HIOKI

2002

3227 mΩHiTESTER

Electronic measuring instruments

CE

9203 DIGITAL PRINTER

Low resistance measurement with fast response for improved line efficiency

Data handling functions provided by optional printer with statistical processing functions

The 3227 mΩ Hitester enables low resistance measurement to be carried out faster and at a higher resolution.The maximum sampling rate of 90 times / second is some five times faster than existing equipment*, for reduced manufacturing and testing line times. The optional GP-IB interface allows full remote control, and also statistical processing using the 9203 DIGITAL PRINTER, thus enabling a range of functions from system use to data management.

*Comparison with HIOKI 3224 mΩ HiTESTER

ISO14001
JQA-E-90091

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

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

Fluorescent display tube for clear indications

* All display segments shown lit for purposes of illustration

- High-precision, high-resolution measurements as small as 10μΩ by means of the four-terminal measurement method.
- Sampling rate variable: 4,16 or 90 times / second (at 90 times / second, 3-1/2-digit display)
- Up to 15 sets of comparator conditions can be held in memory
- Comparator functions for checking variation from a standard value
- Comparator results displayed and also indicated by buzzer and open-collector output signal
- Auto-ranging function
- External setting possible for measurement ranges and comparator settings
- External control possible for trigger inputs, BCD outputs, comparator outputs, and so forth
- Temperature correction function for measurement independent of material and temperature ; ambient temperature can also be measured
- Can display the temperature (t) or increase in temperature (Δ t) of an object, deriving the values from the resistance
- Optional 9203 DIGITAL PRINTER allows data management, including computation of standard deviation, process efficiency index, and histograms
- 9588 GP-IB interface (option)
- 9589 printer interface (option)
- 9203 DIGITAL PRINTER (option)

* Select either one of the 9588 and 9589 options. The 9203 requires the 9589 option.

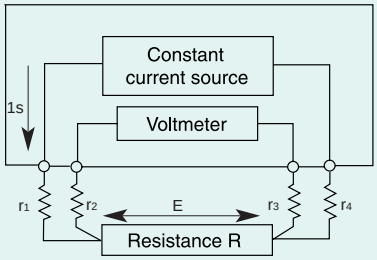
9203 DIGITAL PRINTER

For measurement free of influence of the lead or contact resistance

Four-terminal method

The conventional two-terminal method inevitably produces a reading which includes the resistance of the measurement leads and the contacts. Particularly when measuring low resistances, it is necessary to obtain a reading which eliminates these measurement errors. The four-terminal method provides a value which is independent of the measurement resistances.

Resistance measurement circuit



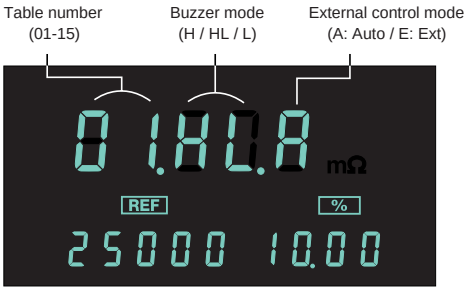
(Values r1 to r4 are the resistances of the test leads plus contact resistances.)

Since the voltmeter has a very high impedance, effectively all of the current Is passes through the resistance R being measured. Measuring the voltage drop E across the resistance R provides a measurement with the effects of the resistances r1 and r4 eliminated.

R=E / Is

9287 Clip-Type Leads (supplied)

Up to 15 sets of comparator conditions can be held in memory



Comparator setting mode

- **Comparison with upper limit (Hi) and lower (Lo)**

Setting range : both upper and lower limits 0 to 99999 reading

- **Comparison with reference value (REF) and range (%)**

Setting range : reference value 0 to 99999 reading range 0.01 to 99.99%

As well as comparison with upper and lower limit values, it is possible to make a comparison as a percentage deviation from a reference value (REF/%). The comparison is carried out on the display reading only, and the result is output using one of three buzzer modes and also an open collector output signal. The unit can hold up to15 sets of comparator conditions in memory, and these can be controlled externally.

