6240A

DC Voltage Current Source/Monitor

Operation Manual

MANUAL NUMBER FOE-8440075C02

First printing March 30, 2007
Printed in Japan

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.
  - 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.

   : 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
Floppy disk drive	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, batteries

Environmental Conditions

This instrument should be only be used in an 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

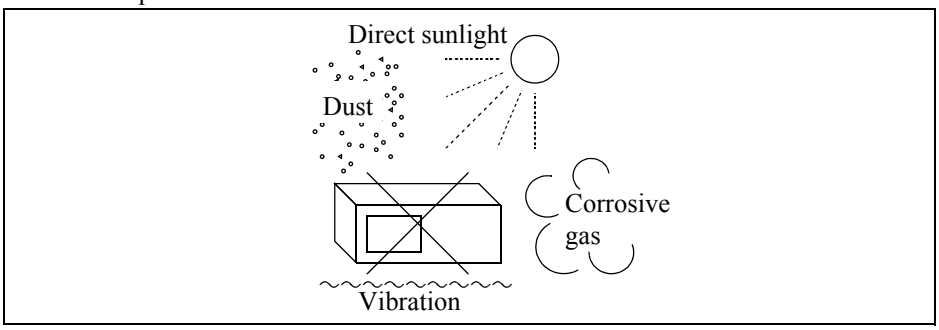
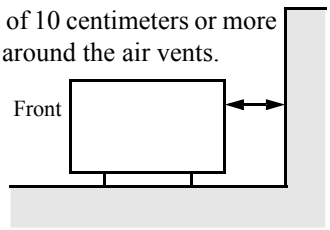


Figure-1 Environmental Conditions

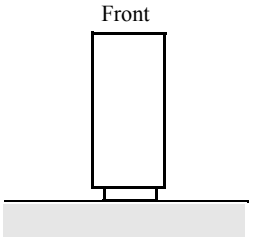
- Operating position



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

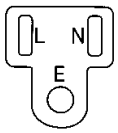
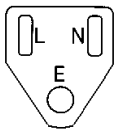
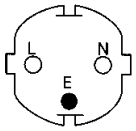
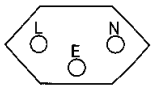
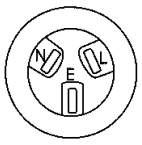
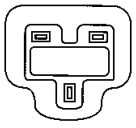
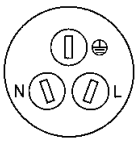
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  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

CE

This is to certify, that

DC Voltage Current Source/Monitor

6240A

instrument, type, designation

complies with the provisions of the EMC Directive 89/336/EEC (All of these factors are revised by 91/263/EEC, 92/31/EEC, 93/68/EEC), 2004/108/EC in accordance with EN61326 and Low Voltage Directive 73/23/EEC (All of these factors are revised by 93/68/EEC), 2006/95/EC in accordance with EN61010.

ADC Corp.

Japan

ROHDE&SCHWARZ

Europe GmbH
Munich, Germany

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

List of Illustrations

LIST OF TABLES

1. PREFACE

The manual describes the accessories, operating environment, precautions, operating check for the personnel who operates the 6240A. Read this manual before using the 6240A.

1.1 Product Overview

The 6240A DC Voltage Current Source/Monitor includes precise generation and measurement resolution functions, as well as various sweep functions and a pulse measurement function which uses a minimum pulse width of 500 μs. The 6240A can be widely used as the power source generator for evaluation and characteristic tests in R & D fields such as the semiconductor or electrical components.

The 6240A characteristics are described below.

- Source and Measurement range — Up to ±15 V, DC ±1 A
Up to ±10 V, pulse ±4 A
(Pulse: Maximum pulse width: 20 ms and duty factor: ≤20%)
- Voltage source/measurement range: 3 V to 15 V
- Current source/measurement range: DC 3 mA to 1 A, AC 3 mA to 4 A (pulse)
- The number of voltage/measurement digits: voltage 4-1/2; measurement 5-1/2
- Voltage source/voltage measurement resolution: source 100 μV; measurement 10 μV
- Current source/current measurement resolution: source 100 nA; measurement 10 nA
- 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: 500 μs
- 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 6240A units
- GPIB for integrating an automated measurement system as standard.

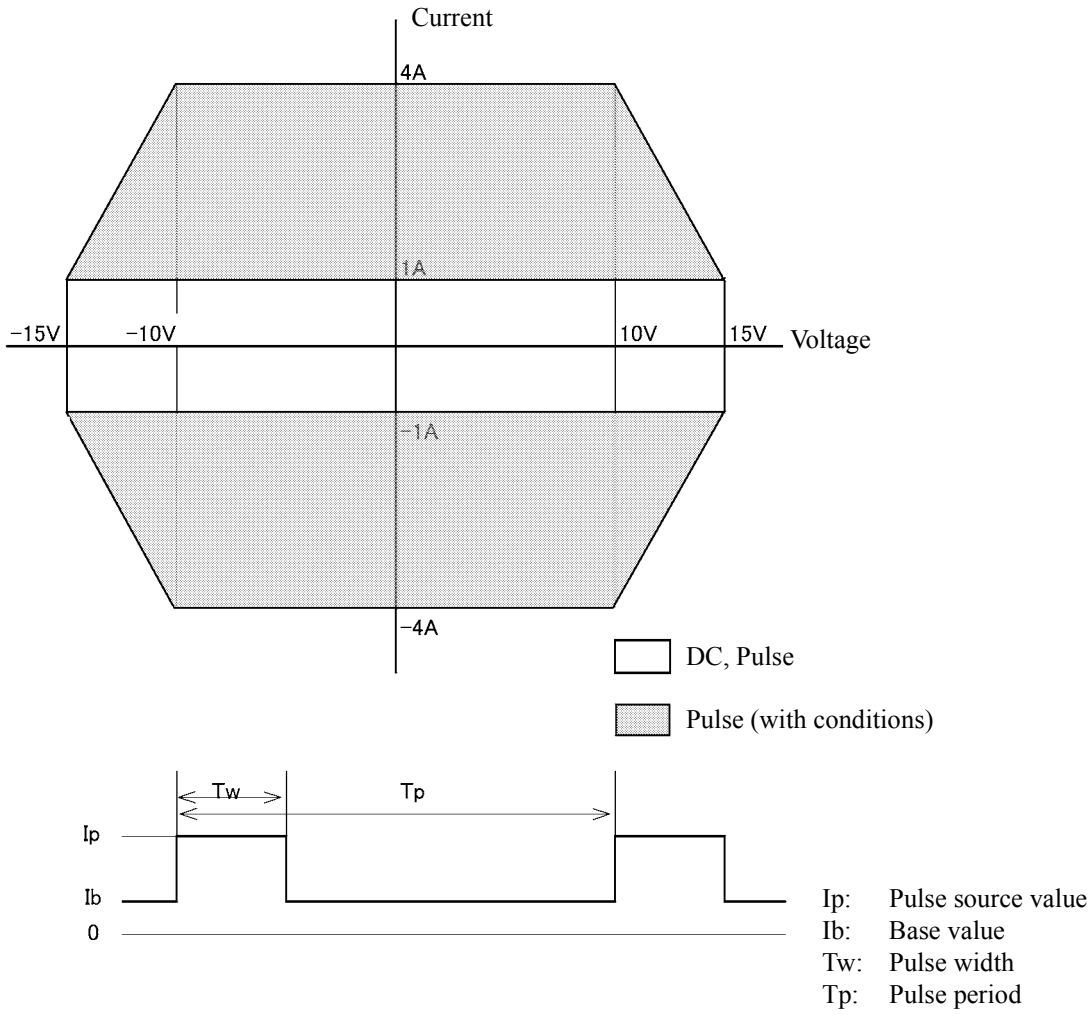


Figure 1-1 Voltage and Current Output Range

1.2 Supplied Accessories

The 6240A standard accessories are listed in Table 1-1. If any accessory is missing or damaged, contact an ADC CORPORATION sales representative. Please specify the part number when ordering.

Table 1-1 Standard Accessory List

Name	Part Number	Quantity	Remarks
Power cable*1	A01402	1	Power cable 3 pin plug
Input and output cable	A01044	1	Red, black, one each
Power fuse	2181.25	1*2	110 V/120 V slow blow
	218.630		220 V/240 V slow blow
Operation Manual	E6240A	1	This manual

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

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

1.3 Optional Accessories

The 6240A optional accessories are listed in Table 1-2. Specify the part number when ordering.

Table 1-2 Standard Accessory List

Name	Part Number	Remarks
Test fixture	12701A	
Connecting Cable	A01041	Test lead (1 m)
	A01047-01	Input and output cable (banana-banana four-wire shield 0.5 m)
	A01047-02	Input and output cable (banana-banana four-wire shield 1 m)
	A01047-03	Input and output cable (banana-banana four-wire shield 1.5 m)
	A01047-04	Input and output cable (banana-banana four-wire shield 2 m)
	A01036-1500	BNC-BNC cable (1.5 m)
Rack mounting set	A02263	JIS standardized rack mounting set (single)
	A02264	JIS standardized rack mounting set (twin)
	A02463	EIA standardized rack mounting set (single)
	A02464	EIA standardized rack mounting set (twin)
Panel mounting set	A02039	Single
	A02040	Twin

1.4 Operating Environment

This section describes the required environmental conditions and power supply conditions.

1.4.1 Environmental Conditions

The 6240A must be installed in an environment meeting the following conditions.

- Ambient temperature: 0°C to +50°C (temperature range for operation).
- Relative humidity: 85% or lower (with no condensation)
- Location not subject to corrosive gasses
- Away from direct sunlight
- Dust free
- No vibrations
- No noise

  The 6240A is designed with full consideration given to the noise contained in the AC power line. Nevertheless, it is recommended that the 6240A be used in an environment with as little line noise as possible.

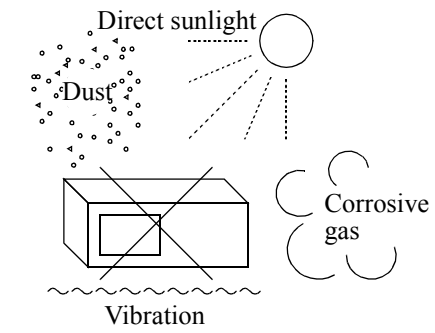
  If a location with line noise is unavoidable, use a noise filter.
- Positioning of the 6240A

  A cooling fan is located in the rear panel and vents are located in 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 6240A in a position with the rear panel facing down.

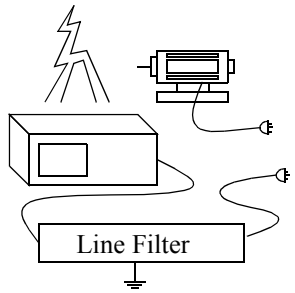
  Obstructing the vents will cause the internal temperature to rise, possibly causing faulty operation.
- Mounting in a rack

  Ensure that exhaust air from other 6240A is not directed at the vents on the side of the 6240A.

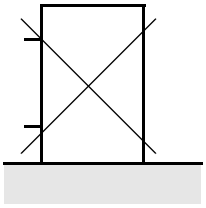
  To prevent the temperature in the rack from rising, install a heat sink fan.



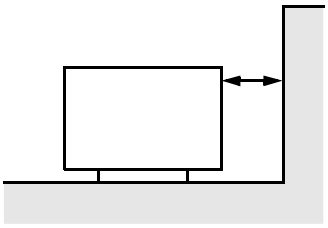
• Avoid operation in these areas.



• Use a noise-cut filter when there is a large amount of noise riding on the power line.



• Do not use the analyzer upright turned the rear panel side down.



• Keep the rear panel 10 centimeters away from the wall

Figure 1-2 Operating Environment

1.4.2 Power Specification

Table 1-3 below shows the 6240A power supply specifications.

NOTE: To prevent damage to the 6240A, do not apply a voltage or frequency that exceeds the specified range.

Table 1-3 Power Supply Specification

	Standard	Optional		
		32	42	44
	AC100 V	AC120 V	AC220 V	AC240 V
Input voltage range	90 V to 110 V	103 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			
Fuse	T1.25A/250 V		T630mA/250 V	

1.4.3 Changing the Source Voltage, Checking and Replacing the Main Fuse

The 6240A source voltage can be changed manually.
The section describes the procedure for changing the source voltage, and checking and replacing the power fuse.

NOTE:

1. ***If the power fuse has blown, a problem has occurred in the 6240A. Contact an ADC CORPORATION sales representative.***
2. ***Always use the same fuse type and rating to prevent fire.***

Changing the voltage selector

1. Set the **POWER** switch on the front panel to OFF.
2. Unplug the power cable from the AC outlet.
3. Open the fuse holder cover on the rear panel by using a flat head screwdriver.

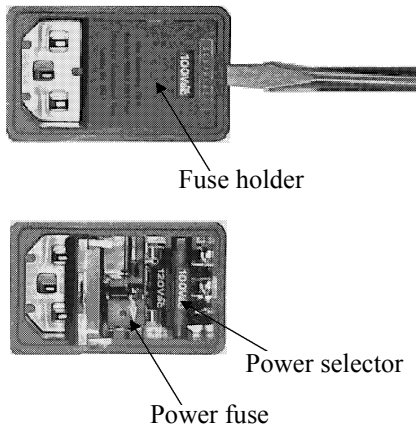


Figure 1-3 Changing the Source Voltage, and Checking and Replacing the Power Fuse

4. Manually rotate the voltage selector to set the target voltage.
   The available settings (100 V, 120 V, 220 V or 240 V) are printed on the voltage selector.
5. Align the voltage selector so that the specified voltage is displayed in front.

Checking and replacing the power fuse

6. Pull out the power fuse marked with an arrow.
   Check if the removed fuse has blown. Also check if it matches the supply voltage. Replace the fuse as required and return it to the original position.
7. Close the cover.

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 with no 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.***

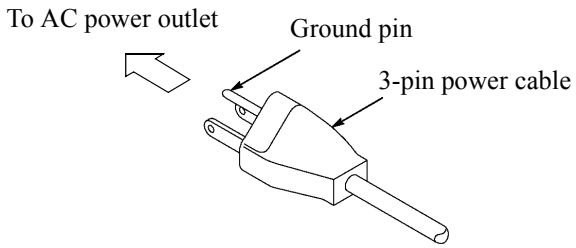


Figure 1-4 Power Cable

1.5 Operating Check

This section describes the simple self-test which must be performed when operating the 6240A for the first time.
Follow the procedure below to ensure the 6240A 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 6240A, do not apply a voltage or frequency that exceeds the specified range. (Refer to Table 1-2.)***

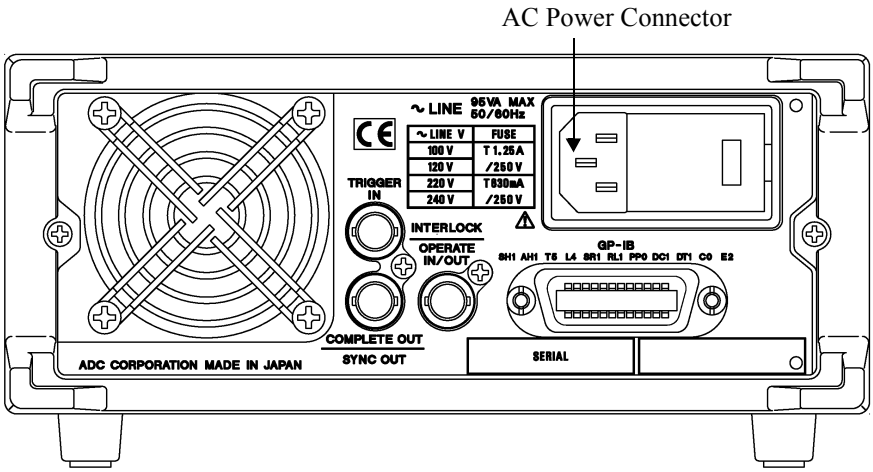


Figure 1-5 Connecting the Power Cable

3. Plug the power cable into an AC outlet.
4. Set the **POWER** switch on the front panel to ON.
   After all the indicators turns on, the self-test is performed. (Duration: approx. 10 sec. See Figure 1-6.)

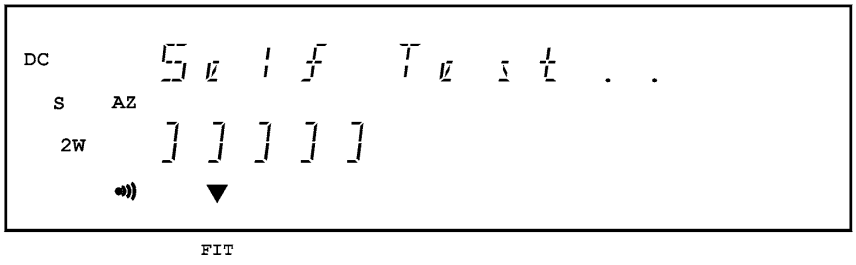


Figure 1-6 Screen Displaying Self-Test

When the test is complete, the model name, line frequency, GPIB address, and software revision appear on the screen (Figure 1-7) and then the start-up screen is displayed (Figure 1-8).

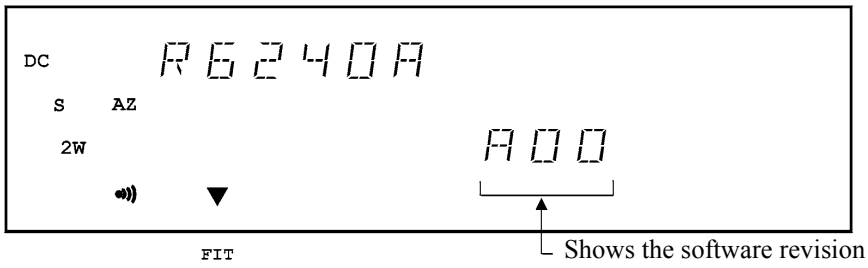


Figure 1-7 Screen Displaying Self-Test Completion

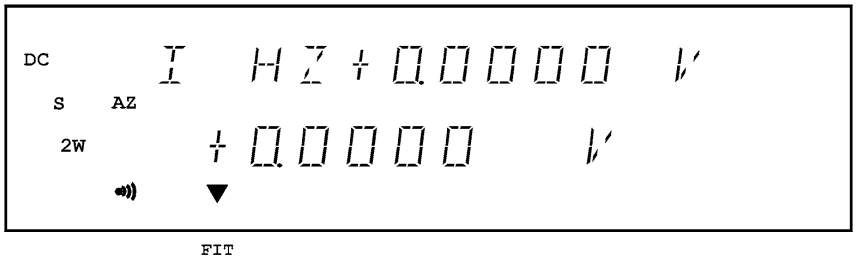


Figure 1-8 Start-up Screen

NOTE:

1. ***Depending on the previous conditions, the screen display may be different from Figure 1-8.***
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)***

---

5. Press **MON** twice to start measuring the voltage. (Figure 1-9).

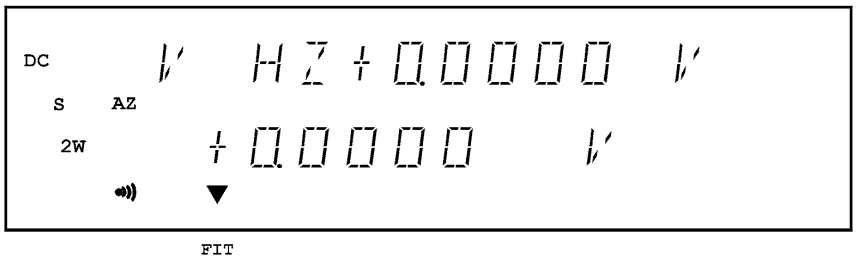


Figure 1-9 VSVM Measurement (In output OFF Standby)

6. Press **OPR** (Operate).
   The OPR indicator turns on and the VSVM measurement starts. (Figure 1-10)

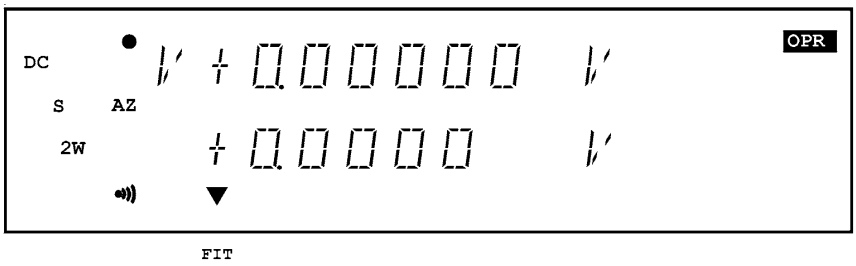


Figure 1-10 Displaying VSVM 3 V Range, 0 V Measurement

7. Check that the VM measured value is within ±350 μV of 0 V in the VS 3 V range.
8. Press **STBY**.
   The OPR lamp goes OFF and the 6240A enters the standby (output OFF) mode.

The self-test is complete.

1.6 Cleaning, Storage, and Transport Methods

1.6.1 Cleaning

Clean the 6240A by wiping or brushing its surface with a soft cloth or cloth which has been dampened in water containing a mild detergent.

NOTE:

1. ***Ensure that water does not penetrate the 6240A (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 6240A in a location where the temperature is within the range of -25°C to +70°C. If storing for an extended period (90 days or longer), place the 6240A in a moisture-proof bag together with a desiccator. Avoid storing the 6240A 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 6240A, use the original box that the 6240A came in. If the box is no longer available, pack the 6240A 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 6240A by 15 cm or more to allow for shock absorbent material.
2. Wrap the 6240A with a protective sheet.
3. Line the box with shock absorbing material so that the 6240A is protected on all sides by cushioning material.
4. Close the box with industrial staples or use packing tape.

When sending the 6240A to 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 6240A to warm up for at least 60 minutes after turning on the power to ensure the 6240A specified accuracy.

1.8 Calibration

In order to use the 6240A in accordance with its specifications, calibration must be performed once a year.

The calibration method is explained in Chapter 8, “CALIBRATION.”

Contact an ADC CORPORATION sales representative for the calibration service.

Recommended period between calibrations	1 year

1.9 Parts with a Limited Life Span

In addition to the parts listed in “Safety Summary,” the 6240A also includes the following parts that have a limited life span.

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

Part name	Average life span	Remarks
Relay for switching between Operation and Standby	1,000,000 cycles (resistive load)	Replace when the switching cycle between “Operate” and “Standby” reaches the numbers of cycles noted 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	30,000 hours	

2. OPERATION

This chapter describes the part names and functions on the front and rear panels and the screen display (annotation) elements. This section describes the operation procedure of the 6240A by using measurement examples.

2.1 Panel Descriptions

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

2.1.1 Front Panel

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

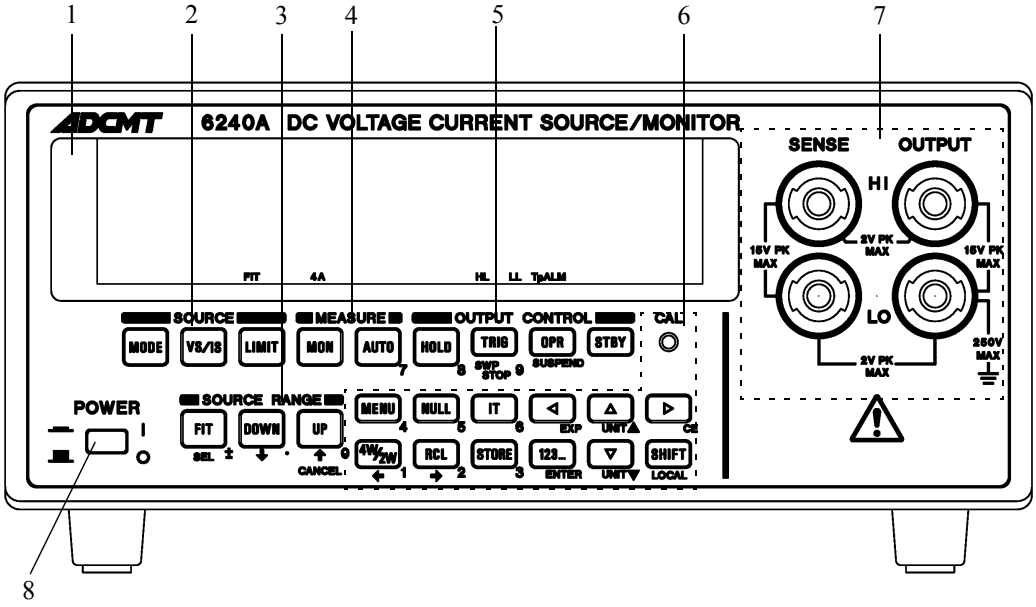


Figure 2-1 Front Panel

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. Other keys
7. Output section
8. POWER switch

2.1.1.1 Display Section

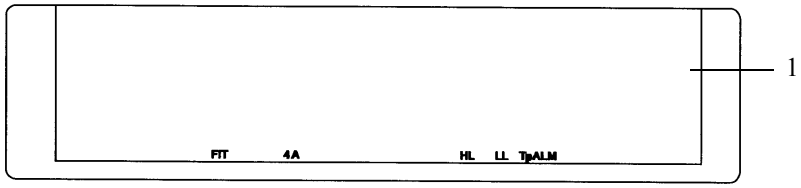


Figure 2-2 Display Section

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

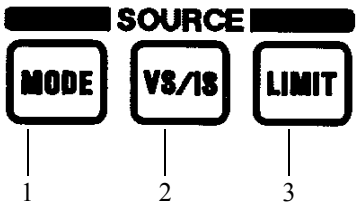


Figure 2-3 SOURCE Section

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

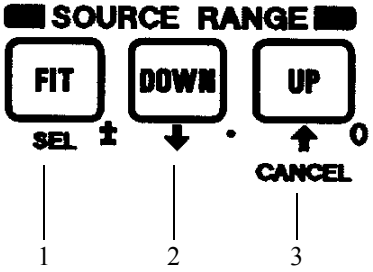


Figure 2-4 SOURCE RANGE Section

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

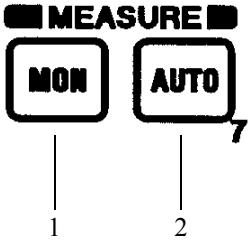


Figure 2-5 MEASURE Section

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

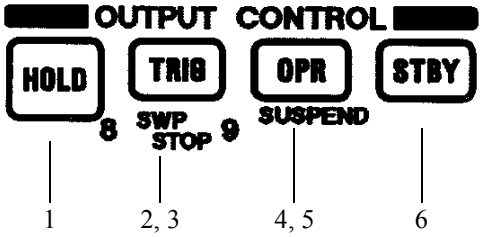


Figure 2-6 OUTPUT CONTROL Section

1. **HOLD** key: Selects the trigger mode (AUTO or HOLD).
2. **TRIG** key: Triggers the measurement and pulse source when the sampling is in the HOLD state in the DC and Pulse Source mode, and starts, pauses or restarts the Sweep, or goes to the next step in the sweep source mode.
3. **SWP STOP (SHIFT, TRIG)** key: Stops the sweep.
4. **OPR** key: Switches between Operate and Suspend* status.
   *: Suspend status outputs the suspended voltage without turning OFF the output relay. OPR indicator flashes.
5. **SUSPEND (SHIFT, OPR)** key: Sets Suspend regardless of the operational or standby status.
6. **STBY** key: Sets the output standby status.

2.1.1.6 Other Keys

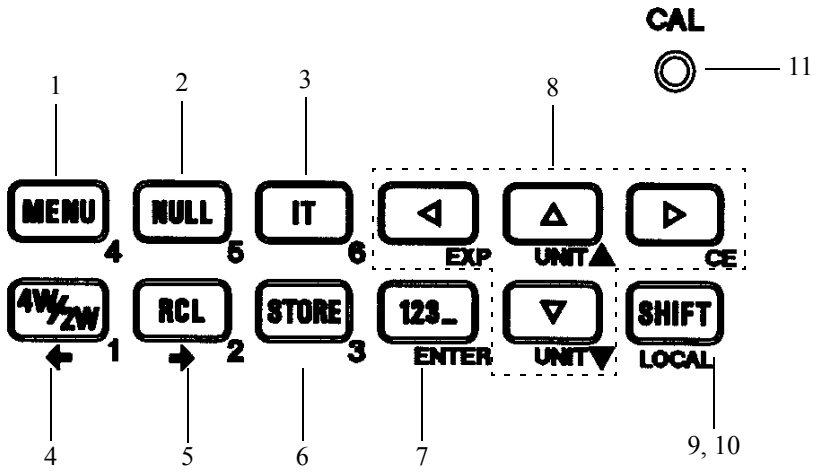


Figure 2-7 Other Keys

1. **MENU** key: Displays a parameter group setting screen.
2. **NULL** key: Sets the Null calculation.
3. **IT** key; Selects the measurement integral time.
4. **4W/2W** key: Selects the output sensing 4-wired and 2-wired connections.
5. **RCL** key: Reads and displays the data stored in the measurement data memory.
6. **STORE** key: Sets the measurement data memory store to ON or OFF.
7. **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.
8. △, ▽, ◁, ▷ key: Select the data and moves the cursor to the digit when setting the parameters.
9. **SHIFT** Key: Selects key shift mode ON or OFF.
10. **LOCAL** key: Operates as a local key when GPIB is remote controlled.
11. **CAL** key: Selects the calibration mode ON or OFF.

2.1.1.7 Output Section

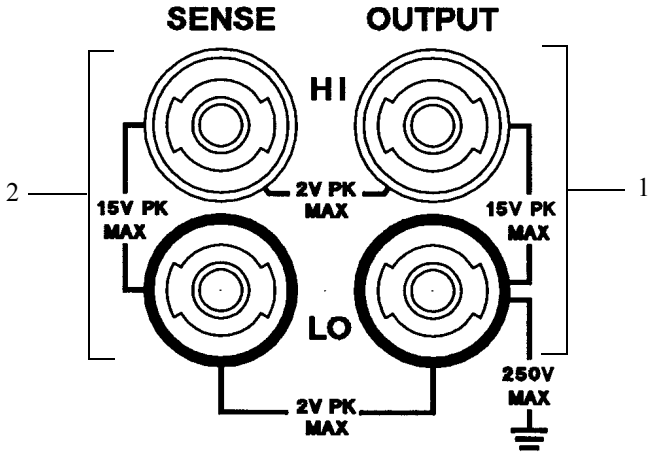


Figure 2-8 Output Section

1. OUTPUT terminal: Voltage and current output terminal.
2. SENSE terminal: Functions as a sensing voltage output in the remote sense mode (4-wire connection) and input terminals for voltage-measurement.

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.

2.1.1.8 POWER Switch

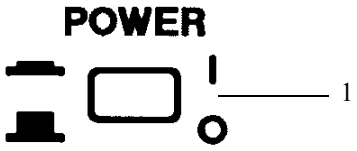


Figure 2-9 POWER Switch

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

2.1.2 Screen Display

This section describes the screen display.

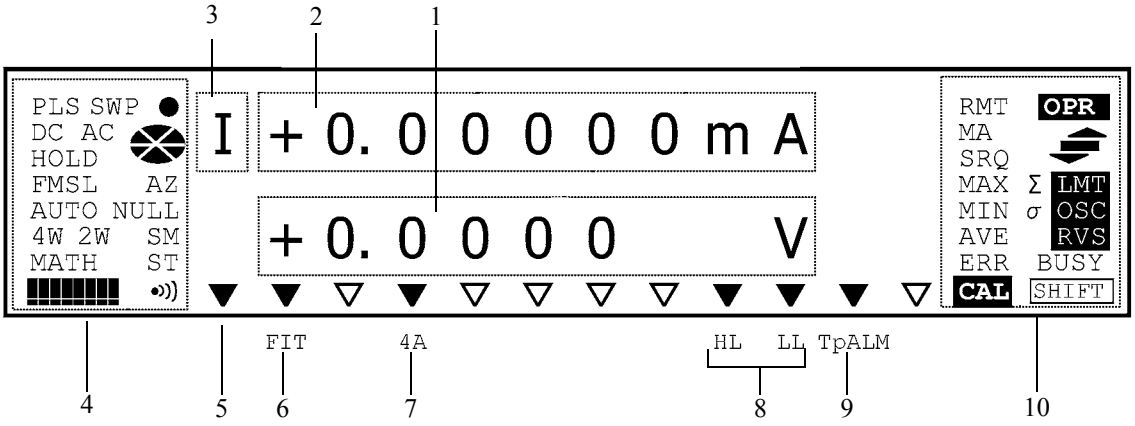


Figure 2-10 Screen Display (Annotations)

1. Source Value:

   Displays voltage source (VS) and current source (IS) values using the unit.

2. Measurement Value

   In Operation:
   Displays measurement value.
   In Standby and Suspend:
   Displays the suspend voltage and the output impedance in Suspend status.
   HZ: High impedance
   LZ: Low impedance
   (For more information on the 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 Indicator

   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 generates direct current.
   AC: (Not in use)
   HOLD: Trigger mode is in hold status.
   FMSL: Displays the FSML measurement integral time by using the indicators in combination.
   AUTO: The Auto range is set to ON.
   4W: The output sensing is set to 4-wire connections.
   2W: The output sensing is set to 2-wire connections.
   MATH: The scaling calculation is ON.
   ● : The every measurement sampling.

: Indicates the sweep operation status.
Rotates while sweeping.
At hold, it stops rotation.
Goes out when the sweep stopped.

AZ: The measurement auto zero function is ON.
NULL: The null calculation is ON.
ST: The measurement data memory is ON.
•)) : The buzzer setting is ON.

5. Auxiliary Indicator for Menu: Blinks if a lower hierarchy is available (DOWN key enabled) when setting the parameter on the Menu screen.

6. FIT Indicator: The source range is set to FIT.

7. 4A Indicator: The current source or current limiter range is 4A.

8. HL/LL Indicator:
HL: The high side is in limiter status.
LL: The low side is in limiter status.

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

10. Right status Indicators:
RMT: The GPIB remote control status.
MA: The GPIB talker or listener.
SRQ: The SRQ is being transmitted.
MAX, MIN, AVE, Σ:
The Max/Min calculations are ON.
σ: Not in use
ERR: The error log is generated.
CAL: The calibration mode is ON.
OPR: Lights up or goes out depending on the following operating status.
In operation: ON
In suspension: Blinks
In Standby: OFF
: When the calculation is ON, either one of the following lights up depending on the results.
LMT: The value is at limiter status.
OSC: (Not in use)
RVS: (Not in use)
BUSY: Blinks until the processing has completed when internal processing time is longer.
SHIFT: The 6240A is in shift mode status.

2.1.3 Rear Panel

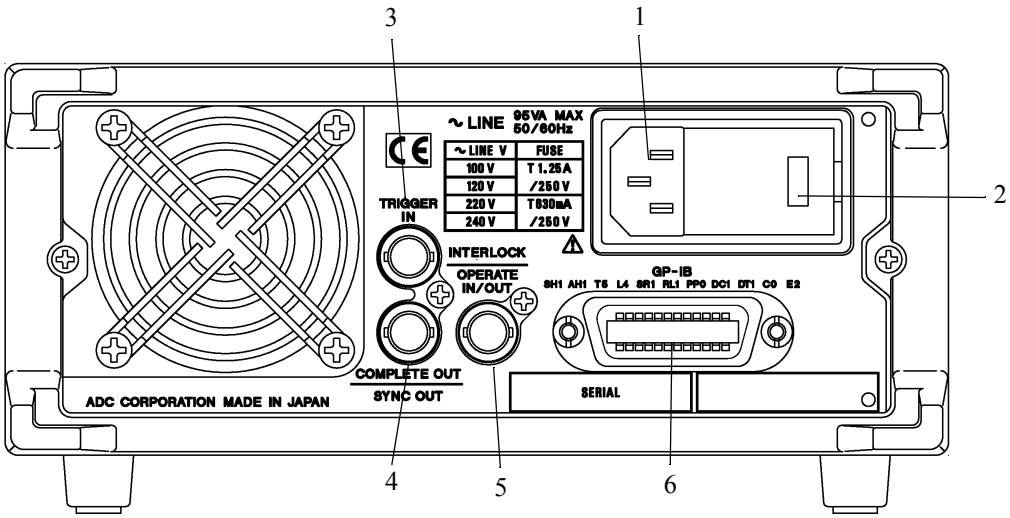


Figure 2-11 Rear Panel

1. AC power connector — Connect the 6240A to the AC power supply by using the supplied power cable.

2. Voltage Selector and Fuse Holder — Select the voltage manually to match the AC power supply. A fuse is contained inside.

   NOTE: 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 negative pulse input. (pulse width 10 µs or over)

4. COMPLETE OUT | SYNC OUT: The output signal is a negative pulse. Select either 10 or 100 µs pulse width. The output circuit is TTL level open drain output and pulled up to + 5 V by 10 kΩ.

   COMPLETE OUT:
   Signal indicating the measurement is completed. It outputs with the any condition of Front, End, Hi, Go, Lo, Hi, or Lo.

   SYNC OUT:
   Outputs the signal synchronized with the source output in pulse and sweeping.

5. INTERLOCK | OPERATE IN/OUT

INTERLOCK:
Interlock input signal. 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. The circuit is TTL level open drain output and is pulled up to +5 V by 10 kΩ.

6. GP-IB: Connector port for connecting GPIB 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.

2.2.1 Setting Source Value

2.2.1.1 Relation between Keys

Figure 2-12 shows the relation between keys.

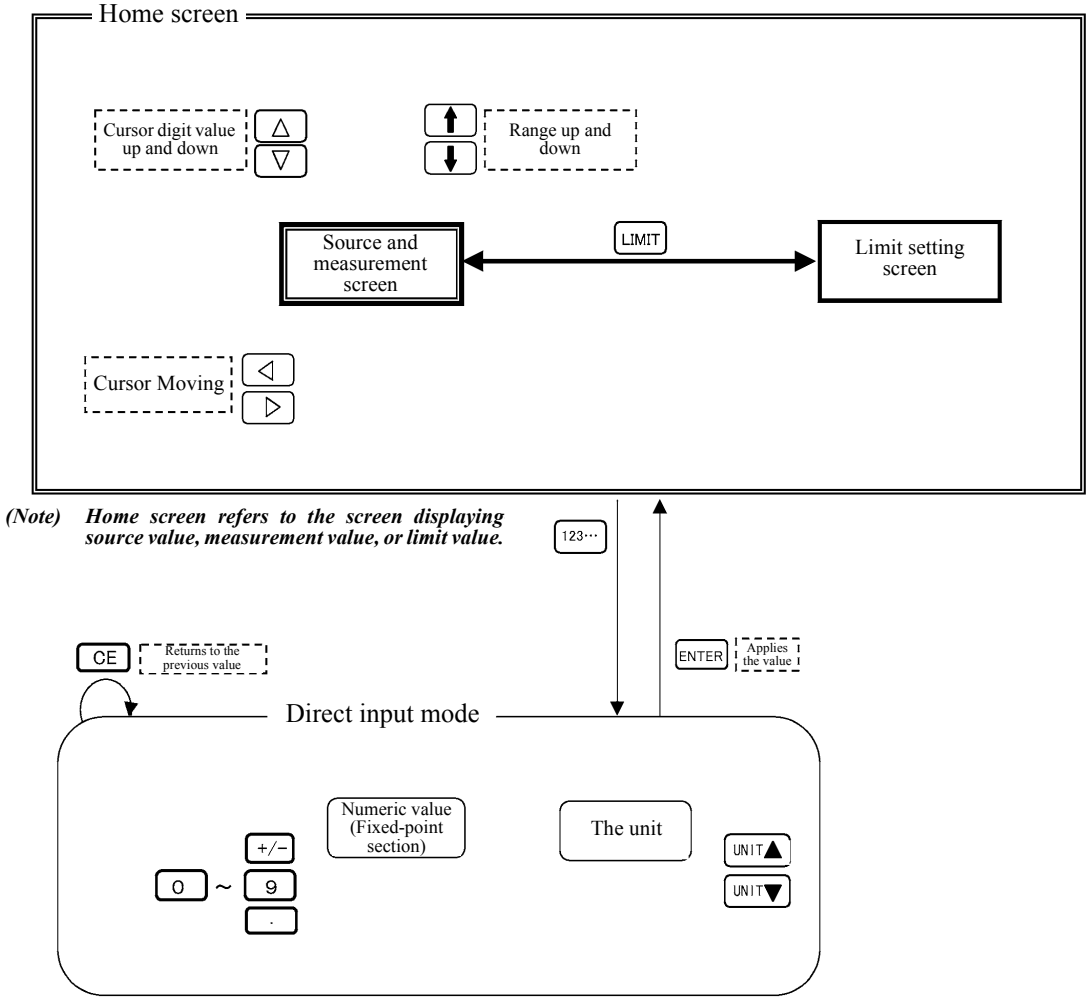
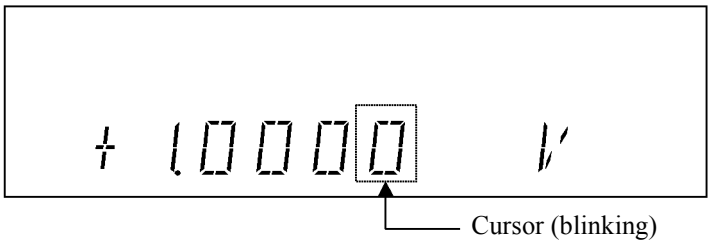


Figure 2-12 Relation between Keys

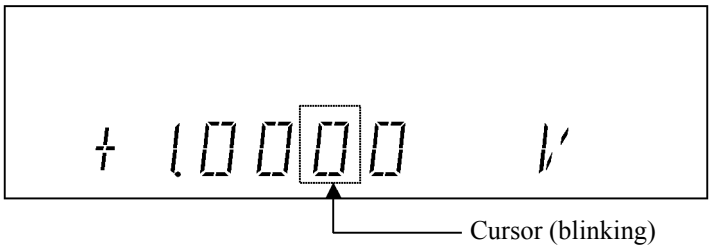
2.2.1.2 Setting the Source Value Using the Cursor Keys (when the FIT Indicator OFF)

1. Changing the values using the cursor keys (◁ ▷) and up/down keys (△ ▽)
   ◁ and ▷ key move the cursor (blinking) position to left and rightward.
   △ and ▽ key can change the value indicated by the cursor.
   See the following diagram.

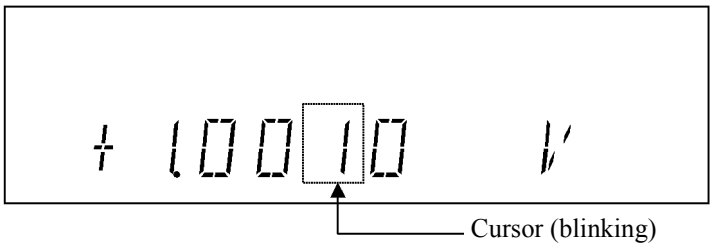


Setting numeric values

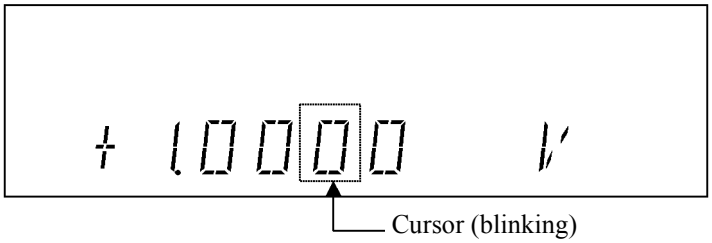
1. Press ◁.
   The cursor moves to the left.



2. Press △.
   The value indicated by the cursor increases by one increment.



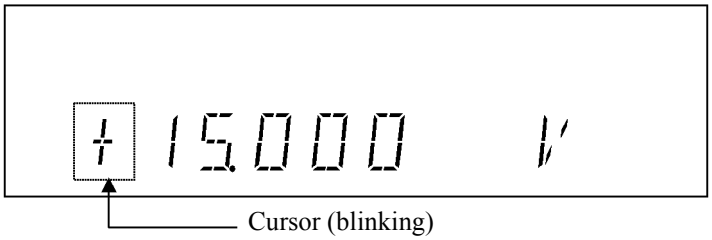
3. Press ▽.
   The value indicated by the cursor decreases by one increment.



