6243/44

DC Voltage Current Source/Monitor

Operation Manual

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Safety Summary

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

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

- **Warning Labels**

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

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

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

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

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

- **Basic Precautions**

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

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

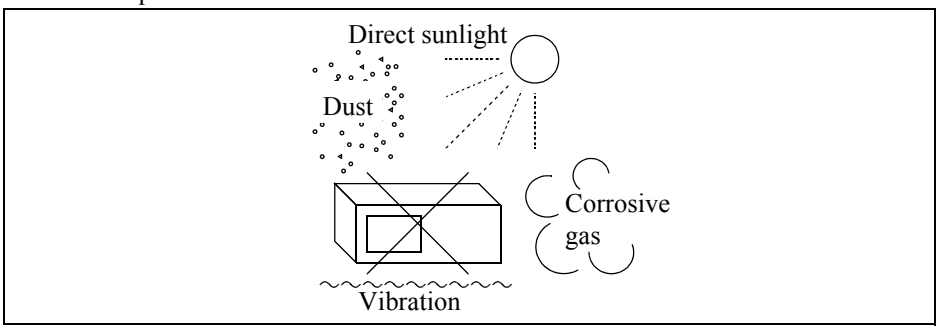
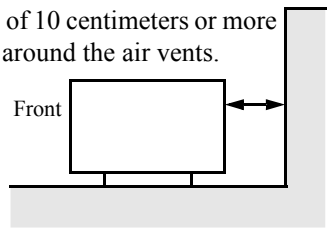


Figure-1 Environmental Conditions

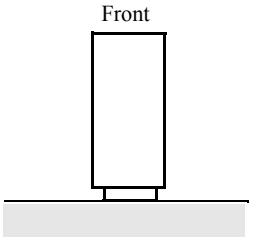
- Operating position



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

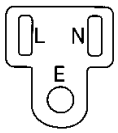
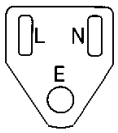
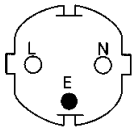
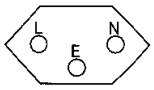
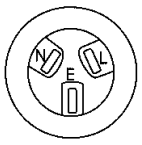
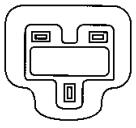
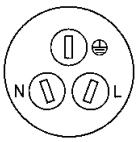
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  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

SAFETY PRECAUTIONS FOR THE 6243/44

Confirm all of the following points before connecting the 6243/44 and the DUT to prevent destruction of the DUT due to an overload of voltage or current:

- The 6243/44 is in the standby mode. (**OPERATE** lamp is off.)
- No error or failure indication is displayed.
- The 6243/44 is grounded. (The ground pin of the power cable is grounded.)
- When using an ADC CORPORATION manufactured test fixture, connecting the **INTERLOCK** terminal to the **LID SIGNAL** on the test fixture makes it possible to set the output to standby status by opening and closing the lid.

When mounting the 6243/44 in a rack

- Make sure that the rack does not topple over if the 6243/44 is off balance.
- Be careful that the rack does not topple over when the slide rail is pulled out.

When the 6243/44 is used in the TR6143 Mode 1

The voltage limiter of the current source function only operates using the same polarity as that of the source.

When the current source value is set to +0 A in the no-load status, or when negative current is generated due to an error, the output terminal may deliver a negative supply voltage. (6243; -130 V, 6244; -26 V)

If these conditions pose a problem, use one of the following procedures.

- Set the value of current source to 10 counts or higher at all times.
- Use the Original Mode.
- Use the TR6143 Mode 2.
  (In TR6143 Mode 2, the GPIB commands are the same as in TR6143 Mode 1. However, the hardware configuration is the same as the 6243/44 so the voltage limiter operates using both polarities.)

Certificate of Conformity

CE

This is to certify, that

DC Voltage Current Source/Monitor

6243

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

Certificate of Conformity

CE

This is to certify, that

DC Voltage Current Source/Monitor

6244

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

PREFACE

This document describes the operations, functions and remote programming of 6243/44 DC Voltage/Current Source/Monitor operations.

This document refers the 6243/44 ROM version B00 or later. (To confirm the ROM version, refer to Section 1.5, “Operational Check.”)

The following functions are not available for the 6243/44 ROM version A02 or earlier.

- Function for switching the pulse width for external single-line output
  The default is always set to 20 μs.

- TR6143 Mode 2 function
  Only the Original Mode and TR6143 Mode 1 functions are available.

1. Contents of this Manual

This document consists of the following chapters:

Safety Summary	Read before using the 6243/44
1. INTRODUCTION	Describes the supplied accessories, operating environment, and how to check the 6243/44 correctly.
2. OPERATION	Describes the front and rear panel operation. Basic operation and measurement examples are given.
3. REFERENCE	The buttons and keys on the front panel, parameter groups, parameter items, and functions are explained.
4. PRACTICAL GUIDE FOR MEASUREMENTS	Explains, in detail, functions used to perform measurements accurately.
5. REMOTE PROGRAMMING	Explains the GPIB interface, hardware connections, the GPIB setup, and lists GPIB commands and programming examples.
6. COMPATIBILITY WITH TR6143	Explains the TR6143 compatibility.
7. PERFORMANCE TESTS	Explains operations used to confirm that the 6243/44 is operating correctly within acceptable limits.
8. CALIBRATION	Explains how to calibrate the 6243/44 to ensure operation within acceptable limits.
9. SPECIFICATIONS	Describes the 6243/44s specifications.
A.1 When Problems Occur (Before Requesting Repairs)	Troubleshooting.
A.2 Error Message List	Error messages are explained here.
DIMENSIONAL OUTLINE DRAWING	External dimensions: Describes the external dimensions.

2. Notational Conventions Used in This Document

In this document, panel keys, parameter groups, parameter items, and parameters are indicated in the following way:

- Panel keys: Bold (Example: **MODE, MENU**)
- Parameter groups, parameter items, parameters: Bold and italic (Example: ***SWEEP TYPE*, *Measure Delay***)

When keys are pressed sequentially in an operating procedure, Key names are separated by a "," (comma) in this manual.

When common function of both the 6243 and 6244 are described, diagrams of either the 6243 or 6244 are used.

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LIST OF ILLUSTRATIONS

LIST OF TABLES

1. INTRODUCTION

This chapter describes the product overview, accessories for the product and the appropriate operating environment.

This chapter also explains the methods used for checking whether or not the 6243/44 is functioning correctly.

1.1 Product Overview

The 6243/44 is a DC Voltage Current Source/Monitor featuring a wide source and measurement range as indicated below.

6243: Voltage 0 to ±110 V; Current 0 to ±2 A

6244: Voltage 0 to ±20 V; Current 0 to ±10 A

The 6243/44 features high accuracy with a source resolution of 4-1/2 digits and a measurement resolution of 5-1/2 digits. As well as various types of sweeping functions and a capacity for measuring pulses with a minimum width of 1 ms. These features make the product a highly suitable power source, for characteristic testing systems testing characteristics and for evaluation in the research and development fields for semiconductors and other electronic components.

The features of this product are indicated below.

- Source, measurement range
  6243: ±2 A up to ±32 V
  ±1 A up to ±64 V
  ±0.5 A up to ±110 V
  6244: ±10 A up to ±7 V
  ±4 A up to ±20 V
  See Figure 1-1.
- Voltage source/measurement range
  6243: 320 mV-110 V
  6244: 320 mV-20 V
- Current source/measurement range
  6243: 32 μA-2 A
  6244: 320 μA-10 A
- Voltage digits/measurement digits
  6243: Source 4-1/2 digits/Measurement 5-1/2 digits
  6244: Source 4-1/2 digits/Measurement 5-1/2 digits
- Voltage source/measurement resolution
  6243: Source 10 μV/Measurement 1 μV
  6244: Source 10 μV/Measurement 1 μV
- Current source/measurement resolution
  6243: Source 1 nA/Measurement 100 pA
  6244: Source 10 nA/Measurement 1 nA
- Voltage source current measurement (VSIM)/Current source voltage measurement (ISVM)
- Voltage source voltage measurement (VSVM)/Current source current measurement (ISIM)
- Sink-enabled bipolar output
- Minimum pulse width: 1 ms

- Linear, log, random sweep functions for characteristic tests
- Limiter (compliance), oscillation, overload, overheat detections
- Synchronized operation by integrating 2 or more units of the 6243/44
- GPIB for integrating an automated measurement system as standard

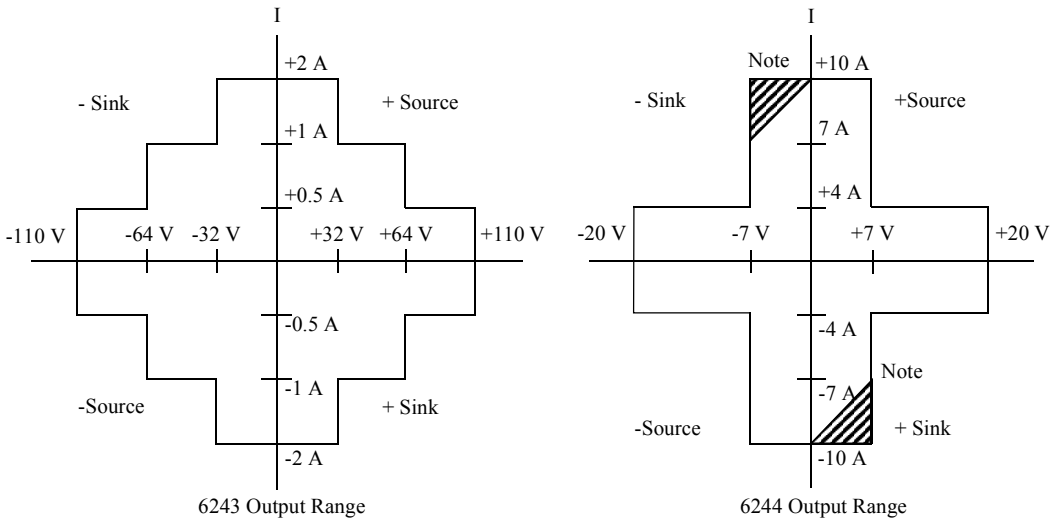


Figure 1-1 Output Range

NOTE: ***The output range corresponding to the hatched areas is shown in the following formula. The operating environment temperature is 0 to 40°C.***

When 0 V ≤ V_0 ≤ 7 V: $I_0 \geq 3/7\ V_0 - 10$ [A]
When -7 V ≤ V_0 ≤ 0 V: $I_0 \geq 3/7\ V_0 + 10$ [A]

I_0: ***Output current [A]***
V_0: ***Voltage between output terminals [V]***

1.2 Supplied Accessories

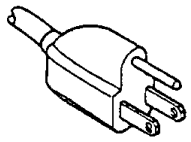
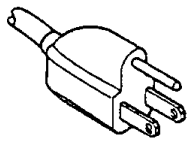
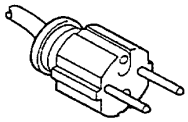
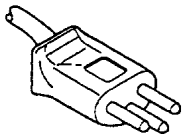
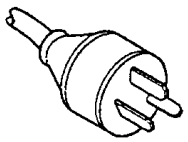
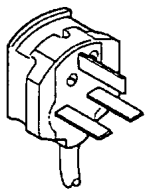
The standard accessories supplied for the 6243/44 are shown in Table 1-1. If any accessory is missing or damaged, contact ADC CORPORATION or the sales representative. When ordering accessories, specify the part number.

Table 1-1 List of Standard Accessories

Name	P/N	Quantity		Remarks
		6243	6244	
Power cable	A01402	1	1	Power cable with 3 pin plug
Input/Output cable	A01044	1	1	Red
		1	1	Black
Power fuse	213004	1	--	110V/120V Slow blow fuse
	218005	--	1	
	213002	1	--	220V/240V Slow blow fuse
	21802.5	--	1	
6243/44 Operation manual	E6243/44	1	1	This manual

*1: The power cable is available in 11 different types. (Refer to Table 1-2)
When ordering the power cable, please specify the part number together with the Option No.

Table 1-2 AC Power Plug Types

Plug configuration	Standards	Rating, color and length	Part 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

1.3 Optional Accessories

The optional accessories for the 6243/44 are shown in Table 1-3.

Table 1-3 List of optional accessories

Name	P/N	Model		Remarks
		6243	6244	
Test fixture	12701A	○	○	
Connection cable	A01041	○	○	Test lead (1 m)
	A01023-100	○	--	Input/Output cable (alligator clip - banana 4-wire shielded: 1 m) with driving guard
	A01038-100	○	--	Input/Output cable (banana - banana 4-wire shielded: 1 m) with driving guard
	A01047-01	--	○	Input/Output cable (banana - banana 4-wire shielded: 0.5 m)
	A01047-02	--	○	Input/Output cable (banana - banana 4-wire shielded: 1 m)
	A01047-03	--	○	Input/Output cable (banana - banana 4-wire shielded: 1.5 m)
	A01047-04	--	○	Input/Output cable (banana - banana 4-wire shielded: 2 m)
	A01036-1500	○	○	BNC-BNC Cable (1.5 m)
Rack-mount kit	A02710	○	○	EIA standard, Twin with front handle
	A02711	○	○	JIS, Twin, with front handle
	A02720	○	○	EIA standard, Twin, without front handle
	A02721	○	○	JIS, Twin, without front handle
	A02469	○	○	EIA, Single
	A02269	○	○	JIS, Single
Side-joint kit	A02641	○	○	4U, Twin
Slide-rail kit	A02615	○	○	

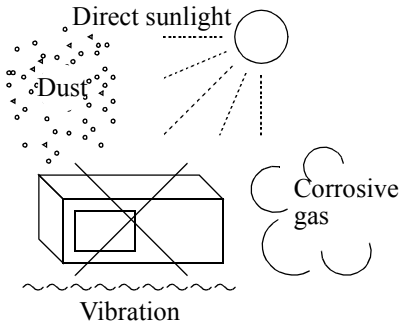
1.4 Operating Environment

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

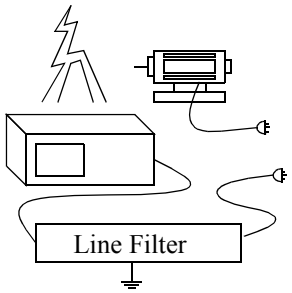
1.4.1 Environmental Conditions

The 6243/44 must be installed in an environment meeting the following conditions.

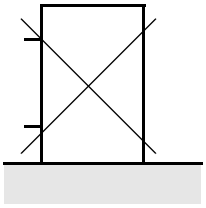
- Ambient temperature: 0°C to +50°C (temperature range for operation).
  For the 6244, however, the temperature range for operation is 0°C to +40°C in the output range indicated by the hatched sections shown in Figure 1-1.
- Relative humidity: 85% or lower (with no condensation)
- Location not subject to corrosive gasses
- Away from direct sunlight
- Dust free
- No vibrations
- No noise
  The 6243/44 is designed with full consideration given to the noise contained in the AC power line. Nevertheless, it is recommended that the 6243/44 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 6243/44
  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 6243/44 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 the rack cannot topple over if the 6243/44 is off balance.
  Ensure that the rack cannot topple over when the slide rail is pulled out.
  Ensure that exhaust air from other 6243/44 is not directed at the vents on the side of the 6243/44.
  To prevent the temperature in the rack from rising, install a heat sink fan.



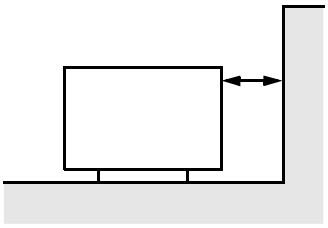
• Avoid operation in these areas.



• 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 Supply Conditions

The power specifications of the 6243/44 are shown in Table 1-4.

Table 1-4 Power Specifications

	Standard model	Option		
		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 to 66 Hz			
Power consumption	6243: ≤340 VA, 6244: ≤400 VA			
Fuse (6243)	T4A/250 V		T2A/250 V	
Fuse (6244)	T5A/250 V		T2.5A/250 V	

NOTE: ***To prevent damage to the 6243/44, do not apply an input voltage or a frequency that exceeds the specified ranges for the 6243/44.***

1.4.3 Changing the Source Voltage Setting and Checking/Replacing the Fuse

The power supply voltage setting of the 6243/44 can be switched manually.

The following explain the procedures for changing the power supply voltage setting, checking the fuse and replacing the fuse.

NOTE:

1. ***If the power fuse blows it may cause abnormalities in the operation of the 6243/44. Contact ADC CORPORATION for servicing.***
2. ***Use a fuse that conforms to the source voltage.***

Setting the Voltage Selector

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

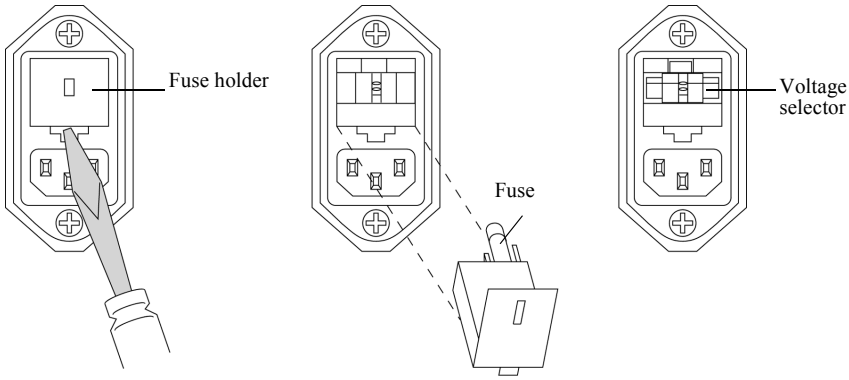


Figure 1-3 Changing the Source Voltage Setting and Checking/Replacing the Fuse

4. Pull out the voltage selector with your fingers.

   The available settings (100 V, 120 V, 220 V and 240 V) are imprinted on the voltage selector.
5. Align the voltage selector so that the voltage value indication corresponding to the used source voltage is at the front, and then insert the selector.

Checking and replacing the fuse

6. Check whether or not the fuse housed in the fuse holder removed in step 3 is blown and whether or not it matches the source voltage. Replace the fuse as required.
7. After checking and/or replacing the fuse, return the fuse holder to its original position.

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. (Refer to Table 1-2.)***
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.***

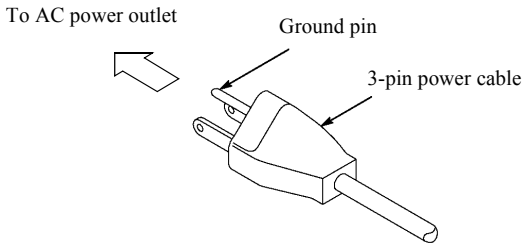


Figure 1-4 Power Cable

1.4.5 Warm-up (Preheating Time)

To ensure that the 6243/44 obtains the specified accuracy, let the 6243/44 warm up for 60 minutes after the power is turned on.

1.5 Operational Check

This section describes the simple operational check performed when the 6243/44 is used for the first time. Perform the operation check by following the procedures shown below to confirm that the 6243/44 is functioning correctly.

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

NOTE: ***To prevent 6243/44 damage, do not apply an input voltage or frequency exceeding the specified ranges for the 6243/44.***

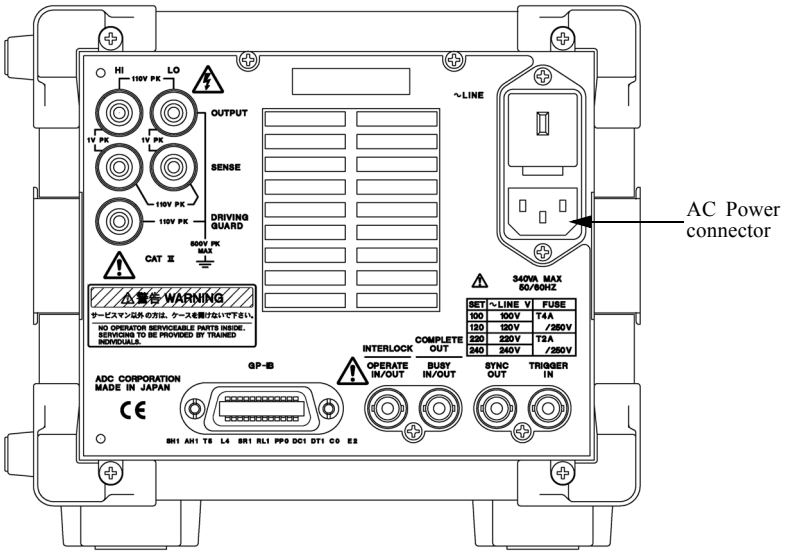


Figure 1-5 Connecting the Power Cable

3. Plug the power cable into an AC outlet.

4. Set the **POWER** switch on the front panel to ON.

   After all the indicators light up, the 6243/44 performs a self test. (Duration: approx. 20 sec. Refer to Figure 1-6)

Figure 1-6 Display during Self test

If the Start-up test finishes correctly, the model name, ROM version, line frequency, and GPIB address appear on the display. (Refer to Figure 1-7) Then the start-up screen appears. (Refer to Figure 1-8)

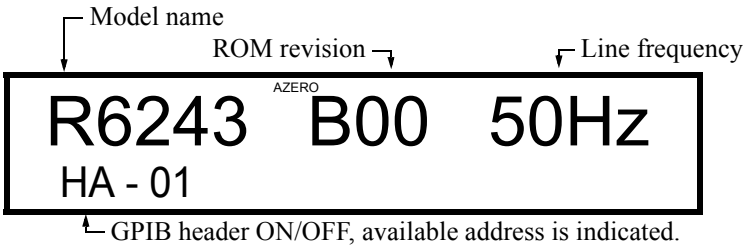


Figure 1-7 Display when Self test is Completed

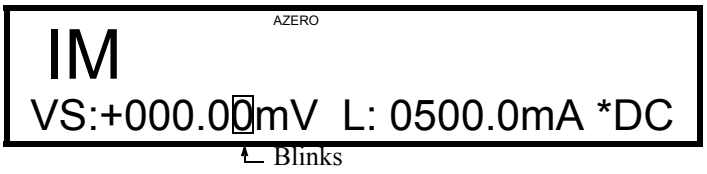


Figure 1-8 Start-up Screen

NOTE:

1. ***Depending on the model and the preset conditions, the displayed contents may differ from those shown in Figure 1-8.***
2. ***If an error occurs, an error message appears on the screen. Refer to the list of error messages and take the relevant action as required. (Refer to Chapter A.2)***

---

5. For 60 Hz regions, switch the line frequency setting (refer to Section 1.6, “Setting the Line Frequency”) and perform the check.

6. Press the **VM/IM** key.

   This initiates the voltage measurement function. (Refer to Figure 1-9)

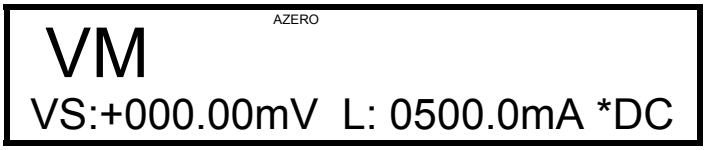


Figure 1-9 VSVM Measurement (In Output OFF Standby)

7. Press the **OPERATE** key.

   The **OPERATE** lamp lights up and VSVM measurement is performed. (Refer to Figure 1-10)

Figure 1-10 VSVM 320 mV Range 0 V Measurement

8. Confirm that the VM measured value is within ±600 μV for 0 V in the VS 320 mV range.

9. Press the **OPERATE** key.

   The **OPERATE** lamp goes off and the 6243/44 enters the standby (output OFF) mode.

This completes the operational check.

1.6 Setting the Line Frequency

Since the 6243/44 employs an integral-type A/D converter, setting the integral time by multiplying the cycle of the line frequency (PLC) eliminates noise introduced through the power line.

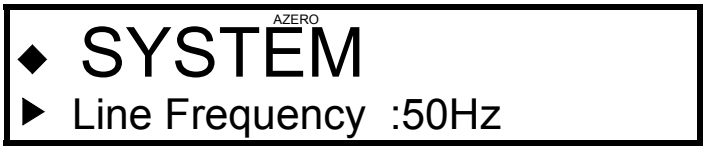
NOTE: ***The factory setting for one cycle is 50 Hz. For 60 Hz regions, change the line frequency to 60 Hz using the following procedure.***

Setting the Line Frequency

1. Press the **MENU** key.
   The Parameter Group selection screen appears.

2. Turn the Data knob to display ***SYSTEM***.

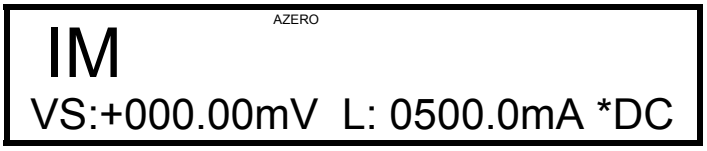
3. Press the ▽ key.
   The parameter selection screen appears.



4. Press the ▽ key.
   The line frequency setting screen appears.

5. Turn the Data knob to set the line frequency to ***60 Hz***.

6. Press the **EXIT** key.
   The Start-up screen returns.



This completes the line frequency setting.

1.7 Cleaning, Storage, and Transport Methods

1.7.1 Cleaning

Wipe dirt off the 6243/44 with a soft cloth or small brush as needed. Clean around the keys on the front panel with a brush. If the dirt is difficult to remove, use a soft cloth moistened with a neutral detergent diluted with water.

NOTE:

1. ***Ensure that water does not penetrate the 6243/44 (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.***
3. ***Avoid using cleansers.***

1.7.2 Storage

Store the 6243/44 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 6243/44 in a moisture-proof bag together with a desiccator. Avoid storing the 6243/44 in a location where there is a lot of dust or where it will be subjected to direct sunlight.

1.7.3 Transport

To transport the 6243/44, use the original box that the 6243/44 came in. If the box is no longer available, pack the 6243/44 in accordance with the following guidelines.

1. Prepare a corrugated cardboard box with dimensions that are larger than the external dimensions of the 6243/44 by 15 cm or more to allow for shock absorbent material.
2. Wrap the 6243/44 with a protective sheet.
3. Line the box with shock absorbing material so that the 6243/44 is protected on all sides by cushioning material.
4. Close the box with industrial staples or use packing tape.

When sending the 6243/44 to ADC CORPORATION 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

1.8 Calibration

In order to use the 6243/44 in accordance with its specifications, calibration must be performed once a year.

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

Contact ADC CORPORATION or the sales representative for the calibration service.

1.9 Parts with a Limited Life Span

In addition to the parts mentioned in “Safety Summary,” the 6243/44 also contains the following parts that have a limited life span.

Replace these parts periodically in accordance with the guidelines listed below.

Contact ADC CORPORATION or the sales representative for replacement parts.

Part name	Average life span	Remarks
Operation/Stand-by relay	100,000 cycles (When connecting a resistive load)	Replace the relay when the switching cycle between “Operate” and “Standby” reaches 100,000 cycles.
Cooling fan	40,000 hours	When the cooling fan malfunctions, “+360 Fan Stop” is displayed and pressing the “Operate” key has no effect. When it is displayed, contact the nearest ADC CORPORATION or the sales representative.
Rotary Encoder	1 million cycles	
Fluorescent character display tube	30,000 hours	

2. OPERATION

This chapter describes the names and functions of the parts on the front and rear panels and the screen display elements. This makes it possible to master the usage of the 6243/44 through performance of basic operations and examples of measurements.

2.1 Panel Descriptions

2.1.1 Front Panel Summary

The following describes the panel keys and section connectors of the front panel.

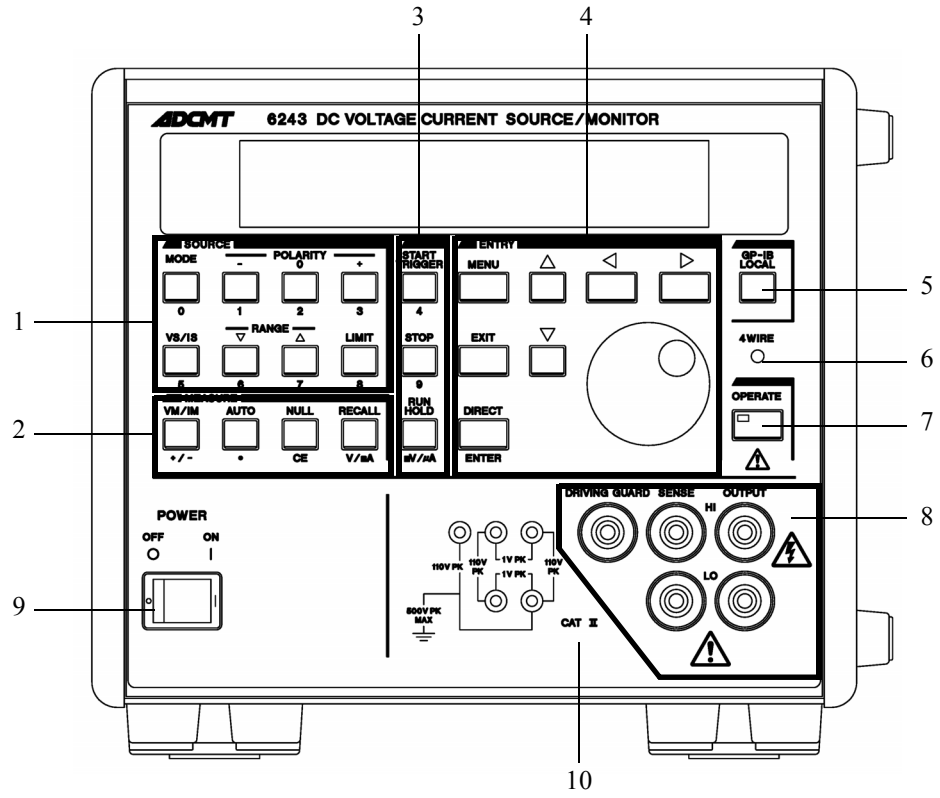


Figure 2-1 Front Panel (6243)

2.1.1 Front Panel Summary

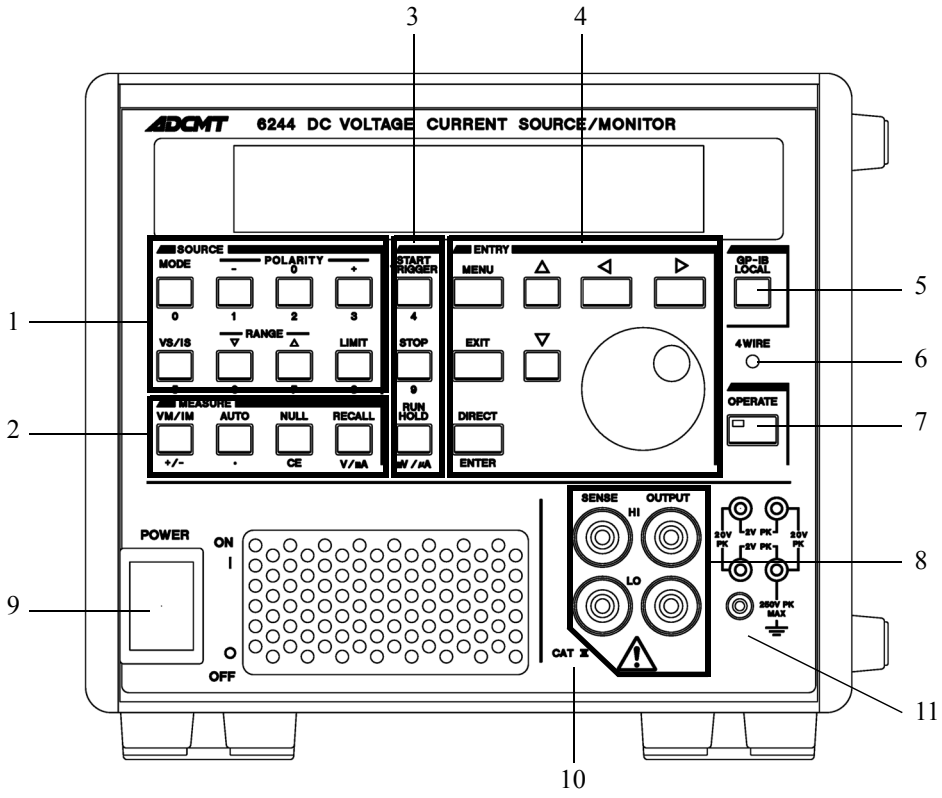


Figure 2-2 Front Panel (6244)

1. SOURCE section

MODE key: Selects the source mode (DC, Pulse, DC sweep, or Pulse sweep).

POLARITY - and + keys: Selects the polarity of the source value.

POLARITY 0 key: Temporarily sets the source value to zero, regardless of the set value.

VS/IS key: Selects the source type (Voltage source or Current source).

RANGE ▽ (**Down**), △ (**Up**) keys: Changes the source and limiter range.

LIMIT key: Toggles between the limiter value setting status and source value setting status.

2. MEASURE section

VM/IM key: Selects the measurement type (Voltage measurement or Current measurement).

AUTO key: Toggles between auto range (AUTO) and fixed range.

NULL key: Sets the NULL calculation.

RECALL key: Displays the data readout screen stored in the measured data buffer.

3. START and TRIGGER section

START/TRIGGER key:	Triggers the measurement and pulse source when the sampling is in the hold state in the DC and Pulse Source mode. Starts, pauses or restarts the sweep in the sweep source mode.
STOP key:	Stops the sweep.
RUN/HOLD key:	Selects free run/hold of measurement and pulse source in the DC, pulse source mode.

4. ENTRY section

MENU key:	Displays the parameter group selection screen.
EXIT key:	Exits the menu screen and returns to the normal screen for measurement.
▽ (**Down**), △ (**Up**) keys:	Changes the layers in the menu screen.
◁ (**Left**), ▷ (**Right**) keys:	Moves the cursor (flashing).
Data knob:	Changes the values indicated by the cursor and selects parameters.
DIRECT/ENTER key:	Moves to the key value setting mode and enters values.

5. GPIB section

GP-IB LOCAL key:	Cancel GPIB from remote control (when **RMT** is lit).

6. **4 WIRE** lamp: Lights in the remote sense (4-wire connection) status.

7. OPERATE section

OPERATE key:	Selects between the Operate (output: ON) and Standby (output: OFF).

WARNING: ***The 6243***
When the output is set to OPERATE, hazardous voltage is output depending on the setting. Be careful of electric shocks.

8. Output terminal section

OUTPUT terminals (**HI**, **LO**):	Output terminals for voltage and current
SENSE terminals (**HI**, **LO**):	Output terminals for voltage output sense in the Remote Sense mode (4-wire connection) and input terminals for current measurement
DRIVING GUARD terminal (**6243** only):	Output terminal for driving guard (method to guard the HI side connection at the same potential as that of the HI SENSE terminal)

WARNING: ***A hazardous voltage is output if conditions such as the following occur: the instrument is damaged, an external hazardous voltage is applied, or relevant setting conditions occur. Be careful of electric shocks.***

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.***

9. **POWER** switch: Turns the power ON/OFF.

10. **CAT** II: This indicates that the 6243/44 complies with the Installation safety requirements for Category II as stipulated by IEC61010 regulations. Installation category (overvoltage category): Classification of parts of installation systems or circuits with standardized limits for transient overvoltages, dependent on the nominal line voltage to earth.
11. Lock screw holes for blocking I/O terminals (6244 only):
    Screw holes for the accessory (A01046) lock.
    To attach the accessory, refer to the instructions provided.

2.1.2 Screen Display

The following describe the screen display.

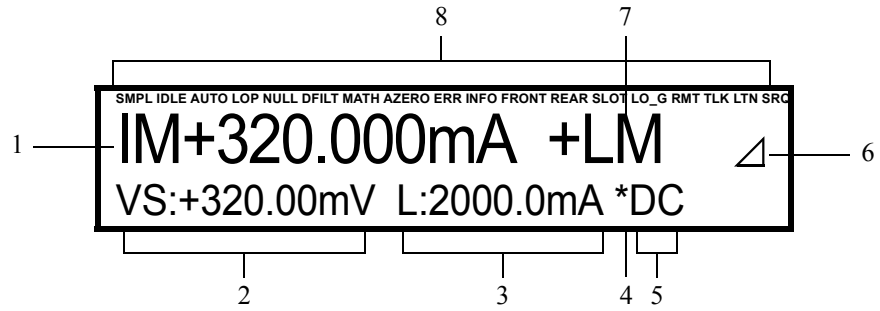


Figure 2-3 Screen Element Descriptions

1. Measured value: Measured value of voltage measurement (VM) or current measurement (IM)
2. Source value: Voltage source value (VS) or current source value (IS)
3. Limiter (compliance) value: Voltage limiter setting (VL) or current limiter setting (IL)
4. Sampling mode: * is indicated when free run is selected for the DC or Pulse Source mode, and when the Sweep Source mode in automatic sweep.
5. Source mode: One of the following abbreviations appears.

   DC: DC
   PLS: Pulse
   SWP: DC sweep
   PSW: Pulse sweep
6. TR6143 mode: Indicates the TR6143 mode.

   ⊿: TR6143 Mode1
   B: TR6143 Mode 2
7. Alarm or Comparator calculation result:
   One of the following indications is shown when an alarm is generated and the Comparator calculation result is indicated.

   +LM, -LM, +lm, -lm: The limiter (compliance) is operating.
   OSC, osc: Oscillation detection
   +RP, -RP, +rp, -rp: Reversed polarity source status (output is in reverse polarity to the indicated source value),
   HI, GO, LO: Indicates the comparator calculation result.

8. Indicators: The indicators are as follows:

AUTO:	Measurement in the auto range.
NULL:	NULL setting is ON.
AZERO:	Auto Zero is ON.
SLOT:	Memory processing of the measured values is in progress.
INFO:	When jitter occurs because the internal processing does not meet the set time parameter.
RMT:	GPIB remote status
TLK:	GPIB talker status
LTN:	GPUB listener status
SRQ:	Sending GPIB SRQ

2.1.3 Rear Panel Summary

The following explain the terminals, connectors and indicators on the rear panel.

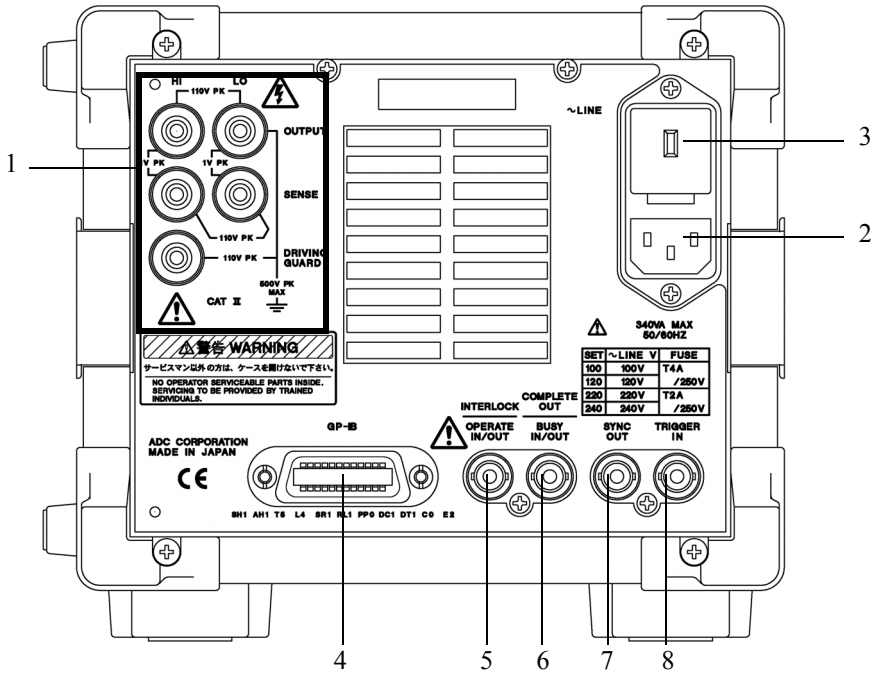


Figure 2-4 Rear Panel (6243)

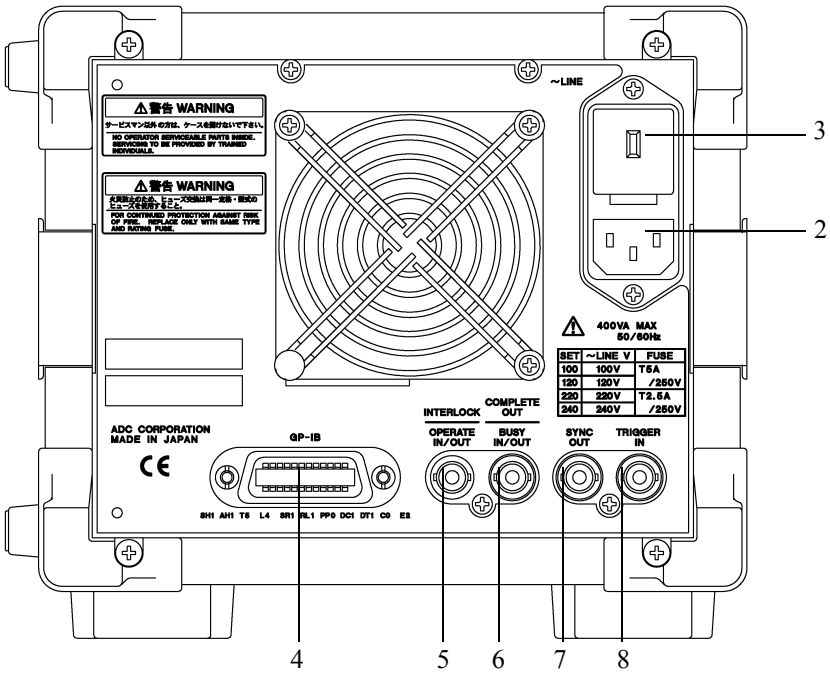


Figure 2-5 Rear Panel (6244)

1. Output terminal section (only 6243)

   OUTPUT terminals (**HI and LO**):Voltage and current output terminals

   SENSE terminals (**HI and LO**):Voltage output terminals in the remote sense mode (4-wire connection) and current measurement input terminals

   DRIVING GUARD terminal: Driving guard output terminal (of Guards the HI side connection while at the same potential as that of the HI SENSE terminal)

WARNING:  ***A hazardous voltage is output if conditions such as the following occur: the instrument is damaged, an external hazardous voltage is applied, or relevant setting conditions occur. Be careful of electric shocks.***

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. AC power connector: Connects the 6243/44 to the AC power supply through this connector with the supplied power cable.

3. Voltage selector, fuse holder: Allows the voltage setting to be switched manually to match the used AC line voltage. A fuse is contained inside the holder.

4. **GP-IB** connector: Used for connecting the 6243/44 to an external controller with a GPIB cable.

5. **INTERLOCK OPERATE IN/OUT** connector:
   Interlock Connector used to operate the ON/OFF input signal, or the ON/OFF output signal.
   At TTL level open drain output, the output is pulled up to +5 V with 10 KΩ.
   For input, the input impedance is approximately 10 KΩ and for output, the output impedance is approximately100 Ω.

6. **COMPLETE OUT BUSY IN/OUT** connector:
   Connector used to output the measurement completion signal, and the I/O signal while the measurement is in progress (busy).
   The completion signal is a negative pulse. The pulse width depends on the setting (20 μs to 30 μs or 100 μs to 200 μs) of the pulse width at the external control signal output.
   At the TTL level open drain output, the output is pulled up to +5 V with 10 KΩ.
   For input, the input impedance is approximately 10 KΩ and for output, the output impedance is approximately 100 Ω.

7. **SYNC OUT** connector: Output connector used to output the signal synchronized with the pulse and sweep source value output.
   At the TTL level open drain output, the output is pulled up to +5 V with 10 KΩ. The output signal is a negative pulse. The pulse width depends on the setting (20 μs to 30 μs or 100 μs to 200 μs) of the pulse width of the external control signal output. The output impedance is approximately 100 Ω.

8. **TRIGGER IN** connector: Input connector used for inputting the measurement trigger for DC and pulse, and for the start, pause, step up trigger for sweep. The TTL level input impedance is approximately 4.7 KΩ, and the input is a negative pulse (pulse width: 10 μs or wider).

WARNING: ***The 6243 When the output is set to OPERATE by using the GPIB command or the OPERATE IN/OUT signal, hazardous voltage is output depending on the setting. Be careful of electric shocks.***

2.2 Basic Operations

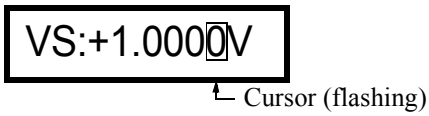
This section explains how to set the source and limiter values, how to operate the menus and how to use the basic measurement functions.

2.2.1 Setting the Source and Limiter Values

(1) Setting numeric values using the cursor and Data knob

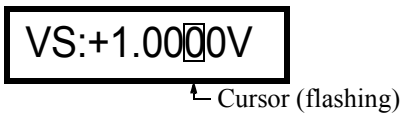
The source and limiter values can be set by rotating the Data knob to change the numeric value at the (flashing) cursor position.

Example.

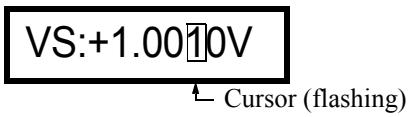


Setting the numeric value

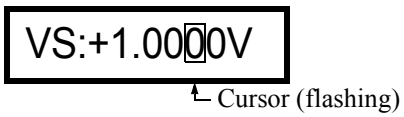
1. Press the ◁ key.
   The cursor moves to the left.



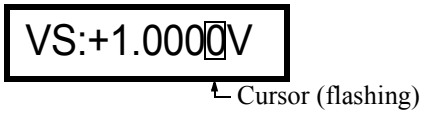
2. Rotate the Data knob clockwise.
   The figure indicated at the cursor position increases by 1.



3. Rotate the Data knob counterclockwise.
   The figure indicated at the cursor position decreases by 1.



4. Press the ▷ key.
   The cursor moves to the right.



(2) Setting the numeric value by direct input

When the **DIRECT** key is pressed, the direct input mode is set. Use of the numeric keys is indicated in blue, and the unit (V/mA and mV/μA) keys become available.

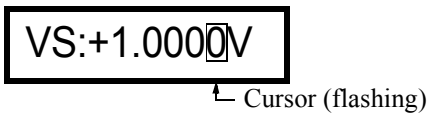
The following two ways are available for direct input.

- When the unit (**V/mA** or **mV/μA**) key is pressed after the value is set, the range is automatically selected so that the set value becomes the maximum number of digits.
- When the unit (**V/mA** or **mV/μA**) key is not pressed after the value is set.

  Setting is done at the current range.

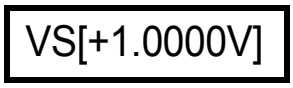
  It is judged whether or not the displayed value (including the 6243/44) immediately before the **ENTER** key is pressed, is within the current range. If outside the range, an error is generated and the display flashes.

Example

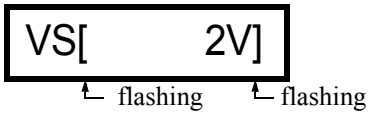


Setting the numeric value

1. Press the **DIRECT** key.
   [ ] appears and indicates that the mode is the direct input mode.

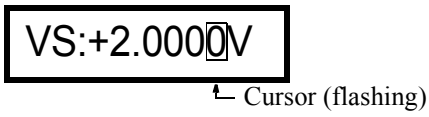


2. Press the **2** key.
   [ ] flashes and indicates that numeric input is in progress.



3. Press the **V/mA** key.
   A 6243/44 valid for the current source function is set.

4. Press the **ENTER** key.
   The numeric value is entered and the direct input mode is released.

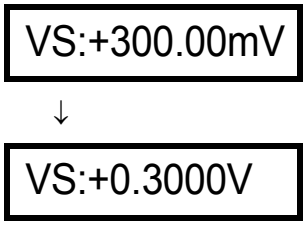


(3) Changing the source and limiter ranges.

The source and limiter ranges are changed by pressing the **RANGE** ▽ (**Down**) or △ (**Up**) key.

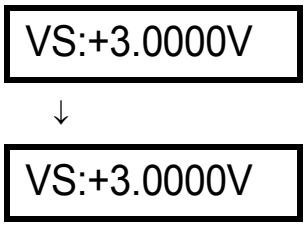
- Range change is performed so that the value before the change becomes the same as the value after the change.

  When the **RANGE** △ (**Up**) key is pressed while the following screen is displayed.
  The range becomes the 3.2 V range.



- The change is not effected if the value after the change exceeds the range limit.

  When the **RANGE** ▽ (**Down**) key is pressed while the following screen is displayed.
  The range does not change as +3 V is outside the limit of the 320 mV range.



2.2.2 Menu Operations and Parameter Settings

Menu operations using the **MENU** key and methods for setting parameters are explained.

Figure 2-6 shows the menu structure of the **MENU** key.

NOTE: ***In accordance with the setting status of the 6243/44, parameters which cannot be changed are not displayed.***

---

1. Press the **MENU** key.

   The parameter group selection screen appears.
   Rotate the Data knob to select the desired parameter group.

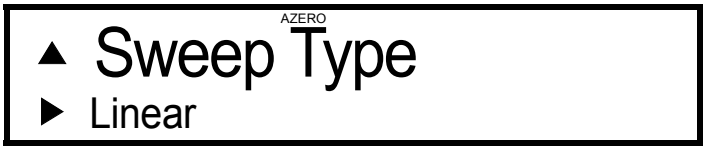
2. Press the ▽ key.

   The parameter item selection screen appears.
   Rotate the Data knob to select the desired parameter item.

3. Press the ▽ key.

   The parameter setting screen appears.
   The following 4 parameter setting ways are available.

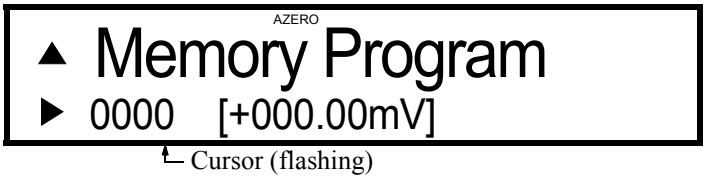
   - When the parameter is indicated by a ▶, the parameter is selected with the Data knob.
     Display example:



   - When the parameter is enclosed in [ ], the numeric value can be entered with the numeric keys and the unit (V/mA or mV/μA) key followed by the **ENTER** key.
     Display example:

   - When ↳ Execute (Press the DIRECT key) is displayed, press the **DIRECT/ENTER** key.
     The selected item is executed.
     Display example:

- When setting the random sweep data, specify the memory address with the Data knob and enter the value with the numeric keys and the unit (V/mA or mV/μA) key.
  Display example:



4. To set the next parameter item, press the △ key.

   The parameter item selection screen appears.

   To set the next parameter group, press the △ key twice, or press the **MENU** key. The parameter group selection screen appears.

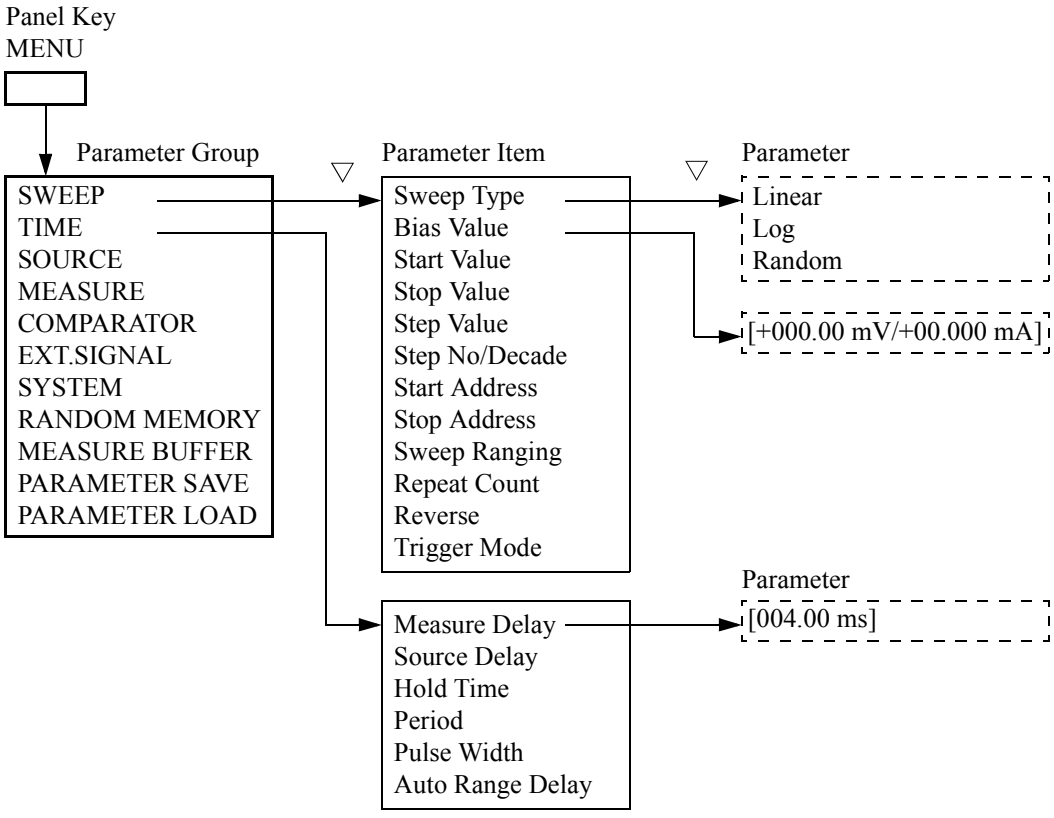


Figure 2-6 Menu Structure (**MENU** key)

2.2.3 DC Measurement

This section explains basic methods of use, i.e., current measurement using a DC voltage source (VSIM), the current limiter by changing the source voltage value, and voltage measurement using a current source (ISVM).
A 1 KΩ resistor is used as the DUT for the measurement.
Figure 2-7 shows the operating statuses and operating points in DC measurements.

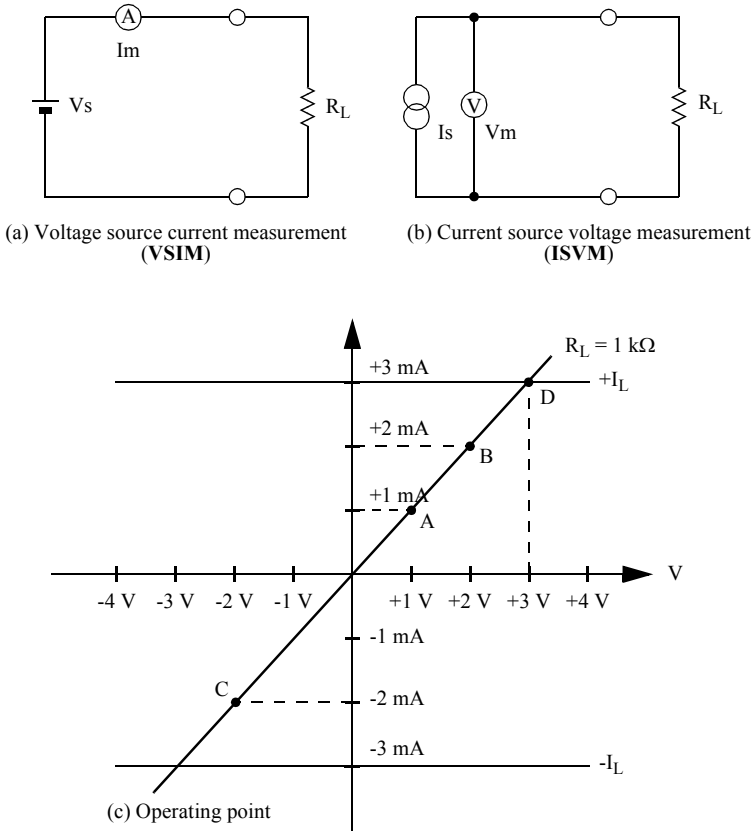


Figure 2-7 Explanatory Drawing of DC Measurement

NOTE: ***To ensure accurate measurement, use the 6243/44 within the specified temperature range. Allow the 6243/44 to warm up for at least 60 minutes after the power is turned ON. In the following example, the warm up stage is assumed to have been completed.***

Turning the power ON.

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

NOTE: ***To prevent 6243/44 failure, do not apply an input voltage or frequency to the 6243/44, that exceeds the specified ranges.***

3. Plug the other end of the power cable into the AC outlet.
4. Set the **POWER** switch on the front panel to ON.
   When the self-test is finished, the measurement screen appears.

NOTE: ***The display after the power is turned ON may vary depending on the conditions saved to "Save 0" during the 6243/44's previous use.***

Initializing the setting conditions

Initializing the 6243/44's setting statuses

5. Press the **MENU** key.
   The parameter group selection screen appears.
6. Select ***PARAMETER LOAD*** by rotating the Data knob.
7. Press the ▽ key.
8. Select ***Load Default*** (parameter) by rotating the Data knob.
9. Press the ▽ key.
10. Press the **DIRECT/ENTER** key.
    Upon completion of initialization, "Done" appears.
11. Press the **EXIT** key.
    The measurement screen returns.

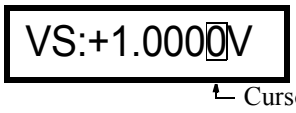
Connecting the DUT

Connect the DUT with the supplied input and output cable and alligator clips.

12. Connect the A08532 alligator clips to the supplied A01044 input and output cable.
13. Connect the input and output cable to **HI OUTPUT** and **LO OUTPUT terminals** of this instrument.
14. Clip the DUT 1 KΩ resistor with the alligator clips.

Setting the source value

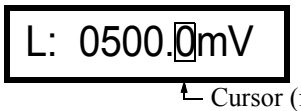
15. Press the **DIRECT, 1, V,** and **ENTER** keys in order.



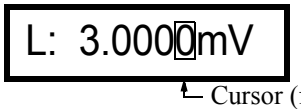
appears.

Setting the current limiter

16. Press the **LIMIT** key.
    The cursor moves to the limiter indication.



17. Press the **DIRECT, 3, mA,** and **ENTER** keys in order.



18. Press the **LIMIT** key.
    The cursor moves to the source value.

NOTE: ***The following show the ideal source and measurement values assuming no errors exist in the measured object (the 1 KΩ resistor), the cable resistance, and the 6243/44 itself.***
Actual measurement values will be different from the values used here due to the above error factors.

