

T O S 5 4 0 0 S E R I E S



WITHSTANDING VOLTAGE / INSULATION RESISTANCE TESTERS

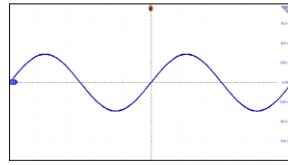
TOS5400 Series

NEW

- PWM amplifier provides highly stable output
- AC withstanding voltage test: 5 kV / 100 mA (500 VA) (TOS5401/TOS5402)
- DC withstanding voltage test: 6 kV / 10 mA (50 W) (TOS5401/TOS5403)
- DC-only model (DC withstanding voltage test / insulation resistance test) enables efficient evaluation of batteries and photovoltaic (PV) systems (TOS5403)
- Touch panel display
- LAN, USB, and RS-232C as standard
- Shorter takt time thanks to faster output control and measurement

High Stability

Equipped with a high-efficiency PWM switching amplifier!



Outputs a stable high voltage unaffected by AC line fluctuations. Allows reliable testing even in regions with large voltage variations. (Input voltage fluctuation rate: $\pm 0.3\%$)

Shorter Takt Time

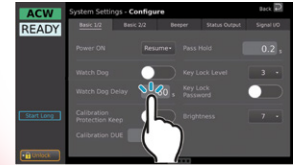
Improved productivity!

The start phase shift function* allows tests to be performed without rise time, which, compared with conventional models, shortens takt time and improves productivity.

*Can be set when the Time Unit is set to "cycle".

Intuitive Operation

Equipped with a 7-inch touch panel.



Touchscreen enables intuitive operation. The display shows not only test settings but also overviews and diagrams, making the interface easier to use.

Simple operation ensures reliable and safe testing!

DC-Only Model

For battery and PV testing!

The TOS5403 is a DC-only model that supports DC withstanding voltage tests and insulation-resistance tests. It can be used for evaluation tests of batteries and photovoltaic (PV) systems that require DC voltage testing.

Multiple Interface Options

Compatible with various types of automation!



Equipped with an LXI compliant LAN, USB 2.0, USB compliant with USB-TMC, and an RS 232C interface.

Even Momentary Discharges Can Be Detected

Current detection sensitivity can be adjusted with the discharge detection function!

The discharge detection function allows adjustment of the current detection response speed (sensitivity), enabling detection of instantaneous discharges and discharges with high-frequency components (supports arc and corona discharges).

TOS5400 series electrical safety testers are designed to perform two of the four safety tests required for electrical products: withstanding voltage and insulation resistance tests. With an output of 5 kV / 100 mA (AC) and 6 kV / 10 mA (DC), these devices can perform withstanding voltage and insulation resistance testing of electronic equipment and components in accordance with safety standards such as IEC, EN, BS, VDE, UL, CSA, GB, and JIS, as well as the requirements of the Japanese Electrical Appliance and Material Safety Act. TOS5400 series is also equipped with a high-efficiency PWM switching amplifier that maintains stable output voltage even if there are AC line voltage or frequency fluctuations, enabling reliable evaluation even in regions with unstable power supply.

This series is the first of Kikusui withstanding voltage and insulation resistance testers with a touchscreen display, enabling intuitive and efficient operation. Thanks to discharge detection feature the response speed (sensitivity) can be adjusted, allowing detection of momentary discharges and discharges containing high frequency components, including arc and corona discharges. This series also has "Start Long" function (hold the START button to begin a test) which helps prevent accidental test starts. TOS5400 series is an excellent choice for a broad range of applications, including R&D and QA testing, certification body test facilities and production line inspections.

New standard models available!



