ADVANTEST®

ADVANTEST CORPORATION

TR6143
DC Voltage and Electric Current Source/Monitor
Operation Manual

MANUAL NUMBER FOE-8335171L01

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

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Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that Advantest 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 Advantest, the protection provided by the equipment may be impaired.

- **Warning Labels**

  Warning labels are applied to Advantest 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 Advantest 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 protected ground 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 Advantest 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 Advantest 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

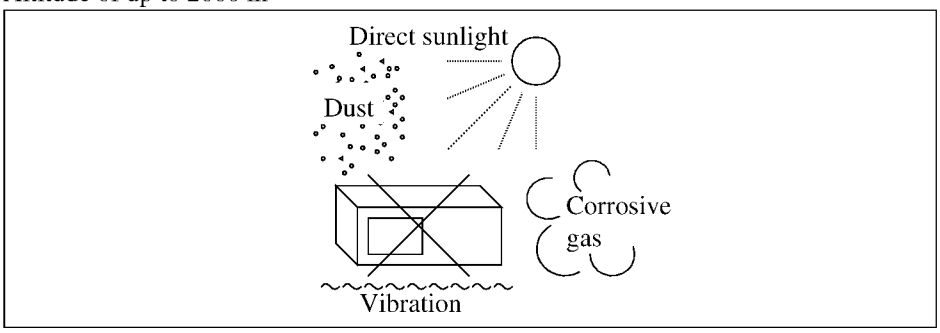


Figure-1 Environmental Conditions

- Operating position

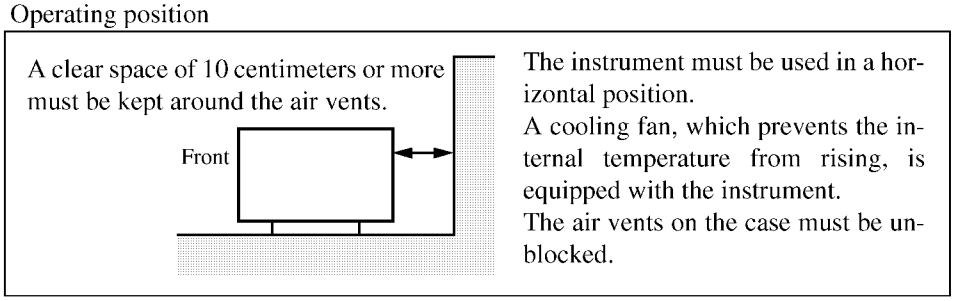


Figure-2 Operating Position

- Storage position

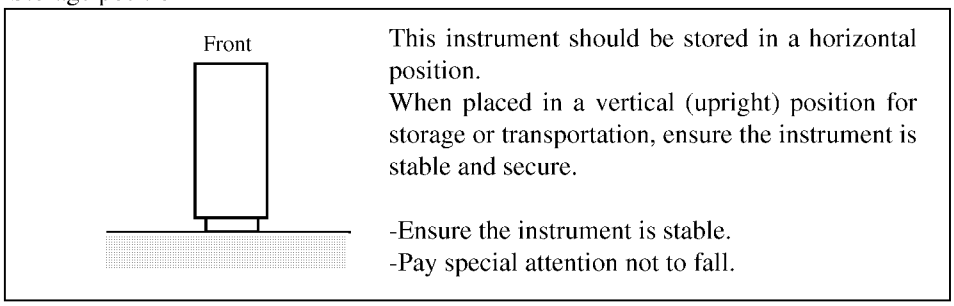


Figure-3 Storage Position

- 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.

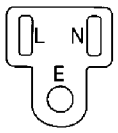
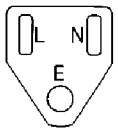
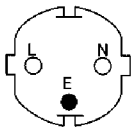
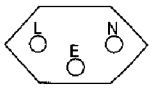
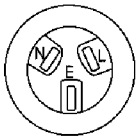
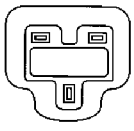
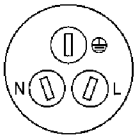
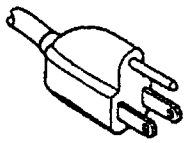
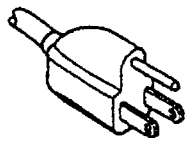
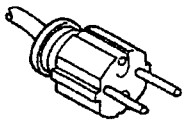
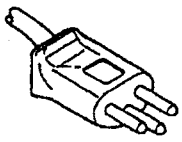
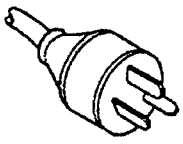
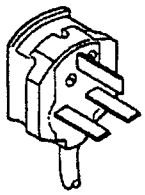
Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) 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

Table of Power Cable Options

There are six power cable options (refer to following table).

Order power cable options by Model number.

