



## Detect contamination that could cause defects. Improve battery cell productivity through high-speed testing.

### Product concept

To assure battery quality over the long term, it's necessary to detect the causes of latent defects in testing processes on production lines. Minuscule insulation defects can eventually degrade battery service life and cause fires. The principal causes of insulation defects are contamination (with metallic matter) and minuscule scratches occurring in production processes.

#### Market requirements

**“We want to prevent shipment of batteries with latent defects that could lead to fires.”**  
**“We want to boost productivity by optimizing costs.”**

The BT5525 is a battery insulation tester that was developed to meet these battery market requirements.



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

Internal short-circuit detection

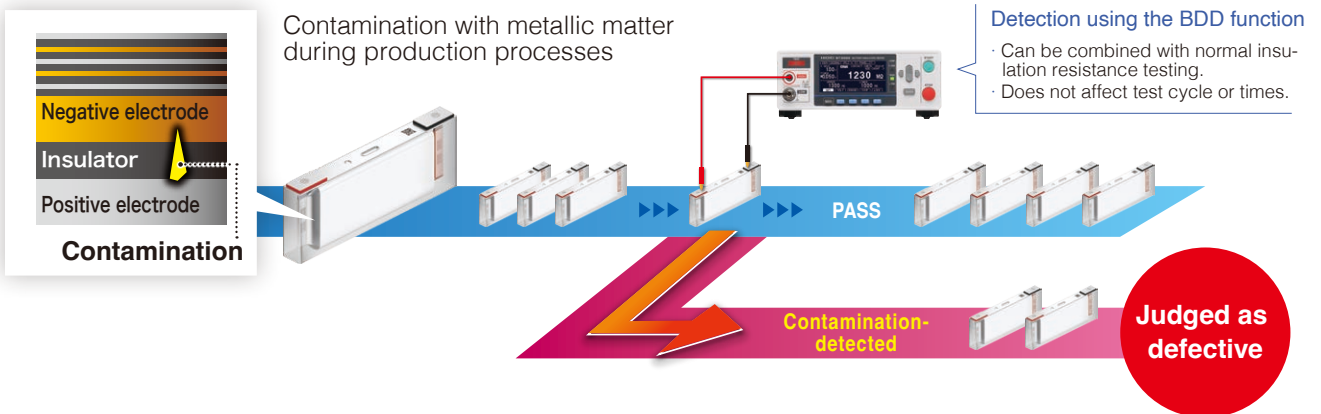
Noise resistance

Prevention of erroneous judgments

**Break Down Detect function (BDD)**

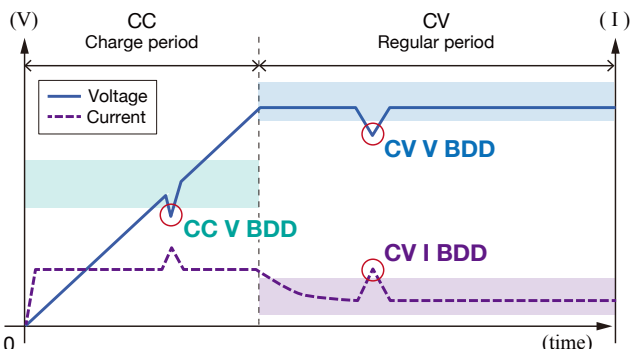
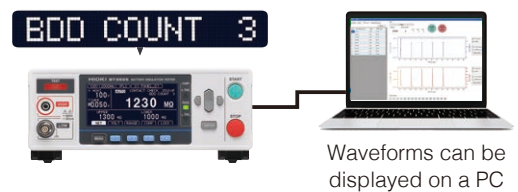
**Detecting minuscule insulation defects caused by contamination**

The BDD function is a proprietary testing function that can detect minuscule internal short-circuits caused by contamination (with metallic matter) at the stage before battery cells are filled with electrolyte. By identifying and eliminating defective parts at an early stage in the production process, the BDD function helps prevent the risk of hazards such as fires and accidents caused by heating after battery shipment. Eliminating latent accident causes such as these facilitates the production of batteries that resist degradation and function economically.



