

## 1.1 TOS5000 Series

Kikusui TOS5000 Series Withstanding Voltage Testers are available in four models listed below. This manual is applicable to the first three models, namely, TOS5101, TOS5051, and TOS5050. (For the last one model, namely, TOS5030, refer to the separate manual dedicated to it.)

Model	Type	AC Output	DC Output	Transformer
TOS5101	AC/DC	10kV/50mA (500VA)	10kV/5mA (50W)	500VA
TOS5051	AC/DC	5kV/100mA (500VA)	5kV/10mA (50W)	500VA
TOS5050	AC	5kV/100mA (500VA)	—	500VA
TOS5030	AC	3kV/10mA (30VA)	—	30VA

### **WARNING**

- *Each of these testers generate hazardous high voltages. Its output terminals, test leadwires, probes, and devices under tests are charged up to these voltages. Be sure to provide full protective measures to guard against electric shock hazard — such as to enclose the test area with rope fences to prevent access by unauthorized persons.*

## 1.2 Features

- The features common to Models TOS5101, TOS5051, and TOS5050 Testers can be summarized as follows:

1. **For tests complying with major industrial standards**

Each of the Tester allows you to conduct withstanding voltage tests (dielectric strength tests) of electrical and electronic devices and components, complying with major industrial standards including UL, CSA, BS, and JIS (Japanese Industrial Standards) and Electrical Equipment Control Ordinances of Japan.

2. **A Transformer's capacity is 500VA**

The Tester has a transformer, rated 500VA.

3. **Rational layouts of keys and switches**

The keys have a slant-plane for easy viewing and convenient operation. The switch for AC/DC select and test voltage range select and the control for test voltage adjustment are installed concentrically, allowing you to operate them conveniently with two concentric knobs. For adjustment of pass/fail-judgement limit current setting and that of timer setting, respective increment/decrement keys are provided. These keys and switches, together with the large display easy to view, are laid out rationally and will assist you to conduct your tests accurately and efficiently.

4. **A large color display**

The Tester has a large color VACUUM FLUORESCENT DISPLAY. It is a wide viewing angle type of display with high intensity, and clearly indicates information in clearly readable large letters and in color annunciators. The indicated information includes test conditions, instrument status, readback current, result of pass/fail judgement, etc., assisting you to conduct your tests accurately and efficiently.

5. **An analog voltmeter and a digital voltmeter**

The Tester has both analog voltmeter ( $\pm 5\%$  FS) and digital voltmeter ( $\pm 1.5\%$  FS) — the former for quick grasp of the voltage and the latter for more accurate readout — assisting you to conduct your tests rapidly but accurately.

6. **A digital ammeter**

The tester has a digital ammeter to measure the current that flows through the DUT (device under test).

7. **A window comparator for pass/fail judgement**

The Tester has a window comparator for pass/fail judgement with reference to both upper (U) and lower (L) criteria (cutoff current). The comparator generates a FAIL signal when the measured current that flows through the DUT is greater than the preset upper limit criterion or even when it is less than the preset lower limit criterion. The L FAIL detection function contributes to improve the test reliability by detecting open-circuiting or imperfect contacting of the test leadwires. Separately for each of U type and L type of fail, the Tester indicates a fail annunciator message on its display and delivers a fail event signal, allowing you to immediately find out the type of the fail.

You can preset the upper limit and lower limit currents (cutoff currents) mutually independently, within the ranges shown in the following table.

Model	Preset range of U/L limits	Number of steps
TOS5101	AC: 0.1mA to 55mA	145 steps
	DC: 0.1mA to 5.5mA	55 steps
TOS5051	AC: 0.1mA to 110mA	200 steps
	DC: 0.1mA to 11mA	101 steps
TOS5050	AC: 0.1mA to 110mA	200 steps

### 8. A digital timer

The timer allows you to preset the period during which the test voltage is to be applied to the DUT. The preset range is 0.5 to 999 seconds (in 1895 steps). When the timer function is ON, the preset period is decremented and the timer indicates the remaining period; when it is OFF, time is incremented and the timer indicates the elapsed period.