	Plug configuration	Standards	Rating, color and length	Model number (Option number)
1		JIS: Japan Law on Electrical Appliances	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
2		UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
3		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
4		SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
5		SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
6		BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417

PREFACE

WARNING

When using the TR6143 as a load, note that if a voltage greater than the output range of the TR6143 is applied, the output amplifier etc. may be destroyed, and expensive repairs may be necessary.
Maximum output range: ±110 V

CAUTION

1. If the temperature inside the TR6143 rises excessively and the amplifier overheats, the temperature sensor will operate to turn off the output. Please use the TR6143 under the following conditions:

   Maximum ambient temperature: +40°C
   Ventilation holes above and under the main body, fan on the real panel : To be well ventilated

2. When the set current generation value of the TR6143 is set to zero under the no load state, the output voltage may become ±120 V regardless of the voltage limiter value.

A set current value of 20 counts more than the set range should be used.

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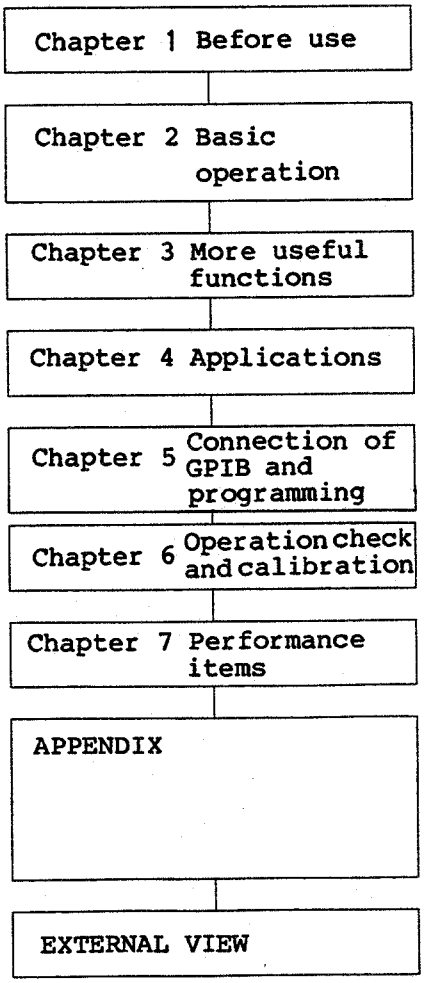
1. BEFORE USE

This chapter contains the structure of this manual, a function outline of the TR6143, and general precautions for use and preparations for measurement. Be sure to read before starting to take measurements.

1.1 How to Use this Manual

This instruction manual is structured in order from basic to more difficult items as shown below so that those who are not familiar with the handling of this kind measuring instruments can fully use the variety of functions of the TR6143.



1.2 Outline

The TR6143 is a programmable DC voltage/current source/monitor used as a power source for semiconductors and electronic parts. It is most suitable for a direct current characteristics test system, and can measure large electric currents.

- o Voltage generation/measurement/limit range: 320 mV to 110 V
- o Current generation/measurement/limit range: 32 µA to 2 A
- o Voltage resolution : 10 µV
- o Current resolution : 1 nA
- o VSIM and ISVM functions which enable current-voltage characteristic test
- o Sinkable bipolar output
- o 4A operation is possible by two instruments being connected in parallel.
- o Linear/log/random sweep function for characteristics test
- o Oscillation detection function to protect the measurement system
- o Single line signal input/output for use in synchronous operation by two or more of these instruments being combined
- o GPIB interface for automatic measurement system

1.3 Checking Appearance and Accessories

On delivery, check whether the DC voltage and electric current source/monitor was damaged during transportation.

Check the number of accessories against Table 1-1. If the TR6143 is damaged or any accessory is missing, contact the nearest dealer or the sales and support offices.

The address and telephone numbers are listed at the end of this manual.

Table 1-1 TR6143 Accessory List

Name	Model	Stock No.	Quantity	Remarks
Power cable	A01402	DCB-DD2428x01	1	
Fuse	EAWK 3.15 A	DFT-AA3R15A	2	100 to 120 VAC
	EAWK 1.6 A	DFT-AA1R6A		220 to 240 VAC
Instruction manual	--	JTR6143	1	Japanese
	--	ETR6143		English

1.4 Power Source Cable and Fuse

(1) Power Source

Ensure that the power voltage to be used matches the indicated value. Use a power frequency at 50 or 60 Hz.

In addition, when connecting the power cable, be sure that the power switch is OFF.

(2) Power Cables

The power cable plug is a three pin type, and the round pin is for ground. If adaptor A09034 attached to the plug is used to connect to a power outlet, connect the ground line (see Figure 1-1 (a)) of the adaptor, or the GND termination on the rear panel of the TR6143 to an external ground.