---

19. Press the **OPERATE** key.
    The **OPERATE** lamp starts flashing and the status is set to Operate (output: ON). The measured current value when 1 V is applied to the 1 KΩ resistor appears. (Indicating the current value of operating point A shown in Figure 2-7 (c).)

20. Move the cursor with the ◁ key and set the voltage source value to ***2 V*** using the Data knob.

    The measured current value when 2 V is applied to the 1 KΩ resistor appears.
    (Indicating the current value of operating point B shown in Figure 2-7 (c).)

21. Press the **POLARITY -** key to set the voltage source value to ***-2 V***.

    The measured current value when -2 V is applied to the 1 KΩ resistor appears.
    (Indicating the current value of operating point C shown in Figure 2-7 (c).)

22. Press the **DIRECT, +/-, 4, V,** and **ENTER** keys in order.

    The voltage source value becomes 4 V in the 32 V range. (4 V in the 20 V range of the 6244.)
    "***+Im***" appears because the current is restricted by the limiter.
    (Indicating the current value of operating point D shown in Figure 2-7 (c).)

23. Press the **VM/IM** key.

    The voltage between the HI-LO terminals appears.
    (Indicating the voltage value of operating point D shown in Figure 2-7 (c).)

24. Press the **VS/IS** key.

    The function becomes the current source function and the limiter display disappears.
    (Indicating the voltage value of operating point D shown in Figure 2-7 (c).)

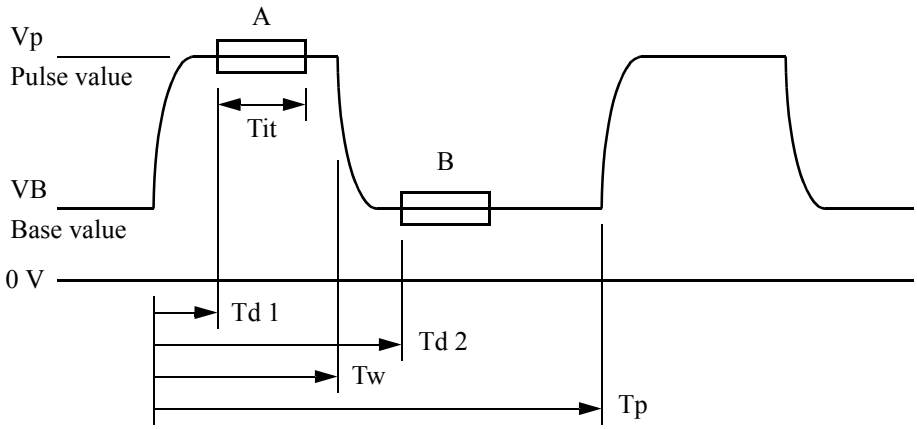
25. Press the **OPERATE** key.

    The **OPERATE** lamp goes out, and the source status is set to Standby (output: OFF).

2.2.4 Pulse Mode Measurement

This section describes an example of the Pulse Source mode measurements.

The described example is one in which measurement points A and B are measured by switching using the voltage source and current measurement (VSIM) mode as shown in Figure 2-8.



Td 1	:	Measure delay (When the measurement point is A:)	; 4 ms	(Default)
Td 2	:	Measure delay (When the measured point is B:)	; 60 ms	
Tw	:	Pulses width	; 50 ms	
Tp	:	Period	; 130 ms	
Tit	:	Integration time	; 1 PLC	(Default)
Vp	:	Pulse value	; 2 V, 2.5 V	
VB	:	Base value	; 1 V, 0.5 V	

Figure 2-8 Pulse Mode Measurement

Initializing the setting conditions

Initializing the 6243/44

1. Press the **MENU** key.
   The parameter group selection screen appears.
2. Select ***PARAMETER LOAD*** in the parameter group by rotating the Data knob.
3. Press the ▽ key.
4. Select the ***Load Default*** parameter by rotating the Data knob.
5. Press the ▽ key.
6. Press the **DIRECT/ENTER** key.
   Upon initialization completion, “Done” appears.
7. Press the **EXIT** key.
   The measurement screen returns.

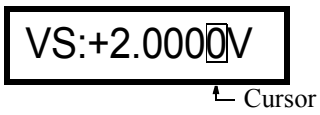
Connecting the DUT

Connect the DUT using the test leads and alligator clips.

8. Connect the alligator clips A08532 to the supplied test leads A01044.
9. Plug the test leads into the **HI OUTPUT** and **LO OUTPUT** terminals.
10. Clip the 1 KΩ resistor with the alligator clips.

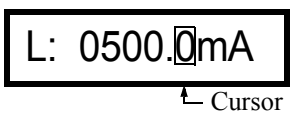
Setting the Pulse value (source value)

11. Press the **DIRECT, 2, V,** and **ENTER** keys in order.

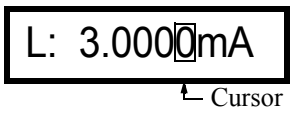


Setting the Current limiter

12. Press the **LIMIT** key.
    The cursor moves to the limiter indication.



13. Press the **DIRECT, 3, mA,** and **ENTER** keys in order.



14. Press the **LIMIT** key.
    The cursor moves to the source value.

Setting the Base value

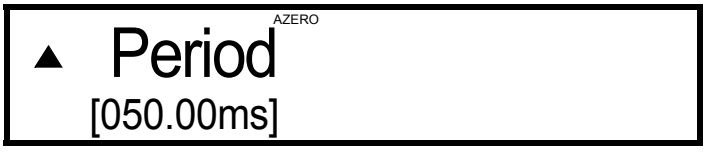
15. Press the **MENU** key.
    The parameter group selection screen appears.
16. Select ***SOURCE*** in the parameter group by rotating the Data knob.
17. Press the ▽ key.

18. Press the ▽ key.

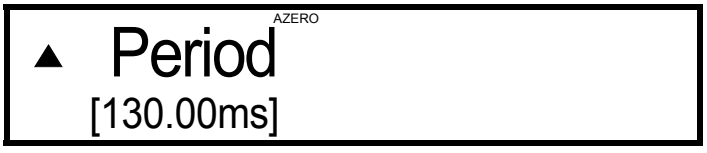
19. Press the **1, V,** and **ENTER** keys in order.

Setting the Period, pulses width, and Measure delay time

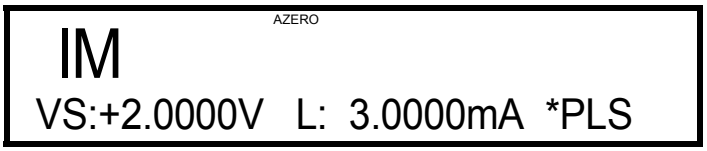
20. Press the △ key twice or press the **MENU** key. The parameter group selection screen returns. Select ***TIME*** in the parameter group by rotating the Data knob.
21. Press the ▽ key and select the ***Period*** parameter by rotating the Data knob.
22. Press the ▽ key.



23. Press the **1, 3, 0, ENTER** keys.



24. Press the △ key and select the ***Pulse Width*** parameter by rotating the Data knob.
25. Set the ***Pulse Width*** to 50 ms using the same procedure as in steps 22 and 23.
26. Press the **EXIT** key.
    The measurement screen appears.
27. Press the **MODE** key.
    The mode is set to the pulse source mode.



NOTE: ***The following show the ideal source and measurement values assuming no errors exist in the measured object (the 1 KΩ resistor), the cable resistance, and the 6243/44 itself.***
Actual measurement values will be different from the values used here due to the above error factors.

Current measurement at a pulse value

28. Press the **OPERATE** key.
    The **OPERATE** lamp lights and the source status is set to Operate (output: ON).
    The measured current value, at the pulse value of 2 V, appears.
    (Measured value at point A in Figure 2-8)

29. Move the cursor with the ◁ key and set the source value (pulse value) to ***2.5 V*** by rotating the Data knob.
    The measured current value, at the pulse value of 2.5 V, appears.

Current measurement at a base value

30. Press the **MENU** key.

    Select ***TIME*** in the parameter group by rotating the Data knob. Select the ***Measure Delay*** parameter and set this to ***60 ms***.

31. Press the **EXIT** key.

    The measurement point moves to point B in Figure 2-8, and the measured current, at the base value, appears.

32. Press the **MENU** key.

    Select ***SOURCE*** in the parameter group by rotating the Data knob. Select the ***Base Value*** parameter and set this to ***0.5 V***.

33. Press the **EXIT** key.

    The measured current at the base value changes.

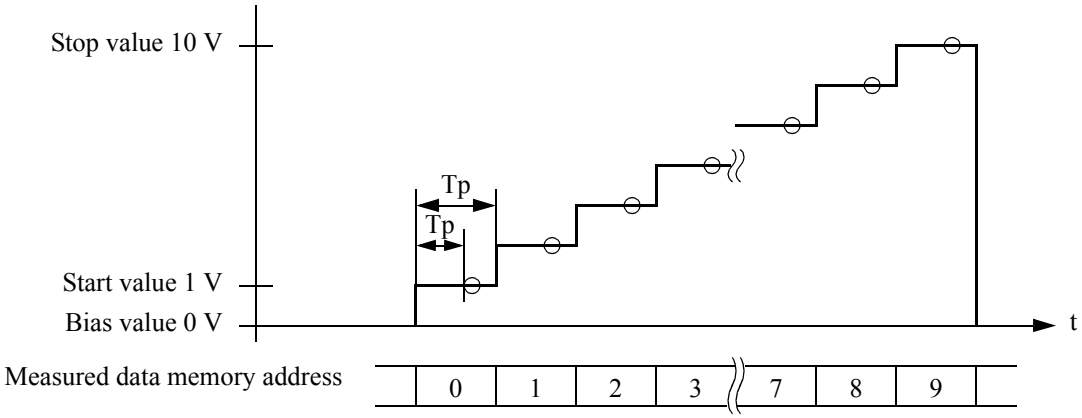
34. Press the **OPERATE** key.

    The **OPERATE** lamp goes out, and the status becomes Standby (output: OFF).

2.2.5 Sweep Mode Measurement

The following describe the procedures followed until the measurement result is read out from the memory using the sweep source mode.

A Linear sweep from 1 V to 10 V is performed in 1 V steps as shown in Figure 2-9 using voltage source and current measurement (VSIM).



Sweep type	:	Linear	(Default)
Bias value	:	0 V	(Default)
Start value	:	1 V	
Stop value	:	10 V	
Step value	:	1 V	(Default)
Integration time	:	1 PLC	(Default)
Measure delay (Td)	:	4 ms	
Period (Tp)		100 ms	
Current limiter		30 mA	

Figure 2-9 Sweep Mode Measurement

Initializing the setting conditions

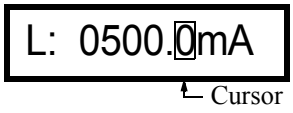
Initializing the 6243/44

1. Press the **MENU** key.
   The parameter group selection screen appears.
2. Select ***PARAMETER LOAD*** in the parameter group by rotating the Data knob.
3. Press the ▽ key.
4. Select the ***Load Default*** parameter by rotating the Data knob.
5. Press the ▽ key.
6. Press the **DIRECT/ENTER** key.
   Upon initialization completion, “Done” appears.

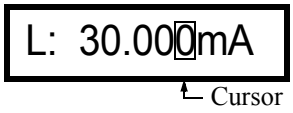
7. Press the **EXIT** key.
   The measurement screen returns.

Setting the current limiter

8. Press the **LIMIT** key.
   The cursor moves to the limiter indication.



9. Press the **DIRECT, 3, 0, mA,** and **ENTER** keys in order.



10. Press the **LIMIT** key.
    The cursor moves to the source value.

Setting the sweep source mode

11. Press the **MODE** key twice.
    The sweep mode is selected and SWP appears in the lower right of the screen.

Setting the start value, stop value and step value

12. Press the **MENU** key.
13. Select ***SWEEP*** in the parameter group by rotating the Data knob.
14. Press the ▽ key and confirm that ***Linear*** (linear sweep) appears as shown below.

15. Rotate the Data knob clockwise by one click and confirm that the Bias Value shows 0 mV.

16. Rotate the Data knob clockwise by one click.

17. Press the ▽ key.

18. Press the **1, V,** and **ENTER** keys in order.

19. Press the △ key and rotate the Data knob clockwise by one click.

20. Press the ▽ key. The Stop Value setting screen appears. Press the **1, 0, V,** and **ENTER** keys in order.

21. Set the Step Value to ***1 V*** using the same procedure as in steps 22 and 23.

Setting the period

22. Press the △ key twice or press the **MENU** key. The parameter group selection screen returns. Select ***TIME*** in the parameter group by rotating the Data knob.

23. Press the ▽ key and select the ***Period*** parameter by rotating the Data knob.

24. Press the ▽ key.

25. Press the **1, 0, 0,** and **ENTER** keys.

Turning ON the Memory Store

26. Press the △ key twice and select ***MEASURE BUFFER*** in the parameter group by rotating the Data knob.

27. Press the ▽ key.

28. Press the ▽ key and change the display to ***Normal*** by rotating the Data knob.

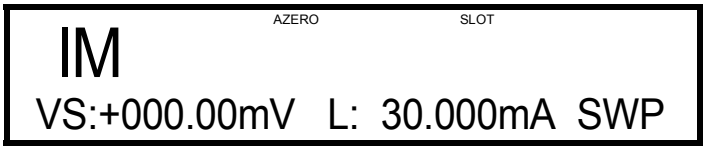
29. Press the **EXIT** key.
    The measurement screen returns.

NOTE: ***The following show the ideal source and measurement values assuming no errors exist in the measured object (the 1 KΩ resistor), the cable resistance, and the 6243/44 itself.***
Actual values will be different from the values used here due to the above error factors.

Starting the Sweep mode measurement

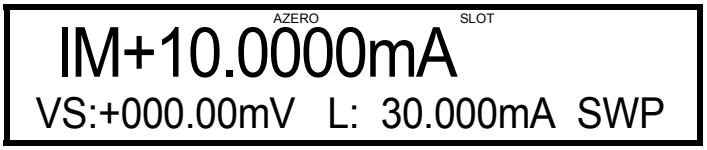
30. Press the **OPERATE** key.

    The **OPERATE** lamp lights up and the source status becomes the Operate (output: ON).
    The source value indicates the Bias value.



31. Press the **START/TRIGGER** key.

    When the Sweep mode measurement is completed, the measurement data of the stop value appears.
    The source value indicates the Bias value.



Reading out the measured results

Reading out the data measured by the Sweep mode measurement

32. Press the **OPERATE** key.

    The source status becomes Standby (output: OFF).

33. Press the **RECALL** key.

    The data stored in the memory address 0 appears.

34. Read the data by rotating the Data knob to change the memory address.

35. Press the **RECALL** key.

    The measurement screen returns.

Turning OFF the Memory Store

36. Press the **MENU** key. Select ***MEASURE BUFFER*** in the parameter group by rotating the Data knob. Set the ***Memory Store*** parameter to ***OFF***. (SLOT in the indicator section goes out.)

NOTE: When the memory is not used, set Memory Store to OFF.

Clearing the memory

37. Select ***MEASURE BUFFER*** in the parameter group and select the ***Memory Clear*** parameter.

38. Press the ▽ key.

39. Press the **DIRECT** key.

40. Press the **EXIT** key.

    The measurement screen returns.

2.3 Measurement Example

2.3.1 Measuring a Diode

The following describes examples of measuring a diode's forward voltage (VF) using a pulse current source and its reverse leak current (IR) by DC voltage source.

NOTE:

1. ***Use a 4-wire connection to ensure an accurate forward voltage measurement.***
2. ***For the 6243, use a shielded cable with driving guard to ensure an accurate measurement of leak current below 1 μA.***
   For details, refer to Section 4.1, "DUT Connection."

The measurement conditions are indicated below.

VF measurement: The forward voltage (VF) by applying a 100 mA current is measured using a pulse in order to prevent a heat generation. The measurement is also made using a NULL calculation in order to cancel errors caused by a voltage drop in the cable when using the 2-wire connection.

VF measurement conditions		
Source mode	:	Pulse
Pulse current	:	100 mA
Base current	:	0 mA
Limiter	:	1.5 V
Pulse width	:	5 ms
Period	:	100 ms
integration time	:	1 ms
Measure delay	:	3 ms
Measurement range	:	VM Auto
NULL	:	ON

IR measurement: The leak current is measured when a 20 V DC voltage is applied in the reverse direction. It is measured with an integration time of 10 PLC in order to cancel induced noise. Also, the measurement is made using NULL calculation in order to cancel errors due to cable leak and CMV.

IR measurement condition		
Source mode	:	DC
Source voltage	:	20 V
Limiter	:	300 μA
Period	:	250 ms
integration time	:	10 PLC
Measurement range	:	IM Auto
NULL	:	ON

Initialing the setting conditions

Initializing the 6243/44

1. Press the **MENU** key.
   The parameter group selection screen appears.
2. Select ***PARAMETER LOAD*** in the parameter group by rotating the Data knob.
3. Press the ▽ key.
4. Select the ***Load Default*** parameter by rotating the Data knob.
5. Press the ▽ key.
6. Press the **DIRECT/ENTER** key.
   Upon initialization completion, “Done” appears.
7. Press the **EXIT** key.
   The measurement screen returns.

Connecting the DUT

8. Connect the diode as shown in Figure 2-10.
   The example illustrated here shows a 2-wire connection.

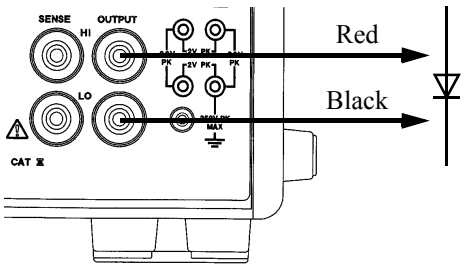


Figure 2-10 Connections for Diode Measurement

Measuring the diode forward voltage (VF)

9. Press the **MENU** key and select ***TIME*** in the parameter group by rotating the Data knob.

   Press the ▽ key and select the ***Measure Delay*** parameter by rotating the Data knob.
   Press the ▽ key and press the **3,** and **ENTER** keys.
   Measure Delay is set to 003.00 ms.

   Press the △ key and select the ***Period*** parameter by rotating the Data knob.
   Press the ▽ key and press the **1, 0, 0,** and **ENTER** keys.
   Period is set to 100.00 ms.

   Press the △ key and select the ***Pulse Width*** parameter by rotating the Data knob.
   Press the ▽ key and press the **5,** and **ENTER** keys.
   Pulse width is set to 005.00 ms.

   Press the △ key twice or press the **MENU** key, and select ***MEASURE*** in the parameter group by rotating the Data knob.

   Press the ▽ key and select the ***Integration Time*** parameter by rotating the Data knob.
   Press the ▽ key and select ***1 ms*** by rotating the Data knob.
   Integration Time is set to 1 ms.

10. Press the **EXIT** key.

    The measurement screen returns.

11. Press the **MODE** key.

    The mode becomes the pulse source mode.

12. Press the **VS/IS** key.

    The function becomes the current source function.

13. Press the **DIRECT, 1, 0, 0, mA,** and **ENTER** keys.

    The source current is set to 100 mA.

14. Press the **LIMIT, DIRECT, 1, ., 5. V,** and **ENTER** keys.

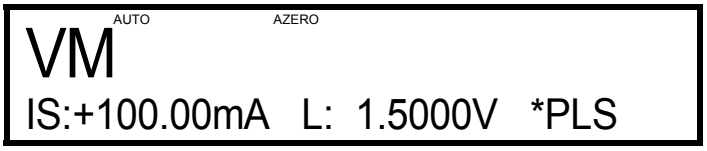
    The voltage limiter is set to 1.5 V.

15. Press the **LIMIT** and **VM/IM** keys.

    The function becomes the voltage measurement function.

16. Press the **AUTO** key.

    The measurement auto range is invoked and the following display appears.



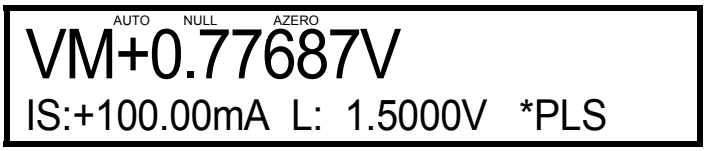
NOTE: ***The following values are for reference only. Actual measurement values will be different from the values used here due to errors caused in the 6243/44, cable resistance and device characteristics.***

Acquiring NULL data (canceling errors caused by cable resistance)

17. Short-curcuit the HI OUTPUT cable (red) with the LO OUTPUT lead (black).
18. Press the **OPERATE** key.

19. Press the **NULL** key.

20. Press the **OPERATE** key.
    The status is change to Standby.
21. Connect the HI OUTPUT (red) lead to the diode's anode.
22. Press the **OPERATE** key.
    The measured result of the diode's forward voltage appears.



23. Press the **NULL** and **OPERATE** keys.
    The status is change to Standby.

Measuring the diode reverse leak current (IR)

24. Press the **MODE** key 3 times.
    The mode becomes the DC source.
25. Press the **VS/IS** key.
    The function becomes the Voltage source.
26. Press the **VM/IM** key.
    The function becomes the Current measurement.

27. Press the **MENU** key and select ***TIME*** in the parameter group by rotating the Data knob.

    Press the △ key and select the ***Period*** parameter by rotating the Data knob.
    Press the ▽ key and press the **2, 5, 0,** and **ENTER** keys.
    Period is set to 250.00 ms.

    Press the △ key twice or press the **MENU** key, and select ***MEASURE*** in the parameter group by rotating the Data knob.

    Press the ▽ key and select the ***Integration Time*** parameter by rotating the Data knob.
    Press the ▽ key and select ***10 PLC*** by rotating the Data knob.
    Integration Time is set to 10 PLC.

28. Press the **EXIT** key.

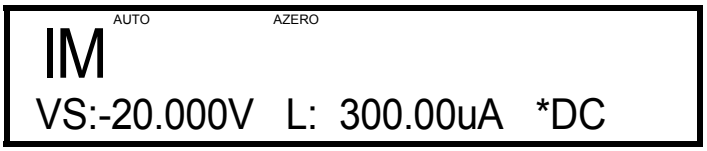
    The measurement screen returns.

29. Press the **DIRECT, +/-, 2, 0, V,** and **ENTER** keys.

    Source voltage is set to -20 V.

30. Press the **LIMIT, DIRECT, 3, 0, 0, μA,** and **ENTER** keys.

    The current limiter is set to 300 μA.



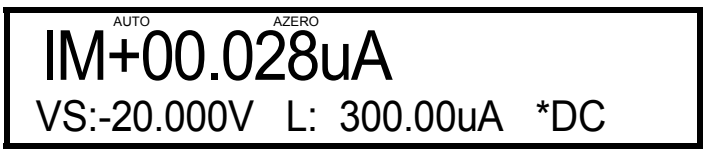
NOTE: ***The following values are for reference only. Actual measurement values will be different from the values used here due to 6243/44 internal errors and device characteristics.***

Acquiring NULL data (canceling errors)

31. Disconnect the HI OUTPUT lead (red).

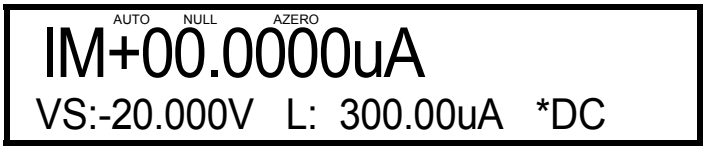
    The status becomes open.

32. Press the **OPERATE** key.



Note

33. Press the **NULL** key.



Note

34. Press the **OPERATE** key.
    The status becomes Standby.
35. Connect the HI OUTPUT (red) lead to the diode's anode.
36. Press the **OPERATE** key.
    The measured result of the diode's reverse leak current (IR) appears.

Note

NOTE: ***For 6244, the current measurement range becomes the 320 μA range.***

37. Press the **OPERATE** key.
    The status becomes Standby.

2.3.2 Battery Charge Test and Discharge Test

The following explain examples of a charge test and a discharge test of secondary batteries such as NiCad and nickel metal hydride batteries.

As the charge and discharge tests by nature require a long time, they should be performed in a system utilizing GPIB. However, the examples given here describe the manual operations with the aim of using and demonstrating the functions of the 6243/44.

A DC constant-current, constant-voltage charge is used for charging, which is finished when the charging current drops below the specified current.

A pulse constant current is used for discharge, which is finished when the battery voltage drops below the specified voltage. The voltage values registered during discharge are stored in the memory and read out upon completion of the test.

However, the memory accommodates up to 5000 data items only and if exceeded, the discharge continues but the data is not stored.

Consequently, only data up to 5000 seconds (= 1.38 hour) are acquired in this example.

NOTE:

1. ***Use a 4-wire connection to ensure accurate voltage measurement.***
2. ***Note for the settings of the source value and limiter value in order to prevent application of a high voltage/ current in relation to the battery's rated voltage and capacity.***

The measurement conditions are listed below.

Charge test: Charging is performed with a 1 A constant current, and when a charge voltage of 1.45 V is reached the charging begins using the constant voltage.
When the charge current drops below 100 mA, the charge is completed.

Electric-charge test conditions		
Source mode	:	DC
Source current	:	1 A
Limiter	:	1.45 V
Period	:	1 s
integration time	:	1 PLC
Measurement range	:	2A range fixed
Memory	:	OFF
Comparator	:	ON
	:	When the charged voltage falls to 100 mA or less, the test is completed.
Remote sensing	:	4 Wire

Discharge test: As shown in Figure 2-11, discharging is performed with a constant current of 2 A, pulse width 100 ms and a cycle of 1 sec. The discharge is completed when the voltage reaches 1.0 V during the discharge.
The battery voltage values registered during the discharge are stored in the memory and read out upon completion of the test.
However, the number of stored data is restricted by the memory capacity. This means that only up to 5000 seconds of data from the start of the discharging can be stored.

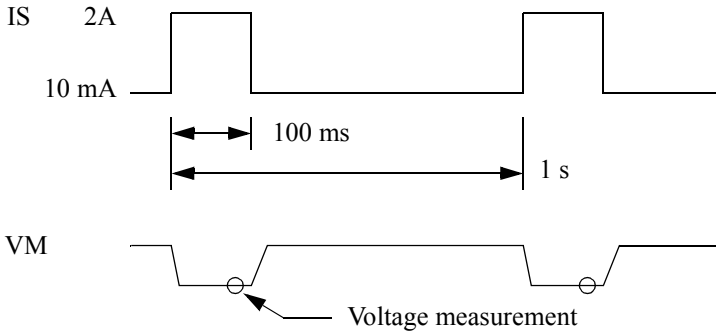


Figure 2-11 Waveform of Battery Discharge Test

Discharge test conditions		
Source mode	:	Pulse
Pulse current	:	2 A
Base current	:	10 mA
Pulse width	:	100 ms
Period	:	1 s
integration time	:	1 ms
Measure delay	:	98 ms
Measurement range	:	3.2 V range fixed
Memory	:	Normal-ON
Comparator	:	ON When discharged voltage becomes 1.0 V or less, the test is completed.
Remote sensing		4 Wire

Initialing the setting conditions

Initializing the 6243/44

1. Press the **MENU** key.
   The parameter group selection screen appears.
2. Select ***PARAMETER LOAD*** in the parameter group by rotating the Data knob.
3. Press the ▽ key.
4. Select the ***Load Default*** parameter by rotating the Data knob.
5. Press the ▽ key.
6. Press the **DIRECT/ENTER** key.
   Upon initialization completion, “Done” appears.
7. Press the **EXIT** key.
   The measurement screen returns.

Connecting the DUT

8. Connect the leads using 4-wire as shown in Figure 2-12 to eliminate voltage drop caused by the leads.

9. Connect the **COMPLETE OUT** terminal and the **OPERATE IN** terminal on the rear panel using the BNC-BNC cable A01036.
The charging and discharging are completed automatically.

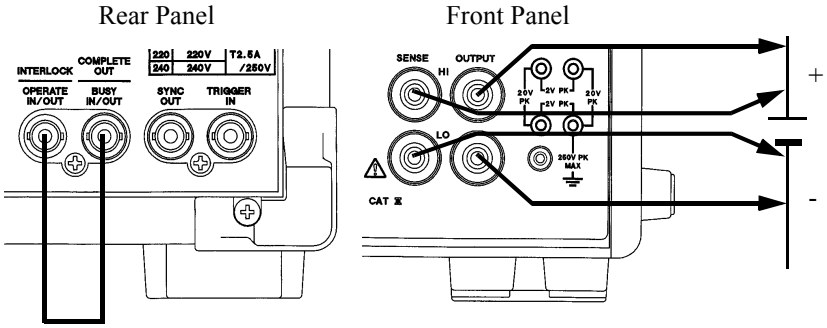


Figure 2-12 Connections for Battery Charge and Discharge Test

Charge Test

10. Press the **MENU** key. Select ***TIME*** in the parameter group by rotating the Data knob.

Press the ▽ key and select the ***Period*** parameter by rotating the Data knob.
Press the ▽ key and press the **1, 0, 0, 0,** and **ENTER** keys.
Period is set to 1000.0 ms.

Press the △ key twice or press the **MENU** key, and select ***SOURCE*** in the parameter group by rotating the Data knob.

Press the ▽ key and select the ***Remote Sensing*** parameter by rotating the Data knob.
Press the ▽ key and select ***4 Wire*** by rotating the Data knob.
Remote Sensing is set to 4 Wire.

Press the △ key twice or press the **MENU** key, and select ***COMPARATOR*** in the parameter group by rotating the Data knob.

Press the ▽ key and select the ***Compare*** parameter by rotating the Data knob.
Press the ▽ key and select ***ON*** by rotating the Data knob.
Compare is set to ON.

Press the △ key and select the ***Upper Data*** parameter by rotating the Data knob.
Press the ▽ key and press the **2, 0, 0, 0, mA,** and **ENTER** keys.
Upper Data is set to +2000.00 mA.

Press the △ key and select the ***Lower Data*** parameter by rotating the Data knob.
Press the ▽ key and press the **1, 0, 0, mA,** and **ENTER** keys.
Lower Data is set to +100.000 mA.

Press the △ key twice or press the **MENU** key, and select ***EXT.SIGNAL*** in the parameter group by rotating the Data knob.

Press the ▽ key and select the ***Operate Signal*** parameter by rotating the Data knob.
Press the ▽ key and select ***Operate OFF In*** by rotating the Data knob.
Operate Signal is set to Operate OFF In.

Press the △ key and select the ***Complete/Busy*** parameter by rotating the Data knob.
Press the ▽ key and select ***Complete Out LO*** by rotating the Data knob.
Complete/Busy is set to Complete Out LO.

11. Press the **EXIT** key.

    The measurement screen returns.

12. Press the **VS/IS** key.

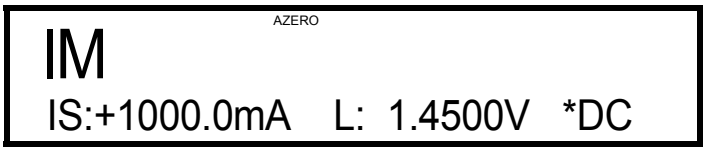
    The function becomes the current source function.

13. Press the **DIRECT, 1, 0, 0, 0 mA,** and **ENTER** keys.

    The source current is set to 1 A.

14. Press the **LIMIT, DIRECT, 1, ., 4, 5, V,** and **ENTER** keys.

    The voltage limiter is set to 1.45 V.



NOTE: ***The following values are for reference only. Actual measurement values will be different from the values used here due to 6243/44 internal errors and device characteristics.***

15. Press the **LIMIT** and **OPERATE** keys.

    Charging is performed with the constant current, and the measured current value appears.

When the charge voltage reaches the specified voltage, the limiter appears because the constant voltage becomes valid.

In this condition, if the measured current drops to 100 mA or lower, the Standby status is automatically set.

This completes the charging.

Discharge test

16. Press the **MODE** key.

    The mode becomes the pulse source mode.

17. Press the **VM/IM** key.

    The function becomes the voltage measurement function.

18. Press the **MENU** key and select ***TIME*** in the parameter group by rotating the Data knob.

    Press the ▽ key and select the ***Measure Delay*** parameter by rotating the Data knob.
    Press the ▽ key and press the **9, 8,** and **ENTER** keys.
    Measure Delay is set to 098.00 ms.

    Press the △ key and select the ***Period*** parameter by rotating the Data knob.
    Press the ▽ key and press the **1, 0, 0, 0,** and **ENTER** keys.
    Period is set to 1000.00 ms.

    Press the △ key and select the ***Pulse Width*** parameter by rotating the Data knob.
    Press the ▽ key and press the **1, 0, 0 ENTER** keys.
    Pulse width is set to 100.00 ms.

    Press the △ key twice or press the **MENU** key, and select ***SOURCE*** in the parameter group by rotating the Data knob.

    Press the ▽ key and select the ***Base Value*** parameter by rotating the Data knob.
    Press the ▽ key and select **1, 0, mA,** and **ENTER** by rotating the Data knob.
    Base Value is set to 10.000 mA.

    Press the △ key and select the ***Remote Sensing*** parameter by rotating the Data knob.
    Press the ▽ key and select ***4 Wire*** by rotating the Data knob.
    Remote Sensing is set to 4 Wire.

    Press the △ key twice or press the **MENU** key, and select ***MEASURE*** in the parameter group by rotating the Data knob.

    Press the ▽ key and select the ***Integration Time*** parameter by rotating the Data knob.
    Press the ▽ key and select ***1 ms*** by rotating the Data knob.
    Integration Time is set to 1 ms.

    Press the △ key twice or press the **MENU** key, and select ***COMPARATOR*** in the parameter group by rotating the Data knob.

    Press the ▽ key and select the ***Compare*** parameter by rotating the Data knob.
    Press the ▽ key and select ***ON*** by rotating the Data knob.
    Compare is set to ON.

Press the △ key and select the ***Upper Data*** parameter by rotating the Data knob.
Press the ▽ key and press the **1, ., 5, V,** and **ENTER** keys.
Upper Data is set to +1.50000 V.

Press the △ key and select the ***Lower Data*** parameter by rotating the Data knob.
Press the ▽ key and press the **1, V,** and **ENTER** keys.
Lower Data is set to +1.00000 V.

Press the △ key twice or press the **MENU** key, and select ***EXT.SIGNAL*** in the parameter group by rotating the Data knob.

Press the ▽ key and select the ***Operate Signal*** parameter by rotating the Data knob.
Press the ▽ key and select ***Operate OFF In*** by rotating the Data knob.
Operate Signal is set to Operate OFF In.

Press the △ key and select the ***Complete/Busy*** parameter by rotating the Data knob.
Press the ▽ key and select ***Complete Out LO*** by rotating the Data knob.
Complete/Busy is set to Complete Out LO.

Press the △ key twice or press the **MENU** key, and select ***MEASURE BUFFER*** in the parameter group by rotating the Data knob.

Press the ▽ key and select the ***Memory Store*** parameter by rotating the Data knob.
Press the ▽ key and select ***Normal-ON*** by rotating the Data knob.
Memory Store is set to Normal-ON.

Press the △ key and select the ***Memory Clear*** parameter by rotating the Data knob.
Press the ▽ key and press the **DIRECT** key.
Memory Clear is executed.

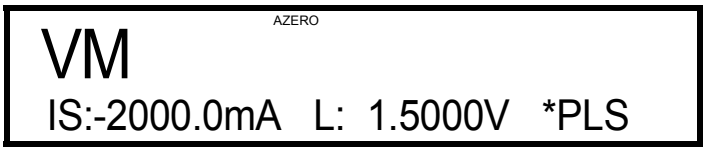
19. Press the **EXIT** key. The measurement screen returns.

20. Press the **DIRECT, +/-, 2, 0, 0, 0, mA,** and **ENTER** keys.

    The source current is set to -2 A.

21. Press the **LIMIT, DIRECT, 1, ., 5, V,** and **ENTER** keys.

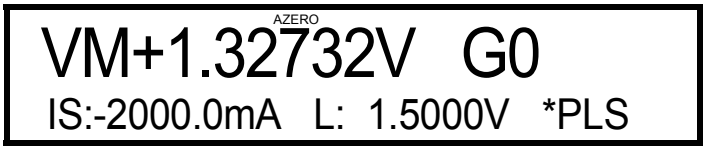
    The voltage limiter is set to 1.5 V.



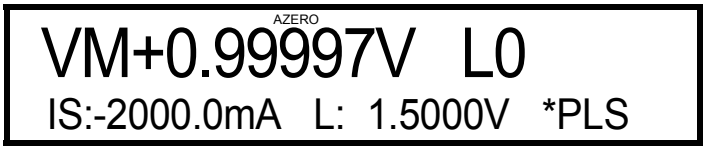
NOTE: ***The following values are for reference only. Actual measurement values will be different from the values used here due to 6243/44 internal errors and device characteristics.***

22. Press the **OPERATE** key.

    Pulse discharge starts and the battery voltage during discharge is measured.

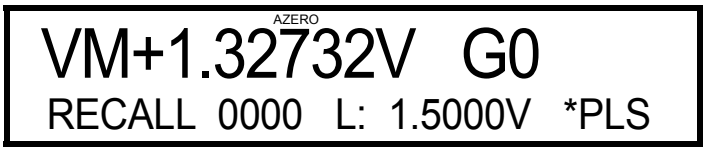


    When the discharge stop voltage (1.0 V) is reached, the status is switched to Standby.



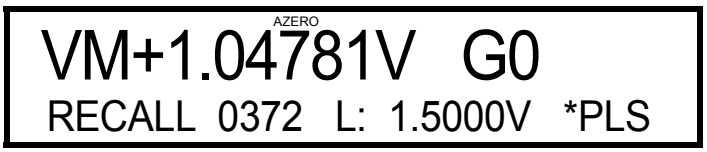
Reading out measured data

23. Press the **RECALL** key to read out the measured values registered during the discharge.



24. Read out the data of the desired time by pressing the ◁ , ▷ keys and rotating the Data knob.

    In this case, Period is set to 1 second which means that the Recall No. matches the elapsed time (seconds).



This completes the discharge test.

2.4 Saving and Loading Parameters

The 6243/44 allows parameters used to be saved in the nonvolatile memory blocks 0 to 3.

Parameters saved in the block 0 are loaded when the power is turned ON.

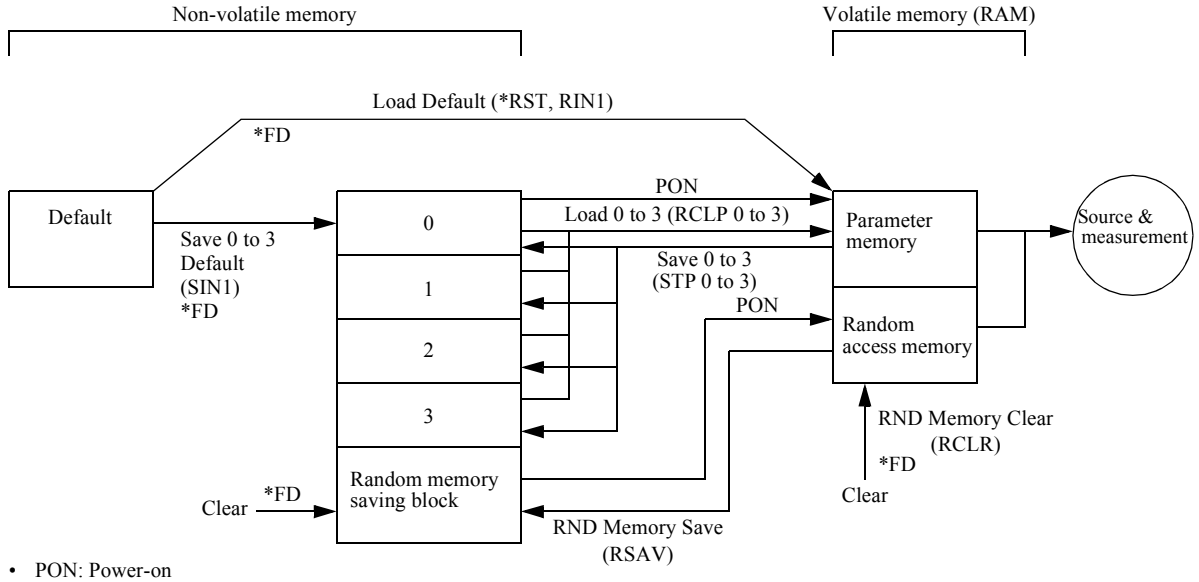
The following describe how to save and load parameters.

(1) Operations for saving and loading parameters

The 6243/44 features a random memory data saving block separately from the parameter saving blocks. Figure 2-13 shows the operations for saving, loading and clearing of parameters and random memory.

NOTE: ***The following parameters are not saved in the blocks 0 to 3. When set, they are always saved in a separate block and loaded when the power is turned ON.***

- ***Line Frequency (50 Hz/60 Hz)***
- ***GPIB address (HA_01)***



- PON: Power-on
- *FD: Factory settings
- ( ): GPIB command

Figure 2-13 Parameter Saving and Loading Operations

(2) Saving and loading parameters

Saving parameters

1. Press the **MENU** key and select ***PARAMETER SAVE*** in the parameter group.
2. Press the ▽ key and select a saving area by rotating the Data knob.
3. Press the ▽ key.
   The following display appears.

4. Press the **DIRECT** key.
   Upon saving completion, “Done” appears.
5. Press the **EXIT** key.
   The measurement screen returns.

Loading parameters

1. Press the **MENU** key and select ***PARAMETER LOAD*** in the parameter group.
2. Press the ▽ key and select a loading area by rotating the Data knob.
3. Press the ▽ key.
   The following display appears.

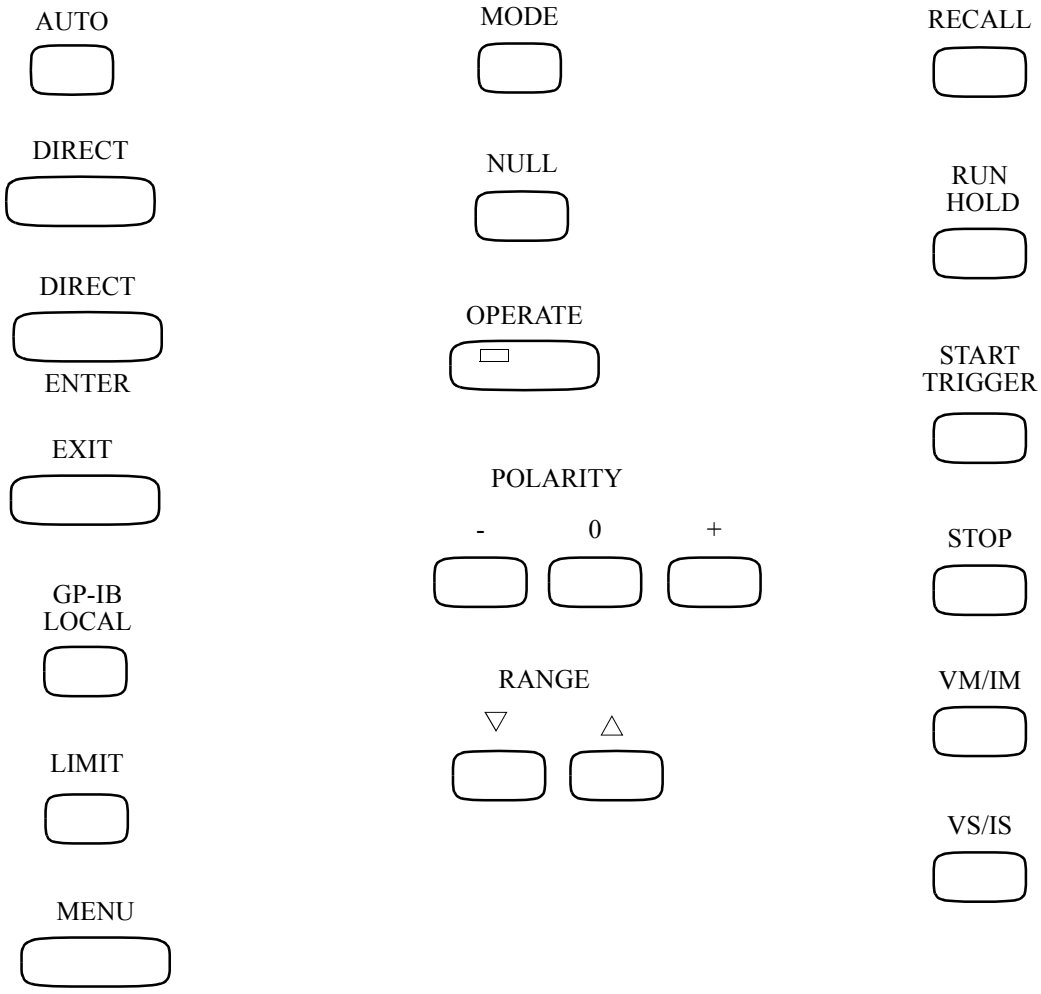
4. Press the **DIRECT** key.
   Upon loading completion, “Done” appears.
5. Press the **EXIT** key.
   The measurement screen returns.

3. REFERENCE

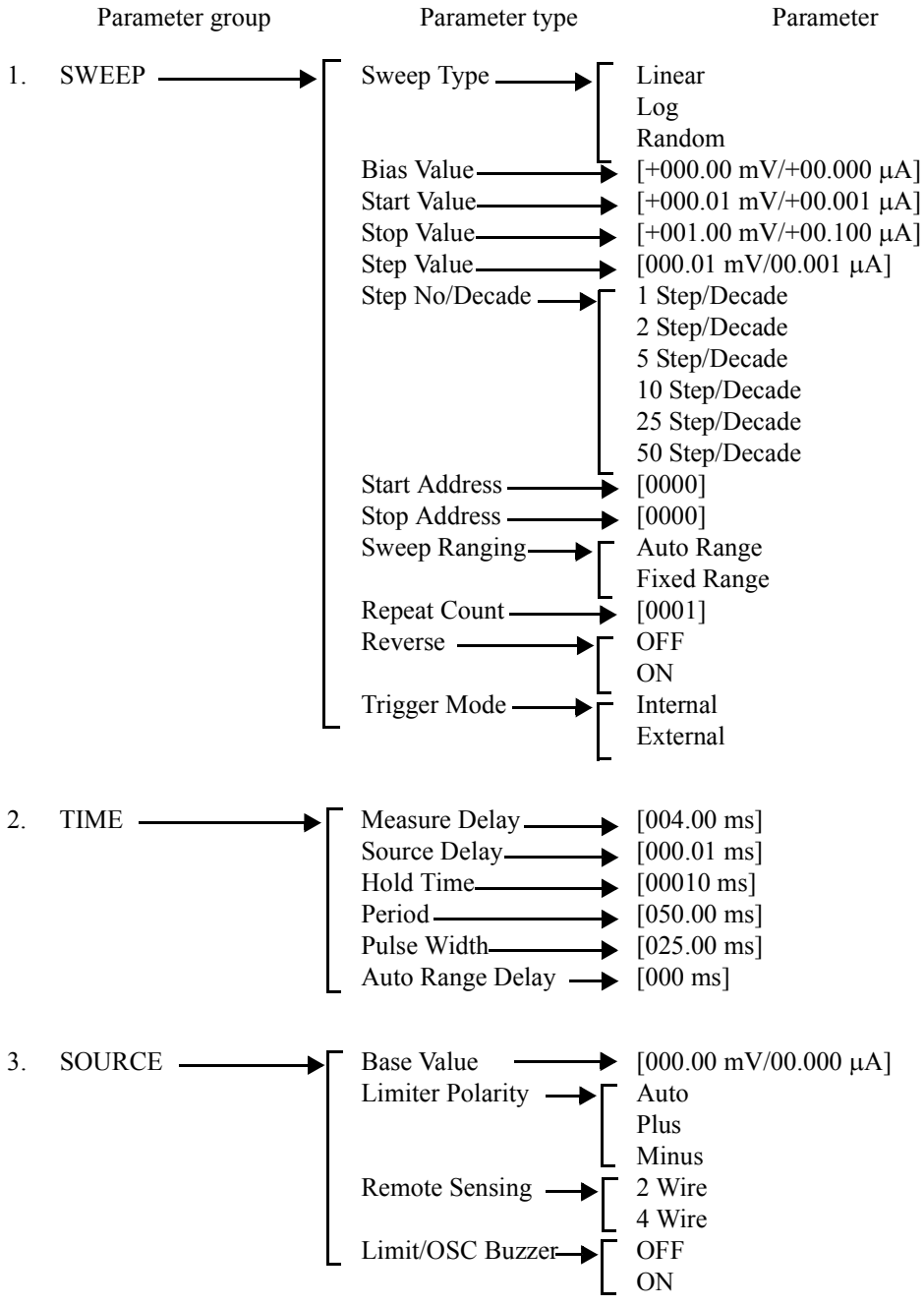
This chapter describes the 6243/44 panel keys, parameter groups, parameters, and the functions of each parameter.

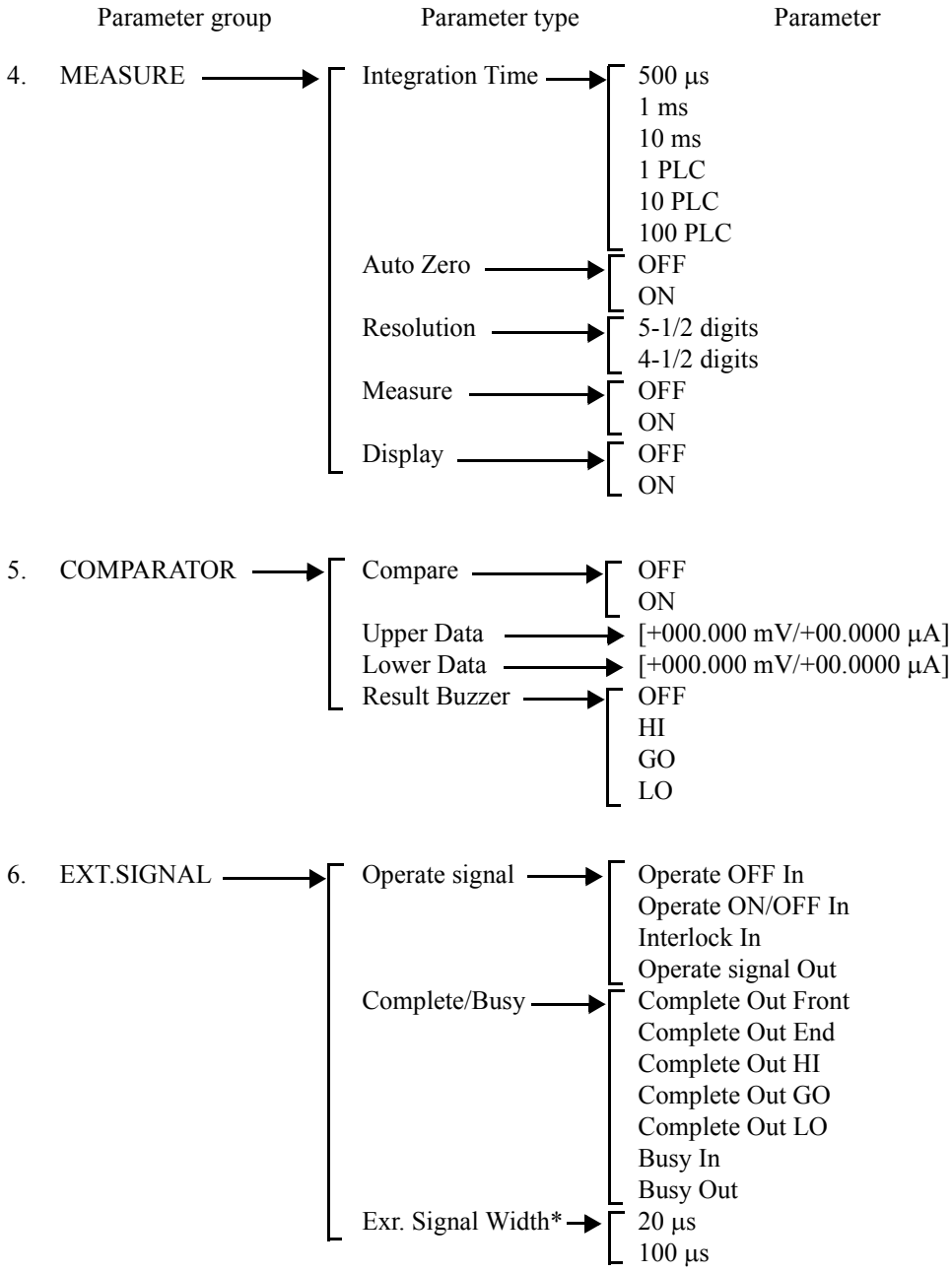
3.1 Menu Index

3.2 Menu Map

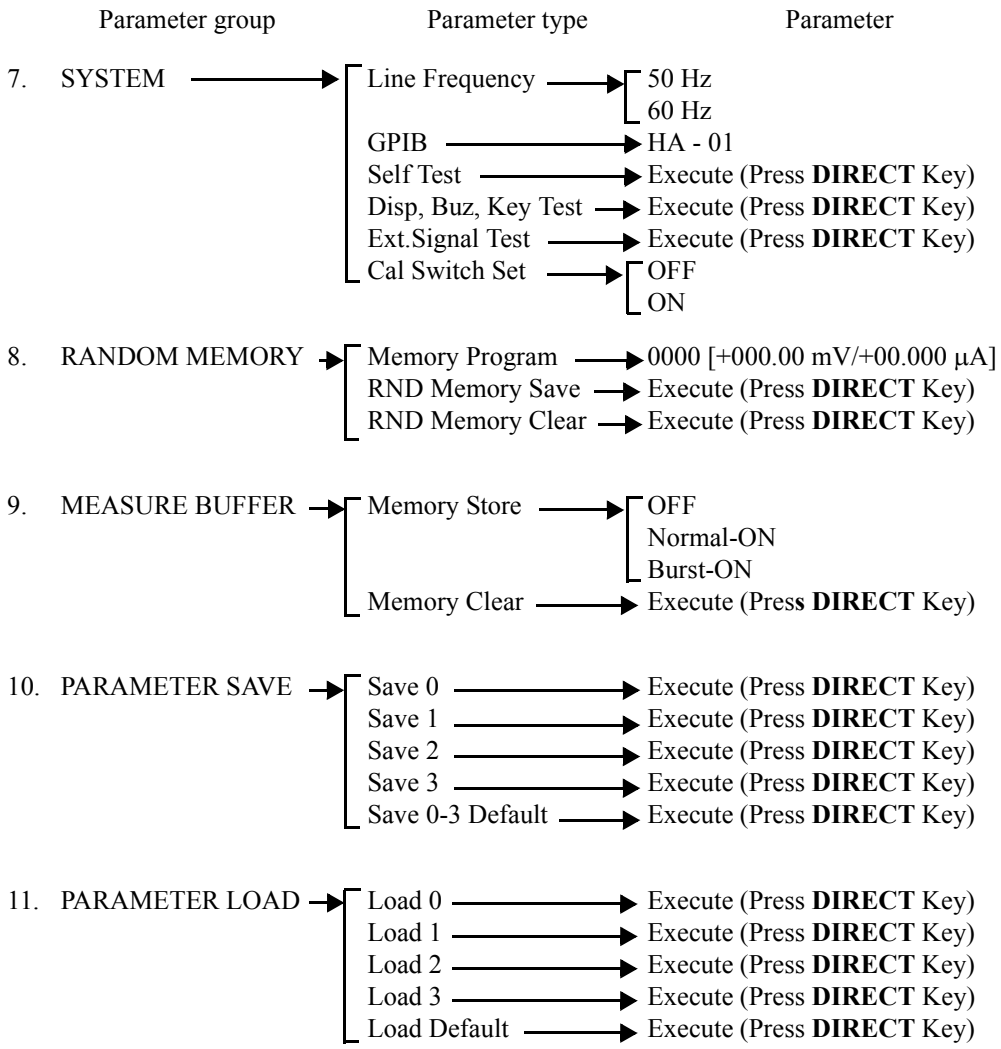


- SWEEP → To 3-4
- TIME → To 3-4
- SOURCE → To 3-4
- MEASURE → To 3-5
- COMPARATOR → To 3-5
- EXT.SIGNAL → To 3-5
- SYSTEM → To 3-6
- RANDOM MEMORY → To 3-6
- MEASURE BUFFER → To 3-6
- PARAMETER SAVE → To 3-6
- PARAMETER LOAD → To 3-6


Parameter group
Parameter type
Parameter
1. SWEEP
Sweep Type
Linear
Log
Random
Bias Value
[+000.00 mV/+00.000 μA]
Start Value
[+000.01 mV/+00.001 μA]
Stop Value
[+001.00 mV/+00.100 μA]
Step Value
[000.01 mV/00.001 μA]
Step No/Decade
1 Step/Decade
2 Step/Decade
5 Step/Decade
10 Step/Decade
25 Step/Decade
50 Step/Decade
Start Address
[0000]
Stop Address
[0000]
Sweep Ranging
Auto Range
Fixed Range
Repeat Count
[0001]
Reverse
OFF
ON
Trigger Mode
Internal
External
2. TIME
Measure Delay
[004.00 ms]
Source Delay
[000.01 ms]
Hold Time
[00010 ms]
Period
[050.00 ms]
Pulse Width
[025.00 ms]
Auto Range Delay
[000 ms]
3. SOURCE
Base Value
[000.00 mV/00.000 μA]
Limiter Polarity
Auto
Plus
Minus
Remote Sensing
2 Wire
4 Wire
Limit/OSC Buzzer
OFF
ON



* This parameter does not appear for A02 or earlier ROM versions.