### 9. Remote control provision

The tester has provisions for remote start/stop control operation. That is, it has a 5-pin DIN connector (for the optional Remote Control Box or High Voltage Test Probe) on its front panel and a 14-pin Amphenol connector on its rear panel. The remote control function, together with the status signal function, will help you conduct efficient automatic labor-saving tests.

### 10. Status signals

The Tester delivers seven status signals — namely, H.V ON, TEST, PASS, U FAIL, L FAIL, READY, and PROTECTION — through its 14-pin Amphenol connector (that is used in common for the remote control signal also) on the rear panel. The signal form is open collector. The Tester can deliver a 100V AC output in response to one of eight states — namely, H.V ON, TEST, PASS, U FAIL, L FAIL, READY, PROTECTION, and POWER ON. As used in conjunction with the remote control function, these status signals will help you to conduct still more efficient automatic labor-saving tests.

### 11. Compact and light

The Testers are compact and light as shown below.

Model	Overall dimensions	Weight
TOS5101	430 mm wide, 177 mm high, 370 mm deep (16.93 wide, 6.97 high, 14.57 deep in.)	19 kg (42 lbs.)
TOS5051	320 mm wide, 132 mm high, 300 mm deep (12.60 wide, 5.20 high, 11.81 deep in.)	16 kg (36 lbs.)
TOS5050	320 mm wide, 132 mm high, 300 mm deep (12.60 wide, 5.20 high, 11.81 deep in.)	15 kg (33 lbs.)

**12. Resume of test state by nonvolatile memory**

When you turn the Tester power OFF, the Tester stores its existing test state in its nonvolatile memory. As you turn the Tester power ON for the next time, by recalling the conditions of test from the nonvolatile memory the Tester automatically restores the test state that existed when you turned OFF power last time.

**13. A safer H.V output terminal**

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

**14. A DANGER lamp**

The Tester has a large and bright DANGER lamp. This lamp lights up so far as electric charge remains on the output terminal, warning you of a possible electric shock hazard.

**15. Interlock provision**

The Tester has an interlock provision to ensure that the Tester cannot deliver its output voltage and the Tester shutdown its output voltage under test condition unless a certain external condition is met. This interlock signal is available if there is open-circuiting or imperfect contacting in the signal line, thereby enhancing further the operation safety.

**16. Keylock function**

The Tester has a keylock function to disable all keys (except the START/STOP keys) to guard against inadvertent key operation by the operator or by key operation by unauthorized persons, thereby improving the reliability of tests.

**17. Switches for safer operation**

A rotary switch is used for AC/DC test mode selection and test voltage range selection. The START switch is of a recessed type. These features, together with the keylock function, enhance operation reliability and safety.

**18. Noise-resistant circuits**

The internal circuits of the Tester are designed to be highly resistant against noise, thereby enhancing the operation reliability.

**■ The features common to Models TOS5101 and TOS5051 (models for DC output also) can be summarized as follows:****1. Automatic discharge function**

When the DC test output voltage is turned off, the output circuit is automatically discharged, thereby discharging the charge that could remain in the device under test (DUT). This feature, together with the DANGER lamp, enhances the test operation safety.

**2. A DC/DC converter for quality DC test voltage**

The Tester has a DC/DC converter which generates a quality test voltage of high stability with less ripple.

