HIOKI

DC HIPOT TESTER ST5680A

NEW

Waveform-Based DC Hipot Safety Testing for EV Batteries

Global standards, contact check, and waveform analysis –
A DC hipot tester built for EV cell, module, and pack production lines

CE 3 year Warranty C SA® US

Forging the Future of High-Quality EV Batteries

Three On-site Challenges for EV Cell/Module/Pack Production Engineers

Increasing adoption of electric vehicles (EVs) and self-driving technology demands higher reliability for automotive components, raising quality standards. EV battery degradation and related issues can cause serious accidents including fires. Therefore, safety and quality control are more critical than ever.

Challenge 1 Regional standards drive multiple testers and higher costs

Each site operates different DC hipot testers to meet local standards such as UKCA, CE, and CSA. This prevents model standardization and makes maintenance and certification management complicated.

Challenge 2 Ensuring contact quality requires add-on continuity checks and complex design

Because line testers lack built-in contact checks, engineers must add dedicated continuity hardware and complex sequencing, increasing test time and line start-up cost.

Challenge 3 High-voltage waveform analysis requires separate scope and HV probe

To review voltage and current as waveforms during hipot tests, engineers must build a separate measurement setup. This causes mismatches with actual line conditions and fragments measurement and analysis workflows.

DC Hipot Tester ST5680A

Three Key Benefits Delivered by ST5680A

The ST5680A is a DC hipot tester for EV batteries that advances DC withstand and insulation testing along three axes: global compliance, contact check, and waveform-based analysis.

Solution 1

One global tester with CE, UKCA, and CSA

By covering major regional standards, the ST5680A lets you standardize testers globally and reduce equipment management, maintenance, and certification costs.

Solution 2

Contact check for simpler system & procedures and higher quality testing

The standard contact check function removes the need for external continuity checkers and complex control logic, achieving both higher test quality for modules/packs and lower equipment design cost.

Solution 3

View and store waveform to improve analysis efficiency and costs

The ST5680A records voltage, current, and insulation resistance waveforms during hipot tests and uses them directly for failure analysis and process improvement. This shortens analysis time and reduces equipment cost without extra devices.

Global Compliance & Unified Test Platforms

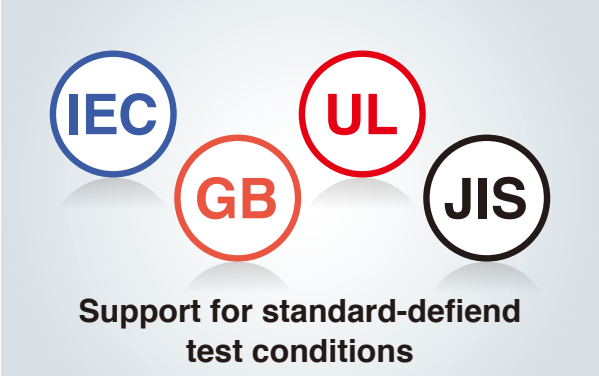
With CE/UKCA/CSA compliance, eliminate region-specific tester variants and standardize globally on one platform.

Challenge 1: **Region-specific standards cause multiple tester models and higher management costs**

Solution 1: **Global Standardization with a Single Model**

Global Compliance and Productivity Improvement with the ST5680A.

- **Global Safety Standards Compliance:** Certified to CE, UKCA, and CSA (NRTL), the ST5680A enables standardization with the same model worldwide
- **Power supply performance for standard-defined test conditions:** Up to 8 kV / 20 mA output supports DC hipot tests specified by international standards

