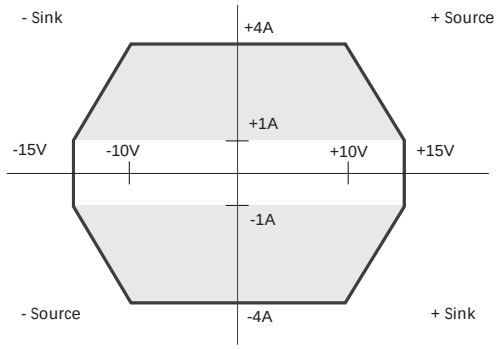
ИСТОЧНИКИ-ИЗМЕРИТЕЛИ R6240A

R6240A is a DC voltage and current source/monitor with high-performance features including source resolution of 4 1/2 digits, measuring accuracy of 5 1/2 digits, and basic accuracy of ±0.025%. The R6240A has a pulse measuring function of pulse width of 500µs in addition to linear, fixed, and random sweep functions. This product can be used for a wide range of applications as a power source for evaluation in research and development of semiconductors and other electronic components, or a power source for a production line characteristic test system.

In particular, the pulse source and pulse load function with the maximum capacity of 4Amps fully demonstrates its capability in evaluation of compact devices of increasing current capacity. At the same time, the individual HI/LO limiter setting function demonstrates its power in evaluation of batteries and power source IC. The new suspend function enables selection of the optimum OFF state for each application, contributing to the throughput improvement.

- Source and measurement with the basic accuracy of ±0.025%
- Measuring accuracy of 5 1/2 digits (±319999), resolution of 10µV, and 10nA
- Source/sink of ±4A for a maximum period of 20ms
- Pulse measurement with minimum pulse width of 500µs and resolution of 1µs
- Linear/fixed/random sweep functions for characteristic measurement
- Individual settings of HI and LO limiters
- Suspend function that enables selection of an output OFF state
- Resistance measurement under constant voltage source or constant current source
- Synchronous measurement of multiple units

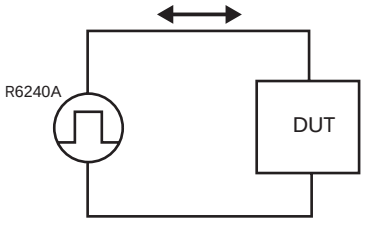
Output range



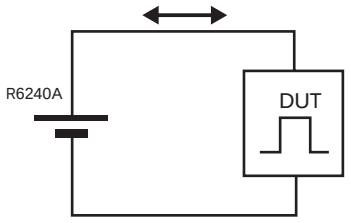
Generation enabled with DC and Pulse

Only pulse source or pulse load enabled
Pulse width: 20ms or less and duty 20% or less

Can generate pulse current of maximum 4A (20ms)

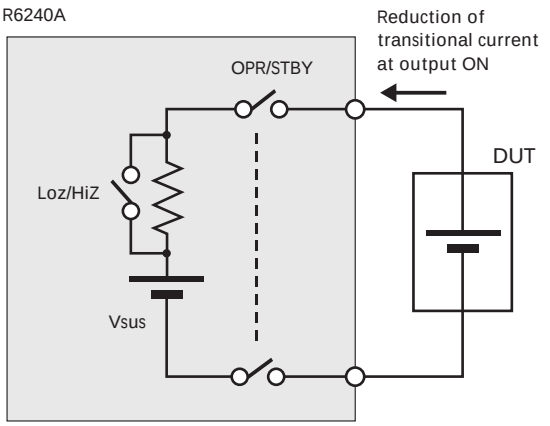


Can supply to pulse load of maximum 4A (20ms)



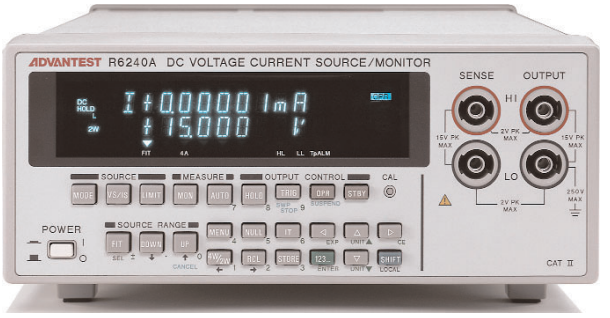
Suspend Function

The R6240A supports three output OFF states, STBY (output relay OFF), HiZ (output relay ON, high resistance state), and LoZ (output relay ON, low resistance state). This eliminates the ON/OFF operations of the unnecessary relays, thereby solving the existing throughput deterioration problem by relay operation time. In addition, the setting of a suspend voltage (voltage at HiZ or LoZ state) prevents transitional current suction that occurs at connection of a voltage output device such as a battery.