**Proprietary method for reliably detecting contamination**

The BDD function is a detection method that combines analog circuitry (peak hold) with digital sampling (at 5 MS/s). It detects minuscule changes by monitoring the amount of change in voltage during charging and the amount of change in steady-state voltage and current after charging. In this way, it resolves the issue of incomplete detection due to sampling timing and resolution, which affects waveform measurement using conventional oscilloscopes or recorders.



**Judgment methods**

<b>CC V</b>	Insulation defects are detected using the voltage value (V) during charging. Judgments are made using the voltage value immediately prior to the change. Setting range: 0.1 V to 500.0 V
<b>CV V</b>	Insulation defects are detected using the steady-state voltage value (V) after charging. Judgments are made using the steady-state voltage (voltage after stabilization). Setting range: 0.1 V to 500.0 V
<b>CV I</b>	Insulation defects are detected using the amount of change (%) in the steady-state current after charging. Judgments are made using the current value immediately prior to the change. Setting range: 0.6% to 999.9%

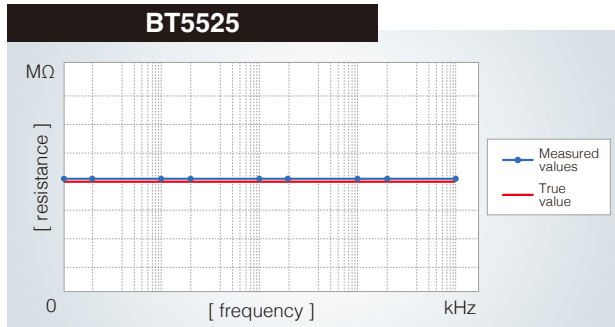
## Noise resistance

### Stable insulation resistance testing, even in noisy environments

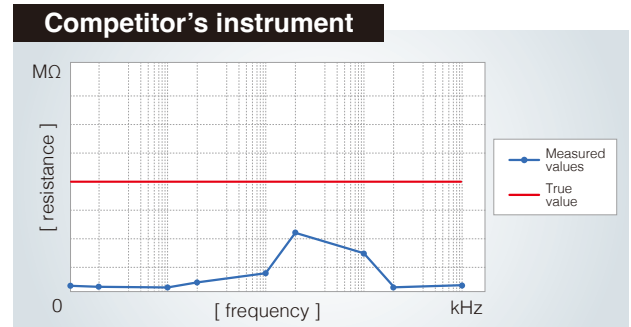
Hioki succeeded in significantly reducing the effects of external noise by drawing on insulation resistance tester measurement technology and design expertise cultivated over many years.

As a result, the BT5525 can perform stable, variation-free insulation resistance testing at a level of quality that lets it detect internal short-circuits caused by contamination.

#### Common-mode noise application simulation



Stable performance, even in noisy environments

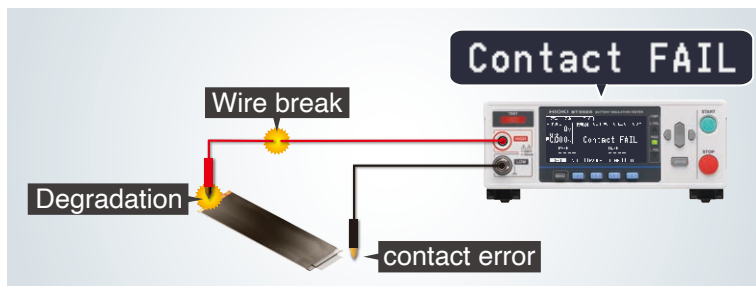


Noise causes variability in measured values

## Contact check function

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

The BT5525 provides a contact check function to determine whether the instrument has made proper contact with the circuit under test by measuring the capacitance between the measurement terminals (stray capacitance and the capacitance of the circuit under test).



#### Preventing erroneous judgments that classify defective parts as non-defective

- When the measurement leads become disconnected during testing
- When degradation of measurement leads results in increased resistance between test locations

#### Simple operation

- Simple wiring connections thanks to use of 2 terminals

## Functionality

BT5525 provides a range of functionality to make insulation resistance testing safer and more convenient.

