6247G/6247C

DC Voltage Current Source/Monitor

Operation Manual

MANUAL NUMBER ***FOE-00000088B00***

Applicable Models
6247G
6247C

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1. PREFACE

This chapter describes the accessories, operating environment, precautions, and operating check for personnel who operate the 6247G/6247C. Read this manual before using the 6247G/6247C.

1.1 Product Overview

The 6247G/6247C is a DC Voltage Current Source/Monitor capable of evaluating high-voltage semiconductors and LED luminaires that demand high efficiency and low power consumption with its wide ranging source and measurement functions.

The 6247G/6247C provides high sensitivity with $4^1/_2$-digit source resolution and $5^1/_2$-digit measurement resolution. In addition, it is equipped with not only the various types of sweep functions but also the pulse measurement function with the minimum pulse width of 50 µs. By using these functions, the 6247G/6247C can be widely used as ideal SMU for evaluating or testing semiconductor and other electronic components.

- Source and measurement: -15 V to +250 V, 0 to ±320 mA
- Voltage range: 5 V, 50 V, 250 V
- Current range: 3 µA to 300 mA
- Display digits Source: $4^1/_2$ Measurement: $5^1/_2$
- Voltage resolution Source: 100 µV Measurement: 10 µV
- Current resolution Source: 100 pA Measurement: 10 pA
- Voltage source current measurement (VSIM)/Current source voltage measurement (ISVM)
- Voltage source voltage measurement (VSVM)/Current source current measurement (ISIM)
- Sink-enabled bipolar output
- Minimum pulse width: 50 µs
- Linear, 2-slope linear, fixed, random sweep functions for characteristic test
- Detection functions such as limiter (compliance), overload, and overheat
- Synchronized operation function by combining two or more 6247G/6247C units
- GPIB and USB (6247G) or RS-232 and USB (6247C) for integrating an automated measurement system

1.2 Supplied Accessories

The 6247G/6247C standard accessories are listed below. If any accessory is missing or damaged, contact an ADC CORPORATION sales representative. Specify the part number when ordering.

Table 1-1 Standard Accessory List

Name	Part number	Quantity	Remarks
Power cable*1	A01402	1	3-pin plug, JIS 2 m
Input and output cable	A01044	1	Red and black each
Alligator clip adapter	A08532	1	Red and black each
Banana tip adapter	A08531	1	Red and black each
Power fuse *2	DFT-AA3R15A-1	1 *2	100 V/120 V slow blow
	DFT-AA2R5A-1		220 V/240 V slow blow
Operation Manual	E6247	1	This manual

*1: The power cable can be changed by specifying the option at the time of order.
For more information, refer to "Safety Summary."

*2: Either of fuses is included depending on the power supply option.

1.3 Optional Accessories

The 6247G/6247C optional accessories are listed below. Specify the part number when ordering.

Table 1-2 Optional Accessory List

Name	Part number	Remarks
Test fixture	12701A	
Connecting cable	A01041	Input cable (test probe)
	A01044	Input and output cable (safety plug)
	A08532	Alligator clip adapter (for A01044)
	A08531	Banana tip adapter (for A01044)
	A01047-01	Input and output cable (high current 0.5 m)
	A01047-02	Input and output cable (high current 1 m)
	A01047-03	Input and output cable (high current 1.5 m)
	A01047-04	Input and output cable (high current 2 m)
	A01036-1500	BNC-BNC cable (1.5 m)
Rack mount set	A02263	Rack mount set (JIS 2U half)
	A02264	Rack mount set (JIS 2U half twin)
	A02463	Rack mount set (EIA 2U half)
	A02464	Rack mount set (EIA 2U half twin)
Panel mount set	A02039	2U half
	A02040	2U half twin

As the rack mount set is not rigid enough to support the instrument by itself, use angle bars to mount the 6247G/6247C on the rack mount set. Contact an ADC CORPORATION sales representative for rack setup and other technical support.

1.4 Operating Environment

This section describes the required environmental and power supply conditions.

1.4.1 Environmental Conditions

The 6247G/6247C must be installed in an environment meeting the following conditions:

- Ambient temperature: 0ºC to +50ºC (temperature range for operation)
  -25ºC to +70ºC (temperature range for storage)
- Relative humidity: 85% or lower (without condensation)
- Location not subject to corrosive gasses
- Away from direct sunlight
- Dust free
- Vibration free
- Noise free

  The 6247G/6247C is designed with full consideration given to the noise contained in the AC power line. Nevertheless, it is recommended that the 6247G/6247C be used in an environment with as little line noise as possible.

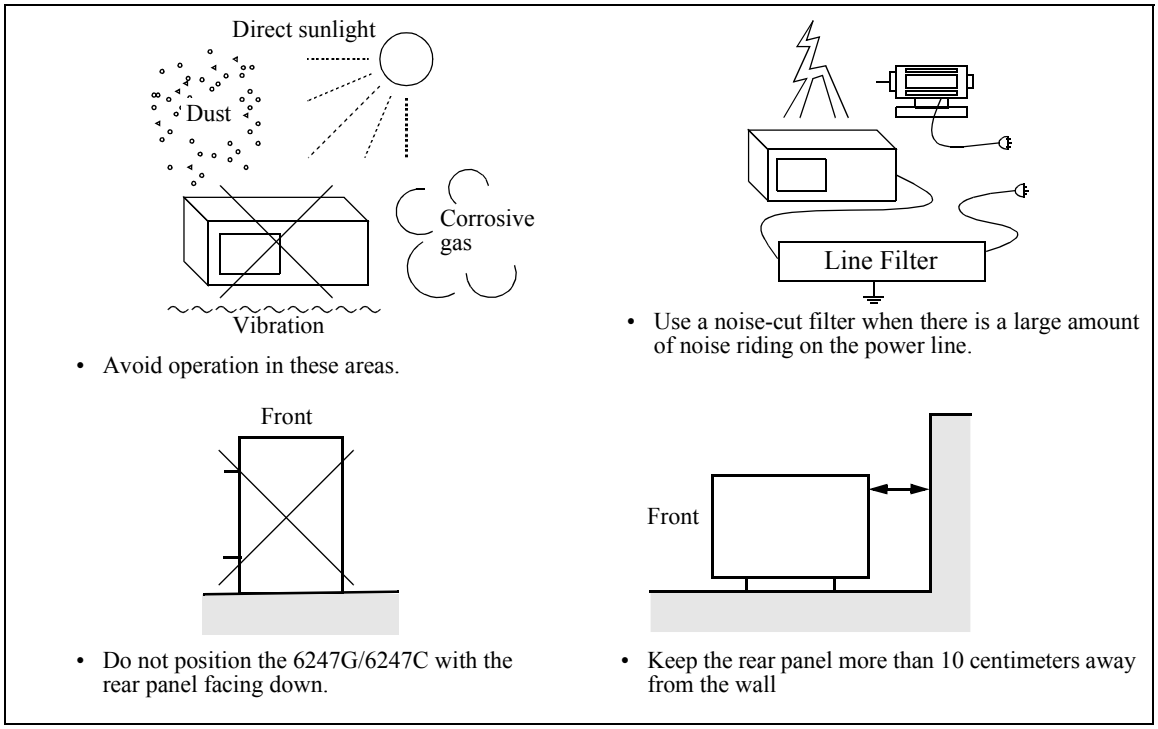
  If line noise is unavoidable, use a noise filter.
- Positioning of the 6247G/6247C

  A cooling fan is located on the rear panel and vents are located on the side panels. Do not block the fan and vents. Leave at least 10 cm of free space between the rear panel and the wall. Also, do not position the 6247G/6247C with the rear panel facing down.

  Obstructing the vents will cause the internal temperature to rise, possibly causing faulty operation.
- Mounting in a rack

  Ensure that exhaust air from other devices is not directed at the vents on the side of the 6247G/6247C.

  To prevent the temperature in the rack from rising, install a heat sink fan.



- Avoid operation in these areas.
- Use a noise-cut filter when there is a large amount of noise riding on the power line.
- Do not position the 6247G/6247C with the rear panel facing down.
- Keep the rear panel more than 10 centimeters away from the wall

Figure 1-1 Operating Environment

NOTE: ***Warm-up Time***
Allow the 6247G/6247C to warm up for at least 60 minutes after turning on the power to ensure the specified accuracy of the 6247G/6247C.

1.4.2 Power Specification

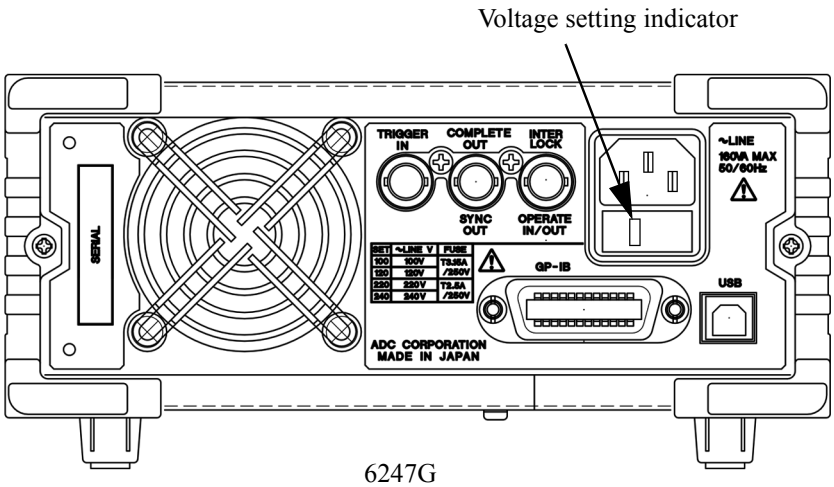
Table 1-3 below shows the 6247G/6247C power supply specifications.

CAUTION: ***To prevent damage to the 6247G/6247C, do not apply a voltage or frequency that exceeds the specified range.***

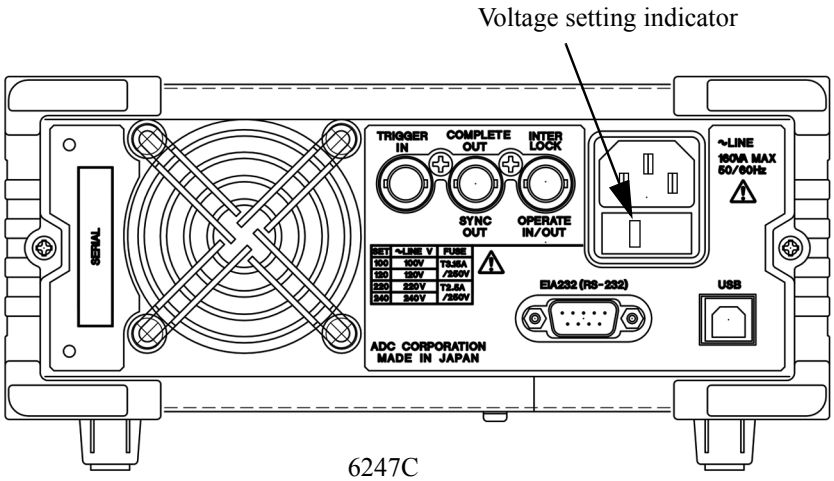
Table 1-3 Power Supply Specification

	Standard	Optional		
		32	42	44
	100 VAC	120 VAC	220 VAC	240 VAC
Input voltage range	90 V to 110 V	108 V to 132 V	198 V to 242 V	207 V to 250 V
Frequency range	48 Hz to 66 Hz			
Power consumption	160 VA or less			
Fuse	T3.15 A/250 V		T2.5 A/250 V	

Ensure that the power voltage setting on the instrument rear panel matches the voltage of the commercial power supply.



6247G



6247C

Figure 1-2 Set Power Voltage Indicator

1.4.3 Changing Power Voltage, and Checking and Replacing Power Fuse

The 6247G/6247C power voltage can be changed manually.

This section describes the procedure for changing the power voltage, and checking and replacing the power fuse.

CAUTION:

1. ***If the power fuse has opened, a problem occurred in this instrument. Contact an ADC CORPORATION sales representative.***
2. ***Always use the same fuse type and rating to prevent fire.***

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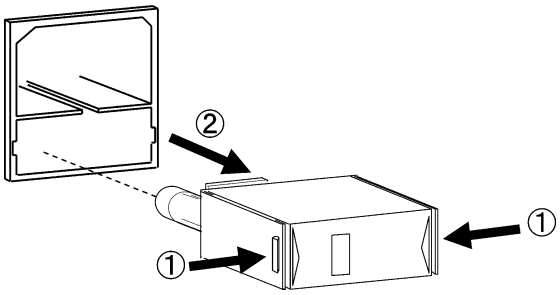
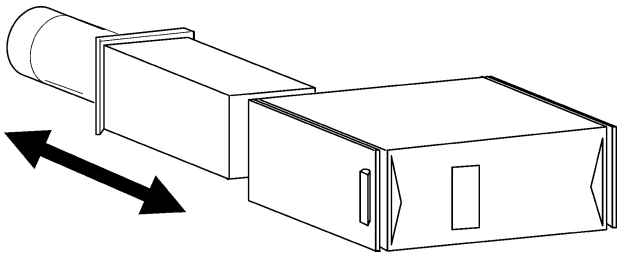
1. Remove the fuse holder assembly from the rear panel.

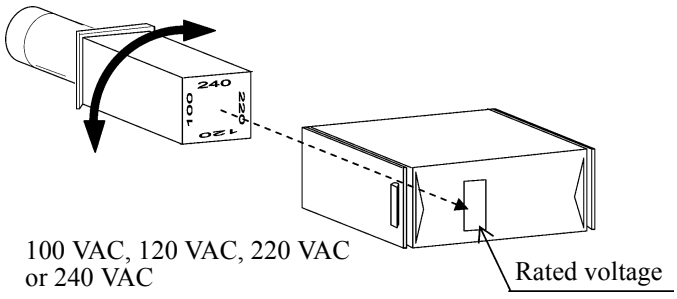
   Push on each side of the fuse holder assembly with a flathead screwdriver (①) and pull the assembly out (②).



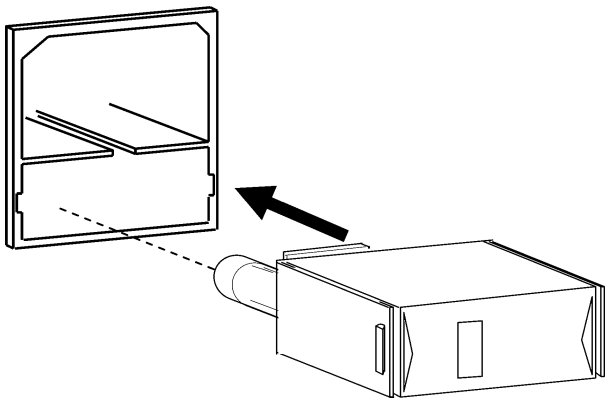
2. Remove the voltage selector from the assembly.



3. Rotate the voltage selector until the correct voltage appears in the window.



4. Insert a rated fuse (See Table 1-3).
5. Return the fuse holder assembly into the rear panel.



6. Verify that a rated fuse is installed and that the correct power voltage appears in the window.

1.4.4 Power Cable

CAUTION:

1. ***Use a power cable that conforms to the power outlet voltage and type. However, for use outside of Japan, use only a power cable approved for the respective country.***
2. ***To prevent electric shock, connect the power cable to an outlet with a ground terminal. If an extension cable without a ground terminal is used, the protective ground feature will be rendered ineffective.***
3. ***Be sure to set the POWER switch on the front panel to OFF before connecting the power cable..***

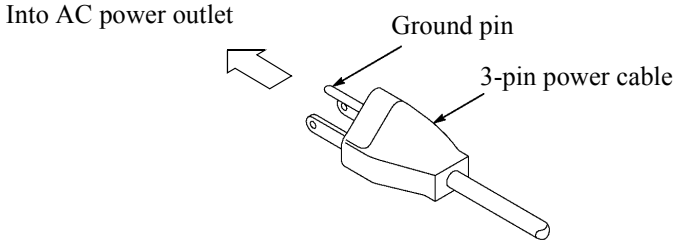


Figure 1-3 Power Cable

1.5 Operating Check

This section describes the simple self-test which must be performed when operating the 6247G/6247C for the first time. Follow the procedure below to ensure the instrument operates correctly.

1. Ensure that the **POWER** switch on the front panel is set to OFF.
2. Plug the power cable into the AC power connector on the rear panel.

CAUTION: ***To prevent damage to the 6247G/6247C, do not apply a voltage or frequency that exceeds the specified range.***

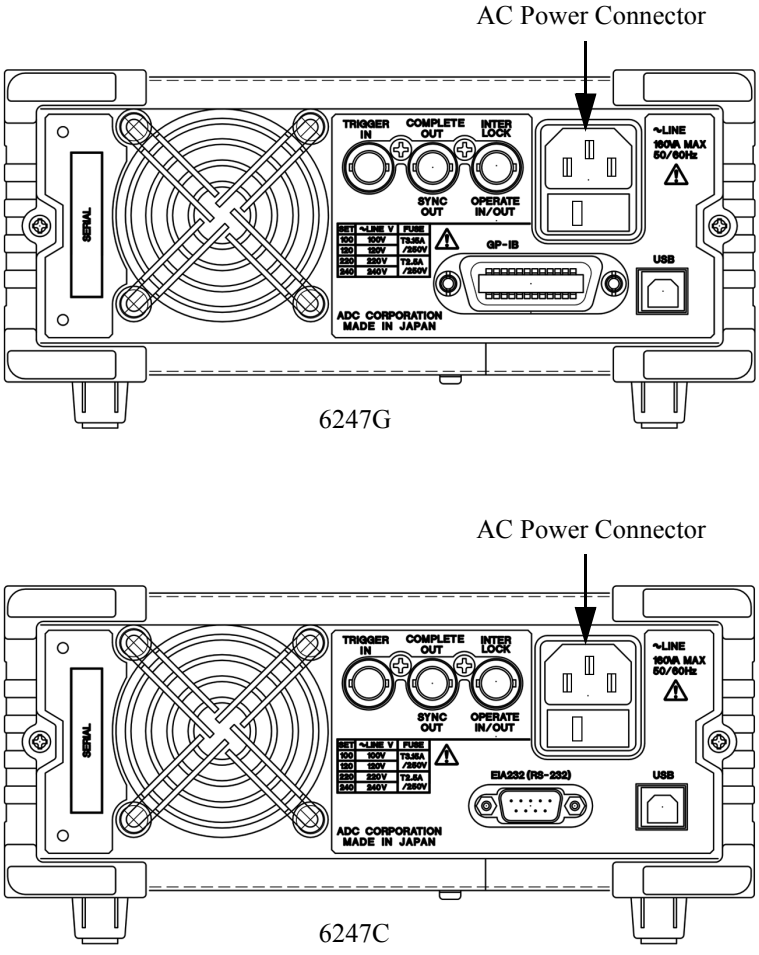


Figure 1-4 Connecting Power Cable

3. Plug the power cable into an AC wall outlet.

4. Turn ON the **POWER** switch on the front panel.

   After all the indicators turn on, a self-test is performed. (Duration: approx. 15 sec. See Figure 1-5.)

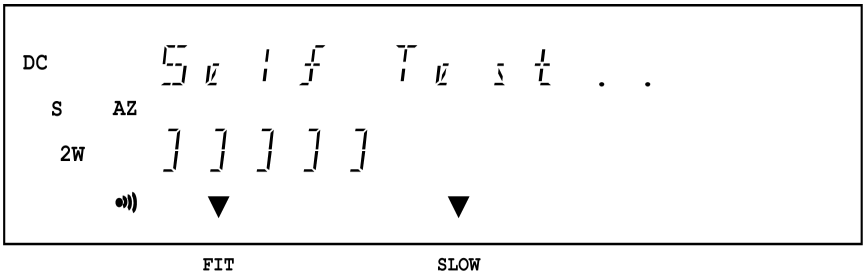


Figure 1-5 Self-Test in Progress

When the test is complete, the model name, line frequency, setting interface information (GPIB address or USB ID) and software revision appear (See Figure 1-6). After that, the start-up screen is displayed (Figure 1-7).

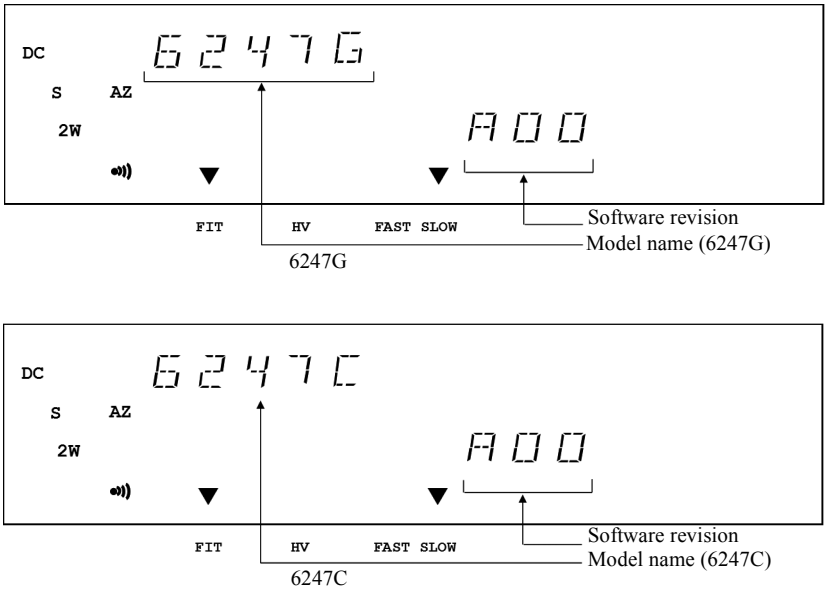


Figure 1-6 Self Test Completion

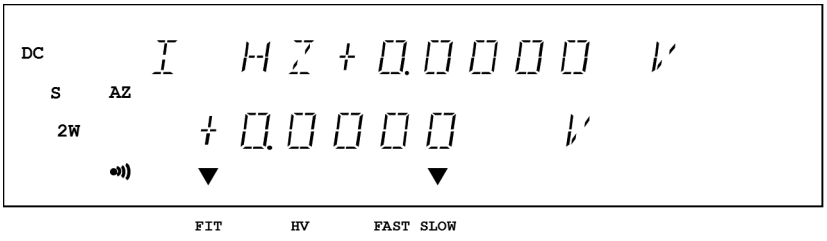


Figure 1-7 Start-Up Display

NOTE:

1. ***Depending on the previous conditions, the screen display may be different from Figure 1-7.***
2. ***If a problem occurs, an error message appears on the screen. Refer to the error message list to solve the problem. (Refer to Section A.2, "Error Message List.")***

5. Press **MON** twice.
   The voltage measurement function starts. (See Figure 1-8.)

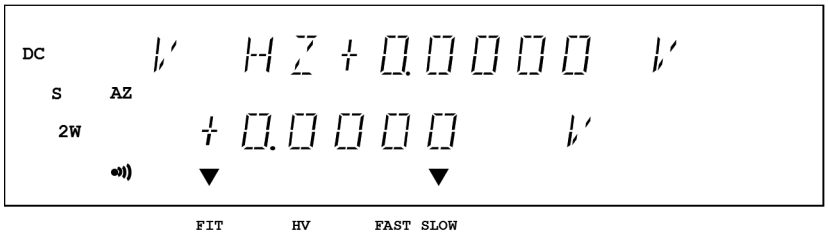


Figure 1-8 VSVM Measurement (Output OFF)

6. Press **OPR**.
   The OPR indicator goes ON and VSVM measurement starts. (See Figure 1-9.)

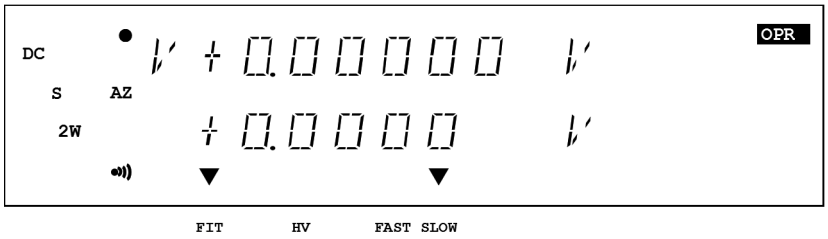


Figure 1-9 VSVM 0 V Measurement in 5 V Range

7. Verify that the VM measured value is within ±350 μV of 0 V in the VS 5 V range.
8. Press **STBY**.
   The OPR indicator goes OFF and the 6247G/6247C enters the Standby (output OFF) status.

The operation check is complete.

NOTE: Be sure to set the output status to Standby (output OFF) before turning OFF the power.

1.6 Cleaning, Storage, and Transport Methods

1.6.1 Cleaning

Clean the 6247G/6247C by wiping or brushing its surface with a soft cloth or cloth which has been dampened in water containing a mild detergent.

CAUTION:

1. ***Ensure that water does not penetrate the 6247G/6247C.***
2. ***Avoid using organic solvents such as benzene, toluene, xylene, acetone, etc. They will cause deformation of the plastic parts.***

1.6.2 Storage

Store the 6247G/6247C in a location where the temperature is within the range of -25°C to +70°C. If storing for an extended period (90 days or longer), place the 6247G/6247C in a moisture-proof bag together with a desiccant. Avoid storing the 6247G/6247C in a location where there is a lot of dust or where it will be subjected to direct sunlight.

1.6.3 Transport

When transporting the 6247G/6247C, pack it in accordance with the following guidelines:

Packing procedure

1. Prepare a corrugated cardboard box with dimensions that are larger than the external dimensions of the 6247G/6247C by 15 cm or more to allow for shock absorbent material. (Using the original box is recommended.)
2. Wrap the 6247G/6247C with a protective sheet.
3. Line the box with shock absorbing material so that the 6247G/6247C is protected on all sides by cushioning material.
4. Close the box with industrial staples or use packing tape.

When sending the 6247G/6247C to an ADC CORPORATION sales representative for service or repairs, attach a label stating the following items.

- Company name and address
- Name of the person in charge
- Serial number (shown on the rear panel)
- Type of service required

1.7 Warm-up Time

Allow the 6247G/6247C to warm up for at least 60 minutes after turning on the power to ensure the specified accuracies of the 6247G/6247C.

1.8 Calibration

Calibrate the 6247G/6247C in accordance with the procedure described in Chapter 8 "CALIBRATION."

When asking ADC for calibration service, contact an ADC CORPORATION sales representative.

Recommended calibration interval	1 year

1.9 Life Limited Parts

In addition to the parts listed in "Safety Summary," the 6247G/6247C also includes the following parts that are life limited.

Follow the guidelines below to replace them. Contact an ADC CORPORATION sales representative for replacement.

Part name	Expected life cycle	Remarks
Operate/Standby relay	1,000,000 operations	Replace when the switching cycle between "Operate" and "Standby" reaches the numbers of cycles noted at left.
Cooling fan	40,000 hours	When the cooling fan is faulty, the message "ERR401 Fan Stop" is displayed and the operation stops. In this case, contact an ADC CORPORATION sales representative.
Vacuum fluorescent display	20,000 hours	
Panel key	500,000 operations	
USB connector	1,500 times	
Rotary knob	1,000,000 operations	

CAUTION: ***The 6247G/6247C internally counts the number of Operate/Standby relay operations. It can be checked from the menu or by using the remote commands. The output relay turns ON or OFF every time the output status switches between Operate and Standby. To enhance the relay durability, use the suspend function. (Refer to Section 5.2.4.4, "Suspend Function.") Normal operation is possible when the above expected life cycle is reached but immediate relay replacement is recommended.***

1.10 Product Disposal and Recycling

Correctly dispose of the 6247G/6247C in accordance with local and national regulations.

Before disposal, remove the following parts from the product to prevent dispersal of substances that may adversely affect the environment, human health, or the ecosystem.

NOTE: ***For assistance with locating a waste disposal company, contact an ADC CORPORATION sales representative.***

Name of substance or removed part	Used?	Location	Unit	Part
Capacitor containing polychlorinated biphenyls (PCBs)	No	-		
Part containing mercury	No	-		
Battery	No	-		
Printed circuit boards	Yes	Unit	Main	Printed circuit boards
Toner cartridge	No	-		
Plastic containing brominated flame retardants	Yes	Unit	BPQ-013001 BPQ-012011 BPF-034288 BPK-012012 BPB-012013 WBL-6247PS	Connectors, diodes, Zener diodes, photocouplers, FET, analog ICs, logic ICs, FLASH memory, transistors
Parts containing asbestos	No	-		
Cathode-ray tubes	No	-		
Chloroflourocarbon (CFC), hydrochlorofluorocarbon (HCFC), hydrofluorocarbon (HFC), or hydrocarbon (HC)	No	-		
Electric-discharge indicator	No	-		
LCD display of 100 cm^2 or larger	No	-		
Connecting cable	Yes	Between units		Power cable Input and output cable
Parts containing flame-resistant ceramic fibers	No	-		
Parts containing radioactive material	No	-		
Electrolytic capacitors containing substance of concern (With height > 25 mm, dia. > 25 mm, or equivalent volume)	No	-		
Arsenic or its compounds	Yes	Unit	Electronic components	Photocouplers, logic ICs

Name of substance or removed part	Used?	Location	Unit	Part
Nickel or its compounds	Yes	Unit		Electronic components, mechanical components
Lead or its compounds	Yes	Unit	BPQ-013001 BPQ-012011 BPF-034288 BPK-012012 BPB-012013 WBL-6247PS	Lead solder used for assembling electronic components on printed circuit boards
PVC	Yes	Unit		PVC components
Antimony or its compounds	Yes	Unit		Electronic components

2. OPERATION

This chapter describes the part names and functions on the front and rear panels and screen display (annotations) elements. The basic operations are explained by using measurement examples.

2.1 Panel Descriptions

This section describes the part names and functions on the front and rear panels, and the screen display (annotation) elements.

Fore more information on the operation, refer to Chapter 4, "REFERENCE."

2.1.1 Front Panel

The following describes the panel keys and connectors for each front panel sections.

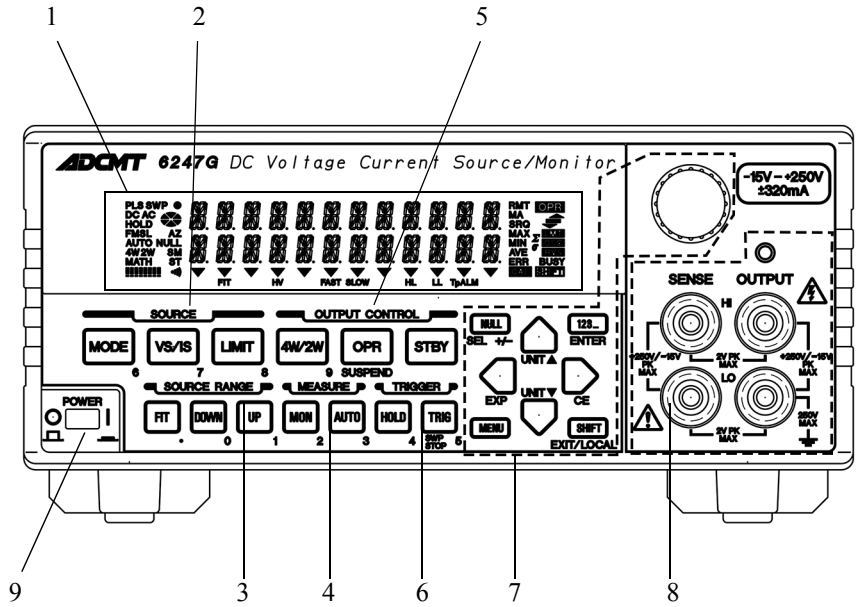


Figure 2-1 Front Panel

The front panel is divided into the following nine sections.

1. Display Section
2. SOURCE Section
3. SOURCE RANGE Section
4. MEASURE Section
5. OUTPUT CONTROL Section
6. TRIGGER Section
7. Other Keys
8. Output Section
9. POWER Switch

2.1.1.1 Display Section

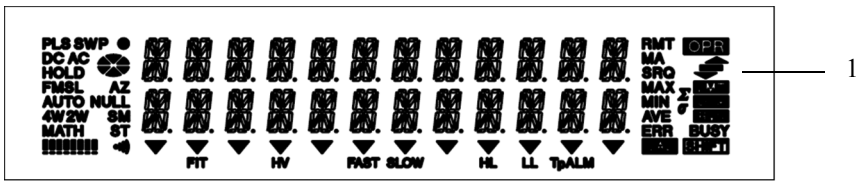


Figure 2-2 Display Section

1. Display: The screen employs a vacuum fluorescent display.
It displays the source value, the measurement value and the unit operational status.
It functions as the setting screen when changing the setting parameters.

2.1.1.2 SOURCE Section

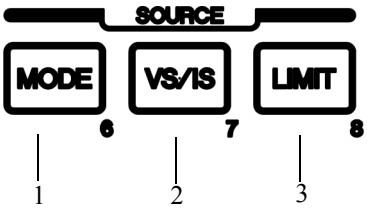


Figure 2-3 SOURCE Section

1. **MODE** key: Selects the source mode (DC, pulse, DC sweep, or pulse sweep).
2. **VS/IS** key: Selects the source function (voltage source or current source).
3. **LIMIT** key: Sets the limit values.

2.1.1.3 SOURCE RANGE Section

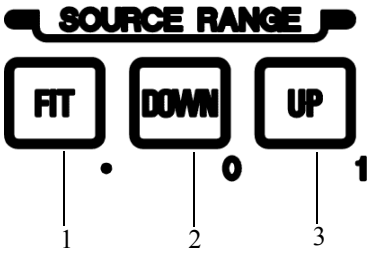


Figure 2-4 SOURCE RANGE Section

1. **FIT** key: Selects the optimum fitting range (FIT) or the currently setting range to input the source values.
2. **DOWN** key: Lowers the source range.
3. **UP** key: Raises the source range.

2.1.1.4 MEASURE Section

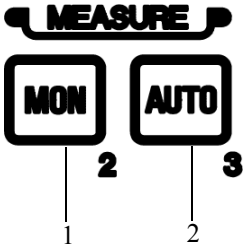


Figure 2-5 MEASURE Section

1. **MON** key: Selects the measurement function (voltage, current, or resistance measurement).
2. **AUTO** key: Selects the measurement Auto range or Fixed range.

2.1.1.5 OUTPUT CONTROL Section

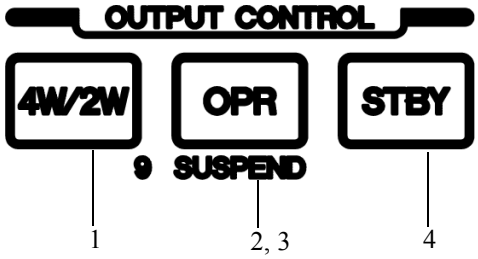


Figure 2-6 OUTPUT CONTROL Section

1. **4W/2W** key: Selects the output sensing 4-wire or 2-wire connection.
2. **OPR** key: Switches between Operate and Suspend.
   * : Suspend status outputs the suspended voltage without turning OFF the output relays. The OPR indicator blinks.
3. **SUSPEND (SHIFT, OPR)** key: Sets Suspend regardless of Operate or Standby status.
4. **STBY** key: Sets the output status to Standby.

2.1.1.6 TRIGGER Section

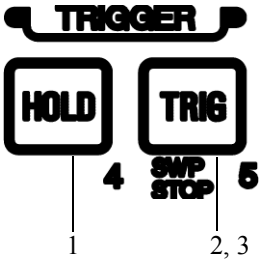


Figure 2-7 TRIGGER Section

1. **HOLD** key: Selects the trigger mode (AUTO or HOLD).
2. **TRIG** key: When the trigger mode is set to HOLD, triggers measurement and pulse source in the DC source or pulse source mode, and starts sweep source or moves to the next step in the sweep source mode. When the trigger mode is set to AUTO, triggers sweep source.
3. **SWP STOP (SHIFT, TRIG)** key: Stops the sweep.

2.1.1.7 Other Keys

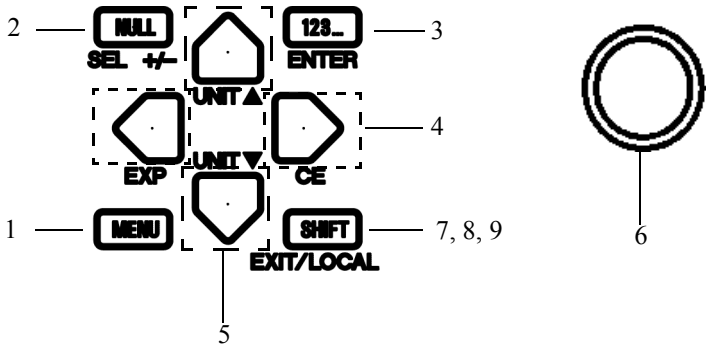


Figure 2-8 Other Keys

1. **MENU** key: Displays the menu.
2. **NULL** key: Turns ON or OFF the NULL calculation.
3. **123...** key: Switches to the direct input mode, sets the value, and executes the source generation on the setting screen which accepts numerical input.
4. , keys: Move the cursor (flashing figure) in parameter setting.
   Select items on the menu screen.
5. , keys: Increase or decreases the source value or limit value at the cursor position.
   Move up and down the hierarchy on the menu screen.
6. key (Rotary knob): Increase or decreases a parameter value at the cursor position (flashing figure). Selects a parameter (flashing characters) or an item on the menu screen.
7. **SHIFT** key: Selects the key shift mode ON or OFF.
8. **EXIT** key (on the Menu screen): Exits the menu screen and returns to the normal screen. Enables the set parameters.
9. **LOCAL** key (during remote operation):
   Switches to local operation from remote operation.

NOTE: Local operation is prohibited if the LLO (Local Lock Out) command is set through the GPIB or USB interface.

2.1.1.8 Output Section

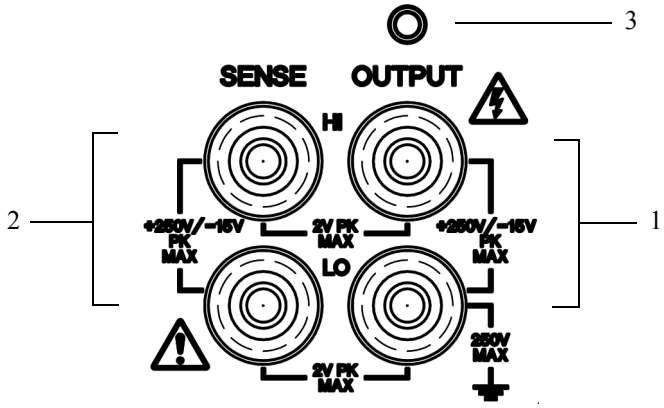


Figure 2-9 Output Section

1. OUTPUT terminals: Voltage and current output terminals
2. SENSE terminals: Functions as sensing terminals for voltage output and input terminals for voltage measurement in the remote sense mode (4-wire connection).
3. OUTPUT Indicator: Lights when the output relay is ON (Operate or Suspend status).

WARNING: ***Electric shock danger.***
A hazardous voltage is output if an external hazardous voltage is applied to the case, causing a potential difference between the case and the LO.

2.1.1.9 POWER Switch

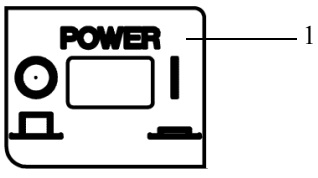


Figure 2-10 POWER Switch

1. **POWER** Switch: Turns the power ON or OFF.

2.1.2 Screen Display (Annotations)

This section describes the screen display (annotations).

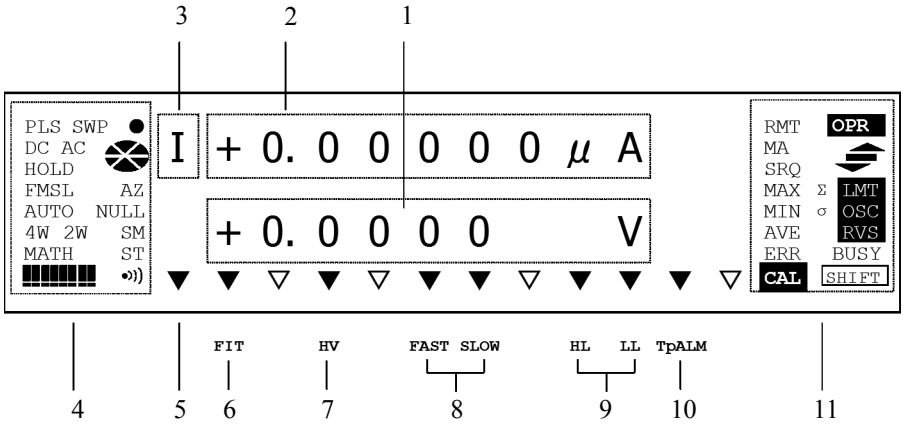


Figure 2-11 Screen Display (Annotations)

1. Source value

   Displays a voltage source (VS) or current source (IS) value with a unit.

2. Measurement value

   In Operate:
   Displays a measurement value.
   In Standby or Suspend:
   Displays the suspend voltage. Displays the output impedance in Suspend status.
   HZ: High impedance status
   LZ: Low impedance status
   (For more information on this operation, refer to Section 5.2, "Functions in Detail.")

3. Measurement function

   Displays the measurement function.

   I: Current measurement (IM)

   V: Voltage measurement (VM)

   R: Resistance measurement (RM)

   _ : Measurement OFF

4. Left status indicators

   PLS: Pulse source mode.

   SWP: Sweep source mode.

   NOTE: PLS+SWP means pulse sweep, and DC+SW means DC sweep.

   DC: DC source mode.

   AC: (Not in use)

   HOLD: The trigger mode is set to HOLD.

FMSL: Displays the measurement integration time by using the indicators in combination.
For more information on this combination, refer to Table 4-1, "Integration Time and Indicator Display."

AUTO: The auto range is set to ON.

4W: The output sensing is set to 4-wire connection.

2W: The output sensing is set to 2-wire connection.

MATH: Scaling calculation is ON.

● : Goes ON for every measurement sampling.

: Indicates the sweep operation status.
Rotates during sweep.
Stops rotation at hold.
Goes OFF when sweep stops.

AZ: The measurement auto zero function is ON.

NULL: NULL calculation is ON.

ST: The measurement data memory is ON.

•)) : Buzzer setting is ON.

(Not in use)

5. Auxiliary indicator for menu — Blinks if a lower hierarchy exists (key enabled) at parameter setting on the menu screen.

6. FIT indicator — Source range is set to FIT.

7. HV indicator — High Voltage indicator.
Goes ON when the suspend voltage is +55 V or higher, when the source value is +55 V or higher in the voltage source function, or when the limit value is +55 V or higher in the current source function.

8. Output response indicator

FAST: The output response is set to Fast.

SLOW: The output response is set to Slow.

9. HL/LL indicator

HL: The high limit status is detected.

LL: The low limit status is detected.

10. TpALM indicator — The measurement period becomes longer than the setting Tp. The following factors are possible:
- Source auto range
- Measurement auto range
- Auto zero
- The measurement time is longer than Tp.

11. Right status indicators

RMT : Remote control

MA: Addressed as Lister or Talker via GPIB

SRQ: SRQ is being transmitted.

MAX, MIN, AVE, ∑:
MX/MIN calculation is ON.

σ: (Not in use)

ERR: An error log is generated.

CAL: Calibration mode is ON.

OPR: Illuminates or extinguishes depending on the output status.

Operate: ON

Suspend: Blinks

Standby: OFF

 : When the comparator calculation is ON, either one of these three indicators goes ON depending on the results.

LMT: The measured value is in the limit status.

OSC: (Not in use)

RVS: (Not in use)

BUSY: (Not in use)

SHIFT: The shift mode is ON.

2.1.3 Rear Panel

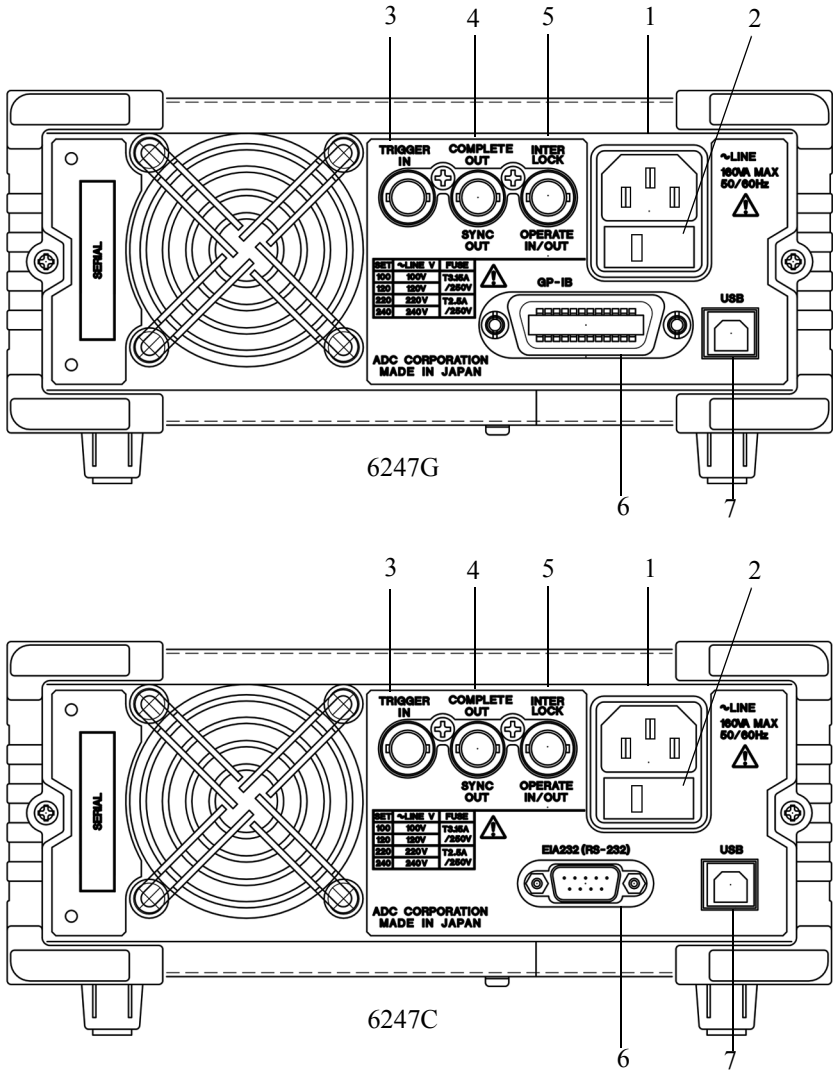


Figure 2-12 Rear Panel

1. AC power connector — Connects the 6247G/6247C to the AC power supply by using the supplied power cable.

2. Voltage selector and fuse holder — Selects voltage manually to match the AC power supply. A fuse is contained inside.

CAUTION: ***Use an appropriate fuse.***

3. TRIGGER IN

Functions as a DC or pulse measurement trigger and a sweep start or step-up trigger.

The input resistance is about 4.7 kΩ and is TTL negative pulse input. (Pulse width 2 μs or over)

4. COMPLETE OUT | SYNC OUT

The output signal is a negative pulse.
Select either 10 μs or 100 μs pulse width.
The output circuit is TTL level open drain output and pulled up to +5 V with 10 kΩ.

COMPLETE OUT :
Signal indicating the measurement is completed.
Outputs with any condition of Front, End, HI, GO, LO and HI or LO.

SYNC OUT :
Sends a signal synchronized with the source output in the pulse source mode or sweep source mode.

5. INTERLOCK | OPERATE IN/OUT

INTERLOCK :
Interlock signal input.
The input resistance is approximately 10 kΩ.

OPERATE IN :
Sets Standby by a rising edge signal input in the STBY In function.
Switches between Operate and Standby or between Operate and Suspend by a level signal input in the OPR/STBY In or OPR/SUS In function. The input resistance is approximately 10 kΩ.

OPERATE OUT :
Sends Operate status with a level signal.
The output circuit is TTL level open drain output and pulled up to +5 V with 10 kΩ.

6. 6247G: GP-IB — Port for connecting the GPIB cable to the external controller.

   6247C: RS-232 — Port for connecting the RS-232 cable to the external controller.

7. USB — Port for connecting the USB cable to the external controller.

2.2 Basic Operation

This section describes the following items:

- Setting the source value
- Setting the limit values
- How to use the menu and basic measurement functions

NOTE: ***The operation procedures listed permit the settings to be made in the shortest time. If the display differs from the one shown, repeat the procedure from the beginning.***

2.2.1 Setting Source Value

2.2.1.1 Relation between Keys

The following figure shows the relation between keys

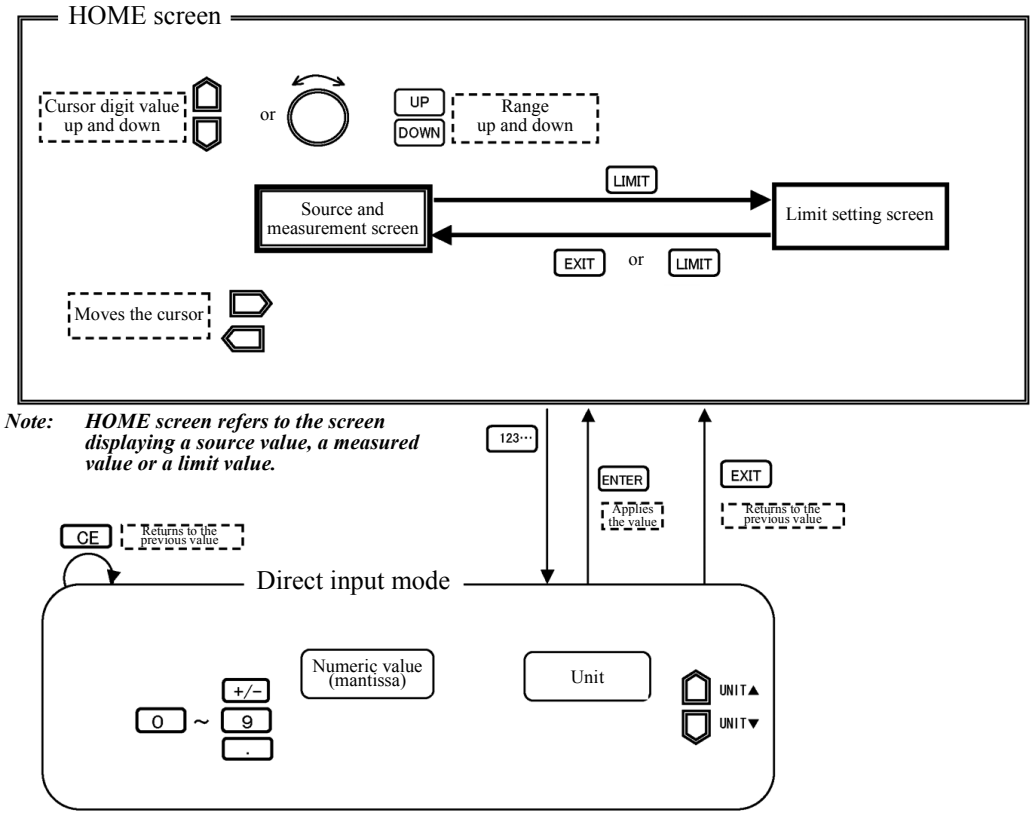
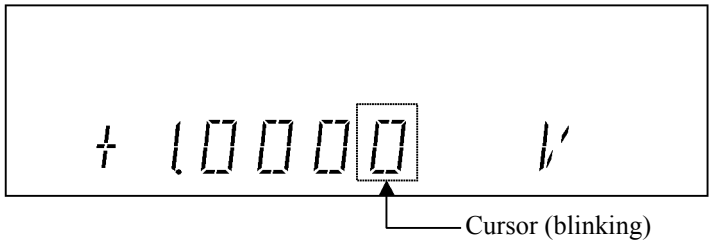


Figure 2-13 Relation between Keys

2.2.1.2 Setting Source Value Using Cursor Keys/Rotary Knob (with FIT Indicator OFF)

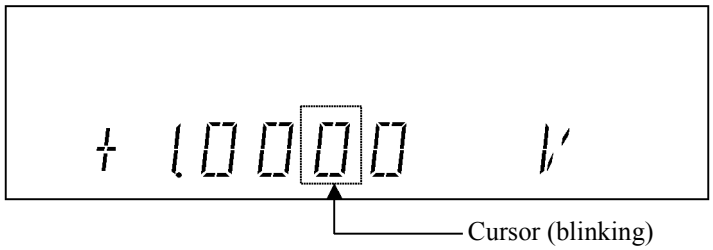
1. Change the source value using the cursor keys (,) and the UP/DOWN keys (,) or the rotary knob ( ).

   and keys move the cursor (blinking) position left and right. , keys, or rotary knob can change the value indicated by the cursor.
   The following figures show the setting procedure.

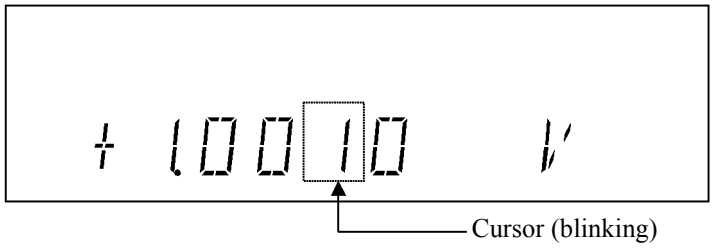


Setting numeric values

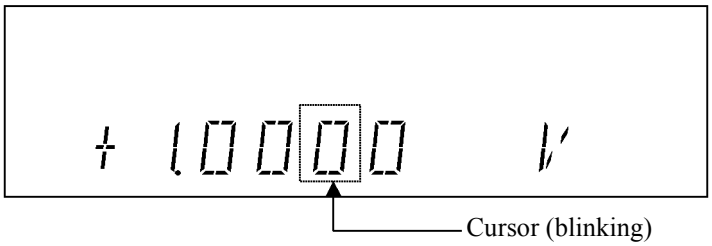
1. Press .
   The cursor moves to the left.



2. Press or rotate one click clockwise.
   The figure indicated by the cursor increases by one increment.



3. Press ▽ or rotate ◯ one click counterclockwise.
   The figure indicated by the cursor decreases by one increment.

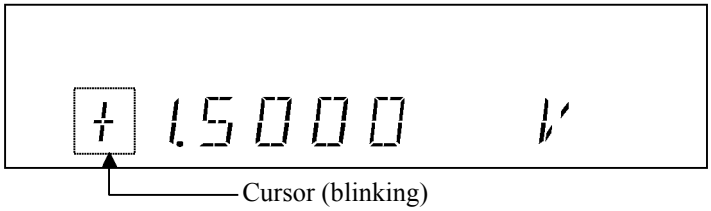


4. Keep pressing △.
   The figure indicated by the cursor increases incrementally while the key is being pressed. The figure stops increasing when the key is released.

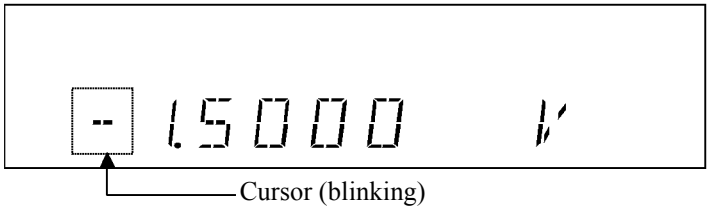
5. When ◯ is rotated, the figure increased by one for each clockwise click or decreases by one for each counterclockwise.

Setting the polarity

1. Pressing ◁ or ▷ moves the cursor position to the polarity display.



2. Press △ or rotate ◯ one click.
   The polarity display changes to negative "-" mark. However, if the figure is 0, it is impossible to set "-".

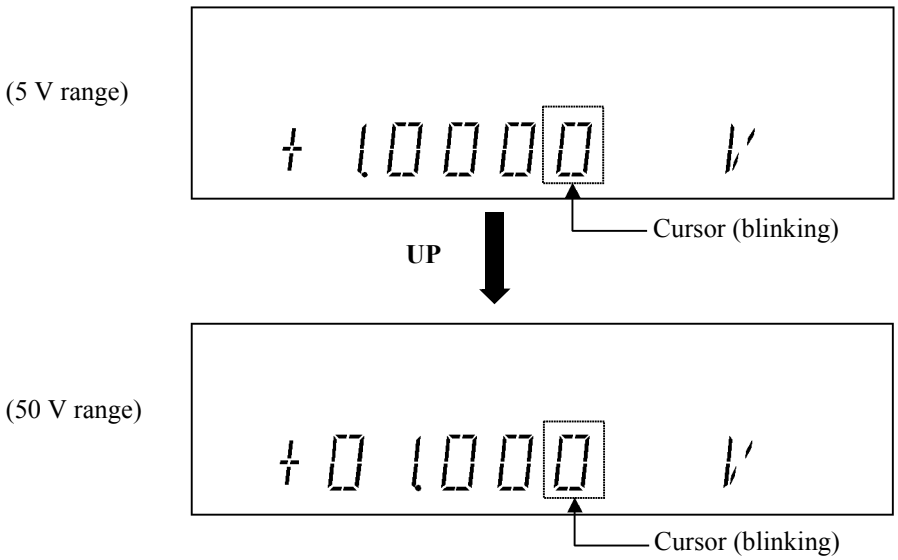


2. Changing the source range

Change the source range by using the **DOWN** or **UP** key.