State at output OFF	Output relay	Output state	Current limiter setting value
LoZ	ON	Vsus, low resistance	VS: set current Limiter (IL) IS: 30 digits of the set current range
HiZ	ON	Vsus, high resistance	30µA
STBY	OFF	Open	—

Vsus:Suspend setting voltage (default = 0V)



For measuring ON resistance of MOSFET and analog SW

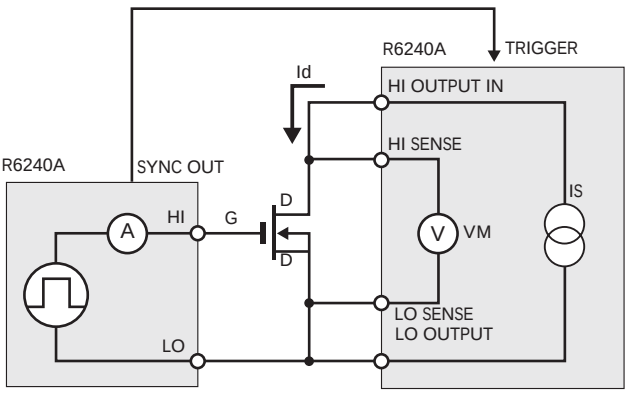
An example of measuring ON resistance of MOSFET is shown below.

On the drain side, by applying ISVM and 4-wire connection, the R6240A determines the current at the ON state with the source current (IS) and the drain voltage at the OFF state with the voltage limiter.

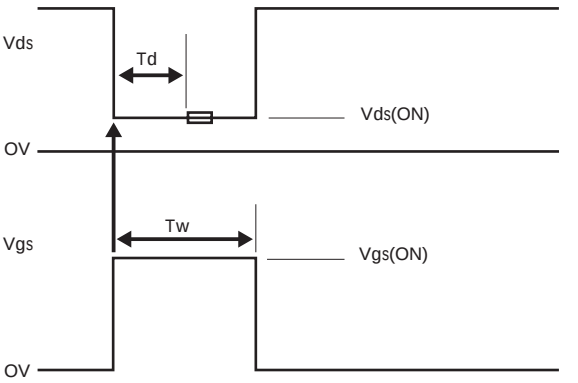
On the gate side, the SYNC OUT signal is input to TRIGGER IN of the R6240A on the drain side as the pulse source of ISVM. In this way, synchronous measurement by two units is achieved. By using the linear, pulse, or sweep function on the gate side and the fixed sweep function on the drain side, gate voltage – ON resistance characteristics can be measured easily.

- Resistance measuring range: 2.5µ-7.5MΩ
- Maximum current (Id Max): 4A (at pulse width 20ms or less)
- Pulse measurement at the minimum pulse width: 500µs and the minimum cycle: 2ms
- Gate current measurement at resolution 10nA

Connection diagram



Measurement waveformwaveform diagram



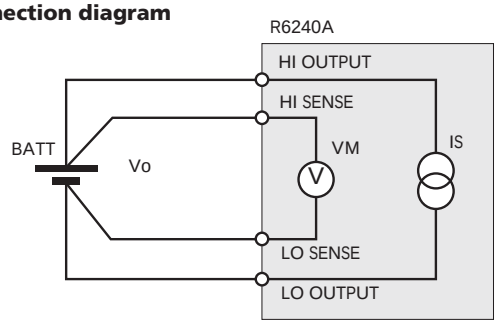
Tds: Drain voltage Vgs: Gate voltage Td: Major delay Tw: Pulse width

For Battery Charge/Discharge Tests and Power Supply Device Evaluation

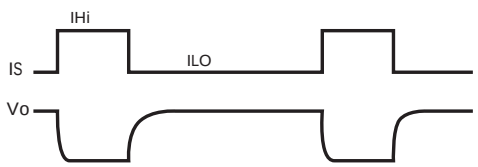
The R6240A handles bipolar output and is capable of ± source and ±sink operations. Therefore, this equipment is capable of 0V sink operation, which is not possible under a general electronic load. With its pulse source function, the R6420A can be used for evaluation of batteries and power supply devices that are used for various portable devices as pulse load.

