Simultaneous high-speed measurement of internal resistance and battery voltage

From large-cell to high-voltage battery testing - HIOKI is The Choice

The BT3563, BT3562, and 3561 BATTERY HiTESTERs support simultaneous high-speed measurement of internal resistance (IR) and battery voltage (OCV) for the ever-expanding production lines of increasingly larger lithium-ion low resistance batteries, and other battery packs for high voltage applications.

- Measure high-voltage battery packs up to 300V (with the BT3563)
- Ideal for high-precision cell voltage measurements (accurate to 0.01% of reading)
- Measurement circuitry employs enhanced current regulation
- Fast 10 ms response and 8 ms sampling time for high-speed measurements (with the BT3563 and BT3562)
- Ranges from 3 mΩ to 3000 Ω (with the BT3563 and BT3562) support coin-size to large-cell batteries
Resistance and voltage measurements

BATTERY HiTESTER BT3563
BT3562
3561

Measurement Parameters and Applications

- High-voltage battery pack testing
- Battery module testing
- Large (low-resistance) cell testing
- High-speed mass production testing of coin batteries
- Fuel cell stack measurements
- Battery research and development measurement applications

BATTERY HiTESTER BT3563
BATTERY HiTESTER BT3562

Voltage measurement ranges: 6V/60V/300V (BT3563)
6V/60V (BT3562)

Resistance measurement ranges: 3mΩ/30mΩ/300mΩ/
3Ω/30Ω/300Ω/3000Ω

Advanced Functions

- Four-Terminal AC Method
  The four-terminal, 1-kHz AC method uses four contact probes to measure resistance independently of that of the measurement leads.

- Measurement Error Detection
  Detects test probe contact failure and broken leads, for 100% measurement reliability.

- Self-Calibrating
  Minor drift and gain fluctuations within the internal measurement circuitry are automatically corrected to maintain high accuracy.

- Averaging Function
  Stable readings can be consistently obtained by averaging two to 16 measurements.

Lithium-Ion and Secondary Batteries

Battery-Powered Devices

- Cell phones
- E-books
- Electric bicycles
- Electric scooters
- EV/HEV
to confirm finished quality

### Features of Battery HiTester Series

**High Precision**
- **Resistance**
  - ±0.5% rdg. ±5 dgt.
- **Voltage**
  - ±0.01% rdg. ±3 dgt.

Common to the BT3563, BT3562 and 3561

**High Resolution**
- **Resistance**: 0.1 μΩ \(^{1}\) (3 mΩ range)
- **Voltage**: 10 μV \(^{1}\) (6 V range)

\(^{1}\) BT3563 and BT3562

**Quick Response**
- **Resistance & Voltage**
  - Simultaneous measurements within 18 ms \(^{2}\)

\(^{2}\) Sampling time + response time: with EX.FAST sampling BT3563 and BT3562

- The 3 mΩ range (with 0.1 μΩ resolution) is ideal for testing ever lower-resistance large cells (BT3563 and BT3562).
- The 6 V range (with 10 μV resolution and 0.01% accuracy) is ideal for the high-precision voltage measurements required for cell testing (BT3563 and BT3562).

- Provides high-speed measurement of high-voltage \(^{3}\) battery packs, for improving productivity (BT3563).

\(^{3}\) BT3563: up to 300V
BT3562: up to 60V

### Measurement Parameters and Applications

- For high-speed production line testing of small battery packs for mobile and portable communications devices
- For high-speed production line testing of small cells
- **High-speed 10ms inspection in the 300mΩ and 3Ω ranges**
- **Improve inspection efficiency during mass production of compact cells**

### Lithium-Ion and Secondary Batteries

- **Battery-Powered Devices**

- **Battery HiTester Series**

- **Measurement Value Storage**
  - Store up to 400 measurement values by external trigger input, for bulk transfer to a computer.
- **Statistical Calculations**
  - Apply statistical calculations to up to 30,000 data points to facilitate process and quality control.
- **Save Measurement Setting Configurations**
  - Up to 126 measurement settings such as comparator setting criteria can be saved and reloaded. Saved configurations can be selected by external control.
Automatic Testing Lines

■ High Speed Interfaces

The fastest 10 ms measurement data can be transferred via the standard RS-232C interface at up to 38,400 bps. Models with the -01 suffix include a GP-IB interface.

■ Handler Interface

Triggering, measurement configuration loading, and zero adjustment can be externally controlled. Output signals provide comparator results, end-of-measurement events, and measurement errors. (Because the BT3563/BT3652 are different from the 3561, consult each model’s Instruction Manual for specific details or designs.)

