TOS5300 SERIES

Hipot Tester/Hipot Tester with Insulation Resistance Test

A new standard for Hipot & Insulation resistance testing Applied to World-Wide input voltage

TOS5300(ACW)
TOS5301(ACW/DCW)
TOS5302(ACW/IR)

USB

New low-cost standard model that provides thorough operability, reliability and safety.

The “TOS5300 Series” is a series of test instruments used in Hipot tests and insulation resistance tests, two of the four tests regarded as necessary for ensuring the safety of electrical products. With an output of 5 kV/100 mA (AC) and 6 kV/10 mA (DC), the series can be used in Hipot & insulation resistance testing of electronic equipment and electronic parts, based on the requirements of IEC, EN, UL, VDE, JIS, and other international safety standards and the Electrical Appliance and Material Safety Law. Also, the test voltage stability is improved with the adoption of a newly developed switching amplifier. Since the output voltage can be kept constant even when the AC line voltage or frequency changes, consistent testing can be performed, even when the power supply environment is in an unstable region. The TOS5300 is also equipped with a number of features that are capable of meeting a variety of test needs. It is a new low-cost standard model that provides thorough operability, reliability and safety.

- The PWM amp system provides highly-stable output
- 5kV/100mA (500VA) AC Hipot test
- 6kV/maximum output 50W DC Hipot tester (TOS5301)
- 25V-1000V (7 steps), 500V or greater, up to 5.00G Ω Insulation Resistance test
- High-precision measurement ±1.5% of reading (with voltmeter 500V or higher, Ammeter 1mA or higher)
- Rise time(AC/DC) / Fall time(AC) control
- Key lock function and Protection cover for key operation
- Equipped with USB interface

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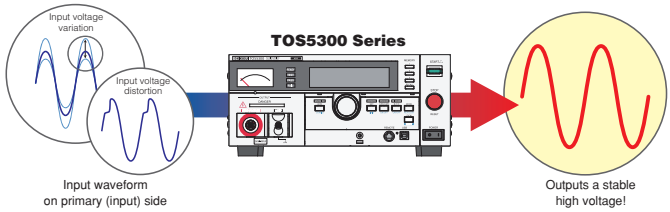
Basic performance

The achievement of AC Hipot testing with a constant stable output! [Input voltage variation : ± 0.3%]

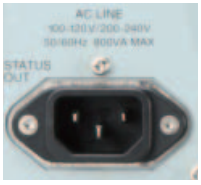
A conventional Hipot tester boosts and outputs the AC line's input voltage through the use of a slide transformer. With this slide transformer system, input voltage fluctuations will affect the output, preventing tests from being performed properly. At times, the application of distortion voltage applied to the EUT may cause a failure of new product (accelerating a deterioration of components). Since the TOS5300 Series equips with a high-efficient PWM amplifier that can output a stable high-voltage without being affected by the variation of AC power line, users can perform "safe", "stable", and highly "reliable" tests with confidence, even in regions with large voltage variations.



Realizing high-precision measurement with high-resolution and high-speed judgement

Equipped with a high-accuracy, high-resolution of True RMS measurement circuit, including a Voltmeter with ±1.5% of reading (500V or greater) / minimum resolution of 1V, and an Ammeter with ±1.5% of reading (1 mA or more) / minimum resolution of 1μA. In addition, it is also equipped with an Auto range function, with achieving a judgment accuracy of ±1.5% of reading. The Lower limit judgment accuracy achieves a level of performance equivalent to the Upper limit judgment accuracy that enables to detect for such a poor contact or disconnections of test leads. Moreover, it realizes the fast judgment by the test time of 0.1 second, while reliable testing can be performed, thanks to high-precision, high-resolution, high-speed measurement and the judgment functions.

Supporting the World-wide input voltage



Usable in any country, without changing the input power supply.The instrument not rely on the input power environment. Supplying the stable test voltage with 50/60 Hz frequencies.

Reducing the tact time

Reduction of the tact time leads to improve the productivity. However, it has been an issue that reducing the tact time may cause to worsen the measurement accuracy when the test time is faster than the measuring response speed. The TOS5300 series has been achieved to set the test time from 0.1s.

