KIKUSUI

ELECTRICAL SAFETY TESTERS

www.kikusui.co.jp

Hipot Testers
Insulation Resistance Testers
Partial Discharge Testers
Ground Bond Testers
Leakage Current Testers

TOS SERIES
ELECTRICAL SAFETY TESTER

TOS SERIES SELECTION GUIDE

High-End Multi-type
Hipot, insulation resistance, ground bond, leakage or partial

TOS9303LC P.4 to 23
AC/DC Hipot Tester with Insulation Resistance, Ground Bond, and Leakage Current Test

ACW 5 kV/100 mA(500 VA)
DCW 5 kV/20 mA, 7.2 kV/13.9 mA(100 W)
IR 0.001 MΩ to 100.0 GΩ (DC-25 V to -1000 V/DC+50 V to +7200 V)
EC 0.001 Ω to 0.600 Ω (3.0 A to 42.0 A)
LC 1 μA to 100 mA(rms)

Rise Time Fall Time LAN USB RS232C Timer

D 430(16.93")(440(17.32"))W×132(5.2")(155(6.10"))H×500(19.69")(550(21.65"))Dmm
W 22 kg(48.5 lbs)

TOS9303 P.4 to 23
AC/DC Hipot Tester with Insulation Resistance and Ground Bond Test

ACW 5 kV/100 mA(500 VA)
DCW 5 kV/20 mA,7.2 kV/13.9 mA(100 W)
IR 0.001 MΩ to 100.0 GΩ (DC-25 V to -1000 V/DC+50 V to +7200 V)
EC 0.001 Ω to 0.600 Ω (3.0 A to 42.0 A)

Rise Time Fall Time LAN USB RS232C Timer

D 430(16.93")(440(17.32"))W×132(5.2")(155(6.10"))H×500(19.69")(540(21.26"))Dmm
W 21 kg(46.3 lbs)

TOS9302 P.4 to 23
AC Hipot Tester with Ground Bond Test

ACW 5 kV/100 mA(500 VA)
EC 0.001 Ω to 0.600 Ω (3.0 A to 42.0 A)

Rise Time Fall Time LAN USB RS232C Timer

D 430(16.93")(440(17.32"))W×132(5.2")(155(6.10"))H×500(19.69")(540(21.26"))Dmm
W 20 kg(44.1 lbs)

Hipot Tester with Insulation Resistance Test

High-End
High-performance type suitable for R&D, quality assurance, and automatic testing systems

TOS9213AS P.24 to 25
DCW 10 kV/5 mA
IR 0.01 MΩ to 9.99 GΩ (DC-25 V to -1500 V)

Rise Time GPIB RS232C Timer

D 430(16.93˝)W×132(5.2˝)H×400(15.75˝)Dmm
W 13 kg(41.89 lbs)

ACW Max. output-voltage of AC hipot testing
DCW Max. output-voltage of DC hipot testing
IR Measurement range of insulation resistance testing
EC Measurement range of ground bond testing
LC Measurement range of leakage current testing
PD Measurement range of partial discharge testing
D Dimensions
W Weight

Rise Time Equipped with rise time control function
Fall Time Equipped with fall time control function
LAN Equipped with LAN interface as standard
GPIB Equipped with GPIB interface as standard
RS232C Equipped with RS232C interface as standard
USB Equipped with USB interface as standard
Timer Equipped with timer function

Hipot Tester

Standard
Standard type suitable for production and inspection lines

TOS5302 P.26 to 31
ACW 5 kV/100 mA(500 VA)
IR 0.03 MΩ to 5 GΩ (DC-25 V to -1000 V)

Rise Time Fall Time USB Timer

D 320(12.60˝)W×132(5.2˝)H×350(13.78˝)Dmm
W 14 kg(30.9 lbs)

TOS5301 P.26 to 31
ACW 5 kV/100 mA(500 VA)
DCW 6 kV/10 mA(50 W)

Rise Time Fall Time USB Timer

D 320(12.60˝)W×132(5.2˝)H×350(13.78˝)Dmm
W 15 kg(33.1 lbs)

TOS5300 P.26 to 31
ACW 5 kV/100 mA(500 VA)

Rise Time Fall Time USB Timer
**"Fall Time" can be set at 0.1 s or OFF

D 320(12.60˝)W×132(5.2˝)H×350(13.78˝)Dmm
W 14 kg(30.9 lbs)

TOS5200 P.32 to 35
ACW 5 kV/100 mA(500 VA)

Rise Time Fall Time USB RS232C Timer
**"Fall Time" can be set at 0.1 s or OFF

D 320(12.60˝)W×132(5.2˝)H×350(13.78˝)Dmm
W 14 kg(30.9 lbs)

TOS5101 P.38 to 39
ACW 10 kV/50 mA(500 VA)
DCW 10 kV/5 mA

Timer

D 430(16.93˝)W×177(6.97˝)H×370(14.57˝)Dmm
W 21 kg(46.3 lbs)

discharge, this analyzer covers it all!

NEW

TOS9301PD P.4 to 23

AC/DC Hipot Tester with Insulation Resistance and Partial Discharge Test

ACW 5 kV/100 mA(500 VA)
DCW 5 kV/20 mA,7.2 kV/13.9 mA(100 W)
IR 0.001 MΩ to 100.0 GΩ (DC-25 V to -1000 V/ DC+50 V to +7200 V)
PD 5 kV/50 mA(250 VA)

Rise Time Fall Time LAN USB RS232C Timer

D 430(16.93")(440(17.32"))W×132(5.2")(150(5.9"))H×525(20.67")(565(22.24"))Dmm
W 22 kg(48.5 lbs)

TOS9301 P.4 to 23

AC/DC Hipot Tester with Insulation Resistance Test

ACW 5 kV/100 mA(500 VA)
DCW 5 kV/20 mA,7.2 kV/13.9 mA(100 W)
IR 0.001 MΩ to 100.0 GΩ (DC-25 V to -1000 V/ DC+50 V to +7200 V)

Rise Time Fall Time LAN USB RS232C Timer

D 430(16.93")(440(17.32"))W×132(5.2")(155(6.10"))H×370(14.57")(410(16.14"))Dmm
W 18 kg(39.7 lbs)

TOS9300 P.4 to 23

AC Hipot Tester with Insulation Resistance Test

ACW 5 kV/100 mA(500 VA)
IR 0.001 MΩ to 100.0 GΩ (DC-25 V to -1000 V)

Rise Time Fall Time LAN USB RS232C Timer

D 430(16.93")(440(17.32"))W×132(5.2")(155(6.10"))H×370(14.57")(410(16.14"))Dmm
W 17 kg(37.5 lbs)

TOS9320 P.7, 22

High-voltage Scanner

High voltage scanner for TOS9300 series multi-channel testing systems

D 430(16.93")(440(17.32"))W×88(3.46")(105(4.13"))H×370(14.57")(390(15.35"))Dmm
W 8 kg(17.6 lbs)

Insulation Resistance Tester

PID Insulation Tester

Ground Bond Tester

TOS7200 P.40 to 43

IR 0.01 MΩ to 5000 MΩ (DC-25 V to -1000 V)

RS232C Timer

D 215(8.47˝)W×66(2.6˝)H×230(9.06˝)Dmm
W 2 kg(4.41 lbs)

TOS7210S P.44 to 45

IR 0.01 MΩ to 5000 MΩ (DC50 V to 2000 V)
0.000 μA to 1900 μA(DC50 V to 2000 V)

RS232C Timer

D 214(8.43)W×81(3.19˝)H×340(13.39˝)Dmm
W 2 kg(4.41 lbs)

TOS6210 P.46 to 47

EC 0.001 Ω to 0.600 Ω (6 A to 62 A)

GPIB RS232C Timer

D 430(16.93˝)W×88(3.47˝)H×270(10.63˝)Dmm
W 11 kg(24.25 lbs)

TOS6200A P.48 to 49

EC 0.001 Ω to 1.200 Ω (3 A to 30 A)

GPIB RS232C Timer

D 430(16.93˝)W×88(3.47˝)H×270(10.63˝)Dmm
W 9 kg(19.84 lbs)

Leakage Current Tester

TOS3200 P.50 to 52

LC 30 μA to 30 mA(rms)

USB GPIB RS232C Timer

D 320(12.6˝)W×88(3.47˝)H×270(10.63˝)Dmm
W 5 kg(11.02 lbs)

Options

- Remote Control Box
- Test Probe
- Test Lead
- Warning Light Unit
- Calibrator for a W. Tester
- High-voltage Digital Voltmeter
- Load resistor for calibration of a Hipot Tester

P.53 to 55

The Electrical Appliance & Material Safety Low (Japan), UL (U.S.A.), CSA (Canada), VDE (Germany) and BS (U.K) are some major examples of safety standards in use throughout the world that require the performing of hipot testing. For this reason, it is necessary to confirm for what portion of what standard testing is to be performed when purchasing a hipot tester. Although the 500 VA capacity hipot testers available from KIKUSUI can basically be applied to tests specified in all safety standards, we recommend that you consult with us prior to purchase in order to select the model that best matches your specific application.

For the withstanding test and the insulation resistance test of the EUT (Equipment Under Test) with turned on electricity.

Our Hipot Testers and Insulation Resistance Testers are designed to test the EUT (Equipment Under Test) with turned off electricity. In case the test requires the EUT (Equipment Under Test) with turned on electricity, please contact with our distributor or agent.

TOS9300 SERIES

Electrical Safety Multi-analyzer

Hipot, Insulation Resistance, Ground Bond, Leakage or Partial Discharge, this analyzer covers it all!

TOS9303LC

TOS9303LC

TOS9300(ACW/IR)
TOS9301(ACW/DCW/IR)
TOS9301PD(ACW/DCW/IR/PD) NEW
TOS9302(ACW/EC)
TOS9303(ACW/DCW/IR/EC)
TOS9303LC(ACW/DCW/IR/EC/LC)

LAN USB RS232C CE UKCA

The TOS9300 series is a high performance electrical safety analyzer that complies to a wide range of universal standards. Hipot, Insulation Resistance, Ground Bond, Leakage Current (touch current and protective conductor current) and partial discharge can all be tested. A total of 6 models are available for standard compliance tests in a wide variety of applications including R&D, quality assurance manufacturing lines and laboratory tests.

- All-in-one safety tester model (TOS9303LC)
- Insulation diagnosis available with partial discharge model (TOS9301PD [NEW])
- New amplifier type allows for 40 A AC/DC ground bond testing (Ground bond tester models)
- Electrical breakdown inspection setting available
- AC5 kV/100 mA, DC7.2 kV/100 W Hipot test
- Touch current/protective conductor current/leakage current testing (TOS9303LC)
- LAN/USB/RS232C standard digital interface
- Easy to read LCD display for real time monitoring during tests, All measurement values and standard outlines displayed in each test
- High voltage scanner capable of output distribution both standalone and when connected with existing withstanding voltage/insulation resistance testing equipment models [TOS5300 series, etc.] (TOS9320)

TOS9300 SERIES

Electrical Safety Multi-analyzer

Basic performance

Color LCD Screen for Improved Visibility!

A brand-new 7-inch LCD display allows for easy access to your custom settings, standard outlines and blueprints for easy operation. (See Exterior Design P4)

User-Friendly 10Key Configuration

The TOS9300 series has included a user-friendly keypad in addition to the basic rotary knob for easy setting configuration. The front panel USB interface also allows for direct control via keyboard.*

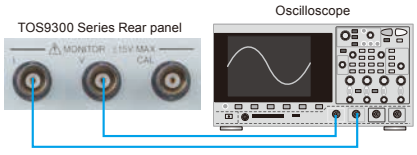
*106/109 Japanese keyboards and 101/104 English keyboard compliant.

Easy Firmware Updates via USB

System firmware can easily be updated via USB memory with update files directly accessible from our website.
(https://www.kikusui.co.jp/en/download/)

I/V Monitor Terminal (Analog Monitor)

Signal outputs on the rear panel I/V terminal allow the user to monitor current/voltage waveforms during hipot tests with only an oscilloscope. Current sensors and high voltage probes not required.



Can connect with an oscilloscope using a BNC cable.
*There is no BNC cable option available. Users need to acquire a BNC cable themselves.

Universal Input Support

●Global Support

TOS9300 Series supports universal input for varying input voltages around the world.

●Programmable Output Frequency

Stable output frequency not dependent on input power source. Testing voltage is supplied at a stable 50/60Hz frequency.

Supports testing for partial discharge (TOS9301PD)

By observing minute partial discharges, it is possible to detect deterioration inside the insulation and "potential defects" that can affect the life of the insulation, which cannot be detected by the withstand voltage test.

STATUS OUT Connector

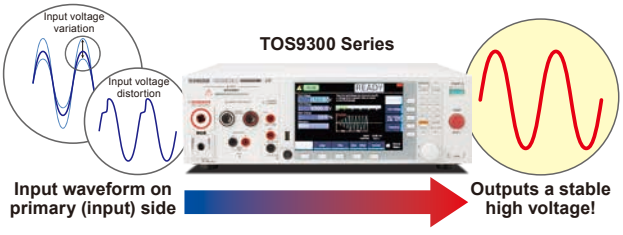
Signals from the rear panel STATUS connector automatically activate the optional warning light (PL02A-TOS) during high voltage output or unsafe test conditions. (See Application P9 and Specification P18)

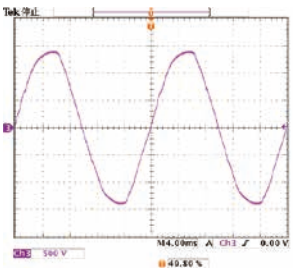
High Precision/High Resolution/High Speed

The TOS9300 is equipped with a highly accurate, high resolution RMS measurement circuit with a voltmeter of ± (1.2% of reading +5 V)/ minimum resolution 0.1 V and an ammeter of ± (1% of reading +2 µA)/ minimum resolution 1 µA. The series also supports an auto range function, ensuring similar accuracy in both the upper and lower limit measurements that can accurately detect connection problems in the test lead. This combined with a measurement speed of 0.1s allows for reliable testing with high accuracy and resolution.

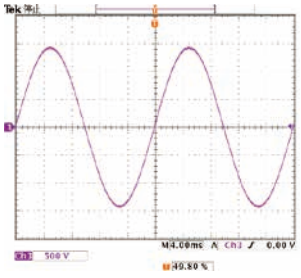
AC Hipot Testing with Stable Output [Input Voltage Variation: ±0.3%]

Conventional hipot testers utilize a slide transformer to output AC line voltage. This design is susceptible to input voltage fluctuation, with outside electrical influence affecting the test results. This can result in distorted voltage being applied to the EUT which can cause product malfunctions down the line due to component malfunction. The TOS9300 series utilizes a highly efficient PWM amplifier capable of stable high-voltage output that is unaffected by changes in the AC power line. The TOS9300 series allows for safe, stable, and highly reliable tests regardless of AC power line instability.





Slide transformer system



PWM amplifier system

● Test items

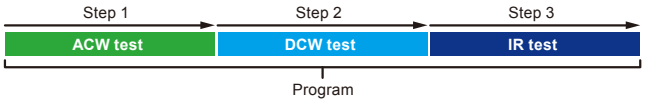
Model	AC Withstanding Voltage (AC Hipot)	DC Withstanding Voltage (DC Hipot)	Insulation Resistance	Earth Continuity (Ground Bond)	Leakage Current	Partial Discharge
TOS9300	●		●			
TOS9301	●	●	●			
TOS9301PD NEW	●	●	●			●
TOS9302	●			●		
TOS9303	●	●	●	●		
TOS9303LC	●	●	●	●	●	

Basic performance

Automatic Testing Feature

Tests can be combined and configured to execute automatically over long periods of time. Automotic tests are composed of programs and steps, which can be configured to initiate one after another.

●Program schematic



	Maximum number of programs	Maximum number of steps *1	Executed under external control	Changing the program name
Program memory (except LC tests)	100	100	–	✓
Program memory (LC tests only) *2	100	100	–	✓

	Maximum number of programs	Maximum number of steps *1	Executed under external control	Changing the program name
External control program memory (except LC tests)	25	100	✓	–
External control Program memory (LC tests only) *2	24	100	✓	–

*1 Per program *2 TOS9303LC only

Contact/Protective Conductor/Patient Leakage Current Test (TOS9303LC)

The TOS9300 series can conduct leakage current (patient current) tests for highly sensitive medical devices. Measurement networks can be easily configured via the front panel. (See Applications P8, Specifications P19)

All Electrical Safety Standard Tests inOne Device! (TOS9303LC)

The TOS9303LC is the "all-rounder" model which supports AC/DC withstanding voltage, insulation resistance, AC/DC earth continuity and leakage currents tests in a single device. It can also be used for contact current, protective conductor current and patient leakage current tests.

Programmable Detection Response Speed

Conventional withstanding voltage testers are generally used to only detect insulation breakdown, and cannot make judgements on instantaneous discharge currents like partial discharge. However, the TOS9300 series is equipped with 5 levels of response speed settings to accurately detect low levels of insulation breakdown. Small discharges not visible to conventional withstanding voltage testers are easily detected with the TOS9300 series.

Value		Description
LPF	Slow	Mean-value response type current detector. This is similar to the current detection response of Kikusui's general-purpose AC withstanding voltage testers. This setting is suitable for detecting dielectric breakdown defined in safety standards and for general hipot tests for general electronic devices and components. This setting is not recommended for detecting corona discharge, which is not considered dielectric breakdown by typical safety standards.
	Medium	Mean-value response type faster than SLOW setting. Upper limit judgement detection is much faster, suitable for withstanding voltage tests on compact electronic components and other EUTs prone to dielectric breakdown. Instantaneous discharges such as corona discharges with high frequencies are detected which may not be suitable for simple withstanding voltage tests.
	Fast	
HPF	Slow	Extremely small discharges such as corona discharges are detected but with low reproductibility.
	Fast	

Basic Memory Function

In addition to automatic testing memory functions, up to 51 basic setting conditions and testing modes can be selected and saved to the main unit or USB memory. Easy testing with no hassle!

Positive Electrode/Negative Electrode Insulation Resistance Testing

Testing voltage from -25 V to -1000 V, +50 V to +7200 V, with a setting resolution is 1 V. Insulation resistance can be tested up to 99.99 GΩ. This makes for easy IEC61730-2 standard PV (solar battery) module insulation resistance testing. (See Application P9)

Electric Discharge Function

A discharge feature enables discharge of electrical energy from the DUT after DC hipot and insulation resistance tests have completed. The setting range for discharge time is between 0.0s - 100.0s.

AC/DC Earth Continuity Testing up to 40 A

Cutting edge amp technology allows for a wide range of applications, including general AC earth conduction testing and EV/PHV system DC earth continuity testing. This also allows for strict adherence to automotive DC standard requirements; expected to increase in the near future.

EARTH FAULT Protection

Mistakenly changing the grounding (GND) setting to "guard" (floating) can result in grounding the test subject which can result in unwanted leakage current emissions from the high voltage output site into the grounding site, resulting in electric shock to the operator. The EARTH FAULT protection function blocks output and terminates the test; eliminating any risk of electric shock and maximizing safety for the operator.

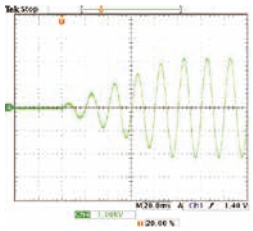
Offset Cancel

The Offset Cancel feature allows the user to eliminate electrical current found in the insulation resistance and stray capacitance among the output cables (only resistance for DC testing). This feature is available in all testing modes for AC withstanding voltage, DC withstanding voltage, insulation resistance, earth continuity and electrical current leakage tests.

Rise Time/Fall Time Control Function

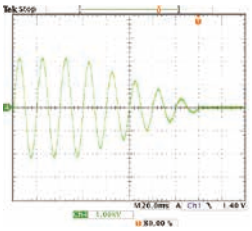
The rise time control function prevents unnecessary stress from being applied to the EUT.

● Rise Time control function



The rise time control feature allows you to gradually increase voltage to a set value while AC/DC hipot tests are conducted.Voltage rise times can be set from 0.1s to 200.0s at a resolution of 0.1s.

● Fall time control function



The fall time control feature allows you to gradually decrease the test voltage after a successful AC/DC hipot test. The voltage fall time can be set from 0s to 200s at a resolution of 0.1s. (OFF is also selectable).

7.2 kV/100 W DC Hipot Test

Capable of performing DC Hipot tests up to 7.2 kV utilizing a stable DC/DC converter with low-ripple and load variation of 1% and below.

TOS9300 SERIES

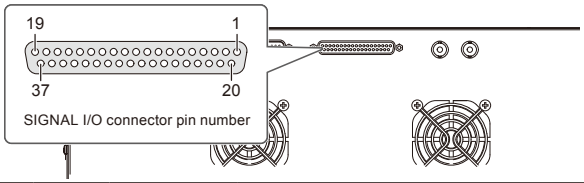
Electrical Safety Multi-analyzer

Interfaces

SIGNAL I/O Connector

The rear panel also has a SIGNAL I/O that can start/stop operation as well as output signals.

TOS9300 example (The SIGNAL I/O connector is the same on all models.)



Pin no.	IN/OUT	Signal name	Description
1	IN	INTERLOCK+	Activate/release interlock.
2	—	COM	Circuit common (chassis potential) shared by input and output.
3	IN	PM0	Select setup memories and auto test program memories.
4	IN	PM1	
5	IN	PM2	
6	IN	PM3	
7	IN	PM4	
8	IN	PM5	
9	IN	PM6	
10	IN	PM7	
11	IN	STB	Recall setup memories and programs selected with the PM0 to PM7 signals.
12	—	Reserved	Not used.
13	—	Reserved	
14	—	Reserved	
15	IN	START	Start a test.
16	IN	STOP	Stop a test.
17	IN	ENABLE	Enable the START signal.
18	—	COM	I/O circuit common (chassis potential).
19	IN	INTERLOCK-	Activate/release interlock.
20	—	COM	I/O circuit common (chassis potential).
21	—	+24V	+24 V internal power supply output terminal. Maximum output current 100 mA.
22	OUT	H.V ON/LINE ON	Set to on in any of the following conditions. Testing. Auto testing. Voltage remaining across the output terminals. Power being supplied to the EUT from the TOS9303LC through AC LINE OUT.
23	OUT	RISE	Set to on when the voltage is rising.
24	OUT	TEST	Set to on during test time.
25	OUT	PASS	Set to on for the duration of time specified by Pass Hold when a PASS judgment is made.
26	OUT	U FAIL	Set to on continuously when a U-FAIL judgment is made. Or set to on continuously along with the L FAIL signal when CONTACT FAIL judgment is made when a scanner is connected.
27	OUT	L FAIL	Set to on continuously when an L-FAIL judgment is made. Or set to on continuously along with the U FAIL signal when CONTACT FAIL judgment is made when a scanner is connected.
28	—	Reserved	Not used.
29	OUT	READY	Set to on when the product is ready to start a test.
30	OUT	PROTECTION	Set to on when a protection function is activated.
31	OUT	STEP END	Set to on when each step ends during an auto test.
32	OUT	CYCLE END	Set to on when the last step ends during an auto test.
33	OUT	ACW	Set to on when the test mode is set to AC withstanding voltage test.
34	OUT	DCW	Set to on when the test mode is set to DC withstanding voltage test.
35	OUT	IR	Set to on when the test mode is set to insulation resistance test.
36	OUT	EC	Set to on when the test mode is set to earth continuity test.
37	OUT	LC	Set to on when the test mode is set to touch current test or protective conductor test.

LAN/USB/RS232C Standard Digital Interface

LXI compatible LAN, USB 2.0, USB-TMC compatible USB, and RS232C as standard digital interface.

* Connecting with a smartphone, tablet, etc. requires a Wi-Fi environment (wireless LAN router etc.).

▲Rear panel•Interface(All models)

◀ Use a browser from a PC, smartphone, or tablet to access the web server built into the TOS9300 series for convenient control and monitoring.

[Recommended browser]
- Requires for the Internet Explorer version 9.0 or later
- Requires for the firefox 8.0 or later
- Requires for the safari / mobile Safari 5.1 or later
- Requires for the Chrome 15.0 or later
- Requires for the Opera 11.0 or later

Peripheral devices

High-voltage scanner TOS9320

TOS9320 Front View

TOS9320 Rear View

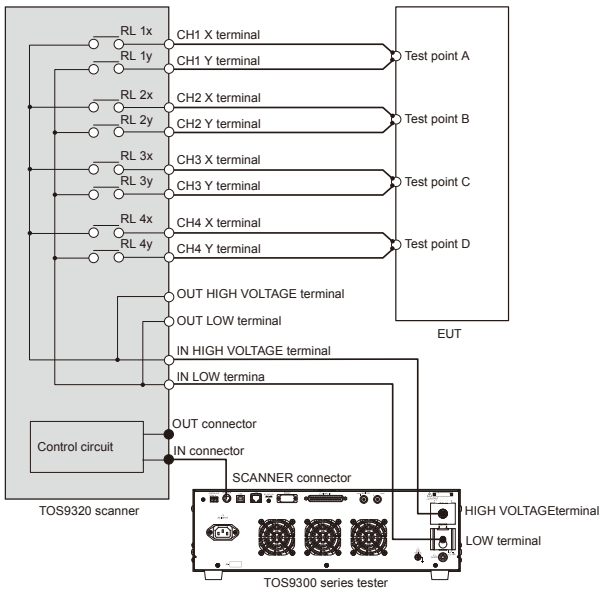
TOS9320

The TOS9320 high voltage scanner allows for rapid distribution of testing voltage from the main unit to multiple testing points for withstanding voltange and insulation resistance testing.
Channels can be controlled via an external device through the rear panel CONTROLLER INTERFACE connector. The scanner can also be used standalone or with an external control device for other Kikusui withstanding voltage and insulation resistance testing instruments. Hipot tests for electronic devices with multiple testing points have never been easier.
(See Application P9)

- Output can be expanded to four channels with one high-voltage scanner. The electric potential of each channel can be arbitrarily set to high, low, or open, and can be tested at any of these four points.
- Up to four high voltage scanners (total 16 channels) can be connected to each unit.
- Output of each channel and contact with testing points can be easily monitored.