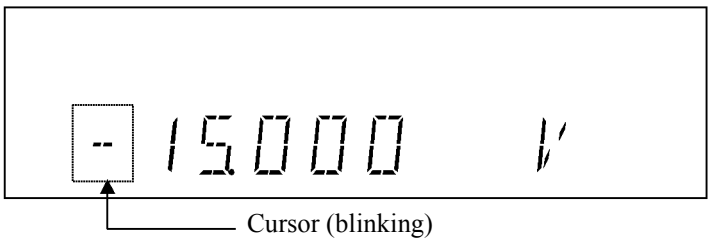
4. Keep pressing △.
   The value increases incrementally while pressing the key.
   The value stops increasing when the key is released.

Setting the polarity

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



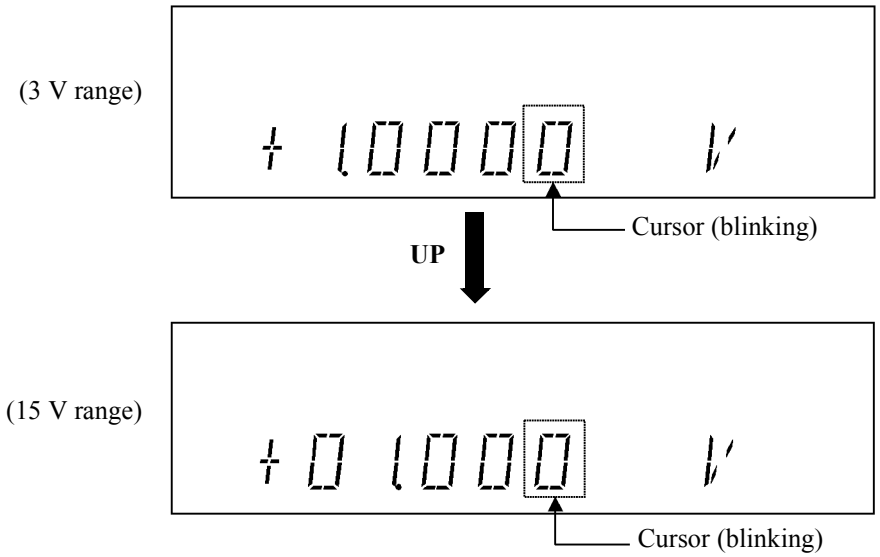
2. Press △.
   The polarity display changes to negative "-" mark. However, if the value is 0, it is impossible to set "-".



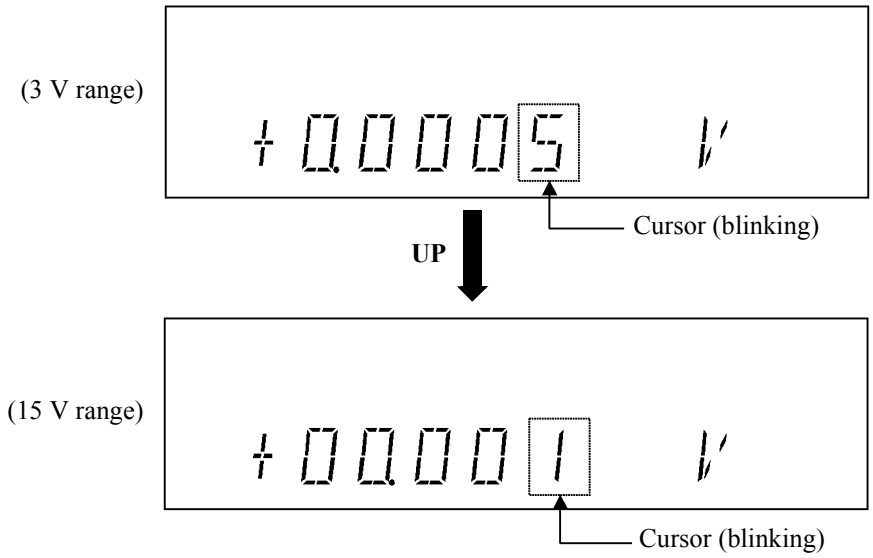
2. Changing Source Range

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

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

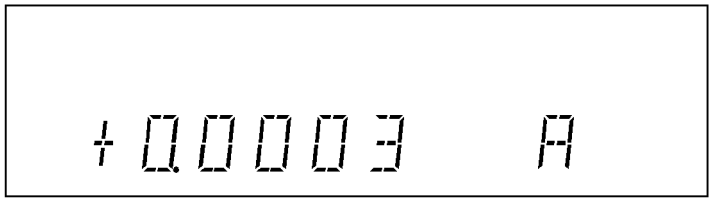


   • If the set value is below the minimum digit, it is rounded off.



- When changing from the 1 A to 4 A range, the smallest digit is rounded off to an even number.

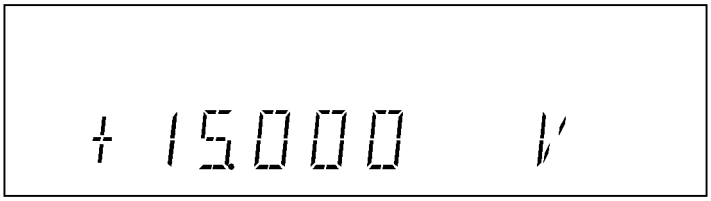
(1 A range)



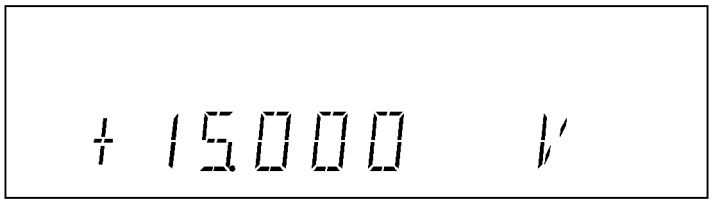
UP

(4 A range)

- If the final value would exceed the valid range, no change is possible.



DOWN

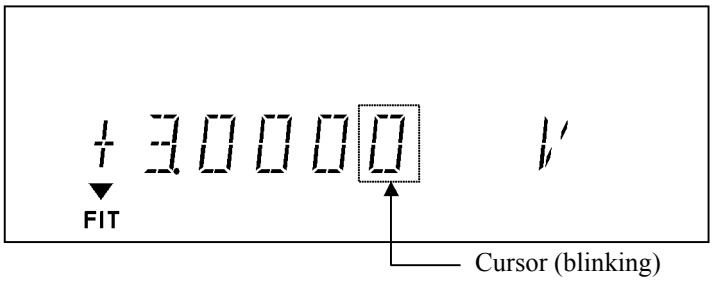


An error is generated and no change occurs.

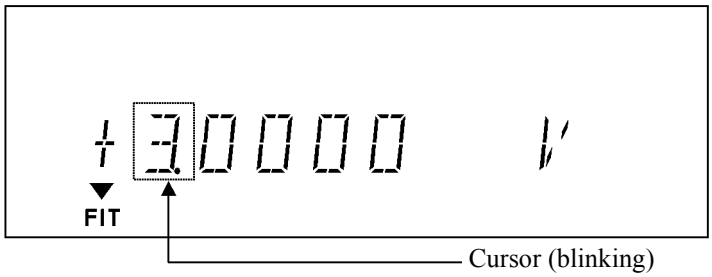
2.2.1.3 Setting Source Value using Cursor (when the FIT Indicator Turns ON)

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

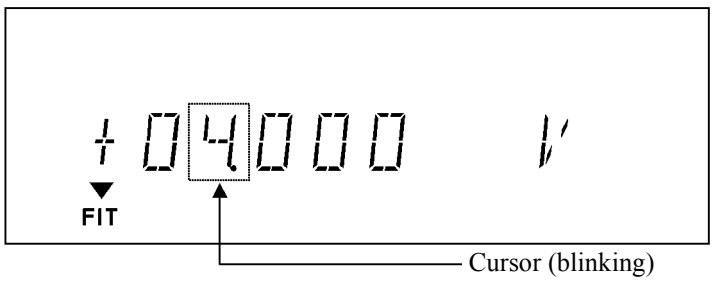
The following figures describe the automatic adjustment.



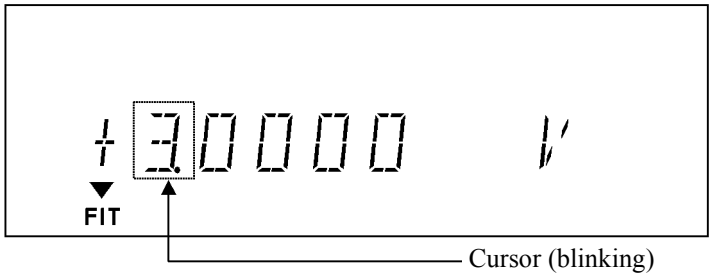
1. Press ◁. The cursor moves to the left.



2. Press △. The setting changes from 3 V to 4 V.
   The source range is automatically set to 15 V.



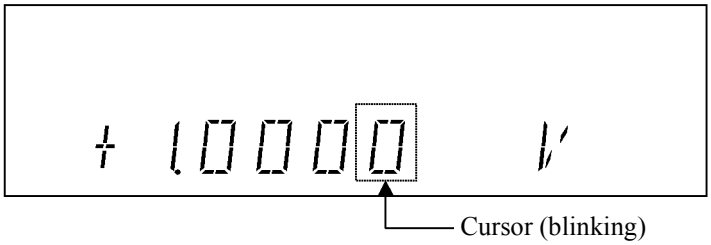
3. Press ▽.
   The source range is automatically set to 3 V.



2.2.1.4 Setting Source Value using Direct Input Mode

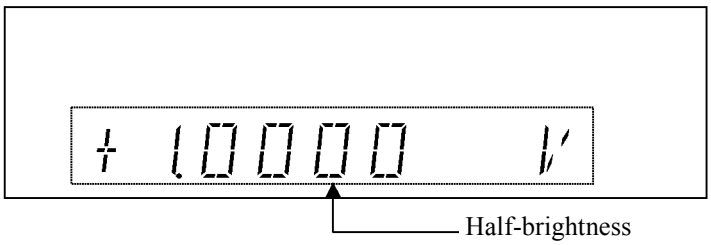
Press **123...** to turn to the direct mode, and set the source value by using the numeric key and the unit key, which are printed in green on the panel.

The following figures describe the setting procedure.

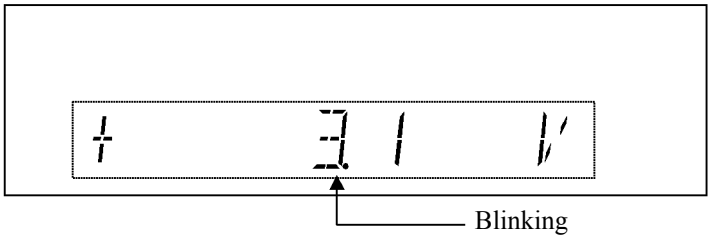


Setting numeric values

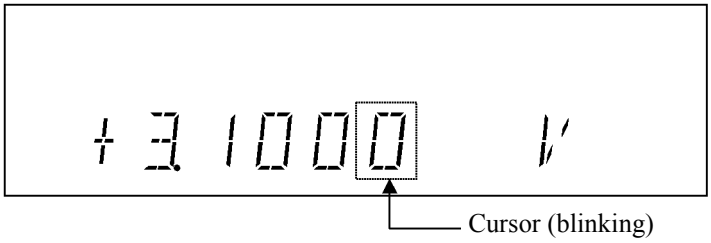
1. Press **123...**.
   The screen is half-lit and indicates direct input mode.



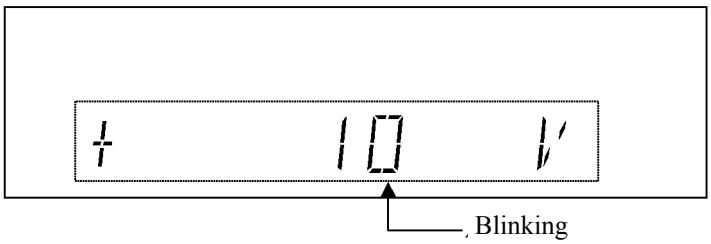
2. Press **3, ., 1** in this order.
   While inputting values, the cursor blinks.



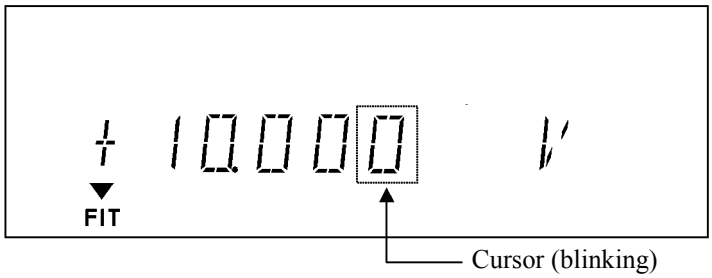
3. Press **ENTER**.
   The numeric value has been applied and the direct input mode is released.



4. Press the **123... , 1, 0, ENTER** keys in order to set + 10 V.
   - If the FIT indicator turns off, the value exceeds the 3 V setting range and an error occurs. The value cannot be set.



   - When the FIT indicator turns on, the optimum 15 V range is set.



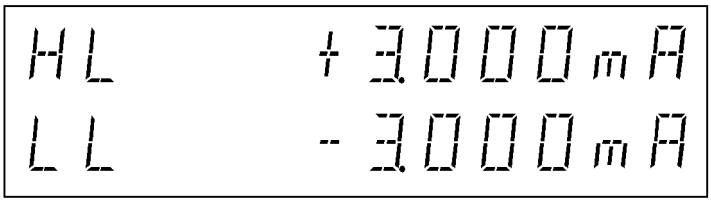
2.2.2 Setting Limiter Value

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.

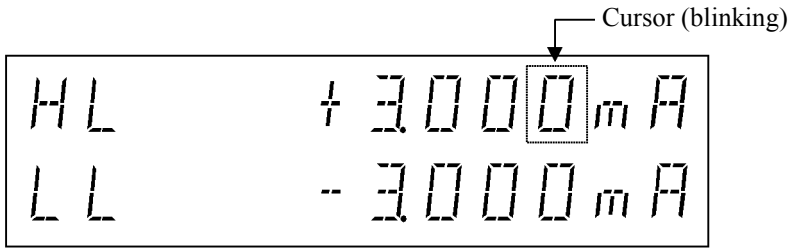
“HL value” refers to Hi limiter value, and “LL value” refers to Lo limiter value.



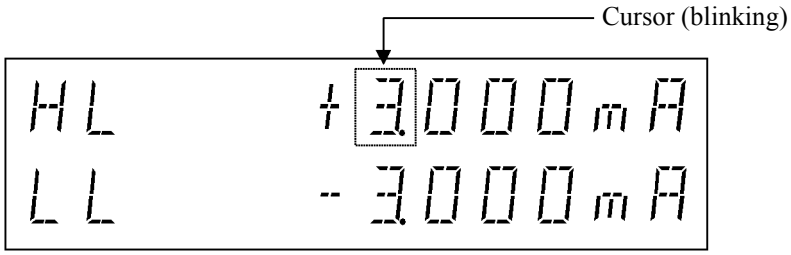
How to change the setting function is described in the **MENU, *SOURCE*,** or ***LMT Input***.

± Balance setting

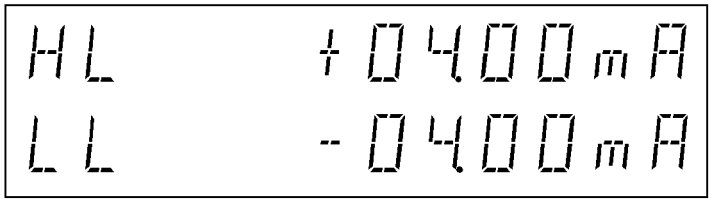
1. Press **LIMIT**.
   The cursor appears on the HL value.



2. Move the cursor to 3.

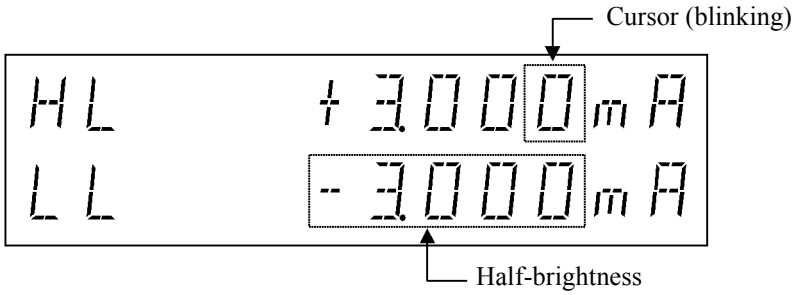


3. Press △.
   The range increases by one step, and the LL value also changes at the same time.
   The LL value can not be changed directly.

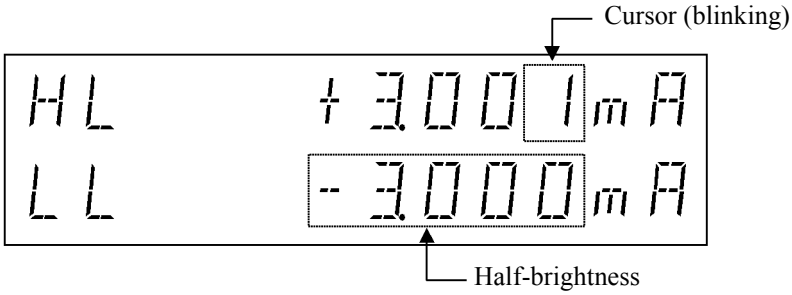


Separate setting

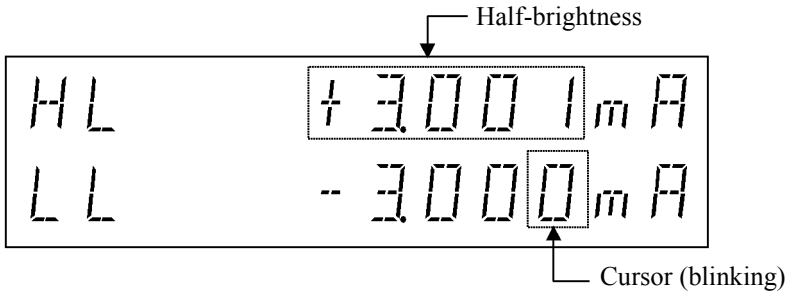
1. Press **LIMIT**.
   The cursor positions at HL value, and LL value is displayed at half-brightness.



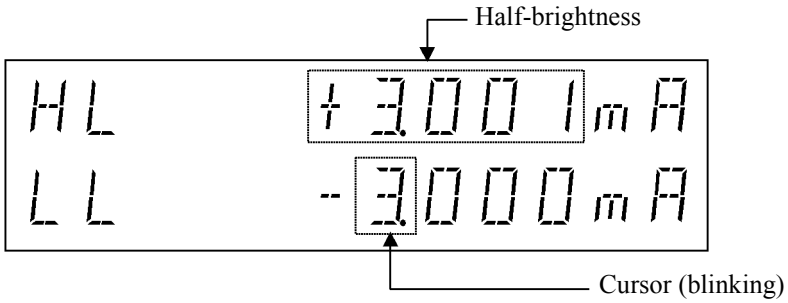
2. Press △.
   Only the HL value changes.



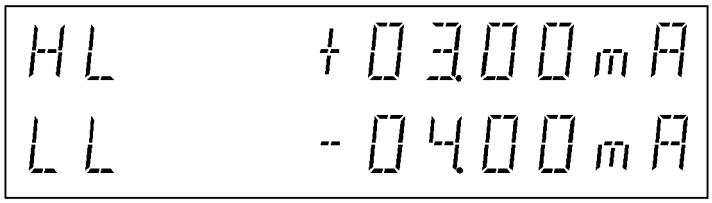
3. Press **FIT (SEL)**.
   The cursor moves to the Lo value, and HL value is displayed at half-brightness.



4. Move the cursor to 3.



5. Press ▽.
   The Lo value changes, and both HL and LL value increase by one step at the same.



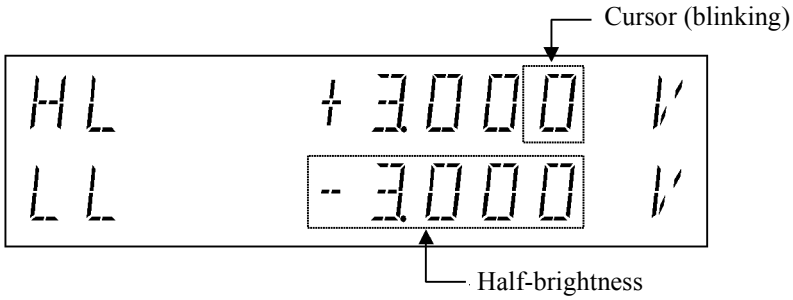
Homo-polarity limiter setting

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

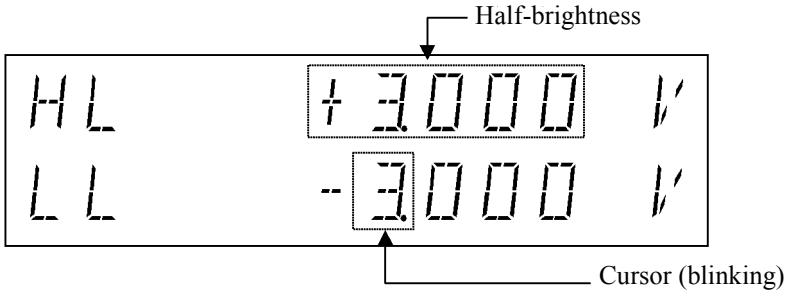
However, the HL and LL value have the following restrictions.

- For ranges other than the 4 A range:
  60 digits ≤ (HL value -LL value)
- For the 4 A range
  120 digits ≤ (HL value -LL value)

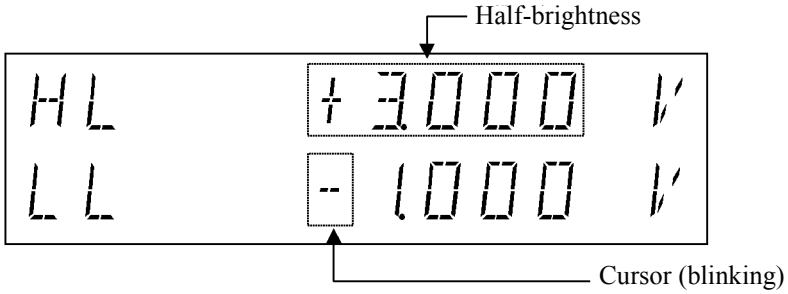
1. Select Separate from **MENU**.
2. Press **VS/IS** to select the current-source function.
3. Press **LIMIT** to display the limiter value setting screen.



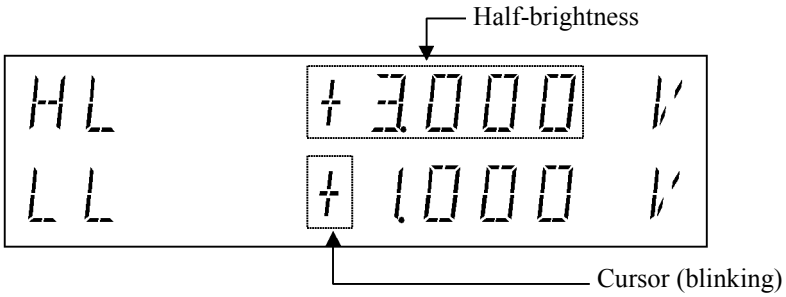
4. Press **FIT (SEL)** to select LL and move the cursor to 3.



5. Press △ twice, and press ◁ once.



6. Press △ to set the same polarity.



2.2.3 Menu Operation

This section describes the basic Menu and parameter setting operations.

2.2.3.1 Relation between Keys

Figure 2-13 shows the relation between keys.

2.2.3 Menu Operation

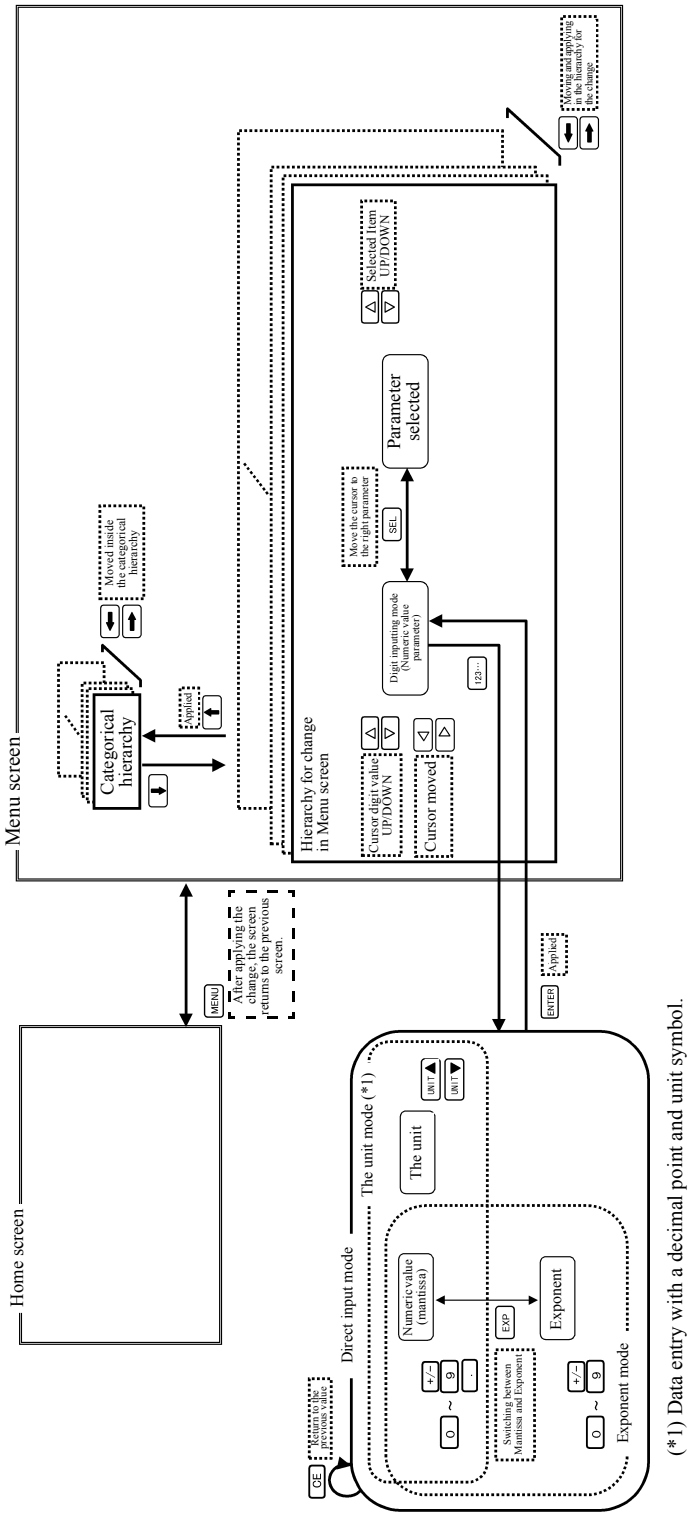


Figure 2-13 Relation between Keys

2.2.3.2 Menu Structure and Parameter Setting

Figure 2-14 shows the menu data structure of MENU key.

1. Press **MENU**.
   The selection screen for categorical hierarchy ***A) SOURCE*** to ***L) SYSTEM*** appears.
2. Select categories by pressing **4W/2W (←)** or **RCL (→)**.
3. Press **DOWN (↓)**.
4. Press **4W/2W (←)** or **RCL (→)** to select the item to be changed.
5. Press ◁, △, ▽, or ▷ to set the data.
   When setting numeric data, pressing **123...** enters direct input mode and then data can be set by using the numeric keys.
6. Press **MENU** to complete the setting and return to the Home screen.
   Pressing **CANCEL (SHIFT and UP)** cancels the setting and returns to the Home screen.
   However, random data cannot be cancelled.

NOTE:

1. ***In the Operate or Suspend modes, only parameter items that can be set are displayed in Figure 2-14.***
2. ***During sweeps, the MENU key is unavailable.***

2.2.3 Menu Operation

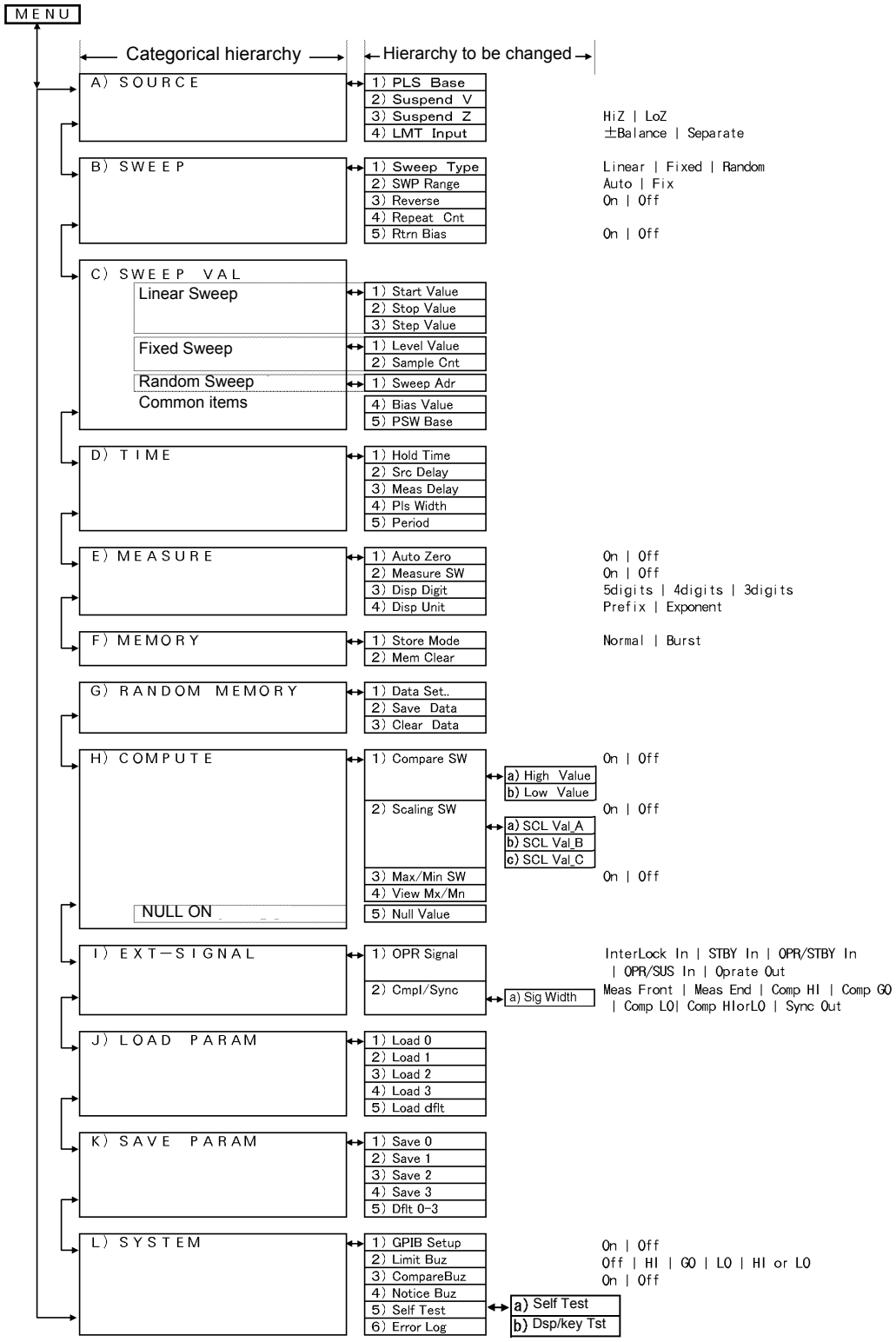


Figure 2-14 Menu Data Structure

2.2.4 Initializing Setting Conditions

The following procedure returns the 6240A to the factory settings.

However, the following items cannot be initialized.

- GPIB address
- Talk only/Addressable
- Header output

1. Press **MENU** and **4W/2W (←)** to select ***J) LOAD PARAM***.
2. Press **DOWN (↓)** and **4W/2W (←)** to select ***5) Load dflt***.
3. Press **ENTER**.
   The initialization procedure is complete.
4. Press **MENU** to return to the Home screen.

2.2.5 DC Measurement

This section describes the basic usage, functions, and operation of the 6240A. An operation that with voltage source current measurement (VSIM), the unit changes the source voltage to limit the current (called current limiter), and also how to control current source voltage measurement (ISVM) are described.
A 1 KΩ resistor is used as the DUT for the measurement.

Figure 2-15 shows DC measurement operating modes and the operating points.

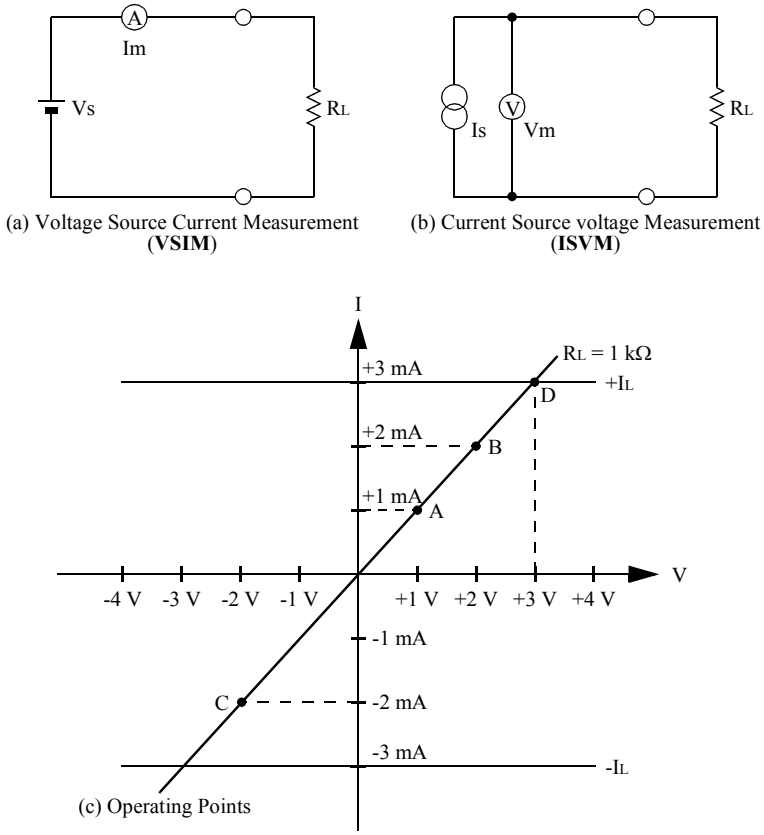


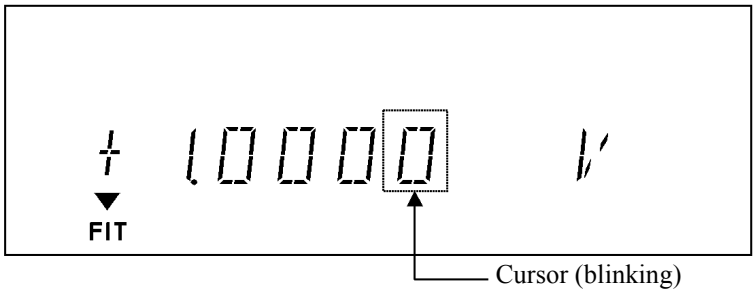
Figure 2-15 DC Measurement

Preparation before measurement

1. Follow the procedure described in Section 2.2.4, "Initializing Setting Conditions" and initialize the settings of this instrument.
2. Connect the sample with the supplied input and output cable and alligator clips.
   - Connect the A08532 alligator clips to the supplied A01044 input and output cable.
   - Connect the input and output cable to HI OUTPUT and LO OUTPUT terminals of this instrument.
   - Clip the sample 1 kΩ resistor with the alligator clips.

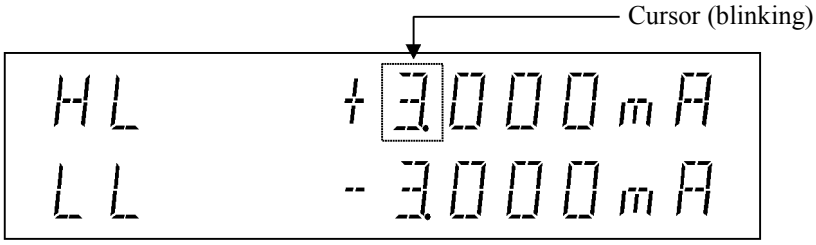
Setting the source value

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



Setting current limiter

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



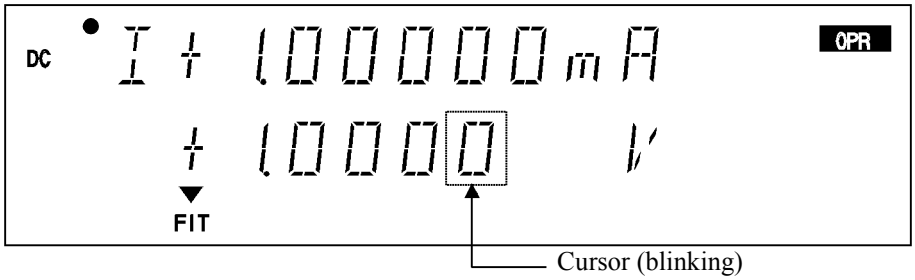
6. Press **LIMIT**.

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 6240A, are assumed to have no 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)

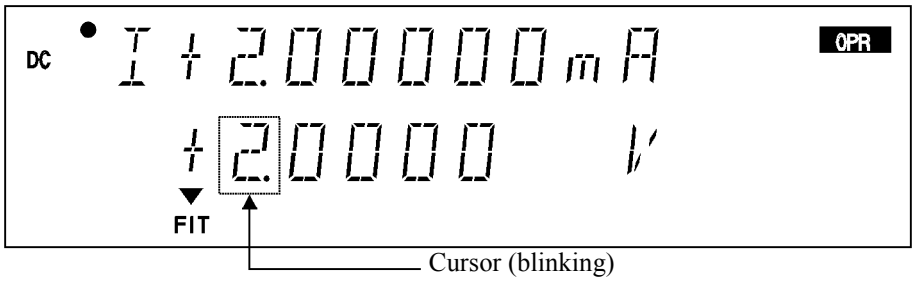
7. Press **OPR**.

   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)

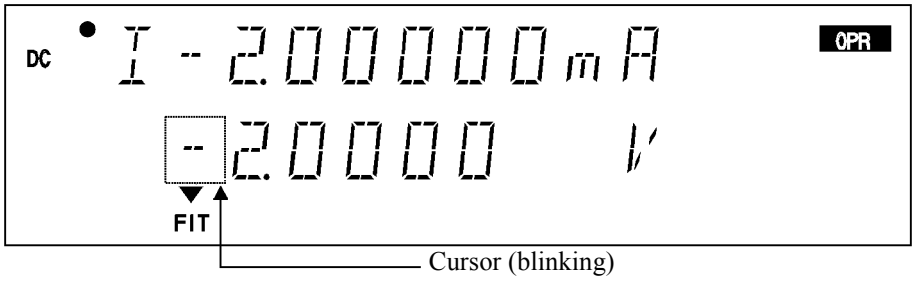


8. Press ◁ to move the cursor to "1", and press △ to change the source value to 2 V.

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



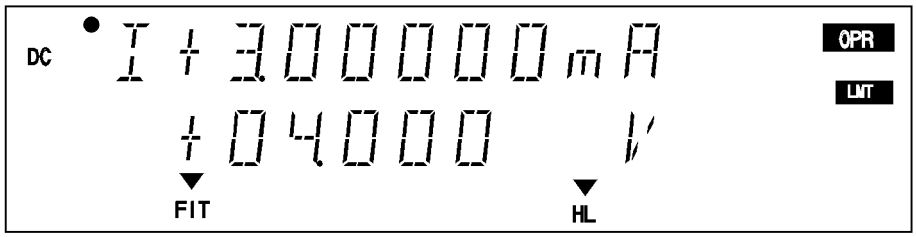
9. Press ◁ to shift the cursor to "+" and press ▽ to change the source value to -2 V. (See point C in Figure 2-15)



10. Press △ to return the source value to +2 V, and the press **123..., 4,** and **ENTER** in order.

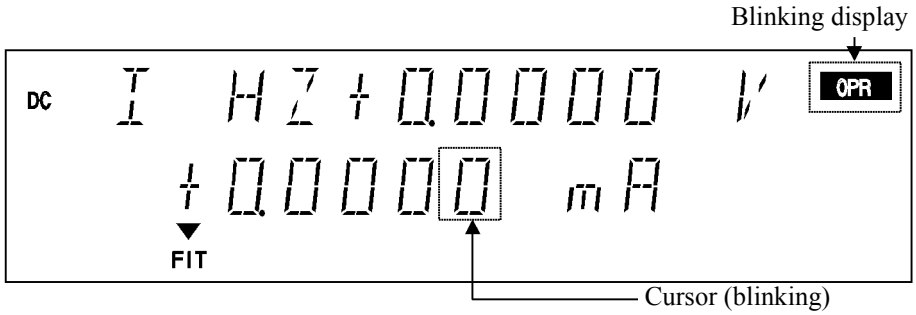
    The voltage-source value is set to 4 V in 15 V range.

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

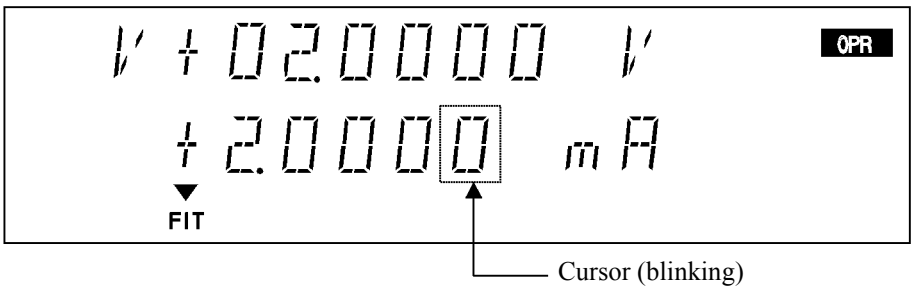


Current-source (ISVM)

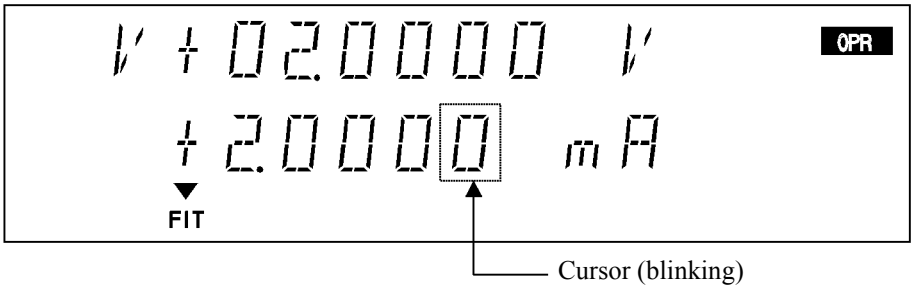
11. Press **VS/IS**.
    The setting changes to the current-source and set Suspend status.