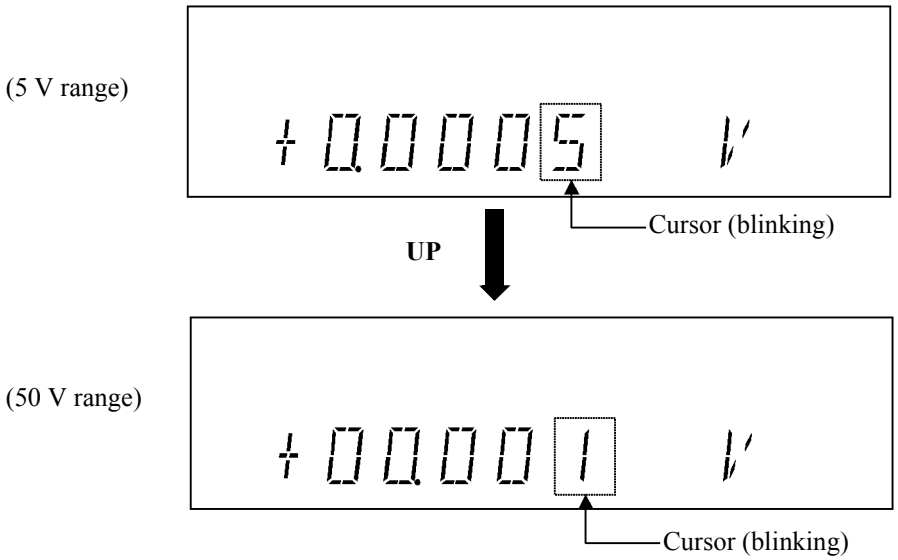
- The range change adjusts to synchronize the source value before and after the change.

Example of changing the 5 V range to the 50 V range



- If the set value is below the lowest digit, it is rounded off.

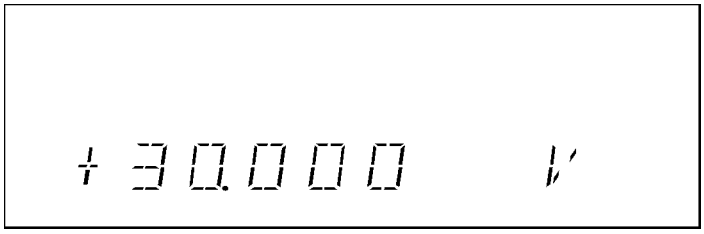
Example of changing the 5 V range to the 50 V range



2.2.1 Setting Source Value

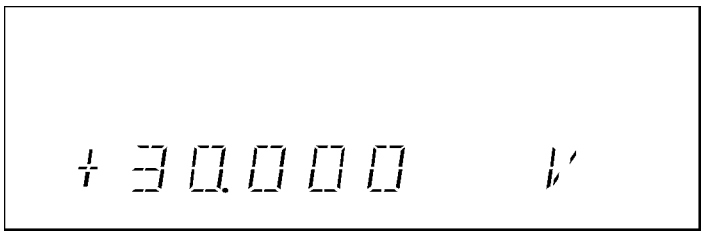
- If the final value would exceed the valid range, change is not possible.

(50 V range)



DOWN

(50 V range)

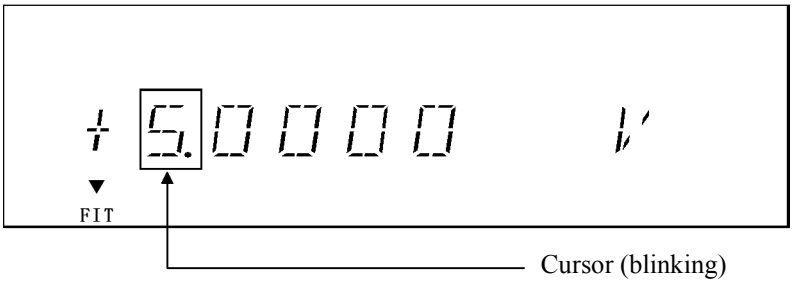


An error is generated and changes do not occur.

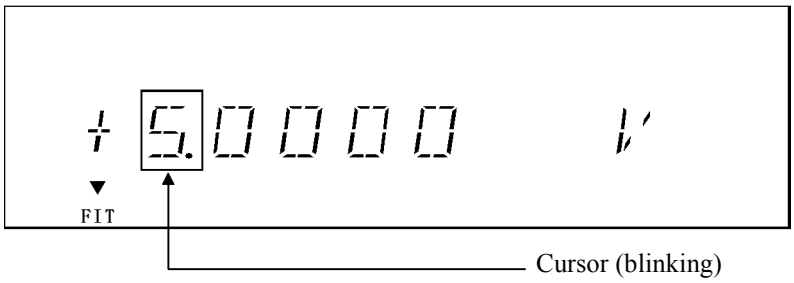
2.2.1.3 Setting Source Value Using Cursor Keys/Rotary Knob (with FIT Indicator ON)

When the FIT indicator turns ON, the range is automatically adjusted so that the source value is generated in the optimum range.

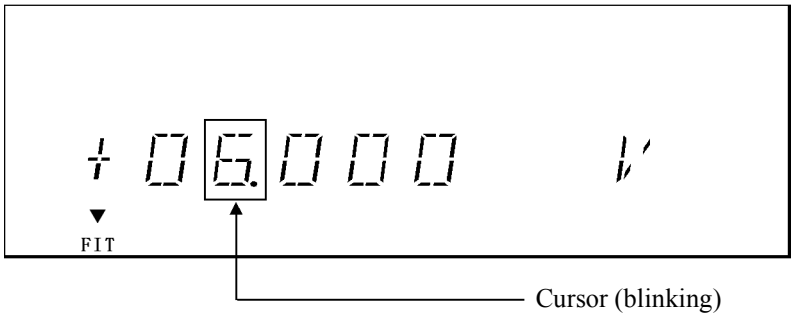
The following figures show the setting procedure.



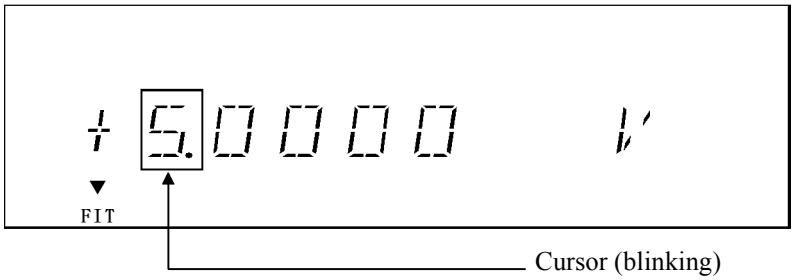
1. Press ◁ to move the cursor to the left.



2. Press △ or rotate ◯ one click clockwise to change the 5 V setting to 6 V. The source range is automatically set to 50 V.



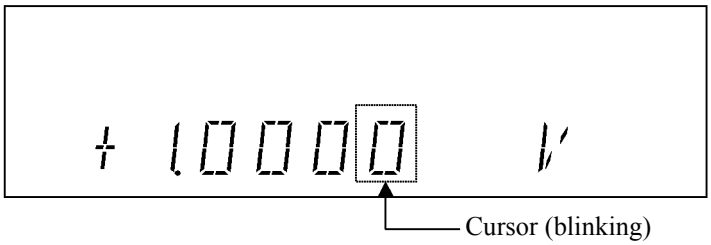
3. Press or rotate one click counterclockwise.
   The source range is automatically set to 5 V.



2.2.1.4 Setting Source Value Using Direct Input Mode

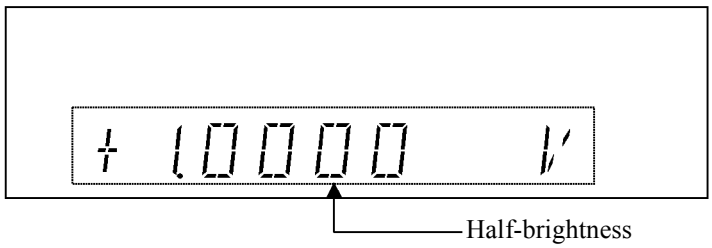
Press the **123...** key to turn to the direct data input mode, and set the source value by using the numeric keys and the unit key which are printed in green on the panel.

The following figures show the setting procedure.

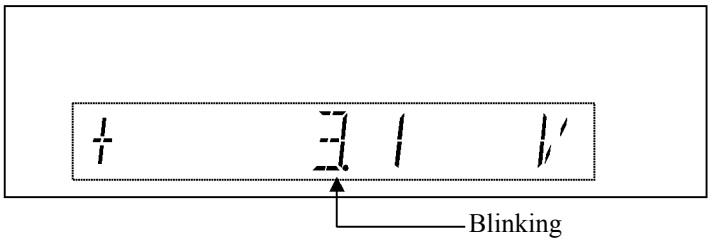


Setting numeric values

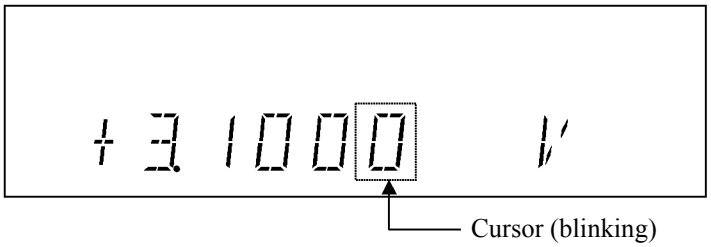
1. Press **123...**.
   The screen is half-brightness and indicates the direct input mode.



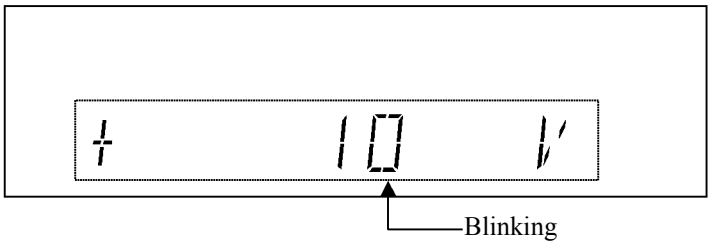
2. Press **3**, **.**, **1** in this order.
   While inputting figures, the cursor blinks.



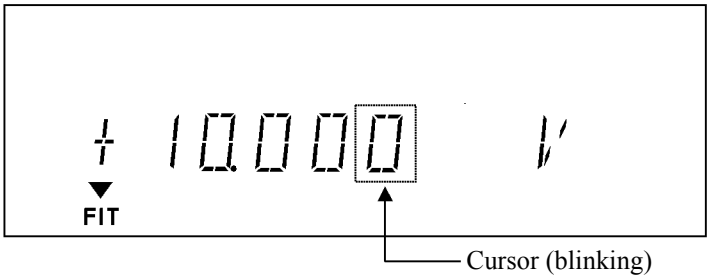
3. Press **ENTER**.
   The numeric value has been applied and the direct input mode is released.



4. Press the **123…**, **1**, **0**, **ENTER** keys in order to set +10 V.
   - When the FIT indicator turns OFF, the value exceeds the 5 V setting range and an error occurs. The value cannot be set.



   - When the FIT indicator turns ON, the optimum 50 V range is set.



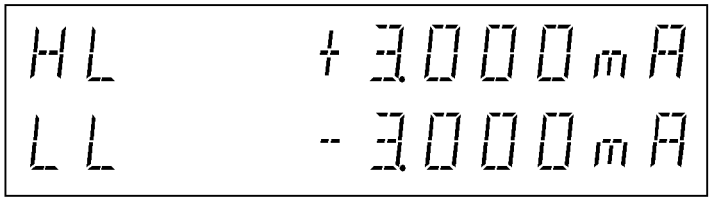
2.2.2 Setting Limiter Values

Press **LIMIT** to set the limit value setting screen.

To change the limit values, follow the procedure described in Section 2.2.1, "Setting Source Value." However, the range cannot be set. (The optimum range is always displayed.)

The HI and LO limit values have two settings. This section describes the difference between them. ("HL value" refers to HI limit value, and "LL value" refers to LO limit value.)

2.2.2.1 Setting Current Limiter



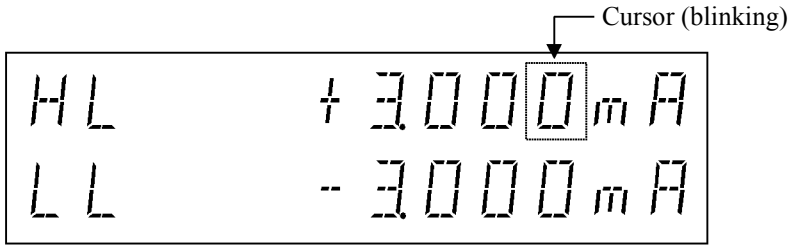
The setting function is changed using **MENU**, ***SOURCE***, and ***LMT Input***. This setting function can be selected only when the current limiter is enabled.

However, the HL and LL values have the following restriction:

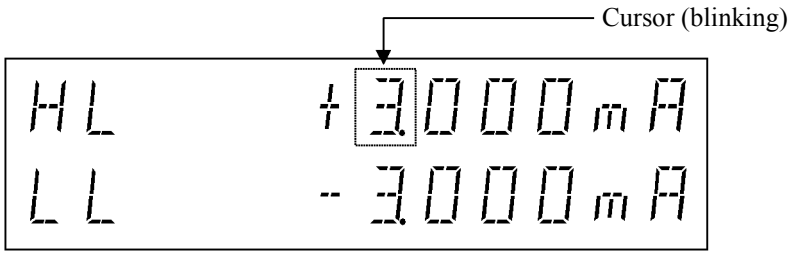
200 digits ≤ (HL value - LL value): 3μA range

±Balance setting

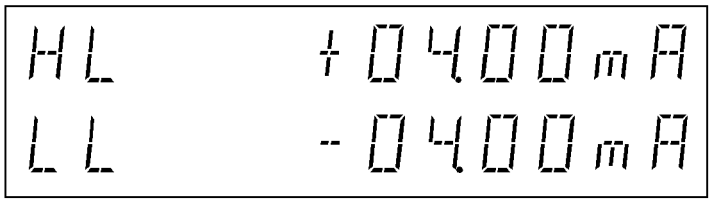
1. Press **LIMIT**.
   The cursor appears on the HL value.



2. Move the cursor to 3.

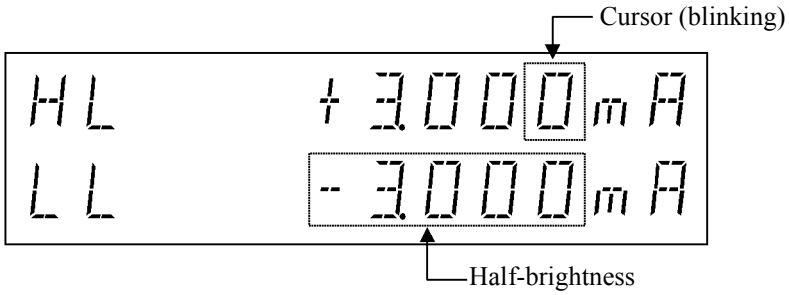


3. Press or rotate one lick clockwise.
   The range increases by one, and the LL value also changes at the same time.
   The LL value cannot be changed directly.

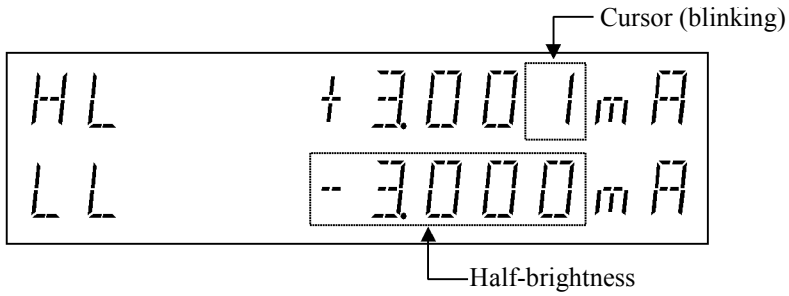


Separate setting

1. Press **LIMIT**.
   The cursor positions on the HL value, and the LL value is displayed at half-brightness.

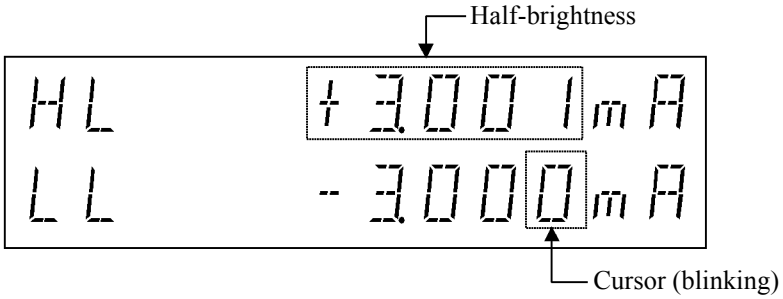


2. Press or rotate one click clockwise.
   Only the HL value changes.

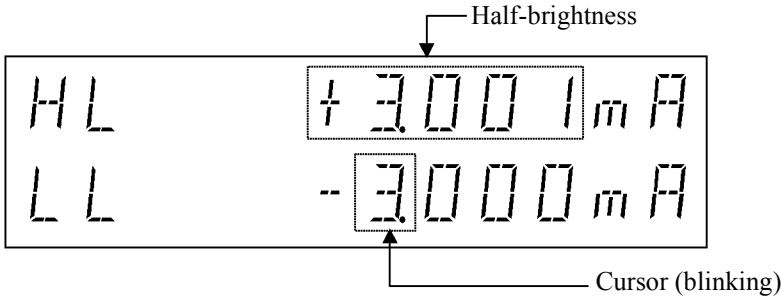


3. Press **NULL (SEL)**.

   The cursor moves to the LL value, and the HL value is displayed at half-brightness.

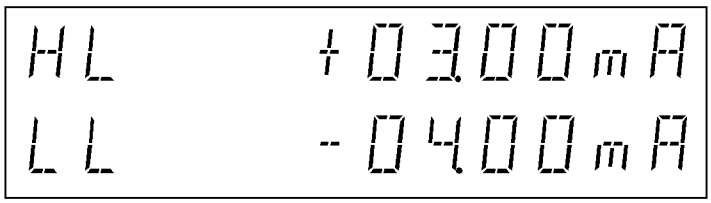


4. Move the cursor to 3.



5. Press ▽ or rotate ◯ one click counterclockwise.

   The LL value changes, and the ranges for both the HL and LL values increase by one at the same time.



2.2.2.2 Setting Voltage Limiter

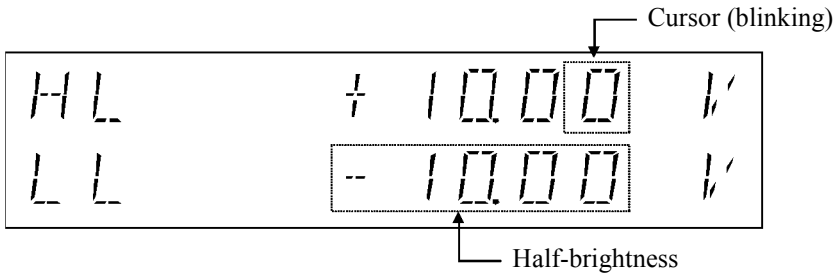
To set the voltage limiter, the HL value and the LL value are separately set. For how to set, refer to "Separate setting" in Section 2.2.2.1, "Setting Current Limiter."

The HL value and the LL value for the voltage limiter can be set to the same polarity.

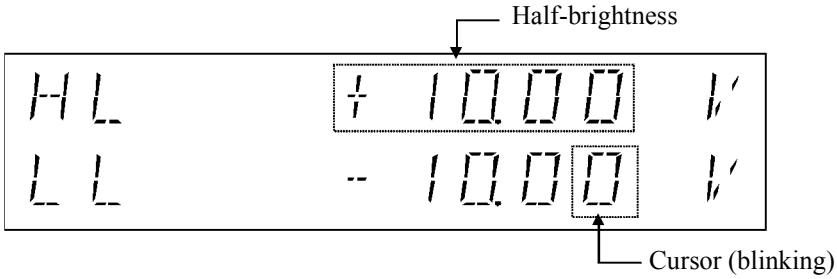
However, the HL and LL values have the following restriction:

60 digits ≤ (HL value - LL value)

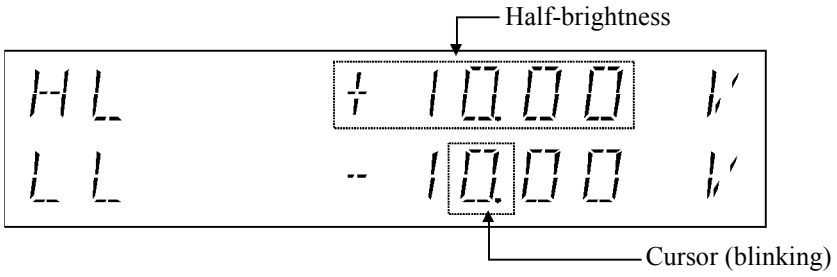
1. Press **VS/IS** to select the current function.
2. Press **LIMIT** to display the limit value setting screen.



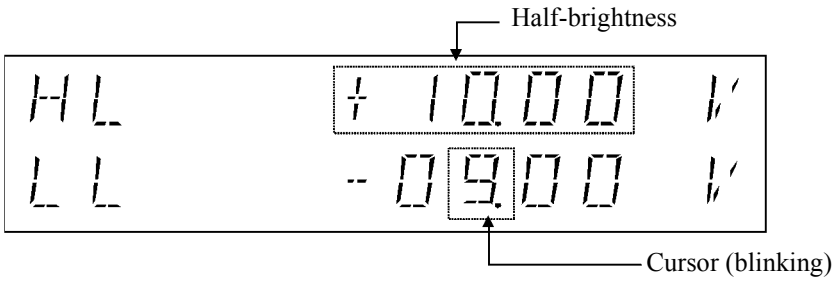
3. Press **NULL (SEL)** to select LL.



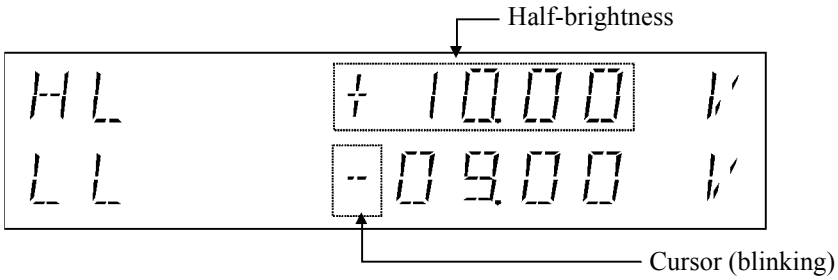
4. Press ◁ twice. (Move the cursor to "0.".)



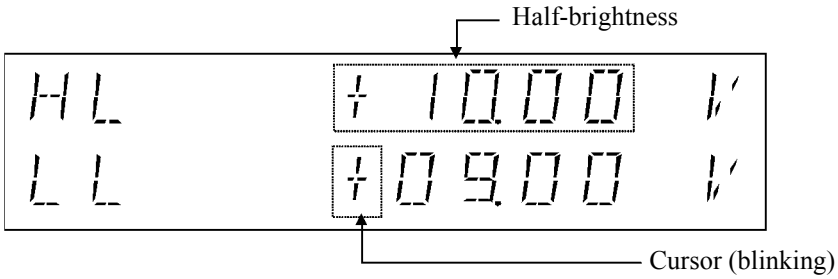
5. Press or rotate one click clockwise.



6. Press twice. (Move the cursor to "-".)



7. Press or rotate one click clockwise to set the same polarity.



2.2.3 Menu Operation

The 6247G/6247C functions and parameters are set on a hierarchical menu.

The menu is a 3-level hierarchical structure.

Level 1	Category level	Select a category.
Level 2	Select level	Select a parameter to set within the category.
Level 3	Input/Run level	Input or select a set value.

Figure 2-14 shows an overview of the menu operations.

2.2.3.1 How to Operate Menu

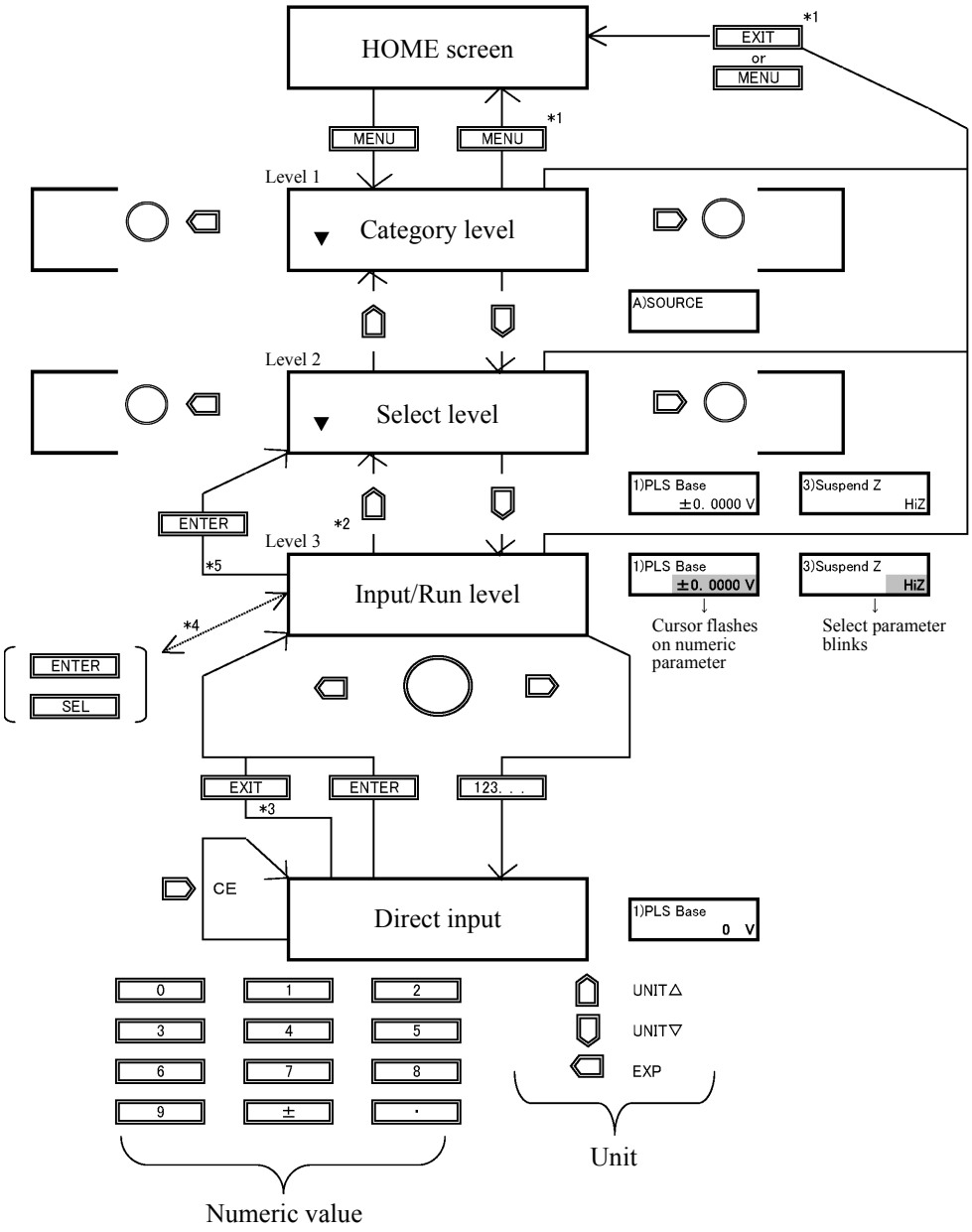
Operate the menu in accordance with the following procedure.

1. Press **MENU**.
   The selection screen for the Category level **A) SOURCE** to **M) SYSTEM** appears.
2. Select a category with , or .
3. Press to enter the Select level.
4. Select a parameter with , or .
5. Press to enter the Input/Run level.
6. Parameter setting and execution operations differ according to the parameter type.
   Set the parameter with , and move the cursor with or .

Table 2-1 shows the menu and key functions.

NOTE: During sweep operation, the MENU key is unavailable.

2.2.3 Menu Operation



*1 Enter a parameter to return to the normal screen.
*2 Enter a parameter to return from the Input/Run level to the Category level.
*3 Press [EXIT] to discard the input data and revert to the directly set value.
*4 Enabled for switching between two parameters.
*5 Enabled when "Push ENTER" is displayed.

Figure 2-14 Menu Operation Overview

Table 2-1 Menu and Keys Functions

Key	Category level	Select level	Input/Run level *1		
			Numeric parameter	Select parameter	Run
	-	Go to Category level	Go to Select level	Go to Select level	Go to Select level
	Go to Select level	Go to Input/Run level	-	-	-
	Go to left category	Go to left parameter	Move cursor to left	Change selection	-
	Go to right category	Go to right parameter	Move cursor to right	Change selection	-
	Go to right or left category	Go to right or left parameter	Increase/decrease figure at cursor	Change selection	-
123...	-	-	Go to direct input screen	-	-
ENTER	-	-	Run and go to Input/Run level	-	Run and go to Select level *2
MENU	Exit menu	Exit menu	Exit menu	Exit menu	Exit menu
EXIT	Exit menu	Exit menu	Exit menu	Exit menu	Exit menu

*1: For more information on the parameters, refer to Section 2.2.3.2, " Menu Structure and Parameter Setting."
*2: When "Push ENTER" is displayed.

2.2.3.2 Menu Structure and Parameter Setting

The parameter type indicates the setting method at the Input/Run level.

Category level / Select level / Input/Run level

MENU

A) SOURCE

		Parameter types
1) PLS Base	Pulse source base value VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
2) Suspend V	Output voltage in Suspend -15.000 V to +250.00 V	Numeric
3) Suspend Z	Output impedance in Suspend HiZ/LoZ	Select
4) LMT Input	How to set the limiter ±Balance/Separate	Select
5) Response	Output response Fast/Slow	Select

B) SWEEP

1) SweepType	Sweep source mode Linear/Fixed/Random/Linear 2	Select
2) SWP Range	Source range for sweep Auto/Fix	Select
3) Reverse	Sweep reverse mode Off/On	Select
4) Repeat Cnt	Sweep repeat count 0 to 1000	Numeric
5) Rtrn Bias	Returns to the bias value when sweep stops. On/Off	Select

(a)

(a)

C) SWEEP VAL

Category level	Select level	Input/Run level	Parameter types
	1) Start Value	Linear sweep start value In Linear mode VS -15.000 V to ±250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	2) Stop Value	Linear sweep stop value In Linear mode VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	3) Step Value	Linear sweep step value In Linear mode VS 0.0001 V to 250.00 V IS 0.0001 µA to 320.00 mA	Numeric
	1) Level Value	Fixed sweep level value In Fixed mode VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	2) Sample Cnt	Fixed sweep sample count In Fixed mode 1 to 8000	Numeric
	1) Sweep Adr	Random sweep start address/stop address In Random mode 0 to 7999 * Use [SEL] to switch between Start and Stop.	Numeric
	1) First Val	2-slope linear sweep first value In Linear 2 mode VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	2) Middle Val	2-slope linear sweep middle value In Linear 2 mode VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	3) Last Val	2-slope linear sweep last value In Linear 2 mode VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	4) Step1 Val	2-slope linear sweep Step 1 value In Linear 2 mode VS 0.0001 V to 250.00 V IS 0.0001 µA to 320.00 mA	Numeric
	5) Step2 Val	2-slope linear sweep Step 2 value In Linear 2 mode VS 0.0001 V to 250.00 V IS 0.0001 µA to 320.00 mA	Numeric
	6) Bias Value	Sweep bias value VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric
	7) PSW Base	Pulse sweep base value VS -15.000 V to +250.00 V IS +0.0000 µA to ±320.00 mA	Numeric

(b)

(b)

D) TIME

Select level	Input/Run level	Parameter types
1) Hold Time	Hold time 1 ms to 60 s	Numeric
2) Src Delay	Source delay time 30 µs to 59.998 s	Numeric
3) Meas Delay	Measurement delay time 50 µs to 59.998 s	Numeric
4) Pls Width	Pulse width 50 µs to 59.998 s	Numeric
5) Period	Period (pulse cycle) 500 µs to 60 s	Numeric
6) A.Rng Delay	Auto range delay time 0 ms to 500 ms	Numeric

E) MEASURE

Select level	Input/Run level	Parameter types
1) Auto Zero	Measurement auto zero On/Off	Select
2) Integ Time	Integration time 100 µs/500 µs/1 ms/5 ms/10 ms/1 PLC/100 ms/200 ms/S/H * S/H is available only when the output mode is set to the pulse mode or the pulse sweep mode.	Select
3) Measure SW	Measurement ON/OFF On/Off	Select
4) Disp Digit	Number of measurement digits 5 digits/4 digits /3 digits	Select
5) Disp Unit	Switching the unit display Prefix/Exponent	Select
6) Mfunc Link	Measurement function link mode On/Off	Select

F) MEMORY

Select level	Input/Run level	Parameter types
1) Store Mode	Measurement data memory Off/Normal/Burst	Select
2) Mem Recall	Measurement data memory recall Recall data number setting (0 to 7999)	Numeric
3) Mem Clear	Measurement data memory clear Press [ENTER] to run.	Run

(c)

(c)

G) RANDOM MEM

Select level	Input/Run level	Parameter types
1) Data Set ..	Random memory setting * Press [SEL] to switch between address and data input.	Numeric
2) Save/Clear	Random memory clear (Ram)/ Random memory save (Ram → Flash) Select Save/Clear and press [ENTER] to run.	Run

H) COMPUTE

Select level	Input/Run level	Parameter types
1) Compare SW	Comparator calculation Off/On	Select
2) Scaling SW	Scaling calculation Off/On	Select
3) Max/Min SW	MAX/MIN calculation Off/On	Select
4) View Mx/Mn	Reading MAX/MIN calculation results a) Sample Number of measurement data b) Maximum Maximum measurement value c) Minimum Minimum measurement value d) Average Measurement average value e) Total Total measurement value * Use the ◁, ▷ or ◯ to select a) to e).	Others

I) CONST

Select level	Input/Run level	Parameter types
1) High Value	Comparator calculation upper-limit value 0 to ±9.99999+E26	Numeric
2) Low Value	Comparator calculation lower-limit value 0 to ±9.99999+E26	Numeric
3) SCL Val_A	Scaling calculation constant A 0 to ±9.99999+E26 0 (zero) is not available.	Numeric
4) SCL Val_B	Scaling calculation constant B 0 to ±9.99999+E26	Numeric
5) SCL Val_C	Scaling calculation constant C 0 to ±9.99999+E26	Numeric
6) Null Value	Null calculation constant 0 to ±9.99999+E26 Can be selected/changed only when NULL calculation is ON.	Numeric

(d)

(d)

J) EXT SIGNAL

Select level	Input/Run level	Parameter types
1) OPR Signal	INTERLOCK/OPERATE IN/OUT control signal function setting STBY In/IntrLock In/Operate Out/OPR/SUS In OPR/STBY In	Select
2) Cmpl/Sync	COMPLETE OUT/SYNC OUT control signal function setting Meas Front/Meas End/Comp HI/Comp GO/Comp LO/ Comp HIorLO/Sync Out	Select
3) Sig Width	Control signal output pulse select 10 µs/100 µs	Select

K) PARAMETER

Select level	Input/Run level	Parameter types
1) Param Load	Loads the saved parameters. Load0/Load1/Load2/Load3/Ld Dflt Select the parameter above and press [ENTER] to run.	Run
2) Param Save	Saves the setting parameters. Save0/Save1/Save2/Save3/Sv Dflt Select the parameter above and press [ENTER] to run.	Run
3) PON. Load	Parameter load at power on. P.OFF/Load0	Select

L) I/F

Select level	Input/Run level	Parameter types
1) I/F BUS	Interface 6247G GPIB/USB 6247C USB/RS-232	Select
2) GPIB Adr	GPIB address When GPIB is selected 0 to 30	Numeric
2) USB Id	USB ID When USB is selected 1 to 127	Numeric
3) Header	Header On/Off	Select
4) Talk Only	Addressable/Talk Only When GPIB or RS-232 is selected Off/On	Select
5) Baud Rate	Baud rate When RS-232 is selected 19200/9600/4800/2400/1200/600/300	Select
6) Data Bit	Number of data bits When RS-232 is selected 8 bit/7 bit	Select
7) Parity	Parity When RS-232 is selected NONE/ODD/EVEN	Select
8) Stop Bit	Number of stop bits When RS-232 is selected 1 bit/2 bit	Select

(e)

(e)

M) SYSTEM

Select level	Input/Run level	Parameter types
1) Limit Buz	Limit detection buzzer On/Off	Select
2) Compare Buz	Comparator calculation result buzzer Off/HI/GO/LO/HI or LO	Select
3) Notice Buz	Process completion notice buzzer On/Off	Select
4) Self Test	Runs the selected self test. Use ◁ , ▷ or ◯ to select. Press [ENTER] to run. a) Self Test; Self Test b) Dsp/KeyTst; Display/Key Test	Others
5) Serial No.	Reads out the serial number. xxxxxxxxx (9 digits)	Display only
6) Error Log	Reads out the error log. a) NoXXXX= ±YYY Use the rotary knob to change XXX. ±YYY is the error number. The lower line displays the error description.	Others
6) Relay Cnt	Operate/Standby relay operation count	Others

NOTE: In Operate or Suspend status, only parameter items that can be set and executed are displayed.

2.2.4 Initializing Setting Conditions

The following procedure initializes the 6247G/6247C to the factory default settings.

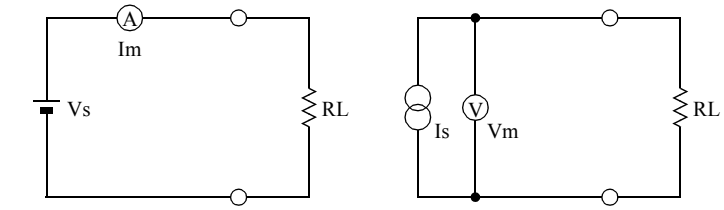
However, the following items are not initialized.

- Selected interface
- GPIB address
- Talk Only/Addressable
- Header output
- USB ID
- RS-232 (baud rate, number of data bits, number of stop bits, parity)
- Parameter load at power ON

Operation	Character display area
1. Press **MENU**, and select **K) PARAMETER** with , or .	K) PARAMETER
2. Press to enter the Select level.	
3. Select **1) Param Load** with , or .	1) Param Load
4. Press to enter the Input/Run level.	1) Param Load **Ent Load0**
5. Select **Ent Ld Dflt** with , or .	1) Param Load **Ent Ld Dflt**
6. Press **ENTER**.	
7. When loading is complete, "**Done**" is displayed and the menu reverts to the Select level.	1) Param Load **Done** ↓ 1) Param Load
8. Press **EXIT** to exit the menu.	

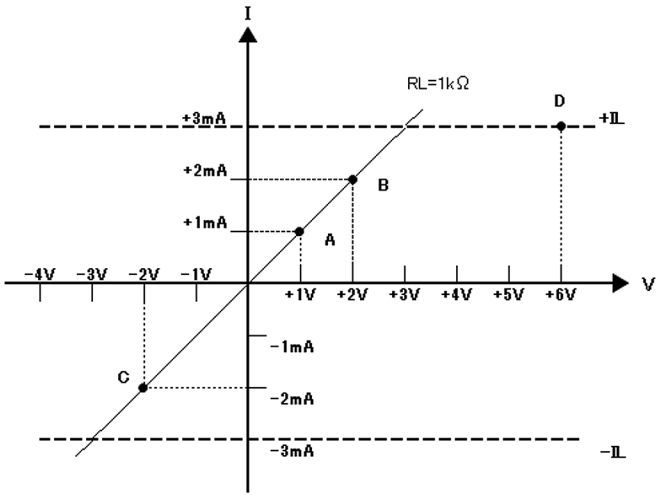
2.2.5 DC Measurement

This section describes the basic operations of voltage source current measurement (VSIM) and current source voltage measurement (ISVM). Also, it describes how the current limiter function works when the source voltage changes in VSIM.
A 1 kΩ resistor is used as DUT for the measurement.
The following figure shows the DC measurement operating status and operating point.



(a) Voltage Source Current Measurement (**VSIM**)

(b) Current Source Voltage Measurement (**ISVM**)



(c) Operating Points

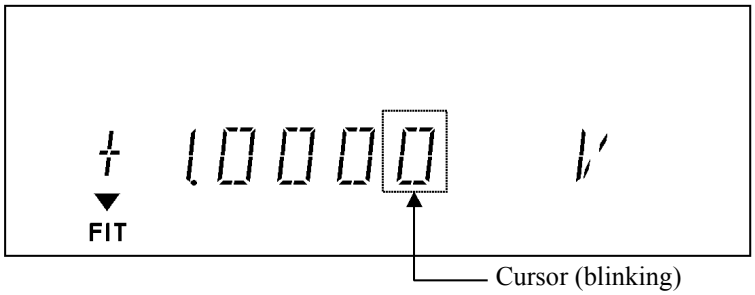
Figure 2-15 DC Measurement

Preparation

1. Initialize the 6247G/6247C in accordance with the procedure described in Section 2.2.4, "Initializing Setting Conditions."
2. Connect the DUT with the supplied input and output cables and alligator clips.
   - Connect the A08532 alligator clips to the A01044 input and output cables.
   - Connect the input and output cables to the HI OUTPUT and LO OUTPUT terminals of the 6247G/6247C.
   - Clip the DUT 1 kΩ resistor with the alligator clips.

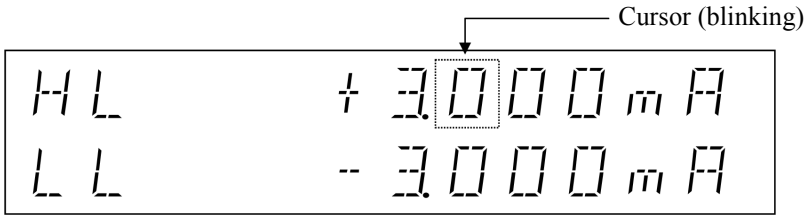
Setting the source value

3. Press **123..., 1**, and **ENTER** in order.



Setting the current limit value

4. Set ±Balance using **MENU**, ***SOURCE*** and ***LMT Input***.
5. Press **LIMIT**.
6. Press **123..., 3,** and **ENTER** in order.



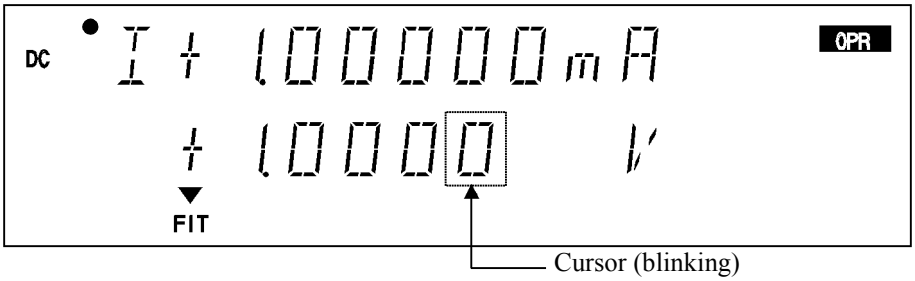
7. Press **LIMIT**.

NOTE: ***The following example operation uses ideal values, assuming that the 1 kΩ resistor, the cables, the 6247G/6247 and other properties have no errors in both source and measurement.***
In the actual operation, some error factors do exist and the measured values will be different from the example.

Voltage source (VSIM)

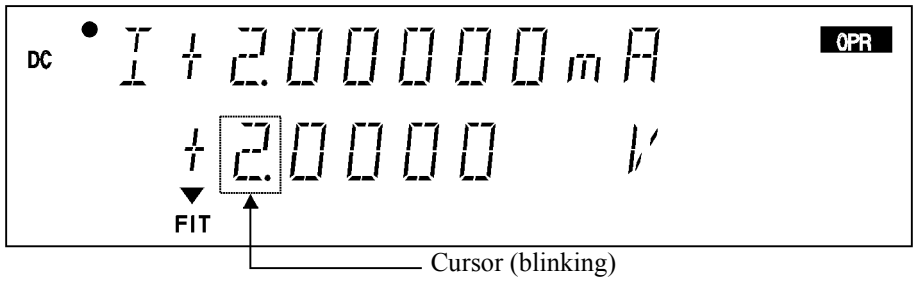
8. Press **OPR**.

   The OPR indicator goes ON showing the Operate status (output ON). The measured current value is displayed when 1 V is applied to the 1 kΩ resistor. (See Point A in Figure 2-15.)

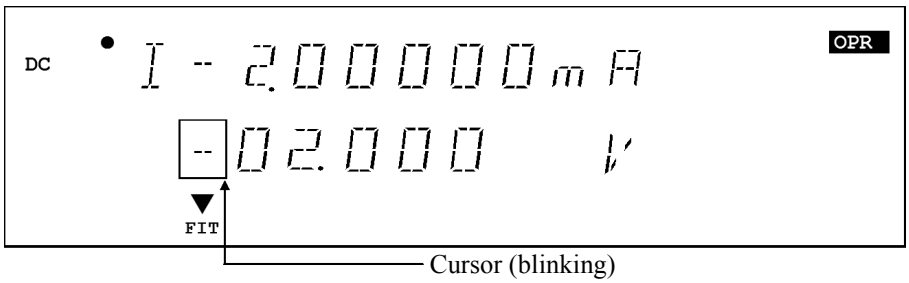


9. Press ◁ to move the cursor to "1," and change the source value to 2 V with △ or ○.

   The measured current value is displayed when 2 V is applied to the 1 kΩ resistor. (See Point B in Figure 2-15.)



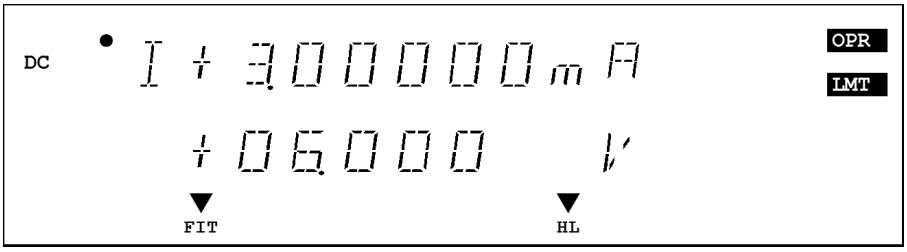
10. Press ◁ to move the cursor to "+," and change the source value to -2 V with △ or ○. (See Point C in Figure 2-15.)
    The source range changes to 50 V.



11. Return the source value to +2 V with ⌂ or ◯, and press **123..., 6** and **ENTER** in order.

    The voltage source value is set to 6 V in the 50 V range.

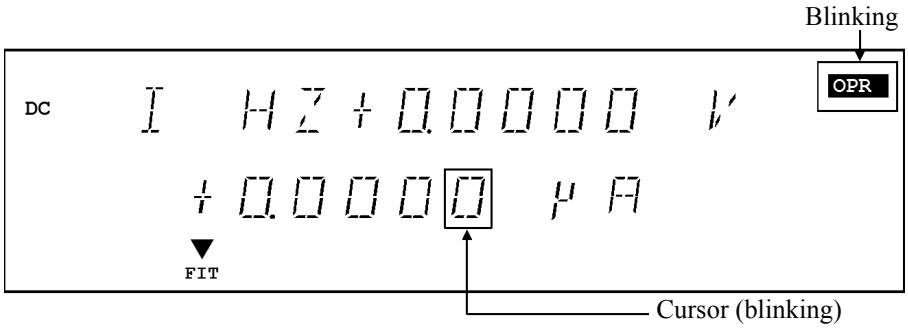
    As the source current is limited by the current limiter, the limiter indicator goes ON. (See Point D in Figure 2-15.)



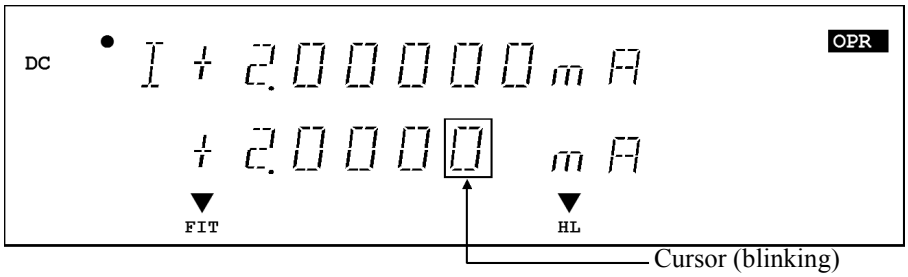
Current source (ISVM)

12. Press **VS/IS**.

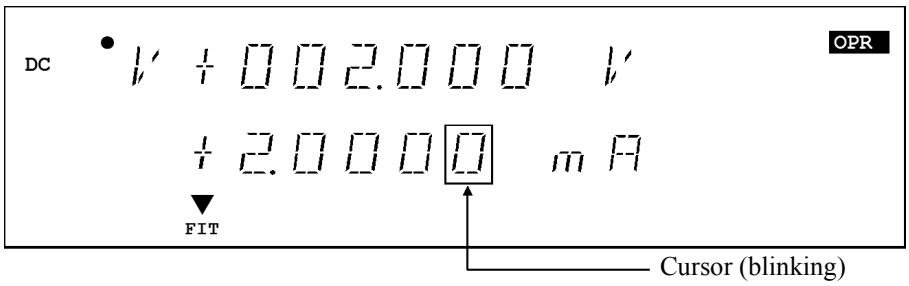
    The measurement changes to current source and the 6247G/6247C sets Suspend status.



13. Press **123..., 2, UNIT** ▲, **ENTER** and **OPR** in order.



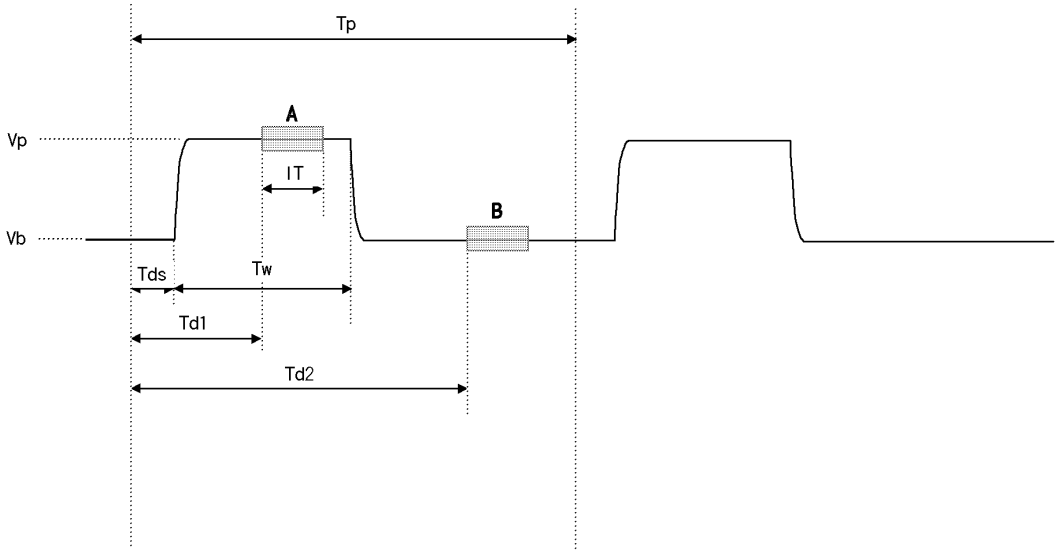
14. Press **MON** twice to switch to voltage measurement. (See Point B in Figure 2-15.)



2.2.6 Pulse Measurement

This section describes an example operation which uses the pulse source mode.

In this example, voltage source current measurement (VSIM) is performed as changing the measurement points A and B in accordance with the following figure:



Tds:	Source delay time	;	1 ms
Tw:	Pulse width	;	50 ms
Td1:	Measurement delay time (at A)	;	3 ms
Td2:	Measurement delay time (at B)	;	60 ms
Tp:	Period time	;	130 ms
IT:	Integration time	;	1 PLC (default)
Vp:	Pulse value	;	2 V, 2.5 V
Vb:	Base value	;	1 V, 0.5 V

Figure 2-16 Pulse Measurement

2.2.6 Pulse Measurement

Preparation

1. Follow the same procedure described in Section 2.2.5, "DC Measurement."

Setting the pulse source value

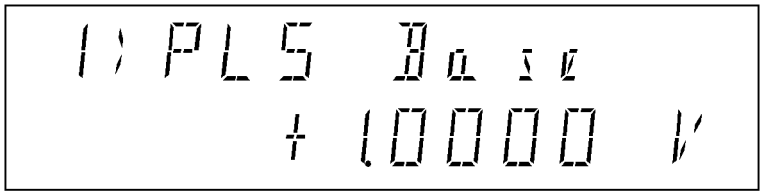
2. Press **123…**, **2**, and **ENTER** in order.
   The pulse source value is set to 2 V.

Setting the current limit value

3. Set ±Balance using **MENU**, ***SOURCE*** and ***LMT Input***.
4. Press **LIMIT**, **123...**, **3** and **ENTER** in order.
   The current limit value is set to ±3 mA.
5. Press **LIMIT**.
   The HOME screen is displayed.

Setting the base value

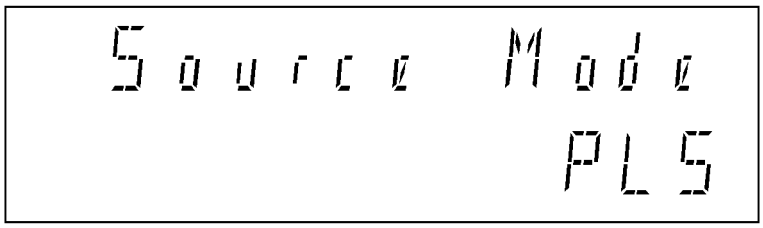
6. Press **MENU**.
7. Press ◁ or ▷ to select **A) SOURCE**. Press ▽ to enter the Select level.
8. After confirming the item is **1) PLS Base**, press ▽ to enter the Input/Run level, and press **123…**, **1** and **ENTER** in order.
   The base value is set to 1 V.



Setting the pulse time

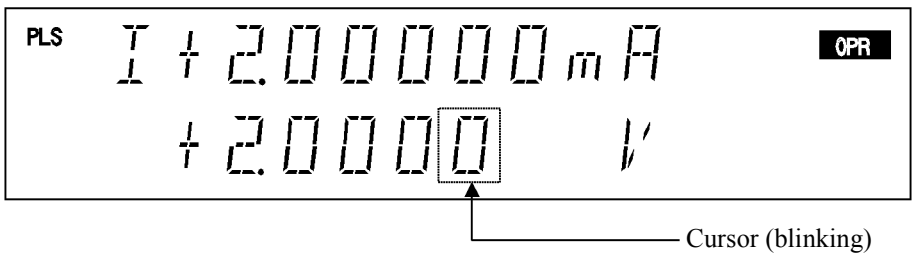
9. Press △, △, ▷, ▷, ▷, and ▽ in this order.
   The time setting select level **D) TIME** is displayed.
10. Press ▷ to select **2) Src Delay**. Press ▽ to enter the Input/Run level.
11. Press **123..., 1,** and **ENTER** in order.
    Tds is set to 1 ms.

12. Press ▲ and ▶ to select **3) Meas Delay**. Press ▼ to go to the Input/Run level.
13. Press **123...**, **3,** and **ENTER** in order.
    Tdl is set to 3 ms.
14. Press ▲ and ▶ to select **4) Pls Width**. Press ▼ to enter the Input/Run level.
15. Press **123...**, **5**, **0**, and **ENTER** in order.
    Tw is set to 50 ms.
16. Press ▲ and ▶ to select **5) Period**. Press ▼ to enter the Input/Run level.
17. Press **123...**, **1**, **3**, **0**, and **ENTER** in order.
    Tp is set to 130 ms.
18. Press **MENU**.
    The HOME screen is displayed.
19. Press **MODE**.
20. Rotate ◯ or press ▲ or ▼ to select **PLS**.

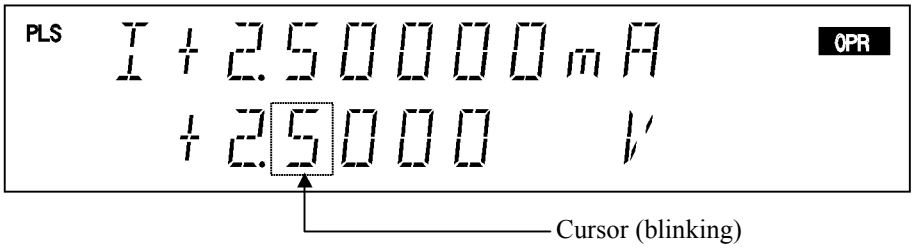


Current measurement with the pulse value

21. Press **ENTER**.
    The HOME screen is displayed.
22. Press **OPR**.
    The Operate status is set.
    The measured current value with the pulse value of 2 V (Point A in Figure 2-16) is displayed.

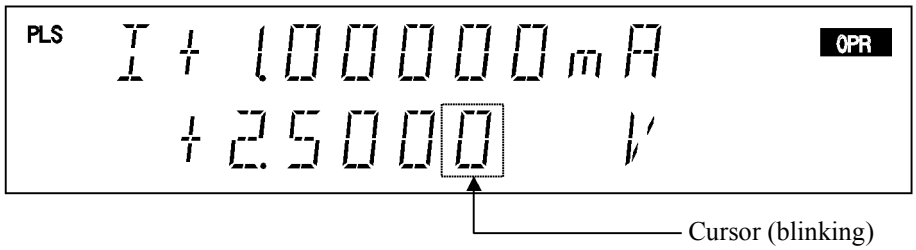


23. Press ◁ and △ to change the source value (pulse value) to 2.5 V.
    The measured current value with the pulse value of 2.5 V is displayed.