Parameter group
Parameter type
Parameter
7. SYSTEM
Line Frequency
50 Hz
60 Hz
GPIB
HA - 01
Self Test
Execute (Press DIRECT Key)
Disp, Buz, Key Test
Execute (Press DIRECT Key)
Ext.Signal Test
Execute (Press DIRECT Key)
Cal Switch Set
OFF
ON
8. RANDOM MEMORY
Memory Program
0000 [+000.00 mV/+00.000 μA]
RND Memory Save
Execute (Press DIRECT Key)
RND Memory Clear
Execute (Press DIRECT Key)
9. MEASURE BUFFER
Memory Store
OFF
Normal-ON
Burst-ON
Memory Clear
Execute (Press DIRECT Key)
10. PARAMETER SAVE
Save 0
Execute (Press DIRECT Key)
Save 1
Execute (Press DIRECT Key)
Save 2
Execute (Press DIRECT Key)
Save 3
Execute (Press DIRECT Key)
Save 0-3 Default
Execute (Press DIRECT Key)
11. PARAMETER LOAD
Load 0
Execute (Press DIRECT Key)
Load 1
Execute (Press DIRECT Key)
Load 2
Execute (Press DIRECT Key)
Load 3
Execute (Press DIRECT Key)
Load Default
Execute (Press DIRECT Key)

3.3 Panel Keys and Parameters

The panel keys and parameters are described as follows:

3.3.1 AUTO key (Measurement Range)

Pressing the **AUTO** key toggles the measurement setting between the Auto range and fixed range.

Auto Range:	Among all the measurement ranges between the set limiter range and the minimum range, the optimum range is selected for the measurement. At this time, the AUTO indicator is ON. When the measurement function and source function are identical, the Auto Range does not work. The measurement range always becomes the same as the source range.
Fixed Range:	Measurement is done in the range set by the limiter range. At this time, the AUTO indicator is OFF. When the measurement function and source function are identical, the measurement range becomes the same as the source range.

3.3.2 DIRECT key (Direct Input Mode)

When the **DIRECT** key is pressed, the Direct Input Mode is set and the functions indicated in blue on the panel are enabled. In this mode, the limiter value and source value enclosed in [ ] can be set.

3.3.3 ENTER (DIRECT) key (Confirming Numeric Values)

Pressing the **ENTER (DIRECT)** key enters numeric values.

3.3.4 EXIT key (Normal Measurement Screen)

Pressing the **EXIT** key recovers the normal measurement screen from the Menu screen.

3.3.5 GP-IB LOCAL key (GPIB Remote Control)

Pressing the **GP-IB LOCAL** key cancels the remote control by GPIB.

At this time, the RMT indicator is OFF.

To switch from the GPIB control to panel operation, press this key.

3.3.6 LIMIT key (Limiter Setting)

Pressing the **LIMIT** key toggles the setting between the source value change mode and the limiter value change mode.

Source value change mode:

The cursor (flashing) indicates a digit of the source value and the following keys are enabled for changing the source value.

- **RANGE** ▽ (**Down**), △ (**Up**) keys
- the ◁, ▷ keys and the Data knob
- Numeric value setting using the direct input mode

Limiter value change mode:

The cursor (flashing) indicates a digit of the limiter value and the keys mentioned above are enabled for changing the limiter value.

3.3.7 MENU key (Setting Parameters)

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

The parameter groups and the parameters are as follows:

1. Select the desired parameter group by rotating the Data knob.
   Press the ▽ key to display the parameter selection screen.
2. Select the desired parameter by rotating the Data knob.
   Press the ▽ key to enable setting and modification of the parameter.

3.3.7.1 SWEEP (Sweep Parameters)

Selecting **SWEEP** and pressing the ▽ key enables selection of parameters related to the sweep source.

SWEEP TYPE	Selects the sweep type between DC sweep and pulse sweep source mode. Linear: Linear sweep Log: Log (logarithm) sweep Random: Sweep by the memory data set in the random memory. (Random Sweep)
Bias Value	Enables the bias value setting (source value in stop condition).
Start Value	Enables the start value setting for linear sweep and log sweep.
Stop Value	Enables the stop value setting for linear sweep and log sweep.

Step Value

Enables the step value setting for linear sweep.
The step number n becomes as follows:

n = | Stop Value - Start Value | / Step Value +1

The step value has no polarity.

Step No/Decade

Selects the division number of 1 decade (/10) for the log sweep.
The output value Vk of the Kth output during sweep is as follows:

$Vk = Vo \times 10^{\frac{k}{n}}$ Vo: Start value
n: Division number of 1 decade

Select the decade division number from among 1, 2, 5, 10, 25, and 50.

Start Address

Enables setting of the start address for random sweep.

Stop Address

Enables setting of the stop address for random sweep.

Sweep Ranging

Selects the source ranging of the sweep.

Auto Range: Sweeps selecting the optimal range at each step from the start value to the stop value.

Fixed Range: Sweeps with a fixed range that is the maximum range in which all the source values from the start value to the stop value can be output.

Repeat Count

Enables setting of the number for sweep repeat times.
When 0 is set, the sweep is repeated infinitely.

Reverse

Selects whether the reverse mode (Round-trip Sweep) is ON or OFF.

ON: Round-trip sweep in the manner of Start → Stop → Start is performed.

OFF: One-way sweep in the manner of Start → Stop is performed.

Trigger Mode

Selects the trigger mode for the sweep.

Internal: Sweep is automatically performed in accordance with the internal trigger.

External: Sweep progresses one step at a time in accordance with operation of the **TRIGGER** key, GPIB trigger command, or a signal input to the **TRIGGER IN** terminal on the rear panel.

3.3.7.2 TIME (Time Parameters)

Selecting **TIME** and pressing the ▽ key enables selection of parameters related to time.

Measure Delay — Enables setting of the Delay Time (Td) from the measurement trigger to the start of measurement.

Source Delay — Enables setting of the Delay Time (Tds) from the trigger to the pulse source and the delay time until the next step value source in the pulse source mode and sweep source mode.

Hold Time — Enables setting of the time (Th) from the start value source until the source delay starts in the sweep source mode.

Period — Enables the following settings for Period time (Tp).

- Free run period in the DC source mode
- 1 step period in the DC sweep source mode
- Pulse period in the pulse source mode and pulse sweep source mode.

Pulse Width — Enables setting of the Pulse Width (Tw).

Auto Range Delay — Enables setting of the Delay Time (Ta) from the range change to the start of measurement in the measurement auto range mode. Used when measuring micro-currents or when the settling time of a device is long.

3.3.7.3 SOURCE (Source Parameters)

Selecting ***SOURCE*** and pressing the ▽ key enables setting of parameters related to the source.

Base Value — Enables setting of the pulse base value for the pulse source mode and pulse sweep source mode.
The polarity of the base value is the same as that of the pulse value.

Limiter Polarity — Selects the limiter polarity.
Limiters have both + and - polarities but it is not possible to obtain an accurate value for both polarities simultaneously by calibration.

Auto:	Accurately sets a limiter with the same polarity as the source polarity.
Plus:	Accurately sets a + polarity limiter regardless of the source polarity.
Minus:	Accurately sets a - polarity limiter regardless of the source polarity.

Remote Sensing Switches between 4-wire connection and 2-wire connection.

2 Wire: 2-wire connection
At this time, **4 WIRE** lamp is OFF.

4 Wire: 4-wire connection
At this time, **4 WIRE** lamp is ON.

Limit/OSC Buzzer Selects whether or not the buzzer sounds (ON or OFF) when limiter, reverse polarity source or oscillation is detected.

ON: The buzzer sounds when limiter, reverse polarity source or oscillation is detected.

OFF: The buzzer is OFF.

3.3.7.4 MEASURE (Measurement Parameters)

Selecting **MEASURE** and pressing the ▽ key enables selection of parameters related to measurement.

Integration Time Selects the integration time of the AD converter.
Select the integration time from 500 μs, 1 ms, 10 ms, 1 PLC, 10 PLC, and 100 PLC.

Auto Zero Toggles the Auto Zero function between ON and OFF.

ON: Cancels the measurement zero point drift one time approximately every 10 seconds.
At this time, the AZERO indicator is ON.

OFF: Sets the Auto Zero function to OFF.
At this time, the AZERO indicator is OFF.

Resolution Selects the measurement resolution.

5-1/2 digits: Measurement with 5-1/2-digit resolution

4-1/2 digits: Measurement with 4-1/2-digit resolution

Measure Toggles measurement between ON and OFF.

ON: Measurement is performed.

OFF: Measurement is not performed.

Display Toggles display of the measured data and display of the source value during sweep between ON and OFF.

ON: Measured data and source value during sweep are displayed.

OFF: Measured data and source value during sweep are not displayed.

3.3.7.5 COMPARATOR (Comparison Operation Parameters)

Selecting ***COMPARATOR*** and pressing the ▽ key enables selection of parameters related to comparator calculation.

Compare Toggles comparator calculation between ON and OFF.

ON: The following comparator calculations are performed.

Upper Data < Measurement result; HI
Lower Data ≤ Measurement result ≤ Upper Data; GO
Measurement result < Lower Data; LO

OFF: Comparator calculation is set to OFF.

Upper Data Enables the upper limit value setting for comparator calculation.

Lower Data Enables the lower limit value setting for comparator calculation.

Result Buzzer Selects the condition on which the buzzer sounds in accordance with the results of comparator calculation.

HI: The buzzer sounds when the result of the comparator calculation is HI.

GO: The buzzer sounds when the result of the comparator calculation is GO.

LO: The buzzer sounds when the result of the comparator calculation is LO.

OFF: The buzzer is OFF.

3.3.7.6 EXT.SIGNAL (External Control Signal Parameters)

Selecting ***EXT.SIGNAL*** and pressing the ▽ key enables selection of parameters related to the external control signal input on the rear panel.

Operate Signal Selects the function of the **INTERLOCK OPERATE IN/OUT** signal input on the rear panel.

Operate OFF In:
Sets Standby when the input signal rises from Lo to Hi.

Operate ON/OFF In:
Sets Standby when the input signal rises from Lo to Hi, and sets Operate when the signal falls from Hi to Lo.

Interlock In: Sets Standby when the input signal rises from Lo to Hi.
If the signal is in the Hi state or open state, operations will not be executed even if the operate command is sent from a key or GPIB.

Operate Signal Out:
Outputs a Lo signal when the 6243/44 is in the Operate status and a Hi signal when in the standby status.

Complete/Busy

Selects the function of the **COMPLETE OUT BUSY IN/OUT** signal input on the rear panel.

Complete Out Front:
Outputs a negative pulse signal at the start of measurement.

Complete Out End:
Outputs a negative pulse signal at the completion of the measurement and completion of a period.

Complete Out HI:
Outputs a negative pulse signal when the comparator calculation result is HI.

Complete Out GO:
Outputs a negative pulse signal when the comparator calculation result is GO.

Complete Out LO:
Outputs a negative pulse signal when the comparator calculation result is LO.

Busy In: Becomes the busy input signal for synchronized operation. When the input signal is Lo, measurement or sweep step operations do not take place until the signal becomes Hi.

Busy Out: Becomes the busy output signal for synchronized operation. Outputs a Lo level signal from the start of the source delay until a period is completed and measurement is completed.

Ext. Signal Width

Selects the output pulse width of the SYNC OUT and COMPLETE OUT signals on the rear panel.

20 μs: The output pulse width becomes approximately 20 μs to 30 μs.

100 μs: The output pulse width becomes approximately 100 μs to 200 μs.

3.3.7.7 SYSTEM (System Parameters)

Selecting ***SYSTEM*** and pressing the ▽ key enable selection of parameters related to the system.

Line Frequency Switches the setting between 50 Hz and 60 Hz to accommodate the line frequency to be used with the 6243/44.

- 50 Hz: The 1 PLC time of the integration time of the AD converter is set to 1 cycle period of 50 Hz.
- 60 Hz: The 1 PLC time of the integration time of the AD converter is set to 1 cycle period of 60 Hz.

GPIB Enables setting of the GPIB Header, Addressable, and Address.

- H/_: Selects Header between ON and OFF.
- A/O: Toggles between Addressable and Talk Only.
- 01: Sets the Address.

Self Test Enables execution of Self Test.
When the **DIRECT** key is pressed, the Self Test is executed.
When the test ends correctly, "Pass" appears.

Disp, Buz, Key Test Enables execution of test for display, buzzer and keys. When the **DIRECT** key is pressed to start the execution, all indicators become ON, the buzzer sounds and the key test mode is engaged. To exit the test mode, press the **EXIT** key.

Ext. Signal Test Enables execution of the test for the external single-wire signal on the rear panel.
To execute this test, connect the **INTERLOCK** and **COMPLETE OUT** terminals, and the **SYNC OUT** and **TRIGGER IN** terminals on the rear panel, and press the **DIRECT** key.

Cal Switch Set Selects ON or OFF status for the calibration mode.

- ON: When the calibration mode is set to ON, the parameters required for calibration become active. For the calibration procedure, refer to "8. CALIBRATION."
- OFF: Ends the calibration mode.

NOTE: ***Normally, use the 6243/44 with the Cal Switch Set parameter set to OFF. If set to ON, calibration data may be rewritten by the operations.***

3.3.7.8 RANDOM MEMORY (Random Memory Settings)

Selecting ***RANDOM MEMORY*** and pressing the ▽ key enables selection of parameters related to the random memory.

Memory Program — Enables data settings of the memory (random memory) for random sweep source data.
Change the digit at the position of the cursor (flashing) by rotating the Data knob to specify the desired memory address. Enter the data enclosed in [ ] using the numeric keys and the unit key.

RND Memory Save — Enables saving of the data set in the random memory to the nonvolatile memory. The saved data is loaded when the power is turned ON.

RND Memory Clear — Enables clearing of the data set in the random memory.

3.3.7.9 MEASURE BUFFER (Measurement Buffer Memory)

Selecting ***MEASURE BUFFER*** and pressing the ▽ key enables selection of parameters related to the measurement buffer memory.

Memory Store — Selects storing of the measured data to the memory.
For details on the memory storing operations, refer to Section 4.13, "Measurement Data Storing Function."

- Normal-ON: Memory store operation takes place in the normal mode.
  At this time, the SLOT indicator is ON.
- Burst-ON: Memory store operation takes place in the burst mode.
  Used for high-speed measurement.
  At this time, the SLOT indicator is ON.
- OFF: Memory store operation is released.
  At this time, the SLOT indicator is OFF.

Memory Clear — Enables clearing of the measurement buffer memory.

3.3.7.10 PARAMETER SAVE (Saving Parameters)

Selecting ***PARAMETER SAVE*** and pressing the ▽ key enables selection of parameters related to saving of parameters.

Save 0	Enables execution of saving parameters in block 0 (nonvolatile memory). Parameters saved in block 0 are loaded when the power is turned ON.
Save 1	Enables execution of saving parameters in block 1 (nonvolatile memory).
Save 2	Enables execution of saving parameters in block 2 (nonvolatile memory).
Save 3	Enables execution of saving parameters in block 3 (nonvolatile memory).
Save 0-3 Default	Enables execution of initialization (reset to factory settings) of the parameters stored in blocks 0 to 3 (nonvolatile memory).

3.3.7.11 PARAMETER LOAD (Loading Parameters)

Selecting ***PARAMETER LOAD*** and pressing the ▽ key enables selection of parameters related to loading of parameters.

Load 0	Enables loading parameters from the block 0 (non-volatile memory).
Load 1	Enables loading parameters from the block 1 (non-volatile memory).
Load 2	Enables loading parameters from the block 2 (non-volatile memory).
Load 3	Enables loading parameters from the block 3 (non-volatile memory).
Load Default	Enables loading the factory settings.

3.3.8 MODE key (Source Mode)

When the **MODE** key is pressed in the Standby status, the mode changes to the Source mode.

The Source mode is indicated in the lower right of the screen by the following indicators.

DC:	DC source mode
PLS:	Pulse source mode
SWP:	DC Sweep source mode
PSW:	Pulse Sweep source mode

3.3.9 NULL key (NULL Calculation)

Pressing the **NULL** key toggles NULL Calculation between ON and OFF.

ON:	The calculation shown below is performed. At this time, the NULL indicator is ON. Measurement data output = Measured valued - Measured value immediately after NULL ON
OFF:	NULL calculation is completed. At this time, the NULL indicator is OFF.

3.3.10 OPERATE key (Output ON/OFF)

Pressing the **OPERATE** key toggles the status between Standby and Operate.

Operate:	Output is ON. **OPERATE** indicator is turned ON.
Standby:	Output is OFF. **OPERATE** indicator is turned OFF.

WARNING: ***The 6243***
When the output is set to OPERATE, hazardous voltage is output depending on the setting.
Be careful of electric shocks.

3.3.11 POLARITY key (Source Polarity)

Pressing the **POLARITY** key sets the polarity of the source value for the DC source mode and Pulse source mode.

+ key:	Outputs the source value and base value with + polarity.
- key:	Outputs the source value and base value with - polarity.
0 key:	Outputs the source value of 0 by setting the entered value to 0 in the currently set source range. Then, the source value cursor (flashing) disappears and modification of the source value is inhibited. Pressing the 0 key again, or pressing the + or - key, restores the previous source value.

3.3.12 RANGE key (Source Range)

Pressing the **RANGE** key changes the source range and limiter range.

The ▽ (**Down**) key: Moves to the lower range.

The △ (**Up**) key: Moves to the higher range.

3.3.13 RECALL key (Measurement Data Recall)

Pressing the **RECALL** key displays the screen for recalling the measurement data stored in the measurement data buffer.

To recall the measurement data, specify the memory address with the ◁, ▷ keys and the Data knob.

To restore the normal measurement screen, press the **RECALL** key again.

3.3.14 RUN HOLD key (Measurement Free Run/Hold)

Pressing the **RUN HOLD** key switches measurement in the DC source mode and Pulse source mode between Free Run and Hold.

Free Run: Measurement and pulse source are performed in accordance with the cycle of the set Period Time (Tp). At this time, * is shown to the left of the source mode indication in the lower right of the screen.

Hold: Measurement and pulse source are performed by the **START TRIGGER** key, GPIB trigger command, or the signal input through the **TRIGGER IN** terminal on the rear panel. At this time, the * shown to the left of the source mode indication in the lower right of the screen is OFF.

3.3.15 START TRIGGER key (Sweep Start, Measurement Trigger)

Pressing the **START TRIGGER** key starts sweep or measurement.

When Hold is selected in the DC source mode and Pulse source mode, measurement or pulse source is performed.

In the DC Sweep source mode and Pulse Sweep source mode, the sweep is started.

3.3.16 STOP key (Sweep Stop)

Pressing the **STOP** key stops sweep.

When the sweep is stopped, the bias value is output.

3.3.17 VM/IM key (Measurement Functions)

Pressing the **VM/IM** key switches between voltage and current measurements.

VM: Voltage measurement

IM: Current measurement

3.3.18 VS/IS key (Source Functions)

Pressing the **VS/IS** key switches between voltage and current sources.

VS: Voltage source

IS: Current source

3.4 List of Settings

This list shows the setting ranges of the 6243/44 parameters and the factory settings.

To return to the factory settings, turn ON the power by pressing the + key.

When returning to the factory settings, all the parameters are initialized except for the line frequency, and the data in the random memory is cleared.

Perameters stored in the non-volatile memory are also initialized and cleared. (Refer to Figure 2-13.)

3.4.1 6243 Setting Ranges and Factory Settings

Panel key	Parameter group	Parameter type	Range	Factory setting
SOURCE		Source mode Source function Source range Source value Limit	DC/PLS/SWP/PSW VS/IS 320 mV to 110 V/32 µA to 2 A 0.00 mV to ± 110 V/0.000 µA to ± 2 A 3 mV to 110 V/300 nA to 2 A	DC VS 320 mV +000.00 mV 0500.0 mA
MEASURE		Measurement function Measurement auto range Null calculation DC & pulse trigger mode	VM/IM Auto / Fixed range ON/OFF RUN/HOLD	IM Fixed (2A range) OFF RUN
MENU	SWEEP	Sweep type Bias value Start value Stop value Step value Number of Logs and steps Start address Stop address Sweep ranging Number of repeat sweeps Reverse mode Sweep trigger mode	Linear/Log/Random 0.00 mV to ± 110 V/0.000 µA to ± 2 A 0.00 mV to ± 110 V/0.000 µA to ± 2 A 0.00 mV to ± 110 V/0.000 µA to ± 2 A 0.01 mV to 110 V/0.001 µA to 2 A 1/2/5/10/25/50 (Step/Decade) 0 to 4999 0 to 4999 Auto/Fixed 0 to 1000 ON/OFF Internal/External	Linear +000.00 mV +000.01 mV +001.00 mV 000.01 mV 10 Step/Decade 0 0 Auto Range 1 OFF Internal
	TIME	Measure delay time Source delay time Hold time Period Pulse width Auto-range display time	0.30 ms to 60000 ms 0.01 ms to 60000 ms 3 ms to 60000 ms 2.00 ms to 60000 ms 1.00 ms to 60000 ms 0 ms to 500 ms	4.00 ms 0.01 ms 00010 ms 50.00 ms 25.00 ms 00000 ms
	SOURCE	Pulse base value Limiter polarity mode Remote sensing Limiter / OSC Buzzer	0.00 mV to 110 V/0.000 µA to 2 A Auto/Plus/Minus 2 Wire/4 Wire ON/OFF	000.00 mV Auto 2 Wire OFF

Panel key	Parameter group	Parameter type	Range	Factory setting
MENU	MEASURE	Integration time Auto zero Number of digits for measurement Measurement ON/OFF Display ON/OFF	500 µs/1 ms/10 ms/1 PLC/10 PLC/100 PLC ON/OFF 5 1/2 or 4 1/2 ON/OFF ON/OFF	1 PLC ON 5 1/2 ON ON
	COMPARATOR	Comparator calculation Comparator -upper limit Comparator -lower limit Comparator result buzzer	ON/OFF 0.000 mV to ± 110 V/0.0000 µA to ± 2 A 0.000 mV to ± 110 V/0.0000 µA to ± 2 A ON/OFF	OFF +00.0000 µA +00.0000 µA OFF
	EXT.SIGNAL	External control signal Complete output mode External Control signal - pulse width	OPR In (On/Off)/Interlock/OPR Out Complete Out (Front/End/HI/GO/LO)/ Busy (In/Out) 20 µs/100 µs	Operate Off In Complete Out End 20 µs
	SYSTEM	Power frequency GPIB address Talker only Header Calibration mode	50 Hz/60 Hz 00 to 30 Addressable/Talk Only ON/OFF ON/OFF	50 Hz 01 Addressable ON OFF
	RANDOM EMORY	Random memory	0 to 4999 [0.00 mV to ± 110 V/ 0.000 µA to ± 2 A]	+000.00 mV
	MEASURE BUFFER	Measurement buffer store	NORMAL/BURST/OFF	OFF

3.4.2 6244 Setting Ranges and Factory Settings

Panel key	Parameter group	Parameter type	Range	Factory setting
SOURCE		Source mode Source function Source range Source value Limit	DC/PLS/SWP/PSW VS/IS 320 mV to 20 V/320 µA to 10 A 0.00 mV to ± 20 V/0.00 µA to ± 10 A 3 mV to 20 V/3 µA to 10 A	DC VS 320 mV +000.00 mV 04.000 A
MEASURE		Measurement function Measurement auto range Null calculation DC & pulse trigger mode	VM/IM Auto / Fixed range ON/OFF RUN/HOLD	IM Fixed (10A range) OFF RUN
MENU	SWEEP	Sweep type Bias value Start value Stop value Step value Number of Logs and steps Start address Stop address Sweep ranging Number of sweep repeats Reverse mode Sweep trigger mode	Linear/Log/Random 0.00 mV to ± 20 V/0.00 µA to ± 10 A 0.00 mV to ± 20 V/0.00 µA to ± 10 A 0.00 mV to ± 20 V/0.00 µA to ± 10 A 0.01 mV to 20 V/0.01 µA to 10 A 1/2/5/10/25/50 (Step/Decade) 0 to 4999 0 to 4999 Auto/Fixed 0 to 1000 ON/OFF Internal/External	Linear +000.00 mV +000.01 mV +001.00 mV 000.01 mV 10 Step/Decade 0 0 Auto Range 1 OFF Internal
	TIME	Measure delay time Source delay time Hold time Period Pulse width Auto-range display time	0.30 ms to 60000 ms 0.01 ms to 60000 ms 3 ms to 60000 ms 2.00 ms to 60000 ms 1.00 ms to 60000 ms 0 ms to 500 ms	4.00 ms 0.01 ms 00010 ms 50.00 ms 25.00 ms 00000 ms
	SOURCE	Pulse base value Limiter polarity mode Remote sensing Limiter / OSC Buzzer	0.00 mV to 20 V/0.00 µA to 10 A Auto/Plus/Minus 2 Wire/4 Wire ON/OFF	000.00 mV Auto 2 Wire OFF
	MEASURE	integration time Auto zero Number of digits for measurement Measurement ON/OFF Display ON/OFF	500 µs/1 ms/10 ms/1 PLC/10 PLC/100 PLC ON/OFF 5 1/2 or 4 1/2 ON/OFF ON/OFF	1 PLC ON 5 1/2 ON ON
	COMPARATOR	Comparator calculation Comparator -upper limit Comparator -lower limit Comparator result buzzer	ON/OFF 0.000 mV to ± 20 V/0.000 µA to ± 10 A 0.000 mV to ± 20 V/0.000 µA to ± 10 A ON/OFF	OFF +000.000 µA +000.000 µA OFF
	EXT.SIGNAL	External control signal Complete output mode External Control signal - pulse width	OPR In (On/Off)/Interlock/OPR Out Complete Out (Front/End/HI/GO/LO) / Busy (In/Out) 20 µs/100 µs	Operate Off In Complete Out End 20 µs

Panel key	Parameter group	Parameter type	Range	Factory setting
MENU	SYSTEM	Power frequency GPIB address Talker only Header Calibration mode	50 Hz/60 Hz 00 to 30 Addressable/Talk Only ON/OFF ON/OFF	50 Hz 01 Addressable ON OFF
	RANDOM EMORY	Random memory	0 to 4999 [0.00 mV to ± 20 V/ 0.000 μA to ± 10 A]	+000.00 mV
	MEASURE BUFFER	Measurement buffer store	NORMAL/BURST/OFF	OFF

4. PRACTICAL GUIDE FOR MEASUREMENTS

This chapter explains the practical guide for individual measurements.

4.1 DUT Connection

4.1.1 Precautions for the Output Terminals (Front and Rear Output Terminals)

Figure 4-1 and Figure 4-2 show the internal wiring of the 6243/44.

The output terminals are cut off from the internal circuit during Standby by the Operate/Standby relay. Only for 6243, the front output terminals and rear output terminals are connected during Standby.

NOTE: ***For the 6243, connect the DUT using either the front output terminals or the rear output terminals.***

CAUTION: ***If an external power source, like a battery, is connected to both the front output terminals and rear output terminals, a short circuit will occur internally.***

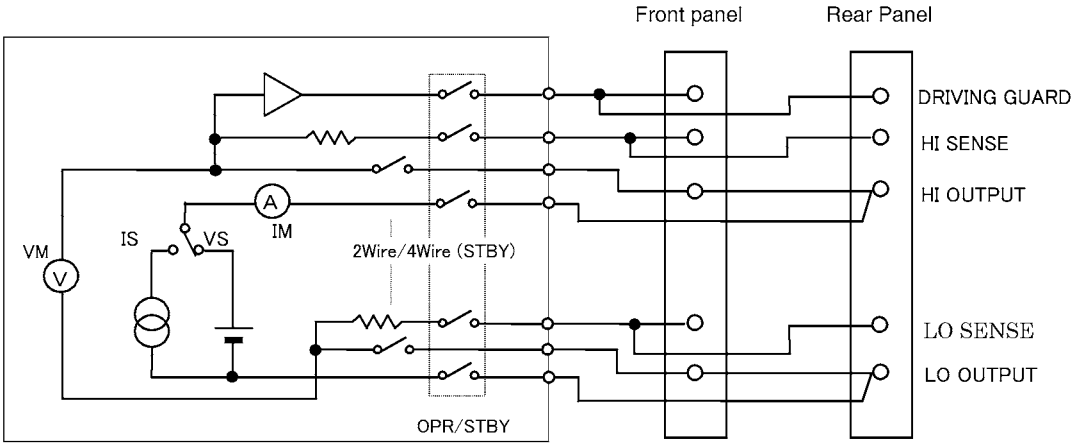


Figure 4-1 Internal Wiring (6243)

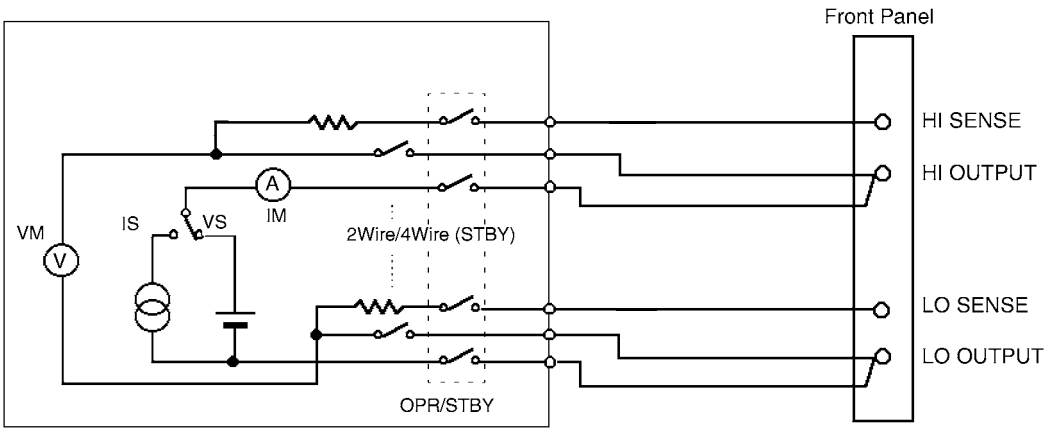


Figure 4-2 Internal Wiring (6244)

4.1.2 Remote Sensing (2-wire/4-wire Connection)

When connecting the 6243/44 and the DUT, select 2-wire connection or 4-wire connection considering the following.

- When the output current is a relatively low current and lead resistance is not a problem, use a 2-wire connection.
- When the output current is a relatively large current and lead resistance is a problem, use a 4-wire connection.
- When used at the specified accuracy

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

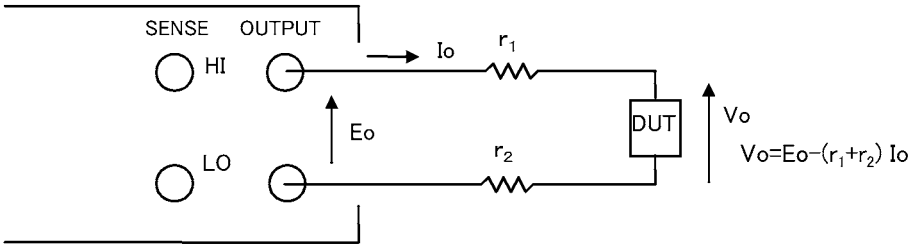
  The line resistance of the supplied leads A01044 is approximately 100 mΩ.
  The above calculations show that a 4-wire connection should be used when the output current is 100 μA or larger.
- When ev error is allowed

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

  When the supplied leads A01044 is used and the error allowance is ev = 10 mV, a 2-wire connection can be used up to 100 mA.

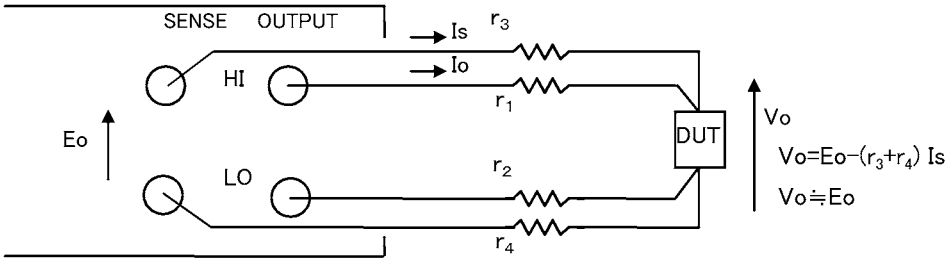
The procedure for a 2-wire connection or a 4-wire connection is as follows:

1. Press the **MENU** key.
2. Select the ***SOURCE*** parameter group and select the ***Remote Sensing*** parameter.
3. For a 2-wire connection, select **2 Wire**.
   For a 4-wire connection, select **4 Wire**.
   When ***4 Wire*** is set, **4 WIRE** indicator is ON on the front panel.



Error occurs due to a voltage drop (r1 and r2)

(a) 2 Wire (2-wire connection)



(b) 4 wire (4-wire connection)

Figure 4-3 2 Wire / 4 Wire Connections

4.1.2 Remote Sensing (2-wire/4-wire Connection)

NOTE: ***For 6243, the maximum remote sensing voltage (allowable voltage difference between OUTPUT-SENSE) is ±0.5 V for both HI and LO sides.***
To meet the specified accuracy, adhere to the following restrictions on r_1 to r_4.
$r_1, r_2 \leq 0.5\ V/Io\ [\Omega]$
(Io: Output current)

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

(Vos = r_1Io, r_2Io)
(Example) When Io = 2 A
$r_1, r_2 \leq 0.5\ V/2\ A = 0.25\ \Omega$
Assuming $r_1, r_2 = 0.25\ \Omega$

$$r_3, r_4 \leq \frac{10\ \mu V}{0.5\ V} \times 220\ k\Omega = 4.4\ \Omega$$

NOTE: ***For 6244, the maximum remote sensing voltage (allowable voltage difference between OUTPUT-SENSE) is ±1.0 V for both HI and LO sides.***
To meet the specified accuracy, adhere to the following restrictions on r_1 to r_4.
$r_1, r_2 \leq 1.0\ V/Io\ [\Omega]$
(Io: Output current)

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

(Vos = r_1Io, r_2Io)
(Example) When Io = 10 A
$r_1, r_2 \leq 1.0\ V/10\ A = 0.1\ \Omega$
Assuming $r_1, r_2 = 0.1\ \Omega$

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

4.1.3 Driving Guard (6243 Only)

The DRIVING GUARD terminal outputs the voltage with the same electric potential as HI SENSE.

WARNING: When connecting a shielded leads as shown in Figure 4-4, be sure to avoid electric shock because up to ±110 V is applied to the shield.

4.1.4 Oscillation Prevention

If the DUT itself oscillates, a capacitance or an inductance exceeding the rated values is connected, the 6243/44 may oscillate (due to the stray capacitance and residual capacitance of the connection leads, scanner, fixture, etc.).

Oscillation of the device and oscillation of the 6243/44 can be distinguished by the oscillation frequency. Oscillation frequency of the 6243/44 cannot exceed 2 MHz.

4.1.4.1 SMU (Source Measurement Unit) Oscillation Prevention

(1) Reasons for oscillation

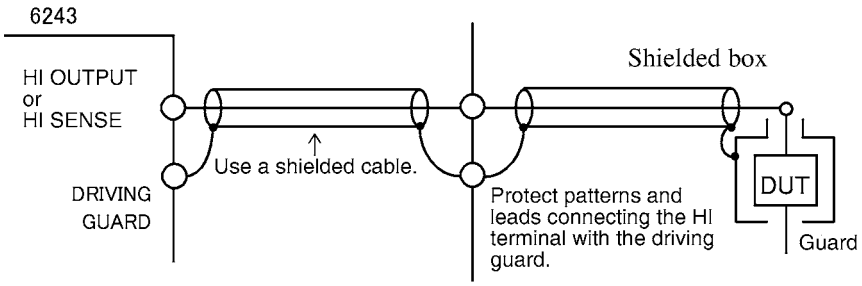
- During voltage source and voltage limiter operation, oscillation may occur due to capacitive load.
- During current source and current limiter operation, oscillation may occur due to inductive load.

(2) Procedure to stop oscillation

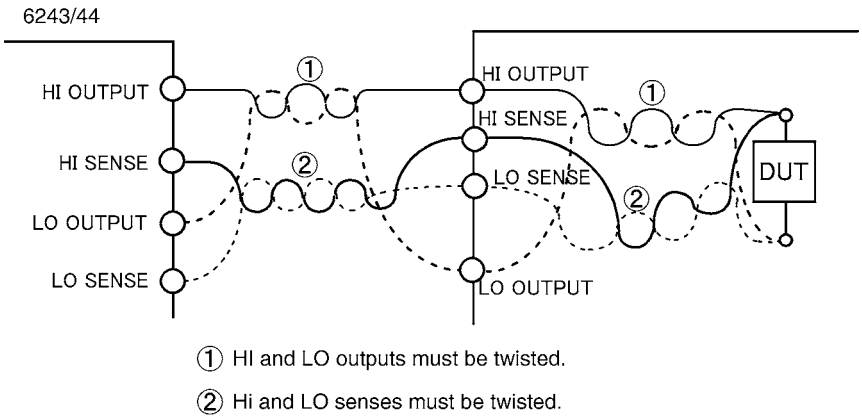
When oscillation occurs, the oscillation detecting circuit activates, indicates the fault and outputs information showing the oscillation status to the header and status byte of the measurement data. In this case, remove the cause of oscillation by using the following procedure.

1. Check that values are within the maximum load capacitance and maximum load inductance indicated in Chapter 9, “SPECIFICATIONS.”
2. Use the shortest connection leads(s) and check for oscillation.
3. If oscillation does not occur when the shortest connection leads(s) are used, connect as shown in Figure 4-4 to reduce capacitance and inductance of the leads and other parts.
4. If the shortest connection leads(s) do not stop oscillation, insert an allowable resistor to the load as shown in Figure 4-6.

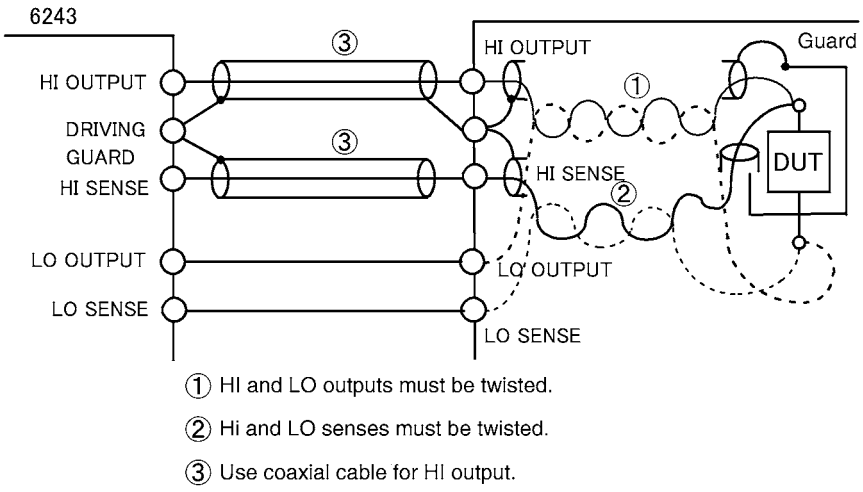
NOTE: ***When using multiple power sources, one of the power sources may cause oscillation, if so, oscillation may be detected in the other power sources. In this case, use the procedures in steps 1 to 4 above to locate the power source to remove the oscillation.***



(a) Connection (using the DRIVING GUARD terminal) to reduce stray capacitance and leak current



(b) Reducing lead inductance in wiring



(c) Reducing inductance when coaxial cables are used

Figure 4-4 Reducing Stray Capacitance and Lead Inductance

4.1.4.2 Oscillation of the Device Itself

The device itself may oscillate due to stray capacitance from the leads or test fixture. The possibility of oscillation is especially high for high hFE transistors and high gm FETs.

Prevent device oscillations taking the measures indicated below.

- Insert a ferrite bead near the device (Figure 4-5).
- Ferrite beads are effective when inserted at transistor bases and at FET gates.
- To minimize leak current, ensure that the ferrite bead does not contact other terminals, the device case, lead wire, or the ferrite beads of other wires.

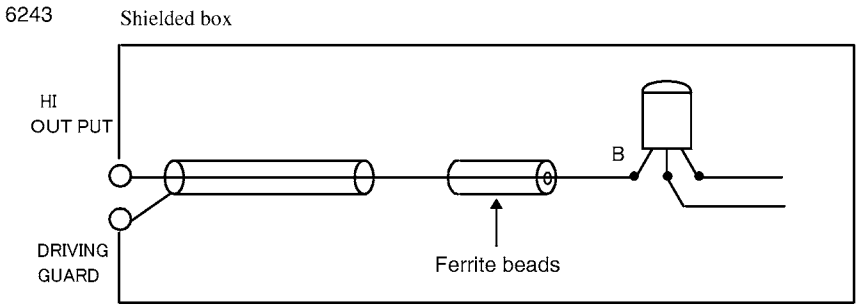


Figure 4-5 Device Oscillation Prevention

- For high-frequency devices such as GaAS FET, proceed as follows:
  - Separate the ground lines of the gate source and the drain source.
  - Insert a ferrite bead and a bypass capacitor in both the gate and the drain so that the high-frequency signal does not travel to the power source.
  - Insert a matching resistor in both the gate and the drain, and match so that the pattern length becomes λ/4, etc.

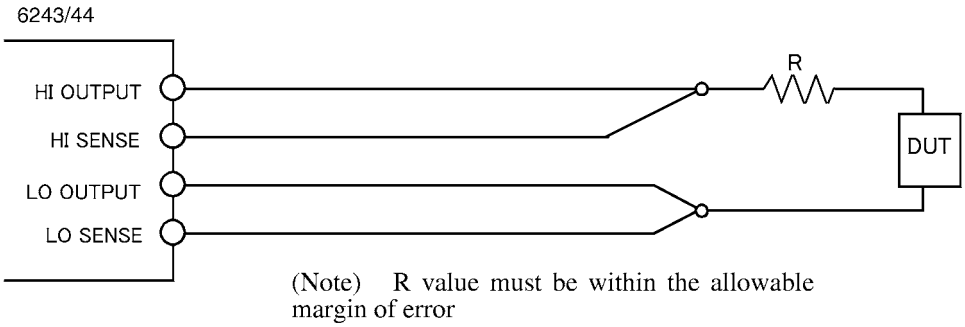


Figure 4-6 SMU Oscillation Prevention

4.1.5 Connection for High-Current Measurement

Always use a 4-wire connection for high-current measurements.

To eliminate over-shoot and response delays due to test lead inductance, inter-twist the **HI OUPUT** and **LO OUTPUT** test leads and also inter-twist **HI SENSE** and **LO SENSE** test leads from output terminals to DUT terminals as shown in Figure 4-7.

To prevent induced noise, use a shielded, stranded test lead for **OUTPUT** and **SENSE** as shown in Figure 4-7.

Be sure to use a shielded test leads, in particular when measuring currents of 1 μA or smaller.

For the OUTPUT test lead, use a wire with a diameter larger than those indicated in the table below and ensure that the voltage differential between **OUTPUT** and **SENSE** is 0.5 V or lower for both Hi and Lo for 6243, and 1.0 V or lower for 6244.

The output range, including this voltage differential, is restricted.

Make sure that the output of **HI OUTPUT - LO OUPUT** terminals is within the maximum output range.

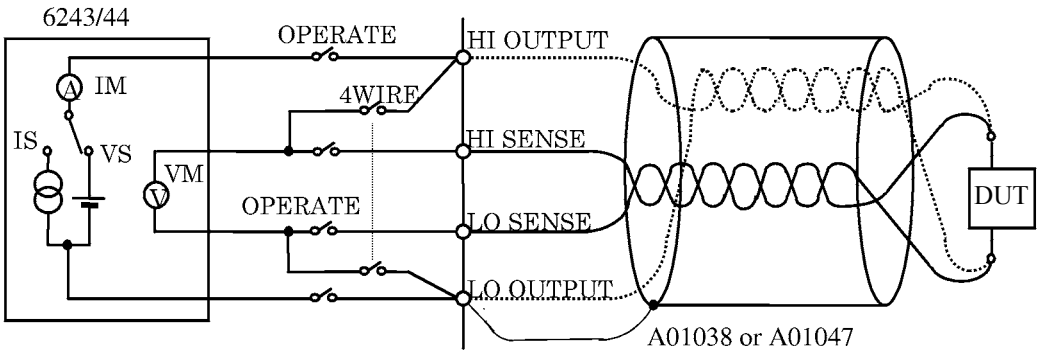


Figure 4-7 Connection for Heavy-Current Measurement

Table 4-1 Allowable Current and Wire Diameter

Current value	Wire size(AWG)
to 2 A	22
to 3.2 A	18
to 10 A	14

4.1.6 Connecting to the Fixture 12701A

Connect to the 12701A as shown in Figure 4-8.

A 4-wire connection is shown here.

For a 2-wire connection, the SENSE connection is not required.

For device connection inside the 12701A, refer to the 12701A instruction manual.

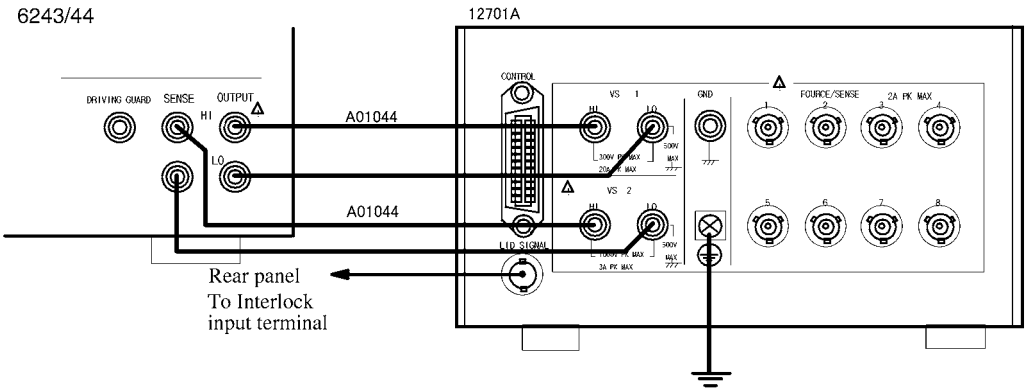


Figure 4-8 Connecting to the 12701A

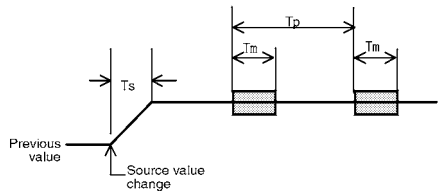
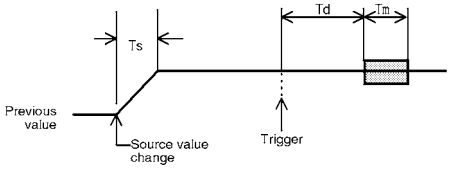
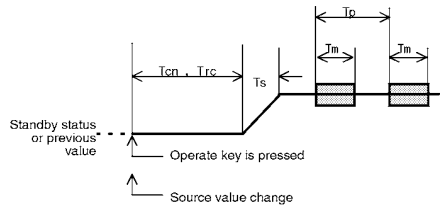
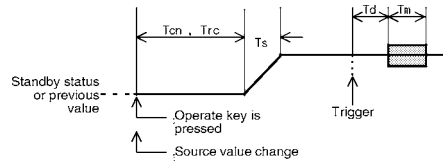
NOTE: Adhere to the following precautions to prevent electric shock.

1. ***Be sure to ground the 12701A's protective ground terminal*** ⏚ **.**
2. ***Be sure to connect the 12701A's LID SIGNAL and the INTERLOCK terminal on the rear panel of the 6243/44, and set the 6243/44's Operate Signal parameter to Interlock In.***
   This will activate the interlock function so that the 6243/44 enters Standby status when the cover of the 12701A is opened.

4.2 Operation in the DC Source Mode

Table 4-2 shows the operation in the DC source mode.

Table 4-2 Operation in the DC Source Mode

<table>
<tr><th>Condition change</th><th>Sampling mode</th><th>Operation</th><th>Description</th><th>Remarks</th></tr>
<tr><td rowspan="2">Changing the source value in the range mid-operation</td><td>Free-run</td><td>(a)
 
</td><td>Continuous measurement in the specified Tp interval</td><td rowspan="3">Td: Measure delay time
Tm: Measurement time
[Integration time
+Measurement data
Processing time]
Ts: Settling time
Tcn : Processing time for Operate
Trc : Range change processing time
Tp : Period</td></tr>
<tr><td>Hold</td><td>(b)
 
</td><td>Measuring after the trigger input or after the specified Td</td></tr>
<tr><td rowspan="2">Changing from the Standby to the Operate mode or changing the range</td><td>Free-run</td><td>(c)
 
</td><td>Output value changes after pressing Operate key, changing the source value, or processing time.</td></tr>
<tr><td>Hold</td><td>(d)
 
</td><td>Measuring after entering the trigger or after the specified Td</td></tr>
</table>

(a) Free-run during Operate status

- Measurement is repeated with the specified Period time intervals.
- The measurement time includes both the AC conversion time and data processing time and depends on the Memory Store mode.
  For details, refer to Section 4.9.3, “Integration Time and Measurement Time.”
- Measurement is performed asynchronously and unrelated to changes in source value.

(b) Hold during Operate status

- When trigger is input, measurement waits for the Measure Delay time and then starts.
- Triggers input during measurement are ignored.

(c) Change from Operate status to Standby status in the free run mode, and source value changes including range changes

- Measurement is not performed during Standby.
- When Operate is specified, the 6243/44 waits for the completion of Operate processing and then source value is output and after the settling time, the 6243/44 starts measurement.
- In order to minimize noise source, for Operate processing, lower the current value to 1 μA or smaller, set the voltage value to 0 V and then turn ON the Operate relay. (For Standby processing, turn OFF the Operate relay in the same manner.)
- For a source value change including a range change during operation, the source value waits for the range change processing time and then changes. Measurement is performed asynchronously and unrelated to changes in source value.

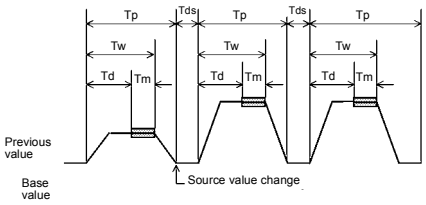
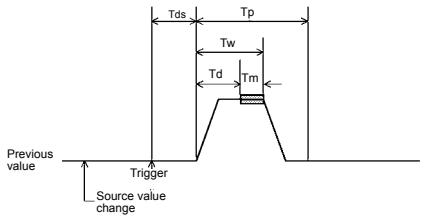
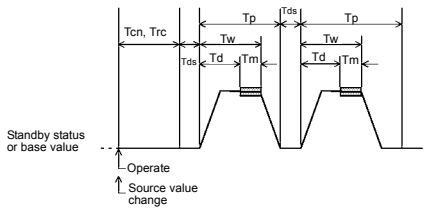
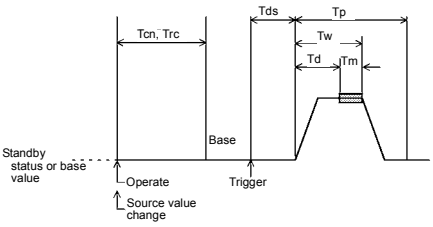
(d) Change from the Operate status to the Standby status in the hold mode, and source value changes including range changes

- When a trigger is input during range change processing, the 6243/44 waits for the processing completion and the Measure Delay time and then the measurement starts.
- Triggers input during the Operate processing and measurement are ignored.

4.3 Operation in the Pulse Source Mode

Table 4-3 shows the operation in the Pulse source mode.

Table 4-3 Operation in the Pulse Source Mode

Condition change	Sampling mode	Operation	Description	Remarks
Changing the source value in the range mid-operation	Free-run	(a) 	Continuous pulse generation in specified Tp + Tds	Tp: Period Tw: Pulse width Tm: Measurement time [Integration time + Measurement data Processing time] Tds: Source delay time Tcn : Operate processing time Trc : Processing time for the range change Fore restrictions of Tp, Tds, Tw, Tm and Td, refer to 4.9.1.
	Hold	(b) 	Single pulse generation after elapsing Tds from the trigger input	
Changing from Standby to Operate or changing the range	Free-run	(c) 	Pulse generation after elapsing Tcn, Trc, and Tds from the time when specifying Operate or changing the source value.	
	Hold	(d) 	Single pulse generation after elapsing Tds from the trigger input	

The measurement point changes depending on the specified Measure Delay time.

For details, refer to Section 4.9.1, "(2) Restrictions on Time Parameters."

The measurement point in the Pulse source mode becomes as follows:

(a) Free-run during Operate status

- The pulse wave is repeated with the cycle of (the specified Period + Source Delay time).
- If the source value is changed, the current pulse operation stops and a pulse wave with a new base value and source value is generated.

(b) Hold during Operate status

- Source value change is the same as (a).
- Triggers input during a Period and during Source Delay time are ignored.

(c) Change from Operate status to Standby status in the free run mode, and source value changes including range changes

- When Operate is specified, the 6243/44 waits for the Operate processing time + Source Delay time and then generates the pulse.
- The source value change including range changes during operation waits for the Range change processing time + Source delay time and then the pulse wave is generated.
- For source value changes including range changes, the base value and the pulse value are changed to be in the same range.

(d) Change from Operate status to Standby status in the hold mode, and source value changes including range changes

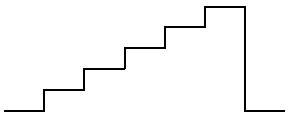
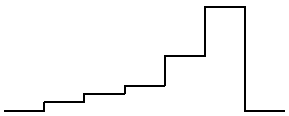
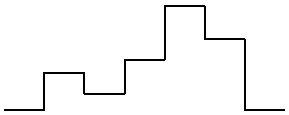
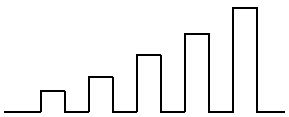
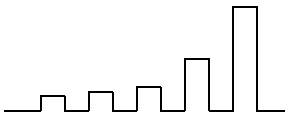
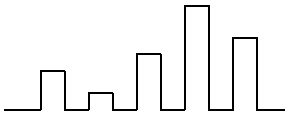
- When a trigger is input during range change processing, the 6243/44 waits for processing completion and then the pulse is generated.
- Triggers input during Period, Source Delay time, and Operate processing are ignored.

4.4 Operation in the Sweep Source Mode

(1) Sweep source mode operation

Table 4-4 shows the operation in the sweep source mode.

Table 4-4 Operation in the Sweep Source Mode

Sweep type			Description	Waveform
DC sweep	Staircase sweep	Linear sweep	Generates stair case wave from the specified start value to stop value.	
		Log sweep	Generates a logarithmic sweep in single decade steps from the specified start value to the stop value.	
	Random sweep		Generates stored sweep source values from the specified start value to the stop value.	
Pulse sweep	Pulse sweep	Linear pulse sweep	Generates stair case pulses using the step value from the start value to the stop value.	
		Log pulse sweep	Generates logarithmic pulses in single decade steps from the specified start value to the stop value.	
	Random pulse sweep		Generates stored pulse source values from the specified start value to the stop value.	

Sweep always progresses from start to stop.

For linear and log sweep, when the stop value is exceeded, the stop value is output and the sweep stops.

For random sweeps, when start address > stop address, the source value stored in the start address is output and the sweep stops.

(2) Changing parameters for sweep measurement

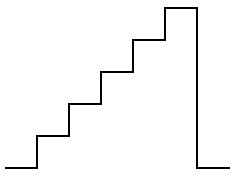
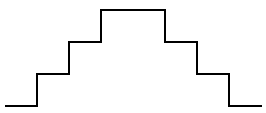
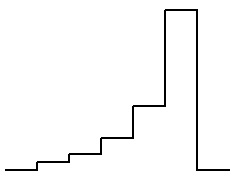
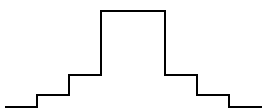
Parameters for sweep measurement can only be changed in Standby status. However, the following items can be changed during sweep stop in the Operate status.

- Time parameters
  - Hold time
  - Source Delay time
  - Measure Delay time
  - Period
  - Pulse width
  - Auto Range Delay time
- Sweep Trigger Mode
- Start address and Stop address of Random Sweep
  (Within the range of the Start address and Stop address specified before operation)
- Repeat count
- Reverse Mode ON/OFF
- Bias Value

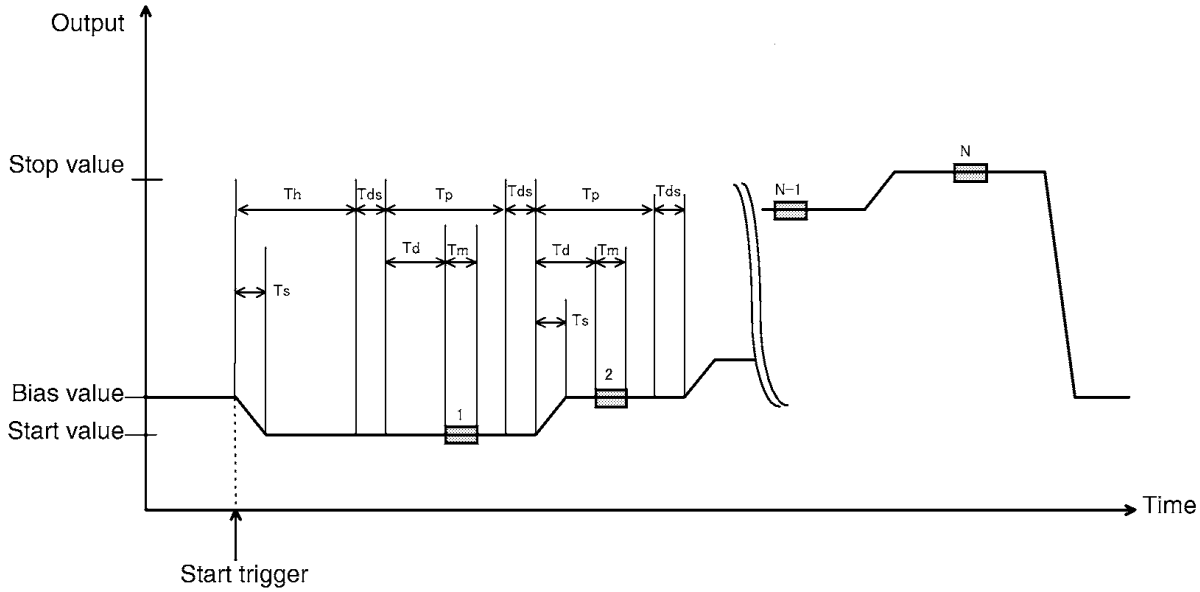
4.4.1 Staircase Sweep

Staircase sweeps, linear sweeps or log sweeps can be selected for the sweep type and one-way sweep or round-trip sweep can be selected with Reverse ON/OFF.