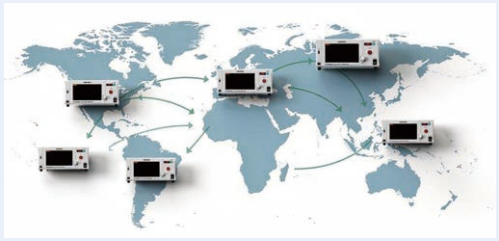


Support for standard-defiend test conditions

Benefit

Drive Equipment Standardization

- Unify test recipes, judgment criteria, and operating procedures across sites



Reduce Management Cost

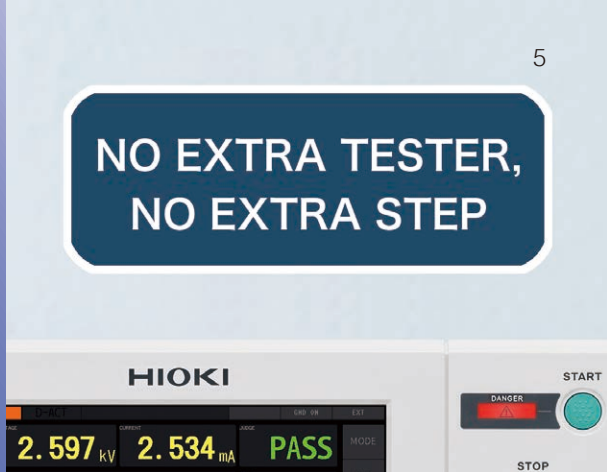
- Fewer model variations simplify spares, calibration, and certification maintenance

Faster Ramp-Up and Training

- Reuse procedures, checklists, and training materials globally

Contact Check for Quality Improvement & Design Cost Reduction

Move beyond add-on continuity check systems. Built-in contact check delivers both high test quality and efficient equipment design.



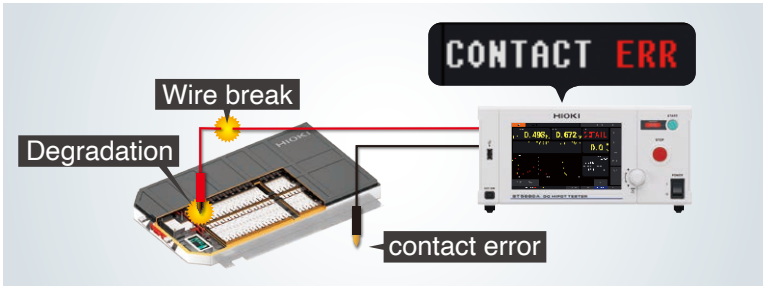
Challenge 2: **Ensuring contact quality requires add-on continuity checks and complex design**

Solution 2: **Contact check for simpler system & procedures and higher quality testing**

Contact check is completed within the tester itself. This eliminates the need for external devices or additional continuity check processes, reducing takt time and start-up man-hours.

The ST5680A features a standard built-in contact check function, enabling complete contact reliability verification inside the tester.

- **Reduction of Processes and Man-hours:** No need for external checkers or separate continuity confirmation steps, this simplifies test steps, significantly reducing takt time and start-up man-hours
- **Simplification of System Design:** External control and PLC sequencing become simpler, reducing debugging workload
- **Reduction of Quality Risks:** Early detection of contact failures in jigs and relays minimizes variation in judgments and reliably prevents shipment of defective high-value products



Preventing erroneous judgments that classify defective parts as non-defective

- When the measurement leads become disconnected during testing
- When the resistance between test locations increases

Examples:
Measurement lead degradation
Jig or high-voltage relay degradation

Simple operation

- Simple wiring connections thanks to use of 2 terminals

Benefit

Improved Measurement Quality

- Reduced risk of missing truly defective products due to poor contact
- Increased reliability for high-value module/pack insulation testing
- Early detection of jig/lead/relay degradation (preventive maintenance)

Lower Design & Ramp-up Cost

- Eliminates additional continuity hardware and wiring
- Simplifies sequences and shortens debug time
- Centralizes contact verification within the tester, simplifying long-term operation and maintenance

Waveform-Based Analysis for Higher Efficiency & Lower Cost

No oscilloscope, no high-voltage probe
Record waveforms with the tester alone to accelerate analysis and process improvement

