ИСТОЧНИКИ-ИЗМЕРИТЕЛИ 6146/6156

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Астана (7172)727-132
Астрахань (8512)99-46-04
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Тверь (4822)63-31-35
Томск (3822)98-41-53
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6156

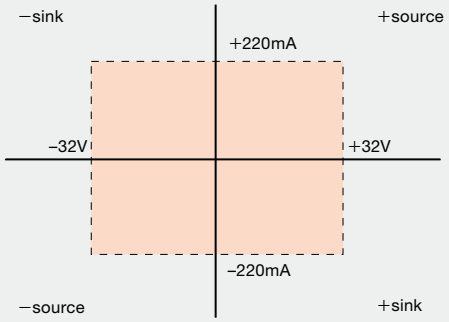
The 6146/6156 is a precision DC voltage/current source suitable for characteristic evaluation of semiconductor or electronic components and modules in R&D fields and for calibration of meters or measuring instruments.

It achieves wide dynamic range, high resolution, high accuracy and low output noise based on the comprehensive DC voltage/current sourcing technologies of ADC, allowing highly reliable and high-throughput system architect.

With various user-friendly functions, the 6146/6156 can not only operate as stand-alone but also can be integrated into an auto measuring system as secondary battery simulator.

In addition, the 6156 is equipped with a thermal electromotive force output function compliant with JIS, allowing easy temperature calibration.

Wide Dynamic Range of Sourcing



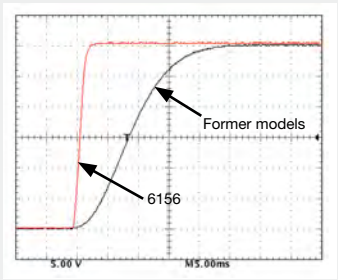
- Source/sink-enabled bipolar output within a range of ±32V and ± 220mA
- Zero-crossing continuous variable output from negative to positive and vice versa

Model	6146	6156
Digits	4½	5½
Output	Bipolar	
Maximum output	±32V / ±220mA	
Voltage source range	1μV to 32.000V	100nV to 32.0000V
Voltage source accuracy (typical)	0.025%	0.015%
Current source range	100nA to 220.00mA	10nA to 220.000mA
Current source accuracy (typical)	0.03%	0.02%
Thermal electromotive force sourcing	–	Available
High-frequency output noise (20MHz)	3mVp-p	
Settling time	10ms	
Interface	GPIB, USB (standard) and BCD (factory option)	
Memory	Up to 5000 data	

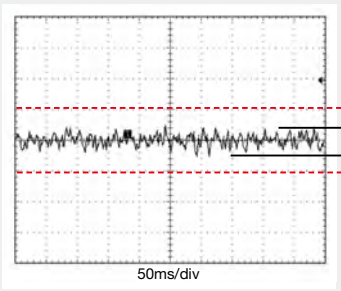
High-Speed Response and Low Noise Voltage/ Current Sourcing

The response time in voltage or current sourcing of the 6146/6156 is greatly improved compared to the former models, and the settling time to reach the final value ±0.1% of 10ms or less is achieved. Consequently, the characteristic evaluation time for components or modules or the takt time for automatic test can be greatly reduced.

Also, it features low output noise of 100μVp-p (30V range, DC to 100Hz band), enhancing the measurement reliability in characteristic evaluation of semiconductors or sensors.



Output response waveform (0V→30V)



Output noise waveform (at 100Hz or less in 30V range)

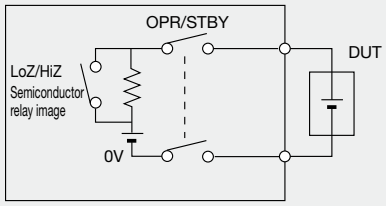
Suspend Function Suitable for Automatic Tests

When DUTs such as electronic components or modules are replaced on automatic test equipment, the output status needs to be “Standby” that opens the output relay so as not to apply unnecessary voltage to the DUTs. Every switching between “Operate” and “Standby” turns ON or OFF the output relay, giving a great impact on the relay lifetime.

The 6146/6156 has a suspend function that keeps the output status in “high impedance (HiZ: output relay ON, high resistance)” or “low impedance (LoZ: output relay ON, low resistance)” without switching the relay. The output OFF status can be selected from these two statuses and “Standby (output relay OFF).”

