Digital Multimeters

High-Speed and Low-Price DMM with a Sampling Rate of 2,000 Times/Second

R6871E/R6871E-DC

■ **R6871E: Low-price and High-Grade Model with Five Basic Measurement Functions**
■ **R6871E-DC: Low-Price Model Focusing on DC Voltage and Resistance Measurement**

(Photo is R6871E-DC)

R6871E/R6871E-DC
Digital Multimeters

The R6871E series is a low-price digital multimeter that allows 7 1/2 over range measurement with a 6 1/2 digit display. It is provided with the measurement functions for DC voltage and current, AC voltage and current, and resistance.
The R6871E-DC is a low-price version which limits the measurement function to DC voltage, current and resistance.
The R6871E series provides a sampling rate of up to 2,000 times per second (in the 4 1/2-digit measurement mode), making it possible to change the integral time according to the accuracy required. Up to 10,000 measurement data can be stored in the built-in memory for further numerical operation and/or direct indication.
In addition, the R6871E series has an input impedance of 10^{10} Ω or higher over input ranges of up to 20 V, allowing high-precision and high-resolution measurement of DC voltage. When used as a multimeter for a measurement system, the standard GPIB interface exhibits its power for remote control of functions and ranges.

■ **Maximum Display of "19999999" and a Measuring Rate of Up to 2,000 Times/Second**

■ **A Single R6871E Incorporates the Measurement Functions for DC Voltage/Current, AC Voltage/Current and Resistance**

■ **Powerful Calculation Function Facilitates Data Analysis**

■ **Smoothing Function Enables Stable Measurement in Environment Subject to Noise**

■ **Multi-Sampling Bulk Output Function**

The multi-sampling bulk output mode allows high-speed data measurement and collection in real-time. The multimeter outputs data while performing measurement in regular intervals (in 10-msec intervals for one seconds) in the 6 1/2 digit display mode.

*** This function was designed under guidance of the Earthquake Research Center of Tokyo University.**

High-Speed and Low-Price DMM with Sampling Rate of 2000 Times/Second

R6871E/R6871E-DC

Specifications

DC Voltage Measurement
Range, maximum readout, maximum resolution, input impedance and maximum input voltage:

Range	7 1/2 digit display		6 1/2 digit display		5 1/2 digit display		4 1/2 digit display		Input impedance	Maximum input voltage		
	Maximum display	Resolution	Maximum display	Resolution	Maximum display	Resolution	Maximum display	Resolution		Between input Hi-Lo	Between GUARD-Chassis	Between GUARD-Lo
200 mV	199.9999 mV	0.1 µV	199.9999 mV	0.1 µV	199.999 mV	1 µV	199.99 mV	10 µV	$10^{10}\Omega$ or more	±1100 V peak for 10 s. ±500 V peak continuously	±500 V peak continuously	±50 V peak continuously
2V	1999.9999 mV	0.1 µV	1999.999 mV	1 µV	1999.99 mV	10 µV	1999.9 mV	100 µV				
20 V	19.999999 V	1 µV	19.99999 V	10 µV	19.9999 V	100 µV	19.999 V	1 mV				
200 V	199.99999 V	10 µV	199.9999 V	100 µV	199.999 V	1 mV	199.99 V	10 mV	10 MΩ±0.5%	±1100 V peak continuously		
1000 V	1100.0000 V	100 µV	1100.000 V	1 mV	1100.00 V	10 mV	1100.0 V	100 mV				

Measurement accuracy: Expressed as ± (% of reading + LS digit value) when auto zero and auto calibration functions are ON (and calibration time interval is 1 hour or less)
Measurement accuracy with 6 1/2 digit display ;

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C±1°C)	90 days (23°C±5°C)	180 days (23°C±5°C)
10 ms	200 mV	0.007+300	0.008+300	Same as for 90 days
	2 V	0.007+60	Same as for 24 hours	
	20 V	0.006+40		
	200 V	0.006+60		
	1000 V	0.006+20		
1 PLC	200 mV	0.0025+40	0.004+40	0.005+40
	2 V	0.0015+8	0.003+8	0.004+8
	20 V	0.0012+5	0.0027+5	0.0037+5
	200 V	0.0015+8	0.003+8	0.004+8
	1000 V	0.0015+4	0.003+4	0.004+4
5 PLC to 100 PLC	200 mV	0.0025+35	0.004+35	0.005+35
	2 V	0.0015+6	0.003+6	0.004+6
	20 V	0.0012+4	0.0027+4	0.0037+4
	200 V	0.0015+6	0.003+6	0.004+6
	1000 V	0.0015+3	0.003+3	0.004+3

PLC (Power Line Cycle) 50 Hz 1 PLC = 20 ms, 60 Hz 1 PLC = 16.7 ms

Measurement accuracy with 7 1/2, 5 1/2 and 4 1/2-digit display: For details, please refer to brochure of R6871E.
Temperature coefficient: Expressed as ± (% of reading + LS digit value) in range from +18°C to +28°C. For 0°C to +18°C and +28°C to +40°C, add 0.0001 to the % of reading.

Range	7 1/2-digit display	6 1/2-digit display	5 1/2-digit display	4 1/2-digit display
200 mV	–	0.0003+3	0.0003+0.3	0.0003+0.03
2 V	0.0003+3	0.0003+0.3	0.0003+0.03	0.0003+0.003
20 V	0.0002+2	0.0002+0.2	0.0002+0.02	0.0002+0.002
200 V	0.0003+3	0.0003+0.3	0.0003+0.03	0.0003+0.003
1000 V	0.0003+1	0.0003+0.1	0.0003+0.01	0.0003+0.001

Noise rejection: At 1 kΩ unbalanced impedance between GUARD-LO

Integration time (IT)	Effective CMR		NMR
	50/60 Hz±0.09%	DC	50/60 Hz±0.09%
Max. 10 ms	100 dB	140 dB	0 dB
Min. 1 PLC	160 dB	140 dB	60 dB

DC Current Measurement (R6871E Only)
Range, maximum readout, maximum resolution, input impedance and maximum input voltage:

Range	6 1/2 digit display		5 1/2 digit display		4 1/2 digit display		Input impedance	Over current protection
	Maximum display	Resolution	Maximum display	Resolution	Maximum display	Resolution		
2 mA	1999.999 µA	1 nA	1999.99 µA	10 nA	1999.9 µA	100 nA	102 Ω or less	2 A current fuse
20 mA	19.99999 mA	10 nA	19.9999 mA	100 nA	1.9999 mA	1 µA	12 Ω or less	
200 mA	199.9999 mA	100 nA	199.999 mA	1 µA	199.99 mA	10 µA	3 Ω or less	
2 A	1999.999 mA	1 µA	1999.99 mA	10 µA	1999.9 mA	100 µA	2 Ω or less	

Measurement accuracy: Expressed as ± (% of reading + LS digit value) when auto zero and auto calibration functions are ON (and calibration time interval is 1 hour or less)
Measurement accuracy with 6 1/2-digit display ;

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C±1°C)	90 days (23°C±5°C)	180 days (23°C±5°C)
10 ms	2 mA	0.06+300	0.1+300	0.13+300
	20 mA		0.085+300	0.11+300
	200 mA		0.065+300	0.075+300
	2 A	0.065+300	0.09+300	0.115+300
1 PLC	2 mA	0.06+40	0.1+40	0.13+40
	20 mA		0.085+40	0.11+40
	200 mA		0.065+40	0.075+40
	2 A	0.065+40	0.09+40	0.115+40
5 PLC to 100 PLC	2 mA	0.06+35	0.1+35	0.13+35
	20 mA		0.085+35	0.11+35
	200 mA		0.065+35	0.075+35
	2 A	0.065+35	0.09+35	0.115+35

Measurement accuracy with 5 1/2 and 4 1/2-digit display: For details, please refer to brochure of R6871E.
Temperature coefficients: Expressed as ± (% of reading + LS digit value) /°C in range from 0°C to +40°C

Range	6 1/2 digit display	5 1/2 digit display	4 1/2 digit display
2 mA	0.0035+5	0.0035+0.5	0.0035+0.05
20 mA			
200 mA	0.0015+5	0.0015+0.5	0.0015+0.05
2 A			

Digital Multimeters

High-Speed and Low-Price DMM with Sampling Rate of 2000 Times/Second

R6871E/R6871E-DC (Continued From Previous Page)

Resistance Measurement
Range, maximum display, maximum resolution, measurement current, maximum open-circuit voltage and maximum input voltage:

Range	Maximum readout (7 1/2 digits)	Resolution				Measurement current	Max. open-circuit voltage	Maximum input voltage		
		7 1/2 digits	6 1/2 digits	5 1/2 digits	4 1/2 digits			Between measurement terminals	Between GUARD-Chassis	Between measurement terminals and GUARD
10 Ω	11.99999 Ω	–	10 μΩ	100 μΩ	1 mΩ	10 mA	24 V	±350 V peak continuously	±500 V peak continuously	±50 V peak continuously
100 Ω	119.99999 Ω	10 μΩ	100 μΩ	1 mΩ	10 mΩ	10 mA				
1 kΩ*	1199.9999 Ω	100 μΩ	1 mΩ	10 mΩ	100 mΩ	10 mA/1 mA*				
10 kΩ	11.999999 kΩ	1 mΩ	10 mΩ	100 mΩ	1 Ω	1 mA				
100 kΩ	119.99999 kΩ	10 mΩ	100 mΩ	1 Ω	10 Ω	100 μA	18 V			
1 MΩ	1199.9999 kΩ	100 mΩ	1 Ω	10 Ω	100 Ω	10 μA				
10 MΩ	11.999999 MΩ	1 Ω	10 Ω	100 Ω	1 kΩ	1 μA				
100 MΩ	119.99999 MΩ	10 Ω	100 Ω	1 kΩ	10 kΩ	100 nA	24 V			
1000 MΩ	1199.9999 MΩ	100 Ω	1 kΩ	10 kΩ	100 kΩ	10 nA				

* When the measured current in the 1 kΩ range is 1 mA, contact ADVANTEST's sales office.

