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Electrometers

High-Speed and High-Accuracy Measurement of 10^{-14} A and 3 x 10^{16} Ω

R8340A

- **Measurement of Micro Current from 10 fA to 19.999 mA**
- **Measurement of High Resistance from 10 Ω to 3 × 10^{16} Ω**
- **High-Speed Charge/Discharge**
- **High-Speed Measurement with 100 Samples/Second**
- **Floating Measurement of 1100 VDC**
- **Standard GPIB Interface**



R8340A

Digital Ultra-High Resistance/Micro Current Meters

The R8340A digital ultra-high resistance/micro current meters use an input amplifier gain switching type I-V converter, high-speed sampling A/D converter and low-noise high-response voltage generator. They are fast and precise, with a range from 10 fA to 19.999 mA for current measurement and 10 Ω to 3 × 10^{16} Ω for resistance measurement.

The R8340A have a continuously variable DC power supply with a voltage from 0.000 V to 1000.0 V as a voltage source for measuring high resistance. They can be used to test and inspect electric insulation materials such as synthetic resin and rubber, switches, connector and capacitors. With the use of accessories R12704 and R172708, surface resistivity rate, volume resistivity rate and the effect of temperature on both rates can be measured.

For micro current measurement, ion current and leak current can be measured with high sensitivity and precision.

The meters have a handler interface to be connected with external devices such as automatic handlers and fixtures. Packed format output is used for higher efficiency in GPIB data transfer, so improved throughput is guaranteed in production lines and incoming inspections.

The meter is provided with the sequence program function to store measurement conditions and procedures, allowing measurements under the same measurement conditions at the touch of a button. The contact check function makes it possible even for beginners to perform simple, stable and highly precise measurement.

■ Measurement Speed Selectable Depending on the Required Measurement Accuracy

The R8340A are provided with the function to select the input resistance and integrating time by input amplifier gain switching. The measurement speed can be selected according to the measurement accuracy required, thus ensuring highly reliable measurement.

■ High-Speed Charging/Discharging of Samples

The built-in voltage generator has a low-noise (5 mVp-p/1,000 V) high-response (3 ms from 0 to 1,000 V) 10W-class power supply that enables the use as source and sink, allowing samples to be charged and discharged very quickly. In addition, the current limit value can be selected both for source and sink.

■ Sequence Program Function Assures Consistent Measurement Results

The R8340A's sequence program function has several measurement sequences in addition to JIS C5102 measurement procedures and conditions as standard. The function makes it possible to store the set measurement conditions, allowing the same results to be obtained even if the measurement is performed by different engineers.

■ Stable Measurement of Grounded Samples

The R8340A is provided with the floating measurement capability for 1100 Vpeak, allowing samples to be measured even with one end of a coaxial cable grounded.

Max. Voltage Generation	Voltage Between Grounding	BCD, Analog Output
1000V	DC1100V	Possible

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Specifications

DC Current Measurement

Measuring range	Maximum display	Resolution	Measuring temperature ± (% of reading + digit)	Temperature coefficient + (% of reading + digit)/˚C	Settling time
200 pA	199.99 pA	10 fA	0.7+6	0.02+0.5	250 ms
2 nA	1999.9 pA	100 fA	0.7+3	0.02+0.2	25 ms
20 nA	19.999 nA	1 pA	0.3+3	0.01+0.2	5 ms
200 nA	199.99 nA	10 pA	0.3+3	0.01+0.2	
2 µA	1999.9 nA	100 pA	0.15+3	0.005+.2	2 ms
20 µA	19.999 pA	1 nA	0.15+2	0.005+0.1	
200 µA	199.99 µA	10 nA	0.1+2	0.005+0.1	
2 mA	1999.9 µA	100 nA	0.1+2	0.005+0.1	
20 mA	19.999 mA	1 µA	0.1+2	0.005+0.1	

The measurement accuracy is the value under the following condition: the automatic calibration is on, temperature is +23˚C±5˚C, relative humidity is 70% or less, for six months. It is indicated by ± (% of reading + digit). The temperature coefficient is the value when the temperature is 0 to 40˚C and the relative humidity is 70% or less, indicated by ± (% of reading + digit)˚C.

The settling time indicates the time to reach ±1% of the final value when the input amplifier gain is set to x 10000, excluding range switching time.

Resistance Measurement

Current range	Measuring range (Ω)	Measurement accuracy (VS 100 V, input amplifier gain is × 10 or more)
200 pA	1×10^{9} to 3×10^{16}	0.8% + 14d
2 nA	1×10^{8} to 3×10^{15}	0.8% + 11d
20 nA	1×10^{7} to 3×10^{14}	0.4% + 11d
200 nA	1×10^{6} to 3×10^{13}	0.4% + 11d
2 µA	1×10^{5} to 3×10^{12}	0.25% + 11d
20 µA	1×10^{4} to 3×10^{11}	0.25% + 10d
200 µA	1×10^{3} to 3×10^{10}	0.2% + 10d
2 mA	1×10^{2} to 3×10^{9}	0.2% + 10d
20 mA	1×10^{1} to 3×10^{8}	0.2% + 10d

Measurement accuracy:
± {(current range accuracy)+(voltage generation accuracy)

$$- \frac{\text{Input voltage drop}}{\text{generated voltage}} \}$$

Temperature coefficient:
± {(current measurement range temperature coefficient) / ˚C
+ (voltage measurement range temperature coefficient) / ˚C }
Maximum display: One to four digits (1 to 9.999)
Settling time: Varies with the current measuring range.

