ADVANTEST

R6451 Series

Digital Multimeter

Operation Manual

MANUAL NUMBER FOE-8311240B04

Applicable Models

R6451A
R6452A
R6452E

This product has been discontinued.
The Operation Manual is provided by ADC Corporation under the agreement with Advantest Corporation.

First printing August 6, 1993
Printed in Japan

MANUAL CHANGES

ADVANTEST Corporation

Date	Feb 17/2003	Manual Change No.	FEE-8440084A01
Manual Name	R6441 Series Digital Multimeter Operation Manual R6451 Series Digital Multimeter Operation Manual		

When you use a R15807A BATTERY UNIT(Ni-MH Battery), parts of the Operation Manual is changed as follows.
When using R15807, it is not necessary to change.

■ **All pages** **R15807 is changed into R15807A.**

■ **Page 1-3** **Change "Section 1.2" and "Section 1.3"**

1.2 User's Options

The following units can be mounted in the instrument by the user:

Unit	Model	Remarks
GPIB interface unit *	R13220	
BCD data output unit *	R13015	Has BCD output and parallel control.
Print interface unit *	R13221	Corresponds to Centronics.
Comparator unit *	R13016	Allows contact output of HI/LO/PASS for measurement data.
Memory card interface unit	R13222	Enables setting conditions and measurement data to be read/written.
Battery unit	R15807A	Enables continuous up to six hours of use with a storage battery.

Note: Only one of the units marked with an asterisk (*) can be mounted in the instrument.

1.3 Replacing Parts with Limited Life

The R6441/51 series uses the following parts with limited life that are not listed in Safety Summary.

Replace the parts listed below after their expected lifespan has expired.

Part name	Life
Storage battery	3 years or a repetition of recharge and electric discharge, 500 times. (See section 8.3.)
Relay	1,000,000 times

■ **Page 2-15 Change "Section 2.5"**

2.5 Precautions when Instrument is Discarded

(1) Never disassemble the instrument.
The instrument uses a lithium battery as a RAM backup power supply. Also, it uses a storage battery in the battery unit.

(2) Contact ADVANTEST when discarding the instrument.
(Refer to the end of this manual for our address and other information.)

■ **Page 8-1 Change "Chapter 8", "Section 8.1" and "Section 8.2"**

8. R15807A BATTERY UNIT (Ni-MH Battery)

8.1 Outline

The R15807A (Ni-MH Battery) is the battery unit which can be re-charged and is applied for the R6441/51 series.

8.2 Specifications

Built-in battery	:	12 V Nickel-Metal hydride battery
Continuous use time	:	Approx. 6 hours
Charging time	:	Approximately 12 hours when AC power is supplied with the R6441/51/52 set to OFF. The charging can be made while the R6441/51/52 is set ON. However, since the charging supplements only the discharged amount, the charging time cannot be prescribed.
Low battery display	:	When the remaining time for usage decreases to approx. 20 minutes, it is indicated on the indicator of the front panel.
External dimensions	:	203 (W) × 29 (H) × 140 (D) mm
Weight	:	1 kg or less

■ **Page 8-2 Change "Section 8.3"**

8.3 Precautions

(1) Precautions for use

① Plug the R15807A battery unit into the R6441/51/52 prior to charging.

② Do not give extreme shock to the built-in battery.

③ Do not disassemble the battery. There is a risk of explosion or fire if a non-ADVANTEST battery is used.

(2) Cautions for discarding

① Never disassemble the battery unit. It uses the Nickel-Metal Hydride battery. If it is broken and alkali liquid adhere to clothes or skin, wash out it immediately. If the acid enter an eye, wash out it with clean water and receive medical treatment.

② Keep the battery away from fire or fireworks.

③ Do not put the battery in the fire. It may cause explosion.

④ Do not incinerate. Recycle by using standard industrial battery recyclers. For assistans with disposal, contact your nearest ADVANTEST office.

(3) Note for the purpose of this manual, the battery life is considered to have expired when the actual capacity is 60 % or less of the rated capacity.

① Before the R15807A is used for the first time after its purchase or when it has not been used for long period of time, recharge it for approx. 12 hours.

② The built-in battery can be recharged 500 times until their capacity falls to 60 % of the rated 1.8Ah at operating temperatures of +25 °C ± 5 °C.

③ Recharge the R15807A at 0 °C to +35 °C and discharge it at 0 °C to +40 °C.

④ When you store over a long period of time, please limit R15807A to the following preservation period by the preservation temperature range and preservation humidity range.

-20 °C through 30 °C	less than 1 year
-20 °C through 40 °C	less than 3 months
-20 °C through 50 °C	less than 1 month
Preservation humidity range	65 % ± 20 %

When you store exceeding the preservation period of a limit, please recharge within each preservation period.

⑤ Estimated three year life expectancy
The battery life may be affected substantially by operating conditions such as overcharging or discharging, atmospheric temperature and the amount of time between recharges.

■ **Page 13-32 Change "Ambient conditions" of "Section 8.3"**

13.5 General Specifications

Ambient conditions : Temperature 0 °C to 50 °C (0 °C to 35 °C when the battery is recharged, 0 °C to 40 °C when the battery is used.)
Humidity 85 % RH or less (75 % or less for 20 MΩ or 200 MΩ of resistance measurement) (However, no do be dewy.)

■ **Page 13-34 Change "(6) R15807 battery unit" of "Section 13.6"**

(6) R15807A battery unit

Built-in battery	:	12 V Nickel-Metal hydride battery
Battery capacity	:	1.8 Ah
Charging method	:	When the R6441/51/52 is connected to AC power with the R6441/51/52 powered off, the time taken to fill up it is approx. 12 hours.
Low battery display	:	When remaining time reaches approx. 20 minutes, low battery indicator is lit up on the front panel. It does not affect R6441/51 series.

Safety Summary

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

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

- **Warning Labels**

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

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

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

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

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

- **Basic Precautions**

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

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

product.

- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

- **Caution Symbols Used Within this Manual**

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

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

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

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

- **Safety Marks on the Product**

The following safety marks can be found on ADC products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

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

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

Main Parts with Limited Life

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

- **Hard Disk Mounted Products**

The operational warnings are listed below.

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

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

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

- **Precautions when Disposing of this Instrument**

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

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

Example: fluorescent tubes, batteries

Environmental Conditions

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

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

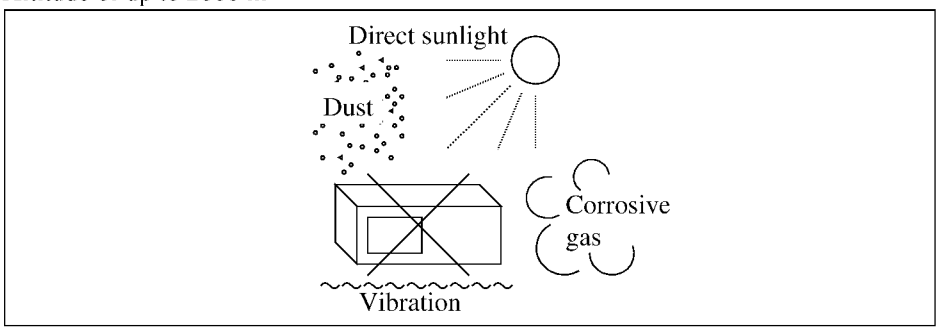


Figure-1 Environmental Conditions

- Operating position

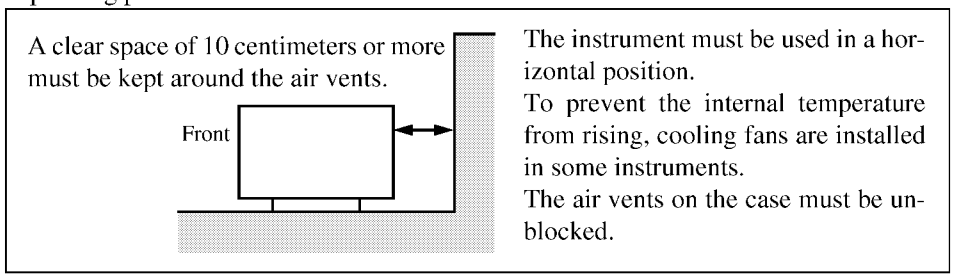


Figure-2 Operating Position

- Storage position

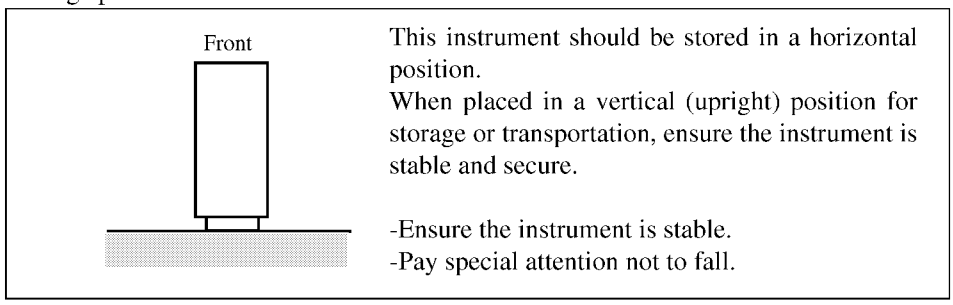


Figure-3 Storage Position

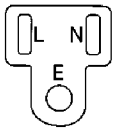
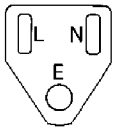
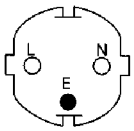
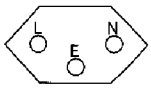
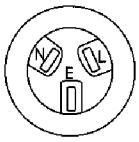
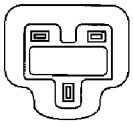
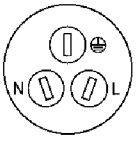
- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

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

PREFACE

Safe Use of R6451 Series

1. This manual contains some information and warning which have to be followed by the user to ensure safe operation and to retain the instrument in safe condition.
   Before getting started, be sure to read this manual.

2. To ensure safe use of this instrument, be sure to use it within the maximum allowable input voltage and current to be applied between input terminals.

3. The electric symbols used for this instrument are as follows:

Symbol	Description	Remarks
	High voltage indication	Indicates that connection/disconnection to/from the indicated terminal is dangerous.
	Refer to instruction manual.	To avoid injury to users or damage to the instrument, warns users to refer to the instruction manual.
	Alternating current (AC)	
	Direct current (DC)	
	Earth	Indicates the field wiring terminal requiring grounding before use of this instrument to prevent electric shock.
	Fuse	
	Diode check function	
	Continuity check function	
	Battery	

How to Use This Manual

Chapter	Contents
1. GENERAL INFORMATION	Provides an outline and introduces features of this instrument and user's options.
2. BEFORE USING THE INSTRUMENT	Shows how to check accessories, environment for use, confirmation and change of power supply, power supply cables, fuses, input cables, and the maximum input voltage and current conditions for measurement terminals. Also, explains precautions for cleaning, transport, and storage.
3. PANEL DESCRIPTIONS	Describes keys, switches, and terminals on both front and rear panels.
4. OPERATIONS	Describes self test, error messages, basic key operations, and initialization of measurement conditions.
5. FUNCTIONS	Describes various functions.
6. MEASUREMENT	Describes various methods of measurement, measurement explanations, and precautions.
7. HOW TO USE VARIOUS INTERFACES	Describes how to use the RS-232, BCD date output, comparators, GPIB, printer, memory cards.
8. R15807 BATTERY UNIT	Explains the R15807 battery unit.
9. Q & A FOR PROBLEM SOLVING	Refer to this chapter if a problem occurs in the instrument.
10. ERROR MESSAGES	Lists error messages used in the instrument.
11. CALIBRATION	Describes how to calibrate the instrument.
12. MEASUREMENT SPEED	Describes measurement operations and provides examples of calculations for the instrument.
13. PERFORMANCE SPECIFICATIONS	Shows the specifications of the instrument.

The following precautionary labels are used in this manual:

Note : Notes
┌ CAUTION ┐ : Denotes restrictions.

┌ WARNING ┐ : Warns of potential damage to the instrument.

┌ DANGER ┐ : Warns of potential danger of bodily injury.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1. GENERAL INFORMATION

1.1 General Description of Products

The R6451A, R6452A, and R6452E are 199999 display-type digital multimeters which use an integration-type A/D converter.

Features:

- The R6452A and R6452E have a 2-channel direct-current voltage measurement terminal which enables dual display.
- The maximum sampling rate of these instruments is 80 times/s.
- The instruments can be connected to external units via interfaces to enable system configuration.
- The instruments are equipped with arithmetic functions such as a null function, scaling function, comparator function, smoothing function, dB/dBm calculation, and MAX/MIN display.
- With an IC memory card (option) installed, the instruments can store/read setting conditions and measurement data.
- The instruments can be equipped with an internal battery unit (option) .
- The display of the instruments consists of fluorescent display tubes, making it bright and easy to read.

Measurement functions:

Measurement functions depends on the model type.

Measurement function	R6451A	R6452A	R6452E
(1) Direct-current voltage measurement	○	○	○
(2) Alternating-current voltage (AC coupling mode) measurement	○	○	–
(3) Resistance measurement	○	○	○
(4) Direct current measurement	○	○	–
(5) Alternating current (AC coupling mode) measurement	○	○	–
(6) Alternating-current voltage (AC + DC coupling mode) measurement	○	○	–
(7) Alternating current (AC + DC coupling mode) measurement	○	○	–
(8) Bch direct-current voltage measurement	–	○	○
(9) Diode measurement	○	○	○
(10) Continuity measurement	○	○	○
(11) 4-20 mA measurement	○	–	–
(12) Temperature measurement	–	○	○
(13) Frequency measurement	–	○	–

1.2 User's Options

The following units can be mounted in the instrument by the user:

Unit	Model	Remarks
GPIB interface unit*	R13220	
BCD data output unit*	R13015	Has BCD output and parallel control.
Print interface unit*	R13221	Corresponds to Centronics.
Comparator unit*	R13016	Allows contact output of HI/LO/PASS for measurement data.
Memory card interface unit	R13222	Enables setting conditions and measurement data to be read/written.
Battery unit	R15807	Enables continuous up to six hours of use with a lead-acid battery.

Note : Only one of the units marked with an asterisk (*) can be mounted in the instrument.

1.3 Replacing Parts with Limited Life

The R6451 series uses the following parts with limited life that are not listed in Safety Summary. Replace the parts listed below after their expected lifespan has expired.

Part name	Life
Lead-acid battery	3 years (See section 8.3.)
Relay	1,000,000 times

2. BEFORE USING THE INSTRUMENT

2.1 External Appearance and Accessory Check

On receiving the instrument, check it for any shipping damages. Next, check that the model name and the quantity of standard accessories are as shown in Table 2-1.

If any crack or damage is found or if any of the standard accessories is missing, contact ATCE, your nearest dealer, or sales and support office.
A list of address and telephone numbers is given at the end of this manual.

Note: When ordering additional accessories, use the model name (or stock number).

Table 2-1 Standard Accessory List

Item	Model name	Stock No.	Quantity	Remarks
Power cable (See Table 2-4)	A01402	DCB-DD2428X01	1	Power cable 3-pin plug
		JCD-AL003EX03	1	AC adapter
Input cable	A01034	AAA-A01034	1	Input cable
Power fuse	218.160	DFT-AAR16A	2 *2	For 100/120 V (slow)
	218.080	DFT-AAR08A		For 220/240 V (slow)
Protection fuse	BLN15	DFS-AM15A	0 *3	For A terminal (fast 250 V)
	216.500	DFS-ANR5A	1	For mA terminal (fast 250 V)
Instruction manual	—	JR6451	1 *1	Japanese manual
	—	ER6451		English manual

Note: *1; One of the two Instruction manual marked with "*1" is fitted in the country.

*2: One of the two fuses marked with an asterisk is fitted in the fuse holder of the power connector.

*3: Don't Standard accessory (optional). Please order when change fuse.

Table 2-2 Accessory List

Accessory	Optional	Quantity
BCD data output unit R13015	Interface cable to R6451 DCB-SS5402X01	1
Comparator unit R13016		
GPIB interface unit R13220	Cable clamp (Connecting clamp) YEE-00623	1
Printer interface unit R13221		
Memory card interface unit R13222	Connector mounting screw M3×6mm	1
Battery unit R15807	Connector mounting screw M3×6mm	2

2.2 Ambient Conditions

(1) Location

① Do not use the instrument in these places:

- Dusty places or those where there is much vibration
- Places exposed to direct sunlight
- Poorly ventilated places
- Places subjected to corrosive or inflammable gases, or steam

② Use the instrument under the following conditions:

- Ambient temperature : 0°C to 50°C
- Humidity : Less than 85% (However, no do be dewy.)

This instrument is designed for indoor use.
It may occasionally be subjected to temperatures between 0°C and -10°C without degradation of its safety.

(2) Noise reduction

Although the instrument is designed to take account of AC power supply line noise, it should be used under conditions where as little noise as possible will be generated.
If noise cannot be avoided, use noise filters.

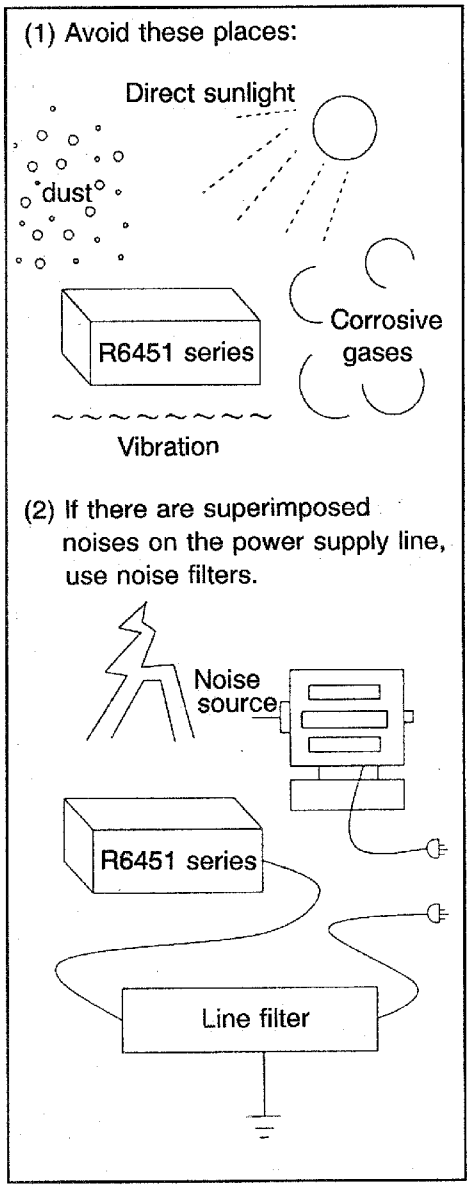


Figure 2-1 Ambient Conditions

2.3 Before Getting Started

2.3.1 Confirmation and Setting of Power Supply Voltage

(1) Confirmation of power supply voltage

Before switching on the instrument, make sure that it is set to the voltage of the power supply.

Table 2-3 Commercial Power Supply Voltage and Corresponding Power Supply Voltage Settings Display

Commercial power supply voltage	Indication of setting power supply voltage for this instrument	Corresponding fuse	
		Type name	Stock No.
100 V	100 V	218.160	DFT-AAR16A
120 V	120 V		
220 V	220 V	218.080	DFT-AAR08A
240 V	240 V		

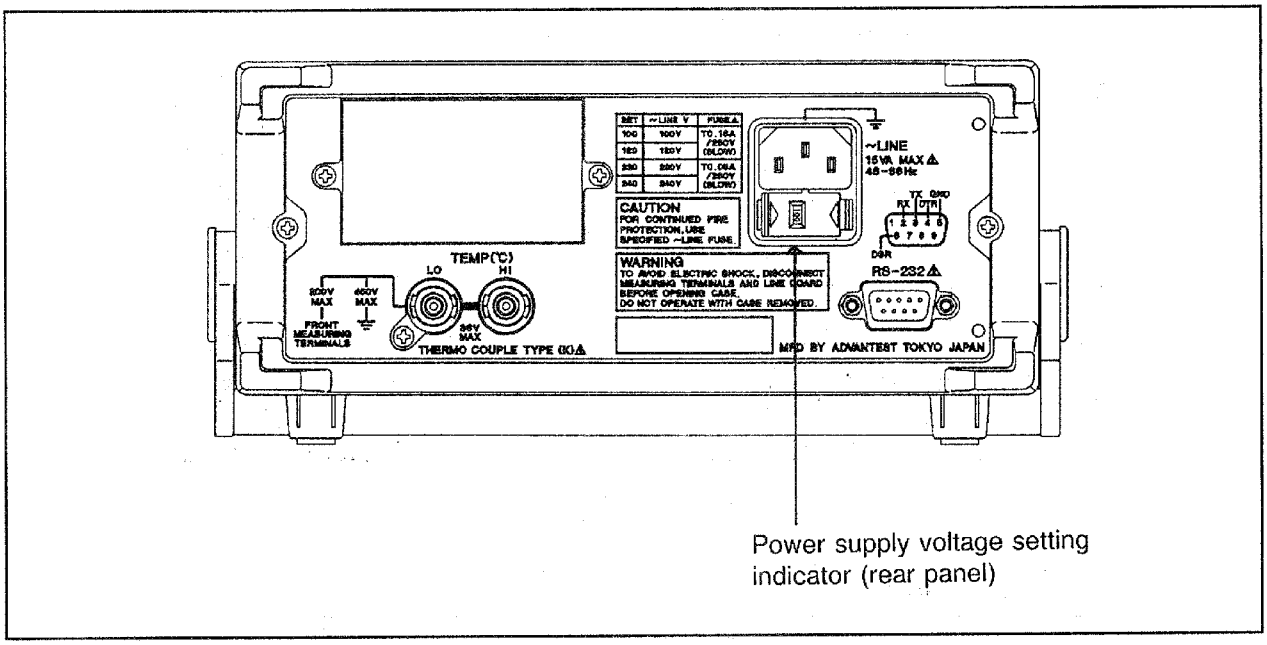


Figure 2-2 Power Supply Voltage Setting Indicator

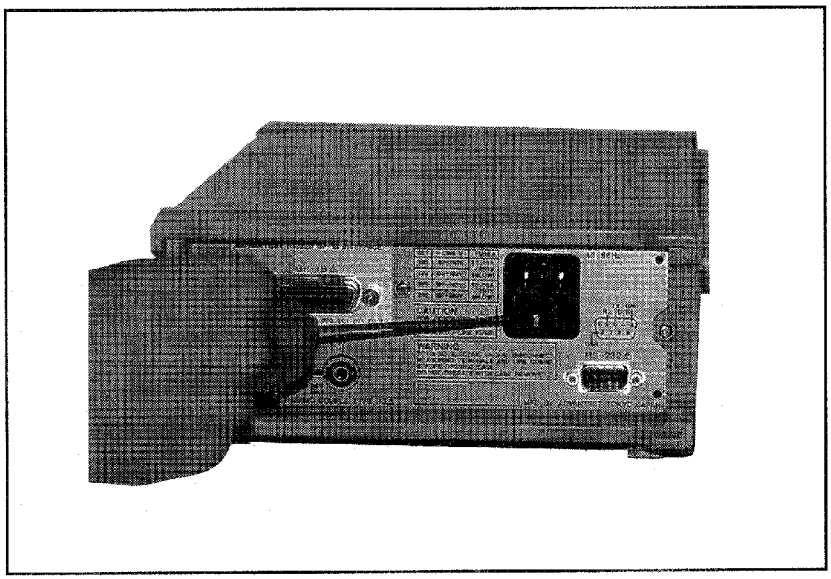
(2) Changing power supply voltage

If the setting of the power supply voltage for the instrument is different from the commercial power supply voltage, change the setting of the instrument as follows:

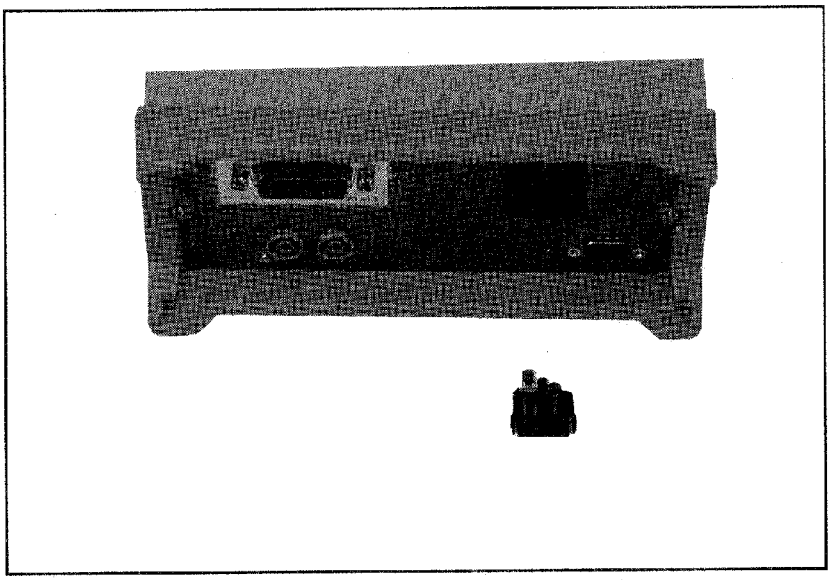
Procedure

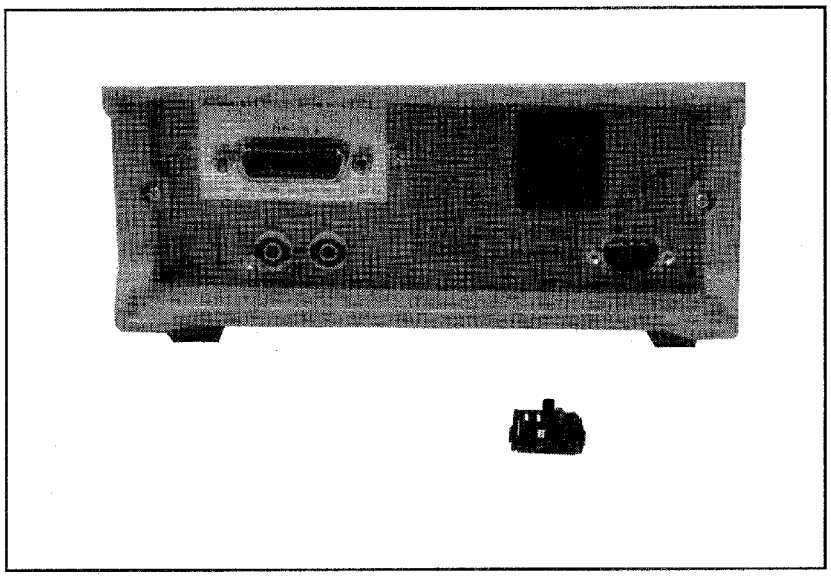
① Remove the holder case.

- To unlatch the side lock, push both sides inwards with a screwdriver.



② Remove the fuse holder and holder case.





③ Voltage display of the fuse holder

Adjustment the voltage displayed on the fuse holder in the holder case window so that it matches that of the commercial power supply to be used.
Table 2-3 shows the display and voltage range available.

④ Changing the fuse

Insert a fuse of the correct rating and replace the fuse holder and holder case.

2.3.2 Power Supply Cables

CAUTION

1. Operating the instrument using a commercial power supply
   (1) Be sure to use the power supply cable supplied. Available voltages are 90 V to 110 V, 48 Hz to 66 Hz. (Depending on specifications, 103 V to 132 V, 198 V to 242 V, or 207 V to 250 V is possible.)
   (2) Before any other connection is made the protective earth terminal shall be connected to a protective conductor.

2. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact.

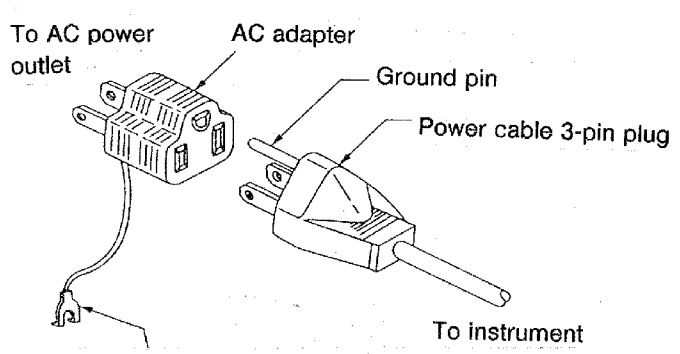
3. The protective action must not be negated by the use of an extension cord without a protective conductor.

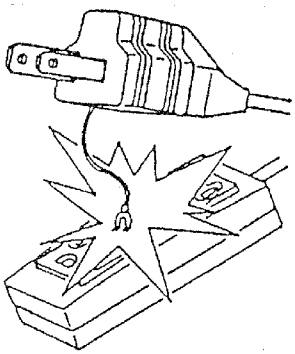
4. Before connecting the power supply cable, make sure that POWER switch is set to OFF.

5. When installing any accessory unit, be sure to turn OFF the POWER switch then disconnect the power and input cables.

- Power Plug Cables (used in Japan only)

Power plug cables (standard) conforms to industry standards.
A three-pin power connector is insufficient for Japan, so a 3-pin-to-2-pin adapter is provided. Is is extremely important when using this adapter for connection to a power outlet to ground the ground pin extending from the adapter, or the grounding terminal on R6451/52's rear panel.
The adapter's pins have different widths. When inserting the adapter in the receptacle, be sure to orient it properly.
If the adapter (standard) will not into the receptacle, use the optional adapter KPR-13.





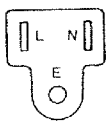
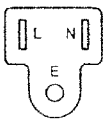
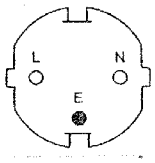
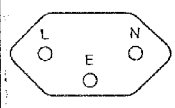
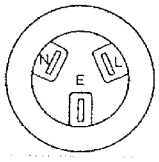
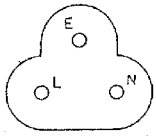
Take care that the adapter grounding lead wire is not in contact with the hot line.

Figure 2-3 Power Cable

- Power Plugs for use outside Japan

The following types of plugs are available. Consult us if other types of plugs are required.

Table 2-4 Power Plugs for Use Outside Japan

Straight type	A01402 (Standard)	A01403 (Opt.95)	A01404 (Opt.96)	A01405 (Opt.97)	A01406 (Opt.98)	A01408
Angle type	A01412	A01413	A01414	A01415	-	-
Applicable Standards	JIS: Japan Law on Electrical Appliances	UL: US CSA: Canada	*	SEV: Switzerland	SAA: Australia New Zealand	
Rating and Color	125 V/7 A, black, 2m	125 V/7 A, black, 2m	250 V/6A, grey, 2m	250 V/6A, grey, 2m	250 V/6A, grey, 2m	250 / 6A
Plug						

CCE: Europe; VED: W. Germany; OVE: Australia; SEMKO: Sweden; DEMKO: Denmark; KEMA: Holland; FIMKO: Finland; NEMKO: Norway; CEBEC: Belgium

2.3.3 Fuses

There are two types of fuse on this instrument: a power fuse and a protection fuse. Replace them using the following procedure:

CAUTION

1. Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.

2. Visual inspection is insufficient for checking fuse disconnection. Measure the resistance value to determine whether the connection is good or not. (Normal values are below 15 Ω.)

3. Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

(1) Replacing the power fuse

Procedure:

① Turn off the POWER switch.

② Remove the power cable.

③ Perform the operation in step (2) of subsection 2.3.1.

(2) Replacing the protection fuse

To protect internal circuits if an overcurrent is applied to the current input terminal, this instrument is equipped with two current-disconnect-type fuses for mA and 10 A input terminals.

Procedure:

(a) mA input terminal protection fuse

The protection fuse for the mA input terminal is mounted on the input terminal of the front panel.

① Rotate the input terminal while pushing in it, then pull it out.

② Replace the fuse with another of the correct rating as shown in Table 2-1 then reinsert the terminal.

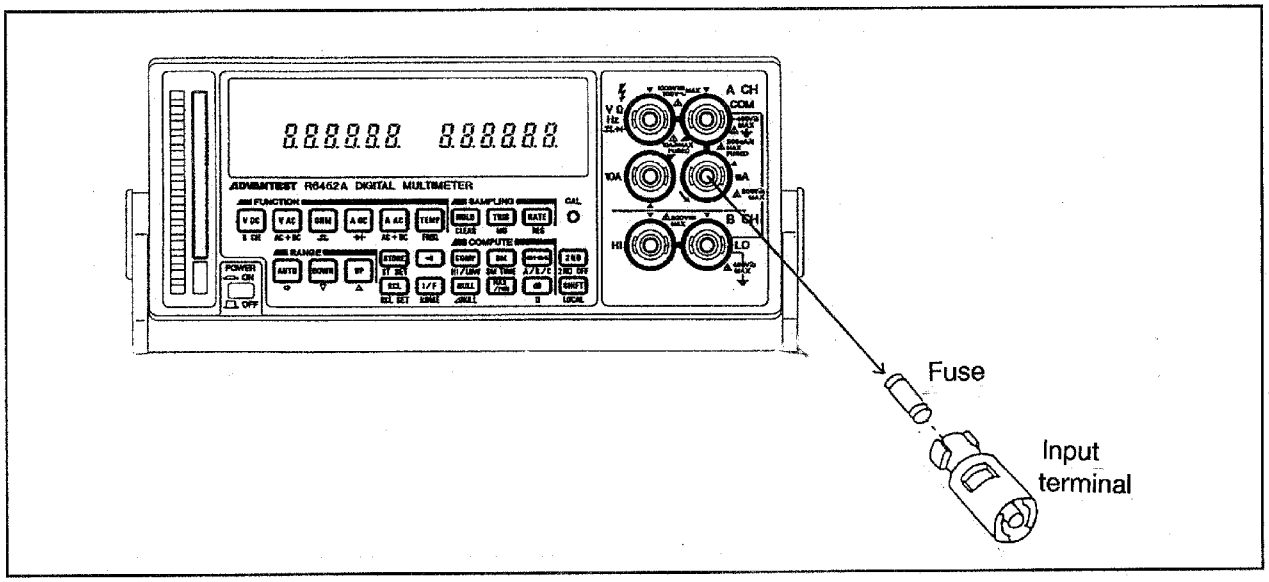


Figure 2-4 mA Input Terminal Protection Fuse

(b) 10 A input terminal protection fuse

Since the protection fuse for the 10 A input terminal is mounted in the instrument near the front panel, the instrument cover should be removed before replacement.

① Remove the instrument cover, referring to ① to ③ of subsection 7.1.1.

② Replace the fuse with another of the correct rating as shown in Table 2-1 then replace the case.

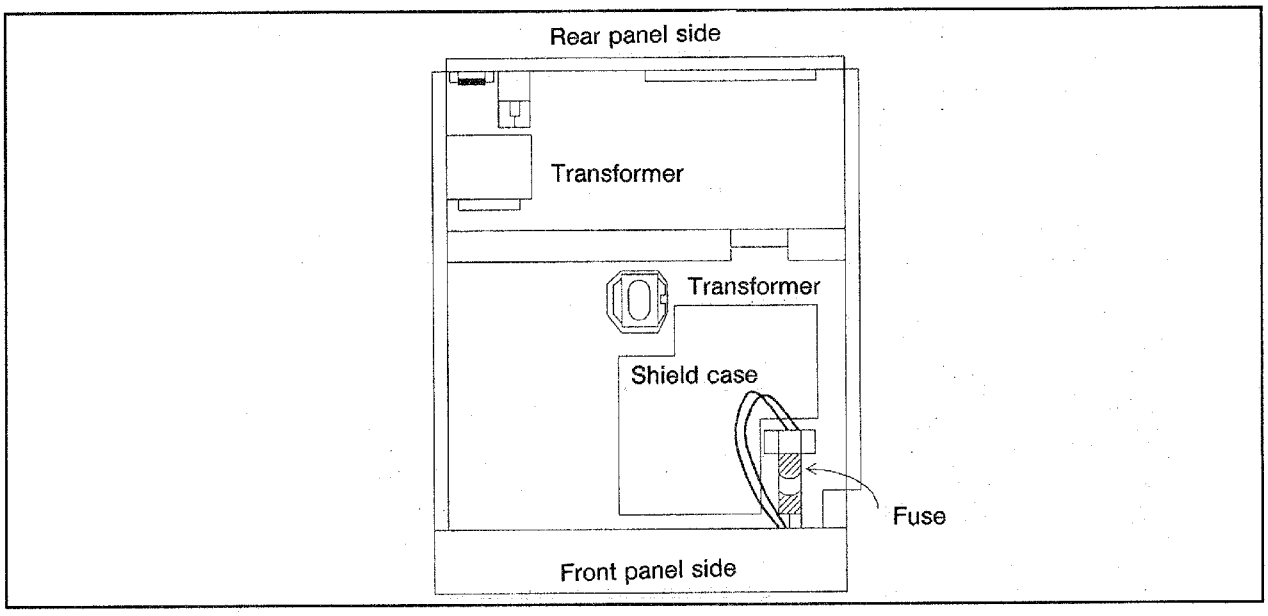


Figure 2-5 10 A Input Terminal Protection Fuse

CAUTION

Use the correct fuse to ensure that the current is disconnected if a voltage of 250 V is inadvertently applied to the current input terminal.
Replace with a fuse of the correct rating.

2.3.4 Warming Up

Warm up the instrument for at least sixty minutes to achieve sufficient measurement accuracy.

2.3.5 Input Cables

Use the A01034 suppled as the input cable of the instrument.
If a problem of short-term stability occurs during measurement of high resistance (megohm) or high sensitivity (microvolt), use the A01001, whose HI side has a shielding line.

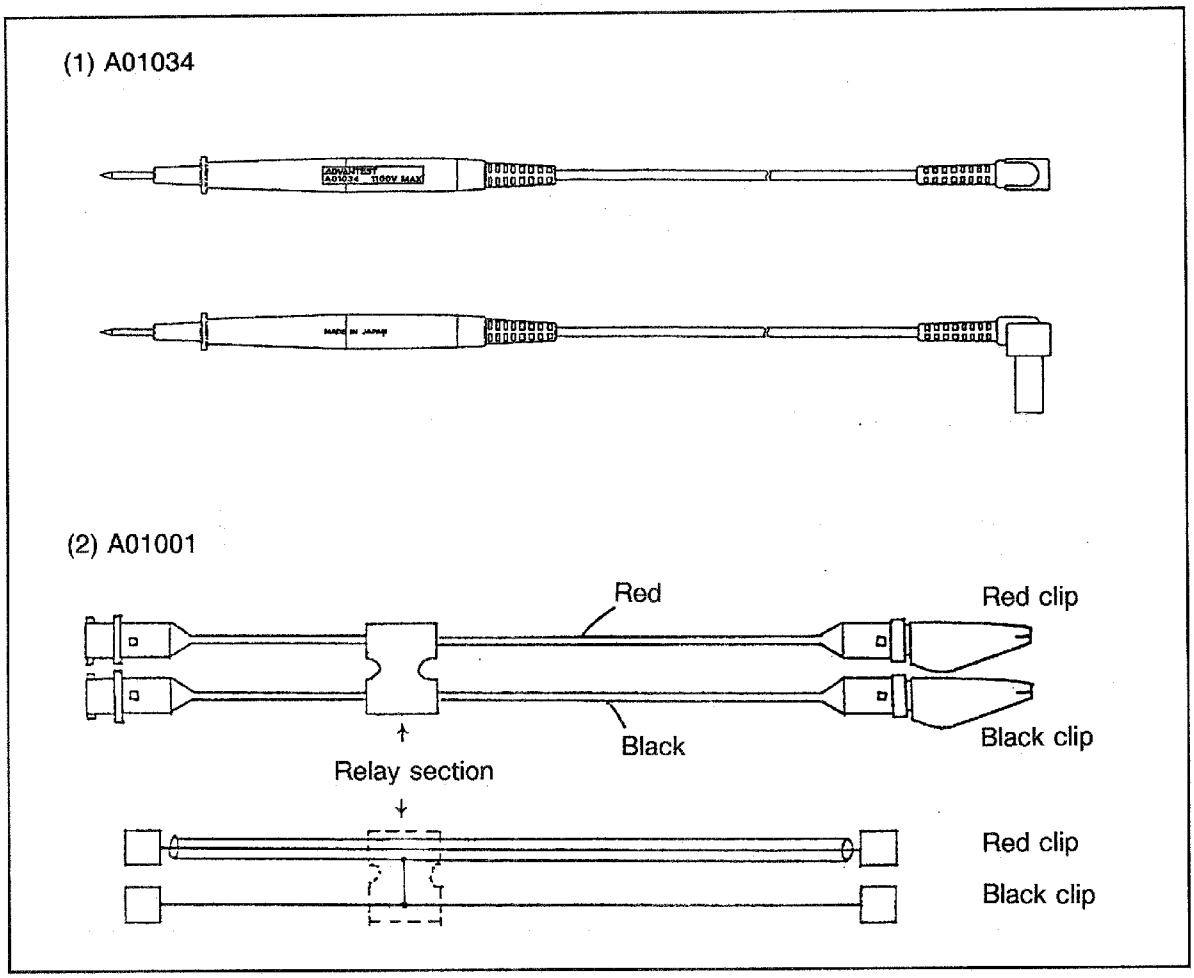


Figure 2-6 Structure of Input Cable

CAUTION

The red line of the A01001 is a shielding line. Take care not cut it inadvertently.

2.3.6 Conditions of Maximum Input Voltage and Current for Measurement Terminals

Table 2-5 shows the maximum values of input terminal between ① and ② voltage and current for safe operation of the instrument.

Table 2-5 Maximum Voltage and Current Applied

Terminal name		Maximum voltage and current
①	②	
Body	COM V Ω Hz Hi Lo mA A +Temp −Temp	450VMAX
COM mA A V Ω Hz	Hi Lo +Temp −Temp	200VMAX
COM	V Ω Hz	1000VMAX
COM	mA	330mA 250VMAX
COM	A	10A 250VMAX
Hi Lo	+Temp −Temp	36VMAX
Hi	Lo	200VMAX
+Temp	−Temp	36VMAX

WARNING

1. Do not apply voltage or use a current exceeding the maximum value.
   This may cause breakage or malfunction of the instrument, or electric shock.

2. A maximum value of circuit voltage for measuring current
   The current cannot measure for the potential of 250 V or more. In this case, the current may cause blown fuses, equipment breakage, or incidental injuries.

2.4 Cleaning, Storage, and Transportation

(1) Cleaning

Use a silicon cloth or other cloth to clean the instrument.

Note: For maintenance or cleaning, do not use a solvent that will deteriorate plastics (such as benzene, acetone, or other organic solvents).

(2) Transportation

Use the original packing material for transportation. If it is not available, pack the instrument as follows:

① Pack the instrument in a vinyl sheet.

② Use a corrugated cardboard box at least 5 mm thick and insert the instrument into the box using a packing material for cushioning.

③ After packing the instrument, insert the accessories, then insert more cushioning material again. Then seal the box and secure it using packing strings.

(3) Storage

If the instrument is not to be used for a long time, cover it with a vinyl sheet or place it in a corrugated cardboard box and store it in a place with no humidity and away from direct sunlight.

Storage conditions: −25°C to +70°C
−20°C to +50°C (with battery unit mounted)

2.5 Precautions when Instrument is Discarded

(1) Never disassemble the instrument.

The instrument uses a lithium battery as a RAM backup power supply. Also, it uses a lead-acid battery in the battery unit.

(2) Contact ADVANTEST when discarding the instrument.

(Refer to the end of this manual for our address and other information.)

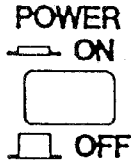
3. PANEL DESCRIPTIONS

3.1 Front Panel

The front panel of the instrument consists of operation keys, displays, input terminals, IC memory cards, and connectors.
Note that the operation keys, displays, and input terminals differ among the R6451A, R6452A, and R6452E.

R6451A : Read the description below while referring to Figure 3-1.
R6452A : Read the description below while referring to Figure 3-2.
R6452E : Read the description below while referring to Figure 3-3.

① Power switch



Pressing the switch turns on the power to the instrument.

Pressing the switch again turns off the power to the instrument.

② Measurement function selection keys

(a) R6451A

V DC	:	Selects direct-current voltage measurement.
V AC	:	Selects alternating-current voltage measurement (AC coupling mode).
OHM	:	Selects resistance measurement (two-line type).
A DC	:	Selects direct current measurement.
A AC	:	Selects alternating-current current measurement (AC coupling mode).
⊣◁	:	Selects diode measurement.

- Press these keys after the [SHIFT].

[SHIFT] [V AC] (AC + DC) : Selects alternating-current voltage measurement (AC + DC coupling mode).

[SHIFT] [OHM] (⦿) : Selects continuity measurement. (If continuity is detected, a buzzer will sound.)

[SHIFT] [A DC] (4-20mA) : Selects 4-20 mA measurement.

[SHIFT] [A AC] (AC + DC) : Selects alternating-current current measurement (AC + DC coupling mode).

(b) R6452A

[V DC] : Selects direct-current voltage measurement.

[V AC] : Selects alternating-current voltage measurement (AC coupling mode).

[OHM] : Selects resistance measurement (two-line type).

[A DC] : Selects direct current measurement.

[A AC] : Selects alternating current measurement (AC coupling mode).

[TEMP] : Selects temperature measurement (thermocouple).

- Press these keys after the [SHIFT].

[SHIFT] [V DC] (B CH) : Selects Bch direct-current voltage measurement.

[SHIFT] [V AC] (AC + DC) : Selects alternating-current voltage measurement (AC + DC coupling mode).

[SHIFT] [OHM] (⦚) : Selects continuity measurement. (If continuity is detected, a buzzer will sound.)

[SHIFT] [A DC] (⊣) : Selects diode measurement.

[SHIFT] [A AC] (AC + DC) : Selects alternating current measurement (AC + DC coupling mode).

[SHIFT] [TEMP] (FREQ) : Selects frequency measurement.

(c) R6452E

[A CH] : Selects direct-current voltage measurement.

[B CH] : Selects Bch direct-current voltage measurement.

[OHM] : Selects resistance measurement (two-line type).

[⦚] : Selects continuity measurement. (If continuity is detected, a buzzer will sound.)

[⊣] : Selects diode measurement.

[TEMP] : Selects temperature measurement (thermocouple).

③ Measurement range selection keys

AUTO : Switches the measurement range to AUTO or MANUAL.

DOWN : Switches the measurement range to MANUAL and decreases it by one level.

UP : Switches the measurement range to MANUAL and increases it by one level.

- Press these keys when in the parameter setting mode (for parameter editing).

AUTO ⇨ : Moves the blinking position to the right.

DOWN ▽
UP △ : Changes the contents of the blinking line.

④ Sample mode and sample rate selection keys

HOLD : Sets the sampling mode to FREE-RUN or HOLD.

TRIG : Orders measurement start when the sampling mode is in HOLD.

RATE : Sets the sampling mode to high speed (FAST), middle speed (MID), or low speed (SLOW).

- Press these keys after the [SHIFT] . (Enters to parameter setting mode.)

[SHIFT] [HOLD] (CLEAR) : Sets the parameter initialization setting mode.

[SHIFT] [RATE] (RES) : Sets the mode in which the number of digits displayed is determined.

- Press this key in the parameter setting mode (constant setting).

[TRIG] (MD) : Calls the display output result.

⑤ Operation selection keys

[COMP] : Selects setting or canceling of the comparator calculation.

[SM] : Selects setting or canceling of the smoothing calculation.

[C(M-B)/A] : Selects setting or canceling of the scaling calculation.

[NULL] : Selects setting or canceling of the null calculation.

[MAX /MIN] : Selects setting or canceling of the MAX and MIN calculation.

[dB] : Selects setting or canceling of the dB and dBm calculation.

- Press these keys after the [SHIFT] . (Enters to parameter setting mode.)

[SHIFT] [COMP] (HI/LOW) : Sets the setting mode for comparison upper limit (HI) or lower limit (LOW) in the comparator calculation, or for comparison result buzzer sounding.

[SHIFT] [SM] (SM TIME) : Sets the setting mode in which the number of times for running average of smoothing calculation is performed is determined.

[SHIFT] [C(M-B)/A] (A/B/C) : Sets the setting mode constant A, B, or C for scaling calculation.

SHIFT + NULL (ΔNULL) : Sets the null value setting mode for null calculation.

SHIFT + dB (D) : Sets the setting mode for constant D of dB or dBm calculation.

⑥ Store/recall selection keys

If the IC memory card is inserted when the memory card interface unit R13222 (option) is installed, measurement conditions and measurement data can be stored (write) or recalled (read) to or from the card.

STORE : Stores (writes) data into the IC memory card.

RCL : Recalls (reads) data from the IC memory card.

- Press these keys after the SHIFT.

SHIFT + STORE (ST SET) : Sets the store condition setting mode.

SHIFT + RCL (RCL SET) : Sets the recall condition setting mode.

- Press these keys in the calibration (CAL) mode.

STORE : Writes calibration values.

RCL : Reads calibration values.

⑦ Buzzer selection keys

(a) R6451A

[·))] : Turns ON the buzzer. Pressing the key again turns OFF the buzzer. (If the buzzer is set to ON, it sounds when a key is pressed, when a setting is made remotely, or when the comparison result of a comparator calculation is generated.)

- Press this key after the [SHIFT].

[SHIFT] [·))] (BAR) : Turns ON the bar graph. Pressing it again turns OFF the bar graph.

(b) R6452A and R6452E

[·))] : Turns ON the buzzer. Pressing the key again turns OFF the buzzer. (If the buzzer is set to ON, it sounds when a key is pressed, when a setting is made remotely, or when the comparison result of a comparator calculation is generated.)

⑧ Interface selection keys

[I/F] : Sets the interface setting mode.

Available interface types are as follows:

- Serial interface (standard equipment)
- BCD data output unit (option R13015)
- Comparator unit (option R13016)
- GPIB interface unit (option R13220)
- Printer interface unit (option R13221)
- Memory card interface unit (option R13222)

- Press this key in the setting mode.

[I/F] (HOME) : The instrument exits the setting mode and returns to the measurement state display.

⑨ Calibration selection key

CAL
◎ : Sets the calibration (CAL) mode. Pressing the key again returns the mode to the normal measurement state.

⑩ ENTER key

(a) R6451A

- Press this key in the setting mode.

ENTER : Fixes the setting.

(b) R6452A and R6452E

2ND : Sets the setting mode for the second display.

- Press this key after the SHIFT .

