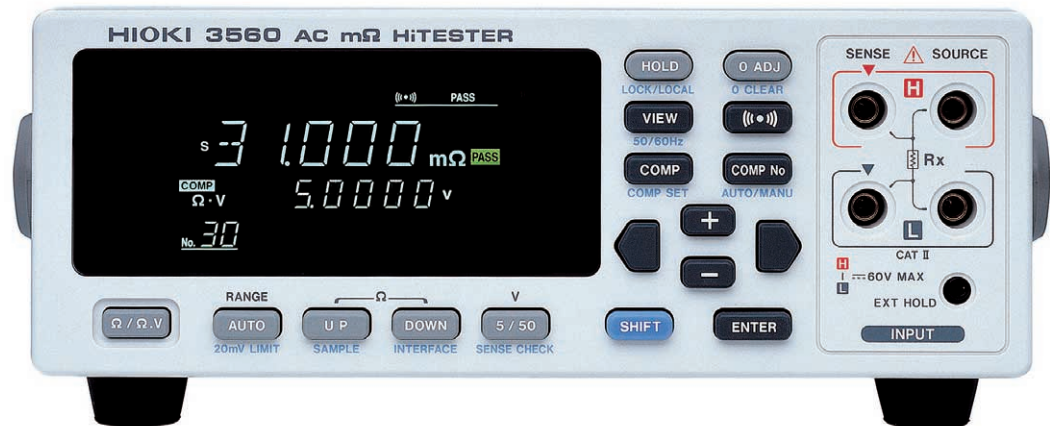


3560 AC mΩ HiTESTER

Components measuring instruments



Contact resistance meter with high-speed response

Covers measurement requirements from contact resistance to internal resistance and voltage of batteries.



ISO14001
JQA-E-90091



<http://www.hioki.co.jp/>

HIOKI company overview, new products, environmental considerations and other information are available on our website.

This contact resistance meter complete with comparator function and external interface utilizes the principles of the AC 4-terminal method that gives priority to line use and allows measurement offering high speed, high accuracy and high resolution.

External output terminal, external control terminal and RS-232C interface are standard features. GP-IB interface and printer interface are optionally available. The instrument also features an Ω and V mode that allows simultaneous measurement and comparison of battery internal resistance and open-circuit voltage. This HiTester is highly suitable for battery inspection lines as one unit can act as both a low-resistance meter and DMM.

Fast response time - approximately 84 ms (60 Hz)



Features

●Fast measurement and fast quality determination

In the FAST mode, the tester performs lightning fast measurements at 60 times/sec with a response time of about 84 ms (at 60 Hz) to reduce the line tact time. This helps increase mass-production efficiency. The comparator has memory for 30 configuration tables which enables one unit to perform quality determination of multiple model types.

●Low-power resistance measurement

Low-power resistance measurement conforming to the international IEC 512-2 standard is possible. Capable of accurately measuring contact resistance without destroying the oxide film on contact surfaces of components such as relays and connectors.

●Battery measurement

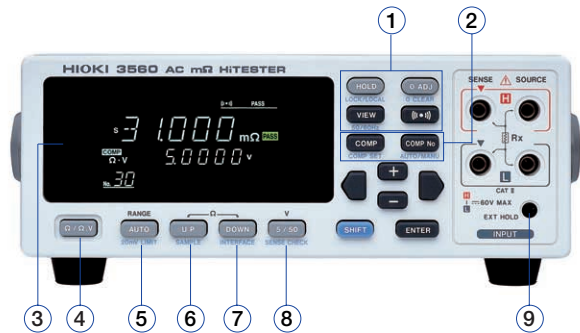
Since DC voltage measuring can be performed simultaneously, it is possible to measure open-circuit voltage of batteries. One unit can measure both internal resistance and open-circuit voltage for complex quality evaluation. Furthermore, using the voltage limiter OFF function enables even more stable measurement of battery internal resistance.