Operation of the high-voltage scanner

[4 channel test system]



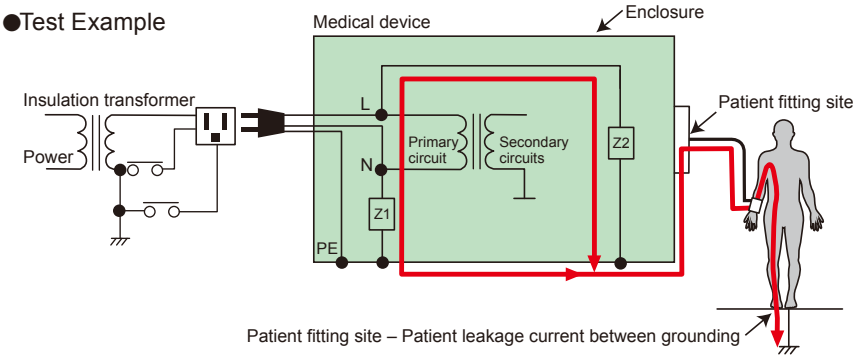
TOS9300 SERIES

Electrical Safety Multi-analyzer

Leakage Current Test

Compatible with medical device leakage current testing (patient current)! (TOS9303LC only)

●Test Example



What is patient leakage current testing?

This test measures current flowing from the point of contact between a medical instrument and a simulated human body network to the ground. If the measurement does not exceed a value deemed harmful to a human being as defined in international safety standards, the product is considered safe and compliant to electric shock prevention requirements.

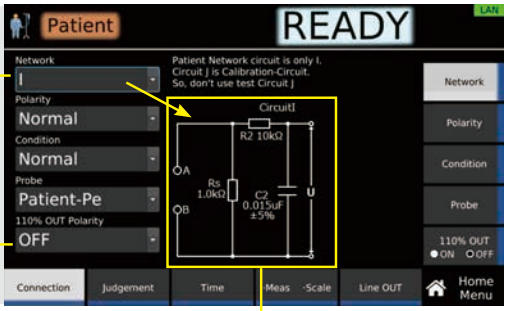
Easy Test Condition Programmability

Internal measurement circuit networks (I IEC60601-1) enable easily programmable test conditions.

*For details on other internally installed measurement circuit networks, see Specifications (P19).

▲TOS9303LC

Setting test conditions



Measurement circuit network (network I IEC60601-1)

Electrical safety standard testing for automotive components

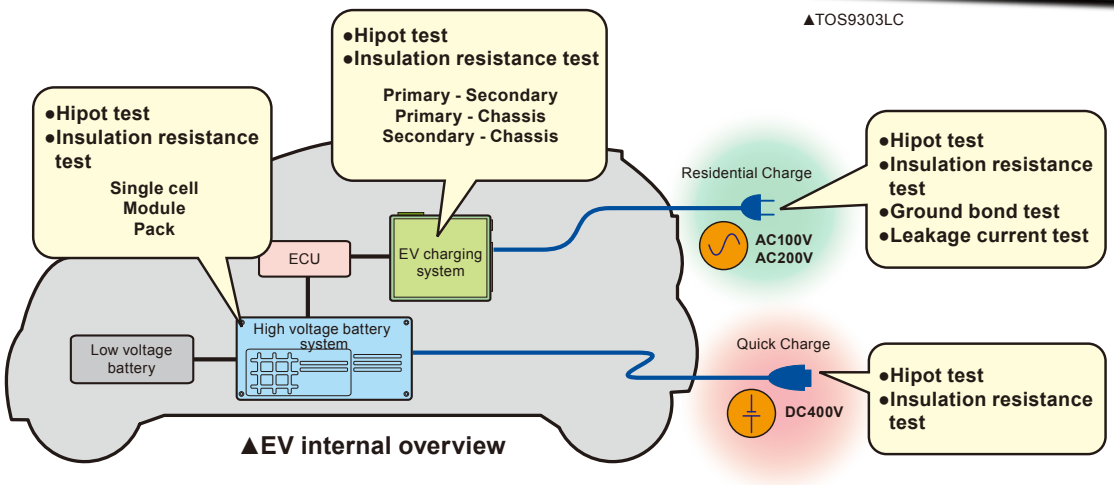
Compatible with both AC and DC, the TOS9303LC complies with a wide varety of safety tests for EV batteries, automotive charging devices and charging connectors. This "all-in-one" safety analyzer can meet the needs of nearly all automotive electrical safety standards.

All in One!

ACW DCW IR EC LC

▲TOS9303LC

IEC61851-21 etc.



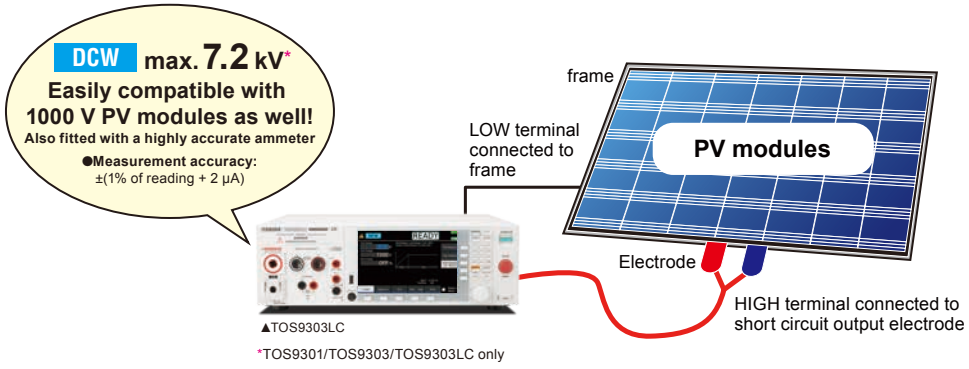
▲EV internal overview

PV (solar battery) module withstanding voltage/insulation resistance testing

Withstanding voltage tests such as IEC61730-2 and JIS C 8992-2 require testing voltage to be drastically increased (4 times the maximum system voltage + 2000 V) and maintained for 1 minute.

[Voltage 1000 V adaptation grade A example]

1000 V × 4-fold + 2000 V = **Test voltage : 6000 V**

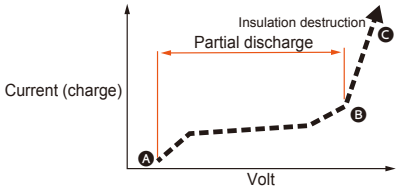


*TOS9301/TOS9303/TOS9303LC only

Partial discharge

[EUT (example): small motors, transformers, insulating materials, etc.]
The partial discharge test detects the state before dielectric breakdown, so it can detect potential defects and manufacturing variations that cannot be detected by the conventional withstand voltage test.

【Partial discharge voltage-Conceptual diagram of current characteristics】

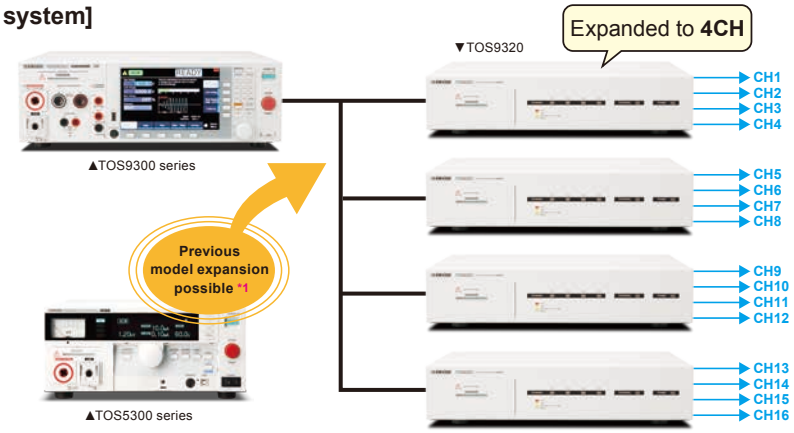


Ⓐ Partial discharge start Ⓐ–Ⓑ Partial discharge Ⓑ–Ⓒ Insulation destruction

Multi-channel withstanding voltage/insulation resistance testing

Multiple testing points can be simultaneously tested to cut costs and save time! The TOS9320 high voltage scanner allows for multi channel expansion for the TOS9300 series as well as previous models.

[16CH Test system]



*1 Independent control of the scanner is required using EXTERNAL I / O.

* Mount on a rack when using two or more scanners.

Unless specified otherwise, the specifications are for the following settings and conditions.
- The product is warmed up for at least 30 minutes.
- TYP: These are typical values that are representative of situations where the product operates in an environment with an ambient temperature of 23 °C. These values do not guarantee the performance of this product.
- setting: Indicates a setting. • range: Indicates the rated value of each range. • reading: Indicates a readout value.
- The various tests are abbreviated as follows: ACW: AC withstanding voltage, DCW: DC withstanding voltage, IR: insulation resistance, EC: earth continuity, LC: leakage current, TC: touch current, PCC: protective conductor current, Patient: patient leakage current, Meter: meter mode

Withstanding Voltage Test

[AC Output function]

Item			TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
AC output section	Output range		0.050 kV to 5.000 kV					
		Resolution	1 V					
		Setting accuracy	±(1.2 % of setting + 0.02 kV) (at no load)					
	Max. rated load *1		500 VA(5 kV / 100 mA)					
	Max. rated current		100 mA (when the output voltage is 0.2 kV or higher)					
	Transformer rating		500 VA					
	Output voltage waveform *2		Sine					
		Distortion	2 % or less. (when the output voltage is 0.5 kV or higher and no load or a pure resistive load is connected)					
	Crest factor		√2 ± 3 % (0.8 kV or more)					
	Frequency		50 Hz / 60 Hz					
		Accuracy	±0.1 %					
	Voltage regulation		±3 % or less (when changing from maximum rated load to no load)					
	Short-circuit current		200 mA or more (output voltage 0.5 kV or higher)					
	Output method		PWM switching					
Start voltage			The voltage at the start of the test can be set.					
		Setting range	1 % to 99 % of the test voltage					
		Resolution	1 %					
Output voltage monitor function			If the output voltage exceeds ±(10 % of setting + 0.05 kV), the output is turned off, and the protection function is activated.					

[DC Output function]

Item			TOS9301	TOS9301PD	TOS9303	TOS9303LC
DC output section	Output voltage range		0.050 kV to 7.200 kV			
		Resolution	1 V			
		Setting accuracy	±(1.2 % of setting + 0.02 kV)			
	Max. rated load *1		100 W (5 kV/20 mA, 7.2 kV/13.9 mA)			
	Max. rated current		20 mA			
	Ripple	7.2 kV no load	20 Vp-p (TYP)			
		Max. rated load	50 Vp-p (TYP)			
	Voltage regulation		1 % or less (when changing from maximum rated load to no load)			
	Short-circuit current		100 mA (TYP) (200 mA peak)			
	Discharge function		Forced discharge after test completion (discharge resistance: 125 kΩ)			
Start voltage			The voltage at the start of the test can be set.			
		Setting range	1 % to 99 % of the test voltage			
		Resolution	1 %			
Output voltage monitor function			If the output voltage exceeds ±(10 % of setting + 0.05 kV), the output is turned off, and the protection function is activated.			

*1 When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting
*2 If an AC voltage is applied to a capacitive load, the output voltage may rise higher than at no load depending on the load capacitance. Further, 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 1.5 kV, the effect of a capacitance of 1 000 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.

[Measurement function]

Item		TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Voltmeter	Measurement range	0 kV to 7.5 kV AC/DC					
	Resolution	0.1 V					
	Accuracy	±(1.2 % of reading + 0.005 kV)					
	Response	Can be switched between true rms and mean-value response rms conversion.					
		Peak-value response in a separate system (the peak-value response is for measuring the dielectric breakdown voltage while rising)					
	Hold function	The voltage measurement after a test is finished is held while the pass/fail judgment is displayed.					
Ammeter *1 *2	Measurement range	AC: 0.00 mA to 110 mA, DC: 0.00 mA to 22 mA (Current including the active component and reactive component)					
	Accuracy	±(1 % of reading + 2 µA) (active component)					
	Response	Can be switched between true rms and mean-value response rms conversion.					
	Hold function	The current measurement after a test is finished is held while the pass judgment is displayed.					
	Offset cancel function	Cancels up to 10 mA of the current flowing through the insulation resistance and stray capacitance components across output cables and the like (resistance component only for DC tests). OFF function available.					
	Calibration	Active component: Calibrated with the rms of a sine wave using a pure resistive load. Reactive component: Not calibrated.					

*1 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 When the temperature and humidity are high, erroneous current from the product's internal and external high-voltage wiring sections to ground increases. When the humidity exceeds 70 %, an erroneous current of about 50 µA may be generated.

[Judgment function]

Item			TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Current judgment operation			The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.					
	UPPER FAIL	Judgment method	UPPER FAIL results when a current greater than or equal to the Upper limit is detected. For DCW, judgment is not made during the judgment delay (Judge Delay).					
		Display	"Upper-FAIL" is displayed.					
		Buzzer	On					
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.					
	LOWER FAIL	Judgment method	LOWER FAIL results when a current less than or equal to the Lower limit is detected. Judgment is not made during Voltage rise time or Voltage fall time of an ACW test.					
		Display	"Lower-FAIL" is displayed.					
		Buzzer	On					
		SIGNAL I/O	The Lower-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	"PASS" is displayed.					
		Buzzer	On (fixed to 50 ms)					
		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.					
Voltage rise rate judgment operation			Monitors the voltage rise rate during Voltage rise time. This is valid when Auto setting of the judgment delay (Delay Auto) is set to on and the output voltage is 200 V or more. The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately.					
	dV/dt FAIL	Judgment method	When the voltage rise rate (dV/dt) is less than approx. 1 V/s.					
		Display	"Upper-FAIL (dV/dt)" is displayed.					
		Buzzer	ON					
		SIGNAL I/O	The U FAIL 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 21.00 mA					
Lower limit setting range			AC: 0.00 mA to 109.99 mA, DC: 0.00 mA to 20.99 mA, OFF. Setting 0.00 is equivalent to OFF.					
Judgment accuracy *1 *2			±(1 % of setting + 5 µA)					
Current detection method			Compares to the reference value using the following method. Calculate true rms values, convert mean-value responses to rms values					
Response speed (filter) switching			Switches the current detection response speed (sensitivity) used in UPPER FAIL judgment between five levels in ACW and DCW tests.					

*1 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 When the temperature and humidity are high, erroneous current from the product's internal and external high-voltage wiring sections to ground increases. When the humidity exceeds 70 %, an erroneous current of about 50 µA may be generated.

[Timer function]

Item	TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Voltage rise time settings range	0.1 s to 200.0 s					
Voltage fall time setting time *1	0.1 s to 200.0 s, OFF					
Test time setting range	0.1 s to 1000.0 s, OFF					
Judgment delay (Judge Delay) setting range *2	0.1 s to 100.0 s, AUTO *3 (DCW only)					
Accuracy	±(100 ppm of setting + 20 ms) (excluding the fall time)					

*1 This setting is used only when a PASS judgment occurs in ACW and DCW tests. During a DCW test, the voltage may not drop all the way within the set time because of the electrostatic capacity inside the product and the EUT.
*2 Less than the sum of the rise time and fall time.
*3 If Delay Auto is set to on, LOWER judgment is not made until the charge time ends.

[Other specifications]

Item		TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Analog monitor *1		Outputs a voltage signal according to the current waveform or voltage waveform					
	I	Current waveform: Scale 50 mA/1 V					
	V	Voltage waveform: Scale 1 kV/1 V					
Grounding mode (GND)		Can be switched between Low and Guard.					
	Low	GND is connected to the low terminal. Measures the current flowing across the low terminal and chassis (normal applications).					
	Guard *2	GND is connected to Guard. Measures only the current flowing through the low terminal (current flowing through the chassis is not measured) (high sensitivity, high accuracy measure-ment applications).					

*1 Monitor signal output is isolated from the chassis (earth). If you connect an oscilloscope or an external device whose BNC shield is grounded, be sure to set the grounding mode (GND) to Guard. The value is not calibrated.
*2 If there is a possibility that the EUT or tools and the like will be grounded or if you are uncertain, do not set GND to Guard. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current. For normal applications, set GND to Low.

Insulation Resistance Test

[Output function]

Item			TOS9300	TOS9301	TOS9301PD	TOS9303	TOS9303LC
Negative polarity	Output voltage range		-0.025 kV to -1 kV				
		Resolution	1 V				
		Setting accuracy	±(1.2 % of setting + 0.002 kV)				
	Max. rated load		1 W (-1 kV/1 mA)				
	Ripple	1 kV no load	2 Vp-p or less				
		Max. rated load	10 Vp-p or less				
	Short-circuit current		12 mA or less				
Positive polarity *1	Output voltage range		–	+0.05 kV to +7.2 kV			
		Resolution		1 V			
		Setting accuracy		±(1.2 % of setting + 0.02 kV)			
	Max. rated load			7.2 W(7.2 kV/1 mA)			
	Ripple	1 kV no load		20 Vp-p or less			
		Max. rated load		50 Vp-p or less			
	Short-circuit current			100 mA (TYP) (200 mA peak)			
Max. rated current			1 mA				
Voltage regulation			1 % or less (when changing from maximum rated load to no load)				
Discharge function			Forced discharge after test completion (discharge resistance: 20 kΩ)				
Output voltage monitor function			If the output voltage exceeds ±(10 % of setting + 0.05 kV), the output is turned off, and the protection function is activated.				

*1 TOS9300 are not supported.

[Measurement function]

Item			TOS9300	TOS9301	TOS9301PD	TOS9303	TOS9303LC
Voltmeter	Measurement range		Negative polarity: 0 Vdc to -1.2 kVdc, positive polarity: 0 Vdc to 7.5 kVdc				
	Resolution		0.1 V				
	Accuracy		Negative polarity: ±(1 % of reading + 0.001 kV), positive polarity: ±(1.2 % of reading + 0.001 kV)				
Resistance meter	Measurement range		0.001 MΩ to 100.0 GΩ (in the range of maximum rated current of 1 mA to 5 nA)				
	Accuracy *1 *2 (when GND is set to Guard) (i: measured current) (R: measurement resistance)	5 nA ≤ i ≤ 50 nA *3	500.000 MΩ ≤ R < 1.000 GΩ: ±(15 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(15 % of reading + 5 MΩ)				
			10.000 GΩ ≤ R ≤ 100.000 GΩ: ±(20 % of reading + 200 MΩ)				
		50 nA < i ≤ 100 nA *3	200.000 MΩ ≤ R < 1.000 GΩ: ±(10 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(10 % of reading + 5 MΩ)				
			10.000 GΩ ≤ R < 50.000 GΩ: ±(10 % of reading + 50 MΩ)				
			50.000 GΩ ≤ R ≤ 100.000 GΩ: ±(20 % of reading + 200 MΩ)				
		100 nA < i ≤ 200 nA *4	100.000 MΩ ≤ R < 1.000 GΩ: ±(7 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 2.000 GΩ: ±(7 % of reading + 5 MΩ)				
			2.000 GΩ ≤ R < 10.000 GΩ: ±(7 % of reading + 10 MΩ)				
			10.000 GΩ ≤ R < 50.000 GΩ: ±(7 % of reading + 100 MΩ)				
		200 nA < i ≤ 1 μA *4	10.000 MΩ ≤ R < 100.000 MΩ: ±(5 % of reading + 0.05 MΩ)				
			100.000 MΩ ≤ R < 1.000 GΩ: ±(5 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(5 % of reading + 5 MΩ)				
			10.000 GΩ ≤ R < 25.000 GΩ: ±(5 % of reading + 50 MΩ)				
		1 μA < i ≤ 1 mA *4	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of reading + 0.003 MΩ)				
			10.000 MΩ ≤ R < 100.000 MΩ: ±(2 % of reading + 0.03 MΩ)				
			100.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of reading + 0.3 MΩ)				
			1.000 GΩ ≤ R < 5.000 GΩ: ±(2 % of reading + 3 MΩ)				
	Accuracy *5 (when GND is set to Low) (i: measured current) (R: measurement resistance)	5 nA ≤ i ≤ 50 nA *3	500.000 MΩ ≤ R < 1.000 GΩ: ±(25 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(25 % of reading + 5 MΩ)				
			10.000 GΩ ≤ R ≤ 100.000 GΩ: ±(30 % of reading + 200 MΩ)				
		50 nA < i ≤ 100 nA *3	200.000 MΩ ≤ R < 1.000 GΩ: ±(20 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(20 % of reading + 5 MΩ)				
			10.000 GΩ ≤ R < 50.000 GΩ: ±(20 % of reading + 50 MΩ)				
			50.000 GΩ ≤ R ≤ 100.000 GΩ: ±(30 % of reading + 200 MΩ)				
		100 nA < i ≤ 200 nA *4	100.000 MΩ ≤ R < 1.000 GΩ: ±(10 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 2.000 GΩ: ±(10 % of reading + 5 MΩ)				
			2.000 GΩ ≤ R < 10.000 GΩ: ±(10 % of reading + 10 MΩ)				
			10.000 GΩ ≤ R < 50.000 GΩ: ±(10 % of reading + 100 MΩ)				
		200 nA < i ≤ 1 μA *4	10.000 MΩ ≤ R < 100.000 MΩ: ±(5 % of reading + 0.05 MΩ)				
			100.000 MΩ ≤ R < 1.000 GΩ: ±(5 % of reading + 0.5 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(5 % of reading + 5 MΩ)				
			10.000 GΩ ≤ R < 25.000 GΩ: ±(5 % of reading + 50 MΩ)				
		1 μA < i ≤ 1 mA *4	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of reading + 0.003 MΩ)				
			10.000 MΩ ≤ R < 100.000 MΩ: ±(2 % of reading + 0.03 MΩ)				
			100.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of reading + 0.3 MΩ)				
			1.000 GΩ ≤ R < 5.000 GΩ: ±(2 % of reading + 3 MΩ)				
	Hold function		The resistance measurement after a test is finished is held while the pass judgment is displayed.				
	Offset cancel function		Cancels up to 2000 GΩ of the unnecessary insulation resistance across output cables and the like. OFF function available.				

*1 Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
*2 If the grounding mode (GND) is set to low in a highly humid environment, leakage current to ground will be generated from the high-voltage wiring sections inside the product and the high-voltage wiring sections between the product and the EUT. This leakage current ranges from several nA to several tens of nA depending on the usage and wiring conditions of the optional TOS9320 high-voltage scanner and greatly affects measurement accuracy. The effects of leakage current can be reduced by making measurements with the offset enabled.
*3 Add 10 % to the accuracy when measuring 100 V or less.
*4 Add 5 % to the accuracy when measuring 100 V or less.
*5 When the measured current is limited to 100 nA or more (no condensation) when the humidity is 50 %rh or less, no external disturbance is present such as swinging test leads, and the offset is enabled.

[Judgment function]

Item			TOS9300	TOS9301	TOS9301PD	TOS9303	TOS9303LC
Behavior based on judgment			The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.				
	UPPER FAIL	Judgment method	UPPER FAIL results when a resistance greater than or equal to the Upper limit is detected. Judgment is not made during or Voltage rise time.				
		Display	"Upper-FAIL" is displayed.				
		Buzzer	On				
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.				
	LOWER FAIL	Judgment method	LOWER FAIL results when a resistance less than or equal to the Lower limit is detected. Judgment is not made during the judgment delay (Judge Delay).				
		Display	"Lower-FAIL" is displayed.				
		Buzzer	On				
		SIGNAL I/O	The Lower-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	"PASS" is displayed.				
		Buzzer	On (fixed to 50 ms)				
		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.				
Voltage rise rate judgment operation			Monitors the voltage rise rate during Voltage rise time. This is valid when Auto setting of the judgment delay (Delay Auto) is set to on and the output voltage is 200 V or more. The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately.				
	dV/dt FAIL	Judgment method	When the voltage rise rate (dV/dt) is less than approx. 1 V/s.				
		Display	"Lower-FAIL (dV/dt)" is displayed.				
		Buzzer	ON				
		SIGNAL I/O	The L FAIL signals are generated continuously until a STOP signal is received.				
Upper limit setting range			0.001 MΩ to 100.000 GΩ (in the range up to the maximum rated current), OFF				
Lower limit setting range			0.000 MΩ to 99.999 GΩ (in the range up to the maximum rated current), OFF. Setting 0.000 is equivalent to OFF.				
Accuracy *1 *2 *3 (when GND is set to Guard) (i: measured current) (R: measurement resistance)		5 nA ≤ i ≤ 50 nA *4	500.000 MΩ ≤ R < 1.000 GΩ: ±(15 % of setting + 0.51 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(15 % of setting + 15 MΩ)				
			10.000 GΩ ≤ R ≤ 100.000 GΩ: ±(20 % of setting + 210 MΩ)				
		50 nA < i ≤ 100 nA *4	200.000 MΩ ≤ R < 1.000 GΩ: ±(10 % of setting + 0.51 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(10 % of setting + 15 MΩ)				
			10.000 GΩ ≤ R < 50.000 GΩ: ±(10 % of setting + 60 MΩ)				
			50.000 GΩ ≤ R ≤ 100.000 GΩ: ±(20 % of setting + 210 MΩ)				
		100 nA < i ≤ 200 nA *5	100.000 MΩ ≤ R < 1.000 GΩ: ±(7 % of setting + 0.51 MΩ)				
			1.000 GΩ ≤ R < 2.000 GΩ: ±(7 % of setting + 15 MΩ)				
			2.000 GΩ ≤ R < 10.000 GΩ: ±(7 % of setting + 20 MΩ)				
			10.000 GΩ ≤ R < 50.000 GΩ: ±(7 % of setting + 110 MΩ)				
		200 nA < i ≤ 1 µA *5	10.000 MΩ ≤ R < 100.000 MΩ: ±(5 % of setting + 0.06 MΩ)				
			100.000 MΩ ≤ R < 1.000 GΩ: ±(5 % of setting + 0.51 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(5 % of setting + 15 MΩ)				
			10.000 GΩ ≤ R < 25.000 GΩ: ±(5 % of setting + 60 MΩ)				
		1 µA < i ≤ 1 mA *5	0.001 MΩ ≤ R < 10.000 MΩ: ±(2 % of setting + 0.013 MΩ)				
			10.000 MΩ ≤ R < 100.000 MΩ: ±(2 % of setting + 0.04 MΩ)				
			100.000 MΩ ≤ R < 1.000 GΩ: ±(2 % of setting + 0.31 MΩ)				
			1.000 GΩ ≤ R < 5.000 GΩ: ±(2 % of setting + 13 MΩ)				
Accuracy *6 (when GND is set to Low) (i: measured current) (R: measurement resistance)		5 nA ≤ i ≤ 50 nA *4	500.000 MΩ ≤ R < 1.000 GΩ: ±(25 % of setting + 0.51 MΩ)				
			1.000 GΩ ≤ R < 10.000 GΩ: ±(25 % of setting + 15 MΩ)				
			10.000 GΩ ≤ R ≤ 100.000 GΩ: ±(30 % of setting + 210 MΩ)				
		50 nA < i ≤ 100 nA *4	200.000 MΩ≤ R < 1.000 GΩ: ±(20 % of setting + 0.51 MΩ)				
			1.000 GΩ≤ R < 10.000 GΩ: ±(20 % of setting + 15 MΩ)				
			10.000 GΩ≤ R < 50.000 GΩ: ±(20 % of setting + 60 MΩ)				
			50.000 GΩ≤ R ≤ 100.000 GΩ: ±(30 % of setting + 210 MΩ)				
		100 nA < i ≤ 200 nA *5	100.000 MΩ≤ R < 1.000 GΩ: ±(10 % of setting + 0.51 MΩ)				
			1.000 GΩ≤ R < 2.000 GΩ: ±(10 % of setting + 15 MΩ)				
			2.000 GΩ≤ R < 10.000 GΩ: ±(10 % of setting + 20 MΩ)				
			10.000 GΩ≤ R < 50.000 GΩ: ±(10 % of setting + 110 MΩ)				
		200 nA < i ≤ 1 µA *5	10.000 MΩ≤ R < 100.000 MΩ: ±(5 % of setting + 0.06 MΩ)				
			100.000 MΩ≤ R < 1.000 GΩ: ±(5 % of setting + 0.51 MΩ)				
			1.000 GΩ≤ R < 10.000 GΩ: ±(5 % of setting + 15 MΩ)				
			10.000 GΩ≤ R < 25.000 GΩ: ±(5 % of setting + 60 MΩ)				
		1 µA < i ≤ 1 mA *5	0.001 MΩ≤ R < 10.000 MΩ: ±(2 % of setting + 0.013 MΩ)				
			10.000 MΩ≤ R < 100.000 MΩ: ±(2 % of setting + 0.04 MΩ)				
			100.000 MΩ≤ R < 1.000 GΩ: ±(2 % of setting + 0.31 MΩ)				
			1.000 GΩ≤ R < 5.000 GΩ: ±(2 % of setting + 13 MΩ)				

*1 Making judgments on 200 µA or less requires at least 3 seconds after the rise time ends. Making judgments when the low pass filter is set to on requires at least 10 seconds after the rise time ends.
*2 Humidity: 70 %rh or less (no condensation), when there is no interference caused by wobbly test leads or other problems.
*3 If the grounding mode (GND) is set to low in a highly humid environment, leakage current to ground will be generated from the high-voltage wiring sections inside the product and the high-voltage wiring sections between the product and the EUT. This leakage current ranges from several nA to several tens of nA depending on the usage and wiring conditions of the optional TOS9320 high-voltage scanner and greatly affects measurement accuracy. The effects of leakage current can be reduced by making measurements with the offset enabled.
*4 Add 10 % to the accuracy when measuring 100 V or less.
*5 Add 5 % to the accuracy when measuring 100 V or less.
*6 When the measured current is limited to 100 nA or more (no condensation) when the humidity is 50 %rh or less, no external disturbance is present such as swinging test leads, and the offset is enabled.