Table 4-5 Sweep Types for Staircase Sweep

Sweep type	Output waveform	Number of steps, No. K output value
Linear sweep Reverse-OFF		No. K output= Start value + (K-1) × (Step value) Number of steps= | Stop value - Start value | /Step value + 1 (Maximum 5000)
Linear sweep Reverse-ON		
Log sweep Reverse-OFF		No. K output = (Start value) × 10 K/n n: Number of divisions per decade • Start value, Stop value≠0 | Start value | ≤ | Stop value | Start value polarity = Stop value polarity
Log sweep Reverse-ON		

4.4.1 Staircase Sweep



(a) Internal trigger mode

Ts; Settling time
Th; Hold time
Tds; Source delay time
Tw; Pulse width
Tp; Period
Td; Measure delay time
Tm; Measurement time
N; Number of measurements

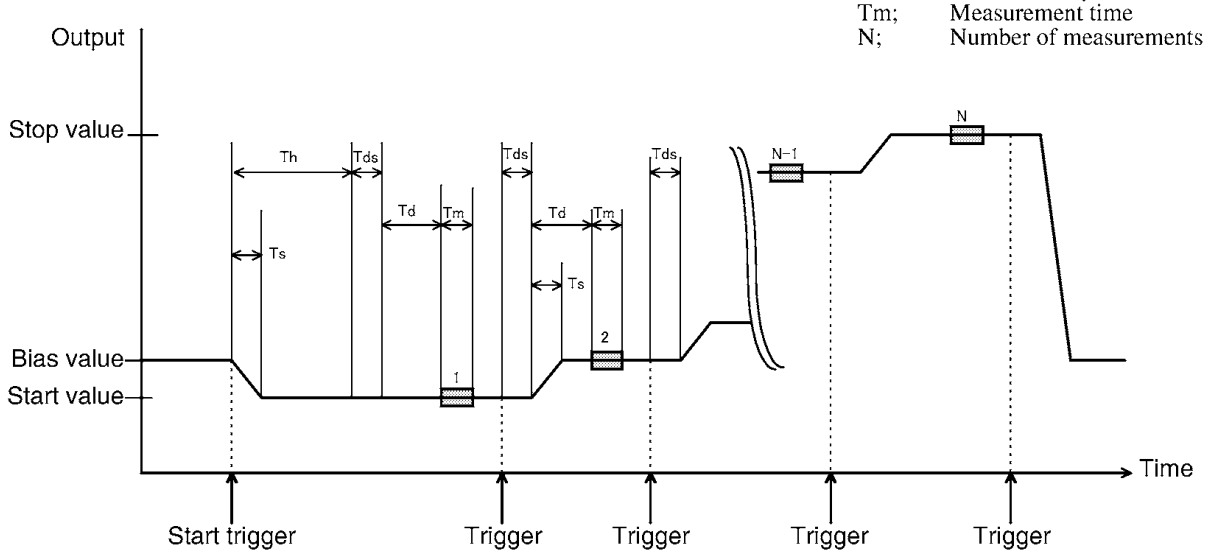


Figure 4-9 Staircase Sweep (One-Way Sweep)

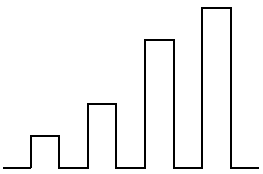
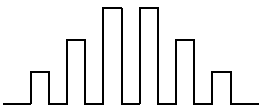
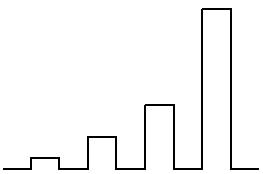
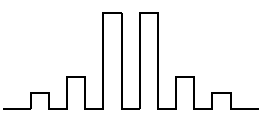
<Explanations of Illustrations>

- Bias values are output before sweep start and after sweep finish.
- When a start trigger is received, the start value is output.
- After receiving a start trigger, the 6243/44 waits for the Hold time + Source Delay time and then the measurement starts.
- When the trigger mode is internal, after completion of measurement and period, the 6243/44 waits for the Source Delay time and then outputs the next Step value or the Bias Value (End Value). When the trigger mode is external, this takes place after the Step Trigger is input.
- After the next Step Value is output, the 6243/44 waits for the Measure Delay time and then the measurement starts.

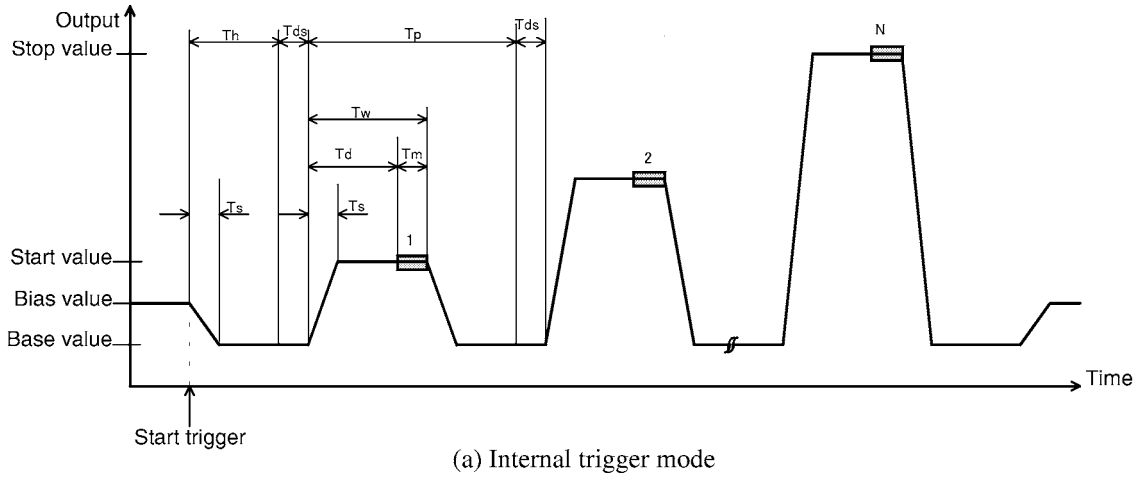
4.4.2 Pulse Sweep

In the same way as the staircase sweep (Section 4.4.1), linear pulse sweeps or log pulse sweeps can be selected for the sweep type and one-way sweep or round-trip sweep can be selected with Reverse ON/OFF.

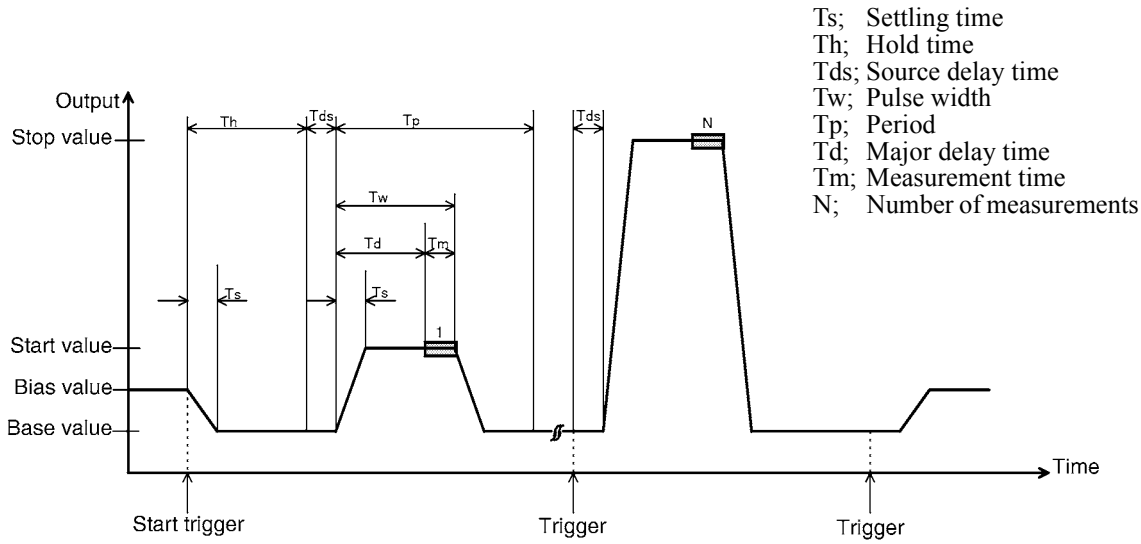
Table 4-6 Sweep Types for Pulse Sweep

Sweep type	Output waveform	Number of steps, No. K output value
Linear pulse sweep Reverse-OFF		No. K output = Start value + (K-1) × (Step value) Number of steps = | Stop value - Start value | /Step value + 1 (Maximum 5000)
Linear pulse sweep Reverse-ON		
Log pulse sweep Reverse-OFF		No. K output = (Start value) × 10 K/n n: Number of divisions per decade • Start value, Stop value≠0 | Start value | ≤ | Stop value | Start value polarity = Stop value polarity
Log pulse sweep Reverse-ON		

4.4.2 Pulse Sweep



(a) Internal trigger mode



Ts; Settling time
Th; Hold time
Tds; Source delay time
Tw; Pulse width
Tp; Period
Td; Major delay time
Tm; Measurement time
N; Number of measurements

(b) External trigger mode

Figure 4-10 Pulse Sweep (One-Way Sweep)

<Explanations of Illustrations>

- Bias Values are output before sweep start and after sweep finish.
- When a start trigger is received, the Base Value is output and the 6243/44 waits for the Hold time.
- After waiting for the Hold time + Source Delay time, the 6243/44 outputs the pulse value.
- After the pulse value is output, the 6243/44 waits for the pulse width time and returns output to the Base Value.
- After the pulse output, the 6243/44 waits for the Measure Delay time and then starts the measurement.

4.4.3 Random Sweep and Random Pulse Sweep

Random Sweep sweeps the source values stored in the random memory from the specified start address to the stop address.

Desired values can be stored in memory so that function waves can also be generated.

Since this memory is shared with random pulse sweeps, it is possible to select whether the stored source value should be generated as a DC wave or a pulse. Figure 4-11 illustrates this relation.

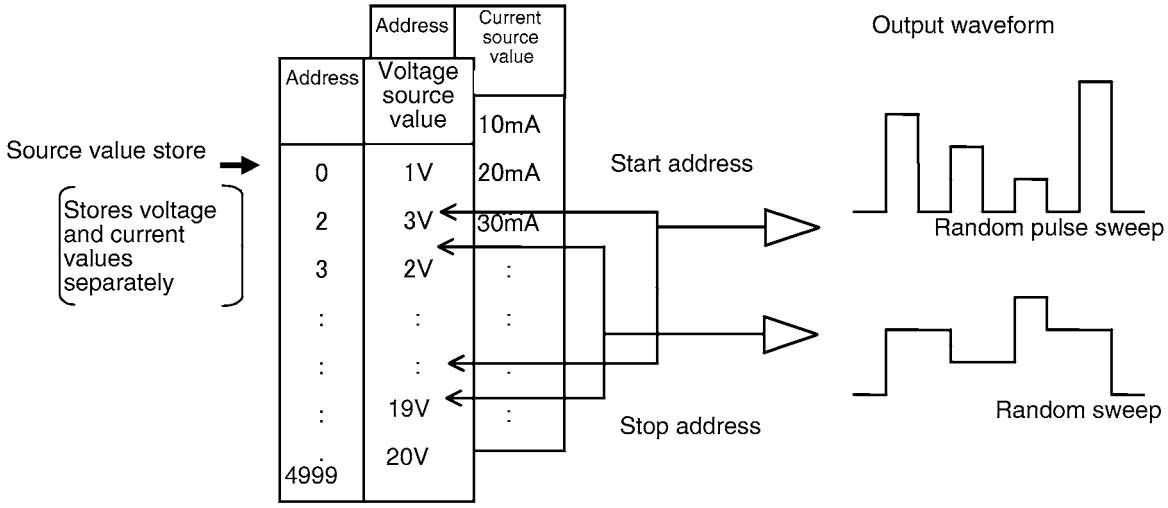


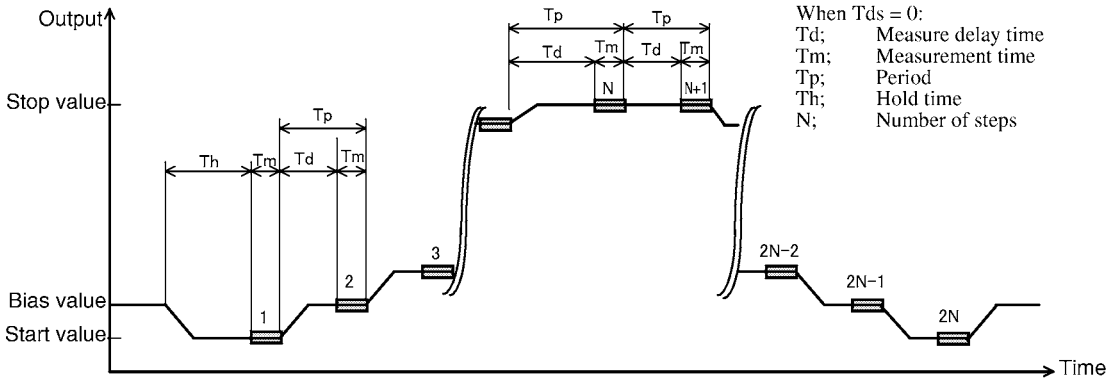
Figure 4-11 Operations of Random Sweep and Random Pulse Sweep

<Explanation of illustration>

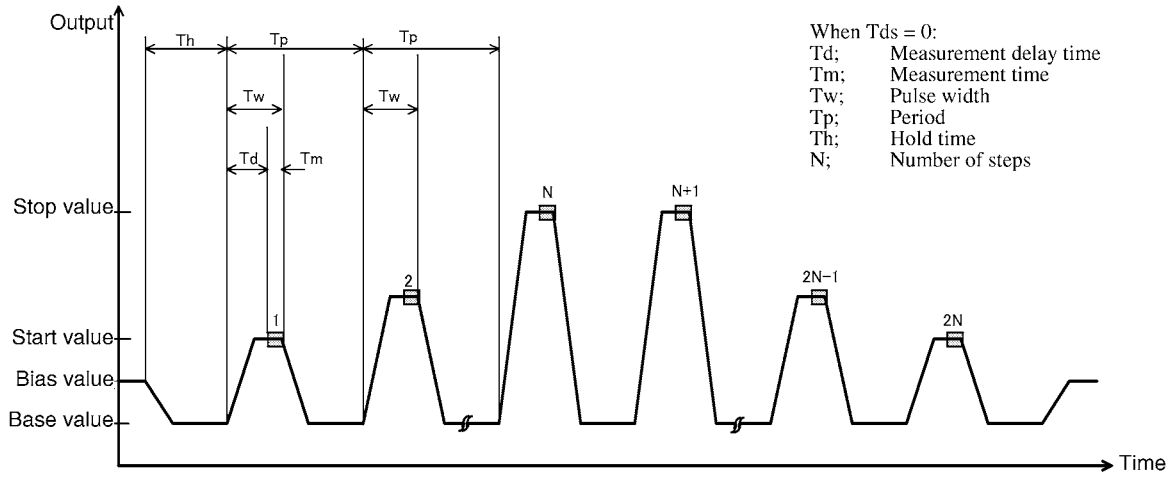
- The random memory allows both the voltage function and the current function to be set between 0 and 4999. Specify the function to be executed.

4.4.4 Round-Trip Sweep (Reverse ON)

This section explains round-trip sweep for Staircase sweep (Section 4.4.1) and Pulse sweep (Section 4.4.2).



(a) Linear round-trip sweep



(b) Linear pulse round-trip sweep

Figure 4-12 Round-Trip Sweep (Reverse ON)

<Explanations of illustrations>

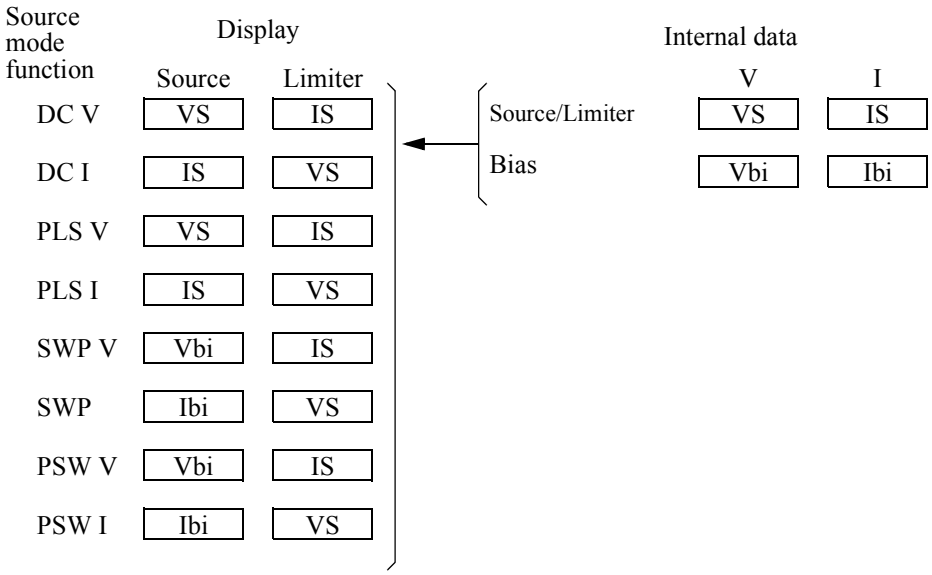
- Following sweep from start value to stop value, sweep is performed from stop value to start value.
- The step count becomes twice that of the one-way sweep.
- Upon completion of the sweep, the bias value is output.

4.5 Source Functions

The following explain operations and restrictions about source.

4.5.1 Changing the Source Mode and Source Function

When the Source Mode or Source Function is changed, the source value and limiter value change as shown in Figure 4-13.



- When the VS or IS value is set to 300 digits or less, the limiter value is set to the minimum value of 300 digits.

Figure 4-13 Changing the Source Mode and Source Function

(1) Function change examples

- Each press on the **VS/IS** key switches the setting as follows:

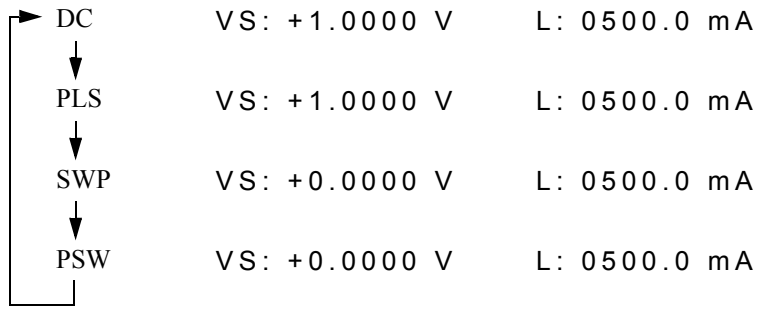
```
VS: +1.0000 V      L: 0500.0 mA
  ↓   ↑
IS: +0500.0 mA     L: 1.0000 V
```

- Pressing the **VS/IS** key twice switches the setting as follows:

```
VS: +0.0000 V      L: 0500.0 mA
  ↓
IS: +0500.0 mA     L: 0.0300 V
  ↓
VS: +0.0300 V      L: 0500.0 mA
```

(2) Mode change examples

When set as follows: Source Value: +1.0000 V. Limiter Value: 0500.0 mA. Bias Value: +0.0000 V.



4.5.2 Source value Restrictions

(1) Output range

The setting range for the source value is restricted by the limiter (compliance) value as shown in the following table. If set out of this range, an error is generated.

Table 4-7 Source Value Setting Range (6243)

Function	Limiter setting	Range
Voltage source	0.3 μA ≤ I_L ≤ 0.5 A 0.5 A < I_L ≤ 1 A 1 A < I_L ≤ 2 A	0 to ± 110 V 0 to ± 64 V 0 to ± 32 V
Current source	3 mV ≤ V_L ≤ 32 V 32 V < V_L ≤ 64 V 64 V < V_L ≤ 110 V	0 to ± 2 A 0 to ± 1 A 0 to ± 0.5 A

Table 4-8 Source Value Setting Range (6244)

Function	Limiter setting	Range
Voltage source	3 μA ≤ I_L ≤ 4 A 4 A < I_L ≤ 10 A	0 to ± 20 V 0 to ± 7 V
Current source	3 mV ≤ V_L ≤ 7 V 7 V < V_L ≤ 20 V	0 to ± 10 A 0 to ± 4 A

(2) Restrictions on each source value

Base value:	The polarity specified at the time of setting is ignored and becomes the same as that of the pulse value.	
Start value:	0 generates an error for log sweep.	
Stop value:	0 generates an error for log sweep.	
Step value:	The polarity specified at the time of setting is ignored and sweep proceeds from Start → Stop.	
	In linear sweep:	(Stop - Start) / Step + 1 > 5000 generates an error.
	In log sweep:	If the polarities of start and stop are not identical, an error is generated. When |Start| > |Stop|, an error is generated.

If an error is generated, operation is not possible.

4.5.3 Source Range

(1) Source ranging

- The source values (pulse values) of the DC mode and pulse source mode are output in the displayed range.
- Base value, bias value, start value and stop value ranges are decided by the fixed/auto range as shown in the following table with no relation to the set values or displayed values.

Range	Operation	Selected range
Fixed range	Data knob Direct mode without unit	Specified range
	Fixed range in the Sweep mode	Maximum range to cover the source values
Auto range	Direct mode with unit Auto range in the Sweep mode	Maximum range to cover the source digits

Set values and decided ranges for auto range

		Setting value	Specified range
6243	Voltage source	0 V ≤ |V| ≤ 320 mV 320 mV < |V| ≤ 3.2 V 3.2 V < |V| ≤ 32 V 32 V < |V| ≤ 110 V	320 mV 3.2 V 32 V 110 V
	Current source	0 A ≤ | I | ≤ 32 μA 32 μA < | I | ≤ 320 μA 320 μA < | I | ≤ 3.2 mA 3.2 mA < | I | ≤ 32 mA 32 mA < | I | ≤ 320 mA 320 mA < | I | ≤ 2 A	32 μA 320 μA 3.2 mA 32 mA 320 mA 2 A
6244	Voltage source	0 V ≤ |V| ≤ 320 mV 320 mV < |V| ≤ 3.2 V 3.2 V < |V| ≤ 20 V	320 mV 3.2 V 20 V
	Current source	0 A ≤ | I | ≤ 320 μA 320 μA < | I | ≤ 3.2 mA 3.2 mA < | I | ≤ 32 mA 32 mA < | I | ≤ 320 mA 320 mA < | I | ≤ 3.2 A 3.2 A < | I | ≤ 10 A	320 μA 3.2 mA 32 mA 320 mA 3.2 A 10 A

Taking the example of DC sweep, Table 4-9 shows how the source range and source data become results of the range specification for the same source value.

Table 4-9 Range and Data Differences in Accordance With Range Specification
(Example: Showing DC Sweep With 6243)

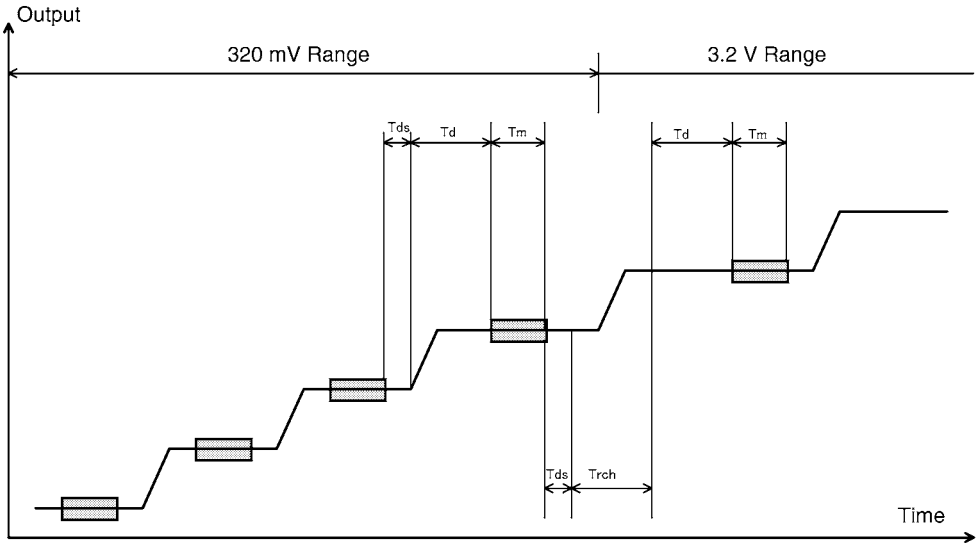
Source setting		Fixed range (110 V range fixed)		Auto range	
Parameter	Setting value	Range	Data	Range	Data
Bias value Start value Stop value	0.1 V 2 V 80 V	110 V 110 V 110 V	0.10 V 2.00 V 80.00 V	320 mV 3.2 V 110 V	100.00 mV 2.0000 V 80.00 V

- 110 V range is selected for all.
- 320 mV range is selected for Bias values.
  3.2 V range is selected for Start values.
  110 V range is selected for Stop values.
  320 mV range to 110 V range is used during sweep.

(2) Range operation during sweep operation

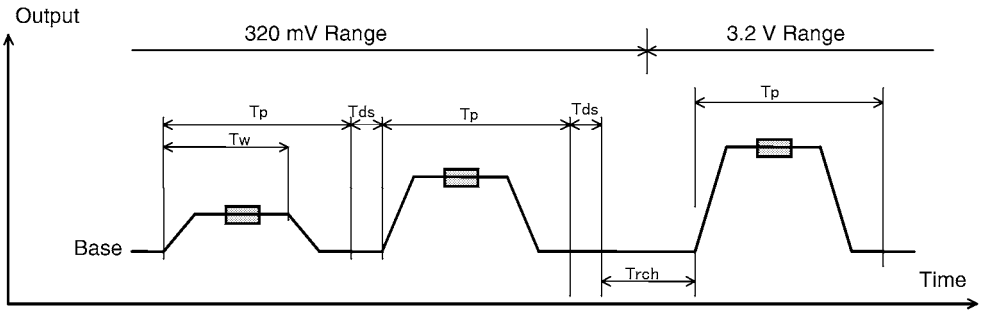
When the auto range is set, the sweep operation sweeps while switching the source range.

The range is switched immediately before the next step is output. Consequently, the step time is prolonged by the amount of time required for the range switch processing.



Tds; Source delay time
Td; Measure delay time
Tm; Measurement time
Trch; Range switching time

(a) For DC sweep



Tds; Source delay time
Tw; Pulse width
Tp; Period
Trch; Range switching time

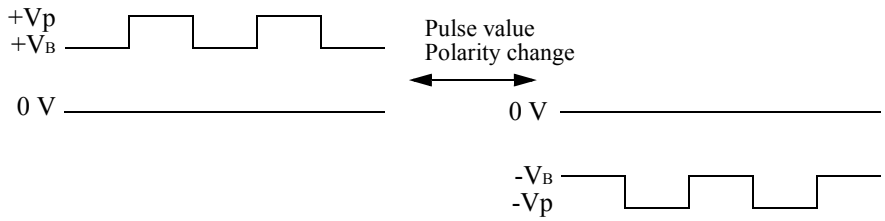
(b) For pulse sweep

Figure 4-14 Range Operation during Sweep

4.5.4 Polarity Change

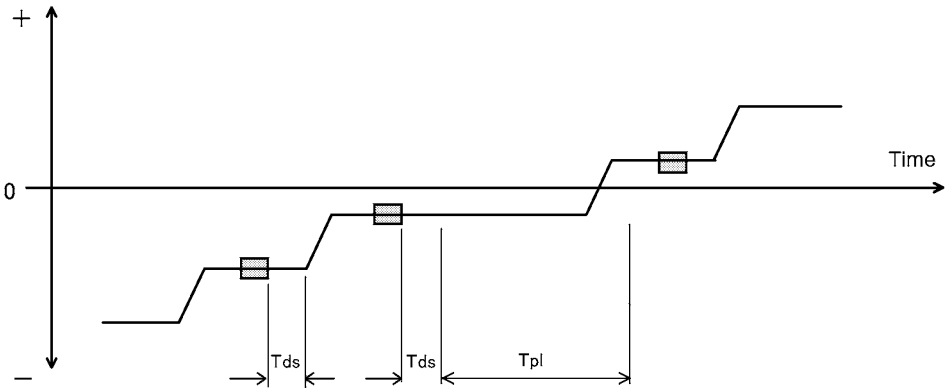
(1) Polarity change in the Pulse source mode

If the polarity of the source value (pulse value) is changed in the Pulse source mode, the polarity of the Base Value also changes as shown in the figure below.

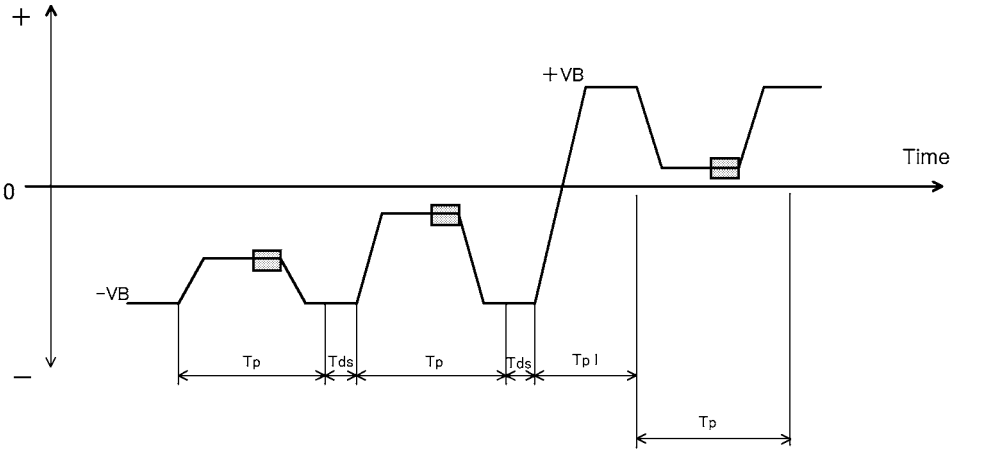


(2) Sweep operation straddling polarities

With the exception of log sweeps and log pulse sweeps, the 6243/44 is capable of sweep straddling polarities. When polarities are straddled, the step time before switching is delayed by the polarity switch time.



(a) DC sweep



Tds; Source delay time
Tp; Period
Tpl; Polarity switching time

* When the polarity of pulse value is changed, the polarity of base value is also changed.

(b) Pulse sweep

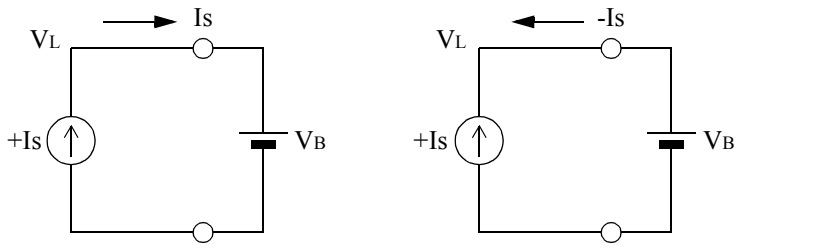
Figure 4-15 Sweep Operation Straddling Polarities

4.5.5 Reverse Polarity Source Operation

When 6243/44 is used with the current source function (IS), the current is normally output with the specified polarity. (Figure 4-16 a) However, when an external source is connected, the voltage limiter (V_L) is smaller than the external source (V_B) and the output current cannot be output with the specified polarity, the 6243/44 output current with the reversed polarity. (Figure 4-16 b)

This operation status is called “reverse polarity source operation.”

The source accuracy in reverse polarity source operation is found by adding approximately 300 digit error to the reverse limiter total accuracy found in Chapter 9, “SPECIFICATIONS.”



(a) VL>VB (Normal operation) (b) VL<VB (Reverse source operation)

Even if +IS is set, +IS is output when $V_L > V_B$,
and -IS is output when $V_L < V_B$.

Figure 4-16 Reverse Polarity Source Operation

NOTE:

1. ***For the voltage source function (VS), the operation becomes a “reverse polarity source operation” under the following conditions. However, this condition should not be used because the condition is occurs immediately before an overload due to the current restriction by the current limiter (I_L) not functioning in this condition.***

   Conditions: ***The following 3 conditions must be met at the same time.***
   The polarities of V_S and V_B are different.
   $|V_S| < |V_B|$
   The difference between $|V_S|$ and $|V_B|$ is small.

2. ***If the difference between $|V_S|$ and $|V_B|$ becomes large under the above conditions, an overload will occur and the 6243/44 will enter Standby.***

4.6 Measurement Function

4.6.1 Measurement Function

Regardless of the source function, the measurement function can be selected as voltage measurement or current measurement.

4.6.2 Measurement Ranging

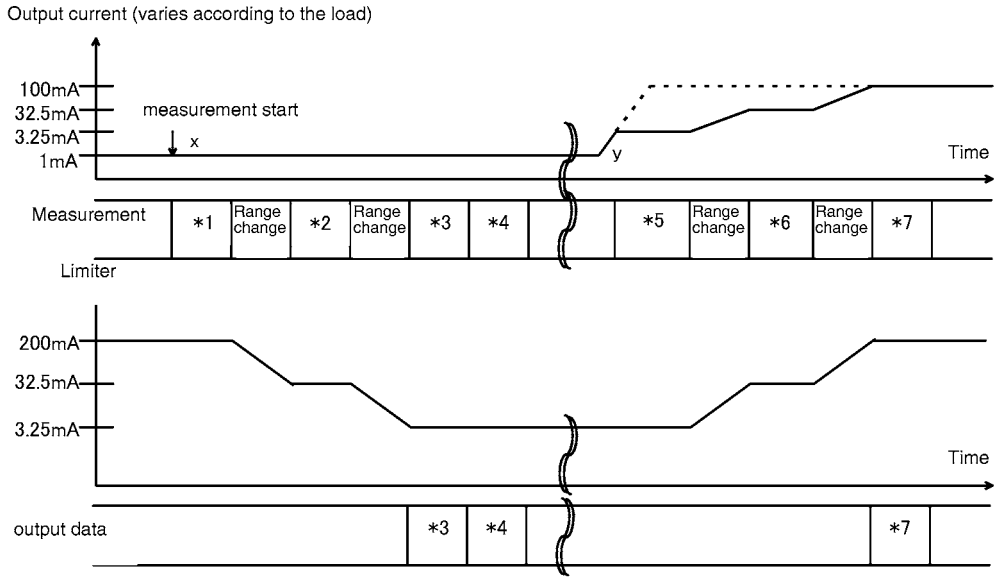
The measurement ranging types and their functions are shown below:

Range	Function	Range before measurement	Operation during measurement
Fixed range	Measure in the Source range or Limiter range	Limiter range or Source range	Fixed range
Auto range	A range to maximize the effective digits for measured value is selected	Limiter range or source range	Auto ranging *

* For voltage source current measurement (VSIM) and current source voltage measurement (ISVM), the measurement range becomes the auto range in which the limiter range is the maximum range.
For voltage source voltage measurement (VSVM) and current source current measurement (ISIM), the measurement range is identical with the source range and the auto range does not function.

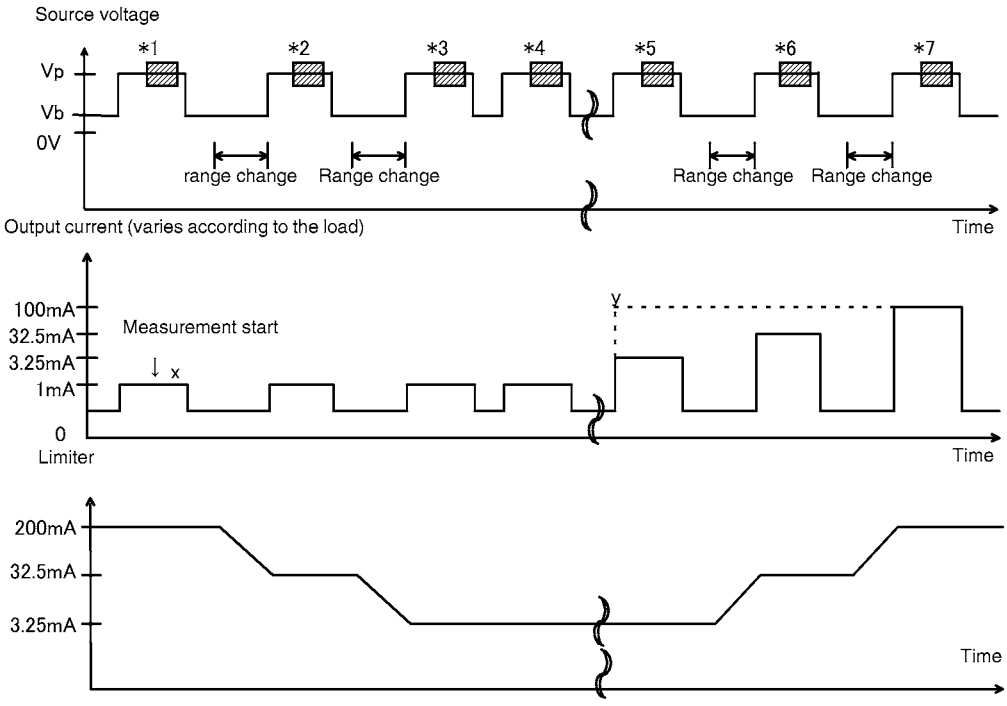
NOTE: ***If the source value or limiter value is set to the full-scale value, errors may cause the measurement value to exceed the full-scale value resulting in Over Range display.***

(1) The measurement auto range in the DC source mode and Pulse source mode



(a) DC source mode

Figure 4-17 Current Measurement in Auto Range and Limiter Operation (1/2)



(b) Pulse source mode

Figure 4-17 Current Measurement in Auto Range and Limiter Operation (2/2)

During the operation of the current measurement auto range, measurement is made while the limiter is changed to a value that is larger than the full scale of the measurement range.

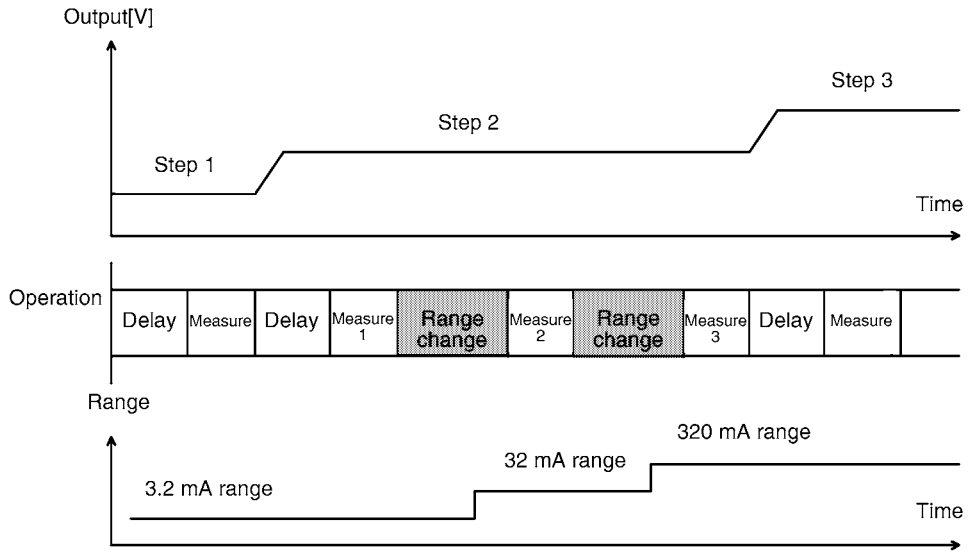
- In the case of *1, range change occurs because the result measured in the 320 mA range is 1 mA. The result of the range change is that the range becomes the 32 mA range, and the limiter is changed to the maximum value (32.5 mA) of the 32 mA range.
- In the case of *2, range change occurs because the result measured in the 32 mA range is 1 mA, and the limiter is changed to 3.25 mA.
- In the case of *3, measurement is made in the 3.2 mA range and measurement data of 1 mA is output.
- At the y point, the output current should change to 100 mA, but because the limiter is set to 3.25 mA, the output current is held at 3.25 mA.
- In the case of *5, if measurement is made in the 3.2 mA range, the measurement becomes 3.25 mA. This becomes over range (over 3.2 mA) and range change occurs.

  The result of the range change is that the range becomes the 32 mA range, and the limiter is also changed to the 32.5 mA.
- In the case of *6, the result measured in the 32 mA range becomes 32.5 mA. Range change follows because this is over range.

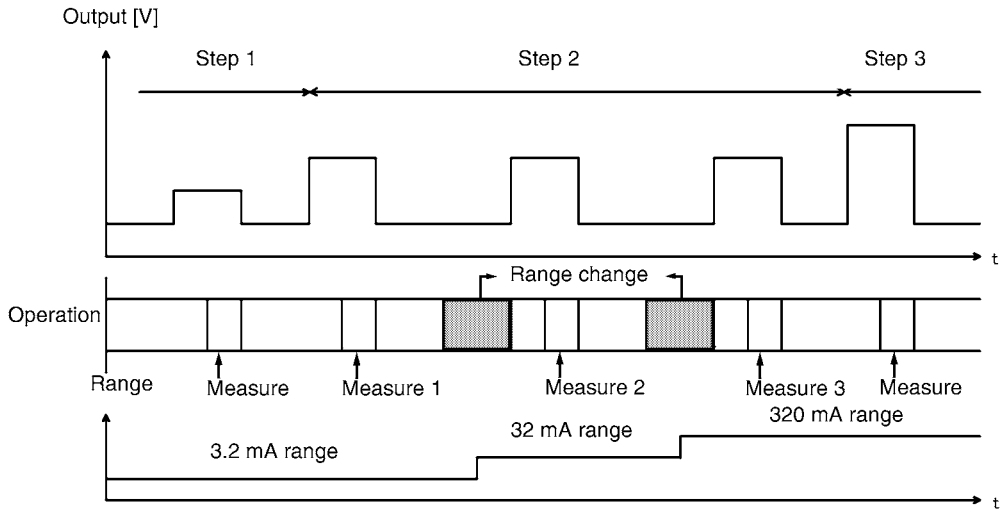
  The result of the range change is that the range becomes the 320 mA range, but this becomes the 200 mA compliance set for this range.
- In the case of *7, the result measured in the 320 mA range becomes 100 mA which is output as output data.

(2) Auto range measurement during sweep

During sweep operation, measurement is made in each step but if the measurement range is set to Auto range, auto ranging is performed until measurement data can be confirmed in each step.



(a) DC sweep



(b) Pulse sweep

Figure 4-18 Auto Ranging during Sweep Mode Measurement

This example shows the operation when DC sweep and Pulse sweep are performed in VSIM.

Because the IM measurement value exceeded 3.2 mA in step 2, range change from 3.2 mA to 32 mA takes place following measurement 1. Then, because the measurement value of measurement 2 also becomes over range, range change from 32 mA to 320 mA takes place.

Then the measurement value of step 2 is confirmed by measurement 3 and the process proceeds to step 3.

NOTE: ***When the measurement auto range is used in the Pulse source and Pulse sweep modes, the following conditions are applied:***

- ***When the measurement point is specified as the Base Value, even if the limiter is set sufficiently high, the limiter may still Operate at the pulse value.***
  This is because the limiter range is decided by the measurement result obtained with the Base Value, the limiter value resulted in a relatively small one as one for the pulse value.
- ***When the measurement point is the pulse value, the limiter may Operate at a Base value due to the Base Value setting for the same reason as described above.***

4.6.3 Auto-Zero Function

The 6243/44 features a function for canceling the offset drift of the AD converter. This "Auto-zero" function periodically measures the zero point and cancels drift.

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

- More than 10 seconds have elapsed since execution of the previous Auto-zero operation and measurement has been completed.

  (However, Auto-zero operation is not performed when the Memory Store operation is set to Burst-ON.)
- When the integration time is changed.

NOTE: ***In the Pulse source mode and the Pulse sweep mode, if the Auto-zero function is engaged, the Base Value is output until the Auto-zero operation is completed.***
Consequently, the base value output time is temporarily extended.
If deemed necessary, set the Auto-zero function to OFF.

4.7 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 and over-current to the device.

The 6243/44's limiters for both voltage and current have both + and - polarities, and the set limiter values (non-polar) are applied for both + and - polarities.

NOTE: ***When an external power source (V_B), such as a battery is connected, set the voltage source value (V_S) and voltage limiter value (V_L) to a value higher than the V_B as shown below.***
$|V_B| < |V_S|$ or $|V_B| < |V_L|$
If V_S or V_L is set to a smaller value than V_B, overload or reverse polarity source may be generated.

4.7.1 Limiter Setting Ranges

The limiter setting range is restricted by the source value.

Table 4-10 and Table 4-11 show the limiter setting ranges in relation to the source values.

Table 4-10 Limiter Setting Range in Relation to the Source Value (6243)

	Source value	Limiter
Voltage source	0 ≤ |Vs| ≤ 32 V	300 nA to 2 A
	32 V < |Vs| ≤ 64 V	300 nA to 1 A
	64 V < |Vs| ≤ 110 V	300 nA to 0.5 A
Current source	0 ≤ |Is| ≤ 0.5 A	3 mV to 110 V
	0.5 A < |Is| ≤ 1 A	3 mV to 64 V
	1 A < |Is| ≤ 2 A	3 mV to 32 V

Table 4-11 Limiter Setting Range in Relation to the Source Value (6244)

	Source value	Limiter
Voltage source	0 ≤ |Vs| ≤ 7 V	3 μA to 10 A
	7 V < |Vs| ≤ 20 V	3 μA to 4 A
Current source	0 ≤ |Is| ≤ 4 A	3 mV to 20 V
	4 A < |Is| ≤ 10 A	3 mV to 7 V

- The minimum setting value for the limiter is 300 digits of the limiter range. Lower setting than this is not possible.

- The limiter is set to a value equal to the absolute value in both + and - polarities.

NOTE:

1. ***Set the current limiter to the largest possible values within the necessary range. The smaller the current limit, the longer the settling time.***
2. ***Set the voltage limiter to the smallest possible values within the necessary range. If the set current cannot be applied to the DUT, or if the output terminal becomes open, the output voltage will reach the voltage limiter value.***
3. ***If the voltage measurement range is set to Auto, the current in the auto range will be a slightly higher value than the full-scale value of the measurement range. (Refer to Section 4.6.2, "Measurement Ranging.")***

The limiter range can be set by pressing the **RANGE** key, or by auto range setting using the direct input mode.

- If set with the direct input mode, the range will automatically be decided by the set value.
  Table 4-12 and Table 4-13 show the range in relation to the limiter setting values.

Table 4-12 Range in Relation to the Limiter Setting Value (6243)

	Limiter setting	Range
Voltage limiter	3 mV ≤ V_L ≤ 320 mV	320 mV
	320 mV < V_L ≤ 3.2 V	3.2 V
	3.2 V < V_L ≤ 32 V	32 V
	32 V < V_L ≤ 110 V	110 V
Current limiter	300 nA ≤ I_L ≤ 32 μA	32 μA
	32 μA < I_L ≤ 320 μA	320 μA
	320 μA < I_L ≤ 3.2 mA	3.2 mA
	3.2 mA < I_L ≤ 32 mA	32 mA
	32 mA < I_L ≤ 320 mA	320 mA
	320 mA < I_L ≤ 2 A	2 A

Table 4-13 Range in Relation to the Limiter Setting Value (6244)

	Limiter value	Range
Voltage limiter	3 mV ≤ V_L ≤ 320 mV	320 mV
	320 mV < V_L ≤ 3.2 V	3.2 V
	3.2 V < V_L ≤ 20 V	20 V
Current limiter	3 μA < I_L ≤ 320 μA	320 μA
	320 μA < I_L ≤ 3.2 mA	3.2 mA
	3.2 mA < I_L ≤ 32 mA	32 mA
	32 mA < I_L ≤ 320 mA	320 mA
	320 mA < I_L ≤ 3.2 A	3.2 A
	3.2 A < I_L ≤ 10 A	10 A

4.7.2 Limiter Polarity Mode

Limiters (compliance) possess both +/- polarities for both voltage source and current source but it is possible to accurately calibrate the setting for only one of these polarities, i.e., either + or -.

The function to select the polarity for this accurate limiter value is called the Limiter polarity mode.

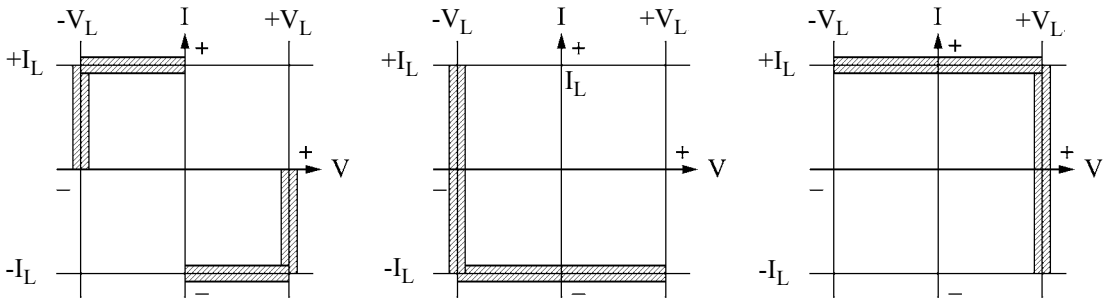
For the accuracy of the other limiter, refer to the information on general accuracy of reverse polarity limiter in Chapter 9, “SPECIFICATIONS.”

Limiter polarity mode

Auto:	Sets the same polarity value as that of the source value to be accurate.
Plus:	Sets + polarity value to be accurate.
Minus:	Sets - polarity value to be accurate.

Use the Auto mode for normal loads (resistors, semiconductors, etc.).

To control the sink current with the current limiter such as battery discharge, set the polarity to Plus or Minus.



(a) Auto (b) Plus (c) Minus

In this area measurements will be inaccurate.

4.8 Alarm Detection

The following alarm detection function is available to help prevent damage to the 6243/44 as well as the DUT. When any of these alarm conditions is detected, a message is displayed and output to the GPIB device event register, error register, measurement data header, etc.

Table 4-14 shows the messages together with their contents and causes.

Table 4-14 Alarm Detection Contents

Message	Description	Cause
Source Unit Error	Source unit malfunction	Malfunction
Fan Stop	The fan stopped.	Malfunction
Over Heat	Over heat (Internal over heat)	• Malfunction • Sync operation outside the specified range • The vent is blocked • Ambient temperature exceeds the specified range
AD Communication Error	Communication error to the AD unit	• Malfunction • Error due to noise
Over Load	Over load	• Over voltage input from external device • Connecting to the external voltage source of exceeding voltage level • Life of relays (For 6244)
OSC/osc	An oscillation is detected	• Connecting L or C which is out of specification. • Device oscillation
± RP/± rp	Reverse polarity source	Reversed polarity source is output.
± LM/± lm	Limiter detection	The voltage or current limiter is operating.
Over Range	Over range	Range over

- When Source 6243/44 Error, Fan Stop, or Over Heat is generated, the output is placed in Standby (output OFF), and operation is not possible until the cause of the error is eliminated.
- When Over Load occurred, the output is placed in Standby.

- The differences between the upper case and the lower case indications of OSC/osc, ±RP/rp, and ±LM/lm are as follows:

Display	Timing of detection	GPIB output		Buzzer
		Sub-header	Status	
OSC, ± RP, ± LM	During measurement	Yes	No	No
osc, ± rp, ± lm	Approximately every 100 ms (Operate status) No detection in 20 ms from the source or limiter change timing	No	Yes	Yes

- The oscillation detection levels of OSC/osc are as follows:

  Oscillation detection related to source system: 10 kHz to 2 MHz, 1 Vp-p or higher

  Oscillation detection related to output terminals: 10 kHz to 50 kHz, 2 Vp-p or higher

  Detection of the own high-frequency oscillation due to the device itself is not possible.

NOTE:

1. ***OSC/osc and ±LM/lm may be detected under the following circumstances even if actual oscillation or limiter is not generated.***
   - ***OSC, ±LM: When the output is changed during measurement***

     Ex.: When the pulse width (Tw) and measure delay (Td) is set to be the same, and the pulse rises or falls during measurement.
   - ***±lm: When the limiter set value is small and the settling time takes 20 ms or longer from the voltage source value change***

     Ex.: When the current limiter is set at 0.3 μA and voltage is changed by 100 V (Refer to Section 4.9.2 (1).)
2. ***osc, ±rp and ±lm are not detected under the following circumstances.***
   - ***When the pulse width is 20 ms or less: detection at the pulse value source point***
   - ***Period - pulse width is 20 ms or less: detection at the base value source point***
   - ***Sweeped for the period of 20 ms or faster***
3. ***The detection result may not appear in the measurement data header even if oscillation, limiter or reverse polarity source is detected in the GPIB status.***

- OSC/osc, ±RP/rp, and ±LM/lm are displayed at the same location as the results of Comparator calculations (HI/GO/LO), and the display priority is as follows:

  1 ±osc
  2 ±rp
  3 ±lm
  } Lower case

  4 ±OSC
  5 ±RP
  6 ±LM
  } Upper case

  7 HI/GO/LO

4.9 Source Timing and Measurement Timing

The 6243/44's timing of source and measurement differs depending on the source mode as shown in Table 4-15.

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

Table 4-15 Source Mode and Time Parameters to Be Considered

Source mode	Trigger mode	Source and measurement	Considerable parameter	Timing chart
DC	RUN	Asynchro-nous	Tp, Tm	Table 4-2
	HOLD		Td, Tm	
PLS Pulse	RUN	Synchronous	Tds, Tp, Tw, Td, Tm	Table 4-3
	HOLD			
SWP DC sweep	Internal	Synchronous	Th, Tds, Tp, Td, Tm	Table 4-9
	External			
PSW Pulse sweep	Internal	Synchronous	Th, Tds, Tp, Tw, Td, Tm	Table 4-10
	External			

Tds: Source Delay
Tp: Period
Tw: Pulse Width
Td: Measure Delay
Th: Hold Time
Tm: Measurement Time (Tm = Tit + Tk)
Tit; Integration Time
Tk; Processing Time

4.9.1 Restrictions on Time Parameters

The following explain the setting ranges of the time parameters and interrelated restrictions.

(1) Setting time ranges

Source Delay time: (Tds)

Setting range	Resolution
10 μs to 600.00 ms	10 μs
600.1 ms to 6000.0 ms	100 μs
6001 ms to 60000 ms	1 ms

Period (pulse cycle): (Tp)

Setting range	Resolution
2 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: (Tw)

Setting range	Resolution
1 ms to 600.00 ms	10 μs
600.1 ms to 6000.0 ms	100 μs
6001 ms to 60000 ms	1 ms

Measure Delay time: (Td)

Setting range	Resolution
300 μs to 600.00 ms	10 μs
600.1 ms to 6000.0 ms	100 μs
6001 ms to 60000 ms	1 ms

Hold Time: (Th)

Setting range	Resolution
3 ms to 60000 ms	1 ms

Auto Range Delay time: (Ta)

Setting range	Resolution
0 ms to 500 ms	1 ms

Measurement Time: (Tm)

Tm = Tit + Tk

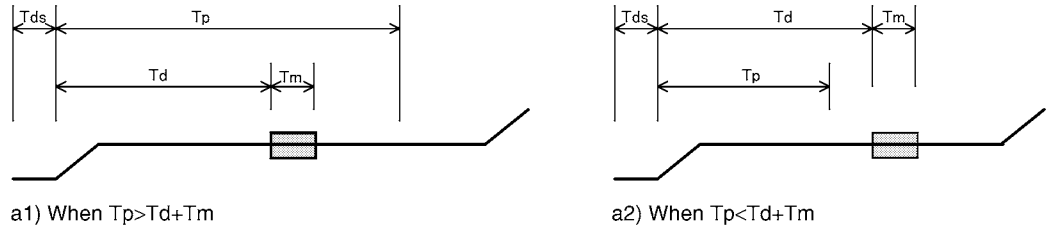
Tit; Integration time
Tk; Processing time (Refer to Section 4.9.3, “Integration Time and Measurement Time.”)

Integration Time: (Tit)

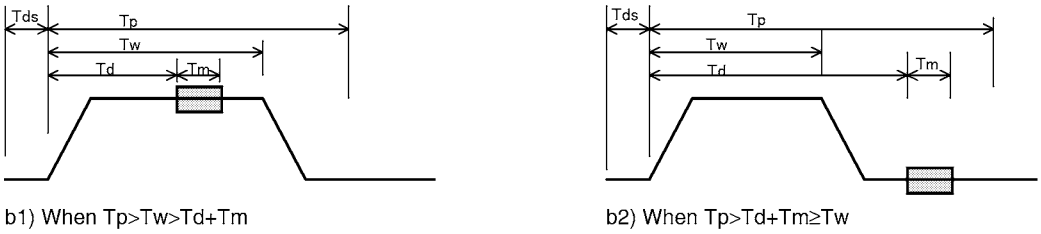
Setting	Integration time	
	LF 50 Hz	LF 60 Hz
500 µs	500 µs	500 µs
1 ms	1 ms	1 ms
10 ms	10 ms	10 ms
1 PLC	20 ms	16.7 ms
10 PLC	200 ms	166.7 ms
100 PLC	2000 ms	1666.7 ms

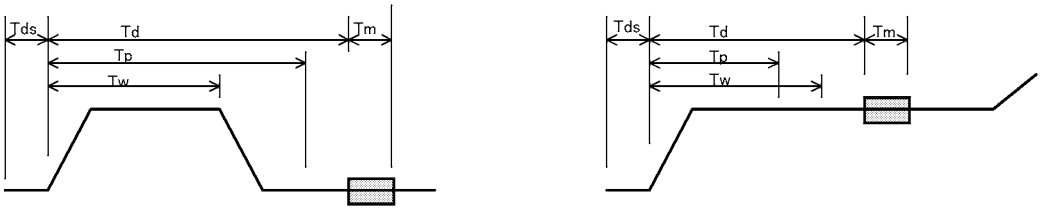
(2) Interrelated time parameter restrictions

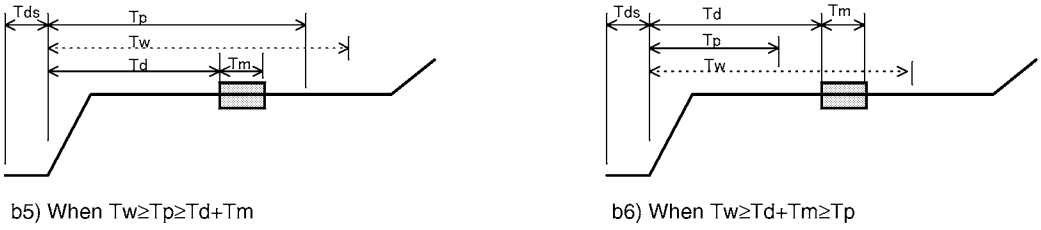
The Period (Tp), Measure Delay (Td), Measurement Time (Tm) and Pulse Width (Tw) time parameters are interrelated, and the measurement point changes in accordance with the relations between these parameters. (Refer to Figure 4-19.)