Measurement accuracy: Expressed as ± (% of reading + LS digit value) when auto zero and auto calibration functions are ON (and calibration time interval is 1 hour or more). Values were measured at four terminals. For 2-wire Ω measurement accuracy, a maximum 0.2 Ω must be added to the 4-wire Ω measurement accuracy.

Measurement accuracy with 7 1/2 digit display

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C±1°C)	90 days (23°C±5°C)	180 days (23°C±5°C)
5 PLC to 100 PLC	100 Ω	0.003+40	0.005+40	0.006+40
	1 kΩ	0.002+25	0.004+25	0.006+25
	10 kΩ			
	100 kΩ			
	1 MΩ	0.004+25	0.006+25	0.007+25
	10 MΩ	0.022+25	0.028+25	0.03+25
	100 MΩ	0.15+25	0.2+25	0.21+25
	1000 MΩ	1.5+25	2+25	2.1+25

Measurement accuracy with 6 1/2-digit display

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C±1°C)	90 days (23°C±5°C)	180 days (23°C±5°C)
10 ms	10 Ω	0.008+300	0.009+300	Same as for 90 days
	100 Ω	0.008+60	0.009+60	
	1 kΩ	0.007+30	0.008+30	
	10 kΩ			
	100 kΩ			
	1 MΩ	0.009+30	0.01+30	
	10 MΩ	0.03+30	0.036+30	
	100 MΩ	0.2+30	0.25+30	
	1000 MΩ	2+30	2.5+30	
1 PLC	10 Ω	0.004+40	0.006+40	0.007+40
	100 Ω	0.003+8	0.005+8	0.006+8
	1 kΩ	0.002+4	0.004+4	0.006+4
	10 kΩ			
	100 kΩ			
	1 MΩ	0.004+4	0.006+4	0.007+4
	10 MΩ	0.022+4	0.028+4	0.003+4
	100 MΩ	0.15+4	0.2+4	0.21+4
	1000 MΩ	1.5+4	2+4	2+4
5 PLC to 100 PLC	10 Ω	0.004+35	0.006+35	0.007+35
	100 Ω	0.003+6	0.005+6	0.006+6
	1 kΩ	0.002+3	0.004+3	0.006+3
	10 kΩ			
	100 kΩ			
	1 MΩ	0.004+3	0.006+3	0.007+3
	10 MΩ	00.022+3	0.028+3	0.03+3
	100 MΩ	0.15+3	0.2+3	0.21+3
	1000 MΩ	1.5+3	2+3	2.1+3

PLC (Power Line Cycle) 50 Hz 1 PLC = 20 ms 60 Hz 1 PLC = 16.7 ms

Measurement accuracy with 5 1/2 and 4 1/2-digit display: For details, please refer to brochure of R6871E.

Temperature coefficients: Expressed as ± (% of reading + LS digit value)/°C in range from 0°C to +40°C for 4-wire Ω measurements. (For 2-wire Ω measurements, add an offset of 0.02 Ω/°C.)

Range	7 1/2-digit display	6 1/2-digit display	5 1/2-digit display	4 1/2-digit display
10 Ω	–	0.0004+3	0.0004+0.3	0.0004+0.03
100 Ω	0.0004+3	0.0004+0.3	0.0004+0.03	0.0004+0.003
1 kΩ to 1 MΩ	0.0004+2	0.0004+0.2	0.0004+0.02	0.0004+0.002
10 MΩ	0.0015+2	0.0015+0.2	0.0015+0.02	0.0015+0.002
100 MΩ	0.015+2	0.015+0.2	0.015+0.02	0.015+0.002
1000 MΩ	0.15+2	0.15+0.2	0.15+0.02	0.15+0.002

* When the measured current in the 1 kΩ range is 1 mA, contact ADVANTEST's sales office.

High-Speed and Low-Price DMM with Sampling Rate of 2000 Times/Second

R6871E/R6871E-DC

AC Voltage Measurement (True RMS) (R6871E only)
Range, maximum display, maximum resolution, input impedance, maximum input voltage:

Range	Maximum display (at 5 1/2-digit display)	Resolution		Input impedance	Maximum input voltage
		5 1/2 digit display	4 1/2 digit display		
200 mV	199.999 mV	1 µV	10 µV	1 MΩ ± 2%, Max. 300 pF AC coupling	520 Vms, 750 V peak between Hi-Lo
2 V	1999.99 mV	10 µV	100 µV		
20 V	19.9999 V	100 µV	1 mV		
200 V	199.999 V	1 mV	10 mV		
500 V	500.00 V	10 mV	100 mV		

Measurement accuracy: Expressed as ± (% of reading + LS digit value) when auto zero and auto calibration functions are ON (and calibration time interval is 1 hour or less). Accuracy is guaranteed from 5% of full scale to maximum 1×10^7 VHz.
Measurement accuracy with 5 1/2 digit display (ACV)

Integration time (IT)	1 ms to 10 ms		1 PLC to 100 PLC	
Frequency range	24 hours (23°C±1°C)	180 days (23°C±5°C)	24 hours (23°C±5°C)	180 days (23°C±5°C)
20 Hz to 45 Hz	0.25+800	0.35+800	0.25+70	0.35+90
45 Hz to 300 Hz	0.1+400	0.2+400	0.1+70	0.2+90
300 Hz to 10 kHz	0.1+400	0.2+400	0.1+70	0.2+90
10 kHz to 100 kHz	0.8+700	1+900	0.8+700	1+900
100 kHz to 1 MHz	7+3000	8+4000	7+3000	8+4000

For 200 mV range, add 100 to digit values given above.

Measurement accuracy with 4 1/2 digit display: Multiply the digit term of the measurement accuracy for 5 1/2 digit display by 1/10.
Temperature coefficient: Multiply 24-hour measurement accuracy given for integration time (IT) of 1 PLC to 100 PLC by 1/10/°C.
Crest factor: 1:4
Response time: Time to settle within 0.2% of value of step input
Fast Approx. 200 ms, Slow: 2s
Note: Slow is from 20 Hz to 1 MHz. Fast is from 300 Hz to 1 MHz. Fast sampling can be performed from 20 Hz to 300 Hz, but measurement accuracy is not guaranteed.
AC+DC measurement accuracy: ACV measurement accuracy +70 digits.

AC Current Measurement (True RMS) (**R6871E** Only)
Range, maximum display, maximum resolution, input impedance and overcurrent protection:

Range	5 1/2 digit display		4 1/2 digit display		Input impedance	Overcurrent protection
	Maximum display	Resolution	Maximum display	Resolution		
2 mA	1999.99 µA	10 nA	1999.9 µA	100 nA	102 Ω or less	2-A current fuse
20 mA	19.9999 mA	100 nA	19.999 mA	1 µA	12 Ω or less	
200 mA	199.999 mA	1 µA	199.99 mA	10 µA	3 Ω or less	
2 A	1999.99 mA	10 µA	1999.9 mA	100 µA	2 Ω or less	

Measurement accuracy: Expressed as ± (% of reading + LS digit value) when auto zero and auto calibration functions are ON (and calibration time interval is 1 hour or less).
Measurement accuracy with 5 1/2-digit display: Guaranteed at inputs above 5% of full scale.

