6241A/6242

DC Voltage Current Source/Monitor

Operation Manual

MANUAL NUMBER FOE-00000029C01

Applicable Models
6241A
6242

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Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that ADC Corporation (hereafter referred to as ADC) bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by ADC, the protection provided by the equipment may be impaired.

• Warning Labels

Warning labels are applied to ADC products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest ADC dealer. Our address and phone number are listed at the end of this manual.

Symbols of those warning labels are shown below together with their meaning.

DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

• Basic Precautions

Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

- Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas.
- When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
- When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
- Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
- Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protective conductor terminal.
- Be sure to use fuses rated for the voltage in question.
- Do not use this instrument with the case open.
- If there is any abnormality such as abnormal heart, smoke, smell or noise, immediately stop using the instrument, turn off the power and disconnect the plug from the outlet.

- Do not place anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this product.
- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

• Caution Symbols Used Within this Manual

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER: Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING: Indicates an item relating to personal safety or health.

CAUTION: Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

• Safety Marks on the Product

The following safety marks can be found on ADC products.

⚠ : ATTENTION - Refer to manual.

⏚ : Protective ground (earth) terminal.

ϟ : DANGER - High voltage.

⚠ : CAUTION - Risk of electric shock.

• Replacing Parts with Limited Life

The following parts used in the instrument are main parts with limited life.
Replace the parts listed below before their expected lifespan has expired to maintain the performance and function of the instrument.
Note that the estimated lifespan for the parts listed below may be shortened by factors such as the environment where the instrument is stored or used, and how often the instrument is used.
The parts inside are not user-replaceable. For a part replacement, please contact the ADC sales office for servicing.

Each product may use parts with limited life.
For more information, refer to the section in this document where the parts with limited life are described.

Main Parts with Limited Life

Part name	Life
Unit power supply	5 years
Fan motor	5 years
Electrolytic capacitor	5 years
LCD display	6 years
LCD backlight	2.5 years
Memory backup battery	5 years

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.
- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations. An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.
- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

When disposing of harmful substances, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances: (1) PCB (polycarbon biphenyl)
(2) Mercury
(3) Ni-Cd (nickel cadmium)
(4) Other
Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

Example: fluorescent tubes, batterie

Environmental Conditions

This instrument should be only be used in an indoor area which satisfies the following conditions:

- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- Altitude of up to 2000 m

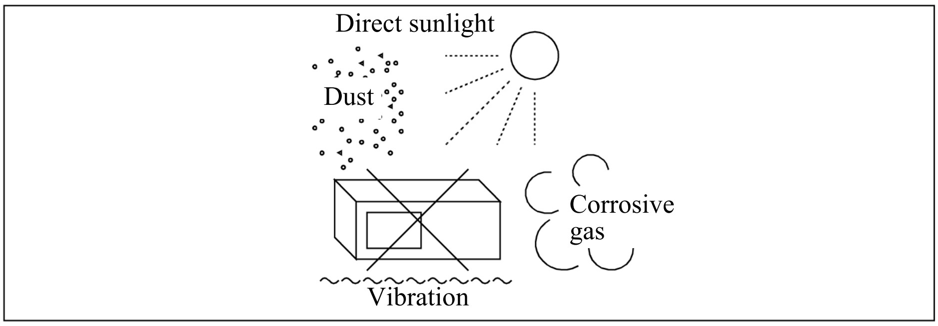
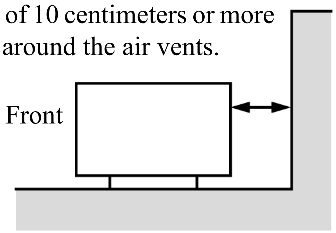


Figure-1 Environmental Conditions

- Operating position

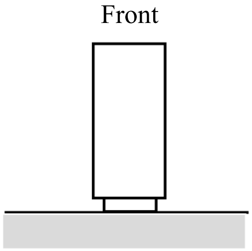
A clear space of 10 centimeters or more must be kept around the air vents.



The instrument must be used in a horizontal position.
To prevent the internal temperature from rising, cooling fans are installed in some instruments.
The air vents on the case must be unblocked.

Figure-2 Operating Position

- Storage position



This instrument should be stored in a horizontal position.
When placed in a vertical (upright) position for storage or transportation, ensure the instrument is stable and secure.

-Ensure the instrument is stable.
-Pay special attention not to fall.

Figure-3 Storage Position

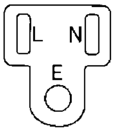
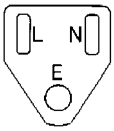
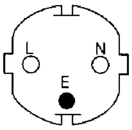
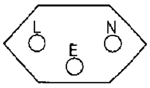
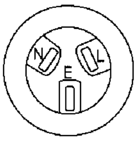
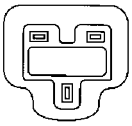
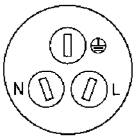
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  Impulse withstand voltage (over-voltage) category II defined by IEC60364-4-443

  Pollution Degree 2

Types of Power Cable

Replace any references to the power cable type, according to the following table, with the appropriate power cable type for your country.

Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
	CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
	SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
	SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
	BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417
	CCC: China	250 V at 10 A Black 2 m (6 ft)	Straight: A114009 (Option 94) Angled: A114109

Certificate of Conformity

This is to certify, that

DC Voltage Current Source/Monitor

6242, 6241A, 6240B

complies with the provisions of the EMC Directive, 2014/30/EC in accordance with EN61326-1, Low Voltage Directive, 2014/35/EC in accordance with EN61010-1/A1, and RoHS Directive, 2011/65/EC in accordance with EN IEC 63000.

Directive: Electro Magnetic Compatibility Directive (EMC):2014/30/EC
Using the following Harmonized Standards
EN 61326-1:2013

Directive: Low Voltage Directive (LVD):2014/35/EC
Using the following Harmonized Standards
EN 61010-1:2010/A1:2019

Directive: RoHS Directive:2011/65/EC
Using the following Harmonized Standards
EN IEC 63000:2018

ADC Corporation

77-1, Miyako Namegawa-machi, Hiki-gun, Saitama 355-0812, JAPAN

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1. PREFACE

This manual describes the accessories, operating environment, precautions, and operating check for personnel who operate the 6241A/6242. Read this manual before using the 6241A/6242.

1.1 Product Overview

The 6241A/6242 is a DC Voltage Current Source/Monitor with wide source/measurment ranges, as shown below.

6241A: Voltage 0 to ±32 V, Current 0 to ±500 mA

6242: Voltage 0 to ±6 V, Current 0 to ±5 A

The instruments offer high sensitivity with $4^{1}/_{2}$ digit source resolution and $5^{1}/_{2}$ digit measurement resolution, as well as various sweep functions and a pulse measurement function with a minimum pulse width of 50 μs. They can be widely used as a power source for evaluation and characteristic tests in R&D fields such as semiconductors or electrical components.

The 6241A/6242 characteristics are described below.

- Source and Measurement range 6241A: Up to ±32 V, ±500 mA
  6242: Up to ±6 V, ±5 A
- Voltage source/measurement range: 6241A: 300 mV to 30 V
  6242: 300 mV to 6 V
- Current source/measurement range: 6241A: 30 μA to 500 mA
  6242: 30 μA to 5 A
- Source digits/measurement digits: source: $4^{1}/_{2}$; measurement: $5^{1}/_{2}$
- Voltage source/voltage measurement resolution: source 10 μV; measurement: 1 μV
- Current source/current measurement resolution: source 1 nA; measurement: 100 pA
- Voltage source current measurement (VSIM) and Current source voltage measurement (ISVM)
- Voltage source voltage measurement (VSVM) and Current source current measurement (ISIM)
- Sink-enabled bipolar output
- Minimum pulse width: 50 μs
- Linear, two-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 6241A/6242 units
- GPIB and USB for integrating an automated measurement system as standard

1.2 Supplied Accessories

The 6241A/6242 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	6241A	6242
Power cable[*1]	A01402	1	Power Cable 3 pin plug	○	○
Input and output cable	A01044	1	Red, black, one each	○	○
Power fuse	DFT-AA2R5A-1	1[*2]	100 V/120 V slow blow	○	-
	DFT-AA1R6A-1		220 V/240 V slow blow		
	DFT-AA4A-1	1[*2]	100 V/120 V slow blow	-	○
	DFT-AA2A-1		220 V/240 V slow blow		
Operation Manual	E6241A	1	This manual	○	○

*1: The power cable included with this instrument depends on the option that was specified when purchased. For more information, refer to “Safety Summary.”
Specify the part number or the option number when ordering.

*2: Fuse type depends on customer specifications when shipped from the factory.

1.3 Optional Accessories

The 6241A/6242 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)
	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 mounting set	A02263	Rack mounting set (JIS 2U half)
	A02264	Rack mounting set (JIS 2U half twin)
	A02463	Rack mounting set (EIA 2U half)
	A02464	Rack mounting set (EIA 2U half twin)
Panel mounting set	A02039	2U half
	A02040	2U half twin

1.4 Operating Environment

This section describes the required environmental and power supply conditions.

1.4.1 Environmental Conditions

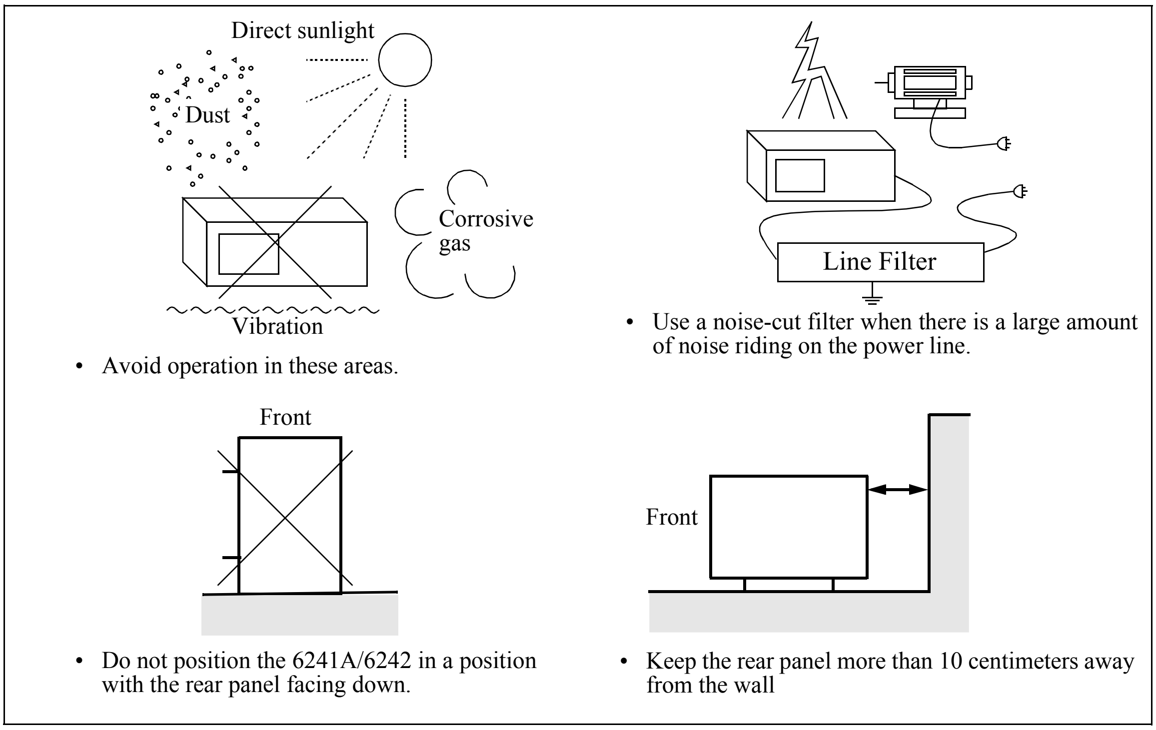
The 6241A/6242 must be installed in an environment meeting the following conditions:

- 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 6241A/6242 is designed with full consideration given to the noise contained in the AC power line. Nevertheless, it is recommended that the 6241A/6242 be used in an environment with as little line noise as possible.
  If line noise is unavoidable, use a noise filter.
- Positioning of the 6241A/6242

  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 6241A/6242 in a position 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 6241A/6242.
  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 6241A/6242 in a position 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 6241A/6242 to warm up for at least 60 minutes after turning on the power to ensure the specified accuracy of 6241A/6242.

1.4.2 Power Specification

Table 1-3 below shows the 6241A/6242 power supply specifications.

CAUTION: ***To prevent damage to the 6241A/6242, 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		95 VA or less (6241A)/180 VA or less (6242)			
Fuse	6241A	T2.5 A/250 V		T1.6 A/250 V	
	6242	T4 A/250 V		T2 A/250 V	

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

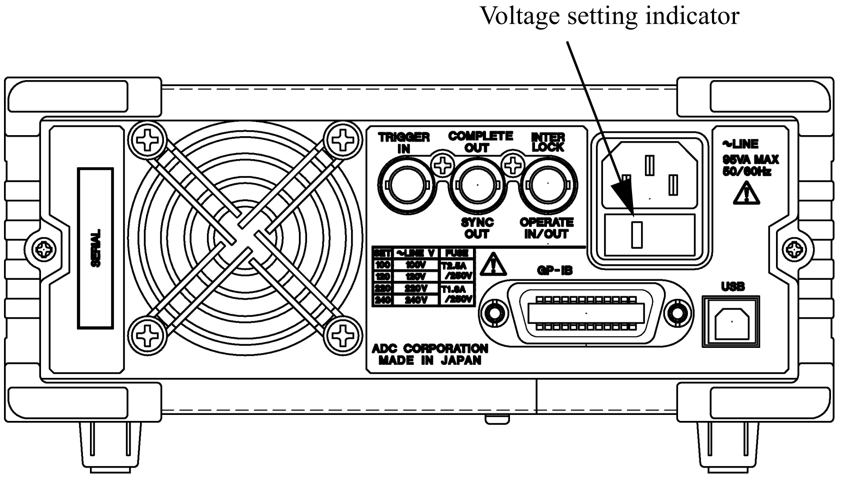


Figure 1-2 Set Power Voltage Indicator

1.4.3 Changing Power Voltage, and Checking and Replacing Power Fuse

The 6241A/6242 power voltage can be changed manually.
This section describes the procedure for changing the power voltage, and checking and replacing the power fuse.

NOTE:

1. ***If the power fuse has opened, a problem has 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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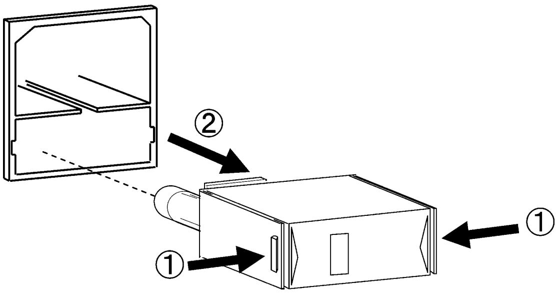
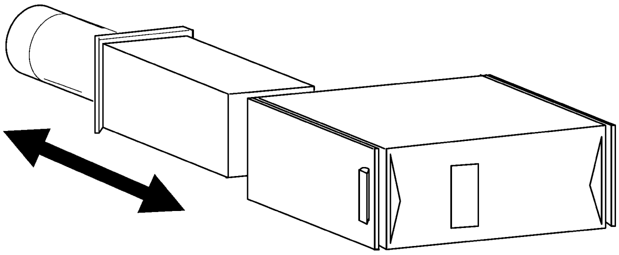
1. Remove the fuse holder assembly from the rear panel.

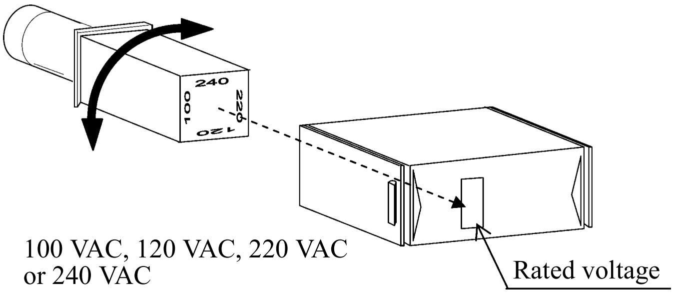
   Push on each side of the fuse holder assembly with a flathead screwdriver (①) and pull the assembly out (②).



2. Remove the voltage selector from the assembly.

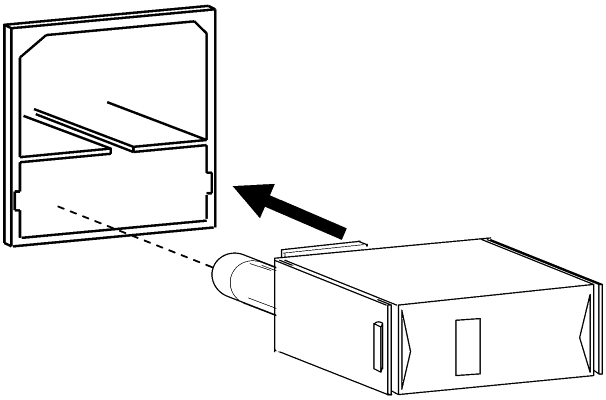


3. Rotate the voltage selector until the correct voltage appears in the window.



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

NOTE:

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 the power cable is connected.***

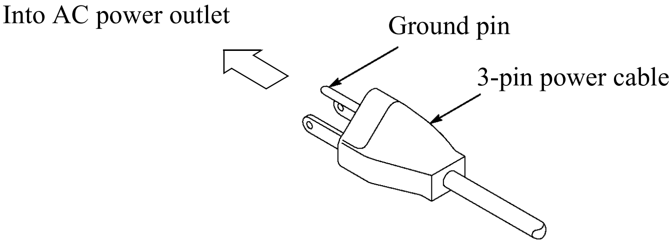


Figure 1-3 Power Cable

1.5 Operating Check

This section describes the simple self-test which must be performed when operating the 6241A/6242 for the first time. Follow the procedure below to ensure the 6241A/6242 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 6241A/6242, do not apply a voltage or frequency that exceeds the specified range.***

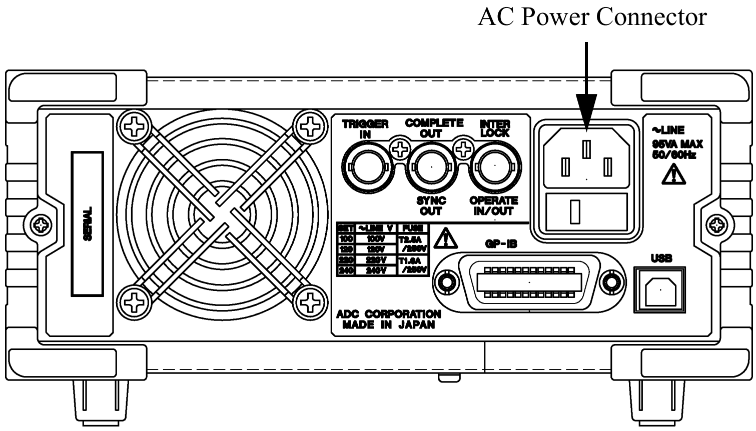


Figure 1-4 Connecting the Power Cable

3. Plug the power cable into an AC wall outlet.
4. Set the **POWER** switch on the front panel to ON.

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

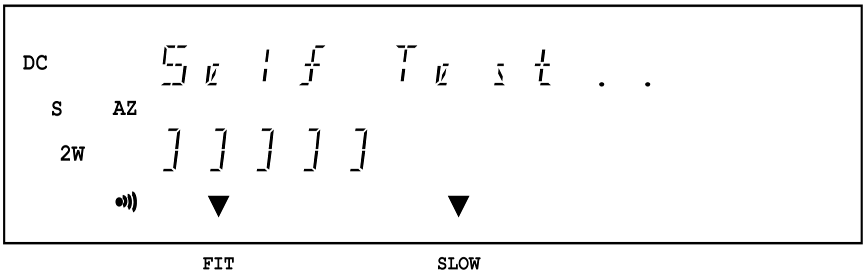


Figure 1-5 Screen Displaying Self-Test

When the test is complete, the model name, line frequency, GPIB address or USB.Id and software revision appear on the screen (Figure 1-6) and then the start-up screen is displayed (See Figure 1-7).

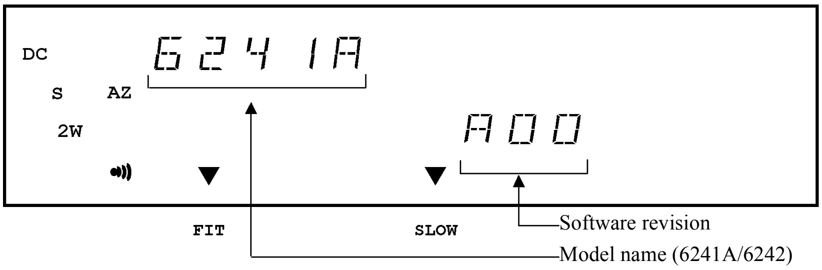


Figure 1-6 Screen Displaying Self-Test Completion

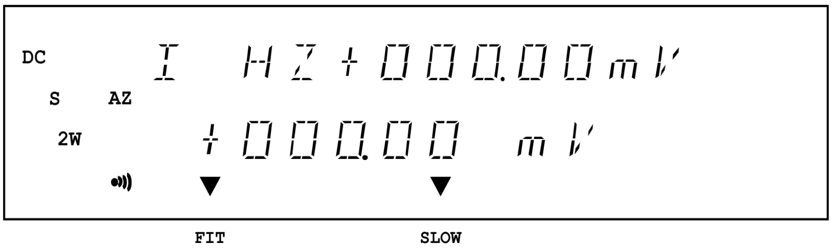


Figure 1-7 Start-up Screen

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.")

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5. Press **MON** twice.

   Voltage-measurement function starts. (See Figure 1-8.)

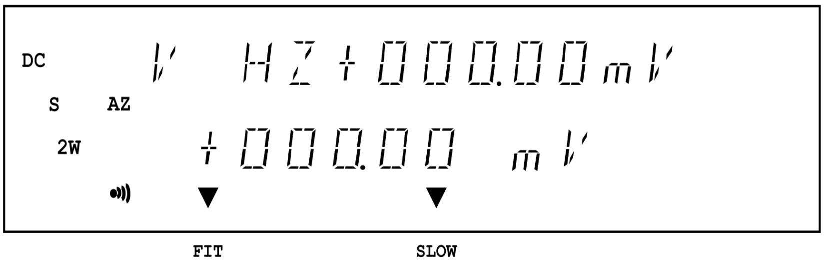


Figure 1-8 VSVM Measurement (In output OFF Standby)

6. Press **OPR**.

   The OPR indicator turns on and the VSVM measurement starts. (See Figure 1-9.)

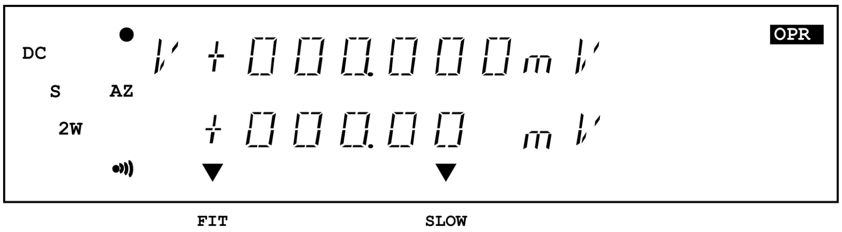


Figure 1-9 Displaying VSVM 300 mV Range, 0 V Measurement

7. Verify that the VM measured value is within ±22 μV of 0 V in the VS 300 mV range.

8. Press **STBY**.

   The OPR indicator goes OFF and the 6241A/6242 enters the standby (output OFF) mode.

The operation check is complete.

1.6 Cleaning, Storage, and Transport Methods

1.6.1 Cleaning

Clean the 6241A/6242 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 6241A/6242 (wring out the cloth so it is damp and not saturated).***
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 6241A/6242 in a location where the temperature is within the range of -25ºC to +70ºC. If storing for an extended period (90 days or longer), place the 6241A/6242 in a moisture-proof bag together with a desiccant. Avoid storing the 6241A/6242 in a location where there is a lot of dust or where it will be subjected to direct sunlight.

1.6.3 Transport

To transport the 6241A/6242, use the original box that it came in. If the box is not available any longer, pack the 6241A/6242 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 6241A/6242 by 15 cm or more to allow for shock absorbent material.
2. Wrap the 6241A/6242 with a protective sheet.
3. Line the box with shock absorbing material so that the 6241A/6242 is protected on all sides by cushioning material.
4. Close the box with industrial staples or use packing tape.

When sending the 6241A/6242 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 6241A/6242 to warm up for at least 60 minutes after turning on the power to ensure the specified accuracy of 6241A/6242.

1.8 Calibration

Calibrations are conducted by ADC. Contact an ADC CORPORATION sales representative for the calibration service.

Recommended period between calibrations	1 year

1.9 Life Limited Parts

In addition to the parts listed in “Safety Summary,” the 6241A/6242 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	Average life span	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.
Fluorescent character display tube	20,000 hours	
Panel key	500,000 operations	
USB connector	1,500 times	
Rotary key	1,000,000 operations	

CAUTION: ***The 6241A/6242 internally counts the number of Operate/Standby relay operations. It can be checked from the menu or by using the remote commands. When the relay count exceeds one million, replace the relay immediately.***

1.10 Product Disposal and Recycling

Correctly dispose of the 6241A/6242 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 or the Call Center.***

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	BPL-034287X02 BPL-034287X03 BPF-034288 BPF-034289 BPB-034291 BPH-034496	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 lamp	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	Photocoupler, logic IC

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	BPL-034287X02 BPL-034287X03 BPF-034288 BPF-034289 BPB-034291 BPH-034496	Electronic components on printed circuit boards, lead solder for surface mounting
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 the screen display (annotation) elements. The operation procedure of the 6241A/6242 is explained in this chapter by using measurement examples.

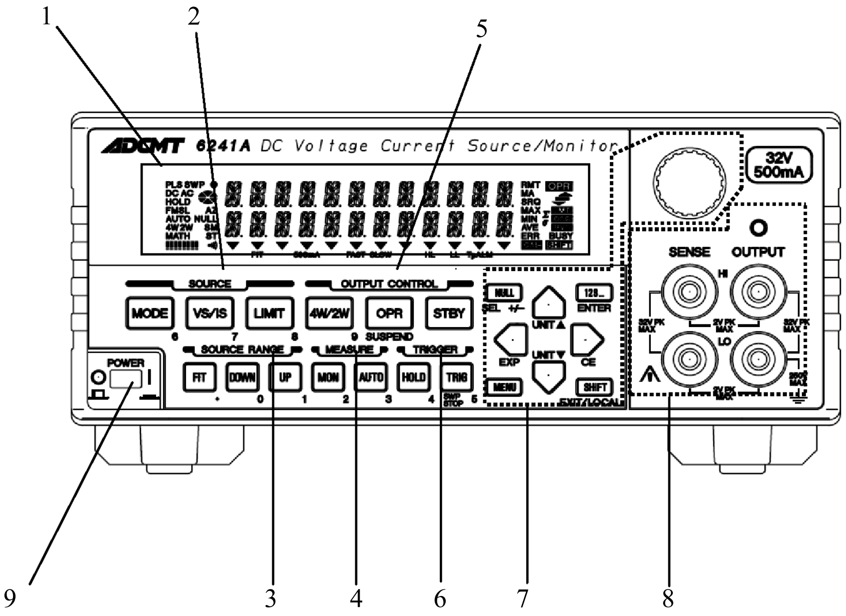
2.1 Panel Descriptions

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

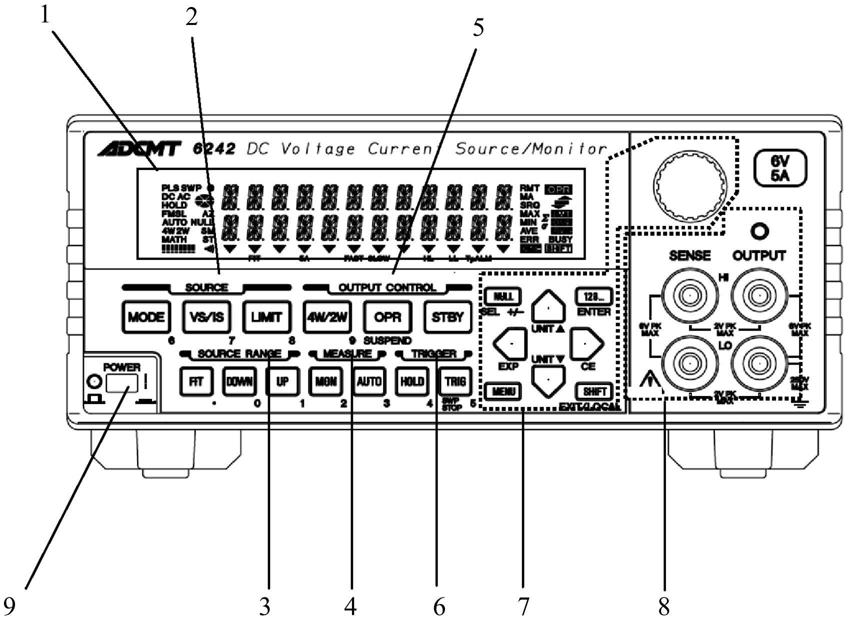
For more information on the operation, refer to Chapter 4, “REFERENCE.”

2.1.1 Front Panel

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



6241A



6242

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

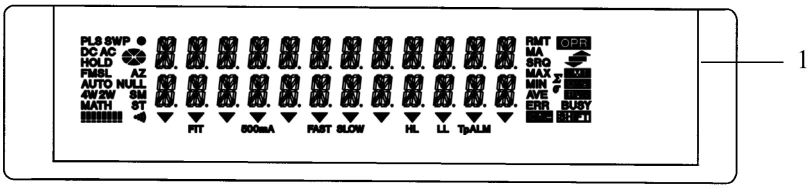


Figure 2-2 Display Section

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

2.1.1.2 SOURCE Section

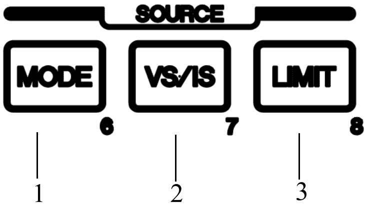


Figure 2-3 SOURCE Section

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 limiter value.

2.1.1.3 SOURCE RANGE Section

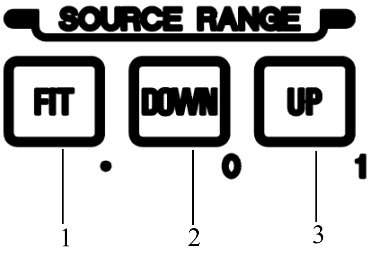


Figure 2-4 SOURCE RANGE Section

1. **FIT** key:	Selects the optimum fitting range (FIT) or the current 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

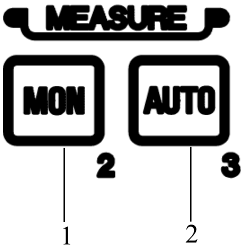


Figure 2-5 MEASURE Section

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

2.1.1.5 OUTPUT CONTROL Section

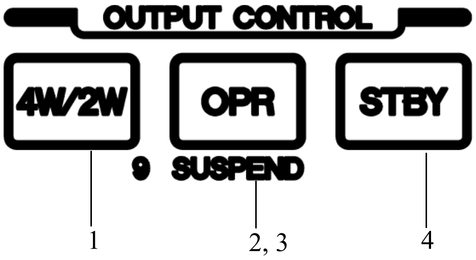


Figure 2-6 OUTPUT CONTROL Section

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 relay. OPR indicator blinks.
3.	**SUSPEND (SHIFT, OPR)** key:	Sets Suspend regardless of the operational or standby status.
4.	**STBY** key:	Sets the output standby status.

2.1.1.6 TRIGGER Section

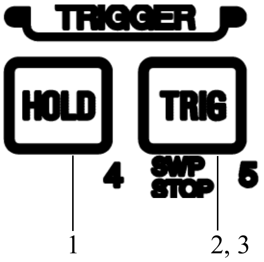


Figure 2-7 TRIGGER Section

1.	**HOLD** key:	Selects the trigger mode (AUTO or HOLD).
2.	**TRIG** key:	Triggers the measurement and pulse source when the trigger mode is in the HOLD state in the DC and Pulse Source mode, and starts, pauses or restarts the Sweep, or changes to the next step in the sweep source mode.
3.	**SWP STOP (SHIFT, TRIG)** key	Stops the sweep.

2.1.1.7 Other Keys

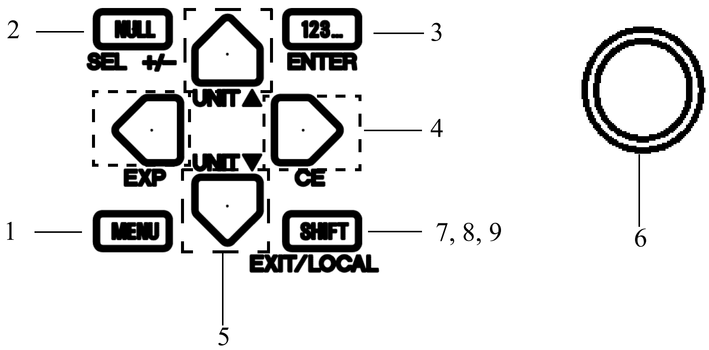


Figure 2-8 Other Keys

1.	**MENU** key:	Displays a parameter group setting (menu) screen.
2.	**NULL** key:	Sets 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 the numerical input.
4.	◁ , ▷ keys:	Moves the cursor (flashing value) to the parameter to be set. Selects items on the Menu screen.
5.	△ , ▽ keys:	Increases or decreases the source value or limiter value at the cursor position. Moves up and down the hierarchies on the Menu screen.
6.	◎ key (Rotary knob):	Increases or decreases the parameter value selected by the cursor (flashing value). Selects the parameter (flashing characters) or item on the Menu screen.
7.	**SHIFT** key:	Selects key shift mode ON or OFF.
8.	**EXIT** key (on Menu screen):	Exists the Menu screen and returns to the normal screen. Enables the set parameters.
9.	**LOCAL** key (in Remote Operation):	Conducts a local operation in remote status.

NOTE: Local operations are prohibited if the LLO (Local Lock Out) command is set on the GPIB/USB Interface.

2.1.1.8 Output Section

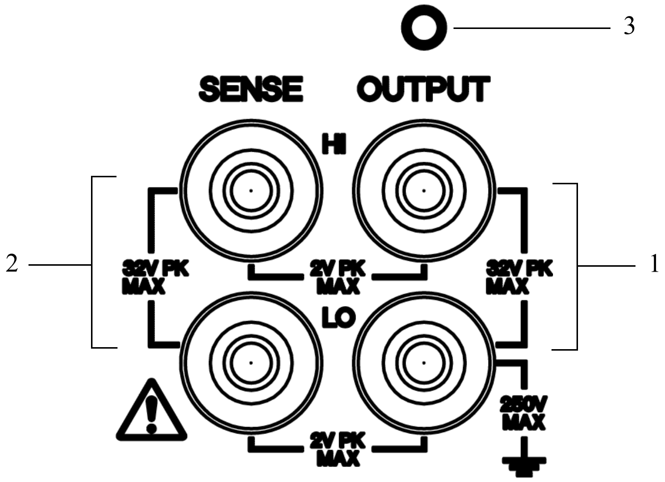


Figure 2-9 Output Section

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

WARNING:

⚠ ***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. Electric shock danger.***

2.1.1.9 POWER Switch

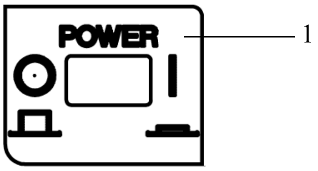
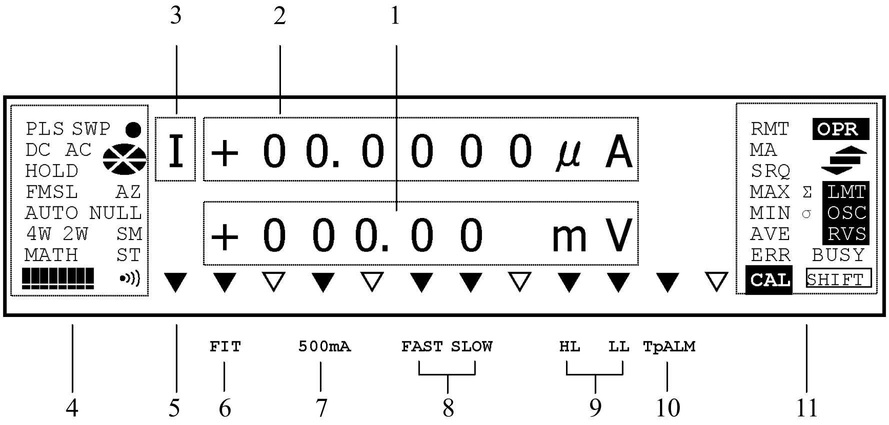


Figure 2-10 POWER Switch

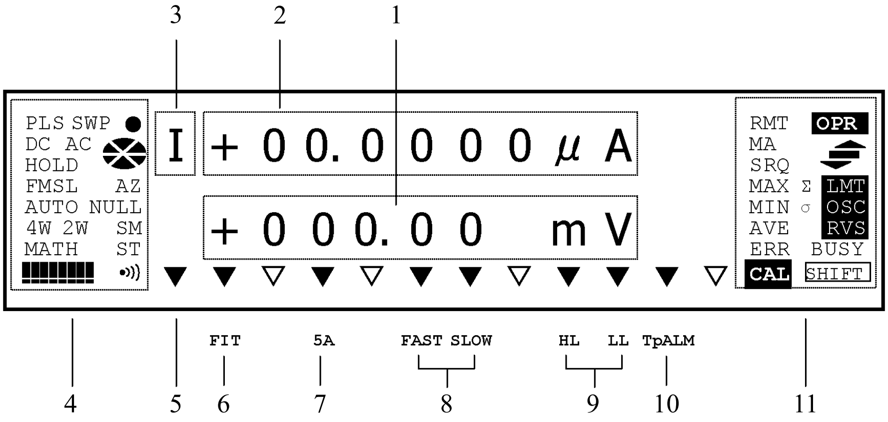
1.	**POWER** Switch:	Turns the power ON or OFF.

2.1.2 Screen Display (Annotations)

This section describes the screen display (annotations).



6241A



6242

Figure 2-11 Screen Display (Annotations)

1. Source Value:	Displays voltage source (VS) or current source (IS) value with a unit.
2. Measurement Value:	In Operation: Displays measurement value. In Standby and 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 functions.
    - I: current measurement (IM)
    - V: voltage measurement (VM)
    - R: resistance measurement (RM)
    - _ : Measurement OFF
4. Left status Indicators:
    - PLS: Source mode is in pulse mode.
    - SWP: Source mode is in Sweep mode.

    NOTE: PLS + SWP is pulse sweep, and DC + SWP is DC sweep.

    - DC: Source mode is in DC mode.
    - AC: (Not in use)
    - HOLD: Trigger Mode is HOLD.
    - FMSL: Displays the measurement integral time by using the indicators in combination.
    - AUTO: Auto range is set to ON.
    - 4W: Output sensing is set to 4-wire connection.
    - 2W: Output sensing is set to 2-wire connection.
    - MATH: Scaling calculation is ON.
    - ● : Lights for every measurement sampling.
    - ⊗ : Indicates the sweep operation status.
      Rotates while sweeping.
      At hold, it stops rotation.
      Goes out when sweep stops.
    - AZ: Measurement auto zero function is ON.
    - NULL: Null calculation is ON.
    - ST: Measurement data memory is ON.
    - •)) : Buzzer setting is ON.
5. Auxiliary Indicator for Menu: Blinks if a lower hierarchy is available (▽ key enabled) when setting the parameter on the Menu screen.
6. FIT Indicator: Source range is set to FIT.
7. 500 mA/5 A Indicator: Current source or current-limiter range is 500 mA/5 A.
8. Output response indicators:
    - FAST: Lights when output response is set to Fast.
    - SLOW: Lights when output response is set to Slow.
9. HL/LL Indicator:
    - HL: High side is in limiter status.
    - LL: Low side is in limiter status.

10. TpALM indicator: Period becomes longer than Tp.
    - Longer because of source auto range;
    - Longer because of measurement auto range;
    - Longer because of measurement auto zero;
    - Measurement time is longer than Tp.

11. Right status Indicators

RMT : Remote control status.

MA: GPIB talker or listener.

SRQ: SRQ is being transmitted.

MAX, MIN, AVE, Σ:
Max/Min calculations are ON.

σ: (Not in use)

ERR: Error log is generated.

CAL: Calibration mode is ON.

OPR: Illuminates or extinguishes depending on the following operating status:

In operation: ON

In suspension: Blinks

In standby: OFF

▲▬▼: When the Comparator calculation is ON, either one of these three indicators illuminates depending on the results.

LMT: Value is at limiter status.

OSC: (Not in use)

RVS: (Not in use)

BUSY: (Not in use)

SHIFT: The 6241A/6242 is in shift mode status.

2.1.3 Rear Panel

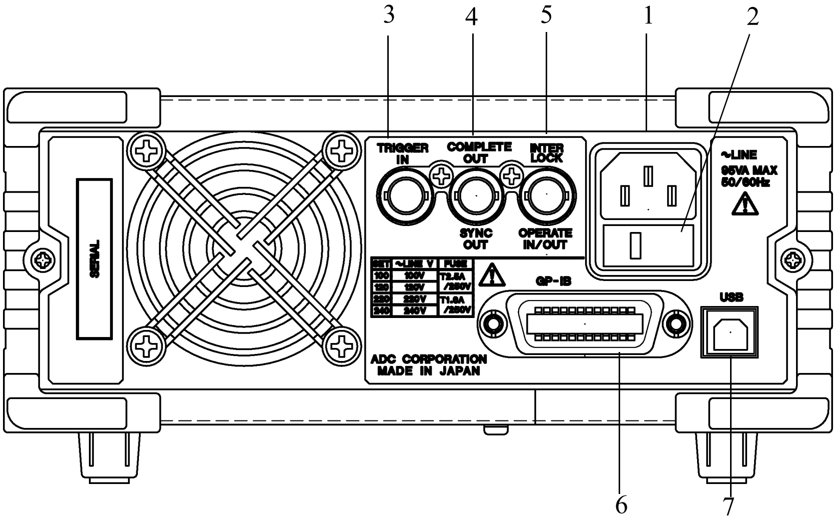


Figure 2-12 Rear Panel

1. AC power connector

Connects the 6241A/6242 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 and pulse measurement-trigger input, and as a start and step-up trigger when sweeping.

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

Output signal is a negative pulse.
Select either 10 or 100 µs pulse width.
Output circuit is a TTL level open drain output and pulled up to +5 V by 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 :
Outputs the signal synchronized with the source output in pulse and sweeping.

5. INTERLOCK | OPERATE IN/OUT

INTERLOCK :
Interlock signal is input. Input resistance is about 10 kΩ.

OPERATE IN :
Sets Standby with rising edge signal input when in STBY In function.
Switches Operate and Standby or Operate and Suspend with level signal input when OPR/STBY In or OPR/SUS In function. Input resistance is about 10 kΩ.

OPERATE OUT :
Outputs operational status with the level signal.
Output circuit is a TTL level open drain output and pulled up to +5 V by 10 kΩ.

6. GP-IB:	Port for connecting GPIB cable to the external controller
7. USB:	Port for connecting USB cable to the external controller

2.2 Basic Operation

This section describes the following items:

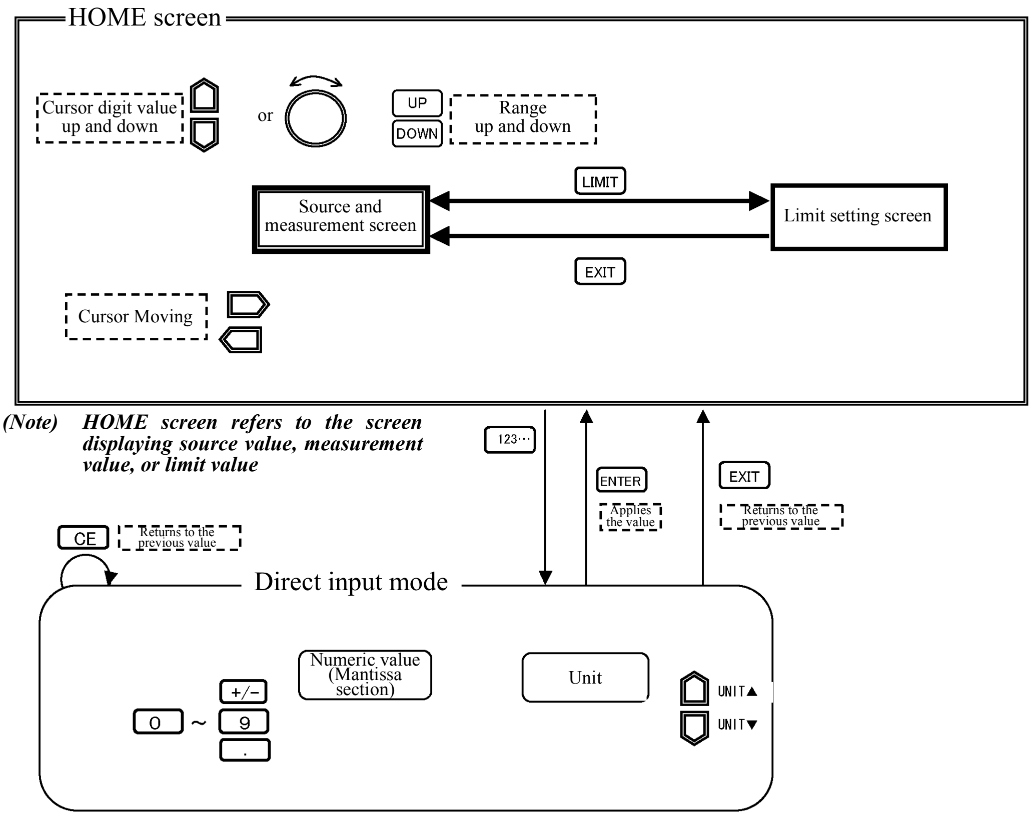
- Setting Source Value
- Setting Limiter Value
- How to use the Menu and basic measurement functions.

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

Figure 2-13 shows the relation between keys.



(Note) HOME screen refers to the screen displaying source value, measurement value, or limit value

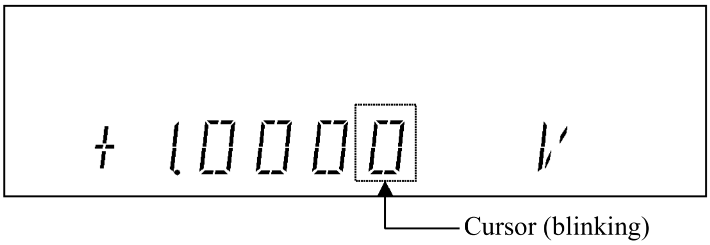
Figure 2-13 Relation between Keys

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

1. Change the values using the cursor keys (◁ , ▷) and up/down keys (△ , ▽) or rotary knob (◯).

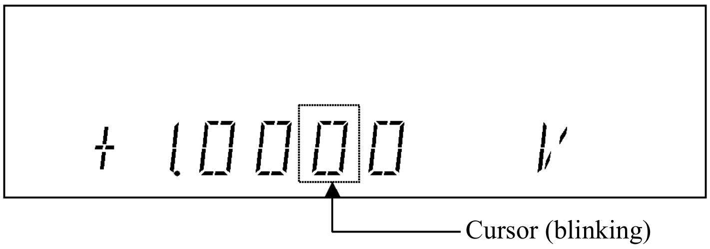
   ◁ and ▷ keys move the cursor (blinking) position left and right. △, ▽ keys, or ◯ rotary knob can change the value indicated by the cursor.

   The following figures describe the setting procedure.

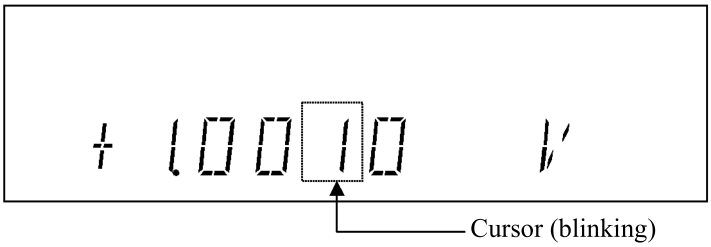


Setting numeric values

1. Press ◁.
   The cursor moves to the left.

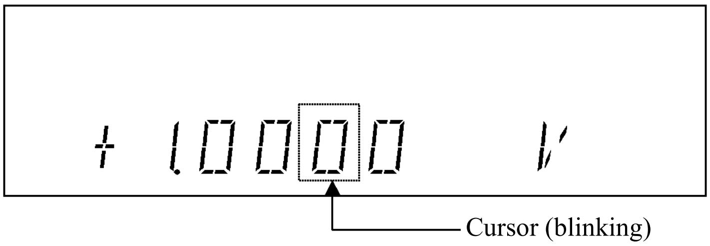


2. Press △ or rotate ◯ one click clockwise.
   The value indicated by the cursor increases by one increment.



3. Press ▽ or rotate ◯ one click counterclockwise.

   The value indicated by the cursor decreases by one increment.



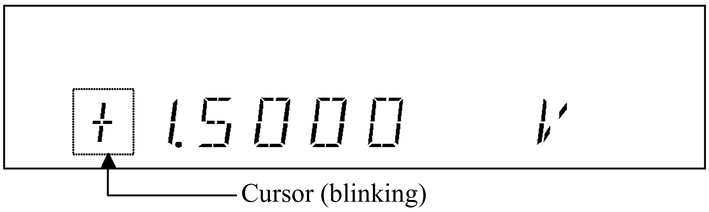
4. Keep pressing △.

   The value increases incrementally while pressing the key. The value stops increasing when the key is released.

5. When ◯ is rotated, the value increases by 1 for each clockwise click or decreases by 1 for each counterclockwise click.

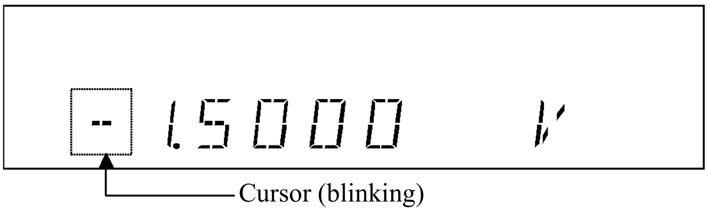
Setting the polarity

1. ◁ 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 value is 0, it is impossible to set "-".

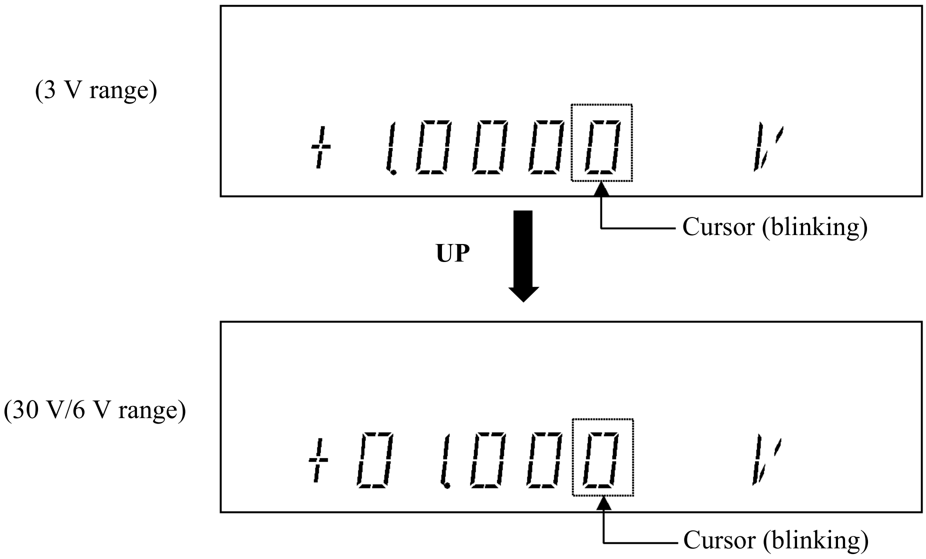


2. Changing source range

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

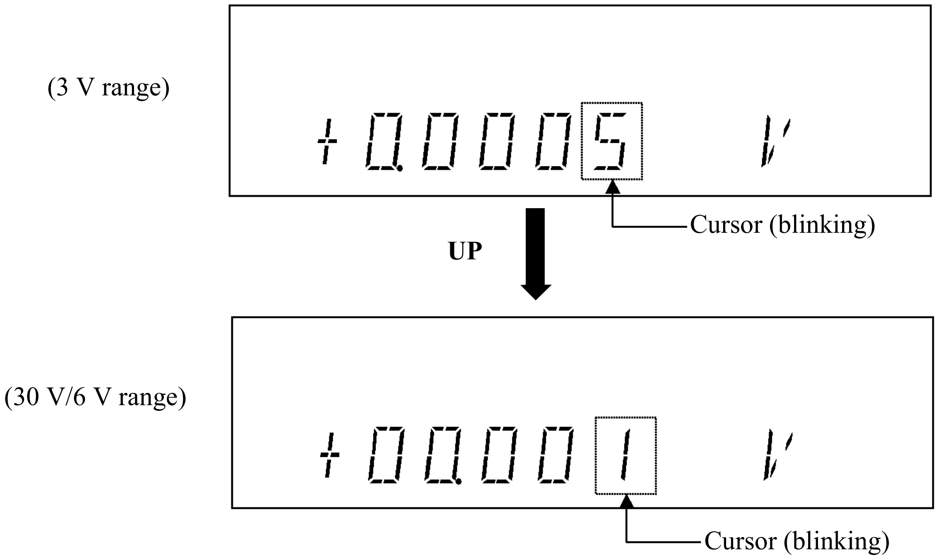
   - The range change adjusts to synchronize the values before and after the change.

   Example of changing the 3 V range to 30 V/6 V range



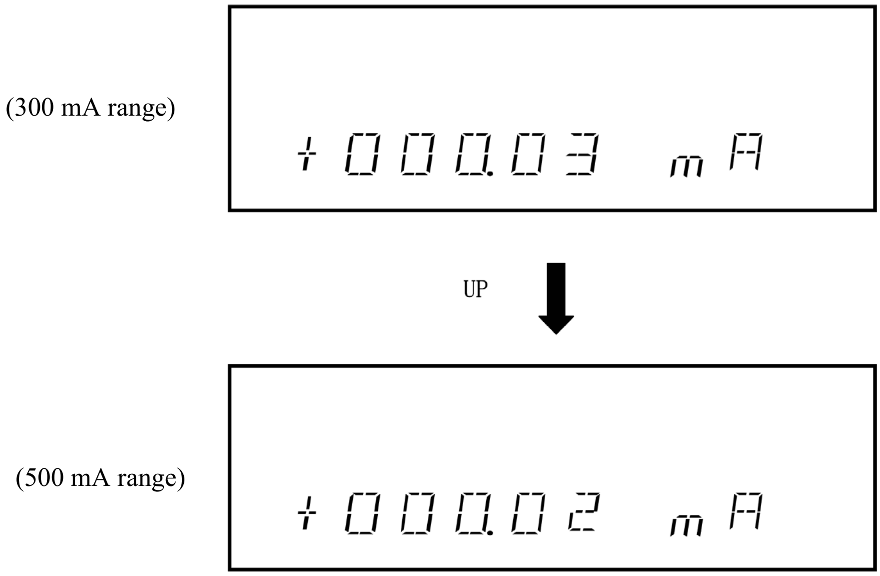
   - If the set value is below the minimum digit, it is rounded off.

   Example of changing the 3 V range to 30 V/6 V range

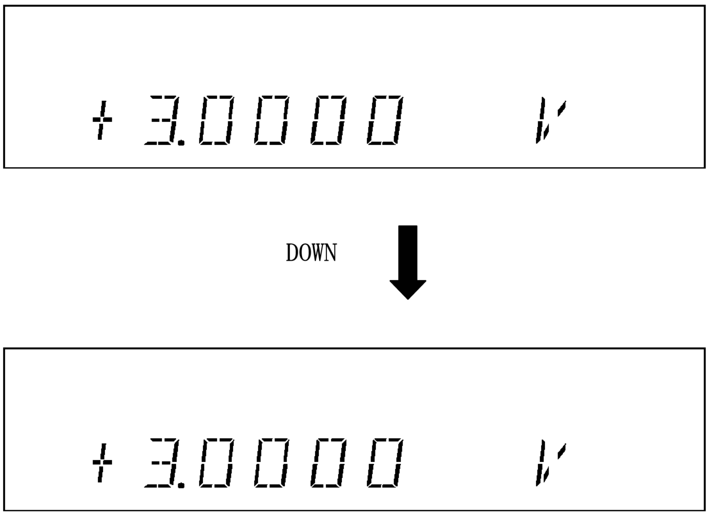


- When changing the 6241A 300 mA range to 500 mA range or changing the 6242 3 A range to 5 A range, the smallest digit is rounded off to an even number.

Example of changing the 300 mA range to 500 mA range (6241A)



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

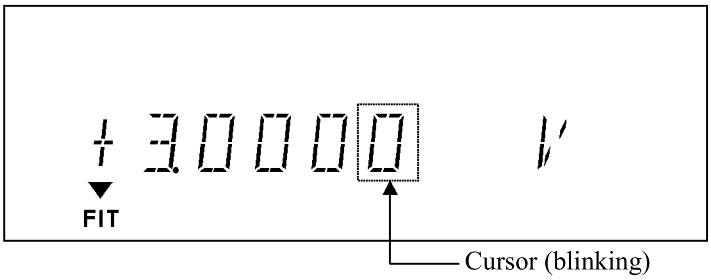


An error is generated and changes do not occur.

