



## Bring additional inspection performance to safety testing. Accelerate battery quality improvements with waveform analysis.

### Product concept

Growing adoption of electric vehicles (EVs) and self-driving technology is leading to more rigorous reliability requirements for automotive components, pushing up quality. Degradation of EV batteries and related issues can lead to serious accidents, including fire. Consequently, safety and quality control are becoming even more important than in the past.

#### Market requirements

“Manufacturers want to manage test results using waveform data to verify battery quality.”

“Manufacturers want to conduct shipping inspections (DC withstand voltage tests) that comply with a range of international standards.”

The ST5680 is a DC Hipot tester that was developed to meet these battery market requirements.



Preventing the shipment of batteries with latent defects that could lead to fires.

Test waveform display

Detection of minuscule defects

Prevention of erroneous judgments



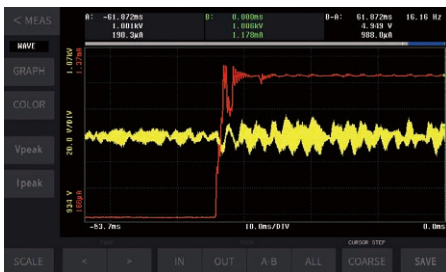
## Waveform display function

### Verify insulation performance with waveforms and values.

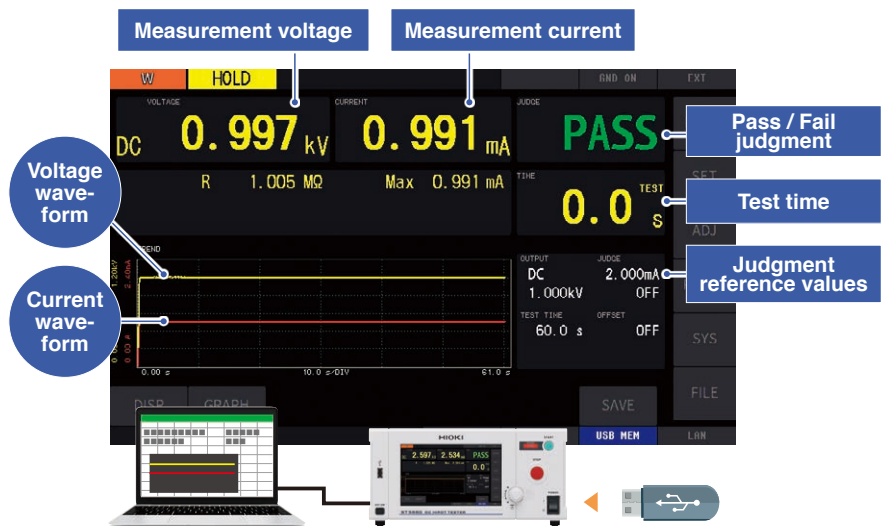
The ST5680 is a DC Hipot tester that can perform DC withstand voltage testing and insulation resistance testing in compliance with a variety of safety standards. In addition to generating PASS/FAIL judgments, the instrument can display and record applied voltage waveforms and leakage current waveforms acquired during testing. Its ability to visualize and analyze testing is useful from a test traceability standpoint.

#### Waveform display of applied voltage and measured current

The behavior of the applied voltage and measured current can be checked by monitoring the waveforms. In addition, the instrument can display voltage, current, and resistance measured values as a time series so that behavior can be reviewed. It can also display an enlarged view of just the waveforms for more detailed review. In this way, the ST5680 lets you analyze results immediately in the field, without using a computer.



Enlarged display of waveforms only



Data can be automatically saved using commands.

Data can also be saved to USB memory.

## Advantages of the waveform display

#### Improving production processes

By analyzing waveforms during testing, you can infer the causes of defects in production processes. And by identifying those causes and improving the processes, you can improve production efficiency.



Improving production efficiency

#### Analyzing defective parts returned from the market

You can also look back at results, at the waveform level, from shipping inspections of products that were later returned due to defects. By improving the standards based on which PASS judgments are made, you can boost production quality.



Improving production quality

#### Promoting inspection quality

The ability to record and manage waveforms is useful from an inspection traceability standpoint. By developing higher-quality testing structures, you can increase the trust of customers.



