# *6253/6254*

# *DC Voltage Current Source/Monitor*

# *Operation Manual*

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*MANUAL NUMBER FOA-00000185A00*



*First printing April 1, 2023*
*Printed in Japan*

# Safety Summary

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

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

- **Warning Labels**

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

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

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

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

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

- **Basic Precautions**

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

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

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

- **Caution Symbols Used Within this Manual**

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

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

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

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

- **Safety Marks on the Product**

The following safety marks can be found on ADC products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

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

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

Main Parts with Limited Life

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

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.

- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations. An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.

- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

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

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

Example: fluorescent tubes, batterie

# Environmental Conditions

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

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

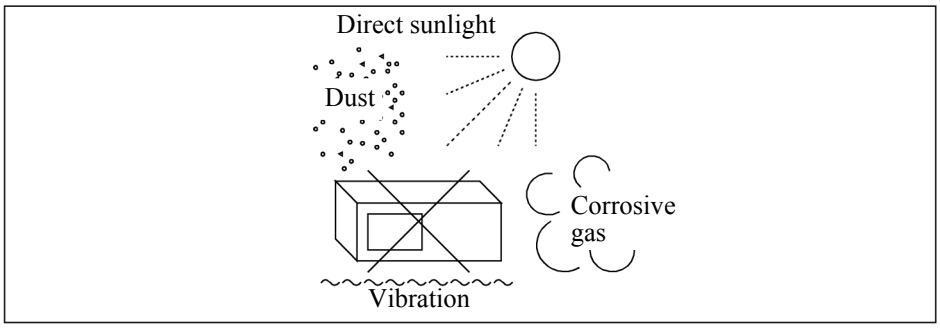



**Figure-1 Environmental Conditions**

- Operating position

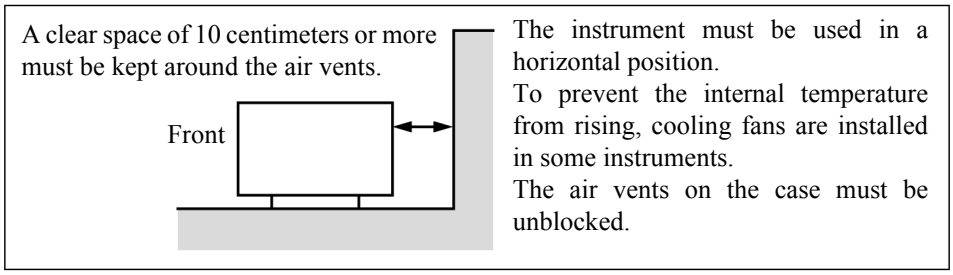



**Figure-2 Operating Position**

- Storage position

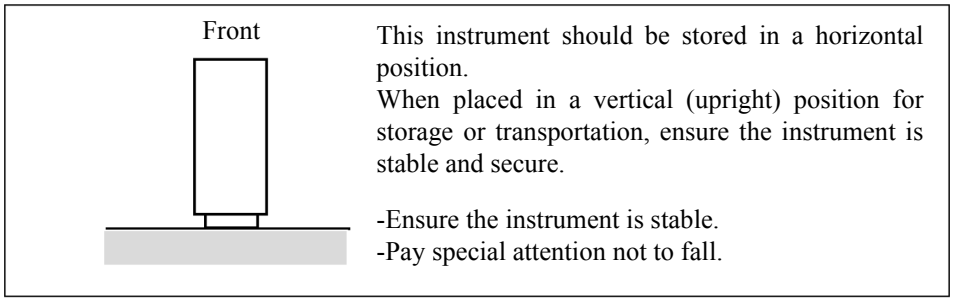



**Figure-3 Storage Position**

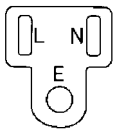
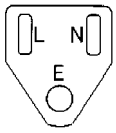
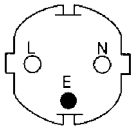
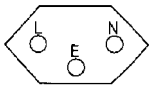
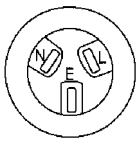
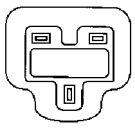
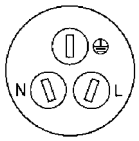
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

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

# Certificate of Conformity

CE

This is to certify, that

## DC Voltage Current Source/Monitor

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## 6253

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instrument, type, designation

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

Directive: Low Voltage Directive (LVD):2014/35/EC
Using the following Harmonized Standards
EN 61010-1:2010 (Ed3)
EN 61010-1:2010+AMD1:2016

Directive: RoHS Directive:2011/65/EC
Using the following Harmonized Standards
EN 50581:2012 and EN IEC 63000:2018


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6253.00

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LIST OF ILLUSTRATIONS

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# 1. PREFACE

This chapter describes the accessories, operating environment, precautions, and operating check for personnel who operate the 6253/6254. Read through this manual before using the 6253/6254.

## 1.1 Product Overview

The 6253/6254 is a DC Voltage Current Source/Monitor that offers high sensitivity with $5^1/_2$-digit source resolution and $6^1/_2$-digit measurement resolution, as well as various sweep functions and a pulse source function with a minimum pulse width of 25 μs. It can be widely used as power source for evaluating semiconductors and electronic components in research and development and as power source for characteristic evaluation systems.

The 6253/6254 characteristics are described below.

- Source and measurement
  6253: ±2 A at ±32 V
  ±1 A at ±64 V
  ±0.5 A at ±110 V
  6254: ±20 A at ±7 V
  ±7 A at ±20 V
  See Figure 1-1, “Output Range.”
- Voltage source/measurement range
  6253: 300 mV to 100 V
  6254: 300 mV to 20 V
- Current source/measurement range
  6253: 3 μA to 2 A
  6254: 300 μA to 20 A
- Display digits
  Source: $5^1/_2$ Measurement: $6^1/_2$
- Voltage resolution
  Source: 5 μV Measurement: 100 nV
- Current resolution
  6253: Source: 50 pA Measurement: 1 pA
  6254: Source: 5 nA Measurement: 100 pA
- Voltage source current measurement (VSIM)/Current source voltage measurement (ISVM)
- Voltage source voltage measurement (VSVM)/Current source current measurement (ISIM)
- Monitors source values of DC voltage or current.
  (Measured separately from the measurement function)
- Sink-enabled bipolar output
- Minimum pulse width
  25 μs
- Linear, fixed, random, multi-slope linear and log sweep functions for characteristic test
- Detection functions such as limit (compliance), oscillation, overload, and overheat
- Synchronized operation function by combining two or more 6253/6254 units
- USB and GPIB as standard and optionally LAN and RS232 available
- Improved operability with a color display and a numeric keypad

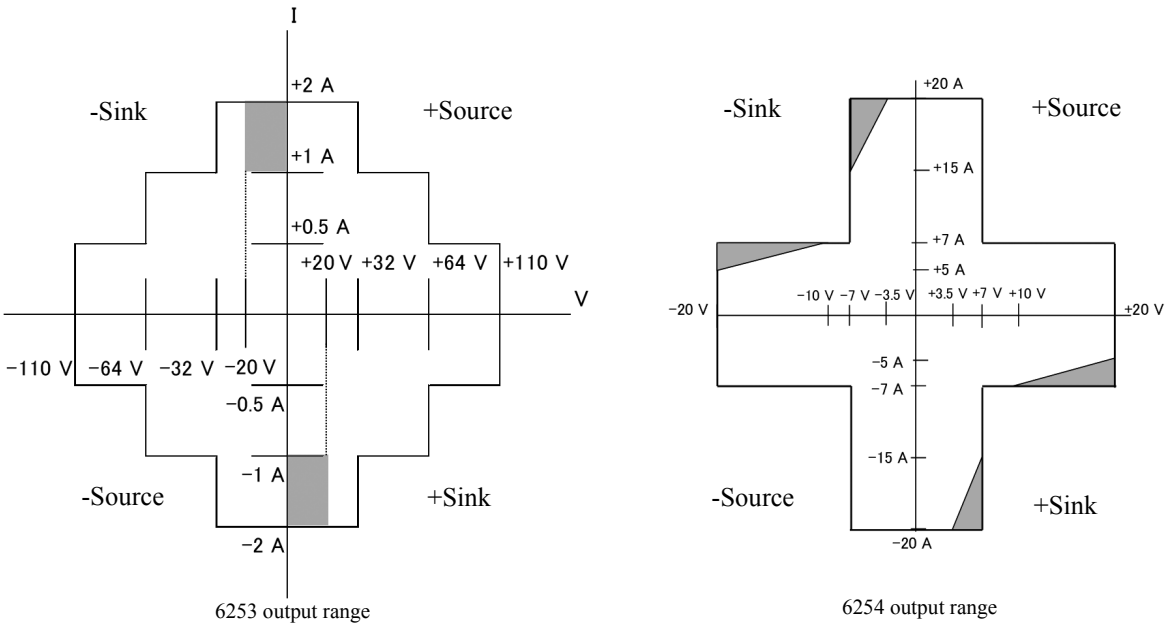


Figure 1-1 Output Range

The operating environment temperature in the shaded areas above is as follows:

6253 0 V to +20 V at -1 A to -2 A
or 0 V to -20 V at +1 A to +2 A: 0 to +35 °C

6254 100 W or more but 140 W or less: 0 to +35 °C
70 W or more but less than 100 W: 0 to +40 °C

## 1.2 Supplied Accessories

The 6253/6254 standard accessories are listed below. If any accessory is missing or damaged, contact an ADC CORPORATION sales representative. Specify the part number when ordering.

Table 1-1 Standard Accessory List

| Name | Part number | Quantity | | Remarks |
|---|---|---|---|---|
| | | 6253 | 6254 | |
| Power cable*1 | A01402 | 1 | 1 | 3-pin plug |
| Input/output cable | A01044 | 1 | - | Red and black |
| Input/output cable (large current) | CC010011 | - | 1 | Red and black |
| Alligator clip adapter | A08532 | 1 | - | Red and black |
| Alligator clip adapter (large current) | CC015007 | - | 1 | Red and black |
| Banana tip adapter | A08531 | 1 | 1 | Red and black |
| Output connector | JCS-RB0005JX04-1 | 1 | - | Output connector (plug) |
| Output connector cover | YEE-1000734 | 1 | - | For output connector (plug) |
| Cable tie | ESM-000257 | 1 | - | For output connector (plug) |
| Power fuse*2 | DFS-AS5A-1 | 1 | - | 100 V/120 V fast blow |
| | DFT-AA5A-1 | - | 1 | 100 V/120 V slow blow |
| | DFS-AS4A-1 | 1 | - | 220 V/240 V fast blow |
| | DFT-AA3R15A-1 | - | 1 | 220 V/240 V slow blow |
| Quick Manual | E6253/6254(Q) | 1 | 1 | English |

*1 : The power cable can be changed by specifying the option at the time of order.
For more information, refer to “Safety Summary.”
Specify the part number or the option number when ordering.

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

## 1.3 Optional Accessories

The 6253/6254 optional accessories are listed below. Specify the part number when ordering.

Table 1-2 Optional Accessory List

| Name | Part number | Remarks |
|---|---|---|
| Test fixture | 12701A | |
| Connecting cable | A01041 | Input cable (test probe) |
| | A01044 | Input and output cable (safety plug) |
| | CC010011 | Input and output cable (safety plug, large current) |
| | A08531 | Banana tip adapter (for A01044/CC010011) |
| | A08532 | Alligator clip adapter (for A01044/CC010011) |
| | CC015007 | Alligator clip adapter (for A01044/CC010011, large current) |
| | A01047-01 | Input and output cable (banana-banana, 4-wire shielded, 0.5 m) |
| | A01047-02 | Input and output cable (banana-banana, 4-wire shielded, 1 m) |
| | A01047-03 | Input and output cable (banana-banana, 4-wire shielded, 1.5 m) |
| | A01047-04 | Input and output cable (banana-banana, 4-wire shielded, 2 m) |
| | A01038-100 | Input and output cable (banana-banana, 4-wire shielded with guard, 1 m) |
| | CC060001-100 | Input and output cable with 5-pin plug and alligator clip (1 m) |
| | CC060002-200 | Input and output cable with 5-pin plug (2 m) |
| | A01036-1500 | Input cable (BNC-BNC, 1.5 m) |
| Rack mount set | A02269 | Rack mount set (JIS 4U single) |
| | CC022004 | Rack mount set (JIS 4U twin) *1 |
| | A02469 | Rack mount set (EIA 4U single) |
| | CC024004 | Rack mount set (EIA 4U twin) *1 |
| Side joint set | A02641 | 4U twin |
| Slide rail set | A02615 | |
| Front handle set | CC028004 | Front handle set (4U) |

*1 : Installing a rack or the slide rail set (A02615) is required.
The side joint set (A02641) is required.

## 1.4 Operating Environment

This section describes the required environmental and power supply conditions.

### 1.4.1 Environmental Conditions

The 6253/6254 must be installed in an environment meeting the following conditions:

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

  The 6253/6254 is designed with full consideration given to the noise contained in the AC power line. Nevertheless, it is recommended that the 6253/6254 be used in an environment with as little line noise as possible.
  If line noise is unavoidable, use a noise filter.
- Positioning

  A cooling fan is located on the rear panel and vents are located on the side panels.
  Do not block these fan and vents. Leave at least 10 cm of free space between the rear panel and the wall.
  Also, do not position the 6253/6254 in a position with the rear panel facing down.
  Obstructing the vents will cause the internal temperature to rise, possibly causing faulty operation.
- Mounting in a rack

  Ensure that exhaust air from other devices is not directed at the vents on the 6253/6254.
  To prevent the temperature in the rack from rising, install a heat sink fan.

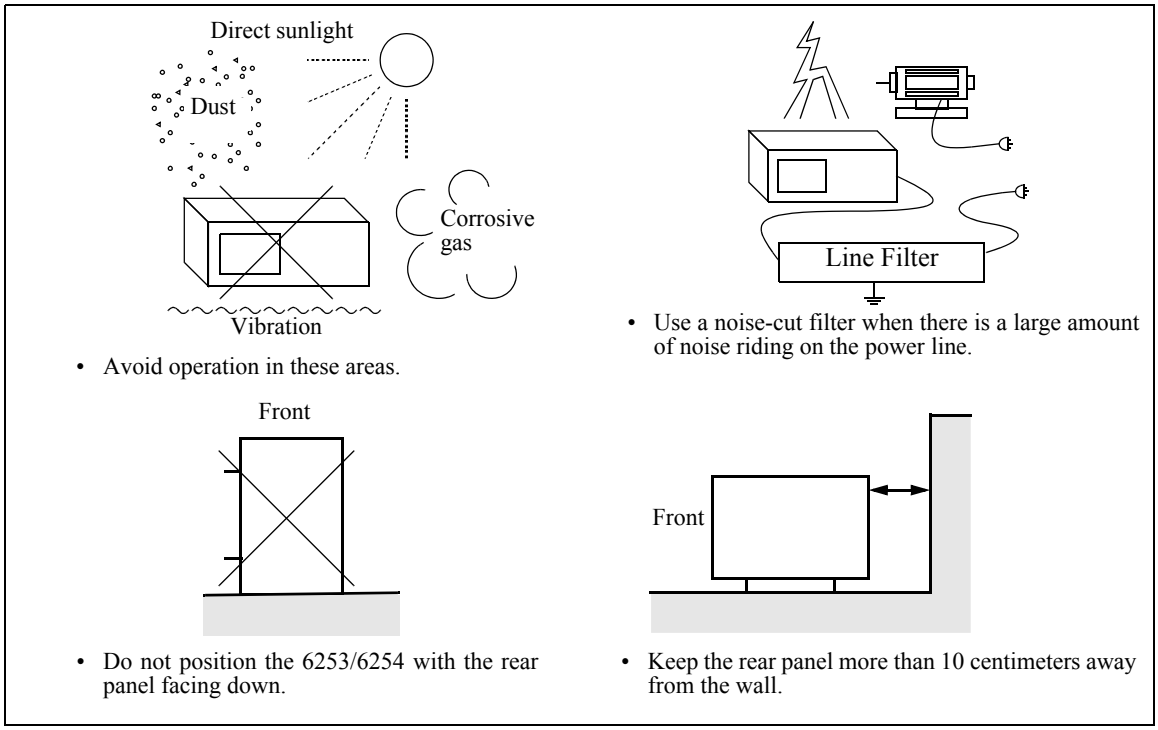


Figure 1-2 Operating Environment

*NOTE: Warm-up time*
*Allow the 6253/6254 to warm up for at least 60 minutes after turning on the power at room temperature to ensure the specified accuracy of the 6253/6254.*

## 1.4.2 Power Specification

Table 1-3 below shows the 6253/6254 power supply specifications.

Table 1-3 Power Supply Specification

| | Standard | Optional | | |
|---|---|---|---|---|
| | | 32 | 42 | 44 |
| | 100 VAC | 120 VAC | 220 VAC | 240 VAC |
| Input voltage range | 90 V to 110 V | 108 V to 132 V | 198 V to 242 V | 216 V to 250 V |
| Frequency range | 48 Hz to 66 Hz | | | |
| Power consumption | 6253: 330 VA or less, 6254: 320 VA or less | | | |
| Fuse (6253) | F5 A/250 V | | F4 A/250 V | |
| Fuse (6254) | T5 A/250 V | | T3.15 A/250 V | |

Ensure that the power voltage setting on the 6253/6254 rear panel matches the voltage of the commercial power supply.

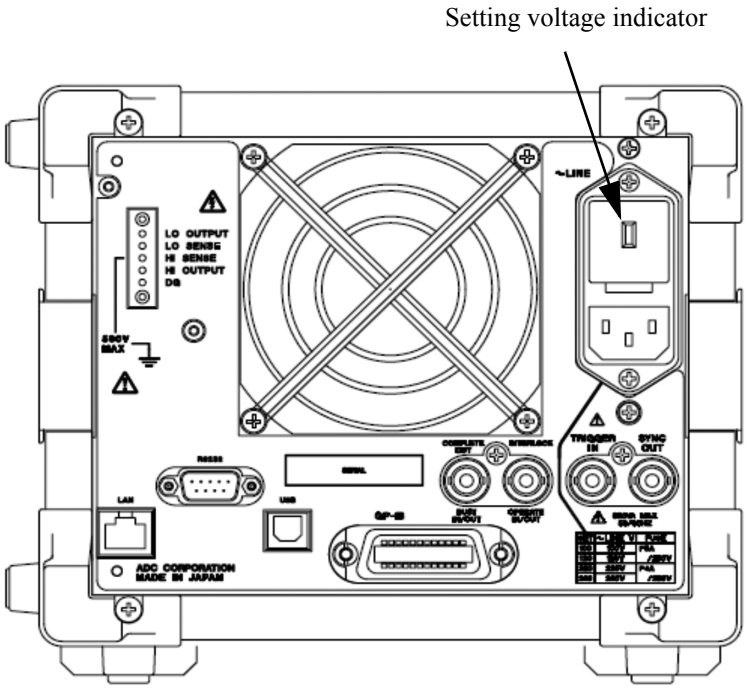


Figure 1-3 Setting Power Voltage Indicator

## 1.4.3 Changing Power Voltage, and Checking or Replacing Power Fuse

The power voltage of the 6253/6254 can be changed manually.
This section describes the procedure for changing the power voltage, and checking or replacing the power fuse.

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*CAUTION:*

1. *If the power is melted, it indicates any problem with the 6253/6254. Contact an ADC CORPORATION sales representative.*
2. *Always use the same fuse type and rating to prevent fire.*

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Changing the power voltage

1. Turn OFF the **POWER** switch on the front panel.
2. Remove the power cable from the AC power outlet.
3. Remove the fuse holder on the rear panel with a flathead screwdriver.

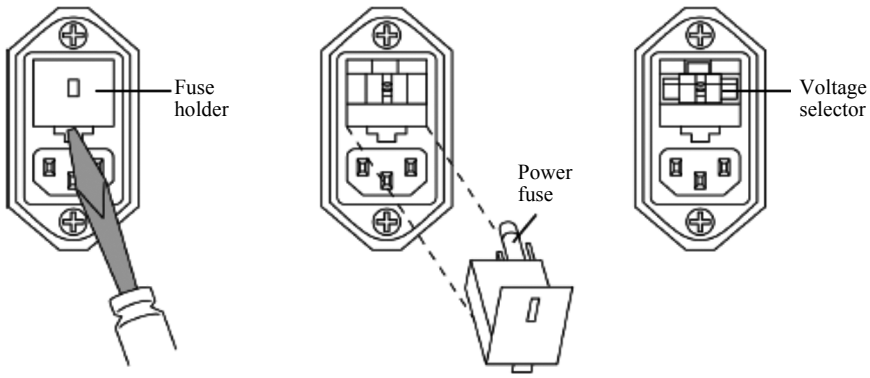


Figure 1-4 Changing Power Voltage, and Checking or Replacing Power Fuse

4. Pull out the voltage selector.
   The selectable voltage values: 100 V, 120 V, 220 V and 240 V are printed on the voltage selector.
5. Insert the voltage selector in the right direction so that voltage to be used faces to the front.

Checking or replacing the power fuse

6. Check if the fuse inside the fuse holder that was removed by Step 3 has been blown. When it has been melted, replace it to a new one and insert to the fuse holder. When you wish to change the power voltage, replace the fuse to another that matches the power voltage to be used.
7. Insert the fuse holder back to the original position on the rear panel until it makes a clicking sound.

## 1.4.4 Power Cable

*CAUTION:*

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

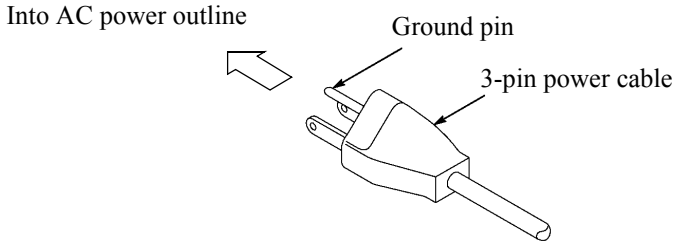


Figure 1-5 Power cable

## 1.5 Operating Check

This section describes the simple self-test which must be performed when operating the 6253/6254 for the first time. Follow the procedure below to ensure the 6253/6254 operates correctly.

1. Ensure 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.

*CAUTION: To prevent damage to the 6253/6254, do not apply a voltage or frequency that exceeds the specified range.*

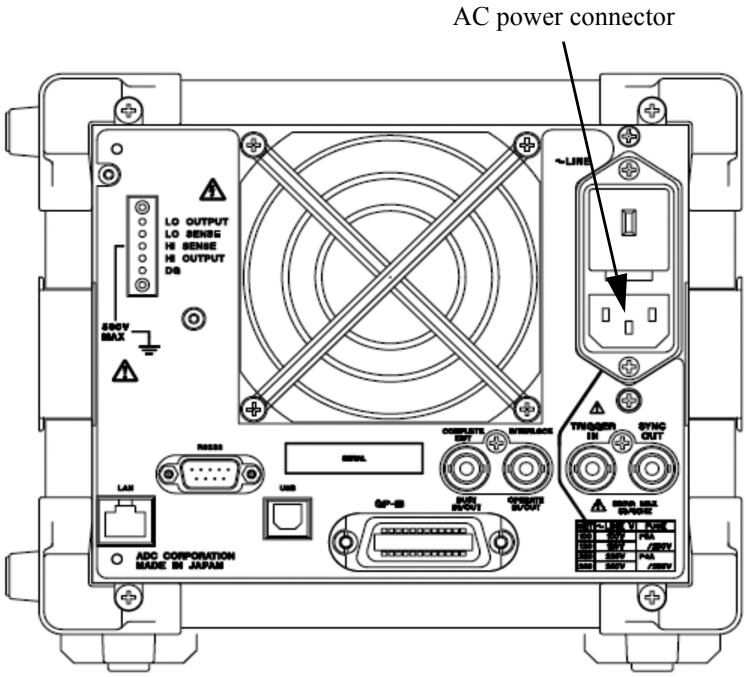


Figure 1-6 Connecting Power Cable

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

4. Set the **POWER** switch on the front panel to ON. (The figures are for the 6253.)
   After all the indicators turn ON, a self-test is performed. (Duration: approx. 15 sec. Figure 1-7)

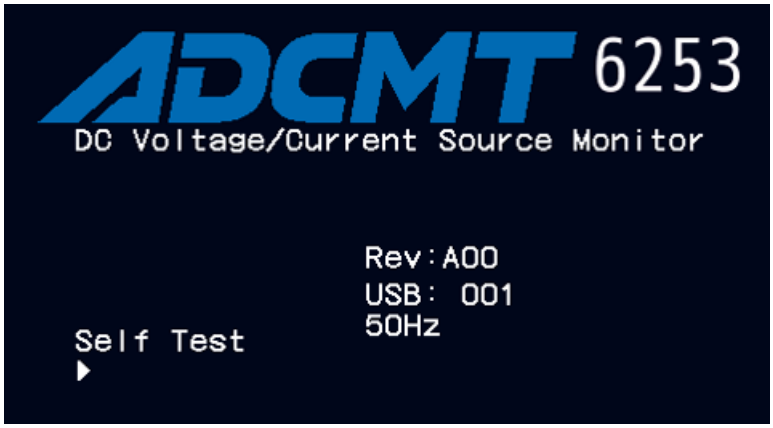


Figure 1-7 Self-Test in Progress

When the test is complete, the model name, line frequency, interface setting, and software revision appear (Figure 1-8). After that, the start-up screen is displayed (Figure 1-9).

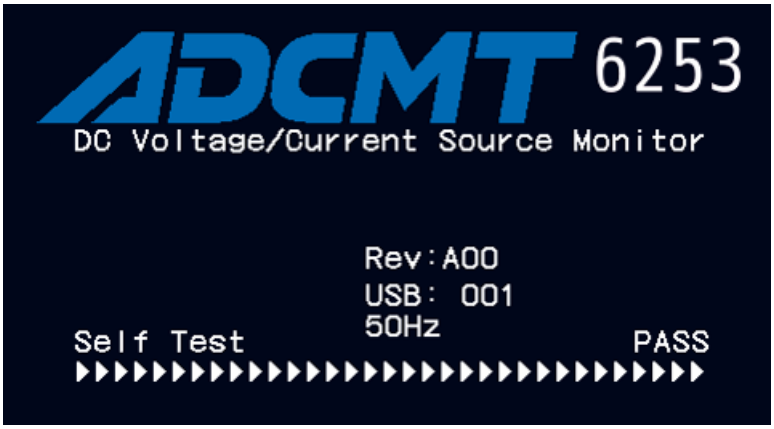


Figure 1-8 Self Test Completion


Figure 1-9 Start-Up Screen

*NOTE:*

1. *Depending on the previous conditions, the screen display may be different from Figure 1-9.*
2. *If a problem occurs, an error message appears on the screen. Refer to the error message list to address the problem. (Refer to Appendix 2, "Error Message List.")*

5. Press the **OPR** key on the front panel.

   Confirm that the measured current value falls within ±300 μA in the current measurement range of 2 A/3 A, and that the measured voltage value falls within ±150 μV in the voltage range of 300 mV.


Figure 1-10 VSIM Measurement Display (Output ON)

6. Press the **STBY** key.

   The **OPR** key goes OFF and the 6253/6254 enters the Standby (output OFF) status.
   The operation check is complete.

# 1.6 Cleaning, Storage, and Transport Methods

## 1.6.1 Cleaning

Clean the 6253/6254 by wiping or brushing its surface with a soft cloth or cloth which has been dampened in water containing a mild detergent.

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*CAUTION:*

1. *Ensure that water does not penetrate the 6253/6254.*
2. *Avoid using organic solvents such as benzene, toluene, xylene, acetone, etc. They will cause deformation of the plastic parts.*

---

## 1.6.2 Storage

Store the 6253/6254 in a location where the temperature is within the range of -25 °C to +70 °C. If storing for an extended period, or 90 days or longer, place the 6253/6254 in a moisture-proof bag together with a desiccant. Avoid storing the 6253/6254 in a location where there is a lot of dust or where it will be subjected to direct sunlight.

## 1.6.3 Transport

To transport the 6253/6254, use the original box that it came in. If the box is not available any longer, pack the 6253/6254 in accordance with the following guidelines.

Packing procedure

1. Prepare a corrugated cardboard box with dimensions that are larger than the external dimensions of the 6253/6254 by 15 cm or more to allow for shock absorbent material.
2. Wrap the 6253/6254 with a protective sheet.
3. Line the box with shock absorbing material so that the 6253/6254 is protected on all sides by cushioning material.
4. Close the box with industrial staples or use packing tape.

When sending the 6253/6254 to an ADC CORPORATION sales representative for service or repairs, attach a label stating the following items.

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

## 1.7 Warm-Up

Allow the 6253/6254 to warm up for at least 60 minutes after turning on the power to ensure the specified accuracy of the 6253/6254.

## 1.8 Calibration

Calibrate the 6253/6254 in accordance with the procedure described in Chapter 7 “CALIBRATION.”
When asking ADC for calibration service, contact an ADC CORPORATION sales representative.

| | |
|---|---|
| Recommended calibration interval | 1 year |

## 1.9 Life Limited Parts

In addition to the parts listed in “Safety Summary,” the 6253/6254 also includes the following parts that are life limited.
Follow the guidelines below to replace them. Contact an ADC CORPORATION sales representative for replacement service.

| Part name | Expected life cycle | Remarks |
|---|---|---|
| Operate/Standby relay | 1,000,000 operations | Replace when the switching cycle between “Operate” and “Standby” reaches the numbers of cycles noted at left. |
| Cooling fan | 60,000 hours | When the cooling fan is faulty, the message “ERR401 Fan Stopped” is displayed and the operation stops. In this case, contact an ADC CORPORATION sales representative. |
| LCD display | 50,000 hours | |
| Panel key | 500,000 operations | |
| USB connector | 1,500 times | |
| GPIB connector | 500 times | |
| LAN connector | 200 time | Factory option |
| RS232 connector | 100 time | Factory option |
| Rotary knob | 1,000,000 operations | |

*CAUTION: The 6253/6254 internally counts the number of Operate/Standby relay operations, and it can be referred by using the MENU or remote commands.*
*For parts replacement, contact an ADC CORPORATION sales representative.*

## 1.10 Product Disposal and Recycling

Correctly dispose of the 6253/6254 in accordance with local and national regulations.

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

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

| Name of substance or removed part | Used? | Location | Unit | Part |
|---|---|---|---|---|
| Capacitor containing polychlorinated biphenyls (PCBs) | No | - | | |
| Part containing mercury | No | - | | |
| Batteries | No | - | | |
| Printed circuit boards | Yes | Unit | MAIN<br>TAP, POWER CONECT<br>AMP, TEMP<br>FRONT/REAR<br>TERMINAL<br>PANEL<br>GPIB I_F | Printed circuit boards |
| Toner cartridge | No | - | | |
| Plastic containing brominated flame retardants | Yes | Unit | BPL-014005, BPQ-020004<br>BPG-017016, BPB-018002<br>BPL-017017, BPQ-020006<br>BPB-018003, BPB-018004<br>BPF-014001, BPB-020007<br>BPB-014025, BPB-020008 | Connectors, diodes, Zener diodes, photocouplers, FET, analog ICs, logic ICs, FLASH memories, transistors |
| Parts containing asbestos | No | - | | |
| Cathode-ray tubes | No | - | | |
| Chlorofluorocarbon (CFC), hydrochlorofluorocarbon (HCFC), hydrofluorocarbon (HFC), or hydrocarbon (HC) | No | - | | |
| Electric-discharge indicator | No | - | | |
| LCD display of 100 $cm^2$ or larger | No | - | | |
| Connecting cable | Yes | Between units | | Power cable<br>Input and output cable |
| Parts containing flame-resistant ceramic fibers | No | - | | |
| Parts containing radioactive material | No | - | | |

| Name of substance or removed part | Used? | Location | Unit | Part |
|---|---|---|---|---|
| Electrolytic capacitors containing substance of concern (With height> 25 mm, dia.> 25 mm, or equivalent volume) | No | - | | |
| Arsenic or its compounds | Yes | Unit | Electronic components | Photocouplers, logic ICs |
| Nickel or its compounds | Yes | Unit | | Electronic components, mechanical components |
| PVC | Yes | Unit | | PVC components |
| Antimony or its compounds | Yes | Unit | | Electronic components |

# 2. PANEL AND OPERATION

This chapter describes the part names on the panels and basic operations.

## 2.1 Front and Rear Panels

This section describes the part names and functions on the front and rear panels.

### 2.1.1 Front Panel

The front panel is described below. (The figure below shows the 6253.)

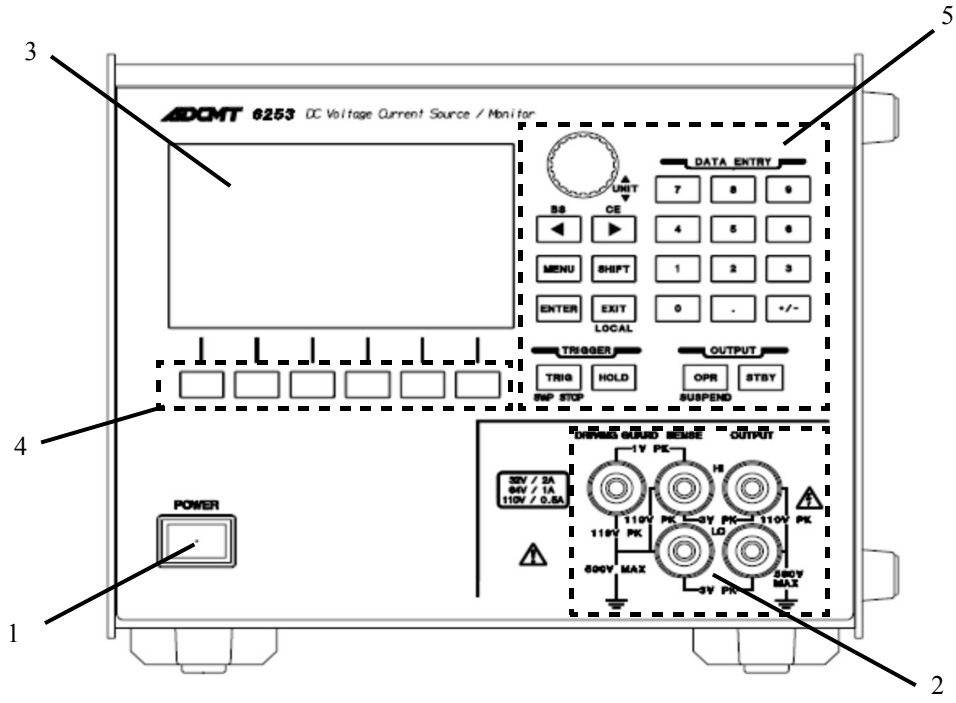



Figure 2-1 Front Panel

1. POWER switch — Turns ON or OFF the power.

2. Output terminal — The output terminal is selectable between 2-wire connection and 4-wire connection. (The DRIVING GUARD is only for the 6253.)
For more information, refer to Section 4.1.1, “Output Terminals (Front and Rear Output Terminals).”

*CAUTION: To prevent damage to the 6253/6254, do not apply a voltage or current that exceeds the specified range.*

3. Display

Displays source values, measured values and other information. For more information, refer to 2.2, “Display.”

4. Soft Keys

The soft keys are used to select the displayed items on the lower side of the screen.

| | |
|---|---|
| Mode | Selecting the source mode |
| Source | Source condition setting |
| Measure | Measurement condition setting |
| Limit | Limit value setting |
| Time | Time setting screen display |

For more information on the soft keys, refer to Section 2.3, “Soft Keys.”

5. Other keys and rotary knob

- Rotary knob

  Increases or decreases the digit at the cursor position, and selects units or parameters. In the direct input mode, it selects units. On the MENU screen, it selects parameters vertically.

- Right and left key

  Move the cursor position at numerical input.

- **MENU** key

  Displays the parameter group setting screen (MENU screen) and the key is lit. Pressing the key again returns to the home screen.

- **SHIFT** key

  When the key is lit, blue colored characters on the panel are enabled.

- **ENTER** key

  Fixes selected parameters. In the direct input mode, the key is lit.

- **EXIT** key (LOCAL)

  Cancels selected parameters or returns to the upper level in the MENU hierarchy.
  In the remote status, it switches to the local status.

- **TRIG** key

  In the HOLD trigger mode, the key triggers measurement and pulse generation for the DC source or pulse source mode, or triggers step generation for the sweep source mode. In the AUTO trigger mode, it works as start key for sweep source. The key is lit during sweep source.

- **HOLD** key

  Switches the trigger mode between AUTO and HOLD.
  Turns ON when the trigger mode is set to HOLD.

- **DATA ENTRY** keys (0 to 9, ., +/-)

  Numerical input keys
  Pressing any numerical input key switches to the direct input mode. The **ENTER** key goes ON at this time.
  Press the **ENTER** key to fix the input.

- **OPR** key

  Switch between Operate (output relay ON) and Suspend*. The key is lit in the Operate status.

  * In the Suspend status, the suspend voltage is output instead of turning OFF the output relays. The key blinks.

*WARNING: Beware of electrical shock! In the Operate status (output relay ON), hazardous voltage may occur depending on the settings.*

- **SUSPEND** (**SHIFT**, **OPR**) key
  Switches to the Suspend status regardless of whether the output status is Operate or Standby. The **OPR** indicator goes OFF.
- **STBY** key
  Switches the output status to Standby. The **OPR** indicator goes OFF.

## 2.1.2 Rear Panel

The rear panel is described below. (The figure below shows the 6253.)

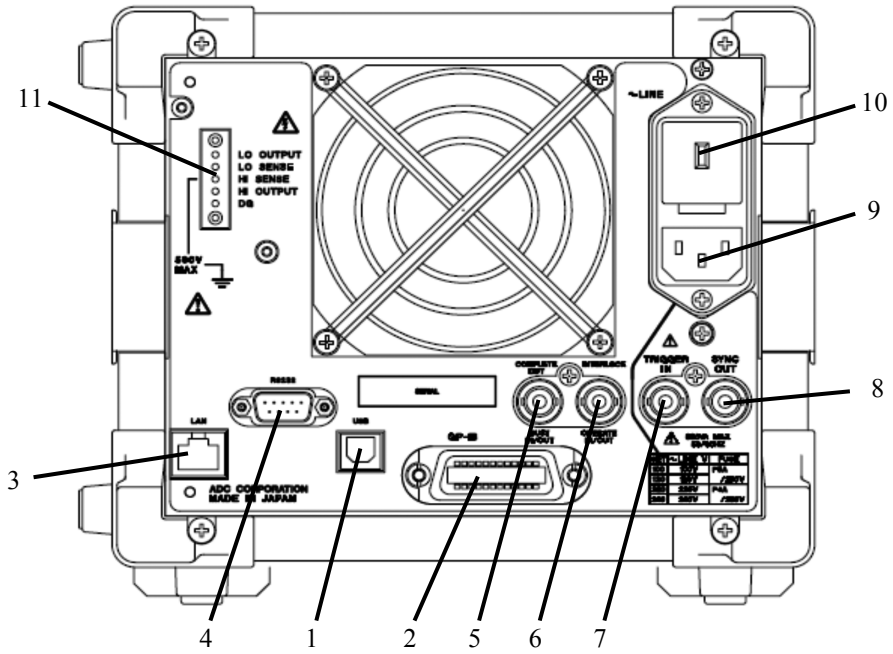



Figure 2-2 Rear Panel

1. USB connector
   Connects to an external controller via a USB cable.
2. GPIB interface connector
   Connects to an external controller via a GPIB cable.
3. LAN interface connector (factory option)
   Connects to an external controller via a LAN cable.
4. RS232 interface connector (factory option)
   Connects to an external controller via a RS232 cable.
5. COMPLETE OUT / BUSY IN/OUT
   Refer to Section 4.2.10, “External Control Signals.”

6. INTER LOCK / OPERATE IN/OUT
   Refer to Section 4.2.10, “External Control Signals.”

7. TRIGGER IN — Refer to Section 4.2.10, “External Control Signals.”

8. SYNC OUT — Refer to Section 4.2.10, “External Control Signals.”

9. AC power connector — Connects to an AC power output via the supplied power cable.

10. Voltage selector and fuse holder — Used to select the voltage manually to match the AC power supply.
A fuse is contained inside.

*CAUTION: Use an appropriate fuse. Refer to Section 1.4.2, “Power Specification.”*

11. Rear output terminal (6253 only) — Refer to Section 4.1.1, “Output Terminals (Front and Rear Output Terminals).”

*CAUTION: To prevent damage to the 6253, do not apply a voltage or current that exceeds the specified range.*

## 2.2 Display

This section describes the annotations displayed on the home screen.


Figure 2-3 Home screen

1. Measured value

   - Operate:
     Indicates the measurement function and the measured value.
     VM (voltage measurement)/IM (current measurement)/RM (resistance measurement)
   - Standby or Suspend:
     Indicates the previous measured value.

2. Monitor value

   - Operate:
     Indicates the monitor value of the source function.
     VM (voltage measurement)/IM (current measurement)
   - Standby or Suspend:
     Indicates the suspend status HZ (high-resistancestatus) or LZ (low-resistance status) and the suspend voltage.

3. Source value
   Indicates the source function and the source value.
   VS (voltage source)/IS (current source)
   Indicate the status in the sweep mode.
   SWP STBY (sweep standby)/SWP STOP (sweep stop)/SWP RUN (sweep in progress)

4. Tw and Tp
   Indicates the pulse width and the period.

5. IT
   Indicates the integration time.

6. MeasRng — Indicates the measurement range: AUTO or FIX.
7. SrcRng — Indicates the source range.
   Shows whether it is AUTO or FIX when the sweep mode is selected.
8. Remote sensing setting — Indicates 2 W (2-wire connection) or 4 W (4-wire connection).
9. Limit (compliance) values — Indicates HL (high limit value) and LL (low limit value).
   When a limit value is detected, ▲ or ▼ turns ON.
10. Source mode — Indicates the source mode: DC, pulse, DC sweep or pulse sweep.
11. Comparator calculation indicators
    Any of these turns ON depending on the comparator calculation result of a measured value when the comparator calculation is ON.
12. Other annotations
    - AZ: Turns On when the Auto Zero function is ON.
    - NULL: Turns ON when the NULL calculation is ON.
    - MATH: Turns ON when the scaling calculation is ON.
    - CMP: Turns ON when the comparator calculation is ON.
    - SLOW/FAST/SR: Output response. When the slew rate is set to ON, “SR” is displayed.
    - MAX: Turns ON when the Max/Min calculation is ON.
    - ST: Turns ON when the measurement data memory is ON.
    - OSC: Turns ON when oscillation is detected.
    - ϟ: Turns ON when high voltage is detected. (6253 only)
    - HiZ/LoZ: Impedance in the Suspend status.
    - HL (high limit value) and LL (low limit value):
      Turns ON when the measured value reaches the limit values.
    - RMT: Turns ON in the remote control status.
    - ERR: Turns ON when there are any error logs. When any of these errors is fatal, the indicator is lit in red. Otherwise, it is lit in blue.

## 2.3 Soft Keys

To set parameters, utilize the MENU hierarchy or the soft keys located on the lower side of the screen.

This section describes the soft key details and operations.


Figure 2-4 Soft Keys at DC or Pulse Source (Top Layer)


Figure 2-5 Soft Keys at Sweep Source (Top Layer)

At the top layer of the soft keys, six parameters are displayed for DC or pulse source, and also six parameters for sweep source.

Selecting any parameter will display its corresponding soft key layer.

Then, press your desired soft keys at each layer to make detailed settings.

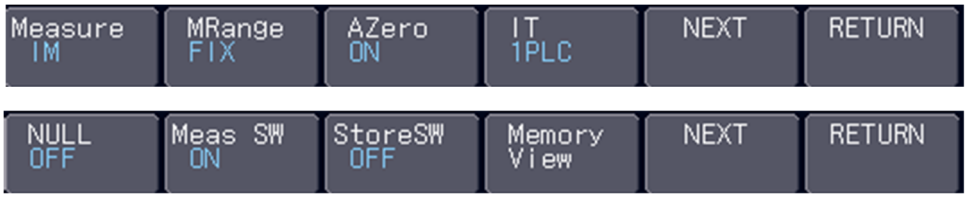
1. Mode Selecting the source mode


- DC DC source
- Pulse Pulse source
- DC Sweep DC sweep source
- Pulse Sweep Pulse sweep source
- RETURN Returning to the top

2. Source Setting the source-related parameters


- Source Selecting the source function, VS or IS
- SrcRng Down Raising the source range
- SrcRng Up Lowering the source range
- RngAuto Source range DC or pulse source: FIT or LOCK
  Sweep source: AUTO or FIX
- Sus Z Impedance in the Suspend status: HiZ or LoZ
- Resp Output response: Slow, Fast or SR (display only)
- 2W/4W Remote sensing setting 2W (2-wire connection) or 4W (4 wire connection)
- Slew Rate Slew rate setting
  (Displayed when the Slew Rate SW in ON.)
- NEXT Page switching
- RETURN Returning to the top

3. Measure Sets the measurement-related parameters.




- Measure Measurement function: VM, IM or RM
- MRange Measurement range: AUTO or FIX
- AZero Auto Zero function: ON or OFF
- IT Setting and displaying the integration time

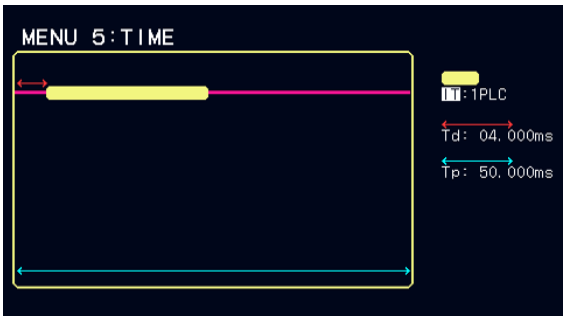

  - Down Decreases the integration time.
  - IT Displays the setting integration time.
  - Up Increases the integration time.
  - RETURN Returns to the Measure layer.
- NULL NULL calculation: ON or OFF
- Meas SW Measurement: ON or OFF
- Store SW Measurement data memory: Normal or OFF

- Memory View List of stored measured values
- NEXT Page switching
- RETURN Returning to the top

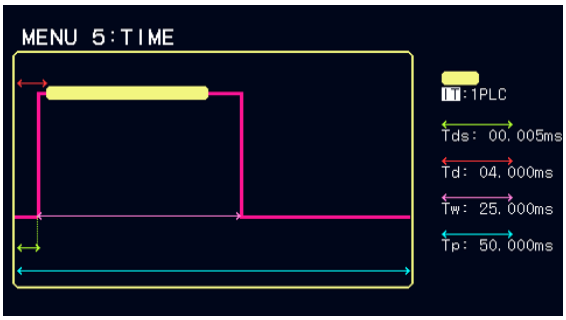
4. Limit Setting the limit values (The cursor moves to HL.)


- HL High limit value
- LL Low limit value
- LMT In Limit setting: ±Balance or INDIV
  - When LMT In is set to ±Balance, setting HL will set LL to the same value of the reverse polarity.
  - INDIV: HL and LL can be set individually.
- RETURN Returning to the top

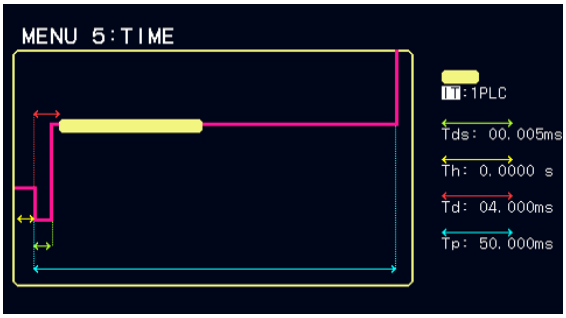
5. Time Displaying the time setting screen (The displayed waveforms are not actual ones, but are rough indication for time setting.)



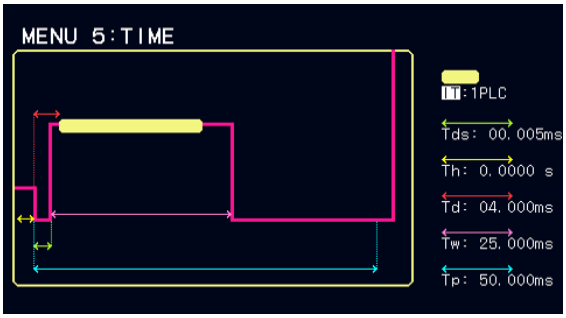

DC source




Pulse source




DC sweep source




Pulse sweep source

The setting parameters vary according to the source mode.

The parameters such as IT and Tp on the level of the time setting screen can be set.

The parameter details and how to operate the Input/Run level are described in Section 2.6.1, “MENU Operation.”

As for the measurement delay value (Td), refer to Section 4.2.8.3, “Measurement Delay and Settling Time.”

6. SWPType Selecting the sweep type


- Linear Linear Sweep
- Fixed Fixed Sweep
- Random Random sweep
- MLinear Multi-Slope Linear Sweep
- Log Log sweep
- RETURN Returning to the top

7. Polarity Switching the polarity for the DC or pulse source mode


- - Negative polarity output
- 0 0 (zero) output
- + Positive polarity output
- RETURN Returning to the top

## 2.4 Basic Operation

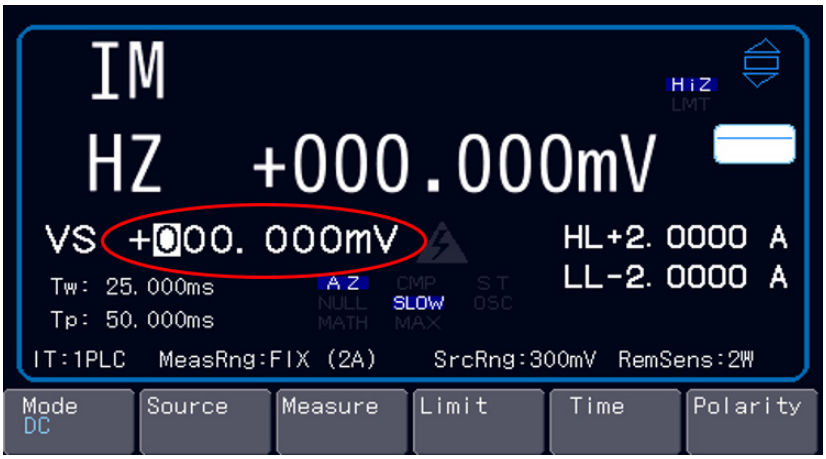
This section describes the basic operations of the 6253/6254.

### 2.4.1 Numerical Input

You can input numbers in two ways. One is by using the right and left keys and the rotary knob, and the other is by using “direct input mode.”

Numbers such as source values and limit values can be input in the parameter edit status.

#### 2.4.1.1 Numerical Input with Right and Left Keys and Rotary Knob

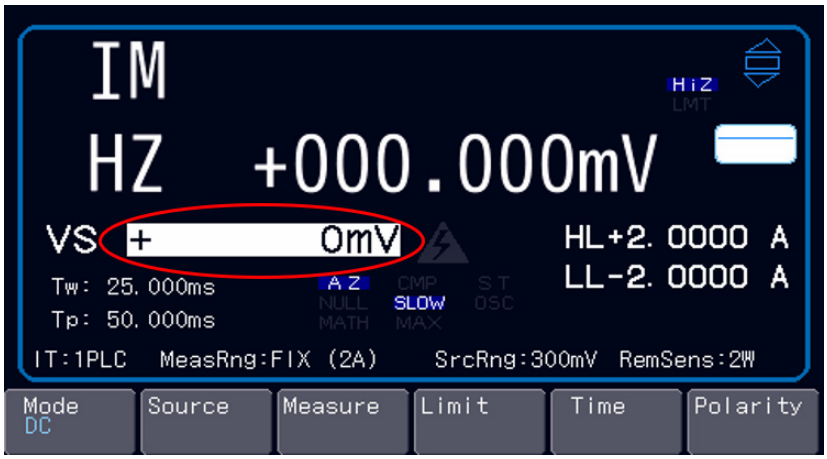



Move the cursor with the right and left keys, and increase or decrease numbers with the rotary knob.

- Right and left key — Moving the cursor
- Rotary knob — Increasing or decreasing numbers and switching the polarities depending on the cursor position.

*NOTE: Any changes to the source value or limit values with the rotary knob are immediately applied.*

### 2.4.1.2 Numerical Input in Direct Input Mode




Pressing any numerical input key switches to the direct input mode.

The **ENTER** key goes ON at this time.

Here, the rotary knob changes units.

Input numbers directly and fix them by pressing the **ENTER** key. To cancel them, press the **EXIT** key.

Press the **BS** key to delete specific figures or the **CE** key to clear all the entry.

## 2.5 Example Operations

Parameter settings are available by using the soft keys or the MENU.

This section describes how to set parameters with the soft keys.

For how to set on the MENU, refer to Section 2.6, “MENU Hierarchy.”

Also, for more information on the soft keys, refer to Section 2.3, “Soft Keys.”

### 2.5.1 DC Source and Measurement

This section describes how to perform voltage source current measurement (VSIM) and how to set the limit values in the DC source mode.

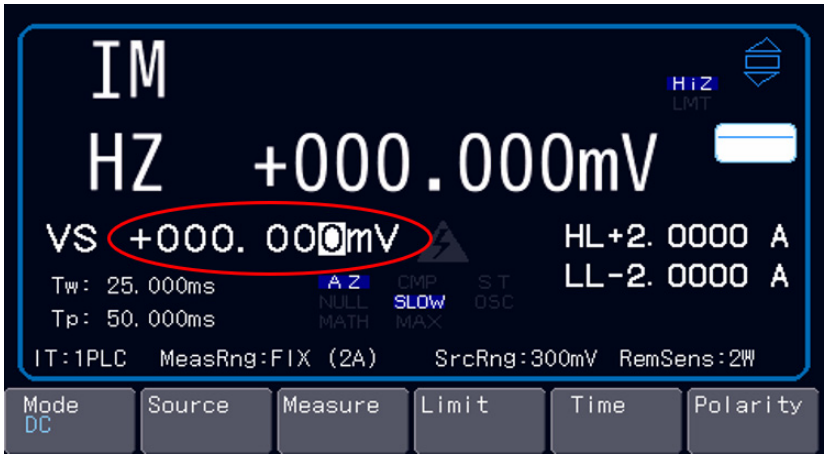
Example 1: VS: +1 V, IL: ±300 mA, Integration time (IT): 1 PLC, Load: 10 Ω

Note that the 6253/6254 is supposed to be set as default.


① Selecting the source mode
Choose “DC” with the soft key **Mode**.
(DC has been set as default.)

② Selecting the source and measurement functions
Choose “VS” with the soft key **Source**, and choose “IM” and set IT with the soft key **Measure**.
(VS and IM have been chosen, and the integration time has been set to 1 PLC as default.)

③ Setting the source value
Set the source value.
For more information how to enter numbers, refer to Section 2.4.1, “Numerical Input.”




When the source range is set to LOCK, out-of-range values cannot be set.
When the source range is set to FIT, the range is switched automatically according to the setting value.

④ Setting the limit values
When voltage source (VS) is selected, current limit (IL) is automatically set, and when current source (IS) is selected, voltage limit (VL) is automatically set in the same way.


Pressing the soft key **Limit** will develop the limit layer and move the cursor to HL.
When LMT In is set to ±Balance, setting HL will set LL to the same value of the reverse polarity.
When LMT In is INDIV, HL and LL can be set individually.
Pressing the soft keys **HL** or **LL** will switch the cursor between HL and LL.
Set the limit values in the same way as the source value setting.
Press the soft key **RETURN** to return to the top layer of the soft keys.

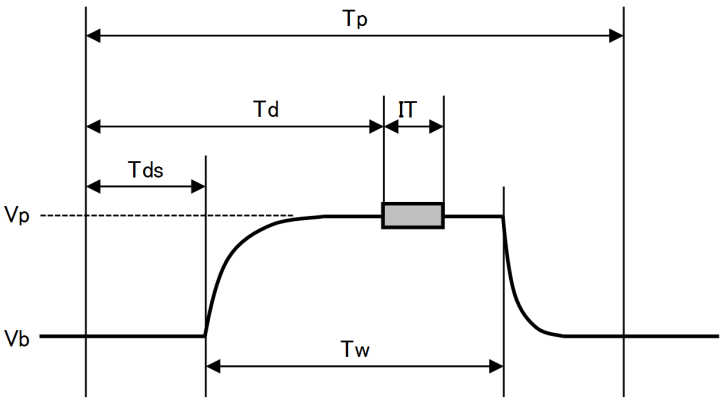
⑤ Operate
Press the **OPR** key. The key goes ON and DC voltage is output.
As VS is + 1 V and the load is 10 Ω current of approximately 100 mA is measured.


## 2.5.2 Pulse Source and Measurement

An example operation of the pulse source mode is described below.

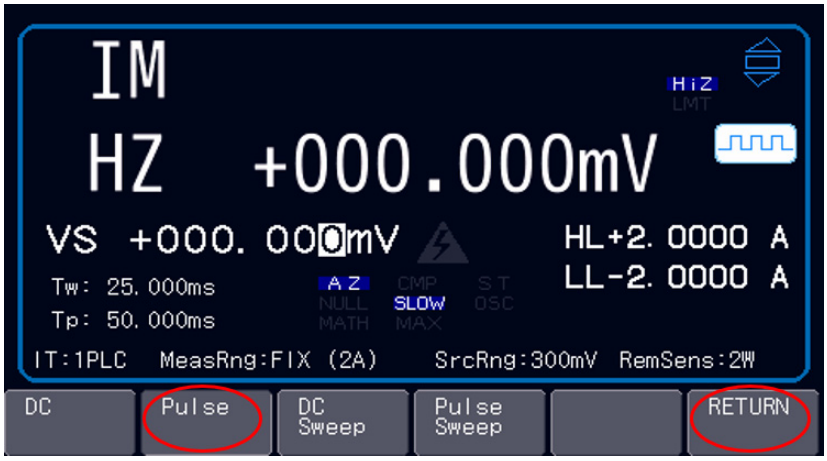
Example 2: IS: +100 mA, VL: ±10 V, Load: 10 Ω

Note that the 6253/6254 is supposed to be set as default.

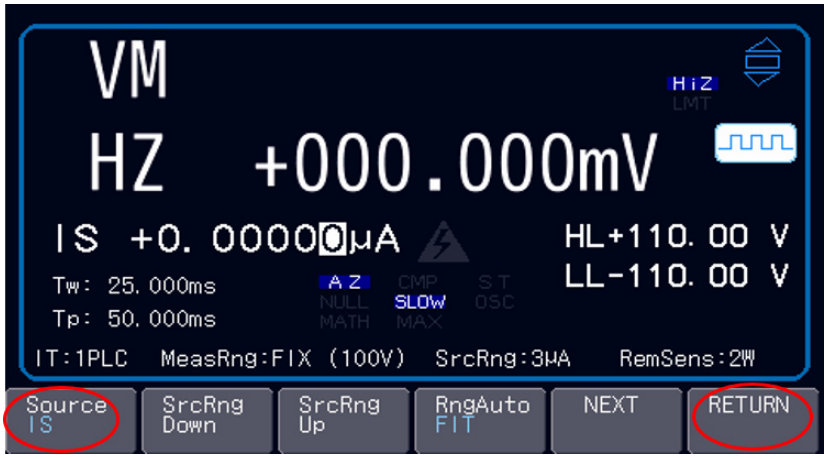



| | (ex. 2) |
|---|---|
| Tp (Period) | : 50 ms |
| Tds (Source delay time) | : 0.005 ms |
| Td (Measurement delay time) | : 4 ms |
| Tw (Pulse width) | : 25 ms |
| IT (Integration time) | : 1 PLC |
| Vp (Pulse value) | : +100 mA |
| Vb (Base value) | : 0 mA |

① Selecting the source mode
Choose “Pulse” with the soft key **Mode**.
Press the soft key **RETURN** to return to the top layer.

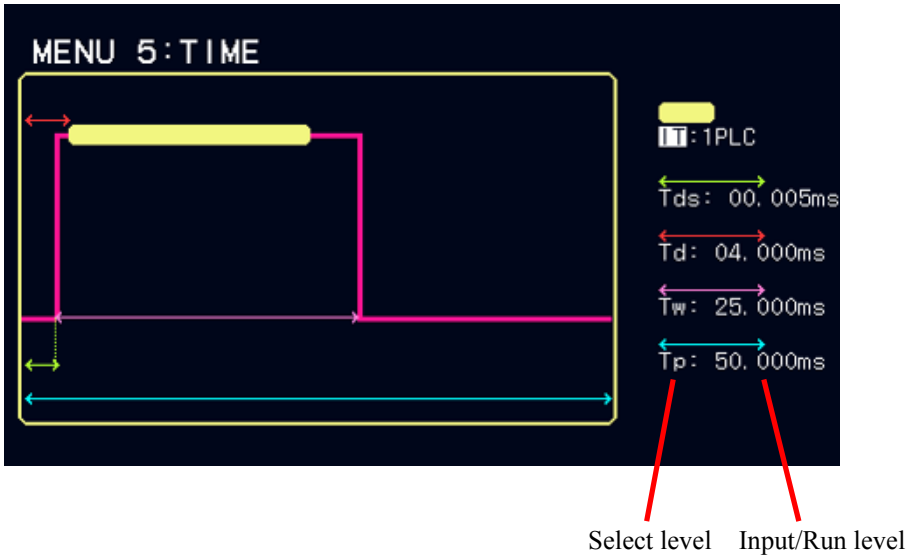



② Selecting the source function
Choose “IS” with the soft key **Source**.
Press the soft key **RETURN** to return to the top layer.