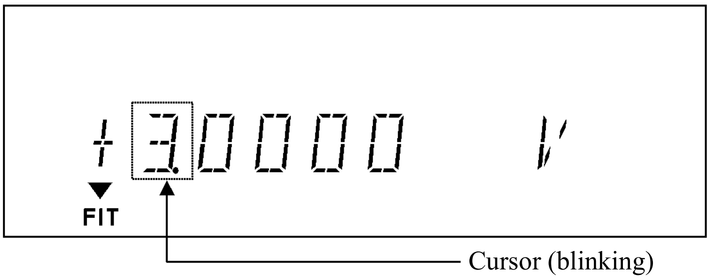
2.2.1.3 Setting Source Value Using Cursor Keys/Rotary Knob (when FIT Indicator is ON)

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

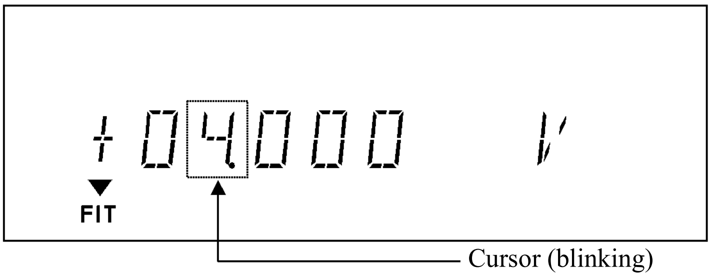
The following figures describe the setting procedure.



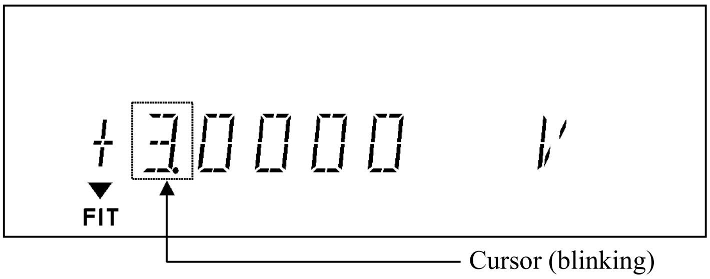
1. Press ◁. The cursor moves to the left.



2. Press △ or rotate ◯ one click clockwise to change the 3 V setting to 4 V. The source range is automatically set to 30 V/6 V.



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

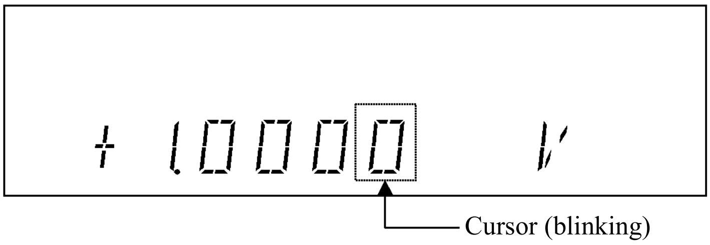


Cursor (blinking)

2.2.1.4 Setting Source Value using Direct Input Mode

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

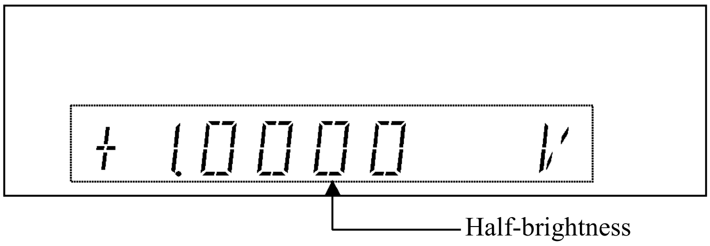
The following figures describe the setting procedure.



Cursor (blinking)

Setting numeric values

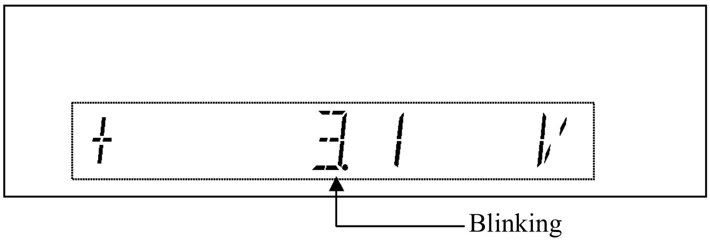
1. Press **123...**.
   The screen is half-brightness and indicates direct input mode.



Half-brightness

2. Press **3**, **.**, **1** in this order.

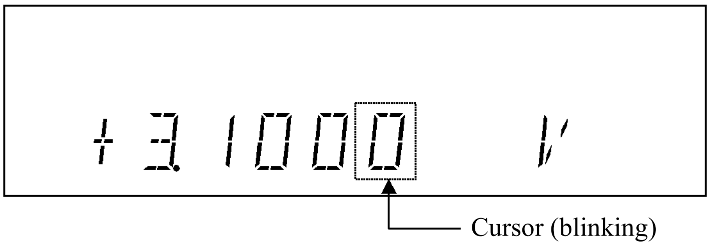
   While inputting values, the cursor blinks.



Blinking

3. Press **ENTER**.

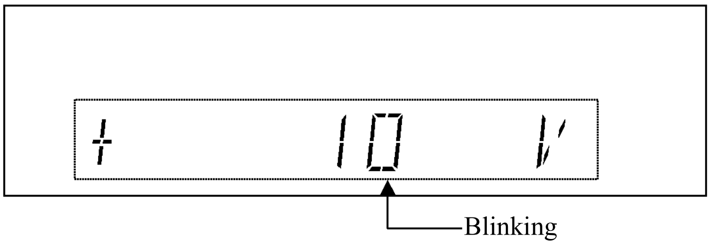
   The numeric value has been applied and the direct input mode is released.



Cursor (blinking)

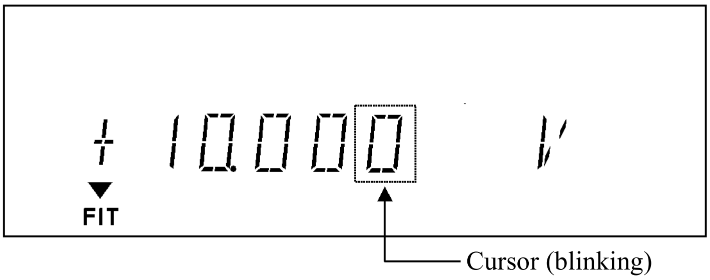
4. Press the **123…**, **1**, **0**, **ENTER** keys in order to set +10 V.
   (For the 6242, the maximum range for setting is ±6 V.)

   - If the FIT indicator turns off, the value exceeds the 3 V setting range and an error occurs. The value cannot be set.



Blinking

   - When the FIT indicator turns on, the optimum 30 V range is set.



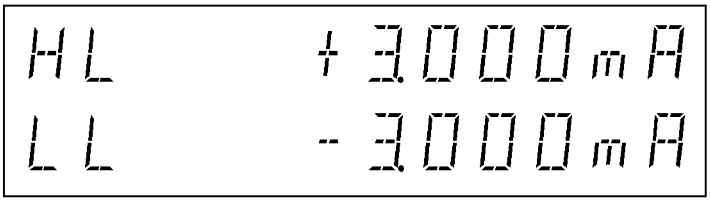
Cursor (blinking)

2.2.2 Setting Limiter Value

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

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

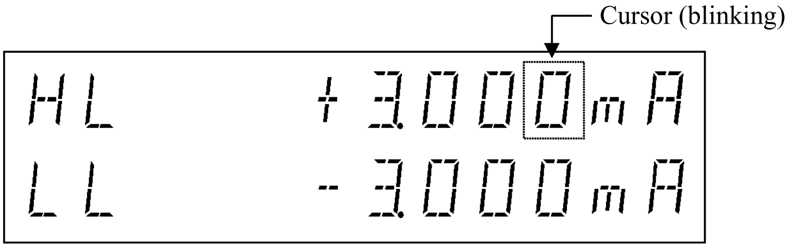
HI and LO limiter values have two settings. This section describes the difference between them. ("HL value" refers to HI limiter value, and "LL value" refers to LO limiter value.)



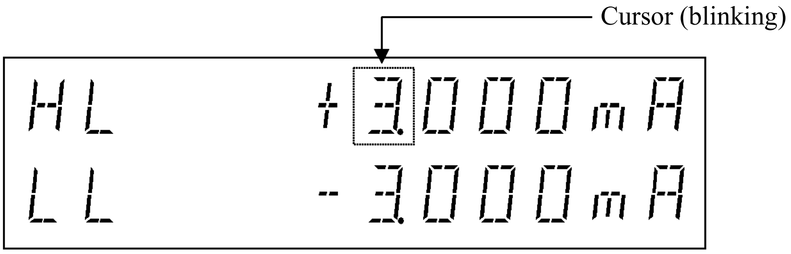
How to change the setting function is described in the **MENU**, ***SOURCE***, and ***LMT Input***.

± Balance setting

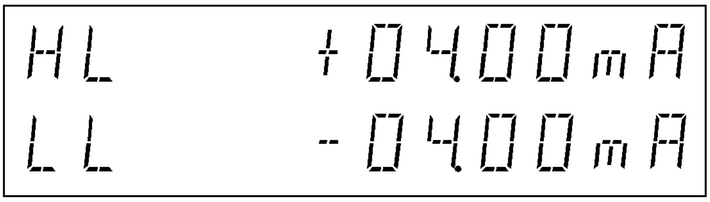
1. Press **LIMIT**.
   The cursor appears on the HL value.



2. Move the cursor to 3.

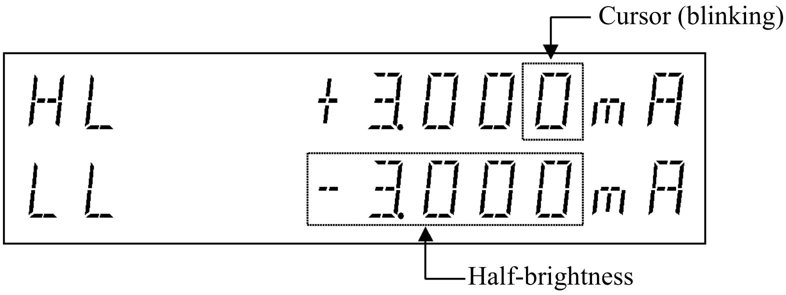


3. Press ⌂ or rotate ○ one click clockwise.
   The range increases by one step, and the LL value also changes at the same time. The LL value cannot be changed directly.

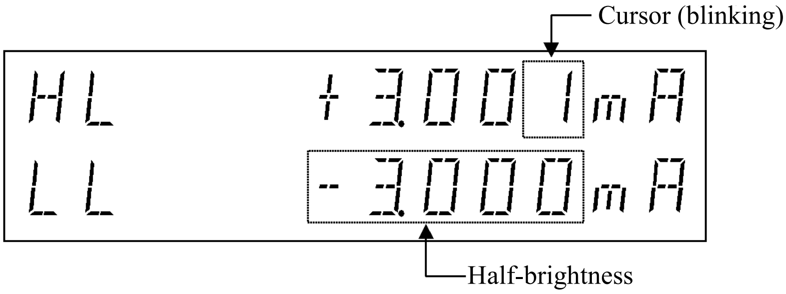


Separate setting

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

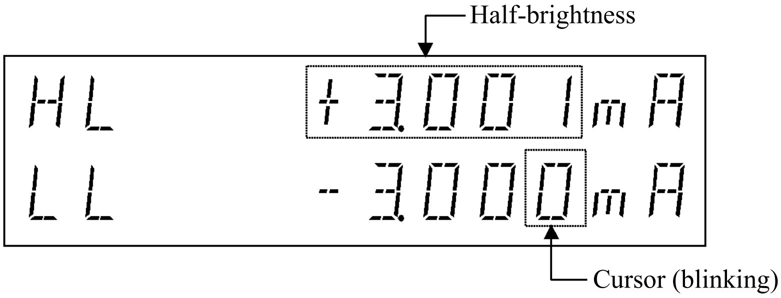


2. Press ⌂ or rotate ○ one click clockwise.
   Only the HL value changes.

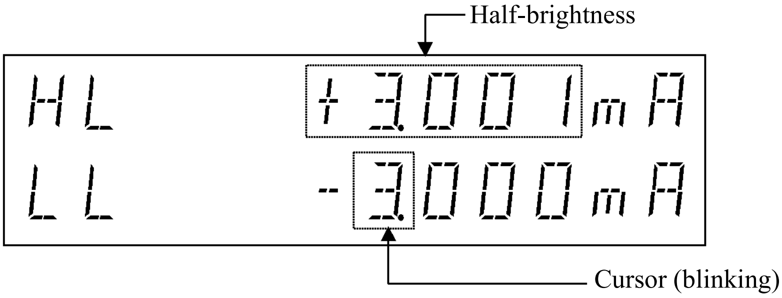


3. Press **NULL (SEL)**.

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

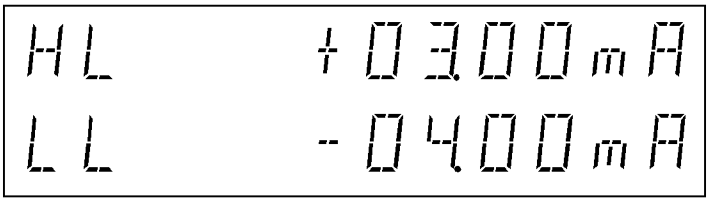


4. Move the cursor to 3.



5. Press ▽ or rotate ◎ one click counterclockwise.

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



Same polarity limiter setting

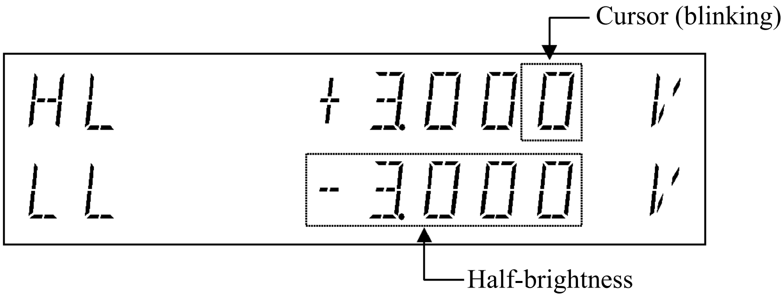
If the Separate setting is selected, it can set the same polarity on the voltage-limiter HL and LL values.

However, the HL and LL values have the following restrictions.

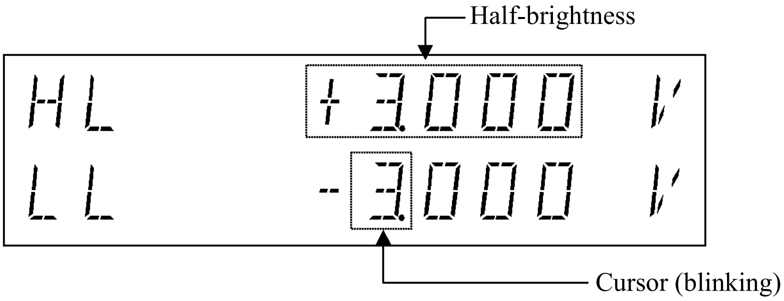
60 digits ≤ (HL value -LL value)

1. Select Separate from **MENU**.
2. Press **VS/IS** to select the current-source function.

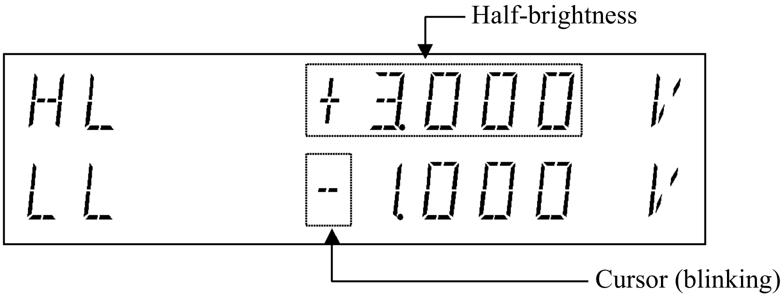
3. Press **LIMIT** to display the limiter value setting screen.



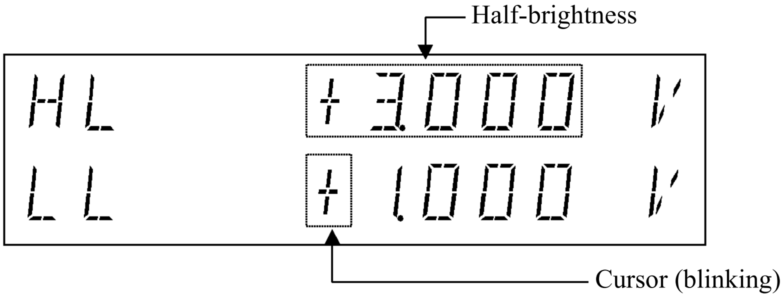
4. Press **NULL (SEL)** to select LL and move the cursor to 3.



5. Press ⇧ twice, and press ⇦ once.



6. Press ⇧ to set the same polarity.



2.2.3 Menu Operation

The 6241A/6242 functions and parameters are set on hierarchical menus.

The menus have a 3-level hierarchy.

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

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

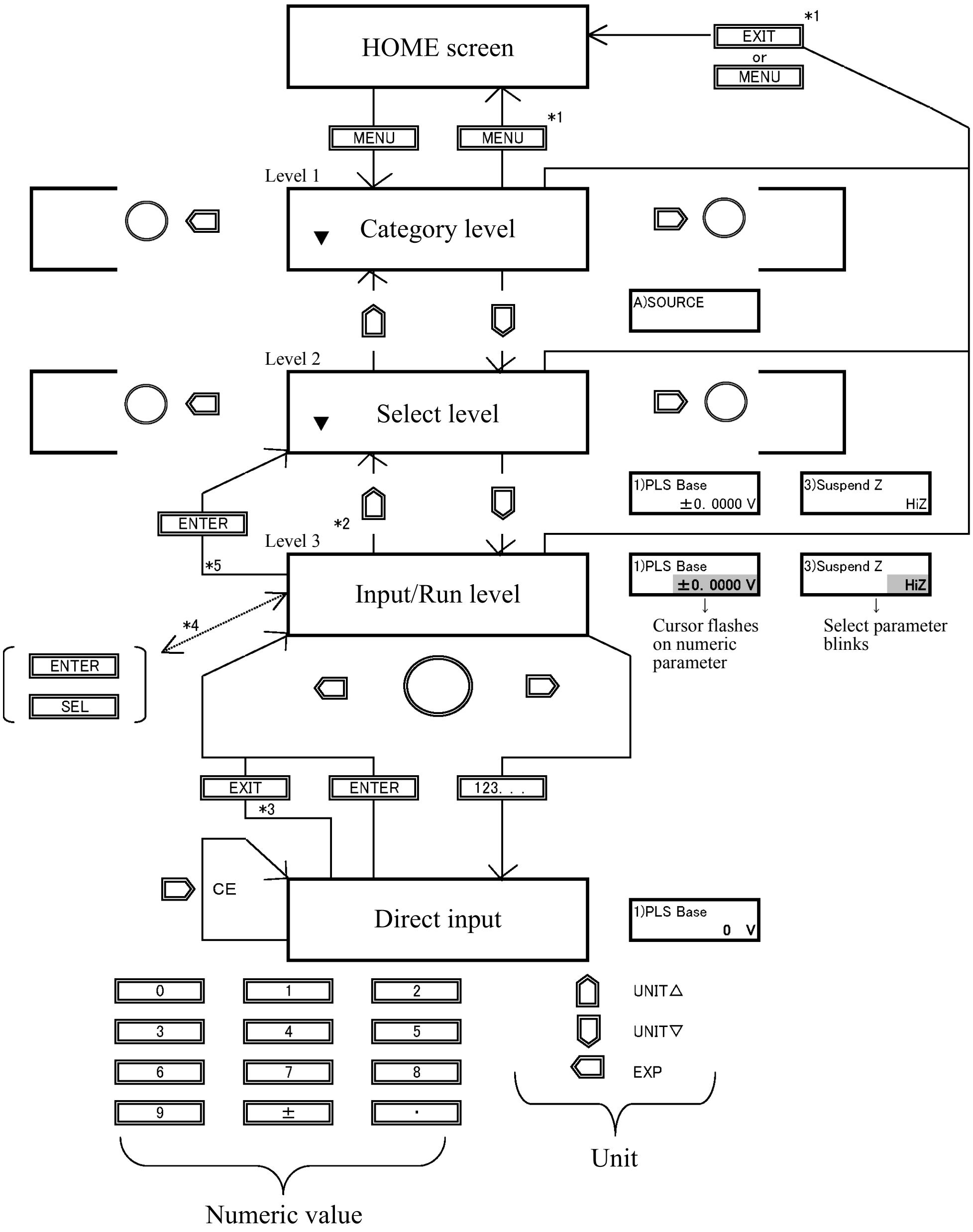
2.2.3.1 Method of Menu Operation

The menu operation procedure is shown below.

1. Press **MENU**.
   The selection screen for the Category level **A) SOURCE** to **M) SYSTEM** appears.
2. Select categories by using ◁ , ▷ or ◯.
3. Press ▽ to enter the Select level.
4. Select parameters by using ◁ , ▷ or ◯.
5. Press ▽ to enter the Input/Run level.
6. Parameter setting and execution operations differ according to the parameter type. Set the parameters by rotating
   ◯, and move the cursor position by using ◁ or ▷.

Table 2-1 shows the menu and key operations.

NOTE: During sweeps, the MENU key is unavailable.



*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 two parameter settings.
*5 Enabled when "Push ENTER" is displayed.

Figure 2-14 Menu Operation Overview

Table 2-1 Keys and Menu 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 Category to left	Go to parameter to left	Move cursor to left	Change selection	-
⇨	Go to Category to right	Go to parameter to right	Move cursor to right	Change selection	-
◯	Go to Category to right or left	Go to parameter to right or left	Increase/decrease digit at cursor	Change selection	-
123...	-	-	Go to Direct screen	-	-
ENTER	-	-	Run, go to Input/ Run level	-	Run, 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, see Parameter Types in 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.

Numeric data divided by a slash (/) represent the 6241A setting range/6242 setting range.

MENU

A) SOURCE

Select level	Input/Run level	Parameter types
1) PLS Base	Pulse source base value VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
2) Suspend V	Output voltage in Suspend +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V	Numeric
3) Suspend Z	Output impedance in Suspend HiZ/LoZ	Select
4) LMT Input	Setting the Limiter ±Balance/Separate	Select
5) Response	Output response Fast/Slow	Select

B) SWEEP

Select level	Input/Run level	Parameter types
1) SweepType	Sweep generation mode Linear/Fixed/Random/Linear 2	Select
2) SWP Range	Source range when sweeping Auto/Fix	Select
3) Reverse	Sweep reverse mode Off/On	Select
4) Repeat Cnt	Number of times sweep is repeated 0 to 1000	Numeric
5) Rtrn Bias	Bias value output when sweep is completed On/Off	Select

(a)

(a)

Category level	Select level	Input/Run level	Parameter types
C) SWEEP VAL	1) Start Value	Linear Sweep Start value In the Linear mode VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	2) Stop Value	Linear Sweep Stop value In the Linear mode VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	3) Step Value	Linear Sweep Step value In the Linear mode VS 000.01 mV to 32.000 V/+000.01 mV to ±06.000 V IS 00.001 µA to 500.00 mA/00.001 µA to 5.0000 A	Numeric
	1) Level Value	Fixed Sweep Level Value In the Fixed mode VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	2) Sample Cnt	Fixed Sweep Sample Count In the Fixed mode 1 to 8000	Numeric
	1) Sweep Adr	Random sweep start address/stop address In the Random mode 0 to 7999 * Use [SEL] key to switch between Start/Stop.	Numeric
	1) First Value	Two-slope Linear Sweep First value In the Linear 2 mode VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	2) Middle Value	Two-slope Linear Sweep Middle value In the Linear 2 mode VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	3) Last Value	Two-slope Linear Sweep Last value In the Linear 2 mode VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	4) Step1 Val	Two-slope Linear Sweep Step1 value In the Linear 2 mode VS 000.01 mV to 32.000 V/+000.01 mV to ±06.000 V IS 00.001 µA to 500.00 mA/00.001 µA to 5.0000 A	Numeric
	5) Step2 Val	Two-slope Linear Sweep Step2 value In the Linear 2 mode VS 000.01 mV to 32.000 V/000.01 mV to 06.000 V IS 00.001 µA to 500.00 mA/00.001 µA to 5.0000 A	Numeric
	6) Bias Value	Sweep bias value VS +000.00 mV to ±32.000 V/+000.00 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric
	7) PSW Base	Pulse sweep base value VS +000.00 mV to ±32.000 V/+000.000 mV to ±06.000 V IS +00.000 µA to ±500.00 mA/+00.000 µA to ±5.0000 A	Numeric

(b)

(b)

Category level	Select level	Input/Run level	Parameter types
D) TIME	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	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 in the Pulse or Pulse Sweep source modes.	Select
	3) Measure SW	Measurement ON or OFF On/Off	Select
	4) Disp Digit	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	1) Store Mode	Measurement data memory Off/Normal/Burst	Select
	2) Mem Recall	Measurement data memory recall Recall data number setting	Numeric
	3) Mem Clear	Measurement data memory clear Press [ENTER] key to run.	Run

(c)

(c)

Category level	Select level	Input/Run level	Parameter types
G) RANDOM MEM	1) Data Set ..	Set random memory * Press the [SEL] key to switch between address/data input.	Numeric
	2) Save/Clear	Random memory clear (Ram)/ Random memory save (Ram → Flash) Select Save/Clear and press [ENTER] key to run.	Run
H) COMPUTE	1) Compare SW	Switches the comparator calculation ON or OFF. Off/On	Select
	2) Scaling SW	Switches the scaling calculation ON or OFF. Off/On	Select
	3) Max/Min SW	Switches the MAX/MIN calculation ON/OFF. Off/On	Select
	4) View Mx/Mn	Reading MAX/MIN calculation results (data) a) Sample The number of operational data items of measurement data b) Maximum Maximum Measurement data value c) Minimum Minimum Measurement data value d) Average Measurement data average value e) Total Measurement data total value * Use the ◁ , ▷ keys, or ◯ rotary knob to select a) to e).	Others
I) CONST	1) High Value	Comparator-calculation upper-limit value 0 to ±999.999E+24	Numeric
	2) Low Value	Comparator-calculation lower-limit value 0 to ±999.999E+24	Numeric
	3) SCL Val_A	Scaling operation constant A 0 to ±999.999E+24 0 (zero) is not available	Numeric
	4) SCL Val_B	Scaling operation constant B 0 to ±999.999E+24	Numeric
	5) SCL Val_C	Scaling operation constant C 0 to ±999.999E+24	Numeric
	6) Null Value	NULL calculation constant 0 to ±999.999E+24 Can be selected/changed only if NULL calculation is ON.	Numeric

(d)

Category level | Select level | Input/Run level | Parameter types

(d)

J) EXT SIGNAL

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	Select control output pulse width 10 µs / 100 s	Select

K) PARAMETER

1) Parm Load	Loads the save parameters. Select Load0/Load1/Load2/Load3/LdDflt and press [ENTER] key to run.	Run
2) Parm Save	Saves the setting parameters. Select Save0/Save1/Save2/Save3/SvDflt and press [ENTER] key to run.	Run
3) PON. Load	Select Load Parameters at power on. P.OFF / Load0	Select

L) I/F

1) I/F BUS	Select interface. GPIB/USB	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 is selected Off/On	Select

(e)

(e)

Category level	Select level	Input/Run level	Parameter types
M) SYSTEM	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	Processing complete notice buzzer On / Off	Select
	4) Self Test	Runs the selected self-tset. Use ◁ and ▷ keys to select the self-test. Press [ENTER] key to run. a) Self Test; Self Test b) Dsp/KeyTst; Display/Key Test	Others
	5) 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 the Operate or Suspend modes, only parameter items that can be set and executed are displayed.

2.2.4 Initializing Setting Conditions

The following procedure returns the 6241A/6242 to the factory settings.

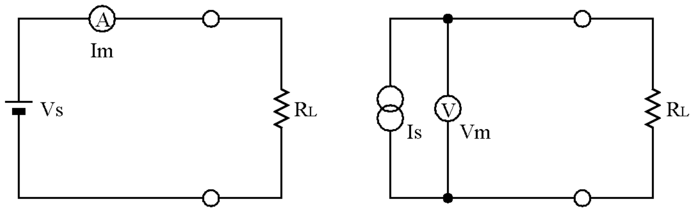
However, the following items cannot be initialized.

- Selected interface
- GPIB address
- Talk only/Addressable
- Header output
- USB.Id
- Load Parameters at power on

Operation	Character display area
1. Press **MENU** and press ◁ or ▷ to select **K) PARAMETER**.	K) PARAMETER
2. Press ▽ to go to the Select level.	1) Parm Load Load0
3. Press ▽ to go to the Input/Run level.	1) Parm Load **Ent Load0**
4. Rotate ◯ to select “Ld Dflt”.	1) Parm Load **Ent Ld Dflt**
5. Press **ENTER**.	
6. When loading is complete, “Done” is displayed and the menu reverts to the Select level.	1) Parm Load Done
7. Press **EXIT** to exit the menu.	1) Parm Load Ld Dflt

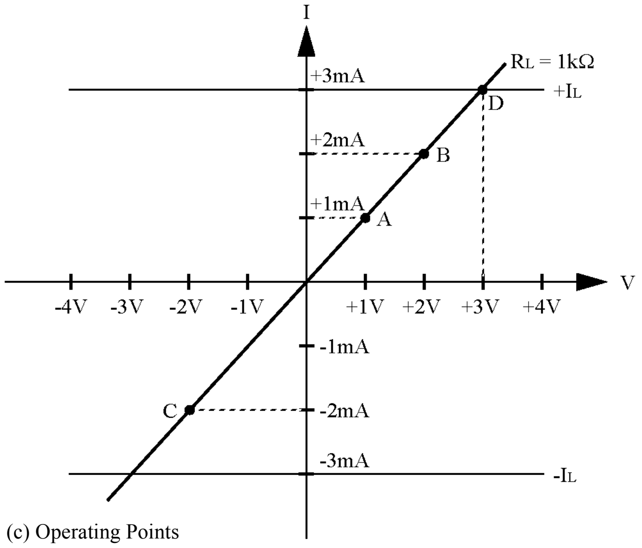
2.2.5 DC Measurement

This section describes the basic usage, functions, operation of the 6241A/6242, and operation with voltage source current measurement (VSIM). The unit changes the source voltage to limit the current (called current-limiter). Also how to control current source voltage measurement (ISVM) is described.
1 KΩ resistor is used as the DUT for the measurement.
Figure 2-15 shows DC measurement operating modes and the operating points.



(a) Voltage Source Current Measurement (VSIM)

(b) Current Source Voltage Measurement (ISVM)



(c) Operating Points

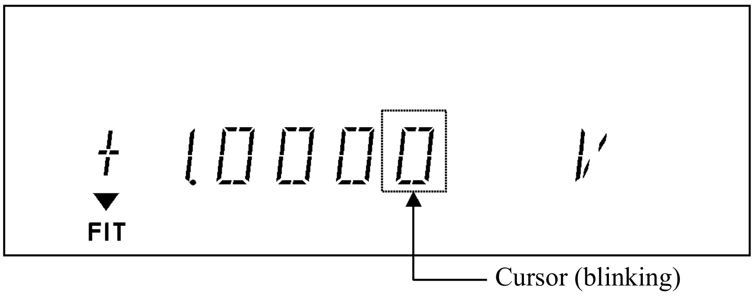
Figure 2-15 DC Measurement

Preparation

1. Follow the procedure described in Section 2.2.4, “Initializing Setting Conditions” and initialize the settings of this instrument.
2. Connect the DUT with the supplied input and output cable.
    - Connect the input and output cable to HI OUTPUT and LO OUTPUT terminals of this instrument.
    - Connect the DUT 1 kΩ resistor.

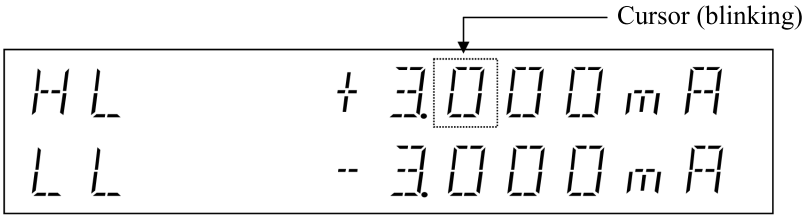
Setting the source value

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



Setting the current-limiter

4. Press **LIMIT**.
5. Press **123..., 3,** and **ENTER** in order.



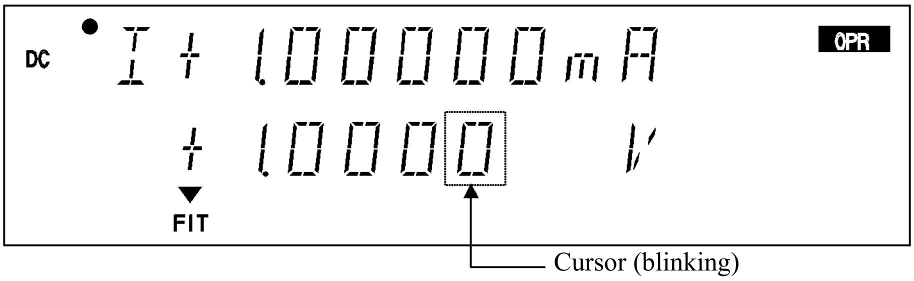
6. Press **LIMIT**.

NOTE: ***The following example operation shows by using ideal values that measured devices and properties such as a 1 kΩ resistor, cable resistance, and the 6241A/6242, are assumed to not have errors in both sources and the measurement.***
In the actual operation, some error factors do exist and the measured values will be different from the example.

Voltage source (VSIM)

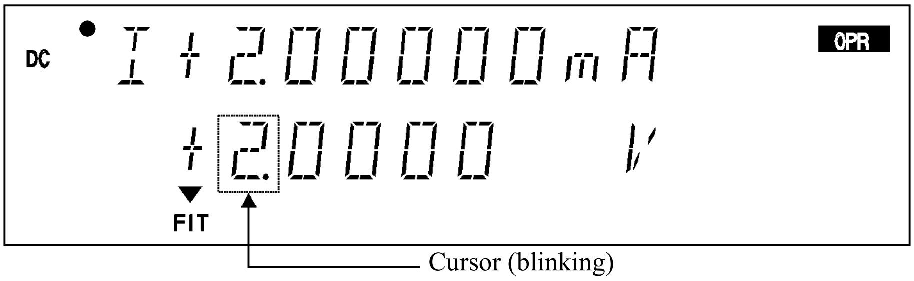
7. Press **OPR**.

   The OPR indicator turns on showing the operational (output ON) status. The current-measurement value is shown when 1 V is applied to a 1 kΩ resistor (See Point A in Figure 2-15).

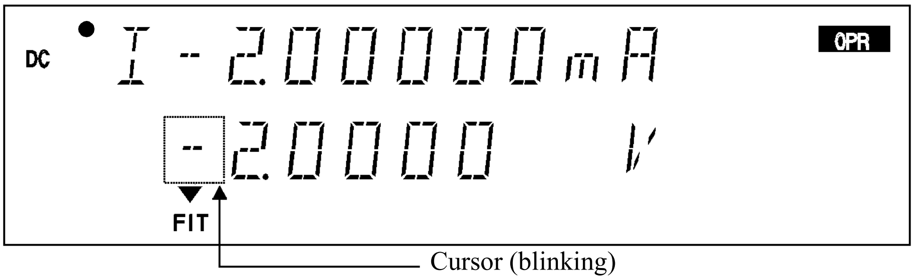


8. Press ◁ to move the cursor to “1”, and use △ or ◯ to change the source value to 2 V.

   The current-measurement value is shown when 2 V is applied to a 1 kΩ resistor (See Point B in Figure 2-15).



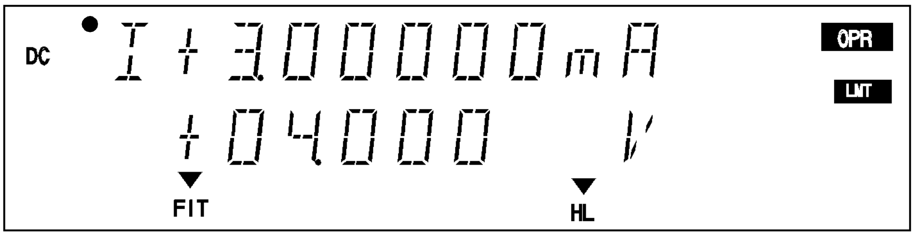
9. Press ◁ to shift the cursor to “+” and use △ or ◯ to change the source value to -2 V (See Point C in Figure 2-15).



10. Use ⌂ or ◯ to return the source value to +2 V, and then press **123..., 4** and **ENTER** in order.

    The voltage-source value is set to 4 V in 30 V/6 V range.

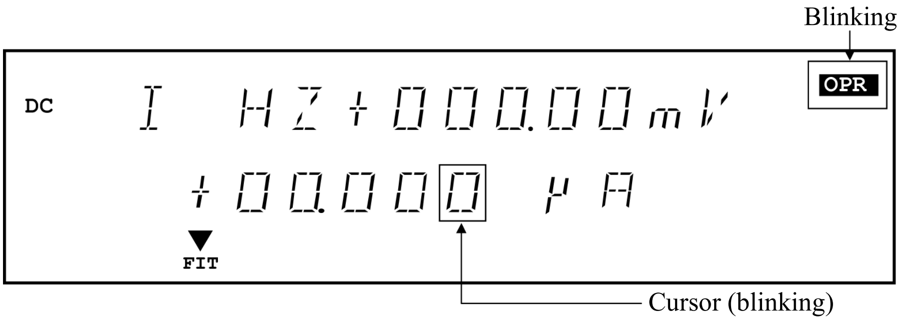
    Because the limiter restricts the source current, the limiter indicator turns on. (See Point D in Figure 2-15)



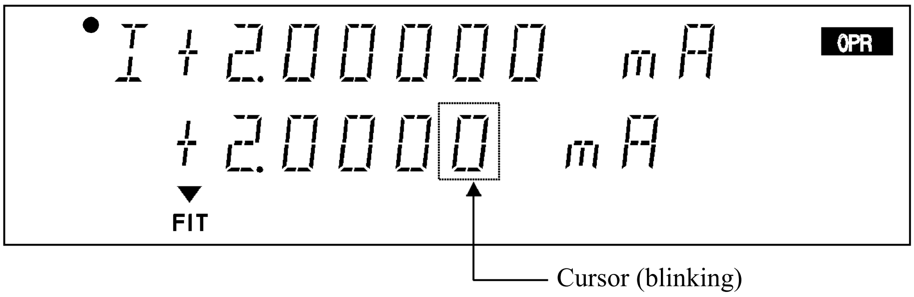
Current-source (ISVM)

11. Press **VS/IS**.

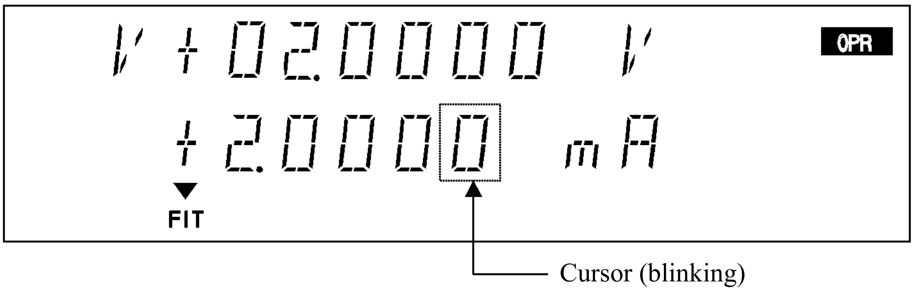
    The setting changes to the current-source and sets Suspend status.



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



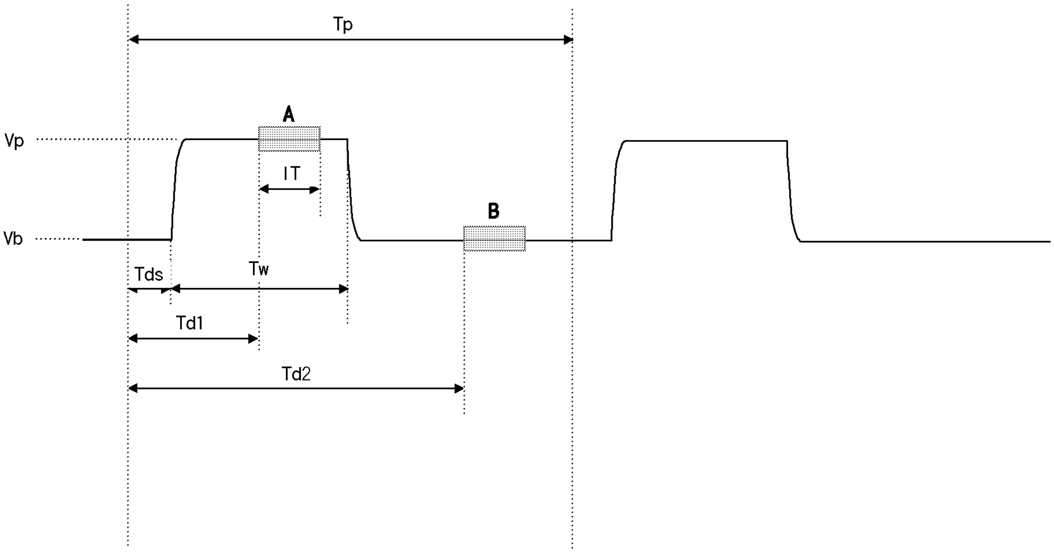
13. Press the **MON** twice to switch voltage-measurement. (See Point B in Figure 2-15)



2.2.6 Pulse Measurement

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

The following describes the example of measurement by changing A and B measurement points as shown in Figure 2-16 for voltage source current measurement (VSIM).



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

Preparation

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

Setting pulse source value

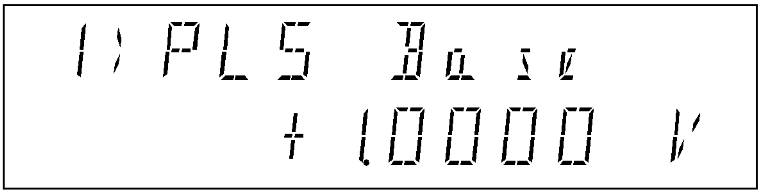
2. Press **123…**, **2**, **UNIT▲**, and **ENTER** in order.
   Set the pulse source value to 2 V.

Setting current-limiter value

3. Press **LIMIT**, **123…**, **3**, and **ENTER** in order.
   Set the current-limiter within ±3 mA.
4. Press **LIMIT**.
   The HOME screen is displayed.

Setting base value

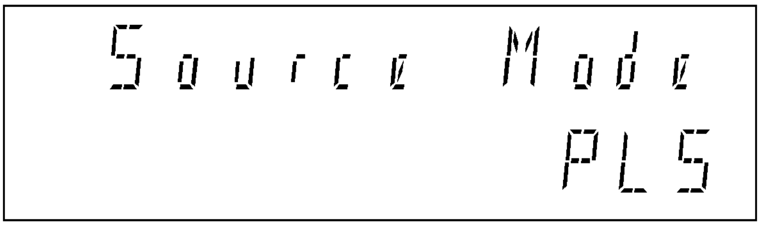
5. Press **MENU**.
6. Press ◁ or ▷ to select **A) SOURCE**. Press ▽ to go to the Select level.
7. After confirming the item is **1) PLS Base**, press ▽ to go to the Input/Run level and press **123…**, **1**, **UNIT▲**, and **ENTER** in order.
   1 V has been set.



Setting pulse time

8. Press △, △, ▷, ▷, ▷ and ▽ in this order.
   Time setting select level **D) TIME** is displayed.
9. Press ▷ to select **2) Src Delay**. Press ▽ to go to the Input/Run level.
10. Press **123..., 1,** and **ENTER** in order.
    Set the Tds to 1 ms.

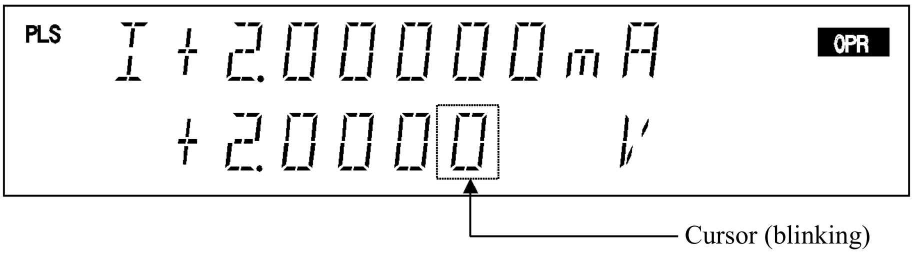
11. Press △ or ▷ to select **3) Meas Delay**. Press ▽ to go to the Input/Run level.
12. Press **123...**, **3,** and **ENTER** in order.
    Set the Td1 to 3 ms.
13. Press △ or ▷ to select **4) Pls Width**. Press ▽ to go to the Input/Run level.
14. Press **123...**, **5**, **0**, and **ENTER** in order.
    Set the Tw to 50 ms.
15. Press △ or ▷ to select **5) Period**. Press ▽ to go to the Input/Run level.
16. Press **123...**, **1**, **3**, **0**, and **ENTER** in order.
    Set the Tp to 130 ms.
17. Press **MENU**.
    The HOME screen is displayed.
18. Press **MODE**.
19. Rotate ◎ or press △ , ▽ to select **PLS**.



Source Mode
PLS

Current-measurement at pulse value

20. Press **ENTER**.
    The HOME screen is displayed.
21. Press **OPR**.
    The operational status is set.
    The current-measured value at pulse value 2 V is displayed on the screen. (See Figure 2-16, Point A)

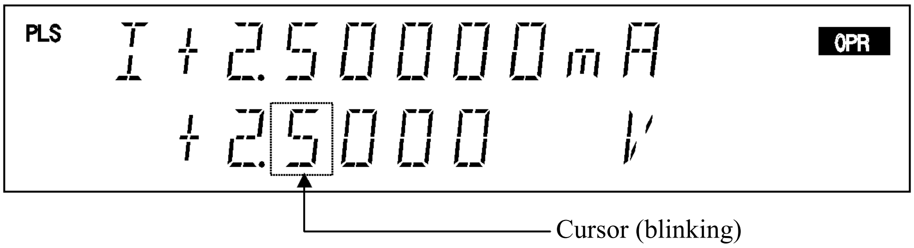


PLS I +2.00000mA OPR
+2.0000 V

Cursor (blinking)

22. Press ◁ and △ to change the source value (pulse value) to 2.5 V.

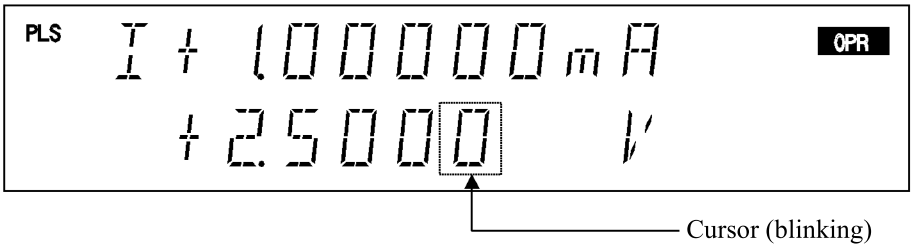
    The current-measured value at pulse value 2.5 V is displayed on the screen.



Current-measurement at base value

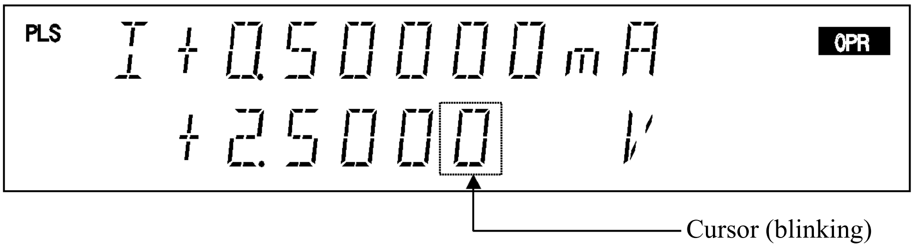
23. Follow procedure 11 to set the major delay time at 60 ms and then press **MENU**.

    The HOME screen is displayed. (Td2)
    The current-measured value at base value 1 V is displayed on the screen.
    (See Point B in Figure 2-16)



24. Follow procedure 6 to change the base value to 0.5 V and then press **MENU**.

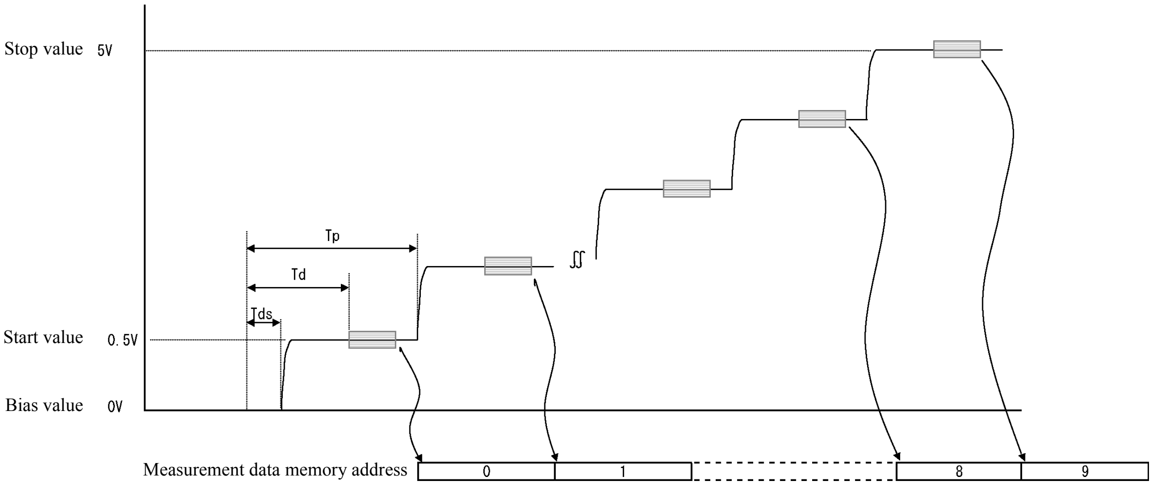
    The HOME screen is displayed. The current-measured value at base value 0.5 V is displayed on the screen.



2.2.7 Sweep Measurement

This section describes the process which reads out the measurement data from memory by using the sweep source mode.

Using voltage source current measurement (VSIM), the 6241A/6242 linear-sweeps from 0.5 to 5 V in 0.5 V steps as shown in Figure 2-17 below.



Source mode:	DC Sweep
Sweep type:	Linear Sweep (default)
Bias value:	0 V (default)
Start value:	0.5 V
Stop value:	5 V
Step value:	0.5 V
Integral time:	1 PLC (default)
Source delay time (Tds):	1 ms
Measurement delay time (Td):	4 ms
Period time (Tp):	100 ms
Current limiter:	30 mA

Figure 2-17 Sweep Measurement

Preparation

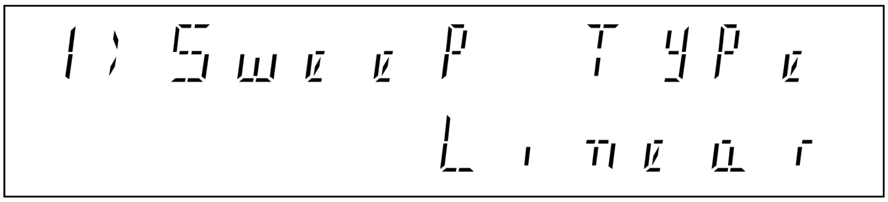
1. Follow the same procedure described in Section 2.2.5, “DC Measurement.”

Setting the current-limiter

2. Press **LIMIT**, **123…**, **3**, **0**, and **ENTER** in order.
   Set the current-limiter within ±30 mA.
3. Press **LIMIT**.
   The HOME screen is displayed.

Setting the sweep source mode

4. Press **MODE**. Rotate ○ or press △ or ▽ to select ***DC-SWP***, and press **ENTER.**
   DC indicator and SWP indicator turn on to show DC Sweep has been set.
5. Press **MENU**.
6. Press ◁ or ▷ to select **B) SWEEP**. Press ▽ to go to the Select level.
7. Verify that ***Linear*** is selected in **1) Sweep Type**.



1) Sweep Type

Linear

Setting sweep source-voltage

8. Press △, ▷, and ▽ to select **1) Start Value**. Press ▽ to go to the Input/ Run level.
9. Press **123…**, **0,** **.**, **5**, **UNIT ▲**, and **ENTER** in order.
   Set the start value at 0.5 V.
10. Press △ and ▷ to select **2) Stop Value**. Press ▽ to go to the Input/Run level.

11. Press **123…**, **5**, **UNIT ▲**, and **ENTER** in order.
    Set the stop value at 5 V.
12. Press ⇧ and ⇨ to select **3) Step Value**. Press ⇩ to go to the Input/Run level.
13. Press **123...**, **0**, **.**, **5**, **UNIT ▲**, and **ENTER** in order.
    Set the step value at 0.5 V.
14. Press ⇧ and ⇨ to select **6) Bias Value**, and verify the bias value is set to 0 mV.

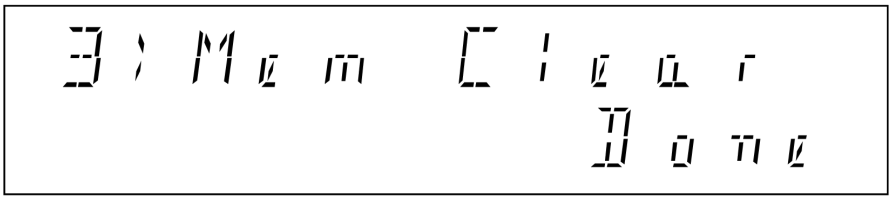
Setting sweep time

15. Press ⇧ and ⇨ to select **D) TIME.**
16. Press ⇩ and ⇨ to select **2) Src Delay**. Press ⇩ to go to the Input/Run level.
17. Press **123…**, **1**, and **ENTER** in order.
    Set the source delay time to 1 ms.
18. Press ⇧ and ⇨ to select **3) Meas Delay**. Press ⇩ to go to the Input/Run level.
19. Press **123…**, **4**, and **ENTER** in order.
    Set the measure delay time to 4 ms.
20. Press ⇧, ⇨ and ⇨ to select **5) Period**. Press ⇩ to go to the Input/Run level.
21. Press **123…**, **1**, **0**, **0**, and **ENTER** in order.
    Set the period time to 100 ms**.**

Setting measurement memory

22. Press ⇧, ⇧, ⇨ and ⇨ to select **F) MEMORY**.
23. Press ⇩ to select **1) Store Mode**. Press ⇩ to go to the Input/Run level.
24. Rotate ◎ to select ***Normal***.
    Set the measurement data memory to Normal-ON.

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



3) Mem Clear
Done

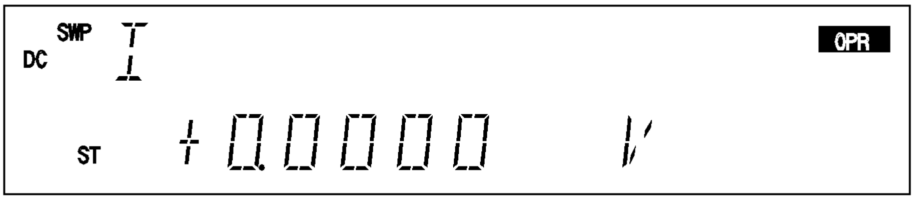
26. Press **MENU**.
The HOME screen is displayed.

27. Ensure that the ST indicator is ON.

Starting sweep measurement

28. Press **OPR**.

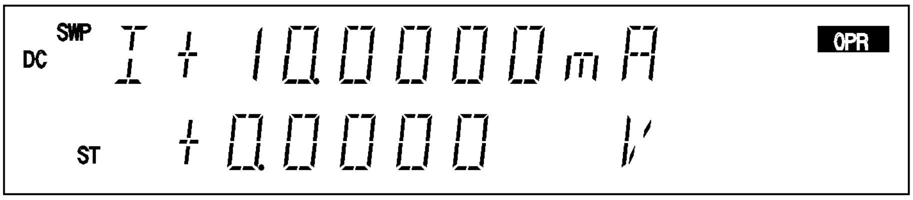
The operational status is set.
The source value shows the bias value.



I
+0.0000 V

29. Press **TRIG**.

The sweep starts while displaying the source and the measurement values. When the sweep is completed, the final measurement value is displayed.



I +10.0000mA
+0.0000 V

Reading measurement results

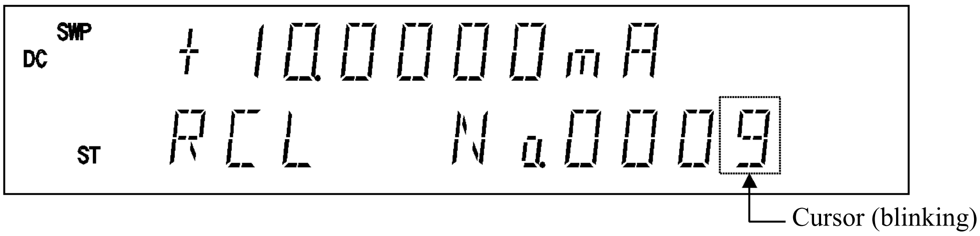
30. Press **STBY** to set the Standby mode.