Attached adaptor A09034 complies with the Electrical Goods Control Law. As widths A and B of the electrodes of the A09034 adaptor differ from each other as shown in Figure 1-1 (b), ensure that the plug is inserted into the outlet the right way round.

If the A09034 cannot be inserted into the outlet to be used, please purchase optional adaptor KPR-13.

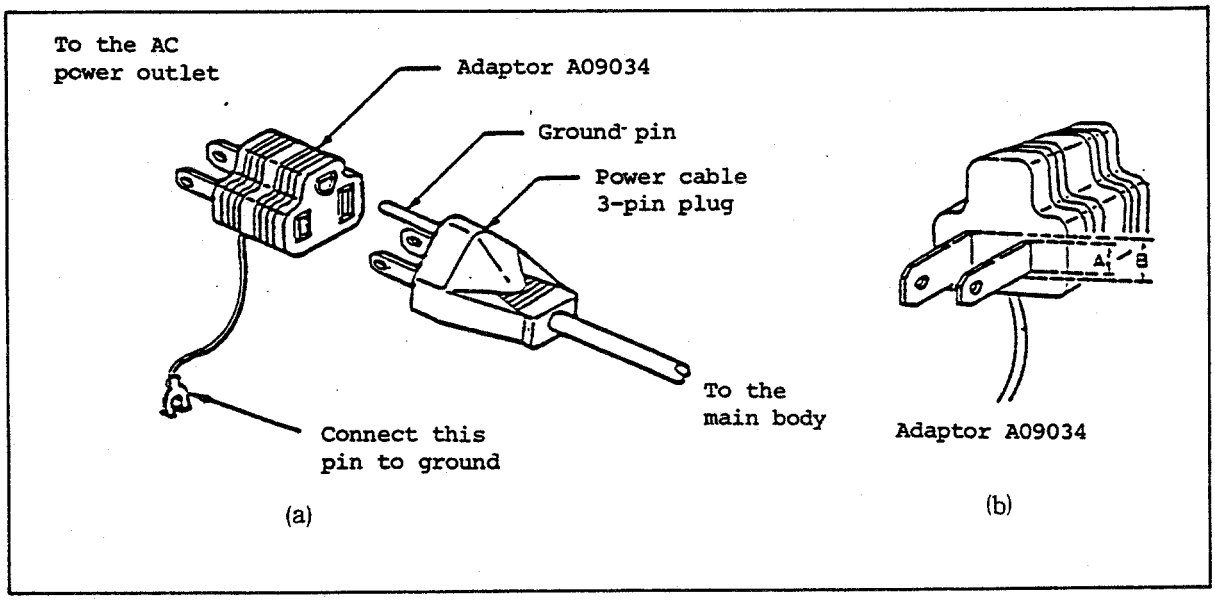


Figure 1-1 Plug and Adaptor of Power Cable

(3) Inspection and Replacement of Power Fuse

The power fuse is housed in a fuse holder on the rear panel.

When a fuse is to be inspected or replaced, it can be removed by the power cable being removed from the outlet and the cap of the fuse holder being turned in the direction of the arrow " " with the holder being lightly pressed.

Replace the fuse with one meeting the specifications in Table 1-2.

CAUTION

Replacement of a fuse must be done after the power cable has been removed from the outlet.

Table 1-2 Specifications for AC Power and Fuse

Power source	Model	Stock No.	Remarks
AC 100 V AC 120 V	EAWK 3.15 A	DFT-AA3R15A	T3.15A/250V
AC 220 V AC 240 V	EAWK 1.6 A	DFT-AA1R6A	T1.6A/250V

1.5 Ambient Environment

(1) Avoid using in locations where there is dust, a lot of vibration or direct sunshine, or corrosive gas.

And use with ambient temperatures of 0 to 40°C and humidities of 80% or less.

(2) As the TR6143 uses a discharge cooling fan to avoid temperature rises, keep the rear side of the TR6143 10 cm or more away from the wall. Do not place any material in contact with the rear surface and do not use the TR6143 in an upright position.

(3) The TR6143 has been designed taking AC power line noise into full consideration. However, it should be used in an environment with as little noise as possible. Use a noise rejection filter when there is a lot of power line noise.

(4) The temperature range for storing the TR6143 is from -25 to +75°C. When the TR6143 will not be used for a long time, cover it with a vinyl cover or put it in a carton and store it in a dry space without direct sunshine.

1.6 Output Terminals

The TR6143 has six output terminals: OUTPUT HI/LO, SENSE HI/LO, DRIVING GUARD, and GUARD.

Outputs are taken from the following:

- o Front output terminal (Binding post type)
- o Rear output terminal (Triaxial type)

However, the front terminal and rear output are connected inside the main body. When connecting to a load, select either the front side or rear side.

