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

- 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.

- 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

Voltage measurement ranges: 6V/60V/300V (BT3563) 6V/60V (BT3562)
Resistance measurement ranges: 3mΩ/30mΩ/300mΩ/3Ω/30Ω/300Ω/3000Ω

BATTERY HiTESTER BT3563
BATTERY HiTESTER BT3562

Lithium-Ion and Secondary Batteries
Cell phones E-books Electric bicycles Electric scooters EV/HEV

Measurement Parameters and Applications
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

Features
- 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).

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 configurations 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 (OAJD)</td>
<td>• Comparator results (R-Hi, R-IN, R-Lo, 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 (OUT1 to OUT9)</td>
</tr>
<tr>
<td>• Load panel settings (7 bits) (LOAD0 to LOAD6)</td>
<td></td>
</tr>
</tbody>
</table>

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

■ 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>Contact State</th>
<th>ERR Output (ASYNC Setting)</th>
<th>TRIG Input</th>
<th>INDEX Output</th>
<th>Comparator Result Output</th>
<th>EOM Output</th>
<th>ERR Output (SYNC Setting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Open</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>

11: 1.5 ms (ERR output response time)
12: Minimum 0.5 ms (measurement trigger pulse width)
13: 0.3 ms (calculation time) 14: 7.8 ms (measurement time) 15: Latched until next trigger (with HOLD setting enabled)
*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, and those including judgment results and statistical calculation results can be printed using an RS-232C-compatible printer.

**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.

**Requirement specification (printer)**

The requirements for a printer to be connected to the instrument are as follows. Confirm compatibility and make the appropriate settings on the printer before connecting it to the instrument.

<table>
<thead>
<tr>
<th>Interface</th>
<th>RS-232C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characters per line</td>
<td>At least 40</td>
</tr>
<tr>
<td>Communication speed</td>
<td>9600 bps</td>
</tr>
<tr>
<td>Data bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>none</td>
</tr>
<tr>
<td>Stop bits</td>
<td>1</td>
</tr>
<tr>
<td>Flow control</td>
<td>none</td>
</tr>
</tbody>
</table>

ASCII data will be sent from the BT3563/BT3562/3561. Please use a printer that can output plain text.

For the RS-232C cable, the connector at the instrument end should be a molded type. The metal type (with hooks preventing the surface from being flat) will not fit due to the instrument's design.
**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
  - ±70V 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

### 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 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 1mA 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**
- Safety: EN61010-1
- EMC: EN61326
- EN61000-3-2
- EN61000-3-3

### BT3563 and BT3562

<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</td>
<td>(50Hz)</td>
<td>8ms</td>
<td>24ms</td>
<td>84ms</td>
</tr>
<tr>
<td></td>
<td>(60Hz)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ω</td>
<td>(50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
</tr>
<tr>
<td></td>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>33ms</td>
</tr>
<tr>
<td>V</td>
<td>(50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
</tr>
<tr>
<td></td>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>33ms</td>
</tr>
</tbody>
</table>

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

### 3561

<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</td>
<td>(50Hz)</td>
<td>7ms</td>
<td>23ms</td>
<td>83ms</td>
</tr>
<tr>
<td></td>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>69ms</td>
</tr>
<tr>
<td>Ω</td>
<td>(50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
</tr>
<tr>
<td></td>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>33ms</td>
</tr>
<tr>
<td>V</td>
<td>(50Hz)</td>
<td>4ms</td>
<td>12ms</td>
<td>42ms</td>
</tr>
<tr>
<td></td>
<td>(60Hz)</td>
<td></td>
<td></td>
<td>33ms</td>
</tr>
</tbody>
</table>

**Sampling Times**
- 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></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3mΩ, 30mΩ, 300mΩ, 3Ω, 30Ω, 300Ω, 3000Ω</td>
<td>3.1000mΩ, 31.000mΩ, 310.00mΩ, 3.1000Ω, 31.000Ω, 310.00Ω, 3100.0Ω</td>
<td>0.1µΩ, 1µΩ, 10µΩ, 100µΩ, 1mΩ, 10mΩ, 100mΩ</td>
<td>100mA, 100mA, 10mA, 1mA, 100µA, 10µA, 10µA</td>
<td>1kHz ±0.2Hz</td>
<td>±0.5%rdg., ±0.5dgt.</td>
<td>±0.05%rdg., ±0.5dgt., °C</td>
<td></td>
</tr>
<tr>
<td>300mΩ, 3Ω</td>
<td>310.00mΩ, 3.1000Ω</td>
<td>10µΩ, 100µΩ</td>
<td>1mA, 1mA</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

#### [Voltage Measurement]

<table>
<thead>
<tr>
<th>Range</th>
<th>Maximum display Value</th>
<th>Resolution</th>
<th>Accuracy[^3]</th>
<th>Temperature coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>6V</td>
<td>±6.00000V</td>
<td>10µV</td>
<td>±0.01%rdg., ±3dgt.</td>
<td>(±0.001%rdg., ±0.3dgt.), °C</td>
</tr>
<tr>
<td>60V</td>
<td>±60.0000V</td>
<td>100µV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300V</td>
<td>±300.000V</td>
<td>1mV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[^3]: Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM

**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. = ±0.005 [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.

#### 3561

**[Resistance Measurement]**

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

[^4]: Measurement current accuracy is ±10%.
[^5]: Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM

#### 3561

**[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[^6]</td>
<td>±0.01%rdg., ±3dgt.</td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>(±0.001%rdg., ±0.3dgt.), °C</td>
</tr>
</tbody>
</table>

[^6]: Add ±3 dgt. for EX FAST, or ±2 dgt. for FAST and MEDIUM
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)

Options (measurement leads)

Measurement leads (for measuring high voltage batteries with Models BT3563 and BT3562)

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

Options (Interface Cables)

RS-232C CABLE 9637
RS-232C CABLE 9638
GP-IB CONNECTOR CABLE 9151-02

Measurement leads (for measuring batteries up to 60 V with BT3563, BT3562, or 3561)

CLIP TYPE LEAD 9287-10
A:130 mm, B:110 mm, L:1100 mm, DC70V

FOUR TERMINAL LEAD 9453
A:250 mm, B:114 mm, L:1300 mm, DC60V

LARGE CLIP TYPE LEAD 9467
A:300 mm, B:116 mm, L:1300 mm, DC60V

Measurement leads (3561 only)

CLIP TYPE LEAD 9452
A:220 mm, B:197 mm, L:166 mm
9452 tip shape

Zero adjustment board (for L2100 only)

Measurements leads (3561 only)

PIN TYPE LEAD 9455
A:260 mm, B:136 mm, L:890 mm
9455 pin (enlarged)

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