Using this function can extend the relay lifetime and improve the system throughout.

In addition, it can prevent transient current from being generated when connecting voltage sourcing devices such as batteries.



LoZ/HiZ: Output resistance switching in Suspend status
OPR/STBY: Operate/Standby switching relay

Output Status Diagram

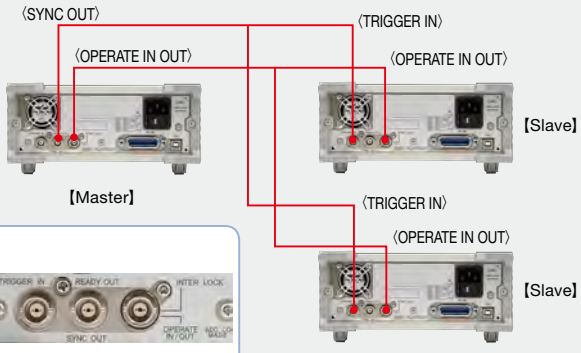
Multiple-Unit Operation and Synchronous Operation with DMM

In an electronic device or module test, voltage sometimes needs to be applied from more than one source. In this case, voltage to be applied to DUTs needs to vary in a synchronous timing.

More than one 6146/6156 units can be synchronized by connecting the Operate and Standby timing signals and variable voltage timing signals from the master to its slaves.

For voltage measurement using DMM, the 6146/6156 builds up an automatic measuring system with the DMM with the minimum waiting time as voltage application timing and measurement timing can be synchronized.

The 6146/6156 has a signal line for synchronous control so that multiple units can output signals in synchronization.
The following shows an example of how three 6146/6156 units synchronize sweep operation using control signals.
“SYNC OUT” and “OPERATE IN OUT” signals from the master are connected to “TRIGGER IN” and “OPERATE IN OUT” signals of its slaves.



Synchronous signal terminals

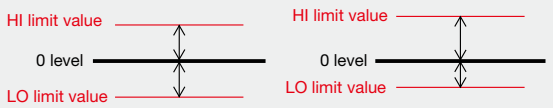
Synchronous operation

HI/LO Limiters Separate Setting

The limiter function is highly important for voltage or current sourcing to protect connected devices.

The current limiter works for voltage source to restrict output current and the voltage limiter works for current source to restrict compliance voltage.

The 6146/6156 has two setting levels for both voltage and current limiters which can be set separately.



The HI limit value and the LO limit value are set to the same value.
【Balance mode】

The HI limit value and the LO limit value are set to different values.
【Separate mode】

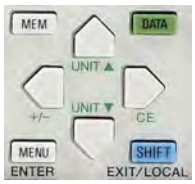
The 6146/6156 has two types of limiter setting modes

HI/LO limiters Separate Setting

User Friendly Operation Panel

Voltage or current values to be generated can be entered directly using the keyswitches on the front panels, and can be varied (increased or decreased) continuously by specifying an arbitrary digit using the rotary knob or the UP and DOWN keys.

Thus, the operability is greatly improved, so that measurement such as a device input and output characteristic test can be performed by simple key operations.



Range switching and UP/DOWN keys

Rotary knob

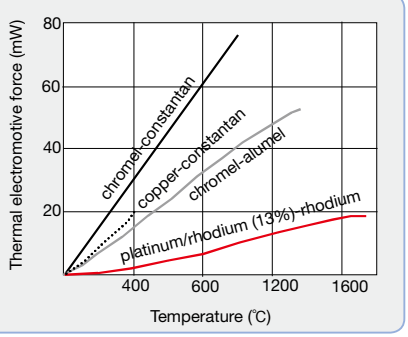
Thermal Electromotive Force Output Function (6156 Only)

The 6156 is capable of generating thermal electromotive force of thermocouples in accordance with JIS standards. Selecting the type of thermocouple and temperature to be generated will output voltage corresponding to the setting temperature.

The type of thermocouple is selectable from type T, J, E, K, S, R, B and N. The JIS standard is JISC1602-1995 or JISC1602-1981. For type N, only JISC1602-1995 is applicable.

The reference junction compensation is at 0℃ or arbitrary temperature (user selectable).