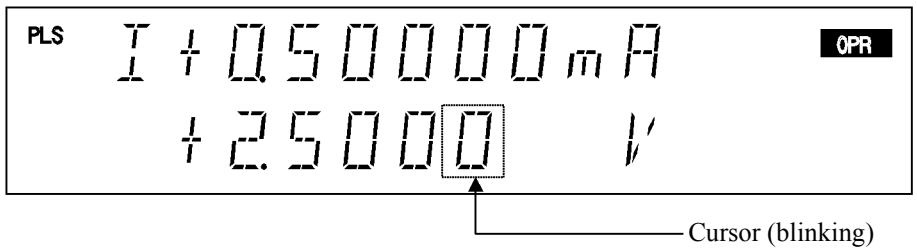


Current measurement with the base value

24. Follow step 12 to set the measurement delay time to 60 ms, and press **MENU**.
    The HOME screen is displayed. (Td2)
    The measured current value with the base value of 1 V is displayed. (See Point B in Figure 2-16.)



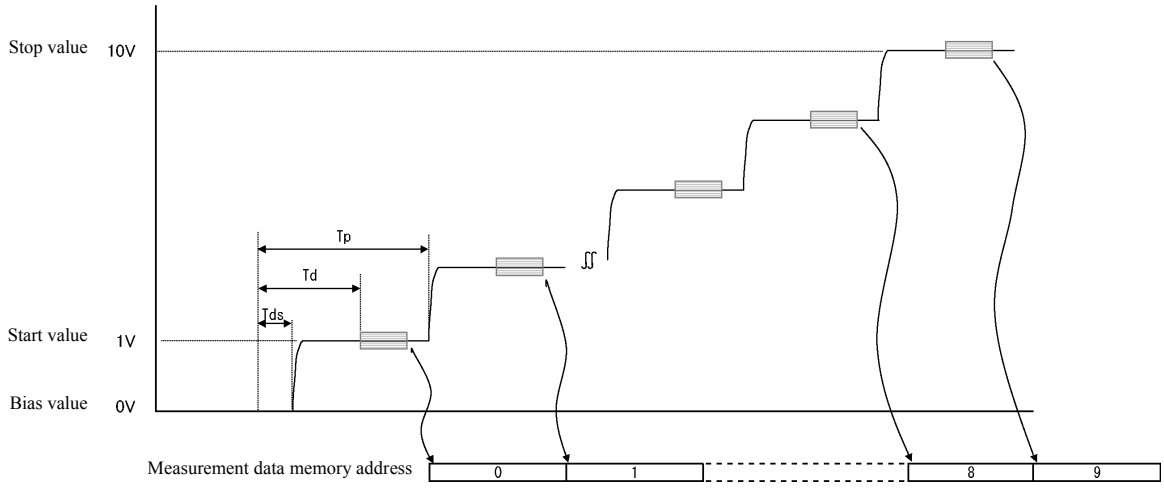
25. Follow step 7 to set the base value to 0.5 V, and press **MENU**.
    The HOME screen is displayed.
    The measured current value with the base value of 0.5 V is displayed.



2.2.7 Sweep Measurement

This section describes how to read out the measurement data from the memory by using the sweep source mode.

In voltage source current measurement (VSIM), linear sweep is performed with steps of 1 V from 1 V to 10 V as shown in Figure 2-17 below.



Source mode:	DC sweep
Sweep type:	Linear sweep (default)
Bias value:	0 V (default)
Start value:	1 V
Stop value:	10 V
Step value:	1 V
Integration time:	1 PLC (default)
Source delay time (Tds):	1 ms
Measurement delay time (Td):	4 ms (default)
Period time (Tp):	100 ms
Current limit value:	30 mA

Figure 2-17 Sweep Measurement

2.2.7 Sweep Measurement

Preparation

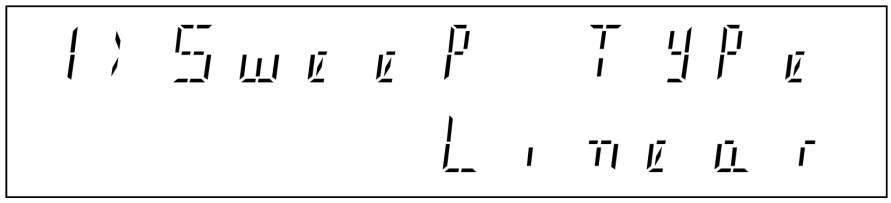
1. Follow the same procedure described in Section 2.2.5, "DC Measurement."

Setting the current limit value

2. Set ±Balance using **MENU**, ***SOURCE*** and ***LMT Input***.
3. Press **LIMIT**, **123...**, **3**, **0** and **ENTER** in order.
   The current limit value is set to ±30 mA.
4. Press **LIMIT**.
   The HOME screen is displayed.

Setting the sweep source mode

5. Press **MODE**. Rotate ◯ or press ⌂ or ▽ to select ***DC-SWP***, and press **ENTER.**
   The DC indicator and the SWP indicator go ON, showing the DC sweep has been set.
6. Press **MENU**.
7. Press ◁ or ▷ to select **B) SWEEP**. Press ▽ to enter the Select level.
8. Verify that ***Linear*** is selected in **1) Sweep Type**.



Setting the sweep source voltage

9. Press ⌂, ▷, and ▽ in this order to select **1) Start Value**. Press ▽ to enter the Input/Run level.
10. Press **123…**, **1** and **ENTER** in order.
    The start value is set to 1 V.
11. Press ⌂ and ▷ to select **2) Stop Value**. Press ▽ to enter the Input/Run level.

12. Press **123…**, **1**, **0** and **ENTER** in order.
    The stop value is set to 10 V.
13. Press ◁ and ▷ to select **3) Step Value**. Press ▽ to enter the Input/Run level.
14. Press **123...**, **1**, and **ENTER** in order.
    The step value is set to 1 V.
15. Press ◁ and ▷ to select **6) Bias Value**.Verify that the bias value is set to 0 V.

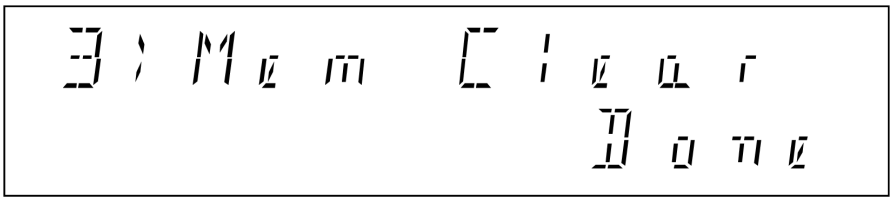
Setting the sweep time

16. Press ◁ and ▷ to select **D) TIME**.
17. Press ▽ and ▷ to select **2) Src Delay**. Press ▽ to enter the Input/Run level.
18. Press **123…**, **1** and **ENTER** in order.
    The source delay time is set to 1 ms.
19. Press ◁ and ▷ to select **3) Meas Delay**. Verify that the measurement delay time is set to 4 ms.
20. Press ▷ twice to select **5) Period**. Press ▽ to enter the Input/Run level.
21. Press **123…**, **1**, **0**, **0**, and **ENTER** in order.
    The period time is set to 100 ms.

Setting the measurement data memory

22. Press ◁, ◁, ▷ and ▷ in this order to select **F) MEMORY**.
23. Press ▽ to select **1) Store Mode**. Press ▽ to enter the Input/Run level.
24. Rotate ◯ to select ***Normal***.
    The measurement data memory is set to Normal-ON.

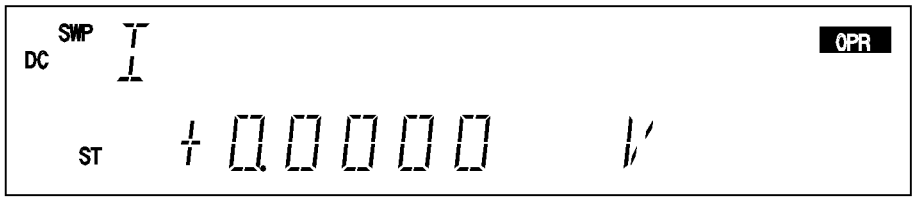
25. Press , and in this order to select **3) Mem Clear**, and press , and **ENTER** to clear the data in the measurement data memory.



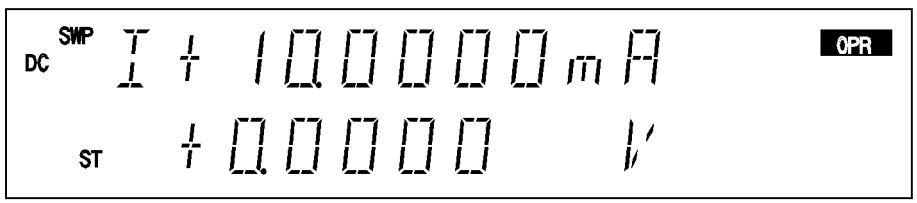
26. Press **MENU**.
    The HOME screen is displayed.
27. Confirm that the ST indicator is ON.

Starting sweep measurement

28. Press **OPR**.
    The Operate status is set.
    The source value indicates the bias balue.



29. Press **TRIG**.
    The sweep measurement starts while displaying the source and measurement values. The sweep status indicator goes ON and rotates during sweep. When the sweep measurement is complete, the final measurement value is displayed and the indicator goes OFF.

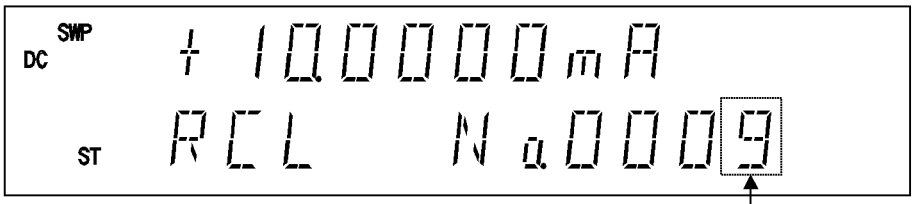


Reading out the measurement results

30. Press **STBY**.
    The Standby status is set.
31. Press **MENU**.

32. Press ◁ or ▷ to select **F) MEMORY**. Press ▽ to enter the Select level.

33. Press ▷ to select **2) Mem Recall**. Press ▽ to enter the Input/Run level.
    The data stored in the measurement data memory is read out.
    The final stored data is displayed.



34. Rotating ◯ changes the memory address and then reads out the stored data one by one.
    Pressing **123...** enters the direct input mode and any memory number to be read can be directly specified.

35. Press **MENU**.
    The HOME screen is displayed.

2.3 Saving and Loading Parameters

The 6247G/6247C can save the setting parameters in the non-volatile memory, area 0 to 3.

The 6247G/6247 has a random memory data save area, separated from the parameter save area.

2.3.1 Auto Load at Power ON

When the 6247G/6247C is turned on, it starts up with the setting parameters from when it was previously turned off.
However, the 6247G/6247C always starts up with the same condition by loading the parameters saved in area 0.
Select which parameters to be loaded at power ON by selecting **K) PARAMETER** and then **3) PON. Load** on the menu screen.

P.OFF	Start up using the parameters when the instrument was last turned off.
Load0	Start up using the parameters saved in area 0.

NOTE:

1. ***The auto load function does not apply to the random memory. At power ON, the random memory data saved in the non-volatile memory is loaded.***
2. ***The GPIB address, USB ID, RS-232 setting parameters and power on loading conditions are always saved in a different area and loaded when the power is switched on.***

2.3.2 Saving Parameters

The setting parameters are saved by menu operations. The following is an example to save the parameters to area 2.

	Operation	Character display area
1.	Press **MENU** and select **K) PARAMETER** with , or .	K) PARAMETER
2.	Enter the Select level with .	1) Param Load
3.	Select **2) Param Save** with , or .	2) Param Save
4.	Enter the Input/Run level with .	2) Param Save **Ent Save0**
5.	Select **Ent Save2** with , or .	2) Param Save **Ent Save2**
6.	Press **ENTER**.	
7.	When saving is complete, "**Done**" is displayed and the menu reverts to the Select level.	2) Param Save **Done** ↓ 2) Param Save
8.	Press **EXIT** to exit the menu.	

2.3.3 Loading Parameters

The setting parameters are loaded by menu operations. The following is an example to load the parameters from area 2.

	Operation	Character display area
1.	Press **MENU** and select **K) PARAMETER** with , or .	K) PARAMETER
2.	Enter the Select level with .	
3.	Select **1) Param Load** with , or .	1) Param Load
4.	Enter the Input/Run level with .	1) Param Load **Ent Load0**
5.	Select **Ent Load2** with , or .	1) Param Load **Ent Load2**
6.	Press **ENTER**.	
7.	When loading is complete, "**Done**" is displayed and the menu reverts to the Select level.	1) Param Load **Done** ↓ 1) Param Load
8.	Press **EXIT** to exit the menu.	

2.3.4 Default Parameters

The following table shows the parameters saved in or loaded from the non-volatile memory and their default values.

Table 2-2 Default Parameter List (1 of 4)

	Parameter		Default value
Always saved	Interface		USB
	GPIB Address	*2	01
	Talk Only/Addressable		Addressable
	USB ID		001
	Header output	*1	ON
	Baud rate	*3	9600
	Parity	*3	None
	Number of data bits	*3	8 bits
	Number of stop bits	*3	1 bit
	Parameter loading at power ON		P.OFF
Saved in non-volatile memory areas 0 to 3	Source function		VS
	Parameters for VS		
	Source value (pulse value) and range		+0.0000 V
	HI/LO limit values and range		+320.0 mA/-320.0 mA
	Bias value and range		+0.0000 V
	Start value and range		+0.0001 V
	Stop value and range		+0.0100 V
	Step value and range		0.0001 V
	Level value and range		+0.0000 V
	Sampling count		0001
	Start address		0000
	Stop address		0000
	First value and range		+0.0001 V
	Middle value and range		+0.0100 V
	Last value and range		+0.0200 V
	First step value and range		0.0001 V
	Second step value and range		0.0001 V
	Source range setting mode FIT/LOCK		FIT
	DC pulse base value and range		+0.0000 V
	Pulse sweep base value and range		+0.0000 V

*1 Not saved in remote control
*2 6247G
*3 6247C

Table 2-2 Default Parameter List (2 of 4)

	Parameter		Default value
Saved in non-volatile memory areas 0 to 3	Parameters for IS		
		Source value (pulse value) and range	+0.0000 μA
		HI/LO limit values and range	+250.0 V/-015.0 V
		Bias value and range	+0.0000 μA
		Start value and range	+0.0000 μA
		Stop value and range	+0.0100 μA
		Step value and range	0.0001 μA
		Level value and range	+0.0000 μA
		Sampling count	0001
		Start address	0000
		Stop address	0000
		First value and range	+0.0000 μA
		Middle value and range	+0.0100 μA
		Last value and range	+0.0200 μA
		First step value and range	0.0001 μA
		Second step value and range	0.0001 μA
		Source range setting mode FIT/LOCK	FIT
		DC pulse base value and range	+0.0000 μA
		Pulse sweep base value and range	+0.0000 μA
	Source mode		DC
	Suspend voltage and range		+0.0000 V
	Suspend status LoZ/HiZ		HiZ
	Limit detection buzzer		OFF
	Sweep mode		LINEAR
	Sweep reverse		OFF
	Sweep repeat count		0001
	Sweep range mode		AUTO
	RTBsw (Return To Bias)		ON

Table 2-2 Default Parameter List (3 of 4)

	Parameter		Default value
Saved in non-volatile memory areas 0 to 3	Measurement function		IM
	Parameters for VM		
		Measurement range	0
		Comparator calculation HIGH value	+0.00000E+00
		Comparator calculation LOW value	+0.00000E+00
		NULL value	+0.00000E+00
		Scaling constant A	+1.00000E+00
		Scaling constant B	+0.00000E+00
		Scaling constant C	+1.00000E+00
	Parameters for IM		
		Measurement range	0
		Comparator calculation HIGH value	+0.00000E+00
		Comparator calculation LOW value	+0.00000E+00
		NULL value	+0.00000E+00
		Scaling constant A	+1.00000E+00
		Scaling constant B	+0.00000E+00
		Scaling constant C	+1.00000E+00
	Parameters for RM		
		Measurement range	0
		Comparator calculation HIGH value	+0.00000E+00
		Comparator calculation LOW value	+0.00000E+00
		NULL value	+0.00000E+00
		Scaling constant A	+1.00000E+00
		Scaling constant B	+0.00000E+00
		Scaling constant C	+1.00000E+00

Table 2-2 Default Parameter List (4 of 4)

	Parameter	Default value
Saved in non-volatile memory areas 0 to 3	Integration time	1PLC
	Measurement ON/OFF	ON
	Unit display PREFIX/EXPO	PREFIX
	Number of measurement display digits	$5^{1}/_{2}$ digits
	Comparator calculation	OFF
	NULL	OFF
	SCALING	OFF
	MAX/MIN calculation	OFF
	Measurement auto range	OFF
	Measurement delay time/range	04.000 ms
	Period	50.000 ms
	Pulse width	25.000 ms
	Hold time	00.003 s
	Source delay time	00.030 ms
	Measurement auto range delay time	00.000 s
	Auto zero	ON
	Trigger mode	AUTO
	COMPLETE output	M_END
	INTERLOCK input/output	STBY_IN
	External control signal pulse width	100 μs
	Notice buzzer	ON
	Remote sensing	2W
	Limit value setting mode	SEPARATE
	Comparator calculation result buzzer	OFF
	Response	SLOW
	Measurement function link mode	OFF

3. MEASUREMENT EXAMPLE

3.1 Diode Measurement

This section describes an example of measuring diode forward voltage (VF) using pulse current.

NOTE: Use 4-wire connection for accurate measurement of the forward voltage.

The measurement conditions are described below.

VF measurement: Use pulse current to measure the forward voltage (VF) at 100 mA to avoid the influence of the heat. Also, use NULL calculation to compensate for the error in cable voltage drop in 2-wire connection.

VF measurement condition example		
Source mode	:	Pulse
Pulse current	:	100 mA
Base current	:	0 mA
Limit value	:	1.5 V
Pulse width	:	5 ms
Period	:	100 ms
Integration time	:	1 ms
Measurement delay	:	3 ms
Measurement range	:	VM AUTO
NULL	:	ON

Connecting the DUT

1. Connect the A08532 alligator clips to the supplied A01044 input and output cables and connect the diode as shown below.
   A 2-wire connection is used in this measurement example.

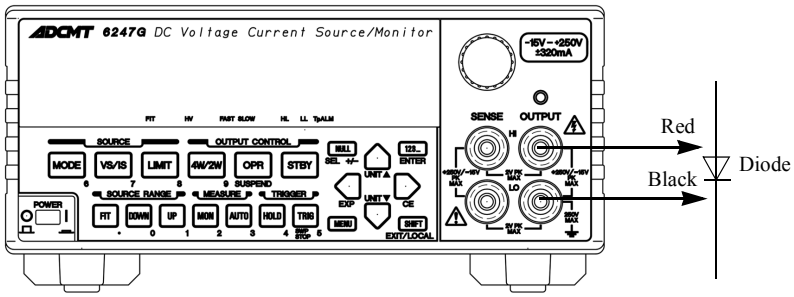


Figure 3-1 Diode Measurement Connection

Measuring the diode forward voltage

2. Set the conditions for VF measurement.
3. Short-circuit the HI OUTPUT cable (red) and the LO OUTPUT cable (black) to obtain the NULL value.
4. Set the output status to Operate.
5. Press **NULL**.
6. Set the output status to Standby or Suspend.
7. Connect the HI OUTPUT cable (red) to the anode of the diode and the LO OUTPUT cable (black) to the cathode.
8. Set the output status to Operate.
   The VF measurement result is displayed.

3.2 Battery Charge and Discharge Test

This section describes an example of charge and discharge test of a rechargeable battery such as NiCad batteries and nickel hydride batteries.
The charge and discharge test takes a long time and should be executed by a system via remote control. However, a manual operation example is described here to show how to use the functions of the 6247G/6247C.
The battery is charged with DC constant current and voltage, and is stopped charging when the charge current reaches the specified current or below.
It is discharged with pulse constant current, and is stopped discharging when the battery voltage reaches the specified voltage or blow. The voltage limit values are set to the same polarity, and the HL value is set as upper charge limit and the LL value as lower discharge limit to avoid overcharge or overdischarge.

The suspend voltage is set to the same voltage as the battery and HiZ to reduce transient current during Operate status.
The discharged voltage is stored in the memory and is read out after the test is complete.
However, the memory can only store 8000 data items. Even if the limit is exceeded, output continues but data is not stored.
In this case, up to 8000 seconds (2.22 hours) worth of data can be stored.

CAUTION:

1. ***Use 4-wire connection for accurate measurement of the forward voltage.***
2. ***Be careful when setting the source value and the limit values so that excessive voltage or current is not applied against the rated voltage or capacity of the battery.***

Test conditions are described below.

Charging test: Charge with a constant current of 320 mA. After the voltage reaches 1.45 V, charge with a constant voltage.
When the current reaches 100 mA or below, stop charging.

Charge test condition example		
Source mode	:	DC
Source current	:	320 mA
Limit value	:	HL value; 1.45 V LL value; 0.95 V
Suspend voltage	:	HiZ; 1.20 V
Period	:	1 s
Integration time	:	1 ms
Measurement range	:	300 mA range fixed
Memory	:	NORMAL, STORE ON
Comparator	:	ON Lower limit value; 100 mA
External control signal	:	OPERATE OUT; STBY IN OPERATE OUT; Comp-LO Pulse width; 100 μs
Remote sensing	:	4-wire

Discharge test: As shown below, discharge with a constant current of 320 mA, a pulse width of 20 ms and a 1 second period. When the voltage reaches 1.0 V, stop discharging.
Store the battery voltage in the memory and read out after the test is complete.
However, the data stored in the memory is limited up to 8000 seconds from the discharge start by the memory capacity.

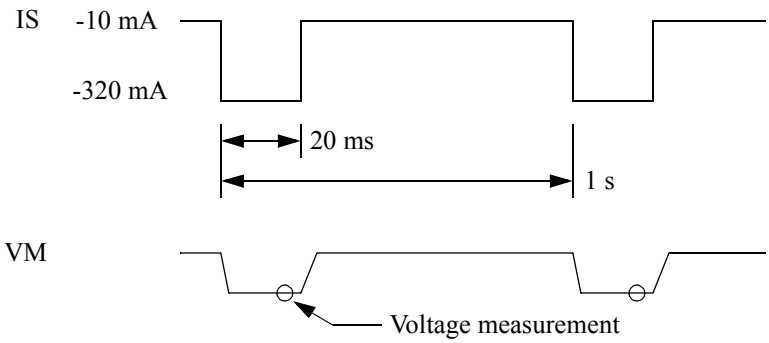
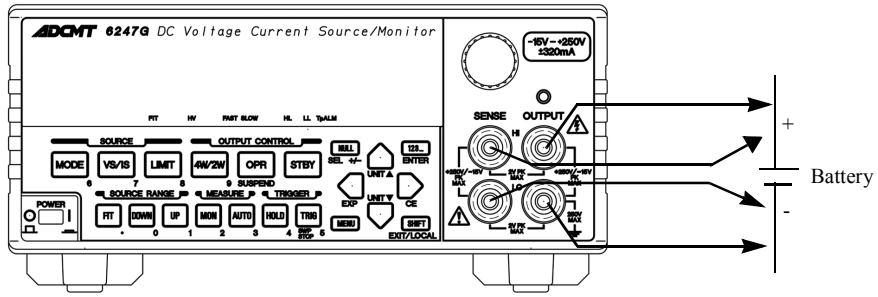


Figure 3-2 Battery Discharge Test Waveforms

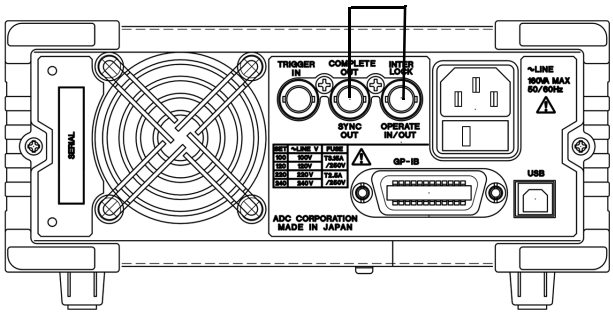
Discharge test condition example		
Source mode	:	Pulse
Pulse current	:	-320 mA
Base current	:	-10 mA
Limit value	:	HL value; 1.45 V
		LL value; 0.95 V
Suspend voltage	:	HiZ; 1.20 V
Pulse width	:	20 ms
Period	:	1 s
Integration time	:	200 ms
Measurement delay	:	18 ms
Measurement range	:	5 V range fixed
Memory	:	NORMAL, STORE ON
Comparator	:	ON
		Upper limit value 1.5 V
		Lower limit value 1.0 V
Remote sensing	:	4-wire

Connecting the DUT

1. Use a 4-wire connection as shown below so that the cables do not cause a voltage drop.
2. Connect the COMPLETE OUT terminal with the OPERATE IN terminal on the rear panel by using the BNC-BNC cables A01036.
   This is to set the instrument Standby automatically after completing the charge or discharge.



Front



Rear (6247G)

Figure 3-3 Battery Charge Discharge Test Connection

Charge test

1. Set current source current measurement.
2. Set the charge test parameters.
3. Set the output status to Operate.

   The battery starts charging with constant current, and the charge current start reducing when the battery voltage reaches + 1.45 V.
   When the charge current reaches 100 mA or less, the output status becomes Standby automatically and charging the battery completes.

Discharge test

1. Set current source voltage measurement.
2. Set the discharge test parameters.
3. Set the output status to Operate.

   The battery starts discharging with pulse current. When the battery voltage reaches + 1.0 V or below, the output status becomes Standby and discharging the battery completes.

4. REFERENCE

This chapter describes panel keys, parameter groups, parameter items and parameter functions in the following sections.

- 4.1 Menu Index: Use this section as an index for the parameters in the menu.
- 4.2 Function Description: Describes panel keys, parameter groups, parameter items and parameter functions.

4.1 Menu Index

Use the Menu Index as the index for the set items in the menu.

4.2 Function Description

This section describes the panel keys and the parameter functions in alphabetical order.

4.2.1 AUTO Key (Measurement Range)

Switches between measurement auto range and fixed range.

Auto range: Measures in the optimum range between the limiter range and the minimum range. The AUTO indicator turns ON.

Fixed range: The measurement range does not vary. The AUTO indicator turns OFF.
If the measurement function and the source function are different, the range is fixed at the limiter range.
If the measurement function and the source function are the same, the range is fixed at the source range.

For more information on the measurement auto range, refer to Section 5.2.5.2, "Measurement Ranging."

4.2.2 DOWN Key (Source Range)

Decreases the source range by one step. However, it is impossible to decrease to the range that cannot output the currently set source value. In this case, the source range setting mode is set to LOCK. (For more information on the LOCK status, refer to Section 4.2.3, "FIT Key (Source Range)."

4.2.3 FIT Key (Source Range)

Switches the source range setting mode.

The source range setting mode is retained at each source function.

FIT status: Sets the optimal range for the input source value.
The FIT ▼ indicator turns ON.

LOCK status: Sets the present source value.
The FIT ▼ indicator turns OFF.

NOTE: Switching between FIT and LOCK does not change the source range.

4.2.4 HOLD Key (Trigger Mode)

Switches the source and measurement trigger mode.

Source mode	AUTO	HOLD
DC/Pulse	Repeats source and measurement within the period time of the time parameter. The sampling indicator turns ON during measurement.	Executes source and measurement with trigger input. The HOLD indicator turns ON.
Sweep	Repeats source and measurement within the period time of the time parameter. The sampling indicator turns ON during measurement. is displayed rotating during sweep.	Executes source and measurement by one step with trigger input, and pauses sweep. The HOLD indicator turns ON.

However, the trigger mode cannot be changed during sweep.

4.2.5 LIMIT Key (Limiter Setting)

Switches between the source value setting screen and the limit value setting screen.

For more information on the limit value setting, refer to Section 2.2.2, "Setting Limiter Values."

4.2.6 MENU Key (Parameter Setting)

Pressing the **MENU** key displays the parameter group setting screen.

Select an item from ***(A) SOURCE*** to ***M) SYSTEM)*** in the Category level menu with or .

For more information on set items and the setting method, refer to Section 2.2.3, "Menu Operation."

SOURCE Sets source-related common elements.

PLS Base Sets the base value at pulse source.

Suspend V Sets the output voltage in Suspend.

Suspend Z Sets the output impedance in Suspend.

HiZ: The output current limit is set to ±100 nA, so the output impedance increases.

LoZ: The output current limit is set to the current limit value at voltage source or 30 digits in the current range (100 digits in the 3 μA range) at current source, so the output impedance decreases.

LMT Input

Selects the current limiter HL and LL values setting.
The voltage limiter in the current source function is always set to Separate regardless of this parameter setting.

±Balance :
The HL and LL values change simultaneously in both polarities.

Separate :
The HL and LL values are separately set in the following range:
(HL value - LL value) > (Minimum setting range)

Response

Selects the source response.

Fast : Fast mode

Slow: Slow mode

SWEEP

Sets the sweep source operation-related parameters.

Sweep Type

Selects the sweep type for the sweep source mode.

Linear: Linear sweep

Fixed: Fixed sweep

Random: Random sweep

Linear 2: 2-slope linear sweep

SWP Range

Selects the range function for the sweep source mode.

Auto: Sweeps in the optimum range at every step from the start value to the stop value.

Fix: Sweeps in the fixed range which can output any source values from the start value to the stop value.

Reverse

Switches reverse mode (round sweep) ON or OFF.

On: Round sweep from the start value to the stop value and back to the start value.

Off: One-way sweep from the start value and to the stop value.

Repeat Cnt

Sets the number of times sweep repeats.
When it is set to 0, sweep repeats infinitely.
When it is set between 1 to 1000 and the reverse mode is ON, each round sweep is counted as 1.

Rtrn Bias

Selects whether sweep stops at the bias value or stop value.

On: : The source value returns to the bias value when sweep stops.

Off: : The source value stays at the stop value when sweep stops.

SWEEP VAL

Sets the values used for the sweep source operation.
The setting parameters are different depending on the sweep tye.

Linear:

SWEEP VAL

Start Value	Sets the start value for linear sweep.
Stop Value	Sets the stop value for linear sweep.
Step Value	Sets the step value for linear sweep.
Bias Value	Sets the bias value (source value before sweep start).
PSW Base	Sets the pulse sweep base value.

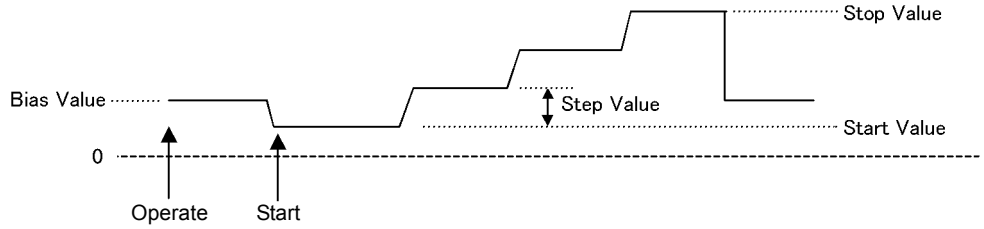
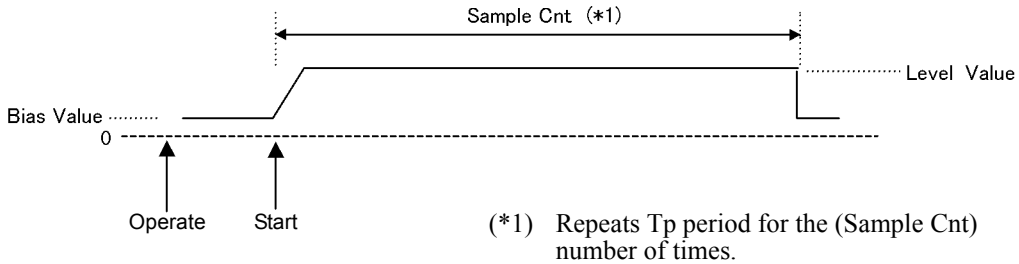


Figure 4-1 Linear Sweep

Fixed:

SWEEP VAL

Level Value	Sets the fixed level value for fixed sweep.
Sample Cnt	Sets the sample count (number of measurement in every Tp period) for fixed sweep.
Bias Value	Sets the bias value (source value before sweep start).
PSW Base	Sets the pulse sweep base value.



(*1) Repeats Tp period for the (Sample Cnt) number of times.

Figure 4-2 Fixed Sweep

Random:

SWEEP VAL

Sweep Adr	Sets the start and stop addresses for random sweep. Select the parameter by using the NULL (SEL) key.
Bias Value	Sets the bias value (source value before sweep start).
PSW Base	Sets the pulse sweep base value.

Linear 2:

SWEEP VAL

First Val	Sets the first value for 2-slope linear sweep.
Middle Val	Sets the middle value for 2-slope linear sweep.
Last Val	Sets the last value for 2-slope linear sweep.
Step1 Val	Sets the step 1 value between the first value and the middle value for 2-slope linear sweep.
Step2 Val	Sets the step 2 value between the middle value and the last value for 2-slope linear sweep.
Bias Value	Sets the bias value (source value before sweep start).
PSW Base	Sets the pulse sweep base value.

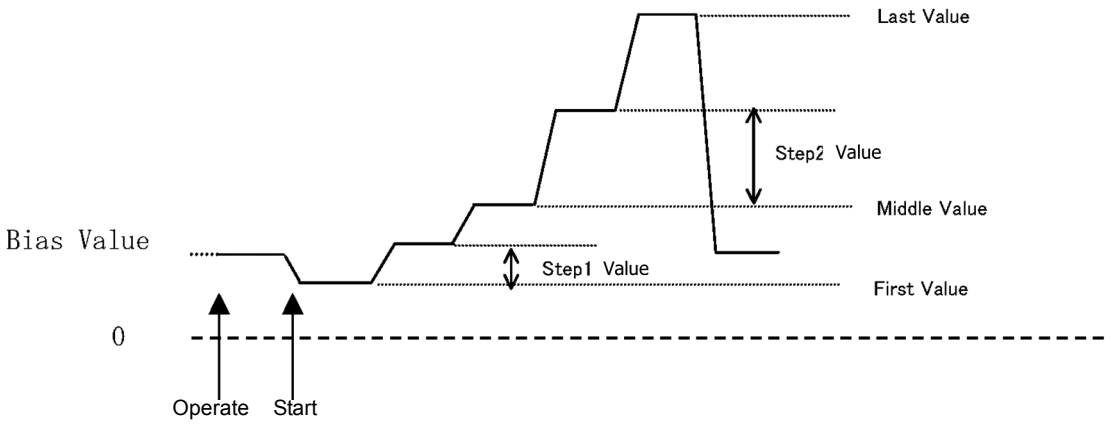


Figure 4-3 2-Slope Linear Sweep

TIME	Sets the time-related parameters such as sweep source time and measurement delay time.
Hold Time	Sets the time from the sweep start to the step period start in the sweep source mode.
Src Delay	Sets the delay time (Tds) from the start of the period time (Tp) to the source start in the pulse source mode or sweep source mode.
Meas Delay	Sets the delay time (Td) from the measurement trigger to the measurement start.
Pls Width	Sets the pulse width (Tw) in the pulse source mode or pulse sweep mode.

Period Sets the following period time (Tp).

- Auto sampling period in the DC source mode
- Pulse source period
- Sweep source 1-step period

A.Rng Delay Sets the wait time (Tar) after changing the range for the measurement auto range.

MEASURE Sets the measurement-related parameters.

Auto Zero Switches the measurement auto zero function ON or OFF.

On: Corrects measurement zero-point drifts approximately every 10 seconds. The AZ indicator turns ON.

Off: Turns OFF the auto zero function. The AZ indicator turns OFF.

Integ Time Sets the measurement integration time.
Select the integration time from 100 μs, 500 μs, 1 ms, 5 ms, 10 ms, 1 PLC, 100 ms, 200 ms and S/H.
S/H is the sample hold mode. The integration time is 100 μs. The sample hold mode can be set only when the pulse source mode or the pulse sweep mode is selected.
The set values are displayed by combining the F, M, S and L indicators as follows:

Table 4-1 Integration Time and Indicator Display

Integration time setting	Indicator			
	F	M	S	L
S/H	Blink			
100 μs	Half			
500 μs	Full			
1 ms		Half		
5 ms		Full		
10 ms			Half	
1 PLC			Full	
100 ms				Half
200 ms				Full

Blink: Indicator blinks with full brightness.
Half: Indicator turns ON with half brightness.
Full: Indicator turns ON with full brightness.

Measure SW Switches measurement auto ON or OFF.

On: Executes measurement.

Off: Does not execute measurement.

Disp Digit

Selects the number of measurement display digits.
Spaces are displayed as blank digits but do not affect any measurement data.

5 digits: Displays measurement data with 5½ digits.

4 digits: Displays measurement data with 4½ digits.

3 digits: Displays measurement data with 3½ digits.

Disp Unit

Selects the output format style for measurement data and comparable upper and lower limit values.

Prefix: Displays measurement data by using a decimal point and a unit symbol.

Exponent:
Displays measurement data in an exponential form.

Mfunc Link

Links the source function to the measurement function.

On: The source function is linked to the measurement function. (VSIM/ISMV)

Off: The measurement function is unaffected by the source function.

MEMORY

Sets the measurement data memory-related parameters.

- While the ST indicator is ON, measurement data is always being stored in the memory.
- When the memory reaches the upper limit: 8000 data sets, the ST indicator blinks and further data cannot be stored.
- When the trigger mode is set to AUTO in the DC or pulse sweep mode, the following parameters cannot be set.

Store Mode

Selects the measurement data memory functions.
The content of the measurement data memory is cleared when the Store Mode is changed.

Normal: Stores data in the measurement data memory in the normal mode.

Burst: Stores data in the measurement data memory in the burst mode. Used for high-speed measurement.

Off: Turns OFF the measurement data memory storage operation.

Mem Recall

Reads out the data stored in the measurement data memory.
The measurement data is displayed on the upper line corresponding to the recall number on the lower line.
The recall number can be set in the range of 0 to 7999. If no measurement data is stored, "No Data" is displayed.

Mem Clear

Clears the measurement data memory.

RANDOM MEM Sets the source data (random memory) for random sweep.

Data Set.. Sets addresses and data in the random memory.
Addresses from 0 to 7999 are available.
Pressing the SEL key switches between the address and data setting parameters.

Save/Clear Saves or clears the random memory.

Save: Saves the setting data in the random memory to the non-volatile memory. The saved data is loaded at power ON.

Clear: Clears the setting data in the random memory. However, the non-volatile memory data is not cleared.

COMPUTE Set the calculation-related parameters.

Compare SW Switches the comparator calculation ON or OFF.

On: Executes the comparator calculation.
The calculation result is reflected on the indicator, the header of data output (Talker output) and the status byte.

HI; High value < Measurement data
GO; Low value ≤ Measurement data ≤ High value
LO; Measurement data < Low value

Off: Turns OFF the comparator calculation.

Scaling SW Switches the scaling calculation ON or OFF.

$$\text{Scaling calculation} = \frac{(\text{Measurement Value}) - \text{Constant B}}{\text{Constant A}} \times \text{Constant C}$$

On: Executes the scaling calculation.
The MATH indicator goes ON.

Off: Turns OFF the scaling calculation.

Max/Min SW Switches the MAX/MIN calculation ON or OFF.

On: Executes the MAX/MIN calculation.
The MAX, MIN, AVE, and ∑ indicators go ON.

Off: Turns OFF the MAX/MIN calculation.

View Mx/Mn Displays the MAX/MIN calculation data.

Sample Number of measurement data

Maximum Maximum measurement data value

Minimum Minimum measurement data value

Average Measurement data average value

Total Total measurement data value

CONST Sets constants for calculations.

High Value Sets the upper limit value of the comparator calculation.

Low Value Sets the lower limit value of the comparator calculation.

SCL Val_A Sets constant A for the scaling calculation.

SCL Val_B Sets constant B for the scaling calculation.

SCL Val_C Sets constant C for the scaling calculation.

Null Value Sets the NULL value.
Not displayed when the NULL calculation is OFF.

EXT SIGNAL Sets the external control signals. The external control signal ports are on the rear panel.

OPR Signal Selects the external control signal input or output function for INTERLOCK/OPERATE IN/OUT.

STBY In:
Sets Standby when the signal level changes from LO to HI.
Set Operate by using the key or remote command.

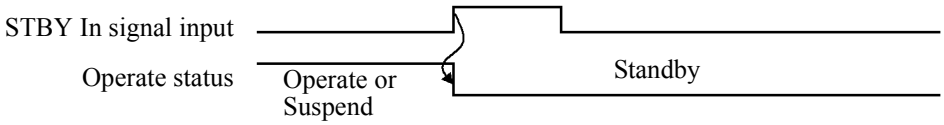


Figure 4-4 STBY In

InterLock In
Sets Standby when the signal level changes from LO to HI.
While the input signal is HI, Operate and Suspend are disabled.

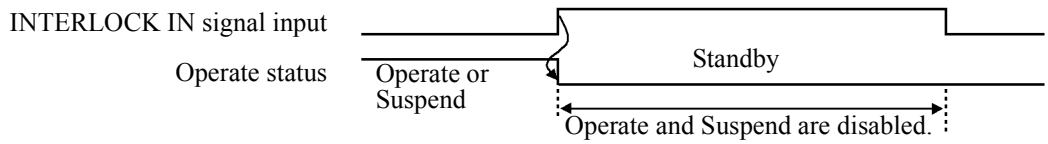


Figure 4-5 InterLock In

Operate Out:
Outputs LO when the 6247G/6247C is in Operate status, and HI in Standby or Suspended status.

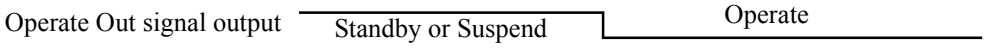


Figure 4-6 Operate Out

OPR/SUS IN:
Sets Suspend when the signal level changes from LO to HI.
Sets Operate when the signal level changes from HI to LO.

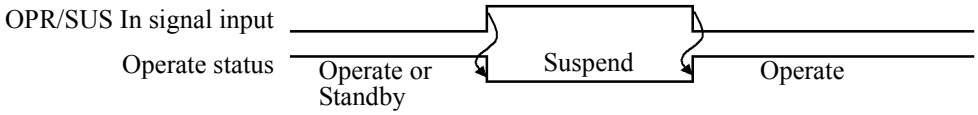


Figure 4-7 OPR/SUS In

OPR/STBY In:
Sets Standby when the signal level changes from LO to HI.
Sets Operate when the signal level changes from HI to LO.

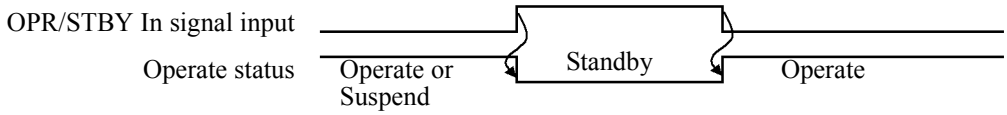


Figure 4-8 OPR/STBY In

Cmpl/Sync Selects the external control signal output function for COMPLETE OUT/SYNC OUT.

Meas Front:
Outputs a negative pulse when the measurement starts.

Meas End:
Outputs a negative pulse when the measurement is completed and the period time ends.

Comp HI:
Outputs a negative pulse when the comparator calculation result is HI.

Comp GO :
Outputs a negative pulse when the comparator calculation result is GO.

Comp LO:
Outputs a negative pulse when the comparator calculation result is LO.

Comp HIorLO:
Outputs a negative pulse when the Comparator calculation result is HI or LO.

Sync Out:
Outputs a negative pulse when the step starts in the sweep source mode, or when the pulse source starts in the pulse source mode.

Sig Width Selects the control signal pulse width, 10 µs or 100 µs.

PARAMETER Loads or saves the setting parameters.

Param Load Loads the setting parameters from the non-volatile memory.
Not displayed on the menu screen in Operate status.

Load0: Loads the data from the non-volatile memory, area 0 as the setting parameters.

Load1: Loads the data from the non-volatile memory, area 1 as the setting parameters.

Load2: Loads the data from the non-volatile memory, area 2 as the setting parameters.

Load3: Loads the data from the non-volatile memory, are 3 as the setting parameters.

Ld Dflt: Loads the factory default setting parameters.

Param Save Saves the setting parameters to the non-volatile memory.

Save0: Saves the current setting parameters to the non-volatile memory, area 0.

Save1: Saves the current setting parameters to the non-volatile memory, area 1.

Save2: Saves the current setting parameters to the non-volatile memory, area 2.

Save3: Saves the current setting parameters to the non-volatile memory, area 3.

Sv Dflt: Saves the factory default setting parameters to all the areas 0 to 3.

PON. Load Selects the parameter loading condition at power ON.

P.OFF: Starts up using the parameters when the instrument was last turned off.

Load0: Starts up using the parameters saved in the non-volatile memory, area 0.

I/F Selects or sets the interface.

I/F BUS Selects the interface.

GPIB: Selects the GPIB interface (6247G).

USB: Selects the USB interface (6247G/6247C).

RS232: Selects the RS-232 interface (6247C).

GPIB Adr Sets the GPIB address from 0 to 30.
Displayed only when the GPIB interface is selected.

USB Id Sets the USB ID from 1 to 127.
Displayed only when the USB interface is selected.

Header Switches the header ON or OFF.

On: Header ON

Off: Header OFF

Talk Only Switches between Addressable and Talk Only.
NOT displayed when the USB interface is selected.

On: Talk only

Off: Addressable

Boud Rate Selects the baud rate.
Displayed only when the RS-232 interface is selected.

19200: 19,200 (baud)

9600: 9,600 (baud)

4800: 4,800 (baud)

2400: 2,400 (baud)

1200: 1,200 (baud)

800: 800 (baud)

300: 300 (baud)

Data Bit Selects the number of data bits.
Displayed only when the RS-232 interface is selected.

8 bit: The number of data bit is 8 bits

7 bit: The number of data bits is 7 bits.

Parity Selects the type of parity bit.
Displayed only when the RS-232 interface is selected.

NONE: No parity bit

ODD: Odd parity bit

EVEN: Even parity bit

Stop Bit Selects the number of stop bits.
Displayed only when the RS-232 interface is selected.

1 bit: The number of stop bits is 1 bit.

2 bit: The number of stop bits is 2 bits.

SYSTEM Sets the 6247G/6247C system parameters.

Limit Buz Switches the limiter detection buzzer ON or OFF.

On: Sounds when the limiter function is activated.

Off: Not sound when the limiter function is activated.

CompareBuz Sets the comparator calculation result buzzer parameter.

Off: Not sound regardless of the comparator calculation result.

HI: Sounds when the comparator calculation result is HI.

GO: Sounds when the comparator calculation result is GO.

LO: Sounds when the comparator calculation result is LO.

HI or LO: Sounds when the comparator calculation result is HI or LO.

Notice Buz	Switches ON or OFF the buzzer which notifies of process completion such as measurement memory full and parameter saving or loading. On: Sounds. Off: Not sound.
Self Test	Executes the self-test for selected items.
Serial No.	Displays the 9-digit serial number.
Error Log	Displays the number of errors that occurred, error codes and error messages. Once this parameter is displayed, the error log content will be cleared and the ERR indicator goes OFF.
Relay Cnt	Displays the operation count of the Operate/Standby relay.

4.2.7 MODE Key (Source Mode)

Selects the source mode by using , or .

Source Mode Switches the source mode.
Enabled only in Standby or Suspend status.

DC: Sets the DC source mode which generates DC voltage or DC current. The DC indicator goes ON.

PLS: Sets the pulse source mode which generates pulse voltage or pulse current. The PLS indicator goes ON.

DC-SWP :
Sets the DC sweep source mode which generates waveforms for DC voltage or DC current sweep.
The DC and SWP indicators go ON.

PLS-SWP :
Sets the pulse sweep source mode which generates waveforms for pulse voltage or pulse current sweep.
The PLS and the SWP indicator go ON.

4.2.8 MON Key (Measurement Mode)

Selects the measurement function (current measurement, voltage measurement or resistance measurement). Pressing this key switches the function. The setting measurement function is displayed by the header and the measurement unit.

Current measurement function:	"I" is displayed on the header. The measurement unit becomes "A."
Voltage measurement function:	"V" is displayed on the header. The measurement unit becomes "V."
Resistance measurement function:	"R" is displayed on the header. The measurement unit becomes "Ω."

4.2.9 NULL/SEL Key

NULL key:	Switches the NULL calculation ON or OFF. For more information on the NULL calculation function, refer to Section 5.2.9.1, "NULL Calculation."
SEL key:	Selects the parameters at the Input/Run level in the menu. For more information, refer to Section 2.2.3, "Menu Operation."

4.2.10 OPR/SUSPEND Key (Operating/Suspend)

OPR key: Switches between Operate and Suspend.

Operate: Turns the output status ON and the OPR indicator turns ON. Displays measurement values when the measurement is ON. (Not displayed when the measurement is OFF.) The operation varies depending on the source mode.

- DC: Generates a setting value and displays a measurement value.
- PLS: Generate a pulse and displays a measurement value.
- DC-SWP and PLS-SWP: Generate a bias value and waits for measurement. Produces sweep data and waits for trigger input. The trigger input starts the sweep and displays a measurement value.

Suspend: Outputs the suspend voltage without turning OFF the output relays. The OPR indicator blinks. The suspend voltage is displayed and the header indicates the suspend status.

- HZ: High impedance status
- LZ: Low impedance status

SUSPEND key (SHIFT):
Sets Suspend in Standby or Operate status.

NOTE: ***Sweep data is produced when the output status is switched as follows in the DC sweep or pulse sweep mode:***

- ***From Standby to Operate***
- ***From Standby to Suspend***
- ***Switched to Operate after changing the sweep parameters during Suspend.***

"Setting" is displayed during sweep data creation. After the sweep data creation finishes, the internal processing for Operate starts.

4.2.11 SHIFT/LOCAL Key (Shift Mode/Local)

SHIFT key (in normal operation): Functions as SHIFT key, and the SHIFT indicator goes ON. In the shift status, function names printed in blue characters on the panel are enabled. Press the SHIFT key again to release the shift status.

LOCAL key (in remote control): Releases remote control. The RMT indicator goes OFF.

NOTE: ***Remote control is not released if the LLO (Local Lock Out) command is set through the GPIB or USB interface.***

4.2.12 STBY Key (Output Standby)

Turns off the output relays to set Standby status. The OPR indicator goes OFF.

NOTE: ***Whenever switching between Operate and Standby, the output relays are turned on or off every time. To extend the relay life spans, using the Suspend function that switches between Operate and Suspend is recommended.***

4.2.13 TRIG/SWP STOP Key (Trigger/Sweep Stop)

TRIG key: Functions as source or measurement trigger key.

Source mode		Trigger mode	
		AUTO	HOLD
DC source/pulse source mode		-	Triggers measurement and pulse source.
Sweep source mode	Before sweep start	Starts sweep.	Starts sweep.
	During sweep	-	Moves to the next step.

SWP STOP key: Stops sweep.

Source mode		Trigger mode	
		AUTO	HOLD
DC source/pulse source mode		-	-
Sweep source mode	Before sweep start	-	-
	During sweep	Stops sweep.	Stops sweep.

4.2.14 UP Key (Source Range)

Increases the source range by one.

The source range setting mode is locked. (For more information on the LOCK status, refer to Section 4.2.3, "FIT Key (Source Range).")

4.2.15 VS/IS Key (Source Function)

Selects the source function, voltage source or current source. The unit indicates the present source function. There are the following restrictions on switching between VS and IS:

- Switching is disabled during sweep in the sweep source mode.
- Switching during sweep stop (start trigger wait status) in the sweep source mode forces into Suspend.
- Switching during Operate in the DC source or pulse source mode forces into Suspend.

4.2.16 123... Key (Direct Input Mode)

Switches into the direct input mode that enables numeral data input, and displays the setting value at half-brightness.
In this status, green colored functions on the panel are enabled. However, the EXP key is only enabled when ***Disp Unit*** is set to Exponent.
Pressing **ENTER** applies the input data and releases the direct input mode.
If the direct input mode is released by **EXIT**, the input data will be cleared and the previously set data will return.

4.2.17 4W/2W Key (Remote Sensingn)

Switches the output sensing between 4-wire and 2-wire connections.

4W: Sets the output sensing to 4-wire connection. The 4W indicator goes ON.

2W: Sets the output sensing to 2-wire connection. The 2W indicator goes ON.

For more information on the remote sensing, refer to Section 5.1.2, "Remote Sensing (2-Wire/4-Wire Connection)."

5. TECHNICAL REFERENCES

This chapter describes the detailed functions for more accurate measurement.

5.1 DUT Connection

5.1.1 Note for Output Terminals

Figure 5-1 below shows the internal wire connection of the 6247G/6247C.
The output terminals are cut off from the internal circuits by the Operate/Standby relays in Standby status.

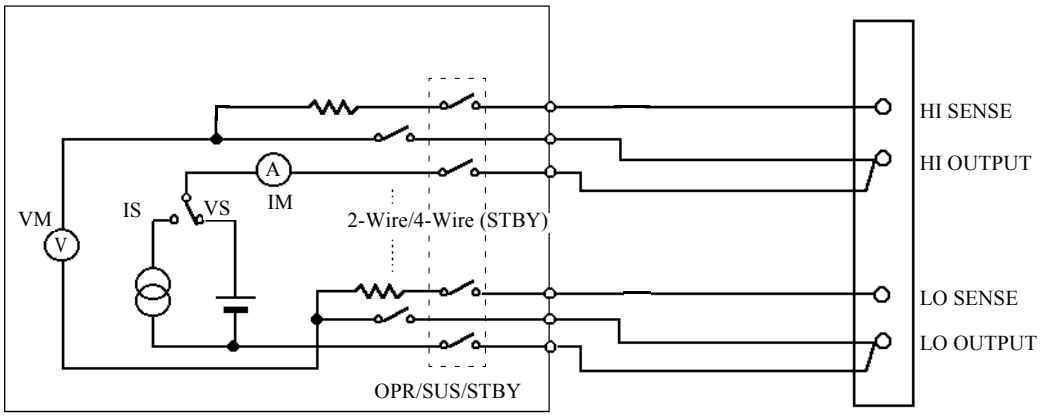


Figure 5-1 Internal Wire Connection

5.1.2 Remote Sensing (2-Wire/4-Wire Connection)

When connecting the 6247G/6247C and the DUT, use 2-wire or 4-wire connection while considering the following conditions:

- Apply 2-wire connection if the output current is relatively low and the cable line resistance does not matter.
- Apply 4-wire connection if the output current is relatively high and the cable line resistance matters.
- When using within the specified accuracy:

  (Line resistance × output current) ≤ 10 μV → 2-wire connection
  (Line resistance × output current) > 10 μV → 4-wire connection

  The line resistance of the supplied cable A01044 is approximately 100 mΩ.
  Thus, when the output current is 100 μA or higher, use the 4-wire connection.
- When allowing the error voltage (ev):

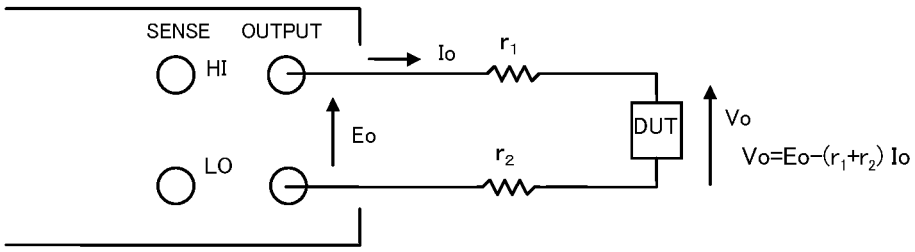
  (Line resistance × output current) ≤ ev → 2-wire connection
  (Line resistance × output current) > ev → 4-wire connection

  When the supplied cable A01044 is used and the error voltage of 10 mV is allowed, the 2-wire connection is used up to 100 mA.

Pressing the **4W/2W** key switches between the 2-wire and 4-wire connections.

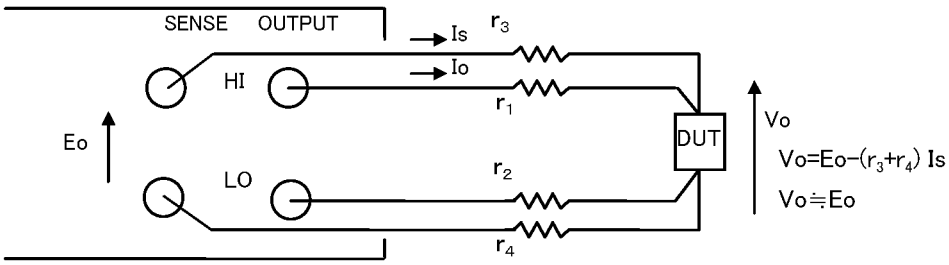
2-wire connection: The 2W indicator goes ON.

4-wire connection: The 4W indicator goes ON.