31. Press **MENU**.

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

33. Press ▷ to select **2) Mem Recall**. Press ▽ to go to the **Input/Run** level.

    This key reads the data stored in the measurement data memory onto the display. It displays the final stored data.



34. Rotating ◎ changes the memory address and then reads the stored data items one by one and displays them on the screen.

    Pressing **123...** enters the direct input mode and an optional memory number can also be specified and read.

35. Press **MENU**.

    The HOME screen is displayed.

2.3 Saving and Loading Parameters

The 6241A/6242 can save the setting parameters in the non-volatile memory, Area 0 to 3.

The 6241A/6242 has a random memory data save area, separated from the parameter save area.

2.3.1 Auto Load at Power On

When the 6241A/6242 is turned on, it starts up with the setting parameters from when it was previously turned off.
To start up using predefined parameters, parameters saved in Area 0 can be loaded at startup.
To select the parameter loading method at power on, select **K) PARAMETER → 3) PON. Load** on the Menu screen.

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

NOTE:

1. ***The auto load function does not apply to random memory. At power ON, the random memory saved in the non-volatile memory is loaded.***
2. ***The GPIB address, USB.Id 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

	Operation	Character display area
1.	Press **MENU** and press ◁ or ▷ to select **K) PARAMETER.**	K) PARAMETER
2.	Press ▽ to go to the Select level.	1) Parm Load Load0
3.	Press ◁ or ▷ to select **2) Parm Save**.	2) Parm Save Save0
4.	Press ▽ to go to the Input/Run level.	2) Parm Save **Ent Save0**
5.	Rotate ○ to select the save area.	2) Parm Save **Ent Save2**
6.	Press **ENTER**.	
7.	When saving is complete, “Done” is displayed and the menu reverts to the Select level.	2) Parm Save Done
8.	Press **EXIT** to exit the menu.	2) Parm Save Save2

2.3.3 Loading Parameters

Operation	Character display area
1. Press **MENU** and press ◁ or ▷ to select **K) PARAMETER.**	K) PARAMETER
2. Press ▽ to go to the Select level.	1) Parm Load Load0
3. Press ◁ or ▷ to select **1) Parm Load**.	1) Parm Load Load0
4. Press ▽ to go to the Input/Run level.	1) Parm Load **Ent Load0**
5. Rotate ◯ to select the load area.	1) Parm Load **Ent Load2**
6. Press **ENTER**.	
7. When loading is complete, "Done" is displayed and the menu reverts to the Select level.	1) Parm Load Done
8. Press **EXIT** to exit the menu.	1) Parm Load Load2

3. MEASUREMENT EXAMPLE

The following explanation relates to the 6241A.

3.1 Measurement of Diode

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

CAUTION: ***Use a 4-wire connection for accurate measurement of the forward voltage.***

The measurement conditions are described below.

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

VF measurement conditions example

Source mode : Pulse
Pulse current : 100 mA
Base current : 0 mA
Limiter : 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 diode as shown in Figure 3-1.
   A two-wire connection is used in this measurement example.

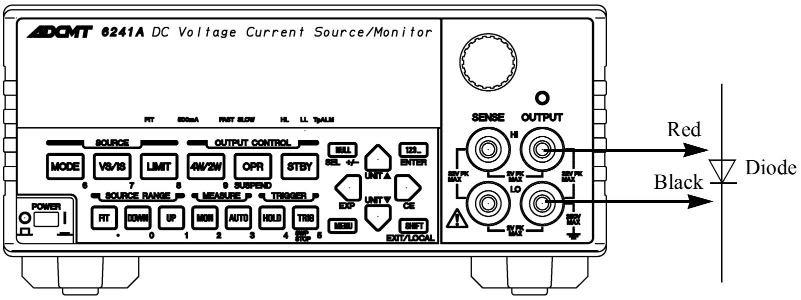


Figure 3-1 Diode Measurement Connection

Measurement of the diode forward voltage

2. Set the VF measurement conditions parameter.
3. Short-circuit the HI OUTPUT cable (red) and LO OUTPUT cable (black) to obtain the NULL value.
4. Turn Operate ON.
5. Press **NULL**.
6. Select the Standby or Suspend mode.
7. Connect anode of the diode to HI OUTPUT cable (red) and cathode to LO OUTPUT cable (black).
8. Turn Operate ON.

   The VF measurement result is displayed.

3.2 Battery Charge and Discharge Test

This section describes an example of the charging and discharging test of rechargeable batteries such as NiCad batteries and nickel-metal hydride batteries.
The charging and discharging tests take a long time and should be executed by a system which uses remote. However, a manual operation example using the functions of the 6241A is described.
Charge with DC constant-current and constant-voltage, and finish the charge when the current reaches below the specified current.
Discharge with pulse constant-current, and finish the discharge when the battery voltage reaches below the specified voltage. Set the voltage-limiter at the same polarity, and avoid overcharge and over-discharge by setting HL value as the charge upper-limit and LL value as discharge lower-limit.
Set the Suspend voltage at the same voltage as the battery to be tested with HiZ to reduce transient current during operating status.

Store the discharged voltage in the memory to display it after completing the test.
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 a maximum of 8000 seconds (=2.22 hours) worth of data can be stored.

CAUTION:

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

Test conditions are described below.

Charging test: Charge with a constant current of 500 mA. After the voltage reaches 1.45 V, charge with a constant voltage.
Stop charging when the current reaches 100 mA or less.

Charging test condition example		
Source mode	:	DC
Source current	:	500 mA
Limiter	:	HL value; 1.45 V LL value; 0.95 V
Suspend voltage	:	HiZ; 1.20 V
Period	:	1 s
Integration time	:	200 ms
Measurement range	:	500 mA range fixed
Memory	:	NORMAL, STORE ON
Comparator	:	ON Comparator lower limit value; 100 mA
External control signals	:	OPERATE OUT; STBY IN COMPPLETE OUT; Comp-LO Pulse width; 100 µs
Remote sensing	:	4-wire

Discharge test: As shown in Figure 3-2, discharge with a 500 mA constant current, pulse width 20 ms, and a 1 second period. Finish the discharge when the voltage reaches 1.0 V.
Store the battery voltage in the memory to display it after completing the test.
However, the data stored in memory is only up to 8000 seconds from starting the discharge due to the limitation of memory capacity.

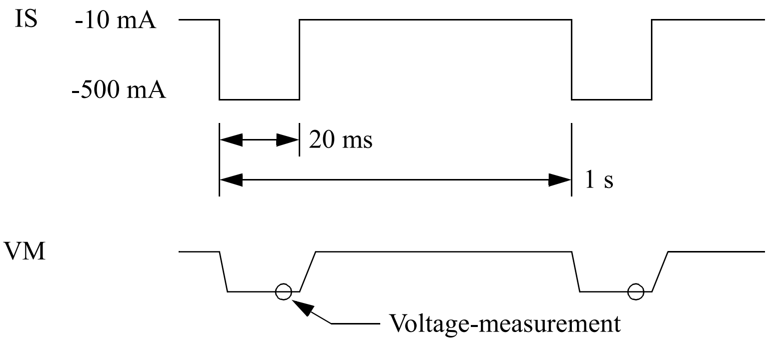
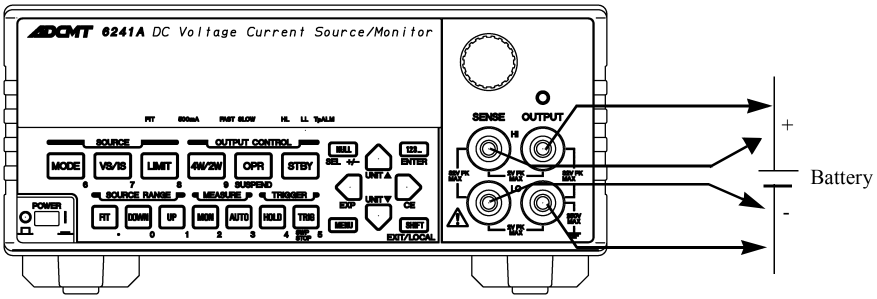


Figure 3-2 Waveform of Battery Discharging Test

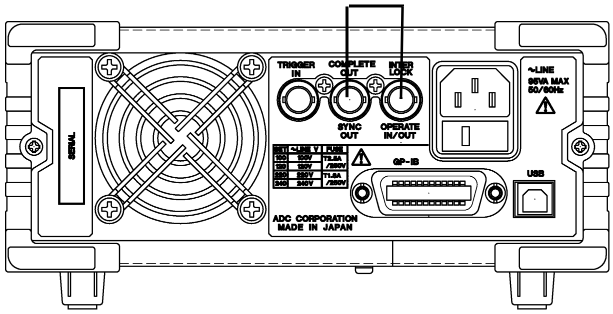
Discharge test conditions		
Source mode	:	Pulse
Pulse current	:	-500 mA
Base current	:	-10 mA
Limiter	:	HL value; 1.45 V LL value; 0.95 V
Suspend voltage	:	HiZ; 1.20 V
Pulse width	:	20 ms
Period	:	1 s
Integration time	:	1 ms
Measurement delay	:	18 ms
Measurement range	:	3 V range fixed
Memory	:	NORMAL, 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 in Figure 3-3 so that the cable does not cause a voltage drop.
2. Connect COMPLETE OUT terminal with OPERATE IN terminal on the rear panel by using the BNC-BNC cable A01036.
   This is to set the unit Standby automatically after completing the charge or discharge.



Front



Rear

Figure 3-3 Battery Charge Discharge Test Connection

Charge test

1. Set at Current-source Current-measurement.
2. Set the charge test conditions parameters.
3. Turn Operate ON.

   The battery starts charging with constant current and the charging current reduces as the battery voltage reaches to +1.45 V.
   The battery charge completes automatically and is set to Standby when reaching 100 mA or less.

Discharge test

1. Set at Current-source Voltage-measurement.
2. Set the discharge test conditions parameters.
3. Turn Operate ON.

   Battery charging starts by using the pulse current and discharging is completed when the battery voltage is +1.0 V or less and the battery automatically enters the stand-by mode.

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 menus.
- 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 menus.

4.2 Function Description

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

4.2.1 AUTO Key (Measurement Range)

Switches between measurement auto range and fixed range.

Auto range: Measures with the optimum range between the limiter range and the minimum range. AUTO indicator turns on.

Fixed range: Measurement range does not vary. 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 a range that cannot output the currently set source value. In this case, the source range setting mode is set to LOCK.

4.2.3 FIT Key (Source Range)

Switches between the source range set modes, FIT and LOCK, to decide the source range.

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

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

LOCK status: Fixes the present source range.
FIT ▼ indicator turns off.

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

4.2.4 HOLD Key (Trigger Mode)

Switches between source and measurement trigger mode.

Source mode	AUTO	HOLD
DC/pulse	Repeats sourcing and measurement within the time-parameter period-time. During measurement, the sampling indicator turns on.	Starts sourcing and measuring with the trigger input. HOLD indicator turns on.
Sweep	Repeats sourcing and measurement within the time-parameter period-time. During measurement, the sampling indicator turns on. During sweeping, ⊗ is displayed rotating.	Starts sourcing and measuring with trigger input, and then pauses the sweep. HOLD indicator turns on.

However, while sweeping, the trigger mode cannot be switched.

4.2.5 LIMIT Key (Limiter Setting)

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

4.2.6 MENU Key (Parameter Setting)

Pressing the **MENU** key displays the parameter group setting screen.
Press ◁ or ▷ to select an item from ***A) SOURCE*** to ***M) SYSTEM*** in the Category level menu.
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 base value at pulse source generated.
Suspend V	Sets the output voltage in Suspend.
Suspend Z	Sets the output impedance in Suspend.
	HiZ: The output current-limiter is restricted to ±300 nA so the output impedance increases.
	LoZ: The output current-limiter is set at the current-limiter value at source voltage and at 30 digits at current-source, so the output impedance decreases.

LMT Input	Selects the limiter HL and LL value setting. ±Balance : Both positive and negative values of HL and LL value change at the same time. Separate : Sets HL and LL value separately. The HL and LL set range is (HL value -(minus) LL value) > (Minimum setting range). The same polarities can be set.
Response	Selects the source response. Fast : Fast mode Slow: Slow mode
SWEEP	Sets the sweep source operations.
Sweep Type	Selects sweep source mode type. Linear: Executes a linear sweep. Fixed: Executes a fixed sweep. Random: Executes a random sweep. Linear 2: Executes two slope linear sweep.
SWP Range	Selects the range functions when sweeping. Auto: Sweeps at each step from the start value to the stop value, each in an optimum range. Fix: Sweeps in the minimum fixed range, which can output any source values, from the start value to the stop value.
Reverse	Switches the reverse mode (double sweep) ON and OFF. On: Sweeps from the start value to the top value and continues sweeping back to the start value. Off: Sweeps from the start value to the top value and then stops.
Repeat Cnt	Sets the number of times to repeat the sweep. Setting 0 repeats indefinitely. When a number between 1 to 1000 is set and the reverse mode is on, each round sweep is counted as 1.
Rtrn Bias	Selects whether the source value returns to the bias value or stays at the existing value. On: Returns to the bias value when the sweep is completed. Off: Stays at the source value when the sweep is completed.
SWEEP VAL	Sets values used when performing a sweep. Parameters vary depending on the sweep type.

In the Linear mode

SWEEP VAL

Start Value	Sets the Linear Sweep start value.
Stop Value	Sets the Linear Sweep stop value.
Step Value	Sets the Linear Sweep step value.
Bias Value	Sets bias value (source value before the sweep start).
PSW Base	Sets the Pulse-Sweep base-value.

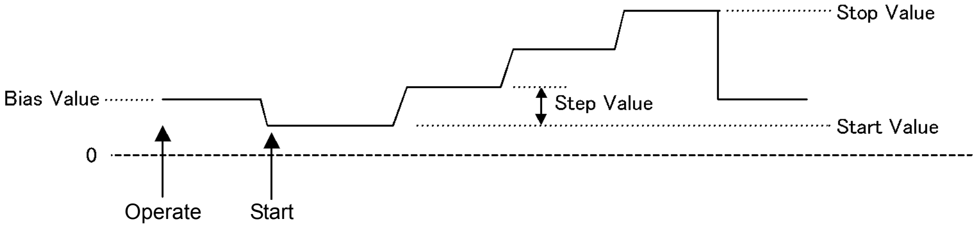


Figure 4-1 Linear Sweep

In the Fixed mode

SWEEP VAL

Level Value	Sets the fixed level value in Fixed sweep.
Sample Cnt	Sets a sample count value in Fixed Sweep (number of measurement times in every Tp period).
Bias Value	Sets bias value (source value before the 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

In Random mode

SWEEP VAL

Sweep Adr	Sets start and stop addresses in Random Sweep mode. Selects the parameters by using NULL (SEL).
Bias Value	Sets bias value (source value before the sweep start).
PSW Base	Sets the Pulse-Sweep base-value.

In the Linear 2 mode

SWEEP VAL

First Value	Sets the Two Slope Linear Sweep first value.
Middle Value	Sets the Two Slope Linear Sweep middle value.
Last Value	Sets the Two Slope Linear Sweep last value.
Step1 Val	Sets the Two Slope Linear Sweep Step1 value (first value to middle value).
Step2 Val	Sets the Two Slope Linear Sweep Step2 value (middle value to last value).
Bias Value	Sets the bias value (source value before the sweep start).
PSW Base	Sets the Pulse-Sweep base-value.

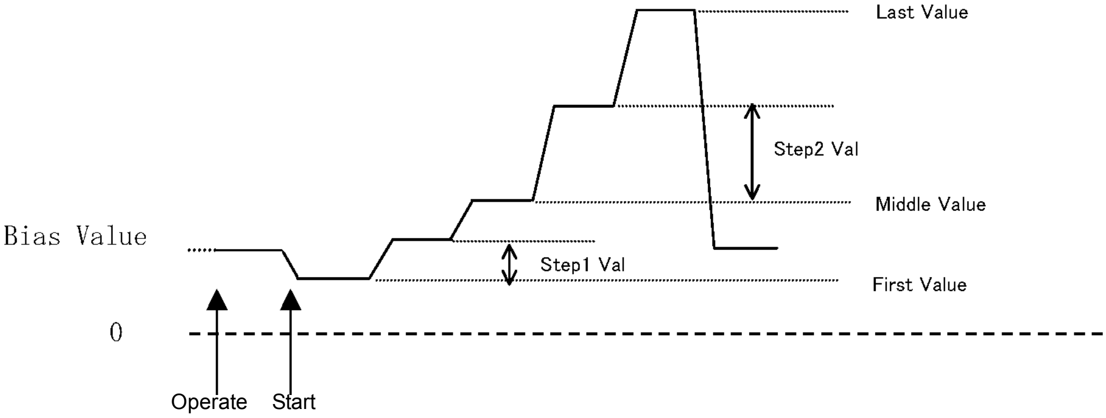


Figure 4-3 Two Slope Linear Sweep

TIME	Sets the sweep source time.
Hold Time	Sets the time from the start to the starting step-cycle, in the sweep source mode.
Src Delay	Sets the delay time (Tds) from the start of the period (Tp) to the sweep generation, in the pulse source and sweep source modes.
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 and sweep source modes.

Period Sets the following period time (Tp).

- DC source mode auto-sampling-period
- Pulse source period
- Sweep source 1step-period

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

MEASURE Settings for measurement.

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

On: Corrects measurement zeropoint drift approximately every 10 seconds. The AZ indicator turns on.

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

Integ Time Sets the measurement integration time.
Integration time: Select from 100 µs; 500 µs; 1 ms; 5 ms; 10 ms; 1 PLC; 100 ms; 200 ms, or S/H. S/H is sample hold mode. The integration time becomes 100 µs. Sample hold mode (S/H) can be set only if the source mode is Pulse mode or Pulse Sweep mode. The set value is displayed by combining F, M, S, and L indicators as follows.

Integration time set	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 illuminates on with half-brightness
Full: indicator illuminates on with full-brightness

Measure SW	Switches measurement 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 (non-used-digits) and 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 measurement data, comparable upper and lower limit value, and output format style. Prefix: Displays measurement data by using a decimal point and the unit symbol. Exponent: Displays measurement data in exponential form.
Mfunc Link	Links the source function to the measurement function. On: Source function is linked to the measurement function (VSIM/ISVM). Off: The measurement function is unaffected by the source function.
MEMORY	Sets the measurement data memory. • While the ST indicator is on, data is being stored in the memory. • When the memory becomes full, the ST indicator blinks and further data cannot be stored. • Cannot move to the Setting level during free run in the DC or Pulse Source mode.
Store Mode	Selects measurement-data-memory functions. The content of the memory is cleared when the Store mode is changed. Normal: Stores data in the memory in normal mode. Burst: Stores data in the memory in burst mode. Used for high-speed measurement. Off: Turns the memory storage operation OFF.
Mem Recall	Reads the data stored in the measurement data memory onto the display. By assigning the recall number on the lower line, it displays the recall data on the upper line. The recall number can be set in the range of 0 to 7999. If data is not stored, “No Data” is displayed.
Mem Clear	Clears the content of the measurement data memory.

RANDOM MEM	Sets source data for the Random Sweep.
Data Set..	Sets random memory contents with an address and data. 0 to 7999 can be used for address settings. Selects the parameters by using the SEL key.
Save/Clear	Saves or clears the random memory. Save: Saves the content of random memory in internal non-volatile memory. The saved data is loaded at power ON. Clear: Clears the content of the random memory.
COMPUTE	Sets calculations.
Compare SW	Switches the Comparator calculation ON or OFF. On: Executes Comparator calculation. The calculation result displays the ⬍ indicator, the header of GPIB output data, and the status byte. HI; High Value < Measurement data GO; Low Value ≤ Measurement data ≤ High Value LO; Measurement data < Low Value Off: Comparator calculation is OFF.
Scaling SW	Switches the scaling calculation ON or OFF. $\text{Scaling calculation} = \frac{\text{(Measurement Value) - Constant B}}{\text{Constant A}} \times \text{Constant C}$ On: Executes scaling calculation. MATH indicator turns on. Off: Turns scaling calculation OFF.
Max/Min SW	Switches the MAX/MIN calculation ON or OFF. On: Executes MAX/MIN calculation. MAX, MIN, AVE, Σ indicators turn on. Off: Turns the MAX/MIN calculation OFF.
View Mx/Mn	Reads the MAX/MIN calculation data.
Sample	Number of operational data items of measurement data
Maximum	Maximum measurement data value
Minimum	Minimum measurement data value
Average	Measurement data average value
Total	Measurement data total value

CONST	Sets constants for calculations.
High Value	Sets the comparator-calculation upper-limit value.
Low Value	Sets the comparator-calculation lower-limit value.
SCL Val_A	Sets Constant A for scaling calculation.
SCL Val_B	Sets Constant B for scaling calculation.
SCL Val_C	Sets Constant C for scaling calculation.
Null Value	Changes Null data when NULL calculation is ON. Not displayed when NULL calculation is OFF.
EXT SIGNAL	Sets the external control signal. The external control signal ports are on the rear panel.

OPR Signal

Selects the external control signal Input/Output functions of INTERLOCK/OPERATE IN/OUT.

STBY In:

Sets Standby by changing the input signal from Lo to Hi. Operate is turned ON by using the key or remote command.

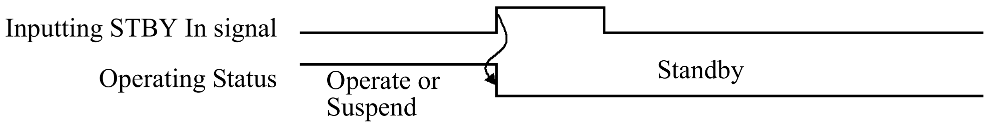


Figure 4-4 STBY In

Inter Lock In

Sets Standby by changing the input signal from Lo to Hi. While the input signal is Hi, Operate and Suspend are disabled.

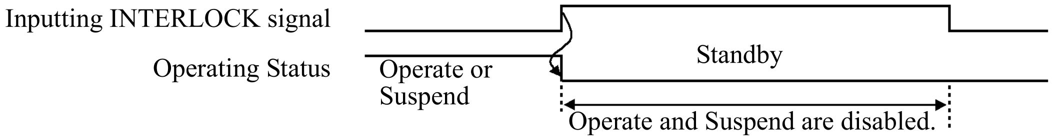


Figure 4-5 InterLock In

Operate Out:

Outputs Lo when the 6241A/6242 is in the Operate, and Hi in Standby or Suspended status.

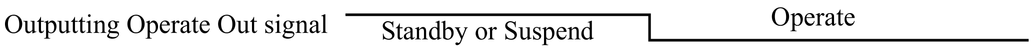


Figure 4-6 Operate Out

OPR/SUS IN

Sets Suspend by changing the input signal from Lo to Hi. Sets Operate by changing the input signal from Hi to Lo.

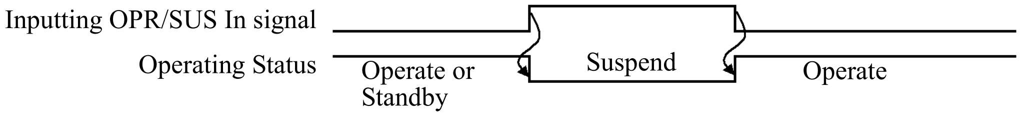


Figure 4-7 OPR/SUS In

OPR/STBY In:

Sets Standby by changing the input signal from Lo to Hi. Sets Operate by changing the input signal from Hi to Lo.

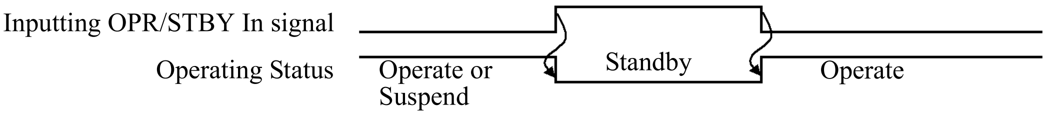


Figure 4-8 OPR/STBY In

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 for sweep source.

Sig Width

Selects 10 µs or 100 µs output-pulse-width.

PARAMETER	Loads and saves the Setting Parameters.
Parm Load	Loads the setting parameters saved into the non-volatile memory. Not displayed on the menu screen while Operate is ON. Load0: Loads the data in non-volatile memory area 0 as the setting parameter. Load1: Loads the data in non-volatile memory area 1 as the setting parameter. Load2: Loads the data in non-volatile memory area 2 as the setting parameter. Load3: Loads the data in non-volatile memory area 3 as the setting parameter. Ld Dflt: Loads the factory shipment setting value as the setting parameter.
Parm Save	Saves the setting parameter in the non-volatile memory. Save0: Saves the current setting parameter in non-volatile memory area 0. Save1: Saves the current setting parameter in non-volatile memory area 1. Save2: Saves the current setting parameter in non-volatile memory area 2. Save3: Saves the current setting parameter in non-volatile memory area 3. Sv Dflt: Saves the factory shipment setting value in all areas, 0 to 3.
PON. Load	Selects the parameters at power ON. P.OFF: Starts up with the parameters set when the unit was previously turned off. Load0: Starts up with the parameters saved in non-volatile memory area 0.
I/F	Selects and sets the interface.
I/F BUS	Selects the interface. GPIB: Selects the GPIB interface. USB: Selects the USB interface.
GPIB Adr	Sets the GPIB Address from 0 to 30. This item does not appear when the USB interface is selected.
USB Id	Sets the USB Address from 1 to 127. This item does not appear when the GPIB interface is selected.

Header	Sets the header ON or OFF. On: Header ON Off: Header OFF
Talk Only	Switches between Addressable and Talk only function. This item does not appear when the USB interface is selected. On: Talk only Off: Addressable
SYSTEM	Sets the 6241A/6242 system parameters.
Limit Buz	Buzzes when the limiter (compliance) activates. On: Turns ON the limit detection buzzer. Off: Turns OFF the limit detection buzzer.
CompareBuz	Buzzes depending on the measurement data Comparator calculation result. Off: Turns OFF the Comparator calculation buzzer. HI: Buzzes when the Comparator calculation results are in HI. GO: Buzzes when the Comparator calculation results are in GO. LO: Buzzes when the Comparator calculation results are in LO. HI or LO: Buzzes when the Comparator calculation results are in HI or LO.
Notice Buz	Buzzes when operations such as Memory Full, saving or loading parameters are complete. On: Turns ON the notice buzzer. Off: Turns OFF the notice buzzer.
Self Test	Executes a self-test for selected test items.
Error Log	Can read the data stored in the error log when ERR indicator turns ON. Displays the number of errors that occurred, and the error contents can be read using an error number and message. When this parameter is displayed, the content of the error log is cleared and ERR indicator also turns off.
Relay Cnt	Displays the operation count of the Operate/Standby relay.

4.2.7 MODE Key (Source Mode)

This key sets the source mode. Use ⇧ , ⇩ or ◯ to select the mode.

Source Mode	Switches between source modes. Enabled only when in Standby or Suspend.	
	DC:	Sets the DC source mode, which generates DC voltages/DC currents. DC indicator turns on.
	PLS:	Sets the pulse source mode, which generates pulse voltages/pulse currents. PLS indicator turns on.
	DC-SWP :	Sets the DC sweep source mode, which generates DC voltage /current Sweep-waveforms. DC and SWP indicators turn on.
	PLS-SWP :	Sets the pulse sweep source mode, which generates pulse voltage/current Sweep-waveforms. PLS and SWP indicators turn on.

4.2.8 MON Key (Measurement Mode)

This key sets the measurement mode.

Monitor	Switches measurement functions.	
	IM:	Sets current-measurement function. Displays “I” at the header and the measurement unit is A.
	VM:	Sets voltage-measurement function. Displays “V” at the header and the measurement unit is V.
	RM:	Sets resistance measurement function. Displays “R” at the header and the measurement unit is Ω.

4.2.9 NULL/SEL key

NULL key:	Sets 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:	This key selects parameters on the Input level menu. For more information, refer to Section 2.2.3, “Menu Operation.”

4.2.10 OPR/SUSPEND (Operating/Suspend)

OPR key: Switches between Operate and Suspend.

Operate: Turns the output status ON and the OPR indicator turns on. Displays measurement value when the measurement is ON. When it is OFF, the display turns off. The following items are displayed depending on the source mode.

DC: Generates a setting value and displays the measurement value.

PLS: Generates pulse and displays the measurement value.

DC-SWP and PLS-SWP:
Generates bias value and waits for measurement. Generates Sweep data and waits for trigger input. The trigger input starts the Sweep and displays the measurement value.

Suspend: Outputs Suspend voltage without turning OFF the output relay. OPR indicator blinks. It displays Suspend voltage and displays Suspended status at the header.

In HZ: High impedance status

In LZ: Low impedance status

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

NOTE: Sweep data is generated when the status is switched at DC-SWP and PLS-SWP as follows:

- ***From Standby to Operate***
- ***From Standby to Suspend***
- ***Switches to Operate if the sweep parameter is changed during Suspend.***

4.2.11 SHIFT/LOCAL (Shift Mode/Local)

SHIFT key (In Normal Operation): Functions as SHIFT key, and the SHIFT indicator turns on.
At Shift status, function names printed in blue characters on the panel are enabled. Press the SHIFT key again to release the shift mode.

LOCAL key (In Remote Operation): Releases remote operation.
Turns off RMT indicator and switches from remote control to Panel operation.

NOTE: Local operations are prohibited if the LLO (Local Lock Out) command is set on the GPIB/USB Interface.

4.2.12 STBY Key (Output Standby)

Turn off the output relay to set Standby status. The OPR indicator turns off.

NOTE: ***Whenever switching between Operate and Standby, the output relay is turned on and off every time. To extend the relay life span, use Suspend function by switching between Operate and Suspend is recommended.***

4.2.13 TRIG/SWP STOP (Trigger/Sweep Stop)

TRIG key: Functions as the source trigger key and measurement trigger key.

Source mode		Trigger mode	
		AUTO	HOLD
DC source/Pulse source mode		-	Triggers measurement and pulse source
Sweep source mode	Before Sweeping	Start Sweeping	Start Sweeping
	During Sweep	-	Moves to the next step

SWP STOP key (SHIFT): Stops Sweep.

Source mode		Trigger mode	
		AUTO	HOLD
DC source/Pulse source mode		-	-
Sweep source mode	Before Sweeping	-	-
	During Sweep	Stop Sweeping	Stop Sweeping

4.2.14 UP Key (Increasing the Source Range)

Increases the source range by one step;
Locks the source range setting mode. (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 source functions, voltage source or current source. The unit indicates VS or IS mode. When changing between VS and IS, the following operations are restricted:

- Cannot be changed during sweep operation when the source mode is Sweep.
- Forces into Suspend during sweep stop (start trigger wait status) when the source mode is Sweep.
- Forces into Suspend when executing during an operation in the DC source/pulse source mode.

4.2.16 123... Key (Direct Input Mode)

This key is used to switch into a direct input mode that can input numeral data and display the setting value at half-brightness.
In this status, green colored functions on the panel are enabled.
However, EXP key is only enabled when ***Disp Unit*** is the exponent and a calculation is executed. Press **ENTER** to apply the input numerical data and to release the direct input mode.
Press **EXIT** to revert to the value when shifted to the direct input mode and release the direct input mode.

4.2.17 4W/2W Key (Remote Sensing Selection)

This key selects output sensing 4-wire or 2-wire connection.

4W: Sets output sensing to 4-wire connection. The 4W indicator turns on.

2W: Sets output sensing to 2-wire connection. The 2W indicator turns on.

5. TECHNICAL REFERENCES

This chapter describes the functions in detail for more accurate measurement.

5.1 DUT Connection

5.1.1 Note for Output Terminals

Figure 5-1 below shows internal wire connection of the 6241A/6242.
Output terminals are cut off from the internal circuits by Operate and Standby relays during the Standby status.

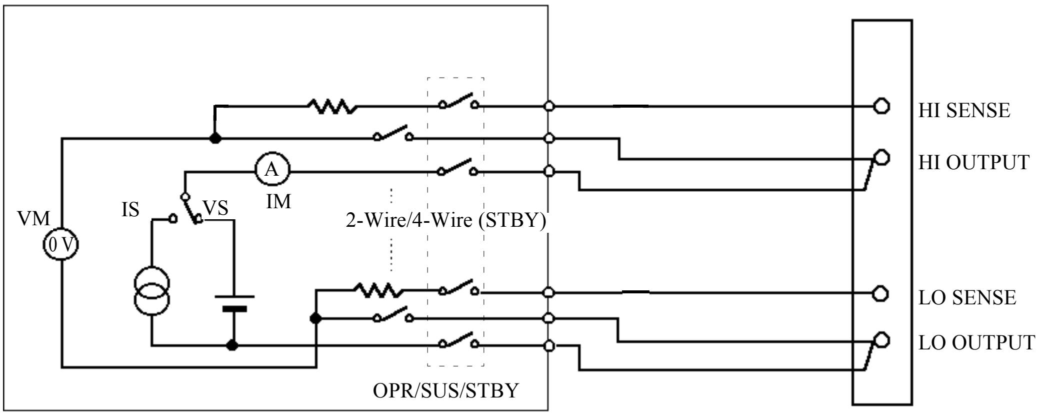


Figure 5-1 Internal Wire Connection

5.1.2 Remote Sensing (2-wire or 4-wire Connection)

When connecting the 6241A/6242 and DUT, connect with 2-wire or 4-wire connections, 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 large and the cable line resistance matters.
- When using within the specified accuracy

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

  The line resistance of attached cable A01044 is approx 100 mΩ. If the total output current is 100 μA or more produced from the above calculation, use the 4-wire connection.
- When allowing ev error

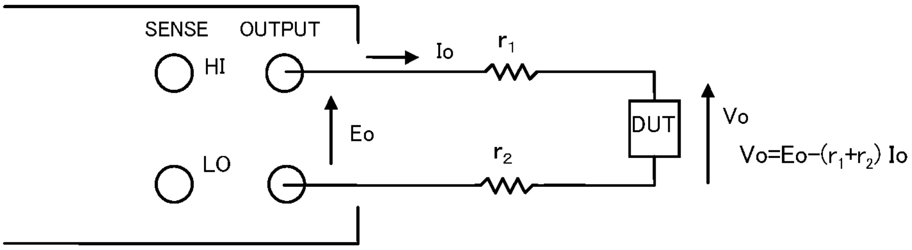
  If (Line resistance × output current) ≤ ev → 2-wire connection
  If (Line resistance × output current) > ev → 4-wire connection

  When using an attached cable A01044 and allowing ev = 10 mV error, up to 100 mA can be used the 2-wire connection.

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

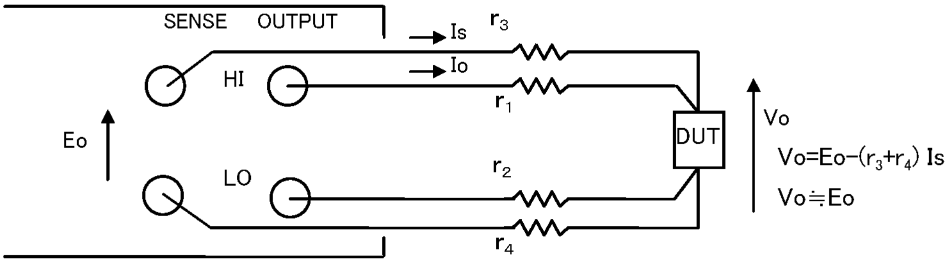
2-wire connection: The 2W indicator illuminates.

4-wire connection: The 4W indicator illuminates.



An error may occur due to r*1* and r2 voltage drop.

(a) 2-wire connection



(b) 4-wire connection

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

NOTE: ***Maximum remote sensing voltage (tolerable voltage difference between OUTPUT and SENSE) is ±1.0 V at both HI and LO sides.***

Maintain the following restriction for r_1 to r_4 to satisfy the specified accuracy.

$r_1, r_2 \leq 1.0\ V/Io\ [\Omega]$

(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 = 0.5 A

$r_1, r_2 \leq 1.0\ V/0.5\ A = 2\ \Omega$

$r_1, r_2 = 2\ \Omega$

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

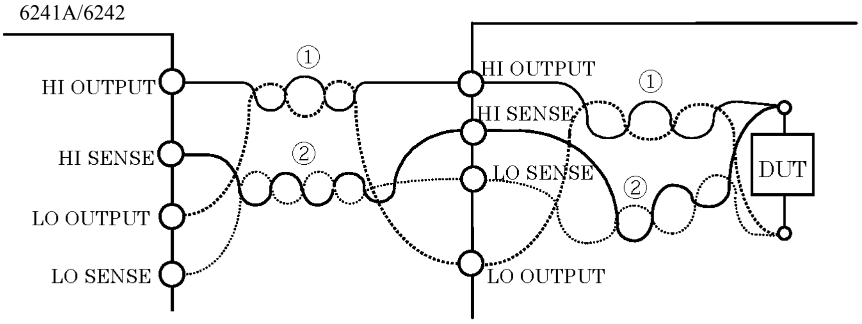
The 6241A/6242 itself may oscillate due to cases where the tested device itself oscillates, or the capacitance or inductance exceeding the specified value is connected
(due to stray capacitance or retained inductance from connected cables, a scanner, or a fixture).

With the oscillation frequency, the difference between the oscillations of the device and that of the 6241A/6242 is evident. The 6241A/6242 does not oscillate at 2 MHz or over.

5.1.3.1 Preventing 6241A/6242 Oscillation

1. Causes of Oscillation
    - Oscillation may occur because of the capacitive load while the voltage source or voltage-limiter is activated.
    - Oscillation may occur because of the inductive load while the current source or current-limiter is activated.
2. Solution
   Remove the causes of oscillation by following the procedure below.
    1. Verify if the load capacitance and load inductance are within the maximum load capacitance and the maximum load inductance indicated in Chapter 9, "SPECIFICATIONS."
    2. Check if the 6241A/6242 still oscillates when cables of the shortest lengths are connected.
    3. If the shorter cables stop the oscillation, then connect the 6241A/6242 and 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 a load 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 in 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 Oscillation from the Device Itself

The device itself may oscillate due to the stray capacitance of cables and test fixtures. 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 filter near the device as in Figure 5-4.
- For transistors it is effective to attach a ferrite filter at the base and for FETs at the gate.
- To minimize a current leak, be careful that a ferrite filter does not touch other terminals, the device case, lead wires, or other ferrite filters.

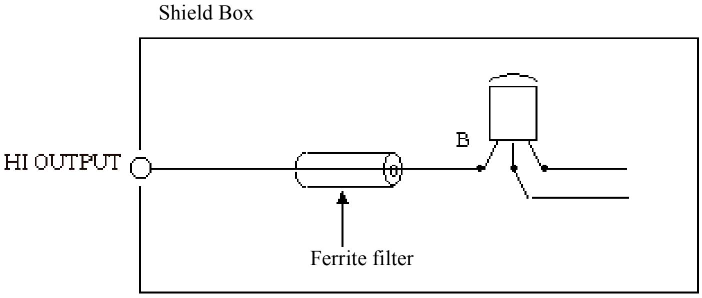
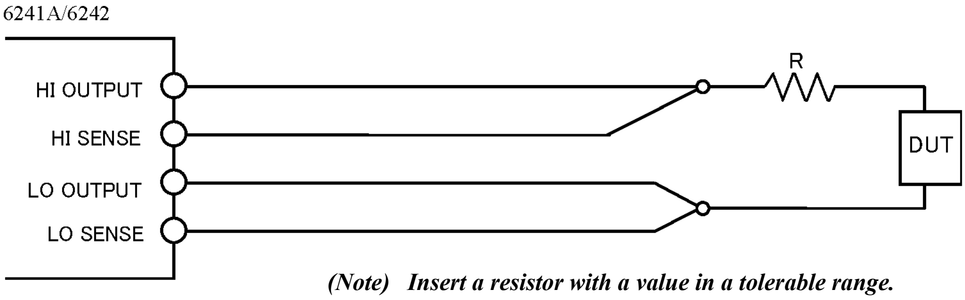


Figure 5-4 Preventing Device Oscillation

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



(Note) Insert a resistor with a value in a tolerable range.

Figure 5-5 6241A/6242 Oscillation Countermeasures

5.1.4 Connection for High Current Measurement

Be sure to use a 4-wire connection to measure the 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 over-shoot and response-delay 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 a shielded cable for measuring the current 1 µA or below.

For the OUTPUT cable, use ones that are thicker than listed wire thickness below, and the voltage difference between **OUTPUT** and **SENSE** must be 1.0 V or below for both Hi and Lo.

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

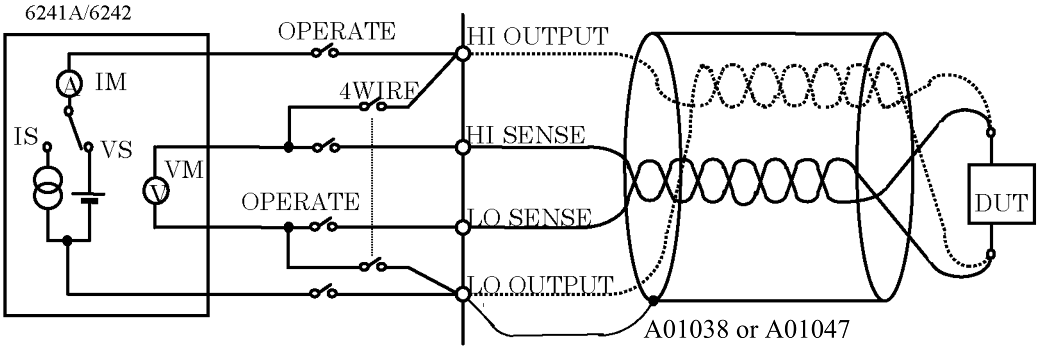


Figure 5-6 Connection for High Current Measurement

Table 5-1 Tolerable Current and Wire Thickness

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

5.1.5 Connecting with the Fixture 12701A

Figure 5-7 shows the connection with the 12701A.
The 4-wire connection is used.
The 2-wire connection does not require the SENSE connection.
For more information on the device connection inside the 12701A, refer to 12701A Instruction Manual.

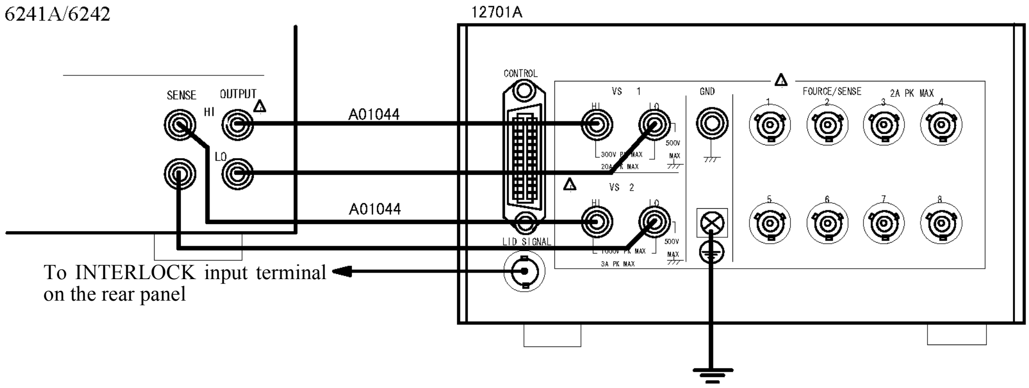


Figure 5-7 Connection with the 12701A

CAUTION: Follow the procedure below to prevent electric shock.

1. ***Be sure to ground the 12701A protective ground terminal*** ⏚ ***.***
2. ***Connect 12701A LID SIGNAL to the INTERLOCK terminal at the 6241A/6242 rear panel, and set the parameter "OPR Signal" to InterLock In.***
   This enables the Interlock function, and the 6241A/6242 is set to Standby status when the 12701A cover is released.

5.2 Functions in Detail

5.2.1 DC Source Mode Operation

Table 5-2 below shows DC source mode operation.

Table 5-2 DC Source Mode Operation (1/2)

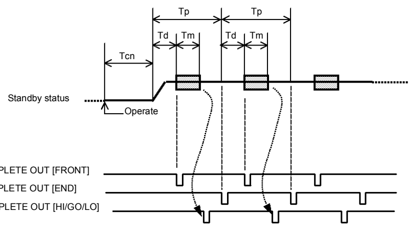
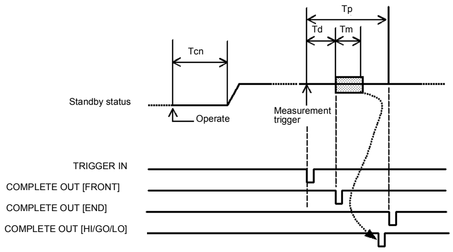
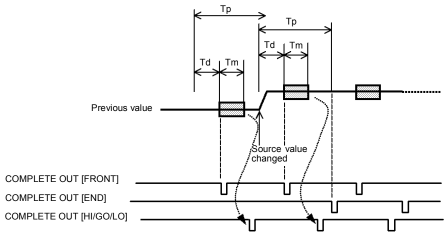
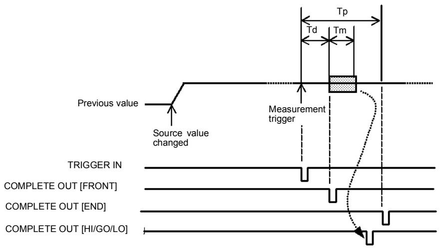
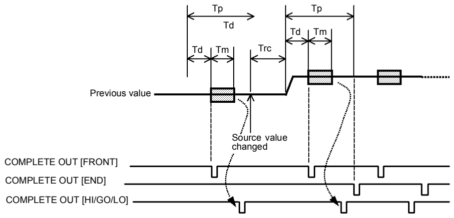
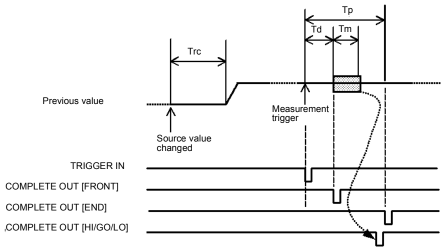
Operational condition	Trigger mode	Explanation	Operation	Remarks
Operate ON	AUTO	Executes consecutive measurement with the set period time Tp.		Tp: Period Time Td: Measurement Delay Time Tm: Measurement Time (Integration time + Measurement data processing time) Tcn: Operation Processing Time
	HOLD	Executes measurement after trigger input.		
Source value changed	AUTO	Changing source value does not induce changing range.		
	HOLD			

Table 5-2 DC Source Mode Operation (2/2)

Operational condition	Trigger mode	Explanation	Operation	Remarks
Source value changed	AUTO	Changing source value induces changing the range.		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. Trigger Mode is AUTO

- The measurement repeats itself in the specified length of the period.
- If the measurement does not finish in the specified period, the period time is extended and TpALM indicator illuminates.

b. Trigger Mode is HOLD

- Measurement starts after the measurement delay time has passed after trigger input.
- Ignores the trigger which is input during the measurement.

c. Standby or Suspended status

- During Standby or Suspended, it does not measure.

5.2.2 Pulse Source Mode Operation

Table 5-3 below shows pulse source mode operation.

Table 5-3 Pulse Source Mode Operation (1/2)

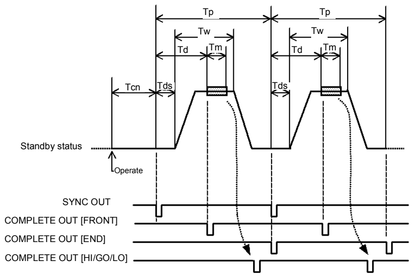
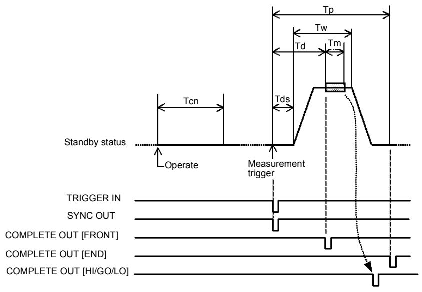
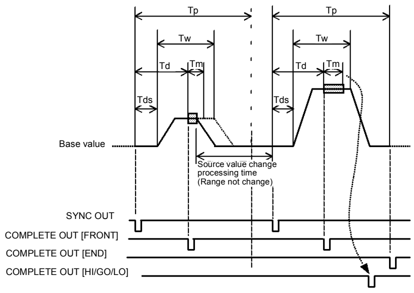
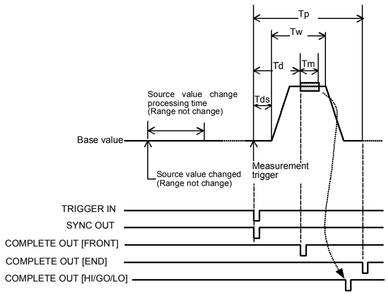
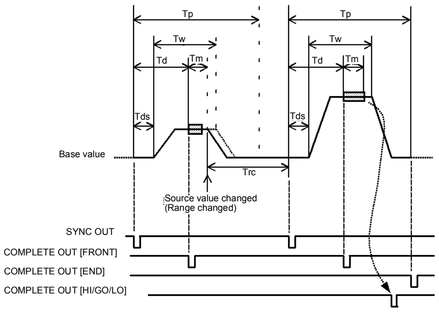
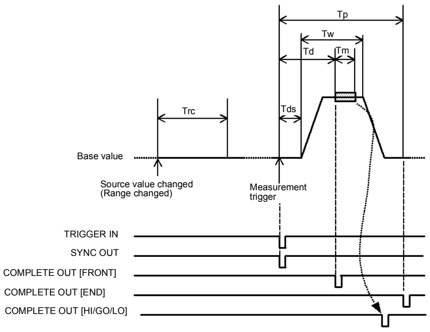
Operational condition	Trigger mode	Explanation	Operation	Remarks
Operate ON	AUTO	Executes consecutive measurement with the set period time Tp.		Tp: Period Time Td: Measurement Delay Time Tds: Source Delay Time Tm: Measurement Time (Integration time + Measurement data processing time) Tcn: Operation Processing Time Trc: Range Change Processing Time
	HOLD	Executes measurement after trigger input.		
Source value changed	AUTO	Changing source value does not induce changing range.		
	HOLD			

Table 5-3 Pulse Source Mode Operation (2/2)

<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Explanation</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Source value changed</td><td>AUTO</td><td rowspan="2">Changing source value induces changing the range.</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>

a. Trigger Mode is AUTO
- The measurement and pulse period are repeated in the specified length of period.
- If the measurement does not finish in the specified period, the pulse width does not change but the pulse period is extended and TpALM indicator illuminates.
- If a source or base value during pulse generation is changed, it stops pulse generation and generates a new pulse with a new base value and source value.

b. Trigger Mode is HOLD
- Measurement starts after the time length from trigger input to the measurement delay time has passed.
- It ignores the trigger input during the period time.
- If trigger is input during range change processing, pulse is generated after range change processing is completed.

c. Pulse source operation after Operate and changing range
- If it is Operate, pulse generation starts after Operate is processed.
- If the source-change entails the range-change, base and pulse values are set at the same range.

d. Standby or Suspended status
- During Standby or Suspended, it does not measure.

5.2.3 Sweep Source Mode Operation

Table 5-4 below shows sweep source mode operation.

Table 5-4 Sweep Source Mode Operation (1/2)

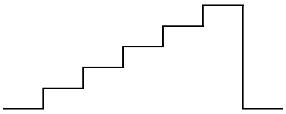
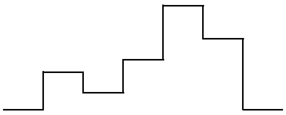
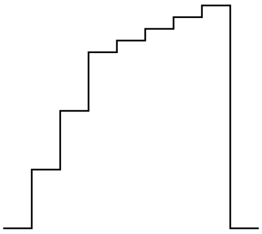
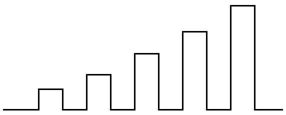
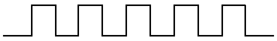
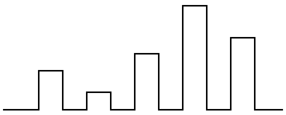
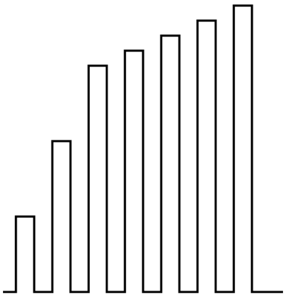
Sweep types		Operation	Waveform
DC Sweep	Linear Sweep	Sweeps with step value staircase wave between the designated start value and stop value.	
	Fixed Sweep	Sweeps specified times of sample counts with specified constant value.	
	Random Sweep	Sweeps the stored source value from the specified starting address to the stop address.	
	Two-slope Linear Sweep	Initially, sweeps the Step 1 value staircase waveform between the designated first value and middle value. Then, sweeps the Step 2 value staircase waveform between the designated middle value and last value.	

Table 5-4 Sweep Source Mode Operation (2/2)

Sweep types		Operation	Waveform
Pulse Sweep	Linear Sweep	Sweeps with a step value staircase waveform pulse-wave between the designated start value and stop value.	
	Fixed Sweep	Sweeps specified times of sample counts with a pulse wave using a specified constant value.	
	Random Sweep	Sweeps the stored source value with a pulse wave from the specified starting address to the stop address.	
	Two-slope Linear Sweep	Initially, sweeps the Step 1 value staircase waveform pulse-wave between the designated first value and middle value. Then, sweeps the Step 2 value staircase waveform pulse-wave between the designated middle value and last value.	

1. Setting up Sweep Type:
   - Select ***DC-SWP*** for DC Sweep and ***PLS-SWP*** for Pulse Sweep by using **MODE** key.
   - Select the item ***B) SWEEP*** by using **MENU** key.
     Select from ***1) Sweep types***; ***Linear*** for Linear Sweep; ***Fixed*** for Fixed Sweep; ***Random*** for Random Sweep, or ***Linear2*** for Two Slope Linear Sweep.

2. Changing Sweep Measurement Parameter

   Sweep measurement parameter is basically changeable only in Standby or Suspend status, but the following items are changeable in Sweep stop status during operation.

   - Time parameter
     - Hold time
     - Source delay time
     - Measurement delay time
     - Pulse width
     - Period time
   - Random-sweep Start-address and Stop-address

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

3. Indicator Display for Sweeping Status

   ⊗ indicates sweeping status is on.

   Sweeping: The indicator rotates.
   HOLD: Indicator stops rotation but remains displayed.
   STOP: Indicator is not displayed.

5.2.3.1 DC Sweep Source Mode Operation

Table 5-5 below shows the DC sweep source mode operation.

Table 5-5 DC Sweep Source Mode (1/2)

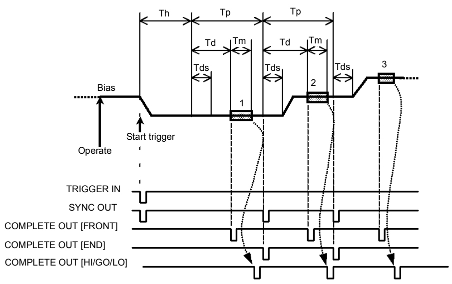
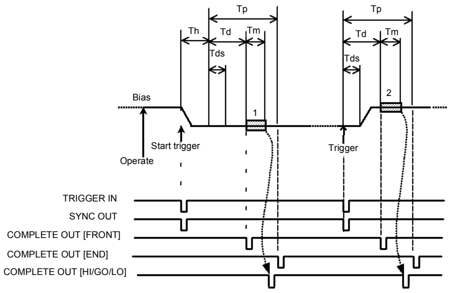
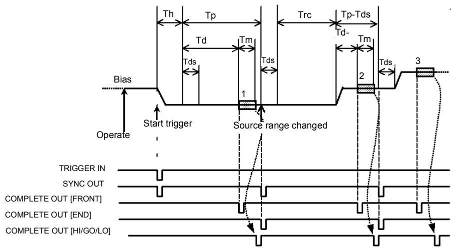
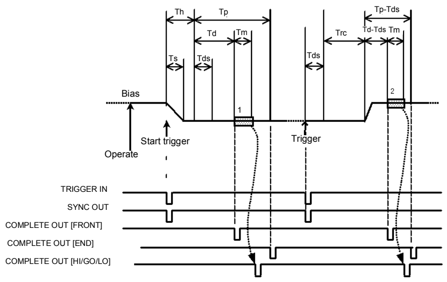
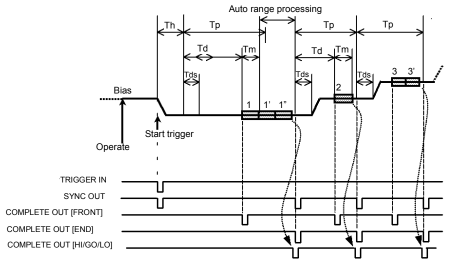
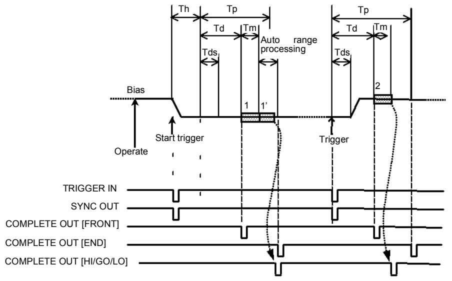
Operational condition	Trigger mode	Explanation	Operation	Remarks
Operate ON	AUTO	Executes consecutive measurements with the set period time Tp.		Th: Hold Time Tp: Period Time Td: Measurement Delay Time Tds: Source Delay Time Tm: Measurement Time (Integration time + Measurement data processing time) Tcn: Operation Processing Time Trc: Range Change Processing Time
	HOLD	Executes measurement after trigger input.		
Change the source range	AUTO	Source range changed while sweeping.		
	HOLD			

Table 5-5 DC Sweep Source Mode (2/2)

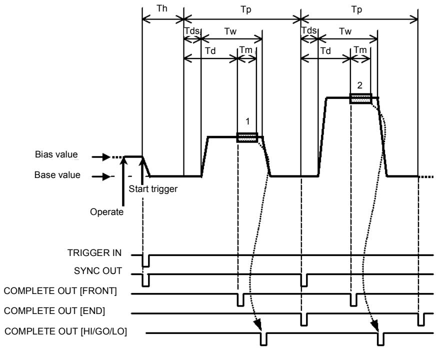
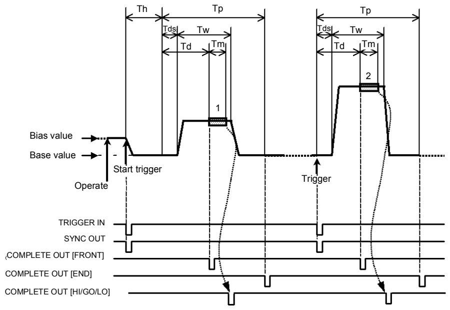
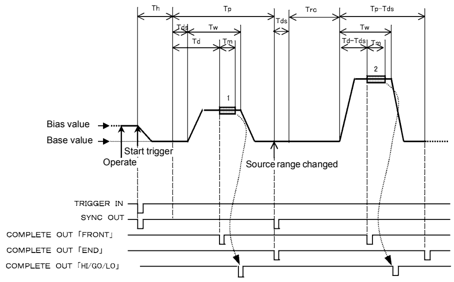
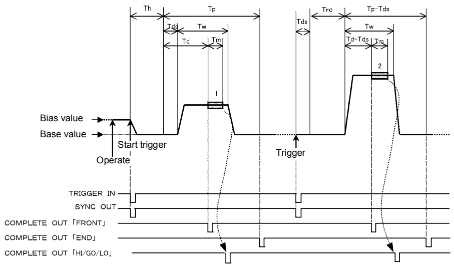
Operational condition	Trigger mode	Explanation	Operation	Remarks
Measure-ment range changed	AUTO	Measurement range changes while sweeping		Th: Hold Time Tp: Period Time Td: Measurement Delay Time Tds: Source Delay Time Tm: Measurement Time (Integration time + Measurement data processing time) Tcn: Operation Processing Time Trc: Range Change Processing Time
	HOLD			

- The output value before sweeping starts is a bias value.
- When start trigger is input, the start value is output.
- When the Hold time passes after the start trigger, sweeping starts.
- If trigger mode is AUTO, sweep step changes after the period time. However, if measurement has not completed, the next step is delayed until the measurement is completed.
- If the trigger mode is HOLD, sweep step is enabled whenever the trigger is input.