Maximum voltages that can be applied:

Between HI/LO	110 V peak
Between LO/GUARD terminals	50 V peak
Between Guard/Case	500 V peak

Do not apply voltages greater than the above.

Voltage must not be applied to the DRIVING GUARD terminal.

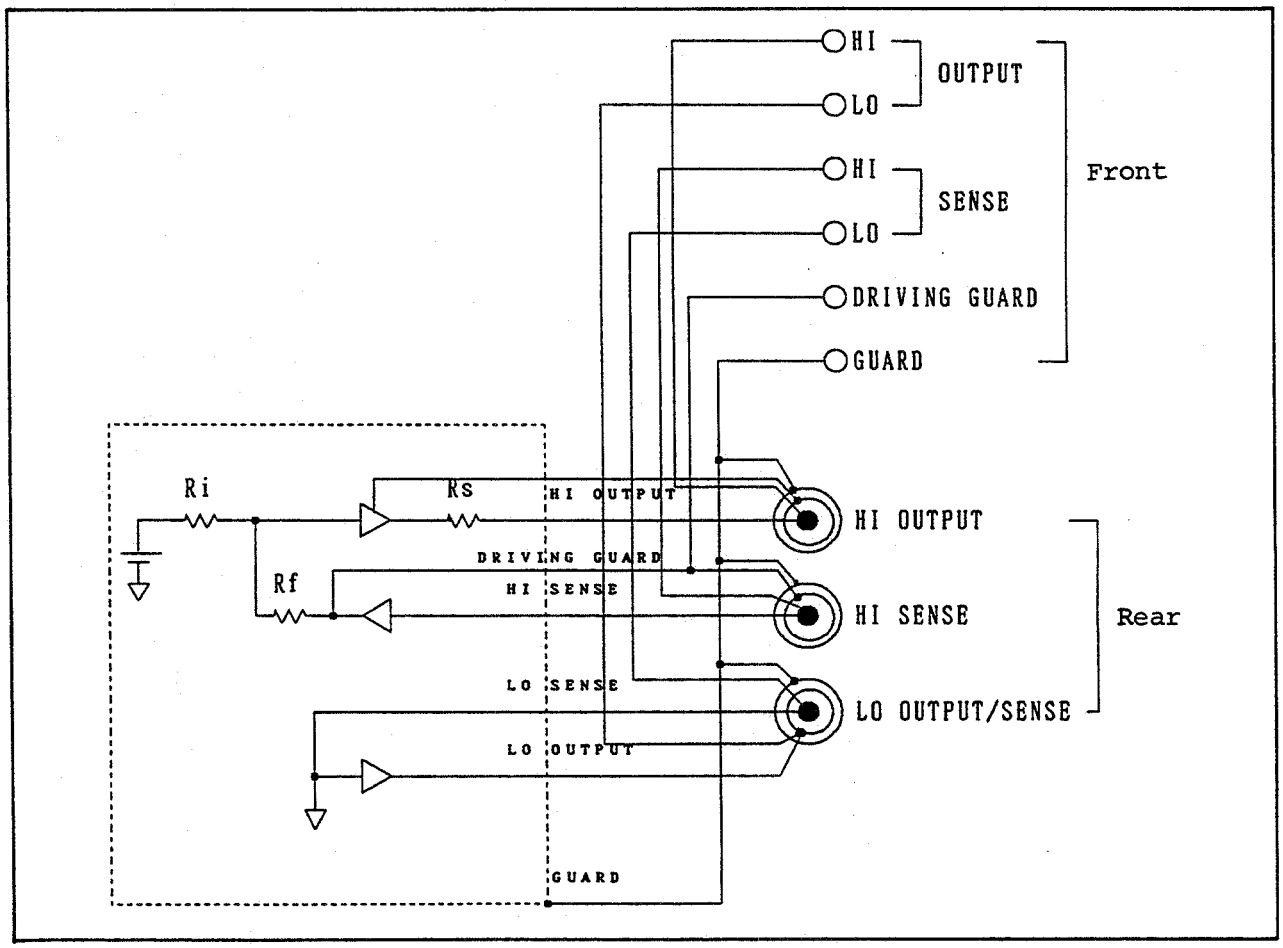


Figure 1-2 Internal Wiring Output Terminals

1.7 Generation Range and Monitor

When the voltage source is operated, the voltage generation value is displayed on the VOLTAGE MONITOR and the current monitor value to be measured is displayed on the CURRENT MONITOR. When the current source is operated, the current generation value is displayed on the CURRENT MONITOR and the voltage monitor value to be measured is displayed on the VOLTAGE MONITOR.

The equivalent circuit of the TR6143 is shown in Figure 1-3.

The relationship between voltages and currents which can be output is shown in Figure 1-4. Output is possible in the range enclosed by solid lines.