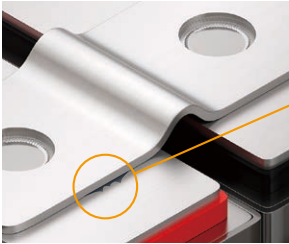
Improving reliability

## Arc discharge detection function

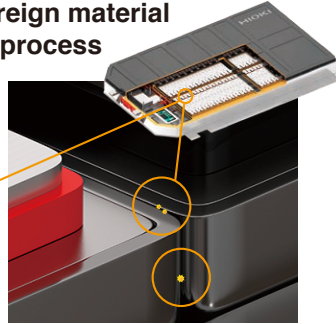
### Prevent minuscule failures due to arc discharges.

The ST5680 can detect arc discharges, which are caused by residual materials like burrs and cuttings. By correctly identifying parts with minuscule insulation defects as defective, the instrument helps prevent the risk of hazards such as fires and accidents caused by heating after shipment.

#### Contamination with foreign material during the production process

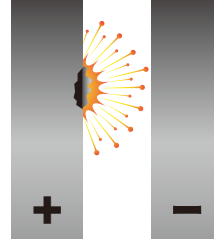


Burrs at a weld location

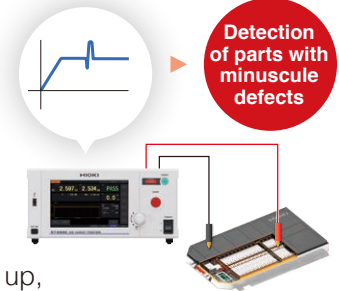


Foreign material between cells

#### Detection of arc discharges triggering a FAIL judgment



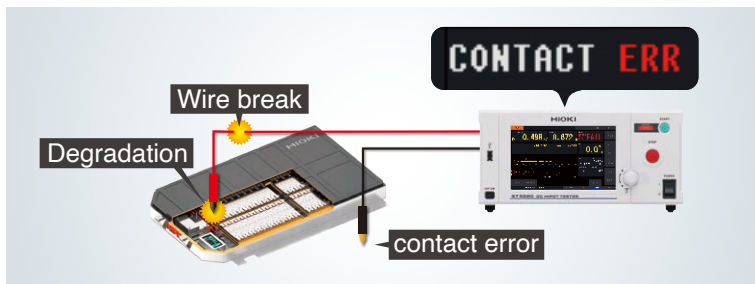
The foreign material burns up, causing damage.



## Contact check function

### Preventing testing do-overs due to erroneous judgments

The instrument can determine whether it has made proper contact with the test target by measuring the capacitance between the measurement terminals (stray capacitance and the capacitance of the test target).



#### 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, etc.

#### Simple operation

- Simple wiring connections thanks to use of 2 terminals

## Functionality

The instrument offers convenient functionality that helps perform withstand voltage testing safely.

#### Voltage limitation function

Sets an upper limit for the voltage output by the instrument. This function helps prevent accidents due to erroneous settings. The setting range is 0.010 kV to 8.000 kV.

#### Auto discharge function

Once each test is complete, the instrument switches automatically to an internal discharge circuit to discharge any residual charge held by the test target. This function helps prevent electric shock due to contact with a circuit in a charged state.

#### Interlock function

This function disables instrument output based on the status of an external device or other hardware to ensure worker safety. It can be disabled using the included interlock cancellation jig, which is affixed to the EXT I/O port.

#### Auto range function

When the range is fixed, measured values outside the range are not displayed. When using the auto range function, the range is switched automatically according to measured values, allowing measured values to be displayed at all times.

#### Panel memory function

This function stores test conditions in the instrument's memory for future recall as necessary. The memory can hold up to 64 sets conditions each for DC withstand voltage testing mode and insulation resistance testing mode.

#### GFI function

This function shuts down the output if a current of 0.5 mA or more flows from the high-voltage output section of the instrument to the ground section of the instrument during the withstand voltage test. It serves to reduce damage in the event of an electric shock caused by worker inattention.

High-performance model specifically designed for DC withstand voltage testing

High output

High stability

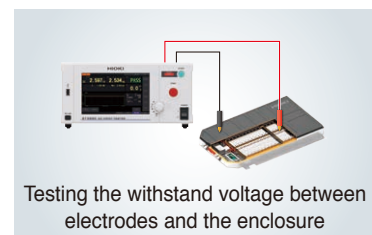
Detection of minuscule currents



Featuring testing quality that's a step above. Accommodate the full array of DC withstand voltage testing applications with specs that comply with a broad range of international standards.