Integration time (IT)	1 ms to 10 ms		1 PLC to 100 PLC	
Frequency range	24 hours (23°C±1°C)	180 days (23°C±5°C)	24 hours (23°C±1°C)	180 days (23°C±5°C)
20 Hz to 45 Hz	0.5+200	0.65+200	0.5+180	0.65+200
45 Hz to 5 kHz	0.35+200	0.5+220	0.35+180	0.5+200

Measurement accuracy with 4 1/2-digit display: Multiply the digit term of the measurement accuracy for 5 1/2-digit display by 1/10.
Temperature coefficient: Multiply 24-hour measurement accuracy given for integration time (IT) of 1 PLC to 100 PLC by 1/10/°C.
Crest factor: 1:4
Response time: Same as for AC voltage measurement.
AC+DC measurement accuracy: ACV measurement accuracy + 70 digits

Measurement Speed
DATA OUT. Mode 0 (All outputs enabled)
Display output only : Parameter conditions

Sampling mode	RUN	Sampling interval	0 ms
Compute	OFF	Auto zero	OFF
Store	OFF	Auto calibration	OFF
Smoothing	OFF	Line frequency	50 Hz
Null	OFF		

Measurement function / Integration time (IT)	DC voltage	AC *1 voltage (AC+DC)	DC current	AC *1 current (AC+DC)	2 WΩ (10 Ω to 1000 MΩ)	4 WΩ (10 Ω to 100 kΩ)	4 WΩ (1000 kΩ)	4 WΩ (10 MΩ)	4 WΩ (100 MΩ)	4 WΩ (1000 MΩ)
100 µs (4 1/2 digits)	2.2 ms	2.5 ms	2.5 ms	2.5 ms	2.5 ms	23.4 ms	65.6 ms	222 ms	536 ms	2591 ms
1 ms (5 1/2 digits)	3.5 ms	3.4 ms	3.9 ms	3.4 ms	3.5 ms	25.7 ms	67.5 ms	224 ms	538 ms	2593 ms
10 ms (6 1/2 digits)	12.4 ms	12.4 ms	13.1 ms	12.4 ms	12.7 ms	43.9 ms	85.7 ms	242 ms	556 ms	2611 ms
5 PLC (7 1/2 digits)	102 ms	102 ms	103 ms	102 ms	103 ms	224 ms	266 ms	423 ms	736 ms	2791 ms

* The measurement period for an integration time of 1 ms to 100 PLC, except for 4 W resistance measurements, is determined by adding the 100 µs measurement period to the integration time. For 4 W resistance measurement, it is the sum of the 100 µs measurement period and twice the integration time.
*1 Can be measured only by R6871E.

Output to the GPIB:
Controller: HP300 Series
GPIB output format: Shortest time with Header=OFF and block delimiter=EOI

Measurement function / Integration time (IT)	DC voltage	AC *3 voltage (AC+DC)	DC *3 current	AC *3 current (AC+DC)	2 WΩ (10 Ω to 1000 MΩ)	4 WΩ (10 Ω to 100 kΩ)	4 WΩ (1000 kΩ)	4 WΩ (10 MΩ)	4 WΩ (100 MΩ)	4 WΩ (1000 MΩ)
100 µs (4 1/2 digits)	2.5 ms	2.8 ms	2.9 ms	2.8 ms	2.9 ms	24.1 ms	66.0 ms	223 ms	536 ms	2591 ms
1 ms (5 1/2 digits)	3.8 ms	3.8 ms	4.3 ms	3.8 ms	3.9 ms	26.1 ms	67.9 ms	225 ms	538 ms	2593 ms
10 ms (6 1/2 digits)	12.9 ms	12.8 ms	13.5 ms	12.8 ms	13.0 ms	44.3 ms	85.1 ms	243 ms	556 ms	2611 ms
5 PLC (7 1/2 digits)	103 ms	103 ms	104 ms	103 ms	103 ms	224 ms	266 ms	423 ms	736 ms	2791 ms

*1 For the standard GPIB output format header = ON, block delimiter = CR/LF (EOI), add approximately 300 µs.
*2 For a sampling mode of single (hold-trigger), add approximately 1.5 ms.
*3 Can be measured only by R6871E.

DATA OUT. Mode 2 (Output of data memory only, saved data output after conversion to true values) : Parameter conditions

Function	VDC		
Compute	OFF	Range	20 V
Store	ON	Sampling mode	RUN
Smoothing	OFF	Sampling interval	0 ms
Null	OFF	Auto zero	OFF
Auto calibration	OFF	Line frequency	50 Hz

Integration time (IT)	100 µs	1 ms	10 ms	1 PLC	5 PLC	10 PLC	20 PLC	50 PLC	100 PLC
Measurement period	1.6 ms	2.9 ms	11.9 ms	22.0 ms	102 ms	202 ms	402 ms	1002 ms	2002 ms

R6871E/R6871E-DC (Continued From Previous Page)

DATA OUT. Mode 3 (Fastest mode, output of data memory only and active saved data): Parameter conditions

Function ; Previous status

Rangex	: OFF	Sampling mode	: RUN
Integration time	: 100 µs	Sampling interval	: 0 ms
Auto zero	: OFF	Auto calibration	: OFF
Compute	: OFF	Store	: ON
Smoothing	: OFF	Null	: OFF

Measurement function (measurement range)	DC voltage	AC voltage (AC+DC)	DC current	AC current (AC+DC)	2 WΩ (10 Ω to 1000 MΩ)	4 WΩ (10 Ω to 100 kΩ)	4 WΩ (1000 kΩ)	4 WΩ (10 MΩ)	4 WΩ (100 MΩ)	4 WΩ (1000 MΩ)
Measurement period	500 µs	500 µs	500 µs	500 µs	500 µs	21.3 ms	62.3 ms	216 ms	523 ms	2534 ms

Integration Time

The integration time (IT) can be set in the following ranges:

4 1/2 digit display	100 µs to 100 PLC
5 1/2 digit display	1 ms to 100 PLC
6 1/2 digit display	10 ms to 100 PLC
7 1/2 digit display	5 PLC to 100 PLC

PLC (Power Line Cycle) 50 Hz 1 PLC = 20 ms, 60 Hz 1 PLC = 16.7 ms

Null Function

The null value is measured when the null function is switched from OFF to ON, and is subtracted from subsequent measurements.
Calibration range: ±1% of the measurement range

Smoothing Function

This function takes a moving average over a number of samples. The number of sample is set with the SM TIME key when the smoothing function is switched on.

Sampling Mode

RUN: Continuous sampling at the specified sampling interval (SI)

SINGLE: A single sample is measured at a specified trigger delay (TD) from input of the trigger signal.

MULTI: A specified number of samples (NS) at SI intervals are measured with a specified trigger delay (TD) from input of the trigger signal.
SI (Sample Interval) 0 to 60,000 ms
TD (Trigger Delay) 0 to 60,000 ms
NS (Number of Samples) 0 to 10,000

Trigger Source:

- Panel switch
- GPIB "E" GET command
- Trigger signal line (negative TTL pulse ⎍)

Data Memory Function

ON/OFF control: Storing of measurement data in memory is controlled by the STORE key.

Memory capacity: 10,000 data values measured around the trigger point (with pre-trigger and post-trigger functions)

Data readout: Data values can be read from memory singly (Single mode) or in a continuous stream of arbitrary length (Continuous mode) using the RECALL key and specifying the memory address. Data are output to the display, GPIB, analog output port, etc. In continuous mode, data are output at intervals of SI.

Calculation Functions

Primary calculation Function:

The following operations can be performed on measured value D:

(1) Scaling $R = \frac{D - Y}{X} \times Z$ (X, Y and Z are constants)

(2) % Deviation $R = \frac{D - X}{|X|} \times 100$ (%)

(3) Delta (Difference of the current data and previous data values)
$R = (\Delta D) = D_t - D_{t-1}$

(4) Multiply (Product of the current delta and previous data value)
$R = D_t \times D_{t-1}$

(5) Decibels (D: measured voltage value)
$R(dB) = 20 \times Y \times \log|D/X|$

(6) Root mean square (rms) $R = \sqrt{\frac{1}{X}\sum_{R=1}^{X} D_k^2}$

(7) dBm (D: Measured voltage value)

$R(dBm) = 10 \log \frac{D^2 / X}{1mW}$ D: Measured voltage value

Converts measured value to dBm on the basis of a set reference resistance X so that 1 mW = 0 dBm.

(8) Resistance temperature correction

$R_{20} = \frac{Rx}{1 + 0.00393 \times (X-20)} \times \frac{1000}{Y}$ (Ω/km)

Rx: Resistance (Ω) measured at temperature T (°C)
X: Room temperature T (°C) (set manually by operator)
Y: Cable length (m) (set manually by operator)
R_{20}: Resistance of cable (Ω / Km), converted for 20°C

Secondary calculation function:

Three types of secondary processing functions can be applied, enabling processing on measured data, data after primary processing and data recalled from data memory.

Calculation type, calculated values and expressions	Constant setting range	Display of calculation results
(1) COMPARATOR 1 (Comparator 1) R(H2): HIGH2 < D R(H1): HIGH < D ≤ HIGH2 R(PASS): LOW1 ≤D ≤ HIGH1 R(L1): LOW2 ≤ D < LOW1 R(L2): D < LOW2	HIGH1, HIGH2, LOW1, LOW2: Upper and lower limit values HIGH1 ≤ HIGH2 LOW2 ≤ LOW1 (HIGH < LOW allowed) LIMIT:	Calculation results indicated by a lamp R(H2): HIGH lamp lighted R(H1): HIGH lamp flashing R(PASS): PASS lamp lighted R(L1): LOW lamp flashing R(L2): LOW lamp lighted Displayed value Depends upon existence of primary calculation setting. None: Normal measured value displayed Exists: Primary calculation results displayed
(2) COMPARATOR 2 (Comparator 2) H2 = LIMIT + %2 H1 = LIMIT + %1 L1 = LIMIT - %1 L2 = LIMIT - %2 R(H2): HIGH2 < D R(H1): HIGH1 < D ≤ HIGH2 R(PASS): LOW1 ≤ D ≤ HIGH1 R(L1): LOW2 ≤ D < LOW1 R(L2): D < LOW2	Reference value (not 0) %1, %2: allowable difference (%) 0.000 to100.00 %1 ≤ %2	Calculation results indicated by a lamp R(H2): HIGH lamp lighted R(H1): HIGH lamp flashing R(PASS): PASS lamp lighted R(L1): LOW lamp flashing R(L2): LOW lamp lighted Displayed value Measured value or primary-processed data are displayed after converting it to % deviation with respect to the reference value.