### BT3563, BT3562 and 3561 External I/O Items

<table>
<thead>
<tr>
<th>Input (no-voltage contacts)</th>
<th>Output (open collector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement trigger (TRIG)</td>
<td>End-of-Measurement (EOM)</td>
</tr>
<tr>
<td>Print (PRINT)</td>
<td>Measurement-in-progress (INDEX)</td>
</tr>
<tr>
<td>Zero adjustment (0ADJ)</td>
<td>Comparator results (V-Hi, V-IN, V-Lo, PASS, FAIL)</td>
</tr>
<tr>
<td>Calibrate (CAL)</td>
<td>Measurement error (ERR)</td>
</tr>
<tr>
<td>Manual comparator (MANU)</td>
<td>General-purpose output (OUTT to OUTT)</td>
</tr>
<tr>
<td>Load panel settings (7 bits)</td>
<td>(LOAD0 to LOAD6)</td>
</tr>
</tbody>
</table>

*1 The input and output signals of the BT3563 and BT3562 are isolated via photoocillers.

■ EXT I/O Connectors (BT3563 and BT3562, accessories not supplied)

- Installed connector (HiTester side): 37-pin D-SUB accepts #4-40 screws
- Mating connectors: DC-37P-ULR (solder type) or DCSP-JB37PR (welded type) from Japan Aviation Electronics Industry, Ltd., or equivalent

■ EXT I/O Connectors (3561, accessories not supplied)

- Installed connector (HiTester side): 57RE-40360-730B (D29) (DDK)
- Mating connectors: 57-30360 (DDK), RC30-36P (Hirose Electric Co., Ltd.), or equivalent

### BT3563 and BT3562 External I/O Timing Chart

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR Output (ASYNC Setting)</td>
<td>11: 1.5 ms (ERR output response time)</td>
</tr>
<tr>
<td>TRIG Input</td>
<td>12: Minimum 0.5 ms (measurement trigger pulse width)</td>
</tr>
<tr>
<td>INDEX Output</td>
<td>13: 0.3 ms (calculation time)</td>
</tr>
<tr>
<td>Comparator Result Output</td>
<td>14: 7.5 ms (measurement time)</td>
</tr>
<tr>
<td>ERR Output (SYNC Setting)</td>
<td>15: Latched until next trigger (with HOLD setting enabled)</td>
</tr>
</tbody>
</table>

*2 Function: ohm-volt sampling, with EX FAST setting

■ Comparator Functions

- Judges Resistance & Voltage Simultaneously

Resistance and voltage can be simultaneously judged Hi/IN/Lo by independent comparators. Judgment results are provided on the display, beeper, and external I/O. The display allows confirming both results at a glance.

- Composite Judgment Result Output

External I/O provides both separate and combined outputs of resistance and voltage judgment results, so composite results can be monitored.

- Alternative Setting Methods

Set judgment thresholds by specifying high/low (Hi/Lo) values or by specifying a standard value and deviation (%).

- Manual Comparator

Comparator judgments can be executed only when required, supporting flexible control by footswitch or PLC.

- Dual Beep Tones

Different beep tones distinguish IN and Hi/Lo judgments. Both tones can be independently enabled or disabled.
Multiple Recording Methods

**Analog Output** (BT3563-01 and BT3562-01 only)

The BT3563-01 and BT3562-01 provide analog output of resistance measurement values. This is convenient for combining recorded data from multiple locations or of various data types, such as for logging long-term measurements and for fuel cell evaluation.

<table>
<thead>
<tr>
<th>Output contents</th>
<th>Measured resistance (displayed value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output rate</td>
<td>0 to 3.1 V DC (corresponding to displayed value of 0 to 31000)</td>
</tr>
<tr>
<td>Resolution</td>
<td>12 bits</td>
</tr>
<tr>
<td>Response time</td>
<td>10 ms</td>
</tr>
</tbody>
</table>

**PC Application Program**

Measurement data can be transferred to a PC for importing to a spreadsheet program or storage as CSV files. Interval and manual measurements can be triggered by a keystroke or external trigger signal.

Download the PC application program from our website:  
http://www.hioki.com/

**Data Printing**

Measurement values, judgment results, and statistical calculation results can be printed via RS-232C on the optional printer model 9670.

- **Interval Printing**
  Elapsed time and measurement values can be printed over a specified interval. The interval can be set from 1 to 3,600 seconds.