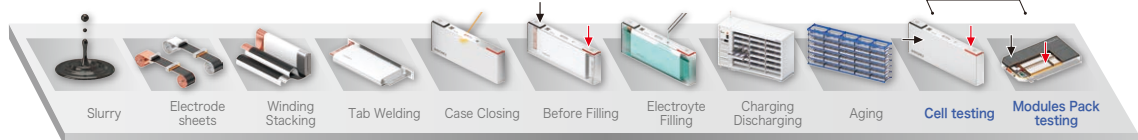
**Ideal for withstand voltage testing of batteries, motors, electronic components, and other parts**

The ST5680 tests insulation performance by applying a high voltage to the test target. It's capable of performing safety testing for a broad assortment of targets, including electronic devices, electronic components, and materials, in settings ranging from R&D labs to production lines. For batteries, it's used to perform withstand voltage testing between the enclosures and electrodes of modules, packs, and cells.



Testing the withstand voltage between electrodes and the enclosure

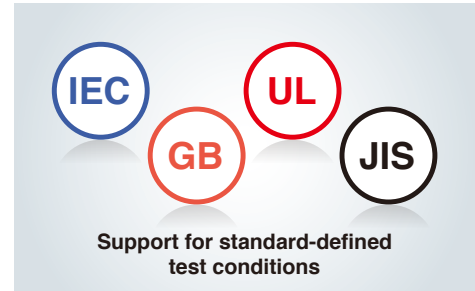
LIB production line processes



**1 Power supply performance that satisfies test conditions defined by international standards**

**Output voltage: Max. 8 kV**  
**Output current: Max. 100 mA**

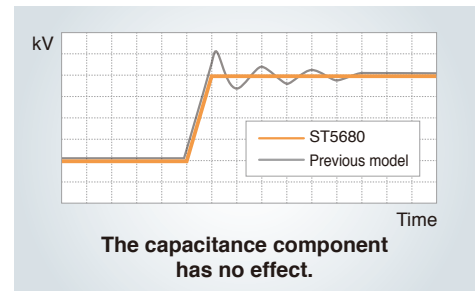
The ST5680 provides two modes: DC withstand voltage test mode, which evaluates insulation by measuring the leakage current in the test target, and insulation resistance test mode, which evaluates insulation by measuring resistance. In DC withstand voltage testing, it can output up to 8 kV, one of the highest values for any instrument of its kind. Test cycle times can be reduced since it can charge test targets quickly with high-capacity, 100 mA output, even if the target includes a capacitance component.



**2 Stable high-voltage output**

**Perform tests without worrying about the capacitance component.**

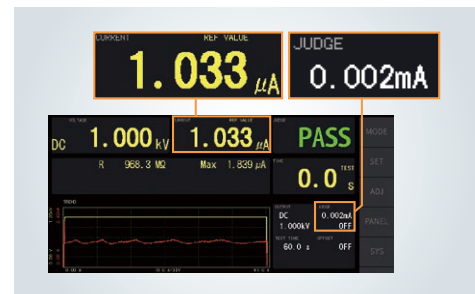
Even if your test target includes a capacitance component, an overshoot-resistant design ensures the ST5680 won't exceed the set voltage when applying voltage to the target, allowing you to perform tests with peace of mind. In addition, you can set a delay time so that no judgments are made while the charging current continues to flow, helping prevent erroneous judgments.



**3 Precise testing of insulation by generating judgments based on minuscule current values**

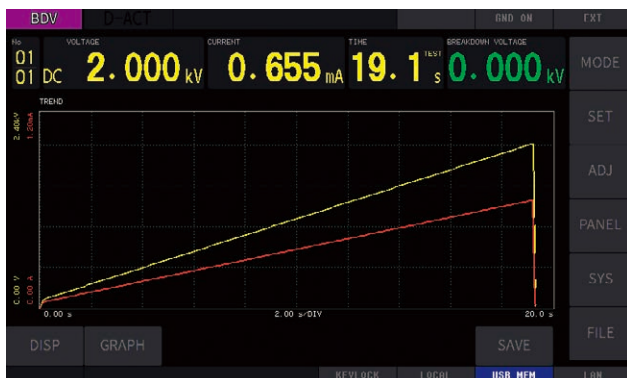
**High-precision judgments with a maximum resolution of 0.001 μA**

As the insulation performance of batteries and motors improves, there's growing demand for the ability to use ever more minuscule current values to generate PASS/FAIL judgments in withstand voltage testing. If you use a withstand voltage tester with low resolution, you won't be able to accurately measure leakage current. Since the ST5680 realizes high-precision performance with a maximum resolution of 0.001 μA, it can accurately measure minuscule leakage currents and use them to generate PASS/FAIL judgments.