5.2.3.2 Pulse Sweep Source Mode Operation

Table 5-6 below shows the pulse sweep source mode operation.

Table 5-6 Pulse Sweep Source Mode Operation

Operational Condition	Trigger Mode	Explanation	Operation	Remarks
Operate ON	AUTO	Executes consecutive measurements with the set period time Tp.		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
	HOLD	Executes measurement after trigger input.		
Change the source range	AUTO	Source range changed while sweeping.		
	HOLD			

For more information on the operation, refer to Section 5.2.3.1, “DC Sweep Source Mode Operation.”

5.2.3.3 Random Sweep and Random Pulse Sweep

The Random Sweep function sweeps the source value stored in the random memory from specified Start address to Stop address.

The memory can store optional values. Therefore, it can generate the function wave.

As Random Pulse Sweep shares the memory, whether to generate DC wave or Pulse wave is selectable. Figure 5-8 below shows this relation.

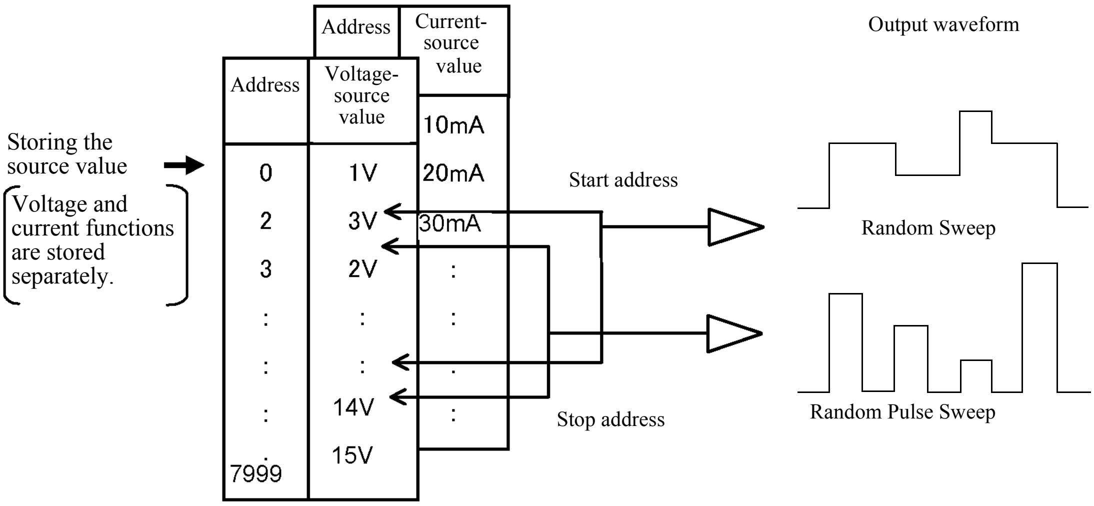


Figure 5-8 Random Sweep and Random Pulse Sweep

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

5.2.3.4 Two Slope Linear Sweep

The Two Slope Linear Sweep initially sweeps the Step 1 value staircase waveform (staircase waveform pulse-wave) between the designated first value and middle value. Next, it sweeps the Step 2 value staircase waveform (staircase waveform pulse-wave) between the designated middle value and last value.

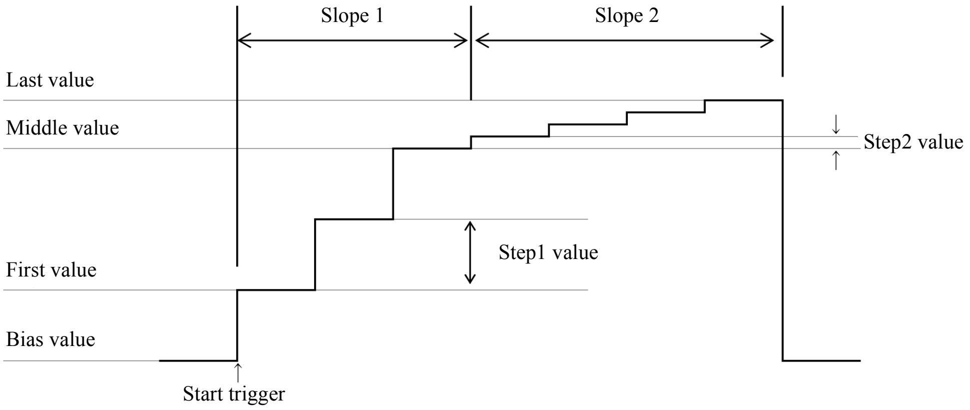


Figure 5-9 Two Slope Linear Sweep

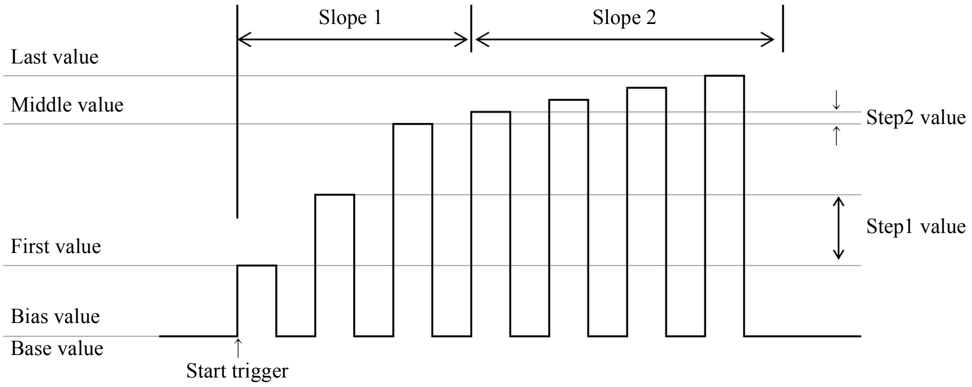


Figure 5-10 Two Slope Linear Pulse Sweep

5.2.3.5 Reverse Function

Switches between one way sweep and round sweep by switching Reverse ON and OFF.

Reverse OFF:	One way sweep
Reverse ON:	Round sweep

Table 5-7 Reverse Operation at DC Sweep

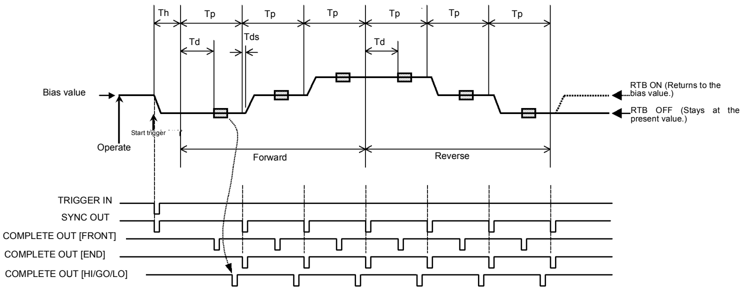
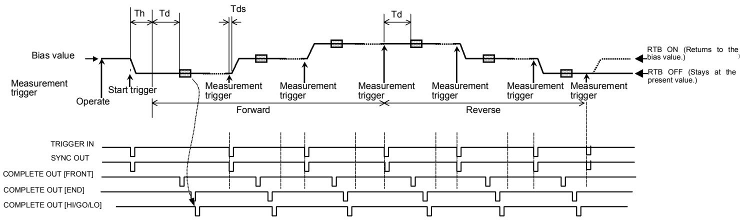
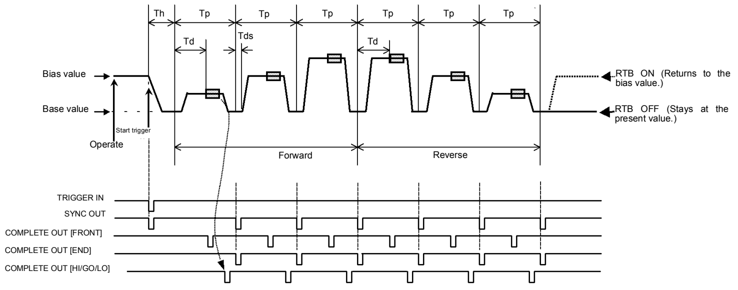
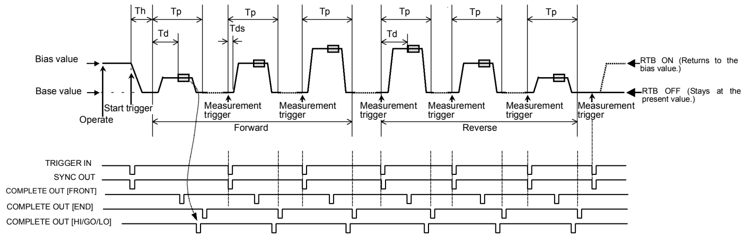
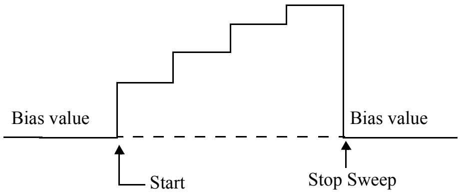
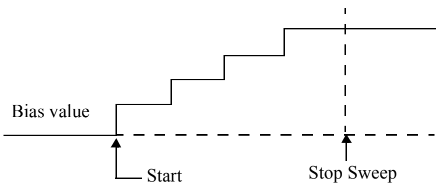
Operational condition	Trigger mode	Operation	Remarks
DC Sweep	AUTO		Th: Hold Time Tp: Period Time Td: Measurement Delay Time Tds: Source Delay Time Tm: Measurement Time (Integration time measurement: Processing Time) Tcn: Operation Processing Time Trc: Range Change Processing Time
	HOLD		

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: Processing Time) Tcn: Operation Processing Time Trc: Range Change Processing Time
	HOLD		

5.2.3.6 RTB Function

RTB setting switches the output value in sweep stop.

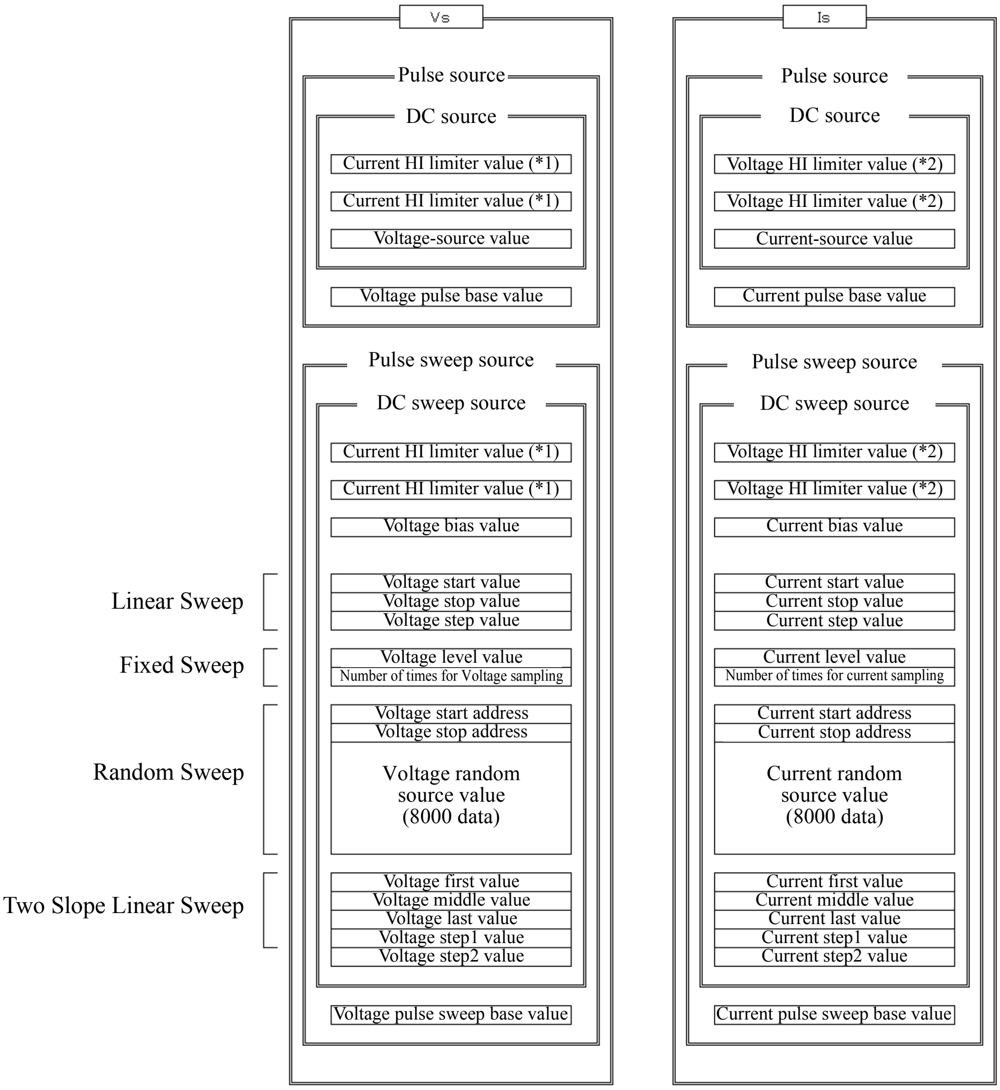
RTB	Waveform	Operation
ON		Return to bias value when sweeping stops.
OFF		Stays as the final output value when sweeping stops.

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 setting parameters related to source.



(*1) (*2): Shared by DC, Pulse, DC sweep , and Pulse sweep.

1. For DC or Pulse source, Vs and Is parameters can be changed regardless of the functions currently set.
2. For DC Sweep or pulse sweep source, only function parameters currently set are changeable.

5.2.4.2 Restrictions on Changing Source Function

Changing the source function has the following restrictions:

1. While operating with DC and Pulse source, changing Vs or Is causes Suspend status.
2. It is impossible to change Vs or Is when the source mode is set to sweep during Sweep. They can be only changed when sweeping is stopped. Suspend status is set when Vs or Is is changed.

5.2.4.3 Source Range

1. Source Range
    - The unit outputs DC source and Pulse source mode source-value (pulse value) in the displayed range.
    - Sweep-range auto- or fix-setting decides the range of bias, base, start, and stop values of sweep source mode as in the list below, regardless of the set or displayed value. Set the sweep range according to item ***B) SWEEP***, ***2) SWP Range*** in 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. The Range a source value is set in (Sweep range is Auto)
   - 6241A

Source function	Setting value	Range set
Voltage-source	0 mV ≤ |Vs| ≤ 320.00 mV	300 mV
	320.00 mV < |Vs| ≤ 3.2000 V	3 V
	3.2000 V < |Vs| ≤ 32.000 V	30 V
Current-source	0 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
	320.00 mA < |Is| ≤ 500.00 mA	500 mA

   - 6242

Source function	Setting value	Range set
Voltage-source	0 mV ≤ |Vs| ≤ 320.00 mV	300 mV
	320.00 mV < |Vs| ≤ 3.2000 V	3 V
	3.2000 V < |Vs| ≤ 06.000 V	6 V
Current-source	0 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
	320.00 mA < |Is| ≤ 3.0000 A	3 A
	3.0000 A < |Is| ≤ 5.0000 A	5 A

3. Operational Range 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, “DC Sweep Source Mode” or Table 5-6, “Pulse Sweep Source Mode Operation.”
   If the period time is extended, TpALM indicator illuminates.

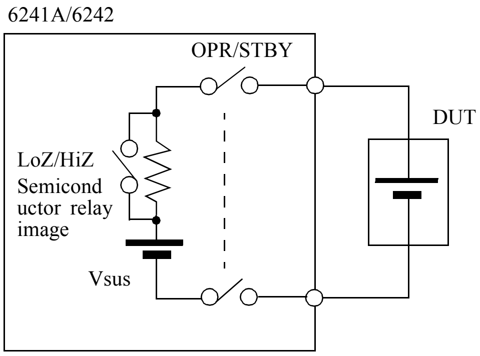
5.2.4.4 Suspend Function

The 6241A/6242 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 action, which reduces deterioration of the throughput due to relay operation time and improves the life span of the relay.

Therefore, setting in Suspend status is recommended whenever turning OFF the output to change the measurement condition.

Figure 5-11 below shows a conceptual diagram of output status.



Vsus: Output voltage in Suspend

LoZ/HiZ: Switches output resistor in Suspend

OPR/STBY: Switching relay between Operate and Standby

Output OFF status	Output relay	Output status	Current-limiter set value
LoZ	ON	Vsus, low resistance	VS: Set current-limiter (I_L) IS: 30 digits from the current setting range
HiZ	ON	Vsus, high resistance	300 nA
STBY	OFF	Open	-

Figure 5-11 Concept of Output Status

1. Operation
    1. Standby status

       Press **STBY** to set Standby status.
       Securely isolates the DUT.
    2. HiZ Suspended status

       Press **SUSPEND (SHIFT, OPR)** to set Suspended status. OPR indicator blinks. This is the status for LoZ/HiZ switch OFF with OPR/STBY relay ON.

       Suspend status outputs Vsus voltage in Vs status regardless of Vs/Is output status.

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

       Operation is as follows during Operate ON.

       Vs setting: Vsus → Vs output

       Is setting: Vsus → Is function → Is output
    3. LoZ Suspended Status

       Same status as HiZ Suspend except the output is in low resistance status.

       Effective to set the DUT in low impedance when the output is OFF.

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

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

       Therefore, HL or LL indicator might illuminate depending on the load status.
2. Setting Suspend Conditions
    1. Sets suspend voltage

       Select and set “A) SOURCE” → “2) Suspend V” on the Menu screen.

       The voltage range of Suspend voltage is the same as that for the voltage source function.
       However, if the Suspend voltage is a value that cannot be set in the source-voltage range, then the new range is set, and the range change occurs even in Operation.

       Some examples for the above explanation are shown below.
       (Values separated by a slash (/) are values for 6241A/6242, respectively.)

Source function	Sets suspend voltage	Source range	Suspend voltage range	Changing source range
Vs	0 V	300 mV	300 mV	No
	10 V/5 V	3 V	30 V/6 V	Yes
	10 V/5 V	30 V/6 V	30 V/6 V	No
Is	0 V	3 mA	300 mV	Yes
	10 V/5 V	500 mA	30 V/6 V	Yes

2. Setting Output Resistance in Suspend

   Select and set "A) SOURCE" → "3) Suspend Z" on the Menu screen.

   HiZ: High resistance output status. Current-limiter is set to 300 nA.

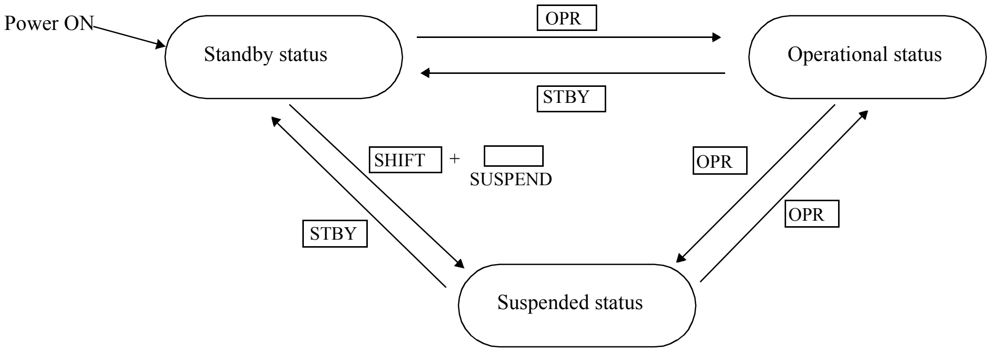
   LoZ: Low resistance output status.

   Vs: Sets current-set limiter value.

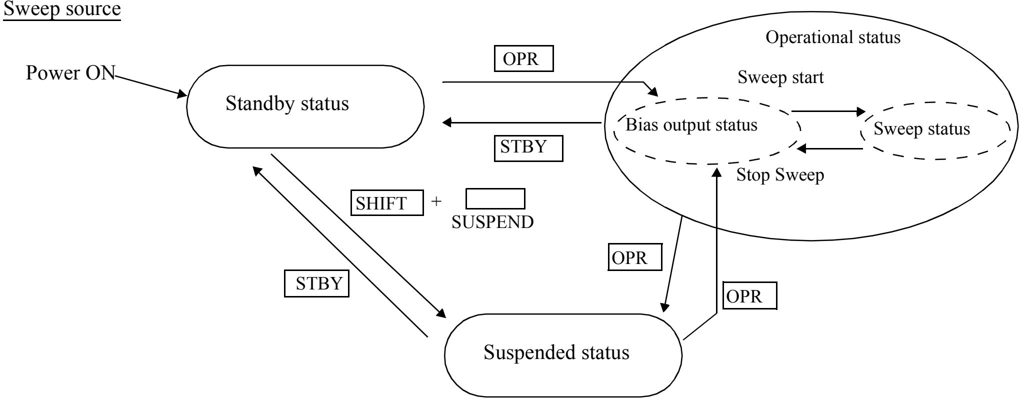
   Is: 30 digits of Is range.

3. Shifting between Operate, Standby, and Suspend

DC source/Pulse source



Sweep source



NOTE: ***The source data while sweeping 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 voltage-source function, the resistance value is displayed by measuring current.

   For current-source function, the resistance value is displayed by measuring the voltage.

   For more information on resistance value calculation in the case of pulse source mode, refer to Section 5.2.5.3, “Measurement Delay Time and Measurement Value.”

In one mode, the measurement function can be selected independently from the source function. In another mode, the linked measurement function is set according to the source function.
Use **E) MEASURE** or **6) Mfunc Link** to change the mode.
If the linked mode is set, when the source function is changed, the measurement function changes as follows:

- Voltage source function / current measurement function VsIm
- Current source function / voltage measurement function IsVm

Immediately after the linked mode is set, the measurement function changes according to the current source function setting, as shown above.

NOTE: The resistance measurement function shows the following messages if it can not normally calculate the resistance value.

Count Few: The source current 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

Measurement range is determined by the relationship between 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 source range	Fixed to limiter range	Fixed to source range	○
Current-source	Fixed to limiter range	Fixed to source range	○	Fixed to source range

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

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

---

1. Operating Range for 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.

   - 6241A

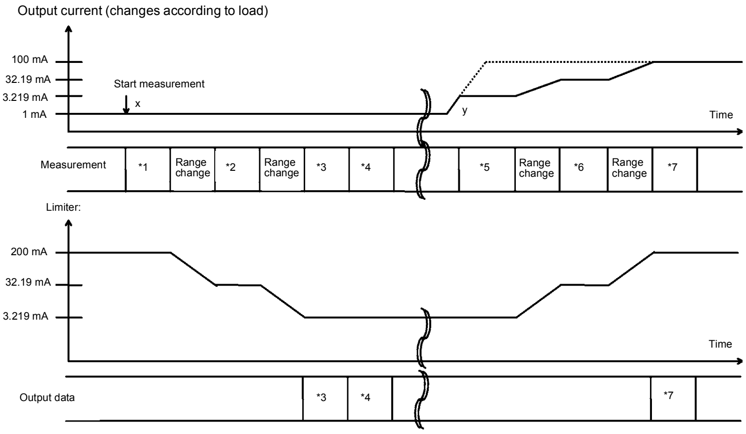
Measurement function	Range	Auto range level	
		DOWN	UP
Voltage-measurement	300 mV	-	321.000
	3 V	0.29999	3.21000
	30 V	02.9999	-
Current-measurement	30 µA	-	32.1000
	300 µA	029.999	321.000
	3 mA	0.29999	3.21000
	30 mA	02.9999	32.1000
	300 mA	029.999	321.000
	500 mA	299.999	-

- 6242

Measurement function	Range	Auto range level	
		DOWN	UP
Voltage-measurement	300 mV	-	321.000
	3 V	0.29999	3.21000
	6 V	02.9999	-
Current-measurement	30 µA	-	32.1000
	300 µA	029.999	321.000
	3 mA	0.29999	3.21000
	30 mA	02.9999	32.1000
	300 mA	029.999	321.000
	3 A	0.29999	3.01000
	5 A	2.89999	-

2. Measurement Auto Range for the DC Source Mode

   This section describes how DC-source-mode-measurement-range and the limiter-range operate using the following diagram examples.
   The current-limiter setting is 200 mA. After measuring 1 mA, the example below measures 100 mA.



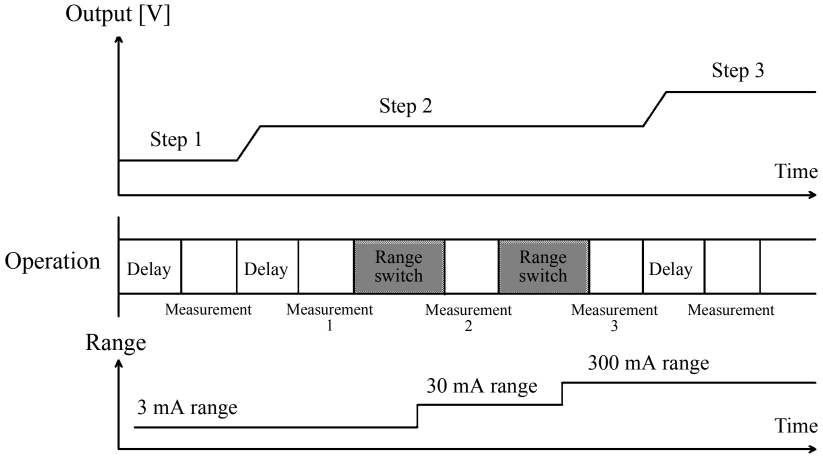
While the measurement auto range is enabled, it measures by changing the limiter value to be larger than the full scale of the measurement range.

- For *1, the measurement result with 300 mA range is 1 mA, and the auto range changes the range. As a result of the range change to 30 mA, the auto range changes the limiter to the maximum value for the 30 mA range (32.19 mA).
- For *2, the measurement result with the 30 mA range is 1 mA, the auto range changes the range and then the limiter changes to 3.219 mA.
- For *3, measuring with the 3 mA range outputs 1 mA measurement data.
- The output current changes to 100 mA at Point y, but the limiter is 3.219 mA and the output current is limited to 3.219 mA.

- For *5, measuring with 3 mA range results in a 3.219 mA measurement value. This is over range (over 3.2 mA), and the auto range changes the range.
  Changing the range results in a 30 mA range, and the limiter is also changed to 32.19 mA.
- For *6, measuring with 30 mA range results in a 32.19 mA measurement value. This is over range, and the range is changed further.
  Although changing the range results in 300 mA, this range is set to the value compliant with the preset 200 mA value.
- For *7, measuring with the 300 mA range results in 100 mA and it is output as the output data.

3. The measurement auto range while sweeping

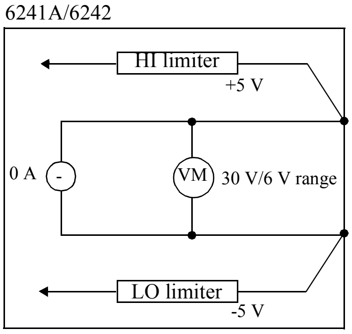
   While sweeping, measurements are performed in each step. If the measurement range is set to auto range, auto ranging continues until measurement data is determined in each step.



4. Measuring an External Power Supply with Current-source voltage-measurement (ISVM)

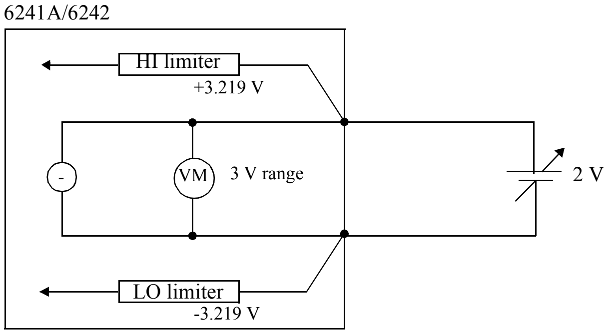
   When an external voltage is measured with Auto range by following the procedure below, Auto range detects overload (OVL) and sets the Standby status.

   1. Set the current-source to 0 A and the limiter voltage to ±5 V.



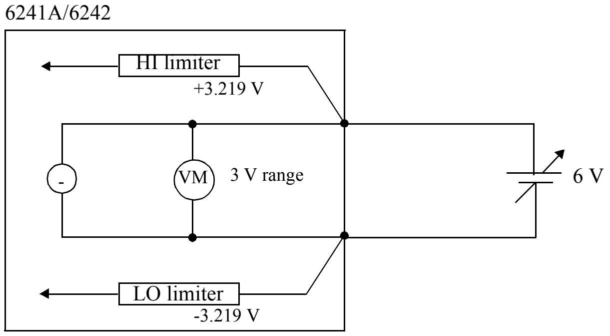
   The VM (voltage-measurement) range at ISVM (Current-Source Voltage Measurement) is set to the same value as the range of the voltage-limiter.

   2. Connect the external power supply at 2 V.



   The 2 V connection causes Auto range to set the measurement range to 3 V. Then the voltage-limiter is also changed to the 3 V range. Therefore, the internal value ±3.219 V is set.

3. Increase the external power supply to 6 V.



With the measurement auto range function, before the range is increased, the following formula,
HI limiter value < external power supply,
causes it to detect the voltage overload and sets Standby.

The operation above is unavoidable in principle.

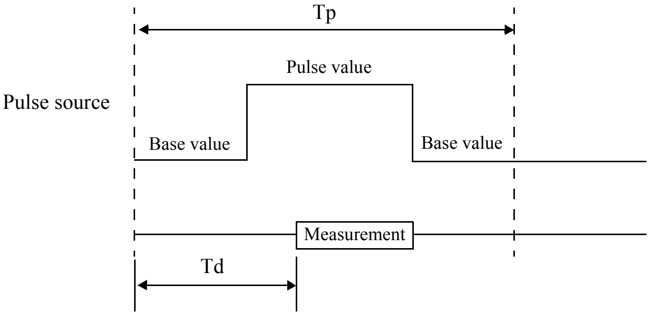
For using the unit in the above condition, do not use the measurement auto range.

NOTE:

1. ***In the current-source function, apply an external VB voltage within the voltage limiter range.***
   $V_{LL} < VB < V_{HL}$
   If exceeding the limiter range, an overload (OVL) is detected and Standby is set.
2. ***For measuring an external voltage supply, measure with the fixed range.***
   When Auto range measures an external voltage, an external voltage change sets overload (OVL).

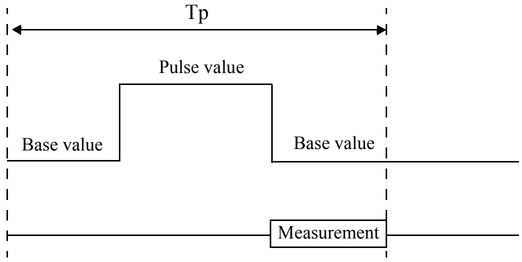
5.2.5.3 Measurement Delay Time and Measurement Value

1. Measuring with Pulse Value Timing



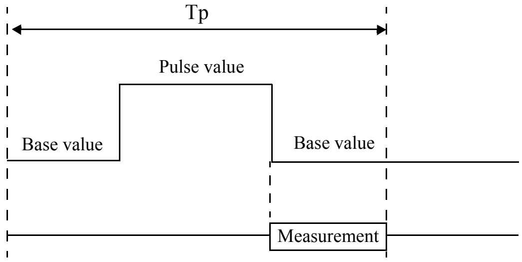
When displaying the resistance value, the calculation is made by the measurement value and pulse value.

2. Measuring with Base Value Timing



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

3. Measuring at the Timing Overlapping with Pulse Value and Base Value



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

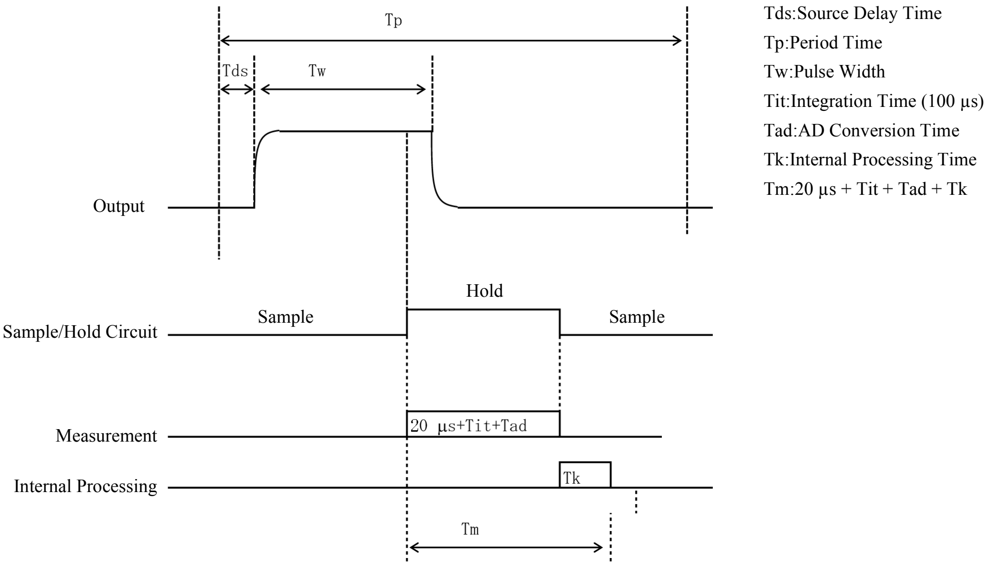
5.2.5.4 Measuring in Sample Hold Mode

Sample hold mode can be set only if the source mode is Pulse mode or Pulse Sweep mode. Set this mode using the integral 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.



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

Figure 5-12 Measuring in Sample Hold Mode

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

- Sample hold mode is released when the source mode is changed to DC mode or DC sweep mode, and the integral time parameter becomes 100 μs. To use the sample hold mode again, set the integral time parameter to sample hold mode.
- In the sample hold mode, the period time setting range is 500 μs to 600 ms. An error message appears and measurement does not start if the value is set out of range. Verify the setting range.
  - An attempt was made to switch from Standby to Operate/Suspend.
  - The period time was changed in Operate/Suspend status.

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

5.2.5.5 Auto Zero Function

The 6241A/6242 has a function for canceling Offset Drift of the AD converter. This “Auto Zero function” periodically measures 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 Operation is set to Burst-ON.)
- When the integration time is changed.

NOTE: When Auto Zero is enabled in Pulse source mode or pulse sweep mode, it generates a base value until it is complete.
Therefore, the time length for outputting the base value is extended. If it is inconvenient, set the Auto-zero function to OFF.

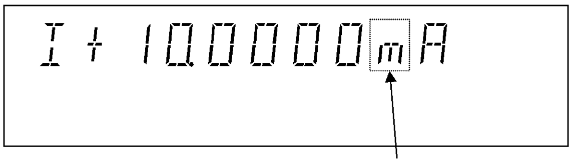
5.2.5.6 Switching Unit Display

Select and set the items, “E) MEASURE ”→“5) Disp Unit” on the Menu screen.

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

Exponent: Displays measurement data in exponential form.

1. Display 10 mA with Prefix



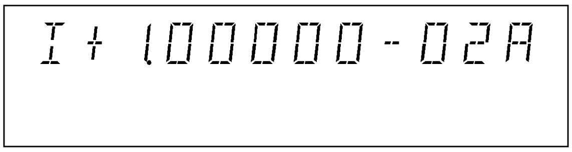
Prefix of the unit

Table 5-9 shows the relation between prefix of the unit and digit (exponent).

Table 5-9 Relation between Prefix of the Unit and Digit

Prefix of the Unit	Pronunciation	Exponent display
Y	Yota	10^{24}
Z	Zeta	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



Decimal point is always after the first digit.
The unit is V or A.

5.2.6 Limiter (Compliance)

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

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

The 6241A/6242 limiters for both voltage and current have both HI and LO limiters and they can be set individually.

For the voltage-limiter, both HI limiter and LO limiter can set not only bipolar, + /- but also homo-polar, + / +, or -/-.

NOTE: ***When an external power supply (V_B), such as a battery is connected in the current source function, set the voltage-limiter value (V_{HL}, V_{LL}) in the following range against V_B.***
$V_{LL} < V_B < V_{HL}$
If set outside the above range, the 6241A/6242 sets overload (OVL) and then Standby.

5.2.6.1 Limiter Setting Ranges

The limiter value can be set with the following conditions.

60 digits ≤ (HL value -LL value)

NOTE:

1. ***Set the current-limiter as high as possible within the required range.***
   The lower the current-limiter is, the longer the settling time is.
2. ***Set the voltage-limiter as low as possible within the required range.***
   For cases where current cannot be applied to a loaded sample of DUTs, or the output terminal is open, the output voltage reaches to the voltage limiter.

5.2.6.2 Setting the Limiter

1. Setting Types

   Two types of limiter settings are available; one is ±Balance setting. This sets the same absolute value on the bipolars, + and -; the other is Separate setting. This sets different value on each polarity.

   For more information on these settings, refer to Section 2.2.2, “Setting Limiter Value.”

2. Set Range

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

   The set values are set in the optimal range.

3. Separate Setting Operation

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

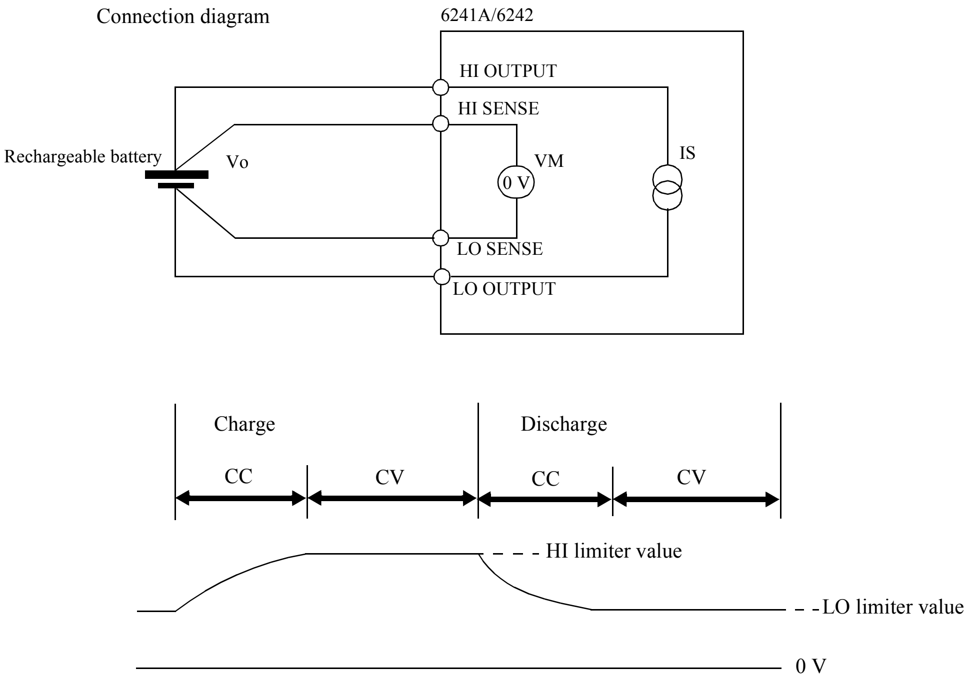


Figure 5-13 Rechargeable Battery Charge and Discharge Operations

Setting the HI limiter value for constant voltage charging, and the LO limiter value for discharging termination voltage, provides CV/CC operation as in Figure 5-13.

NOTE: ***From an external device applying higher voltage than the HI limiter value or lower voltage than the LO limiter value sets overload (OVL) and then Standby.***
For example, connecting a battery of lower voltage than LO limiter 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 measured data when detecting the limiter.
HL and LL indicate that the unit is currently detecting the limiter.
The following table shows a relation between limiter detection timing and Display/Remote outputs.

Display	Remote outputs		Buzzer
	Sub header	Status	
LMT	○	×	×
HL, LL	×	○	○

5.2.7 Alarm Detection

The following alarm detective function is available to help prevent damage to the 6241A/6242 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, error register, and measurement data header.
Table 5-10 below shows the messages and their descriptions and causes.

Table 5-10 Alarm Detection Contents

Message	Description	Cause
Source Unit	Source unit malfunction	Malfunction
Fan Stop	Fan stopped	Malfunction
Over Heat	Overheat (Internal over heat)	• Malfunction • Sink operation outside the specified range • The vents are blocked. • Ambient temperature exceeds the specified range.
Over Load	Overload	• Over voltage applied from external device • Connecting to the external voltage source exceeded the voltage-limiter setting • If output sensing is 4-wire connection, LO OUTPUT and LO SENSE may occur in an open status.
LMT, HL/LL indicator	Limiter detected	The voltage or current-limiter is operating.

- When Source Unit or Fan Stop is generated, the output is placed in Standby and operation is not possible until the power is turned on again.
- When Over Heat is displayed, the output is placed in Standby (output OFF) and operation is not possible until the cause of the error is removed.
- When Over Load occurs, the output is placed in Standby.

5.2.8 Source Timing and Measurement Timing

The 6241A/6242'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 timings for source and measurement, and set the relevant parameters.

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

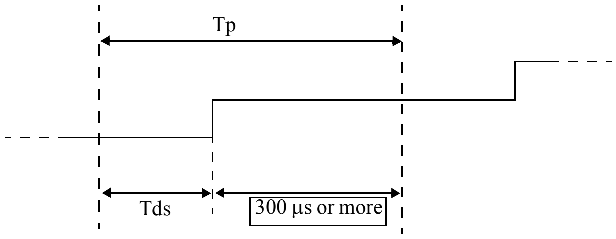
Source mode		Th	Tds	Td	Tw	Tp	Tm	Timing diagram
DC	Trigger mode AUTO			●		●	●	Table 5-2
	Trigger mode HOLD			●		●	●	
Pulse			●	●	●	●	●	Table 5-3
DC Sweep		●	●	●		●	●	Table 5-5
Pulse Sweep		●	●	●	●	●	●	Table 5-6

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

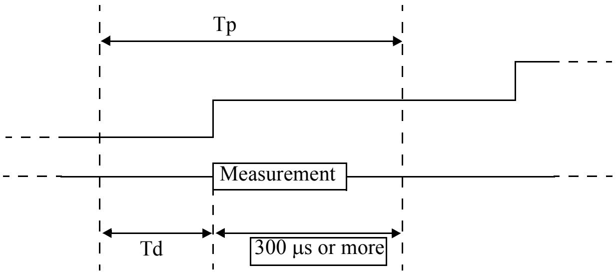
5.2.8.1 Restriction on Time Parameter

Time parameters have restrictions for setting in relation to the others. If the time parameters are set to exceed the restriction, the error messages are displayed when the operation is turned on or when sweep starts, and measurement does not start.

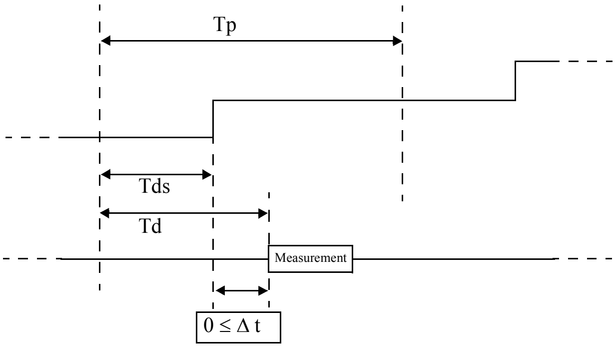
1. Restricted settings
   - Source delay time (Tds) + 300 μs < period time (Tp)



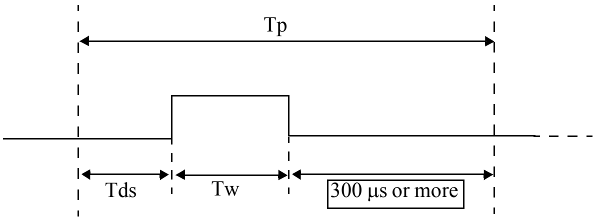
   - Measurement delay time (Td) + 300 μs < period time (Tp)



   - 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 setting restrictions and source mode

   The table below shows the relationship between the restrictions in section 1 above and the source mode.

Restrictions:	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 set time

   The source delay time, measurement delay time, and pulse width set resolution are determined by the period time resolution. The rounded off value is set as the resolution.

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

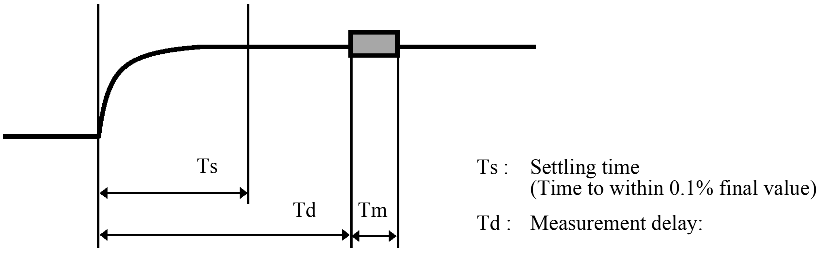
The following table shows rounded-off result and the minimum set value for each resolution.

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 illuminates. Auto zero may not execute in some cases.***

5.2.8.2 Measurement Delay and Settling Time

In Pulse source and Sweep source mode, the 6241A/6242 waits for a source value and the settling of a sample and then starts measurement.
This section describes the settling time of the 6241A/6242 and the measurement delay to be set.



Ts : Settling time
(Time to within 0.1% final value)

Td : Measurement delay:

1. Switching the settling time

   The settling time can be set to enhance the system throughput or to reduce noise and ensure stability with respect to L and C loads. Select and set **A) SOURCE → 5) Response** on the Menu screen.

   Fast : Fast mode

   Slow: Slow mode

2. For the voltage-source

   Settling time (Ts) of the 6241A/6242 is defined by the changes in voltage-source value (Vs), the current-limiter set value DIL (digit), and the settling time setting (Fast/Slow), as shown below.

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

   - Fast mode

     Current-limiter range is 300 μA to 500 mA
     Ts=50+(Vs × 30000/DIL) [μs]

     Current-limiter range is 30 μA
     Ts=(50+(Vs × 30000/DIL)) × 3 [μs]

     Current-limiter range is 3 A, 5 A
     Ts=(50+(Vs × 30000/DIL)) × 4 [μs]

   - Slow mode

     Current-limiter range is 300 μA to 500 mA
     Ts=300+(Vs × 100000/DIL) [μs]

     Current-limiter range is 30 μA
     Ts=(300+(Vs × 100000/DIL)) × 1.25 [μs]

     Current-limiter range is 3 A, 5 A
     Ts=(300+(Vs × 100000/DIL)) × 1.5 [μs]

   Example) Ts values when current-limiter range is 300 μA to 500 mA Units [μs]

Vs[V]	Current-limitter setting value DIL [digit]							
	500		1000		2000		3000	
	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
1	110	500	80	400	65	350	60	333
3	230	900	140	600	95	450	80	400
6	410	1500	230	900	140	600	110	500
10	650	2300	350	1300	200	800	150	633
30	1850	6300	950	3300	500	1800	350	1300

NOTE: 500 mA range is available for 6241A only. 3 A, 5 A ranges are available for 6242 only.

3. For the Current-source

   Settling time (Ts) of the 6241A/6242 is defined by the changes in 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.

Unit [µs]

Range	Fast	Slow
30 µA	Ts=(60 × VRL)/(Is × Rs)+200	Ts=(100 × VRL)/(Is × Rs)+300
300 µA to 300 mA	Ts=(16 × VRL)/(Is × Rs)+50	Ts=(60 × VRL)/(Is × Rs)+150
500 mA	Ts=(30 × VRL)/(Is × Rs)+80	Ts=(100 × VRL)/(Is × Rs)+200
3 A, 5 A	Ts=(10 × VRL)/(Is × Rs)+100	Ts=(20 × VRL)/(Is × Rs)+400

Rs value	
Range	Rs [Ω]
30 µA	22 k
300 µA	2.2 k
3 mA	220
30 mA	22
300 mA	2.2
500 mA	2.2
3 A	22 m
5 A	22 m

NOTE: 500 mA range is available for 6241A only. 3 A, 5 A ranges are available for 6242 only.

(Example) 3 mA range, slow mode, 1 mA current with 1 kΩ resistance

Is=1 mA
VRL=1 mA × 1 kΩ=1 V
Ts=(60 × VRL)/(Is × Rs)+150
Ts=(60 × 1 V)/(1 mA × 220 Ω)+150=422.7
Therefore,
Set as Td > 423 µs.

5.2.8.3 Integration Time and Measurement Time

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

Tm = Tit + Tk

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

Internal processing time (Tk) is shown below, in accordance with the source mode and the Memory store mode.

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

Also, when the Memory store mode is OFF and Normal-ON, the following processing times are added by NULL calculation, Scaling calculation, Max/Min calculation, and the Comparator calculation.

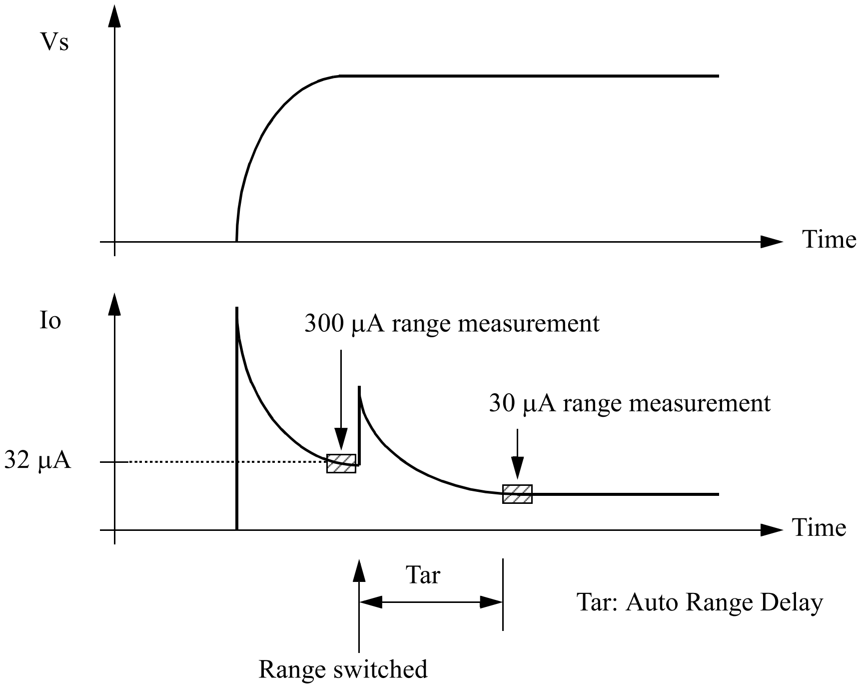
NULL calculation ON:	Approx. 0.2 ms
Scaling calculation ON:	Approx. 1 ms
Max/Min calculation ON:	Approx. 1 ms
Comparator calculation ON:	Approx. 15 ms
In measuring resistance:	Approx. 1 ms

(Example) When in the DC source mode, and Integration time: 1 PLC (50 Hz),
Memory Store: Normal-ON, NULL calculation: ON, Scaling calculation: ON,
Max/Min calculation: ON, Comparator calculation: ON
measurement time is 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

Used when measuring capacitive load (C_L) by voltage source current measurement (VSIM).

When measuring current in Auto Range by applying a voltage to C_L, after C_L is charged the current value drops and the measurement range decreases. This delay is applied when measuring current value fluctuations over time after the measurement range is switched.



The auto range delay function is enabled only in current measurement (IM) auto range.
The auto range delay function 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 30 μA range. For other ranges, the value is set in 1/10 multiples, as shown in the table below.

Measurement range	Setting value	Example
30 μA	Tar	500 ms
300 μA	Tar/10	50 ms
3 mA	Tar/100	5 ms
30 mA	Tar/1000	1 ms
300 mA or greater	0	0 ms

- Tar target

  Calculate the Tar setting using the expression below.

  $$\text{Tar} = \frac{C_L \times 50\ \text{mV}}{30\ \mu\text{A}} = 1500 \times C_L \qquad [\text{s}]$$

  (Example) If $C_L = 1\ \mu\text{F}$
  Tar = 1500 × 1 μ = 1.5 ms
  Set Tar = 2 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 data (Xnull)

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

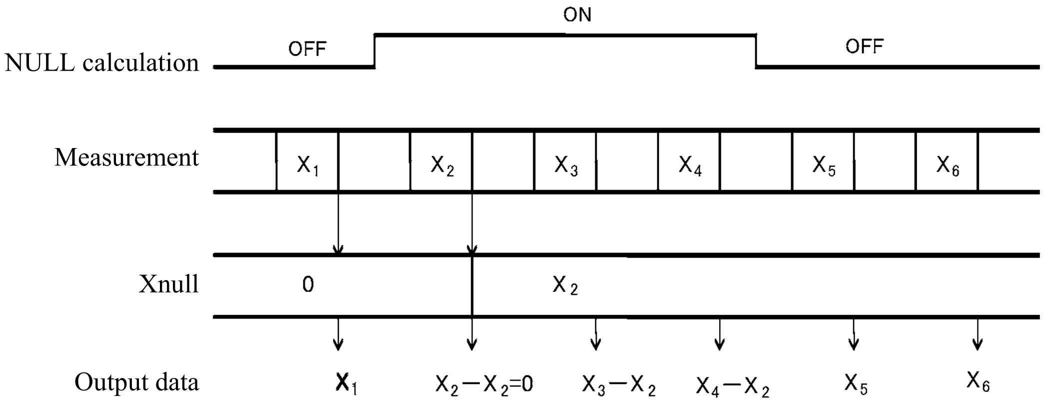


Figure 5-14 NULL Calculation Timing

- NULL indicator illuminates when NULL calculation is ON.
- Rewriting NULL data is performed when a NULL calculation is set to ON from OFF or when NULL calculation is initialized.
- If the measured value is over range data and NULL calculation is turned ON, the display shows Over Range, and the NULL value becomes the first data item after Over Range is released.
- If a NULL calculation result is over the full scale of the present measurement range, it displays up to the double value of the full-scale. However, ±999.9999 mA for current measurements in the 500 mA range using the 6241A; ±9.99999 A for current measurements in the 5 A range using the 6242.
- The calculation is turned OFF by changing the measurement function or executing the *RST command.
- NULL data can be changed while the NULL calculation is ON.
  Select and set items, ***I) CONST***, ***Null Value*** on the Menu screen.
  The range for setting is between 0 to ±999.999E + 24.

5.2.9.2 Scaling Calculation

1. Calculation expression

   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

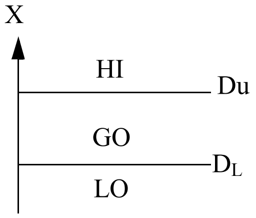
2. Operation
   - When Scaling calculation is ON, MATH indicator illuminates.
   - The set ranges of Constant A, Constant B, and Constant C are 0 to ±999.999E+24 (however, Constant A $\neq 0$).
   - If the calculation results exceed ±999.999E + 24, it is scaling-over and the error message ±SCL Over is displayed.
   - This function is turned OFF by executing the *RST command.
   - Changing the measurement function does not turn OFF this function.

5.2.9.3 Comparator Calculation

1. Calculation expression

   The result of a Comparator calculation is judged as shown below:

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

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

   - When the measurement data is over range, + data is judged as HI and - (negative) data is judged as LO.
   - Comparator calculation is executed for a NULL calculation result if the NULL calculation is ON. When the NULL calculation result data is over range, the judgment is HI if the calculation result is + and LO in case of -.
   - Because the internal measurement resolution and calculation resolution are smaller than the display resolution, the displayed data may be judged as HI, LO when $X = D_L$, $X = Du$ respectively.

