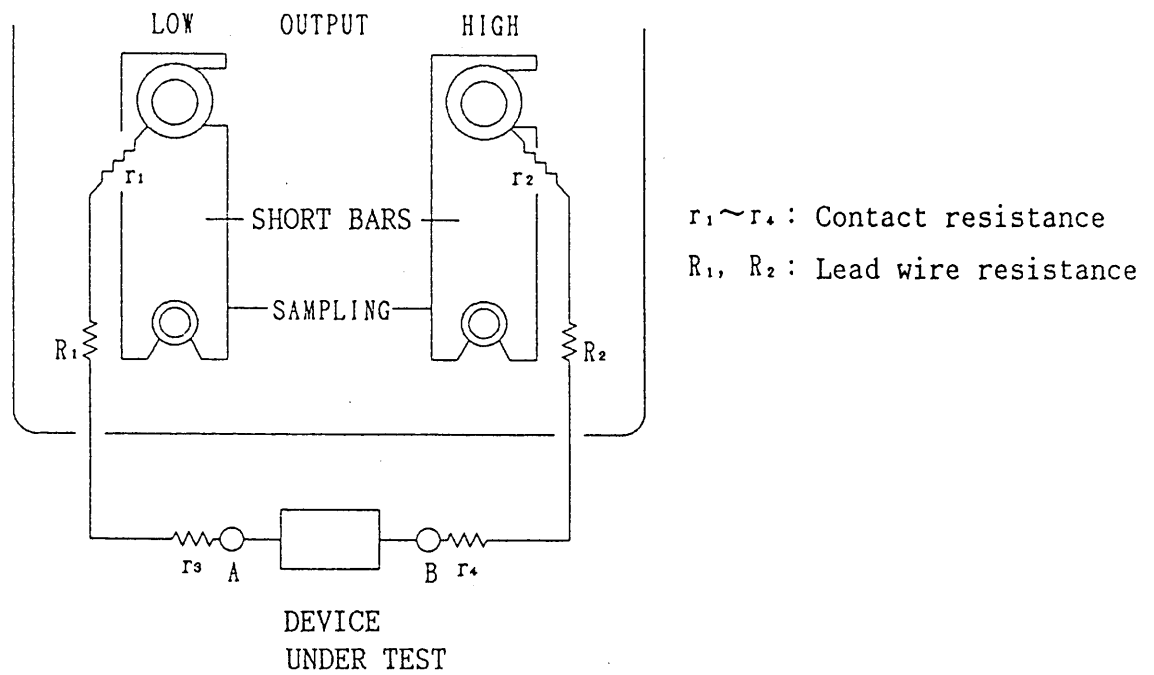


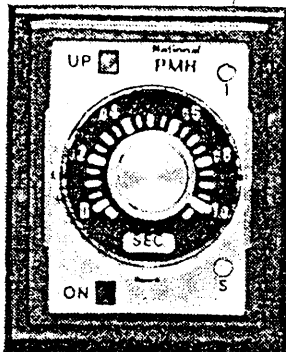
Figure 4.12

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□ Switching Timer Ranges

By manipulating slide switches on the timer panel of the Tester, a desired timer range can be selected from four types of ranges. When the timer range is switched, the numerals for scale and the time unit are changed so that the specified time can be read easily.

Slide switch
to select
scale figures]