#### Current limit function

The charging current applied to cells can be limited to a user-specified value ranging from 50  $\mu$ A to 50 mA. This function can shorten charging times when there is capacitance between test terminals or in the circuit under test.

#### Auto discharge function

Prevents damage to other devices during the next test by discharging any charge accumulated in the circuit under test within the instrument after testing. Discharging occurs at 40 mA or greater after measurement completes.

#### Measurement conditions memory function

Stores measurement conditions in the instrument's memory for future recall as necessary. Up to 15 sets of measurement conditions can be stored. Saved conditions persist even if the instrument is powered off.

#### Comparator function

Performs automatic pass/fail judgments based on judgment standard upper and lower limit values set by the user. A beep tone is used to notify the user of judgment results. The setting range is 0.000 M $\Omega$  to 9999 M $\Omega$ .

#### Test time function

Allows the user to set the time during which the test voltage is applied from 0.050 s to 999.999 s. The time can be set in increments of 0.001 s.

#### Auto range function

Automatically selects the measurement range based on the measured insulation resistance value. The following measurement ranges are available: 2 M $\Omega$ , 20 M $\Omega$ , 200 M $\Omega$ , and 2000 M $\Omega$ .



## The standard model in Hioki's line of Battery insulation tester

High-speed

Compact

Reasonably priced



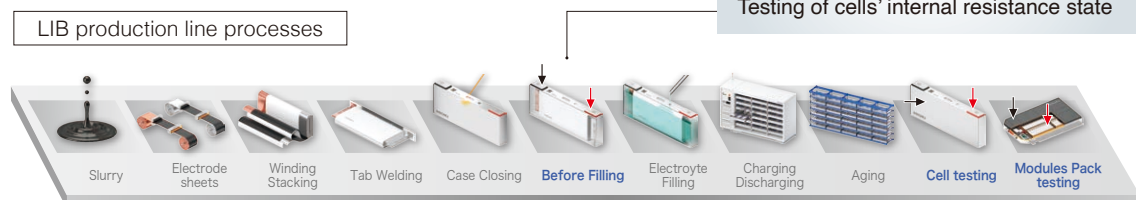
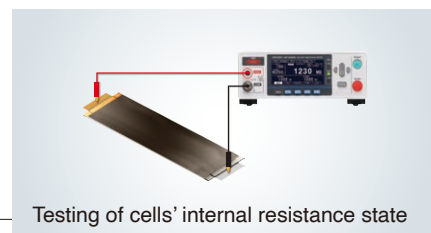
**High-speed testing to increase production volume.**

**Easy to add instruments while saving space.**

**Invest in quality at a reasonable cost.**

### Ideal for insulation resistance testing before battery electrolyte filling

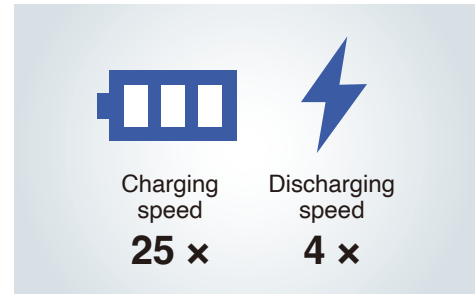
The BT525 tests insulation between electrodes before cells are filled with electrolyte. Its maximum test voltage is 500 V. If certain test conditions are satisfied, it can also perform insulation testing between module/pack electrodes and the enclosure.



**1 High-speed testing to increase production volume**

**Shorten cycle times with a maximum charging current of 50 mA**

The BT5525 features high-speed charging at up to 50 mA and high-speed discharging of residual charge at 40 mA. The instrument's dramatically improved charging and discharging performance boosts testing speed, accelerating charging by about 25 times compared to previous models, and discharging by about 4 times. In this way, it can shorten insulation resistance testing times for batteries, which manufacturers are producing at ever-higher levels of capacity. \*Compared to Hioki's INSULATION TESTER ST5520.