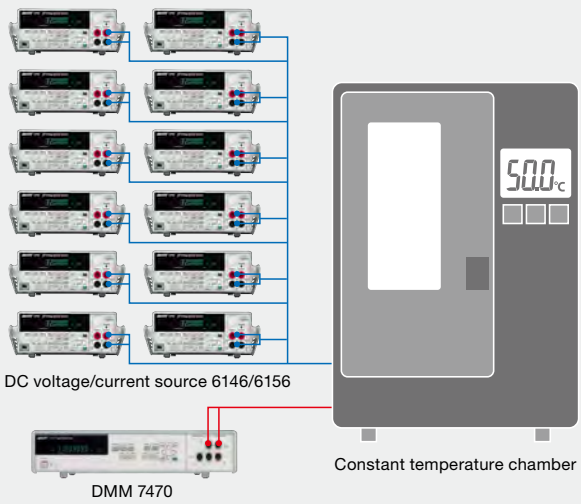
This function enables temperature calibration of thermometers and other measuring instruments.



The 6156 thermal electromotive force output function can linearize the temperature and the thermal electromotive force of each thermocouple. Thus, thermometers can be calibrated easily just by setting the temperature to be calibrated on the 6156.

For Reliability Test of Semiconductors and Electronic Components

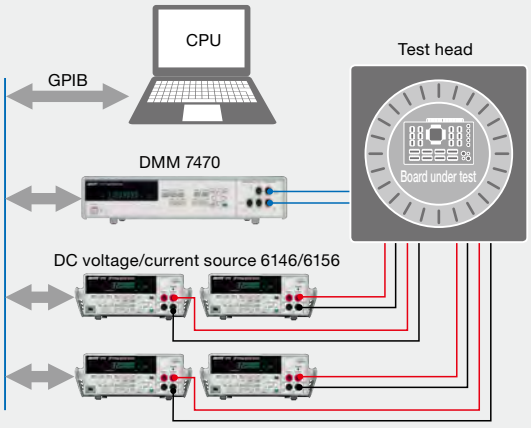
To secure the reliability of electronic components such as semiconductor and sensors, aging tests with current applied are conducted on the devices. Such tests require highly stable voltage sources.
In some tests, the normal operating range of the devices is verified by changing the supply voltage.
With its low noise, high stability and high sourcing resolution, the 6146/6156 offers high reliability in these tests.



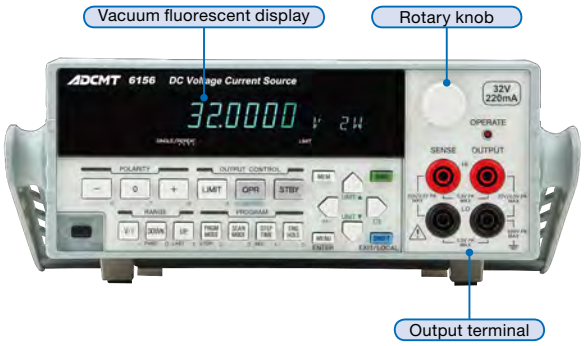
- The 6146/6156 is used as power source to the devices or input signal.
- A digital multimeter monitors output voltage of the devices.
- The 6146/6156 and the digital multimeter can acquire long-time aging data using GPIB or USB.

For Embedded Power Source or Signal Source in a Board Tester

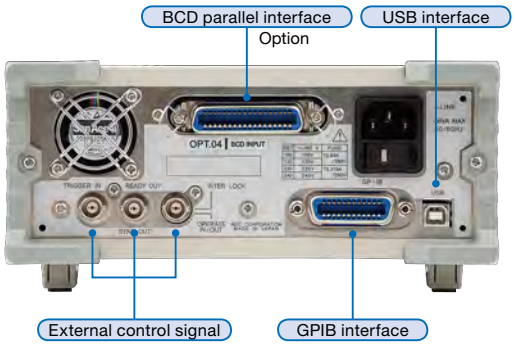
Control boards used in home electric appliance and industrial equipment undergo functional tests at shipping and incoming inspections.
The 6146/6156 can be used as embedded power source in a board tester, applying voltage to a board under test and applying voltage or current as pseudo sensor signal.
As the 6146/6156 stabilizes its output values with a settling time of 10 msec or less, the time of a multi-item test can be reduced.
In addition, the 6146/6156 is equipped with GPIB and USB interfaces for remote control as standard, allowing highly flexible system architect.