**Insulation breakdown voltage (BDV) measurement function**

The ST5680's BDV function can check the insulation breakdown voltage of the test target. It can increase the applied voltage at a set speed and check the voltage that leads to insulation breakdown. Test methods are defined by standards, including continuous voltage rise testing and stepped voltage rise testing. The ST5680 can perform both tests. The instrument can be used to evaluate insulation performance (dielectric strength) in R&D work.



**Example of continuous voltage rise test**

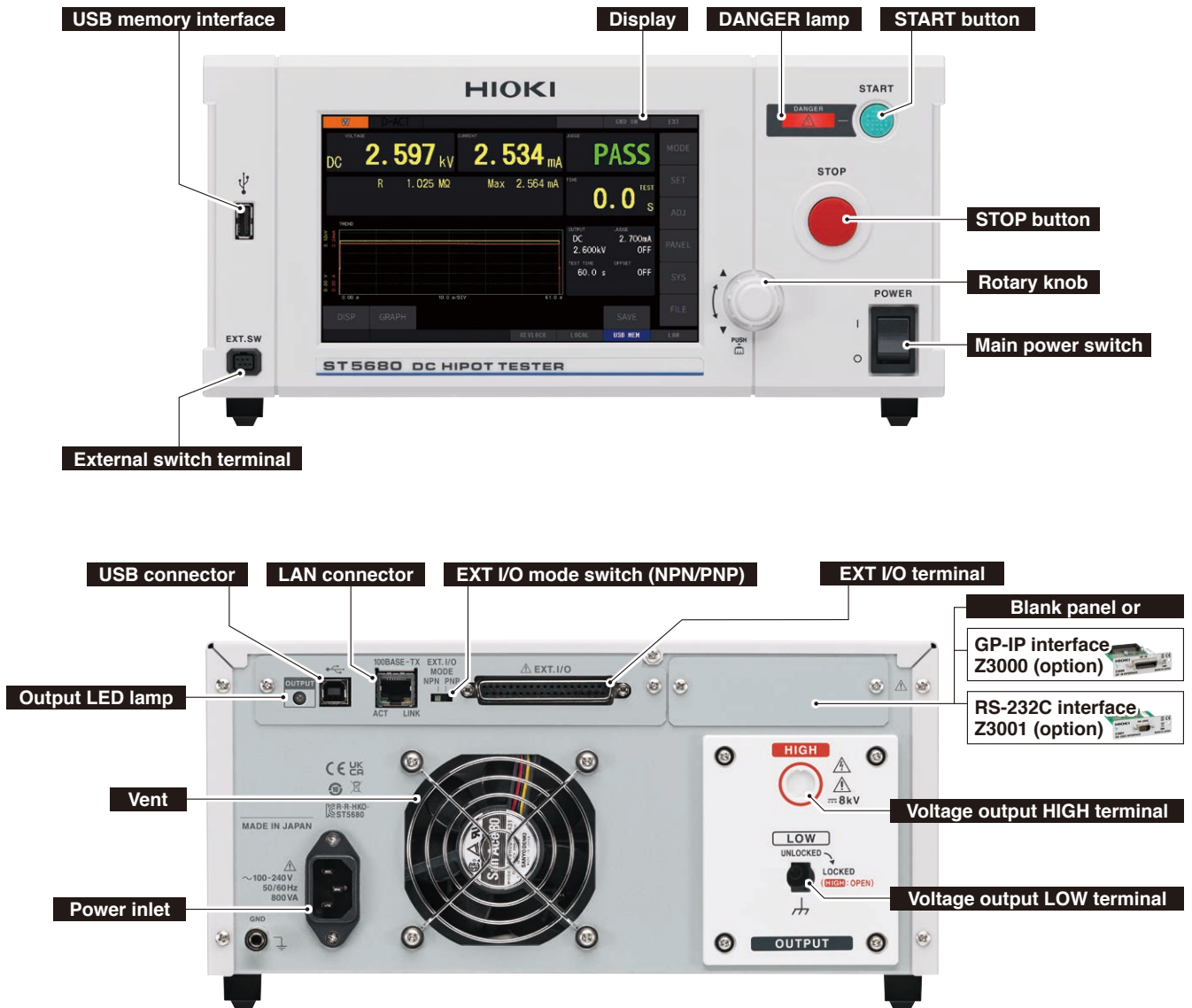
MODE: RATE, START VOLTAGE: 100 V, RISE RATE (voltage rise per second): 100 V, END VOLTAGE: 2 kV, allowable value (judgment standard): 2 mA