▲ TOS5402

WITHSTANDING VOLTAGE / INSULATION RESISTANCE TESTERS

TOS5400 Series

3 Models

Features & Functions

- ACW: 5 kV / 100 mA (500 VA); DCW: 6 kV / 10 mA (50 W) ● IR: 25 V - 1000 V / up to 10.000 G Ω (400 V or higher) ● Highly accurate measurements: $\pm 1.5\%$ of reading (voltage: 500 V or higher, current: 1 mA or higher) ● New PWM amplifier ● Touch panel display ● Rise time/ fall time control function ● Discharge function ● Universal AC input ● AUTO function ● LAN, USB, RS 232C ● Panel memory function ● Key lock function ● START Long function (press and hold START for approx. 1 second to begin a test); temporary release and double action setting available

Supported tests/ models	TOS5403	TOS5402	TOS5401
AC Withstanding Voltage Test (ACW)		●	●
DC Withstanding Voltage Test (DCW)	●		●
Insulation Resistance Test (IR)	●	●	

Specifications

Withstanding Voltage Test Section

Output function

AC output section (ACW only)

Item	TOS5401, TOS5402	
Output range	0.05 kV to 5.00 kV	
Output setting accuracy	±(2% of setting + 20 V) (at no load)	
Output setting range	0.000 kV to 5.500 kV 0.000 kV to 1.500 kV (When Time Unit is set to Cycle and Phase Shift is set to 0°)	
Output resolution	1 V	
Maximum rated output ¹	500 VA (5 kV/100 mA)	
Maximum rated voltage	5 kV	
Maximum rated current	100 mA (when the output voltage is 0.5 kV or higher)	
Transformer capacity	500 VA	
Output voltage waveform ²	Waveform	Sine
	Phase shift	The output voltage waveform can start with a phase shifted approx. 90° from the zero-crossing point.
	Distortion rate	3% or less. (when the output voltage is 0.5 kV or higher and no load or a pure resistive load is connected)
Frequency	50 Hz/60 Hz	
Frequency accuracy	±0.5 % (excluding during voltage rise time)	
Voltage regulation	±10 % or less (when changing from maximum rated load to no load)	
Input line regulation	±0.3 % (5 kV at no load; power supply voltage: 90 V to 250 V)	
Short-circuit current	200 mA or more (output voltage 1.0 kV or higher)	
Output method	PWM switching	

- ¹ When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting.
² Waveform distortions may occur if an EUT whose capacitance is dependent on voltage (for example, an EUT that consists of ceramic capacitors) is connected as the load. However, if the test voltage is 1.5kV, the effect of a capacitance of 1000pF or less can be ignored. Because the high-voltage power supply of the TOS54 series uses the PWM switching method, if the test voltage is 500V or less, the switching and spike noise proportions are large. The lower the test voltage, the greater the waveform is distorted.

DC output section (DCW only)

Item	TOS5401, TOS5403
Output range	0.05 kV to 6.00 kV
Output setting accuracy	±(2 % of setting + 20 V) (at no load)
Output setting range	0.000 kV to 6.200 kV
Output resolution	1 V
Maximum rated output ¹	50 W (5 kV/10 mA)
Maximum rated voltage	6 kV
Maximum rated current	10 mA
Ripple (TYP)	5kV no load 50 Vp-p Max. rated load 100 Vp-p
Voltage regulation	3 % or less (when changing from maximum rated load to no load)
Short-circuit current (TYP)	40 mA (when generating 6 kV output)
Discharge function	Forced discharge after test completion (discharge resistance: 125 kΩ) ² ; Maximum capacitance: 1 μF ³ ; Discharge time: 0.0 to 100.0 seconds; Discharge function during interlock activation: ON/OFF

- ¹ When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting.
² In the following conditions, charging current may activate a FAIL judgment or trigger the protection function. EUT capacitance: 1 μF; Rise Time: 1.0 second or less; Judge Delay: 1.2 seconds or less.
³ Maximum capacitance that can be discharged within 2 seconds in a DC withstanding voltage test. Tests can still be conducted beyond the maximum capacitance, but the discharge time will increase.