[Timer function]

Item	TOS9300	TOS9301	TOS9301PD	TOS9303	TOS9303LC
Voltage rise time settings range	0.1 s to 200.0 s				
Test time setting range	0.1 s to 1000.0 s, OFF				
Judgment delay (Judge Delay) setting range *1	0.1 s to 100.0 s, AUTO *2				
Accuracy *3	±(100 ppm of setting + 20 ms)				

*1 Less than the sum of the rise time and fall time.
*2 If Delay Auto is set to on, UPPER judgment is not made until the charge time ends.
*3 This excludes fall time.

[Other specifications]

Item		TOS9300	TOS9301	TOS9301PD	TOS9303	TOS9303LC
Grounding mode (GND)		Can be switched between Low and Guard.				
	Low	GND is connected to the low terminal. Measures the current flowing across the low terminal and chassis (normal applications).				
	Guard *1	GND is connected to Guard. Measures only the current flowing through the low terminal (cur-rent flowing through the chassis is not measured) (high sensitivity, high accuracy measurement applications).				
Filter function		A low-pass filter can be inserted into the ammeter measurement circuit. *2				

*1 If there is a possibility that the EUT or tools and the like will be grounded or if you are uncertain, do not set GND to Guard. Doing so is extremely dangerous because the ammeter will be shorted and will not be able to measure current. For normal applications, set GND to Low.
*2 When the low pass filter is on, a judgment delay of at least 5 seconds and a test time are required.

Earth Continuity Test

[Output function]

Item			TOS9302	TOS9303	TOS9303LC
Current setting range *1			3.0 A to 42.0 A AC/DC		
		Resolution	0.1 A		
		Accuracy	±(1 % of setting + 0.4 A)		
AC	Maximum rated output *2		220 VA (at the output terminal)		
	Distortion		2 % or less (20 A or more, using a 0.1 Ω pure resistive load)		
	Frequency		Select 50 Hz or 60 Hz. Sine		
		Accuracy	±200 ppm		
	Open terminal voltage		6 Vrms or less		
	Output method		PWM switching		
DC	Maximum rated output		220 W (at the output terminal)		
	Ripple		±0.4 Ap-p or less (TYP)		
	Open terminal voltage		6.0 V or less		

*1 No greater than the maximum rated output and resistance no greater than the output terminal voltage 5.4 V.
*2 When tests are performed consecutively, output time limit and rest time may become necessary depending on the upper limit setting.

[Measurement function]

Item		TOS9302	TOS9303	TOS9303LC
Output ammeter	Measurement range	0.0 A to 45.0 A AC/DC		
	Resolution	0.01 A		
	Accuracy	±(1 % of reading + 0.2 A)		
	Response	AC: true rms value: DC: mean value		
	Hold function	The current measurement after a test is finished is held while the pass or fail judgment is displayed.		
Output voltmeter	Measurement range	AC: 0.00 V to 6.00 V, DC: 0.00 V to 8.50 V		
	Resolution	0.001 V		
	Offset cancel function	Cancels up to 5 V (AC/DC) of the unnecessary voltage from measurements. OFF function available.		
	Accuracy	±(1 % of setting + 0.02 V)		
	Response	AC: true rms value: DC: mean value		
	Hold function	The voltage measurement after a test is finished is held while the pass or fail judgment is displayed.		
Resistance meter	Measurement range *1	1 mΩ to 600 mΩ		
	Resolution	1 mΩ		
	Offset cancel function	Cancels up to 10 Ω of the unnecessary resistance from measurements. OFF function available.		
	Accuracy	±(2 % of reading + 3 mΩ)		
	Hold function	The resistance measurement after a test is finished is held while the pass judgment is displayed.		

*1 Calculated from the measured output voltage and measured output current.

[Judgment function]

Item			TOS9302	TOS9303	TOS9303LC
Behavior based on judgment			Judgment based on resistance or sensing voltage can be selected. The output is shut off when a judgment is made. Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.		
	UPPER FAIL	Judgment method	UPPER FAIL results when a resistance greater than or equal to the Upper limit is detected or when a sensing voltage is detected. Judgment is not made during a contact check.		
		Display	"Upper-FAIL" is displayed.		
		Buzzer	On		
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.		
	LOWER FAIL	Judgment method	LOWER FAIL results when a resistance less than or equal to the lower limit (Lower) is detected or when a sensing voltage is detected.		
		Display	"Lower-FAIL" is displayed.		
		Buzzer	On		
		SIGNAL I/O	The Lower-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	"PASS" is displayed.		
		Buzzer	On (fixed to 50 ms)		
		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 con-tinuously until a STOP signal is received.		
Resistance judgment	Upper limit setting range		0.0001 Ω to 10.0000 Ω		
	Lower limit setting range		0.0000 Ω to 9.9999 Ω		
	Judgment accuracy		±(2 % of setting + 3 mΩ)		
Voltage judgment	Upper limit setting range		0.001 V to 5.000 V AC/DC		
	Lower limit setting range		0.000 V to 4.999 V AC/DC		
	Judgment accuracy		±(2 % of setting + 0.05 V)		
Calibration			Calibrated using a pure resistive load (with the rms of a sine wave for AC)		
Contact check function			Checks that current flows through the test leads and then starts the test. (OFF setting available)		

[Timer function]

Item	TOS9302	TOS9303	TOS9303LC
Current rise time settings range	0.1 s to 200.0 s		
Current fall time setting time *1	0.1 s to 200.0 s, OFF		
Test time	0.1 s to 1000.0 s, OFF		
Accuracy	±(100 ppm of setting + 20 ms) (excluding the fall time)		

*1 This setting is used only when a PASS judgment occurs. During a DC test, the voltage may not drop all the way within the set time because of the electrostatic capacity inside the product and the EUT.

Partial Discharge Test

[Output function]

Item			TOS9301PD
AC output section	Output range		0.050 kV to 5.000 kV
		Resolution	1 V
		Setting accuracy	±(1.2% of setting + 0.02kV) (at no load)
	Max. rated load		250 VA (5 kV/ 50mA)
	Max. rated current		50 mA (when the output voltage is 0.2 kV or higher)
	Output voltage waveform*1		Sine
		Distortion	2 % or less. (when the output voltage is 0.5 kV or higher and no load or a pure resistive load is connected)
	Crest factor		√2 ± 3 % (0.8 V or higher)
	Frequency		50 Hz/60 Hz
		Accuracy	±0.1 %
	Voltage regulation		±3 % or less (when changing from maximum rated load to no load)
	Output method		PWM switching
Output voltage monitor function			If the output voltage exceeds ±(10 % of setting + 0.05 kV), the output is turned off, and the protection function is activated.

*1 If an AC voltage is applied to a capacitive load, the output voltage may rise higher than at no load depending on the load capacitance. Further, 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 1 000pF 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.

[Measurement function]

Item			TOS9301PD
Voltmeter	Measurement range		0.00 kV to 7.50 kV AC/DC
	Resolution		0.1 V
	Accuracy		±(1.2 % of reading + 0.05 kV)
	Response		Can be switched between true rms and peak-value response.
	Hold function		The voltage measurement after a test is finished is held while the pass/fail judgment is displayed.
Electric charge measurement	Electric charge measurement method		IEC60664-1 Edition 3.0 compliant
	Measurement range		0 pC to 10000 pC
	Measurement resolution	100pC range	0.1 pC
		1000pC range	0.1 pC
		10000pC rang	1 pC
	Accuracy*1	100pC range	±(5 % of full scale + 7 pC)
		1000pC range	±(5 % of full scale)
		10000pC rang	±(5 % of full scale)
	Measurement interval		Determined based on the measured values in each cycle of an applied voltage.
	Hold function		The electric charge after a test is finished is held while the pass judgment is displayed.
	Maximum electrostatic capacity of the EUT		10 nF
	Peak hold function		Holds the maximum value during a measurement.
	Filter function		A low-pass filter can be inserted into the electric charge measurement circuit.
	Discharge inception voltage, discharge inception voltage measurement		Measures the voltage at which discharge exceeding a preset electric charge starts and the voltage at which discharge ceases (complies with IEC60664-1 third edition).
	Calibration (Precalibration)		Calibrate using the built-in calibration capacitor (1000 pF).
	Pulse counting function		Counts the number of pulses that have passed through the high-pass filter and makes a FAIL judgment if the count exceeds the upper limit.
		Upper limit setting range	1 to 100000
	BPF characteristics switching function		Can switch the characteristics of the band-pass filter in the electric charge measuring circuit
		Center frequency	100 kHz / 160 kHz / 300 kHz
	Coupling capacitor		0.01 µF

*1 When Band Pass Filter is set to 160 kHz.

[Judgment function]

Item			TOS9301PD
Electric discharge judgment			The output is shut off when a judgment is made.
	UPPER FAIL (Current)	Judgment method	A current higher than or equal to the upper limit is measured.
		Display	"Upper-FAIL (Current)" is displayed.
		Buzzer	On
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.
	UPPER FAIL (Coulomb)	Judgment method	An electric charge greater than or equal to the upper limit is measured.
		Display	"Upper-FAIL (Coulomb)" is displayed.
		Buzzer	On
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.
	UPPER FAIL (Pulse)	Judgment method	A discharge pulse count greater than or equal to the upper limit is measured.
		Display	"Upper-FAIL (Pulse)" is displayed.
		Buzzer	On
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.
	PASS	Judgment method	Upper-FAIL does not happen after the test time has elapsed.
		Display	"PASS" is displayed.
		Buzzer	On
		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 current limit			50 mA (with no calibration)
Upper limit of electric charge (Upper Coulomb)		Setting range	1 pC to 10000 pC
		Accuracy	As per the accuracy of electric charge measurement
Pulse count judgment criteria (Upper Pulse Count) setting range			1 to 100000 (with no calibration)

[Timer function]

Item	TOS9301PD
Voltage rise time (Rise Time) setting range	0.1 s to 200.0 s
Voltage fall time (Fall Time) setting range *1	0.1 s to 200.0 s, OFF
Test time setting range	0.1 s to 1000.0 s, OFF
Accuracy	±(100 ppm of setting + 20 ms) (excluding Fall Time)

*1 This setting is used only when PASS judgment occurs.

[Other specifications]

Item		TOS9301PD
Analog monitor*1		Outputs a voltage signal according to the current waveform, voltage waveform, or electric discharge waveforms.
	V	Voltage waveform: Scale 1kV/1V
	Qpd	Electric discharge: Full scale of the scale measurement range/10 V
	Ipd*2	Partial discharge current waveform

*1 Monitor signal output is isolated from the chassis (earth).
*2 The lpd waveforms are the ones that can be obtained after the actual discharge waveforms have passed the TOS9301PD measurement filter. Therefore, the scale varies according to the frequency response of the discharge waveform.

Leakage Current Test

[Measurement function]

Item				TOS9303LC
Measurement Item	TC			Touch current measurement
		Measurement mode		Uses a measurement circuit network representing the impedance of a human body and measures the voltage drop across a reference resistance to calculate the touch current.
		Probe settings	Enc - Pe	A terminal: measurement terminal (for connecting to the enclosure of the EUT) B terminal: open
			Enc - Enc	A and B terminals: measurement terminal (for connecting to the enclosure of the EUT)
			Enc - Liv Enc - Neu	A terminal: measurement terminal (for connecting to the enclosure of the EUT) B terminal: open
	PCC			Protective conductor current measurement
		Measurement method		Measures the voltage drop across a reference resistance inserted in the middle of the protective ground line to calculate the protective conductor current. The measurement impedance is 150 Ω.
	Patient			Patient leakage current measurement
		Measurement method		Uses a network conforming to IEC 60601 and measures the voltage drop across a reference resistance to calculate the patientleakage current.
	Meter			Measures the current flowing or voltage applied across the A and B terminals (simultaneous measurement not possible).
		Measurement method	Current measurement	Uses a measurement circuit network representing the impedance of a human body and measures the voltage drop across a reference resistance to calculate the current flowing across the A and B terminals.
			Voltage measurement	Measures the voltage applied across the A and B terminals.
Current measurement mode			DC	Eliminates AC components and measures only the DC component.
			RMS	Measures the true rms value (switch AC and AC+DC)
			Peak *1	Measures waveform peak values

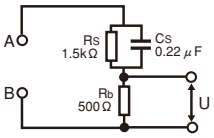
*1 Current measurements may not be stable due to the effects of the power supply line waveform or the wiring environment between the product and the EUT.

[Measurement circuit network]

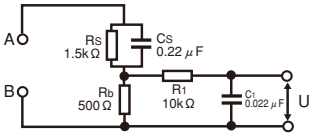
Item		TOS9303LC
Network	A (IEC 60990 compliant) *1	(1.5 kΩ // 0.22 μF) + 500 Ω, reference measurement element: 500 Ω
	B (IEC 60990 compliant)	(1.5 kΩ // 0.22 μF) + 500 Ω // (10 kΩ + 22 nF), reference measurement element: 500 Ω, voltage measurement U1 and U3 switchable
	C (IEC 60990 compliant)	(1.5 kΩ // 0.22 μF) + 500 Ω // (10 kΩ + (20 kΩ + 6.2 nF) // 9.1 nF), reference measurement element: 500 Ω, voltage measurement U1 and U3 switchable
	D (Electrical Appliances and Materials Safety Act, etc.)	1 kΩ, reference measurement element: 1 kΩ
	E (Electrical Appliances and Materials Safety Act)	1 kΩ // (10 kΩ + 11.225 nF + 579 Ω), reference measurement element:1kΩ
	F (UL and the like)	1.5 kΩ // 0.15 μF, reference measurement element: 1.5 kΩ
	G	2 kΩ, reference measurement element: 2 kΩ
	H (IEC 61010-1)	375 Ω // 0.22 μF + 500 Ω, reference measurement element: 500 Ω
	I (Patient, IEC 60601-1wet)	1 kΩ // 10 kΩ + 0.015 μF, reference measurement element: 1 kΩ
	J (through)	For voltmeter calibration
	PCC-1	150 Ω, reference measurement element: 150 Ω
	PCC-2 (IEC 60598-1)	150 Ω // 1.5 μF, reference measurement element: 150 Ω
Network constant tolerance		Resistance: ±0.1 %, capacitor 0.15 μF: ±2 %, others: ±1 %

*1 Current measurements may not be stable due to the effects of the power supply line waveform or the wiring environment between the product and the EUT.

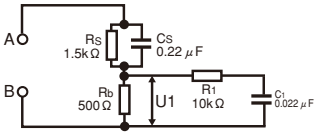
● Measurement circuit network
(NetworkA IEC 60990 Fig. 3 U1 measurement)



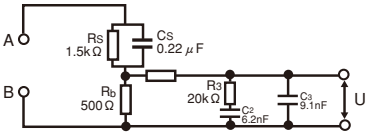
● Measurement circuit network
(NetworkB IEC 60990 Fig. 4 U2 measurement)



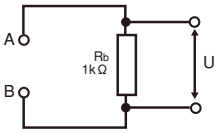
● Measurement circuit network
(NetworkB1 IEC 60990 Fig. 4 U1 measurement)



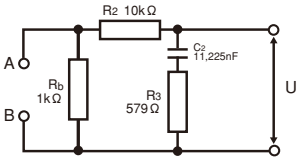
● Measurement circuit network
(NetworkC IEC 60990 Fig. 5 U3 measurement)



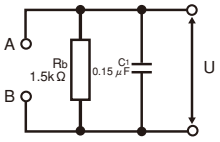
● Measurement circuit network
(NetworkD Electrical Appliances and Materials Safety Act etc.)



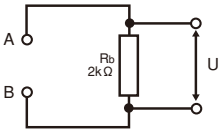
● Measurement circuit network
(NetworkE Electrical Appliances and Materials Safety Act etc.)



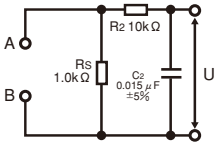
● Measurement circuit network
(NetworkF IEC 61029)



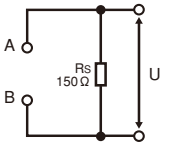
● Measurement circuit network
(NetworkG IEC 60745)



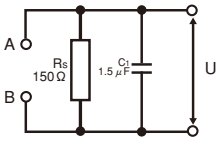
● Measurement circuit network
(NetworkI IEC 60601-1)



● Measurement circuit network
(NetworkPCC-1)



● Measurement circuit network
(NetworkPCC-2 IEC60598-1)



[Measurement section] The range varies by network

Item				TOS9303LC
Measurement range *1	Range 1			DC, RMS: 1.00 µA(min.) to 200.00 µA(max), Peak: 1.00 µA(min.) to 282.00 µA(max)
	Range 2			DC, RMS: 12.50 µA(min.) to 2000.0 µA(max), Peak: 17.50 µA(min.) to 2830.0 µA(max)
	Range 3			DC, RMS: 125.0 µA(min.) to 20.000 mA(max), Peak: 175.0 µA(min.) to 28.300 mA(max)
	Range 4			DC, RMS: 1.250 mA(min.) to 100.00 mA(max), Peak: 1.750 mA(min.) to 100.00 mA(max)
	Range switching			Auto or Fix selectable. If a measurement falls outside the measurement range of each range, the measured value blinks as a warning.
		Auto		The range is set automatically according to the measurements.
		Fix		For TC and PCC measurements, the measurement range is selected automatically according to the UPPER value. For meter measurements, the range is fixed to the specified range.
	Bandwidth switching			Can be expanded to a bandwidth that allows measurements from 0.1 Hz, which is required in the measurement of medical instruments and the like.
		Normal		Normal measurement bandwidth: 15 Hz to 1 MHz
		Expand		Expands the measurement range to 0.1 Hz to 1 MHz
Total accuracy *2 (when network A, B, or C is used) *3	Range 1	DC		±(5.0 % of reading + 2 µA)
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 2 µA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 2 µA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 2 µA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 10 µA)
			15 Hz ≤ f ≤ 1 kHz	±(10.0 % of reading + 10 µA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 10 µA)
			100 kHz < f ≤ 1 MHz	±(20.0 % of reading + 10 µA)
	Range 2	DC		±(5.0 % of reading + 20 µA)
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 10 µA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 8 µA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 10 µA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 10 µA)
			15 Hz ≤ f ≤ 1 kHz	±(10.0 % of reading + 10 µA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 10 µA)
			100 kHz < f ≤ 1 MHz	±(20.0 % of reading + 10 µA)
	Range 3	DC		±(5.0 % of reading + 50 µA)
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 20 µA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 20 µA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 20 µA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 50 µA)
			15 Hz ≤ f ≤ 1 kHz	±(7.0 % of reading + 50 µA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 50 µA)
			100 kHz < f ≤ 1 MHz	±(20.0 % of reading + 50 µA)
	Range 4	DC		±(5.0 % of reading + 0.5 mA)
		RMS	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 0.2 mA)
			15 Hz ≤ f ≤ 100 kHz	±(7.0 % of reading + 0.2 mA)
			100 kHz < f ≤ 1 MHz	±(10.0 % of reading + 0.2 mA)
		Peak	0.1 Hz ≤ f < 15 Hz	±(10.0 % of reading + 0.5 mA)
			15 Hz ≤ f ≤ 1 kHz	±(7.0 % of reading + 0.5 mA)
			1 kHz < f ≤ 100 kHz	±(10.0 % of reading + 0.5 mA)
			100 kHz < f ≤ 1 MHz	±(20.0 % of reading + 0.5 mA)
Input resistance				1 MΩ ± 1 %
Input capacitance				200 pF or less (internal voltmeter input capacitance: 100 pF or less)
Common mode rejection ratio				10 kHz or less: 60 dB or more, 10 kHz to 1 MHz: 40 dB or more
Offset cancel function				Cancels up to 10 mA of the unnecessary current from measurements. OFF function available.

*1 Voltmeter band expansion is possible when network I is selected.
*2 0.1 Hz ≤ f < 15 Hz is for when voltmeter band expansion (VoltMeter BandWidth) is set to Expand. Requires at least 120 second of test time.
*3 A value converted to current for measurements using Network A, B, C or H with voltmeter accuracy of this product as the reference.
If a network other than A, B, C or H is used, calculate as follows:
For Network D, E, or I, the ■ part of ±(□% of reading + ■A) is half the value.
For F, the ■ part is one-third the value.
For G, the ■ part is one-fourth the value.
For PCC-1 or PCC-2, the ■ part is 3.3 times the value.

[Judgment function] The range varies by network

Item			TOS9303LC
Behavior based on judgment			Judgment starts after the judgment delay (Judge Delay). Buzzer volume level can be set in the range of 0 (OFF) to 10 for pass and fail separately. In an auto test, the buzzer is valid only for the judgment that takes place at the end of the program.
	UPPER FAIL	Judgment method	UPPER FAIL results when a current greater than or equal to the upper limit (Upper) is detected.
		Display	"Upper-FAIL" is displayed.
		Buzzer	On
		SIGNAL I/O	The Upper-FAIL signal is generated continuously until a STOP signal is received.
	LOWER FAIL	Judgment method	LOWER FAIL results when a current less than or equal to the lower limit (Lower) is detected.
		Display	"Lower-FAIL" is displayed.
		Buzzer	On
		SIGNAL I/O	The Lower-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	"PASS" is displayed.
		Buzzer	On (fixed to 50 ms)
		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 Setting range	RANGE 1		DC, RMS: 0.1 µA(min.) to 200 µA(max), Peak: 0.1 µA(min.) to 282 µA(max)
	RANGE 2		DC, RMS: 15.1 µA(min.) to 2.00 mA(max), Peak: 21.3 µA(min.) to 2.83 mA(max)
	RANGE 3		DC, RMS: 151 µA(min.) to 20.00 mA(max), Peak: 213 µA(min.) to 28.3 mA(max)
	RANGE 4		DC, RMS: 1.51 mA(min.) to 100 mA(max), Peak: 2.13 mA(min.) to 100 mA(max)
Lower Setting range			A value that is -1 digit from the upper setting range.
Judgment accuracy			Conforms to total accuracy(Read "reading" as "upper setting" of total accuracy.)

[Timer function]

Item		TOS9303LC
Judgment delay (Judge Delay)	Setting range	1 s to 1000 s, OFF
	Accuracy	±(100 ppm of setting + 20 ms)
Test time	Setting range	1 s to 1000 s, OFF
	Accuracy	±(100 ppm of setting + 20 ms)

[Other specifications]

Item			TOS9303LC
Voltage conversion			Displays the estimated current converted with the preset supply voltage (Conv Voltage), based on the voltage supplied to the EUT and the measured current. (This is invalid in meter mode.)
		Setting range	80.0 V to 300.0 V, OFF
		Resolution	0.1 V
Power supply line polarity selection			Set the polarity of the power supply line to supply to the EUT to positive or negative.
Single fault mode (Condition) selection			Set the EUT single fault mode to normal, neutral line disconnection (Fault Neu), or protective ground wire disconnection (Fault PE).
Ground check			In the touch current test between the enclosure and power supply line, if the EUT enclosure is grounded, CONTACT FAIL occurs.
Measurement check			Checks the measurement function by shorting across the A and B terminals. If an error is found, the protection function is activated.
Supply voltage measurementAC LINE (EUT)		Measurement range	80.0 V to 250.0 V
		Resolution	0.01 V
		Accuracy	±(3 % of reading + 1 V)
Supply current measurementAC LINE (EUT)		Measurement range	0.1 A to 15.00 A
		Resolution	0.001 A
		Accuracy	±(5 % of reading + 30 mA)
Power measurement(active power)		Measurement range	10 W to 1500 W
		Accuracy	±(5 % of reading + 8 W) (with the supply voltage at 80 V or more, at a load power factor of 1)
Voltage measurement across the A and B termi-nals	Measurement range	DC	10.00 V to 300.0 V
		RMS	10.00 V to 300.0 V
		Peak	15.00 V to 430.0 V
	Input impedance		Approx. 40 MΩ
	Accuracy *1		±(3 % of reading + 2 V) (measurement range fixed to AUTO)
	SELV detection		Set a voltage for detecting SELV. When the value is exceeded, the DANGER LED lights.
		Setting range	10.0 V to 99.9 V, OFF
		Resolution	0.1 V
Measurement terminal	Rated voltage	Between the A and B terminals	250 V
		Between the terminals and chassis	250 V
	Rated current		100 mA
	Measurement category		CAT-II
	Valid terminal display		Terminals valid for measurement are indicated on the display.
	110% terminal		A terminal for supplying the voltage applied to the AC LINE IN inlet.
Power supply for the EUT	Nominal voltage range		100 V to 240 V, 50 Hz/60 Hz
	Input voltage range (allowable voltage range)		85 Vac to 250 Vac
	Rated output capacity		1500 VA
	Maximum operating current		15 A (Overcurrent protection is activated at approximately 15.7 A.)
	Inrush current		70 Apeak max. (within 20 ms)

*1 If voltage is measured with the A and B terminals open, measurements will be easily affected by induced voltage.