**Example of stepped voltage rise testing**

MODE: STEP, START VOLTAGE: 100 V, RISE RATE (voltage rise per second): 100 V, HOLD TIME: 1 s, number of steps: 20, allowable value (judgment standard): 2 mA

## Interfaces



## Options



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



**UNPROCESSED 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 the Z3001, 9-pin to 9-pin, cross, 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 communications 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 programmable logic controller (PLC), which can be used to control it and retrieve test results. Furthermore, the instrument provides 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 name	Functionality	I/O
START	Test start and W-IR/IR-W, program, and BDV mode trigger signal	In
INTERLOCK	Interlock cancellation	In
LOAD1	Panel load	In
LOAD3		In
LOAD5		In
LOAD7		In
ISO_5V	Insulated power supply +5 V (-5 V) output	-
ISO_COM	Insulated power supply common	-
ERR	Measurement error output	Out
U_FAIL	Output at UPPER_FAIL judgment	Out
L_FAIL	Output at LOWER_FAIL judgment	Out
H.V.ON	Output during voltage generation	Out
W-FAIL	Output at FAIL state during withstand voltage testing	Out
W-MODE	Output during withstand voltage testing	Out
STEP_END	Output at completion of each step during program testing	Out
ARC_DET	Output at arc detection	Out
PASS	Output at PASS judgment	Out
TEST	Output during testing (customer function)	Out
STOP	Test stop and PASS/FAIL hold cancellation	In
EXT_EN	Input signal enable for external I/O signals	In
LOAD0	Panel load	In
LOAD2		In
LOAD4		In
LOAD6		In
LD_VALID	Panel load execution	In
ISO_COM	Insulated power supply common	-
READY	Output at standby state	Out
PROTECTION	Output at protection function operation	Out
CONT_ERR	Output at contact error	Out
IR-FAIL	Output at FAIL state 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), which switches between current sink (NPN) and current source (PNP) operation, can be used to change the type of programmable logic controller (PLC) that the instrument supports.

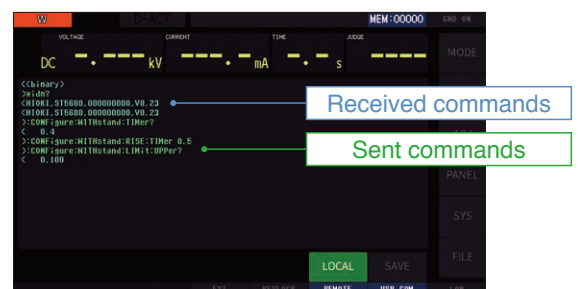
### I/O handler test function

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, which displays commands and responses on the measurement screen, is a useful tool when creating programs. It can be used to display communications commands and query responses on the screen.



### Color LCD display with touch screen

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



# Specifications (Accuracy guaranteed for 1 year)

Main functions	
DC Hipot test	
Insulation resistance test	
Breakdown voltage test	
Waveform display functionality	
Arc discharge detection	
Contact check function	
DC Hipot test	
Output voltage	DC 0.010 kV to 8.000 kV (1 V resolution)
Load regulation	±1% or less
Output setting accuracy	±(1.2% of setting + 20 V)
Output current/cutoff current	Max. 100 mA
Current accuracy	> 3.00 mA: ±(1.5% rdg. + 2 µA) ≤ 3.00 mA: ±1.5% rdg.
Maximum resolution	0.001 µA
Test time	0.1 s to 999 s, continuous (timer off)
Voltage ramp up / ramp down time	0.1 s to 300 s / 0.1 s to 300 s, off
Short-circuit current	200 mA or less
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	±(1.2% of setting + 2 V)
Resistance value display range	10.00 kΩ to 200.0 GΩ (0.01 kΩ resolution)
Accuracy guarantee range	10.00 kΩ to 99.99 GΩ
Resistance accuracy	±(1.5% rdg. + 3 dgt.) *See below for details
Test time	0.1 s to 999 s, continuous (timer off)
Voltage rise / fall time	0.1 s to 300 s / 0.1 s to 300 s, off
Breakdown voltage test	
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 functionality	
Waveform display content	Voltage, current, insulation resistance
Sampling rate	500 kS/s
Resolution	256 K words
Arc discharge 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 method
Setting description	Threshold (capacitance) setting: 1.0 nF to 100.0 nF
Memory functionality	
Saving of waveforms/ graphs	Save to USB memory Save formats: BMP, PNG, CSV