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



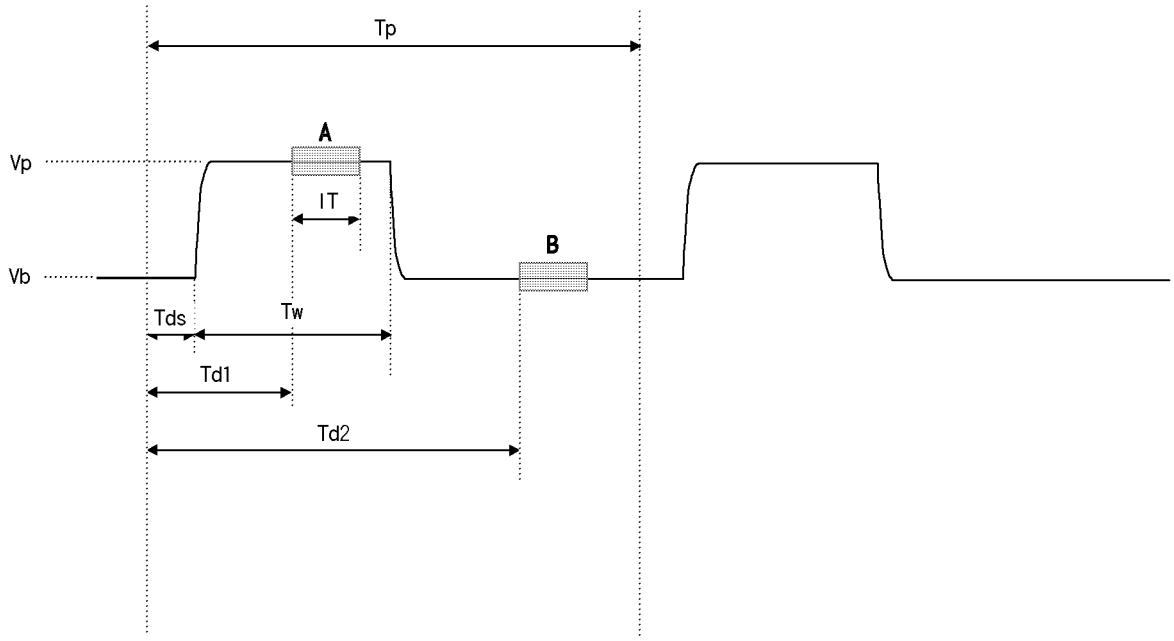
13. Press the **MON** twice to switch voltage-measurement.
    (See point B in Figure 2-15)



2.2.6 Pulse Measurement

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

The following describes the measuring pulse mode by changing A and B measurement points as shown in Figure 2-16 for voltage source current measurement.



Tds:	Source delay time	;	1 ms
Tw:	Pulse width	;	50 ms
Td1:	Measurement delay time (A at)	;	3 ms
Td2:	Measurement delay time (B at)	;	60 ms
Tp:	Period time	;	130 ms
IT:	Integral 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 procedure described in Section 2.2.5, “DC Measurement” to prepare for the measurement.

Setting pulse source value

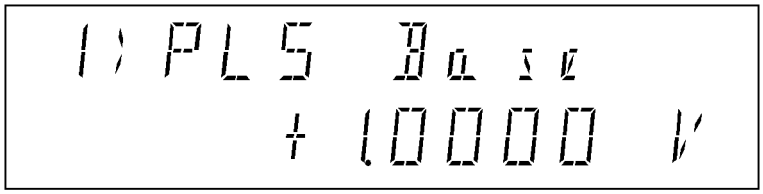
2. Press **123..., 2,** and **ENTER** in order.

Setting current-limiter value

3. Press **LIMIT, 123..., 3, UNIT ▼,** and **ENTER** in order.
4. Press **LIMIT** to return to the Home screen.

Setting base value

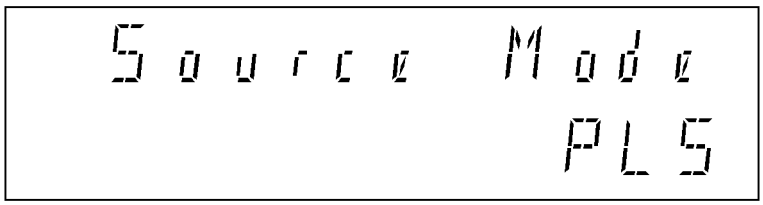
5. Press **MENU**.
6. Press **4W/2W (←)** and **RCL (→)** to select ***A) SOURCE***, and press **DOWN (↓)** to move to the change hierarchy.
7. After confirming the item is ***I) PLS Base***, press **123... , 1,** and **ENTER** in order.
   1 V has been set.



Setting pulse time

8. Press **UP (↑), RCL (→), RCL (→), RCL (→),** and **DOWN (↓)** to enter into the time setting.
9. Press **RCL (→)** to select ***2) Src Delay***.
10. Press **123..., 1,** and **ENTER** in order to set Tds to 1 ms.
11. Press **RCL (→)** to select ***3) Meas Delay***.
12. Press **123..., 3,** and **ENTER** in order to set Td1 to 3 ms.

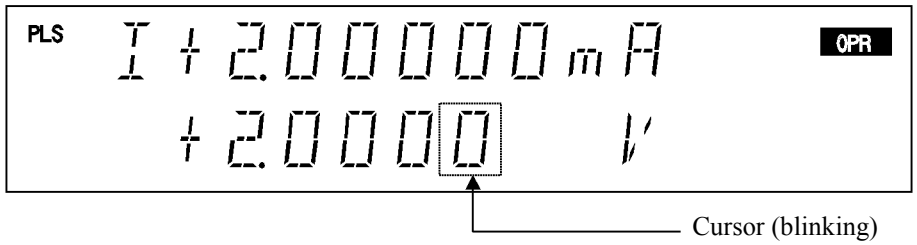
13. Press **RCL (→)** to select ***4) Pls width***.
14. Press **123..., 5, 0,** and **ENTER** in order to set Tds to 50 ms.
15. Press **RCL (→)** to select ***5) Period***.
16. Press**123..., 1, 3, 0,** and **ENTER** in order to set Tp to 130 ms.
17. Press **MENU** to return to the Home screen.
18. Press **MODE** to display the ***Source Mode*** setting screen.
19. Press ▽ to select ***PLS***.



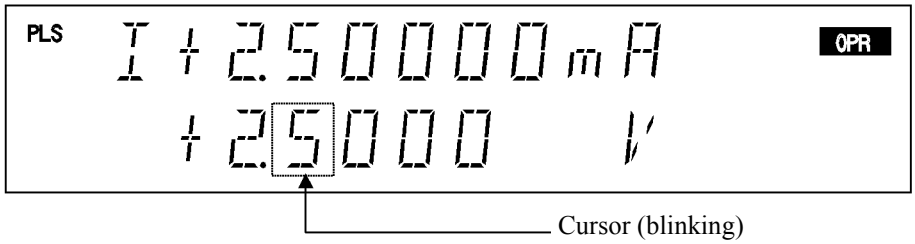
Current-measurement at pulse value

20. Press **ENTER** to return to the Home screen.
21. Press **OPR** to set the 6240A in the operation mode.

    The current-measured value at pulse value 2 V is displayed on the screen (See Figure 2-16, Point A).

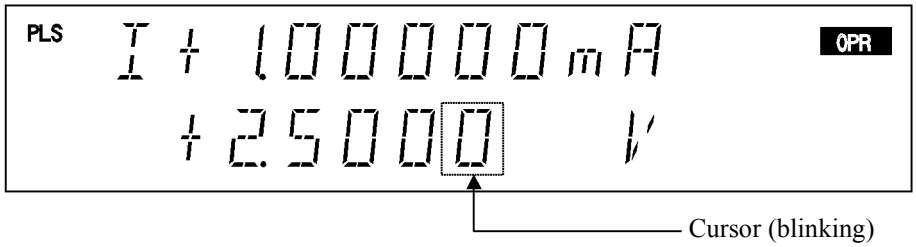


22. Press ◁ and △ to change the source value (pulse value) to 2.5 V.
    The current-measured value at pulse value 2.5 V is displayed on the screen.

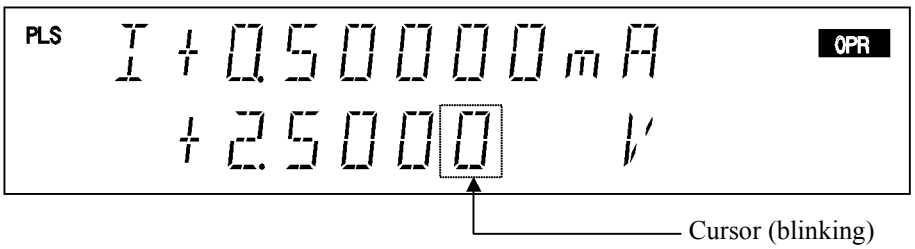


Current-measurement at base value

23. Follow the procedure 11 to set the major delay time at 60 ms and then press **MENU**.
    The Home screen (Td2) is displayed.
    The current-measured value at base value 1 V is displayed on the screen.
    (See the B point in Figure 2-16).



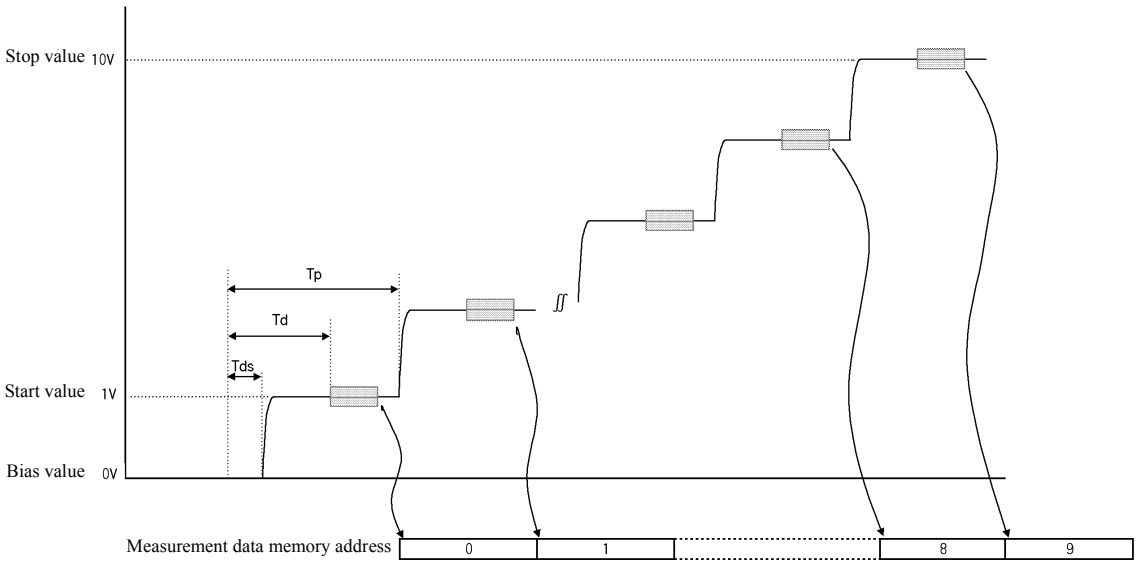
24. Follow the procedure 6 to change the base value to 0.5 V and then press **MENU**.
    The Home screen is displayed.
    The current-measured value at base value 0.5 V is displayed on the screen.



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 6240A linear-sweeps from 1 to 10 V 1 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:	1 V
Stop value:	10 V
Step value:	1 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

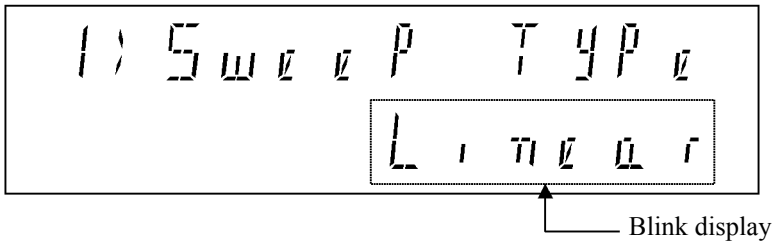
1. Follow the same procedure described in Section 2.2.5, “DC Measurement.”

Setting the current-limiter

2. Press **LIMIT**, **123..., 3, 0,** and **ENTER** in order, to set the current limiter within ±30 mA.
3. Press **LIMIT** to return to the Home screen.

Setting the sweep source mode

4. Press **MODE,** ▽**,** ▽**,** and **ENTER** in order.
   DC indicator and SWP indicator turns on to show DC Sweep has been set.
5. Press **MENU**.
6. Press **4W/2W (←)** and **RCL (→)** to select ***B) SWEEP***, and press **DOWN (↓)** to move to the change hierarchy.
7. Check that ***Linear*** is selected in ***1) Sweep Type***.



Setting sweep source-voltage

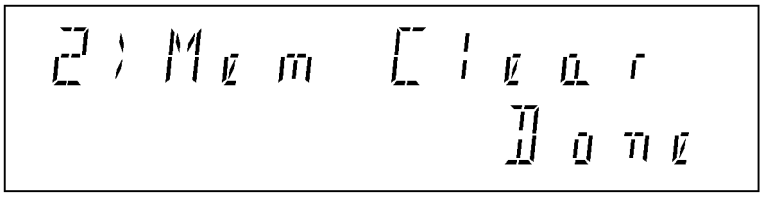
8. Press **UP (↑), RCL (→), DOWN (↓)** in order to select ***1) Start Value***.
9. Press **123..., 1,** and **ENTER** in order to set the start value at 1 V.
10. Press **RCL (→)** to select ***2) Stop Value***.
11. Press **123..., 1, 0,** and **ENTER** in order to set the stop value at 10 V.
12. Press **RCL (→)** to select ***3) Step Value***.
13. Press **123... , 1,** and **ENTER** in order to set the step value at 1 V.
14. Press **RCL (→)** to select ***4) Bias Value***, and check the bias value is set to 0 V.

Setting sweep time

15. Press **UP (↑)** and **RCL (→)** to select ***D) TIME***.
16. Press **DOWN (↓)** and **RCL (→)** to select ***2) Src Delay***.
17. Press **123..., 1,** and **ENTER** in order to set the source delay time at 1 ms.
18. Press **RCL (→)** to select ***3) Meas Delay***.
19. Press **123..., 4,** and **ENTER** in order to set the major delay time at 4 ms.
20. Press **RCL (→)** twice to select ***5) Period***.
21. Press **123..., 1, 0, 0,** and **ENTER** in order to set the period time at 100 ms.

Setting measurement memory

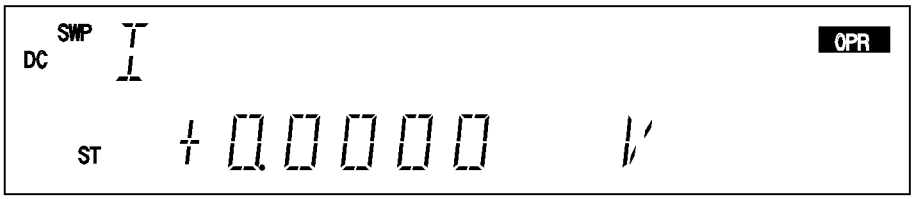
22. Press **UP (↑)** and **RCL (→)** twice to select ***F) MEMORY***.
23. Press **DOWN (↓)** to check that ***1) Store Mode*** is set to ***Normal***.
24. Press **RCL (→)** and **ENTER** to clear the data in the measurement data memory.



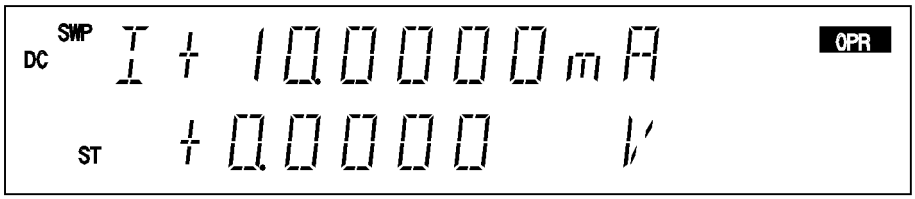
25. Press **MENU** to return to the Home screen.
26. Press **STORE**.
    The ST indicator turns on and STORE ON is set.

Starting sweep measurement

27. Press **OPR** to set the operational status.
    The source value shows the bias value.

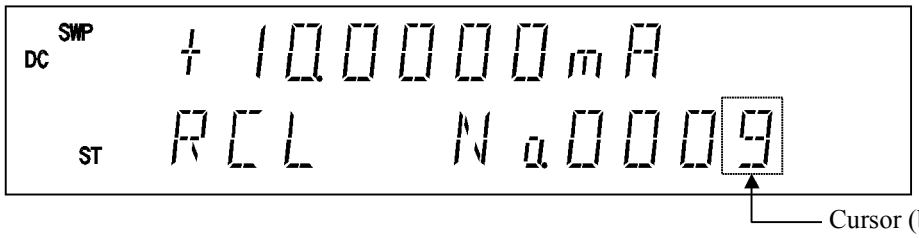


28. Press **TRIG**.
    The sweep starts while displaying the source and the measurement value. When the sweep is completed, the final measurement value is displayed.



Reading measurement results (data)

29. Press **STBY** to set the Standby mode.
30. Press **RCL** to read the data stored in the measurement data memory.
    It displays the final stored data.



31. Keep pressing ▽ changes the memory number and then reads the stored data one by one and displays them on the screen.
    Pressing **123...** enters the direct input mode and optional memory number can also be specified and read.
32. Press **RCL** to return to the Home screen.

2.3 Saving and Loading Parameters

The 6240A can save the setting parameters in the non-volatile memory, the domain 0 to 3.

The data saved in the domain 0 is loaded at power ON.

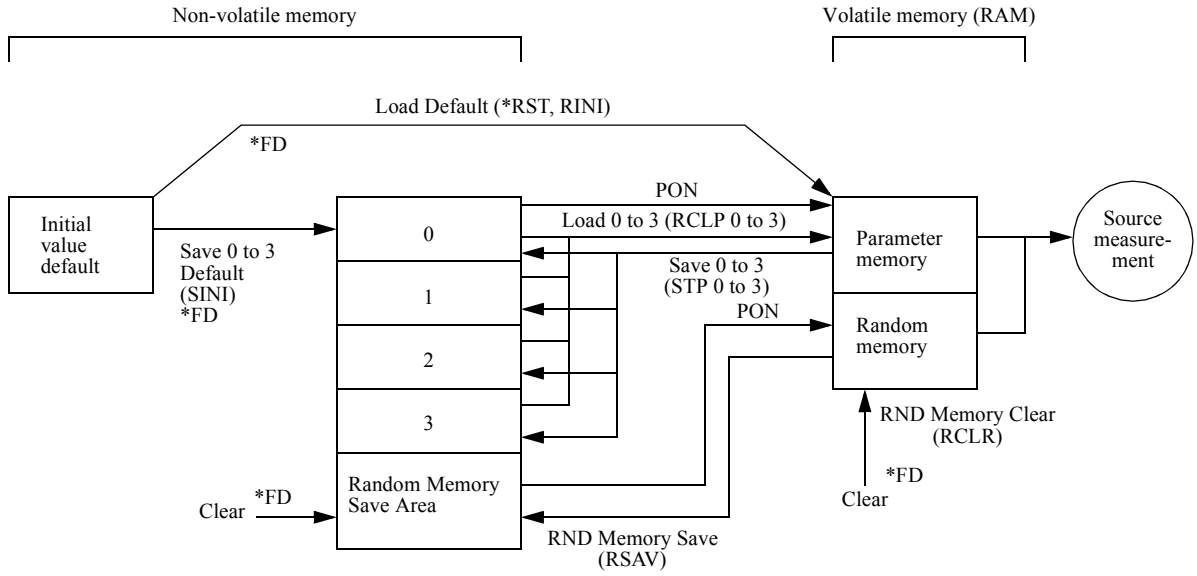
This section describes the operation and procedure for saving and loading the parameters.

1. Saving and Loading Parameter Operation

   The 6240A has a random memory data save area, separated from the parameter save area.

   Figure 2-18 shows saving, loading, and clearing the parameters and random memory.

NOTE: ***The following parameter cannot be saved in areas 0 to 3.***
When set, the parameter is always saved in a different area and loaded when the power is switched on.
- ***GPIB address (HA_01)***



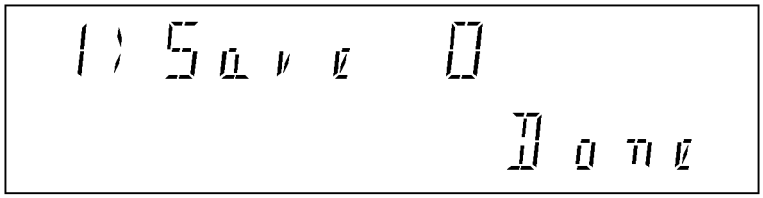
- PON: Power ON
- *FD: Initialized at factory shipment
- () refers to GPIB command.

Figure 2-18 Saving and Loading Parameters

2. Procedure for Saving and Loading Parameters

Saving parameters

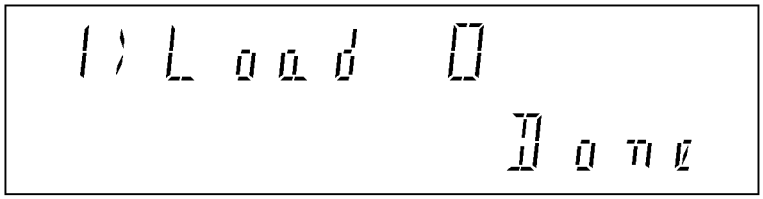
1. Press **MENU**.
2. Press **4W/2W (←)** and **RCL (→)** to select ***K) SAVE PARAM***.
3. Press **DOWN (↓)** and then **4W/2W (←)** and **RCL (→)** to select the save area.
4. Press **ENTER**.
   Saving is completed.



5. Press **MENU** to return to the Home screen.

Loading parameters

1. If the 6240A is in Operate or Suspend status, select the Standby mode.
   The Standby mode is displayed on the setting screen only in Standby status.
2. Press **MENU**.
3. Press **4W/2W (←)** and **RCL (→)** to select ***J) LOAD PARAM***.
4. Press **DOWN (↓)**, **4W/2W (←)** and **RCL (→)** to select the load area.
5. Press **ENTER**.
   Loading is completed.



6. Press **MENU** to return to the Home screen.

3. MEASUREMENT EXAMPLE

3.1 Measurement of Diode

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

NOTE: Use 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 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
Integral time:	1 ms
Measurement delay:	3 ms
Measurement range:	VM AUTO
NULL:	ON

Connecting a sample

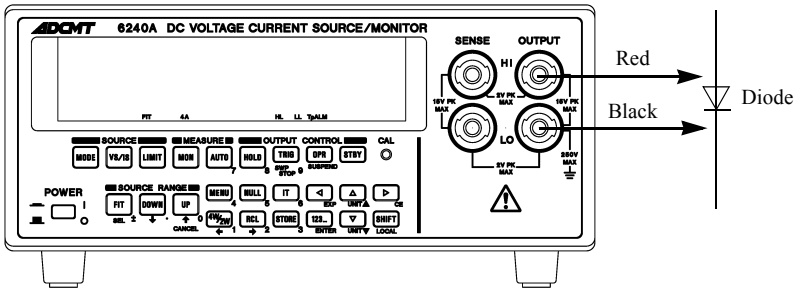


Figure 3-1 Diode Measurement Connection

Measurement of the diode forward voltage

1. Set the VF measurement conditions parameter.
2. Short-circuit the HI OUTPUT cable (red) and LO OUTPUT cable (black) to obtain the Null value.
3. Turn on Operate.
4. Press **NULL**.
5. Select the Standby or Suspend mode.
6. Connect anode of the diode to HI OUTPUT cable (red) and cathode to LO OUTPUT cable (black).
7. Turn the 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 the system which uses GPIB. However, a manual operation example of using the functions of the 6240A is described.
Charge with DC constant-current and constant-voltage, and finish the charge when the charged current reaches below the specified voltage.
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 of the sample battery - HiZ - to reduce the transient current in operating status.

Store the discharged voltage in the memory to read it out after completing the test.
However, the memory can only store 5000 data items. Even if the limit is exceeded, output continues but no data is stored.
In this case, up to a maximum of 5000 minutes (=1.38 time) worth of data can be stored.

NOTE:

1. ***Use 4-wire connection to execute an accurate voltage-measurement.***
2. ***Be careful when setting the source value and limiter value so that excessive voltage and current may not be applied against the battery's rated-voltage and capacity.***

Test conditions are described below.

Charging test: Charge with constant current 1 A. After the charged voltage reaches 1.45 V, charge with constant voltage.
Stop charging when the charged current reaches 100 mA or less.

Charging Test Condition Example	
Source mode:	DC
Source current:	1 A
Limiter:	HL value; 1.45 V
	LL value; 0.95 V
Suspend voltage:	HiZ ; 1.20 V
Period:	1 s
Integral time:	200 ms
Measurement range:	1 A 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: Shown in Figure 3-2, discharge with the 2 A constant current, pulse width 20 ms, and a 1 second cycle. Finish the discharge when the voltage reaches 1.0 V.
Store the battery voltage in the memory to read it out after completing the test. However, the data stored in the memory is up to 5000 minutes from starting the discharge due to the restriction of memory capacity.

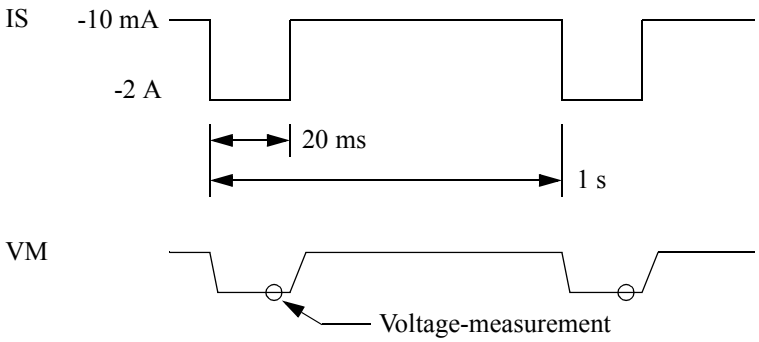
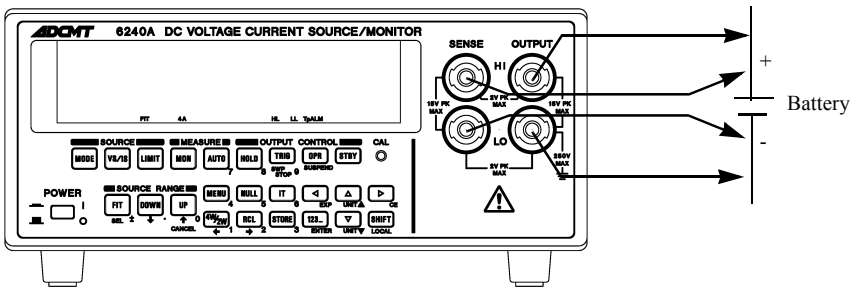


Figure 3-2 Waveform of Battery Discharging Test

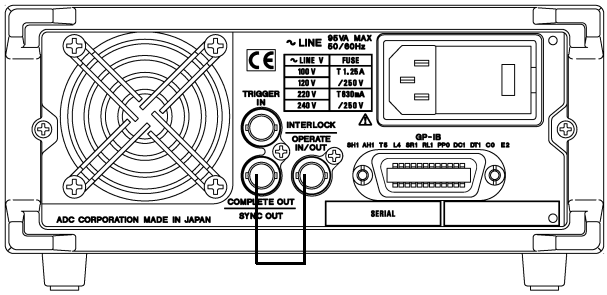
Discharge Test Conditions	
Source mode:	Pulse
Pulse current:	-2 A
Base current:	-10 mA
Limiter:	HL value; 1.45 V
	LL value; 0.95 V
Suspend voltage:	HiZ ; 1.20 V
Pulse width:	20 ms
Period:	1 s
Integral time:	1 ms
Measurement delay:	18 ms
Measurement range:	3 V range fixed
Memory:	NORMAL, STORE ON
Comparator:	ON
	Upper limit value 1.5 V
	Lower limit value 1.0 V
Remote sensing:	4-wire

Connecting the sample

1. Connect by using 4-wire 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 sets 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.

- Menu index: Use this index as a key index to chapter 4.
- Menu map: Shows panel key menu configuration.
- Function description: Describes parameter groups, parameter items, and parameter functions.

4.1 Menu Index

Use the Menu index as a key word index for searching descriptions.

4.2 Menu Map

This section describes panel key menu configurations.

NOTE: ( ) ***refers to panel keys.***
Other labels refer to parameters.

AUTO

DOWN

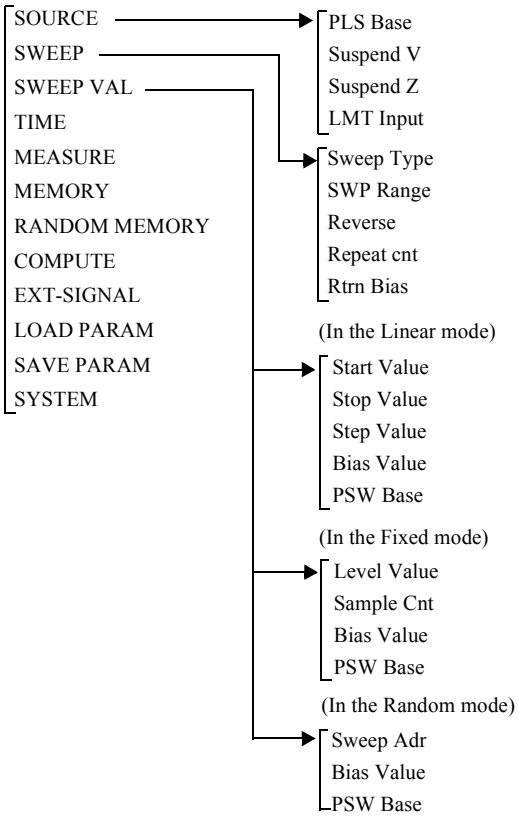
FIT

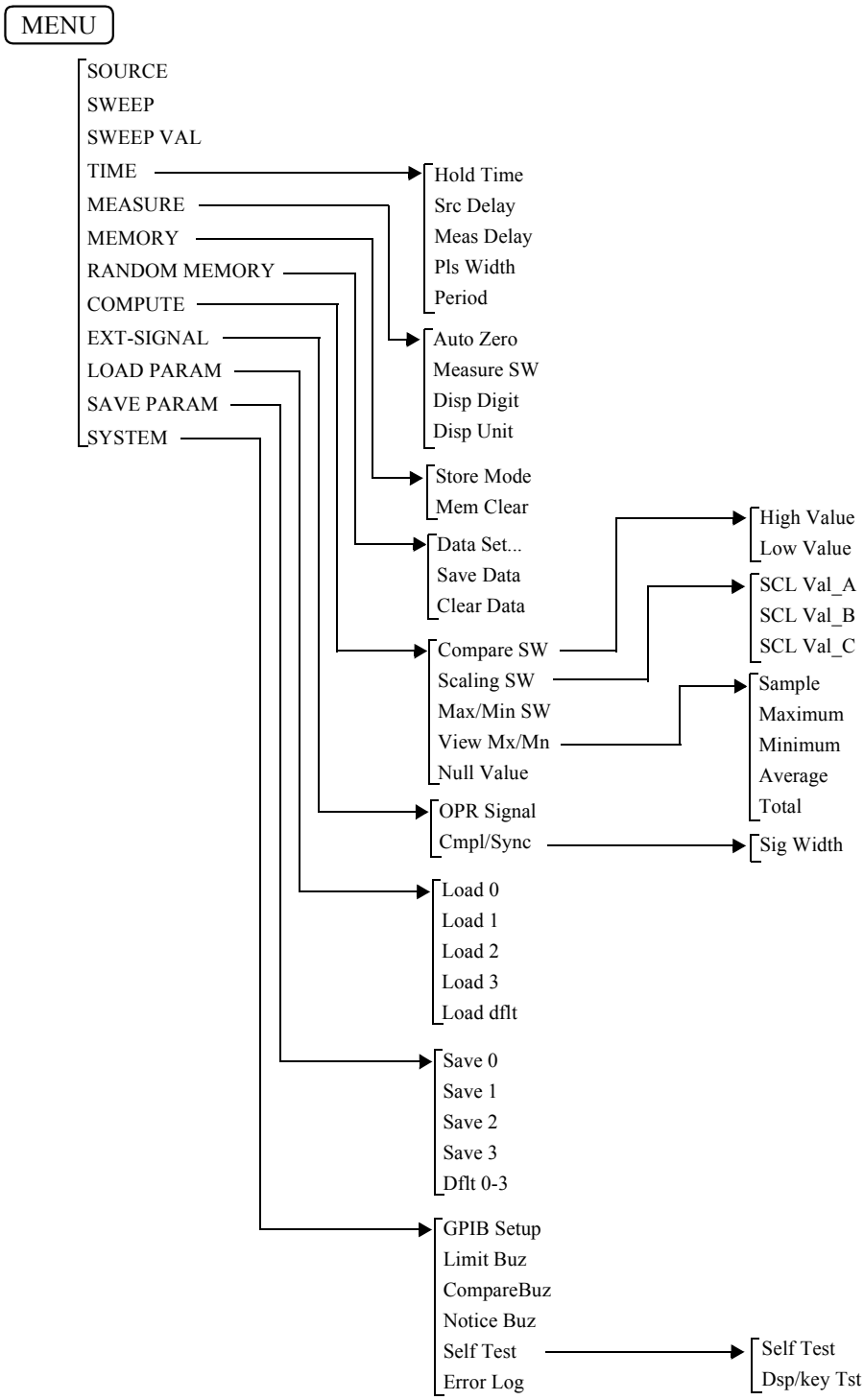
HOLD

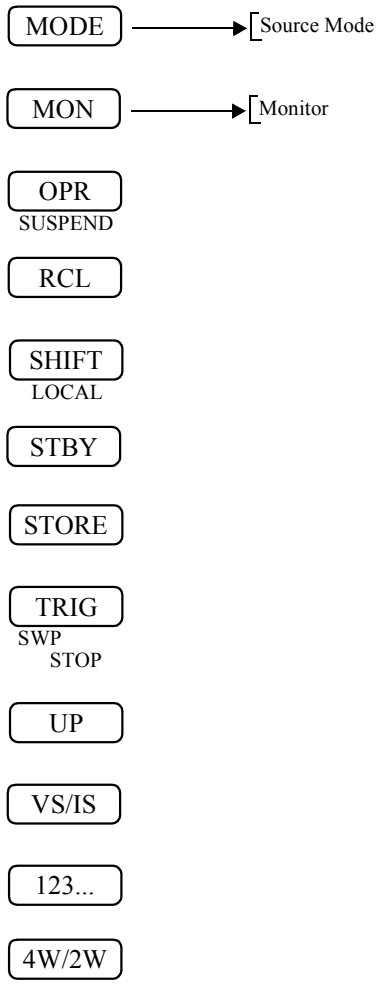
IT

LIMIT

MENU




MENU
SOURCE
SWEEP
SWEEP VAL
TIME
MEASURE
MEMORY
RANDOM MEMORY
COMPUTE
EXT-SIGNAL
LOAD PARAM
SAVE PARAM
SYSTEM
Hold Time
Src Delay
Meas Delay
Pls Width
Period
Auto Zero
Measure SW
Disp Digit
Disp Unit
Store Mode
Mem Clear
Data Set...
Save Data
Clear Data
Compare SW
Scaling SW
Max/Min SW
View Mx/Mn
Null Value
High Value
Low Value
SCL Val_A
SCL Val_B
SCL Val_C
Sample
Maximum
Minimum
Average
Total
OPR Signal
Cmpl/Sync
Sig Width
Load 0
Load 1
Load 2
Load 3
Load dflt
Save 0
Save 1
Save 2
Save 3
Dflt 0-3
GPIB Setup
Limit Buz
CompareBuz
Notice Buz
Self Test
Error Log
Self Test
Dsp/key Tst


MODE
Source Mode
MON
Monitor
OPR
SUSPEND
RCL
SHIFT
LOCAL
STBY
STORE
TRIG
SWP
STOP
UP
VS/IS
123...
4W/2W

4.3 Function Description

This section describes panel key and parameter functions.

4.3.1 AUTO Key (Measurement Range)

Switches between measurement auto range and fixed range.

Auto range: Measures the minimum range between the limiter range and the optimal range.
AUTO indicator turns on.
If the measurement function and the source function are different, the auto range function activates.
If the measurement function and the source function are the same, the function is fixed at the source range even if the AUTO indicators is on.

	Voltage-measurement	Current-measurement	Resistance-measurement
Voltage-source	---	●	●
Current-source	●	---	●

● : Measurement auto range enabled
--- : Fixed at source range

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

4.3.2 DOWN Key (Source Range)

Decreases the source range by one step.
However, it is impossible to decrease a range that can not output the current set values.
In this case, the source range setting mode is set to LOCK.

4.3.3 FIT Key (Source Range)

It 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: Set the optimal range for the inputted source.
FIT ▼ indicator turns on.

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

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

4.3.4 HOLD Key (Trigger Mode)

Switches between source and measurement trigger mode.

Source mode	AUTO	HOLD
DC, pulse	Repeats sourcing and measuring within the period specified by the time parameter. While measuring, the sampling indicator is on.	Starts sourcing and measuring with the trigger input. HOLD indicator turns on.
Sweep	Repeats sourcing and measurement within the time-parameter period-time. While measurement, the sampling indicator turns on. While 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.

4.3.5 IT Key (Integration Time)

Sets the measurement integration time.
The setup value is displayed by combining F, M, S, and L indicators as follows.

Integration time set	Lamp			
	F	M	S	L
100 µs	Half			
500 µs	Full			
1 ms		Half		
5 ms		Full		
10 ms			Half	
1 PLC			Full	
100 ms				Half
200 ms				Full

Half: indicator turns on with half-brightness
Full: indicator turns on with full-brightness

4.3.6 LIMIT Key (Limiter Setting)

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

4.3.7 MENU Key (Parameter Setting)

Pressing **MENU** key displays the parameter group setting up screen. Select category items by using **4W/2W (←)** and **RCL (→)** keys.

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 ±30 μA 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.

SWEEP Settings for 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.
- ***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 Set 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, a 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.
Settings C 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 the bias value (Sweep start source value).

PSW Base Sets the Pulse Sweep base value.

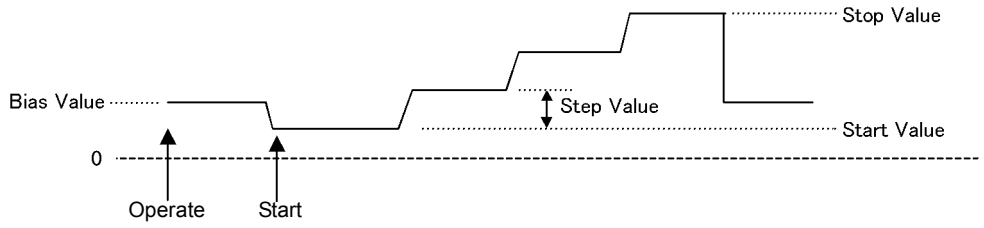


Figure 4-1 Linear Sweep

In the Fixed mode

SWEEP VAL

Level Value Sets the fixed level value in Fixed sweep.

Sample Cnt Sets a sample count in Fixed Sweep (number of measurement times in every Tp period).

Bias Value Bias value (source value at the sweep start).

PSW Base Set base value of Pulse Sweep.

(*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. Select parameters by pressing FIT (SEL) key.

Bias Value Sets bias value (source value at the sweep start).

PSW Base Sets the Pulse-Sweep base-value.

TIME Sets the time sweep generation time.

Hold Time Sets the time from the start to the starting step-cycle, in the sweep source mode.

Src Delay Sets the time from the start of the period (Tp) to delay time (Tds) 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

MEASURE Settings for measurement.

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

- On: Corrects measurement zeropoint drift approximately every 10 minutes. The AZ indicator turns on.
- Off: Turns the auto zero function OFF. The AZ indicator turns off.

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 5 1/2 digits.
- 4 digits: Displays measurement data with 4 1/2 digits.
- 3 digits: Displays measurement data with 3 1/2 digits.

Disp Unit Selects the measurement data, comparable upper and lower limit value, and output format style.

- Prefix: Displays measurement data by using a small number and the unit symbol.
- Exponent: Displays measurement data in exponential form.

MEMORY Sets the measurement data memory.

- Switching between Normal and Burst clears the memory contents.
- While the ST indicator is on, data is being stored in the memory.
- When the memory becomes full, the ST indicator blinks and no more data can be stored.

Store Mode Selects measurement-data-memory functions.

- Normal: Stores data in the memory with in the normal mode. Controls data storage by switching the store switch ON or OFF. When changing from Burst to Normal, the store switch is turned OFF and ST indicator turns off.
- Burst: Executes memory store operation with in the burst mode. Used for high-speed measurement. ST indicator automatically turns on, and the store switch does not activate.

Mem Clear Clears the contents of the measurement data memory.

RANDOM MEMORY Sets source data for the Random Sweep.

Data Set... Sets random memory contents with an address and data.
0 to 4999 can be used for address settings.
Select parameters by using the SEL key (press SHIFT).

Save Data Saves random memory contents in internal non-volatile memory.
The saved data is loaded at power ON.

Clear Data Clears the contents 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.

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

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

Scaling SW Switch the scaling calculation ON or OFF.

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 OFF scaling calculation.

SCL Val_A Sets Constant A.

SCL Val_B Sets Constant B.

SCL Val_C Sets Constant C.

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

On: Executes MAX/MIN calculation.
MAX, MIN, AVE, and ∑ indicators turn on

Off: Turns OFF the MAX/MIN calculation.

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

Sample The number of operational data of measurement data

Maximum	Maximum Measurement data value
Minimum	Minimum Measurement data value
Average	Measurement data average value
Total	Measurement data integrated value
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 the Standby mode by changing the input signal from Lo to Hi.
Operate is turned ON by using the key or GPIB command.

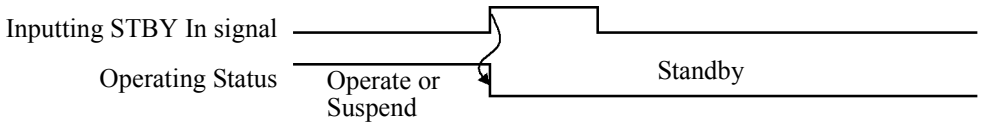


Figure 4-3 STBY In

InterLock In: Sets Standby by rising input signal from Lo to Hi.
While the input signal is Hi, Operate and Suspend are disabled.

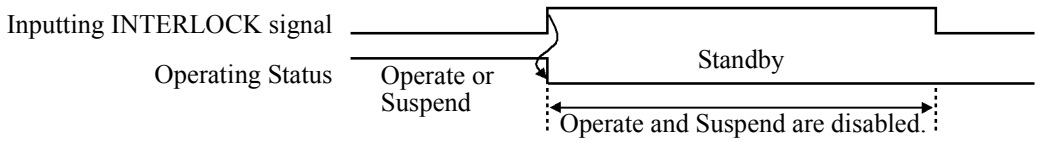


Figure 4-4 InterLock In

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.

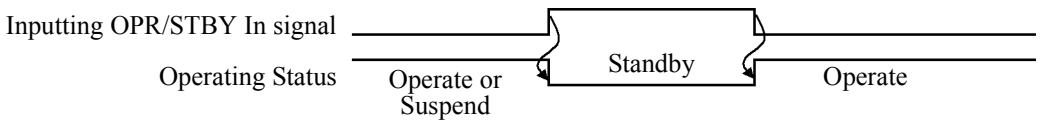


Figure 4-5 OPR/STBY In

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.

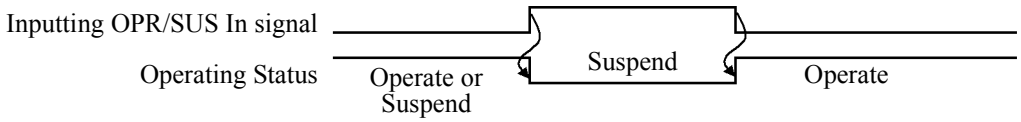


Figure 4-6 OPR/SUS In

Operate Out: Outputs Lo when the 6240A is in the Operate mode and outputs Hi when in the Standby or Suspend mode.