SHIFT 2ND : Cancels the second display.
2ND OFF

⑪ SHIFT/LOCAL keys

(a) R6451A

SHIFT : Sets the shift mode.

- Press this key in the remote operation.

SHIFT : The instrument enters local operation.
LOCAL

Note: If the LLO (LOCAL LOCKOUT) command is set through the GPIB interface, the key entry will be ignored.

(b) R6452A and R6452E

SHIFT : Sets the shift mode.

- Press this key in the remote operation.

  SHIFT (LOCAL) : The instrument enters the local operation.

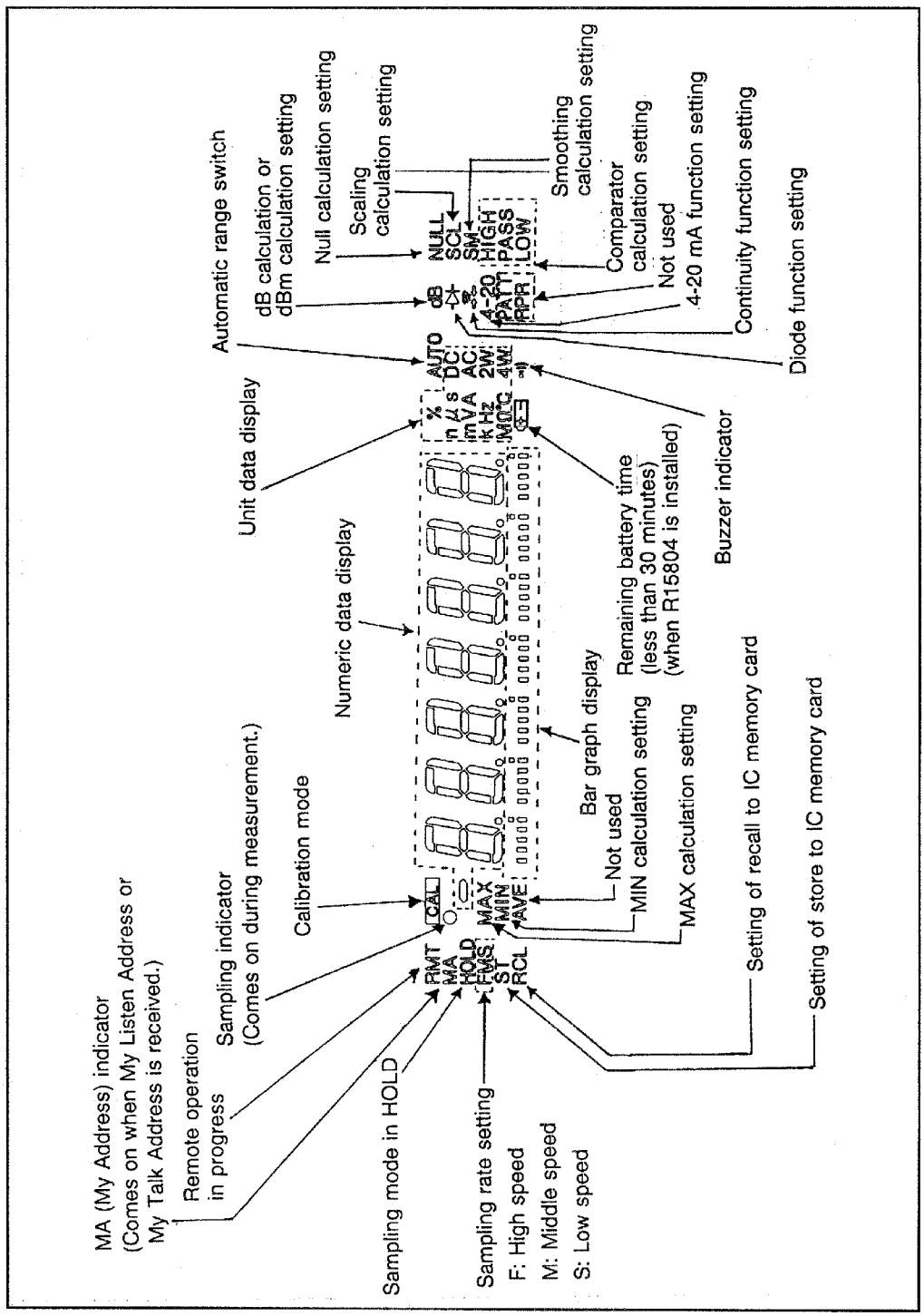
  Note: If the LLO (LOCAL LOCKOUT) command is set through the GPIB interface, the key entry will be ignored.

- Press this key in the setting mode.

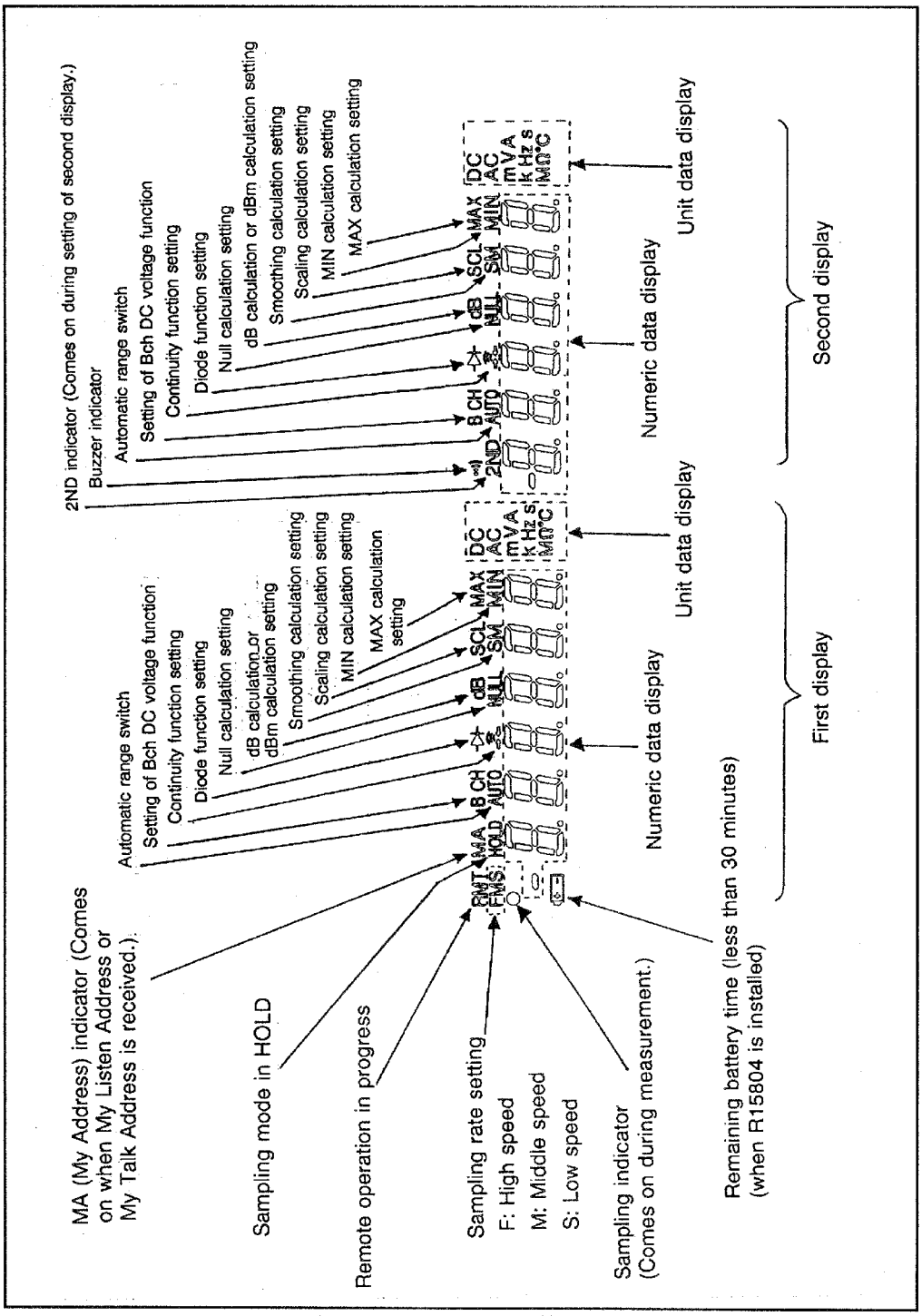
  SHIFT : Fixes the setting.

⑫ Display

(a) R6452A

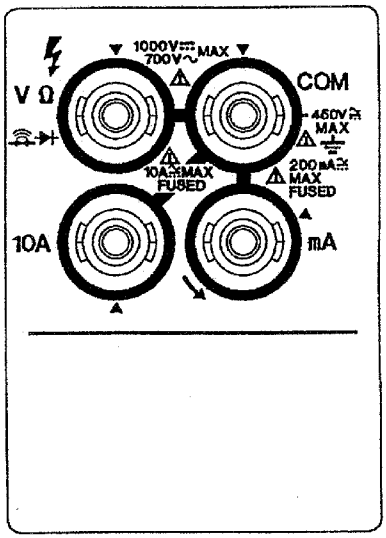


(b) R6452A and R6452E



⑬ Connector

(a) R6451A



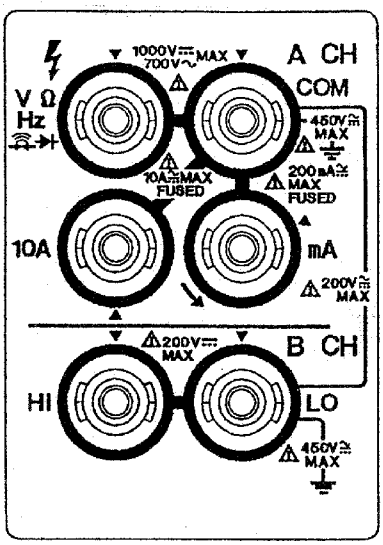
V Ω ⊣⊢ : HI terminal for DC voltage, AC voltage, resistance, diode, or continuity measurement

COM : LO terminal common to all types of measurement

10A : 10A HI terminal for DC current or AC current measurement

mA : 200 mA HI terminal for DC current or AC current measurement

(b) R6452A



V Ω Hz : HI terminal for DC voltage, AC voltage, resistance, diode, continuity, or frequency measurement

COM : LO terminal common to all types of Ach measurement

10A : 10A HI terminal for DC current or AC current measurement

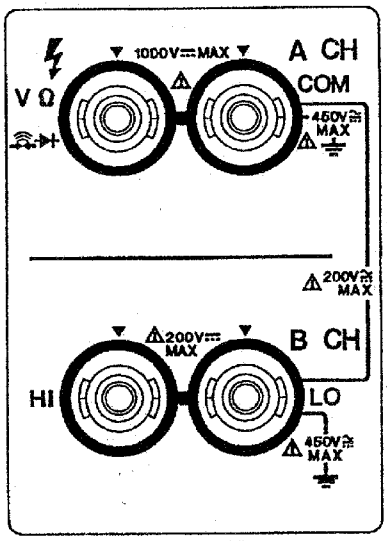
mA : 200 mA HI terminal for DC current or AC current measurement

HI : HI terminal for Bch DC voltage measurement

LO : LO terminal for Bch DC voltage measurement

Note: A terminal for temperature measurement is provided on the rear panel.

(c) R6452E



V Ω ⦚ ⊣◀ : HI terminal for DC voltage, AC voltage, resistance, diode, or continuity measurement

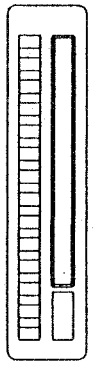
COM : LO terminal common to all types of Ach measurement

HI : HI terminal for Bch DC voltage measurement

LO : LO terminal for Bch DC voltage measurement

Note: A terminal for temperature measurement is provided on the rear panel.

⑭ IC memory card connector



The IC memory card is available when memory card interface unit R13222 (option) is installed.

The optional product should be used for the IC memory card.
Also, SRAM (Static Random Access Memory) cards falling within JEIDA (Japan Electronics Industry Development Association) guideline Ver. 4 or above can be used. However, the attribute field of the IC memory card must include the following device information:

Device information:

Device type	:	with SRAM backup
Device speed	:	100 ns to 250 ns
Common memory capacity	:	64 kbytes to 16 Mbytes Note that this instrument can use up to 64 kbytes.

R6451 SERIES
DIGITAL MULTIMETER
INSTRUCTION MANUAL

3.1 Front Panel

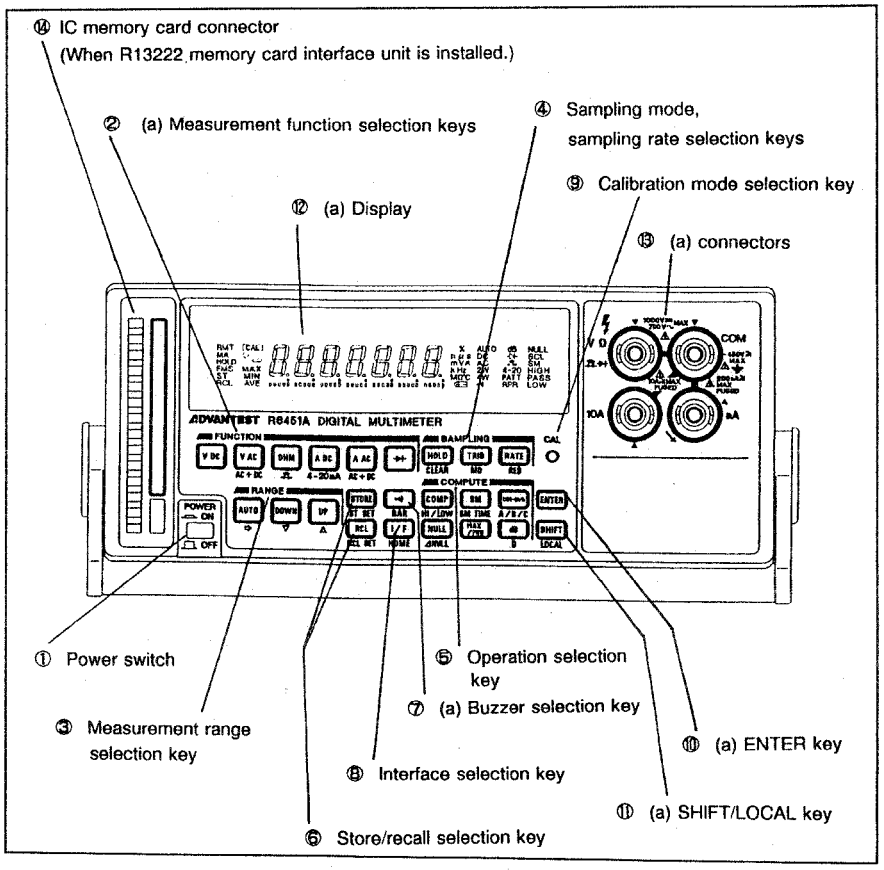


Figure 3-1 R6451A Front-panel Description

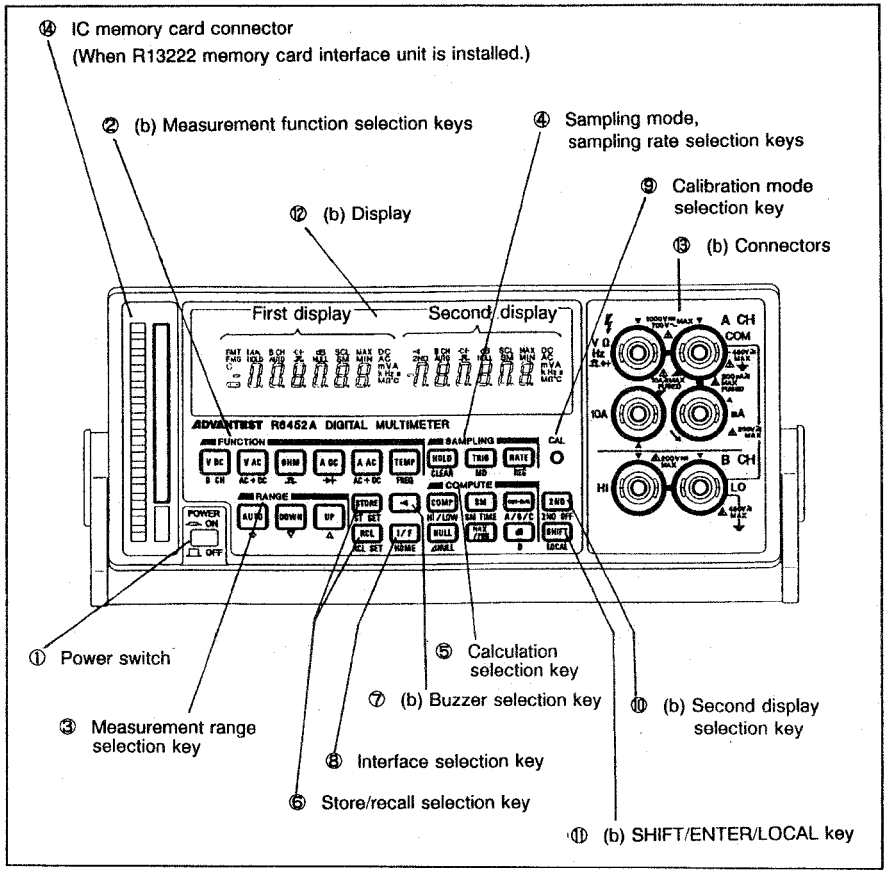


Figure 3-2 R6452A Front-panel Description

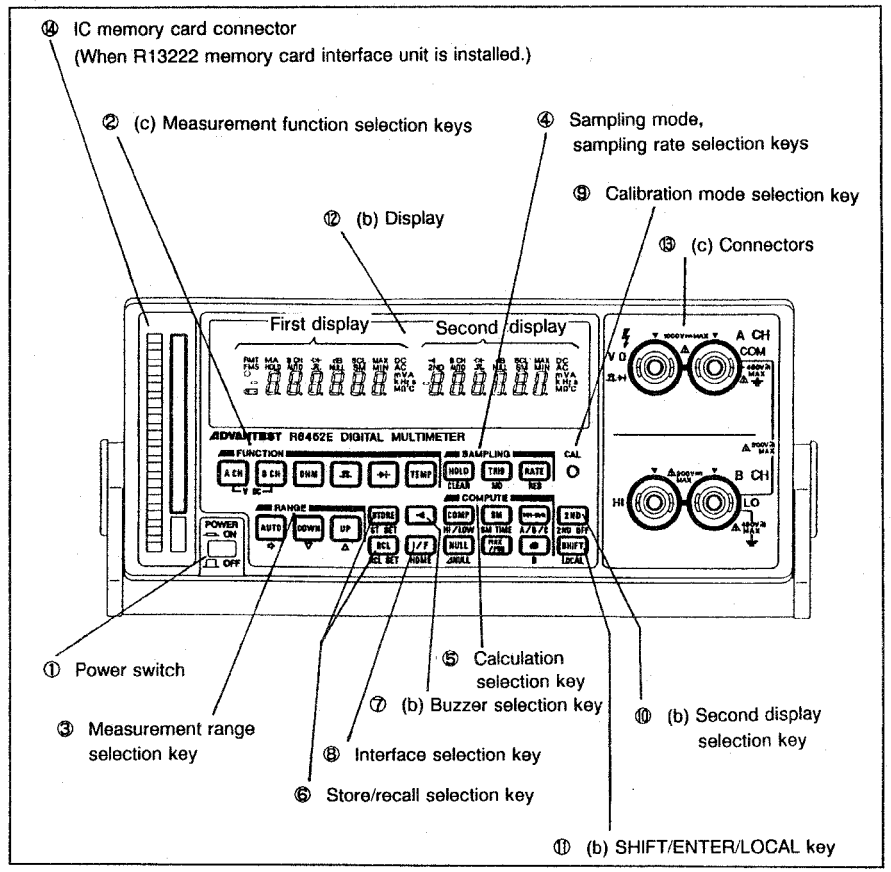
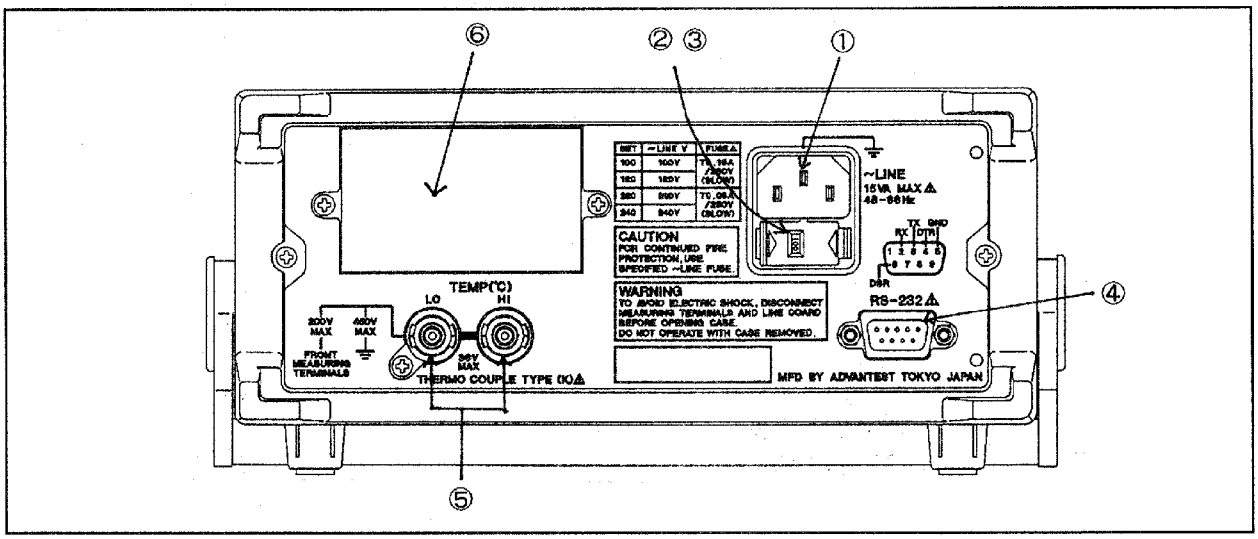


Figure 3-3 R6452E Front-panel Description

3.2 Rear-panel Description



① Power supply connector : Connector for AC power supply
Connects the power cable (standard equipment A01402) to this connector.

② Power supply change : Selects the power type among 100 V, 120 V, 220 V, and 240 V.

③ Fuse holder : Is equipped with a slow-blow 0.16 A (100/200 V) or 0.08 A (220/240 V) fuse. The holder contains spare fuses.

④ RS-232 connector : Connector for RS-232
Enables the setting of data output and measurement conditions and easy configuration of the automatic measurement system.

⑤ Input terminal for temperature measurement (R6452A/E only)
: Allows thermocouples to be connected for temperature measurement.

⑥ Accessory interface : Accommodates one of the following interfaces:
GPIB
BCD
Printer interface
Comparator output

4. OPERATIONS

4.1 Getting Started

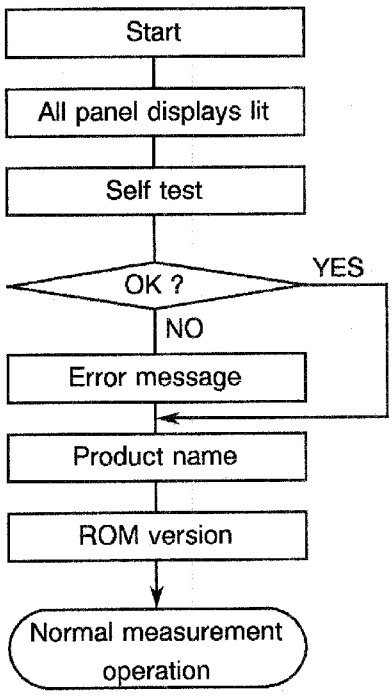
(1) Self test

The self test items which are automatically performed when the instrument is started (by turning ON the POWER switch), their error messages, and the operation flow after getting started are described below:

Table 4-1 Self Test Items and Error Messages

Test No.	Self test item	Error message
1	RAM read/write check	ERR 1
2	Communication check for panel control CPU	ERR 2
3	CAL data check	ERR 3, 4, 5
4	Backup parameter check	ERR 6
5	Communication check for analog control CPU	ERR 7

Operation flow after getting started



4.2 Initialization of Measurement Conditions

(1) Storing/retaining measurement conditions

When the POWER switch is turned OFF the measurement conditions are stored/retained in the internal memory.

(2) Initializing condition

To initialize the instrument, perform the following:

① Master reset

- For panel operation

1. Press the [SHIFT] .
2. Press the [HOLD / CLEAR] .
3. In case of R6451A, press the [ENTER].

   In case of R6452A or R6452E, press the [SHIFT] .

- For remote control
  Transfer the remote control command "Z".

② Setting start conditions

The start conditions can be set only by remote control.
Transfer the remote control command "C".

Table 4-2 Initialization

Item	Initialization setting			Mater reset	Power on
Function	DCV			○	
Range	Auto range			○	
Hold operation	Free-run			○	
Sampling rate	SLOW			○	
Number of digits displayed	5 1/2 digit mode			○	
Arithmetic function	OFF			○	
Arithmetic constant	Comparator constant	HI	000001E+0	○	
		LOW	000000E+0	○	
	Number of times for SM		10	○	
	Scaling constant	A	000001E+0	○	
		B	000000E+0	○	
		C	000001E+0	○	
	Null constant		000000E+0	○	
	dB constant	D	000001E+0	○	
Remote operating conditions	Refer to each "Interface" section.			○	○
Panel display	Enable			○	○
CAL mode	Cancel			○	
Each test mode	Cancel			○	○
Display *	Single			○	

* : R6452A and R6452E only

4.3 Basic Key Operations

(1) Setting measurement functions
(For details, refer to Chapter 5.)

Measurement function	Key operation		
	R6451A	R6452A	R6452E
(1) DC voltage measurement	V DC	V DC	A CH
(2) AC voltage measurement (AC coupling mode)	V AC	V AC	———
(3) Resistance measurement	OHM	OHM	OHM
(4) DC current measurement	A DC	A DC	———
(5) AC current measurement (AC coupling mode)	A AC	A AC	———
(6) AC voltage measurement (AC + DC coupling mode)	SHIFT V AC (AC+DC)	SHIFT V AC (AC+DC)	———
(7) AC current measurement (AC + DC coupling mode)	SHIFT A AC (AC+DC)	SHIFT A AC (AC+DC)	———
(8) Bch DC voltage measurement	———	SHIFT V DC (B CH)	B CH
(9) Diode measurement	⊣|	SHIFT A DC (⊣|)	⊣|
(10) Continuity measurement	OHM (≋)	SHIFT OHM (≋)	≋
(11) 4-20 mA measurement	SHIFT A DC (4-20mA)	———	———
(12) Temperature measurement	———	TEMP	TEMP
(13) Frequency measurement	———	SHIFT TEMP (FREQ)	———

Example: Measurement function of R6451A set to DC voltage (AC + DC coupling mode).

Key operation:

① Press the [SHIFT] to enter the shift mode.

② Press the [V AC] (AC + DC) to set the AC voltage (AC + DC coupling mode).

(2) Setting second display (R6452A and R6452E only)

To display the result of the measurement function on the second display, press the [2ND] prior to the key operation (1).

Example: With R6452A, first display set to Bch DC voltage and second display set to AC voltage (AC + DC coupling mode).

Key operation:

① Press the [SHIFT] to enter the shift mode.

② Press the [V DC] (B CH) to set the first display to Bch DC voltage.

③ Press the [2ND] to move to the second display.

④ Press the [SHIFT] to enter the shift mode.

⑤ Press the [V AC] (AC + DC) to set the second display to AC voltage (AC + DC coupling mode).

(3) Deleting second display (R6452A and R6452E only)

Key operation:

① Press the [SHIFT] to enter the shift mode.

② Press the [2ND] (2ND OFF) to delete the second display.

(4) Changing from manual range to auto range

Key operation:

Press the [AUTO] .

(5) Changing range in manual range

Key operation:

Press the [DOWN] or [UP] .

(6) Changing from free-run mode to hold mode

Key operation:

Press the [HOLD] .

(7) Sampling execution instruction in hold mode

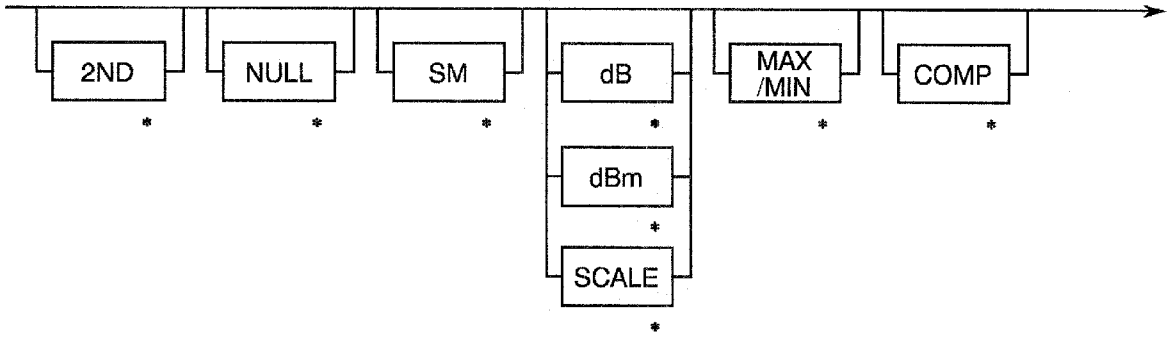
Key operation:

Press the [TRIG] .

(8) Execution and halting calculation

This operation will halt the calculation being executed or execute a halted operation.

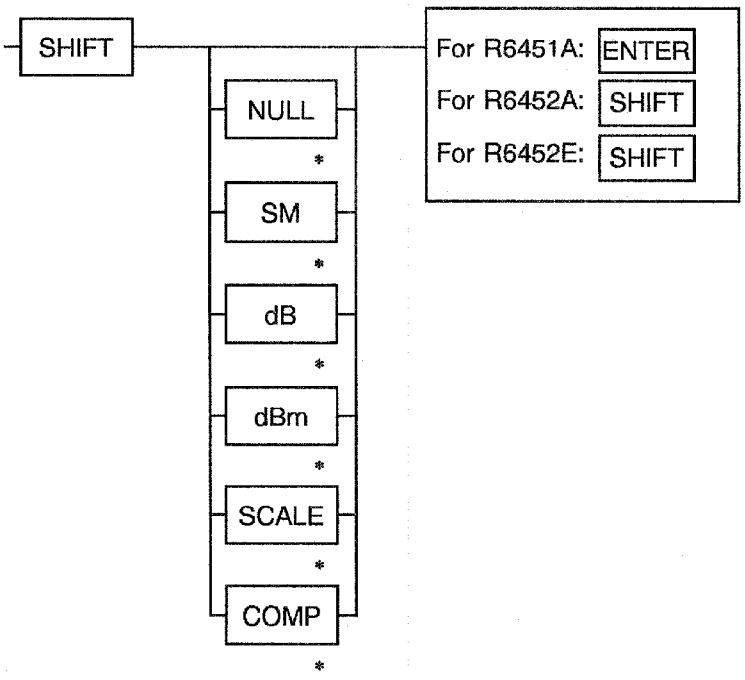
Key operation:



Note: Press the keys marked with an asterisk as required.
The [2ND] is used for execution and halting of the calculation for the second display (R6452A and R6452E only).

(9) Setting of arithmetic (calculation) constant

Key operation:



Note: Press the keys marked with an asterisk as required.

5. FUNCTIONS

5.1 Range Setting

The AUTO , DOWN , and UP are used for range setting.

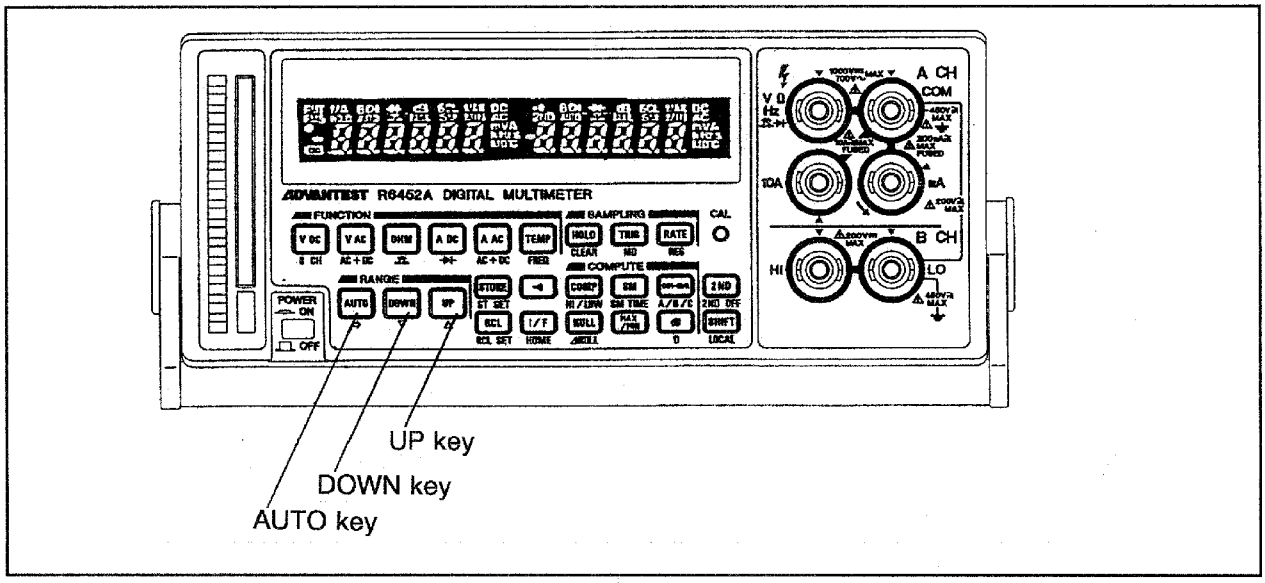


Figure 5-1 Range Setting

- Setting of auto range and manual range

  The AUTO is used for selection of the auto range and manual range.

  When the auto range is set, AUTO is lit on the display.
  When the manual range is set, AUTO goes off.

- Operation during manual range setting

  Pressing the DOWN decreases the range by one level, with the setting remaining in the manual range.

  Pressing the UP increases the range by one level, with the setting remaining in the manual range.

- Operation during auto range setting

  Pressing the AUTO does not change the range level but changes the setting to the manual range.

The variable ranges for each measurement function and the fixed ranges are as follows:

Table 5-1 Measurement Functions and Variable Ranges

Measurement function	Range	R6451A	R6452A	R6452E
DC voltage measurement	200 mV	○	○	○
	2000 mV	○	○	○
	20 V	○	○	○
	200 V	○	○	○
	1000 V	○	○	○
AC voltage measurement	200 mV	○	○	—
	2000 mV	○	○	—
	20 V	○	○	—
	200 V	○	○	—
	700 V	○	○	—
Resistance measurement	200 Ω	○	○	○
	2000 Ω	○	○	○
	20 kΩ	○	○	○
	200 kΩ	○	○	○
	2000 kΩ	○	○	○
	20 MΩ	○	○	○
	200 MΩ	○	○	○
DC current measurement *1	200 mA	○	○	—
	10 A	○	○	—
AC current measurement *1	200 mA	○	○	—
	10 A	○	○	—
Frequency measurement	20 Hz	—	○	—
	200 Hz	—	○	—
	2000 Hz	—	○	—
	20 kHz	—	○	—
	200 kHz	—	○	—
Bch DC voltage measurement	2000 mV	—	○	○
	20 V	—	○	○
	200 V	—	○	○

*1: Only for manual range

Table 5-2 Fixed Range Functions

Measurement function	R6451A	R6452A	R6452E
Diode measurement	○	○	○
Continuity measurement	○	○	○
4-20 mA measurement	○	—	—
Temperature measurement	—	○	○

5.2 Setting of Sampling Conditions

The HOLD , TRIG , and RATE are used for setting the sampling conditions.

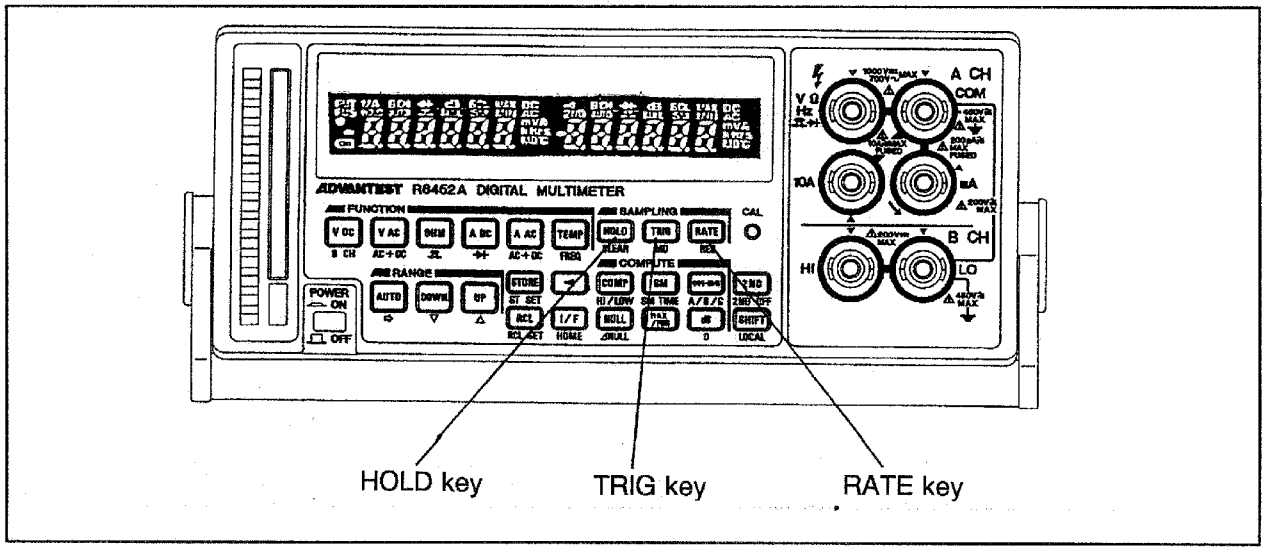


Figure 5-2 Setting of Sampling Conditions

(1) Setting of hold free-run

Pressing the HOLD sets the sampling to the free-run state or the hold state.

In the free-run state, pressing the HOLD changes the setting to the hold state and lights up HOLD on the display.

In the hold state, pressing the HOLD changes the setting to the free-run state and turns off HOLD on the display.

HOLD indicates the state of the setting.

(2) Setting of trigger

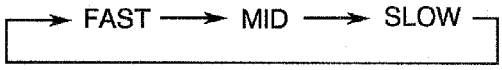
Pressing the TRIG once allows one sampling to be executed in the hold state.

In the sampling state, the sampling indicator is lit up on the display.

(3) Setting of sampling rate

Pressing the RATE changes the sampling rate.

Each pressing of the RATE switches the states as follows:



The setting of the sampling rate is indicated on the display as follows:

FAST : F is lit.

MID : M is lit.

SLOW : S is lit.

(4) Relationship between sampling rate and number of digits used for measurement

If the sampling rate is changed, the number of digits used for measurement also will change. The relationship between the sampling rate for the DC voltage and the number of digits used for measurement is as follows:

Table 5-3 Relationship between Sampling Rate and Maximum Number of Digits Displayed in DCV Function

Sampling rate		Number of digits used used for measurement (maximum number of digits displayed)
Setting	Times/sec.	
FAST	80	1999
MID	10	19999
SLOW	2.5	199999

Note: The maximum number of digits displayed (display length) depends on the measurement function to being used. (See Table 5-4.)

Table 5-4 Relationship between Measurement Function and Maximum Number of Digits Displayed

Measurement function	Range	Sampling rate and maximum number of digits displayed			Applicable model (R64xxx)		
		FAST	MID	SLOW	51A	52A	52E
DC voltage measurement	200 mV	199.9--	199.99-	199.999	○	○	○
	2000 mV	1999.--	1999.9-	1999.99	○	○	○
	20 V	19.99--	19.999-	19.9999	○	○	○
	200 V	199.9--	199.99-	199.999	○	○	○
	1000 V	1099.--	1099.9-	1099.99	○	○	○
AC voltage measurement (AC coupling mode)	200 mV	199.9--	199.99-	199.999	○	○	–
	2000 mV	1999.--	1999.9-	1999.99	○	○	–
	20 V	19.99--	19.999-	19.9999	○	○	–
	200 V	199.9--	199.99-	199.999	○	○	–
	700 V	709.--	709.9-	709.99	○	○	–
Resistance measurement	200 Ω	199.9--	199.99-	199.999	○	○	○
	2000 Ω	1999.--	1999.9-	1999.99	○	○	○
	20 kΩ	19.99--	19.999-	19.9999	○	○	○
	200 kΩ	199.9--	199.99-	199.999	○	○	○
	2000 kΩ	1999.--	1999.9-	1999.99	○	○	○
	20 MΩ	19.99--	19.999-	19.9999	○	○	○
	200 MΩ	199.9--	199.99-	199.99-	○	○	○
DC current measurement	200 mA	199.9--	199.99-	199.999	○	○	–
	10 A	10.99--	10.999-	10.9999	○	○	–
AC current measurement (AC coupling mode)	200 mA	199.9--	199.99-	199.999	○	○	–
	10 A	10.99--	10.999-	10.9999	○	○	–
AC voltage measurement (AC + DC coupling mode)	200 mV	199.9--	199.9--	199.99-	○	○	–
	2000 mV	1999.--	1999.--	1999.9-	○	○	–
	20 V	19.99--	19.99--	19.999-	○	○	–
	200 V	199.9--	199.9--	199.99-	○	○	–
	700 V	709.--	709.--	709.9-	○	○	–
AC current measurement (AC + DC coupling mode)	200 mA	199.9--	199.9--	199.99-	○	○	–
	10 A	10.99--	10.99--	10.999-	○	○	–

(cont'd)

Measurement function	Range	Sampling rate and maximum number of digits displayed			Applicable model (R64xxx)		
		FAST	MID	SLOW	51A	52A	52E
Bch DC voltage measurement	2000 mV	1999.--	1999.9-	199.999	–	○	○
	20 V	19.99--	19.999-	19.9999	–	○	○
	200 V	199.9--	199.99-	199.999	–	○	○
Diode measurement	2000 mV	1999.--	1999.9-	1999.99	○	○	○
Continuity measurement	200 Ω	199.9--	199.99-	199.999	○	○	○
4-20 mA measurement	100 %	999.--	999.9-	999.99	○	–	–
Temperature measurement	1000 °C	1370.--	1370.0-	1370.0-	–	○	○
Frequency measurement	20 Hz	19.999-	19.999-	19.999-	–	○	–
	200 Hz	199.99-	199.99-	199.99-	–	○	–
	2000 Hz	1999.9-	1999.9-	1999.9-	–	○	–
	20 kHz	19.999-	19.999-	19.999-	–	○	–
	200 kHz	199.99-	199.99-	199.99-	–	○	–

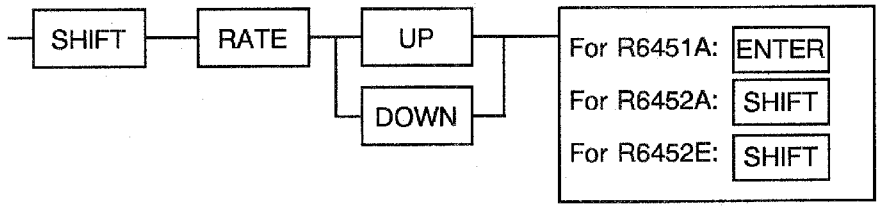
(5) Changing the display digits

The [SHIFT] and [RATE / RES] are used to set the number of digits displayed.

The [UP] and [DOWN] are used to change the setting.

The range of the number of digits displayed is 199999 to 1999.

The setting flowchart for the number of digits displayed is as follows:



5.3 Dual Display (R6452A and R6452E only)

R6452A and R6452E have two portions of display each including a six-digit numeric indicator, a unit indicator, and an operation indicator, enabling simultaneous display of two measurement results.

The left-hand portion is called the "First display" and the right-hand portion is called the "Second display".
The measurement function, measurement range, calculation (except for the comparator calculation on the second display), and number of digits displayed can be set for each of the first and second displays. Therefore, unlike the existing method where two multimeters were required for measurement, or where it was necessary to change the input cable connection, a single multimeter enables measurement and display of two objects. (For measurement examples, see "5.3.3 Dual Display Operation Example".)

Measurement and display are performed in the following order: measurement for first display, display of first display, measurement for second display, display of second display.

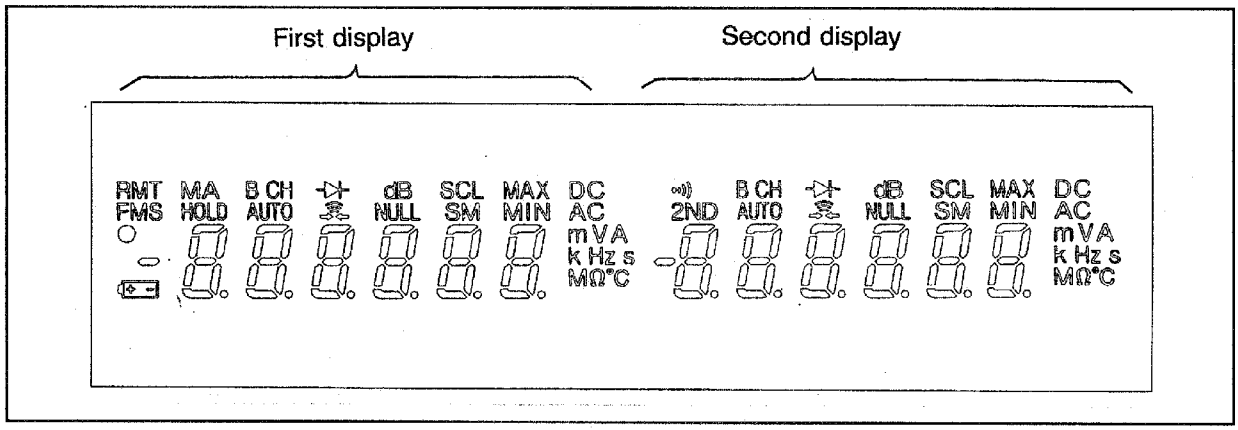


Figure 5-3 Display on Front Panel (R6452A and R6452E only)

5.3.1 Setting and Canceling of Second Display

(1) 2ND key

Pressing the [2ND] turns on the 2ND indicator on the display. Pressing the key again turns it off.

Key operation when 2ND is lit : The operation applies to the second display.
Key operation when 2ND is off : The operation applies to the first display.

(2) Setting of second display

① Press the [2ND] to turn on the 2ND indicator on the display.

② Press the desired function key.

(3) Canceling of second display

Pressing the [SHIFT] and [2ND] (2ND OFF) in that order causes the second display to be canceled, and measurement is applied to the first display only.

Note: The second display can be canceled irrespective of whether the 2ND indicator is lit.

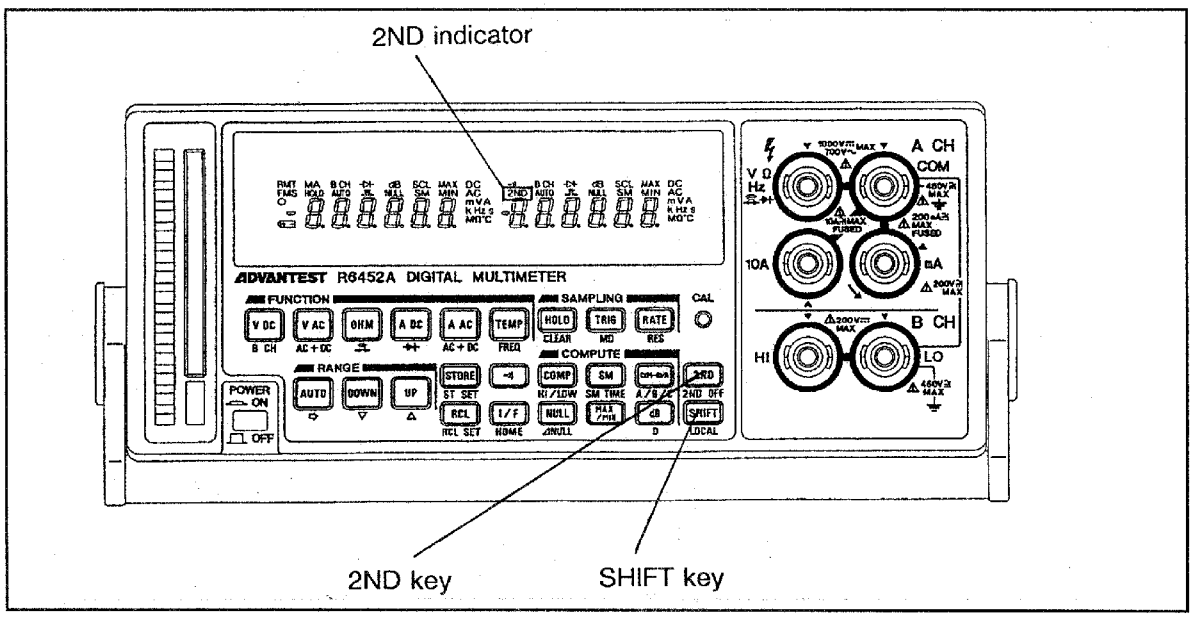
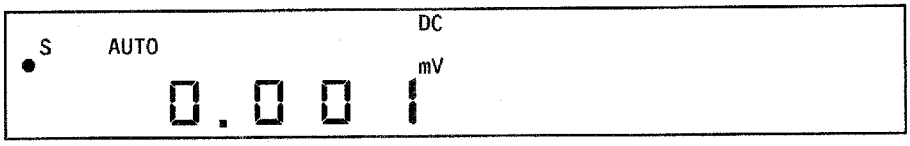


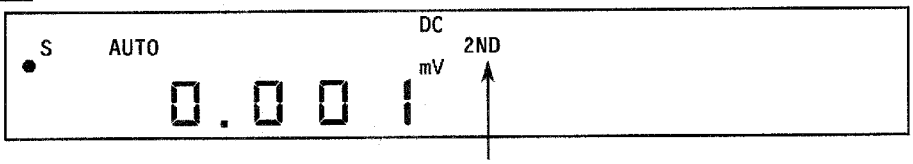
Figure 5-4 Keys Relating to Second Display

(4) Operation example

Example 1: Sets the DC voltage measurement function for the second display of R6452A.