③ Selecting the measurement function.
Choose "VM" with the soft key **Measure**.
Press the soft key **RETURN** to return to the top layer.


④ Time settings
Display the time setting screen with the soft key **Time**.



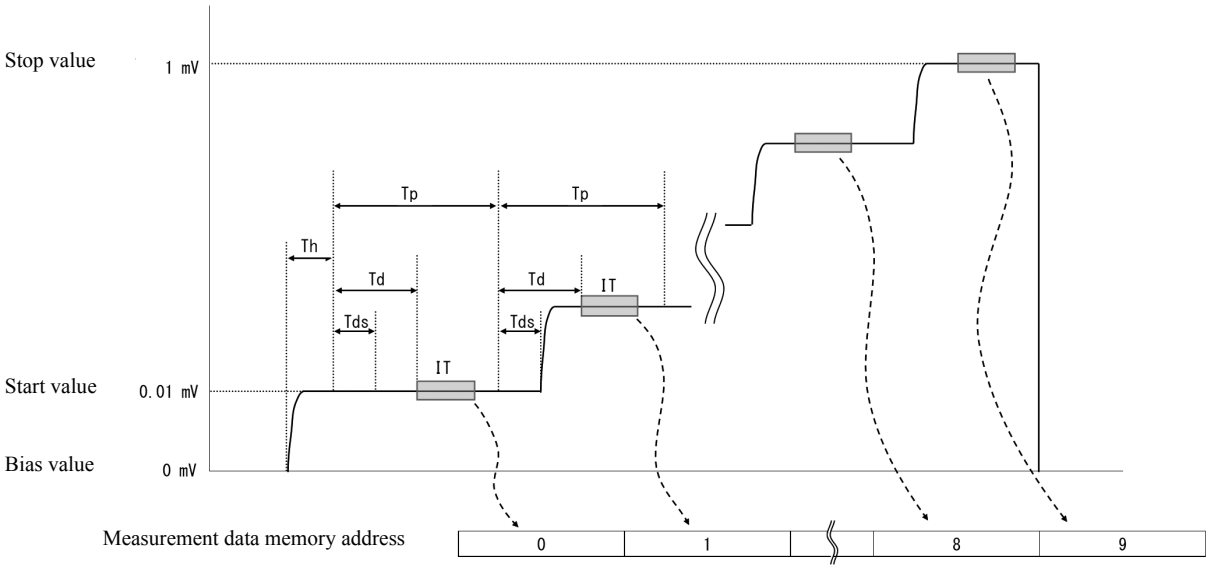

Set the relevant parameters such as IT and Tp on the time setting screen.
The parameter details and how to operate the Input/Run level are described in Section 2.6.1, "MENU Operation."
Press the **EXIT** key to return to the home screen.

⑤ Setting the source value, the limit values, and Operate
As in the case of DC source, set the source current value (pulse value) and limit voltage values.
Press the **OPR** key to output pulse current.
As IS is + 100 mA and the load is 10 Ω, voltage of approximately 1 V is measured.

## 2.5.3 Sweep Measurement

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

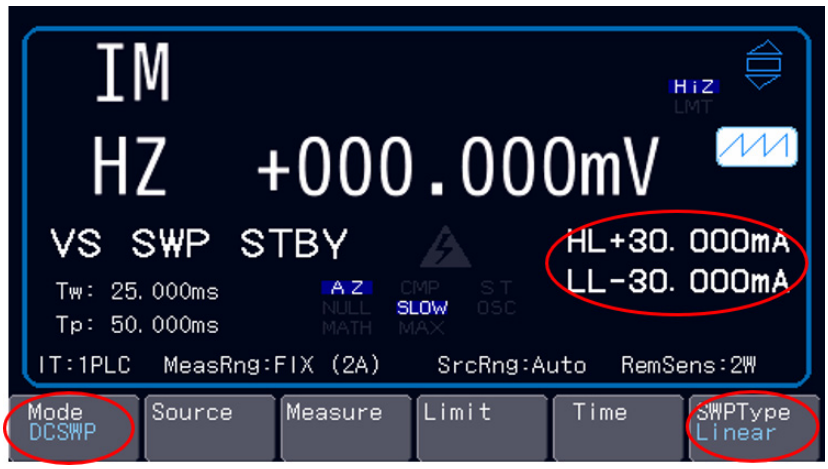
Example 3: VSIM: 0.01 mV to 1 mV (0.01 mV step), Linear sweep, Load: 10 Ω




(ex. 3)

Mode : DC Sweep
Sweep Type : Linear
Sweep Range : Fix
Bias Value : 0 mV
Start Value : 0.01 mV
Stop Value : 1 mV
Step Value : 0.01 mV
IL : ±30 mA

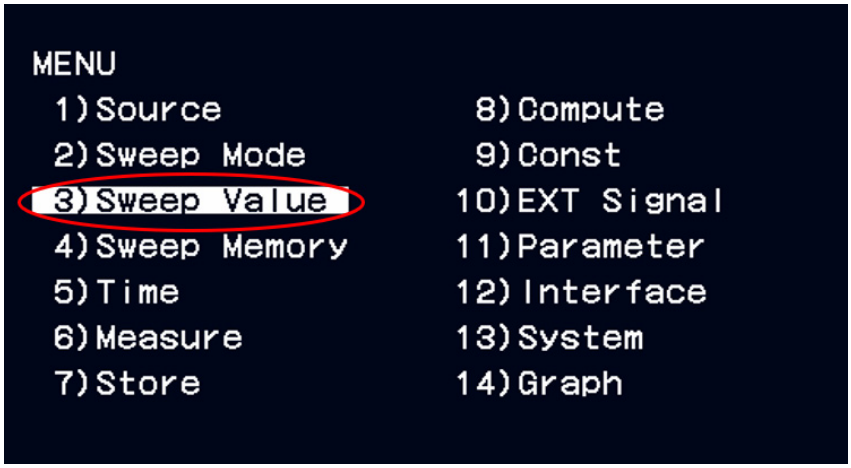
| | | (ex. 3) |
|---|---|---|
| Tp | (Period) | : 50 ms |
| IT | (Integration time) | : 1 PLC |
| Th | (Hold time) | : 0 ms |
| Td | (Measurement delay time) | : 4 ms |
| Tds | (Source delay time) | : 0.005 ms |



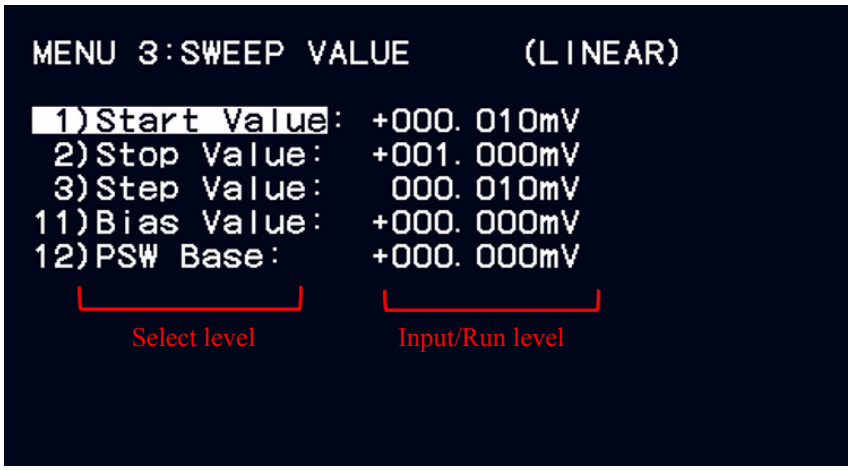

① Selecting the source mode
Choose “DC sweep” with the soft key **Mode**.
Press the soft key **RETURN** to return to the top layer. The soft key **SWPType** is displayed.
Choose “Linear” with the soft key: **SWPType**.

② Selecting the source and measurement functions and setting the limit values.
Choose “VS” with the soft key: **Source**, choose “IM” with the soft key **Measure**, and set the IL value with the soft key **Limit**.

③ Setting the sweep value (The sweep value setting is available only by MENU operation.)
Press the **MENU** key to develop the MENU hierarchy.
Select “3) Sweep value” with the rotary knob, and display the Sweep Value layer with the **ENTER** key.



④ Input values at the Sweep Value layer.




Select the parameters on the left of the Sweep Value layer with the rotary knob.

Press the **ENTER** key to move to the Input/Run level on the right to edit the values.

Input the values in the edit status and press the **ENTER** key to fix them and return to the Select level.

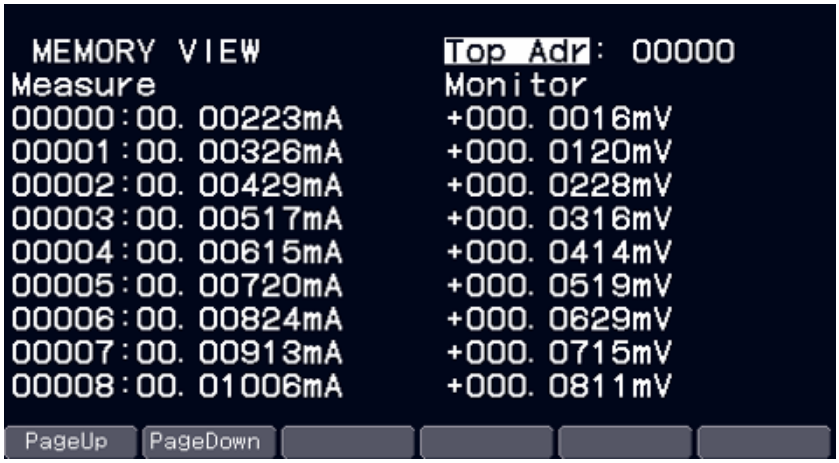
Press the **MENU** key to return to the home screen.

⑤ Time settings
Display the time setting screen with the soft key **Time**
Set the relevant parameters as in the case of pulse source.

⑥ Setting the measurement memory and Operate
Press the soft key **Measure** first and the soft key **StoreSW** second to select Normal.
The "ST" appears on the screen.


Press the **OPR** key to output the bias value.
Press the **TRIG** key to start sweep measurement.

⑦ Checking the measurement data
After completion of sweep measurement, press the soft key **Memory View** in **Measure** to display the data stored in the measurement data memory. When limit detection occurs, the relevant measured values are displayed in red.



## 2.6 MENU Hierarchy

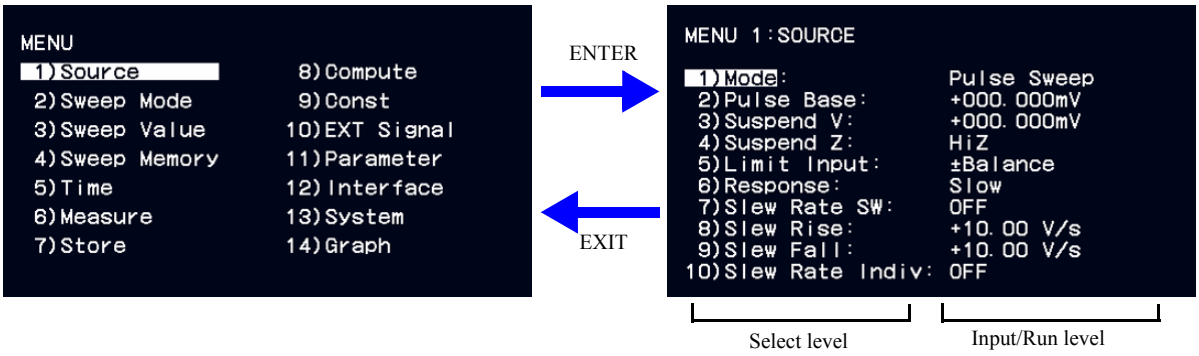
This section describes the MENU hierarchy details.

### 2.6.1 MENU Operation

Press the **MENU** key will display the MENU hierarchy (top layer).

The MENU is a 2-layer hierarchical structure.

| | | |
|---|---|---|
| First layer | MENU layer (top layer) | Select MENU parameters. |
| Second layer | Parameter layer | Select level: Select parameters on each layer. |
| | | Input/Run level: Enter values or select parameters in the edit status. |




- MENU layer operation
  1. Select parameters with the rotary knob.
  2. Move to the second layer with the **ENTER** key.

- Home screen
  1. Press the **MENU** key to return to the home screen. Pressing the **HOME** key in the edit status will cancel the entry and return to the home screen.

- Select level operation
  1. Select parameters with the rotary knob.
  2. Press the **ENTER** key to move to the Input/Run level and enter the edit status.
  3. Press the **EXIT** to return to the first layer.

- Edit status operation
  1. Numerical input is available by using the rotary knob and right and left keys or by using the direct input mode. Select parameters with the rotary knob.
  2. Press the **ENTER** key to fix the entry and return to the select level. To cancel the entry, press the **EXIT** key and return to the select level.

Figure 2-6 MENU Hierarchy Operation

## 2.6.2 Menu Structure and Parameter List

MENU

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 1) Source | 1) Mode | Source mode<br>DC/Pulse/DC Sweep/Pulse Sweep |
| | 2) Pulse Base | Base value at pulse source |
| | | VS<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V<br>IS<br>6253: +0.00000 µA to ±2.00000 A<br>6254: +000.000 µA to ±20.0000 A |
| | 3) Suspend V | Output voltage in the Suspend status<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V |
| | 4) Suspend Z | Output impedance in the Suspend status<br>HiZ/LoZ |
| | 5) Limit Input | Limit setting<br>±Balance/Individual |
| | 6) Response | Output response<br>Fast/Slow |
| | 7) Slew Rate SW | Slew rate setting<br>ON/OFF |
| | 8) Slew Rise | Slew rate rise time setting |
| | 9) Slew Fall | Slew rate fall time setting |
| | 10) Slew Rate Indiv | Slew rage rise and fall time individual setting<br>ON/OFF |
| 2) Sweep Mode | 1) Sweep Type | Sweep source mode<br>Linear/Fixed/Random/MLinear/Log |
| | 2) Sweep Range | Sweep source range<br>Auto/Fix *Fix only for the Burst mode |
| | 3) Sweep Reverse | Sweep reverse mode<br>Single/Reverse |
| | 4) Repeat Count | Sweep repeat count<br>0 to 1000 *Invalid in the Burst mode. |
| | 5) Return Bias | Bias value output at the end of sweep<br>ON/OFF |

MENU

3) Sweep Value

| Category | Select | Edit (Input/Run level) | |
|---|---|---|---|
| 3) Sweep Value | 1) Start Value | Linear sweep start value | When selecting Linear |
| | | VS<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V | IS<br>6253: +0.00000 µA to ±2.00000 A<br>6254: +000.000 µA to ±20.0000 A |
| | 2) Stop Value | Linear sweep stop value | When selecting Linear |
| | | VS<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V | IS<br>6253: +0.00000 µA to ±2.00000 A<br>6254: +000.000 µA to ±20.0000 A |
| | 3) Step Value | Linear sweep step value | When selecting Linear |
| | | VS<br>6253: 000.001 mV to 110.000 V<br>6254: 000.001 mV to 20.0000 V | IS<br>6253: 0.00001 µA to 2.00000 A<br>6254: 000.001 µA to 20.0000 A |
| | 1) Level Value | Fixed sweep level value | When selecting Fixed |
| | | VS<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V | IS<br>6253: +0.00000 µA to ±2.00000 A<br>6254: +000.000 µA to ±20.0000 A |
| | 2) Sample Count | Fixed sweep sample count | When selecting Fixed |
| | | 1 to 20000 | |
| | 1) Start Adr<br>2) Stop Adr | | When selecting Random |
| | | Start address<br>0 to 19999 | Stop address<br>0 to 19999 |
| | 1) Start Value | Log sweep start value (common with the Liner sweep) | When selecting Log |
| | | VS<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V | IS<br>6253: +0.00000 µA to ±2.00000 A<br>6254: +000.000 µA to ±20.0000 A |
| | 2) Stop Value | Log sweep stop value (common with the Liner sweep) | When selecting Log |
| | | VS<br>6253: -110.000 V to +110.000 V<br>6254: -20.0000 V to +20.0000 V | IS<br>6253: +0.00000 µA to ±2.00000 A<br>6254: +000.000 µA to ±20.0000 A |
| | 3) Step Decade | Number of partitions by ten for the Log sweep<br>1/2/5/10/25/50 | When selecting Log |

MENU → 3) Sweep Value

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 3) Sweep Value | 1) Slope Cnt | Number of slopes of the Multi-slope linear sweep — When selecting MLinear<br>2 to 4 |
| | 2) 1st Value | 1st value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |
| | 3) 2nd Value | 2nd value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |
| | 4) 3rd Value | 3rd value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |
| | 5) 4th Value | 4th value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |
| | 6) Last Value | Last value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |
| | 7) Step1 Value | 1st step value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: 000.001 mV to 110.000 V; 6254: 000.001 mV to 20.0000 V<br>IS: 6253: 0.00001 µA to 2.00000 A; 6254: 000.001 µA to 20.0000 A |
| | 8) Step2 Value | 2nd step value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: 000.001 mV to 110.000 V; 6254: 000.001 mV to 20.0000 V<br>IS: 6253: 0.00001 µA to 2.00000 A; 6254: 000.001 µA to 20.0000 A |
| | 9) Step3 Value | 3rd step value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: 000.001 mV to 110.000 V; 6254: 000.001 mV to 20.0000 V<br>IS: 6253: 0.00001 µA to 2.00000 A; 6254: 000.001 µA to 20.0000 A |
| | 10) Step4 Value | 4th step value of the Multi-slop linear sweep — When selecting MLinear<br>VS: 6253: 000.001 mV to 110.000 V; 6254: 000.001 mV to 20.0000 V<br>IS: 6253: 0.00001 µA to 2.00000 A; 6254: 000.001 µA to 20.0000 A |
| | 11) Bias Value | Sweep bias value<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |
| | 12) PSW Base | Pulse sweep base value<br>VS: 6253: -110.000 V to +110.000 V; 6254: -20.0000 V to +20.0000 V<br>IS: 6253: +0.00000 µA to ±2.00000 A; 6254: +000.000 µA to ±20.0000 A |

MENU

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 4) Sweep Memory | Top Adr | Random memory setting top address<br>Select and change with the soft key **SetAdr**. |
| | SetAdr | Random memory setting top address<br>Switch to the Top Adr setting. *Use the soft key to run. |
| | PageUp | Page scroll up |
| | PageDown | Page scroll down |
| | SAVE | Random memory save (to the non-volatile memory)<br>*Use the soft key to run. |
| | LOAD | Random memory load (from the non-volatile memory)<br>*Use the soft key to run. |
| | CLEAR | Random memory clear<br>*Use the soft key to run. |
| 5) Time | 1) Hold Time (Th) | Hold time<br>0 ms to 6 s |
| | 2) Source Delay (Tds) | Source delay time<br>5 µs to 59997 ms |
| | 3) Meas Delay (Td) | Measurement delay time<br>20 µs to 59997 ms |
| | 4) PLS Width (Tw) | Pulse width<br>25 µs to 59997 ms |
| | 5) Period (Tp) | Period<br>50 µs to 60000 ms |
| | 6) Auto Rng Delay (Tar) | Auto range delay time<br>0 ms to 5000 ms |

MENU

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 6) Measure | 1) Auto Zero | Measurement Auto Zero<br>ON/OFF |
| | 2) Integ Time | Integration time<br>5 μs/10 μs/100 μs/500 μs/1 ms/10 ms/1 PLC/2 PLC/200 ms/Variable |
| | 3) Variable IT | Variable integration time<br>100 μs to 1000 ms  Setting resolution: 100 μs |
| | 4) Measure SW | Measurement ON/OFF<br>ON / OFF |
| | 5) Disp Digit | Measurement digits<br>6 digits/5 digits/4 digits/3 digits |
| | 6) Disp Unit | Unit display switching<br>Prefix / Exponent |
| | 7) Mfunc Link | Measurement function link mode<br>ON/OFF |
| | 8) Sample/Trigger | Sample count by one trigger<br>1 to 20000 |
| 7) Store | 1) Store Mode | Measurement data memory<br>OFF/Normal/Burst |
| | 2) Memory Clear | Measurement data memory clear<br>Press the **ENTER** key to execute. |
| | 3) Memory View | Measurement data memory viewing |

MENU

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 8) Compute | 1) Compare SW | Comparator calculation ON/OFF<br>OFF/ON |
| | 2) Scaling SW | Scaling calculation ON/OFF<br>OFF/ON |
| | 3) Max/Min SW | MAX/MIN calculation ON/OFF<br>OFF/ON |
| | 4) NULL SW | NULL calculation ON/OFF<br>OFF/ON |
| | 5) Max/Min View | Max/Min calculation result reading<br>Maximum Maximum measurement value<br>Minimum Minimum measurement value<br>Average Average measurement value<br>Total Total measurement value<br>Sample Count Number of calculated measurement data |
| 9) Const | 1) High Value | Comparator calculation upper limit value<br>0 to ±999.9999Y * |
| | 2) Low Value | Comparator calculation lower limit value<br>0 to ±999.9999Y |
| | 3) Scaling Value A | Scaling calculation constant A<br>0 to ±999.9999Y However, “0” is unacceptable. |
| | 4) Scaling Value B | Scaling calculation constant B<br>0 to ±999.9999Y |
| | 5) Scaling Value C | Scaling calculation constant C<br>0 to ±999.9999Y |
| | 6) NULL Value | NULL calculation constant<br>0 to ±999.9999Y<br>Can be selected/changed only when NULL calculation is ON. |

*Y is prefix “yotta” that indicates $10^{24}$.

MENU

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 10) EXT Signal | 1) OPR Signal | INTERLOCK/OPERATE IN/OUT control signal function setting<br>Disable/Interlock/STBY IN/ OPR/SBY IN/ OPR/SUS IN/OPR OUT |
| | 2) Complete/Busy | COMPLETE OUT/BUSY IN control signal function setting<br>Disable/MeasFront/Meas End/CMP HI/CMP GO/CMP LO/Busy In/<br>Busy Out/CMP HI or LO/Sweep End |
| | 3) TRIG IN | External trigger input<br>Disable/Enable |
| | 4) Sig Width | Control signal output pulse select<br>10 μs / 100 μs |
| 11) Parameter | 1) Param Load | Loading saved parameters<br>Load0 / Load1 / Load2 / Load3 / LoadDefault<br>Select one of these parameters above and press the **ENTER** key to run. |
| | 2) Param Save | Saves the setting parameters.<br>Save0 / Save1 / Save2 / Save3 / SetDefaultAll<br>Select one of these parameters above and press the **ENTER** key to run. |

MENU

12) Interface

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 12) Interface | 1) I/F BUS | Interface selection<br>USB/GPIB/LAN/RS232/USBCDC |
| | 2) Header | Header<br>ON/OFF |
| | 3) Output Monitor | Monitor output<br>ON/OFF |
| | 4) GPIB Address | GPIB address<br>0 to 30 |
| | 5) USB ID | USB. ID<br>1 to 127 |
| | 6) RS232 Config | RS232 configuration |
| | 1) Baud Rate | Baud rate<br>19200/9600/4800/2400/1200/600/300 |
| | 2) Data Bit | Data bit<br>8 bit/7 bit |
| | 3) Parity Bit | Parity bit<br>NONE/ODD/EVEN |
| | 4) Stop Bit | Stop bit<br>1 bit/2 bit |
| | 7) IP Address | IP address<br>0.0.0.0 to 255.255.255.255 |
| | 8) Gateway | Default gateway<br>0.0.0.0 to 255.255.255.255 |
| | 9) Subnet Mask | Subnet mask<br>0.0.0.0 to 255.255.255.255 |
| | 10) MAC Address | MAC address<br>*Viewing only and setting Not available |
| | 11) Output Format | Output data format<br>ASCII/REAL64 |

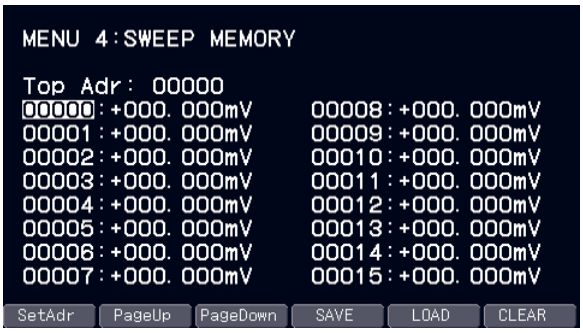
MENU

| Category | Select | Edit (Input/Run level) |
|---|---|---|
| 13) System | 1) Limit Buzzer | Limit detection buzzer<br>ON/OFF |
| | 2) Compare Buzzer | Comparator calculation result buzzer<br>OFF/HI/GO/LO/HIorLO |
| | 3) Notice Buzzer | Process completion notice buzzer<br>ON/OFF |
| | 4) Self Test | Runs the selected self test.<br>Use the rotary knob to select<br>and the **ENTER** key to run.<br>1) Self Test: Self test execution<br>2) LCD Pattern Display: Display test<br>3) Key & Buzzer Test: Key and buzzer test |
| | 5) Relay Count | Relay counter reading<br>*Viewing only and setting Not available |
| | 6) Serial No/REV | Serial number and software revision reading<br>*Viewing only and setting Not available |
| | 7) LCD Off | LCD display OFF |
| | 8) PON Load | Parameter loading at power ON<br>Power Off/Load0 |
| | 9) Error Log | Error log reading |
| | 10) Compati Mode | 6243/6244-compatible mode<br>ON/OFF |
| 14) Graph | 1) Graph | Displays the step numbers of the measurement data memory on the horizontal axis and the measured values on the vertical axis. |
| | 2) Monitor-Measure Graph | Displays the monitor value of the measurement data memory on the horizontal axis and the measured values on the vertical axis. |

## 2.7 Sweep Memory Settings (Random Sweep)

This section describes how to set the source data (sweep memory) that is used for random sweep.

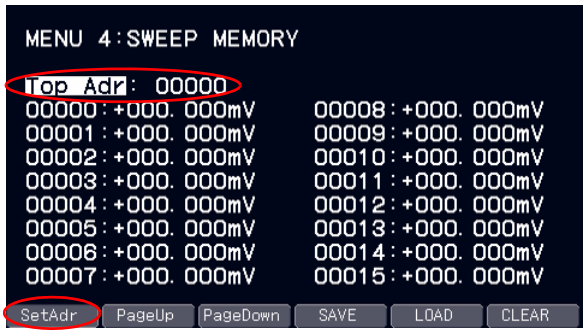
The settings are done at ***4) Sweep Memory*** on the ***MENU*** layer.




① Switching addresses

Switch addresses with the rotary knob.

To scroll pages, use the soft keys **PageUp** and **PageDown**.

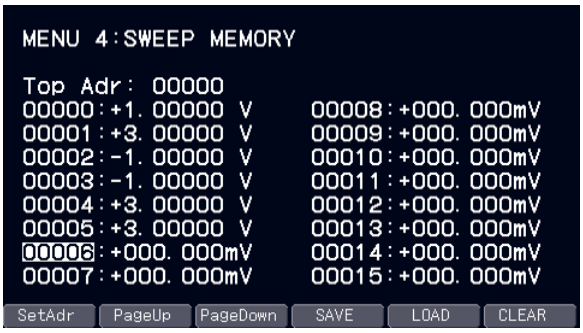



② Setting the top address

Switch the top address with the soft key **SetAdr**.

Press the **ENTER** key to edit the address.

The page of the address specified at "Top Adr" is displayed.



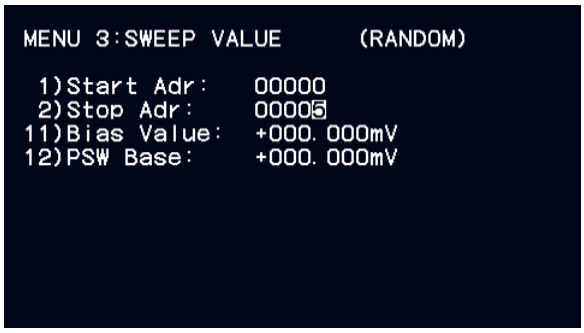

③ Entering memory data

Press the **ENTER** key at a specified address to enter the edit status.

Enter any source value in the edit status.

To save the input value, press the soft key **SAVE**.

To load the saved value, press the soft key **LOAD**.




④ Setting random sweep

Set the start value at ***1) Start Adr*** and the stop value at ***2) Stop Adr*** in ***3) Sweep Value*** on the ***MENU*** layer.

(The start address should be less than the stop address.)

Source values from addresses 0 to 5 are generated in the case of the above screen.

Return to the home screen, press the **OPR** key to output the bias value and press the **TRIG** key to start sweep.

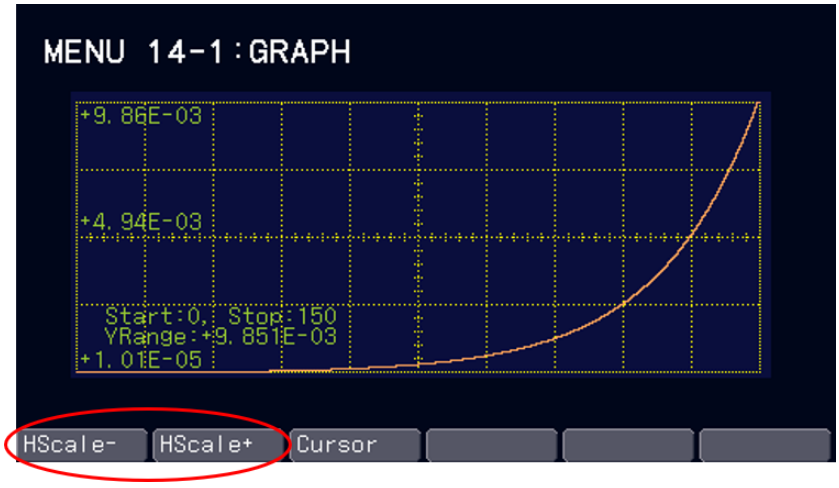
## 2.8 Measurement Data Graph Display

This chapter describes how to view the measurement data saved in the memory in the sweep source mode.

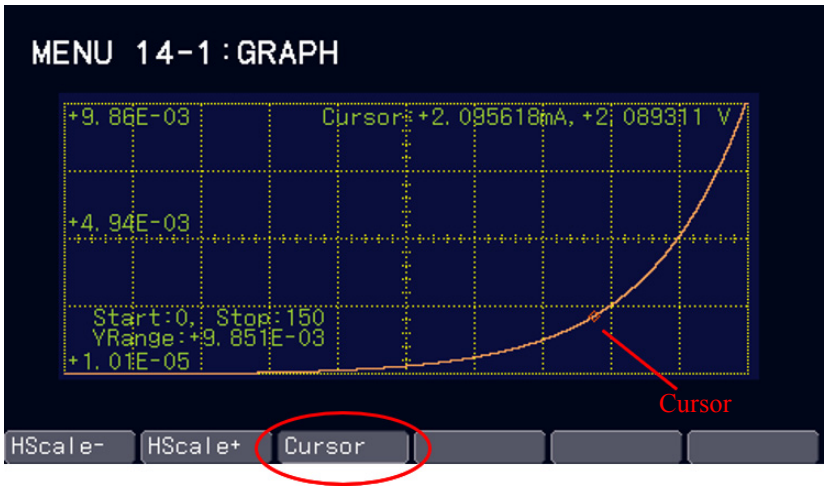
To display the graph, choose ***14) Graph*** on the ***MENU*** layer.

1) Graph: Displays a graph that indicates the step numbers in the memory on the vertical axis and the measured values on the horizontal axis.

① Graph zoom-in/zoom-out
Press the soft key **HScale+** to halve the display range of the horizontal axis.
Press the soft key **HScale-** to double the display range of the horizontal axis.



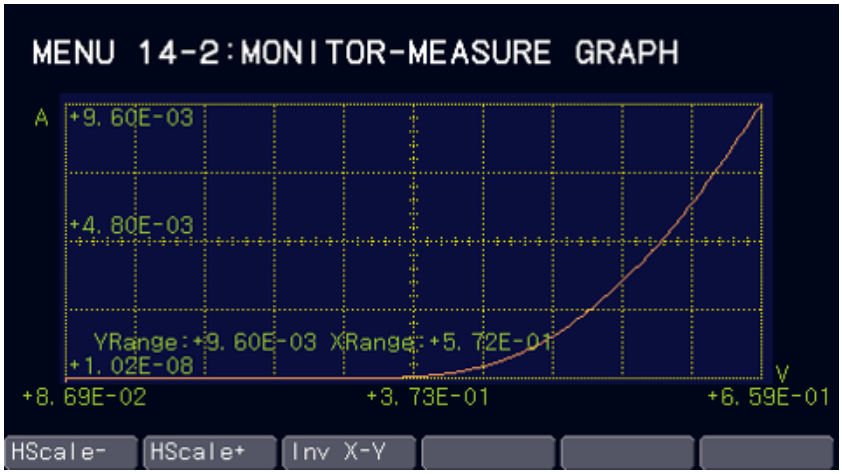

② Cursor display
Press the soft key **Cursor** to turn ON or OFF the cursor display.
Rotating the rotary knob with the cursor display ON will move the cursor on the graph. At this time, the monitor value and the measured value at the cursor position are displayed on the upper right on the graph.



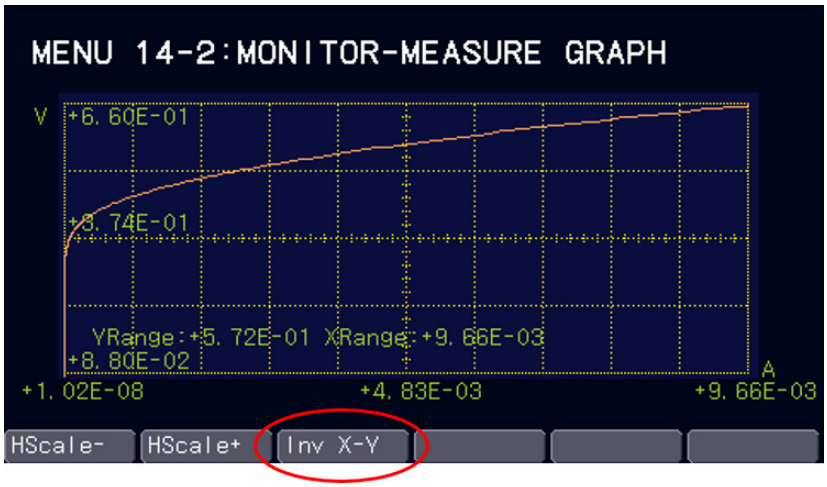

To move the cursor easily, after enlarging the display with the soft key **HScale+**, scroll the graph by rotating the rotary knob and then turn ON the cursor display with the soft key **Cursor**.

2) Monitor-Measure Graph: Displays a graph that indicates the monitor values in the memory on the vertical axis and the measured values on the horizontal axis.

① Graph vertical and horizontal data switching
As an example, the measurement data of diode I-V characteristics is shown below.
Condition: ISVM: 0.01 µV to 10 mV, Log sweep (number of partitions by ten: 50), VL: ±10 V
The following graph shows the voltage measurement values V on the horizontal axis and the current monitor values I on the vertical axis.




Switch the vertical axis and the horizontal axis on the graph by using the soft key **Inv X-Y**.
The following graph shows the current monitor values I on the horizontal axis and the voltage measurement values V on the vertical axis.




② Graph scroll
Rotate the rotary knob to scroll the graph vertically.
It cannot be scrolled horizontally.

# 3. REFERENCE

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

## 3.1 Menu Index

Use the Menu Index as index for the setting parameters in the MENU.

## 3.2 Function Description

This section describes the panel keys and the parameter functions.

### 3.2.1 MENU Key (Parameter Setting)

Pressing the **MENU** key will display the parameter group setting screen. The **MENU** key goes ON.

The MENU parameters are described below:

***1) Source*** Sets source-related parameters.

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

- DC: Sets the DC source mode which generates DC voltage or DC current.
- Pulse: Sets the pulse source mode which generates pulse voltage or pulse current.
- DC Sweep: Sets the DC sweep source mode which generates waveforms for DC voltage or current sweep.
- Pulse Sweep: Sets the pulse sweep source mode which generates waveforms for pulse voltage or current sweep.

***Pulse Base*** Sets the base value at pulse source.

***Suspend V*** Sets the output voltage in the Suspend status.

***Suspend Z*** Sets the output impedance in the Suspend status.

- HiZ: The output current limit is set to ±100 nA for the 6253 or ±3 μA for the 6254, resulting in a large output impedance.
- LoZ: The output current limit is set to the current limit value at voltage source or to 3000 digits in the current range (10000 digits in the 3 μA range) at current source, so the output impedance decreases.

***Limit Input*** Selects the current limit HL and LL values setting.

- ±Balance: The HL and LL values change simultaneously in both polarities.
- Individual: The HL and LL values are separately set.

***Response*** Selects the source response.

- Fast: Fast response
- Slow: Slow response, but high stability to loads

***Slew Rate SW*** Selects the slew rate setting.

ON: Variable slew rate (SR) function ON

OFF: Variable slew rate (SR) function OFF

When the slew rate function is ON, "SR" is displayed on the screen.

***Slew Rise*** Sets the slew rate rise time.

***Slew Fall*** Sets the slew rate fall time.

***Slew Rate Indiv*** Switches the slew rate rise and fall time individual setting.

ON: The slew rate rise time and fall time are set to different values.

OFF: The slew rate rise time and fall time are set to the same value.

***2) Sweep Mode*** Sets the sweep source-related parameters.

***Sweep Type*** Selects the sweep type.

Linear: Linear sweep

Fixed: Fixed sweep

Random: Random sweep

MLinear: Multi-slope linear sweep

Log: Log sweep

***Sweep Range*** Selects the range function for sweep source.

Auto: Sweeps in the optimum range at every step from the start value to the stop value. *Switches to Fix in the Burst mode.

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

***Sweep Reverse*** Switches the reverse mode (round sweep).

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

Reverse: Round sweep from the start value to the stop value and back to the start value

***Repeat Count*** Sets the number of times sweep repeats.
When it is set to 0, sweep repeats infinitely.
When it is set between 1 and 1000 and the Sweep Reverse is set to Reveres, each round sweep is counted as 1. *Invalid in the Burst mode.

***Return Bias*** Selects the bias output setting at the end of sweep.

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

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

***3) Sweep Value*** Sets the vales used for sweep source operation.
The setting parameters are different depending on the sweep type.

Linear

***Start Value*** Sets the start value for linear sweep.

***Stop Value*** Sets the stop value for linear sweep.

***Step Value*** Sets the step value for linear sweep.

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

***PSW Base*** Sets the pulse sweep base value.

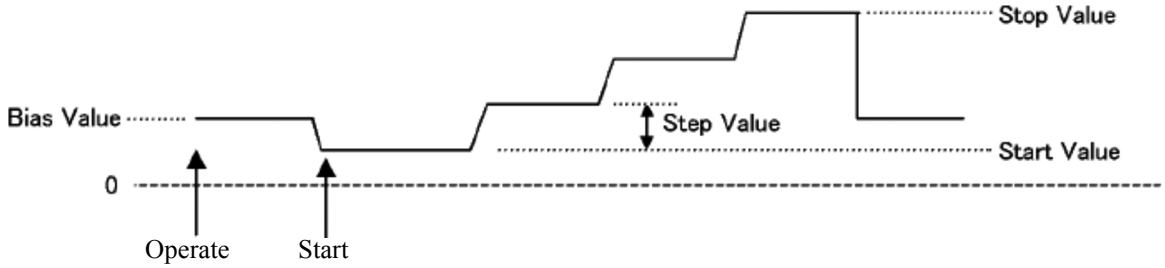



Figure 3-1 Linear Sweep

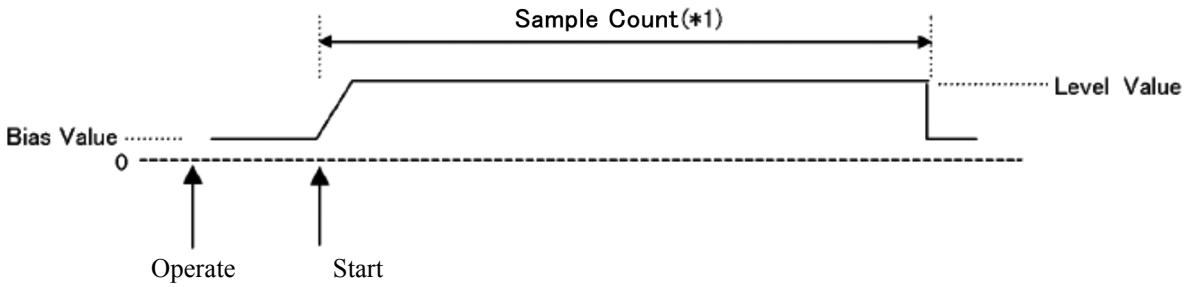
Fixed

***Level Value*** Sets the fixed level value for fixed sweep.

***Sample Count*** Sets the sample count (number of measurements in every period Tp: 1 to 20000) for fixed sweep.

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

***PSW Base*** Sets the pulse sweep base value.




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

Figure 3-2 Fixed Sweep

Random

***Start Adr*** Sets the start address for random sweep.

***Stop Adr*** Sets the stop address for random sweep.

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

***PSW Base*** Sets the pulse sweep base value.

Log

***Start Value*** Sets the start value for log sweep.

***Stop Value*** Sets the stop value for log sweep.

***Step Decade*** Selects the number of partitions by decade or ten.
The kth output value or Vk during sweep is as follows:

$Vk = Vo \times 10^{k/n}$ Vo: Start value
n: Number of partitions by ten

Select the number of partitions by decade from 1, 2, 5, 10, 25 and 50.

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

***PSW Base*** Sets the pulse sweep base value.

MLinear

***Slope Cnt*** Sets the number of slopes (2 to 4) for multi-slope linear sweep.

***1st Value*** Sets the 1st value for multi-slope linear sweep.

***2nd Value*** Sets the 2nd value for multi-slope linear sweep.

***3rd Value*** Sets the 3rd value for multi-slope linear sweep.

***4th Value*** Sets the 4th value for multi-slope linear sweep.

***Last Value*** Sets the last value for multi-slope linear sweep.

***Step1 Value*** Sets the 1st step value between the 1st value and the 2nd value for multi-slope linear sweep.

***Step2 Value*** Sets the 2nd step value between the 2nd value and the 3rd value or between the 2nd value and the last value for multi-slope linear sweep.

***Step3 Value*** Sets the 3rd step value between the 3rd valuee and the 4th value or between the 3rd value and the last value for multi-slope linear sweep.

***Step4 Value*** Sets the 4th step value between the 4th value and the last value for multi-slope linear sweep.

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

***PSW Base*** Sets the pulse sweep base value.

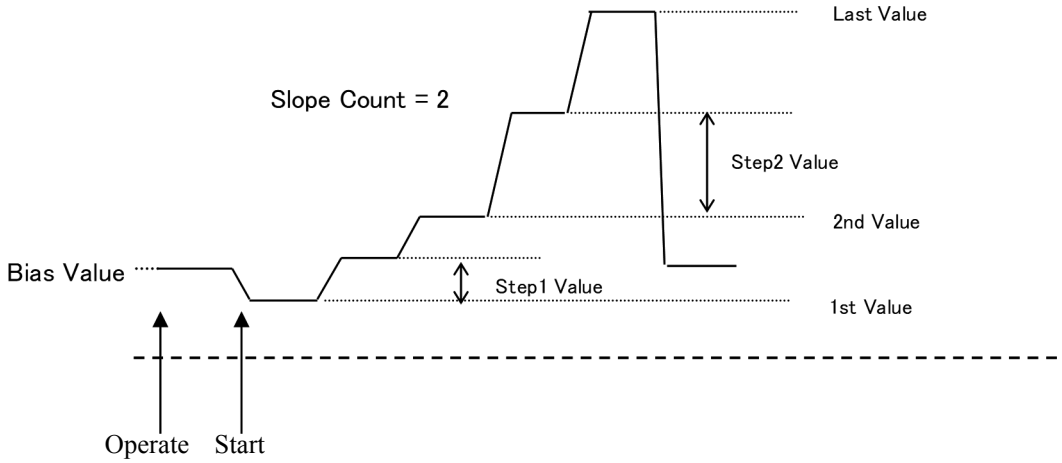



Figure 3-3 Multi-Slope Linear Sweep

***4) Sweep Memory*** Displays the source data screen for random sweep.

***Top Adr***: Displays and sets the top address.

Soft key **SetAdr** Sets the top address and switches the address setting.

Soft key **PageUp** Scrolls up one page.

Soft key **PageDown** Scrolls down one page.

Soft key **SAVE** Saves the random memory.

Soft key **LOAD** Loads the random memory.

Soft key **CLEAR** Clears the random memory.

***5) Time*** Sets the time-related parameters for source and measurement.

***Hold Time (Th)*** Sets the time from the sweep start to the step period start in the sweep source mode.

***Source Delay (Tds)*** Sets the delay time (Tds) from the start of the period time (Tp) to the source start in the pulse source mode or sweep source mode.

***Meas Delay (Td)*** Sets the delay time (Td) from the measurement trigger to the measurement start.

***PLS Width (Tw)*** Sets the pulse width (Tw) in the pulse source mode or pulse sweep mode.

***Period (Tp)*** Sets the following period time (Tp).

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

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

***6) Measure*** Sets the measurement-related parameters.

***Auto Zero*** Switches the measurement Auto Zero function ON or OFF.

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

OFF: Turns OFF the Auto Zero function. The AZ indicator turns OFF.

***Integ Time*** Sets the measurement integration time.
Select the integration time from
5 μs, 10 μs, 100 μs, 500 μs, 1 ms, 10 ms, 1 PLC, 2 PLC, 200 ms, and Variable.

***Variable IT*** Sets the variable integration time between 100 μs and 1000 ms.

***Measure SW*** Switches measurement ON or OFF.

ON: Executes measurement.

OFF: Not execute measurement.

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

6 digits: Displays measurement data with $6^1/_2$ digits.

5 digits: Displays measurement data with $5^1/_2$digits.

4 digits: Displays measurement data with $4^1/_2$ digits.

3 digits: Displays measurement data with $3^1/_2$ digits.

***Disp Unit*** Selects the output format style for measurement data and comparator upper and lower limit values.

Prefix: Displays measurement data by using a unit symbol.

Exponent: Displays measurement data in an exponential form.

***Mfunc Link*** Links the measurement function to the source function.

ON: The source function is linked to the measurement function. (VSIM/ISVM)

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

***Sample/Trigger*** Performs sampling the specified number of times by one trigger when the trigger mode is HOLD.
The sampling count is settable between 1 to 20,000. (Not available in the sweep source mode.)

***7) Store*** Sets the measurement data memory-related parameters.

***Store Mode*** Selects the measurement data memory functions.
The data in the measurement data memory are cleared when the Store Mode is changed.

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

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

OFF: Turns OFF the measurement data memory storage operation.

***Memory Clear*** Clears data in the measurement data memory.
Press the **ENTER** key to run.

***Memory View*** Displays the measurement data memory.

**Top Adr**: Displays and sets the top address.

Soft key **PageUp** Scrolls up one page.

Soft key **PageDown** Scrolls down one page.

***8) Compute*** Set the calculation-related parameters.

***Compare SW*** Switches the comparator calculation ON or OFF.

ON: Executes the comparator calculation.

The calculation result is reflected on the comparator calculation indicator, the header of remote output data and the status byte. The CMP indicator goes ON.

HI: High value < Measurement data

GO: Low value ≤ Measurement data ≤ High value

LO: Measurement data < Low value

OFF: Turns OFF the comparator calculation.

***Scaling SW*** Switches the scaling calculation ON or OFF.

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

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

OFF: Turns OFF the scaling calculation.

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

ON: Executes the MAX/MIN calculation.
The MAX indicator goes ON.

OFF: Turns OFF the MAX/MIN calculation.

***NULL SW*** Switches the NULL calculation ON or OFF.

ON: Executes the NULL calculation.
The NULL indicator goes ON.

OFF: Turns OFF the NULL calculation.

***Max/Min View*** Reads out the MAX/MIN calculation data.

| | |
|---|---|
| Maximum | Maximum measurement value |
| Minimum | Minimum measurement value |
| Total | Total measurement value |
| Average | Average measurement value |
| Sample Count | Number of calculated measurement data |

***9) Const*** Sets calculation constants.

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

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

***Scaling Value A*** Sets constant A for the scaling calculation.

***Scaling Value B*** Sets constant B for the scaling calculation.

***Scaling Value C*** Sets constant C for the scaling calculation.

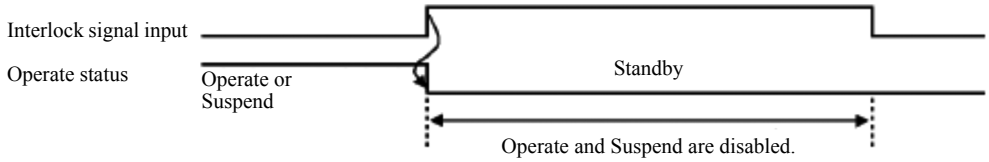
***NULL Value*** Changes the NULL value when the NULL calculation is ON.

***10) EXT Signal*** Sets the parameters related to the external control signals on the rear panel.

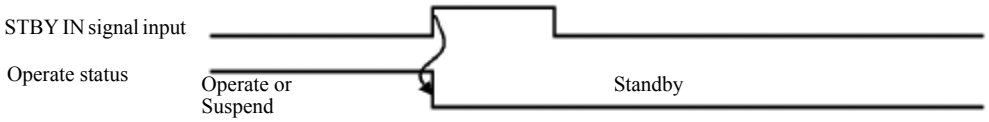
***OPR Signal*** Selects the input or output function of the external control signals: INTERLOCK and OPERATE IN/OUT.

Disable: Disables the input and output.

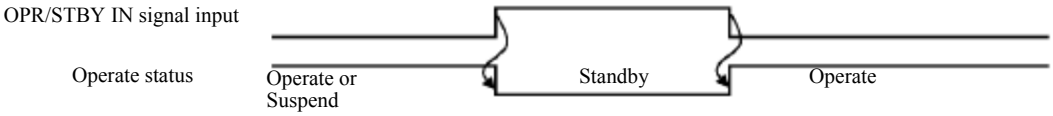
Interlock: Sets Standby when the signal level changes from LO to HI. While the input signal is HI, Operate and Suspend are disabled.



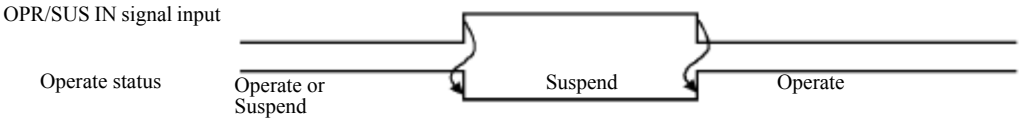

STBY IN: Sets Standby when the signal level changes from LO to HI. Set Operate by using the keys or remote commands.



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




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




OPR OUT: Outputs LO when the 6253 is in the Operate status, and HI in the Standby or Suspended status.


***Complete/Busy*** Selects the input or output function of external control signals: COMPLETE OUT and BUSY IN/OUT.

| | |
|---|---|
| Disable: | Disables the input and output. |
| MeasFront: | Outputs a negative pulse when the measurement starts. |
| Meas End: | Outputs a negative pulse when the measurement is completed and the period time ends. |
| CMP HI: | Outputs a negative pulse when the comparator calculation result is HI. |
| CMP GO: | Outputs a negative pulse when the comparator calculation result is GO. |
| CMP LO: | Outputs a negative pulse when the comparator calculation result is LO. |
| CMP HI/LO: | Outputs a negative pulse when the comparator calculation result is HI or LO. |
| Busy In: | Inputs a busy signal for synchronous operation. When the input is LO, measurement and sweep step operation are not performed until it becomes HI. |
| Busy Out: | Outputs a busy signal for synchronous operation. The LO level signal is output from the start of the period to the end of the measurement and period. |
| Sweep End: | Outputs a negative pulse at the end of the sweep. |

***TRIG IN*** Sets the external trigger input.

Disable: Disables the external trigger input.

Enable: Enables the external trigger input.

***Sig Width*** Selects the output pulse width, 10 μs or 100 μs.

***11) Parameter*** Loads or saves setting parameters.

***Param Load*** Loads saved parameters save in the non-volatile memory. Not available in the Operate status.

Load0 to 3: Loads the setting parameters from areas Save0 to 3.

LoadDefault: Loads the factory default settings (RINI command) as setting parameters.

***Param Save*** Saves the setting parameters.

Save0 to 3: Saves the setting parameters into areas Save0 to 3 of the non-volatile memory.

SetDefaultALL: Sets the factory default settings (RINI command) in all the areas from 0 to 3.

***12) Interface*** Selects or sets the interface.

***I/F BUS*** Selects the interface.

USB: Selects the USB interface.

GPIB: Selects the GPIB interface.

LAN: Selects the LAN interface.

RS232: Selects the RS-232 interface.

USB CDC: Selects the USBCDC interface.

***Header*** Switches the header ON or OFF.

***Output Monitor*** Switches the source value monitor ON or OFF.

***GPIB Address*** Sets the GPIB address from 0 to 30.

***USB ID*** Sets the USB ID from 1 to 127.

***RS232 Config*** Sets the RS-232 configuration.

***Baud Rate*** Selects the baud rate.

19200: 19,200 (bps)

9600: 9,600 (bps)

4800: 4,800 (bps)

2400: 2,400 (bps)

1200: 1,200 (bps)

600: 600 (bps)

300: 300 (bps)

***Data Bit*** Selects the number of data bits.

8 bit: Data length of 8 bits

7 bit: Data length of 7 bits

***Parity Bit*** Selects the parity bit.

NONE: No parity bit

ODD: Odd parity bit

EVEN: Even parity bit

***Stop Bit*** Selects the stop bit.

1 bit: Stop bit of 1 bit

2 bit: Stop bit of 2 bits

***IP Address*** Sets the IP address between 0.0.0.0 and 255.255.255.255.

***Gateway*** Sets the default gateway between 0.0.0.0 and 255.255.255.255.

***Subnet Mask*** Sets the subnet mask between 0.0.0.0 and 255.255.255.255.

***MAC Address*** Displays the MAC address. (Viewing only)

***Output Format*** Selects the output format.

ASCII: Output measured values in character strings.

REAL64: Outputs measured values in the IEEE754 format.

***13) System*** Sets the system-related parameters.

***Limit Buzzer*** Sounds when the limit (compliance) is activated.

ON: Turns ON the limit detection buzzer.

OFF: Turns OFF the limit detection buzzer.

***Compare Buzzer*** Sounds according to the comparator calculation result of measurement data.

OFF: Turns OFF the comparator calculation buzzer.

HI: Sounds when the comparator calculation result is HI.

GO: Sounds when the comparator calculation result is GO.

LO: Sounds when the comparator calculation result is LO.

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

***Notice Buzzer*** Sounds when operations such as memory full, saving or loading parameters are complete.

ON: Turns ON the notice buzzer.

OFF: Turns OFF the notice buzzer.

***Self Test*** Executes the self-test for selected items.
Select items with the rotary knob and press the **ENTER** key to run.

1) Self Test: Self test execution

2) LCD Pattern Display: Display test

3) Key & Buzzer Test: Key and buzzer test

***Relay Count*** Displays relay operation count.
(Viewing only)

***Serial No/REV*** Displays the serial number and software revision. (Viewing only)

***LCD Off*** Turns OFF the display.
The **EXIT** key blinks while the display turns OFF.
Press the **EXIT** key to turn ON the display again.

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

Power Off: Starts up using the setting parameters when the power last turned OFF.

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

***Error Log*** Displays the number of errors that occurred
Press the **ENTER** key to display the error log list.

***Compati Mode*** Sets the 6243/6244-compatible mode.
(Changing this setting will initialize the 6253/6254.)

ON: Turns ON the 6243/6244-compatible mode.

OFF: Turns OFF the 6243/6244-compatible mode.

***14) Graph*** Sets the system parameters.

***Graph*** Displays the step numbers of the measurement data memory on the horizontal axis and the measured values on the vertical axis.

***Monitor-Measure Graph*** Displays the monitor value of the measurement data memory on the horizontal axis and the measured values on the vertical axis.

### 3.2.2 SHIFT Key (Shift Mode)

In the shift mode, the **SHIFT** key is lit and the blue characters on the panel are enabled.

Press the **SHIFT** key again to release the shift mode and turn OFF the **SHIFT** key.

### 3.2.3 Soft Keys

The soft keys are used to select the displayed items on the lower side of the screen.

The displayed parameters vary according to the selected item.

For more information on the soft keys, refer to Section 2.3, “Soft Keys.”

### 3.2.4 ◀ ▶ Keys (Right and Left Keys)

The ◀ ▶ Keys are used to move the cursor position for numerical input.

### 3.2.5 ENTER Key

The ENTER key is used to confirm input numbers or selected items.

### 3.2.6 EXIT Key/LOCAL Key

**EXIT** key: Cancels selected items.
Returns to the previous value and releases the edit status.
On the MENU layer, the display moves to the upper level.

**LOCAL** key: Enters the local operation status.
The RMT indicator goes OFF and remote control switches to panel operation.

## 3.2.7 TRIG Key and SWP STOP Key (Trigger/Sweep Stop)

**TRIG** key: Functions as source or measurement trigger key.

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

**SWP STOP** key (shift mode): Stops sweep.

| Source mode | | AUTO | HOLD |
|---|---|---|---|
| DC/Pulse | | - | - |
| Sweep | Before sweep start | - | - |
| | During sweep | Stops sweep. | Stops sweep. |

## 3.2.8 HOLD Key (Trigger Mode)

The **HOLD** key is used to switch the trigger mode for source and measurement.

| Source mode | AUTO | HOLD |
|---|---|---|
| DC/Pulse | Repeats source and measurement with the period time of the time parameter. | Executes source and measurement by trigger input.<br>The **HOLD** key is lit. |
| Sweep | | Executes source and measurement by one step by trigger input, and pauses sweep.<br>The **HOLD** key is lit.<br>*Invalid in the Burst mode. |

## 3.2.9 DATA ENTRY Keys (Numerical Data Input)

The DATA ENTRY keys are used to change the voltage source value, current source value, limit values and other numerical parameters.

**0** to **9** keys: Enter numerical data 0 to 9

**.**key: Enters a decimal point

**+/-** key: Sets polarities +/-

Rotary knob: Changes the prefix of numerical data (p, n, μ, m, k, M, etc.).

**CE** key: Cancels input data at data setting.

**BS** key: Deletes the last character of input data.

**ENTER** key: Confirms input data and stores the parameter.

**EXIT** key: Cancels numerical data input.
Returns to the previous value and releases the edit status.

## 3.2.10 OPR Key/SUSPEND Key (Operate/Suspend)

**OPR** key: Switches the output status between Operate and Suspend.
Pressing this key in the Standby or Suspend status will switch to the Operate status.
In the Operate status, the output turns ON and the **OPR** key is lit.
Pressing this key in the Operate status will switch to the Suspend status.
In the Suspend status, suspend voltages are output without turning OFF the output relays.
The **OPR** key flashes.

**SUSPEND** key (shift mode):
The Suspend status is selectable between HiZ (high impedance status) and LoZ (low impedance status).
Fore more information, refer to Section 4.2.4.6, “Operate, Standby and Suspend.”

---

*WARNING: Beware of electrical shock! In the Operate status (output relay ON), hazardous voltage may occur depending on the settings.*

---

## 3.2.11 STBY Key (Output Standby)

The **STBY** key is used to turn OFF the output relays to set Standby status. The **OPR** indicator goes OFF.

---

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

---

# 4. TECHNICAL REFERENCES

This chapter describes the detailed functions to perform more accurate source and measurement.

## 4.1 DUT Connection

### 4.1.1 Output Terminals (Front and Rear Output Terminals)

The following figure shows the internal connections of the 6253/6254.

The output terminals are cut off from the internal circuits by the Operate/Standby relays in the Standby status. The front output terminal and the rear output terminal are mutually connected in the Standby status as well.