High-Speed and Low-Price DMM with Sampling Rate of 2000 Times/Second

R6871E/R6871E-DC

(3) Statistical processing
R(MAX): Maximum value for N measurements
R(MIN): Minimum value for N measurements

R(AVE): $\frac{1}{N} \times \sum_{R=1}^{N} Dk$

R(P-P): | R(MAX)-R(MIN) |

R(σ): $\sqrt{\frac{1}{N-1} \times \sum_{R=1}^{N} (Dk - \overline{D})^2}$

R(UCL): R(AVE) + 3R(σ)
R(LCL): R(AVE) - 3R(σ)
R(COUNT): Number of samples

Input/Output Functions

Input connectors: Four input connectors (front and rear) can be switched by front panel switch operation.
Front inputs: DC/AC voltage, DC/AC current, 2 WΩ, 4 WΩ
Rear inputs: DC/AC voltage, DC/AC current, 2 WΩ, 4 WΩ
DCV, 2 WΩ, 4 WΩ (R6781E-DC)
* Can be input from the rear current input connector when the front/rear switch is set to FRONT.

GPIB Interface

Standard: IEEE 488-1978
Interface functions SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Remote programming:
All front panel functions (except power on/off and front/rear input switching)
Data output:
ASCII format

Control signals:

TRIGGER input signal: TTL negative pulse, minimum 100 us
COMPLETE output signal: TTL negative pulse, Approx. 130 µs
Input connector: Type BNC

Front/rear inputs: DC/AC voltage, DC/AC current, 2 WΩ, 4 WΩ (**R6871E**)
DCV, 2 WΩ, 4 WΩ (**R6871E-DC**)

General Specifications

Measurement system: Integration measurement
Input system: Floating and guarded
Range switching: Manual, auto, and remote
Data display: 7-segment green LED
Polarity display: Minus sign (-)
Units display: 5 × 7 dot matrix LED
Beeper (can be switched on/off):
- Panel key entry
- Errors
- Comparator calculation

Soft calibration: All measurement functions (DC/AC voltage, DC/AC current, resistance) can be calibrated by front panel key operations or GPIB programming.
Storage environment: -25 to +70°C
Operating environment: Temperature: 0°C to +40°C, Humidity: 85% RH or less (70% RH or less in 10 MΩ, 100MΩ, and 1000 MΩ resistance ranges)
Power supply: Specified at the time of ordering.

Option No.	Standard	32	42	44
Line voltage (V)	90 to 110	103 to 132	198 to 242	207 to 250

After purchase, modification is to be made at the factory.
Power frequency: 48 to 66 Hz
Power consumption: **R6871E** 35 VA or less
R6871E-DC 30 VA or less
Dimensions (mm): Approx. 300 (W) × 132 (H) × 450 (D)
Mass: **R6871E** 9.5 kg maximum
R6871E-DC 8.5 kg maximum

Standard Accessories

Product name	Model	Product code	Remarks
Power cable	**A01402**		
Input cable	**MI-37**		For voltage, current, and 2-wire resistance measurement
Input cable	**A01005**		For 4-wire resistance measurement

Accessories (Sold Separately)

A02236 Rack Mount Set (JIS Standard)
A02434 Rack Mount Set (EIA Standard)
A02026 Panel Mount Set

Digital Multimeters

DMM with a Resolution of 10 nV and 1 μΩ and 6 1/2 Digit Display

R6561

- **Maximum Display of "1199999" and 6 1/2 Digit Display**
- **High-Sensitivity Measurement with 10 nV Resolution**
- **Low-Resistance Measurement with 1μΩ Resolution**
- **Built-In Floating Current Source**
- **Digital Smoothing Function and Null Function for Stable Measurement**
- **Standard GPIB Interface**

R6561
Digital Multimeter

In addition to DC voltage, micro DC voltage measurement and both high- and low-power resistance measurements, the R6561 features a 6 1/2 digit display with a maximum display of 1199999.

Micro DC current measurements are made with a sensitivity of up to 10 nV, and the multimeter is designed for minimum aging drift, ensuring highly stable measurements over a longer period of time. With this performance, the R6561 is suitable for use in basic research and experimentation in semiconductors and electronic components, in metals and superconductivity.

Resistance measurements with a maximum resolution of 1 μΩ, combined with automatic offset cancellation, and the use of a floating current source ensures high-precision measurements free from the influence of thermo electromotive force and the line resistances. In addition, the open-circuit measurement voltage has been held to below 20 mVpeak (in low-power mode), making the R6561 suitable for measurement of contact resistance of electronic components.

To ensure stable measurements and measurement results with enhanced reliability, the R6561 provides diverse features such as selectable integration time, the null function that enables offset correction, the digital smoothing function, and calculation functions for processing of measured data. The input and output functions include full remote operation via the GPIB interface, analog output, trigger input, measurement completion signal output - all provided as standard features.

■ 10 nV Resolution is Ideal for Use in R&D of Electronic Components and Metals

The R6561 can measure micro DC volt with a maximum resolution of 10 nV, highest in its class, which is sufficient for measurements of thermo electromotive force. When combined with a current generator to measure micro resistances with very small current, this level of resolution is essential. The R6561 is suitable for such applications as measurement of critical temperature in superconductivity requires a resolution of 10 nV.

■ 1 μΩ Resolution Ideal for Contact Resistance Measurement of Electronic Components

In measurements of relay ON resistance of several tens of mΩ and connector contact resistance which can be as low as several mΩ, the R6561 with its 1 μΩ resolution and the ability to measure to 1% order is ideal.

■ Built-in Floating Current Source

The R6561, in contrast to conventional digital multimeters, features a built-in floating power supply for the constant current source. This enables resistance measurement with very small voltage and large connection resistance and suppressed heat generation in the same way as super-conductivity measurement of ceramic devices.

In addition, the number of sampling required for each measurement to eliminate the influence of lead resistance can be minimized, thereby achieving reduced measurement time.

■ Limiter for Holding the Open Terminal Voltage to below 20 mVpeak or Less

In measurement of the contact resistance of electronic components under low voltage and current, the open circuit voltage is held to 20 mVpeak or less so that the oxide film of the device be measured directly without destruction. This allows measurement under the conditions prescribed by the JIS C5402 standard, test method of connectors of electronic equipment.

■ Built-In Digital Smoothing and Null Functions for Highly Reliable Measurement

The R6561 employs moving average which displays the average of the number of samples as the measurement result. The digital smoothing function can average noise components without sacrificing the measurement speed, allowing highly reliable data to be obtained even with low signal levels.
The R6561 is also provided with the null function for micro resistance measurement, which measures errors of connection cables, compensates the offset voltage, inputs the offset voltage value, and measures the relative value with respect to the input value.

■ Resistance Measurement with Maximum Power Consumption of 10 μW

When measuring thermisters or thermoresistances whose resistance varies with temperature, the heat generated in the device has remarkable effect on measurements. The ability of the R6561 to minimize the power consumption with low current, allows measurements which are free from effects of heat.

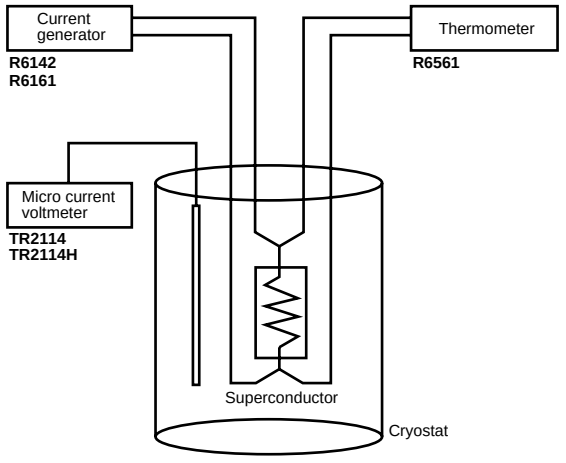
■ Automatic Offset Cancellation for Micro Resistance Measurement

In resistance measurements, since the voltage sensitivity is measured with a resolution of 10 nV, the thermoelectromotive force generated at contact points becomes problematic.
The R6561 obtains accurate measurement values by means of the automatic offset cancellation function which eliminates thermoelectromotive force under no-current condition from the voltage at the time of current drawing.