Slide switch]
to select
unit of time

Settings of slide switches				
	Setting range	0.05S~ 1.0S	0.5S~ 10S	0.05M~ 1.0M

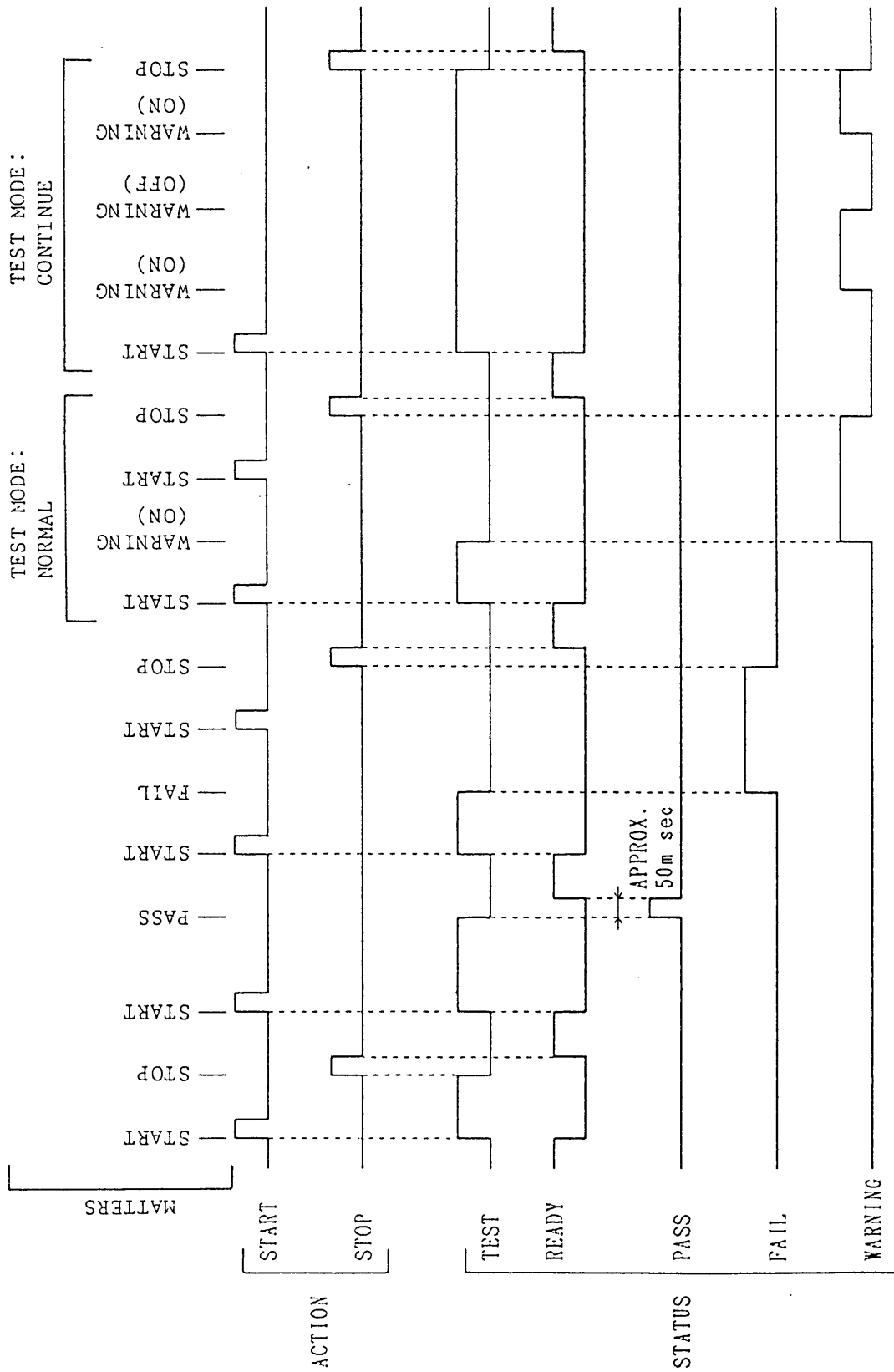
S: Second- M: Minute

Throw the slide switches to
the top or bottom positions.

Note: Be sure to set the timer for 0.5 seconds or a longer period.