*CAUTION: Connect a sample to either of the front or rear output terminal. If external power sources such as batteries are connected to both of the output terminals, a short circuit will occur internally.*

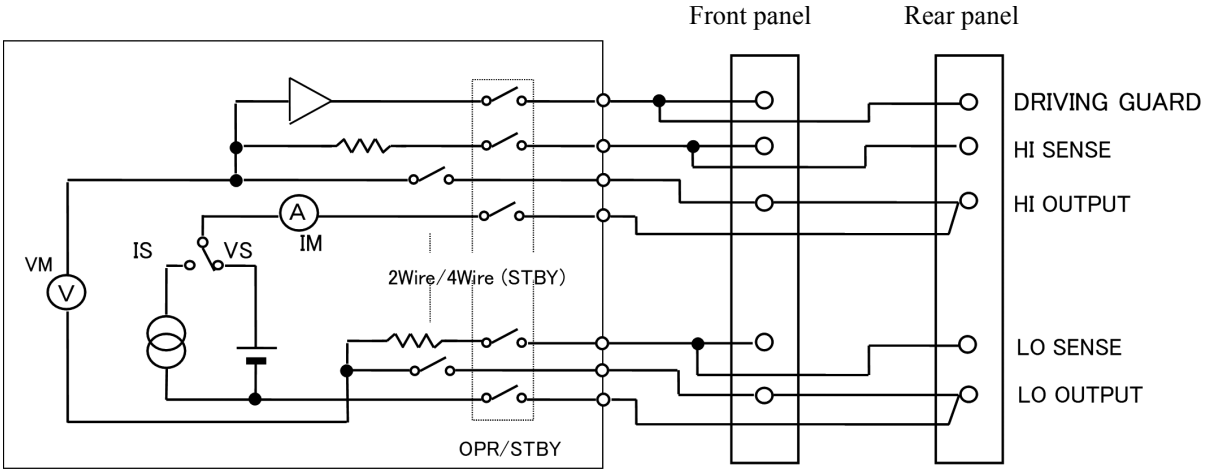



Figure 4-1 Internal Connection

Only the 6253 is equipped with the rear terminal and the DRIVING GUARD.

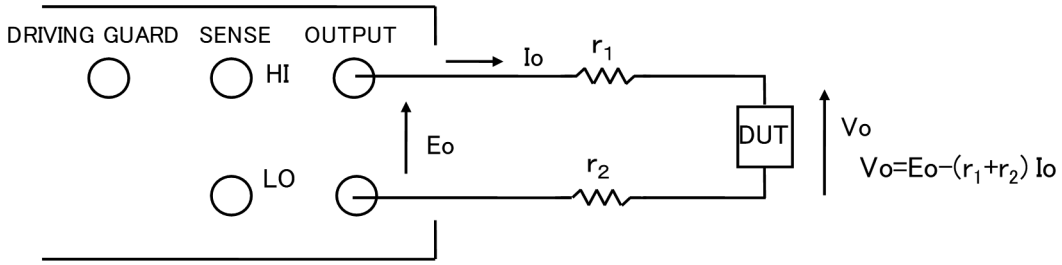
## 4.1.2 Remote Sensing (2-Wire/4-Wire Connection)

When connecting a DUT to the 6253/6254, use 2-wire or 4-wire connection while considering the following conditions:

- Apply 2-wire connection if the output current is relatively low and the cable line resistance does not matter.
- Apply 4-wire connection if the output current is relatively high and the cable line resistance matters.
- When using within the specified accuracy:
  (Line resistance × output current) ≤ 10 μV → 2-wire connection
  (Line resistance × output current) > 10 μV → 4-wire connection
  The line resistance of the supplied cable A01044 is approximately 100 mΩ.
  Thus, when the output current is 100 μA or higher, use the 4-wire connection.
- When allowing the error voltage (ev):
  (Line resistance × output current) ≤ ev → 2-wire connection
  (Line resistance × output current) > ev → 4-wire connection
  When the supplied cable A01044 is used and the error voltage of 10 mV is allowed, the 2-wire connection can be used up to 100 mA.

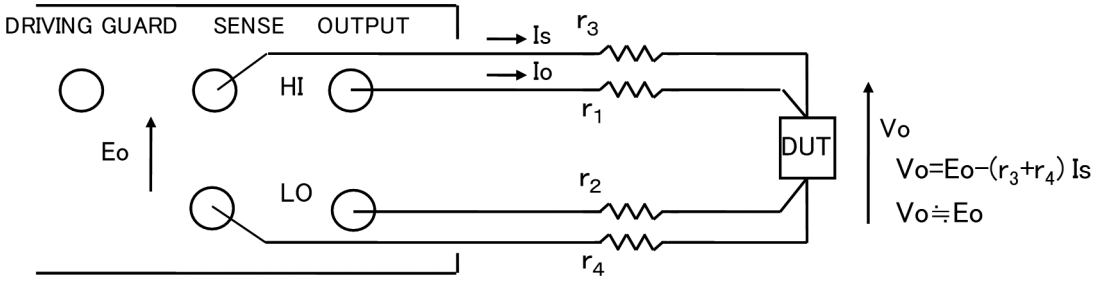
Use the following procedure to apply 2-wire or 4-wire connection.

1. Press the soft key **Source**.
2. Press the soft key **NEXT**.
3. Press the soft key **2W/4W**, and choose **2W** for 2-wire connection or **4W** for 4-wire connection.




An error may occur due to voltage drop at $r_1$ and $r_2$.

(a) 2-wire connection




(b) 4-wire connection

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

---

*NOTE: The maximum remote sensing voltage (tolerable voltage difference between OUTPUT and SENSE) is ±3 V at both the HI and LO sides. However, when the maximum output voltage is between HI SENSE and LO SENSE, it becomes ±0.5 V for the 6253 or ±1 V for the 6254.*

*To satisfy the specified accuracy, maintain the following restriction for $r_1$ to $r_4$.*

*$r_1, r_2 \leq 3\ V/Io\ [\Omega]$ (Io = Output current)*

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

*(Vos = $r_1$Io, $r_2$Io)*

*(Example) If Io = 2 A*

*$r_1, r_2 \leq 3\ V/2\ A = 1.5\ \Omega$*

*$r_1, r_2 = 1.5\ \Omega$*

*Then,*

*$r_3, r_4 \leq \frac{10\ \mu V}{3\ V} \times 220\ k\Omega = 0.73\ \Omega$*

---

## 4.1.3 Preventing Oscillation

The DUT itself may oscillate, or the 6253/6254 may oscillate if capacitance or inductance exceeding the specified value is connected (due to stray capacitance or retained inductance from connected cables, a scanner, or a fixture).

Judge whether the DUT or the 6253/6254 oscillates by the oscillation frequency. The 6253/6254 does not oscillate at 2 MHz or over.

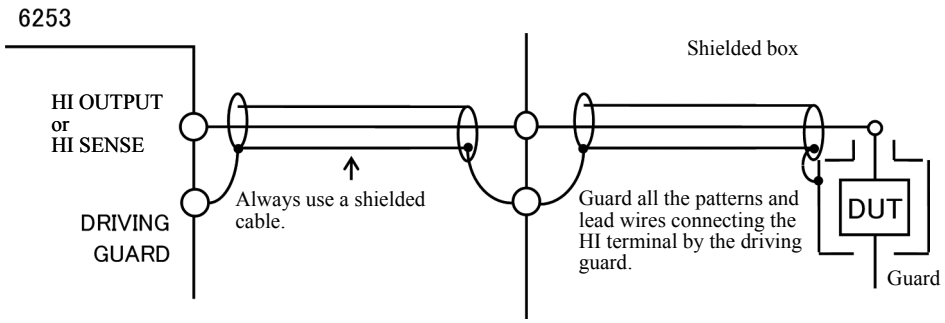
### 4.1.3.1 Preventing 6253/6254 Oscillation

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

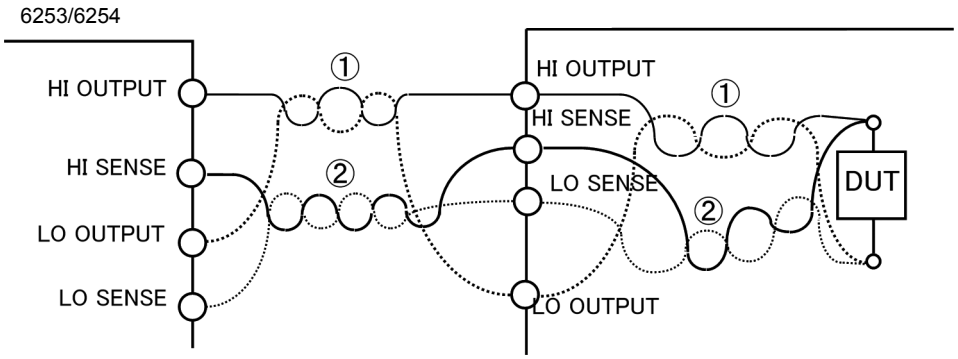
   Remove the causes of oscillation according to the following procedure:

   1. Verify if the load capacitance or load inductance does not exceed the maximum load capacitance or load inductance specified in Chapter 8, "SPECIFICATIONS."
   2. Check if the 6253/6254 still oscillates when cables of the shortest lengths are connected.
   3. If the shorter cables stop the oscillation, then connect cables as shown in Figure 4-3 to reduce the capacitance and inductance of the cables and other devices.
   4. If the oscillation does not stop even if the cables are the shortest possible, insert an allowable resistor for the DUT as shown in Figure 4-5.

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

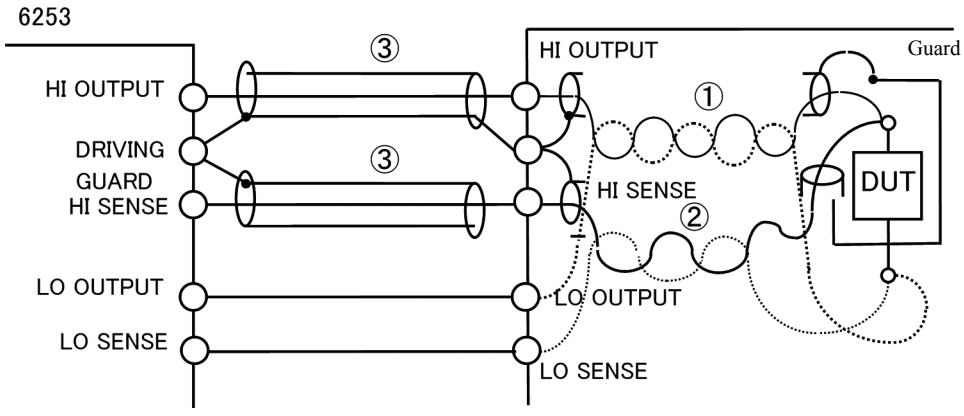



● Reducing stray capacitance and leak current by using the DRIVING GUARD terminal




① The HI OUTPUT and the LO OUTPUT must be twisted in pairs.
② The HI SENSE and the LO SENSE must be twisted in pairs.

● Reducing lead inductance in wiring




① The HI OUTPUT and the LO OUTPUT must be twisted in pairs.
② The HI SENSE and the LO SENSE must be twisted in pairs.
③ Use a coaxial cable on the HI side.

● Reducing inductance when using a coaxial cable

Figure 4-3 Reducing Stray Capacitance and Lead Inductance

### 4.1.3.2 Preventing DUT Oscillation

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

Take the following measures to prevent oscillation.

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

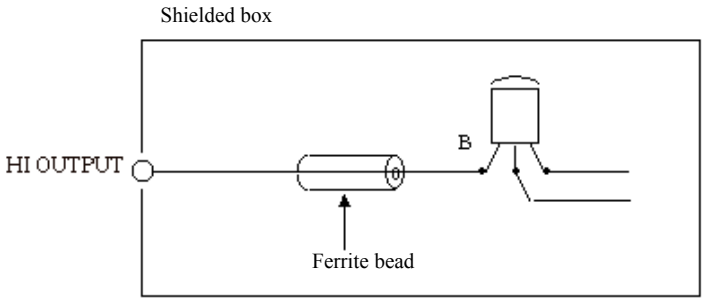



Figure 4-4 Preventing DUT Oscillation

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

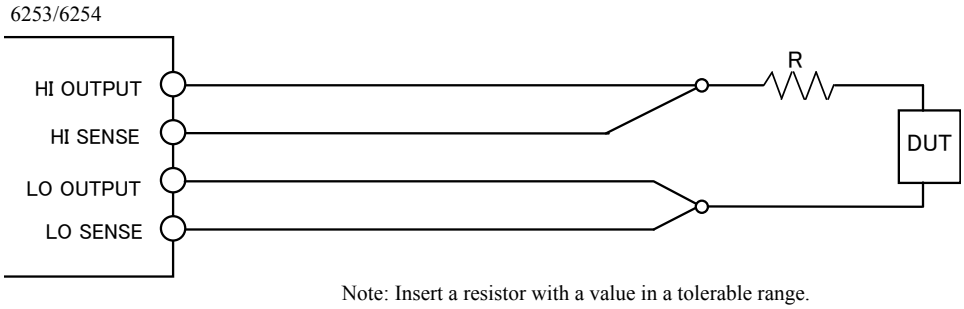



Figure 4-5 Preventing 6253/6254 Oscillation

## 4.1.4 Connection for High Current Measurement

Be sure to use 4-wire connection to measure high current.
Twist together the cables between **HI OUTPUT** and **LO OUTPUT** and between **HI SENSE** and **LO SENSE** from the output terminal to the DUT terminal as in Figure 4-6 to avoid overshoot or delay in response because of cable inductance.

To prevent induction noise, use twisted-pair shielded cables for **OUTPUT** and **SENSE** as in Figure 4-6. Especially, be sure to use shielded cables when measuring current of 1 μA or less.

The cables for **OUTPUT** must satisfy the thickness requirement below, and the voltage difference between **OUTPUT** and **SENSE** must be 3 V or less for both **HI** and **LO**.
There is a limit on the output range including this voltage difference. Be sure to set the voltage between the **HI OUTPUT** and **LO OUTPUT** terminals within the maximum output range.

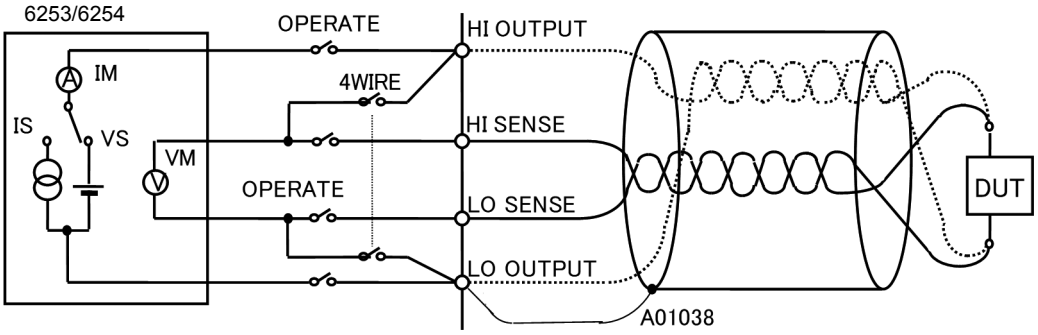



Figure 4-6 Connection for High Current Measurement

Tolerable Current and Wire Thickness

| Current | Wire (AWG) |
|---|---|
| 2 A or less | 22 |
| 3.2 A or less | 18 |
| 20 A or less | 14 |

## 4.1.5 Connection with Fixture 12701A

The following figure shows the connection with the 12701A.

This example uses 4-wire connection.

2-wire connection does not require the SENSE connection.

For more information on the device connection inside the 12701A, refer to the 12701A Operation Manual.

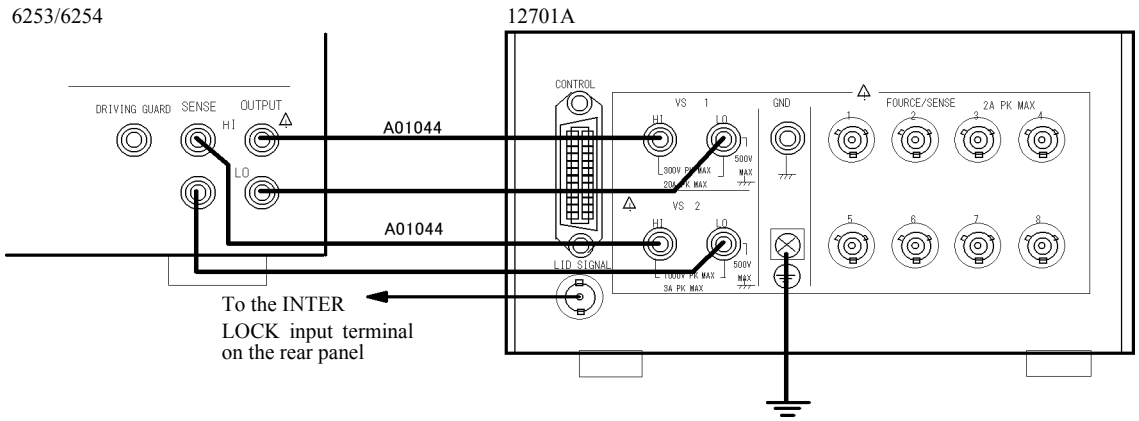



Figure 4-7 Connection with 12701A

*WARNING:*

*Follow the procedure below to prevent electric shock.*

1. *Be sure to ground the 12701A protective grounding terminal.*
2. *Connect the 12701A LID SIGNAL to the INTERLOCK terminal on the 6253/6254 on the rear panel, and set the parameter "OPR Signal" to Interlock.*
   *This enables the interlock function. If the 12701A cover opens, the 6253/6254 will be set to Standby.*

## 4.2 Functions in Detail

### 4.2.1 Operations in DC Source Mode

The following table shows operations in the DC source mode.

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

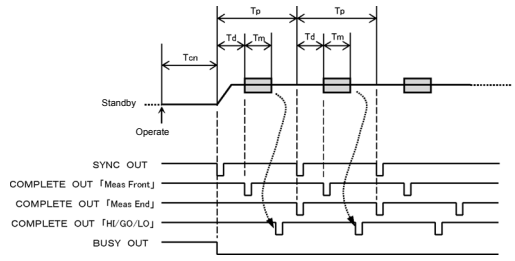
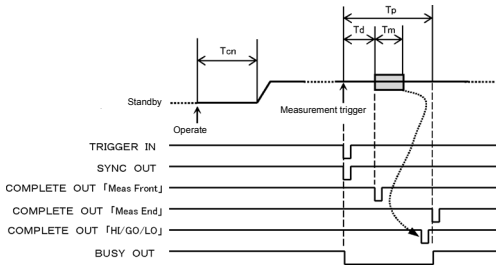
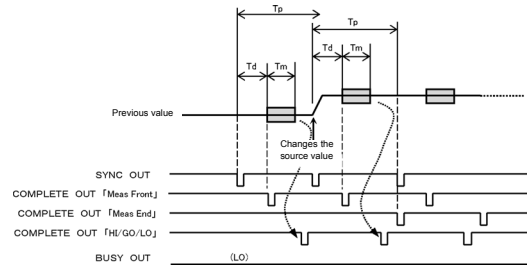
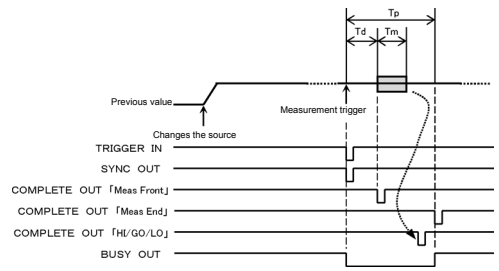
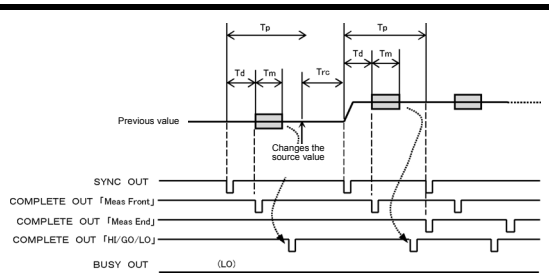
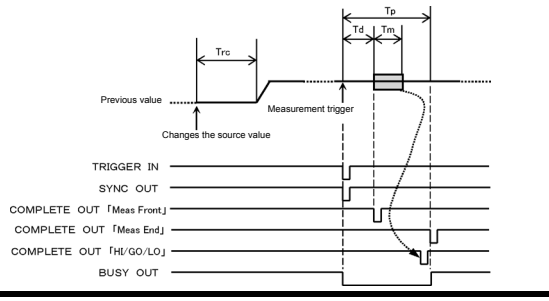
| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Operate ON | AUTO | Executes continuous measurement with the setting period time Tp. |  | Tp: Period time<br>Td: Measurement delay time<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | Executes measurement after trigger input. |  | |
| Changing the source value | AUTO | Source value changing does not induce range changing. |  | |
| | HOLD | |  | |

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

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

a. When the trigger mode is AUTO:
   - The measurement repeats itself at intervals of the specified period time.
   - If the measurement does not finish in the specified period, the period time is extended.

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

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

## 4.2.2 Operations in Pulse Source Mode

The following table shows operations in the pulse source mode.

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

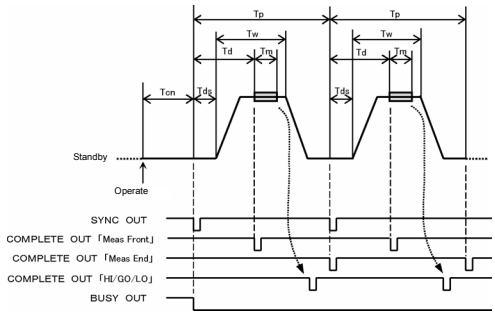
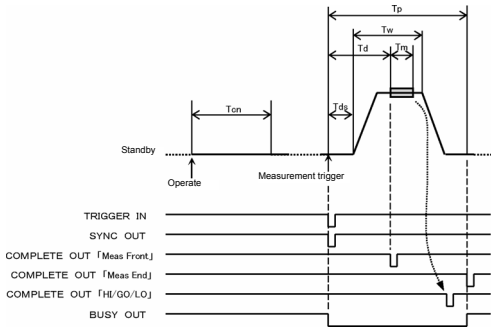
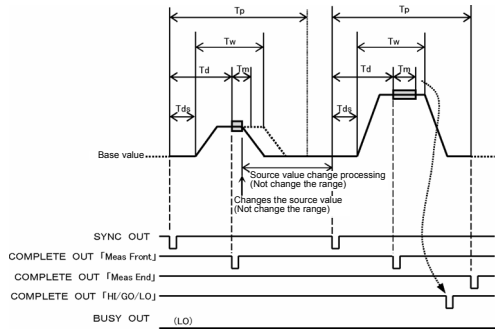
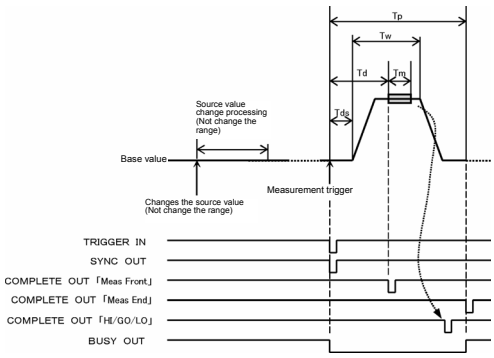
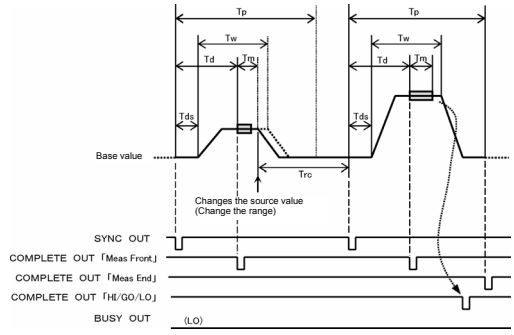
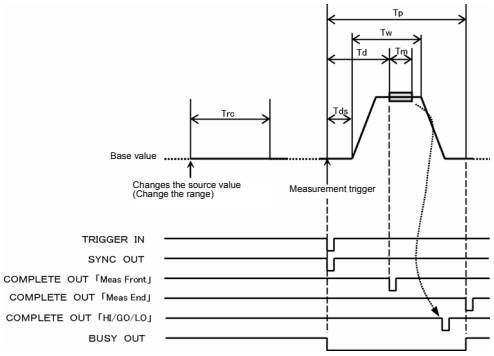
| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Operate ON | AUTO | Executes continuous measurement with the setting period time Tp. |  | Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tw: Pulse width<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | Executes measurement after trigger input. |  | |

Table 4-2 Operations in Pulse Source Mode (2 of 2)

| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Changing the source value | AUTO | Source value changing does not induce range changing. |  | Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tw: Pulse width<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | |  | |
| Changing the source value | AUTO | Source value changing induces range changing. |  | |
| | HOLD | |  | |

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

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

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

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

## 4.2.3 Operations in Sweep Source Mode

The Table 4-3 shows operations in the sweep source mode.

Table 4-3 Operations in Sweep Source Mode (1 of 2)

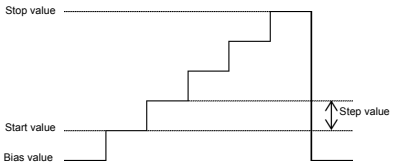
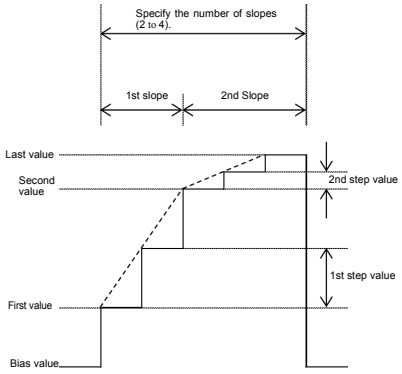
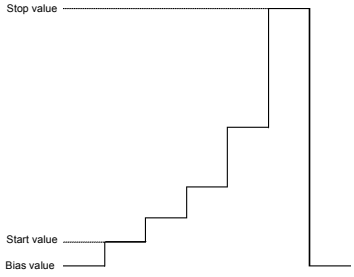
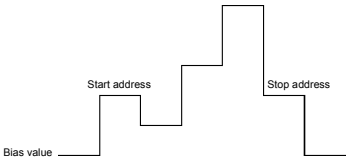
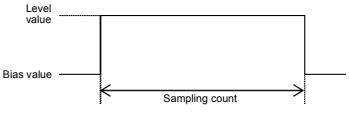
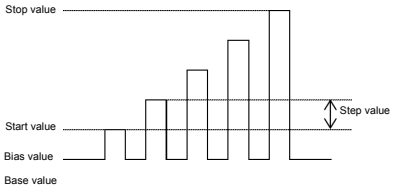
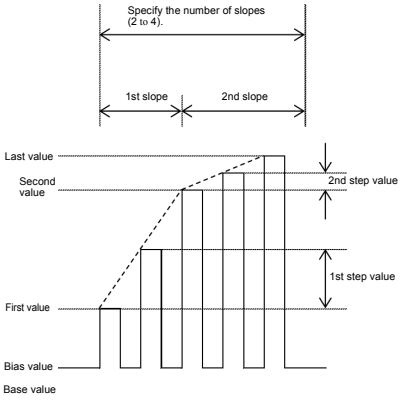
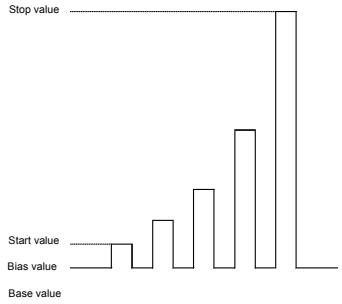
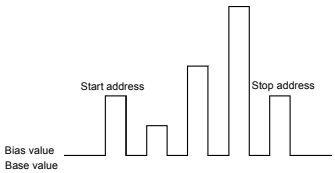
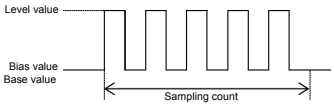
| Sweep type | | Operational Descriptions | Waveform |
|---|---|---|---|
| DC Sweep ***DCSWP*** | Linear sweep ***Linear*** | Generates staircase waveforms of the step value between the start value and the stop value.<br><br>Kth output value = Start value + (K - 1) × (Step value)<br>Number of steps = (\|Stop value – Start value\|) / (Step value) +1 |  |
| | Multi-slop linear sweep ***MLinear*** | Generates staircase waveforms of different slopes by specifying the number of slopes between 2 and 4.<br><br>1st slope:<br>Kth output value = First value + (K - 1) × (1st step value)<br>Number of steps = (\|Second value - First value\|) / (1st step value) +1<br>2nd slope:<br>Kth output value = Second value + (K - 1) × (2nd step value)<br>Number of steps = (\|Last value - Second value\|) / (2nd step value) +1 |  |
| | Log sweep ***Log*** | Generates staircase waveforms logarithmically divided by the number of steps by decade.<br><br>Kth output value = Start value × S<br>$S = 10^{(K-1)/n}$<br>n: Number of partitions by decade (1,2,5,10,25,50)<br>• Start value, Stop value ≠ 0<br>• \|Start value\| ≤ \|Stop value\|<br>• Start value polarity = Stop value polarity |  |
| | Random sweep ***Random*** | Generates waveforms of the source values stored in the memory from the start address to the stop address. |  |
| | Fixed level sweep ***Fixed*** | Generates waveforms of the specified level by the specified sampling count. |  |

Table 4-3 Operations in Sweep Source Mode (2 of 2)

| Sweep type | | Operational Descriptions | Waveform |
|---|---|---|---|
| Pulse sweep ***PLSSWP*** | Linear sweep ***Linear*** | Generates staircase pulse waveforms of the step value between the start value and the stop value.<br>Kth output value = Start value + (K - 1) × (Step value)<br>Number of steps = (\|Stop value – Start value\|) / (Step value) +1 |  |
| | Multi-Slope Linear Sweep ***MLinear*** | Generates staircase pulse waveforms of different slopes by specifying the number of slopes between 2 and 4.<br>1st slope:<br>Kth output value = First value + (K - 1) × (1st step value)<br>Number of steps = (\|Second value - First value\|) / (1st step value) +1<br>2nd slope:<br>Kth output value = Second value + (K - 1) × (2st step value)<br>Number of steps = (\|Last value - Second value\|) / (2nd step value) +1 |  |
| | Log sweep ***Log*** | Generates staircase pulse waveforms logarithmically divided by the number of steps by decade.<br>Kth output value = Start value × S<br>$S = 10^{(K-1)/n}$<br>n: Number of partitions by decade (1, 2, 5, 10, 25, 50)<br>• Start value, Stop value ≠ 0<br>• \|Start value\| ≤ \| Stop value\|<br>• Start value polarity = Stop value polarity |  |
| | Random sweep ***Random*** | Generates pulse waveforms of the source values stored in the memory from the start address to the stop address. |  |
| | Fixed level sweep ***Fixed*** | Generates pulse waveforms of the specified level by the specified sampling count. |  |

1. Setting the sweep type
   - Select ***DC Sweep*** or ***Pulse Sweep*** by using the soft key **MODE**.
   - Select ***Linear, MLinear, Log, Random*** or ***Fixed*** by using the soft key **SWPType**.

2. Changing the sweep measurement parameters

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

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

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

### 4.2.3.1 Operations in DC Sweep Source Mode

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

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

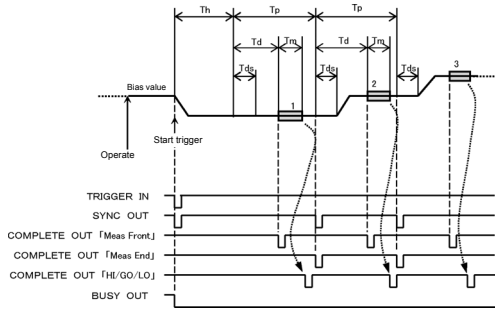
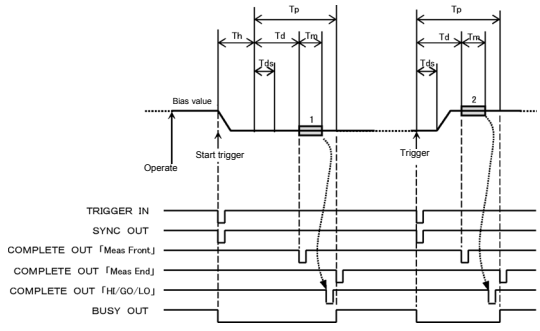
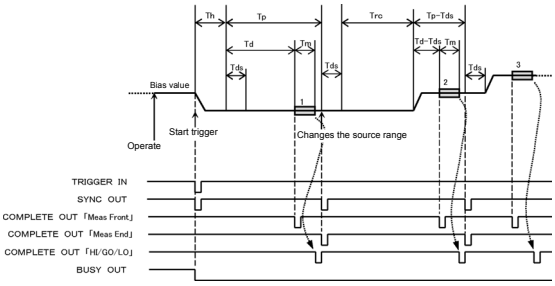
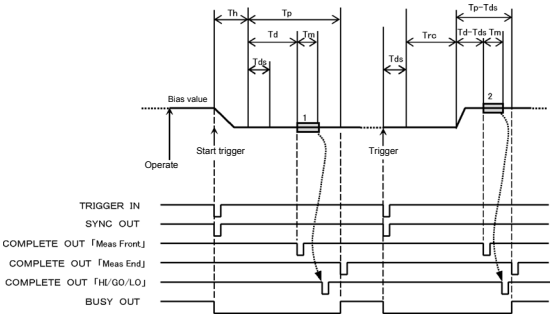
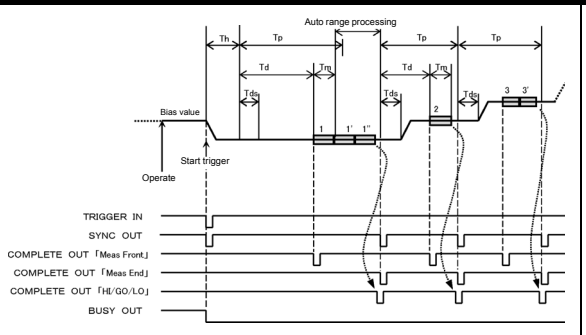
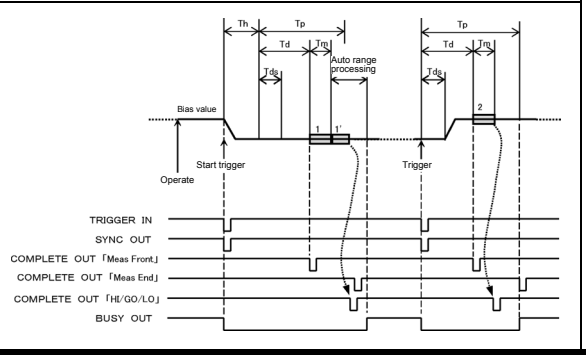
| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Operate ON | AUTO | Executes continuous measurement with the setting period time Tp. |  | Th: Hold time<br>Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | Executes measurement after trigger input. |  | |
| Changing the source range | AUTO | Changes the source range during sweep. |  | |
| | HOLD | |  | |

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

| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Changing the measurement range | AUTO | Changes the measurement range during sweep. |  | Th: Hold time<br>Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | |  | |

- The bias value is output before the sweep starts.
- The start value is output when the start trigger is input, and the sweep starts when the hold time has passed after start trigger input.
- When the trigger mode is AUTO, the sweep goes to the next step after every period time.

  However, if the measurement has not finished, the next step is delayed until the measurement is completed.
- When the trigger mode is HOLD, the sweep goes to the next step by every trigger input.

### 4.2.3.2 Operations in Pulse Sweep Source Mode

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

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

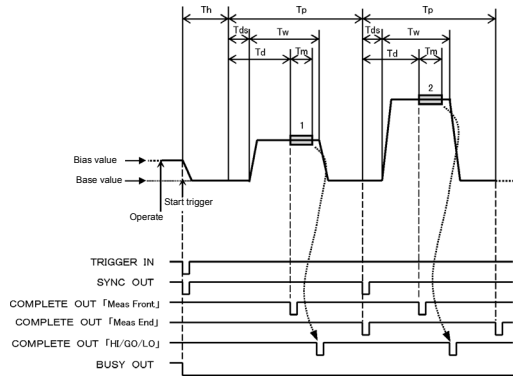
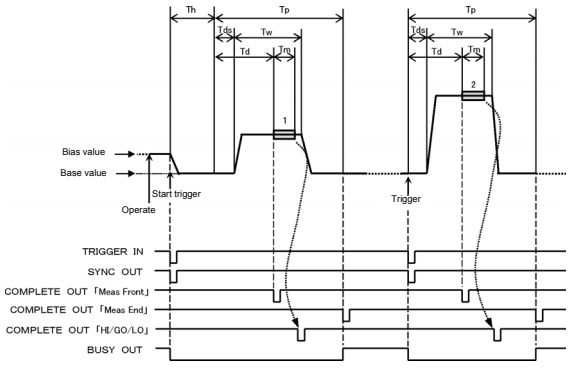
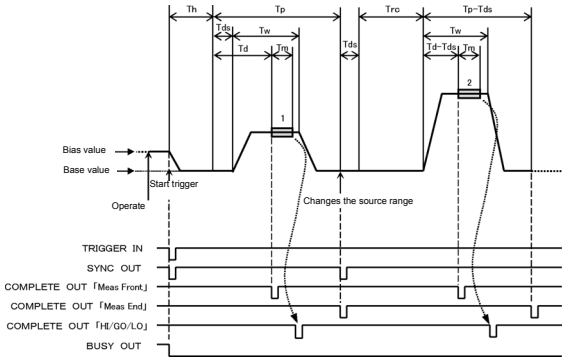
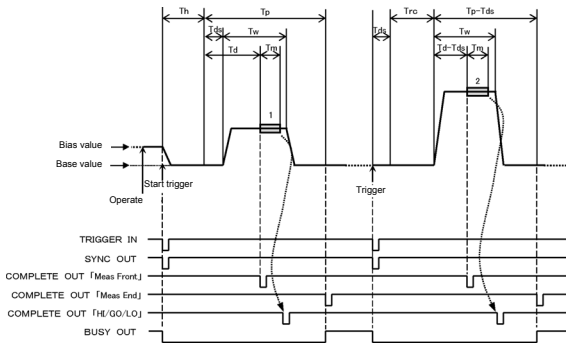
| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Operate ON | AUTO | Executes continuous measurement with the setting period time Tp. |  | Th: Hold time<br>Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tw: Pulse width<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | Executes measurement after trigger input. |  | |

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

| Operational condition | Trigger mode | Description | Operation | Remarks |
|---|---|---|---|---|
| Changing the source range | AUTO | Changes the source range during sweep. |  | Th: Hold time<br>Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tw: Pulse width<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD | |  | |

- The bias value is output before the sweep starts.
- The base value is output when the start trigger is input, and the sweep starts when the hold time has passed after start trigger input.
- When the trigger mode is AUTO, the sweep goes to the next step after every period time.

  However, if the measurement has not finished, the next step is delayed until the measurement is completed.
- When the trigger mode is HOLD, the sweep goes to the next step by every trigger input.

### 4.2.3.3 Random Sweep and Random Pulse Sweep

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

Function waveforms also can be generated by setting arbitral values in the memory.

As the random pulse sweep function shares this memory, whether to generate DC waveforms or pulse waveforms is selectable. Figure 4-8 below shows this relation.
Address 0 to address 19999 are available for the voltage and current functions respectively in the memory.

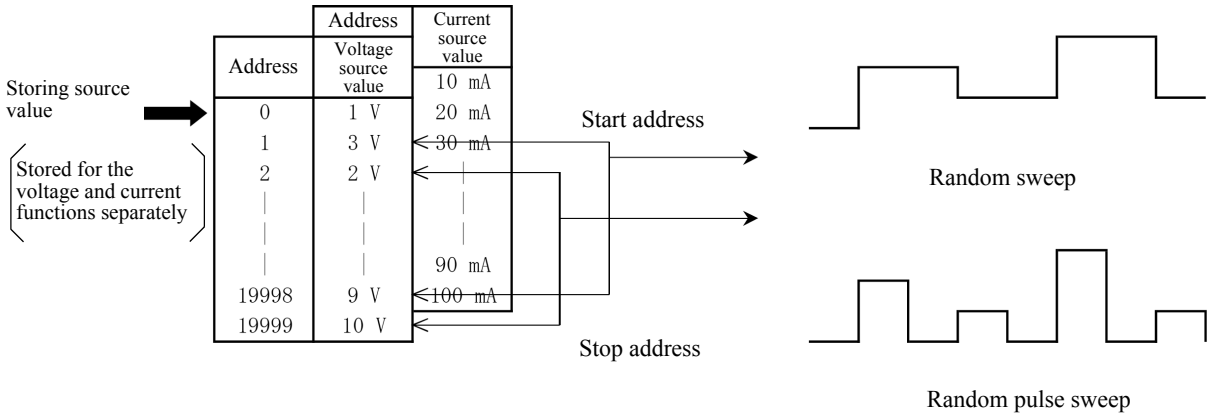



Figure 4-8 Random Sweep and Random Pulse Sweep

### 4.2.3.4 Multi-Slope Linear Sweep

The multi-slope linear sweep function can sweep the output with different slopes by specifying the number of slopes between 2 to 4.

When the first value is less than the last value, the step values are added. When the first value is larger than the last value, the step values are subtracted.

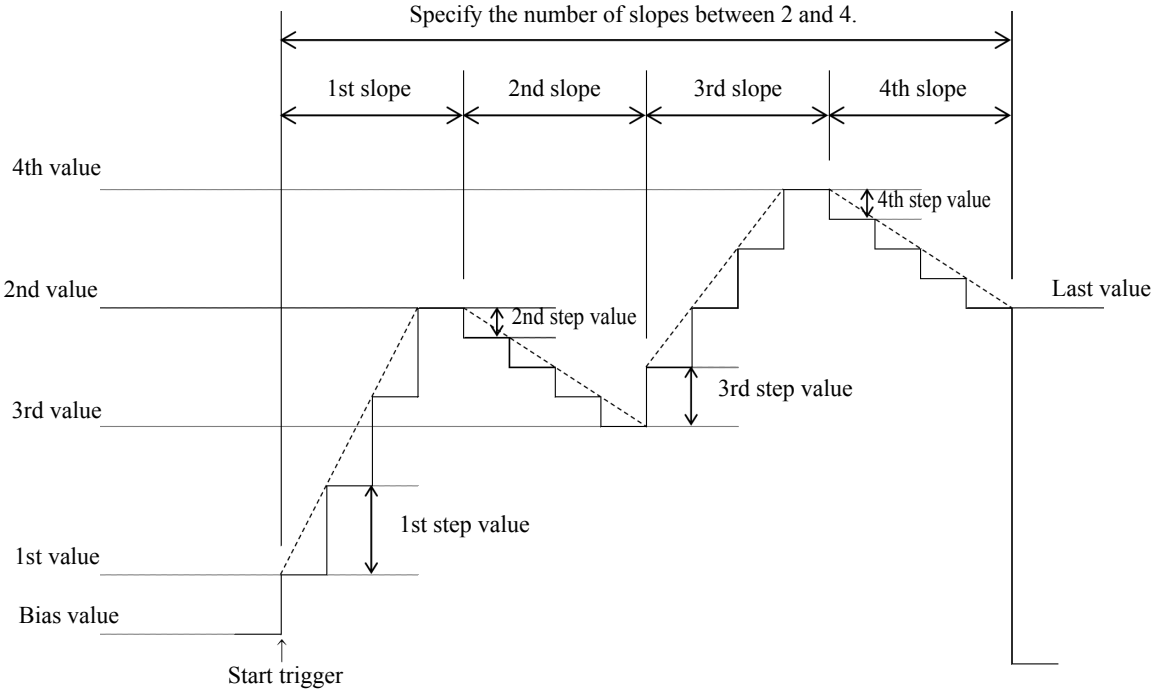



Figure 4-9 Multi-Slope Linear Sweep

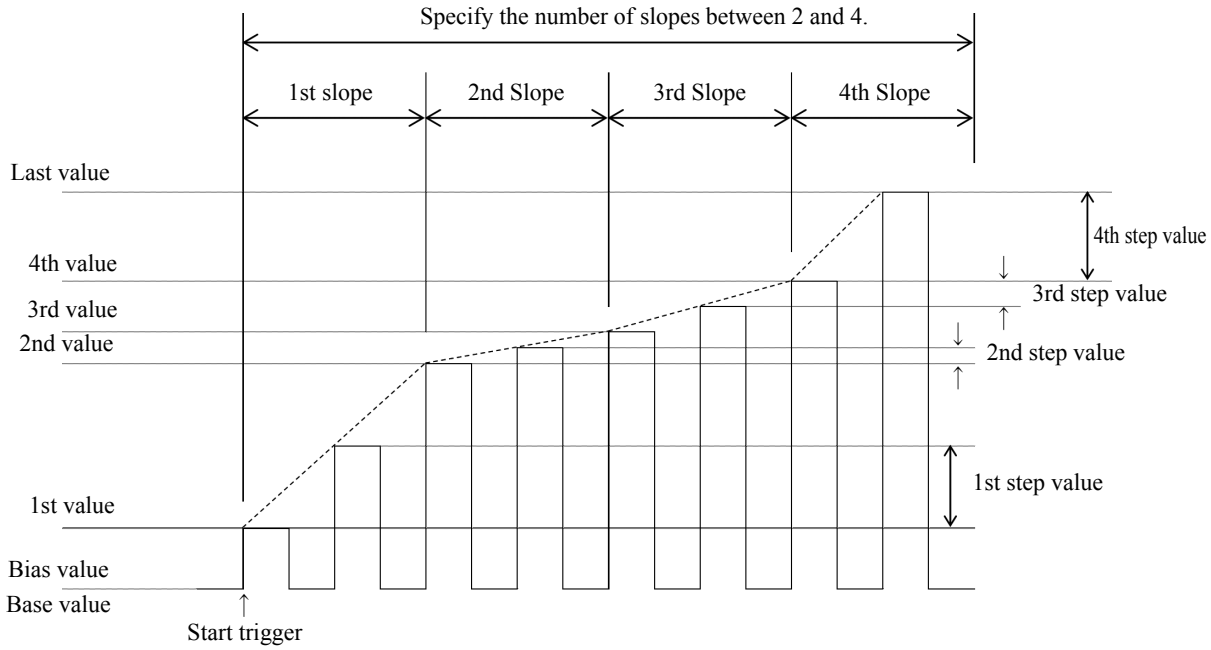



Figure 4-10 Multi-Slope Linear Pulse Sweep

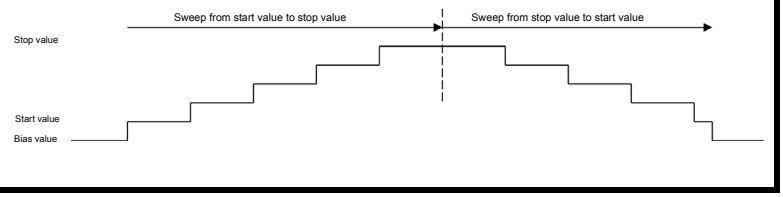
### 4.2.3.5 Reverse Function

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

Reverse OFF: One-way sweep

Reverse ON: Round sweep

The linear sweep sweeps as shown below.

| Sweep type | Descriptions | Waveform |
|---|---|---|
| Linear sweep<br>***Linear*** | Generates staircase waveforms of the number of steps from the start value to the stop value, then sweeps backwards in the same way from the stop value to the start value. |  |

Other types of sweeps also begin sweeping backwards to the start value at the stop value when the reverse mode is set to ON.

The following table shows the measurement and source timings in the sweep source mode with the reverse mode is set to ON (round sweep).

Table 4-6 Reverse Operations in DC Sweep Mode

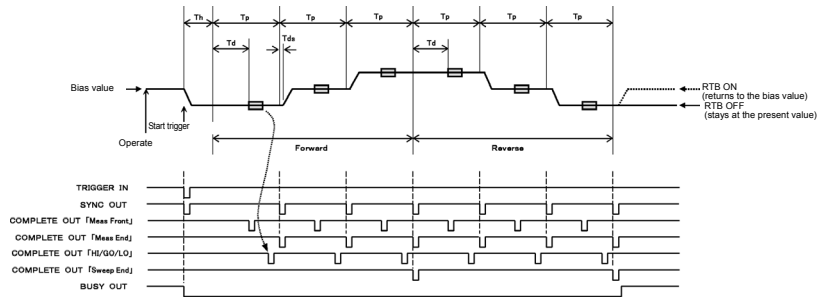
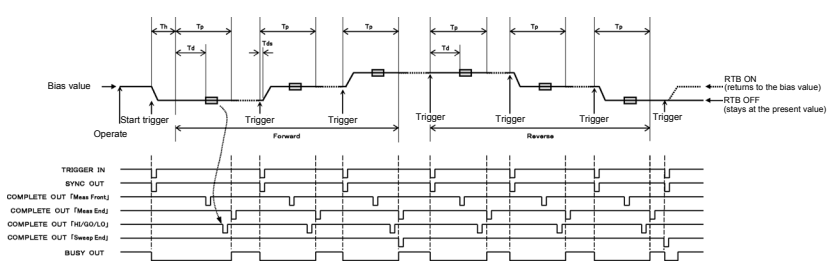
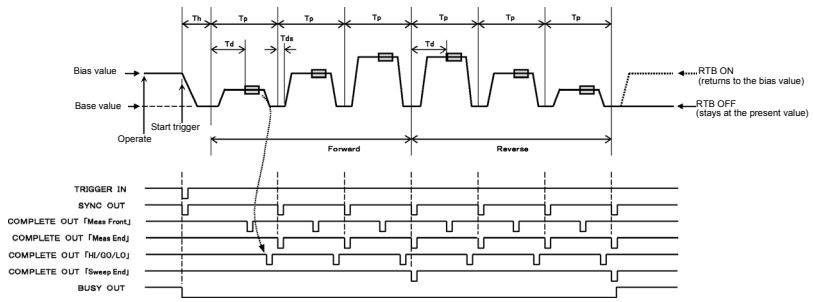
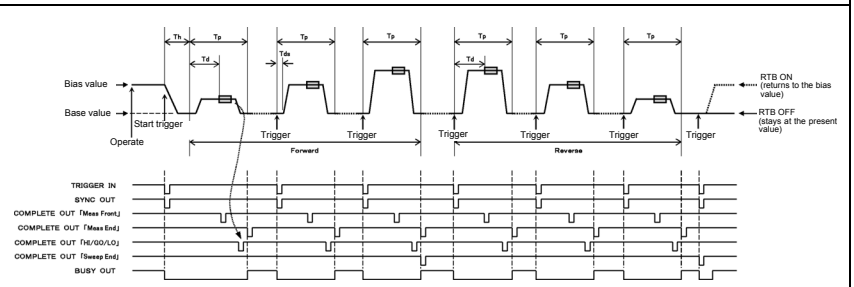
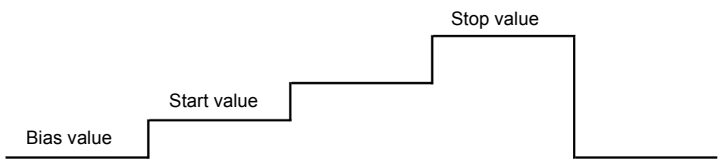
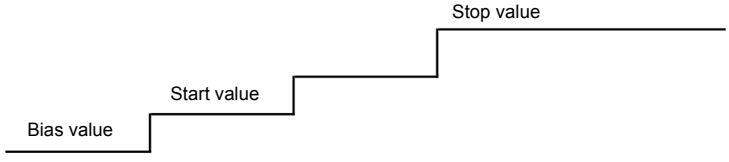
| Operational condition | Trigger mode | Operation | Remarks |
|---|---|---|---|
| DC Sweep | AUTO |  | Th: Hold time<br>Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD |  | |

Table 4-7 Reverse Operations in Pulse Sweep Mode

| Operational condition | Trigger mode | Operation | Remarks |
|---|---|---|---|
| Pulse sweep | AUTO |  | Th: Hold time<br>Tp: Period time<br>Td: Measurement delay time<br>Tds: Source delay time<br>Tm: Measurement time (Integration time + Measurement data processing time)<br>Tcn: Operate processing time<br>Trc: Range change processing time |
| | HOLD |  | |

## 4.2.3.6 Output Value at Sweep Stop

The output value at sweep stop varies depending on the RTB (Return to Bias) setting.

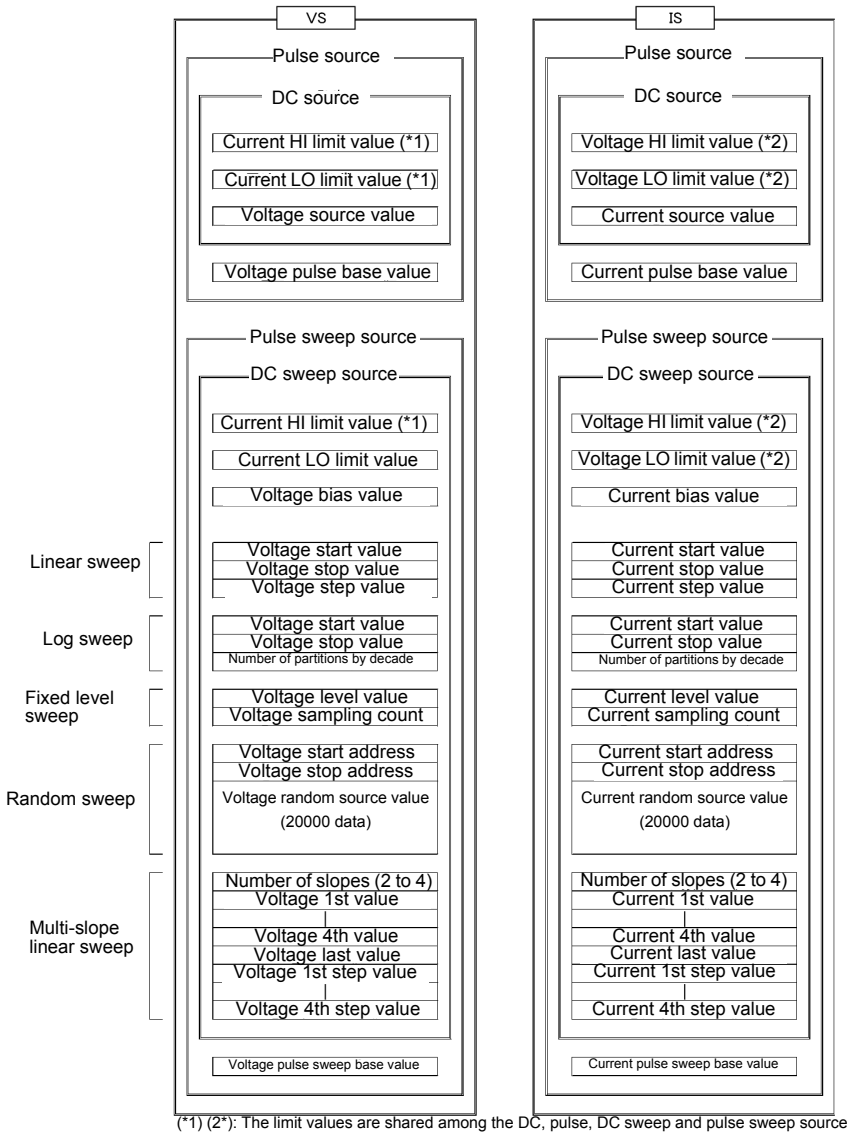
| RTB | Waveform | Operational Descriptions |
|---|---|---|
| ON |  | Returns to the bias value when sweep stops. |
| OFF |  | Stays at the stop value when sweep stops. |

## 4.2.4 Source Function

This section describes restrictions on and operations of the source function.

### 4.2.4.1 Source Mode, Source Function and Setting Parameters

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




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

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

### 4.2.4.2 Restrictions on Switching Source Function

There are following restrictions on switching the source function:

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

### 4.2.4.3 Source Value Restrictions

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

- For the 6253

| Source function | Limit value setting | Source range |
|---|---|---|
| Voltage source (VS) | 0.1 μA ≤ IL ≤ 0.5 A | 0 to ±110 V |
| | 0.5 A < IL ≤ 1 A | 0 to ±64 V |
| | 1 A < IL ≤ 2 A | 0 to ±32 V |
| Current source (IS) | 3 mV ≤ VL ≤ 32 V | 0 to ±2 A |
| | 32 V < VL ≤ 64 V | 0 to ±1 A |
| | 64 V < VL ≤ 110V | 0 to ±0.5 A |

- For the 6254

| Source function | Limit value setting | Source range |
|---|---|---|
| Voltage source (VS) | 3 μA ≤ IL ≤ 7 A | 0 to ±20 V |
| | 7 A < IL ≤ 20 A | 0 to ±7 V |
| Current source (IS) | 3 mV ≤ VL ≤ 7 V | 0 to ±20 A |
| | 7 V < VL ≤ 20 V | 0 to ±7 A |

### 4.2.4.4 Source range

1. Source range
   - The source values (pulse values) for the DC source or pulse source mode are output in the displayed range.
   - The ranges of the bias, base, start and stop values for the sweep source mode are decided depending on whether the sweep range is set to Auto or Fix as below regardless of the setting values or displayed values.
     Set the sweep range by selecting the parameters ***2) Sweep Mode*** and ***2) Sweep Range*** in the menu.

| Sweep range setting | Range |
|---|---|
| Auto | Sets every setting value to the optimum range so the number of enabled digits is the largest.<br>If any of the setting values is set to a different range, the range changes during the sweep. |
| Fix | Fixes to the maximum range that can output all setting values including source values.<br>The range is not changed while sweeping. |

2. Range to be set when the sweep range is Auto
   - For the 6253

| Source function | Setting value | Range |
|---|---|---|
| Voltage source (VS) | 0 mV ≤ \|Vs\| ≤ 320.000 mV | 300 mV |
| | 320.000 mV < \|Vs\| ≤ 3.20000 V | 3 V |
| | 3.20000 V < \|Vs\| ≤ 10.0000 V | 10 V |
| | 10.0000 V < \|Vs\| ≤ 32.0000 V | 30 V |
| | 32.0000 V < \|Vs\| ≤ 110.000 V | 100 V |
| Current source (IS) | 0 μA ≤ \|Is\| ≤ 3.20000 μA | 3 μA |
| | 3.20000 μA < \|Is\| ≤ 32.0000 μA | 30 μA |
| | 32.0000 μA < \|Is\| ≤ 320.000 μA | 300 μA |
| | 320.000 μA < \|Is\| ≤ 3.20000 mA | 3 mA |
| | 3.20000 mA < \|Is\| ≤ 32.0000 mA | 30 mA |
| | 32.0000 mA < \|Is\| ≤ 320.000 mA | 300 mA |
| | 320.000 mA < \|Is\| ≤ 2.00000 A | 2 A |

- For the 6254

| Source function | Setting value | Range |
|---|---|---|
| Voltage source (VS) | 0 mV ≤ \|Vs\| ≤ 320.000 mV | 300 mV |
| | 320.000 mV < \|Vs\| ≤ 3.20000 V | 3 V |
| | 3.20000 V < \|Vs\| ≤ 20.0000 V | 20 V |
| Current source (IS) | 0 μA ≤ \|Is\| ≤ 320.000 μA | 300 μA |
| | 320.000 μA < \|Is\| ≤ 3.20000 mA | 3 mA |
| | 3.20000 mA < \|Is\| ≤ 32.0000 mA | 30 mA |
| | 32.0000 mA < \|Is\| ≤ 320.000 mA | 300 mA |
| | 320.000 mA < \|Is\| ≤ 3.20000 A | 3 A |
| | 3.20000 A < \|Is\| ≤ 20.0000 A | 20 A |

3. Ranging during sweep

   The period time may be extended if a range change occurs while sweeping.

   For more information on the sweep operation in this case, see Table 4-4, “Operations in DC Sweep Source Mode” or Table 4-5, “Operations in Pulse Sweep Source Mode.”

### 4.2.4.5 HV (High Voltage) Display (6253 Only)

When the voltage source value or voltage limit value is set to high voltage of 55 V or higher on the 6253, ϟ indicator is displayed for safety.

| Function | Source mode | Output status | Indicator lighting condition |
|---|---|---|---|
| VS | DC | OPR | 55 V ≤ Source value |
| | | SUS | 55 V ≤ Suspend voltage |
| | Pulse | OPR | 55 V ≤ Source value<br>55 V ≤ Pulse base value |
| | | SUS | 55 V ≤ Suspend voltage |
| | DC sweep | OPR | 55 V ≤ Bias value<br>55 V ≤ Sweep value |
| | | SUS | 55 V ≤ Suspend voltage |
| | Pulse sweep | OPR | 55 V ≤ Bias value<br>55 V ≤ Pulse sweep base value<br>55 V ≤ Sweep value |
| | | SUS | 55 V ≤ Suspend voltage |
| IS | All modes | OPR | 55 V ≤ Voltage limit value |
| | | SUS | 55 V ≤ Suspend voltage |

### 4.2.4.6 Operate, Standby and Suspend

1. Transitions among Operate, Standby, and Suspend

   The 6253/6254 has three output statuses: Operate, Standby and Suspend.

   The output relay is connected and the setting values are output in the Operate status, the output relay is disconnected in the Standby status, and the Suspend status is high-resistance or low-resistance status where the output relay is connected but Vsus voltages are output.

   The following figure shows transitions of the output status.