- Capable of handling pulses of various portable telephones due to its minimum pulse width of 500 µs and resolution of 1µs.
- Capable of CV → CC operation for both charging and discharging due to its HI and LO voltage limiters
  Both the HI and LO voltage limiters allow the + setting (or – setting). For instance, if HI is set to +1.8V and LO is set to 1.2V, at charging, the constant charge voltage state is reached at +1.8V and at discharging, the constant discharge voltage terminates at +1.2V (constant voltage state).
- Avoids unnecessary discharge at the output ON state by setting a Suspend voltage (Vsus).
  A general power supply is 0V or an open state of 0V when output is OFF and when output is ON, a low impedance state of 0V always occurs.
  In this case, the battery discharges instantaneously. However, for instance by setting the Suspend voltage of the R6240A to +1.2V, unnecessary discharge can be avoided since the voltage of the output terminal is the same as that of the battery, which is +1.2V, even in a temporary low impedance state that occurs when the output is ON. This function is useful for preventing FET from being set to ON instantaneously at the output ON state when it is used as a gate voltage of J-FET or GaAsFET.

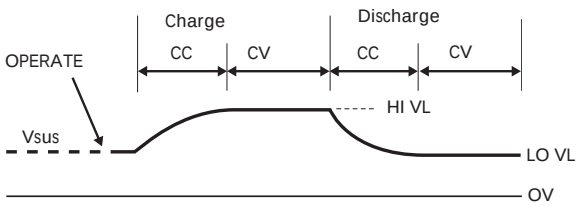
Connection diagram



Pulse discharge waveform



Battery charge waveform



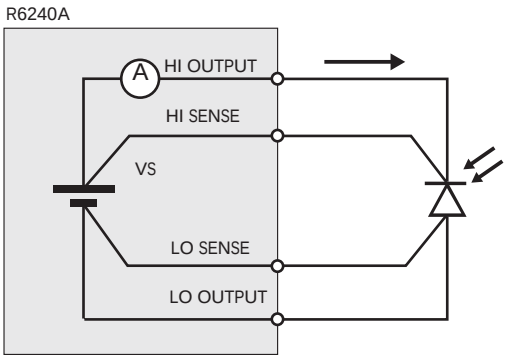
HI VL: HI voltage limiter LO VL: LO voltage limiter

For Evaluation of Solar Batteries

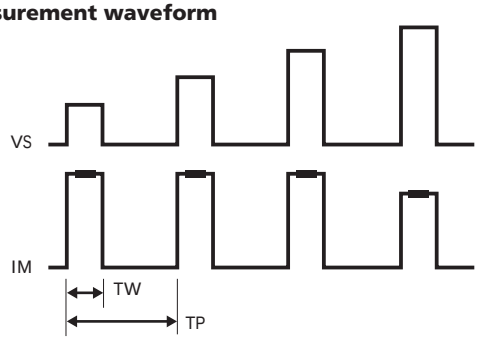
Since the conversion efficiency of solar batteries is influenced by a bias application time, measurement by pulse application is effective for finding a true conversion efficiency. The R6240A pulse sweep function enables measuring of the characteristics of photoelectric voltage – photoelectric current and photoelectric voltage – photoelectric power at a high speed. By changing the pulse width, characteristic changes that occur according to the application time can be measured easily.