■ Comparator Function

Two settings are available for the resistance measurement mode: the upper limit and lower limit value settings. In the low-resistance and voltage measurement mode, the upper limit and lower limit value settings can be made separately for the two measurement items. When both are determined as IN, PASS is indicated, in other cases FAIL is indicated. In addition to the Hi/IN/Lo and PASS/FAIL indications, the results can also be signaled by a buzzer and output via an open-collector output.

Up to 30 comparator configuration tables can be memorized, each storing settings for a measurement mode, measurement range, upper and lower limit values and a buzzer mode.

■ Basic button explanation



1. HOLD button (in addition to holding the display, this also allows measurement control by measurement trigger)
VIEW button (allows check of comparator conditions by one-touch operation and setting of power supply frequency)
Executes zero adjustment and switches the buzzer ON/OFF.
2. COMP button (used for switching the comparator ON/OFF and to switch to the condition setting mode)
COMP No. button (used for selecting the comparator table and the result output trigger)
3. Clearly visible display employing fluorescence display tube.
4. Switches between the resistance and resistance/voltage measurement modes.
5. Switches the auto range ON/OFF, and switches the open terminal voltage limiter ON/OFF.
6. Raises the range and switches the sampling rate.
7. Lowers the range and switches between the RS-232C and the GP-IB interface mode.
8. Switches the voltage range, and switches the sense check function ON/OFF.
9. External hold terminal

●High-resolution measuring

High-resolution measurement with a resolution of 1 $\mu\Omega$ in the 30 m Ω range.

●Sense check function for prevention of erroneous measurements

Earlier instruments only perform sense check on the source side, but the 3560 unit also performs this on the sense side to guarantee against erroneous measuring and wrong evaluation.

●Interface provided

RS-232C interface and external control terminal are standard features. Printer interface and GB-IP interface are available as options.

●Comfortable operation

The number of switch operations has been reduced to achieve simple and intuitively understandable operation.

●Versatile array of leads

Various lead types, such as clip leads, pin leads and 4-terminal leads, are available, allowing you to select the most suitable type for the component to be measured.



Resistance comparator value setting



Voltage comparator value setting



Buzzer mode setting

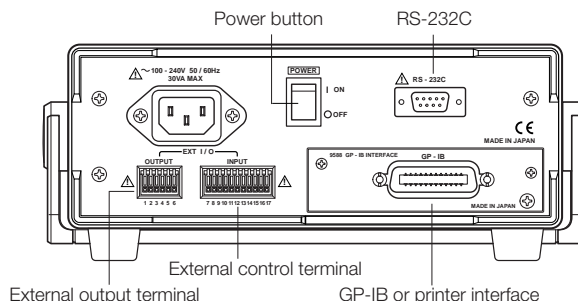
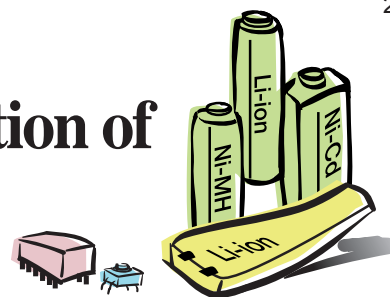
■ Comparator setting example

Resistance range 300 m Ω (upper limit value 180.00 m Ω /lower limit value 170.00 m Ω), voltage range 5 V (upper limit value 3.8000 V/lower limit value 3.5000 V), Table No.1, buzzer set to sound for PASS.

High-Speed Measuring for Construction of Highly Efficient Lines.

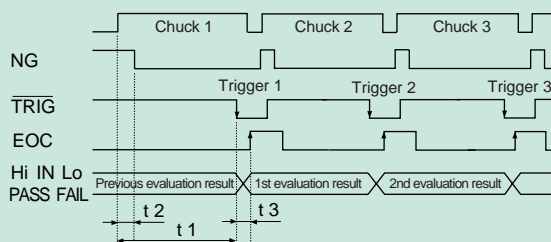
Designed for System Use

External control and external output terminals are provided. External control can be used for selecting the comparator table, as trigger and for requesting printout, etc. The external output can be used for output of comparator results, measurement completion (EOC) and NG output. These external input and output capabilities have been designed with construction of systems in mind.