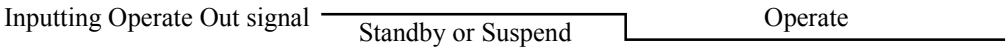


Figure 4-7 Operate Out

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 cycle period ends.
- Comp HI: Outputs a negative pulse when the 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 HI or LO: Outputs a negative pulse when the Comparator calculation result is HI or LO.
- Sync Out: Outputs a negative pulse when the Step starts for pulse source.

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

LOAD PARAM Loads the setting parameters saved into the non-volatile memory. Not displayed on the menu screen while Operate is ON.

- ***Load 0*** Loads area 0 data into the non-volatile memory as a setting parameter.
- ***Load 1*** Loads area 1 data into the non-volatile memory as a setting parameter.
- ***Load 2*** Loads area 2 data into the non-volatile memory as a setting parameter.
- ***Load 3*** Loads area 3 data into the non-volatile memory as a setting parameter.
- ***Load dflt*** Loads the factory shipment setting value as a setting parameter.

SAVE PARAM Saves the setting parameter in the non-volatile memory. At power ON, area 0 data in the non-volatile memory is always loaded.

- ***Save 0*** Saves the current setting parameter in non-volatile memory area 0.
- ***Save 1*** Saves the current setting parameter in non-volatile memory area 1.
- ***Save 2*** Saves the current setting parameter in non-volatile memory area 2.
- ***Save 3*** Saves the current setting parameter in non-volatile memory area 3.
- ***Dflt 0-3*** Saves the factory shipment setting value in all domains, 0 to 3.

SYSTEM Sets the 6240A system parameters.

- ***GPIB Setup*** Sets GPIB header, addressable, and address.

  Selects the parameters by using FIT (SEL).

  H/_: Sets the header ON or OFF.

  A/o: Switches between Addressable and Talk only function.

  0 to 30: Sets addresses.

- ***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 in HI.
GO:	Buzzes when the result of Comparator calculation results in GO.
LO:	Buzzes when the Comparator calculation results in LO.
HI or LO:	Buzzes when the Comparator calculation results 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 numbers of errors that are occurred, and the error contents can be read using a error number or message.
When this parameter is displayed, the contents of the error log is cleared and ERR indicator also turns off.

4.3.8 MODE Key (Source Mode)

The key sets a source mode. Press △ or ▽ to select the key.

Source Mode Switches between source modes.
Enabled only when in Standby.

- 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 indicator turns on.
- PLS-SWP: Sets the pulse sweep source mode, which generates pulse voltage/current Sweep-waveforms.
  PLS and SWP indicators turns on.

4.3.9 MON Key (Measurement Mode)

The 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.

4.3.10 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 DC with 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.
  It 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***

4.3.11 RCL Key (Recalling Measurement Data)

This key 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 4999. If no data is stored, “No Data” is displayed.

4.3.12 SHIFT/LOCAL (Shift Mode/GPIB Local)

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

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

4.3.13 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 duration, using Suspend function by switching Operate and Suspend is recommended.***

4.3.14 STORE Key (Measurement Data Memory ON and OFF)

Switches measurement data memory storage ON or OFF. When ON, the ST indicator turns on.

- Measured data is stored when Store is ON.
- The memory is cleared when Store is OFF.
- When the memory is full, the ST indicator is flashes and the storage is complete.
- While memory data is being stored in the Burst mode the STORE key is disabled.

The conditions described below also clear the memory:

- Clearing the memory from the MENU-MEMORY-Mem Clear screen
- Switching from Normal to Burst

4.3.15 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 generation
Sweep generation 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 generation mode	Before Sweeping	-	-
	During Sweep	Stop Sweeping	Stop Sweeping

4.3.16 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 4.3.3, “FIT Key (Source Range).”)

4.3.17 VS/IS Key (Source Function)

Selects source functions, voltage source or current source.
The display indicates VS or IS mode.
When changing between VS or IS, the following operations are restricted:

- Can not change if the source mode is Sweep and at the same time Operate or Suspend.
- Executing the source function during Operate at DC and pulse source causes Suspend forcibly.

4.3.18 123... 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.
Under this status, green colored characters on the panel are effective functions.
However, EXP key is only enabled when ***Disp Unit*** is the exponent and the calculation is executed. Press **ENTER** to apply the input numerical data and to release the direct input mode.

4.3.19 4W/2W Key (Selects Remote Sensing)

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

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

2W: Sets output sensing 2-wire.
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 6240A.

Output terminals are cut off from the internal circuits by Operate and Standby relays during the Standby status.

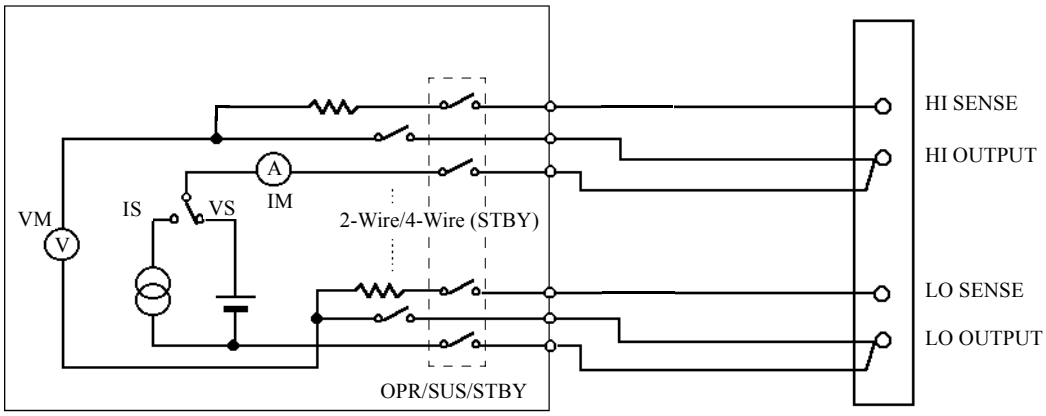


Figure 5-1 Internal Wire Connection

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

When connecting the 6240A and DUT, connect with 2-wire or 4-wire, considering the following conditions:

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

  If (Line resistance × output current) ≤ 10 μV, then apply 2-wire connection

  If (Line resistance × output current) > 10 μV, then apply 4-wire connection

  The attached cable A01044 line resistance 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, then use 2-wire connection

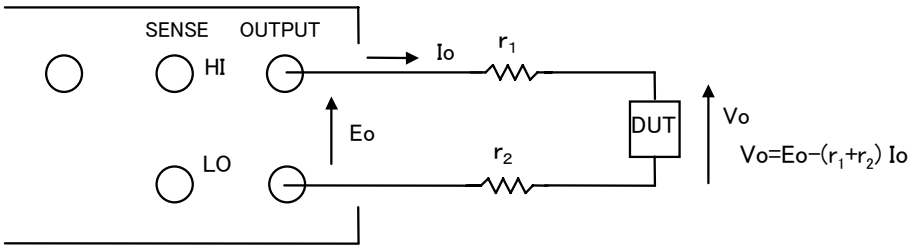
  If (Line resistance × output current) > ev, then use 4-wire connection

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

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

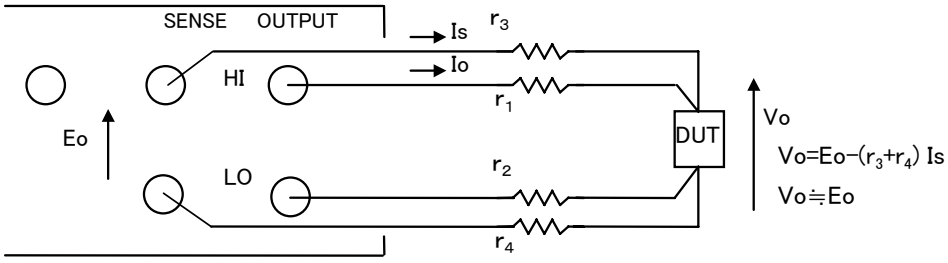
2-wire connection: The 2W indicator turns on.

4-wire connection: The 4W indicator turns on.



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

(a) 2-wire



(b) 4-wire

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

NOTE: ***Maximum remote sensing voltages (tolerable voltage difference between OUTPUT and SENSE) are ±1.0 V at both HI and LO side.***
Keep the following restriction for r1 to r4 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 lo = 4 A
$r_1, r_2 \leq 1.0\ V/4\ A = 0.25\ \Omega$
$r_1, r_2 = 0.25\ \Omega$ ***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 6240A itself may oscillate due to the cases that the tested device itself oscillates, or the capacitance or inductance that exceeds the specified value is connected.
(Due to stray capacitance or retained inductance from cables connected, a scanner, or a fixture).

With the oscillation frequency, you can tell the difference between the oscillations of the device and that of the 6240A.

The 6240A does not oscillate at 2 MHz or over.

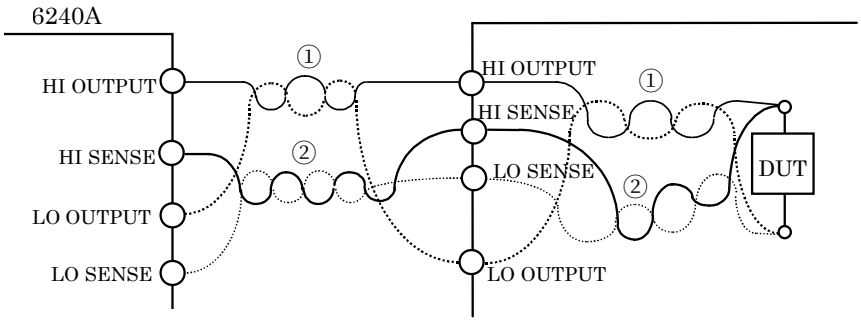
5.1.3.1 Preventing SMU from Oscillation

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. Check if the oscillation is within the maximum load capacitance or the maximum inductance load indicated in Chapter 9, “SPECIFICATIONS.”
   2. Check if the 6240A still oscillates when the cables are connected in the shortest lengths.
   3. If the shortest cables stop the oscillation, then connect the 6240A 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, insert the resistor with an tolerable load as shown in Figure 5-5.

NOTE: ***When more than one power supplies are used, oscillation of one unit may cause the others to detect oscillation as well.***
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 Floating Capacitance and Lead Inductor

5.1.3.2 Oscillation from the Device Itself

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

Take the following measures to prevent oscillation.

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

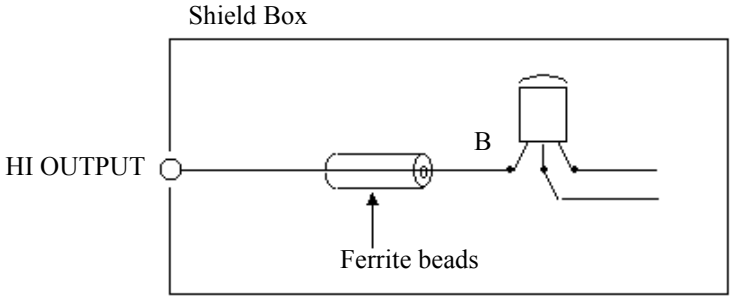


Figure 5-4 Preventing Device Oscillation

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

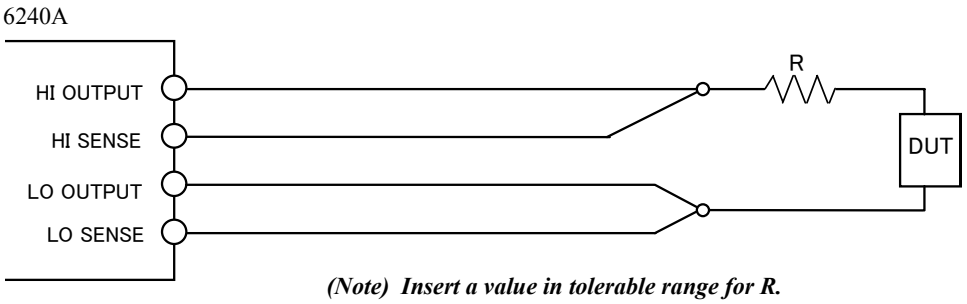


Figure 5-5 Solution for SMU Oscillation

5.1.4 Connection for High-current-measurement

Be sure to connect with 4-wire to measure the high current.

Strand the cables in 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 delay caused by over-shoot or response-delay because of cable inductance.

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

Especially, be sure to use a shielded wire for measuring the 1 μA or below current.

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

The output range has another restriction including voltage difference. Be sure to set the voltage between the terminals of **HI** and **LO OUTPUT** should be within the maximum output range.

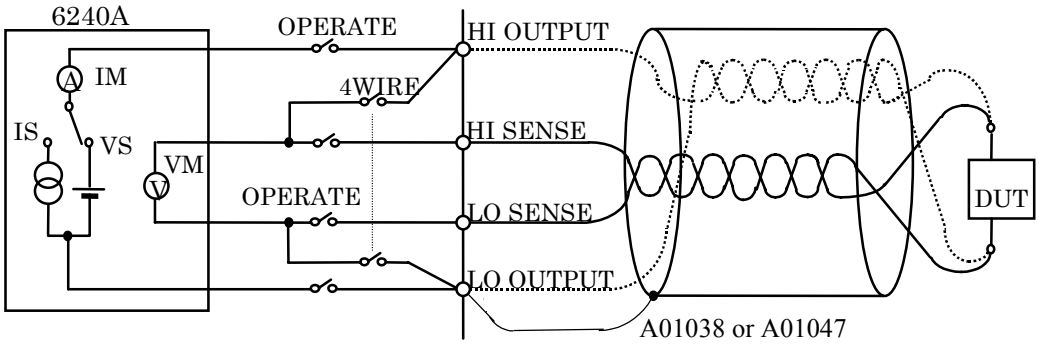


Figure 5-6 Connection for High Current Measurement

Table 5-1 Tolerable Current and Wire Diameter

Current value	Diameter (AWG)
up to 2 A	22
up to 4 A	18

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.

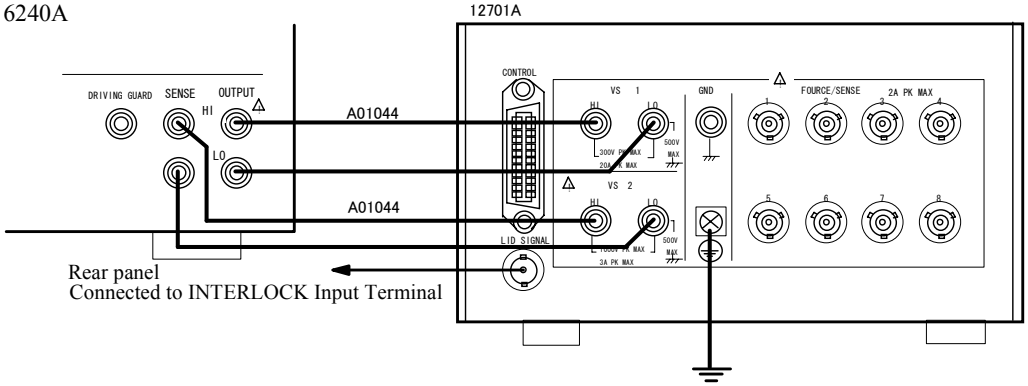


Figure 5-7 Connection with the 12701A

CAUTION: Follow the procedure below to prevent electric shock.

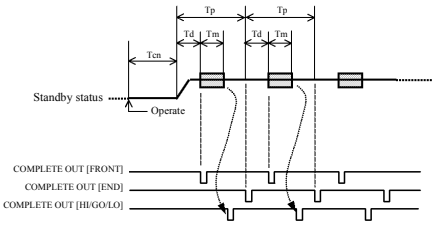
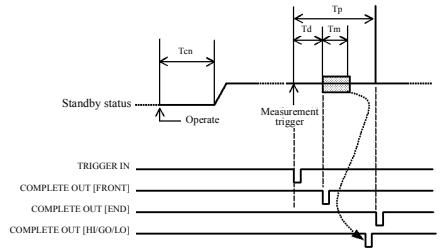
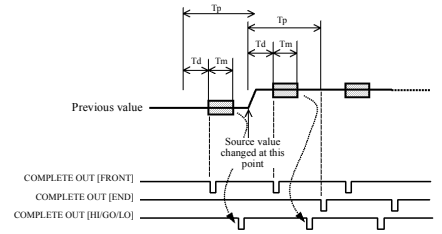
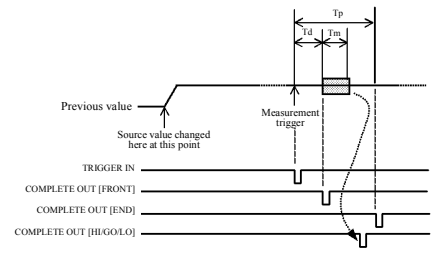
1. ***Be sure to ground the 12701A protective ground terminal ⏚.***
2. ***Connect 12701A LID SIGNAL to the INTERLOCK terminal at the 6240A rear panel, and set the parameter "OPR Signal" to InterLock In.***
   This enables Interlock function, and 6240A is set to Standby status when the 12701A cover is released.

5.2 Functions in Detail

5.2.1 DC Source Mode Operation

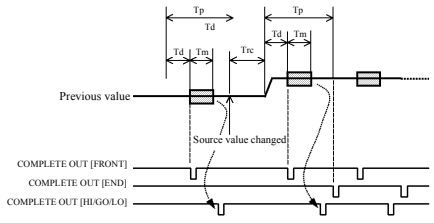
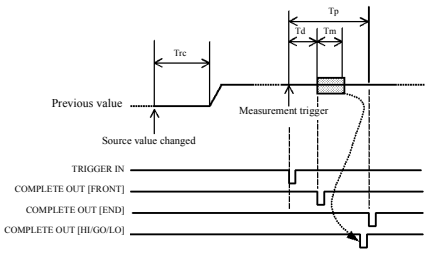
Table 5-2 below shows DC source mode operation.

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

Operational condition	Trigger mode	Description	Operation	Remarks
Operate ON	AUTO	Executes consecutive measurement within 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 source value	AUTO	For changing source value not induce changing range		
	HOLD			

5.2.1 DC Source Mode Operation

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

Operational condition	Trigger mode	Description	Operation	Remarks
Change source value	AUTO	Changing source value induces changing the range.		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			

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 turns on.

b. Trigger Mode is HOLD:
   - Measurement starts after length of the measurement delay time has passed after trigger input.
   - Ignores the trigger which is inputted during the measurement.

c. Standby or Suspend:
   - Does not measure during Standby or Suspend.

5.2.2 Pulse Source Mode Operation

Table 5-3 below shows pulse source mode operation.

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

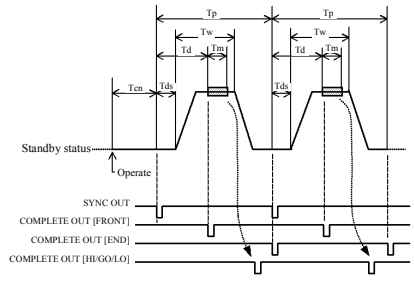
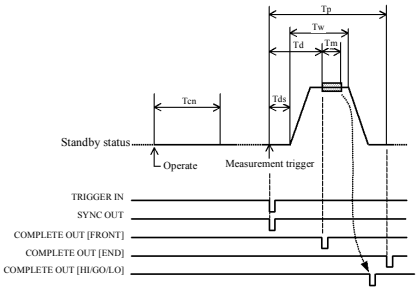
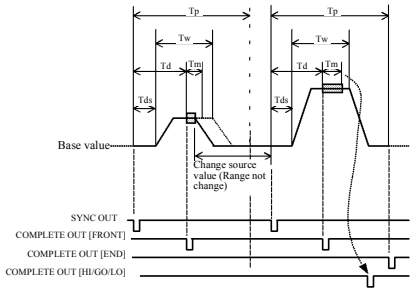
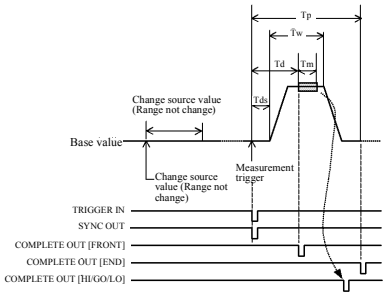
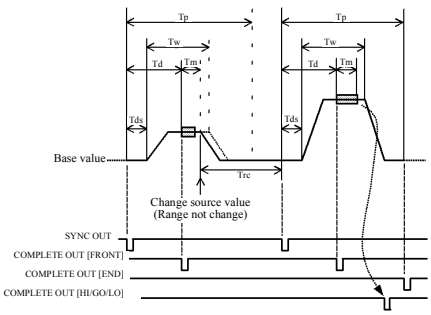
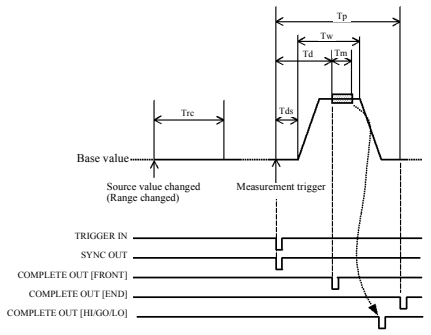
<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Description</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Operate ON</td><td>AUTO</td><td>Executes consecutive measurement with the set period time Tp.</td><td> 
</td><td rowspan="3">Th: Hold time
Tp: Period Time
Td: 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>Executes measurement after trigger input.</td><td> 
</td></tr>
<tr><td rowspan="2">Source value changed</td><td>AUTO</td><td rowspan="2">Changing source value does not induce changing range.</td><td> 
</td></tr>
<tr><td>HOLD</td><td> 
</td></tr>
</table>

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

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

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.
   - If a source or base value during pulse generation is changed, it stops pulse generation and generates new pulse with a new base value and a source value.

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

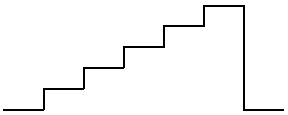
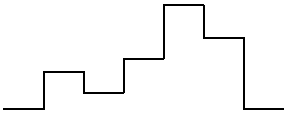
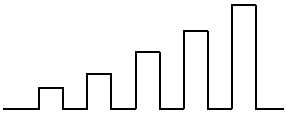
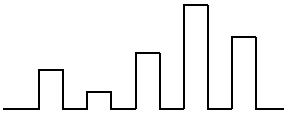
c. Pulse source generation after operate and changing range
   - If it is Operate, pulse generation starts after Operate is processed.
   - If the source-change entails the range-change, base and pulse value are set at the same range.

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

Sweep Types		Operation	Waveform
DC Sweep	Linear Sweep	Sweeps with 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 starting address to the stop address.	
Pulse Sweep	Linear Pulse Sweep	Sweeps with staircase waveform pulse-wave between the designated start value and stop value.	
	Fixed Pulse Sweep	Sweeps specified times of sample counts with pulse wave with specified constant value.	
	Random Pulse Sweep	Sweeps the stored source value with pulse wave from the starting address to the stop address.	

1. Setting up Sweep Type:
   - Selects ***DC-SWP*** for DC Sweep and ***PLS-SWP*** for pulse Sweep by using **MODE** key.
   - Selects the item ***B) SWEEP*** by using **MENU** key.
     Selects from ***1) Sweep types***; ***Linear*** for Linear Sweep; ***Fixed*** for fixed Sweep; and ***Random*** for Random Sweep.

2. Changing Parameter for Sweep Measurement

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

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

     (They are changeable in the range from start address to stop address when they are moved from Standby status to suspend)
   - Sweep function parameter
     - Number of repetition times
     - 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

   indicator shows that it is in sweep status

   In Sweeping: The indicator rotates

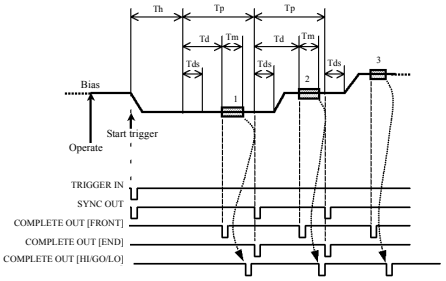
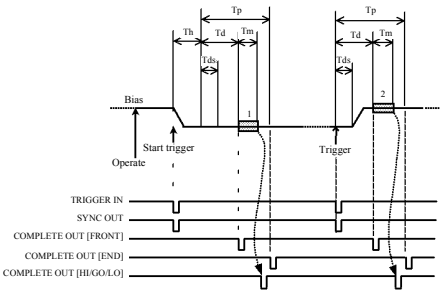
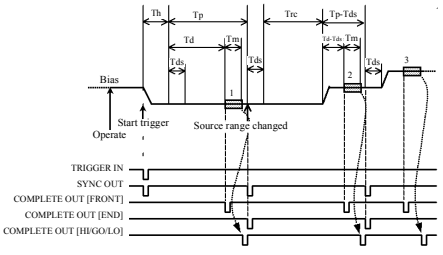
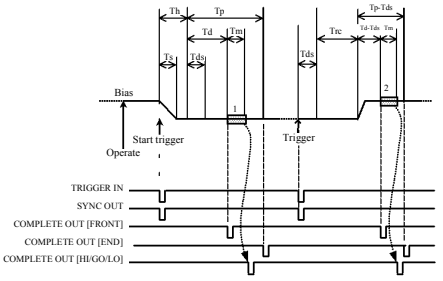
   In HOLD: Indicator stops rotation and turns on.

   In STOP: Indicator turns off

5.2.3.1 DC Sweep Source Mode

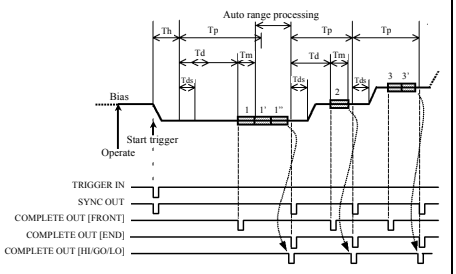
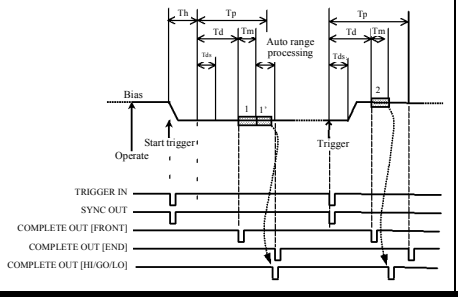
Table 5-5 below shows the DC sweep source mode operation.

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

Operational condition	Trigger mode	Description	Operation	Remarks
Operate ON	AUTO	Executes consecutive measurement 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 source range	AUTO	Source range changed while in sweeping.		
	HOLD			

5.2.3 Sweep Source Mode Operation

Table 5-5 DC Sweep Source Mode Operation (2 of 2)

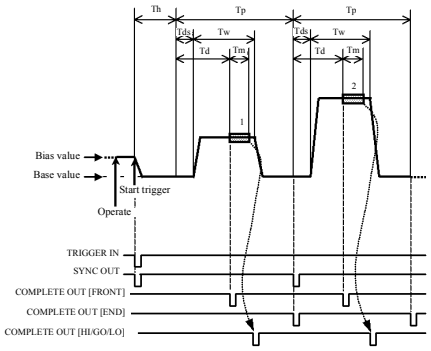
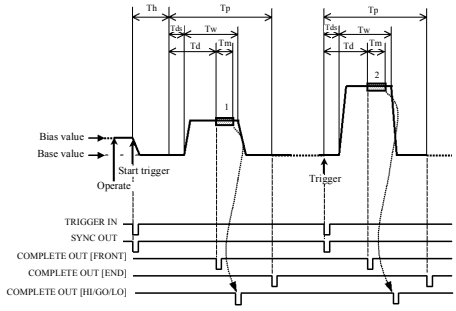
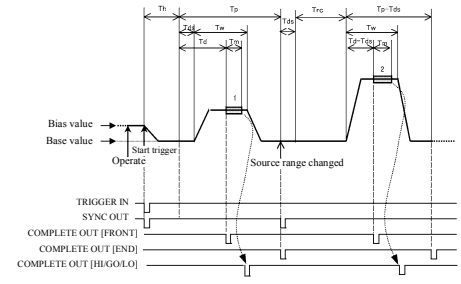
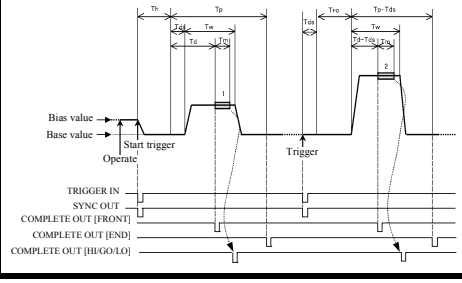
Operational condition	Trigger mode	Description	Operation	Remarks
Measure-ment range changed	AUTO	Measurement range changes while in sweeping		Th: Hold time Tp: Period Time Td: Measurement Delay Time Tds: Source Delay Time Tm: Measurement Time (Integration time + Measurement data pro-cessing time) Tcn: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

- The output value before start sweeping is bias value.
- When start trigger is inputted, the start value is outputted.
- After length of Hold time passes after the start trigger, sweeping starts.
- If trigger mode is AUTO, sweep step changes after the period time.
  However, if measurement is not completed, next step is delayed until the measurement is completed.
- If the trigger mode is HOLD, sweep step is activated whenever trigger is inputted.

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

<table>
<tr><th>Operational condition</th><th>Trigger mode</th><th>Description</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Operate ON</td><td>AUTO</td><td>Executes consecutive measurement with the set period time Tp.</td><td> 
</td><td rowspan="3">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>Executes measurement after trigger input.</td><td> 
</td></tr>
<tr><td rowspan="2">Change source range</td><td>AUTO</td><td rowspan="2">Source range changed while in sweeping.</td><td> 
</td></tr>
<tr><td>HOLD</td><td> 
</td></tr>
</table>

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

5.2.3.3 Random Sweep and Random Pulse Sweep

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

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

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

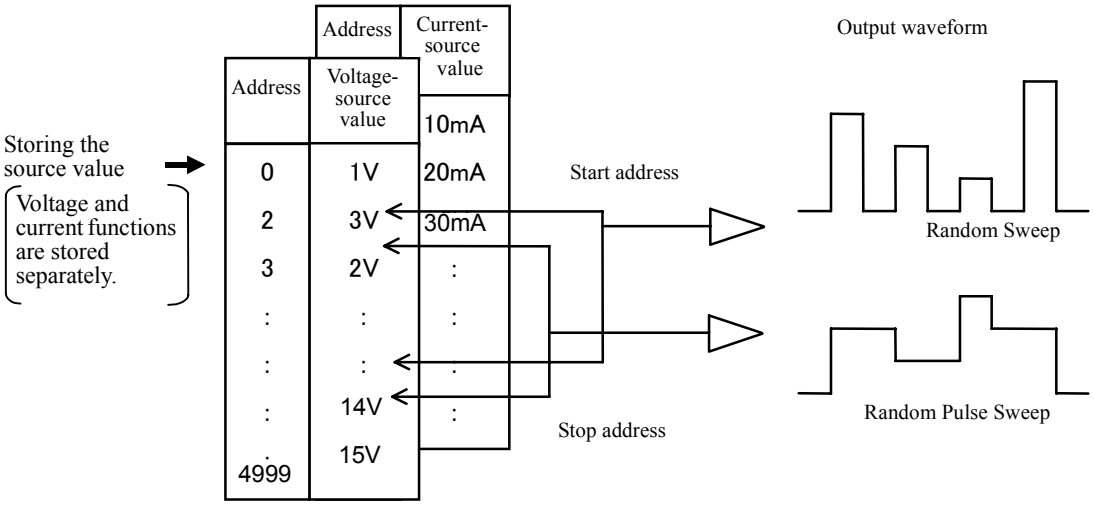


Figure 5-8 Random Sweep and Random -Pulse Sweep

Random memory can be set for both voltage and current function each from 0 to 4999.

5.2.3.4 Reverse Function

It can switch 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

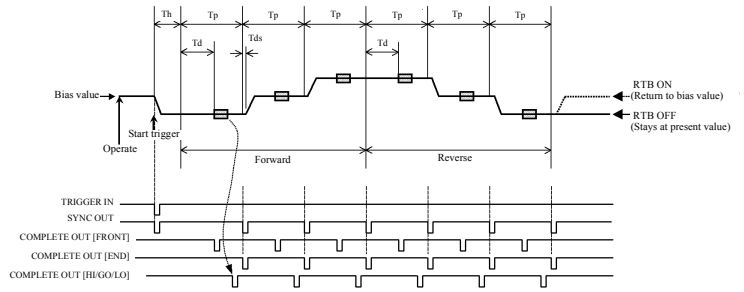
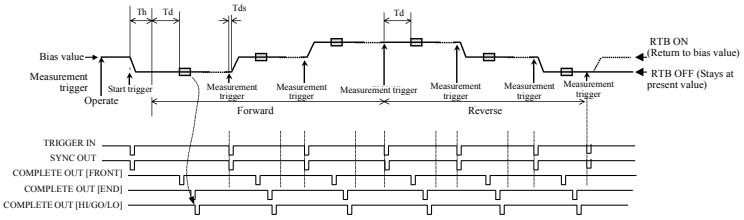
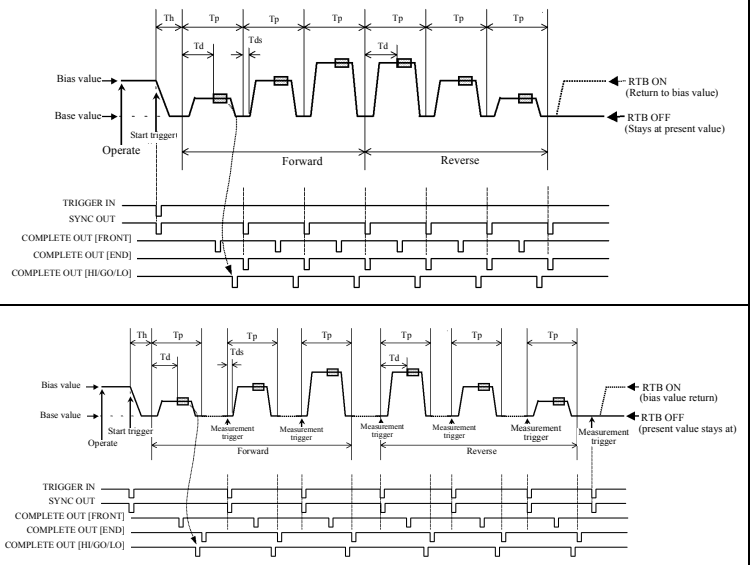
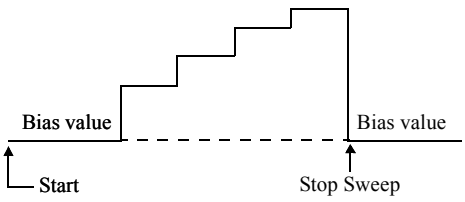
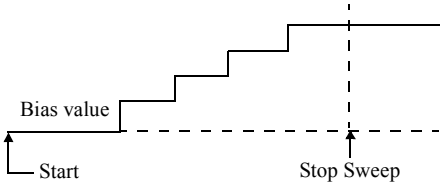
Operational Condition	Trigger Mode	Operation	Remarks
DC Sweep	AUTO		Th: Hold time Tp: Period Time Td: Measurement Delay Time Tds: Source Delay Time Tm: Measurement Time (Integration time + Measurement data processing time) Tcn: Operation Processing Time Trc: Range Change Processing Time
	HOLD		

Table 5-8 Reverse Operation at Pulse Sweep

<table>
<tr><th>Operational Condition</th><th>Trigger Mode</th><th>Operation</th><th>Remarks</th></tr>
<tr><td rowspan="2">Pulse Sweep</td><td>AUTO</td><td rowspan="2"> 
</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></tr>
</table>

5.2.3.5 RTB Function

RTB setting can switches the output value in sweep stop.

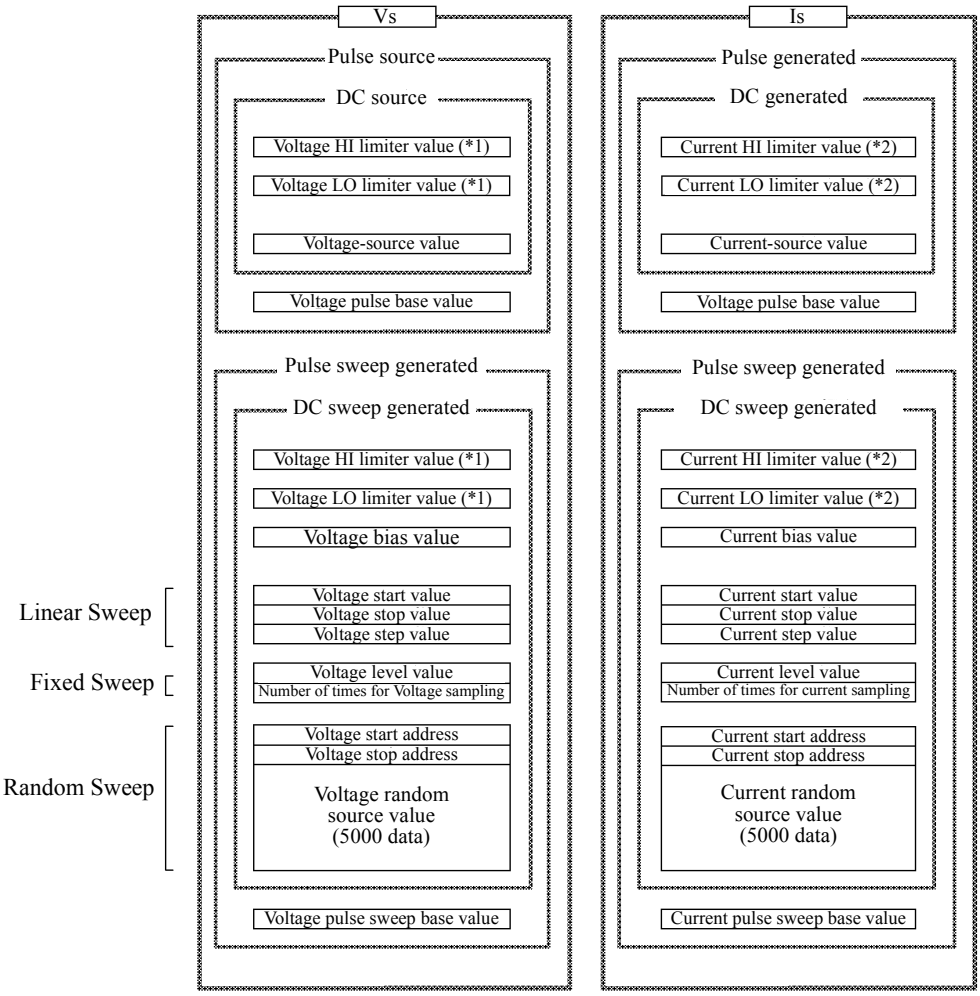
RTB	Waveform	Operation
ON		Return to bias value when the sweeping stops.
OFF		Stays as the final value when the sweeping stops.

5.2.4 Source Function

The section describes restrictions on the source function and the operations.

5.2.4.1 Source Mode, Source function, and the Setting Parameters

The following shows the relations 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 or Is parameter can be changed regardless of the functions currently set.
2. For DC Sweep or pulse sweep source, only the function parameters currently set are changeable.

5.2.4.2 Restrictions on Changing Source Function

Changing the source function has the following restrictions:

1. In 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.

5.2.4.3 Restrictions on the Output Range

For more information on the voltage and current output-range, see Figure 1-1.

1. Restrictions on Setting Source Value
   The source value setting range are restricted as follows:

Table 5-9 Restrictions on Setting Source Value

Mode \ Function	Voltage-source	Current-source
DC source	No setting restrictions	It is impossible to set if exceeding ±1A range because it is power over error.
Pulse source	No setting restrictions	If setting over ±1A range, there is a restriction on pulse width and duty. (*1)

(*1) Pulse width and duty are restricted as follows.

1. Pulse Width Restriction

$$Tw \leq \frac{60}{Ip\text{-}1} \quad (ms)$$

2. Pulse duty-ratio restriction
   Exceeding the following range is duty over error and can not be set.

$$\frac{Tw}{Tp} \leq \frac{1\text{-}Ib}{Ip\text{-}Ib} \qquad (Ip \leq 2A)$$

$$\frac{Tw}{Tp} \leq \frac{4}{5} \cdot \frac{1\text{-}Ib}{Ip\text{-}Ib} \qquad (2A < Ip)$$

Tw: Pulse width
Tp: Period Time
Ip: Pulse source current
Ib: Base current

NOTE: ***Calculate Ip and Ib as | Ip | and | Ib |.***
If the polarity of Ip and Ib are different, calculate as Ib=0.

2. Restriction on Load Current Pulse in voltage Source

   Hardware is restricted as follows when the load current exceeds ±1 A range.

   1. Restriction on Load-Current Pulse-Width·

      $$Tw \leq \frac{(15\text{-}Vo) \cdot 12}{Ip\text{-}1} \quad (ms)$$

      However,

      $$Tw \leq \frac{120}{Ip\text{-}1} \quad (ms)$$

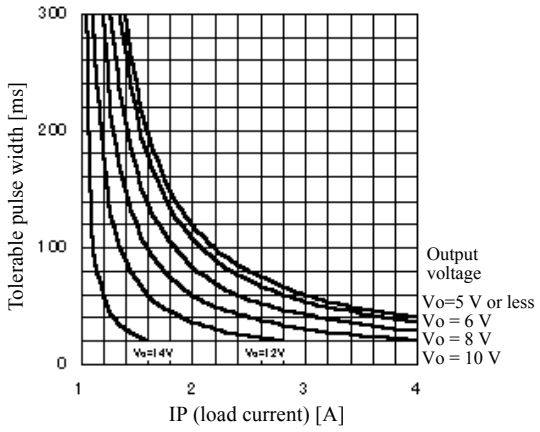
      Tw: Load current pulse width
      Ip: Load current
      Vo: Output voltage

   2. Duty ratio Restriction on Load Current Pulse

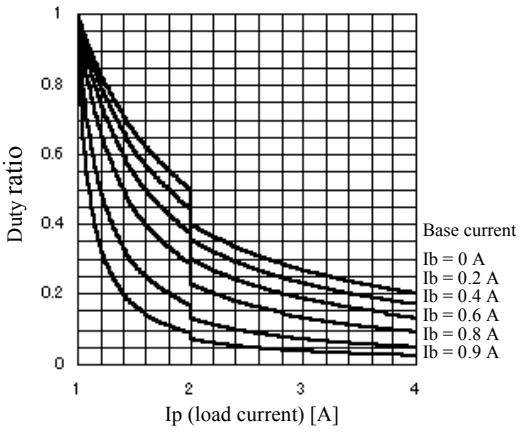
      Range is the same as the pulse duty-ratio restriction described in *1, Step 2.

NOTE: ***Applying the load current exceeding the above restriction makes the unit detect overload and set Standby status.***
For the prevention from being damaged, do not apply voltage or frequency that exceeds the specification range to the 6240A.

Restriction on load-current pulse-width at VS



Duty ratio restriction on load-current pulse at



5.2.4.4 Source Range

1. Source Ranging
   - 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, start, and stop values as in the list below, regardless of the set or displayed value.
     Set the sweep range according to the items. ***B: SWEEP, 2) SWP Range*** in Menu.