Interface (Common)

Item			TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
REMOTE			5-pin DIN connector. Connect the following option to remotely control the starting and stopping of tests. • Remote control box RC01-TOS, RC02-TOS • High voltage test probe HP01A-TOS, HP02A-TOS (when the test voltage is 4 kVac 5 kVdc or less)					
SIGNAL I/O			D-sub 37-pin connector. For the pin arrangement					
	Function		Enable/disable interlock, recall setup memories, recall auto test programs, start/stop testing, monitor the test and voltage generation status, monitor the test status, monitor judgment results, monitor the step execution status of auto tests, monitor the activation status of protection functions					
	Input specifications		The input signals are all low-active control. The input terminal is pulled up to +12 V by a resistor. Leaving the input terminal open is equivalent to applying a high level signal.					
		High-level input voltage	11 V to 15 V					
		Low-level input voltage	0 V to 4 V					
		Low-level input current	-5 mA max.					
		Input time width	5 ms min.					
	Output specifications	Output method	Open collector output (4.5 Vdc to 30 Vdc)					
		Output withstanding voltage	30 Vdc					
		Output saturation voltage	Approx. 1.1 V (25 °C)					
		Maximum output current	400 mA(TOTAL)					
STATUS OUT			Output terminal of an option product.					
	Positive terminal (red)		Outputs +24 V. Use Status Out of CONFIG settings to set the output conditions.					
	Negative terminal (black)		+24 V circuit common.					
SCANNER			MINI DIN 8-pin connector. Terminal for the optional TOS9320 high voltage scanner. The maximum number of connections is 4 devices(16 channels).					
USB (host)			Standard type A socket, FAT32, 32 GB or less Complies with the USB 2.0 specifications; data rate: 12 Mbps (full speed)					
Remote control			All functions except turning on and off the power, key lock, and auto test can be remotely controlled.					
	RS232C	Hardware	D-sub 9-pin connector (EIA-232D compliant) Baudrate: 9600, 19200, 38400, 57600, 115200 bps Data length: 8 bits; stop bits: 1 bit; parity bit: none, flow control: none/CTS-RTS					
		Message terminator	LF during reception, LF during transmission.					
	USB (device)	Hardware	Standard Type B connector. Complies with the USB 2.0 specifications; data rate: 480 Mbps (high speed)					
		Message terminator	LF or EOM during reception, LF + EOM during transmission.					
		Device class	Complies with the USBTMC-USB488 device class specifications.					
	LAN	Hardware	IEEE 802,3 100Base-TX/10Base-T Ethernet. Auto-MDIX compliant.IPv4, RJ-45 connector.					
		Compliant standards	LXI 1.5 Core Specification 2011					
		Communication protocol	VXI-11, HiSLIP, SCPI-RAW, SCPI-Telnet					
		Message terminator	VXI-11, HiSLIP: LF or END during reception, LF + END during transmission. SCPI-RAW: LF during reception, LF during transmission.					
Display			7-inch LCD					

Other Functions (Common)

Item		TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Auto test		Auto execution by combining ACW, DCW, IR, and EC. For LC, a combination is possible only using TC, PCC, and Patient.					
Test condition memory	Setup memory	Up to 51 test conditions (ACW, DCW, IR, EC, LC, PD) can be saved.					
	Program(except LC tests)	Up to 100 program (ACW, DCW, IR, EC, PD) combinations, each containing 100 steps, can be saved.					
	Program(LC tests only)	Up to 100 program (TC, PCC, Patient) combinations, each containing 100 steps, can be saved.					
	Program memory(except LC tests)	Up to 25 program (ACW, DCW, IR, EC, PD) combinations, each containing 100 steps, can be saved.					
	Program memory (LC tests only)	Up to 24 program (TC, PCC, Patient) combinations, each containing 100 steps, can be saved.					
Test result memory		Records up to 1000 latest test result of independent tests and auto tests. These are cleared when the power is turned off. Test results can be saved in CSV format to a USB memory device.					
System clock		For recording the calibration time and test times					
	Recordable time	Up to year 2038					
	Calibration period setting	Displays a warning at power-on when the specified period passes. Select whether to activate a protection function or only display a warning in the display area when a warning occurs.					
Measurement display		Maximum and minimum measurements can be displayed.					
	Normal	Displays measurements during a test. Maximum and minimum values are not held.					
	Maximum and minimum value display	Displays the maximum current measurement for withstanding voltage (ACW/DCW) tests, the minimum resistance measurement for insulation resistance (IR) tests, the resistance measurement or voltage measurement for earth continuity (EC) tests.					
Test start method	Double Action	When you press STOP, “READY” is shown for 0.5 seconds. A test starts only when you press START within this period.					
	Momentary	Tests are only executed while the START switch is held down.					
	Start Long	A test starts only when the START switch is held down for at least 1 second.					
PASS judgment display time (Pass Hold)		Set the time to hold the pass judgment result display (0.05 s to 10.00 s) or hold it until STOP is pressed (Infinity).					
STOP signal disable (Fail Mode)		It is possible to set the instrument so that fail judgment results and PROTECTION mode cannot be released from a device connected to the SIGNAL I/O connector or REMOTE connector.					
Key lock		Lock the operation of the keys to prevent changing the settings or overwriting memory or programs by mistake.					

Other Functions (Common)

Item		TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Protection functions		If a protection function is activated during a test, the output is shut off and the test is stopped immediately.In an LC test, the power supply to the EUT is stopped, and the A and B terminals are opened.Conditions that cause a protection function to be activated are as follows.					
	Interlock	Interlock is activated.					
	Power Supply	There is an error in the power supply section.					
	Output Error	An output voltage outside of the following range is detected. ACW, DCW, IR test, PD test: ±(10 % of setting + 50 V) EC test: ±(10 % of setting + 2 A)					
	Over Load	An output power or output current outside of the following range is detected. ACW: 550 VA, DCW: 110 W or 50 mA, IR (7200 V test): 110 W or 25 mA, IR (-1000 V test): 2 mA, EC: 240 VA, LC: AC LINE OUT current at approx. 15.7 A or power at 1600 VA.					
	Over Heat	The internal temperature of the product is abnormally high.					
	Over Rating	During a withstanding voltage test, an output current is generated for a length of time that exceeds the output time limit					
	Cal	The preset calibration period is exceeded.					
	Remote	The REMOTE connector is connected or disconnected.					
	Signal I/O	There is a change in the SIGNAL I/O connector's ENABLE signal.					
	Communication	An internal communication error is occurring.					
	Over Range	A value exceeding the maximum value of the measurement range is detected.					
	Measure	An error is detected in the LC test measurement check.					
	Short	A relay operation error is detected in an LC test.					
	Earth Fault	When the grounding mode (GND) is set to Guard, abnormal current flows from the high voltage output of this product to ground.					
	Scan I/F	While scanning, the interface cable is disconnected. Or, the channel-assigned scanner is not detected.					

General Specifications (Common)

Item			TOS9300	TOS9301	TOS9301PD	TOS9302	TOS9303	TOS9303LC
Backup battery life			3 years (at 25 °C)					
Environment	Installation location		Indoors, 2000 m or less					
	Spec guaranteed range	Temperature	5 °C to 35 °C (41 °F to 95 °F) (18°C to 28°C for partial discharge tests)					
		Humidity	20 %rh to 80 %rh (20%rh to 70%rh for partial discharge tests) (no condensation)					
	Operating rang	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 120 V, 200 V to 240 V (90 Vac to 132 V, 170 V to 250 V)					
	Power consumption	No load(READY state)	100 VA or less					
		Rated load	800 VA max.					
	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)			1500 Vac, 1 minute, 20 mA or less					
Earth continuity			25 Aac, 0.1 Ω or less					
Weight			TOS9300: Approx. 17 kg (37.5 lb.), TOS9301: Approx. 18 kg (39.7 lb.), TOS9301PD: Approx. 22 kg (48.5 lb.), TOS9302: Approx. 20 kg (44.1 lb.), TOS9303: Approx. 21 kg (46.3 lb.), TOS9303LC: Approx. 22 kg (48.5 lb.)					
Accessories			Power cord (1 pc., *length: 2.5 m : The attached power cord varies depending on the shipment destination.) High-voltage test lead (TL31-TOS (1 pair)), SIGNAL I/O plug (1 set), High-voltage warning sticker (1 pc.), Setup Guide (1 copy), CD-ROM (1 disc), Safety Information (1 copy), Heavy object warning label (1 pc., *Not included with the TOS9300) Test leads for earth continuity test (TL13-TOS (1 pair., *TOS9302, TOS9303,TOS9303LC only)) [TOS9303LC only: Spare fuse (1 pc.), Test leads for leakage current test (2 red, 1 black), Flat probe (1 sheet)]					
Electromagnetic compatibility *1 *2			Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN 61326-1 (Class A *3), EN 55011 (Class A *3, Group 1 *4), EN 61000-3-2, EN 61000-3-3 Applicable under the following conditions The maximum length of all cabling and wiring connected to the product must be less than 2.5 m.Shielded cables are being used when using the SIGNAL I/O.The high-voltage test lead TL31-TOS is in use.Electrical discharges are applied only to the EUT.					
Safety *1			Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU *2, EN 61010-1 (Class I *5 , Pollution Degree 2 *6)					

*1 Does not apply to specially ordered or modified products.
*2 Only on models that have CE/UKCA marking on the panel.
*3 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.
*4 This is a Group 1 instrument. 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.
*5 This is a Class I instrument. Be sure to ground this product's protective conductor terminal. The safety of this product is guaranteed only when the product is properly grounded.
*6 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.

High Voltage Scanner

[Basic specifications]

Item			TOS9320
Maximum operating voltage		AC	5 kV
		DC	7.2 kV
Number of channels			4 (Each channel can be set to high, low, or open.)
Maximum connections			4 units Channel numbers are assigned according to the order in which connections are made to the TOS9300 series tester. 1st scanner: CH1 to CH4, 2nd scanner:CH5 to CH8, 3rd scanner: CH9 to CH12, 4th scanner: CH13 to CH16
Contact check function			Available
Indicators		DANGER	Lights in sync with the TOS9300 series tester
		CHANNEL	Indicates the setting of each channel with color. Red: High, Green: Low, Orange: Contact being checked, Off: Open
		EXTERNAL	Lights when external control is on
		POWER	Lights when the power is on

[Interface and other functions]

Item			TOS9320
Control switch			EXTERNAL I/O switch for switching the following controls. ON: External control through the CONTROLLER INTERFACE OFF: Control from the TOS9300 series tester
CONTROLLER INTERFACE (external control)			D-sub 25-pin connector.
	Function		Sets each channel to high or low or all channels to open. Outputs the setting of each channel.
	Input		The input signals are all low-active control. The input terminal is pulled up to +12 V by a resistor. Leaving the input terminal open is equivalent to applying a high level signal.
		High-level input voltage	11 V to 15 V
		Low-level input voltage	0 V to 4 V
		Low-level input current	-5 mA max.
		Input time width	5 ms min.
	Output	Output method	Open collector output (4.5 Vdc to 30 Vdc)
		Output withstanding voltage	30 Vdc
		Output saturation voltage	Approx. 1.1 V (25°C, 77°F)
		Maximum output current	400 mA (TOTAL)
TOS9300 series tester interface			MINI DIN 8-pin connector. Accuracy guaranteed up to 4 units (16 channels)

[General specifications]

Item			TOS9320
Environment	Installation location		Indoors, 2000 m or less
	Spec guaranteed range	Temperature	5°C to 35°C (41°F to 95°F)
		Humidity	20%rh to 70%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		50 VA max.
	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)			1500 Vac for 1 minute, 20 mA or less
Earth continuity			25 Aac/0.1 Ω or less
Weight			Approx. 8 kg (17.6 lb)
Accessories			Power cord (1 pc., length: 2.5 m: The attached power cord varies depending on the shipment destination.) High-voltage test lead [TL31-TOS] (8 red), Lead for high voltage parallel connection TL33-TOS (1 pair), Interface cable (1 pc.), CONTROLLER INTERFACE plug (1 set), High-voltage warning sticker (2 pc.), Channel labels (For the panel (1 sheet), For the test leads (1 sheet)), User's manual (1 copy), Safety Information (1 copy)
Electromagnetic compatibility *1 *2			Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU, EN 61326-1 (Class A *3), EN 55011 (Class A *3, Group 1 *4), EN 61000-3-2, EN 61000-3-3 Applicable under the following conditions The maximum length of all cabling and wiring connected to this product is less than 2.5 m. A shielded cable is used for the connection to the CONTROLLER INTERFACE. The high-voltage test lead TL31-TOS is in use. Electrical discharges are applied only to the EUT.
Safety *1			Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU *2, EN 61010-1 (Class I *5, Pollution Degree 2 *6)

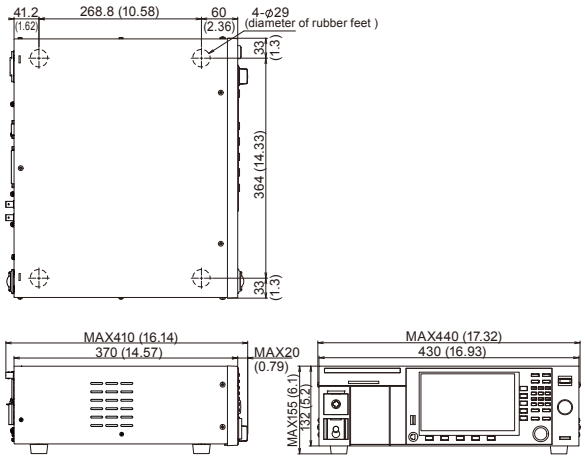
*1 Does not apply to specially ordered or modified products.
*2 Only on models that have CE/UKCA marking on the panel.
*3 This is a Class A instrument. This product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.
*4 This is a Group 1 instrument. 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.
*5 This is a Class I instrument. Be sure to ground this product's protective conductor terminal. The safety of this product is guaranteed only when the product is properly grounded.
*6 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.

TOS9300 SERIES

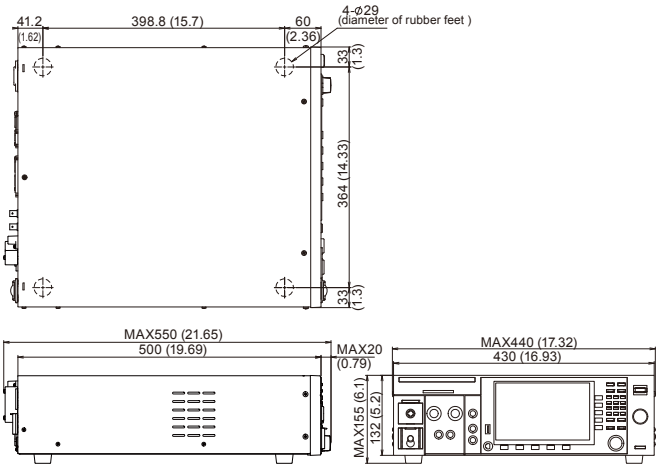
Electrical Safety Multi-analyzer

External Dimensions (Unit:mm(inches))

TOS9300 / TOS9301



TOS9303LC



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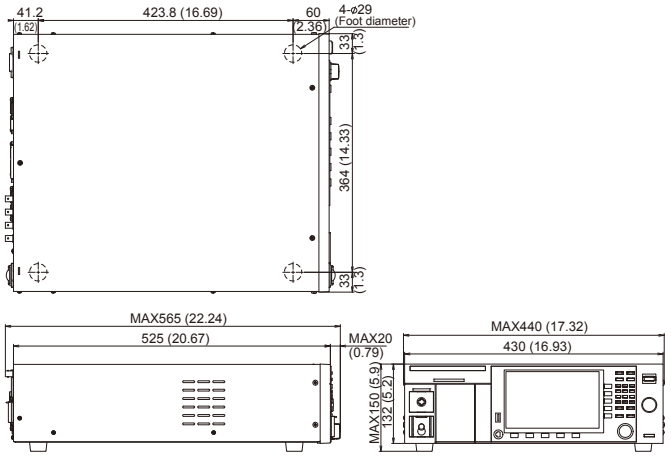

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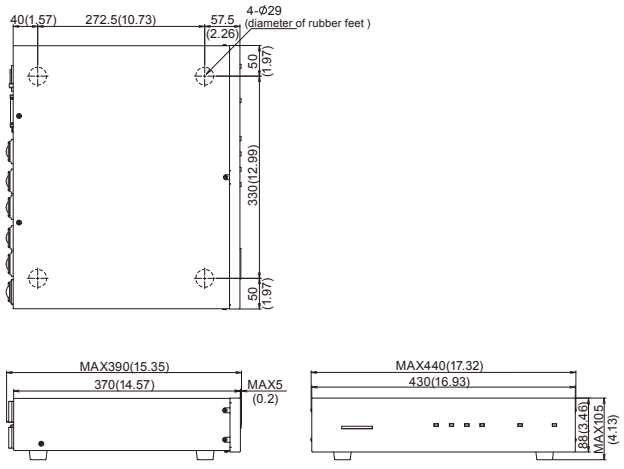
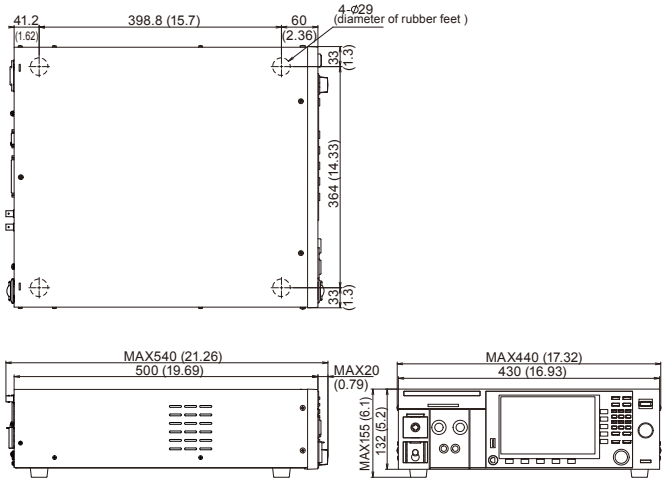


TOS9302 / TOS9303



TOS9213AS

Hipot Tester with Insulation Resistance Test

For the insulation testing of PV(Photovoltaic) module

TOS9213AS(DCW/IR) *While Supplies Last

GPIB RS232C

Accompanied with the features and performance of TOS9200 series, and it extends additional features and specifications exclusively applied to the PV module testing.

The TOS9213AS, DC Withstanding Voltage/Insulation Resistance Tester, is the test instrument that can handle the insuration test with high voltage and high resolution required for the evaluation of the PV module, Cable, Connector, and Junction Box. The TOS9213AS is equipped with functions of the DC withstanding voltage testing and the insulation resistance testing accompanied with the features and performance of Kikusui's high-end model TOS9200 series, and it extends additional features and specifications exclusively applied to the PV module testing. Furthermore, the TOS9213AS improves the current measurement accuracy of the DC withstanding voltage testing from the original specification of the TOS9000 series.

- Up to 10 kV / 5 mA with a maximum output of 50 W in DC withstanding voltage test
- Perform insulation resistance testing in the range of –25 V to –1500 V / 0.01 MΩ to 9.99 GΩ
- Applies for the testing of IEC61730-2 standard
- High-precision current measurement, 1 µA of the setting resolution for judgement
- Low output ripple of 100V p-p at 10 kV with consideration of capacitive load
- Capable of setting voltage rise rate by Rise Time Control Function, equipped with Discharge Function
- Capable of converting judgements of insulation resistance test into values of resistance and current
- Capable of applying high voltage and monitoring current for PID symptom (–1500 VDC / 100 µA)

TOS9213AS

Hipot Tester with Insulation Resistance Test

*The highlighted text in red indicates the improved specification exclusively applied to the PV module testing.

Hipot Tester

Output section(DC)		
Output-voltage range		0.05 kV to 10.0 kV DC
	Resolution	10 V
	Accuracy	±(1.5% of setting +20 V)
Maximum rated load *1		50 W (10 kV/5 mA)
Maximum rated current		5 mA
Ripple	No load at 10kV	100 Vp-p Typ.
	Maximum rated load	100 Vp-p Typ.
Voltage regulation		1% or less [maximum rated load → no load]
Short-circuit current		40 mA Typ.
Discharge function		Forced discharge at the end of test (discharge resistance: 500 kΩ) The discharge time can be set to a value from 0.5 s to 300 s. (*2)
Start voltage		The voltage at the start of the test can be set as the start voltage.
	Setting range	0% to 99% of the test voltage (resolution of 1%)
Output-voltage monitoring function		If the output voltage exceeds ±(10% of setting + 50 V), output is cut off and the protection function activates.
Voltmeter		
Analog	Scale	10 kV AC/DC F.S
	Accuracy	±5% F.S
	Indicator	Mean-value responsive
Digital	Measurement range	0.0 kV to 10.5 kV DC
	Resolution	10 V
	Accuracy	±(1.0% of reading + 20 V)
	Response	Mean-value responsive (response time of 200 ms)
	HOLD function	The voltage measured at the end of test is held during the PASS and FAIL period.

*1: Limitation on output
The tester's withstanding voltage generator is designed to radiate half as much heat as the rated output, in consideration of the size, weight, cost, and other factors of the tester. It is therefore necessary to use the tester within the ranges specified below. Operations deviating from these ranges may heat the output section excessively, thereby activating the protective circuit. In such a case, suspend the test and wait until the temperature falls to the normal level.

Output limitation in withstanding voltage testing

Ambient temperature		Upper reference	Pause	Output time
t ≤ 40 °C	DC	2.5mA < i	At least as long as the output time	Maximum of 1 minute
		i ≤ 2.5mA	At least as long as the judgement wait time (WAIT TIME)	Continuous output possible

[Output time = voltage rise time + test time + voltage fall time]

*2: About the discharge time settingIf
you set the discharge time to 0.0 s or if the voltage between the output terminals exceeds approximately 30 V even after the specified discharge time has passed, the TOS9213S will continue discharging until the voltage between the output terminals falls below approximately 30 V.

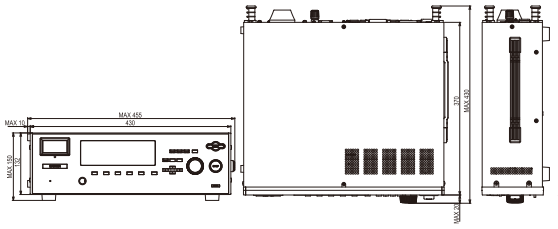
Ammeter	
Measurement range	0.00 mA to 5.5 mA DC
Accuracy *3	0μA to 2.00mA: ±(3% of reading + 5μA)
	2.01mA to 5.50mA: ±(3% of reading +10μA)
Response	Mean-value responsive (response time of 200 ms)
Hold function	The measured current at the end of the test is held during the PASS period.

Judgement function	
Setting range for the upper reference (UPPER)	1 μA to 999 μA 1 μA STEP 1.00 mA to 5.5 0mA 0.01 mA STEP
Setting range for the lower ref-erence (LOWER)	1 μA to 999 μA 1 μA STEP 1.00 mA to 5.50 mA 0.01 mA STEP (With the LOWER OFF function)
Judgement accuracy *3	0 μA to 2.00 mA: ±(3% of setting + 5 μA) 2.01 mA to 5.50 mA: ±(3% of setting + 10 μA)
Response switching function	The current detection response for UPPER FAIL judgement can be set to FAST/MID/SLOW (*4)
Time	
Setting range for the voltage rise time (RISE TIME)	0.1 s to 200 s
Setting range for the test time (TEST TIME)	0.3 s to 999 s (With the TIMER OFF function)

*3: When the GND LOW/GUARD setting is set to LOW, the humidity must not exceed 70 % rh.

*4: In the MID and SLOW modes, depending on the discharge method, the voltage monitoring function may operate and the TOS9213S may enter the PROTECTION status before UPPER FAIL detection takes place.

External dimensional diagrams



Unit: mm

Insulation Resistance Tester

Output section		
Output-voltage range		-25 V to -1500 V
	Resolution	1 V
	Accuracy	±(1.5% of setting+2 V)
Maximum rated load		1 W(-1000 V/1 mA), 0.15 W(-1500 V/0.1 mA)
Maximum rated current		1 mA
Ripple	1 kV no-load	2 Vp-p or less
	Maximum rated load	10 Vp-p or less
Voltage regulation		1% or less [Maximum rated load no load]
Short-circuit current		12 mA or less
Discharge function		Forced discharge at the end of test (discharge resistance: 25 kΩ)The discharge time can be set to a value from 0.5s to 300 s.(*2)
Output-voltage monitoring function		If the output voltage exceeds ±(10% of the setting + 50 V), output is cut off and the protection function activates.
Voltmeter		
Analog	Scale	10 kV DC F.S
	Accuracy	±5% F.S
	Indicator	Mean-value responsive
Digital	Measurement range	0 V to -1700 V
	Resolution	1 V
	Accuracy	±(1.0% of reading +1 V)
Resistance meter		
Measurement range		0.01 MΩ - 9.99 GΩ (Within the maximum rated current range of 1 mA to 50 mA)
Accuracy		

50 nA ≤ i ≤ 100 nA	100 nA < i ≤ 200 nA	200 nA < i ≤ 1 μA	1 μA < i ≤ 1 mA
±(20% of reading.)	±(10% of reading.)	±(5% of reading.)	±(2% of reading.)