■ Setting

The table number (comparator setting number), buzzer mode, method of outputting comparator result, and reference value and range are set. For an upper and lower limit comparison the upper and lower limits are set, and for a reference value comparison the reference value and deviation range are set, as shown in the figure on the left.

Temperature correction (TC function) regardless of material or temperature

Temperature correction setting mode

9188 Temperature probe (supplied)

Using the 9188 temperature probe, it is possible to correct the displayed resistance value to the required temperature by any thermal coefficient. Conventional units have temperature correction using a copper wire at 20 °C, but the 3227 provides converted values regardless of material or temperature.

■ Setting

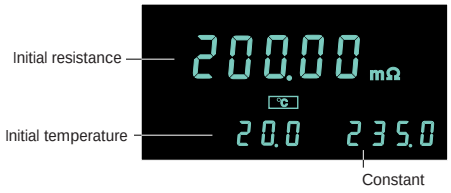
For example, if the ambient temperature is 30 °C, and a resistance of 100 Ω of a copper wire is to be converted to the value at 20 °C, then this correction can be obtained by making settings as shown below for the corrected temperature and the thermal coefficient (when the conductivity is close to 1, for copper this is 3930 ppm).

Formula for converting 100 Ω resistance of copper to 20 °C at an ambient temperature 30 °C :

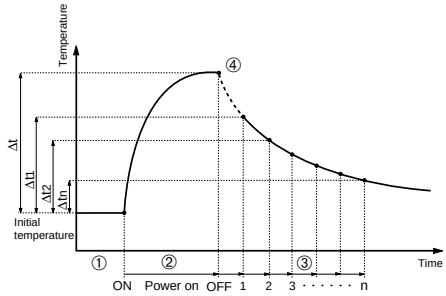
$R_{t0} = R_t/\{1+\alpha_{t0}\times(t-t_0)\} = 100 / \{1 + (3930 \times 10^{-6}) \times (30 - 20)\} \fallingdotseq 96.21\ \Omega$

R_{t0}: corrected resistance value / R_t: measured resistance value / α_{t0}: thermal coefficient of resistance t(°C): ambient temperature / t_0 (°C): temperature of corrected value

Useful Temperature Conversion Function for Motor / Coil Evaluation



Temperature conversion setup mode



This function display the temperature (t) or increase in temperature (Δt) of an object, deriving the values from the measured resistance of the object and the ambient temperature. It is also possible to use the calculated value for making comparisons. When evaluating motors and coils, it is necessary to confirm the maximum temperature increase that will occur while power is applied to the component. this function makes it easy to estimate the maximum temperature.

* The temperature conversion function can not be used at the same time as the temperature compensation function

① Allow the motor or coil to reach room temperature, and then measure the resistance (r_0) and ambient temperature (t_0) before supplying power to the motor or coil.

② Turn on the power, and then turn the power off once you think that the increased temperature of the motor or coil has reached a plateau.

③ After the power is turned off, the device measures the change in temperature (Δt_1 to Δt_n) at fixed intervals on the basis of the resistance (r_t) and the ambient temperature (t). ④ The device then graphs the temperature data that was collected (Δt_1 to Δt_n) and