(a) DC sweep







(b) Pulse source and Pulse sweep

Figure 4-19 Output Waveform in Accordance With Time Parameters

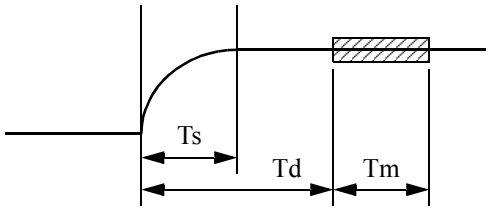
When Tw ≥ Tp as in b4), b5) and b6), the next Tds starts with no return to the base at the end of the pulse width. Consequently, in the Pulse source mode, a constant value (pulse value) is output as in the DC source mode.

In the Pulse sweep, the next step (pulse value) is output when the Tds ends as in DC sweep.

4.9.2 Measure Delay and Settling Time

In the Pulse source mode and the Sweep source mode, the 6243/44 waits for the source value and DUT to settle before measurement.

The following explain the 6243/44's settling time and the required Measure Delay.



Ts: Settling time
Td: Measure Delay

(1) Voltage source

The 6243/44's settling time (Ts) is calculated from the voltage source change value (Vs) and source limiter set value DIL (digits) according to the following formula. Set the Measure Delay (Td) higher than Ts.

- 6243
  - When the current limiter range is 320 μA to 2 A: $Ts = 0.3 + (0.8 + 5000/DIL) \times Vs/100$ [ms]
  - When the current limiter range is 32 μA: $Ts = 0.3 + (0.8 + 13000/DIL) \times Vs/100$ [ms]

  Example: Ts unit (ms)

Current limiter range	Vs [V]	Current limiter setting DIL(digits)				
		300	3000	5000	10000	32000
320 μA to 2 A	1	0.5	0.3	0.3	0.3	0.3
	10	2.0	0.5	0.5	0.4	0.4
	20	3.8	0.8	0.7	0.6	0.5
	32	5.9	1.1	0.9	0.7	0.6
	64	11.5	1.9	1.5	1.1	0.9
	110	19.5	3.0	2.3	1.7	1.4
32 μA	1	0.7	0.4	0.3	0.3	0.3
	10	4.7	0.8	0.6	0.5	0.4
	20	9.1	1.3	1.0	0.7	0.5
	32	14.4	1.9	1.4	1.0	0.7
	64	28.5	3.6	2.5	1.6	1.1
	110	48.8	5.9	4.0	2.6	1.6

- 6244
  - When the current limiter range is 320 μA to 10 A: Ts = 0.3 + (0.8 + 7500/DIL) × Vs/100 [ms]

  Example: Ts unit (ms)

Current limiter range	Vs [V]	Current limiter setting DIL(digits)				
		300	3000	5000	10000	32000
320 μA to 10 A	1	0.6	0.3	0.3	0.3	0.3
	10	2.9	0.6	0.5	0.5	0.4
	20	5.5	1.0	0.8	0.6	0.5

(2) Current source

The 6243/44's settling time (Ts) becomes, in accordance with the current source change value (Is), the current sense resistance (Rs) and the load voltage, ($V_{RL} = R_L \cdot Is$).

Set the Measure Delay (Td) higher than Ts.

- 6243

Ts value			Unit [μs]
Range	$\|V_{RL}\| \le 10$ V		$\|V_{RL}\| > 10$ V
	$\|Is\| \ge 18000$ digits	$\|Is\| < 18000$ digits	
32 μA	35 V_{RL} / (Rs · Is)		
320 μA to 2 A	300	Either 28 V_{RL} or 9 V_{RL} / (RsIs) + 200 which is greater the other.	

Rs value	
Range	Rs [Ω]
32 μA	22 k
320 μA	2.2 k
3.2 mA	220
32 mA	22
320 mA	2.2
2 A	0.22

Example 1: When 0.2 mA is applied to a 100 kΩ resistor in the 3.2 mA range

Is = 0.2 mA

V_{RL} = 0.2 mA × 100 kΩ = 20 V

28 V_{RL} = 28 × 20 = 560 μs

9 V_{RL} / (Rs · Is) + 200 = 9 × 20 / (220 × 0.2 mA) + 200
= 4291 μs

From this follows that Ts = 4291 μs

Make setting so that Td ≥ 4.29 ms

Example 2: When 0.2 mA is applied to a 100 kΩ resistor in the 320 μA range

Is = 0.2 mA
V_{RL} = 20 V
28 V_{RL} = 560 μs
9 V_{RL} / (Rs · Is) + 200 = 9 × 20 / (2.2 k × 0.2 mA) + 200
= 609 μs
From this follows that Ts = 609 μs
Make setting so that Td ≥ 610 μs

When a capacitive load (C_L) is connected as the load, time is also required for C_L charging in addition to the settling time described above.

$$Tc = \frac{C_L \cdot V_{RL}}{Is}$$ Tc: Charge time

Set Measure Delay (Td) higher than the higher of the Ts and Tc described above.

Example 3: When a current is applied at 1 μA and until it reaches 20 V for 0.1 μF in the 32 μA range

Is = 1 μA
V_{RL} = 20 V
TS = 35 V_{RL} / (Rs · Is) = 35.20 / (22 k · 1 μA)
= 31.8 ms
Tc = C_L · V_{RL} / Is = 0.1 μF · 20 V / 1 μA = 2 s
Make setting so that Td ≥ 2 s

- 6244

Ts value			Unit [μs]
Range	|V_{RL}| ≤ 10 V		|V_{RL}| > 10 V
	|Is| ≥ 18000 digits	|Is| < 18000 digits	
320 μA to 10 A	300	Either 28 V_{RL} or 9 V_{RL} / (RsIs) + 200 which is greater than the other	

Rs value	
Range	Rs [Ω]
320 μA	2.2 k
3.2 mA	220
32 mA	22
320 mA	2.2
3.2 A	0.25
10 A	22 m

Example 1: When 0.2 mA is applied to a 100 kΩ resistor in the 3.2 mA range

Is = 0.2 mA
V_{RL} = 0.2 mA × 100 kΩ = 20 V
28 V_{RL} = 28 × 20 = 560 μs
9 V_{RL} / (Rs · Is) + 200 = 9 × 20 / (220 × 0.2 mA) + 200
= 4291 μs
From this follows that Ts = 4291 μs
Make setting so that Td ≥ 4.29 ms

When a capacitive load (C_L) is connected as the load, time is also required for C_L charging in addition to the settling time described above.

$$Tc = \frac{C_L \cdot V_{RL}}{Is}$$ Tc: Charge time

Set Measure Delay (Td) higher than the higher of the Ts and Tc described above.

4.9.3 Integration Time and Measurement Time

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

Tm = Tit + Tk

The integration time (Tit) can be selected and set between 500 μs and 2000 ms.

The internal processing time Tk becomes, in accordance with the source mode and the Memory Store mode.

Source mode	Memory Store	Tk [ms]
DC	OFF	5.5
	Normal-ON	5.8
	Burst-ON	3.2
Pulse	OFF	4.5
DC sweep	Normal-ON	4.7
Pulse sweep	Burst-ON	2.2

Also, when the Memory Store mode is OFF and Normal-ON, the following processing times are added by NULL calculation, Comparator calculation, and measured value display.

NULL ON: 0.25 ms

Compare ON: 0.6 ms

Display OFF: -0.25 ms

Example: When in the DC source mode, and integration time: 1 PLC (50 Hz), Memory Store: Normal-ON, NULL operation: ON, Comparator calculation: ON, measurement time becomes as follows.

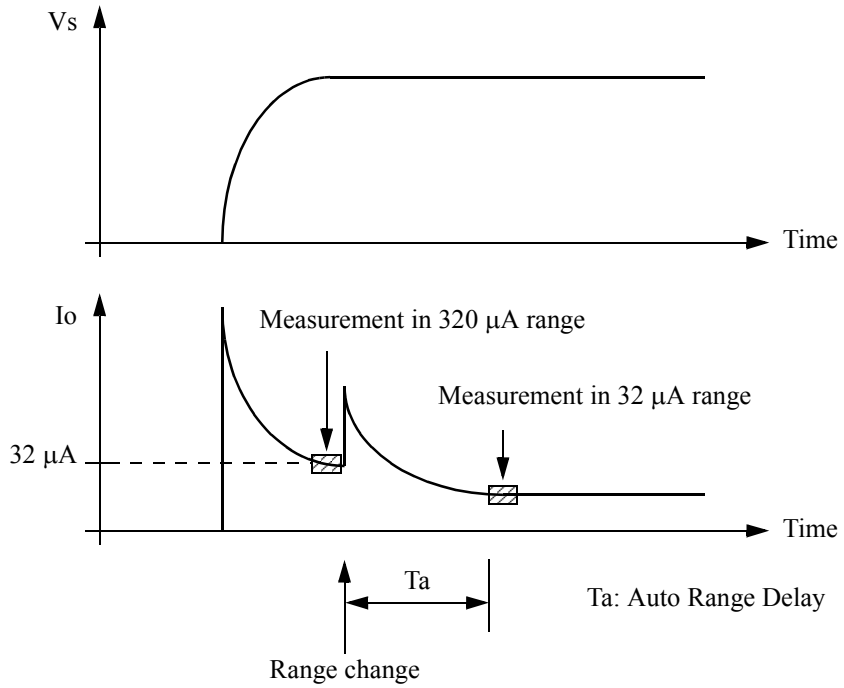
Tit = 20 ms
Tk = 5.8 + 0.25 + 0.6 = 6.65 ms
Tm = Tit + Tk = 26.65 ms

4.9.4 Auto Range Delay

This function is used for measuring a capacitive load (C_L) by voltage source current measurement (VSIM).

When voltage is applied to the C_L and current measurement is conducted using the Auto Range, the current value drops when the C_L is charged and the measurement range is lowered.

Using this delay, The current value change generated when the measurement range is switched is measured.



The Auto Range Delay function is only valid with the current measurement (IM) Auto Range.

The Auto Range Delay function does not function for fixed range and the voltage measurement (VM) Auto Range

The Auto Range Delay (Ta) is set as a value for the 32 µA range for both 6243 and 6244, and for the other ranges a 1/10-value is set for each range as shown in the following table.

Measurement range	Setting value	Example
32 µA	Ta	500 ms
320 µA	Ta/10	50 ms
3.2 mA	Ta/100	5 ms
32 mA	Ta/1000	1 ms
320 mA or higher	0	0 ms

- Ta guideline

  Use the following formula to calculate the guideline for the Ta setting.

  $$Ta = \frac{C_L \times 50\ mV}{32\ \mu A} = 1500 \times C_L \qquad [s]$$

  Example: When $C_L = 1\ \mu F$

  $Ta = 1500 \times 1\ \mu = 1.5$ ms

  Set Ta so that Ta = 2 ms.

4.10 Computing Functions

4.10.1 NULL Calculation

The NULL calculation is a calculation for canceling leak current, off set values, etc.

(a) Calculation expression

R = X - Xnull X: Current measurement data
Xnull: Null data

(b) Timing of acquiring NULL data (Xnull)

- After the NULL operation 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.

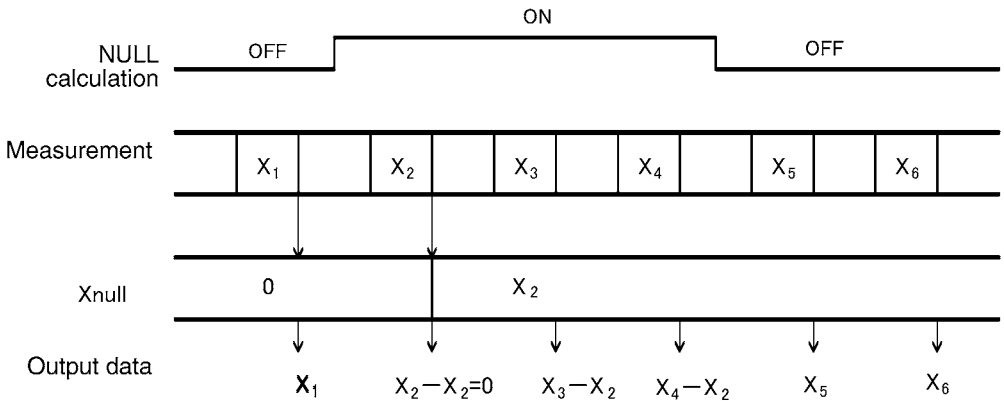


Figure 4-20 Timing of NULL Calculation

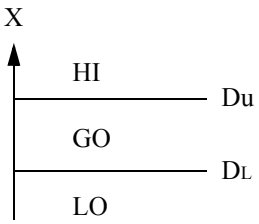
- Rewriting of NULL data is performed when a NULL calculation is switched from OFF to ON, and when initialization is carried out.
- When the NULL data is over range data, all subsequent NULL operation results become over range data.
- When the NULL operation result exceeds the full scale of the current measurement range, they are indicated at the next higher range.
- Changing the measurement function can turn OFF NULL operation.
- The measurement auto range cannot be lowered below range in which the NULL data were acquired.

4.10.2 Comparator Calculation

(1) Calculation expression

The result of a Comparator calculation is decided 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 - data is judged as LO.
- When NULL calculation is set to ON, Comparator calculation is performed comparing with the NULL calculation result.

  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) Output of calculated result

The calculated result is output to the output data header and the status register's device event register. Also, the HI/GO/LO signal selected with the negative pulse is output to the COMPLETE OUT output terminal on the rear panel.

(3) Setting range for upper limit and lower limit

6243

Comparator	Voltage value	Current value	Default
Upper limit	0 to ± 110.000	0 to ± 2.00000	0 A
Lower limit	0 to ± 110.000	0 to ± 2.00000	0 A

6244

Comparator	Voltage value	Current value	Default
Upper limit	0 to ± 20.0000	0 to ± 10.0000	0 A
Lower limit	0 to ± 20.0000	0 to ± 10.0000	0 A

4.11 External Control Signals

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

Table 4-16 shows the signal names, levels, and functions.

Table 4-16 External Control Signal Functions (1 of 2)

Signal	Input/ Output	Level	Impedance	Function
TRIGGER IN	Input	TTL Negative pulse (10 μs or longer)	Approx. 4.7 kΩ	Measurement start in the DC source mode Pulse value output in the Pulse source mode Start, Step-up and Pause in the Sweep source mode
SYNC OUT	Output	TTL Negative pulse (Approx. 20 to 30 μs)*3	Approx. 100 Ω Open drain (+5 V pulled up with 10 kΩ)	Pulse value output signal in the Pulse source mode Step-up signal in the Sweep source mode
COMPLETE OUT *1	Output	TTL Negative pulse (Approx. 20 to 30 μs)*3	Approx.100 Ω (+5 V pulled up with 10 kΩ)	Measurement start signal (Front) Measurement complete and Period complete signal (END) Comparator result signal (HI/GO/LO)
BUSY OUT *1		TTL Negative level		This signal is output during measurement. (Lo level during Source delay through measurement complete and Period complete)
BUSY IN *1	Input	TTL Negative level	Approx.10 kΩ	This signal is input during measurement. (When the BUSY input signal is LO, measurement or Step operation is not performed.)
INTERLOCK IN *2	Input	TTL Negative level	Approx.10 kΩ	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.
OPERATE OFF IN *2				When this input signal is changed from LO to HI, the output becomes Standby.
OPERATE ON/OFF 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.

Table 4-16 External Control Signal Functions (2 of 2)

Signal	Input/ Output	Level	Impedance	Function
OPERATE SIGNAL OUT *2	Output	TTL Negative level	Approx.100 Ω (+5 V pulled up with 10 kΩ)	The signal is LO during Operate. The signal is HI during Standby.

For *1 and *2, the same terminals are used by switching.
*3 becomes approximately 100 to 200 μs when the output pulse width of the external control signal is set to 100 μs.

Note the following precautions.

- Do not input the TRIGGER IN signal in the Standby status.
- Ensure that the TRIGGER IN signal, the trigger from the **TRIGGER** key, and GPIB trigger (*TRG) do not overlap.
- The minimum repeat time of the TRIGGER IN signal is shown below. Signals repeated faster than this may be ignored and may cause irregularities in measurement or voltage source.

  Minimum repeat time:

  Conditions: Source range: Fixed range

  Measurement range: Fixed. Trigger Mode: External trigger. Measurement digits:5-1/2 digits. Integration time: 500 μs. Measure Delay: 0.3 ms. Source Delay: 10 μs. Period: 2 ms. Pulse Width: 1 ms

Measurement	Memory mode	Minimum repeat time
OFF	-	2.5 ms
ON	BURST	5 ms
	NORMAL	10 ms
	OFF	

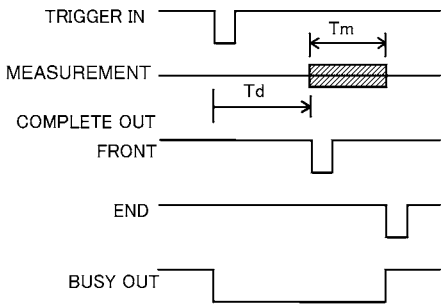
- TRIGGER IN signal dependant sweep start may take place with approximately 400 μs jitter and approximately 3.5 ms delay because of the time required for internal processing of the start source.
- The SYNC OUT signal is not output in the DC source mode.
- The BUSY IN signal is detected upon completion of measurement and period, and if it is LO level, the next measurement does not start.
- Use the BUSY IN signal in synch with the operation of the 6243/44.

  Operation is not guaranteed if it is input asynchronously with no relation to the operation of the 6243/44.
- When the BUSY IN signal is LO level, do not input the trigger (*TRG) from the **TRIGGER** key or GPIB. Operation is not ensured in this case.

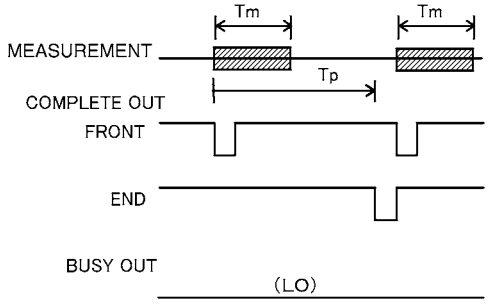
WARNING: ***The 6243***
When the output is set to OPERATE by using the GPIB command or the OPERATE IN/OUT signal, hazardous voltage is output depending on the setting.
Be careful of electric shocks.

4.11.1 Signal Timing

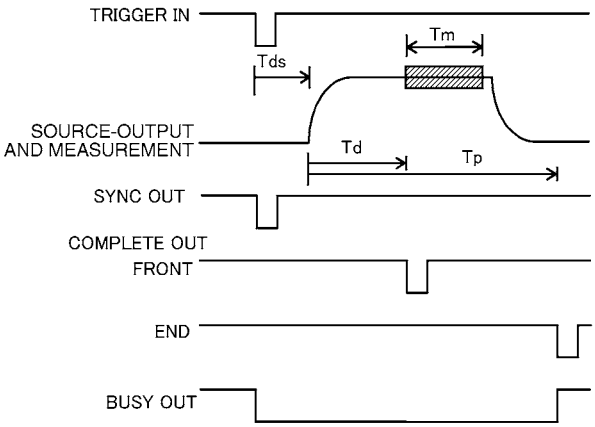
The TRIGGER IN, SYNC OUT, COMPLETE OUT timing in each of the source modes is shown in the following.



(a) DC source mode (HOLD)

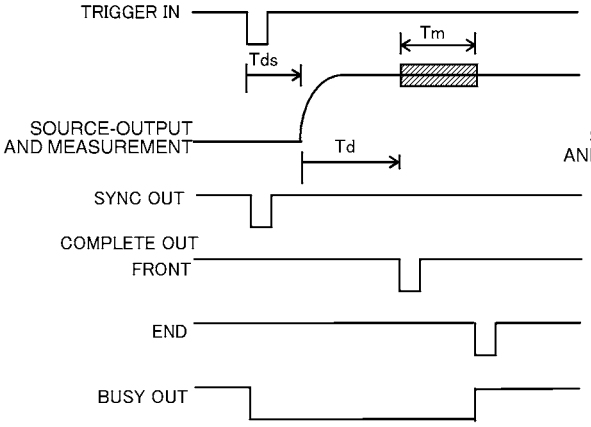


(b) DC source mode (RUN)

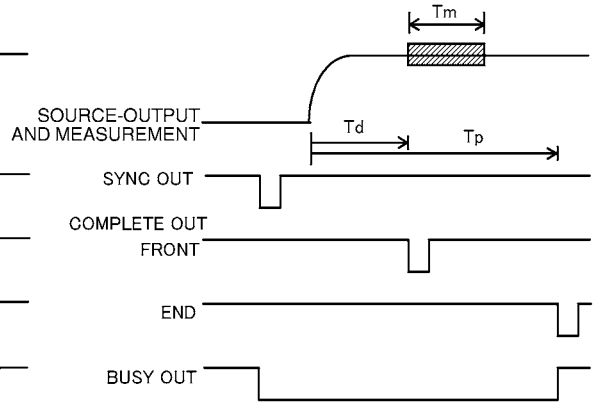


Tds; Source delay
Td; Measure delay
Tp; Period
Tm; Measurement time

(c) Pulse Source Mode, Pulse Sweep Source Mode



(d) DC Sweep Source Mode (External Trigger)



(e) DC Sweep Source Mode (Internal Trigger)

Figure 4-21 Timing of External Control Signals

4.11.2 Control of Scanner

The following example shows how to control the 7210 scanner.

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

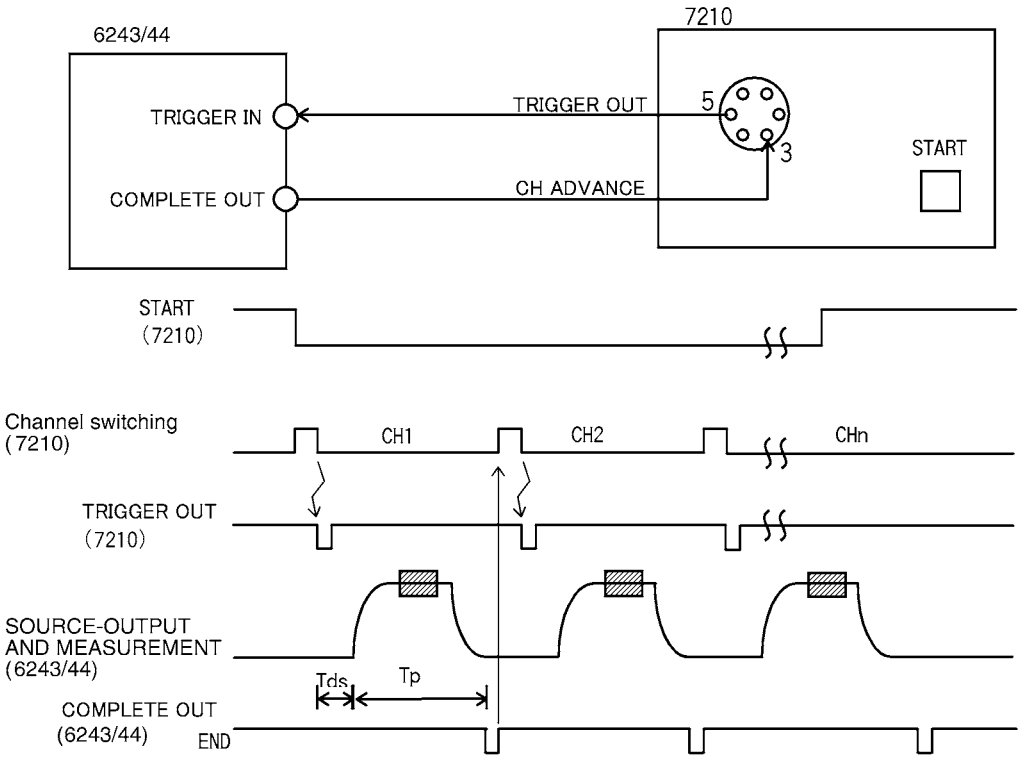


Figure 4-22 Control of Scanner

4.12 Synchronized Operation, Serial Connection, and Parallel Connection

Synchronized operation, serial connection, and parallel connection for use of multiple 6243/44 units are explained in the following.

4.12.1 Synchronized Operation

The synchronized operation of the 6243/44 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 Measure Delay and Source Delay. For details on these timings, refer to Section 4.11, “External Control Signals.”

The following explains an example of synchronized operation using the BUSY signal.

When using the BUSY signal, there are following features.

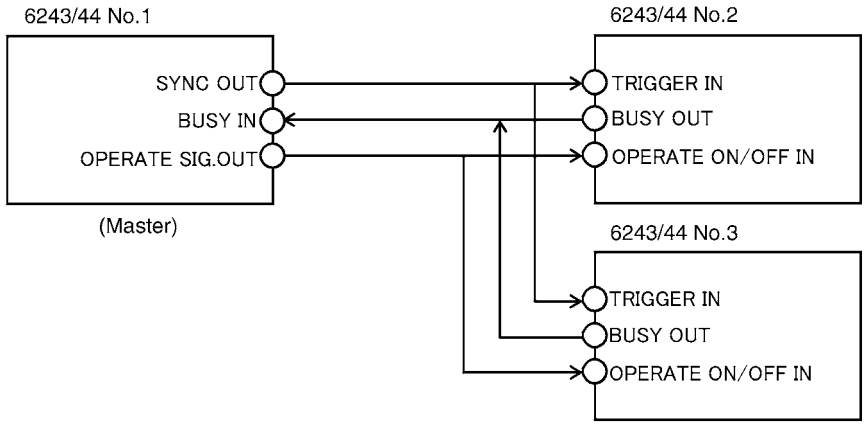
- The source and measurement steps are matched with the slowest.
- Despite source or measurement range changes taking place, synchronization is still possible in every step. (However, the timing of source measurement cannot be synchronized if a range change is made.)

Figure 4-23 shows a connection diagram and timing chart for synchronized operation using the BUSY signal. This example shows synchronization of 6243/44 No. 2 and No. 3 by the signal from 6243/44 No. 1 in the Pulse source mode. Also, the Operate/Standby status is controlled by the Operate Signal.

- Settings

Parameter item	No.1	No.2	No.3
Complete/Busy	Busy In	Busy Out	Busy Out
Operate Signal	Out	ON/OFF In	ON/OFF In
RUN/HOLD (Panel key)	RUN	HOLD	HOLD

- Connections



- Operating timing

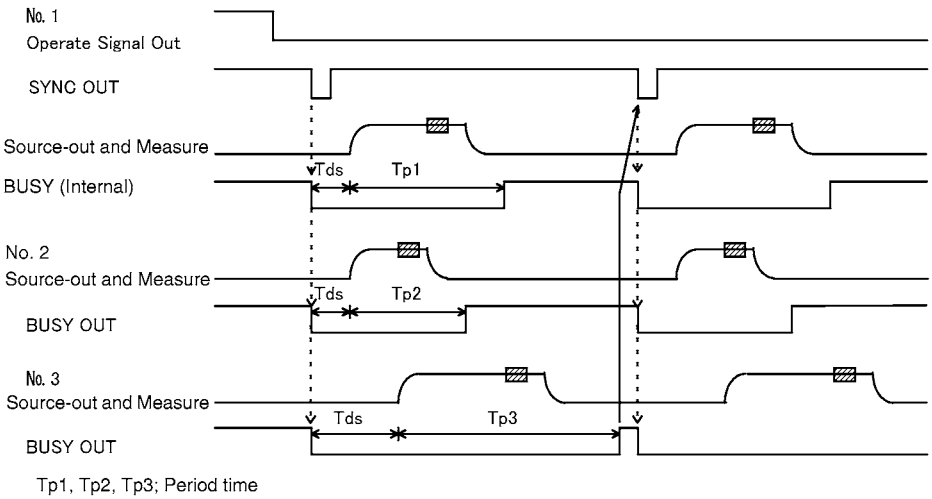
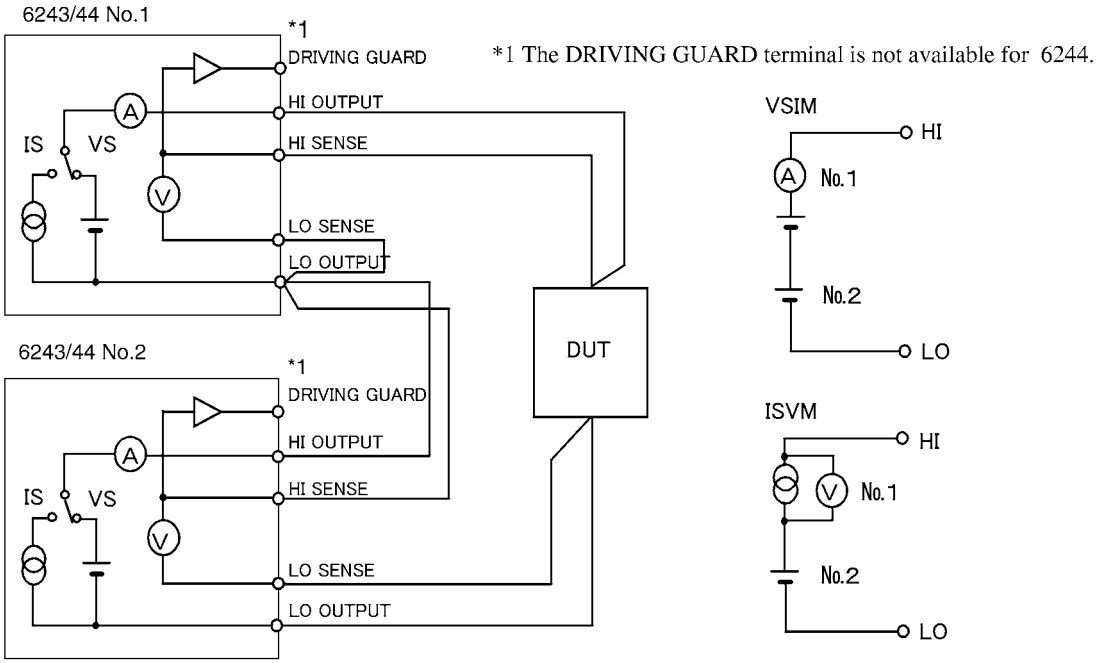


Figure 4-23 Synchronized Operation Using the BUSY Signal

4.12.2 Serial Connection

Using two 6243/44 units in series enables use of a source up to ±220 V/±0.5 A (6243) or ±40 V/±4 A (6244).

Figure 4-24 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 4-24 Serial Connection

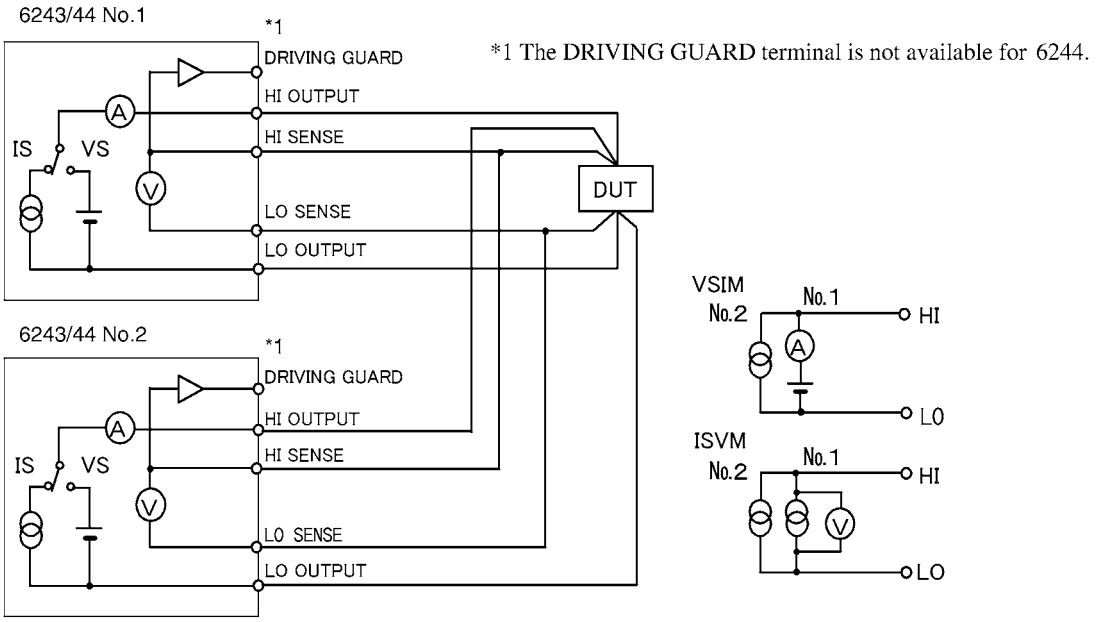
NOTE:

1. ***If the load is short--circuited, reverse polarity voltage is applied to the 6243/44 themselves. Depending on the settings, overload or reverse source 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 6243/44 may be damaged.
3. ***When using constant current, the current setting value becomes the smaller of the two current settings as shown in Figure 4-24. The other becomes the constant voltage.***
4. ***When serially connecting a 6243 and a 6244, set each of them to 20 V or lower.***

4.12.3 Parallel Connection

Using two 6243/44 units in parallel connection enables use of a source up to ±4 A/±32 V (6243) or ±20 A/ ±7 V (6244).

Figure 4-25 shows a connection diagram in which two units are connected in parallel using a 4-wire connection. Two units are used for voltage measurement when measuring voltage 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 4-25 Parallel Connection

NOTE:

1. ***If the load is opened, current flows from the higher to the lower of the set voltages. Depending on the settings, overload and reverse source 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 use as sink are decided by the set voltage, and voltage control is performed in accordance with this balance.***

4.13 Measurement Data Storing Function

The 6243/44 features a measurement data memory for storing up to 5000 measurement data.

The following explain how data is stored in and cleared from the measurement data memory.

4.13.1 Storing Measured Data into Data Memory (Memory Store)

There are two ways to store the measured data. They are Normal mode and Burst mode. After pressing the **MENU** key, select ***MEASURE BUFFER*** in the parameter group and then select the ***Memory Store*** parameter.

The SLOT indicator is ON when either the Normal mode or the Burst mode is selected.

Figure 4-26 shows a conceptual diagram of storing measured data.

Table 4-17 compares the operations in the Normal mode and the Burst mode.

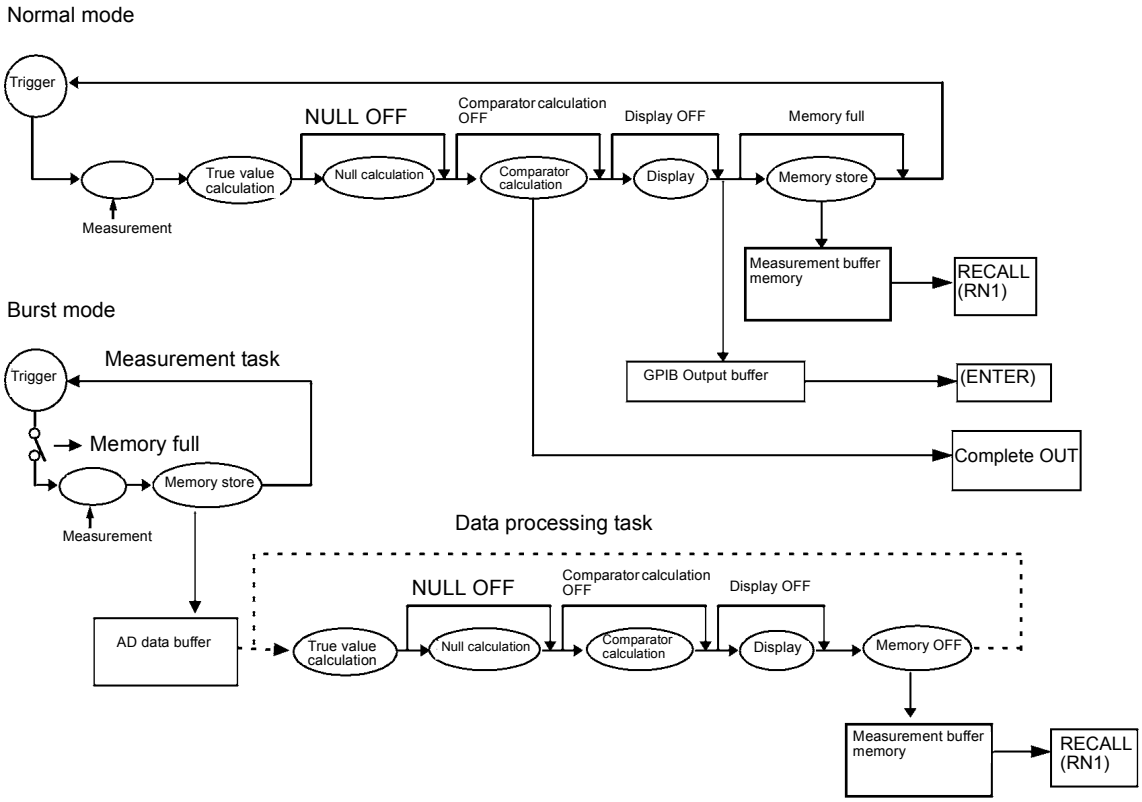


Figure 4-26 Conceptual Diagram of Storing Measured Data

Table 4-17 Comparison of Storing Measured Data

		Normal	Burst
Recommended Application		Low speed measurement When storing measured data fore regular measurements 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	4 ms
Measured value display		Displays in real time	Displays in idle time of measurement tasks or when measurement is not performed.
Data output	Read the latest data by ENTER key	Available	Not available
	RECALL and RNI commands	Available	
Operation when Memory Full		SLOT indicator flashes. MFL (bit 10) of the device event register becomes HI.	
		Storing data is stopped.	Measurement stops. Sweep mode: STOP DC or Pulse mode: HOLD
Comparator calculation result	Complete Out HI/GO/LO signal	Outputs in real time	No output
	Buzzer		
	HI/GO/LO display		Displays in idle time of measurement tasks or when measurement is not performed.

(*) Integration time: 500 µs. Source delay: 10 µs. Measure delay: 300 µs.

NOTE:

In the following cases, Memory Store ON/OFF and storing operation changes do not take place.

- ***During free run in the DC, Pulse source modes***
- ***In the Operate status of the sweep source mode***

4.13.2 Clearing Saved Data (Memory Clear)

The saved data can be performed in the following.

- When the Memory Clear parameter is executed
- When the Normal mode or the Burst mode is turned ON
- When the Normal mode or the Burst mode is switched
- When the power is turned OFF and ON
- When the TR6143 compatible mode is switched

4.14 Operating Principles

4.14.1 Block Diagram

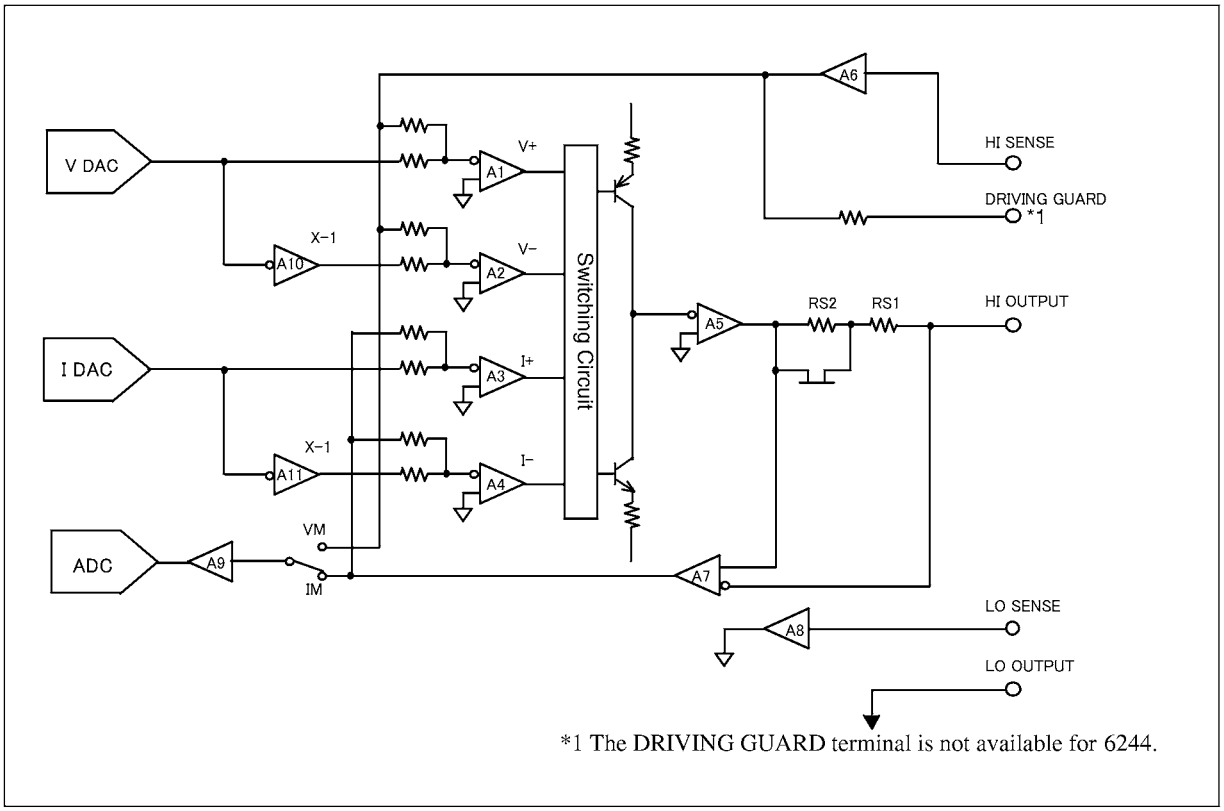


Figure 4-27 Block Diagram of Source and Measurement Sections

4.14.2 Operating Principles

The following is a simple explanation of the block diagram for the 6243/44's source and measurement sections shown in Figure 4-27.

- The 6243/44 contains the DA converter VDAC for setting the voltage source and the voltage limiter. The 6243/44 also has the DA converter IDAC for setting the current source and the current limiter. Each of the DA converters features a conversion accuracy of 16 bits.

  The output from the DA converter is input to the 4 error amps V+, V-, I+, and I-. However, in the V- and I- error amps a reversed output is supplied. (from A_{10}, A_{11})

- The 4 error amps are connected as follows:

  For voltage source with + output, connected are V+ error amp and I+ and I- error amps for current limiter use.

  For voltage source with - output, the V- error amp, I+ and I- error amps are connected for current limiter use.

  For current source with + output, the I+ error amp, V+ and V- error amps are connected for voltage limiter use.

  For current source with - output, I+ error amp, V+ and V- error amps are connected for voltage limiter use.

  This enables both + and - limiter control for both voltage source and current source.

- 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 and current limiter.

- Voltage range is switched for A_6 and A_9, respectively, and the voltage measurement always takes place in the same range as that of both voltage source and voltage limiter.

- The A_9 amp makes up the measurement ranging circuit.

- The A_6 and A_7 amps have high input impedance to minimize leak.

- The A_8 amp also has 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 500 μs to 100 PLC.

5. 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.

5.1 GPIB Command Index

Use the following GPIB command index as the index for GPIB commands in Chapter 5.

5.2 GPIB Remote Programming

The 6243/44 comes with a GPIB (General Purpose Interface Bus) conforming to the IEEE standard 488-1978 as standard enabling remote control from an external controller.

5.2.1 What GPIB Is

GPIB is a high-performance bus for integrating computers and measuring instruments.

The operation of GPIB is defined by the IEEE standard 488-1978. Since GPIB interface has bus structure, each device is specified by assigning a unique address. Up to 15 devices can be connected in parallel on one bus. Each GBIP device features one or more of the following functions.

- Talker: The device specified for sending data to the bus is referred to as “talker.” On the GPIB bus, only one device can function as the active talker.
- 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: The device specifying the talker and the listeners is referred to as the “controller.” On the GPIB bus, only one device can operate as the active controller. Those controllers that can control IFC and REN messages are referred to as “system controllers.”

Only one system controller is allowed on one single GPIB bus. If multiple 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.

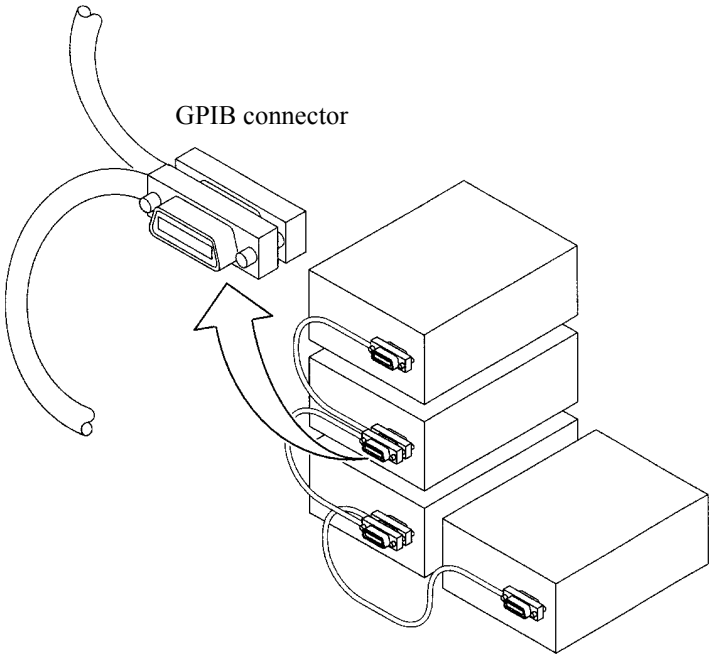
- Interface messages: Control the GPIB bus.
- Device messages: Control the measuring instruments.

5.2.2 GPIB Setup

(1) GPIB connection

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

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



The precautions for the GPIB interface connection are as follows:

- The total length of the GPIB cables used in one bus system must not exceed 20 meters and must not be longer than 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 on one bus is 15.
- No restrictions are applied for cable connections. However, do not connect 4 or more GPIB connectors on one device. Putting 4 or more connectors on one device will exercise a force upon the mounting section of the connector that could damage the section.

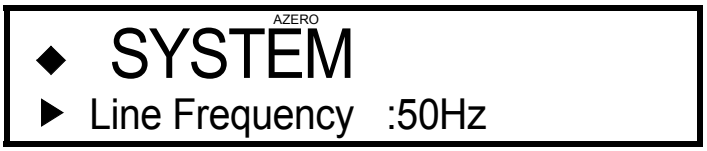
Example: The total cable length that can be used in a system made up of 5 devices is 10 meters or less. (5 devices × 2 m/device = 10 m)
Within the range in which the total cable length does not exceed the allowable length, the cables can be arranged freely. However, when connecting 10 or more devices, 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) GPIB address setting

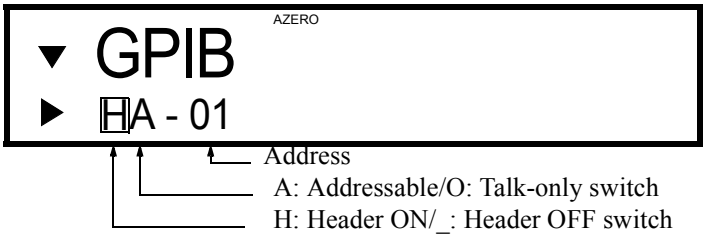
1. Press the **MENU** button and rotate the Data knob.
   The parameter group selection screen appears as shown below.

2. Press the ▽ button.
   The parameter selection screen appears as shown below.

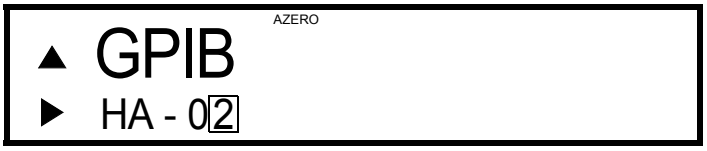


3. Select ***GPIB*** by rotating the Data knob.
   The following screen appears.

4. Press the ▽ button.
   The current GPIB address appears.



5. Move the cursor with the ◁ ▷ buttons and change the address by rotating the Data knob.



6. Press the **EXIT** button.
   The measurement screen returns.

This completes setting of the GPIB address.

5.2.3 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. (The SDC and DCL commands can be used.)
DT1	With the Device Trigger function. (The GET command can be used.)
C0	Without the Controller function.
E2	The three state bus driver can be used.

5.2.4 Responses to Interface Messages

The responses of the 6243/44 to the interface messages described in the following are defined by the IEEE standard 488-1978.

For how to send interface messages to the 6243/44, refer to the instruction manual for the controller.

(1) Interface Clear (IFC)

This message is sent directly to the 6243/44 through the signal line.

The 6243/44 stops the operations of the GPIB bus by this message. All inputs and outputs are stopped, but the I/O buffer is not cleared. (This is cleared by the DCL message.)

(2) Remote Enable (REN)

This message is sent directly to the 6243/44 through the signal line. When this message is true, the 6243/44 is specified as a listener and is put in the remote status. This status continues until GTL is received, REN becomes false, or the **LOCAL** button is pressed. When set in the local status, the 6243/44 ignores all the received data.

In the remote status, all the button inputs are ignored except for the **LOCAL** button. In the local-lock-out status, all the button inputs are ignored.

(3) Serial Poll Enable (SPE)

When the 6243/44 receives this message from an external source, the 6243/44 enters the Serial Poll mode. In this mode, when the 6243/44 is specified as a talker, status bytes are transmitted instead of normal messages. This mode continues until the Serial Poll Disable (SPD) message or the IFC message is received.

When the 6243/44 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)

Upon receipt of DCL, the 6243/44 executes the following.

- Clears the input buffer and the output buffer.
- Resets the parser section, execution control section, and 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 6243/44.
- Interruption of, or influence upon, the operation that the 6243/44 is currently performing.
- Modification of status bytes expects 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 6243/44 is a listener. In other cases, this message is ignored.

(6) Go To Local (GTL)

This message sets the 6243/44 to local status. When the local status is set, all the operations on the front panel are enabled.

(7) Local Lock Out (LLO)

This message sets the 6243/44 to local lock out status. In this status, when the 6243/44 is in the remote status, all the operations on the front panel are disabled. (In the normal remote status, pressing the **LOCAL** button will enable operations via the front panel.)

To set the 6243/44 to the normal remote status at this time, use one of the following methods.

- Send the GTL message to the 6243/44.
- Make the REN message false. (At this time, the local lock out status is also released.)
- Turn OFF and ON the power.

5.2.5 Message Exchange Protocol

The 6243/44 receives program messages and issues response data from and to the controller and other devices through the GPIB bus. Program messages comprise 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 6243/44 has the following two buffers.

(a) 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 OFF and ON the power.
- Execute DCL or SDC.

(b) Output buffer

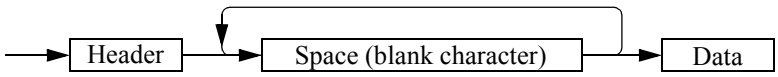
Buffer for storing data until read from the controller. (Accommodates 255 bytes.)

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

- Turn OFF and ON the power.
- Execute DCL or SDC.

5.2.6 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 (*) 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 characters in the header makes the command into a query command.

(2) Space (blank character)

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

(3) Data

If the command requires multiple data sets, multiple data sets are separated by comma (,). A space may be used directly before or after a comma (,). For details on the data types, refer to Section 5.2.7, "Data Format."

(4) Description of multiple commands

The 6243/44 allows multiple commands to be described consecutively or separated by semicolon (;), comma (,) or space (_) on one line.

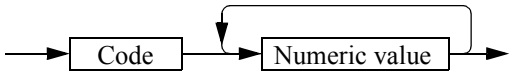
5.2.7 Data Format

The 6243/44 uses the following data types for input and output of data.

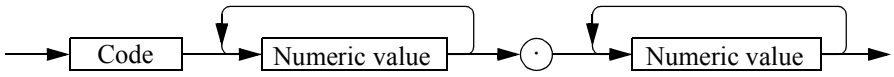
(1) Numeric values

Numeric value formats comprise the following 3 formats and any format can be used for input to the 6243/44. Depending on the command, 6243/44 description is also attached for input.

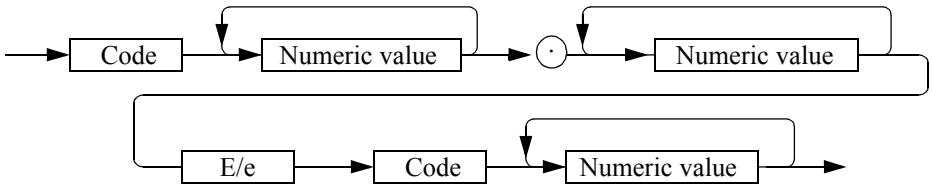
- Integer type: NR1 format



- Fixed-point type: NR2 format



- Floating-point type: NR3 format



However, the numeric characters in the Command column in “Table 5-5 GPIB Command List” are treated as headers. (NR1, NR2, NR3 are not accepted.)

(2) Unit

A list of the units that can be used for special commands is shown below.

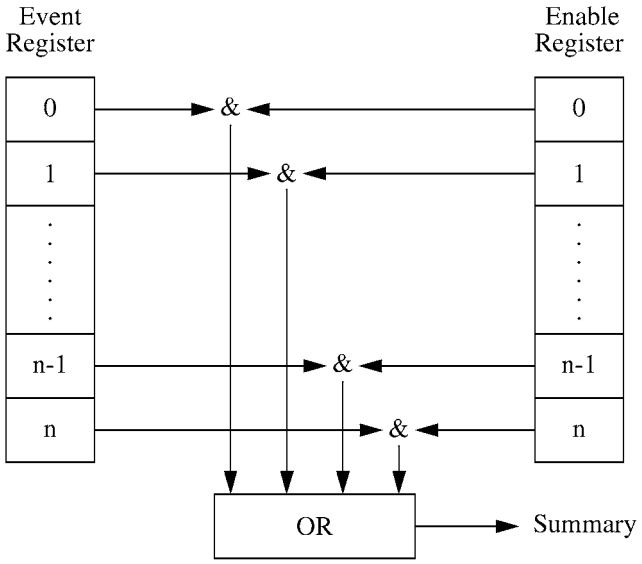
Unit	Exponent	Meaning
V	10^{0}	Voltage
MV	10^{-3}	Voltage
UV	10^{-6}	Voltage
A	10^{0}	Current
MA	10^{-3}	Current
UA	10^{-6}	Current

5.2.8 Status Byte

The 6243/44 features a hierarchical status register structure that conforms to the IEEE standard 488.2-1987 and can send various statuses of the 6243/44 to the controller. The following explain the operation model of this status byte together with the event allocation.

(1) Status Register

The 6243/44 employs a status register model as defined by the IEEE standard 488.2-1987 that consists of an Event Register and an Enable Register.



(a) Event Register

The event register latches and keeps the status for each event. (It may also hold changes.)

Once this register is set, it remains set until it is read out by query or cleared by *CLS.

Data cannot be written to the Event Register.

(b) 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 the OR of the result is generated as the summary. The summary is written to the Status Byte Register.

Data can be written to the Enable Register.

The 6243/44 has the following 4 types of status registers.

- Status Byte Register
- Standard Event Register
- Device Event Register
- Error Register

5.2.8 Status Byte

Figure 5-1 shows the structure of status registers.