2. Outputting Calculation Result

   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 the negative-pulse are output to the COMPLETE OUT output terminal on the rear panel.

3. Operation

   - All the ⬍ indicators illuminate when the Comparator calculation is ON. ▲, ■, or ▼ indicator illuminates depending on the calculation result of HI, GO, or LO.
   - The range between upper- and lower-limit is between 0 to 999.999E + 24.
   - This function is turned OFF by executing the *RST command.
   - Changing the measurement function does not turn OFF this function.
   - When the Comparator calculation result meets with the alarm condition, it buzzes. Select the items, ***M) SYSTEM***, ***2) Compare Buz*** on the Menu screen to set the alarm condition.

5.2.9.4 Max/Min Calculation

1. Calculation expression

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

2. Calculation result

   Select the items, ***H) COMPUTE***, ***4) View Mx/Mn*** on the Menu screen to refer to the results.

   1. Number of measurement times
   2. Maximum value
   3. Minimum value
   4. Average value
   5. Total value

3. Operation

   - The enabled data except for over range and error data is calculated.
   - It buzzes when the alarm setting is ON and the maximum value or minimum value is updated. However, it may buzz even when the displayed data does not change. This is because the measurement resolution is smaller than that of the display.
   - The calculation is turned OFF by changing the measurement function or executing the *RST command.
   - The calculation result is cleared and the calculation is restarted under the following conditions:

     1. Switching NULL calculation between ON and OFF
     2. Changing NULL data
     3. Switching Scaling calculation between ON and OFF
     4. Changing Scaling Constant

5.2.10 External Control Signals

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

Table 5-12 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	• Measurement start in the DC source mode • Pulse output in the Pulse source mode • Start in the Sweep source mode • Step-up
COMPLETE OUT *1	Output	TTL negative pulse (10 µs or more) *3	Approx. 100 Ω open drain (+5 V 10 kΩ pulled up)	• 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	• When this input signal is changed from “LO → HI”, the output becomes Standby. • When the signal is “HI” or Open, the output cannot be changed to Operate.
STBY IN *2				• When this input signal is changed from “LO → HI”, the output becomes Standby.
OPR/STBY IN *2				• When this input signal is changed from “LO → HI”, the output becomes Standby. • When this input signal is changed from “HI → LO”, the output becomes Operate.
OPR/SUS IN *2				• When this input signal is changed from “LO → HI”, the output becomes Suspend. • When this input signal is changed from “HI → LO”, the output becomes Operate.
OPERATE OUT *2	Output	TTL negative level *3	Approx. 100 Ω open drain (+5 V 10 kΩ pulled up)	• Outputs “LO” when Operate • Outputs “HI” when Standby or Suspend

For *1 and *2, the same terminal is used by switching.
*1: SYNC OUT signal is not generated in the DC source mode.
*3: The output signal pulse width can be set 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 in slave CH in the synchronized operation, TRIGGER IN signal controls the timing of source and measurement to synchronize with the external devices.
Confirm the following restrictions before inputting the external trigger to prevent malfunctions of source and the measurement.

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, the trigger from the TRG key, and Remote trigger (*TRG) do not overlap.
3. Restrictions on Pulse period setting value Tp and Hold time setting value Th
   When using the external trigger (TRIGGER IN signal) setting, pulse period Tp and Hold time Th are restricted (see Table 5-13 and Table 5-14).
4. Restrictions on the time Thp (ext) from Sweep-start to the next Trigger signal input
   Setting the time Thp (ext) from inputting Sweep-start trigger-signal to inputting the next step trigger signal is restricted for the sweep source (see Table 5-13 and Table 5-14).
5. Restrictions on the required time Top from specifying Operate to inputting the external trigger
   Minimum time is required for the time Top from specifying Operate by a remote command or an external signal (OPR In signal) to inputting the external Trigger (See Table 5-15).
6. Allow the 6241A/6242 at least 10 ms after completion of the previous Sweep to input sweep-start TRIGGER-IN signal.

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: Period setting time

Th: Hold setting time

Tp (ext): TRIGGER IN signal period time

Th (ext): TRIGGER IN signal Hold-time
(Time from inputting Sweep start trigger to generating start source value)

Thp (ext): Time from inputting Sweep start trigger to inputting a trigger for the next step source value

Top: Time from specifying Operate to inputting TRIGGER IN signal

*1: The approx. value calculating from Number of steps × 0.5 ms is added in the Sweep source mode.

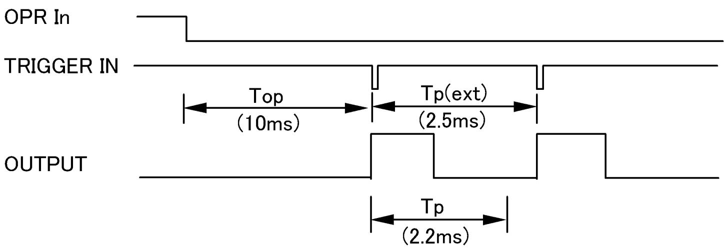
Tp (ext) min: The operational minimum period of TRIGGER IN signal

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 BURST mode (*2)

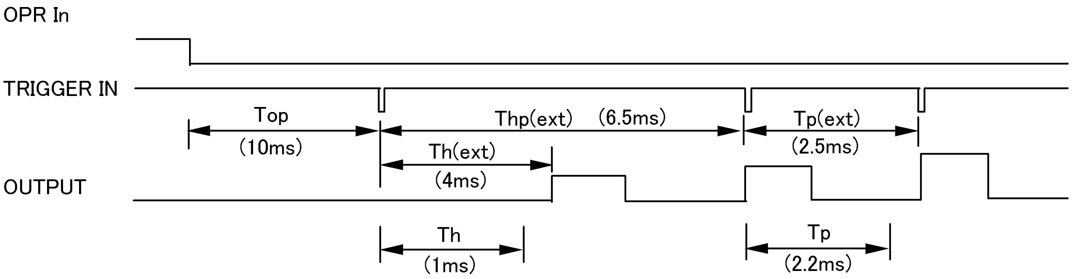
*2: High-speed-burst operational status
High-speed burst operational status starts when TRIGGER IN signal is input with the conditions, Measurement range; fixed, SWP Range; fixed, Trigger mode; HOLD, and Memory mode; BURST. And it is as follows:

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

- When the source mode is PLS (Memory mode; BURST, Measurement; ON and the minimum value)



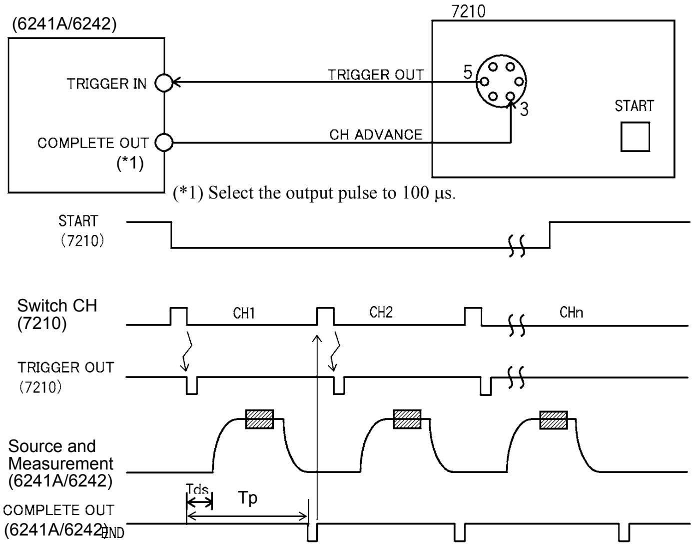
- When the source mode is PLS SWP (Memory mode; BURST, Measurement; ON and the minimum value)



5.2.10.2 Control of Scanner

The following example shows how to control the 7210 scanner.

The following figure shows the timing and a connection diagram for an example in which measurement is done in the Pulse source mode and the 7210 Channel switch is performed by the COMPLETE OUT (END) signal.



(*1) Select the output pulse to 100 µs.

Figure 5-15 Control of Scanner

5.2.11 Operating Multiple 6241A/6242

This section describes synchronized operation, serial connection, and parallel connection using more than one 6241A/6242.

5.2.11.1 Synchronized Operation

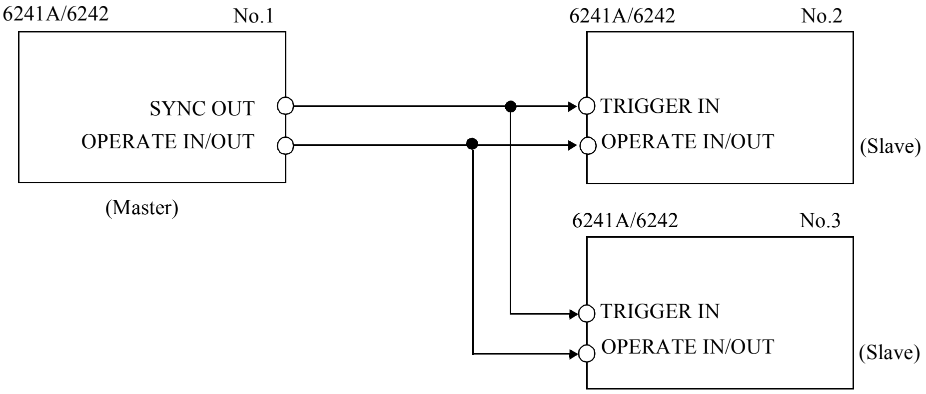
The synchronized operation of the 6241A/6242 units allows synchronization of measurement timing in the DC source mode, as well as allowing synchronization of both source and measurement in the Pulse source mode and the Sweep source mode.

The timing control for the synchronization is performed by the external control signals of TRIGGER IN, SYNC OUT, COMPLETE OUT, and the setting of time parameters such as Measurement Delay and Source Delay.

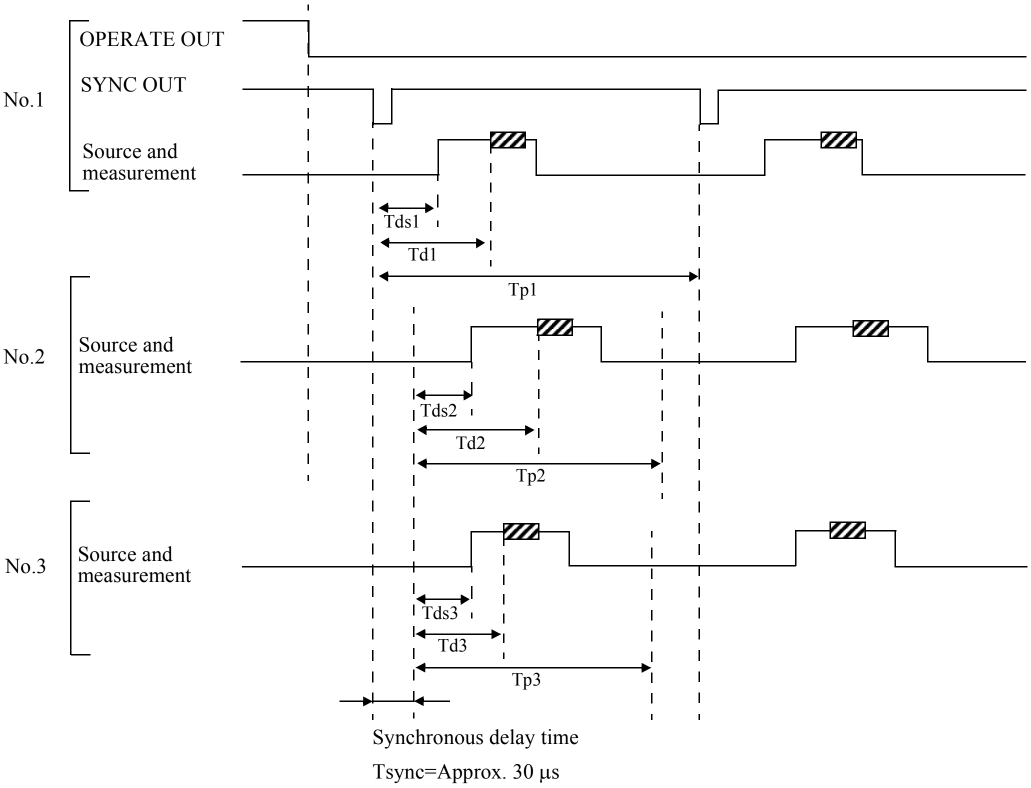
1. Three unit synchronous operation using SYNC OUT
   - Setting

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

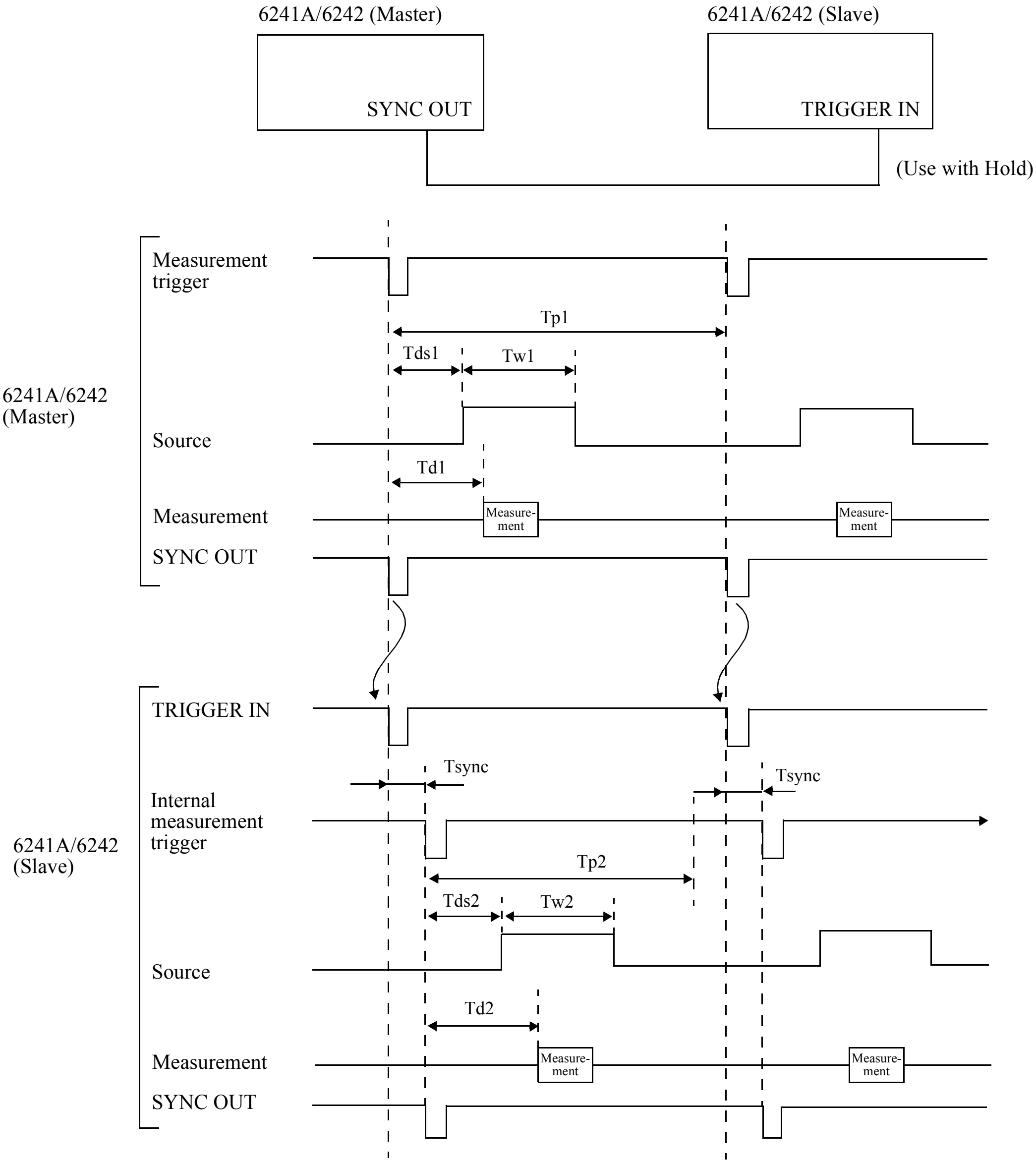
   - Connection



- Operational Timing



2. Restriction on Setting
    - The 6241A/6242 has a Tsync (approx. 30 µs) time delay from the external trigger input to the measurement start. Consider this time delay when using 6241A/6242 units in synchronous operation.
    - Set all three 6241A/6242 units with both source and measurement range fixed and turn OFF the Auto Zero.
    - Slave Tp and Th have restrictions on using the external trigger (Refer to Section 5.2.10.1).
    - The first synchronous Sweep step has a gap step within the Th accurate range.



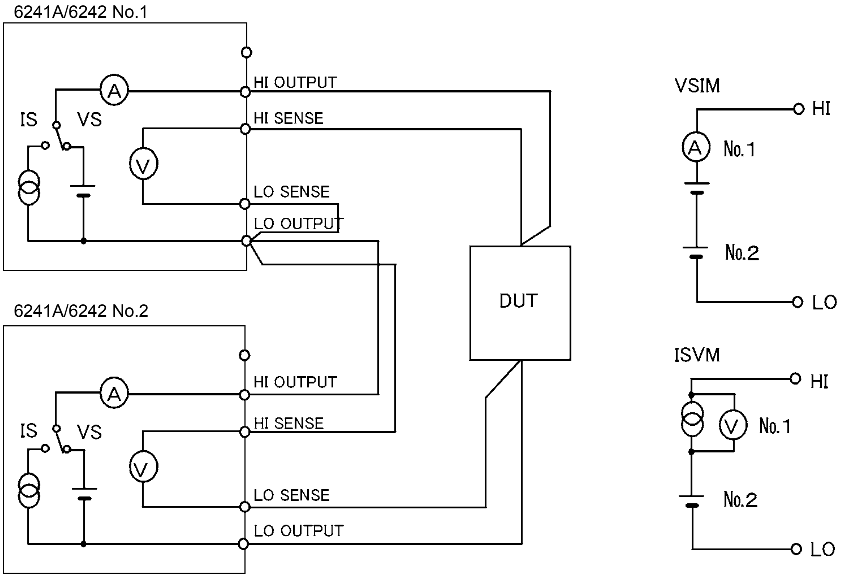
Therefore, consider Tsync time and set the relevant setting as follows:

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

5.2.11.2 Serial Connection

Connecting two 6241A/6242 units in series enables use of a source up to ±64 V/±0.5 A (6241A) or ±12 V/±5 A (6242).

Figure 5-16 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.



Output voltage = No. 1 output voltage + No. 2 output voltage (for constant voltage)
Output current = The smaller of the currents set for No. 1 or No. 2 (for constant current)

Figure 5-16 Serial Connection

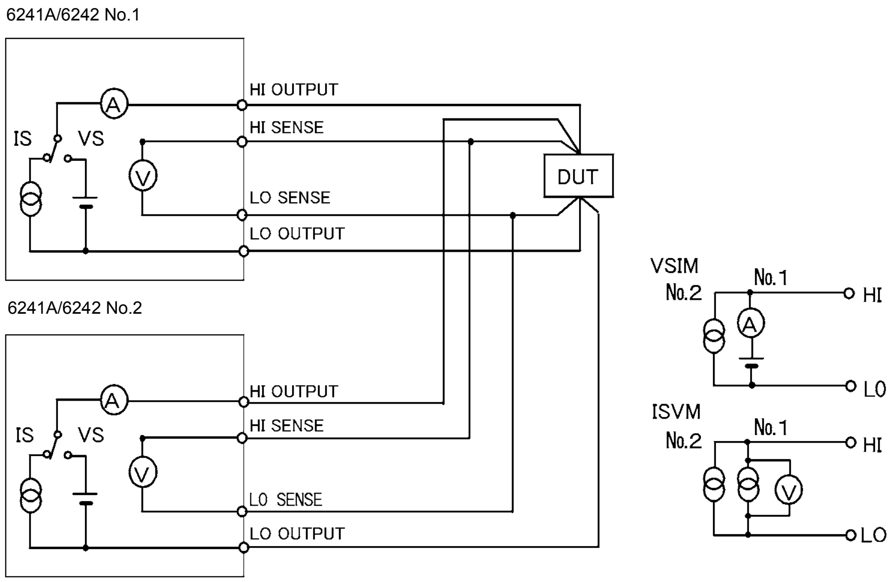
CAUTION:

1. ***If the load is short-circuited, reverse polarity voltage is applied to the 6241A/6242 themselves. 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 3 or more units serially. If the load is short-circuited, the maximum applicable voltage will be exceeded, and the 6241A/6242 may be damaged.***
3. ***When using constant current, the current setting becomes the smaller of the two current settings as shown in Figure 5-16. The other becomes the constant voltage.***

5.2.11.3 Parallel Connection

Connecting two 6241A/6242 units in parallel enables use of a source up to 1 A/32 V (6241A), 10 A/6 V (6242).

Figure 5-17 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 batteries.



Output voltage = The smaller of the voltages set for No. 1 or No. 2 (for constant voltage)
Output current = No. 1 + No. 2 set current (for constant current)

Figure 5-17 Parallel Connection

NOTE:

1. ***If the load is opened, the 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 3 or more units are connected in parallel, the one to be used as source and the one to be used as sink are decided by the set voltage, and the voltage control is performed in accordance with this balance.***

5.2.12 Measurement Data Storing Function

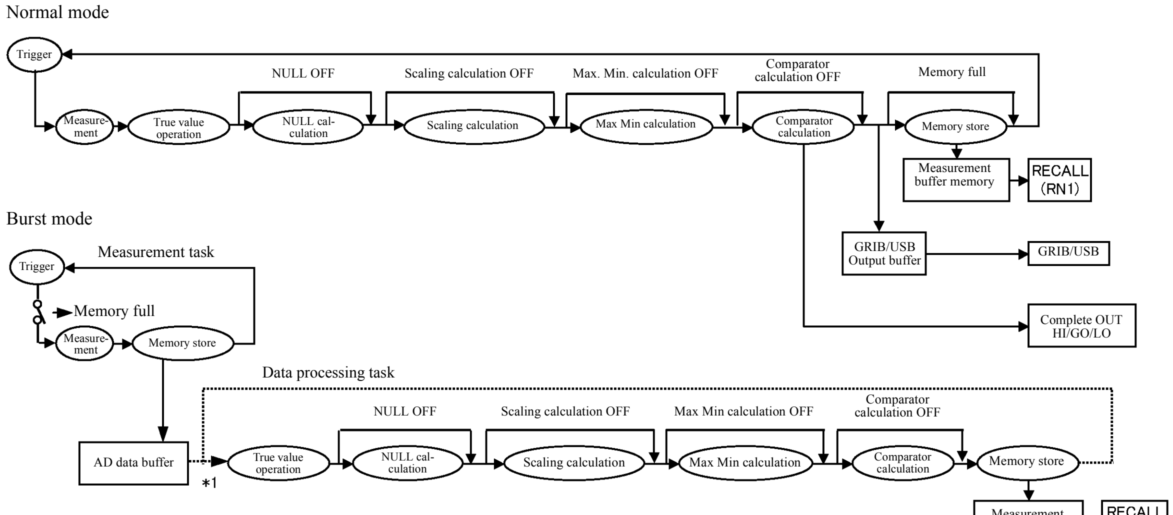
The 6241A/6242 features a measurement data memory for storing up to 8000 measurement data items.

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

5.2.12.1 Storing Measured Data into Data Memory (Memory Store)

Two ways of storing the measured data are available; Normal mode and Burst mode. Select the items, ***F) MEMORY*, *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 operation 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 Storing Measured Data

Table 5-16 Comparison of Storing Measured Data

		Normal	Burst
Recommended application		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 number of times such as Sweep measurement.
Minimum repeat time (*)		10 ms	2 ms
Measurement value 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 ENTER key	Available	Not available
	RECALL and RN1 commands	Available	
Operation when Memory Full		ST indicator blinks MFL (bit 10) of the device event status register becomes HI.	
		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/GO/LO display		Displays in idle time of measurement tasks, or when measurement is not performed
Number of memory stored reached flag Device Event Status Register ASM (bit4)		This flag bit is set when number of measured data reaches the number stored set (using the RNM command) in the measurement buffer memory.	

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

NOTE: In the following cases, Memory Store ON/OFF and storing operation changes cannot be performed.

- ***During free run in the DC, Pulse source modes***
- ***During sweep operation in Sweep source mode***

5.2.13 Clearing Saved Data (Memory Clear)

The saved data can be cleared in the following conditions:

- When the Memory Clear parameter is executed.
- When the RL command is executed.
- When the store mode is set to ON (Normal mode or Burst mode).
- When the Normal mode or the Burst mode is switched.
- When the power is turned ON.

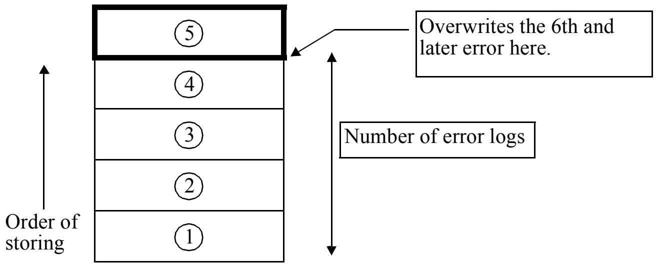
5.2.14 Error log

The 6241A/6242 holds error numbers in the error log memory when it detects an error.

1. Operation

   A maximum of 5 memory areas are available for the error log 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 illuminates when an error log is stored.



Error log

2. Clearing an error log

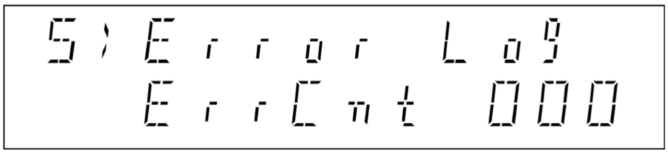
   The error logs are cleared by the following and the ERR indicator is extinguished.

   - Power ON
   - When reading error log (This error log is cleared after displaying the error log screen and completing the Menu screen.)
   - When the ERL? or *CLS command is executed.

   Not cleared by *RST.

3. Reading error log

   Select the items, ***M) SYSTEM***, ***5) Error Log*** on the Menu screen.



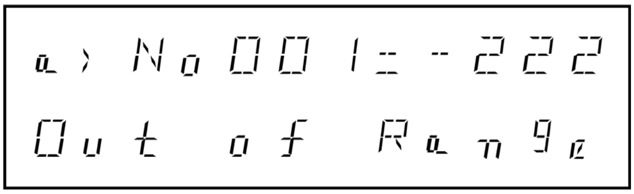
```
5) Error   Log
   ErrCnt  000
```

The number of errors is displayed.

Press ▽ to display the error content display screen.

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.



```
a) No001:-222
Out of Range
```

5.2.15 Self Test

The 6241A/6242 can self-test the internal operation 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 (1/2)

	Display Error Code	Description	Executing Method			Message	TER register (*1)		6241A	6242
			Power ON	*TST?	Key operation		Register	Data		
1	001	ROM check SUM	●			ROM Chk SUM	-	-	-	-
2	002	Display section ROM/RAM	●			Panel Memory				
3	003	LCA data	●			LCA data				
4	004	Reading from or writing into RAM	●			RAM Rd/Wt				
5	005	Display communication	●			Panel Comm				
6	011	Analog section communication	●	●	●	Analog Comm				
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	Save 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	Ratio between AD operation IR1 and IR2	●	●	●	AD Ratio 1 to 2	b	1	○	○
14	102	Ratio between AD operation IR2 and IR3	●	●	●	AD Ratio 2 to 3		2	○	○
15	103	Ratio between AD operation IR3 and IR4	●	●	●	AD Ratio 3 to 4		4	○	○
16	104	Ratio between AD operation IR4 and IR5	●	●	●	AD Ratio 4 to 5		8	○	○
17	111	Analog section RST line test	●	●	●	ADRST Sig		16	○	○
18	112	Analog section TRIG line test	●	●	●	ADTRG Sig		32	○	○
19	151	AD operation ZERO X10	●	●	●	ADx10 Zero		64	○	○
20	152	AD operation ZERO X1	●	●	●	ADx1 Zero		128	○	○
21	201	VSVM 300mV ZERO	●	●	●	VSVM 0.3V Z	c	1	○	○
22	202	VSVM 300mV +FS	●	●	●	VSVM 0.3V +F		2	○	○
23	203	VSVM 300mV -FS	●	●	●	VSVM 0.3V -F		4	○	○
24	204	VSVM 3V ZERO	●	●	●	VSVM 3V Zero		8	○	○
25	205	VSVM 3V +FS	●	●	●	VSVM 3V +FS		16	○	○
26	206	VSVM 3V -FS	●	●	●	VSVM 3V -FS		32	○	○
27	207	VSVM 30V ZERO	●	●	●	VSVM 30V Z		64	○	-
28	208	VSVM 30V +FS	●	●	●	VSVM 30V +FS		128	○	-
29	209	VSVM 30V -FS	●	●	●	VSVM 30V -FS		256	○	-
30	207	VSVM 6V ZERO	●	●	●	VSVM 6V Zero		64	-	○
31	208	VSVM 6V +FS	●	●	●	VSVM 6V +FS		128	-	○
32	209	VSVM 6V -FS	●	●	●	VSVM 6V -FS		256	-	○
33	211	High Limit 300mV +FS	●	●	●	HL 0.3V +FS		512	○	○
34	212	High Limit 300mV -FS	●	●	●	HL 0.3V -FS		1024	○	○
35	213	High Limit 3V +FS	●	●	●	HL 3V +FS		2048	○	○
36	214	High Limit 3V -FS	●	●	●	HL 3V -FS		4096	○	○
37	215	High Limit 30V +FS	●	●	●	HL 30V +FS		8192	○	-
38	216	High Limit 30V -FS	●	●	●	HL 30V -FS		16384	○	-
39	215	High Limit 6V +FS	●	●	●	HL 6V +FS		8192	-	○
40	216	High Limit 6V -FS	●	●	●	HL 6V -FS		16384	-	○

Table 5-17 Self-test Items (2/2)

	Display Error Code	Description	Executing Method			Message	TER register (*1)		6241A	6242
			Power ON	*TST?	Key operation		Register	Data		
41	221	Low Limit 300mV +FS	●	●	●	LL 0.3V +FS	b	256	○	○
42	222	Low Limit 300mV -FS	●	●	●	LL 0.3V -FS		512	○	○
43	223	Low Limit 3V +FS	●	●	●	LL 3V +FS		1024	○	○
44	224	Low Limit 3V -FS	●	●	●	LL 3V -FS		2048	○	○
45	225	Low Limit 30V +FS	●	●	●	LL 30V +FS		4096	○	○
46	226	Low Limit 30V -FS	●	●	●	LL 30V -FS		8192	○	○
47	225	Low Limit 30V +FS	●	●	●	LL 30V +FS		4096	○	○
48	226	Low Limit 30V -FS	●	●	●	LL 30V -FS		8192	○	○
49	225	Low Limit 6V +FS	●	●	●	LL 6V +FS		4096	-	○
50	226	Low Limit 6V -FS	●	●	●	LL 6V -FS		8192	-	○
51	231	IM 30μA ZERO	●	●	●	IM 30μA Zero	d	1	○	○
52	232	IM 300μA ZERO	●	●	●	IM 300μA Z		2	○	○
53	233	IM 3mA ZERO	●	●	●	IM 3mA Zero		4	○	○
54	234	IM 30mA ZERO	●	●	●	IM 30mA Zero		8	○	○
55	235	IM 300mA ZERO	●	●	●	IM 300mA Z		16	○	○
56	236	IM 500mA ZERO	●	●	●	IM 500mA Z		32	○	-
57	236	IM 3A ZERO	●	●	●	IM 3A Zero		32	-	○
58	237	IM 5A ZERO	●	●	●	IM 5A Zero		64	-	○
59	241	ISIM 30μA +FS	●	●	●	IS 30μA +FS	e	1	○	○
60	242	ISIM 30μA -FS	●	●	●	IS 30μA -FS		2	○	○
61	243	ISIM 300μA +FS	●	●	●	IS 300μA +FS		4	○	○
62	244	ISIM 300μA -FS	●	●	●	IS 300μA -FS		8	○	○
63	245	ISIM 3mA +FS	●	●	●	IS 3mA +FS		16	○	○
64	246	ISIM 3mA -FS	●	●	●	IS 3mA -FS		32	○	○
65	247	ISIM 30mA +FS	●	●	●	IS 30mA +FS		64	○	○
66	248	ISIM 30mA -FS	●	●	●	IS 30mA -FS		128	○	○
67	249	ISIM 300mA +FS	●	●	●	IS 300mA +FS		256	○	○
68	250	ISIM 300mA -FS	●	●	●	IS 300mA -FS		512	○	○
69	251	ISIM 500mA +FS	●	●	●	IS 500mA +FS		1024	○	-
70	252	ISIM 500mA -FS	●	●	●	IS 500mA -FS		2048	○	-
71	251	ISIM 3A +FS	●	●	●	IS 3A +FS		1024	-	○
72	252	ISIM 3A -FS	●	●	●	IS 3A -FS		2048	-	○
73	253	ISIM 5A +FS	●	●	●	IS 5A +FS		4096	-	○
74	254	ISIM 5A -FS	●	●	●	IS 5A -FS		8192	-	○
75	301	OVL detection check	●	●	●	OVL Check	d	256	○	○
76	311	Sample hold check	●	●	●	S/H Check		512	○	○
77	-	All the panels light ON	●		●	Visually display check	-	-	○	○
78	-	Buzzer	●		●	Verify with the buzzer sound			○	○
79	-	Panel key			●	Visual key display 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

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

   Select the items, ***M) SYSTEM***, ***5) Self Test*** on the Menu screen to execute the self test by manual operation.

   Press ⬇ and then press ⬅ or ➡ to select “Executing the Test” and “Display/Key Test” items.

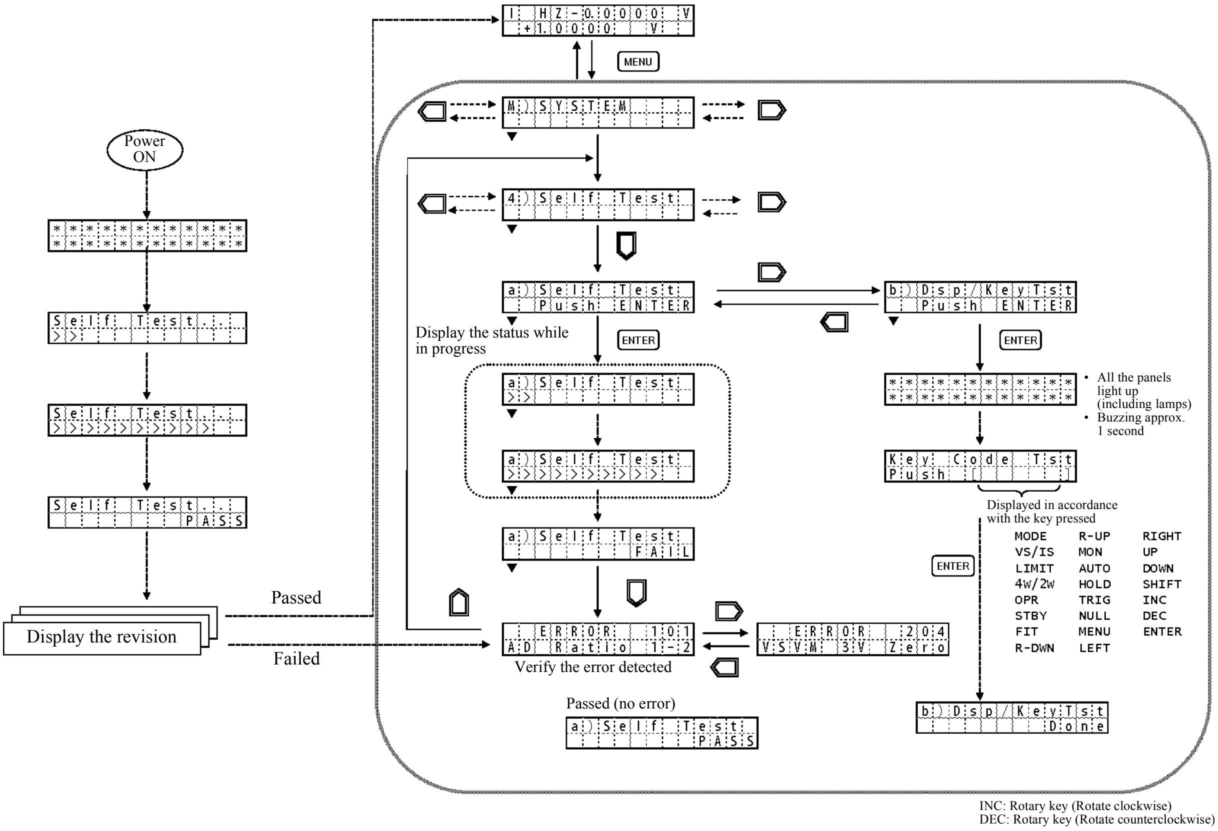


Figure 5-19 Self-test Operation

5.3 Compatibility with 6243/44

The 6241A/6242 shares the same command system as the 6240A.
This section describes the compatibility with the earlier 6243/44 models.

5.3.1 Remote Command Compatibility

The 6241A/6242 has the same function as the 6243/44 function but does not have command compatibility.

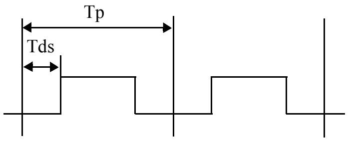
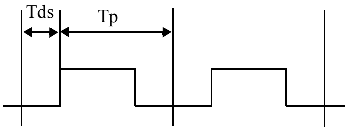
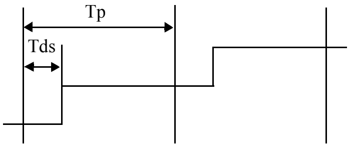
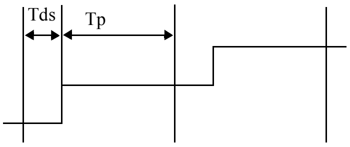
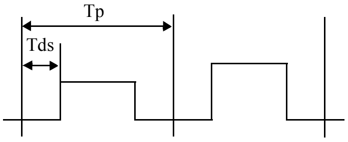
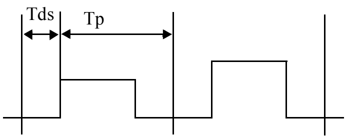
For more information on the remote operation, refer to Section 6.7.3, “Remote Command List.”

The following commands have compatibility.

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

5.3.2 Difference of Period-Parameters in Pulse Source Mode and Sweep Source Mode

Note that the definition of the period parameter Tp is different from that of the 6243/44.

Source mode	6240A/6241A/6242	6243/44
Pulse		
DC Sweep		
Pulse Sweep		

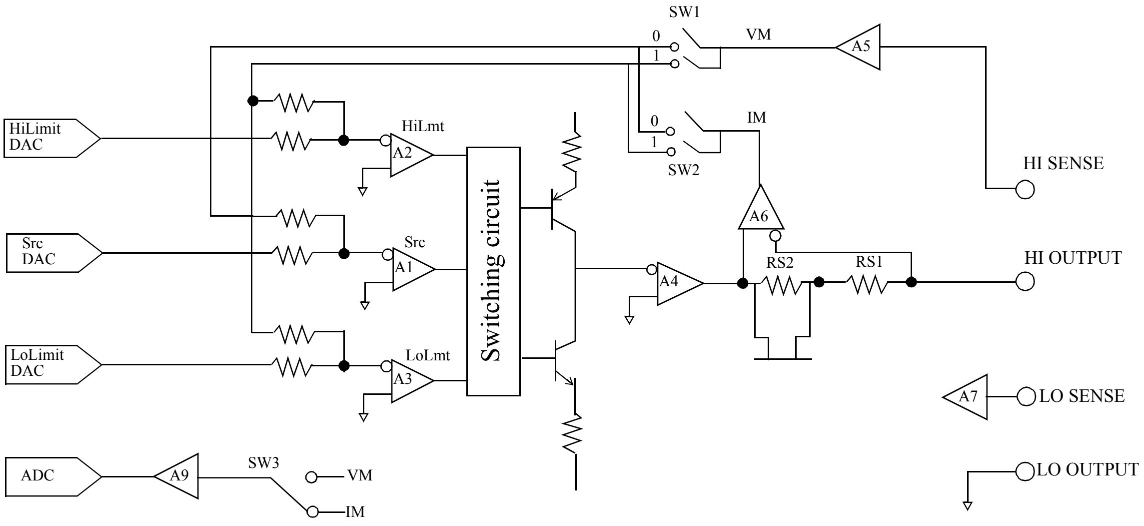
5.3.3 Notes for Synchronous Operation

The 6243/44 does not have a delay time from the external trigger input to the measurement start, but the 6241A/6242 has Tsync delay time.

Therefore, consider the Tsync delay time when using the 6241A/6242 with the 6243/44 in synchronous operation. For more information, refer to Section 5.2.11.1, “Synchronized Operation.”

5.4 Operational Principles

5.4.1 Block Diagram



5.4.2 Operational Principles

- The 6241A/6242 contains a SrcDAC DA converter for setting the voltage source or current source. The 6241A/6242 also has the HiLimitDAC and LoLimitDAC DA converters for setting the current-limiter and the voltage limiter.
  The SrcDAC has 16 bit conversion accuracy, and the HiLimitDAC and LoLimitDAC have 13 bit conversion accuracy.
  The output from the DA converters is input to three error amps, Src (A1), HiLmt (A2), and LoLmt (A3) respectively.
- For voltage source, the SrcDAC becomes the voltage-source DAC, and Src error-amp (A1) becomes the voltage-source error-amp. Also, HiLimitDAC becomes the DAC for the current-limiter on the Hi-side and the HiLmt error amp (A2) becomes an error amp for current-limiter on the Hi-side. Likewise, LoLimitDAC and LoLmt error amp (A3) work as current-limiter on the Lo side.
  At this time, for SW1 and SW2 in the feedback circuit, 0 is ON for SW1 and 1 is ON for SW2.
  For current source, the use of each DAC and error amp 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 the voltage measurement, voltage source, and the voltage limiter always take place in the same range.
- The A_5 and A_6 amps have high input impedance to minimize leakage.
- The A_7 amps also has a 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 Interface and describes the connections and settings. This chapter also contains lists of commands for programming and introduces program examples.

6.1 Using an Interface

The 6241A/6242 offers GPIB and USB interfaces. They cannot be used at the same time. Select which interface you wish to use.

6.1.1 Selecting the Interface

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

1. The selected interface is saved in nonvolatile memory. The selected interface does not change when the unit is turned off or reset.
2. A unique unit address is set in the interface. If multiple instruments are connected to the USB interface, set individual identifying addresses (USB.Id).

The following table shows the interface set items and default settings.

Set item	Default setting
Selected interface	USB
Header ON/OFF	ON
GPIB address/USB.Id	1
GPIB Talker Functions	Addressable

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 Remote Command Index

Use the following remote command index for using remote commands in Chapter 6.

6.3 GPIB

6.3.1 Overview

GPIB (General Purpose Interface Bus) allows external control of the 6241A/6242 measurement function settings, measurement parameter settings, and reading measurement data, making it simple to configure an automated measurement system.
As GPIB signals from the 6241A/6242 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 Specification

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 function
AH1	Acceptor Handshake function
T5	Basic Talker function, Talker Clear function specified by the listener, Talk-Only Mode function, Serial Poll function
L4	Basic Listener function and Listener Clear function specified by the talker
SR1	Service Request function
RL1	Remote/Local switching function
PP0	Without the Parallel Poll function
DC1	Device Clear function (The SDC and DCL commands can be used.)
DT1	Device Trigger function (GET command can be used.)
C0	Without the Controller function
E2	3-state bus driver used

6.3.2 Precautions when Using GPIB

1. Do not use connection cables to the measuring instrument and bus cables to controllers that are longer than necessary. Ensure that the cables do not exceed 20 m in length. ADC offers the following standard bus cables.

Table 6-2 Standard Bus Cable

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

2. The bus-cable connectors are piggyback type connects with both male and female sides. They can be stacked on top of each other.
   When connecting a bus-cable, do not connect three or more connectors on top of each other. Fully tighten the connector screws.
3. Verify the power supply conditions, grounding status, and (if necessary) parameter settings for each instrument before turning on each instrument.
   Ensure that all instruments connected to the bus are turned on. The overall system operation cannot be guaranteed if any of the instruments is not turned on.
4. Connecting and disconnecting cables

   Turn off all connected instruments before connecting or disconnecting a GPIB cable with the chassis commonly grounded for all the devices connected and to be connected. Use a common ground for the chassis of each connected instrument.
5. ATN interrupt during message transmission

   If an ATN request interruption occurs during transfer of messages between devices, the ATN has priority and the previous status is cleared.
6. When using the system in the talk-only mode, do not connect the controller.
7. Up to 255 characters can be recognized in a single program command transmission.
   An error occurs if the program command exceeds 255 characters.
8. Retain the REN line at Low for 5 ms or longer following the transmission of program command.

6.3.3 Setting GPIB

These settings are enabled if the GPIB interface is selected.

- Setting the Address

	Operation	Character Display Area
1.	Press **MENU** and press ◁ or ▷ to select **L) I/F.**	L) I/F
2.	Press ▽ to go to the Select level.	1) I/F BUS GPIB
3.	Press ◁ or ▷ to select **2) GPIB**. (Current address setting)	2) GPIB Adr 01
4.	Press ▽ to go to the Select level.	2) GPIB Adr 01
5.	To set the address, press ◁ or ▷ to select the digit to change and use ◯ to increase or decrease the value. Alternatively, directly enter the address value pressing the **123...** key.	2) GPIB Adr 17
6.	Press **EXIT** to exit the menu.	

- Talk only setting

	Operation	Character Display Area
1.	Press **MENU** and ◁ or ▷ to select **L) I/F.**	L) I/F
2.	Press ▽ to go to the Select level.	1) I/F BUS GPIB
3.	Press ◁ or ▷ to select **4) Talk Only**. (Current address)	4) Talk Only Off
4.	Press ▽ to go to the Select level.	4) Talk Only Off
5.	Rotate ◯ to set the Talk Only ON or OFF.	4) Talk Only ON
6.	Press **EXIT** to exit the menu.	

6.4 USB

6.4.1 Overview

The 6241A/6242 is USB (Universal Serial Bus) equipped conforming to USB 2.0 standard.
USB allows function settings and reading of measurement data with respect to multiple instruments connected to the bus using a PC, making it simple to configure an automated measurement system.

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

6.4.2 USB Specifications

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

6.4.3 USB Setup

6.4.3.1 Connection to PC

Connect the USB connector (B type) on the rear of the instrument to the PC USB connector with a cable. Fully insert all connectors.

Use a USB hub to connect multiple instruments to a single PC.

6.4.3.2 USB Id Setup

These settings are enabled if the USB interface is selected on the following menu.

Operation	Character Display Area
1. Press **MENU** and press ◁ or ▷ to select **L) I/F**.	L) I/F
2. Press ▽ to go to the Select level.	1) I/F BUS USB
3. Press ◁ or ▷ to select **2) USB Id**. (Current address setting)	2) USB Id 001
4. Press ▽ to go to the Select level.	2) USB Id 002
5. To set the address, press ◁ or ▷ to select the digit to change and use ○ to increase or decrease the value. Alternatively, directly enter the address value pressing the **123...** key.	
6. Press EXIT to exit the menu.	

6.4.3.3 Precautions when Using USB

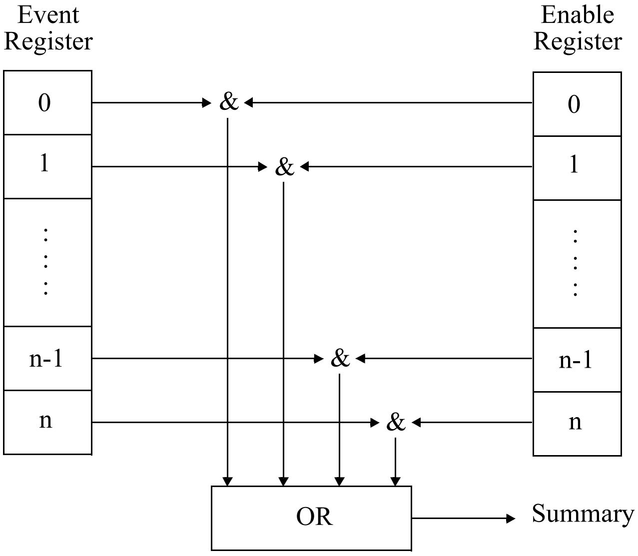
When running a query command, leave a 20 msec wait time right after the previous command.

6.5 Status Register Structure

The 6241A/6242 has a hierarchical status register structure that conforms to the IEEE standard 488.2-1987 and can send various statuses of the 6241A/6242A to the controller. The following explains an operational model of the status structure and assigning events.

1. Status Register

   The 6241A/6242 employs a status register model as defined by the IEEE standard 488.2-1987 that consists of an Event Register and 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 query or cleared by *CLS.
  Data cannot be written into the Event Register.

- Enable Register

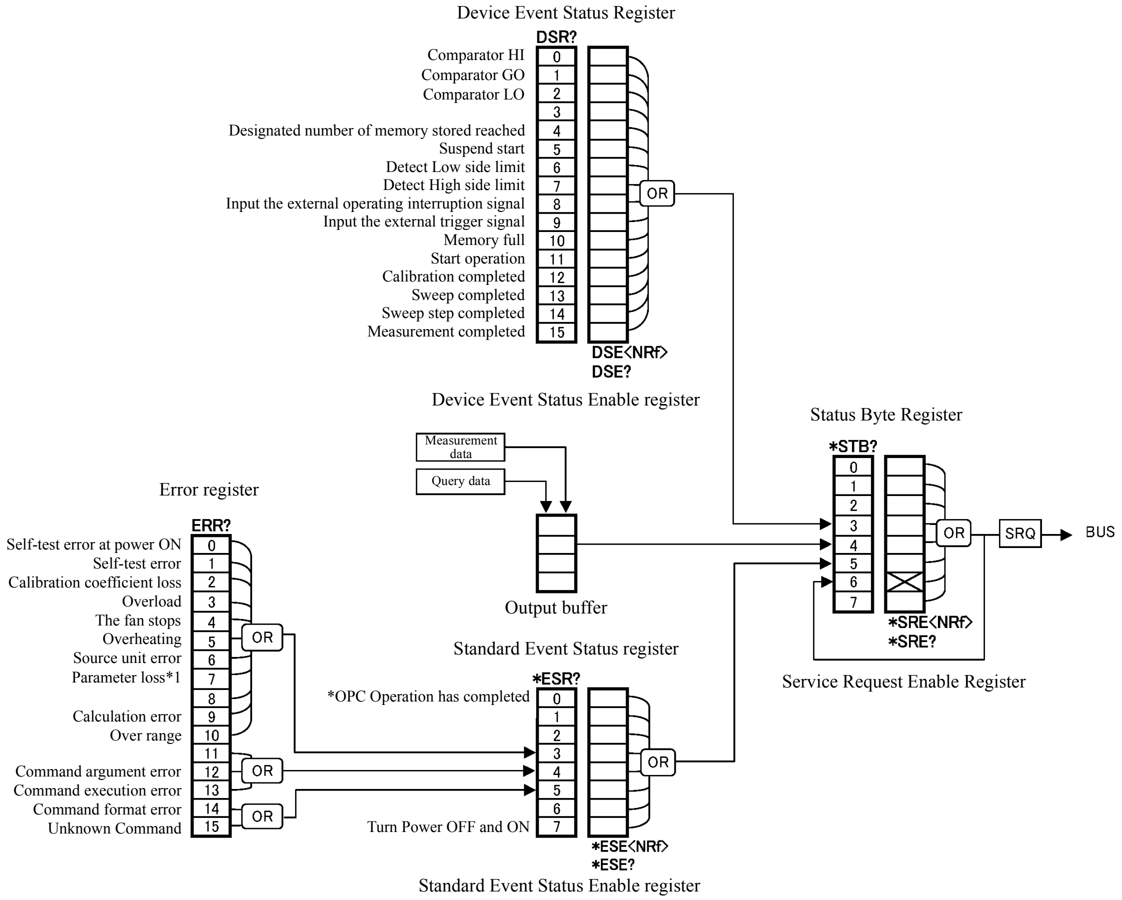
  The Enable Register specifies for which bits in the Event Register a valid status summary should be generated. The logical AND operation is executed between Enable Register queries and Event Register, and the OR result is generated as a summary. The summary is written into the Status Byte Register.
  Data can be written into the Enable Register.

The 6241A/6242 has the following 4 types of status registers.

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

Figure 6-1 below shows the 6241A/6242 status register structure.

Status Register Structure



*1: Parameter loss means saved parameter data loss or backup parameter data loss.

Figure 6-1 Structure of Status Register

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 are 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 Register. And, this Status Byte Register's summary is transmitted as a service request to the controller. Consequently, the function of the Status Byte Register is slightly different from that of the Status Register structure. The Status Byte Register is explained in the following:
   Figure 6-2 below shows the structure of the Status Byte Register.

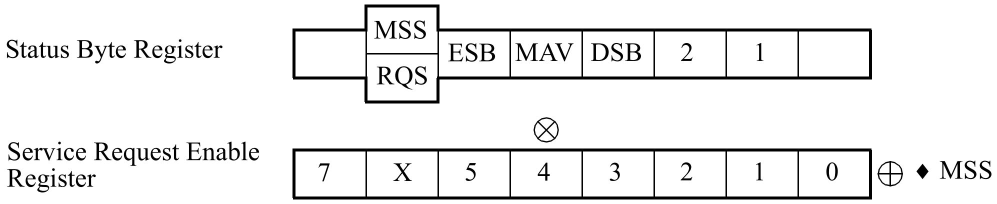


Figure 6-2 Structure of Status Byte Register

The Status Byte Register is similar to the Status Register except for the following 3 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 the RQS of the service request.

This register responds to the serial poll from the controller.
When responding to the serial poll, bit 0 to 5 of the Status Byte Register, bit 7, and RQS, 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.

Table 6-3 below describes each bit of the Status Byte Register.

Table 6-3 Status Byte Register (STB)

bit	Name	Description
0	Not used	Always set to 0
1	Not used	Always set to 0
2	Not used	Always set to 0
3	DSB Device Event Status	ON: 1 is set when any of the DESR incidents occur and 1 is set, if the corresponding DESER bit is also 1. OFF: 0 is set when DESR is cleared by reading (DSR?).
4	MAV Message Available	ON: 1 is set when output data is entered in the output buffer. OFF: 0 is set when the output buffer is read and becomes empty.
5	ESB Standard Event Status	ON: 1 is set when any of the SESR incidents occur and 1 is set, if the corresponding SESER bit is also 1. OFF: 0 is set when SESR is cleared by reading (*ESR?).
6	MSS Master Summary	ON: 1 is set when any of the STB incidents occur and 1 is set, if the corresponding SRER bit is 1.
	RQS Request Service	ON: 1 is set when MSS is set to 1, and SRQ is generated. OFF: When STB is read by the Serial poll.
7	Not used	Always set to 0

Common conditions on which the Status Byte Register is cleared.

- Every bit is cleared when the power is turned ON.
- *CLS clears every bit except MAV which is not cleared if data exists in the output buffer.
- All the bits in DSB, MAV, and ESB are cleared
- Not cleared even if read by *STB?.

Conditions on which the Service Request Enable Register is cleared.

- Power is turned ON.
- *SRE0 command is executed.

4. Standard Event Status Register

   Table 6-4 below shows the functions assigned to the Standard Event Status Register.

Table 6-4 Standard Event Status Register (ESR)

bit	Name	Description
0	OPC Operation Complete	ON: When all operation is completed after receiving the *OPC command, bit 0 is set to 1.
1	Not used	Always set to 0
2	Not used	Always set to 0
3	DDE Device Dependent Error	ON: 1 is set when an error related to the hardware occurs.
4	EXE Execution Error	ON: 1 is set when a received command is not currently executable. 1 is set when incorrect data is entered in a command parameter.
5	CME Command Error	ON: 1 is set when the received command is incorrectly spelled.
6	Not used	Always set to 0
7	PON Power On	ON: 1 is set when the power is turned OFF and ON.

Common conditions on which the Standard Event Status Register is cleared.

- Every bit is cleared when the power is turned ON.
- *CLS clears every bit.
- Every bit is cleared when read by *ESR?.

Conditions on which the Standard Event Status Enable Register is cleared.

- Power is turned ON.
- *ESE0 command is executed.

5. Device Event Status Register

Table 6-5 below shows the functions assigned to the Device Event Status Register.