The 6146/6156 supplies power and applies voltage as pseudo sensor signal to the board under test.
The 6146 has a minute voltage resolution of 1μV and the 6156 has that of 100nV. Thus, the 6146/6156 can be used as a substitute for sensor signal and make correct PASS/FAIL judgment on the board.



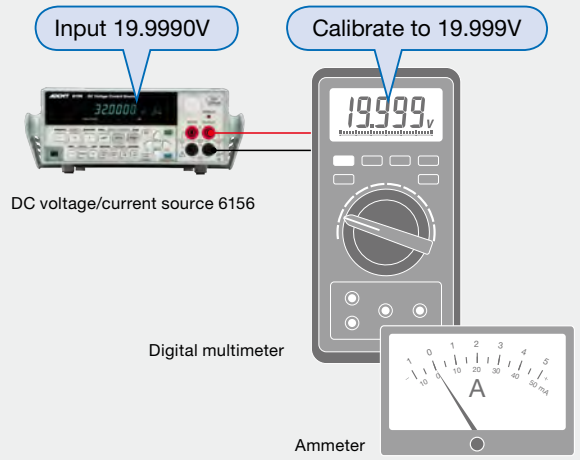
Front Panel (6156)



Rear Panel (6146/6156)

For Calibration of Meters and Measuring Instruments

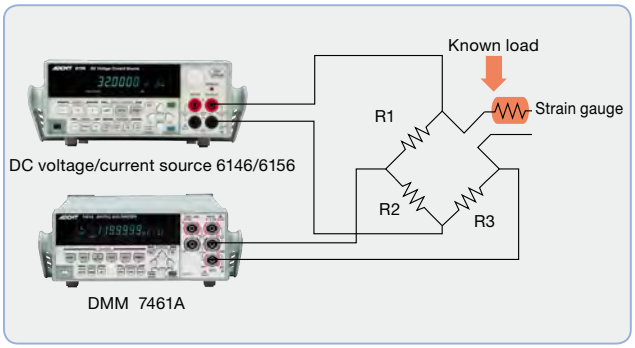
Meters or measuring instruments used in plants or instrumentation systems need to be calibrated periodically.
The 6146/6156 is suitable for calibration of these meters or instruments with its high source accuracy.
The calibration time can be reduced by storing voltages or currents of points to be calibrated in the memory of the 6146/6156 and reading them out by turns.



Various meters including digital multimeters can be calibrated using the 6146/6156.
Zero point and full scale calibrations are available by easy operation.

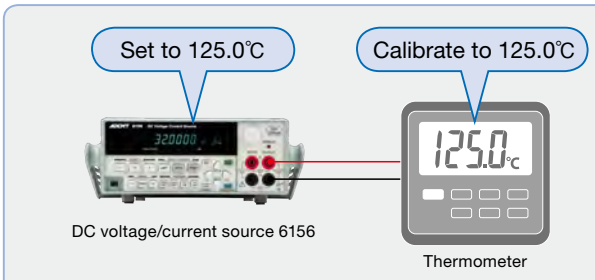
For Characteristic Test of Strain Sensors (Strain Gauges)

A strain gauge used in a strain or pressure sensor utilizes subtle variation in resistance.
In a strain gauge test, resistance with a known load applied is measured using a Wheatstone bridge circuit.
As a voltage source for the Wheatstone bridge circuit, the 6146/6156 is best suited with its high stability.
The output voltage is measured by using a digital multimeter such as the 7461A.



For Calibration of Thermometers (6156 Only)