Input Resistance

Current range	Input amplifier gain switching			
	× 1	× 10	× 100	× 10000
200 pA	10 GΩ	1 GΩ	100 MΩ	10 kΩ or less
2 nA	1 GΩ	100 MΩ	10 MΩ	1 kΩ or less
20 nA	100 MΩ	10 MΩ	1 MΩ	100 Ω or less
200 nA	10 MΩ	1 MΩ	100 kΩ	11 Ω or less
2 µA	1 MΩ	100 k Ω	10 kΩ	2 Ω or less
20 µA	100 kΩ	10 kΩ	1 kΩ	1 Ω or less
200 µA	10 kΩ	1 kΩ	100 Ω	1 Ω or less
2 mA	1.1 kΩ	110 Ω	11 Ω	1 Ω or less
20 mA	180 Ω	18 Ω	3 Ω	1 Ω or less

Input voltage drop: ± (measuring current × input resistance + 500µV)
Input bias current: 30 fA or less (temperature +23˚C±1˚C, relative humidity 50% or less)
Input capacitance: 30 pF or less (excluding the input cables)
Maximum voltage: 1.1 k Vpeak

DC Voltage Generation

Output voltage	Set resolution	Generation accuracy ± (% of setting + digit)	Temperature coefficient ± (% of setting + digit)/˚C	Output noise (10-500 Hz)
0.000V to 10.000V	2.5 mV	0.1 + 10 d (10 mV)	0.008 + 0.5 d (500 µV)	1 mVp-p
10.003V to 100.00V	25 mV	0.1 + 8 d (80 mV)	0.008 + 0.3 d (3 mV)	2 mVp-p
100.03V to 1000.0V	250 mV	0.1 + 8 d (800 mV)	0.008 + 0.3 d (30 mV)	5 mVp-p

The measurement accuracy is the value under the following condition:

Temperature is +23˚C±5˚C, relative humidity is 70% or less, for six months. It is indicated by ± (% of reading + digit).

The temperature coefficient is the value when the temperature is 0 to 40°C and the relative humidity is 70 % or less, indicated by ± (% of reading + digit)/˚C.

Output voltage	Current compliance setting		
	300 mA	100 mA	10 mA
0.000 V to 30.00 V	±300 mA	±100 mA	±10 mA
30.03 V to 100.00 V	±100 mA	±100 mA	±10 mA
100.03 V to 1000.0 V	±10 mA	±10 mA	±10 mA

Current compliance accuracy (source/sink):
When temperature is +23˚C±5˚C and relative humidity is 70% or less
300 mA: ±300 mA to ±500 mA
100 mA: ±100 mA to ±150 mA
10 mA: ±10 mA to ±20 mA

Settling time: Pure resistive load t = 3 ms (max.)

$$\text{Capacitive load } t = \frac{CV}{i} \text{ (charging time) + to (convergence time)}$$

t: Settling time (Time to reach ±1% of the final value, excluding range switching time at forward resistance load)
C: Capacitive load
V: Output voltage
i: Charging current (The maximum value is the current compliance.)
t0: Convergence time (See the table below.)

Output voltage \ Chapacity	0.22 µF	22 µF	33 µF
0.000 V to 100.00 V	0.1	3.0	7.0
100.3 V to 1000.0 V	4.2	15	150

(msec)

Overshoot voltage:

Output voltage \ Chapacity	Pure resistance	0.22 µF	22 µF	33 µF
0.000 V to 100.00 V	0.05	0.05	3.0	3.0
100.3 V to 1000.0 V	0.05	36	24	10

(V)

Measurement speed, maximum indication (in current measurement) :

Integration time	Number of samplings during free run	Maximum display
2 ms	100 times/s*1	3 1/2-digit 1999
1 PLC	50 Hz: 30 times/s 60 Hz: 33 times/s	4 1/2-digit 19999
5 PLC	8.5 times/s	
10 PLC	4.5 times/s	
4 × 10 PLC	1 times/s	
8 × 10 PLC	0.5 times/s	
16 × 10 PLC	0.3 times/s	

*1: When display is OFF, automatic calibration is OFF and memory store is ON.