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□ Status Timing Chart



5. OPERATING PRINCIPLE

5.1 Block Diagram

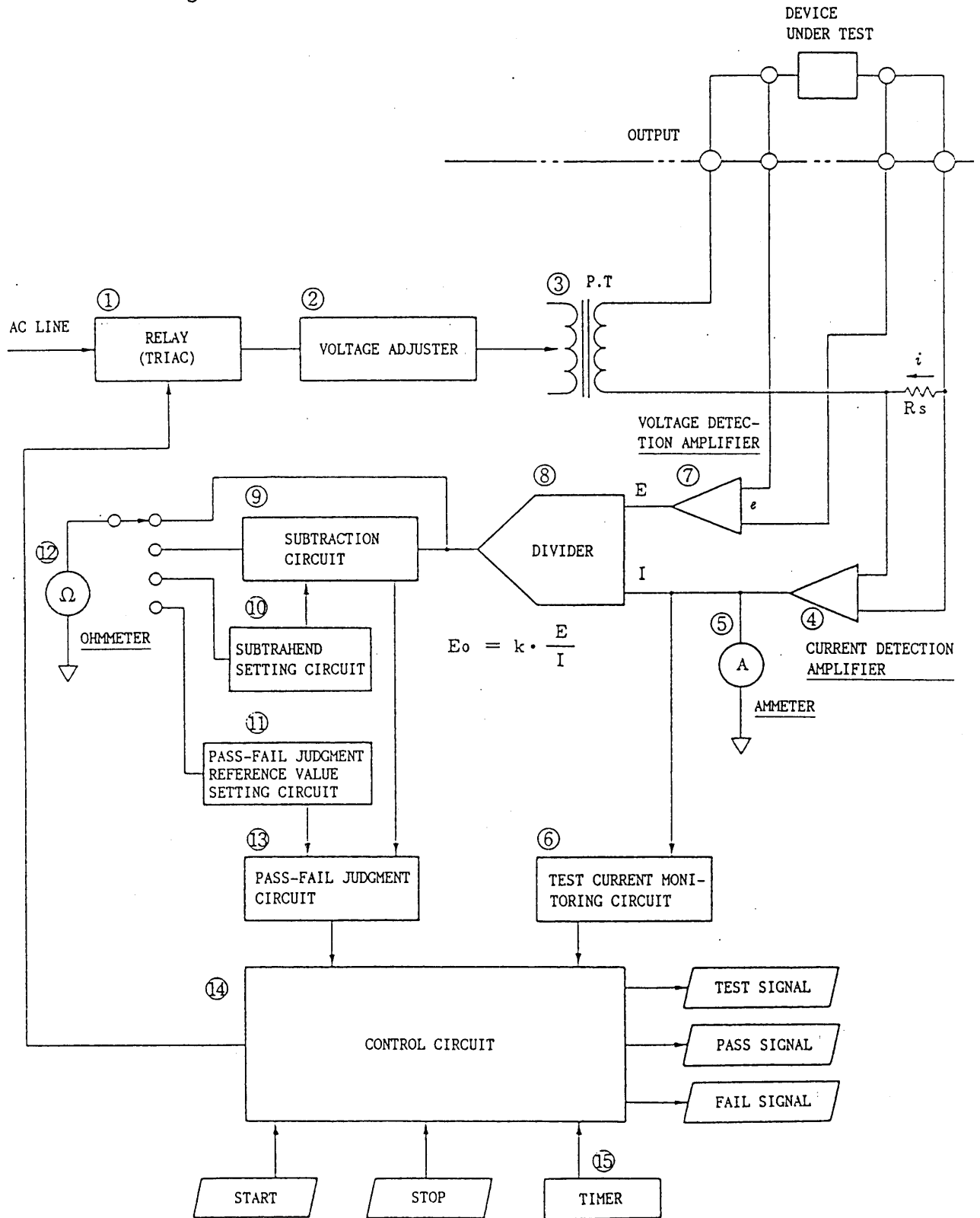


Figure 5.1

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5.2 Explanation of Components

① Relay

Opens/closes the voltage from line by triac. The voltage is input to an output transformer through a voltage adjuster for the low resistance test.

② Voltage adjuster

Adjusts the output current (output voltage) by using a slide transformer.

③ P.T.