- Minimum pulse width: 500µs, Minimum cycle: Measurement of 2ms pulse
- Maximum current 4A for pulse width 20ms or less
- Minimum voltage step: 100µ (3V range)

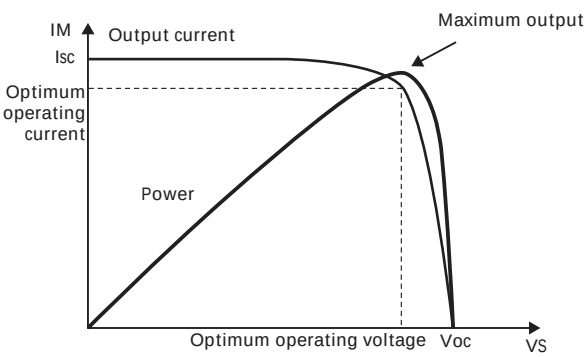
Connection diagram



Measurement waveform



Characteristics of photoelectric voltage_photoelectric current, and photoelectric voltage_photoelectric power



Isc: End current Voc: Open voltage

Specifications

All the accuracies are guaranteed for one year when the equipment is used at temperatures of 23 ± 5°C and relative humidity of 85% or less.

Voltage source/Measurement range

Range	Source range	Setting resolution	Measurement range	Measurement resolution
3V	0~±3.1000V	100µV	0~±3.19999V	10µV
15V	0~±15.000V	1mV	0~±15.1999V	100µV

Current source/Measurement range

Range	Source range	Setting resolution	Measurement range	Measurement resolution
3mA	0~±3.1000mA	100nA	0~±3.19999mA	10nA
30mA	0~±31.000mA	1µA	0~±31.9999mA	100nA
300mA	0~±310.00mA	10µA	0~±319.999mA	1µA
1A	0~±1.0000A	100µA	0~±1.01999A	10µA
4A[*1)]	0~±4.0000A	200µA	0~±4.01999A	10µA

[*1)]The source range is restricted by the duty factor condition.
For a 4A pulse source, maximum pulse width 20ms/duty factor≤20%

Resistance Measurement range

Range	Source range	Setting resolution	Measurement range	Measurement resolution
Determined by the operation of Voltage range / Current range	—	—	0~7.5MΩ	Minimum 2µΩ

However, the measurement resolution under integration times 100µs and 500µs will be as follows.

Integration time	100µs	500µs
Measurement resolution (digits)	10	2

Voltage limiter (compliance) range

Range	Maximum setting	Minimum setting[*2)]	Setting resolution
3V	3.100V	60mV	1mV
15V	15.00V	600mV	10mV

Current limiter (compliance) range

Range	Maximum setting	Minimum setting[*2)]	Setting resolution
3mA	3.100mA	60µA	1µA
30mA	31.00mA	600µA	10µA
300mA	310.0mA	6mA	100µA
1A	1.000A	60mA	1mA
4A	4.000A	120mA	1mA

[*2)]Minimum difference between the HI side and LO side in the limiter settings

Total accuracy: Including calibration accuracy, 1-day stability, temperature coefficient, and linearity
1-day stability: Under constant power supply and load
Temperature coefficient: At temperature of 0 to 50ºC

Voltage Source

Range	Total accuracy	1-day stability	Temperature coefficient
	±(% of setting+V)		±(ppm of setting+V)/ºC
3V	0.025+350µV	0.01+200µV	15+30µV
15V [*3)]	0.025+3mV[*3)]	0.01+2mV	15+300µV

Voltage Limiter

Range	Total accuracy	1-day stability	Temperature coefficient
	±(% of setting+V)		±(ppm of setting+V)/ºC
3V	0.05+3mV	0.01+1mV	15+100µV
15V[*3)]	0.07+30mV	0.01+10mV	15+1mV

[*3)]For the 15V range, a value of 100µV is added at each remote sense voltage of 0.1V

Current Source

Range	Total accuracy	1-day stability	Temperature coefficient
	±(% of setting+A+A × Vo/1V)		±(ppm of setting+A+A × Vo/1V)/ºC
3mA	0.03+800nA+30nA	0.01+400nA+10nA	20+100nA+1nA
30mA	0.03+8µA+300nA	0.01+4µA+100nA	20+1µA+10nA
300mA	0.045+80µA+3µA	0.01+40µA+1µA	20+20µA+100nA
1A	0.05+800µA+30µA	0.02+400µA+10µA	35+100µA+1µA
4A	0.25+1mA+55µA	0.08+400µA+10µA	35+100µA+2µA