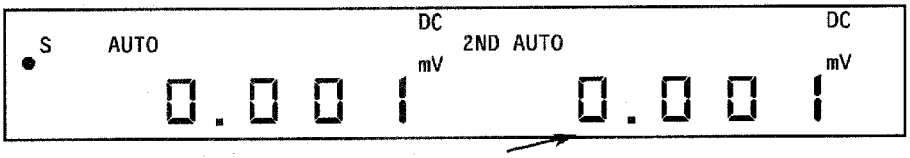


① Press the [2ND].



The 2ND indicator will light up.

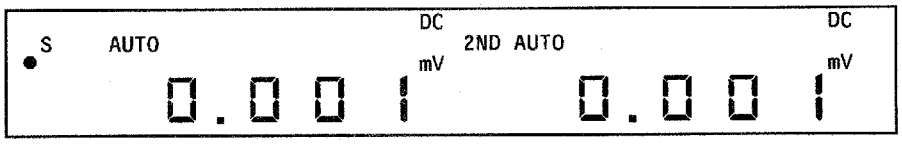
② Press the [V DC].



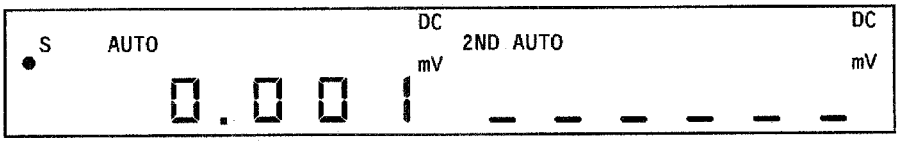
The second display shows the setting of DC voltage measurement.

Note: To set the range keys ([AUTO] , [DOWN] , or [UP]) or the calculation keys ([NULL] , [SM] , [dB] , [C(M-B)/A] or [MAX /MIN]), the 2ND indicator should be lit and the setting should be made after setting a measurement function. (If a measurement function has not been set on the second display, setting of the range or calculation key for the second display will be ignored.)

Example 2: Sets measurement for the first display only and cancels the measurement for the second display.

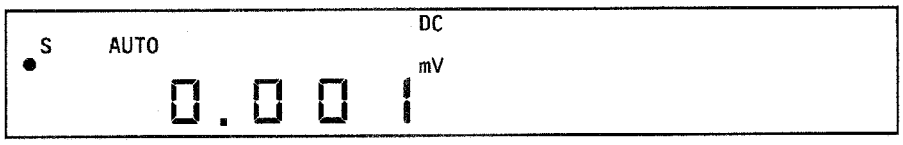


① Press the SHIFT.



The first display will be set to the SHIFT mode.

② Press the 2ND.



The setting for the second display will be canceled.

5.3.2 Dual Display Limitation

The dual display is disabled when the following functions are executed.

① Execution of comparator function

If the comparator function is started, the dual display will be automatically stopped.
This is because the function uses the first display for calculation and the second for displaying the result.
However, the following arithmetic functions are available in the dual display state:

- Null function
- Scaling function
- Smoothing function
- dB function
- MAX/MIN function

② Execution of IC memory card operation

Only the measurement data indicated on the first display can be stored in the memory card. Therefore, when data are stored in or read from the card, only the first display becomes available automatically.

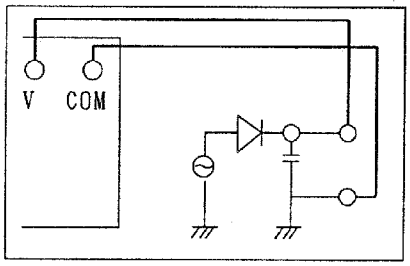
5.3.3 Dual Display Operation Example

The following are the concrete examples of typical dual display operations.

Example 1: Measures DC and ripple voltages on the rectification circuit (R6452A only).

(This example shows the DC voltage on the first display and the ripple voltage on the second display.)

(1) Connecting the terminals



As shown in left-hand figure, connect the Ach COM terminal and V terminal to the measurement points for the DC and ripple voltages.

(2) Displaying DC voltage on the first display

① Confirm that the 2ND indicator at the top left of the second display is off.

If it is lit, perform the following:

Press the [SHIFT] to enter the shift mode.

Press the [2ND] (2ND OFF) to turn off the 2ND indicator.

② Press the [V DC] to set the DC voltage measurement function.

(3) Displaying ripple voltage on the second display

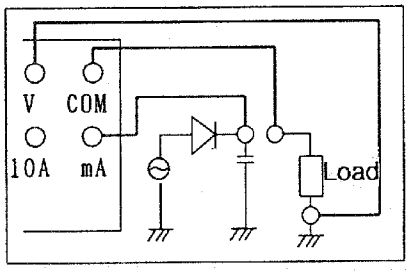
① Press the [2ND] to enter the mode in which the second display is available.

② Press the [V AC] to set the AC voltage (AC coupling mode) measurement function.

Example 2: Measures the DC voltage and the load current on the rectification circuit (R6452A only) (when the common terminal is used for common connection).

(This example shows the DC voltage on the first display and the load current on the second display.)

(1) Connecting terminals



As shown in the left-hand figure, connect the COM and V terminals to the measurement point for DC voltage and 10 A or mA terminal to the point for current.

(2) Displaying DC voltage on the first display

① Confirm that the 2ND indicator at the top left of the second display is off.

If it is lit, perform the following:

Press the [SHIFT] to enter the shift mode.

Press the [2ND] to turn off the 2ND indicator.

2ND OFF

② Press the [V DC] to set the DC voltage measurement function.

(3) Displaying load current on the second display

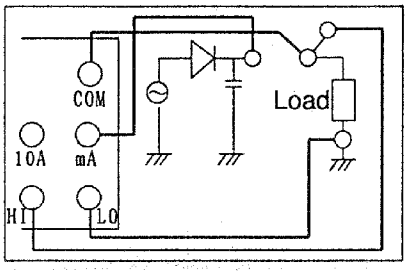
① Press the [2ND] to enter the mode in which the second display is available.

② Press the [ADC] to set the DC current measurement function.

Example 3: Measures the input DC voltage and the load current on the power supply circuit (R6452A only) (when the common terminal is not used for common connection).

(This example shows DC voltage on the first display and load current on the second display.)

(1) Connecting terminals



As shown in the left-hand figure, connect the Bch HI and LO terminals to the measurement point for DC voltage and COM terminal and 10 A or mA terminal to the point for current.

(2) Displaying DC voltage on the first display

① Confirm that the 2ND indicator at the top left of the second display is off.
If it is lit, perform the following:

Press the [SHIFT] to enter the shift mode.

Press the [2ND] to turn off the 2ND indicator.
2ND OFF

② Press the [SHIFT] to enter the shift mode.

③ Press the [V DC] to set 2ch DC voltage measurement function.
B CH

(3) Displaying load current on the second display

① Press the [2ND] to enter the mode in which the second display is available.

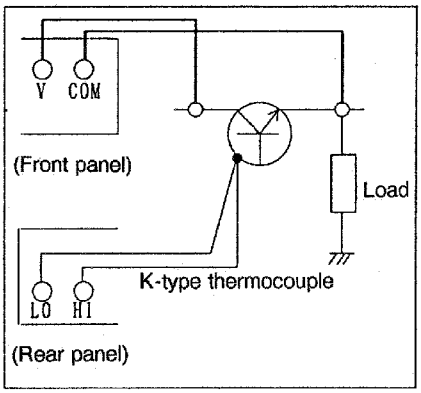
② Press the [A DC] to set the DC current measurement function.

If the maximum value of the CMV (common voltage) between the COM terminal and Bch HI and LO terminal is less than 200 V, Bch can be measured. If it exceeds 200 V, OL C (common voltage over) will appear on the display.

Example 4: Measures the voltage between the collector and the emitter of the transistor and the case temperature (R6452A and R6452E only).

(This example shows the DC collector-to-emitter voltage on the first display and the case temperature on the second display.)

(1) Connecting terminals



As shown in the left-hand figure, connect the COM and Ach V terminals to the measurement point for DC voltage. Use a K-type thermocouple at the temperature measurement point and connect the HI and LO terminals of the rear panel to the point.

(2) Displaying the DC collector-to-emitter voltage on the first display

① Confirm that the 2ND indicator at the top left of the second display is off.
If it is lit, perform the following:

Press the [SHIFT] to enter the shift mode.

Press the [2ND] to turn off the 2ND indicator.
2ND OFF

② Press the [V DC] to set the Ach DC voltage measurement function.

(3) Displaying the case temperature on the second display

① Press the [2ND] to enter the mode in which the second display is available.

② Press the [TEMP] to set the temperature measurement function.

If the maximum value of CMV (common voltage) between the COM terminal and the HI and LO terminal of the rear panel is less than 200 V, the temperature can be measured.
If it exceeds 200 V, OL C (common voltage over) will appear on the display.

5.4 Arithmetic Functions

(1) Calculation items

The following are the calculation items and their functions:

Calculation item	Function	Calculation expression
NULL	Subtracts a fixed value from measurement value.	Measurement value - NULL value
SM	Obtains running average.	
dB	Performs 20LOG calculation.	20 log (Measurement value/D)
dBm	Performs 10LOG calculation.	
SCALE	Performs scaling calculation.	(Measurement value - B)/A*C
MAX/MIN	Obtains maximum or minimum value after calculation.	
COMP	Determines comparison result (good or no good).	

Note: A, B, C, and D are user-defined constants.

The following are functions to which calculation can be applied:

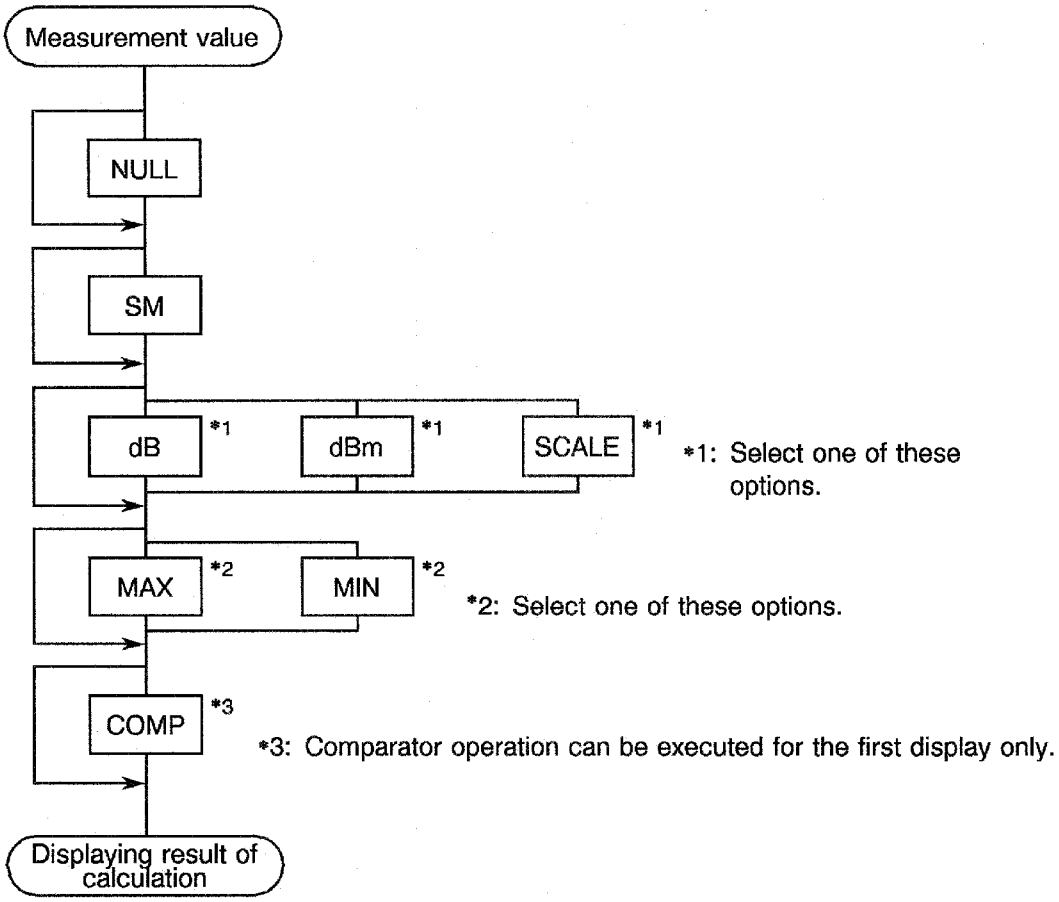
Measurement function	Calculation								Applicable model		
	NULL	SMOOTH	dB	dBm	SCALE	MAX	MIN	COMP	R6451A	R6452A	R6452E
DC voltage measurement	○	○	○	○	○	○	○	○	○	○	○
AC voltage measurement (AC coupling mode)	○	○	○	○	○	○	○	○	○	○	–
Resistance measurement	○	○	–	–	○	○	○	○	○	○	○
DC current measurement	○	○	○	–	○	○	○	○	○	○	–
AC current measurement (AC coupling mode)	○	○	○	–	○	○	○	○	○	○	–
AC voltage measurement (AC + DC coupling mode)	○	○	○	○	○	○	○	○	○	○	–
AC voltage measurement (AC + DC coupling mode)	○	○	○	○	○	○	○	○	○	○	–
Bch DC voltage measurement	○	○	○	○	○	○	○	○	–	○	○
Diode measurement	○	○	–	–	○	○	○	○	○	○	○
Continuity measurement	○	○	–	–	○	○	○	○	○	○	○
4-20 mA measurement	○	○	–	–	○	○	○	○	○	–	–
Temperature measurement	○	○	–	–	○	○	○	○	–	○	○
Frequency measurement	○	○	–	–	○	○	○	○	–	○	–

Note: In case of R6452A and R6452E, comparator (COMP) calculation cannot be executed for the second display in the dual display mode.

(2) Combination of calculation

The result of calculation can be computed again according to the calculation flowchart below.

Calculation flow



Any types of calculation can be combined according to the calculation flow above.
If multiple types of calculation are set to ON, upstream result of the calculation is computed again as shown in below. The following are the sequence and the results of calculation execution when all types of calculation are set to ON.

Key	Description	Display
NULL	NULL calculation is performed on the measurement value.	Result 1
SM	Smoothing calculation is performed on result 1.	Result 2
dB/dBM/SCALE	Either of dB, dBm, or SCALE calculation is performed on result 2.	Result 3
MAX/NIM	Either of MAX or MIN calculation is performed on result 3.	Result 4
COMP	One type of comparator calculation is performed on result 4.	Result 5

5.4.1 NULL Arithmetic Function

(1) NULL calculation

NULL calculation is used to obtain a measurement result (displayed value) by subtracting NULL constant from the measurement value.

Displayed value = Measurement value – NULL constant

Pressing the [NULL] starts the NULL calculation and lights up the NULL indicator on the display.

In the execution of NULL calculation, pressing the [NULL] again cancels the calculation and turns off the NULL indicator.

(2) NULL constant

NULL constant utilizes the sampling data immediately after execution of NULL calculation ([NULL] is pressed). When in the overload condition, NULL calculation cannot be executed.

Pressing the [SHIFT] [NULL] (ΔNULL) in the execution of NULL calculation causes the NULL constant to be displayed .

The [AUTO] (⇨) , [DOWN] (▽) , [UP] (△) can be used to change NULL constants.

The range of NULL constant setting is:

Setting range	Minimum setting value
– 999999.E + 6 to + 999999.E + 6	0.00000E-3

To set the exponent part, use the subunits (m k M).

Note that it is not permissible to specify a NULL constant which causes the NULL calculation result to overload. The error message "Err 10" will be displayed.

(3) Auto range and NULL calculation

If the NULL calculation is executed, its operation is effective in the range in which the NULL calculation has been executed (NULL ON range) or in the range above the NULL ON range.

If the range decreases and is below the NULL ON range, the NULL calculation will be canceled. The auto range operation is applied to the measurement values not to the NULL calculation result. Therefore, if the measurement is not executed in the maximum range, the result may be displayed as an overload.

(4) NULL operation when changing the measurement function

If the NULL operation has been set to a measurement function and the function has been changed to a new one, the NULL calculation will be canceled for the new function. However, when the new function is changed back to the old one, the NULL calculation will become available with the previously set NULL constant.

(5) NULL operation when changing the measurement range

The NULL operation is effective in the range to which the NULL operation is set or in a higher range. However, if the NULL calculation is below the preset-level range, it will be canceled. When the NULL operation is again set to the preset level or a higher range, the NULL calculation is executed using the previously set NULL constants.

(6) NULL operation when changing the sample rate

When the sample rate is changed as follows, the NULL calculation is canceled. If the sample rate is returned to its original setting, the NULL calculation will be executed using the previously set NULL constants.

Sample rate before change		Sample rate after change
FAST	→	MID/SLOW
MID	→	SLOW

CAUTION

While the NULL calculation is being executed, the actual measurement value is not displayed.
Therefore, great care should be taken, since in some circumstances a dangerous voltage may not be noticeable on the input connector or test lead line.

5.4.2 Smoothing Function

(1) Smoothing calculation

The smoothing function may be used when there is a superimposed noise on the measurement signals. Since the running average is calculated for a specified number of times of the measurement value, the measurement value having less dispersion will be obtained.
The calculation expression of the smoothing function is:

Display = (Measurement value 1 + ... + Measurement value N)/N

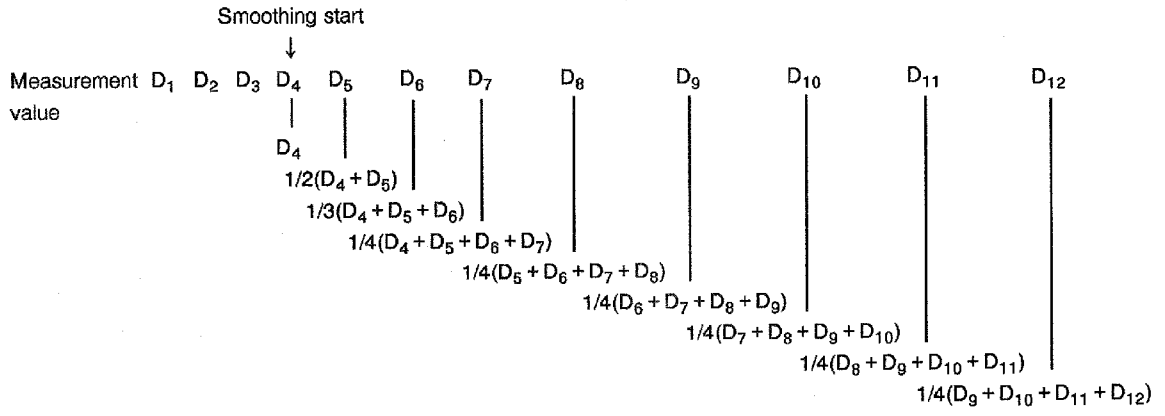
Pressing the SM starts the calculation and lights up the SM on the display or makes it blink.

The SM blinks until the smoothing has been repeated N times. The SM lights up when the number of times smoothing has been performed reaches N.

If the SM is pressed again during the execution of the smoothing calculation, the calculation will be canceled and the SM will be turned off.
The N + 1st data appears as follows:

Display = (Measurement value 2 + ... + Measurement value N + 1)/N

Each time one complete cycle of smoothing calculation is completed, the running average is displayed for all the cycles of the measurement up till that time.
The following is an example in which the number of times smoothing is to be performed is specified as four.



When n cycles of smoothing have been completed, the result of the smoothing calculation D(sm) is as follows:

Result of smoothing calculation $D(sm) = \frac{1}{T}\sum_{i=n-T+1}^{n} Di$	D(sm) :	Result of smoothing calculation when n cycles of smoothing have been completed
	Di :	Measurement value (before smoothing calculation)
	T :	Specified number of times of smoothing (range:2 to 100 times)

(2) Setting the number of times of smoothing

To set the number of times of smoothing, press the SHIFT and SM (SM TIME) to enter the times setting mode.

The available setting range is 2 to 100.

Use the UP (△) for increasing the number and the DOWN (▽) to decrease it.

The setting number changes in the order shown below:

→ 2 → 3 → 4 → · · · → 98 → 99 → 100 →

(3) Smoothing operation when changing the measurement function

If the measurement function in which smoothing has been is changed to a new one, smoothing cannot be executed in the new function.
If the function is changed back to the old setting, smoothing will be executed starting at N = 1.

If it is required to execute smoothing in a new measurement function, press the SM again.

(4) Smoothing operation when changing the measurement range

If the range level is changed in the smoothing operation, it will restart at N = 1.

(5) Smoothing operation when changing other settings

If any of the following is changed in the smoothing operation, it will restart at N = 1.

- Measurement range
- Sample rate
- Number of times of smoothing

(6) Smoothing calculation and OL (overload)

If the measurement value is overloaded during smoothing, the value will be ignored.
(In this case, all the data for the specified times, excluding the failed cycle due to overload, are used as valid data.)

5.4.3 dB and dBm Arithmetic Functions

(1) dB calculation and dBm calculation

dB calculation is used for decibel conversion and can be applied to the voltage and current measurements.

dBm calculation is used for the calculation of power gain per 1 mV and can be applied to the voltage measurement only.

If the measurement value obtained during the execution of dB/dBm calculation is zero, it will be determined to be an error and the error message "Err D" will appear.

The dB, dBm, and scaling calculations cannot be selected at the same time. (Select any one of them.)

The calculation expressions of dB and dBm are as follows:

$$\text{For dB: Display} = 20 \log_{10} \frac{\text{Measurement value}}{\text{Constant D}}$$

$$\text{For dBm: Display} = 10 \log_{10} \frac{(\text{Measurement value})^2/\text{constant D}}{10^{-3}}$$

Pressing the [dB] starts the calculation and lights up the dB on the display. In case of dBm, the subunit "m" will light up at the same time.

Every time the [dB] is pressed, the operation type is changed as follows:

Execution of dB calculation → Execution of dBm calculation → Cancellation of calculation → (back to Execution of dB calculation)

(2) Setting constant D

The range available for constant D is:

Setting range	Minimum setting value
0.00001E-3 to +999999.E+6	0.00001E-3

Use the subunits (m k M) to set the exponent part.

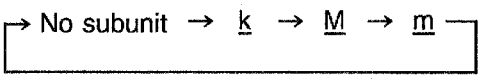
Key operation:

① Press the [SHIFT] then [dB / D] to enter the setting mode for the constant D.

② Pressing the [AUTO] to highlight the point to be changed. The highlighted point moves in the following order.

- Uppermost digit of the number to lowermost digit
- Subunit
- Decimal

③ Highlight the point to be changed and use the [UP] or [DOWN] to change the value of the number and sub-unit.
Note that the subunit changes in the following order:



If it is required to set the measurement value to the constant D, press the [TRIG] in this mode.

The data for which the measurement has been completed and displayed will be set as the constant D together with the subunit.

④ After setting the constant D, press the [SHIFT] in the case of R6452A and R6452E, and press the [ENTER] in the case of R6451A.

(3) dB/dBm calculation when changing the measurement functions

If the measurement function in which the dB/dBm calculation has been set is changed to a new one, the calculation cannot be executed in the new function.

When the function is changed back to the old one, the dB/dBm calculation is effective again. If it is required to execute the dB/dBm calculation in the new function, press the dB again.

(4) Display of dB/dBm calculation results

Unlike in the case of other measurement values, the decimal position of the dB/dBm calculation result is independent of the preset range, i.e., the decimal position is always fixed. (XXX.XXX)

Example: When the 20 V range and 10 V is entered for the DC voltage measurement

Measurement value : 10.0000 V
dB calculation result : 20.000 dB

CAUTION

While the dB/dBm calculation is being executed, the actual measurement value is not displayed.
Therefore, great care should be taken, since in some circumstances a dangerous voltage may not be noticeable on the input connector or test lead line.

5.4.4 Scaling Function

(1) Scaling calculation

The calculation expression of the scaling is:

$$\text{Display} = \frac{\text{Measurement value M-B constant}}{\text{Constant A}} * \text{Constant C}$$

Pressing the C(M-B)/A lights up the SCALE on the display and starts the scaling calculation.

If the C(M-B)/A is pressed again during the execution of the scaling calculation, the calculation will be canceled and the SCALE on the display goes off.

(2) Scaling constant

The scaling constant is set as follows:

[Examples of scaling constant A and B]

R6451A		R6452A and R6452E			Meaning
Key operation	Display	Key operation	First display	Second display	
① SHIFT	------	① SHIFT	------		Shift mode
② C(M-B)/A A/B/C	A	② C(M-B)/A A/B/C	A		Constant A setting mode
③ ENTER	123456	③ SHIFT	123456	A	Previously set value of constant A (Example)
④ AUTO ⇨ UP △ DOWN ▽	123333	④ AUTO ⇨ UP △ DOWN ▽	123333	A	Changing setting value of constant A Refer to "(3) Changing numeric value of constant".
⑤ ENTER	Measurement value	⑤ SHIFT	Measurement value		Setting end

R6451A		R6452A and R6452E			Meaning
Key operation	Display	Key operation	First display	Second display	
① SHIFT	------	① SHIFT	------		Shift mode
② C(M-B)/A A/B/C	A	② C(M-B)/A A/B/C	A		Constant A setting mode
③ UP △	B	③ UP △	B		Constant B setting mode
④ ENTER	123456	④ SHIFT	123456	A	Previously set value of constant A (Example)
⑤ AUTO ⇨ UP △ DOWN ▽	123333	⑤ AUTO ⇨ UP △ DOWN ▽	123333	A	Changing setting value of constant A Refer to "(3) Changing numeric value of constant".
⑥ ENTER	Measurement value	⑥ SHIFT	Measurement value		Setting end

Note: Press the I/F to suspend the setting.

(3) Changing numeric value of constant

The ranges of constant A, B, and C are as follows:

Constant	Setting range	Minimum setting value
A	– 999999.E + 6 to + 999999.E + 6	0.00001E-3
B	– 999999.E + 6 to + 999999.E + 6	0.00001E-3
C	– 999999.E + 6 to + 999999.E + 6	0.00001E-3

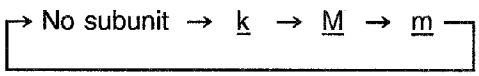
Use the subunits (m k M) to set the exponent part.

Key operation:

① Pressing the [AUTO] in the constant setting mode to highlight the point to be changed. The highlighted point moves in the following order:

- Uppermost digit of the number to lowermost digit
- Subunit
- Decimal

② Highlight the point to be changed and use the [UP] or [DOWN] to change the value of the number and subunit.
Note that the subunit changes in the following order:



If it is required to set the measurement value to the scaling constant, press the [TRIG] in this mode.

The data for which the measurement has been completed and displayed will be set as the scaling constant together with the subunit.

③ After setting the constant, press the [SHIFT] in the case of R6452A and R6452E, and press the [ENTER] in the case of R6451A.

(4) S.OL (Scaling over)

If the result of scaling calculation exceeds 999.999E+6, "S.OL" will appear.

In this case, even if the auto range function is used, the level of the range cannot be increased. (This is because the function judges the range level using the measurement value before the calculation.)

Also, if the result of the scaling calculation is below 0.00001E-3, "0.00000E-3" will appear.

(5) Scaling calculation when changing the measurement functions

If the measurement function in which the scaling operation has been set is changed to a new one, the calculation cannot be executed in the new function. If the function is changed back to the old one, the scaling calculation will be enabled.

If it is required to execute the scaling calculation in the new function, press the C(M-B)/A again.

CAUTION

While the scaling calculation is being executed, the actual measurement value is not displayed.
Therefore, great care should be taken, since in some circumstances a dangerous voltage may not be noticeable on the input connector or test lead line.

(6) Displaying the result of scaling calculation

Unlike in the case of other measurement values, the decimal position of the scaling calculation result is independent of the preset range.

Example: 2000 mV range, 1 V is input for measuring DC voltage.

Measurement value : 1000.00 mV
Scaling calculation result : 1.00000 V

5.4.5 MAX and MIN Arithmetic Function

(1) MAX calculation and MIN calculations

The calculation expressions of MAX and MIN are as follows:

MAX: Display = Maximum value of the results of calculation

MIN: Display = Minimum value of the results of calculation

Every time the MAX /MIN is pressed, the operations are changed as follows:

Maximum value → Minimum value → Cancellation →

If the MAX calculation is selected, the MAX will light up on the display and the maximum value appears.
If the MIN calculation is selected, the MIN will light up on the display and the minimum value appears.
The MAX and MIN calculations are executed independently, and if either has been set, the calculation for the setting will be started and the result of it alone will appear.
If the setting is changed from MAX to MIN calculation, the MIN value after the change will appear.
When the error message "Err d" or "OL C" is output, the calculation for MAX and MIN cannot be executed.

(2) Changing of measurement functions and MAX/MIN calculations

If the function in which the MAX or MIN calculation has been set is changed to a new function, neither calculation can be executed in the new function. When the function returns to the old one, the MAX or MIN value will be cleared and the calculation will start automatically.

(3) Changing other conditions and MAX/MIN calculation

If any of the following is changed, the MAX or MIN value will be cleared and the calculation will start for the changed condition.

- Measurement range
- Sample rate
- Number of displayed digits
- ON/OFF for calculations except for comparator
- Calculation constant during operation

Example: If the constant A is changed during execution of MAX or scaling calculation, the MAX value will be cleared and the calculation for a new MAX value will start after the change.

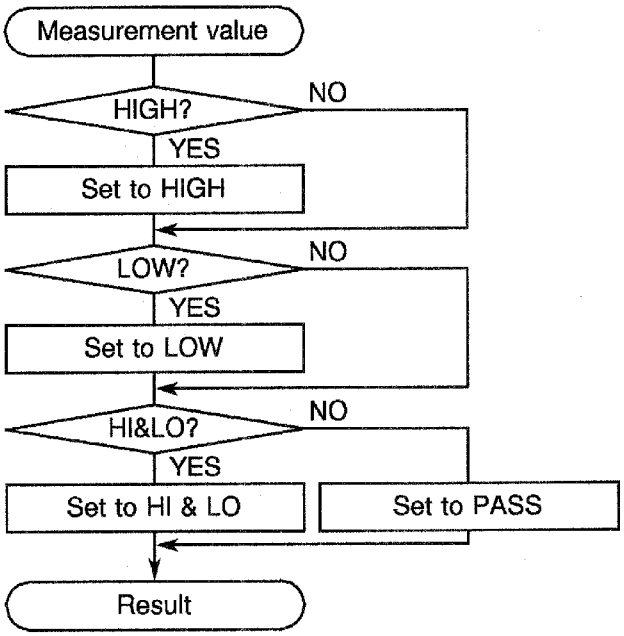
5.4.6 Comparator Function

(1) Comparator calculation

The calculation expression of the comparator function is:

HIGH =	(Measurement value > Setting value for HI)
LOW =	(Measurement value < Setting value for LOW)
PASS =	(Setting value for LOW ≦ Measurement value ≦ Setting value for HI)
HI LO =	(Measurement value > Setting value for HI) & (Measurement value < Setting value for LOW)

Judgment order flow



- R6451A
  Pressing the [COMP] starts the calculation.

  One of the indicators HIGH, PASS, or LOW will light up on the right side of display.

- R6452A and R6452E
  Pressing the [COMP] causes the calculation to be executed for the first display only.

  The result of HI, LO, or PASS will appear on the second display.
  At this time, the measurement for the second display will be canceled.
  If an error message "Err d" or "OL C" appears, the comparator calculation will be disabled.

(2) Setting judgment conditions

The following are setting examples for the HI constant, LO constant, and buzzer:

- R6451A

Key operation	Panel display	Indicator	Meaning
① [SHIFT]	------		Shift mode
② [COMP] HI/LOW	CP HI		HI constant setting mode
③ [ENTER]	654321	HIGH	Previously set value of HI constant
④ [AUTO] ⇨ / [UP] △ / [DOWN] ▽	654321	HIGH	Changing the setting value of HI constant Refer to "(3) Setting numeric value of constant".
⑤ [ENTER]	Measurement value		Setting end

(cont'd)

Key operation	Panel display	Indicator	Meaning
① SHIFT	------		Shift mode
② COMP HI/LOW	CP HI		HI constant setting mode
③ UP △	CP LO		LO constant setting mode
④ ENTER	654321	LOW	Previously set value of LOW constant
⑤ AUTO ⇨	654321	LOW	Changing the setting value of LOW constant Refer to "(3) Setting numeric value of constants".
UP △			
DOWN ▽			
⑥ ENTER	Measurement value		Setting end
① SHIFT	------		Shift mode
② COMP HI/LOW	CP HI		HI constant setting mode
③ DOWN ▽	CP	•))	Buzzer setting mode
④ ENTER	CP	•)) LOW	Previously buzzer setting condition
⑤ UP △	CP	•))	Changing the previously buzzer setting condition Refer to "(4) Setting the buzzer".
DOWN ▽		HIGH LOW	
⑥ ENTER	Measurement value		Setting end

- R6452A and R6452E

Key operation	First display	Second display	Meaning
① SHIFT	------		Shift mode
② COMP (HI/LOW)	CP	HI	HI constant setting mode
③ SHIFT	654321	HI	Previously set value of HI constant
④ AUTO ⇨ UP △ DOWN ▽	654321	HI	Changing the setting value of HI constant Refer to "(3) Setting numeric value of constants".
⑤ SHIFT	Measurement value		Setting end
① SHIFT	------		Shift mode
② COMP (HI/LOW)	CP	HI	HI constant setting mode
③ UP △	CP	LO	LO constant setting mode
④ SHIFT	654321	LO	Previously set value of LOW constant
⑤ AUTO ⇨ UP △ DOWN ▽	654321	LO	Changing the setting value of LO constant Refer to "(3) Setting numeric value of constants".
⑥ SHIFT	Measurement value		Setting end

(cont'd)

Key operation	First display	Second display	Meaning
① SHIFT	------		Shift mode
② COMP HI/LOW	CP	HI	HI constant setting mode
③ DOWN ▽	CP	•))	Buzzer setting mode
④ SHIFT	CP	•)) LOW	Previously buzzer setting condition
⑤ UP △	CP	•))	Changing the previously buzzer setting condition
DOWN ▽		HI LO	Refer to "(4) Setting the buzzer".
⑥ SHIFT	Measurement value		Setting end

(3) Setting numeric value of constants

The ranges for the HI and LO constants are as follows:

Constant	Setting range	Minimum setting value
HI	– 999999.E + 6 to + 999999.E + 6	0.00000E-3
LO	– 999999.E + 6 to + 999999.E + 6	0.00000E-3

Use the subunits (m k M) to set the exponent part.

Key operation:

① Press the AUTO to highlight the point to be changed. The highlighted point moves in the following order:

- Uppermost digit of the numeric value to the lowermost
- Subunit
- Decimal

② Highlight the point to be changed and use the [UP] or [DOWN] to change the numeric value and subunit.
The subunit changes in the following order:

→ No subunit → k → M → m →

If the measurement value is set to the HI or LO constant, press the [TRIG] in this mode.

The data for which the measurement has been completed and displayed will be set as a constant together with the subunit.

③ After setting, press the [SHIFT] in the case of R6452A and R6452E, and the [ENTER] in the case of R6451A.

If the constant setting is made in such a way that the HI constant is less than the LO constant, in some cases the result of the calculation will be "HI and LO". In this case, the result is indicated by:

- R6451A : The indicators HIGH and LOW are lit at the same time.
- R6452A and R6452E : "HI LO" appears on the second display.

(4) Setting the buzzer

The buzzer tone can be changed according to the result of the calculation. However, the buzzer sounds only when ·)) is lit up on the display. When ·)) is off, the buzzer does not sound.
The setting of buzzer tones according to the result of the calculation is as follows:

Enter the buzzer setting mode.

Use the [UP] or [DOWN] to select the buzzer setting.

Each time the setting key is pressed, the setting is changed in the following order:

→ HI LO → PASS → HIGH → LO →
(HI or LO)

(5) Changing the measurement function and comparator operation

If the measurement function in which the comparator operation has been set is changed to a new one, the comparator operation will be canceled in the new function. If the function is changed back to the old function, the comparator operation will start automatically.

However, if the second display is enabled on the R6452A or R6452E, the comparator operation will not start automatically when the function is changed back to the old one.

(6) Changing the measurement range and comparator operation

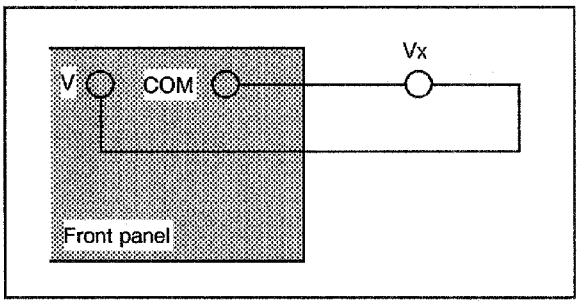
After the measurement range has been changed, the comparator function continues to operate.

The judgment standard value does not change from the previously set value because it has a unit.

6. MEASUREMENT

6.1 DC Voltage Measurement

(1) Connect the object to be measured between the COM and V terminals on the front panel.



(2) Press the V DC .

WARNING

To avoid damaging the instrument, do not apply a voltage exceeding the maximum allowable voltage.

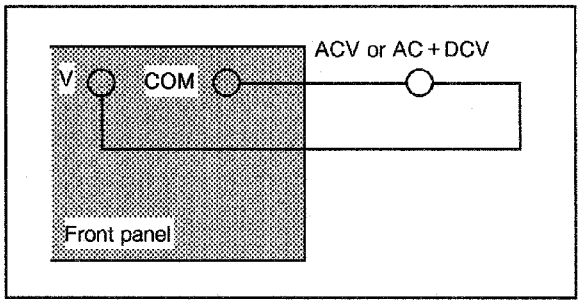
Terminal name		Maximum applicable voltage
COM	V	1100 V MAX
COM or V	Earth to body	450 V MAX

6.2 AC Voltage Measurement (R6452A and R6452E only)

For AC voltage measurement, select one of the two functions below.

1. Extract the AC from the superimposed voltage consisting of DC and AC, and measure the AC voltage only.
2. Measure all objects.

(1) Connect the object to be measured between the COM and V terminals on the front panel.



(2) • AC voltage (AC coupling mode):

Press the [V AC] .

• AC voltage (AC + DC coupling mode):

① Press the [SHIFT] .

② Press the [V AC] (AC+DC) .

Note: Crest factor: 3:1

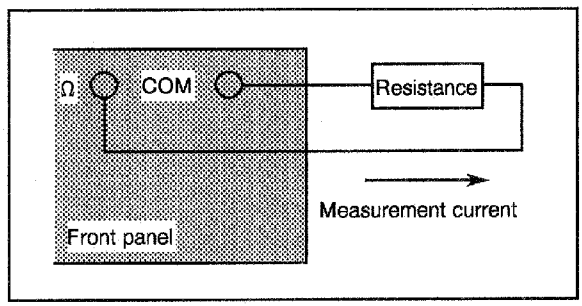
Maximum applicable voltage : Prescribed by the product of the voltage of the signal and frequency. Less than 710 Vrms, 710 VDC, 1000 Vpeak, or 1000000 V*Hz

WARNING

To avoid damaging the instrument, do not apply a voltage exceeding the maximum allowable voltage.

6.3 Resistance Measurement

(1) Connect the object to be measured between the COM and Ω terminals on the front panel.



(2) Press the OHM .

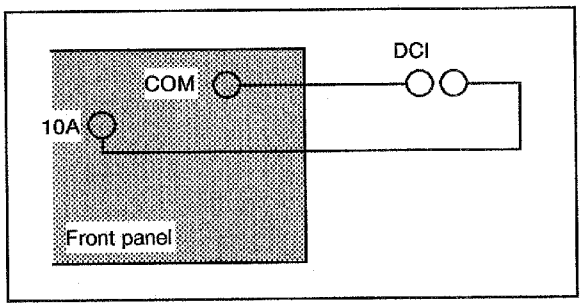
WARNING

When measuring the resistance, the maximum allowable voltage to be applied between the COM and Ω terminals is 500 Vpeak. To avoid damaging the instrument, do not apply a voltage exceeding the maximum allowable voltage.

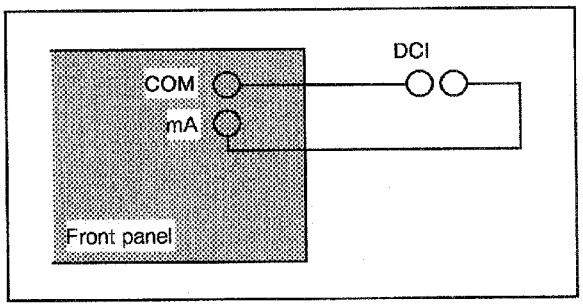
If low resistance is measured, it is necessary to measure the resistance of the lead line as well. If it is desired to eliminate the resistance component due to the lead line, use the NULL function in the arithmetic function.

6.4 DC Current Measurement (R6452A and R6452E only)

(1) • When measuring the 10 A, connect the object to be measured between the COM and 10 A terminals on the front panel.



• When measuring the mA, connect the object to be measured between the COM and mA terminals on the front panel.



(2) Press the A DC .

WARNING

1. Do not apply more than 10 A.
   When other functions are used after 10 A has been applied, a thermoelectric power is generated because the temperature in the input terminal and internal circuits is increased by the applied 10 A.
   If, in particular, high-sensitivity measurement is made after 10 A is applied, the internal temperature should be balanced in advance.

2. Use replacement fuses with the same rating.

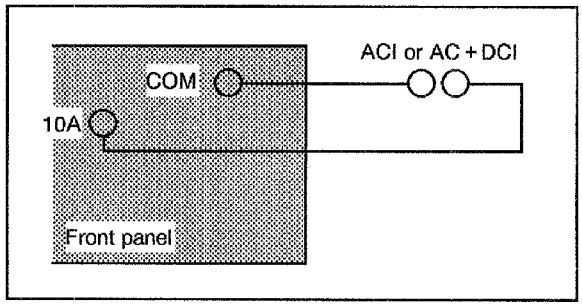
CAUTION

Select a correct input terminal according to the input range to be used. Selection of a wrong one may result in wrong measurements.

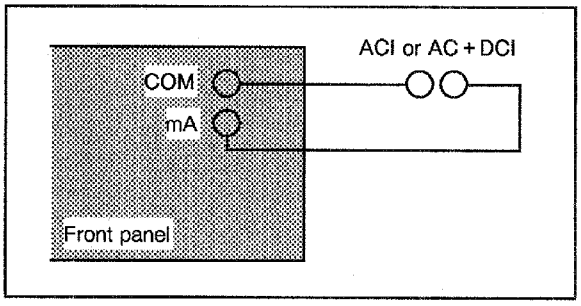
200 mA range	:	Select the mA input terminal.
10 A range	:	Select the 10 A input terminal.

6.5 AC Current Measurement (R6452A and R6452E only)

(1) • When measuring the 10 A, connect the object to be measured between the COM and 10 A terminals on the front panel.



• When measuring the mA, connect the object to be measured between the COM and mA terminals on the front panel.



(2) • To measure AC current (AC coupling mode)

Press the [A AC] .

• To measure AC current (AC + DC coupling mode)

① Press the [SHIFT] .

② Press the [A AC] (AC + DC) .

WARNING

1. Do not apply more than 10 A.

2. When other functions are used after 10 A has been applied, a thermoelectric power is generated because the temperature in the input terminal and internal circuits is increased by the applied 10 A.
   If, in particular, high-sensitivity measurement is made after 10 A is applied, the internal temperature should be balanced in advance.

3. Use replacement fuses with the same rating.

CAUTION

Select a correct input terminal according to the input range to be used. Selection of a wrong one may result in wrong measurements.

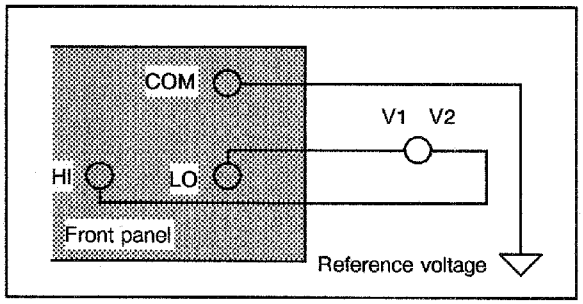
200 mA range	:	Select the mA input terminal.
10 A range	:	Select the 10 A input terminal.

6.6 Bch DC Voltage Measurement (R6452A and R6452E only)

Both R6452A and R6452E are equipped with a 2ch input terminal as standard which is used for DC voltage measurement. With this input terminal, measurement can be made of DC current at two points, AC and DC voltages, and current and DC voltage.

(1) Connect the reference voltage with the COM terminal on the front panel and connect the object to be measured between the HI and LO terminals.

Measurement = V2-V1



(2) • R6452A

① Press the SHIFT .

② Press the V DC (B CH) .

• R6452E

Press the B CH .

WARNING

1. Common mode voltage
   The common mode voltage is the voltage which is applied between the COM terminal and the HI or LO terminal of the Bch, and can be used for applying the DC voltage there.

   Up to 200 VDC can be applied. To avoid damaging the instrument, do not apply a voltage exceeding the maximum direct-current voltage.

2. Maximum allowable voltage
   To avoid damaging the instrument, do not apply a voltage exceeding the maximum allowable voltage.

Terminal name		Maximum applied voltage
COM	Bch HI or LO	200 VDC
HI	LO	200 VDC

CAUTION

If A ch. and B ch. are used for different measurements and the measurement range is changed (between 200 mV and 2000mV, or between 20V, 200 V and 1000 V) relays are used when the channels are switched.
The relay contact life expectancy is considered to have expired when a billion relay contacts have been performed. However, this is affected substantially by the sampling rate and other operating conditions, as shown in the table below.
When relay switching is performed we recommend that you reduce the sampling rate to a lower rate.

Estimated relay contact life when the relay switching is performed

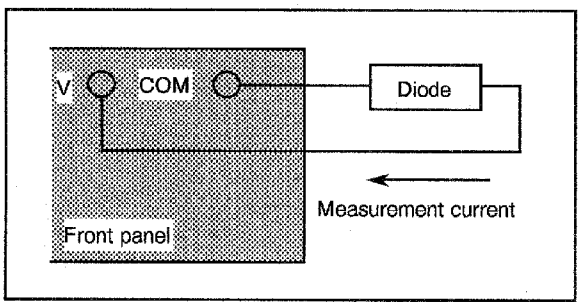
*No calculation is performed.

Sampling rate / Response time / Operating condition	Fast	Medium	Slow
	44.8ms	220.8ms	820.8ms
Consecutive operation	51.8 days	255.6 days	950 days
8 hours / day, 20 days / month	7.8 months	38.3 months	142.5 months

6.7 Diode Measurement

(1) Connect the diode between the V and COM terminals on the front panel.

A DC current of approximately 1mA flows from the terminal to the COM terminal. Measure and display the voltage generated between the terminals (voltage drop in the forward direction).



(2) • R6452A and R6452E

Press the [⊣|] .

A diode mark will light up as a function indicator.

• R6451A

① Press the [SHIFT] .

② Press the [A DC / ⊣|] .

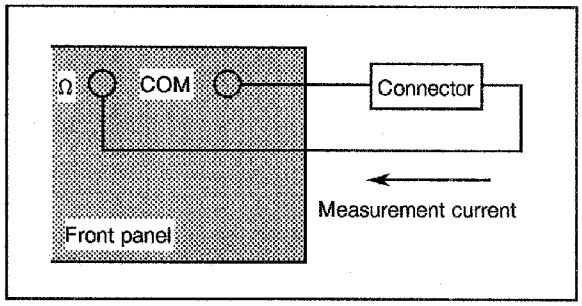
A diode mark will light up as a function indicator.

Note: The generated voltage to be measured is less than 2 V. If the voltage exceeds this value, "OL" (over) will be displayed.

6.8 Continuity Measurement

(1) Connect the object to be measured for its continuity between the Ω and COM terminals on the front panel.

A DC current of approximately 3 mA flows from the V terminal to the COM terminal. Measure and display the voltage generated between the terminals (voltage drop in the forward direction). If continuity is detected, a buzzer will sound.



(2) • R6452A and R6452E

① Press the SHIFT .

② Press the OHM .

• R6451A

Press the .

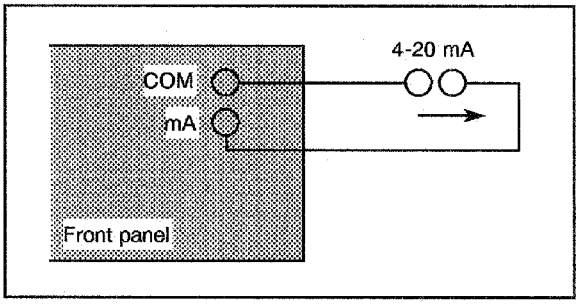
Note: The resistance to be measured is less than 200 Ω. If the value exceeds this value, "OL" (over) will be displayed. If the value is less than 20 Ω, a buzzer will sound to indicate continuity.

For the continuity measurement, the buzzer is always set to ON.

6.9 4-20 mA Measurement (R6451A only)

The 4-20 mA measurement is a measurement function for analog data in which a measured amperage is represented as a percentage; 4 mA = 0 , 20 mA = 100%, and so on.

(1) Connect the object to be measured between the mA and COM terminals on the front panel.



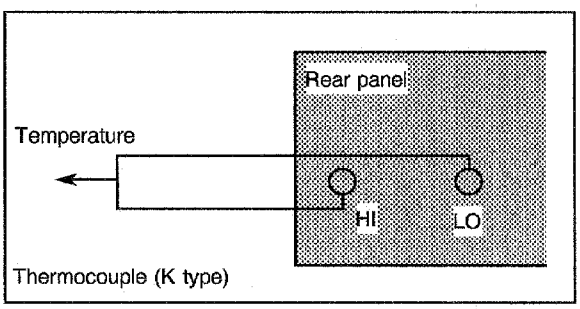
(2) ① Press the SHIFT .

② Press the A DC (4-20 mA) .

Note: If the number of digits displayed exceeds 120%, "OL" (over) will be displayed.

6.10 Temperature Measurement (R6452A and R6452E only)

(1) Use the input terminal on the rear panel. If the thermocouple (K type) is connected to the input terminal, the temperature measurement will be such that the temperature of the terminal is guaranteed inside.



(2) Press the TEMP .