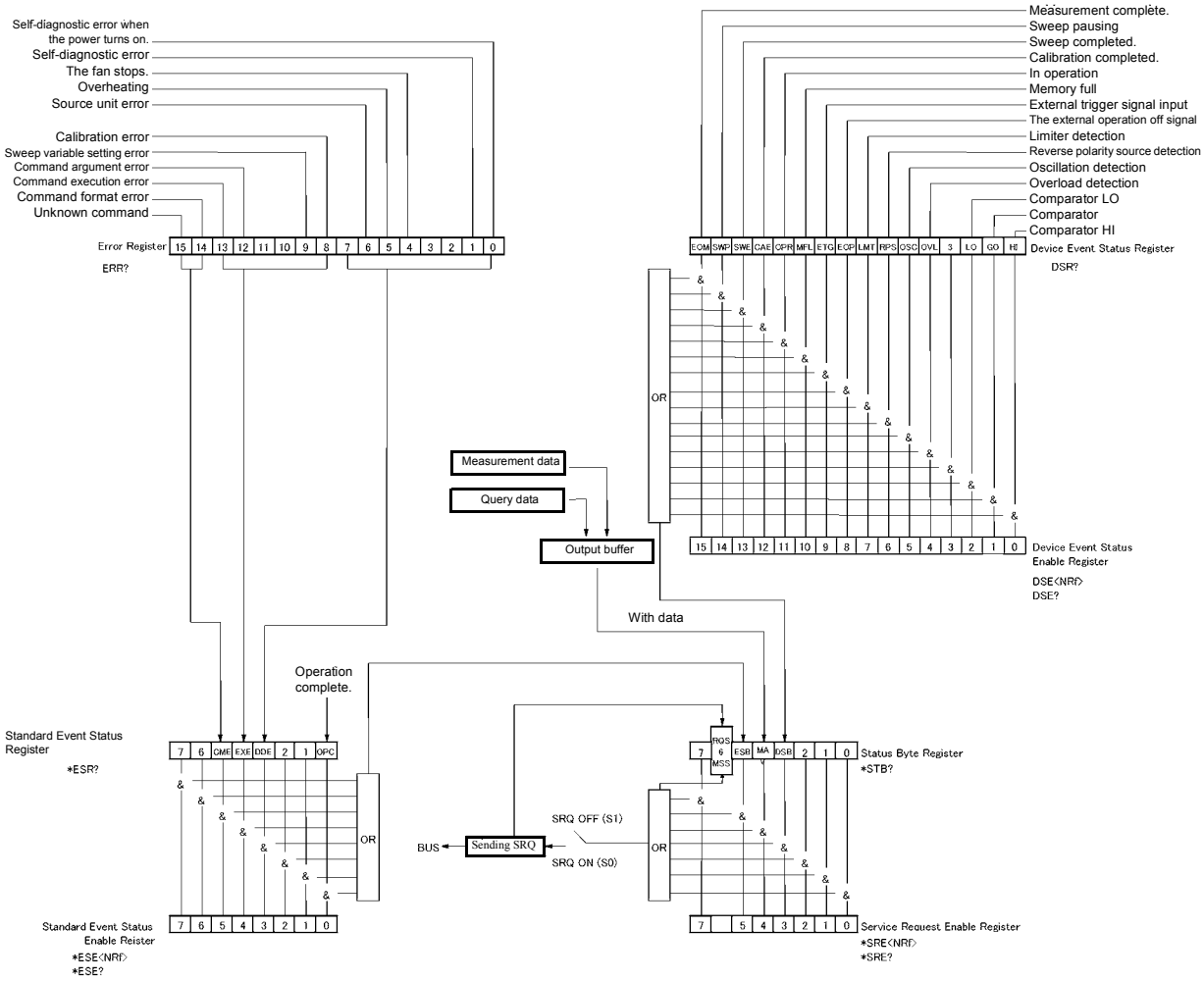


Figure 5-1 Structure of Status Registers

(2) Event Enable Register

Each Event Register has an Event Enable Register that determines which bit to enable. The Enable Register sets the relevant byte in decimal values.

- Service Request Enable Register setting: *SRE
- Standard Event Status Enable Register setting: *ESE
- Device Event Enable Register setting: DSE

Example: Enabling 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: Enabling 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, the 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 5-2 shows the structure of the Status Byte Register.

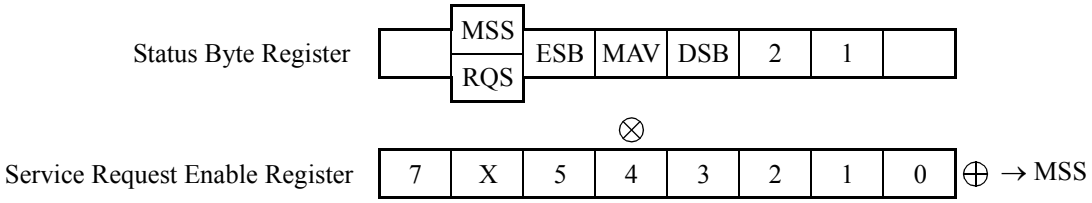


Figure 5-2 Structure of Status Byte Register

Except for the following 3 points, the Status Byte Register is similar to the Status Register.

- The Status Byte Register's summary is written to bit 6 of the Status Byte Register.
- The Enable Register's bit 6 is always enabled and cannot be changed.
- The Status Byte Register's bit 6 (MSS) writes the RQS of the service request.

This register responds to the serial poll from the controller. When responding to the serial poll, the Status Byte Register's bit 0 to 5, bit 7 and RQS are read out, after which RQS is reset to 0.

Other bits are not cleared until their factors become 0.

The Status Byte Register, RQS, and MSS can be cleared by executing "*CLS."

Accompanying this, the SRQ line also becomes false.

Table 5-1 shows the meaning of each of the Status Byte Register's bits.

Table 5-1 Status Byte Register

bit	Function definition	Description
7	Not used.	Always set to 0.
6	MSS Master Summary	ON: When a factor occurs in either STB, bit 6 is set to 1 if the bit corresponding to SRER is set to 1.
	RQS Request Service	ON: MSS is set to 1. Accordingly RQS is set to 1. If the service request is set to ON at this point, SRQ is sent. OFF: When STB is read out with the serial poll.
5	ESB Standard Event Status	ON: When a factor occurs in SESR and 1 is set, this bit is set to 1 if the bit corresponding to SESER is set to 1. OFF: When SESR is cleared by reading out (*ESR?), bit 5 is set to 0.
4	MAV Message Available	ON: When output data is entered in the output buffer, bit 4 is set to 1. OFF: When the output buffer is read out and become empty, this bit is set to 0.
3	DSB Device Event Status	ON: When a factor occurs in DESR and 1 is set, this bit is set to 1 if the bit corresponding to DESER is set to 1. OFF: When DESR is cleared by reading out (*DSR?), bit 3 is set to 0.
2	Not used.	Always set to 0.
1	Not used.	Always set to 0.
0	Not used.	Always set to 0.

Common conditions on which the Status Byte Register is cleared

- Everything is cleared when the power is turned OFF and ON.
- *CLS clears everything except that MAV is not cleared if data exist in the output buffer.
- When all the bits in DSB, MAV, and ESB are cleared
- Not cleared even if read out by *STB?

Conditions on which the Status Byte Enable Register is cleared

- When the power is turned OFF and ON
- When the *SRE0 command is executed

(4) Standard Event Register

Table 5-2 shows the functions assigned to the Standard Event Register.

Table 5-2 Standard Event Register

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

Common conditions on which the Standard Event Register is cleared

- Everything is cleared when the power is turned OFF and ON
- *CLS clears everything
- Everything is cleared when read out by *ESR?

Conditions on which the Standard Event Enable Register is cleared

- When the power is turned OFF and ON
- When the *ESE0 command is executed

(5) Device Event Register

Table 5-3 shows the functions assigned to the Device Event Register.

Table 5-3 Device Event Register (1 of 2)

bit	Function definition	Description
15	EOM End Of Measure	ON: When measurement is complete, bit 15 is set to 1. OFF: When measurement data is read out, bit 15 is set to 0.
14	SWP Sweep Pause	ON: When the sweep pauses, bit 14 is set to 1. OFF: When the paused sweep status is cleared, bit 14 is set to 0. When the sweep stops or starts, bit 14 is set to 0.
13	SWE Sweep End	ON: When the sweep is completed correctly, bit 13 is set to 1. OFF: When the sweep starts, bit 13 is set to 0.
12	CAE Calibration End	ON: When calibration is complete, bit 12 is set to 1. OFF: When calibration starts, bit 12 is set to 0.

Table 5-3 Device Event Register (2 of 2)

bit	Function definition	Description
11	OPR Operate	ON: When the operating status is set, bit 11 is set to 1. OFF: When the standby status is set, bit 11 is set to 0.
10	MFL Memory Full	ON: When the measurement buffer memory is full, bit 10 is set to 1. OFF: When the measurement buffer memory is not full, bit 10 is set to 0.
9	ETG Ext.Trigger In	ON: When an external trigger signal input is detected, bit 9 is set to 1.
8	EOP Ext.Operate Off In	ON: When an external operation off signal input is detected, bit 8 is set to 1.
7	LMT Limiter	ON: When the limiter is detected, bit 7 is set to 1.
6	RPS Reverse Pol. Source	ON: When a reverse polarity source is detected, bit 6 is set to 1.
5	OSC Oscillation	ON: When an oscillation is detected, bit 5 is set to 1.
4	OVL Over Load	ON: When an overload is detected, bit 4is set to 1.
3	Not used.	Always set to 0.
2	LO comparator LO	ON: When the comparison operation result is LO, bit 2 is set to 1. OFF: When the comparison operation result is HI or GO, bit 2 is set to 0. When the comparison operation is set to OFF.
1	GO comparator GO	ON: When the comparison operation result is GO, bit 1 is set to 1. OFF: When the comparison operation result is HI or LO, bit is 1 set to 0. When the comparison operation is set to OFF.
0	HI comparator HI	ON: When the comparison operation result is HI, bit 0 is set to 1. OFF: When the comparison operation result is LO or GO, bit 0 is set to 0. When the comparison operation is set to OFF.

Common conditions on which the Device Event Register is cleared

- Everything is cleared when the power is turned OFF and ON
- *CLS clears everything
- Everything is cleared when read out by DSR?

Conditions on which the Device Event Enable Register is cleared

- When the power is turned OFF and ON
- When the DSE0 command is executed

(6) Error Register

Table 5-4 shows the functions assigned to the Error Register.

Table 5-4 Error Register

bit	Function definition	Description
15	Unknown Command	ON: When receiving an unknown remote command, bit 15 is set to 1.
14	Syntax Error	ON: When a remote command syntax error occurs, bit 14 is set to 1.
13	Execution Error	ON: When a remote command execution error occurs, bit 13 is set to 1.
12	Parameter Error	ON: When a remote command argument error occurs, bit12is set to 1.
11		Always set to 0.
10		Always set to 0.
9	Sweep Parameter Error	ON: When a sweep parameter error occurs during operation, bit 9 is set to 1.
8	Calibration Error	ON: When external calibration is not completed correctly, bit 8 is set to 1.
7		Always set to 0.
6	Source Unit Error	ON: When a source unit abnormality is detected, bit 6 is set to 1.
5	Over Heat	ON: When overheating is detected, bit 5 is set to 1. After the overheating status is cleared, this bit is not set to 0.
4	Fan Stop	ON: When program detects that the fan has stopped, bit 4 is set to 1. After the status in which the fan has stopped is cleared, bit 4 does not reset to 0.
3		Always set to 0.
2		Always set to 0.
1	Self Test Error	ON: When a self test error occurs, bit 1 is set to 1.
0	Power ON Test Error	ON: When the power is turned ON and a self test error occurs, bit 0 is set to 1.

Common conditions on which the Error Register is cleared

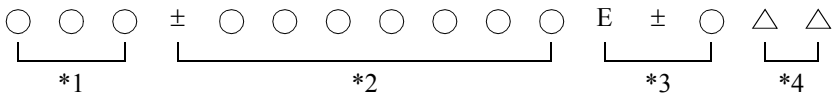
- Everything is cleared when the power is turned OFF and ON
- *CLS clears everything M

Not cleared even if read out by ERR?

5.2.9 Date Output Format (Talker)

(1) Measurement data output format (ASCII)

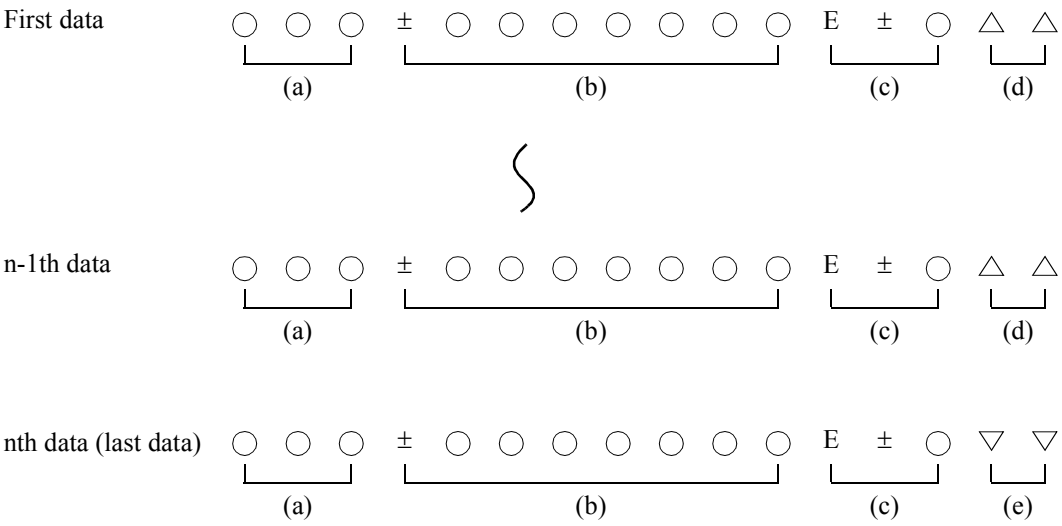
For normal measurement and when the data is read out from the measurement buffer memory with RN1



*1: Header (Event header 2 characters + Sub header 1 character)
*2: Fixed-point part (Polarity + decimal point + 5 to 6-digit figure)
*3: Exponent part (E + polarity + 1-digit figure)
*4: Block delimiter

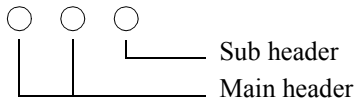
(2) Measurement buffer memory output format (two or more data)

When two or more data is read from the measurement buffer memory, each data is delimited by the string delimiter.



(a) Header (Main header 2 characters + Sub header 1 character)
(b) Fixed-point part (Polarity + decimal point + 5 to 6-digit figure)
(c) Exponent part (E + polarity + 1-digit figure)
(d) String delimiter
(e) Block delimiter

(a) Header



Main header	Description
DV	Voltage measurement value
DI	Current measurement value
EE	Data is not stored in the specified recall buffer memory number.

Sub header	Description	Priority
S	Oscillation.	1
R	Connects the reverse polarity source.	2
M	The limit source	3
O	Over the measurement range	4
H	The comparison operation result is HI.	5
G	The comparison operation result is GO.	
L	The comparison operation result is LO.	
N	NULL operation value	6
Space	Other	7

(b) Fixed-point part and exponent part

The fixed-point part and exponent part are determined by the measurement function, the range and the number of measurement digits.

Measurement function	Range	Fixed-point		Exponent part (three characters)
		5 1/2-digit measurement (eight characters)	4 1/2-digit measurement (seven characters)	
Voltage	320 mV	± ddd.ddd	± ddd.dd	E - 3
	3.2 V	± d.ddddd	± d.dddd	E + 0
	32 V/20 V	± dd.dddd	± dd.ddd	E + 0
	110 V	± ddd.ddd	± ddd.dd	E + 0
Current	32 μA	± dd.dddd	± dd.ddd	E - 6
	320 μA	± ddd.ddd	± ddd.dd	E - 6
	3.2 mA	± d.ddddd	± d.dddd	E - 3
	32 mA	± dd.dddd	± dd.ddd	E - 3
	320 mA	± ddd.ddd	± ddd.dd	E - 3
	2 A/3.2 A	± d.ddddd	± d.dddd	E + 0
	10 A	± dd.dddd	± dd.ddd	E + 0
Measurement over range		+999.999	+999.99	E + 9
Data is not stored when recalling.		+888.888	+888.88	E + 8

*1: No data was found when data is read out from the measurement buffer memory.

(c) String delimiter

A string delimiter is output to set off sets of data.

The string delimiter can be specified by commands.

String delimiter	Setting command	Initial value
“ , ” Comma	SL0	◯
“ ” Space	SL1	
CR LF	SL2	

(d) Block delimiter

A block delimiter is output to indicate the end of one set of data.

The block delimiter can be specified by commands.

Block delimiter	Setting command	Initial value
CR LF + EOI	DL0	◯
LF	DL1	
EOI	DL2	

5.2.10 GPIB Code List

5.2.10.1 GPIB Code List

Default indicates the factory default settings, and the initialized statuses resulting from the *RST and RINI commands.
However, *1 is not initialized by the RINI command and *2 is not initialized by the RINI and *RST commands.
During sweep operation and in the operate status in the DC/pulse mode, commands cannot be accepted except for those marked with the ○ symbol in Table 5-5.
During DC/PLS operation, those commands marked with the △ symbol are only accepted in the Hold status.
During sweep operation, those commands marked with the △ symbol are only accepted in the status in which sweep operation is stopped.
During standby, all the commands can be accepted.

NOTE: ***The figures in the commands in the GPIB Command List should be treated as 1 English integer character.***
An error results, if MD1 is expressed as MD0001, MD1.000, MD1e-0, etc.
The NR1 to NR3 formats can be used for the numeric character data appearing in <data> such as D commands, etc.

WARNING: ***The 6243***
When the output is set to OPERATE by using the GPIB command or the OPERATE IN/OUT signal, hazardous voltage is output depending on the setting.
Be careful of electric shocks.

Table 5-5 GPIB Command List (1 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
SOURCE	Source mode	MD0	DC source mode	○		
		MD1	Pulse source mode			
		MD2	DC sweep source mode			
		MD3	Pulse sweep source mode			
		MD?	The Source-mode query command Responds with MD...		○	○
	Source function	VF	Voltage source function		○	
		IF	Current source function		○	
	Source function and source range settings	V3	Voltage source, 320 mV range		○	
		V4	Voltage source, 3.2 V range		○	
		V5	Voltage source, 32 V and 20 V ranges		○	
		V6	Voltage source, 110 V range *a	○	○	
		I-1	Current source, 32 μA range *a		○	
		I0	Current source, 320 μA range		○	
		I1	Current source, 3.2 mA range		○	
		I2	Current source, 32 mA range		○	
		I3	Current source, 320 mA range		○	
		I4	Current source, 2 A and 3.2 A ranges		○	
		I5	Current source, 10 A range *b		○	

*a: An error occurs for the 6244.
*b: An error occurs for the 6243.

5.2.10 GPIB Code List

Table 5-5 GPIB Command List (2 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
SOURCE (Continued)	Source function and source range settings	V?/I?	he source function and source range query command Responds with V or I...		○	○
	Source value (pulse value) and limiter value (Continued)	D	Unit specification: The optimal range is set automatically. D<data> UNIT Units: MV, V, UA, MA, and A The limiter value is set when a unit that is not used for the current source function is specified.		○	
			No unit specification: The current source function and source range are used. D<data>			
			Default value: D+000.00E-3V, D0500.0E-3A (6243) D+000.00E-3V, D04.000E+0A (6244)	○		
		D?	The source value and limiter value query command Responds with: D ± aaaaaaE+aUNIT, DbbbbbbE+bUNIT aaaa: Voltage or current source value bbbb: Current or voltage limiter value (polarity is indicated by space.) Unit: V or A The voltage and current value responses depend on the current source function.		○	○
	Pulse base value	DB	Unit specification: The optimal range is set automatically. DB<data>UNIT The <data> unit is ignored. Units: MV, V, UA, and MA An error occurs when a unit that is not used for the current source function is specified,		○	
			Default value (6243): DB 000.00E-3V (for the voltage function) DB 00.000E-6A (for the current function) Default value (6244): DB 000.00E-3V (for the voltage function) DB 000.00E-6A (for the current function)	○		
		DB?	The pulse base value query command. Responds with: DB aaaaaaE+aUNIT aaaa: Voltage or current source value (polarity is indicated by space.) Unit: V or A The voltage and current base value responses depend on the current source function.		○	○
	Limiter polarity mode	PL0	Auto: Enters the same polarity as the source value.	○	○	
		PL1	Plus: Enters the correct positive value.		○	
		PL2	Minus: Enters the correct negative value.		○	
		PL?	The limiter polarity mode query command. Responds with PL...		○	○
	Remote sensing	RS0	2 Wire	○	○	
		RS1	4 Wire		○	
		RS?	The setting remote sensing query command. Responds with RS...		○	○
	The oscillation, reverse polarity source, and limiter detection buzzer	UZ0	OFF	○	○	
		UZ1	The buzzer sounds when the oscillation, reverse polarity source, or limiter is detected.		○	
		UZ?	The oscillation, reverse polarity source, and limiter detection buzzer query command. Responds with UZ...		○	○
	Buffer control	B	The source value can be buffer controlled and output using *TRG. The H command sets the buffer control to OFF. (An error occurs when the DC mode is not used.)	OFF *1	○	
		B?	Enquires about the buffer controlled source value. The same response as the source value query response is used. (Without the limiter value.) When the buffer is set to OFF, D+999.99E+9V or D+999.99E+9A.		○	○
OPERATE	Operating or standby	E	Output is set to ON. (for the operating status)		○	○
		H	Output is set to OFF. (for the standby status)	○*1	○	○
		E?	The output ON or OFF query command.		○	○
		H?	Responds with "E" and "H."		○	○
MEASURE	Measurement function	F0	Not measured.		○	
		F1	Voltage measurement (VM)		○	
		F2	Current measurement (IM)	○	○	
		F?	The measurement function query command. Responds with F...		○	○
	Auto range	R0	Auto range		○	
		R1	The limiter value range is used.	○	○	
		R?	The auto range query command Responds with R...		○	○

Table 5-5 GPIB Command List (3 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
MEASURE (Continued)	Integration time	IT0	500 µs		○	
		IT1	1 ms		○	
		IT2	10 ms		○	
		IT3	1 PLC	○	○	
		IT4	10 PLC		○	
		IT5	100 PLC		○	
		IT?	The integration time query command. Responds with IT...		○	○
	Auto zero	AZ0	OFF		○	
		AZ1	ON	○	○	
		AZ?	The auto zero query command. Responds with AZ...		○	○
	The number of digit for the measurement display	RE4	The number of digit for the measurement display 4 1/2		○	
		RE5	The number of digit for the measurement display 5 1/2	○	○	
		RE?	The measurement digit display query command. Responds with RE...		○	○
	The ON or OFF display	DS0	Display OFF		○	○
		DS1	Display ON	○	○	○
		DS?	The display ON or OFF query command. Responds with DS...		○	○
Operation NULL COMPARA-TOR	NULL operation	NL0	NULL operation OFF	○	○	
		NL1	NULL operation ON		○	
		NL?	The NULL operation ON or OFF query command. Responds with NL...		○	○
		NLX?	The NULL operation constant value query command. The same response as the measurement data output format (ASCII) is used. Responds with when the NULL operation is set to OFF: DV+000.000E-3 or DI+00.0000E-6 (6243) DV+000.000E-3 or DI+000.000E-6 (6244)		○	○
	Comparison operation	CO0	OFF	○	○	
		CO1	ON		○	
		CO?	The comparison operation query command. Responds is with CO...		○	○
	The upper and lower limit values for the comparison operation	KH	Specifying a unit: The optimal range is automatically set. KH <data1>UNIT, <data2>UNIT <data1>: Upper limit value (Current or voltage value) <data2>: Lower limit value (Current or voltage value) UNIT: Units: UA, MA, A, MV and V An error occurs when an unused unit in the current measurement function is specified.		○	
			No unit specification: The current range is used. KH <data1>, <data2>			
			Default value: KH+00.0000E-6A, +00.0000E-6A (6243) KH+000.000E-6A, +000.000E-6A (6244)	○		
		KH?	The query command for the upper and lower limit comparison values. KH ± aaaaaaaE+aUNIT, ± bbbbbbbE+bUNIT aaaa: Upper limit value (Current or voltage value) bbbb: Lower limit value (Current or voltage value) Unit: V or A The voltage and current value responses depend on the current measurement function.		○	○
	The comparison operation result buzzer.	BZ0	The buzzer does not sound as a result from the comparison operation.	○	○	
		BZ1	The buzzer sounds with the HI comparison operation result.		○	
		BZ2	The buzzer sounds with the GO comparison operation result.		○	
		BZ3	The buzzer sounds with the LO comparison operation result.		○	
		BZ?	The query command that sounds the comparison operation result buzzer. Responds with BZ...		○	○

5.2.10 GPIB Code List

Table 5-5 GPIB Command List (4 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
TIME	Time parameter	SP	SP <data1>, <data2>, <data3>, <data4> <data1>:Hold time (00003 to 60000) <data2>:Major delay time (000.30 to 60000) <data3>:Period (002.00 to 60000) <data4>:Pulse width (001.00 to 60000) (Unit: ms) Only the pulse width can be omitted.		○	△
			Default value: SP00010, 004.00, 050.00, 025.00	○		
		SP?	The time parameter query command. Responds with: SPaaaaa, bbbbb, ccccc, ddddd aaaaa: Hold time bbbbb: Major delay time ccccc: Period ddddd: Pulse width (Unit: ms)		○	○
	Source delay time	SD	SD <data> <data>: Source delay time (000.01 to 60000) (Unit: ms)		○	△
			Default value: SD000.01	○		
		SD?	The source delay time query command. Responds with: SDaaaaa aaaaa: Source delay time (Unit: ms)		○	○
	Measurement auto range delay	RD	RD <data> <data>: Auto range delay time (00000 to 00500) (Unit: ms)		○	△
			Default value: RD00000	○		
		RD?	The auto range delay time query command. Responds with: RDaaaaa aaaaa: The auto range delay time (Unit: ms)		○	○
START TRIGGER	The trigger mode for the DC pulse source mode	M0	RUN (Free run)	○	○	
		M1	HOLD (Hold)		○	
		M?	The DC pulse trigger mode query command. Responds with M...		○	○
	The trigger mode for the sweep source mode	ST0	Automatic trigger mode	○	○	△
		ST1	External trigger mode		○	△
		ST?	The sweep trigger mode query command. Responds with ST...		○	○
	Trigger	*TRG	DC mode When HOLD is set: Measurement trigger Sweep mode Automatic trigger sweep: The sweep starts and pauses. External trigger sweep: The sweep starts and triggers signal output.		○	○
	Sweep cancellation	SWSP	The sweep stops. (The value is returned to the bias value.)		○	○
EXT.SIGNAL	The Operate Signal signal setting	OP0	The operate OFF signal is input. (IN)	○	○	
		OP1	The operate ON or OFF signal is input. (IN)		○	
		OP2	The interlock is input. (IN)		○	
		OP3	The Operate Signal is output. (OUT)		○	
		OP?	The Operate Signal setting query command. Responds with OP...		○	○
	The Complete/Busy signal setting	CP0	COMPLETE signal output timing: The measurement starts. (Front)		○	
		CP1	The COMPLETE signal output timing: The measurement is completed. (End)	○	○	
		CP2	The COMPLETE signal output timing: The comparison operation HI.		○	
		CP3	The COMPLETE signal output timing: The comparison operation GO.		○	
		CP4	The COMPLETE signal output timing: The comparison operation LO.		○	
		CP5	The BUSY signal is input.		○	
		CP6	The BUSY signal is output.		○	
		CP?	The Complete/Busy signal setting query command. Responds with CP...		○	○
	The external single wire output signal pulse width setting *c	CW0	20 µs	○		
		CW1	100 µs			
		CW?	The query command that sets the external single wire output signal pulse width. Responds with CW...		○	○

*c: When specifying this setting to the 6243/44 which uses the ROM version A02 or earlier, a command syntax error occurs.

Table 5-5 GPIB Command List (5 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
SWEEP	Linear sweep	SN	Specifying a unit: The optimal range is automatically set. SN <data>UNIT, <data2>UNIT, <data3>UNIT <data1>UNIT: The start value (The voltage or current value) <data2>UNIT: The stop value (The voltage or current value) <data3>UNIT: The step value (The voltage or current value) (The polarity is ignored.) Units: MV, V, UA and MA • Only the sweep type is set when all setting values are omitted. Each value cannot be omitted individually. • An error occurs when an unused unit in the current source function is specified.		○	
			Default value: SN+000.01E-3V, +001.00E-3V, 000.01E-3V	○		
		SN?	The linear sweep query command Responds with: SN ± aaaaaaE ± aUNIT, ± bbbbbbE ± bUNIT, ccccccE ± cUNIT aaaa: The start value bbbb: The stop value cccc: The step value (polarity is indicated by space.) Unit: V or A The voltage and current value responses depend on the current source function setting.		○	○
	Log sweep	SG	Specifying a unit: The optimal range is automatically set. SG <data>UNIT, <data2>UNIT, <data3> <data1>UNIT: The start value (The voltage or current value) <data2>UNIT: The stop value (The voltage or current value) <data3>: The number of the step split (1, 2, 5, 10, 25, and 50) Unit: MV, V, UA and MA The number of the split: 1, 2, 5, 10, 25, and 50 • Only the sweep type is set when all setting values are omitted. Each value cannot be omitted individually. • An error occurs when an unused unit in the current source function is specified.		○	
			Default value: SG+000.01E-3V, +001.00E-3V, 10	○		
		SG?	The log sweep query command Responds with: SG ± aaaaaaE ± aUNIT, ± bbbbbbE ± bUNIT, cc aaaa: The start value bbbb: The stop value cc: The number of the split (1, 2, 5, 10, 25, and 50) Unit: V or A The voltage and current value responses depend on the current source function setting.		○	○
	Random sweep	SC	SC <data1>, <data2> The SC start address and stop address <data1>: The start address (0 to 4999) <data2>: The stop address (0 to 4999) • Only the sweep type is set when all setting values are omitted. Each value cannot be omitted individually. • The start address and stop address set during the operation can be changed while the sweep operation pauses.		○	△
			Default value: SC0000, 0000	○		
		SC?	The random sweep query command Responds with: SCaaaa, bbbb aaaa: The start address (0 to 4999) bbbb: The stop address (0 to 4999)		○	○
	The sweep type query	SX?	Responds with Linear sweep: The same response as the SN? command response. Log sweep: The same response as the SG? command response. Random sweep: The same response as the SC? command response.		○	○
	Bias value	SB	Unit Specification: The optimal range is set automatically. SB <data>UNIT Units: MV, V, UA and MA An error occurs when an unused unit in the current source function is specified.		○	△
			No unit specification: The current bias range is used. SB <data>			
			Default value (6243): SB+000.00E-3V (Voltage function) SB+00.000E-6A (Current function) Default value (6244): SB+000.00E-3V (Voltage function) SB+000.00E-6A (Current function)	○		
		SB?	The bias value query command Responds with: SB ± aaaaaaE+aUNIT aaaa: Voltage or current source value Units: V or A The voltage and current value responses depend on the current source function.		○	○
	Sweep range settings	SR0	The sweep range automatic setting	○	○	
		SR1	The sweep range fixed setting		○	
		SR?	The sweep range setting query command. Responds with SR...		○	○

Table 5-5 GPIB Command List (6 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
SWEEP (Continued)	The sweep repetition number	SS	SS <data> <data>: The sweep repetition number(0 to 1000) The sweep can be repeated continuously when set to 0.		○	△
			Default value: SS0001	○		
		SS?	The sweep repetition query command Responds with SS...		○	○
	Reverse mode	SV0	Reverse OFF	○	○	△
		SV1	Reverse ON		○	△
		SV?	The reverse mode query command Responds with SV...		○	○
	Random sweep memory data setting	N	The optimal range is automatically set.		○	
		P	N <data1>, D <data2>UNIT, D <data3>UNIT, ····· , P <data1>: The memory address (0 to 4999) <data2>: The voltage or current source value at the <data1> address <data3>: The voltage or current source value at the <data1> + 1 address UNIT: Unit An error occurs when an unused unit in the current source function is specified. P: The random sweep memory data settings are completed.			
			Default value (6243): D+000.00E-3V (Voltage function) D+00.000E-6A (Current function) Default value (6244): D+000.00E-3V (Voltage function) D+000.00E-6A (Current function)	○*2		
	Random sweep memory data settings	N?	The random sweep memory data query command N? <data> <data>: Memory address (0 to 4999) Response: Nddd, D±aaaaaaE+aUNIT, P ddd: Memory address aaa: Voltage or current source value Units: V or A P: Terminator The voltage and current value responses depend on the current source function.		○	○
		NP?	The random sweep memory setting query command. Responds with: The random sweep memory setting is completed. : 0 The random sweep memory is being set. :1		○	○
	Saving and clearing random sweep memory data	RSAV	Saves the random sweep data in the memory.		○	
		RCLR	Initializes the random sweep data. (The saved data is not initialized.)		○	
MEASURE BUFFER (STORE)	Measurement buffer memory Memory store mode	SM0	OFF	○	△	△
		SM1	Normal (NORMAL-ON)		△	△
		SM2	Burst (BURST-ON)		△	△
		SM?	The measurement data buffer query command Responds with: SM...		○	○
	The measurement buffer memory Stored data query command.	SZ?	Response: nnnn: The amount of stored data in the measurement buffer memory (0 to 5000)	0 *2	○	○
	Clearing the measurement buffer memory	RL	Clears the measurement buffer memory.		△	△
(RECALL)	Switches the data output mode and specifies a recall number	RN0	RN0, <adrs>" Clears the measurement buffer memory recall mode. <adrs>: Recall data number (0 to 4999) The address is not changed when <adrs> is omitted.	○	○	○
		RN1	RN1, <adrs> Sets the measurement buffer memory recall mode. <adrs>: Recall number (0 to 4999) The address is not changed when <adrs> is omitted. When data is recalled using ENTER • The recalled data has the same format as that of the measurement data output(ASCII) With the header ON and OFF • The recall data number is incremented after the data output. • When no data is stored in the specified number Output: EE +888.888E+8 (omitted). No recall data is incremented at this point. • The measurement buffer memory data is not deleted when it is recalled.		○	○

Table 5-5 GPIB Command List (7 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
MEASURE BUFFER (RECALL) (Continued)	The measurement buffer memory recall number query.	RN?	Responds with: Response: RN0,0 to RN0,4999 or RN1,0 to RN1,4999		○	○
	Measurement buffer memory Recall range	RDN	RDN<adr1>,<adr2> Range specification of memory read by using "RDT?" <adr1>: The first recall data number (0 to 4999) <adr2>: The last recall data number (0 to 4999)		○	○
			Default value : RDN0000, 0000	○		
	Measurement buffer memory Recall from range	RDN?	The reading range query command Responds with: RDNaaaa, bbbb aaaa: The first recall data number bbbb: The flast recall data number		○	○
		RDT?	Recall the measurement buffer memory from specified range Response: See Section 5.2.9, "Date Output Format (Talker)" • If data does not exist in the specified number, the output becomes "EE+888.888E+8". • The recall execution state is released by executing this command.		○	△
PARAMETER SAVE/LOAD	Saving data	STP0	Saves data to USER-0.		○	
		STP1	Saves data to USER-1.		○	
		STP2	Saves data to USER-2.		○	
		STP3	Saves data to USER-3.		○	
		SINI	Memory saved in USER-0 to USER-3 are initialized.		○	
	Loading data	RCLP0	Loads data from USER-0.			
		RCLP1	Loads data from USER-1.			
		RCLP2	Loads data from USER-2.			
		RCLP3	Loads data from USER-3.			
		RINI	Initializes the parameter in the parameter memory area. (Data other than the ones in the default *1 and *2 in this table are default.)			
SYSTEM	Power frequency	LF0	50 Hz	○	○	
		LF1	60 Hz		○	
		LF?	The power frequency query command Responds with: LF...		○	○
	Self test	*TST?	Executes the self test and the returns the result. Responds with: 0: Pass 1: Fail		○	
		TER?	Returns each register's self test result in detail. Responds with: a, b, c, and d (a, b, c, and d are equivalent to 0 to 65535.)		○	
	Initializing the instrument	C	The same as the device clear DCL. (The GPIB input and output buffers are cleared.)		○	○
		*RST	Initializes the parameter. (Data other than the ones in the default *2 in this table are default.)		○	○
	Instrument Information	*IDN?	The Instrument information query command. Responds with: ADC Corp., R6243, XXXXXXXX, YYYYY ADC Corp.: Manufacture (nine characters) R6243: Instrument name (six characters) R6243 or R6244 XXXXXXXX: The serial number (eight digits) YYYYY: ROM revision number		○	○
Compatible operation mode	Query	ACT?	Response: The original mode: R6243 or R6244 TR6143 mode 1: TR6143 TR6143 mode 2: TR6143		○	○

5.2.10 GPIB Code List

Table 5-5 GPIB Command List (8 of 9)

Item		Command	Description	Default	Operation	
					During DC/ PLS operation	During sweep operation
GPIB	Block delimiter	DL0	CR/LF, EOI	○*1	○	○
		DL1	LF		○	○
		DL2	EOI		○	○
		DL?	The block delimiter query command The response is DL...		○	○
	String delimiter	SL0	Comma “,”	○*1	○	○
		SL1	Space “ “		○	○
		SL2	CR/LF		○	○
		SL?	The string delimiter query command Responds with: SL...		○	○
	Header output	OH0	OFF		○	
		OH1	ON	○ *2	○	
		OH?	The header output query command Responds with: OH...		○	○
	Service request	S0	ON		○	
		S1	OFF	○ *1	○	
		S?	The service request query command The Responds with S...		○	○
	Status	*STB?	The status byte register query command		○	○
		*SRE	Sets the service request enable register. *SREddd (0 to 255)	0 *2	○	○
		*SRE?	The service request enable register query command		○	○
		*ESR?	The standard event status register query command		○	○
		*ESE	Sets the standard event status enable register *ESEddd (0 to 255)	0 *2	○	○
		*ESE?	The standard event status enable register query command		○	○
		DSR?	The device invent register query command		○	○
		DSE	Sets the device invent enable register DSEddddd (0 to 65535)	0 *2	○	○
		DSE?	The device invent enable register query command		○	○
		ERR?	The error invent register query command		○	○
		*CLS	Clears the event register.		○	○
	OPC	*OPC	Sets the SESR LSB after all operations are completed.		○	○
		*OPC?	Returns ASCII 1 after all operations are completed.		○	○
		*WAI	Pauses all operations before termination.		○	○

Table 5-5 GPIB Command List (9 of 9)

Item		Command	Description			Default	Operation	
							During DC/ PLS operation	During sweep operation
CALIBRATION	Calibration mode	XENT	Enters the calibration mode. (Cal Switch ON + operation)				○	
		XOUT	Exit the calibration mode. (Cal Switch OFF + standby)			When the range and polarity are set in the calibration mode.		
		X?	The calibration switch status query command Responds with: X0: OFF, X1: ON			Normal and calibration modes		
		XX?	The calibration mode query command Responds with: XX0 for the normal mode, XX1 for the calibration mode					
	Executing calibration	XVS	Voltage source function calibration			When the range and polarity are set in the calibration mode.		
		XVM	Voltage measurement function calibration					
		XIS	Current source function calibration					
		XIM	Current measurement function calibration					
		XR3		32 µA	Range			
		XR4	320 mV	320 µA				
		XR5	3.2 V	3.2 mA				
		XR6	32 V/20 V	32 mA				
		XR7	110 V	320 mA				
		XR8		2 A/3.2 A				
		XR9		10 A				
		XS+	Positive polarity source					
		XS-	Negative polarity source					
		XNXT	Changes the calibration mode (Continues with the following calibration.)			When in the calibration mode		
		XD	Performs calibration in the current setting range. XD <data>: The DMM reading value Zero point and full scale point calibration			Zero and full scale point calibration in the calibration mode		
		XDN1	- 0.5 count		Source calibration Calibration coefficient in the current source range (zero, gain) is corrected.	Zero and full scale calibration in the calibration mode		
		XDN2	- 5 count					
		XDN3	- 50 count					
		XDN4	- 500 count					
		XDN5	- 5000 count					
		XUP1	+ 0.5 count		Source calibration Calibration coefficient in the current source range (zero, gain) is corrected.			
		XUP2	+ 5 count					
		XUP3	+ 50 count					
		XUP4	+ 500 count					
		XUP5	+ 5000 count					
	Saving or clearing calibration coefficient	XWR	Saving the calibration coefficient into memory			When the range and polarity are set in the calibration mode.		
		XINI	Initializing the calibration coefficient					

5.2.10.2 TER? Command Response

Table 5-6 shows the responses and their meanings when the results of self-tests are recalled using the TER? command. Figures are added for data where multiple reasons for the error exist.
Response: a, b, c, d

Example: When the response is 0,24,0,0
Indicates that self-test errors occurred at the two positions AD 3.2 V ZERO and AD 320 mV ZERO

Table 5-6 TER? Command Response (1 of 2)

Register	Data	Error message
a	0	Pass (No error)
	1	RAM Read/Write
	2	Logic-Panel Communication
	4	Logic-Analog Communication
	8	CAL Data Check Sum
	16	Parameter Check Sum
b	0	Pass (No error)
	1	AD Ratio IR1/IR2
	2	AD Ratio IR2/IR3
	4	AD Ratio IR3/IR4
	8	AD 3.2V ZERO
	16	AD 320mV ZERO
c	0	Pass (No error)
	1	VSVM 320mV +ZERO
	2	VSVM 320mV -ZERO
	4	VSVM 320mV +FS
	8	VSVM 320mV -FS
	16	VSVM 3.2V +ZERO
	32	VSVM 3.2V -ZERO
	64	VSVM 3.2V +FS
	128	VSVM 3.2V -FS
	256	VSVM 32V +ZERO /VSVM 20V + ZERO
	512	VSVM 32V -ZERO /VSVM 20V - ZERO
	1024	VSVM 32V +FS /VSVM 20V + FS
	2048	VSVM 32V -FS /VSVM 20V - FS
	4096	VSVM 110V +ZERO
	8192	VSVM 110V -ZERO
	16384	VSVM 110V +FS
	32768	VSVM 110V -FS

Table 5-6 TER? Command Response (2 of 2)

Register	Data	Error message
d	0	Pass (No error)
	1	IM 32μA ZERO
	2	IM 320μA ZERO
	4	IM 3.2mA ZERO
	8	IM 32mA ZERO
	16	IM 320mA ZERO
	32	IM 2A ZERO /IM 3.2A ZERO
	64	IM CMV
	128	OVL CHECK
	256	IM 10A ZERO

5.2.11 Program Examples

Explained here are basic program examples operating the 6243/44 from a computer through the GPIB bus.

Computer:	Fujitsu FMV-6266T6, Windows 95
GPIB hardware:	AT-GPIB/TNT(PnP) manufactured by NATIONAL INSTRUMENTS
Used module:	Niglobal.bas, Vbib-32.bas (supplied with AT-GPIB/TNT(PnP)
Applied language:	Visual Basic 5

The following examples are Visual Basic program examples performing the same operations as those described in Section 2.2, “Basic Operations.”

- Program example 1: Example of DC measurement introduced in Section 2.2.3
- Program example 2: Example of pulse measurement introduced in Section 2.2.4
- Program example 3: Example of sweep measurement introduced in Section 2.2.5
- Program example 4: Example of diode measurement introduced in Section 2.3.1
- Program example 5: Example of recalling measurement data from the measurement buffer memory as fast as possible

5.2.11.1 Program Example 1: DC 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                             ' 6243/44 address
  Dim vig As Integer                             ' 6243/44 device descriptor

  board = 0                                      ' GPIB board address 0
  pad = 1                                        ' 6243/44 address 1

  Call ibdev(board, pad, 0, T10s, 1, 1, vig)     ' Opening and initializing device (6243/44) (timeout 10 s)
  Call ibconfig(vig, IbcUnAddr, 1)               ' Address setting performed for each transmission or reception
  Call ibeos(vig, &H40A)                         ' Setting terminator to LF for sending command

  Call SUBsend(vig, “C,*RST”)                    ' DCL and parameter initialization
  Call SUBsend(vig, “M1”)                        ' Trigger mode hold

  Call SUBsend(vig, “D1V,D3MA”)                  ' DC source value 1 V, limiter value 3 mA
  Call SUBsend(vig, “E”)                         ' E: Output ON
  Call SUBmeas(vig)                              ' Measurement trigger & data recall

  Call SUBsend(vig, “D2V”)                       ' DC source value 2 V
  Call SUBmeas(vig)                              ' Measurement trigger & data recall
```

```
   Call SUBsend(vig, “D-2V”)                        ’ DC source value -2 V
   Call SUBmeas(vig)                                ’ Measurement trigger & data recall

   Call SUBsend(vig, “D4V”)                         ’ DC source value 4 V
   Call SUBmeas(vig)                                ’ Measurement trigger & data recall

   Call SUBsend(vig, “F1”)                          ’ Voltage measurement function
   Call SUBmeas(vig)                                ’ Measurement trigger & data recall

   Call SUBsend(vig, “IF”)                          ’ Current source function
   Call SUBmeas(vig)                                ’ Measurement trigger & data recall

   Call ibwrt(vig, “H”)                             ’ Output OFF

   Call ibonl(vig, 0)                               ’ Setting device (6243/44) to offline
End Sub                                             ’ Event procedure completed


                                                    ’ Subroutine
Private Sub SUBmeas(vig As Integer)                 ’ Measurement data recall by measurement trigger
   Dim dt As String * 20                            ’ 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


                                                    ’ 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(Chr$(10))

 End Sub
```

5.2.11.2 Program Example 2: Pulse 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                    ' 6243/44 address
   Dim vig As Integer                    ' 6243/44 device descriptor

   board = 0                             ' GPIB board address 0
   pad = 1                               ' 6243/44 address 1

   Call ibdev(board, pad, 0, T10s, 1, 1, vig)   ' Opening and initializing device (6243/44) (timeout 10 s)
   Call ibconfig(vig, IbcUnAddr, 1)      ' Address setting performed for each transmission or reception
   Call ibeos(vig, &H40A)                ' Setting terminator to LF for sending command

   Call SUBsend(vig, "C,*RST")           ' DCL and parameter initialization
   Call SUBsend(vig, "M1")               ' Trigger mode hold
   Call SUBsend(vig, "MD1")              ' Pulse generation mode

   Call SUBsend(vig, "D2V,D3MA")         ' Pulse source value 2 V, limiter value 3 mA
   Call SUBsend(vig, "DB1V")             ' Pulse base value 1 V
   Call SUBsend(vig, "SP3,1,130,50")     ' Hold time 3 ms, measure delay time 1 ms
                                         ' Period 130 ms, pulse time 50 ms
   Call SUBsend(vig, "E")                ' Output ON
   Call SUBmeas(vig)                     ' Measurement trigger & data recall

   Call SUBsend(vig, "D2.5V")            ' Pulse source value 2.5 V
   Call SUBmeas(vig)                     ' Measurement trigger & data recall

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

   Call SUBsend(vig, "DB0.5V")           ' Pulse base value 0.5 V
   Call SUBmeas(vig)                     ' Measurement trigger & data recall

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

   Call ibonl(vig, 0)                    ' Setting device (6243/44) to offline
End Sub                                  ' Event procedure completed

                                         ' Subroutine
Private Sub SUBmeas(vig As Integer)      ' Measurement data recall by measurement trigger
   Dim dt As String * 20                 ' 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

                                                ' 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(Chr$(10))

End Sub
```

5.2.11.3 Program 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                            ' 6243/44 address
   Dim vig As Integer                            ' 6243/44 device descriptor
   Dim dt As String * 20                         ' Data reception buffer
   Dim s As Integer                              ' Serial poll result storage variable

   board = 0                                     ' GPIB board address 0
   pad = 1                                       ' 6243/44 address 1

   Call ibdev(board, pad, 0, T10s, 1, 1, vig)    ' Opening and initializing device (6243/44) (timeout 10 s)
   Call ibconfig(vig, IbcUnAddr, 1)              ' Address setting performed for each transmission or reception
   Call ibeos(vig, &H40A)                        ' Setting terminator to LF for sending command


   Call SUBsend(vig, "C,*RST")                   ' DCL and parameter initialization
   Call SUBsend(vig, "*CLS")                     ' Initializing status byte
   Call SUBsend(vig, "*SRE8")                    ' Setting bit 3 for the Service Request Enable Register to 1
   Call SUBsend(vig, "DSE8192")                  ' Setting bit 13 for the Service Event Enable Register to 1
   Call SUBsend(vig, "S0")                       ' SRQ transmission mode
                                                 ' Register setting for transmitting SRQ following completion of sweep
   Call SUBsend(vig, "MD2")                      ' Sweep generation mode

   Call SUBsend(vig, "SN1V,10V,1V")              ' Linear sweep: Start 1 V, stop 10 V, step 1 V
   Call SUBsend(vig, "SB0V")                     ' Sweep bias value 0 V
   Call SUBsend(vig, "SP3,4,100")                ' Hold time 3 ms, measure delay time 4 ms
                                                 ' Period 100 ms
   Call SUBsend(vig, "D30MA")                    ' Limiter value 30 mA

   Call SUBsend(vig, "SM1")                      ' Memory Store ON

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


                                                 ' Waiting for sweep measurement completion
   Call ibwait(vig, RQS Or TIMO)                 ' Waiting for SQL transmission
   If (ibsta And TIMO) Then                      ' In case of timeout
      Call MsgBox("SRQ Time Out", vbOKOnly, "Error")
                                                 ' Error indicated
   Else                                          ' If no timeout
      Call ibrsp(vig, s)                         ' executing serial poll
   End If                                        ' Ending If
```

```
   Call SUBsend(vig, "H")                          ' 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 +888.888E+8") Then
         Exit Do                                   ' If recalled data is empty, 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 device (6243/44) to offline
End Sub                                            ' Ending event procedure

                                                   ' 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) + 1            ' Specifying display position for text box (Text1)
   Text1.SelText = dt & vbCrLf                     ' Displaying measurement data in text box (Text1)
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(Chr$(10))

End Sub
```

5.2.11.4 Program Example 4: Diode 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                             ' 6243/44 address
  Dim vig As Integer                             ' 6243/44 device descriptor

  board = 0                                      ' GPIB board address 0
  pad = 1                                        ' 6243/44 address 1

  Call ibdev(board, pad, 0, T10s, 1, 1, vig)     ' Opening and initializing device (6243/44)
  Call ibconfig(vig, IbcUnAddr, 1)               ' Address setting performed for each transmission or reception
  Call ibeos(vig, &H40A)                         ' Setting terminator to LF for sending command

  Call SUBsend(vig, "C,*RST")                    ' DCL and parameter initialization
  Call SUBsend(vig, "M1")                        ' Trigger mode hold

                                                 ' (1) Diode forward voltage measurement (VF)
  Call SUBsend(vig, "MD1")                       ' Pulse generation mode
  Call SUBsend(vig, "IF")                        ' Current source function
  Call SUBsend(vig, "F1")                        ' Voltage measurement function
  Call SUBsend(vig, "D100MA,D1.5V")              ' Pulse current source value 100 mA, voltage limiter value 1.5 V
  Call SUBsend(vig, "DB0A")                      ' Pulse base value 0 A
  Call SUBsend(vig, "SP3,1,100,5")               ' Hold time 3 ms, measure delay time 1 ms
                                                 ' Period 100 ms, pulse time 5 ms
  Call SUBsend(vig, "IT1")                       ' Integration time 500 µs
  Call SUBsend(vig, "R0")                        ' Measurement auto range

  Call SUBsend(vig, "E")                         ' Output ON
  Call SUBmeas(vig)                              ' Measurement trigger & data recall
  Call SUBsend(vig, "H")                         ' Output OFF

                                                 ' (2) Diode reverse leak current measurement (IR)
  Call SUBsend(vig, "MD0")                       ' DC source mode
  Call SUBsend(vig, "VF")                        ' Voltage source function
  Call SUBsend(vig, "F2")                        ' Current measurement function
  Call SUBsend(vig, "D-20V,D300UA")              ' DC voltage source value 20 V, current limiter value 300 µA
  Call SUBsend(vig, "SP3,100,100")               ' Hold time 3 ms, measure delay time 100 ms
                                                 ' Period 100 ms
  Call SUBsend(vig, "IT4")                       ' Integration time 10PLC

  Call SUBsend(vig, "E")                         ' Output ON
  Call SUBmeas(vig)                              ' Measurement trigger & data read out
  Call SUBsend(vig, "H")                         ' Output OFF
```

```
   Call ibonl(vig, 0)                                ' Setting device (6243/44) to offline
End Sub                                              ' Event procedure completed

                                                     ' Subroutine
Private Sub SUBmeas(vig As Integer)                  ' Recalling measurement data by measurement trigger
   Dim dt As String * 20                             ' 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

                                                     ' 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(Chr$(10))

End Sub
```

5.2.11.5 Program Example 5: Using Measurement Buffer Memory

(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 board address
  Dim pad As Integer                             ' 6243/44 address
  Dim vig As Integer                             ' 6243/44 device descriptor
  Dim dt As String * 20                          ' Data reception buffer
  Dim dt_sz As Integer                           ' Number of measurement buffer memory data
  Dim dt_rn(100) As String * 15                  ' 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 board address 0
  pad = 1                                        ' 6243/44 address 1

  Call ibdev(board, pad, 0, T30s, 1, 1, vig)     ' Opening and initializing device (6243/44) (timeout 30 s)
  Call ibconfig(vig, IbcUnAddr, 1)               ' Address setting performed for each transmission or reception
  Call ibeos(vig, &H40A)                         ' Setting terminator to LF for sending command

                                                 ' 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
                                                 ' Registering setting for transmitting SRQ following completion of sweep
  Call SUBsend(vig, "MD2")                       ' Sweep generation mode

  Call SUBsend(vig, "SN0.1V,10V,0.1V")           ' Linear sweep: Start 0.1 V, stop 10 V, step 0.1 V
  Call SUBsend(vig, "SB0V")                      ' Sweep bias value 0 V
  Call SUBsend(vig, "SP3,4,100")                 ' Hold time 3 ms, measure delay time 4 ms
                                                 ' Period 100 ms
  Call SUBsend(vig, "D30MA")                     ' Limiter value 30 mA

  Call SUBsend(vig, "SM1")                       ' Memory Store ON

  Call SUBsend(vig, "E")                         ' Output ON
  Call SUBsend(vig, "*TRG")                      ' Starting sweep

                                                 ' Waiting for sweep measurement completion
  Call ibwait(vig, RQS Or TIMO)                  ' Waiting for SQL transmission
  If (ibsta And TIMO) Then                       ' In case of timeout
    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, "H")                        ' 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 number to numerical variable
  Call SUBsend(vig, "OH0")                      ' Setting output data 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 and
                                                ' specifying output number from 0
  For i = 1 To dt_sz                            ' Repeating for number of memory data
    Call SUBread(vig, dt)                       ' Measurement buffer memory data recall
                                                ' Outputting memory data by data recall after memory recall mode
                                                ' setting, adding output number by 1
    dt_rn(i) = dt
                                                ' Storing recalled data in order
  Next i                                        ' Ending For
  Call SUBsend(vig, "RN0,0")                    ' Releasing measurement buffer memory output mode

                                                ' Displaying measurement data
  For i = 1 To dt_sz                            ' Repeating for number of memory data
    dt = Str(i) & ":" & dt_rn(i) & vbCrLf       ' Creating display character string
    Text1.SelStart = Len(Text1.Text) + 1        ' 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 device (6243/44) to offline
End Sub                                         ' Event procedure completed

                                                ' Subroutine
Private Sub SUBread(vig As Integer, dt As String)   ' Talker data recall
  Call ibrd(vig, dt)                            ' Talker data recall

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(Chr$(10))