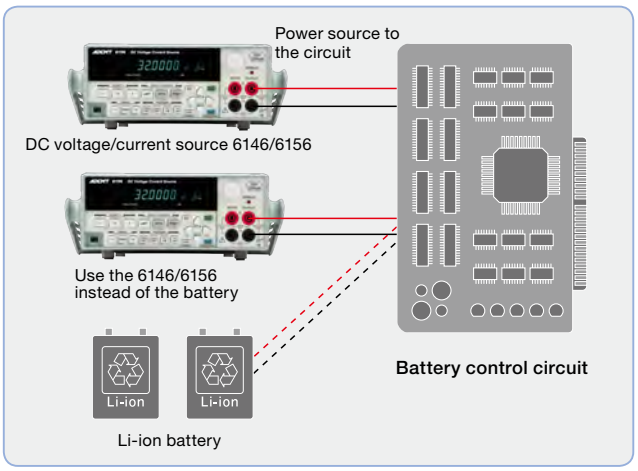
When calibrating a thermometer that uses a thermocouple as a temperature sensor, DC voltage corresponding to thermal electromotive force of the thermocouple needs to be applied.
The 6156 generates easily thermal electromotive force of thermocouples compliant with JIS. For reference junction compensation, the 6156 has a “room temperature compensation ON/OFF” function that generates thermal electromotive force to arbitrary temperature just by setting the source temperature and the room temperature.



- Set the temperature to be calibrated and the room temperature using the 6156 “thermal electromotive force output” function.
- The 6156 generates voltage corresponding to the setting temperature.
- Calibrate the thermometer to the setting temperature.

For Evaluation Test of Secondary Battery Control Circuits

As a secondary battery such as a lithium ion battery is high-energy density, the control circuit plays an important role in monitoring the charge-discharge characteristics.
To test the operation of this control circuit, the 6146/6156 can be used as a battery simulator.
The control circuit is tested correctly by changing the voltage of the battery simulator for each test item.
The 6146/6156 realizes such precise characteristic measurement with its wide measurement range, high sourcing resolution and low output noise.



Specifications

All accuracy specifications are satisfied at a temperature of 23℃ ±5℃ and a relative humidity not exceeding 85%.

Voltage/current source

6146

Voltage source range:

Range	Source range	Setting resolution
30mV	0 to ±32.000mV	1μV
300mV	0 to ±320.00mV	10μV
3V	0 to ±3.2000V	100μV
30V	0 to ±32.000V	1mV

Current source range:

Range	Source range	Setting resolution
3mA	0 to ±3.2000mA	100nA
30mA	0 to ±32.000mA	1μA
200mA	0 to ±220.00mA	10μA

Overall accuracy: Includes calibration accuracy, 1-day stability, the temperature coefficient, and linearity.
1-day stability: At constant power and load
Temperature coefficient: At temperature of 0 to 50℃

Voltage source:

Range	Overall accuracy (1year)	Overall accuracy (90days)	1-day stability (23℃±1℃)	1-day stability (23℃±5℃)	Temperature coefficient
	± (% of setting+V)				± (ppm of setting+V) /℃
30mV	0.03+5μV	0.025+4μV	0.006+4μV	0.01+4μV	20+200nV
300mV	0.03+25μV	0.025+20μV	0.006+5μV	0.01+10μV	20+2μV
3V	0.025+200μV	0.02+200μV	0.005+20μV	0.008+30μV	15+10μV
30V	0.025+2mV	0.02+2mV	0.005+100μV	0.008+200μV	15+40μV

Current source:

Range	Overall accuracy (1year)	Overall accuracy (90days)	1-day stability (23℃±1℃)	1-day stability (23℃±5℃)	Temperature coefficient
	± (% of setting+A)				± (ppm of setting+A) /℃
3mA	0.03+250nA	0.025+250nA	0.008+20nA	0.01+20nA	20+4nA
30mA	0.03+2.5μA	0.025+2.5μA	0.008+200nA	0.01+200nA	20+40nA
200mA	0.035+25μA	0.03+25μA	0.008+2μA	0.01+2μA	20+400nA

Source linearity: ±60ppm of range or less

6156

Voltage source range:

Range	Source range	Setting resolution
30mV	0 to ±32.0000mV	100nV
300mV	0 to ±320.000mV	1μV
3V	0 to ±3.20000V	10μV
30V	0 to ±32.0000V	100μV

Current source range:

Range	Source range	Setting resolution
3mA	0 to ±3.20000mA	10nA
30mA	0 to ±32.0000mA	100nA
200mA	0 to ±220.000mA	1μA

Overall accuracy: Includes calibration accuracy, 1-day stability, the temperature coefficient, and linearity
1-day stability: At constant power and load, and temperature of 23℃±1℃
Temperature coefficient: At temperature of 0 to 50℃

Voltage source:

Range	Overall accuracy (1year)	Overall accuracy (90days)	1-day stability	Temperature coefficient
	± (% of setting+V)			± (ppm of setting+V)/℃
30mV	0.02+5μV	0.018+5μV	0.002+3μV	15+200nV
300mV	0.02+10μV	0.018+10μV	0.003+3μV	15+700nV
3V	0.015+80μV	0.008+70μV	0.001+10μV	8+7μV
30V	0.015+240μV	0.01+200μV	0.001+40μV	8+25μV

Current source:

Range	Overall accuracy (1year)	Overall accuracy (90days)	1-day stability	Temperature coefficient
	± (% of setting+A)			± (ppm of setting+A) /℃
3mA	0.02+50nA	0.018+50nA	0.0015+15nA	15+4nA
30mA	0.02+500nA	0.018+500nA	0.0025+150nA	15+40nA
200mA	0.025+5μA	0.022+5μA	0.004+1.5μA	20+400nA

Source linearity: ±6ppm of range or less

Thermal electromotive force

6156 only

Thermal electromotive force source range:

Thermocouple	Source range	Setting resolution
T (CC)	–200.0℃ to +400.0℃	0.1℃
J (IC)	–200.0℃ to +1200.0℃	0.1℃
E (CRC)	–200.0℃ to +1000.0℃	0.1℃
K (CA)	–200.0℃ to +1372.0℃	0.1℃
S (PR10)	–10.0℃ to +1768.0℃	0.1℃
R (PR13)	–10.0℃ to +1768.0℃	0.1℃
B (PR30)	+330.0℃ to +1820.0℃	0.1℃
N	–200.0℃ to +1300.0℃	0.1℃

Room temperature setting range: –25℃ to +85℃
For thermocouple type B, the room temperature of less than 0℃ is deemed to be 0℃.
Standard setting: JIS C1602-1995 or JIS C1602-1981
For type N, JIS C1602-1995 is applied.

Thermal electromotive force overall accuracy:

Thermocouple	Source temperature range	Accuracy	
		Range	± (% of setting+℃)
T (CC)	–200.0℃ to +400.0℃	–200.0℃ to –120.1℃	0.034+0.5℃
		–120.0℃ to –50.1℃	0.025+0.3℃
		–50.0℃ to +400.0℃	0.02+0.2℃
J (IC)	–200.0℃ to +1200.0℃	–200.0℃ to –150.1℃	0.035+0.6℃
		–150.0℃ to –501℃	0.025+0.5℃
		–50.0℃ to +1200.0℃	0.02+0.4℃
E (CRC)	–200.0℃ to +1000.0℃	–200.0℃ to –150.1℃	0.035+0.5℃
		–150.0℃ to –50.1℃	0.026+0.4℃
		–50.0℃ to 1000.0℃	0.02+0.3℃
K (CA)	–200.0℃ to +1372.0℃	–200.0℃ to –150.1℃	0.037+0.7℃
		–150.0℃ to –50.1℃	0.026+0.6℃
		–50.0℃ to +1100.0℃	0.02+0.4℃
		+1100.1℃ to +1372.0℃	0.023+0.4℃
S (PR10)	–10.0℃ to +1768.0℃	–10.0℃ to +550.0℃	0.02+1℃
		+550.1℃ to +1768.0℃	0.02+0.6℃
R (PR13)	–10.0℃ to +1768.0℃	–10.0℃ to +300.0℃	0.02+0.7℃
		+300.1℃ to +1768.0℃	0.02+0.6℃
B (PR30)	+330.0℃ to +1820.0℃	+330.0℃ to +1000.0℃	0.02+1.5℃
		+1000.1℃ to +1820.0℃	0.02+0.7℃
N	–200.0℃ to +1300.0℃	–200.0℃ to –130.1℃	0.04+1℃
		–130.0℃ to –50.1℃	0.025+0.7℃
		–50.0℃ to +1300.0℃	0.02+0.5℃

6146/6156

Maximum load/output resistance:
3V/30V range: output resistance in 4-wire connection
Other ranges: output resistance in 2-wire connection

	Range	Maximum load	Output resistance
Voltage source	30mV	1.5μA*1	Approx. 2Ω
	300mV	15μA*1	
	3V	±220mA	2mΩ or less
	30V		2mΩ or less
Current source	3mA	Output compliance voltage : ±32V	500MΩ or higher
	30mA		320MΩ or higher
	200mA		32MΩ or higher