Current Limiter

Range	Total accuracy	1-day stability	Temperature coefficient
	±(% of setting+A+A × Vo/1V)		±(ppm of setting+A+A × Vo/1V)/ºC
3mA	0.045+3.5µA+30nA	0.01+1µA+10nA	20+200nA+1nA
30mA	0.045+35µA+300nA	0.01+10µA+100nA	20+2µA+10nA
300mA	0.055+350µA+3µA	0.01+100µA+1µA	20+10µA+100nA
1A	0.1+3.5mA+30µA	0.02+1mA+10µA	40+200µA+1µA
4A	0.25+6mA+55µA	0.08+1mA+10µA	40+200µA+2µA

Vo;Compliance voltage(-15V to +15V)

Voltage measurement

(Auto zero: ON, Integration time:1PLC to 200ms)

Range	Total accuracy	1-day stability	Temperature coefficient
	±(% of reading+V)		±(ppm of reading+V)/ºC
3V	0.025+120µV	0.008+60µV	15+15µV
15V	0.025+2mV	0.008+250µV	15+50µV

Current measurement

(Auto zero: ON, Integration time:1PLC to 200ms)

Range	Total accuracy	1-day stability	Temperature coefficient
	±(% of reading+A+A × Vo/1V)		±(ppm of reading+A+A × Vo/1V)/ºC
3mA	0.03+700nA+30nA	0.01+350nA+10nA	20+70nA+1nA
30mA	0.03+7µA+300nA	0.01+3.5µA+100nA	20+700nA+10nA
300mA	0.045+70µA+3µA	0.01+35µA+1µA	20+7µA+100nA
1A	0.05+ 700µA+30µA	0.02+350µA+10µA	35+70µA+1µA
4A	0.25+ 800µA+55µA	0.08+350µA+10µA	35+70µA+2µA

Vo;Compliance voltage(-15V to +15V)

Resistance Measurement (Voltage Source)

(Auto zero: ON, Integration time:1PLC to 200ms)

Total accuracy	1-day stability	Temperature coefficient
±(% of reading)±(digits+digits+digits)		±(ppm of reading)±(digits+digits+digits)/ºC

reading item: (setting item at voltage source + reading item of current measurement)
Full scale item: (digit value of the full scale item at voltage source + digit value of the full scale item of current measurement + digit value of the CMV item)[*4)]

Resistance Measurement (Current Source)

(Auto zero: ON, Integration time:1PLC to 200ms)

Total accuracy	1-day stability	Temperature coefficient
±(% of reading)±(digits+digits+digits)		±(ppm of reading)±(digits+digits+digits)/ºC

reading item: (setting item of current source + reading item of voltage measurement)
Full scale item: (digit value of the full scale item of the current source + digit value of the full scale item of voltage measurement + digit value of the CMV item)[*4)]

[*4)] CMV item = (A x Vo/1V) "Source or measurement current" × "source or measurement voltage/digit value of 1V

Integration time: For measurement accuracy from 100µs to 10ms and 1-day stability, the following error is added.

Range		Integration time 10ms	5ms	1ms	500µs	100µs
Unit: digits (in 5 1/2 digit display)						
Voltage measurement	3V	8	12	20	30	35
	15V	5	10	15	20	25
Current measurement	3mA~1A	12	18	25	30	35
	4A	24	30	45	55	65

Source linearity: ±3 digits or less
(However, for the 4A range, ±0.2% of setting ±5digits or less)
Maximum output current:
0 to 15V; ±1A(DC),
0 to 10V: ±4A
(Maximum pulse width 20ms/duty factor≤20%)
Maximum compliance voltage: 1A (DC): 0 to ±15V, 4A (pulse); 0 to ±10V
Output noise: No load at voltage source, [Vp-p] within the maximum load
For the current source, [Ap-p] under the following load resistance

Voltage Source

Range	Load resistance	Low frequency noise		High frequency noise
		DC~100Hz	DC~10kHz	DC~20MHz
3V	—	100μV	400μV	5mV
15V	—	1mV	3mV	6mV