6kV/50WDC Hipot test (Model TOS5301)

Capable to perform DC Hipot test up to 6 kV. (Model TOS5301) Equipped with a stable DC/DC converter with a low-ripple and the load variation of 3% or less.

Insulation resistance test for 25V to 1000V*

The TOS5302 is equipped with an insulation resistance tester. The test voltages can be set from 25V, 50V, 100V, 125V, 250V, 500V and 1000V. And for setting at 500V and above, it can perform the insulation resistance test up to 5.00 GΩ.

*At 500V and above, measurements up to 5.00 GΩ are possible.

Protection cover prevents physical operation error in the production site

In many cases, workers on electronic equipment production lines and inspection lines are not technical experts. Therefore, it is possible that the operators may change setting conditions and make operation errors. In order to prevent from such cases, the TOS5300 is equipped with a key lock function and a protection cover to disable a physical key operation from the front panel.

New design of output terminal improves safety and functionality

In consideration of safety for the operator and the environment, the output terminal of HIGH-side has been placed in the most distant location from the control area. The free rotation machanisim protects from twisting (or breaking) of the cable. Also, with having the lock function for the LOW terminal on the main unit, the metal plate is no longer attached to the test lead of LOW-side, and it makes to resist damage to the test lead. Because of elimination of these projected components, the TOS5300 can avoid from unexpected accidents such as when the unit travels to other location. And also when the test lead is snagged on something, or unexpected stress is applied on the test lead, the High (High-voltage) test lead is designed to disconnect easily, but the Low (ground) test lead is designed to resist disconnection.
In order to prevent the insertion error, the color coding of the cable are classified to HIGH (red) and LOW (black) , and the plug shape of terminal are also different design.

▲ View with the protection cover removed

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Unless specified otherwise, the specifications are for the following settings and conditions.
- The warm-up time is 30 minutes.
- TYP:These are typical values. These values do not guarantee the performance of the product.
- rdng: Indicates the readout value.
- set: Indicates a setting.
- f.s: Indicates full scale.

Hipot Tester

			TOS5300	TOS5301	TOS5302
AC output section	Output range		0.05 kV to 5.00 kV		
		Accuracy	±(2 % of set + 20 V) when no load is connected		
		Setting range	0.00 kV to 5.50 kV		
		Resolution	10 V steps		
	Max. rated output *1		500 VA (5 kV/100 mA)		
	Max. rated voltage		5 kV		
	Max. rated current		100 mA (when the output voltage is 0.5 kV or greater)		
	Transformer rating		500 VA		
	Output voltage waveform *2		Sine		
		Distortion	If the output voltage is 0.5 kV or more: 3 % or less (when no load or a pure resistive load is connected).		
	Frequency		50 Hz or 60 Hz		
		Accuracy	±0.5 % (excluding during voltage rise time)		
	Voltage regulation		10 % or less (when changing from maximum rated load to no load)		
	Input voltage variation		±0.3 % (5 kV when no load is connected; power supply voltage: 90 V to 250 V)		
	Short-circuit current		200 mA or more (when the output voltage is 1.0 kV or greater)		
	Output method		PWM switching		
DC output section	Output range		—	0.05 kV to 6.00 kV	—
		Accuracy		± (2 % of set + 20 V) When no load is connected	
		Setting range		0.00 kV to 6.20 kV	
		Resolution		10 V STEP	
	Max. rated output *1			50 W (5 kV / 10 mA)	
	Max. rated voltage			6 kV	
	Max. rated current			10 mA	
	Ripple(TYP)	5 kV when no load is connected		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 generation 6 kV output)	
	Discharge feature			Forced discharge after test completion (discharge resistance: 125 kΩ)	
Start Voltage			The voltage at the start of withstanding voltage tests can be set to 50% of the test voltage.		
Limit Voltage			The test voltage upper limit can be set . AC: 0.00 kV to 5.50 kV, DC: 0.00 kV to 6.20 kV		
Output voltage monitor feature			If output voltage exceeds the specified value + 350 V or is lower than the specified value - 350 V, output is turned off, and protective features are activated.		
Voltmeter	Analog	Scale	6 kV AC/DC f.s		
		Accuracy	± 5 % f.s		
		Indication	Average value response/rms scale		
	Digital	Measurement range	0.000 kV to 6.500 kV AC/DC		
		Display	□ . □□□ kV		
		Accuracy	V < 500 V: ±(1.5 % of rdng + 20 V); V ≥ 500 V: ±1.5 % of rdng		
		Response	True rms (response time: 50 ms)		
		Hold feature	After a test is finished, the measured voltage is retained until the PASS or FAIL judgment is cleared.		
Ammeter	Digital	Measurement range	AC: 0.00 mA to 110 mA	AC: 0.00 mA to 110 mA DC: 0.00 mA to 11 mA	AC: 0.00 mA to 110 mA
		Display	i = measured current i < 1 mA: □□□ µA 1 mA ≤ i < 10 mA: □ . □□□ mA 10 mA ≤ i < 100 mA: □□ . □□ mA 100 mA ≤ i: □□□ . □ mA		
		Accuracy *3	1.00 mA ≤ i: ±(1.5 % of rdng); i < 1.00 mA: ±(1.5 % of rdng + 30 µA)		
		Response	True rms (response time: 50 ms)		
		Hold feature	After a test is finished, the measured voltage is retained until the PASS judgment is cleared.		