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

2. The Range that a source value is set in (Sweep range is Auto)

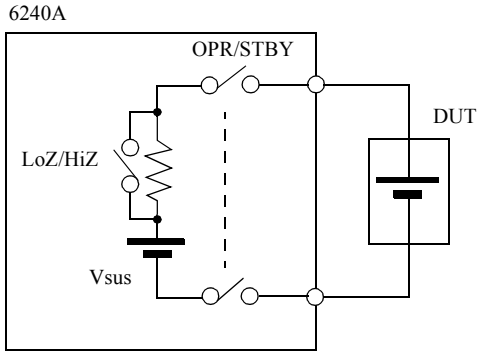
Source function	Setting value	Range set
Voltage-source	0 V ≤ |Vs| ≤ 3.1000 V	3 V range
	3.1000 V < |Vs| ≤ 15.000 V	15 V range
Current-source	0 mA ≤ |Is| ≤ 3.1000 mA	3 mA range
	3.1000 mA < |Is| ≤ 31.000 mA	30 mA range
	31.000 mA < |Is| ≤ 310.00 mA	300 mA range
	310.00 mA < |Is| ≤ 1.0000 A	1 A range
	1.0000 A < |Is| ≤ 4.0000 A	4 A range

3. Ranging Operation during in Sweep

   The period time may be extended if the range change occurs during sweeping.
   For more information on the sweep operation in this case, see Table 5-5, “DC Sweep Source Mode Operation” or Table 5-6, “Pulse Sweep Source Mode Operation.”
   If the period time is extended, TpALM indicator turns on.

5.2.4.5 Suspend Function

The 6240A can select three output OFF status; 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 omit unnecessary relay ON/OFF action, which enables reducing deteriorating of the throughput due to relay operation time and can improve life duration of relay.
Therefore, setting in Suspend status is recommended as possible when you turn OFF the output to change the measurement condition.
Figure 5-9 below shows the 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 (IL) IS: 30 digits from the current setting range
HiZ	ON	Vsus high resistance	30 μA
STBY	OFF	Open	-

Figure 5-9 Concept of Output Status

1. Operation
   1. Standby status

      Press **STBY** to set Standby status.
      It securely isolates DUT.

   2. HiZ Suspended status

      Press **SUSPEND (SHIFT, OPR)** to set Suspended status. OPR indicator blinks.
      It is a status of LoZ/HiZ switch OFF with OPR/STBY relay ON.
      Suspend status outputs Vsus voltage regardless of Vs/Is output status.
      Since the output is high resistance status, it does not almost affect on DUT.
      It operates as follows during Operate ON.

      Vs setting: Vsus → Vs output

      Is setting: Vsus → Is function → Is output

3. LoZ Suspended Status

   It is the same status as HiZ Suspend except the output is in low resistance status.
   It is effective to set DUT in low impedance when the output is OFF.
   The output response-speed becomes faster because limiter range is not changed in Operate ON.

4. Current-limiter in Suspend

   Suspend always sets Vs status, and the current-limiter setting becomes the values as shown in Figure 5-9, “Concept of Output Status.”
   Therefore, HL or LL might turn on depending on the load status.

2. Setting Suspend Conditions

1. Setting Suspend Voltage

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

   The voltage range of Suspend voltage is the same as that of the voltage source function. However, if the Suspend voltage is a value that can not 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.

Source Function	Setting Suspend Voltage	Source Range	Suspend Voltage Range	Changing Source Range
Vs	0 V	3 V	3 V	No
	10 V	3 V	15 V	Yes
	10 V	15 V	15 V	No
Is	0 V	3 mA	3 V	Yes
	10 V	1 A	15 V	Yes

2. Setting Output Resistance in Suspend

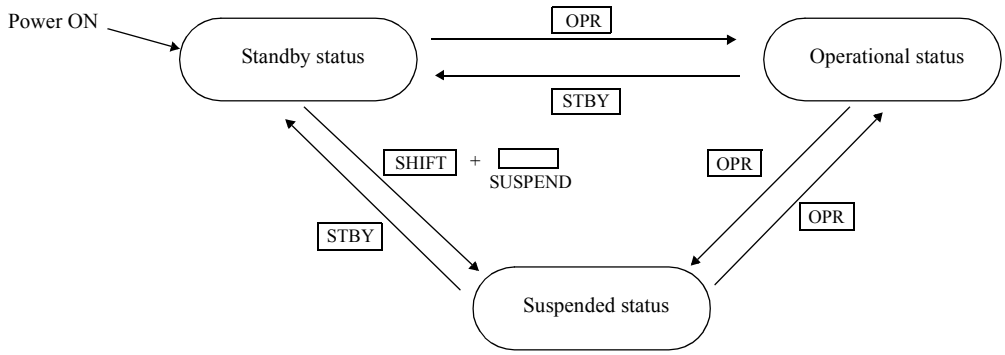
   Select and set “A) SOURCE” and then “3) Suspend Z” on the Menu screen.

   HiZ: High resistance output status. Current-limiter is set to 30 μA.

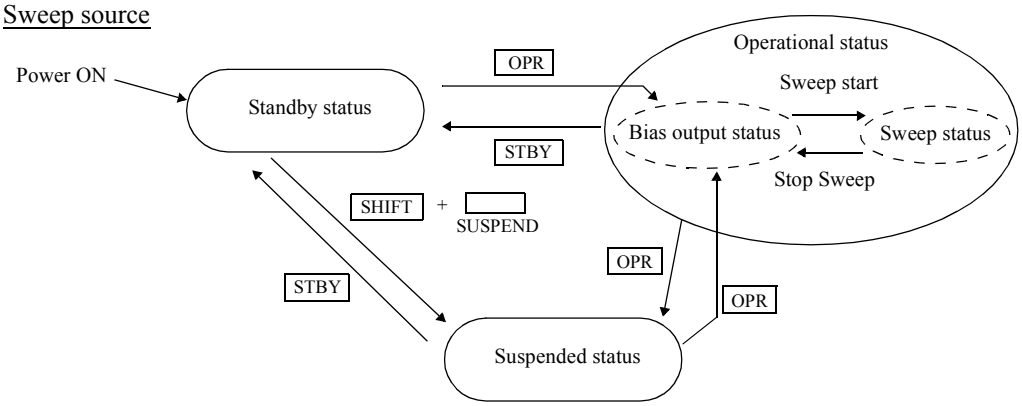
   LoZ: Low resistance output status.
   Vs: Sets current-set limiter value. (However 1 A max).
   Is: 30 digits of Is range.

3. Shifting between Operate, Standby, and Suspend

DC source/Pulse source



Sweep source



NOTE: ***The source data in sweeping is generated with the following timing.***
1. Standby → Operate
2. Standby → Suspend

5.2.5 Measurement Function

5.2.5.1 Measurement Function

Measurement functions can be selected regardless of the source functions.

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 the Measurement Value.”

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 20 digits or below, or current-measurement value is 200 digits or below.***

HiLimit RM: ***It is in HI limiter status.***

Lo Limit RM: ***It is in 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.***

---

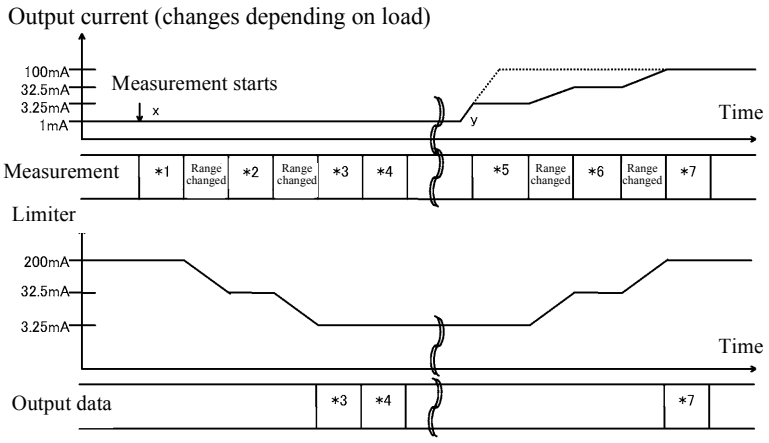
1. Operating Range for Measurement Auto Range

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

Measurement function	Range	Auto range level	
		DOWN	UP
Voltage-measurement	3 V	-	3.20000
	15 V	02.9999	-
Current-measurement	3 mA	-	3.20000
	30 mA	02.9999	32.0000
	300 mA	029.999	320.000
	1 A	0.29999	1.02000
	4 A	0.99999	-

2. Measurement Auto Range for the DC Source Mode

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



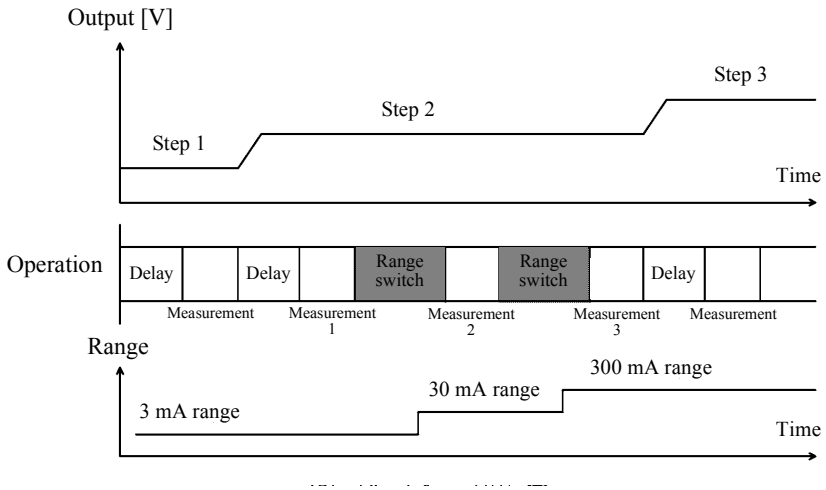
   While the measurement auto range is activated, it measures as changing the limiter value to be larger than the full scale of the measurement range.

   - 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 changed to 30 mA, the auto range changes the limiter to the maximum value for 30 mA range (32.99 mA).
   - For *2, the measurement result with 30 mA range is 1 mA, the auto range changes the range and then the limiter changed to 3.299 mA.
   - For *3, measuring with 3 mA range outputs 1 mA measurement data.
   - The output current changes to100 mA at Point y, but the limiter is 3.299 mA and the output current is limited to 3.299 mA.

- For *5, measuring with 3 mA results in 3.299 mA measurement value. This is over range (over 3.2 mA), and the auto range changes the range.
  Changing range results in 30 mA range, and the limiter is also changed to 32.99 mA.
- For *6, measuring with 30 mA range results in 32.99 mA. This is over range, and the range is changed more further.
  Although changing range results in 300 mA, this range is set to the value compliant with the preset value 200 mA.
- For *7, measuring with 300 mA range results in 100 mA and it is output as the output data.

3. The measurement auto range in sweeping

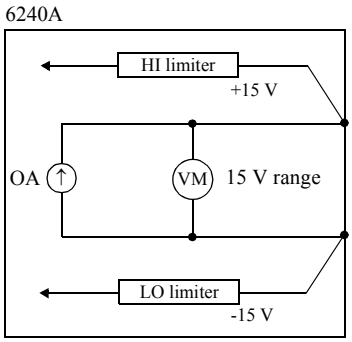
   While in sweeping, measurements are performed in each step. If the measurement range is set as auto range, auto ranging continues until measurement data is determined in each step.



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

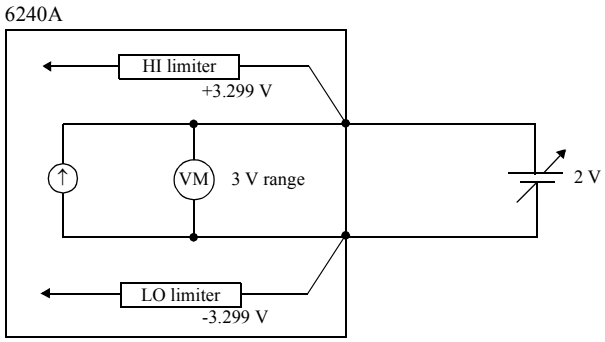
   When an external voltage is measured with Auto range by following a procedure shown below, Auto range detects overload (OVL) and it sets Standby status.

   1. Set the current-source 0 A and the limiter voltage ±15 V.



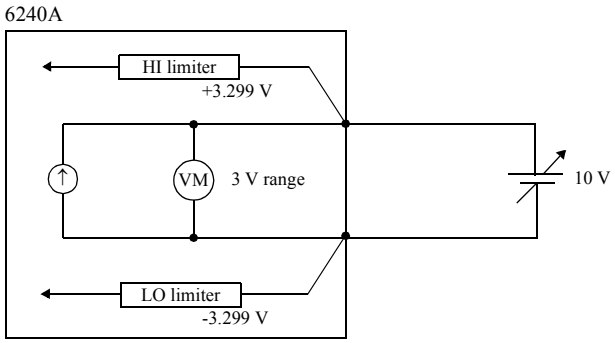
   The VM (voltage-measurement) range at ISVM (Current-Source Voltage Measurement) is set to the same value as the range of the voltage-limiter.

2. Connect the external power supply 2 V.



2 V connection makes the Auto range to set the measurement range 3 V.
Then the voltage-limiter is also changed to 3 V range. Therefore, the internal value ±3.299 V is set.

3. Increase the external power supply to 10 V.



With the measurement auto range function, before the range is increased, the following formula, HI limiter value < external power supply, makes it detect the voltage overload and sets Standby. The operation above is unavoidable in principle.

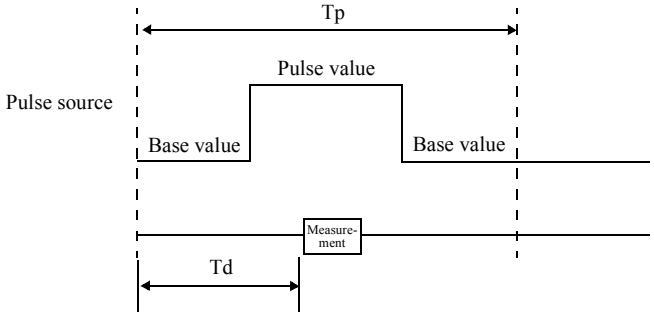
For using the unit with the condition above, do not use the measurement auto range.

NOTE:

1. ***In the current-source function, apply an external voltage VB within the limiter range.***
   $V_{LL} < VB < V_{HL}$
   If exceeding the limiter range, it detects overload (OVL) and sets Standby.
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).

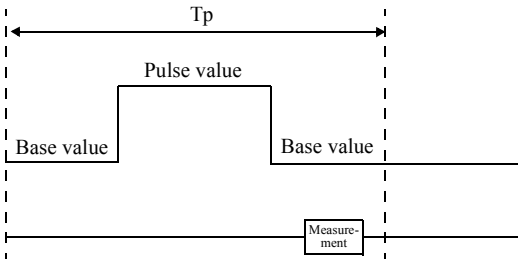
5.2.5.3 Measurement Delay Time and the Measurement Value

1. Measuring with Pulse Value Timing



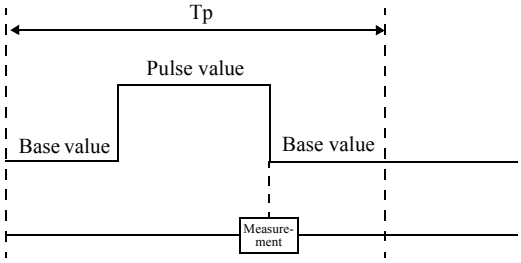
When displaying the resistance value, the calculation is made by the measurement value and pulse value.

2. Measurement 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 becomes 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 Auto Zero Function

The 6240A 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 activated in Pulse source mode or pulse sweep mode, it generates base value until it is completed.***
Therefore, the time length for outputting the base value is extended. If it is inconvenient, set the Auto-zero function to OFF.

5.2.5.5 Switching Display of the Unit

Select and set the items, “E) MEASURE ” → “4) Disp Unit” on the Menu screen.

Prefix: Displays measurement data with small numbers and the unit.

Exponent: Displays measurement data with digit (exponent) style.

1. Display 10 mA with Prefix

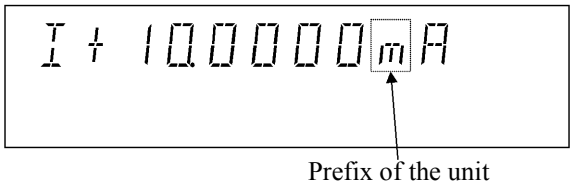
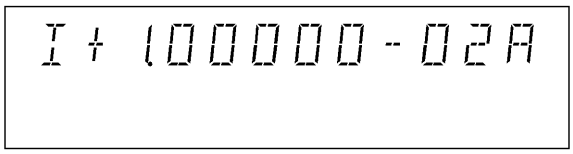


Table 5-10 shows the relation between prefix of the unit and digit (exponent).

Table 5-10 Relation between Prefix of the Unit and Digit

Prefix of the Unit	How it reads	Digit (exponent)
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}
h	Hecto	10^{2}
da	Deca	10^{1}
d	Deci	10^{-1}
c	Centi	10^{-2}
m	Mili	10^{-3}
μ	Micro	10^{-6}
n	Nano	10^{-9}
p	Pico	10^{-12}
f	Femto	10^{-15}
a	Ato	10^{-18}
z	Zepto	10^{-21}
y	Yokto	10^{-24}

2. When displaying 10 mA with Exponent



Prefix of the unit

Decimal point is always put on the top 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 damage due to over-voltage or over-current.

The 6240A 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, set the voltage-limiter value (V_{HL}, V_{LL}) in the following range.***
$V_{LL} < V_B < V_{HL}$
If set outside the above range, the 6240A sets overload (OVL) and then Standby.

5.2.6.1 Limiter Setting Ranges

The limiter value can be set with the following conditions.

- For other than 4 A range
  60 digits ≤ (HL value -LL value)
- For 4 A range
  120 digits ≤ (HL value -LL value)

NOTE:

1. ***Set the current-limiter to the largest within the required range.***
   The smaller the current-limiter is, the longer the settling time is.
2. ***Set the voltage-limiter to the smallest within the required range.***
   For the case that current can not 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 setting the limiter are available; one is ±Balance setting. It sets the same absolute value on the bipolars, + and -; the other is Separate setting. It sets different value on each polarity.

   For more information on the setting, refer to Section 2.2.2, "Setting Limiter Value."

2. Set Range

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

   The set values are set in the optimal range.

3. Separate Setting Operation

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

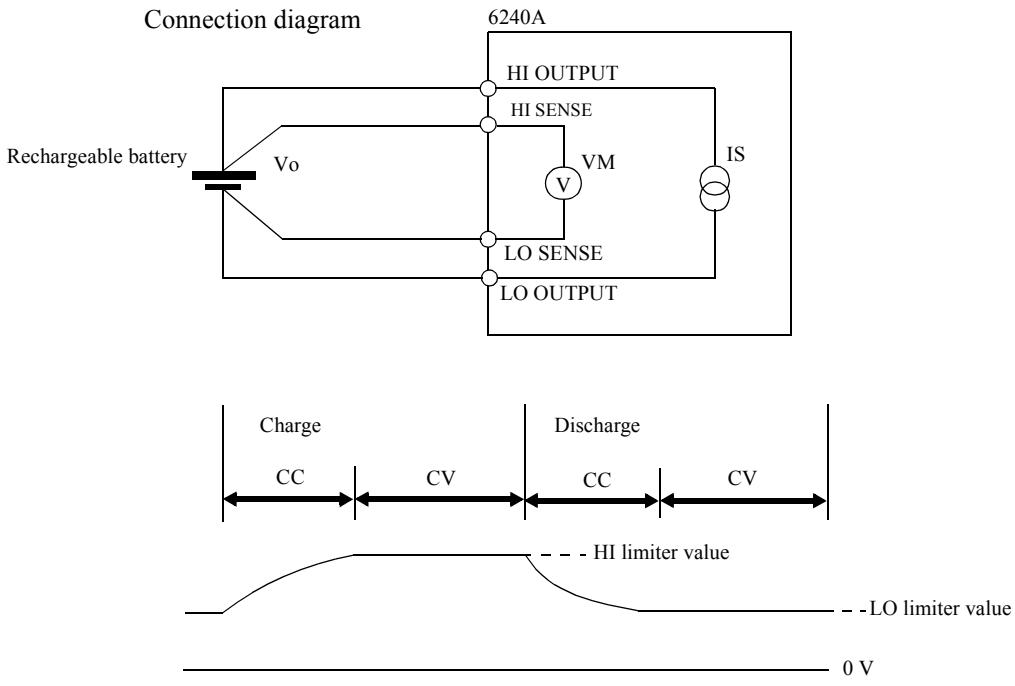


Figure 5-10 Rechargeable Battery Charge and Discharge Operations

Setting HI limiter value as the constant voltage charging, and LO limiter value as the discharging termination voltage, gives CV/CC operation as in Figure 5-10.

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

5.2.6.3 Displaying and Outputting of the 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/GPIB outputs.

Display	GPIB output		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 6240A as well as the DUT. When any of these alarm conditions is detected, a message is displayed and outputted to the GPIB device event register, error register, or measurement data header.
Table 5-11 below shows the messages and their contents and causes.

Table 5-11 Alarm Detection Contents

Message	Content	Cause
Source Unit	Source unit malfunction	Malfunction
Fan Stop	Fan stopped	Malfunction
Over Heat	Over heat (Internal over heat)	• Malfunction • Sink operation outside the specified range • The ventilator is blocked • Ambient temperature exceeds the specified range
Over Load	Overload	• Over voltage applied from external device • Connecting to the external voltage source of exceeding the voltage level • 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 the 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 the 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 6240A's timing of source and measurement differs depending on the source mode as shown in Table 5-12.

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

Table 5-12 Source Mode and Time Parameters to be Considered

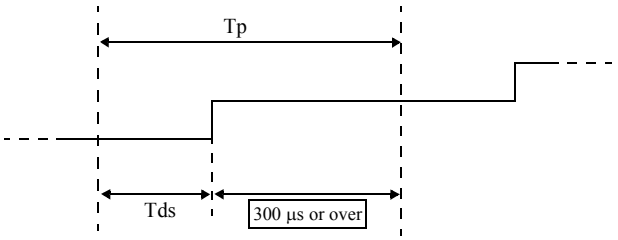
Source mode		Th	Tds	Td	Tw	Tp	Tm	Timing diagram
DC	Trigger mode AUTO			●		●	●	Table 5-2
	Trigger mode HOLD			●		●	●	
Pulse			●	●	●	●	●	Table 5-3
DC Sweep		●	●	●		●	●	Table 5-5
Pulse Sweep		●	●	●	●	●	●	Table 5-6

Item	Content	Categorical hierarchy	Change hierarchy
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)	IT	-

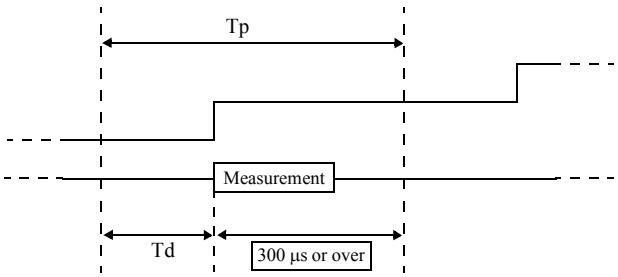
5.2.8.1 Restriction on Time Parameter

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

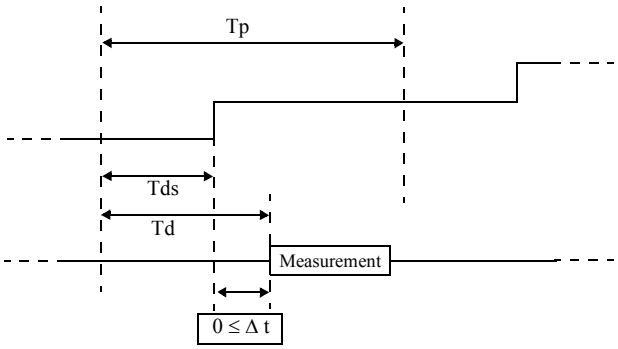
1. Restricted settings
   - Source delay time (Tds) + 300 μs < period time (Tp)



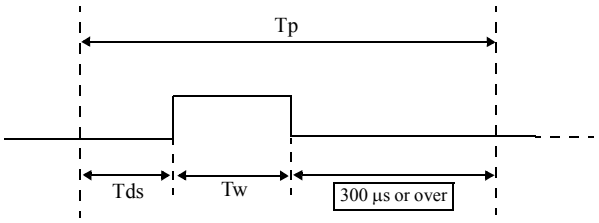
   - Measurement delay time (Td) + 300 μs < Period time (Tp)



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



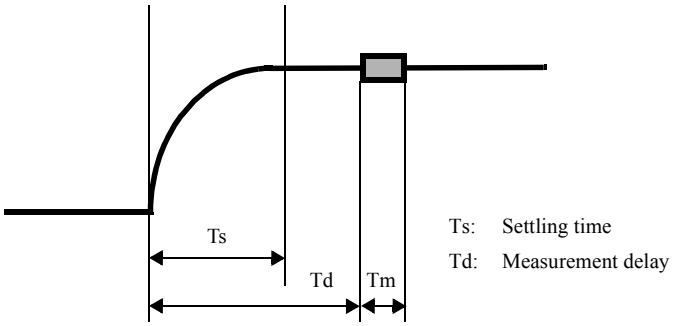
- Source delay time (Tds) + Pulse width (Tw) + 300 μs < period time (Tp)



NOTE: ***If set as Tp < (Td + Tm), the actual period becomes Td + Tm, and TPALM indicator turns on.***

5.2.8.2 Measurement Delay and the Settling Time

In Pulse source and Sweep source mode, the 6240A waits source value and the settling of a sample and then measure.
This section describes the settling time of the 6240A and the measurement delay to be set.



1. For the voltage-source

   Settling time (Ts) of the 6240A is defined in relation with the voltage-source variable value (Vs) and the current-limiter set value DIL (digits) as shown below.

   Set the measurement delay (Td) to Ts or over.
   Ts=0.3+(0.8+1000/DIL)*Vs/100

(Example) The unit of Ts (ms)

Current-limiter range	Vs [V]	Current-limiter set value DIL (digits)				
		30	320	500	1000	3000
3mA to 4A	1	0.6	0.3	0.3	0.3	0.3
	3	1.3	0.4	0.4	0.4	0.3
	5	2.0	0.5	0.4	0.4	0.4
	10	3.7	0.7	0.6	0.5	0.4
	15	5.4	0.9	0.7	0.6	0.5

2. For the Current-source

The 6240A Settling time (Ts) is defined in relation with the current-source value (Is), the current sense resistance (Rs), and the load voltage (VRL=Is · RL) as shown below.

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

The unit of Ts [μs]

Range	
3mA to 1A	16VRL/(Rs · Is)+100
4A	32VRL/(Rs · Is)+100

Rs value	
Range	Rs [Ω]
3mA	220
30mA	22
300mA	2.25
1A	0.25
4A	0.25

(Example) Apply 0.1 mA to 10 kΩ resistor in 3 mA range

Is = 0.1 mA

VRL = 0.1 mA × 10 kΩ=1 V

16 VRL/(Rs · Is) + 100 = 827 μs

Therefore,

Set as Td > 827 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 and between 100 μs to 200 ms.

Internal processing time Tk becomes, in accordance with the source mode and the Memory store mode.

Source mode	Memory Store	Tk [ms]
DC	OFF	Approx. 4
	Normal-ON	Approx. 4
	Burst-ON	Approx. 1
Pulse DC Sweep Pulse Sweep	OFF	Approx. 4
	Normal-ON	Approx. 4.5
	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. 8 ms
Max/Min calculation ON: Approx. 1 ms
Comparator calculation ON: Approx. 15 ms
In measuring resistance: Approx. 10 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 becomes as follows:

Tit = 20ms
Tk = 4 + 0.2 + 8 + 1 + 15 = 28.2 ms
Tm = Tit + Tk = 48.2 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: Current measurement data
Xnull: NULL data

b. Timing of acquiring NULL data (Xnull)

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

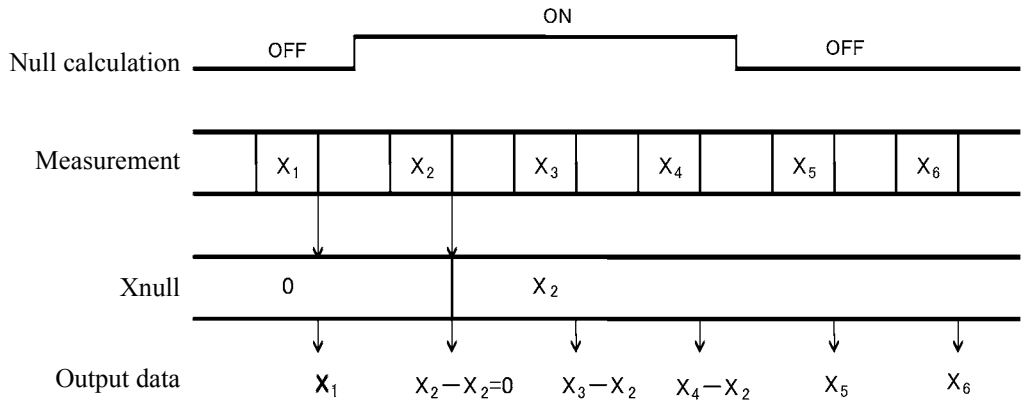


Figure 5-11 NULL Calculation Timing

- NULL indicator turns on 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 displayed value becomes the first data after Over Range is released.
- If a NULL calculation result is over the present measurement range, it displays up to the double value of the full-scale.
- NULL calculation is turned to OFF when the measurement function is changed or *RST command is executed.
- NULL data can be changed while the NULL calculation is ON.
  Select and set items, ***H) COMPUTE, NULL Value*** data 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 as following formula:

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

   X: Measurement value

2. Operation

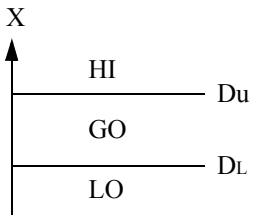
   - When Scaling calculation is ON, MATH indicator turns on.
   - The set ranges of Constant A, Constant B, and Constant C are between 0 to ±999.999E + 24. ($A \neq 0$).
   - If the calculation results exceed ±999.999E + 24, it is scaling-over and the error message ±SCL Over is displayed.
   - This is turned OFF by executing the *RST command.
   - Changing the measurement function can 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
   $D_L \leq X \leq Du$ ..... GO
   $X < D_L$ ..... LO



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

   - When the measurement data is over range data, + data is judged as HI and - (negative) data is judged as LO.
   - Comparator calculation is executed for NULL calculation result if the NULL calculation is ON.

     When the NULL calculation result is over range data, the judgment is HI if the calculation result is + and LO in case of -.
   - Because the internal measurement resolution and calculation resolution is 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 resistor in the status resistor.
   Also, HI, GO, and LO signals selected with the negative-pulse is output to the COMPLETE OUT output terminal on the rear panel.

3. Operation
   - All the indicators turn on when the Comparator calculation is ON. , , or indicator turns on 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 condition for buzzing, it buzzes.

     Select the items, ***L) SYSTEM, 3) Compare Buz*** on the Menu screen to set the condition of buzzing.

5.2.9.4 Max/Min Calculation

1. Calculation expression

   Max/Min calculation calculates the maximum, minimum, average, and integrated value 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 the result.
   1. Number of Measurement times
   2. Maximum value
   3. Minimum value
   4. Average value
   5. Integrated value
3. Operation
   - The effective data except for over range and error data is calculated.
   - It buzzes when the 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 5-13 shows the signal names, levels and functions.

Table 5-13 External Control Signal Functions

Signal	Input/ output	Level	Impedance	Function
TRIGGER IN	Input	TTL negative pulse (10 μs or over)	Approx. 4.7 kΩ	• Measurement start in the DC source mode • Pulse value output in the Pulse source mode • Start in the Sweep source mode • Step-up
COMPLETE OUT *1	Output	TTL negative pulse (10 μs or over) *3	Approx. 100 Ω open drain (+ 5 V 10 Ω 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 k Ω	• When this input signal is changed from LO to 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 to HI, the output becomes Standby.
OPR/STBY IN *2				• When this input signal is changed from LO to HI, the output becomes Standby. • When this input signal is changed from HI to LO, the output becomes Operate.
OPR/SUS IN *2				• When this input signal is changed from LO to HI, the output becomes Suspend. • When this input signal is changed from HI to LO, the output becomes Operate.
OPERATE OUT *2	Output	TTL negative level	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 terminals are used by switching.
*1: SYNC OUT signal is not generated in the DC source mode.
*3: The output 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 units.

Restrictions:

1. Do not input the TRIGGER IN signal in Standby status or at switching between Operate, Suspend, and Standby.
2. Ensure that the TRIGGER IN signal, the trigger from the TRG key, and GPIB trigger (*TRG) do not overlap.
3. Restrictions on Pulse Cycle setting value Tp and Hold time setting value Th.

   When using the external trigger (TRIGGER IN signal) setting pulse cycle Tp or Hold time Th is restricted (See Table 5-14 and Table 5-15).
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 the next step is restricted for the sweep source (See Table 5-14 and Table 5-15).
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 from GPIB or from an external signal (OPR In signal) to inputting the external Trigger (See Table 5-16).
6. Allow the 6240A at least 10 ms after completion of the previous Sweep to Input sweep-start TRIGGER-IN signal.

Table 5-14 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	1ms ≤ Tp ≤ Tp (ext)-TA	1.3ms	1ms ≤ Th ≤ Th (ext)-3ms 4ms ≤ Th (ext)	Thp (ext)= Th (ext)+Tp (ext)
	NORMAL	10ms ≤ Tp ≤ Tp (ext)-TA	15ms		
	OFF				
ON	BURST	2.2ms ≤ Tp ≤ Tp (ext)-TA	2.5ms		
	NORMAL	10ms ≤ Tp ≤ Tp (ext)-TA	15ms		
	OFF				

Table 5-15 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 5-16 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 the next step source value

Top: Time from specifying Operate to inputting TRIGGER IN signal

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

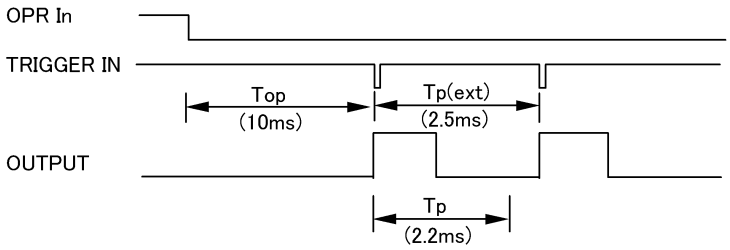
Tp (ext) min: The minimum period of TRIGGER IN signal

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 operating status in BURST mode (*2)

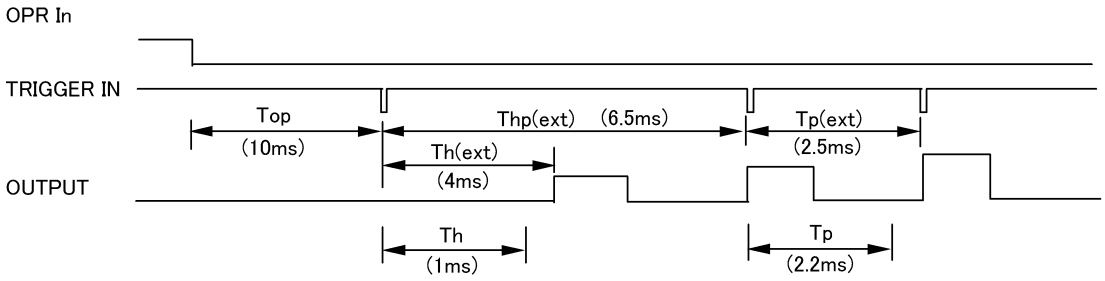
*2: High-speed-burst operational status
High-speed burst operational status starts when TRIGGER IN signal is inputted with the conditions, Measurement range; fixed, SWP Range; fixed, Trigger mode; HOLD, and Memory mode; BURST. And it is as follows:

- 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 lights up, 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 Controlling a 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.

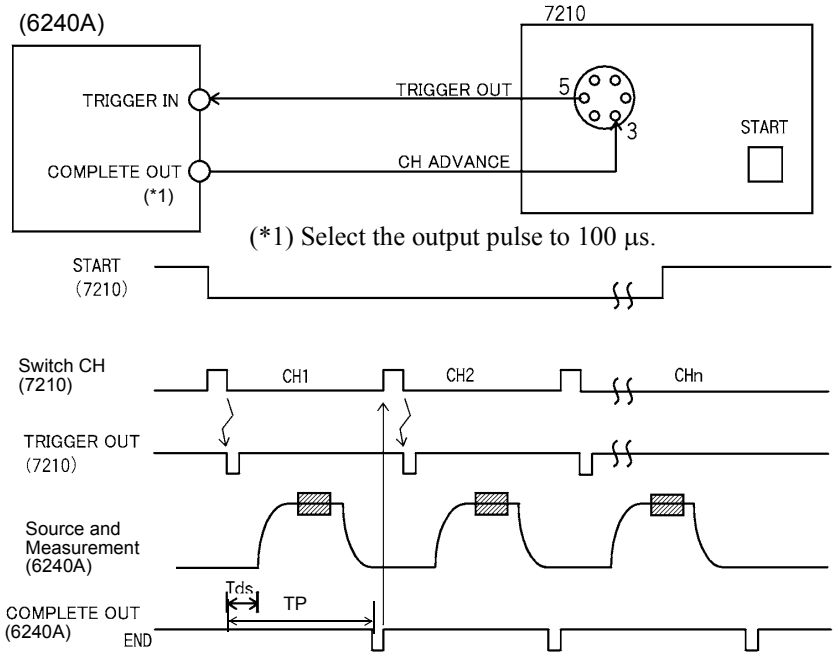


Figure 5-12 Control of Scanner

5.2.11 Operating Multiple 6240A

This section describes synchronized operation, serial connection, and parallel connection using more than one 6240A.

5.2.11.1 Synchronized Operation

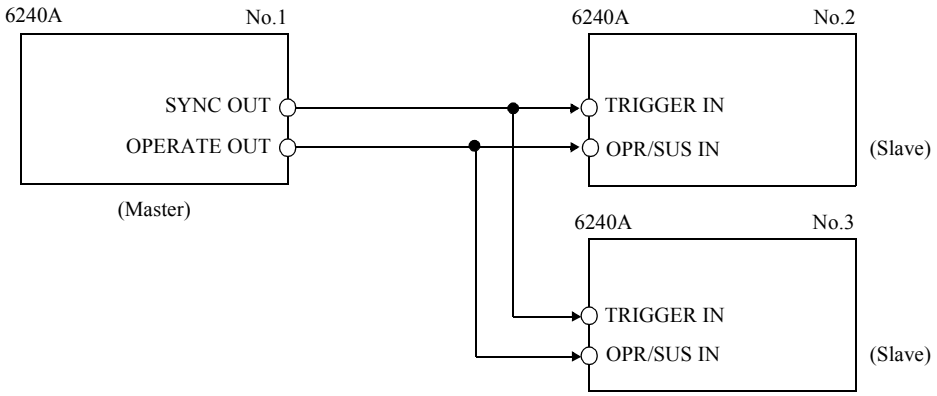
The synchronized operation of the 6240A units requires synchronization of measurement timing in the DC source mode, and also requires synchronization of both source and measurement in the Pulse source mode and the Sweep source mode.

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.

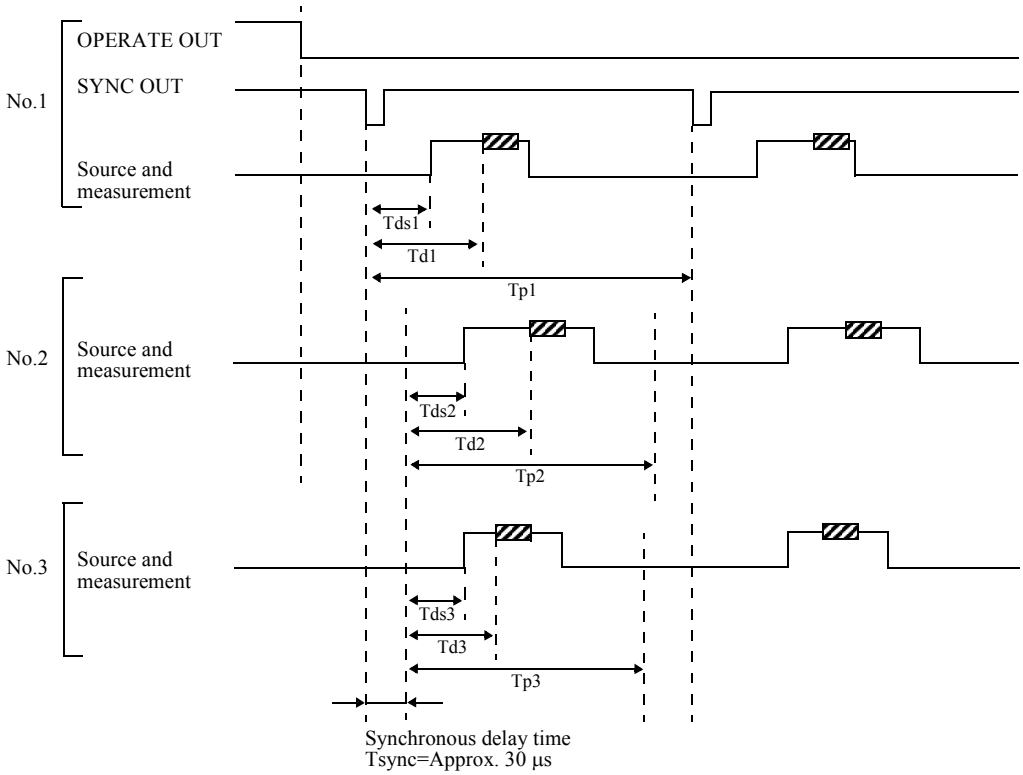
1. Three unit synchronous operation using SYNC OUT
   - Setting

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

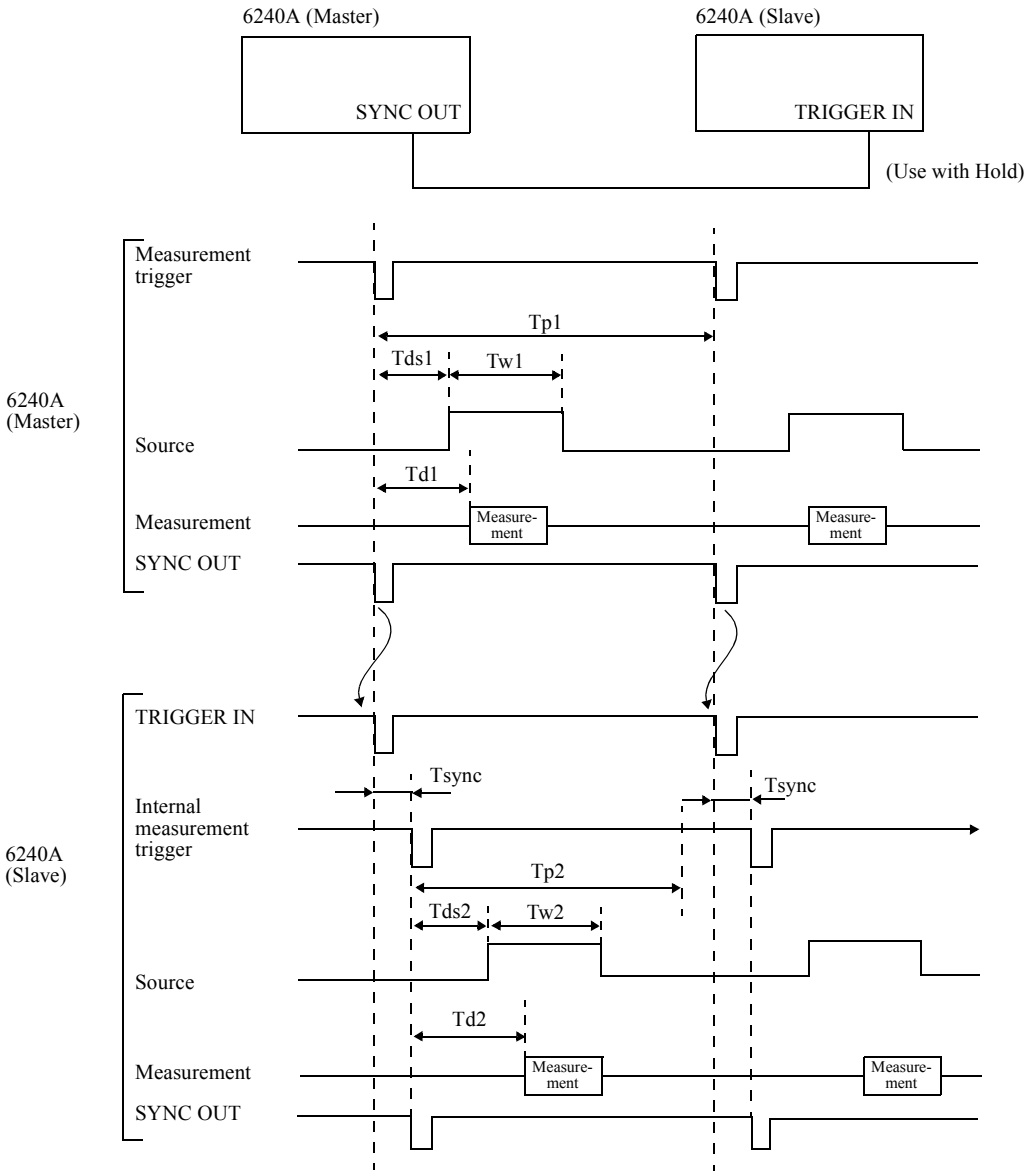
   - Connection



- Operational Timing



2. Restriction on Setting
   - The 6240A has Tsync (approx. 30 µs) time delay from the external trigger input to the measurement start.
     Consider this time delay to use the two 6240A units in synchronous operation.
   - Set all the three 6240A 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.