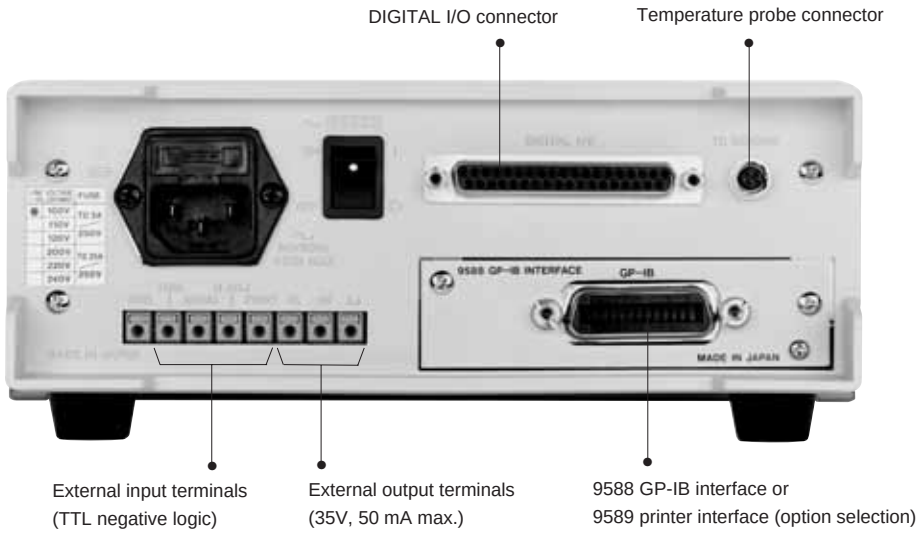
For example, with a copper wire at an initial temperature (t_0) of 20 °C and a resistance (r_0) of 200 mΩ, assume that the nth measurement values were 25 °C for the ambient temperature (t) and 210 mΩ for the resistance (r_t). The device then calculates and displays the increase in temperature (Δt_n) at that point according to the following formula:

$\Delta t_n = r_t / r_0 (T+ t_0)-(T+t)$ *T is a constant. (copper: 235; aluminum:230)

$= (210 \times 10^{-3}) / (200 \times 10^{-3}) \times (235 + 20) - (235 + 25) = 7.75$ °C

Interface for powerful external control, comparator and range switching

The external I / O terminals and DIGITAL I / O connector enable full external control in an automatic measurement system, providing not only the comparator result output, but also BCD output, and input of range settings, comparator table setting, zero - adjustment and so forth.



External I / O terminals

Input terminals (TTL negative logic)

[TRIG: measurement trigger]
When the HOLD key is enabled, updates the display.

[MANU: comparator output request]
When the external control mode is EXT, this causes the comparator result to be output.

[0 ADJ: zero adjustment]
This allows external control of zero adjustment.

[PRINT: print request]
When a printer is connected, this starts printing.

Output terminals (open collector negative logic: 35 V, 50 mA max.)

[Hi, IN, and Lo]
The comparator result is shown as “Hi”,“IN”or “Lo” in color, and buzzer and open collector outputs are also provided. There are two output modes: AUTO mode, in which the result is output for every sampling, and EXT mode, in which the result is only when the MALU terminal is short - circuited, to allow automatic testing on production line.

Interfaces (options)

The optional interfaces are provided by plug - in units, so it is possible to change interfaces easily if required.

■ 9588 GP - IB interface (option)

This allows full external control, and also data transfer to a personal computer.

■ 9589 Printer interface (option)

This allows measurement results and comparator results to be output either to the optional 9203 DIGITAL PRINTER or to a general-purpose printer with a standard Centronics interface. In particular, with the 9203 DIGITAL PRINTER it is possible not only simply to print the data but also to carry out various statistical computations.

Temperature probe connector

Connect the supplied 9188 temperature probe to allow temperature correction of the resistance measurement and also direct measurement of the ambient temperature.

including comparator result output, and

DIGITAL I/O connector

This connector allows external setting of the comparator table number and range, and also provides a BCD output, measurement end (EOC) signal, and comparator failure (NG) signal, allowing integration into an automatic line for testing a range of different components.

Digital I/ O connector pin assignments

PIn	Input / output	Signal name
1	Power supply	VCC
2		VCC
3	Output	BCD
≀		≀
12		BCD
13	Output	EOC
14	Input	COMP 0
15		COMP 1
16		COMP 2
17		COMP 3
18	Ground	GND
19		GND