**2 Easy to add instruments while saving space**

**Compact footprint makes it easy to integrate the BT5525 into other systems**

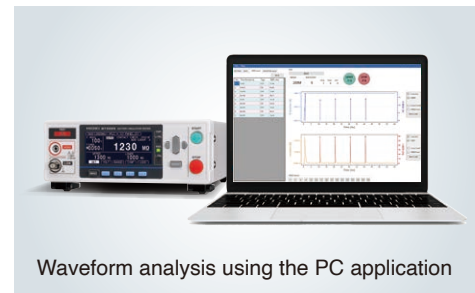
Drawing on many years of expertise in product design, Hioki has delivered high performance in a compact package. The instrument can be embedded in testing systems, allowing their size to be reduced. Manufacturers can deploy compact testing systems to make the most of limited production space.



**3 Invest in quality at a reasonable cost**

**Boost productivity by minimizing cost**

The BT5525's functionality and performance make it a cost-effective solution due to careful consideration given to the demands of battery insulation resistance testing. Fluctuations in voltage and current during insulation resistance testing can be viewed using a dedicated PC application. The instrument can output a test voltage of up to 500 V. The instrument satisfies insulation resistance testing conditions for everything from the large batteries used in electric vehicles (EVs) to small battery cells.



Waveform analysis using the PC application

**PC application for analyzing waveforms**

A free PC application from Hioki can be used to review fluctuations in voltage and current. The ability to review waveforms can be useful when analyzing test results and when determining judgment reference values for testing lines. Since data can be output in the CSV format, waveforms can also be reviewed in other applications, for example Excel.

**Start/stop control**

Measurement on the BT5525 can be started and stopped using the application.

**BDD judgment results list**

The application displays BDD times and associated measured values.

**Voltage monitor display**

The application displays test voltage waveforms. You can review CC V and CV V BDD locations.

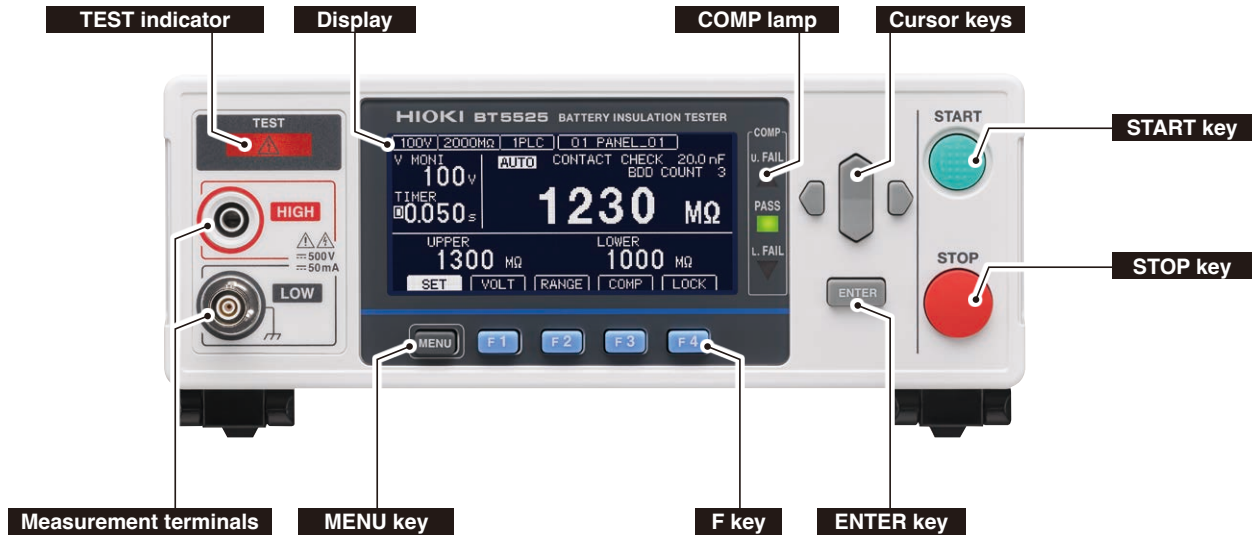
**Current monitor display**

The application displays current waveforms. You can review CV I BDD locations.