End Sub
```

6. COMPATIBILITY WITH TR6143

This chapter describes compatibility with the earlier model TR6143.

The 6243 and 6244 feature the Original Mode and the TR6143 Mode for compatibility with the conventional TR6143. Furthermore, the TR6143 mode features two types, i.e., Mode 1 and Mode 2.

TR6143 Mode 1: The voltage limiter in the current source function only works with the same polarity as that of the source. Consequently, if the current source value is set to ±0 A in the non-load condition, it may rise as high as the reverse polarity line voltage.

TR6143 Mode 2: The voltage limiter in the current source function works for both polarities.

Other items are all the same for Mode 1 and Mode 2.

Products with an A02 or earlier ROM revision do not feature the TR6143 Mode 2 function.

NOTE: ***The TR6143 Mode is designed so that user programs used in the TR6143 can be used in 6243/44 without major modifications. However, some functions such as command processing time are not compatible with TR6143. This means that all the programs used with the TR6143 are not guaranteed.***
Since some functions like bias value are restricted, use the Original Mode to create new user programs.
When the TR6143 mode is used for the current source function, use the TR6143 Mode 2 because the bipolar limiter will operate.

6.1 Setting the TR6143 Mode

Setting the TR6143 mode

For TR6143 Mode 1

While pressing the **LOCAL** and **DIRECT** buttons, turn ON the power.
TR6143 Action appears in the lower right of the screen, the TR6143 Mode 1 is invoked and all the lamps light up. At this time, ⊿ appears in the upper right of the measurement screen.

For TR6143 Mode 2

While pressing the **MENU** and **DIRECT** buttons, turn ON the power.
TR6143 Action appears in the lower right of the screen, the TR6143 Mode 2 is invoked and all the lamps light up. At this time, B appears in the upper right of the measurement screen.

NOTE: ***Once the TR6143 mode is set, the 6243/44 will always start-up in the TR6143 mode whenever the power is turned ON.***
In this case, the following parameters will always be established in fixed conditions.

Source mode: DC. Measurement digits: 4-1/2 digits. Measurement: ON. Display: ON. Auto Range Delay: 0 ms.

Releasing the TR6143 Mode

While pressing the **MODE** and **DIRECT** buttons, turn ON the power.
R6243 Action** appears in the lower right of the screen, the TR6143 Mode is released and all the lamps light up. At this time, parameters are initialized and the ? symbol shown in the upper right of the measurement screen disappears.
*: For 6244, ***R6244 Action*** appears.

6.2 Differences Between the TR6143 Mode and the Original Mode

Some functions are different between the TR6143 Mode and the Original Mode (normal mode). Table 6-1 shows these differences.

Table 6-1 Differences Between the TR6143 Mode and the Original Mode (1 of 2)

Function	Original mode	TR6143 mode
Changing the source function (GPIB)	VS/IS The measurement function does not change.	VSIM/ISVM The measurement function changes.
Voltage limiter	The bipolar limiter operates.	TR6143 mode 1: Only the limiter for a single polarity operates. TR6143 mode 2: The bipolar limitter operates.
	Auto, Plus, or Minus can be selected in the Limiter Polarity mode.	The voltage limiter has the same polarity as the current source
Limiter polarity mode	Auto, Plus, or Minus can be selected	None
Changing the source, limiter, and range	A constant value can be set before or after the range is changed. (Example) Increasing the measured range scale 10.000 V → 010.00 V (Example) Decreasing the measured range scale 10.000 V → DOWN → 10.000 V	A constant count value can be set. (Example) Increasing the measured range scale 10.000 V → UP → 100.00 V (Example) Decreasing the measured range scale 01.000 V → DOWN → 0.1000 V
	If a changed value is not within the allowable range, the range is not changed. (Example) The range scale is not decreased. 10.000 V → DOWN → 10.000 V	If a changed value exceeds the allowable display value, an acceptable source value can be set. (Example) Increasing the measured range scale 30.000 V → UP → 030.00 V
Bias value	6243: 0.00 mV to ± 110.00 V 0.000 μA to ± 2000.0 mA 6244: 0.00 mV to ± 20.000 V 0.00 μA to ± 10.000 A	None

Table 6-1 Differences Between the TR6143 Mode and the Original Mode (2 of 2)

Function		Original mode	TR6143 mode
Measurement data buffer	Mode	Burst, Normal, or OFF	ON/OFF
	Storing	5000 fixed data (Data is not overwritten)	5000 FIFO data (Data is not overwritten)
	Read out	Data can be read out using **RECALL**.	Data cannot be read out using **RECALL**.
	Operation when the memory is full	Burst : DC and pulse source ; The HOLD status is set. : The sweep starts ; The STOP status is set. Normal: Data storage stops.	DC source ; Pulse and sweep source starts. ; Source and measurement pauses.
GPIB	Command	Refer to, “5.2.10 GPIB Code List.”	Refer to, “6.4.1 TR6143 Mode GPIB Code List.”
	Output the measurement data buffer data.	Read out using RN1	Read out using ENTER
		The binary data output mode is unavailable.	The binary data output mode is available.
	Status	Refer to, “5.2.8 Status Byte.”	Refer to, “6.4.3 Status Byte in TR6143 Mode.”
TIME	The minimum resolution of the major delay period and pulse width	0.01 ms	1 ms

6.3 List of Defaults in the TR6143 Mode

6.3.1 6243 Default Values

Table 6-2 shows the initial values and setting ranges of parameters in the TR6143 mode.

Table 6-2 List of Defaults in the TR6143 Mode (6243) (1 of 2)

Parameter group	Parameter item	Parameter setting range	Factory setting
SOURCE (Front key)	Source mode	DC/PLS/SWP/PSW	DC
	Source function	VS/IS	VS
	Source range	320 mV to 110 V/32 µA to 2 A	110 V
	Source value	0.00 mV to ± 110 V/0.000 µA to ± 2 A	+000.00 V
	Limiter value	3 mV to 110 V/300 nA to 2 A	0500.0 mA
MEASURE (Front key)	Measurement function	VM/IM	IM
	Measurement auto range	Auto/Fixed	Fixed (2A range)
	Null operation	ON/OFF	OFF
	Trigger mode for DC and pulse	RUN/HOLD	RUN
SWEEP	Sweep type	Linear/Log/Random	Linear
	The start value	0.00 mV to ± 110 V/0.000 µA to ± 2 A	+000.00 V
	The stop value	0.00 mV to ± 110 V/0.000 µA to ± 2 A	+000.00 V
	The step value	0.01 mV to 110 V/0.001 µA to 2 A	000.00 V
	Log, the step height.	1/2/5/10/25/50 (Step/Decade)	10 Step/Decade
	The start address	0 to 4999	0
	The stop address	0 to 4999	0
	The sweep range	Auto/Fixed	Auto Range
	The sweep repetition number	0 to 1000	1
	The reverse mode	ON/OFF	OFF
	The sweep trigger mode	Internal/External	Internal
TIME	Major delay time	1 ms to 60000 ms	10 ms
	Hold time	10 ms to 60000 ms	00010 ms
	Period	2 ms to 60000 ms	10 ms
	Pulse width	1 ms to 60000 ms	25 ms
	Auto range delay time	0 ms to 500 ms	0000 ms
SOURCE	Pulse base value	0.00 mV to 110 V/0.000 µA to 2 A	000.00 V
	Remote sensing	2 Wire/4 Wire	2 Wire
	Limiter /OSC buzzer	ON/OFF	OFF

6.3.1 6243 Default Values

Table 6-2 List of Defaults in the TR6143 Mode (6243) (2 of 2)

Parameter group	Parameter item	Parameter setting range	Factory setting
MEASURE	Integration time	500 μs/1 ms/10 ms/1 PLC/10 PLC/100 PLC	1 PLC
	Auto zero	ON/OFF	ON
	Measurement digit	5 1/2-digit, 4 1/2-digit	4 1/2-digit
	Measurement ON/OFF	ON/OFF	ON
	Display ON/OFF	ON/OFF	ON
COMPARATOR	Comparator operation	ON/OFF	OFF
	The Comparator upper limit	0.000 mV to ± 110 V/0.0000 μA to ± 2 A	+0000.00 mA
	The Comparator lower limit	0.000 mV to ±110 V/0.0000 μA to ± 2 A	+0000.00 mA
	The buzzer the sounds depending one the Comparator result	ON/OFF	OFF
EXT.SIGNAL	The external operation single wire signal	Operate In (On/Off)/Interlock/Operate Out	Operate Off In
	Complete output mode	Complete Out (Front/End/HI/GO/LO) /Busy (In/Out)	Complete Out End
	The external single wire output signal pulse width	20 μs/100 μs	20 μs
RANDOM MEMORY	Random memory	0 to 4999 [0.00 mV to ± 110 V/0.000 μA to ± 2 A]	+000.00 mV
MEASURE BUFFER	Storing in the measurement buffer.	ON/OFF	OFF

Indicates divergences from the Original Mode.

6.3.2 6244 Default Values

Table 6-3 shows the initial values and setting ranges of parameters in the TR6143 mode.

Table 6-3 List of Defaults in the TR6143 Mode (6244) (1 of 2)

Parameter group	Parameter item	Parameter setting range	Factory setting
SOURCE (Front key)	Source mode	DC/PLS/SWP/PSW	DC
	Source function	VS/IS	VS
	Source range	320 mV to 110 V/32 µA to 2 A	110 V
	Source value	0.00 mV to ± 110 V/0.000 µA to ± 2 A	+000.00 V
	Limiter value	3 mV to 110 V/300 nA to 2 A	0500.0 mA
MEASURE (Front key)	Measurement function	VM/IM	IM
	Measurement auto range	Auto/Fixed	Fixed (3.2 A range)
	Null operation	ON/OFF	OFF
	DC and Pulse Trigger mode	RUN/HOLD	RUN
SWEEP	Sweep type	Linear/Log/Random	Linear
	The start value	0.00 mV to ± 110 V/0.000 µA to ± 2 A	+000.00 V
	The stop value	0.00 mV to ± 110 V/0.000 µA to ± 2 A	+000.00 V
	The step value	0.01 mV to 110 V/0.001 µA to 2 A	000.00 V
	Log, the step height.	1/2/5/10/25/50 (Step/Decade)	10 Step/Decade
	The start address	0 to 4999	0
	The stop address	0 to 4999	0
	The sweep range	Auto/Fixed	Auto Range
	The sweep repetition number	0 to 1000	1
	The reverse mode	ON/OFF	OFF
	The sweep trigger mode	Internal/External	Internal
TIME	Major delay time	1 ms to 60000 ms	10 ms
	Hold time	10 ms to 60000 ms	00010 ms
	Period	2 ms to 60000 ms	10 ms
	Pulse width	1 ms to 60000 ms	25 ms
	Auto range delay time	0 ms to 500 ms	0000 ms
SOURCE	Pulse base value	0.00 mV to 110 V/0.000 µA to 2 A	000.00 V
	Remote sensing	2 Wire/4 Wire	2 Wire
	Limiter /OSC buzzer	ON/OFF	OFF
MEASURE	Integration time	500 µs/1 ms/10 ms/1 PLC/10 PLC/100 PLC	1 PLC
	Auto zero	ON/OFF	ON
	Measurement digit	5 1/2-digit, 4 1/2-digit	4 1/2-digit
	Measurement ON/OFF	ON/OFF	ON
	Display ON/OFF	ON/OFF	ON

6.3.2 6244 Default Values

Table 6-3 List of Defaults in the TR6143 Mode (6244) (2 of 2)

Parameter group	Parameter item	Parameter setting range	Factory setting
COMPARATOR	Comparator operation	ON/OFF	OFF
	The Comparator upper limit	0.000 mV to ± 110 V/0.0000 μA to ± 2 A	+0000.00 mA
	The Comparator lower limit	0.000 mV to ±110 V/0.0000 μA to ± 2 A	+0000.00 mA
	The buzzer the sounds depending one the Comparator result	ON/OFF	OFF
EXT.SIGNAL	The external operation single wire signal	Operate In On/Off/Interlock/Operate Out	Operate Off In
	Complete output mode	Complete Out Front/End/HI/GO/LO/Busy In/Out	Complete Out End
	The external single wire output signal pulse width	20 μs/100 μs	20 μs
RANDOM MEMORY	Random memory	0 to 4999 [0.00 mV to ± 110 V/0.000 μA to ± 2 A]	+000.00 mV
MEASURE BUFFER	Storing in the measurement buffer.	ON/OFF	OFF

Indicates divergences from the Original Mode.

6.4 GPIB in the TR6143 Mode

Explained here are the GPIB commands, output data format, and status byte in the TR6143 mode.

6.4.1 TR6143 Mode GPIB Code List

In the TR6143 mode, the (1) TR6143 unique commands can be used but the (2) commands cannot be used. Other commands can be used in both the Original Mode and the TR6143 mode.

(1) TR6143 mode unique commands

Table 6-4 shows the TR6143 commands that are not available in the Original Mode. The defaults indicate the status of commands which can be initialized by factory default initialization, DCL, or C command.

During sweep operation and DC/pulse mode operation, only commands with the ○ symbol in Table 6-4 are accepted.

All the commands are accepted in the standby status.

Table 6-4 TR6143 Mode Unique Commands (1 of 2)

Item		Command	Description	Default setting	Operation		6243/44 commands	Remarks
					During DC/PLS operation	During sweep operation		
Source	Source function, source range, and measurement function settings	V3	Voltage source, 320 mV range, current measurement		○		V3	
		V4	Voltage source, 3.2 V range, current measurement		○		V4	
		V5	Voltage source, 32 V and 20 V ranges, current measurement		○		V5	
		V6	Voltage source, 110 V range, current measurement	○	○		V6 *4	*1
		I-1	Current source, 32 μA range, voltage measurement		○		I-1 *4	
	(TR6143 mode)	I0	Current source, 320 μA range, voltage measurement		○		I0	
		I1	Current source, 3.2 mA range, voltage measurement		○		I1	
		I2	Current source, 32 mA range, voltage measurement		○		I2	
		I3	Current source, 320 mA range, voltage measurement		○		I3	
		I4	Current source, 2 A and 3.2 A ranges, voltage measurement		○		I4	
		I5	Current source, 10 A range, voltage measurement		○		I5 *5	
	Source mode	C1	DC mode	○	○	○	MD0	
		T0	DC sweep mode automatic trigger		○	○	MD2, ST0	
		T1	DC sweep mode external trigger		○	○	MD2, ST1	
	Source response	RP0	SLOW		○		-	*2
		RP1	FAST		○		-	
Measurement	Auto zero	AC0	OFF		○		AZ0	
		AC1	ON	○	○		AZ1	
Measurement operation	Comparison operation result buzzer	UZ3	The buzzer sounds when the comparison operation result is HI.	○	○		BZ1	
		UZ4	The buzzer sounds when the comparison operation result is GO.		○		BZ2	
		UZ5	The buzzer sounds with the comparison operation result is LO.		○		BZ3	
Sweep	Sweep repetition number	T2	Repeats once	○	○	△	SS1	
		T3	Repeats continuously		○	△	SS0	
	Random sweep memory complete setting.	C3	Used when setting the random sweep memory with the N command. (Example: N30, D1V, D2V, C3)				P	

6.4.1 TR6143 Mode GPIB Code List

Table 6-4 TR6143 Mode Unique Commands (2 of 2)

Item		Command	Description	Default setting	Operation		6243/44 commands	Remarks
					During DC/PLS operation	During sweep operation		
Source / measure-ment	Time parameter	SI	SIdd dd: Period (0 to 99 × 100 ms)		○		SP ~	
	Trigger	T9	DC: Measurement HOLD status: Measurement trigger Auto trigger sweep: Starts and pauses the sweep. External trigger sweep: Starts the sweep and triggers signal output.		○	○	*TRG	
	Auto sweep pause	C2	Auto trigger sweep: Pauses the sweep.			○		
GPIB	Talker output	OM0	The source value is output using ASCII.		○	○	−	
		OM1	The measurement value is output using ASCII.	○	○	○	−	*3
		OM2	The measurement value is output in binary.		○	○	−	
		OM3	The measurement buffer memory data is output.		○	○	−	
		OM4	The operating status is output.		○	○	−	
	Header output	S4	OFF		○		OH0	
		S5	ON	○	○		OH1	
	The TR6143 status byte function	S2	The TR6143 status byte is set to level 0.	○	○	○	−	
		S3	The TR6143 status byte is set to level 1.		○	○	−	
	The TR6143 mask bit settings	MS	MSddd ddd:Mask bit decimal value (0 to 255)		○	○	−	
Measure-ment buffer memory	Measurement buffer-Store	OM6	OFF	○	○	○	−	
		OM5	ON (Memory data is output with OM1 and OM2.)		○	○	−	
	Measurement buffer-Delete	C4	Deletes the measurement buffer memory.		○	△	RL	
Initialization	Initialization	C	The parameter is initialized.		○	○	*RST	
		DCL	(This will be the default value.)		○	○		

*1: Command operation differs with the mode.
In the Original Mode, V - is set to voltage source, I -, current source.
In the TR6143 Mode, V - is set to voltage source current measurement, I -, current source voltage measurement.
*2: Since the 6243/44 does not feature a source response switching function, this command will not work even if issued (no error generated).
*3: In the Original Mode, this is fixed as “measurement value is output with ASCII.”
*4: Becomes Syntax Error for 6244.
*5: Becomes Syntax Error for 6243.
-: Becomes Execution Error in the Original Mode.

(2) Commands that cannot be used in the TR6143 mode

Table 6-5 shows the commands that cannot be used in the TR6143 mode.

Using these commands in the TR6143 mode will generate Command Execution Error.

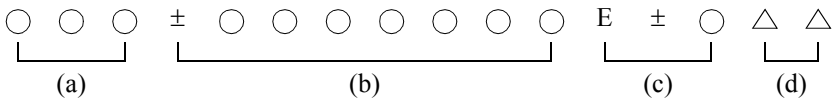
Table 6-5 Commands that cannot be used in the TR6143 Mode

Item		Unavailable commands
SOURCE	Limiter polarity	PL0, PL1, PL2
	The limiter polarity query	PL?
MEASURE BUFFER	The measurement buffer memory storage mode	SM0, SM1, SM2
	The store mode query	SM?
	Enquiring about the amount of stored data	SZ?
	Clearing the memory	RL
	Specifying a recall number	RN
	Enquiring about the recall number	RN?
SAVE/LOAD	Saving data	STP1, STP2, STP3
	Clearing User 0 to 3	SINI
	Loading	RCLP0, RCLP1, RCLP2, RCLP3
	Initializing the load parameter	RINI
GPIB	Status	*STB?, *SRE, *SRE?, *ESR?, *ESE, *ESE?, *CLS, DSR?, DSE, DSE?, ERR?
	OPC	*OPC, *OPC?, *WAI
TIME	Source delay time	SD
CALIBRATION	Calibration	XENT and all calibration commands

6.4.2 Data Output Format in the TR6143 Mode (Talker)

(1) Measurement data output format (ASCII)

When ASCII data output is specified for OM0 and OM1, the normal source and measurement data and the data from the measurement data buffer memory are output in the following ASCII format.



(a) Header (Header 3 characters)
(b) Fixed-point part (Polarity + decimal point + 5 to 6-digit figure)
(c) Exponent part (E + polarity + 1-digit figure)
(d) Block delimiter

- Header

Header	Description	Priority
DV	Voltage source value and voltage measurement value	
DI	Current source value and current measurement value	
OS	Oscillation detection (OSC)	1
LM	Limiter source (LMT)	2
OL	The measurement range is exceeded (Over Range)	3
DVH/DIH	The comparison operation result is HI.	4
DVG/DIG	The comparison operation result is GO.	
DVL/DIL	The comparison operation result is LO.	

- Fixed-point part and exponent part

  The fixed-point part and exponent part are determined by the source/measurement function, range, and number of measurement digits.

Measurement function	Range	Fixed-point		Exponent value
		5 1/2-digit measurement (eight characters)	4 1/2-digit measurement (seven characters)	
Voltage	320 mV	± ddd.ddd	± ddd.dd	E - 3
	3.2 V	± d.ddddd	± d.dddd	E + 0
	32 V/20 V	± dd.dddd	± dd.ddd	E + 0
	110 V	± ddd.ddd	± ddd.dd	E + 0
Current	32 μA	± dd.dddd	± dd.ddd	E - 6
	320 μA	± ddd.ddd	± ddd.dd	E - 6
	3.2 mA	± d.ddddd	± d.dddd	E - 3
	32 mA	± dd.dddd	± dd.ddd	E - 3
	320 mA	± ddd.ddd	± ddd.dd	E - 3
	2 A/3.2 A	± d.ddddd	± d.dddd	E + 0
	10 A	± dd.dddd	± dd.ddd	E + 0
Over range		+999.999	+999.99	E + 9

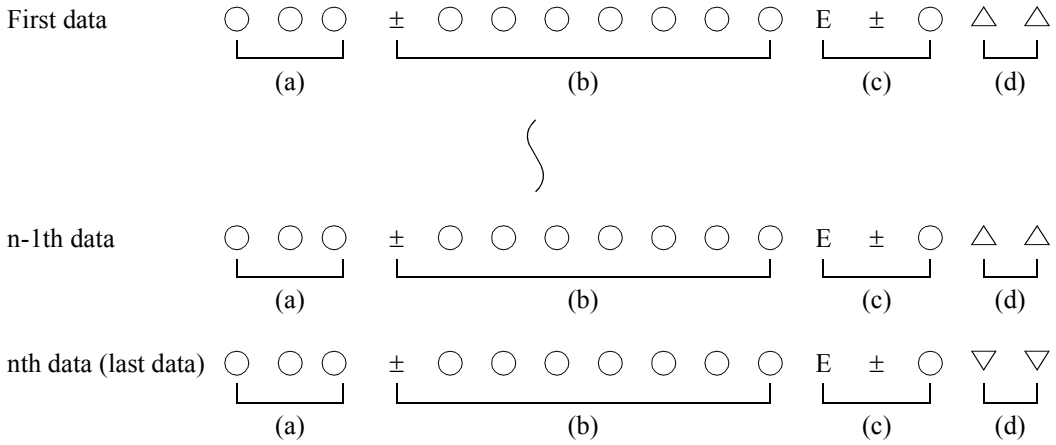
- Block delimiter

  A block delimiter is output to indicate the end of one set of data.
  The block delimiter can be specified by commands.

Block delimiter	Setting command	Default setting
CR LF + EOI	DL0	○
LF	DL1	
EOI	DL2	

(2) Measurement buffer data output format (ASCII)

When measurement buffer store is turned on by OM5 and ASCII data output is subsequently specified, all the data at the time when the talker is specified by the controller in the buffer are recalled continuously.



(a) Header (Main header 2 characters + Sub header 1 character)
(b) Fixed-point part (Polarity + decimal point + 5 to 6-digit figure)
(c) Exponent part (E + polarity + 1-digit figure)
(d) String delimiter
(e) Block delimiter

- Header

Header	Description	Priority
DV	Voltage source value and voltage measurement value	
DI	Current source value and current measurement value	
OS	Oscillation detection (OSC)	1
LM	Limiter source (LMT)	2
OL	The measurement range is exceeded (Over Range)	3
DVH/DIH	The comparison operation result is HI.	4
DVG/DIG	The comparison operation result is GO.	
DVL/DIL	The comparison operation result is LO.	

- Fixed-point part and exponent part

  The fixed-point part and exponent part are determined by the source/measurement function, range and number of measurement digits.

Measurement function	Range	Fixed-point		Exponent value
		5 1/2-digit measurement (eight characters)	4 1/2-digit measurement (seven characters)	
Voltage	320 mV	± ddd.ddd	± ddd.dd	E - 3
	3.2 V	± d.ddddd	± d.dddd	E + 0
	32 V/20 V	± dd.dddd	± dd.ddd	E + 0
	110 V	± ddd.ddd	± ddd.dd	E + 0
Current	32 μA	± dd.dddd	± dd.ddd	E - 6
	320 μA	± ddd.ddd	± ddd.dd	E - 6
	3.2 mA	± d.ddddd	± d.dddd	E - 3
	32 mA	± dd.dddd	± dd.ddd	E - 3
	320 mA	± ddd.ddd	± ddd.dd	E - 3
	2 A/3.2 A	± d.ddddd	± d.dddd	E + 0
	10 A	± dd.dddd	± dd.ddd	E + 0
Over range		+999.999	+999.99	E + 9

- String delimiter

  A string delimiter is output to set off sets of data.
  The string delimiter can be specified by commands.

String delimiter	Setting command	Default
"," Comma	SL0	○
" " Space	SL1	
CR LF	SL2	

- Block delimiter

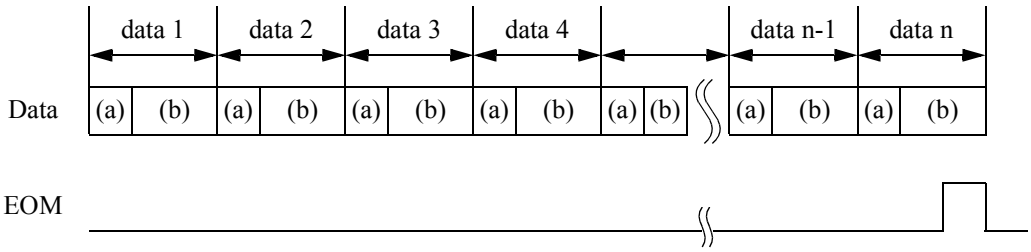
  A block delimiter is output to indicate the end of one set of data.
  The block delimiter can be specified by commands.

Block delimiter	Setting command	Default
CR LF + EOI	DL0	○
LF	DL1	
EOI	DL2	

Output after recall of the last data in the buffer at the time the talker is specified by the controller

(3) Measurement buffer output format (Binary)

When measurement buffer store is turned ON by OM5 and binary data output is subsequently specified by OM2, measurement data is output in the following binary format.



(a) Header (Flag + V/I + Range code)

(b) Data

- Data structure

	D7	D6	D5	D4	D3	D2	D1	D0
Header	Flag			V/I	Range code			

- Flag

D7	D6	D5	Description
0	0	0	Current or voltage measurement data
0	0	1	Data when the comparison operation result is GO
0	1	0	Data when the comparison operation result is LO
0	1	1	Data when the comparison operation result is HI
1	0	0	Data when the limiter (LMT) performs.
1	0	1	Data output when an oscillation is detected (OSC)
1	1	0	Over range data

- V/I: V/I = 0; Indicates the current measurement data
  V/I = 1; Indicates the voltage measurement data

- Range code

V/I	Range code				Measurement data	Range
D4	D3	D2	D1	D0		
1	0	1	0	0	Voltage	320 mV
	0	1	0	1		3.2 V
	0	1	1	0		32 V/20 V
	0	1	1	1		110 V
0	0	0	1	1	Current	32 μA
	0	1	0	0		320 μA
	0	1	0	1		3.2 mA
	0	1	1	0		32 mA
	0	1	1	1		320 mA
	1	0	0	0		2 A/3.2 A
	1	0	0	1		10 A

- Data
  - Complement-on-two data
  - Depending on the Resolution setting, the byte length changes as follows:

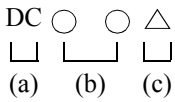
Resolution	Byte	Bit	Data range	Default
4-1/2 digits	2 Byte	b15 to b0	-32000 to +32000	○
5-1/2 digits	3 Byte	b23 to b0	-320000 to +320000	

  - Examples of data when Resolution is 4-1/2 digits

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Data
0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	+32000
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	+1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1
1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	-32000

(4) Measurement data number output

When measurement data number output is specified by OM3, the measurement data number is output in the following format.



(a) Header (ON/OFF possible by S5/S4 command)

(b) Data number

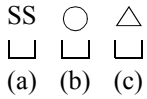
(c) Block delimiter

- Data number (16-bit binary data output in the order from high order to low order)

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0	Decimal number	The number of data
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0, 0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0, 1	1
0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	11, 128	2944
0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	1	19, 135	4999

(5) Operation status

When operation status output is specified by OM4, the operation status is output in the following format.



(a) Header (ON/OFF possible by S5/S4 command)

(b) Data number

(c) Block delimiter

• Data number (8-bit binary data output)

bit	Decimal number	Condition to be set	Condition to be cleared
b7	128	Limiter detection (LMT)	Clearing the limiter
b6	64	Oscillation detection (OSC)	Clearing the oscillation detection
b5	32	Overheating detection (OVH)	When the operation starts.
b4	16	Overload detection (OVL)	When the operation starts.
b3	8	None	None
b2	4	None	None
b1	2	During sweep	Sweep stop
b0	1	Operating status	Standby

6.4.3 Status Byte in TR6143 Mode

The status byte in the TR6143 Mode can be switched between Level 0 and Level 1 by the S2/S3 command. Table 6-6 shows the meaning of each bit in the Status Byte Register for Level 0 and Level 1, respectively.

Table 6-6 Status Bytes in the TR6143 Mode

bit	Function definition		Description	
	Level 0 (S2)	Level 1 (S3)	Level 0 (S2)	Level 1 (S3)
7	OPERATE OFF		ON: When an external operation off signal input is detected, bit 7 is set to 1. OFF: When the status byte is read out with the serial poll, bit 7 is set to 0.	
6	SRQ		ON: Status byte bits 0 to 7, which are not masked using the MS command, are set to 1. Accordingly, bit 6 is set to 1. If the service request is set to ON at this point, SRQ is sent. OFF: When the status byte is read out with the serial poll, bit 6 is set to 0.	
5	TRIGGER IN		ON: When the external trigger signal input is detected, bit 5 is set to 1. OFF: When the status byte is read out with the serial poll, bit 5 is set to 0.	
4	Not used.		Always 0.	
3	SWEEP END	BUFFER FULL	ON: When the sweep repeats once, bit 3 is set to 1 when the sweep is completed. OFF: When the sweep starts, the source mode is changed, and the status byte is read out with the serial poll, bit 3 is set to 0.	ON: When the measurement buffer memory is full, bit 3 is set to 1. OFF: While the measurement buffer memory is unfilled, bit 3 is 0.
2	RECEIVE READY	MEASURE END	ON: When the command is ready to be received, bit 2 is set to 1. OFF: When the command is received and the status byte is read out with the serial poll, bit 2 is set to 0.	ON: When the measurement is completed, bit 2 is set to 1. OFF: When the measurement starts and measurement data is read out, bit 2 is set to 0.
1	SYNTAX ERROR		ON: Bit 1 is set to 1 when: An unknown remote command is received. A remote command syntax error occurs. A remote command argument error occurs. and A remote command execution error occurs. OFF: When correct remote command are received up to the block delimiter, bit 1 is set to 0.	
0	LMT/OSC		ON: When the limiter and oscillation are detected, bit 0 is set to 1. OFF: When the limiter detection status and oscillation detection status are cleared, bit 0 is set to 0.	

- The Status Byte Register is cleared by the C command and when the power is turned OFF and ON.

7. PERFORMANCE TESTS

This chapter describes the operations used for checking whether the 6243/44 can perform correctly within the accuracy ranges specified.

7.1 6243 Tests

7.1.1 Measuring Instruments Required for Performance Tests

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

7.1.2 Connections

The connections required for the performance tests are the same as those shown in "Figure 8-1 Connections for Calibration."

7.1.3 Test Methods

Execute the performance tests under the following conditions in a location free of dust, vibrations, noise, etc.

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

Set the ***Line Frequency*** to 50 Hz or 60 Hz to match the line frequency.

(1) Self test, display, buttons, buzzer, external single-wire signal test

1. Press the **MENU** button and select ***SYSTEM*** in the parameter group. Then execute ***Self Test, Disp.Buz.Key.Test, Ext.Signal Test****.

NOTE: ***Perform the Ext.Signal Test with INTERLOCK and COMPLETE OUT connected, and with SYNC OUT and TRIGGER IN connected on the rear panel.***

NOTE: ***If the outcome of this test is Fail, confirm the contents of the error by referring to "A.2 Error Message List."***

(2) Voltage source measurement test

1. Connect the 6243 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 at 10 PLC or longer.
3. Set the 6243 to the DC source mode, free-run, and the integration time at 10 PLC or longer.
4. Select voltage source voltage measurement and Operate.
5. With ±ZERO and ±F.S generated in the 320 mV range to 110 V range, verify that the difference between the source set value and the DMM measured value and the difference between the 6243 measured value and the DMM measured value are within the accuracy described in Section 9.1, "6243 Specifications."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6243/44 as outlined in Section 8.1, "6243 Calibration" or contact an ADC CORPORATION sales representative for calibration or servicing.***

(3) Current source measurement test

1. Connect the 6243 and the DMM as shown in Figure 8-1 (b).
2. Set DMM to DCI, auto range, and the integration time at 10 PLC or longer.
3. Set the 6243 to DC source mode, free run, and the integration time at 10 PLC or longer.
4. Select current source current measurement and Operate.
5. With ±ZERO and ±F.S generated in the 30 μA range to 2 A range, verify that the difference between the source set value and the DMM measured value and the difference between the 6243 measured value and the DMM measured value are within the accuracy described in Section 9.1, "6243 Specifications."
   However, if 6581 is used as DMM, the ±F.S of the 2 A range should be ±1 A.

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6243/44 as outlined in Section 8.1, "6243 Calibration" or contact an ADC CORPORATION sales representative for calibration or servicing.***

7.2 6244 Tests

7.2.1 Measuring Instruments Required for Performance Tests

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

7.2.2 Connections

The connections required for the performance tests are the same as those indicated in “Figure 8-3 Connections for Calibration.”

7.2.3 Test Methods

Execute the performance test under the following conditions in a location free of dust, vibrations, noise, etc.

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

Set the ***Line Frequency*** to 50 Hz or 60 Hz to match the line frequency.

(1) Self test, display, buttons, buzzer, external single-wire signal test

1. Press the **MENU** button and select ***SYSTEM*** in the parameter group. Then execute ***Self Test, Disp.Buz.Key.Test,Ext.Signal Test****.

NOTE: ***Perform the Ext.Signal Test with INTERLOCK and COMPLETE OUT connected, and with SYNC OUT and TRIGGER IN connected on the rear panel.***

NOTE: ***If the outcome of this test is Fail, confirm the contents of the error by referring to “A.2 Error Message List.”***

(2) Voltage source measurement test

1. Connect the 6244 and the DMM as shown in Figure 8-3 (a).
2. Set the DMM to DCV, auto range, and the integration time at 10 PLC or longer.
3. Set the 6244 to DC source mode, free run, and the integration time at 10 PLC or longer.
4. Select voltage source voltage measurement and Operate.
5. With ±ZERO and ±F.S generated in the 320 mV range to 20 V range, verify that the difference between the source set value and the DMM measured value and the difference between the 6244 measured value and the DMM measured value are within the accuracy described in Section 9.2, "6244 Specifications."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6243/44 as outlined in Section 8.2, "6244 Calibration" or contact an ADC CORPORATION sales representative for calibration or servicing.***

(3) Current source measurement test (320 μA - 320 mA range)

1. Connect the 6244 and the DMM as shown in Figure 8-3 (b).
2. Set the DMM to DCI, auto range, and the integration time at 10 PLC or longer.
3. Set the 6244 to DC source mode, free run, and the integration time at 10 PLC or longer.
4. Select current source current measurement and Operate.
5. With ±ZERO and ±F.S generated in the 300 μA range to 320 mA range, verify that the difference between the source set value and the DMM measured value, and the difference between the 6244 measured value and the DMM measured value, are within the accuracy described in Section 9.2, "6244 Specifications."

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6243/44 as outlined in Section 8.2, "6244 Calibration" or contact an ADC CORPORATION sales representative for calibration or servicing.***

(4) Current source measurement test (3.2 A, 10 A range)

1. Connect the 6244, the DMM, and a 3.2 A standard resistor for calibration as shown in Figure 8-3 (c).
2. Set the DMM to DCV, auto range, and the integration time at 10 PLC or longer.
3. Set the 6244 to DC source mode, free run, and the integration time at 10 PLC or longer.
4. Select current source current measurement and Operate.
5. With ±ZERO and ±F.S generated in the 3.2 A range, verify that the difference between the source set value and the DMM measured value and the difference between the standard resistance value and the current conversion value are within the accuracy described in Section 9.2, “6244 Specifications.”
6. With the standard resistor replaced with a 10 A standard resistor for calibration and the current range set to the 10 A range, perform the verification in the same manner as in step 5.

NOTE: ***If the result of this test does not fall within the accuracy specifications, calibrate the 6243/44 as outlined in Section 8.2, “6244 Calibration” or contact an ADC CORPORATION sales representative for calibration or servicing.***

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8. CALIBRATION

This chapter explains how to calibrate the 6243/44 to ensure that the 6243/44 is used within the specified accuracy ranges.

In order to use the 6243/44 with the specified accuracy, periodic calibration at least once a year is recommended.

Contact an ADC CORPORATION sales representative for the calibration service.

8.1 6243 Calibration

8.1.1 Cables and Measuring Instruments Required for Calibration

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

Range	Zero		Full scale		Recommended instrument	Cable
	Calibration point	Required accuracy	Calibration point	Required accuracy		
320 mV 3.2 V 32 V 110 V	0 V	1.5 µV 5 µV 50 µV 500 µV	± 300 mV ± 3 V ± 30 V ± 100 V	15 ppm	6581*1	A01044 (Supplied accessories)*3
32 µA 320 µA 3.2 mA 32 mA 320 mA 2 A *2	0 A	50 pA 500 pA 5 nA 50 nA 500 nA 5 µA	± 30 µA ± 300 µA ± 3 mA ± 30 mA ± 300 mA ± 1 A	120 ppm 120 ppm 120 ppm 120 ppm 210 ppm 170 ppm		

*1: Use the 6581 under the following conditions.
Integration time: 20 PLC. Auto ZERO: ON. Within 24 hours following INT CAL.
*2: Use 1A for 2 A range full-scale calibration.
*3: When much externally induced noise exists, use shielded cables like A01001, etc.

8.1.2 Safety Precautions

(1) Use an AC power supply with the specified voltage.

(2) Set the ***Line Frequency*** to ***50 Hz*** or ***60 Hz*** to match the line frequency.

(3) Calibrate the 6243/44 under the following conditions in a location free of dust, vibrations, line noise, etc.

Temperature: 23°C ± 3°C

Relative humidity: 70% or lower

(4) Wait 2 hours or longer for warm-up to accurately calibrate the 6243/44.

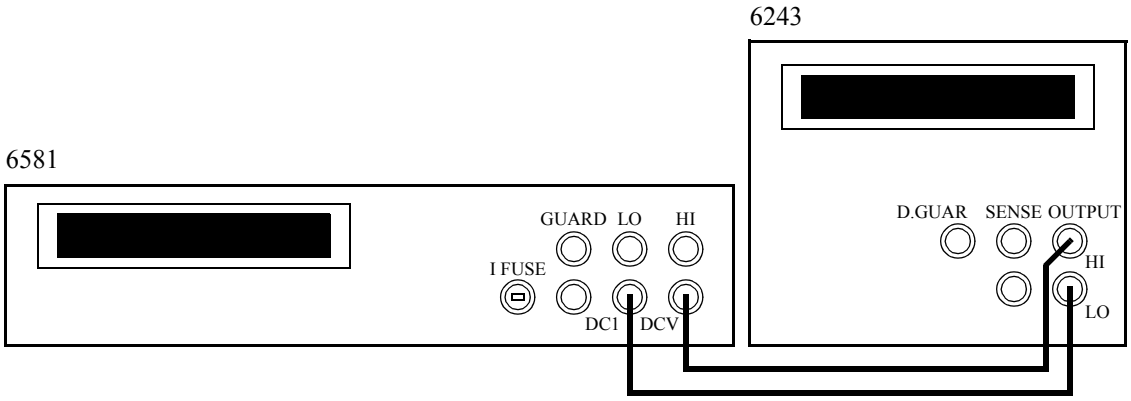
Allow the measuring instruments to be used for the calibration to warm up for the period of time specified for the instruments.

The 6581 requires a warm-up time of 4 hours or longer.

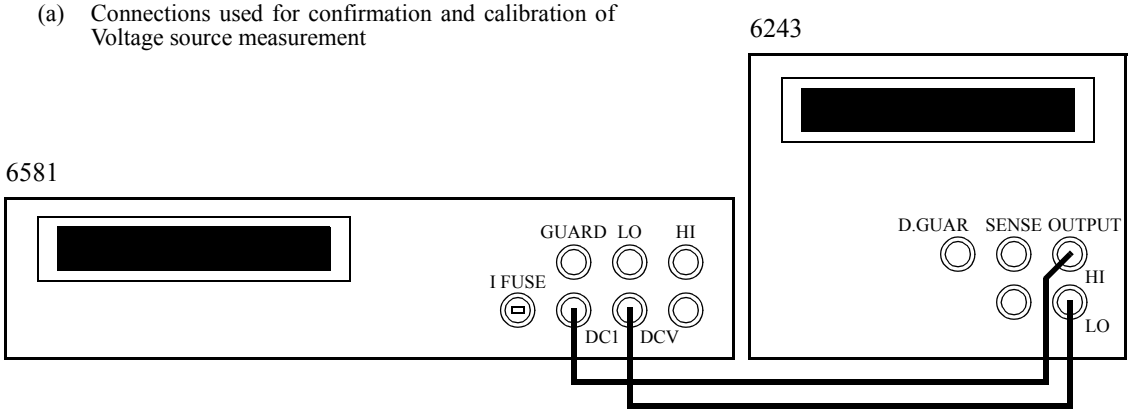
(5) Upon completion of warm-up, note down the date of the calibration and the date for the next scheduled calibration on a card or sticker, etc. for convenience.

8.1.3 Connections

Figure 8-1 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

8.1.4 Calibration Points and Tolerance Range

Calibrate the 6243/44 using measuring instruments satisfying the required accuracy outlined in Section 8.1.1, “Cables and Measuring Instruments Required for Calibration” meeting the tolerance ranges shown in the following table.

Range	Source calibration			Measurement calibration		
	Calibration point		Tolerance range	Calibration point		Tolerance range
	Zero	Full scale		Zero	Full scale	
320 mV 3.2 V 32 V 110 V	± 0 V	± 300 mV ± 3 V ± 30 V ± 100 V	10 µV 100 µV 1 mV 10 mV	0 V	300 mV 3 V 30 V 100 V	10 µV 20 µV 200 µV 2 mV
32 µA 320 µA 3.2 mA 32 mA 320 mA 2 (1 A)	± 0 A	± 30 µA ± 300 µA ± 3 mA ± 30 mA ± 300 mA ± 1 A	1 nA 10 nA 100 nA 1 µA 10 µA 100 µA	0 A	30 µA 300 µA 3 mA 30 mA 300 mA 1 A	500 pA 5 nA 50 nA 500 nA 5 µA 30 µA

8.1.5 Calibration Procedure

Figure 8-2 shows an overview of the calibration procedure.

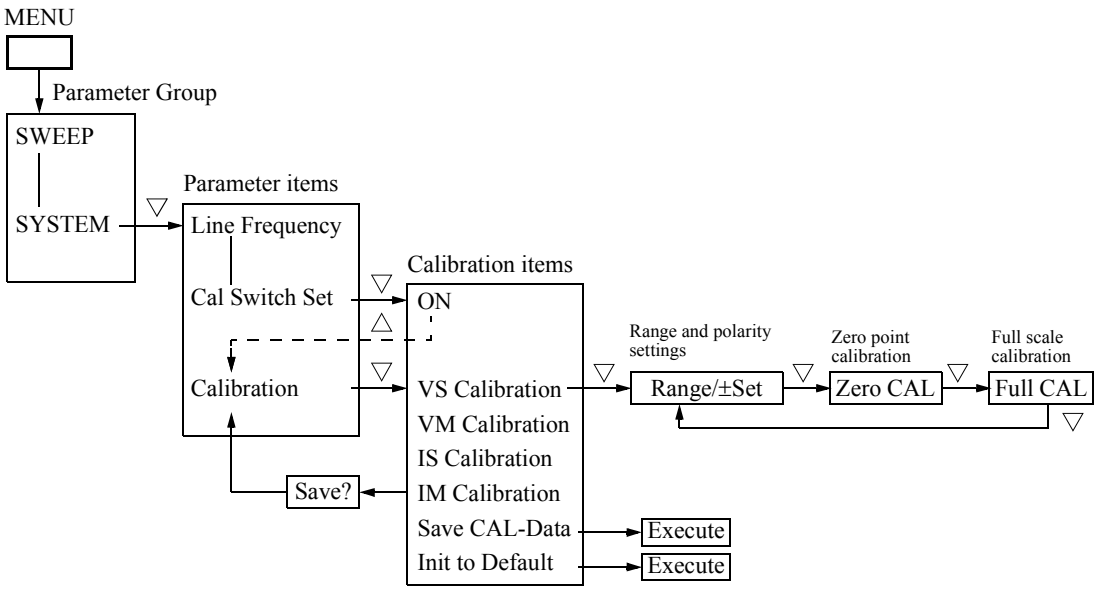


Figure 8-2 Overview of the Calibration Procedure

(1) Calibration of voltage source and current source

Calibration of voltage source is explained.

Calibration of voltage source is performed with the connections shown in Figure 8-1 (a) and the DC Voltage function and auto range are used for the DMM measurement function.

Calibration of current source is performed in the same way as calibration of voltage source.

But the connections are made as shown in Figure 8-1 (b) and the DC current function and auto range are used for the DMM measurement function.

1. Press the **MENU** button and select ***SYSTEM*** in the parameter group and select the ***Cal Switch Set*** parameter to set it to ***ON***.

   When ***Cal Switch Set*** is set to ***ON***, ***Calibration*** is added to the ***SYSTEM*** parameters.

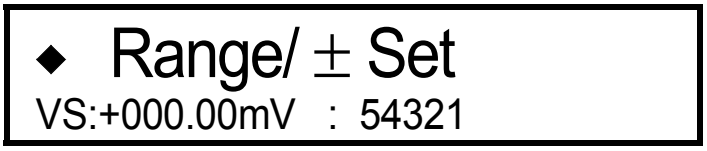
2. Press the △ button to select ***Calibration*** on the parameter selection screen.

3. Press the ▽ button.

   The calibration mode is invoked, and the calibration item selection screen appears.

4. Press the ▽ button.

   The voltage source calibration mode is invoked, and the range/polarity setting screen appears.



5. Set the range and generation polarity by pressing the **RANGE** △ (**Up**) and ▽ (**Down**) buttons and the **POLARITY** **+** and **-** buttons.

6. Press the ▽ button.

   The generation zero calibration mode is invoked, and the zero calibration screen appears.

   The digit indicated by the cursor (blinking) shows how many counts the source value moves when the Data knob is rotated one click, as shown below.

Cursor number	Value generated by rotating the data knob incrementally	
	Range	
	110 V	Ranges other than 110 V
1	0.21363	0.53407
2	2.1363	5.3407
3	21.363	53.407
4	213.63	534.07
5	2136.3	5340.7

7. Rotate the Data knob to adjust so that the DMM measured value comes within the tolerance range shown in Section 8.1.4, “Calibration Points and Tolerance Range.”

   The calibration can be performed by moving the cursor with the ◁ and ▷ buttons and selecting the significance with one click-rotation of the Data knob at a time.

   For changing the source value using the Data knob, wait until the DMM measured value becomes stable.

8. Upon completion of zero calibration, press the ▽ button.

   The full calibration mode is invoked.

9. Calibrate so that the DMM measured value comes within the tolerance range shown in Section 8.1.4, “Calibration Points and Tolerance Range” in the same manner as for zero calibration.

10. Upon completion of full calibration, press the ▽ button.

    The range and polarity setting screen shown in Step 4 returns.

11. Press the **POLARITY -** button, and calibrate the minus source value using the procedures described in steps 6 to 11.

12. Calibrate the other ranges in the same manner by selecting the range and polarity on the setting screen in step 4, and perform the calibration by using the procedures described in steps 6 to 11.

13. Upon completion of voltage source calibration, press the △ button.

    The calibration item selection screen appears.

(2) Calibration of voltage measurement and current measurement

Calibration of voltage measurement is explained.

Calibration of voltage measurement is performed with the connections shown in Figure 8-1 (a) and the DCV function and auto range are used for the DMM measurement function.

Calibration of current measurement is performed in the same way as calibration of voltage measurement. However, the connections are made as shown in Figure 8-1 (b) and the DCI function and auto range are used for the DMM measurement function.

1. Select ***VM Calibration*** on the calibration item selection screen in the calibration mode and press the ▽ button.

   The voltage measurement calibration mode is invoked, and the range setting screen appears.

2. Set the range by pressing the **RANGE** ▽ (**Down**), △ (**Up**) buttons.

3. Press the ▽ button.

   The measurement zero calibration mode is invoked.

4. Enter the DMM measurement value using the numeric and unit buttons.

5. Press the **ENTER** button.

   Calibration is performed and the measured value appears.

6. Check that the difference between the 6243 measured value and the DMM measured value is within the tolerance range shown in Section 8.1.4, “Calibration Points and Tolerance Range.”

7. Upon completion of zero calibration, press the ▽ button.

   The full calibration mode is invoked.

8. Calibrate so that the difference between the 6243 measured value and the DMM measured value comes within the tolerance range shown in Section 8.1.4, “Calibration Points and Tolerance Range” in the same manner as for zero calibration.

9. Upon completion of full calibration, press the ▽ button.
   The range setting screen shown in step 1 returns.
10. Calibrate the other ranges in the same manner by selecting the range on the range setting screen in step 1, and perform the calibration by using the procedures described in steps 3 to 9.
11. Upon completion of voltage measurement calibration, press the △ button.
    The calibration item selection screen appears.

(3) Saving calibration data

NOTE: ***Upon completion of calibration, be sure to store the calibration data in the nonvolatile memory. If the data is not saved following calibration, the source values and the measurement values prior to the calibration are valid.***

1. Select ***Save Cal-data*** on the calibration item selection screen in the calibration mode and press the ▽ button.

2. Press the **DIRECT** button.
   Upon saving of calibration data, “Done” appears.

(4) Exiting calibration

NOTE: ***Upon completion of calibration, be sure to set Cal Switch Set to OFF.***

1. Press the △ button on the calibration item selection screen.
   The following screen appears asking whether or not the data is to be saved.

2. To save the data, press the ***1*** button. - or -
   To exit without saving the data, press the ***0*** button.
   The standby status is invoked and the parameter selection screen appears.
3. Select the ***Cal Switch Set*** parameter and set it to ***OFF***.
4. Press the **EXIT** button.
   The normal measurement screen returns.

This completes calibration.

8.1.6 Initializing Calibration Data

Normally, the calibration data is not initialized unless the calibration values are abnormal for one reason or another.

NOTE: ***When calibration data is initialized and saved, the default calibration values are saved and the previous calibration data is lost.***
Be sure to recalibrate all the ranges in this case.

---

1. Select ***Init to Default*** on the Calibration Item Selection screen in the calibration mode and press the ▽ button.

2. Press the **DIRECT** button.
   Upon completion of calibration data initialization, “Done” appears.

8.2 6244 Calibration

8.2.1 Cables and Measuring Instruments Required for Calibration

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

Range	Zero		Full scale		Standard resistor	Recommended instrument	Cable
	Calibration point	Required accuracy	Calibration point	Required accuracy			
320 mV 3.2 V 20 V	0 V	1.5 µV 5 µV 50 µV	± 300 mV ± 3V ± 18 V	15 ppm	---	6581 *1	A01044 *2 (Supplied accessories)
320 µA 3.2 mA 32 mA 320 mA	0 A	500 pA 5 nA 50 nA 500 nA	± 300 µA ± 3 mA ± 30 mA ± 300 mA	120 ppm 120 ppm 120 ppm 210 ppm			
3.2 A	0 V (0 A) *3	1.5 µV	± 300 mV (± 3 A) *3	15 ppm	0.1 Ω 150 ppm		A01044 *2 (Supplied accessories) A01035 (Supplied accessories for 6581)
10 A		1.5 µV	± 90 mV (± 9 A) *3	25 ppm	0.01 Ω 150 ppm		

*1: Use the 6581 under the following conditions.
Integration time: 20 PLC. Auto ZERO: ON. Within 24 hours following INT CAL.
*2: When much externally induced noise exists, use a shielded cable like A01001, etc.
*3: The 3.2 A range and the 10 A range are calibrated with a standard resistor and voltage value conversion.

8.2.2 Safety Precautions

(1) Use an AC power supply with the specified voltage.

(2) Set the ***Line Frequency*** to ***50 Hz*** or ***60 Hz*** to match the line frequency.

(3) Calibrate the 6243/44 under the following conditions in a location free of dust, vibrations, line noise, etc.

Temperature: 23°C ± 3°C

Relative humidity: 70% or lower

(4) Wait for 2 hours or longer for warm-up to accurately calibrate the 6243/44.

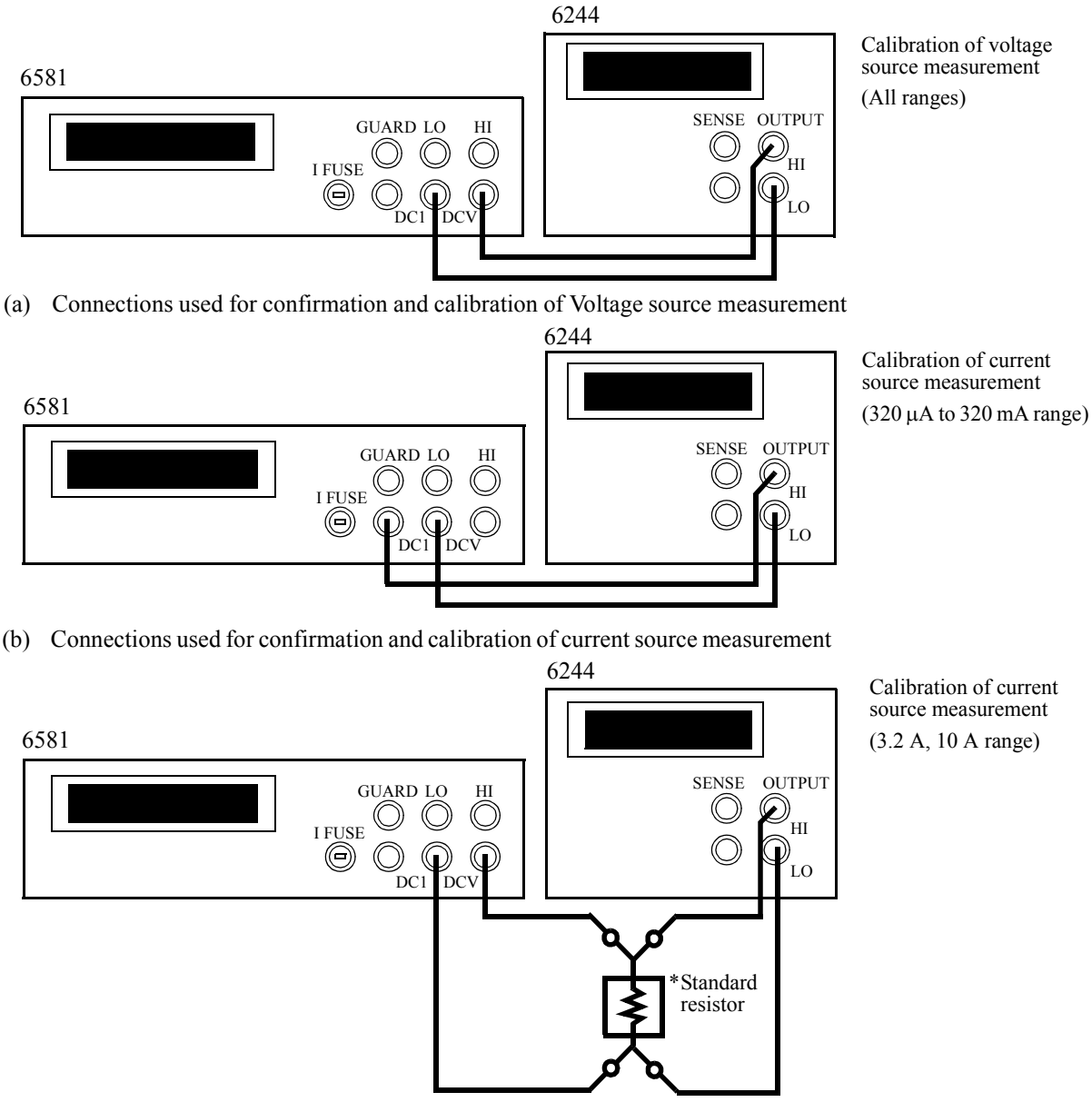
Allow the measuring instruments to be used for the calibration to warm up for the period of time specified for the instruments.

The 6581 requires a warm-up time of 4 hours or longer.

(5) Upon completion of warm-up, note down the date of the calibration and the date for the next scheduled calibration on a card or sticker, etc. for convenience.

8.2.3 Connections

Connections for Calibration shows the connections for calibration using the 6581 and a standard resistor.



(a) Connections used for confirmation and calibration of Voltage source measurement

(b) Connections used for confirmation and calibration of current source measurement

(c) Confirmation of current source measurement and connections for calibration

* Standard resistor value for 3.2 A range calibration: 0.1 Ω
10 A range calibration: 0.01 Ω

Figure 8-3 Connections for Calibration

8.2.4 Calibration Points and Tolerance Range

Calibrate the 6243/44 using measuring instruments satisfying the required accuracy outlined in Section 8.2.1, “Cables and Measuring Instruments Required for Calibration” meeting the tolerance ranges shown in the following table.

Range	Source calibration			Measurement calibration		
	Calibration point		Tolerance range	Calibration point		Tolerance range
	Zero	Full scale		Zero	Full scale	
320 mV 3.2 V 20 V	± 0 V	± 300 mV ± 3 V ± 18 V	10 µV 100 µV 1 mV	0 V	300 mV 3 V 18 V	10 µV 20 µV 200 µV
320 µA 3.2 mA 32 mA 320 mA 3 A 10 A	± 0 A	± 300 µA ± 3 mA ± 30 mA ± 300 mA ± 3 A ± 9 A	10 nA 100 nA 1 µA 10 µA 100 µA 1 mA	0 A	300 µA 3 mA 30 mA 300 mA 3 A 9 A	5 nA 50 nA 500 nA 5 µA 50 µA 500 µA

8.2.5 Calibration Procedure

Figure 8-4 shows an overview of the calibration procedure.

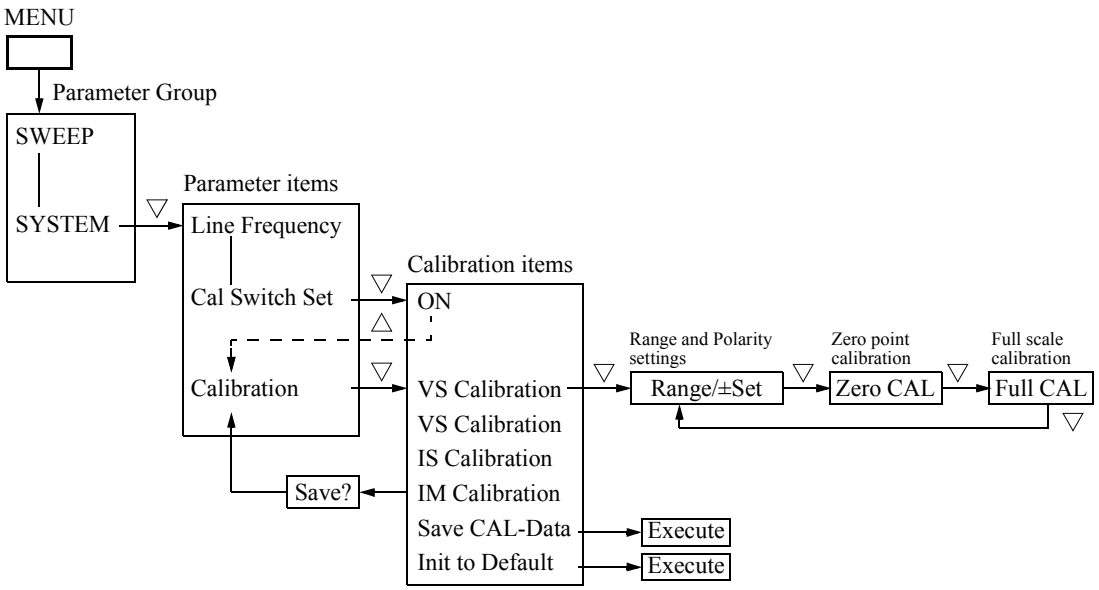


Figure 8-4 Overview of Calibration Procedure

(1) Calibration of voltage source and current source

Calibration of voltage source is explained.

Calibration of voltage source is performed with the connections shown in Figure 8-3 (a) and the DCV function and auto range are used for the DMM measurement function.