[i=measured current]

[In the humidity range of 20 % to 70 % R.H (no condensation), with no disturbance such as swinging of the test leadwire]

Judgement function		
Judgement method		The UPPER/LOWER judgement can be switched between the resistance value-based judgement and current value-based judgement.The action for the judgement method by the current valued-based judgement, Display, Buzzer, SIGNAL I/O can be referred to the action in Withstanding Voltage Test Mode.
Setting range for the upper reference(UPPER)	Resistance value-based judgment	0.01 MΩ to 9.99 GΩ [Below the maximum rated current]
	Current value-based judgment	0.1 μA to 1.00 mA
Setting range for the lower reference (LOWER)	Resistance value-based judgment	0.01 MΩ to 9.99 GΩ [Below the maximum rated current]
	Current value-based judgment	0.1 μA to 1.00 mA
Time		
Setting range for the voltage rise time (RISE TIME)		0.1 s to 200 s
Setting range for the test time(TEST TIME)		0.5 s to 999 s (With the TIMER OFF function)

General Specifications

Power requirements	Nominal voltage range (Allowable voltage)	100 V to 120 V AC / 200 V to 240 V AC (85 V to 130 V AC / 170 V to 250 V AC) Selectable
Power con-sumption	Using no load (READY)	100 VA or less
	Using the rated load	Maximum of 200 VA
Allowable frequency range		47Hz to 63Hz
Insulation resistance		30 MΩ or more (500 V DC) [between the AC LINE and chassis]
Withstanding voltage		1390 V AC, 2 seconds, 20 mA or less [between the AC LINE and chassis]
Earth continuity		25 A AC/0.1 Ω or less
Safety		Conforms to the requirements of the following standard. IEC 61010-1 Class I Pollution degree 2
Warranty range	Temperature/ Humidity	5°C to 35°C/20% to 80% rh(No condensation)
Operating range	Temperature/ Humidity	0°C to 40°C/20% to 80%rh(No condensation)
Storage range	Temperature/ Humidity	-20°C to 70°C/90 % RH or less (No condensation)
Dimensions(maximum)		430[16.93 inch](455[17.91 inch])W× 132[5.20 inch](150[5.91 inch])H× 370[14.57 inch](430[16.93 inch])Dmm
Weight		Approx. 12 kg (Approx. 26.46 lbs)
Accessory		AC Power cord 1 pc., High-voltage test leadwire TL01-TOS (1.5 m)1 set, Interlock jumper 1 pc., HIGH VOLTAGE DANGER sticker 1 sheet, Fuse 1pc., Operation Manual 1 copy

TOS5300 SERIES

Hipot Tester/Hipot Tester with Insulation Resistance Test

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

TOS5301

TOS5302

TOS5300

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

DRIVERS USB CE

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

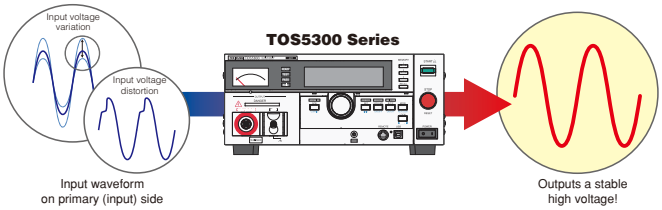
The “TOS5300 Series” is a series of test instruments used in Hipot tests and insulation resistance tests, two of the four tests regarded as necessary for ensuring the safety of electrical products. With an output of 5 kV/100 mA (AC) and 6 kV/10 mA (DC), the series can be used in Hipot & insulation resistance 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
- 5 kV/100 mA (500 VA) AC Hipot test
- 6 kV/maximum output 50 W DC Hipot tester (TOS5301)
- 25 V-1000 V (7 steps), 500 V or greater, up to 5.00 GΩ Insulation Resistance test
- High-precision measurement ±1.5% of reading (with voltmeter 500 V or higher, Ammeter 1 mA or higher)
- Rise time(AC/DC) / Fall time(AC) control
- Key lock function and Protection cover for key operation
- Equipped with USB interface

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 (500 V or greater) / minimum resolution of 1 V, 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.

nsulation resistance test for 25 V to 1000 V*

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 500 V 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

TOS5300 SERIES

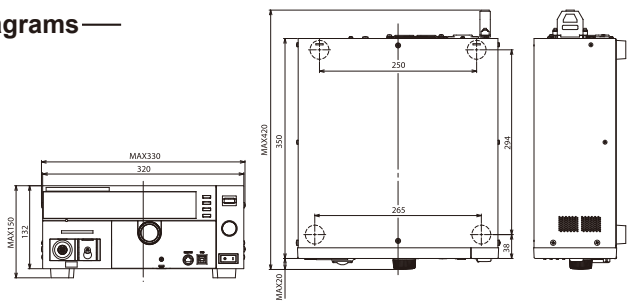
Hipot Tester/Hipot Tester with Insulation Resistance Test

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 reading + 20 V); V ≥ 500 V: ±1.5 % of reading		
		Response *3	True rms, Average value response / rms display switchable		
		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: □ . □□□ mA 1 mA ≤ i < 10 mA: □ . □□□ mA 10 mA ≤ i < 100 mA: □□ . □□ mA 100 mA ≤ i: □□□ . □ mA		
		Accuracy *4	1.00 mA ≤ i: ±(1.5 % of rdng); i < 1.00 mA: ±(1.5 % of reading + 30 μA)		
		Response *3	True rms, Average value response / rms display switchable		
		Hold feature	After a test is finished, the measured current is retained until the PASS judgment is cleared.		

External dimensional diagrams



Unit: mm

Hipot Tester

<table>
<tr><th colspan="2"></th><th>TOS5300</th><th>TOS5301</th><th>TOS5302</th></tr>
<tr><td rowspan="5">Judgment feature</td><td>Judgment method and judgment operation</td><td colspan="3">
<table>
<tr><th>Judgment</th><th>Judgment method</th><th>Display</th><th>Buzzer</th><th>SIGNAL I/O</th></tr>
<tr><td>UPPER FAIL</td><td>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.</td><td>FAIL LED lights OVER is displayed on the screen</td><td>ON</td><td>Generates a U-FAIL signal</td></tr>
<tr><td>LOWER FAIL</td><td>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.</td><td>FAIL LED lights UNDER is displayed on the screen</td><td>ON</td><td>Generates a L-FAIL signal</td></tr>
<tr><td>PASS</td><td>If the specified time elapses without any problems, the output is turned off, and a PASS judgment occurs.</td><td>PASS LED lights</td><td>ON</td><td>Generates a PASS signal</td></tr>
</table>
• 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.
</td></tr>
<tr><td>Upper limit setting</td><td>AC: 0.01 mA to 110 mA</td><td>AC: 0.01 mA to 110 mA
DC: 0.01 mA to 11 mA</td><td>AC: 0.01 mA to 110 mA</td></tr>
<tr><td>Lower limit setting</td><td>AC: 0.01 mA to 110 mA / OFF</td><td>AC: 0.01 mA to 110 mA / OFF
DC: 0.01 mA to 11 mA / OFF</td><td>AC: 0.01 mA to 110 mA / OFF</td></tr>
<tr><td>Judgment accuracy *4</td><td colspan="3">1.00 mA ≤ i: ±(1.5 % of set), i < 1.00 mA: ±(1.5 % of set + 30 µA)</td></tr>
<tr><td>Current detection method</td><td colspan="3">Calculates the current's true rms value and compares this value with the reference value</td></tr>
<tr><td>Calibration</td><td colspan="3">Calibrated with the rms of a sine wave using a pure resistive load</td></tr>
<tr><td rowspan="5">Time</td><td>Voltage rise time</td><td colspan="3">0.1 s to 10.0 s</td></tr>
<tr><td>Resolution</td><td colspan="3">0.1 s</td></tr>
<tr><td>Voltage fall time</td><td colspan="3">0.1 s / OFF (only enabled when a PASS judgment occurs)</td></tr>
<tr><td>Test time</td><td colspan="3">0.1 s to 999 s, can be turned off (TIMER OFF)</td></tr>
<tr><td>Resolution</td><td colspan="3">0.1 s to 99.9 s: 0.1 s. 100 s to 999 s: 1 s.</td></tr>
<tr><td></td><td>Accuracy</td><td colspan="3">±(100 ppm + 20 ms) excluding Fall Time
Excluding AC: Fall Time
Add DC: Rise Time Add ±50 ms at 1 kV or more, Add ±100 ms at less than 1kV.</td></tr>
</table>

*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: For both True rms and Mean-value response, 50 ms or above response time is required to satisfy the measurement accuracy.

*4: 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

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 reading + 1 V)
Resistance meter	Measurement range / measurement accuracy *4 *5	25 V	0.03 MΩ ≤ R ≤ 25 MΩ / ±(2 % of reading + 2 digits) 25 MΩ < R ≤ 125 MΩ / ±5 % of reading 125 MΩ < R ≤ 250 MΩ / ±10 % of reading
		50 V	0.05 MΩ ≤ R ≤ 50 MΩ / ±(2 % of reading + 2 digits) 50 MΩ < R ≤ 250 MΩ / ±5 % of reading 250 MΩ < R ≤ 500 MΩ / ±10 % of reading
		100 V	0.100 MΩ ≤ R ≤ 100 MΩ / ±2 % of reading 100 MΩ < R ≤ 500 MΩ / ±5 % of reading 500 MΩ < R ≤ 1 GΩ / ±10 % of reading
		125 V	0.125 MΩ ≤ R ≤ 125 MΩ / ±2 % of reading 125 MΩ < R ≤ 625 MΩ / ±5 % of reading 625 MΩ < R ≤ 1.25 GΩ / ±10 % of reading
		250 V	0.250 MΩ ≤ R ≤ 250 MΩ / ±2 % of reading 250 MΩ < R ≤ 1.25 GΩ / ±5 % of reading 1.25 GΩ < R ≤ 2.5 GΩ / ±10 % of reading
		500 V	0.50 MΩ ≤ R ≤ 500 MΩ / ±2 % of reading 500 MΩ < R ≤ 2.5 GΩ / ±5 % of reading 2.5 GΩ < R ≤ 5 GΩ / ±10 % of reading
		1000 V	1 MΩ ≤ R < 1 GΩ / ±2 % of reading 1 GΩ ≤ R ≤ 5 GΩ / ±5 % of reading
	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

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 consumptio	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)				1400 Vac, 2 seconds (Routine test) / 1500 Vac, 1 minutes (Type test)		
Earth continuity *1				25 AAC, 0.1 Ω or less		
Safety (Does not apply to specially ordered or modified TOS5300 Series testers.)				Complies with the requirements of the following directive and standard. Low Voltage Directive 2006/95/EC, EN 61010-1 Class I *4 , Pollution degree 2		
Electromagnetic compatibility (EMC) *1 (Does not apply to specially ordered or modified TOS5300 Series testers.) (Limited to products that have the CE mark on their panels.)				Complies with the requirements of the following directive and standard. EMC Directive 2004/108/EC, EN 61326-1(Class A*2), EN 55011(Class A*2, Group1*3) 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 must be less than 2.5 m. The shielded cable is being used when using the SIGNAL I/O. The high test lead TL31-TOS		
Dimensions				320[12.60 inch] (330[12.99 inch]) W × 132[5.20 inch] (150[5.19 inch]) H × 350[13.78 inch] (420[16.54 inch]) D mm		
Weight				Approx. 14 kg (Approx. 30.9 lbs.)	Approx. 15 kg (Approx. 33.1 lbs.)	Approx. 14 kg (Approx. 30.9 lbs.)
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.*5		

*1: Only on models that have the CE marking on the panel. Although signals are insulated with output terminals, each signal is common. Logic setting is also possible.
*2: This is a Class A equipment. 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.
*3: This is a Group 1 equipment. 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.
*4: This is a Class I equipment. Be sure to ground this product’s protective conductor terminal. The safety of this product is only guaranteed when the product is properly grounded.
*5: Contains the User's Manual, the Cimmunication Interface Manual, VISA library (KI-VISA), IVI-COM driver, and Safety evaluation test.

TOS5200 SERIES

AC Hipot Tester

An ideal AC Hipot Tester with low cost of ownership, built on more than 50 years of experience in market

TOS5200(ACW)

RS232C USB CE

The low cost of "New standard AC Hipot tester" with high-usability, reliability, and safety aspect.

TOS5200 is designed for AC Hipot Test with 500 VA capacity and 200 mA short circuit current output capability. Equipped with the PWM amplifier, the TOS5200 can provide a stable & reliable output without being affected by AC power line. Thus, it is a perfect solution for electronic equipment or devices complied to IEC, EN, UL, VDE and JIS etc. requirement. The TOS5200 covers most of features of which our upper class model of the AC Hipot Test, it achieves the superb cost / performance ratio for those who need 200 VA or 500 VA capacity, or both. Also, it equips the Interlock function together with other safety features, the operator can carry out the test with higher current value in safe.

- Highly-stable output is realized with the PWM switching amplifier system
- 5 kV / 100 mA (500 VA) AC Hipot test
- High-precision measurement of "±1.5 % of reading" (with the Voltmeter 500 V or higher, the Ammeter 1 mA or higher)
- Rise time / Fall time control function
- Supporting the World-wide input voltage
- Reducing the tact time
- The Keylock function & the Protection cover for the front panel operation
- Equipped with USB / RS232C interface

TOS5200 SERIES

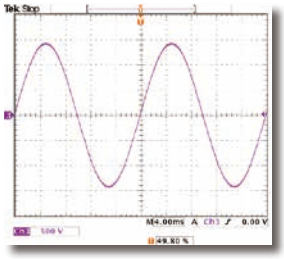
AC Hipot Tester

Basic performance

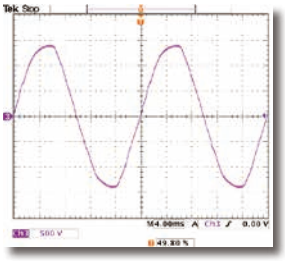
Highly stable output is realized with PWM Switching Amplifier!

Equipped with the PWM switching amplifier system, the TOS5200 realizes highly stable output not affected by input form AC line.A conventional Hipot Tester boosts and outputs the AC line's input voltage using a slide transformer system and which, the input voltage fluctuations will affect the output, preventing test from being performed properly. Since the TOS5200 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.

The output waveform is essential factor in Hipot (Withstanding oltage) testing!



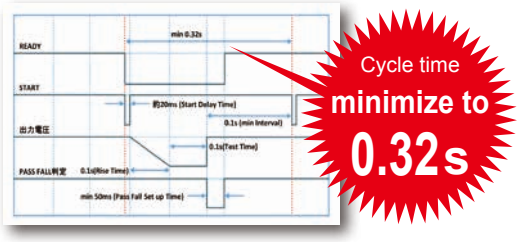
▲ AC output waveform of TOS5200



▲ AC output waveform of the slide transformer system

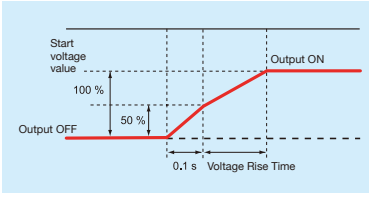
Capable of Test Time setting from 0.1s, which enables to reduce the tact time !

The TOS5200 can set the test time from 0.1 sec without sacrificing measurement accuracy.This makes test time 5 times faster compared to the TOS5050A (max test time:0.5sec) and it leads to reduce the tact time.Reduction of the tact time leads to improve the productivity, so it has been an issue that reducing the tact time may cause to worsen the measurement accuracy when the test time is faster than measurement respond speed.



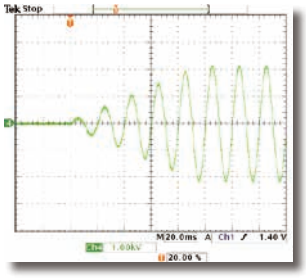
Rise time / Fall time control function

The rise time control function is to prevent the excessive stress that is being applied to the EUT (test object). The Hipot (Withstanding voltage) test is conducted to verify the safety performance of the EUT and which test voltage for Hipot (Withstanding voltage) test is applied approximately five to ten times greater than the voltage that handles by the EUT. If a high voltage is applied rapidly with no rise time, the transitional large voltage (current) will be occurred, and it may cause a damage to the EUT. For this reason, safety standards stipulate the procedure of Hipot (Withstanding voltage) test, and the test voltage must be gradually increased to the specified voltage when the test is performed. The rise time control function adopted in the TOS5200 can set the voltage rise time from 0.1s to 10.0s (at a resolution of 0.1s) and also it is capable to set the 50% (fixed) of the applied test voltage. In addition, the fall time control function enables to decrease the test voltage gradually after the completion of a PASS judgement. The voltage fall time is fixed at 0.1s (OFF is also selectable).



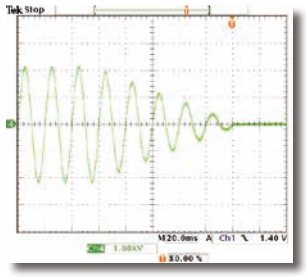
▲ Start voltage can be set at 50 % of the test voltage

Rise Time control function



▲ Rise time control waveform (example)

The Rise time control function enables you to increases the test voltage gradually to reach the setting voltage while the AC Hipot (Withstanding voltage) test is conducted. The voltage rise time can be set from 0.1s to 10.0s at a resolution of 0.1s.



▲ Fall time control waveform (example)

The Fall time control function enables you to decrease the test voltage gradually when the PASS judgment is made at the AC Hipot (Withstanding voltage) test. The voltage fall time is fixed at 0.1s. (OFF is also selectable).

High Precision, High Resolution, Realizing high-speed judgment

High-precision measurement ±1.5% of reading (with voltmeter 500 V or higher, Ammeter 1 mA or higher) The auto-range function achieves the equivalent specifications of the judgment accuracy for the upper and lower fail, and it makes effective to detect the contact failure or the disconnected status of the test lead. Moreover, the test time as fast as 0.1s realize the high-speed judgment. It assures to perform testing with the high-precision, high-resolution, high-speed-measurement, and the judgment function.

Improved the setting resolution of the leak current by 0.01 mA !

TOS5200 can set the current limit from0.01 mA to 110 mA.
(TOS5050A: 0.1 mA to 110 mA)

- Enables to clarify the actual value of device under test (DUT)
- The setting resolution of the lower limit setting has been improved from the previous model, it enables to defect the failure more accurately.

TOS5200 SERIES

AC Hipot Tester

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.

Withstanding voltage tester

AC Output section	Output range		0.05 kV to 5.00 kV
		Accuracy	± (2 % of set + 20 V) when no load is connected
		Operating 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)
	Crest factor		√2 ± 3 % less than (when the output voltage is 800 V or greater, no load)
	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
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
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	Digital	Measurement range	0.000 kV to 6.500 kV AC
		Display	□ . □□□ kV
		Accuracy	V < 500 V: ± (1.5 % of reading + 20 V), V ≥ 500 V: ±1.5 % of reading
		Response *3	True rms, Average value response/rms display switchable
		Hold feature	After a test is finished, the measured voltage is retained until the PASS or FAIL judgment is cleared.
Ammeter	Digital	Measurement range	0.00 mA to 110 mA
		Display	i = measured current i < 1 mA: □ . □□□ mA 1 mA ≤ i < 10 mA: □ . □□□ mA 10 mA ≤ i < 100 mA: □□ . □□ mA 100 mA ≤ i: □□□ . □ mA
		Accuracy *4	1.00 mA ≤ i: ± (1.5 % of reading), i < 1.00 mA: ± (1.5 % of reading + 30 µA)
		Response *3	True rms, Average value response/rms display switchable
		Hold feature	After a test is finished, the measured current value is retained until the PASS judgment is cleared.
Judgment feature	Judgment method and judgment operation		See table below
	Upper limit setting		0.01 mA to 110 mA
	Lower limit setting		0.01 mA to 110 mA / OFF
	Judgment accuracy *4		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 s0 / 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 FAIL judgment occurs.	FAIL LED lights; UPPER 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 withstanding voltage tests.	FAIL LED lights; LOWER is displayed on the screen	ON	Generates a U-FAIL signal
PASS	If the specified time elapses without any problems, the output is turned off, and a PASS judgment occurs.	PASS LED lights; displayed on the screen	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 withstanding voltage 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		Pause time	Output time
t ≤ 40 °C	50 mA < i ≤ 110 mA	Greater than or equal to the output time	30 min. max.
	i ≤ 50 mA	Not necessary	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: For both True rms and Mean-value response, 50 ms or above response time is required to satisfy the measurement accuracy.

*4: Regarding ammeter and judgment accuracy:
During AC withstanding voltage 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	5 kV
When using 350 mm long test leads that are suspended in air (TYP)	2 µA	4 µA	10 µA
When using the accessory, high test lead TL31-TOS (TYP)	16 µA	32 µA	80 µA

In case of 70 % humidity or higher, it is considerable to add 50 µA on the Limit value.

TOS5200 SERIES

AC Hipot Tester

Other features / Interfaces

Test mode			
	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 TOS5200 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 TOS5200 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 withstanding voltage tests: ±350 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 withstanding voltage test: 550 VA.
	Over Heat Protection		The internal temperature of the TOS5200 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.
	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 TOS5200 was being controlled through the USB interface.
Interfaces		USB	USB Specification 2.0
		RS232C *1	D-SUB 9-pin connector on the rear panel (compliant with EIA-232-D) All functions other than the POWER switch and KEY-LOCK
		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

*1: "Talk mode" can be set, when RS232C is used as comunication interface.

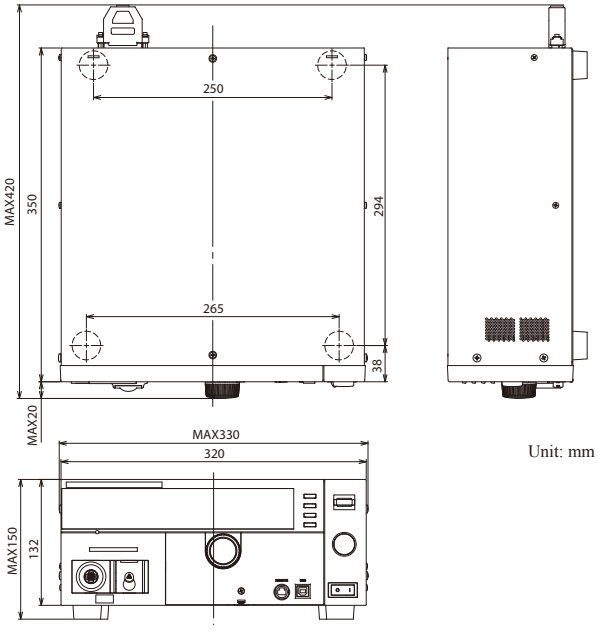
Talk mode	Description		
0	It responds only for commands from PC. (Default setting)		
1	It responds automatically for start and end test, and returns the status, setting value, measured value.		
	Response at start		<START>
	Response at end of test	Status	<PASS>, <U_FAIL>, <L_FAIL>, <PROT>, <ABOUT>
		Setting value, Measured value	Test No., Programme No., Test mode, Measured voltage, Measured current, Test time

General

Display			LCD: LED backlight
Environment	Installation location		Indoors, at a height of up to 2000 m
	Spec guaranteed range temperature/ humidity		5 °C to 35 °C (41 °F to 95 °F)/20 %rh to 80 %rh (no condensation)
	Operating range temperature/ humidity		0 °C to 40 °C (32 °F to 104 °F)/20 %rh to 80 %rh (no condensation)
	Storage range temperature/ humidity		-20 °C to 70 °C (-4 °F to 158 °F)/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 consumptio	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)			1500 VAC, one minute
Earth continuity			25 AAC, 0.1 Ω or less
Electromagnetic compatibility (EMC) *1			Complies with the requirements of the following directive and standard. EMC Directive 2014/30/EU, EN 61326-1(ClassA *2), EN 55011(ClassA *2, Group1 *3), EN 61000-3-2, EN 61000-3-3 Applicable under the following conditions The maximum length of all cabling and wiring connected to the TOS5200 must be less than 2.5 m. The shielded cable is being used when using the SIGNAL I/O. The high test lead TL31-TOS
Safety *1			Complies with the requirements of the following directive and standard. Low Voltage Directive 2014/35/EU, EN 61010-1 (Class I *4 Pollution degree 2)
Dimensions (mm(inches))(maximum)			320 (12.6") (330(12.99")) W × 132(5.2") (150(5.91")) H × 350(13.78") (420(16.54")) D
Weight			Approx. 14 kg (30.9 lbs)
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. / Setup Guide / Quick Reference(1 each for English and Japanese) / Safety informaion / CD-R *5

*1: Only on models that have the CE marking on the panel. Although signals are insulated with output terminals, each signal is common. Logic setting is also possible.
*2: This is a Class A equipment. 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.
*3: This is a Group 1 equipment. 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.
*4: This is a Class I equipment. Be sure to ground this product's protective conductor terminal. The safety of this product is only guaranteed when the product is properly grounded.
*5: Contains the User's Manual, the Cimmunication Interface Manual, VISA library (KI-VISA), IVI-COM driver, and Safety evaluation test.

External dimensional diagrams



Unit: mm

TOS5101

Hipot Tester

Basic model series with excellent cost performance

TOS5101(ACW/DCW)

High-end model of TOS series having AC, DC10kV output
Conforming to demands of various component standards testing and margin test

TOS5101 is designed exclusively for withstand voltage testing of electronic equipment and components conforming to various safety standards. The use of a high luminance, large fluorescent display tube for the display enables data including measured values, status and judgment results to be extremely legible. The PASS/FAIL function employs a window comparator method that enables TOS5101 to make fail judgment of current leakage over the upper reference value and below the lower reference value which can be set on the front panel.
Thus, highly reliable testing can be performed including that for test lead disconnection and defective contact. In addition, in order to prevent erroneous operation and accidents, the TOS5101 is also equipped with a Key Lock function and Interlock function, a high-voltage output terminal having a narrowed insertion port, a large DANGER lamp, and an automatic discharge function (during DC operation) that removes charge from the test piece. These features give the TOS5101 a high degree of safety and reliability.

*In general, when the capacitance of DUT has a voltage dependence (such as a “High-dielectric constant ceramic capacitor”), please take a caution that the waveform distortion may occurs.