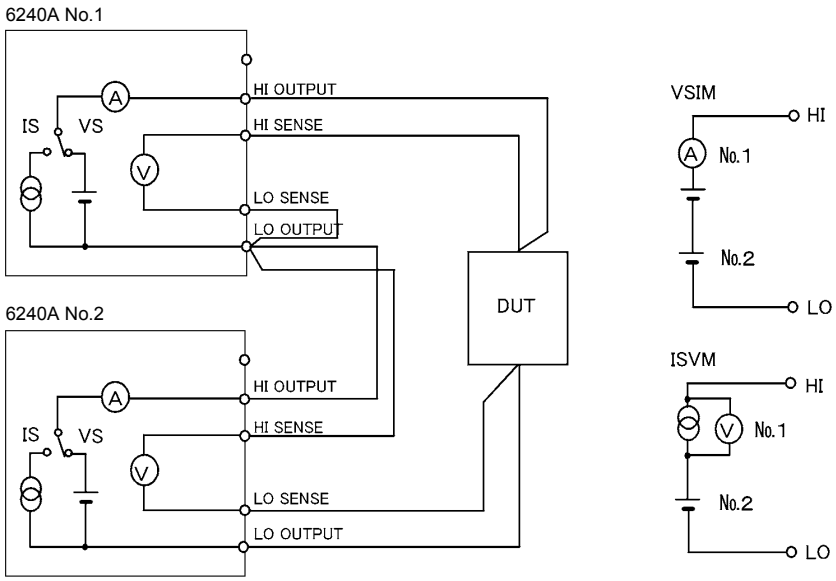
Therefore, consider Tsync time and set the relevant setting as follows:

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

5.2.11.2 Serial Connection

Using two 6240A units in series enables use of a source up to ±30 V/±1 A.

Figure 5-13 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 5-13 Serial Connection

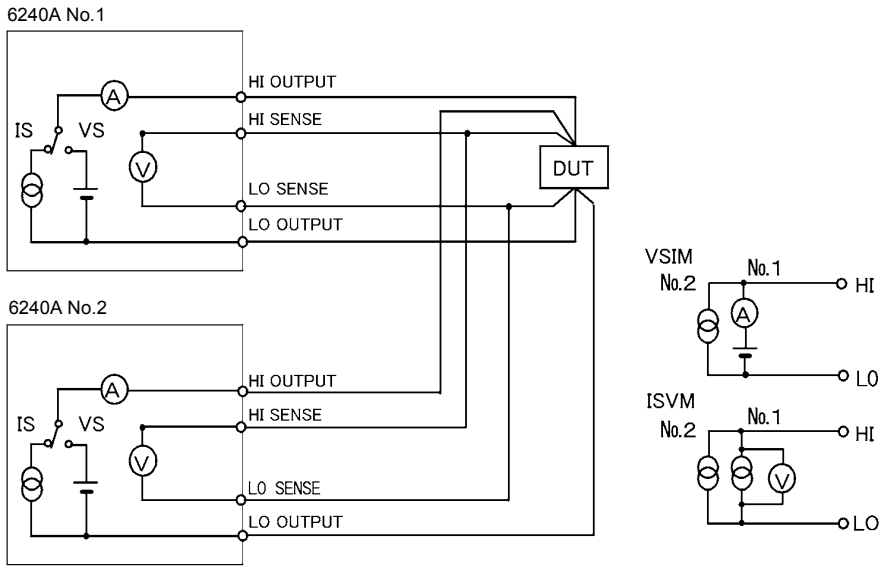
CAUTION:

1. ***If the load is short-circuited, reverse polarity voltage is applied to the 6240A themselves. Depending on the settings, overload may be generated when short-circuit occurs.***
2. ***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 6240A may be damaged.***
3. ***When using constant current, the current setting becomes the smaller of the two current settings as shown in Figure 5-13. The other becomes the constant voltage.***

5.2.11.3 Parallel Connection

Using two 6240A units in parallel connection enables use of a source up to 2 A/15 V.

Figure 5-14 shows a connection diagram in which two units in parallel using a 4-wire connection. Two unit are used for voltage measurement when measuring voltages at two points such as for 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 5-14 Parallel Connection

CAUTION:

1. ***If the load is opened, the current flows from the higher to the lower of the set voltage. Depending on the settings, 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 sync 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 6240A features a measurement data memory for storing up to 5000 measurement data.

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

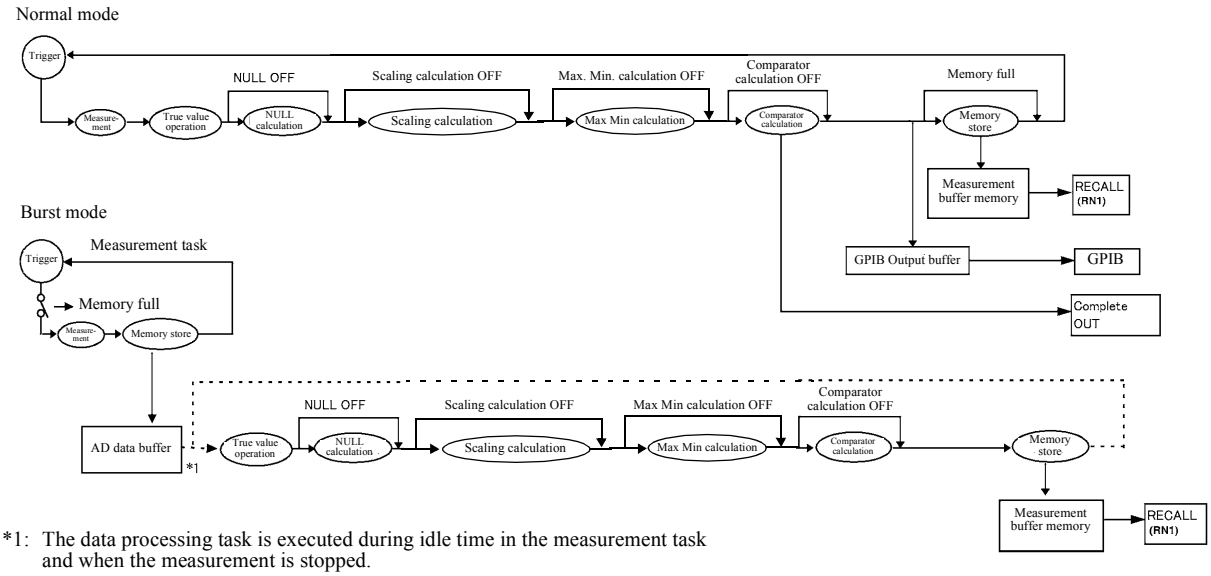
5.2.12.1 Storing Measured Data into Data Memory (Memory Store)

Two ways of storing the measured data is 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.

The STORE switch Switches storing function between ON and OFF in the Normal mode.

When changing from the Burst mode to Normal mode Memory Store turns to be OFF.

Figure 5-15 shows a conceptual diagram of storing measured data. Table 5-17 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 5-15 Conceptual Diagram of Storing Measured Data

Table 5-17 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 task or when measurement is not performed.
Data output	Reads the latest data by ENTER key	Available	Not available
	RECALL and RNI commands	Available	
Operation when Memory Full		ST lamp flashes MFL (bit 10) of the device event status resistor 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

(*) Integration time: 100 μs. Source delay: 30 μs. Major 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***
- ***In the operate status of the sweep source mode at***

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 store mode is turned ON
- When the Normal mode or the Burst mode is switched
- When the power is turned ON

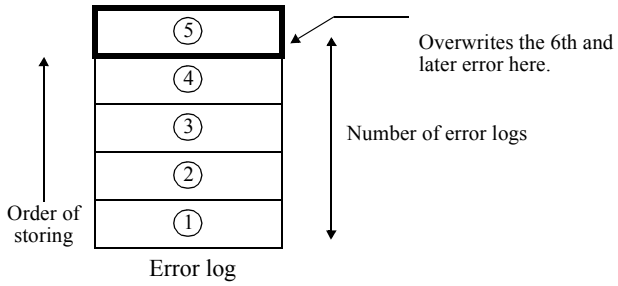
5.2.14 Error Log

The 6240A holds error numbers in the error log memory when it detects an error.

1. Operation

   A maximum of 5 memory areas available for the error log and they operate as follows:

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



2. Clearing an Error Log

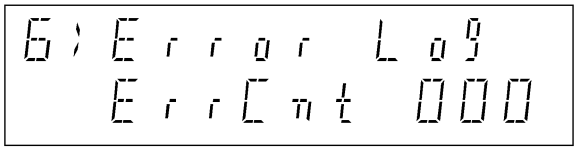
   The error logs are cleared under the following causes and the ERR indicator turns off.

   - When the power is turned ON.
   - When Reading error log
     (This error log is cleared after displaying the error log screen and completing the Menu screen.)
   - When the ERL? command is executed.

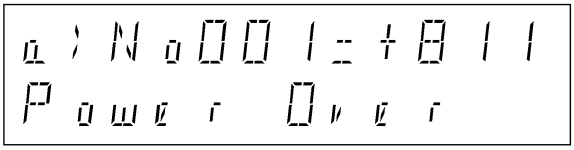
   The error log is not cleared by *RST *CLS.

3. Reading error log

   Select the items, ***L) SYSTEM, 6) Error Log*** on the Menu screen.



   The number of errors is displayed.
   Press **DOWN (↓)** to display the error contents display screen.
   Press △ or ▽ to change the error log number.
   The example below shows an error display when the value exceeds 1A in the DC mode.



5.2.15 Self Test

The 6240A 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 5-18.

Table 5-18 Self-test Items

	Display Error Code	Content	Executing Method			Display Message	TER resistor (*1)	
			Power ON	*TST?	Key operation		Resistor	Data
1	001	ROM check SUM	●			ROM Chk SUM	-	-
2	002	Display section communication/RAM	●			Panel Comm		
3	-	LCA data	●			(Consecutive buzzer ON)		
4	004	Reading from or writing into RAM	●			RAM Rd/Wt		
5	005	Analog section communication	●	●	●	Analog Comm		
6	012	CAL data SUM	●	●	●	CAL data SUM	a	2
7	013	Parameter SUM	●	●	●	Param SUM		4
8	101	Comparison between AD operation IR1: IR2	●	●	●	AD Ratio 1-2	b	1
9	102	Comparison between AD operation IR2 and IR3	●	●	●	AD Ratio 2-3		2
10	103	Comparison between AD operation IR3 and IR4	●	●	●	AD Ratio 3-4		4
11	104	Comparison between AD operation IR4 and IR5	●	●	●	AD Ratio 4-5		8
12	105	AD operation Zero	●	●	●	AD Zero Meas		16
13	201	VSVM 3V ZERO	●	●	●	VSVM 3V Zero	c	1
14	202	VSVM 3V +FS	●	●	●	VSVM 3V +FS		2
15	203	VSVM 3V -FS	●	●	●	VSVM 3V -FS		4
16	204	VSVM 15V ZERO	●	●	●	VSVM 15V 0		8
17	205	VSVM 15V +FS	●	●	●	VSVM 15V +FS		16
18	206	VSVM 15V -FS	●	●	●	VSVM 15V -FS		32
19	211	High Limit 3V +FS	●	●	●	HL 3V +FS		64
20	212	High Limit 3V -FS	●	●	●	HL 3V -FS		128
21	213	High Limit 15V +FS	●	●	●	HL 15V +FS		256
22	214	High Limit 15V -FS	●	●	●	HL 15V -FS		512
23	221	Low Limit 3V +FS	●	●	●	LL 3V +FS		1024
24	222	Low Limit 3V -FS	●	●	●	LL 3V -FS		2048
25	223	Low Limit 15V +FS	●	●	●	LL 15V +FS		4096
26	224	Low Limit 15V -FS	●	●	●	LL 15V -FS		8192
27	231	IM 3mA ZERO	●	●	●	IM 3mA Zero	d	1
28	232	IM 30mA ZERO	●	●	●	IM 30mA Zero		2
29	233	IM 300mA ZERO	●	●	●	IM 300mA 0		4
30	234	IM 1A ZERO	●	●	●	IM 1A Zero		8
31	235	IM 4A ZERO	●	●	●	IM 4A Zero		16
32	301	OVL detection check	●	●	●	OVL Check		64
33	-	All the panels light ON	●		●	Visually display check	-	-
34	-	Buzzer	●		●	Check with the buzzer sound		
35	-	Panel key			●	Visually key display check		

(*1) TER? Command response resistor and data.
In the error resistor (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, ***L) SYSTEM, 5) Self Test*** on the Menu screen to execute the self test by manual operation.

   Press **DOWN (↓)** and select items "executing the test" and "display/key test" by using **4W/2W (←) RCL (→)**.

   Figure 5-16 below shows the key operation procedure and the power ON operation.

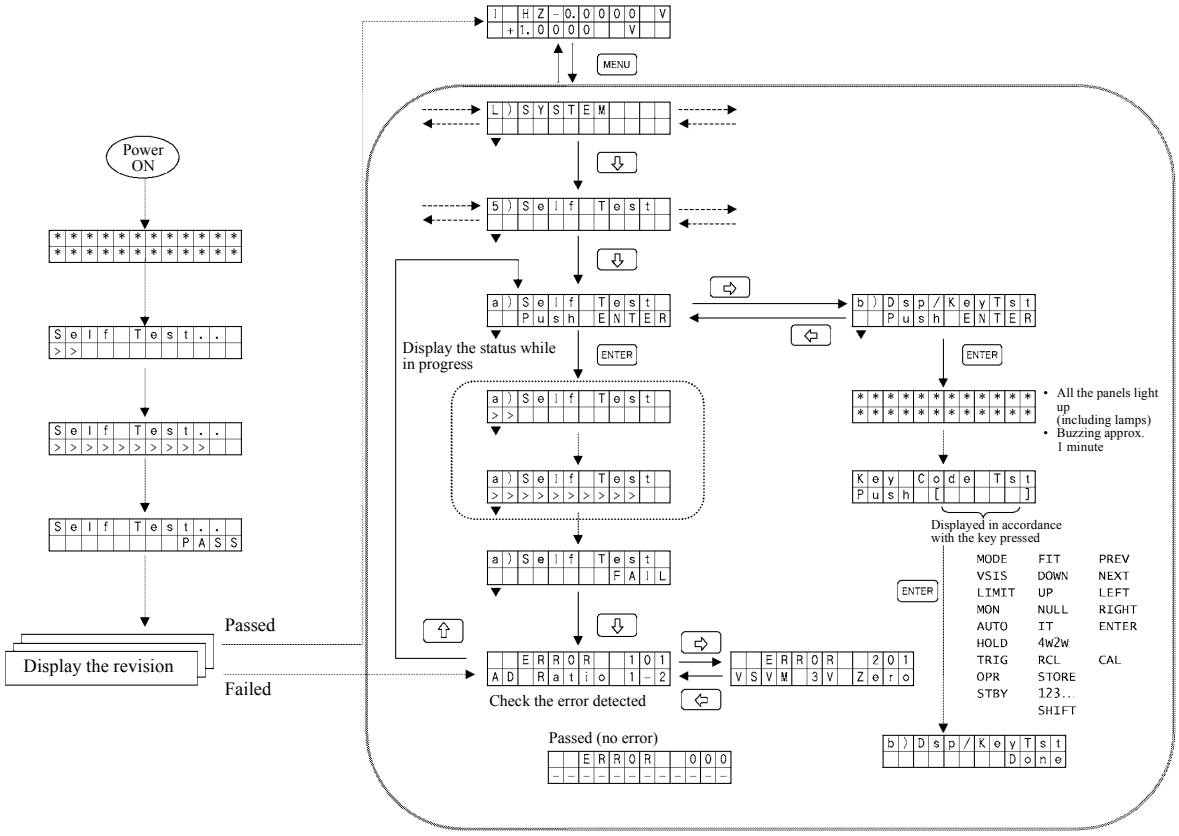


Figure 5-16 Self-test Operation

5.3 Compatibility with 6243/44

This section describes the compatibility with the earlier model 6243/44.

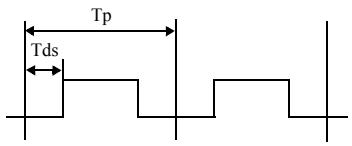
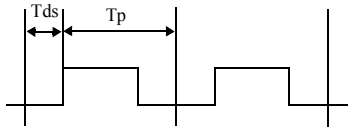
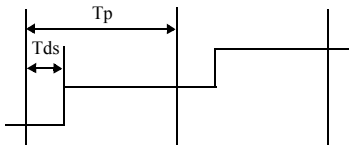
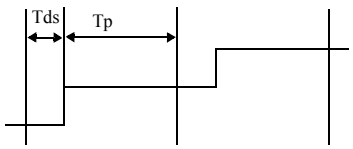
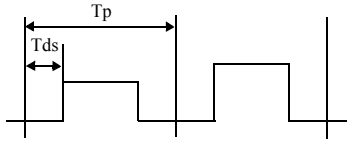
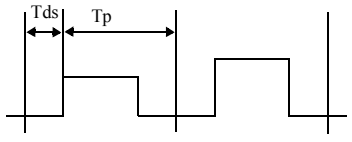
5.3.1 GPIB Command Compatibility

The 6240A has the same function as the 6243/44 function but has no command compatibility.
For more information on the remote operation, refer to Section 6.3.1, “GPIB Command List.”
Following commands have the compatibility.

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

5.3.2 The difference of the Cycle-parameters in the Pulse Source Mode and the Sweep Source Mode

Ensure that the definition of the cycle parameter Tp is different from that of the 6243/44.

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

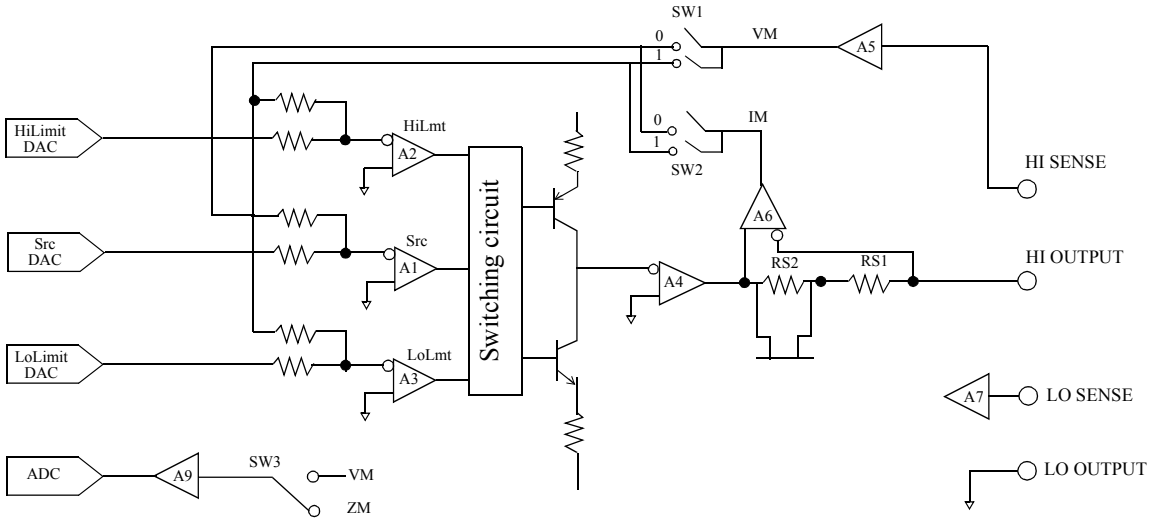
5.3.3 Notes for Synchronous Operation

The 6243/44 has no delay time from the external trigger input to the measurement start, but the 6240A has Tsync delay time.

Therefore, consider the Tsync delay time when using the 6240A with the 6243/44 in synchronous operation. For more information, refer to Section 5.2.11.1, “Synchronized Operation.”

5.4 Operating Principles

5.4.1 Block Diagram



5.4.2 Operational Principles

- The 6240A contains the DA converter SrcDAC for setting the voltage source or current source.

  The 6240A also has two DA converters, HiLimitDAC and LoLimitDAC, for setting the current limiter and the voltage limiter.
  The SrcDAC has 16 bit conversion accuracy, and The HiLimitDAC and The LoLimitDAC have13 bit conversion accuracy.
  The output from the DA converter is inputted to three error amps, Src (A1), HiLmt (A2), and LoLmt (A3).

- 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 is 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 both current source or current limiter.

- Voltage range switching is done by A5, and the voltage measurement, voltage source, and the voltage limiter always take place in the same range.
- The A5 and A6 amp have high input impedance to minimize leak.
- The A7 amp also has the high input impedance to reduce error for 4-wire connection.
- The AD converter employs 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 Interface and describes the connections and settings. This chapter also contains lists of commands for programming and introduces program examples.

6.1 GPIB Command Index

Use the following GPIB command index as the index for GPIB command in Chapter 6.

6.2 GPIB Operation

The 6240A comes with a GPIB (General Purpose Interface Bus) conforming to the IEEE standard 488-1978 as standard enabling remote control from an external controller.

6.2.1 What GPIB Is

GPIB is a high-performance bus for integrating computers measuring instruments.
The GPIB operation is defined by the IEEE Standards 488-1978.
Since GPIB interface has bus structure, each device is specified by assigning a unique address.
Up to 15 devices can be connected to one bus in parallel on the bus. Each GPIB device features one or more of the following functions:

- Talker

  The device specified for sending data to bus is referred to as “talker.” Only one device can function as the active talker on the GPIB bus.

- Listener

  Devices specified for receiving data on the bus are referred to as “listeners.” The GPIB bus accommodates multiple devices operating as active listeners.

- Controller

  that the device specifying the talker and the listener is referred to as the “controller.” Only one device can operate as the active controller on the GPIB bus.
  Those controllers that can control IFC and REN messages are referred to as “system controllers.”

Only one system controller it is allowed on one GPIB bus.
If more than one controllers are on the same bus, the system controller becomes the active controller for the system start-up, and other devices with controller capacity function as addressable units.
To make another controller the active controller, the Take Control (TCT) interface message is used.
At this time, the active controller becomes a non-active controller.
The controller controls the entire system by sending interface messages and device messages to each measuring instrument.
These message types have the following functions.

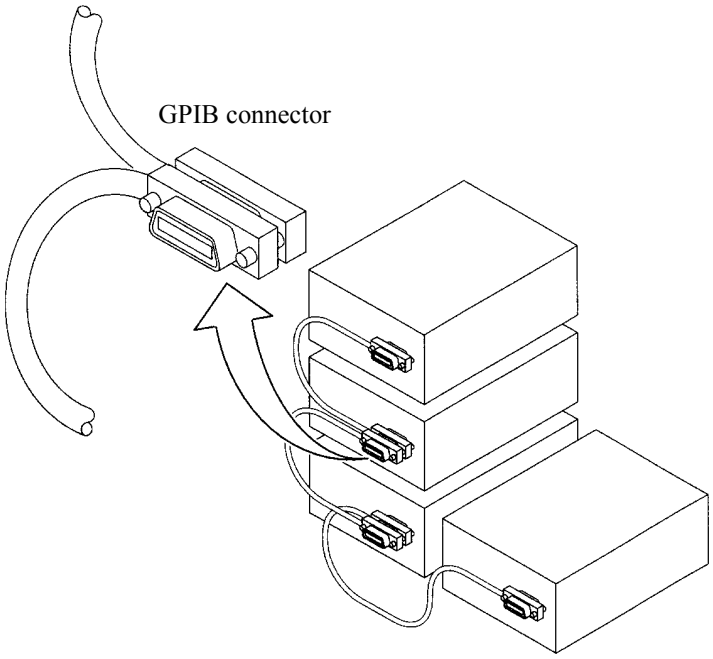
- Interface messages: Control the GPIB bus.
- Device messages: Control measuring instruments.

6.2.2 GPIB Setup

1. GPIB Connection

   The following describes the standard GPIB connection and the precautions for the connection.

   Secure the GPIB connectors with two screws provided to prevent the connectors from coming loose during use.



The precautions for the GPIB interface connection are as follows:

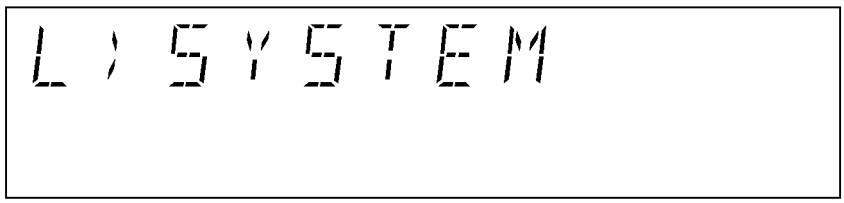
- The total lengths of the GPIB cables used in one bus system must not exceed 20 meters and must not be longer than the 2 m × the number of the connected devices.
  The GPIB controller itself is also counted as one device.
- The maximum number of devices that can be connected to one bus is 15.
- No restrictions are applied for cable connections. However, do not connect 4 or more GPIB connectors on the device.
  Putting 4 or more GPIB connectors on one device will exercise a force upon the mounting section of the connector that could damage the section.

(Example) The total cable length that can be used in a system made up of 5 devices is 10 meters or less (5 units × 2 m/device = 10 m).
Within the range in which the total cable length does not exceed the allowable length, the cable can be arranged freely.
However, when connecting 10 or more devices, cables shorter than 2 meters must be used for some devices because the total cable length must not exceed 20 meters.

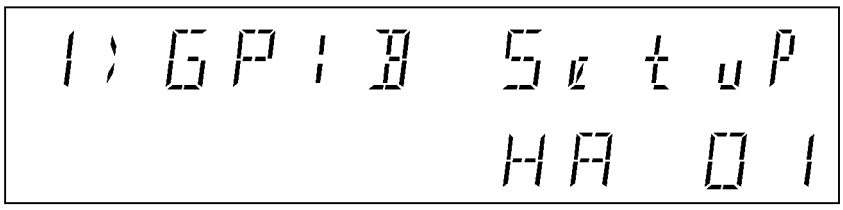
- Connection and removal of GPIB cables must be performed with the power turned OFF, and with the chassis commonly grounded for all the devices connected and to be connected.
- If an ATN request interruption occurs during transfer of messages between devices, the ATN will have priority.
  The previous conditions are cleared.
- When using the system in the talk-only mode, do not connect the controller.
- Retain the REN line at Low for 5 ms or longer following the transmission of program codes.

2. Setting GPIB Address

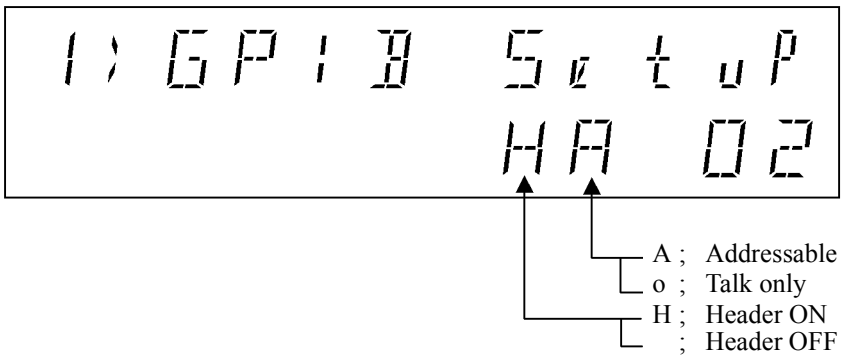
1. Press **MENU** and **4W/2W (←)** or **RCL (→)** to display the following screen.



2. Press **DOWN (↓)**.
   The setting screen is displayed as follows.



3. Press △, ▽, or **123...** (direct input mode) to set the address.
   The following shows a display example of changing address from 01 to 02.



4. Press **SEL** key to select the items in Addressable or Header and press △ or ▽ to set them

5. Press **MENU** to display the Home screen.

The GPIB address setting is completed.

6.2.3 GPIB Interface Functions

Code	Description
SH1	With the Source Handshake function.
AH1	With the Acceptor Handshake function.
T5	With the Basic Talker function, Serial Poll function, Talker Clear function specified by the listener, and Talk-Only Mode function.
L4	With the Basic Listener function and Listener Clear function specified by the talker.
SR1	With the Service Request function.
RL1	With the Remote function, Local function, Local -Lock Out function.
PP0	Without the Parallel Poll function.
DC1	With the Device Clear function. (TheSDC and DCL commands can be used.)
DT1	With Device Trigger function (The GET command can be used.)
C0	Without the Controller function.
E2	The three state bus driver can be used.

6.2.4 Response to Interface Messages

The response of the 6240A to the Interface message described in the following are defined by the IEEE standard 488-1978.

For how to send interface messages to the 6240A, refer to the instruction manual for the controller.

1. Interface Clear (IFC)

   This message is sent directly to the 6240A through the signal line.
   The 6240A stops the operations of the GPIB bus by this message.

2. Remote Enable (REN)

   This message is sent directly to the 6240A through the signal line. When the message is true, the 6240A is specified as a listener and is put in the remote status.
   This status continues until REN becomes false or the **LOCAL** key is pressed. When set in local status, the 6240A ignores all the received data.
   In the remote status, all the key inputs are ignored except for the **LOCAL** key.
   In the Local -Lock out status, all the key inputs are ignored.

3. Serial Poll Enable (SPE)

   When the 6240A receives the message from an external source, the 6240A enters the Serial Poll mode.
   In this mode, when the 6240A is specified as a talker, status bytes are transmitted instead of normal messages. The mode continues until the Serial Poll Disable (SPD) message or the IFC message is received.
   When the 6240A is sending the Service Request (SRQ) message to the controller, the response data's bit 6 (RQS bit) becomes 1 (TRUE).

   When the transmission is completed, the RQS bit becomes 0 (FALSE).
   The Service Request (SRQ) message is sent directly through the signal line.

4. Device Clear (DCL)

   When the 6240A receives DCL, the 6240A executes the following.:

   - Clears the input buffer and the output buffer.
   - Resets the parser section, execution control section, response data generation section
   - Cancels all the commands that impede the remote command to be executed next
   - Cancels the commands temporarily stopped because they are waiting for other parameters.

   The following items are not executed:

   - Modification of data set or stored in the 6240A
   - Interruption of, or influence upon, the operation that the 6240A is currently performing.
   - Modification of status bytes except for MAV (MAV becomes 0 as the result of clearing the output buffer).

5. Selected Device Clear (SDC)

   Performs the same operation as DCL. However, SDC can only be executed when the 6240A is a listener. In other cases, this message is ignored.

6. Go To Local (GTL)

   This message sets the 6240A to local status. When the local status is set, all the operation on the front panel are enabled.

7. Local Lock Out (LLO)

   This message sets the 6240A to local lock out status. In this status, when the 6240A is in the remote status, all the operation on the front panel are disabled.

   (In the normal remote status, pressing **LOCAL** key will enable operations on the front panel).

   To set the 6240A to the Local status at this time, use one of the following methods:.

   - Send the GTL message to the 6240A.
   - Make the REN message false. (At this time, the local lockout status is also released.)
   - Turn OFF and ON the power.

6.2.5 Message Exchanging Protocol

The 6240A receives program messages and issues response data from and to the controller and other devices through the GPIB bus.
Program messages include the commands and queries (“query” refers in particular to commands that ask for response data in return). The exchange of these data follows a specific procedure. This procedure is explained in the following.

1. GPIB buffer types

   The 6240A has the following two buffers.

   - Input buffer

     This is a buffer for temporarily storing data for command analysis.
     (It accommodates 255 bytes and input above this generates an error).

     The input buffer is cleared by either of the following methods.

     - Turn ON the power.
     - Executing DCL or SDC.

   - Output buffer

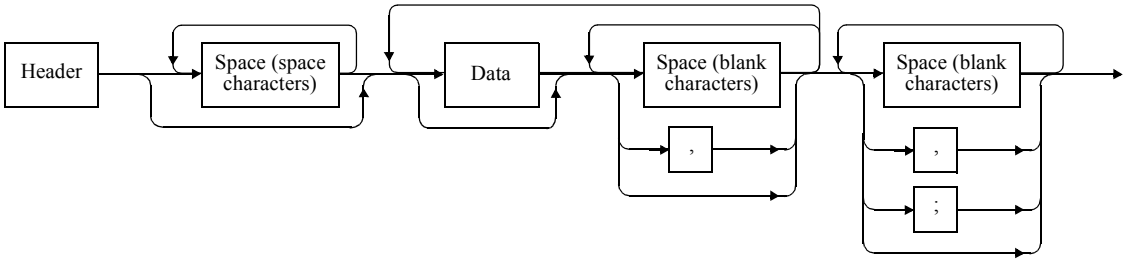
     Buffer for storing data until read from the controller (Accommodates 255 bytes).

     The output buffer is cleared by either of the following methods.

     - Turn ON the power.
     - Executing DCL or SDC

6.2.6 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 makes the command into a query command.

2. Space (blank characters)

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

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 6.2.7, “Data Format.”

4. Describing Multiple Commands

   The 6240A allows multiple commands to be described consecutively or separated by semicolon (;), comma (,), or space ( ) on one line.

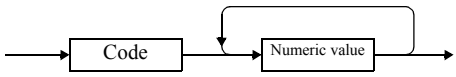
6.2.7 Data Format

The 6240A uses the following data types for input and output of data.

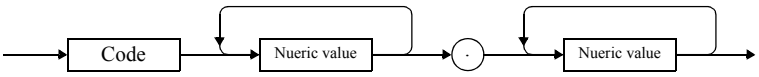
1. Numeric values

   Numeric value formats comprise the following three formats and any format can be used for input to the 6240A.
   Depending on the command, 6240A description is also attached for input.

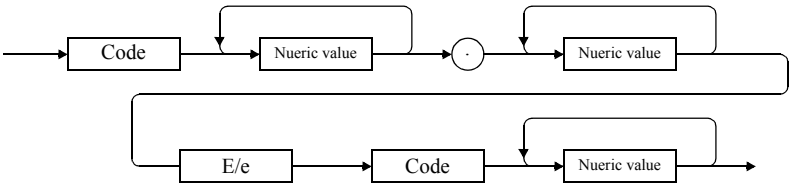
   - Integer type: NR1 format



   - Fixed-point type: NR2 format



   - Floating-point type: NR3 format Code



2. Unit

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

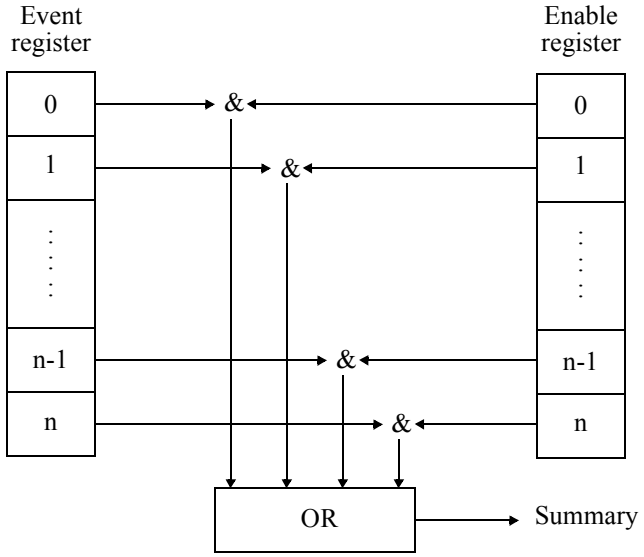
Unit	Exponent	Meaning
V	10^{0}	Voltage
MV	10^{-3}	Voltage
UV	10^{-6}	Voltage
A	10^{0}	Current
MA	10^{-3}	Current
UA	10^{-6}	Current

6.2.8 Status Register Structure

The 6240A has a hierarchical status register structure that conforms to the IEEE standard 488.2-1987 and can send various statuses of the 6240A to the controller.
Following explains an operational model of the status structure and assigning events.

1. Status Register

   The 6240A 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 keeps 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 Enable register quires the Event register by AND. and OR of the result is generated.
  The summary is written into the Status Byte Register.
  Data can be written into the Enable Register.

The 6240A 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 6240A status register structure.

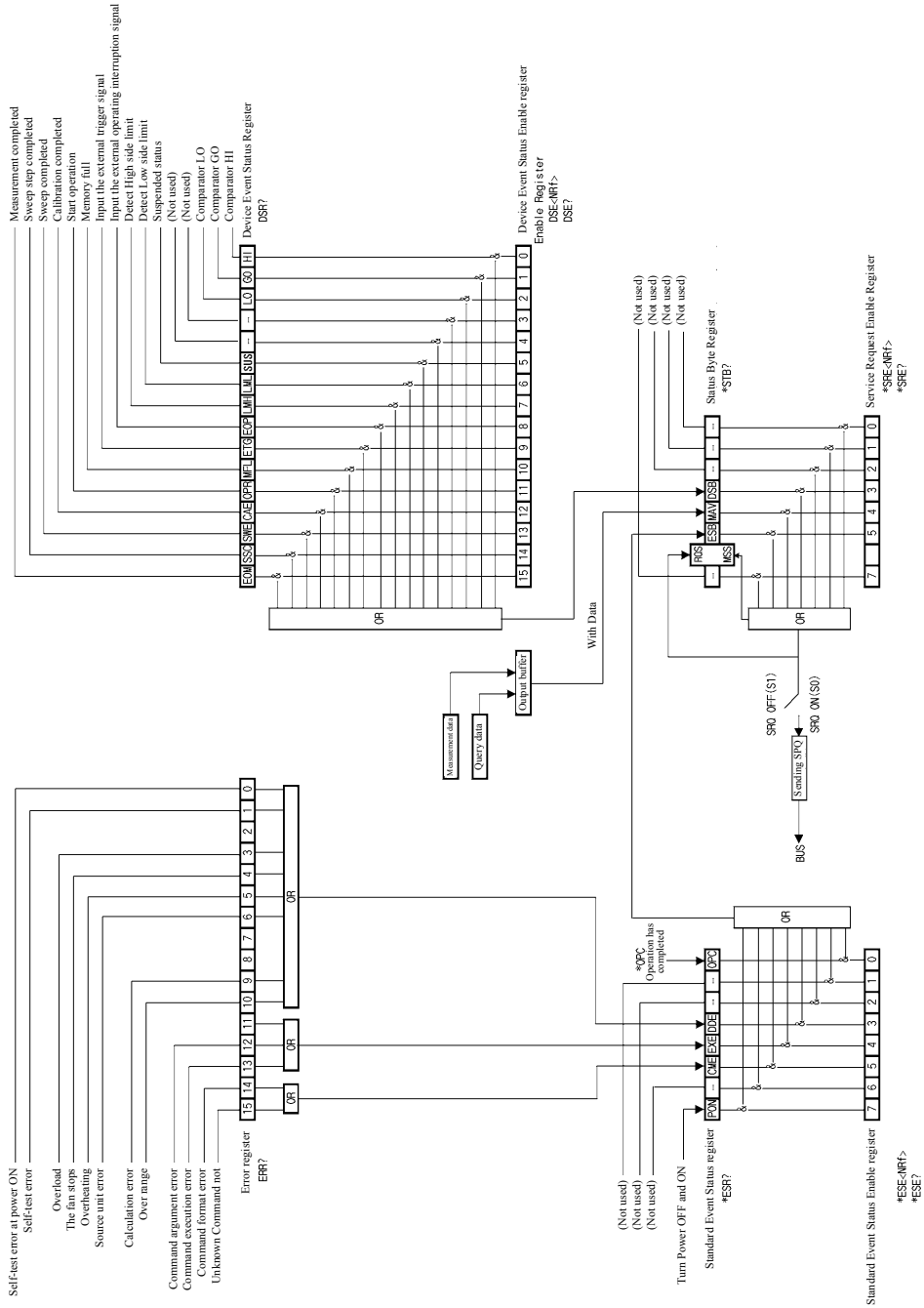


Figure 6-1 Structure of Status Register

2. Event Enable Register

   Each Event Register has an Enable Register that decides which bit 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: 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.
   PRINT @ 8; “DSE32768” (N88BASIC program example)
   OUTPUT 708; “DSE32768” (HP200, 300 series program example)

   (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.
   PRINT @ 8; “*SRE40” (N88BASIC program example)
   OUTPUT 708; “*SRE40” (HP200, 300 series program example)

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 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 Following.
   Figure 6-2 below shows the structure of the Status Byte Register.

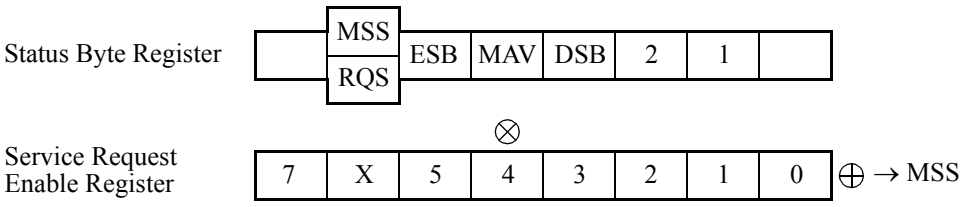


Figure 6-2 Structure of Status Byte Register

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 the bit 6 of the Status Byte Register.
- The Enable Register’s bit 6 is always enabled and cannot be unchanged.
- The Status Byte Register’s bit 6 (MSS) writes the RQS of the service request.

This register responses to the serial poll from the controller.
When responding to the serial poll, the Status Byte Register's bit 0 to 5, bit 7, and RQS, are read, after which RQS is set to 0.
Other bits are not cleared until their factor become 0.
The Status Byte Register, RQS, and MSS Can be cleared by executing "*CLS." Accompanying this, the SRQ line also becomes False.

Table 6-1 below shows the meaning of each bit of the Status Byte Register.

Table 6-1 Status Byte Register (STB)

bit	Name	Descriptions
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 that MAV is not cleared if data exists in the output buffer.
- When 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.

- When the power is turned ON.
- *When the *SRE0 command is executed.

4. Standard Event Status Register

Table 6-2 below shows the functions assigned to the Standard Event Status Register.

Table 6-2 Standard Event Status Register (ESR)

bit	Name	Descriptions
0	OPC Operation Complete	ON: When all operation is completed after receiving the *OPC command, bit o 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 executable currently. 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.

- When the power is turned ON.
- When the *ESE0 command is executed.

5. Device Event Status Register

Table 6-3 below shows the functions assigned to the Device Event Status Register.