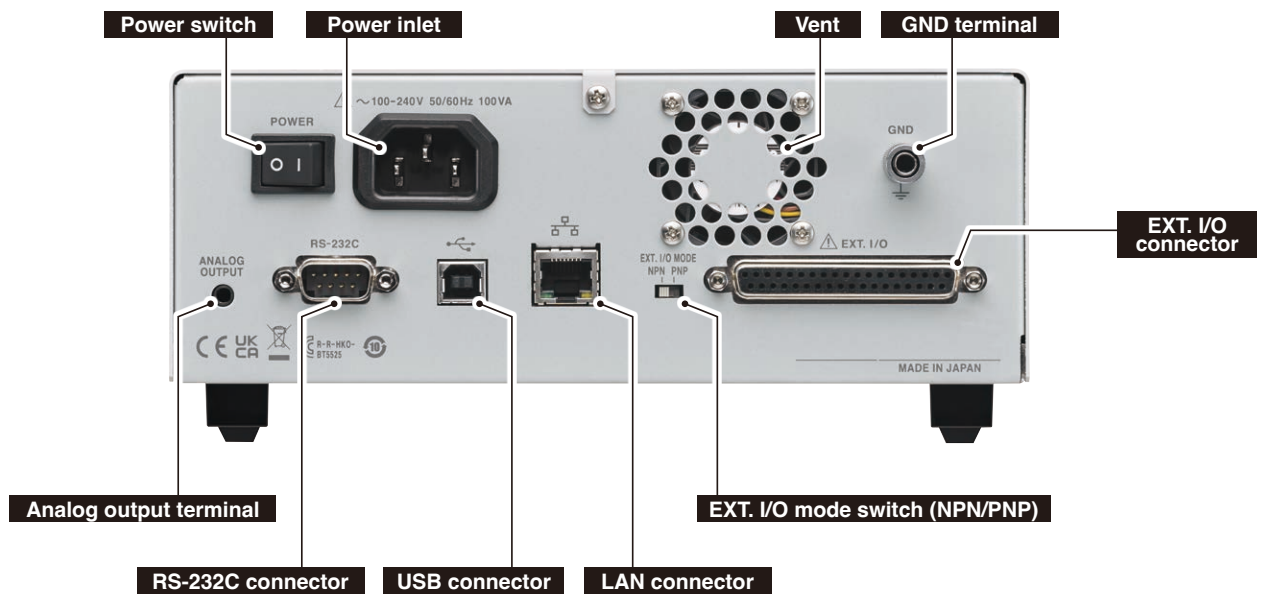
No.	Time Stamp [ms]	Type	BDD value
1	1.016	CCV	17.66
2	10.813	CVI	59.63
3	10.978	CVV	13.65
4	25.764	CVI	55.71
5	26.991	CVV	14.18
6	30.765	CVI	59.53
7	30.912	CVV	14.22
8	42.765	CVI	62.41
9	43.935	CVV	14.28

\*Window layout remains under development.

## Interfaces



\*The LOW terminal is a dedicated HIOKI connector, so only our optional L2131 or L2133 can be connected.