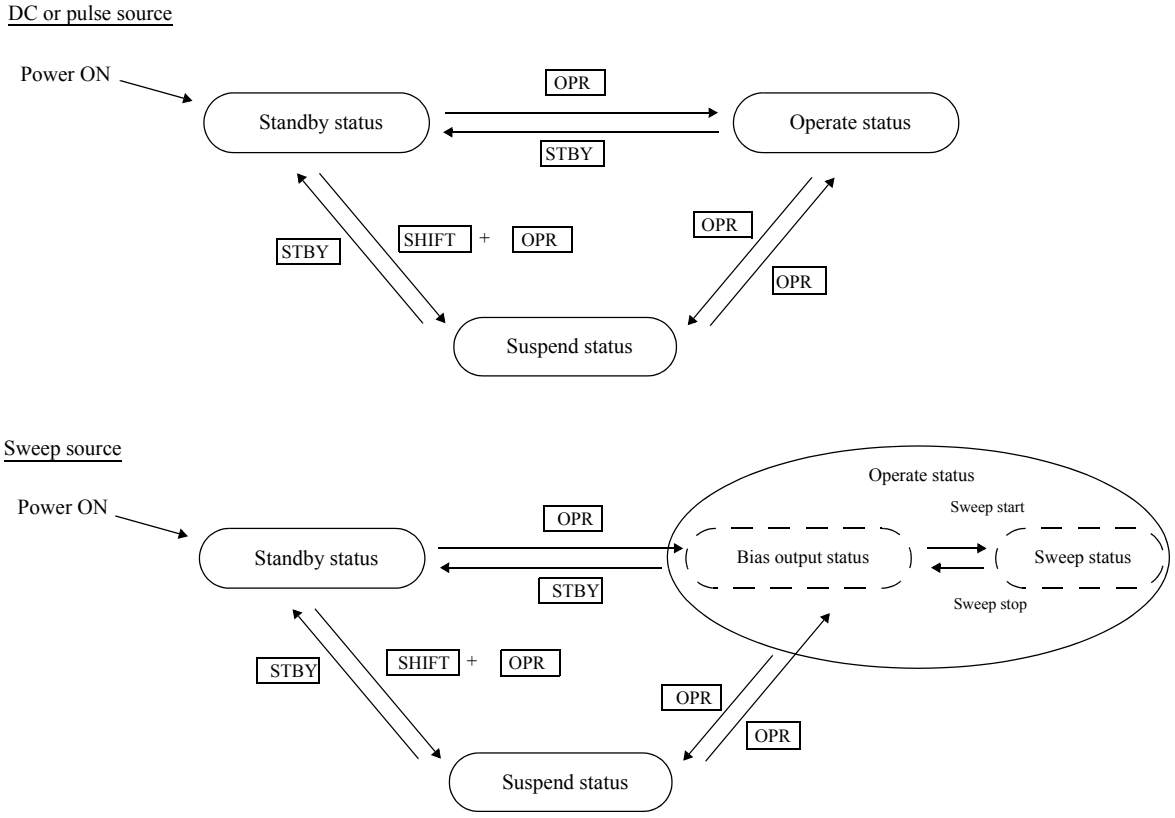



Figure 4-11 Output Status Transitions

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

1. *Standby → Operate*
2. *Standby → Suspend*
3. *When Operate is set after changing the sweep parameters in Suspend status*

2. Suspend Function

   Using this function can reduce unnecessary relay ON/OFF actions, which reduces deterioration of the throughput due to relay operation time and improves the life spans of the relays.

   Therefore, using the suspend function is recommended whenever turning OFF the output to change the source conditions.

   There are two Suspend statuses: HiZ (high resistance) and LoZ (low resistance).

   The following table shows the output status and internal setting values.

Table 4-8 Output Status and Internal Setting Values

| Status at Output OFF | Output relay | Output status | Setting current limit value |
|---|---|---|---|
| LoZ | ON | Vsus, low resistance | VS: Setting current limit values (IL)<br>IS: 10000 digits in the 3μA range<br>3000 digits in other ranges |
| HiZ | ON | Vsus, high resistance | 6253: 100 nA (3 μA range)<br>6254: 3 μA (300 μA range) |
| STBY | OFF | Open | - |

3. Operational Descriptions

   1. Standby status

      Pressing the **STBY** key will switch to the Standby Status. The **OPR** key goes OFF.

      The 6253/6254 is surely isolated from the DUT.

   2. HiZ Suspend status

      Pressing the **OPR** key or the **SHIFT** + **OPR** keys will set Suspend status. The **OPR** key blinks.

      This is the high-resistance status in which Vsus voltage is output with the OPR/STBY relay ON. In this status, the DUT is rarely affected.

      The 6253/6254 operates as follows in the Operate status.

      VS setting: Vsus → Current limit value setting → VS output

      IS setting: Vsus → IS function → IS output

   3. LoZ Suspend status

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

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

      The output response speed is faster because the limit values do not change in the Operate status.

      VS setting: Vsus → VS output

      IS setting: Vsus → IS function → IS output

   4. Operate status

      Pressing the **OPR** key will switch to the Operate status. The **OPR** key goes ON.

4. Setting Suspend conditions

1. Setting the suspend voltage

Set selecting ***1) Source*** and then ***3) Suspend V*** in the menu.

The voltage range for the suspend voltage is the same as that for the voltage source function.

However, if the suspend voltage cannot be output in the currently setting source range, the range switches to the output-enabled range in the Operate status.

Some examples for the above explanation are shown below.

| Source function | Suspend voltage | Source range /Limit range | Suspend voltage range | Source range switching |
|---|---|---|---|---|
| VS | 0 V | 300 mV | 300 mV | No |
| | 10 V | 3 V | 10 V/20 V | Yes |
| | 10 V | 10 V/20 V | 10 V/20 V | No |
| IS | 0 V | 3 V | 300 mV | Yes |
| | 10 V | 10 V/20 V | 10 V/20 V | No |

2. Setting the output resistance in Suspend status

Set selecting → ***1)Source*** and then ***4) Suspend Z*** in the menu

HiZ (high impedance): High resistance output status.

6253: The current limit value is set to 100 nA (3 μA range).

6254: The current limit value is set to 3 μA (300 μA range).

LoZ (low impedance): Low resistance output status

VS: The setting current limit value is applied.

IS: The current limit value is set to 10000 digits (100 nA) in the 3μA range, or 3000 digits in other ranges.

## 4.2.5 Measurement Function

### 4.2.5.1 Measurement Function

The measurement function is classified into the following types:

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

   Resistance values are obtained by dividing voltage by current.

   For more information on resistance value calculation for the pulse source mode, refer to Section 4.2.5.4, “Measurement Delay Time and Measurement Value.”

The measurement function has two modes. In one mode, the measurement function can be selected independently from the source function. In another mode, the linked measurement function is set according to the source function.

Use ***6) Measure*** and ***6) Mfunc Link*** in the menu to switch the mode.

When the link mode is selected, the measurement function is set as follows by changing the source function:

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

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

---

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

*Count Few: The current source value is less than 20 digits or the measured current value is less than 200 digits.*

*VSource=0: The voltage source value is 0.*

*HiLimit RM: HI limit status*

*LoLimit RM: LO limit status*

---

### 4.2.5.2 Source Value Monitor

The 6253/6254 monitors the source values for DC voltage and current, separately from the measurement function.

The integration time and measurement timing are shared by the measurement function. The measurement range is fixed to the source range.

### 4.2.5.3 Measurement Ranging

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

| Source function | Measurement auto range OFF | | Measurement auto range ON | |
|---|---|---|---|---|
| | Voltage measurement | Current measurement | Voltage measurement | Current measurement |
| Voltage source | Fixed to the source range | Fixed to the limit range | Fixed to the source range | ✓ |
| Current Source | Fixed to the limit range | Fixed to the source range | ✓ | Fixed to the source range |

✓: Auto range operation enabled (The limit range being set is used as the maximum range.)

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

1. Operating range for the measurement auto range

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

   • For the 6253

| Measurement Function | Range | Auto range level | |
|---|---|---|---|
| | | DOWN | UP |
| Voltage measurement | 300 mV | - | 321.0000 |
| | 3 V | 0.299999 | 3.210000 |
| | 10 V | 02.99999 | 10.10000 |
| | 30 V | 09.99999 | 32.10000 |
| | 100 V | 029.9999 | - |
| Current measurement | 3 μA | - | 3.210000 |
| | 30 μA | 02.99999 | 32.10000 |
| | 300 μA | 029.9999 | 321.0000 |
| | 3 mA | 0.299999 | 3.210000 |
| | 30 mA | 02.99999 | 32.10000 |
| | 300 mA | 029.9999 | 321.0000 |
| | 2 A | 0.299999 | - |

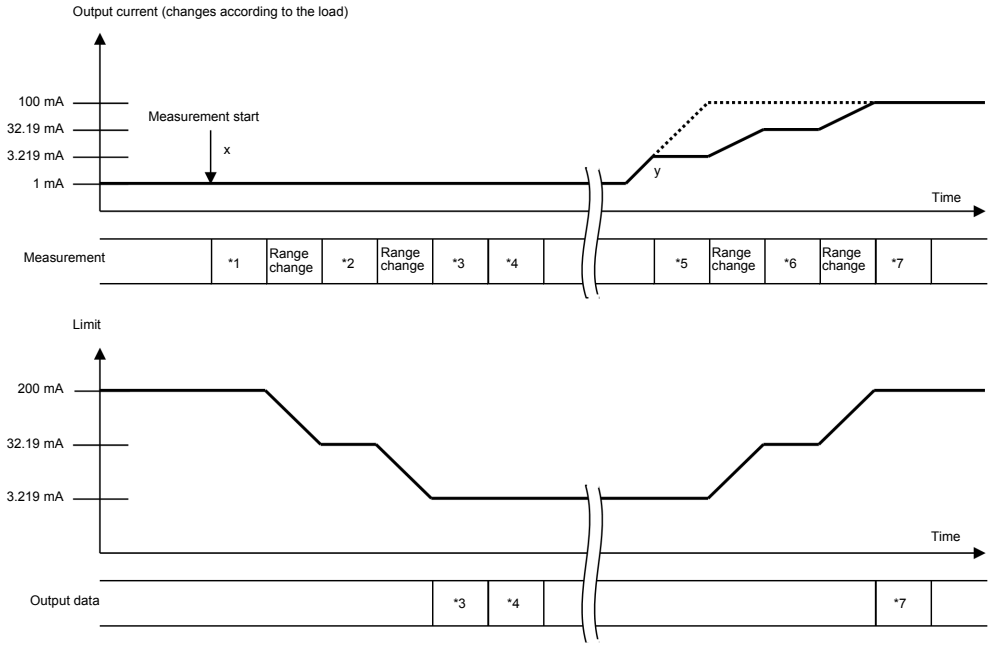
- For the 6254

| Measurement Function | Range | Auto range level | |
|---|---|---|---|
| | | DOWN | UP |
| Voltage measurement | 300 mV | - | 321.0000 |
| | 3 V | 0.299999 | 3.210000 |
| | 20 V | 02.99999 | - |
| Current measurement | 300 μA | - | 321.0000 |
| | 3 mA | 0.299999 | 3.210000 |
| | 30 mA | 02.99999 | 32.10000 |
| | 300 mA | 029.9999 | 321.0000 |
| | 3 A | 0.299999 | 3.210000 |
| | 20 A | 02.99999 | - |

2. Measurement auto range for the DC source mode

   The following example shows how the measurement range and the limit range operate in the DC source mode.

   In this example, with the current limit value set to 200 mA, current of 1 mA is measured and then 100 mA.

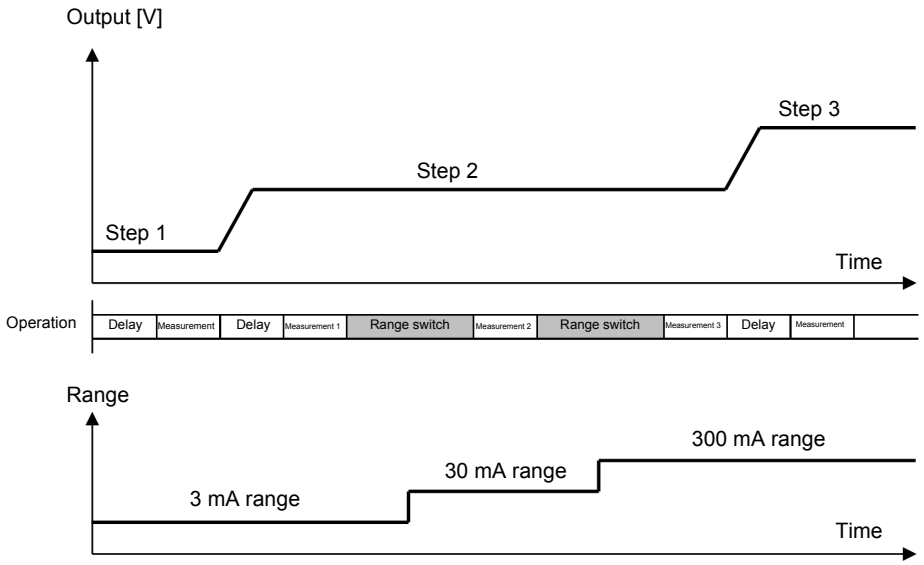


While the measurement auto range is enabled, the measurement is made while the limit is changed to a value that is larger than the full scale of the measurement range.

- For *1, the measurement result in the 300 mA range is 1 mA,
  The auto range changes the range to 30 mA, and the limit value changes to the maximum value, 32.19 mA for the 30 mA range.
- For *2, the measurement result in the 30 mA range is 1 mA. The auto range changes the range, and the limit value changes to 3.219 mA.
- For *3 and *4, measuring in the 3 mA range outputs 1 mA measurement data.
- The output current is supposed to change to 100 mA at Point y. However, as the limit value is 3.219 mA, the output current is limited to 3.219 mA.
- For *5, the measurement result in the 3 mA range is 3.219 mA. This is over range (over 3.2 mA). The auto range changes the range to the 30 mA range, and the limit value also changes to 32.19 mA.
- For *6, the measurement result in the 30 mA range is 32.19 mA. This is over range.
  The auto range changes the range to the 300 mA range. However, the setting compliance current, 200 mA is applied in this range.
- For *7, the measurement result in the 300 mA range is 100 mA and it is output as output data.

3. Measurement auto range during sweep

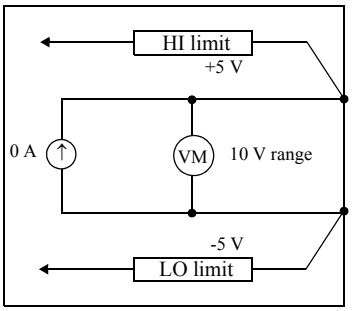
   While sweeping, measurement is performed in each step. When the measurement range is set to Auto, auto ranging continues until measurement data is determined in each step.



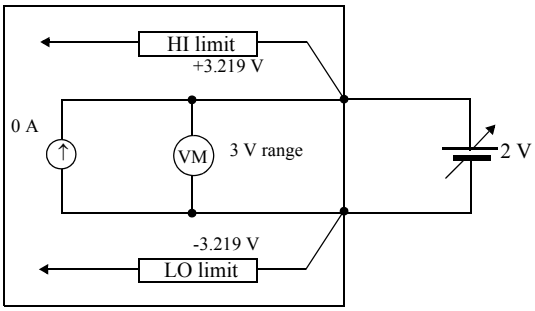
4. Measuring an external power supply by current source voltage measurement (ISVM)

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

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

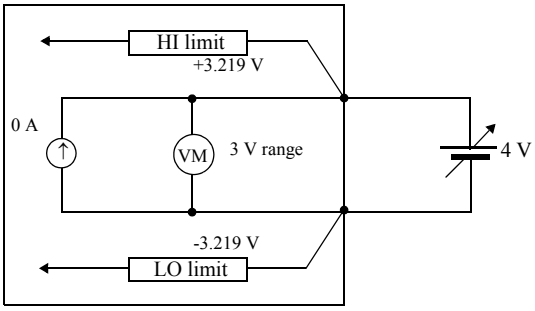



   2. Connect the external power supply of 2 V.




   Connecting 2 V causes the measurement auto range to set the measurement range to the 3 V range. Then the voltage limit is also changed to the 3 V range. Therefore, the internal value ±3.219 V is set.

3. Increase the external power supply to 4 V.




In this case, the external voltage exceeds the HI limit value. Thus, before increasing the range, the auto measurement function detects voltage overload and sets the output status to Standby.

The operation above is unavoidable in principle.

For using the 6253/6254 under the above condition, do NOT use the measurement auto range.

---

*CAUTION:*

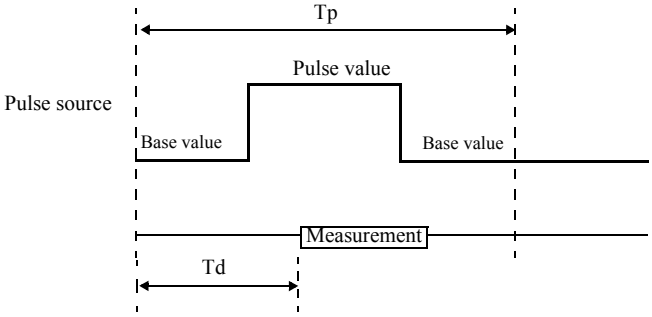
1. *In the current source function, apply an external voltage $V_B$ within the voltage limit range.*
   *$V_{LL} < V_B < V_{HL}$*
   *If the voltage exceeds the limit range, an overload (OVL) is detected and the output status is set to Standby.*
2. *For measuring an external voltage, set the measurement range to fixed range.*
   *When the external voltage is measured with the auto range, change in the external voltage sets overload (OVL).*
3. *Set the measurement delay value considering the ranging by auto range and the settling time.*

---

### 4.2.5.4 Measurement Delay Time and Measurement Value

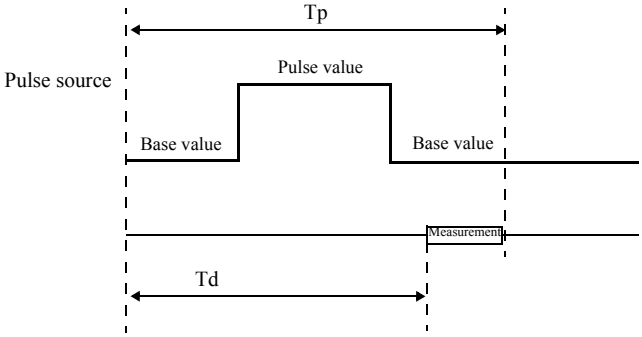
The measurement timing in the pulse source mode or pulse sweep mode varies depending on the measurement delay timing (Td) as described below.

1. Measurement at the pulse value timing



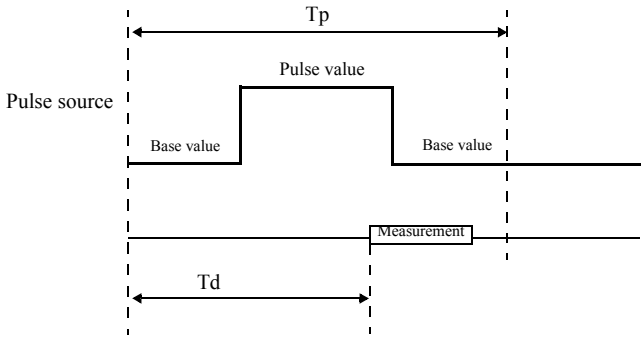

For resistance value display, the resistance value is calculated by the measured value and the monitor value of the pulse value.

2. Measurement at the base timing




For resistance value display, the resistance value is calculated by the measured value and the monitor value of the base value.

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




The measured value and the monitor value change depending on the time ratio of the pulse value to the base value during the measured time. For resistance value display, the resistance value is calculated by the measured value and the monitor value, and it is not correct.

### 4.2.5.5 Auto Zero Function

The 6253/6254 has a function for canceling offset drift of the AD converter. This "Auto Zero function" periodically measures the zero point and cancels drift.

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

- More than 10 seconds have elapsed since the previous auto zero operation and measurement has been completed.
- The integration time is changed.

---

*NOTE: When the Auto Zero function is enabled in the pulse source mode or pulse sweep mode, the base value continues to be output until the auto zero operation is completed. Also, when the trigger mode is set to AUTO in the DC sweep mode, setting ON the Auto Zero prevents the DC sweep to move to the next step until the auto zero operation is completed even if the period time ends.*
*Therefore, the time for outputting the base value or step source value for sweep is extended temporarily. If it is inconvenient, set the Auto Zero function to OFF.*

---

## 4.2.6 Limit (Compliance)

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

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

Both the voltage and current limits on the 6253/6254 have HI and LO limit values which can be set individually.

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

---

*NOTE: When an external power supply ($V_B$) such as a battery is connected in the current source function, set the voltage limit values ($V_{HL}$ and $V_{LL}$) in the following range against $V_B$.*
*$V_{LL} < V_B < V_{HL}$*
*If these values are set outside the above range, the 6253/6254 detects overload (OVL) and then sets Standby.*

---

### 4.2.6.1 Limit Setting Ranges

The limit value setting range is restricted by the source value. The following table shows the limit setting ranges in relation to the source values.

- For the 6253

| Source function | Source value | Limit setting range |
|---|---|---|
| Voltage source (VS) | 0 V ≤ \|VS\| ≤ 32 V | 0.1 μA to 2 A |
| | 32 V < \|VS\| ≤ 64 V | 0.1 μA to 1 A |
| | 64 V < \|VS\| ≤ 110 V | 0.1 μA to 0.5 A |
| Current source (IS) | 0 A ≤ \|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 |

- For the 6254

| Source function | Source value | Limit setting range |
|---|---|---|
| Voltage source (VS) | 0 V ≤ \|VS\| ≤ 7 V | 3 μA to 20 A |
| | 7 V < \|VS\| ≤ 20 V | 3 μA to 7 A |
| Current source (IS) | 0 A ≤ \|IS\| ≤ 7 A | 3 mV to 20 V |
| | 7 A < \|IS\| ≤ 20 A | 3 mV to 7 V |

The minimum limit values must be set under the following conditions:

600 digits ≤ (HL value - LL value): Voltage limit, and current limit in other than 3 μA range

2000 digits ≤ (HL value - LL value): Current limit in the 3 μA range

10 digits ≤ Current limit

*NOTE:*

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

### 4.2.6.2 Setting Limit Values

1. Setting types

   Two types of limit value settings are available; one is ***±Balance*** setting. This sets the same absolute value on both the polarities, + and -; the other is ***Individual*** setting. This sets a different value on each polarity.

2. Setting ranges

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

   The setting values are set in the optimal ranges.

3. Usage for ***Individual*** setting

   By setting both the HI limit and LO limit values to + (positive) voltage, the 6253/6254 can be used for rechargeable battery charge and discharge testing.

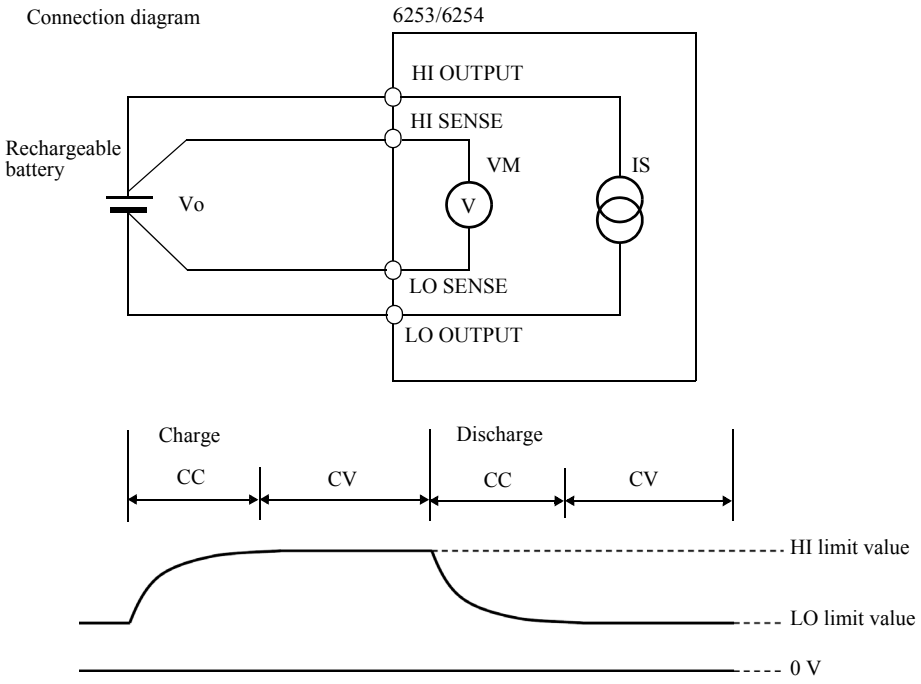



Figure 4-12 Rechargeable Battery Charge and Discharge Operations

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

---

*CAUTION:*

1. *Applying higher voltage than the HI limit value or lower voltage than the LO limit value from an external device will cause overload (OVL) and then set Standby.*
   *For example, connecting a battery of lower voltage than the LO limit voltage results in overload (OVL) and then Standby.*
2. *To prevent damage to the 6253/6254, do not apply a voltage or frequency that exceeds the specified range.*

---

### 4.2.6.3 Displaying and Outputting of Limit Detection

Four indicators, **HLMT**, **LLMT**, ▲, and ▼ are used for displaying the limit detection.

**HLMT** and **LLMT** indicate that measured data is obtained in the limit detection status.

▲ and ▼ indicate that the limit is currently being activated.

The following table shows a relation between limit detection display, remote output and buzzer.

| Display | Remote output | | Buzzer |
|---|---|---|---|
| | Sub header | Status | |
| **HLMT**, **LLMT** | Yes | No | No |
| ▲, ▼ | No | Yes | Yes |

## 4.2.7 Alarm Detection

The 6253/6254 has a function to detect the following alarms to prevent itself and the DUT from being damaged. When any of these alarms is detected, a message is displayed and output to the remote device event status register, the error register and the header of measurement data.

The following table shows the messages, their descriptions and causes.

Table 4-9 Alarm Detection Contents

| Message | Description | Cause |
|---|---|---|
| Source Unit Err | Source unit malfunction | • Malfunction |
| Fan Stopped | Fan stopped | • Malfunction<br>• A foreign matter clogs the fan. |
| Over Heat | Overheat (Internal overheat) | • Malfunction<br>• Sink operation outside the specified range<br>• The vents are blocked.<br>• Ambient temperature exceeds the specified range. |
| Over Load | Overload | • Over voltage applied from an external device<br>• Connecting to an external voltage source exceeding the voltage limit setting<br>• LO OUTPUT and LO SENSE open in 4-wire connection |
| OSC indication | Oscillation | • Connecting to a load L or C outside the specified range<br>• Device oscillation |
| HLMT/LLMT, ▲/▼ indication | Limit activated | • The voltage or current limit is activated. |

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

### 4.2.7.1 Oscillation Detection

The output may oscillate due to device capacitance (C) or cable inductance (L). The 6253/6254 detects such an oscillation by the output terminal and the internal circuit and displays an alarm together with the measured value.
If an oscillation is detected, make the response slower so that oscillations do not occur and change the timings such as measurement delay before restarting measurement. In the pulse source or pulse sweep source modes, oscillations are not detected.
Oscillation detection is possible within a range between approximately 1 kHz and 1 MHz.

The following table shows the oscillation detection sensitivity.

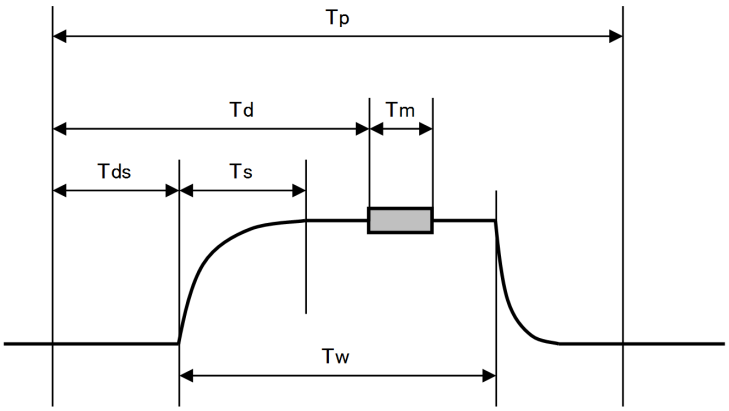
Table 4-10 Oscillation Detection Sensitivity

| Frequency | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz |
|---|---|---|---|---|---|---|
| Detection sensitivity (mVp-p) | - | 70 | 50 | 50 | 400 | - |

## 4.2.8 Source and Measurement Timing

### 4.2.8.1 Basic Source and Measurement Timing

The following figure shows the basic timing of source and measurement.




Tp: Repeat period for the DC and pulse source mode, or step period for the sweep source mode

Tds: Source delay time

Ts: Settling time

Td: Measurement delay time

Tw: Pulse width

Tm: Measurement time
Tm = Tit + Tk

Tit: Integration time

Tk: Measurement data processing time

Figure 4-13 Basic Source and Measurement Timing

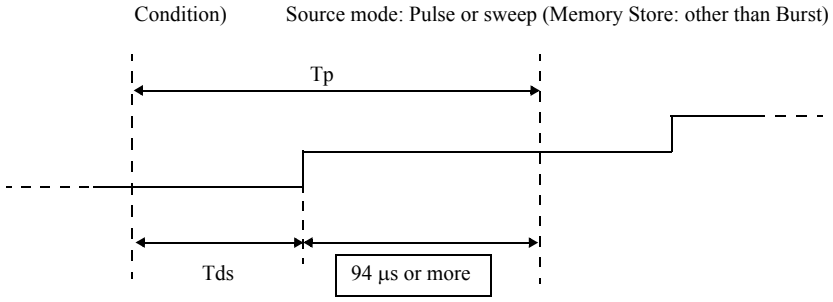
- To ensure stable measurement results, set the measurement delay time Td larger than the settling time Ts.

  Tds + Ts < Td

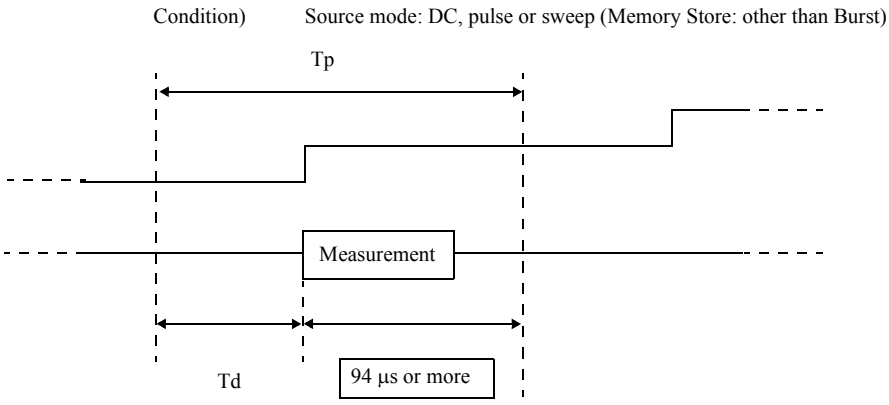
### 4.2.8.2 Restrictions on Time Parameters

There are restrictions on setting the time parameters in relation to the others. If the time parameters are set exceeding any of these restrictions, an error message will be displayed when the output is set to Operate or when sweep starts, and measurement will not start.

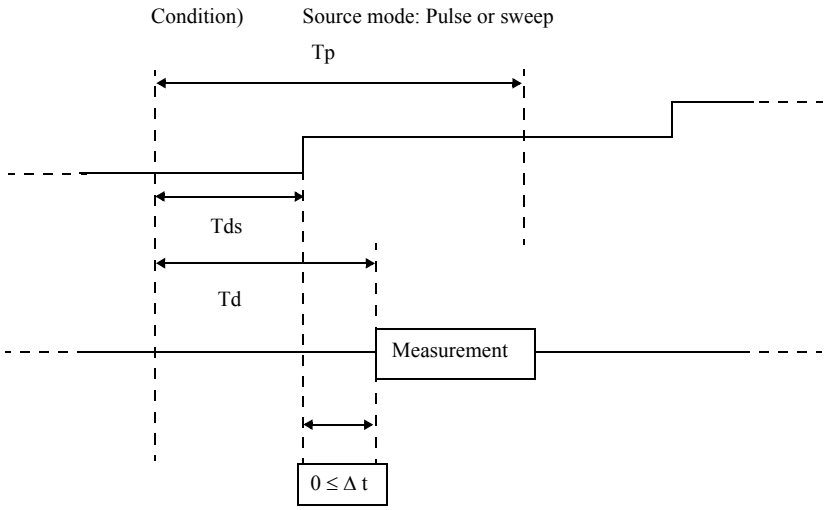
1. Restrictions
   - [Source delay time (Tds) + 94 μs] < Period time (Tp) (Tds + 94 μs < Tp)



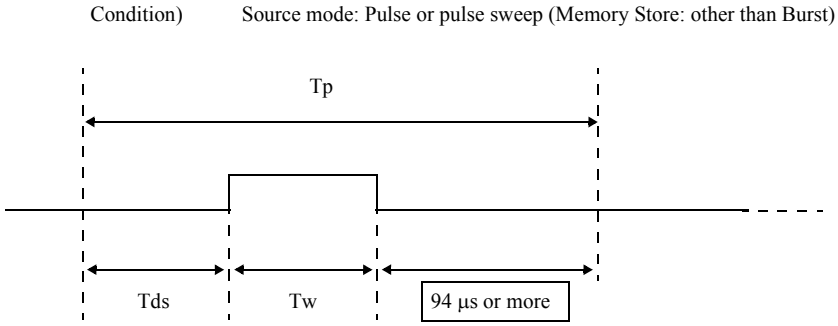

   - [Measurement delay time (Td) + 94 μs] < Period time (Tp) (Td + 94 μs < Tp)



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




- [Source delay time (Tds) + pulse width (Tw) + 94 μs] < Period time (Tp)
(Tds + Tw + 94 μs < Tp)

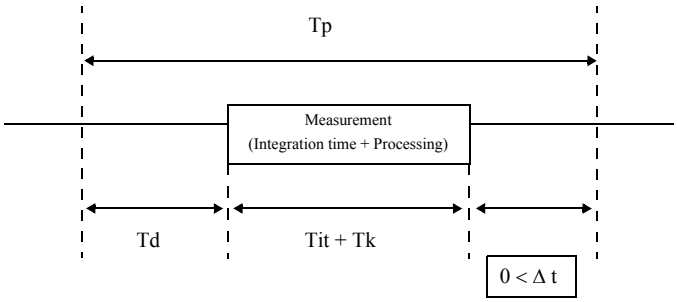



- 500 μs > Period time (Tp) (500 μs > Tp)

Condition) Source mode: DC, pulse or sweep (Memory Store: other than Burst)
Measurement ON, Calculation: OFF

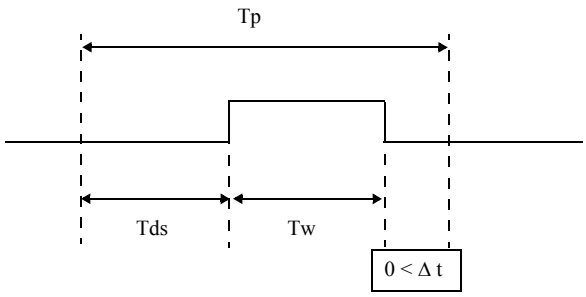
- [Measurement delay time (Td) + integration time (Tit) + AD processing time (Tk)] < Period time (Tp)
  (Td + Tit + Tk < Tp)

Condition)  Source mode: Sweep (Memory Store: Burst)




- [Source delay time (Tds) + Pulse width (Tw)] < Period time (Tp)
  (Tds + Tw < Tp)

Condition)  Source mode: Pulse sweep (Memory Store: Burst)



2. Restrictions in accordance with source modes

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

| | Restriction | Source mode | | | | | |
|---|---|---|---|---|---|---|---|
| | | DC | PLS | Memory Store: other than Burst | | Memory Store: Burst | |
| | | | | DC-SWP | PLS-SWP | DC-SWP | PLS-SWP |
| | (Tds + 94 μs < Tp) | - | ✓ | ✓ | ✓ | - | - |
| | (Td + 94 μs < Tp) | ✓ | ✓ | ✓ | ✓ | - | - |
| | (Tds ≤ Td) | - | ✓ | ✓ | ✓ | ✓ | ✓ |
| | (Tds + Tw + 94 μs < Tp) | - | ✓ | - | ✓ | - | - |
| *1 | (500 μs ≤ Tp) | ✓ | ✓ | ✓ | ✓ | - | - |
| | (Td + Tit + Tk < Tp) | - | - | - | - | ✓ | ✓ |
| | (Tds + Tw < Tp) | - | - | - | - | - | ✓ |

*1: Measurement ON
✓: Restriction applied

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

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

| Period time setting range | Resolution |
|---|---|
| 0.050 ms to 60.000 ms | 1 μs |
| 60.01 ms to 600.00 ms | 10 μs |
| 600.1 ms to 6000.0 ms | 100 μs |
| 6001 ms to 60000 ms | 1 ms |

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

| Time parameter | Period time resolution | | | |
|---|---|---|---|---|
| | 1 μs | 10 μs | 100 μs | 1 ms |
| Source delay time (Tds) | 5 μs | 20 μs | 200 μs | 2 ms |
| Measurement delay time (Td) | 20 μs | 20 μs | 200 μs | 2 ms |
| Pulse width (Tw) | 25 μs | 30 μs | 100 μs | 1 ms |

*NOTE: If set as Tp < (Td + Tm), the actual period becomes Td + Tm.*
*Auto Zero may not be executed in some cases.*

### 4.2.8.3 Measurement Delay and Settling Time

In the pulse source or sweep source mode, the 6253/6254 waits for source value and sample settling and then starts measurement.

This section describes the settling time of the 6253/6254 and the measurement delay to be set.

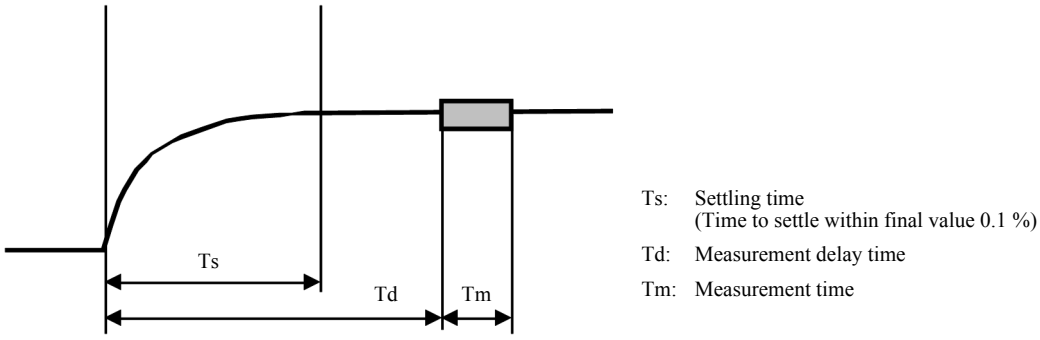



Figure 4-14 Settling Time and Measurement Delay Time

1. Setting the output response (***Fast/Slow***)

   The output response can be set to ***Fast***, which increases the system throughput by speeding up the settling time (Ts), or ***Slow***, which reduces output noise and ensures the stability for loads L and C. Select ***MENU***, ***1) Source*** and ***6) Response*** in this order.

2. Voltage source

   The settling time (Ts) of the 6253/6254 is defined by the voltage source value (Vs), the current limit value DIL (digits), and the output response (Fast/Slow), as shown below.
   Set the measurement delay (Td) to Ts or over.

| IL range | Output response | |
|---|---|---|
| | Fast | Slow |
| 3 μA | Ts = 500 + 100(Vs × 60000 / DIL) μs | |
| 30 μA | Ts = 200 + 100(Vs × 30000 / DIL) μs | Ts = 300 + 100(Vs × 40000 / DIL) μs |
| 300 μA | Ts = 100 + 100(Vs × 10000 / DIL) μs | Ts = 800 + 100(Vs × 20000 / DIL) μs |
| 3 mA to 20 A | Ts = 80 + 100(Vs × 3000 / DIL) μs | Ts = 600 + 100(Vs × 15000 / DIL) μs |

(Example) Output response: Fast, Vs: 2 V, IL: 3 mA and resistance: 10 kΩ

IL = 3 mA → DIL = 30000 d

Ts = 80 + 100 (Vs × 3000 / DIL)

Ts = 80 + 100 (2 V × 3000 / 30000 d) = 100 μs

From the above, set as Td > 100 μs.

3. Current source

The settling time (Ts) of the 6253/6254 is defined by the current source value (Is), the current sense resistance (Rs), the load voltage (VRL = Is × RL), and the output response (Fast/Slow), as shown below.
Set the measurement delay (Td) to Ts or over.

| IS range | Output response | |
|---|---|---|
| | Fast | Slow |
| 3 μA | Ts = 300 + (300 × VRL) / (Is × Rs) μs | |
| 30 μA | Ts = 100 + (120 × VRL) / (Is × Rs) μs | Ts = 300 + (200 × VRL) / (Is × Rs) μs |
| 300 μA | Ts = 40 + (45 × VRL) / (Is × Rs) μs | Ts = 100 + (120 × VRL) / (Is × Rs) μs |
| 3 mA to 2 A | Ts = 40 + (15 × VRL) / (Is × Rs) μs | Ts = 100 + (80 × VRL) / (Is × Rs) μs |

| Rs value | |
|---|---|
| Range | Rs (Ω) |
| 3 μA | 220 k |
| 30 μA | 22 k |
| 300 μA | 2.2 k |
| 3 mA | 220 |
| 30 mA | 22 |
| 300 mA | 2.2 |
| 2/3 A | 0.2 |
| 20 A | 0.02 |

(Example) Output response: Slow, 3 mA range, Is: 1 mA and resistance: 1 kΩ

Is = 1 mA

VRL = 1 mA × 1 kΩ = 1 V

Ts = 100 + (80 × VRL) / (Is × Rs)

Ts = 100 + (80 × 1 V) / (1 mA × 220) = 463.6 μs

From the above, set as Td > 464 μs.

### 4.2.8.4 Integration Time and Measurement Time

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

Tm = Tit + Tk + Tsys

The integration time (Tit) can be selected between 5 μs and 1000 ms.

The measurement data processing time (Tk) details are shown in the Table 4-11.

The internal processing time (Tsys) is determined depending on the Memory Store mode as below.

| Source mode | Memory Store | Tsys |
|---|---|---|
| DC, Pulse | OFF, Normal | Approx. 150 μs* |
| Sweep | Burst | Approx. 150 μs* |
| | OFF, Normal | Approx. 150 μs* |

* When the display is OFF. When the display is ON, Tsys is about 2 ms.

Table 4-11 Integration Time and Processing Time

| Integration time | Tit (ms) | | Tk (ms) | Tit + Tk (ms) | |
|---|---|---|---|---|---|
| | 50 Hz | 60 Hz | | 50 Hz | 60 Hz |
| 5 μs | 0.005 | | 0.013 | 0.018 | |
| 10 μs | 0.01 | | 0.024 | 0.034 | |
| 100 μs | 0.1 | | 0.08 | 0.18 | |
| 500 μs | 0.5 | | 0.04 | 0.54 | |
| 1 ms | 1 | | 0.04 | 1.04 | |
| 10 ms | 10 | | 0.04 | 10.04 | |
| 1 PLC | 20 | 16.666 | 0.04 | 20.04 | 16.706 |
| 2 PLC | 40 | 33.333 | 0.04 | 40.04 | 33.373 |
| 200 ms | 200 | | 0.04 | 200.04 | |
| Other | 0.1 to 1000 | | 0.04 | Tit + 0.04 | |

When the Memory Store mode is set to OFF or Normal, executing the NULL, scaling, Max/Min or comparator calculation will add the following processing time respectively.

| | |
|---|---|
| NULL calculation ON: | Approx. 0.2 ms |
| Scaling calculation ON: | Approx. 1 ms |
| Max/Min Calculation ON: | Approx. 1 ms |
| Comparator calculation ON: | Approx. 1 ms |
| Resistance Measurement: | Approx. 1 ms |

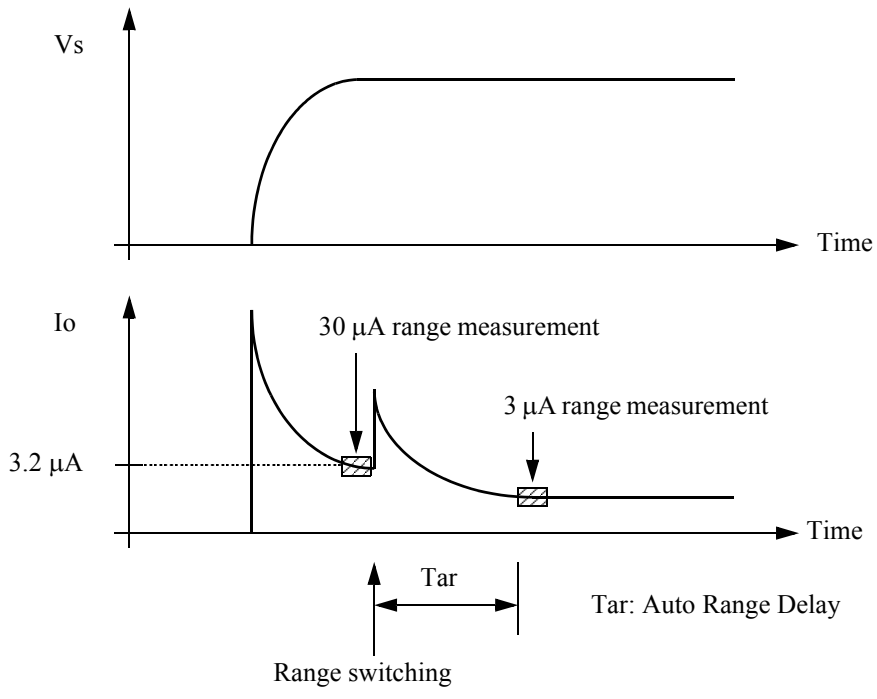
(Example) DC source mode, integration time: 1 PLC (50 Hz), Memory Store: Normal, NULL calculation: ON, Scaling calculation: ON, Max/Min calculation: ON, Comparator calculation: ON. The measurement time is obtained as follows:

Tit = 20 ms
Tk = 0.04 ms
Tsys = 2 + 0.2 + 1 + 1 + 1 = 5.2 ms
Tm = Tit + Tk + Tsys = 25.24 ms

### 4.2.8.5 Auto Range Delay

The Auto Range Delay function is used when a capacitive load ($C_L$) is measured by voltage source current measurement (VSIM).

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



The Auto Range Delay function is enabled only in the current measurement (IM) auto range.

It does not work in the fixed range or voltage measurement (VM).

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

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

- Tar (s) measure

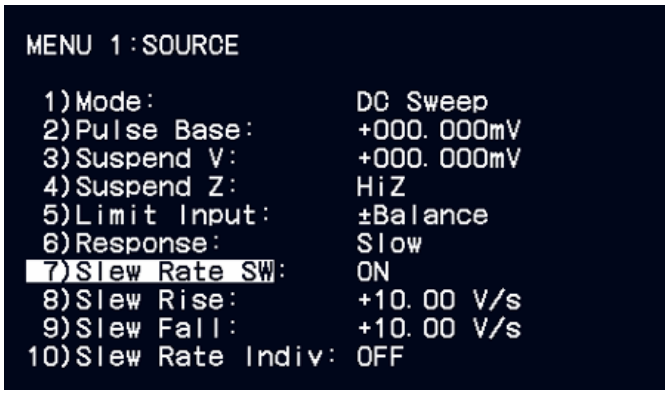
  Calculate the Tar setting using the expression below.

  $$Tar = \frac{C_L \times 50\ mV}{3\ \mu A} = 16666 \times C_L$$

  (Example) If $C_L = 1\ \mu F$
  $Tar = 16666 \times 1\ \mu F = 16.6$ ms
  Set Tar = 16.6 ms

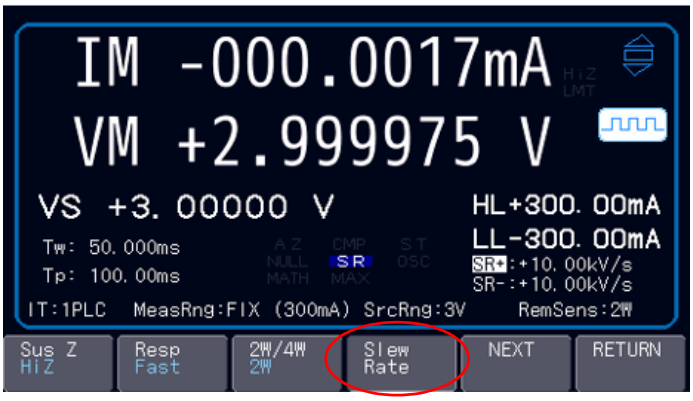
### 4.2.8.6 Variable Slew Rate

The variable slew rate is used to set the rise time and fall time to any values.




7) Slew Rate SW
   Variable slew rate ON or OFF
8) Slew Rise
   Rise time setting
9) Slew Fall
   Fall time setting
10) Slew Rate Indiv
    Rise and fall time individual setting
    ON or OFF

Setting the Slew Rate SW to ON will allow the slew rate setting from the home screen as well.
(For the 6253, this function is available from software revision B00 or later.)




SR+ : Slew Rise
SR- : Slew Fall

Press the soft key **Source** and then **Slew Rate** to set “SR+” or “SR-”

There are the following four ranges for the variable slew rate and the output response changes automatically.

- For voltage source (Common for all ranges)

  * This function is applicable from software revision B00 or later for the 6253.
    To update the software to B00, the 6353 needs to be sent back to the factory for service.

| Range | Setting value | Response | Setting accuracy (typical value) |
|---|---|---|---|
| 1 | 10.00 to 99.99 V/s | Slow | ± (20 % + 500 digits) |
| 2 | 100.0 to 999.9 V/s | Slow | Pure resistive load |
| 3 | 1.000 to 9.999 kV/s | Fast | IL: 3 mA range |
| 4 | 10.00 to 99.99 kV/s | Fast | When the limit does not activate |

- For current source (Invalid for 300 μA range or lower)

| Range | 3 mA range | 30 mA range | Response |
|---|---|---|---|
| | Setting value | Setting value | |
| 1 | 10.00 to 99.99 mA/s | 100.0 to 999.9 mA/s | Slow |
| 2 | 100.0 to 999.9 mA/s | 1.000 to 9.999 A/s | Slow |
| 3 | 1.000 to 9.999 A/s | 10.00 to 99.99 A/s | Fast |
| 4 | 10.00 to 99.99 A/s | 100.0 to 999.9 A/s | Fast |

| Range | 300 mA range | 2 A/3 A range | Response |
|---|---|---|---|
| | Setting value | Setting value | |
| 1 | 1.000 to 9.999 A/s | 10.00 to 99.99 A/s | Slow |
| 2 | 10.00 to 99.99 A/s | 100.0 to 999.9 A/s | Slow |
| 3 | 100.0 to 999.9 A/s | 1.000 to 9.999 kA/s | Fast |
| 4 | 1.000 to 9.999 kA/s | 10.00 to 99.99 kA/s | Fast |

| Range | 20 A range | Response | Setting accuracy (typical value) |
|---|---|---|---|
| | Setting value | | |
| 1 | 100.0 to 999.9 A/s | Slow | ± (20 % + 500 digits)* |
| 2 | 1.000 to 9.999 kA/s | Slow | Pure resistive load |
| 3 | 10.00 to 99.99 kA/s | Fast | VL: 3 V range |
| 4 | 100.0 to 999.9 kA/s | Fast | When the limit does not activate |

*It is doubled in the 20 A range.

*NOTE:*

1. *During Operate, the setting value can be changed only in the same range. When range change occurs, set the output status to Standby.*
2. *The Auto Range for source and measurement is not available.*
3. *When the Slew Rate Indiv is ON, the range corresponding to the slower setting value is applied, and the fastest value in that range is set as the faster value.*

   *(Example) Slew Rise: 100.0 V/s and Slew Fall: 5.000 kV/s*
   *Slew rate range: 2*
   *Slew Rise: 100 .0 V/s*
   *Slew Fall: 999.9 V/s*
4. *The slew rate is never faster than the settling time.*

## 4.2.9 Calculation Functions

### 4.2.9.1 NULL Calculation

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

a. Calculation expression

R = X - Xnull

R : Calculation result
X : Present measurement data
Xnull : NULL value

b. Timing of acquiring NULL value (Xnull)

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

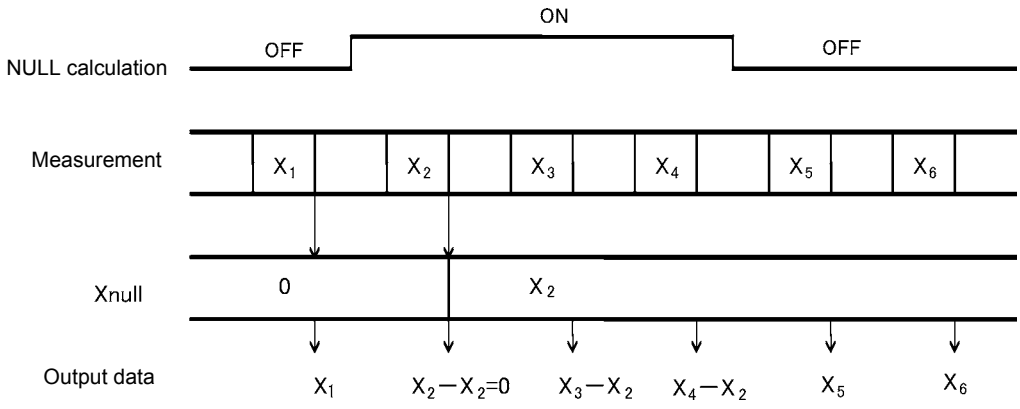



Figure 4-15 NULL Calculation Timing

- "**NULL**" is displayed when the NULL calculation is ON.
- The NULL value is rewritten when the NULL calculation switches from OFF to ON or when the NULL calculation is initialized.
- If the measured value is over-range data and the NULL calculation is turned ON, the display shows Over Range. The first data item after the Over Range is released becomes the NULL value.
- If the NULL calculation result is over the full scale of the present measurement range, it displays up to the double value of the full scale.
- The NULL calculation is turned OFF by changing the measurement function or executing the *RST command.
- The NULL value can be changed while the NULL calculation is ON.
  Select and set items, ***9) Const*** and ***6) NULL Value*** on the menu screen.
  The setting range is between 0 and ±999.9999E + 24.

### 4.2.9.2 Scaling Calculation

1. Calculation expression

   The scaling calculation is defined using the following formula:

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

   X: Measurement value

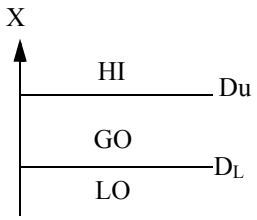
2. Operation
   - When the scaling calculation is ON, "**MATH**" is displayed.
   - The setting ranges of Constant A, Constant B, and Constant C are 0 to ±999.9999E+24 (however, Constant A ≠ 0).
   - If the calculation result exceeds ±999.9999E + 24, it is scaling-over and the error message ±SCL Over is displayed.
   - The scaling calculation is turned OFF by executing the *RST command.
   - Changing the measurement function does not turn OFF this calculation.

### 4.2.9.3 Comparator Calculation

1. Calculation expression

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

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




X: Measured value
Du: Upper limit value
$D_L$: Lower limit value

   - When the measured value is over range, positive measured data (X > 0) is judged as HI and negative one (X < 0) is judged as LO.
   - When the NULL calculation is ON, the comparator calculation is executed comparing with the NULL calculation result.
     If the NULL calculation result data is over range, positive measured data is judged as HI and negative one is judged as LO in the same way.
   - Because the internal measurement and calculation resolutions are smaller than the display resolution, the displayed data may be judged as HI or LO when $X = D_L$ or X = Du respectively.

2. Calculation result output

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

3. Operation

   - "**CMP**" is displayed when the comparator calculation is ON. ▲ (HI), ▬ (GO), or ▼ (LO) indicator is displayed depending on the calculation result of HI, GO, or LO.
   - The setting range for the upper and lower limits is between 0 and ±999.9999E + 24.
   - The comparator calculation is turned OFF by executing the *RST command.
   - Changing the measurement function does not turn OFF this calculation.
   - When the comparator calculation result meets with its buzzer condition, the buzzer sounds.
     Select the parameters, ***13) System*** and ***2) Compare Buzzer*** on the menu screen to set the buzzer condition.

### 4.2.9.4 Max/Min Calculation

1. Calculation expression

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

2. Calculation result

   Select the parameters, ***8) Compute*** and ***5) Max/Min View*** on the menu screen to refer to the results.

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

3. Operation

   - Valid data except over-range data and error data is calculated.
   - When the maximum or minimum value is updated with the notice buzzer set to ON, the buzzer sounds. However, the buzzer may also sound when the displayed data does not change. This is because the measurement resolution is smaller than the display resolution.
   - The Max/Min calculation is turned OFF by changing the measurement function or executing the *RST command.
   - When the total value exceeds ±999.9999E+24, it is displayed as "**Over**."
   - The calculation result is cleared and the calculation restarts under any of the following conditions:

     1. Switching the NULL calculation between ON and OFF
     2. Changing the NULL value
     3. Switching the scaling calculation between ON and OFF
     4. Changing any of the scaling constants.

## 4.2.10 External Control Signals

The external control signals are used to synchronize multiple units and control external devices such as scanners and digital multimeters.

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

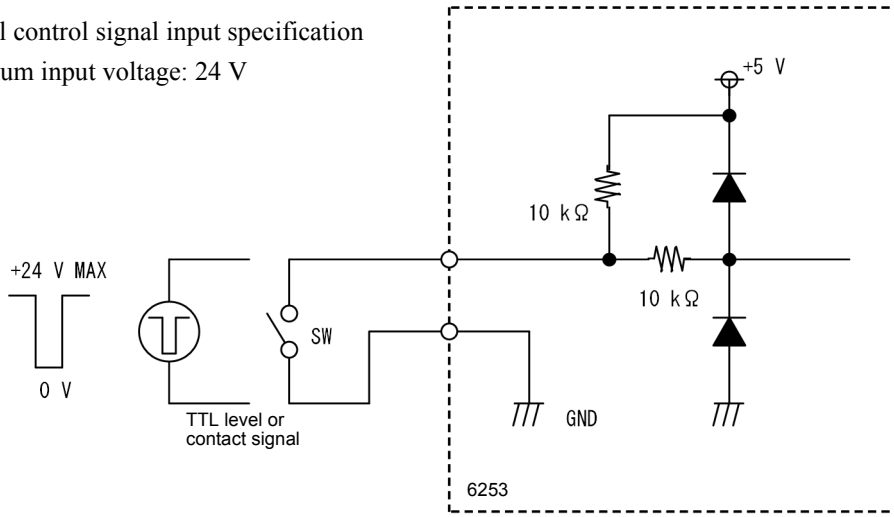
Table 4-12 External Control Signal Functions

| Signal | Input/ output | Level | Description |
|---|---|---|---|
| TRIGGER IN | Input | TTL negative pulse (2 μs or more) | • Measurement start for the DC source mode<br>• Pulse output for the pulse source mode<br>• Start or step-up for the sweep source mode |
| SYNC OUT | Output | TTL negative pulse (10 μs or more) *3 | • Period start signal for the DC source mode<br>• Pulse output signal for the pulse source mode<br>• Step-up signal for the sweep source mode |
| COMPLETE OUT *1 | Output | TTL negative pulse (10 μs or more) *3 | • Measurement start signal (Meas Front) *4<br>• Measurement complete and period complete signal (Meas End) *4<br>• Comparator calculation result signal (CMP HI/GO/LO) *4<br>• Sweep end or stop signal (Sweep end) |
| BUSY OUT *1 | | TTL negative level | • Operating signal output<br>(“LO” is output from the source start until the measurement end and period end) |
| BUSY IN *1 | Input | TTL negative level | • Operating signal input *4<br>(The step operation for measurement or sweep is not performed when the input signal is “LO.”) |
| INTERLOCK *2 | Input | TTL negative level | • Sets Standby when the signal level changes from LO to HI.<br>• When the signal is “HI” or the input is open, the output cannot be changed to Operate. |
| STBY IN *2 | | | • Sets Standby when the signal level changes from LO to HI. |
| OPR/SBY IN *2 | | | • Sets Standby when the signal level changes from LO to HI.<br>• Sets Operate when the signal level changes from HI to LO. |
| OPR/SUS IN *2 | | | • Sets Suspend when the signal level changes from LO to HI.<br>• Sets Operate when the signal level changes from HI to LO. |
| OPERATE OUT *2 | Output | TTL negative level | • Outputs LO in the Operate status.<br>• Outputs HI in the Standby or Suspend status. |

*1, *2: The same terminal is used by switching respectively.
*3: The output signal pulse width can be switched to 100 μs.
*4: Invalid when the measurement data memory is set to Burst

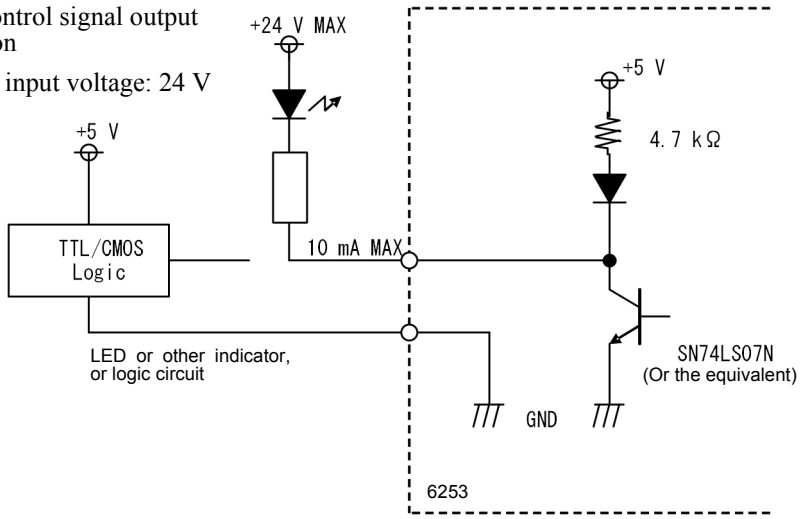
External control signal input specification

Maximum input voltage: 24 V




External control signal output specification

Maximum input voltage: 24 V



### 4.2.10.1 Restrictions on Using External Trigger

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

The TRIGGER IN signal controls the source and measurement timings to synchronize with external devices as the slave channels.