- Complies with various safety standards
- AC / DC output (0 to 10 kV)
- Large color display
- Digital voltmeter and ammeter
- Digital timer
- Window comparator type employed for PASS / FAIL judgement.
- Equipped with remote control function
- Various signal outputs
- Automatic discharge function (during DC operation)
- Provided with zero turn-on switch
- Compact size

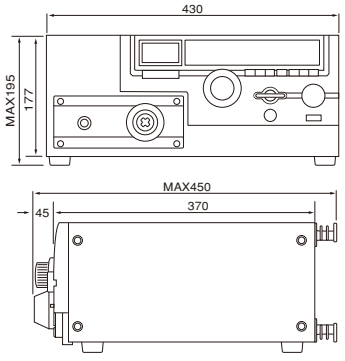
TOS5101

Hipot Tester

Output block		
Applied Voltage		0 to 5/ 0 to 10 kV AC and DC
AC		
Maximum Rated *1		500VA / 10 kV, 50 mA
Waveform		Commercial line waveform
Voltage Regulation		Max. 15% (for max. rated load to no load)
Switching		Use of a zero turn-on switch
DC		
Applied Voltage		50W / 10 kV, 5 mA
Ripple		100 Vp-p typ. at 10 kV, no load 200 Vp-p typ. at max. rated output
Maximum Rated *1		Max. 3% (for max. rated load to no load)
Output Voltmeters		
Analog	Scale	10 kV full scale , AC/DC
	Class	JIS Class 2.5
	Accuracy	±5% of full scale
	AC Indication	Mean value response / rms value scale
Digital	Full Scale	5 kV/ 10 kV full scale
	Accuracy	±1.5% of full scale
	AC Response	Mean value response / rms value display
Ammeter		
Digital	Accuracy	±(5% + 20μA) of upper cutoff current
	AC Response	Mean value response / rms value display
Pass/fail Judgement Function		
Type of Judgement		Window comparator type ●FAIL judgement *When current detected above upper cutoff current *When current detected below lower cutoff current (FAIL signal generated when FAIL judgement made) ● PASS judgement *When set time has elapsed and no abnormality is detected
Upper cutoff current setting range		AC: 0.1 to 55 mA DC: 0.1 to 5.5 mA
Lower cutoff current setting range		AC: 0.1 to 55 mA DC: 0.1 to 5.5 mA
Judgement Accuracy		±(5% of upper cutoff current + 20μA)
Current Detection		Integration of current absolute value followed by comparison with reference value.
Calibration		With rms value of sine wave using a pure resistance load.
No-load output voltage required for detection		Approx. 970 V when set to 50 mA AC
		Approx. 160 V when set to 5 mA DC
Test Time Setting Range		0.5 to 999 sec (±10 ms) (timer-off function provided)
Accuracy		±20 ms
Line Voltage		100V±10%, 50/60 Hz (Nominal voltages of 110V, 120V, 220V, 230V and 240V available as factory options.)
Power Requirements		
for line voltage of 100 V		Max. 50 VA under no-load conditions
		/ Approx. 600 VA at rated load
for line voltage of 100 V to 200 V		Max. 50 VA under no-load conditions
		/ Approx. 600 VA at rated load
for line voltage of 220 V to 240 V		Max. 50 VA under no-load conditions
		/ Approx. 610 VA at rated load
Electromagnetic compatibility (EMC) *3		Conforms to the requirements of the following directive and standard.*2 EMC Directive 2004/108/EC EN 61326-1 EN 61000-3-2 EN 61000-3-3 Under following conditions 1. Used HV test leadwires which is supplied. 2. No discharge in testing. 3. Used the shielded cable which length is less than three meters when the SIGNAL I/O is used.
Safty *3		Conforms to the requirements of the following directive and standard. *2,*4 Low Voltage Directive 2006/95/EC EN 61010-1 Pollution degree 2 UL1244(The UL-approved products with input voltage of 120VAC satisfy the UL1244 standerd.)
Insulation resistance		30 MΩ or more (500 V DC)
Hipot		1390 VAC, 2 seconds [between the AC LINE and chassis]
		1200 VAC, 1 second [UL-approved products only]
Environment		Specification range : 5 °C to 35°C / 20 %rh to 80 %rh
		Operable range : 0 °C to 40°C / 20 %rh to 80 %rh
		Storage range : -20 °C to 70 °C / 80 %rh or less
Dimensions (maximum)		430[16.9 inch] W × 177[6.97 inch] (195[7.68 inch]) H × 370[14.6 inch] (450[17.7 inch]) D mm
Weight		
for line voltage of 100 V		Approx. 21 kg (Approx. 46.30 lbs)
for line voltage of 100 V to 120 V		Approx. 23 kg (Approx. 50.70 lbs)
for line voltage of 220 V to 240 V		Approx. 24 kg (Approx. 52.91 lbs)
Accessories		
High-voltage test lead		TL01-TOS (max.allowablevoltage: 5 kV /1.5m) TL03-TOS (max.allowablevoltage: 10 kV /1.5m)
Others		14-pin amphenol plug (assembled)

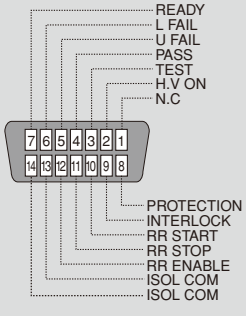
*1: Continuous output time may be limited depending on current high limit reference value and ambient temperature.
*2: Only on models that have CE marking on the panel. Not applicable to custom order models.
*3: Not applicable to custom order models.
*4: This instrument is a Class I equipment. Be sure to ground the protective conductor terminal of the instrument. The safety of the instrument is not guaranteed unless the instrument is grounded properly.

External dimensional diagrams



Unit: mm

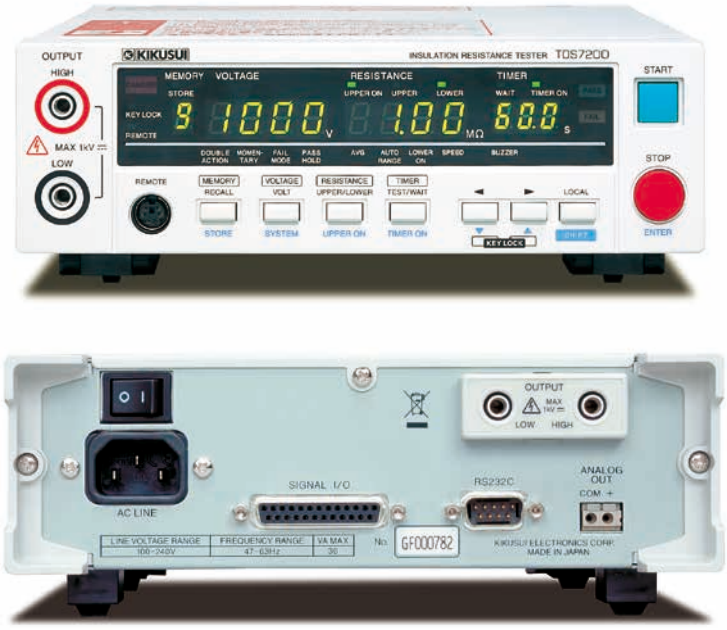
[Pin Configuration for the SIGNAL I/O Connector]



TOS7200

Insulation Resistance Tester

Complied with the test voltage -25 V to -1000 Vdc of the JIS C 1302-2002



TOS7200(IR)

RS232C

Testing voltage range -25 V to -1,000 V,
Resistance measurement range 0.01 MΩ to 5,000 MΩ

The TOS7200 is an insulation resistance tester available for a wide range of various electric and electronic components, as well as electric and electronic equipment. The output voltage can be set at desired value in the range of - 25 V to -1,000 V with a resolution of 1 V. (conforms with the output characteristics of the JIS C 1302-2002) . As it is fitted with a window comparator and timer function, the tester is capable of efficiently conducting insulation resistance tests based on various safety standards. In addition, this product is equipped with panel memory as standard feature, which can be recalled by remote control, SIGNAL I/O connector, and the RS-232C interface for easy automatic testing system construction.

- Provided with the discharge function
- Equipped with the window comparator
- Hold function
  (which holds the measured resistance at the end of testing while PASS judgment is being output)
- Provided with the timer function
- Rear output terminals
- Measured-value monitoring terminals
- Equipped with the panel memory
  (enabling 10 different settings to be stored)
- Equipped with the SIGNAL I/O connector and remote control terminal
- Equipped with the RS232C interface as standard

TOS7200

Insulation Resistance Tester

Output section		
Output voltage range		-25 V to -1000 V
	Resolution	1 V
	Accuracy	±(1.5 % of setting + 2 V)
Maximum rated load		1 W (1 000 V/1 mA)
Maximum rated current		1 mA
Output terminals	Output type	Floating
	Isolation voltage	±1000 VDC
Ripple	1000 V / under no load	2 Vp-p or less
	Maximum rated load	10 Vp-p or less
Short-circuiting current		12 mA or less
Output rise time		50 ms or less (10 % to 90 %) [no load]
Discharge function		Forced discharge at the end of test (discharge resistance: 25 kΩ)
Voltmeter		
Measurement range		0 V to -1200 V
Resolution		1 V
Accuracy		±(1 % of reading +1 V)
Resistance meter		
Measurement range		0.01 MΩ to 5000 MΩ (In the range of over 100 nA to a maximum rated current of 1 mA)
Display		R < 10.0 MΩ: □.□□ MΩ 10.0MΩ ≤ R < 100.0MΩ: □□.□ MΩ 100.0MΩ ≤ R < 1000MΩ: □□□ MΩ 1000MΩ ≤ R ≤ 5000MΩ: □□□□ MΩ R = measured insulation resistance
Accuracy		100 nA < i ≤ 200 nA: ± (10 % of reading) 200 nA < i ≤ 1 µA: ± (5 % of reading) 1 µA < i ≤ 1 mA: ± (2 % of reading) i =measured output-voltage value/measured resistance value [In the humidity range of 20 %rh to 70 %rh (no condensation), with no disturbance such as swinging of the test leadwire]
Measurement range		The current measurement range is selectable between AUTO and FIX.
	AUTO	Automatically changes the current measurement range according to the measured current value.
	FIX	Fixes the current measurement range based on the output voltage set value and LOWER set value (in UPPER OFF status).
Holding function		Holds the resistance value obtained at the end of testing while a PASS judgment is being output.
Judgment function		

Judgement method/action

Judgement	Judgement method	Display	Buzzer	SIGNAL I/O
UPPER FAIL	If a resistance value equal or higher than the upper resistance is detected, the tester shuts off the output and returns an UPPER FAIL judgment.	FAIL LED lights. UPPER LED lights.	ON	Outputs an U FAIL signal
LOWER FAIL	If a resistance value equal or less than the lower resistance is detected, the tester shuts off the output and returns a LOWER FAIL judgment. Note that no judgment is made within the judgment wait time (WAIT TIME) after the start of the test.	FAIL LED lights. LOWER LED lights.	ON	Outputs a L FAIL signal
PASS	If no abnormality is found when the set test time has elapsed, the tester shuts off the output and returns a PASS judgment.	PASS LED lights.	ON	Outputs a PASS signal

- A PASS signal is output for approx. 200 ms. However, if the PASS HOLD function is set to "HOLD," the signal is continuously output until a STOP signal is input.
- An UPPER FAIL or LOWER FAIL signal is continuously output until a STOP signal is input.
- The FAIL and PASS buzzer volumes are adjustable. However, they cannot be adjusted individually, as they are set in common.

Setting range for the upper resistance (UPPER)	0.01 MΩ to 5000 MΩ [In the range of the maximum rated current or less]
Setting range for the lower resistance (LOWER)	0.01 MΩ to 5000 MΩ [In the range of the maximum rated current or less]

Judgement accuracy For both UPPER and LOWER

Judgement current		100 nA < i ≤ 200 nA	200nA < i ≤ 1 µA	1 µA < i ≤ 1 mA
UPPER, LOWER	0.01 ≤ R < 10.0 MΩ	—	—	± (2 % of setting + 3digit)
	10.0 ≤ R < 50.0 MΩ	—	± (5 % of setting + 5digit)	± (2 % of setting + 3digit)
	50.0 ≤ R < 100 MΩ	—	± (5 % of setting + 5digit)	± (2 % of setting + 3digit)
	100 MΩ ≤ R < 200 MΩ	± (10 % of setting + 5digit)	± (5 % of setting + 5digit)	± (2 % of setting + 3digit)
	200 MΩ ≤ R < 500 MΩ	± (10 % of setting + 5digit)	± (5 % of setting + 5digit)	± (2 % of setting + 3digit)
	500 MΩ ≤ R < 1000 MΩ	± (10 % of setting + 5digit)	± (5 % of setting + 5digit)	± (2 % of setting + 3digit)
	1000 MΩ ≤ R < 2000 MΩ	± (10 % of setting + 50digit)	± (5 % of setting + 50digit)	—
	2000 MΩ ≤ R < 5000 MΩ	± (10 % of setting + 100digit)	± (5 % of setting + 50digit)	—

Judgement current = test voltage /(UPPER,LOWER)

[The humidity must be in the range of 20 %rh to 70 %rh (no condensation permitted), and there must be no disturbance such as swinging of the test leadwires.]
[The lower judgment requires a test duration of 0.5 s or more after the wait time has expired. It also requires a wait time of 1.0 s or more for a lower judgment of 200 nA or less.]

Time	
Setting range for the test duration (TEST TIME)	0.5 s to 999 s (TIMER OFF function provided)
Setting range for the wait time (WAIT TIME)	0.3 s to 10 s [TEST TIME > WAIT TIME]
Accuracy	±(100 ppm + 20 ms)

Interface and Other Functions

REMOTE	6-pin mini-DIN connector on the front panel The optional remote controller RC01-TOS or RC02-TOS is connected to remotely control starting/stopping of a test (note that a DIN-mini DIN adapter is required).
SIGNAL I/O	D-SUB 25-pin connector on the rear panel For names and descriptions of connector signals.

No.	Signal name	I/O	Description of signal
1	PM0	I	LSB *
2	PM1	I	*
3	PM2	I	*
4	PM3	I	MSB *
5	N.C		
6	N.C		
7	N.C		
8	N.C		
9	STB	I	Input terminal for the strobe signal of the panel memory
10	N.C		
11	N.C		
12	N.C		
13	COM		Circuit common (chassis potential)
14	HV ON	O	ON during a test or while a voltage remains between the output terminals
15	TEST	O	ON during a test
16	PASS	O	ON for approx. 0.2 seconds when PASS judgment is made, or continuously ON while PASS HOLD is activated
17	U FAIL	O	Continuously ON if an insulation resistance equal to or exceed-ing the upper resistance is detected, resulting in FAIL judgment
18	L FAIL	O	Continuously ON if an insulation resistance equal to or falling below the lower resistance is detected, resulting in FAIL judg-ment
19	READY	O	ON during standby
20	N.C		
21	START	I	Input terminal for the START signal
22	STOP	I	Input terminal for the STOP signal
23	ENABLE	I	Remote control enable signal input terminal
24	N.C		
25	COM		Circuit common (chassis potential)

[Pin Configuration for the SIGNAL I/O Connector]

* 1-digit BCD active LOW input
Panel memory's selection signal input terminal
Memory recall by latching this selection signal at the rise of the strobe signal

Input specifications			
	High-level input voltage	11 V to 15 V	All input signals are active Low controlled. The input terminal is pulled up to +12 V using a resistor. Opening the input terminal is equivalent to inputting a high-level signal.
	Low-level input voltage	0 V to 4 V	
	Low-level input current	-5 mA maximum	
	Input time width	5 ms minimum	
Output specifications			
	Output method	Open collector output (4.5 V to 30 V DC)	
	Output withstand voltage	30 V DC	
	Output saturation voltage	Approx. 1.1 V (at 25°C)	
	Maximum output current	400 mA (TOTAL)	
ANALOG OUT		Outputs a logarithmically compressed voltage corresponding to the measured resistance value	
	+	Vo = log (1 + Rx / 1MΩ) where Rx = measured resistance value (1 MΩ: 0.30 V; 10 MΩ: 1.04 V; 100 MΩ: 2.00 V; 1000 MΩ: 3.00 V; 10000 MΩ or more: 4.00 V). Output impedance: 1 kΩ	
	COM	Analog output-circuit common	
	Accuracy	±(2 % of full scale)	
RS232C		D-SUB 9-pin connector on the rear panel (compliant with EIA-232-D) All functions other than the POWER switch and KEY-LOCK function are remotely controllable.	
	Baud rate	9600 bps / 19200 bps / 38400 bps (data: 8 bits; parity: none; stop bit: 2 bits fixed)	
Display		7-segment LED, 4-digit voltage display, 4-digit insulation resistance display, and 3-digit time display	
Memory function		A maximum of 10 types of test conditions can be stored in memory.	
Backup battery life		3 years or more (at 25 °C)	
TEST MODE			
	MOMENTARY	A test is conducted only when the START switch is pressed.	
	FAIL MODE	Disables cancellation of FAIL judgment using a stop signal via remote control.	
	DOUBLE ACTION	Starts a test only when the STOP switch is pressed and the START switch is pressed within approximately a half-second.	
	PASS HOLD	Allows the time of holding PASS judgment to be set to 0.2 s or HOLD.	
KEYLOCK		Places the tester in a state in which no keystroke other than the START/STOP switch is accepted.	

General Specifications

Environment	
Installation location	Indoors and at altitudes up to 2000 m
Warranty range	Temperature 5 °C to 35 °C
	Humidity 20 %rh to 80 %rh (no condensation)
Operating range	Temperature 0 °C to 40 °C
	Humidity 20 %rh to 80 %rh (no condensation)
Storage range	Temperature -20 °C to 70 °C
	Humidity 90 %rh or less (no condensation)
Power requirements	
Nominal voltage range (allowable voltage range)	100 V to 240 V AC (85 V to 250 V AC)
Power consumption at rated load	30 VA maximum
Allowable frequency range	47 Hz to 63 Hz
Insulation resistance	30 MΩ or more (500 V DC) [AC LINE to chassis]
Hipot	1390 V AC for 2 seconds, 10 mA or less [AC LINE to chassis]
Ground bond	25 A AC / 0.1 Ω or less
Electromagnetic compatibility (EMC) *1	

Conforms to the requirements of the following directive and standard.
EMC Directive 2004/108/EC
EN 61326-1 (Class A) EN 55011 (Class A, Group 1)
EN 61000-3-2
EN 61000-3-3
Under following conditions
1. Used HV test leadwires TL08-TOS which is supplied.
2. No discharge occurs at outside of the tester.
3. Used the shielded cable which length is less than three meters when the SIGNAL I/O is used.

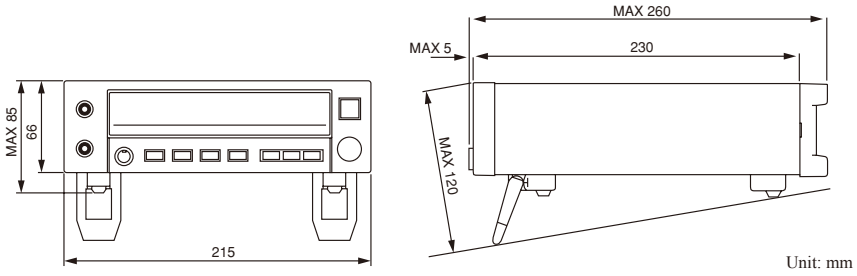
Safety *1, *2	

Conforms to the requirements of the following directive and standard.
Low Voltage Directive 2006/95/EC
EN 61010-1
Class I
Pollution degree 2

Dimensions (maximum)	215[8.46 inch] W × 66[2.60 inch] (85[3.35 inch]) H × 230[9.06 inch] (260[10.24 inch]) D mm
Weight	Approx. 2 kg (Approx.4.41 lbs)
Accessories	AC power cable 1 pc. TL08-TOS high-voltage test leadwires (1.5 m) 1 set Operation Manual 1 copy

*1: Only on models that have CE marking on the panel. Not applicable to custom order models.
*2: This instrument is a Class I equipment. Be sure to ground the protective conductor terminal of the instrument. The safety of the instrument is not guaranteed unless the instrument is grounded properly.

External dimensional diagrams



Unit: mm

TOS7210S

PID Insulation Tester

To evaluate the PID* effect of the PV module!

TOS7210S(SPEC80776)(IR)

RS232C

The tester that evaluates the PID effect of the PV module precisely and efficiently.

The PID insulation tester (TOS7210S) is designed based on the insulation resistance tester (TOS7200) to carry out the evaluation of the PID (Potential Induced Degradation) effect of the PV module precisely and efficiently. Being equipped with the output ability of 2000 V and the ammeter with nA resolution as well as a polarity switching function, the TOS7210S is also applicable not only to the PID evaluation but also the evaluation of the insulators that requires a high sensitivity of measurement. The tester is equipped with the panel memory that is externally accessible and the RS232C interface is also equipped as standard that can be flexibly compatible with the automated system.

- Capable of arbitrary setting of the output voltage
- Polarity switching function
- The output is floating from the ground
- Analog output terminal
- Equipped with RS232C as standard

[PID effect]

The PID effect is a phenomenon that the amount of power generation by a cell remarkably decreases when high voltage is applied between the solar cell and the frame for long hours. It is supposed that the higher the applied voltage is and/or the higher and more humid the environment is, the further deterioration accelerates.

*Potential Induced Degradation

TOS7210S

PID Insulation Tester

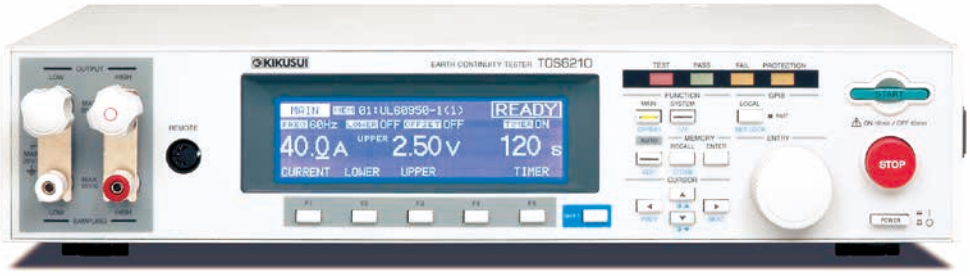
Output section			
	Output voltage range		50 V to 2000 V
		Resolution	1 V
		Accuracy	± (1.5 % of setting + 2 V)
	Maximum rated output		2 W (2000 V/1 mA)
	Maximum rated current		1 mA
	Output terminals	Output type	Floating
		Isolation voltage	±1000 Vdc (The terminal that polarity is set to positive polarity)　+1000 Vdc and -3000 Vdc (The terminal that polarity is set to negative polarity)
	Ripple	2000 V/under no load	20 Vp-p or less
		Maximum rated load	20 Vp-p or less
	Voltage regulation		1 % or less (Maximum rated load → No load)
	Short-circuiting current		2 mA or less (Instant 200 mA or less)
	Output rise time		60 ms or less (10 % to 90 %, no load)
	Discharge function		Forced discharge at the end of test (discharge resistance: 20 kΩ)
Voltmeter			
	Measurement range		0 V to 2400 V
	Resolution		1 V
	Accuracy		± (1 % of reading +1 V)
Resistance meter			
	Measurement range		0.01 MΩ to 5000 MΩ (In the range of over 100 nA to a maximum rated current of 1 mA)
	Display		□ . □□ MΩ [R < 10.0 MΩ]　□□ . □ MΩ [10.0 MΩ ≤ R < 100.0 MΩ] □□□ MΩ [100.0 MΩ ≤ R < 1000 MΩ]　□□□□ MΩ [1000 MΩ ≤ R ≤ 5000 MΩ]　(R = measured insulation resistance)
	Accuracy *1		± (10 % of reading) [100 nA < i ≤ 200 nA]　± (5 % of reading) [200nA < i ≤ 1 μA]　±(2 % of reading) [1 μA < i ≤ 1 mA] (i= measured output-voltage value/measured resistance value)
	Measurement range		The current measurement range is selectable between AUTO and FIX.
		AUTO	Automatically changes the current measurement range according to the measured current value.
		FIX	Fixes the current measurement range based on the output voltage set value and LOWER set value (in UPPER OFF status).
	Holding function		Holds the resistance value obtained at the end of testing while a PASS judgment is being output.
Ammeter			
	Measurement range		0.000 μA to 1900 μA
	Display		□ . □□□ μA [i < 10.00 μA]　□□ . □□ μA [10.00 μA ≤ i < 100.0 μA] □□□ . □ μA [100.0 μA ≤ i < 1000 μA]　□□□□ μA [1000 μA ≤ i]　(i= measured current value)
	Accuracy *2		±(4% of reading +0.005 μA) [i < 10.00 μA]　±(4% of reading +0.005 μA) [10.00 μA ≤ i < 100.0 μA] ±(2% of reading +0.005 μA) [100.0 μA ≤ i < 1000 μA]　±(2% of reading) [1000 μA ≤ i]　(i= measured current value)
	Measurement range		The current measurement range is selectable between AUTO and FIX.
		AUTO	Automatically changes the current measurement range according to the measured current value.
		FIX	Fixes the current measurement range based on the output voltage set value and LOWER set value (in UPPER OFF status).
Judgment function			
	Judgement method/ action	UPPER FAIL Judgement	If a resistance value equal or less than the lower resistance is detected, the tester shuts off the output and returns an UPPER FAIL judgment.
		LOWER FAIL Judgement	If a resistance value equal or less than the lower resistance is detected, the tester shuts off the output and returns a LOWER FAIL judgment. Note that no judgment is made within the judgment wait time (WAIT TIME) after the start of the test.
Time			
	Setting range for the test duration		0.5 s to 999 s (Consecutive operation by setting TEST TIME as OFF)
	Setting range for the wait time		0.3 s to 10 s (TEST TIME > WAIT TIME)
	Accuracy		±(100 ppm + 20 ms)
SIGNAL I/O			D-SUB 25-pin connector on the rear panel
	Input specifications	High-level input voltage	11 V to 15 V　All input signals are active Low controlled. The input terminal is pulled up to +12 V using a resistor. Opening the input terminal is equivalent to inputting a high-level signal.
		Low-level input voltage	0 V to 4 V
		Low-level input current	-5 mA maximum
		Input time width	5 ms minimum
	Output specifications	Output method	Open collector output (4.5 Vdc to 30 Vdc)
		Output withstand voltage	30 Vdc
		Output saturation voltage	Approx. 1.1 V (at 25°C)
		Maximum output current	400 mA (TOTAL)
ANALOG OUT			Outputs the measured resistance, measured current and voltage, and current range in DC voltage.
	Measured resistance		$V_0 = \log\left(1 + \frac{R_X}{1M\Omega}\right)$　*Rx:Resistance measurement* Rx: (1 MΩ: 0.3 V, 10 MΩ: 1.04 V, 100 MΩ: 2.00 V, 1000 MΩ: 3.00 V, 10000 MΩ or more: 4.00 V)　Output impedance: 1 kΩ
	Measured current		Renge1: V_0 [V]= measured value [μA]/ 512　Renge3: V_0 [V]= measured value [μA]/8 Renge2: V_0 [V]= measured value [μA]/64　Renge4: V_0 [V]= measured value [μA]
	COM		Analog output-circuit common
	Accuracy		±(2 % of full scale)
RS232C			D-SUB 9-pin connector on the rear panel (compliant with EIA-232-D) All functions other than the POWER switch and KEY-LOCK
	Baud rate		9600 bps/19200 bps/38400 bps (data: 8 bits; parity: none; stop bit: 2 bits fixed)
REMOTE			6-pin mini-DIN connector on the front panel. The optional remote controller RC01-TOS or RC02-TOS is connected to control remotely starting/ stopping of a test (note that a DIN-mini DIN adapter is required).
Display			7-segment LED, 4-digit voltage display, 4-digit insulation resistance display, 4-digit current display, and 3-digit time display
Memory function			A maximum of 10 types of test conditions can be stored in memory
TEST MODE		MOMENTARY	A test is conducted only when the START switch is pressed.
		FAIL MODE	Disables cancellation of FAIL judgment using a stop signal via remote control.
		DOUBLE ACTION	Starts a test only when the STOP switch is pressed and the START switch is pressed within approximately a half-second.
		PASS HOLD	Allows the time of holding PASS judgment to be set to 0.2 s or HOLD
KEYLOCK			Places the tester in a state in which no keystroke other than the START/STOP switch is accepted
Environment			
	Installation location		Indoors and at altitudes up to 2000 m
	Warranty range	Temperature/Humidity	15 °C to 30 °C/20 % rh to 80 % rh (no condensation) (59 °F to 86 °F)
	Operating range	Temperature/Humidity	0 °C to 40 °C/20 % rh to 80 % rh (no condensation) (32 °F to 104 °F)
	Storage range	Temperature/Humidity	-20 °C to 70 °C/90 % rh or less (no condensation) (-4 °F to 158 °F)
Power requirements			
	Nominal voltage range(allowable voltage range)		100 Vac to 240 Vac (85 Vac to 250 Vac)
	Power consumption	At rated load	30 VA maximum
	Allowable frequency range		47 Hz to 63 Hz
Insulation resistance			30 MΩ or more (500 Vdc) (AC LINE to chassis)
Hipot			1500 Vac for 1 second, 10 mA or less (AC LINE to chassis), 3000 V AC for 1 second (A, B terminals to chassis)
Ground bond			25 Aac/0.1 Ω or less
Dimensions (mm (inch)) (maximum dimensions) /Weight			214 (8.43") W × 81(3.19") (115 (4.53")) H × 340 (13.39") (385 (15.16")) D/Approx. 2 kg (Approx.4.41 lbs)

*1: Humidity: 20 %rh to 70 %rh (no condensation). No bends in the test leads.
*2: Humidity: 20 %rh to 80 %rh (no condensation). No bends in the test leads. Humidity 20 %rh to 70 %rh when either of terminal A or terminal B is grounded (no condensation). No bends in the test leads.