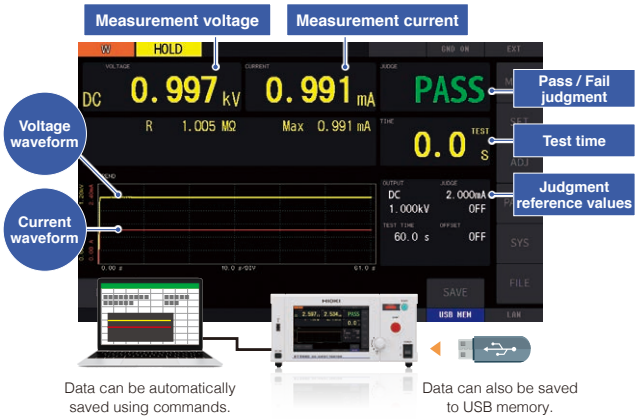
Challenge 3: **High-voltage waveform analysis requires separate scope and HV probe**

Solution 3: **View and store waveform to improve analysis efficiency and costs**

The ST5680A can directly display and record the behavior during DC hipot and insulation resistance tests as time-series waveforms, significantly improving waveform analysis efficiency.

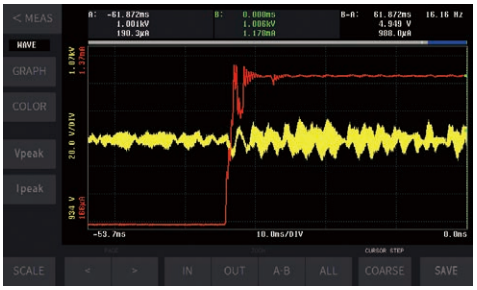
- **All-In-One Measurement:** No external setup such as an oscilloscope or high-voltage probe is required
- **Practical Waveform Recording:** Detailed analysis is possible with a maximum recording time of 128 seconds and a sampling rate of up to 500 kS/s
- **Seamless Data Integration:** In addition to on-screen confirmation on the instrument, data can be saved and retrieved via USB or LAN

This enables consistent waveform acquisition in the actual production environment and rapid failure analysis without modifying the existing production line configuration.



Data can be automatically saved using commands.

Data can also be saved to USB memory.



Capture transient changes with **microsecond (μs) resolution**

Benefit

Improved Analysis Efficiency

- Observe voltage ramp behavior and leakage trends beyond PASS/FAIL to speed root-cause identification
- Retrospective analysis for defective/returned products using stored waveform logs
- Compare waveforms before/after process changes to quantify improvement

Cost Reduction & Enhanced Traceability

- Reduce equipment cost (no scope/HV-probe) and maintenance overhead
- Simplify safety/training by consolidating measurement into one instrument
- Store waveforms by lot/line to strengthen traceability and re-analysis

Built for Safe, Repeatable, and Operator-Friendly Testing

To operate hipot and insulation resistance tests reliably on mass production lines, you need daily testing that is both safe and highly repeatable. The ST5680A combines the safety functions required in production with a range of support features that enhance test stability and ease of operation, helping reduce human error and standardize test conditions.

Reducing Risks and Preventing Mistakes in High-Voltage Testing

Voltage Limit Function

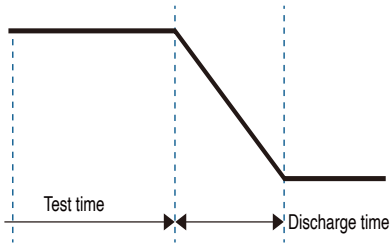
By presetting the upper voltage limit, the system prevents over-voltage output caused by operator error or setting mistakes. This reduces the risk of accidents during testing and minimizes rework (voltage limit range: **0.010 kV to 8.000 kV**).

Prevent over-voltage output

Automatic Residual-Charge Discharge Supports Safe Operation

Automatic Discharge Function

After the test is completed, any remaining charge on the test object is automatically discharged inside the tester. This reduces the risk of accidental contact and improves operational safety.



Automatic discharge after test

Easy Integration into Line Safety and Standardized Procedures

Interlock Function

The tester enables voltage output only when external safety covers, door switches, and connected devices are in a safe state. This simplifies interlocked safety design and supports standardized safety procedures.

Shut down output when the interlock is activated

Keeps Measurement Displays Easy to Read and Reduces Operator Errors

Auto Range Function

By automatically switching the measurement range according to the measured value, the system always maintains an easy-to-read display range. This reduces the operator's reading workload and minimizes the risk of misreading due to incorrect digits or range errors.