## 9.1 TOS5050

Model		TOS5050	
Test voltage	Applied voltage	0 to 2.5 or 0 to 5kV AC	
	Output rating (Note 1)	500VA/5kV, 100mA (with nominal AC line voltage)	
	Transformer rating	500VA	
	Short-circuit current (Note 2)	200 mA or more (when the output voltage is 900 V or more at 2.5 kV range or 1.3 kV or more at 5 kV range.)	
	Waveform (Note 3)	AC line voltage waveform	
	Voltage regulation (with nominal AC line voltage)	15% or better (against change from maximum rated load to no load)	
	Switching	With zero-turn-on (zero-start) switch	
Output voltmeters	Analog voltmeter	Scale	5kV fs (no mirror)
		Class	JIS Class 2.5
		Accuracy	$\pm 5\%$ fs
		Response, graduation	Mean-value response, rms-value graduation
	Digital voltmeter	Full scale	2.5kV/5kV fs
		Accuracy	$\pm 1.5\%$ fs
Response, display		Mean-value response, rms-value display	
Ammeter	Digital ammeter	Accuracy	$\pm [(5\% \text{ of upper cutoff current}) + 20\mu\text{A}]$
		Response, display	Mean-value response, rms-value display
Pass/fail judgement	Type of judgement	<ul style="list-style-type: none"> <li>Window comparator type</li> <li>If the current detected is larger than the preset upper cutoff current, the Tester gives a FAIL judgement.</li> <li>If the current detected is less than the preset lower cutoff current, the Tester gives a FAIL judgement.</li> <li>As the Tester gives a FAIL judgement, it cuts off the output and delivers a FAIL signal.</li> <li>If the test period elapses without any unacceptable conditions, the Tester gives a PASS judgement.</li> </ul>	
	Upper cutoff current setting range	0.1 to 110mA	
	Lower cutoff current setting range	0.1 to 110mA	
	Judgement accuracy	$\pm [(5\% \text{ of upper cutoff current}) + 20\mu\text{A}]$ (Note 4)	
	Current detection	The absolute value of current is integrated and compared with the preset cutoff current value.	
	Calibration	Calibrated for r.m.s, value of sine wave, with pure-resistive load	
	No-load output voltage	Approx. 460V, at 100mA setting required for detection (Note 5)	
Test time	Setting range	0.5 to 999 s. (with Timer-off function)	
	Accuracy	$\pm 20$ ms	

Note 1: Pay attention to the limitations on output voltage delivery time as follows: The heat dissipation of the high voltage generator section of the Tester is one-half of the normal wattage with respect to the rated output from the viewpoints of size, weight, and cost of the Tester. Due to this, be sure to operate the Tester within the limits shown in the below tables. If you operate the Tester exceeding these limits, the thermal fuse in the Tester may blow out.

TOS5050			
Ambient temperature $t$	Upper cutoff current $I$ (mA)	Pause period	Maximum allowable continuous test period
$t \leq 40^{\circ}\text{C}$ ( $t \leq 104^{\circ}\text{F}$ )	$50 < I \leq 110$	Not less than test period	$\leq 30$ min
	$I \leq 50$	Not required	Infinite

Note 2: When the nominal power supply voltage can be maintained with the output shorted.

Note 3: Test voltage waveform:

When an AC test voltage is applied to a capacitive DUT, it is possible that the voltage becomes higher even than that when in the no load state. Furthermore, waveform distortion also may occur if the capacitance of the DUT is voltage-dependent (such as of ceramics capacitors). When the test voltage is not higher than 1.5kV and the capacitance is not larger than 1000 pF, such test voltage changes are only of negligible levels.

Note 4: When in the AC mode, the current which flows through the stray capacitances of the test leadwires, test jigs, and other items on the test circuit also causes measuring errors. The total judgement accuracy is the sum of this current and the above-mentioned judgement accuracy. Approximate values of such currents are shown in the following table. Note that, in high-sensitivity high-voltage test, the current which flows through the stray capacitances may become larger than the preset lower cutoff current and the LOWER PASS/FAIL judgement may not be successfully done.

Output voltage	1kV	2kV	3kV	4kV	5kV
When 350-mm-long test leadwires are used being suspended in air	$2\mu\text{A}$	$4\mu\text{A}$	$6\mu\text{A}$	$8\mu\text{A}$	$10\mu\text{A}$
When accessory test leadwires TL01-TOS are used (typical)	$16\mu\text{A}$	$32\mu\text{A}$	$48\mu\text{A}$	$64\mu\text{A}$	$80\mu\text{A}$

When other test leadwires than the above are used, the values of the currents may differ depending on the conditions.