Output transformer to obtain the test current of up to 30A.

④ Current detection amplifier

Amplifies the signal representing the current flowing through the tested object so that the signal can be applied to ammeter and divider at the proper level.

⑤ Ammeter

Indicates the amount of the current flowing through the tested object. The ammeter also indicates the test current monitoring reference value.

⑥ Test current monitoring circuit

Checks if the amount of the current flowing through the tested object is proper or not.

⑦ Voltage detection amplifier

Amplifies the signal representing the potential difference between the two ends of tested object so that the signal can be applied to divider at the proper level. Also, this amplifier can switch gains.

⑧ Divider

Performs calculation on the values of voltage and current using the signals output from the voltage and current detection amplifiers.

$$E_0 = k \cdot \frac{E}{I} \dots\dots\dots \text{Formula 5.1 (k: constant)}$$

where E = Voltage input signal
 I = Current input signal
 E₀ = Output

Further, Formula 5.2 is obtained by defining e, i, and R as follows:
 e = Potential difference between two ends of tested object
 i = Current flowing through tested object
 R = Resistance of tested object

$$\left. \begin{array}{l} E = k_1 \cdot e \\ I = k_2 \cdot i \end{array} \right\} \dots\dots\dots \text{Formula 5.2}$$

When Formula 5.2 is substituted for Formula 5.1, Formula 5.3 is obtained.

$$E_0 = k \cdot \frac{k_1}{k_2} \cdot \frac{e}{i} \dots\dots\dots \text{Formula 5.3 (k} \cdot \frac{k_1}{k_2} \text{ : constant)}$$

Since $\frac{e}{i}$ means R, the voltage output from the divider is proportional to the resistance of the tested object.

Even if the test current "i" changes for some reason, the output voltage "E₀" remains unchanged because the potential difference between two ends of tested object "e" changes by the same ratio as "i". In other words, the resistance of tested object can be measured correctly even if the test current changes.

Logically, E₀ in Formula 5.1 remains unchanged if the numerator and denominator in this formula change at the same time by the same ratio, but actually, the divider makes calculation errors when the value of the denominator is reduced.

When the value of the denominator in Formula 5.1 gets close to 0, the errors increase sharply and the value of E₀ (the value indicated by ohmmeter) becomes unstable. To stop this, the Tester stops calculation when the value of test current becomes less than 3A. Therefore, if a test is executed without connecting an object to be tested (with the circuit opened), both the ohmmeter and ammeter indicate "0" as if the

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Tester were in ready state. For such a test, however, a WARNING alarm is raised by the test current monitoring function, so that the user can notice the difference from the ready state.

⑨ Subtraction circuit

Calculation circuit to cancel the residual resistance that cannot be eliminated in the course of measurement. This circuit subtracts a predetermined subtrahend from the measured value. Basically, the subtraction is unnecessary if the resistance is measured in 4-terminal mode. The subtraction function is useful when the complete 4-terminal measurement cannot be done because jigs and probes are used.

⑩ Subtrahend setting circuit

Sets the value of subtrahend for the subtraction explained above.

⑪ PASS-FAIL judgment reference value setting circuit

Sets the reference value to be used for PASS-FAIL judgment.

⑫ Ohmmeter

Indicates the result to measurement (actually measured value or result of subtracting a predetermined value from the actually measured value). Also indicates the value of subtrahend and PASS-FAIL judgment reference value.

⑬ PASS-FAIL judgment circuit

Compares the result of measurement (actually measured value or result of subtracting a predetermined value from the actually measured value) with the PASS-FAIL judgment reference value, and makes judgment.

⑭ Control circuit

Controls all the sequences of the Tester. This circuit is highly reliable because it is a logic circuit composed of CMOS ICs.

⑮ Timer

Sets the test time period.