Common

Item	TOS5401	TOS5402	TOS5403
Start voltage function	The initial voltage at test start can be set to 1 % to 99 % of the test voltage. Resolution: 1 % Disabled if the Time Unit is set to Cycle.		n/a
Limit voltage function	The upper limit of the test voltage can be set. ACW: 0.000 kV to 5.500 kV, DCW: 0.000 kV to 6.200 kV ACW: 0.000 kV to 1.500 kV (When Time Unit is set to Cycle and Phase Shift is set to 0°)		n/a
Output voltage monitor function	If the output voltage deviates more than ±(350 V) from the set value, the output is turned off, and the protection function is activated.		

Measurement function

Digital voltmeter

Item	TOS5401	TOS5402	TOS5403
Measuring range	AC/DC: 0.000 kV to 6.500 kV	AC: 0.000 kV to 6.500 kV	DC: 0.000 kV to 6.500 kV
Display	□.□□□ kV		
Accuracy	V < 500 V: ±(1.5 % of reading + 10 V) V ≥ 500 V: ±1.5 % of reading		
Response ¹	ACW: True rms/ Mean-value response rms display can be switched. DCW and IR: Mean-value		Mean-value
Hold function	Holds the measured voltage value at the end of the test while the PASS/FAIL judgement is displayed.		

- ¹ The true rms value and the average response rms value, require a response time of at least 50 ms in order to meet the measurement accuracy

Digital ammeter

Item	TOS5401	TOS5402	TOS5403
Measuring range	AC: 0.00 mA to 110 mA DC: 0.00 mA to 11 mA	AC: 0.00 mA to 110 mA	DC: 0.00 mA to 11 mA
Display (i = measured current)	i < 10 μA	□.□ μA	
	10 μA ≤ i < 100 μA	□□.□ μA	
	100 μA ≤ i < 1 mA	□□□.□ μA	
	1 mA ≤ i < 10 mA	□□□□.□ mA	
	10 mA ≤ i < 100 mA	□□□□□.□ mA	
	100 mA ≤ i	□□□□□.□ mA	
Accuracy ¹ (i = measured current)	1.00 mA ≤ i ±(1.5 % of reading) i < 1.00 mA ±(1.5 % of reading + 20 μA)		
Response ²	ACW: True rms/ Mean-value response rms display can be switched. DCW: Mean-value		Mean-value
Hold function	The current measurement after a test is finished is held while the pass judgment is displayed.		

- ¹ When the humidity is 70% or higher, add 50 μA. During AC voltage tests, current also flows in the stray capacitance of items such as the test leads and tools. For details on stray capacitance, see "Stray Capacitance of AC Withstanding Voltage Tests"
² The true rms value and the average response rms value, require a response time of at least 50 ms in order to meet the measurement accuracy.

Judgment function

Item	TOS5401	TOS5402	TOS5403
Function	The output is shut off when a judgment is made. Beep volume level can be set for PASS and FAIL separately.		
UPPER FAIL	Judgment method	Upper limit (Upper) is detected.	
	Display	Shown on the display.	
	Beep sound	On	
LOWER FAIL	SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.	
	Judgment method	Lower limit (Lower) is detected. Voltage rise time (Rise Time) Voltage fall time (Fall Time)	
	Display	Shown on the display	
PASS	Beep sound	On	
	SIGNAL I/O	The L-FAIL signal is generated continuously until a STOP signal is received.	
	Judgment method	PASS judgment is made if Upper-FAIL or Lower-FAIL has not occurred when the test time elapses.	
PASS	Display	Shown on the display	
	Beep sound	ON (fixed at 0.2 s regardless of Pass Hold setting)	
	SIGNAL I/O	The PASS signal is generated for the length of time specified by the Pass Hold setting. If Pass Hold is set to Infinity, the PASS signal is generated continuously until a STOP signal is received.	
Upper limit setting range	AC: 0.01 mA to 110.00 mA DC: 0.01 mA to 11.00 mA		DC: 0.01 mA to 11.00 mA
Lower limit setting range	AC: 0.00 mA to 109.99 mA, or OFF DC: 0.00 mA to 10.99 mA, or OFF		DC: 0.00 mA to 10.99 mA, or OFF
Judgment accuracy ²	1.00 mA ≤ i i < 1.00 mA	±(1.5 % of setting) ±(1.5 % of setting + 20 μA)	
Current detection method	Calculates the current's true rms value or mean-value and compares this value with the reference value		
Calibration	Calibrated with the rms of a sine wave using a pure resistive load		
Discharge detection function	Function	Separately from the Upper judgment, it is possible to choose between low-pass filter (LPF) and high-pass filter (HPF) to detect a discharge at the EUT	
	LPF	The judgment criterion is set to a value greater than the set Upper value. It can be switched between three levels: Fast, Medium, Slow. It is generally for normal withstanding voltage test.	
	HPF	The judgment criterion is set to a fixed value independently of the set Upper value. It can be switched between three levels: High, Medium, Low. It is mainly for detecting small discharges.	