Note 5: In order to be able to make a FAIL judgement when in the state that the output terminals are shorted, a certain minimal level of no-load output voltage is necessary due to the internal resistance of the output circuit. This item indicates such minimal output voltage.

Model		TOS5050																								
Ambient temperature and humidity	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																								
	Storage range	-20 to 70°C (-4 to 158°F), ≤ 80% RH																								
SAFETY (Note 6)		<p>Conforms to the requirements of the following standard.</p> <ul style="list-style-type: none"> <li>• UL1244 (The UL-approved products with input voltage of 120VAC satisfy the UL1244 standard.)</li> </ul>																								
Electromagnetic compatibility (EMC) (Note 6)		<p>Conforms to the requirements of the following standard.</p> <p>EN61326</p> <p>Under following conditions</p> <ol style="list-style-type: none"> <li>1. Used HV test leadwires which is supplied.</li> <li>2. No discharge in testing.</li> <li>3. Used the shielded cable which length is less than three meters when the SIGNAL I/O is used.</li> </ol>																								
AC line power requirements	Voltage and frequency	100V±10%, 50/60 Hz (Factory modification options: Nomal 110/120/220/230/240V)																								
	Power consumption Without load (READY status) <table style="margin-left: 40px;"> <tr><td>100V line</td><td>≤ 15VA</td></tr> <tr><td>110V line</td><td>≤ 20VA</td></tr> <tr><td>120V line</td><td>≤ 20VA</td></tr> <tr><td>220V line</td><td>≤ 25VA</td></tr> <tr><td>230V line</td><td>≤ 25VA</td></tr> <tr><td>240V line</td><td>≤ 25VA</td></tr> </table> With rated load <table style="margin-left: 40px;"> <tr><td>100V line</td><td>Approx. 600VA</td></tr> <tr><td>110V line</td><td>Approx. 600VA</td></tr> <tr><td>120V line</td><td>Approx. 600VA</td></tr> <tr><td>220V line</td><td>Approx. 610VA</td></tr> <tr><td>230V line</td><td>Approx. 640VA</td></tr> <tr><td>240V line</td><td>Approx. 610VA</td></tr> </table>	100V line	≤ 15VA	110V line	≤ 20VA	120V line	≤ 20VA	220V line	≤ 25VA	230V line	≤ 25VA	240V line	≤ 25VA	100V line	Approx. 600VA	110V line	Approx. 600VA	120V line	Approx. 600VA	220V line	Approx. 610VA	230V line	Approx. 640VA	240V line	Approx. 610VA	
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Model	TOS5050
Insulation resistance	$\geq 30M\Omega$ , with 500V DC
Withstanding voltage	1390 V AC (2 seconds), between AC line and chassis
	1200V AC (1 second), UL-approved products only
Dimensions Excluding protrusions	320 W $\times$ 132 H $\times$ 300 D mm (12.6 W $\times$ 5.20 H $\times$ 11.8 D in.)
	320 W $\times$ 150 H $\times$ 365 D mm (12.6 W $\times$ 5.91 H $\times$ 14.4 D in.)
Weight (Note 7)	15 kg (33 lbs)

Note 6: Not applicable to custom order models.

Note 7: When a Tester is modified to operate on an optional AC line voltage by factory modification, the Tester will become heavier by approximately 2 kg (4.41 lbs) for the 110/120V line or by approximately 3 kg (6.61 lbs) for the 220/230/240V line.