Optimize the measurement range

Accelerates Setup and Test Condition Changeover with Recall

Panel Memory Function

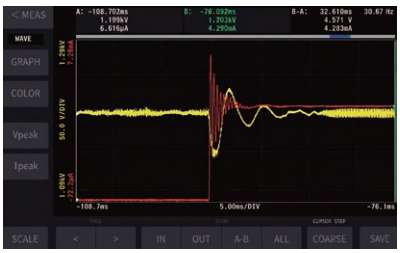
Frequently used test conditions can be stored in the tester, allowing standardized operation. This reduces setup time during line startup and when changing product types or models (**up to 64 condition sets** per mode).

tore and recall up to 64 settings per mode

Monitors Voltage Fluctuations to Prevent Shipment of Marginal Defects

ARC Detection Function

During the withstand voltage test, the tester continuously monitors the applied test voltage and detects abnormal conditions when voltage fluctuations exceed a preset threshold. This helps prevent marginal defects—such as those caused by minor discharges from foreign matter, burrs, or similar imperfections—from passing inspection.



Detect abnormal events from voltage fluctuation rate

Testing quality that’s a step above

Utilize the full array of DC withstand voltage testing applications with specs that comply with a broad range of international standards

High-performance model specifically designed for
DC withstand voltage testing

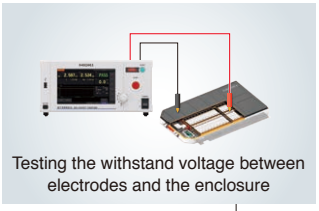
DC HIPOT TESTER ST5680A

A DC withstand voltage testing platform that covers everything from R&D to production lines
Reduces false judgments and enhances screening sensitivity

DC HIPOT TESTER ST5680A

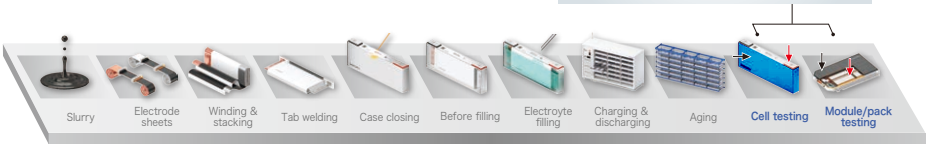
Consistent evaluation across cells, modules, and packs

The ST5680A supports a broad range of DC withstand voltage applications, enabling consistent insulation evaluation from lab validation to line testing. For EV batteries, it is used to test insulation between enclosures and electrodes for cells, modules, and packs.



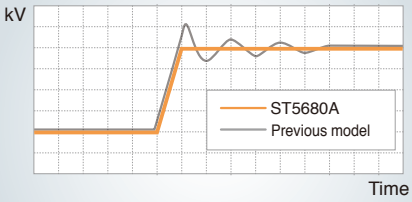
Testing the withstand voltage between electrodes and the enclosure

LIB production line processes



Reduce false judgments with stable, overshoot-resistant high-voltage output

An overshoot-resistant output design helps avoid exceeding the set voltage even for capacitive DUTs. A delay time can be set so that PASS/FAIL judgments are not made while charging current is still flowing, helping prevent erroneous judgments.



The capacitance component has no effect.

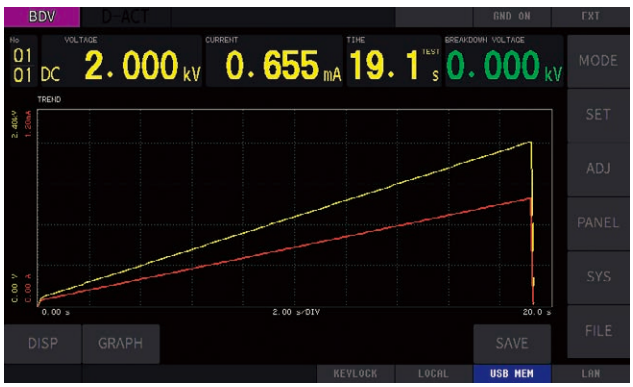
Catch smaller leakage currents for stronger screening.