Timing Chart Example

The following shows a timing example for reading out the comparator results using the HOLD function and external input and output features.



t1: Approx. 80 ms (FAST 60 Hz), approx. 660 ms (MEDIUM 60 Hz), approx. 1.6s (SLOW 60 Hz)
 Approx. 95 ms (FAST 50 Hz), approx. 795 ms (MEDIUM 50 Hz), approx. 1.92s (SLOW 50 Hz)
 t2: Approx. 10 ms
 t3: Approx. 10 ms

In the HOLD mode, the sequence is simple as EOC is retained until the next trigger is input. Furthermore, the display and output are retained until the next EOC is entered.

- t1: [Stabilizing time] Following chuck, the trigger is input after the measuring current has stabilized.
- t2: [Detection time] Time from when chuck is detected until the NG signal becomes Lo.

* t1 and t2 differ with the measured object. The figures are reference values in case of pure resistance.

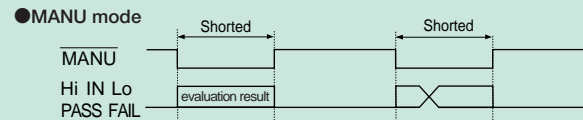
- t3: [Evaluation time] The time from when the measurement value is judged at the point when the trigger is input and until the EOC signal is output. The comparison result is decided on the rising edge of EOC. At this point, the evaluation result is obtained.

Nature of external control and outputs (negative logic)

- Control (CMOS/5 V max.)
 - Measurement trigger (TRIG)
 - Comparator output request (MANU)
 - Zero adjustment request (0 ADJ)
 - Print request (PRINT)
 - Comparator table selection (COMP)
 - EXT.DCV (DC5 V - 24 V)
 - GND
- Output (Open-collector output/35 V - 50 mA max.)
 - Comparator result signals (Hi, IN, Lo/PASS, FAIL)
 - Measurement termination signal (EOC)
 - Measurement irregularity detection signal (NG)

Switch between automatic and manual output of comparator results (set using panel buttons)

In the AUTO mode, the comparator results are continuously output. In the MANU mode, the results are only output when the external MANU and GND terminals are shorted.



RS-232C Interface Specifications

Transmission method: Start-stop synchronization, full duplex.
 Transmission speed: 9600 bps. Data length: 8 bits. Parity: None. Stop bit: 1 bit. Handshake: Hardware. Delimiter: CR+LF. Connecting cable: D-Sub 9-pin female/female connector. Reverse connection.

External Interfaces (Options)

9588GP-IB interface or 9589 printer interface can be installed. The 9588 allows full remote control of the main unit from a personal computer. The 9589 allows connection of the optional 9203 Digital Printer or a standard printer with Centronics interface. Connecting the 9203 provides multi-function printing, such as interval printing, statistical processing of maxima, minima, average, standard deviation, histogram and graph printing.

9588 GP-IB INTERFACE Specifications

Conforming standard: IEEE-488.1 1987/Reference standard: IEEE-488.2 1987

9203 DIGITAL PRINTER Specifications



- Printer type: Thermal Line Printer
- Statistical processing: Up to 99,999 data points
- Histogram and graphics: Up to 5,000 data points
- Dimensions and mass: Approx. 215 Wx160Hx54Dmm, 1kg / [8.5" W x 6.3" H x 2.1" D, 35.3 oz.]

*Note: Further details are provided in our brochure for the DC low-resistance ohmmeter "3227 mΩ HITESTER". 9203 Version 2.00 or later versions are compatible with the 3560.