Other Functions

NULL function: R = X - X_{NULL}
Subtracts the measurement data when NULL is set from the measurement data.
X: Measurement data
X_{NULL}: Measurement data when NULL is set

COMPARE Function:
R(Hi): X > Y, R(Go): Y β X β Z
R(Lo): X < Z
Compares the measurement data with the set data.
X: Measurement value Y: High level set value
Z: Low level set value

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PRGM (sequence program) function: Major sequences such as capacitor leak measurement and JIS C5102 are built in.
CONTACT (contact check) function: Checks the contact of materials by C measurement. Checks capacitor with insufficient capacities by initializing standard sample.
Set item CONTACT LEVEL: Judgment at n times the standard sample
Automatic range level function: When the automatic current measurement range is set to UP, the level can be selected from 20000, 2000, or 200; when it is set to DOWN, the level can be selected from 1799, 179, or 17. This enables fast response measurement according to the number of required digits.
Data memory: 1000 data items can be stored.
Buzzer: The buzzer reports Hi/Lo of the COMPARE calculation results, program end and abnormality in two tones.

I/O Functions

GPIB interface: Conforms to IEEE and 488-1978.
Outputs measurement data, generated voltage, status and error messages.
Binary packed format (IEEE 754 floating decimal point) is available.

Handler interface: I/O signal to time external devices such as automatic handler and fixture (24-pin Amphenol connector)
Input; *TRIGGER, LID SIGNAL, STBY
Output; *COMPLETE, *EOM, *INDEX, *ALARM, *LO, *GO, *HI, *NO CONTACT

Single wire signal (BNC connector):
*TRIGGER (input),
LID SIGNAL (input),
*COMPLETE (output)

BCD output: The output format can be selected from OFF, BCD, or BINARY (50-pin Amphenol connector). TTL positive logic

D/A output: Converts any 2- or 3-digit display data to analog form and outputs them.
Output voltage: ±1 V
Conversion output: Three-digit display 000 to ±999 to ±0.999 V +50% offset setting possible.
Output when offset: (-500 to 0 V, 000 to 0.5 V, +499 to 0.999 V)
Digit selection: 19999, 19999, 19999, 19999
Conversion accuracy: ±0.2%±2 d (warranty for six months under 23˚C±5˚C and 70% RH)
Output resistance: 1 Ω or less
Maximum load current: ±0.5 mA
Output connector: Binding post

General Specifications

Normal mode noise rejection rate: (at 50/60 Hz ±0.09%)

Integration time	NMRR	ECMRR
2 ms	0 dB	60 dB or more
1 PLC to 16 x 10 PLC	60 dB or more	120 dB or more

Effective common mode noise rejection ratio: ECMRR shown above (1 kΩ unbalanced impedance between LO and GND terminals, DC and 50/60 Hz ±0.09%)

Measurement method: Integration method

Input method: Floating method
Data display: Seven-segment green LED
Unit/indicator display: 5 × 7 dot matrix green LED
Input terminal: Triaxial connector (INPUT)
Black binding post (LO, GND)
Blue binding post (GUARD)
Voltage output terminal: Red binding post (V SOURCE)
Input protection fuse: 1 A fuse
Maximum voltage applied between terminals:
Between INPUT and other terminals: 1100 Vpeak (1 minute)
Between LO and GUARD: 1100 Vpeak
Between LO and GND: 1100 Vpeak
Between GUARD and GND: 1100 Vpeak
Between V SOURCE and other terminals:
When 0 V to 100.00 V is set, +100 Vpeak
When 100.03 V to 1000.0 V is set, +1000 Vpeak
Warm-up time: Approx. 30 min
(Time to reach the specified accuracy)
Operating environment: Temperature 0˚C to 40˚C,
Relative humidity 85% or less
Storage temperature: -25 to 70˚C
Power supply: Specified at the time of ordering.

Option No.	Standard	31	32	42	43	44
Power supply voltage (V)	90 to 110	103 to 127	108 to 132	198 to 242	207 to 250	216 to 250

48 to 66 Hz

Power consumption: 90 VA or less
Dimensions: Approx. 424(W) × 88(H) × 350(D) mm
Mass: 8 kg max.

Standard Accessories

Name	Model name	Product code Remarks
Power cable	**A01402**	
Input cable	**A01018 - 100**	TRIAX - alligator clip Banana tip - alligator clip

Accessories (Optional)

A02706 EIA Rack mount set A (with front handles)
A02707 JIS Rack mount set A (with front handles)
A02716 EIA Rack mount set B (without front handles)
A02717 JIS Rack mount set B (without front handles)
A02701 Front handle set
A01009-50, 100, 150, 200 Input cable (TRIAX-TRIAX connector)
MC-04S × 01, × 02 Input cable (for connecting TRIAX and TR44)
A01239-50, 100, 150, 200
(High withstand voltage TRIAX-TRIAX connector)
A04201 TRIAXJ-TRIAXJ Adaptor
A04202 TRIAXJ-BNC P Adaptor 1
A04203 TRIAXJ-BNC P Adaptor 2
A04207 BNCJ-MP Adaptor
A04208 TRIAXJ Receptacle
TR40 Series Electrometer Accessories
R12600 Series Test Lead
R12700 Series Test Fixture

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