With **a minimum resolution of 0.001 µA**, the ST5680A measures minuscule leakage currents accurately and uses them for precise PASS/FAIL judgments—supporting higher insulation-performance requirements in batteries, motors, and other components.

Quantify dielectric strength to improve design margins and validation

The BDV function evaluates insulation breakdown voltage by ramping the applied voltage and detecting when breakdown occurs. It supports both continuous and stepped voltage rise methods, making it easy to perform standards-based dielectric strength testing in R&D.

IEC 60243, JIS C2110, etc.
standard compliant testing



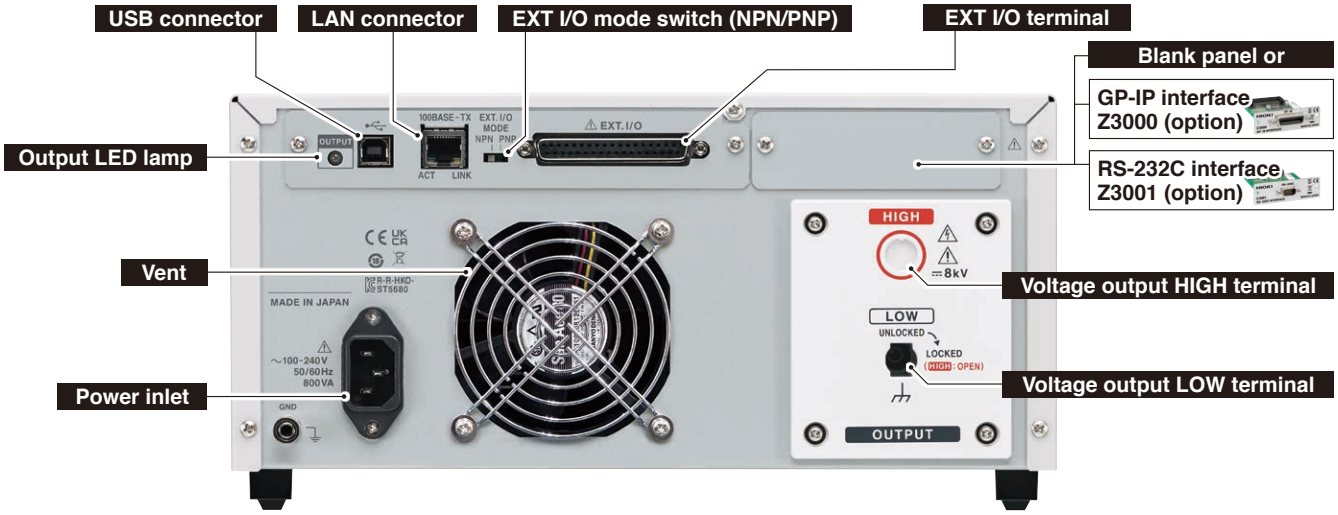
Example of continuous voltage rise test

RATE mode
100 V start voltage
100 V/s rise rate
2 kV end voltage
2 mA allowable value (judgment standard)

Example of stepped voltage rise testing

STEP mode
100 V start voltage
100 V step volt
1 s hold time
20 steps
2 mA allowable value (judgment standard)

Interfaces



Accessories

HIGH VOLTAGE TEST LEAD L2260
Clip terminal to special connector, red and black, 1.5 m

UNTERMINATED LEAD CABLE L2261
Bare wire to special connector, red and black, 5 m

GP-IB INTERFACE Z3000
For external control use

RS-232C INTERFACE Z3001
For external control use

GP-IB CONNECTOR CABLE 9151-02
For the Z3000, 2 m

RS-232C CABLE L9637
For Z3001, 9-pin to 9-pin, null-modem cable, 3 m

REMOTE CONTROL BOX (SINGLE) 9613
For starting/stopping measurement, one-handed use, 1.5 m

REMOTE CONTROL BOX (DUAL) 9614
For starting/stopping measurement, two-handed use, 1.5 m

External control and other communication interfaces

EXT I/O **LAN** **USB** **GP-IB (option)** **RS-232C (option)**

The instrument ships standard with LAN and USB connectors. An optional GP-IB or RS-232C interface can also be added.
The instrument can be connected to a PC or PLC (programmable logic controller), which can be used to control it and retrieve test results. Furthermore, the instrument is equipped with external I/O terminals to facilitate instrument control and retrieval of instrument status and judgment results.