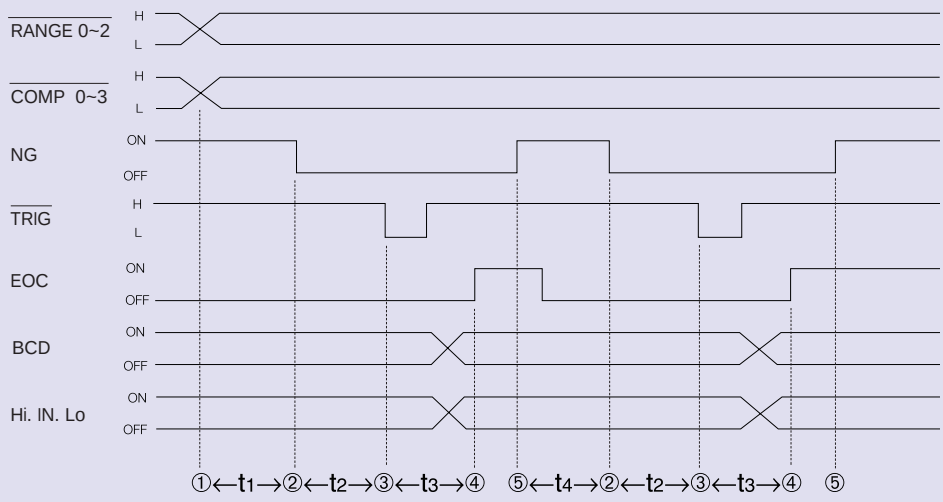
PIn	Input / output	Signal name
20	Power supply	VCC
21		VCC
22	Output	BCD
≀		≀
31		BCD
32	Output	NG
33	Input	RANGE 0
34		RANGE 1
35		RANGE 2
36	Ground	GND
37		GND

* VCC: voltage (GND + 5 V) / approx. 200 mA max.
GND: voltage (0 V)

Sample application

The following timing chart illustrates how this unit can be incorporated into an automatic testing line.

Timing chart for external control



①:Change the measurement range and comparator table number, using the external control terminals.
(If the test object is the same type, the states of the RANGE 0 to 2 and COMP 0 to 3 signals are kept the same. If the range and comparator table setting are not changed, these terminals can be left open-circuit.)

t1:Wait while unit stabilizes after changing measurement range setting.
(If the response time is 10 ms or more, then range switching and chucking can be carried out at any time.)

②:Chuck test object.

t2:Wait for response time after chucking.
(The response time depends on the test object, and it is therefore necessary to adjust the timing until the measurement value stabilizes.)

③:Apply measurement trigger to start measurement.

t3:Measurement time. Wait until EOC signal goes to ON.

④:When EOC signal rises, BCD and comparator result outputs are assured, and required data can be read.

⑤:Remove test object.

t4:Prepare for next measurement, and repeat steps ② to

⑤:To change the range or comparator table number, start from step ①.

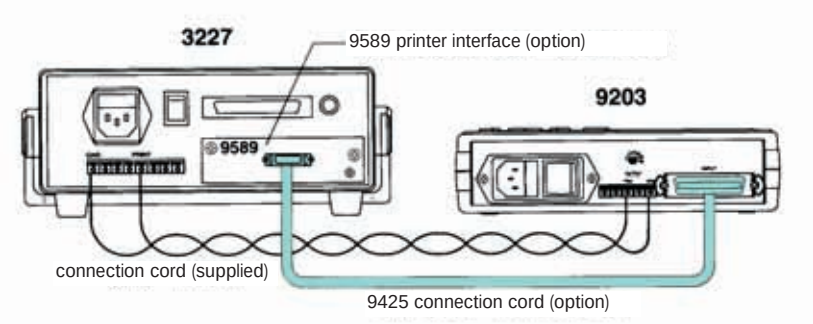
*For input terminals, "H" represents 5 V and "L" represents 0 V; for output terminals "ON" and "OFF" indicate the output transistor being on or off. The timing chart illustrates the flow of processing, and does not define the times.

Optional digital printer provides standard deviation, histograms, and other statistical processing

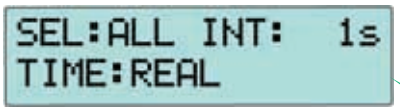
The 9203 DIGITAL PRINTER provides conventional printing of measurement values and decision results, and also a range of statistical and graphing functions, including maximum value, minimum value, average value, standard deviation, histograms, and process productivity index.