An error may occur due to r1 and r2 voltage drop.

(a) 2-wire connection



(b) 4-wire connection

Figure 5-2 2-Wire and 4-Wire Connections

NOTE: ***The maximum remote sensing voltage (tolerable voltage difference between OUTPUT and SENSE) is ±1.0 V at both HI and LO sides.***
To satisfy the specified accuracy, maintain the following restriction for r_1 to r_4.
$r_1, r_2 \leq 1.0\ V/Io\ [\Omega]$
(Io = Output current)

$$r_3, r_4 \leq \frac{10\ \mu V}{Vos} \times 220\ k\Omega\ [\Omega]$$

(Vos = r_1Io, r_2Io)

(Example) If Io = 0.3 A
$r_1, r_2 \leq 1.0\ V/0.3\ A = 3.3\ \Omega$
$r_1, r_2 = 3\ \Omega$
then,

$$r_3, r_4 \leq \frac{10\ \mu V}{1.0\ V} \times 220\ k\Omega = 2.2\ \Omega$$

5.1.3 Preventing Oscillation

The DUT itself may oscillate, or the 6247G/6247C may oscillate if capacitance or inductance exceeding the specified value is connected (due to stray capacitance or retained inductance from connected cables, a scanner, or a fixture).

Judge whether the DUT or the 6247G/6247C oscillates by the oscillation frequency. The 6247G/6247C does not oscillate at 2 MHz or over.

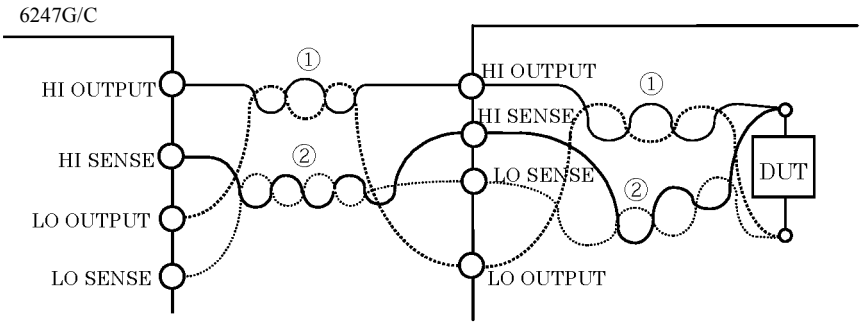
5.1.3.1 Preventing 6247G/6247C Oscillation

1. Causes
   - Oscillation may occur because of the capacitive load in voltage source or while the voltage limiter is activated.
   - Oscillation may occur because of the inductive load in current source or while the current limiter is activated.
2. Solution

   Remove the causes of oscillation according to the following procedure:

   1. Verify if the load capacitance or load inductance does not exceed the maximum load capacitance or load inductance specified in Chapter 9, "SPECIFICATIONS."
   2. Check if the 6247G/6247C still oscillates when cables of the shortest lengths are connected.
   3. If the shorter cables stop the oscillation, then connect the 6247G/6247C and the DUT as shown in Figure 5-3 to reduce the capacitance and inductance of cables and other devices.
   4. If the oscillation does not stop even if the cables are the shortest possible, insert an allowable resistor for the DUT as shown in Figure 5-5.

   NOTE: ***When more than one power supply unit is used, oscillation in one unit may cause oscillation in other units. Then find the particular power supply that may stop the oscillation, following the procedure from 1 to 4 above.***



① Wire HI OUTPUT and LO OUTPUT in twisted pairs.

② Wire HI SENSE and LO SENSE in twisted pairs.

Figure 5-3 Reducing Stray Capacitance and Lead Inductor

5.1.3.2 Preventing DUT Oscillation

The DUT itself may oscillate due to the stray capacitance of cables and a test fixture. Particularly a high h_{FE} transistor or a high gm FET has a higher probability of oscillation.

Take the following measures to prevent oscillation.

- Attach a ferrite bead near the DUT as in Figure 5-4.
- For the transistor it is effective to attach the ferrite bead at the base, and for the FET at the gate.
- To minimize a current leak, be careful that the ferrite bead does not touch other terminals, the DUT case, lead wires, or other ferrite beads.

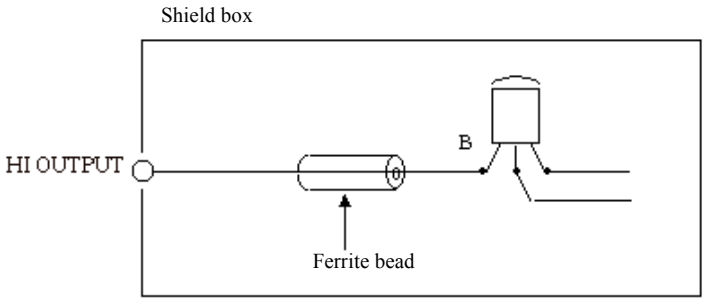


Figure 5-4 Preventing DUT Oscillation

- For a high frequency device such as a GaAS FET, take the following measures.
  - Separate the ground line of the gate power supply from that of the drain power supply.
  - Insert ferrite beads and by-pass capacitors both at the gate and the drain so that high frequency signals do not enter the power supplies.
  - Insert matching resistors both at the gate and the drain or make the pattern length λ/4 for matching.

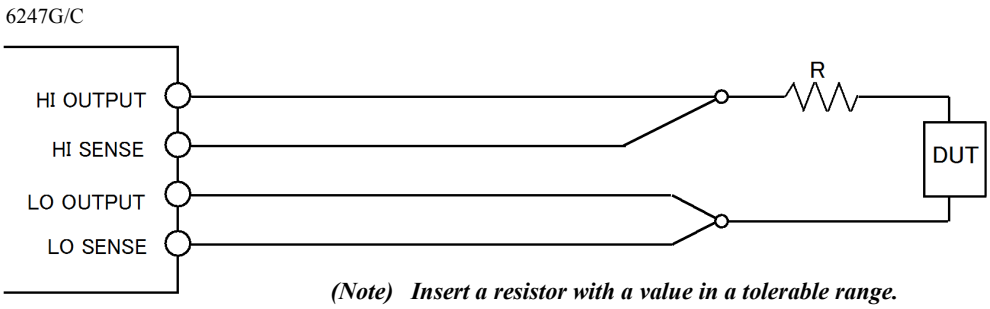


Figure 5-5 Preventing 6247G/6247C Oscillation

5.1.4 Connection for High Current Measurement

Be sure to use 4-wire connection to measure high current.

Twist together the cables between **HI OUTPUT** and **LO OUTPUT** and between **HI SENSE** and **LO SENSE** from the output terminals to the DUT terminals as in Figure 5-6 to avoid overshoot or delay in response because of cable inductance.

Use twisted pair shielded cables for **OUTPUT** and **SENSE** as in Figure 5-6 to prevent induction noise.

Especially, be sure to use shielded cables when measuring current of 1 μA or less.

The cables for **OUTPUT** must satisfy the thickness requirement below, and the voltage difference between **OUTPUT** and **SENSE** must be 1.0 V or less for both HI and LO.

Be sure to set the voltage between the **HI SENSE** and **LO SENSE** terminals within the maximum output range.

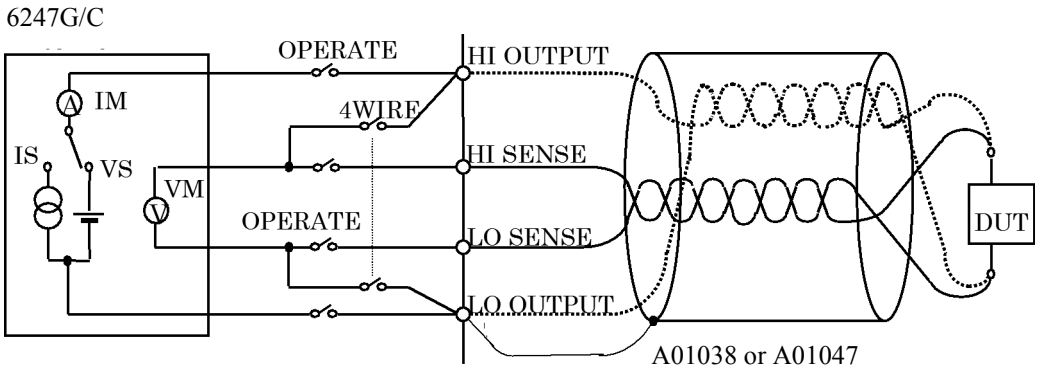


Figure 5-6 Connection for High Current Measurement

Table 5-1 Tolerable Current and Wire Thickness

Current	Wire (AWG)
to 500 mA	24
to 2 A	22
to 3.2 A	18
to 5 A	16

5.1.5 Connection with Fixture 12701A

The following figure shows the connection with the 12701A.
4-wire connection is used.
2-wire connection does not require the SENSE connection.
For more information on the device connection inside the 12701A, refer to 12701A Operation Manual.

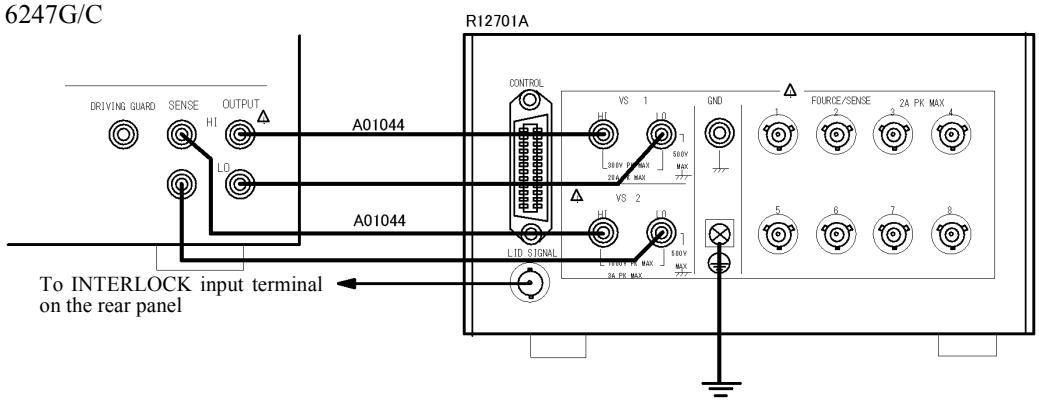


Figure 5-7 Connection with 12701A

CAUTION: Follow the procedure below to prevent electric shock.

1. ***Be sure to ground the 12701A protective grounding terminal*** ⏚ **.**
2. ***Connect the 12701A LID SIGNAL to the INTERLOCK terminal on the 6247G/6247C rear panel, and set the parameter "OPR Signal" to InterLock In.***
   This enables the interlock function. When the 12701A cover opens, the 6247G/6247C will be set to Standby.

5.2 Functions in Detail

5.2.1 Operations in DC Source Mode

The following table shows operations in the DC source mode.

Table 5-2 Operations in DC Source Mode (1 of 2)

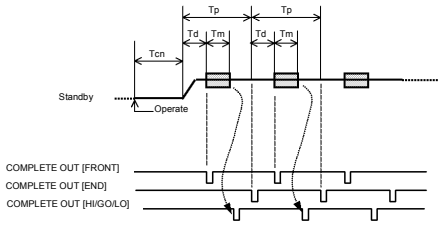
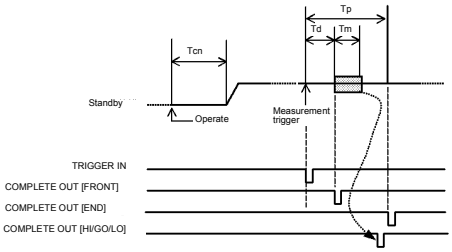
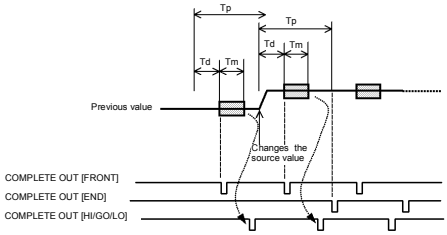
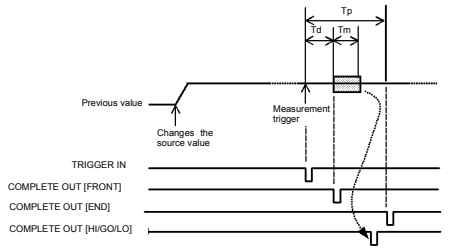
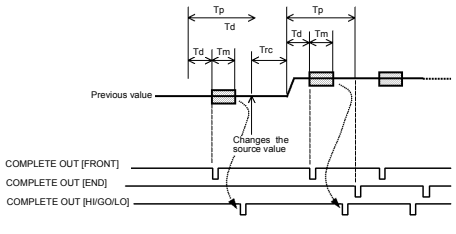
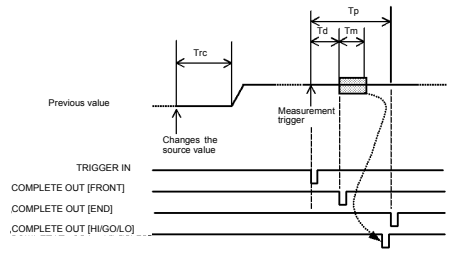
<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Description</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Operate ON</td><td>AUTO</td><td>Executes continuous measurement with the setting period time Tp.</td><td> 
</td><td rowspan="2">Tp: Period time
Td: Measurement delay time
Tm: Measurement time (Integration time + Measurement data processing time)
Tcn: Operation processing time</td></tr>
<tr><td>HOLD</td><td>Executes measurement after trigger input.</td><td> 
</td></tr>
<tr><td rowspan="2">Changing the source value</td><td>AUTO</td><td rowspan="2">Source value changing does not induce range changing.</td><td> 
</td></tr>
<tr><td>HOLD</td><td> 
</td></tr>
</table>

Table 5-2 Operations in DC Source Mode (2 of 2)

Operational condition	Trigger mode	Description	Operation	Remarks
Changing the source value	AUTO	Source value changing induces range changing.		Tp: Period time Td: Measurement delay time Tm: Measurement time (Integration time + Measurement data processing time) Tcn: Operation processing time Trc: Range change processing time
	HOLD			

a. When the trigger mode is AUTO:
   - The measurement repeats itself at intervals specified by the period time.
   - If the measurement does not finish in the specified period, the period time is extended and the TpALM indicator goes ON.

b. When the trigger mode is HOLD:
   - The measurement starts when the measurement delay time has passed after trigger input.
   - Trigger input during measurement is ignored.

c. In Standby or Suspended status:
   - The measurement is not executed in Standby or Suspend status.

5.2.2 Operations in Pulse Source Mode

The following table shows operations in the pulse source mode.

Table 5-3 Operations in Pulse Source Mode (1 of 2)

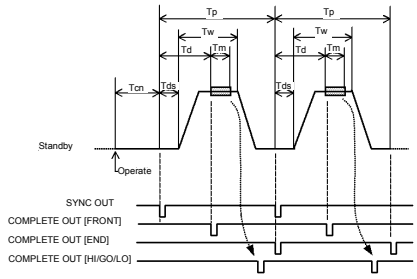
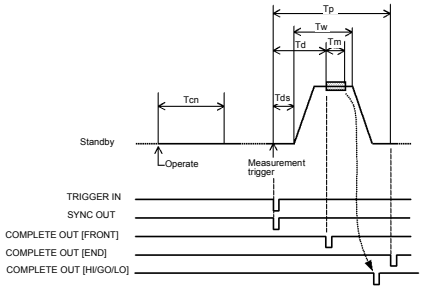
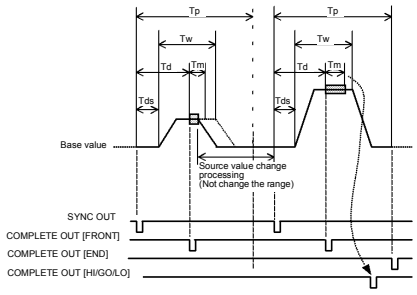
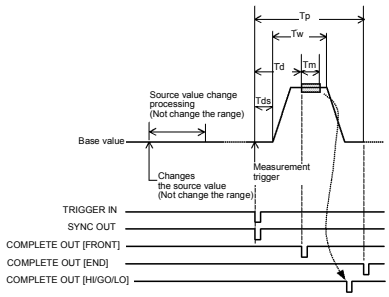
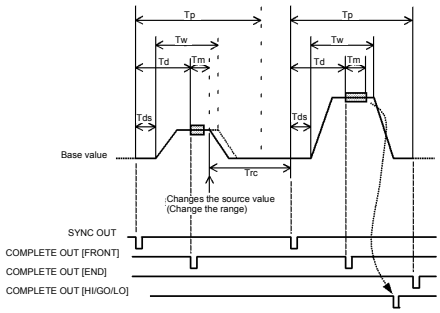
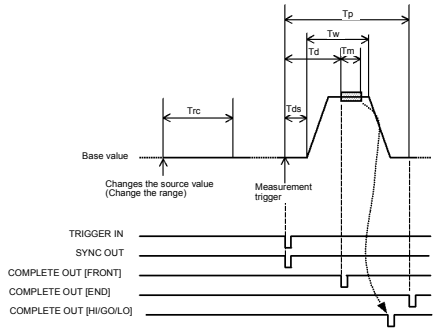
<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Description</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Operate ON</td><td>AUTO</td><td>Executes continuous measurement with the setting period time Tp.</td><td> 
</td><td rowspan="3">Tp: Period time
Tw: Pulse width
Td: Measurement delay time
Tds: Source delay time
Tm: Measurement time (Integration time + Measurement data processing time)
Tcn: Operation processing time
Trc: Range change processing time</td></tr>
<tr><td>HOLD</td><td>Executes measurement after trigger input.</td><td> 
</td></tr>
<tr><td rowspan="2">Changing the source value</td><td>AUTO</td><td rowspan="2">Source value changing does not induce range changing.</td><td> 
</td></tr>
<tr><td>HOLD</td><td> 
</td></tr>
</table>

Table 5-3 Operations in Pulse Source Mode (2 of 2)

Operational condition	Trigger mode	Description	Operation	Remarks
Changing the source value	AUTO	Source value changing induces range changing.		Th: Hold time Tp: Period time Tw: Pulse width Td: Measurement delay time Tds: Source delay time Tm: Measurement rime (Integration time + Measurement data processing time) Tcn: Operation processing time Trc: Range change processing time
	HOLD			

a. When the trigger mode is AUTO:
   - The measurement and the pulse cycle repeat at intervals specified by the period time.
   - If the measurement does not finish in the specified period, the pulse width does not change but the pulse cycle is extended and the TpALM indicator goes ON.
   - If the source value or the base value is changed during pulse generation, the pulse source operation stops and restarts with the new source value or base value.

b. When the trigger mode is HOLD:
   - The measurement starts when the measurement delay time has passed after trigger input.
   - Trigger input during period time is ignored.
   - If a trigger is input during range change processing, pulse generation starts when the range change processing is completed.

c. When setting to Operate or changing the range
   - Pulse generation starts when the Operate processing time has passed after setting to Operate.
   - If the source change entails the range change, the base value and pulse value are set in the same range.

d. In Standby or Suspended status:
   - The measurement is not executed in Standby or Suspend status.

5.2.3 Operations in Sweep Source Mode

The following table shows operations in the sweep source mode.

Table 5-4 Operations in Sweep Source Mode (1 of 2)

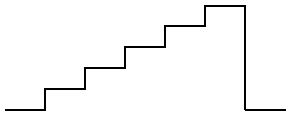
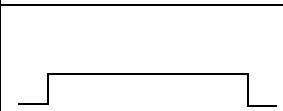
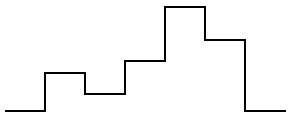
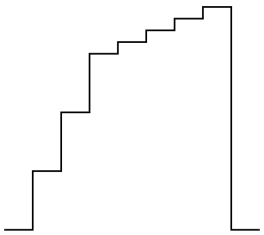
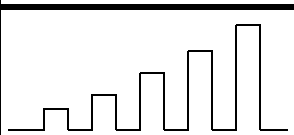
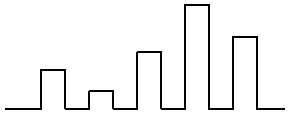
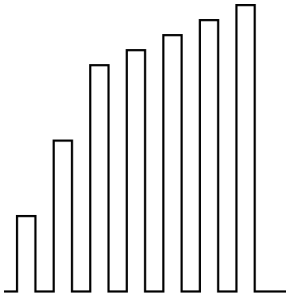
Sweep types		Description	Waveform
DC sweep	Linear sweep	Sweeps with staircase waveforms of the step value between the first value and the last value.	
	Fixed sweep	Sweeps with waveforms of the specified constant value the specified number of sample count.	
	Random sweep	Sweeps with waveforms of the source values stored in the memory from the start address to the stop address.	
	2-slope linear sweep	Sweeps with staircase waveforms of the 1st step value between the first value and the middle value, and sweeps with staircase waveforms of the 2nd step value between the middle value and the last value.	

Table 5-4 Operations in Sweep Source Mode (2 of 2)

Sweep types		Description	Waveform
Pulse sweep	Linear sweep	Sweeps with staircase pulse waveforms of the step value between the first value and the last value.	
	Fixed sweep	Sweeps with pulse waveforms of the specified constant value the specified number of sample count.	
	Random sweep	Sweeps with pulse waveforms of the source values stored in the memory from the start address to the stop address.	
	2-slope linear sweep	Sweeps with staircase pulse waveforms of the 1st step value between the first value and the middle value, and sweeps with staircase pulse waveforms of the 2nd step value between the middle value and the last value.	

1. Setting the sweep tyme
   - Select ***DC-SWP*** for DC Sweep and ***PLS-SWP*** for pulse sweep by using the **MODE** key.
   - Select the item ***B) SWEEP*** by using the **MENU** key.
     Select ***Linear*** for linear Sweep, ***Fixed*** for fixed sweep, ***Random*** for random sweep or ***Linear2*** for 2-slope linear sweep from ***1) Sweep Type***.

NOTE: ***The maximum number of sweep steps is 8000. If the number of steps is set to more than this, the error message "801 Over Step" is displayed in Operate status.***

2. Changing the sweep measurement parameters

   The sweep measurement parameters are basically changeable only in Standby or Suspend status, but the following parameters are changeable during sweep stop in Operate status.

   - Time parameter
     - Hold time
     - Source delay time
     - Measurement delay time
     - Pulse width
     - Period time
   - Start address and stop address for random sweep

     (These are changeable in the start address to stop address range when switching from Standby status to Operate or Suspend.)
   - Sweep function parameter
     - Repeat count
     - Reverse mode ON or OFF
     - RTB ON or OFF
     - Measurement auto range ON or OFF
     - Measurement ON or OFF
     - Measurement integration time
     - Selecting COMPLETE OUT or SYNC OUT external control signal output function

3. Indicator display for sweep status

    indicates the sweep status.

   Sweeping: The indicator rotates.

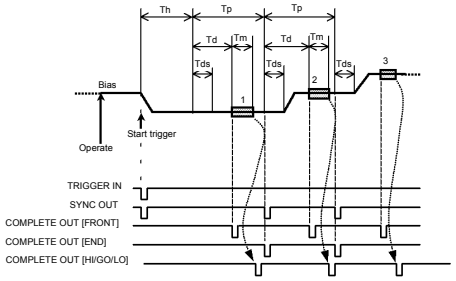
   HOLD: The Indicator stops rotation but remains displayed.

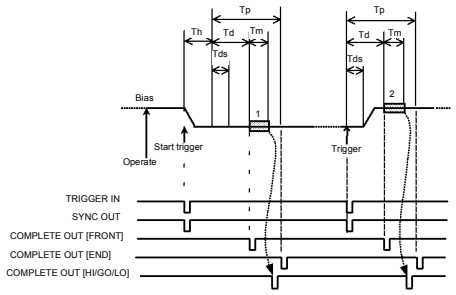
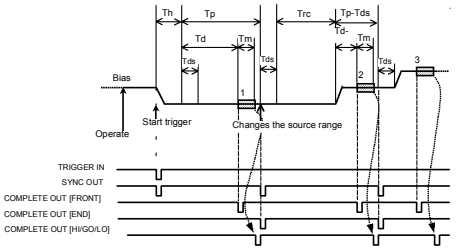
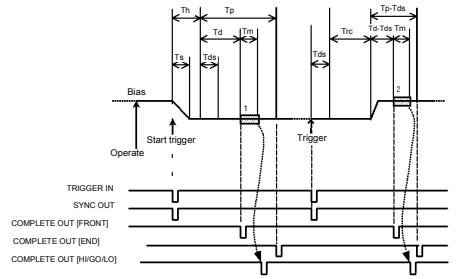
   STOP: Indicator is not displayed.

5.2.3.1 Operations in DC Sweep Source Mode

The following table shows operations in the DC sweep source mode.

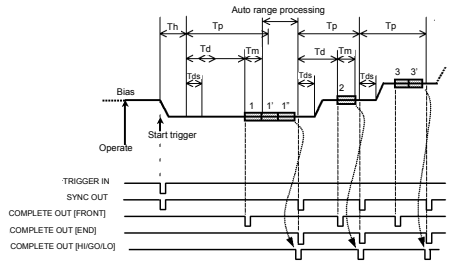
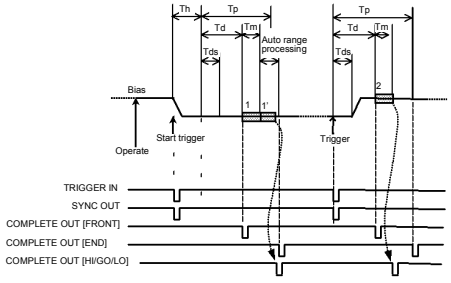
Table 5-5 Operations in DC Sweep Source Mode (1 of 2)

<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Description</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Operate ON</td><td>AUTO</td><td>Executes continuous measurement with the setting period time Tp.</td><td> 
</td><td rowspan="2">Th: Hold time
Tp: Period time
Td: Measurement delay time
Tds: Source delay time
Tm: Measurement time (Integration time + Measurement data processing time)
Tcn: Operate processing time
Trc: Range change processing time

When the repeat count is set to other than 1, the hold time (Th) is skipped in the second or later sweep operation.</td></tr>
<tr><td>HOLD</td><td>Executes measurement after trigger input.</td><td> 
</td></tr>
<tr><td rowspan="2">Changing the source range</td><td>AUTO</td><td rowspan="2">Changes the source range during sweep.</td><td> 
</td></tr>
<tr><td>HOLD</td><td> 
</td></tr>
</table>

5.2.3 Operations in Sweep Source Mode

Table 5-5 Operations in DC Sweep Source Mode (2 of 2)

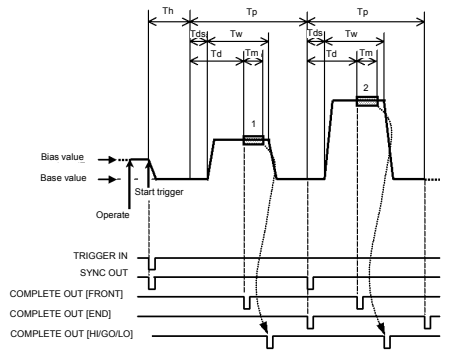
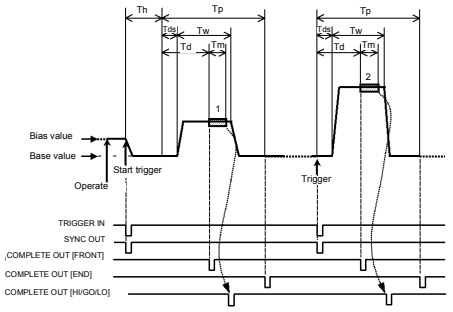
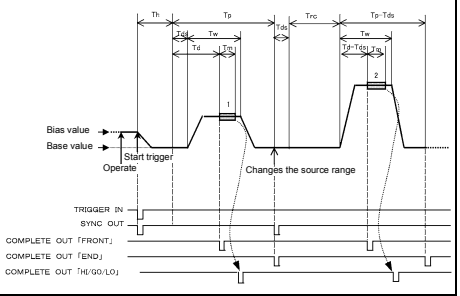
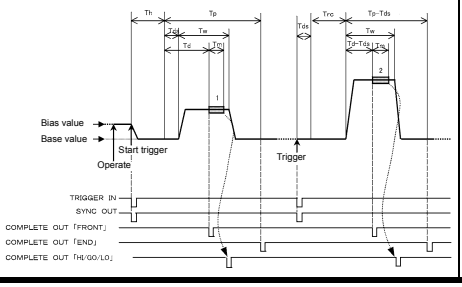
<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Description</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Changing the measure-ment range</td><td>AUTO</td><td rowspan="2">Changes the mea-surement range during sweep.</td><td> 
</td><td rowspan="2">Th: Hold time
Tp: Period time
Td: Measurement delay time
Tds: Source delay time
Tm: Measurement time (Integration time + Measurement data processing time)
Tcn: Operation processing time
Trc: Range change processing time</td></tr>
<tr><td>HOLD</td><td> 
</td></tr>
</table>

- The bias value is output before the sweep starts.
- The start value is output when the start trigger is input.
- The sweep starts when the hold time has passed after start trigger input.
- When the trigger mode is AUTO, the sweep goes to the next step after every period time. However, if the measurement has not completed, the next step is delayed until the measurement is completed.
- When the trigger mode is HOLD, the sweep goes to the next step by every trigger input.

5.2.3.2 Operations in Pulse Sweep Source Mode

The following table shows operations in the pulse sweep source mode.

Table 5-6 Operations in Pulse Sweep Source Mode

Operational Condition	Trigger Mode	Description	Operation	Remarks
Operate ON	AUTO	Executes continuous measurement with the setting period time Tp.		Th: Hold time Tp: Period time Tw: Pulse width Td: Measurement delay time Tds: Source delay time Tm: Measurement time (Integration time + Measurement data processing time) Tcn: Operate processing time Trc: Range change processing time
	HOLD	Executes measurement after trigger input.		When the repeat count is set to other than 1, the hold time (Th) is skipped in the second or later sweep operation.
Change the source range	AUTO	Changes the source range during sweep.		
	HOLD			

For more information on the operations, refer to Section 5.2.3.1, "Operations in DC Sweep Source Mode."

5.2.3.3 Random Sweep and Random Pulse Sweep

The random sweep function sweeps waveforms of the source values stored in the random memory from the specified start address to the stop address.

As the random pulse sweep function shares the memory, whether to generate DC waveforms or pulse waveforms is selectable. Figure 5-8 below shows this relation.

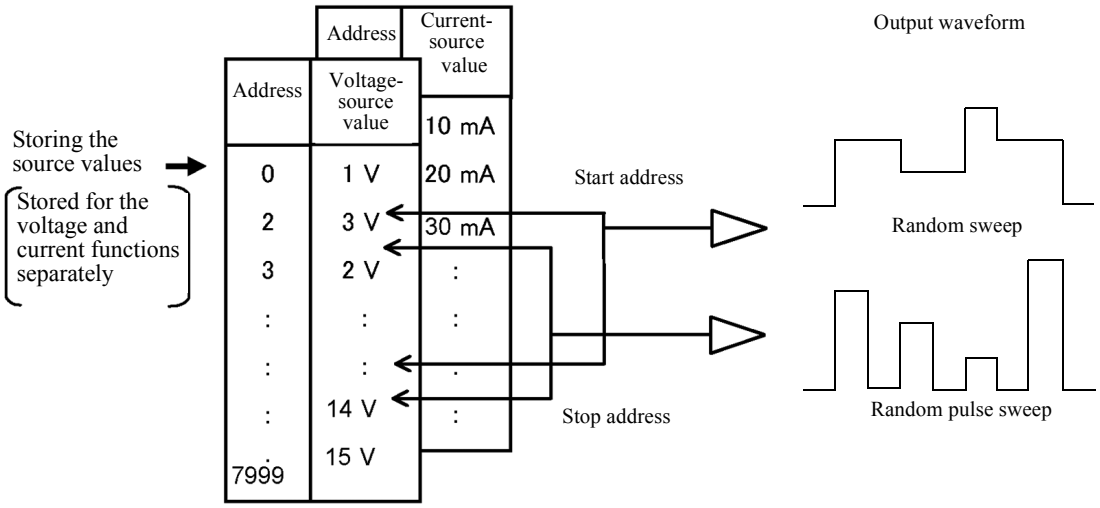


Figure 5-8 Random Sweep and Random Pulse Sweep

- The random memory can be set for each voltage and current function from 0 to 7999.

5.2.3.4 2-Slope Linear Sweep

The 2-slope linear sweep function initially sweeps staircase waveform (staircase pulse waveform) of the 1st step value between the designated first value and middle value. Next, it sweeps staircase waveforms (staircase pulse waveforms) of the 2nd step value between the designated middle value and last value.

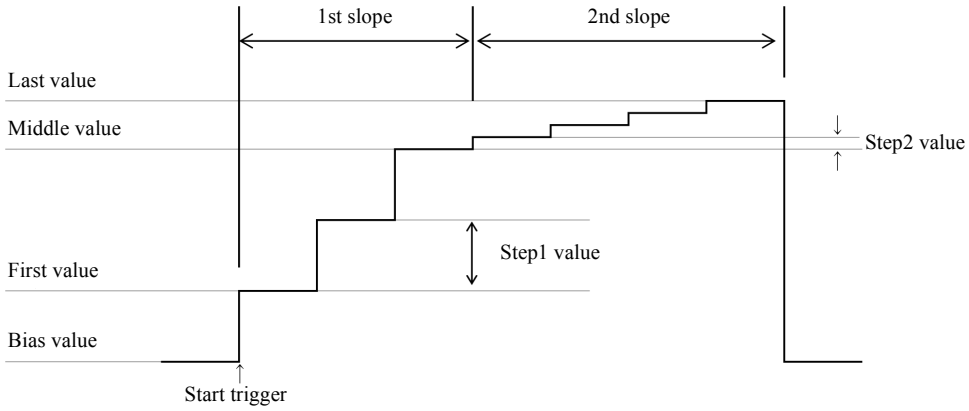


Figure 5-9 2-Slope Linear Sweep

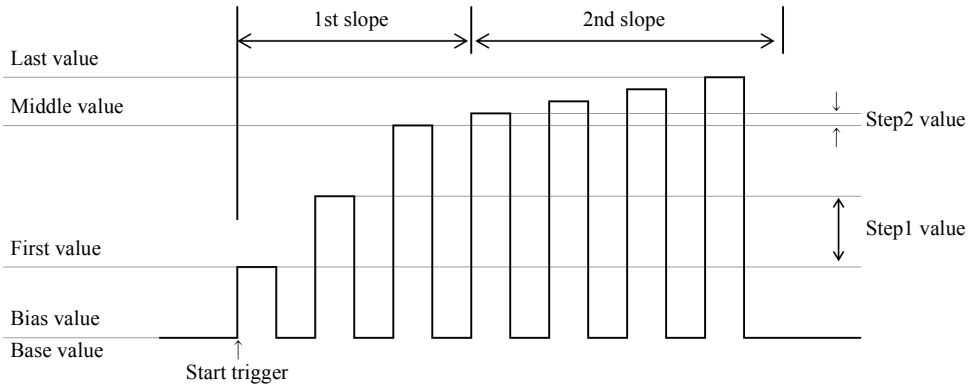


Figure 5-10 2-Slope Linear Pulse Sweep

5.2.3.5 Reverse Function

Turning ON or OFF the reverse function switches the sweep operation between one-way sweep and round sweep.

Reverse OFF: One-way sweep

Reverse ON: Round sweep

Table 5-7 Reverse Operations in DC Sweep Mode

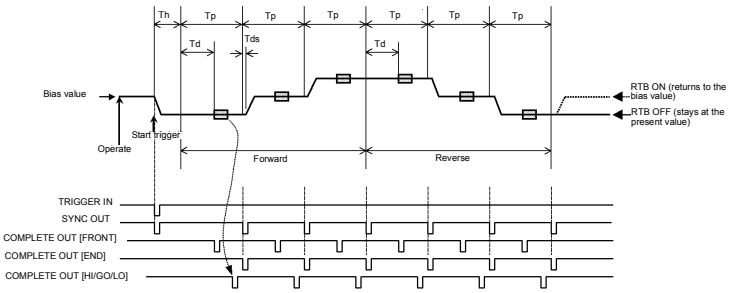
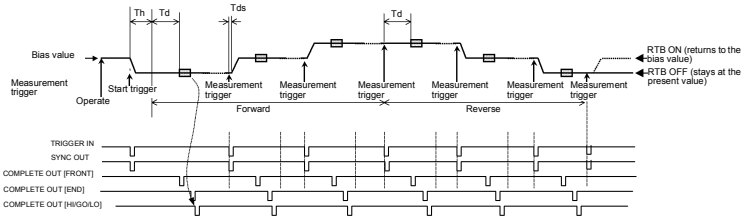
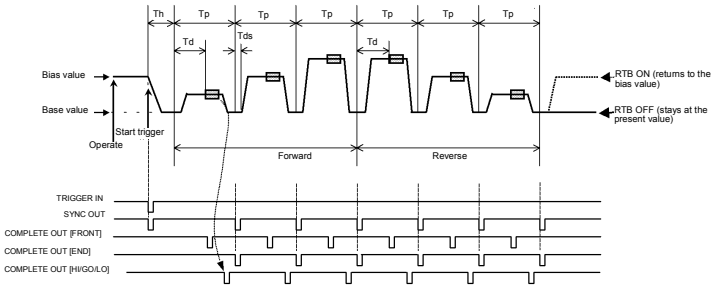
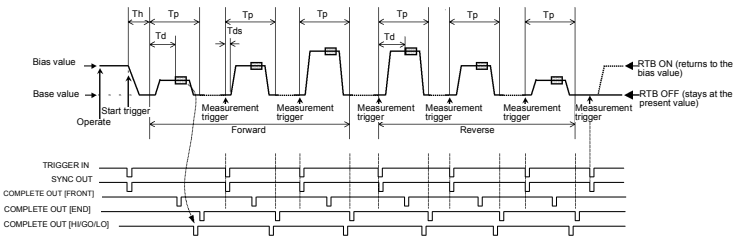
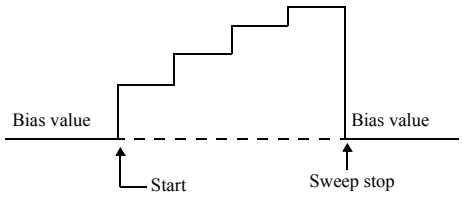
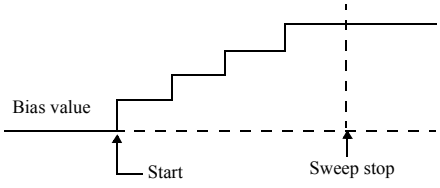
Operational condition	Trigger mode	Operation	Remarks
DC sweep	AUTO		Th: Hold time Tp: Period time Td: Measurement delay time Tds: Source delay time Tm: Measurement time (Integration time + Measurement data processing time) Tcn: Operate processing time Trc: Range change processing time When the repeat count is set to other than 1, the hold time (Th) is skipped in the second or later sweep operation.
	HOLD		

Table 5-8 Reverse Operation at Pulse Sweep

Operational condition	Trigger mode	Operation	Remarks
Pulse sweep	AUTO		Th: Hold time Tp: Period time Td: Measurement delay time Tds: Source delay time Tm: Measurement time (Integration time + Measurement data processing time) Tcn: Operate processing time Trc: Range change processing time When the repeat count is set to other than 1, the hold time (Th) is skipped in the second or later sweep operation.
	HOLD		

5.2.3.6 RTB (Return to Bias) Function

RTB setting switches the output value at sweep stop.

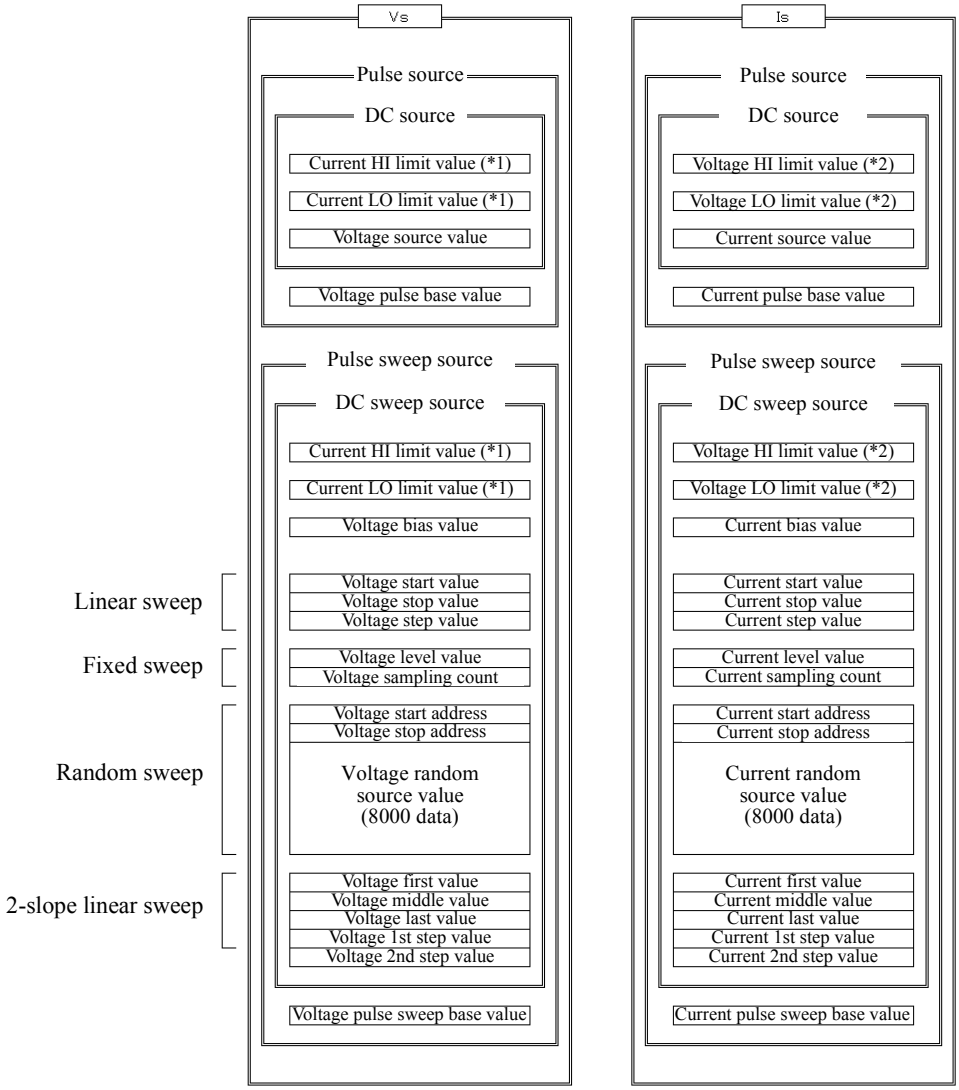
RTB	Waveform	Operation
ON		Returns to the bias value when sweep stops.
OFF		Stays at the stop value when sweep stops.

5.2.4 Source Function

This section describes restrictions on the source function and operations.

5.2.4.1 Source Mode, Source Function and Setting Parameters

The following shows relationships between the source-related setting parameters.



(*1) (*2): The limit values are shared by the DC, pulse, DC sweep and pulse sweep source modes.

1. For the DC or pulse source modes, the VS and IS parameters can be changed regardless of the functions currently set.
2. For the DC or pulse sweep modes, only function parameters currently set are changeable.

5.2.4.2 Restrictions on Switching Source Function

Switching the source function has the following restrictions:

1. While operating in the DC or pulse source mode, switching between VS and IS causes Suspend status.
2. Switching between VS and IS is impossible during sweep. They can be switched when the sweep is stopped. Switching VS and IS causes Suspend status.

5.2.4.3 Source Range

1. Source range
   - The source value (pulse value) for the DC or pulse source mode is output in the displayed range.
   - The range of the bias, base, start and stop values for the sweep source mode is decided by setting the sweep range to Auto or fixed as listed below regardless of the set or displayed value. Set the sweep range according to the parameters ***B) SWEEP***, ***2) SWP Range*** in the menu.

Sweep range setting	Range
Fix	Fixes the maximum range that can output any of the set values including the source values. The range is not changed while sweeping.
Auto	Sets every setting value to the optimum range so the enabled digit is the largest. If there are values in a different range, the range changes during the sweep.

2. Range to be set when the sweep range is Auto

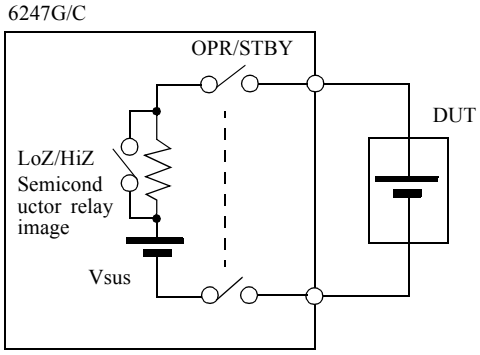
Source function	Setting value	Range
Voltage source	0 V ≤ Vs ≤ +5.0000 V	5 V
	-1.0000 V ≤ Vs < 0 V	
	+5.0000 V < Vs ≤ +50.000 V	50 V
	-10.000 V ≤ Vs < -1.0000 V	
	+50.000 V < Vs ≤ +250.00 V	250 V
	-15.00 V ≤ Vs < -10.000 V	
Current source	0 μA ≤ |Is| ≤ 3.2000 μA	3 μA
	3.2000 μA < |Is| ≤ 32.000 μA	30 μA
	32.000 μA < |Is| ≤ 320.00 μA	300 μA
	320.00 μA < |Is| ≤ 3.2000 mA	3 mA
	3.2000 mA < |Is| ≤ 32.000 mA	30 mA
	32.000 mA < |Is| ≤ 320.00 mA	300 mA

3. Ranging during sweep

   The period time may be extended if a range change occurs while sweeping. For more information on the sweep operation in this case, see Table 5-5, "Operations in DC Sweep Source Mode" or Table 5-6, "Operations in Pulse Sweep Source Mode."
   If the period time is extended, the TpALM indicator illuminates.

5.2.4.4 Suspend Function

The 6247G/6247C can select from three output statuses; Standby (output relay OFF), Suspend HiZ (output relay ON and high resistance), and Suspend LoZ (output relay ON and low resistance).
Using this function can reduce unnecessary relay ON/OFF actions, which reduces deterioration of the throughput due to relay operation time and improves the life spans of the relays.
Therefore, using the suspend function is recommended whenever turning OFF the output to change the source conditions.
Table 5-11 below shows a conceptual diagram of output status.



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

Output OFF status	Output relay	Output status	Setting current limit value
LoZ	ON	Vsus, low resistance	VS: Setting current limit values(I_L) IS: 100 digits in the 3 μA range 30 digits in other than 3 μA range
HiZ	ON	Vsus, high resistance	100 nA (3 μA range)
STBY	OFF	Open	-

Figure 5-11 Concept of Output Status

1. Operation
    1. Standby status

       Pressing the **STBY** key sets Standby status.

       The DUT is surely isolated.
    2. HiZ Suspend status

       Pressing the **SUSPEND (SHIFT+OPR)** key sets Suspend status. The OPR indicator blinks. This is the status for the LoZ/HiZ switch OFF with the OPR/STBY relay ON.

       Suspend status outputs Vsus voltage in VS status regardless of VS/IS output status.

       As the output status is high resistance, it rarely affects the DUT.

       The 6247G/6247C operates as follows in Operate status.

       VS setting: Vsus → VS output

       IS setting: Vsus → IS function → IS output
    3. LoZ Suspend status

       LoZ Suspend status is the same as HiZ Suspend status except that the output status is low resistance.

       This status is effective in setting the DUT to low impedance status when the output is OFF.

       The output response speed is faster because the limiter range does not change in Operate status.
    4. Current limiter in Suspend

       Suspend status always sets VS status, and the current limiter setting changes to the values shown in Figure 5-11, "Concept of Output Status."

       Therefore, the HL or LL indicator might illuminate depending on the DUT status.
2. Setting Suspend conditions
    1. Setting the suspend voltage

       Set selecting ***A) SOURCE*** and then ***2) Suspend V*** in the menu.

       The source range for the suspend voltage is the same as that for the voltage source function. However, if the suspend voltage cannot be output in the currently setting source range, the range switches to the output-enabled range in Operate status.

       Some examples for the above explanation are shown below.

Source function	Suspend voltage	Source range	Suspend voltage range	Source range switching
VS	0 V	5 V	5 V	No
	10 V	5 V	50 V	Yes
	10 V	50 V	50 V	No
IS	0 V	3 μA	5 V	Yes
	10 V	300 mA	50 V	Yes

2. Setting the output resistance in Suspend status

   Set selecting ***A) SOURCE*** and then ***3) Suspend Z*** in the menu.

   HiZ: High resistance output status. The current limit values are set to 100 nA (3 μA range).

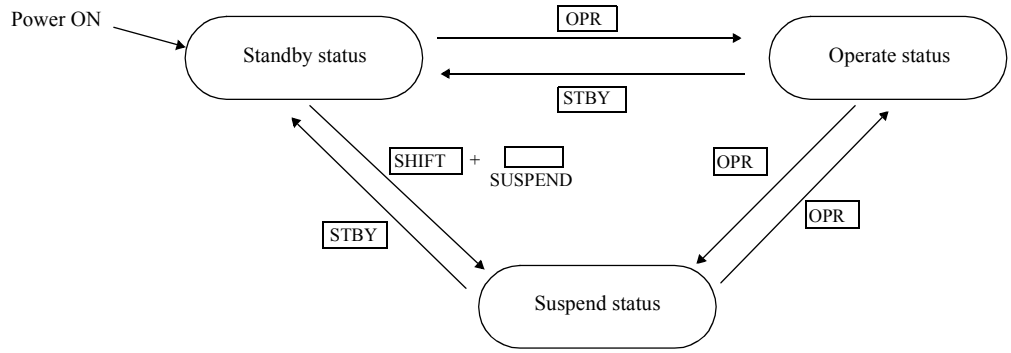
   LoZ: Low resistance output status.

   VS: The setting current limit values are applied.

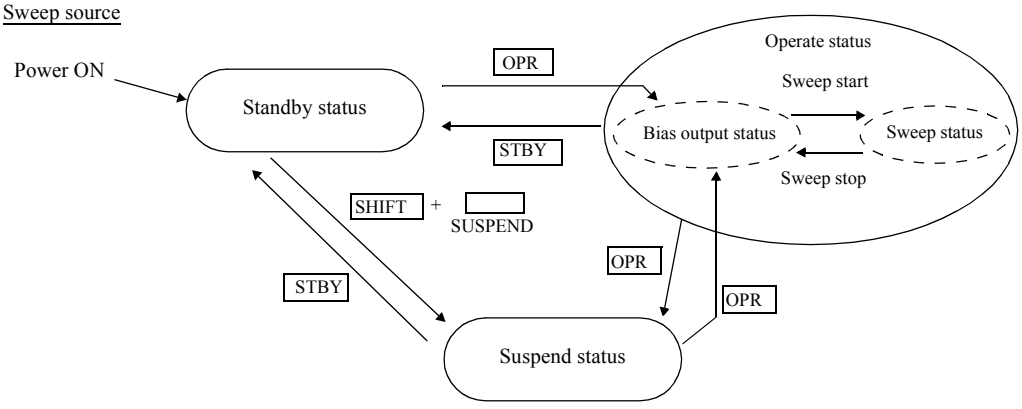
   IS: The current limit values are set to 100 digits (100 nA) when the IS range is 3 μA range, or 30 digits when it is other than 3 μA range.

3. Shifting between Operate, Standby, and Suspend

DC source/Pulse source



Sweep source



NOTE: ***The source data during sweep is generated with the following timing.***

1. Standby → Operate

2. Standby → Suspend

3. When Operate is set after changing the sweep parameters in Suspend status

5.2.5 Measurement Function

5.2.5.1 Measurement Function

The following measurement functions are available.

1. Voltage measurement function
2. Current measurement function
3. Resistance measurement function

   For the voltage source function, resistance values are displayed by measuring current.

   For the current source function, resistance values are displayed by measuring voltage.

   For more information on resistance value calculation for the pulse source mode, refer to Section 5.2.5.3 , "Measurement Delay Time and Measurement Value."

When the measurement function link mode is set to OFF, the measurement function can be selected independently from the source function. When it is set to ON, the measurement function is set according to the source function.
Use ***E) MEASURE*** and ***6) Mfunc Link*** to switch this mode ON or OFF.
When this mode is set to ON, the measurement function is set as follows by changing the source function.

- Voltage source function/current measurement function VSIM
- Current source function/voltage measurement function ISVM

Also, immediately after the measurement function link mode is set to ON, the measurement function changes according to the currently set source function as shown above.

NOTE: ***The resistance measurement function shows the following messages if it cannot normally execute resistance value calculation.***

Count Few:	***The current source value is below 20 digits, or current measurement value is below 200 digits.***
VSource=0:	***The voltage source value is 0.***
HiLimit RM:	***HI limiter status***
Lo Limit RM:	***LO limiter status***

5.2.5.2 Measurement Ranging

The measurement range is determined by the relationship between the measurement auto range ON/OFF and the source/measurement function.

Source function	Measurement auto range OFF		Measurement auto range ON	
	Voltage measurement	Current measurement	Voltage measurement	Current measurement
Voltage source	Fixed to the source range	Fixed to the limiter range	Fixed to the source range	✓
Current Source	Fixed to the limiter range	Fixed to the source range	✓	Fixed to the source range

✓: Auto range operation enabled (operates with the limiter range as the maximum)

NOTE: ***For the pulse source or pulse sweep source mode, the range is always fixed even when the measurement auto range is set to ON.***

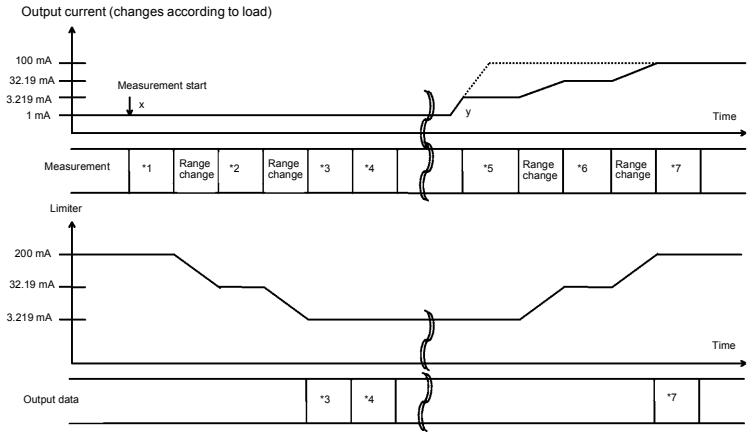
1. Operating range for the measurement auto range

   When the measurement auto range is enabled, the upper and lower range levels are within ±20 digits of the values shown in the table below.

Measurement function	Range	Auto range level	
		DOWN	UP
Voltage measurement (Positive)	5 V	-	5.01000
	50 V	04.9999	50.1000
	250 V	049.999	-
Voltage measurement (Negative)	5 V	-	1.01000
	50 V	00.9999	10.1000
	250 V	009.999	-
Current measurement (Positive/Negative)	3 μA	-	3.21000
	30 μA	02.9999	32.1000
	300 μA	029.999	321.000
	3 mA	0.29999	3.21000
	30 mA	02.9999	32.1000
	300 mA	029.999	-

2. Measurement auto range for the DC source mode

   The following example shows how the measurement range and the limiter range operate in the DC source mode.
   In this example, the current limit value is set to 200 mA. Current of 1 mA is measured and then 100 mA.

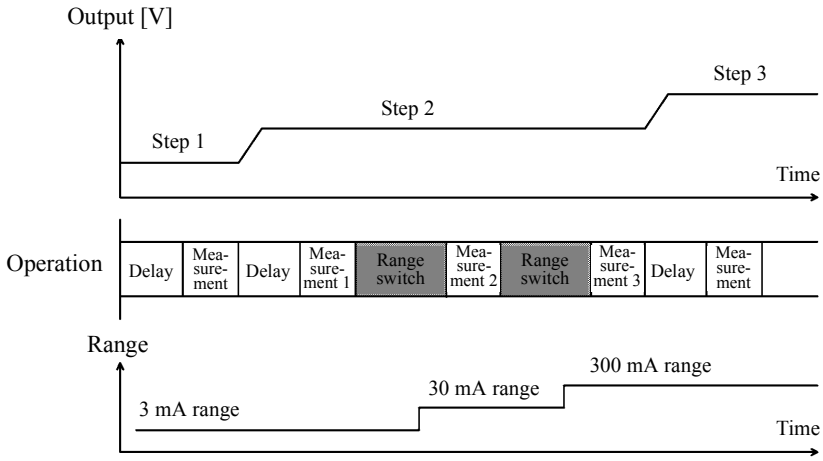


While the measurement auto range is enabled, the measurement is executed by changing the limit value to be larger than the full scale of the measurement range.

- For *1, the measurement result with 300 mA range is 1 mA, The auto range changes the range to 30 mA, and the limit value changes to the maximum value, 32.19 mA for the 30 mA range.
- For *2, the measurement result with the 30 mA range is 1 mA. The auto range changes the range, and the limit value changes to 3.219 mA.
- For *3, measuring with the 3 mA range outputs 1 mA measurement data.
- The output current is supposed to change to 100 mA at Point y. However, as the limit value is 3.219 mA, the output current is limited to 3.219 mA.
- For *5, the measurement result with the 3 mA range is 3.219 mA. This is over range (over 3.2 mA).
  The auto range changes the range to the 30 mA range, and the limit value also changes to 32.19 mA.
- For *6, the measurement result with the 30 mA range is 32.19 mA. This is over range.
  The auto range changes the range to the 300 mA range. However, the range is limited to the setting compliance current 200 mA.
- For *7, the measurement result with the 300 mA range is 100 mA and it is output as output data.