*1 : Load that gives an error of 0.01% of the range

Output noise: Voltage source: within the range from no-load to maximum load
Current source: at load resistance of 1kΩ

	Range	Low frequency noise		High frequency noise
		DC to 100Hz	DC to 10kHz	DC to 20MHz
Voltage source [Vp-p]	30mV	5μV	10μV	3mV
	300mV	15μV	30μV	
	3V	30μV	120μV	
	30V	100μV	300μV	
Current source [Ap-p]	3mA	30nA	100nA	6μA
	30mA	300nA	400nA	
	200mA	3μA	3μA	

Settling time: Time to settle to the final value ±0.1% when varying from zero to the full scale.
Setting conditions: Source values and limiter values are full-scale settings.
Load conditions: Pure resistive load and 200pF max. load capacitance

	Range	Settling time
Voltage source	30mV	10ms or less
	300mV	
	3V	
	30V	
Current source	3mA	10ms or less
	30mA	
	200mA	

Overshoot: ±0.1% max., pure resistive load, at end of standard cable
Line regulation: ±0.003% of range or less
Load regulation: ±0.003 % of range or less (in 4-wire connection with maximum load)
(excluding the 30mV and 300mV ranges)
Maximum load capacitance: Maximum value that does not oscillate in voltage source or voltage limiter
Voltage source/voltage limiter: 1000μF
Maximum load inductance: Maximum value that does not oscillate in current source or current limiter
Current source/current limiter: 1mH
CMRR: Voltage output 100dB or higher
Current output 72dB or higher
At unbalanced impedance 1kΩ and in DC and AC 50/60Hz ± 0.1%

Voltage/current limiter:

	Setting range	Resolution	Setting accuracy
Voltage limiter	1V to 32V	100mV	±5% of setting±100mV
Current limiter	5mA to 220mA	1mA	±10% of setting±1mA+60μA/1V

※The current limiter is available in the 3V and 30V ranges.

Source Function

Memory recall: Reads out a specified memory number.
Reads out memory numbers by turn at intervals specified by the step time.
Scan mode: Hold Reads out a memory number by trigger input.
Single Scans once from the first number through the last number.
Repeat Scans repeatedly from the first number through the last number.
Maximum memory: 5000 data

Maximum remote sensing voltage:
HI OUTPUT-HI SENSE ±0.3V Max
LO OUTPUT-LO SENSE ±0.3V Max
(The voltage between HI SENSE and LO SENSE must be within the maximum output voltage range)
GPIB interface: Compliant with IEEE-488.2-1987
Interface function SH1, AH1, T6, L3, SR1, RL1, PP0, DC1, DT1, C0, E2
Connector Amphenol 24pin
USB interface: USB 2.0 Full-speed
Connector Type B
BCD parallel interface (factory option):
Remote programming output level, polarity, range, Operate, load signal
Connector Amphenol 36 pin
External control signal:
TRIGGER IN
READY OUT/SYNC OUT
INTERLOCK/OPERATE IN/OPERATE OUT,
Connector BNC
Operate hold function:
Starts up with output ON at recover from a power failure.

General Specifications

Operating environment: Ambient temperature 0℃ to +50℃
Relative humidity 85% or below, with no condensation
Storage environment: Ambient temperature –25℃ to +70℃
Relative humidity 85% or below, with no condensation
Warming up time: 30 minutes or longer
Display: 5-digit decimal (6146)/6-digit decimal (6156)
7-segment vacuum fluorescent display
Power supply: AC power 100V/120V/220V/and240V (User selectable)

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

Specify the option number when ordering.
When changing the power voltage, use only a power cable and rated fuse approved for the respective country.

Line frequency: 50Hz/60Hz
Power consumption: 56VA or less
Dimensions: Approx. 212 (width)×88 (height)×340 (depth) mm
Mass: 4kg or less
Safety: Compliant with IEC61010-1 Ed.3
EMI: Compliant with EN61326 classA

Supplied accessories

Part number	Name
A01402	Power cable (JIS 2m)
A01044	Input and output cable (safety plug)
A08531	Banana tip adapter (for A01044)
A08532	Alligator clip adapter (for A01044)

Option

	Option number
BCD parallel interface	6146+04
	6156+04