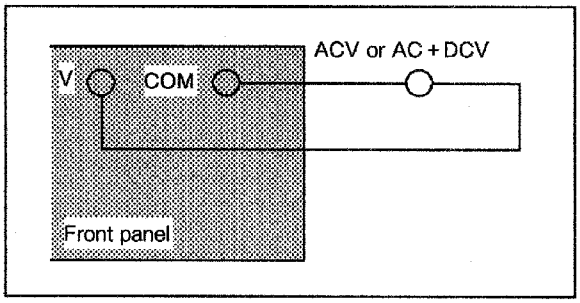
Note: The input terminal for the temperature measurement is very sensitive to temperature. Leave the terminal for approximately three minutes to ensure the stability of the terminal temperature. The time required may depend on the environment in which the thermocouple is mounted.

WARNING

The voltage difference between this terminal and the 2ch input terminal is a maximum of 46 Vpeak. Care should be taken not apply a voltage exceeding this value.

6.11 Frequency Measurement (R6452A only)

(1) Connect the object to be measured between the V and COM terminals on the front panel.



(2) ① Press the SHIFT .

② Press the TEMP (FREQ) .

Note: If the measurement is made with the range below 20 Hz or above 200 kHz, accurate measurement cannot be guaranteed.

If the measurement for ACI or AC + DCI is combined with the frequency measurement in the dual display mode, the frequency of ACI or AC + DCI will be measured.

7. USING VARIOUS INTERFACES

7.1 Mounting Various Interfaces

Interface type		Model name	Details
User's options*	GPIB interface unit	R13220	See section 7.6.
	BCD data output unit	R13015	See section 7.4.
	Printer interface unit	R13221	See section 7.7.
	Comparator unit	R13016	See section 7.5.
	Memory card interface unit	R13222	See section 7.8.
	Battery unit	R15807	See chapter 8.
Standard	RS-232 interface	——	See section 7.3.

* : User's options are units mounted on the instrument by the users.

7.1.1 Mounting of GPIB/BCD/Printer/Comparator Unit

Only one of the following units can be mounted on the rear panel of the instrument.

- GPIB interface unit
- BCD data output unit
- Printer interface unit
- Comparator unit

CAUTION

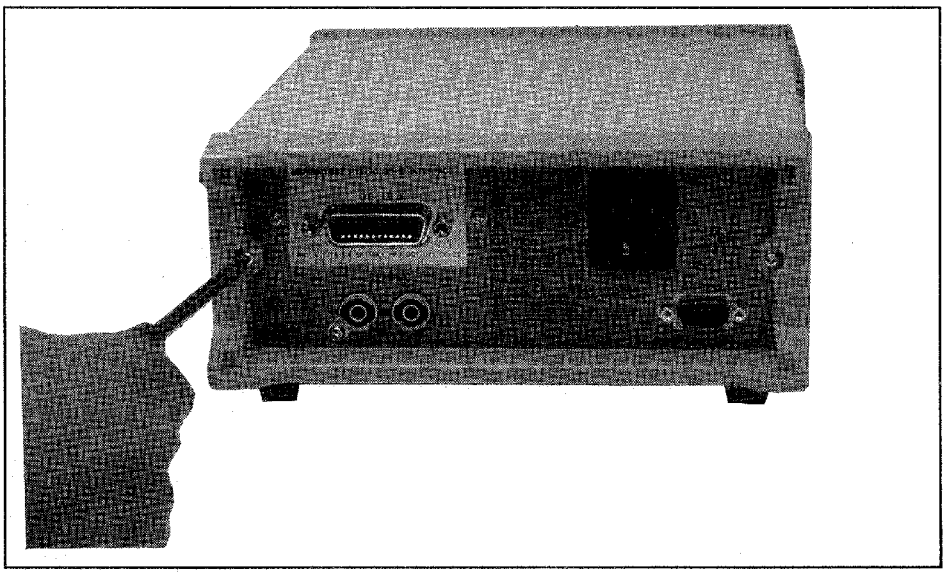
Before a unit is mounted to the instrument, disconnect the power supply plug and input cable to avoid the possibility of electric shock or damage to the instrument.

Mounting procedure:

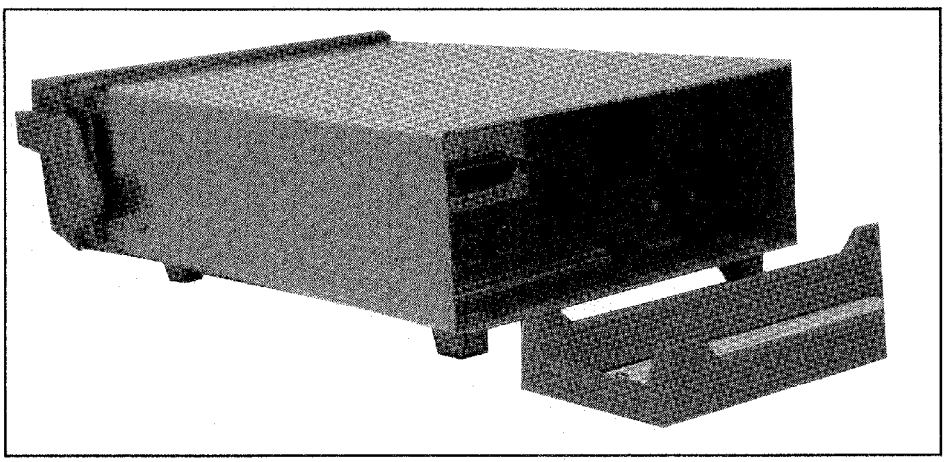
CAUTION

When the apparatus is connected to its supply, terminals may be live, and the opening of covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.
The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

① Remove the Phillips-head (cross-tip) screw securing the rear foot on the rear panel using a 3 mm Phillips-head (cross-tip) screwdriver.

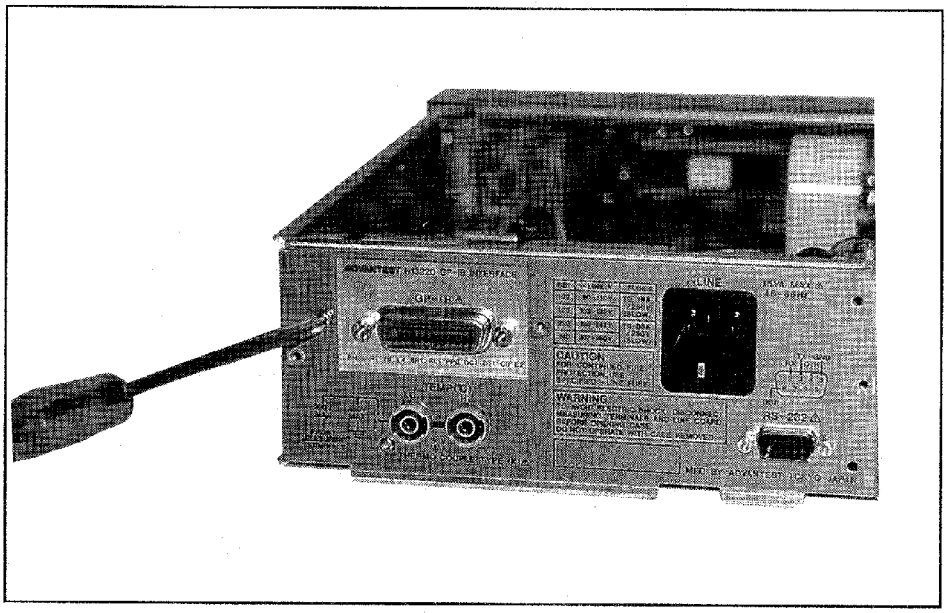


② Remove the rear foot.

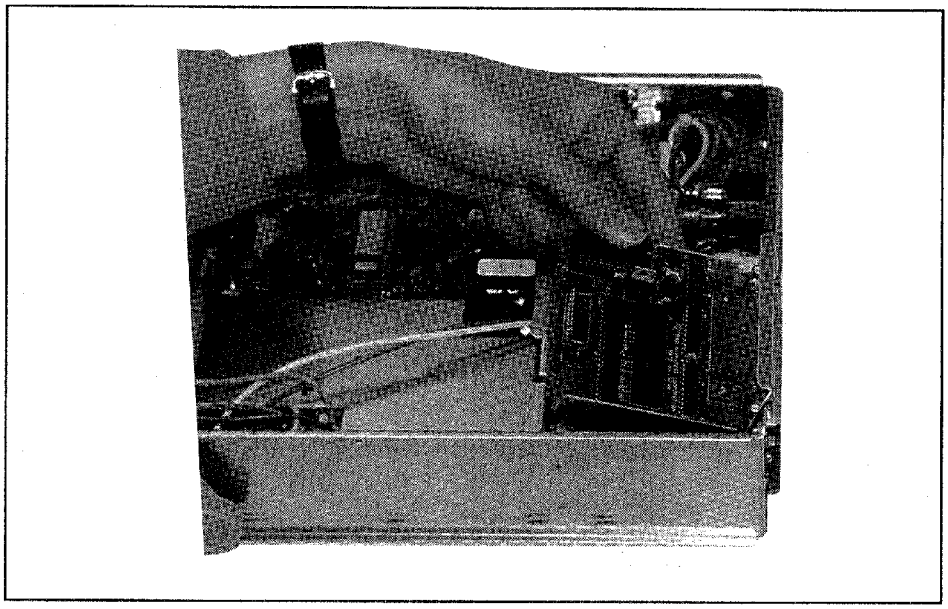


③ Remove the case from the instrument.

④ With the 3 mm Phillips-head screwdriver, remove the Phillips-head screws securing the blind patch and other options to the interface.

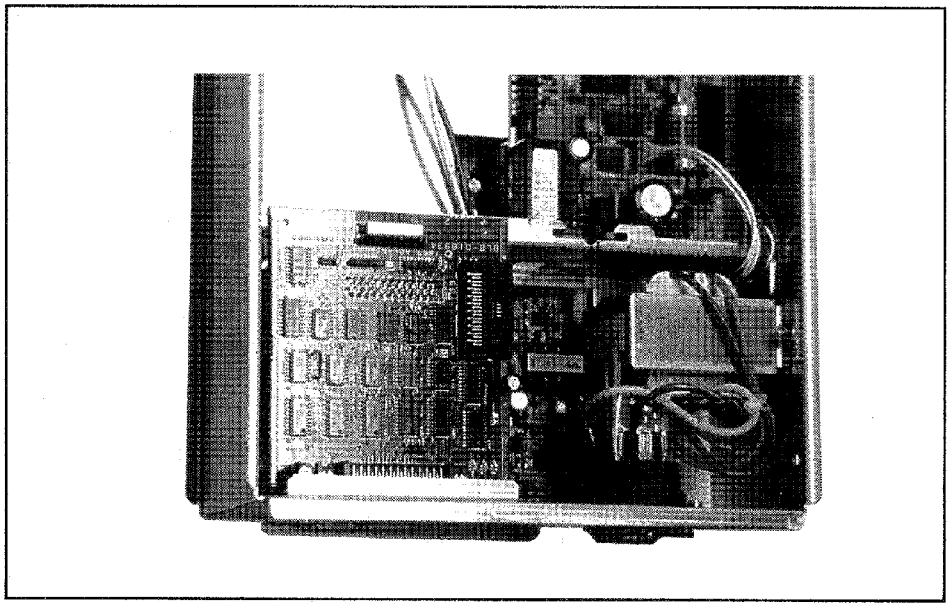


⑤ Slide the interface board into the slot to mount it.



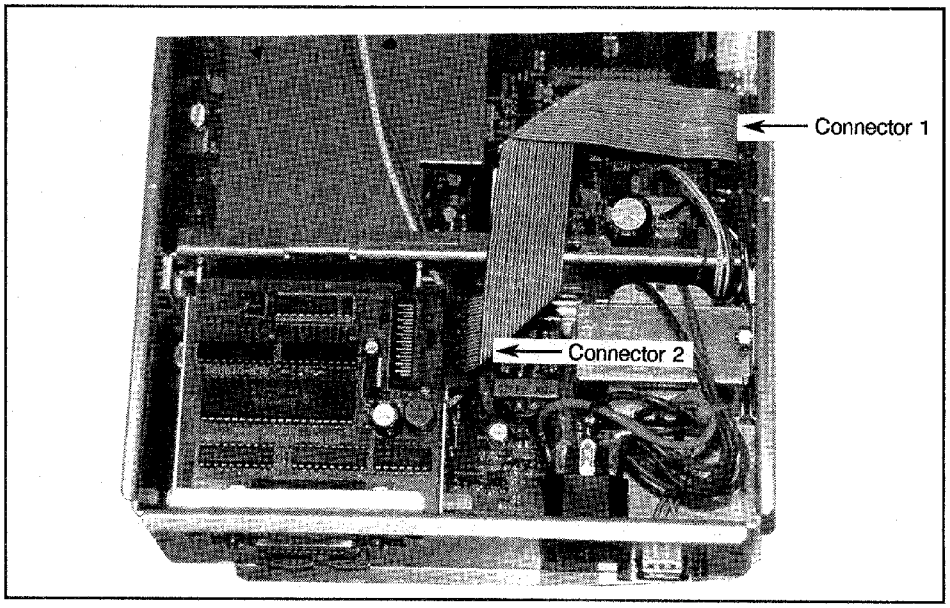
⑥ Fix the Phillips-head screws removed in step ④.

Mounting example of BCD board:

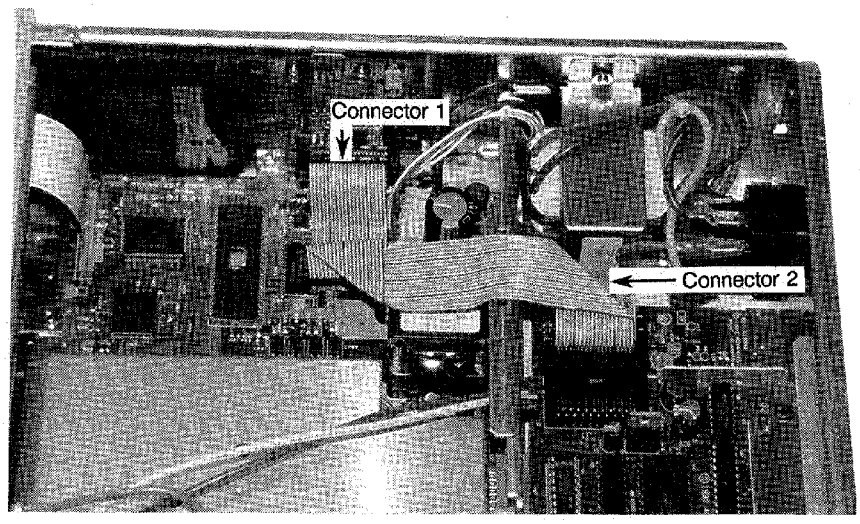


⑦ Connect the cable to the instrument.

- Memory card interface unit not installed
  Connect connectors 1 and 2 using the cable supplied, as shown in the photograph.



- Memory card interface unit installed
  Use the connector on the memory card interface unit for connection.
  Connect connectors 1 and 2 using the cable supplied, as shown in the photograph.



⑧ Replace the instrument case and secure the rear foot with the Phillips-head screws.

7.1.2 Mounting Memory Card Interface Unit

CAUTION

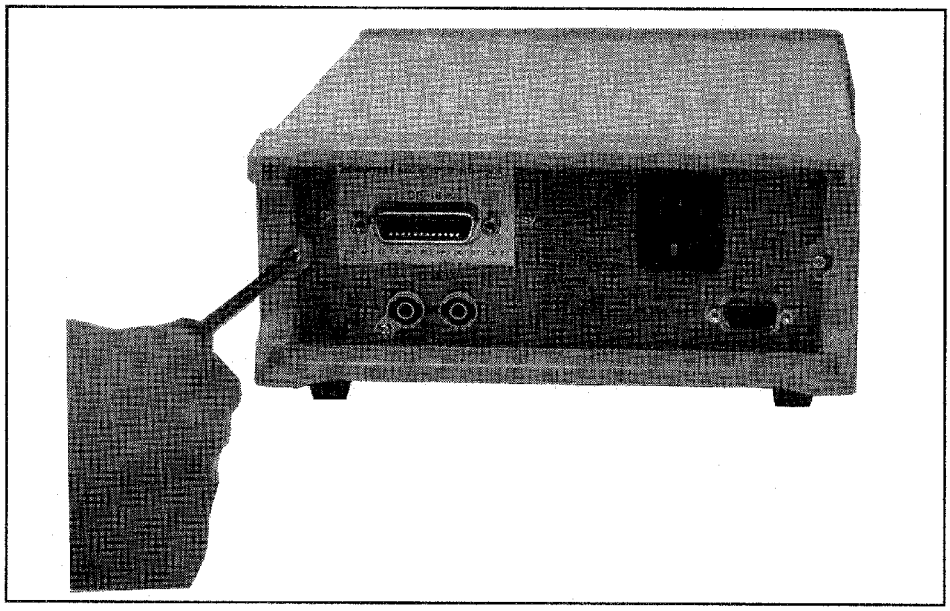
1. Before mounting the memory card interface unit on the instrument, be sure to disconnect the power supply plug and input cable to avoid the possibility of electric shock or damage to the instrument.

2. To protect the electric circuit of the instrument against static electricity, be sure to use an earth band. The memory card interface unit consists of parts (such as CMOSs) which are sensitive to static electricity.

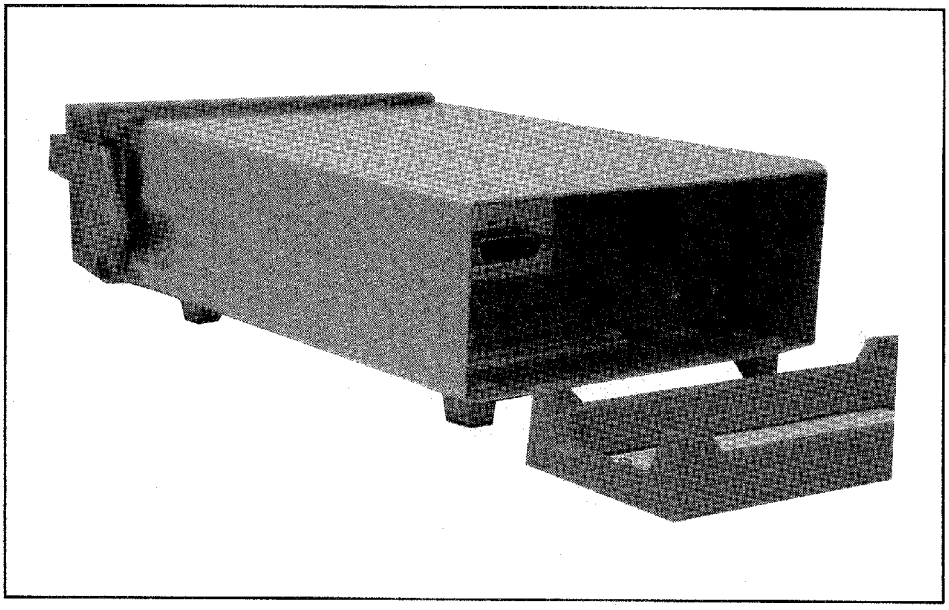
3. Use specified tools or their equivalents to avoid damage to Phillips-head screws.

Mounting procedure:

① Remove the two Phillips-head screws securing the rear foot on the rear panel using the 3 mm Phillips-head screwdriver.



② Remove the rear foot.



③ Remove the case from the instrument.

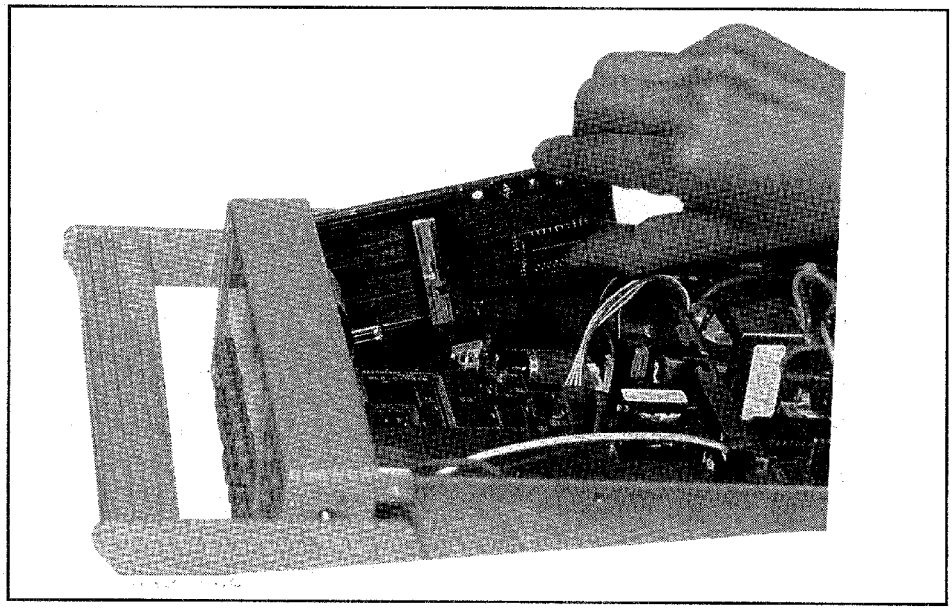
④ • Battery unit mounted

After removing the battery unit, mount the memory card interface unit. To remove the battery unit, remove the two Phillips-head screws from the sides of the instrument and disconnect the connection cable from the instrument. (To mount the battery unit, see section 7.4.)

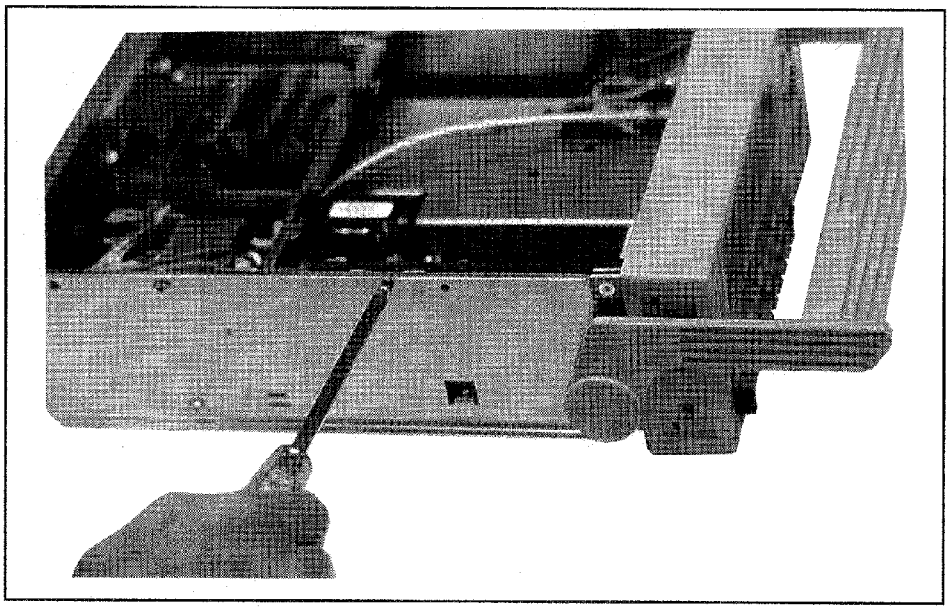
• Battery unit not mounted

Go to ⑤.

⑤ Mount the memory card interface unit.

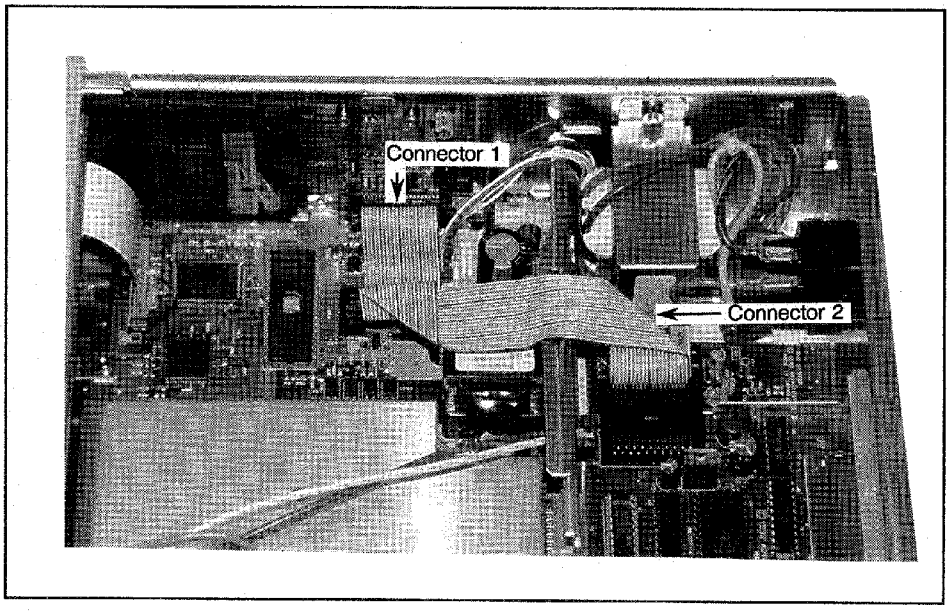


⑥ Secure the memory card interface unit using the two Phillips-head screws.



⑦ External control option mounted on the rear panel

For connection to an instrument equipped with the external control option, use the connector on the memory card interface unit.



⑧ Cover the case on the instrument and secure the rear foot using the Phillips-head screws.

7.2 Selecting External Interfaces

To set the operating conditions of the external interfaces, use the [I/F] .

With the [I/F], set the following conditions:

- GPIB
- RS-232
- BCD
- Comparator
- IC memory card
- Printer

In addition to the IC memory card, only one interface can be selected.
The IC memory card is used for initialization.

Key operation	Display of R6451A	R6452A and R6452E		Descriptions
		First display	Second display	
① [I/F]	SCI ON	SCI	ON	Display when RS-232 is selected When not selected, setting is OFF.
② [UP] *	GP OFF	GP	OFF	Selects GPIB setting mode.
③ [UP] *	BCD OFF	BCD	OFF	Selects BCD setting mode.
④ [UP] *	CP OFF	CP	OFF	Selects comparator setting mode.
⑤ [UP] *	PR OFF	PR	OFF	Selects printer setting mode.
⑥ [UP] *	CARD	CARD		Selects IC card memory setting mode. Use the [UP] or [DOWN] to select the display from 1 to 6.

* : In operations ② to ⑥, if the interface is not mounted, no display is indicated.

7.3 RS-232 Interface

7.3.1 Configuration of RS-232 Interface

The RS-232 interface is a standard equipment of the instrument.
It enables the setting of various measurement functions for the instrument, the setting of measurement parameters, the reading of the measurement data, and easy configuration of the automatic measurement system.
Since the interface is electrically isolated from the measurement signal system, external instruments do not affect measurement values.

7.3.2 RS-232 Data Format

Start bits	7-data bits	Parity bits	Stop bits

Start bits	8-data bits	Stop bits

Setting state

Baud rate	:	9600, 4800, 2400, 1200, 600, or 300
Parity	:	even, odd, or no
Number of data bits	:	8 or 7 data bits / 1 parity bit
Number of stop bits	:	1 or 2 bits
Echo	:	on or off

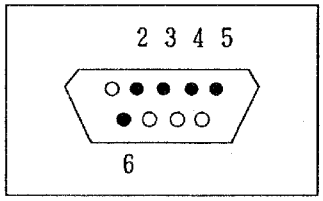
Setting items

Output data header	Only mode	Baud rate	Data length	Parity	Stop bit	Echo
ON	ON	9600 4800 2400	7	even odd	1	ON
OFF	OFF	1200 600 300	8	no	1 2	OFF

Note: Depending on the data length, selection of the parity bit and stop bit will be limited.
The underlined parts are the factory settings.

For the setting method (operation of front panel), see subsection 7.1.2.

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



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

The instrument is equipped with 50-character buffer, if the buffer is full, the "data terminal ready (DTR)" is set to false. If the DTR is false, the data transmission must be stopped before the number of characters for the data reaches ten.
When the characters in the input buffer have been processed, the number of characters in the buffer decreases and the DTR is set to true.

"Transmission data (TxD)" checks the state of the "data set ready (DSR)" in the instrument, and if the DSR is set to false, suspends the output. When the DSR is set to true, the "Transmission data (TxD)" restarts the data transmission.

CAUTION

The instrument cannot perform flow control using the X parameters (XON/XOFF).
Care should be taken when the instrument is connected to instruments with the X parameters.

7.3.3 Setting RS-232

The setting conditions and the factory settings of the RS-232 are as follows:

Setting condition	Factory setting
Output data ON/OFF header	ON
Talk only ON/OFF	OFF
Baud rate	9600 BAUD
Data length	8 BIT
Parity	None
Number of stop bits	1 BIT
Echo	ON

Initial states of measurement condition are as follows:

Item	Initialize setting	Master reset	Power on
Status byte	0	○	○
Inable all status	255	○	○
String delimiter	, (comma)	○	○

(1) RS-232 setting example

R6451A		R6452A and R6452E			Meanings
Key operation	Display	Key operation	First display	Second display	
RS-232 currently selected					
① I/F	SCI on	① I/F	SCI	on	Option setting mode
RS-232 not currently selected					
UP DOWN	SCI oFF	UP DOWN	SCI	oFF	Display for selecting RS-232
② ENTER	Ho SCI	② SHIFT	Ho	SCI	Display for previous setting
③ AUTO UP DOWN	_o SCI	③ AUTO UP DOWN	_o	SCI	Display for selecting header OFF and only mode See "(2) Setting header and only ON/OFF".

(cont'd)

R6451A			R6452A and R6452E			Meanings
Key operation		Display	Key operation	First display	Second display	
④	ENTER	9600 bA	④ SHIFT	9600	bAud	Display for previous setting
⑤	UP / DOWN	4800 bA	⑤ UP / DOWN	4800	bAud	Display for selecting 4800 baud See "(3) Setting the baud rate".
⑥	ENTER	7 dAtA	⑥ SHIFT	7 bit	dAtA	Display for previous setting
⑦	UP / DOWN	8 dAtA	⑦ UP / DOWN	8 bit	dAtA	Display for selecting 8 bit See "(4) Setting the data length".
⑧	ENTER	no PAr	⑧ SHIFT	no	PAr	Display for previous setting See "(5) Setting parity".
⑨	ENTER	1 StoP	⑨ SHIFT	1 bit	StoP	Display for previous setting
⑩	UP / DOWN	2 StoP	⑩ UP / DOWN	2 bit	StoP	Display for selecting 8 bit See "(6) Setting the stop bits".
⑪	ENTER	on Ech	⑪ SHIFT	on	Echo	Display for previous setting
⑫	UP / DOWN	oFF Ech	⑫ UP / DOWN	oFF	Echo	Display for selecting echo ON See "(7) Setting the echo".
⑬	ENTER	SCI on	⑬ SHIFT	SCI	on	Confirmation of setting end
⑭	ENTER	Measurement value	⑭ SHIFT	Measurement value		Setting end

Note: Use the I/F (HOME) to suspend the setting.

(2) Setting the output data ON/OFF header and talk only mode ON/OFF

① Enter the option setting mode.

Each time the [AUTO] ⇨ is pressed, the selectable point flashes in the following order:

- Output data header

Display	Description
H	Indicates header ON.
-	Indicates header OFF.

- Talk only (Used for automatically sending the measurement values to the printer or terminals.)

Display	Description
0	Indicates talk only ON.
-	Indicates talk only OFF.

② Flash the point to be selected and use the [UP] △ and [DOWN] ▽ to change the setting.

(3) Setting the baud rate

Enter the baud rate setting mode.

Use the [UP] △ and [DOWN] ▽ to change the baud rate setting.

The baud rate options are changed in the following order:

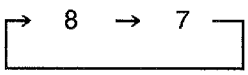
→ 9600 → 300 → 600 → 1200 → 2400 → 4800 →

(4) Setting the data length

Enter the data length setting mode.

Use the UP △ and DOWN ▽ to change the data length setting.

The data length options are changed in the following order:

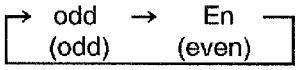


(5) Setting parity

Enter the parity setting mode.

Use the UP △ and DOWN ▽ to change the parity setting.

Only when the data length setting is 7 bit, the parity options are changed in the following order:

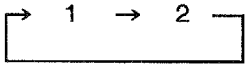


(6) Setting the stop bits

Enter the stop bits setting mode.

Use the UP △ and DOWN ▽ to change the stop bits setting.

Only when the data length setting is 8 bit, the stop bit options are changed in the following order:

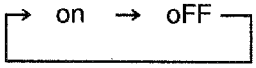


(7) Setting the echo

Enter the echo setting mode.

Use the UP △ and DOWN ▽ to change the echo setting.

The echo options are changed in the following order:



7.3.4 Output Data Format

The types of the output data transmitted through RS-232 are classified into:

- Echo
- Prompt
- Measurement data
- Inquiry result (for inquiry command)
- Recall data (when the IC memory card is used)

The contents and format of each data type are as follows:

(1) Echo output

The echo is output only when the RS-232 setting sets the echo output to ON.
Basically, the received data are transmitted without any change, but <^C> (CONTROL C), <LF> is not transmitted as the echo output.

(<LF> + (PROMPT) + (DELIMITER)

Note: The delimiter is set to <CR> + <LF> and cannot be changed.

(2) Prompt

The result of a command received through the RS-232 is output while being displayed by the prompts. <LF> is output first, followed by the prompt delimiter.
There are the following three kinds of prompt:

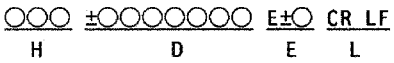
Prompt	Contents
=>	The command is normally received/analyzed and processed.
?>	An abnormality is detected when a command is received, analyzed, or executed. (Err 10).
@>	An abnormality is detected when accessing the IC memory card. (Err 32, 34, 35, 36, 37, 38, or 39)

For the meanings of the error messages, see "Table 10-1 Error Messages".

(3) Output of the measurement data (for only mode)

In the only mode, the measurement data can be output only when the RS-232 is available for transmission after the measurement and the transmission buffer has become empty.
The delimiter is output for each measurement value.

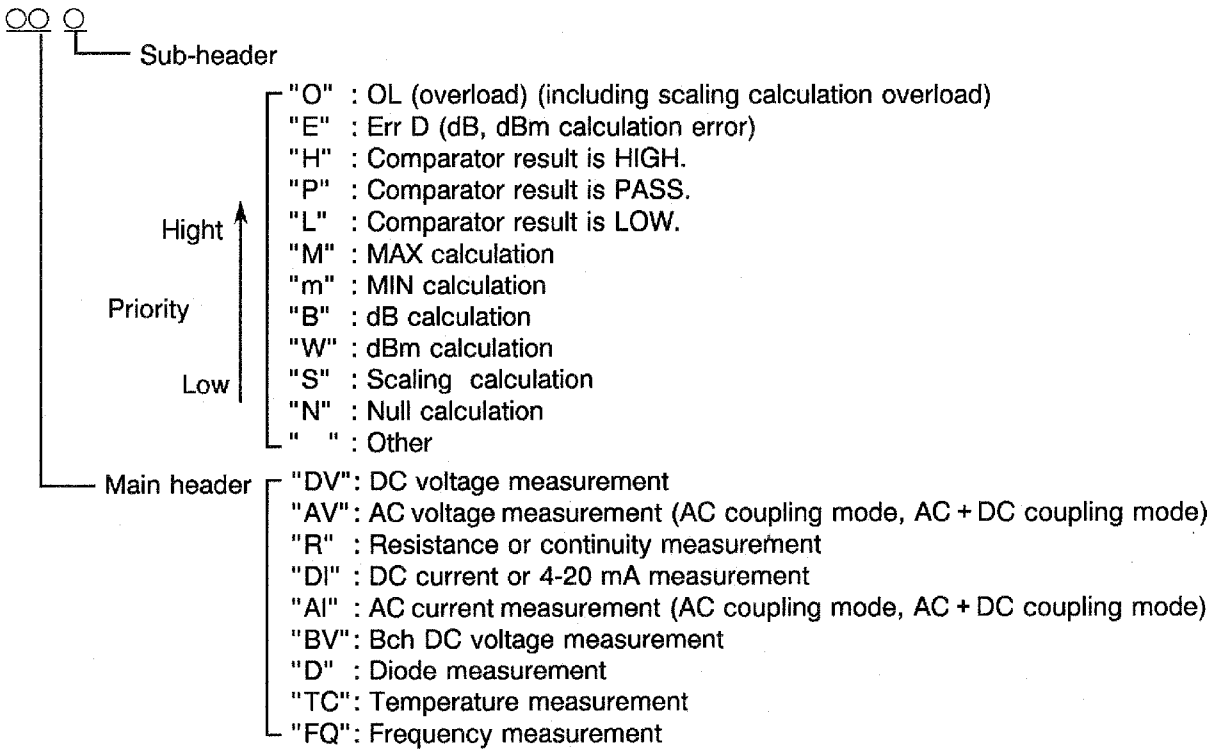
The data output format of the measurement values and the calculation data is as follows:



H : Header (ASCII code consisting of three characters)
D : Mantissa (polarity + decimal + number with four to six digits)
E : Exponent (E + polarity + number with one digit)
L : Delimiter (used for end indication of one data)

1. Header

When the header is set to ON, an ASCII code consisting of three characters is output as follows:
When the header is set to OFF, the code is omitted.



2. Mantissa and Exponent

The mantissa part of the measurement value varies in accordance with the settings of the sample rate and the number of displayed digits. (See Table 7-1.)
The decimal position moves according to the display of the instrument.
The exponent part is displayed in accordance with the selection of the measurement functions and measurement ranges and its displayed value corresponds to the setting of the subunit (m, K, M, or G).

Table 7-1 Mantissa and Exponent Parts

Measurement function	Range	Main header	Maximum values of mantissa parts			Exponent	Applicable models (R64XXX)		
			FAST	MID	SLOW		51A	52A	52E
DC voltage measurement	200 mV	DV	199.9--	199.99-	199.999	E-3	○	○	○
	2000 mV	DV	1999.--	1999.9-	1999.99	E-3	○	○	○
	20 V	DV	19.99--	19.999-	19.9999	E+0	○	○	○
	200 V	DV	199.9--	199.99-	199.999	E+0	○	○	○
	1000 V	DV	1099.--	1099.9-	1099.99	E+0	○	○	○
AC voltage measurement (AC coupling mode)	200 mV	AV	199.9--	199.99-	199.999	E-3	○	○	—
	2000 mV	AV	1999.--	1999.9-	1999.99	E-3	○	○	—
	20 V	AV	19.99--	19.999-	19.9999	E+0	○	○	—
	200 V	AV	199.9--	199.99-	199.999	E+0	○	○	—
	700 V	AV	709.--	709.9-	709.99	E+0	○	○	—
Resistance measurement	200 Ω	R	199.9--	199.99-	199.999	E+0	○	○	○
	2000 Ω	R	1999.--	1999.9-	1999.99	E+0	○	○	○
	20 kΩ	R	19.99--	19.999-	19.9999	E+3	○	○	○
	200 kΩ	R	199.9--	199.99-	199.999	E+3	○	○	○
	2000 kΩ	R	1099.--	1099.9-	1099.99	E+3	○	○	○
	20 MΩ	R	19.99--	19.999-	19.9999	E+6	○	○	○
	200 MΩ	R	199.9--	199.99-	199.99-	E+6	○	○	○
DC current measurement	200 mA	DI	199.9--	199.99-	199.999	E-3	○	○	—
	10 A	DI	10.99--	10.999-	10.9999	E+0	○	○	—
AC current measurement (AC coupling mode)	200 mA	AI	199.9--	199.99-	199.999	E-3	○	○	—
	10 A	AI	10.99--	10.999-	10.9999	E+0	○	○	—
AC voltage measurement (AC + DC coupling mode)	200 mV	AV	199.9--	199.9--	199.99-	E-3	○	○	—
	2000 mV	AV	1999.--	1999.--	1999.9-	E-3	○	○	—
	20 V	AV	19.99--	19.99--	19.999-	E+0	○	○	—
	200 V	AV	199.9--	199.9--	199.99-	E+0	○	○	—
	700 V	AV	709.--	709.--	709.9-	E+0	○	○	—

Table 7-1 Mantissa and Exponent Parts (cont'd)

Measurement function	Range	Main header	Maximum values of mantissa parts			Exponent	Applicable models (R64XXX)		
			FAST	MID	SLOW		51A	52A	52E
AC current measurement	200 mA	AI	199.9--	199.9--	199.99-	E-3	○	○	—
(AC + DC coupling mode)	10 A	AI	10.99--	10.99--	10.999-	E+0	○	○	—
Bch DC voltage measurement	2000 mV	BV	1999.--	1999.9-	1999.9-	E-3	—	○	○
	20 V	BV	19.99--	19.999-	19.999-	E+0	—	○	○
	200 V	BV	199.9--	199.99-	199.99-	E+0	—	○	○
Diode measurement	2000 mV	D	1999.--	1999.9-	1999.99	E-3	○	○	○
Continuity measurement	200 Ω	R	199.9--	199.99-	199.999	E+0	○	○	○
4-20 mA measurement	100 %	DI	999.--	999.9-	999.99	E+0	○	—	—
Temperature measurement	1000 °C	TC	1370.--	1370.0-	1370.0-	E+0	—	○	○
Frequency measurement	20 Hz	FQ	19.999-	19.999-	19.999-	E+0	—	○	—
	200 Hz	FQ	199.99-	199.99-	199.99-	E+0	—	○	—
	2000 Hz	FQ	1999.9-	1999.9-	1999.9-	E+0	—	○	—
	20 kHz	FQ	19.999-	19.999-	19.999-	E+3	—	○	—
	200 kHz	FQ	199.99-	199.99-	199.99-	E+3	—	○	—

3. Delimiter

The delimiter consists of two bytes data: CR($13_{(10)}$) and (LF($10_{(10)}$).

(4) Inquiry result output by inquiry command

The result of the inquiry by the inquiry command is output in the order: <LF>, inquiry result, delimiter, and prompt.

If there are multiple results of inquiry, as in the case of the test results, each result will be separated by the string delimiter, and the last result is followed by the delimiter.

(<LF> + (Inquiry result) + (String delimiter)
(Inquiry result) + (String delimiter)
⋮
(Inquiry result) + (Delimiter)

Among the three types of the string delimiter shown below, the selected one only will be output.

- <Comma>
- Space
- <CR> + <LF>

(5) Recalling the measurement data file of the IC memory card

When recalling the IC memory card, a prompt is output when the recall inquiry is set after the command has been analyzed. If the recall is made correctly the recall result will be output. (For recall of the measurement data file only)

If the recall fails, a prompt indicating that the operation on the IC memory card has faild (@>) will be output.

The following are the output data when the recall of the measurement data has been correctly:

- Recall of the setting information for measuring the measurement data file
  To generate the recall of the setting information used for measurement, each of items is separated by a string delimiter, and the last item is followed by the delimiter.

  (<LF>) + (Prompt) + (Delimiter)
  (Model name, version) + (String delimiter)
  ⋮
  (Measurement data, the number of samples) + (Delimiter)

- Recall of the measurement data for the measurement data file
  To generate the recall of the measurement data, each measurement data is separated by a string delimiters, and the last data is followed by the delimiter.

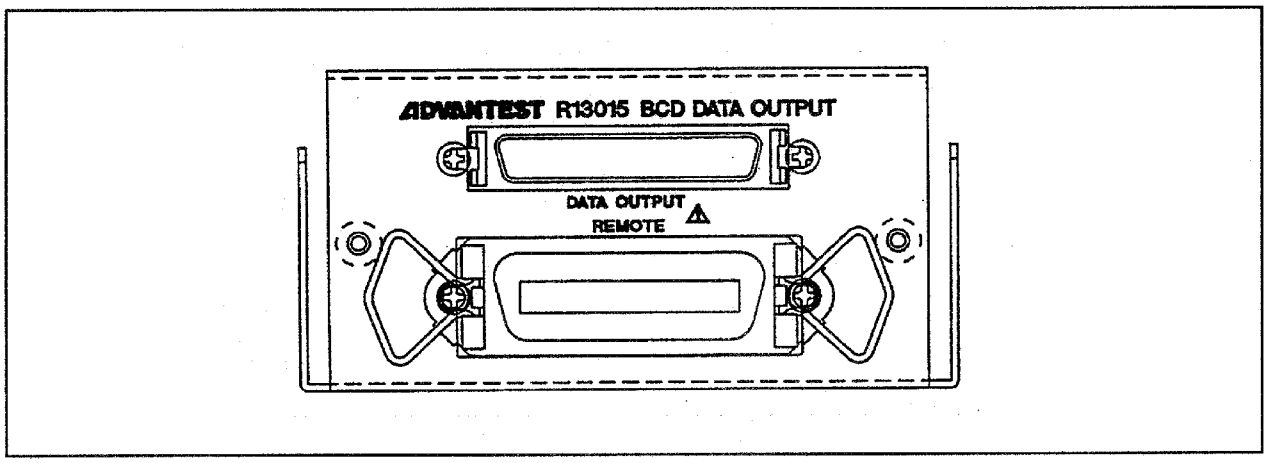
  (<LF>) + (Prompt) + (Delimiter)
  (Recalled measurement data) + (String delimiter)
  ⋮
  (Recalled measurement data) + (Delimiter)

7.4 BCD Data Output Unit R13015

7.4.1 Outline

With the BCD data output unit R13015 installed on the instrument, the measurement result will be converted into a BCD parallel code and can be output to external digital equipments such as a digital recorder. Also, it is equipped with a remote control which enables the external controller to control the setting of various measurement conditions and the start of the measurement.

Since the input/output signal system is electrically isolated from the measurement signal system of the instrument, measurement values cannot be affected by external equipments.



DATA OUTPUT connector

Used for data output. (Dai-ichi Electronics Industry Co. ; DHA-RA50)

REMOTE connector

Used for the remote control input. (Dai-ichi Electronics Industry Co. product 57-40240)
Use a Dai-ichi Electronics Industry Co. product 57-30240 for connector or an equivalent connector.
Use our product MO-09 or MO-28 for cables.

7.4.2 Specifications and Performances

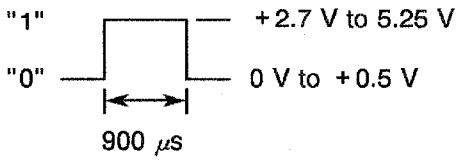
Data output

Output code : BCD (Binary Coded Decimal) code

Contents : Measurement data, decimal, polarity, and unit

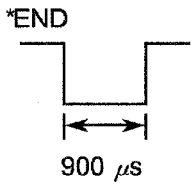
Signal level : TTL level positive pulse

Print command signal (PRINT CMD)
: TTL level positive pulse



Control signals: Control using the 15 lines of *STROBE, *FCA, *FCB, *FCC, *FCD, *RCA, *RCB, *RCC, *RCD, *PRA, *PRB, *HOLD, *NULL, *COMP, and *BUZ
TTL level negative pulse (* indicates the negative pulse signals.)
(* STROBE signal operates on the fall edge.)

* END signal : TTL level negative pulse



External start signal:

EXT ST. A : TTL level positive pulse Operates on the rise edge.

*EXT ST. B : TTL level negative pulse Operates on the fall edge.

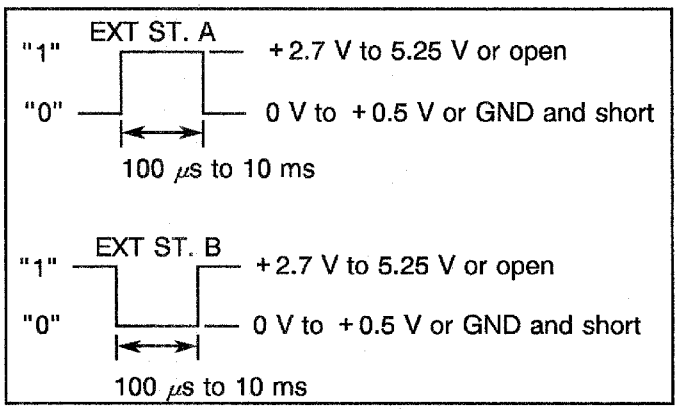


Figure 7-1 Figure Title

7.4.3 Output Data Codes

Table 7-2 BCD Data Output Codes

Output name	Output signal	Code				Output name	Output signal	Code			
		8	4	2	1			8	4	2	1
Data	0	0	0	0	0	Function	* (OVER)	0	0	0	0
	1	0	0	0	1		H (HIGH)	1	1	0	1
	2	0	0	1	0		L (LOW)	1	1	1	0
	3	0	0	1	1		(PASS)	0	1	1	0
	4	0	1	0	0		Space	0	1	1	0
	5	0	1	0	1	Unit	mV	0	0	0	0
	6	0	1	1	0		kHz	0	0	0	1
	7	0	1	1	1		V	0	0	1	0
	8	1	0	0	0		°C	0	0	1	1
	9	1	0	0	1		Ω	0	1	0	0
	–	1	0	1	0		kΩ	0	1	0	1
	+	1	0	1	1		MΩ	1	0	1	1
	Space	1	1	0	0		μA	1	0	0	0
Decimal	10^0		0	0	0		mA	1	0	1	0
	10^1		0	0	1		A (space)	1	1	1	1
	10^2		0	1	0		Hz (space)	1	1	1	1
	10^3		0	1	1		%	0	1	1	0
	10^4		1	0	0						

- A space should be used for the polarity of the AC voltage (AC, AC + DC), AC current (AC, AC + DC), or resistance measurement.
  However, when the NULL calculation is executed, " + " or " – " is output.
- In the FAST (three digit) mode, a space is used as 10^0 digit.

Table 7-3 Data Output Connector
(Dai-ichi Electronics Industry Co. ; 57-40500)

Pin arrangement					
Pin No.			Pin No.		
1	SIG. GND		26	2^0	*3
2	2^0	10^0 digit	27	2^1	10^6 digit
3	2^1		28	2^2	
4	2^2		29	2^3	
5	2^3		30	2^0	
6	2^0	10^1 digit	31	2^1	10^7 digit
7	2^1		32	2^2	
8	2^2		33	2^3	
9	2^3		34	2^0	Function
10	2^0	10^2 digit	35	2^1	
11	2^1		36	NC	(HI)
12	2^2		37	NC	(HI)
13	2^3		38	2^2	Function
14	2^0	10^3 digit	39	2^3	
15	2^1		40	2^0	Unit
16	2^2		41	2^1	
17	2^3		42	2^2	
18	2^0	10^4 digit	43	2^3	
19	2^1		44	2^0	Decimal point *2
20	2^2		45	2^1	
21	2^3		46	2^2	
22	2^0	10^5 digit	47	PRINT CMD	
23	2^1		48	EXT ST. A	
24	2^2		49	NC	*1
25	2^3		50	SIG. GND	

*1 : Do not use pin 49 NC terminal (not used) as a relay terminal.