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Hipot Tester

		TOS5300	TOS5301	TOS5302
Judgment feature	Judgment method and judgment operation	See table below		
	Upper limit setting	AC: 0.01 mA to 110 mA	AC: 0.01 mA to 110 mA DC: 0.01 mA to 11 mA	AC: 0.01 mA to 110 mA
	Lower limit setting	AC: 0.01 mA to 110 mA / OFF	AC: 0.01 mA to 110 mA / OFF DC: 0.01 mA to 11 mA / OFF	AC: 0.01 mA to 110 mA / OFF
	Judgment accuracy *3	1.00 mA ≤ i: ±(1.5 % of set), i < 1.00 mA: ±(1.5 % of set + 30 μA)		
	Current detection method	Calculates the current's true rms value and compares this value with the reference value		
	Calibration	Calibrated with the rms of a sine wave using a pure resistive load		
Time	Voltage rise time	0.1 s to 10.0 s		
	Resolution	0.1 s		
	Voltage fall time	0.1 s / OFF (only enabled when a PASS judgment occurs)		
	Test time	0.1 s to 999 s, can be turned off (TIMER OFF)		
	Resolution	0.1 s to 99.9 s: 0.1 s. 100 s to 999 s: 1 s.		
	Accuracy	±(100 ppm + 20 ms) excluding Fall Time		

Judgment	Judgment method	Display	Buzzer	SIGNAL I/O
UPPER FAIL	If a current that is greater than or equal to the upper limit is detected, the output is turned off, and an UPPER the output is turned off, and an UPPER FAIL judgment occurs. During the voltage rise time (Rise Time) of DC hipot tests, an UPPER FAIL judgment also occurs if there is a problem with the voltage rise ratio.	FAIL LED lights OVER is displayed on the screen	ON	Generates a U-FAIL signal
LOWER FAIL	If a current that is less than or equal to the lower limit is detected, the output is turned off, and a LOWER FAIL judgment occurs. This judgment is not performed during voltage rise time (Rise Time) of all tests and during the voltage fall time (Fall Time) of AC hipot tests.	FAIL LED lights UNDER is displayed on the screen	ON	Generates a L-FAIL signal
PASS	If the specified time elapses without any problems, the output is turned off, and a PASS judgment occurs.	PASS LED lights	ON	Generates a PASS signal

- If PASS HOLD is enabled, the PASS signal is generated continuously until the TOS5300 Series receives a STOP signal.
- The UPPER FAIL and LOWER FAIL signals are generated continuously until the TOS5300 Series receives a STOP signal.
- The FAIL and PASS buzzer volume levels can be changed.
- For PASS judgments, the length of time that the buzzer sounds for is fixed to 0.2 seconds. Even if PASS HOLD is enabled, the buzzer turns off after 0.2 seconds.

*1. Regarding the output time limits:
Taking size, weight, and cost into consideration, the heat dissipation capability of the voltage generator that is used for hipot tests has been designed to be one half that of the rated output. Use the TOS5300 Series within the following limits. If you use the product in a manner that exceeds these limits, the output section may overheat, and the internal protection circuits may be activated. If this happens, stop testing, and wait until the TOS5300 Series returns to its normal temperature.