Confirm the following restrictions before using the external trigger to prevent any malfunctions in source and measurement.

Restrictions:

1. Do not input the TRIGGER IN signal in the Standby status, or when switching between Operate, Suspend, and Standby.
2. Ensure that the TRIGGER IN signal, trigger from the **TRIG** key and remote trigger (*TRG) do not overlap.
3. Restrictions on setting the setting period Tp and hold time Th

   When the external trigger (TRIGGER IN signal) is used, there are restrictions on setting the period Tp and the hold time Th. (See Table 4-13 and Table 4-14.)
4. Restrictions on the time Thp (ext) from sweep start to the next trigger signal input

   For the sweep source mode, there are restrictions on setting the time Thp (ext) from the trigger signal input for sweep start to the trigger signal input for the next step. (See Table 4-13 and Table 4-14.)
5. Restrictions on the required time Top from specifying Operate to inputting the external trigger

   The minimum time is required for the time Top from specifying Operate by a remote command or the external signal (OPERATE IN signal) to inputting the external trigger. (See Table 4-15.)
6. Allow the 6253/6254 at least 10 ms after completion of the previous sweep to input the TRIGGER IN signal for sweep start.
7. If the TRIGGER IN signal timing and the measured value display timing match, synchronization may be lost. In this case, set the display OFF or perform BUSY/OUT control.

Table 4-13 Restrictions on Tp, Tp (ext), Th, and Th (ext)

| Measurement | Tp, Tp (ext) | Tp (ext) min | Th, Th (ext) | Thp (ext) |
|---|---|---|---|---|
| OFF | 0.1 ms ≤ Tp ≤ Tp (ext)-TA | 0.7 ms | 0 ms ≤ Th ≤ Th (ext)-0.1 ms<br>0.1 ms ≤ Th (ext) | Thp (ext)<br>=Th (ext)+Tp (ext) |
| ON | 0.5 ms ≤ Tp ≤ Tp (ext)-TA | 1 ms | | |

Table 4-14 TA Value

| TA value | Tp setting time |
|---|---|
| 1 ms | 0.050 ms to 60.000 ms |
| 1 ms | 60.01 ms to 600.00 ms |
| 1 ms | 600.1 ms to 6000.0 ms |
| 2 ms | 6001 ms to 60000 ms |

Table 4-15 Restrictions on Top

| Status before Operate | | Top |
|---|---|---|
| Standby | | 120 ms *1 |
| Suspend | HiZ | 60 ms |
| | LoZ | 10 ms |

Tp: Setting period time (Slave Tp)

Th: Setting hold time

Tp (ext): TRIGGER IN signal period time (Master Tp)

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

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

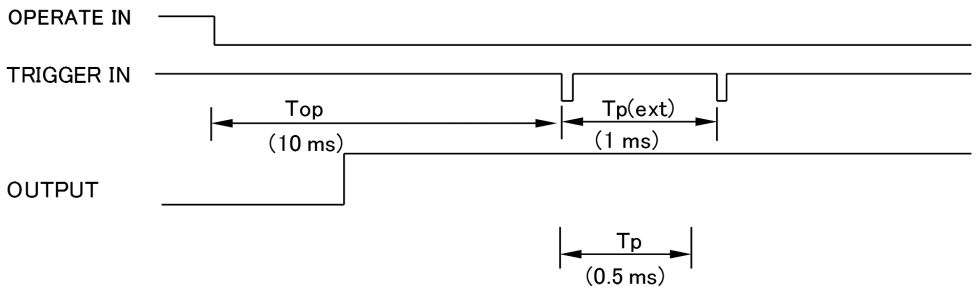
Top: Time from specifying Operate to inputting TRIGGER IN signal

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

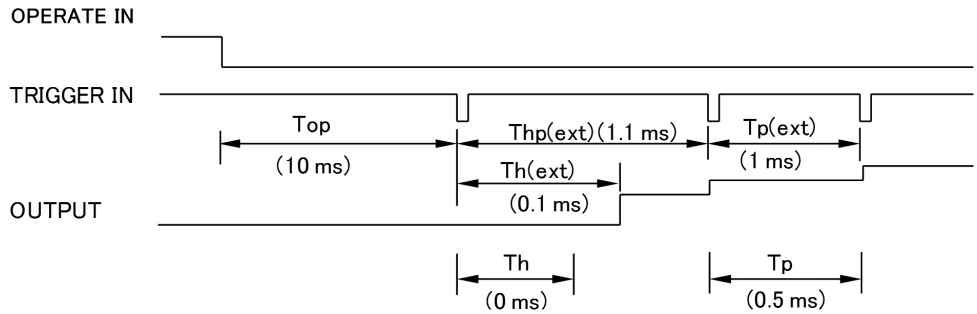
Tp (ext) min: The minimum operational period of the TRIGGER IN signal

Conditions: source range: fixed, measurement range: fixed, trigger mode: HOLD, integration time: 10 μs, Auto Zero: OFF, measurement delay: 20 μs, source delay: 5 μs, pulse width: 25 μs

- Example for the DC source mode




- Example for the sweep source mode



## 4.2.11 Multiple Unit Operation

This section describes synchronous operation, serial connection and parallel connection by using more than one 6253/6254 units.

### 4.2.11.1 Synchronous Operation

The synchronous operation of the 6253/6254 allows synchronous measurement in the DC source mode, and synchronous source and measurement in the pulse source and sweep source modes.

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

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 and measurement cannot be synchronized if a range change is made.)

1. Synchronous operation of three units using SYNC OUT

   The Operate and Standby timings and the source and measure timings are synchronized. The source and measurement steps are matched with the slowest one.

   The following shows the settings and connections for synchronous operation.

Table 4-16 Settings for 3-Unit Synchronous Operation by SYNC OUT

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

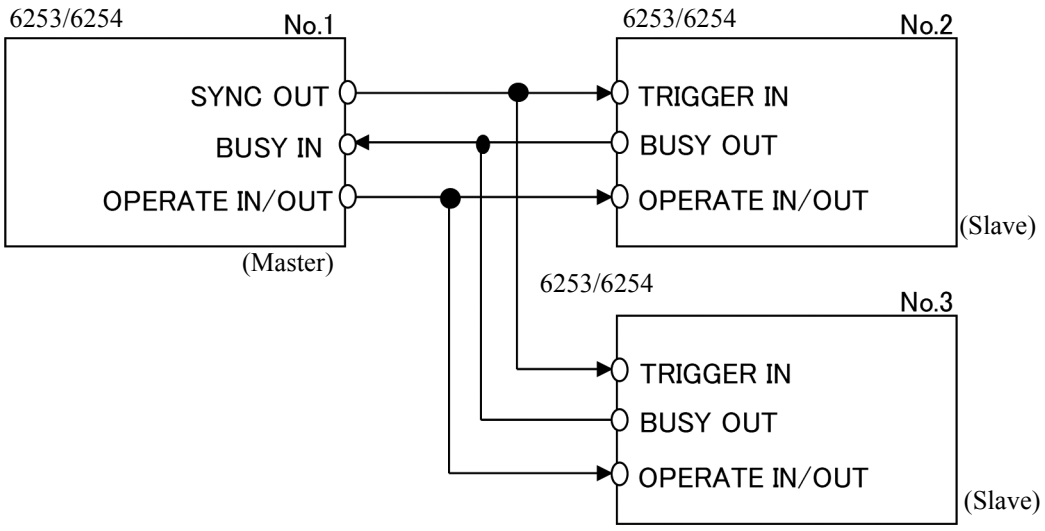
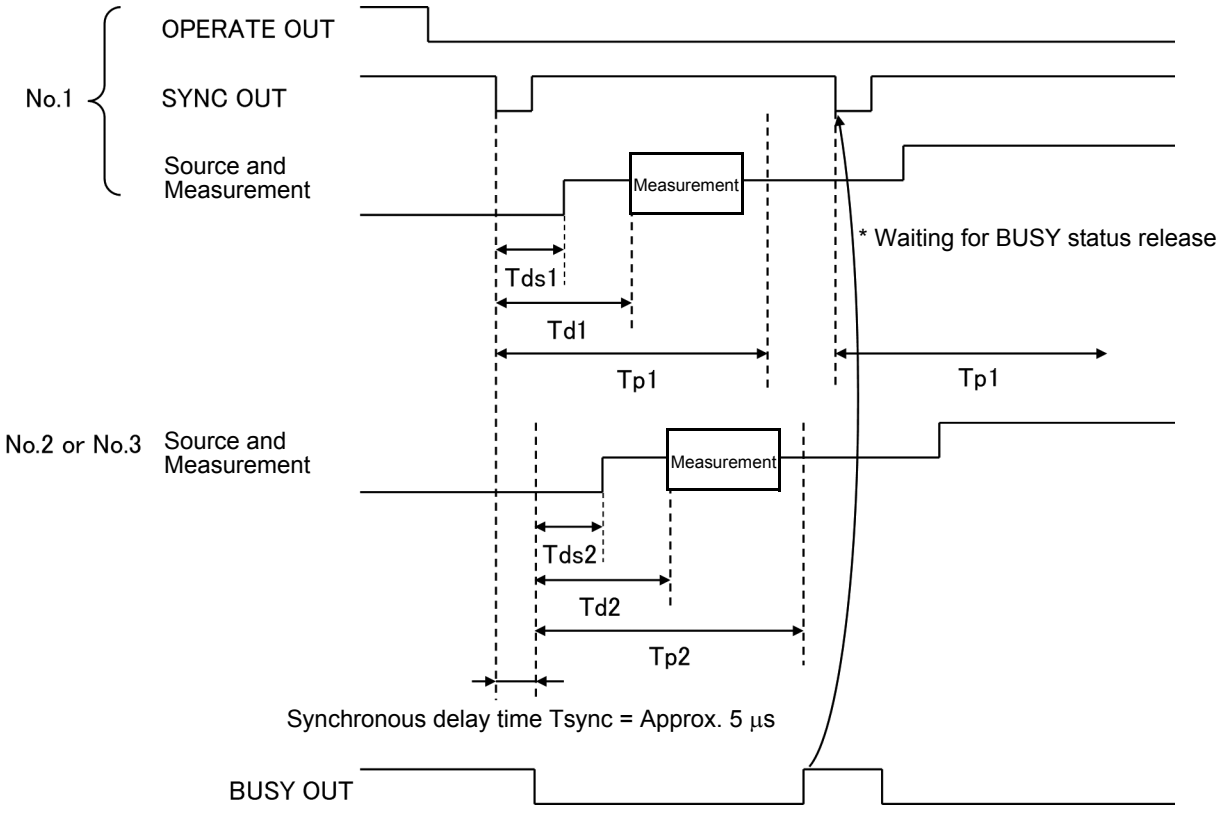
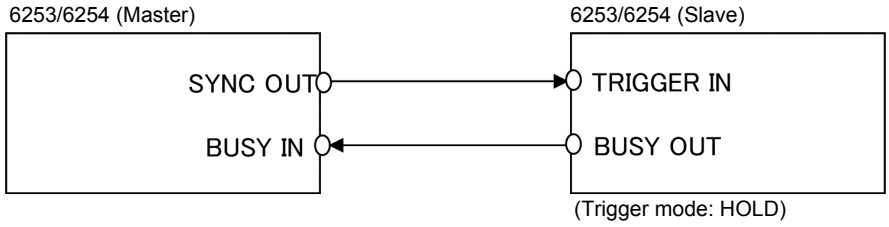
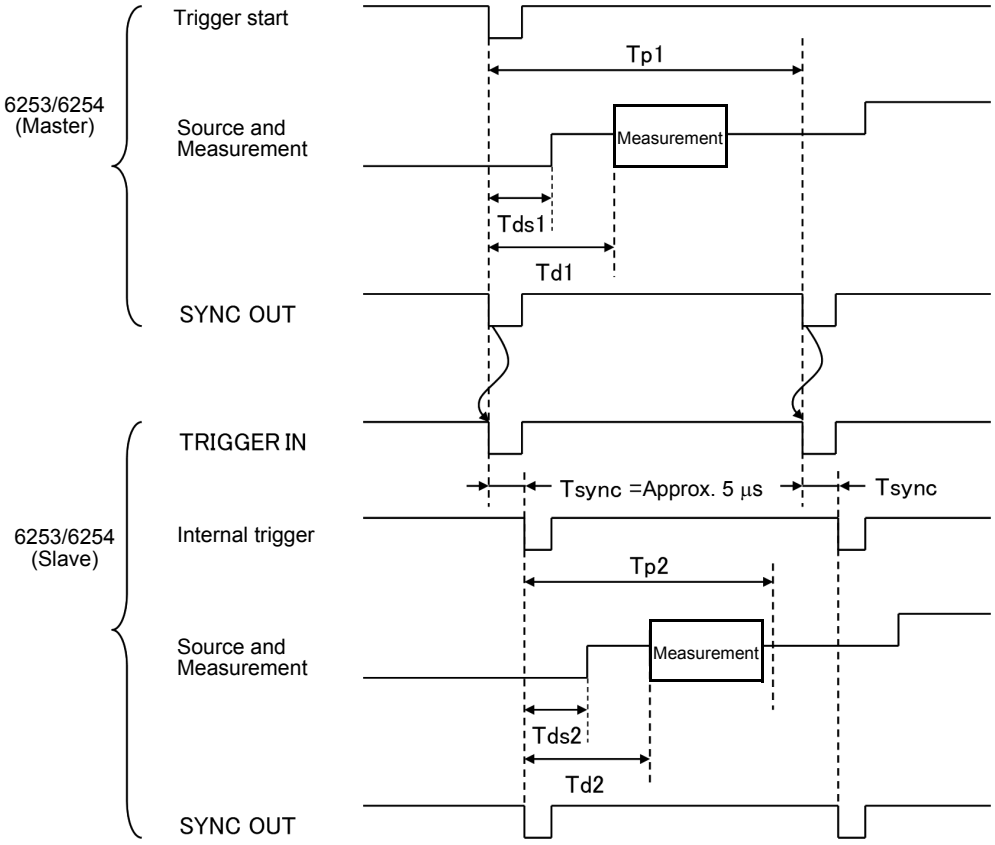



Figure 4-16 Connections for 3-Unit Synchronous Operation by SYNC OUT



2. Restrictions on setting
   - The 6253/6254 has a Tsync time delay of approximately 5 μs from the external trigger input to the measurement start. Consider this time delay when using two or more 6253/6254 units in synchronous operation.
   - There are restrictions on setting Tp and Th of the slaves when using the external trigger.
   - The first synchronous sweep step is displaced within the Th accurate range.
   - Tp for synchronous operation is limited to the value below.
     Master Tp ≥ 1 ms, Slave Tp ≥ 500 μs
   - The period may be extended depending on the timing of measured value display. If it matters, set the display OFF.



From the above, considering the Tsync time, make the relevant settings as follows:

1. Tds1 ≅ Tds2 + Tsync (5 μs)
2. Td1 ≅ Td2 + Tsync (5 μs)
3. Tp1 ≥ Tp2 + TA (1 ms)
   (Tp1 ≥ 1 ms, Tp2 ≥ 500 μs)
4. Th1 ≅ Th2 - Th(ext) - Tp(ext)
   (Th (ext) min = 0.1 ms, Tp (ext) min = 1 ms)

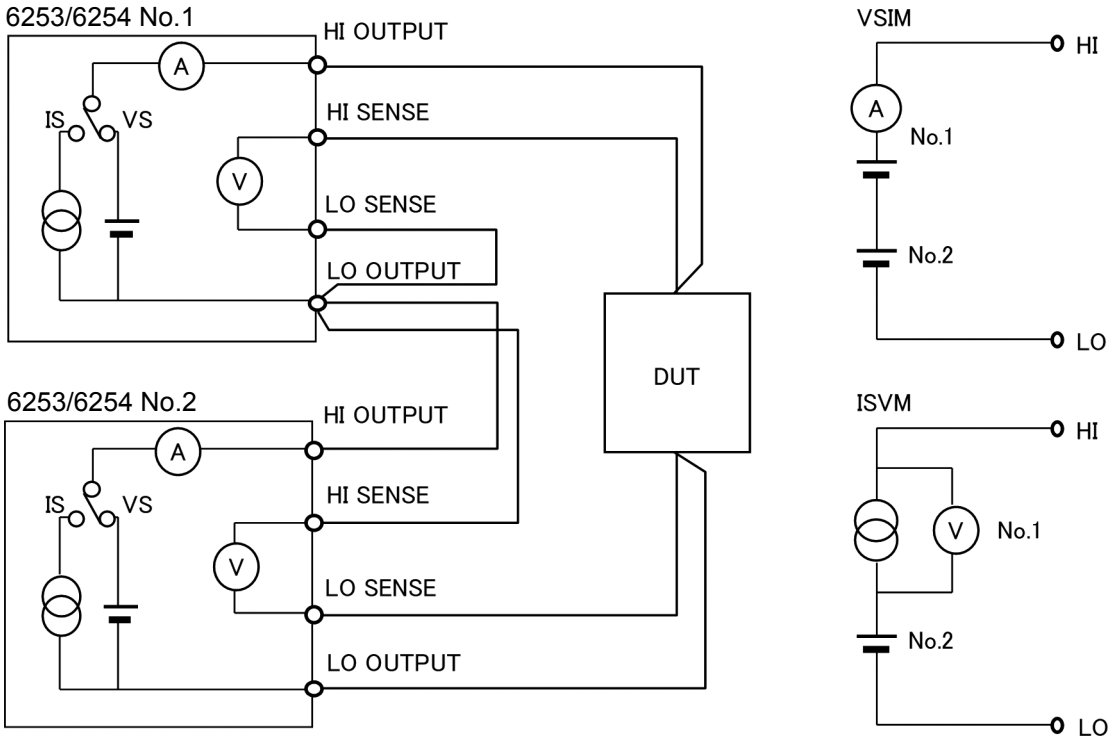
Example) Tds1 = 35 μs
Td1 = 55 μs
Tp1 = 1.5 ms
Th1 = 1.1 ms
Tds2 = 30 μs
Td2 = 50 μs
Tp2 = 500 μs
Th2 = 0 ms

*NOTE: A single master can control up to five slaves.*

### 4.2.11.2 Serial Connection

Two 6253/6254 units serially connected can generate up to ±220 V/±0.5 A (6253) or ±40 V/±7 A (6254).

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




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 4-17 Serial Connection

---

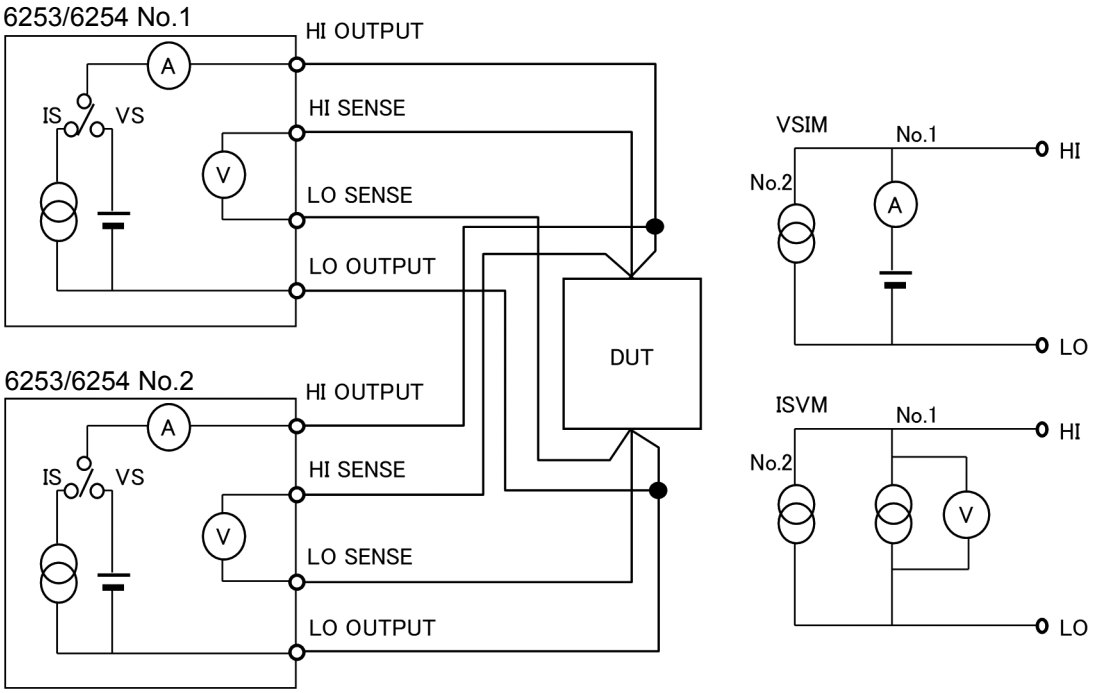
*CAUTION:*

1. *If the load is short-circuited, the two 6253/6254 units apply reverse polarity voltage to each other.*
   *Depending on the settings, an overload may be generated when a short circuit occurs.*
2. *Only two units can be connected serially. Do not connect three or more units serially.*
   *If the load is short-circuited, the maximum applicable voltage will be exceeded, and the 6253/6254 may be damaged.*
3. *When using constant current, the smaller setting current of No.1 and No.2 becomes constant current as in Figure 4-17. The other one becomes the constant voltage.*

---

### 4.2.11.3 Parallel Connection

Two 6253/6254 units connected in parallel can generate up to ±4 A/±32 V (6253) or ±40 A/±7 V (6254). The following figure shows a connection diagram in which two units are connected in parallel using a 4-wire connection. Two units are used for voltage measurements at two points of different timing, such as for a pulse charge and discharge test of a battery.




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

Figure 4-18 Parallel Connection

*CAUTION:*

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

## 4.2.12 Measurement Data Memory Function

The 6253/6254 features a measurement data memory for storing up to 20,000 measurement data items.

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

### 4.2.12.1 Memory Store

Two ways of storing the measured data are available; Normal mode and Burst mode.

Select the parameters, ***7) Store*** and ***1) Store Mode*** on the menu screen to set the Normal mode or Burst mode.

Figure 4-19 shows a conceptual diagram for storing measured data. Table 4-17 compares the operations in the Normal mode and the Burst mode

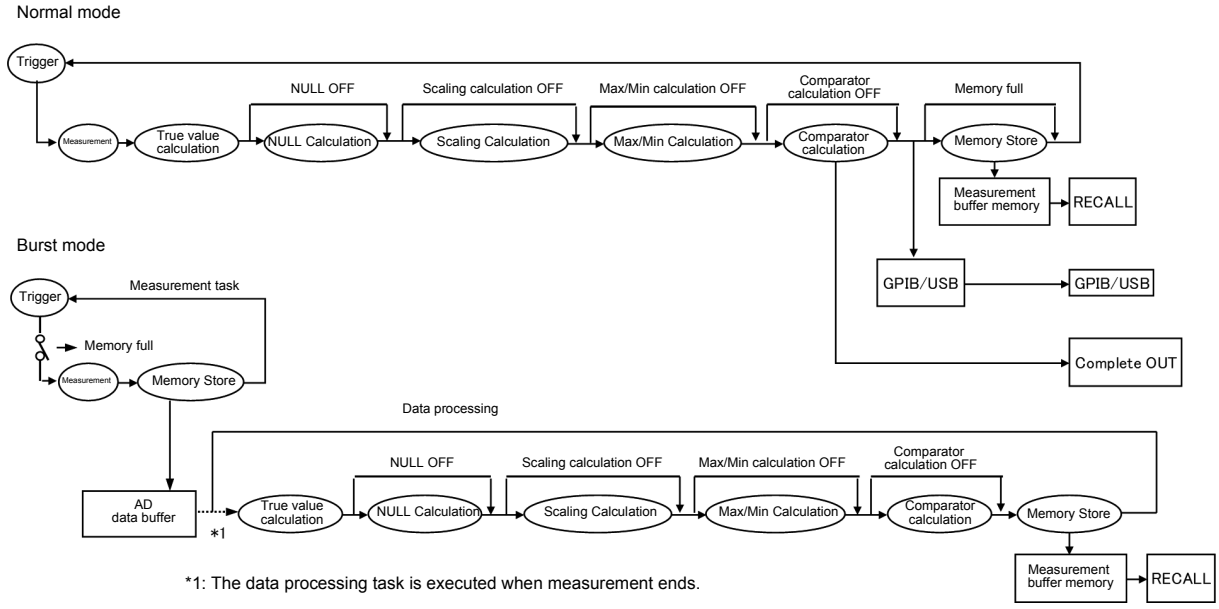



Figure 4-19 Conceptual Diagram of Memory Store

Table 4-17 Comparison of Memory Store Operations

| Memory Store mode | | Normal | Burst |
|---|---|---|---|
| Available source mode | | All | DC sweep, pulse sweep (range fixed, Auto Zero: OFF, Complete/ Busy: Sweep end), DC, pulse |
| Recommended usage | | Normal measurement When storing measured data for regular measurement such as DC or pulse measurement | High-speed measurement When reading the measured data after measuring a certain number of times such as sweep measurement |
| Minimum repeat time (*) | | 500 µs | 50 µs |
| Measurement data display | | Displayed in real time | No display |
| Data output | Reading the latest data by the ENTER key | Available | Not available |
| | RECALL and RN1 commands | Available | |
| Operation at memory full | | The ST indicator is lit in light blue. MFL (bit 10) of the device event status register is set. | |
| | | Storing data is stopped. | Measurement stops. Sweep mode: STOP |
| Comparator calculation results | COMPLETE OUT HI/GO/LO signal | Output in real time | No output |
| | Buzzer | | |
| | HI/LO/GO display | | No display |
| Flag for the specified number of memory stored data reached Device Event Status Register ASN (bit4) | | This flag bit is set when the number of measured data reaches the specified number of stored data in the measurement buffer memory (using the RNM command). | |

(*) Integration time: 5 µs, Source delay: 5 µs, Measurement delay: 20 µs

*NOTE: Turning ON or OFF Memory Store or changing the Store mode is impossible during sweep operation in the sweep source mode.*

## 4.2.13 Memory Clear

The memory data is cleared in any of the following conditions:

- When executing Memory Clear by menu operation
- When executing the RL command
- When setting the Store mode to ON (Normal or Burst)
- When switching between the Normal mode and the Burst mode
- Power ON
- When executing sweep in the Burst mode

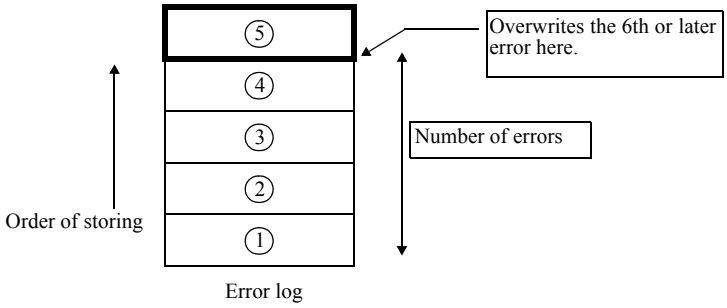
## 4.2.14 Error Log

The 6253/6254 holds the error number in the error log memory when it detects an error.

1. Operation

   The error log has five memory areas and operates as follows:

   - Errors are stored in the order of detection.
   - If more than five errors are detected, then the last stored error is overwritten.
   - The "**ERR**" is displayed when errors are stored.




2. Clearing error log

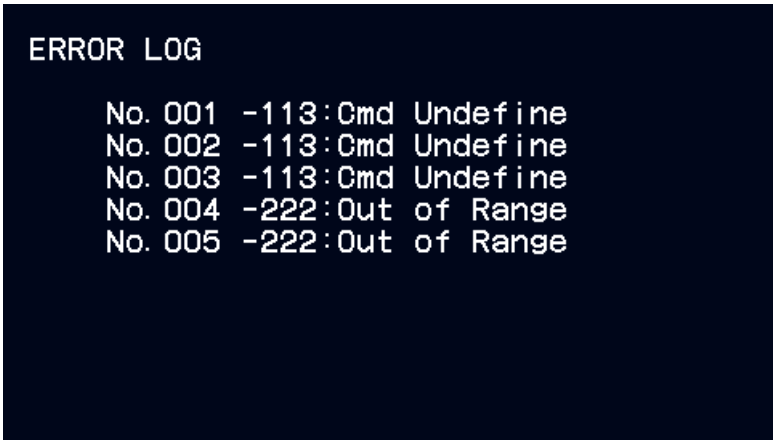
   The error log is cleared in any of the following conditions and the "**ERR**" indicator disappears.

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

   *Not cleared by *RST.

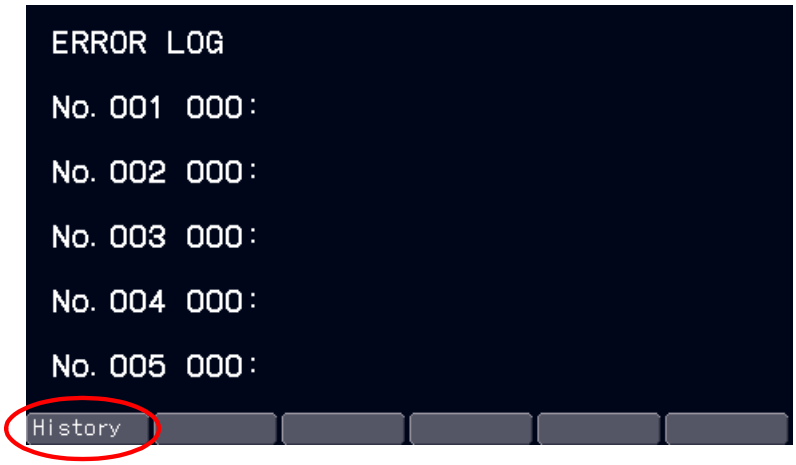
3. Reading out the error log

   Select the parameters, ***13) System*** and ***9) Error Log*** in the menu.

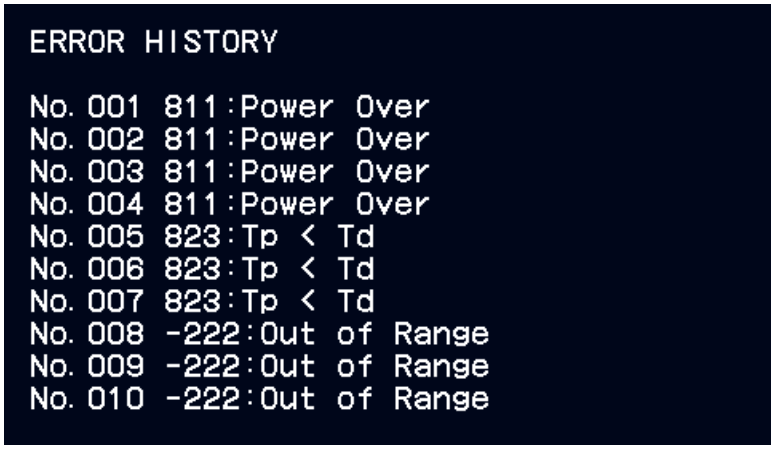


## 4.2.15 Error History

The contents of the error log are erased by viewing or reading. However, errors stored in the error history are retained after the power is turned OFF, and the latest ten errors can be displayed.
(Applicable from software revision B00 or later for the 6253)




Press the soft key **History** to display the error history.




The 11th and succeeding errors are overwritten in order. (No.010 is the latest)

The error history can be read by the remote command “ERH?.”

(e.g.) <ERH?> 811, 811, 811, 811, 823, 823, 823,-222,-222,-222

## 4.2.16 Self-Test

The 6253/6254 can self-test internal operations by turning on the power, executing the remote command, or manual operation.

1. The self-test items and output results are shown below.

Table 4-18 Self-Test Items (1 of 4)

| Error code | Description | Execution method | | TER register (*1) | | 6253 | 6254 |
|---|---|---|---|---|---|---|---|
| | | Power ON | *TST? | Register | Data | | |
| 001 | ROM check SUM | ✓ | | - | - | ✓ | ✓ |
| 004 | RAM read/write | ✓ | | | | ✓ | ✓ |
| 005 | Analog section communication | ✓ | ✓ | | | ✓ | ✓ |
| 012 | CAL data SUM | ✓ | ✓ | a | 2 | ✓ | ✓ |
| 013 | Parameter SUM | ✓ | ✓ | | 4 | ✓ | ✓ |
| 501 | Calibration data lost | ✓ | ✓ | | 16 | ✓ | ✓ |
| 502 | Saved data lost | ✓ | ✓ | | 32 | ✓ | ✓ |
| 503 | Saved parameter data lost | ✓ | ✓ | | 64 | ✓ | ✓ |
| 101 | AD 1 operation IR1/IR2 ratio | ✓ | ✓ | b | 1 | ✓ | ✓ |
| 102 | AD 1 operation IR2/IR3 ratio | ✓ | ✓ | | 2 | ✓ | ✓ |
| 103 | AD 1 operation IR3/IR4 ratio | ✓ | ✓ | | 4 | ✓ | ✓ |
| 104 | AD 1 operation IR4/IR5 ratio | ✓ | ✓ | | 8 | ✓ | ✓ |
| 105 | AD 1 operation IR5/IR6 ratio | ✓ | ✓ | | 16 | ✓ | ✓ |
| 111 | Analog section RST line test | ✓ | ✓ | | 32 | ✓ | ✓ |
| 112 | Analog section TRIG line test | ✓ | ✓ | | 64 | ✓ | ✓ |
| 121 | AD 2 operation IR1/IR2 ratio | ✓ | ✓ | | 128 | ✓ | ✓ |
| 122 | AD 2 operation IR2/IR3 ratio | ✓ | ✓ | | 256 | ✓ | ✓ |
| 123 | AD 2 operation IR3/IR4 ratio | ✓ | ✓ | | 512 | ✓ | ✓ |
| 124 | AD 2 operation IR4/IR5 ratio | ✓ | ✓ | | 1024 | ✓ | ✓ |
| 125 | AD 2 operation IR5/IR6 ratio | ✓ | ✓ | | 2048 | ✓ | ✓ |
| 151 | AD 1 operation ZERO | ✓ | ✓ | | 4096 | ✓ | ✓ |
| 152 | AD 2 operation ZERO | ✓ | ✓ | | 8192 | ✓ | ✓ |

Table 4-18 Self-Test Items (2 of 4)

| Error code | Description | Execution method | | TER register (*1) | | 6253 | 6254 |
|---|---|---|---|---|---|---|---|
| | | Power ON | *TST? | Register | Data | | |
| 201 | VSVM 300 mV ZERO | ✓ | ✓ | c | 1 | ✓ | ✓ |
| 202 | VSVM 300 mV +FS | ✓ | ✓ | | 2 | ✓ | ✓ |
| 203 | VSVM 300 mV -FS | ✓ | ✓ | | 4 | ✓ | ✓ |
| 204 | VSVM 3 V ZERO | ✓ | ✓ | | 8 | ✓ | ✓ |
| 205 | VSVM 3 V +FS | ✓ | ✓ | | 16 | ✓ | ✓ |
| 206 | VSVM 3 V -FS | ✓ | ✓ | | 32 | ✓ | ✓ |
| 207 | VSVM 10 V ZERO | ✓ | ✓ | | 64 | ✓ | ✓ |
| 208 | VSVM 10 V +FS | ✓ | ✓ | | 128 | ✓ | ✓ |
| 209 | VSVM 10 V -FS | ✓ | ✓ | | 256 | ✓ | ✓ |
| 210 | VSVM 30 V ZERO | ✓ | ✓ | | 512 | ✓ | - |
| | VSVM 20 V ZERO | | | | | - | ✓ |
| 211 | VSVM 30 V +FS | ✓ | ✓ | | 1024 | ✓ | - |
| | VSVM 20 V +FS | | | | | - | ✓ |
| 212 | VSVM 30 V -FS | ✓ | ✓ | | 2048 | ✓ | - |
| | VSVM 20 V -FS | | | | | - | ✓ |
| 213 | VSVM 100 V ZERO | ✓ | ✓ | | 4096 | ✓ | - |
| 214 | VSVM 100 V +FS | ✓ | ✓ | | 8192 | ✓ | - |
| 215 | VSVM 100 V -FS | ✓ | ✓ | | 16384 | ✓ | - |

Table 4-18 Self-Test Items (3 of 4)

| Error code | Description | Execution method | | TER register (*1) | | 6253 | 6254 |
|---|---|---|---|---|---|---|---|
| | | Power ON | *TST? | Register | Data | | |
| 216 | High Limit 300 mV +FS | ✓ | ✓ | d | 1 | ✓ | ✓ |
| 217 | High Limit 300 mV -FS | ✓ | ✓ | | 2 | ✓ | ✓ |
| 218 | High Limit 3 V +FS | ✓ | ✓ | | 4 | ✓ | ✓ |
| 219 | High Limit 3 V -FS | ✓ | ✓ | | 8 | ✓ | ✓ |
| 220 | High Limit 10 V +FS | ✓ | ✓ | | 16 | ✓ | ✓ |
| 221 | High Limit 10 V -FS | ✓ | ✓ | | 32 | ✓ | ✓ |
| 222 | High Limit 30 V +FS | ✓ | ✓ | | 64 | ✓ | - |
| | High Limit 20 V +FS | | | | | - | ✓ |
| 223 | High Limit 30 V -FS | ✓ | ✓ | | 128 | ✓ | - |
| | High Limit 20 V -FS | | | | | - | ✓ |
| 224 | High Limit 100 V +FS | ✓ | ✓ | | 256 | ✓ | - |
| 225 | High Limit 100 V -FS | ✓ | ✓ | | 512 | ✓ | - |
| 226 | Low Limit 300 mV +FS | ✓ | ✓ | | 1024 | ✓ | ✓ |
| 227 | Low Limit 300 mV -FS | ✓ | ✓ | | 2048 | ✓ | ✓ |
| 228 | Low Limit 3 V +FS | ✓ | ✓ | | 4096 | ✓ | ✓ |
| 229 | Low Limit 3 V -FS | ✓ | ✓ | | 8192 | ✓ | ✓ |
| 230 | Low Limit 10 V +FS | ✓ | ✓ | | 16384 | ✓ | ✓ |
| 231 | Low Limit 10 V -FS | ✓ | ✓ | | 32768 | ✓ | ✓ |

Table 4-18 Self-Test Items (4 of 4)

| Error code | Description | Execution method | | TER register (*1) | | 6253 | 6254 |
|---|---|---|---|---|---|---|---|
| | | Power ON | *TST? | Register | Data | | |
| 232 | Low Limit 30 V +FS | ✓ | ✓ | e | 1 | ✓ | - |
| | Low Limit 20 V +FS | | | | | - | ✓ |
| 233 | Low Limit 30 V -FS | ✓ | ✓ | | 2 | ✓ | - |
| | Low Limit 20 V -FS | | | | | - | ✓ |
| 234 | Low Limit 100 V +FS | ✓ | ✓ | | 4 | ✓ | - |
| 235 | Low Limit 100 V -FS | ✓ | ✓ | | 8 | ✓ | - |
| 236 | IM 3 μA ZERO | ✓ | ✓ | | 16 | ✓ | - |
| 237 | IM 30 μA ZERO | ✓ | ✓ | | 32 | ✓ | - |
| 238 | IM 300 μA ZERO | ✓ | ✓ | | 64 | ✓ | ✓ |
| 239 | IM 3 mA ZERO | ✓ | ✓ | | 128 | ✓ | ✓ |
| 240 | IM 30 mA ZERO | ✓ | ✓ | | 256 | ✓ | ✓ |
| 241 | IM 300 mA ZERO | ✓ | ✓ | | 512 | ✓ | ✓ |
| 242 | IM 2 A ZERO | ✓ | ✓ | | 1024 | ✓ | - |
| | IM 3 A ZERO | | | | | - | ✓ |
| 243 | IM 20 A ZERO | ✓ | ✓ | | 2048 | - | ✓ |
| 301 | OVL detection check | ✓ | ✓ | | 4096 | ✓ | ✓ |

(*1) TER? command response register and data

In the error register (ERR?) the following bits are set.

- At power ON: bit 0
- In executing the self-test: bit1

2. Self-test execution by manual operation

When executing the self test by manual operation, select the parameters ***13) System*** and ***4) Self Test*** in that order in the menu.

| Self-test item | Description |
|---|---|
| 1) Self Test | Press the **ENTER** key to execute the self-test.<br>Press the **EXIT** key to finish. |
| 2) LCD Pattern Display | Press the **ENTER** key to execute the display test.<br>Press the **EXIT** key to finish. |
| 3) Key & Buzzer Test | Press the **ENTER** key to execute the key and buzzer test.<br>Press the **EXIT** key to finish. |

## 4.3 Compatibility

The 6253/6254 shares the same command system as the 6240B, 6241A, 6242, 6247G and 6247C. This section describes the compatibility with the earlier model 6243/6244.

### 4.3.1 Remote Command Compatibility

The 6253/6254 has the same functions as the 6243/6244 but some commands are different. The following compatible-commands are also available.

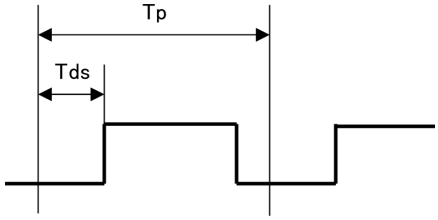
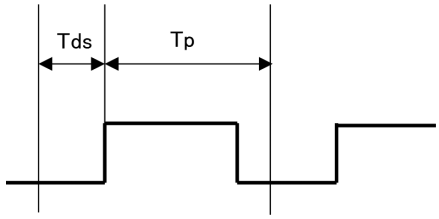
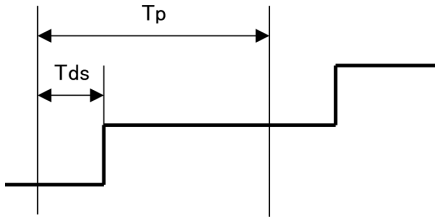
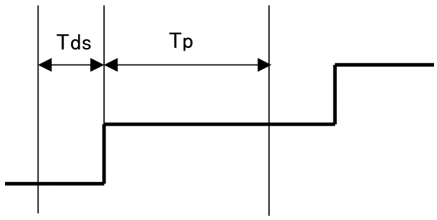
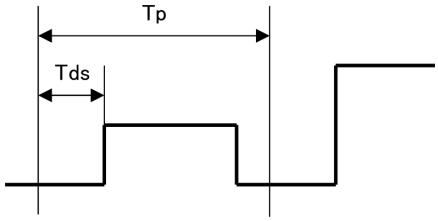
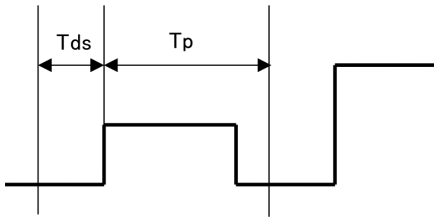
- V command
- I command
- D command
- DB command
- H command
- E command
- N and P commands
- KH command

To enhance the compatibility, use the compatible mode. Select the parameters ***13) System*** and ***10) Compati Mode*** in the menu to set the 6243/6244-compatible mode to ON. For more information on the compatible mode, refer to Section 5.1.2, "Compatibility."

*NOTE: Changing the 6243/6244-compatible mode setting will initialize the parameters.*

## 4.3.2 Difference in Source Period Parameter

Note that the period parameter Tp is defined differently from the 6243/6244 as below.

| Source mode | 6253/6254 | 6243/6244 |
|---|---|---|
| Pulse |  |  |
| DC sweep |  |  |
| Pulse sweep |  |  |

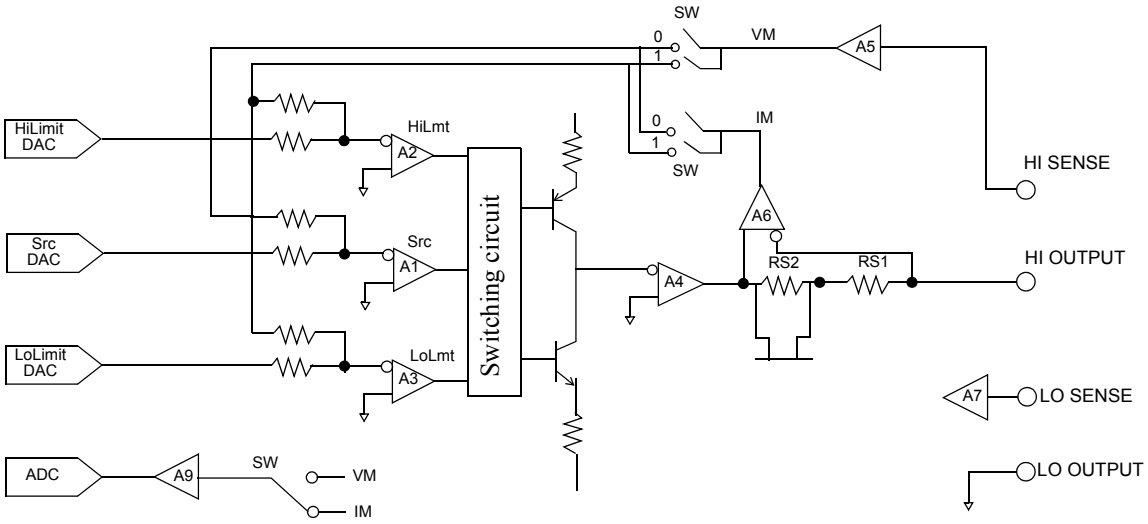
## 4.3.3 Precautions for Synchronous Operation

While the 6243/6244 has no delay time from external trigger input to measurement start, the 6253/6254 has the delay time Tsync.

Thus, when operating the 6243/6244 and the 6253/6254 in synchronization, consider the delay time Tsync in reference to Section 4.2.11.1, “Synchronous Operation.”

## 4.4 Operational Principles

### 4.4.1 Block Diagram




### 4.4.2 Operational Principles

- The 6253/6254 contains a DA converter SrcDAC, for setting the voltage source or current source. It also has two DA converters, HiLimitDAC and LoLimitDAC for setting the current limits and voltage limit.
  The SrcDAC has 18-bit conversion accuracy, and the HiLimitDAC and LoLimitDAC have 16-bit conversion accuracy.
  The output from the DA converters is input to three error amplifiers, Src (A1), HiLmt (A2), and LoLmt (A3) respectively.
- For voltage source, the SrcDAC becomes a voltage-source DAC, and the Src error amplifier (A1) becomes a voltage-source error amplifier.
  Also, HiLimitDAC becomes a DAC for current limit on the Hi side and the HiLmt error amplifier (A2) becomes an error amplifier for current limit on the Hi side.
  Likewise, the LoLimitDAC and the LoLmt error amplifier (A3) work as current limit on the Lo side.
  At this time, 0 is ON for SW1 in the feedback circuit and 1 is ON for SW2.
  For current source, the usage is switched between each DAC and error amplifier; for SW1 1 is ON and for SW2 0 is ON to generate current.
- The roles of source and limit are switched by the switching circuit shown in the above figure, comparing the feedback amount for each, then switching to the larger one.
- Current range switching is done by switching the current detection resistor Rs. Consequently, the current measurement always takes place in the same range as that of current source or current-limit.

- Voltage range switching is done by $A_5$, and voltage measurement, voltage source, and voltage limit always take place in the same range.
- The $A_5$ and $A_6$ amplifiers have high input impedance to minimize leakage.
- The $A_7$ amplifier also has high input impedance to reduce errors for 4-wire connection.
- The AD converter employs an integral type AD, and the integration time can be set between 5 μs and 1000 ms.

# 5. REMOTE PROGRAMMING

This chapter provides an overview of the USB, GPIB, LAN and RS232 interfaces and describes their connections and settings.

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

## 5.1 Using Interface

The 6253/6254 is equipped with the USB and GPIB interfaces. The RS232 and LAN interfaces are also available as factory options.

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

### 5.1.1 Selecting Interface

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

1. The selected interface is saved in the nonvolatile memory and does not change by turning OFF the power or resetting the interface.
2. A unique unit address needs to be set on the interface. When selecting the USB interface and connecting multiple instruments, set individual identifying addresses (USB ID).

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

| Setting item | Default setting |
|---|---|
| Interface selection (I/F BUS) | USB |
| Header ON/OFF | ON |
| GPIB address | 01 |
| USB ID | 001 |
| Baud rate | 9600 |
| Data bit | 8 bit |
| Parity bit | NONE |
| Stop bit | 1 bit |
| IP address | 192.168.000.001 |
| Default gateway | 192.168.000.001 |
| Subnet mask | 255.255.255.000 |
| MAC address | An unique address assigned |

3. Switching the interface will initialize the block delimiter setting.

## 5.1.2 Compatibility

The 6243/6244-compatible mode has some functional restrictions to enhance the compatibility.
In order to optimize the functions of the 6253/6254, it is recommended to use the normal mode unless the compatibility should be considered.
For more information on the compatibility, also refer to the following sections:

5.7 Data Output Format (Talker Format)

5.8.3 Remote Command List

- In the compatible mode, the following commands require specifying the unit.

Normal mode

| | | |
|---|---|---|
| Linear sweep | SN<br>[±<st>,<br>±<sp>,<br><step>] | <st>: Start value<br><sp>: Stop value<br><step>: Step value (The polarity is ignored.)<br>When omitting all the setting values, set the sweep type only.<br>However, it is impossible to omit them respectively. |
| | SN? | Response: SN±<st>, ±<sp>, <step><br>st, sp, step : <d.dddddE±d> |

Compatible mode

| | | |
|---|---|---|
| Linear sweep | SN<br>[±<st>,<br>±<sp>,<br><step>] | <st>UNIT: Start value<br><sp>UNIT: Stop value<br><step>UNIT: Step value (The polarity is ignored.)<br>When omitting all the setting values, set the sweep type only.<br>However, it is impossible to omit them respectively. |
| | SN? | Response: SN±<st>, ±<sp>, <step><br>st, sp, step : <d.dddddE±d>UNIT |

Normal mode

| | | |
|---|---|---|
| Log sweep | SG<br>[±<st>,<br>±<sp>,<br><step>] | <st>: Start value<br><sp>: Stop value<br><step>: Number of partitions by 10 (1, 2, 5, 10, 25, 50)<br>When omitting all the setting values, set the sweep type only.<br>However, it is impossible to omit them respectively. |
| | SG? | Response: SG±<st>, ±<sp>, <step><br>st, sp : <d.dddddE±d><br>step : <dd> |

Compatible mode

| | | |
|---|---|---|
| Log sweep | SG<br>[±<st>,<br>±<sp>,<br><step>] | <st>UNIT: Start value<br><sp>UNIT: Stop value<br><step>: Number of partitions by 10 (1, 2, 5, 10, 25, 50)<br>When omitting all the setting values, set the sweep type only.<br>However, it is impossible to omit them respectively. |
| | SG? | Response: SG±<st>, ±<sp>, <step><br>st, sp : <d.ddddE±d>UNIT<br>step : <dd> |

Normal mode

| | | |
|---|---|---|
| Bias value | SB data | data : Bias value |
| | SB? | Response: SB±<d.dddddE±d> |

Compatible mode

| | | |
|---|---|---|
| Bias value | SB data | <data>UNIT: Bias value |
| | SB? | Response: SB±<d.dddddE±d>UNIT |

- The commands that do not exist for the 6243/6244 but only for the 6253/6254 operate as they are. However, the following commands respond in $4^{1}/_{2}$ digits.
  SOV?, SUV?, DBV?, DBI?, SF?, SE?, SES?
- Memory-related commands
  The commands SZ? and RDN? are output basically in 4 digits. However, they are output in 5 digits when storing or setting more than 9999 data.
- Talker format
  Refer to Section 5.7, “Data Output Format (Talker Format).”
- RM (resistance measurement) restriction
  In the compatible mode, the RM (resistance measurement) is not executable.

## 5.2 USB

### 5.2.1 Overview

The 6253/6254 is equipped with USB (Universal Serial Bus) conforming to USB 2.0 standard.

USB allows function settings and reading of measurement data with respect to multiple instruments connected to the bus from a PC, making it simple to configure an automated measurement system.

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

### 5.2.2 USB Specifications

- Standard: Complies with USB2.0 Full-Speed
- Connectors: USB type B (female)
- ID: USB ID, settable from 1 to 127 (*)
- Remote/Local: Available
- Input commands: Function setting and query with ASCII character string commands
- Output format: Measurement data and query response in ASCII character strings and IEEE 754 format (*).
- Driver: ADC instruments USB driver
  CDC-ACM driver (For USBCDC, applicable from software revision B00 for the 6253)

(*) Disabled when USBCDC is selected

### 5.2.3 Setting Up USB

#### 5.2.3.1 Connecting with Personal Computer

Connect the USB connector (type B) on the rear of the 6253/6254 to that on a personal computer with a cable.

Fully insert all connectors.

Use a USB hub to connect multiple instruments to a single personal computer.

## 5.3 GPIB

### 5.3.1 Overview

GPIB (General Purpose Interface Bus) allows you to externally set the measurement functions and parameters on the 6253/6254 and read out the measured data, making it simple to configure an automated measurement system.

As GPIB signals from the 6253/6254 are electrically isolated inside the unit from the measurement signal system, connecting external devices does not affect the measured values.

The remote commands are the same as with USB.

- General specifications

  Standard: IEEE-488.2

  Code: ASCII code

  Logic level: Logical 0 “High” +2.4 V min.
  Logical 1 “Low” +0.4 V max.

Table 5-1 Interface Function

| Code | Function |
|---|---|
| SH1 | Source Handshake capability |
| AH1 | Acceptor handshake capability |
| T6 | Basic Talker, unaddressed if MLA, serial poll |
| L4 | Basic Listener, unaddressed if MTA |
| SR1 | Service Request capability |
| RL1 | Remote/Local switching capability |
| PP0 | No Parallel Poll capability |
| DC1 | Device Clear capability (The SDC and DCL commands can be used.) |
| DT1 | Device Trigger capability (The GET command can be used.) |
| C0 | No Controller capability |
| E2 | Using tri-state bus drivers |

## 5.3.2 Precautions when Using GPIB

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

Table 5-2 Standard Bus Cable

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

2. The bus cables have piggyback connectors. A piggyback connector has both a male connector and a female connector by itself. The male and female connectors can be stacked on top of each other. When connecting the bus cables, do not stack three or more connectors. Be sure to fix the bus cables with clamping screws.
3. Check the power requirements, grounding conditions and setting conditions of each device before turning it ON.
   Be sure to turn ON all the devices connected to the bus. The overall system operation cannot be guaranteed if any of the devices is not turned ON.
4. Connecting and disconnecting cables

   Turn OFF all the devices before connecting or disconnecting the GPIB cables. Check that the chassis of the devices on the bus are connected to each other and to the ground before connecting or disconnecting any GPIB cables.
5. ATN interrupt during message transmission

   If an ATN request interruption occurs during transfer of messages between the devices, the ATN has priority and the previous status is cleared.
6. Up to 255 characters can be recognized in a single program command transmission.
   An error occurs if the program command exceeds 255 characters.
7. Retain the REN line at Low for 5 ms or longer following the transmission of a command.

## 5.4 LAN

### 5.4.1 Overview

To remotely control the 6253/6254 via the LAN interface, connect the LAN port on the panel to a personal computer.

The 6253/6254 can be controlled by plugging in a network or directly connecting to a host computer.

The LAN interface is a factory option. (LAN interface: 6253+06/6254+06)

### 5.4.2 Setting Up LAN

Set ***I/F BUS*** on the interface menu to "LAN."

Using the LAN interface requires the following settings. (These settings cannot be changed by remote control.)

Table 5-3 LAN Setting Items

| Setting item | Description |
|---|---|
| IP address | IP address setting<br>The default value is 192.168.0.1. |
| Default gateway | Default gateway setting<br>The default value is 192.168.0.1. |
| Subnet mask | Subnet mask setting<br>The default value is 255.255.255.0. |
| MAC address | A unique MAC address is displayed for each unit.<br>This address cannot be changed. |

*For the setting details, verify with the network manager.

### 5.4.3 Communication Setting on Personal Computer

When controlling the 6253/6254 remotely via the LAN interface, make the communication settings of the control software on the computer side as follows:

Table 5-4 Communication Settings when Using LAN

| Item | Setting value |
|---|---|
| TCP/IP port number (destination) | 5025 |
| Delimiter | LF or CR + LF |

### 5.4.4 Network Connection

When connecting the 6253/6254 to a network, verify the necessary information with the network manager.

If an invalid address is specified for the network, both the network and the 6253/6254 may operate unexpectedly.

*NOTE: When the computer and the 6253/6254 exist on different networks (not on the same subnet), it is necessary to set the gateway correctly.*

Verify the physical connection between the 6253/6254 and the computer according to the following procedure:

1. Set the network connection correctly without connecting cables, and turn OFF the 6253/6254.
2. Connect the cables with the power OFF. Connect the 6253/6254 to the computer or the network terminal such as hub by using the cables.
3. Turn ON the 6253/6254.

### 5.4.5 IP Connection Check

The “ping” command is used to verify connections on IP networks from computers. This command sends IP packets to network devices and receives responses from them to confirm the IP network normality.

The “ping” command is available on Windows or under UNIX. In case of Windows, enter as follows from the command prompt.

C:¥>ping 192.168.0.1 (*)

(*) The argument following “ping” indicates a network device to be verified. Here, input the IP address assigned to the 6253/6254. “192.168.0.1” is just an example. Replace this argument according to the operating environment in actual cases.

The following shows an example of “ping” command execution results when the proper connection is confirmed.

```
C:¥>ping 192.168.0.1

Pinging 192.168.0.1 with 32 bytes of data:

Reply from 192.168.0.1: bytes=32 time<10ms TTL=128
Reply from 192.168.0.1: bytes=32 time=20ms TTL=128
Reply from 192.168.0.1: bytes=32 time=20ms TTL=128
Reply from 192.168.0.1: bytes=32 time=30ms TTL=128

Ping statistics for 192.168.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 3ms

C:¥>
```

Here is an example of “ping” command execution results when responses cannot be received and timeout occurs due to a failure on the network.

```
C:¥ >ping 192.168.0.1

Pinging 192.168.0.1with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.0.1:

    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:¥>
```

When timeout occurs, there may be a problem with the IP address settings or network connections of the 6253/6254 or the computer.

## 5.4.6 Communication Method

The 6253/6254 uses TCP/IP to communicate with a computer. The TCP/IP communication is performed according to the following procedure:

1. After turning ON, the 6253/6254 waits for the computer sending a TCP/IP connection request with the specified port number (refer to Table 5-4.)
2. The computer sends the TCP/IP connection request to the 6253/6254.
3. The 6253/6254 accepts the TCP/IP connection request to establish the connection.
4. After the connection establishment, the communication is performed by sending or receiving simple 7-bit ASCII codes.
5. The computer sends commands or queries to the 6253/6254.

   The command or query messages are characters that end with CR+LF or LF.
6. The 6253/6254 receives, interrupts and executes the commands or queries. When these queries are received correctly, it returns response messages.

   The response messages are characters with delimiters added.

Only single personal computer is connectable to the 6253/6254.

---

*Note for Using LAN*

*When sending a query command, be sure to read it out without fail.*

---

## 5.5 RS-232

### 5.5.1 Overview

RS-232 allows you to externally control the 6253/6254 instead of operating the front panel (*). As RS-232 signals are electrically isolated from the measurement signal system, the measured values are not affected by noise or other factors of the external device.

The remote commands are the same as with USB.

The RS-232 interface is a factory option. (RS-232 interface: 6253+03/6254+03)

*Front panel operation is necessary for turning the power ON/OFF and setting the interface.