Current Source

Range	Load resistance	Low frequency noise		High frequency noise
		DC~100Hz	DC~10kHz	DC~20MHz
3mA	1kΩ	200nA	2μA	6μA
30mA	1kΩ	2μA	15μA	20μA
300mA	1kΩ	20μA	100μA	150μA
1A	100Ω	200μA	1mA	1.5mA
4A	100Ω	200μA	1mA	1.5mA

Switching Noise

		Central value[p-p]	Load resistance
Output ON/OFF noise	Voltage source	600mV	At 100kΩ
	Current source	600mV	At 100kΩ
Range switching noise	Voltage source	50mV	—
	Current source	100 digits+50mV	—
	Voltage limiter	50mV *5)	—
	Current limiter	50mV *5)	—
	Voltage measurement	50mV *5)	—
	Current measurement	50mV *5)	—
Power OFF noise		600mV	At 100kΩ

*5)The limiter is inactive. When the limiter is active, the noise level is the same as that of the source range switching noise.

Settling time

Time required to reach the ±0.03% of the final value when output is changed from zero to the full-scale value (for the 4A range, time required to reach ±0.1% of the final value). However, this applies under the conditions of net load resistance, load capacity of 200pF or less, and full-scale source and limiter setting values.

	Range	settling time
Voltage source	3V	300μs or less
	15V	700μs or less
Current source	3mA	700μs or less
	30mA	
	300mA	
	1A	2ms or less
	4A	500μs or less

3mA to 1A indicate the settling current range of compliance voltage 15V. 4A indicates the settling current of compliance voltage 10V.

Overshoot: ±0.1% or less (under the net resistance load and at the standard cable end)
Line regulation: ±0.003% of range or less
Load regulation
Voltage source : ±0.003% of range or less (at 4-wire connection under the maximum load)
Current source: According to the CMV item (AXVo/1V) of the total accuracy

Output resistance: At 2-wire connection, excluding the output cable
Maximum load capacity: Maximum load capacity that does not generate oscillation while the voltage source or voltage limiter is active

Range	Output resistance (Ω)		Maximum load capacity
	Voltage source	Current source	
3mA	10mΩ or lower	100MΩ or higher	100μF
30mA	10mΩ or lower	10MΩ or higher	100μF
300mA	10mΩ or lower	1MΩ or higher	2000μF
1A	10mΩ or lower	100kΩ or higher	2000μF
4A	10mΩ or lower	50kΩ or higher	2000μF

Resistance of the cable attached as the standard:100mΩ or lower

Maximum inductive load: Maximum inductive load that does not generate oscillation while the voltage source or current limiter is active.

Current source range/current limiter range	3mA~4A
Maximum inductive load	1mH

Effective CMRR: Under unbalanced impedance 1kΩ
Under DC and AC50/60Hz±0.08%

	Integration time	
	100μs~10ms	1PLC~200ms
Voltage measurement/Current measurement	60dB	120dB

I**NMRR**: :Under AC50/60Hz±0.08%

	Integration time	
	100μs~10ms	1PLC~200ms
Voltage measurement/Current measurement	0dB	60dB

Source and measurement function

DC source and measurement:	Source and measurement of DC voltage and current
Pulse source and measurement:	Source and measurement of pulse voltage and current (however, not possible for measurement auto range at pulse source)
DC sweep source and measurement:	Source and measurement by linear, random, fixed, and level
Pulse sweep source and measurement:	Source and measurement by linear, random, fixed, and level (however, not possible for measurement auto range at pulse source)
Integration time:	8 types including 100μs/500μs/1ms/5ms/10ms/1PLC/100ms/200ms
Sweep mode:	Reverse ON (two-way)/OFF(one-way)
Sweep repeat count:	1 to 1000, infinite
Maximum number of sweep steps:	5000 steps
Maximum random sweep memory:	5000 data
Measurement data memory:	5000 data
Measurement auto range:	Effective at VSIM and ISVM only
Limiter:	A separate limiter can be set on the HI side and the LO side (however, current limiters of the same polarity are not allowed)
Operation function:	NULL operation, compare operation (HI/GO/LO) Scaling operation MAX, MIN, AVE, and TOTAL operations
Trigger method:	Automatic trigger and external trigger
Output terminal:	Front; safety socket HI OUTPUT, HI SENSE, LO OUTPUT LO SENSE
Maximum input voltage between terminals:	15V peak MAX(HI_LO) 2V peak MAX(OUTPUT_SENSE) 250V MAX(LO_Frame)
Maximum remote sensing voltage:	±1V MAX HI OUTPUT - HI SENSE, LO OUTPUT - LO SENSE, (The voltage between HI SENSE and LO SENSE must be within the maximum output voltage range)