- In addition to interval printing, provides automatic printing of statistical results, including standard deviation and histograms
- Printing of process productivity index (Cp: dispersion, CpK: bias) for production line productivity management
- Graph printing function for at-a-glance grasp of measurement changes
- Data handing capacity: 99,999 values (maximum 5,000 for histogram and graph printing)
- Thermal printer for high-speed output

CE



Printer display panel

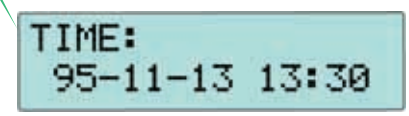


■ printing settings
Select the type of data to be printed, the interval, and whether to print the real or elapsed time.

■ Histogram settings
Select whether to set the canter value, rank width, and number of ranks automatically or manually, and in the manual case set the values for the center value, rank width, and number of ranks.

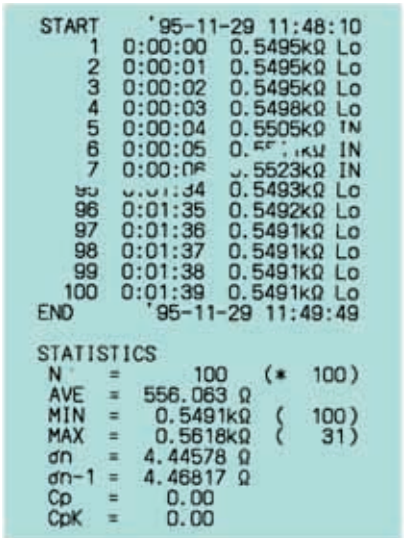
■ Menu screen
Select the required settings.

■ Statistical processing setting
Set the upper and lower limits for calculating the process productivity index (Cp and Cpk).
* The process productivity refers to the ability to meet quality standards, and indicates the variance of the process quality. Generally, if this value is at least 1.0 it is considered safe to continue production.



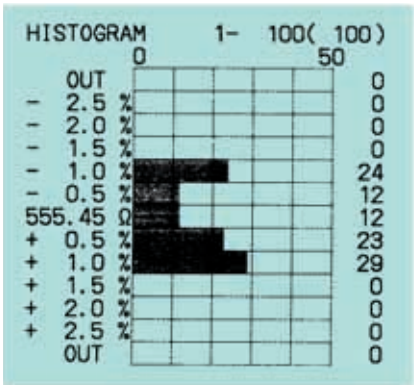
■ Clock setting screen
Set the internal clock and calendar.

Printing examples



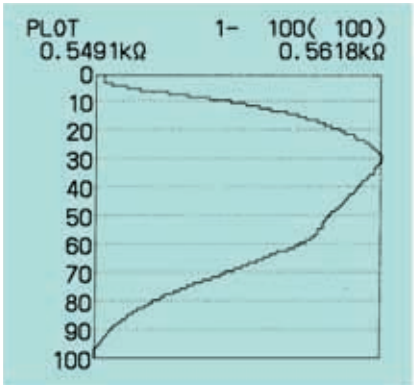
■ Statistical processing

Total number of data values, number of valid data values, average value, maximum and minimum values and their measurement numbers, standard deviation, process productivity index, and bias are printed.



■ Histogram

In the automatic mode, the minimum and maximum valid data values are found, and their mean used as the center value, then the rank width is optimized to give ± 5 ranks.



■ Graph

The minimum and maximum valid data values are used to set the full-scale range, and the values plotted by sample number. The variation of values over time can be seen at a glance.