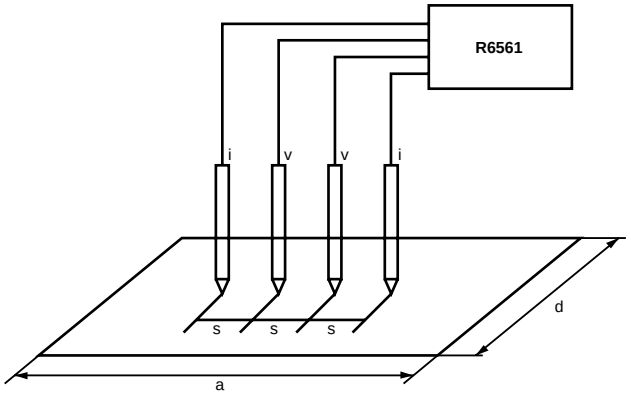
■ D/A Converter Output Analog Signal Monitoring

In high-sensitivity measurement with 10 nV resolution, it is sometimes necessary to make relative measurement by checking voltage variation within a defined period of time. With the standard D/A converter output, the R6561 allows recording and observation of voltage variation when a pen recorder is connected.

Applying superconductor to critical temperature measurement



Measurement of the resistance rate of sheet resistance by 4-wire method.



$$\rho_s = \frac{V}{i} C$$

$\frac{V}{i}$: Measured directly by the R6561.

C : Constants determined by s, a and d.

Digital Multimeters

DMM with a Resolution of 10 nV and 1 μΩ and 6 1/2-Digit Display

R6561 (Continued From Previous Page)

Specifications

DC Voltage Measurement
Ranges, maximum display, maximum resolution, input impedance, maximum input voltage:

Range	6 1/2-digit display		5 1/2-digit display		4 1/2-digit display		Input impedance	Input bias current	Maximum input voltage		
	Maximum display	Maximum resolution	Maximum display	Maximum resolution	Maximum display	Maximum resolution			Hi-Lo terminal voltage	GUARD-Chassis voltage	GUARD-Lo terminal voltage
1000 mV	1199.999 mV	1μV	1199.99 mV	10μV	1199.9 mV	100μV	10^{10} Ω or more	20 pA max.	±600 Vpeak, continuously	±500 Vpeak, continuously	±50 Vpeak continuously
10 V	11.99999 V	10μV	11.9999 V	100μV	11.999 V	1mV					
100 V	119.9999 V	100μV	119.999 V	1mV	119.99 V	10mV	10 MΩ ±0.5%				
500 V	519.999 V	1mV	519.99 V	10mV	519.9 V	100mV					

Measurement accuracy: Expressed as ± (% of reading + digits) of the value obtained with auto zero and auto calibration on (with a calibration interval of less than 1 hour)
Measurement accuracy for 6 1/2-digit display:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23± 1°C)	90 days (23± 5°C)	180 days (23± 5°C)
1 PLC	1000mV	0.002 +6	0.004 +7	0.005 +7
	10 V	0.0018+4	0.0035+4	0.0045+4
	100 V	0.002 +5	0.0042+6	0.0052+6
	500 V	0.002 +4	0.004 +4	0.005 +4
5 PLC to 100 PLC	1000mV	0.002 +5	0.004 +6	0.005 +6
	10 V	0.0018+3	0.0035+3	0.0045+3
	100 V	0.002 +4	0.0042+5	0.0052+5
	500 V	0.002 +3	0.004 +3	0.005 +3

Measurement accuracy with 5 1/2-digit display: Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.
Measurement accuracy with 4 1/2-digit display: Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/100.
Temperature coefficient: Expressed as ± (% of reading + digits) / °C for values in the temperature range of 0 to 40°C

Range	6 1/2-digit display	5 1/2-digit display	4 1/2-digit display
1000 mV	0.0004+0.3	0.0004+0.03	0.0004+0.003
10 V	0.0003+0.1	0.0003+0.01	0.0003+0.001
100 V	0.0004+0.3	0.0004+0.03	0.0004+0.003
500 V	0.0004+0.1	0.0004+0.01	0.0004+0.001

Noise rejection: With unbalanced 1 kΩ impedance between GUARD and Lo terminals

Effective CMR		NMR
50/60 Hz ±0.09%	DC	50/60 Hz ± 0.09%
160 dB	140dB	60dB

Measurement rate: 35 times/s (with 1 PLC integration time, auto-zero off)

Low DC Voltage Measurement
Ranges, maximum display, maximum resolution, input impedance, maximum allowable signal-source resistance, maximum input voltage:

Range	6 1/2-digit display		5 1/2-digit display		4 1/2-digit display		Input impedance	Maximum allowable signal-source resistance	Maximum input voltage		
	Maximum display	Maximum resolution	Maximum display	Maximum resolution	Maximum display	Maximum resolution			Hi-Lo terminal voltage	GUARD-Chassis voltage	GUARD-Lo terminal voltage
1000 μV	–	–	1199.99 μV	10 nV	1199.9 μV	100 nV	10^{8} Ω or more	100 Ω	±30 Vpeak, continuously	±500 Vpeak, continuously	±50 Vpeak, continuously
10 mV	11.99999 mV	10 nV	11.9999 mV	100 nV	11.999 mV	1 μV					
100 mV	119.9999 mV	100 nV	119.999 mV	1 μV	119.99 mV	10 μV	10^{9} Ω or more	1 kΩ			
1000 mV	1199.999 mV	1 μV	1199.99 mV	10 μV	1199.9 mV	100 μV	10^{10} Ω or more	—			
10 V	11.99999 V	10 μV	11.9999 V	100 μV	11.999 V	1 mV					

Measurement accuracy: Expressed as ± (% of reading + digits) the value obtained with auto zero and auto calibration on (with a calibration interval of less than 1 hour) and with zero adjustment performed by pressing the ZERO ADJ key
Measurement accuracy for 6 1/2-digit display:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23± 1°C)	90 days (23± 5°C)	180 days (23± 5°C)
5 PLC 10 PLC	10 mV	0.005+15	0.008+15	0.009+15
	100 mV	0.003+8	0.005+8	0.006+8
	1000 mV	0.002+6	0.004+6	0.005+6
	10 V	0.0018+4	0.0035+4	0.0045+4
20 PLC 50 PLC 100 PLC	10 mV	0.005+10	0.008+10	0.009+10
	100 mV	0.003+5	0.005+5	0.006+5
	1000 mV	0.002+5	0.004+5	0.005+5
	10 V	0.0018+3	0.0035+3	0.0045+3

Measurement accuracy for 5 1/2-digit display:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23± 1°C)	90 days (23± 5°C)	180 days (23± 5°C)
5 PLC 10 PLC	1000 μV	0.005+15	0.008+15	0.009+15
	10 mV to 10 V	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		
20 PLC 50 PLC 100 PLC	1000 μV	0.005+10	0.008+10	0.009+10
	10 mV to 10 V	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		

Measurement accuracy for 4 1/2-digit display:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23± 1°C)	90 days (23± 5°C)	180 days (23± 5°C)
5 PLC 10 PLC	1000 μV	Multiply the digit term of the measurement accuracy for 5 1/2-digit display by 1/10.		
	10 mV to 10 V	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/100.		
20 PLC 50 PLC 100 PLC	1000 μV	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		
	10 mV to 10 V	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/100.		

Temperature coefficient: Expressed as ± (% of reading + digits) / °C for values in the temperature range of 0 to 40°C) with ± 100 nV / °C (temperature difference between Hi and Lo terminals) added

Range	6 1/2-digit display	5 1/2-digit display	4 1/2-digit display
1000 μV	–	0.0005+3	0.0005+0.3
10 mV	0.0005+3	0.0005+0.3	0.0005+0.03
100 mV	0.0004+1	0.0004+0.1	0.0004+0.01
500 mV	0.0004+0.3	0.0004+0.03	0.0004+0.003
10 V	0.0004+0.1	0.0004+0.01	0.0004+0.001

Zero stability: ± 50 nV/day
Measurement rate: 4 times/s (with 5 PLC integration time, auto-zero off)

DMM with a Resolution of 10 nV and 1 μΩ and 6 1/2-Digit Display

R6561

Resistance Measurement

Ranges, maximum display, maximum resolution, measurement current, maximum power dissipation, maximum open-circuit voltage:

Mode	Range	6 1/2-digit display		5 1/2-digit display		4 1/2-digit display		Measurement current	Maximum power dissipation	Maximum open-circuit voltage
		Maximum display	Maximum resolution	Maximum display	Maximum resolution	Maximum display	Maximum resolution			
Hi Power	1000 mΩ	1199.999 mΩ	1 μΩ	1199.99 mΩ	10 μΩ	1199.9 mΩ	100 μΩ	10 mA	100 μW	1 V max.
	10 Ω	11.99999 Ω	10 μΩ	11.9999 Ω	100 μΩ	11.999 Ω	1 mΩ	10 mA	1 mW	
	100 Ω	119.9999 Ω	100 μΩ	119.999 Ω	1 mΩ	119.99 Ω	10 mΩ	1 mA	100 μW	
	1000 Ω	1199.999 Ω	1 mΩ	1199.99 Ω	10 mΩ	1199.9 Ω	100 mΩ	100 μA	10 μW	
	10 kΩ	–	–	11.9999 kΩ	100 mΩ	11.999 kΩ	1 Ω	10 μA	1 μW	
Lo Power	100 mΩ	–	–	119.999 mΩ	1 μΩ	119.99 mΩ	10 μΩ	10 mA	10 μW	20 mV max.
	1000 mΩ	–	–	1199.99 mΩ	10 μΩ	1199.9 mΩ	100 μΩ	1 mA	1 μW	
	10 Ω	–	–	11.9999 Ω	100 μΩ	11.999 Ω	1 mΩ	100 μA	100 nW	
	100 Ω	–	–	119.999 Ω	1 mΩ	119.99 Ω	10 mΩ	10 μA	10 nW	
	1000 Ω	–	–	–	–	1199.9 Ω	100 mΩ	1 μA	1 nW	