## Options



### CLIP TYPE LEAD L2130

For HIGH terminal, banana / alligator clip, red, cord length 1.5 m

### CLIP TYPE LEAD L2131

For LOW terminal, special triaxial / alligator clip, black, cord length 1.5 m

### UNTERMINATED LEAD L2132

For HIGH terminal, banana / cut wire, red, cord length 5 m

### UNTERMINATED LEAD L2133

For LOW terminal, special triaxial / cut wire, black, cord length 5 m

### OUTPUT CORD L9094

For analog output, banana plugs (red, black), cord length 1.5 m

### RS-232C CABLE L9637

For external control, double shielding, 9-pin / 9-pin, cord length 3 m

## External control and other communications interfaces

**EXT. I/O**

**RS-232C**

**LAN**

**USB**

The BT5525 ships standard with LAN, RS-232C, and USB interfaces, allowing it to be connected to a PC or programmable logic controller (PLC). This capability can be used to control the instrument 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	Measurement start	In
STOP	Measurement stop	In
TEST	From test start to discharge complete	Out
VON	Voltage monitor value is within 10% of set voltage value.	Out
BDD	BDD results	Out
C_CHECK_FAIL	Contact check judgment	Out
SYSTEM_ERR	Instrument error	Out
PASS	Comparator judgment	Out
UPPER FAIL	Comparator judgment	Out
LOWER FAIL	Comparator judgment	Out
ISO_5V	Insulated power supply $\pm 5$ V output	-
ISO_COM	Insulated power supply common	-
LOAD0	Panel number selection	In
LOAD1	Panel number selection	In
LOAD2	Panel number selection	In
LOAD3	Panel number selection	In
LOAD_VALID	Panel load execution	In
INTERLOCK	Interlock	In

#### 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, the included interlock cancellation jig is used to turn off the interlock function.

### EXT. I/O mode switch (NPN/PNP)

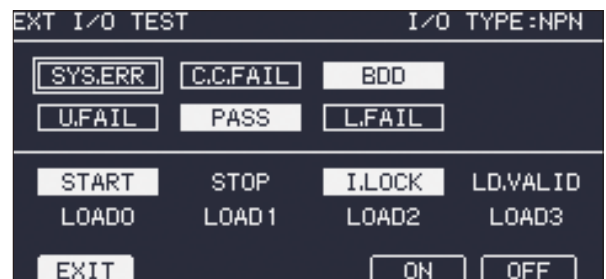
The EXT. I/O mode switch (NPN/PNP), which switches between current sink (NPN) and current source (PNP) operation, can be used to change the type of programmable logic controller (PLC) that the instrument supports.

### 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 test function

In addition to manually switching output signals on and off, this functionality can be used to view input signal status on the screen.



### 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.





# Specifications (Accuracy guaranteed for 1 year)

Main functions	
Insulation resistance test	
Break Down Detect function (BDD)	
Contact check function	
Output specifications	
Output voltage	25 V to 500 V, Setting resolution 1 V
Charging current (Current limit function)	50 $\mu$ A to 50 mA <sup>*1*2*3</sup> , Minimum setting resolution 10 $\mu$ A
Short-circuit current	60 mA or less
Discharge current	40 mA or greater
Measurement specifications	
Resistance value display range	0.050 M $\Omega$ to 9999 M $\Omega$
Resistance range	2 M $\Omega$ , 20 M $\Omega$ , 200 M $\Omega$ , 2000 M $\Omega$ , AUTO
Time specifications	
Test time	0.050 s to 999.999 s, OFF
Comparator delay time	0.001 s to 999.999 s, AUTO
Display update speed	1 PLC
Sampling time	1 PLC to 100 PLC
Memory functions	
Panel save function	Saves up to 15 sets of measurement conditions
Measured value memory function	Saves up to 999 measured values in the instrument's internal memory
Judgment functions	
Test modes	Continuous test, PASS STOP, FAIL STOP
Comparator function	UPPER_FAIL : Measured value > upper limit value PASS : Upper limit value $\geq$ measured value $\geq$ lower limit value LOWER_FAIL : Measured value < lower limit value
Various functions	
Break Down Detect function (BDD)	Detecting minuscule insulation defects caused by contamination
Contact check function	2-terminal capacitance measurement method
Automatic data output function	Automatic output of measurement results via communication interface after completion of test
Command monitor function	Screen display of commands being sent and received
External I/O monitor function	Screen display of output signal ON/OFF and input signal status
Analog output function	Converts measured values to 0 to 4 V DC and outputs
Basic Specifications	
Operating temperature and humidity	0°C to 40°C, 80% RH or less (non-condensing)
Standard compliance	Safety : IEC 61010 EMC : IEC 61326
Power supply	100 V to 240 V AC
Power consumption	Approx. 20 VA <sup>*4</sup>
Maximum rated power	100 VA
Interfaces	USB, LAN, RS-232C, EXT. I/O
Outline dimension	215 mm (8.46 in) W x 80 mm (3.15 in) H x 306.5 mm (12.07 in) D (excluding protruding parts)
Mass	2.8 kg (98.8 oz) $\pm$ 0.1 kg (3.5 oz)
Product warranty period	3 years
Accessories	Power cord, EXT. I/O male connector, EXT. I/O connector cover, EXT. I/O interlock cancellation jig, Startup Guide

Model:  
**BATTERY INSULATION TESTER BT5525**

Model No. (Order code): **BT5525**



The instrument is not able to perform measurement by itself. Please purchase optional test leads separately as appropriate for your measurement application. The LOW terminal is a dedicated HIOKI connector, so only our optional L2131 or L2133 can be connected.