### 5.5.2 Precautions when Using RS-232

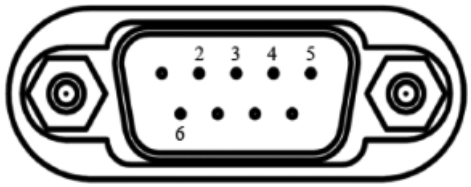
Turn OFF the connected device before connecting or disconnecting the cross cable. Also, check that the chassis of the device is connected to the ground before connecting or disconnecting the cable.

## 5.5.3 Specifications

The specifications of RS-232 are shown below.

| Setting item | Value | Factory default |
|---|---|---|
| Baud rate | 19200/9600/300/600/1200/2400/4800 | 9600 |
| Data bit | 8 bit/7 bit | 8 bit |
| Parity bit | NONE/ODD/EVEN | NONE |
| Stop bit | 1 bit/2 bit | 1 bit |

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




| Pin number | Input/output | Description |
|---|---|---|
| 2 | Input | Receive data (RxD) |
| 3 | Output | Transmit data (TxD) |
| 4 | Output | Data terminal ready (DTR) |
| 5 | - | Signal ground (SG) |
| 6 | Input | Data set ready (DSR) |
| 1, 7 to 9 | - | No connection |

The transmit data (TxD) checks the status of the data set ready (DSR) inside the 6253/6254. If the data set ready (DSR) is false, data output is interrupted. When it is true, data is output.

*CAUTION: Flow control by X parameters (XON/XOFF) is not available on the 6253/6254.*

## 5.5.4 Setting RS-232

Set ***I/F BUS*** on the interface menu to “RS232.”

The RS232 Config settings such as baud rate, data bit, parity bit and stop bit should be made.

## 5.5.5 Command Transmission and Response

### 5.5.5.1 Command Transmission

There are two types of remote commands as follows:

- Setting command: Command to set parameters to the 6253/6254
- Query command: Command to read the setting parameters from the 6253/6254
  A question mark (?) is placed at the end of the command.

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

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

### 5.5.5.2 Response

A prompt is output to a command that was sent as follows:

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

### 5.5.5.3 Response to Setting Command and Query Command

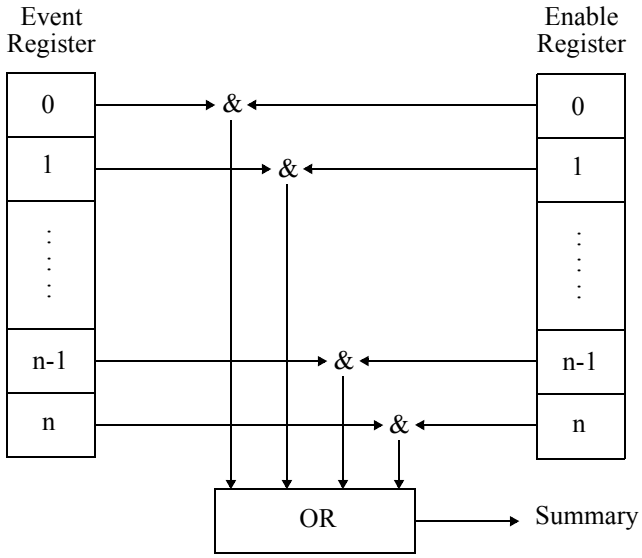
1. Response to a setting command
   <LF>=><CR><LF>
2. Response to a query command
   <LF> query response <CR><LF><LF>=><CR><LF>

## 5.6 Status Register Structure

The 6253/6254 has a hierarchical status register structure that conforms to the IEEE standard 488.2-1987 and can send various statuses of itself to the controller. The following explains an operational model of the status structure and allocation of events.

1. Status Register

   The 6253/6254 employs a status register model as defined by the IEEE standard 488.2-1987. A status register consists of an Event Register and an Enable Register.




- Event Register

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

- Enable Register

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

The 6253/6254 has the following four types of status registers.

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

The Figure 5-1 show the 6253/6254 status register structure.

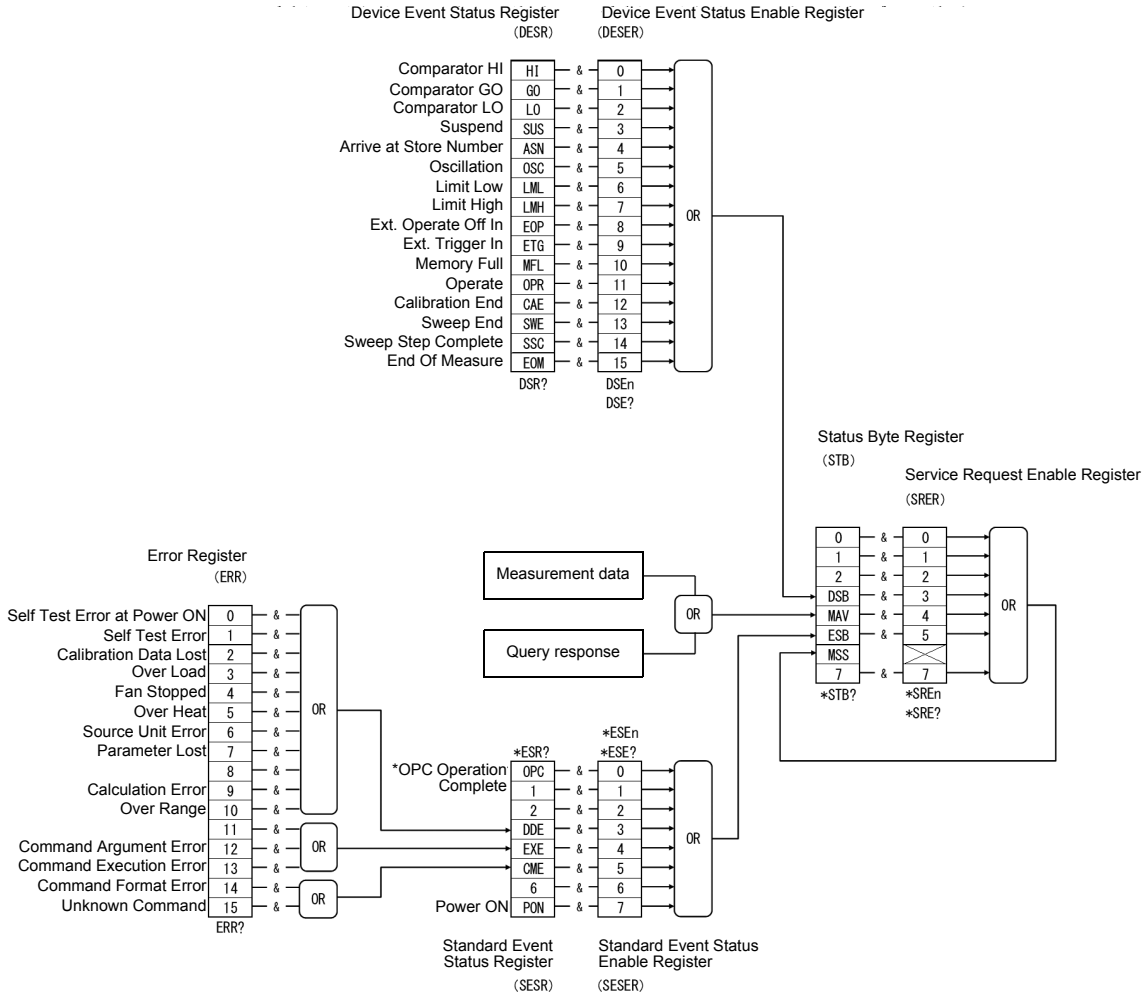



Figure 5-1 Status Register Structure

2. Event Enable Register

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

   - Service Request Enable Register setting: *SRE
   - Standard Event Status Enable Register setting: *ESE
   - Device Event Enable Register setting: DSE

   (Example) Enables only the EOM bit of the Device-Event Register.
   When the EOM bit of the Device Event Register is set to 1, the DSB bit of the Status Byte Register is set to 1.

   (Example) Enables the Status Byte Register's DSB (Device Event Status Register summary) bit and the ESB (Standard Event Status Register summary) bit.
   When the DSB bit or the ESB bit is set to 1, the Status Byte Register's MSS bit is set to 1.

3. Status Byte Register

   The Status Byte Register summarizes the information from the status registers. This Status Byte Register's summary is transmitted as a service request to the controller. Consequently, the Status Byte Register is slightly different from other status registers in structure. The Status Byte Register is explained in the following:
   The following figure shows the structure of the Status Byte Register.

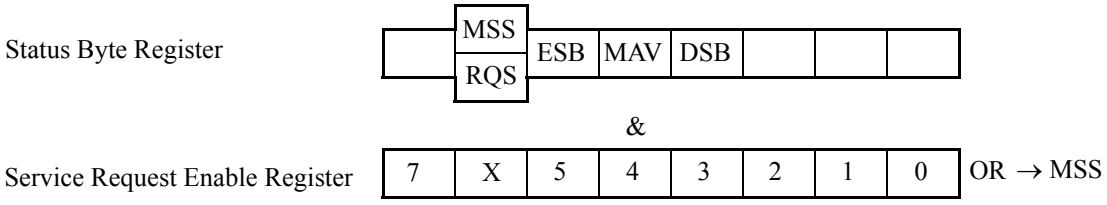



Figure 5-2 Status Byte Register Structure

The Status Byte Register conforms to other status registers except the following three points.

- The summary of the Status Byte Register is written into bit 6 of the Status Byte Register.
- The Enable Register's bit 6 is always enabled and cannot be changed.
- The Status Byte Register's bit 6 (MSS) writes RQS (request service).

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

The following table describes each bit of the Status Byte Register.

Table 5-5 Status Byte Register (STB)

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

Common conditions in which the Status Byte Register is cleared

- All cleared when the power is turned ON.
- All cleared by *CLS except that MAV is not cleared if data exists in the output buffer.
- Not cleared even if read by *STB?

Conditions in which the Service Request Enable Register is cleared

- Cleared when the power is turned ON.
- Cleared when the *SRE0 command is executed.

4. Standard Event Status Register

The following tables show the allocations of the Standard Event Status Register.

Table 5-6 Standard Event Status Register (SESR)

| bit | Name | Description |
|---|---|---|
| 0 | OPC<br>Operation Complete | ON : Set to 1 when all operations are complete after receiving the *OPC command. |
| 1 | Not in use | Always set to 0. |
| 2 | Not in use | Always set to 0. |
| 3 | DDE<br>Device Dependent Error | ON : Set to 1 when a device-dependent error occurs. |
| 4 | EXE<br>Execution Error | ON : Set to 1 when a received command is not currently executable.<br>Set to 1 when incorrect data is entered in a command parameter. |
| 5 | CME<br>Command Error | ON : Set to 1 when a received command is incorrectly spelled. |
| 6 | Not in use | Always set to 0. |
| 7 | PON<br>Power On | ON : Set to 1 when the power is turned ON. |

Common conditions in which the Standard Event Status Register is cleared

- All cleared when the power is turned ON.
- All cleared by *CLS.
- All cleared when read by *ESR?

Conditions in which the Standard Event Status Enable Register is cleared

- Cleared when the power is turned ON.
- Cleared when the *ESE0 command is executed.

5. Device Event Status Register

The following tables show the allocations of the Device Event Status Register.

Table 5-7 Device Event Status Register (DESR)

| bit | Name | Description |
|---|---|---|
| 0 | HI<br>Comparator HI | ON : Set to 1 when the comparator calculation result is HI. |
| 1 | GO<br>Comparator GO | ON : Set to 1 when the comparator calculation result is GO. |
| 2 | LO<br>Comparator LO | ON : Set to 1 when the comparator calculation result is LO. |
| 3 | SUS<br>Suspend | ON: Set to 1 when Suspend status is set.<br>OFF: Set to 0 when Operate or Standby status is set. |
| 4 | ASN<br>Arrive at Store Number | ON : Set to 1 when the number of measured data reaches the specified number of stored data in the memory. |
| 5 | OSC<br>Oscillation | ON : Set to 1 when oscillation is detected. |
| 6 | LML<br>Limiter Low | ON : Set to 1 when the low limit value is detected. |
| 7 | LMH<br>Limiter High | ON : Set to 1 when the high limit value is detected. |
| 8 | EOP<br>Ext.Operate Off In | ON : Set to 1 when an external operating interruption signal input is detected. |
| 9 | ETG<br>Ext.Trigger In | ON : Set to 1 when an external trigger signal input is detected. |
| 10 | MFL<br>Memory Full | ON : Set to 1 when the measurement buffer memory is full.<br>OFF : Set to 0 when the measurement buffer memory becomes not full. |
| 11 | OPR<br>Operate | ON : Set to 1 when Operate status is set.<br>OFF : Set to 0 when Standby or Suspend status is set. |
| 12 | CAE<br>Calibration End | ON : Set to 1 when calibration is complete.<br>OFF : Set to 0 when calibration starts. |
| 13 | SWE<br>Sweep End | ON : Set to 1 when sweep is complete.<br>OFF : Set to 0 when sweep starts. |
| 14 | SSC<br>Sweep Step Complete | ON : Set to 1 when sweep step is complete in the HOLD trigger mode.<br>OFF : Set to 0 when sweep step starts.<br>Set to 0 when sweep is paused or starts. |
| 15 | EOM<br>End Of Measure | ON : Set to 1 when measurement is complete.<br>OFF : Set to 0 when measurement starts.<br>Set to 0 when the measurement data is read out. |

Common conditions in which the Device Event Status Register is cleared

- All cleared when the power is turned ON.
- All cleared by *CLS.
- All cleared when read by DSR?

Conditions in which the Device Event Status Enable Register is cleared

- Cleared when the power is turned ON.
- Cleared when the DSE0 command is executed.

6. Error Register

The following table shows the allocations of the Error Register.

Table 5-8 Error Event Register (ERR)

| bit | Description |
|---|---|
| 0 | ON : Set to 1 when a self-test error occurs at power ON. |
| 1 | ON : Set to 1 when a self-test error occurs. |
| 2 | ON : Set to 1 when calibration data is lost in the self test at power ON, and the default calibration values are used.<br>Set to 0 when the power is reset after recalibration. |
| 3 | ON : Set to 1 when an overload is detected.<br>Not set to 0 even if the overload is cleared. |
| 4 | ON : Set to 1 when “fan stopped” is detected.<br>Not set to 0 even if the “fan stopped” is cleared. |
| 5 | ON : Set to 1 when overheat is detected.<br>Not set to 0 even if the overheat is cleared. |
| 6 | ON : Set to 1 when the source unit malfunctions. |
| 7 | ON : Set to 1 when the saved parameters are lost in the self test at power ON and the default parameters are used. |
| 8 | Always set to 0. |
| 9 | ON : Set to 1 when a calculation error occurs. |
| 10 | ON : Set to 1 when an over rang occurs. |
| 11 | Always set to 0. |
| 12 | ON : Set to 1 when a remote command argument error occurs. |
| 13 | ON : Set to 1 when a remote command execution error occurs. |
| 14 | ON : Set to 1 when a remote command format error occurs. |
| 15 | ON : Set to 1 when an unknown remote command is received. |

Common conditions in which the Error Register is cleared

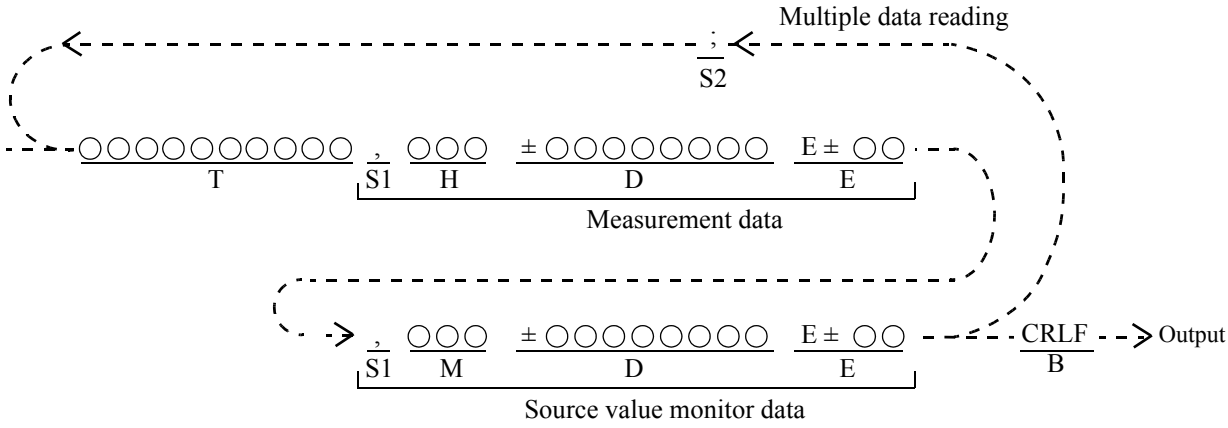
- All cleared when the power is turned ON.
- All cleared by *CLS.

*NOTE: The error register is not cleared when read by ERR?.*

## 5.7 Data Output Format (Talker Format)

### 5.7.1 Normal Mode

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



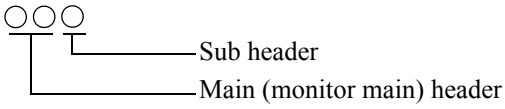

T: Time stamp (10-digit figure)
H: Header (main header characters + sub header of 1 character)
D: Mantissa part (polarity + decimal point + 7-digit figure)
E: Exponent part (E + polarity + 2-digit figure)
S1: String delimiter 1
S2: String delimiter 2
B: Block delimiter
M: Header (monitor main header characters + blank of 1 character)

Time stamp

A clock value in milliseconds is output. It is counted every 10 milliseconds.
When the time stamp output is OFF, the following string delimiter 1 is also not output.

The clock value returns to “0” approximately 1,193 hours after the power ON.
It can be initialized by using the remote commands.

1. Header




The header is not output when the header setting is OFF.

- Main header
  - DV: DC voltage measurement
  - DI: DC current measurement
  - RM: DC voltage measurement/DC current measurement (resistance display)
  - EE: No data in the specified measurement memory
- Monitor main header
  - SV: DC voltage measurement
  - SI: DC current measurement
  - EE: No data in the specified measurement memory
- Sub header

High ↑ Priority ↓ Low

| | |
|---|---|
| S: | Oscillation Detection |
| U: | High limit detected |
| B: | Low limit detected |
| O: | Range over |
| Z: | For resistance measurement, the voltage source value is set to 0 (zero). |
| E: | Calculation error (scaling function or total function) |
| H: | The comparator calculation result is HI. |
| G: | The comparator calculation result is GO. |
| L: | The comparator calculation result is LO. |
| C: | Scaling calculation data |
| N: | NULL calculation data |
| : | Others (space output) |

2. Mantissa part and exponent part

The exponent columns below show exponents when scaling calculation is not performed.

| Measurement function | | | Unit display | |
|---|---|---|---|---|
| | | | Decimal point and unit symbol form | |
| | | | Mantissa part | Exponent part |
| DC voltage measurement | Measurement range | 300 mV | ±ddd.dddd | E-03 |
| | | 3 V | ±d.dddddd | E+00 |
| | | 10 V | ±dd.ddddd | E+00 |
| | | 30 V/20V | ±dd.ddddd | E+00 |
| | | 100 V | ±ddd.dddd | E+00 |
| DC current measurement | | 3 μA | ±d.dddddd | E-06 |
| | | 30 μA | ±dd.ddddd | E-06 |
| | | 300 μA | ±ddd.dddd | E-06 |
| | | 3 mA | ±d.dddddd | E-03 |
| | | 30 mA | ±dd.ddddd | E-03 |
| | | 300 mA | ±ddd.dddd | E-03 |
| | | 2 A/3 A | ±d.dddddd | E+00 |
| | | 20 A | ±dd.ddddd | E+00 |
| Resistance measurement | Significant digits | 1 digit | ±00000.0d | E-09 to E+09 |
| | | | ±000000.d | |
| | | | ±000000d. | |
| | | 2 digits | ±00000.dd | |
| | | | ±00000d.d | |
| | | | ±00000dd. | |
| | | 3 digits | ±0000d.dd | |
| | | | ±0000dd.d | |
| | | | ±0000ddd. | |
| | | 4 digits | ±000d.ddd | |
| | | | ±000dd.dd | |
| | | | ±000ddd.d | |
| | | 5 digits | ±00d.dddd | |
| | | | ±00dd.ddd | |
| | | | ±00ddd.dd | |
| | | 6 digits | ±0d.ddddd | |
| | | | ±0dd.dddd | |
| | | | ±0ddd.ddd | |

| Measurement function | Mantissa part | Exponent part |
|---|---|---|
| High limit value detected in resistance measurement *1 | +9.999999 | E+37 |
| Low limit value detected in resistance measurement *1 | +9.999999 | E+36 |
| ±Range over | +9.999999 | E+35 |
| VS is set to 0 (zero). *1 | +9.999999 | E+33 |
| ±Scaling error | +9.999999 | E+32 |
| ±TOTAL error | +9.999999 | E+31 |
| No data exists at recall. *2 | +8.888888 | E+30 |

*1: This may occur in resistance measurement.

*2: Data does not exist when the measurement buffer memory data is read out.

3. Block delimiter

A block delimiter is output to specify the end of a unit of data.

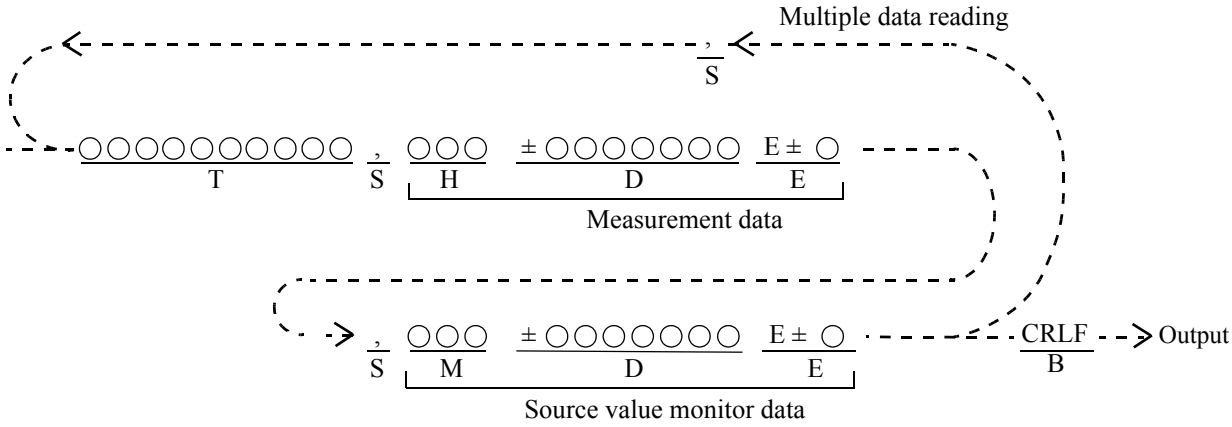
The type of block delimiters can be specified by the following commands:

| Block delimiter | Command | Default |
|---|---|---|
| CR LF <EOI> | DL0 | ✓ |
| LF | DL1 | |
| <EOI> | DL2 | |

* EOI is a function for GPIB. It is unavailable for other than GPIB.

## 5.7.2 Compatible Mode

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



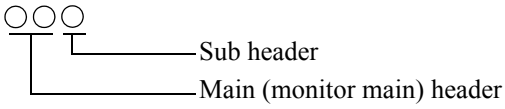

T: Time stamp (10-digit figure)
H: Header (main header characters+ sub header of 1 character)
D: Mantissa part (polarity + decimal point + 6-digit figure)
E: Exponent part (E + polarity + 1-digit figure)
S: String delimiter
B: Block delimiter
M: Header (monitor main header characters + blank of 1 character)

Time stamp

A clock value in milliseconds is output. It is counted every 10 milliseconds.
When the time stamp output is OFF, the following string delimiter is also not output.

The clock value returns to “0” approximately 1,193 hours after the power ON.
It can be initialized by using the remote commands.

1. Header




The header is not output when the header setting is OFF.

- Main header
  - DV: DC voltage measurement
  - DI: DC current measurement
  - EE: No data in the specified measurement memory
- Monitor main header
  - SV: DC voltage measurement
  - SI: DC current measurement
  - EE: No data in the specified measurement memory
- Sub header

High ↑ Priority ↓ Low

| | |
|---|---|
| S: | Oscillation Detection |
| M: | High limit detected |
| M: | Low limit detected |
| O: | Range over |
| E: | Calculation error (scaling function or total function) |
| H: | The comparator calculation result is HI. |
| G: | The comparator calculation result is GO. |
| L: | The comparator calculation result is LO. |
| C: | Scaling calculation data |
| N: | NULL calculation data |
| : | Others (space output) |

2. Mantissa part and exponent part
   The exponent columns below show exponents when scaling calculation is not performed.

| Measurement function | | | Unit display | |
|---|---|---|---|---|
| | | | Decimal point and unit symbol form | |
| | | | Mantissa part | Exponent part |
| DC voltage measurement | Measurement range | 300 mV | ±ddd.ddd | E-3 |
| | | 3 V | ±d.ddddd | E+0 |
| | | 10 V | ±dd.dddd | E+0 |
| | | 30 V/20 V | ±dd.dddd | E+0 |
| | | 100 V | ±ddd.ddd | E+0 |
| DC current measurement | | 3 μA | ±d.ddddd | E-6 |
| | | 30 μA | ±dd.dddd | E-6 |
| | | 300 μA | ±ddd.ddd | E-6 |
| | | 3 mA | ±d.ddddd | E-3 |
| | | 30 mA | ±dd.dddd | E-3 |
| | | 300 mA | ±ddd.ddd | E-3 |
| | | 2 A/3 A | ±d.ddddd | E+0 |
| | | 20 A | ±dd.dddd | E+0 |

| Measurement function | Mantissa part | Exponent part |
|---|---|---|
| ±Range over | +999.999 | E+9 |
| ±Scaling error | | E+2 |
| ±TOTAL error | | E+1 |
| No data exists at recall. *1 | +888.888 | E+8 |

*1: Data does not exist when the measurement buffer memory data is read out.

## 5.7.3 REAL64 Format

The REAL64 format conforms to the IEEE-754 double precision floating point standard, and consists of 64 bits (8 bytes).

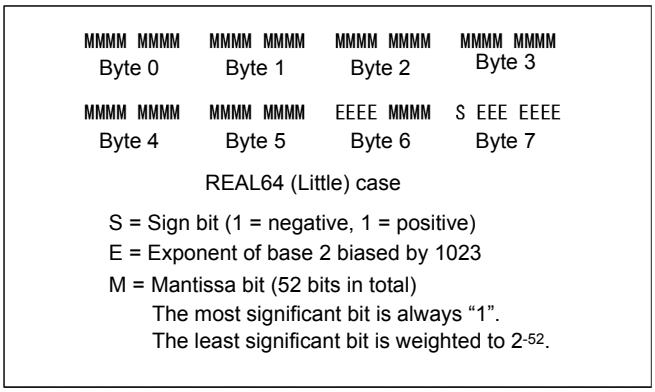



Figure 5-3 REAL64 Output Format

The REAL64 format is valid for the following data.

- Measurement data
- Measurement data in the internal memory

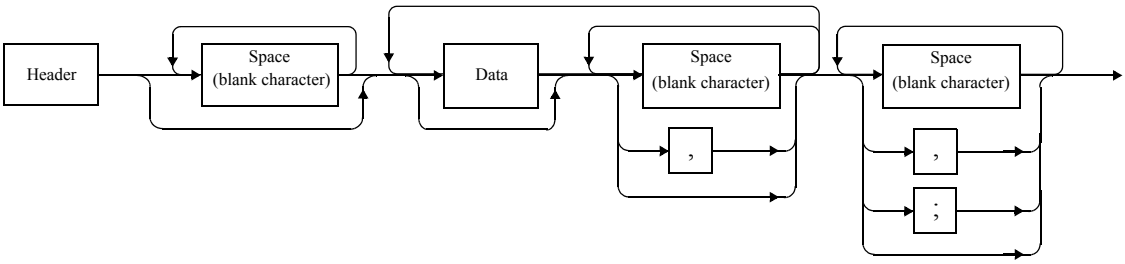
When the REAL64 bit is valid,

- The output data element is not output.
- The block delimiter is always a single-line signal (“EOI”).

# 5.8 Remote Commands

## 5.8.1 Command Syntax

The command syntax is defined by the following format.




1. Header

   There are two types of headers: common command headers and simple headers. A common command header has an asterisk mark (*) placed in front of the mnemonic.
   A simple header is a functionally independent command that has no hierarchical structure.
   Placing a question mark (?) right after the header forms a query command.

2. Space (blank character)

   One or more spaces can be inserted, and spaces also may be omitted.

3. Data

   When a command requires multiple data sets, data sets are separated by commas (,). Spaces may be used directly before and after commas (,). For more information on the data types, refer to Section 5.8.2, “Data Format.”

4. Describing multiple commands

   The 6253/6254 allows multiple commands to be described consecutively or separated by semicolons (;), commas (,), or spaces (␣) in one line.

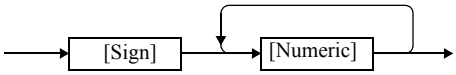
## 5.8.2 Data Format

The 6253/6254 uses the following data types for data input and output.

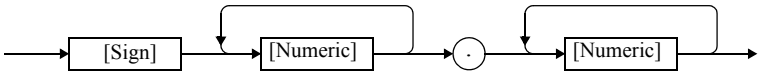
1. Numeric data

   There are three numeric data formats, any of which can be used for input. Depending on the command, a unit can be added when entering data.

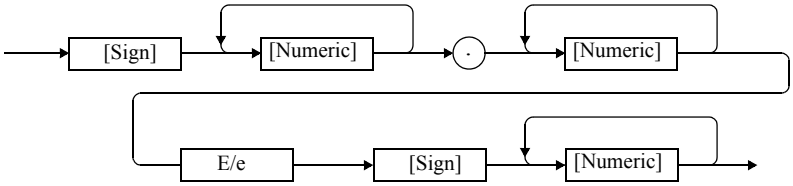
   - Integer type: NR1 format




   - Fixed-point type: NR2 format




   - Floating-point type: NR3 format




2. Units

   The table below lists the units that can be used for the D command or some commands in the compatible mode.

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

*NOTE: When numeric data is expressed in an exponent format for the 6253/6254, the number conversion time becomes too long if the exponent is set to ±31 or higher (xx.xxxE±31). The exponent setting should not exceed ±30.*

## 5.8.3 Remote Command List

1. The Default column shows default settings at Power ON or at factory shipment.
   - The Power ON column shows the status when the power is turned ON.
   - The *RST or RINI command initializes the settings to factory default.
     However, the RINI command cannot initialize *5 and the RINI or *RST command cannot initialize *6.
2. Note for description in the command list
   - Parameter enclosed in [ ] can be omitted.
   - Parameters enclosed in < > are single delimited data items.
   - The symbols in the Operation column shows the following:

     △ in DC pulse OPR/SUS column:

     Acceptable only in the HOLD trigger mode or in the Suspend status

     △ in Sweep OPR/SUS column:

     Acceptable only when sweep stops or in the Suspend status.
   - ▲: Acceptable only in the Suspend status.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Source | Source mode | MD0 | DC mode | | ✓ | ▲ | ▲ |
| | | MD1 | Pulse mode | | | | |
| | | MD2 | DC sweep mode | | | | |
| | | MD3 | Pulse sweep mode | | | | |
| | | MD? | Response: MD0 to MD3 | | | Yes | Yes |
| | Source function | VF | Voltage source function | | ✓ | Yes | △ |
| | | IF | Current source function | | | Executing this function sets Suspend | Executing this function sets Suspend |
| | | V? | Response: V0, V3 to V6 for VF | | | Yes | Yes |
| | | I? | I-2 to I5 for IF | | | | |
| | Source range | SVRX | Optimal range | | ✓ | Yes | No |
| | | SVR3 | 300 mV range | | | | |
| | | SVR4 | 3 V range | | | | |
| | | SVR0 | 10 V range *a | | | | |
| | | SVR5 | 30 V range/20 V range | | | | |
| | | SVR6 | 100 V range *a | | | | |
| | | SVR? | Response: SVRX0, SVRX3 to SVRX6 (for the optimal range)<br>SVR0, SVR3 to SVR 6 (for the fixed range) | | | Yes | Yes |
| | | SIRX | Optimal range | | ✓ | Yes | No |
| | | SIR-2 | 3 μA range *a | | | | |
| | | SIR-1 | 30 μA range *a | | | | |
| | | SIR0 | 300 μA range | | | | |
| | | SIR1 | 3 mA range | | | | |
| | | SIR2 | 30 mA range | | | | |
| | | SIR3 | 300 mA range | | | | |
| | | SIR4 | 2 A range/3 A range | | | | |
| | | SIR5 | 20 A range *b | | | | |
| | | SIR? | Response: SIRX-2 to SIRX4 (for the optimal range)<br>SIR-2 to SIR 4 (for the fixed range) | | | Yes | Yes |
| | Source value | SOV ±data | Voltage source value setting | | 0 | Yes | No |
| | | SOI ±data | Current source value setting | | 0 | | |
| | | SOV? | Response: SOV±d.dddddE±d *1,*2 | | | Yes | Yes |
| | | SOI? | SOI±d.dddddE±d *1,*2 | | | | |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

*2: Outputs the value that is currently generated or the value that is generated during Operate.

*a: In the 6254, this command will result in an error.

*b: In the 6253, this command will result in an error.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Source | Spot command | G ±data | Executes the measurement trigger after setting the source value for the currently set source function. | | | Yes | No |
| | Limit value | LMV ±<data1> [, ±<data2>] | Voltage limit value setting | | ±110 V / ±20 V | Yes | △ |
| | | LMI ±<data1> [, <±data2>] | Current limit value setting<br>Both the HI and LO limit values can be set.<br>• In comparison between data1 and data 2, the larger value is the HI limit value and the smaller one is the LO limit value.<br>• When data 2 is omitted, +data1 and –data 1 are assumed as HI and LO limit values respectively regardless of the data1 polarity.<br>*NOTE:*<br>*1. LMI data1 and data 2 cannot be set homopolar.*<br>*2. Set the difference between the HI and LO limit values to 600 digits (2000 digits in the 3 μA range) or more.* | | ±2 A / ±20 A | | |
| | | LMV? | Response: LMV±<hl>, ±<ll> *1 | | | Yes | Yes |
| | | LMI? | LMI±<hl>, ±<ll><br>hl : <d.ddddE±d> (High limit value)<br>ll : <d.ddddE±d> (Low limit value) | | | | |
| | Suspend voltage | SUV ±data | Suspend voltage setting<br>Setting range: 0 to ±110 V / 0 to ±20 V | | 0 | Yes | △ |
| | | SUV? | Response: SUV±d.dddddE±d *1 | | | Yes | Yes |
| | Suspend HiZ/LoZ | SUZ0 | HiZ: High resistance output status | | ✓ | Yes | △ |
| | | SUZ1 | LoZ: Low resistance output status | | | | |
| | | SUZ? | Response: SUZ0 or SUZ1 | | | Yes | Yes |
| | Pulse base value | DBV ±data | Voltage pulse vase value | | 0 | Yes | ▲ |
| | | DBI ±data | Current pulse base value | | 0 | | |
| | | DBV? | Response: DBV±d.dddddE±d *1 | | | Yes | Yes |
| | | DBI? | DBI±d.dddddE±d | | | | |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Source | Trigger mode | M0<br>M1 | AUTO<br>HOLD | | ✓ | Yes | △ |
| | | M? | Response: M0 or M1 | | | Yes | Yes |
| | | ST0<br>ST1 | AUTO<br>HOLD<br>• This command has the same function as the M command. | | ✓ | Yes | △ |
| | | ST? | Response: STS0 or ST1 | | | Yes | Yes |
| | Operate/ Standby | SBY<br>OPR<br>SUS | Sets the output to OFF (Standby).<br>Sets the output to ON (Operate).<br>Sets the output to Suspend | ✓ | ✓ | Yes | Yes |
| | | SBY?,<br>OPR?,<br>SUS? | The present output status is returned.<br>Response:<br>Status: Operate → OPR; Suspend → SUS; Standby → SBY | | | Yes | Yes |
| | Remote sensing | RS0<br>RS1 | 2 W<br>4 W | | ✓ | Yes | △ |
| | | RS? | Response: RS0 or RS1 | | | Yes | Yes |
| | Time parameter | SP <Th>, <Td>, <Tp> [, <Tw>] | Th : Hold time<br>Td : Measurement delay time<br>Tp : Period<br>Tw : Pulse width<br>Unit: ms<br>Tw can be omitted. | | 0 ms<br>4 ms<br>50 ms<br>25 ms | Yes | △ |
| | | SP? | Response: SP<Th>, <Td>, <Tp>, <Tw><br>Th, Td, Tp, Tw: <d.dddd> *1 | | | Yes | Yes |
| | | SD Tds | Tds : Source delay time (unit: ms) | | 0.005 ms | Yes | △ |
| | | SD? | Response: SDd.dddd *1 | | | Yes | Yes |
| | Response | FL0<br>FL1 | SLOW<br>FAST | | ✓ | Yes | △ |
| | | FL? | Response: FL0 or FL1 | | | Yes | Yes |
| | Slew rate | SRS0<br>SRS1 | OFF<br>ON | | ✓ | No | No |
| | | SRS? | Response: SRS0 or SRS1 | | | Yes | Yes |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Source | Slew rate value | SRW <data1> [,<data2>] | Slew rate value setting (unit: V/s) *1<br>The rise time and fall time values can be set for the slew rate.<br>• When specifying data1 and data2, data1 is the rise time and data2 is the fall time.<br>• When omitting data2, data 1 is both the rise time and the fall time. | | 10.0 V/s | Yes | △ |
| | | SRW? | Response: SRW<srr>,<srr> *1<br>srr: <dd.ddE+d> (slew rate rise time)<br>srf: <dd.ddE+d> (slew rate fall time) | | | Yes | Yes |
| Sweep | Linear sweep | SN [±<st>, ±<sp>, <step>] | <st>: Start value<br><sp>: Stop value<br><step>: Step value (The polarity is ignored.)<br>If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately. | | 0.01 mV/ 0.01 µA<br>1 mV/ 1 µA<br>0.01 mV/ 0.01 µA | Yes | ▲ |
| | | SN? | Response: SN ±<st>, ±<sp>, <step> *1<br>st, sp, step: <d.dddddE±d> | | | Yes | Yes |
| | Fixed level sweep | SF [±<lvl>, <cnt>] | lvl: Level source value<br>cnt: Sampling count (1 to 20000)<br>If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately. | | 0 V/0 A<br>1 | Yes | ▲ |
| | | SF? | Response: SF±<lvl>,<cnt> *1<br>lvl: <d.ddddE±d><br>cnt: <ddddd> | | | Yes | Yes |
| | Log sweep | SG [±<st>, ±<sp>, <step>] | <st>: Start value<br><sp>: Stop value<br><step>: Number of partitions by ten (1, 2, 5, 10, 25, 50)<br>If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately. | | 0.01 mV/ 0.01 µA<br>1 mV/ 1 µA<br>10 | Yes | ▲ |
| | | SG? | Response: SG±<st>,±<sp>,<step> *1<br>st,sp:<d.ddddE±d><br>step :<dd> | | | Yes | Yes |
| | Random sweep | SC [<st>, <sp>] | st: Start address (0 to 19999)<br>sp: Stop address (0 to 19999)<br>If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately. | | 0<br>0 | Yes | ▲ *3 |
| | | SC? | Response: SC<st>, <sp><br>st, sp: <ddddd> | | | Yes | Yes |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

*3: At sweep stop in the Operate status, the values can be changed only between the start and stop addresses that were set in the Standby or Suspend status.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Sweep | Multi-slop linear sweep | SE [<cnt>,±<1d>,±<2d>,±<3d>,±<4d>,±<ld>] | cnt: Number of slopes (2 to 4)<br>1d: 1st value<br>2d: 2nd value<br>3d: 3rd value<br>4d: 4th value<br>ld: Last value<br>If all the settings are omitted, set the sweep type only. However, it is not allowed to omit each value separately. | | 2<br>0.01 mV/ 0.01 µA<br>1 mV/ 1 µA<br>2 mV/ 2 µA<br>3 mV/ 3 µA<br>2 mV/ 2 µA | Yes | ▲ |
| | | SE? | Response:<br>SE<cnt>,±<1d>,±<2d>,±<3d>,±<4d>,±<ld><br><cnt>:<d>1d,2d,3d,4d,ld: <d.dddddE±d> *1 | | | | |
| | | SES <st1>,<st2>,<st3>,<st4> | st1: 1st step value (polarity ignored)<br>st2: 2nd step value (polarity ignored)<br>st3: 3rd step value (polarity ignored)<br>st4: 4th step value (polarity ignored) | | 0.01 mV/ 0.01 µA<br>0.02 mV/ 0.02 µA<br>0.03 mV/ 0.03 µA<br>0.04 mV/ 0.04 µA | Yes | ▲ |
| | | SES? | Response: SES<st1>,<st2>,<st3>,<st4><br>st1,st2,st3,st4: <d.ddddE±d> *1 | | | | |
| | Sweep type | SX? | The sweep type of the present source function is returned.<br>Response: Linear sweep:<br>Same as the SN? response<br>Fixed level sweep<br>Same as the SF? response<br>Log sweep:<br>Same as the SG? response<br>Random sweep:<br>Same as the SC? response<br>Multi-slope linear sweep:<br>Same as the SE? response | | | Yes | Yes |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Sweep | Random sweep memory data | N [adr]<br>P | Random sweep memory data setting starts from the N command and completes at the P command.<br>N<adr>, SVR<n>, SOV<data1>, SOV <data2>, ... ,P (for voltage setting)<br>N<adr>, SIR<n>, SOI<data1>, SOI <data2>, ... ,P (for current setting)<br>adr: Memory address (0 to 19999)<br>data1: Voltage or current source value at adr<br>data2: Voltage or current source value at adr+1<br>*NOTE:*<br>*1. When no source range is specified, the optimal range is set.*<br>*2. Source values different from the present source function cannot be set.* | | 0<br>0<br>*6 | Yes | No |
| | | N? [adr] | Response: N<adr>, SVR<n>, SOV±<data>, P<br>(For voltage source value)<br>N<adr>, SIR<n>, SOI±<data>, P<br>(For current source value)<br>adr: <ddddd><br>n: <d><br>data: <d.ddddE±d> *1 | | | Yes | Yes |
| | | NP? | Query of the random sweep memory setting status<br>Response: 0 …Random sweep memory setting complete<br>1 … Random sweep memory is being set. | 0 | | Yes | Yes |
| | | RSAV | Saves the random sweep data. | | | Yes | No |
| | | RLOD | Loads the random sweep data. | | | Yes | No |
| | | RCLR | Initializes the random sweep data.<br>(Data saved in the memory is not initialized.) | | | Yes | No |
| | Pulse sweep base value | BS [data] | data: Pulse sweep base value | | 0 | Yes | ▲ |
| | | BS? | Response: BS±<d.ddddE±d> *1 | | | Yes | Yes |
| | Bias value | SB [data] | data: Bias value | | 0 | Yes | ▲ |
| | | SB? | Response: SB±<d.ddddE±d> *1 | | | Yes | Yes |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

*6: Not initialized by the RINI or *RST command.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Sweep | RTB (Return to Bias) | RB0 | OFF (Stays at the final value when sweep stops.) | | | Yes | △ |
| | | RB1 | ON (Returns to the bias value when sweep stops.) | | ✓ | | |
| | | RB? | Response: RB0 or RB1 | | | Yes | Yes |
| | Sweep range | SR0 | Auto | | ✓ | Yes | ▲ |
| | | SR1 | Fixed | | | | |
| | | SR? | Response: SR0 or SR1 | | | Yes | Yes |
| | Reverse mode | SV0 | OFF (Single) | | ✓ | Yes | △ |
| | | SV1 | ON (Reverse) | | | | |
| | | SV? | Response: SV0 or SV1 | | | Yes | Yes |
| | Sweep repeat count | SS cnt | cnt: Count (0 to 1000) *Invalid in the Burst mode (0 indicates infinite loop.) | | 1 | Yes | △ |
| | | SS? | Response: SSdddd | | | Yes | Yes |
| | Sweep stop | SWSP | Stops sweep. | | | Yes | Yes |
| | Trigger | *TRG | Sweep start trigger<br>Measurement trigger | | | Yes | Yes |
| Measurement | Function | F0 | Measurement OFF | | | Yes | △ |
| | | F1 | DC voltage measurement (DCV) | | | | |
| | | F2 | DC current measurement (DCI) | | ✓ | | |
| | | F3 | Resistance measurement (OHM) | | | | |
| | | F? | Response: F0 to F3 | | | Yes | Yes |
| | Measurement range | R0 | AUTO range | | | Yes | △ |
| | | R1 | Fixed to the limit value range<br>(However, if the measurement function and the source function are the same, the measurement range conforms to the source range.) | | ✓ | | |
| | | R? | Response: R0 or R1 | | | Yes | Yes |
| | Measurement function link mode | FX0 | OFF | | | Yes | △ |
| | | FX1 | ON (VSIM/ISVM) | | ✓ | | |
| | | FX? | Response: FX0 or FX1 | | | Yes | Yes |

5.8.3 Remote Command List

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Measurement | Integration time | IT-3 | 5 μs | | | Yes | △ |
| | | IT-2 | 10 μs | | | | |
| | | IT-1 | 100 μs | | | | |
| | | IT0 | 500 μs | | | | |
| | | IT1 | 1 ms | | | | |
| | | IT2 | 10 ms | | | | |
| | | IT3 | 1 PLC | | ✓ | | |
| | | IT4 | 2 PLC | | | | |
| | | IT5 | 200 ms | | | | |
| | | IT6 | Arbitrary time (Variable integration) | | | | |
| | | IT? | Response: IT-3 to IT6 | | | Yes | Yes |
| | | OIT data | Arbitrary integration time setting (unit: ms)<br>data: 0.1 ms to 1000 ms | | 200 | Yes | △ |
| | | OIT? | Response: OITdddd.d | | | Yes | Yes |
| | Auto Zero | AZ0 | OFF | | | Yes | △ |
| | | AZ1 | ON | | ✓ | | |
| | | AZ? | Response: AZ0 or AZ1 | | | Yes | Yes |
| | Measurement display digits | RE3 | $3^1/_2$ digits | | | Yes | △ |
| | | RE4 | $4^1/_2$ digits | | | | |
| | | RE5 | $5^1/_2$ digits | | | | |
| | | RE6 | $6^1/_2$ digits | | ✓ | | |
| | | RE? | Response: RE3 to RE6 | | | Yes | Yes |
| | Unit display format | DM0 | Decimal point and unit symbol format | | ✓ | Yes | △ |
| | | DM1 | Exponent form | | | | |
| | | DM? | Response: DM0 or DM1 | | ✓ | Yes | Yes |
| | Display ON/ OFF | DS0 | Display OFF | | | Yes | △ |
| | | DS1 | Display ON | ✓ | | | |
| | | DS? | Response: DS0 or DS1 | | | Yes | Yes |
| | Measurement auto range delay | RD data | data: Measurement auto range delay time (Unit: ms)? *1 | | 0 | Yes | △ |
| | | RD? | Response: RDddddd.d | | | Yes | Yes |
| | Sample count per trigger | SPN cnt | cnt: Sampling count per trigger in the DC or pulse source mode (1 to 20000) | | 1 | Yes | No |
| | | SPN? | Response: SPN<cnt> cnt: <ddddd> | | | Yes | Yes |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Measurement | Measurement data memory | SM0<br>SM1<br>SM2 | Store OFF<br>Normal<br>Burst<br>The same operation as in the Normal mode takes place in the DC or pulse source mode. | ✓ | ✓ | Yes *7<br><br>△ | ▲ |
| | | SM? | Response: SM0 to SM2 | | | Yes | Yes |
| | | RL | Initializes the stored data. | | | △ | △ |
| | | RN n[,adr] | n : 0... Releases recall execution status.<br>1... Sets recall execution status.<br>adr: Recall data number (0 to 19999)<br>(The data number does not change if this setting is omitted.)<br>Reading out the recall data by using the talker function after the recall execution status is set will perform the following operation.<br>• Increments the recall data number after the data output.<br>• If data does not exist in the specified number, the output becomes < EE + 8.888888E + 30 ><br>• Reading out does not erase the data in memory.<br>• Not executable via LAN | | ✓ | Yes | △ |
| | | RN? | Response: RNn, adr<br>n : <d><br>adr: <ddddd> | | | Yes | Yes |
| | | RDN adr1, adr2 | Specifies the memory range to be read by RDT?.<br>adr1: First recall data number (0 to 19999)<br>adr2: Last recall data number (0 to 19999) | (0, 0) | (0, 0) | Yes | △ |
| | | RDN? | Response: RDN adr1, adr2<br>adr1, adr2: <ddddd> | | | Yes | Yes |
| | | RDT? | Reads out data from the specified memory range.<br>Response: Data is read out from the specified range in the format described in Section 5.7, "Data Output Format (Talker Format)" using semicolons ";".<br>• When data does not exist in the specified number, <EE+8.888888E+30> is output.<br>• Executing this command releases the recall execution status.<br>• Not executable via RS-232<br>• In the compatible mode, commas (",") are used as delimiter. | (0) | | Yes | △ |

*7: Operational only between SM0 and SM1.

5.8.3 Remote Command List

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Measurement | Measurement data memory | SZ? | Reads out the number of stored data<br>response: <ddddd> | 0 | *6 | Yes | Yes |
| | | RNM adr | adr: Sets the maximum number of stored data (0 to 20000).<br>When the measurement buffer memory is used and the number of stored data in the buffer memory matches this value, bit 4 (ASN) of the Device Event Status Register (DESR) is set. | 0 | *6 | △ | △ |
| | | RNM? | Response: RNMddddd | | | Yes | Yes |
| | Measurement data output request (LAN, RS-232 and USBCDC only) | MON? | Response: Refer to Section 5.7, "Data Output Format (Talker Format)." | | | Yes | Yes |
| Calculation | NULL calculation | NL0<br>NL1 | OFF<br>ON | | ✓ | Yes | △ |
| | | NL? | Response: NL0 or NL1 | | | Yes | Yes |
| | | NLX ± data | Sets the NULL constant. (An error occurs when the NULL calculation is set to OFF.) *4 | | 0 | Yes | △ |
| | | NLX? | Response: NLX±d.dddddE±dd | | | Yes | Yes |
| | Comparator calculation | CO0<br>CO1 | OFF<br>ON | | ✓ | Yes | △ |
| | | CO? | Response: CO0 or CO1 | | | Yes | Yes |
| | | KHI ± data<br>KLO ± data | Sets the upper limit.<br>Sets the lower limit. *4 | | 0<br>0 | Yes | △ |
| | | KHI?<br>KLO? | Response: KHI±d.ddddE±dd<br>KLO±d.ddddE±dd | | | Yes | Yes |
| | Scaling calculation | SCL0<br>SCL1 | OFF<br>ON | | ✓ | Yes | △ |
| | | SCL? | Response: SCL0 or SCL1 | | | Yes | Yes |
| | | KA a<br>KB b<br>KC c | a: Constant A ...0 "zero" is invalid<br>b: Constant B<br>c: Constant C *4 | | 1<br>0<br>1 | Yes | △ |
| | | KA?<br>KB?<br>KC? | Response: KA±d.dddddE±dd<br>KB±d.dddddE±dd<br>KC±d.dddddE±dd *4 | | | Yes | Yes |

*4: The setting range is from 0 to ±999.9999E+24.
*6: Not initialized by the RINI or *RST command.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Calculation | Max/Min calculation | MN0 | OFF | | ✓ | Yes | △ |
| | | MN1 | ON | | | | |
| | | MN? | Response: MN0 or MN1 | | | Yes | Yes |
| | | AVE? | Reads out the average value. | 0 | | | |
| | | MAX? | Reads out the maximum value. | -9.999999 E+26 | | | |
| | | MIN? | Reads out the minimum value. | +9.999999 E+26 | | | |
| | | TOT? | Reads out the total value. | 0 | | | |
| | | AVN? | Reads out the measurement count. | 0 | | | |
| | | | Response: AVN d.dddddE+dd *4 | | | | |
| | | | Response: d.dddddE+dd | | | | |
| System | User parameter | STP0 | Saves the current setting parameters to area 0 of the non-volatile memory. | | | Yes | △ |
| | | STP1 | Saves the current setting parameters to area 1 of the non-volatile memory. | | | | |
| | | STP2 | Saves the current setting parameters to area 2 of the non-volatile memory. | | | | |
| | | STP3 | Saves the current setting parameters to area 3 of the non-volatile memory. | | | | |
| | | SINI | Sets the factory default settings in all the areas from 0 to 3. | | | | |
| | | RCLP0 | Loads the data from area 0 of the non-volatile memory as setting parameters. | | | No | No |
| | | RCLP1 | Loads the data from area 1 of the non-volatile memory as setting parameters. | | | | |
| | | RCLP2 | Loads the data from area 2 of the non-volatile memory as setting parameters. | | | | |
| | | RCLP3 | Loads the data from area 3 of the non-volatile memory as setting parameters. | | | | |
| | | RINI | Loads the factory default settings as setting parameters. | | | | |
| | | LUP0 | Loads the parameters that were set before power OFF at power ON. | | ✓ *6 | Yes | △ |
| | | LUP1 | Loads parameters from area 0 of the non-volatile memory at power ON. | | | | |
| | | LUP? | Response: LUP0 or LUP1 | | | Yes | Yes |
| | Initialization | *RST | Initializes parameters. (The parameters except marked by *6 in this list are the factory default values.) | | | Yes | Yes |
| | | C | Device clear (Do not write this command with another command in succession in a single line.) | | | Yes | Yes |

*4: The setting range is from 0 to ±999.9999E+24.
*6: Not initialized by the RINI or *RST command.

5.8.3 Remote Command List

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| System | Instrument information | *IDN? | Response: Outputs the instrument information by using commas.<br>ADC Corp.,nnnn,XXXXXXXXX,YYYYY<br>ADC Corp.: manufacturer (9 characters)<br>nnnn: model name “6253” or “6254” (4 characters)<br>xxxxxxxxx: serial number (9 characters)<br>yyyyy: Software revision (5 characters) | | | Yes | Yes |
| | Power frequency | LF? (Auto setting) | Response: LF0 ... 50 Hz<br>LF1 ... 60 Hz | | | Yes | Yes |
| | Notice buzzer | NZ0 | OFF | | | Yes | △ |
| | | NZ1 | ON | | ✓ *6 | | |
| | | NZ? | Response: NZ0 or NZ1 | | | Yes | Yes |
| | Comparator calculation buzzer | BZ0 | OFF | | ✓ *6 | Yes | △ |
| | | BZ1 | ON (Comparator calculation result: HI) | | | | |
| | | BZ2 | ON (Comparator calculation result: GO) | | | | |
| | | BZ3 | ON (Comparator calculation result: LO) | | | | |
| | | BZ4 | ON (Comparator calculation result: HI or LO) | | | | |
| | | BZ? | Response: BZ0 to BZ4 | | | Yes | Yes |
| | Limit detection buzzer | UZ0 | OFF | | ✓ *6 | Yes | △ |
| | | UZ1 | ON | | | | |
| | | UZ? | Response: UZ0 or UZ1 | | | Yes | Yes |
| | Self-test | *TST? | Executes the test and reads out the results.<br>Response: 0 ... Pass<br>1 ... Fail | | | No | No |
| | | TER? | The self-test result is returned with the contents of each register.<br>Response: a, b, c, d, e (a, b, c, d: 0 to 65535) | | | Yes | Yes |
| | Error log | ERL? | Reads out error logs.<br>The error count and contents are all cleared by read-out.<br>Response: ±ddd, ±ddd, ±ddd, ±ddd, ±ddd<br>(+ is shown as a space.) | | | Yes | Yes |
| | | ERC? | Reads out the error count.<br>Response: ddd<br>000: No errors<br>001 to 999: error count<br>(006 to 999: to be overwritten) | | | Yes | Yes |
| | Relay counter | RLY? | Reads out the relay counter value.<br>Response: ddddddddd (up to 999999999) | | | No | No |

*6: Not initialized by the RINI or *RST command.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| System | OPERATE/ INTERLOCK signal | OP0 | STBY In signal input (IN) | | ✓ | No | No |
| | | OP1 | OPR/STBY In signal input (IN) | | | | |
| | | OP2 | InterLock In signal input (IN) | | | | |
| | | OP3 | Operate Out signal output (OUT) | | | | |
| | | OP4 | OPR/SUS In signal input (IN) | | | | |
| | | OP5 | IN/OUT disabled | | | | |
| | | OP? | Response: OP0 to OP5 | | | Yes | Yes |
| | External trigger | TG0 | External trigger disabled | | | Yes | △ |
| | | TG1 | External trigger enabled | | ✓ | | |
| | | TG? | Response: TG0 or TG1 | | | Yes | Yes |
| | COMPLETE/ BUSY signal | CP0 | COMPLETE signal output Meas Front (measurement start) | | | Yes | △ |
| | | CP1 | COMPLETE signal output Meas End (measurement end and period time end) | | ✓ | | |
| | | CP2 | COMPLETE signal output Comp HI (Comparator calculation result: HI) | | | | |
| | | CP3 | COMPLETE signal output Comp GO (Comparator calculation result: GO) | | | | |
| | | CP4 | COMPLETE signal output Comp LO (Comparator calculation result: LO) | | | | |
| | | CP5 | BUSY signal input | | | | |
| | | CP6 | BUSY signal output | | | | |
| | | CP7 | COMPLETE signal output Comp HI or LO (Comparator calculation result: HI or LO) | | | | |
| | | CP8 | COMPLETE signal output Sweep End (Sweep end or stopped) | | | | |
| | | CP9 | Input and output disabled | | | | |
| | | CP? | Response: CP0 to CP9 | | | Yes | Yes |
| | | CW0 | Synchronous control signal output width: 10 μs | | ✓ | Yes | △ |
| | | CW1 | Synchronous control signal output width: 100 μs | | | | |
| | | CW? | Response: CW0 or CW1 | | | Yes | Yes |
| | Compatible mode | CMP0 | OFF | | | Yes | Yes |
| | | CMP1 | ON | | | | |
| | | CMP? | Response: CMP0 or CMP1 | | | Yes | Yes |
| | Others | S0 | This command is for compatibility and executes nothing. | | ✓ | Yes | Yes |
| | | S1 | | | | | |
| | | S? | Always S0 | | | Yes | Yes |

## 5.8.3 Remote Command List

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Remote | Block delimiter | DL0<br>DL1<br>DL2 | CRLF<EOI><br>LF<br><EOI> | ✓ | *5<br>*8 | Yes | △ |
| | | DL? | Response: DL0 or DL1 | | | Yes | Yes |
| | Header | OH0<br>OH1 | OFF<br>ON | | ✓ *6 | Yes | △ |
| | | OH? | Response: OH0 or OH1 | | | Yes | Yes |
| | Source value monitor data | OSM0<br>OSM1 | OFF<br>ON | | ✓ *6 | Yes | △ |
| | | OSM? | Response: OSM0 or OSM1 | | | Yes | Yes |
| | Time stamp | OTM0<br>OTM1 | OFF<br>ON | | ✓ *6 | Yes | △ |
| | | OTM? | Response: OTM0 or OTM1 | | | Yes | Yes |
| | Time stamp reset | TINI | Resets the time stamp counter. | | | Yes | △ |
| | Output data format | DFO0<br>DFO1 | ASCII<br>REAL64 (IEEE754) | | ✓ | Yes | △ |
| | | DFO? | Response: DFO0 or DFO1 | | | Yes | Yes |
| | Status | *STB? | Query of the Status Byte Register<br>Response: ddd | | | Yes | Yes |
| | | *SRE | Sets the Service Request Enable Register (0 to 255). | 0 | *6 | Yes | Yes |
| | | *SRE? | Response: ddd | | | Yes | Yes |
| | | *ESR? | Query of the Standard Event Status Register<br>Response: ddd | | | Yes | Yes |
| | | *ESE | Sets the Standard Event Status Enable Resister (0 to 255). | 0 | *6 | Yes | Yes |
| | | *ESE? | Response: ddd | | | Yes | Yes |
| | | DSR? | Query of the Device Event Status Register<br>Response: ddddd | | | Yes | Yes |
| | | DSE | Sets the Device Event Status Enable Register (0 to 65535). | 0 | *6 | Yes | Yes |
| | | DSE? | Response: ddddd | | | Yes | Yes |
| | | ERR? | Query of the error register<br>Response: ddddd | | | Yes | Yes |
| | | *CLS | Status clear | | | Yes | Yes |

*5: Not initialized by the RINI command.
*6: Not initialized by the RINI or *RST command.
*8: EOI is a function for GPIB. It is unavailable for other than GPIB.