*2 : The decimal point codes are associated with the following location:

1. 9. 9. 9. 9. 9.
↑ ↑ ↑ ↑ ↑
10^4 10^3 10^2 10^1 10^0

Voltages on pins 26 to 33, 36, and 37 are pulled up by a 10 kΩ.

*3 : If a function has a polarity, it will be displayed in 10^6 digit (+;1011, -;1010).

7.4.4 Remote Control Setting Codes

Remote control codes are set on the fall edge of the STROBE signal.

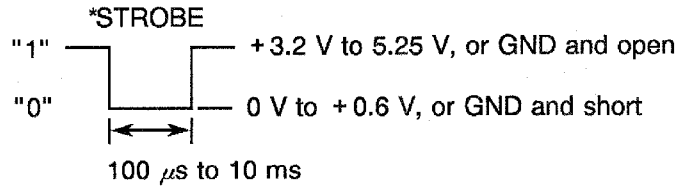


Table 7-4 Measurement Function Setting Codes

Measurement function	Setting code				R6451A	R6452A	R6452E
	*FCD	*FCC	*FCB	*FCA			
DC voltage measurement	0	0	0	1	○	○	○
AC voltage measurement (AC coupling mode)	0	0	1	0	○	○	—
Resistance measurement	0	0	1	1	○	○	○
DC current measurement	0	1	0	1	○	○	—
AC current measurement (AC coupling mode)	0	1	1	0	○	○	—
Continuity measurement	0	1	1	1	○	○	○
AC voltage measurement (AC + DC coupling mode)	1	0	0	0	○	○	—
AC current measurement (AC + DC coupling mode)	1	0	0	1	○	○	—
4-20 mA measurement	1	0	1	0	○	—	—
Diode measurement	1	0	1	1	○	○	○
Temperature measurement	1	1	0	0	—	○	○
Bch DC voltage measurement	1	1	0	1	—	○	○
Frequency measurement	1	1	1	0	—	○	—

Table 7-5 Measurement Ranges Setting Codes

Measurement range						Setting code			
DC voltage	AC voltage (AC, AC+DC)	Resistance measurement	DC current/ AC current	Bch DC voltage frequency	Frequency	*RCD	*RCC	*RCB	*RCA
AUTO	AUTO	AUTO	AUTO	-	AUTO	0	0	0	0
-	-	-	-	-	20 Hz	0	0	1	0
200 mV	200 mV	200 Ω	-	-	200 Hz	0	0	1	1
2000 mV	2000 mV	2000 Ω	-	2000 mV	2000 Hz	0	1	0	0
20 V	20 V	20 kΩ	-	20 V	20 kHz	0	1	0	1
200 V	200 V	200 kΩ	200 mA	200 V	200 kHz	0	1	1	0
1000 V	700 V	2000 kΩ	-	-	-	0	1	1	1
-	-	20 MΩ	10 A	-	-	1	0	0	0
-	-	200 MΩ	-	-	-	1	0	0	1

Note: If a code which is not permitted is used for the setting, it will be ignored.

Table 7-6 Other Setting Codes

Sampling mode	*PRA *PRB	FAST	*PRB:0 *PRA:1
		MID	*PRB:1 *PRA:0
		SLOW	*PRB:1 *PRA:1
Hold	*HOLD	OFF	0
		ON	1
Null calculation	*NULL	OFF	0
		ON	1
Comparator calculation	*COMP	OFF	0
		ON	1
Buzzer	*BUZ	OFF	0
		ON	1

Comparator output

According to the result of the comparator calculation, any of HI, PASS, or LO will be set to high level.
Output current (I out) ±35 mA

Table 7-7 Pin Assignment of Remote Control Input Connector: 57-40240 (Dai-ichi Electronics Co.)

Pin No.	Signal
1	GND
2	*EXT.ST.B
3	*FCA
4	*FCB
5	*FCC
6	*FCD
7	*RCA
8	*RCB
9	*RCC
10	*RCD
11	*STROBE
12	GND
13	GND
14	*PRA
15	*PRB
16	*HOLD
17	*NULL
18	*COMP
19	*BUZZER
20	HI
21	PASS
22	LO
23	*END
24	GND

7.4.5 Operation

(1) BCD selection

R6451A			R6452A and R6452E			Description
Key operation		Display	Key operation	First display	Second display	
①	I/F	SCI on	① I/F	SCI	on	Option setting mode
②	UP	bcd oFF	② UP	bcd	oFF	Display for selecting BCD
	DOWN		DOWN			
③	ENTER	bcd on	③ SHIFT	bcd	on	Confirmation for the settings above setting
	ENTER	Measurement value	SHIFT	Measurement value		Setting end

Note: Use the I/F to suspend the setting.

(2) Connection with various units

① Check the input level of the unit to be connected.
Figure 7-2 shows the output circuit of the BCD output unit.

- Data, function, decimal, and print command signal
- Unit output (40 to 43 pins)
- HI level pins other than above

② Since the output data are output at the print command signal output timing, use the print command signal as the STROBE signal for transmitting data to the external instrument.

(3) Remote control

The five control lines *RCA, *RCB, *RCC, *RCD, and *STROBE are used to control the measurement ranges on the REMOTE connector. The five signal lines operate using negative logic, so if the line is to be set to "1" (true), connect each pin of the signal lines to GND (pins 1 and 24).
If it is to be set to "0" (false), open each signal line.

For remote setting, set the codes of range to be set (four bits of *RCA, *RCB, *RCC, and *RCD) and set *STROVE to "remote enable (0)".
The setting is made at the fall edge of the STROBE signal.

Figure 7-2 shows the input circuit for the *RCA, *RCB, *RCC, *RCD, and *STROBE signals.

(4) External start

The sampling start can be controlled externally. There are two inputs for the external start signal: REMOTE connector (pin 2) and DATA OUTPUT (pin 48). There are connected to the OR circuit in the instrument.
A pulse of 100 ms to 10 ms is applied as the external start signal.

(5) Measurement timing

If the instrument is incorporated in the measurement system by mounting the BCD data output unit, set the system sequence in accordance with the timing chart in "12.1 Measurement operation".

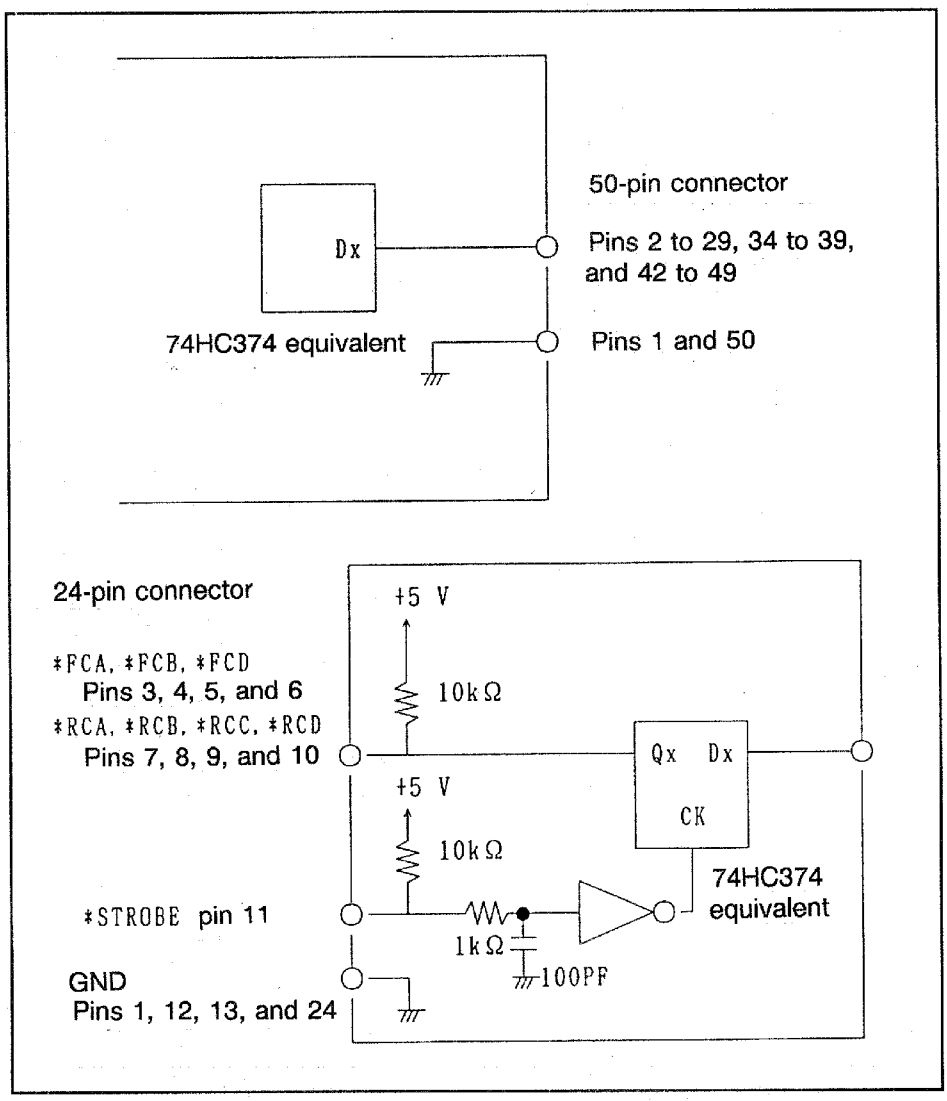


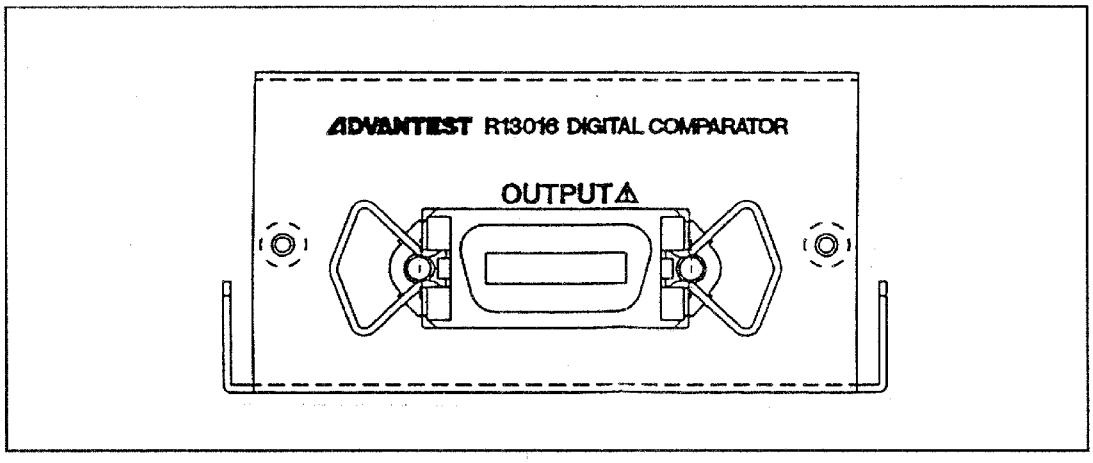
Figure 7-2 Input/Output Circuits of BCD Output Unit

7.5 Comparator Unit R13016

7.5.1 Outline

With the comparator unit R13016 installed in the instrument, the instrument can digitally compare the measurement value with the upper/lower limit values preset on the panel, classify the results into HI, PASS, and LO, and make buzzer sound according to the result. With a photo MOS relay contact and open collector output, the comparison result can be sent to an external equipment. Also, it is equipped with an external start function.

Since the photo MOS relay contact and open collector output are electrically isolated from the measurement signal system, the measurement values cannot be affected by external equipments.



Output connector

The comparison result is output by the photo MOS relay contact and open collector.
The pin numbers and signal names of the connector are as follows:

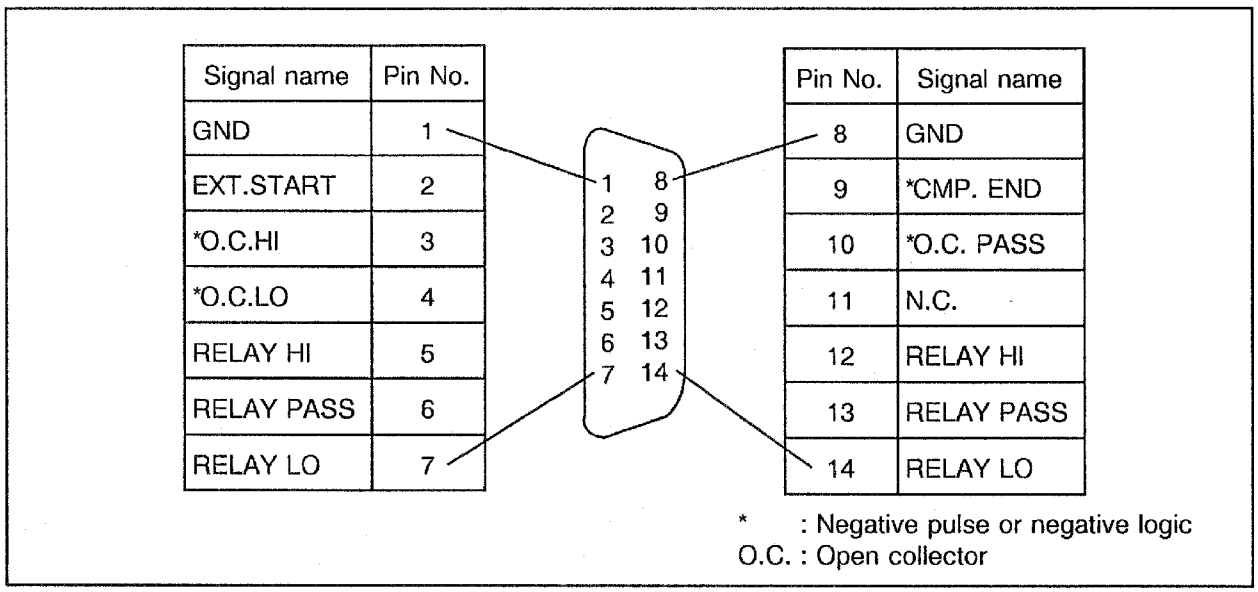


Figure 7-3 Pin Numbers and Signal Names of Comparator Unit

7.5.2 Specifications

Setting values of upper limit (HI LIMIT) and lower limit (LO LIMIT)
: Numeric value six digits + exponent (0.00000E-3 to ±999999+E6)

Comparison level : Two values of upper limit (HI LIMIT) and lower limit (LO LIMIT)

Judgment conditions : HIgH ; Measurement data > HI LIMIT
PASS ; HI LIMIT > measurement data > LO LIMIT
LOw ; Measurement data < LO LIMIT

Level setting : Key entry on the panel

Photo MOS relay contact and transistor output (open collector):

ON ; Photo MOS relay contact make, transistor output ON
OFF ; Photo MOS relay contact break, transistor output OFF

Output / Judgment	HI	PASS	LO
HI	ON	OFF	OFF
PASS	OFF	ON	OFF
LO	OFF	OFF	ON

Photo MOS relay contact capacity:

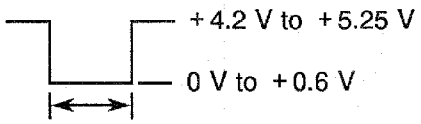
Contact allowable voltage: DC 50 V
Contact allowable current: DC 120 mA
Contact-to-logic earth withstand voltage: 150 Vpeak

Transistor output capacity:

Collector-to-emitter voltage: DC + 50 Vmax
Collector current: DC 300 mA

Compare end signal *CMP. END:

TTL level negative pulse

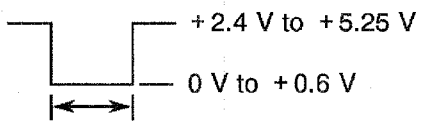


Approx. 900 μs

Digital comparator

External start signal EXT. START:

TTL level negative pulse



100 μs to 10 ms

Buzzer alarm : The buzzer sounds when the comparison result is HI, PASS, LO, and HI or LO.

Output connector : 57-40140 (Dai-ichi Electronics Industry Co.)
The connection cable corresponding to the connector is ADVANTEST MO-29 (optional product).

7.5.3 Operation

(1) After turning ON the power switch of the instrument, input the measurement signal.

(2) Selecting the comparator

R6451A		R6452A and R6452E			Description
Key operation	Display	Key operation	First display	Second display	
① I/F	SCI on	① I/F	SCI	on	Option setting mode
② UP DOWN	CP oFF	② UP DOWN	CP	oFF	Display for selecting comparator
③ ENTER	CP on	③ SHIFT	CP	on	Confirmation of setting end
④ ENTER	Measurement value	④ SHIFT	Measurement value		Setting end

(3) Setting upper and lower limit values

Using the panel of the instrument, set the values in the same manner as for the setting of the instrument.
See subsection "5.4.6".

(4) The measurement and comparison will be started. The comparison end signal (negative pulse) is output when the comparison result is determined.

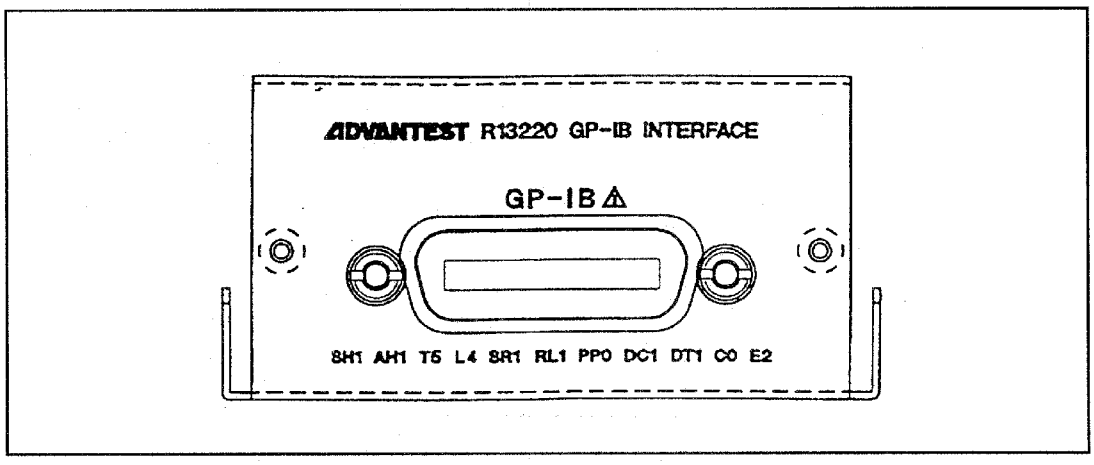
If the measurement value is displayed by "Err d" (dB operation error) or "OL C" (Bch DCV common over R6452A and R6452E only) during the comparator calculation, the comparison result will not be updated.

7.6 GPIB Interface Unit R13220

7.6.1 Outline

With the GPIB (General-Purpose Interface Bus) interface unit R13220 installed in the instrument, the instrument can easily configure the automatic measurement system because it allows the external equipment to control setting of various measurement functions for the instrument, the setting of measurement parameters, and the reading of the measurement data.

Since the GPIB signal from the instrument is electrically isolated from the measurement signal system, the measurement value cannot be affected by the external unit.



General specifications

Electrical specification	:	Complies with the IEEE standard 488-1978 and IEC standard 652-1.
Mechanical specification	:	IEEE standard 488-1978
Codes used	:	ASCII codes
Logic level	:	Logic 0 : "High" state, +2.4 V or abov
		Logic 1 : "Low" state, +0.4 V or below
Interface functions	:	See Table 7-8.

Table 7-8 GPIB Interface Functions

Code	Function
SH1	Source handshake function
AH1	Acceptor handshake function
T5	Basic talker function, talker cancel function by listener specification, talk-only mode function, and serial poll function
L4	Basic listener function, and listener cancel function by talker specification
SR1	Service request function
RL1	Remote/local switch function
PP0	Without parallel/poll function
DC1	Device clear function (SDC and DLC commands are available.)
DT1	Device trigger function (GET command is available.)
C0	Without controller function
E1	Open collector output

7.6.2 Connection with Configured Equipment

Since the GPIB system consists of multiple units, the following should be taken into account:

(1) Before making a connection between the instrument and the controller and peripheral equipments, check the condition and operation of each equipment according to their instruction manual.

(2) Keep the connection cables to the measurement instruments and the bus cables to the controller as short as possible. The cables should not exceed 20 m.
The cables below are available as standard bus cables from ADVANTEST.

Table 7-9 Standard Bus Cables

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

(3) Since the bus cable connectors are of the piggyback type and have both male and female adapters at each end, they can be stacked.
If the bus cable is connected, do not stack more than two connectors. Also, be sure to secure the connector with the connector securing Phillips-head screws.

(4) After checking the power supply conditions, grounding conditions, and, as required, setting conditions of each configured unit turn on the power of each unit.
Be sure to turn on the power of all of the units connected to the bus to ensure operation of whole system cannot be assured.

7.6.3 GPIB Setting

The setting items of the GPIB and their factory settings are as follows:

Setting item	Factory setting
Header ON/OFF	ON
Addressable/talk-only	Addressable
Address	8

Initial states of measurement condition are as follows:

Item	Initialize setting	Master reset	at power on
Status byte	0	○	○
Inable all status	255	○	○
Block delimiter	CR/LF	○	○
String delimiter	, (comma)	○	○

(1) Setting example of GPIB

Use the panel keys on the instrument to select GPIB talk/listen address and header ON/OFF.

R6451A			R6452A and R6452E				Description
Key operation		Display	Key operation		First display	Second display	
①	IF	SCI on	①	IF	SCI	on	Option setting mode
②	UP DOWN	GP oFF		UP DOWN	GP	oFF	Display for selecting GPIB
③	ENTER	HA 08	③	ENTER	HA 08	GP	Display for previous setting
④	AUTO UP DOWN	HA 01	④	AUTO UP DOWN	HA 01	GP	Display when the selection is header ON, addressable, GPIB address 1. See (2) Address and header setting
⑤	ENTER	GP on	⑤	SHIFT	GP	on	Confirmation of setting end
⑥	ENTER	Measurement value	⑥	SHIFT	Measurement value		Setting end

Note: Press the I/F to suspend the setting.

(2) Address setting and ON/OFF setting of output data header

① Enter the option setting mode.

Each time the AUTO is pressed, the selectable point flashes in the following order:

- Output data header

Display	Description
H	Indicates header ON.
-	Indicates header OFF.

- Addressable/Talk only

Display	Description
A	Indicates addressable mode.
-	Indicates talk only mode.

- GPIB address

Display	0 to 30 (There are 31 kinds in total.)

② Flash the point to be selected and use the UP and DOWN to change the setting.

7.6.4 Output Data Format

The output data format of the measurement values and calculation data is:

```
OOO ±OOOOOOO E±O CR LF
 H      D     E   L
```

H : Header (ASCII code consisting of three characters)
D : Mantissa (polarity + decimal + number with four to six digits)
E : Exponent (E + polarity + number with one digit)
L : Delimiter (used for end indication of one data)

(1) Header

When the header is set to ON, an ASCII code consisting of three characters is output as follows:
When the header is set to OFF, the code is omitted.

OO O
- O — Sub-header
  - "O" : OL (overload) (including scaling calculation overload)
  - "E" : Err D (dB, dBm calculation error)
  - "H" : Comparator result is HIGH.
  - "P" : Comparator result is PASS.
  - "L" : Comparator result is LOW.
  - "M" : MAX calculation
  - "m" : MIN calculation
  - "B" : dB calculation
  - "W" : dBm calculation
  - "S" : Scaling calculation
  - "N" : Null calculation
  - " " : Other

  (Hight ↑ Priority ↓ Low)
- OO — Main header
  - "DV": DC voltage measurement
  - "AV": AC voltage measurement (AC coupling mode, AC + DC coupling mode)
  - "R" : Resistance or continuity measurement
  - "DI" : DC current or 4-20 mA measurement
  - "AI" : AC current measurement (AC coupling mode, AC + DC coupling mode)
  - "BV": Bch DC voltage measurement
  - "D" : Diode measurement
  - "TC": Temperature measurement
  - "FQ": Frequency measurement

* : For OL (overdata), the data are output as follows:
Example of 51/2-digit mode (when in DC voltage measurement, 200 mA range)

```
DVO +999. 999 E+9
 |      |      |
 |      |      └── Exponent
 |      └───────── Mantissa
 └──────────────── Header
```

(2) Mantissa and exponent

The mantissa part of the measurement value varies in accordance with the settings of the sample rate and the number of displayed digits. (See Table 7-10.)
The decimal position moves according to the display of the instrument.
The exponent part is displayed in accordance with the selection of the measurement functions and measurement ranges, and its displayed value corresponds to the setting of the subunit (m, K, M, or G).

Table 7-10 Mantissa and Exponent Parts

Measurement function	Range	Main header	Maximum values of mantissa parts			Exponent	Applicable models (R64XXX)		
			FAST	MID	SLOW		51A	52A	52E
DC voltage measurement	200 mV	DV	199.9--	199.99-	199.999	E-3	○	○	○
	2000 mV	DV	1999.--	1999.9-	1999.99	E-3	○	○	○
	20 V	DV	19.99--	19.999-	19.9999	E+0	○	○	○
	200 V	DV	199.9--	199.99-	199.999	E+0	○	○	○
	1000 V	DV	1099.--	1099.9-	1099.99	E+0	○	○	○
AC voltage measurement (AC coupling mode)	200 mV	AV	199.9--	199.99-	199.999	E-3	○	○	—
	2000 mV	AV	1999.--	1999.9-	1999.99	E-3	○	○	—
	20 V	AV	19.99--	19.999-	19.9999	E+0	○	○	—
	200 V	AV	199.9--	199.99-	199.999	E+0	○	○	—
	700 V	AV	709.9-	709.9-	709.99	E+0	○	○	—
Resistance measurement	200 Ω	R	199.9--	199.99-	199.999	E+0	○	○	○
	2000 Ω	R	1999.--	1999.9-	1999.99	E+0	○	○	○
	20 kΩ	R	19.99--	19.999-	19.9999	E+3	○	○	○
	200 kΩ	R	199.9--	199.99-	199.999	E+3	○	○	○
	2000 kΩ	R	1099.--	1099.9-	1099.99	E+3	○	○	○
	20 MΩ	R	19.99--	19.999-	19.9999	E+6	○	○	○
	200 MΩ	R	199.9--	199.99-	199.99-	E+6	○	○	○
DC current measurement	200 mA	DI	199.9--	199.99-	199.999	E-3	○	○	—
	10 A	DI	10.99--	10.999-	10.9999	E+0	○	○	—
AC current measurement (AC coupling mode)	200 mA	AI	199.9--	199.99-	199.999	E-3	○	○	—
	10 A	AI	10.99--	10.999-	10.9999	E+0	○	○	—
AC voltage measurement (AC + DC coupling mode)	200 mV	AV	199.9--	199.9--	199.99-	E-3	○	○	—
	2000 mV	AV	1999.--	1999.--	1999.9-	E-3	○	○	—
	20 V	AV	19.99--	19.99--	19.999-	E+0	○	○	—
	200 V	AV	199.9--	199.9--	199.99-	E+0	○	○	—
	700 V	AV	709.--	709.--	709.9-	E+0	○	○	—
AC current measurement (AC + DC coupling mode)	200 mA	AI	199.9--	199.9--	199.99-	E-3	○	○	—
	10 A	AI	10.99--	10.99--	10.999-	E+0	○	○	—

(cont'd)

Measurement function	Range	Main header	Maximum values of mantissa parts			Exponent	Applicable models (R64XXX)		
			FAST	MID	SLOW		51A	52A	52E
Bch DC voltage measurement	2000 mV	BV	1999.--	1999.9-	1999.9-	E-3	—	○	○
	20 V	BV	19.99--	19.999-	19.999-	E+0	—	○	○
	200 V	BV	199.9--	199.99-	199.99-	E+0	—	○	○
Diode measurement	2000 mV	D	1999.--	1999.9-	1999.99	E-3	○	○	○
Continuity measurement	200 Ω	R	199.9--	199.99-	199.999	E+0	○	○	○
4-20 mA measurement	100 %	DI	999.--	999.9-	999.99	E+0	○	—	—
Temperature measurement	1000 °C	TC	1370.--	1370.0-	1370.0-	E+0	—	○	○
Frequency measurement	20 Hz	FQ	19.999-	19.999-	19.999-	E+0	—	○	—
	200 Hz	FQ	199.99-	199.99-	199.99-	E+0	—	○	—
	2000 Hz	FQ	1999.9-	1999.9-	1999.9-	E+0	—	○	—
	20 kHz	FQ	19.999-	19.999-	19.999-	E+3	—	○	—
	200 kHz	FQ	199.99-	199.99-	199.99-	E+3	—	○	—

(3) Delimiter

The delimiter can be selected using remote command from among the three types shown in Table 7-11:

Table 7-11 Delimiter

Delimiter	Settings	Remote command	Initial value
CR LF (EOI)	Sends two-byte data of CR ($13_{(10)}$) and LF ($10_{(10)}$). When LF is sent, the single-line signal EOI is also sent.	DL0	○
LF	Sends the one-byte data of LF ($10_{(10)}$).	DL1	
Last byte (EOI)	The single-line signal EOI is sent together with the Last byte.	DL2	

7.6.5 Remote Commands

With the controller, the instrument can externally set the selection of the measurement and calculation functions. The following are the remote commands:

Command type	Description or caution	Refer to:
Function setting	Measurement function	Table 7-12
Range setting	Measurable range for each function	Table 7-13
Other functions setting	Setting remote command for other than function/range	Table 7-14
Inquiry command	Reads out the current settings.	Table 7-15
Self-test command	Self-test command for various checks	Table 7-17
Maintenance command	Be careful for use of this command.	Table 7-18

The program module of this instrument checks the data which is input according to the prescribed format and converts the data into the internal status flag or the internal code depending on the header code of the data.

When the module recognizes the terminator of data or the header of subsequent data, the module processes the input format. The format consists of the header (code part), data, and terminator. However, some headers are not followed by data.
The delimiter is detected by the LF ($10_{(10)}$) or EOI.

The operation of the measurement which is started by the E or GET command.

If the sample mode of the instrument is set to HOLD and the measurement is started by the E or GET command, refer to "12.1 Measurement Operation".

Table 7-12 Command Codes of Selecting Measurement Functions

Code	Function	Initial value	Model to be used		
			R6451A	R6452A	R6452E
F1	DC voltage measurement	○	○	○	○
F2	AC voltage measurement (AC coupling mode)		○	○	—
F3	Resistance measurement		○	○	○
F5	DC current measurement		○	○	—
F6	AC current measurement (AC coupling mode)		○	○	—
F7	AC voltage measurement (AC + DC coupling mode)		○	○	—
F8	AC current measurement (AC + DC coupling mode)		○	○	—
F12	Bch DC voltage measurement		—	○	○
F13	Diode measurement		○	○	○
F22	Continuity measurement		○	○	○
F32	4-20 mA measurement		○	—	—
F40	Temperature measurement		—	○	○
F50	Frequency measurement		—	○	—

Table 7-13 Selecting Ranges Command Codes

Code	DC voltage measurement	AC voltage measurement (AC coupling mode)	Resistance measurement	DC/AC current measurement (AC coupling mode)	AC voltage measurement (AC + DC coupling mode)	AC current measurement (AC + DC coupling mode)	Bch DC voltage measurement	Frequency measurement
R0	AUTO	AUTO	AUTO	—	AUTO	—	AUTO	AUTO
R2	—	—	—	—	—	—	—	20 Hz
R3	200 mV	200 mV	200 Ω	—	200 mV	—	—	200 Hz
R4	2000 mV	2000 mV	2000 Ω	—	2000 mV	—	2000 mV	2000 Hz
R5	20 V	20 V	20 kΩ	—	20 V	—	20 V	20 kHz
R6	200 V	200 V	200 kΩ	200 mA	200 V	200 mA	200 V	200 kHz
R7	1000 V	700 V	2000 kΩ	—	700 V	—	—	—
R8	—	—	20 MΩ	10 A	—	10 A	—	—
R9	—	—	200 MΩ	—	—	—	—	—

Note: "—" indicates undefined ranges.
If undefined functions or ranges are used, a SYNTAX error will occur.
Also, if a range is set to fixed-range functions, the SYNTAX error will occur.

Table 7-14 Selecting Functions Command Codes

Function	Command	Contents
Sample mode specification	M0 M1	Free-run Hold
Trigger command	E	Measurement start command (Has the function equivalent to the TRIG .) Has the function equivalent to "GET" command.
Sample rate specification	PR1 PR2 PR3	FAST MID SLOW
Number of displayed digits specification	RE3 RE4 RE5	3 1/2 digit display 4 1/2 digit display 5 1/2 digit display
NULL calculation mode specification	NL0 NL1	NULL calculation off NULL calculation on
Smoothing calculation mode specification	SM0 SM1	Smoothing calculation off Smoothing calculation on
dB calculation mode specification	DB0 DB1 DB2	dB calculation off dB calculation on dBm calculation on
Scaling calculation mode specification	SC0 SC1	Scaling calculation off Scaling calculation on
MAX/MIN calculation mode specification	MN0 MN1 MN2	MAX/MIN calculation off MAX calculation on MIN calculation on
Comparater calculation mode specification	CO0 CO1	Comparater calculation off Comparater calculation on
Setting of measurement value to constant D	KDM	Sets the measurement value to the constant D for dB/dBm calculation .
Setting of measurement value to constant A	KAM	Sets the measurement value to the scaling constant A.
Setting of measurement value to constant B	KBM	Sets the measurement value to the scaling constant B.
Setting of measurement value to constant C	KCM	Sets the measurement value to the scaling constant C.
Setting of measurement value to constant HI	HIM	Sets the measurement value to the comparater constant HI.
Setting of measurement value to constant LO	LOM	Sets the measurement value to the comparater constant LO.

(cont'd)

Function	Command and parameter
Setting NULL value	KNL ± ○○○○○○E ± ○ └ One-digit number 0 to 6 └ Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible
Setting number of times for smoothing	TI○○○ 2 to 100 times (initial value: 10 times)
Setting dB/dBm calculation constant	KD ± ○○○○○○E ± ○ └ One-digit number 0 to 6 └ Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible
Setting scaling calculation constant A	KA ± ○○○○○○E ± ○ └ One-digit number 0 to 6 └ Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible
Setting scaling calculation constant B	KB ± ○○○○○○E ± ○ └ One-digit number 0 to 6 └ Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible

(cont'd)

Functions	Commands and parameters
Setting scaling calculation constant C	KC ± ○○○○○○E ± ○ One-digit number 0 to 6 Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible
Setting comparater calculation constant HI	HI ± ○○○○○○E ± ○ One-digit number 0 to 6 Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible
Setting comparater calculation constant LO	LO ± ○○○○○○E ± ○ One-digit number 0 to 6 Omissible All exponent is omissible. One-digit to six-digit number + decimal (0. to 999999.) Omissible
Entering calibration value	PC ± ○○○○○○ One-digit to six-digit number without decimal (0 to 999999.) Omissible Note: Be sure to enter data with 5 1/2 digit

(cont'd)

Function	Command	Parameter
CAL mode specification	CAL0 CAL1	Canceling CAL mode Setting CAL mode
Buzzer mode specification	BZ0 BZ1 BZ2 BZ3 BZ4	off on (Comparater calculation result is HI/LO.) on (Comparater calculation result is PASS.) on (Comparater calculation result is HI.) on (Comparater calculation result is LO.)
Range Fix (AUTO to MANUAL)	RX	Switches auto range to manual range.
Display deletion mode specification	DS0 DS1	Display off (Measurement data is not displayed.) Display on (Measurement data is displayed.) Note: Pressing LOCAL key on the panel will turn on display.
Device clear	C	Same processing as in powering on. Equivalent to "DCL" or "SDC" command.
Master reset	Z	Initializes various internal parameters. Equivalent to the initialization from the panel. Including the processing of remote command "C".
Setting status mask	MS○○○ | 0 to 255	Masks the specified bytes of the status bytes. □▨□□□□□ But bit 6 (RQS) cannot be masked.
Header mode specification	H0 H1	Does not add header to output data. Adds header to output data.
Block delimiter mode specification (GPIB only)	DL0 DL1 DL2	Sets block delimiter to "CR/LF" and "EOI". Sets block delimiter to "LF". Sets block delimiter to "EOI".
String delimiter specification	SL0 SL1 SL2	Specifies string delimiter to ",". Specifies string delimiter to "space". Specifies string delimiter to "CR/LF".
SRQ mode specification (GPIB only)	S0 S1	Enables "SRQ" mode. Disables "SRQ" mode.
Status clear	CS	Clears status bytes to 0.

(cont'd)

Function	Command	Parameter
Store to memory card	ST	• Storing setting ST: File name └ Cnnn (0 to 999) • Storing the data ST: File name : Number of of data └ 1 to 9999 (1000 for omission) └ Dnnn (0 to 999) • File close when storing data ST: END
Recall from memory card	RCL	• Recalling setting RCL: File name └ Cnnn (0 to 999) • Recalling data RCL: File name : Type └ D (all data) C(setting information) └ Dnnn (0 to 999) RCL: File name : D : Start : Number of data Number of data (1 to 999) └ Start number (1 to 9999)
Initialize memory card	MCINIT	Initializes IC memory card.

The inquiry command returns the current setting conditions.

Table 7-15 Inquiry Commands

Inquirie	Command	Parameter
Reading out battery condition	BATT?	"EMPTY" at LOW BATTERY "CHARGED" not at LOW BATTERY
Reading out model information	IND?	ADVANTEST CORP., R645○○, REV. X△△. △△. △△. △△, SER. □□□□□□□□ ○: Model name △: Revision □: Serial number
Output request of measurement data (RS-232 only)	MD?	Measurement value is output. Note: Set the only-mode for continuous output.
Output request of status bytes (RS-232 only)	SB?	Refer to "Service request of GPIB interface unit" section.

Table 7-16 Commands for R6452A and R6452E only

Function	Commands	Parameter
2nd display mode specification	DE0	2nd display off
Setting channel specification	D1 D2	1st 2nd (2nd ON by D2, Fn)
Output data specification	SD0 SD1 SD2	First and second displays are remotely output. Only first display is remotely displayed. Only second display is remotely displayed.

Table 7-17 Commands for Self Test

Test Item	Result display	Contents
TST1 (RAM R/W check)	TST01:PASS TST01:FAILdddd	Normal Abnormal (dddd is abnormality detection address.)
TST2 (main-to-panel communication check)	TST02:PASS TST02:FAIL01 TST02:FAIL02	Normal Abnormal ("Panel self-test end" is not received.) Abnormal (communication check abnormal)
TST3 (CAL data check)	TST03:PASS TST03:CHANGE01 TST03:CHANGE02 TST03:FAIL01 TST03:FAIL02 TST03:FAIL03	Normal SRAM CAL data abnormal (normal after repairing) EEPROM CAL data abnormal (normal after repairing) SRAM CAL data abnormal (repair is impossible.) EEPROM CAL data sum check abnormal (repair is impossible.) EEPROM CAL data comparison check abnormal (repair is impossible.)
TST4 (parameter check)	TST04:PASS TST04:CHANGE TST04:FAIL	Normal Abnormal (normal after repairing) Abnormal
TST5 (main-to-AD communication check)	TST05:PASS TST05:FAIL	Normal Abnormal
TST6 (panel display)		
TST7 (panel key)	TST07:dd	Stores the key which has been pressed. (dd is key code.)
TST8 (panel buzzer)		
TST9 (A/D VER., ID detection)	TST09:vv:id TST09:FAIL	vv: A/D VER, id: analog ID Abnormal
TST?	If multiple tests has been executed, output the results with being separated by commas.	Inquires test result above. (only for the result which has been executed)

7.6.6 Notes on Command Setting

(1) Notes on parameter setting

- Spaces are ignored.
- Lower-case alphabets are converted to upper-cases in processing.
- If undefined codes are received, a SYNTAX error is generated without changing settings.

(2) Up to 40 characters are used for each line.

(3) The following commands should be sent at least 3 msec before the talker is specified.

RCL : Recall command from IC memory card
BATT? : Read command for battery condition
IDN? : Read command for model information
TST? : Read command for self-test result

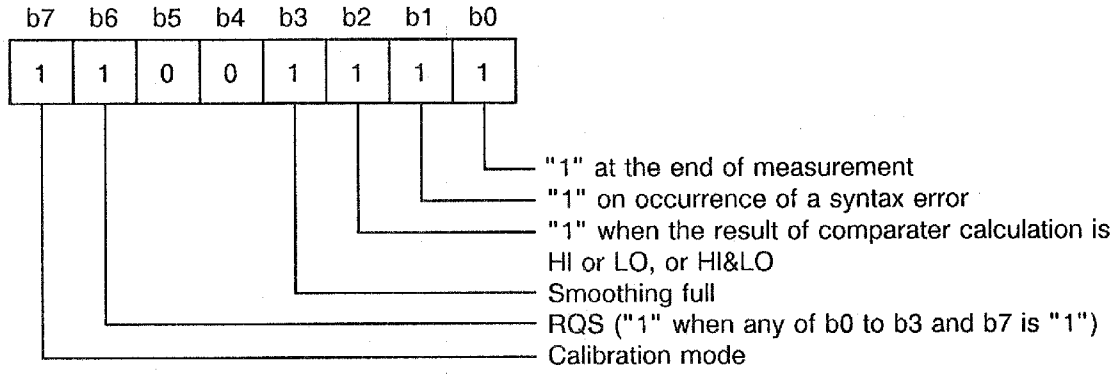
7.6.7 Service Request (SRQ)

When the instrument is set in the SO mode, the instrument transmits a service request (SRQ) to the controller at the end of a measurement operation or on receiving an undefined code. Upon receiving the service request, the controller transmits the status bytes by executing the serial polling. When set in the S1 mode, the instrument does not transmit service requests, but the controller transmits the status bytes.

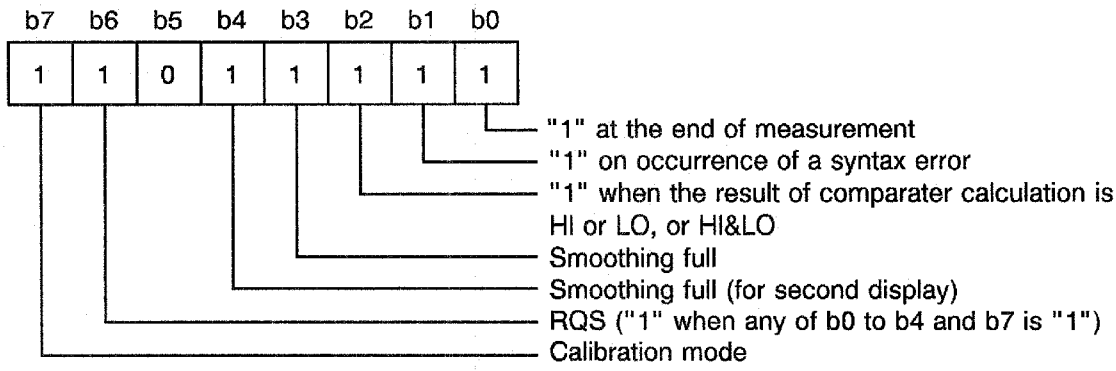
Since the instrument operates as shown in section "7.6.8" when the measurement is terminated or when the service request is transmitted by the SYNTAX error (in S0 mode), care should be taken for programming.

Status bytes

For R6451A:



For R6452A and R6452E:



Clear timing

The service requests are all cleared when power is turned on, "SDL" or "DLC" is received, or "C", "Z", or "CS" command is received.
There are clear timings other than above, as follows:

Bits	Clear timing
b0	• When the measurement data output to GPIB is complete. • When the measurement function is changed. • When the measurement range is changed. • When the sample rate is changed. • When the trigger command or trigger is received.
b1	• When the remote command is received (next "BI").
b2	• When the comparater calculation is set to OFF. • When the serial polling is executed.
b3	• When the smoothing calculation is set to OFF. • When the serial polling is executed. • When the measurement function is changed. • When the measurement range is changed. • When the sample rate is changed. • When the number of times for smoothing operation is changed.
b4	(R6452A and R6452E only) • When the second display is set to OFF. • When the smoothing calculation is set to OFF. • When the serial polling is executed. • When the measurement function is changed. • When the measurement range is changed. • When the sample rate is changed. • When the number of times for smoothing operation is changed.
b5	• Always 0
b6	• When all the bits 0 to 4 and 7 are 0.
b7	• When the calibration mode is canceled.

(1) Service request at the end of measurement

The instrument transmits a service request when it is not designated as a talker at the end of a measurement operation. It responds to the controller's serial polling, but its status byte is not cleared until it is designated as a talker to transmit measurement data.

MSB							LSB
0	1	0	0	0	0	0	1

ASCII code : A
Decimal code : 65

(2) Service request on occurrence of a syntax error

When the instrument receives an undefined program code status byte during remote programming, it transmits a service request. The status byte is not cleared, because of its remote setting, until the instrument is designated as a listener.

MSB							LSB
0	1	0	0	0	0	1	0

ASCII code : B
Decimal code : 66

If a measurement end and a syntax error occur concurrently, the corresponding two bits of the status byte are set at the same time (ASCII code: C, decimal code: 67).

MSB							LSB
0	1	0	0	0	0	1	1

ASCII code : C
Decimal code : 67

(3) Service request by the result of comparator

The instrument transmits a service request when the result of comparison is HI or LO.

MSB							LSB
0	1	0	0	0	1	0	1

ASCII code : E
Decimal code : 69

(4) Service request by smoothing full

The instrument transmits a service request when the smoothing is executed and the number of times for the execution reaches the specified number.

MSB							LSB
0	1	0	0	1	0	0	1

ASCII code : I
Decimal code : 73

(5) Service request by smoothing full of second display (R6452A and R6452E only)

The instrument transmits a service request when the smoothing is executed and the number of times for the execution reaches the specified number.

MSB							LSB
0	1	0	1	0	0	0	1

ASCII code : Q
Decimal code : 81

(6) Service request by calibration mode

The instrument transmits a service request when the calibration mode is set.

MSB							LSB
1	1	0	0	0	0	0	1

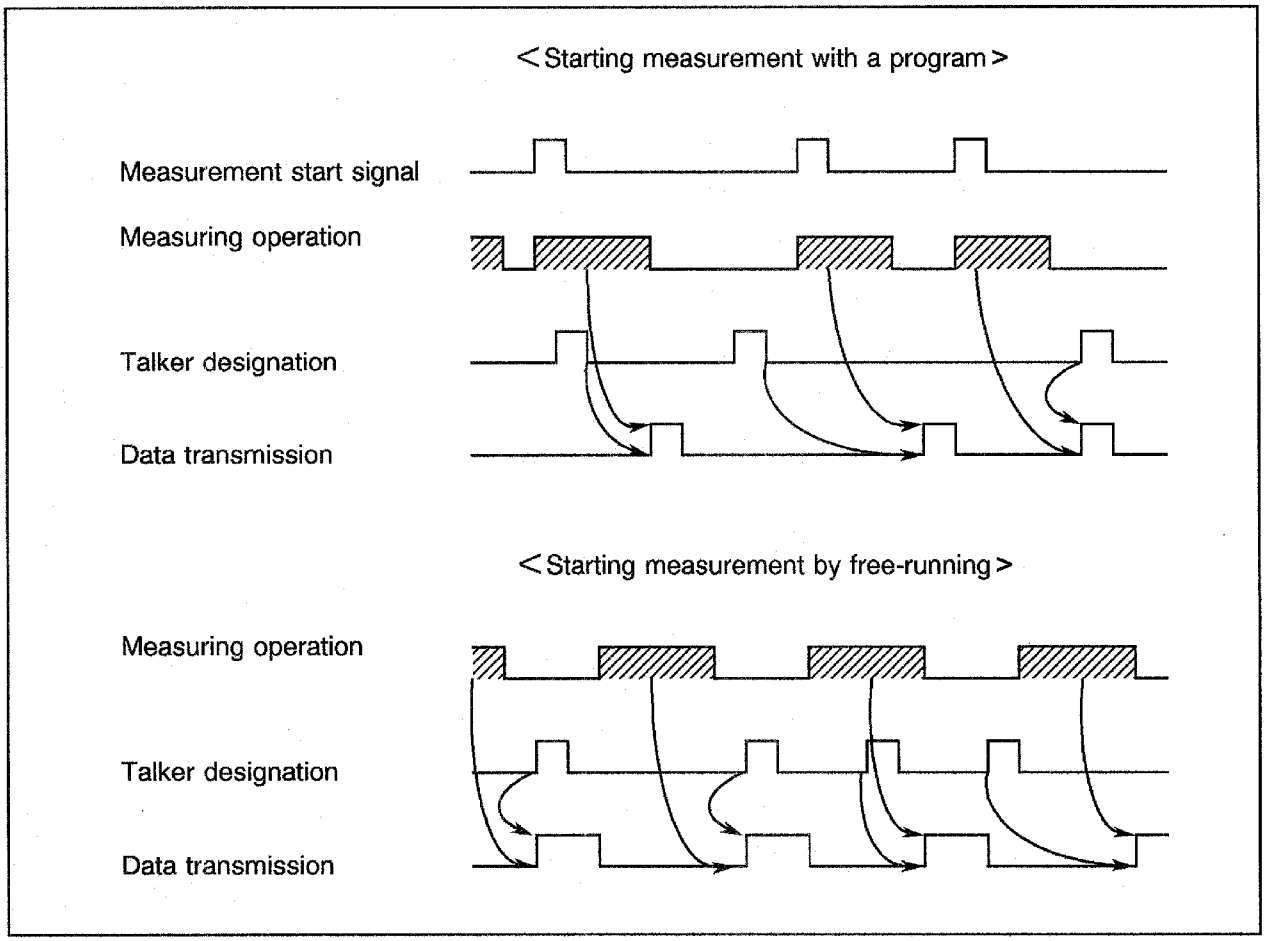
ASCII code :
Decimal code : 193

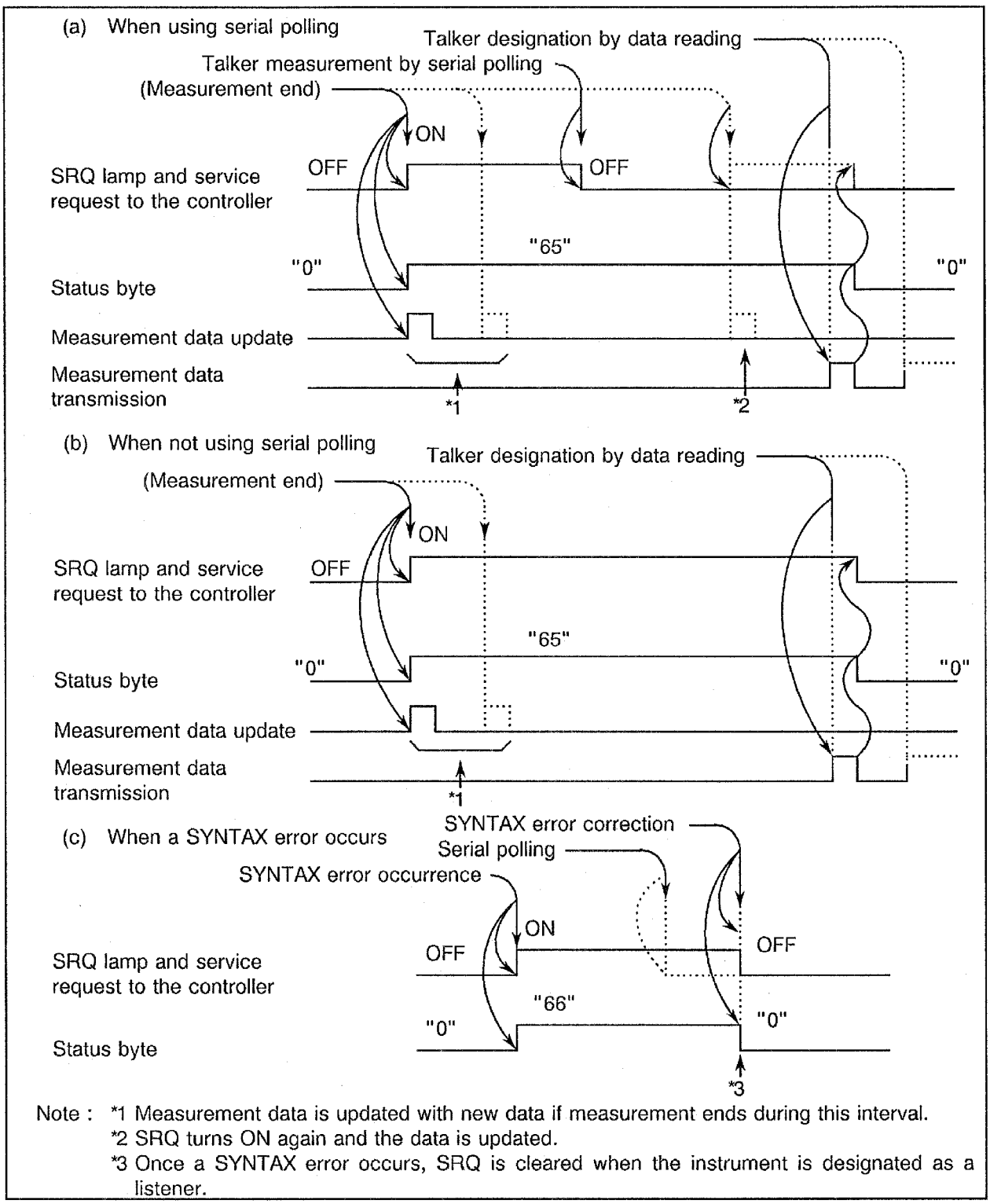
7.6.8 Operating Notes

(1) Operation at the service request

Since the instrument operates as shown in Figure 7-4 when the measurement is ended or when the service request is transmitted by the SYNTAX error (in S0 mode), care should be taken during programming.