	Saves test condition settings internally in the instrument.
Panel memory function	DC withstand voltage testing/insulation resistance testing: Up to 64 sets of settings each Program testing: Up to 30 programs (max. 50 steps) Insulation breakdown voltage testing: 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 > upper limit value PASS: Upper limit value ≥ measured value ≥ lower limit value LOWER_FAIL: Measured value < lower limit value
List of major functions	
Interlock	Disables output based on the status of an external device.
GFI	Protects workers from electric shock.
Auto discharge	Discharges the target via internal circuitry at the end of the test. Discharge resistance: 700 kΩ
Offset cancellation	Measures the current flowing along the test path and subtracts it from measurement results.
Set voltage modification during testing	Allows the set voltage to be changed during testing using either the rotary knob or communications commands.
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 a 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: IEC 61326
Power supply	100 to 240 V AC
Power consumption	Approx. 180 VA*
Maximum rated power	800 VA
Interface	Communications: 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	10.0 kg (352.74 oz) ±0.2 kg (7.05 oz)
Product warranty	3 years
Accessories	Power cord, CD-ROM (PDF: User Manual, Communications Manual), EXT I/O male connector, EXT I/O connector cover, EXT I/O interlock cancellation jig, Startup Guide

\*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).

## Insulation resistance measurement accuracy (Accuracy guaranteed test voltage range: 50 V to 2000 V)

Measurement range		10 kΩ to 99.99 GΩ <sup>1)</sup>	
IR	Accuracy	10 nA ≤ I ≤ 3 µA	100 MΩ to 999.9 MΩ 1.00 GΩ to 99.99 GΩ ±(20% rdg.) <sup>2)</sup> , <sup>3)</sup> , <sup>4)</sup>
		100 nA ≤ I ≤ 30 µA	10.00 MΩ to 99.99 MΩ 100.0 MΩ to 999.9 MΩ ±(5% rdg.) <sup>2)</sup> , <sup>3)</sup> , <sup>4)</sup>
		1 µA ≤ I ≤ 300 µA	1.000 MΩ to 9.999 MΩ 10.00 MΩ to 99.99 MΩ ±(2% rdg. + 5 dgt.) <sup>2)</sup> , <sup>3)</sup> , <sup>4)</sup>
		10 µA ≤ I ≤ 3 mA	100.0 kΩ to 999.9 kΩ 1.000 MΩ to 9.999 MΩ ±(1.5% rdg. + 3 dgt.) <sup>2)</sup> , <sup>3)</sup> , <sup>4)</sup>
		100 µA ≤ I ≤ 30 mA	10.00 kΩ to 99.99 kΩ 100.0 kΩ to 999.9 kΩ
		1 mA ≤ I ≤ 100 mA	10.00 kΩ to 99.99 kΩ

<sup>1)</sup> For maximum rating 500 VA range  
<sup>2)</sup> If the test voltage is 10 V to 99 V, add ±10% to the measurement accuracy.  
<sup>3)</sup> If the test voltage is 100 V to 999 V, add ±5% to the measurement accuracy.  
<sup>4)</sup> If the test voltage is 1000 V to 2000 V, add ±2% to the measurement accuracy.

## Product name

**DC HIPOT TESTER ST5680**

Model number (order code) : ST5680



The instrument is not able to perform measurement by itself. The HIGH and LOW terminals use dedicated Hioki connectors to which only Hioki options L2260 and L2261 can be connected. Please purchase optional test leads as appropriate for your measurement application.

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**HEADQUARTERS**  
81 Koizumi,  
Ueda, Nagano 386-1192 Japan  
<https://www.hioki.com/>



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