■ 9203 DIGITAL PRINTER specification

Printer : Thermal line printer
Lifetime : At least 2 million lines
Print medium : 9233 recording paper, 58 mm × 10 m (approximately 3000 lines equivalent)
Clock : Real time or elapsed time printing
[Data printed]
Maximum number of printed values : 1 to 99,999
Printed data selection : ALL, IN, HL, VAL (valid data only), OFF
Decision result codes : Hi, IN, Lo, OF, NG
Printing interval : MANU / AUTO
MANU setting : printing when print key pressed
AUTO setting : 1/ 2 / 5 / 10 / 15 / 20 / 30 seconds, 1/ 2 /5 / 10 / 15 / 20 / 30 minutes, 1 hour
Cancel function : immediately previous data values can be deleted (up to maximum 5,000 values)
[Computation functions]
Data handing capacity : 99,999 values
Functions computed : number of values, maximum, minimum, and average values, standard deviation, process productivity index, bias (upper and lower limit settings)
Computation expressions :

Average : $\bar{x} = \frac{\sum x}{n}$

Standard deviation : $\sigma_n = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n}}$

$\sigma_{n-1} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n-1}}$

Process productivity index : $Cp = \frac{|(\text{upper limit}) - (\text{lower limit})|}{6\sigma_{n-1}}$

Bias: $C_{PK} = \frac{|(\text{upper limit})-(\text{lower limit})| - |(\text{upper limit})+(\text{lower limit})-2\bar{x}|}{6\sigma_{n-1}}$

*The upper and lower limit are set on the 9203.

[Histogram printing]
Data handing capacity : 5,000 values (if more than 5,000 present, most recent 5,000 values are used)
Operation mode : AUTO / MANU
MANU setting : Set center value (±, 5-digit signed value, and unit specification)
Set rank width :
0.1 / 0.2 / 0.5 / 1 / 2 / 5 / 10 / 20 % (±5 ranks)
0.1 / 0.2 / 0.5 / 1 / 2 / 5 / 10 / % (±10 ranks)
AUTO setting : Center value and rank width set automatically
[Graph printing]
Data handing capacity : Same as for histogram
Operation mode : AUTO only
Minimum and maximum values determine full scale ; time axis is 1 value per line.
[External input / output terminals]
Input : PRINT / STOP
Output : TRIG / ERROR (open collector)
Interface : Centronics
Withstand voltage : Body to power supply 1.5 kV AC (current sensitivity 20 mA)
Insulation resistance : Body to power supply at least 100 MΩ
Operating temperature and humidity range : 0 to 40 °C, 80% R.H. maximum (no condensation)
Power supply : 100 to 240 V AC(±10%, 250V max.), 50 / 60 Hz
power consumption : 30 VA max.
Dimensions and weight : 215(W) × 160(H) × 54(D) mm; approx. 1 kg
Supplied accessories : Power cord (1), recording paper (1 roll), lead for 3277 (2 × 2 m). spare fuse (T4A / 250 V)

■ 3227 mΩ HiTESTER general specifications

Measurement method:	Four-terminal method Double integration method
Operating method:	Fluorescent display tube
Display:	Resistance value “30000” 4-1/2 digits (3-1/2 digits in FAST mode) Temperature value “4000” 3-1/2 degits
Display digits:	
Auto-ranging:	Yes (Not valid when comparator function is enabled)
Input out of range:	“OF” indication
Maximum applied voltage:	100V DC / AC rms (circuit protected by fuse)
Sampling rate:	Resistance measurement “SLOW” 4 times / second “MEDIUM” 16 times / second “FAST” 90 times / second Temperature measurement: 4 times / second
Response time:	Approx. 500 ms (SLOW) Approx. 150 ms (MEDIUM) Approx. 50 ms (FAST) (From chucking to comparator result. Values may vary, however, depending on the items being tested.)
Comparator:	Up to 15 sets of comparator conditions (tables) can be held Comparison method switchable (OFF / AUTO / EXT) Buzzer mode switchable (Hi / Lo, IN or OFF) Display and open collector output
External control:	Open collector outputs BCD 5 digits (parallel), measurement completed, NG comparator result (Hi, IN or Lo) TTL inputs Range selection, comparator table number selection, trigger, print, zero-adjust, comparator output
External interface:	GP - IB (IEEE 488.2) (option)
Printer interface:	Ccntronics (option)
Operating temperature and humidity:	0 to 40 °C, 80 % R.H or less (no condensation)
Power Supply:	100, 110, 120, 200, 220 or 240 V AC ± 10 % (50 / 60 Hz), 40 VA max .; specify at time of order
Dimensions and mass:	215 (W) × 80 (H) × 320 (D) mm; approx. 3.1kg
Supplied Accessories:	9287 clip-type leads (1set), 9188 temperature probe, power code, spare power supply (T 0.25 A / 250V) and circuit protection (F 1A / 250V) fuses (1each)