(2) Differences in transmitted data dependent on the timing of talker designation





Note : *1 Measurement data is updated with new data if measurement ends during this interval.
*2 SRQ turns ON again and the data is updated.
*3 Once a SYNTAX error occurs, SRQ is cleared when the instrument is designated as a listener.

Figure 7-4 Service Request Operation Timing Chart

7.6.9 R6451's Status Changes when Powered on and Receiving Commands

The instrument enters the states shown in Table 7-18 when it is powered on and when it receives each commands.

Table 7-18 Status Change by Each Command

Command	Talker	Listener	SRQ	Status	Transmitted data
POWER ON	Cleared	Cleared	Cleared	Cleared	Cleared
IFC	Cleared	Cleared	—	—	—
DCL SDC C	—	—	Cleared	Cleared	Cleared
GET E	—	—	—	Measured data present bit cleared	Cleared
Talker designation for the instrument	Set	Cleared	—	—	
Talker cancellation	Cleared	—	—	—	—
Listener designation for the instrument	Cleared	Set	—	—	—
Listener cancellation	—	Cleared	—	—	—
Serial polling	—	—	Cleared	Comparator result present bit cleared	—

Note : Horizontal bars (–) denote that the existing state does not change.
DCL : Device Clear
SDC : Selected Device Clear
GET : Group Execute Trigger

7.6.10 Sample Programs

The following are sample programs that run on NEC's PC9801.

Example 1: Start the R6451 externally to perform DC voltage measurement in the 20 V range and read out the measurement data to display it on the CRT.

	Program
100	`DMM=8`
110	`'`
120	`ISET IFC`
130	`ISET REN`
140	`CMD DELIM=0`
150	`'`
160	`PRINT @DMM;"Z"`
170	`PRINT @DMM;"F1,R5,PR2"`
180	`INPUT @DMM;A$`
190	`PRINT A$`
200	`GOTO 180`
210	`'`
220	`END`

	Description
100	Assign the R6451 address 8 for the variable "DMM".
110	
120	Send "Interface clear".
130	Set "Remote enable" to "true".
140	Set the delimiter to "CR + LF".
150	
160	Initialize all parameters of R6451.
170	Set parameters for R6451. F1 : DC voltage measurement R5 : 20 V range PR2: Sampling rate set to MID
180	Read out measurement data from R6451.
190	Display measurement data on CRT.
200	Branch to line 180.
210	
220	Program end

Example 2: After setting the resistance measurement and the hold mode, start the measurement by the trigger. Detect the measurement end using the SRQ interruption and read the measurement result.

	Program
100	DMM=8
110	ISET IFC
120	ISET REN
130	CMD DELIM=0
140	'
150	DEF SEG=SEGPTR(7)
160	A%=PEEK(&H9F3)
170	A%=A% AND & HBF
180	POKE &H9F3,A%
190	'
200	ON SRQ GOSUB 290
210	PRINT @DMM;"Z"
220	PRINT @DMM;"F3,PR3,M1,S0"
230	SRQ ON
240	WAITF=0
250	PRINT @DMM;"E"
260	IF WAITF=1 THEN 240
270	GOTO 260
280	'
290	POLL DMM,S
300	IF S<>65 THEN 340
310	INPUT @DMM;A$
320	PRINT A$
330	WAITF=1
340	SRQ ON
350	RETURN
360	'
370	END

	Description
100	Assign the R6451 address 8 for the variable "DMM".
110	Send "Interface clear".
120	Set "Remote enable" to "true".
130	Set the delimiter to "CR + LF".
140	
150	┐
160	├ *1: Clear SRQ signal in the GPIB of PC9801.
170	├
180	┘
190	
200	Specify the jump address of subroutine by SRQ interruption.
210	Initialize all the R6451 parameters
220	Set the R6451 parameters. F3 : Resistance measurement PR3 : Sampling rate to SLOW M1 : Hold mode S0 : SRQ on
230	Set the SRQ interruption to "Enable".
240	Clear the interruption receive flag.
250	Start the measurement by using trigger.
260	Branch to line 240 if the interruption receive flag is set.
270	Branch to line 260.
280	
290	Execute the serial polling and store the R6451 status in the variable "S".
300	Branch to line 340 if the status has not been measured.
310	Read out the measured data from R6451.
320	Display the measured data on CRT.
330	Set the interruption receive flag.
340	Set the SRQ interruption to "Enable".
350	Subroutine end
360	
370	Program end

*1 : In some case the SRQ processing may not operate correctly if the PC9801 does not clear the SRQ signal in the GPIB.
If the SRQ is used, be sure to program the line 150 to 180 in the same manner as shown in above.
If N88-BASIC is used on the MS-DOS, specify the segment base to "DEF SEG = SEGPTR(7)"; otherwise, specify to "DEF SEG = &H60".

Example 3: Read out the data file which has been stored in the IC memory card in advance and display the setting information on the CRT at the storing time and measurement data. (This example requires the R13222 memory card interface unit and the IC memory card.)

	Program		Description
100	`OPTION BASE 1`	100	Specify the minimum value of the subscript on the arrangement to 1.
110	`DMM=8`	110	Assign R6451 address 8 for the variable "DMM".
120	`DIM A$(21)`	120	*2: Define the character type array variable "A$".
130	`DIM DT(4000)`	130	*3: Define the array variable "DT".
140	`'`	140	
150	`ISET IFC`	150	Send "Interface clear".
160	`ISET REN`	160	Set "Remote enable" to "true".
170	`CMD DELIM=0`	170	Set the delimiter to "CR + LF".
180	`'`	180	
190	`PRINT @DMM;"SL2"`	190	Set the string delimiter of R6451 to "CR + LF".
200	`PRINT @DMM;"RCL:D001:C"`	200	Request R6451 to read out the setting information of the file "D001" in the IC memory card.
210	`FOR I=1 TO 100 : NEXT I`	210	*4: Waiting time
220	`FOR I=1 TO 21`	220	Repetition of 21 times
230	`INPUT @DMM;A$(I)`	230	Read out one line of the setting information from R6451.
240	`PRINT A$(I)`	240	Display the read setting information on the CRT.
250	`NEXT I`	250	
260	`'`	260	
270	`INPUT WAIT 100,A$`	270	
280	`'`	280	
290	`D$=MID$(A$(21),11,4)`	290	With the read setting information, take out the number of data in the file into the character-type array variable "D$".
300	`DCOUNT=VAL(D$)`		Read the status with scaling.
310	`PRINT @DMM;"RCL:D001:D:1:"+D$`	300	Convert the number of data from the character-type array to the numeric type and assign it for the variable "DCOUNT".
320	`FOR I=1 TO 100 : NEXT I`	310	Request R6451 to read out all the data in the file "D01" of the IC memory card, starting at the beginning in the file.
330	`FOR I-1 TO DCOUNT`	320	*4: Waiting time
340	`INPUT @DMM;A$`	330	Repetition of the number of data.
350	`DT(I)=VAL(A$)`	340	Read out one data from R6451.
360	`NEXT I`	350	Convert the read data to the numeric type and assign it for the variable "DT".
370	`'`	360	
380	`FOR I=1 TO DCOUNT`	370	
390	`PRINT I, DT(I)`	380	Repetition of the number of data.
400	`NEXT I`		
410	`'`		
420	`END`		

(cont'd)

390	Display one data on the CRT.
400	
410	
420	Program end

*2 : There are 21 line of setting information in the data file which has been stored in the IC memory card. A$ is the character type array variable with which all the setting information is read out from the data file.

*3 : Define the size of array more than the data size to be read out.

*4 : A waiting time of approx. 20 msec is required for analysis processing of the read out command.

7.7 Printer Interface Unit R13221

7.7.1 Outline

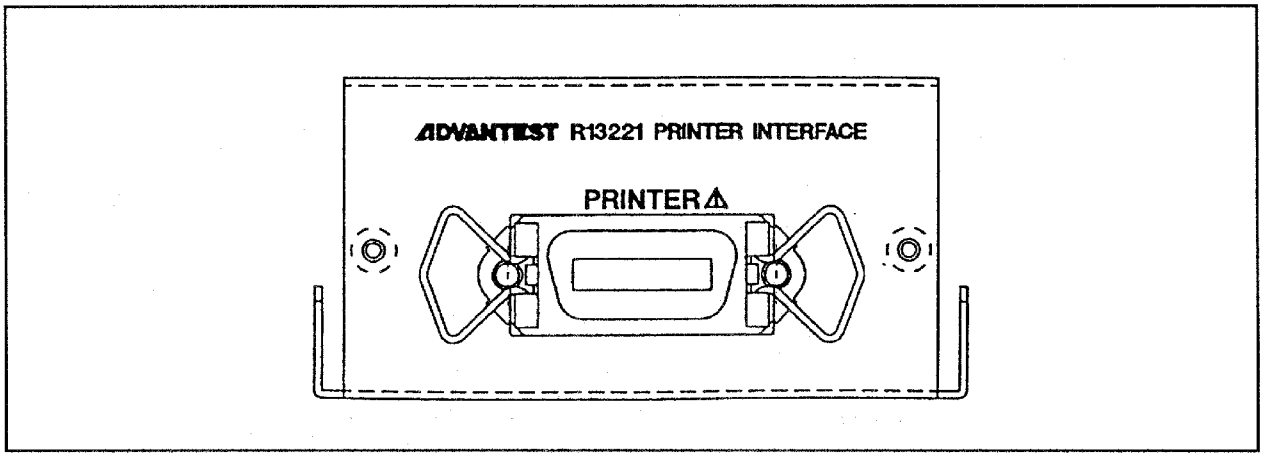
With the printer interface unit R13221 installed into the instrument, the measurement value can be printed on the external printer through the Centronics connector.
Since the output Centronics connector is electrically isolated from the measurement signal system, the measurement value cannot be affected by external unit.
It is possible to set the print interval to any value of 1 second to 4 hours, stop, or continuous (print when data is generated in the R6451).

7.7.2 Specifications

Output code : Centronics (Recommended printer : Seiko Electronics DPU-201G)

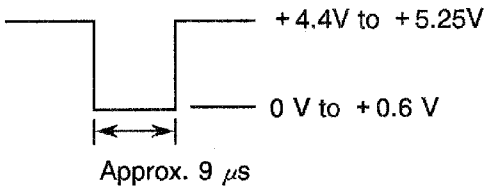
Output data contents : Measurement data, decimal point, polarity, and unit

Output connector : 57-40140 (Dai-ichi Electronics Industry Co.)



Terminal	Signal	Terminal	Signal
1	STB	8	DB6
2	DB0	9	DB7
3	DB1	10	NC
4	DB2	11	BUSY
5	DB3	12	NC
6	DB4	13	NC
7	DB5	14	GND

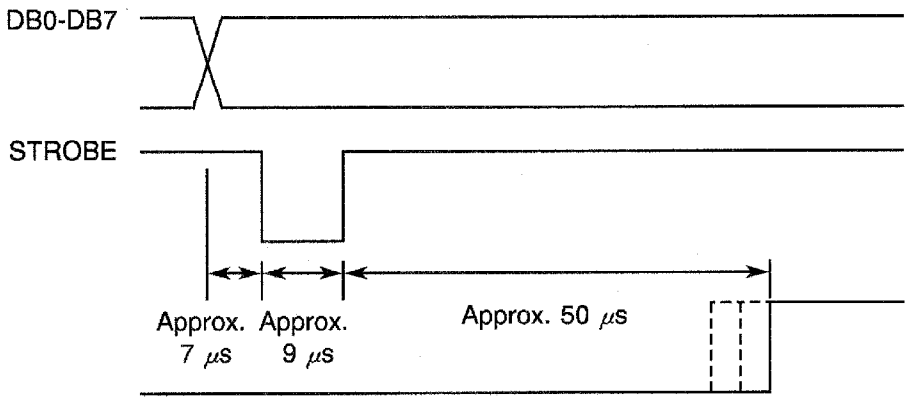
STB (STROBE) signal : TTL level negative pulse



DB0-DB7 (Data signal) : TTL level signal
Parallel data (8 bits)
H data 1 ; +4.4 V to +5.25 V
L data 0 ; 0 V to +0.6 V

BUSY input : Receives the signal from the printer.

H data 1 ; +2.7 V to +5.25 V
Indicates that the printer cannot receive data.
Data is not transmitted.
L data 0 ; 0 V to +0.6 V
Indicates that the printer can receive data.
Data is transmitted.



7.7.3 Operation

(1) Connecting to printer

Turn off both printer and the instrument. Plug the connection cable supplied with the printer into the DATA OUTPUT connector.

(2) Operate the printer according to the operation procedure.

(3) Setting the print time

Set the interval for the printing.
If it is set to "continuous" (0), printing is started at the time when data is generated on the instrument. In the HOLD mode, when the [TRIG] is pressed, the measurement is started and the data is printed. If the printing interval (1 to F) is specified, each printing is started at the specified interval whether the instrument is in HOLD or FREE RUN mode.

The relationship between the panel display and printing time intervals is:

Display	Printing intervals
Stop	STOP
cont	Continuous
5 s	5 sec.
10 s	10 sec.
20 s	20 sec.
30 s	30 sec.

Display	Printing intervals
1 M	1 min.
2 M	2 min.
5 M	5 min.
10 M	10 min.
20 M	20 min.
30 M	30 min.

Display	Printing intervals
60 M	1 hour
120 M	2 hours
180 M	3 hours
240 M	4 hours

(4) Setting the print type

Set the output code of "Ω, OHM" in the characters to be printed.
The relationship between the panel display and the output codes is:

Switch	Character	Code (hexadecimal)
OH M	OHM	4Fh 48h 4Dh
Ω	Ω	FCh

(5) Various setting examples

The following are the setting conditions and factory setting of the printer:

Setting condition	Factory setting
Printer printing instruction interval	STOP
Font	Resistance: OHM

R6451A			R6452A and R6452E				Description
Key operation		Display	Key operation		First display	Second display	
①	I/F	SCI on	①	I/F	SCI	on	Option setting mode
②	UP DOWN	Pr oFF	②	UP DOWN	Pr	oFF	Display for selection printer
③	ENTER	In. StoP	③	SHIFT	StoP	Int	Display for previous setting
④	UP DOWN	In. cont	④	UP DOWN	cont	Int	Display for setting print time interval to continuous Refer to "(a) Setting the printing time interval".
⑤	ENTER	Font OH M	⑤	SHIFT	OH M	Font	Display for previous setting
⑥	UP DOWN	Font Ω	⑥	UP DOWN	Ω	Font	Display for setting the printing font to Ω Refer to "(b) Setting the printing font".
⑦	ENTER	Pr on	⑦	SHIFT	Pr	on	Confirmation of setting end
⑧	ENTER	Measurement value	⑧	SHIFT	Measurement value		Setting end

(a) Setting the printing time interval

Enter the printing time interval setting mode.

Use the [UP] and [DOWN] to switch the setting of the printing time interval.

Each time the setting key is pressed, the setting is changed in the following order:

→ StoP (Stop) → cont (Continue) → 5 s → 10 s → 20 s → 30 s → 1 M → 2 M →
240 M ← 180 M ← 120 M ← 60 M ← 30 M ← 20 M ← 10 M ← 5 M ←

(b) Setting the printing font

Enter the printing font setting mode.

Use the [UP] and [DOWN] to switch the setting of the printing font.

Each time the setting key is pressed, the setting is changed in the following order:

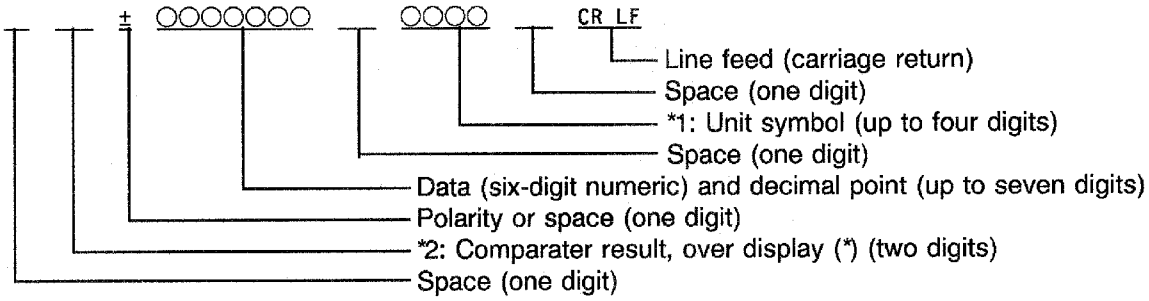
→ OH M → Ω →

7.7.4 Output Data Format

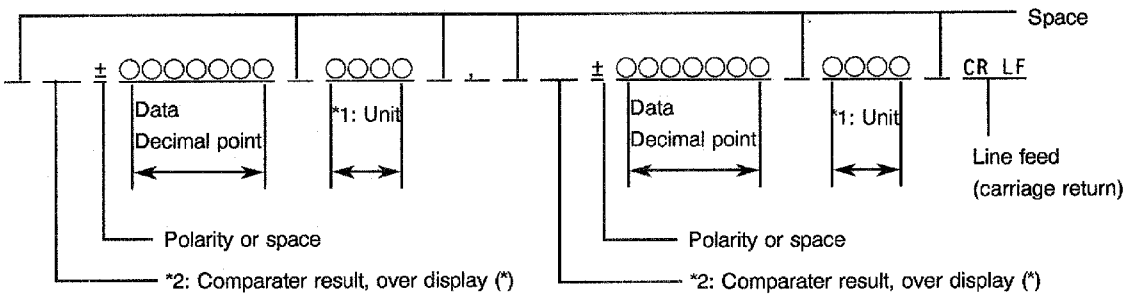
The following are data formats to output the measurement and calculation data to the printer.

(1) Printing format

(a) R6451A or single display



(b) R6452A and R6452E



*1 : Unit symbol
The unit symbol consists of subunit and basic unit.

Subunit : m, k, M, and G
Basic unit: V, A, OHM, Ω, °C, Hz, %, dB, and dBm

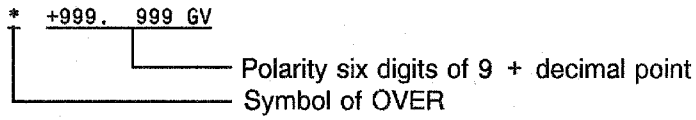
*2 : Comparater result, over display
The comparater result and over display are output according to the conditions below:

(Space) : When comparater calculation is set to OFF.
H : When comparater calculation result is HIGH.
P : When comparater calculation result is PASS.
L : When comparater calculation result is LOW.
HL : When comparater calculation result is HIGH&LOW.
* : At range over
E : At "ERR D" (dBm error)

Note: If the range over occurs during the execution of the comparater calculation, the range over has a priority and "*" is output.

Example: In case of over data, data is output as follows:

In 5 1/2 digits display:



(2) Data (six-digit number) and decimal point (automatic interruption), polarity, symbol of over

The exponent part of the measurement value consists of six-digit number (fixed length). The position of the decimal point varies depending on the display of the instrument. The exponent part for the high-speed sampling (FAST mode, 3 1/2 digit measurement) consists of five-digit number.
The polarity is represented by a space for AC voltage/current and by + or – for the NULL calculation. Also, + or – is used for the polarity of the DC voltage, DC current, and temperature measurement.

7.8 Memory Card Interface Unit R13222

7.8.1 Outline

With the memory card interface unit R13222 installed into the instrument, can store or read out the setting conditions and the measurement data.

Note: Care should be taken for battery consumption of the IC memory card.

(1) Specifications

Memory card type	:	Complies with Japan Electronics Industry Development Association standard Ver. 4.1.
Memory card used	:	SRAM card with a capacity of 64 Kbytes or more
Capacity at format	:	64 Kbytes fixed
Number of record files	:	Setting conditions ..... 59 files
		Measurement data (11 data or less) ..... 118 files
		Measurement data (51 data or less) ..... 59 files
		Measurement data (129 data or less) ..... 29 files
		Measurement data (523 data or less) ..... 8 files
		Measurement data (1035 data or less) ..... 4 files
		Measurement data (2020 data or less) ..... 2 files
		Measurement data (4000 data or less) ..... 1 files

(2) Memory space

There are two parts of memory space in the IC memory card.

① Common memory

② Attribute memory

The common memory is the memory space for normal use. The attribute memory is placed in the IC memory card with being separated from the common memory and is used for storage of the card attribute information. Some types of the IC memory cards are not equipped with the attribute memory.
The instrument requires the IC memory card equipped with the attribute memory in which the card attribute information (device information) is written.

(3) Storage capacity

① If the IC memory card is used only for the storage of the setting condition files, up to 59 files can be stored.

② If the IC memory card is used for the storage of the setting condition and data files, the number of the setting condition files to be stored decreases compared with ① because of the data file capacity added.

③ If the IC memory card is used only for the data files, the number of files to be stored is somewhat limited since the capacity of the data file varies with the amount of data per file.

(4) Initializing the measurement conditions

Item	Initialization setting	Master reset	Power on
Store/recall operation	Cancel	○	○
Formatting operation	Cancel	○	○
Data sample number	1000	○	○
File number	1	○	○

7.8.2 IC Memory Card Initialization (Formatting)

If the IC memory card is initialized, the internal measurement data and setting conditions are all cleared. The initialization allows the IC memory card to be commonly used for the same type of model; i.e., the IC memory card which has been initialized by R6452A can be commonly used for R6452A.

Use the [I/F] to initialize the IC memory card.

R6451A			R6452A and R6452E			Description
Key operation		Display	Key operation	First display	Second display	
①	[I/F]	SCI on	① [I/F]	SCI	on	Option setting mode
②	[UP] [DOWN]	CArd	② [UP] [DOWN]	CArd		Display for selecting IC memory card
③	[ENTER]	Init	③ [SHIFT]	Init	CArd	Confirmation of initialization
④	[ENTER]	Measurement value	④ [SHIFT]	Measurement value		Initialization of IC memory card

7.8.3 Internal Format of IC Memory Card

The measurement data file stores the setting information at the time of setting and the measurement data.

(1) Setting information at the time of setting

The setting information at the time of setting consists of the number of data bytes for the setting information and the setting information items. Since the number of data bytes for the setting information is used internally, it is not output at the recall.
All the data of the setting information is represented with the ASCII format.
Each item is enclosed with " " and separated by CR/LF.

The following are all the items of setting information and the format.

Item	Number of byte	Format examples
Head position of measurement result	7	"360"**
Model name, version	27	"R6451A,REV.A00.00.00.00"**
Measurement function	22	"FUNCTION V DC "**
Measurement range mode	16	"MANUAL RANGE"**
Sample rate	15	"SLOW-RATE "**
Number of digits to be output	18	"RESOLUTION 5.5"**
NULL calculation setting	12	"NULL OFF"**
Smoothing calculation setting	17	"SMOOTHING OFF"**
dB calculation setting	10	"dB OF"**
dBm calculation setting	11	"dBm OFF"**
Scaling calculation setting	15	"SCALING OFF"**
MAX/MIN calculation setting	15	"MAX/MIN OFF"**
Comparater calculation setting	18	"COMPARATER OFF"**
Scaling constant A	17	"A = +000001.E+0"**
Scaling constant B	17	"B = +000000.E+0"**
Scaling constant C	17	"C = +000001.E+0"**
dB/dBm calculation constant D	17	"D = +000001.E+0"**
Comparater setting value HI	18	"HI = +000001.E+0"**
Comparater setting value LO	18	"LO = +000000.E+0"**
NULL value	20	"NULL = +0.00000E+0"**
Number of times for smoothing	15	"SM TIME=010"**
Number of measurement data samples	17	"N.SAMPLE=1000"**

(Note) ** : CR/LF

(2) Measurement data format

The measurement data consists of the symbol, mantissa, and exponent parts. One piece of data is 13-byte long (fixed) and CR/LF is placed at the end of the piece (13-byte data includes CR/LF).
Accordingly, changing the number of displayed digits does not change the data length.

Format examples

5 1/2 digit output : +1800.00E-3 CR LF

4 1/2 digit output : +1800.0E-3 CR LF

3 1/2 digit output : +1800.E-3 CR LF

7.8.4 Storing Setting Conditions

The IC memory card can store up to 59 types of the setting conditions for the multimeter.
In R6452A and R6452E, the setting conditions of the dual display can be stored both for the first and second displays. However, the measurement conditions is stored only for the first display.
(STORE) is displayed on the second display in the storing mode of setting.

(1) Storing the measurement conditions

R6451A			R6452A and R6452E			Description
Key operation		Display (indicator)	Key operation	First display	Second display	
①	SHIFT	-----	① SHIFT	-----		Shift mode
②	STORE ST SET	dAtA (ST) or cond (ST)	② STORE ST SET	dAtA or cond	StorE	Display for previous setting
③	UP DOWN	cond (ST)	③ UP DOWN	cond	StorE	Display for selecting the setting condition storage
④	ENTER	FL c001 (ST)	④ SHIFT	c-001	StorE	Display for previous setting
⑤	AUTO UP DOWN	FL c999 (ST)	⑤ AUTO UP DOWN	c-999	FILE	Sets the file number to "999". Refer to "(2) Setting file number for setting condition storage".
⑥	ENTER	cond (ST)	⑥ SHIFT	cond	FILE	Confirmation of setting end
⑦	ENTER	Measurement value	⑦ SHIFT	Measurement value	StorE	Setting end
⑧	STORE	cond (ST) (Displayed for 0.5 second) Measurement value	⑧ STORE	cond (Displayed for 0.5 second) Measurement value	StorE	Execution of storing (Set the setting condition into the file number 999.)

(2) Setting the file number for setting condition storage

① Enter the file number setting mode.

Pressing the [AUTO] flashes the changeable point.

② After flashing the point to be changed, use the [UP] and [DOWN] to change the file number.

7.8.5 Recalling Setting Conditions

The setting conditions for the multimeter stored in the IC memory card are recalled and the R6451/52 can start operation under the condition recalled.

(1) Recalling during measurement

R6451A		R6452A and R6452E			Description
Key operation	Display (indicator)	Key operation	First display	Second display	
① [SHIFT]	-----	① [SHIFT]	-----		Shift mode
② [RCL] RCL SET	cond (RCL) or dAtA (RCL)	② [RCL] RCL SET	cond or dAtA	rECALL rECALL	Display for previous setting
③ [UP] [DOWN]	cond (RCL)	③ [UP] [DOWN]	cond	rECALL	Display for selecting the setting condition storage
④ [ENTER]	FL c001(RCL)	④ [SHIFT]	c-001	FILE	Display for previous setting
⑤ [AUTO] [UP] [DOWN]	FL c999(RCL)	⑤ [AUTO] [UP] [DOWN]	c-999	FILE	Sets the file number to "999". Refer to "(2) Setting file number for setting condition storage".
⑥ [ENTER]	cond (RCL)	⑥ [SHIFT]	cond	rECALL	Confirmation of setting end
⑦ [ENTER]	Measurement value	⑦ [SHIFT]	Measurement value		Setting end

(cont'd)

R6451A		R6452A and R6452E			Description
Key operation	Display (indicator)	Key operation	First display	Second display	
⑧ RCL	cond (RCL) (Displayed for 0.5 second) Measurement value	⑧ RCL	cond (Displayed for 0.5 second) Measurement value	rECALL	Execution of recall (Set the setting condition into the file number 999.)

(2) Setting the file number for setting condition storage

① Enter the file number setting mode.
Pressing the AUTO flashes the changeable point.

② After flashing the point to be changed, use the UP and DOWN to change the file number.

7.8.6 Storing Measurement Data

The measurement data can be stored in the IC memory card. One file can includes up to 4000 pieces of data. If the number of pieces exceeds the maximum value, during storage operation, it will be stopped.
The data in the same file must have the same measurement conditions (measurement functions, calculations, sampling rate, range (the autorange is considered to be identical range), the number of displayed lines, etc.). If any of measurement conditions is changed during storage operation, it will be stopped.

Note: After the storage operation of the measurement data, in some case it may be somewhat reduced to record the setting condition at the time of measurement.

Example: In case of FAST mode, approx. 12 pieces of data for measurement values are reduced.

R6452A and R6452E:

① In case of dual display, the data on the first display is stored. The second display shows STORE and the measurement is executed in the single operation.
(After the STORE operation is finished, the dual display can not be functioned.)

② If the measurement data is stored in the IC memory card during the comparater calculation, the comparater calculation result does not appear.
(The result will appear only in the remote output mode.)

(1) Storing the measurement data

R6451A		R6452A and R6452E			Descriptions
Key operation	Display (indicator)	Key operation	First display	Second display	
① SHIFT	-----	① SHIFT	-----		Shift mode
② STORE ST SET	dAtA (ST) or cond (ST)	② STORE ST SET	dAtA or cond	StorE StorE	Display for previous setting
③ UP DOWN	dAtA (ST)	③ UP DOWN	dAtA	StorE	Display for selecting the setting condition storage
④ ENTER	FL d001 (ST)	④ SHIFT	d-001	FILE	Display for previous setting
⑤ AUTO UP DOWN	FL d999 (ST)	⑤ AUTO UP DOWN	d-999	FILE	Sets the file number to "999". Refer to "(2) Setting file number for setting condition storage".
⑥ ENTER	SA 1000 (ST)	⑥ SHIFT	n. 1000	SAPL	Display for previous setting
⑦ AUTO UP DOWN	SA 4000 (ST)	⑦ AUTO UP DOWN	n. 4000	SAPL	Set the number of samples to 4000.
⑧ ENTER	dAtA (ST)	⑧ SHIFT	dAtA	StorE	Confirmation of setting end
⑨ ENTER	Measurement value	⑨ SHIFT	Measurement value		Setting end

(cont'd)

R6451A		R6452A and R6452E			Descriptions
Key operation	Display (indicator)	Key operation	First display	Second display	
⑩ STORE	Measurement value (ST) ((st) is lit up until the measurement reaches the specified number of samples.)	⑩ STORE	Measurement value	StorE (2-display is lit up until the measurement reaches the specified number of samples.)	Execution of storing (Set the setting condition into the file number 999.)

(2) Setting the file number for measurement data storage

① Enter the file number setting mode.

Pressing the AUTO flashes the changeable point.

② After flashing the point to be changed, use the UP and DOWN to change the file number.

7.8.7 Recalling Measurement Data

The measurement data can be read out from the IC memory card.

The display is not updated during reading. Pressing the UP reads out the data which was stored next to the currently displayed data. Pressing the DOWN reads out the data which was stored prior to the currently displayed data.

Pressing the SHIFT shows the sample number of the currently disk played data.

With the UP or DOWN, the sample number can be increased or decreased.

Pressing the [SHIFT] again shows the measurement value corresponding to the displayed sample number.

(During reading, only the [UP], [DOWN], [SHIFT], and [RCL] are available.)

Notes:
- If the data is remotely recalled, it does not appear on the panel.
- The result of comparater calculation cannot be recalled.

(1) Recalling the measurement data

R6451A		R6452A and R6452E			Description
Key operation	Display (indicator)	Key operation	First display	Second display	
① [SHIFT]	-----	① [SHIFT]	-----		Shift mode
② [RCL] RCL SET	dAtA (RCL) or cond (RCL)	② [RCL] RCL SET	dAtA or cond	rECALL rECALL	Display for previous setting
③ [UP] [DOWN]	dAtA (RCL)	③ [UP] [DOWN]	dAtA	rECALL	Display for selecting the setting condition storage
④ [ENTER]	FL d001(RCL)	④ [SHIFT]	d-001	FILE	Display for previous setting
⑤ [AUTO] [UP] [DOWN]	FL d999(RCL)	⑤ [AUTO] [UP] [DOWN]	d-999	FILE	Sets the file number to "999". Refer to "(2) Setting file number for setting condition storage".
⑥ [ENTER]	n.1000 (RCL)	⑥ [SHIFT]	n. 1000	dAtA	Display for previous setting
⑦ [AUTO] [UP] [DOWN]	n.4000 (RCL)	⑦ [AUTO] [UP] [DOWN]	n. 4000	dAtA	Set the number of samples to 4000.
⑧ [ENTER]	dAtA (RCL)	⑧ [SHIFT]	dAtA	rECALL	Confirmation of setting end
⑨ [ENTER]	Measurement value	⑨ [SHIFT]	Measurement value		Setting end

(cont'd)

R6451A			R6452A and R6452E			Description
Key operation		Display (indicator)	Key operation	First display	Second display	
⑩	RCL	Stored measurement value (RCL)	⑩ RCL	Stored measurement value	rECALL	Execution of recall
⑪	SHIFT	no. 1(RCL)	⑪ SHIFT	no. 1	rECALL	Display for sample number
⑫	UP	no. 2(RCL)	⑫ UP	no. 2	rECALL	Sample number + 1
⑬	SHIFT	Stored measurement value (RCL)	⑬ SHIFT	Stored measurement value	rECALL	Display the measurement value stored in the sample No.2.
⑭	RCL (RCL SET)	Measurement value	⑭ RCL (RCL SET)	Measurement value		Exit recall mode.

Note: If the UP or DOWN is held down during reading, the data can be read out continuously.

(2) Setting file number for the measurement data storage

① Enter the file number setting mode.

Pressing the AUTO flashes the changeable point.

② After flashing the point to be changed, use the UP and DOWN to change the file number.

8. R15807 BATTERY UNIT

8.1 Outline

The R15807 is the battery unit which can be re-charged and is applied for the R6451 series.

8.2 Specifications

Built-in battery	:	12 V lead-acid battery, it is possible to repeat charge/discharge.
Continuous use time	:	Approx. 6 hours
Charging time	:	Approximately 12 hours when AC power is supplied with the R6451/52 set to OFF. The charging can be made while the R6451/52 is set ON. However, since the charging supplements only the discharged amount, the charging time cannot be prescribed.
Low battery display	:	When the remaining time for usage decreases to approx. 30 minutes, it is indicated on the indicator of the front panel.
External dimensions	:	203 (W) x 29 (H) x 140 (D) mm
Weight	:	1 kg or less

8.3 Precautions

(1) Precautions for use

① Plug the R15807 battery unit into the R6451/52 prior to charging.

② Do not store or use the built-in battery upside-down.

③ Do not give extreme shock to the built-in battery.

(2) Cautions for discarding

① Never disassemble the battery unit. It uses the lead-acid battery. If it is broken and sulfuric acid adhere to clothes or skin, wash out it immediately. If the acid enter an eye, wash out it with clean water and receive medical treatment.

② Keep the battery away from fire or fireworks.

③ Do not put the battery in fire. It may cause explosion.

④ Contact ADVANTEST when the battery is discarded.
(Refer to the end of this manual for our address and other information.)

(3) Note for the purpose of this manual, the battery life is considered to have expired when the actual capacity is 50% or less of the rated capacity.

① Before the R15807 is used for the first time after its purchase or when it has not been used for longer than three months, recharge it for approx. 12 hours.

② The built-in battery can be recharged more than 200 times until their capacity falls to 50% of the nominal 1.8Ah at operating temperatures of +25°C ± 5°C.

③ Recharge the R15807 at 0°C to +35°C and discharge it at -20°C to +40°C.

④ If you store the battery for more than three months, recharge the battery regularly. The recharge time varies according to the ambient temperature as shown below. The battery can be stored for up to 12 months.

Below 20°C:	every 9 months
20°C through 30°C:	every 6 months
30°C or more:	every 3 months

⑤ Estimated three year life expectancy

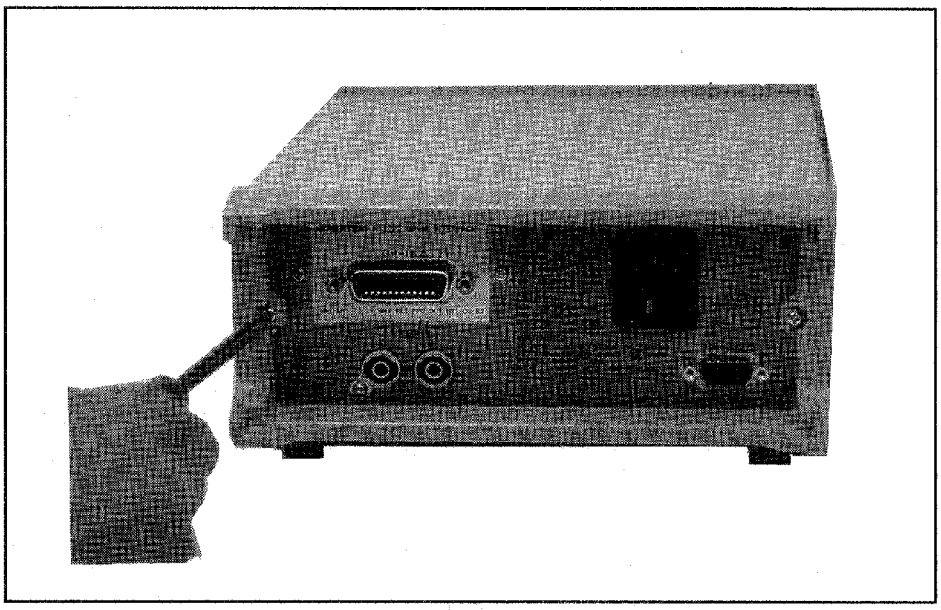
The battery life may be affected substantially by operating conditions such as overcharging or discharging, atmospheric temperature and the amount of time between recharges.

8.4 Mounting Battery Unit

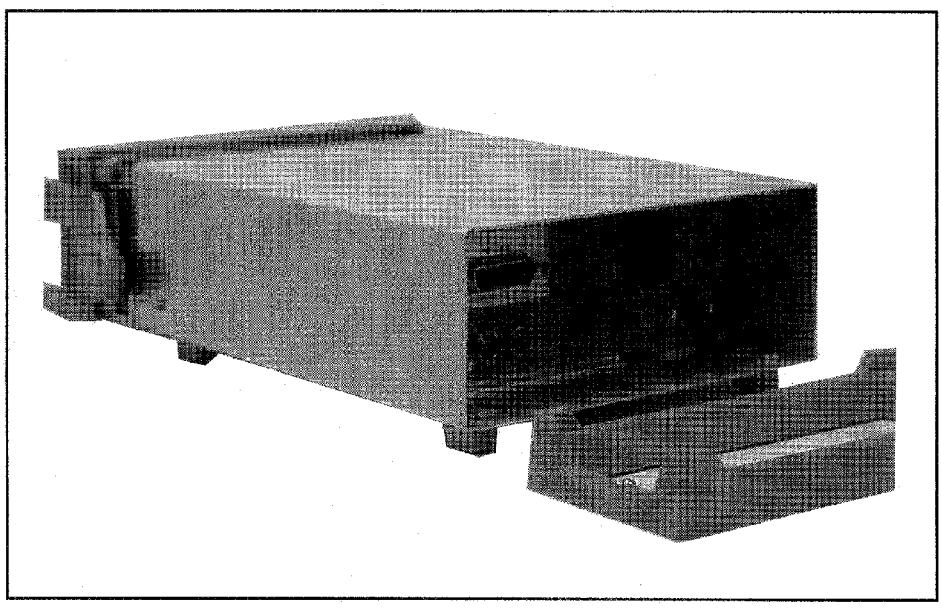
Mounting procedure

Note: Make sure that the R6451/52 power switch is OFF before mounting the R15807 battery unit.

① Remove the Phillips-head screws fixing the rear foot on the rear panel using a Phillips-head screwdriver (3 mm).

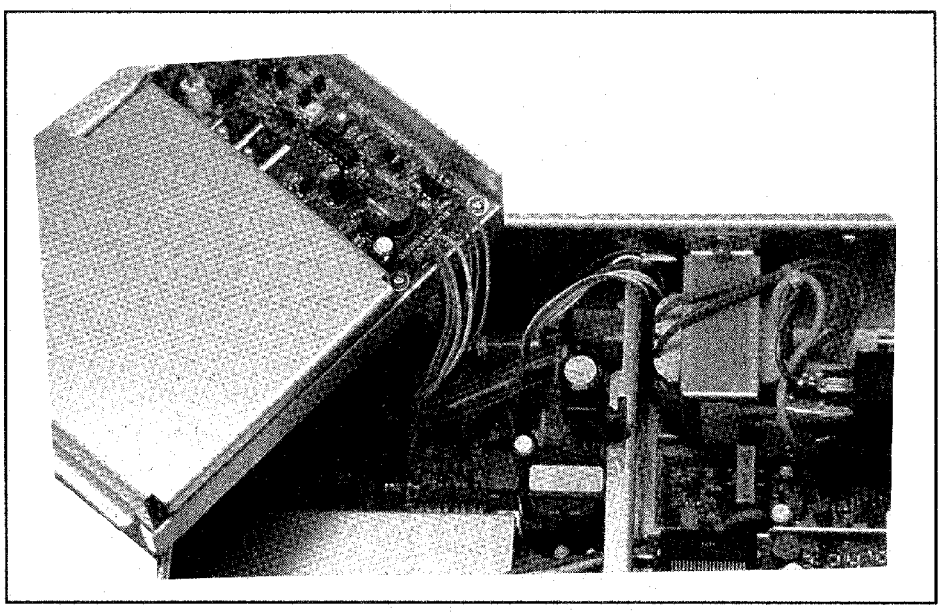


② Remove the rear foot from the R6451/52.

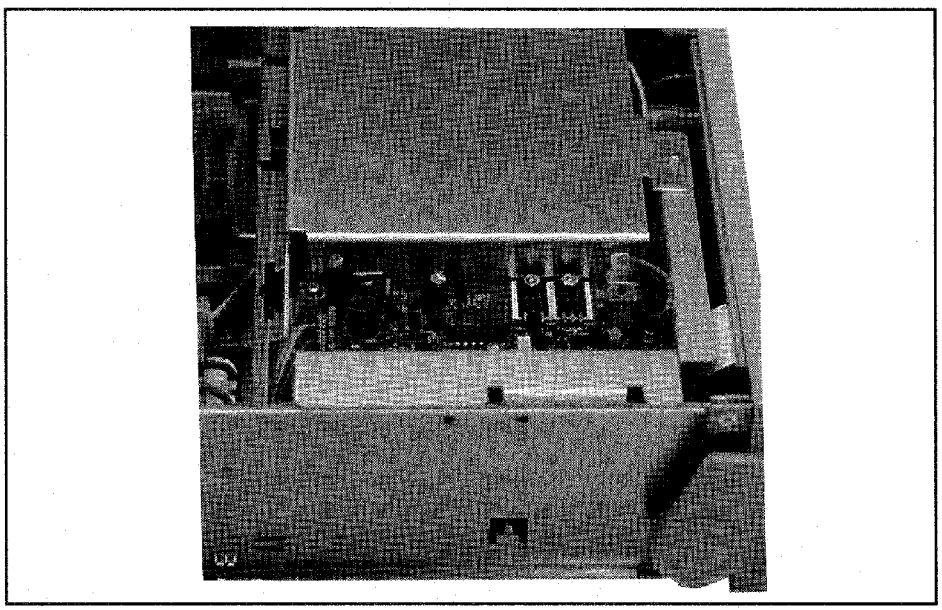


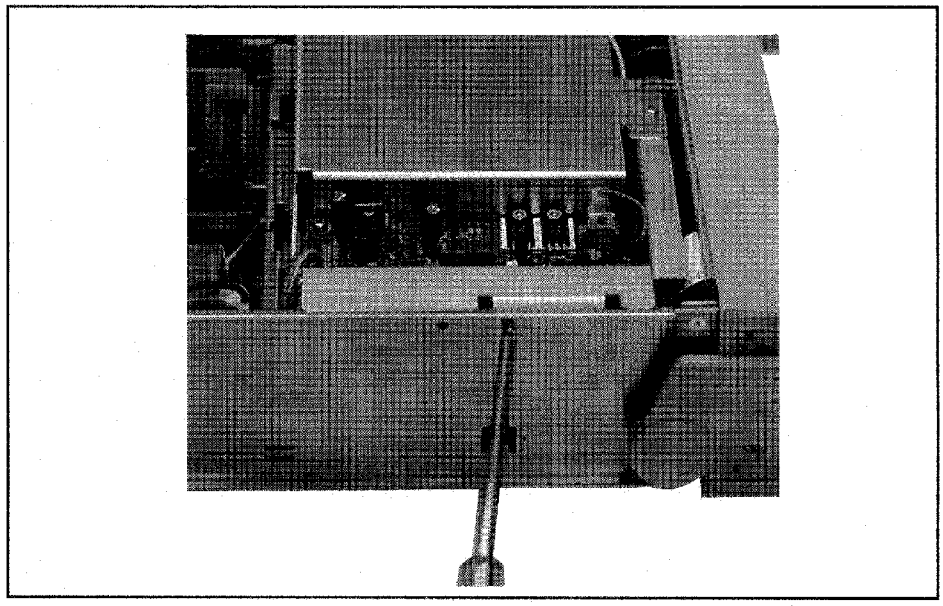
③ Remove the case from the R6451/52.

④ Connect the board with the cables.



⑤ Mount the battery unit on the R6451/52 and secure it with the Phillips-head screws.





8.5 Charging Battery Unit

① Mount the R15807 battery unit into the R6451/52. (See Section 8.4.)

② Turn the R6451/52 power switch OFF to supply AC power (indicated voltage on the rear panel) of 50 Hz or 60 Hz.

The R15807 battery unit takes approx. 12 hours to fully charge. Since this unit has an internal charge control, charging can be continued without overcharging after the R15807 has been fully charged.

9. Q & A FOR PROBLEM SOLVING

Symptom	Checks	Action
1. R6451/52 cannot be powered on.	• Check the AC outlet. • Check the power fuse. • Check the set voltage (indication on the AC outlet).	• Connect it to the AC outlet. • Replace the fuse. • Change the setting.
2. Key does not respond.	• Check if PMT is lit. • Check if the display OFF mode is set.	• Press the SHIFT (LOCAL). • Send the DS1 command from the external control.
3. Displayed digits is less than 5 1/2 digit.	• Select the sampling mode. • Select the displayed digit.	• Press the RATE to select SLOW. • Press the SHIFT and RATE (RES) to set 5 1/2 digit. • Some functions have a maximum of 4 1/2 digit.
4. Input signal cannot be measured.	• Check that the input cable is correctly connected. • Check that the input cable is not damaged.	• Connect the cable again. • Replace the cable.
5. Measurement value is erratic.	• Induction noises are superimposed in the high-resistance measurement.	• Use the shielded input cable (A01001).
6. Electric current cannot be measured.	• Protection fuse is disconnected.	• Replace the fuse.
7. COL display is set when in 2ch input.	• A voltage of more than 200 V is applied between the COM terminal and HI/LO terminal.	• Reduce the voltage on the COM terminal.
8. Sampling cannot be executed.	• HOLD is lit.	• Press the HOLD to set free-run.

Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation.

The protection is likely to be impaired if, for example, the apparatus:

- shows visible damage,
- fails to perform the intended measurements,
- has been subjected to prolonged storage under unfavourable conditions,
- has been subjected to severe transport stresses.

If the R6451/52 shows any of the following conditions, its protection function may be damaged. In this case, contact ATCE, nearest dealer, or sales and support office to check failures and safety.

- Apparent breakage which can be visually determined.
- When a measurement to be done is impossible.

- Precautions for free-run setting

  If a measurement condition is changed by the remote command (function, range, etc.) when measurement data are being read out with the sample mode set to free-run, there is a possibility that the data for the condition before changing is output.

  This is because the R6451/52 gives a priority to the output request when the data output request is received during analysis of the remote command.

  After the data output, the remote command analysis is continued.

  For the data output after the analysis, the data after the condition change is used.

  To output surely the data after condition change, we recommend that the hold mode be used.

  Example: Program when 10 measurement values are output after the measurement function is changed to AC voltage.

	Program
100	`DMM=8`
110	`'`
120	`ISET IFC`
130	`ISET REN`
140	`CMD DELIM=0`
150	`'`
160	`PRINT @DMM;"F2,R5,M1"`
170	`FOR N=1 TO 10`
180	`PRINT @DMM;"E"`
190	`INPUT @DMM;A$`
200	`PRINT A$`
210	`NEXT N`
220	`'`
230	`END`

	Description
100	Assign R6451/52 address 8 for the variable "DMM".
110	
120	Send "Interface clear".
130	Set "Remote enable" to "true".
140	Set the delimiter to "CR + LF".
150	
160	Set parameters for R6451/52. F2 : AC voltage measurement R5 : 20 V range M1 : Hold mode
170	Repetition of 10 times
180	Start the measurement by triggering the R6451/52.
190	Read out measurement data from R6451/52.
200	Display measurement data on CRT.
210	
220	
230	Program end

10. ERROR MESSAGES

Table 10-1 Error Messages

Error message	Description
ERR 01	RAM READ/WRITE error An abnormality is detected in the result of the RAM READ/WRITE test executed in the self test mode.
ERR 02	Panel communication check error An abnormality is detected in the panel communication check executed in the self test mode.
ERR 03	SRAM, EEPROM CAL data error An error is detected in sum check for both SRAM CLA data and EEPROM CAL data which were executed in the self test mode.
ERR 04	SRAM CAL data error An error is detected in the sum check for SRAM CAL data executed in the self test mode.
ERR 05	EPROM CAL data error/CAL data comparison error • An error is detected in the sum check for EEPROM CAL data executed in the self test mode. • The sum check results for the EEPROM CAL data and the SRAM CAL data are normal, but an error is detected in the comparison check between both.
ERR 06	Parameter check error An error is detected in the internal backup parameter setting.
ERR 07	Communication check between MAIN and analog parts An error is detected in the communication check between MAIN and analog parts.
ERR 08	Diagnosis error for analog part An error is detected in the received data from the analog part when an diagnosis is executed on the analog part.
ERR 10	SYNTAX error An error is detected in the receiving, analysis, or execution of the remote command.
ERR11	Calibration execution error An error is detected in the calibration settings.

(cont'd)

Error message	Description
ERR 20	Model type setting error 1 An error is detected in the manufacture name, product name, revision, or product number.
ERR 21	Model type setting error 1 An error is detected in the product name ("R6451A", "R6452A" and "R6452E").
ERR 30	IC memory card format check error An error is detected in the format of the installed IC memory card.
ERR 32	IC memory card initialization error IC memory card cannot be initialized.
ERR 34	End-of-file detection error The end of the file to be recalled cannot be found.
ERR 35	IC memory card access error • IC memory card is not installed. • IC memory card is removed during execution of store/recall. • IC memory card is write protected.
ERR 36	IC memory card recall file open error A specified file cannot be found.
ERR 37	Insufficient space for file registration Sufficient space is not available for file writing on the IC memory card.
ERR 38	Measurement data recall sample number setting error An error is detected in the specified sample number when the measurement data is recalled.
ERR 39	Recall data error • The file cannot be recalled because it is stored using a model different from this R6451/52. • An error is detected in the setting information of the recall data.
ERR d	dB/dBm calculation error The measurement value is zero during the execution of the dB or dBm calculation.

11. CALIBRATION

To ensure the measurement accuracy of the R6451/52, calibration must be performed at least once every guarantee period (one year).
The R6451/52 can be calibrated using keys on the front panel or remote control.

11.1 Preparing for Calibration

(1) Power supply

As a power supply, use an AC power source having a voltage within range indicated on the rear panel (100 V, 120 V, 220 V, or 240 V) and a frequency of 50 Hz or 60 Hz or the battery unit R15807.

(2) Ambient conditions

The R6451/52 must be calibrated under the following conditions:

Temperature : +23°C ± 3°C
Humidity : 70% RH or less
Free from dust, vibration, and noise.

(3) Warm up

Warm up the R6451/52 for at least 60 minutes (pre-heating). Also, warm up each calibration standards as well.

(4) Calibration standards

Table 11-1 Standard Equipment for Calibration

Standard	Working range	Accuracy
Standard DC voltage generator	100 mV to 2 V 10 V to 1000 V	±0.002% or less ±0.0015% or less
Standard AC voltage generator (R6451A and R6452A only)	10 mVrms to 700 Vrms Frequency 1 kHz	±0.03% or less
Standard resistor (R6451A and R6452A only)	180 Ω 1.8 kΩ 18 kΩ 180 kΩ 1.8 MΩ 18 MΩ 180 MΩ	±0.01% or less ±0.005% or less ±0.005% or less ±0.005% or less ±0.005% or less ±0.1% or less ±1% or less
Standard DC current generator (R6451A and R6452A only)	100 mA to 200 mA 5 A to 10 A	±0.015% or less ±0.03% or less
Standard AC current generator (R6451A and R6452A only)	10 mA to 200 mA 0.5 A to 10 A Frequency 1 kHz	±0.05% or less ±0.1% or less
0°C freezing point generator (R6452A and R6452E only)	0°C	±0.3°C or less

11.2 Calibration Methods

Each range of each measurement function should be calibrated.
For the DC voltage measurement, resistance measurement, DC current measurement, and Bch DC voltage measurement, the zero point and full-scale point should be calibrated.
For the AC voltage measurement and AC current measurement, 1/10 full-scale point and full-scale point should be calibrated. It is impossible to calibrate the temperature measurement but check that the measurement points is within the prescribed range to satisfy the measurement accuracy.

11.2.1 Calibration Items and Recommended Input Ranges

Table 11-2 Calibration Items and Recommended Input Ranges

Measurement function	Range	Calibration point	Recommend input range
DC voltage measurement	200 mV	Zero point Full scale	0 mV 160mV to 200mV
	2000 mV	Zero point + full-scale – full-scale	0 mV 1.6 V to 2 V – 1.6 to – 2 V
	20 V	Zero point Full scale	0 V 16 V to 200 V
	200 V	Zero point Full scale	0 V 160 V to 200 V
	1000 V	Zero point Full scale	0 V 800 V to 1000 V
AC voltage measurement (AC coupling mode) (R6452A and R6452E only)	200 mV	1/10 full-scale Full scale	16 mV to 200 mV, 1kHz 160 mV to 200 mV, 1kHz
	2000 mV	1/10 full-scale Full scale	160 mV to 200 mV, 1kHz 1.6 V to 2 V, 1kHz
	20 V	1/10 full-scale Full scale	1.6 V to 2 V, 1kHz 16 V to 20 V, 1kHz
	200 V	1/10 full-scale Full scale	16 V to 20 V, 1kHz 160 V to 200 V, 1kHz
	700 V	1/10 full-scale Full scale	50 V to 70 V, 1kHz 500 V to 700 V, 1kHz

(cont'd)

Measurement function	Range	Calibration point	Recommend input range
Resistance measurement	200 Ω	Zero point	0 Ω
		Full scale	160 kΩ to 200 kΩ
	2000 Ω	Zero point	0 Ω
		Full scale	1.6 kΩ to 2 kΩ
	20 kΩ	Zero point	0 Ω
		Full scale	16 kΩ to 20 kΩ
	200 kΩ	Zero point	0 Ω
		Full scale	160 kΩ to 200 kΩ
	2000 kΩ	Zero point	0 Ω
		Full scale	1.6 MΩ to 2 MΩ
	20 MΩ	Zero point	0 Ω
		Full scale	16 MΩ to 20 MΩ
	200 MΩ	Zero point	0 Ω
		Full scale	100 MΩ to 200 MΩ
DC current measurement (R6451A and R6452A only)	200 mA	Zero point	0 mA
		Full scale	160 mA to 200 mA
	10 A	Zero point	0 A
		+ full-scale	8 A to 10 A
AC current measurement (AC coupling mode) (R6451A and R6452A only)	200 mA	1/10 full-scale	16 mA to 20 mA, 1 kHz
		Full scale	160 mA to 200 mA, 1 kHz
	10 A	1/10 full-scale	0.8 A to 1 A, 1kHz
		Full scale	8 A to 10 A, 1kHz
Bch DC voltage measurement (R6452A and R6452E only)	2000 mA	Zero point	0 mV
		Full scale	1.6 V to 2 V
	20 V	Zero point	0 V
		Full scale	16 V to 20 V
	200 V	Zero point	0 V
		Full scale	160 V to 200 V
Temperature measurement (only checking) (R6452A and R6452E only)		Zero point	0°C

11.2.2 Calibration Procedure

Note: Only particular functions or ranges can be calibrated. First, calibrate 2000 mV rage of the DC voltage measurement. Remaining functions and ranges have no priority for calibration.

(1) Setting calibration mode

Press the CAL ◎ key on the front panel. For calibration mode indicator, the R6451A lights up the CAL indicator and R6452A and R6452E shows "CAL" on the second display.

Note: Since the CAL switch is ineffective when functions having no calibration point is set, be sure to press the switch after setting any function shown in Table 11-2 (excluding the temperature measurement).

CAUTION

Power off the R6451/52 after canceling the calibration mode.
The R6451/52 stores the calibration data into the internal non-volatile memory and all the data is written in the gross when the calibration mode is canceled. Therefore, if the R6451/52 is powered off in the calibration mode, the data may not be stored.

(2) Setting calibration function

With the key or switch on the front panel or remote control, set the function to be calibrated.

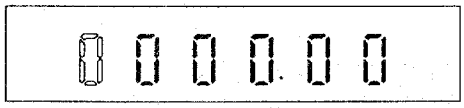
(3) Setting calibration range

With the key or switch on the front panel or remote control, set the range to be calibrated.

(4) Calibrating each range

① Apply the input within a range shown in Table 11-2 after the function and range is set.

② Pressing the [RCL] flashes the number of changeable digit.



Flashing

③ Pressing the [AUTO] moves the changeable point to the right.

→10^5 digits → 10^4 digits → 10^3 digits → 10^2 digits → 10^1 digits → 10^0 digits →

④ Pressing the UP increases the number by one as shown below while pressing the DOWN decreases it by one. Also, with the exception of 10^5 digits, the number moves to upper or lower digits when 9 or 1 is displayed.

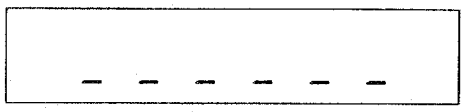
→ 0 → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 →
← −1 ← −2 ← −3 ← −4 ← −5 ← −6 ← −7 ← −8 ← −9 ←

⑤ Set the displayed value to the input value in the steps ③ and ④.

⑥ Use the I/F to cancel the setting of calibration value because of wrong entry of the number and the R6451/52 returns the status before pressing the RCL.

⑦ Press the STORE to execute the calibration.

The display is as shown in the right:



CAUTION

When the calibration value is set through remote control, the calibration value is decided with being read from right to left. Therefore, if the maximum number of digits for the range is 4 1/2, be sure to enter the calibration value with 5 1/2 digit.

(5) With repeating (2) to (4), calibrate each function and each range.

(6) Canceling the calibration mode

When the calibration mode is canceled by pressing the CAL switch on the front panel again or through remote control, the finally calibrated function and range are set and R6451/52 returns to the measurement status.

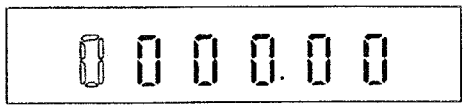
11.3 Examples of Calibration

Example 1: Calibration for 2000 mV range of DC voltage measurement function

① Press CAL ◎ to enter the calibration mode.

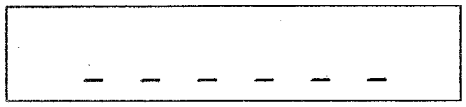
② Press the [V DC] to set the DC voltage measurement function and use the [UP] or [DOWN] to set 2000 mV range.

③ Short the input or enter 0 V and press the [RCL].

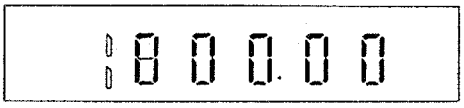


Flashing

④ After confirming that 0 is displayed, press the [STORE]. If 0 does not appear, use the [AUTO], [DOWN], or [UP] to display 0 and press the [STORE] for calibration.

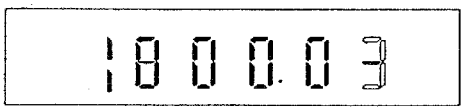


⑤ Enter DC voltage +1.8 V and press the [RCL].



Flashing

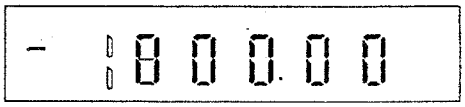
⑥ Use the [AUTO], [DOWN], or [UP] to adjust the displayed value to the calibration value of the standard DC voltage generator. (Example 1800.03 mV)



Flashing

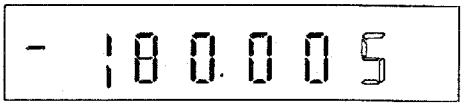
⑦ Press the [STORE] to execute the calibration.

⑧ Input the DC voltage −1.8 V and press the [RCL]

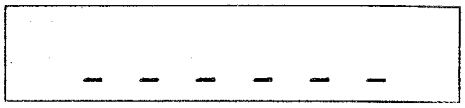


Flashing

⑨ Use the [AUTO], [DOWN], or [UP] to adjust the displayed value to the calibration value of the standard DC voltage generator.
(Example 180.005 mV)



⑩ Press the [STORE] to execute the calibration.



CAL
⑪ Press ◎ to cancel the calibration mode and exit the mode.

Example 2: Calibration for 200 mV range of AC voltage measurement function (AC coupling mode) (R6451A and R6452A only)

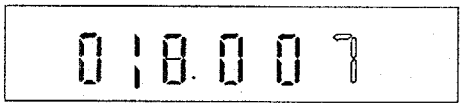
CAL
① Press ◎ to enter the calibration mode.

② Press the [V AC] to set the AC voltage measurement function (AC coupling mode) and use the [DOWN] to set 200 mV range.

③ Enter AC voltage 18 mV, 1 kHz and press the [RCL] .

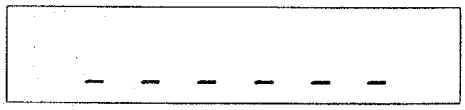
Flashing

④ Use the [AUTO] , [DOWN] , or [UP] to adjust the displayed value to the calibration value of the standard AC voltage generator. (Example 18.007 mV)

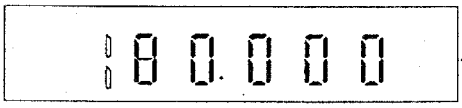


Flashing

⑤ Press the [STORE] to execute the calibration.



⑥ Input the AC voltage 180 mV, 1 kHz and press the [RCL] .



⑦ Use the [AUTO] , [DOWN] , or [UP] to adjust the displayed value to the calibration value of the standard AC voltage generator. (Example 180.005 mV)

Flashing

Flashing

⑧ Press the [STORE] to execute the calibration.

CAL
⑨ Press ◎ to cancel the calibration mode and exit the mode.

11.4 Checking Temperature Measurement (R6452A and R6452E only)

The calibration is not necessary for the temperature measurement function. Check that the measurement point is within the prescribed range to satisfy the measurement accuracy. The temperature measurement must be checked after the calibration for the 20 V range of the Bch DC voltage measurement.

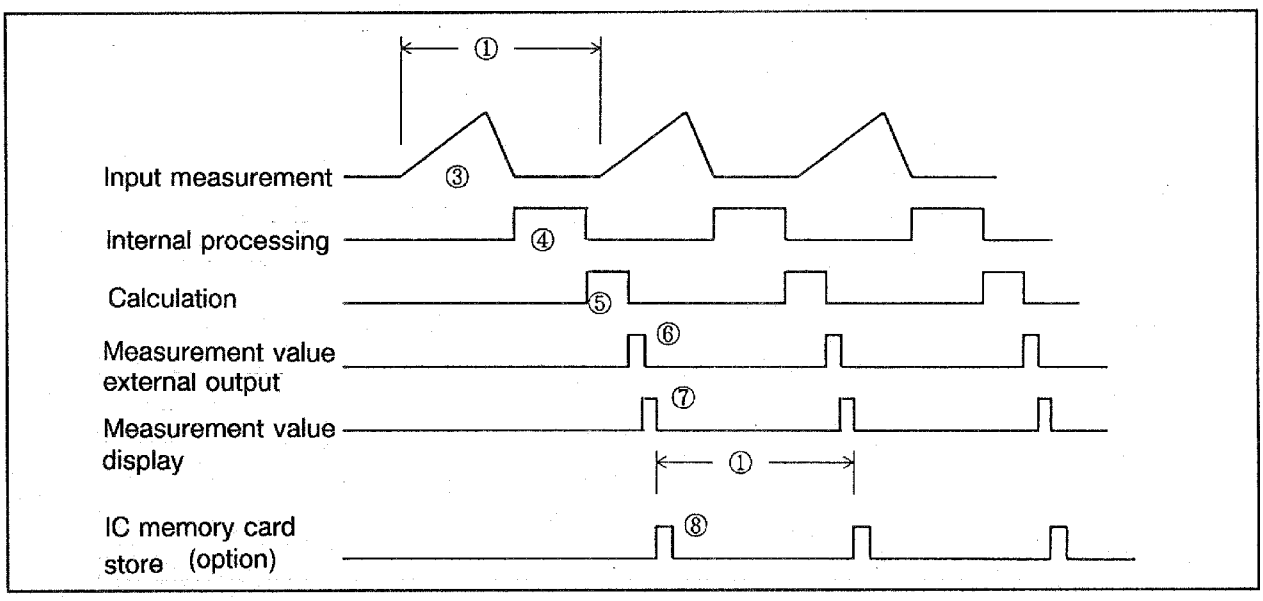
- Input : 0°C
- Allowable range : ±1.0°C or less

12. MEASUREMENT SPEED

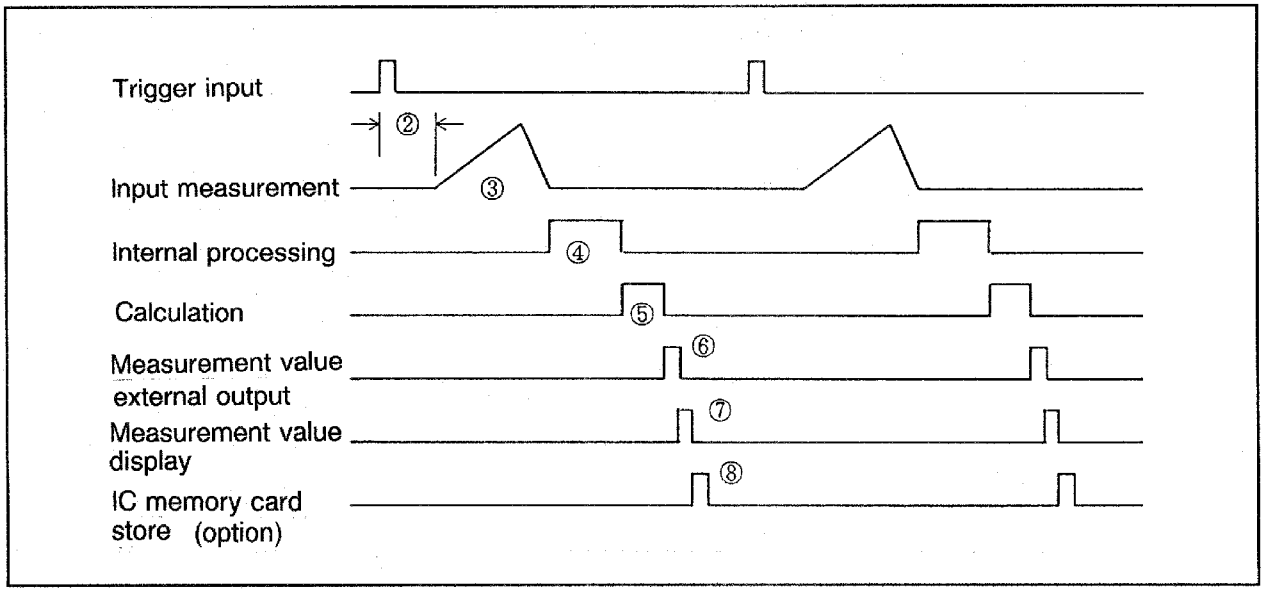
12.1 Measurement Operations

The following are the outline of the measurement operations:

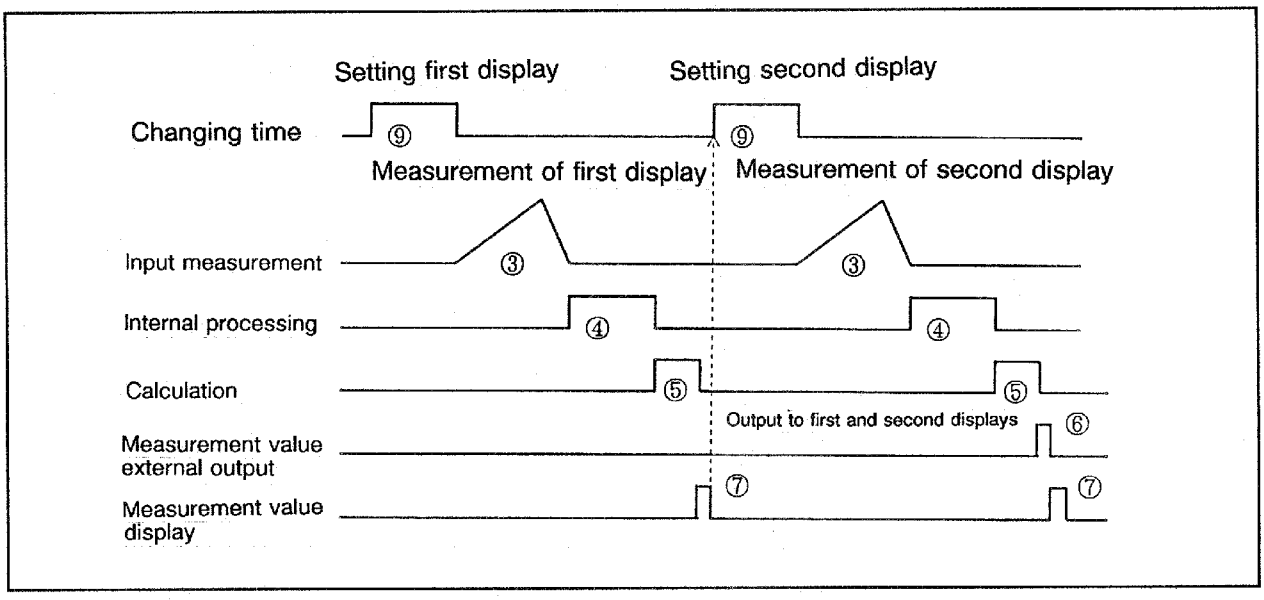
(1) Free-run



(2) Hold/trigger



(3) Free-run in dual display measurement (R6452A and R6452E only)



12.2 Measurement Speed

① Measurement period

Table 12-1 shows the measurement periods when the sampling mode is set to free-run.

Table 12-1 Measurement Period

Measurement function \ Sampling rate	FAST	MID	SLOW
DC voltage measurement	12.5(80)	100(10)	400(2.5)
AC voltage measurement (AC coupling mode) (R6451A and R6452A only)	12.5(80)	100(10)	400(2.5)
Resistance measurement	12.5(80)	100(10)	400(2.5)
DC current measurement (R6451A and R6452A only)	12.5(80)	100(10)	400(2.5)
AC current measurement (AC coupling mode) (R6451A and R6452A only)	12.5(80)	100(10)	400(2.5)
AC voltage measurement (AC + DC coupling mode) (R6451A and R6452A only)	38(26.3)	220(4.5)	820(1.2)
AC current measurement (AC + DC coupling mode) (R6451A and R6452A only)	38(26.3)	220(4.5)	820(1.2)
Bch DC voltage measurement (R6452A and R6452E only)	12.5(80)	100(10)	400(2.5)
Diode measurement	12.5(80)	100(10)	400(2.5)
Continuity measurement	12.5(80)	100(10)	400(2.5)
4-20 mA measurement (R6451A only)	12.5(80)	100(10)	400(2.5)
temperature measurement (R6452A and R6452E only)	12.5(80)	100(10)	400(2.5)
Frequency measurement (R6452A only)	210(4.7)	300(3.3)	600(1.6)

② Trigger delay time

When the sampling mode is set to hold, the delay time taken from the trigger input to measurement start is 5 mS or less.

③ Input measurement time (A/D conversion)

The times to be taken to measure the input (A/D conversion) are:

- FAST : Approx. 9 mS
- MID : Approx. 97 mS
- SLOW: Approx. 397 mS

④ Internal processing time

The internal processing time to be taken to convert the A/D converted data into the format to be output is approx. 3.2 mS.

⑤ Computation times

The time to be taken to execute each operation are:

- Null : Approx. 0.1 mS
- Smoothing : Approx. 1.2 mS
- dB : Approx. 5.2 mS
- dBm : Approx. 5.6 mS
- Scaling : Approx. 2.3 mS
- MAX : Approx. 0.6 mS
- MIN : Approx. 0.6 mS
- Comparator : Approx. 0.8 mS

⑥ Measurement value external output time

This is the time taken to output the measurement result to each interface.

⑦ Measurement value display time

The time taken to display the measurement value is approx. 0.6 mS.

⑧ IC memory card store time

In case that the optional IC memory card is installed, the time taken to store the measurement value in the IC memory card is approx. 1.2 mS.

⑨ Changing time

Table 12-2 shows the changing time of functions and ranges in the normal measurement.

Table 12-2 Changing Time

Before change \ After change	VDC 200 mV 2000 mV	VDC 20 V 200 V 1000 V	VAC 200 mV 2000 mV 20 V	VAC 200 V 700 V	OHM 200 Ω to 2 MΩ	OHM 20 MΩ	OHM 200 MΩ
VDC 200 mV 2000 mV	7	13	1500	1500	300	500	2000
VDC 20 V 200 V 1000 V	13	7	1500	1500	300	500	2000
VAC 200 mV 2000 mV 20 V	13	13	1500	1500	300	500	2000
VAC 200 V 700 V	13	13	1500	7	300	500	2000
OHM 200 Ω to 2 MΩ	13	13	1500	1500	300	500	2000
OHM 20 MΩ	13	13	1500	1500	300	-	2000
OHM 200 MΩ	13	13	1500	1500	300	500	-
ADC	13	7	1500	1500	300	500	2000
AAC	13	7	1500	1500	300	500	2000
Bch VDC	13	13	1500	1500	300	500	2000
⊣◁	13	13	1500	1500	300	500	2000
)))	13	13	1500	1500	300	500	2000
4-20 mA	13	7	1500	1500	300	500	2000
TEMP	13	13	1500	1500	300	500	2000
FREQ	13	13	1500	1500	300	500	2000

Unit[mS]

VDC : DC voltage measurement
VAC : AC voltage measurement (AC coupling mode) (R6451A and R6452A only)
OHM : Resistance measurement
ADC : DC current measurement (R6451A and R6452A only)
AAC : AC current measurement (AC coupling mode) (R6451A and R6452A only)
Bch VDC : Bch DC voltage measurement (R6452A and R6452E only)
⊣◁ : Diode measurement
))) : Continuity measurement
4-20 mA : 4-20 mA measurement (R6451A only)
TEMP : Temperature measurement (R6452A and R6452E only)
FREQ : Frequency measurement (R6452A only)

(cont'd)

After change / Before change	ADC	AAC	Bch VDC	⊣	)))	4-20 mA	TEMP	FREQ
VDC 200 mV 2000 mV	300	3000	8	300	300	300	8	1500
VDC 20 V 200 V 1000 V	300	3000	8	300	300	300	8	1500
VAC 200 mV 2000 mV 20 V	300	3000	8	300	300	300	8	1500
VAC 200 V 700 V	300	3000	8	300	300	300	8	1500
OHM 200 Ω to 2 MΩ	300	3000	8	300	300	300	8	1500
OHM 20 MΩ	300	3000	8	300	300	300	8	1500
OHM 200 MΩ	300	3000	8	300	300	3600	8	1500
ADC	7	3000	8	300	300	7	8	1500
AAC	300	7	8	300	300	300	8	1500
Bch VDC	300	3000	8	300	300		100	1500
⊣	300	3000	8	-	300	300	8	1500
)))	300	3000	8	300	-	300	8	1500
4-20 mA	7	3000		300	1500	-		
TEMP	300	3000	100	300	300		-	1500
FREQ	300	3000	8	300	300		8	7

Unit[mS]

VDC : DC voltage measurement
VAC : AC voltage measurement (AC coupling mode) (R6451A and R6452A only)
OHM : Resistance measurement
ADC : DC current measurement (R6451A and R6452A only)
AAC : AC current measurement (AC coupling mode) (R6451A and R6452A only)
Bch VDC : Bch DC voltage measurement (R6452A and R6452E only)
⊣ : Diode measurement
))) : Continuity measurement
4-20 mA : 4-20 mA measurement (R6451A only)
TEMP : Temperature measurement (R6452A and R6452E only)
FREQ : Frequency measurement (R6452A only)

- Dual display measurement (R6452A and R6452E only)

  In the dual display measurement, values for the first and second display are alternately measured. The measurement time to be taken is (measurement time for the first display) + (measurement time for the second display) + (changing time for the first display) + (changing time for the second display). Therefore, in some case, the changing time for the dual display measurement may be different from the times shown in Table 12-2.
  Table 12-3 shows the changing time of the functions/ranges for the dual display measurement which are different from that in Table 12-2.

Table 12-3 Changing Time

After change / Before change	VDC 200 mV 2000 mV	VDC 20 V 200 V 1000 V	VAC 200 mV 2000 mV 20 V	VAC 200 V 700 V	OHM 200 Ω to 2 MΩ	OHM 20 MΩ	OHM 200 MΩ
Bch VDC	7	7	7	7	7	7	7
TEMP	7	7	7	7	7	7	7
FREQ	13	13	7	7	300	500	2000
After change / Before change	ADC	AAC	⊣⊢	⦚	4-20mA	FREQ	
VAC 200 mV 2000 mV 20 V	300	3000	300	300	300	4	
VAC 200 V 700 V	300	3000	300	300	300	4	
AAC	300	7	300	300	300	4	
Bch VDC	7	7	7	7		7	
TEMP	7	7	7	7		7	
FREQ	300	7	300	300		7	

Unit[mS]

VDC : DC voltage measurement
VAC : AC voltage measurement (AC coupling mode) (R6451A and R6452A only)
OHM : Resistance measurement
ADC : DC current measurement (R6451A and R6452A only)
AAC : AC current measurement (AC coupling mode) (R6451A and R6452A only)
Bch VDC : Bch DC voltage measurement (R6452A and R6452E only)
⊣⊢ : Diode measurement
⦚ : Continuity measurement
4-20 mA : 4-20 mA measurement (R6451A only)
TEMP : Temperature measurement (R6452A and R6452E only)
FREQ : Frequency measurement (R6452A only)

12.3 Measurement Speed Computation Examples

Example 1: Free-run

Function	:	DC voltage measurement (VDC)
Range	:	2000 mV range
Sampling mode	:	Free-run
Sampling rate	:	FAST
Operation	:	dB
IC memory card	:	Store

In the case that the sampling mode is set to free-run, since the calculation and measurement value output are done within the time for the subsequent input measurement (A/D conversion), the measurement speed is determined by the measurement interval. Therefore, the measurement speed in this example is 12.5 mS according to Table 12-1.

Example 2: Hold/trigger

Function	:	Resistance measurement (OHM)
Range	:	20 kΩ range
Sampling mode	:	Hold
Sampling rate	:	MID
Calculation	:	Comparater
Trigger delay time	:	13 mS ——②
Input measurement time	:	97 mS ——③
Internal processing time	:	3.2 mS ——④
Comparater calculation time	:	0.8 mS ——⑤
Measurement value display time	:	0.6 mS ——⑦
TOTAL	:	114.6 mS

Example 3: Dual display measurement (R6452A and R6452E only)

Sampling mode : Free-run
Sampling rate : SLOW

- First display

Function : DC voltage measurement (VDC)
Range : 200 mV range
Calculation : Null

- Second display

Function : Bch DC voltage measurement (Bch VDC)
Range : 20 V range
Calculation : None

Changing time for first display	:	7 mS —⑨	(Table 12-3)
Input measurement time for first display	:	397 mS—③	
Internal processing time for first display	:	3.2 mS —④	
Null calculation time for first display	:	0.1 mS —⑤	
Measurement value display time for first display	:	0.6 mS —⑦	
Changing time for second display	:	8 mS —⑨	(Table 12-2)
Input measurement time for second display	:	397 mS—③	
Internal processing time for second display	:	3.2 mS —④	
Measurement value display time for second display	:	0.6 mS —⑦	
TOTAL	:	816.7 mS	

13. Specifications

Measurement accuracy : One-year guarantee under the use of a temperature of 23°C ± 5°C and a humidity of 85% or less (in case of 20 MΩ and 200 MΩ of the resistance measurement, 75% or less).
Display : ± % of reading ± digits

Temperature coefficient : (0.1 × applied temperature)/°C at a temperature 0°C to 50°C

13.1 R6451A Performance Specifications

(1) DC voltage measurement

- Resolution and maximum readings

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mV	100 μV	10 μV	1 μV	199.9	199.99	199.999
2000 mV	1 mV	100 μV	10 μV	1999.	1999.9	1999.99
20 V	10 mV	1 mV	100 μV	19.99	19.999	19.9999
200 V	100 mV	10 mV	1 mV	199.9	199.99	199.999
1000 V	1 V	100 mV	10 mV	1099.	1099.9	1099.99

- Measurement accuracy and input impedance

Range	Measurement accuracy			Input impedance
	FAST	MID	SLOW	
200 mV	0.018 + 2	0.018 + 2	0.018 + 6	1 GΩ or more
2000 mV	0.018 + 2	0.018 + 2	0.018 + 5	
20 V	0.020 + 2	0.020 + 2	0.020 + 5	11.1 MΩ ± 1%
200 V	0.020 + 2	0.020 + 2	0.020 + 5	10.1 MΩ ± 1%
1000 V	0.020 + 2	0.020 + 2	0.020 + 5	10.0 MΩ ± 1%

- Maximum allowable input voltage: between input terminals ± 1100 V (continuous)

- Noise rejection ratio

Sampling rate	Effective common-mode noise rejection ration (unbalanced impedance 1 kΩ) 50/60 Hz ± 0.1%, DC	Normal-mode noise rejection ratio 50/60 Hz ± 0.1%
FAST	Approx. 60 dB	0 dB
MID	Approx. 120 dB	Approx. 50 dB
SLOW		

(2) AC voltage measurement (AC coupling mode)

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mV	100 μV	10 μV	1 μV	199.9	199.99	199.999
2000 mV	1 mV	100 μV	10 μV	1999.	1999.9	1999.99
20 V	10 mV	1 mV	100 μV	19.99	19.999	19.9999
200 V	100 mV	10 mV	1 mV	199.9	199.99	199.999
700 V	1 V	100 mV	10 mV	709.	709.9	709.99

- Measurement accuracy

Sampling rate: FAST

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 19	0.2 + 17	0.5 + 17	4 + 20
2000 mV	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
20 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
200 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
700 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6

Sampling rate: MID

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 45	0.2 + 30	0.5 + 30	4 + 60
2000 mV	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
20 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
200 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
700 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51

Sampling rate: SLOW

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
2000 mV	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
20 V	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
200 V	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
700 V	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500

- Measurement method : TrueRMS
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Input impedance : 1.1 MΩ ± 10%, 100 pF or less
- Maximum allowable input voltage : 800 Vrms, 1100 Vpeak, 10^7 VHz
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(3) Resistance measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 Ω	100 mΩ	10 mΩ	1 mΩ	199.9	199.99	199.999
2000 Ω	1 Ω	100 mΩ	10 mΩ	1999.	1999.9	1999.99
20 kΩ	10 Ω	1 Ω	100 mΩ	19.99	19.999	19.9999
200 kΩ	100 Ω	10 Ω	1 Ω	199.9	199.99	1999.999
2000 kΩ	1 kΩ	100 Ω	10 Ω	1999.	1999.9	1999.99
20 MΩ	10 kΩ	1 kΩ	100 Ω	19.99	19.999	19.9999
200 MΩ	100 kΩ	10 kΩ	10 kΩ	199.9	199.99	199.99

- Measurement current and measurement accuracy

Range	Measurement current	Measurement accuracy		
		FAST	MID	SLOW
200 Ω	3 mA	0.04 + 2	0.04 + 2	0.04 + 6
2000 Ω	1 mA	0.02 + 2	0.02 + 2	0.02 + 5
20 kΩ	100 μA	0.02 + 2	0.02 + 2	0.02 + 5
200 kΩ	10 μA	0.02 + 2	0.02 + 2	0.02 + 5
2000 kΩ	1 μA	0.03 + 2	0.03 + 2	0.03 + 6
20 MΩ	100 nA	0.2 + 2	0.2 + 3	0.2 + 10
200 MΩ	10 nA	2.0 + 2	2.0 + 2	2.0 + 2

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ

(4) DC current measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mA	100 μA	10 μA	1 μA	199.9	199.99	199.999
10 A	10 mA	1 mA	100 μA	10.99	10.999	10.9999

- Measurement accuracy and input terminal resistance

Range	Measurement accuracy			Input terminal resistance
	FAST	MID	SLOW	
200 mA	0.1 + 2	0.1 + 2	0.1 + 6	2Ω or less
10 A	0.2 + 2	0.2 + 2	0.2 + 6	0.05Ω or less

- Overload current protection : 200 mA terminal (0.5 A/250 V) IEC127 sheet 1 immediately blown fuse protection
  10 A terminal (15 A/250 V) breaking capacity 10000 A immediately blown fuse protection

(5) AC current measurement (AC coupling mode)

- Resolution, maximum reading, and input terminal resistance

Range	Resolution			Maximum reading			Input terminal resistance
	FAST	MID	SLOW	FAST	MID	SLOW	
200 mA	100 μA	10 μA	1 μA	199.9	199.99	199.999	2Ω or less
10 A	10 mA	1 mA	100 μA	10.99	10.999	10.9999	0.05Ω or less

- Measurement accuracy

Range	FAST		MID		SLOW	
	20 Hz to 1 kHz	1 kHz to 5 kHz	20 Hz to 1 kHz	1 kHz to 5 kHz	20 Hz to 1 kHz	1 kHz to 5 kHz
200 mA	0.6 + 17	5.0 + 17	0.6 + 30	5.0 + 30	0.6 + 200	5.0 + 200
10 A	0.6 + 22	5.0 + 22	0.6 + 35	5.0 + 35	0.6 + 200	5.0 + 200

- Measurement method : TrueRMS
- Overload current protection : 200 mA terminal (0.5 A/250 V) IEC127 sheet 1 immediately blown fuse protection
  10 A terminal (15 A/250 V) breaking capacity 10000 A immediately blown fuse protection
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(6) AC voltage measurement (AC + DC coupling mode)

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLW	FAST	MID	SLW
200 mV	100 μV	100 μV	10 μV	199.9	199.99	199.99
2000 mV	1 mV	1 mV	100 μV	1999.	1999.	1999.9
20 V	10 mV	10 mV	1 mV	19.99	19.99	19.999
200 V	100 mV	100 mV	10 mV	199.9	199.9	199.99
700 V	1 V	1 V	100 mV	709.	709.	709.9

- Measurement accuracy
  Sampling rate: FAST, MID

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 19	0.2 + 17	0.5 + 17	4 + 20
2000 mV	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
20 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
200 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
700 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6

Sampling rate: SLOW

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 45	0.2 + 30	0.5 + 30	4 + 60
2000 mV	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
20 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
200 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
700 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51

- Measurement method : TrueRMS
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Input impedance : 1.1 MΩ ± 10%, 100 pF or less
- Maximum allowable input voltage : 800 Vrms, 1100 Vpeak, 10^7 VHz
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(7) AC current measurement (AC + DC coupling mode)

- Resolution, maximum reading, and input terminal resistance

Range	Resolution			Maximum reading			Input terminal resistance
	FAST	MID	SLOW	FAST	MID	SLOW	
200 mA	100 μA	100 μA	10 μA	199.9	199.9	199.99	2Ω or less
10 A	10 mA	10 mA	1 mA	10.99	10.99	10.999	0.05Ω or less

- Measurement accuracy

Range	FAST, MID		SLOW	
	20 Hz to 1 kHz	1 kHz to 5 kHz	20 Hz to 1 kHz	1 kHz to 5 kHz
200 mA	0.6 + 17	5.0 + 17	0.6 + 30	5.0 + 30
10 A	0.6 + 22	5.0 + 22	0.6 + 35	5.0 + 35

- Measurement method : TrueRMS
- Overload current protection : 200 mA terminal (0.5 A/250 V) IECI27 sheet 1 immediately blown fuse protection
  10 A terminal (15 A/250 V) breaking capacity 10000 A immediately blown fuse protection
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(8) Diode measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	1 mV	100 μV	10 μV
Maximum reading	1999.	1999.9	1999.99

- Measurement current and measurement accuracy

	FAST	MID	SLOW
Measurement current	1 mA		
Measurement accuracy	0.02 + 2	0.02 + 2	0.02 + 5

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.

(9) Continuity measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 Ω	100 mΩ	10 mΩ	1 mΩ	199.9	199.99	199.999

- Measurement current and measurement accuracy

Range	Measurement current	Measurement accuracy		
		FAST	MID	SLOW
200 Ω	3 mA	0.04 + 2	0.04 + 2	0.04 + 6

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ
- Continuity judgment level : When the output value is less than 20 Ω, a buzzer sounds.

(10) 4-20 mA measurement

- Reading value, resolution, and maximum reading

Reading value		Resolution			Maximum reading		
0%	100%	FAST	MID	SLOW	FAST	MID	SLOW
4 mA	20 mA	1%	0.1%	0.01%	999.	999.9	999.99

- Measurement accuracy and input terminal resistance

	FAST	MID	SLOW
Measurement accuracy	0.1 + 2	0.1 + 2	0.1 + 6
Input terminal resistance	2Ω or less		

- Overload current protection : 200 mA terminal 0.5 A/250 V IECI27 sheet 1 immediately blown fuse protection
  10 A terminal 15 A/250 V breaking capacity 10000 A immediately blown fuse protection

(11) Measurement time

- Sampling mode: Free-run

Measurement function	Measurement time		
	FAST	MID	SLOW
DC voltage measurement	12.5(80)	100(10)	400(2.5)
AC voltage measurement (AC coupling mode)	12.5(80)	100(10)	400(2.5)
Resistance measurement	12.5(80)	100(10)	400(2.5)
DC current measurement	12.5(80)	100(10)	400(2.5)
AC current measurement (AC coupling mode)	12.5(80)	100(10)	400(2.5)
AC voltage measurement (AC + DC coupling mode)	38(26.3)	220(4.5)	820(1.2)
AC current measurement (AC + DC coupling mode)	38(26.3)	220(4.5)	820(1.2)
Diode measurement	12.5(80)	100(10)	400(2.5)
Continuity measurement	12.5(80)	100(10)	400(2.5)
4-20 mA measurement	12.5(80)	100(10)	400(2.5)

Unit: mS (times/sec.)

13.2 R6452A Performance Specifications

(1) DC voltage measurement

- Resolution and maximum readings

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mV	100 μV	10 μV	1 μV	199.9	199.99	199.999
2000 mV	1 mV	100 μV	10 μV	1999.	1999.9	1999.99
20 V	10 mV	1 mV	100 μV	19.99	19.999	19.9999
200 V	100 mV	10 mV	1 mV	199.9	199.99	199.999
1000 V	1 V	100 mV	10 mV	1099.	1099.9	1099.99

- Measurement accuracy and input impedance

Range	Measurement accuracy			Input impedance
	FAST	MID	SLOW	
200 mV	0.018 + 2	0.018 + 2	0.018 + 6	1 GΩ or more
2000 mV	0.018 + 2	0.018 + 2	0.018 + 5	
20 V	0.020 + 2	0.020 + 2	0.020 + 5	11.1 MΩ ± 1%
200 V	0.020 + 2	0.020 + 2	0.020 + 5	10.1 MΩ ± 1%
1000 V	0.020 + 2	0.020 + 2	0.020 + 5	10.0 MΩ ± 1%

- Maximum allowable input voltage: ± 1100 V (continuous)

- Noise rejection ratio

Sampling rate	Effective common-mode noise rejection ration (unbalanced impedance 1 kΩ) 50/60 Hz ± 0.1%, DC	Normal-mode noise rejection ratio 50/60 Hz ± 0.1%
FAST	Approx. 60 dB	0 dB
MID	Approx. 120 dB	Approx. 50 dB
SLOW		

(2) AC voltage measurement (AC coupling mode)

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mV	100 μV	10 μV	1 μV	199.9	199.99	199.999
2000 mV	1 mV	100 μV	10 μV	1999.	1999.9	1999.99
20 V	10 mV	1 mV	100 μV	19.99	19.999	19.9999
200 V	100 mV	10 mV	1 mV	199.9	199.99	199.999
700 V	1 V	100 mV	10 mV	709.	709.9	709.99

- Measurement accuracy

Sampling rate: FAST

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 19	0.2 + 17	0.5 + 17	4 + 20
2000 mV	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
20 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
200 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
700 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6

Sampling rate: MID

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 45	0.2 + 30	0.5 + 30	4 + 60
2000 mV	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
20 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
200 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
700 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51

Sampling rate: SLOW

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
2000 mV	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
20 V	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
200 V	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500
700 V	0.6 + 350	0.2 + 200	0.5 + 200	4 + 500

- Measurement method : TrueRMS
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Input impedance : 1.1 MΩ ± 10%, 100 pF or less
- Maximum allowable input voltage : 800 Vrms, 1100 Vpeak, 10^7 VHz
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(3) Resistance measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 Ω	100 mΩ	10 mΩ	1 mΩ	199.9	199.99	199.999
2000 Ω	1 Ω	100 mΩ	10 mΩ	1999.	1999.9	1999.99
20 kΩ	10 Ω	1 Ω	100 mΩ	19.99	19.999	19.9999
200 kΩ	100 Ω	10 Ω	1 Ω	199.9	199.99	199.999
2000 kΩ	1 kΩ	100 Ω	10 Ω	1999.	1999.9	1999.99
20 MΩ	10 kΩ	1 kΩ	100 Ω	19.99	19.999	19.9999
200 MΩ	100 kΩ	10 kΩ	10 kΩ	199.9	199.99	199.99

- Measurement current and measurement accuracy

Range	Measurement current	Measurement accuracy		
		FAST	MID	SLOW
200 Ω	3 mA	0.04 + 2	0.04 + 2	0.04 + 6
2000 Ω	1 mA	0.02 + 2	0.02 + 2	0.02 + 5
20 kΩ	100 μA	0.02 + 2	0.02 + 2	0.02 + 5
200 kΩ	10 μA	0.02 + 2	0.02 + 2	0.02 + 5
2000 kΩ	1 μA	0.03 + 2	0.03 + 2	0.03 + 6
20 MΩ	100 nA	0.2 + 2	0.2 + 3	0.2 + 10
200 MΩ	10 nA	2.0 + 2	2.0 + 2	2.0 + 2

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ

(4) DC current measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mA	100 μA	10 μA	1 μA	199.9	199.99	199.999
10 A	10 mA	1 mA	100 μA	10.99	10.999	10.9999

- Measurement accuracy and input terminal resistance

Range	Measurement accuracy			Input terminal resistance
	FAST	MID	SLOW	
200 mA	0.1 + 2	0.1 + 2	0.1 + 6	2Ω or less
10 A	0.2 + 2	0.2 + 2	0.2 + 6	0.05Ω or less

- Overload current protection : 200 mA terminal (0.5 A/250 V) IEC127 sheet 1 immediately blown fuse protection
  10 A terminal (15 A/250 V) breaking capacity 10000 A immediately blown fuse protection

(5) AC current measurement (AC coupling mode)

- Resolution and maximum reading and input terminal resistance

Range	Resolution			Maximum reading			Input terminal resistance
	FAST	MID	SLOW	FAST	MID	SLOW	
200 mA	100 μA	10 μA	1 μA	199.9	199.99	199.999	2Ω or less
10 A	10 mA	1 mA	100 μA	10.99	10.999	10.9999	0.05Ω or less

- Measurement accuracy

Range	FAST		MID		SLOW	
	20 Hz to 1 kHz	1 kHz to 5 kHz	20 Hz to 1 kHz	1 kHz to 5 kHz	20 Hz to 1 kHz	1 kHz to 5 kHz
200 mA	0.6 + 17	5.0 + 17	0.6 + 30	5.0 + 30	0.6 + 200	5.0 + 200
10 A	0.6 + 22	5.0 + 22	0.6 + 35	5.0 + 35	0.6 + 200	5.0 + 200

- Measurement method : TrueRMS
- Overload current protection : 200 mA terminal (0.5 A/250 V) IECI27 sheet 1 immediately blown fuse protection
  10 A terminal (15 A/250 V) breaking capacity 10000 A immediately blown fuse protection
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(6) AC voltage measurement (AC + DC coupling mode)

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mV	100 μV	100 μV	10 μV	199.9	199.99	199.99
2000 mV	1 mV	1 mV	100 μV	1999.	1999.	1999.9
20 V	10 mV	10 mV	1 mV	19.99	19.99	19.999
200 V	100 mV	100 mV	10 mV	199.9	199.9	199.99
700 V	1 V	1 V	100 mV	709.	709.	709.9

- Measurement accuracy
  Sampling rate: FAST, MID

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 19	0.2 + 17	0.5 + 17	4 + 20
2000 mV	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
20 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
200 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6
700 V	0.6 + 5	0.2 + 3	0.5 + 3	4 + 6

Sampling rate: SLOW

Range	20 Hz to 45 Hz	45 Hz to 20 kHz	20 kHz to 30 kHz	30 kHz to 100 kHz
200 mV	0.6 + 45	0.2 + 30	0.5 + 30	4 + 60
2000 mV	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
20 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
200 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51
700 V	0.6 + 36	0.2 + 21	0.5 + 21	4 + 51

- Measurement method : TrueRMS
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Input impedance : 1.1 MΩ ± 10%, 100 pF or less
- Maximum allowable input voltage : 800 Vrms, 1100 Vpeak, 10^7 VHz
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(7) AC current measurement (AC + DC coupling mode)

- Resolution, maximum reading, and input terminal resistance

Range	Resolution			Maximum reading			Input terminal resistance
	FAST	MID	SLOW	FAST	MID	SLOW	
200 mA	100 μA	100 μA	10 μA	199.9	199.9	199.99	2Ω or less
10 A	10 mA	10 mA	1 mA	10.99	10.99	10.999	0.05Ω or less

- Measurement accuracy

Range	FAST, MID		SLOW	
	20 Hz to 1 kHz	1 kHz to 5 kHz	20 Hz to 1 kHz	1 kHz to 5 kHz
200 mA	0.6 + 17	5.0 + 17	0.6 + 30	5.0 + 30
10 A	0.6 + 22	5.0 + 22	0.6 + 35	5.0 + 35

- Measurement method : TrueRMS
- Overload current protection : 200 mA terminal (0.5 A/250 V) IEC127 sheet 1 immediately blown fuse protection
  10 A terminal (15 A/250 V) breaking capacity 10000 A immediately blown fuse protection
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(8) Bch DC voltage measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
2000 mV	1 mV	100 μV	100 μV	1999.	1999.9	1999.9
20 V	10 mV	1 mV	1 mV	19.99	19.999	19.999
200 V	100 mV	10 mV	10 mV	199.9	199.99	199.99

- Measurement accuracy and in-phase signal rejection

Range	Measurement accuracy			in-phase signal rejection (between B input and COM terminals)
	FAST	MID	SLOW	
2000 mV	0.025 + 2	0.025 + 2	0.025 + 2	± 0.05%
20 V	0.025 + 2	0.025 + 2	0.025 + 2	
200 mV	0.025 + 2	0.025 + 2	0.025 + 2	

- Input impedance : between B input terminals 10 MΩ ± 5%
  between B input and COM terminals 5 MΩ ± 5%

- Maximum allowable input voltage:

  Between B input terminals : ±200 V (continuous)
  Between B input and COM terminals : ±200 V (continuous)
  Between B input terminal and chassis : ±450 V (continuous)

- Noise rejection ratio

Sampling rate	Effective common-mode noise rejection ration (unbalanced impedance 1 kΩ) 50/60 Hz ± 0.1%, DC	Normal-mode noise rejection ratio 50/60 Hz ± 0.1%
FAST	Approx. 60 dB	0 dB
MID	Approx. 120 dB	Approx. 50 dB
SLOW		

(9) Diode measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	1 mV	100 μV	10 μV
Maximum reading	1999.	1999.9	1999.99

- Measurement current and measurement accuracy

	FAST	MID	SLOW
Measurement current	3 mA		
Measurement accuracy	0.02 + 2	0.02 + 2	0.02 + 5

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ

(10) Continuity measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	100 mΩ	10 mΩ	1 mΩ
Maximum reading	199.9	199.99	199.999

- Measurement current and measurement accuracy

	FAST	MID	SLOW
Measurement current	3 mA		
Measurement accuracy	0.04 + 2	0.04 + 2	0.04 + 6

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ
- Continuity judgment level : When the output value is less than 20 Ω, a buzzer sounds.