Maximum input voltage:

Between Hi and Lo terminals: ±30 V peak, continuously

Between GUARD terminal and chassis: ± 500 V peak, continuously

Between GUARD and Lo terminals: ± 50 V peak, continuously

Measurement accuracy: Expressed as ± (% of reading + digits) of the value obtained with auto zero and auto calibration on (with a calibration interval of less than 1 hour) and with zero adjustment performed by pressing the ZERO ADJ key

Measurement accuracy for 6 1/2-digit display in the Hi POWER mode:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C ± 1°C)	90 days (23°C ± 5°C)	180 days (23°C ± 5°C)
5 PLC 10 PLC	1000 mΩ	0.012+20	0.017+20	0.02+20
	10 Ω	0.008+8	0.012+8	0.015+8
	100 Ω			
	1000 Ω			
20 PLC 50 PLC 100 PLC	1000 mΩ	0.012+15	0.017+15	0.02+15
	10 Ω	0.008+5	0.012+5	0.015+5
	100 Ω			
	1000 Ω			

Measurement accuracy for 5 1/2-digit display in the Hi POWER mode:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C ± 1°C)	90 days (23°C ± 5°C)	180 days (23°C ± 5°C)
5 PLC 10 PLC	1000 mΩ	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		
	10 Ω			
	100 Ω			
	1000 Ω			
	10 kΩ	0.008+6	0.0a12+6	0.015+6
20 PLC 50 PLC 100 PLC	1000 mΩ	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		
	10 Ω			
	100 Ω			
	1000 Ω			
	10 kΩ	0.008+5	0.012+5	0.015+5

Measurement accuracy for 4 1/2-digit display in the Hi POWER mode:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C ± 1°C)	90 days (23°C ± 5°C)	180 days (23°C ± 5°C)
5 PLC 10 PLC	1000 mΩ	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		
	10 Ω			
	100 Ω			
	1000 Ω			
	10 kΩ	Multiply the digit term of the measurement accuracy for 5 1/2-digit display by 1/10.		
20 PLC 50 PLC 100 PLC	1000 mΩ	Multiply the digit term of the measurement accuracy for 6 1/2-digit display by 1/10.		
	10 Ω			
	100 Ω			
	1000 Ω			
	10 kΩ	Multiply the digit term of the measurement accuracy for 5 1/2-digit display by 1/10.		

Measurement accuracy for 5 1/2-digit display in the Lo POWER mode:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C±1°C)	90 days (23°C±5°C)	180 days (23°C±5°C)
5 PLC 10 PLC	100 mΩ	0.02+20	0.025+20	0.03+20
	1000 mΩ	0.015+15	0.02+15	0.025+15
	10 Ω	0.01+15	0.015+15	0.02+15
	100 Ω			
20 PLC 50 PLC 100 PLC	100 mΩ	0.02+15	0.025+15	0.03+15
	1000 mΩ	0.015+10	0.02+10	0.025+10
	10 Ω	0.01+10	0.015+10	0.02+10
	100 Ω			

Measurement accuracy for 4 1/2-digit display in the Lo POWER mode:

Integration time (IT)	Range	Measurement accuracy		
		24 hours (23°C ± 1°C)	90 days (23°C ± 5°C)	180 days (23°C ± 5°C)
5 PLC 10 PLC	100 mΩ	Multiply the digit term of the measurement accuracy for 5 1/2-digit display by 1/10.		
	1000 mΩ			
	10 Ω			
	100 Ω			
	1000 Ω	0.01+10	0.015+10	0.02+10
20 PLC 50 PLC 100 PLC	100 mΩ	Multiply the digit term of the measurement accuracy for 5 1/2-digit display by 1/10.		
	1000 mΩ			
	10 Ω			
	100 Ω			
	1000 Ω	0.01+5	0.015+5	0.02+5

Temperature coefficient:

Multiple the reading and digits terms of the 90-day measurement accuracies by 1/10 each, for the temperature range of 0 to +40°C, in the Hi POWER or Lo POWER mode, with an integration time of 5 PLC.

Measurement rate: 1 time/second (with an integration time of 5PLC)

Digital Multimeters

DMM with a Resolution of 10 nV and 1 μΩ and 6 1/2 Digit Display

R6561 (Continued From Previous Page)

Integration Time
The following six integration times can be selected. (1 PLC can be used only for DC voltage measurement.)
1, 5, 10, 20, 50, and 100 PLC
PLC (Power Line Cycle)
50 Hz: 1 PLC = 20 ms
60 Hz: 1 PLC ≒ 16.7 ms

Null Function
When the NULL function is switched from off to on, the null value is measured, and this value is subtracted from subsequent measured values. The correction range is ±1% of each range.

Smoothing Function
A moving average of the measurement data is taken from a specified number of samples to apply digital filtering.

Sampling Modes
RUN: Sampling is performed continuously.
HOLD: One sample only is made for each input of a trigger signal.

Calculation Functions
Primary calculation functions: The following calculations are performed with respect to measured value D (X, Y and Z are constants).

(1) Scaling $R=\frac{D-Y}{X}\times Z$

(2) % deviation $R=\frac{D-Y}{|X|}\times 100(\%)$

(3) Delta $R(\Delta D)=D_t - D_{t-1}$ (difference with respect to the previous data value)

(4) Multiply $R=D_t \times D_{t-1}$ (product with the previous data value) D

(5) Decibels $R(dB)=20Y\log\left|\frac{D}{X}\right|$

(6) Effective value (rms) $R=\sqrt{\frac{1}{X}\times\sum_{K=1}^{X}Dk^2}$

(7) dBm $R\ (dBm) = 10\log\frac{D^2/X}{1mw}$

D: Voltage measurement value
This performs a conversion to units of dBm, with 0 dBm representing the voltage that results in 1 mW dissipation when applied to a reference resistance value of X.

(8) Resistance temperature correction

$$R_{20}=\frac{R_x}{1+0.00393\times(X-20)}\times\frac{1000}{Y}\ (\Omega/km)$$

R_{20}: Lead resistance (Ω/km) at 20°C
R_X: Resistance value (Ω) at temperature X°C
X: Room temperature at measurement (°C)
Y: Length of wire measured (m)

Secondary calculation functions:
Calculations performed on measured values or on the results of primary calculations

(1) Comparator 1
R(H2): HIGH2 < D
R(H1): HIGH1 < D ≤ HIGH2
P(PASS): LOW1 ≤ D ≤ HIGH1
R(L1): LOW2 ≤ D < LOW1
R(L2): D < LOW2

(2) Comparator 2
R(H2): (LIMIT + %2) < D
R(H1): (LIMIT + %1) < D ≤ (LIMIT + %2)
P(PASS): (LIMIT – %1) ≤ D ≤ (LIMIT + %1)
R(L1): (LIMIT – %2) ≤ D < (LIMIT – %1)
R(L2): D < (LIMIT - %2)

(3) Statistical processing
R(MAX): Maximum value for N measurements
R(MIN): Minimum value for N measurements

R(AVE): $R=\frac{1}{N}\times\sum_{K=1}^{N}Dk$

R(P-P): |R(MAX) - R(MIN)|

R(σ): $\sqrt{\frac{1}{N-1}\times\sum_{K=1}^{N}(Dk-\overline{D})^2}$

R(UCL): R(AVE) + 3R(σ)
R(LCL): R(AVE) – 3R(σ)
R(COUNT): Number of samples (N)

Input and Output Functions
Trigger input signal: A signal that triggers a measurement can be supplied from a BNC connector on the rear panel.
Negative TTL-level pulse with a pulse width of 100 us or more

Complete output signal: When measurement is completed, a signal that notifies the end of measurement is output from a BNC connector on the rear panel.
Negative TTL-level pulse with a pulse width of approx. 130 μs

GPIB Interface:
Standard: IEEE 488-1978
Output data format: ASCII format
Interface functions: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Remote programming: All R6561 front panel functions (with the exception of the POWER switch, Lo-GUARD shorting switch, and ZERO ADJ key switch) can be controlled.