3. Measurement auto range during sweep

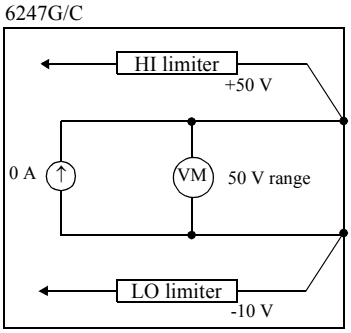
   While sweeping, measurements are performed in each step. When the measurement range is set to Auto, auto ranging continues until measurement data is determined in each step.



4. Measuring an eternal power supply with current source voltage measurement (ISVM)

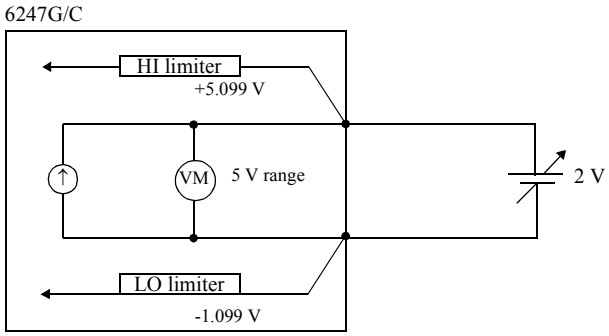
   When an external voltage is measured with Auto range by following the procedure below, overload (OVL) is detected and the output status is set to Standby.

   1. Set the current source to 0 A and the limit voltage to +50 V/-10 V.



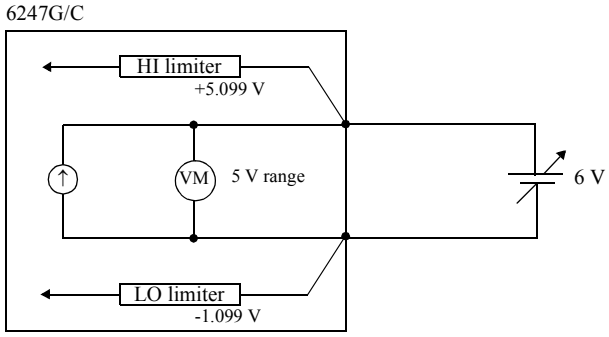
   The voltage measurement range with ISVM is set to the same as the voltage limiter range.

2. Connect the external power supply of 2 V.



Connecting 2 V causes the measurement auto range to set the measurement range to the 5 V range. Then the voltage limiter is also changed to the 5 V range. Therefore, the internal values +5.099 V and -1.099 V are set.

3. Increase the external power supply to 6 V



In this case, the external voltage exceeds the HI limit value.

Thus, before increasing the range, the auto measurement function detects voltage overload and sets the output status to Standby.

The operation above is unavoidable in principle.

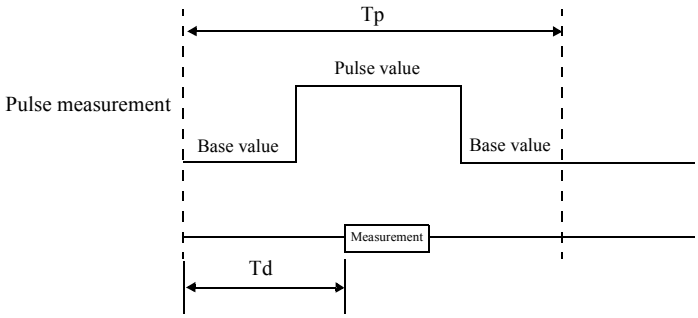
For using the 6247G/6247C under the above condition, do not use the measurement auto range.

NOTE:

1. ***In the current source function, apply an external VB voltage within the voltage limiter range.***
   $V_{LL} < VB < V_{HL}$
   If the voltage exceeds the limiter range, an overload (OVL) is detected and the output status is set to Standby.
2. ***For measuring an external voltage, set the measure range to fixed range.***
   When the external voltage is measured with the auto range, change in the external voltage sets overload (OVL).

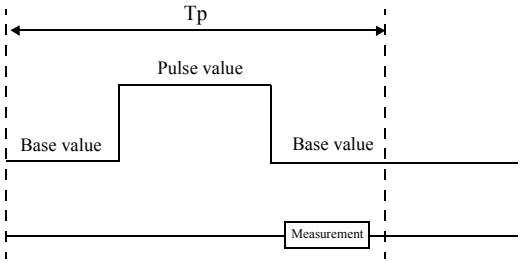
5.2.5.3 Measurement Delay Time and Measurement Value

1. Measurement at the pulse value timing



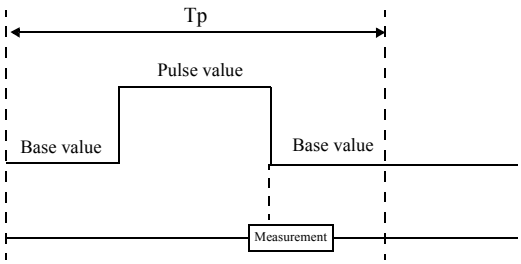
When displaying the resistance value, the calculation is made by the measurement value and the pulse value.

2. Measurement at the base value timing



When displaying the resistance value, the calculation is made by the measurement value and the base value.

3. Measuring at the timing overlapping with the pulse value and the base value



The measurement value changes depending on the time ratio of the pulse value to the base value in the measured time. The resistance value is calculated from the measurement value and pulse value, which makes the value inaccurate.

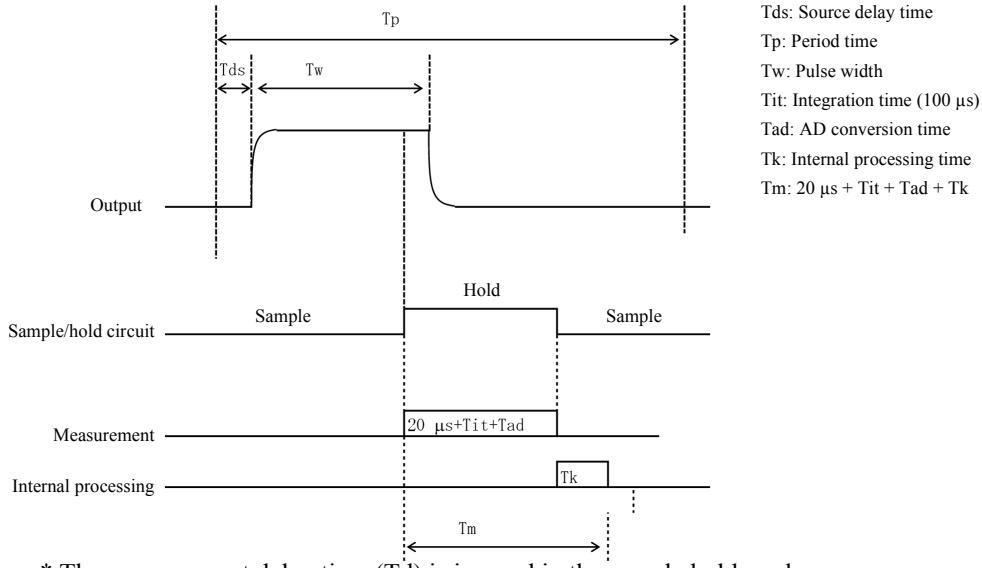
5.2.5.4 Measurement in Sample Hold Mode

The sample hold mode can be set only when the source mode is pulse mode or pulse sweep mode. Set this mode using the integration time parameter.

The measurement conditions in the sample hold mode are as follows:

- Source mode : Pulse mode or pulse sweep mode only
- Integration time : 100 µs
- Measurement timing : Holds immediately before pulse falling edge (pulse complete).
- Limit on executable period time : 600 ms max.

Sample hold measurement operation for pulse source is shown below.



* The measurement delay time (Td) is ignored in the sample hold mode.

Figure 5-12 Measurement in Sample Hold Mode

Beware of the following points when setting the sample hold mode.

- When the source mode is changed to DC mode or DC sweep mode, the sample hold mode is released and the integration time parameter becomes 100 µs. To use the sample hold mode again, set the integration time parameter to sample hold mode.
- In the sample hold mode, the period time setting range is from 500 µs to 600 ms. An error message appears at the following timing and the measurement does not start if it is set out of the range. Verify the setting range.
  - When the output status is switched from Standby to Operate or Suspend.
  - When the period time is changed in Operate or Suspend status.

NOTE: There is not any limit detection during measurement in the sample hold mode.

5.2.5.5 Auto Zero Function

The 6247G/6247C has a function for canceling offset drift of the AD converter. This "auto zero function" periodically measures the zero point and cancels drift.

When the Auto-Zero function is set to ON, auto zero operation takes place under the following conditions:

- More than 10 seconds have elapsed since execution of the previous auto zero operation and measurement has been completed.
  (However, auto zero operation is not performed when the memory store mode is set to Burst.)
- The integration time is changed.

NOTE: ***When the auto zero function is enabled in the pulse source mode or pulse sweep mode, the base value continues to be output until the auto zero operation is complete. Also, when the source mode is the DC sweep mode and the trigger mode is set to AUTO, the sweep does not move to the next step during the auto zero operation even if the period time ends.***
Therefore, the time for outputting the base value during pulse generation or the time for outputting the step source value during sweep is extended. If it is inconvenient, set the auto zero function to OFF.

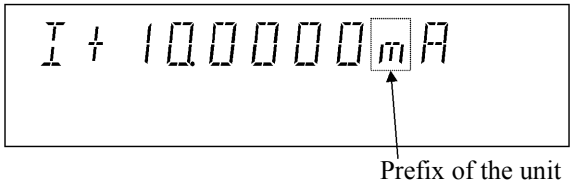
5.2.5.6 Switching Unit Display

Set the display unit by selecting the parameters ***E) MEASURE → 5) Disp Unit*** in the menu.

Prefix: Displays measurement data by using a decimal point and a unit symbol.

Exponent: Displays measurement data in an exponential form.

1. When displaying 10 mA with Prefix

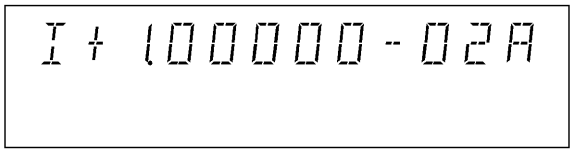


The following table shows the relation between prefixes of exponents.

Table 5-9 Relation between Prefixes and Exponents

Prefix	Text	Exponent
Y	yotta	10^{24}
Z	zetta	10^{21}
E	exa	10^{18}
P	peta	10^{15}
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}
z	zepto	10^{-21}
y	yocto	10^{-24}

2. When displaying 10 mA with Exponent



A decimal point is always after the first digit.
The unit is V, Ω or A.

5.2.6 Limiter (Compliance)

For voltage source, the current limiter is set. For current source, the voltage limiter is set.

Appropriate settings of these limiters can prevent DUT damage due to over-voltage or over-current.

The 6247G/6247C limiters for both voltage and current have HI and LO limit values and they can be set individually.

For the voltage limiter, the HI limit and the LO limit values can set not only bipolar, + /- but also homopolar, + / +, or -/-.

NOTE: ***When an external power supply (V_B) such as a battery is connected in the current source function, set the voltage limiter values (V_{HL}, V_{LL}) in the following range against V_B.***
$V_{LL} < V_B < V_{HL}$
If these values are set outside the above range, the 6247G/6247C detects overload (OVL) and then sets Standby.

5.2.6.1 Limiter Setting Ranges

The limit values can be set with the following conditions.

60 digits ≤ (HL value - LL value): Voltage limit values

200 digits ≤ (HL value - LL value): Current limit values in 3 μA range

---

NOTE:

1. ***Set the current limit values as large as possible within the required range.***
   The smaller the current limit values are, the longer the settling time is.
2. ***Set the voltage limit values as small as possible within the required range.***
   For cases where the setting current cannot be applied to a DUT, or the output terminals open, the output voltage reaches to the voltage limit values.

5.2.6.2 Setting Limiters

1. Setting Types

   For setting the current limit values, two types of limiter settings are available; one is ±Balance setting. This sets the same absolute value on both the polarities, + and -; the other is Separate setting. This sets a different value on each polarity.

   For setting the voltage limit values, only the Separate setting is available regardless of the limit value setting parameter.

   For more information on these settings, refer to Section 2.2.2, "Setting Limiter Values."

2. Setting ranges

   For the HI limit and the LO limit values, the ranges are always the same.

   The setting values are set in the optimal ranges.

3. Usage for Separate setting

   Setting both the HI limit and LO limit values to + (positive) voltage can be used for rechargeable battery charge and discharge testing.

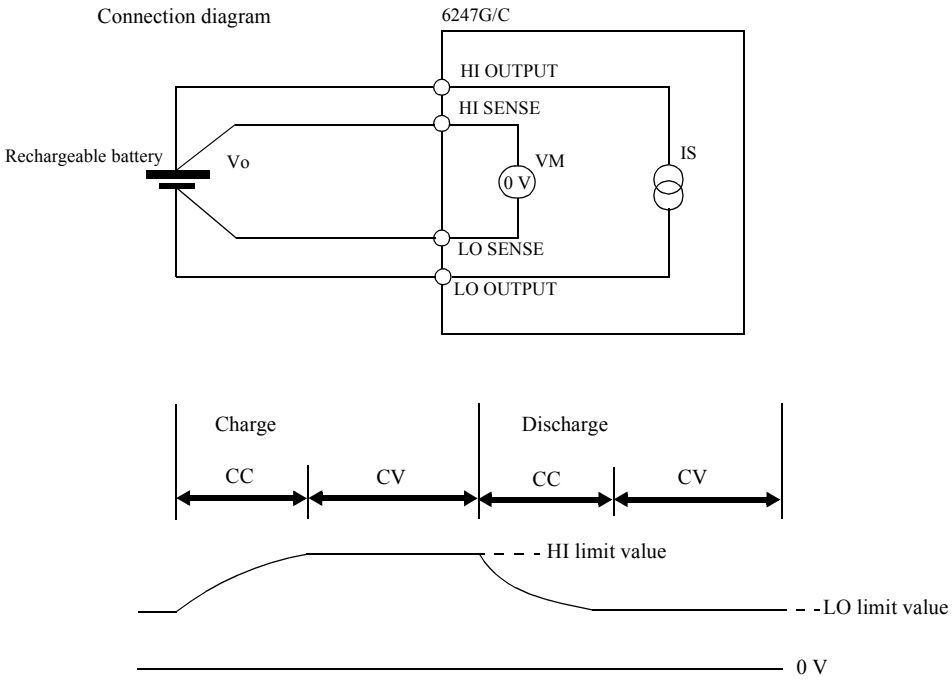


Figure 5-13 Rechargeable Battery Charge and Discharge Operations

Setting the HI limit value as voltage for charging constant voltage and the LO limit value as voltage for discharging termination provides CV/CC operation as shown in the above figure.

NOTE: ***From an external device applying higher voltage than the HI limit value or lower voltage than the LO limit value sets overload (OVL) and then Standby.***
For example, connecting a battery of lower voltage than the LO limit voltage results in overload (OVL) and then Standby.

5.2.6.3 Displaying and Outputting of Limiter Detection

Three indicators, LMT, HL, and LL are used for displaying the limiter detection.
LMT indicates that measured data is obtained in the limiter detection status.
HL and LL indicate that the limiter is currently being activated.
The following table shows a relation between limiter detection timing and display/remote output.

Display	Remote output		Buzzer
	Sub header	Status	
LMT	Yes	No	No
HL/LL	No	Yes	Yes

5.2.7 Alarm Detection

The following alarm detective function is available to prevent damage to the 6247G/6247C as well as the DUT. When any of these alarm conditions is detected, a message is displayed and output to the remote device event register, the error register and the header of measurement data.
The following table shows the messages and their descriptions and causes.

Table 5-10 Alarm Detection Contents

Message	Cause
Source Unit	Source unit malfunction
Fan Stopped	Malfunction
Over Heat	• Malfunction • Sink operation outside the specified range • The vents are blocked • Ambient temperature exceeds the specified range
Over Load	• Over voltage applied from an external device • Connecting to an external voltage source exceeding the voltage limiter setting • If output sensing is 4-wire connection, LO OUTPUT and LO SENSE may open
LMT/HL/LL indicator	The voltage or current limiter is activated.

- When Source Unit or Fan Stopped occurs, the output is set to Standby and operation is not possible until the power is turned on again.
- When Over Heat occurs, the output is set to Standby and operation is not possible until the cause of the error is removed.
- When Over Load occurs, the output is set to Standby.

5.2.8 Source and Measurement Timing

The 6247G/6247C's timing of source and measurement differs depending on the source mode as shown in Table 5-11.

To ensure accurate measurement, consider the relevant timing for source and measurement, and set the required parameters.

Table 5-11 Source Mode and Time Parameters to Be Considered

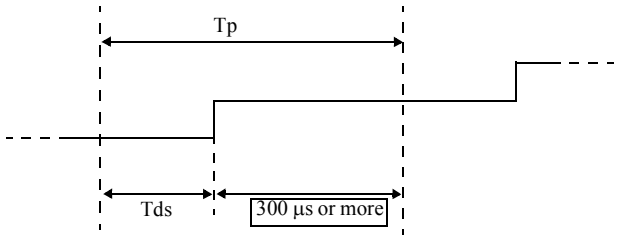
Source mode		Th	Tds	Td	Tw	Tp	Tm	Timing diagram
DC	Trigger mode AUTO			●		●	●	Table 5-2
	Trigger mode HOLD			●		●	●	
Pulse			●	●	●	●	●	Table 5-3
DC sweep		●	●	●		●	●	Table 5-5
Pulse sweep		●	●	●	●	●	●	Table 5-6

Item	Description	Category level	Select level Input/Run level
Th	Hold time	**MENU** key ↓ D) TIME	1) Hold Time
Tds	Source delay time		2) Src Delay
Td	Measurement delay time		3) Meas Delay
Tw	Pulse width		4) Pls Width
Tp	Period time		5) Period
Tm	Measurement time (Integration time + Processing time)	**MENU** key ↓ E) MEASURE	2) Integ Time

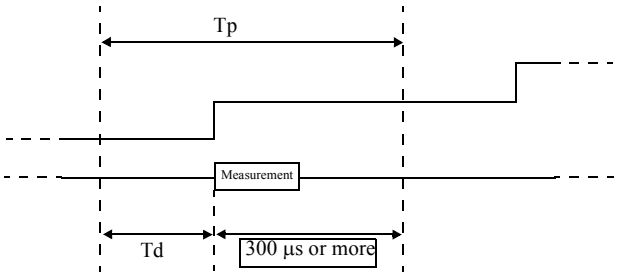
5.2.8.1 Restriction on Time Parameters

The time parameters have restrictions for setting in relation to the others. If the time parameters are set to exceed any of these restrictions, an error message is displayed when the output is set to Operate or when sweep starts, and measurement does not start.

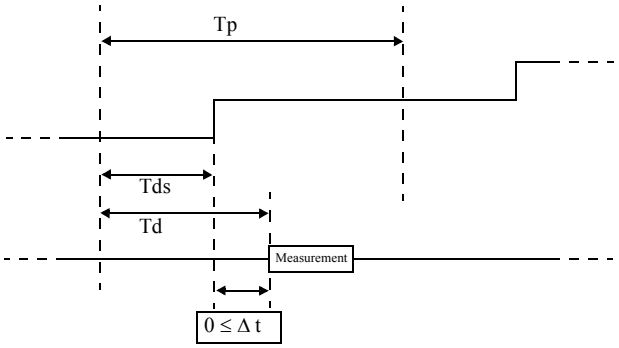
1. Restrictions
   - Source delay time (Tds) + 300 μs < period time (Tp)



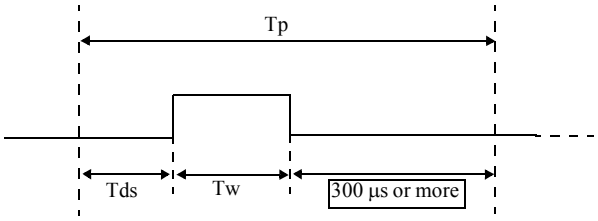
   - Measurement delay time (Td) + 300 μs < period time (Tp)



   - Source delay time (Tds) ≤ Measurement delay time (Td)



- Source delay time (Tds) + pulse width (Tw) + 300 μs < period time (Tp)



- Period time (Tp) ≤ 600 ms

  Conditions: Source mode Pulse mode or pulse sweep mode
  Integration time Sample hold mode

2. Relationship between restrictions and source mode

   The table below shows the relationship between the restrictions described above and the source mode.

Restriction	Source mode			
	DC	PLS	DC-SWP	PLS-SWP
[Tds + 300 μs < Tp]	-	✓	✓	✓
[Td + 300 μs < Tp]	✓	✓	✓	✓
[Tds ≤ Td]	-	✓	✓	✓
[Tds + Tw + 300 μs < Tp]	-	✓	✓	✓
[600 ms ≤ Tp]	-	✓	-	✓

3. Source delay time, measurement delay time and pulse width

   The setting resolutions of the source delay time, the measurement delay time and the pulse width are determined by the period time resolution. Values rounded off to the resolution are set.

Period time setting range	Resolution
0.500 ms to 60.000 ms	1 μs
60.01 ms to 600.00 ms	10 μs
600.1 ms to 6000.0 ms	100 μs
6001 ms to 60000 ms	1 ms

NOTE: Even if the measurement is set to OFF, the restrictions on the measurement delay time are valid.

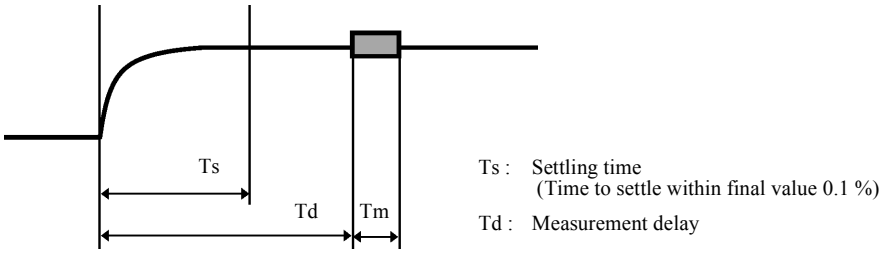
Consequently, the minimum setting values for each resolution are obtained as listed in the table below.

Period time	Resolution		
	10 µs	100 µs	1 ms
Source delay time (Tds)	30 µs	200 µs	2 ms
Measurement delay time (Td)	50 µs	200 µs	2 ms
Pulse width (Tw)	50 µs	100 µs	1 ms

NOTE: ***If set as Tp < (Td + Tm), the actual period becomes Td + Tm, and TpALM indicator goes ON. Auto zero may not be executed in some cases.***

5.2.8.2 Measurement Delay and Settling Time

In the pulse source or sweep source mode, the 6247G/6247C waits for a source value and the settling of a sample and then starts measurement.
This section describes the settling time of the 6247G/6247C and the measurement delay to be set.



1. Switching the settling time (response)

   Setting the settling time enhances the system throughput or reduces output noise to ensure stability with respect to L and C loads. Setting the settling time by selecting **A) SOURCE → 5) Response** on the menu screen.

   Fast : Fast mode

   Slow: Slow mode

2. Voltage source

   The settling time (Ts) of the 6247G/6247C is defined by the voltage source value (VS), the current limit values (digits), and the settling time setting (Fast/Slow), as shown below.

   Set the measurement delay (Td) to Ts or over.

   ① When VS is less than 10 V
   - Fast Ts = 80 × α × VS × SR [μs]
   - Slow Ts = 140 × α × VS × SR [μs]

   ② When VS is 10 V or higher
   - Fast Ts = α × VS / SR +140 [μs]
   - Slow Ts = α × VS / SR +700 [μs]

   α : Current limiter range coefficient

   VS: Source voltage [V]

   SR: Slew rate [V/μs]

α : Current limiter range coefficient				
Current limiter range	Response			
	Fast		Slow	
	①	②	①	②
3 μA	3	20	2	6
30 μA	2	3	1.5	2
300 μA	2	1.5	1.5	1.5
3 mA to 300 mA	1	1	1	1

SR: Slew rate				
Current limiter count value (digits)	Response			
	Fast		Slow	
	①	②	①	②
3000	0.2	0.5	0.2	0.1
2000	0.2	0.5	0.2	0.1
1000	0.4	0.4	0.4	0.1
500	0.5	0.3	0.5	0.08

(Example) Settling time (Ts) in the Slow mode with VS: 0 V → 3 V and IL: 3.000 mA

$Ts = \alpha \times 140 \times VS \times SR$

$= 1 \times 140 \times 3\ V \times 0.2 = 84\ \mu s$

3. Current source

The settling time (Ts) of the 6247G/6247C is defined by the current source value (Is), the current sense resistance (Rs), the load voltage (VRL = Is × RL), and the settling time setting (Fast/Slow), as shown below.

Set the measurement delay (Td) to Ts or over.

① When VRL is less than 10 V

- Fast/Slow $Ts = \beta \times (10 \times VRL) / (Is \times Rs) + 50$ (IS: 30 μA to 300 mA range)
- Slow $Ts = \beta \times (10 \times VRL) / (Is \times Rs) + 250$ (IS: 3 μA range)

② When VS is 10 V or higher

- Fast $Ts = \beta \times (2 \times VRL) / (Is \times Rs) + 100$ (IS: 30 μA to 300 mA range)
- Slow $Ts = \beta \times (10 \times VRL) / (Is \times Rs) + 500$ (IS: 30 μA to 300 mA range)
- Fast/Slow $Ts = \beta \times (10 \times VRL) / (Is \times Rs) + 100$ (IS: 3 μA range)

Rs value	
Range	Rs [Ω]
3 μA	220 k
30 μA	22 k
300 μA	2.2 k
3 mA	220
30 mA	22
300 mA	2.2

β: Current source range coefficient		
Current source range	Response	
	Fast	Slow
3 μA	10	10
30 μA	10	5
300 μA	2.5	1.5
3 mA to 300 mA	1	1

(Example) Settling time (Ts) in the Slow mode when 1 mA current is applied to 1 kΩ resistance in the 3 mA range.

VRL = 1 mA × 1 kΩ = 1 V

Ts= β × (10 × VRL) / (Is × Rs) + 50 = 1 × (10 × 1 V) / (1 mA × 220 Ω) + 50

= 95.5 μs ≒ 96 μs

5.2.8.3 Integration Time and Measurement Time

The measurement time (Tm) is calculated from the integration time (Tit) and the internal processing time (Tk) according to the following formula:

Tm = Tit + Tk

The integration time (Tit) can be selected between 100 μs to 200 ms.

The internal processing time (Tk) is determined by the source mode and memory store mode settings as below.

Source mode	Memory store	Tk [ms]
DC Pulse	OFF	Approx. 4
	Normal-ON	Approx. 4
	Burst-ON	Approx. 1
DC sweep Pulse sweep	OFF	Approx. 5
	Normal-ON	Approx. 5
	Burst-ON	Approx. 1

When the memory store mode is OFF or Normal-ON, the following processing times are added by NULL calculation, scaling calculation, Max/Min calculation, and comparator calculation.

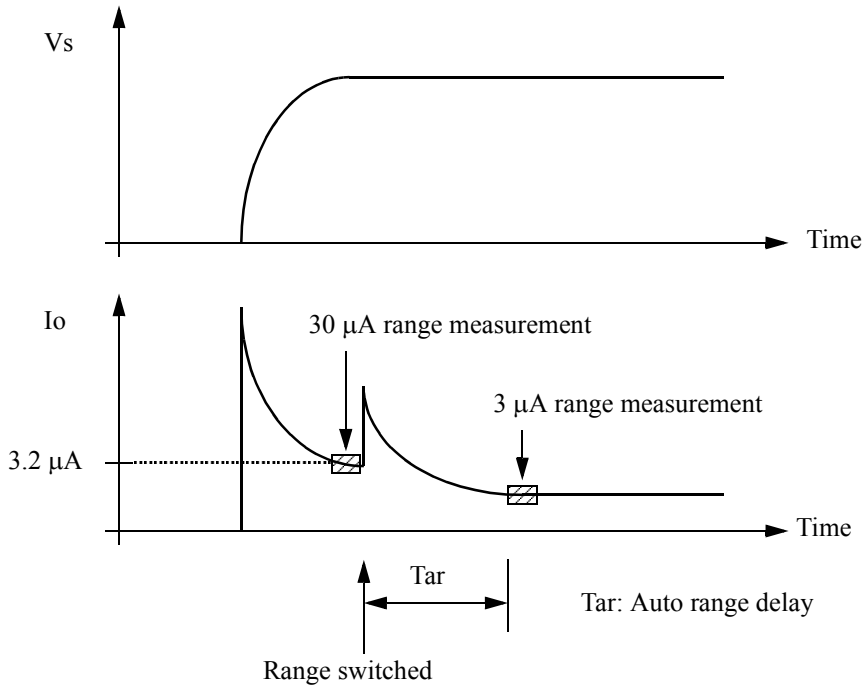
NULL calculation ON: Approx. 0.2 ms
Scaling calculation ON: Approx. 1 ms
Max/Min calculation ON: Approx. 1 ms
Comparator calculation ON: Approx. 15 ms
In measuring resistance: Approx. 1 ms

(Example) DC source mode, integration time: 1 PLC (50 Hz), memory store: Normal-ON, NULL calculation: ON, scaling calculation: ON, Max/Min calculation: ON, comparator calculation: ON
In these conditions, the measurement time is calculated as follows:
Tit = 20 ms
Tk = 4 + 0.2 + 1 + 1 + 15 = 21.2 ms
Tm = Tit + Tk = 41.2 ms

5.2.8.4 Auto Range Delay

The auto range delay function is used when a capacitive load (C_L) is measured by voltage source current measurement (VSIM).

When voltage is applied to C_L and current is measured in Auto range, after C_L is charged the current value drops and the measurement range decreases. This function delays the measurement for the temporal response in the current value that occurs when the measurement range is switched.



The auto range delay function is enabled only in the current measurement (IM) auto range.
It does not work in the fixed range or voltage measurement (VM).

The auto range delay (Tar) is set as a value with respect to the 3 µA range. For other ranges, the values in 1/10 multiples are set, as shown in the table below.

Measurement range	Setting value	Example
3 µA	Tar	5000 ms
30 µA	Tar/10	500 ms
300 µA	Tar/100	50 ms
3 mA	Tar/1000	5 ms
30 mA or higher	0	0 ms

- Tar measure

  Calculate the Tar setting using the expression below.

  $$Tar = \frac{C_L \times 50\ mV}{3.2\ \mu A} = 15000 \times C_L \qquad [s]$$

  (Example) If $C_L = 1\ \mu F$
  $Tar = 15000 \times 1\ \mu = 15\ ms$
  Set Tar = 15 ms

5.2.9 Calculation Functions

5.2.9.1 NULL Calculation

NULL calculation is used to cancel leak current or offset value.

a. Calculation expression

R = X - Xnull X: Present measurement data
Xnull: NULL data

b. Timing to acquire NULL value (Xnull)

- After the NULL calculation is set to ON, the next measured data item is acquired as NULL value.
- The timing of NULL value acquisition in DC operation is shown below.

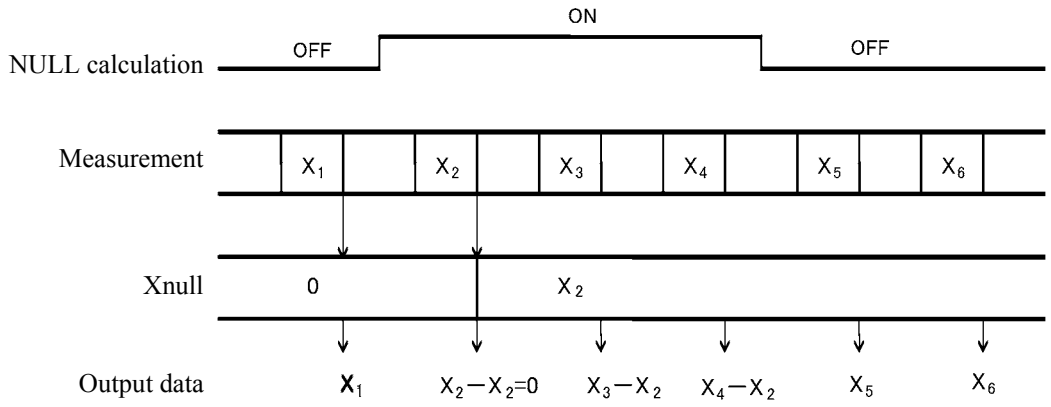


Figure 5-14 NULL Calculation Timing

- The NULL indicator goes ON when the NULL calculation is ON.
- The NULL value is rewritten when the NULL calculation switches from OFF to ON or when the NULL calculation is initialized.
- If the measured value is over-range data and the NULL calculation is turned ON, the display shows Over Range. The first data item after the Over Range is released becomes the NULL value.
- If the NULL calculation result is over the full scale of the present measurement range, it displays up to the double value of the full scale.
- The NULL calculation is turned OFF by changing the measurement function or executing the *RST command.
- The NULL value can be changed while the NULL calculation is ON.
  Select and set items, ***I) CONST*** and ***6) Null Value*** on the menu screen.
  The setting range is between 0 to ±9.99999E + 26.

5.2.9.2 Scaling Calculation

1. Calculation expression

   The scaling calculation is defined using the following formula:

$$\text{Scaling calculation} = \frac{\text{X-Constant B}}{\text{Constant A}} \times \text{Constant C}$$

   X: Measurement value

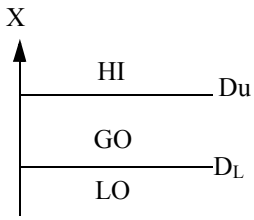
2. Operation
   - When the scaling calculation is ON, the MATH indicator goes ON.
   - The set ranges of Constant A, Constant B, and Constant C are 0 to ±9.99999+E26 (however, Constant A ≠ 0).
   - If the calculation result exceeds ±9.99999E + E26, it is scaling-over and the error message ±SCL Over is displayed.
   - The scaling calculation is turned OFF by executing the *RST command.
   - Changing the measurement function does not turn OFF this calculation.

5.2.9.3 Comparator Calculation

1. Calculation expression

   The result of the comparator calculation is judged as shown below:

   Du < X ..... HI
   $D_L \leq X \leq Du$ ..... GO
   $X < D_L$ ..... LO



X: Measurement value
Du: Upper limit value
D_L: Lower limit value

   - When the measurement data is over range, + (positive) data is judged as HI and - (negative) data is judged as LO.
   - The comparator calculation is executed against a NULL calculation result when the NULL calculation is ON.
     When the NULL calculation result data is over range, + (positive) data is judged as HI and - (negative) data is judged as LO in the same way.
   - Because the internal measurement and calculation resolutions are smaller than the display resolution, the displayed data may be judged as HI or LO when X = D_L, X = Du respectively.

2. Calculation result output

   The calculation result is output to the output data header and the device event register in the status register. Also, HI, GO, and LO signals selected with negative pulses are output to the COMPLETE OUT output terminal on the rear panel.

3. Operation

   - All the indicators goes ON when the comparator calculation is ON. , , or indicator goes ON depending on the calculation result of HI, GO, or LO.
   - The setting range for the upper and lower limits is between 0 to 9.99999 + E26.
   - The comparator calculation is turned OFF by executing the *RST command.
   - Changing the measurement function does not turn OFF this calculation.
   - When the comparator calculation result meets with the alarm condition, the comparator buzzer sounds. Select the parameters, ***M) SYSTEM*** and ***2) Compare Buz*** on the menu screen to set the alarm condition.

5.2.9.4 Max/Min Calculation

1. Calculation expression

   The Max/Min calculation obtains the maximum, minimum, average, and total values while the calculation is set to ON.

2. Calculation result

   Select the parameters, ***H) COMPUTE*** and ***4) View Mx/Mn*** on the menu screen to refer to the results.

   1. Number of measurements (a: Sample)
   2. Maximum value (b: Maximum)
   3. Minimum value (c: Minimum)
   4. Average value (d: Average)
   5. Total value (e: Total)

3. Operation

   - Valid data except over-range data and error data is calculated.
   - When the maximum or minimum value is updated with the notice buzzer set to ON, the buzzer sounds. However, the buzzer may also sound when the displayed data does not change. This is because the measurement resolution is smaller than the display resolution.
   - The Max/Min calculation is turned OFF by changing the measurement function or executing the *RST command.
   - The calculation result is cleared and the calculation restarts under the following conditions:

     1. Switching the NULL calculation between ON and OFF
     2. Changing the NULL value
     3. Switching the scaling calculation between ON and OFF

5.2.10 External Control Signals

These signals are I/O signals for synchronizing multiple units, scanner or DMM control, and interlock or other external controls.

The following table shows the signal names, levels and functions.

Table 5-12 External Control Signal Functions

Signal	Input/ Output	Level	Impedance	Function
TRIGGER IN	Input	TTL negative pulse (2 μs or more)	Approx. 4.7 kΩ	• Starts measurement in the DC source mode. • Outputs pulses in the pulse source mode. • Starts the sweep source mode. • Step-up
COMPLETE OUT *1	Output	TTL negative pulse (10 μs or more) *3	Approx. 100 Ω open drain (Pulled up to +5 V with 10 kΩ)	• Measurement start signal (FRONT) • Measurement complete and period complete signal (END) • Comparator calculation result signal (HI/GO/LO)
SYNC OUT *1	Output			• Pulse output signal in the pulse source mode • Step-up signal in the sweep source mode
INTERLOCK IN *2	Input	TTL negative level	Approx. 10 kΩ	• Sets Standby when the signal level changes from LO to HI. • When the signal is HI or the input is Open, the output cannot be changed to Operate.
STBY IN *2				• Sets Standby when the signal level changes from LO to HI.
OPR/STBY IN *2				• Sets Standby when the signal level changes from LO to HI. • Sets Operate when the signal level changes from HI to LO.
OPR/SUS IN *2				• Sets Suspend when the signal level changes from LO to HI. • Sets Operate when the signal level changes from HI to LO.
OPERATE OUT *2	Output	TTL negative level *3	Approx. 100 Ω open drain (Pulled up to +5 V with 10 kΩ)	• Outputs LO in Operate status. • Outputs HI in Standby or Suspend status.

*1, *2: The same terminal is used by switching respectively.
*1: The SYNC OUT signal is not output in the DC source mode.
*3: The output signal pulse width can be se to 100 μs.

5.2.10.1 Restrictions on Using External Trigger

This section describes restrictions on using the external trigger (TRIGGER IN signal).

As slave in the synchronized operation, the TRIGGER IN signal controls the source and measurement timings to synchronize with external devices.
Confirm the following restrictions before inputting the external trigger to prevent any malfunctions.

Restrictions:

1. Do not input the TRIGGER IN signal in Standby status, or when switching between Operate, Suspend, and Standby.
2. Ensure that the TRIGGER IN signal, trigger from the TRG key and remote trigger (*TRG) do not overlap.
3. Restrictions on setting the pulse period Tp and the hold time Th
   When the external trigger (TRIGGER IN signal) is used, there are restrictions on setting the pulse period Tp and the hold time Th. (See Table 5-13 and Table 5-14.)
4. Restrictions on the time Thp (ext) from sweep start to the next trigger signal input
   For the sweep source mode, there are restrictions on setting the time Thp (ext) from the trigger signal input for sweep start to the trigger signal input for the next step. (See Table 5-13 and Table 5-14.)
5. Restrictions on the required time Top from specifying Operate to inputting the external trigger
   The minimum time is required for the time Top from specifying Operate by a remote command or the external signal (OPR In signal) to inputting the external trigger. (See Table 5-15.)
6. Allow the 6247G/6247C at least 10 ms after completion of the previous sweep to input the TRIGGER IN signal for sweep start.

Table 5-13 Restrictions on Tp, Tp (ext), Th, and Th (ext)

Measurement	Memory mode	Tp, Tp (ext)	Tp (ext) min	Th, Th (ext)	Thp (ext)
OFF	BURST	1 ms ≤ Tp ≤ Tp (ext)-TA	1.3 ms	1 ms ≤ Th ≤ Th (ext)-3 ms 4 ms ≤ Th (ext)	Thp (ext)= Th (ext)+Tp (ext)
	NORMAL	10 ms ≤ Tp ≤ Tp (ext)-TA	15 ms		
	OFF				
ON	BURST	2.2 ms ≤ Tp ≤ Tp (ext)-TA	2.5 ms		
	NORMAL	10 ms ≤ Tp ≤ Tp (ext)-TA	15 ms		
	OFF				

Table 5-14 TA Value

Memory mode		Tp Setting time
BURST	NORMAL, OFF	
300 µs	5 ms	1.000 ms to 60.000 ms
400 µs		60.01 ms to 600.00 ms
500 µs		600.1 ms to 6000.0 ms
2 ms		6001 ms to 60000 ms

Table 5-15 Restriction on Top

Status before Operate		Top
Standby		120 ms *1
Suspend	HIZ	60 ms
	LOZ	10 ms

Tp: Setting period time

Th: Setting hold time

Tp (ext): TRIGGER IN signal period time

Th (ext): TRIGGER IN signal hold time
(Time from sweep start trigger input to source value generation)

Thp (ext): Time from sweep start trigger input to next step trigger input

Top: Time from specifying Operate to inputting TRIGGER IN signal

*1: Approximately the time of "the number of steps × 0.5 ms" is added in the sweep source mode.

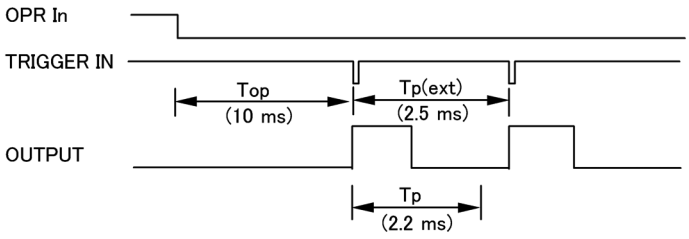
Tp (ext) min: The minimum operational period of the TRIGGER IN signal

Conditions:
source range; fixed, measurement range; fixed, trigger mode; HOLD, integration time; 100 µs, Auto Zero; OFF, measurement delay;100 µs, source delay; 30 µs, pulse width; 500 µs, at high-speed burst operational status in the BURST mode (*2)

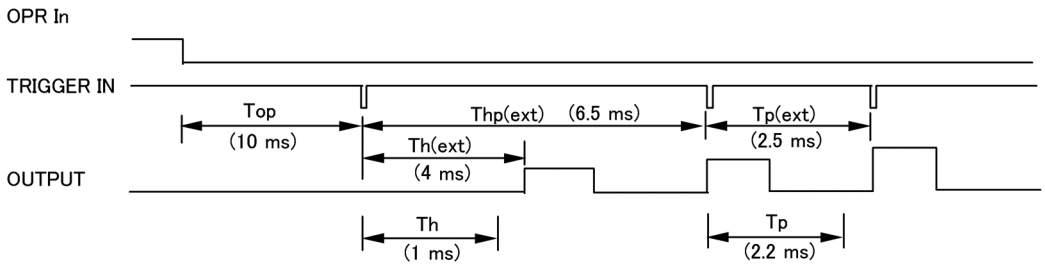
*2: High-speed burst operational status
The High-speed burst operational status starts when the TRIGGER IN signal is input with the conditions: measurement range; fixed, SWP range; fixed, trigger mode; HOLD, and memory mode; BURST. And it is as follows:

- The indicator is always displayed rotating.
- Pressing the TRG key or executing the *TRG command is ignored until the source measurement condition is changed or Suspend or Standby is specified.
- When TpALM turns on, this operational status stops and the step time becomes the same as NORMAL and OFF.

- When the source mode is PLS (Minimum value with the memory mode; BURST and measurement; ON)



- When the source mode is PLS SWP (Minimum value with the memory mode; BURST and measurement; ON)



5.2.10.2 Scanner Control

This section shows an example of controlling the 7210 scanner.

In this example, the measurement is performed in the pulse source mode and the channels of the 7210 are switched by the COMPLETE OUT (END) signal. The following shows the connection diagram and the timings.

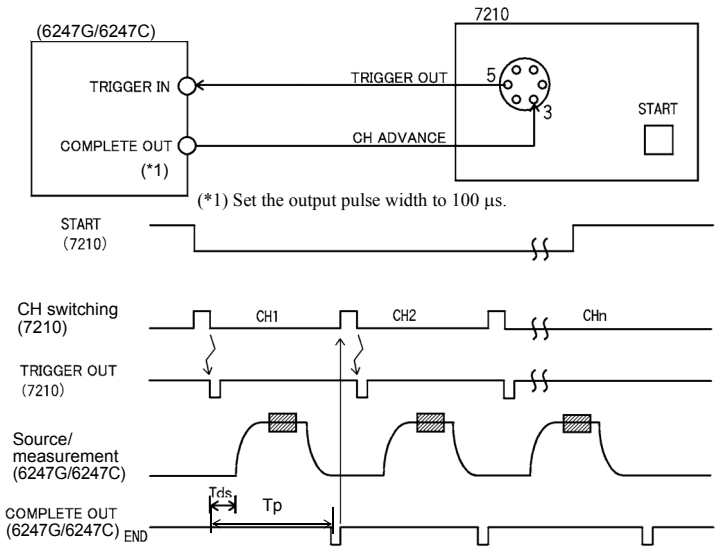


Figure 5-15 Scanner Control

5.2.11 Operating Multiple 6247G/6247C

This section describes synchronous operation, serial connection, and parallel connection using more than one 6247G/6247C.

5.2.11.1 Synchronous Operation

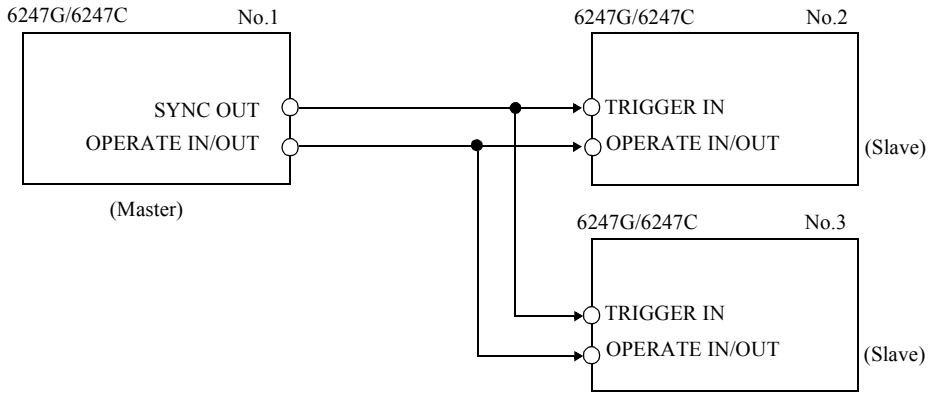
The synchronous operation of multiple 6247G/6247C units allows synchronization of measurement timing in the DC source mode, as well as allowing synchronization of both source and measurement in the pulse source mode and the sweep source mode.

The timing control for the synchronization is performed by the external control signals; TRIGGER IN, SYNC OUT and OPERATE OUT, and the time parameter settings such as measurement delay and source delay.

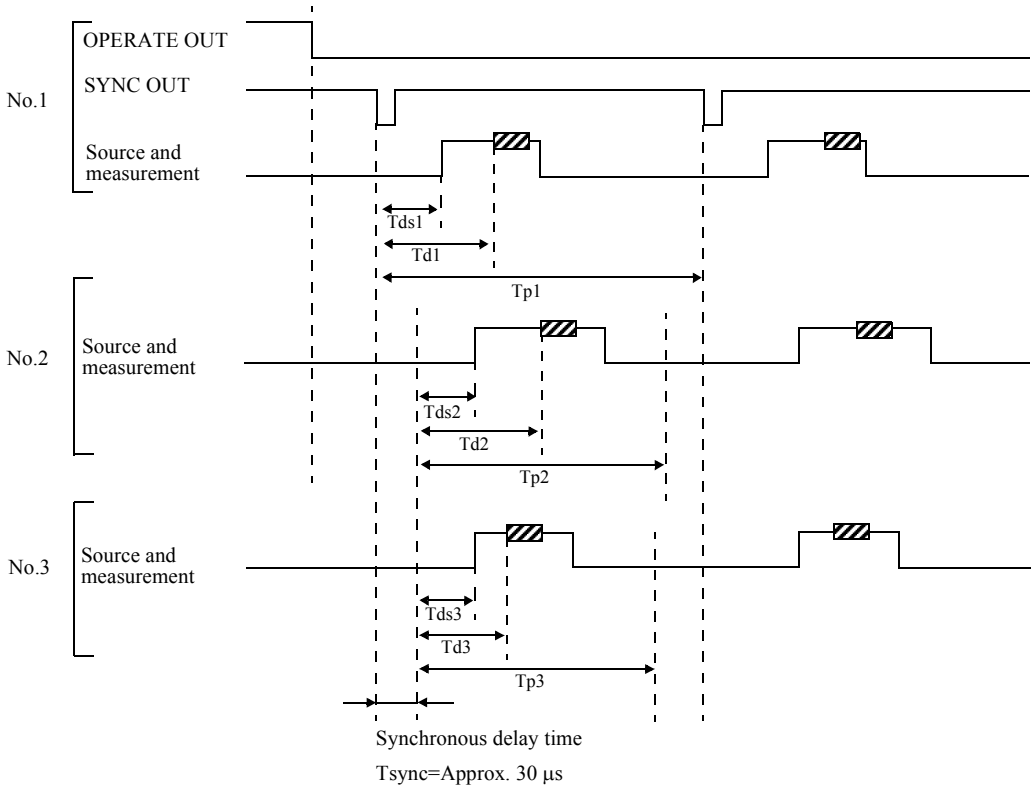
1. Three unit synchronous operation using SYNC OUT
   - Setting

Parameter	No.1	No.2	No.3
SYNC OUT control signal	SYNC OUT	-	-
OPERATE IN/OUT control signal	OPERATE OUT	OPR/SUS IN	OPR/SUS IN
Trigger mode	AUTO	HOLD	HOLD

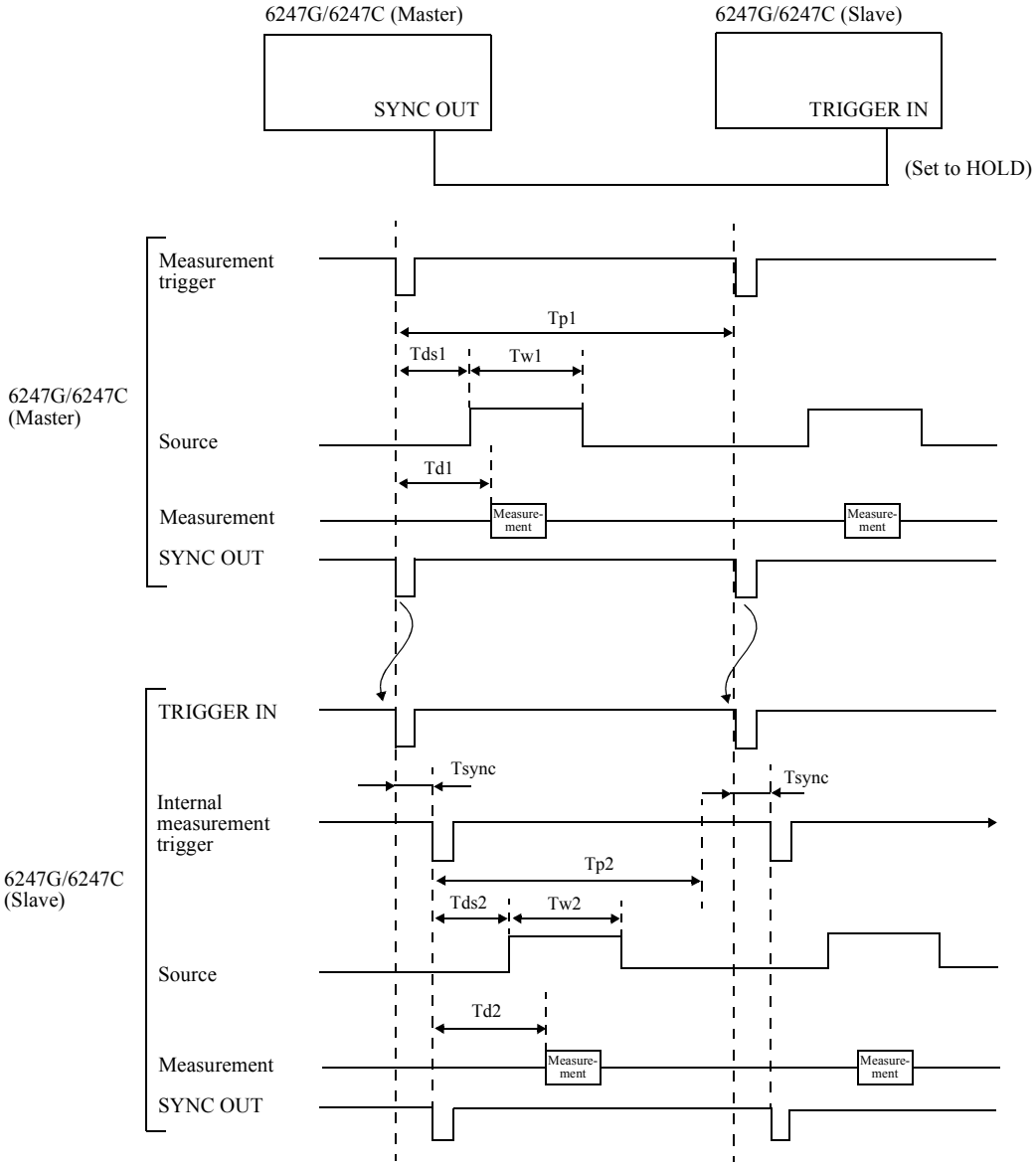
   - Connection



- Operational Timing



2. Restrictions on setting
   - The 6247G/6247C has a Tsync (approx. 30 µs) time delay from the external trigger input to the measurement start. Consider this time delay when using two or more 6247G/6247 units in synchronous operation.
   - For all three units, set the measurement range to Fixed and auto zero to OFF.
   - Using the external trigger has restrictions on setting Tp and Th for slaves. (Refer to Section 5.2.10.1).
   - The first synchronous sweep step has a gap within the Th accuracy range.



Thus, consider the Tsync time and set the relevant setting as follows:

1. Tds2 ≅ Tds1 - Tsync
2. Td2 ≅ Td1 - Tsync
3. Tw2 ≅ Tw1
4. Tp2 ≤ Tp1-T_A

5.2.11.2 Serial Connection

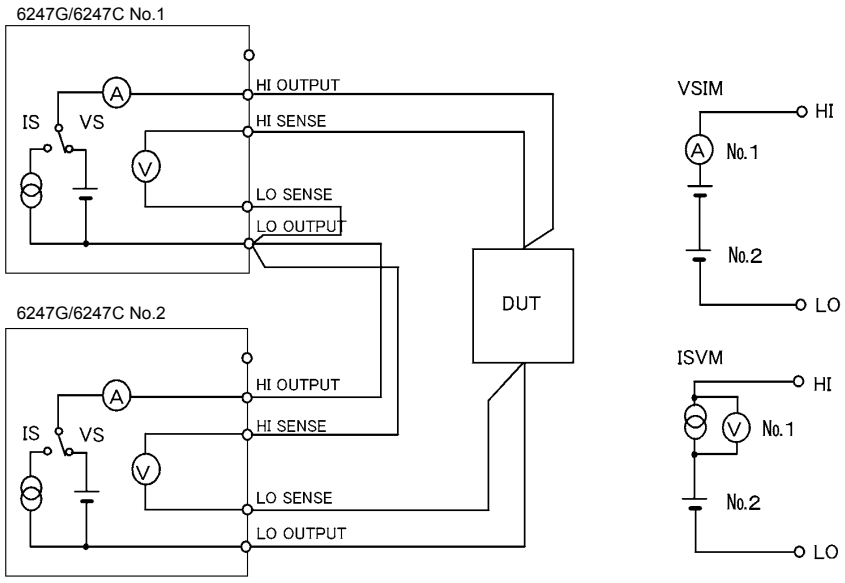
Two 6247G/6247C units serially connected can generate up to - 30 V to +500 V/±320 mA.

The following figure shows a connection diagram in which two units are serially connected using a 4-wire connection. The SENSE connection is not required for a 2-wire connection.

In ISVM serial connection, when the load voltage is less than 250 V against the setting current source value of No.1, set the constant voltage source value of No.2 to 0 V.