Table 6-3 Device Event Status Register (DSR) (1 of 2)

bit	Name	Contents
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	Not used	Always set to 0
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 detecting an external operation off signal is detected.
9	ETG Ext.Trigger In	ON: 1 is set when detecting 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 operating 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 completed. OFF: 0 is set when calibration starts.
13	SWE Sweep End	ON: 1 is set when Sweep is completed. 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 completes(except for the high-speed burst operating status) OFF: 0 is set when Sweep step starts 0 is set when Sweep stops or starts

Table 6-3 Device Event Status Register (DSR) (2 of 2)

bit	Name	Contents
15	EOM End Of Measure	ON: 1 is set when the measurement is completed. 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

- When the power is turned ON.
- When the DSE0 command is executed.

6. Error Register

Table 6-4 below shows the functions assigned the Error register.

Table 6-4 Error Register (ERR)

bit	Contents
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.
2	Always set to 0.
3	ON: 1 is set when overload is detected. 0 is not set after overload is cleared.
4	ON: 1 is set when the program detects that the fan has stopped. 0 is not set after the status in which the fan has stopped is cleared.
5	ON: 1 is set when overheating is detected. 0 is not set after the overheating status is cleared.
6	ON: 1 is set when a source unit abnormality is detected.
7	Always set to 0
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.

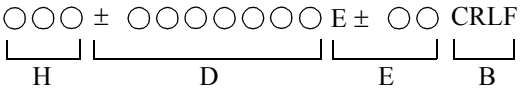
Common conditions on which the Error Register is cleared.

- 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?.

6.2.9 Data Output Format (Talker Format)

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



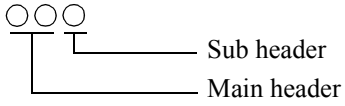
H: Header (Main header characters + Sub header of 1 character)

D: Fixed-point part (polarity + 6 digit decimal figures)

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

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: Not data in the specified measurement memory

- Sub header

High ↑ Priority ↓ Low

U: High limit
B: Low limit
O: Range over
Z: For resistance measurement, set the voltage-source value to 0 (zero)
F: For measuring the resistance, the current-source value is below 20 counts
or current-measurement value is below 200 counts
E: Operation error (scaling function or total function)
H: The comparison operation result is HI
G: The comparison operation result is GO
L: The comparison operation result is LO
C: Scaling operation data
N: NULL operation data
: Others (space output)

2. Fixed-point part and Exponent part

The exponent column in the list below shows the cases that Scaling operation are not performed.

Measurement function			Unit display			
			Decimal number and unit symbol form		Exponent form	
			Fixed-point part	Exponent part	Fixed-point part	Exponent part
DC voltage measurement	Measurement range	3 V	±d.ddddd	E+00	±d.ddddd	E+00
		15 V	±dd.dddd	E+00		E+01
DC current measurement		3 mA	±d.ddddd	E-03		E-03
		30 mA	±dd.dddd	E-03		E-02
		300 mA	±ddd.ddd	E-03		E-01
		1 A	±d.ddddd	E+00		E+00
		4 A	±d.ddddd	E+00		E+00
Resistance measurement	Available digits	1 digit	±0000.0d	E-06 to E+06	±00000d.	E-08 to E+06
			±00000.d			
			±00000d.			
		2 digits	±0000.dd		±0000d.d	E-07 to E+07
			±0000d.d			
			±0000dd.			
		3 digits	±000d.dd		±000d.dd	E-06 to E+08
			±000dd.d			
			±000ddd.			
		4 digits	±00d.ddd		±00d.ddd	
			±00dd.dd			
			±00ddd.d			
		5 digits	±0d.dddd		±0d.dddd	
			±0dd.ddd			
			±0ddd.dd			

Measurement function	Unit display			
	Decimal number and unit symbol form		Exponent form	
	Fixed-point part	Exponent part	Fixed-point part	Exponent part
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
± 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 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 is no data found when reading out measurement buffer memory data.

3. Block delimiter

Output the block delimiter to show the end of data.
There 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	

6.3 GPIB Command

6.3.1 GPIB 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 *6; the *RST command cannot initialize *6.
2. Note for description in the command list
   - The parameter in [ ] can be omitted.
   - The parameter in < > is one divided data.
   - △ in the Operation column indicates the following.

     During DC or pulse operation and suspension: Accepted only in HOLD or suspend status.

     During seep operation and suspension: Accepted only when sweep-stop or suspend status.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	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		●	Sus-pended when executed	×
		IF	Current source function				
		V?	Response: VF: V4 to V5 IF: I1 to I5			○	○
		I?					
	Source range	SVRX	Optimal range		●	○	×
		SVR4	3 V range				
		SVR5	15 V range				

6.3.1 GPIB Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Source	Source range	SVR?	Response: SVRX4 or SVRX5 (optimal range) SVR4 or SVR5 (fixed range)			○	○
		SIRX	Optimal range		●	○	×
		SIR1	3 mA range				
		SIR2	30 mA range				
		SIR3	300 mA range				
		SIR4	1 A range				
		SIR5	4 A range				
		SIR?	Response: SIRX1 to SIRX5 (optimal range) SIR1 to SIR5 (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			○	○
	Limiter value	LMV ±data1 [,±data2]	Sets voltage limiter value		±15V	○	×
		LMI ±data1 [,±data2]	Sets current limiter value		±1A		
			Both High and Low value can be set for the limiter value • When comparing the data1 and data 2, the larger value is High limiter value and the smaller one is Low limiter value. • Data 2 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 in the same polarity.*** ***2. Set the difference of High limiter value and Low limiter value as 60 digits or over.***				
		LMV?	Response: LMVR ± < hl> ± < ll > *1			○	○
		LMI?	LMIL ± < hl> ± < ll > *1				
			hl: < d. dddE ± d > (High limiter value) ll: < d. dddE ± d > (Low limiter value) *1				

*1: The response decimal point position is different depending on the set value.
For the source value, limiter value, and time parameter setting range, refer to the performance specifications.
*2: Outputs the value that is currently generated or the value that is generated at operation.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Source	Suspend voltage	SUV ± data	Sets suspend voltage Setting range: 0 to ±15 V		0	○	△
		SUV?	Response: SUV ± d.ddddE ± d *1			○	○
	Suspend Hiz/Loz	SUZ0	Hiz: High resistance output status		●	○	△
		SUZ1	Loz: Low resistance output status				
		SUZ?	Response: SUZ0 or SUZ1			○	○
	Pulse base value	DBV ± data	Voltage pulse base value		0	○	×
		DBI ± data	Current pulse base value		0		
		DBV?	Response: DBV ± d.ddddE ± d *1			○	○
		DBI?	DBI ± d.ddddE ± d				
	Trigger mode	M0	AUTO		●	○	△
		M1	HOLD				
		M?	Response: M0 or M1			○	○
	Operating or Standby	SBY	Output is set to OFF (Standby)	●	●	○	○
		OPR	Output is set to ON (Operate)			○	○
		SUS	Suspends the output (Suspend)			○	○
		SBY?, OPR?, SUS?	Response the present output status. Response: Status: SBY?, OPR?, SUS? Operating: OPR Suspended: SUS Standby: SBY			○	○
	Remote sensing	RS0	2W		●	○	△
		RS1	4W				
		RS?	Response: RS0 or RS1			○	○

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

6.3.1 GPIB Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Source	Time parameter	SP Th,Td,Tp[,Tw]	Th: Hold time Td: Measurement Delay Time Tp: Period Tw: Pulse width Unit: ms Tw can be omitted		3 ms 4 ms 50 ms 25 ms	○	△
		SP?	Response: SP<Th>,<Td>,<Tp>,<Tw> Th,Td,Tp,Tw:<d.dddd> *1			○	○
		SD Tds	Tds: Source delay time (unit: ms)		0.03 ms	○	△
		SD?	Response: SDd.dddd *1			○	○
Sweep	Linear Sweep	SN [± st, ± sp, step]	st: Start value sp: Stop value step: Step value (ignores the polarity) If omit all the settings, set sweep type only. However, it is not allowed to omit setting each value separately.		0.1 mV/ 0.1 µA 10 mV/ 10 µA 0.1 mV/ 0.1 µA	○	×
		SN?	Response: SN ± <st>, ± <sp>, <step> *1 st,sp,step: <d.ddddE ± d>			○	○
	Fixed level sweep	SF [± lvl,cnt]	lvl: Level source value cnt: Number of sampling times (1 to 5000) If omit all the settings, set sweep type only. However It is not allowed to omit each value separately.		0 V/0 A 1	○	×
		SF?	Response: SF ± <lvl>,<cnt> *1 lvl: <d.ddddE ± d> cnt: <dddd>			○	○
	Random sweep	SC [st,sp]	st: Start address (0 to 4999) sp: Stop address (0 to 4999) If omit all the settings, set Sweep type only. However it is not allowed to omit each value separately.		0 0	○	△*3
		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 or stop address that was set while it is in the Standby status.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Sweep	Sweep type	SX?	Responds the sweep type of 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			○	○
	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 4999) data1: Voltage or current source value of the adr address data2: Voltage or current source value of the adr+1 address ***Note:*** ***1. If the source range is not specified, optimum value is used.*** ***2. A source value different from the current-source function can not 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 in 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			○	○

*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: The value cannot be initialized by using the RINI or *RST command.

6.3.1 GPIB Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Sweep	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			○	○
	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			○	○
Mea-surement	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 the measurement function and the source function is same, the range becomes same as the source range)				
		R?	Response: R0 or R1			○	○

*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	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Mea-surement	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				
		IT?	Response: IT0 to IT7			○	○
	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 1/2 digits			○	△
		RE4	Displays 4 1/2 digits				
		RE5	Displays 5 1/2 digits		●		
		RE?	Response: RE3 to RE5			○	○
	Measurement buffer memory	ST0	Store OFF	●	●	○*7	△
		ST1	Normal ON				
		ST2	Burst ON			△	
		ST?	Response: ST0 to ST2			○	○
		RL	Initializes the stored data			△	△

*7: Operational only between ST0 and ST1

6.3.1 GPIB Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	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 4999) (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 no data exists 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>			○	○
		SZ?	Reads out the stored data Response: <dddd>	0	*6	○	○
Operation	NULL operation	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.ddddd E ± dd			○	○
	Comparison operation	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.ddddd E ± dd			○	○
		KLO?	KLO ± d.ddddd E ± dd				

*4: The setting range is 0 to ±999.999E + 24.
*6: It is not initialized by RINI or *RST command.

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Opera-tion	Scaling operation	SCL0	OFF		●	○	△
		SCL1	ON				
		SCL?	Response: SCL0 or SCL1			○	○
		KA a	a: A constant (0 (zero) is not available)		1	○	△
		KB b	b: B constant		0		
		KC c	c: C constant		1		
		KA?	Response: KA ± d.dddddE ± dd			○	○
		KB?	KB ± d.dddddE ± dd				
		KC?	KC ± d.dddddE ± dd				
	MAX/ MIN operation	MN0	OFF		●	○	△
		MN1	ON				
		MN?	Response: MN0 or MN1			○	○
		AVE?	Reads out the average value	0			
		MAX?	Reads out the maximum value	-9.99999 E+26			
		MIN?	Reads out the minimum value	+9.99999 E+26			
		TOT?	Reads out the integrated value	0			
		AVN?	Reads out the number of measurement times Response: AVN d.dddddE+dd	0			
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 the non-volatile memory area 0 as the setting parameter	●		×	×
		RCLP1	Loads the data in the non-volatile memory area 1 as the setting parameter				
		RCLP2	Loads the data in the non-volatile memory area 2 as the setting parameter				
		RCLP3	Loads the data in the non-volatile memory area 3 as the setting parameter				
		RINI	Loads the default value as the setting parameter				

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

6.3.1 GPIB Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
System	Initializing the instrument	*RST	Initializes the parameter (The default values are not mentioned *6 in this table)			○	○
		C	Clears the device			○	○
	Instrument information	*IDN?	Response: The instrument information query command ADC Corp., R6240A, XXXXXXXXX, YYYYY ADC Corp.: Manufacturer (9 characters) R6240A: Instrument name (6 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			○	○
	Comparison operation result buzzer	BZ0	OFF		●	○	△
		BZ1	ON (when the comparison operation result is HI)				
		BZ2	ON (when the comparison operation result is GO)				
		BZ3	ON (when the comparison operation result is LO)				
		BZ4	ON (when the comparison operation 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)			○	○

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
System	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			○	○
	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 (Comparison operation result is HI)				
		CP3	Outputs the COMPLETE signal Comp GO (Comparison operation result is GO)			○	△
		CP4	Outputs the COMPLETE signal Comp LO (Comparison operation result is LO)				
		CP5	Outputs the COMPLETE signal Comp HI or LO (Comparison operation result is HI or LO)				
		CP6	Outputs the Sync Out signal				
		CP?	Response: CP0 to CP6			○	○
		CW0	Specifies the width of the synchronous control signal output width: 10 μs			○	△
		CW1	Specifies the width of the synchronous control signal output width: 100 μs		●		
		CW?	Response: CW0 or CW1			○	○
GPIB	Block delimiter	DL0	CRLF<EOI>	●	*5	○	△
		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: The value cannot be initialized by using the RINI command.
*6: It is not initialized by RINI or ÅñRST command.

6.3.1 GPIB Command List

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	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 completed			○	○

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

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation and suspension	During sweep operation and suspension
Calibration	Calibration switch	CAL0	OFF (Exits the calibration mode)	●		×	×
		CAL1	ON (Enters the calibration mode)				
		CAL?	Response: CAL0 or CAL1			○	○
	Calibration data	XINI	Initializes the calibration data area (Calibration data in non-volatile memory is not initialized)			×	×
		XWR	Saves the calibration data in the non-volatile memory			×	×
	Executing calibration	XVS	Selects voltage source function calibration			×	×
		XIS	Selects current source function calibration				
		XVLH	Selects voltage limiter (High) calibration				
		XVLL	Selects voltage limiter (Low) calibration				
		XILH	Selects current limiter (High) calibration				
		XILL	Selects current limiter (Low) calibration				
		XVM	Selects voltage measurement function calibration				
		XIM	Selects current measurement function calibration				
	Calibration range	XR1 XR2 XR3 XR4 XR5	Sets the calibration range XR1: - / 3 mA XR2: - / 30 mA XR3: - / 300 mA XR4: 3 V / 1 A XR5: 15 V / 4 A			×	×
	Calibration data	XDAT	Changes to the DMM data input mode			×	×
		XD	Data: Inputs DMM read data				
		XADJ	Changes to the calibration data fine adjustment mode			×	×
		XUP	Fine adjusts the calibration data (UP)				
		XDN	Fine adjusts the calibration data (DOWN)				
		XNXT	Moves on to the next calibration			×	×

6.3.1 GPIB Command List

Commands for maintaining compatibility with previous models

Item		Command	Description	Default		Operation	
				Power ON	Factory shipment	During DC/pulse operation	During sweep operation
Source	Source function and source range	V4	Voltage source function of 3 V range			Suspended when executed	
		V5	Voltage source function of 15 V 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 1 A range				
		I5	Current source function of 4 A range				
		V?	Response: V 4, V 5 or I1 to I5			○	○
		I?					
	Source value (pulse value) and limiter value	D ± data UNIT	Source setting is different depending of the units used. With UNIT: Automatically sets the optimal range. Available units: V, mA, and A Without UNIT: Set the current source function and range. If specifying the 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.***			○	○

<table>
<tr><th colspan="2" rowspan="2">Item</th><th rowspan="2">Command</th><th rowspan="2">Description</th><th colspan="2">Default</th><th colspan="2">Operation</th></tr>
<tr><th>Power ON</th><th>Factory shipment</th><th>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 4999)
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 goes the FIT range.
2. The source different from the current-source function can not be set.</td><td></td><td>0
*6</td><td>○</td><td>×</td></tr>
</table>

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

6.3.2 TER? Command

The TER? command reads out the self test result.

1. Command response

   ddddd,ddddd,ddddd,ddddd
   a b c d

2. Meaning of the value a, b, c, and d

   The TER register column in Table 5-18 shows the error causes and resister values of a, b, c, and d. If a VSVM15 V + FS error occurs during the self test, the following command is responded.

   00000,00000,00016,00000

6.4 Programming Example

A basic program example to operate the 6240A from a computer via GPIB connection is introduced below.

Computer:	FMV-5350ML3 (FUJITSU), Windows98
GPIB software:	PCI-GPIB (NATIONAL INSTRUMENTS)
Module:	Niglobal.bas, Vbib-32.bas (the software included with NI-488.2)
Language:	Visual Basic 6

Visual Basic program examples to perform same operation as described in Section 2.2, “Basic Operation”.

- Program example 1: Example of DC measurement introduced in Section 2.2.5
- Program example 2: Example of Pulse measurement introduced in Section 2.2.6
- Program example 3: Example of Sweep measurement introduced in Section 2.2.7
- Program example 4: Example of reading out measurement data from the measurement buffer memory as fast as possible

6.4.1 Programming Example 1: DC Measurement

```
Option Explicit                              ' Explicit declaration for all variables

Private Sub Start_Click()                    ' Event procedure of the command button (Start)
  Dim board As Integer                       ' GPIB board address
  Dim pad As Integer                         ' 6240A address
  Dim vig As Integer                         ' 6240A device descriptor

  board=0                                    ' GPIB board address 0
  pad=1                                      ' 6240A address 1

  Call ibdev(board,pad,0,T10s,1,0,vig)       ' Opening the 6240A and initializing it (time out 10 s)
  Call ibconfig(vig,IbcUnAddr,1)             ' Setting the address for every transmitting and receiving

  Call SUBsend(vig,"C,*RST")                 ' Initializing DCL and parameter
  Call SUBsend(vig,"M1")                     ' Trigger mode hold
  Call SUBsend(vig,"VF")                     ' Voltage source function
  Call SUBsend(vig,"F2")                     ' Current measurement function

  Call SUBsend(vig,"SOV1,LMI0.003")          ' DC source value 1 V, limiter value 3 mA
  Call SUBsend(vig,"OPR")                    ' Setting output to ON
  Call SUBmeas(vig)                          ' Reading measurement trigger and data

  Call SUBsend(vig,"SOV2")                   ' DC source value 2 V
  Call SUBmeas(vig)                          ' Reading measurement trigger and data

  Call SUBsend(vig,"SOV-2")                  ' DC source value -2 V
  Call SUBmeas(vig)                          ' Measurement trigger & data recall

  Call SUBsend(vig,"SOV4")                   ' DC source value 4 V
  Call SUBmeas(vig)                          ' Measurement trigger & data recall

  Call SUBsend(vig,"F1")                     ' Voltage measurement function
```

```
  Call SUBsend(vig,"IF")                  ' Current source function
  Call SUBsend(vig,"SOI0.002,LMV3"        ' DC source value 2 mA, limiter value 3 V
  Call SUBsend(vig,"OPR")                 ' Setting output to ON
  Call SUBmeas(vig)                       ' Measurement trigger & data recall

  Call SUBsend(vig,"SBY")                 ' Setting output to OFF

  Call ibonl(vig,0)                       ' Setting the 6240A to offline
End Sub                                   ' Event procedure completed

                                          ' Subroutine
Private Sub SUBmeas(vig As Integer)       ' Measurement data recall by measurement trigger
  Dim dt As String*17                     ' Data reception buffer

  Call ibwrt(vig,"*TRG" & Chr(10))        ' Measurement trigger actuated
  Call ibrd(vig,dt)                       ' Measurement data recall

  Text1.SelStart=Len(Text1.Text)          ' Specifying display position for text box (Text 1)
  Text1.SelText=dt                        ' Displaying measurement data in text box (Text 1)
End Sub

                                          ' Subroutine
Private Sub SUBsend(vig As Integer,cmd As String)
                                          ' Send command character string

  Call ibwrt(vig,cmd & Chr(10))           ' Sending command character string + terminator LF (Char (10))

End Sub
```

(Output example)

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

6.4.2 Programming Example 2: Pulse Measurement

```
Option Explicit                              ' Exlicit declaration for all the variables

Private Sub Start_Click()                    ' Event procedure for the command button (Start)
  Dim board As Integer                       ' GPIB board address
  Dim pad As Integer                         ' 6240A address
  Dim vig As Integer                         ' 6240A device descriptor

  board=0                                    ' GPIB board address 0
  pad=1                                      ' 6240A address 1

  Call ibdev(board,pad,0,T10s,1,0,vig)       ' Opening and initializing device (6240A) (time out 10 s)
  Call ibconfig(vig,IbcUnAddr,1)             ' Address setting performed for each transmission or reception

  Call SUBsend(vig,"C,*RST")                 ' DCL and parameter Initialization
  Call SUBsend(vig,"M1")                     ' Trigger mode hold
  Call SUBsend(vig,"VF")                     ' Voltage source function
  Call SUBsend(vig,"F2")                     ' Current measurement function
  Call SUBsend(vig,"MD1")                    ' Pulse source mode

  Call SUBsend(vig,"SOV2,LMI0.003")          ' Pulse source value 2 V, limiter value 3 mA
  Call SUBsend(vig,"DBV1")                   ' Pulse base value 1 V
  Call SUBsend(vig,"SP3,1,130,50")           ' Hold time 3 ms, measurement delay time 1 ms
                                             ' Period 130 ms, pulse time 50 ms
  Call SUBsend(vig,"OPR")                    ' Output ON
  Call SUBmeas(vig)                          ' Measurement trigger & data recall

  Call SUBsend(vig,"SOV2.5")                 ' Pulse source value 2.5 V
  Call SUBmeas(vig)                          ' Measurement trigger & data recall

  Call SUBsend(vig,"SP3,60,130,50")          ' Hold time 3 ms, measurement delay time 60 ms
                                             ' Period 130 ms, pulse time 50 ms
  Call SUBmeas(vig)                          ' Measurement trigger & data recall

  Call SUBsend(vig, "DBV0.5")                ' Pulse base value 0.5 V
  Call SUBmeas(vig)                          ' Measurement trigger & data recall

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

  Call ibonl(vig,0)                          ' Setting the 6240A to offline
End Sub                                      ' Event procedure completed

                                             ' Subroutine
Private Sub SUBmeas(vig As Integer)          ' Measurement data recall by measurement trigger
  Dim dt As String*17                        ' Data reception buffer

  Call ibwrt(vig, "*TRG"&Chr$(10))           ' Measurement trigger actuated
  Call ibrd(vig,dt)                          ' Measurement data recall

  Text1.SelStart=Len(Text1.Text)+1           ' Specifying display position for Text Box (Text1)
  Text1.SelText=dt&vbCrLf                    ' Displaying measurement data in Text box (Text1)
End Sub                                      ' Event procedure completed
```

```
                                        ' Subroutine
Private Sub SUBmeas(vig As Integer)     ' Measurement data recall by measurement trigger
  Dim dt String*17                      ' Data reception buffer

  Call ibwrt(vig,"*TRG" & Chr(10))      ' Measurement trigger actuated
  Call ibwrt(vig,dt)                    ' Measurement data recall

  Text1.SelStart=Len(Text1.Text)        ' Specifying display position for Text Box (Text1)
  Text1.SelText=dt                      ' Displaying the measurement data in Text box (Text 1)
End Sub


                                        ' Subroutine
Private Sub SUBsend(vig As Integer,cmd As String)
                                        ' Sending command character string

  Call ibwrt(vig,cmd & Chr(10))         ' Sending command character string + terminator LF (Char (10))

End Sub
```

(Output example)

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

6.4.3 Programming Example 3: Sweep Measurement

```
Option Explicit                              ' Explicit declaration for all variables

Private Sub Start_Click()                    ' Event procedure for the command button (Start)
  Dim board As Integer                       ' GPIB board address
  Dim pad As Integer                         ' 6240A address
  Dim vig As Integer                         ' 6240A device descriptor
  Dim dt As String*17                        ' Data reception buffer
  Dim s As Integer                           ' Serial poll results storage variable

  board = 0                                  ' GPIB board address 0
  pad = 1                                    ' 6240A address 1

  Call ibdev(board,pad,0,T10s,1,0,vig)       ' Opening and initializing device (6240A) (time out 10 s)
  Call ibconfig(vig,IbcUnAddr,1)             ' Address setting performed for each transmission or reception


  Call SUBsend(vig,"C,*RST")                 ' DCL and parameter Initialization
  Call SUBsend(vig,"*CLS")                   ' Initializing status byte
  Call SUBsend(vig,"*SRE8")                  ' Setting bit3 for the Service Request Enable Register to 1
  Call SUBsend(vig,"DSE8192")                ' Setting bit 13 for the Device Event Enable register to 1
  Call SUBsend(vig,"S0")                     ' SRQ transmission mode
                                             ' Register setting for transmitting SRQ following completion of Sweep
  Call SUBsend(vig,"VF")                     ' Voltage source function
  Call SUBsend(vig,"F2")                     ' Current measurement function
  Call SUBsend(vig,"MD2")                    ' Sweep source mode

  Call SUBsend(vig,"SN1,10,1")               ' Linear Sweep: Start 1 V, stop 10 V, and step 1 V
  Call SUBsend(vig,"BS0")                    ' Sweep bias value 0 V
  Call SUBsend(vig,"SP3,4,100")              ' Hold time 3 ms, Measurement delay time 4 ms
                                             ' Period 100 ms
  Call SUBsend(vig,"LMI0.03")                ' Limiter value 30 mA

  Call SUBsend(vig,"ST1,RL")                 ' Memory Store ON, clearing memory

  Call SUBsend(vig,"OPR")                    ' Output ON
  Call SUBsend(vig,"*TRG")                   ' Sweep starts

                                             ' Waiting for sweep measurement completion
  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")
                                             ' Error indication
  Else                                       ' If no timeout
    Call ibrsp(vig,s)                        ' Executing serial poll
  End If                                     ' Ending If

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

                                             ' Measurement buffer memory data recall
  Call SUBsend(vig,"RN1,0")                  ' Setting to measurement buffer memory recall mode and
                                             ' Specifying recall address from 0
  Do                                         ' Infinite loop


    Call SUBread(vig,dt)                     ' Measurement buffer memory data recall
```

```
                                        ' Outputting memory data by data recall after memory recall mode
                                        ' setting, adding recall number by 1
    If 1=InStr(1,dt,"EE+8.88888E+30") Then
                                        ' If recalled data is empty,
      Exit Do                           ' exiting infinite loop
    End If                              ' Ending If
  Loop                                  ' Ending Do
  Call SUBsend(vig,"RN0,0")             ' Releasing measurement buffer memory recall mode

  Call ibonl(vig,0)                     ' Setting the 6240A to offline
End Sub                                 ' Event procedure completed

                                        ' Subroutine
Private Sub SUBread(vig As Integer,dt As String)
                                        ' Recalling talker data

  Call ibrd(vig,dt)                     ' Recalling talker data

  Text1.SelStart=Len(Text1.Text)        ' Specifying display position for Text Box (Text1)
  Text1.SelText=dt                      ' Displaying measurement data in text box (Text 1)
End Sub

                                        ' Subroutine
Private Sub SUBsend(vig As Integer,cmd As String)
                                        ' Sending command character string

  Call ibwrt(vig,cmd & Chr(10))         ' Sending command character string + terminator LF (Char (10))

End Sub
```

(Output example)

```
  DI +01.0000E-03
  DI +02.0000E-03
  DI +03.0000E-03
  DI +04.0000E-03
  DI +05.0000E-03
  DI +06.0000E-03
  DI +07.0000E-03
  DI +08.0000E-03
  DI +09.0000E-03
  DI +10.0000E-03
  EE +8.88888E+30
```

6.4.4 Programming Example 4: Using Measurement Buffer Memory

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

```
Option Explicit                              ' Explicit declaration for all variables

Private Sub Start_Click()                    ' Event procedure for the command button (Start)
  Dim board As Integer                       ' GPIB port address
  Dim pad As Integer                         ' 6240A address
  Dim vig As Integer                         ' 6240A device descriptor
  Dim dt As String*17                        ' Data reception buffer
  Dim dt_sz As Integer                       ' Number of measurement buffer memory data
  Dim dt_rn(100) As String*16                ' Measurement buffer memory data storage string variable
  Dim i As Integer,s As Integer              ' i: Loop variable, s: Serial poll result storage variable

  board = 0                                  ' GPIB port address 0
  pad = 1                                    ' 6240A address 1

  Call ibdev(board,pad,0,T30s,1,0,vig)       ' Opening and initializing the 6240A (timeout 30 s)
  Call ibconfig(vig,IbcUnAddr,1)             ' Address setting performed for each transmission or reception

                                             ' Executing Sweep measurement
  Call SUBsend(vig,"C,*RST")                 ' DCL and parameter Initialization
  Call SUBsend(vig,"*CLS")                   ' Status byte initialization
  Call SUBsend(vig,"*SRE8")                  ' Setting bit 3 for the Service Request Enable Register to 1
  Call SUBsend(vig,"DSE8192")                ' Setting bit 13 for the Device Event Enable Register to 1
  Call SUBsend(vig,"S0")                     ' SRQ transmission mode
                                             ' Register setting for transmitting SRQ following completion of Sweep
  Call SUBsend(vig,"VF")                     ' Voltage source function
  Call SUBsend(vig,"F2")                     ' Current source function
  Call SUBsend(vig,"MD2")                    ' Sweep source mode

  Call SUBsend(vig,"SN0.1,10,0.1")           ' Linear Sweep: Start 0.1 V, stop 10 V, and step 0.1 V
  Call SUBsend(vig,"SB0")                    ' Sweep bias value 0 V
  Call SUBsend(vig,"SP3,4,100")              ' Hold time 3 ms, Measurement delay time 4 ms
                                             ' Period:  100 ms
  Call SUBsend(vig,"LMI0.03")                ' Limiter value:  30 mA

  Call SUBsend(vig,"ST1,RL")                 ' Memory store ON, clearing memory

  Call SUBsend(vig,"OPR")                    ' Output ON
  Call SUBsend(vig,"*TRG")                   ' 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")                    ' Output OFF
```

```
                                        ' Measurement buffer memory data recall
                                        ' No output data header, block delimiter EOI
  Call SUBsend(vig,"SZ?")               ' Measurement buffer memory data number query
  Call SUBread(vig, dt)                 ' Measurement buffer memory data number recall
  dt_sz = Val(dt)
                                        ' Converting recalled data to numerical variable
  Call SUBsend(vig, "OH0")              ' Setting output data number header to OFF
  Call SUBsend(vig, "DL2")              ' Setting -output data block delimiter to EOI
  Call SUBsend(vig, "RN1,0")            ' Setting to measurement buffer memory output mode
                                        ' Specifying output number from 0
  For i=1 To dt_sz                      ' Repeating for number of memory
    Call SUBread(vig, dt)               ' Measurement buffer memory data recall
                                        ' Outputting memory data by 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 SUBsend(vig, "RN0,0")            ' Releasing measurement buffer memory output mode

                                        ' Displaying the measurement data
  For i=1 To dt_sz                      ' Memory data repeats itself several times
    dt=Str(i)&":"&dt_rn(i)              ' Form character strings
    Text1.SelStart=Len(Text1.Text)      ' Specifying display position for text Box (Text1)
    Text1.SelText=dt                    ' Displaying measurement data in text box (Text1)
  Next i                                ' Ending For

  Call ibonl(vig, 0)                    ' Setting the 6240A to offline
End Sub                                 ' Event procedure completed

                                        ' Subroutine
Private Sub SUBread(vig As Integer,dt As String)
                                        ' Recalling talker data

  Call ibrd(vig, dt)                    ' Recalling talker data

End Sub

                                        ' Subroutine
Private Sub SUBsend(vig As Integer, cmd As String)
                                        ' Sending command character string

  Call ibwrt(vig, cmd & Chr(10))        ' Sending command character string + terminator LF (Char (10))

End Sub
```

(Output example)

```
  1:+00.1000E-03
  2:+00.2000E-03
  3:+00.3000E-03
  | (Omitted)
  98:+09.8000E-03
  99:+09.9000E-03
  100:+10.0000E-03
```

7. PERFORMANCE TEST

This chapter describes the methods for checking whether the 6240A can operate in the specified accuracy.

7.1 Measuring Instruments Required for Performance Tests

The test measuring instruments required for the performance tests are as the same as those shown in Section 8.1, “Cables and Measuring Instruments Required for Calibration” and the standard register for the 4 A source and measurement test.

Use a standard register of rated current 4 A or over, the resistance value 100 mΩ, and the accuracy 150 ppm.

7.2 Connection

The connections required for the performance test are the same shown in Figure Figure 8-4, “Calibration Procedure (2).”

7.3 Test Methods

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

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

Self-test, display, key, and buzzer tests

1. Press **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 contents of the error.***

Voltage source measurement test

1. Connect the 6240A 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 6240A to the 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 3 V range to 15 V range, verify that the difference between the source set value and the DMM measured value and difference between the 6240A 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 6240A 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 mA and 1 A)

1. Connect the 6240A 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 6240A 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 3 mA range to 1 A range, verify that the difference between the source set value and the DMM measurement value and the difference between the 6240A 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 6240A as outlined in Chapter 8, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.***

4 A source measurement test (4 A range)

1. Connect the 6240A to DMM and to the standard register for the 4 A source and measurement test as shown in Figure 8-2.
2. Set DMM to DCV, 1000 mV range, and Integration time at 10 ms.
   Also, select the measurement mode with the external trigger.
3. Select current source current measurement, Pulse mode, and set the 6240A Integration time at 10 ms.
4. Set Pulse width (Tw): 20 ms, Period time (Tp): 310 ms, and the measurement delay (Td): 9 ms.
5. Set the Cmpl and Sync of EXTERNAL SIGNAL to MeasFront.
6. Set the pulse value to ±4 A and base value to 0 A and select Operate.
7. Verify that the difference between the source set value and the current value calculated from the DMM measured value and standard resistance 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 6240A 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 6240A to ensure that the 6240A is used within the specified accuracy ranges.
In order to use the 6240A 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 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		
3 V	0 V	5 µV	± 3 V	10 ppm	6581*1	A01044 (Supplied accessories)*2
15 V		50 µV	± 30 V	20 ppm		
3 mA	0 A	5 nA	± 3 mA	120 ppm		
30 mA		50 nA	± 30 mA	120 ppm		
300 mA		500 nA	± 300 mA	210 ppm		
1 A		5 µA	± 1 A	170 ppm		
4 A		5 µA	± 1 A	170 ppm		

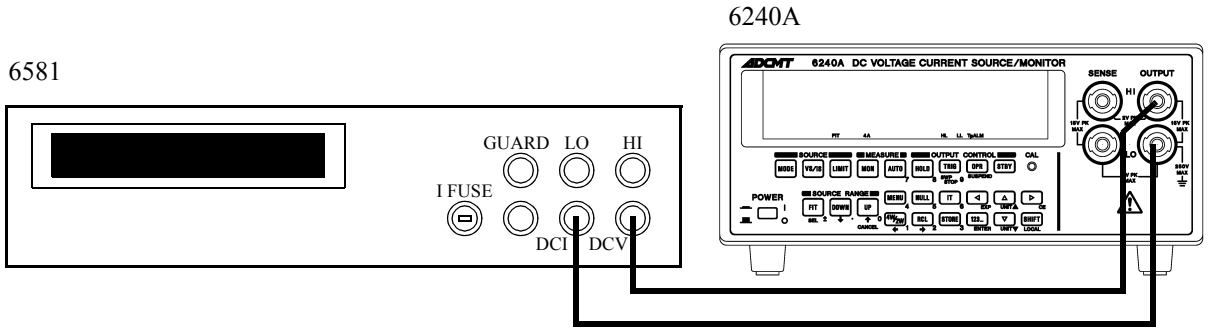
*1: Use the 6581 under the following conditions:
Integration time: 10 PLC. Auto ZERO: ON. Within 24 hours following INT CAL.
*2: When much externally induced noise exists, use shielded cables, such as A01001, etc.

8.2 Safety Precautions

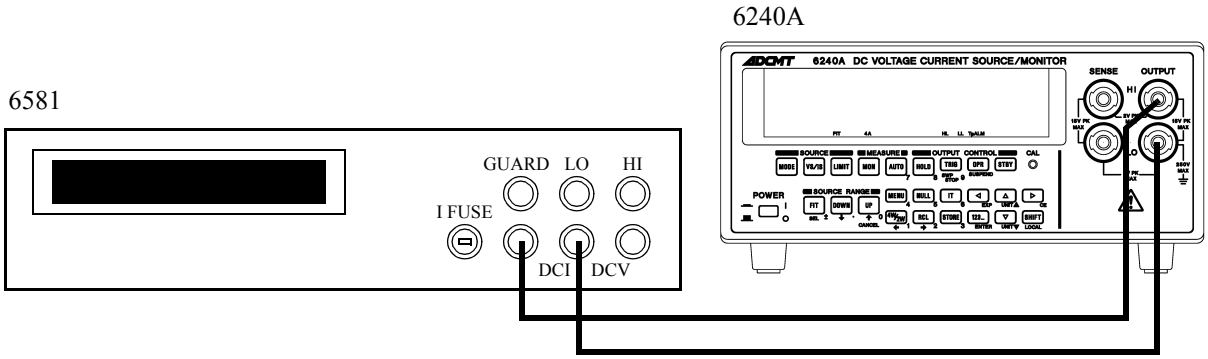
1. Use an AC power supply with the specified voltage.
2. Calibrate the 6240A under the following conditions in a location free of dust, vibrations, or line noise, etc.
3. Temperature: 23°C ± 3°C
   Relative humidity: 70% or lower
4. Allow the 6240A 2 hours or longer for warming-up to be calibrated.
   Allow the measuring instruments to be used for the calibration the period of time specified for warming-up before the calibration.
   Warming up time for 6581 requires more than 4 hours.
5. After the calibration, note down the dates of the calibration and the next scheduled calibration on a card or sticker, etc for convenience.
6. Calibration can not be operated by key operations.
   Use the GPIB remote command to calibrate the measuring instruments with the computer.

8.3 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 Calibration

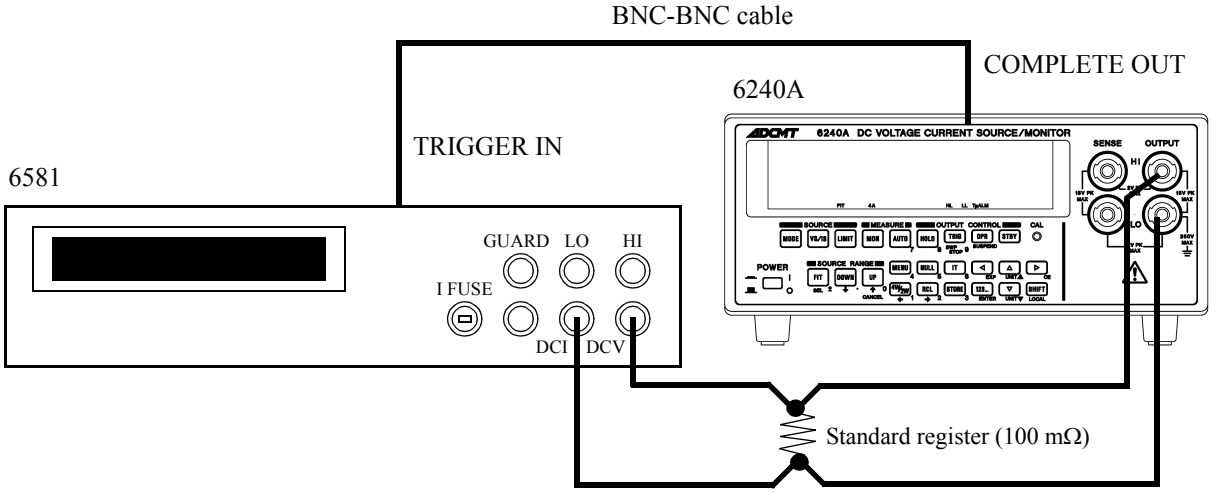


Figure 8-2 Connections for Confirmation of 4 A Current Source Measurement

8.4 Calibration Points and Tolerance Range

For calibration, using the measurement instruments satisfying the required accuracy described in Section 8.1, “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	3 V	0 V	+3.0000 V	100 μV
	15 V		+15.000 V	1 mV
Current-source	3 mA	0 A	+3.0000 mA	100 nA
	30 mA		+30.000 mA	1 μA
	300 mA		+300.00 mA	10 μA
	1 A		+1.0000 A	100 μA
	4 A		+1.0000 A	200 μA
Voltage-measurement	3 V	0 V	+3.00000 V	20 μV
	15 V		+15.0000 V	200 μV
Current-measurement	3 mA	0 A	+3.00000 mA	50 nA
	30 mA		+30.0000 mA	500 nA
	300 mA		+300.000 mA	5 μA
	1 A		+1.00000 A	50 μA
	4 A		+1.00000 A	50 μA
Voltage HI limiter:	3 V	0 V	+3.000 V	500 μV
	15 V		+15.00 V	5 mV
Voltage LO limiter:	3 V	0 V	-3.000 V	500 μV
	15 V		-15.00 V	5 mV
Current HI limiter	3 mA	0 A	+3.000 mA	700 nA
	30 mA		+30.00 mA	7 μA
	300 mA		+300.0 mA	70 μA
	1 A		+1.000 A	500 μA
	4 A		+1.000 A	500 μA
Current LO limiter	3 mA	0 A	-3.000 mA	700 nA
	30 mA		-30.00 mA	7 μA
	300 mA		-300.0 mA	70 μA
	1 A		-1.000 A	500 μA
	4 A		-1.000 A	1 mA

8.5 Calibrating Operation

Use GPIB remote command to calibrate the 6240A.
Figure 8-3 to Figure 8-6 show the calibration procedure.
For more information on GPIB commands, refer to the calibration Section 6.3.1, “GPIB Command List.”