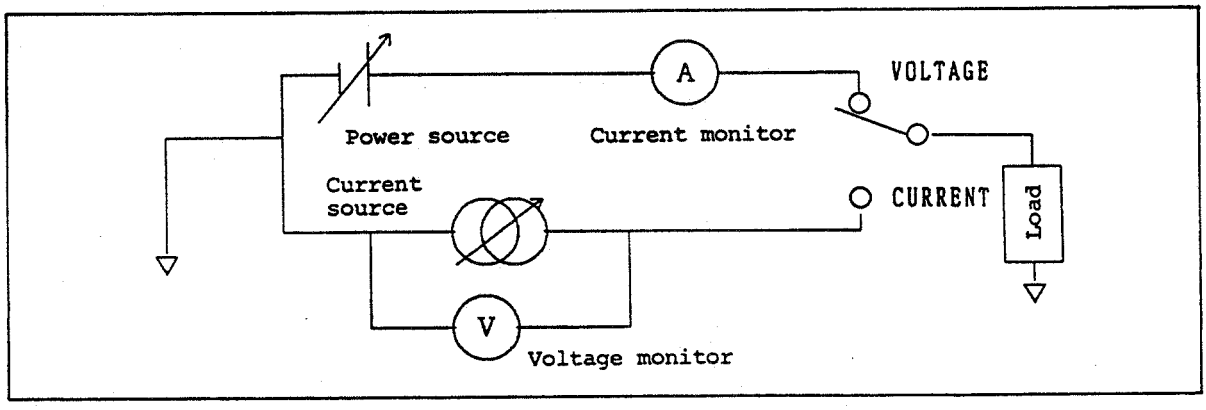


Figure 1-3 Equivalent Circuit

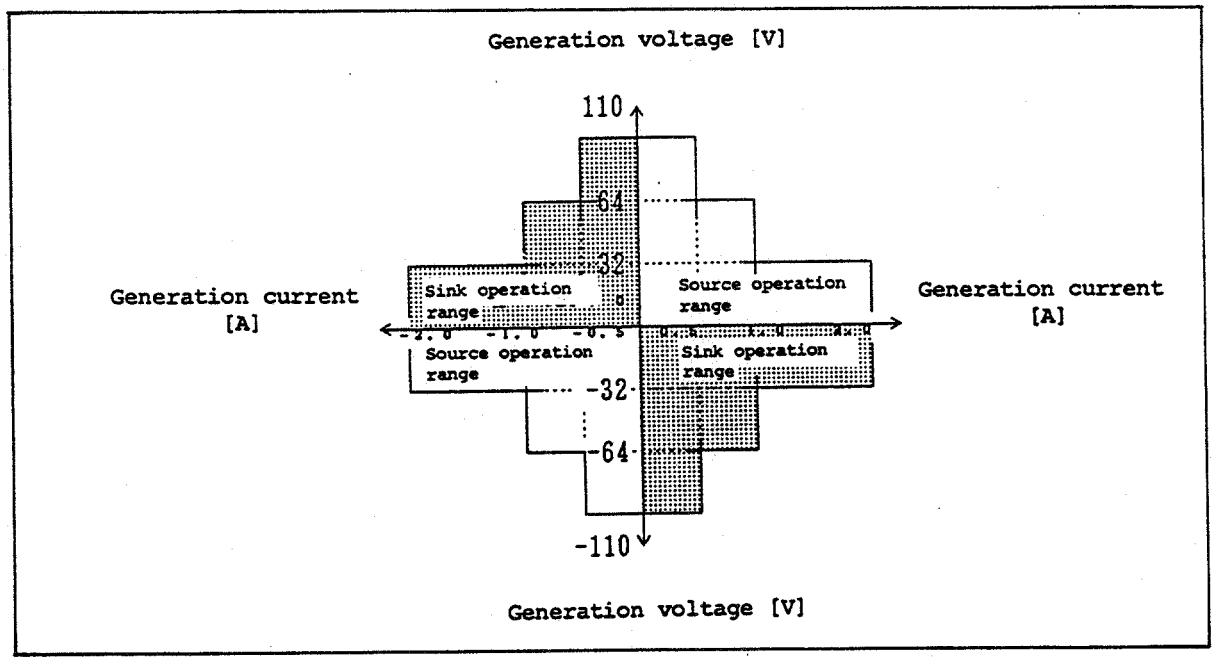


Figure 1-4 Output Range

CAUTION

When using the TR6143 as a load (when using it in the sink operation range), note that if a voltage greater than the output range of the TR6143 is applied externally, the TR6143 may be destroyed.

1.8 Limiters

In order to prevent excess current or excess voltage being applied to a load, a current limiter and voltage limiter can be set.

Figure 1-5 shows examples of setting the limiters.