Ambient temperature	Upper limit		Pause time	Output time
t ≤ 40 °C	AC	50 mA < i ≤ 110 mA	Greater than or equal to the output time	30 min. max.
		i ≤ 50 mA	Not necessary	Continuous output possible
	DC	5 mA < i ≤ 11 mA	Greater than or equal to the output time	1 min. max.
		i ≤ 5 mA	Greater than or equal to the wait time (WAIT TIME)	Continuous output possible

(Output time = voltage rise time + test time + voltage fall time)

*2. Regarding the test voltage waveform:
Waveform distortions may occur if an DUT whose capacitance is dependent on voltage (for example, an DUT that consists of ceramic capacitors) is connected as the load. However, if the test voltage is 1.5 kV, the effect of a capacitance of 1000 pF or less can be ignored.Because the product's high-voltage power supply uses the PWM switching method, if the test voltage is 500 V or less, the switching and spike noise proportions are large. The lower the test voltage, the greater the waveform is distorted.

*3. Regarding ammeter and judgment accuracy:
During AC hipot tests, current also flows in the stray capacitance of items such as the measurement leads and jigs. This current that flows in the stray capacitances is added to the current that flows in the DUT, and the sum of these currents is measured.Especially if you want to perform judgments with high sensitivity and accuracy, it is necessary to consider methods to limit the current that flows in these stray capacitances, such as by adding upper and lower limits.

Output voltage	1 kV	2 kV	3 kV	4 kV	5 kV
When using 350 mm long test leads that are suspended in air (TYP)	2 μA	4 μA	6 μA	8 μA	10 μA
When using the accessory, high test lead TL31-TOS (TYP)	16 μA	32 μA	48 μA	64 μA	80 μA

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Insulation Resistance Tester

			TOS5302
Output section	Output voltage		25 V, 50 V, 100 V, 125 V, 250 V, 500 V, 1000 VDC (negative)
		Accuracy	-0 %, +5 %
	Max. rated load		1 W (-1000 V DC / 1 mA)
	Max. rated current		1 mA
	Ripple	1000 V when no load is connected	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 feature		Forced discharge after test completion (discharge resistance: approx. 25 kΩ)
	Limit voltage		The test voltage upper limit can be set : 25 V, 50 V, 100 V, 125 V, 250 V, 500 V, 1000 V
	Output voltage monitor feature		If output voltage exceeds "10 % of set + 10 V" or is lower than "-(10 % of set + 10 V)," output is turned off, and protective features are activated.
Volt-meter	Analog	Scale	6 kV AC/DC f.s
		Accuracy	± 5 % f.s
		Indication	Average value response/rms scale
	Digital	Measurement range	0 V to -1200 V
		Display	Measured voltage: V < 100 V / 100 V ≤ V < 1000 V / 1000 V ≤ V Display: □□ V / □□□ V / □□□□ V
		Accuracy	± (1 % of rdng + 1 V)
Resistance meter	Measurement range / measurement accuracy *4 *5	25 V	0.03 MΩ ≤ R ≤ 25 MΩ / ±(2 % of rdng + 2 digits) 25 MΩ < R ≤ 125 MΩ / ±5 % of rdng 125 MΩ < R ≤ 250 MΩ / ±10 % of rdng
		50 V	0.05 MΩ ≤ R ≤ 50 MΩ / ±(2 % of rdng + 2 digits) 50 MΩ < R ≤ 250 MΩ / ±5 % of rdng 250 MΩ < R ≤ 500 MΩ / ±10 % of rdng
		100 V	0.100 MΩ ≤ R ≤ 100 MΩ / ±2 % of rdng 100 MΩ < R ≤ 500 MΩ / ±5 % of rdng 500 MΩ < R ≤ 1 GΩ / ±10 % of rdng
		125 V	0.125 MΩ ≤ R ≤ 125 MΩ / ±2 % of rdng 125 MΩ < R ≤ 625 MΩ / ±5 % of rdng 625 MΩ < R ≤ 1.25 GΩ / ±10 % of rdng
		250 V	0.250 MΩ ≤ R ≤ 250 MΩ / ±2 % of rdng 250 MΩ < R ≤ 1.25 GΩ / ±5 % of rdng 1.25 GΩ < R ≤ 2.5 GΩ / ±10 % of rdng
		500 V	0.50 MΩ ≤ R ≤ 500 MΩ / ±2 % of rdng 500 MΩ < R ≤ 2.5 GΩ / ±5 % of rdng 2.5 GΩ < R ≤ 5 GΩ / ±10 % of rdng
		1000 V	1 MΩ ≤ R < 1 GΩ / ±2 % of rdng 1 GΩ ≤ R ≤ 5 GΩ / ±5 % of rdng
	Display *5		25 kΩ ≤ R < 1.00 MΩ: □□□ kΩ 1.00 MΩ ≤ R < 10.0 MΩ: □ . □□ MΩ 10.0 MΩ ≤ R < 100 MΩ: □□ . □ MΩ 100.0 MΩ ≤ R < 1.00 GΩ: □□□ MΩ 1.00 GΩ ≤ R ≤ 9.99 GΩ: □ . □□ GΩ
Hold feature			After a test is finished, the measured resistance is retained until the PASS judgment is cleared.
Current detection response speed			Can be switched between three levels: Fast, Mid, Slow
Judgment feature	Judgment method and judgment operation		See table below
	Upper limit setting range		0.03 MΩ to 5.00 GΩ
	Lower limit setting range		0.03 MΩ to 5.00 GΩ
	Judgment accuracy (the same for UPPER and LOWER)		Measurement accuracy + 2 digits Humidity: 20 %rh to 70 %rh (no condensation). No interference caused by wobbly test leads or other problems. For judgments of 200 nA or less, a test time of at least 1.0 seconds is necessary. If the current detection response speed is set to Mid, a test time of at least 0.3 seconds is necessary. If the current detection response speed is set to Slow, a test time of at least 0.5 seconds is necessary.
Time	Voltage rise time		10 ms (TYP)
	Test Time		0.1 s to 999 s, can be turned off (TIMER OFF)
		Resolution	0.1 s to 99.9 s: 0.1 s. 100 s to 999 s:1 s.
	Accuracy		± (100 ppm + 20 ms)