EXT I/O interface

The EXT I/O connector on the rear of the instrument can be used to control the instrument by outputting TEST signals and judgment result signals and inputting START and STOP signals.

IN: signal input to instrument OUT: signal output from instrument

Signal	Functionality	I/O
START	Test start and W-IR/IR-W, program, and BDV mode trigger signal	In
INTERLOCK	Releases interlock to allow operation	In
LOAD1	Panel setting load	In
LOAD3		In
LOAD5		In
LOAD7		In
ISO_5V	Isolated power supply +5 V (-5 V) output	–
ISO_COM	Isolated power supply common	–
ERR	Measurement error output	Out
U_FAIL	Output on upper-limit FAIL condition	Out
L_FAIL	Output on lower-limit FAIL condition	Out
H.V.ON	Output during voltage generation	Out
W-FAIL	Output on FAIL condition during withstand voltage testing	Out
W-MODE	Output during withstand voltage testing	Out
STEP_END	Output on completion of each step during program testing	Out
ARC_DET	Output at arc detection	Out
PASS	Output on PASS condition	Out
TEST	Output during testing (user-defined)	Out
STOP	Test stop and PASS/FAIL hold release	In
EXT_EN	External I/O input enable	In
LOAD0	Panel setting load	In
LOAD2		In
LOAD4		In
LOAD6		In
LD_VALID	Panel settings load execution	In
READY	Output at standby state	Out
PROTECTION	Output at protection function operation	Out
CONT_ERR	Output at contact error	Out
IR-FAIL	Output on FAIL condition during insulation resistance testing	Out
IR-MODE	Output during insulation resistance testing	Out
PROG_END	Output at completion of final step during program testing	Out
OUT0	General-purpose output	Out
OUT1	General-purpose output	Out

About interlock functionality

Interlock functionality serves to shut off instrument output. When the interlock function operates, START key operation is disabled. Similarly, test operation cannot be started using the EXT I/O START signal or communications commands.
To start testing, use the included interlock cancellation jig to turn off the interlock function.

LAN interface

The instrument provides an Ethernet 100Base-TX interface. A 10Base-T or 100Base-TX compatible LAN cable can be used to connect the instrument to a network so that it can be controlled by a PC or other device.

EXT I/O mode switch (NPN/PNP)

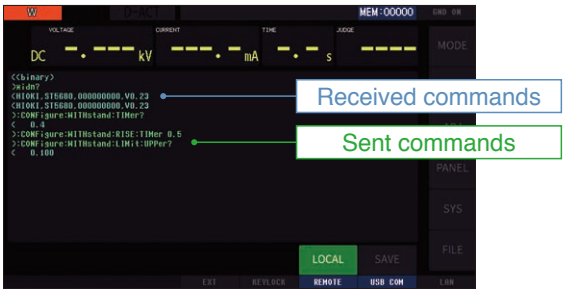
The EXT I/O mode switch (NPN/PNP) selects current-sinking (NPN) or current-sourcing (PNP) operation, allowing compatibility with different PLC types.

I/O handler test function

This function lets you check whether output signals are being properly output from the EXT I/O terminal and whether input signals are being properly read.

Command monitor function

This function displays communication commands and query responses on the measurement screen, making it useful when creating programs.



Color LCD display with touch screen

The instrument has a 7-inch color LCD display and touch screen, improving visibility and enabling intuitive operation.