- ¹ In the following conditions, charging current may activate a FAIL judgment or trigger the protection function. EUT capacitance: 1 μF; Rise Time: 1 second or less; Judge Delay: 1.2 seconds or less.
² When the humidity is 70% or higher, add 50 μA. During AC voltage tests, current also flows in the stray capacitance of items such as the test leads and tools. For details on stray capacitance, see "Stray Capacitance of AC Withstanding Voltage Tests"

Timer function

Item	TOS5401	TOS5402	TOS5403
Voltage rise time (Rise Time)	Setting range	0.1 s to 100s, or OFF. If Time Unit is set to CYCLE in ACW tests: ¹ • If Phase Shift is set to 0°: Fixed to OFF. • If Phase Shift is set to 90°: Fixed to 1/4 Cycle.	n/a
	Setting resolution	0.1 s	
Voltage fall time (Fall Time)	Setting range	0.1 s to 100 s, only enabled when a PASS judgment occurs. Disabled if the Time Unit is set to CYCLE.	n/a
	Setting resolution	0.1 s	
Test Time	Setting range	0.1 to 1000 seconds, or OFF. If Time Unit is set to CYCLE in ACW tests: • At 50 Hz: 2 to 50000 cycles • At 60 Hz: 2 to 60000 cycles	n/a
	Setting resolution	0.1 s or 1 Cycle	
Judgment delay (Judge Delay)	Setting range	0.1 s to 100 s	n/a
	Setting resolution	0.1 s	0.1 s
Accuracy	±(100 ppm + 20 ms) excluding Fall Time		

- ¹ If Phase Shift is set to 90°, the time for quarter-wave length is fixed as Rise Time; therefore, the voltage is output for Test Time + 1/4 cycles. For example, if Test Time is set to 2, Time Unit to Cycle, Phase Shift to 90°, and Frequency to 50 Hz, voltage is output for approx. 45 ms (20 ms × (2 + 1/4 cycles)).

Insulation Resistance Test Section

Output function

Item	TOS5402, TOS5403
Output voltage	25 Vdc to 1000 Vdc, negative polarity
Output setting accuracy	±(1.0 % of setting + 2 V)
Output setting range	0.00 kV to 1.02 kV
Output setting regulation	1 V
Max. rated load	1 W (-1000 Vdc/1 mA)
Max. rated current	1 mA
Ripple	1000 V no load 2 Vp-p or less Max. rated load 10 Vp-p or less
Voltage regulation	1 % or less (when changing from maximum rated load to no load)
Short-circuit current	12 mA or less
Discharge function	Forced discharge after test completion (discharge resistance: approx. 25 kΩ) ¹ Maximum capacitance: 2 μF ² Discharge time: 0.0 to 100.0 seconds Discharge function during interlock activation: ON/OFF
Output voltage monitor function	If the output voltage exceeds ±(10 % of setting + 10 V), the output is turned off, and the protection function is activated.

- ¹ In the following conditions, charging current may activate a FAIL judgment or the protection function: EUT capacitance: 2 μF; Rise Time: seconds or less; Judge Delay: 2.0 seconds or less; Low Pass Filter: OFF
² Maximum capacitance that can be discharged within 2 seconds in an insulation resistance test. Tests can still be conducted beyond the maximum capacitance, but the discharge time will increase.