When the load voltage is 250 V or higher, set the source value as follows:

No.1 setting voltage (250 V) + No. 2 setting voltage > Load voltage



Output voltage = No. 1 output voltage + No. 2 output voltage (for constant voltage)
Output current = The smaller setting currents of No.1 and No.2 (for constant current)

Figure 5-16 Serial Connection

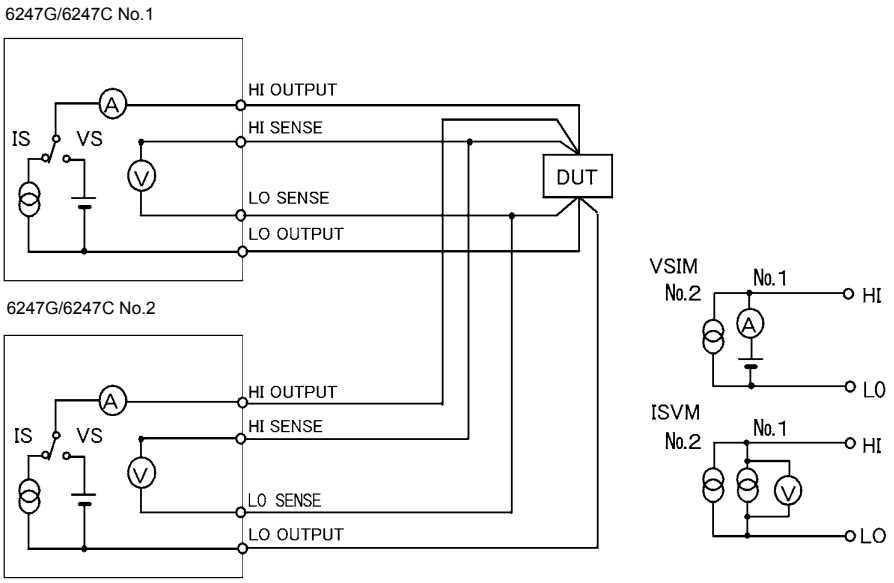
CAUTION:

1. ***If the load is short-circuited, the two 6247G/6247C units apply reverse polarity voltage to each other. Depending on the settings, an overload may be generated when a short circuit occurs.***
2. ***Only two units can be connected serially. Do not connect three or more units serially. If the load is short-circuited, the maximum applicable voltage will be exceeded, and the 6247G/6247C may be damaged.***
3. ***When using constant current, the smaller setting current of No.1 and No.2 becomes constant current as in Figure 5-16. The other one becomes the constant voltage.***
4. ***Always set the source response of the serially-connected units to the same.***

5.2.11.3 Parallel Connection

Two 6247G/6247C units connected in parallel can generate up to ±640 mA/-15 V to +250 V.

The following shows a connection diagram in which two units are connected in parallel using a 4-wire connection. Two units are used for voltage measurements at two points of different timing, such as for a pulse charge and discharge test of a battery.



Output voltage = The smaller setting voltages of No. 1 and No. 2 (for constant voltage)
Output current = No.1 setting current + No. 2 setting current (for constant current)

Figure 5-17 Parallel Connection

CAUTION:

1. ***If the load is opened, current flows from the higher to the lower of the set voltage. Depending on the settings, an overload may be generated.***
2. ***If the load is opened when three or more units are connected in parallel, which one to be used as source and the other to be used as sink are decided by the setting voltage, and the voltage control is performed in accordance with this balance.***
3. ***Always set the source response of the connected units in parallel to the same.***

5.2.12 Measurement Data Memory Function

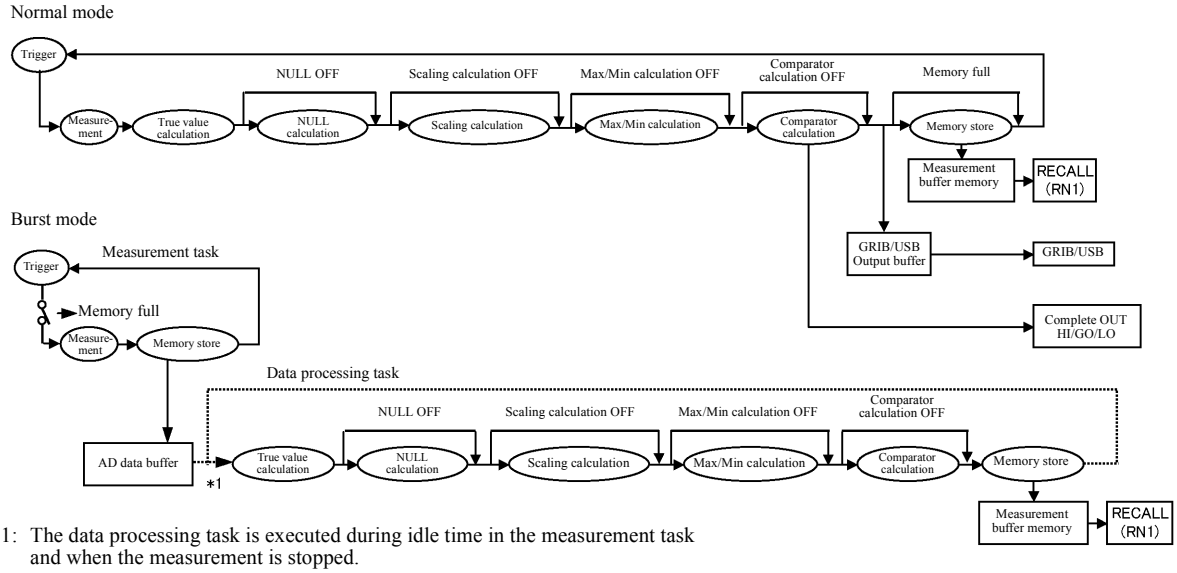
The 6247G/6247C features a measurement data memory for storing up to 8000 measurement data items.

This section describes how data is stored in and cleared from the measurement data memory.

5.2.12.1 Memory Store

Two ways of storing the measured data are available; Normal mode and Burst mode. Select the parameters, ***F) MEMORY*** and ***1) Store Mode*** on the menu screen to set the Normal mode or Burst mode.

Figure 5-18 shows a conceptual diagram for storing measured data. Table 5-16 compares the operations in the Normal mode and the Burst mode.



*1: The data processing task is executed during idle time in the measurement task and when the measurement is stopped.

Figure 5-18 Conceptual Diagram of Memory Store

Table 5-16 Comparison of Memory Store Operations

		Normal	Burst
Recommended usage		Low-speed measurement When storing measured data for regular measurement such as DC or pulse measurement	High-speed measurement When reading the measured data after measuring a certain number of times such as sweep measurement
Minimum repeat time (*)		10 ms	2 ms
Measurement data display		Displayed in real time	Displayed in idle time of measurement tasks, or when measurement is not performed.
Data output	Reads the latest data by the ENTER key.	Available	Not available
	RECALL and RN1 commands	Available	
Operation at memory full		The ST indicator blinks. MFL (bit 10) of the device event status register is set.	
		Storing data is stopped.	Measurement stops. Sweep mode: STOP DC or pulse mode: HOLD
Comparator calculation results	Complete Out HI/GO/LO signal	Output in real time	Not output
	Buzzer		
	HI/LO/GO display		Displays in idle time of measurement tasks, or when measurement is not performed.
Flag for the specified number of memory stored data reached Device Event Status Register ASM (bit4)		This flag bit is set when the number of measured data reaches the specified number of stored data in the measurement buffer memory (using the RNM command).	

(*) Integration time: 100 µs. Source delay: 30 µs. Measurement delay: 100 µs.

NOTE: ***In the following cases, store mode ON/OFF and storing operation changes cannot be performed.***
- ***During auto trigger mode in the DC or pulse source mode***
- ***During sweep operation in the sweep source mode***

5.2.12.2 Memory Clear

The memory data is cleared in the following conditions:

- When Memory Clear is executed on the menu screen
- When the RL command is executed
- When the store mode is switched from OFF to Normal
- When the store mode is switched from Burst to Normal
- Power ON

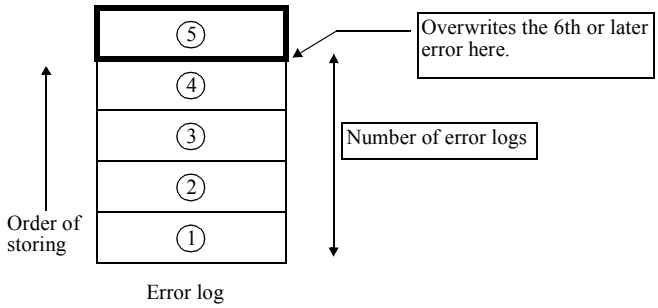
5.2.13 Error log

The 6247G/6247C holds the error number in the error log memory when it detects an error.

1. Operation

   A maximum of five memory areas are available for error logs and they operate as follows:

   - A maximum 5 error numbers are stored in the order of detection.
   - If detection exceeds more than 5, then the fifth error log is overwritten by the last error.
   - The ERR indicator goes ON when an error log is stored.



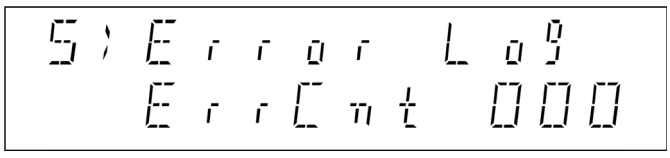
2. Clearing an error log

   The error logs are cleared in the following conditions and the ERR indicator goes OFF. However, the error logs are not cleared by the *RST command.

   - Power ON
   - When reading the error logs (The error logs are cleared after displaying the error log screen and completing the menu screen.)
   - When the ERR? or *CLS command is executed.

3. Reading out error logs

   Select the parameters, ***M) SYSTEM*** and ***5) Error Log*** on the menu screen.

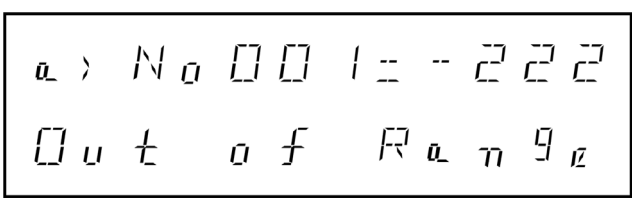


   The number of errors is displayed.

   Press ◻ to display the error contents.

   Turn ◯ to change the error log number.

   An error message such as the one below appears if the entered value is set out of range.



5.2.14 Self Test

The 6247G/6247C can self-test internal operations by turning on the power, executing the remote command, or manual operation.

1. For more information on the self-test items and output results, see Table 5-17.

Table 5-17 Self-Test Items (1 of 2)

	Error code	Description	Execution method			Message	TER register (*1)	
			Power ON	*TST?	Key operation		Register	Data
1	001	ROM check SUM	●			ROM Chk SUM	-	-
2		LCA data	●			(Buzzer only)		
3	004	RAM read/write	●			RAM Rd/Wt		
4	002	Display section communication	●			Panel Comm		
5	005	Analog section communication	●	●	●	Analog Comm		
6	008	FLASH writing error	●			Flash Write		
7	012	CAL data SUM	●	●	●	CAL data SUM	a	2
8	013	Parameter SUM	●	●	●	Param SUM		4
9	501	Calibration data lost	●	●	●	CAL dt Lost		16
10	502	Saved data lost	●	●	●	Save dt Lost		32
11	503	Saved parameter data lost	●	●	●	Para dt Lost		64
12	130	SCI communication error	●	●	●	No resp SCI		128
13	101	AD operation IR1/IR2 ratio	●	●	●	AD Ratio 1-2	b	1
14	102	AD operation IR2/IR3 ratio	●	●	●	AD Ratio 2-3		2
15	103	AD operation IR3/IR4 ratio	●	●	●	AD Ratio 3-4		4
16	104	AD operation IR4/IR5 ratio	●	●	●	AD Ratio 4-5		8
17	111	Analog section SRT line test	●	●	●	ADRST Sig		16
18	112	Analog section TRIG line test	●	●	●	ADTRG Sig		32
19	152	AD operation ZERO	●	●	●	AD Zero		128

5.2.14 Self Test

Table 5-17 Self-Test Items (2 of 2)

	Error code	Description	Execution method			Message	TER register (*1)	
			Power ON	*TST?	Key operation		Register	Data
20	201	VSVM 5 V ZERO	●	●	●	VSVM 5V Zero	c	1
21	202	VSVM 5 V +FS	●	●	●	VSVM 5V +FS		2
22	203	VSVM 5 V -FS	●	●	●	VSVM 5V -FS		4
23	204	VSVM 50 V ZERO	●	●	●	VSVM 50V Z		8
24	205	VSVM 50 V +FS	●	●	●	VSVM 50V +FS		16
25	206	VSVM 50 V -FS	●	●	●	VSVM 50V -FS		32
26	207	VSVM 250 V ZERO	●	●	●	VSVM 250V Z		64
27	208	VSVM 250 V +FS	●	●	●	VSVM 250V +F		128
28	209	VSVM 250 V -FS	●	●	●	VSVM 250V -F		256
29	211	High Limit + 5 V FS	●	●	●	HL +5V FS		512
30	212	High Limit -1 V FS	●	●	●	HL -1V FS		1024
31	213	High Limit + 50 V FS	●	●	●	HL +50V FS		2048
32	214	High Limit -10 V FS	●	●	●	HL -10V FS		4096
33	215	High Limit + 250 V FS	●	●	●	HL +250V FS		8192
34	216	High Limit -15 V FS	●	●	●	HL -15V FS		16384
35	221	Low Limit + 5 V FS	●	●	●	LL +5V FS	b	256
36	222	Low Limit -1 V FS	●	●	●	LL -1V FS		512
37	223	Low Limit + 50 V FS	●	●	●	LL +50V FS		1024
38	224	Low Limit -10 V FS	●	●	●	LL -10V FS		2048
39	225	Low Limit + 250 V FS	●	●	●	LL +250V FS		4096
40	226	Low Limit -15 V FS	●	●	●	LL -15V FS		8192
41	230	IM 3 µA ZERO	●	●	●	IM 3uA Zero	d	1
42	231	IM 30 µA ZERO	●	●	●	IM 30uA Zero		2
43	232	IM 300 µA ZERO	●	●	●	IM 300uA Z		4
44	233	IM 3 mA ZERO	●	●	●	IM 3mA Zero		8
45	234	IM 30 mA ZERO	●	●	●	IM 30mA Zero		16
46	235	IM 300 mA ZERO	●	●	●	IM 300mA Z		32
47	301	OVL detection check	●	●	●	OVL Check		64
48	311	Sample hold check	●	●	●	S/H Check		512
49	-	All the panels light ON	●		●	(Visual check)	-	-
50	-	Buzzer			●	(Buzzer sound check)		
51	-	Panel key			●	(Visual check)		

(*1) TER? command response register and data
In the error register (ERR?) the following bits are set.

At power ON; bit 0

In executing the self-test; bit 1

*As for the error codes, 501, 502, 503, 130 and 571, these error register bits are not set even if an error occurs at power ON.

2. Self-test execution by manual operation or turning the power ON

   When executing the self test by manual operation, select the parameters ***M) SYSTEM*** and ***5) Self Test*** in that order on the menu screen and press **ENTER**.

   Press ▽ and then press ◁ or ▷ to select the parameters "Self Test" and "Dsp/Key Tst."

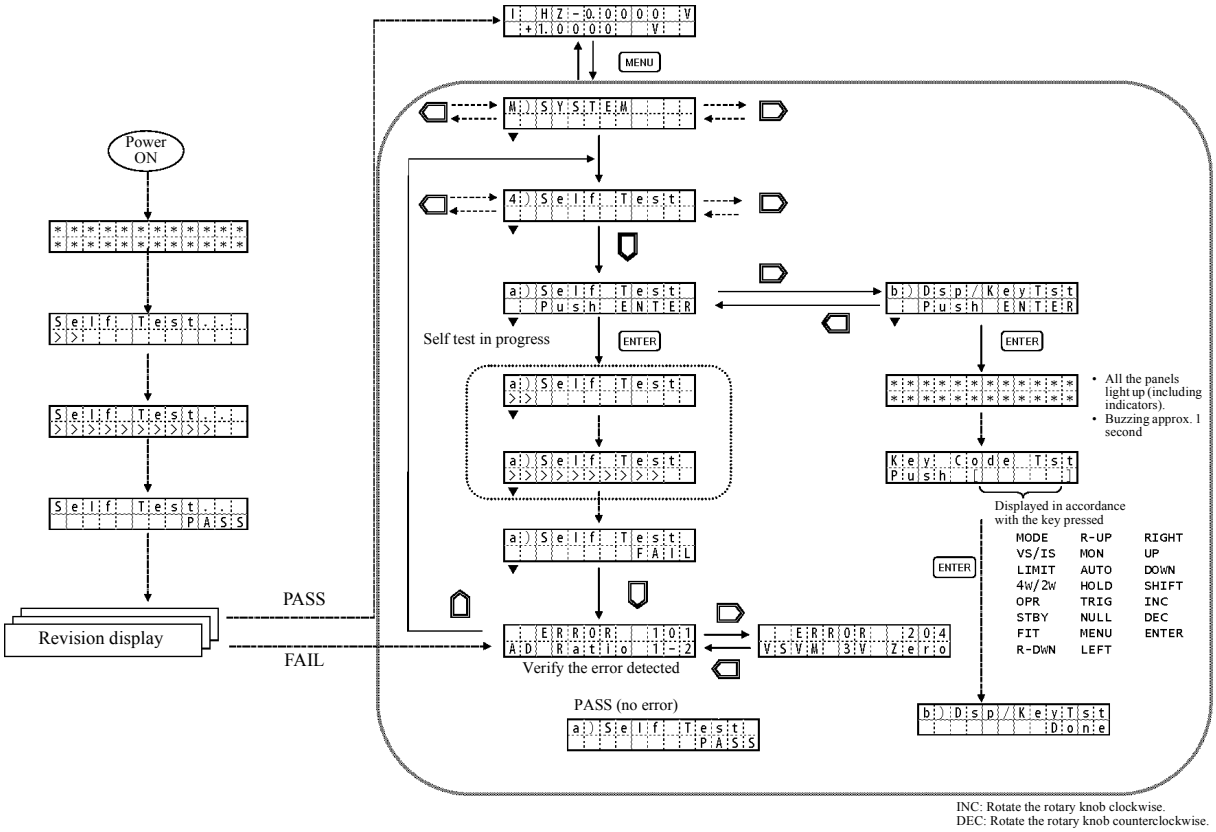


Figure 5-19 Self-Test Operation

5.3 Compatibility

The 6247G/6247C shares the same command system as the 6240A/6241A/6242.
This section describes the compatibility with the earlier 6243/6244 models.

5.3.1 Remote Command Compatibility

The 6247G/6247C has the same functions as the 6243/6244 but does not have command compatibility.

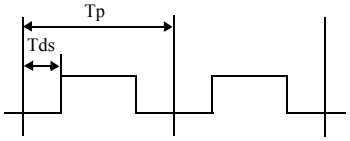
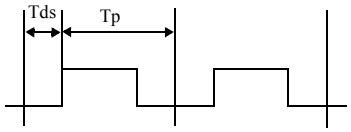
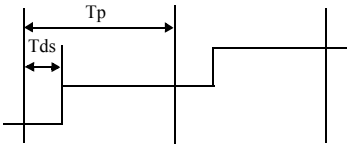
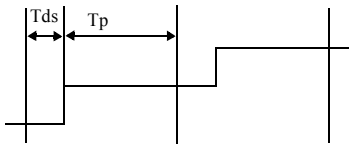
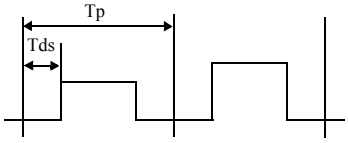
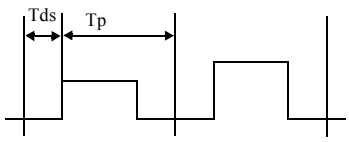
For more information on the remote operation, refer to Section 6.7.4, "Remote Command List."

The following commands have compatibility.

- V command
- I command
- D command
- H command
- E command
- N command

5.3.2 Difference in Period Parameter for Pulse Source and Sweep Source

Note that the definition of the period parameter Tp is different from that of the 6243/6244.

Source mode	6240A/41A/42/47G/47C	6243/44
Pulse		
DC sweep		
Pulse sweep		

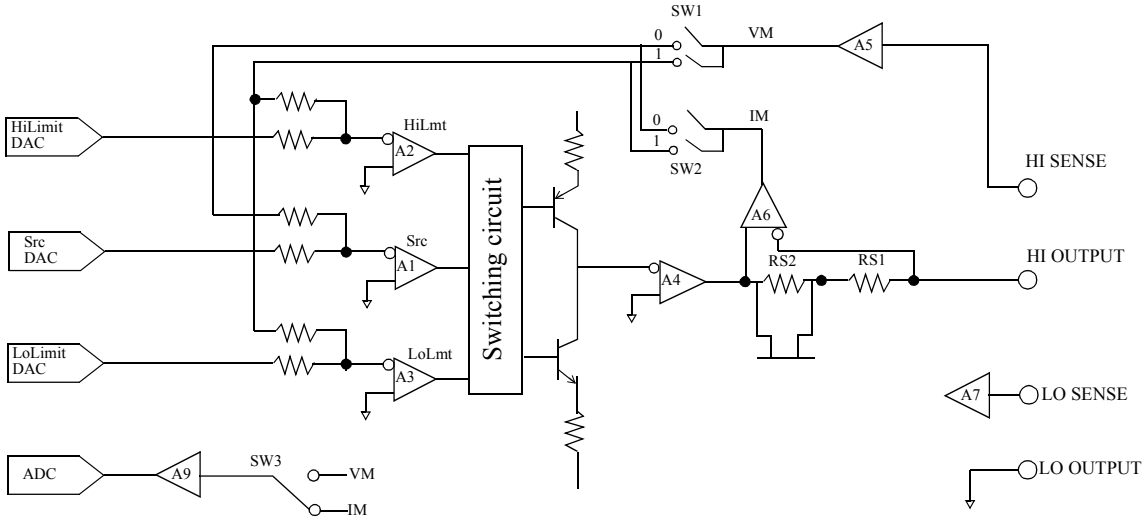
5.3.3 Notes for Synchronous Operation

The 6243/6244 does not have a delay time from the external trigger input to the measurement start, but the 6247G/6247C has Tsync delay time

Therefore, consider the Tsync delay time when using the 6247G/6247C with the 6243/6244 in synchronous operation. For more information, refer to Section 5.2.11.1, "Synchronous Operation."

5.4 Operational Principles

5.4.1 Block Diagram



5.4.2 Operational Principles

- The 6247G/6247C contains a DA converter SrcDAC, for setting the voltage source or current source. The 6247G/6247C also has DA converters, HiLimitDAC and LoLimitDAC for setting the current limiters and the voltage limiters.
  The SrcDAC has 16-bit conversion accuracy, and the HiLimitDAC and the LoLimitDAC have 13-bit conversion accuracy.
  The output from the DA converters is input to three error amplifiers, Src (A1), HiLmt (A2), and LoLmt (A3) respectively.
- For voltage source, the SrcDAC becomes a voltage-source DAC, and the Src error amplifier (A1) becomes a voltage-source error amplifier.
  Also, HiLimitDAC becomes a DAC for current limiter on the HI side and the HiLmt error amplifier (A2) becomes an error amplifier for current limiter on the HI side. Likewise, the LoLimitDAC and the LoLmt error amplifier (A3) work as current limiter on the LO side.
  At this time, 0 is ON for SW1 in the feedback circuit and 1 is ON for SW2.
  For current source, the use of each DAC and error amplifier are switched; for SW1 1 is ON and for SW2 0 is ON to generate the current.
- Source and limiter are switched by the switching circuit shown in the above figure, comparing the feedback amount for each, then switching to the larger one.
- Current range switching is done by switching the current detection resistor Rs. Consequently, the current measurement always takes place in the same range as that of current source or current-limiter.

- Voltage range switching is done by A_5, and voltage measurement, voltage source, and voltage limiter always take place in the same range.
- The A_5 and A_6 amplifiers have high input impedance to minimize leakage.
- The A_7 amplifier also has high input impedance to reduce error for 4-wire connection.
- The AD converter employs an integral type AD, and the integration time can be set between 100 μs to 200 ms.

6. REMOTE PROGRAMMING

This chapter provides an overview of the GPIB, USB and RS-232 interfaces and describes the connections and settings.

This chapter also contains lists of commands for programming and introduces program examples.

6.1 Using Interface

The 6247G is equipped with the GPIB and USB interfaces, and the 6247C with the RS-232 and USB interfaces.

These interfaces cannot be used at the same time. Select which interface you wish to use.

6.1.1 Selecting Interface

The interface can only be selected from the front panel menu.

1. The selected interface is saved in the non-volatile memory. The selected interface does not change when the unit is turned off or the interface is reset.
2. When selecting the GPIB interface, set a unique unit address. (6247G)

   When selecting the USB interface and connecting multiple instruments, set individual identifying addresses (USB ID).

The following table shows the interface setting items and default settings for each model.

6247G:

Setting item	Default setting
Selected interface	USB
Header ON/OFF	ON
GPIB address/USB ID	1
GPIB Taker function	Addressable

6247C:

Setting item	Default setting
Selected interface	USB
Header ON/OFF	ON
USB ID	1
RS-232 Talk Only	OFF
Baud rate	9600
Parity	None
Number of data bits	8 bits
Number of stop bits	1 bit

To set the interface, select L) I/F → 1) I/F BUS on the menu screen.

To set header ON/OFF, select L) I/F → 3) Header on the menu screen.

6.2 GPIB

The 6247G is equipped with the GPIB interface as standard.

6.2.1 Overview

GPIB (General Purpose Interface Bus) allows external control of the 6247G/6247C measurement function settings, parameter settings, and reading data, making it simple to configure an automated measurement system.
As GPIB signals from the 6247G/6247C are electrically isolated inside the unit from the measurement signal system, the connection of external devices does not affect the measured values.

The remote commands are the same as with USB.

- General specifications

  Standard: IEEE-488.2

  Code: ASCII code

  Logic level: Logical 0 (High) +2.4 V min.
  Logical 1 (Low) +0.4 V max.

Table 6-1 Interface Function

Code	Function
SH1	Source Handshake capability
AH1	Acceptor handshake capability
T5	Basic Talker, unaddressed if MLA, Talk Only, serial poll
L4	Basic Listener, unaddressed if MTA
SR1	Service Request capability
RL1	Remote/Local switching capability
PP0	No Parallel Poll capability
DC1	Device Clear capability (The SDC and DCL commands can be used.)
DT1	Device Trigger capability (The GET command can be used.)
C0	No Controller capability
E2	Using tri-state bus drivers

6.2.2 Precautions when Using GPIB

1. Do not use longer connection cables or bus cables than necessary. Operations using 20 m or longer cables are not guaranteed. ADC CORPORATION offers the following standard bus cables.

Table 6-2 Standard Bus Cable

Name	Length
408JE-1P5	0.5 m
408JE-101	1 m
408JE-102	2 m
408JE-104	4 m

2. Bus cables have piggyback connectors. A piggyback connector has both a male connector and a female connector by itself. The male and female connectors can be stacked on top of each other.
   Be sure to fix the piggyback-type bus cables with clamping screws. Also, do not stack three ore more connectors to prevent breakage.
3. Check the power requirements, grounding conditions, and setting conditions of each device before turning on all the devices connected to the bus. If any device is not turned on, the system may not operate correctly.
4. Turn off all the devices on the bus before connecting or disconnecting the GPIB cables. Check that the chassis of the devices on the bus are connected to each other and to the ground before connecting or disconnecting any GPIB cables.
5. If an ATN request interruption occurs during transfer of messages between the devices, the ATN has priority and the previous status is cleared.
6. When using the Talk Only mode, do not connect the controller.
7. An error occurs if a single command transmission exceeds 256 characters.
8. Retain the REN line at Low for 5 ms or longer following the transmission of a command.

6.2.3 Setting GPIB

These settings are enabled when the GPIB interface is selected.

- Setting the address

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS GPIB
3. Select **2) GPIB Adr** with ◁ or ▷ . (Currently set address)	2) GPIB Adr 01
4. Enter the Input/Run level with ▽ .	2) GPIB Adr **01**
5. To set the address, press ◁ or ▷ to select the digit to be changed and use ○ to increase or decrease the figure. Alternatively, directly enter the address pressing the **123...** key.	2) GPIB Adr **17**
6. Press **EXIT** to exit the menu.	

- Setting Talk Only

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS GPIB
3. Select **4) Talk Only** with ◁ or ▷ . (Currently set status)	4) Talk Only Off
4. Enter the Input/Run level with ▽ .	4) Talk Only **Off**
5. Select Talk Only ON or OFF with ○ .	4) Talk Only **On**
6. Press **EXIT** to exit the menu.	

6.3 USB

6.3.1 Overview

The 6247G/6247C is equipped with USB (Universal Serial Bus) conforming to USB 2.0 standard. USB allows function settings and reading of measurement data with respect to multiple instruments connected to the bus from a PC, making it simple to configure an automated measurement system.

NOTE: All operations using a PC or hub cannot be guaranteed.

6.3.2 USB Specifications

- Standard: Complies with USB2.0 Full-Speed
- Connectors: USB type B (female)
- ID: USB ID, settable from 1 to 127
- Remote/Local: Available
- Input commands: Function setting and query with ASCII character string commands
- Output format: Measurement data and query response with ASCII character strings
- Driver: ADC measuring instrument USB driver

6.3.3 Setting Up USB

6.3.3.1 Connecting with a PC

Connect the USB connector (type B) on the rear of the 6247G/6247C to that on the PC with a cable. Fully insert all connectors.

6.3.3.2 Setting USB ID

These settings are enabled when the USB interface is selected.

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷.	L) I/F
2. Enter the Select level with ▽.	1) I/F BUS USB
3. Select **2) USB Id** with ◁ or ▷. (Currently set ID)	2) USB Id **001**
4. Enter the Input/Run level with ▽.	2) USB Id **002**
5. To set the ID, press ◁ or ▷ to select the digit to be changed and use ◯ to increase or decrease the figure. Alternatively, directly enter the ID pressing the **123...** key.	
6. Press **EXIT** to exit the menu.	

6.3.3.3 Precautions when Using USB

When running a query command, leave a 20 ms wait time right after the previous command.

6.4 RS-232

The 6247C is equipped with the RS-232 interface as standard.

6.4.1 Overview

RS-232 allows external control of the 6247G/6247C measurement function settings, parameter settings, and reading data, making it simple to configure an automated measurement system.

As RS-232 signals are electrically isolated from the measurement signal system, the measured values are not affected by the external device.

The remote commands are the same as with USB.

6.4.2 Precaution when Using RS-232

Turn OFF the connected device before connecting or disconnecting the cross cable. Also, check that the chassis of the device is connected to the ground before connecting or disconnecting the cable.

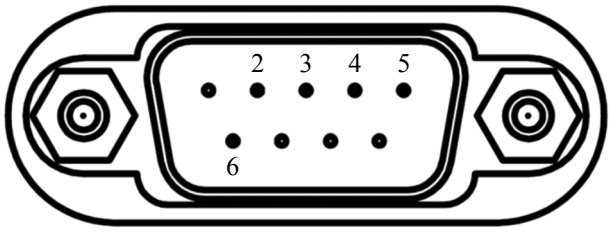
6.4.3 Specifications

The specifications of RS-232 are shown below.

Setting item	Value	Default setting
Output header *	ON/OFF	ON
Talk Only	ON/OFF	OFF
Baud rate	19200/9600/4800/2400/1200/600/300	9600
Parity	None/Even/Odd	None
Number of data bits	8 bits/7 bits	8 bits
Number of stop bits	1 bit/2 bits	1 bit

*: Common with the USB interface setting

The RS-232 connector on the rear panel is a 9-pin connector (DB-9, male).



Pin number	Input/output	Description	
2	Input	Receive data	(RxD)
3	Output	Transmit data	(TxD)
4	Output	Data terminal ready	(DTR)
5	-	Signal ground	(SG)
6	Input	Data set ready	(DSR)

Up to 251 characters are recognizable in a single program code transmission.

An error occurs if the program code exceeds 251 characters.

The transmit data (TxD) checks the status of the data set ready (DSR) inside the 6247G/6247C. If the data set ready (DSR) is false, data output is interrupted. When it is true, data is output.

CAUTION: ***Flow control by X parameters (XON/XOFF) is not available on the 6247G/6247C.***

6.4.4 Setting RS-232

These settings are enabled when the RS-232 interface is selected.

- Setting Talk Only

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS RS232
3. Select **4) Talk Only** with ◁ or ▷ . (Currently set status)	4) Talk Only Off
4. Enter the Input/Run level with ▽ .	4) Talk Only **Off**
5. Select Talk Only ON or OFF with ◯ .	4) Talk Only **On**
6. Press **EXIT** to exit the menu.	

- Setting the baud rate

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS RS232
3. Select **5) Baud Rate** with ◁ or ▷ . (Currently set status)	5) Baud Rate 4800
4. Enter the Input/Run level with ▽ .	5) Baud Rate **4800**
5. Set the baud rate with ◯ . (Select from 300/600/1200/2400/4800/9600/19200)	5) Baud Rate **9600**
6. Press **EXIT** to exit the menu.	

- Setting the number of data bits

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS RS232
3. Select **6) Data Bit** with ◁ or ▷ . (Currently set status)	6) Data Bit 8 bit
4. Enter the Input/Run level with ▽ .	6) Data Bit **8 bit**
5. Set the number of data bits, 8 bit or 7 bit with ◯ .	6) Data Bit **7 bit**
6. Press **EXIT** to exit the menu.	

- Setting the parity

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS RS232
3. Select **7) Parity** with ◁ or ▷ . (Currently set status)	7) Parity ODD
4. Enter the Input/Run level with ▽ .	7) Parity **ODD**
5. Set the parity, NONE, ODD or EVEN with ◯ .	7) Parity **NONE**
6. Press **EXIT** to exit the menu.	

- Setting the number of stop bits

Operation	Character display area
1. Press **MENU** and select **L) I/F** with ◁ or ▷ .	L) I/F
2. Enter the Select level with ▽ .	1) I/F BUS RS232
3. Select **8) Stop Bit** with ◁ or ▷ . (Currently set status)	8) Stop Bit 1 bit
4. Enter the Input/Run level with ▽ .	8) Stop Bit **1 bit**
5. Set the number of stop bits, 2 bit or 1 bit with ◯ .	8) Stop Bit **2 bit**
6. Press **EXIT** to exit the menu.	

6.4.5 Command Transmission and Response

6.4.5.1 Command Transmission

There are two types of remote commands as follows:

- Setting command: Command to set parameters to the 6247G/6247C
- Query command: Command to read the setting parameters from the 6247G/6247C
  A question mark (?) is placed at the end of the command.

Up to 251 characters are recognizable in a single command transmission. (Sending 252 characters or more results in an error.)

Place the control code <CR> (delimiter) at the end of a command to be sent.

6.4.5.2 Response

As reply to a command that was sent, the result is output with a prompt.

There are two types of prompts as follows:

Prompt	Description
=>	A command is normally received, analyzed and executed.
?>	En error is detected in receiving, analyzing or executing a command.

6.4.5.3 Response to Setting Command and Query Command

1. Response to a setting command
   <LF>=><CR><LF>
2. Response to a query command
   <LF> query response <CR><LF><LF>=><CR><LF>

6.4.5.4 Response to "MON?" Command

- Measurement data and measurement memory data are obtained as query response to the "MON?" command.

The response to the "MON?" command varies depending on whether the memory recall mode is set to ON or OFF.

"CR" and "LF" correspond to the control codes <CR> and <LF> respectively.

1. When the memory recall is OFF

Measurement data	
Exists	Not exist
L_F Measurement data C_RL_F L_F=>C_RL_F	L_F?>C_RL_F

2. When the memory recall is ON

Measurement data	
Exists	Not exist
L_F Measurement memory data C_RL_F L_F=>C_RL_F	L_FEES_P+8.88888E+30C_RL_F L_F=>C_RL_F *

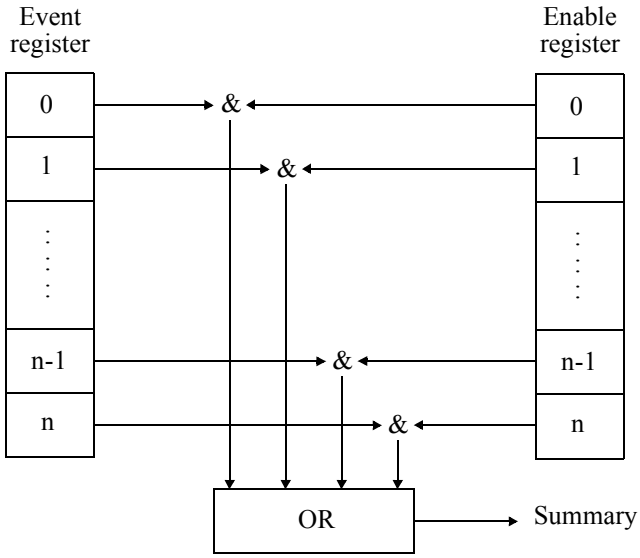
*When there is a header

6.5 Status Register Structure

The 6247G/6247C has a hierarchical status register structure that conforms to the IEEE standard 488.2-1987 and can send various statuses of the 6247G/6247C to the controller. The following explains an operational model of the status structure and allocation of events.

1. Status Register

   The 6247G/6247C employs a status register model as defined by the IEEE standard 488.2-1987. A status register consists of an event register and an enable register.



- Event register

  The event register latches and maintains the status for each event. (It may also hold changes.)
  Once the register is set, it remains set until it is read out by a query or cleared by *CLS.
  Data cannot be written into the event register.

- Enable register

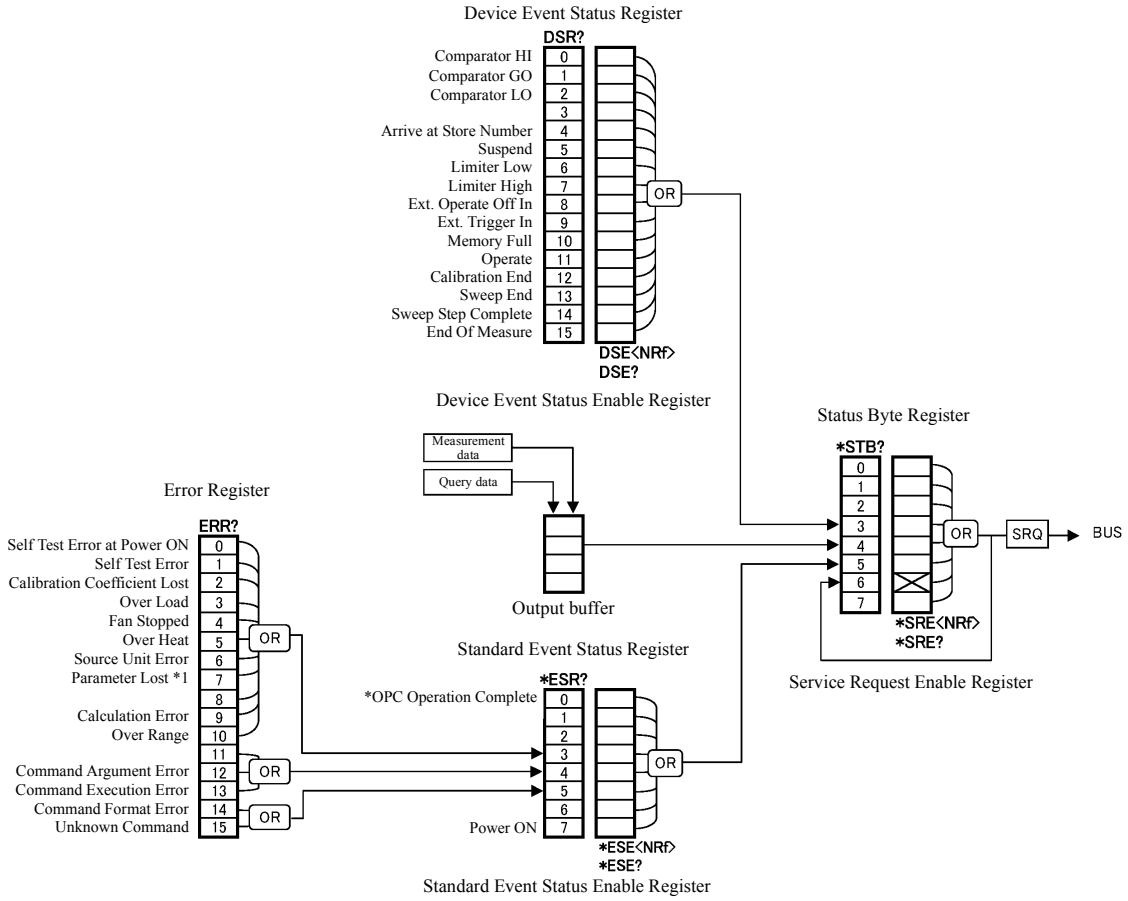
  The enable register specifies for which bits in the event register a valid status summary should be generated. The logical AND operation is executed between the enable register and the event register, and the OR result is generated as a summary. The summary is written into the status byte register.
  Data can be written into the enable register.

The 6247G/6247C has the following four types of status registers.

- Status Byte Register (STB)
- Standard Event Status Register (SESR)
- Device Event Status Register (DESR)
- Error Event Register (ERR)

The following figure shows the 6247G/6247C status register structure.

Status Register Structure



*1: Parameter Lost means save parameter data lost or backup parameter data lost.

Figure 6-1 Status Register Structure

2. Event Enable Register

   Each Event Register has an Enable Register that decides which bit is to be enabled. The Enable Register sets the relevant bit in decimal values.

   - Service Request Enable Register setting: *SRE
   - Standard Event Status Enable Register setting: *ESE
   - Device Event Enable Register setting: DSE

   (Example) Enables only the EOM bit of the Device-Event Register.
   When the EOM bit of the Device Event Register is set to 1, the DSB bit of the Status Byte Register is set to 1.

   (Example) Enables the Status Byte Register's DSB (Device Event Status Register summary) bit and the ESB (Standard Event Status Register summary) bit.
   When the DSB bit or the ESB bit is set to 1, the Status Byte Register's MSS bit is set to 1.

3. Status Byte Register

   The Status Byte Register summarizes the information from the status registers. This Status Byte Register's summary is transmitted as a service request to the controller. Consequently, the Status Byte Register is slightly different from other status registers in structure. The Status Byte Register is explained in the following:
   The following figure shows the structure of the Status Byte Register.

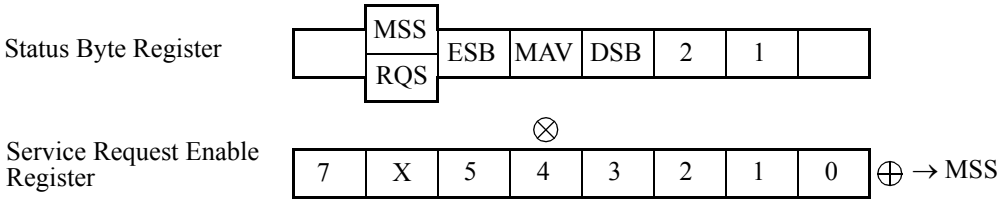


Figure 6-2 Status Byte Register Structure

The Status Byte Register conforms to other status registers except the following three points.

- The summary of the Status Byte Register is written into bit 6 of the Status Byte Register.
- The Enable Register's bit 6 is always enabled and cannot be changed.
- The Status Byte Register's bit 6 (MSS) writes RQS (request service).

This register responds to a serial poll from the controller.
When responding to the serial poll, bit 0 to 5, bit 7, and RQS of the Status Byte Register are read, after which RQS is reset to 0. Other bits are not cleared until their factors become 0.
The Status Byte Register, RQS, and MSS can be cleared by executing "*CLS." Accompanying this, the SRQ line also becomes False.

The following table describes each bit of the Status Byte Register.

Table 6-3 Status Byte Register (STB)

bit	Name	Description
0	Not in use	Always set to 0
1	Not in use	Always set to 0
2	Not in use	Always set to 0
3	DSB Device Event Status	ON: Set to 1 when any of the DESR incidents occurs and the bit is set to 1, if the corresponding DESER bit is also 1. OFF: Set to 0 when DESR is cleared by reading (DSR?).
4	MAV Message Available	ON: Set to 1 when output data is entered in the output buffer. OFF: Set to 0 when the output buffer is read and becomes empty.
5	ESB Standard Event Status	ON: Set to 1 when any of the SESR incidents occurs and the bit is set to 1, if the corresponding SESER bit is also 1. OFF: Set to 0 when SESR is cleared by reading (*ESR?).
6	MSS Master Summary	ON: Set to 1 when any of the STB incidents occurs and the bit is set to 1, if the corresponding SRER bit is also 1.
	RQS Request Service	ON: Set to 1 when MSS is set to 1 and SRQ is generated. OFF: Set to 0 when STB is read by a serial poll.
7	Not in use	Always set to 0

Common conditions in which the Status Byte Register is cleared

- All cleared when the power is turned ON.
- All cleared by *CLS except that MAV is not cleared if data exists in the output buffer.
- Cleared when all the DSB, MAB and ESB bits are cleared.
- Not cleared even if read by *STB?.

Conditions in which the Service Request Enable Register is cleared

- Cleared when the power is turned ON.
- Cleared when the *SRE0 command is executed.

4. Standard Event Status Register

The following table shows the allocations of the Standard Event Status Register.

Table 6-4 Standard Event Status Register (ESR)

bit	Name	Description
0	OPC Operation Complete	ON: Set to 1 when all operations are complete after receiving the *OPC command.
1	Not in use	Always set to 0
2	Not in use	Always set to 0
3	DDE Device Dependent Error	ON: Set to 1 when a device-dependent error occurs.
4	EXE Execution Error	ON: Set to 1 when a received command is not currently executable. Set to 1 when incorrect data is entered in a command parameter.
5	CME Command Error	ON: Set to 1 when a received command is incorrectly spelled.
6	Not in use	Always set to 0
7	PON Power On	ON: Set to 1 when the power is turned ON.

Common conditions in which the Standard Event Status Register is cleared

- All cleared when the power is turned ON.
- All cleared by *CLS.
- All cleared when read by *ESR?.

Conditions in which the Standard Event Status Enable Register is cleared

- Cleared when the power is turned ON.
- Cleared when the *ESE0 command is executed.

5. Device Event Status Register

The following table shows the allocations of the Device Event Status Register.

Table 6-5 Device Event Status Register (DSR)

bit	Name	Description
0	HI Comparator HI	ON: Set to 1 when the comparator calculation result is HI.
1	GO Comparator GO	ON: Set to 1 when the comparator calculation result is GO.
2	LO Comparator LO	ON: Set to 1 when the comparator calculation result is LO.
3	Not in use	Always set to 0
4	ASN Arrive at Store Number	ON : Set to 1 when the number of measured data reaches the specified number of stored data in the memory.
5	SUS Suspend	ON: Set to 1 when Suspend status is set. OFF: Set to 0 when Operate or Standby status is set.
6	LML Limiter Low	ON: Set to 1 when the low limit value is detected.
7	LMH Limiter High	ON: Set to 1 when the high limit value is detected.
8	EOP Ext. Operate Off In	ON: Set to 1 when an external operating interruption signal input is detected.
9	ETG Ext. Trigger In	ON: Set to 1 when an external trigger signal input is detected.
10	MFL Memory Full	ON: Set to 1 when the measurement buffer memory is full. OFF: Set to 0 when the measurement buffer memory becomes not full.
11	OPR Operate	ON: Set to 1 when Operate status is set. OFF: Set to 0 when Standby or Suspend status is set.
12	CAE Calibration End	ON: Set to 1 when calibration is complete. OFF: Set to 0 when calibration starts.
13	SWE Sweep End	ON: Set to 1 when sweep is complete. OFF: Set to 0 when sweep starts.
14	SSC Sweep Step Complete	ON: Set to 1 when sweep step is compete in the HOLD trigger mode (except for the high-speed burst operating status). OFF: Set to 0 when sweep step starts. Set to 0 when sweep is paused and starts.
15	EOM End Of Measure	ON: Set to 1 when measurement is complete. OFF: Set to 0 when measurement starts. Set to 0 when the measurement data is read out.

Common conditions in which the Device Event Status Register is cleared

- All cleared when the power is turned ON.
- All cleared by *CLS.
- All cleared when read by DSR?.

Conditions in which the Device Event Status Enable Register is cleared

- Cleared when the power is turned ON.
- Cleared when the DSE0 command is executed.

6. Error Register

The following table shows the allocations of the Error Register.

Table 6-6 Errors Register (ERR)

bit	Description
0	ON: Set to 1 when a self-test error occurs at power ON.
1	ON: Set to 1 when a self-test error occurs. Set to 1 when an error occurs in Flash write.
2	ON : Se to 1 when calibration data is lost in the self test at power ON, and the default calibration values are used. Set to 0 when the power is reset after recalibration.
3	ON: Set to 1 when an overload is detected. Not set to 0 even if the overload is cleared.
4	ON: Set to 1 when "fan stopped" is detected. Not set to 0 even if the "fan stopped" is cleared.
5	ON: Set to 1 when overheat is detected. Not set to 0 even if the overheat is cleared.
6	ON: Set to 1 when the source unit malfunctions.
7	ON: Set to 1 when the saved parameters are lost in the self test at power ON and the default parameters are used. (Parameters saves by Save/Load, or parameters stored when the power is turned off.)
8	Always set to 0.
9	ON: Set to 1 when a calculation error occurs.
10	ON: Set to 1 when an over rang occurs.
11	Always set to 0.
12	ON: Set to 1 when a remote command argument error occurs.
13	ON: Set to 1 when a remote command execution error occurs.
14	ON: Set to 1 when a remote command format error occurs.
15	ON: Set to 1 when an known remote command is received.

Common conditions in which the Error Register is cleared

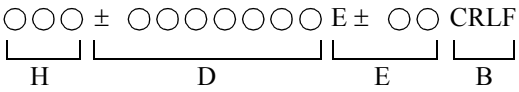
- All cleared when the power is turned ON.
- All cleared by *CLS.

NOTE: The error register is not cleared when read by ERR?.

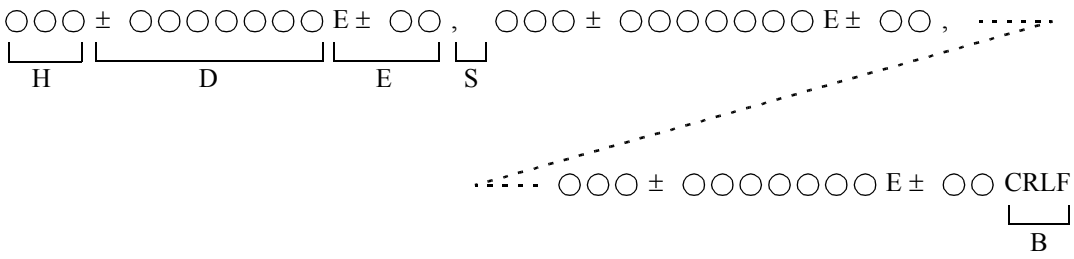
6.6 Data Output Format (Talker Format)

The measurement data and the measurement data memory (RECALL) are read in the following format. Using GPIB allows multiple data to be read.

Single data reading :



Multiple data reading :



H: Header (main header characters + sub header of 1 character)

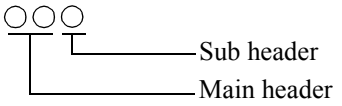
D: Mantissa part (polarity + decimal point + 6 digit figures)

E: Exponent part (E + polarity + 2 digit figures)

S: String delimiter

B: Block delimiter

1. Header



The header is not output when the header setting is OFF.

- Main header

  DV: DC voltage measurement

  DI: DC current measurement

  RM: DC current measurement (resistance displayed)

  EE: No data in the specified measurement memory

- Sub header

High ↑ Priority ↓ Low

U:	High limit detected
B:	Low limit detected
O:	Range over
Z:	For resistance measurement, the voltage source value is set to 0 (zero).
F:	For resistance measurement, the current source value is below 20 digits or the current measurement value is below 200 digits.
E:	Calculation error (scaling function or total function)
H:	The comparator calculation result is HI.
G:	The comparator calculation result is GO.
L:	The comparator calculation result is LO.
C:	Scaling calculation data
N:	NULL calculation data
:	Others (space output)

2. Mantissa part and exponent part
   The exponent column in the list below shows cases of the scaling calculation not being performed.

Measurement function			Unit display			
			Decimal point and unit symbol form		Exponent form	
			Mantissa part	Exponent part	Mantissa part	Exponent part
DC voltage measurement	Measurement range	5 V	±d.dddddd	E+00	±d.dddddd	E+00
		50 V	±dd.ddddd	E+00		E+01
		250 V	±ddd.dddd	E+00		E+02
DC current measurement		3 μA	±d.dddddd	E-06		E-06
		30 μA	±dd.ddddd	E-06		E-05
		300 μA	±ddd.dddd	E-06		E-04
		3 mA	±d.dddddd	E-03		E-03
		30 mA	±dd.ddddd	E-03		E-02
		300 mA	±ddd.dddd	E-03		E-01
Resistance measurement	Significant digits	1 digit	±0000.0d	E-09 to E+09	±00000d.	E-08 to E+11
			±00000.d			
			±00000d.			
		2 digits	±0000.dd		±0000d.d	
			±0000d.d			
			±0000dd.			
		3 digits	±000d.dd		±000d.dd	
			±000dd.d			
			±000ddd.			
		4 digits	±00d.ddd		±00d.ddd	
			±00dd.dd			
			±00ddd.d			
		5 digits	±0d.dddd		±0d.dddd	
			±0dd.ddd			
			±0ddd.dd			
High limit value detected in resistance measurement *1			+9.99999	E+37	+9.99999	E+37
Low limit value detected in resistance measurement *1			+9.99999	E+36	+9.99999	E+36
±Range over			±9.99999	E+35	±9.99999	E+35
IS is below 20 digits or IM is below 200 digits. *1			+9.99999	E+34	+9.99999	E+34

Measurement function	Unit display			
	Decimal point and unit symbol form		Exponent form	
	Mantissa part	Exponent part	Mantissa part	Exponent part
VS is set to 0 (zero). *1	+9.99999	E+33	+9.99999	E+33
±Scaling error	±9.99999	E+32	±9.99999	E+32
±TOTAL error	±9.99999	E+31	±9.99999	E+31
No data exists at recall. *2	+8.88888	E+30	+8.88888	E+30

*1: This may occur in resistance measurement.
*2: Data does not exist when the measurement buffer memory data is read out.

3. String delimiter

   A string delimiter ", " (comma) is output to specify a boundary in a data stream.
   It is used when multiple data sets are read out from the measurement data memory.

4. Block delimiter

   A block delimiter is output to specify the end of a unit of data.
   The type of block delimiters can be specified by the following commands:

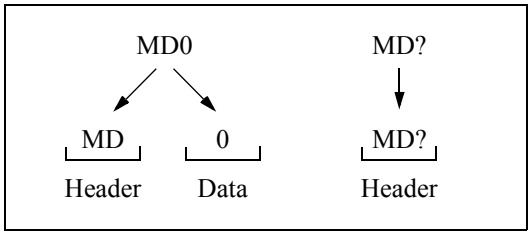
Block delimiter	Command	Default
CR LF+EOI	DL0	✓
LF	DL1	
EOI	DL2	
LF+EOI	DL3	

(EOI is a GPIB function. It is not available on USB or RS-232.
As for RS-232, the block delimiter is always CR LF regardless of the setting.)

6.7 Remote Commands

6.7.1 Command Syntax

1. Remote command structure



A remote command consists of a header and data.

(Some remote commands do not have data.)

A remote command that ends with a question mark "?" is called "query command." The question mark is included in the header.

2. Inserting spaces

Between multiple remote commands: Spaces can be inserted.

Between header and data: Spaces can be inserted.

If a command string falls within the maximum number of characters that can be transmitted (GPIB: 255 characters, USB: 64 characters, RS-232: 251 characters), there is no limit to the number of spaces.

3. Connecting remote commands

MD0	+	VF	+	F2	=	MD0VFF2
DC source		Voltage source function		Current measurement function		

If a command string falls within the maximum number of characters that can be transmitted (GPIB: 255 characters, USB: 64 characters, RS-232: 251 characters), more than one command can be described consecutively.

4. Inserting commas ","

MD0VFF2	=	MD0, VF, F2

Between multiple remote commands: Commas can be inserted.
Between header and data: Commas cannot be inserted.
Between multiple data: Insert commas to separate between the data

NOTE: ***If a command string ends with a comma "," it is not recognized and an error occurs.***

6.7.2 Data Format

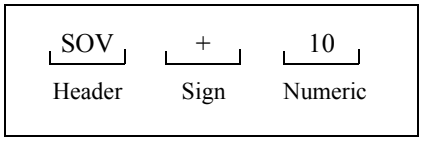
The 6247G/6247C uses the following data types for data input and output.

1. Numeric data

   The 6247G/6247C uses the following formats for data input and output.

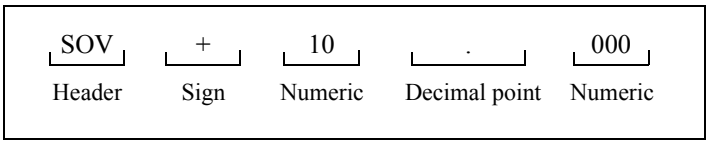
   1. NR1 format: Integer type

      Example: +10, -10

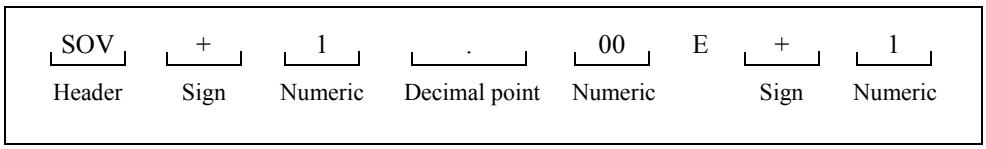
   2. NR2: Fixed-point type

      Example: +10.000, -10.000

   3. NR3 format: Floating-point type

      Example: +1.0E+1, -1.0E+1

2. Units

   The table below lists the units that can be used for the D command.