Specifications

(Accuracy guaranteed for 1 year)

Main functions	
DC hipot test, insulation resistance test, breakdown voltage test, waveform display, arc discharge detection, contact check	
DC hipot test	
Output voltage	DC 0.010 kV to 8.000 kV (1 V resolution)
Output setting accuracy	±20 V (for < 3 kV, no load) ±0.4% of setting ± 8 V (for ≥ 3 kV, no load)
Output/cutoff current	Max. 20 mA
Current accuracy	< 3.00 mA: ±(1.5% of rdg. + 2 μA)
	3.00 mA ≤: ±1.5% rdg.
	For 0°C ≤ t* < 18°C: Base accuracy + base accuracy x [1 + 0.1 x (18 – t*)]. For 28°C < t* ≤ 40°C: Base accuracy + base accuracy x [1 + 0.1 x (t* – 28)]. * t = ambient temperature
Maximum resolution	0.001 μA
Test time	0.1 s to 999 s, continuous (timer off)
Voltage ramp up/down time	Ramp-up: 0.1 s to 300 s; ramp-down: 0.1 s to 300 s; off
Test modes	W to IR, IR to W, program test
Insulation resistance test	
Output voltage	DC 10 V to 2000 V (1 V resolution)
Output setting accuracy	±20 V (no load)
Resistance value display range	100.0 kΩ to 200.0 GΩ (0.01 kΩ resolution)
Accuracy guaranteed range	100.0 kΩ to 99.99 GΩ
Resistance accuracy	±1.5% rdg. (see "Insulation resistance measurement accuracy" below for details)
Test time	0.1 s to 999 s, continuous (timer off)
Voltage rise/fall time	Rise: 0.1 s to 300 s; fall: 0.1 s to 300 s; off
BDV measurement	
Test method	Continuous voltage rise test, stepped voltage rise test
Settings	Insulation breakdown voltage (kV), insulation breakdown strength (kV/mm)
Setting description	Start voltage, end voltage, rise speed, arc detection, electrode distance, upper limit current
Waveform display	
Type	Voltage, current, insulation resistance
Sampling rate	Max. 500 kS/s
Display length setting	0.5 s to 128 s (9 selectable settings)
Memory capacity	512 kilowords
Arc detection	
Detection method	Monitoring of fluctuations in the test voltage
Setting description	Test voltage variability: 1% to 50%
Contact check functionality	
Detection method	Capacitance measurement
User-definable settings	Threshold (capacitance): 1.0 nF to 100.0 nF
Memory functionality	
Saving of waveforms/graphs	Save to USB memory; save formats: BMP, PNG, CSV
Panel memory function	Saves test condition settings internally in the instrument
	DC withstand voltage testing and insulation resistance testing: Up to 64 sets of settings each
	Program testing: up to 30 programs (max. 50 steps)
	BDV measurement: up to 10 sets of settings
Data memory function	Saves measured values in the instrument's internal memory (up to 32,000 values)
Judgment functionality	
Judgment output	PASS judgment, FAIL judgment (UPPER FAIL, LOWER FAIL)
	UPPER_FAIL: measured value > use-defined upper limit value
	PASS: user-defined upper limit value ≥ measured value ≥ user-defined lower limit value
	LOWER_FAIL: measured value < user-defined lower limit value
List of major functions	
Interlock	Disables output based on the status of an external device
Auto discharge	Discharges the target via internal circuitry at the end of the test Discharge resistance: 716 kΩ (residual voltage 30 V or less)
Offset cancellation	Measures the current flowing along the test path and subtracts it from measurement results
Measurement speed	NORMAL (100 ms), FAST (20 ms), FAST2 (10 ms)
Momentary out	Outputs the test voltage only while the START button is being pressed
Command monitor	Displays commands being sent and received on the screen
I/O handler test	Allows you to check whether signals are being input and output properly via the EXT. I/O terminal
Key lock	Disables changes to test conditions
Self-check	Checks the touch screen, display, LED, instrument memory, and EXT. I/O
Calibration deadline check	Lets you set a calibration deadline in advance and displays a warning once it's passed
EXT SW	Allows the instrument to be operated using remote control
	Options: remote control box (single) 9613, remote control box (dual) 9614
Basic specifications	
Operating temperature and humidity range	0°C to 40°C, 80% RH or less (non-condensing)
Standard compliance	Safety: IEC 61010
	EMC: EN 61326
Power supply	100 to 240 V AC
Power consumption	Approx. 180 VA
	Power supply conditions are 220 V power supply voltage, 50/60 Hz power supply frequency, DC withstand voltage test mode, 2.5 kV test voltage, and 5 mA load current (500 kΩ load resistance).
Maximum rated power	800 VA
Interfaces	Communication (standard): USB, LAN, EXT. I/O
	Options: RS-232C (Z3001), GP-IB (Z3000)
	Memory: USB drive
External dimensions	305 mm (12.01 in) W × 142 mm (5.59 in) H × 430 mm (16.93 in) D (excluding protruding parts)
Weight	10.4 kg (366.85 oz) ± 0.2 kg (7.05 oz)
Product warranty	3 years
Accessories (see the "Precautions for use" below)	Power cord, EXT. I/O male connector, EXT I/O connector cover, EXT. I/O interlock cancellation jig, startup guide