6. MAINTENANCE

6.1 Calibration

(1) Instruments required for calibration

To calibrate the Tester, the following standard resistors and measuring instruments are required:

- ① Standard Resistor I: Resistor of $0.12\Omega \pm 0.5\%$ with the current capacity of 30A
- ② Standard Resistor II: Resistor of $0.6\Omega \pm 0.5\%$ with the current capacity of 12A
- ③ AC Ammeter I: 30A \pm less than 1%
- ④ AC Ammeter II: 12A \pm less than 1%

③ and ④ can be replaced by the voltmeters that can measure 3.6V AC and 7.2V AC respectively with the accuracy of plus/minus less than 0.5%

- ⑤ Standard resistors and ammeters for measuring and checking any necessary points of the Tester.

To check the subtraction circuit, the following resistors are required:

- ⑥ Standard Resistor III: Resistor of $0.22\Omega \pm 0.5\%$ with the current capacity of 30A
- ⑦ Standard Resistor IV: Resistor of $0.7\Omega \pm 0.5\%$ with the current capacity of 12A

- (2) Before turning on the power, adjust mechanical "0" for the ohmmeter and ammeter. Then, turn on the power and leave the Tester for heat run for more than 15 minutes.

(3) Checking supply voltages

Before calibrating the Tester, check the supply voltages. Confirm that the voltages are within the following ranges:

+24V (TP104): +23 to +30V

+15V (TP102): +14.25 to +15.75V

-15V (TP103): -14.25 to -15.75V

- (4) Offset adjustment for divider
(See Figure 6.1 for the allocation of the adjustment resistors mentioned in this paragraph and subsequent paragraphs.)
- ① Adjust RV105 to set the pointer of ohmmeter to "0" position.
 - ② Connect the standard resistor of 0.12Ω to the OUTPUT terminal of the Tester and press the START button. Change the test current from 10A to 30A and see the values of resistance indicated by ohmmeter. Adjust RV104 to minimize the difference between the resistance against 10A and that against 30A.
 - ③ Execute step ① again.
- (5) Calibration of ammeter
- ① Connect an ammeter of 30A to the OUTPUT terminal of the Tester. To use a voltmeter instead of ammeter, connect the current terminal of the standard resistor of 0.12Ω to the OUTPUT terminal and connect the voltmeter to the voltage terminal of the standard resistor.
 - ② Turn the TEST CURRENT dial counterclockwise to the utmost limit ("0" position), and press the START button. Then, slowly turn the dial clockwise till the connected ammeter indicates 30A. When standard resistor and voltmeter are connected in place of ammeter, adjust the dial till the voltmeter indicates 3.60V.
 - ③ Adjust RV109 till the ammeter on front panel indicates 30A.
- (6) Calibration of ohmmeter
- ① Connect the standard resistor of 0.12Ω to the OUTPUT terminal of the Tester in 4-terminal mode.
 - ② Select the 0.1Ω range for the ohmmeter of the Tester. Press the START button, supply the current of approximately 30A, and adjust RV107 till the ohmmeter indicates 0.12Ω .

(7) Calibration of MONITOR signal output voltage

- ① Select the 0.1Ω range for the ohmmeter of the Tester.
- ② Set the PASS-FAIL judgment reference value to 0.1Ω by using the JUDGE pre-set resistor with push switch on front panel. While pressing the switch, adjust RV108 till the output voltage of MONITOR signal becomes 10.0V.

(8) Check indicators and subtraction circuit operation when necessary.