Voltage measurement input resistance:	100MΩ or higher
Voltage measurement input leak current:	±100nA or lower
GP-IB interface:	Complies with IEEE-std.488-1978 Interface function: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Single-wire signal:	● TRIGGER IN ● INTERLOCK/OPERATE IN/OPERATE OUT ● COMPLETE OUT/SYNC OUT

Setting time

Minimum pulse width: 500µs

Minimum step (repeat) time: Under fixed source/measurement range, integration time of 100µs,
major delay time of 100µs, operation OFF, and voltage/current measurement

Measurement	Memory mode	Minimum step time
OFF	—	1ms
ON	BURST	2ms
	NORMAL	
	OFF	10ms

Source delay time

Setting range	Resolution *6)	Setting accuracy
0.030ms~60.000ms	1µs	±(0.1%+10µs)
60.01ms~600.00ms	10µs	
600.1ms~6000.0ms	100µs	
6001ms~59998ms	1ms	

Period (pulse cycle)

Setting range	Resolution	Setting accuracy
1.000ms~60.000ms	1µs	±(0.1%+10µs)
60.01ms~600.00ms	10µs	
600.1ms~6000.0ms	100µs	
6001ms~60000ms	1ms	

Pulse width

Setting range	Resolution *6)	Setting accuracy
0.500ms~60.000ms	1µs	±(0.1%+10µs)
60.01ms~600.00ms	10µs	
600.1ms~6000.0ms	100µs	
6001ms~59998ms	1ms	

Major delay time

Setting range	Resolution *6)	Setting accuracy
0.100ms~60.00ms	1µs	±(0.1%+10µs)
60.01ms~600.00ms	10µs	
600.1ms~6000.0ms	100µs	
6001ms~59998ms	1ms	

*6)The setting resolution is determined by the period time resolution.

Hold time

Setting range	Resolution	Setting accuracy
1ms~60000ms	1ms	±(2%+3ms)

- Please read the instruction manual before using this product for the correct use.
- A part of the specification may be changed without prior notice due to user requests or enhancement of the quality control of ADVANTEST CORP.

General Specifications

Operating environment:	Ambient temperature; 0˚C to 50˚C, Relative humidity; 85% or less (no condensation)
Storage environment:	Ambient temperature; -25˚C to +70˚C, Relative humidity; 85% or less (no condensation)
Warmup:	60 minutes or more (until the specified accuracy is reached)
Display:	16 segments x 12 digits fluorescent character display
Power supply:	AC 100V/120V/220V/240V (switcheable by the user)

Option No.	Standard	OPT.32	OPT.42	OPT.44
Power source voltage	100V	120V	220V	240V

Line frequency:	50Hz/60Hz
Power consumption:	95VA or less
Dimensions:	About 212(W) x 88(H) x 400(D)mm
Mass:	5kg or less

Main unit

DC voltage and current source/monitor:	R6240A

Standard accessories

Power cable:	A01402
Input/output cable (Red and black safety cable, 1m):	A01044
Alligator clip adaptor:	A08532
Banana chip adaptor:	A08531

Accessories

Text fixture:	R12701A
Test lead (1m):	A01041
Input/output cable (Banana-banana, 4-wire shield, 0.5m):	A01047-01
Input/output cable (Banana-banana, 4-wire shield, 1m):	A01047-02
Input/output cable (Banana-banana, 4-wire shield, 1.5m):	A01047-03
Input/output cable (Banana-banana, 4-wire shield, 2m):	A01047-04
BNC_BNC cable (1.5m):	A01037-1500
EIA rack mounting set:	A02463
JIS rack mounting set:	A02263
EIA rack mounting set (twin):	A02464
JIS rack mounting set (twin):	A02264
Panel mounting set:	A02039
Panel mounting set (twin):	A02040