Print example

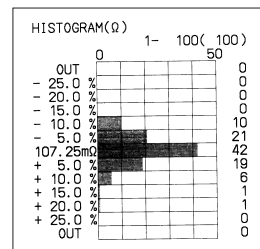
```
START '98- 9- 7 13:41:52
1 13:41:52 109.09mΩ Pass
1.6083 V
2 13:42:00 107.63mΩ Pass
1.6089 V
3 13:42:06 113.33mΩ Pass
1.6091 V
4 13:42:11 108.75mΩ Pass
1.6093 V

95 13:55:13 104.02mΩ Pass
1.6081 V
96 13:55:21 109.34mΩ Pass
1.6070 V
97 13:55:28 104.06mΩ Pass
1.6071 V
98 13:55:36 118.10mΩ Fail
1.6100 V
99 13:55:44 112.70mΩ Pass
1.6082 V
100 13:55:51 110.48mΩ Pass
1.6103 V
END '98- 9- 7 13:56:11

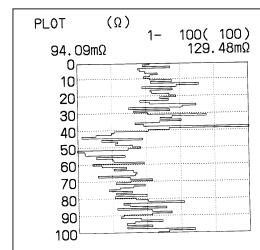
STATISTICS
N = 100 (* 100)
AVE = 107.247mΩ
MIN = 94.09mΩ ( 52)
MAX = 129.48mΩ ( 38)
σn = 5.972mΩ
σn-1 = 8.002mΩ
Cp = 140.91
Cpk = 3.16

STATISTICS
N = 100 (* 100)
AVE = 1.610 V
MIN = 1.6066 V ( 16)
MAX = 1.6132 V ( 31)
σn = 0.001 V
σn-1 = 0.001 V
```

Statistical processing



Resistance value histogram



Resistance value graph printout

■ Specifications

Measurement method: Resistance AC (1 kHz ± 0.2 Hz) 4-terminal method
A/D method: Σ - Δ method with sample hold function
Display: Fluorescent character display tube.
 Resistance [31000], voltage [50000] counter
Auto-ranging: Provided (disabled when comparator is ON)
Input overrange: " OF " display
Measurement irregularity: " ---- " display (NG: External output of measurement irregularity signal)

Sampling rate:

	50 Hz	60 Hz
[FAST]	50 times/s	60 times/s
[MEDIUM]	6.25 times/s	7.52 times/s
[SLOW]	1.56 times/s	1.88 times/s

Response time:

	50 Hz	60 Hz
[FAST]	100 ms	84 ms
[MEDIUM]	800 ms	667 ms
[SLOW]	1.92 s	1.60 s

(When non-conductive resistance is measured. The response time differs depending on the measured object.)

Comparator: Comparator output (Resistance/voltage measurement mode)

Resistance Voltage	Hi	IN	Lo
Hi	FAIL (red)	FAIL (red)	FAIL (red)
IN	FAIL (red)	PASS (green)	(FAIL) (red)
Lo	FAIL (red)	FAIL (red)	FAIL (red)

* Restricted to Hi, IN, Lo in the resistance measurement mode.

- **Mode switch:** Switchable between AUTO and MANU.
- **Comparator points:** Up to 30 comparator condition settings can be memorized.
- **Buzzer output:** [Resistance measurement mode]: Switchable between Hi, Lo and IN.
[Resistance/voltage measurement mode]: Switchable between PASS and FAIL.

Maximum input voltage: DC 60 V max. (AC input is not possible)
Withstand voltage: Between power supply line and protective ground terminal / AC 2.3 kV rms for 1 minute
External output terminals: [Open-collector output] (DC 35 V-50 mA max.) comparator results, measurement termination, measurement irregularity signal
External control terminal: [CMOS input] Measurement trigger, comparator trigger, printer, zero-adjustment, comparator number selection, external power supply possible (DC 5 V to 24 V)
Interfaces: RS-232C (standard), GP-IB or printer interface [Centronics] (option)
Environment conditions: Operating temperature and humidity range: 0 to 40°C (32°F to 104°F), 80% rh or less.
(no condensation) Storage temperature and humidity range: -10 to 50°C (14°F to 122°F), 80% rh or less.
Operating conditions: Indoors, below an altitude of 2000 m.
Power supply: AC 100 V to 240 V (±10%), automatic voltage selection, 50/60Hz
Maximum rated power: 30 VA
Dimensions and mass: 215W × 80H × 320D mm, 2.1 kg / [8.5"W × 3.1"H × 12.6"D, 74.1 oz.] (not including options)
Included accessory: 9287 CLIP TYPE LEADS (1)
Conforming standards: EMC EN55011:1991+A1:1997+A2:1996
EN50082-1:1992
Safety EN61010-1:1993+A2:1995
EN61010-2-031:1994
Pollution degree 2, over-voltage category II (envisioned over-voltage 2.5 kV)