Specifications

Measurement function Digital voltmeter

Item	TOS5402, TOS5403	
Measuring range	0 V to - 1200 V	
Display (v = measured voltage)	v < 10 V	□.□ V
	10 V ≤ v < 100 V	□□.□ V
	100 V ≤ v < 1000 V	□□□.□ V
	1000 V ≤ v	□□□□.□ V
Accuracy	±(1 % of reading + 1 V)	

Resistance meter

Item	TOS5402, TOS5403	
Measurement range / accuracy ¹ (i: Measurement current) (R = measured insulation resistance)	40 nA ≤ i ≤ 100 nA	200.00 MΩ ≤ R ≤ 10.000 GΩ: ±(20 % of reading)
	100 nA < i ≤ 200 nA	100.00 MΩ ≤ R < 5.000 GΩ: ±(10 % of reading) 5.000 GΩ ≤ R ≤ 10.000 GΩ: ±(20 % of reading)
	200 nA < i ≤ 1000 nA	10.000 MΩ ≤ R < 5.000 GΩ: ±(5 % of reading)
	1 μA < i ≤ 2 mA	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of reading + 5digit) 10.000 MΩ ≤ R < 2.000 GΩ: ±(2 % of reading)
	25 kΩ ≤ R < 1.000 MΩ	□□□ kΩ
Display (R = measured insulation resistance)	1.000 MΩ ≤ R < 20.0 GΩ	□.□□□ MΩ
		□□.□□ MΩ
		□□□.□ GΩ
		□□□□ GΩ
		□□.□□ GΩ
20.0 GΩ ≤ R	OVER	
Hold function	The resistance measurement after a test is finished is held while the pass judgment is displayed.	
Response	Average response (averaged time: Fixed at 100ms)	

¹ Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
For measurements of 200 nA or less, the humidity 50 %rh or less.

Judgment function

Item	TOS5402, TOS5403		
Judgment method and judgment operation ¹	Function	The output is shut off when a judgment is made. Beep volume level can be set for PASS and FAIL separately.	
	UPPER FAIL	Judgment method	Upper limit (Upper) is detected. Voltage rise time (Rise Time)
		Display	Shown on the display
		Beep sound	On
		SIGNAL I/O	The U FAIL signal is generated continuously until a STOP signal is received.
	LOWER FAIL	Judgment method	Lower limit (Lower) is detected or when there is an abnormality during the voltage rise.
		Display	Shown on the display
		Beep sound	On
		SIGNAL I/O	The L-FAIL signal is generated continuously until a STOP signal is received.
	PASS	Judgment method	PASS judgment is made if Upper-FAIL or Lower-FAIL has not occurred when the test time elapses.
		Display	Shown on the display
		Beep sound	ON (fixed at 0.2 s regardless of Pass Hold setting)
SIGNAL I/O		The PASS signal is generated for the length of time specified by the Pass Hold setting. If Pass Hold is set to Infinity, the PASS signal is generated continuously until a STOP signal is received.	
Upper limit setting range	0.001 MΩ to 10.000 GΩ		
Lower limit setting range	0.000 MΩ to 9.999 GΩ		
Judgment accuracy (common between Upper and Lower) ^{2, 3, 4}	Measurement accuracy + 2 digits		

¹ In the following conditions, charging current may activate a FAIL judgment or the protection function: EUT capacitance: 2 μF; Rise Time: 1.5 seconds or less; Judge Delay: 2.0 seconds or less; Low Pass Filter: OFF
² Humidity: 70%rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
³ For judgments of 5 μA or less, a test time of at least 1.0 seconds is necessary.
⁴ When the low pass filter is set to medium, a test time of at least 0.3 seconds is required. When the low pass filter is set to slow, a test time of at least 0.5 seconds is required.