Commands considering the compatibility with the 6243/6244

<table>
<tr><th colspan="2" rowspan="2">Item</th><th rowspan="2">Command</th><th rowspan="2">Description</th><th colspan="2">Default</th><th colspan="2">Operation possibility</th></tr>
<tr><th>Power ON</th><th>Factory shipment</th><th>DC/pulse OPR/SUS</th><th>Sweep OPR/SUS</th></tr>
<tr><td rowspan="3">Remote</td><td rowspan="3">Operation Complete</td><td>*OPC</td><td>After all operations are complete, sets LSB of the Standard Event Status Register.</td><td></td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td>*OPC?</td><td>Response: 1 (after all operations completed)</td><td></td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td>*WAI</td><td>Waits until all operations are complete (GPIB only).</td><td></td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="14">Calibration</td><td rowspan="2">Calibration mode</td><td>CAL0<br>CAL1</td><td>OFF (Exits the calibration mode.)<br>ON (Enters the calibration mode.)</td><td>✓</td><td></td><td>No</td><td>No</td></tr>
<tr><td>CAL?</td><td>Response: CAL0 or CAL1</td><td></td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="2">Calibration data</td><td>XINI</td><td>Initializes the calibration data area for calibration. (Not initializes the calibration data in the non-volatile memory.)</td><td></td><td></td><td>No</td><td>No</td></tr>
<tr><td>XWR</td><td>Saves the calibration data to the non-volatile memory.</td><td></td><td></td><td>No</td><td>No</td></tr>
<tr><td rowspan="8">Calibration execution</td><td>XVS</td><td>Selects the voltage source function calibration</td><td rowspan="8"></td><td rowspan="8"></td><td rowspan="8">No</td><td rowspan="8">No</td></tr>
<tr><td>XIS</td><td>Selects the current source function calibration.</td></tr>
<tr><td>XVLH</td><td>Selects the voltage limit (High) calibration.</td></tr>
<tr><td>XVLL</td><td>Selects the voltage limit (Low) calibration.</td></tr>
<tr><td>XILH</td><td>Selects the current limit (High) calibration.</td></tr>
<tr><td>XILL</td><td>Selects the current limit (Low) calibration.</td></tr>
<tr><td>XVM</td><td>Selects the voltage measurement function calibration.</td></tr>
<tr><td>XIM</td><td>Selects the current measurement function calibration.</td></tr>
<tr><td>Calibration range</td><td>XR-2<br>XR-1<br>XR0<br>XR1<br>XR2<br>XR3<br>XR4<br>XR5<br>XR6</td><td>Sets the calibration range.
<table>
<tr><th></th><th>Voltage range</th><th>Current range</th></tr>
<tr><td>XR-2</td><td>-</td><td>3 μA *a</td></tr>
<tr><td>XR-1</td><td>-</td><td>30 μA *a</td></tr>
<tr><td>XR0</td><td>10 V *a</td><td>300 μA</td></tr>
<tr><td>XR1</td><td>-</td><td>3 mA</td></tr>
<tr><td>XR2</td><td>-</td><td>30 mA</td></tr>
<tr><td>XR3</td><td>300 mV</td><td>300 mA</td></tr>
<tr><td>XR4</td><td>3 V</td><td>2 A/3 A</td></tr>
<tr><td>XR5</td><td>30 V/20 V</td><td>20 A *b</td></tr>
<tr><td>XR6</td><td>100 V *a</td><td>-</td></tr>
</table></td><td></td><td></td><td>No</td><td>No</td></tr>
<tr><td rowspan="5">Calibration data</td><td>XDAT<br>XD data</td><td>Changes to the DMM data input mode.<br>data: Inputs DMM read data.</td><td></td><td></td><td>No</td><td>No</td></tr>
<tr><td>XADJ</td><td>Changes to the calibration data fine adjustment mode.</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">No</td><td rowspan="3">No</td></tr>
<tr><td>XUP</td><td>Calibration data fine adjustment (UP)</td></tr>
<tr><td>XDN</td><td>Calibration data fine adjustment (DOWN)</td></tr>
<tr><td>XNXT</td><td>Moves to the next calibration.</td><td></td><td></td><td>No</td><td>No</td></tr>
</table>

*a: In the 6254, this command will result in an error.
*b: In the 6253, this command will result in an error.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Source | Source function and source range | V3 | Voltage source function 300 mV range | | | Yes Executing this function sets Suspend | ▲ |
| | | V4 | Voltage source function 3 V range | | | | |
| | | V0 | Voltage source function 10 V range *a | | | | |
| | | V5 | Voltage source function 30 V range/20 V range | | | | |
| | | V6 | Voltage source function 100 V range *a | | | | |
| | | I-2 | Current source function 3 μA range *a | | | | |
| | | I-1 | Current source function 30 μA range *a | | | | |
| | | I0 | Current source function 300 μA range | | | | |
| | | I1 | Current source function 3 mA range | | | | |
| | | I2 | Current source function 30 mA range | | | | |
| | | I3 | Current source function 300 mA range | | | | |
| | | I4 | Current source function 2 A range/3 A range | | | | |
| | | I5 | Current source function 20 A range *b | | | | |
| | | V?<br>I? | Response: V0, V3 to V6 or I-2 to I5 | | | Yes | Yes |
| | Source value (pulse value) and limit value | D ±data [UNIT] | The source value setting is different depending on whether UNIT is specified or not.<br>With UNIT ... Automatically sets the optical range.<br>Available unit: UV,MV,V,UA,MA,A<br>Without UNIT...Sets the present function and range.<br>When setting a unit that is different from that of the present source function, the input data is set as limit value as follows.<br>+data: HI limit value<br>-data: LO limit value | | | Yes | No |
| | | D? | Response: D±<data1>UNIT, D <data2>UNIT<br>data1... Voltage or current source value <d.ddddE±d> *1<br>data2... Voltage or current limit value (The polarity is space.) <0d.dddE±d> *1<br>UNIT...V or A<br>*NOTE:*<br>*When the absolute values of HI and LO limit values are different, the response becomes as D ±d.ddddE ± dUNIT, D 09.999E ± 9UNIT.* | | | Yes | Yes |
| Other | Dummy command | S0<br>S1 | This command does not execute anything. | | | | |
| | | S? | Response: S0 | | | | |

*1: The decimal point position in response varies depending on the setting value.
For the source value, limit value, and time parameter setting ranges, refer to the specifications.

*a: In the 6254, this command will result in an error.

*b: In the 6253, this command will result in an error.

<table>
<tr><th colspan="2" rowspan="2">Item</th><th rowspan="2">Command</th><th rowspan="2">Description</th><th colspan="2">Default</th><th colspan="2">Operation possibility</th></tr>
<tr><th>Power ON</th><th>Factory shipment</th><th>DC/pulse OPR/SUS</th><th>Sweep OPR/SUS</th></tr>
<tr><td rowspan="4">Source</td><td rowspan="2">Pulse base value and pulse sweep base value</td><td>DB ±data [UNIT]</td><td>The base value setting is different depending on whether UNIT is specified or not.<br>With UNIT ... Automatically sets the optical range.<br>Available unit:<br>UV,MV,V,UA,MA,A<br>Without UNIT ...Sets the present function and range.<br>When setting a unit that is different from that of the present source function, an error occurs.<br>For the pulse sweep mode, set the pulse sweep base value.</td><td></td><td>0</td><td>Yes</td><td>No</td></tr>
<tr><td>DB?</td><td>Response: DB±<data>UNIT<br>data ...Voltage or current base value<br><d.dddddE±d><br>UNIT...V or A<br>The voltage or current base value is returned depending on the currently set source function.<br>For the pulse sweep mode, the pulse sweep base value is returned.</td><td></td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="2">Operate/ Standby</td><td>H<br>E</td><td>Sets the output to OFF (Standby).<br>Sets the output to ON (Operate).</td><td>✓</td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td>E?, H?</td><td>Returns the present output status.<br>Response:<br><table><tr><th>Status</th><th>E?, H?</th></tr><tr><td>Operate</td><td>E</td></tr><tr><td>Suspend</td><td>H</td></tr><tr><td>Standby</td><td>H</td></tr></table></td><td></td><td></td><td>Yes</td><td>Yes</td></tr>
<tr><td>Sweep</td><td>Random sweep memory data (using D command)</td><td>N [adr]<br>P</td><td>Random sweep memory data setting starts from the N command and completes at the P command.<br>N<adr>, D<data1><UNIT>,<br>D<data2><UNIT>, ..., P<br>adr: Memory address (0 to 19999)<br>data1: Voltage or current source value at adr<br>data2: Voltage or current source value at adr+1<br>NOTE:<br>• When no source range is specified, the optimal range is set.<br>• Source values different from the present source function cannot be set.</td><td></td><td>0<br>*6</td><td>Yes</td><td>No</td></tr>
</table>

*6: Not initialized by the RINI or *RST command.

| Item | | Command | Description | Default | | Operation possibility | |
|---|---|---|---|---|---|---|---|
| | | | | Power ON | Factory shipment | DC/pulse OPR/SUS | Sweep OPR/SUS |
| Calculation | Comparator calculation upper and lower limit values | KH ±<data1> UNIT, ±<data2> UNIT | <data1>UNIT: upper limit<br><data2>UNIT: lower limit<br>UNIT: UV,MV,V,UA,MA,A *4 | | 0<br>0 | Yes | △ |
| | | KH? | Response: KH±<data1>UNIT, KH±<data2>UNIT<br>data1... current or voltage upper limit value<br>data2... current or voltage lower limit value<br><d.ddddE±d><br>UNIT: V or A<br>The current or voltage value is returned depending on the measurement function. | | | Yes | Yes |

*4: The setting range is from 0 to ±999.9999E+24.

## 5.8.4 TER? Command

The TER? command reads out the self set results.

1. Command response

   ddddd,ddddd,ddddd,ddddd,ddddd
   a b c d e

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

   The TER register column in Table 4-18 shows the error factors and register values for a, b, c, d and e. For example, an error in VSVM 3 V +FS of the self test is returned as follows.

   00000, 00000, 00016, 00000, 00000

## 5.9 Sample Programs

This section describes program examples to remotely control the 6253/6254 via GPIB or USB.

Download these programs from ADC's website.

https://www.adcmt.com/en/download/sampleprogram

### 5.9.1 Program Example for GPIB

[Operating environment]

| | |
|---|---|
| OS: | Microsoft Windows 7 |
| GPIB hardware: | NATIONAL INSTRUMENTS GPIB-USB-HS |
| Module: | Niglobal.bas, Vbib-32.bas (included in GPIB-USB-HS) |
| Language: | Microsoft Excel Visual Basic for Application (VBA) |

- Program example 1: Example of DC measurement introduced in Section 2.5.1
- Program example 2: Example of pulse measurement introduced in Section 2.5.2
- Program example 3: Example of sweep measurement introduced in Section 2.5.3

### 5.9.2 Program Example for USB

[Operating environment]

| | |
|---|---|
| OS: | Microsoft Windows 7 |
| Module: | ausb.bas (ADC instruments USB driver) |
| Language: | Microsoft Excel Visual Basic for Application (VBA) |

- Program example 1: Example of DC measurement introduced in Section 2.5.1
- Program example 2: Example of pulse measurement introduced in Section 2.5.2
- Program example 3: Example of sweep measurement introduced in Section 2.5.3

Download the ADC instruments USB driver from ADC's website.

https://www.adcmt.com/en/download/usbdriver

# 6. PERFORMANCE TEST

This chapter describes the methods for checking whether the 6253/6254 operates in the specified accuracy.

## 6.1 Measuring Instrument Necessary for Performance Test

For the performance test, use a measuring instrument which meets the specifications shown in Section 7.1, "Measuring Instrument Necessary for Calibration."

## 6.2 Connections

The connections required for the performance test are the same as shown in Figure 7-1, "Connections for Calibration (The figure is the 6253.)."

## 6.3 Test Method

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

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

Self-test, display, key, and buzzer tests

1. Press the **MENU** key to select ***13) System*** from the parameter group and execute the self-test in reference to Section 4.2.16, "Self-Test."

*NOTE: If an error occurs during the test, refer to Section 4.2.16, "Self-Test" to verify the content of the error.*

Voltage source and measurement test

1. Connect the 6253/6254 and a DMM (digital multimeter) as shown in Figure 7-1 (a).
2. Set the DMM to DCV, auto range and integration time of 10 PLC or longer.
3. Set the source mode to DC, the trigger mode to AUTO, and the integration time to 200 ms.
4. Select voltage source voltage measurement, and set the output to Operate.
5. With ZERO and ± Full Scale generated in the 300 mV range to 100 V range, verify that the differences between the source values and the DMM measured values and between the 6253/6254 measured values and the DMM measured values are within the accuracies described in Chapter 8, "SPECIFICATIONS."

*NOTE: If the result of this test does not fall within the accuracy specifications, calibrate the 6253/6254 as outlined in Chapter 7, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.*

Current source and measurement test (from 3 μA to 300 mA)

1. Connect the 6253/6254 and a DMM as shown in Figure 7-1 (b).
2. Set the DMM to DCI, auto range and integration time of 10 PLC or longer.
3. Set the source mode to DC, the trigger mode to AUTO, and the integration time to 200 ms.
4. Select current source current measurement, and set the output to Operate.
5. With ZERO and ± Full Scale generated in from the 3 μA range to 300 mA range, verify that the differences between the source values and the DMM measured values and between the 6253/6254 measured values and the DMM measured values are within the accuracies described in Chapter 8, "SPECIFICATIONS."

*NOTE: If the result of this test does not fall within the accuracy specifications, calibrate the 6253/6254 as outlined in Chapter 7, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.*

Current source and measurement test (2 A)

1. Connect the 6253/6254 and a DMM as shown in Figure 7-1 (c)
   The resistance value is as follows:

| Range | Standard resistance value |
|---|---|
| 2 A/3 A | 100 mΩ |
| 20 A | 10 mΩ |

2. Set the DMM to DCV, auto range and integration time of 10 PLC or longer.
3. Set the source mode to DC, the trigger mode to AUTO, and the integration time to 200 ms.
4. Select current source current measurement, and set the output to Operate.
5. With ZERO and ± Full Scale generated in the 2 A range to 20 A range, verify that the differences between the source values and the current-converted values that is obtained by "DMM measured value/Standard resistance value" are within the accuracies described in Chapter 8, "SPECIFICATIONS."

*NOTE: If the result of this test does not fall within the accuracy specifications, calibrate the 6253/6254 as outlined in Chapter 7, "CALIBRATION" or contact an ADC CORPORATION sales representative for the calibration or servicing.*

# 7. CALIBRATION

This chapter describes how to calibrate the 6253/6254 to perform within the specified accuracy ranges.
In order to use the 6253/6254 in the specified accuracies, periodic calibration at least once a year is recommended.
Contact an ADC CORPORATION sales representative for the calibration service.

## 7.1 Measuring Instrument Necessary for Calibration

The following table shows the required accuracies of a measuring instrument used for calibration.

| Range | ZERO | | FS | | Standard resistor | Recommended DMM | Cable |
|---|---|---|---|---|---|---|---|
| | Calibration point | Required accuracy | Calibration point | Required accuracy | | | |
| 300 mV | 0 V | 500 nV | ±300 mV | 20 ppm | | 7481/7482 or 6581*1 | A01044/ CC010011 (supplied accessory) *2 |
| 3 V | | 2 µV | ±3 V | 20 ppm | | | |
| 10 V | | 10 µV | ±10 V | 20 ppm | | | |
| 20 V | | 20 µV | ±20 V | 20 ppm | | | |
| 30 V | | 20 µV | ±30 V | 20 ppm | | | |
| 100 V | | 100 µV | ±100 V | 20 ppm | | | |
| 3 µA | 0 A | 10 pA | ±3 µA | 120 ppm | | | |
| 30 µA | | 20 pA | ±30 µA | 120 ppm | | | |
| 300 µA | | 200 pA | ±300 µA | 120 ppm | | | |
| 3 mA | | 2 nA | ±3 mA | 120 ppm | | | |
| 30 mA | | 20 nA | ±30 mA | 120 ppm | | | |
| 300 mA | | 200 nA | ±300 mA | 120 ppm | | | |
| 2 A | 0 V (0 A)*3 | 2 µV | ±200 mV (±2 A)*3 | 20 ppm | 100 mΩ Required accuracy: 150 ppm | | A01044/ CC010011 (supplied accessory) *2 |
| 3 A | 0 V (0 A)*3 | 2 µV | ±300 mV (±3 A)*3 | 20 ppm | | | |
| 20 A | 0 V (0 A)*3 | 2 µV | ±100 mV (±10 A)*3 | 20 ppm | 10 mΩ Required accuracy: 200 ppm | | |

*1: Use the 7481/7482 or 6581 under the following conditions.
Integration time: 10 PLC. Auto Zero: ON. Within 24 hours following INT CAL.
*2: When much externally induced noise exists, use shielded cables such as A01001.
*3: The calibration performs voltage conversion by using the standard resistor in this range.

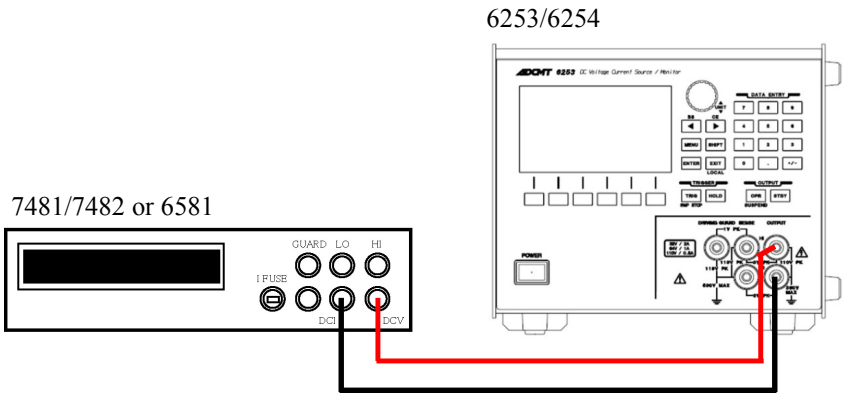
## 7.2 Safety Precautions

1. Use an AC power supply with the specified voltage.
2. Execute calibration under the following conditions in a location free of dust, vibration, noise or other adverse conditions:

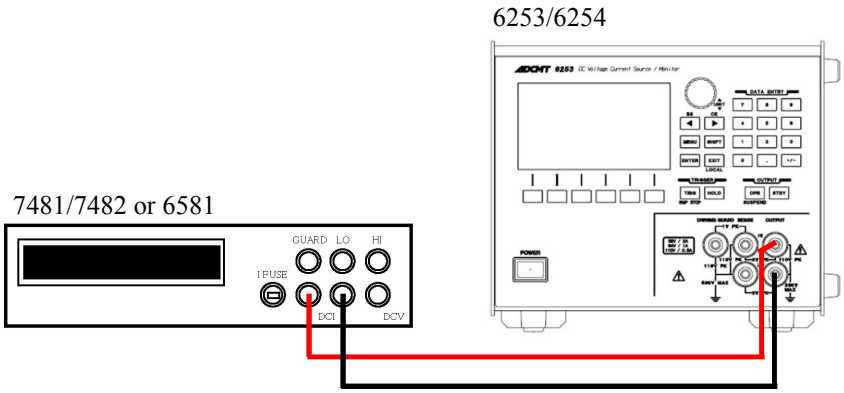
   Temperature 23 ± 3 °C
   Relative humidity 70% or lower
3. Allow the 6253/6254 to warm-up for 2 hours or longer before calibration.
   Allow other measuring instruments to be used in calibration to warm-up for the period of time specified before the calibration.
   The 7481/7482 and the 6581 need to be warmed up for 4 hours or more.
4. After calibration, note the dates of the calibration and the next scheduled calibration on a card or sticker, etc. for convenience.
5. Calibration by key operation is not available.
   Execute calibration by using remote commands via USB, GPIB, LAN or RS232.
6. When much externally induced noise exists, use shielded cables.

## 7.3 Connections

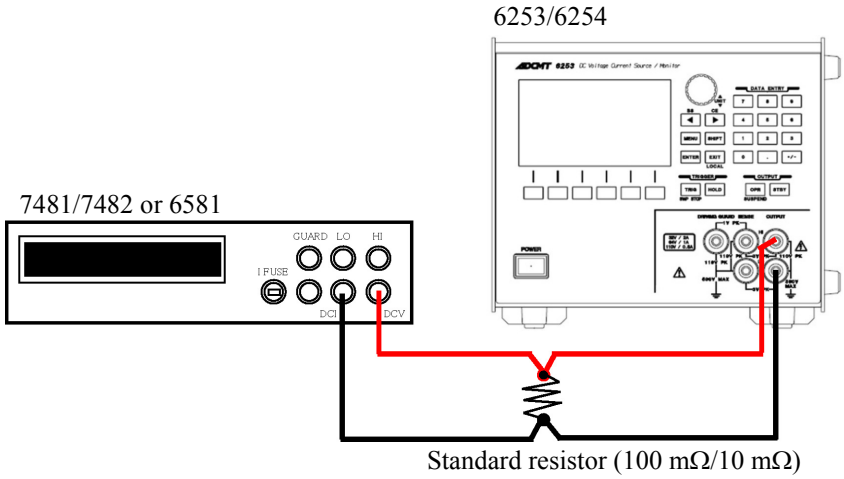
The following figure shows connections for calibrating the 6253/6254 using the 7481/7482 or 6581.




(a) Checking and calibrating voltage source measurement




(b) Checking and calibrating current source measurement (3 µA to 300 mA range)




(c) Checking and calibrating current source measurement (2 A to 20 A range)

Figure 7-1 Connections for Calibration (The figure is the 6253.)

## 7.4 Calibration Points and Tolerance Ranges

For calibration, use measuring instruments satisfying the required accuracy described in Section 7.1, "Measuring Instrument Necessary for Calibration" to meet the tolerance ranges shown in the following table.

| Item | Range | Calibration point | | Toreranece range |
|---|---|---|---|---|
| | | ZERO | Full Scale | |
| Voltage source | 300 mV | 0 V | +300.000 mV | 30 μV |
| | 3 V | | +3.00000 V | 50 μV |
| | 10 V*a | | +10.0000 V | 100 μV |
| | 20 V*b | | +20.0000 V | 200 μV |
| | 30 V*a | | +30.0000 V | 500 μV |
| | 100 V*a | | +100.000 V | 1 mV |
| Current source | 3 μA*a | 0 A | +3.00000 μA | 50 pA |
| | 30 μA*a | | +30.0000 μA | 500 pA |
| | 300 μA | | +300.000 μA | 5 nA |
| | 3 mA | | +3.00000 mA | 50 nA |
| | 30 mA | | +30.0000 mA | 500 nA |
| | 300 mA | | +300.000 mA | 5 μA |
| | 2 A*a | | +2.00000 A | 50 μA |
| | 3 A*b | | +3.00000 A | 50 μA |
| | 20 A*b | | +10.0000 A | 1 mA |
| Voltage measurement | 300 mV | 0 V | +300.0000 mV | 5 μV |
| | 3 V | | +3.000000 V | 10 μV |
| | 10 V*a | | +10.00000 V | 50 μV |
| | 20 V*b | | +20.00000 V | 100 μV |
| | 30 V*a | | +30.00000 V | 100 μV |
| | 100 V*a | | +100.0000 V | 500 μV |
| Current measurement | 3 μA*a | 0 A | +3.000000 μA | 50 pA |
| | 30 μA*a | | +30.00000 μA | 100 pA |
| | 300 μA | | +300.0000 μA | 1 nA |
| | 3 mA | | +3.000000 mA | 10 nA |
| | 30 mA | | +30.00000 mA | 100 nA |
| | 300 mA | | +300.0000 mA | 1 μA |
| | 2 A*a | | +2.000000 A | 10 μA |
| | 3 A*b | | +3.000000 A | 10 μA |
| | 20 A*b | | +10.00000 A | 500 μA |

*a: 6253 only
*b: 6254 only

| Item | Range | Calibration point | | Toreranece range |
|---|---|---|---|---|
| | | ZERO | Full Scale | |
| Voltage HI limit | 300 mV | 0 V | +300.00 mV | 50 μV |
| | 3 V | | +3.0000 V | 100 μV |
| | 10 V*a | | +10.000 V | 1 mV |
| | 20 V*b | | +20.000 V | 1 mV |
| | 30 V*a | | +30.000 V | 1 mV |
| | 100 V*a | | +100.00 V | 10 mV |
| Voltage LO limit | 300 mV | 0 V | -300.00 mV | 50 μV |
| | 3 V | | -3.0000 V | 100 μV |
| | 10 V*a | | -10.000 V | 1 mV |
| | 20 V*b | | -20.000 V | 1 mV |
| | 30 V*a | | -30.000 V | 1 mV |
| | 100 V*a | | -100.00 V | 10 mV |
| Current HI limit | 3 μA*a | 0 A | +3.0000 μA | 100 pA |
| | 30 μA*a | | +30.000 μA | 1 nA |
| | 300 μA | | +300.00 μA | 10 nA |
| | 3 mA | | +3.0000 mA | 100 nA |
| | 30 mA | | +30.000 mA | 1 μA |
| | 300 mA | | +300.00 mA | 10 μA |
| | 2 A*a | | +2.0000 A | 100 μA |
| | 3 A*b | | +3.0000 A | 100 μA |
| | 20 A*b | | +10.000 A | 2 mA |
| Current LO limit | 3 μA*a | 0 A | -3.0000 μA | 100 pA |
| | 30 μA*a | | -30.000 μA | 1 nA |
| | 300 μA | | -300.00 μA | 10 nA |
| | 3 mA | | -3.0000 mA | 100 nA |
| | 30 mA | | -30.000 mA | 1 μA |
| | 300 mA | | -300.00 mA | 10 μA |
| | 2 A*a | | -2.0000 A | 100 μA |
| | 3 A*b | | -3.0000 A | 100 μA |
| | 20 A*b | | -10.000 A | 2 mA |

*a: 6253 only
*b: 6254 only

## 7.5 Calibration Procedure

The 6253/6254 is calibrated by using the remote commands through USB, GPIB, LAN or RS232.
Figure 7-2 to Figure 7-8 show the calibration procedures. For more information on the remote commands, refer to the calibration parameters described in Section 5.8.3, “Remote Command List.”

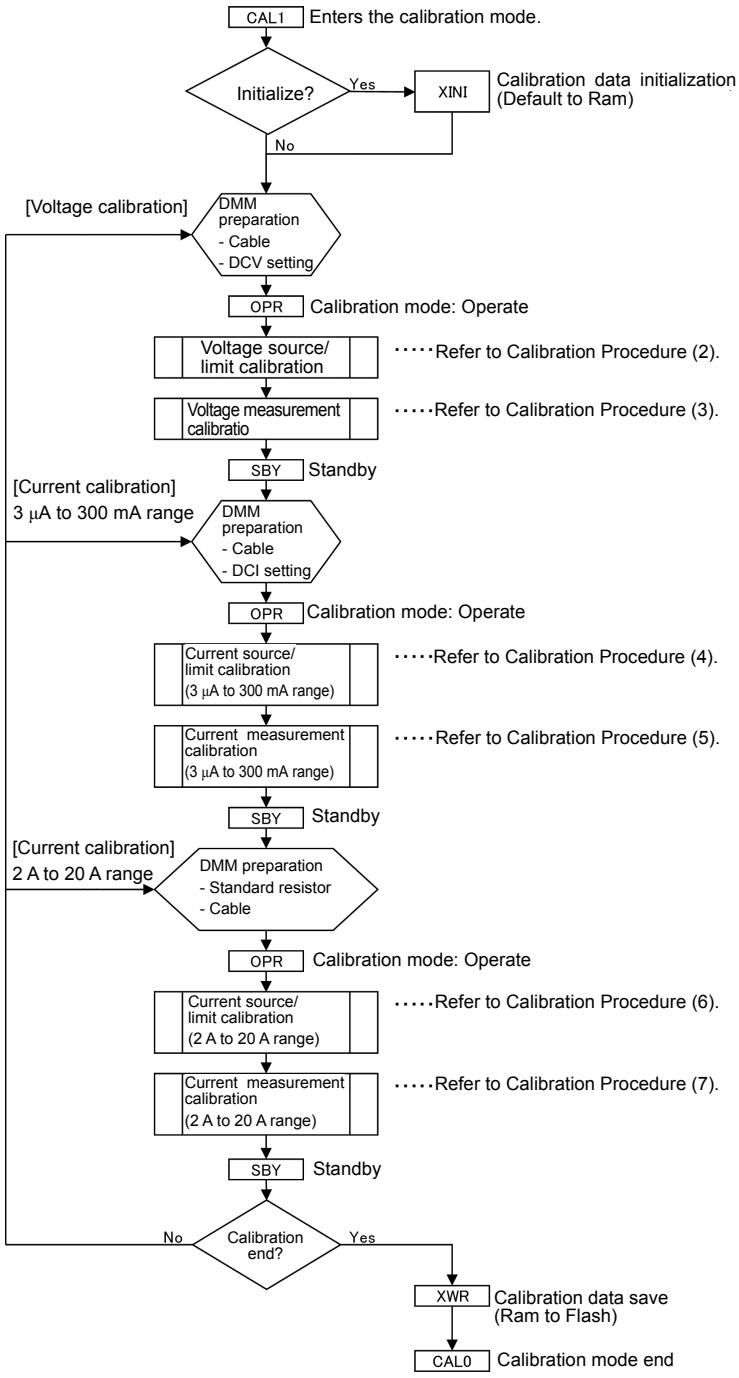



Figure 7-2 Calibration Procedure (1)

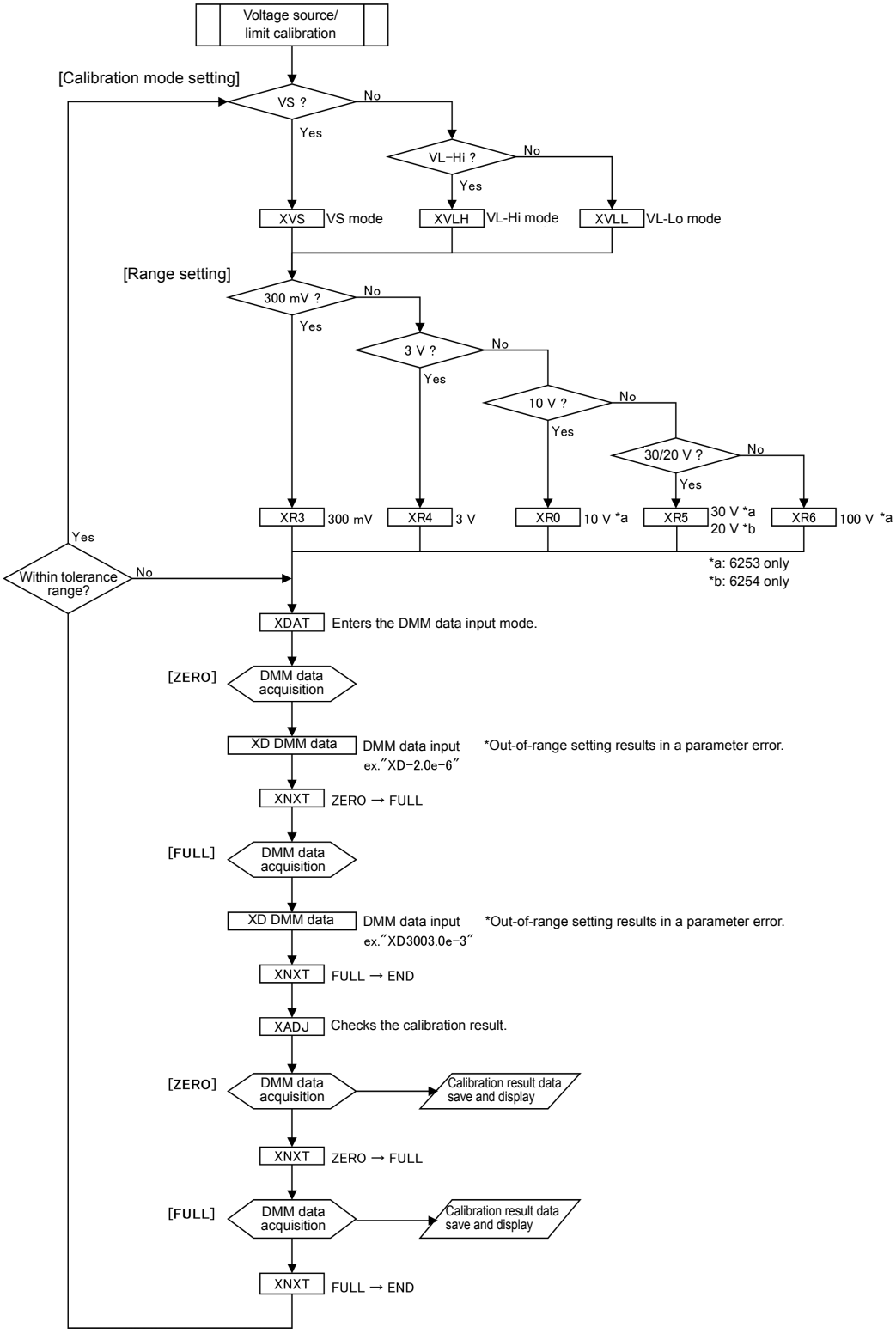



Figure 7-3 Calibration Procedure (2)

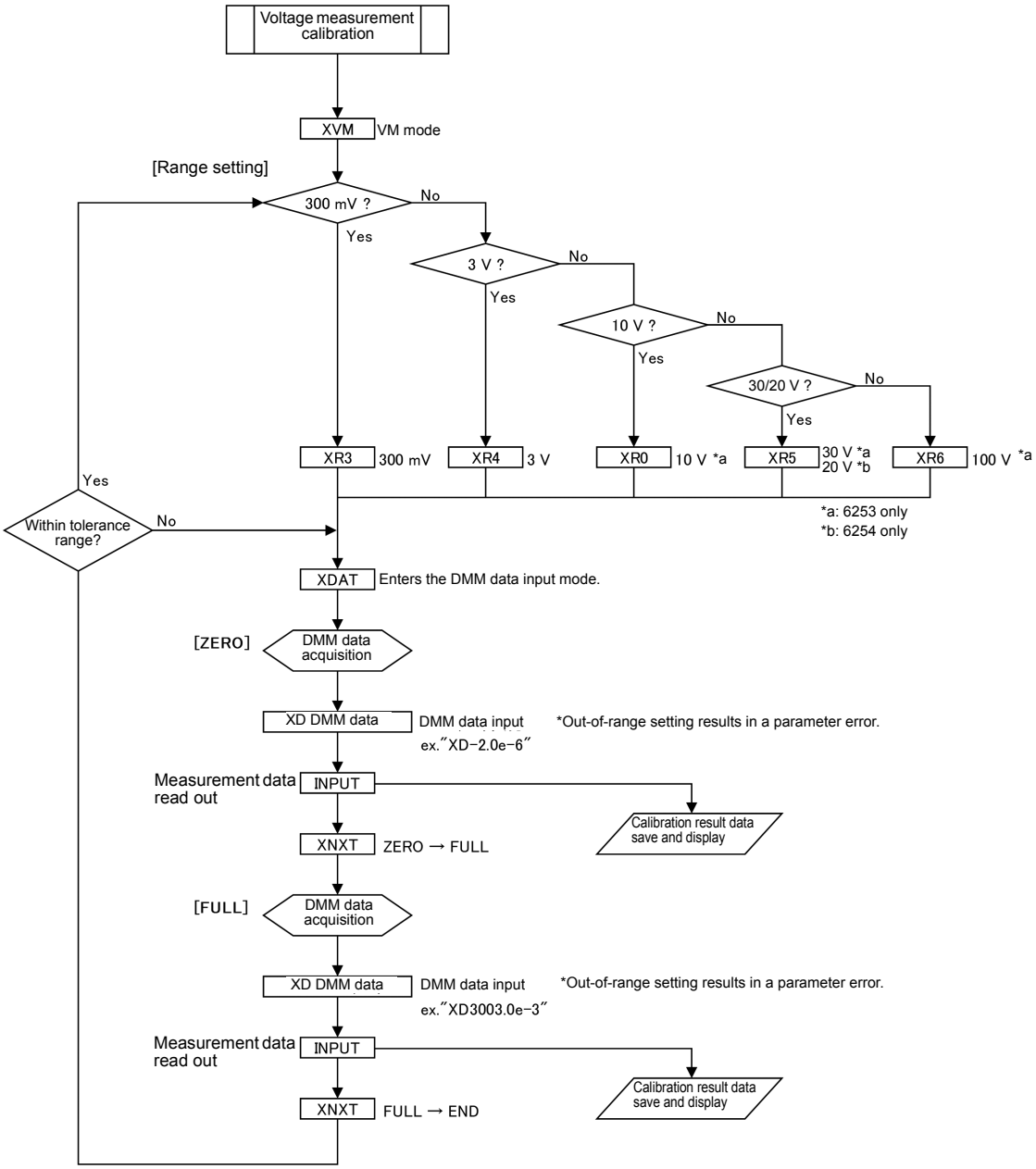



Figure 7-4 Calibration Procedure (3)

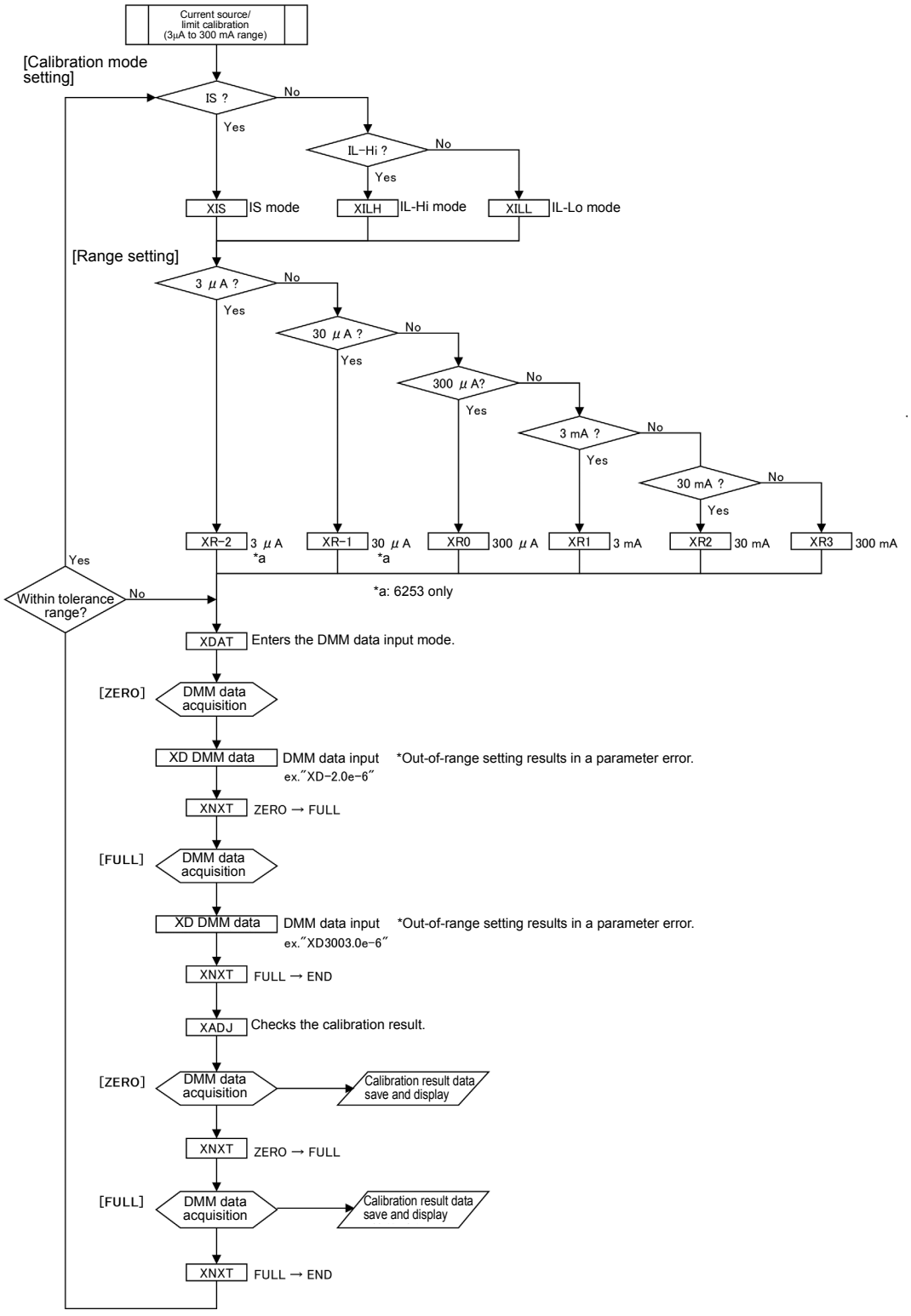



Figure 7-5 Calibration Procedure (4)

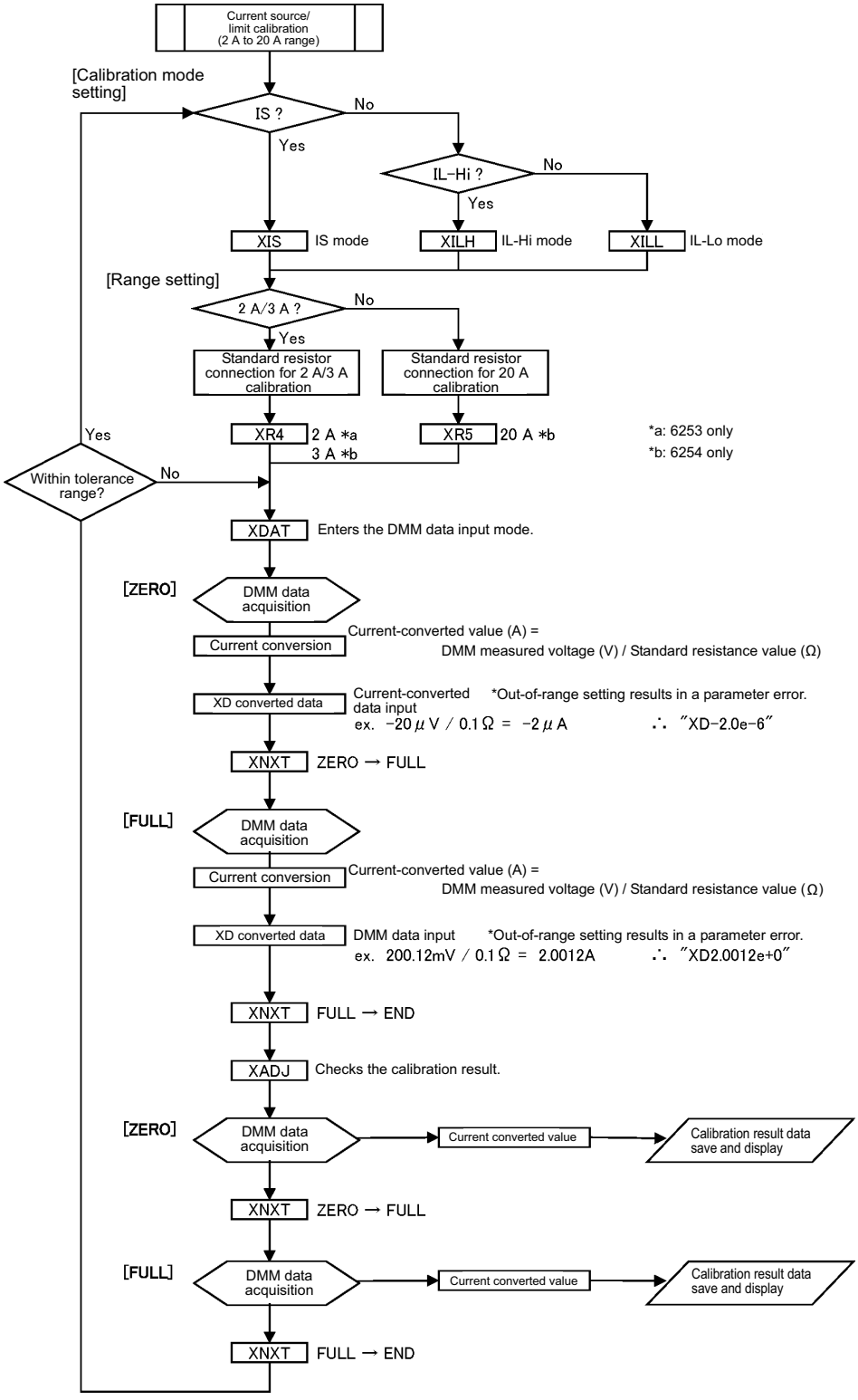



Figure 7-6 Calibration Procedure (5)

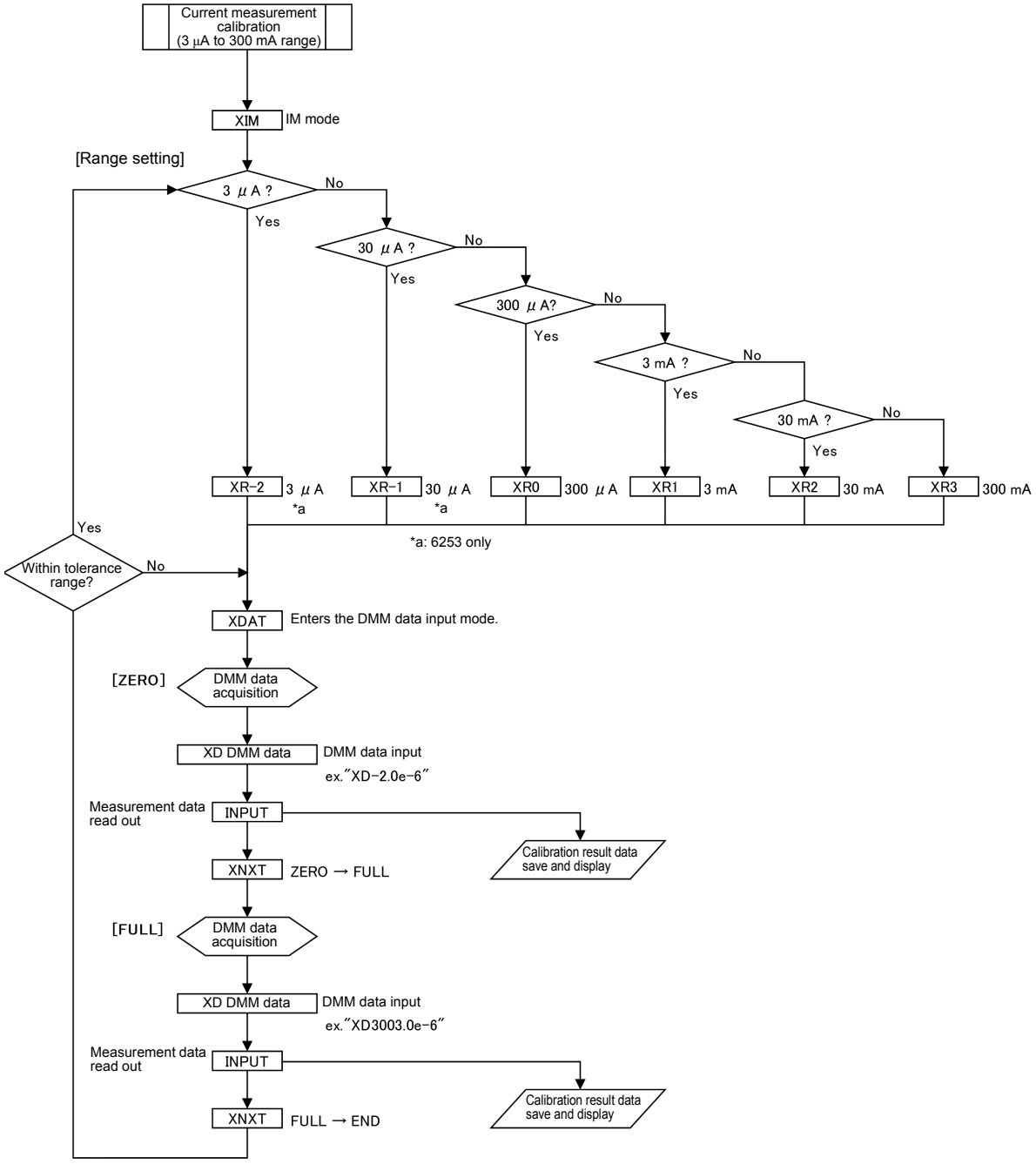



Figure 7-7 Calibration Procedure (6)

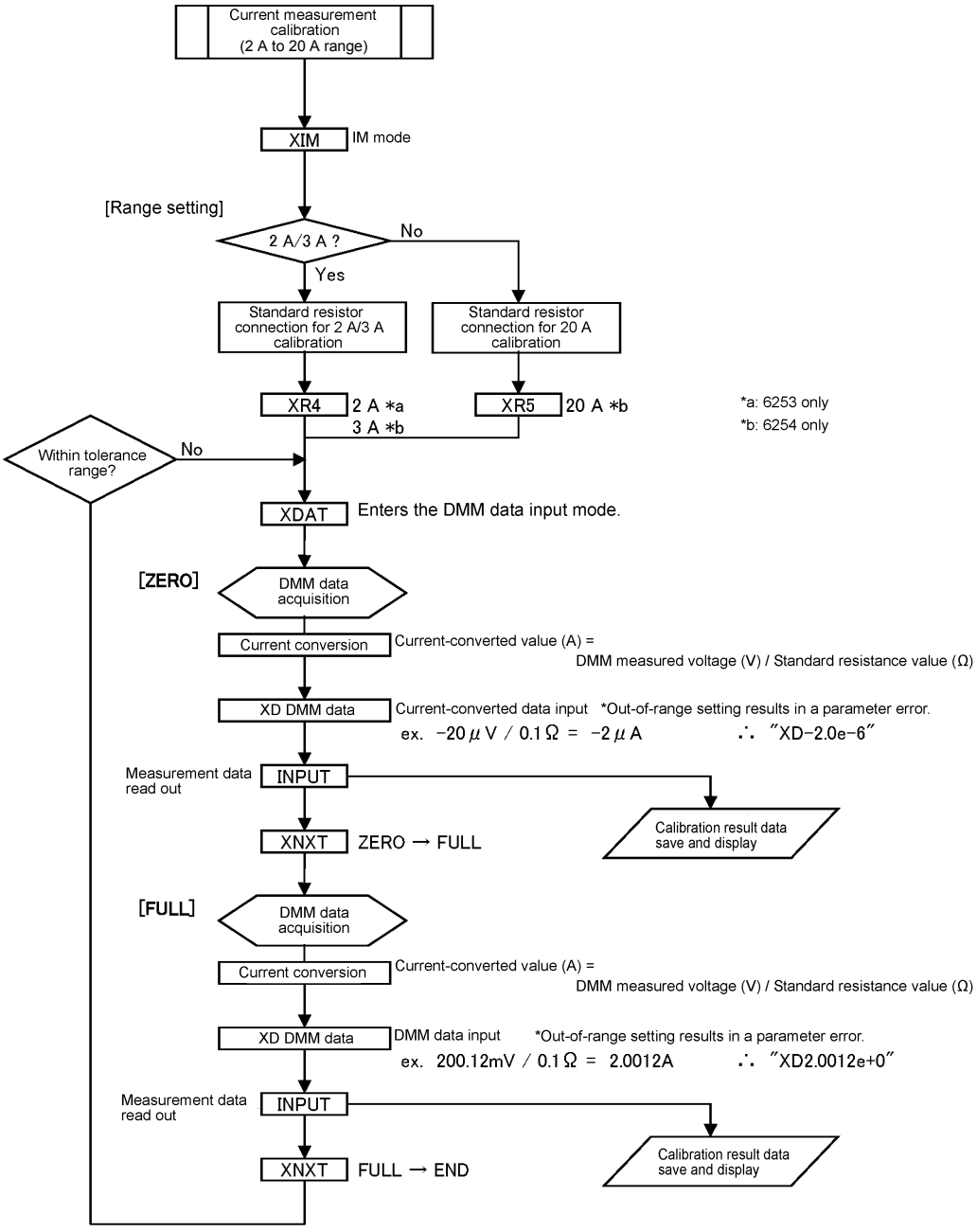



Figure 7-8 Calibration Procedure (7)

## 7.5.1 Overall Calibration Procedure

This section describes the overall calibration procedure according to Figure 7-2 Calibration Procedure (1).

1. Enter the calibration mode by CAL1.
2. When executing all the calibrations, initialize calibration data only once by XINI at the start of the calibrations.
3. When executing voltage calibration, make connection in reference to Figure 7-1 Connections for Calibration (The figure is the 6253.) (a). When executing current calibration, make connection in reference to Figure 7-1 Connections for Calibration (The figure is the 6253.) (b) and Figure 7-1 Connections for Calibration (The figure is the 6253.) (c).
4. Set the output status to Operate in the calibration mode by OPR.
5. Execute voltage calibration according to Figure 7-3 Calibration Procedure (2) and Figure 7-4 Calibration Procedure (3), or execute current calibration according to Figure 7-5 Calibration Procedure (4), Figure 7-6 Calibration Procedure (5), Figure 7-7 Calibration Procedure (6) and Figure 7-8 Calibration Procedure (7).
6. Set the output status to Standby by SBY.
7. Store the calibration data to the non-volatile memory by XWR.
8. Finish the calibration mode by CAL0.

## 7.5.2 Voltage Source/Voltage Limit Calibration

1. Select the voltage calibration mode.

   | | |
   |---|---|
   | Voltage source: | XVS |
   | Voltage HI limit: | XVLH |
   | Voltage LO limit: | XVLL |

2. Select the range.

   | | | |
   |---|---|---|
   | 300 mV range: | XR3 | |
   | 3 V range: | XR4 | |
   | 10 V range: | XR0 *a | *a: 6253 only |
   | 20 V range: | XR5 *b | *b: 6254 only |
   | 30 V range: | XR5 *a | |
   | 100 V range: | XR6 *a | |

3. Enter the DMM data input mode by XDAT.
4. Set the DMM read value by XD data.
5. Move to the full-scale calibration mode by XNXT.
6. Set the DMM read value by XD data.
7. Finish the DMM data input mode by XNXT.

8. Move to the zero calibration data fine adjustment mode by XADJ.
9. Check the zero calibration value.
   Fine-adjust the calibration coefficient by XUP and XDN.
10. Move to the full-scale calibration data fine adjustment mode by XNXT.
11. Check the full-scale calibration value.
    Fine-adjust the calibration coefficient by XUP and XDN.
12. Move to the next step
    When changing the voltage calibration mode: XNXT
    When moving to voltage measurement calibration: XNXT → XVM

## 7.5.3 Voltage Measurement Calibration

1. Move to the voltage measurement calibration mode by XVM.
2. Select the range.

| | | |
|---|---|---|
| 300 mV range | XR3 | |
| 3 V range: | XR4 | |
| 10 V range: | XR0 *a | *a: 6253 only |
| 20 V range: | XR5 *b | *b: 6254 only |
| 30 V range: | XR5 *a | |
| 100 V range: | XR6 *a | |

3. Enter the DMM data input mode by XDAT.
4. Set the DMM read value by XD data.
5. Read and check the measurement data by INPUT.
6. Move to the full-scale calibration mode by XNXT.
7. Set the DMM read value by XD data.
8. Read and check the measurement data by INPUT.
9. Move to the next step
   When changing the voltage range: XNXT
   When moving to current source or current limit calibration:
   XNXT → XIS, XILH, XILL

## 7.5.4 Current Source/Current Limit Calibration (3 μA to 300 mA)

1. Select the current calibration mode.
   Current source: XIS
   Current HI limit: XILH
   Current LO limit: XILL
2. Select the range.

| | | |
|---|---|---|
| 3 μA : | XR-2 *a | *a: 6253 only |
| 30 μA : | XR-1 *a | |
| 300 μA : | XR0 | |
| 3 mA : | XR1 | |
| 30 mA : | XR2 | |
| 300 mA : | XR3 | |

3. From this step, perform the same procedure as described in Section 7.5.2, "Voltage Source/Voltage Limit Calibration."
4. Move to the next step
   When changing the current calibration mode: XNXT
   When moving to current measurement calibration: XNXT → XIM

## 7.5.5 Current Source/Current Limit Calibration (2 A to 20 A)

1. Make a connection in reference to Figure 7-1 (c) and set the DMM measurement function to DCV.
   Then, select the current calibration mode.
   Current source: XIS
   Current HI limit: XILH
   Current LO limit: XILL
2. Select the range.

| | | |
|---|---|---|
| 2 A : | XR4 *a | *a: 6253 only |
| 3 A : | XR4 *b | *b: 6254 only |
| 20 A : | XR5 *b | |

3. Enter the DMM data input mode by XDAT.
4. Obtain the DMM reading value by using the following formula:
   data = DMM reading value (V) / Standard resistance value (Ω)
5. Set the calculated data by XD data.
6. Move to the full-scale calibration mode by XNXT.
7. Obtain the DMM reading value by using the following formula:
   data = DMM reading value (V) / Standard resistance value (Ω)
8. Set the calculated data by XD data.

9. Finish the DMM data input mode by XNXT.
10. Move to the zero calibration data fine adjustment mode by XADJ.
11. Check the zero calibration value.
    Fine-adjust the calibration coefficient by XUP and XDN.
12. Move to the full-scale calibration data fine adjustment mode by XNXT.
13. Check the full-scale calibration value.
    Fine-adjust the calibration coefficient by XUP and XDN.
14. Move to the next step
    When changing the current calibration mode: XNXT
    When moving to current measurement calibration: XNXT → XIM

## 7.5.6 Current Measurement Calibration (3 μA to 300 mA)

1. Move to the current measurement calibration mode by XIM.
2. Select the range.

| | | |
|---|---|---|
| 3 μA : | XR-2 *a | *a: 6253 only |
| 30 μA : | XR-1 *a | |
| 300 μA : | XR0 | |
| 3 mA : | XR1 | |
| 30 mA : | XR2 | |
| 300 mA : | XR3 | |

3. From this step, perform the same procedure as described in Section 7.5.3, “Voltage Measurement Calibration.”

## 7.5.7 Current Measurement Calibration (2 A to 20 A)

1. Make a connection in reference to Figure 7-1 (c) and set the DMM measurement function to DCV.
2. Move to the voltage calibration mode by XIM.
   Select the range.

   | | | |
   |---|---|---|
   | 2 A : | XR4 *a | *a: 6253 only |
   | 3 A : | XR4 *b | *b: 6254 only |
   | 20 A : | XR5 *b | |

3. Enter the DMM data input mode by XDAT.
4. Obtain the DMM reading value by using the following formula:
   data = DMM reading value (V) / Standard resistance value (Ω)
5. Set the calculated data by XD data.
6. Read and check the measurement data by INPUT.
7. Move to the full-scale calibration mode by XNXT.
8. Obtain the DMM reading value by using the following formula:
   data = DMM reading value (V) / Standard resistance value (Ω)
9. Set the calculated data by XD data.
10. Read and check the measurement data by INPUT.
11. Move to the next step
    When changing the current calibration range: XNXT
    When moving to voltage source/voltage limit calibration:
    XNXT → XVS, XVLH, XVLL

# 8. SPECIFICATIONS

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

## 8.1 Source and Measurement

### 8.1.1 6253 Source and Measurement

| | Range | Source range | Setting resolution | Measurement range | Measurement resolution *1) |
|---|---|---|---|---|---|
| Voltage source/ measurement range | 300 mV | 0 to ±320.000 mV | 5 µV | 0 to ±320.9999 mV | 100 nV |
| | 3 V | 0 to ±3.20000 V | 50 µV | 0 to ±3.209999 V | 1 µV |
| | 10 V | 0 to ±10.0000 V | 100 µV | 0 to ±10.09999 V | 10 µV |
| | 30 V | 0 to ±32.0000 V | 500 µV | 0 to ±32.09999 V | 10 µV |
| | 100 V | 0 to ±110.000 V | 1 mV | 0 to ±110.9999 V | 100 µV |
| Current source/ measurement range | 3 µA | 0 to ±3.20000 µA | 50 pA | 0 to ±3.209999 µA | 1 pA |
| | 30 µA | 0 to ±32.0000 µA | 500 pA | 0 to ±32.09999 µA | 10 pA |
| | 300 µA | 0 to ±320.000 µA | 5 nA | 0 to ±320.9999 µA | 100 pA |
| | 3 mA | 0 to ±3.20000 mA | 50 nA | 0 to ±3.209999 mA | 1 nA |
| | 30 mA | 0 to ±32.0000 mA | 500 nA | 0 to ±32.09999 mA | 10 nA |
| | 300 mA | 0 to ±320.000 mA | 5 µA | 0 to ±320.9999 mA | 100 nA |
| | 2 A | 0 to ±2.00000 A | 50 µA | 0 to ±2.009999 A | 1 µA |
| Resistance measurement | Determined by voltage range/ current range calculations | - | - | 0 Ω to 550 GΩ | Minimum 0.05 µΩ |

*1) The measurement resolution for the integration time of 5 µs, 10 µs, 100 µs and 500 µs is shown below:

| Integration time | 5 µs | 10 µs | 100 µs | 500 µs |
|---|---|---|---|---|
| Measurement resolution (digits) | 20 | 10 | 4 | 2 |

Voltage/current limit (compliance) range:

| | Setting range | Setting resolution *2) |
|---|---|---|
| Voltage limit | 0 V to 320.00 mV | 10 µV |
| | 320.01 mV to 3.2000 V | 100 µV |
| | 3.2001 V to 10.000 V | 1 mV |
| | 10.001 V to 32.000 V | 1 mV |
| | 32.001 V to 110.00 V | 10 mV |
| Current limit | 0.0010 µA to 3.2000 µA | 100 pA |
| | 3.2001 µA to 32.000 µA | 1 nA |
| | 32.001 µA to 320.00 µA | 10 nA |
| | 320.01 µA to 3.2000 mA | 100 nA |
| | 3.2001 mA to 32.000 mA | 1 µA |
| | 32.001 mA to 320.00 mA | 10 µA |
| | 320.01 mA to 2.0000 A | 100 µA |

*2) Where, (Hi limit value - Lo limit value) ≥ 600 digits (2000 digits for 3 µA range)

Accuracy: Includes calibration accuracy, 1-day stability, temperature coefficient, and linearity.
1-day stability: At constant power and load
Temperature coefficient: At temperature of 0 to 50 °C

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of setting + V) | | ± (ppm of setting + V)/°C |
| Voltage source | 300 mV | 0.02 + 150 µV | 0.008 + 80 µV | 15 + 15 µV |
| | 3 V | 0.02 + 200 µV | 0.008 + 100 µV | 15 + 30 µV |
| | 10 V | 0.02 + 600 µV | 0.008 + 500 µV | 15 + 100 µV |
| | 30 V | 0.02 + 2 mV | 0.008 + 1 mV | 15 + 300 µV |
| | 100 V | 0.02 + 6 mV | 0.008 + 5 mV | 15 + 1 mV |
| Voltage limit | 300 mV | 0.025 + 250 µV | 0.01 + 100 µV | 15 + 30 µV |
| | 3 V | 0.025 + 500 µV | 0.01 + 300 µV | 15 + 50 µV |
| | 10 V | 0.025 + 5 mV | 0.01 + 3 mV | 15 + 500 µV |
| | 30 V | 0.025 + 5 mV | 0.01 + 3 mV | 15 + 500 µV |
| | 100 V | 0.025 + 50 mV | 0.01 + 20 mV | 15 + 2 mV |

Voltage limit additional error: When the Hi limit value is set to a negative value and the Lo limit value is set to a positive value, an error of ±0.1% of setting is added.