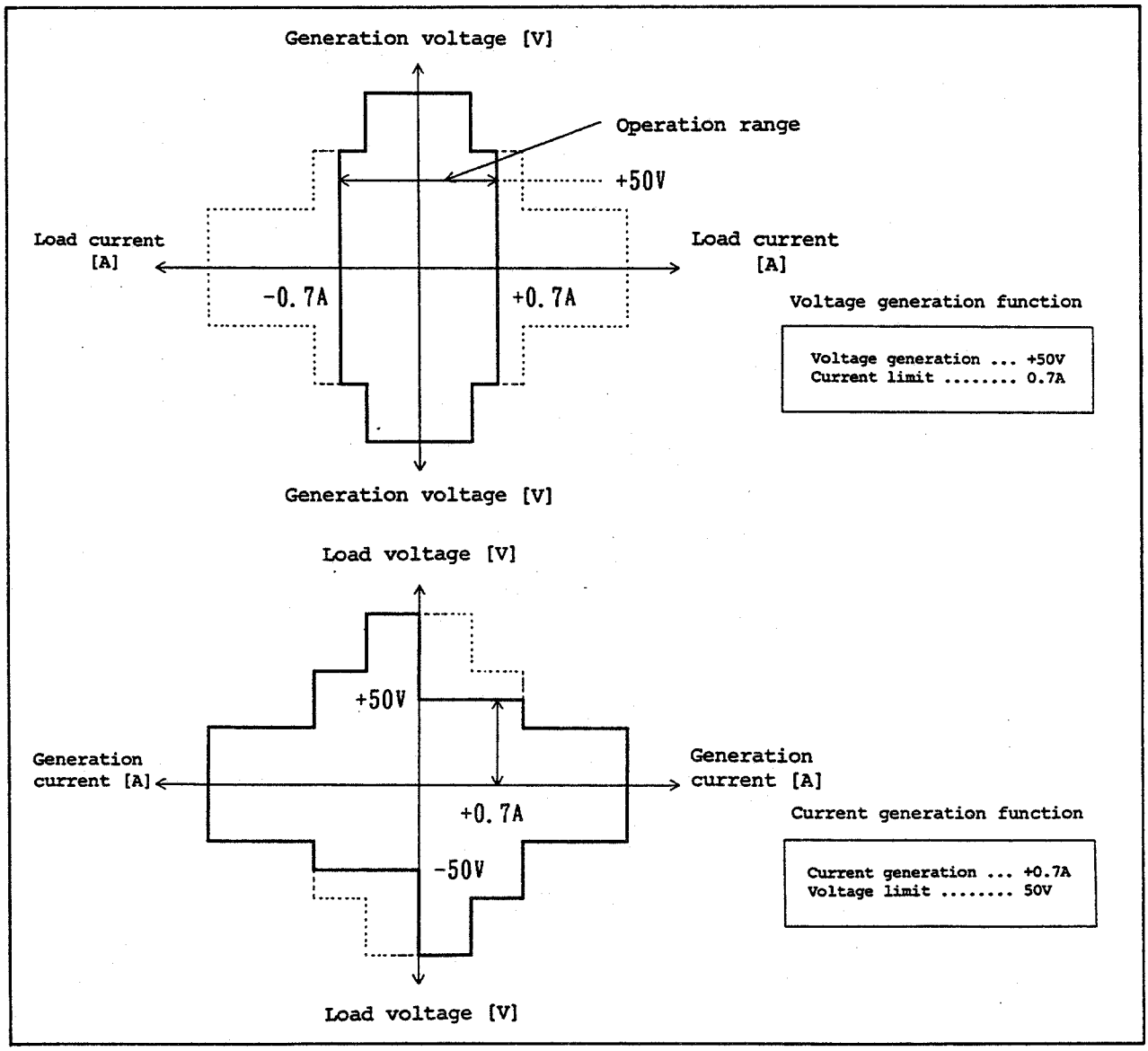


Figure 1-5 Examples of Setting Voltage and Current Limiters

2. BASIC OPERATION

2.1 Explanation of the Panel

See Figures 2-4 and 2-5. The function of each part is explained below in the numbered order in the figure.

(1) MODE Switch

This switch is used to select either the DC mode (⎓) or SWEEP mode (⎍).
The selected mode is indicated by a lamp in the switch.

(2) V/I Switches and VOLTAGE and CURRENT lamps

These switches are used to select the generation function. The selected function is indicated by a VOLTAGE lamp or CURRENT lamp turning on. The VOLTAGE lamp indicates the voltage generation function (V) and the CURRENT lamp indicates the current generation function (I).

CAUTION

When the limit value becomes less than 300 counts by the function being changed, the limit value automatically changes to 300 counts.

(3) RANGE Switch

o This switch is usually used to change the generation range.