Timer function

Item	TOS5402, TOS5403	
Voltage rise time (Rise Time)	Setting range	0.1s to 100s, or OFF
	Setting resolution	0.1s
Voltage fall time (Fall Time)	0.1s to 100s or OFF (only enabled when a PASS judgment occurs)	
Judgment delay (Judge Delay)	Setting range	0.1s to 100s
	Setting resolution	0.1s
Accuracy	±(100ppm + 20ms) excluding Fall Time	

Auto Test

Item	Specifications
Number of programs	61
Number of steps	2
Test mode	The same settings as for single test settings are possible, except for the following. The same test can be selected consecutively. • Limit Voltage is fixed to the maximum rated value per test mode. • Test Time is fixed to ON. • In IR test, Lower is fixed to ON (only for models that support IR testing).
Fail judgment operation	The following operations are selectable: • Continue: All steps are executed even for a FAIL judgment. • Abort: Automatic test ends for a FAIL judgment.
Interval time between steps	0.1 s to 100 s
Step start condition	The following operations are selectable: • Immediate: When the INIT or INIT:TEST command is received via remote control, starts all steps consecutively. • BUS: Step 1 can be started using the software trigger from remote control. After it is completed, the operation pauses. When the command is then received again, Step 2 starts. • External: Step 1 starts upon performing the start operation. After a step is completed, the operation is paused. When you perform another start operation, step 2 starts. • Once: When you perform a start operation, all steps are executed consecutively.

General Specifications

Item	Specifications		
Environment	Installation location	Indoors, 2000 m or less, Pollution Degree 2 ¹	
	Spec guaranteed range	Temperature	5 °C to 35 °C (41 °F to 95 °F)
		Humidity	20 %rh to 80 %rh (no condensation)
	Operating range	Temperature	0 °C to 40 °C (32 °F to 104 °F)
		Humidity	20 %rh to 80 %rh (no condensation)
	Storage range	Temperature	-20 °C to 70 °C (-4 °F to 158 °F)
Humidity		90 %rh or less (no condensation)	
Power Supply	Nominal voltage range (allowable voltage range)	100 Vac to 240 Vac (90 Vac to 250 Vac)	
	Power consumption	No load (READY state)	100 VA or less
		Rated load	800 VA max. Maximum 200 VA for TOS5403 only.
	Allowable frequency range	47 Hz to 63 Hz	
Insulation resistance (between AC LINE and chassis)	30 MΩ or more (500 Vdc)		
Withstanding voltage (between AC LINE and chassis)	1400 Vac for 2 seconds		
Earth continuity	25 Aac/0.1 Ω or less		
External dimensions	320(330)W × 132(150)H × 350(380) D mm (max. size)		
Weight	TOS5401: Approx. 16 kg (35.27 lb), TOS5402: Approx. 15 kg (33.07 lb), TOS5403: Approx. 9 kg (19.84 lb)		
Electromagnetic compatibility (EMC) ^{2, 3}	Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN 61326-1(Class A ⁴) EN 61000-3-2 EN 61000-3-3 EN 55011(Class A ⁴ , Group 1 ⁵) Applicable under the following conditions: The maximum length of all cabling and wiring connected to the TOS54 series must be less than 2.5m. Use the included high voltage test leads. Electrical discharges are applied only to the EUT. Shielded cables are being used when using the SIGNAL I/O.		
Safety ²	Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU ³ EN 61010-1, EN61010-2-034 (Class I ⁶ , Pollution Degree 2 ¹)		

¹ Pollution is addition of foreign matter (solid, liquid or gaseous) that may produce a reduction of dielectric strength or surface resistivity. Pollution Degree 2 assumes that only non-conductive pollution will occur except for an occasional temporary conductivity caused by condensation.

² Does not apply to specially ordered or modified products.

³ Only for models with CE marking / UKCA marking on their body.

⁴ This is a Class A instrument. This product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

⁵ This product belongs to Group 1 products. This product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purpose.

⁶ The TOS54 series is a Class I device. Be sure to ground the protective conductor terminal of the TOS54 series. The safety of this product is guaranteed only when the product is properly grounded.



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