- \*1: Constraints involving the output generator will result in an error, making measurement impossible, if a capacitive load of approximately 50  $\mu$ F or greater is connected while using a current limit setting of 5.1 mA or greater.
- \*2: When using a current limit setting of 5.1 mA or greater, measurement will be forcibly stopped if the output voltage is not at least 20 V at 200 ms after the start of measurement. Measurement will be possible 1 s after forcibly stopped.
- \*3: If the set current limit value is from 5.1 mA to 50.0 mA, the current will be limited to 5 mA after the output voltage reaches the set voltage.
- \*4: Power supply conditions are 220 V supply voltage, 50, 60 Hz supply frequency, 200 V test voltage, 2 mA current limit, and load (1 G $\Omega$  resistor and 0.1  $\mu$ F capacitor connected in parallel).

Set voltage	Resistance range	Resistance value display range	Resolution	Guaranteed accuracy range	Basic accuracy
25 V $\leq$ V $\leq$ 100 V	2 M $\Omega$	0.050 M $\Omega$ to 9.999 M $\Omega$	0.001 M $\Omega$	0.050 M $\Omega$ to 2.000 M $\Omega$	$\pm$ 1.5% rdg., $\pm$ 2 dgt.
				2.001 M $\Omega$ to 9.999 M $\Omega$	$\pm$ 15% rdg.
	20 M $\Omega$	1.80 M $\Omega$ to 99.99 M $\Omega$	0.01 M $\Omega$	1.80 M $\Omega$ to 20.00 M $\Omega$	$\pm$ 1.5% rdg., $\pm$ 2 dgt.
				20.01 M $\Omega$ to 99.99 M $\Omega$	$\pm$ 5% rdg.
100 V $\leq$ V $\leq$ 500 V	200 M $\Omega$	18.0 M $\Omega$ to 999.9 M $\Omega$	0.1 M $\Omega$	18.0 M $\Omega$ to 200.0 M $\Omega$	$\pm$ 2.5% rdg.
				200.1 M $\Omega$ to 999.9 M $\Omega$	$\pm$ 5% rdg.
	2 M $\Omega$	0.200 M $\Omega$ to 9.999 M $\Omega$	0.001 M $\Omega$	0.200 M $\Omega$ to 2.000 M $\Omega$	$\pm$ 1.5% rdg., $\pm$ 2 dgt.
				2.001 M $\Omega$ to 9.999 M $\Omega$	$\pm$ 10% rdg.
20 M $\Omega$	1.00 M $\Omega$ to 99.99 M $\Omega$	0.01 M $\Omega$	1.00 M $\Omega$ to 20.00 M $\Omega$	$\pm$ 1.5% rdg., $\pm$ 2 dgt.	
			20.01 M $\Omega$ to 99.99 M $\Omega$	$\pm$ 15% rdg.	
200 M $\Omega$	10.0 M $\Omega$ to 999.9 M $\Omega$	0.1 M $\Omega$	10.0 M $\Omega$ to 200.0 M $\Omega$	$\pm$ 2.5% rdg.	
			200.1 M $\Omega$ to 999.9 M $\Omega$	$\pm$ 5% rdg.	
2000 M $\Omega$	100 M $\Omega$ to 9999 M $\Omega$	1 M $\Omega$	100 M $\Omega$ to 2000 M $\Omega$	$\pm$ 2.5% rdg.	
			2001 M $\Omega$ to 9999 M $\Omega$	$\pm$ 5% rdg.	

\*Display indicates Over.F or Under.F when the display range is exceeded.

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