TOS6210

Ground Bond Tester

Ground Bond tester supporting standard compliance tests up to 60A



TOS6210

GPIB RS232C DRIVERS CE

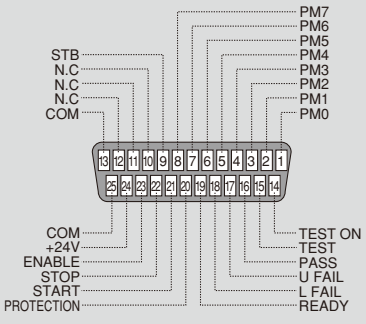
Test up to 60 A is possible!

While inheriting the basic performance and functions of its predecessor (TOS6200), such as a constant current driving system that provides current waveforms with little skew and high measurement accuracy, the TOS6210 tester extends the maximum test current from 30 A to 60 A, which is demanded by the new standard. In addition, the tester also lets you judge the acceptability of the device under test based on the drop in voltage, as required in the standard. What's more, you can preset test conditions of up to 20 different types of safety standards, such as those for information technology equipment, home appliances, medical devices, and measuring instruments, in the memory on the main unit's panel.

A simple memory call operation allows you to set up a protective earth or protective bonding continuity test as stipulated in UL60950-1 and other relevant specifications including IEC and JIS standards. The tester also features a set of functions that meet the specific needs of testing personnel, such as an offset cancellation function and a memo function that allows you to input calibration dates, production numbers, and other test-related information and read the input information later via the GPIB or RS232C interface.

- Test current value: 6 A to 60 A AC / Resistance value: 0.001 Ω to 0.600 Ω
- Voltage drop-based judgment function
- Offset cancelling function
- Stores 100 test conditions in memory
- Incorporates test conditions into program
- Contact check function
- Equipped with standard GPIB and RS232C interfaces
- Equipped with standard test lead (TL12-TOS)

[Pin Configuration for the SIGNAL I/O Connector]



TOS6210

Ground Bond Tester

Output block		
Current setting range (*1)		6.0 to 62.0 A AC (With respect to resistance resulting in output power of the maximum rated Output or less and an output terminal voltage of 5.4 V or less)
	Resolution	0.1A
	Accuracy	± (1% of setting + 0.4A)
Maximum rated output		220 VA (at the output terminals)
Distortion factor		2% or less (with respect to 0.1 Ω pure resistance load of 20 A or greater)
Frequency		50/60 Hz, sine wave (selectable)
	Accuracy	±200ppm
Open terminal voltage		6 Vrms or less
Output method		PWM switching method
Output ammeter		
Measurement range		0.0 to 66.0 A AC
Resolution		0.1A
Accuracy		± (1% of reading + 0.4A)
Response		Mean value response/rms value display (response time: 200 ms)
Holding function		The current measured at the end of test is held during the PASS or FAIL inteval
Output voltmeter		
Measurement range		0.00 to 6.00 V AC
Resolution		0.01V
Offset cancel function		0.00 to 5.40 V (Offset ON/OFF function provided)
Accuracy		± (1% of reading + 0.02V)
Response		Mean value response/rms value display (response time: 200 ms)
Holding function		The voltage measured at the end of test is held during the PASS or FAIL inteval
Ohmmeter (*2)		
Measurement range		0.001 to 0.600 Ω
Resolution		0.001 Ω
Offset cancel function		0.000 to 0.600 Ω (Offset ON/OFF function provided)
Accuracy		± (2% of reading + 0.003 Ω)
Holding function		The resistance measured at the end of test is held during the PASS or FAIL interval
Pass/fail judgement function (*3)		
Resistance value-based judgement		Window comparator system •If a resistance value equal to or greater than the upper reference value is detected, a FAIL determination is returned. •If a resistance value equal to or less than the lower reference value is detected, a FAIL determination is returned. •If a resistance value has been judged as FAIL, the tester shuts off the output and generates a FAIL signal. •If the set time elapses without abnormalities, the tester shuts off the output and generates a PASS signal.
	Setting range for the upper reference value (UPPER)	0.001 to 0.600 Ω
	Setting range for the lower reference value (LOWER)	0.001 to 0.600 Ω
	Resolution	0.001 Ω
	Judgement accuracy	± (2% of UPPER + 0.003 Ω)
Sampled voltage value-based judgement		Window comparator system •If a voltage value equal to or greater than the upper reference value is detected, a FAIL determination is returned. •If a voltage value equal to or less than the lower reference value is detected, a FAIL determination is returned. •If a voltage value has been judged as FAIL, the tester shuts off the output and generates a FAIL signal. •If the set time elapses without abnormalities, the tester shuts off the output and generates a PASS signal.
	Setting range for the upper reference value (UPPER)(*4)	0.01 to 5.40 V
	Setting range for the lower reference value (LOWER)	0.01 to 5.40 V
	Resolution	0.01 V
	Judgement accuracy	± (2% of UPPER + 0.05 V)
Calibration		Calibration is performed with the rms value of the sine wave, using a pure resistance load.
LED	PASS	Lights for approximately 0.2 sec when the measured value has been judged as PASS. It is lit continuously when the PASS holding time is set to HOLD.
	UPPER FAIL	Lights if a resistance or voltage value equal to or greater than the upper reference value is detected and judged FAIL.
	LOWER FAIL	Lights if a resistance or voltage value equal to or greater than the upper reference value is detected and judged FAIL.
Buzzer		•The buzzer sounds for the pass holding time has been set if the measured value has been judged as PASS. •The buzzer sounds continuously under the following condition: The measured value has been judged as PASS when the PASS holding time is set to HOLD. The measured value has been judged as UPPER FAIL. The measured value has been judged as LOWER FAIL. •The buzzer volume for FAIL or PASS judgment are adjustable. Note that it cannot be adjusted individually since setting is shared with the setting for PASS.
Time		
Test time	Setting range	0.3 to 999 s Timer ON/OFF function is available.
	Accuracy	± (100 ppm of setting + 20 ms)

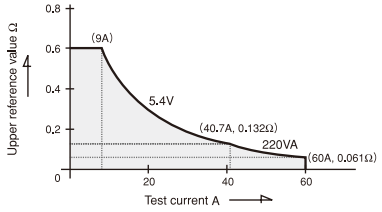
Environment		
Operating environment		Indoor use, Overvoltage Category II
Warranty range	Temperature	5° to 35°C
	Humidity	20 %rh to 80 %rh (non condensing)
Operating range	Temperature	0° to 40°C
	Humidity	20 %rh to 80 %rh (non condensing)
Storage range	Temperature	-20° to 70°C
	Humidity	90 %rh or less (non condensing)
Altitude		Up to 2000 m
Power requirement		
Allowable voltage range		85 to 250 V AC
Power consumption	At no load (READY)	60 VA or less
	At rated load	420 VA max.
Allowable frequency range		47 Hz to 63 Hz
Insulation resistance		30 MΩ min. (500 V DC), between AC line and chassis
Hipot		1390 V AC (2 seconds), between AC line and chassis
Ground bond		25 A AC/0.1 Ω max.
Electromagnetic compatibility (EMC) (*5,6)		
Conforms to the requirements of the following directive and standard. EMC Directive 2014/30/EU, EN61326, EN61000-3-2, EN61000-3-3 Under following conditions 1. Used test leadwire (TL12-TOS) which is supplied. 2. Used the shielded cable which length is less than three meters when the SIGNAL I/O is used.		
Safety (*5)		
Conforms to the requirements of the following directive and standard. Low Voltage Directive 2014/35/EU, EN61010-1, Class I, Pollution degree 2		
Physical dimensions(maximum)		430[16.93 inch] (455[17.91 inch]) W × 88[3.46 inch] (140[5.51 inch]) H × 270[10.63 inch] (350[13.78 inch]) D mm
Weight		Approx. 11 kg(Approx.24.25 lbs)
Accessories		
AC power cord: 1 piece, Test leadwire TL12-TOS: 1 set, Short bar: 2 pieces (These are inserted between the OUTPUT and SAMPLING terminals.), AC power fuse: 2 pieces (2, including one spare in the fuse holder), Operation manual: 1 copy		

*1: Time limitation with respect to output. The heat radiation capacity at the output block of the tester is designed to be one-third of the rated output, accounting for size, weight, cost, and other factors.
Always use the tester within the limitation values given below. Use of the tester beyond these limits will cause the temperature of the output block to rise excessively, potentially tripping the internal protection circuit. In this case, suspend testing for approximately 30 minutes, then press the STOP switch. When temperatures fall to normal levels, the tester will revert to ready status.

Output time limitation			
Ambient temperature t (°C)	Test current I (A)	Pause time	Maximum allowable continuous test time
t ≤ 40°	40 < I ≤ 60	Equal to or greater than the test time	≤ 10 minutes
	20 < I ≤ 40	Equal to or greater than the test time	≤ 30 minutes
	I ≤ 20	Not required	Continuous output possible

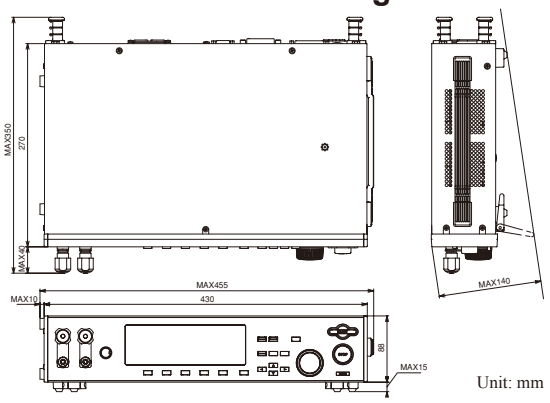
*2: About ohmmeter's response time. A resistance value is instantaneously obtained, calculated using the measured voltage and current values. The response time of the ohmmeter complies with the response times of the voltmeter and ammeter.
*3: Resistance value-based and sampled voltage value-based judgments cannot be simultaneously conducted.
*4: Limited by the maximum rated output and the output terminal voltage. The tester can be used within the range shown below.

Allowable range in which to determine the test current value and upper reference value



*5: Not applicable to custom order models.
*6: Only on models that have CE marking on the panel.

External dimensional diagrams



Unit: mm

TOS6200A

Ground Bond Tester

Pursuing to maximize an easy operation, stylish design of Ground Bond Tester

TOS6200A

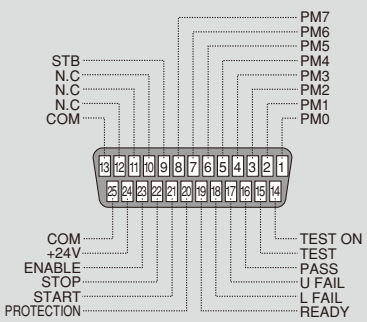
GPIB RS232C DRIVERS CE

Adopting the constant current method to apply automated testing system
Perfect feature for the Production line which requires reduced tact time

The TOS6200A is designed to perform the ground bond tests required for class-I devices by safety standards such as IEC, EN, VDE, BS, UL, JIS, and the Electrical Appliance and Material Safety Low (Japan). Equipped with a new high-efficiency power supply, it is compact and lightweight, about half the size and weight of our conventional products, while achieving a large output of 150 VA. Use of the constant current method eliminates the need to reset test currents even in the face of fluctuating resistance values for the device being tested. The test duration can also be set from 0.3 s, making the tester suitable for production line testing, which requires reduced cycle time. This tester is also designed for ease of use, featuring a large, easy-to-read display, memory capacity for storage of 100 types of test conditions, and incorporation of test conditions into programs to enable automatic testing. The standard equipped GPIB and RS232C interfaces allow the user to use PCs or other devices to control test conditions such as test current, resistance value for judgement, and test duration, and enables read-back of measured values and test results.

- Test current value: 3 A to 30 A AC / Resistance value: 0.001 Ω to 1.200 Ω
- Offset cancelling function
- Stores 100 test conditions in memory
- Incorporates test conditions into program
- Contact check function
- Equipped with standard GPIB and RS232C interfaces
- Equipped with standard test lead (TL11-TOS)

[Pin Configuration for the SIGNAL I/O Connector]



TOS6200A

Ground Bond Tester

Output block		
Current setting range (*1)		3.0 Aac to 31.0 Aac (With respect to resistance resulting in output power of the maximum rated Output or less and an output terminal voltage of 5.4 V or less)
	Resolution	0.1 A
	Accuracy	± (1% of setting + 0.2 A)
Maximum rated output		150 VA (at the output terminals)
Distortion factor		2% or less (with respect to 0.1 Ω pure resistance load of 10 A or greater)
Frequency		50/60 Hz, sine wave (selectable)
	Accuracy	±200 ppm
Open terminal voltage		6 Vrms or less
Output method		PWM switching method
Output ammeter		
Measurement range		0.0 Aac to 33.0 Aac
Resolution		0.1 A
Accuracy		± (1% of reading + 0.2 A)
Response		Mean value response/rms value display (response time: 200 ms)
Holding function		The current measured at the end of test is held during the PASS or FAIL inteval
Output voltmeter		
Measurement range		0.00 Vac to 6.00 Vac
Resolution		0.01 V
Accuracy		± (1% of reading + 0.02 V)
Response		Mean value response/rms value display (response time: 200 ms)
Holding function		The voltage measured at the end of test is held during the PASS or FAIL inteval
Ohmmeter (*2)		
Measurement range		0.001 Ω to 1.200 Ω
Resolution		0.001 Ω
Offset cancel function		0.000 Ω to 1.200 Ω (Offset ON/OFF function provided)
Accuracy		± (2% of reading + 0.003 Ω)
Holding function		The resistance measured at the end of test is held during the PASS interval
Pass/fail judgement function		
Resistance value-based judgement		Window comparator system •If a resistance value equal to or greater than the upper reference value is detected,a FAILdetermination is returned. •If a resistance value equal to or less than the lower reference value is detected, a FAIL determination is returned. •If a resistance value has been judged as FAIL, the tester shuts off the output and generates a FAIL signal. •If the set time elapses without abnormalities, the tester shuts off the output and generates a PASS signal.
Setting range for the upper rerence value (UPPER)		0.001 Ω to 1.200 Ω
Setting range for the upper rerence value (LOWER)		0.001 Ω to 1.200 Ω
Resolution		0.001 Ω
Judgement accuracy		± (2% of UPPER + 0.003 Ω)
Calibration		Calibration is performed with the rms value of the sine wave, using a pure resistance load.
LED	PASS	Lights for approximately 0.2 sec when the measured value has been judged as PASS.It is lit continuously when the PASS holding time is set to HOLD.
	UPPER FAIL	Lights if a resistance value equal to or greater than the upper reference value is detected and judged FAIL.
	LOWER FAIL	Lights if a resistance value equal to or greater than the upper reference value is detected and judged FAIL.

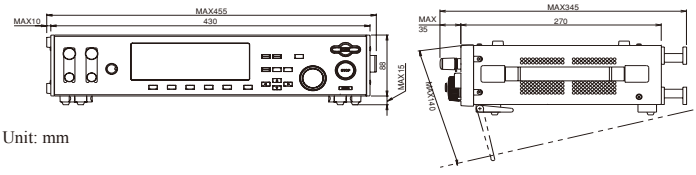
Buzzer		•The buzzer sounds for the pass holding time has been set if the measured value has been judged as PASS. •The buzzer sounds continuously under the following condition: The measured value has been judged as PASS when the PASS holding time is set to HOLD. The measured value has been judged as UPPER FAIL. The measured value has been judged as LOWER FAIL. •The buzzer volume for FAIL or PASS judgment are adjustable. Note that it cannot be adjusted individually since setting is shared with the setting for PASS.
Time		
Test Time	Setting range	0.3 s to 999 s Timer ON/OFF function is available.
	Accuracy	± (100ppm of setting + 20ms)
Environment		
Operating environment		Indoor use, Overvoltage Category II
Warranty range		Temperature : 5°C to 35°C Humidity : 20 %rh to 80 %rh (non condensing)
Operating range		Temperature : 0°C to 40°C Humidity : 20 %rh to 80 %rh (non condensing)
Storage range		Temperature : -20°C to 70°C Humidity : 90 %rh or less (non condensing)
Altitude		Up to 2000 m
Power requirement		
Allowable voltage range		85 Vac to 250 Vac
Power consumption	At no load (READY)	60 VA or less
	At rated load	280 VA max.
Allowable frequency range		47 Hz to 63 Hz
Insulation resistance		30 MΩ min. (500 Vdc), between AC line and chassis
Withstanding voltage		1390 Vac (2 seconds), between AC line and chassis
Earth continuity		25 Aac/ 0.1 Ω max.
Safety (*3) Conforms to the requirements of the following directive and standard.		
Low Voltage Directive 2014/35/EU, EN 61010-1 (Class I, Pollution degree 2)		
Electromagnetic compatibility (EMC) (*3,4)		
Conforms to the requirements of the following directive and standard. EMC Directive 2014/30/EU, EN 61326-1 (Class A), EN 55011 (Class A, Group 1), EN 61000-3-2, EN 61000-3-3 Under following conditions 1. Used test leadwire (TL11-TOS for TOS6200A, TL12-TOS for TOS6210) which is supplied. 2. Used the shielded cable which length is less than three meters when the SIGNAL I/O is used.		
Physical dimensions (maximum)		430[16.93 inch] (455[17.91 inch]) W × 88[3.46 inch] (140[5.51 inch]) H × 270[10.63 inch] (345[13.58 inch]) D mm
Weight		Approx. 9 kg (Approx.19.84 lbs)
Accessories		
AC power cord		1 piece
Test leadwire TL11-TOS		1 set
Short bar		2 pieces (These are inserted between the OUTPUT and SAMPLING terminals.)
AC power fuse		2 pieces (2, including one spare in the fuse holder)
Operation manual		1 copy

*1: Time limitation with respect to output
The heat radiation capacity at the output block of the tester is designed to be one-third of the rated output, accounting for size, weight, cost, and other factors. Always use the tester within the limitation values given below. Use of the tester beyond these limits will cause the temperature of the output block to rise excessively, potentially tripping the internal protection circuit. In this case, suspend testing for approximately 30 minutes, then press the STOP switch. When temperatures fall to normal levels, the tester will revert to ready status.

Output time limitation			
Ambient temperature t (°C)	Test current I (A)	Pause time	Maximum allowable continuous test time
t ≤ 40°	15 < I ≤ 30	Equal to or greater than the test time	≤ 30 minutes
	I ≤ 15	Not required	Continuous output possible

*2: About ohmmeter's response time
A resistance value is instantaneously obtained, calculated using the measured voltage and current values. The response time of the ohmmeter complies with the response times of the voltmeter and ammeter.
*3: Not applicable to custom order models.
*4: Only on models that have CE marking on the panel.

External dimensional diagrams

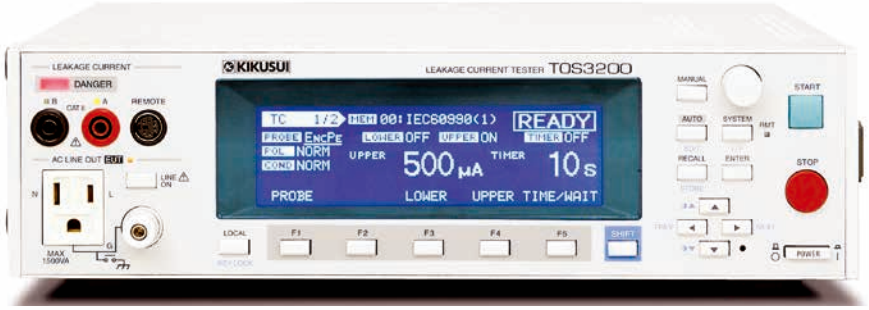


Unit: mm

TOS3200

Leakage Current Tester

Supports touch current and protective conductor current (earth leakage current) tests



TOS3200

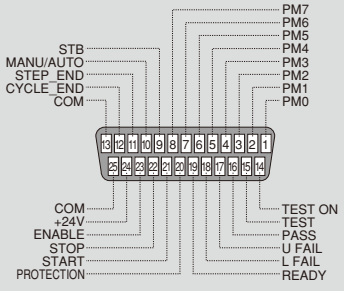
GPIB RS232C USB

A leakage current tester has now been added to the TOS Series... Conforms to international standard IEC 60990 ("Methods of measurement of touch current and protective conductor current").

The Leakage Current Tester TOS3200 is designed to test for leakage current (Touch Current and Protective Conductor Current) of general electrical apparatuses, excluding those used for medical purposes. With this tester, you can conduct tests conforming to various standards including IEC, UL, JIS and Electrical Appliance and Material Safety Law (Japan). You can set test conditions through simple operations on the panel because this tester holds in its memory the 51 types of test conditions for IT-related electrical equipment, electrical appliances, audio & visual equipment, lighting fixtures, power tools, and measuring and control instruments, accordingly with the standards of IEC/JIS and Electrical Appliance and Material Safety Law.

- Capable of measuring leakage current in three modes
- Eight built-in measurement circuit networks
- Up to 30 mA for RMS measurement
- Easy-to-understand operation
- Enables the continuous execution of tests
- Capable of saving test results
- 51 types of standard test conditions are preset
- Lets you manage the calibration time limit
- USB interface provided as standard

[Pin Configuration for the SIGNAL I/O Connector]



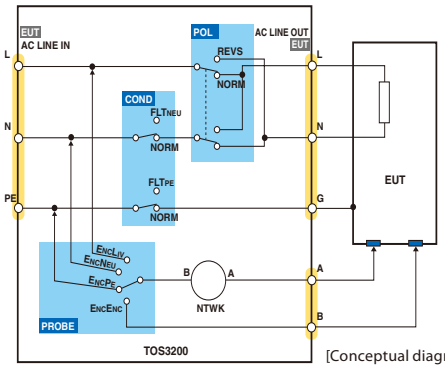
TOS3200

Leakage Current Tester

Capable of measuring leakage current in three modes

● Touch current (TC) operating mode*

Enables you to measure the touch current flowing between the enclosure (accessible portion) of the electrical equipment under test (EUT) and the power line incorporating the earth wire, via Measuring Devices. For Measuring Devices, eight measurement circuit networks (NTWKs) conforming to the applicable standards are provided as standard. The switching of the polarities of the power line to the EUT, as well as single-fault conditions, are automatically set with relays inside the tester.



[Conceptual diagram of the TC measurement]

● Protective conductor current (PCC) operating mode*

Enables you to measure the current flowing through the protective conductor (earth wire) by connecting the power plug (NEMA5-15 or an equivalent) of an item of 100 V electrical equipment to the socket on the front panel. A multi-outlet is available as an option (sold separately) to accommodate the different plugs used around the world.

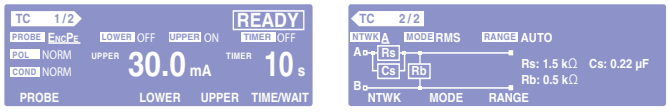
● Meter (METER) operating mode

In the same way as an ordinary multimeter, enables you to measure voltage and current using measurement terminals A and B on the front panel. For voltage measurement, it offers a "safety extra low voltage" (SELV) detection function; for current measurement, it offers a measurement function using measurement circuit networks (NTWKs).