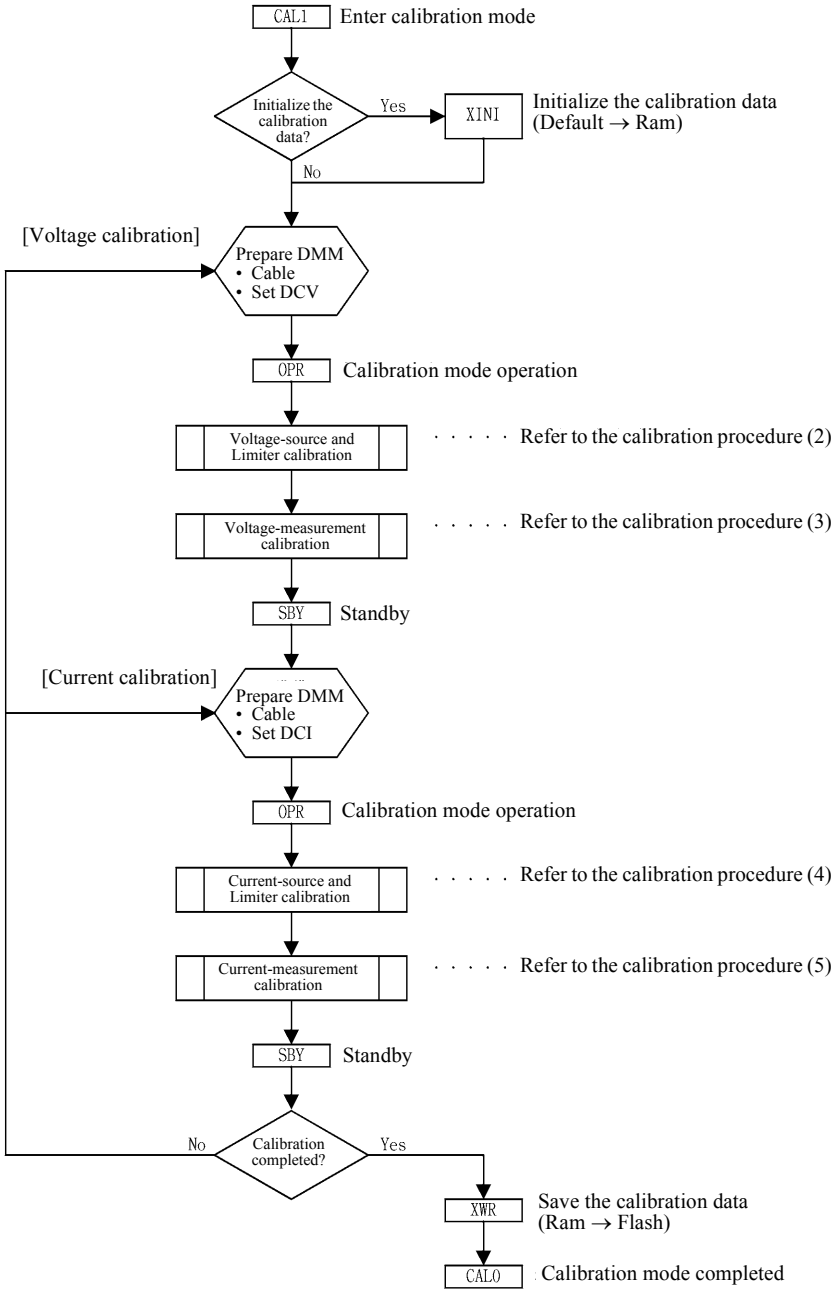


Figure 8-3 Calibration Procedure (1)

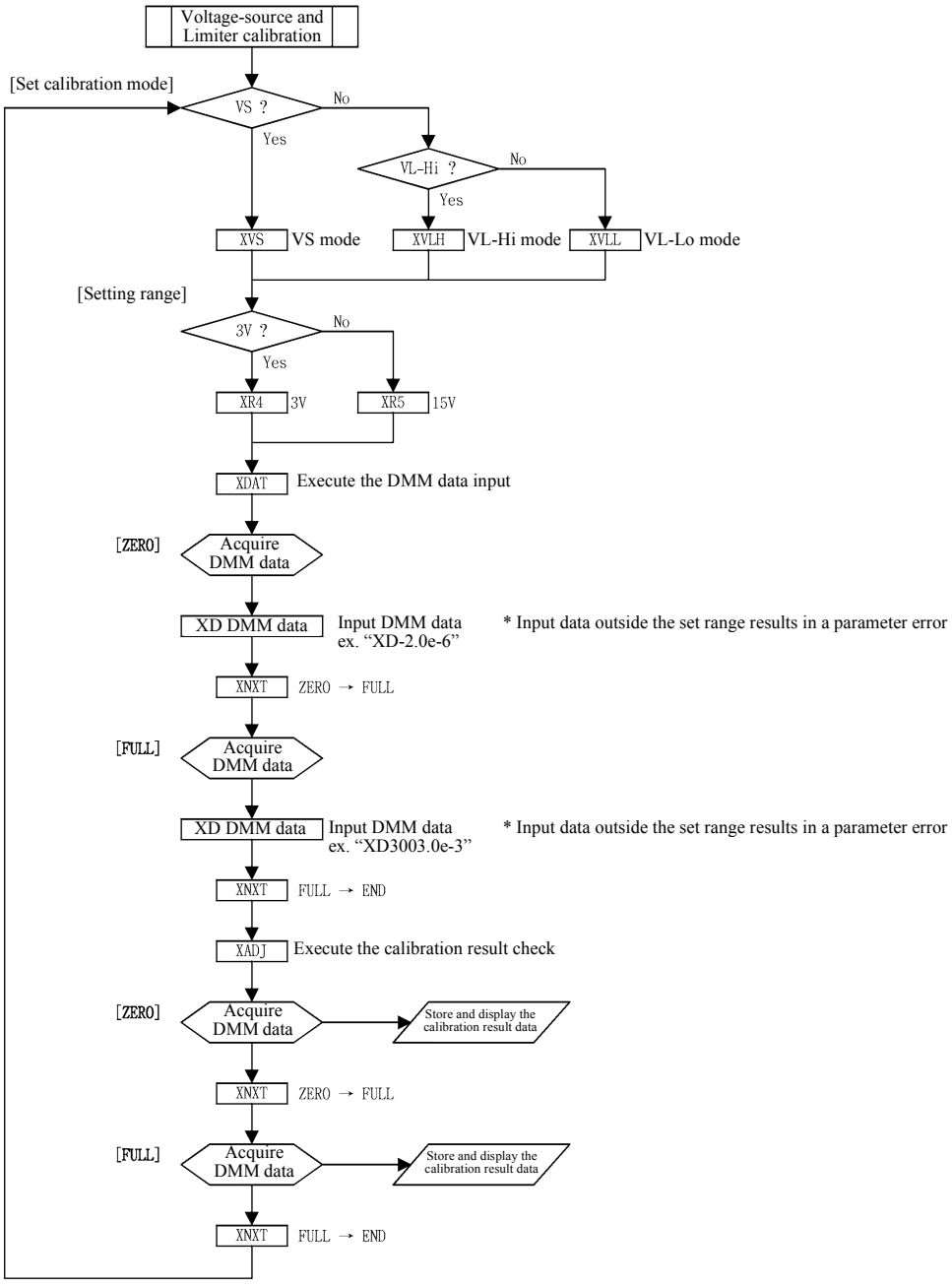


Figure 8-4 Calibration Procedure (2)

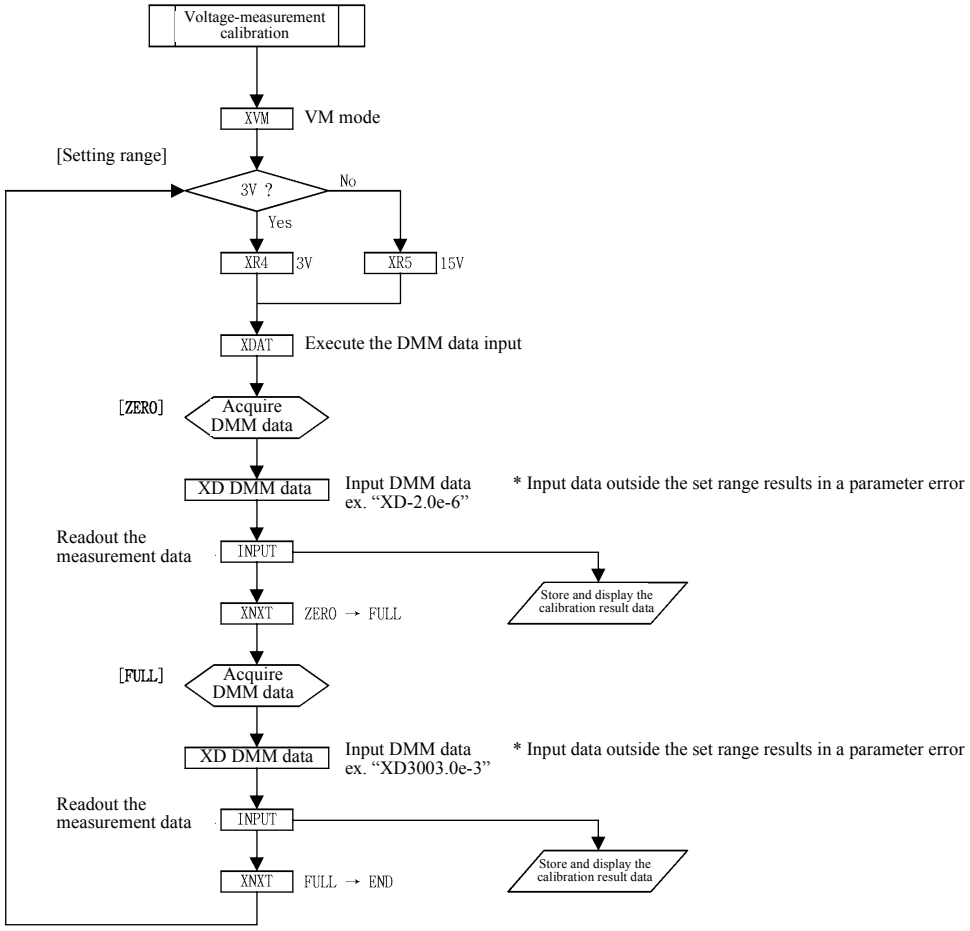


Figure 8-5 Calibration Procedure (3)

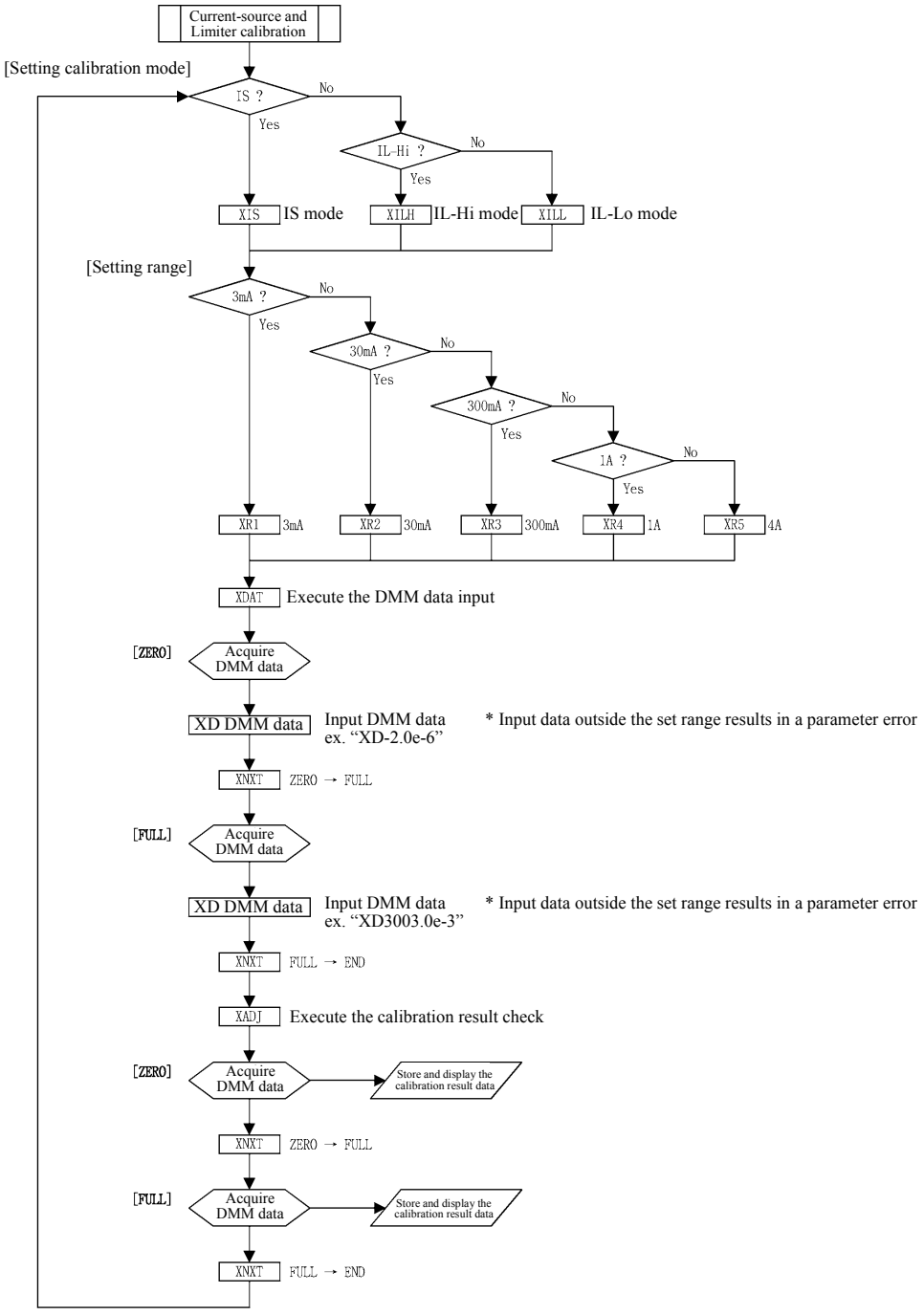


Figure 8-6 Calibration Procedure (4)

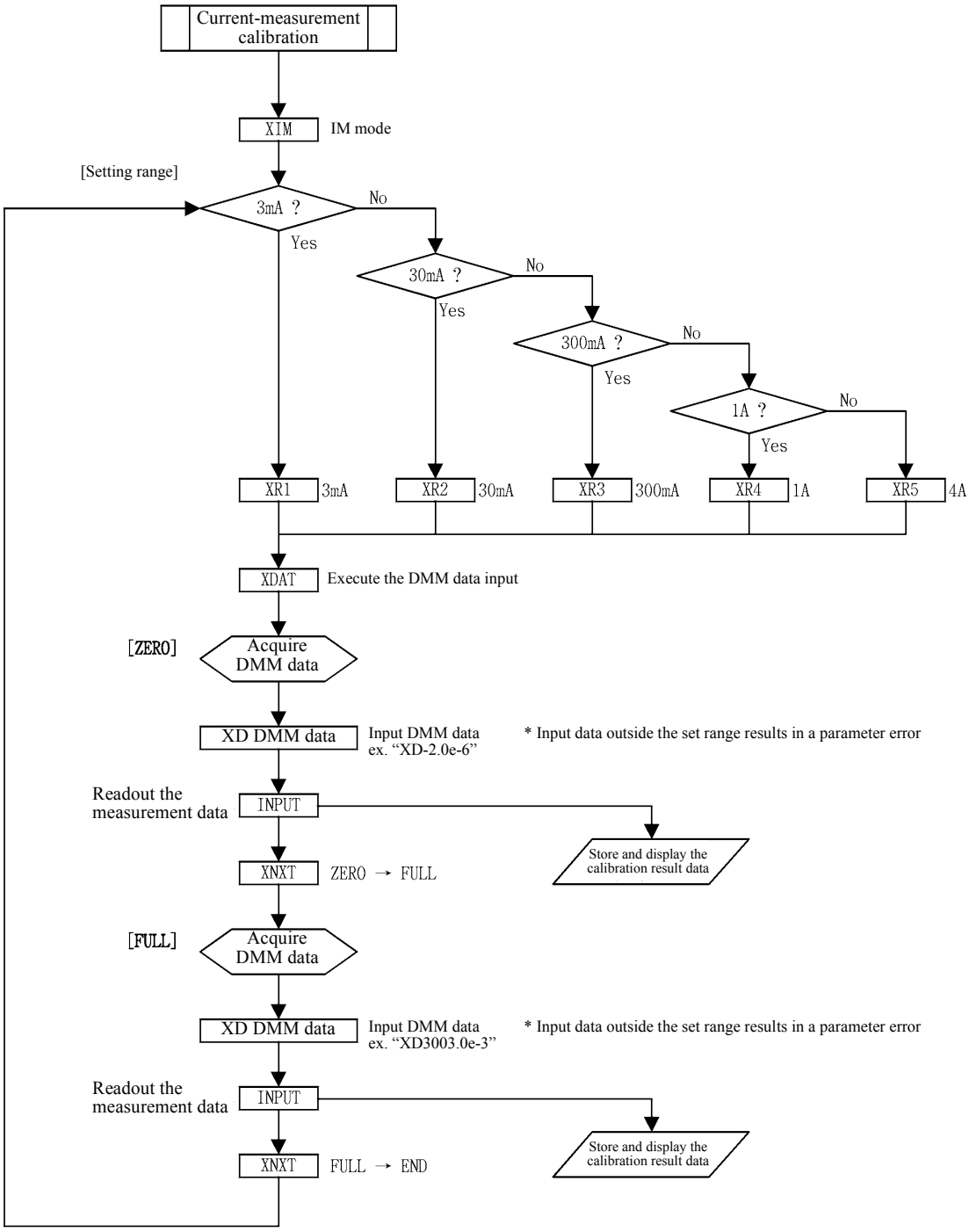


Figure 8-7 Calibration Procedure (5)

8.5.1 Calibration Procedure

This section describes the calibration procedure according to Figure 8-3, “Calibration Procedure (1).”

1. Executing CAL1 sets the calibration mode.
2. When executing all of the calibration items, initialize the calibration data by using XINI only once before the calibration is started.
3. When executing a voltage calibration, refer to Section 8.3, “Connections,” to connect units.
4. Set the calibration mode as the operation mode by using OPR.
5. Carry out the calibration according to the procedure shown in Figure 8-4 and Figure 8-5.
6. Press STBY to set the Standby mode.
7. Select XWR to store the calibration data in the non-volatile memory.
8. Select CAL0 to complete the calibration.

8.5.2 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.
   3 V range: XR4
   15 V range: XR5
3. Using XDAT, set the DMM data input mode.
4. Set up DMM read value using XD data.
5. Select XNXT to move on to the full-scale calibration mode.
6. Set up DMM read value using XD data.
7. Select XNXT to exit from the DMM data input mode.
8. Select XADJ to move on to Zero-calibration-data Fine-adjustment-mode.
9. Check the zero calibration value.
   XUP and XDN can fine-calibrate the calibration coefficient.
10. XNXT shifts to Full-scale Calibration Data Fine Adjust mode.

11. Check the full-scale calibration value.
    XUP and XDN can fine-calibrate the calibration coefficient.
12. Move on to the next step.
    When the voltage calibration mode is changed: XNXT
    When the operation goes to voltage-measurement calibration process: XVM

8.5.3 Voltage-measurement Calibration

1. Using XVM, change the mode to Voltage-measurement Calibration mode.
2. Select the range.
    3 V range: XR4
    15 V range: XR5
3. Using XDAT, set the DMM data input mode.
4. Set up DMM read value using XD data.
5. Readout the measurement data and check.
6. Select XNXT to move on to the full-scale calibration mode.
7. Set up the DMM read value using XD data.
8. Readout and check the measurement data.
9. Move on to the next step.
    When the voltage range is changed: XNXT
    When the operation goes to current-source and voltage limiter calibration process: XIS, XVLH, XVLL

8.5.4 Current-source and Current-limiter Calibration

1. Select Current Mode Calibration.

Current-source:	XIS
Current Hi limiter:	XILH
Current Lo limiter	XILL

2. Select the range.

3 mA range:	XR1
30 mA range:	XR2
300 mA range:	XR3
1 A range:	XR4
4 A range:	XR5

3. Perform the following procedure the same as described in Section 8.5.2, “Voltage-source and Voltage-limiter Calibration.”

4. Move on to the next step.

When the current calibration mode is changed:	XNXT
When the operation goes to current-measurement calibration process:	XIM

8.5.5 Current-measurement Calibration

1. Using XIM, change the mode to current-measurement Calibration mode.

2. Select the range.

3 mA range:	XR1
30 mA range:	XR2
300 mA range:	XR3
1 A range:	XR4
4 A range:	XR5

3. Perform the following procedure the same as described in Section 8.5.3, “Voltage-measurement Calibration.”

9. SPECIFICATIONS

All accuracy specifications are guaranteed for one year at a temperature of 23 ±5°C and a relative humidity not exceeding 85%.

9.1 Source and Measurement

Voltage-source/measurement range
Current-source/measurement range

	Range	Source range	Setting resolution	Measurement range	Measurement resolution
Voltage-source/ measurement range	3 V	0 to ± 3.1000 V	100 μV	0 to ± 3.19999 V	10 μV
	15 V	0 to ± 15.000 V	1 mV	0 to ± 15.1999 V	100 μV
Current-source/ measurement range	3 mA	0 to ± 3.1000 mA	100 nA	0 to ± 3.19999 mA	10 nA
	30 mA	0 to ± 31.000 mA	1 μA	0 to ± 31.9999 mA	100 nA
	300 mA	0 to ± 310.00 mA	10 μA	0 to ± 319.999 mA	1 μA
	1 A	0 to ± 1.0000 A	100 μA	0 to ± 1.01999 A	10 μA
	4 A*1	0 to ± 4.0000 A	200 μA	0 to ± 4.01999 A	10 μA
Resistance measurement	Determined by voltage range and current range calculations	-	-	0 to 7.5 MΩ	Minimum 2 μΩ

*1: Source range is restricted by the duty factor conditions.
4 A pulse source, maximum pulse width 20 ms and duty factor ≤ 20%
However the measurement resolution with Integration time 100 μs and 500 μs are as follows.

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

Voltage- and Current-limiter (compliance) range:

	Range	Maximum Setting range	Minimum Setting range*2	Setting resolution
Voltage-limiter	3 V	3.100 V	60 mV	1 mV
	15 V	15.00 V	600 mV	10 mV
Current-limiter	3 mA	3.100 mA	60 μA	1 μA
	30 mA	31.00 mA	600 μA	10 μA
	300 mA	310.0 mA	6 mA	100 μA
	1 A	1.000 A	60 mA	1 mA
	4 A	4.000 A	120 mA	1 mA

*2: The minimum set value of the difference between HI and LO side of the limiter value.

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)/°C
Voltage-source	3 V	0.025 + 350 μV	0.01 + 200 μV	15 + 30 μV
	15 V*3	0.025 + 3 mV*3	0.01 + 2 mV	15 + 300 μV
Voltage-limiter	3 V	0.05 + 3 mV	0.01 + 1 mV	15 + 100 μV
	15 V*3	0.07 + 30 mV	0.01 + 10 mV	15 + 1 mV

*3: 15 V range adds 100 μV per the remote sense voltage 0.1 V

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of setting + A +A × Vo/1V)		± (ppm of setting + A + A × Vo/1V)/°C
Current-source	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
	1 A	0.05 + 800 μA + 30 μA	0.02 + 400 μA + 10 μA	35 + 100 μA + 1 μA
	4 A	0.25 + 1 mA + 55 μA	0.08 + 400 μA + 10 μA	35 + 100 μA + 2 μA
Current limiter	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
	1 A	0.1 + 3.5 mA + 30 μA	0.02 + 1 mA + 10 μA	40 + 200 μA + 1μA
	4 A	0.25 + 6 mA + 55 μA	0.08 + 1 mA + 10 μA	40 + 200 μA + 2 μA

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

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

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

	Range	Overall accuracy	1-day stability	Temperature coefficient
		± (% of reading + A + A × Vo/1V)		± (ppm of reading + A + A × Vo/1V)/°C
Current-measurement	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
	1 A	0.05 + 700 µA + 30 µA	0.02 + 350 µA + 10 µA	35 + 70 µA + 1 µA
	4 A	0.25 + 800 µA + 55 µA	0.08 + 350 µA + 10 µA	35 + 70 µA + 2 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)/°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	

Vo: Compliance-voltage (-15 V to + 15 V) (Auto zero ON, Integration time: 1 PLC to 200 ms)
*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 100 μs to 10 ms measurement accuracy and 1-day stability.

Measurement range	Integration time				
	10 ms	5 ms	1 ms	500 μs	100 μs
3 V	8	12	20	30	35
15 V	5	10	15	20	25
3 mA to 1 A	12	18	25	30	35
4 A	24	30	45	55	65

The unit: digits (at 5 1/2 digit display)

Source linearity: ±3 digits or less (4 A range is ±0.2% of setting ±5 digits or less)

Maximum output current: 0 to ±15 V; ±1 A (DC)
0 to ±10 V; ±4 A (maximum pulse width: 20 ms, Duty factor ≤ 20%)

Maximum Compliance-voltage: 1 A (DC) up to; 0 to ±15 V
Up to 4 A (pulse) ; 0 to ±10 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 register	Low frequency noise		High frequency noise
			DC to 100 Hz	DC to 10 kHz	DC to 20 MHz
Voltage-source	3 V	-	100 μV	400 μV	5 mV
	15 V	-	1 mV	3 mV	6 mV
Current-source	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
	1 A	100 Ω	200 μA	1 mA	1.5 mA
	4 A	100 Ω	200 μA	1 mA	1.5 mA

Switching noise

		Typical value [p-p]	Load register
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	100 digits + 50 mV	-
	Voltage-limiter	50 mV*5	-
	Current-limiter	50 mV*5	-
	Voltage-measurement	50 mV*5	-
	Current-measurement	50 mV*5	-
Power OFF noise		600 mV	At 100 kΩ

*5: Limiter is not in operation
While the limiter is activated, it is the same as the source range switch noise

Settling time: The time that takes to fall in the final value ±0.03% when varying from zero to the full scale.
(For 4 A range, it is the time to reach in ±0.1%)
However resistive load, the load capacitance 200 pF or less, the source value, and the limiter setting must be at full-scale

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

3 mA to 1 A is for settling compliance-voltage 15 V
4 A is for settling compliance-voltage 10 V

Over shoot: ±0.1% or less
(Resistive load, loaded with standard cable width)

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 (A × Vo/1 V)

Output register: 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 status

Current range	Output registance (Ω)		Maximum load capacitance
	Voltage-source	Current-source	
3 mA	10 mΩ or less	100 MΩ or higher	100 μF
30 mA		10 MΩ or higher	100 μF
300 mA		1 MΩ or higher	2000 μF
1 A		100 kΩ or higher	2000 μF
4 A		50 kΩ or higher	2000 μF

Standard attached cable register: 100 mΩ or less

Maximum inductance: The maximum inductance that does not oscillate in current-source or current-limiter operational-status

Current-source range Current-limiter range	Maximum Load inductance
3 mA to 4 A	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 and Random fixed level.
Pulse Sweep source and measurement:	Source and the measurement with Linear and Random fixed level. (However, measurement auto range in Pulse source is impossible)
Integration time:	8 types available: 100 μs; 500 μs; 1 ms; 5 ms; 10 ms; 1 PLC; 100 ms; and 200 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:	5000 steps
Random sweep maximum memory:	5000 data
The measurement data memory:	5000 data
Measurement auto range:	Available only in VSIM or ISVM
Limiter:	It is possible to set separately at HI and LO side (However, if 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:	15 V peak Max (between HI-LO) 2 V peak Max (between OUTPUT and SENSE) 250 V Max (between LO and chassis)
Maximum remote sensing voltage:	±1 V Max; 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:	100 MΩ or over
Voltage-measurement-input leak current:	±100 nA or below
GPIB interface:	Compliant with IEEE-488.1-1978 Interface function; “SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2”
External control signal:	TRIGGER IN INTERLOCK/OPERATE IN/OPERATE OUT COMPLETE OUT/SYNC OUT

9.3 Set Time

Minimum pulse width: 500 µs

Minimum step (repeat) time: Source/measurement range; Fixed, Integration time; 100 µs, measurement delay time; 100 µs, Calculation; OFF, and in Voltage and current-measurement

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

Source delay time:

Set range	Resolution	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	Resolution	Accuracy
1.000 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	Resolution	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 59998 ms	1 ms	

Measurement delay time:

Set range	Resolution	Accuracy
0.100 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	

Hold time:

Set range	Resolution	Accuracy
1 ms to 60000 ms	1 ms	±(2% + 3 ms)

9.4 General Specification

Operating environment conditions: Ambient temperature 0°C to + 50°C, relative humidity 85% or below, with no condensation

Storage environment conditions: Ambient temperature -25°C to + 70°C, relative humidity 85% or below, with no condensation

Warming up time: 60 minutes or longer
(Until it falls 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 can switch)

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

Line frequency: 50 Hz/60 Hz

Power consumption: 95 VA or less

External dimensions: Approx. 212 (width) × 88 (height) × 400 (depth) mm

Mass: 5 kg or lower

APPENDIX

A.1 When Problems Occur (Before Requesting Repairs)

If problems are encountered when using the 6240A, inspect the 6240A referring to Table A-1.
If the problem is not answered 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 6240A before requesting service.

Table A-1 Items to be Inspected before Requesting the Repair (1 of 2)

Q (Symptom)	A (Cause and Solution)
1. Turning on the **POWER** switch does not display the screen.	Cause: Power fuse is blown. Solution: Replace it to the correct fuse.
2. Not output the set source value.	Cause: It is in Standby or Suspended status. Solution: Set Operate and check that the **OPR** indicator is ON.
	Cause: Remote sensing setting is incorrect. Solution: Check 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: Check the source value.
	Cause: Detection of the overload voltage (Over Load) has set Standby. Solution: Remove the cable.
	Cause: Heat detection (Over Heat) or Fan detection (Fan Stopped) is activated to set Standby status. Solution: Remove the cable and turn OFF the **POWER** switch. Turn ON the **POWER** switch again.
	Cause: The limiter is operating. Solution: Check the limiter setting.
	Cause: • **OUTPUT** terminal and **SENSE** terminal are incorrectly connected. • **SENSE** is not connected correctly at 4-wire connection. Solution: Check cable connections again.
	Cause: Standby due to the Interlock signal. Solution: • Change the Interlock signal to the other settings • Set the Interlock signal LO.

Table A-1 Items to be Inspected before Requesting the Repair (2 of 2)

Q (Symptom)	A (Cause and Solution)
3. Measurement value is not outputted.	Cause: It is in Standby or Suspended status. Solution: Set Operate and check that the **OPR** indicator is ON.
	Cause: Measurement is not ON. Solution: Check measurement ON/OFF setting.
	Cause: When measuring in auto range, the measurement value is unstable and the range is not confirmed, and Therefore the measurement data is not outputted. Solution: Change to a fixed range and measure.
	Cause: No TRIG INPUT signal is input even when the trigger signal cable is connected to the external trigger. Solution: Check TRIG INPUT connection cable and the signal.
4. It represents the source value or measurement value is not stable or is an error value.	Cause: Function or range settings have an error. Solution: Check the setting again.
	Cause: Cable connection is wrong. Solution: Check cable connections again.
	Cause: The cable is disconnected. Solution: Check the cables with the tester. If error, replace it.
	Cause: The cable is connected to a wrong terminal. Solution: Check cable connections again.
	Cause: The induction noise scatters the measurement value. Solution: Set the integration time 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. It became unable to inputwith the measurement controlling key while setting.	Cause: In inputting with direct mode, the set value is half-lighted and only the keys printed green on the panel are effective. Solution: Press **123...** key to complete the direct input mode.

A.2 Error Message List

If an error occurs when using the 6240A, an error number and an error message appear. These contents are explained in the following:

Table A-2 Error Message List (1 of 2)

Classification	Display error code	Message	Explanation
Self-test	001	ROM Chk SUM	ROM check SUM error
	002	Panel Comm	Display communication/RAM error
		Consecutive buzzer ON	LCA error (including LCA check SUM error)
	004	RAM Rd/Wt	RAM read or write error
	005	Analog Comm	Analog communication error
	012	CAL data SUM	CAL data SUM error
	013	Param SUM	Parameter SUM error
	101	AD Ratio 1-2	Test error in the comparison between AD operation IR1 and IR2
	102	AD Ratio 2-3	Test error in the comparison between AD operation IR2 and IR3
	103	AD Ratio 3-4	Test error in the comparison between AD operation IR3 and IR4
	104	AD Ratio 4-5	Test error in the comparison between AD operation IR4 and IR5
	105	AD Zero Meas	Test error in AD operation Zero
	201	VSVM 3V Zero	VSVM 3 V ZERO test error
	202	VSVM 3V +FS	VSVM 3 V + FS test error
	203	VSVM 3V -FS	VSVM 3 V - FS test error
	204	VSVM 15V 0	VSVM 15 V ZERO test error
	205	VSVM 15V +FS	VSVM 15 V + FS test error
	206	VSVM 15V -FS	VSVM 15 V-FS test error
	211	HL 3V +FS	High Limit 3 V + FS test error
	212	HL 3V -FS	High Limit 3 V - FS test error
	213	HL 15V +FS	High Limit 15 V + FS test error
	214	HL 15V -FS	High Limit 15 V - FS test error
	221	LL 3V +FS	Low Limit 3 V + FS test error
	222	LL 3V -FS	Low Limit 3 V - FS test error
	223	LL 15V +FS	Low Limit 15 V + FS test error
	224	LL 15V -FS	Low Limit 15 V - FS test error
	231	IM 3mA Zero	Test error with 1 M, 3 mA, and Zero
	232	IM 30mA Zero	Test error with 1 M, 30 mA, and Zero
	233	IM 300mA 0	Test error with 1 M, 300 mA, and Zero
	234	IM 1A Zero	Test error with 1 M, 1 A, and Zero
	235	IM 4A Zero	Test error with 1 M, 4 A, and Zero
	301	OVL Check	OVL-detection-check error

Table A-2 Error Message List (2 of 2)

Classification	Display error code	Message	Explanation
Hard error	401	Fan Stopped	Fan stopped
	402	Over Heat	Overheat
	403	Source Unit	The source circuit error
	404	Over Load	Overload
Source or 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 20 counts or below, or IM is 200 counts or below
	-	±SCL Over	Scaling over
	-	Total ±Over	Integrated value over
Operation	801	Over Step	5000 < Number of Sweep step
	811	Power Over	Generates the value exceeding DC 1 A
	812	Duty Over	Pulse duty restriction over
	821	Tw too Long	Tw value is over against the pulse
	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 Tp > Tds)
	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

A.3 Execution Time

A.3.1 GPIB Remote Execution Time (Typical Value)

Computer: FMV6266T6 made by FUJITSU, Windows95
GPIB hardware: AT-GPIB/TNT (PnP) made by National Instruments
Module: Niglobal. bas, Vbib-32. bas (attached to AT-GPIB/TNT (PnP))
Language: Visual Basic 5

Item		Program code		Conditions	Executing time [ms]
Operate, Suspend, or Standby	Operate	OPR	(At Standby)	Source mode: DC pulse IT: IPLC (20 ms) Source function: VS/IS Other rest: Default value	120/92
			(In Suspend HiZ)		60/34
			(In Suspend LoZ)		8/8
		OPR	(At Standby)	Source mode: Sweep Number of step: 100 IT: IPLC (20 ms) Other rest: Default value	160
			(In Suspend HiZ)		58
			(In Suspend LoZ)		6
	Suspend	SUS	(OPR → SUS LoZ)	Source mode: DC pulse IT: IPLC (20 ms) Source function: VS/IS Other rest: Default value	6/9
			(OPR → SUS HiZ)		60/43
			(SBY → SUS LoZ)		110/110
			(SBY → SUS HiZ)		61/62
	Standby	SBY	(In Operate)	Source mode: DC pulse IT: 1 PLC (20 ms) Source function: VS/IS Other rest: Default value	110/80
			(In Suspend HiZ)		45/46
			(In Suspend LoZ)		100/100
Source function		VF	(In IS operational status)	Source mode: DC pulse Operate and HOLD status	11
			(In Suspend)		4
		IF	(In VS operational status)		62
			(In Suspend)		4
Change the source range		V4 to V5 (Setting VF)			16
		I1 to I5 (Setting IF)			16 to 33

A.3.1 GPIB Remote Execution Time (Typical Value)

Item		Program code	Conditions		Executing time [ms]
Voltage-source	Source value Pulse value Base value Bias value	SOV<data> BS<data> SB<data>	Operate and HOLD status	Range not changed	5 to 6
				Range changed	16
Current-source	Source value Pulse value Base value Bias value	SOI<data> BS<data> SB<data>		Range not changed	5 to 6
				Range changed	31 to 46
Voltage-limiter value*		LMV<data>		Range not changed	5 to 6
				Range changed	16
Current-limiter value*		LMI<data>		Range not changed	5 to 6
				Range changed	31 to 72
Measurement function		F0 to F3	Source mode:	DC or pulse operate and HOLD status	16
Integration time		IT0			6
		IT1			7
		IT2			8
		IT3			12
		IT4			17
		IT5 (50 Hz/60 Hz)			27/24
		IT6			110
		IT7			210
Time parameter	Th, Td, Tp, Tw	SP<data>,<data>,<data>,<data>			11 to 18
	Tds	SD<data>			5 to 16
Sweep type	Linear	SN<data>	Standby status		6 to 20
	Fixed	SF<data>			5 to 6
	Random	SC<data>			4 to 10
Source mode		MD0 to MD3			4
Set random data *		N<adrs>,<data>> P			6 to 20

* The command with data <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; 51/2 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

Conditions for source value	Execution time
When generating the DC-pulse- and Sweep-step-value	9 ms
When Sweep start value generated	13 ms

   • The time from Receiving source command + Measurement by Trigger input (*TRG) and to completing data output to GPIB

   In DC Pulse source mode

Source	Command	Execution time
Voltage-source	SOV<data> (<data>: 1 character)	14 ms
Current-source	SOI<data> (The unit<data>: 1 character)	14 ms

2. Data read time

Item	The number of data	Execution time
Source-value data-reading by Query	1	18 ms
Read measurement buffer memory after RNI command Condition: number of measurement digits; 51/2 digits, Header; OFF, Block delimiter; EOI (DL2)	1	8 ms
	100	404 ms

3. Sweep start to Data read time

   It represents a time from executing 100 step sweep to completing the data output from memory to GPIB with RNI command.

   Conditions: Source range; Fixed
   Source range; Fixed, Trigger mode; Internal trigger, Number of measurement digits; 5 1/2 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; EOL (DL2)

Memory mode	Period	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

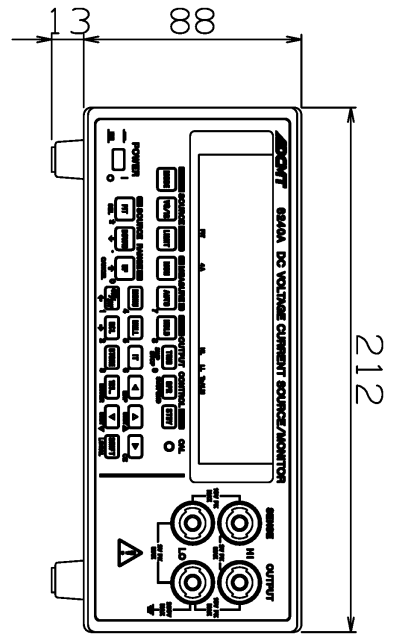
   The time from external trigger signal input to the time the source value (pulse value or base value) starts to change.
   For the time from when the source value changes to when the source value is settled, refer to Section 5.2.8.2.

   Conditions: Source range; fixed
   Measurement range; fixed, Trigger mode; HOLD or external trigger
   Source delay; 30 µs

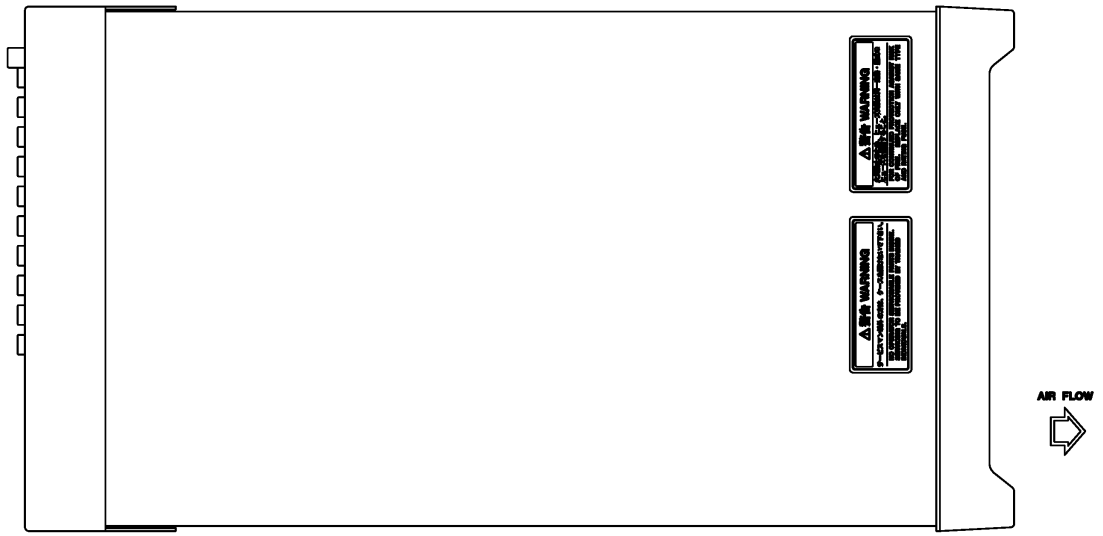
Source mode	Source value	Execution time
Pulse	Pulse value	60 µs
DC Sweep	Start value	1 ms
	Step value	60 µs
Pulse Sweep*	Start (base) value	1 ms
	Step value	60 µs

* The pulse sweep start value represents the time from trigger to base value generation. (Time from the base value generation to the start pulse generation varies depending on the Hold time.)

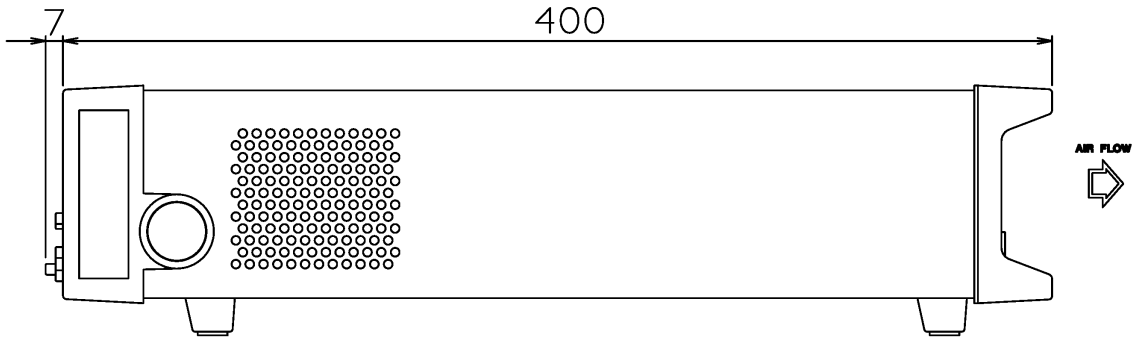
2. Switching time
   - Source function change time: 3 ms
   - Source range change time
     Voltage source function: 8 ms
     Current source function: 35 ms
   - Measurement range change time
     Voltage measurement function: 8 ms
     Current measurement function: 35 ms
   - Measurement auto range processing time
     Voltage measurement function: Integration time + 8 ms
     Current measurement function: Integration time + 35 ms



6240A FRONT VIEW



6240A TOP VIEW



6240A 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

[L]

[M]

[N]

[O]

[P]

[R]

[S]

[T]

[U]

[V]

[W]

IMPORTANT INFORMATION FOR ADC CORPORATION SOFTWARE

PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by ADC CORPORATION (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by ADC CORPORATION (hereafter referred to as "PRODUCTS").

SOFTWARE License

All rights in and to the SOFTWARE (including, but not limited to, copyright) shall be and remain vested in ADC CORPORATION. ADC CORPORATION hereby grants you a license to use the SOFTWARE only on or with ADC CORPORATION PRODUCTS.

Restrictions

(1) You may not use the SOFTWARE for any purpose other than for the use of the PRODUCTS.
(2) You may not copy, modify, or change, all or any part of, the SOFTWARE without permission from ADC CORPORATION.
(3) You may not reverse engineer, de-compile, or disassemble, all or any part of, the SOFTWARE.

Liability

ADC CORPORATION shall have no liability(1) for any PRODUCT failures, which may arise out of any misuse (misuse is deemed to be use of the SOFTWARE for purposes other than its intended use) of the SOFTWARE.
(2) For any dispute between you and any third party for any reason whatsoever including, but not limited to, infringement of intellectual property rights.

LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, ADC CORPORATION will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, ADC CORPORATION will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at ADC CORPORATION's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by ADC CORPORATION or (ii) specifically recommended or authorized by ADC CORPORATION and performed in accordance with ADC CORPORATION's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than ADC CORPORATION or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by ADC CORPORATION, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by ADC CORPORATION;

   (e) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war;

   (f) any negligent act or omission of the Purchaser or any third party other than ADC CORPORATION; or

   (g) any product exported from a country where the product was sold.

5. EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADC CORPORATION HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.

6. THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.

7. ADC CORPORATION WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADC CORPORATION HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL BUYER

The product should be thoroughly inspected immediately upon original delivery to buyer. If the product is damaged in any way, a claim should be filed by the buyer with carrier immediately.

CUSTOMER SERVICE DESCRIPTION

Contact an ADC CORPORATION sales representative if a failure occurs.

(1) The repair service lasts ten years from the delivery date of the Product.

(2) The repair and calibration services may be declined if either of the following situations arise.

1) When required parts cannot be procured.

2) When the performance of the Product cannot be maintained after repair.

ADCMT® ADC CORPORATION

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