<table>
<thead>
<tr>
<th>Printing system</th>
<th>Thermal line-dot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printout width</td>
<td>72 mm</td>
</tr>
<tr>
<td>Printing speed</td>
<td>47.5 mm/s</td>
</tr>
<tr>
<td>Power</td>
<td>AC Adapter Model 9671 or Battery Pack Model 9672</td>
</tr>
<tr>
<td>Size and weight</td>
<td>Approx. 119W × 77H × 174D mm, approx. 500 g</td>
</tr>
</tbody>
</table>

Printer operation requires AC Adapter 9671 and RS-232C Cable 9638.
Specifications

## BT3563, BT3562 and 3561 Specifications

### Measurement types
- Resistance and voltage

### Resistance measurement method
- Four-terminal AC (1-kHz) method

### Functions
- ΩV, Ω and V

### Rated voltage
- **[BT3563(-01)]**
  - ±300V DC rated input voltage
  - ±300V DC maximum rated voltage to ground
- **[BT3562(-01)]**
  - ±60V DC rated input voltage
  - ±70V DC maximum rated voltage to ground
- **[3561(-01)]**
  - ±22V DC rated input voltage
  - ±70V DC maximum rated voltage to ground

### Input resistance
- **[BT3563(-01) and BT3562(-01)]**
  - 3mΩ/30mΩ/300mΩ ranges: Approx. 90kΩ
  - 3Ω/30Ω/300Ω/3000Ω ranges: Approx. 1MΩ
- **[3561(-01)]**
  - Approx. 1MΩ

### Sampling rate
- Four steps – Extra Fast, Fast, Medium or Slow

### Response time
- **[BT3563(-01) and BT3562(-01)]**
  - Approx. 10 ms for measurements
  - Approx. 3 ms for measurements
- **[3561(-01)]**
  - Approx. 3 ms for measurements

### Total measurement time
- Sampling time + Response time

### Zero-adjustment
- 1000-count range (both resistance and voltage)

### Triggering
- Internal or external

### Delay time
- On/off, 0 to 9999 seconds

### Averaging samples
- On/off, 2 to 16 samples

### Statistical calculations
- Total data count; valid data count; minimum, maximum and average values; standard deviation; population standard deviation and process capability indices

### Measurement value output function
- Measurement values are output via RS-232C upon trigger input

### Measurement value memory
- Up to 400 measurements

### Panel save/load
- Up to 126 configuration settings

### Analog Output
- Measurement (displayed value, from 0 to 3.1 V DC)

### External interface
- External I/O, RS232C (9600, 19200 or 38400 bps), Printer RS-232C (all models), GP-IB (Model BT3563-01, BT3562-01 and 3561-01 only)

### Other functions
- Over-range display, measurement error detection, self-calibration, dual comparators, key-lock

### BT3563, BT3562 and 3561 General Specifications

#### Operating temperature & humidity
- 0 to 40˚C, 80% rh or less (non-condensating)

#### Storage temperature & humidity
- -10 to 50˚C, 80% rh or less (non-condensating)

#### Guaranteed accuracy temperature & humidity
- 23˚C ±5˚C, 80% rh or less (non-condensating)

#### Operating conditions
- Indoors, below 2000 m ASL

#### Rated supply voltage
- 100 to 240 V AC (auto-selecting)

#### Rated supply frequency
- 50/60 Hz

#### Rated power consumption
- 30 VA

#### Insulation withstand potential
- **[BT3563(-01), BT3562(-01)]**
  - 1.39 kV AC for 15 s (with 10 mA cut-off current) between all mains supply terminals and protective ground terminal
  - 2.224 kV AC for 15 s (with 1 mA cut-off current) between all measurement jacks and interfaces
  - 1.39 kV AC for 15 s (with 1 mA cut-off current) between all measurement jacks and protective ground terminal
- **[3561(-01)]**
  - 1.69 kV AC for 15 s (with 10 mA cutoff current) between all mains supply terminals and protective ground, interfaces, and measurement jacks

#### Dimensions
- Approx. 215W × 80H × 295D mm (without projections)

#### Mass
- Approx. 2.4 kg

#### Accessories
- Power Cord (1)

#### Applicable Standards
- EN61010-1
- EN61326
- EN61000-3-2
- EN61000-3-3

### BT3563 and BT3562

#### [ Sampling Times ]

<table>
<thead>
<tr>
<th>Function</th>
<th>EX.FAST</th>
<th>FAST</th>
<th>MEDIUM</th>
<th>SLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΩV (50Hz)</td>
<td>8ms</td>
<td>24ms</td>
<td>84ms</td>
<td>259ms</td>
</tr>
<tr>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>70ms</td>
<td></td>
</tr>
<tr>
<td>Ω (50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
<td>157ms</td>
</tr>
<tr>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>33ms</td>
<td>130ms</td>
</tr>
<tr>
<td>V (50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
<td>157ms</td>
</tr>
<tr>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>35ms</td>
<td>150ms</td>
</tr>
</tbody>
</table>

Items in the parentheses () indicate supply frequency settings; Tolerance: ±5 ms for SLOW sampling, and ±1 ms for other settings.