Unit	Exponent	Meaning
V	10^{0}	Voltage
MV	10^{-3}	Voltage
UV	10^{-6}	Voltage
A	10^{0}	Current
MA	10^{-3}	Current
UA	10^{-6}	Current

NOTE: ***When numeric data is expressed in an exponent format in the 6247G/6247C, the number conversion time becomes too long if the exponent is set to ±31 or higher (xx.xxxE±31). The exponent setting should not exceed ±30.***

6.7.3 Remote Command Index

Use the following remote command index for Section 6.7.4, "Remote Command List."

6.7.4 Remote Command List

1. The Default column shows default settings at Power ON or at factory shipment.
   - The Power ON column shows the status when the power is turned ON.
   - The *RST or RINI command initializes the settings to factory default.
     However, the RINI command cannot initialize *5 and the RINI or *RST command cannot initialize *6.
2. Note for description in the command list
   - Parameter enclosed in [ ] can be omitted.
   - Parameters enclosed in < > are single delimited data items.
   - The symbols in the Operation column shows the following:

     ○ : Acceptable

     × : Not acceptable

     △ in DC pulse OPR/SUS column: Acceptable only in the HOLD trigger mode or in Suspend status.

     △ in Sweep OPR/SUS column: Acceptable only when sweep stops or in Suspend status.

     ▲ : Acceptable in the Suspend status.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Source	Source mode	MD0	DC mode		●	▲	▲
		MD1	Pulse mode				
		MD2	DC sweep mode				
		MD3	Pulse Sweep mode				
		MD?	Response: MD0 to MD3			○	○
	Source function	VF	Voltage source function		●	○ Executing this function sets Suspend.	△ Executing this function sets Suspend.
		IF	Current source function				
		V?	Response: V4 to V6 for VF I-2 or I3 for IF			○	○
		I?					
	Source range	SVRX	Optimal range		●	○	×
		SVR4	5 V range				
		SVR5	50 V range				
		SVR6	250 V range				
		SVR?	Response: SVRX4 to SVRX6 (for the optimal range) SVR 4 to SVR 6 (for the fixed range)			○	○

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Source	Source function	SIRX	Optimal range		●		
		SIR-2	3 µA range				
		SIR-1	30 µA range				
		SIR0	300 µA range			○	×
		SIR1	3 mA range				
		SIR2	30 mA range				
		SIR3	300 mA range				
		SIR?	Response: SIRX-2 to SIRX3 (for the optimal range) SIR-2 to SIR 3 (for the fixed range)			○	○
	Source value	SOV ±data	Voltage source value setting		0	○	×
		SOI ±data	Current source value stting		0		
		SOV?	Response: SOV ± d.ddddE ± d *1, *2			○	○
		SOI?	SOI ± d.ddddE ± d			○	○
	Spot command	G ±data	Executes the measurement trigger after setting the source value for the currently set source function.			○	×
	Limit value	LMV ±data1 [,±data2]	Voltage limit value setting		±250 V/ −15 V	○	△
		LMI ±data1 [,±data2]	Current limit value setting		±320 mA		
			Both the HI and LO limit values can be set. • In comparison between data1 and data 1, the larger value is the HI limit value and the smaller is the LO limit value. • data 2 can be omitted. In this case, +data1 and -data 1 are assumed as HI and LO limit values respectively regardless of the data polarity. ***Note:*** ***1. LM1 data1 and data 2 cannot be set homopolar.*** ***2. For LMV, set the difference between the HI and LO limit values to 60 digits or more.*** ***3. In the 3 µA range for LMI, set the difference between the HI and LO limit values to 200 digits or more.***				
		LMV?	Response: LMV ± <hl>, ± <ll> *1			○	○
		LMI?	LMI ± <hl>, ± <ll> *1 hl: <d.dddE ± d>(High limit value) ll: <d.dddE ± d> (Low limit value) *1				

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.
*2: Outputs the value that is currently generated or the value that is generated during Operate.

6.7.4 Remote Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Source	Suspend voltage	SUV ± data	Suspend voltage setting Setting range: -15 V to +250 V		0	○	△
		SUV?	Response: SUV ± d.ddddE ± d *1			○	○
	Suspend Hiz/Loz	SUZ0	Hiz: High resistance output status		●	○	△
		SUZ1	Loz: Low resistance output status				
		SUZ?	Response: SUZ0 or SUZ1			○	○
	Pulse base value	DBV ± data	Voltage pulse base value		0	○	▲
		DBI ± data	Current pulse base value		0		
		DBV? DBI?	Response: DBV ± d.ddddE ± d *1 DBI ± d.ddddE ± d			○	○
	Trigger mode	M0	AUTO		●	○	△
		M1	HOLD				
		M?	Response: M0 or M1			○	○
	Operate/Standby	SBY	Sets the output to OFF (Standby)	●	●	○	○
		OPR	Sets the output to ON (Operate)			○	○
		SUS	Sets the output to Suspend			○	○
		SBY?, OPR?, SUS?	The present output status is returned. Response: Status / SBY?, OPR?, SUS? Operate / OPR Suspend / SUS Standby / SBY			○	○
	Remote sensing	RS0	2W		●	○	△
		RS1	4W				
		RS?	Response: RS0 or RS1			○	○

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications..

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Source	Time parameter	SP Th,Td,Tp[,Tw]	Th: Hold time Td: Measurement delay time Tp: Period Tw : Pulse width Unit: ms Tw can be omitted.		3 ms 4 ms 50 ms 25 ms	○	△
		SP?	Response: SP<Th>,<Td>,<Tp>,<Tw> Th,Td,Tp,Tw:<d.dddd> *1			○	○
		SD Tds	Tds: Source delay time (unit: ms)		0.03 ms	○	△
		SD?	Response: SDd.dddd *1			○	○
	Response	FL0	SLOW		●	○	△
		FL1	FAST				
		FL?	Response: FL0 or FL1			○	○
Sweep	Linear sweep	SN [± st, ± sp, step]	st: Start value		0.1 mV/ 0.0001 µA	○	▲
			sp: Stop value		10 mV/ 0.01 µA		
			step: Step value (The polarity is ignored.)		0.1 mV/ 0.0001 µA		
			If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately.				
		SN?	Response: SN ± <st>, ± <sp>, <step> *1 st,sp,step: <d.ddddE ± d>			○	○
	Fixed level sweep	SF [± lvl, cnt]	lvl: Level source value		0 V/0 A	○	▲
			cnt: Sampling count (1 to 8000)		1		
			If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately.				
		SF?	Response: SF ± <lvl>,<cnt> *1 lvl: <d.ddddE ± d> cnt: <dddd>			○	○
	Random sweep	SC [st,sp]	st: Start address (0 to 7999)		0	○	△*3
			sp: Stop address (0 to 7999)		0		
			If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately.				▲
		SC?	Response: SCst,sp st,sp:<dddd>			○	○

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.
*3: The values can be changed only between the start and stop address that was set in the Standby status.

6.7.4 Remote Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Sweep	2-slop linear sweep	SM [±fd, ±md, ±ld, st1, st2]	fd: First value		0.1 mV/ 0.0001 μA	○	▲
			md: Middle value		10 mV/ 0.01 μA		
			ld: Last value		20 mV/ 0.02 μA		
			st1: 1st step value		0.1 mV/ 0.0001 μA		
			st2: 2nd step value		0.1 mV/ 0.0001 μA		
			If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately.				
		SM?	Response: SM<±fd>, ±<md>,±<ld>,<st1>,<st2>*1 fd,md,ld,,st1,st2: <d.ddddE±d>			○	○
	Sweep type	SX?	The sweep type of the present source function is returned. Response: Linear sweep: Same as the SN? response Fixed level sweep: Same as the SF? response Random sweep: Same as the SC? response 2-slope linear sweep: Same as the SM? response			○	○

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Sweep	Random sweep memory data	N [adr] P	Random sweep memory data setting starts from the N command and completes at the P command. N<adr>,SVR<n>,SOV<data1>,SOV<data2>,...,P (for voltage setting) N<adr>,SIR<n>,SOI<data1>,SOI<data2>,...,P (for current setting) adr: Memory address (0 to 7999) data1: Voltage or current source value at adr data2: Voltage or current source value at adr+1 ***Note:*** ***1. When no source range is specified, the optimal range is set.*** ***2. Source values different from the present source function cannot be set.***		0 0 *6	○	×
		N? [adr]	Response: N<adr>,SVR<n>,SOV ± <data>,P (For voltage source value) N<adr>,SIR<n>,SOI ± <data>,P (For current source value) adr: <dddd> n: <d> data: <d.ddddE ± d> *1			○	○
		NP?	Query of the random sweep memory setting status Response: 0... Random sweep memory setting complete 1... Random sweep memory is being set.	0		○	○
		RSAV	Saves the random sweep data.			○	×
		RLOD	Loads the random sweep data.			○	×
		RCLR	Initializes the random sweep data. (Data saved in the memory is not initialized.)			○	×
	Pulse sweep base value	BS [data]	data: Pulse sweep base value		0	○	▲
		BS?	Response: BS ± <d.ddddE ± d> *1			○	○
	Bias value	SB [data]	data: Bias value		0	○	▲
		SB?	Response: SB ± <d.ddddE ± d> *1			○	○
	RTB (Return To Bias)	RB0	OFF (Stays at the final value when sweep stops.)			○	△
		RB1	ON (Returns to the bias value when sweep stops.)		●		
		RB?	Response: RB0 or RB1			○	○

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.
*6: Not initialized by the RINI or *RST command.

6.7.4 Remote Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Sweep	Sweep range	SR0	Auto		●	○	▲
		SR1	Fixed				
		SR?	Response: SR0 or SR1			○	○
	Reverse mode	SV0	OFF		●	○	△
		SV1	ON				
		SV?	Response: SV0 or SV1			○	○
	Sweep repeat count	SS cnt	cnt: Count (0 to 1000) (0 indicates infinite loop)		1	○	△
		SS?	Response: SSdddd			○	○
	Sweep stop	SWSP	Stop sweep			○	○
	Trigger	*TRG	Sweep start trigger Measurement trigger			○	○
Mea sure-ment	Function	F0	Measurement OFF			○	△
		F1	DC voltage measurement (DCV)				
		F2	DC current measurement (DCI)		●		
		F3	Resistance measurement (OHM)				
		F?	Response: F0 to F3			○	○
	Measurement range	R0	AUTO range			○	△
		R1	Fixed to the limit value range		●		
			(However, if the measurement function and the source function are same, the measurement range conforms to the source range.)				
		R?	Response: R0 or R1			○	○
	Measurement function link mode	FX0	OFF		●	○	△
		FX1	ON (VSIM/ISVM) (However, if measurement is set to OFF, the measure-ment OFF status remains even after this parameter is changed.)				
		FX?	Response: FX0 or FX1			○	○

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Measurement	Integration time	IT0	100 µs			○	△
		IT1	500 µs				
		IT2	1 ms				
		IT3	5 ms				
		IT4	10 ms				
		IT5	1 PLC		●		
		IT6	100 ms				
		IT7	200 ms				
		IT8	S/H (Sample hold mode)				
		IT?	Response: IT0 to IT8			○	○
	Auto zero	AZ0	OFF			○	△
		AZ1	ON		●		
		AZ?	Response: AZ0 or AZ1			○	○
	Unit display	DM0	Decimal point and unit symbol form		●	○	△
		DM1	Exponent form				
		DM?	Response: DM0 or DM1			○	○
	Display digits	RE3	$3^1/_2$ digits			○	△
		RE4	$4^1/_2$ digits				
		RE5	$5^1/_2$ digits		●		
		RE?	Response: RE3 to RE5			○	○
	Measurement auto range delay	RD Ard	Ard: Measurement auto range delay time (Units: ms) *1		0	○	△
		RD?	Response: RDddddd.			○	○
	Measurement buffer memory	ST0	Store OFF	●	●	○ *7	△
		ST1	Normal ON				
		ST2	Burst ON			△	
		ST?	Response:ST0 to ST2			○	○
		RL	Initializes the stored data.			△	△

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.
*7: Operational only between ST0 and ST1.

6.7.4 Remote Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Measurement	Measurement buffer memory	RN n[,adr]	n: 0... Releases recall execution status. 1... Sets recall execution status. adr: Recall data number (0 to 7999) (The data number does not change if this setting is omitted.) Reading out the recall data by using the talker function after the recall execution status is set performs the following operation. • Increments the recall data number after the data output. • If data does not exist in the specified number, the output becomes < EE + 8.88888E + 30 > • Reading out does not erase the data in memory.	●	●	○	△
		RN?	Response: RNn,adr n : <d> adr: <dddd>			○	○
		RDN adr1,adr2	Specifies the memory range to be read by RDT?. (GPIB only) adr1: First recall data number (0 to 7999) adr2: Last recall data number (0 to 7999)	(0,0)	(0,0)	○	△
		RDN?	Response: RDN adr1,adr2 (GPIB only) adr1,adr2 : <dddd>			○	○
		RDT?	Reads out data from the specified memory range. (GPIB only) Response: Data is read out from the specified range in the format described in Section 6.6, "Data Output Format (Talker Format)." using delimiters ",". • When data does not exist in the specified number, <EE+8.88888E+30> is output. • Executing this command releases the recall execution status.	(0)		○	△
		SZ?	Reads out the number of stored data Response: <dddd>	0	*6	○	○
		RNM adr	adr: Sets the maximum number of stored data (0 to 8000). When the measurement memory is used and the number of stored data in the buffer memory matches this value, bit 4 (ASM) of the Device Event Status Register is set.	0	*6	△	△
		RNM?	Reads out the maximum number of stored data. Response: RNMdddd			○	○
	Measurement data output request (RS-232 only)	MON?	Response: Refer to Section 6.4.5, "Command Transmission and Response."			○	○

*6: Not initialized by the RINI or *RST command.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
Cal-cula-tion	NULL calculation	NL0	OFF		●	○	△
		NL1	ON				
		NL?	Response: NL0 or NL1			○	○
		KNL ± data	Sets the NULL constant. (An error occurs when the NULL calculation is set to OFF.) *4		0	○	△
		KNL?	Response: KNL ± d.ddddE ± dd			○	○
	Comparator calculation	CO0	OFF		●	○	△
		CO1	ON				
		CO?	Response: CO0 or CO1			○	○
		KHI ± data	Sets the upper limit.		0	○	△
		KLO ± data	Sets the lower limit. *4		0		
		KHI?	Response: KHI ± d.ddddE ± dd			○	○
		KLO?	KLO ± d.ddddE ± dd				
	Scaling calculation	SCL0	OFF		●	○	△
		SCL1	ON				
		SCL?	Response: SCL0 or SCL1			○	○
		KA a	a: Constant A (0 (zero) is invalid.)		1	○	△
		KB b	b: Constant B		0		
		KC c	c: Constant C *4		1		
		KA?	Response: KA ± d.ddddE ± dd			○	○
		KB?	KB ± d.ddddE ± dd				
		KC?	KC ± d.ddddE ± dd				
	MAX/MIN calculation	MN0	OFF		●	○	△
		MN1	ON				
		MN?	Response: MN0 or MN1			○	○
		AVE?	Reads out the average value.	0			
		MAX?	Reads out the maximum value.	-9.99999 E+26			
		MIN?	Reads out the minimum value.	+9.99999 E+26			
		TOT?	Reads out the total value.	0			
		AVN?	Reads out the measurement count. Response: AVN d.ddddE+dd	0			

*4: The setting range is from 0 to ±9.99999E+26.

6.7.4 Remote Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
System	User parameter	STP0	Save the setting parameters into the non-volatile memory, area 0.			○	△
		STP1	Save the setting parameters in the non-volatile memory, area 1.				
		STP2	Save the setting parameters in the non-volatile memory, area 2.				
		STP3	Save the setting parameters in the non-volatile memory, area 3.				
		SINI	Sets the factory default settings in all the areas from 0 to 3.				
		RCLP0	Loads the data in non-volatile memory, area 0 as setting parameters.	●		×	×
		RCLP1	Loads the data in non-volatile memory, area 1 as setting parameters.				
		RCLP2	Loads the data in non-volatile memory, area 2 as setting parameters.				
		RCLP3	Loads the data in non-volatile memory, area 3 as setting parameters.				
		RINI	Loads the factory default settings as setting parameters.				
	Initialization	*RST	Initializes parameters. (The parameters except marked by *6 in this list are the factory default values.)			○	○
		C	Device clear			○	○
	Instrument information	*IDN?	Tells the instrument to ask itself. Response: ADC Corp.nnnnn,xxxxxxxxx,yyyyy ADC Corp.:manufacturer (9 characters) nnnnn: model "6247G" (5 characters) or "6247C" (5 characters) xxxxxxxxx: serial number (9 characters) xxxxx: ROM revision (5 characters)			○	○
	Power frequency	Auto setting				○	○
		LF?	Response: LF0...50 Hz LF1...60 Hz				
	Notice buzzer	NZ0	OFF			○	△
		NZ1	ON		●		
		NZ?	Response: NZ0 or NZ1			○	○

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
System	Comparator calculation buzzer	BZ0	OFF		●		
		BZ1	ON (Comparator calculation result: HI)				
		BZ2	ON (Comparator calculation result: GO)			○	△
		BZ3	ON (Comparator calculation result: LO)				
		BZ4	ON (Comparator calculation result: HI or LO)				
		BZ?	Response: BZ0 to BZ4			○	○
	Limit detection buzzer	UZ0	OFF		●	○	△
		UZ1	ON				
		UZ?	Response: UZ0 or UZ1			○	○
	Self test	*TST?	Executes the test and reads out the results. Response: 0; Pass 1; Fail			×	×
		TER?	The self-test result of each register is returned. Response: a, b, c, d (a,b,c,d: 0 to 65535)			○	○
	Error log	ERL?	Reads out error logs. The number of errors and the error descriptions are all cleared. Response: ± ddd, ± ddd, ± ddd, ± ddd, ± ddd (+ is shown as a space.)			○	○
		ERC?	Reads out the number of errors. Response: ddd 000: No error 001 to 999 (Error count : to be overwritten)			○	○
	Relay counter	RLY?	Reads out the relay counter data. Response: ddddddddd (up to 999999999)			×	×
	Interlock	OP0	STBY In signal input (IN)		●		
		OP1	OPR/STBY In signal input (IN)				
		OP2	InterLock In signal input (IN)			×	×
		OP3	Operate Out signal output (OUT)				
		OP4	OPR/SUS In signal input (IN)				
		OP?	Response: OP0 to OP4			○	○

6.7.4 Remote Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
System	Synchronous control signal setting	CP0	COMPLETE signal output Meas Front (measurement start)			○	△
		CP1	COMPLETE signal output Meas End (measurement end)		●		
		CP2	COMPLETE signal output Comp HI (Comparator calculation result: HI)				
		CP3	COMPLETE signal output Comp GO (Comparator calculation result: GO)				
		CP4	COMPLETE signal output Comp LO (Comparator calculation result: LO)				
		CP5	COMPLETE signal output Comp HI or LO (Comparator calculation result: HI or LO)				
		CP6	Sync Out signal output				
		CP?	Response: CP0 to CP6			○	○
		CW0	Specifies the synchronous control signal output width: 10 µs			○	△
		CW1	Specifies the synchronous control signal output width: 100 µs		●		
		CW?	Response: CW0 or CW1			○	○
GPIB	Block delimiter *9	DL0	CRLF<EOI>	●		○	△
		DL1	LF		*5		
		DL2	<EOI>				
		DL3	LF<EOI>		*8		
		DL?	Response: DL0 to DL3			○	○
	Header	OH0	OFF			○	△
		OH1	ON		*6 ●		
		OH?	Response: OH0 or OH1			○	○

*5: Not initialized by the RINI command.
*6: Not initialized by the RINI or *RST command.
*8: EOI is a GPIB function and cannot be output by USB or RS-232.
*9: The block delimiter for RS-232 is fixed to <CR><LF>.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	DC/pulse OPR/SUS	Sweep OPR/SUS
GPIB	SRQ	S0	ON		*5	○	△
		S1	OFF	●			
		S?	Response: S0 or S1			○	○
	Status	*STB?	Query of the Status Byte Register (STB). Response: ddd			○	○
		*SRE	Sets the Service Request Enable Register (0 to 255).	0	*6	○	○
		*SRE?	Response: ddd			○	○
		*ESR?	Query of the Standard Event Status Register (ESR). Response: ddd			○	○
		*ESE	Sets the Standard Event Status Enable Resister (0 to 255).	0	*6	○	○
		*ESE?	Response: ddd			○	○
		DSR?	Query of the Device Event Status Register (DSR). Response: ddddd			○	○
		DSE	Sets the Device Event Status Enable Register (0 to 65535).	0	*6	○	○
		DSE?	Response: ddddd			○	○
		ERR?	Query of the Error Register (ERR). Response: ddddd			○	○
		*CLS	Status clear			○	○
	Operation Complete	*OPC	After all operations are complete, sets LSB of the Standard Event Status Register.			○	○
		*OPC?	Response: 1 (after all operations completed)			○	○
		*WAI	Waits until all operations are complete (GPIB only).			○	○

*5: Not initialized by the RINI command.
*6: Not initialized by the RINI or *RST command.

6.7.4 Remote Command List

<table>
<tr><th colspan="2" rowspan="2">Item</th><th rowspan="2">Command</th><th rowspan="2">Description</th><th colspan="2">Default</th><th colspan="2">Operation</th></tr>
<tr><th>Power ON</th><th>Factory shipment</th><th>DC/pulse OPR/SUS</th><th>Sweep OPR/SUS</th></tr>
<tr><td rowspan="20">Cali-bra-tion</td><td rowspan="3">Calibration switch</td><td>CAL0</td><td>OFF (Exits the calibration mode.)</td><td>●</td><td></td><td rowspan="2">×</td><td rowspan="2">×</td></tr>
<tr><td>CAL1</td><td>ON (Enters the calibration mode.)</td><td></td><td></td></tr>
<tr><td>CAL?</td><td>Response: CAL0 or CAL1</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">Calibration data</td><td>XINI</td><td>Initializes the calibration data. (Not initializes the calibration data in the non-volatile memory.)</td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td>XWR</td><td>Saves the calibration data in the non-volatile memory.</td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td rowspan="8">Calibration execution</td><td>XVS</td><td>Selects the voltage source function calibration</td><td></td><td></td><td rowspan="8">×</td><td rowspan="8">×</td></tr>
<tr><td>XIS</td><td>Selects the current source function calibration.</td><td></td><td></td></tr>
<tr><td>XVLH</td><td>Selects the voltage limiter (High) calibration.</td><td></td><td></td></tr>
<tr><td>XVLL</td><td>Selects the voltage limiter (Low) calibration.</td><td></td><td></td></tr>
<tr><td>XILH</td><td>Selects the current limiter (High) calibration.</td><td></td><td></td></tr>
<tr><td>XILL</td><td>Selects the current limiter (Low) calibration.</td><td></td><td></td></tr>
<tr><td>XVM</td><td>Selects the voltage measurement function calibration.</td><td></td><td></td></tr>
<tr><td>XIM</td><td>Selects the current measurement function calibration.</td><td></td><td></td></tr>
<tr><td>Calibration range</td><td>XR-2
XR-1
XR0
XR1
XR2
XR3
XR4
XR5
XR6</td><td>Sets the calibration range.
<table>
<tr><th></th><th>Voltage range</th><th>Current range</th></tr>
<tr><td>XR-2</td><td>-</td><td>3 µA</td></tr>
<tr><td>XR-1</td><td>-</td><td>30 µA</td></tr>
<tr><td>XR0</td><td>-</td><td>300 µA</td></tr>
<tr><td>XR1</td><td>-</td><td>3 mA</td></tr>
<tr><td>XR2</td><td>-</td><td>30 mA</td></tr>
<tr><td>XR3</td><td>-</td><td>300 mV</td></tr>
<tr><td>XR4</td><td>5 V</td><td>-</td></tr>
<tr><td>XR5</td><td>50 V</td><td>-</td></tr>
<tr><td>XR6</td><td>250 V</td><td>-</td></tr>
</table></td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td rowspan="4">Calibration data</td><td>XDAT</td><td>Changes to the DMM data input mode.</td><td></td><td></td><td rowspan="2">×</td><td rowspan="2">×</td></tr>
<tr><td>XD ±data</td><td>±data: Inputs DMM read data.</td><td></td><td></td></tr>
<tr><td>XADJ</td><td>Changes to the calibration check mode.</td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td>XNXT</td><td>Moves on to the next calibration.</td><td></td><td></td><td>×</td><td>×</td></tr>
</table>

*5: Not initialized by the RINI command.
*6: Not initialized by the RINI or *RST command.

Command compatible with former models

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation	During sweep operation
Source	Function and source range	V4	Voltage source function 5 V range			○ Sus-pended when executed	×
		V5	Voltage source function 50 V range				
		V6	Voltage source function 250 V range				
		I-2	Current source function 3 μA range				
		I-1	Current source function 30 μA range				
		I0	Current source function 300 μA range				
		I1	Current source function 3 mA range				
		I2	Current source function 30 mA range				
		I3	Current source function 300 mA range				
		V? I?	Response: V4 to V6 or I-2 to I3			○	○
	Source value (pulse value) and limit value	D ± data UNIT	The source value setting is different depending on whether UNIT is specified or not. With UNIT: Automatically sets the optical range. Available unit: mV, V, μA ,mA, A Without UNIT: Sets the present function and range. When a unit that is different from that of the present source function is set, the input data is set as limit value as follows. +data: HI limit value -data: LO limit value			○	×
		D?	Response: D ± <data1>UNIT,D <data2>UNIT data1: Voltage or current source value <d.ddddE ± d> *1 data2: Voltage or current limit value (The polarity is space.) <0d.dddE ± d> *1 UNIT: V or A ***Note:*** ***When the absolute values of HI and LO limit values are different, the response becomes, D ± d.ddddE ± dUNIT, D 09.999E + 9UNIT.***			○	○

<table>
<tr><th colspan="2" rowspan="2">Item</th><th rowspan="2">Command</th><th rowspan="2">Description</th><th colspan="2">Default</th><th colspan="2">Operation</th></tr>
<tr><th>Power ON</th><th>Default setting</th><th>During DC/ pulse operation</th><th>During sweep operation</th></tr>
<tr><td rowspan="4">Source</td><td rowspan="3">Operate/Standby</td><td>H</td><td>Sets the output to OFF (Standby).</td><td rowspan="2">●</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2">○</td></tr>
<tr><td>E</td><td>Sets the output to ON (Operate).</td></tr>
<tr><td>E?, H?</td><td>Returns the present output status.
Response:
<table><tr><th>Status</th><th>E?, H?</th></tr><tr><td>Operate</td><td>E</td></tr><tr><td>Suspend</td><td>H</td></tr><tr><td>Standby</td><td>H</td></tr></table></td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>Random sweep memory data (using D command)</td><td>N [adr]

P</td><td>Random sweep memory data setting starts from the N command and completes at the P command.
N<adr>,D<data1><UNIT>,D<data2><UNIT>,...,P
adr: Memory address (0 to 7999)
data1: Voltage or current source value at adr
data2: Voltage or current source value at adr+1

Note:
1. When no source range is specified, the optimal range is set.
2. Source values different from the present source function cannot be set.</td><td></td><td>0

*6</td><td>○</td><td>×</td></tr>
</table>

*6: Not initialized by the RINI or *RST command.

6.7.5 TER? Command

The TER? command reads out the self set results.

1. Command response

   ddddd,ddddd,ddddd,ddddd,ddddd
   a b c d e

2. Descriptions of values a, b, c, d and e

   The TER register column in Table 5-17 shows the error factors and register values for a, b, c, d and e. For example, an error in VSVM 50V +FS of the self test is returned as follows.

   00000, 00000, 00016, 00000, 00000

6.8 Sample Programs

This section describes program examples to remotely control the 6247G/6247C via GPIB, USB or RS-232.

These sample programs perform the same operations as described in Section 2.2, "Basic Operation."
Download these programs from ADC's website.

http://www.adcmt.com/samplesoft/samplesoft_01.html

6.8.1 Program Example for GPIB

[Operating environment]

OS:	Microsoft WindowsXP Professional
GPIB hardware:	NATIONAL INSTRUMENTS GPIB-USB-HS
Module:	Niglobal.bas, Vbib-32.bas (included in GPIB-USB-HS)
Language:	Microsoft Excel Visual Basic for Application (VBA)

These program examples perform the same operations as described in Section 2.2, "Basic Operation."

- Program example 1: Example of DC measurement introduced in Section 2.2.5
- Program example 2: Example of pulse measurement introduced in Section 2.2.6
- Program example 3: Example of sweep measurement introduced in Section 2.2.7
- Program example 4: Example of reading out measurement data from the measurement buffer memory as fast as possible.

6.8.2 Program Example for USB

[Operating environment]

OS:	Microsoft WindowsXP Professional
Module:	ausb.bas (ADC instruments USB driver)
Language:	Microsoft Excel Visual Basic for Application (VBA)

- Program example: Example of DC measurement introduced in Section 2.2.5

Download the ADC instruments USB driver from ADC's website.

http://www.adcmt.com/driverssoft/USB_driver.html

6.8.3 Program Example for RS-232

[Operating environment]

OS:	Microsoft WindowsXP Professional
Language:	Microsoft Excel Visual Basic for Application (VBA)
Control:	Microsoft Communications Control

- Program example: Example of DC measurement introduced in Section 2.2.5

7. PERFORMANCE TEST

This chapter describes the methods for checking whether the 6247G/6247C operates in the specified accuracy.

7.1 Measuring Instrument Necessary for Performance Test

Use a measuring instrument for the performance test which meets the specifications shown in Section 8.1, "Measuring Instrument and Cables Necessary for Calibration."

7.2 Connections

The connections required for the performance test are the same as shown in Figure 8-1, "Connections for Calibration."

7.3 Test Method

Execute the performance test under the following conditions in a location free of dust, vibration, noise or other adverse conditions:

Temperature: 23 ± 5°C

Relative humidity: 70% or lower

Warm-up: 60 minutes or longer

Self-test, display, key, and buzzer tests

1. Press the **MENU** key to select ***SYSTEM*** and refer to Section 5.2.14, "Self Test" to execute.

NOTE: ***If an error occurs during the test, refer to Section 5.2.14, "Self Test" to verify the content of the error.***

Voltage source and measurement test

1. Connect the 6247G/6247C and a DMM (Digital Multi-Meter) as shown in Figure 8-1 (a).
2. Set the DMM to DCV, auto range and integration time of 10 PLC or longer.
3. Set the 6247G/6247C to DC source mode, AUTO trigger mode and integration time of 200 ms.
4. Select voltage source voltage measurement, and set the output to Operate.
5. With ZERO and ± Full Scale generated in the 5 V range to 250 V range, verify that the difference between the source value and the DMM measured value is within the accuracy described in Chapter 9, "SPECIFICATIONS."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6247G/6247C as outlined in Chapter 8, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.***

Current source and measurement test (3 μA range)

1. Connect the 6247G/6247C and a DMM (Digital Multi-Meter) as shown in Figure 8-1 (b).
2. Set the DMM to DCI, auto range and integration time of 10 PLC or longer.
3. Set the 6247G/6247C to DC source mode, AUTO trigger mode and integration time of 200 ms.
4. Select current source current measurement, and set the output to Operate.
5. With ZERO and ± Full Scale generated in the 3 μA range, verify that the difference between the source value and the DMM measured value is within the accuracy described in Chapter 9, "SPECIFICATIONS."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6247G/6247C as outlined in Chapter 8, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.***

Current source and measurement test (30 μA to 300 mA range)

1. Connect the 6247G/6247C and a DMM (Digital Multi-Meter) as shown in Figure 8-1 (c).
2. Set the DMM to DCI, auto range and integration time of 10 PLC or longer.
3. Set the 6247G/6247C to DC source mode, AUTO trigger mode and integration time of 200 ms.
4. Select current source current measurement, and set the output to Operate.
5. With ZERO and ± Full Scale generated in the 30 μA range to the 300 mA range, verify that the difference between the source value and the DMM measured value is within the accuracy described in Chapter 9, "SPECIFICATIONS."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6247G/6247C as outlined in Chapter 8, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.***

8. CALIBRATION

This chapter describes how to calibrate the 6247G/6247C to perform within the specified accuracy ranges.

In order to use the 6247G/6247C in the specified accuracies, periodic calibration at least once a year is recommended.

Contact an ADC CORPORATION sales representative for the calibration service.

8.1 Measuring Instrument and Cables Necessary for Calibration

The following table shows the required accuracies of a DMM and cables used for calibration.

Range	ZERO		F. S.		Cable
	Calibration point	Required accuracy	Calibration point	Required accuracy	
5 V	0V	5 μV	+5 V	20 ppm	A01044 (supplied accessory) *1
			–1 V	20 ppm	
50 V		50 μV	+50 V	20 ppm	
			-10 V	20 ppm	
250 V		500 μV	+200 V	20 ppm	
			-15 V	20 ppm	
3 μA	0A	50 pA	± 3 μA	120 ppm	A01035
30 μA		50 pA	± 30 μA	120 ppm	A01044 (supplied accessory) *1
300 μA		500 pA	± 300 μA	120 ppm	
3 mA		5 nA	± 3 mA	120 ppm	
30 mA		50 nA	± 30 mA	120 ppm	
300 mA		500 nA	± 300 mA	210 ppm	

*1: When much externally induced noise exists, use shielded cables, such as A01001, etc.

8.2 Safety Precautions

1. Use an AC power supply with the specified voltage.
2. Execute calibration under the following conditions in a location free of dust, vibration, noise or other adverse conditions:

   Temperature 23°C ± 3°C

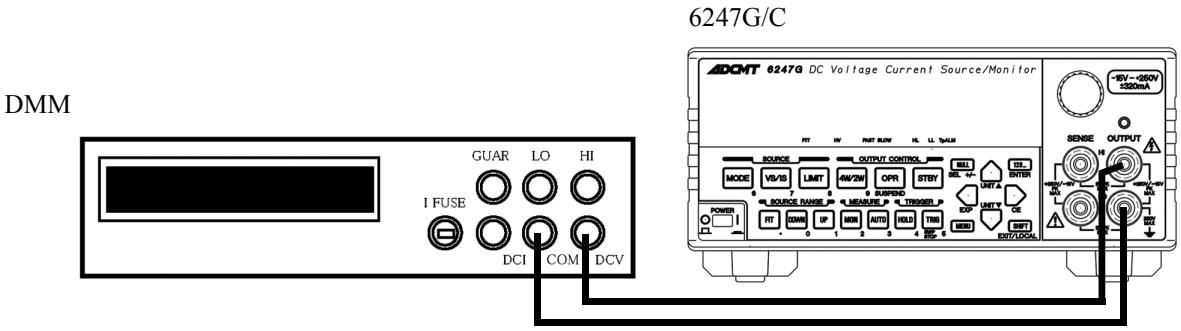
   Relative humidity 70% or lower
3. Allow the 6247G/6247C to warm-up for two hours or longer before calibration.

   Allow the measuring instrument to be used in calibration to warm-up for the period of time specified before the calibration.
4. After calibration, note the dates of the calibration and the next scheduled calibration on a card or sticker, etc. for convenience.
5. Calibration by key operation is not available.

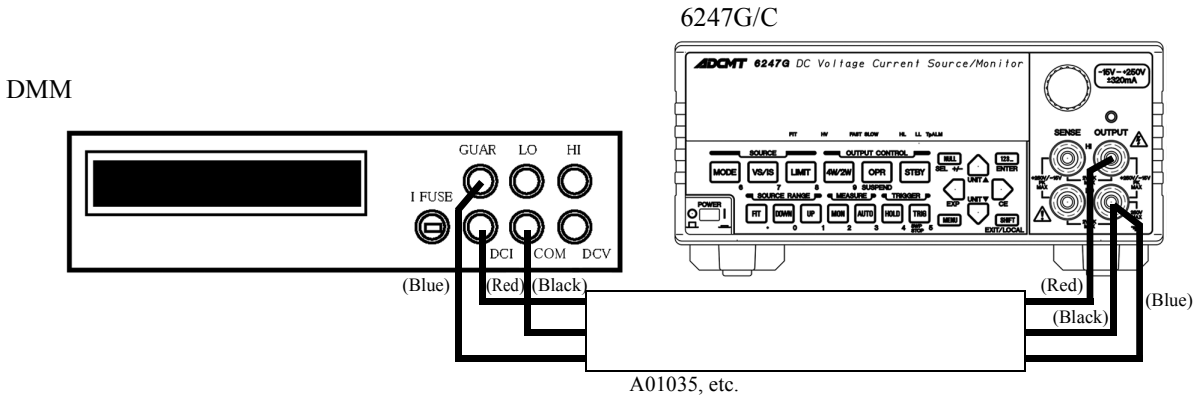
   Execute calibration by using a remote commands via GPIB, USB or RS-232.

8.3 Connections

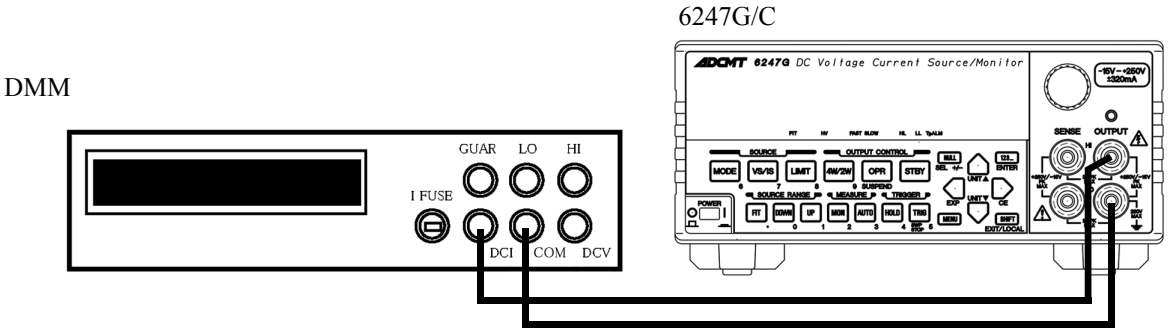
The following figure shows connections for calibrating the 6247G/6247C using a DMM.



(a) Checking and calibrating voltage source measurement



(b) Checking and calibrating current source measurement (**3 μA** range)



(c) Checking and calibrating current source measurement (**30 μA** to **300 mA** range)

Figure 8-1 Connections for Calibration

8.4 Calibration Points and Tolerance Ranges

For calibration, use a measuring instruments satisfying the required accuracy described in Section 8.1, "Measuring Instrument and Cables Necessary for Calibration", meeting the tolerance ranges shown in the following table.

Item	Range	Calibration point		Tolerance range
		ZERO	Full Scale	
Voltage source	5 V	0 V	+5.0000 V	±100 μV
	50 V		+50.000 V	±1 mV
	250 V		+200.00 V	±10 mV
Current source	3 μA	0 A	+3.0000 μA	±100 pA
	30 μA		+30.000 μA	±1 nA
	300 μA		+300.00 μA	±10 nA
	3 mA		+3.0000 mA	±100 nA
	30 mA		+30.000 mA	±1 μA
	300 mA		+300.00 mA	±10 μA
Voltage measurement	5 V	0 V	+5.00000 V	±10 μV
	50 V		+50.0000 V	±100 μV
	250 V		+200.000 V	±1 mV
Current measurement	3 μA	0 A	+3.00000 μA	±100 pA
	30 μA		+30.0000 μA	±300 pA
	300 μA		+300.000 μA	±3 nA
	3 mA		+3.00000 mA	±30 nA
	30 mA		+30.0000 mA	±300 nA
	300 mA		+300.000 mA	±3 μA
Voltage HI limiter	5 V	0 V	+5.000 V	±500 μV
	50 V		+50.00 V	±5 mV
	250 V		+200.0 V	±50 mV
Voltage LO limiter	5 V	0 V	-1.000 V	±500 μV
	50 V		-10.00 V	±5 mV
	250 V		-015.0 V	±50 mV

Item	Range	Calibration point		Tolerance range
		ZERO	Full Scale	
Current HI limiter	3 μA	0 A	+3.000 μA	±500 pA
	30 μA		+30.00 μA	±5 nA
	300 μA		+300.0 μA	±50 nA
	3 mA		+3.000 mA	±500 nA
	30 mA		+30.00 mA	±5 μA
	300 mA		+300.0 mA	±50 μA
Current LO limiter	3 μA	0 A	-3.000 μA	±500 pA
	30 μA		-30.00 μA	±5 nA
	300 μA		-300.0 μA	±50 nA
	3 mA		-3.000 mA	±500 nA
	30 mA		-30.00 mA	±5 μA
	300 mA		-300.0 mA	±50 μA

8.5 Calibration Procedure

The 6247G/6247C is calibrated by using the remote commands through GPIB, USB or RS-232.
Figure 8-2 to Figure 8-8 shows the calibration procedures. For more information on the remote commands, refer to the calibration parameters described in Section 6.7.4, "Remote Command List"

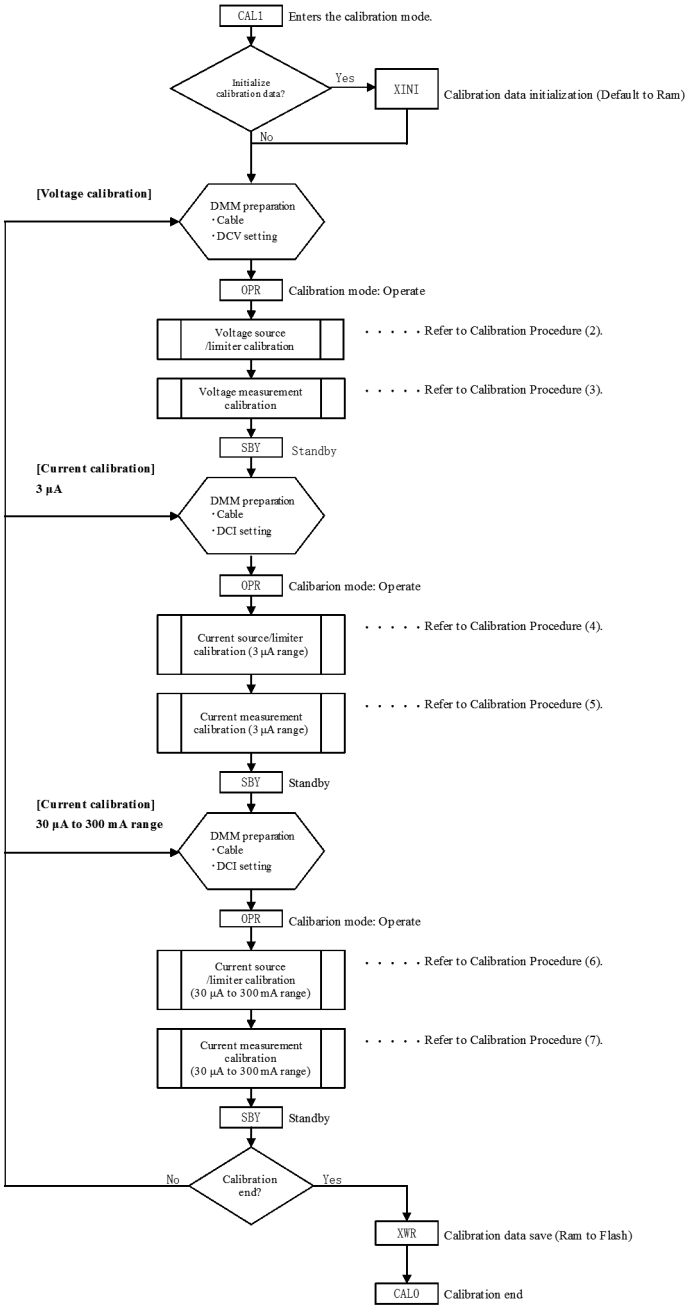


Figure 8-2 Calibration Procedure (1)

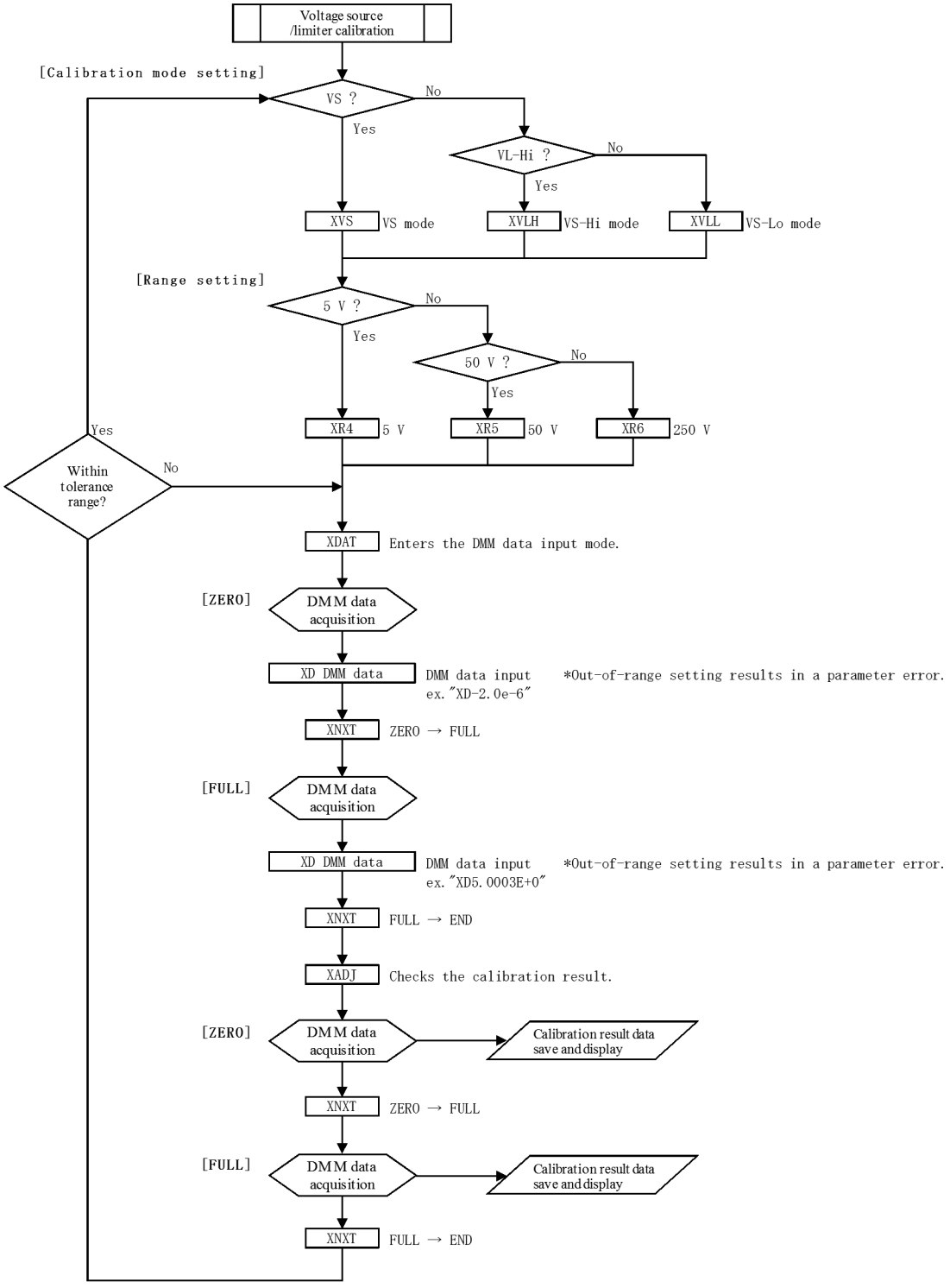


Figure 8-3 Calibration Procedure (2)

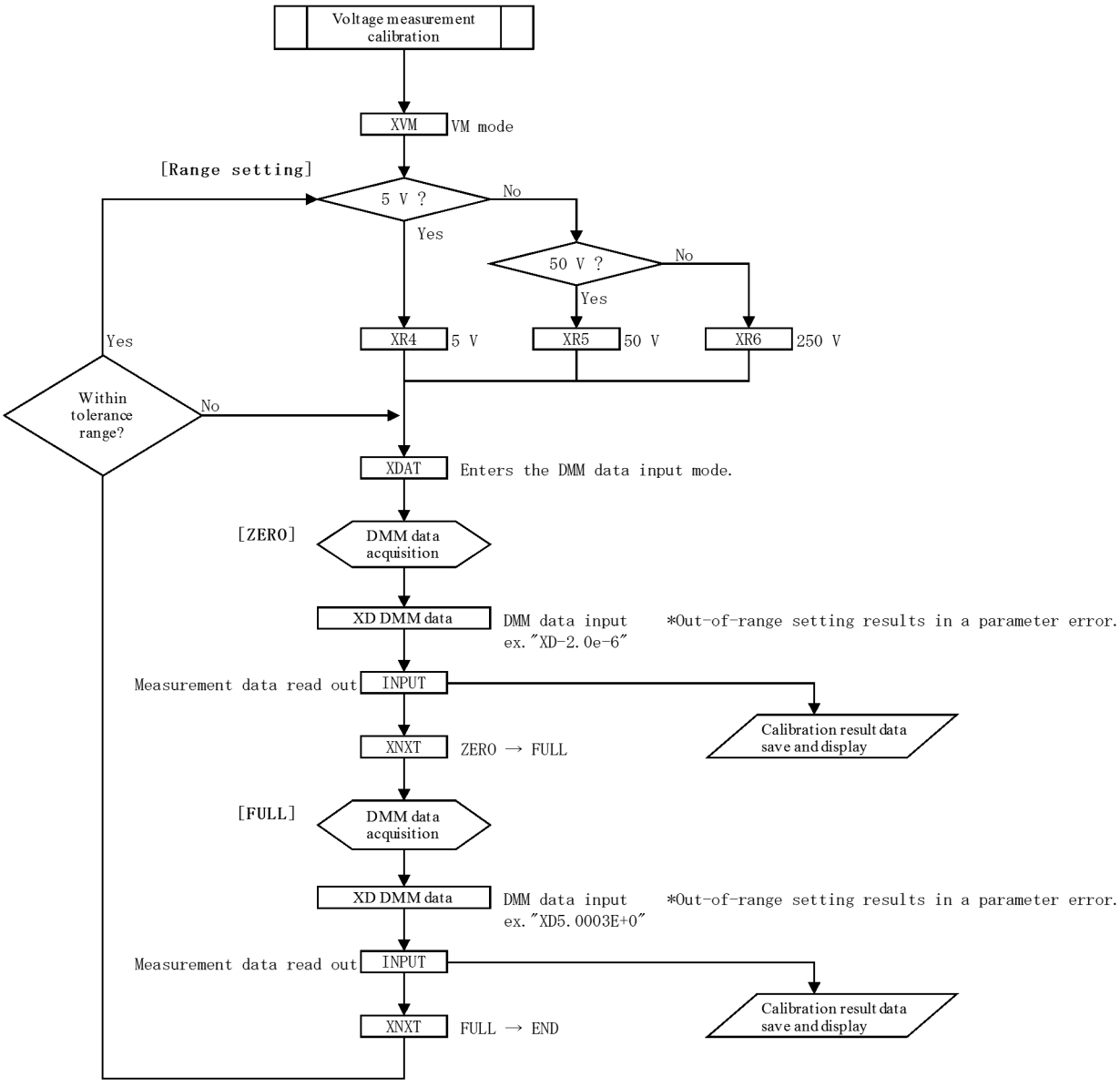


Figure 8-4 Calibration Procedure (3)

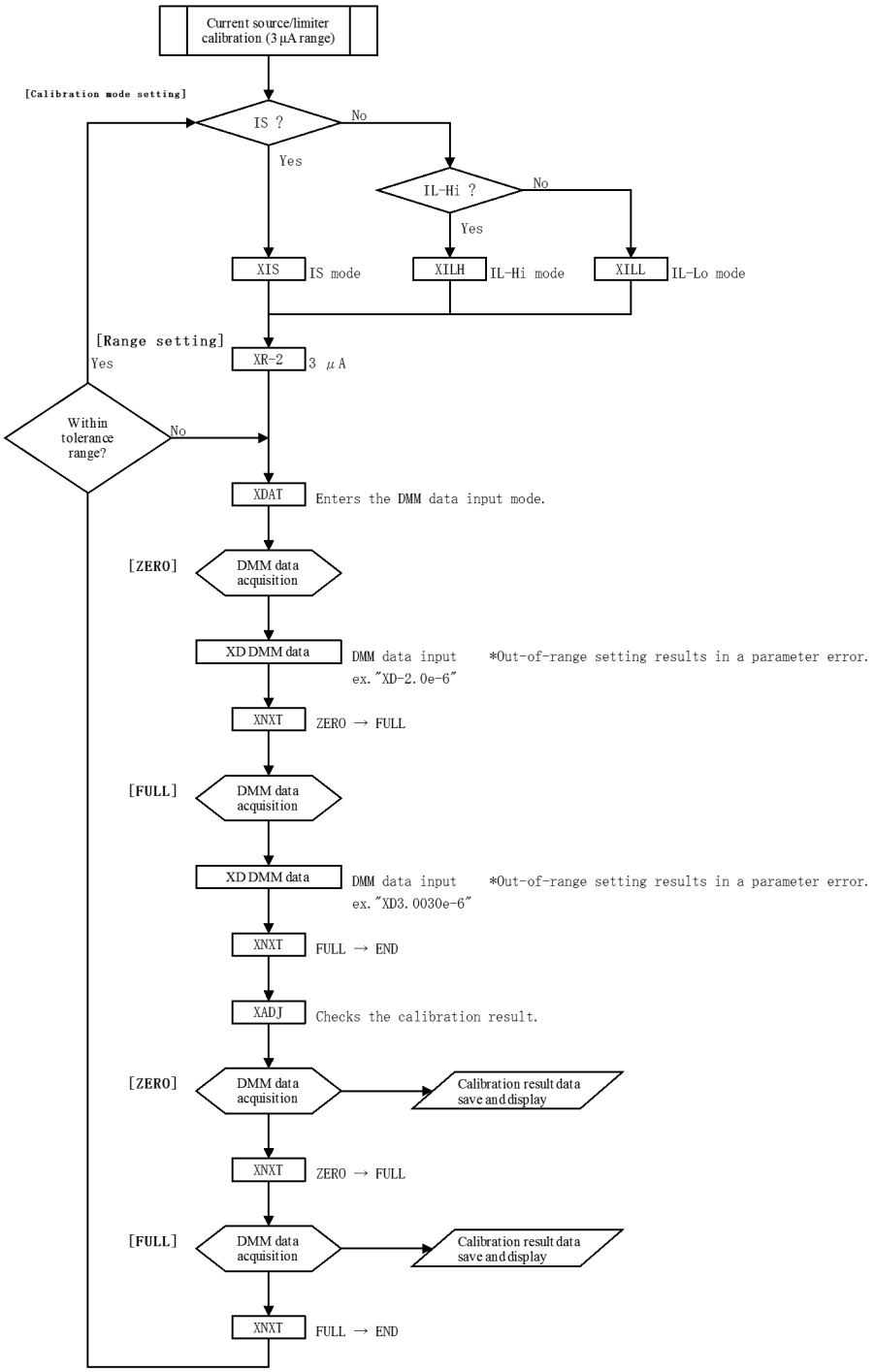


Figure 8-5 Calibration Procedure (4)