Table 6-5 Device Event Status Register (DSR)

bit	Name	Description
0	HI Comparator HI	ON: 1 is set if Comparator calculation result is HI.
1	GO Comparator GO	ON: 1 is set if Comparator calculation result is GO.
2	LO Comparator LO	ON: 1 is set if Comparator calculation result is LO.
3	Not used	Always set to 0
4	ASN Arrive at Store Number	ON : 1 is set when number of measured data reaches the number of memory store set.
5	SUS Suspend	ON: 1 is set when the Suspend status is set. OFF: 0 is set when the Operate or Standby status is set.
6	LML Limiter Low	ON: 1 is set when the Low limiter is detected.
7	LMH Limiter High	ON: 1 is set when the High limiter is detected.
8	EOP Ext.Operate Off In	ON: 1 is set when an external operation off signal is detected.
9	ETG Ext.Trigger In	ON: 1 is set when the external trigger signal input is detected.
10	MFL Memory Full	ON: 1 is set when the measurement buffer memory is full. OFF: 0 is set when the measurement buffer memory becomes not full.
11	OPR Operate	ON: 1 is set when the Operational status is set. OFF: 0 is set when the Standby or Suspended status is set.
12	CAE Calibration End	ON: 1 is set when the calibration is complete. OFF: 0 is set when calibration starts.
13	SWE Sweep End	ON: 1 is set when Sweep is complete. OFF: 0 is set when Sweep starts.
14	SSC Sweep Step Complete	ON: 1 is set when the trigger mode is set to HOLD and Sweep step is complete (except for the high-speed burst operating status). OFF: 0 is set when Sweep step starts. 0 is set when Sweep stops and starts.
15	EOM End Of Measure	ON: 1 is set when the measurement is complete. OFF: 0 is set when the measurement starts. 0 is set when the measurement data is read.

Common conditions on which the Device Event Status Register is cleared

- Every bit is cleared when the power is turned ON.
- *CLS clears every bit.
- Every bit is cleared when read by DSR?.

Common conditions on which the Device Event Status Enable Register is cleared

- Power is turned ON.
- DSE0 command is executed.

6. Error Register

Table 6-6 below shows the functions assigned to the Error Register.

Table 6-6 Error Register (ERR)

bit	Description
0	ON: 1 is set when the power is turned ON and a self-test error occurs
1	ON: 1 is set when the self-test error occurs. 1 is set when a flush writing abnormality occurs.
2	ON : 1 is set when the calibration data is lost during the power On check and the default calibration values are used. Reverts to 0 when the power is reset after recalibration.
3	ON: 1 is set when an overload is detected. 0 is not set even if an overload is cleared.
4	ON: 1 is set when the program detects that the fan has stopped. 0 is not set even if the status in which the fan has stopped is cleared.
5	ON: 1 is set when overheating is detected. 0 is not set even if the overheating status is cleared.
6	ON: 1 is set when a source unit abnormality is detected.
7	ON: 1 is set when the saved parameters are lost during the power On check and the default parameters are used. (Parameters saves by Save/Load, or paramters stored when the unit was turned off.)
8	Always set to 0.
9	ON: 1 is set when a calculation error occurs.
10	ON: 1 is set when an over range occurs.
11	Always set to 0.
12	ON: 1 is set when a remote command argument error occurs.
13	ON: 1 is set when a remote command execution error occurs.
14	ON: 1 is set when a remote command syntax error occurs.
15	ON: 1 is set when receiving an unknown remote command.

Common conditions on which the Error Register is cleared.

- Every bit is cleared when the power is turned ON.
- *CLS clears every bit.

NOTE: The Error Register is not cleared if read by ERR?.

6.6 Data Output Format (Talker Format)

The measurement data and the measurement data memory (RECALL) is read out in the following format.

Single data :

$$\underbrace{\bigcirc\bigcirc\bigcirc}_{H}\ \underbrace{\pm\ \bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc}_{D}\ \underbrace{E\pm\ \bigcirc\bigcirc}_{E}\ \underbrace{\text{CRLF}}_{B}$$

Multiple data :

$$\underbrace{\bigcirc\bigcirc\bigcirc}_{H}\ \underbrace{\pm\ \bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc}_{D}\ \underbrace{E\pm\ \bigcirc\bigcirc}_{E}\ \underbrace{,}_{S}\quad \bigcirc\bigcirc\bigcirc\ \pm\ \bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\ E\pm\ \bigcirc\bigcirc\ ,\ \cdots\cdots$$

$$\cdots\cdots\ \bigcirc\bigcirc\bigcirc\ \pm\ \bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\bigcirc\ E\pm\ \bigcirc\bigcirc\ \underbrace{\text{CRLF}}_{B}$$

H: Header (Main header characters + Sub header of 1 character)

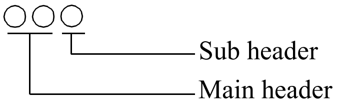
D: Mantissa part (polarity + 6 digit decimal figures)

E: Exponent part (E + polarity + 2 digit figures)

S: String delimiter

B: Block delimiter

1. Header



The header is not output if it is set to OFF.

- Main header

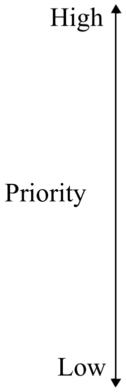
  DV: DC voltage measurement

  DI: DC current measurement

  RM: DC current measurement (resistance displayed)

  EE: Data not in the specified measurement memory

- Sub header



U: High limit occurs.
B: Low limit occurs.
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 counts or current-measurement value is below 200 counts.
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	Mea-sure-ment range	300 mV	±ddd.dddd	E-03	±d.dddddd	E-01
		3 V	±d.dddddd	E+00		E+00
		30 V/6 V	±dd.ddddd	E+00		E+01
DC current measurement		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
		500 mA/300 mA	±ddd.dddd	E-03		E-01
		3 A	±d.dddddd	E+00		E+00
		5 A	±d.dddddd	E+00		E+00
Resistance measurement	Avail-able digits	1 digit	±0000.0d	E-09 to E+09	±00000d.	E-11 to E+09
			±00000.d			
			±00000d.			
		2 digits	±0000.dd		±0000d.d	E-10 to E+10
			±0000d.d			
			±0000dd.			
		3 digits	±000d.dd		±000d.dd	E-09 to E+11
			±000dd.d			
			±000ddd.			
		4 digits	±00d.ddd		±00d.ddd	
			±00dd.dd			
			±00ddd.d			
		5 digits	±0d.dddd		±0d.dddd	
			±0dd.ddd			
			±0ddd.dd			
Detects High limit during the resistance measurement.*1			+9.99999	E+37	+9.99999	E+37
Detects Low limit during the resistance measurement.*1			+9.99999	E+36	+9.99999	E+36

Measurement function	Unit display			
	Decimal point and unit symbol form		Exponent form	
	Mantissa part	Exponent part	Mantissa part	Exponent part
±Range over	±9.99999	E+35	±9.99999	E+35
IS is below 20 counts, or IM is below 200 counts.*1	+9.99999	E+34	+9.99999	E+34
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
Data is not stored when recalling.*2	+8.88888	E+30	+8.88888	E+30

*1: This may be detected when measuring the resistance.

*2: There was not any data found when reading out measurement buffer memory data.

3. String delimiter

   To show the delimitation of data, the comma "," is output.
   When two or more data is read from the measurement data memory, it is output.

4. Block delimiter

   Outputs the block delimiter to show the end of data.
   These are commands that can specify a block delimiter.

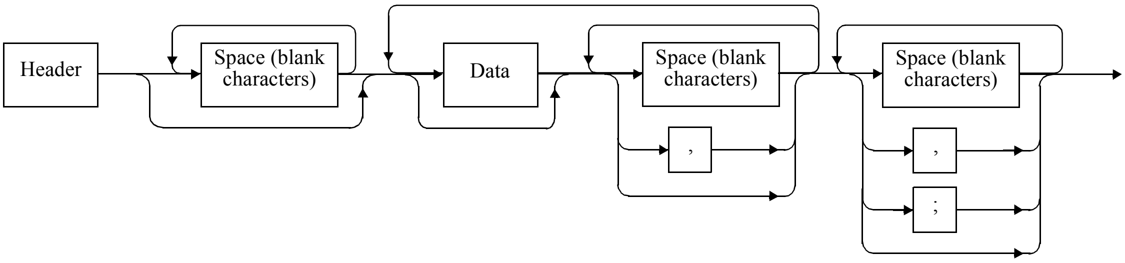
Block delimiter	Commands for setting	Default
CR LF+EOI	DL0	○
LF	DL1	
EOI	DL2	
LF+EOI	DL3	

(EOI is a GPIB function. It is not output by USB.)

6.7 Remote Command

6.7.1 Command Syntax

The command syntax is defined by the following format.



1. Header

   The header normally contains the common command header and the simple header. The common command header has an asterisk mark (*) placed in front of the mnemonic.
   The simple headers do not have hierarchical structure and are functionally independent commands.
   Placing a question mark (?) right after the English character in the header changes the command into a query command.

2. Space (blank characters)

   One or more spaces can be used (Spaces may be omitted).

3. Data

   If the command requires multiple data sets, data sets are separated by comma (,). A space may be used directly before or after comma (,). For more information on the data types, refer to Section 6.7.2, "Data Format."

4. Describing Multiple Commands

   The 6241A/6242 allows multiple commands to be described consecutively or separated by semicolon (;), comma (,), or space (␣) on one line.

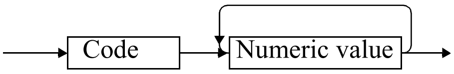
6.7.2 Data Format

The 6241A/6242 uses the following data types for input and output of data.

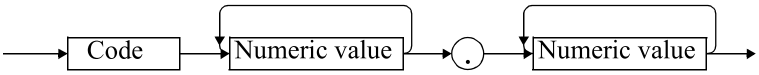
1. Numeric values

   Numeric value formats comprise the following three formats and any format can be used for numeric value input to the 6241A/6242. Depending on the command, unit of measure can be attached for input.

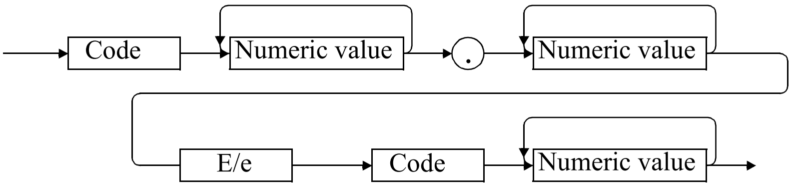
   - Integer type: NR1 format



   - Fixed-point type: NR2 format



   - Floating-point type: NR3 format Code



2. Units of measure

   A list of the units that can be used for D command is shown below.

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 exponent format in the 6241A/6242, 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 List

1. The Default column shows an item which is initialized at Power ON or at factory shipment.
    - The Power ON column show the status when power is ON.
    - *RST and RINI command initialize values to the default.
      However, the RINI command cannot initialize *5 and RINI and *RST command cannot initialize *6.
2. Note for description in the command list
    - The parameter in [ ] can be omitted.
    - The parameter in < > is a single delimited data item.
    - △ in the Operation column indicates the following.
      During DC or pulse operation and suspension;
      Accepted only in HOLD or suspend status.
      During sweep operation and suspension; Accepted only when sweep-stop or suspend status.
    - ▲ in the Operation column is accepted only in the suspend status.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
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		●	○ Suspended when executed	△ Suspended when executed
		IF	Current source function				
		V?	Response: VF: V3 to V5			○	○
		I?	IF: I-1 to I4 / I-1 to I5				
	Source range	SVRX	Optimal range		●	○	×
		SVR3	300 mV range				
		SVR4	3 V range				
		SVR5	30 V/6 V range				
		SVR?	Response: SVRX3 to SVRX5 (optimal range) SVR3 to SVR5 (fixed range)			○	○

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Source	Source range	SIRX	Optimal range		●	○	×
		SIR-1	30 µA range				
		SIR0	300 µA range				
		SIR1	3 mA range				
		SIR2	30 mA range				
		SIR3	300 mA range				
		SIR4	500 mA/3 A range				
		SIR5	5 A range *9				
		SIR?	Response: SIRX-1 to SIRX 5 (fixed range) SIR-1 to SIR 5 (fixed range)			○	○
	Source value	SOV ±data	Sets voltage source value.		0	○	×
		SOI ±data	Sets current source value.		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.			○	×
	Limiter value	LMV ±data1 [,±data2]	Sets voltage limiter value.		±32 V/ ±6 V	○	△
		LMI ±data1 [,±data2]	Sets current-limiter value.		±500 mA/ ±300 mA		
			Both High and Low values can be set for the limiter values. * When comparing data1 and data2, the larger value is High limiter value and the smaller is Low limiter value. * data2 can be omitted. In this case, +data1 and -data1 are assumed as High limit and Low limit, regardless of the data1 polarity. ***Note:*** ***1. LMI data1 and data2 can not be set at the same polarity.*** ***2. Set the difference of High limiter value and Low limiter value as 60 digits or over.***				
		LMV?	Response: LMV ± <hl>, ± <ll> *1			○	○
		LMI?	LMI ± <hl>, ± <ll> *1 hl: <d.dddE ± d> (High limiter value) ll: <d.dddE ± d> (Low limiter value) *1				

*1: The response decimal point is different depending on the set value.
For the source value, limit value, and time parameter set up range, refer to the performance specifications.

*2: Outputs the value that is currently generated or the value that is generated at operation.

*9: An error occurs in 6241A.

<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 and suspension</th><th>During sweep operation and suspension</th></tr>
<tr><td rowspan="18">Source</td><td rowspan="2">Suspend voltage</td><td>SUV ± data</td><td>Sets suspend voltage.
Setting range: 0 to ± 32 V / 0 to ± 6 V</td><td></td><td>0</td><td>○</td><td>△</td></tr>
<tr><td>SUV?</td><td>Response: SUV ± d.ddddE ± d *1</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">Suspend Hiz/Loz</td><td>SUZ0</td><td>Hiz: High resistance output status</td><td></td><td>●</td><td rowspan="2">○</td><td rowspan="2">△</td></tr>
<tr><td>SUZ1</td><td>Loz : Low resistance output status</td><td></td><td></td></tr>
<tr><td>SUZ?</td><td>Response: SUZ0 or SUZ1</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">Pulse base value</td><td>DBV ± data</td><td>Voltage pulse base value</td><td></td><td>0</td><td rowspan="2">○</td><td rowspan="2">▲</td></tr>
<tr><td>DBI ± data</td><td>Current pulse base value</td><td></td><td>0</td></tr>
<tr><td>DBV?
DBI?</td><td>Response: DBV ± d.ddddE ± d *1
DBI ± d.ddddE ± d</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">Trigger mode</td><td>M0</td><td>AUTO</td><td></td><td>●</td><td rowspan="2">○</td><td rowspan="2">△</td></tr>
<tr><td>M1</td><td>HOLD</td><td></td><td></td></tr>
<tr><td>M?</td><td>Response: M0 or M1</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">Operate/ Standby</td><td>SBY</td><td>Output is set to OFF (Standby)</td><td>●</td><td>●</td><td>○</td><td>○</td></tr>
<tr><td>OPR</td><td>Output is set to ON (Operating)</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>SUS</td><td>Suspends the output (Suspend)</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>SBY?, OPR?, SUS?</td><td>Responds to the current output status
Response:
<table>
<tr><th>Status</th><th>SBY?, OPR?, SUS?</th></tr>
<tr><td>Operating</td><td>OPR</td></tr>
<tr><td>Suspended</td><td>SUS</td></tr>
<tr><td>Standby</td><td>SBY</td></tr>
</table></td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">Remote Sensing</td><td>RS0</td><td>2W</td><td></td><td>●</td><td rowspan="2">○</td><td rowspan="2">△</td></tr>
<tr><td>RS1</td><td>4W</td><td></td><td></td></tr>
<tr><td>RS?</td><td>Response: RS0 or RS1</td><td></td><td></td><td>○</td><td>○</td></tr>
</table>

*1: The response decimal point is different depending on the set value.
For the source value, limit value, and time parameter set up range, refer to the performance specifications.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Source	Time parameter	SP Th,Td,Tp[,Tw]	Th: Hold time		3 ms	○	△
			Td: Measurement delay time — Unit: ms		4 ms		
			Tp: Period — Tw can be omitted.		50 ms		
			Tw : Pulse width		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		0.01 mV/ 0.001 µA	○	▲
			sp: Stop value		1 mV/ 0.1 µA		
			step: Step value (ignores the polarity)		0.01 mV/ 0.001 µA		
			If all the settings are omitted, set 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: Number of samplings (1 to 8000)		1		
			If all the settings are omitted, set 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 Sweep type only. However it is not allowed to omit each value separately.				▲
		SC?	Response: SCst,sp st,sp:<dddd>			○	○

*1: The response decimal point is different depending on the set value.
For the source value, limit value, and time parameter set up range, refer to the performance specifications.

*3: The values can be changed only between the start and stop address that was set while it is in the Standby status.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Sweep	Two Slope Linear Sweep	SM	fd: first value		0.01 mV/ 0.001 µA	○	▲
		[±fd, ±md, ±ld, st1, st2]	md: middle value		1 mV/ 0.1 µA		
			ld: last value		2 mV/ 0.2 µA		
			st1:Step 1 value		0.01 mV/ 0.001 µA		
			st2:Step 2 value		0.01 mV/ 0.001 µA		
			If all the settings are omitted, set 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?	Responds to the sweep type current source function. Response: Linear sweep: Same as the SN? response Fixed level sweep: Same as the SF? response Random sweep: Same as the SC? response Two Slope Linear Sweep: Same as the SM? response			○	○

*1: The response decimal point is different depending on the set value.
For the source value, limit value, and time parameter set up range, refer to the performance specifications.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Sweep	Random sweep memory data	N [adr] P	Random sweep memory data setting starts from N command and completes at P command. N<adr>,SVR<n>,SOV<data1>,SOV <data2>,...,P (voltage setting) N<adr>,SIR<n>,SOI<data1>,SOI <data2>,...,P (current setting) adr: Memory address (0 to 7999) data1: adr address voltage or current-source value data2: Voltage or Current-source value of the address adr + 1 ***Note:*** ***1. Not specifying the source range causes the FIT range to be specified.*** ***2. A source value different from the current-source function cannot be set.***		0 0 *6	○	×
		N? [adr]	Response: N<adr>,SVR<n>,SOV ± <data>,P (Voltage-source value) N<adr>,SIR<n>,SOI ± <data>,P (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 setting.	0		○	○
		RSAV	Saves the random sweep data.			○	×
		RLOD	Loads the random sweep data.			○	×
		RCLR	Initializes the random sweep data. (Data saved in 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 output value when sweep is stopped.)			○	△
		RB1	ON (Returns to bias value when sweep is stopped.)		●		
		RB?	Response: RB0 or RB1			○	○

*1: The response decimal point is different depending on the set value.
For the source value, limit value, and time parameter set up range, refer to the performance specifications.
*6: It is not initialized by RINI or *RST command.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Sweep	Sweep range	SR0	Auto		●	○	▲
		SR1	Fixed				
		SR?	Response: SR0 or SR1			○	○
	Reverse mode	SV0	OFF		●	○	△
		SV1	ON				
		SV?	Response: SV0 or SV1			○	○
	Number of times sweep is repeated	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			○	○
Measurement	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 limiter value range. (However, if measurement function and source function are same, range becomes same as source range.)		●		
		R?	Response: R0 or R1			○	○
	Measurement Function Link Mode	FX0	OFF		●	○	△
		FX1	ON (VSIM/ISVM) (However, if measurement is OFF, measurement remains OFF after this parameter is changed.)				
		FX?	Response: FX0 or FX1			○	○

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Mea sure-ment	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			○	○
	Switching the unit display	DM0	Displays unit in the decimal number and unit form.		●	○	△
		DM1	Displays unit in the exponent form.				
		DM?	Response: DM0 or DM1			○	○
	Number of digits displayed for the measurement	RE3	Displays $3\frac{1}{2}$ digits			○	△
		RE4	Displays $4\frac{1}{2}$ digits				
		RE5	Displays $5\frac{1}{2}$ 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 response decimal point is different depending on the set value. For the source value, limit value, and time parameter set up range, refer to the performance specifications.

*7: Operational only between ST0 ↔ ST1

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
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 is not changed 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	Readout range setting for "RDT?" (GPIB only) adr1: Number of the first read data (0 to 7999) adr2: Number of the last read data (0 to 7999)	(0,0)	(0,0)	○	△
		RDN?	Response: RDN adr1,adr2 (GPIB only) adr1,adr2 : <dddd>			○	○
		RDT?	Read out data from specified range (GPIB only) Response: See Section 6.6, "Data Output Format." • If data does not exist in the specified number, the output becomes < EE+8.88888E+30 > • The recall execution state is released by executing this command.	(0)		○	△
		SZ?	Reads out the stored data Response: <dddd>	0	*6	○	○
		RNM adr	adr: Sets number of stored data targets (0 to 8000). When the measurement buffer memory is used, Bit 4 (ASM) of the Device Event Status Register (DSR) is set when the number of data items stored in buffer memory matches this value.	0	*6	△	△
		RNM?	Reads the stored target address set value. Response: RNMdddd			○	○

*6: It is not initialized by RINI or *RST command.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
Cal-culation	NULL calculation	NL0	OFF		●	○	△
		NL1	ON				
		NL?	Response: NL0 or NL1			○	○
		KNL ± data	Sets Null constant (An error occurs if NULL OFF is set) *4		0	○	△
		KNL?	Response: KNL ± d.dddddE ± dd			○	○
	Comparator calculation	CO0	OFF		●	○	△
		CO1	ON				
		CO?	Response: CO0 or CO1			○	○
		KHI ± data	Sets upper limit value.		0	○	△
		KLO ± data	Sets lower limit value. *4		0		
		KHI?	Response: KHI ± d.dddddE ± dd			○	○
		KLO?	KLO ± d.dddddE ± dd				
	Scaling calculation	SCL0	OFF		●	○	△
		SCL1	ON				
		SCL?	Response: SCL0 or SCL1			○	○
		KA a	a: Constant A (0 (zero) is not available)		1	○	△
		KB b	b: Constant B		0		
		KC c	c: Constant C *4		1		
		KA?	Response: KA ± d.dddddE ± dd			○	○
		KB?	KB ± d.dddddE ± dd				
		KC?	KC ± d.dddddE ± 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.	-9.99999E+26			
		MIN?	Reads out the minimum value.	+9.99999E+26			
		TOT?	Reads out the total value.	0			
		AVN?	Reads out the number of measurement times. Response: AVN d.dddddE+dd	0			

*4: The setting range is from 0 to ± 999.999E + 24.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
System	User parameter	STP0	Saves the set parameter to non-volatile memory area 0.			○	△
		STP1	Saves the set parameter to non-volatile memory area 1.				
		STP2	Saves the set parameter to non-volatile memory area 2.				
		STP3	Saves the set parameter to non-volatile memory area 3.				
		SINI	Sets the default values to all the memory areas from 0 to 3.				
		RCLP0	Loads the data in non-volatile memory area 0 as the setting parameter.	●		×	×
		RCLP1	Loads the data in non-volatile memory area 1 as the setting parameter.				
		RCLP2	Loads the data in non-volatile memory area 2 as the setting parameter.				
		RCLP3	Loads the data in non-volatile memory area 3 as the setting parameter.				
		RINI	Loads the default value as the setting parameter.				
	Initializing the instrument	*RST	Initializes the parameter. (Items except *6 are default values.)			○	○
		C	Clears the device.			○	○
	Instrument information	*IDN?	The instrument information query command Response: ADC Corp.,nnnnn,xxxxxxxxx,yyyyy ADC Corp.:Manufacturer (9 characters) nnnnn: Devicve name "6241A" (5 characters), "6242" (4 characters) xxxxxxxxx: Serial number (9 characters) yyyyy: ROM revision number (5 characters)			○	○
	Electrical frequency	Automatic 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	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
System	Comparator calculation results buzzer	BZ0	OFF		●	○	△
		BZ1	ON (when the comparator calculation result is HI)				
		BZ2	ON (when the comparator calculation result is GO)				
		BZ3	ON (when the comparator calculation result is LO)				
		BZ4	ON (when the comparator calculation result is HI or LO)				
		BZ?	Response: BZ0 to BZ4			○	○
	Limit detection buzzer	UZ0	OFF		●	○	△
		UZ1	ON				
		UZ?	Response: UZ0 or UZ1			○	○
	Self test	*TST?	Executes and reads out the results. Response: 0; Pass 1; Fail			×	×
		TER?	Returns self test result of each register. Response: a, b, c, and d (a, b, c, and d are equivalent to 0 to 65535.)			○	○
	Error log	ERL?	Reads out error description. Number of errors and error descriptions are 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: Number of errors (006 to 999: Can be overwritten)			○	○
	Relay counter	RLY?	Reads out the relay counter data. Response: ddddddddd (up to 999999999)			×	×
	Interlock setting	OP0	Inputs the STBY In signal (IN).		●	×	×
		OP1	Inputs the OPR/SRBY In signal (IN).				
		OP2	Inputs the Interlock In signal (IN).				
		OP3	Outputs the Operate Out signal (OUT).				
		OP4	Inputs the OPR/SUS In signal (IN).				
		OP?	Response: OP0 to OP4			○	○

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
System	Input and output setting of the synchronous control signal	CP0	Outputs the COMPLETE signal. Meas Front (Measurement Start)			○	△
		CP1	Outputs the COMPLETE signal. Meas End (Measurement End)		●		
		CP2	Outputs the COMPLETE signal. Comp HI (Comparator calculation result is HI)				
		CP3	Outputs the COMPLETE signal. Comp GO (Comparator calculation result is GO)				
		CP4	Outputs the COMPLETE signal. Comp LO (Comparator calculation result is LO)				
		CP5	Outputs the COMPLETE signal. Comp HI or LO (Comparator calculation result is HI or LO)				
		CP6	Outputs the Sync Out signal				
		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	DL0	CRLF<EOI>	●	*5 *8	○	△
		DL1	LF				
		DL2	<EOI>				
		DL3	LF<EOI>				
		DL?	Response: DL0 to DL3			○	○
	Header output	OH0	OFF			○	△
		OH1	ON		*6 ●		
		OH?	Response: OH0 or OH1			○	○

*5: It is not initialized by RINI command.

*6: It is not initialized by RINI or *RST command.

*8: EOI is a GPIB function. It is not output by USB.

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation and suspension	During sweep operation and suspension
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 Standard Event Status Enable Register (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 description (ERR) Response: ddddd			○	○
		*CLS	Clears the status.			○	○
	Operation complete	*OPC	After completing all the operation, set LSB of the Standard Event Status Register			○	○
		*OPC?	Response: 1 (after all operation completed)			○	○
		*WAI	Waits until all the operation is complete (GPIB only).			○	○

*5: It is not initialized by RINI command.

*6: It is not initialized by RINI or *RST command.

<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 and suspension</th><th>During sweep operation and suspension</th></tr>
<tr><td rowspan="20">Cali-bration</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 area. (Calibration data in non-volatile memory is not initialized.)</td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td>XWR</td><td>Saves the calibration data in non-volatile memory.</td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td rowspan="8">Executing calibration</td><td>XVS</td><td>Selects voltage source function calibration.</td><td></td><td></td><td rowspan="8">×</td><td rowspan="8">×</td></tr>
<tr><td>XIS</td><td>Selects current source function calibration.</td><td></td><td></td></tr>
<tr><td>XVLH</td><td>Selects voltage limiter (High) calibration.</td><td></td><td></td></tr>
<tr><td>XVLL</td><td>Selects voltage limiter (Low) calibration.</td><td></td><td></td></tr>
<tr><td>XILH</td><td>Selects current-limiter (High) calibration.</td><td></td><td></td></tr>
<tr><td>XILL</td><td>Selects current-limiter (Low) calibration.</td><td></td><td></td></tr>
<tr><td>XVM</td><td>Selects voltage measurement function calibration.</td><td></td><td></td></tr>
<tr><td>XIM</td><td>Selects current measurement function calibration.</td><td></td><td></td></tr>
<tr><td>Calibration range</td><td>XR-1
XR0
XR1
XR2
XR3
XR4
XR5</td><td>Sets the calibration range.
<table>
<tr><th></th><th>Voltage range</th><th>Current range</th></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>300 mV</td><td>300 mA</td></tr>
<tr><td>XR4</td><td>3 V</td><td>500 mA/3 A</td></tr>
<tr><td>XR5</td><td>30 V/6 V</td><td>5 A *9</td></tr>
</table></td><td></td><td></td><td>×</td><td>×</td></tr>
<tr><td rowspan="6">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</td><td>data: Inputs DMM read data.</td><td></td><td></td></tr>
<tr><td>XADJ</td><td>Changes to the calibration data fine adjustment mode.</td><td></td><td></td><td rowspan="3">×</td><td rowspan="3">×</td></tr>
<tr><td>XUP</td><td>Fine adjusts the calibration data (UP).</td><td></td><td></td></tr>
<tr><td>XDN</td><td>Fine adjusts the calibration data (DOWN).</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: It is not initialized by RINI command.
*6: It is not initialized by RINI or *RST command.
*9: Results in an error on the 6241A.

Commands for maintaining compatibility with previous models

Item		Command	Description	Default		Operation	
				Power ON	Default setting	During DC/ pulse operation	During sweep operation
Source	Source range function and source range	V3	Voltage source function of 300 mV range			○ Sus-pended when executed	×
		V4	Voltage source function of 3 V range				
		V5	Voltage source function of 30 V range/6 V range				
		I-1	Current source function of 30 µA range				
		I0	Current source function of 300 µA range				
		I1	Current source function of 3 mA range				
		I2	Current source function of 30 mA range				
		I3	Current source function of 300 mA range				
		I4	Current source function of 500 mA range/3 A range				
		I5	Current source function of 5 A range *9				
		V? I?	Response: V3 to V5 or I-1 to I5			○	○
	Source value (Pulse value) andLimiter value	D ± data UNIT	Source setting is different depending of the UNIT used. With UNIT: Automatically sets the optimal range. Available units; mV, V, µA, mA, A Without UNIT: Set the current source function and range. If specifying a unit that is different from the current source function, the limiter value will be set as shown below. +data is High limiter value. -data is Low limiter value.			○	×
		D?	Response: D ± <data1>UNIT,D <data2>UNIT data1: Voltage or current source value <d.ddddE ± d> *1 data2: Voltage or current-limiter value (The polarity is space) <0d.dddE ± d> *1 UNIT: V or A ***Note:*** ***If the absolute values of High and Low limits are different, the response becomes D± d.ddddE ± dUNIT, D09.999E + 9 UNIT.***			○	○

*9: Results in an error in the 6241A.

<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">Operating or Standby</td><td>H</td><td>Output is set to OFF (Standby).</td><td>●</td><td></td><td>○</td><td>○</td></tr>
<tr><td>E</td><td>Output is set to ON (Operating).</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>E?, H?</td><td>Responds to the current output status.
Response:<table><tr><th>Status</th><th>E?, H?</th></tr><tr><td>Operating</td><td>E</td></tr><tr><td>Suspended</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>The random-sweep memory-data starts from N command and completes at P command.
N<adr>,D<data1><UNIT>,D<data2><UNIT>,...,P
adr:Memory address (0 to 7999)
data1:adr address voltage or current-source value
data2:adr + 1 address voltage or current-source value
<i>Note:</i>
<i>1. Not specifying the source range causes the FIT range to be specified.</i>
<i>2. A source value different from the current-source function cannot be set.</i></td><td></td><td>0
*6</td><td>○</td><td>×</td></tr>
</table>

*6: It is not initialized by RINI or *RST command.

6.7.4 TER? Command

The TER? command reads out the self test result.

1. Command response

$$\underbrace{ddddd}_{a},\underbrace{ddddd}_{b},\underbrace{ddddd}_{c},\underbrace{ddddd}_{d},\underbrace{ddddd}_{e}$$

2. Description of values a, b, c, d, and e

   The TER register column in Table 5-17 shows the error causes and register values of a, b, c, d and e. If a VSVM3 V + FS error occurs during the self test, the command response is as follows.

   00000, 00000, 00016, 00000, 00000

6.8 Sample Programs

6.8.1 Programming Examples with GPIB

A basic program example to operate the 6241A/6242 from a computer via GPIB connection is introduced below.

Operating Environment

Computer:	DELL OPTIPLEX 170L (Pentium® 4 CPU 2.80GHz)
GPIB hardware:	GPIB-USB-HS (NATIONAL INSTRUMENTS)
Module:	Niglobal.bas, Vbib-32.bas (the software included with GPIB-USB-HS)
Language:	Microsoft Excel Visual Basic for Application

These programs 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

---

NOTE: The GPIB address is set to 1 for the 6241A/6242.

6.8.1.1 Programming Example 1: DC Measurement

```
Option Explicit                             ' Explicit declaration for all variables

Private Sub Sampl1 GPIB_Click()             ' Event procedure for the command button
  Dim board As Integer                      ' GPIB board address
  Dim pad As Integer                        ' 6241A/6242 address
  Dim vig As Integer                        ' 6241A/6242 device descriptor
  Dim dt As String*20                       ' Data reception buffer

  board=0                                   ' GPIB board address 0
  pad=1                                     ' 6241A/6242 address 1

  Call ibdev(board,pad,0,T10s,1,0,vig)      ' Opening and initializing device (6241A/6242) (time out 10 s)

  Call ibconfig(vig,IbcUnAddr,1)            ' Address setting performed for each transmission or reception

  Call ibwrt(vig, "C,*RST" & vbLf)          ' DCL and parameter Initialization
  Call ibwrt(vig, "OH1" & vbLf)             ' Header ON

  Call ibwrt(vig, "M1" & vbLf)              ' Trigger mode hold
  Call ibwrt(vig, "VF" & vbLf)              ' Voltage source function
  Call ibwrt(vig, "F2" & vbLf)              ' Current measurement function
  Call ibwrt(vig, "SOV1,LMI0.003" & vbLf)   ' DC Source value 1 V, Limiter value 3 mA
  Call ibwrt(vig, "OPR" & vbLf)             ' Output ON
  Call SUBmeas(vig, dt)                     ' Measurement trigger & data recall
  Cells(1, 1) = Left(dt, 15)                ' Assigns data to the designated cell.
```

```
  Call ibwrt(vig, "SOV2" & vbLf)              ' DCSource value 2 V
  Call SUBmeas(vig, dt)                       ' Measurement trigger & Data recall
  Cells(2, 1) = Left(dt, 15)                  ' Assigns data to the designated cell.

  Call ibwrt(vig, "SOV-2" & vbLf)             ' DCSource value -2 V
  Call SUBmeas(vig, dt)                       ' Measurement trigger & Data recall
  Cells(3, 1) = Left(dt, 15)                  ' Assigns data to the designated cell.

  Call ibwrt(vig, "SOV4" & vbLf)              ' DCSource value 4 V
  Call SUBmeas(vig, dt)                       ' Measurement trigger & Data recall
  Cells(4, 1) = Left(dt, 15)                  ' Assigns data to the designated cell.

  Call ibwrt(vig, "F1" & vbLf)                ' Voltage-measurement function
  Call ibwrt(vig, "IF" & vbLf)                ' Current source function

  Call ibwrt(vig, "SOI0.002,LMV3" & vbLf)
                                              ' DC Source value 2 mAA, Limiter value 3 V
  Call ibwrt(vig, "OPR" & vbLf)               ' Output ON
  Call SUBmeas(vig, dt)                       ' Measurement trigger & data recall
  Cells(5, 1) = Left(dt, 15)                  ' Assigns data to the designated cell.

  Call ibwrt(vig, "SBY" & vbLf)               ' Output OFF

  Call ibonl(vig, 0)                          ' Setting the 6241A/6242 to offline
End Sub                                       ' Event procedure complete

                                              ' Subroutine
Private Sub SUBmeas(vig As Integer, dt As String)
                                              ' Measurement trigger & Measurement data recall

  Call ibwrt(vig, "*TRG" & vbLf)              ' Measurement trigger actuated
  Call ibrd(vig,dt)                           ' Measurement data recall
End Sub
```

(Output example)

```
  DI +1.00000E-03
  DI +2.00000E-03
  DI -2.00000E-03
  DIU+3.00000E-03
  DV +2.00000E-00
```

6.8.1.2 Programming Example 2: Pulse Measurement

```
Option Explicit                             ' Explicit declaration for all variables

Private Sub Sampl2_GPIB_Click()             ' Event procedure for the command button
  Dim board As Integer                      ' GPIB board address
  Dim pad As Integer                        ' 6241A/6242 address
  Dim vig As Intege                         ' 6241A/6242 device descriptor
  Dim dt As String*20                       ' Data reception buffer

  board=0                                   ' GPIB board address 0
  pad=1                                     ' 6241A/6242 address 1

  Call ibdev(board,pad,0,T10s,1,0,vig)      ' Opening and initializing device (6241A/6242) (time out 10 s)
  Call ibconfig(vig,IbcUnAddr,1)            ' Address setting performed for each transmission or reception

  Call ibwrt(vig, "C,*RST" & vbLf)          ' DCL and parameter Initialization
  Call ibwrt(vig, "OH1" & vbLf)             ' Header ON
  Call ibwrt(vig, "M1" & vbLf)              ' Trigger mode hold
  Call ibwrt(vig, "VF" & vbLf)              ' Voltage source function
  Call ibwrt(vig, "F2" & vbLf)              ' Current measurement function
  Call ibwrt(vig, "MD1" & vbLf)             ' Pulse source mode

  Call ibwrt(vig, "SOV2,LMI0.003" & vbLf)   ' Pulse source value 2 V, Limiter value 3 mA
  Call ibwrt(vig, "DBV1" & vbLf)            ' Pulse base value 1 V
  Call ibwrt(vig, "SP3,1,130,50" & vbLf)    ' Hold time 3 ms, Measurement delay time 1 ms
                                            ' Period 130 ms, pulse time 50 ms

  Call ibwrt(vig, "OPR" & vbLf)             ' Output ON
  Call SUBmeas(vig, dt)                     ' Measurement trigger & data recall
  Cells(1, 1) = Left(dt, 15)                ' Assigns data to the designated cell

  Call ibwrt(vig, "SOV2.5" & vbLf)          ' Pulse source value 2.5 V
  Call SUBmeas(vig, dt)                     ' Measurement trigger & data recall
  Cells(2, 1) = Left(dt, 15)                ' Assigns data to the designated cell

  Call ibwrt(vig, "SP3,60,130,50" & vbLf)   ' Hold time 3 ms, Measurement delay time 60 ms
                                            ' Period 130 ms, pulse time 50 ms
  Call SUBmeas(vig, dt)                     ' Measurement trigger & data recall
  Cells(3, 1) = Left(dt, 15)                ' Assigns data to the designated cell

  Call ibwrt(vig, "DBV0.5" & vbLf)          ' Pulse base value 0.5 V
  Call SUBmeas(vig, dt)                     ' Measurement trigger & data recall
  Cells(4, 1) = Left(dt, 15)                ' Assigns data to the designated cell

  Call ibwrt(vig, "SBY" & vbLf)             ' Output OFF

  Call ibonl(vig,0)                         ' Setting the 6241A/6242 to offline
End Sub                                     ' Event procedure completed
                                            ' Subroutine
Private Sub SUBmeas(vig As Integer, dt As String)
                                            ' Measurement trigger & Measurement data recall

  Call ibwrt(vig, "*TRG" & vbLf)            ' Measurement trigger actuated
  Call ibrd(vig,dt)                         ' Measurement data recall
```

```
End Sub
```

(Output example)

```
  DI +2.00000E-03
  DI +2.50000E-03
  DI +1.00000E-03
  DI +0.50000E-03
```

6.8.1.3 Programming Example 3: Sweep Measurement

```
Option Explicit                             ' Explicit declaration for all variables

Private Sub Sampl3_GPIB_Click()             ' Event procedure for the command button
  Dim board As Integer                      ' GPIB board address
  Dim pad As Integer                        ' 6241A/6242 address
  Dim vig As Integer                        ' 6241A/6242 device descriptor
  Dim dt As String*20                       ' Data reception buffer
  Dim s As Integer                          ' Serial poll results storage variable
  Dim rowNum As Integer                     ' Cell number

  board = 0                                 ' GPIB board address 0
  pad = 1                                   ' 6241A/6242 address 1

  Call ibdev(board,pad,0,T10s,1,0,vig)      ' Opening and initializing device (6241A/6242) (time out 10 s)
  Call ibconfig(vig,IbcUnAddr,1)            ' Address setting performed for each transmission or reception


  Call SUBsend(vig, "C,*RST" & vbLf)        ' DCL and parameter Initialization
  Call SUBsend(vig, "*CLS" & vbLf)          ' Status byte initialization
  Call SUBsend(vig, "*SRE8" & vbLf)         ' Setting bit3 for the Service Request Enable Register to 1
  Call SUBsend(vig, "DSE8192" & vbLf)       ' Setting bit13 for the Device Event Enable Register to 1
  Call SUBsend(vig, "S0" & vbLf)            ' SRQ transmission mode
                                            ' Register setting for transmitting SRQ following completion of
                                              Sweep
  Call SUBsend(vig, "OH1" & vbLf)           ' Header ON

  Call SUBsend(vig,"VF" & vbLf)             ' Voltage source function
  Call SUBsend(vig, "F2" & vbLf)            ' Current measurement function
  Call SUBsend(vig, "MD2" & vbLf)           ' Sweep source mode

  Call SUBsend(vig, "SN0.5,5,0.5" & vbLf)   ' Linear Sweep: Start 0.5 V, stop 5 V, and step 0.5 V
  Call SUBsend(vig, "SB0" & vbLf)           ' Sweep bias value 0 V
  Call SUBsend(vig, "SP3,4,100" & vbLf)     ' Hold time 3 ms, Measurement delay time 4 ms
                                            ' Period: 100 ms
  Call SUBsend(vig, "LMI0.03" & vbLf)       ' Limiter value: 30 mA

  Call SUBsend(vig, "ST1,RL" & vbLf)        ' Storing Measured Data into Data Memory (Memory Store)
                                              ON, Clearing Saved Data (Memory Clear)
  Call SUBsend (vig, "OPR" & vbLf)          ' Output ON
  Call SUBsend(vig, "*TRG" & vbLf)          ' Starting Sweep

                                            ' Waiting for Sweep measurement completing
  Call ibwait(vig,RQS Or TIMO)              ' Waiting for SRQ transmission
  If (ibsta And TIMO) Then                  ' In case of time out
    Call MsgBox("SRQ Time Out",vbOKOnly,"Error")
                                            ' Indicating error
  Else                                      ' If no timeout
    Call ibrsp(vig,s)                       ' Executing serial poll
  End If                                    ' Ending If
```

```
  Call SUBsend(vig, "SBY" & vbLf)             ' Output OFF

  rowNum = 1                                  ' Designates the first row number in the cell


                                              ' Measurement buffer memory data recall
  Call SUBsend(vig, "RN1,0" & vbLf)           ' Setting to measurement buffer memory recall mode and
                                              ' Specifying recall address from 0
  Do                                          ' Infinite loop
    Call ibrd(vig,dt)                         ' Measurement buffer memory data recall
                                              ' Outputting memory data by data recall after memory recall
                                                mode setting, adding recall number by 1


    Cells(rowNum, 1) = Left(dt, 15)           ' Assigns data to the designated cell.
    If 1=InStr(1,dt,"EE+8.88888E+30") Then
                                              ' If recalled data is empty,
      Exit Do                                 ' exiting infinite loop
    End If                                    ' Ending If
    rowNum = rowNum + 1                       ' Cell row number +1
  Loop                                        ' Ending Do
  Call SUBsend(vig, "RN0,0" & vbLf)           ' Releasing to measurement buffer memory recall mode

  Call ibonl(vig,0)                           ' Setting the 6241A/6242 to offline
End Sub                                       ' Event procedure complete
```

(Output example)

```
  DI +00.5000E-03
  DI +01.0000E-03
  DI +01.5000E-03
  DI +02.0000E-03
  DI +02.5000E-03
  DI +03.0000E-03
  DI +03.5000E-03
  DI +04.0000E-03
  DI +04.5000E-03
  DI +05.0000E-03
  EE +8.88888E+30
```

6.8.1.4 Programming Example 4: Using Measurement Buffer Memory

(Example: 100 measurement data items are recalled in the shortest time)

```
Option Explicit                             ' Explicit declaration for all variables

Private Sub Sampl4_GPIB_Click()             ' Event procedure for the command button
  Dim board As Integer                      ' GPIB board address
  Dim pad As Integer                        ' 6241A/6242 address
  Dim vig As Integer                        ' 6241A/6242 device descriptor
  Dim dt As String*20                       ' Data reception buffer
  Dim dt_sz As Integer                      ' Number of measurement buffer memory data items
  Dim dt_rn(100) As String*20               ' Measurement buffer memory data storage array variable
  Dim i As Integer,s As Integer             ' i: For Loop variable, s: Serial poll result storage variable

  board=0                                   ' GPIB board address 0
  pad = 1                                   ' 6241A/6242 address 1

  Call ibdev(board,pad,0,T30s,1,0,vig)      ' Opening and initializing device (6241A/6242) (time out 30 s)
  Call ibconfig(vig,IbcUnAddr,1)            ' Address setting performed for each transmission or reception

                                            ' Executing Sweep measurement
  Call ibwrt(vig, "C,*RST" & vbLf)          ' DCL and parameter Initialization
  Call ibwrt(vig, "*CLS" & vbLf)            ' Status byte initialization
  Call ibwrt(vig, "*SRE8" & vbLf)           ' Setting bit3 for the Service Request Enable Register to 1.
  Call ibwrt(vig, "DSE8192" & vbLf)         ' Setting bit13 for the Device Event Enable Register to 1.
  Call ibwrt(vig, "S0" & vbLf)              ' SRQ transmission mode
                                            ' Register setting for transmitting SRQ following completion of
                                              Sweep
  Call ibwrt(vig, "VF,F2" & vbLf)           ' Voltage source, Current measurement function
  Call ibwrt(vig, "MD2" & vbLf)             ' Sweep source mode

  Call ibwrt(vig, "SN0.05,5,0.05" & vbLf)   ' Linear Sweep: Start 0.05 V, stop 5 V, and step 0.05 V
  Call ibwrt(vig, "SB0" & vbLf)             ' Sweep bias value 0 V
  Call ibwrt(vig, "SP3,4,100" & vbLf)       ' Hold time 3 ms, Measurement delay time 4 ms
                                            ' Period: 100 ms
  Call ibwrt(vig, "LMI0.03" & vbLf)         ' Limiter value: 30 mA

   Call ibwrt(vig, "ST1,RL" & vbLf)         ' Storing Measured Data into Data Memory (Memory Store)
                                              ON,Clearing Saved Data (Memory Clear)

  Call ibwrt(vig, "OPR" & vbLf)             ' Output ON
  Call ibwrt(vig, "*TRG" & vbLf)            ' Starting Sweep

                                            ' Waiting for Sweep measurement completing
  Call ibwait(vig,RQS Or TIMO)              ' Waiting for SRQ transmission
  If (ibsta And TIMO) Then                  ' In case of time out
    Call MsgBox("SRQ Time Out",vbOKOnly,"Error")
                                            ' Indicating error
  Else                                      ' If no timeout
    Call ibrsp(vig,s)                       ' Executing serial poll
  End If                                    ' Ending If

  Call ibwrt(vig, "SBY" & vbLf)             ' Output OFF
                                            ' Measurement buffer memory data recall
                                            ' No output data header, block delimiter EOI
  Call ibwrt(vig, "SZ?" & vbLf)             ' Measurement buffer memory data number query
  Call ibrd(vig, dt)                        ' Measurement buffer memory data number recall
  dt_sz = Val(dt)                           ' Converting recalled data to numerical variable
  Call ibwrt(vig, "OH0" & vbLf)             ' Setting output data header to OFF
```

```
  Call ibwrt(vig, "DL2" & vbLf)               ′ Setting output data block delimiter to EOI
  Call ibwrt(vig, "RN1,0" & vbLf)             ′ Setting to measurement buffer memory output mode
                                              ′ Specifying output number from 0
  For i=1 To dt_sz                            ′ Repeats as much as the number of memory data.
    Call ibrd(vig, dt)                        ′ Measurement buffer memory data recall
                                              ′ Outputting memory data by data recall after memory recall
                                                mode setting, adding output number by + 1

    dt_rn(i) = dt                             ′ Storing recalled data in order
  Next i                                      ′ Ending For
  Call ibwrt(vig, "RN0,0" & vbLf)             ′ Releasing to measurement buffer memory output mode


                                              ′ Displaying the measurement data
  For i=1 To dt_sz                            ′ Repeats as much as the number of memory data.
    Cells(i, 1) = i                           ′ Assigns memory number to the designated cell.
    Cells(i, 2) = "'" & Left(dt_rn(i), 12)    ′ Assigns data to the designated cell.
  Next i                                      ′ Ending For

  Call ibonl(vig, 0)                          ′ Setting the 6241A/6242 to offline
End Sub                                       ′ Event procedure completed
```

(Output example)

```
    1 +00.0500E-03
    2 +00.1000E-03
    3 +00.1500E-03
    | (Omitted)
   98 +04.9000E-03
   99 +04.9500E-03
  100 +05.0000E-03
```

6.8.2 Programming Examples with USB

A basic program example to operate the 6241A/6242 from a computer via USB connection is introduced below.

Operating Environment

Computer:	DELL OPTIPLEX 170L (Pentium® 4 CPU 2.80GHz)
Module :	asub.bas (Software supplied with USB driver for ADC measuring instruments.)
Language:	Microsoft Excel Visual Basic for Application

Conducts the same operations as the GPIB sample program in “6.8.1.1 Programming Example 1: DC Measurement” using the USB interface.

NOTE: The USB.Id is set to 1 for the 6241A/6242.

6.8.2.1 Programming Example: DC Measurement

```
Option Explicit                             ' Explicit declaration for all variables

Private Const OK As Integer = 0             ' Definition of OK

Private Sub Sampl1_USB_Click()              ' Event procedure for the command button


  Dim vig As Long                           ' USB handle
  Dim myID As Long                          ' Declares the 6241A/6242 USB.Id variable.
  Dim ret As Long                           ' Declares the driver return value variable.
  Dim dt As String                          ' Declares the USB data reception buffer variable.

  myID = 1                                  ' USB.Id No. "1"

  ret = ausb_start(10)                      ' Initialize USB, Timeout:10 s
  If ret <> OK Then                         ' If USB initialization is NG
    MsgBox "USB Initialization Error", vbExclamation
    GoTo err_exit
  End If

  Call mSecSleep(100)                       ' USB initialization wait time (100 ms)

  ret = ausb_open(vig, myID)                ' Open VIG for MyID: No.1, acquire USB handle
  If ret <> OK Then                         ' If opening device is NG
    MsgBox "Device Open Error", vbExclamation
    GoTo err_exit
  End If

  Call ausbwrt(vig, "*RST")                 ' Initialize parameter
  Call ausbwrt(vig, "OH1")                  ' Header ON

  Call ausbwrt(vig, "M1")                   ' Trigger mode hold
  Call ausbwrt(vig, "VF")                   ' Voltage source function
  Call ausbwrt(vig, "F2")                   ' Current measurement function

  Call ausbwrt(vig, "SOV1,LMI0.003")        ' DC source value 1 V, limiter value 3 mA
  Call ausbwrt(vig, "OPR")                  ' Output ON
  Call SUBmeas(vig, dt)                     ' Measurement trigger & Measurement data recall
```

```
  Cells(1, 1) = Left(dt, 15)                ' Assigns data to the designated cell.

  Call ausbwrt(vig, "SOV2")                 ' DC source value 2V
  Call SUBmeas(vig, dt)                     ' Measurement trigger & Measurement data recall
  Cells(2, 1) = Left(dt, 15)                ' Assigns data to the designated cell.

  Call ausbwrt(vig, "SOV2")                 ' DC source value -2V
  Call SUBmeas(vig, dt)                     ' Measurement trigger & Measurement data recall
  Cells(3, 1) = Left(dt, 15)                ' Assigns data to the designated cell.

  Call ausbwrt(vig, "SOV4")                 ' DC source value 4V
  Call SUBmeas(vig, dt)                     ' Measurement trigger & Measurement data recall
  Cells(4, 1) = Left(dt, 15)                ' Assigns data to the designated cell.

  Call ausbwrt(vig, "F1")                   ' Voltage-measurement function
  Call ausbwrt(vig, "IF")                   ' Current source function

  Call ausbwrt(vig, "SOI0.002,LMV3")        ' DC source value 2 mA, limiter value 3 V
  Call ausbwrt(vig, "OPR")                  ' Output ON
  Call SUBmeas(vig, dt)                     ' Measurement trigger & Measurement data recall
  Cells(5, 1) = Left(dt, 15)                ' Assigns data to the designated cell.

  Call ausbwrt(vig, "SBY")                  ' Output OFF

err_exit:

  ret = ausb_close(vig)                     ' Close device
  If ret <> OK Then                         ' If closing device is NG
    MsgBox "Device Close Error", vbExclamation
  End If

  ret = ausb_end()                          ' End USB
  If ret <> OK Then                         ' If end USB is NG
    MsgBox "USB End Error", vbExclamation
  End If
End Sub                                     ' Event procedure completed

                                            ' Subroutine
Private Sub SUBmeas(id As Long, dt As String)
                                            ' Measurement trigger & Measurement data recall

  Call ausbwrt(id, "*TRG")                  ' Measurement trigger actuated
  Call ausbrd(id,dt)                        ' Measurement data recall

End Sub


                                            ' Subroutine
Private Sub ausbwrt(id As Long, command As String)
                                            ' Send command subroutine
  Dim ret As Long                           ' Declares the driver return value variable.

  ret = ausb_write(id, command)             ' Send command
  If ret <> OK Then
    MsgBox "Send Error", vbExclamation
    GoTo err_exit
  End If

  Exit Sub
err_exit:
```

```
  ret = ausb_close(id)
  If ret <> OK Then
    MsgBox "Device Close Error", vbExclamation
  End If

  ret = ausb_end()
  If ret <> OK Then
    MsgBox "USB End Error", vbExclamation
  End If
End Sub

                                             ' Subroutine
Private Sub ausbrd(id As Long, dt As String)
                                             ' Receive data subroutine
  Dim ret As Long                            ' Declares the driver return value variable.
  Dim siz As Long

  ret = ausb_read(id, dt, 50, siz)           ' Receive data
  If ret = OK Then
    dt = Left$(dt, siz - 1)
  Else
    ret = ausb_clear(id)                     ' Clear device
    MsgBox "Receive Error", vbExclamation
    GoTo err_exit
  End If

  Exit Sub
err_exit:

  ret = ausb_close(id)
  If ret <> OK Then
    MsgBox "Device Close Error", vbExclamation
  End If

  ret = ausb_end()
  If ret <> OK Then
    MsgBox "USB End Error", vbExclamation
  End If
End Sub
```

(Output example)

```
  DI +1.00000E-03
  DI +2.00000E-03
  DI -2.00000E-03
  DIU+3.00000E-03
  DV +2.00000E+00
```

7. PERFORMANCE TEST

This chapter describes the methods for checking whether the 6241A/6242 can operate in the specified accuracy.

7.1 6241A Tests

7.1.1 Measuring Instruments Required for Performance Tests

The test measuring instruments required for the performance tests are the same as those shown in Section 8.1.1, “Cables and Measuring Instruments Required for Calibration.”

7.1.2 Connection

The connections required for the performance test are the same as shown in Figure 8-1, “Connections for 6241A Calibration.”

7.1.3 Test Methods

Execute the performance test under the following conditions in a location free of dust, vibration, noise or other adverse conditions:

Temperature:	23 ± 5ºC
Relative humidity:	70% or lower
Warm-up:	60 minutes or longer

Self-test, display, key, and buzzer tests

1. Press **MENU** key to select ***SYSTEM*** in the parameter group and refer to Section 5.2.15, “Self Test” to execute.

NOTE: ***If Error is displayed during the test, refer to Section 5.2.15, “Self Test” to verify the content of the error.***

Voltage source measurement test

1. Connect the 6241A and the DMM (Digital Multi-Meter) as shown in Figure 8-1 (a).
2. Set the DMM to DCV, auto range, and the Integration time 10 PLC or longer.
3. Set the 6241A to DC source mode, free run, and Integration time at 200 ms.
4. Select voltage source voltage measurement and Operate.
5. With Zero and ± F.S generated in the 300 mV range to 30 V range, verify that the difference between the source set value and the DMM measurement value and the difference between the 6241A measured value and the DMM measured value are within the accuracy described in Chapter 9, "SPECIFICATIONS."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6241A as outlined in Chapter 8, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.***

Current source measurement test (in the range between 30 µA and 500 mA)

1. Connect the 6241A and DMM as shown in Figure 8-1 (b).
2. Set DMM to DCI, auto range, and Integration time at 10 PLC or longer.
3. Set the 6241A to DC source mode, free run, and Integration time at 200 ms.
4. Select current source current measurement and Operate.
5. With Zero and ±F.S generated in the 30 µA range to 500 mA range, verify that the difference between the source set value and the DMM measurement value and the difference between the 6241A measured value and the DMM measured value are within the accuracy described in Chapter 9, "SPECIFICATIONS."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6241A as outlined in Chapter 8, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.***

7.2 6242 Tests

7.2.1 Measuring Instruments Required for Performance Tests

The test measuring instruments required for the performance tests are the same as those shown in Section 8.2.1, “Cables and Measuring Instruments Required for Calibration.”

7.2.2 Connection

The connections required for the performance test are the same as shown in Figure 8-7, “6242 Connections for Calibration.”

7.2.3 Test Methods

Execute the performance test under the following conditions in a location free of dust, vibration, noise or other adverse conditions:

Temperature:	23 ± 5ºC
Relative humidity:	70% or lower
Warm-up:	60 minutes or longer

Self-test, display, key, and buzzer tests

1. Press **MENU** key to select ***SYSTEM*** in the parameter group and refer to Section 5.2.15, “Self Test” to execute.

NOTE: ***If Error is displayed during the test, refer to Section 5.2.15, “Self Test” to check the content of the error.***

Voltage source measurement test

1. Connect the 6242 and the DMM (Digital Multi-Meter) as shown in Figure 8-7 (a).
2. Set the DMM to DCV, auto range, and the Integration time 10 PLC or longer.
3. Set the 6242 to DC source mode, free run, and Integration time at 200 ms.
4. Select voltage source voltage measurement and Operate.
5. With Zero and ±F.S generated in the 300 mV range to 6 V range, verify that the difference between the source set value and the DMM measurement value and the difference between the 6242 measured value and the DMM measured value are within the accuracy described in Chapter 9, “SPECIFICATIONS.”