(11) Temperature measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	1 °C	0.1 °C	0.1 °C
Maximum reading	-50. to 1370.	-50.0 to 1370.0	-50.0 to 1370.0

- Measurement accuracy and in-phase signal rejection

Measurement accuracy (FAST, MID, SLOW)	In-phase signal rejection (between temperature measurement terminal and COM terminal)
0.15% + 2.0 °C	0.05 °C/V

- Thermocouple : K(CA)
- Maximum allowable input voltage :
  - Between temperature measurement terminals : ±36 V (continuous)
  - Between temperature measurement and COM terminals : ±200 V (continuous)
  - Between temperature measurement terminal and chassis : ±450 V (continuous)

(12) Frequency measurement

- Resolution, measurement ranges, maximum reading, and measurement accuracy

Range	Resolution	Measurement range*	Maximum reading	Measurement accuracy
20 Hz	1 mHz	17 Hz to 20 Hz	19.999	0.02 + 2
200 Hz	10 mHz	20 Hz to 200 Hz	199.99	0.02 + 2
2000 Hz	100 mHz	20 Hz to 2000 Hz	1999.9	0.02 + 2
20 kHz	1 Hz	20 Hz to 20 kHz	19.999	0.02 + 2
200 kHz	10 Hz	200 Hz to 200 kHz	199.99	0.02 + 2

*: Frequencies outside the ranges as shown above can be displayed but out of guarantee.

- Input sensitivity

Input signal	Input terminal	Frequency range	Input sensitivity (sine wave)
AC voltage	VAC	20 Hz	1 Vrms
		20Hz to 200 Hz	100 mVrms
		200Hz to 100 kHz	30 mvrms
		100 kHz to 200 kHz	100 mVrms
AC current	200 mA	20Hz to 200 Hz	100 mArms
		200 Hz to 5 kHz	30 mArms
	10 A	20Hz to 200 Hz	7 Arms
		200 Hz to 5 kHz	3 Arms

- Measurement method : TrueRMS
- Input range : 5% or more of full scale
- Crest factor : 3:1 on full scale
- Input impedance : 1.1 MΩ ± 10%, 100 pF or less
- Maximum allowable input voltage : 800 Vrms, 1100 Vpeak, 10^7 VHz
- Response time : Approx. 1 sec. (until it reaches a value within 0.1% of the final value at the same range)

(13) Measurement time

- Sampling mode: free-run
- Singe display

Measurement function	Measurement time		
	FAST	MID	SLOW
DC voltage measurement	12.5(80)	100(10)	400(2.5)
AC voltage measurement (AC coupling mode)	12.5(80)	100(10)	400(2.5)
Resistance measurement	12.5(80)	100(10)	400(2.5)
DC current measurement	12.5(80)	100(10)	400(2.5)
AC current measurement (AC coupling mode)	12.5(80)	100(10)	400(2.5)
AC voltage measurement (AC + DC coupling mode)	38(26.3)	220(4.5)	820(1.2)
AC current measurement (AC + DC coupling mode)	38(26.3)	220(4.5)	820(1.2)
Bch DC voltage measurement	12.5(80)	100(10)	400(2.5)
Diode measurement	12.5(80)	100(10)	400(2.5)
Continuity measurement	12.5(80)	100(10)	400(2.5)
Temperature measurement	12.5(80)	100(10)	400(2.5)
Frequency measurement	210(4.7)	300(3.3)	600(1.6)

Unit: mS (times/sec.)

13.3 R6452E Performance Specifications

(1) DC voltage measurement

- Resolution and maximum readings

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 mV	100 μV	10 μV	1 μV	199.9	199.99	199.999
2000 mV	1 mV	100 μV	10 μV	1999.	1999.9	1999.99
20 V	10 mV	1 mV	100 μV	19.99	19.999	19.9999
200 V	100 mV	10 mV	1 mV	199.9	199.99	199.999
1000 V	1 V	100 mV	10 mV	1099.	1099.9	1099.99

- Measurement accuracy and input impedance

Range	Measurement accuracy			Input impedance
	FAST	MID	SLOW	
200 mV	0.018 + 2	0.018 + 2	0.018 + 6	1 GΩ or more
2000 mV	0.018 + 2	0.018 + 2	0.018 + 5	
20 V	0.020 + 2	0.020 + 2	0.020 + 5	11.1 MΩ ± 1%
200 V	0.020 + 2	0.020 + 2	0.020 + 5	10.1 MΩ ± 1%
1000 V	0.020 + 2	0.020 + 2	0.020 + 5	10.0 MΩ ± 1%

- Maximum allowable input voltage: ± 1100 V (continuous)

- Noise rejection ratio

Sampling rate	Effective common-mode noise rejection ration (unbalanced impedance 1 kΩ) 50/60 Hz ± 0.1%, DC	Normal-mode noise rejection ratio 50/60 Hz ± 0.1%
FAST	Approx. 60 dB	0 dB
MID	Approx. 120 dB	Approx. 50 dB
SLOW		

(2) Resistance measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLOW	FAST	MID	SLOW
200 Ω	100 mΩ	10 mΩ	1 mΩ	199.9	199.99	199.999
2000 Ω	1 Ω	100 mΩ	10 mΩ	1999.	1999.9	1999.99
20 kΩ	10 Ω	1 Ω	100 mΩ	19.99	19.999	19.9999
200 kΩ	100 Ω	10 Ω	1 Ω	199.9	199.99	199.999
2000 kΩ	1 kΩ	100 Ω	10 Ω	1999.	1999.9	1999.99
20 MΩ	10 kΩ	1 kΩ	100 Ω	19.99	19.999	19.9999
200 MΩ	100 kΩ	10 kΩ	10 kΩ	199.9	199.99	199.99

- Measurement current and measurement accuracy

Range	Measurement current	Measurement accuracy		
		FAST	MID	SLOW
200 Ω	3 mA	0.04 + 2	0.04 + 2	0.04 + 6
2000 Ω	1 mA	0.02 + 2	0.02 + 2	0.02 + 5
20 kΩ	100 μA	0.02 + 2	0.02 + 2	0.02 + 5
200 kΩ	10 μA	0.02 + 2	0.02 + 2	0.02 + 5
2000 kΩ	1 μA	0.03 + 2	0.03 + 2	0.03 + 6
20 MΩ	100 nA	0.2 + 2	0.2 + 3	0.2 + 10
200 MΩ	10 nA	2.0 + 2	2.0 + 2	2.0 + 2

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ

(3) Bch DC voltage measurement

- Resolution and maximum reading

Range	Resolution			Maximum reading		
	FAST	MID	SLW	FAST	MID	SLOW
2000 mV	1 mV	100 μV	100 μV	1999.	1999.9	1999.9
20 V	10 mV	1 mV	1 mV	19.99	19.999	19.999
200 V	100 mV	10 mV	10 mV	199.9	199.99	199.99

- Measurement accuracy and in-phase signal rejection

Range	Measurement accuracy			in-phase signal rejection (between B input and COM terminals)
	FAST	MID	SLOW	
2000 mV	0.025 + 2	0.025 + 2	0.025 + 2	±0.05%
20 V	0.025 + 2	0.025 + 2	0.025 + 2	
200 V	0.025 + 2	0.025 + 2	0.025 + 2	

- Input impedance : between B input terminals 10 MΩ ±5%
  between B input and COM terminals 5 MΩ ±5%
- Maximum allowable input voltage:
  Between B input terminals : ±200 V (continuous)
  Between B input and COM terminals : ±200 V (continuous)
  Between B input terminal and chassis : ±450 V (continuous)
- Noise rejection ratio

Sampling rate	Effective common-mode noise rejection ration (unbalanced impedance 1 kΩ) 50/60 Hz ±0.1%, DC	Normal-mode noise rejection ratio 50/60 Hz ±0.1%
FAST	Approx. 60 dB	0 dB
MID	Approx. 120 dB	Approx. 50 dB
SLOW		

(4) Diode measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	1 mV	100 μV	10 μV
Maximum reading	1999.	1999.9	1999.99

- Measurement current and measurement accuracy

	FAST	MID	SLOW
Measurement current	3 mA		
Measurement accuracy	0.02 + 2	0.02 + 2	0.02 + 5

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ

(5) Continuity measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	100 mΩ	10 mΩ	1 mΩ
Maximum reading	199.9	199.99	199.999

- Measurement current and measurement accuracy

	FAST	MID	SLOW
Measurement current	3 mA		
Measurement accuracy	0.04 + 2	0.04 + 2	0.04 + 5

- Open terminal voltage : Max. 7 V
- Maximum allowable input voltage : ±500 V
- Zero resistance error : 0.05Ω or less in each range (when NULL function is used)
  Excluding cable resistance from the measurement accuracy.
- Response time : Approx. 0.5 sec. for 20 MΩ
  Approx. 2.0 sec. for 200 MΩ
- Continuity judgment level : When the output value is less than 20 Ω, a buzzer sounds.

(6) Temperature measurement

- Resolution and maximum reading

	FAST	MID	SLOW
Resolution	1 °C	0.1 °C	0.1 °C
Maximum reading	-50. to 1370.	-50. to 1370.	-50. to 1370.

- Measurement accuracy and in-phase signal rejection

Measurement accuracy (FAST, MID, SLOW)	In-phase signal rejection (between temperature measurement terminal and COM terminal)
0.15% + 2.0 °C	0.05 °C/V

- Thermocouple : K(CA)
- Maximum allowable input voltage :
  Between temperature measurement terminals : ±36 V (continuous)
  Between temperature measurement and COM terminals : ±200 V (continuous)
  Between temperature measurement terminal and chassis : ±450 V (continuous)

(7) Measurement time

- Sampling mode: free-run
- Singe display

Measurement function	Measurement time		
	FAST	MID	SLOW
DC voltage measurement	12.5(80)	100(10)	400(2.5)
Resistance measurement	12.5(80)	100(10)	400(2.5)
Bch DC voltage measurement	12.5(80)	100(10)	400(2.5)
Diode measurement	12.5(80)	100(10)	400(2.5)
Continuity measurement	12.5(80)	100(10)	400(2.5)
Temperature measurement	12.5(80)	100(10)	400(2.5)

Unit: mS (times/sec.)

13.4 Interface Specifications

Standard : RS-232 (adaptive connector Dsub 9 pins)
- Baud rates : 9600, 4800, 2400, 1200, 600, and 300
- Data length : 7/8 bits
- Parity : even/odd/none
- Stop bit : 1/2
- Echo : on/off

Set the condition on the front panel.

Options : R13015 BCD data output unit
R13016 comparater unit
R13220 GPIB interface unit
R13221 printer interface unit
(Multiple units cannot be installed on one R6451/52.)

Selection condition : Selects one type on the front panel.
(Multiple interface cannot be selected for one R6451/52.)

13.5 General Specifications

Ambient conditions	:	Temperature 0°C to 50°C (0 °C to 35°C when the battery is used) Humidity 85% RH or less (75% RH or less for 20 MΩ or 200 MΩ of resistance measurement) (However, no do be dewy.)
Storage temperature range	:	-25°C to 50°C (-20°C to 50°C when the battery is used)
Voltage proof	:	450 V (continuous) between COM terminal and chassis/power line
Display	:	decimal 6 digits, 7-segment fluorescent display tube (R6452A and R6452E have dual display function.)
Range switch	:	Manual or automatic
Input method	:	Floating method
Measurement type	:	Integral type
Over-input display	:	OL display
Operation functions	:	Null, smoothing, dB, dBm, scaling, MAX, MIN, and comparater
accessories	:	Power cable A01402 Input cable A01034 Power fuse Protection fuse
Dimensions	:	Approx. 212 (w)×88 (h)×310 (d) mm
Weight	:	Body 2.2 kg or less
Including options	:	3.5 kg or less
Power supply	:	DC power : at least (continuous) six-hour use with R15807 battery unit. AC power : 90 to 250 V (selectable by user) 48 to 66 Hz

Option No.	Power voltage (V)
Standard	90 to 110
32	103 to 132
42	198 to 242
44	207 to 250

Power consumption	:	15 VA or less

13.6 Options

(1) R13015 BCD data output unit

Output data	:	BCD parallel codes
Output data contents	:	Measurement data, decimal point, polarity, and unit
Print command signal output	:	TTL level positive pulse (pulse width = approx. 1 mS)
External start signal	:	A (data output) : TTL level positive logic (pulse width = 100 μS to 10 mS) B (remote control input) : TTL level negative logic (pulse width = 100 uS to 10 mS)
Input impedance	:	Approx. 10 kΩ
External control	:	function, range, external start, buzzer on/off, sampling mode, sampling rate, null calculation, and comparater calculation
Connector	:	Data output : 50-pin (DHA-RC50 Dai-ichi Electronics Industry product) Remote input : 24-pin (57-40240 Dai-ichi Electronics Industry product)
Power supply	:	Supplied from the R6451 series

(2) R13016 comparater unit

Comparison level	:	Upper and lower limit values (two values) HIGH LIMIT/ LOW LIMIT
Judgment condition	:	HIGH measurement data > HIGH LIMIT PASS HIGH LIMIT ≥ measurement data ≥ LOW LIMIT LOW measurement data < LOW LIMIT
Level setting	:	Through front panel
END signal	:	TTL level negative logic (pulse width = approx. 1 mS)
Contact output	:	Optical MOS relay HI, PASS, LO
Contact capacity	:	Open/close allowable voltage 50 V Open/close allowable current 0.1 A
Voltage proof	:	200 V between contact and input/output signal/chassis
Transistor output	:	Open collector output Maximum collector voltage 50 V Maximum collector current 0.3 A
Buzzer output	:	Buzzer output is possible when the result is HIGH, PASS, LOW or HIGH/LOW.
Connector	:	14-pin (Dai-ichi Electronics Industry product)
Power supply	:	Supplied from R6451 series

(3) R13220 GPIB interface unit

Electrical specification	:	Complies with IEEE 488-1978 and IEC 625-1
Mechanical specification	:	Complies with IEEE 488-1978
Connector	:	24-pin
Interface specification	:	SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, and E2
Used codes	:	ASCII codes
Addressing	:	31 kinds of talker/listener addresses can be set through the front panel.
Power supply	:	Supplied from R6451 series

(4) R13221 printer interface unit

Output code	:	Centronics standard
Output data contents	:	Measurement data, decimal point, polarity, and unit
Printing interval	:	(continuous), 5 sec. to 4 hours
Setting method	:	Set from the R6451/52's panel
Connector	:	14-pin (57-40140 Dai-ichi Electronics Industry product)
Power supply	:	Supplied from R6451 series (excluding printer power)

(5) R13220 memory card interface unit

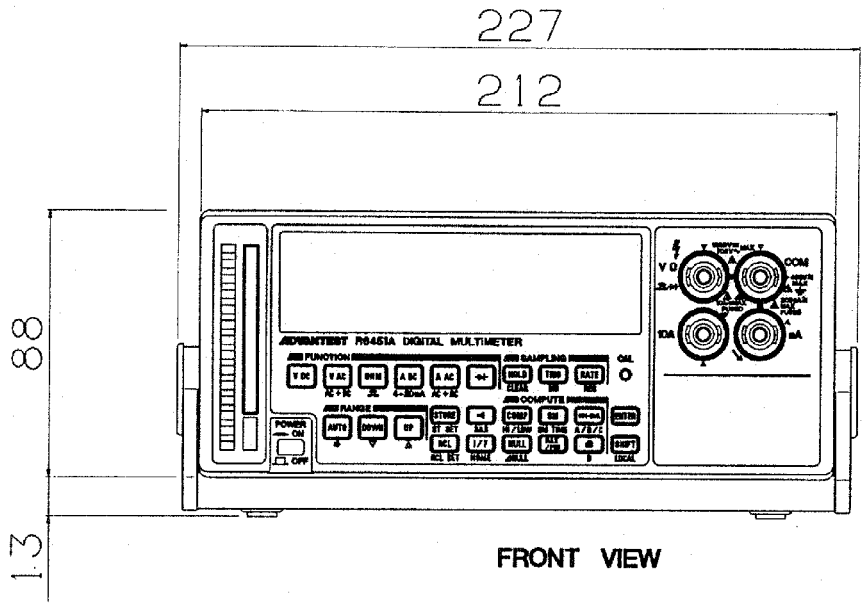
Used card	:	SRAM card complying with JEIDA ver.4 (including attribute information)
Memory contents	:	Stores measurement data and panel settings in DOS format. (Maximum number of files registered:128/maximum number of pieces of data:4000)

(6) R14807 battery unit

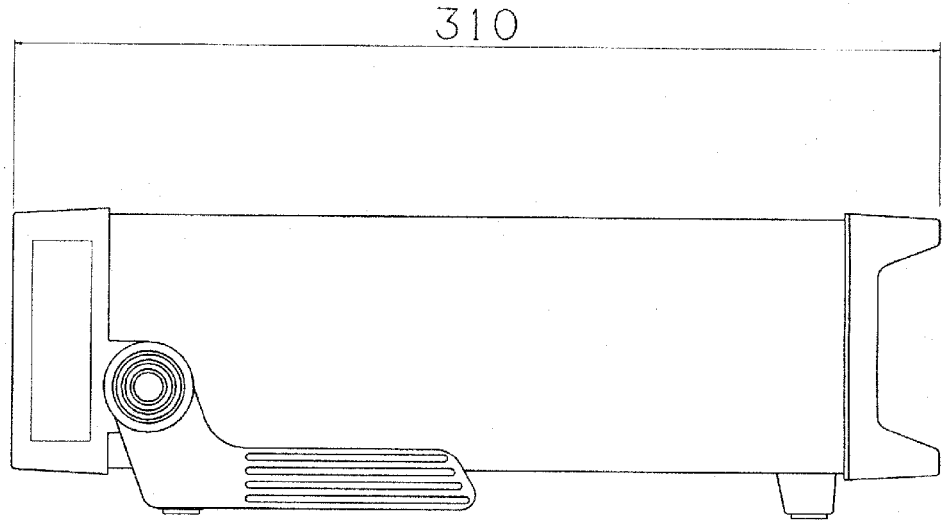
Built-in battery	:	12 V lead-acid battery, Charging/discharging can be repeated.
Battery capacity	:	1.8 Ah
Charging method	:	When the R6451/52 is connected to AC power with the R6451/52 powered off, the time taken to fill up it is approx. 12 hours.
Low battery display	:	When remaining time reaches approx. 30 minutes, low battery indicator is lit up on the front panel. It does not affect R6451 series.

13.7 Accessories

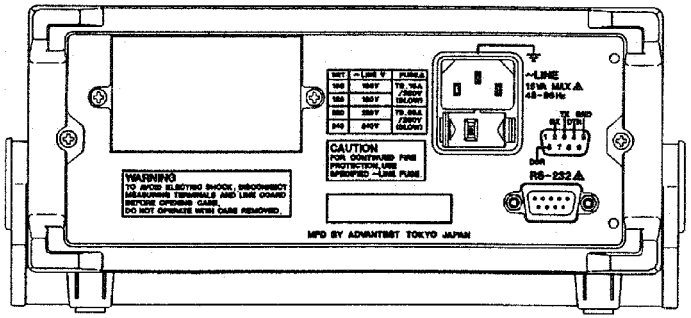
- A08210 thermocouple selector
  - Thermocouple : Type K (CA)
  - Number of CHs : 4 ch, manual switch
- A08212 thermocouple (combined with A08210 for use)
  - Thermocouple : Type K (CA)
  - Measurement range : Upper limit +250 °C
  - Degree : JIS C1602 0.75 degree
  - Tolerance : ±2.5°C or measurement temperature ±0.75%
- A08213 sheath type thermo couple (combined with A08210 for use)
  - Thermocouple : Type K (CA)
  - Measurement range : Upper limit +600 °C
  - Degree : JIS C1602 0.75 degree
  - Tolerance : ±2.5°C or measurement temperature ±0.75%
- TR1101-130 sheath type thermo couple
  - Thermocouple : Type K (CA)
  - Measurement range : Upper limit +600 °C
  - Degree : JIS C1602 0.75 degree
  - Tolerance : ±2.5°C or measurement temperature ±0.75%
- TR1111 terminal adapter
- A01001 input cable
- A01265 RS-232 cable (Dsub9-Dsub25 1 m long)
- A02263 JIS rack mounting kit
- A02264 JIS rack mounting kit (twin)
- A02463 EIA rack mounting kit
- A02464 EIA rack mounting kit



FRONT VIEW



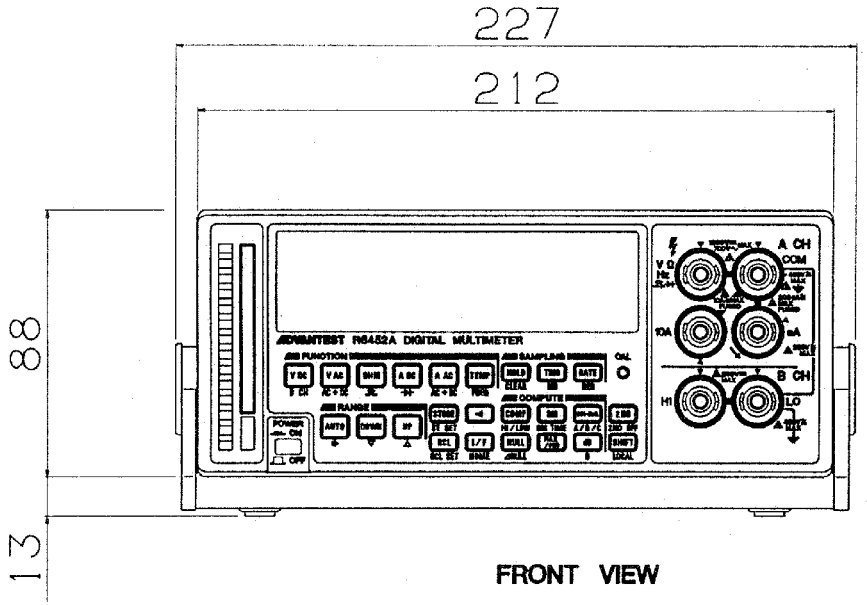
SIDE VIEW



REAR VIEW

EXT1-9309-A

R6451A
EXTERNAL VIEW



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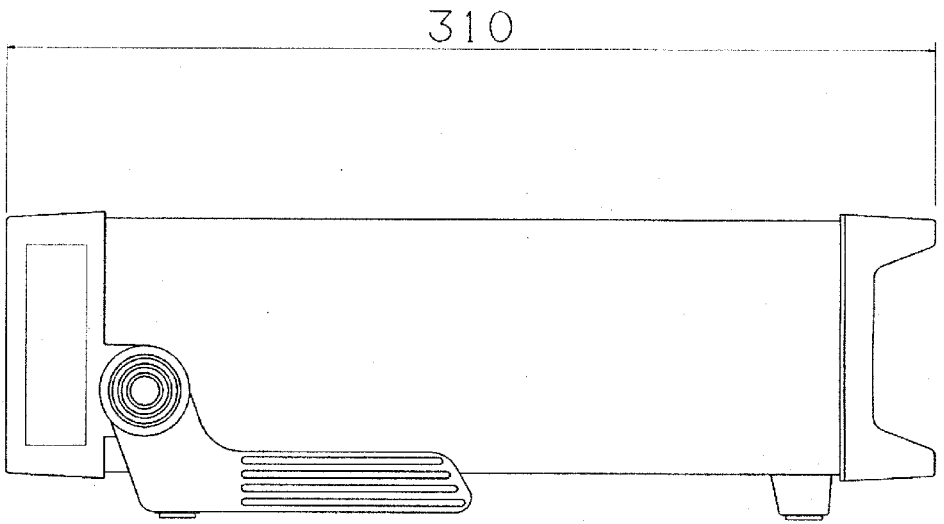

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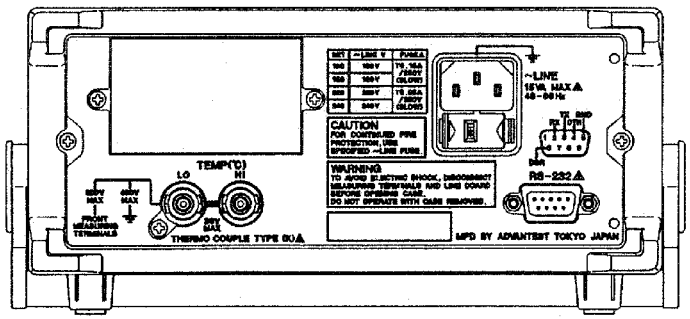
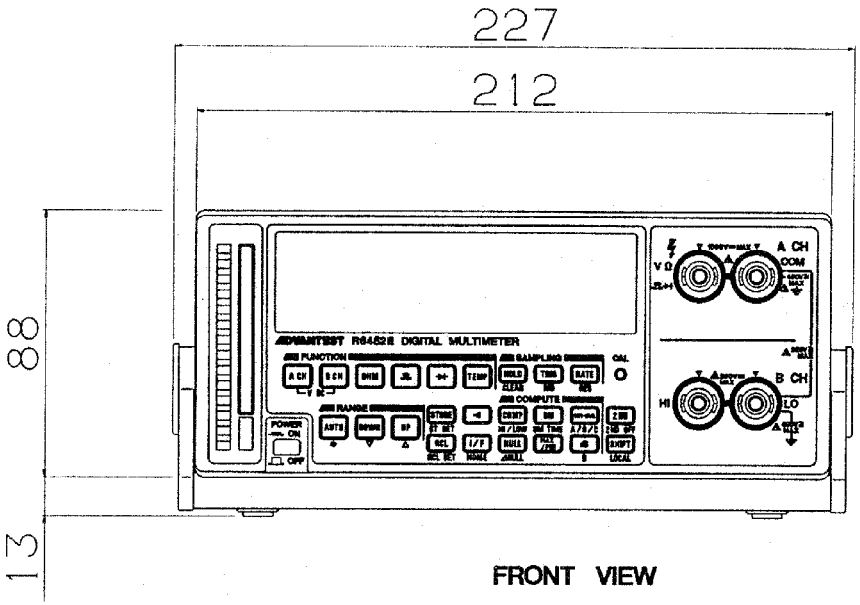


REAR VIEW

EXT2-9309-A

R6452A
EXTERNAL VIEW



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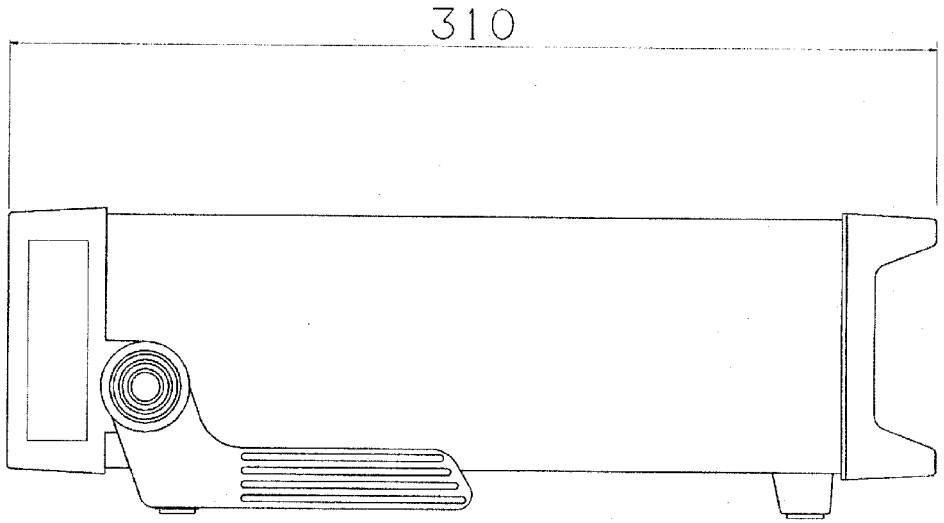
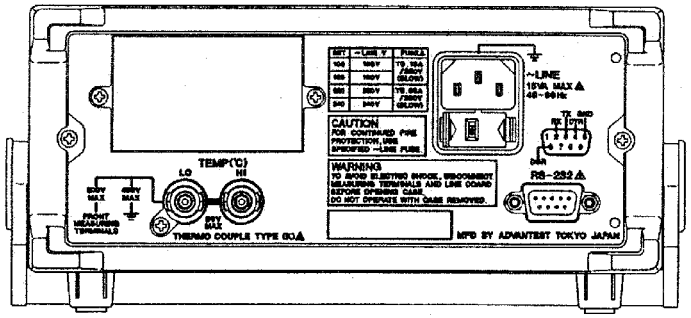


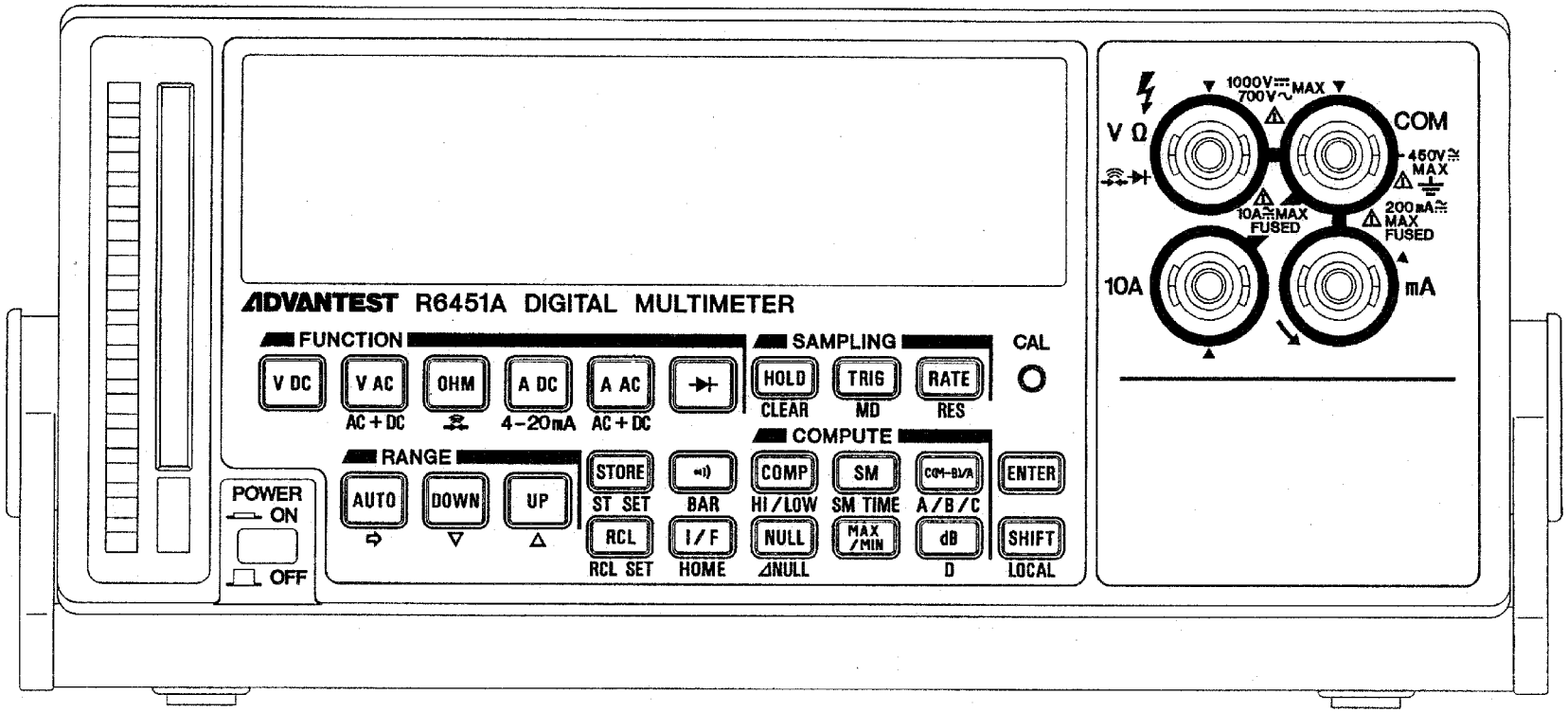
SIDE VIEW



REAR VIEW

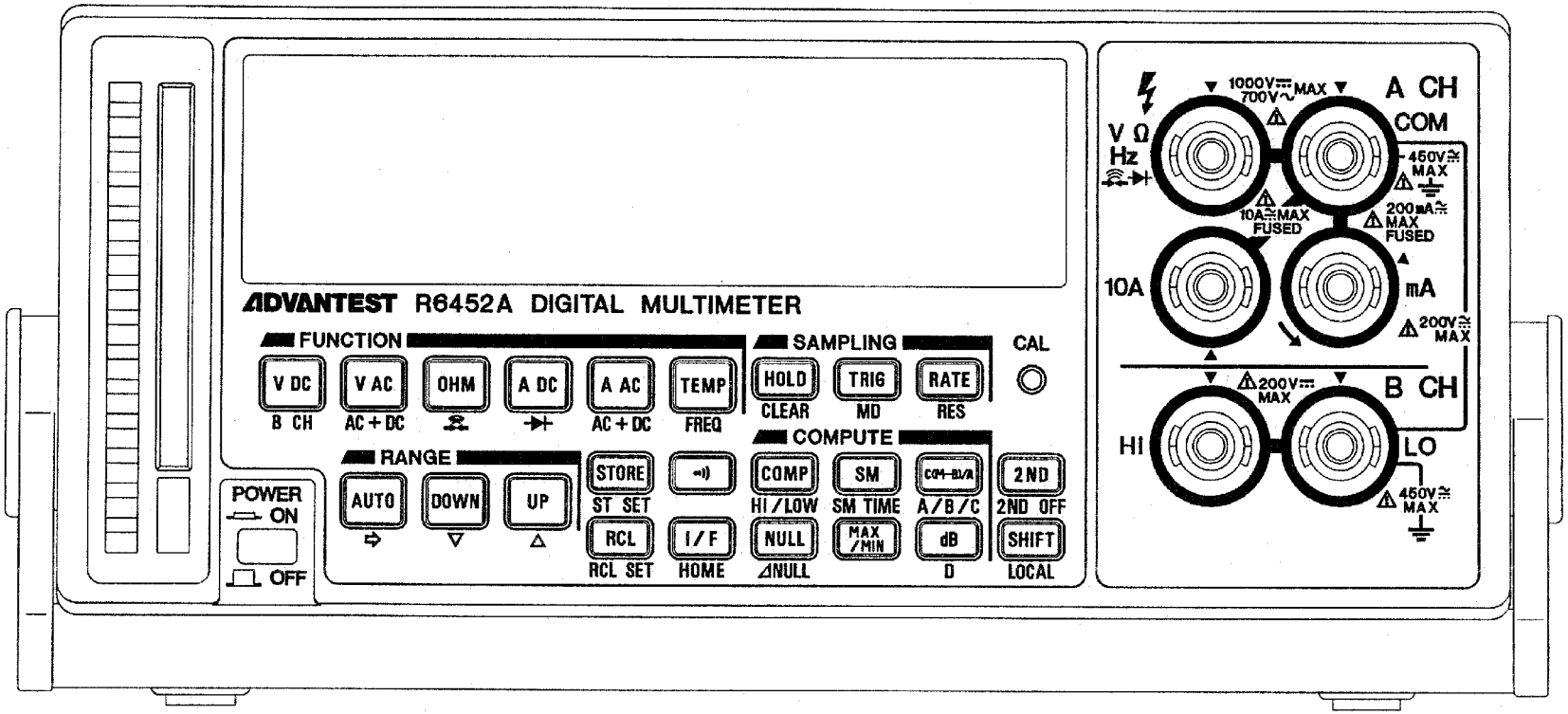
EXT3-9309-A

R6452E
EXTERNAL VIEW



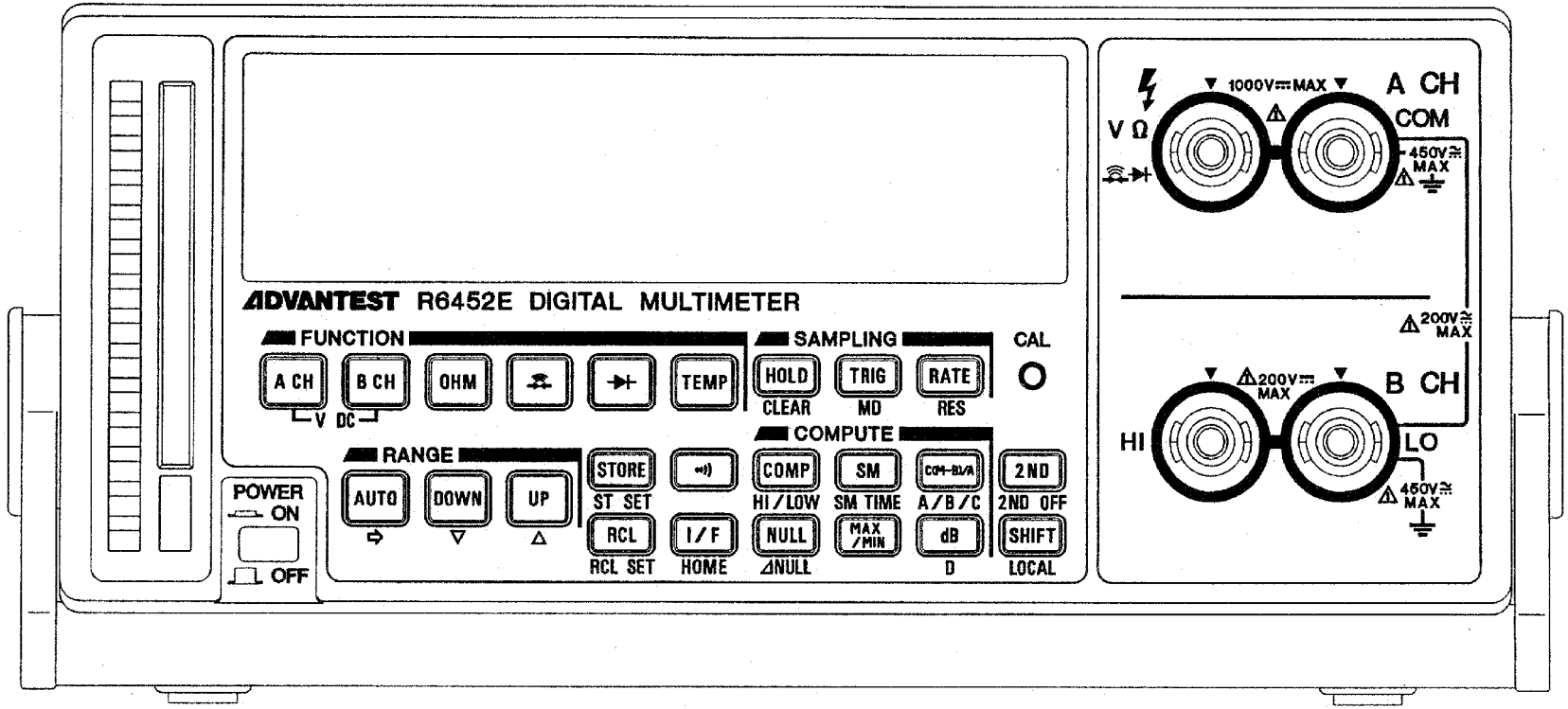
EXT4-9309-A

R6451A
FRONT VIEW



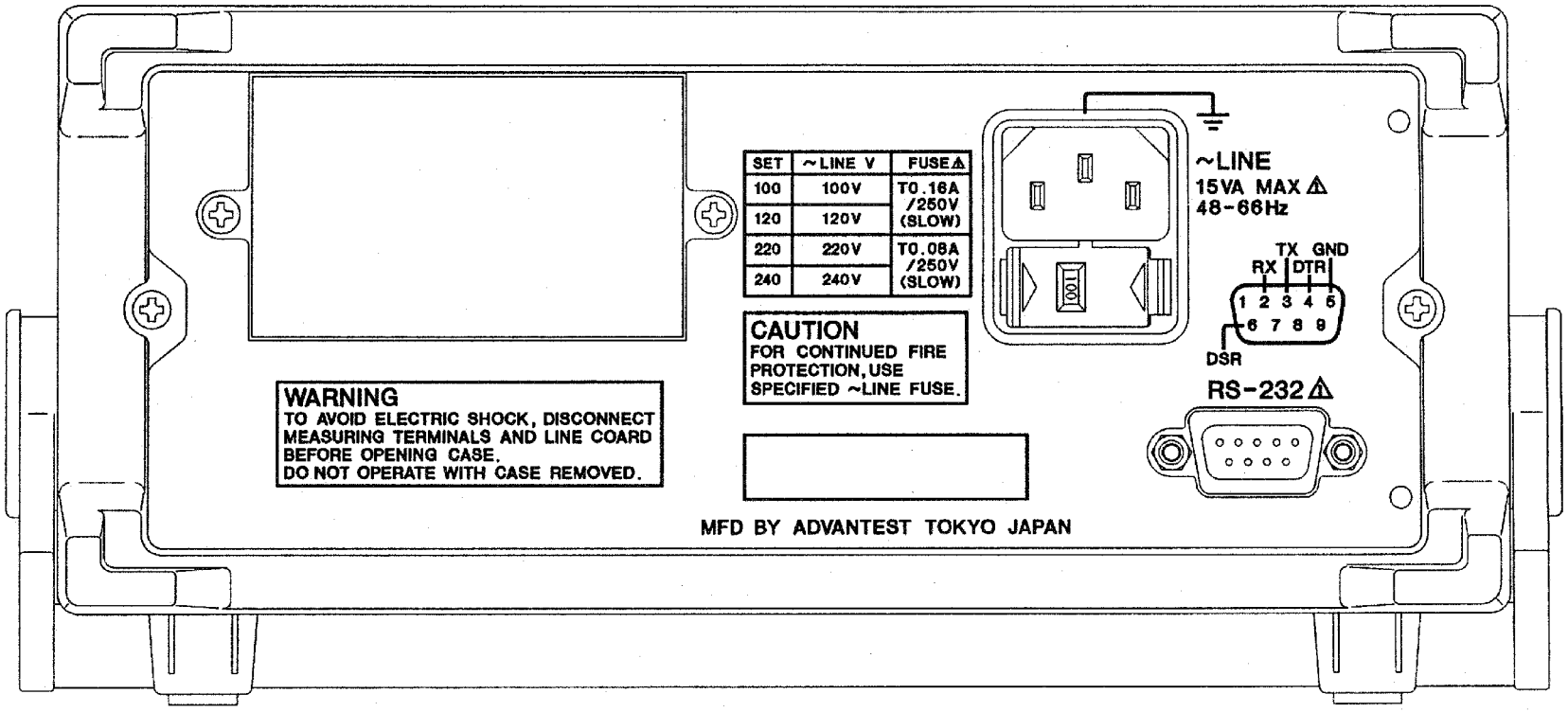
EXT5-9309-A

R6452A
FRONT VIEW



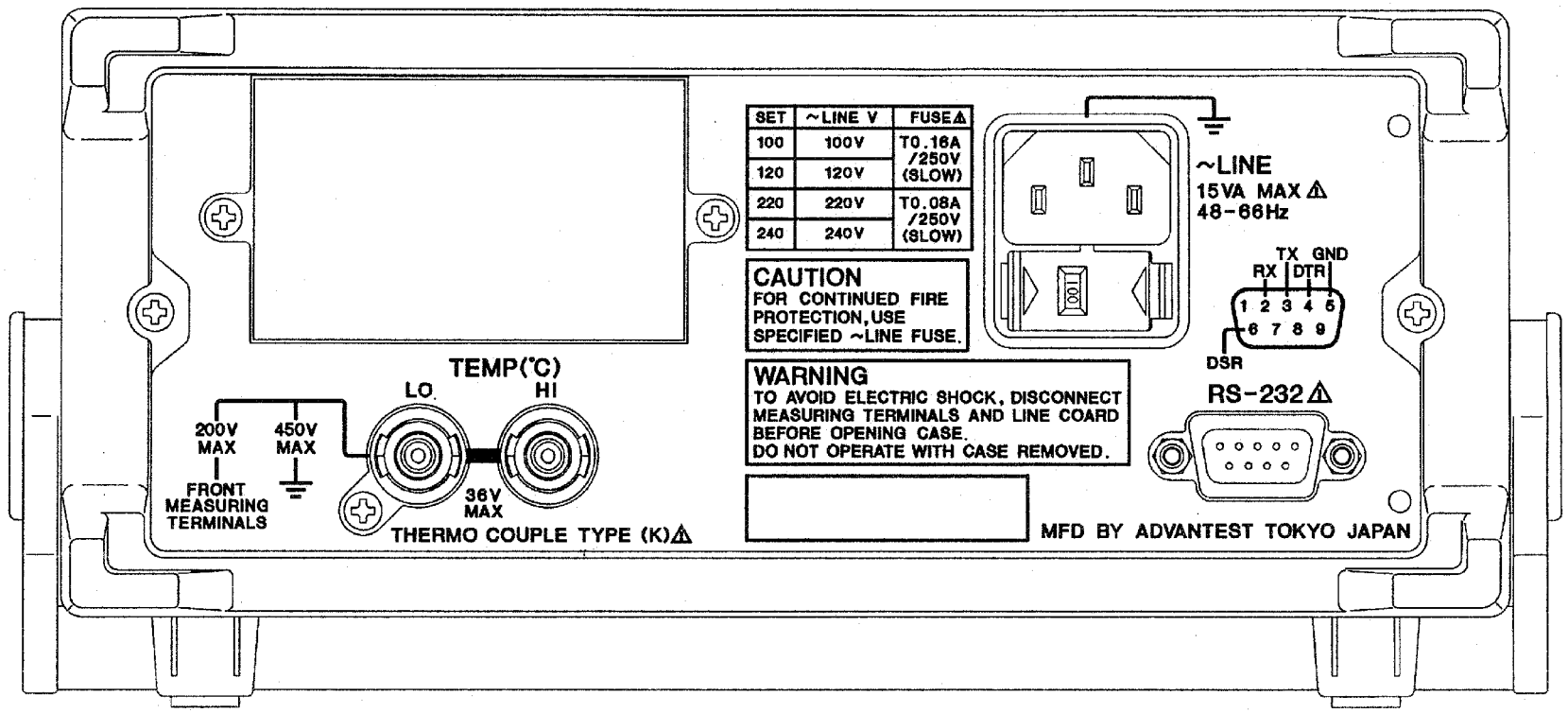
EXT6-9309-A

R6452E
FRONT VIEW



EXT7-9309-A

R6451A
REAR VIEW



EXT8-9309-A

R6452A/E
REAR VIEW

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