*TC=Touch Current PCC=Protective Conductor Current

Easy-to-understand operation

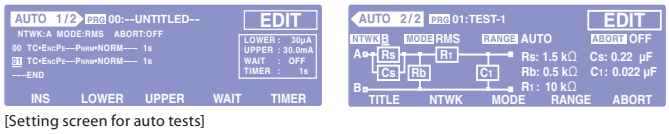
Simple operation is possible thanks to the intuitively understandable test condition menu and the function keys/rotary knobs.



[Setting screen for touch current (TC) measurement]

Enables the continuous execution of tests

Allows you to automatically conduct TC and PCC tests as a single sequence program by setting their test conditions as up to 100 independent tests (steps). You can set up to 100 sequence programs, with up to 500 steps in total. To support automation test, measurement point (probe setting) can be switched over without turning off EUT power line.



[Setting screen for auto tests]

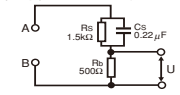
Up to 30 mA for RMS measurement

Capable of measuring 30 µA to 30 mA for DC/RMS measurement and 50 µA to 90 mA for PEAK measurement, both in three ranges. Two range switching functions are provided, namely, a fixed range function (FIX) and auto range function (AUTO), which conform to the current to be measured.For RMS measurement, the "true root-mean-square value" is achieved.

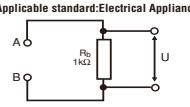
Eight built-in measurement circuit networks

It offers built-in eight measurement circuit networks for measuring the touch current of general electrical equipment.

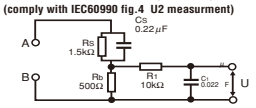
●Measurement circuit network(network A)
(comply with IEC60990 fig.3 U1 measurment)



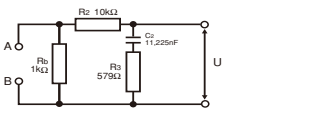
●Measurement circuit network(network D)
(Applicable standard:Electrical Appliance and Material Safety Law)



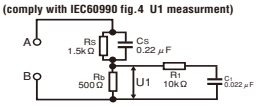
●Measurement circuit network(network B)
(comply with IEC60990 fig.4 U2 measurment)



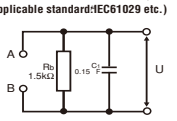
●Measurement circuit network (network E)
(Applicable standard:Electrical Appliance and Material Safety Law)



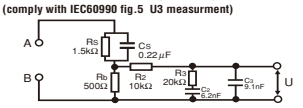
●Measurement circuit network(network B1)
(comply with IEC60990 fig.4 U1 measurment)



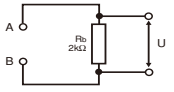
●Measurement circuit network (network F)
(Applicable standard:IEC61029 etc.)



●Measurement circuit network(network C)
(comply with IEC60990 fig.5 U3 measurment)



●Measurement circuit network (network G)
(Applicable standard:IEC60745 etc.)



Capable of saving test results

For independent tests, enables you to save not only test results but also the test date and time and the test conditions for up to 50 tests; for auto tests, you can save this data for up to 50 programs. You can also save the test results as external records using the USB and other interfaces.

51 types of standard test conditions are preset

The memory in the main unit is pre-written with 51 types of test conditions for general electrical equipment, which conform to IEC 60990 and the standards listed below. You can set the standard test conditions merely by calling them.

[Standards covered by the memory]

Standard No.	Applicable electrical equipment
IEC60950	Information technology equipment
IEC60335	Household and similar electrical appliances
IEC60065	Audio, video and similar electronic apparatus
IEC60745	Hand-held motor-operated electric tools
IEC60598	Luminaires
IEC61010	Electrical equipment for measurement, control, and laboratory use
Electrical Appliance and Material Safety Law	Electrical appliances
IEC61029	Transportable motor-operated electric tools

Lets you manage the calibration time limit

For independent tests, enables you to save not only test results but also the test date and time and the test conditions for up to 50 tests; for auto tests, you can save this data for up to 50 programs. You can also save the test results as external records using the USB and other interfaces.

USB interface provided as standard

In addition to the SIGNAL I/O, GPIB, and RS232C interfaces, a USB interface is also provided as standard.

Range of other functions

- "MAX function," which retains the largest current measured.
- "CONV function," which converts the measured current value into the corresponding value for the preset power voltage.
- "SELV function," which causes the DANGER lamp to turn ON if a preset safety extra low voltage (SELV) is exceeded in meter measurement mode.
- "CHECK function," which performs self-analysis of the measurement circuit networks.

TOS3200

Leakage Current Tester

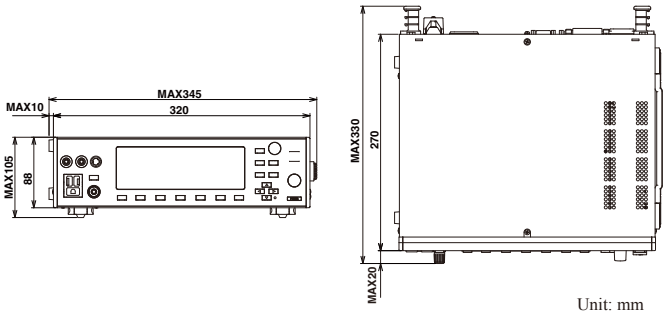
Measurement item, measurement mode			
Measurement item			3 types, namely, touch current (TC) measurement, protective conductor current (PCC) measurement, and METER
Measurement method	TC		Measure the voltage drop across the reference resistor, using a measurement circuit network (NTWK), and then calculate the current.
	PCC		Measure the voltage drop across the reference resistor connected to the protective earth wire, and then calculate the current.
	METER		Measure the voltage and current using the measurement terminals.
Measurement mode			DC/RMS/PEAK (RMS being the true root-mean-square value)
Measurement circuit network (NTWK)	Network A		Basic measurement element: (1.5 kΩ//0.22 μF) + 500 Ω
	Network B/B1		Basic measurement element: (1.5 kΩ//0.22 μF) + 500 Ω//(10 kW + 0.022 μF)
	Network C		Basic measurement element: (1.5 kΩ//0.22 μF) + 500 Ω//(10 kΩ + (20 kΩ + 6.2 nF)//9.1 nF)
	Network D		Basic measurement element: 1 kΩ
	Network E		Basic measurement element: 1 kΩ//(10 kΩ + 11.225 nF + 579 Ω)
	Network F		Basic measurement element: 1.5 kΩ//0.15 μF
	Network G		Basic measurement element: 2 kΩ
Network constant tolerance			Resistance: ±0.1%, capacitor 0.15 μF: ±2%, other: ±1%
Current measurement section			
Measurement range	Range 1		DC/RMS: 30 μA to 600 μA, PEAK: 50 μA to 850 μA (*3)
	Range 2		DC/RMS: 125 μA to 6.00 mA, PEAK: 175 μA to 8.50 mA (*3)
	Range 3		DC/RMS: 1.25 mA to 30.0 mA, PEAK: 1.75 mA to 90.0 mA (*3)
Range switching			AUTO/FIX
Measured current (i) display/resolution			i < 1mA: □□□ μA/1 μA, 1 mA ≦ i < 10 mA: □.□□ mA/0.01 mA 10 mA ≦ i < 100 mA: □□.□ mA/0.1 mA
Measurement accuracy(*5)	Range 1	DC	±(5.0% of rdng + 20 μA)
		RMS	15 Hz ≦ f ≦ 10 kHz: ±(2.0% of rdng + 8 μA)
			10 kHz < f ≦ 1 MHz: ±(5.0% of rdng + 10 μA)
		PEAK	15 Hz ≦ f ≦ 10 kHz: ±(5.0% of rdng + 10 μA)
	Range 2	DC	±(5.0% of rdng + 50 μA)
		RMS	15 Hz ≦ f ≦ 10 kHz: ±(2.0% of rdng + 20 μA)
			10 kHz < f ≦ 1 MHz: ±(5.0% of rdng + 20 μA)
		PEAK	15 Hz ≦ f ≦ 1 kHz: ± (2.0% of rdng + 50 μA)
			1 kHz < f ≦ 10 kHz: ± (5.0% of rdng + 50 μA)
	Range 3	DC	±(5.0% of rdng + 0.5 mA)
		RMS	15 Hz ≦ f ≦ 10 kHz: ±(2.0% of rdng + 0.2 mA)
			10 kHz < f ≦ 1 MHz: ±(5.0% of rdng + 0.2 mA)
		PEAK	15 Hz ≦ f ≦ 1 kHz: ± (2.0% of rdng + 0.5 mA)
			1 kHz < f ≦ 10 kHz: ± (5.0% of rdng + 0.5 mA)
Input resistance, input capacitance			1 MΩ±1%, < 200 pF
Common mode rejection ratio			f ≦ 10 kHz: 60 dB or greater, 10 kHz < f ≦ 1 MHz: 40 dB or greater
Judgement function			
Judgement method			Pass/fail judgement by setting upper and lower current limits in window comparator mode
Judgement			U-FAIL for currents above the upper limit; L-FAIL for currents below the lower limit.
Display, etc.			U-FAIL/L-FAIL/PASS display, buzzer sounding
PASS hold			The time for which a PASS judgement is retained can be set to 0.2 s to 10.0 s or to HOLD
Setting range	Range 1		DC/RMS: 30 μA to 600 μA, PEAK: 50 μA to 850 μA (*4)
	Range 2		DC/RMS: 151 μA to 6.00 mA, PEAK: 213 μA to 8.50 mA (*4)
	Range 3		DC/RMS: 1.51 mA to 30.0 mA, PEAK: 2.13 mA to 90.0 mA (*4)
Judgement accuracy			Conforms to measurement accuracy. (Read rdng as set.)
Measurement of voltage between A and B			
Measurement range			DC/RMS: 10.000 V to 300.0 V, PEAK: 15.000 V to 430.0 V
Accuracy			±(3% of rdng + 2 V), measurement range fixed at AUTO
Input impedance			Approx. 40 MΩ
SELV detection			Set the SELV to detect; if this value is exceeded, the DANGER lamp is turned ON
SELV setting range			10 V to 99 V, in 1-V steps, OFF function provided
Timer, test execution function, memory			
Timer	Test wait time		Setting range: 0 s to 999 s, accuracy: ±(100 ppm of set + 20 ms)
	Test time		Setting range: 1 s to 999 s/OFF function, accuracy: ±(100 ppm of set + 20 ms)
Text execution			Auto test (AUTO): Automatic execution of up to 100 steps (test conditions) Independent test (MANUAL): Independent execution of TC, PCC, or METER measurement
Memory	Test conditions		AUTO: Up to 100 sequence programs can be saved (up to 500 steps in total). MANUAL: Up to 100 sequence programs can be saved.
	Test results		The user can select whether to save the judgement results when they are output at the end of the tests. AUTO: Test results for up to 50 programs can be recorded. MANUAL: Test results for up to 50 tests can be recorded.

Other functions			
Measured value conversion (CONV)			Converts the measured current value into the corresponding value at the preset power voltage
			Setting range: 80.0 V to 300.0 V, OFF function provided
MEASURE MODE			Selects a measured value from those below
			NORM: Displays the measured value in the measurement period
			MAX: Displays the largest measured value in the measurement period
Power positive/negative phase selection (POL)			NORM: Positive phase connection, REVS: Negative phase connection
Single fault selection (COND)			NORM: Normal, FLTNEU: Disconnection of the neutral wire, FLTPE: Disconnection of the protective earth wire
Earth check			Generates CONTACTFAIL if the enclosure is grounded in a TC (EncLiv, EncNeu) test
MEASURE CHECK			Checks the measurement function between measurement terminals A and B, and places the tester in the PROTECTION state if an error is detected
Voltage measurement(EUT)			Measurement range: 80.0 V to 250.0 V, resolution: 0.1 V, accuracy: ±(3% of rdng + 1 V)
Current measurement(EUT)			Measurement range: 0.1 A to 15.00 A, resolution: 0.01 A, accuracy: ±(5% of rdng + 30 mA)
Power measurement (effective power)			Measurement range: 10 W to 1500 W
			Accuracy (at a power voltage of 80 V or higher and a load power factor of 1): ±(5% of rdng + 8 W)
System clock	Recording		Items: Calibration date and time, test date and time, permissible date and time: Up to 2099
	Calibration time limit management(CAL PROTECT)		Enables the setting of a calibration time limit. Once this time has passed, a warning is output at power on
			ON: Places the tester in the PROTECTION state (disables the use of the tester), OFF: Displays warning.
Protective operation			Relay operation error, overload, over range, measurement function check, failure of internal battery, etc.
Interface			
RS232C			D-Sub 9-pin connector (conforming to EIA-232D), baud rate: 9600/19200/38400 bps (For connection to a PC, use a "9-pin female-female reverse" cable.)
GPIB			Conforms to IEEE Std. 488-1978. (SH1,AH1,T6,TE0,L4,LE0,SR1,PP0,DC1,DT0,C0,E1)
USB			USB Specification2.0
REMOTE			6-pin MINIDIN connector (for HP21-TOS (separately sold option) only)
SIGNAL I/O			25-pin D-Sub connector
General			
Measurement erminals	Rated voltage/current		Terminals A to B: 250 V, terminal to chassis: 250 V, 100 mA
	Measurement category		CAT II
	Effective terminal display		Terminals effective to measurement are indicated with LED lamps.
Environment	Specification assured range		Temperature: 5°C to 35°C, humidity: 20% rh to 80% rh (no condensation)
	Operating range		Temperature: 0°C to 40°C, humidity: 20% rh to 80% rh (no condensation)
	Storage range		Temperature: –20°C to 70°C, humidity: 90% rh or less (no condensation)
	Mounting location		Indoors, altitude of 2000 m or less
Power	Input power		Nominal input rating:100Vac to 240Vac, 50/60Hz, power consumption: 70 VA max.
	for EUT		Nominal input rating:100Vac to 240Vac, 50/60Hz
			Rated output capacity: 1500 VA, maximum current: 15 A, rush current: 70 A peak max. (within 20 ms)
Insulation resistance			30 MΩ or greater (500 Vdc) (between AC line and chassis, between measurement terminal and chassis)
Withstand voltage			1390 Vac, 2 seconds/20 mA or less (between AC line and chassis)
Ground bond			25 Aac/0.1 Ω or less
Safety (*1)			Conforms to the requirements of the directive and standard below. Low Voltage Directive 2014/35/EU, EN61010-1 (Class I, Pollution degree 2)
Electromagnetic compatibility (*1, *2)			Conforms to the requirements of the directive and standard below. EMC Directive 2014/30/EU, EN 61326-1 (Class A), EN 55011 (Class A, Group 1), EN61000-3-2, EN61000-3-3, Applicable conditions: All cables and wires used to connect to this product must be shorter than 3 meters. Use the supplied test leads.
Outside dimensions, weight			320[12.60 inch] (345[13.58 inch]) W × 88[3.46 inch] (105[4.13 inch]) H × 270[10.63 inch] (335[13.19 inch]) D mm, approx. 5 kg(approx. 11.02 lbs)
Accessories			1 set of test leads (TL21-TOS: red and black, one each, with alligator clips) 1 flat probe (FP01-TOS), 1 spare fuse (15 A, for EUT power) 1 instruction manual, 1 circuit principle diagram sticker 2 power cords (for the tester and for the EUT AC line)

• The warm-up time must be 30 minutes or longer.
• rdng denotes a reading, set denotes the set value, and EUT is the electrical equipment under test.

*1: May not apply to custom-made or modified products.
*2: Limited to products with CE marking on their panels.
*3: The maximum range is indicated. The range differs depending on the measurement circuit network.
*4: The maximum range is indicated. The range differs depending on the measurement circuit network. Also, the UPPER setting in each range when the FIX range is selected is indicated.
*5: Current converted value in Network A,B,C and PCC measurement,based on built-in voltmeter accuracy.

External dimensional diagrams



Unit: mm

Others

High-Voltage Digital Voltmeter

■149-10A

- Measurement of high voltages (AC/DC) of up to 10 kV maximum.
- Large 4 1/2 digit LED display
- High measuring accuracy and input resistance
- Light weight of only 3 kg
- Compact design
- Excellent ease of maintenance

Specifications	
Operating System	Double integration system (sampling cycle: 3 times/sec)
DC Voltage	Measuring range: 0.500 kV to 10,000 kV Accuracy: ±(0.5 % of reading + 0.03 % of range) Input resistance: 1000 MΩ ± 2 %
AC Voltage	Measuring range: 0.500 kV to 10,000 kV Accuracy: ±(1 % of reading + 0.05 % of range) Frequency characteristics: 50/60 Hz (sine wave rms value display of mean value response) Input resistance: 1000 MΩ ± 2%
Power Requirements	100V±10%, approx. 10 VA
Dimensions (MAX)	134[5.27 inch]W × 164[6.46 inch]H × 270[10.63 inch]D mm (140[5.51 inch]W × 189[7.44 inch]H × 350[13.78 inch]D mm)
Weight	approx. 3 kg (approx. 6.61 lbs)
Accessories	TL05-TOS high-voltage test lead: 1 HTL-2.5DH high-voltage coaxial cable: 1

UL Resistance Load

■RL01-TOS

This device is described in section 125, paragraph 2-1B1 of UL1492. The RL01-TOS is a variable load resistor for checking the output voltage of hipot testers used in dielectric strength testing on production lines. (Complies with UL regulations including UL1270, UL1409 and UL1410.)

Specifications	
Resistors	120, 159, 210, 279, 369, 489, 648, 858, 1,137, 1,500, 1,989 and 2,148 kΩ
Resistance Accuracy	+1 %, -0 % of nominal value when set to 120 kΩ, ±1 % of nominal value when set to other values
Maximum OperatingVoltage	1300 V (continuous rating)
Maximum Overload Voltage	1400 V for 5 seconds (application may not be repeated within 1 minute)
Dimensions (MAX)	200[7.87 inch]W × 100[3.94 inch]H × 260[10.24 inch]D mm (210[8.27 inch]W × 120[4.72 inch]H × 295[11.61 inch]D mm)
Weight	approx. 2.6 kg(approx. 5.73 lbs)
Accessories	TL04-TOS high-voltage test lead: 2 TL05-TOS high-voltage test lead: 1

Calibration Resistor for Insulation Resistance Tester

■929-1M
■929-10M
■929-100M

The 929 Series Standard Resistors are for calibration of Insulation Testers.

Specifications			
Model	929-1M	929-10M	929-100M
Nominal resistance	1 MΩ	10 MΩ	100 MΩ
Accuracy of resistance	1 % at 25˚C ±10 ˚C		
Temperature coefficient	100 ppm/˚C or better		
Voltage coefficient	1 ppm/V or better		
Working voltage rating	1.2 kV		
Dimensions (MAX)	64[25.20 inch]W × 24[9.45 inch]H × 30[11.81 inch]D mm		

*The 929 series standard resistors can not be installed directly to the TOS series. Please use the test lead for connection.

Rack Mount Bracket

Product Name	JIS Standard	EIA Standard
	Bracket Model No	Bracket Model No.
TOS9300	KRB150-TOS	KRB3-TOS
TOS9301	KRB150-TOS	KRB3-TOS
TOS9301PD	KRB150-TOS	KRB3-TOS
TOS9302	KRB150-TOS	KRB3-TOS
TOS9303	KRB150-TOS	KRB3-TOS
TOS9303LC	KRB150-TOS	KRB3-TOS
TOS9320	KRB100-TOS	KRB2-TOS
TOS5302	KRA200-TOS	KRA4-TOS
TOS5301	KRA200-TOS	KRA4-TOS
TOS5300	KRA200-TOS	KRA4-TOS
TOS5200	KRA200-TOS	KRA4-TOS
TOS6200A	KRB100-TOS	KRB2-TOS
TOS6210	KRB100-TOS	KRB2-TOS
TOS3200	KRB150-TOS	KRB3-TOS

Option

Test Lead

■TL01-TOS
[cable length: 1.5 m/max. operating voltage: 5 kV]

■TL02-TOS
[cable length: 3 m/max. operating voltage: 5 kV]

■TL03-TOS
[cable length: 1.5 m/max. operating voltage: 10 kV]

■TL04-TOS
[cable length: 1.5 m/max. operating voltage: 5 kV (for TOS1200, RL01-TOS)]

■TL05-TOS
[cable length: 1.5 m/max. operating voltage: 5 kV (for 149-10A, RL01-TOS)]

■TL06-TOS
[cable length: 0.5 m/max. operating voltage: 5 kV (for parallel connection of TOS9220/9221)]

■TL07-TOS
[cable length: 1.5 m/max. operating voltage: 5 kV (for TOS9220/9221)]

■TL08-TOS
[cable length: 1.5 m/max. operating voltage: 1 kV (for TOS7200)]

■TL11-TOS
[cable length: 1.5 m/max. operating current: 30 A (for TOS6200A)]

■TL12-TOS
[cable length: 1.5 m/max. operating current: 60 A (for TOS6210)]

■TL13-TOS
[cable length: 1.6 m/max. operating current: 40 A (for TOS9302, 9303, 9303LC)]

■TL21-TOS
[cable length: 1.5 m (for TOS3200)]

■TL22-TOS
[cable length: 1.7 m/max. rated voltage: 1000 V /max. rated current: 10 A (for TOS9303LC)]

■TL31-TOS
[cable length: 1.5 m/max. operating voltage: 5 kV (for TOS5300 Series)]

■TL32-TOS
[cable length: 3 m/max. operating voltage: 5 kV (for TOS5300 Series)]

■TL33-TOS
[cable length: 0.5 m/max. operating voltage: 5 kV (for TOS9320)]

■TL51-TOS
[cable length: 1.5 m (for TOS7210S)]

■HTL-2.5DH
[cable length: 1.5 m/max. operating voltage: 10 kV (for 149-10A)]

Test Probe

■HP01A-TOS*
[cable length: 1.8 m/max. operating voltage: 4 kV AC(RMS), 5kV DC]

■HP02A-TOS*
[cable length: 3.5 m/max. operating voltage: 4 kV AC(RMS), 5kV DC]

* The optional Adaptor DD-5P/9P is required for the connection.

■HP11-TOS
[cable length:1.8 m/max.operating voltage:1 kV DC/ max.operating current:100 mA]

■HP21-TOS
[cable length:1.8 m/max.operating voltage:250 Vrms/ max.operating current:100 mA]

■LP01-TOS
[cable length: 2 m/max. operating current: 30 A]

■LP02-TOS
[cable length: 2 m/max. operating current: 60 A]

■FP01-TOS
(flat probe for TOS3200, TOS9303LC)

Option

Remote Control Box

■RC01-TOS*
[one-hand operation/dimensions: 200W×70H×39D mm]
Accessory cable length: 1.5 m

■RC02-TOS*
[both-hands operation/dimensions: 330W×70H×39D mm]
Accessory cable length: 1.5 m


RC01-T0S


RC02-T0S

* The optional Adaptor DD-5P/6P is required for the connection.

Warning Light Unit

■PL01-TOS (for 100 V AC)

■PL02A-TOS (for 24 V DC)

DIN Cable

■DD-3 5P
[cable length: 3 m/DIN plug to DIN plug]

Conversion Cable

■DD-5P/6P
[Adapter / DIN to Mini DIN]

■DD-5P/9P
[Adapter /DIN to Mini DIN]

The DD-5P/9P DIN adapter cable (5 pin to 9 pin) is for connecting the following option products to the TOS9300/TOS5300/TOS5200 series.

- Remote control box(RC01-TOS/RC02-TOS)
- High voltage test probe(HP01A-TOS/HP02A-TOS)
- Test probe for touch current test(HP21-TOS)

Multi Outlet

■OT01-TOS (multi outlet for TOS3200)

Terminal Unit

■TU01-TOS (for TOS5300/TOS5200 Series)

This is a terminal unit for converting a 25-pin SIGNAL I/O connector of TOS5300/5301/5302/5200 to a 14-pin SIGNAL I/O connector of TOS5050A/5051A.
By connecting via this product, the external control performed with TOS5050A/5051A can be performed with TOS5300/5301/5302/5200 at the same time.

Cross Reference of options for Electrical Safety Testers

Model	Remote Control		Warning Light Unit, Terminal Unit			Test Probe						Test Lead													
	RC01/ 02-TOS	DD- 3 5P	PL01- TOS	PL02A- TOS	TU01- TOS	HP01A/ 02A-TOS	HP11- TOS	HP21- TOS	LP01- TOS	LP02- TOS	FP01- TOS	TL01/02/ 03-TOS	TL04- TOS	TL05- TOS	TL06- TOS	TL07- TOS	TL08- TOS	TL11/ 12-TOS	TL13- TOS	TL21- TOS	TL22- TOS	TL31/ 32-TOS	TL33- TOS	TL51- TOS	HTL2.5- DH
TOS9300	○			○		○																○	○		
TOS9301	○			○		○																○	○		
TOS9301PD	○			○		○																○	○		
TOS9302	○			○		○													○			○	○		
TOS9303	○			○		○													○			○	○		
TOS9303LC	○			○		○		○			○								○		○	○	○		
TOS9320																○						○	○		
TOS9213AS	○	○		○		○						○	○		○										
TOS5101	○	○	○									○													
TOS5302	○			○	○	○																○			
TOS5301	○			○	○	○																○			
TOS5300	○			○	○	○																○			
TOS5200	○			○	○	○																○			
TOS6200A	○	○							○	○								○							
TOS6210	○	○							○	○								○							
TOS7200	○	○					○										○								
TOS7210S	○	○																						○	
TOS3200								○			○									○					
149-10A														○											○
RL01-TOS													○	○	○										

: Required the converting adapter "DD-5p/6p" : Allows to use within the cable rating : Required the converting adapter "DD-5p/9p"

KIKUSUI

KIKUSUI ELECTRONICS CORPORATION

Southwood 4F,6-1 Chigasaki-chuo,Tsuzuki-ku,Yokohama,224-0032,Japan
Phone: (+81)45-482-6353,Facsimile: (+81)45-482-6261,www.kikusui.co.jp

KIKUSUI AMERICA, INC. 1-310-214-0000 | www.kikusuiamerica.com

KIKUSUI AMERICA INC.
3625 Del Amo Blvd, Suite 160, Torrance, CA 90503
Phone : 310-214-0000 Facsimile : 310-214-0014

KIKUSUI TRADING (SHANGHAI) Co., Ltd. | www.kikusui.cn

KIKUSUI
Room 305,Shenggao Building , No.137,Xianxia Road, Shanghai City, China
Phone : 021-5887-9067 Facsimile : 021-5887-9069

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