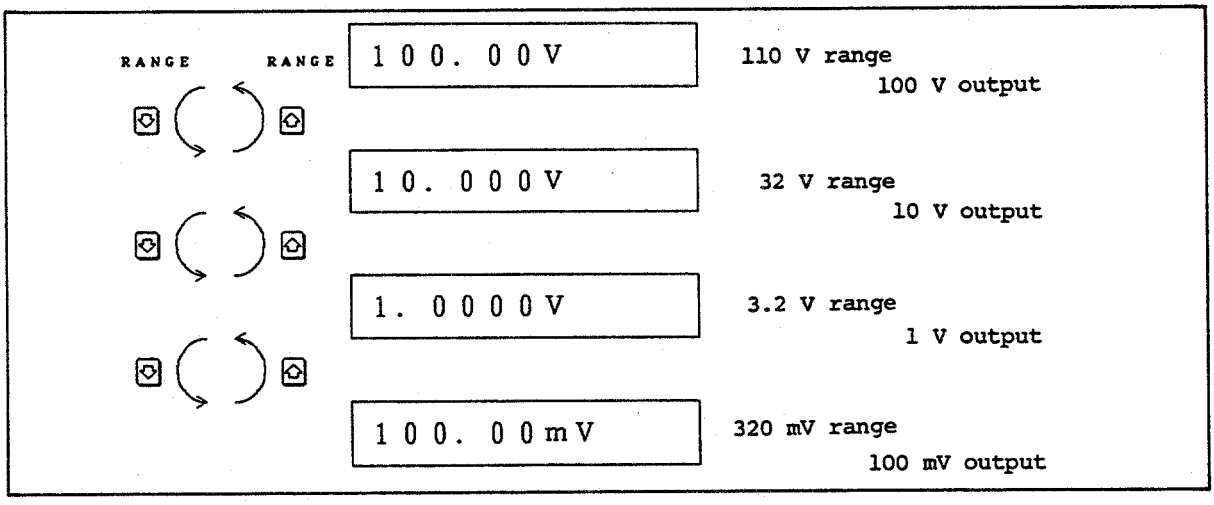


Figure 2-1 Example of Range Change Operation

o In the limit setting mode (LIMIT lamp ON), this is used to change the limit range or monitor range.
o See 2.2.1 Numeral setting for details.

(4) POLARITY (-, 0, or +) Switch

This switch is used to select the generation polarity or no generation. See 2.7 Zero Setting for zero generation.

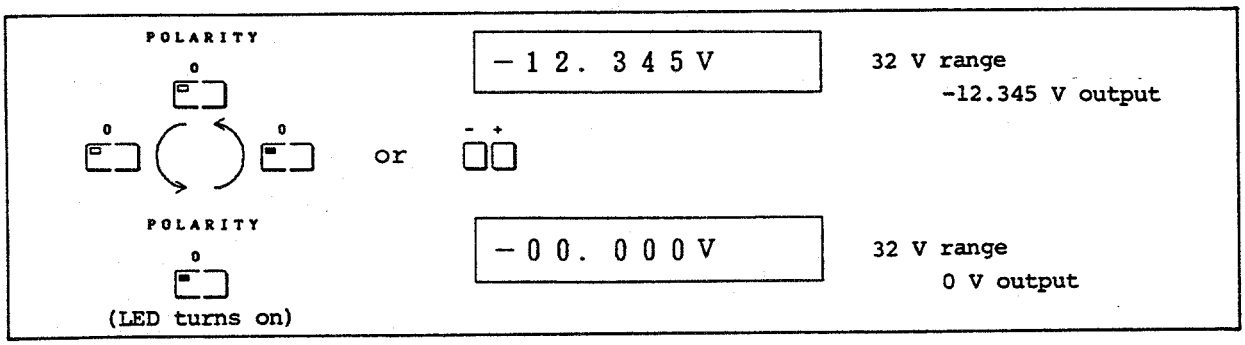


Figure 2-2 Example of Zero Generation Operation

(5) ◁, and ▷ Switches

These switches are used to specify a digit used to decrease a set value with a data knob. The digit used to increase or decrease is indicated by a half-bright cursor.

(6) Data Knob

Usually the data knob is used to increase or decrease the voltage or current generation value. The digit used to increase or decrease is indicated by a half-bright cursor. (see ⑤ ◁ and ▷ Switches.)

The data knob is also used to increase or decrease the voltage or current limit value in the limit setting mode (LIMIT lamp ON).

(7) VOLTAGE Display

o Usually displays the voltage generation value, voltage limit value, or voltage monitor value.
With the voltage generation function (VOLTAGE lamp ON) the voltage generation value is displayed.
With the current generation function (CURRENT lamp ON), the voltage limit value (in the standby mode), voltage monitor value (in the operating mode), or any detected limit, excess applied voltage, or oscillation is displayed.