Judgment	Judgment method	Display	Buzzer	SIGNAL I/O
UPPER FAIL	If a resistance that is greater than or equal to the upper limit is detected, the output is turned off, and an UPPER FAIL judgment occurs. This judgment is not performed during voltage rise time (Rise Time).	FAIL LED lights; OVER is displayed on the screen	ON	Generates a U-FAIL signal
LOWER FAIL	If a resistance that is less than or equal to the lower limit is detected or if a problem occurs during the voltage rise time (Rise Time), the output is turned off, and a LOWER FAIL judgment occurs.	FAIL LED lights; UNDER is displayed on the screen	ON	Generates a L-FAIL signal
PASS	If the specified time elapses without any problems, the output is turned off, and a PASS judgment occurs.	PASS LED lights	ON	Generates a PASS signal

- If PASS HOLD is enabled, the PASS signal is generated continuously until the TOS5300 Series receives a STOP signal.
- The UPPER FAIL and LOWER FAIL signals are generated continuously until the TOS5300 Series receives a STOP signal.
- The FAIL and PASS buzzer volume levels can be changed.
- For PASS judgments, the length of time that the buzzer sounds for is fixed to 0.2 seconds. Even if PASS HOLD is enabled, the buzzer turns off after 0.2 seconds.

*4. Humidity: 20 %rh to 70 %rh (no condensation). No bends in the test leads. *5. R = measured insulation resistance

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Hipot Tester/Hipot Tester with Insulation Resistance Test