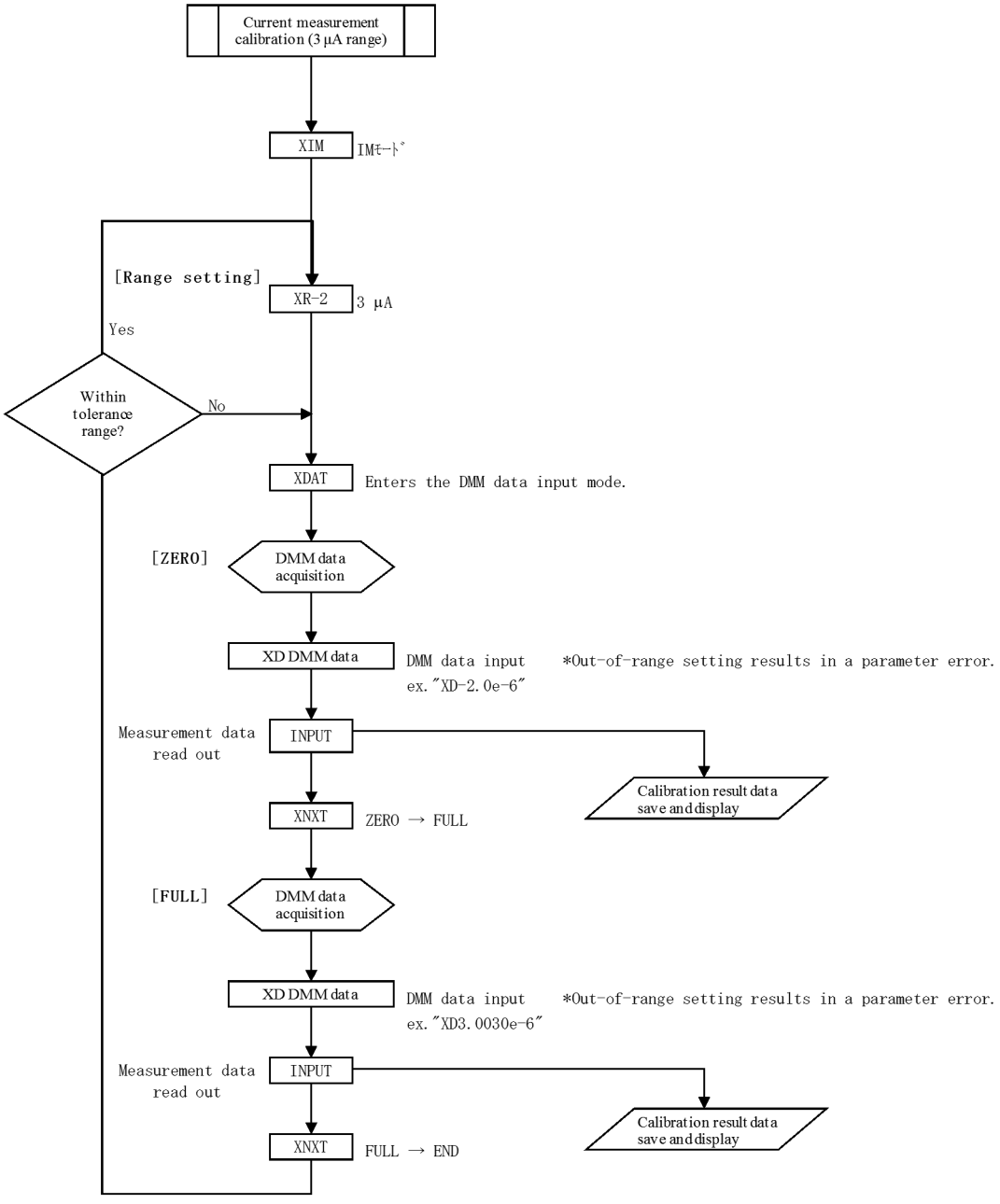


Figure 8-6 Calibration Procedure (5)

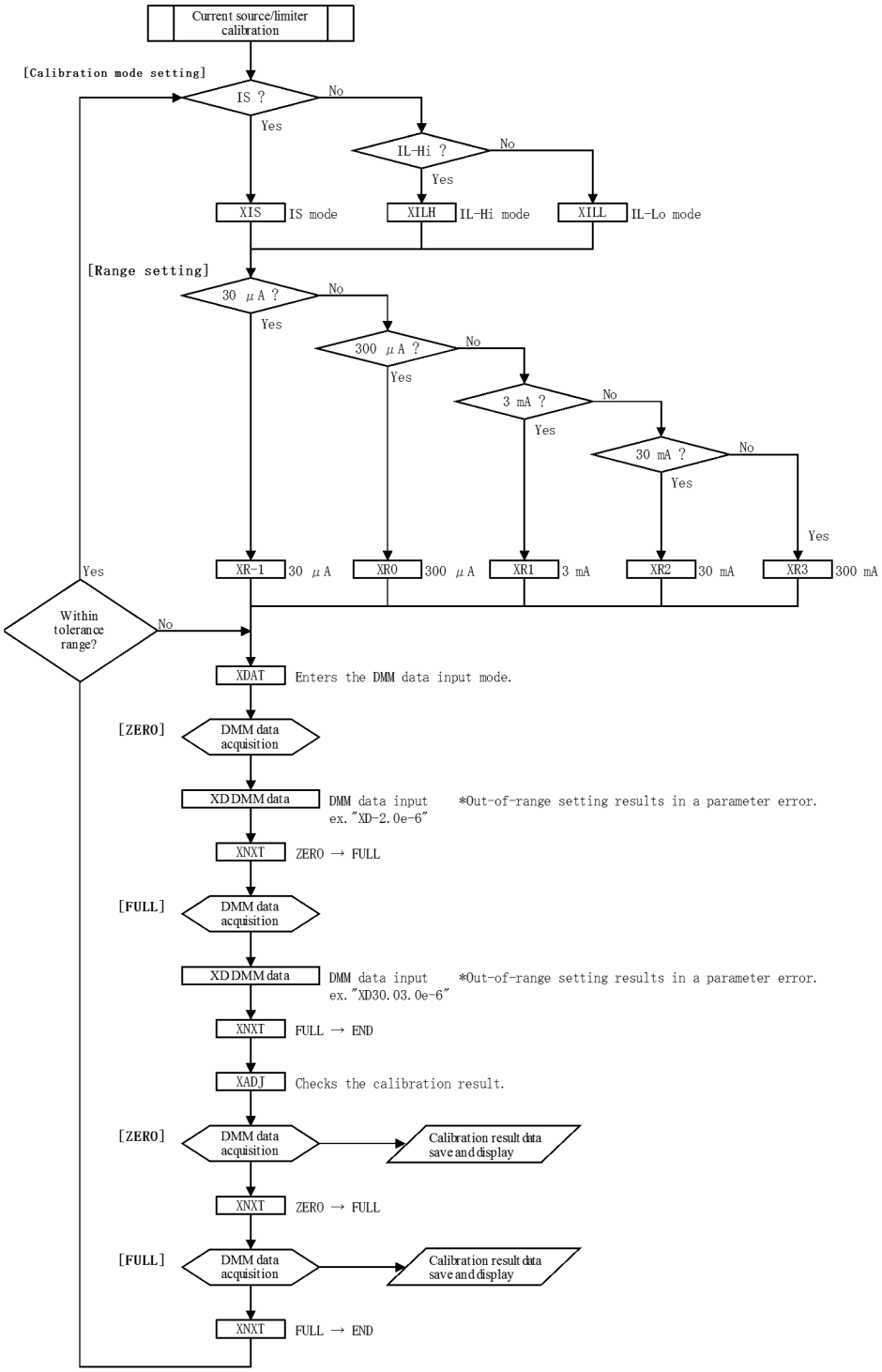


Figure 8-7 Calibration Procedure (6)

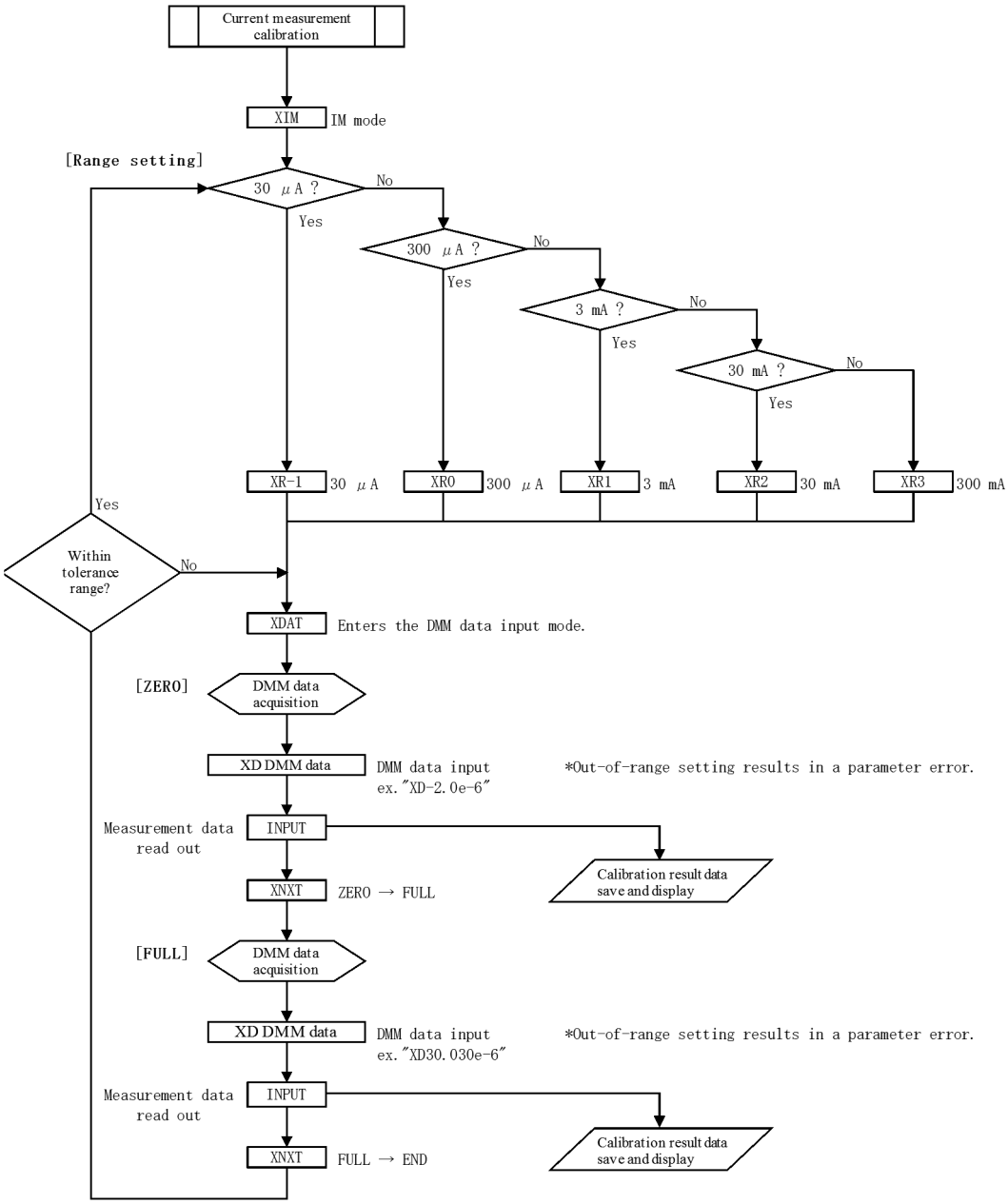


Figure 8-8 Calibration Procedure (7)

8.5.1 Overall Calibration Procedure

The overall procedure of calibrations is described by using an example of voltage calibration according to Figure 8-2 Calibration Procedure (1).

1. Enter the calibration mode by CAL1.
2. When executing all the calibrations, initialize calibration data only once by XINI at the start of the calibrations.
3. When executing voltage calibration, make connection for voltage calibration in reference to Figure 8-1 (a) Checking and calibrating voltage source measurement of Figure 8-1 in Section 8.3, "Connections."
4. Press OPR to set the output status to Operate in the calibration mode.
5. Execute the voltage source and limiter calibration and the voltage measurement calibration according to Figure 8-3 Calibration Procedure (2) and Figure 8-4 Calibration Procedure (3) respectively.
6. Press SBY to set the output status to Standby.
7. Store the calibration data to the non-volatile memory by XWR.
8. Finish the calibration mode by CAL0.

8.5.2 Voltage Source/Voltage Limiter Calibration

1. Select the voltage calibration mode.
   Voltage source: XVS
   Voltage HI limiter: XVLH
   Voltage LO limiter: XVLL
2. Select the range.
   5 V range: XR4
   50 V range: XR5
   250 V range: XR6
3. Enter the DMM data input mode by XDAT.
4. Set the DMM read value by XD data.
5. Move to the full-scale calibration mode by XNXT.
6. Set the DMM read value by XD data.
7. Finish the DMM data input mode by XNXT.
8. Move to the zero calibration check mode by XADJ.
9. Check the zero calibration value.
10. Move to the full-scale calibration check mode by XNXT.
11. Check the full-scale calibration value.
12. Move to the next step.
    When changing the voltage calibration mode: XNXT
    When moving to the voltage measurement calibration: XVM

8.5.3 Voltage Measurement Calibration

1. Move to the voltage measurement calibration mode by XVM.
2. Select the range.
   5 V range: XR4
   50 V range: XR5
   250 V range: XR6
3. Enter the DMM data input mode by XDAT.
4. Set the DMM read value by XD data.
5. Read out and check the measurement data.
6. Move to the full-scale calibration mode by XNXT.
7. Set the DMM read value by XD data.
8. Read out and check the measurement data.
9. Move to the next step.
   When changing the voltage range: XNXT
   When moving to the current source or voltage limiter calibration: XIS, XVLH, XVLL

8.5.4 Current Source/Current Limiter Calibration (3 μA Range)

1. Select the current calibration mode.
   Current source: XIS
   Current HI limiter: XILH
   Current LO limiter: XILL
2. Select the 3 μA range.
   3 μA rang: XR-2
3. From this step, perform the same procedure as described in Section 8.5.2, "Voltage Source/Voltage Limiter Calibration."
4. Move to the next step.
   When changing the current calibration mode: XNXT
   When moving to the current measurement calibration: XIM

8.5.5 Current Measurement Calibration (3 μA Range)

1. Move to the current measurement calibration mode by XIM.
2. Select the 3 μA range.
   3 μA range: XR-2
3. From this step, perform the same procedure as described in Section 8.5.3, "Voltage Measurement Calibration."

8.5.6 Current Source/Current Limiter Calibration (30 μA to 300 mA Range)

1. Select the current calibration mode.
   Current source: XIS
   Current HI limiter: XILH
   Current LO limiter: XILL
2. Select the range.
   30 μA range: XR-1
   300 μA range: XR0
   3 mA range: XR1
   30 mA range: XR2
   300 mA range: XR3
3. From this step, perform the same procedure as described in Section 8.5.2, "Voltage Source/Voltage Limiter Calibration."
4. Move to the next step.
   When changing the current calibration mode: XNXT
   When moving to the current measurement calibration: XIM

8.5.7 Current Measurement Calibration (30 μA to 300 mA Range)

1. Move to the current measurement calibration mode by XIM.
2. Select the range.
   30 μA range: XR-1
   300 μA range: XR0
   3 mA range: XR1
   30 mA range: XR2
   300 mA range: XR3
3. From this step, perform the same procedure as described in Section 8.5.3, "Voltage Measurement Calibration."

9. SPECIFICATIONS

All accuracy specifications are guaranteed for one year at a temperature of 23 ± 5°C and a relative humidity not exceeding 85%.

9.1 Source and Measurement

	Range	Source range	Setting resolution	Measurement range	Measurement resolution
Voltage source/ measurement range	5 V	-1.0000 to +5.0000 V	100 μV	-1.00999 to +5.00999 V	10 μV
	50 V	-10.000 to +50.000 V	1 mV	-10.0999 to +50.0999 V	100 μV
	250 V	-15.00 to +250.00 V	10 mV	-15.099 to + 250.999 V	1 mV
Current source/ measurement range	3 μA	0 to ±3.2000 μA	100 pA	0 to ±3.20999 μA	10 pA
	30 μA	0 to ±32.000 μA	1 nA	0 to ±32.0999 μA	100 pA
	300 μA	0 to ±320.00 μA	10 nA	0 to ±320.999 μA	1 nA
	3 mA	0 to ±3.2000 mA	100 nA	0 to ±3.20999 mA	10 nA
	30 mA	0 to ±32.000 mA	1 μA	0 to ±32.0999 mA	100 nA
	300 mA	0 to ±320.00 mA	10 μA	0 to ±320.999 mA	1 μA
Resistance measurement range	Determined by voltage range/ current range calculations	-	-	0 Ω to 125 GΩ	Minimum 30 μΩ

However, the measurement resolution with integration time of 100 μs, 500 μs or S/H (Sample Hold) is as follows:

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

Voltage/current limiter (compliance) range:

	Maximum setting range	Setting resolution *1
Voltage limiter	-1.000 V to +5.000 V	1 mV
	-10.00 V to +50.00 V	10 mV
	-15.0 V to 250.0 V	100 mV
Current limiter	10 nA to 3.2 μA	1 nA
	3.201 μA to 32 μA	10 nA
	32.01 μA to 320 μA	100 nA
	320.1 μA to 3.2 mA	1 μA
	3.201 mA to 32 mA	10 μA
	32.01 mA to 320 mA	100 μA

*1 : Where, (Hi limiter value - Lo limiter value) ≥ 60 digits (200 digits in the 3 μA range)

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°C

	Range	Accuracy	1-day stability	Temperature coefficient
		± (% of setting + V)		± (ppm of setting + V)/°C
Voltage source	5 V	0.02 + 500 μV	0.01 + 200 μV	20 + 40 μV
	50 V	0.02 + 5 mV	0.01 + 2 mV	20 + 0.4 mV
	250 V	0.025 + 50 mV	0.01 + 20 mV	20 + 4 mV
Voltage limiter	5 V	0.05 + 3 mV *2	0.01 + 1 mV	50 + 300 μV
	50 V	0.05 + 30 mV *2	0.01 + 10 mV	50 + 3 mV
	250 V	0.05 + 300 mV *2	0.01 + 100 mV	50 + 30 mV

*2: Voltage limiter additional error: When the Hi limit value is set to a negative value and the Lo limit value is set to a positive value, an error of ±1% of setting is added.

	Range	Accuracy	1-day stability	Temperature coefficient
		± (% of setting + A + A × Vo/1 V)		± (ppm of setting + A + A × Vo/1 V)/°C
Current source	3 μA	0.03 + 5 nA + 30 pA	0.01 + 3 nA + 10 pA	30 + 0.5 nA + 1 pA
	30 μA	0.03 + 15 nA + 300 pA	0.01 + 8 nA + 100 pA	30 + 1.5 nA + 10 pA
	300 μA	0.03 + 150 nA + 3 nA	0.01 + 80 nA + 1 nA	30 + 15 nA + 0.1 nA
	3 mA	0.03 + 1.5 μA + 30 nA	0.01 + 0.8 μA + 10 nA	30 + 0.15 μA + 1 nA
	30 mA	0.03 + 15 μA + 300 nA	0.01 + 8 μA + 100 nA	30 + 1.5 μA + 10 nA
	300 mA	0.045 + 150 μA + 3 μA	0.015 + 80 μA + 1 μA	45 + 15 μA + 0.1 μA
Current limiter	3 μA	0.045 + 8 nA + 30 pA	0.01 + 5 nA + 10 pA	40 + 1 nA + 1 pA
	30 μA	0.045 + 35 nA + 300 pA	0.01 + 20 nA + 100 pA	40 + 3.5 nA + 10 pA
	300 μA	0.045 + 350 nA + 3 nA	0.01 + 100 nA + 1 nA	40 + 35 nA + 0.1 nA
	3 mA	0.045 + 3.5 μA + 30 nA	0.01 + 1 μA + 10 nA	40 + 0.35 μA + 1 nA
	30 mA	0.045 + 35 μA + 300 nA	0.01 + 10 μA + 100 nA	40 + 3.5 μA + 10 nA
	300 mA	0.055 + 350 μA + 3 μA	0.015 + 100 μA + 1 μA	45 + 35 μA + 0.1 μA

Vo : Compliance voltage (-15 V to +250 V)

	Range	Accuracy	1-day stability	Temperature coefficient
		± (% of reading + V)		± (ppm of reading + V)/°C
Voltage measurement	5 V	0.02 + 120 μV	0.008 + 50 μV	20 + 15 μV
	50 V	0.02 + 1.2 mV	0.008 + 0.5 mV	20 + 0.15 mV
	250 V	0.02 + 10 mV	0.008 + 8 mV	20 + 1 mV

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

	Range	Accuracy	1-day stability	Temperature coefficient
		± (% of reading + A + A × Vo/1 V)		± (ppm of reading + A + A × Vo/1 V)/°C
Current measurement	3 μA	0.03 + 4 nA + 30 pA	0.01 + 2.5 nA + 10 pA	30 + 0.45 nA + 1 pA
	30 μA	0.03 + 12 nA + 300 pA	0.01 + 7 nA + 100 pA	30 + 1.5 nA + 10 pA
	300 μA	0.03 + 120 nA + 3 nA	0.01 + 70 nA + 1 nA	30 + 15 nA + 0.1 nA
	3 mA	0.03 + 1.2 μA + 30 nA	0.01 + 0.7 μA + 10 nA	30 + 0.15 μA + 1 nA
	30 mA	0.03 + 12 μA + 300 nA	0.01 + 7 μA + 100 nA	30 + 1.5 μA + 10 nA
	300 mA	0.045 + 120 μA + 3 μA	0.015 + 70 μA + 1 μA	30 + 15 μA + 0.1 μA

(Auto zero: ON, integration time: 1 PLC to 200 ms)
Vo: Compliance voltage (-15 V to +250 V)

	Condition	Accuracy	1-day stability	Temperature coefficient
Resistance measurement		± (% of reading) ± (digits + digits + digits)		± (ppm of reading) ± (digits + digits + digits)/ °C
	Voltage source	Reading item: (Voltage source setting item + Current measurement reading item) Full-scale item:(Voltage source full-scale item digit value + current measurement full-scale item digit value + CMV item digit value)*3		
	Current source	Reading item: (Current source setting item + Voltage measurement reading item) Full-scale item:(Current source full-scale item digit value + Voltage measurement full-scale item digit value + CMV item digit value)*3		

(Auto zero: ON, integration time: 1PLC to 200 ms)
Vo : Compliance voltage (-15 V to +250 V)
*3 : CMV item = (A × Vo/1 V); source or measurement current × source or measurement voltage/1 V digit value

The full-scale item tolerances listed below are added to the integration time 100 μs to 10 ms, the S/H measurement accuracy and the 1-day stability.

	Measurement range	Integration time Unit: digits (at $5^1/_2$ digit display)					
		10 ms	5 ms	1 ms	500 μs	100 μs	S/H
Voltage measurement	5 V	5	15	20	30	100	120
	50 V	5	15	20	30	100	120
	250 V	5	15	20	30	100	120
Current measurement	3 μA	600	1000	1500	2000	2000	3000
	30 μA	200	300	300	300	500	2000
	300 μA	40	50	60	80	200	1500
	3 mA	40	50	60	80	200	500
	30 mA	40	50	60	80	200	300
	300 mA	40	50	60	60	200	300

S/H: Measurement in the sample hold mode (integration time: 100 μs)

Source linearity: ±3 digits or less
Maximum output current: ±320 mA at -15 V to +250 V;
Maximum compliance voltage: -15 V to ±250 V at up to ±320 mA;

Output noise: For voltage source, within the range from no load to the maximum load [Vp-p]
For current source, at the following load [Ap-p]

	Range	Load resistance	Low frequency noise		High frequency noise
			DC to 100 Hz	DC to 10 kHz	DC to 20 MHz
Voltage source	5 V	-	200 μV	400 μV	10 mV
	50 V	-	300 μV	1 mV	10 mV
	250 V	-	500 μV	5 mV	10 mV
Current source	3 μA	10 kΩ	10 nA	60 nA	800 nA
	30 μA	10 kΩ	10 nA	60 nA	800 nA
	300 μA	10 kΩ	50 nA	150 nA	800 nA
	3 mA	1 kΩ	500 nA	2 μA	10 μA
	30 mA	1 kΩ	4 μA	10 μA	20 μA
	300 mA	1 kΩ	40 μA	60 μA	100 μA

Switching noise:

		Typical value [p-p]	Load resistance
Output ON/OFF noise	Voltage source	1 V	At 100 kΩ
	Current source	1 V	At 100 kΩ
Range switching noise	Voltage source	100 mV	-
	Current source Current measurement Current limiter	100 digits+100 mV *4	-
	Voltage limiter	100 mV *5	-
	Voltage measurement	100 mV *5	-
Power OFF noise		1 V	At 100 kΩ

*4: "digits" indicates current source $4^{1}/_{2}$ digit values.
*5: The limiter is inactive. While the limiter is active, it is the same as the current source range switching noise.

Settling time: Time to reach the final value ±0.1% at pure resistance load and load capacity of 2.5 pF and with compliance set to full scale
Voltage source in the 250 V range: at load where the output current is 20% or less of the setting limit value (FAST: 600 μs, SLOW: 2.5 ms at full load)

(Typical value)	Source range	Limiter range	Output response	
			FAST	SLOW
Voltage source Output current: 320 mA	5 V	3 mA to 300 mA	300 μs	2.2 ms
	50 V			
	250 V			
Current source Output voltage: 5 V	3 mA	250 V	120 μs	
	30 mA			
	300 mA			
Current Source Output voltage: 250 V	3 mA	250 V	800 μs	4.5 ms
	30 mA			
	300 mA			

Over shoot: ±5% or less under pure resistance load and at the standard cable end
(3 μA, 30 μA and 300 μA ranges excluded)

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: Depending on the accuracy CMV (A × Vo/1V)

Output resistance: At 4-wire connection (Output cable not included)

Maximum load capacitance:
Maximum load capacitance that does not generate oscillation in voltage source or voltage limiter status

Current range	Output resistance (Ω)		Maximum load capacitance
	Voltage source	Current source	
3 μA	3 Ω or less	10 GΩ or higher	1 μF
30 μA	500 mΩ or less	1000 MΩ or higher	1 μF
300 μA	100 mΩ or less	1000 MΩ or higher	1 μF
3 mA	10 mΩ or less	100 MΩ or higher	100 μF
30 mA	10 mΩ or less	10 MΩ or higher	100 μF
300 mA	10 mΩ or less	1 MΩ or higher	2000 μF

Supplied cable resistance: 100 mΩ or less

Maximum inductive load:

Maximum inductive load that does not generate oscillation in current source or voltage limiter status

Current source range/ current limiter range	Response	3 μA, 30 μA	300 μA	3 mA to 300 mA
Maximum inductive load	FAST	100 μH	200 μH	1 mH
	SLOW	500 μH	1 mH	

Effective CMRR: With unbalanced impedance of 1 kΩ
At DC and AC 50/60 Hz ±0.08%

	Integration time	
	100 μs to 10 ms	1 PLC to 200 ms
Voltage source/ current measurement	35 dB	95 dB
Current source/ voltage measurement	35 dB	95 dB

NMRR: At AC 50/60 Hz ± 0.08%

	Integration time	
	100 μs to 10 ms	1 PLC to 200 ms
Voltage measurement/ current measurement	0 dB	60 dB

9.2 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, measurement auto range in pulse source is impossible)
DC sweep source and measurement:	Source and measurement by linear, 2- slope linear, random and fixed levels
Pulse sweep source and measurement:	Source and measurement by linear, 2- slope linear, random and fixed levels (However, measurement auto range in pulse source is impossible)
Integration time:	9 types: 100 μs, 500 μs, 1 ms, 5 ms, 10 ms, 1 PLC, 100 ms, 200 ms and S/H S/H: Sample hold (integration time: 100 μs) measurement (Enabled only in the pulse source or pulse sweep source modes.) (PLC: Power Line Cycle 50 Hz: 20 ms, 60 Hz: 16.66 ms)
Sweep mode:	Reverse ON (round) / OFF (one way)
Sweep repeat count:	1 to 1000 times or infinite
Maximum number of sweep steps:	8000 steps
Maximum random sweep memory:	8000 data
Measurement data memory:	8000 data
Measurement auto range:	Available only in VSIM or ISVM
Measurement function link mode:	Links the source function to the measurement function. (VSIM or ISVM) ON/OFF available
Limiter:	The HI and LO limit values can be set individually. (However, setting the current limit values of the same polarity are not allowed.)
Calculation function:	NULL calculation Comparator calculation (HI, GO, or LO) Scaling calculation MAX, MIN, AVE, TOTAL calculations
Trigger style:	Auto trigger, External trigger
Output terminal:	Front; Safety socket HI OUTPUT, HI SENSE, LO OUTPUT, and LO SENSE
Maximum input:	+250 V/-15 V peak Max (between HI-LO) 2 V peak Max (between OUTPUT and SENSE) 250 V Max (between LO and chassis)
Maximum remote sensing voltage:	±1 V 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:	10 GΩ or higher

Voltage measurement input leak current:
±100 pA or lower

GPIB (6247G only):
Compliant with IEEE-488.2-1987
Interface function;SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Connector;Amphenol 24 pin

USB:
USB 2.0 Full-speed
Connector; Type B

RS-232 (6247C only):
Compliant with EIA232
Baud rate; 19200, 9600, 4800, 2400, 1200, 600, 300
Parity; Even, Odd and None
Number of data bits; 7 bits, 8 bits
Number of stop bits; 1 bit, 2 bits
Connector; Dsub 9 pin

External control signal:
TRIGGER IN,
INTERLOCK, OPERATE IN/OUT,
OPERATE OUT, SYNC OUT
Connector; BNC

9.3 Setting Time

Minimum pulse width: 50 µs

Minimum step (repeat) time: Under fixed source/measurement range, integration time of 100 µs, the minimum measurement or source delay time, calculation function OFF, and voltage/current measurement

Measurement	Memory mode	Minimum step time
OFF	-	0.5 ms
ON	BURST	2 ms
	NORMAL	10 ms
	OFF	

Source delay time:

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

Period (pulse cycle):

Setting range	Resolution *6	Setting accuracy
0.500 ms to 60.000 ms	1 µs	±(0.1% + 10 µs)
60.01 ms to 600.00 ms	10 µs	
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Pulse width:

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

Measurement delay time:

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

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

Hold time:

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

Auto range delay time:

Setting range	Resolution	Setting accuracy
0ms to 5000 ms	1 ms	±(2% + 3 ms)

9.4 General Specifications

Operating environment conditions: Ambient temperature 0°C to +50°C, relative humidity 85% or below, with no condensation

Storage environment conditions: Ambient temperature -25°C to +70°C, relative humidity 85% or below, with no condensation

Warming up time: 60 minutes or longer (until it settles in the specified accuracies.)

Display: 16 segments × 12 digits vacuum fluorescent display

Power supply: AC power 100 V, 120 V, 220 V, and 240 V (User selectable)

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

Specify the option number when ordering.
Use a power cable and a fuse that are compliant with the safety standard when changing the power supply voltage.

Line frequency: 50 Hz/60 Hz

Power consumption: 160 VA or less

Dimensions: Approx. 212 (width) × 88 (height) × 340 (depth) mm

Mass: 7.3 kg or less

Safety: Compliant with IEC61010-1 Ed.3

EMI: Compliant with EN61326-1 classA

9.5 Supplementary Descriptions

9.5.1 How to Calculate Accuracy for Current Source, Current Measurement and Current Limiter

Example) Calculating the accuracy in current source of 2.7 mA (3 mA range)

The accuracy formula in the current source range of 3mA is as follows:

	Range	Accuracy ±(% of setting + A + A × Vo / 1V)
Current source	3 mA	0.03 + 1.5 μA + 30 nA

The accuracies in current source and current measurement are always calculated by using the output voltage of 1 V.

Assume that the output voltage is 1V.

Accuracy = ±(% of setting + A + A × Vo / 1V)
= ±(2.7 mA × 0.03% + 1.5 μA + 30 nA × 1 V / 1 V)
= **± 2.34 μA**

Thus, the accuracy in current source of 2.7 mA (3 mA range) is specified between 2.6977 mA to 2.7023 mA.

On the other hand, assume that the output voltage is 15 V.

Accuracy = ±(2.7 mA × 0.03% + 1.5 μA + 30 nA × 15 V / 1 V)
= **± 2.76 μA**

Thus, the accuracy is specified between 2.6972 mA to 2.7028 mA

NOTE: ***Vo in the 1-day stability, current limiter and temperature coefficient for voltage source all indicates source voltage.***

9.5.2 How to Calculate Accuracy for Resistance Measurement

Example) Calculating the accuracy in current source of 3 mA (3 mA range) and voltage measurement of 3 V (5 V range)

The accuracies for resistance measurement must be calculated separately.

The accuracy formula for resistance measurement is as follows:

Condition	Accuracy ±(% of reading) ±(digits + digits + digits)
Voltage source	Reading item: (Voltage source setting item + Current measurement reading item) Full-scale item: (Voltage source full-scale item digit value + current measurement full-scale item digit value + CMV item digit value)
Current source	Reading item: (Current source setting item + Voltage measurement reading item) Full-scale item: (Current source full-scale item digit value + Voltage measurement full-scale item digit value + CMV item digit value)

The accuracies in the 3 mA range for current source and in the 5 V range for voltage measurement are calculated from the specifications as follows:

Accuracy in the 3 mA range for current source: 0.03 + 1.5 μA + 30 nA

Accuracy in the 5 V range for voltage measurement: 0.02 + 120 μV

Here, the reading item for current source is as follows:

Reading item for current source = Current source setting item + Voltage measurement reading item

=0.03 + 0.02 = **0.05 %**

Next, the full-scale (FS) item for current source is as follows:

Full-scale item for current source =Current source full-scale item digit value- - - - - - - - - ①

+ Voltage measurement full-scale item digit value - - - ②

+ CMV item digit value- ③

① Current source full-scale item digit value

The source resolution in the 3 mA range for current source is 100 nA according to the specification.

The accuracy of the offset item is 1.5 μA.

Thus, the current source full-scale item digit value is 15 digits.

② Voltage measurement full-scale item digit value

The measurement resolution in the 5 V range for voltage measurement is 10 μV according to the specification.

The accuracy of the offset item is 120 μV.

Thus, the voltage measurement full-scale item digit value is 12 digits.

③ CMV item digit value

CMV = A × Vo / 1 V

= 30 nA × 3 V / 1 V (*1)

= 90 nA

The source resolution in the 3 mA range for current source is 100 nA according to the specification.

Thus, the CMV item digit value is 0.90 digits.

From ①, ② and ③

Full-scale (FS) item for current source = 15 digits + 12 digits + 0.9 digits

= **27.9 digits**

From the above results,

Accuracy = **± 0.05% ± 27.9 digits**

Next, the accuracy in current source of 3 mA and voltage measurement of 3 V is calculated.

Measurement resistance value R = V / I = 3 V / 3 mA = 1 kΩ (Display: 1.0000 kΩ)

Accuracy = ±(1 kΩ × 0.05%) ±27.9 digits

= **±0.5 Ω × ±27.9 digits**

Thus, the accuracy is specified between 0.9967 kΩ to 1.0033 kΩ.

*1: In accuracy calculation for resistance measurement, the measurement voltage value is used as output voltage Vo.

APPENDIX

A.1 When Problems Occur (Before Requesting Repairs)

If any problem is encountered when using the 6247G/6247C, inspect the unit referring to Table A-1. If the problem cannot be solved by the suggested remedial actions, contact an ADC CORPORATION sales representative.
Fees will be charged for repairs by ADC CORPORATION even if the problem is one of those listed in Table A-1. Therefore, carefully inspect the 6247G/6247C before requesting service.

Table A-1 Items to be Inspected before Requesting the Repair (1 of 2)

Q (Symptom)	A (Cause and Solution)
1. Turning on the **POWER** switch does not display the screen.	Cause: The power fuse is open. Solution: Replace it with the correct fuse.
2. Does not output the setting source values.	Cause: The output status is Standby or Suspend. Solution: Set the output status to Operate and check that the **OPR** indicator on the front panel is ON.
	Cause: Incorrect remote sensing setting. Solution: Check the 4W/2W indicator on the front panel to see if the remote sensing is set as desired.
	Cause: The source value is set to 0 V or 0 A. Solution: Verify the source value.
	Cause: Detection of an overload voltage (Over Load) has set it to Standby. Solution: Disconnect the connection cables.
	Cause: Heat detection (Over Heat) or fan detection (Fan Stopped) has activated, setting it to Standby status. Solution: Remove the cables and turn OFF the **POWER** switch. Turn ON the **POWER** switch.
	Cause: The limiter is activated. Solution: Verify the limiter setting.
	Cause: • The **OUTPUT** terminal and the **SENSE**terminal are incorrectly connected. • The SENSE terminal is incorrectly connected in 4-wire connection. Solution: Verify cable connections again.
	Cause: The interlock signal sets the output status to Standby. Solution: • Change the interlock setting. • Set the Interlock signal to LO.

Table A-1 Items to be Inspected before Requesting the Repair (2 of 2)

Q (Symptom)	A (Cause and Solution)
3. Does not output the measurement values.	Cause: The output status is Standby or Suspend. Solution: Set the output status to Operate and check that the **OPR** indicator on the front panel is ON.
	Cause: Measurement is OFF. Solution: Verify measurement ON/OFF setting.
	Cause: When measuring in the auto range, the value is unstable and the range is unconfirmed, therefore measurement data is not output. Solution: Change to the fixed range and measure.
	Cause: A trigger signal is not input although the trigger signal cable is connected to the external trigger. Solution: Solution: Verify the TRIG INPUT connection cable and the signal.
4. A source value indication is unstable or is in error	Cause: Function or range settings have an error. Solution: Check the settings again.
	Cause: Incorrect cable connection. Solution: Check cable connections again.
	Cause: Disconnected cable. Solution: Verify the cables with a tester. If in error, replace it.
	Cause: A cable is connected to a wrong terminal. Solution: Check cable connections again.
	Cause: The induction noise scatters the measured values. Solution: Set the integration time to 1 PLC or longer.
5. The measurement value is over range.	Cause: The measured value after NULL calculation becomes twice or more of the full-scale value. Solution: Raise the source value or limiter range.
6. Unable to input settings with the control key.	Cause: In the direct input mode, the setting value is at half-brightness and only the green keys on the panel are enabled. Solution: Press the **123...** key to cancel the direct input mode.

A.2 Error Message List

If an error occurs when using the 6247G/6247C6, an error code and a message appear on the screen. The contents are explained in the following:

Table A-2 Error Message List (1 of 3)

Classification	Error code	Message	Description
Self test	001	ROM Chk SUM	ROM check SUM error
	002	Panel Comm	Display communication/RAM error
		(Continuous buzzer ON)	LCA data error
	004	RAM Rd/Wt	RAM read/write error
	005	Analog Comm	Analog section communication error
	008	Flash Write	FLASH memory writing error
	012	CAL data SUM	CAL data SUM error
	013	Param SUM	Parameter SUM error
	101	AD Ratio 1-2	AD operation IR1/IR2 ratio test error
	102	AD Ratio 2-3	AD operation IR2/IR3 ratio test error
	103	AD Ratio 3-4	AD operation IR3/IR4 ratio test error
	104	AD Ratio 4-5	AD operation IR4/IR5 ratio test error
	111	ADRST Sig	Analog section SRT line test error
	112	ADTRG Sig	Analog section TRIG line test error
	152	AD Zero	AD operation ZERO test error
	201	VSVM 5V Zero	VSVM 5 V ZERO test error
	202	VSVM 5V +FS	VSVM 5 V +FS test error
	203	VSVM 5V -FS	VSVM 5 V -FS test error
	204	VSVM 50V Z	VSVM 50 V ZERO test error
	205	VSVM 50V +FS	VSVM 50 V +FS test error
	206	VSVM 50V -FS	VSVM 50 V -FS test error
	207	VSVM 250V Z	VSVM 250 V ZERO test error
	208	VSVM 250V +F	VSVM 250 V +FS test error
	209	VSVM 250V -F	VSVM 250 V -FS test error
	211	HL +5V FS	High Limit + 5 V +FS test error
	212	HL -1V FS	High Limit +5 V -FS test error
	213	HL +50V FS	High Limit + 50 V +FS test error
	214	HL -10V FS	High Limit +50 V -FS test error
	215	HL +250V FS	High Limit + 250 V +FS test error
	216	HL -15V FS	High Limit +250 V -FS test error

Table A-2 Error Message List (2 of 3)

Classification	Error code	Message	Description
Self test	221	LL +5V FS	Low limit -1 V +FS test error
	222	LL -1V FS	Low limit -1 V -FS test error
	223	LL +50V FS	Low limit -10 V +FS test error
	224	LL -10V FS	Low limit -10 V -FS test error
	225	LL +250V FS	Low limit -15 V +FS test error
	226	LL -15V FS	Low limit -15 V -FS test error
	230	IM 3µA Zero	IM 3 µA ZERO test error
	231	IM 30µA Zero	IM 30 µA ZERO test error
	232	IM 300µA Z	IM 300 µA ZERO test error
	233	IM 3mA Zero	IM 3 mA ZERO test error
	234	IM 30mA Zero	IM 30 mA ZERO test error
	235	IM 300mA Z	IM 300 mA ZERO test error
	301	OVL Check	OVL detection check error
	311	S/H Check	Sample hold test error
	130	No resp SCI	SCI communication error
	501	CAL dt Lost	CAL data lost
	502	Save dt Lost	Parameters saved by "STP" command lost
	503	Para dt Lost	Saved parameters lost
Hardware error	401	Fan Stopped	Fan stopped
	402	Over Heat	Overheat
	403	Source Unit	Source unit circuit error
	404	Over Load	Overload
Source/measurement error	-	±OverRange	Measurement over range
	-	HiLimit RM/LoLimit RM	Resistance measurement in limit detection status.
	-	VSource=0	Resistance measurement with source value = 0
	-	Count Few	IS is below 20 digits or IM is below 200 digits.
	-	±SCL Over	Scaling over
	-	±TotalOver	Total value error

Table A-2 Error Message List (3 of 3)

Classification	Error code	Message	Description
Operation	801	Over Step	8000 < Number of sweep steps
	822	Tp < Tds	Timer condition error (Not Tp > Tds + 300 μs)
	823	Tp < Td	Timer condition error (Not Tp > Td + 300 μs)
	824	Tp < Tds+Tw	Timer condition error (Not Tp > Tds + Tw + 300 μs)
	825	Td < Tds	Timer condition error (Not Td > Tds)
	828	600ms < Tp	S/H timer condition error (Not Tp ≤ 600 ms)
	831	Interlock	Disabled by interlock
	855	CAL data	Calibration data error
Remote command error	-102	Cmd Syntax	Command syntax error
	-113	Cmd Undefine	Command undefined
	-200	Cmd Exec	Execution error (Command currently not executable)
	-222	Out of Range	The input value is out of range.
USB communication	140	CPU Comm	USB/SCI communication error (illegal code received)
	141	ILL Comm	USB/SCI communication error (another code received)
	150	USB error	USB communication error
RS-232 communication	160	RS-232 error	RS-232 communication error

A.3 Execution Time

A.3.1 GPIB/USB Remote Execution Time (Typical Value)

Computer: DELL OPTIPLEX 755 Windows XP

GPIB hardware: NATIONAL INSTRUMENTS PCI-GPIB

Item		Program code		Condition	GPIB Unit [ms]	USB Unit [ms]
Operate/ Suspend/ Standby	Operate	OPR	(In Standby)	Source mode: DC, pulse IT: 1 PLC (20 ms) Source function: VS/IS Other: default	121/103	135/117
			(In Suspend HiZ)		67/50	82/64
			(In Suspend LoZ)		7/12	22/27
		OPR	(In Standby)	Source mode: sweep Number of steps: 100 IT: 1 PLC (20 ms) Other: default	142	156
			(In Suspend HiZ)		64	78
			(In Suspend LoZ)		7	23
	Suspend	SUS	(OPR → SUS LoZ)	Source mode: DC, pulse IT: 1 PLC (20 ms) Source function: VS/IS Other: default	6/12	22/28
			(OPR → SUS HiZ)		70/52	85/68
			(SBY → SUS LoZ)		121/84	136/118
			(SBY → SUS HiZ)		63/61	77/76
	Standby	SBY	(In Operate)	Source mode: DC, pulse IT: 1 PLC (20 ms) Source function: VS/IS Other: default	112/93	127/109
			(In Suspend HiZ)		48/47	63/62
			(In Suspend LoZ)		111/87	126/121
Source function		VF	(In IS Operate)	Source mode: DC, pulse Operate and HOLD status	13 to 53	27 to 69
			(In Suspend)		5 to 7	19 to 20
		IF	(In VS Operate)		9 to 10	23 to 25
			(In Suspend)		5 to 7	20 to 21
Change the source range		V4 to V6 (In VF Operate)			9 to 10	23 to 25
		I-2 to I3 (In IF Operate)			23 to 45	38 to 61

Item		Program code	Condition		GPIB Unit [ms]	USB Unit [ms]
Voltage source *1	Source value Pulse value Base value Bias value	SOV<data> BS<data> SB<data>	Operate and HOLD status	Range not changed	5 to 8	21 to 22
				Range changed	9 to 10	25 to 27
Current source *1	Source value Pulse value Base value Bias value	SOI<data> BS<data> SB<data>		Range not changed	6 to 8	23 to 25
				Range changed	24 to 46	42 to 63
Voltage limit value *1		LMV<data>		Range not changed	4 to 7	19 to 25
				Range changed	9 to 11	26 to 30
Current limit value *1		LMI<data>		Range not changed	5 to 6	22 to 25
				Range changed	24 to 65	42 to 83
Measurement function		F0 to F3	Source mode: DC, pulse Operate and HOLD status		7	20
Integration time *2		IT0			6	22
		IT1			7	23
		IT2			7	23
		IT3			1611	27
		IT4			16	31
		IT5			26	41
		IT6			106	122
		IT7			206	222
Time parameter *1	Th, Td, Tp, Tw	SP<data>,<data>,<data>,<data>			6 to 9	26 to 30
	Tds	SD<data>			5	21
Sweep type *1	Linear	SN<data>	Standby status		6	22 to 25
	Fixed	SF<data>			4 to 5	20 to 23
	Random	SC<data>			4 to 6	20 to 23
	2-slope	SM<data>			6 to 8	24 to 31
Source mode		MD0 to MD3			5	21
Random data setting *1		N<adrs>,<data>, P			7 to 10	28 to 33

*1:The processing time for commands including <data> varies depending on the data length.
*2:When the power frequency is 50 Hz

1. Measurement execution time

   Conditions: Source range; fixed
   Measurement range; fixed, Trigger mode; external trigger,
   Number of measurement digits; 5½ digits
   Integration time; 100 µs, Measurement delay; 0.3 ms, Source delay; 30 µs
   Period; 2 ms, Pulse width; 1 ms
   Header; OFF, Block delimiter; EOI (DL2)

   • Time from measurement by trigger input (*TRG) to completion of data output to GPIB/USB

Source value condition	GPIB execution time	USB execution time
In DC or pulse source	5 ms	18 ms
When the sweep start value is output	8 ms	19 ms
When the sweep step value is output	6 ms	19 ms

   • Time from measurement by source command reception and trigger input (*TRG) and to completion of data output to GPIB/USB
   In the DC or pulse source mode

Source	Command	GPIB execution time	USB execution time
Voltage source	SOV<data> (<data>: 1 character)	8 ms	23 ms
Current source	SOI<data> (No unit, <data>: 3 characters)	8 ms	25 ms

   • Time from measurement by spot command reception (measurement trigger after setting the source value for the setting source function) to completion of data output to GPIB/USB
   In the DC or pulse source mode

Source	Command	GPIB execution time	USB execution time
Voltage source	G<data> (<data>: 1 character)	6 ms	19 ms
Current source	G<data> (No unit, <data>: 3 characters)	7 ms	21 ms

2. Data read time

Item	Number of data	GPIB execution time	USB execution time
Source value data read by query	1	3 ms	20 ms
Measurement buffer memory read after RN1 command (individual read out) Condition: Number of measurement digits; 5½ digits, Header;OFF, Block delimiter; EOI (DL2)	1	3 ms	20 ms
	100	131 ms	1.31 s
	1000	1.31 s	13.1 s
Measurement buffer memory read after RDT? command (collective read out) Condition: Number of measurement digits; 5½ digits, Header; OFF, Block delimiter; EOI (DL2)	1	3 ms	
	100	69 ms	
	1000	626 ms	

3. Sweep start data read time (GPIB execution time)

Indicates the time from executing 100-step or 1000-step sweep to completing the data output from the memory to GPIB with RN1 command, and the collective read-out time.

Conditions: Source range; fixed
Measurement range; fixed, Trigger mode; internal trigger,
Number of measurement digits; 5½ digits, Integration time; 100 µs
Measurement delay; 0.1 ms, Hold time; 1 ms, Source delay; 30 µs
Pulse width; 1 ms
Header; OFF, Block delimiter; EOI (DL2)

Number of steps	Memory mode	Period	Read out by RN1 command	Collective read out
100	Normal-ON	10 ms	1135 ms	1070 ms
	Burst	2 ms	335 ms	270 ms
1000	Normal-ON	10 ms	11.3 s	10.7 s
	Burst	2 ms	3.3 s	2.7 s

A.3.2 Internal Processing Time (Typical Value)

1. Source processing time

   Time from external trigger signal input until the source value (pulse value or base value) starts to change.
   For the time from when the source value changes to when the source value settles, refer to Section 5.2.8.2.

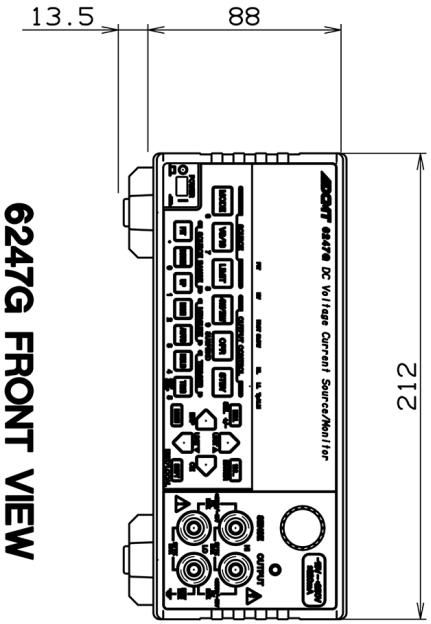
   Conditions: Source range; fixed
   Measurement range; fixed, Trigger mode; HOLD or external trigger
   Source delay; 30 µs

Source mode	Source value	Execution time
Pulse	Pulse value	60 µs
DC sweep	Start value	1 ms
	Step value	60 µs
Pulse sweep*	Start (base) value	1 ms
	Step value	60 µs

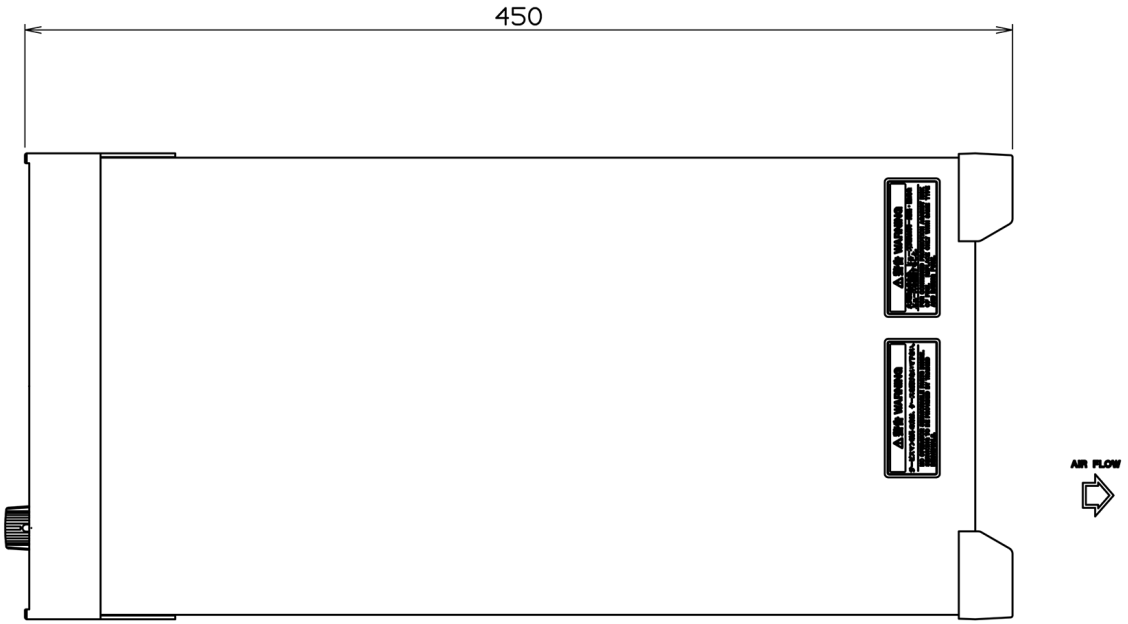
* The pulse sweep start value represents the time from trigger to base value generation.
(The time from the base value generation to the start pulse generation varies depending on the hold time.)

2. Switching time

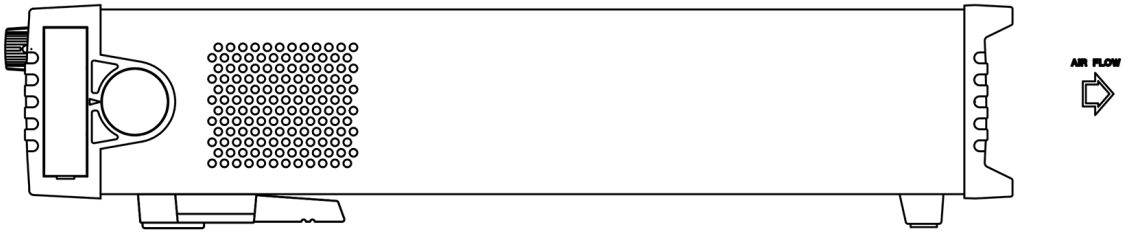
   - Source function change time: 5 ms
   - Source range change time
     Voltage source function: 8 ms
     Current source function: 24 ms
   - Measurement range change time
     Voltage measurement function: 8 ms
     Current measurement function: 35 ms
   - Measurement auto range processing time
     Voltage measurement function: Integration time + 8 ms
     Current measurement function: Integration time + 35 ms



6247G FRONT VIEW



6247G TOP VIEW



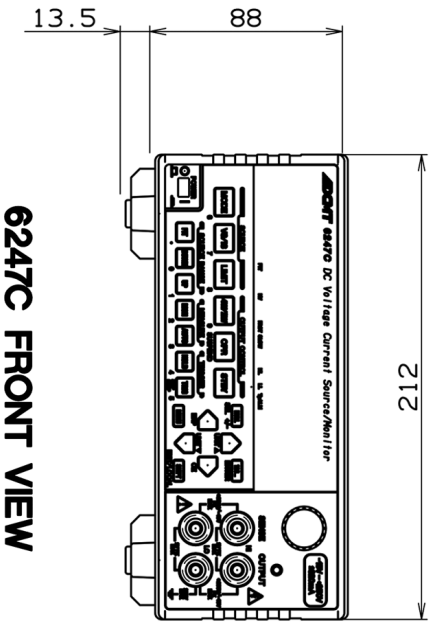
6247G RIGHT SIDE VIEW

Unit: mm

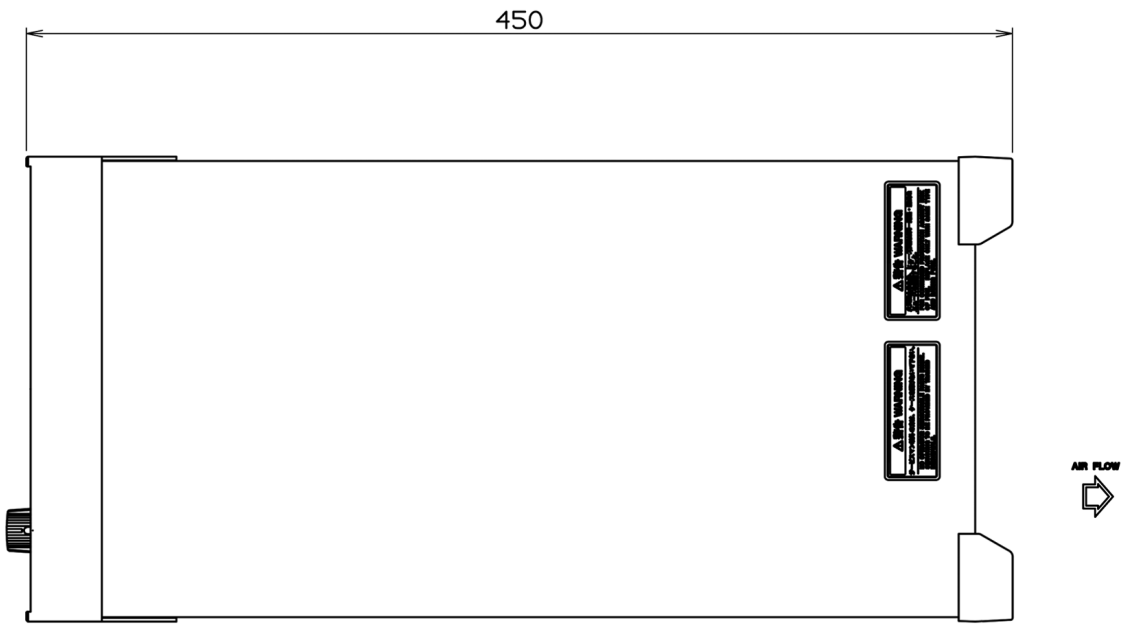
NOTE

This drawing shows external dimensions of this instrument.
The difference in products and options used can cause a change in the appearance.

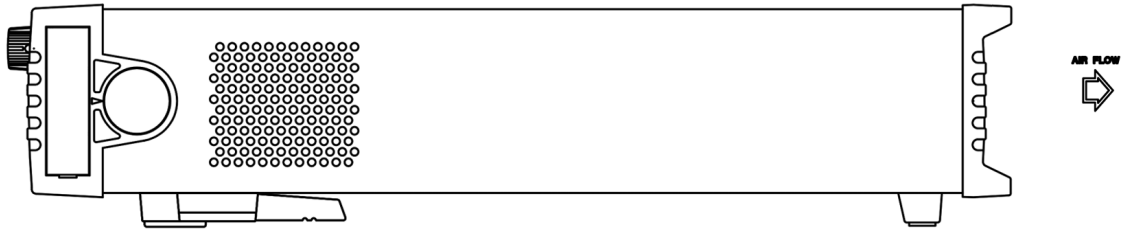
DIMENSIONAL OUTLINE DRAWING



6247C FRONT VIEW



6247C TOP VIEW



6247C RIGHT SIDE VIEW

Unit: mm

NOTE

This drawing shows external dimensions of this instrument.
The difference in products and options used can cause a change in the appearance.

DIMENSIONAL OUTLINE DRAWING

ALPHABETICAL INDEX

[R]

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