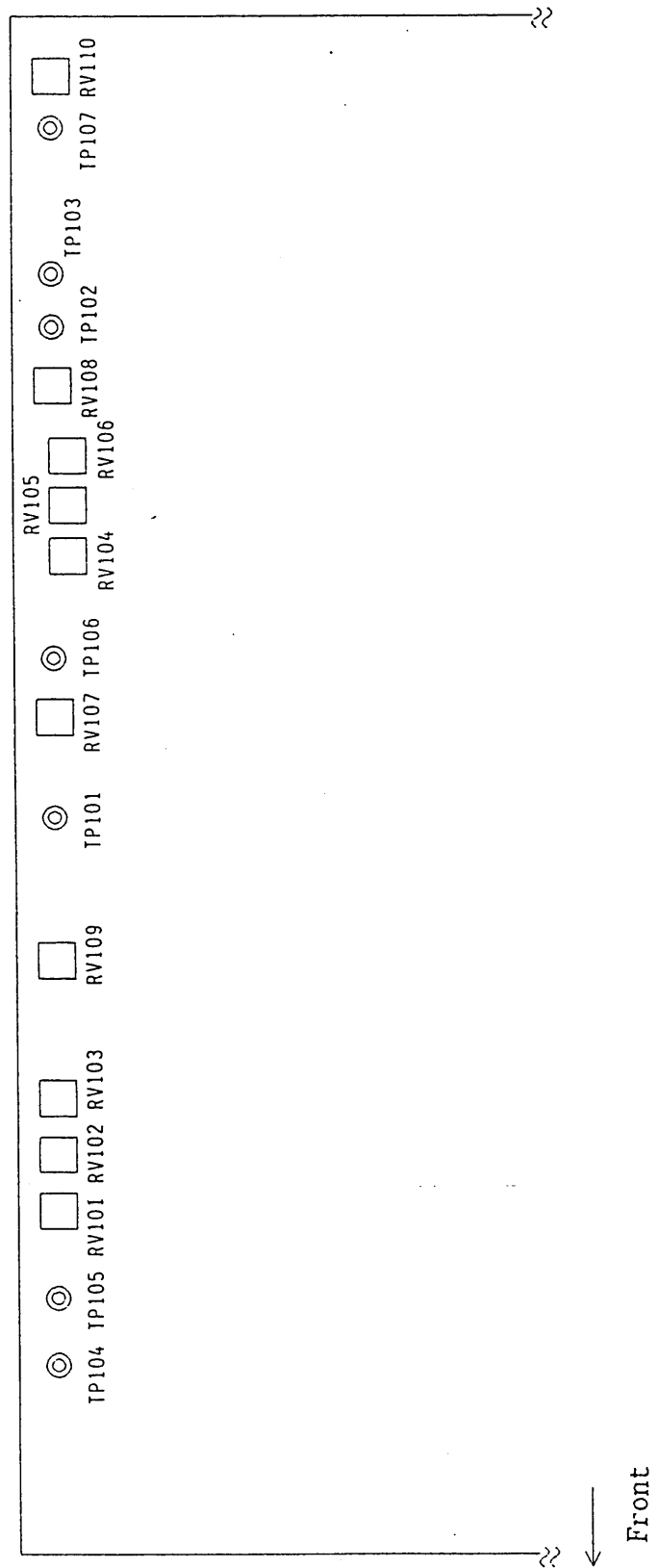


Figure 6.1

Note: This figure illustrates the main board (PCB-A1) inserted in the left slot of the Tester, viewed from inside of chassis.

7. OPTIONS

Option for TOS6100 only

LTP-2 Low Resistance Test Probe

The LTP-2 is a test probe for the low ohm tester whose start/stop operation can be remote-controlled. A flexible cable easy to handle and capable of supporting the current of 30A is used. The cable length is approximately 2 m.

Options common to our withstand voltage, insulation, and low ohm testers

RC01-TOS Remote Control Box

Used to remote-control the start/stop operation of the tester. The length of the connection cable is approximately 1.5 m.

PL01-TOS Warning Light Unit

Indicates that the tester is in the test-on state. This unit is driven by the TEST contact signal.

BZ01-TOS Buzzer Unit

If the electronic buzzer built in the tester is not loud enough, this buzzer unit can be used to emit buzzer sound. It is driven by the FAIL contact signal.

BH3M-TOS Rack Mount Brackets for JIS

Brackets used for mounting the tester on a rack. These brackets are designed for JIS (metric system).

BH4-TOS Rack Mount Brackets for EIA

Brackets used for mounting the tester on a rack. These brackets are designed for EIA (yard-pound system).