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6242 as outlined in Chapter 8, “CALIBRATION” or contact an ADC CORPORATION sales representative for the calibration or servicing.***

Current source measurement test (in the range between 30 µA and 300 mA)

1. Connect the 6242 and DMM as shown in Figure 8-7 (b).
2. Set DMM to DCI, auto range, and Integration time at 10 PLC or longer.
3. Set the 6242 to DC source mode, free run, and Integration time at 200 ms.
4. Select current source current measurement and Operate.
5. With Zero and ±F.S generated in the 30 µA range to 300 mA range, verify that the difference between the source set value and the DMM measurement value and the difference between the 6242 measured value and the DMM measured value are within the accuracy described in Chapter 9, “SPECIFICATIONS.”

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6242 as outlined in Chapter 8, “CALIBRATION” or contact an ADC CORPORATION sales representative for the calibration or servicing.***

Current source measurement test (in the range between 3 A and 5 A)

1. Connect the 6242 to DMM and to the standard resistor as shown in Figure 8-7.

   The following table shows the standard resistance values.

Range	Standard resistance value
3 A	100 mΩ
5 A	10 mΩ

2. Set DMM to DC V, auto range, and Integration time at 10 PLC or longer.
3. Set the 6242 to DC source mode, free run, and Integration time at 200 ms.
4. Select current source current measurement and Operate.
5. Generate ZERO and ± F.S in the 3 A and 5 A ranges. Verify that the difference between the source set value and the converted current value calculated from the DMM measured value and standard resistance 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 6242 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 6241A/6242 to ensure that the 6241A/6242 is used within the specified accuracy ranges.
In order to use the 6241A/6242 in the specified accuracy, periodic calibration at least once a year is recommended.
Contact an ADC CORPORATION sales representative for the calibration service.

8.1 6241A Calibration

8.1.1 Cables and Measuring Instruments Required for Calibration

The table below shows the cables and measuring instrument accuracy required for calibration in each range.

Range	ZERO		FS		Recommended instrument	Cable
	Calibration point	Required accuracy	Calibration point	Required accuracy		
300 mV 3 V 30 V	0 V	500 nA 5 µV 50 µV	±300 mV ±3 V ±30 V	16 ppm 10 ppm 21 ppm	6581 *1	A01044 (Standard accessory)*2
30 µA 300 µA 3 mA 30 mA 300 mA 500 mA	0 A	50 pA 500 pA 5 nA 50 nA 500 nA 500 nA	±30 µA ±300 µA ± 3 mA ±30 mA ±300 mA ±500 mA	120 ppm 122 ppm 122 ppm 122 ppm 230 ppm 200 ppm		

*1: Use the 6581 under the following conditions:
Integration time: 10 PLC. Auto ZERO: ON. Within 24 hours following INT CAL.

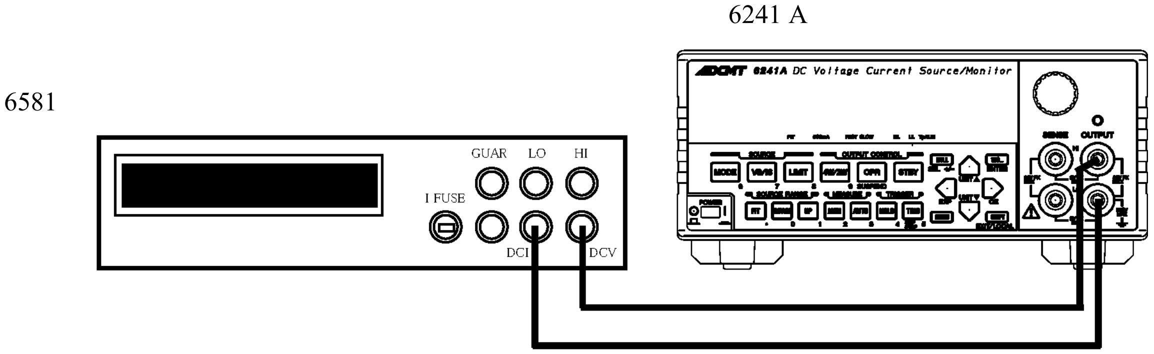
*2: When much externally induced noise exists, use shielded cables, such as A01001, etc.

8.1.2 Safety Precautions

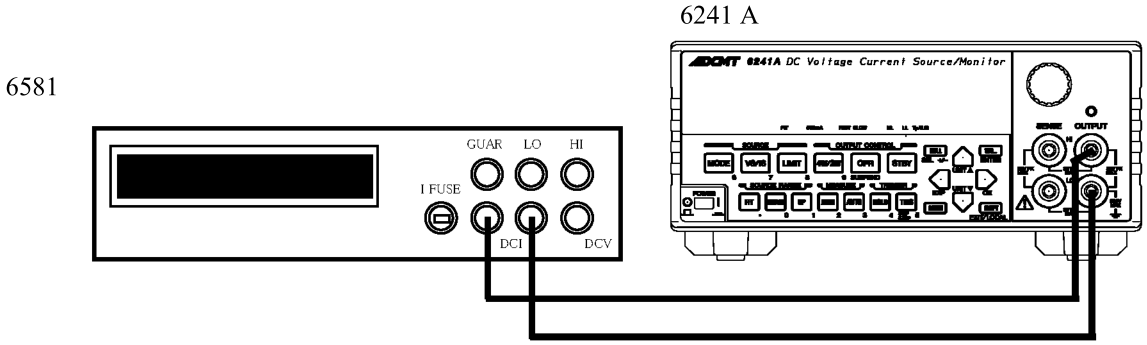
1. Use an AC power supply with the specified voltage.
2. Execute calibration under the following conditions in a location free of dust, vibration, noise or other adverse conditions:
3. Temperature: 23°C ±3°C
   Relative humidity: 70% or lower
4. Allow the 6241A to warm-up for 2 hours or longer before calibration. Allow the measuring instruments to be used in the calibration to warm-up for the period of time specified before the calibration. Warm-up time for the 6581 requires more than 4 hours.
5. After calibration, note the dates of the calibration and the next scheduled calibration on a card or sticker, etc. for convenience.
6. Calibration can not be performed by key operations.
   Use the GPIB/USB remote command to calibrate this instrument with the computer.

8.1.3 Connections

Figure 8-1 below shows the connections for calibration using the 6581.



(a) Connections used for confirmation and calibration of Voltage source measurement.



(b) Connections used for confirmation and calibration of Current source measurement.

Figure 8-1 Connections for 6241A Calibration

8.1.4 Calibration Points and Tolerance Range

For calibration, use the measurement instruments satisfying the required accuracy described in Section 8.1.1, “Cables and Measuring Instruments Required for Calibration”, meeting the tolerance ranges shown in the following table.

Item	Range	Calibration point		Tolerance range
		ZERO	F.S	
Voltage-source	300 mV	0 V	+300.00 mV	10 µV
	3 V		+3.0000 V	100 µV
	30 V		+30.000 V	1 mV
Current-source	30 µA	0 A	+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
	500 mA		+500.00 mA	20 µA
Voltage-measurement	300 mV	0 V	+300.000 mV	2 µV
	3 V		+3.00000 V	20 µV
	30 V		+30.0000 V	200 µV
Current-measurement	30 µA	0 A	+30.0000 µA	200 pA
	300 µA		+300.000 µA	2 nA
	3 mA		+3.00000 mA	20 nA
	30 mA		+30.0000 mA	200 nA
	300 mA		+300.000 mA	5 µA
	500 mA		+500.000 mA	5 µA
Voltage HI limiter:	300 mV	0 V	+300.00 mV	50 µV
	3 V		+3.0000 V	500 µV
	30 V		+30.000 V	5 mV
Voltage LO limiter:	300 mV	0 V	-300.00 mV	50 µV
	3 V		-3.0000 V	500 µV
	30 V		-30.000 V	5 mV

Item	Range	Calibration point		Tolerance range
		ZERO	F.S	
Current HI limiter	30 μA	0 A	+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
	500 mA		+500.0 mA	500 μA
Current LO limiter	30 μA	0 A	-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
	500 mA		-500.0 mA	500 μA

8.1.5 Calibrating Operation

Use GPIB or USB remote command to calibrate the 6241A.
Figures 8-2 to 8-6 show the calibration procedure. For more information on remote commands, refer to Section 6.7.3, "Remote Command List."

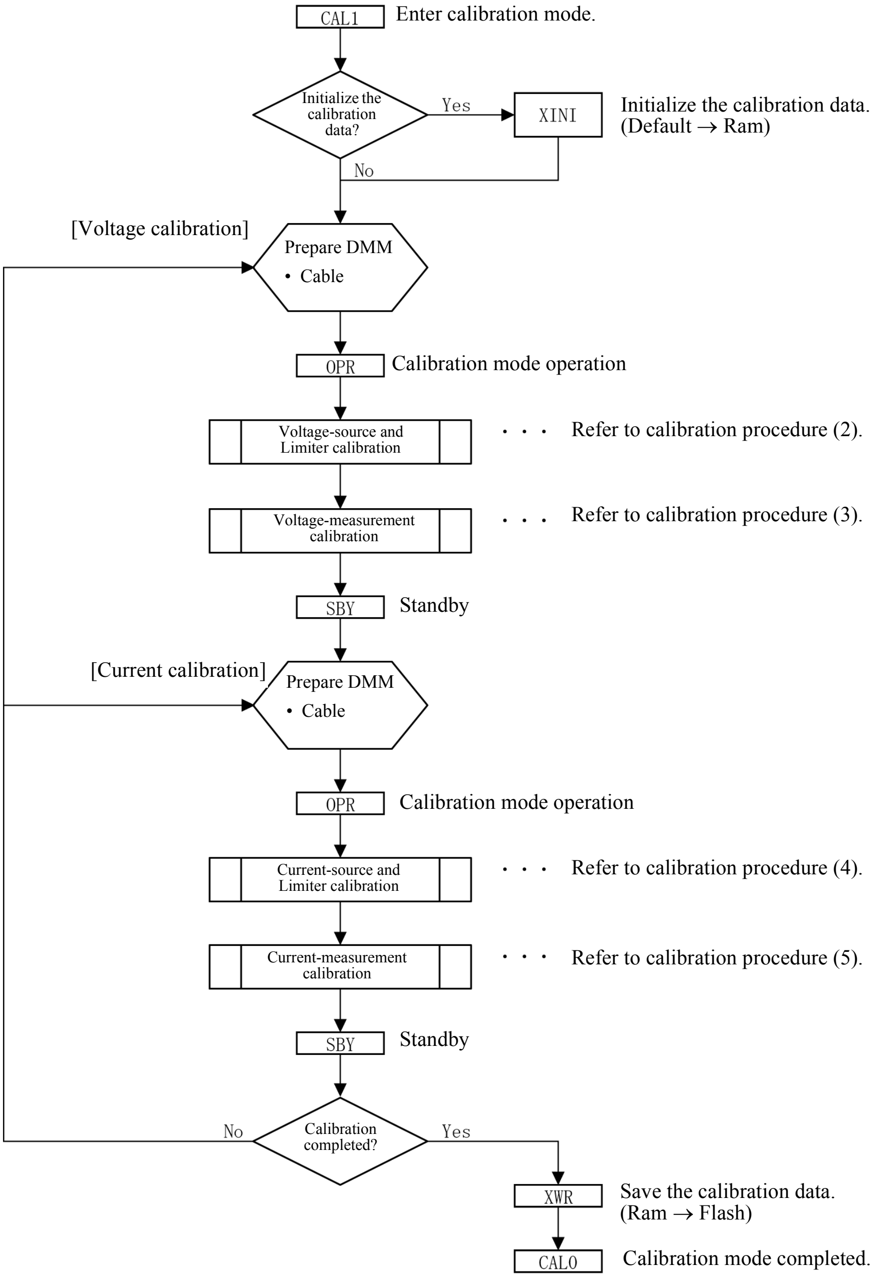


Figure 8-2 6241A Calibration Procedure (1)

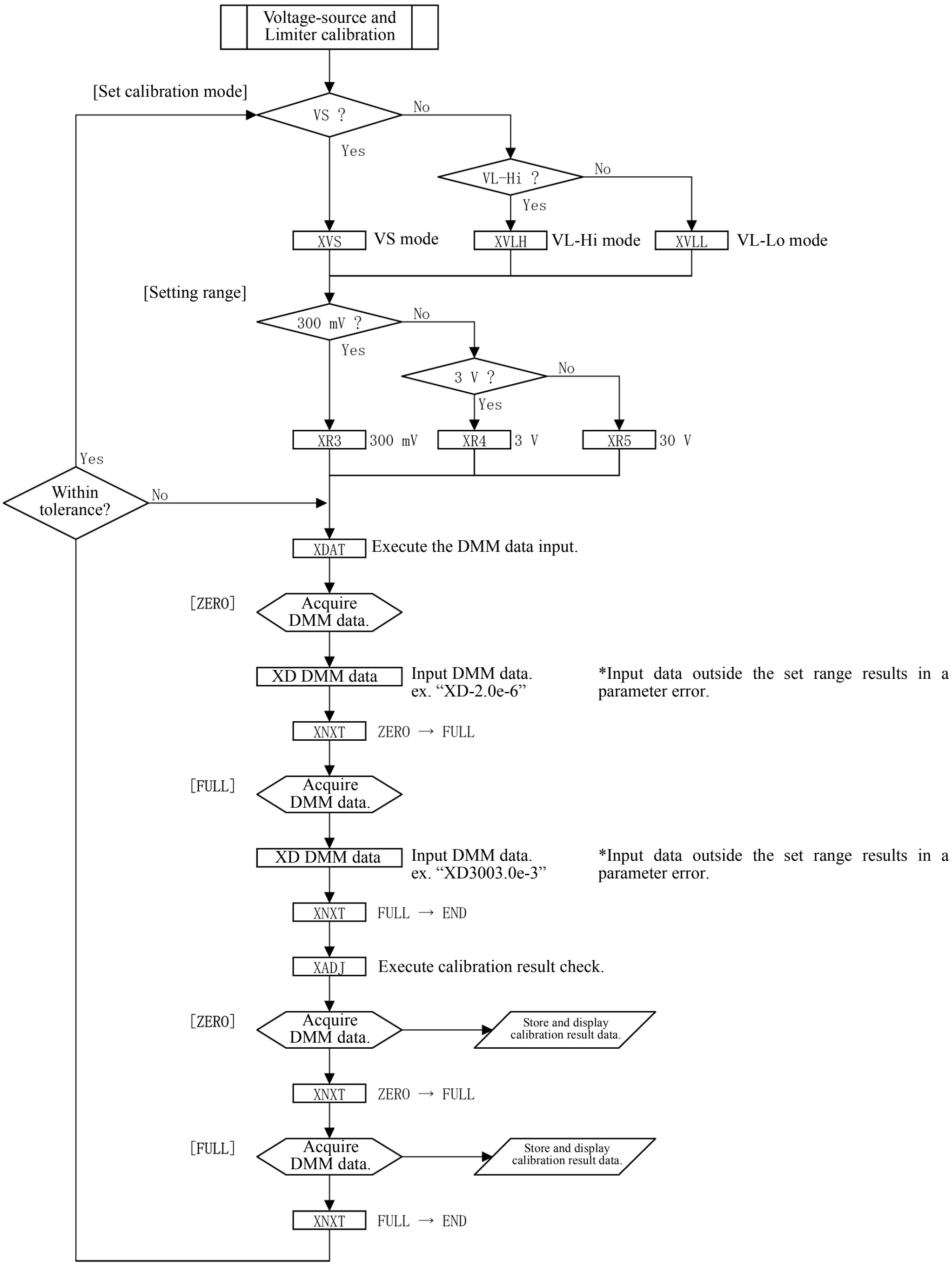


Figure 8-3 6241A Calibration Procedure (2)

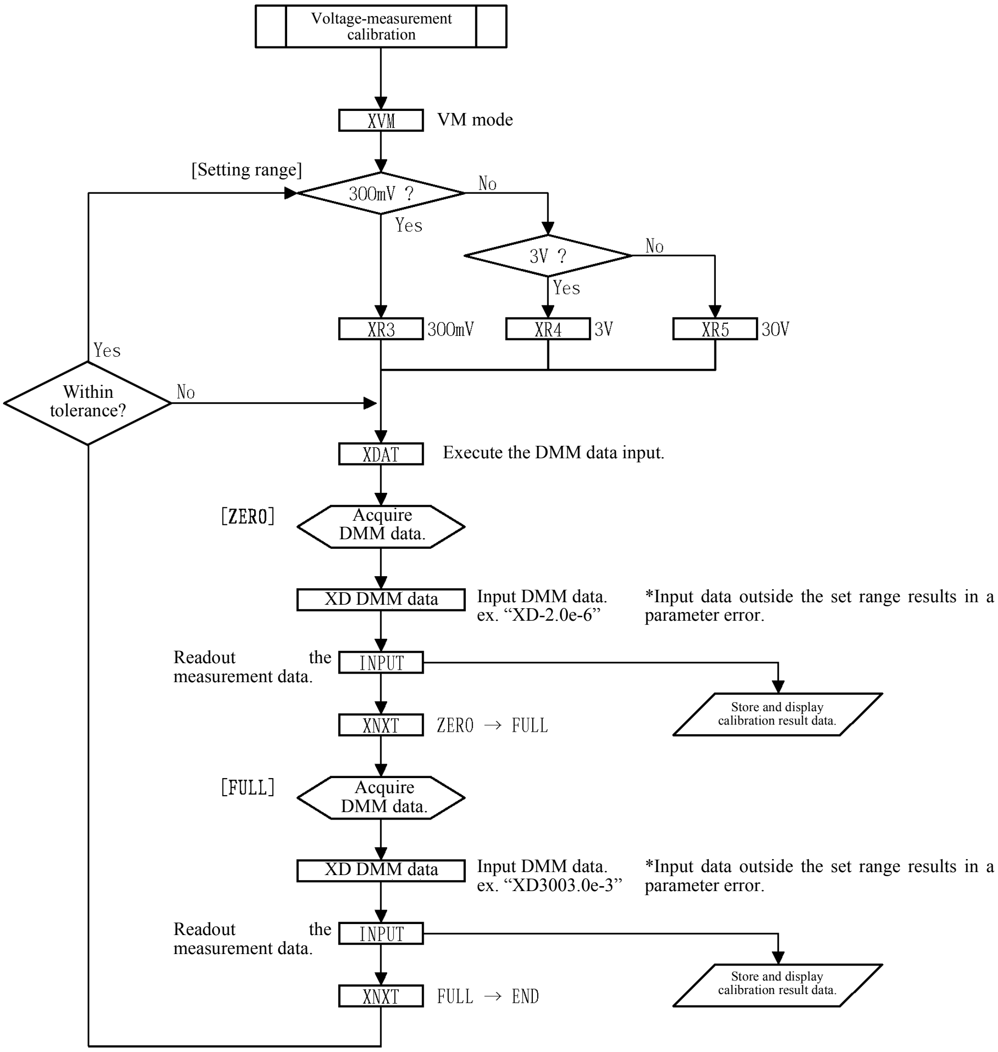


Figure 8-4 6241A Calibration Procedure (3)

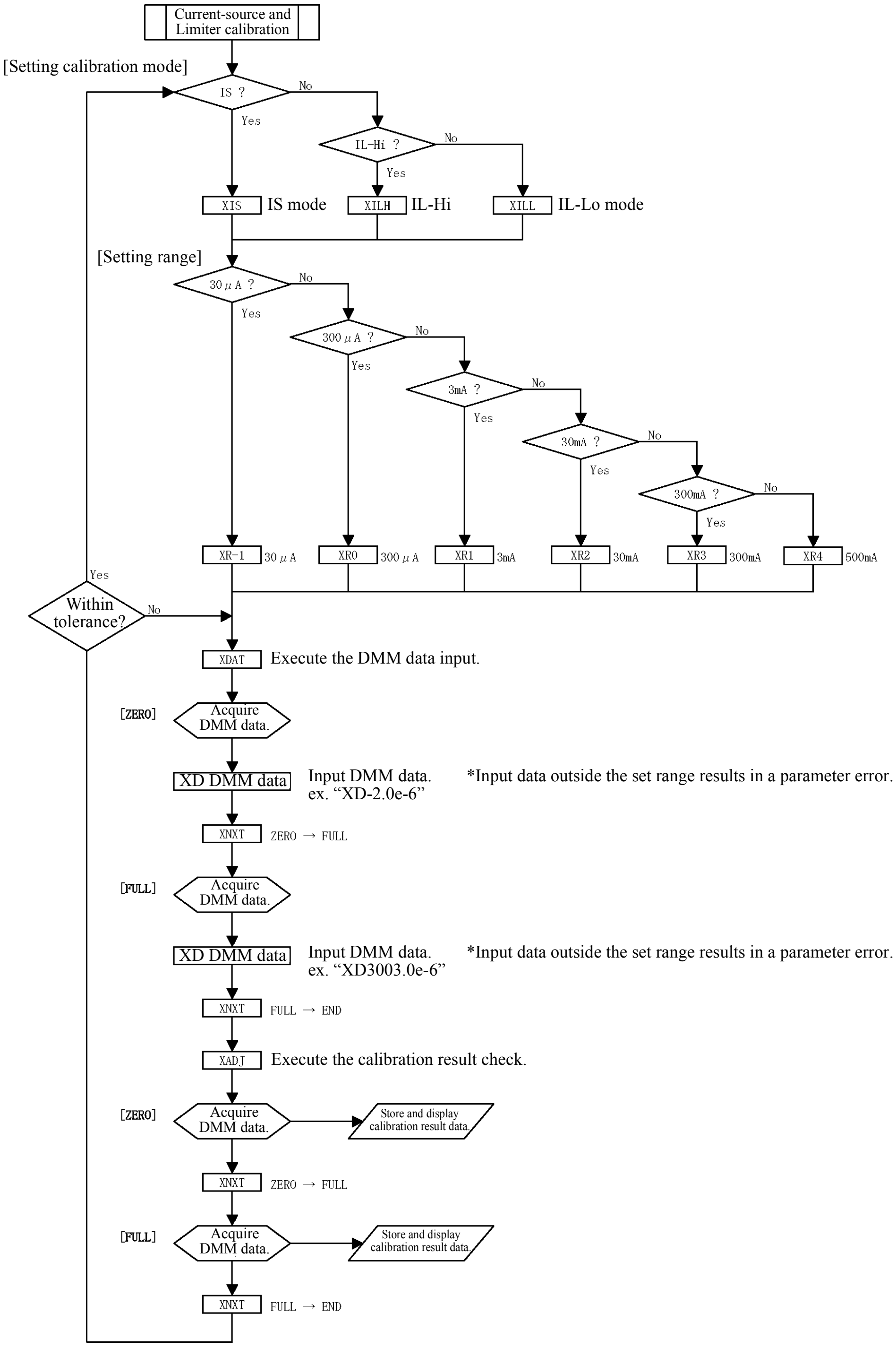


Figure 8-5 6241A Calibration Procedure (4)

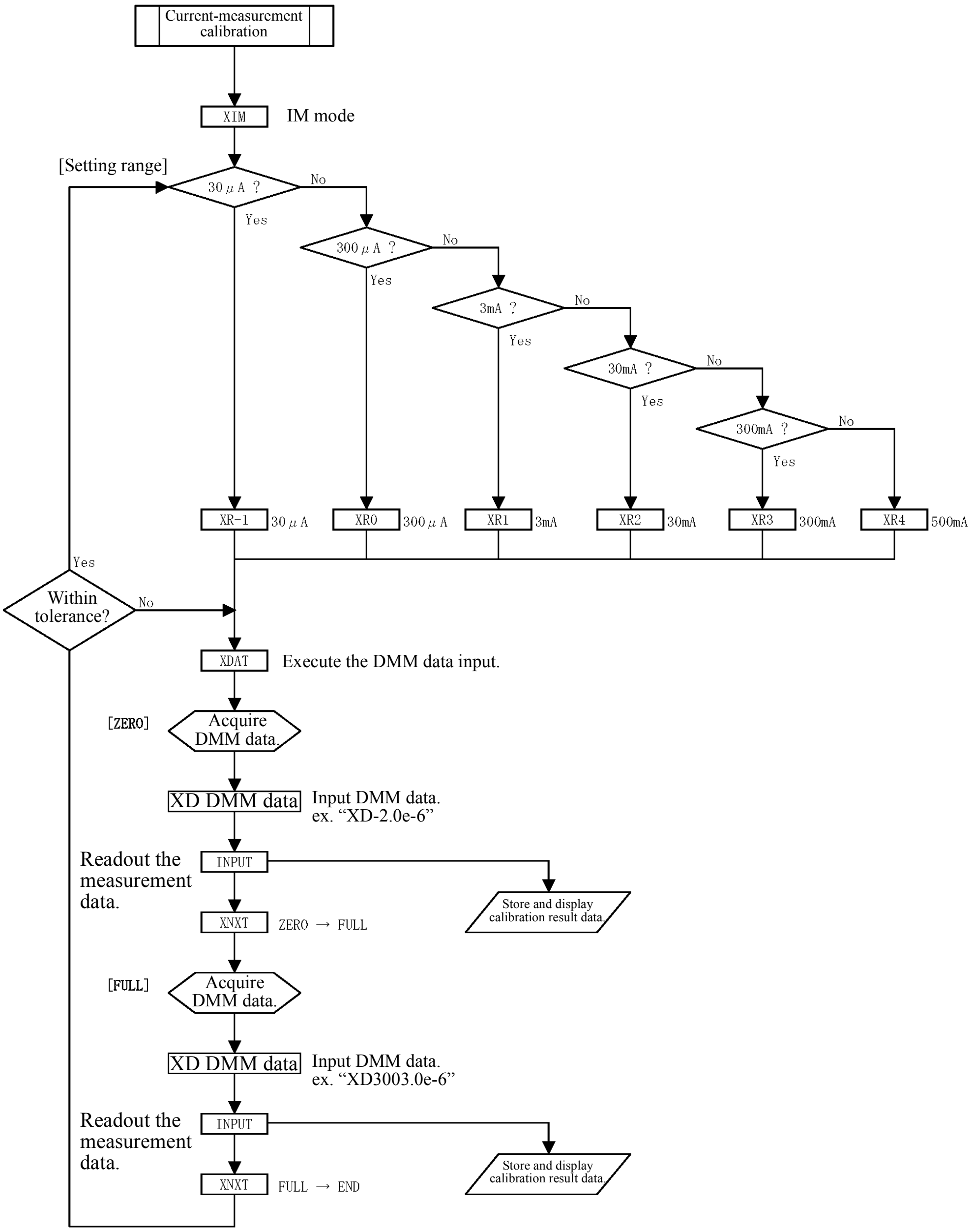


Figure 8-6 6241A Calibration Procedure (5)

8.1.5.1 Calibration Procedure

For details about the calibration procedure, see Figure 8-2, "6241A Calibration Procedure (1)."

1. Use CAL1 to enter the calibration mode.
2. When executing all calibration items, initialize the calibration data by using XINI only once before calibration is started.
3. When executing a voltage calibration, refer to Section 8.1.3, "Connections", to connect units.
4. Set the calibration mode as the operation mode by using OPR.
5. Conduct calibration according to Figure 8-3, "6241A Calibration Procedure (2)" or Figure 8-4, "6241A Calibration Procedure (3)."
6. Press SBY to set the Standby mode.
7. Select XWR to store the calibration data in the non-volatile memory.
8. Select CAL0 to complete calibration.

8.1.5.2 Voltage-source and Voltage-limiter Calibration

1. Select the voltage calibration mode.

Voltage-source:	XVS
Voltage Hi limiter:	XVLH
Voltage Lo limiter:	XVLL

2. Select the range.

300 mV range:	XR3
3 V range:	XR4
30 V range:	XR5

3. Using XDAT, set the DMM data input mode.
4. Set up the DMM read value using XD data.
5. Select XNXT to proceed to the full-scale calibration mode.
6. Set up the DMM read value using XD data.
7. Select XNXT to exit from the DMM data input mode.
8. Select XADJ to proceed to the zero calibration data fine adjustment mode.
9. Verify the zero calibration value.
   XUP and XDN can fine-adjust the calibration coefficient.
10. XNXT shifts to full-scale calibration data fine adjustment mode.

11. Verify the full-scale calibration value.
    XUP and XDN can fine-adjust the calibration coefficient.
12. Proceed to the next step.
    When the voltage calibration mode is changed: XNXT
    When the operation proceeds to voltage-measurement calibration process: XVM

8.1.5.3 Voltage-measurement Calibration

1. Using XVM, change the mode to voltage measurement calibration mode.
2. Select the range.
    300 mV range: XR3
    3 V range: XR4
    30 V range: XR5
3. Using XDAT, set the DMM data input mode.
4. Set up the DMM read value using XD data.
5. Read out and verify the measurement data.
6. Select XNXT to proceed to the full-scale calibration mode.
7. Set up the DMM read value using XD data.
8. Read out and verify the measurement data.
9. Proceed to the next step.
    When the voltage range is changed: XNXT
    When the operation proceeds to current-source and voltage limiter calibration process: XIS, XVLH, XVLL

8.1.5.4 Current-source and Current-limiter Calibration

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
500 mA range:	XR4

3. Perform the same procedure as described in Section 8.1.5.2, “Voltage-source and Voltage-limiter Calibration.”

4. Proceed to the next step.

When the current calibration mode is changed:	XNXT
When the operation proceeds to current-measurement calibration process:	XIM

8.1.5.5 Current-measurement Calibration

1. Using XIM, change the mode to current measurement calibration mode.

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
500 mA range:	XR4

3. Perform the same procedure as described in Section 8.1.5.3, “Voltage-measurement Calibration.”

8.2 6242 Calibration

8.2.1 Cables and Measuring Instruments Required for Calibration

The table below shows the cables and measuring instrument accuracy required for calibration in each range.

Range	ZERO		FS		Standard resistance value	Recommended instrument	Cable
	Calibration point	Required accuracy	Calibration point	Required accuracy			
300 mV	00 V	500 nA	±300 mV	16 ppm		6581 *1	A01044 (Standard accessory)*2
3 V		5 µV	±3 V	10 ppm			
6 V		50 µV	±6 V	21 ppm			
30 µA	0 A	50 pA	±30 µA	120 ppm			
300 µA		500 pA	±300 µA	122 ppm			
3 mA		5 nA	± 3 mA	122 ppm			
30 mA		50 nA	±30 mA	122 ppm			
300 mA		500 nA	±300 mA	230 ppm			
3 A	0 V (0 A) *3	1.5 µV	±300 mV (±3 A) *3	16 ppm	100 mΩ Required accuracy: 150 ppm		A01044 (Standard accessory)*2
5 A		1.5 µV	±50 mV (±5 A) *3	60 ppm	10 mΩ Required accuracy: 150 ppm		A01035 (6581 Standard accessory)

*1: Use the 6581 under the following conditions:
Integration time: 10 PLC. Auto ZERO: ON. Within 24 hours following INT CAL.

*2: When a lot of externally induced noise exists, use shielded cables, such as A01001, etc.

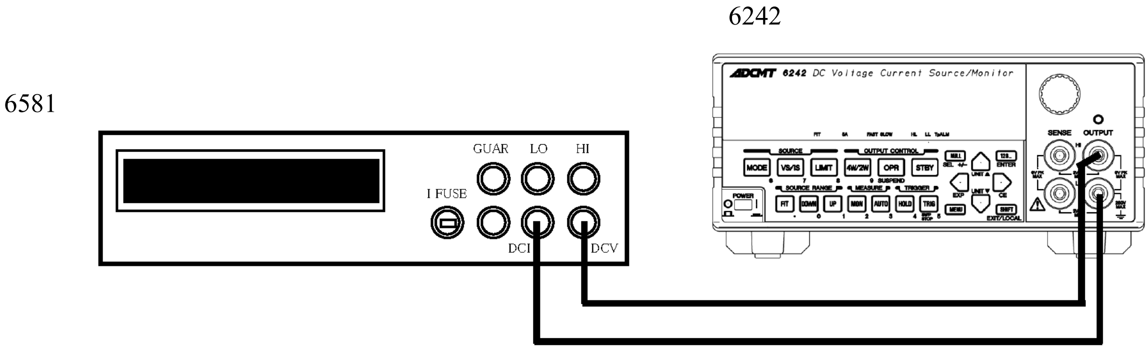
*3: The 3 A and 5 A ranges of the 6242 are calibrated using voltage conversion with a standard resistance.

8.2.2 Safety Precautions

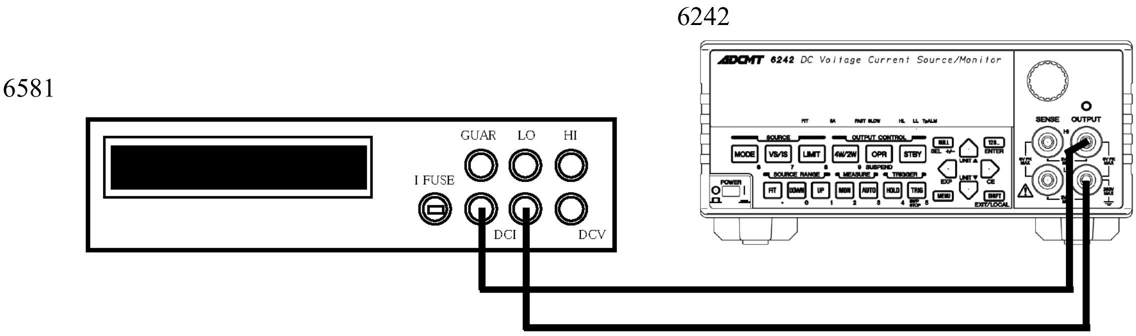
1. Use an AC power supply with the specified voltage.
2. Execute calibration under the following conditions in a location free of dust, vibration, noise or other adverse conditions:
3. Temperature: 23ºC ±3ºC
   Relative humidity: 70% or lower
4. Allow the 6242 to warm-up for 2 hours or longer before calibration. Allow the measuring instruments to be used in the calibration to warm-up for the period of time specified before the calibration. Warm-up time for the 6581 requires more than 4 hours.
5. After calibration, note the dates of the calibration and the next scheduled calibration on a card or sticker, etc for convenience.
6. Calibration can not be performed by key operations.
   Use the GPIB/USB remote command to calibrate this instrument with the computer.

8.2.3 Connections

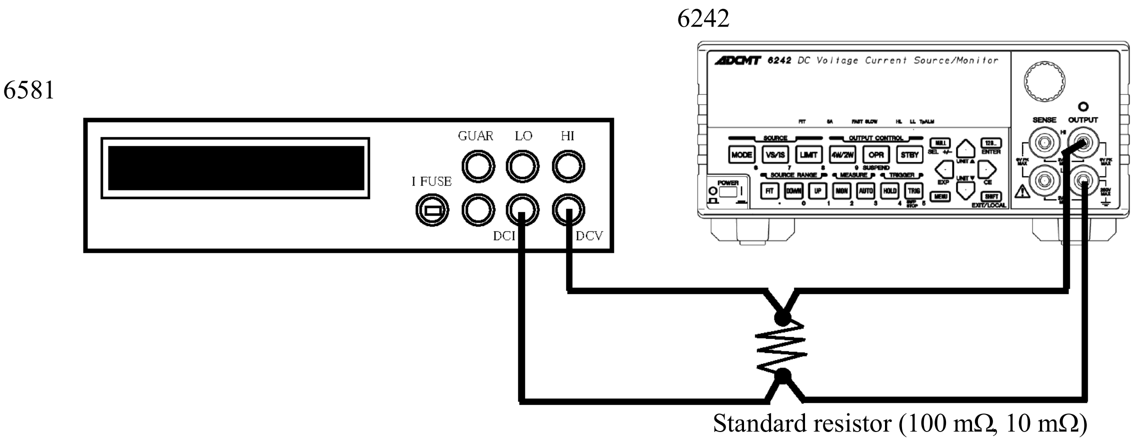
Figure 8-7 below shows the connections for calibration using the 6581.



(a) Connections used for confirmation and calibration of Voltage source measurement.



(b) Connections used for confirmation and calibration of Current source measurement (30 µA to 300 mA range)



(c) Connections used for confirmation and calibration of Current source measurement (3 A, 5 A range)

Figure 8-7 6242 Connections for Calibration

8.2.4 Calibration Points and Tolerance Range

For calibration, use the measurement instruments satisfying the required accuracy described in Section 8.2.1, “Cables and Measuring Instruments Required for Calibration”, meeting the tolerance ranges shown in the following table.

Item	Range	Calibration point		Tolerance range
		ZERO	F.S	
Voltage-source	300 mV	0 V	+300.00 mV	10 µV
	3 V		+3.0000 V	100 µV
	6 V		+06.000 V	0.6 mV
Current-source	30 µA	0 A	+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
	3 A		+3.0000 A	100 µA
	5 A		+5.0000 A	200 µA
Voltage-measurement	300 mV	0 V	+300.000 mV	2 µV
	3 V		+3.00000 V	20 µV
	6 V		+06.0000 V	200 µV
Current-measurement	30 µA	0 A	+30.0000 µA	200 pA
	300 µA		+300.000 µA	2 nA
	3 mA		+3.00000 mA	20 nA
	30 mA		+30.0000 mA	200 nA
	300 mA		+300.000 mA	5 µA
	3 A		+3.00000 A	50 µA
	5 A		+5.00000 A	50 µA
Voltage HI limiter	300 mV	0 V	+300.0 mV	50 µV
	3 V		+3.000 V	500 µV
	6 V		+06.00 V	5 mV
Voltage LO limiter	300 mV	0 V	-300.0 mV	50 µV
	3 V		-3.000 V	500 µV
	6 V		-06.00 V	5 mV

Item	Range	Calibration point		Tolerance range
		ZERO	F.S	
Current HI limiter	30 μA	0 A	+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
	3 A		+3.000 A	500 μA
	5 A		+5.000 A	1 mA
Current LO limiter	30 μA	0 A	-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
	3 A		-3.000 A	500 μA
	5 A		-5.000 A	1 mA

8.2.5 Calibrating Operation

Use GPIB or USB remote command to calibrate the 6242.
Figures 8-9 to 8-14 show the calibration procedure. For more information on remote commands, refer to the calibration Section 6.7.3, " Remote Command List."

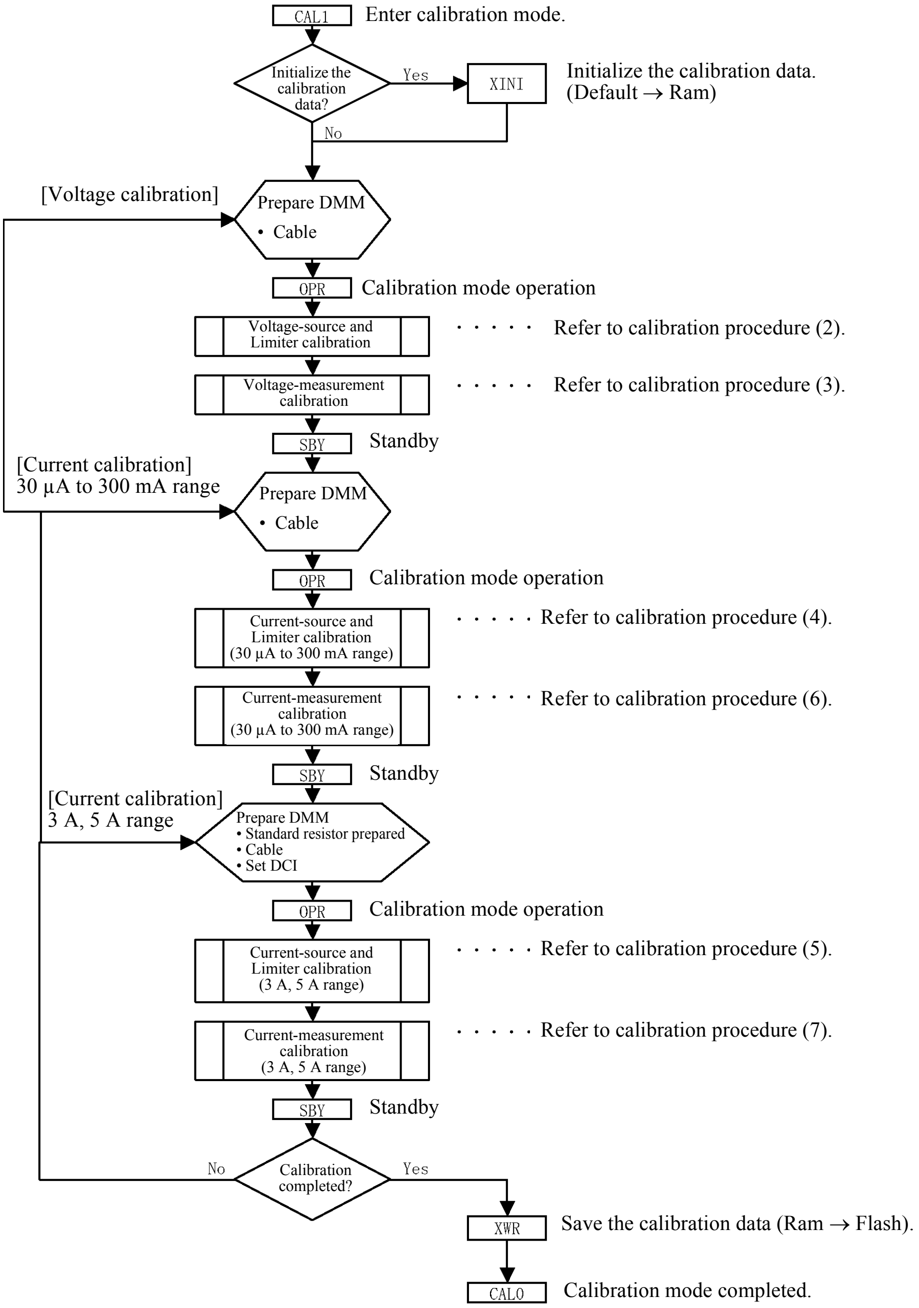


Figure 8-8 6242 Calibration Procedure (1)

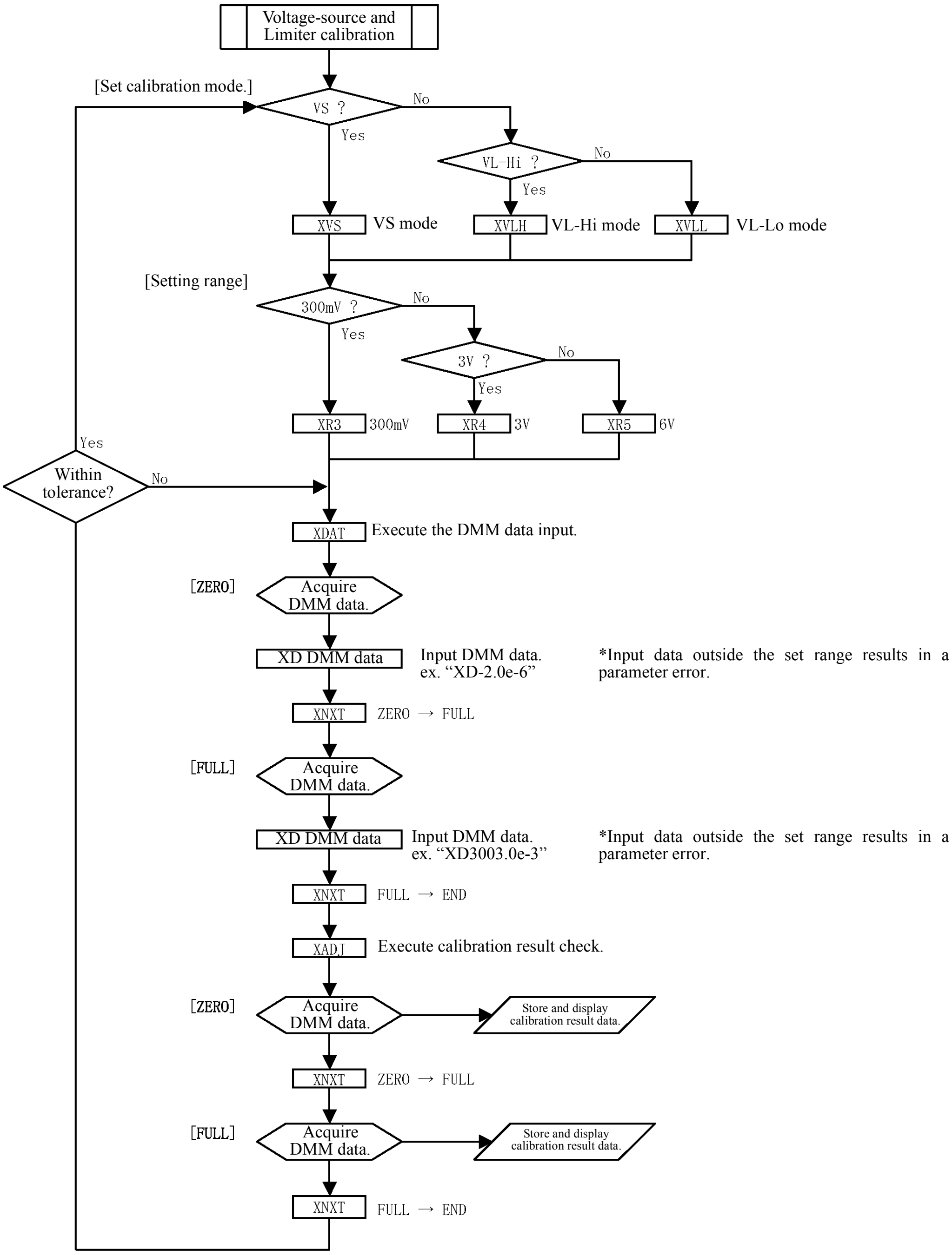


Figure 8-9 6242 Calibration Procedure (2)

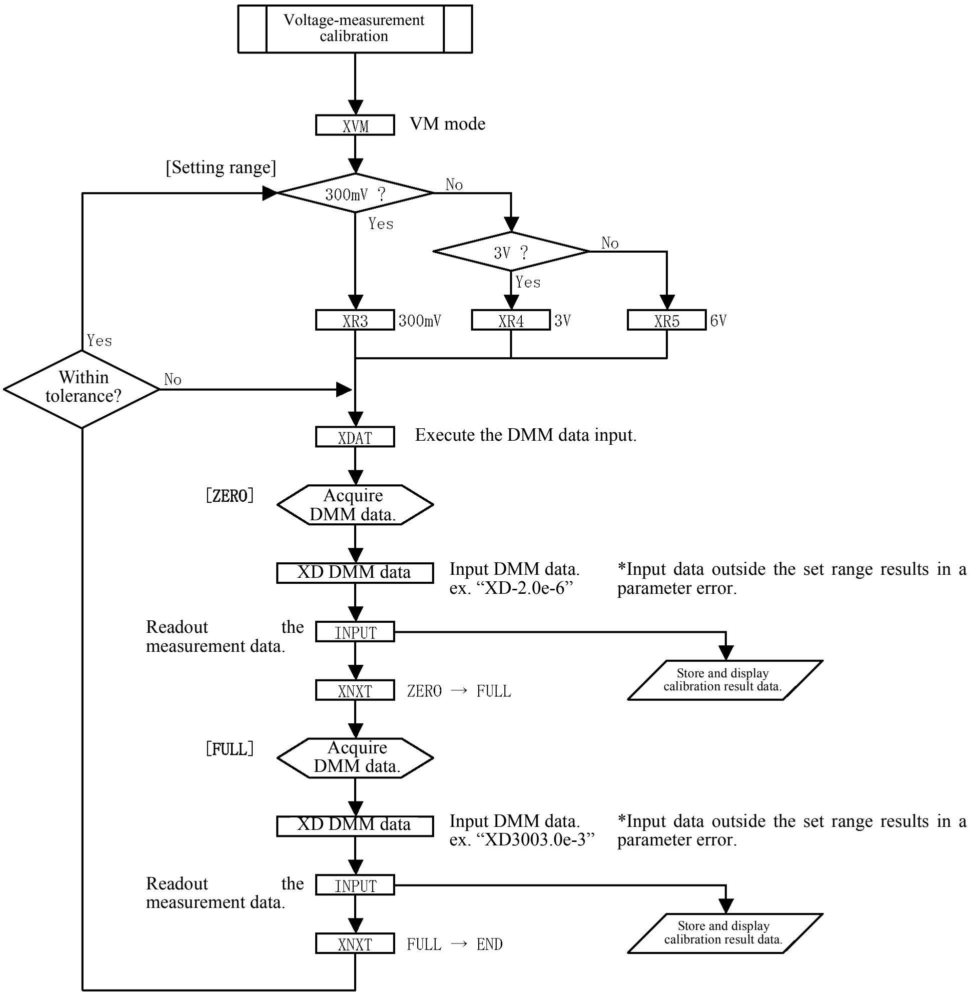


Figure 8-10 6242 Calibration Procedure (3)

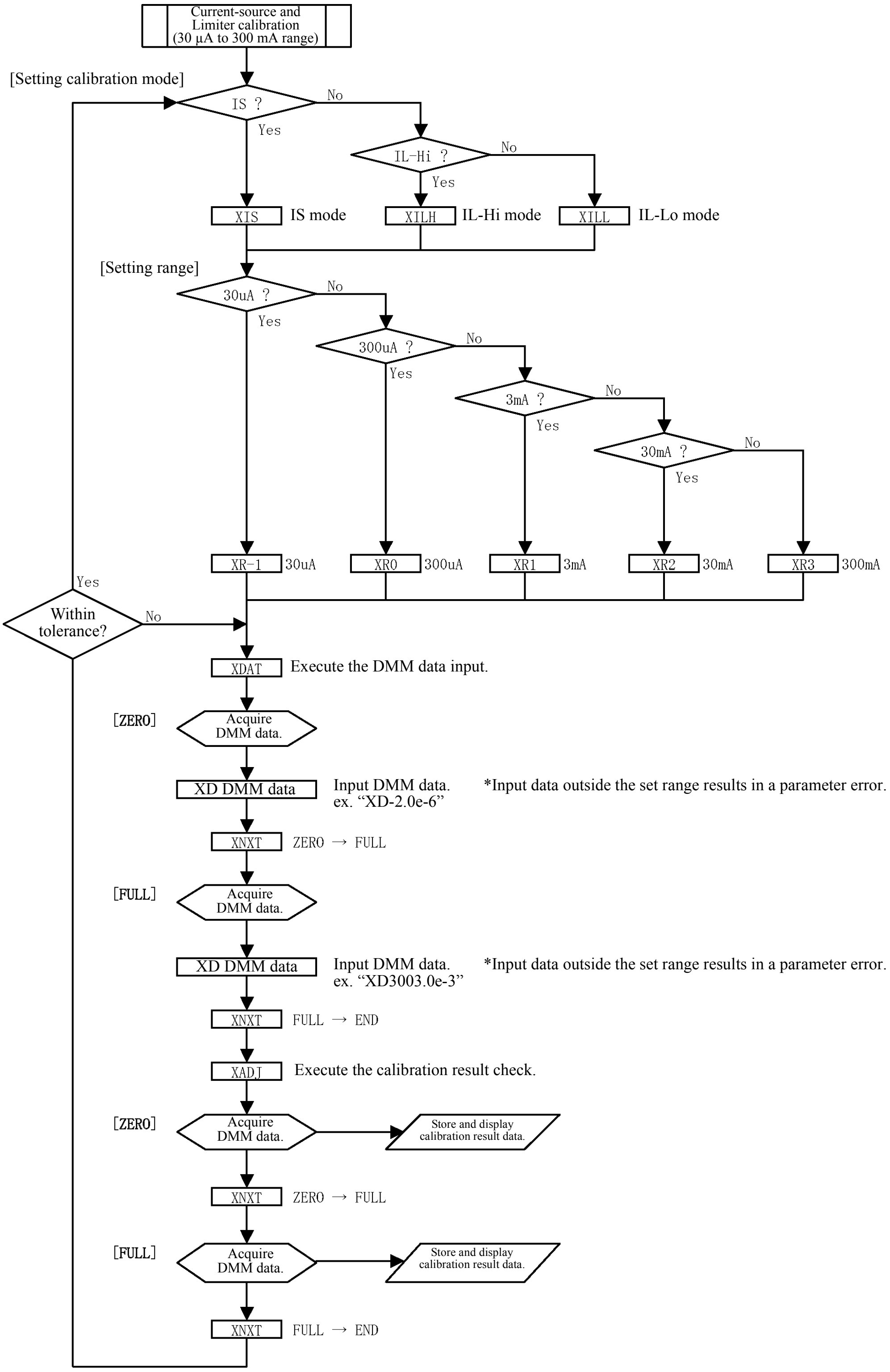


Figure 8-11 6242 Calibration Procedure (4)

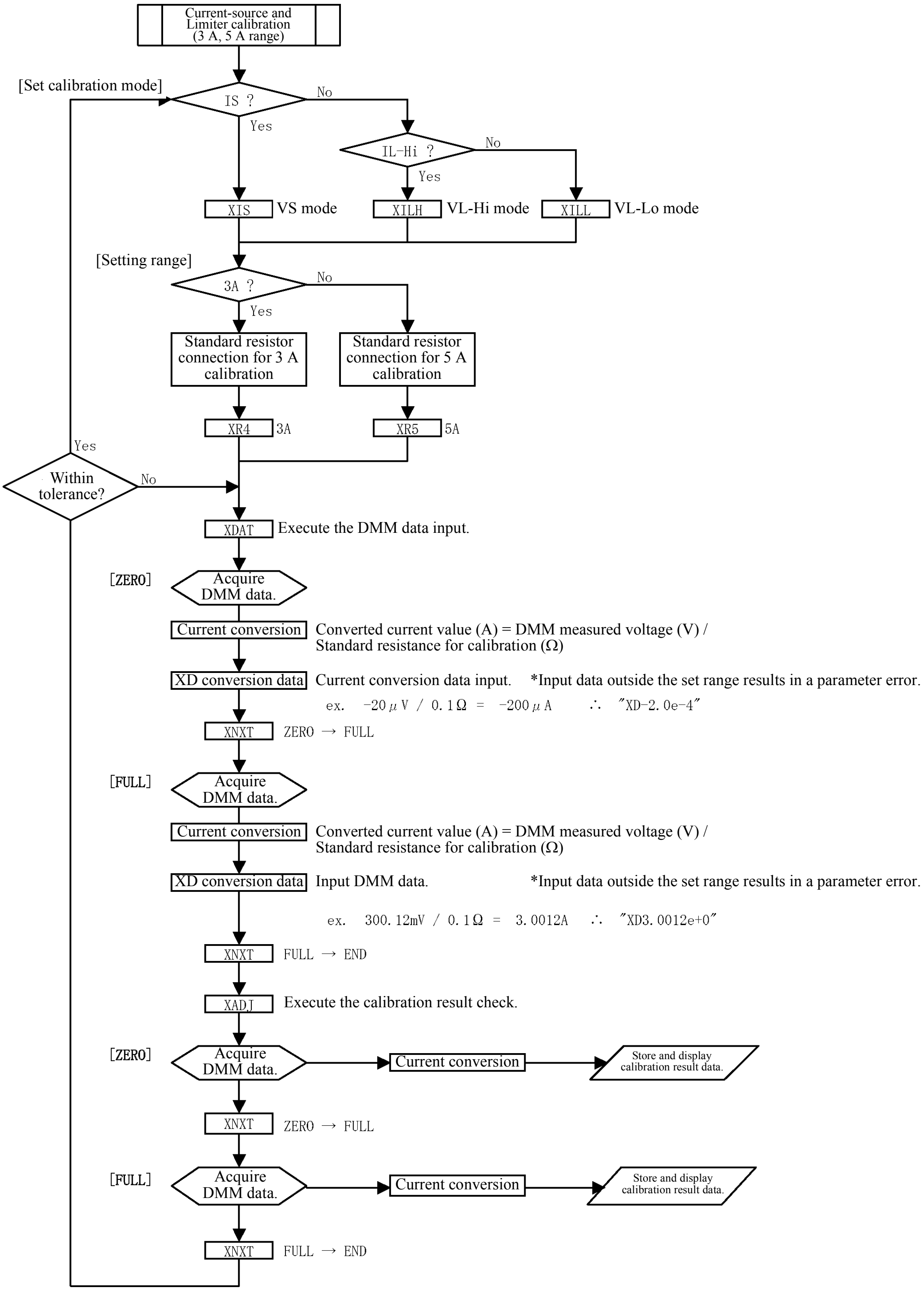


Figure 8-12 6242 Calibration Procedure (5)

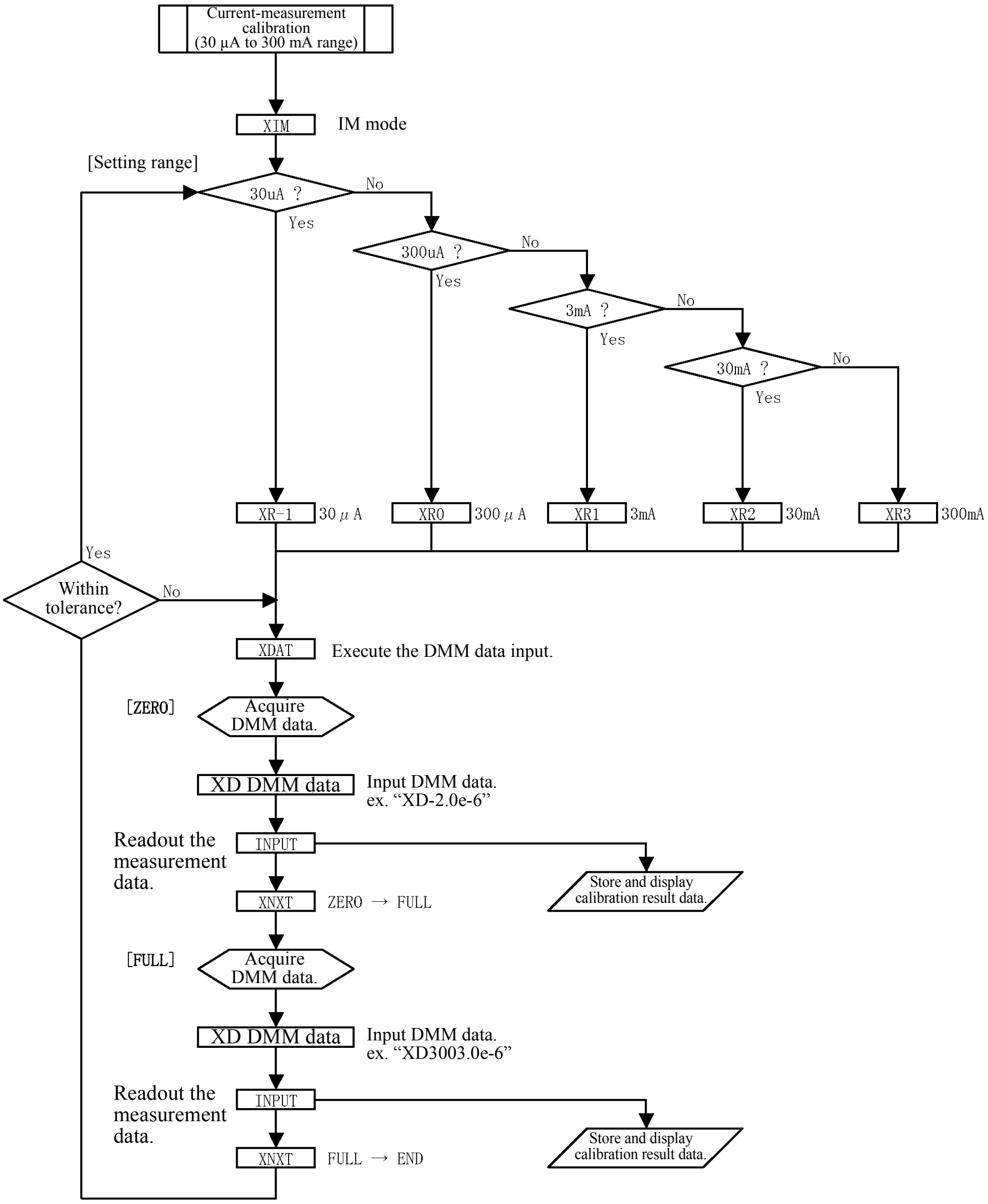


Figure 8-13 6242 Calibration Procedure (6)

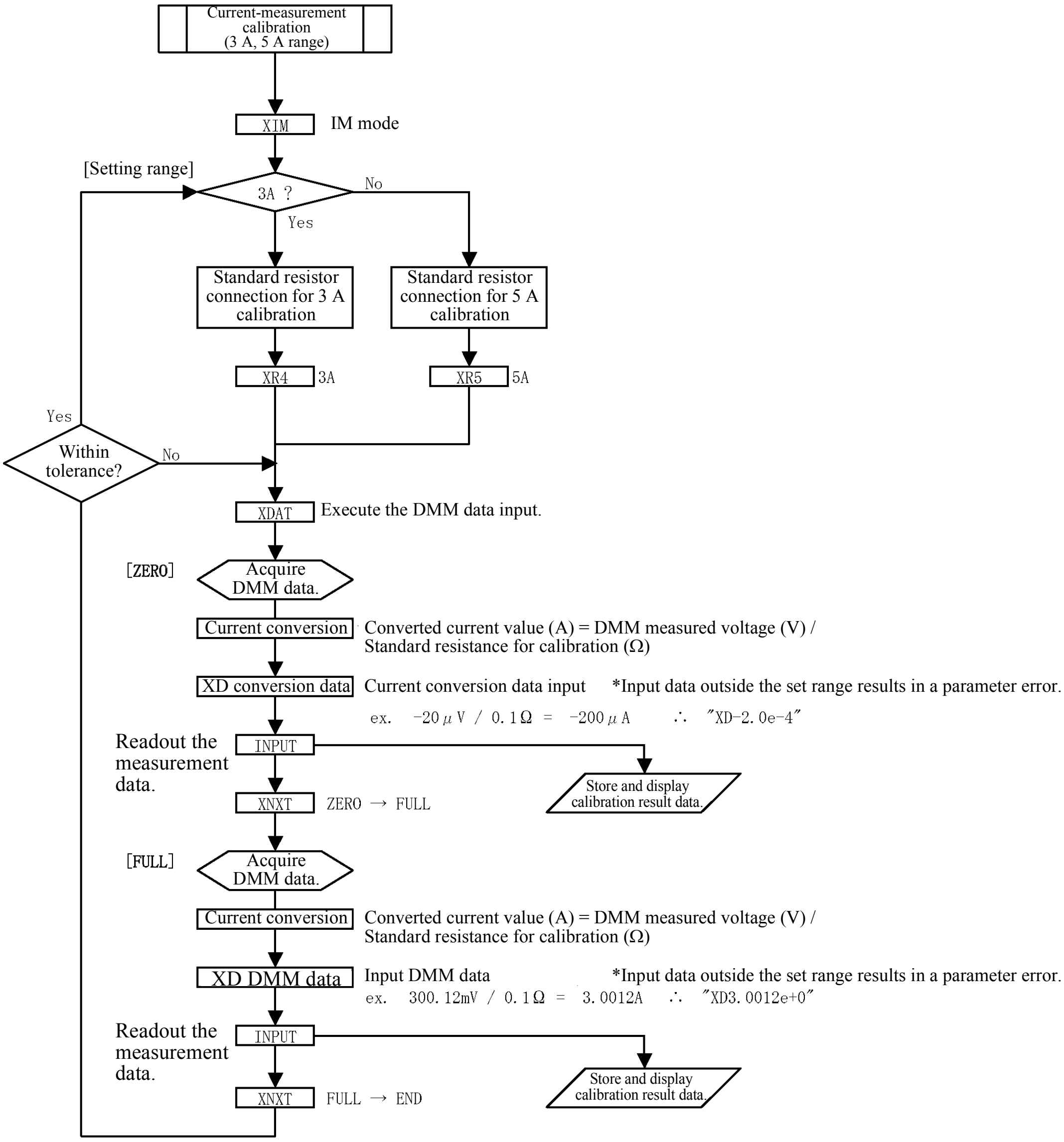


Figure 8-14 6242 Calibration Procedure (7)

8.2.5.1 Calibration Procedure

For details about the calibration procedure, see Figure 8-8, “6242 Calibration Procedure (1).”