Insulation resistance measurement accuracy

Test voltage setting value V_{SET} *1	LOWER LIMIT setting range	Resistance range	Resistance meter basic accuracy	
			When measurement is performed normally	When the offset cancel is enabled
50 V ≤ V_{SET} < 100 V	100.0 kΩ to 999.9 kΩ	1 MΩ	±11.5% of reading ± 0.3 kΩ	±18.5% of reading ± 0.3 kΩ
	1.000 MΩ to 9.999 MΩ	10 MΩ	±12% of reading ± 0.005 MΩ	±32% of reading ± 0.005 MΩ
	10.00 MΩ to 99.99 MΩ	100 MΩ	±15% of reading	±35% of reading
	100.0 MΩ to 999.9 MΩ	1 GΩ	±30% of reading*2	±40% of reading*2
100 V ≤ V_{SET} < 1000 V	100.0 kΩ to 999.9 kΩ	1 MΩ	±6.5% of reading ± 0.3 kΩ	±13.5% of reading ± 0.3 kΩ
	1.000 MΩ to 9.999 MΩ	10 MΩ	±6.5% of reading ± 0.003 MΩ	±13.5% of reading ± 0.003 MΩ
	10.00 MΩ to 99.99 MΩ	100 MΩ	±7% of reading ± 0.05 MΩ	±27% of reading ± 0.05 MΩ
	100.0 MΩ to 999.9 MΩ	1 GΩ	±10% of reading	±30% of reading
	1.000 GΩ to 9.999 GΩ	10 GΩ	±25% of reading*3	±35% of reading*3
1000 V ≤ V_{SET} ≤ 2000 V	100.0 kΩ to 999.9 kΩ	1 MΩ	±3.5% of reading ± 0.3 kΩ	±10.5% of reading ± 0.3 kΩ
	1.000 MΩ to 9.999 MΩ	10 MΩ	±3.5% of reading ± 0.003 MΩ	±10.5% of reading ± 0.003 MΩ
	10.00 MΩ to 99.99 MΩ	100 MΩ	±4% of reading ± 0.05 MΩ	±24% of reading ± 0.05 MΩ
	100.0 MΩ to 999.9 MΩ	1 GΩ	±7% of reading	±27% of reading
	1.000 GΩ to 9.999 GΩ	10 GΩ	±22% of reading	±32% of reading
	10.00 GΩ to 99.99 GΩ	100 GΩ	±22% of reading*4	±32% of reading*4

*1. No accuracy specification for 10 V ≤ VSET < 50 V; *2. No accuracy specification for resistance measurement values exceeding 999.9 MΩ;
*3. No accuracy specification for resistance measurement values exceeding 9.999 GΩ; *4. No accuracy specification for resistance measurement values exceeding 99.99 GΩ.

Product name

DC HIPOT TESTER ST5680A

Model number (order code): ST5680A

Precautions for use

- Measurement requires connection of a test object using appropriate test leads.
- The HIGH and LOW terminals use dedicated Hioki connectors to which only Hioki optional test leads L2260 and L2261 can be connected.
- Please purchase optional test leads as appropriate for your measurement application.

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