Model	TOS5050	
Remote control function	REMOTE connector (5-pin DIN connector, on front panel)	<p>The Tester has the following provisions for remote-control of test start/stop.</p> <ul style="list-style-type: none"> <li>• To control the Tester from an optional Remote Control Box RC01-TOS or RC02-TOS.</li> <li>• To control the Tester from an optional High Voltage Test Probe HP01A-TOS or HP02A-TOS (when the test voltage is less than 4kV rms AC or 5kV DC).</li> </ul>
	SIGNAL I/O connector (14-pin Amphenol connector, on rear panel)	<ul style="list-style-type: none"> <li>• To control the Tester from a make-contact device (such as a relay or a switch).</li> <li>• To control the Tester with a low-active control signal from a logic circuit.</li> </ul> <p>Conditions of low-active control signal (Note 8):</p> <ul style="list-style-type: none"> <li>• High level input voltage : 11 to 15V</li> <li>• Low level input voltage : 0 to 4V</li> <li>• Low level input current : -5mA Max.</li> <li>• Input time requirement : <math>\geq 5</math> ms.</li> </ul>
Interlock	<p>The Tester accepts an interlock input signal applied through function the SIGNAL I/O connector (14-pin Amphenol connector on the rear panel). When this signal is applied, the Tester drives itself into the PROTECTION status.</p>	

Note 8: SIGNAL I/O input

The control signal input circuits are isolated from other internal circuits, except that the common lines of the input circuits are directly connected to those of the signal output circuits. The ratings are 30V DC, 30V rms AC MAX.

The input terminals are pulled up to +15V with resistors. To make the input terminals open is equivalent to that the high level signals are applied to the terminals.

## Signal Output Functions

Signal Name	Conditions for Signal Generation	Types of Signals
H.V ON	During the test time (period the Tester delivers the test voltage)	Open-collector signal (Note 9), DANGER lamp
TEST	During the test time (period the Tester delivers the test voltage)	Open-collector signal (Note 9), Vacuum Fluorescent Display
PASS	For PASS judgement. Delivered for approximately 0.2 s.	Open-collector signal (Note 9), Vacuum Fluorescent Display, buzzer (Note 10)
U FAIL	For U FAIL judgement (detected current is larger than upper cutoff current)	Open-collector signal (Note 9), Vacuum Fluorescent Display, buzzer (Note 10)
L FAIL	For L FAIL judgement (detected current is less than lower cutoff current)	Open-collector signal (Note 9), Vacuum Fluorescent Display, buzzer (Note 10)
READY	When the Tester is ready to execute the test	Open-collector signal (Note 9), Vacuum Fluorescent Display
PROTECTION	When the Tester is in the PROTECTION status	Open-collector signal (Note 9), Vacuum Fluorescent Display
STATUS SIGNAL OUTPUT	When one of the DIP switches for the following items is set to ON and the corresponding status has occurred. If two or more items are set to ON, the signal is delivered on the logical sum of such items. 1: H.V ON 2: TEST 3: PASS 4: U FAIL 5: L FAIL 6: READY 7: PROTECTION 8: POWER ON	100V AC (Note 11) (even when the AC line voltage is other than 100V)

Note 9: The ratings of the open-collector signal are 4.5 to 30V DC, 400mA (maximum, in total). The above open-collector output circuits are isolated from other internal circuits, except that the common lines of the output circuits are directly connected to those of the signal input circuits. The common lines of all open-collector circuits are connected together. The ratings are 30V DC, 30V rms AC MAX.

Note 10: Loudness of the buzzer for PASS/FAIL annunciations can be controlled with the buzzer control. It is in common for both PASS and FAIL annunciations — it does not control them separately.

Note 11: The ratings of the STATUS OUTPUT signal are 100V AC, 0.3A (maximum).

## Accessories

Item	Q'ty	Remarks
AC input power cable	1	
H.V test leadwires TL01-TOS (1.5 meters long)	1 set	
14-pin Amphenol plug	1	Assembly type
"DANGER! HIGH VOLTAGE" sticker	1	
Operation manual	1	
AC power fuses	2	In fuse holder cap (one for present use and the other for spare)