■ Temperature measurement

Temperature sensor:	Platinum resistor
Lead length:	Approx. 1.5 m
Range to guarantee accuracy:	0.00 °C to 40.00 °C
Accuracy:	± 0.5 °C

■ Temperature correction function

Temperature correction range:	0.00 °C to 40.00 °C
Reference temperature range:	-10.0 °C to 99.9 °C
Thermal coefficient specification range:	± 99999 ppm
Accuracy:	When temperature correction applied, add ± 0.25 % rdg. to tolerance for resistance measurement

■ Resistance measurement ranges

● 4-1/2 digits (sampling: SLOW / MEDIUM*)

Range	300mΩ	3mΩ	30Ω	300Ω	3kΩ	30kΩ	300kΩ
Resolution	10μΩ	100μΩ	1mΩ	10mΩ	100mΩ	1Ω	10Ω
Measuring Current	100mA		10mA	1mA		10μA	
Maximum Applied Voltage	30mV	300mV			3V	300mV	3V
Accuracy	±0.1%rdg. ±8dgt.	±0.08%rdg. ±3dgt.				±0.1%rdg. ±3dgt.	
Temperature coefficient	(±0.01%rdg. ±0.5dgt.) / ˚C						
Open-Terminal Voltage	7.0V max.						

* When sampling speed is MEDIUM, add 3 digits. each tolerance.

Measurement conditions: 23 ˚C ± 5 ˚C, 80 % R.H. or less (no condensation), measurement range fixed, after 30 minutes warming up, after zero - adjustment

● 3-1/2 digits (sampling: FAST)

Range	300mΩ	3Ω	30Ω	300Ω	3kΩ
Resolution	100μΩ	1mΩ	10mΩ	100mΩ	1Ω
Measuring Current	100mA		10mA	1mA	
Maximum Applied Voltage	30mV	300mV			3V
Accuracy	±0.2%rdg. ±5dgt.				
Temperature coefficient	(±0.01%rdg. ±0.1dgt.) / ˚C				
Open-Terminal Voltage	7.0V max.				

■ Options

9588 GP - IB INTERFACE
9589 PRINTER INTERFACE
9203 DIGITAL PRINTER
9233 RECORDING PAPER (10 m, 10 rolls)
9425 CONNECTION CORD (2 m)
{20-pin half-pinch (D-sub)
|
36-pin (D-sub)}

9287 CLIP TYPE LEADS (also supplied)
9188 TEMPERATURE PROBE (also supplied)
9452 CLIP TYPE LEADS
9453 FOUR TERMINAL LEADS
9455 PIN TYPE LEADS (for high - density use)
9461 PIN TYPE LEADS
9467 LARGE CLIP TYPE LEADS
9151-02 GP - IB INTERFACE CABLE (2 m)
9151-04 GP - IB INTERFACE CABLE (4 m)

9467
Max clip diameter 29 mm

HIOKI
HIOKI E. E. CORPORATION

HEAD OFFICE :
81 Koizumi, Ueda, Nagano, 386-1192, Japan
TEL +81-268-28-0562 / FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp

HIOKI USA CORPORATION :
6 Corporate Drive, Cranbury, NJ 08512 USA
TEL +1-609-409-9109 / FAX +1-609-409-9108
E-mail: hioki@hiokiusa.com

DISTRIBUTED BY

Europe Representative Office :
Meineckestrasse 48, 40474 Dusseldorf, Germany
TEL / FAX +49-211-4544153
E-mail: hioki-eu@doitsu.de

Shanghai Representative Office :
1108 Union Building, 100 Yan An Road (East),
Shanghai, 200002, P.R.China
TEL +86-21-6328-9947/4938
FAX +86-21-6328-2064
E-mail: hioki-sh@sh.cngb.com

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