Analog Output
Output voltage: 0 to 0.999 V
Output modes and converted output:

Output mode	Converted output
OFF	0 V
Lower 3 digits of displayed value	Digital display 000 to 500 to 999 Analog output 0.000 to 0.500 to 0.999 V
Lower 3 digits of displayed value + OFFSET (500)	Digital display -500 to 000 to 499 Analog output 0.000 to 0.500 to 0.999 V
Lower 2 digits of displayed value	Digital display 00 to 50 to 99 Analog output 0.000 to 0.500 to 0.990 V
Lower 2 digits of displayed value + OFFSET (50)	Digital display -50 to 00 to 49 Analog output 0.000 to 0.500 to 0.990 V

Conversion accuracy: ± 0.3% of full scale (23 ± 5°C, 85% humidity max., for 180 days)
Output impedance: Approx. 600 Ω
Output connector: Type BNC

DMM with a Resolution of 10 nV and 1 μΩ and 6 1/2-Digit Display

R6561

General Specifications

Measurement method: Integration
Input configuration: Floating and guarded
Input terminals: Binding posts (DC voltage measurement)
Round 6-pin connector (low DC voltage and resistance measurements)
Range switching: Manual, auto and remote
Data display: 7-segment green LED
Polarity display: For negative values only
Unit display: 5 × 7 dot matrix LED
Beeper function: Can be turned on or off. When on, the beeper sounds for the following conditions
- Input signal overscale
- Error
- Panel key entry
- Comparator calculation execution
- Other special conditions

Error display: If an error occurs during measurement, calculation, parameter setting, or self-test, the corresponding error code is displayed.
Soft calibration: Calibration of each function and range for DC voltage, low DC voltage and resistance measurement can be performed from the front panel or via the GPIB interface.
Warm-up time: Approx. 60 minutes
Operating environment: Temperature: 0 to 40˚C,
Humidity: 85% RH or less
Storage temperature: -25 to 70˚C
Power requirements: To be selected from the following for your order

Option No.	Standard	32	42	44
Line voltage (V)	90 to 110	103 to 132	198 to 242	207 to 250

Line frequency: 48 to 66 Hz
Power consumption: 33 VA or less
Outer dimensions: Approx. 240(W) × 132(H) × 400(D) mm
Mass: 7.0 kg max.

Standard Accessories

Product name	Model	Remarks
Power cable	**A01402**	
Input cable	**MI-37**	For DC voltage measurement
Input cable	**A01004**	For low DC voltage and 4-wire resistance measurement

Accessories (Sold separately)

A01015 Input Cable for 4-Wire Resistance Measurements
A01020 Input Cable
A02240 Rack Mount Set (JIS Standard)
A02439 Rack Mount Set (EIA Standard)
A02031 Panel Mount Set
A01031 Pen type kelvin probe (connector type)

Digital Multimeters

5 1/2 Digit DMM Series Enabling Dual Input and Display

R6451/6452 Series

- **R6451A: General-Purpose Low-Price DMM with Standard Measurement Functions**
- **R6452A: Full-Functional DMM with Dual-Channel Input and Dual Display**
- **R6452E: Low-Price DMM with Dual-Channel Input and Dual Display**

(Photo is R6452A)

R6451/6452 Series
Digital Multimeters

New R6451/6452 series digital multimeters were designed for diverse applications. The series is provided with a variety of interfaces for use in R&D sections and production lines and it ensures battery operation for field applications. With dual-channel input and dual display, the R6451/6452 series provides a new measurement environment.
The series includes three models: R6451A low-price basic model, R6452A with full measurement functions including frequency measurement, and R6452E focusing DC voltage, resistance and temperature measurement.

- **Dual-Channel Input for New Measurement Environment (R6452A/6452E)**
- **Maximum Display of 199999 (with a Sampling Rate of 2.5 Times/Second) and Maximum Sampling Rate of 80 Times/Second (with a Maximum Display of 1999)**
- **AC Voltage and Current (AC + DC) Measurement with True RMS (R6451A/6452A) and Frequency Measurement (R6452A)**
- **Standard RS-232C Interface and Optional GPIB Interface and BCD Data Output Units**
- **Memory Card (SRAM Card Conforming to JEIDA Ver.4) Ensures Data Compatibility with Personal Computers**
- **Various Interfaces Can be Implemented for Automated Measurements**
- **Optional Battery Unit Allows the Use as a High-Performance DMM for Field Measurement**
- **Diverse and Combination Calculation Functions**
- **Memory Function for Panel Settings (Recalls Previous Condition Settings at Power On)**
- **Large Easy-to-Read Electron-Ray Indicator Tube**
- **High-Speed Analog Bar Graph with a Sampling Rate of 80 Times/Second is Available for Instantaneous Trendy Check (R6451A)**
- **Wide Power Range (90 to 250 V)**

Digital Multimeters

4 1/2 Digit DMM Series for Diverse Applications

R6441 Series

- **R6441A: DMM with low-price basic model**
- **R6441B: Multi-functional DMM with Frequency Measurements**
- **R6441C: DMM with Terminals Dedicated for Floating Current Measurement**
- **R6441D: DMM with Enhanced Current Measurement**

(Photo is R6441C)

R6441 Series
Digital Multimeters

New R6441 series digital multimeters were designed for diverse applications. The series is provided with a variety of interfaces for use in R&D sections and production lines; it ensures battery operation for field applications. With dual-channel input and dual display, the R6441 series provides a new measurement environment.
The series includes three models: R6441A low-price basic model, R6441B with enhanced AC measurement functions, R6441C with enhanced very small current and floating method current measurement functions, and R6441D low-price model with enhanced current measurement functions.

- **Maximum Display of 199999 (with a Sampling Rate of 2.5 Times/Second) and Maximum Sampling Rate of 80 Times/Second (with Maximum Display of 1999)**
- **AC Voltage and Current Measurement with True RMS (R6441B/6441C/6441D), AC + DC Measurement (R6441B) and Frequency Measurement (R6441B)**
- **Standard RS-232C Interface and Optional GPIB Interface and BCD Data Output Units**
- **Memory Card (SRAM Card Conforming to JEIDA Ver.4) Ensures Data Compatibility with Personal Computers**
- **Various Interfaces Can be Implemented for Automated Measurement**
- **Optional Battery Unit Allows the Use as a High-Performance DMM for Field Measurement**
- **Diverse and Combination Calculation Functions**
- **Memory Function for Panel Settings (Recalls Previous Condition Settings at Power On)**
- **Large Easy-to-Read Electron-Ray Indicator Tube**
- **High-Speed Analog Bar Graph with a Sampling Rate of 80 Times/Second is Available for Instantaneous Trendy Check (R6441A)**
- **Wide Power Range (90 to 250 V)**
- **Input Terminal Dedicated for Floating DC/AC Current (in 2- and 5-A Ranges) (R6441C)**

R6441 Series

Specifications

Measurement accuracy: 23 ± 5˚C, 85% RH or less (75% or less is guaranteed for 1 year at 20-M and 200-MΩ ranges.) The display value is ± % of reading ± digits.

Temperature coefficient: 0.1 × (measurement accuracy)/˚C at 0 to 50˚C. The display value is (± % of reading ± digits)/˚C.

DC voltage measurement

d:digit

Range	20 mV	200 mV	2000 mV	20 V	200 V	1000 V
Maximum display	19999					10999
Resolution	1 µV	10 µV	100 µV	1 mV	10 mV	100 mV
Measurement accuracy	±0.04%±5d	± 0.04% ± 2d				
Input impedance	1 GΩ or more			11.1MΩ±1%	10.1M±1%	10.0MΩ±1%
Maximum allowable applied voltage	1100 V (all ranges, continuous)					

DC voltage noise rejection ratio

Sampling rate	Effective common mode noise rejection ratio (unbalanced impedance of 1 kΩ)	Normal mode noise rejection ratio
	50/60 Hz ± 0.1%, DC	50/60 Hz ± 0.1%
FAST	Approx. 60 dB	0 dB
MID	Approx. 120 dB	Approx. 60 dB
SLOW		

AC voltage measurement

R6441A (with average measurement and rms value display)

Range		200 mV	2000 mV	20 V	200 V	700 V
Maximum display		19999				7099
Resolution		10 µV	100 µV	1 mV	10 mV	100 mV
Measurement accuracy	20 to 45 Hz	±0.6%±40d	±0.6%±35d	±0.6%±45d	±0.6%±45d	±0.6%±35d
	45 to 20 kHz	±0.25%±35d	±0.25%±30d	±0.25%±40d	±0.25%±40d	±0.25%±30d
	20 to 30 kHz	±0.8%±40d	±0.8%±35d	±0.8%±45d	±0.8%±45d	±0.8%±35d
	30 to 100 kHz	±5%±50d	±5%±50d	±5%±50d	±5%±50d	±5%±50d
Input impedance		1.1 MΩ ± 10%, 100 pF or less				
Maximum allowable applied voltage		800 Vrms, 1100 Vpeak, 10^7 VHz				
Response time		Approx. 4 seconds for VAC voltage and approx. 2 seconds for VAC voltage filter (0.1% or less of the final value in the same range)				

* The frequency range of the VAC filter is 300 Hz to 100 kHz.