■ Measurement Ranges

Conditions for guaranteed accuracy: at 23°C±5°C [73.4°F ±9°F], 80% rh (no condensation), following 30 min. warming-up, and after zero adjustment

[Resistance measurement] (Sampling speed : SLOW)

Range	30 mΩ	300 mΩ	3 Ω	30 Ω	300 Ω	3 kΩ
Maximum display value	31.000 mΩ	310.00 mΩ	3.1000 Ω	31.000 Ω	310.00 Ω	3.1000 kΩ
Resolution	1 μΩ	10 μΩ	100 μΩ	1 mΩ	10 mΩ	100 mΩ
Measurement current	7.4 mA	1 mA	100 μA	10 μA	5 μA	1.5 μA
Accuracy	±0.5%rdg. ±8dgt. * In the case of MEDIUM: Add 3 dgt. to the above dgt. error FAST: ±0.5% rdg. ±8 dgt. (30 mΩ)/±0.5% rdg. ±6 dgt. (other ranges) However, in the case of FAST, the display counter decreases 4 digits in all ranges.					
Temperature modulus	(±0.05% rdg. ±0.8 dgt.)/°C (1.8°F) *FAST: 300 m to 3 kΩ range (±0.05% rdg. ±0.6 dgt.)/°C (1.8°F)					
Open-terminal voltage	20 mV peak max. (when limiter is ON)					

[Voltage measurement] (Sampling speed : SLOW)

Range	DC 5 V	DC 50 V
Maximum display	±5.0000 V	±50.000 V
Resolution	100 μV	1 mV
Accuracy	±0.05%rdg. ±5dgt.	±0.05%rdg. ±5dgt.
Temperature modulus	(±0.005% rdg. ±0.5 dgt.)/°C (1.8°F)	

* MEDIUM: Add 3 dgt. to the accuracy dgt. error
FAST: Add 5 dgt. to the accuracy dgt. error
 * During charging, the measurement value may be unsteady due to ripple voltage.
 * Resistance with inductance elements may not always be measurable.

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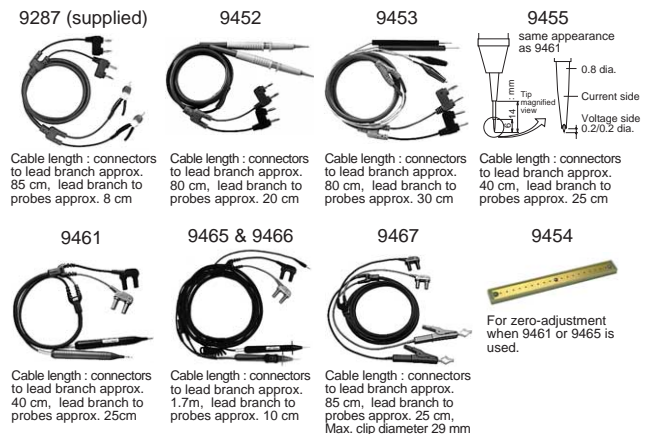
● Options

- 9452 CLIP TYPE LEADS
- 9453 FOUR TERMINAL LEADS
- 9454 ZERO ADJUSTMENT BOARD (for 9461,9465)
- 9455 PIN TYPE LEADS (for high-density use)
- 9461 PIN TYPE LEADS
- 9465 PIN TYPE LEADS
- 9466 REMOTE CONTROL SWITCH
- 9467 LARGE CLIP TYPE LEADS
- 9588 GP-IB INTERFACE
- 9151-02 GP-IB CONNECTION CABLE (2 meters)
- 9151-04 GP-IB CONNECTION CABLE (4 meters)
- 9589 PRINTER INTERFACE
- 9203 DIGITAL PRINTER

9425 CONNECTION CORD (20-pin half-pitch—36pin/D-sub)

[for connecting the 3560 to the 9203/2meters]

9233 RECORDING PAPER (for the 9203/10meters,10rolls)



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