1. Set the calibration mode as the operation mode by using CAL1.
2. When executing all calibration items, initialize the calibration data by using XINI only once before calibration is started.
3. When executing a voltage calibration, refer to Section 8.2.3, “Connections,” to connect units.
4. Set the calibration mode as the operation mode by using OPR.
5. Conduct calibration according to Figure 8-9, “6242 Calibration Procedure (2)” and Figure 8-10, “6242 Calibration Procedure (3).”
6. Press SBY to set the Standby mode.
7. Select XWR to store the calibration data in the non-volatile memory.
8. Select CAL0 to complete calibration.

8.2.5.2 Voltage-source and Voltage-limiter Calibration

1. Select the voltage calibration mode.
   Voltage-source: XVS
   Voltage HI limiter: XVLH
   Voltage LO limiter: XVLL
2. Select the range.
   300 mV range: XR3
   3 V range: XR4
   6 V range: XR5
3. Using XDAT, set the DMM data input mode.
4. Set up the DMM read value using XD data.
5. Select XNXT to proceed to the full scale calibration mode.
6. Set up the DMM read value using XD data.
7. Select XNXT to exit from the DMM data input mode.
8. Select XADJ to proceed to zero calibration data fine adjustment mode.
9. Verify the zero calibration value.
   XUP and XDN can fine adjust the calibration coefficient.
10. XNXT shifts to full-scale calibration data fine adjustment mode.

11. Verify the full-scale calibration value.
    XUP and XDN can fine-adjust the calibration coefficient.
12. Proceed to the next step.
    When the voltage calibration mode is changed: XNXT
    When the operation proceeds to voltage-measurement calibration process: XVM

8.2.5.3 Voltage-measurement Calibration

1. Using XVM, change the mode to voltage measurement calibration mode.
2. Select the range.

300 mV range :	XR3
3 V range:	XR4
6 V range:	XR5

3. Using XDAT, set the DMM data input mode.
4. Set up the DMM read value using XD data.
5. Read out and verify the measurement data.
6. Select XNXT to proceed to the full-scale calibration mode.
7. Set up the DMM read value using XD data.
8. Read out and verify the measurement data.
9. Proceed to the next step.
   When the voltage range is changed: XNXT
   When the operation proceeds to current-source and voltage limiter calibration process: XIS, XVLH, XVLL

8.2.5.4 Current-source and Current-limiter Calibration (30 µA to 300 mA)

1. Select 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. Perform the same procedure as described in Section 8.2.5.2, “Voltage-source and

Voltage-limiter Calibration."

4. Proceed to the next step.

   When the current calibration mode is changed: XNXT

   When the operation proceeds to current-measurement calibration process: XIM

8.2.5.5 Current-source and Current-limiter Calibration, (3 A, 5 A)

1. For this calibration range, connect the instrument as shown in Figure 8-7, "6242 Connections for Calibration (c)" and set the DMM measurement function to DCV.

   Current-source: XIS

   Current HI limiter: XILH

   Current LO limiter: XILL

2. Select the range.

   3 A range: XR4

   5 A range: XR5

3. Using XDAT, set the DMM data input mode.
4. Determine the DMM read value using the following expression.

   data = DMM read value [V] / standard resistance [Ω]

5. Set the calculated value using XD data.
6. Select XNXT to proceed to the full-scale calibration mode.
7. Determine the DMM read value using the following expression.

   data = DMM read value [V] / standard resistance [Ω]

8. Set the calculated value using XD data.
9. Select XNXT to exit from the DMM data input mode.
10. Select XADJ to proceed to zero-calibration-data fine adjustment mode.
11. Verify the zero calibration value.

    XUP and XDN can fine-adjust the calibration coefficient.

12. XNXT shifts to full-scale calibration data fine adjustment mode.
13. Verify the full-scale calibration value.

    XUP and XDN can fine-adjust the calibration coefficient.

14. Proceed to the next step.

    When the current calibration mode is changed: XNXT

    When the operation proceeds to current-measurement calibration process: XIM

8.2.5.6 Current-measurement Calibration (30 µA to 300 mA)

1. Using XIM, change the mode to current measurement calibration mode.
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. Perform the same procedure as described in Section 8.2.5.3, "Voltage-measurement Calibration."

8.2.5.7 Current-measurement Calibration (3 A, 5 A)

1. For this calibration range, connect the instrument as shown in Figure 8-7, "6242 Connections for Calibration (c)" and set the DMM measurement function to DCV.
2. Using XIM, change the mode to the current measurement mode.
3. Select the range.
   3 A: XR4
   5 A: XR5
4. Using XDAT, set the DMM data input mode.
5. Determine the DMM read value using following expression.
   data = DMM read value [V] / standard resistance [Ω]
6. Set the calculated value using XD data.
7. Read out and verify the measurement data.
8. Select XNXT to proceed to the full-scale calibration mode.
9. Determine the DMM read value using following expression.
   data = DMM read value [V] / standard resistance [Ω]
10. Set the calculated value using XD data.
11. Read out and verify the measurement data.
12. Proceed to the next step.
    When the current range is changed: XNXT
    When the operation proceeds to voltage-source and current-limiter calibration process: XVS, XILH, XILL

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

9.1.1 6241A Source and Measurement

	Range	Source range	Setting Resolution	Measurement range	Measurement Resolution
Voltage-source/ measurement range	300 mV	0 to ± 320.00 mV	10 μV	0 to ± 320.999 mV	1 μV
	3 V	0 to ± 3.2000 V	100 μV	0 to ± 3.20999 V	10 μV
	30 V	0 to ± 32.000 V	1 mV	0 to ± 32.0999 V	100 μV
Current-source/ measurement range	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
	500 mA	0 to ± 500.00 mA	20 μA	0 to ± 500.999 mA	1 μA
Resistance measurement	Determined by voltage range and current range calculations	-	-	0 to 1.6 GΩ	Minimum 2 μΩ

However the measurement resolution with Integration time 100 μs, 500 μs and S/H (Sample Hold) is as follows.

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

Voltage- and Current-limiter (compliance) range:

	Maximum setting range	Setting resolution [*1]
Voltage-limiter	0 V to 320 mV	100 µV
	320.1 mV to 3.2 V	1 mV
	3.201 V to 32 V	10 mV
Current-limiter	100 nA 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
	320.1 mA to 500 mA	100 µA

*1: Where, (Hi limiter value - Lo limiter value) ≥ 60 digits

Overall accuracy:	Includes calibration accuracy, 1-day stability, the temperature coefficient, and linearity.
1-day stability:	At Power and Load constant
Temperature coefficient:	Temperature of 0 to 50°C

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of setting + V)		± (ppm of setting + V)/°C
Voltage-source	300 mV	0.02 + 150 µV	0.01 + 70 µV	15 + 15 µV
	3 V	0.02 + 350 µV	0.01 + 200 µV	15 + 30 µV
	30 V	0.02 + 3 mV [*2]	0.01 + 2 mV	15 + 300 µV
Voltage-limiter	300 mV	0.10 + 500 µV [*3]	0.05 + 200 µV	100 + 50 µV
	3 V	0.05 + 3 mV [*3]	0.01 + 1 mV	15 + 100 µV
	30 V	0.05 + 30 mV [*3]	0.01 + 10 mV	15 + 1 mV

*2: 30 V range adds 200 µV per the remote sense voltage 0.1 V.

*3: Voltage limiter additional error: If Hi limiter is set to a negative value and Lo limiter is set to a positive value, add an error of ±0.1 % of setting.

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of setting + A +A × Vo/1 V)		± (ppm of setting + A + A × Vo/1 V)/°C
Current-source	30 μA	0.03 + 10 nA + 300 pA	0.01 + 5 nA + 100 pA	20 + 1 nA + 10 pA
	300 μA	0.03 + 80 nA + 3 nA	0.01 + 40 nA + 1 nA	20 + 10 nA + 100 pA
	3 mA	0.03 + 800 nA + 30 nA	0.01 + 400 nA + 10 nA	20 + 100 nA + 1 nA
	30 mA	0.03 + 8 μA + 300 nA	0.01 + 4 μA + 100 nA	20 + 1 μA + 10 nA
	300 mA	0.045 + 80 μA + 3 μA	0.01 + 40 μA + 1 μA	20 + 10 μA + 100 nA
	500 mA	0.05 +160 μA + 6 μA	0.02 + 80 μA + 1 μA	20 + 12 μA + 200 nA
Current-limiter	30 μA	0.045 + 35 nA + 300 pA	0.01 + 10 nA + 100 pA	20 + 8 nA + 10 pA
	300 μA	0.045 + 350 nA + 3 nA	0.01 + 100 nA + 1 nA	20 + 20 nA + 100 pA
	3 mA	0.045 + 3.5 μA + 30 nA	0.01 + 1 μA + 10 nA	20 + 200 nA + 1 nA
	30 mA	0.045 + 35 μA + 300 nA	0.01 + 10 μA + 100 nA	20 + 2 μA + 10 nA
	300 mA	0.055 + 350 μA + 3 μA	0.01 + 100 μA + 1 μA	20 + 20 μA + 100 nA
	500 mA	0.055 + 500 μA + 6 μA	0.02 + 100 μA + 1 μA	40 + 20 μA + 200 nA

Vo : Compliance-voltage (-32 V to +32 V)

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of reading + V)		± (ppm of reading + V)/°C
Voltage-measurement	300 mV	0.02 + 75 μV	0.008 + 50 μV	15 + 15 μV
	3 V	0.02 + 120 μV	0.008 + 60 μV	15 + 15 μV
	30 V	0.02 + 1.2 mV *2	0.008 + 400 μV	15 + 150 μV

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

*2: 30 V range adds 200 μV per the remote sense voltage 0.1 V

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of reading + A +A × Vo/1 V)		± (ppm of reading + A + A × Vo/1 V)/°C
Current-measurement	30 μA	0.03 + 8 nA + 300 pA	0.01 + 4 nA + 100 pA	20 + 1 nA + 10 pA
	300 μA	0.03 + 70 nA + 3 nA	0.01 + 35 nA + 1 nA	20 + 7 nA + 100 pA
	3 mA	0.03 + 700 nA + 30 nA	0.01 + 350 nA + 10 nA	20 + 70 nA + 1 nA
	30 mA	0.03 + 7 μA + 300 nA	0.01 + 3.5 μA + 100 nA	20 + 700 nA + 10 nA
	300 mA	0.045 + 70 μA + 3 μA	0.01 + 35 μA + 1 μA	20 + 7 μA + 100 nA
	500 mA	0.05 + 120 μA + 6 μA	0.02 + 60 μA + 1 μA	35 + 10 μA + 200 nA

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

	Condition		Overall accuracy	1-day stability	Temperature coefficient
			± (% of reading) ± (digits + digits + digits)		± (ppm of reading) ± (digits + digits + digits)/°C
Resistance measurement	At 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)[*4]		
	At 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)[*4]		

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

Vo : Compliance-voltage(-32 V to +32 V)

*4 : 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 measurement accuracy and 1-day stability.

	Measurement range	Integration time Units: digits (For $5^{1}/_{2}$-digit display)					
		10 ms	5 ms	1 ms	500 µs	100 µs	S/H
Voltage-measurement	300 mV	10	15	20	30	60	200
	3 V	5	8	10	15	30	50
	30 V	5	8	10	15	30	50
Current measurement	30 µA	200	300	300	300	300	300
	300 µA	20	30	30	30	70	100
	3 mA	10	30	30	30	50	80
	30 mA	10	30	30	30	50	100
	300 mA	10	15	15	15	50	100
	500 mA	10	30	30	50	100	200

S/H: Measurement in sample hold mode (Integration time: 100 µs)

When LO OUTPUT is grounded to the chassis, the additional error of integration time in 30 µA range is the same as that in 300 µA range.

Source linearity:	±3 digits or less (500 mA range is ±5 digits or less.)
Maximum output current:	0 to ±32 V; ±500 mA
Maximum Compliance-voltage:	500 mA up to; 0 to ±32 V

Output noise: For voltage-source, within the range from no-load to maximum load [Vp-p]
For current-source, at the following load resistance [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	300 mV	-	50 µV	200 µV	3 mV
	3 V	-	50 µV	300 µV	3 mV
	30 V	-	500 µV	2 mV	4 mV
Current-source	30 µA	10 kΩ	10 nA	60 nA	500 nA
	300 µA	10 kΩ	30 nA	150 nA	600 nA
	3 mA	1 kΩ	200 nA	2 µA	6 µA
	30 mA	1 kΩ	2 µA	15 µA	20 µA
	300 mA	1 kΩ	20 µA	100 µA	150 µA
	500 mA	1 kΩ	20 µA	100 µA	150 µA

Switching noise:

		Typical value [p-p]	Load resistance
Output ON /OFF noise	Voltage-source	600 mV	At 100 kΩ
	Current-source	600 mV	At 100 kΩ
Range switching noise	Voltage-source	50 mV	-
	Current-source Current-limiter	fast: 100 digits + 50 mV *5 slow: 300 digits + 50 mV *5	-
	Voltage-limiter	50 mV *6	-
	Voltage-measurement	50 mV *6	-
	Current-measurement	50 mV *6	-
Response switching noise		80 mV	
Power OFF noise		600 mV	At 100 kΩ

*5: “digits” indicates current-source 4½ digit values. Double these values in the 500 mA range.

*6: Limiter is not in operation. While the limiter is enabled, it is the same as the current source range switching noise.

Settling time:

The time it takes to settle to the final value ±0.1 % when varying from zero to the full scale.

Setting conditions: Source values and limiter values are full-scale settings.

Load conditions: Resistive load and 200 pF max. load capacitance

	Source range	Limiter range	Settling time	
			Output response	
			FAST	SLOW
Voltage-source (Output current: 500 mA)	300 mV	500 mA	200 µs or less	1 ms or less
	3 V		70 µs or less	400 µs or less
	30 V		300 µs or less	1.5 ms or less
Current-source (Output voltage: 30 V)	30 µA	30 V	2 ms or less	3.5 ms or less
	300 µA		600 µs or less	2.5 ms or less
	3 mA			
	30 mA			
	300 mA			
	500 mA		700 µs or less	3 ms or less

Typical value	Source range	Limiter range	Settling time	
			Output response	
			FAST	SLOW
Voltage-source (Output current: 20% max. full-scale)	300 mV	3 mA to 300 mA	35 µs or less	300 µs or less
	3 V		30 µs or less	200 µs or less
	30 V		100 µs or less	500 µs or less
Current-source (Output voltage: 1 V)	30 µA	3 V	800 µs or less	1 ms or less
	300 µA		30 µs or less	200 µs or less
	3 mA			
	30 mA			
	300 mA			
	500 mA		50 µs or less	250 µs or less

Overshoot: ±0.1% max. Resistive load, at end of standard cable (excluding 30 µA, 300 µA ranges)

Line regulation: ±0.003 % of range or less

Load regulation: Voltage-source; ±0.003 % of range or less (At 4-wire connection with maximum load)

Current-source; depending on the overall accuracy CMV item (A × Vo/ 1 V)

Output resistance: In 2-wire connection (Output cable not included)

Maximum load capacitance: The maximum load capacitance that does not oscillate in voltage-source or voltage-limiter operational status

Current range	Output resistance (Ω)		Maximum load capacitance
	Voltage-source	Current-source	
30 μA	500 mΩ or less	1000 MΩ or higher	1 μF
300 μA	100 mΩ or less	1000 MΩ or higher	1 μ F
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
500 mA	10 mΩ or less	1 MΩ or higher	2000 μF

Standard attached cable resistance: 100 mΩ or less

Maximum load inductance: The maximum load inductance that does not oscillate in current-source or current-limiter operational-status

Current-source range Current-limiter range	Response	30 μA	300 μA	3 mA to 500 mA
Maximum load inductance	FAST	100 μH	200 μH	1 mH
	SLOW	500 μH	1 mH	

Effective CMRR: At unbalanced impedance 1 kΩ
In DC and AC 50/60 Hz ± 0.08 %

	Integration time	
	100 μs to 10 ms	1 PLC to 200 ms
Voltage-measurement and Current-measurement	60 dB	120 dB

NMRR: At AC 50/60 Hz ± 0.08%

	Integration time	
	100 μs to 10 ms	1 PLC to 200 ms
Voltage-measurement and Current-measurement	0 dB	60 dB

9.1.2 6242 Source and Measurement

	Range	Source range	Setting resolution	Measurement range	Measurement resolution
Voltage-source/ measurement range	300 mV	0 to ± 320.00 mV	10 µV	0 to ± 320.999 mV	1 µV
	3 V	0 to ± 3.2000 V	100 µV	0 to ± 3.20999 V	10 µV
	6 V	0 to ± 6.000 V	1 mV	0 to ± 6.0999 V	100 µV
Current-source/ measurement range	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
	3 A	0 to ± 3.0000 A	100 µA	0 to ± 3.00999 A	10 µA
	5 A	0 to ± 5.0000 A	200 µA	0 to ± 5.00999 A	10 µA
Resistance measurement	Determined by voltage range and current range calculations	-	-	0 to 304 MΩ	Minimum 0.2 µΩ

However the measurement resolution with Integration time 100 µs, 500 µs and S/H (sample hold) are as follows.

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

Voltage- and Current-limiter (compliance) range:

	Maximum setting range	Setting resolution [*1]
Voltage-limiter	0 V to 320 mV	100 μV
	320.1 mV to 3.2 V	1 mV
	3.201 V to 6 V	10 mV
Current-limiter	100 nA 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
	320.1 mA to 3 A	1 mA
	3.001 A to 5 A	1 mA

*1: However, (HI limiter value - Lo limiter value) ≥ 60 digits

Overall accuracy:	Includes calibration accuracy, 1-day stability, the temperature coefficient, and linearity.
1-day stability:	At Power and Load constant
Temperature coefficient:	In the temperature of 0 to 50°C

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of setting + V)		± (ppm of setting + V)/ºC
Voltage-source	300 mV	0.02 + 150 μV	0.01 + 70 μV	15 + 15 μV
	3 V	0.02 + 350 μV	0.01 + 200 μV	15 + 30 μV
	6 V	0.025 + 3 mV [*2]	0.01 + 2 mV	15 + 300 μV
Voltage-limiter	300 mV	0.10 + 500 μV [*3]	0.05 + 200 μV	100 + 50 μV
	3 V	0.05 + 3 mV [*3]	0.01 + 1 mV	15 + 100 μV
	6 V	0.16 + 30 mV [*3]	0.018 + 10 mV	36 + 1 mV

*2: 6 V range adds 200 μV per the remote sense voltage 0.1 V.

*3: Voltage limiter additional error: If Hi limiter is set to a negative value and Lo limiter is set to a positive value, add an error of ±0.1% of setting.

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of setting + A +A × Vo/1 V)		± (ppm of setting + A + A × Vo/1 V)/°C
Current-source	30 μA	0.03 + 10 nA + 300 pA	0.01 + 5 nA + 100 pA	20 + 1 nA + 10 pA
	300 μA	0.03 + 80 nA + 3 nA	0.01 + 40 nA + 1 nA	20 + 10 nA + 100 pA
	3 mA	0.03 + 800 nA + 30 nA	0.01 + 400 nA + 10 nA	20 + 100 nA + 1 nA
	30 mA	0.03 + 8 μA + 300 nA	0.01 + 4 μA + 100 nA	20 + 1 μA + 10 nA
	300 mA	0.045 + 80 μA + 3 μA	0.01 + 40 μA + 1 μA	20 + 10 μA + 100 nA
	3 A	0.08 + 2.5 mA + 150 μA	0.06 + 1.5 mA + 25 μA	50 + 300 μA + 20 μA
	5 A	0.15 +2.5 mA + 150 μA	0.12 + 1.5 mA + 25 μA	50 + 300 μA + 20 μA
Current-limiter	30 μA	0.045 + 35 nA + 300 pA	0.01 + 10 nA + 100 pA	20 + 8 nA + 10 pA
	300 μA	0.045 + 350 nA + 3 nA	0.01 + 100 nA + 1 nA	20 + 20 nA + 100 pA
	3 mA	0.045 + 3.5 μA + 30 nA	0.01 + 1 μA + 10 nA	20 + 200 nA + 1 nA
	30 mA	0.045 + 35 μA + 300 nA	0.01 + 10 μA + 100 nA	20 + 2 μA + 10 nA
	300 mA	0.055 + 350 μA + 3 μA	0.01 + 100 μA + 1 μA	20 + 20 μA + 100 nA
	3 A	0.1 + 4 mA + 150 μA	0.06 + 2 mA + 25 μA	80 + 500 μA + 20 μA
	5 A	0.15 + 4 mA + 150 μA	0.12 + 2 mA + 25 μA	80 + 500 μA + 20 μA

Vo : Compliance-voltage (-6 V to +6 V)

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (%of reading + V)		± (ppm of reading + V)/°C
Voltage-measurement	300 mV	0.02 + 75 μV	0.008 + 50 μV	15 + 15 μV
	3 V	0.02 + 120 μV	0.008 + 60 μV	15 + 15 μV
	6 V	0.02 + 1.2 mV *2	0.008 + 600 μV	15 + 150 μV

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

*2: 6 V range adds 200 μV per the remote sense voltage 0.1 V.

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of reading + A +A × Vo/1 V)		± (ppm of reading + A + A × Vo/1 V)/°C
Current-measurement	30 μA	0.03 + 8 nA + 300 pA	0.01 + 4 nA + 100 pA	20 + 1 nA + 10 pA
	300 μA	0.03 + 70 nA + 3 nA	0.01 + 35 nA + 1 nA	20 + 7 nA + 100 pA
	3 mA	0.03 + 700 nA + 30 nA	0.01 + 350 nA + 10 nA	20 + 70 nA + 1 nA
	30 mA	0.03 + 7 μA + 300 nA	0.01 + 3.5 μA + 100 nA	20 + 700 nA + 10 nA
	300 mA	0.045 + 70 μA + 3 μA	0.01 + 35 μA + 1 μA	20 + 7 μA + 100 nA
	3 A	0.08 +2.2 mA + 150 μA	0.05 +1.5 mA + 25 μA	50 + 300 μA + 20 μA
	5 A	0.15 +2.2 mA + 150 μA	0.12 +1.5 mA + 25 μA	50 + 300 μA + 20 μA

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

	Condition	Overall accuracy	1-day stability	Temperature coefficient
		± (% of reading) ± (digits + digits + digits)		± (ppm of reading) ± (digits + digits + digits)/ ºC
Resistance measurement	At 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)[*4]		
	At 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)[*4]		

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

Vo : Compliance-voltage(-6 V to +6 V)

*4 : CMV item = (A × Vo/1 V); source or measurement current × source or measurement voltage/1 V digit value

The full-scale item tolerance listed below, is added to the integration time 10 ms to 100 μs measurement accuracy and 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	300 mV	10	15	20	30	60	200
	3 V	5	8	10	15	30	50
	6 V	5	8	10	15	30	50
Current measurement	30 μA	200	300	300	300	300	300
	300 μA	20	30	30	30	70	100
	3 mA	10	30	30	30	50	80
	30 mA	10	30	30	30	50	100
	300 mA	10	15	15	15	50	100
	3 A	20	30	75	75	250	500
	5 A	20	30	75	75	250	500

S/H: Measurement in sample hold mode (Integration time: 100 μs)

When LO OUTPUT is grounded to the chassis, the additional error of integration time in the 30 μA range is the same as that in 300 μA range.

Source linearity:	±3 digits or less (5 A range is ±5 digits or less)
Maximum output current:	0 to ±6 V; ±5 A
Maximum Compliance-voltage:	5 A up to; 0 to ±6 V

Output noise: For voltage-source, within the range from no-load to maximum load [Vp-p]
For current-source, at 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	300 mV	-	50 μV	200 μV	3 mV
	3 V	-	50 μV	300 μV	3 mV
	6 V	-	500 μV	2 mV	4 mV
Current-source	30 μA	10 kΩ	10 nA	60 nA	500 nA
	300 μA	10 kΩ	30 nA	150 nA	600 nA
	3 mA	1 kΩ	200 nA	2 μA	6 μA
	30 mA	1 kΩ	2 μA	15 μA	20 μA
	300 mA	1 kΩ	20 μA	100 μA	150 μA
	3 A	10 Ω	500 μA	1 mA	10 mA
	5 A	10 Ω	500 μA	1 mA	10 mA

Switching noise:

		Typical value [p-p]	Load resistance
Output ON /OFF noise	Voltage-source	600 mV	At 100 kΩ
	Current-source	600 mV	At 100 kΩ
Range switching noise	Voltage-source	50 mV	-
	Current-source Current-limiter	fast: 100 digits+50 mV *5 slow: 300 digits+50 mV *5	-
	Voltage-limiter	50 mV *6	-
	Voltage-measurement	50 mV *6	-
	Current-measurement	50 mV *6	-
Response switching noise		80 mV	
Power OFF noise		600 mV	in 100 kΩ

*5: “digits” indicates current-source 4½ digit values. In 3 A and 5 A ranges, fast: 300 digits +50 mV, slow: 600 digits +50 mV.

*6: Limiter is not in operation. While the limiter is enabled, it is the same as the current source range switching noise.

Settling Time

The time to reach ±0.1% the final value when varying the output from zero to full-scale.
Setting conditions: Source values and limiter values are full-scale settings.
Load conditions: Resistive load and 200 pF max. load capacitance

	Source range	Limiter range	Settling time	
			Output response	
			FAST	SLOW
Voltage-source (Output current: 5 A)	300 mV	5 A	300 µs or less	1 ms or less
	3 V		200 µs or less	500 µs or less
	6 V		400 µs or less	800 µs or less
Current-source (Output voltage: 6 V)	30 µA	6 V	2 ms or less	3 ms or less
	300 µA		200 µs or less	600 µs or less
	3 mA			
	30 mA			
	300 mA			
	3 A		700 µs or less	1.5 ms or less
	5 A			

Typical value	Source range	Limiter range	Settling time	
			Output response	
			FAST	SLOW
Voltage-source (Output current: with less than 20% of full scale load)	300 mV	3 mA to 300 mA	35 µs or less	300 µs or less
	3 V		30 µs or less	200 µs or less
	6 V		40 µs or less	300 µs or less
Current-source (Output voltage: 1 V)	30 µA	3 V	800 µs or less	1 ms or less
	300 µA		30 µs or less	200 µs or less
	3 mA			
	30 mA			
	300 mA			
	3 A		100 µs or less	300 µs or less
	5 A			

Over shoot:	±0.1% or less Resistive load, at end of standard cable (except for 30 µA, 300 µA, 3 A, 5 A range)
Line regulation:	±0.003% of range or less
Load regulation:	Voltage-source; ±0.003 % of range or less (At 4-wire connection with maximum load)

Current-source; depending on the overall accuracy CMV item (A × Vo/1 V)

Output resistance: In 2-wire connection (Output cable not included)

Maximum load capacitance: The maximum load capacitance that does not oscillate in voltage-source or voltage-limiter operational status

Current range	Output resistance (Ω)		Maximum load capacitance
	Voltage-source	Current-source	
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
3 A/5 A	10 mΩ or less	70 kΩ or higher	2000 μF

Standard attached cable resistance: 100 mΩ or less

Maximum load inductance: The maximum load inductance that does not oscillate in current-source or current-limiter operational-status

Current-source range Current-limiter range	Response	30 μA	300 μA	3 mA to 5 A
Maximum Load inductance	FAST	100 μH	200 μH	1 mH
	SLOW	500 μH	1 mH	

Effective CMRR: At unbalanced impedance 1 kΩ
In DC and AC 50/60 Hz ± 0.08%

	Integration time	
	100 μs to 10 ms	1 PLC to 200 ms
Voltage-measurement and Current-measurement	60 dB	120 dB

NMRR: At AC 50/60 Hz ± 0.08%

	Integration time	
	100 μs to 10 ms	1 PLC to 200 ms
Voltage-measurement and Current-measurement	0 dB	60 dB

9.2 Source and Measurement Function

DC source and measurement:	Source/measurement of DC voltage/current
Pulse source and measurement:	Source/measurement of pulse voltage/current (However, measurement auto range in Pulse source is impossible.)
DC sweep source and measurement:	Source and the measurement with Linear, Two slope Linear, Random and fixed level.
Pulse Sweep source and measurement:	Source and the measurement with Linear, Two slope Linear, Random and fixed level. (However, measurement auto range in Pulse source is impossible.)
Integration time:	Select from 100 μs; 500 μs; 1 ms; 5 ms; 10 ms; 1 PLC; 100 ms; 200 ms, or S/H. S/H: Measuring in Sample Hold Mode (Integration time: 100 μs) (Enabled only in the pulse source and pulse sweep source modes.) (PLC: Power Line Cycle, 50 Hz: 20 ms, 60 Hz: 16.66 ms)
Sweep mode:	Reverse ON (forward to backward)/OFF (one way)
Number of times of repeating Sweep:	1 to 1000 times or infinite
Maximum number of step for Sweep:	8000 steps
Random sweep maximum memory:	8000 data items
The measurement data memory:	8000 data items
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:	It is possible to set separately at HI and LO sides. (However, in case of current-limiter, the same polarity can not be set.)
Calculation function:	NULL calculation comparator calculation (HI, GO, or LO) Scaling calculation MAX, MIN, AVE, TOTAL calculation
Trigger style:	Auto-trigger, External-trigger
Output terminal:	Front; Safety socket HI OUTPUT, HI SENSE, LO OUTPUT, and LO SENSE
The maximum voltage applied between the terminals:	6241A: 32 V peak Max (between HI-LO) 6242: 6 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; Between HI OUTPUT - HI SENSE and LO OUTPUT - LO SENSE (the output voltage between HI SENSE and LO SENSE must be within the maximum output voltage range)

Voltage-measurement input resistance: 1 GΩ or more

Voltage-measurement-input leakage current:
±1 nA or below

GPIB interface:	Compliant with IEEE-488.2-1987 Interface function; SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Connector; Amphenol 24 pin
USB interface:	USB 2.0 Full-speed Connector; Type B
External control signal:	TRIGGER IN INTERLOCK, OPERATE IN/OUT COMPLETE OUT, SYNC OUT Connector; BNC

9.3 Set Time

Minimum pulse width:	50 μs
Minimum step (repeat) time:	Source/measurement range; Fixed, Integration time; 100 μs, measurement/source delay time; Minimum, Calculation; OFF, and in Voltage and current-measurement

Measurement	Memory mode	Minimum step time
OFF	-	0.5 ms
ON	BURST	2 ms
	NORMAL	10 ms
	OFF	

Source delay time:

Set range	Setting resolution *7	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):

Set range	Setting resolution *7	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:

Set range	Setting resolution *7	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:

Set range	Setting resolution *7	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	

*7: The setting resolution is determined by the period time resolution.

Hold time:

Set range	Resolution	Accuracy
1 ms to 60000 ms	1 ms	±(2% + 3 ms)

Auto range delay time

Set range	Resolution	Accuracy
0 ms to 500 ms	1 ms	±(2% + 3 ms)

9.4 General Specification

Operating environment conditions:	Ambient temperature 0ºC to +50ºC, relative humidity 85% RH or below, with no condensation
Storage environment conditions:	Ambient temperature -25ºC to +70ºC, relative humidity 85% RH or below, with no condensation
Warming up time:	60 minutes or longer (Until it settles in the specified accuracy.)
Display:	16 segment × 12 digits Fluorescent character display tube
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.
When changing the power voltage, use only a power cable and rated fuse approved for the respective country.

Line frequency:	50 Hz/60 Hz
Power consumption:	6241A: 95 VA or less 6242: 180 VA or less
External dimensions:	Approx. 212 (width) × 88 (height) × 400 (depth) mm
Mass:	6241A: 6 kg or less 6242: 6.5 kg or less
Safety:	Compliant with IEC61010-1
EMI:	EN61326 classA

APPENDIX

A.1 When Problems Occur (Before Requesting Repairs)

If problems are encountered when using the 6241A/6242, 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 6241A/6242 before requesting service.

Table A-1 Items to be Inspected before Requesting the Repair (1/2)

Q (Symptom)	A (Cause and Solution)
1. Turning on the **POWER** switch does not display the screen.	Cause: Power fuse is open. Solution: Replace it with the correct fuse.
2. Does not output the set source value.	Cause: It is in Standby or Suspended status. Solution: Set Operate and verify that the **OPR** indicator is ON.
	Cause: Remote sensing setting is incorrect. Solution: Verify the 4W/2W indicator on the front panel to see if the remote sensing is set as desired.
	Cause: Set at 0 V or 0 A. Solution: Verify the source value.
	Cause: Detection of an overload voltage (Over Load) has set it to Standby. Solution: Remove the cable.
	Cause: Heat detection (Over Heat) or Fan detection (Fan Stopped) has activated, setting it to Standby status. Solution: Remove the cable and turn OFF the **POWER** switch. Turn ON the **POWER** switch again.
	Cause: The limiter is operating. Solution: Verify the limiter setting.
	Cause: • **OUTPUT** terminal and **SENSE** terminal are incorrectly connected. • **SENSE** is not connected correctly at 4-wire connection. Solution: Verify cable connections again.
	Cause: Entered Standby status due to the Interlock signal. Solution: • Change the Interlock setting to another setting. • Set the Interlock signal LO.

Table A-1 Items to be Inspected before Requesting the Repair (2/2)

Q (Symptom)	A (Cause and Solution)
3. Measurement value is not being output.	Cause: Unit in Standby or Suspended status. Solution: Set to Operate and verify that the **OPR** indicator is ON.
	Cause: Measurement is not ON. Solution: Verify measurement ON/OFF setting.
	Cause: When measuring in auto range, the value is unstable and the range unconfirmed, therefore measurement data is not output. Solution: Change to a fixed range and measure.
	Cause: A trigger signal is not input even when the trigger signal cable is connected to the external trigger. Solution: Verify TRIG INPUT connection cable and the signal.
4. A source value or measurement value indication is unstable or is in error.	Cause: Function or range settings have an error. Solution: Verify the setting again.
	Cause: Cable connection is wrong. Solution: Verify cable connections again.
	Cause: The cable is disconnected. Solution: Verify the cables with the tester. If in error, replace it.
	Cause: The cable is connected to a wrong terminal. Solution: Verify cable connections again.
	Cause: The induction noise scatters the measurement value. Solution: Set the integration time to 1 PLC or over.
5. The measurement value is over range.	Cause: When the NULL calculation value becomes twice or more of the value of full-scale. Solution: Raise the source value or limiter range.
6. Unable to input settings with the measurement control key.	Cause: While inputting with direct mode, the set value is at half-brightness and only the green keys on the panel are enabled. Solution: Press **123...** key to complete the direct input mode.

A.2 Error Message List

If an error occurs when using the 6241A/6242, an error number accompanied by an error message appear on the screen. These are explained in the following:

Table A-2 Error Message List (1/4)

Classification	Display error code	Message	Explanation	6241A	6242
Self-test	001	ROM Chk SUM	ROM check SUM error	○	○
	002	Panel Comm	Display communication/RAM error	○	○
		Consecutive buzzer ON	LCA data error	○	○
	004	RAM Rd/Wt	RAM read or write error	○	○
	005	Analog Comm	Analog communication error	○	○
	008	Flash Write	Flash memory write error	○	○
	012	CAL data SUM	CAL data SUM error	○	○
	013	Param SUM	Parameter SUM error	○	○
	101	AD Ratio 1-2	Ratio test error between AD operation IR1 and IR2	○	○
	102	AD Ratio 2-3	Ratio test error between AD operation IR2 and IR3	○	○
	103	AD Ratio 3-4	Ratio test error between AD operation IR3 and IR4	○	○
	104	AD Ratio 4-5	Ratio test error between AD operation IR4 and IR5	○	○
	111	ADRST Sig	Test error in analog unit RST line	○	○
	112	ADRST Sig	Test error in analog unit TRIG line	○	○
	151	ADx10 Zero	AD operation X10 ZERO test error	○	○
	152	ADx1 Zero	AD operation X1 ZERO test error	○	○
	201	VSVM 0.3V Z	VSVM 300 mV ZERO test error	○	○
	202	VSVM 0.3V +F	VSVM 300 mV +FS test error	○	○
	203	VSVM 0.3V -F	VSVM 300 mV -FS test error	○	○
	204	VSVM 3V Zero	VSVM 3 V ZERO test error	○	○
	205	VSVM 3V +FS	VSVM 3 V +FS test error	○	○
	206	VSVM 3V -FS	VSVM 3 V -FS test error	○	○
	207	VSVM 30V Z	VSVM 30 V ZERO test error	○	-
		VSVM 6V Zero	VSVM 6 V ZERO test error	-	○
	208	VSVM 30V +FS	VSVM 30 V +FS test error	○	-
		VSVM 6V +FS	VSVM 6 V +FS test error	-	○
	209	VSVM 30V -FS	VSVM 30 V -FS test error	○	-
		VSVM 6V -FS	VSVM 6 V -FS test error	-	○

Table A-2   Error Message List (2/4)

Classification	Display error code	Message	Explanation	6241A	6242
Self-test	211	HL 0.3V +FS	High Limit 300 mV +FS test error	○	○
	212	HL 0.3V -FS	High Limit 300 mV -FS test error	○	○
	213	HL 3V +FS	High Limit 3 V +FS test error	○	○
	214	HL 3V -FS	High Limit 3 V -FS test error	○	○
	215	HL 30V +FS	High Limit 30 V +FS test error	○	-
		HL 6V +FS	High Limit 6 V +FS test error	-	○
	216	HL 30V -FS	High Limit 30 V -FS test error	○	-
		HL 6V -FS	High Limit 6 V -FS test error	-	○
	221	LL 0.3V +FS	Low Limit 300 mV +FS test error	○	○
	222	LL 0.3V -FS	Low Limit 300 mV -FS test error	○	○
	223	LL 3V +FS	Low Limit 3 V +FS test error	○	○
	224	LL 3V -FS	Low Limit 3 V -FS test error	○	○
	225	LL 30V +FS	Low Limit 30 V +FS test error	○	-
		LL 6V +FS	Low Limit 6 V +FS test error	-	○
	226	LL 30V -FS	Low Limit 30 V -FS test error	○	-
		LL 6V -FS	Low Limit 6 V -FS 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	○	○
	236	IM 500mA Z	IM 500 mA Zero test error	○	-
		IM 3A Zero	IM 3A Zero test error	-	○
	237	IM 5A Zero	IM 5A Zero test error	-	○
	241	IS 30µA +FS	ISIM 30 µA +FS test error	○	○
	242	IS 30µA -FS	ISIM 30 µA -FS test error	○	○
	243	IS 300µA +FS	ISIM 300 µA +FS test error	○	○
	244	IS 300µA -FS	ISIM 300 µA -FS test error	○	○
	245	IS 3mA +FS	ISIM 3 mA +FS test error	○	○
	246	IS 3mA -FS	ISIM 3 mA -FS test error	○	○
	247	IS 30mA +FS	ISIM 30 mA +FS test error	○	○
	248	IS 30mA -FS	ISIM 30 mA -FS test error	○	○
	249	IS 300mA +FS	ISIM 300 mA +FS test error	○	○
	250	IS 300mA -FS	ISIM 300 mA -FS test error	○	○

Table A-2 Error Message List (3/4)

Classification	Display error code	Message	Explanation	6241A	6242
Self-test	251	IS 500mA +FS	ISIM 500 mA +FS test error	○	-
		IS 3A +FS	ISIM 3A +FS test error	-	○
	252	IS 500mA -FS	ISIM 500 mA -FS test error	○	-
		IS 3A -FS	ISIM 3A -FS test error	-	○
	253	IS 5A +FS	ISIM 5A +FS test error	-	○
	254	IS 5A -FS	ISIM 5A -FS 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 with STP command lost	○	○
	503	Para dt Lost	Saved parameters lost	○	○
Hard error	401	Fan Stopped	Fan stopped	○	○
	402	Over Heat	Overheat	○	○
	403	Source Unit	Source circuit error	○	○
	404	Over Load	Overload	○	○
Source and Measurement error	-	±OverRange	Measurement range over	○	○
	-	HiLimit RM/LoLimit RM	Resistance measurement under the limit status	○	○
	-	VSource=0	Measurement of resistance with Source value = 0	○	○
	-	Count Few	IS is below 20 counts, or IM is below 200 counts	○	○
	-	±SCL Over	Scaling over	○	○
	-	±TotalOver	Total value over	○	○
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 status by Interlock	○	○
	855	CAL data	Calibration data error	○	○
Remote command error	-102	Cmd Syntax	Command syntax error	○	○
	-113	Cmd Undefine	Command not defined	○	○
	-200	Cmd Exec	Execution error (It is a command which is presently un-executable)	○	○
	-222	Out of Range	Input value is out of the set range	○	○

Table A-2 Error Message List (4/4)

Classification	Display error code	Message	Explanation	6241A	6242
USB communication	140	CPU Comm	USB/SCI communications error (illegal code received)	○	○
	141	ILL Comm	USB/SCI communications error (another code received during a response)	○	○
	150	USB error	USB communication error	○	○

A.3 Execution Time

A.3.1 GPIB/USB Remote Execution Time (Typical Value)

Computer:	FMV6667CL6c manufactured by FUJITSU, Windows98SE
GPIB hardware:	PCI-GPIB (NATIONAL INSTRUMENTS)
Language:	Visual Basic 6

Item		Program code		Conditions	GPIB Unit [ms]	USB Unit [ms]
Operate, Suspend, or Standby	Operate	OPR	(At Standby)	Source mode: DC, pulse IT: 1 PLC (20 ms) Source function: VS/IS Others: Default values	127/93	139/104
			(In Suspend HiZ)		50/17	63/28
			(In Suspend LoZ)		12/17	24/28
		OPR	(At Standby)	Source mode: Sweep Number of steps: 100 IT: 1 PLC (20 ms) Others: Default values	170	181
			(In Suspend HiZ)		51	63
			(In Suspend LoZ)		12	25
	Suspend	SUS	(OPR → SUS LoZ)	Source mode: DC, pulse IT: 1 PLC (20 ms) Source function: VS/IS Others: Default values	11/17	24/29
			(OPR → SUS HiZ)		53/18	65/30
			(SBY → SUS LoZ)		126/88	137/98
			(SBY → SUS HiZ)		87/87	98/98
	Standby	SBY	(In Operate)	Source mode: DC, pulse IT: 1 PLC (20 ms) Source function: VS/IS Others: Default values	94/61	106/71
			(In Suspend HiZ)		51/51	64/64
			(In Suspend LoZ)		93/52	106/64
Source function		VF	(In IS operational status)	Source mode: DC, pulse	20 to 62	33 to 72
			(In Suspend)	Operate and HOLD status	10	22
		IF	(In VS operational status)		55 to 61	66 to 73
			(In Suspend)		10	22
Change the source range		V3 to V5 (Setting VF)			14 to 16	26 to 28
		I-1 to I4 / I-1 to I5 (Setting IF)			28 to 51	40 to 64

Item		Program code	Conditions		GPIB Unit [ms]	USB Unit [ms]
Voltage-source*	Source value Pulse value Base value Bias value	SOV<data> BS<data> SB<data>	Operate and HOLD status	Range not changed	9 to 12	22 to 25
				Range changed	15 to 28	26 to 42
Current-source*	Source value Pulse value Base value Bias value	SOI<data> BS<data> SB<data>		Range not changed	21 to 29	35 to 43
				Range changed	43 to 66	57 to 79
Voltage-limiter value*		LMV<data>		Range not changed	9 to 11	22 to 24
				Range changed	14 to 27	25 to 42
Current-limiter value*		LMI>data>		Range not changed	22 to 25	36 to 41
				Range changed	42 to 66	55 to 79
Measurement function		F0 to F3	Source mode: DC, pulse Operate and HOLD status		10	23
Integration time		IT0			12	25
		IT1			13	26
		IT2			14	27
		IT3			22	35
		IT4			33	45
		IT5			52	65
		IT6			212	225
		IT7			412	425
Time parameter	Th, Td, Tp, Tw	SP<data>,<data>,<data>,<data>			15 to 18	31 to 35
	Tds	SD<data>			9 to 20	23 to 36
Sweep type*	Linear	SN<data>	Standby status		12 to 36	26 to 52
	Fixed	SF<data>			10 to 11	24 to 26
	Random	SC<data>			9 to 10	23 to 25
	Two-slope	SM<data>			15 to 67	31 to 86
Source mode		MD0 to MD3			9	23
Set random data *		N<adrs>,<data>, P			12 to 28	30 to 47

* The command with <data> is different in processing time according to the data length.

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)

- The time from trigger input (*TRG) to measurement and to completion of data output to GPIB/ USB

Conditions for source value	GPIB Execution time	USB Execution time
When DC or Pulse source is generated	9 ms	18 ms
When Sweep start value is generated	12 ms	21 ms
When Sweep step value is generated	10 ms	19 ms

- The time from Receiving source command + Measurement by Trigger input (*TRG) and to completing data output to GPIB/USB
In DC or Pulse source mode

Source	Command	GPIB Execution time	USB Execution time
Voltage-source	SOV<data> (<data>: 1 character)	13 ms	23 ms
Current-source	SOI<data> (No unit, < data>: 3 characters)	14 ms	25 ms

- The time from measurement due to receiving a spot command (measurement trigger after setting the source value for currently set Source function) to completion of data output to GPIB/ USB.
In DC or Pulse source mode

Source	Command	GPIB Execution time	USB Execution time
Voltage-source	G<data> (<data>: 1 character)	11 ms	19 ms
Current-source	G<data> (No unit, < data>: 3 characters)	12 ms	21 ms

2. Data read time

Item	Number of data	GPIB Execution time	USB Execution time
Source-value data-reading by Query	1	6 ms	18 ms
Read measurement buffer memory after RN1 command Condition: number of measurement digits; 5½ digits, Header; OFF, Block delimiter; EOI (DL2)	1	7 ms	20 ms
	100	403 ms	1.33 s

3. Sweep start to Data read time

   Indicates a time from executing 100 step sweep to completing the data output from memory to GPIB with RN1 command.

   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)

Memory mode	Period	GPIB Execution time
Normal-ON	10 ms	1.4 s
Burst-ON	2 ms	0.6 s

A.3.2 Internal Processing Time (Typical Value)

1. Source processing time

   The time from external trigger signal input to the time 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.

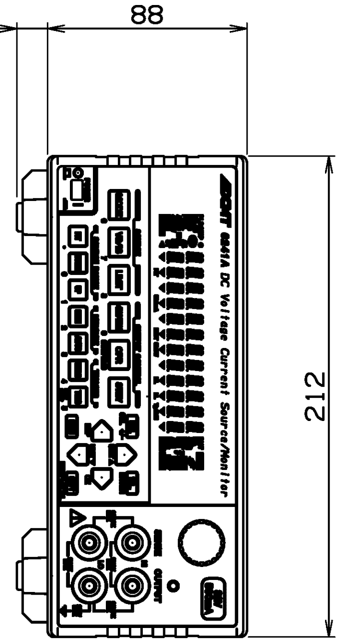
   Conditions: Source range; fixed
   Measurement range; fixed, Trigger mode; HOLD or external trigger
   Source delay; 30 µs

Source mode	Source value	Execution time
Pulse	Pulse value	60µs
DC Sweep	Start value	1 ms
	Step value	60 µs
Pulse Sweep*	Start (base) value	1 ms
	Step value	60 µs

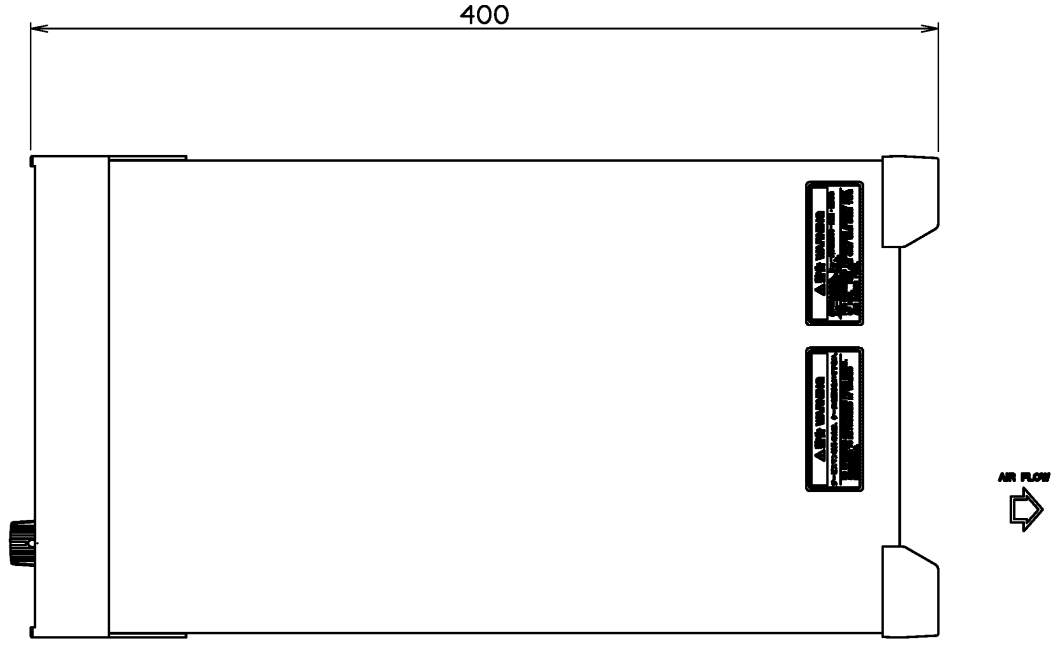
*The pulse sweep start value represents the time from trigger to base value generation. (Time from the base value generation to the start pulse generation varies depending on the Hold time.)

2. Switching time

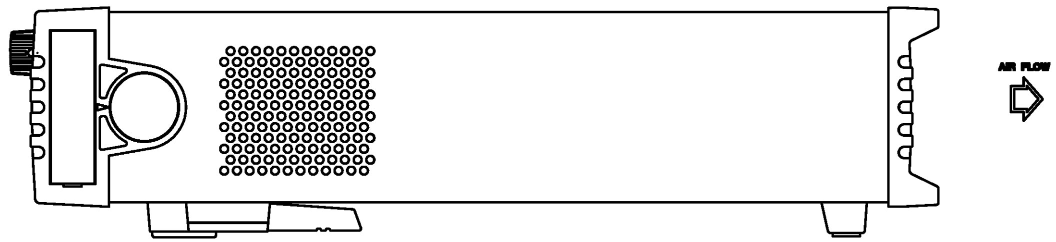
   - Source function change time: 5 ms
   - Source range change time
     Voltage source function: 8 ms
     Current source function: 24 ms
   - Measurement range change time
     Voltage-measurement function: 8 ms
     Current measurement function: 35 ms
   - Measurement auto range processing time
     Voltage measurement function: Integration time + 8 ms
     Current measurement function: Integration time + 35 ms



6241A FRONT VIEW



6241A TOP VIEW



6241A 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 of the instrument.

DIMENSIONAL OUTLINE DRAWING

ALPHABETICAL INDEX