R6441B (True RMS, AC, AC+DC) / **R6441C/6441D** (True RMS, AC)
With an input of 5% or more of the full scale

Range	200 mV	2000 mV	20 V	200 V	700 V
Maximum display	19999				7099
Resolution	10 µV	100 µV	1 mV	10 mV	100 mV
20 Hz to 45 Hz	±0.6%±35d				
45 Hz to 20 kHz	±0.2%±30d				
20 kHz to 30 kHz	±0.5%±30d				
30 kHz to 100 kHz	±4%±50d				
Input impedance	1.1 MΩ±10%, 100 pF or less				
Crest factor	3:1 at the full scale				
Maximum allowable applied voltage	800 Vrms, 1100 Vpeak, 10^7 VHz				
Response time	Approx. 1 second (0.1% or less of the final value in the same range)				

Resistance measurement

Range	200 Ω	2000 Ω	20 kΩ	200 kΩ	2000 kΩ	20 MΩ	200 MΩ
Maximum display	19999						
Resolution	10 mΩ	100 mΩ	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ
Measured applied current	3 mA	1 mA	100 µA	10 µA	1 µA	100 nA	10 nA
Measurement accuracy	±0.07%±10d	±0.07%±2d			±0.1%±2d	±0.3%±5d	±3.0%±10d
Open circuit voltage	7.5 V or less						
Maximum allowable applied voltage	±500 V						

* When the null function is used

In-circuit resistance measurement

Range	200 Ω	2000 Ω	20 kΩ	200 kΩ	2000 kΩ	20 MΩ
Maximum display	19999					
Resolution	10 mΩ	100 mΩ	1 Ω	10 Ω	100 Ω	1 kΩ
Measured applied current	1 mA	100 µA	10 µA	1 µA	100 nA	10 nA
Measurement accuracy	±0.07%±100d	±0.07%±20d			±0.1%±20d	±0.3%±50d
Open circuit voltage	7.5 V or less					
Maximum allowable applied voltage	±500 V					

* When the null function is used

DC current measurement

R6441A/6441B

Range	20 mA	200 mA	2000 mA	10 A
Maximum display	19999			10999
Resolution	1 µA	10 µA	100 µA	1 mA
Measurement accuracy	±0.2%±5d		±0.6%±5d	
Input terminal resistance	1.5 Ω or less *1		0.04 Ω or less *1	
Overcurrent protection	0.5 A/250 V IEC 127 sheet 1 Protected by a quick-blowing fuse		15 A/250 V with 10000-A interrupting capacity Protected by a quick-blowing fuse	

*1 The resistance of the protection fuse is excluded.

R6441C/6441D

Range	2 µA *1	20 µA *1	200 µA	2000 µA	20 mA	200 mA	2000 mA*1	5 A *1
Maximum display	19999						1999	4999
Resolution	100 pA	1 nA	10 nA	100 nA	1 µA	10 µA	100 µA	1 mA
Measurement accuracy	±0.2%±5d						±2%±50d	±2%±5d
Input terminal resistance	Approx. 10 kΩ or less*2		102 Ω or less *2		2 Ω or less *2		0.1 Ω or less *2	
Overcurrent protection	0.5 A/250 V IEC 127 sheet 1 Protected by a quick-blowing fuse						6 A/250 V with 10000-A interrupting capacity Protected by a quick-blowing fuse	

* When the floating method for 2000-mA and 5-A ranges and the null function are used.

*1 Mounted only on the R6441C.

*2 The resistance of the protection fuse is excluded.

AC current measurement

R6441A (with average measurement and rms value display)

Range		200 mA	10 A
Maximum display		10 µA	1 mA
Resolution		19999	10999
Measurement accuracy	20 Hz to1 kHz	±0.8%±40d	±0.8%±40d
	1 to 5 kHz	±5.0%±40d	±5.0%±40d
Input terminal resistance		1.5 Ω or less *1	0.04 Ω or less *1
Overcurrent protection		0.5 A/250 V IEC 127 sheet 1 Protected by a quick-blowing fuse	15 A/250 V with 10000-A interrupting capacity Protected by a quick-blowing fuse
Response time		Approx. 4 seconds for AC current and approx. 2 seconds for AC current filter (0.1% or less of the final value in the same range)	

* The AC current filter is 300 Hz to 5 kHz. (Display with input switching is not possible when an AC current filter is used.)

*1 The resistance of the protection fuse is excluded.

R6441B (True RMS, AC, AC+DC)

With an input of 5% or more of the full scale

Range		200 mA	10 A
Maximum display		10 µA	1 mA
Resolution		19999	10999
Measurement accuracy	20 Hz to 1 kHz	±0.8%±40d	±0.8%±40d
	1 kHz to 5 kHz	±5.0%±40d	±5.0%±40d
Crest factor		3:1 at the full scale	
Input terminal resistance		1.5 Ω or less *1	0.04 Ω or less *1
Overcurrent protection		0.5 A/250 V IEC 127 sheet 1 Protected by a quick-blowing fuse	15 A/250 V with 10000-A interrupting capacity Protected by a quick-blowing fuse
Response time		Approx. 1 second (0.1% or less of the final value in the same range)	

*1 The resistance of the protection fuse is excluded.

R6441 Series (Continued From Previous Page)

R6441C/6441D (True RMS, AC)
With an input of 5% or more of the full scale

Range		200 µA	2000 µA	20 mA	200 mA	2000 mA *1	5 A *1
Maximum display		19999				19999	4999
Resolution		10 nA	100 nA	1 µA	10 µA	100 µA	1 mA
Measurement accuracy	20Hz to 500Hz	±0.8%±40d				±2%±40d	
	500Hz to 5kHz	±5.0%±40d					
Crest factor		3:1 at the full scale					
Input terminal resistance		Approx. 102 Ω or less *2		2 Ω or less *2		0.1 Ω or less *2	
Overcurrent protection		0.5 A/250 V IEC 127 sheet 1 Protected by a quick-blowing fuse				6 A/250 V with 10000-A interrupting capacity Protected by a quick-blowing fuse	
Response time		Approx. 1 second (0.1% or less of the final value in the same range)					

* Floating method is used for 200-mA and 5-A ranges.

*1 Mounted only on the R6441C.

*2 The resistance of the protection fuse is excluded.

Frequency measurement
R6441B

Range	20 Hz	200 Hz	2 kHz	20 kHz	200 kHz
Maximum display	19999				
Measurement accuracy	1 mHz	10 mHz	100 mHz	1 Hz	10 Hz
Measurement time	±0.02%±2d				

* Waveform : Sine, square
Duty ratio : 3 or less

Sampling mode: Free-run

Function	Measurement time		
	FAST (3 1/2)	MID (4 1/2)	SLOW (4 1/2)
DC voltage measurement	12.5 (80)	100 (10)	400 (2.5)
AC voltage measurement (AC coupling)	12.5 (80)	100 (10)	400 (2.5)
Resistance measurement	12.5 (80)	100 (10)	400 (2.5)
DC current measurement	12.5 (80)	100 (10)	400 (2.5)
AC current measurement	12.5 (80)	100 (10)	400 (2.5)
Frequency measurement (R6441B)	210 (4.7)	300 (3.3)	600 (1.5)
Conductive measurement	12.5 (80)	100 (10)	400 (2.5)
Diode measurement	12.5 (80)	100 (10)	400 (2.5)

Unit [ms] (times/second)

Conductive measurement: Measurement range of 200 Ω and continuity judgment value of 20 Ω
Other specifications are the same as those for the 200 Ω range for resistance measurement.

Diode measurement: Measurement range of 2000 mV
Other specifications are the same as those for the 2000 Ω range for resistance measurement.

Sampling rate	FAST	MID	SLOW
Number of measurements (times/second)	80	10	2.5

Calculation function: Null, smoothing, dB/dBm, scaling, MAX/MIN, comparator

General specifications
Measurement method: Integrating type
Input method: Floating type
Range switching: Auto and manual
Data display: 5-digit decimal, 7-segment electron ray indicator tube
Overinput indication: "OL" is displayed for inputs out of the rated measurement range.
Low-battery indication: If the battery power voltage drops to below the rated voltage, a low-battery mark is indicated in the display section.
Dielectric strength: Withstands 450 V continuously applied between the COM terminal and chassis and between the Com terminal and AC power line.
Operating environment:
Operating temperature: 0 to 50˚C
(0 to 40˚C when the battery is mounted)
Operating humidity: 85% RH or less
Storage temperature: -25 to 70˚C
(-20 to 50˚C when the battery is mounted)
Power consumption: 15 VA or less
AC power: Specified at time of ordering.

Option No.	Standard	32	42	44
Power voltage (V)	90 to 110	103 to 132	198 to 242	207 to 250

DC power supply: 6-hour continuous operation is possible by means of the R15807 battery unit.
Dimensions: Approx. 212 (W) × 88 (H) × 310 (D) mm
Mass: 2.2 kg maximum (main unit), 3.5 kg maximum (with options)
Accessories:

Product name	**A01402**	**A01034**
Model	Power cable	Input cable x1

Standard accessories: RS-232C, baud rate of 9600, 4800, 2400, 1200, 600, and 300

Optional accessories
A08316 Alligator clip adapter
A08317 Miniature clip adapter
A01001 Input cable
A01265 RS-232C cable (For 1 m, 250- and 9-pin (DMM))
A09507 SRAM card (64 kbytes)
TR1116 DC high-voltage probe
TR1111 Terminal adapter
A02464 EIA rack mount kit (twin)
A02463 EIA rack mount kit
A02264 JIS rack mount kit (twin)
A02263 JIS rack mount kit
R16215 Carrying bag