### 3561

#### [ Sampling Times ]

<table>
<thead>
<tr>
<th>Function</th>
<th>EX.FAST</th>
<th>FAST</th>
<th>MEDIUM</th>
<th>SLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΩV (50Hz)</td>
<td>7ms</td>
<td>23ms</td>
<td>83ms</td>
<td>258ms</td>
</tr>
<tr>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>69ms</td>
<td>225ms</td>
</tr>
<tr>
<td>Ω (50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
<td>157ms</td>
</tr>
<tr>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>33ms</td>
<td>150ms</td>
</tr>
<tr>
<td>V (50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
<td>157ms</td>
</tr>
<tr>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>35ms</td>
<td>150ms</td>
</tr>
</tbody>
</table>

Items in the parentheses () indicate supply frequency settings; Tolerance: ±5 ms for SLOW sampling, and ±1 ms for other settings.
## Measurement Ranges and Accuracy

### BT3563, BT3562 and 3561

#### Conditions of Guaranteed Accuracy

- **Temperature & humidity:** 23 °C ±5 °C, 80% rh or less (non-condensating)
- **Zero-adjustment:** After executing zero-adjustment
- **Warm-up time:** At least 30 min.
- **Self-calibration:** Unless using SLOW sampling, execute self-calibration after warm-up and restrict temperature fluctuations to within ±2 °C after calibration.

### BT3563 and BT3562

#### [Resistance Measurement]

<table>
<thead>
<tr>
<th>Range</th>
<th>3mΩ</th>
<th>30mΩ</th>
<th>300mΩ</th>
<th>3Ω</th>
<th>30Ω</th>
<th>300Ω</th>
<th>3000Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum display Value</td>
<td>3.1000mΩ</td>
<td>31.000mΩ</td>
<td>310.00mΩ</td>
<td>3.1000Ω</td>
<td>31.000Ω</td>
<td>310.00Ω</td>
<td>3100.0Ω</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1µΩ</td>
<td>1µΩ</td>
<td>10µΩ</td>
<td>100µΩ</td>
<td>1mΩ</td>
<td>10mΩ</td>
<td>100mΩ</td>
</tr>
<tr>
<td>Measurement Current(^1)</td>
<td>100mA</td>
<td>100mA</td>
<td>10mA</td>
<td>1mA</td>
<td>100µA</td>
<td>10µA</td>
<td>10µA</td>
</tr>
<tr>
<td>Measurement Current Frequency</td>
<td>1kHz ±0.2Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy(^2)</td>
<td>±0.5%rdg. ±10dgt.</td>
<td>±0.5%rdg. ±5dgt.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>(±0.05%rdg. ±1dgt.) / °C</td>
<td>(±0.05%rdg. ±0.5dgt.) / °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open-Circuit Voltage</td>
<td>25V peak</td>
<td>7V peak</td>
<td>4V peak</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Measurement current accuracy is ±10%.
\(^2\) 30mΩ to 3000Ω ranges: Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM
3mΩ range: Add ±30 dgt. for EX FAST, or ±10 dgt. for FAST, or ±5 dgt. for MEDIUM

#### [Voltage Measurement]

<table>
<thead>
<tr>
<th>Range</th>
<th>6V</th>
<th>60V</th>
<th>300V (only BT3563)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum display Value</td>
<td>±6.00000V</td>
<td>±60.000V</td>
<td>±300.000V</td>
</tr>
<tr>
<td>Resolution</td>
<td>10µV</td>
<td>100µV</td>
<td>1mV</td>
</tr>
<tr>
<td>Accuracy(^3)</td>
<td>±0.01%rdg. ±3dgt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>(±0.001%rdg. ±0.3dgt.) / °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^3\) Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM

### 3561

#### [Resistance Measurement]

<table>
<thead>
<tr>
<th>Range</th>
<th>300mΩ</th>
<th>3Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum display Value</td>
<td>310.00mΩ</td>
<td>3.1000Ω</td>
</tr>
<tr>
<td>Resolution</td>
<td>10µΩ</td>
<td>100µΩ</td>
</tr>
<tr>
<td>Measurement Current(^4)</td>
<td>10mA</td>
<td>1mA</td>
</tr>
<tr>
<td>Measurement Current Frequency</td>
<td>1kHz ±0.2Hz</td>
<td></td>
</tr>
<tr>
<td>Accuracy(^5)</td>
<td>±0.5%rdg. ±5dgt.</td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>(±0.05%rdg. ±0.5dgt.) / °C</td>
<td></td>
</tr>
<tr>
<td>Open-Circuit Voltage</td>
<td>7V Peak</td>
<td></td>
</tr>
</tbody>
</table>

\(^4\) Measurement current accuracy is ±10%.
\(^5\) Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM

#### [Voltage Measurement]

<table>
<thead>
<tr>
<th>Range</th>
<th>20V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum display Value</td>
<td>±19.9999V</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1mV</td>
</tr>
<tr>
<td>Accuracy(^5)</td>
<td>±0.01%rdg. ±3dgt.</td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>(±0.001%rdg. ±0.3dgt.) / °C</td>
</tr>
</tbody>
</table>

\(^5\) Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM

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**About Accuracy**

Accuracy is calculated from the reading error (±% rdg.) determined by the measurement value and range, and the digit error (± dgt.).

**Calculation Example**

- **Measurement value:** 1 Ω, **Measurement range:** 3 Ω
- Specified accuracy (from table below): ±0.5% rdg., ±5 dgt.
  - (A) Reading error (±% rdg.): 1 Ω × 0.5% = ±0.005 Ω
  - (B) Digit error (± dgt.): ±5 dgt. = ±0.0005 Ω (at 0.0001 Ω resolution)
  - (C) Total error (A + B): ±0.0055 Ω

Applying total error (C) to the measurement value of 1 Ω gives an error limit of 0.9945 to 1.0055 Ω.
**Option Configurations**

### Main unit

**BATTERY HiTESTER BT3563**
BT3563-01 (with GP-IB and analog output)

**BATTERY HiTESTER BT3562**
BT3562-01 (with GP-IB and analog output)

**BATTERY HiTESTER 3561**
3561-01 (with GP-IB)

- Measurement leads are not included. Purchase the appropriate lead option for your application separately.
- The male (system side) of the EXT I/O connector is also available. Please inquire with your HIOKI distributor.

### Options (measurement leads)

**Measurement leads**

- **PIN TYPE LEAD L2100**
  - A: 300 mm, B: 172 mm, L: 1400 mm
  - For high voltage battery measurements, 600 V DC max., BT3560 and BT3562 only

- **CLIP TYPE LEAD 9287-10**
  - A: 130 mm, B: 83 mm, L: 1300 mm, DC70V

- **FOUR TERMINAL LEAD 9453**
  - A: 250 mm, B: 136 mm, L: 1800 mm, DC60V

- **LARGE CLIP TYPE LEAD 9467**
  - A: 300 mm, B: 130 mm, L: 1300 mm, DC95V

- **PIN TYPE LEAD 9770**
  - A: 260 mm, B: 148 mm, L: 850 mm, DC70V

- **PIN TYPE LEAD 9771**
  - A: 260 mm, B: 113 mm, L: 800 mm, DC70V

- **CLIP TYPE LEAD 9452**
  - A: 220 mm, B: 197 mm, L: 1600 mm

- **PIN TYPE LEAD 9455**
  - A: 260 mm, B: 136 mm, L: 890 mm

- **PIN TYPE LEAD 9770**
  - A: 260 mm, B: 140 mm, L: 850 mm, DC70V

### Options (Printer and Interface Cables)

**Printer options**

- **PRINTER 9670**
  - Requires AC Adapter Model 9671

- **AC ADAPTER 9671**
  - For 9670, AC100 to 240V

- **RS-232C CABLE 9638**
  - For Printer 9670, 9- to 25-pin crossover, 1.8m

- **RECORDING PAPER 9237**
  - For 9670, 80 mm × 25 m, 4 rolls

**Interface (RS-232C and GP-IB)**

- **RS-232C CABLE 9637**
  - 9- to 9-pin crossover, 1.8m

- **RS-232C CABLE 9638**
  - 9- to 25-pin crossover, 1.8m

- **GP-IB CONNECTOR CABLE 9151-02**
  - 2m

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