Calibration of current source in the 320 μA to 320 mA ranges is performed in the same way as calibration of voltage source. But the connections are made as shown in Figure 8-3 (b), and the DCI function and auto range are used for the DMM measurement function.

Calibration of current source in the 3.2 A and 10 A ranges is performed in the same way as calibration of voltage source. But the connections are made as shown in Figure 8-3 (c), and the DCV function and auto range are used for the DMM measurement function. The tolerance range is calculated by the following formula.

Tolerance value [A] = DMM measured value [V]/Standard resistor value [Ω]

1. Press the **MENU** button and select ***SYSTEM*** in the parameter group and select the ***Cal Switch Set*** parameter to set it to ***ON***.

   When ***Cal Switch Set*** is set to ***ON***, ***Calibration*** is added to the ***SYSTEM*** parameters.

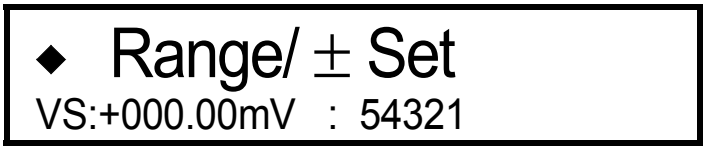
2. Press the △ button to select ***Calibration*** on the parameter selection screen.

3. Press the ▽ button.

   The calibration mode is invoked, and the calibration item selection screen appears.

4. Press the ▽ button.

   The voltage source calibration mode is invoked, and the range/polarity setting screen appears.



5. Set the range and generation polarity by pressing the **RANGE** △ (**Up**) and ▽ (**Down**) buttons and the **POLARITY** + and - buttons.

6. Press the ▽ button.

   The generation zero calibration mode is invoked, and the zero calibration screen appears.

   The digit indicated by the cursor (blinking) shows how many counts the source value moves when the Data knob is rotated one click, as shown below.

Cursor number	Value generated by rotating the data knob incrementally
	All functions / All ranges
1	0.53407
2	5.3407
3	53.407
4	534.07
5	5340.7

7. Rotate the Data knob to adjust so that the DMM measured value comes within the tolerance range shown in Section 8.2.4, “Calibration Points and Tolerance Range.”

   The alignment is performed by moving the cursor with and ◁ and ▷ buttons and selecting the significance with one click-rotation of the Data knob at a time.

   To modify the source value by rotating the Data knob, wait until the DMM measured value becomes stable.

8. Upon zero calibration completion, press the ▽ button.

   The full calibration mode is invoked.

9. Calibrate so that the DMM measured value comes within the tolerance range shown in Section 8.2.4, “Calibration Points and Tolerance Range” in the same manner as for zero calibration.

10. Upon completion of full calibration, press the ▽ button.

    The range and polarity setting screen shown in step 4 returns.

11. Press the **POLARITY -** button, and calibrate the minus source value using the procedures described in steps 6 to 11.
12. Calibrate the other ranges in the same manner by selecting the range and polarity on the setting screen in step 4, and then calibrate using the procedures described in steps 6 to 11.
13. Upon completion of voltage source calibration, press the △ button.
    The calibration item selection screen appears.

(2) Calibration of voltage measurement and current measurement

Calibration of voltage measurement is explained.

Calibration of voltage measurement is performed with the connections shown in Figure 8-3 (a) and the DC voltage function and auto range are used for the DMM measurement function.

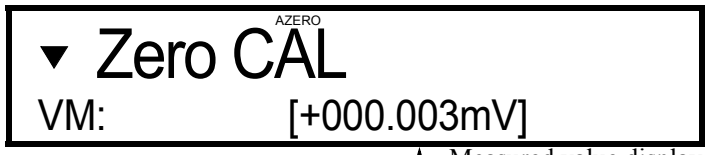
Calibration of current measurement in the 320 μA to 320 mA ranges is performed in the same way as calibration of voltage measurement. However, the connections are made as shown in Figure 8-3 (b), and the DC current function and auto range are used for the DMM measurement function.

Calibration of current measurement in the 3.2 A and 10 A ranges is performed in the same way as calibration of voltage measurement. However, the connections are made as shown in Figure 8-3 (c) and the DC voltage function and auto range are used for the DMM measurement function. The input value is the one measured using the following formula.

Input value [A] = DMM measured value [V]/Standard resistor value [Ω]

1. Select ***VM Calibration*** on the calibration item selection screen in the calibration mode and press the ▽ button.
   The voltage measurement calibration mode is invoked, and the range setting screen appears.

2. Set the range by pressing the **RANGE** ▽ (**Down**), △ (**Up**) buttons.
3. Press the ▽ button.
   The measurement zero calibration mode is invoked.



4. Enter the DMM measurement value using the numeric and unit buttons.
5. Press the **ENTER** button.
   Calibration is performed and the measured value appears.

6. Check that the difference between the 6244 measured value and the DMM measured value is within the tolerance range shown in Section 8.2.4, “Calibration Points and Tolerance Range.”

7. Upon completion of zero point calibration, press the ▽ button.

   The full calibration mode is invoked.

8. Calibrate so that the difference between the 6244 measured value and the DMM measured value comes within the tolerance range shown in Section 8.2.4, “Calibration Points and Tolerance Range” in the same manner as for zero calibration.

9. Upon completion of full calibration, press the ▽ button.

   The range setting screen shown in step 1 returns.

10. Calibrate the other ranges in the same manner by selecting the range on the range setting screen in step 1, and perform the calibration by using the procedures described in steps 3 to 9.

11. Upon completion of the voltage measurement calibration, press the △ button.

    The calibration item selection screen appears.

(3) Saving calibration data

NOTE: ***Upon completion of calibration, be sure to store the calibration data in the nonvolatile memory. If the data is not saved following calibration, the source values and the measurement values prior to the calibration are valid.***

---

1. Select ***Save Cal-data*** on the calibration item selection screen in the calibration mode and press the ▽ button.

2. Press the **DIRECT** button.

   Upon saving of calibration data, “Done” appears.

(4) Exiting calibration

NOTE: ***Upon completion of calibration, be sure to set Cal Switch Set to OFF.***

1. Press the △ button on the calibration item selection screen.
   The following screen appears asking whether or not the data is to be saved.

2. To save the data, press the ***1*** button. - or -
   To exit without saving the data, press the ***0*** button.
   The standby status is invoked and the parameter selection screen appears.
3. Select the ***Cal Switch Set*** parameter and set it to ***OFF***.
4. Press the **EXIT** button.
   The normal measurement screen returns.

This completes calibration.

8.2.6 Initializing Calibration Data

Normally, the calibration data is not initialized unless the calibration values are initialized.

NOTE: ***When the calibration data is initialized and saved, the default calibration values are saved and the previous calibration data are lost.***
Be sure to recalibrate all the ranges in this case.

1. Select ***Init to Default*** on the Calibration Item Selection screen in the calibration mode and press the ▽ button.

2. Press the **DIRECT** button.
   Upon completion of calibration data initialization, "Done" appears.

9. SPECIFICATIONS

This chapter describes the specifications of 6243/44.

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

9.1 6243 Specifications

9.1.1 Voltage/Current Source

Source range:

	Range	Source Range	Resolution
Voltage Source	320 mV 3.2 V 32 V 110 V	0 to ± 320.00 mV 0 to ± 3.2000 V 0 to ± 32.000 V 0 to ± 110.00 V	10 μV 100 μV 1 mV 10 mV
Current source	32 μA 320 μA 3.2 mA 32 mA 320 mA 2 A	0 to ± 32.000 μA 0 to ± 320.00 μA 0 to ± 3.2000 mA 0 to ± 32.000 mA 0 to ± 320.00 mA 0 to ± 2000.0 mA	1 nA 10 nA 100 nA 1 μA 10 μA 100 μA

Voltage, current limiters (compliance) range:

	Range	Maximum setting range	Minimum setting range	Resolution
Voltage limiter	320 mV 3.2 V 32 V 110 V	320.00 mV 3.2000 V 32.000 V 110.00 V	3 mV 30 mV 300 mV 3 V	10 μV 100 μV 1 mV 10 mV
Current limiter	32 μA 320 μA 3.2 mA 32 mA 320 mA 2 A	32.000 μA 320.00 μA 3.2000 mA 32.000 mA 320.00 mA 2000.0 mA	300 nA 3 μA 30 μA 300 μA 3 mA 30 mA	1 nA 10 nA 100 nA 1 μA 10 μA 100 μA

Overall accuracy: Including calibration accuracy, 1-day stability, temperature coefficients, and linearity

Voltage source / Voltage limiter	Range	Overall accuracy ± (% of setting + V)
	320 mV	0.03 + 200 μV
	3.2 V	0.03 + 600 μV
	32 V	0.03 + 6 mV
	110 V	0.03 + 30 mV
Current source / Current limiter	Range	Overall accuracy ± (% of setting + A + A × Vo/1 V)
	32 μA	0.03 + 10 nA + 300 pA
	320 μA	0.03 + 100 nA + 3 nA
	3.2 mA	0.03 + 1 μA + 30 nA
	32 mA	0.03 + 10 μA + 300 nA
	320 mA	0.05 + 100 μA + 3 μA
	2 A	0.06 + 1 mA + 30 μA

Vo: Compliance voltage (0 V to ±110 V)

1-day stability: Constant source and load

Voltage source / Voltage limiter	Range	Overall accuracy ± (% of setting + V)
	320 mV	0.01 + 100 μV
	3.2 V	0.01 + 300 μV
	32 V	0.01 +3 mV
	110 V	0.01 + 20 mV
Voltage source / Voltage limiter	Range	Overall accuracy ± (% of setting + A + A × Vo/1 V)
	32 μA	0.015 + 4 nA + 200 pA
	320 μA	0.015 + 40 nA + 2 nA
	3.2 mA	0.01 + 400 nA + 20 nA
	32 mA	0.01 + 4 μA + 200 nA
	320 mA	0.015 + 40 μA + 2 μA
	2 A	0.03 + 400 μA + 20 μA

Vo: Compliance voltage (0 V to ±110 V)

Temperature coefficients: At 0 to 50°C

Voltage source / Voltage limiter	Range	Temperature coefficient ± (ppm of setting + V)/°C
	320 mV	15 + 20 µV
	3.2 V	15 + 50 µV
	32 V	15 + 500 µV
	110 V	15 + 2 mV
Current source / Current limiter	Range	Temperature coefficient ± (ppm of setting + A + A × Vo/1 V)/°C
	32 µA	25 + 1 nA + 10 pA
	320 µA	25 + 10 nA + 100 pA
	3.2 mA	20 + 100 nA + 1 nA
	32 mA	20 + 1 µA + 10 nA
	320 mA	20 + 10 µA + 100 nA
	2 A	20 + 100 µA + 1 µA

Vo: Compliance voltage (0 V to ±110 V)

Overall accuracy of reverse polarity limiters:

The accuracy of the source value and reverse polarity limiters is obtained by adding the data in the following table to the overall limiter accuracy. (However, stability and temperature coefficients do not apply to the following table.)

Reverse polarity / Voltage limiter	Range	Temperature coefficient ± (ppm of setting + V)/°C
	320 mV	0.25 + 8 mV
	3.2 V	0.25 + 8 mV
	32 V	0.25 + 80 mV
	110 V	0.25 + 300 mV
Reverse polarity / Current limiter	Range	Temperature coefficient ± (ppm of setting + A + A × Vo/1 V)/°C
	32 µA	0.25 + 650 nA
	320 µA	0.25 + 6.5 µA
	3.2 mA	0.25 + 65 µA
	32 mA	0.25 + 650 µA
	320 mA	0.25 + 6.5 mA
	2 A	0.25 + 65 mA

Source linearity: ±0.01% of range

Maximum output current: ±2 A up to 32 V, ±1 A up to 64 V, ±0.5 A up to 110 V

Maximum tracking voltage: ±110 V up to 0.5 A, ±64 V up to 1 A, ±32 V up to 2 A

Output noise: At no load to the voltage source and at maximum load [Vp-p].
At load resistance to the current source as shown below [Ap-p].

	Range	Load resistor	Low-frequency noise		High-frequency noise
			DC to 100 Hz	DC to 10 kHz	DC to 20 MHz
Voltage source	320 mV 3.2 V 32 V 110 V	— — — —	60 µV 100 µV 1 mV 3 mV	300 µV 400 µV 3 mV 5 mV	5 mV 5 mV 6 mV 10 mV
Current source	32 µA 320 µA 3.2 mA 32 mA 320 mA 2 A	10 kΩ 10 kΩ 1 kΩ 1 kΩ 1 kΩ 100 Ω	10 nA 30 nA 200 nA 2 µA 20 µA 200 µA	60 nA 150 nA 2 µA 15 µA 100 µA 1 mA	500 nA 600 nA 6 µA 20 µA 150 µA 1.5 mA

Switching noise:

		Nominal	Load resistor
Source-ON / OFF noise	Voltage source Current source	600 mV 600 mV	100 kΩ
Range-switching noise	Voltage source Current source Voltage limiter Current limiter Voltage measurement Current measurement	50 mV 70 digits + 50 mV 50 mV (*2) 50 mV (*1) (*2) 50 mV (*2) 50 mV (*1) (*2)	— — — — — —
Polarity-switching noise	Voltage source Current source	50 mV 50 mV/RL	— RL
Power-OFF noise		600 mV	100 kΩ

*1: 80 mV when the voltage source range is the 110 V range.
*2: When the limiter is not in operation. Becomes the same as when the limiter operates.
RL: Load resistor value.

Settling time: The time to reach, from the start time, ±0.03% of the final value, by changing the output from zero to full scale. However, in the case of a purity load resistor, load capacity will be below 2.5 pF, source value, and the limiter setting will be at full scale.

	Range	Settling time
Voltage source	320 mV	300 μ or less
	3.2 V	
	32 V	700 μ or less
	110 V	2 m or less
Current source	32 μA	5 ms or less
	320 μA	3 ms or less
	3.2mA	
	32 mA	
	320 mA	
	2 A	

Line regulation: ±0.003% of range

Load regulation: Voltage source: Within ±0.003% of range at the maximum load with 4 Wire connection

Current source: Depends on CMV section (A × Vo/1 V) of overall accuracy.

Output resistance: 2 Wire connection excluding output cables

Maximum load capacity:

Maximum load capacity at which oscillation does not occur during voltage source or when the voltage limiter is operating.

Range	Output resistance		Maximum load capacity
	Voltage source	Current source	
32 μA	500 mΩ or lower	1×10^9 Ω or higher	1 μF
320 μA	100 mΩ or lower	1×10^9 Ω or higher	1 μF
3.2 mA	10 mΩ or lower	1×10^8 Ω or higher	100 μF
32 mA	10 mΩ or lower	1×10^7 Ω or higher	100 μF
320 mA	10 mΩ or lower	1×10^6 Ω or higher	2000 μF
2 A	10 mΩ or lower	1×10^5 Ω or higher	2000 μF

Resistance of standard accessory cable: 100 mΩ or lower

Maximum inductance: Maximum inductance at which oscillation does not occur during current source or when the current limiter is operating.

Current source range Current limiter range	Maximum inductance
32 μA	100 μH
320 μA	500 μH
3.2 mA to 2 A	1 mH

9.1.2 Voltage/Current Measurement

Measurement range:

	Range	Range	Resolution
Voltage measurement	320 mV 3.2 V 32 V 110 V	0 to ± 320.000 mV 0 to ± 3.20000 V 0 to ± 32.0000 V 0 to ± 110.000 V	1 μV 10 μV 100 μV 1 mV
Current measurement	32 μA 320 μA 3.2 mA 32 mA 320 mA 2 A	0 to ± 32.0000 μA 0 to ± 320.000 μA 0 to ± 3.20000 mA 0 to ± 32.0000 mA 0 to ± 320.000 mA 0 to ± 2000.00 mA	100 pA 1 nA 10 nA 100 nA 1 μA 10 μA

However, measurement resolution becomes as follows when the integration time is 500 μs or 1 ms.

Integral time	Resolution (digits)
500 μs	5
1 ms	3

Overall accuracy: Including calibration accuracy, 1-day stability, temperature coefficients, and linearity

Voltage measurement	Range	Overall accuracy ± (% of reading + V)
	320 mV 3.2 V 32 V 110 V	0.03 + 100 µV 0.03 + 150 µV 0.03 + 1 mV 0.03 + 8 mV
Current measurement	Range	Overall accuracy ± (% of reading + A + A × Vo/1 V)
	32 µA 320 µA 3.2 mA 32 mA 320 mA 2 A	0.03 + 8 nA + 300 pA 0.03 + 80 nA + 3 nA 0.03 + 800 nA + 30 nA 0.03 + 8 µA + 300 nA 0.05 + 80 µA + 3 µA 0.06 + 800 µA + 30 µA

Vo: Compliance voltage (0 V to ±110 V) (Auto Zero ON, integration time 1 to 100 PLC)

1-day stability: When the AC power and load are constant:

Voltage measurement	Range	Overall accuracy ± (% of reading + V)
	320 mV 3.2 V 32 V 110 V	0.008 + 50 µV 0.008 + 100 µV 0.008 + 500 µV 0.008 + 3 mV
Current measurement	Range	Overall accuracy ± (% of reading + A + A × Vo/1 V)
	32 µA 320 µA 3.2 mA 32 mA 320 mA 2 A	0.015 + 3.5 nA + 200 pA 0.015 + 35 nA + 2 nA 0.01 + 350 nA + 20 nA 0.01 + 3.5 µA + 200 nA 0.015 + 35 µA + 2 µA 0.03 + 350 µA + 20 µA

Vo: Compliance voltage (0 V to ±110 V) (Auto Zero ON, integration time 1 to 100 PLC)

The following errors are added to the accuracy and 1-day stability when the integration time is 10 ms to 500 µs.

Measurement range	Integration time(digits)		
	10 ms	1 ms	500 µs
320 mV	30	50	60
3.2 V to 110 V	6	12	15
32 µA	30	50	70
320 µA	15	25	30
3.2 mA to 2 A	10	15	20

Temperature coefficients: At 0 to 50°C

Voltage measurement	Range	Temperature coefficient ± (ppm of reading + V)/°C
	320 mV 3.2 V 32 V 110 V	15 + 8 µV 15 + 10 µV 15 + 50 µV 15 + 500 µV
Current measurement	Range	Temperature coefficient ± (ppm of reading + A + A × Vo/1 V)/°C
	32 µA 320 µA 3.2 mA 32 mA 320 mA 2 A	25 + 600 pA + 10 pA 25 + 6 nA + 100 pA 20 + 60 nA + 1 nA 20 + 600 nA + 10 nA 20 + 6 µA + 100 nA 20 + 60 µA + 1 µA

Vo: Compliance voltage (0 V to ±110 V) (Auto Zero ON, integration time 1 to 100 PLC)

Effective CMRR: Unbalanced impedance 1 kΩ
DC and AC 50/60 Hz ±0.08%

	Integration time	
	500 µs to 10 ms	1 PLC to 100 PLC
Voltage source / current measurement	60 dB	120 dB

NMRR: AC 50/60 Hz ±0.08%

	Integration time	
	500 µs to 10 ms	1 PLC to 100 PLC
Voltage source / current measurement	0 dB	60 dB

9.1.3 Source and Measurement Functions

DC source/measurement	:	Source/measurement of DC voltage/current
Pulse source/measurement	:	Source/measurement of pulse voltage/current Pulse LO value gets the same polarity as HI value.
DC sweep source/measurement	:	Source/measurement by Linear, log, and random
Pulse sweep source/measurement	:	Source/measurement by Linear, log, and random Pulse LO value gets the same polarity as HI value.
Sweep mode	:	Reverse ON (Round-trip) / OFF (One-way)
No. of sweep repeats	:	1 to 1000 times, infinite
Max. number of sweep steps	:	5000 steps
Max. memory for random sweep	:	5000 data items
Measurement data buffer memory	:	5000 data items
Calculation functions	:	NULL calculation Comparison calculation (HI/GO/LO)
Trigger method	:	Automatic trigger (DC free run/Pulse repeat) Source/measurement by external trigger
Output terminals	:	Front and rear; safety socket HI OUTPUT, HI SENSE, LO OUTPUT, LO SENSE, DRIVING GUARD
Max. source voltage between terminals	:	(HI - LO, DG - LO): 110 V peak MAX (OUTPUT - SENSE): 1 V peak MAX (HI - DG): 1 V peak MAX (LO - Case): 500 V peak MAX
Max. remote sensing voltage	:	±0.5 V MAX ; HI OUTPUT - HI SENSE, LO OUTPUT - LO SENSE (the voltage between HI SENSE - LO SENSE must be within the range of the maximum output voltage)
Voltage measurement input resistance	:	1 GΩ or higher
Voltage measurement input leakage current	:	±2 nA or lower
Max. guard offset voltage	:	±2 mV; between HI (SENSE) - DG
Max. allowable guard capacity	:	1000 pF; between HI (OUTPUT or SENSE) - DG
Max. allowable shield capacity	:	5000 pF; between DG - LO (OUTPUT or SENSE)
GPIB	:	Complies with IEEE-Std. 488-1978 Interface functions; SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Single-wire signals	:	TRIGGER IN SYNC OUT COMPLETE OUT/BUSY IN/BUSY OUT INTERLOCK/OPERATE IN/OPERATE OUT

9.1.4 Setting Time

Minimum pulse width: 1 ms

Minimum step (repeat) time: Source range fixed, free run or internal trigger mode, source delay time 10 µs

Measurement	Memory mode	Minimum step time
OFF	—	2 ms
ON	BURST	4 ms
	NORMAL	10 ms
	OFF	

Measurement range fixed, integration time 500 µs, and measure delay time 300 µs when measurement is ON.

Integration time: 500 µs/1 ms/10 ms/1 PLC/10 PLC/100 PLC

Source delay time:

Setting range	Resolution	Accuracy
10 µs to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Period (pulse cycle):

Setting range	Resolution	Accuracy
2 ms to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Pulse width:

Setting range	Resolution	Accuracy
1 ms to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Measure delay time:

Setting range	Resolution	Accuracy
300 µs to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Hold time:

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

Auto range delay time:

Setting range	Resolution	Accuracy
0 ms to 500 ms	1 ms	±(5% + 1 ms)

9.1.5 General Specifications

Operating environment conditions: Ambient temperature 0°C to 50°C.
Relative humidity: 85% or lower (with no condensation)

Storage environment conditions: Ambient temperature -25°C to +70°C.
Relative humidity: 85% or lower (with no condensation)

Warm-up: 60 minutes or longer (until the specified accuracy is reached)

Display: 5 × 7 dot matrix fluorescent character display tube

Power supply: AC power, 100 V, 120 V, 220 V, 240 V (user switchable)

Option No.	Standard	opt. 32	opt. 42	opt. 44
Power supply voltage	100 V	120 V	220 V	240 V

Line frequency: 50 Hz/60 Hz

Power consumption: 340 VA or less

External dimensions: Approximately 212 (W) × 177 (H) × 450 (D) mm

Mass: 15 kg or less

9.2 6244 Specifications

9.2.1 Voltage/Current Source

Source range: Max. output current ±10 A up to 7 V, ±4 A up to 20 V

	Range	Source range	Resolution
Voltage source	320 mV 3.2 V 20 V	0 to ± 320.00 mV 0 to ± 3.2000 V 0 to ± 20.000 V	10 µV 100 µV 1 mV
Current source	320 µA 3.2 mA 32 mA 320 mA 3.2 A 10 A	0 to ± 320.00 µA 0 to ± 3.2000 mA 0 to ± 32.000 mA 0 to ± 320.00 mA 0 to ± 3200.0 mA 0 to ± 10.000 A	10 nA 100 nA 1 µA 10 µA 100 µA 1 mA

Voltage, current limiter (compliance) range:

	Range	Maximum setting	Minimum setting	Resolution
Voltage limiter	320 mV 3.2 V 20 V	320.00 mV 3.2000 V 20.000 V	3 mV 30 mV 300 mV	10 µV 100 µV 1 mV
Current limiter	320 µA 3.2 mA 32 mA 320 mA 3.2 A 10 A	320.00 µA 3.2000 mA 32.000 mA 320.00 mA 3200.0 mA 10.000 A	3 µA 30 µA 300 µA 3 mA 30 mA 300 mA	10 nA 100 nA 1 µA 10 µA 100 µA 1 mA

Overall accuracy: Including calibration accuracy, 1-day stability, temperature coefficients, and linearity

Voltage source / Voltage limiter	Range	Overall accuracy ± (% of setting + V)
	320 mV	0.03 + 300 μV
	3.2 V	0.03 + 600 μV
	20 V	0.03 + 6 mA
Current source / Current limiter	Range	Overall accuracy ± (% of setting + A + A × Vo/1 V)
	320 μA	0.03 + 100 nA + 3 nA
	3.2 mA	0.03 + 1 μA + 30 nA
	32 mA	0.03 + 10 μA + 300 nA
	320 mA	0.05 + 100 μA + 3 μA
	3.2 A	0.06 + 1 mA + 30 μA
	10 A	0.1 + 10 mA + 300 μA

Vo: Compliance voltage (0 V to ±20 V)

1-day stability: When the AC power and load are constant:

Voltage source / Voltage limiter	Range	Overall accuracy ± (% of setting + V)
	320 mV	0.01 + 150 μV
	3.2 V	0.01 + 300 μV
	20 V	0.01 + 3 mV
Voltage source / Voltage limiter	Range	Overall accuracy ± (% of setting + A + A × Vo/1 V)
	320 μA	0.015 + 42 nA + 2 nA
	3.2 mA	0.01 + 420 nA + 20 nA
	32 mA	0.01 + 4.2 μA + 200 nA
	320 mA	0.015 + 42 μA + 2 μA
	3.2 A	0.03 + 420 μA + 20 μA
	10 A	0.08 + 4.2 mA + 200 μA

Vo: Compliance voltage (0 V to ±20 V)

Temperature coefficients: At 0 to 50°C

Voltage source / Voltage limiter	Range	Temperature coefficient ± (ppm of setting + V)/°C
	320 mV 3.2 V 20 V	15 + 30 µV 15 + 50 µV 15 + 500 µV
Current source / Current limiter	Range	Temperature coefficient ± (ppm of setting + A + A × Vo/1 V)/°C
	320 µA 3.2 mA 32 mA 320 mA 3.2 A 10 A	25 + 10 nA + 100 pA 20 + 100 nA + 1 nA 20 + 1 µA + 10 nA 20 + 10 µA + 100 nA 20 + 100 µA + 1 µA 90 + 1 mA + 10 µA

Vo: Compliance voltage (0 V to ±20 V)

Overall accuracy of reverse polarity limiters:

The accuracy of source value and reverse polarity limiters is obtained by adding the data in the following table to the overall limiter.
(However, stability and temperature coefficients do not apply to the following table.)

Reverse polarity / Voltage limiter	Range	Overall accuracy ± (% of setting + V)
	320 mV 3.2 V 20 V	0.25 + 8 mV 0.25 + 8 mV 0.25 + 80 mV
Reverse polarity / Current limiter	Range	Overall accuracy ± (% of setting + A)
	320 µA 3.2 mA 32 mA 320 mA 3.2 A 10 A	0.25 + 6.5 µA 0.25 + 65 µA 0.25 + 650 µA 0.25 + 6.5 mA 0.25 + 65 mA 0.25 + 650 mA

Source linearity: ±0.012% of range
However, the following errors are added for the 320 mA, 3.2 A, and 10 A ranges.

	Range	± (% of setting)
Current source	320 mV	0.01
	3.2 V	0.02
	10 V	0.07

Maximum output current: ±10 A up to 7 V, ±4 A up to 20 V

Maximum tracking voltage: ±20 V up to 4 A, ±7 V up to 10 A

Output noise: Voltage source is non-load and within maximum load [Vp-p].
Current source is at load resistance as shown below [Ap-p].

	Range	Load	Low-frequency noise		High-frequency noise
			DC to 100 Hz	DC to 10 kHz	DC to 20 MHz
Voltage source	320 mV 3.2 V 20 V	— — —	60 μV 100 μV 1 mV	300 μV 400 μV 3 mV	5 mV 5 mV 6 mV
Current source	320 μA 3.2 mA 32 mA 320 mA 3.2 A 10 A	10 kΩ 1 kΩ 1 kΩ 1 kΩ 100 Ω 10 Ω	30 nA 200 nA 2 μA 20 μA 200 μA 2 mA	150 nA 2 μA 15 μA 100 μA 1 mA 10 mA	600 nA 6 μA 20 μA 150 μA 1.5 mA 15 mA

Switching noise:

		Nominal	Load
Source-ON/OFF noise	Voltage source Current source	600 mV 600 mV	100 kΩ
Range-switching noise	Voltage source Current source Voltage limit Current limit Voltage measurement Current measurement	50 mV 70 digits + 50 mV 50 mV (*1) 50 mV (*1) 50 mV (*1) 50 mV (*1)	— — — — — —
Polarity-switching noise	Voltage source Current source	50 mV 50 mV/RL	— RL
Power-OFF noise		600 mV	100 kΩ

*1: When the limiter is not in operation. Becomes the same as source range switching noise when the limiter operates.
RL: Load resistor value.

Settling time; The time to reach, from the start time, ±0.03% of the final value, by changing the output from zero to full scale. However, in the case of a purity load resistor, load capacity will be below 2.5 pF, source value, and limiter setting will be at full scale.

	Range	Settling time
Voltage source	320 mV	300 μs or less
	3.2 V	
	20 V	700 μs or less
Current source	320 μA	3 ms or less
	3.2 mA	
	32 mA	
	320 mA	
	3.2 A	
	10 A	

Line regulation: ±0.003% of range

Load regulation: Voltage source: Within ±0.003% of range at the maximum load and with 4 Wire connection

Current source: Depends on CMV section (A × Vo/1 V) of over all accuracy.

Output resistance: 2 Wire connection excluding output cable

Maximum load capacity:

Maximum load capacity at which oscillation does not occur during voltage source or when the voltage limiter is operating.

Range	Output resistance		Maximum load capacity
	Voltage source	Current source	
320 μA	100 mΩ or lower	1×10^9 Ω or higher	1 μF
3.2 mA	10 mΩ or lower	1×10^8 Ω or higher	100 μF
32 mA	10 mΩ or lower	1×10^7 Ω or higher	100 μF
320 mA	10 mΩ or lower	1×10^6 Ω or higher	2000 μF
3.2 A	10 mΩ or lower	1×10^5 Ω or higher	2000 μF
10 A	10 mΩ or lower	1×10^4 Ω or higher	2000 μF

Resistance of standard accessory cable: 100 mΩ or lower

Maximum inductance: Maximum inductance at which oscillation does not occur during current source or when the current limiter is operating.

Current source range Current limiter range	Maximum inductance
320 μA	500 μH
3.2 mA to 10 A	1 mH

9.2.2 Voltage/Current Measurement

Measurement range:

	Range	Measurement range	Resolution
Voltage measurement	320 mV 3.2 V 20 V	0 to ±320.000 mV 0 to ±3.20000 V 0 to ±20.0000 V	1 μV 10 μV 100 μV
Current measurement	320 μA 3.2 mA 32 mA 320 mA 3.2 A 10 A	0 to ±320.000 μA 0 to ±3.20000 mA 0 to ±32.0000 mA 0 to ±320.000 mA 0 to ±3200.00 mA 0 to ±10.0000 A	1 nA 10 nA 100 nA 1 μV 10 μV 100 μV

However, when the integration time is 500 μs or 1 ms, measurement resolution becomes as follows.

Integration time	Resolution(digits)
500 μs	5
1 ms	3

Overall accuracy: Including calibration accuracy, 1-day stability, temperature coefficients, and linearity

Voltage measurement	Range	Overall accuracy ± (% of reading + V)
	320 mV 3.2 V 20 V	0.03 + 200 μV 0.03 + 200 μV 0.03 + 1 mV
Current measurement	Range	Overall accuracy ± (% of reading + A + A × Vo/1 V)
	320 μA 3.2 mA 32 mA 320 mA 3.2 A 10 A	0.03 + 80 nA + 3 nA 0.03 + 800 nA + 30 nA 0.03 + 8 μA + 300 nA 0.05 + 80 μA + 3 μA 0.06 + 800 μA + 30 μA 0.1 + 8 mA + 300 μA

Vo: Compliance voltage (0 V to ±20 V) (Auto Zero ON, integration time 1 to 100 PLC)

1-day stability: When the AC power and load are constant:

Voltage measurement	Range	Overall accuracy ± (% of reading + V)
	320 mV 3.2 V 20 V	0.008 + 100 µV 0.008 + 100 µV 0.008 + 500 µV
Current measurement	Range	Overall accuracy ± (% of reading + A + A × Vo/1 V)
	320 µA 3.2 mA 32 mA 320 mA 3.2 A 10 A	0.015 + 40 nA + 2 nA 0.01 + 400 nA + 20 nA 0.01 + 4 µA + 200 nA 0.015 + 40 µA + 2 µA 0.03 + 400 µA + 20 µA 0.08 + 4 mA + 200 µA

Vo: Compliance voltage (0 V to ±20 V) (Auto Zero ON, integration time 1 to 100 PLC)

The following errors are added to the accuracy and 1-day stability when the integration time is 10 ms to 500 µs.

	Range	Integration time (Unit: digits)		
		10 ms	1 ms	500 µs
Voltage measurement	320 mV	30	50	60
	3.2 V to 20 V	6	12	15
Current measurement	320 µA	15	25	30
	3.2 mA to 10 A	10	15	20

Temperature coefficients: At 0 to 50°C

Voltage measurement	Range	Temperature coefficient ± (ppm of reading + V)/°C
	320 mV 3.2 V 20 V	15 + 20 µV 15 + 20 µV 15 + 50 µV
Current measurement	Range	Temperature coefficient ± (ppm of reading + A + A × Vo/1 V)/°C
	320 µA 3.2 mA 32 mA 320 mA 3.2 A 10 A	25 + 8 nA + 100 pA 20 + 80 nA + 1 nA 20 + 800 nA + 10 nA 20 + 8 µA + 100 nA 20 + 80 µA + 1 µA 60 + 800 µA + 10 µA

Vo: Compliance voltage (0 V to ±20 V) (Auto Zero ON, integration time 1 to 100 PLC)

Effective CMRR: Unbalanced impedance 1 kΩ
DC and AC 50/60 Hz ±0.08%

	Integration time	
	500 μs to 10 ms	1 PLC to 100 PLC
Voltage measurement/ Current measurement	60 dB	120 dB

NMRR: AC 50/60 Hz ±0.08%

	Integration time	
	500 μs to 10 ms	1 PLC to 100 PLC
Voltage measurement/ Current measurement	0 dB	60 dB

9.2.3 Source and Measurement Functions

DC source/measurement	:	Source/measurement of DC voltage/current
Pulse source/measurement	:	Source/measurement of pulse voltage/current Pulse LO value gets the same polarity as HI value.
DC sweep source/measurement	:	Source/measurement by Linear, log, and random
Pulse sweep source/measurement	:	Source/measurement by Linear, log, and random Pulse LO value gets the same polarity as HI value.
Sweep mode	:	Reverse ON (Round-trip) / OFF (One-way)
No. of sweep repeats	:	1 to 1000 times, infinite
Max. number of sweep steps	:	5000 steps
Max. memory for random sweep	:	5000 data items
Measurement data buffer memory	:	5000 data items
Calculation functions	:	NULL calculation Comparison calculation (HI/GO/LO)
Trigger method	:	Automatic trigger (DC free run/Pulse repeat) Source/measurement by external trigger
Output terminals	:	Front; safety socket HI OUTPUT, HI SENSE, LO OUTPUT, LO SENSE
Max. source voltage between terminals	:	(HI - LO): 20 V peak MAX (OUTPUT - SENSE): 2 V peak MAX (LO - Case): 250 V peak MAX
Max. remote sensing voltage	:	±1 V MAX ; HI OUTPUT - HI SENSE, LO OUTPUT - LO SENSE (the voltage between HI SENSE - LO SENSE must be within the range of the maximum output voltage)
Voltage measurement input resistance	:	1 GΩ or higher
Voltage measurement input leakage current	:	±2 nA or lower
GPIB	:	Complies with IEEE-Std. 488-1978 Interface functions SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Single-wire signal	:	TRIGGER IN SYNC OUT COMPLETE OUT/BUSY IN/BUSY OUT INTERLOCK/OPERATE IN/OPERATE OUT

9.2.4 Setting Time

Minimum pulse width: 1 ms

Minimum step (repeat) time: Source range fixed, free run or internal trigger mode, source delay time 10 µs

Measurement	Memory mode	Minimum step time
OFF	—	2 ms
ON	BURST	4 ms
	NORMAL	10 ms
	OFF	

Measurement range fixed, integration time 500 µs, and measure delay time 300 µs when measurement is ON.

Integration time: 500 µs/1 ms/10 ms/1 PLC/10 PLC/100 PLC

Source delay time:

Range	Resolution	Accuracy
10 µs to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Period (pulse cycle):

Range	Resolution	Accuracy
2 ms to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Pulse width:

Range	Resolution	Accuracy
1 ms to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

9.2.4 Setting Time

Measuring-delay time:

Range	Resolution	Accuracy
300 µs to 600.00 ms	10 µs	±(0.1% + 30 µs)
600.1 ms to 6000.0 ms	100 µs	
6001 ms to 60000 ms	1 ms	

Hold time:

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

Auto range delay time:

Range	Resolution	Accuracy
0 ms to 500 ms	1 ms	±(5% + 1 ms)

9.2.5 General Specifications

Operating environment conditions: Ambient temperature 0°C to 50°C. Relative humidity: 85% or lower (with no condensation)
However, the operating temperature is 0°C to 40°C in the following output ranges:

When 0 V ≤ Vo ≤ 7 V: $Io \geq \frac{3}{7} Vo - 10$ [A]

When -7 V ≤ Vo ≤ 0 V: $Io \geq \frac{3}{7} Vo + 10$ [A]

Vo: Voltage between output terminals [V]
Io: Output current [A]

Storage environment conditions: Ambient temperature -25°C to +70°C. Relative humidity: 85% or lower (with no condensation)

Warm-up: 60 minutes or longer (until specified accuracy is reached)

Display: 5 × 7 dot matrix fluorescent character display tube

Power supply: AC power, 100 V, 120 V, 220 V, 240 V (user switchable)

Option No.	Standard	opt 32	opt 42	opt 44
Power supply voltage	100 V	120 V	220 V	240 V

Line frequency: 50 Hz/60 Hz

Power consumption: 400 VA or less

External dimensions: Approximately 212 (W) × 177 (H) × 500 (D) mm

Mass: 15 kg or lower

APPENDIX

A.1 When Problems Occur (Before Requesting Repairs)

If problems are encountered when using the 6243/44, inspect the 6243/44 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 6243/44 before requesting service.

Table A-1 Inspection Items Before Requesting Repairs (1 of 2)

Q (symptom)		A (causes and solutions)	
1	The display does not appear with the **POWER** switch set to ON.	Cause Solution	Power fuse is blown Replace with a specified type fuse.
2	The source set is not output.	Cause Solution	The Standby mode is set. Switch to the Operate mode and confirm with the front panel **LED**.
		Cause Solution	Remote sensing is not set correctly. Check the remote sensing setting with the front panel **LED**.
		Cause Solution	The source value is set to 0 V or 0 A. Check the source value.
		Cause Solution	A voltage over load (OVL) is detected putting the system in the Standby mode. Unplug the connection cable.
		Cause Solution	Over heating or a cooling fan failure put the system in standby condition. Unplug the connection cable and set the **POWER** switch to OFF. Set the **POWER** switch to ON again.
		Cause Solution	The limiter is operating. Check the limiter setting.
		Cause Solution	- The **OUTPUT** and **SENSE** terminal connections are reversed. - **SENSE** is not connected correctly in the 4-wired connection. Check the cable connection.
		Cause Solution	The interlock signal put the system in the Standby mode. - Set the interlock setting to **OPERATE IN**. - Set the interlock signal to LO.

Table A-1 Inspection Items Before Requesting Repairs (2 of 2)

Q (symptom)	A (causes and solutions)	
3 The measurement value is not output.	Cause Solution	The system is set in the Standby mode. Set to the Operate mode and confirm with the front panel **LED**.
	Cause Solution	Measurement not set to ON. Confirm the measurement ON/OFF condition.
	Cause Solution	When measuring in the auto range, the measurement value is unstable and measurement data cannot be output. Change to a fixed range and measure.
	Cause Solution	No trigger signal is input with an external trigger specified. - Check the TRIG INPUT connection cable and signal. - Check the trigger input setting.
4 The source value or measurement value is unstable or an irregular value is indicated.	Cause Solution	An error in function or range setting. Check the settings.
	Cause Solution	The 50 Hz or 60 Hz power supply frequency is set incorrectly. Set to a suitable frequency.
	Cause Solution	Incorrect cable connection. Check the cable connection.
	Cause Solution	A break in the cable. Check the cable and replace if necessary.
	Cause Solution	The cable is connected to an incorrect terminal. Check the cable connection.
	Cause Solution	No appropriate shield is made to measure or output the low current. Connect the cable according to the precautions for low-current measurement.
	Cause Solution	Measurement values are dispersed due to the inductive noise. Set the minimum integral time to 1 PLC or higher.
5 The measurement value exceeds the range.	Cause Solution	When a source value or limit value is set to full scale, the measurement value becomes over-ranged with an error value. Increase the source or limit range. Set source value and limit value to less than the full scale.

A.2 Error Message List

If an error occurs when using the 6243/44, an error number and an error message appear. These contents are explained in the following:

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

Category	Error No.	Display message	Description
Self-test	None	None (Buzzer sounds continuously when the power is turned on.)	Logic circuit problem.
	+291	Communication error	Communication error in the display unit.
	+292	D.P. Ram Read/Write	D.P.RAM error in the display unit
	+301	Rom Check Sum	Check sum test error in ROM.
	+302	Ram Read/Write	Read / write test error in RAM.
	+303	Logic-Panel Communication	Communication error between the logic and display units.
	+310	Logic-Analog Communication	Check sum test error in calibration data.
	+311	Cal Data Check Sum	Check sum error in parameter data.
	+312	Parameter Check Sum	Test error for the IR1 and IR2 AD operation comparison.
	+320	A/D Ratio IR1/IR2	Test error for the IR1 and IR2 AD operation comparison.
	+321	A/D Ratio IR2/IR3	Test error for the IR2 and IR3 AD operation comparison.
	+322	A/D Ratio IR3/IR4	Test error for the IR3 and IR4 AD operation comparison.
	+323	A/D 3.2 V ZERO	3.2 v ranging AMP ZERO test error.
	+324	A/D 320 mV ZERO	320 mV ranging AMP ZERO test error.
	+330	VSVM 320 mV +ZERO	VSVM 320 mV +ZERO test error.
	+331	VSVM 320 mV -ZERO	VSVM 320 mV -ZERO test error.
	+332	VSVM 320 mV +FS	VSVM 320 mV +FS test error.
	+333	VSVM 320 mV -FS	VSVM 320 mV -FS test error.
	+334	VSVM 3.2 V +ZERO	VSVM 3.2 V +ZERO test error.
	+335	VSVM 3.2 V -ZERO	VSVM 3.2 V -ZERO test error.
	+336	VSVM 3.2 V +FS	VSVM 3.2 V +FS test error.
	+337	VSVM 3.2 V -FS	VSVM 3.2 V -FS test error.
	+338	VSVM 32 V +ZERO	VSVM 32 V +ZERO test error (6243).
	+338	VSVM 20 V +ZERO	VSVM 20 V +ZERO test error (6244).
	+339	VSVM 32 V -ZERO	VSVM 32 V -ZERO test error (6243).
	+339	VSVM 20 V -ZERO	VSVM 20 V -ZERO test error (6244).
	+340	VSVM 32 V +FS	VSVM 32 V +FS test error (6243).
	+340	VSVM 20 V +FS	VSVM 20 V +FS test error (6244).
	+341	VSVM 32 V -FS	VSVM 32 V -FS test error (6243).
	+341	VSVM 20 V -FS	VSVM 20 V -FS test error (6244).
	+342	VSVM 110 V +ZERO	VSVM 110 V +ZERO test error.
	+343	VSVM 110 V -ZERO	VSVM 110 V -ZERO test error.
	+344	VSVM 110 V +FS	VSVM 110 V +FS test error.
	+345	VSVM 110 V -FS	VSVM 110 V -FS test error.

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

Category	Error No.	Display message	Description
Self-test	+350	IM 32 μA ZERO	261 IM 32 μA ZERO test error.
	+351	IM 320 μA ZERO	IM 32 μA ZERO test error.
	+352	IM 3.2 mA ZERO	IM 3.2 mA ZERO test error.
	+353	IM 32 mA ZERO	IM 32 mA ZERO test error.
	+354	IM 320 mA ZERO	IM 320 mA ZERO test error.
	+355	IM 2 A ZERO	IM 2 A ZERO test error (6243).
	+355	IM 3.2 A ZERO	IM 3.2 mA ZERO test error (6244)
	+356	IM CMV	IM CMV test error.
	+357	OVL Check	OVL detection check error
	+358	IM 10 A ZERO	IM 10 A ZERO test error
Hardware failure	+360	Fan Stop	Cooling fan failure
	+361	Over Heat	Internal circuit overheat
	+362	Source Unit	The source unit malfunctions
Execution error	+201	Calibration	Calibration error
	+210	Sweep Data>5000 (Linear)	The number of steps has exceeded 5000.
	+211	|Start|>|Stop| (Log)	In a log sweep, the starting value is greater than the stop value.
	+212	Start, Stop Polarity (Log)	In a log sweep, the starting and stopping polarities are different.
	+213	Power Over	Source limiter setting exceeds the output range.
	+214	Start, Stop =0 (Log)	In a log sweep, the staring or stopping value is 0.
	+215	Step =0 (Linear)	The step value for a linear sweep is 0.
	+216	Start ≒ 0 at FixRange (Log)	For a log sweep, the fix range starting value is 0.
Command error	+101	Command Execution	GPIB command execution error. GPIB argument range error.
	+102	Command Syntax	GPIB command syntax error An unrecognized command is received.
Source / measurement message	None	OSC/osc	Oscillation measurement / oscillations detected.
	None	± RP/± rp	Reversed polarity source measurement / reversed polarity source connections detected
	None	± LM/± lm	Limit measurement / Limiter detected
	None	Over Range	The measurement value has exceeded the range.
	None	Over Load	Over load
	None	HI	Comparative calculation result HI
	None	GO	Comparative calculation result GO
	None	LO	Comparative calculation result LO
External single line signal test	None	Failed 01,03,05,07,09,11,13,15	SYNC OUT or TRIGGER IN malfunction
	None	Failed 02,03,06,07,10,11,14,15	OPERATE OUT or BUSY IN malfunction
	None	Failed 04 to 07, 12 to 15	BUSY OUT or OPERATE IN malfunction
	None	Failed 08 to 15	COMPLETE OUT or OPERATE IN malfunction

A.3 Execution Time

A.3.1 GPIB Remote Execution Time (Nominal Values)

Computer: Fujitsu FMV-6266T6, Windows 95

GPIB hardware: AT-GPIB/TNT (PnP) manufactured by NATIONAL INSTRUMENTS

Used module: Niglobal.bas, Vbib-32.bas (supplied with AT-GPIB/TNT (PnP))

Applied language: Visual Basic 5

(1) Program code execution time

Time from the program code reception to the time when the next program code reception becomes ready.

Item		Program code	Condition		Execution time Unit: ms
Operate / Standby	Operate	E	Source mode: DC or Pulse		120
			Source mode: Sweep		310
	Standby	H			80
Source function		VF, IF	Source mode: DC or Pulse operation, and Hold mode	With a current range change	18
		V3 to V6, I-1 to I4		Without a current range change	38
Source range change		V3 to V6			12
		I-1 to I4			33
Voltage source / Voltage limiter*	Source value Limiter value Pulse value Base value Bias value	D<data>, DB<data>, SB<data> Without unit	Operate and HOLD mode	Without polarity change	11 to 17
				With polarity change	16 to 22
		D<data>unit, DB<data>unit, SB<data>unit With unit		Without polarity change	13 to 21
				With polarity change	17 to 26
				With range change	17 to 26

A.3.1 GPIB Remote Execution Time (Nominal Values)

Item		Program code	Condition		Execution time Unit: ms
Current source / Current limiter*	Source value Limiter value Pulse value Base value Bias value	D<data>, DB<data>, SB<data> Without unit		Without polarity change	13 to 21
				With polarity change	16 to 22
		D<data>unit, DB<data>unit, SB<data>unit With unit		Without polarity change	16 to 22
				With polarity change	17 to 26
				With range change	37 to 44
Measurement function		F0 to F2	Source mode: DC or Pulse operate and HOLD mode		8
Integral time		IT0			13
		IT1			14
		IT2			32
		IT3 (50 Hz/60 Hz)			52/45
		IT4 (50 Hz/60 Hz)			420/350
		IT5 (50 Hz/60 Hz)			420/350
Time parameter*	Th, Td, Tp, Tw	SP<data>, <data>, <data>, <data>			15 to 31
	Tds	SD<data>			9 to 14
Sweep type*	Linear	SN<data>unit	Standby mode		9 to 28
	Log	SG<data>unit			9 to 25
	Random	SC<data>			6 to 10
Source mode		MD0 to MD3			4
Random data setting*		N<adrs>, <data>, (unit> P			9 to 17

* The processing time for commands accompanied by <data> changes in accordance with the data length.

(2) Measurement execution time

Conditions: Source range: Fixed Range
Measurement range: Fixed. Trigger mode: External trigger.
Measurement digits: 5-1/2 digits.
Integration time: 500 µs. Measure delay: 0.3 ms. Source delay: 10 µs.
Period: 2 ms. Pulse width: 1 ms
Header: OFF. Block delimiter: EOI (DL2)

- Time from trigger input (*TRG) to measurement and data output completion to GPIB

Source value condition	Execution time
When the DC, Pulse or Sweep step value is generated:	18 ms
When the Sweep start value is generated:	23 ms

- Time from source command reception + trigger input (*TRG) to measurement and data output completion to GPIB
  DC, pulse source mode

Source	Command	Execution time
Voltage source	D<data> (Without unit, <data>: 1 character)	29 ms
	D<data>unit (With unit, <data>: 1 character)	31 ms
Current source	D<data> (Without unit, <data>: 1 character)	32 ms
	D<data>unit (With unit, <data>: 1 character)	35 ms

(3) Data read time

Item	No. of data	Execution time
Source value reading time by query	1	16 ms
Measurement buffer memory reading time after submitting the RN1 command Condition: Number of measurement digits: 5 1/2, header: OFF, Block delimiter: EOI(DL2)	1	10 ms
	100	710 ms

(4) Time from sweep start to data read

Time for data output completion from memory to GPIB by RN1 command for 100-step sweep

Conditions: Source range: Fixed Range
Measurement range: Fixed. Trigger mode: Internal trigger.
Measurement digits: 5-1/2 digits. Integration time: 500 µs.
Measure delay: 0.3 ms. Hold time: 3 ms. Source delay: 10 µs. Pulse width: 1 ms.
Header: OFF. Block delimiter: EOI (DL2)

Memory mode	Period	Execution time
Normal-ON	10 ms	1.7 s
Burst-ON	4 ms	1.3 s

A.3.2 Internal Execution Time (Nominal Values)

(1) Source execution time

Time from the external trigger input to the time when the source value (pulse value, base value, etc.) start changing

The time from source value change to settle is as shown in Section 4.9.2.

Conditions: Source range: Fixed Range
Measurement range: Fixed. Trigger mode: HOLD or external trigger.
Source delay: 10 μs

Source mode	Source value	Execution time
Pulse	Pulse value	17 μs
DC sweep	Start value	3.8 ms
	Step value	17 μs
Pulse sweep	Start value	3.8 ms
	Step value	17 μs

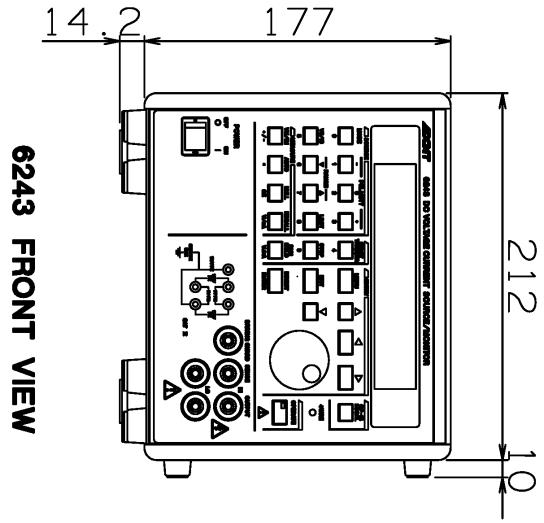
* The start value for pulse sweep indicates the time from trigger to base value source. (The time from base value source to start pulse source depends on Hold time.)

(2) Time from external trigger input to measurement and memory store

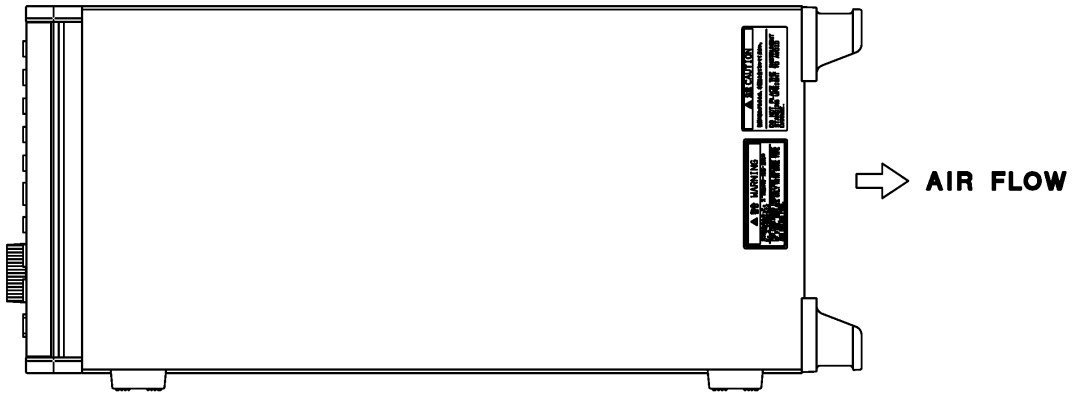
Memory mode	Execution time
Normal-ON	8 ms
Burst-ON	5 ms

(3) Switching execution time

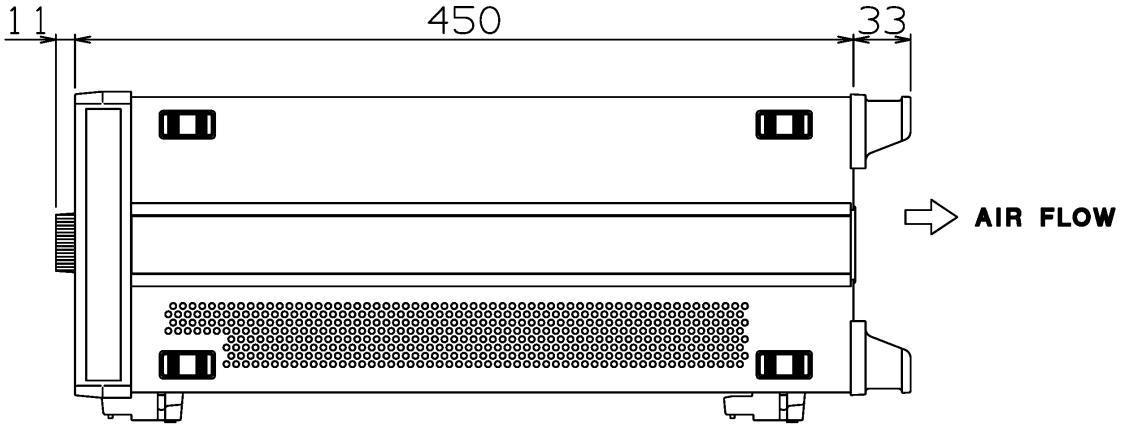
- Source function change time: 4.5 ms
- Source range change time
  Voltage source function: 3 ms
  Current source function: 22.5 ms
- Source polarity change time: 3 ms
- Measurement range change time
  Voltage measurement function: 2.5 ms
  Current measurement function: 22.5 ms
- Measurement auto range execution time
  Voltage measurement function: Integration time + 2.5 ms
  Current measurement function: Integration time + 22.5 ms



6243 FRONT VIEW



6243 TOP VIEW



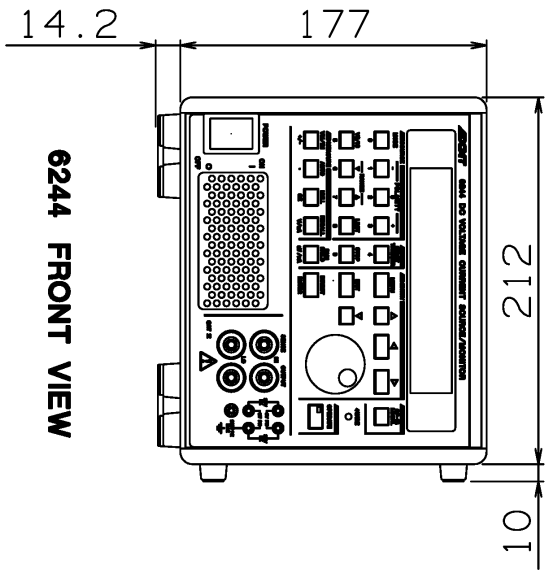
6243 RIGHT SIDE VIEW

Unit: mm

NOTE

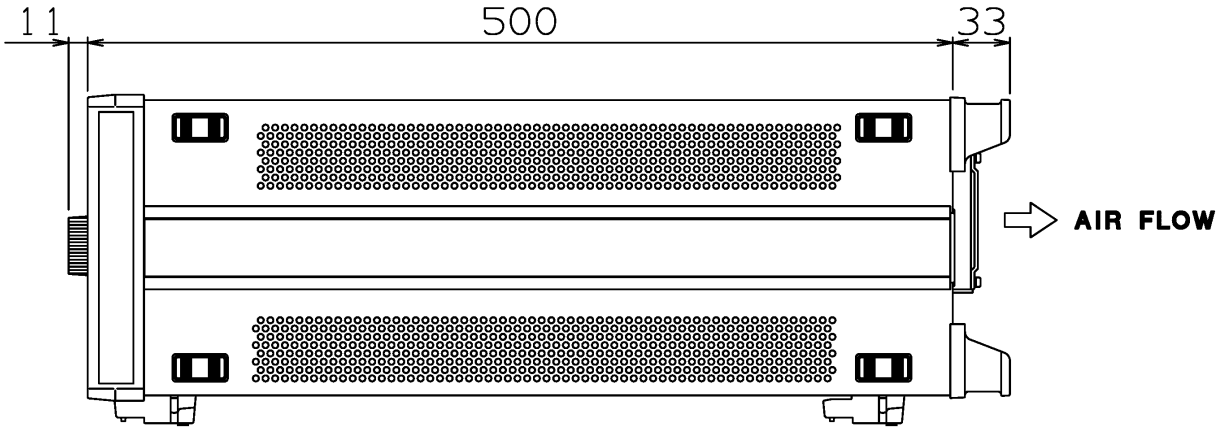
This drawing shows external dimensions of this instrument.
The difference in products and options used can cause a change in the appearance of the instrument.

6243 DIMENSIONAL OUTLINE DRAWING



6244 FRONT VIEW

6244 TOP VIEW



6244 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.

6244 DIMENSIONAL OUTLINE DRAWING

ALPHABETICAL INDEX

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

ADCMT® ADC CORPORATION

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