Other Features / Interfaces

			TOS5300	TOS5301	TOS5302
Double action feature			Tests can only be started by pressing and releasing STOP and then pressing START within 0.5 seconds of releasing the STOP switch.		
Length of time to maintain a PASS judgment result			You can set the length of time to maintain a PASS judgment: 50 ms, 100 ms, 200 ms, 1 s, 2 s,5 s, or HOLD.		
Momentary feature			Tests are only executed while the START switch is held down.		
Fail mode feature			This feature enables you to prevent remotely transmitted stop signals from clearing FAIL judgments and PROTECTION modes.		
Timer feature			This feature finishes tests when the specified time elapses.		
Output voltage monitor feature			If output voltage exceeds "setting + 350 V" or is lower than "setting - 350 V," the TOS5300 Series switches to PROTECTION mode, output is turned off, and testing finishes.		
Memory			Up to three sets of test conditions can be saved to memory.		
Key lock			Locks panel key operations (settings and changes).		
Protective features			Under any of the following conditions, the TOS5300 Series switches to the PROTECTION state, immediately turns output off, and stops testing. A message is displayed on the screen.		
	Interlock Protection		An interlock signal has been detected.		
	Power Supply Protection		An error was detected in the power supply.		
	Volt Error Protection		While monitoring the output voltage, a voltage outside of the rated limits was detected. AC or DC hipot tests: ±350 V Insulation resistance test: ±(10 % of set + 10 V)		
	Over Load Protection		During a withstanding voltage test, a value that is greater than or equal to the output limit power was specified. AC hipot test: 550 VA. DC hipot test: 55 VA.		
	Over Heat Protection		The internal temperature of the TOS5300 Series became too high.		
	Over Rating Protection		During a withstanding voltage test, the output current was generated for a length of time that exceeds the regulated time.		
	Calibration Protection		The specified calibration period has elapsed.		
	Remote Protection		A connection to or disconnection from the front-panel REMOTE connector was detected.		
	SIGNAL I/O Protection		The rear-panel SIGNAL I/O connector's ENABLE signal has changed.		
	USB Protection		The USB connector has been disconnected while the TOS5300 Series was being controlled through the USB interface.		
System clock			Set in the following format: year/month/day hour/minutes/seconds.		
	Calibration date		Set when the TOS5300 Series is calibrated.		
	Calibration period setting		Sets the period before the next calibration is necessary.		
	Notification of when the calibration period elapses		Sets the operation that is performed when the specified calibration period elapses. When the TOS5300 Series turns on, it can display a notification or switch to the protection mode and disable testing.		
Interfaces		USB	USB Specification 2.0		
		REMOTE	Front-panel 9-pin MINI DIN connector. By connecting an optional device to this connector, you can control the starting and stopping of tests remotely.		
		SIGNAL I/O	Rear-panel D-sub 25-pin connector		

General Specifications

				TOS5300	TOS5301	TOS5302
Display				VFD: 256 × 64 dots + 4 status indicators		
Backup battery life				3 years (at 25 °C or 77 °F)		
Environment	Installation location			Indoors, at a height of up to 2000 m		
	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	When no load is connected (READY)		100 VA or less		
		When rated load isconnected		800 VA max.		
	Allowable frequency range			47 Hz to 63 Hz		
Insulation resistance (between AC LINE and the chassis)				30 MΩ or more (500 VDC)		
Withstanding voltage (between AC LINE and the chassis)				1390 VAC, 2 seconds, 20 mA or less		
Earth continuity				25 AAC, 0.1 Ω or less		
Safety *6				Complies with the requirements of the following directive and standard. Low Voltage Directive 2006/95/EC, EN 61010-1 Class I Pollution degree 2		
Electromagnetic compatibility (EMC) *6 *7				Complies with the requirements of the following directive and standard. EMC Directive 2004/108/EC, EN 61326-1, EN 61000-3-2, EN 61000-3-3 Applicable under the following conditions The maximum length of all cabling and wiring connected to the TOS5300 Series must be less than 3 m. The high test lead TL31-TOS is being used. Electrical discharges are not occurring outside the DUT.		
Dimensions				See "Outline drawing."		
Weight				Approx. 14 kg (30.9 lb.)	Approx. 15 kg (33.1 lb.)	Approx. 14 kg (30.9 lb.)
Accessories				Power cord : 1pc. / High test lead (TL31-TOS) : 1set (1 red wire and 1 black wire, each with alligator clips); 1.5 m / D-sub 25-pin plug : 1set ; assembly type / High-voltage warning sticker : 1pc. / User's manual : 1pc. / CD-R : 1pc. *8		

*6. Does not apply to specially ordered or modified TOS5300 Series testers.
*7. Limited to products that have the CE mark on their panels.
*8. Contains the User's Manual, the Communication Interface Manual, the KI-VISA library, and the Safety evalution test.