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of setting + A +A × Vo/1 V) | | ± (ppm of setting + A + A × Vo/1 V)/°C |
| Current source | 3 μA | 0.03 + 500 pA + 30 pA | 0.01 + 300 pA + 20 pA | 20 + 150 pA + 1 pA |
| | 30 μA | 0.03 + 4 nA + 300 pA | 0.01 + 2.5 nA + 200 pA | 20 + 1 nA + 10 pA |
| | 300 μA | 0.025 + 40 nA + 3 nA | 0.01 + 25 nA + 2 nA | 20 + 10 nA + 100 pA |
| | 3 mA | 0.025 + 350 nA + 30 nA | 0.008 + 200 nA + 20 nA | 20 + 100 nA + 1 nA |
| | 30 mA | 0.025 + 3.5 μA + 300 nA | 0.008 + 2 μA + 200 nA | 20 + 1 μA + 10 nA |
| | 300 mA | 0.03 + 35 μA + 3 μA | 0.01 + 20 μA + 2 μA | 20 + 10 μA + 100 nA |
| | 2 A | 0.04 + 350 μA + 30 μA | 0.015 + 250 μA + 20 μA | 20 + 100 μA + 1 mA |
| Current limit | 3 μA | 0.03 + 1.5 nA + 30 pA | 0.01 + 500 pA + 20 pA | 20 + 200 pA + 1 pA |
| | 30 μA | 0.03 + 10 nA + 300 pA | 0.01 + 3 nA + 200 pA | 20 + 1 nA + 10 pA |
| | 300 μA | 0.03 + 100 nA + 3 nA | 0.01 + 30 nA + 2 nA | 20 + 10 nA + 100 pA |
| | 3 mA | 0.03 + 1 μA + 30 nA | 0.01 + 300 nA + 20 nA | 20 + 100 nA + 1 nA |
| | 30 mA | 0.03 + 10 μA + 300 nA | 0.01 + 3 μA + 200 nA | 20 + 1 μA + 10 nA |
| | 300 mA | 0.05 + 100 μA + 3 μA | 0.015 + 30 μA + 2 μA | 20 + 10 μA + 100 nA |
| | 2 A | 0.06 + 1 mA + 30 μA | 0.03 + 300 μA + 20 μA | 20 + 100 μA + 1 mA |

Vo: Compliance voltage

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of reading + V) | | ± (ppm of reading + V)/°C |
| Voltage measurement | 300 mV | 0.02 + 120 μV | 0.006 + 60 μV | 15 + 12 μV |
| | 3 V | 0.02 + 120 μV | 0.006 + 80 μV | 15 + 15 μV |
| | 10 V | 0.02 + 500 μV | 0.006 + 200 μV | 15 + 50 μV |
| | 30 V | 0.02 + 1.2 mV | 0.006 + 800 μV | 15 + 150 μV |
| | 100 V | 0.02 + 5 mV | 0.006 + 2 mV | 15 + 500 μV |

(Auto Zero: ON, integration time: 1 PLC to 200 ms)

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of reading + A + A × Vo/1 V) | | ± (ppm of reading + A + A × Vo/1 V)/°C |
| Current measurement | 3 μA | 0.025 + 500 pA + 30 pA | 0.01 + 300 pA + 20 pA | 20 + 100 pA + 1 pA |
| | 30 μA | 0.025 + 4 nA + 300 pA | 0.01 + 2.5 nA + 200 pA | 20 + 500 pA + 10 pA |
| | 300 μA | 0.025 + 35 nA + 3 nA | 0.01 + 25 nA + 2 nA | 20 + 5 nA + 100 pA |
| | 3 mA | 0.025 + 300 nA + 30 nA | 0.01 + 200 nA + 20 nA | 20 + 40 nA + 1 nA |
| | 30 mA | 0.025 + 3 μA + 300 nA | 0.01 + 2 μA + 200 nA | 20 + 400 nA + 10 nA |
| | 300 mA | 0.03 + 30 μA + 3 μA | 0.01 + 20 μA + 2 μA | 20 + 4 μA + 100 nA |
| | 2 A | 0.04 + 300 μA + 30 μA | 0.015 + 250 μA + 20 μA | 20 + 40 μA + 1 mA |

Vo: Compliance voltage
(Auto Zero: ON, integration time: 1 PLC to 200 ms)

| | Source Condition | Accuracy ±(% of reading) ±(digits + digits + digits) | |
|---|---|---|---|
| Resistance measurement | Voltage source | Reading error:<br>Full-scale error: | (Voltage source setting error + Current measurement reading error)<br>(Voltage source full-scale error digit value + Current measurement full-scale error digit value + CMV error digit value)*3) |
| | Current source | Reading error:<br>Full-scale error: | (Current source setting error + Voltage measurement reading error)<br>(Current source full-scale error digit value + Voltage measurement full-scale error digit value + CMV error digit value)*3) |

(Auto Zero: ON, integration time: 1 PLC to 200 ms)

*3) CMV error = (A × Vo/1 V): "Source or measurement current" × "Source or measurement voltage"/ 1 V digit value

The full-scale error tolerances listed below are added to the measurement accuracies with integration time of 10 ms to 5 μs and the 1-day stability.

| | Measurement range | Integration time Unit: digits (at $6^1/_2$ digit display) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 10 ms | 1 ms | 500 μs | 100 μs | 10 μs | 5 μs |
| Voltage measurement | 300 mV | 150 | 200 | 400 | 600 | 8000 | 10000 |
| | 3 V | 50 | 100 | 200 | 300 | 5000 | 8000 |
| | 10 V | 50 | 100 | 200 | 300 | 5000 | 8000 |
| | 30 V | 50 | 100 | 200 | 300 | 5000 | 8000 |
| | 100 V | 50 | 100 | 200 | 300 | 5000 | 8000 |
| Current measurement | 3 μA | 600 | 1000 | 1500 | 2000 | 5000 | 10000 |
| | 30 μA | 200 | 300 | 300 | 300 | 5000 | 10000 |
| | 300 μA | 100 | 100 | 200 | 300 | 5000 | 8000 |
| | 3 mA | 100 | 100 | 200 | 300 | 5000 | 8000 |
| | 30 mA | 100 | 100 | 200 | 300 | 5000 | 8000 |
| | 300 mA | 100 | 100 | 200 | 300 | 5000 | 8000 |
| | 2 A | 100 | 100 | 200 | 300 | 5000 | 8000 |

Source linearity: ±10 digits or less

Maximum output current: ±2 A at ±32 V
±1 A at ±64 V
±0.5 A at ±110 V

Maximum compliance voltage: ±110 V at ±0.5 A
±64 V at ±1 A
±32 V at ±2 A

Output noise: For voltage source, within the range from no load to the maximum load (Vp-p)
For current source, at the following load resistance (Ap-p)

Voltage source

| Range | Load resistance | Low frequency noise | | High frequency noise |
|---|---|---|---|---|
| | | DC to 100 Hz | DC to 10 kHz | DC to 20 MHz |
| 300 mV | - | 60 μV | 300 μV | 5 mV |
| 3 V | - | 100 μV | 400 μV | 5 mV |
| 10 V | - | 1 mV | 3 mV | 6 mV |
| 30 V | - | 1 mV | 3 mV | 6 mV |
| 100 V | - | 3 mV | 5 mV | 10 mV |

Current source

| Range | Load resistance | Low frequency noise | | High frequency noise |
|---|---|---|---|---|
| | | DC to 100 Hz | DC to 10 kHz | DC to 20 MHz |
| 3 μA | 10 kΩ | 10 nA | 60 nA | 500 nA |
| 30 μA | 10 kΩ | 10 nA | 60 nA | 500 nA |
| 300 μA | 10 kΩ | 30 nA | 150 nA | 600 nA |
| 3 mA | 1 kΩ | 200 nA | 2 μA | 6 μA |
| 30 mA | 1 kΩ | 2 μA | 15 μA | 20 μA |
| 300 mA | 1 kΩ | 20 μA | 100 μA | 150 μA |
| 2 A | 100 Ω | 200 μA | 1 mA | 1.5 mA |

Switching noise

| | | Typical value [p-p] | Load resistance |
|---|---|---|---|
| Output ON/OFF noise | Voltage source | 600 mV | At 100 kΩ |
| | Current source | 600 mV | At 100 kΩ |
| Range switching noise | Voltage source | 50 mV | - |
| | Voltage limit | 50 mV *4) | |
| | Voltage measurement | 50 mV *4) | |
| | Current source<br>Current measurement<br>Current limit | 700 digits + 50 mV *5) | - |
| Power OFF noise | | 600 mV | At 100 kΩ |

*4) The limit is inactive. While the limit is active, it is the same as the current source range switching noise.
*5) "digits" indicates current source $5^1/_2$ digit values.

Settling time:

Time to reach the final value ±0.1 % at pure resistance load and load capacity of 2.5 pF or less and with the compliance set to the full-scale value
Voltage source in the 100 V range: at load where the output current falls within 20 % or less of the setting limit value

| (Typical value) | Source range | Limit range | Output response | |
|---|---|---|---|---|
| | | | FAST | SLOW |
| Voltage source | 300 mV | 2 A | 100 µs | 1 ms |
| | 3 V | | | |
| | 10 V | | | |
| | 30 V | | 200 µs | 2 ms |
| | 100 V | 300 mA | 300 µs | 3 ms |
| Current source | 3 µA | 100 V | 10 ms | |
| | 30 µA | | 5 ms | |
| | 300 µA | | 2 ms | 5 ms |
| | 3 mA | | | |
| | 30 mA | | 800 µs | |
| | 300 mA | | | |
| | 2 A | 30 V | | |

Overshoot: ±5 % or less under pure resistance load and at the standard cable end (3 μA, 30 μA and 300 μA ranges excluded)

Line regulation: ±0.003% of range or less

Load regulation: Voltage source: ±0.003% of range or less (by 4-wire connection and under the maximum load)
Current source: Depending on the accuracy CMV error (A × Vo/1V)

Output resistance: By 4-wire connection (Output cable not included)

Maximum load capacitance: Maximum load capacitance that does not generate oscillation in voltage source or voltage limit status

| Output resistance (Ω) | | | Maximum load capacitance |
|---|---|---|---|
| Current range | Voltage source | Current source | |
| 3 μA | 3 Ω or less | 10 GΩ or higher | 1 μF |
| 30 μA | 500 mΩ or less | 1000 MΩ or higher | 1 μF |
| 300 μA | 100 mΩ or less | 1000 MΩ or higher | 1 μF |
| 3 mA | 10 mΩ or less | 100 MΩ or higher | 100 μF |
| 30 mA | 10 mΩ or less | 10 MΩ or higher | 100 μF |
| 300 mA | 10 mΩ or less | 1 MΩ or higher | 2000 μF |
| 2 A | 10 mΩ or less | 100 kΩ or higher | 2000 μF |

Supplied cable resistance: 100 mΩ or less

Maximum inductive load: Maximum inductive load that does not generate oscillation in current source or current limit status

| Current source range/ current limit range | Response | 3 μA, 30 μA | 300 μA | 3 mA to 2 A |
|---|---|---|---|---|
| Maximum inductive load | FAST | 100 μH | 200 μH | 500 μH |
| | SLOW | 100 μH | 500 μH | 1 mH |

Effective CMRR: With unbalanced impedance of 1 kΩ
At DC and AC 50/60 Hz ± 0.08%

| | Integration time | |
|---|---|---|
| | 5 µs to 10 ms | 1 PLC to 200 ms |
| Current measurement/ voltage measurement | 60 dB | 120 dB |

NMRR: At AC 50/60 Hz ± 0.08 %

| | Integration time | |
|---|---|---|
| | 5 µs to 10 ms | 1 PLC to 200 ms |
| Voltage measurement/ current measurement | 0 dB | 60 dB |

## 8.1.2 6254 Source and Measurement

| | Range | Source range | Setting resolution | Measurement range | Measurement resolution *1) |
|---|---|---|---|---|---|
| Voltage source/ measurement range | 300 mV | 0 to ±320.000 mV | 5 µV | 0 to ±320.9999 mV | 100 nV |
| | 3 V | 0 to ±3.20000 V | 50 µV | 0 to ±3.209999 V | 1 µV |
| | 20 V | 0 to ±20.0000 V | 200 µV | 0 to ±20.09999 V | 10 µV |
| Current source/ measurement range | 300 µA | 0 to ±320.000 µA | 5 nA | 0 to ±320.9999 µA | 100 pA |
| | 3 mA | 0 to ±3.20000 mA | 50 nA | 0 to ±3.209999 mA | 1 nA |
| | 30 mA | 0 to ±32.0000 mA | 500 nA | 0 to ±32.09999 mA | 10 nA |
| | 300 mA | 0 to ±320.000 mA | 5 µA | 0 to ±320.9999 A | 100 nA |
| | 3 A | 0 to ±3.20000 A | 50 µA | 0 to ±3.209999 A | 1 µA |
| | 20 A | 0 to ±20.0000 A | 500 µA | 0 to ±20.09999 A | 10 µA |
| Resistance measurement | Determined by voltage range/ current range calculations | - | - | 0 Ω to 1 GΩ | Minimum 0.005 µΩ |

*1) The measurement resolution for the integration time of 5 µs, 10 µs, 100 µs and 500 µs is shown below

| Integration time | 5 µs | 10 µs | 100 µs | 500 µs |
|---|---|---|---|---|
| Measurement resolution (digits) | 20 | 10 | 4 | 2 |

Voltage/current limit (compliance) range:

| | Setting range | Setting resolution *2) |
|---|---|---|
| Voltage limit | 0 V to 320.00 mV | 10 µV |
| | 320.01 mV to 3.2000 V | 100 µV |
| | 3.2001 V to 20.000 V | 1 mV |
| Current limit | 000.10 µA to 320.00 µA | 10 nA |
| | 320.01 µA to 3.2000 mA | 100 nA |
| | 3.2001 mA to 32.000 mA | 1 µA |
| | 32.001 mA to 320.00 mA | 10 µA |
| | 320.01 mA to 3.2000 A | 100 µA |
| | 3.2001 A to 20.000 A | 1 mA |

*2) Where, (Hi limit value - Lo limit value) ≥ 600 digits

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

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of setting + V) | | ± (ppm of setting + V)/°C |
| Voltage source | 300 mV | 0.02 + 150 μV | 0.008 + 80 μV | 15 + 15 μV |
| | 3 V | 0.02 + 200 μV | 0.008 + 100 μV | 15 + 30 μV |
| | 20 V | 0.02 + 600 μV | 0.008 + 500 μV | 15 + 100 μV |
| Voltage limit | 300 mV | 0.025 + 250 μV | 0.01 + 100 μV | 15 + 30 μV |
| | 3 V | 0.025 + 500 μV | 0.01 + 300 μV | 15 + 50 μV |
| | 20 V | 0.025 + 5 mV | 0.01 + 3 mV | 15 + 500 μV |

Voltage limit additional error: When the Hi limit value is set to a negative value and the Lo limit value is set to a positive value, an error of ±0.1 % of setting is added.

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of setting + A +A × Vo/1 V) | | ± (ppm of setting + A + A × Vo/1 V)/°C |
| Current source | 300 μA | 0.025 + 40 nA + 3 nA | 0.01 + 25 nA + 2 nA | 20 + 10 nA + 100 pA |
| | 3 mA | 0.025 + 350 nA + 30 nA | 0.008 + 200 nA + 20 nA | 20 + 100 nA + 1 nA |
| | 30 mA | 0.025 + 3.5 μA + 300 nA | 0.008 + 2 μA + 200 nA | 20 + 1 μA + 10 nA |
| | 300 mA | 0.025 + 35 μA + 3 μA | 0.01 + 20 μA + 2 μA | 20 + 10 μA + 100 nA |
| | 3 A | 0.04 + 350 μA + 30 μA | 0.02 + 250 μA + 20 μA | 20 + 100 μA + 1 mA |
| | 20 A | 0.1 + 8 mA + 300 μA | 0.08 + 3 mA + 100 μA | 40 + 1 mA + 10 mA |
| Current limit | 300 μA | 0.03 + 100 nA + 3 nA | 0.01 + 30 nA + 2 nA | 20 + 10 nA + 100 pA |
| | 3 mA | 0.03 + 1 μA + 30 nA | 0.01 + 300 nA + 20 nA | 20 + 100 nA + 1 nA |
| | 30 mA | 0.03 + 10 μA + 300 nA | 0.01 + 3 μA + 200 nA | 20 + 1 μA + 10 nA |
| | 300 mA | 0.03 + 100 μA + 3 μA | 0.015 + 30 μA + 2 μA | 20 + 10 μA + 100 nA |
| | 3 A | 0.05 + 1 mA + 30 μA | 0.03 + 300 μA + 20 μA | 20 + 100 μA + 1 mA |
| | 20 A | 0.1 + 15 mA + 300 μA | 0.08 + 3 mA + 100 μA | 40 + 1 mA + 10 μA |

Vo: Compliance voltage

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of reading + V) | | ± (ppm of reading + V)/°C |
| Voltage measurement | 300 mV | 0.02 + 60 µV | 0.006 + 60 µV | 15 + 12 µV |
| | 3 V | 0.02 + 120 µV | 0.006 + 80 µV | 15 + 15 µV |
| | 20 V | 0.02 + 500 µV | 0.006 + 200 µV | 15 + 50 µV |

(Auto Zero: ON, integration time: 1 PLC to 200 ms)

| | Range | Accuracy | 1-day stability | Temperature coefficient |
|---|---|---|---|---|
| | | ± (% of reading + A + A × Vo/1 V) | | ± (ppm of reading + A + A × Vo/1 V)/°C |
| Current measurement | 300 µA | 0.025 + 35 nA + 3 nA | 0.01 + 25 nA + 2 nA | 20 + 5 nA + 100 pA |
| | 3 mA | 0.025 + 300 nA + 30 nA | 0.01 + 200 nA + 20 nA | 20 + 40 nA + 1 nA |
| | 30 mA | 0.025 + 3 µA + 300 nA | 0.01 + 2 µA + 200 nA | 20 + 400 nA + 10 nA |
| | 300 mA | 0.025 + 30 µA + 3 µA | 0.01 + 20 µA + 2 µA | 20 + 4 µA + 100 nA |
| | 3 A | 0.04 + 300 µA + 30 µA | 0.02 + 250 µA + 20 µA | 20 + 40 µA + 1 mA |
| | 20 A | 0.1 + 4 mA + 300 µA | 0.08 + 2.5 mA +200 µA | 40 + 400 µA + 10 µA |

Vo: Compliance voltage
(Auto Zero: ON, integration time: 1 PLC to 200 ms)

| | Source Condition | Accuracy | |
|---|---|---|---|
| | | ±(% of reading)<br>±(digits + digits + digits) | |
| Resistance measurement | Voltage source | Reading error:<br>Full-scale error: | (Voltage source setting error + Current measurement reading error)<br>(Voltage source full-scale error digit value + Current measurement scale error digit value + CMV error digit value)*3) |
| | Current source | Reading error:<br>Full-scale error: | (Current source setting error + Voltage measurement reading error)<br>(Current source full-scale error digit value + Voltage measurement full-scale error digit value + CMV error digit value)*3) |

(Auto Zero: ON, integration time: 1 PLC to 200 ms)
*3) CMV error = (A × Vo/1 V): “Source or measurement current” × “Source or measurement voltage”/1 V digit value

The full-scale error tolerances listed below are added to the measurement accuracies with integration time of 10 ms to 5 µs and the 1-day stability.

| | Measurement range | Integration time Unit: digits (at $6^1/_2$ digit display) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 10 ms | 1 ms | 500 µs | 100 µs | 10 µs | 5 µs |
| Voltage measurement | 300 mV | 150 | 200 | 400 | 600 | 8000 | 10000 |
| | 3 V | 50 | 100 | 200 | 300 | 5000 | 8000 |
| | 20 V | 50 | 100 | 200 | 300 | 5000 | 8000 |
| Current measurement | 300 µA | 100 | 150 | 200 | 300 | 5000 | 8000 |
| | 3 mA | 100 | 150 | 200 | 300 | 5000 | 8000 |
| | 30 mA | 100 | 150 | 200 | 300 | 5000 | 8000 |
| | 300 mA | 100 | 150 | 200 | 300 | 5000 | 8000 |
| | 3 A | 100 | 150 | 200 | 300 | 5000 | 8000 |
| | 20 A | 100 | 150 | 200 | 300 | 5000 | 8000 |

Source linearity: ±10 digits or less
(±60 digits for the 3 A range and ±80 digits for the 20 A range)

Maximum output current: ±20 A at ±7 V
±7 A at ±20 V

Maximum compliance voltage: ±20 V at ±7 A
±7 V at ±20 A

Output noise: For voltage source, within the range from no load to the maximum load (Vp-p)
For current source, at the following load resistance (Ap-p)

Voltage source:

| Range | Load resistance | Low frequency noise | | High frequency noise |
|---|---|---|---|---|
| | | DC to 100 Hz | DC to 10 kHz | DC to 20 MHz* |
| 300 mV | - | 60 µV | 300 µV | 5 mV |
| 3 V | - | 100 µV | 400 µV | 5 mV |
| 20 V | - | 1 mV | 3 mV | 6 mV |

*10 mV at 3 A or higher

Current source:

| Range | Load resistance | Low frequency noise | | High frequency noise |
|---|---|---|---|---|
| | | DC to 100 Hz | DC to 10 kHz | DC to 20 MHz |
| 300 μA | 10 kΩ | 30 nA | 150 nA | 600 nA |
| 3 mA | 1 kΩ | 200 nA | 2 μA | 6 μA |
| 30 mA | 1 kΩ | 2 μA | 15 μA | 20 μA |
| 300 mA | 1 kΩ | 20 μA | 100 μA | 150 μA |
| 3 A | 100 Ω | 200 μA | 1 mA | 1.5 mA |
| 20 A | 10 Ω | 2 mA | 10 mA | 15 mA |

Switching noise:

| | | Typical value [p-p] | Load resistance |
|---|---|---|---|
| Output ON/OFF noise | Voltage source | 600 mV | At 100 kΩ |
| | Current source | 600 mV | |
| Range switching noise | Voltage source | 50 mV | - |
| | Voltage limit | 50 mV *4) | |
| | Voltage measurement | 50 mV *4) | |
| | Current source<br>Current measurement<br>Current limit | 700 digits + 50 mV *5) | |
| Power OFF noise | | 600 mV | At 100 kΩ |

*4) The limit is inactive. While the limit is active, it is the same as the current source range switching noise.

*5) "digits" indicates current source $5^1/_2$ digit values.

Settling time:

Time to reach the final value ±0.1 % at pure resistance load and load capacity of 2.5 pF or less and with the compliance set to the full-scale value
Voltage source in the 20 V range: at load where the output current falls within 20% or less of the setting limit value

| (Typical value) | Source range | Limit range | Output response | |
|---|---|---|---|---|
| | | | FAST | SLOW |
| Voltage source | 300 mV | 20 A | 100 μs | 1 ms |
| | 3 V | | | |
| | 20 V | 3 A | 200 μs | 2 ms |
| Current source | 300 μA | 20 V | 2 ms | 5 ms |
| | 3 mA | | | |
| | 30 mA | | 800 μs | |
| | 300 mA | | | |
| | 3 A | | | |
| | 20 A | 3 V | | |

Overshoot: ±5 % or less under pure resistance load and at the standard cable end (300 μA, 3 A and 20 A ranges excluded)

Line regulation: ±0.003 % of range or less

Load regulation: Voltage source: ±0.003 % of range or less (by 4-wire connection and under the maximum load)
Current source: Depending on the accuracy CMV error (A × Vo/1 V)

Output resistance: By 4-wire connection (Output cable not included)

Maximum load capacitance: Maximum load capacitance that does not generate oscillation in voltage source or voltage limit status

| Output resistance (Ω) | | | Maximum load capacitance |
|---|---|---|---|
| Current range | Voltage source | Current source | |
| 300 μA | 100 mΩ or less | 1000 MΩ or higher | 1 μF |
| 3 mA | 10 mΩ or less | 100 MΩ or higher | 100 μF |
| 30 mA | 10 mΩ or less | 10 MΩ or higher | 100 μF |
| 300 mA | 10 mΩ or less | 1 MΩ or higher | 2000 μF |
| 3 A | 10 mΩ or less | 100 kΩ or higher | 2000 μF |
| 20 A | 10 mΩ or less | 10 kΩ or higher | 2000 μF |

Supplied cable resistance: 100 mΩ or less

Maximum inductive load: Maximum inductive load that does not generate oscillation in current source or current limit status

| Current source range/ current limit range | | 300 μA | 3 mA to 20 A |
|---|---|---|---|
| | Response | | |
| Maximum inductive load | FAST | 200 μH | 500 μH |
| | SLOW | 500 μH | 1 mH |

Effective CMRR: With unbalanced impedance of 1 kΩ
At DC and AC 50/60 Hz ± 0.08 %

| | Integration time | |
|---|---|---|
| | 5 μs to 10 ms | 1 PLC to 200 ms |
| Current measurement/ voltage measurement | 50 dB | 110 dB |

NMRR: At AC 50/60 Hz ± 0.08 %

| | Integration time | |
|---|---|---|
| | 5 μs to 10 ms | 1 PLC to 200 ms |
| Voltage measurement/ current measurement | 0 dB | 60 dB |

## 8.2 Source and Measurement Functions

DC source and measurement: Source and measurement of DC voltage and current

Pulse source and measurement: Source and measurement of pulse voltage and current
(However, measurement auto range in pulse source is impossible.)

DC sweep source and measurement:
Source and measurement by linear, multi-slope linear, random, log and fixed levels

Pulse sweep source and measurement:
Source and measurement by linear, multi-slope linear, random, log and fixed levels (However, measurement auto range in pulse source is impossible.)

Source value monitor: Monitoring of DC voltage current source values (Separately from the measurement function)

Integration time: 10 types available: 5 μs, 10 μs, 100 μs, 500 μs, 1 ms, 10 ms, 1 PLC, 2 PLC, 200ms and arbitrary value (variable integration)
(PLC: Power Line Cycle 50 Hz: 20 ms, 60 Hz: 16.66 ms)

Variable integration range: 100 μs to 1000 ms (setting resolution: 100 μs)

Sweep reverse mode: ON (reverse) / OFF (single)

Sweep repeat count: 1 to 1000 times or infinite

Maximum number of sweep steps:
20000 steps

Maximum random sweep memory:
20000 data

Sampling count: 1 to 20000 times
(Plural samplings done by single trigger)
(Enabled only when setting to HOLD in the DC or pulse mode)

Measurement data memory: 20000 data

Measurement auto range: Available only in VSIM or ISVM

Measurement function link mode:
Links the measurement function to the source function.
VSIM or ISVM, ON/OFF available

Limit: The HI and LO limit values can be set individually.
(However, setting the current limit values with the same polarity is not allowed.)

Calculation function: NULL calculation
Comparator calculation (HI, GO, or LO)
Scaling calculation
MAX, MIN, AVE, TOTAL calculations

Trigger style: Auto trigger, External trigger

Output terminal:

| | |
|---|---|
| Front | Safety socket |
| Rear | 5-pin rectangular (6253 only)<br>HI OUTPUT, HI SENSE, LO OUTPUT, LO SENSE, DRIVING GUARD |

Maximum input voltage:

6253: 110 V peak (between HI and LO, between DG and LO)
3 V peak (between OUTPUT and SENSE)
1 V peak (between HI and DG)
500 V maximum (between LO and chassis)

6254: 20 V peak (between HI and LO)
3 V peak (between OUTPUT and SENSE)
250 V maximum (between LO and chassis)

Maximum remote sensing voltage:

±3 V maximum HI OUTPUT - HI SENSE,
LO OUTPUT - LO SENSE
(The voltage between HI OUTPUT and LO OUTPUT must be within the maximum output voltage range.)

Voltage measurement input resistance:

6253: 10 GΩ or higher
6254: 1 GΩ or higher

Voltage measurement input leak current:

6253: ±100 pA or lower
6254: ±2 nA or lower

## 8.3 Interface Functions

| | |
|---|---|
| USB: | USB 2.0 Full-speed<br>Type B connector |
| GPIB: | Compliant with IEEE-488.2<br>Amphenol 24 pin connector<br>Interface function<br>SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 |
| RS-232<br>(Factory option)<br>6253+03, 6254+03 | Compliant with EIA232C (RS-232)<br>Baud rate 19200, 9600, 4800, 2400, 1200, 600, 300<br>Parity EVEN, ODD, NONE<br>Number of data bit<br>7 bits, 8 bits<br>Number of stop bits<br>1 bit, 2 bits<br>9-pin Dsub connector |
| LAN:<br>(Factory option)<br>6253+06, 6254+06 | Compliant with IEEE802.3<br>10BASE-T, 100BASE-TX<br>RJ-45 connector |
| External control signal: | TRIGGER IN<br>SYNC OUT<br>COMPLETE OUT, BUSY IN, BUSY OUT<br>INTERLOCK, STBY IN, OPR/STBY IN, OPR/SUS IN, OPERATE OUT<br>BNC connector |

## 8.4 Setting Time

Minimum pulse width: 25 µs

Minimum step (repeat) time: Under fixed source/measurement range, integration time of 5 µs, the minimum measurement or source delay time, calculation function OFF, and voltage/current measurement

| Measurement | Source mode | Memory mode | Minimum step time |
|---|---|---|---|
| OFF | Common | OFF, Normal | 125 µs |
| | | Burst | 50 µs |
| ON | DC, pulse | OFF, Normal | 500 µs *6) |
| | Sweep | Burst | 50 µs |
| | | OFF, Normal | 500 µs *6) |

*6) For the 6253, Tp - (Td + IT) > 30 ms when the display is ON and the software revision is A03 or less

Source delay time:

| Setting range | Resolution *7) | Setting accuracy |
|---|---|---|
| 0.005 ms to 60.000 ms | 1 µs | ±(0.1 % + 10 µs) |
| 60.01 ms to 600.00 ms | 10 µs | |
| 600.1 ms to 6000.0 ms | 100 µs | |
| 6001 ms to 59997 ms | 1 ms | |

Period (pulse cycle):

| Setting range | Resolution *7) | Setting accuracy |
|---|---|---|
| 0.050 ms to 60.000 ms | 1 µs | ±(0.1 % + 10 µs) |
| 60.01 ms to 600.00 ms | 10 µs | |
| 600.1 ms to 6000.0 ms | 100 µs | |
| 6001 ms to 60000 ms | 1 ms | |

*7) The setting resolution is determined by the period time resolution.

Pulse width:

| Setting range | Resolution *7) | Setting accuracy |
|---|---|---|
| 0.025 ms to 60.000 ms | 1 µs | ±(0.1 % + 10 µs) |
| 60.01 ms to 600.00 ms | 10 µs | |
| 600.1 ms to 6000.0 ms | 100 µs | |
| 6001 ms to 59997 ms | 1 ms | |

Measurement delay time:

| Setting range | Resolution *7) | Setting accuracy |
|---|---|---|
| 0.020 ms to 60.000 ms | 1 μs | ±(0.1 % + 10 μs) |
| 60.01 ms to 600.00 ms | 10 μs | |
| 600.1 ms to 6000.0 ms | 100 μs | |
| 6001 ms to 59997 ms | 1 ms | |

*7) The setting resolution is determined by the period time resolution.

Hold time:

| Setting range | Resolution | Setting accuracy |
|---|---|---|
| 0 ms to 6000.0 ms | 100 μs | ± (2 % + 2 ms) |

Auto range delay time:

| Setting range | Resolution | Setting accuracy |
|---|---|---|
| 0 ms to 5000.0 ms | 100 μs | ± (2 % + 2 ms) |

## 8.5 General Specifications

Operating environment conditions:

Temperature: 0 °C to +50 °C, relative humidity 85% or below with no condensation
The temperature condition varies at current sink.

Storage environment conditions:

Temperature -25 °C to +70 °C, relative humidity 85% or below with no condensation

Warming up time: 60 minutes or longer

Display: 4.3-inch color LCD display

Power supply: AC power 100 V, 120 V, 220 V, and 240 V (User selectable)

| Option No. | Standard | OPT.32 | OPT.42 | OPT.44 |
|---|---|---|---|---|
| Power voltage | 100 V | 120 V | 220 V | 240 V |

Specify the option number when ordering.
Use a power cable and a fuse that are compliant with the safety standard when changing the power supply voltage.

Line frequency: 50 Hz/60 Hz

Power consumption: 6253: 330 VA or less
6254: 320 VA or less

Dimensions: 6253: Approx. 212 (width) × 177 (height) × 450 (depth) mm
6254: Approx. 212 (width) × 177 (height) × 500 (depth) mm

Mass: 6253: 15 kg or less
6254: 13 kg or less

Safety: Compliant with IEC61010-1 Ed.3

EMC: Compliant with EN61326-1 classA

Vibration proof: Compliant with IEC60068-2-6, 2G

## 8.6 Supplementary Descriptions

### 8.6.1 How to Calculate Accuracy for Current Source, Current Measurement and Current Limit

Example) Calculating the accuracy in current source of 3 mA (3 mA range) with resistance of 1 kΩ connected

The accuracy formula in the current source range of 3 mA is as follows:

| | Range | Accuracy<br>±(% of setting + A + A × Vo / 1 V) |
|---|---|---|
| Current source | 3 mA | 0.025 + 350 nA + 30 nA |

The output voltage Vo is 3V. Therefore,

$$\begin{aligned}\text{Accuracy} &= \pm(\%\ \text{of setting} + A + A \times Vo / 1\ V) \\ &= \pm(3\ mA \times 0.025\ \% + 350\ nA + 30\ nA \times 3\ V / 1\ V) \\ &= \pm\ 1.19\ \mu A\end{aligned}$$

Thus, the accuracy in current source of 3 mA (3 mA range) is specified between 2.99881 mA to 3.00119 mA.

*NOTE: Vo in the 1-day stability, current limit and temperature coefficient for current source all indicates voltage between output terminals.*

## 8.6.2 How to Calculate Accuracy for Resistance Measurement

Example) Calculating the accuracy in current source of 3 mA (3 mA range) and voltage measurement of 3 V (3 V range)

Accuracies for resistance measurement must be calculated separately.

The accuracy formula for resistance measurement is as follows:

| Condition | Accuracy<br>±(% of reading) ±(digits + digits + digits) | |
|---|---|---|
| Voltage source | Reading error: | (Voltage source setting error + Current measurement reading error) |
| | Full-scale error: | (Voltage source full-scale error digit value + current measurement full-scale error digit value + CMV error digit value) |
| Current source | Reading error: | (Current source setting error + Voltage measurement reading error) |
| | Full-scale error: | (Current source full-scale error digit value + Voltage measurement full-scale error digit value + CMV error digit value) |

The accuracies in the 3 mA range for current source and in the 3 V range for voltage measurement are calculated from the specifications as follows:

Accuracy in the 3 mA range for current source: 0.025 + 350 nA + 30 nA

Accuracy in the 3 V range for voltage measurement: 0.02 + 120 μV

Here, the reading error for current source is as follows:

Reading error for current source = Current source setting error + Voltage measurement reading error

= 0.025 + 0.02 = 0.045 %

Next, the full-scale error for current source is as follows:

Full-scale error for current source = Current source full-scale error digit value - - - - - - - - - - - - ①

+ Voltage measurement full-scale error digit value - - - - - - ②

+ CMV error digit value - - - - - - - - - - - - - - - - - - - - - - - - ③

① Current source full-scale error digit value

The source resolution in the 3 mA range for current source is 50 nA according to the specification.

The offset error accuracy is 350 nA.

Thus, the current source full-scale error digit value is 35 digits.

② Voltage measurement full-scale error digit value

The measurement resolution in the 3 V range for voltage measurement is 1 μV according to the specification.

The offset item accuracy is 120 μV.

Thus, the voltage measurement full-scale error digit value is 120 digits.

③ CMV error digit value

CMV = A × Vo / 1 V

= 30 nA × 3 V / 1 V (*1)

= 90 nA

The source resolution in the 3 mA range for current source is 50 nA according to the specification.

Thus, the CMV error digit value is 9 digits.

From ①, ② and ③

Full-scale error for current source = 35 digits + 120 digits + 9 digits

= 164 digits

From the above results,

Accuracy = ±(0.045 + 164) digits

Next, calculate the accuracy in current source of 3 mA and voltage measurement of 3 V.

Measurement resistance value R = V / I = 3 V / 3 mA = 1 kΩ (Display: 1.0000 kΩ)

Accuracy = ±(1 kΩ × 0.045 %) ±164 digits

= ±0.45 Ω ±164 digits

Thus, the accuracy is specified between 0.999386 kΩ to 1.000614 kΩ.

*1: In accuracy calculation for resistance measurement, the measurement voltage value is used as output voltage Vo.

# APPENDIX

## A.1 When Problems Occur (Before Requesting Repairs)

If any problem is encountered when using the 6253/6254, inspect the unit referring to Table A-1. If the problem cannot be solved by the suggested remedial actions, contact an ADC CORPORATION sales representative.
Fees will be charged for repairs by ADC CORPORATION even if the problem is one of those listed in Table A-1. Therefore, carefully inspect the 6253/6254 before requesting service

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

| Q (Symptom) | A (Cause and Solution) |
|---|---|
| 1. Turning on the **POWER** switch does not display the screen. | Cause: The power fuse is open.<br>Solution: Replace it with the correct fuse. |
| 2. Does not output the setting source values. | Cause: The output status is Standby or Suspend.<br>Solution: Set the output status to Operate and check that the **OPR** indicator on the front panel is ON. |
| | Cause: Incorrect remote sensing setting<br>Solution: Check the 2W/4W indicator on the front panel to see if the desired remote sensing is specified. |
| | Cause: The source value is set to 0 V or 0 A.<br>Solution: Verify the source value. |
| | Cause: Detection of an overload voltage (Over Load) has set it to Standby.<br>Solution: Disconnect the connection cables. |
| | Cause: Heat detection (Over Heat) or fan detection (Fan Stopped) has activated, setting it to Standby status<br>Solution: Remove the cables and turn OFF the **POWER** switch. Turn ON the **POWER** switch again. |
| | Cause: The limit is activated.<br>Solution: Verify the limit setting. |
| | Cause: • The **OUTPUT** terminal and the **SENSE** terminal are incorrectly connected.<br>• **SENSE** is incorrectly connected in 4-wire connection.<br>Solution: Verify cable connections again. |
| | Cause: The interlock signal sets the output status to Standby.<br>Solution: • Change the interlock setting.<br>• Set the interlock signal to LO. |

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

| Q (Symptom) | A (Cause and Solution) |
|---|---|
| 3. Does not output the measurement values. | Cause: The unit is in the HOLD status.<br>Solution: Release the HOLD status, or input measurement trigger. |
| | Cause: Measurement is OFF.<br>Solution: Verify measurement ON/OFF setting. |
| | Cause: When measuring in the auto range, the value is unstable and the range unconfirmed, therefore measurement data is not output.<br>Solution: Change to the fixed range and measure. |
| | Cause: A trigger signal is not input although the trigger signal cable is connected to the external trigger.<br>Solution: Verify the TRIGGER connection cable and the signal. |
| 4. Source values and measurement values are unstable or abnormal. | Cause: Function or range settings have an error.<br>Solution: Check the settings again. |
| | Cause: Incorrect cable connection<br>Solution: Check cable connections again. |
| | Cause: Disconnected cable<br>Solution: Verify the cables with a DMM. If in error, replace it. |
| | Cause: The induction noise scatters measured values.<br>Solution: Set the integration time to 1 PLC or longer. |
| 5. The measurement value is over range. | Cause: The measured value after NULL calculation becomes twice or more of the full-scale value.<br>Solution: Raise the source value or limit range. |

## A.2 Error Message List

If an error occurs when using the 6253/6254, an error code and a message appear on the screen. The contents are explained in the following:

Table A-2 Error Message List (1 of 3)

| Error code | Message | Description | 6253 | 6254 |
|---|---|---|---|---|
| 001 | ROM Chk SUM | ROM check SUM error | ✓ | ✓ |
| 004 | RAM Rd/Wt | RAM read/write error | ✓ | ✓ |
| 005 | Analog Comm | Analog section communication error | ✓ | ✓ |
| 012 | CAL data SUM | CAL data SUM error | ✓ | ✓ |
| 013 | Param SUM | Parameter SUM error | ✓ | ✓ |
| 101 | AD1 Ratio 1-2 | AD1 operation IR1/IR2 ratio test error | ✓ | ✓ |
| 102 | AD1 Ratio 2-3 | AD1 operation IR2/IR3 ratio test error | ✓ | ✓ |
| 103 | AD1 Ratio 3-4 | AD1 operation IR3/IR4 ratio test error | ✓ | ✓ |
| 104 | AD1 Ratio 4-5 | AD1 operation IR4/IR5 ratio test error | ✓ | ✓ |
| 105 | AD1 Ratio 5-6 | AD1 operation IR5/IR6 ratio test error | ✓ | ✓ |
| 111 | ADRST Sig | Analog section RST line test error | ✓ | ✓ |
| 112 | ADTRG Sig | Analog section TRIG line test error | ✓ | ✓ |
| 121 | AD2 Ratio 1-2 | AD2 operation IR1/IR2 ratio test error | ✓ | ✓ |
| 122 | AD2 Ratio 2-3 | AD2 operation IR2/IR3 ratio test error | ✓ | ✓ |
| 123 | AD2 Ratio 3-4 | AD2 operation IR3/IR4 ratio test error | ✓ | ✓ |
| 124 | AD2 Ratio 4-5 | AD2 operation IR4/IR5 ratio test error | ✓ | ✓ |
| 125 | AD2 Ratio 5-6 | AD2 operation IR5/IR6 ratio test error | ✓ | ✓ |
| 151 | AD1 Zero | AD1 operation ZERO test error | ✓ | ✓ |
| 152 | AD2 Zero | AD2 operation ZERO test error | ✓ | ✓ |
| 201 | VSVM 300mV Zero | VSVM 300 mV ZERO test error | ✓ | ✓ |
| 202 | VSVM 300mV +FS | VSVM 300 mV +FS test error | ✓ | ✓ |
| 203 | VSVM 300mV -FS | VSVM 300 mV –FS test error | ✓ | ✓ |
| 204 | VSVM 3V Zero | VSVM 3 V ZERO test error | ✓ | ✓ |
| 205 | VSVM 3V +FS | VSVM 3 V +FS test error | ✓ | ✓ |
| 206 | VSVM 3V -FS | VSVM 3 V –FS test error | ✓ | ✓ |
| 207 | VSVM 10V Zero | VSVM 10 V ZERO test error | ✓ | - |
| 208 | VSVM 10V +FS | VSVM 10 V +FS test error | ✓ | - |
| 209 | VSVM 10V -FS | VSVM 10 V –FS test error | ✓ | - |
| 210 | VSVM 30V Zero | VSVM 30 V ZERO test error | ✓ | - |
| | VSVM 20V Zero | VSVM 20 V ZERO test error | - | ✓ |
| 211 | VSVM 30V +FS | VSVM 30 V +FS test error | ✓ | - |
| | VSVM 20V +FS | VSVM 20 V +FS test error | - | ✓ |

Table A-2 Error Message List (2 of 3)

| Error code | Message | Description | 6253 | 6254 |
|---|---|---|---|---|
| 212 | VSVM 30V -FS | VSVM 30 V –FS test error | ✓ | - |
| | VSVM 20V -FS | VSVM 20 V -FS test error | - | ✓ |
| 213 | VSVM 100V Zero | VSVM 100 V ZERO test error | ✓ | - |
| 214 | VSVM 100V +FS | VSVM 100 V +FS test error | ✓ | - |
| 215 | VSVM 100V -FS | VSVM 100 V –FS test error | ✓ | - |
| 216 | HL 300mV +FS | High Limit 300 mV +FS test error | ✓ | ✓ |
| 217 | HL 300mV -FS | High Limit 300 mV -FS test error | ✓ | ✓ |
| 218 | HL 3V +FS | High Limit 3 V +FS test error | ✓ | ✓ |
| 219 | HL 3V -FS | High Limit 3 V -FS test error | ✓ | ✓ |
| 220 | HL 10V +FS | High Limit 10 V +FS test error | ✓ | ✓ |
| 221 | HL 10V -FS | High Limit 10 V -FS test error | ✓ | ✓ |
| 222 | HL 30V +FS | High Limit 30 V +FS test error | ✓ | - |
| | HL 20V +FS | High Limit 20 V +FS test error | - | ✓ |
| 223 | HL 30V -FS | High Limit 30 V -FS test error | ✓ | - |
| | HL 20V -FS | High Limit 20 V -FS test error | - | ✓ |
| 224 | HL 100V +FS | High Limit 100 V +FS test error | ✓ | - |
| 225 | HL 100V -FS | High Limit 100 V -FS test error | ✓ | - |
| 226 | LL 300mV +FS | Low limit 300 mV +FS test error | ✓ | ✓ |
| 227 | LL 300mV -FS | Low limit 300 mV -FS test error | ✓ | ✓ |
| 228 | LL 3V +FS | Low limit 3 V +FS test error | ✓ | ✓ |
| 229 | LL 3V -FS | Low limit 3 V -FS test error | ✓ | ✓ |
| 230 | LL 10V +FS | Low limit 10 V +FS test error | ✓ | - |
| 231 | LL 10V -FS | Low limit 10 V -FS test error | ✓ | - |
| 232 | LL 30V +FS | Low limit 30 V +FS test error | ✓ | - |
| | LL 20V +FS | Low Limit 20 V +FS test error | - | ✓ |
| 233 | LL 30V -FS | Low limit 30 V -FS test error | ✓ | - |
| | LL 20V -FS | Low Limit 20 V -FS test error | - | ✓ |
| 234 | LL 100V +FS | Low limit 100 V +FS test error | ✓ | - |
| 235 | LL 100V -FS | Low limit 100 V -FS test error | ✓ | - |
| 236 | IM 3μA Zero | IM 3 μA ZERO test error | ✓ | - |
| 237 | IM 30μA Zero | IM 30 μA ZERO test error | ✓ | - |
| 238 | IM 300μA Zero | IM 300 μA ZERO test error | ✓ | ✓ |
| 239 | IM 3mA Zero | IM 3 mA ZERO test error | ✓ | ✓ |
| 240 | IM 30mA Zero | IM 30 mA ZERO test error | ✓ | ✓ |
| 241 | IM 300mA Zero | IM 300 mA ZERO test error | ✓ | ✓ |
| 242 | IM 2A Zero | IM 2 A ZERO test error | ✓ | - |
| | IM 3A Zero | IM 3 A ZERO test error | - | ✓ |

Table A-2 Error Message List (3 of 3)

| Error code | Message | Description | 6253 | 6254 |
|---|---|---|---|---|
| 243 | IM 20A Zero | IM 20 A ZERO test error | - | ✓ |
| 301 | OVL Check | OVL detection check error | ✓ | ✓ |
| 501 | CAL dt Lost | CAL data lost | ✓ | ✓ |
| 502 | Save dt Lost | Parameters saved by “STP” command lost | ✓ | ✓ |
| 503 | Para dt Lost | Saved parameters lost | ✓ | ✓ |
| 401 | Fan Stopped | Fan stopped | ✓ | ✓ |
| 402 | Over Heat | Overheat | ✓ | ✓ |
| 403 | Source Unit | Source unit circuit error | ✓ | ✓ |
| 404 | Over Load | Overload | ✓ | ✓ |
| 405 | | Overload (when sourcing with reverse polarity) | ✓ | ✓ |
| 801 | Over Step | 20000 < Number of sweep steps | ✓ | ✓ |
| 802 | Start > Stop | Start value larger than stop value for log sweep | ✓ | ✓ |
| 803 | Start,Stop Polarity | Different polarities between start value and stop value for log sweep | ✓ | ✓ |
| 804 | Start,Stop = 0 | Start value or stop value = 0 for log sweep | ✓ | ✓ |
| 811 | Power Over | Source or limit setting exceeding output range | ✓ | ✓ |
| 822 | Tp < Tds | Timer condition error (Not Tp > Tds + 94 μs) (Other than Burst) | ✓ | ✓ |
| 823 | Tp < Td | Timer condition error (Not Tp > Td + 94 μs) (Other than Burst) | ✓ | ✓ |
| 824 | Tp < Tds+Tw | Timer condition error (Not Tp > Tds + Tw + 94 μs) (Other than Burst) | ✓ | ✓ |
| 825 | Td < Tds | Timer condition error (Not Td > Tds) | ✓ | ✓ |
| 826 | Tp < Td+Tm | Timer condition error (Not Tp > Td+Tm (Tit+Tk)) (Burst) | ✓ | ✓ |
| 827 | Tp < Tds+Tw | Timer condition error (Not Tp > Tds+Tw) (Burst) | ✓ | ✓ |
| 828 | Tp < 0.5ms | Timer condition error (Not Tp > 500 μs)<br>(Other than Burst and measurement ON) | ✓ | ✓ |
| 829 | Tp < 0.125ms | Timer condition error (Tp > 125 μs)<br>(Other than Burst and measurement OFF) | ✓ | ✓ |
| 831 | Interlock | Disabled by interlock | ✓ | ✓ |
| 855 | CAL data | Calibration data error | ✓ | ✓ |
| -102 | Cmd Syntax | Command syntax error | ✓ | ✓ |
| -113 | Cmd Undefine | Command undefined | ✓ | ✓ |
| -200 | Cmd Exec | Execution error (Command currently not executable) | ✓ | ✓ |
| -222 | Out of Range | Input value out of setting range | ✓ | ✓ |
| 150 | USB error | USB communication error | ✓ | ✓ |
| 160 | TCP error | TCP communication error | ✓ | ✓ |
| 170 | RS-232 error | RS-232 communication error | ✓ | ✓ |

## A.3 Execution Time

### A.3.1 Remote Execution Time (Typical Value)

1. Measurement execution time

   Conditions Source range: fixed
   Measurement range: fixed, Trigger mode: external trigger,
   Number of measurement digits: $6^1/_2$ digits
   Integration time: 100 μs, Measurement delay: 0.3 ms, Source delay: 30 μs
   Period: 2 ms, Pulse width: 1 ms
   Header: OFF, Block delimiter: LF (DL1)

   - Time from measurement by trigger input (*TRG) to completion of data output

| Source value condition | USB | GPIB | LAN |
|---|---|---|---|
| DC or pulse source | 5 ms | 2 ms | 2 ms |
| When the sweep start value is output | 7 ms | 5 ms | 5 ms |
| When the sweep step value is output | 5 ms | 2 ms | 2 ms |

   - Time from measurement by source command reception and trigger input (*TRG) and to completion of data output
     In the DC or pulse source mode

| Source | Command | USB | GPIB | LAN |
|---|---|---|---|---|
| Voltage source | SOV<data> (<data>: 1 character) | 6 ms | 5 ms | 5 ms |
| Current source | SOI<data> (No unit, <data>: 3 characters) | 6 ms | 5 ms | 5 ms |

   - Time from measurement by spot command reception (measurement trigger execution after setting the source value for the setting source function) to completion of data output
     In the DC or pulse source mode

| Source | Command | USB | GPIB | LAN |
|---|---|---|---|---|
| Voltage source | G<data> (<data>: 1 character) | 6 ms | 5 ms | 5 ms |
| Current source | G<data> (No unit, <data>: 3 characters) | 6 ms | 5 ms | 5 ms |

2. Data read time

| Item | Number of data | USB | GPIB | LAN |
|---|---|---|---|---|
| Source value data read by query | 1 | 1 ms | 1 ms | 1 ms |
| Measurement buffer memory read after RDT? command (collective read out)<br>Condition:<br>Number of measurement digits: $6^1/_2$ digits,<br>Header: OFF, Block delimiter: LF (DL1) | 1 | 4 ms | 1 ms | 1 ms |
| | 100 | 15 ms | 11 ms | 11 ms |
| | 1000 | 99 ms | 99 ms | 102 ms |
| | 10000 | 923 ms | 985 ms | 1015 ms |

The execution time may be shortened by setting LCD OFF.

## A.3.2 Internal Processing Time (Typical Value)

1. Source processing time

   Time from external trigger signal input until the source value (pulse value or base value) starts to change.
   For the time from when the source value changes to when the source value settles, refer to Section 4.2.8.3, “Measurement Delay and Settling Time.”

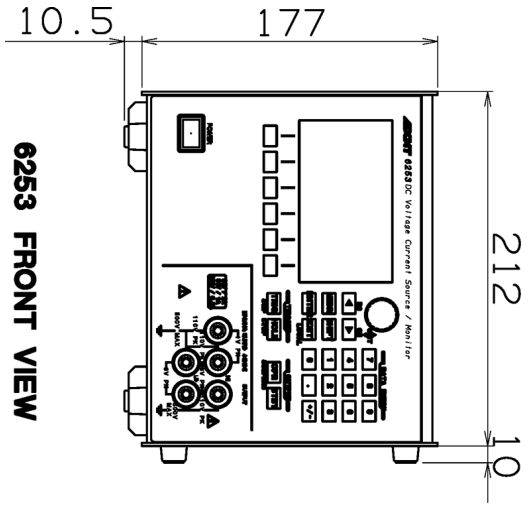
   Conditions Source range: fixed
   Measurement range: fixed, Trigger mode: HOLD or external trigger
   Source delay: 5 µs

| Source mode | Source value | Execution time |
|---|---|---|
| Pulse | Pulse value | 12 µs |
| DC sweep | Start value | 44 µs |
| | Step value | 12 µs |
| Pulse sweep * | Start (base) value | 44 µs |
| | Step value | 12 µs |

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

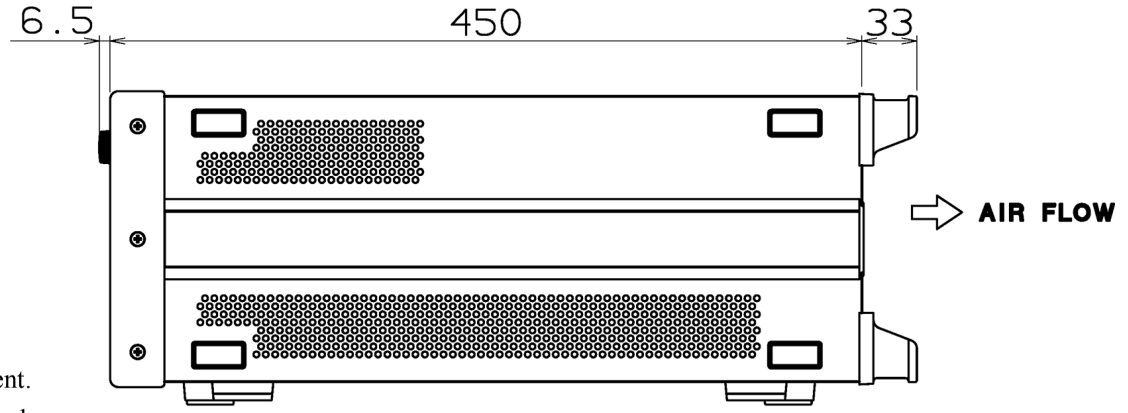
2. Switching time

   - Source function change time: 5 ms
   - Source range change time
     Voltage source function: 8 ms
     Current source function: 24 ms
   - Measurement range change time
     Voltage measurement function: 8 ms
     Current measurement function: 35 ms
   - Measurement auto range processing time
     Voltage measurement function: Integration time + 8 ms
     Current measurement function: Integration time + 35 ms




**6253 FRONT VIEW**


**6253 TOP VIEW**




**6253 RIGHT SIDE VIEW**

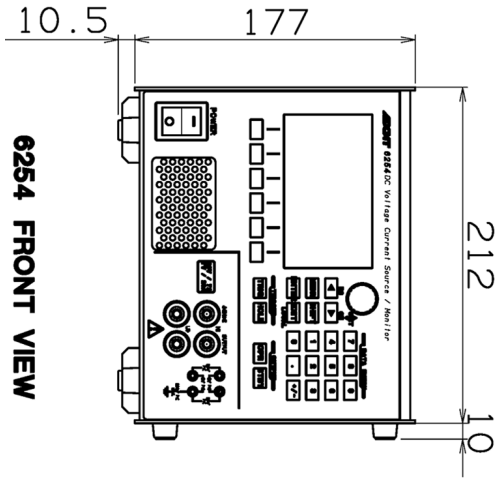
Unit : mm

NOTE

This drawing shows external dimensions of this instrument.

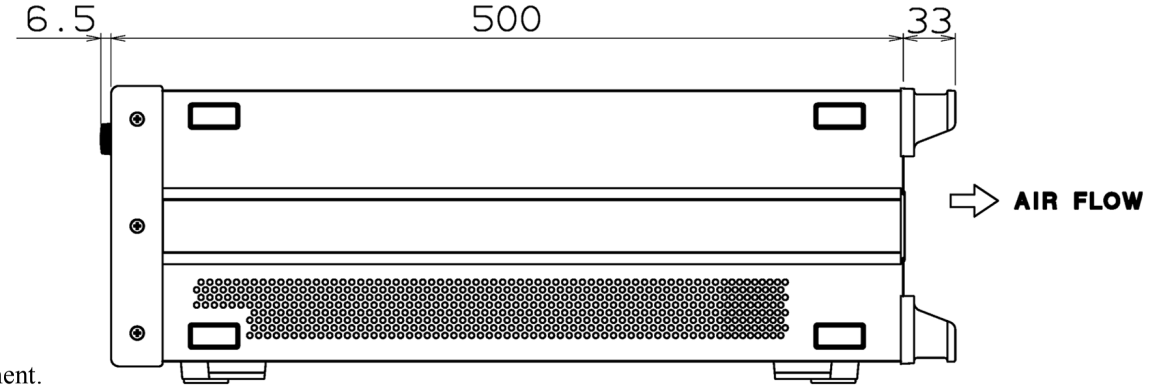
The difference in products and options used can cause a change in the appearance.

# DIMENSIONAL OUTLINE DRAWING




6254 FRONT VIEW


6254 TOP VIEW




6254 RIGHT SIDE VIEW

Unit : mm

NOTE

This drawing shows external dimensions of this instrument.

The difference in products and options used can cause a change in the appearance.

# DIMENSIONAL OUTLINE DRAWING

# ALPHABETICAL INDEX

## [K]



## [L]



## [M]



## [N]



## [O]



## [P]



## [R]



## [S]

## [T]



## [U]



## [V]



## [W]

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## LIMITED WARRANTY

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

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

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

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

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

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

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

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

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

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

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

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## CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL BUYER

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

## CUSTOMER SERVICE DESCRIPTION

Contact an ADC CORPORATION sales representative if a failure occurs.

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

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

1) When required parts cannot be procured.

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

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