Display	Meaning
LIMIT	Limit detected
OUEr	Excess applied voltage detected
HEAt	Overheating detected
oSC	Oscillation detected

o The voltage limit value is displayed in the limit setting mode (LIMIT lamp ON).

(8) CURRENT Display

- o Usually, the current generation value, current limit value, or current monitor value is displayed.
  In the voltage generation mode (VOLTAGE lamp ON), the current limit value (in the standby mode), current monitor value (in the operating mode), or any detected limit, excess applied voltage, or oscillation is displayed.

- o The current limit value is displayed in the limit setting mode (LIMIT lamp ON).

(9) MONITOR Lamp

This lamp is used to indicate that this is a measurement display. (see Figure 2-3.)

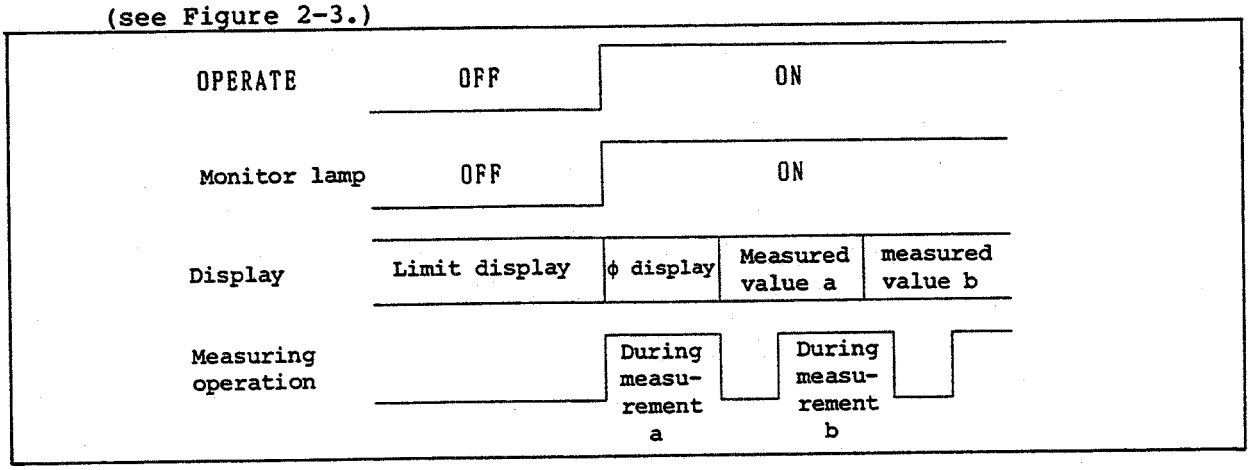


Figure 2-3 Measuring Operation and Monitor Lamp

(10) HI, GO, and LO Lamps

These lamps are used to display a comparison operation.
- o Measured value > Comparative upper limit value ... HI lamp ON
- o Comparative lower limit value $\leqq$ Measured value $\leqq$ Comparative upper limit value . GO lamp ON

- o Measured value < Comparative lower limit value ... LO lamp ON

(11) LIMIT Switch

- o For the voltage generation function, this switch is used to set the current limit value.
- o For the current generation function, this switch is used to set the voltage limit value.

(12) OPERATE Switch

This switch is used to specify either the setting of the operation mode (output ON) or standby mode (output OFF).

(13) OUTPUT and SENSE Terminals

The OUTPUT terminal is for current output.

The SENSE terminal is for voltage input (for feedback input).

For a two-terminal connection (see 2.3 (1) Two-terminal connection), an OUTPUT terminal is connected to the load.

For a four-terminal connection (see 2.3 (2) Four-terminal connection), both the OUTPUT terminal and SENSE terminal are connected to loads.

(14) SENSE Switch

This switch is used to specify either a two-terminal connection (2-WIRE ▬) or a four-terminal connection (4-WIRE ▮▮).

(15) DRIVING GUARD Terminal

This terminal is used to prevent noise being induced via the HI terminal and to prevent the response from dropping due to the capacitance between the cable wires when the TR6143 is used in the low current range (32 μA to 3.2 mA).

(16) GUARD Terminal

This terminal is used to reject noise signals between the frame (if it is grounded, between the ground) and the load. Usually, GUARD switch is set to SHORT.

(17) GUARD Switch

This switch is used to short the GUARD terminal and OUTPUT LO terminal internally.

(18) AUTO RANGE Switch

This switch is used to specify whether the monitor range is to be selected manually or automatically.

When it is set to AUTO RANGE, the AUTO RANGE lamp comes on.

The optimum monitor range is selected automatically according to the size of the monitor signal when the TR6143 is set in the AUTO RANGE mode.

Table 2-1 shows the UP and DOWN levels.

Table 2-1 UP and DOWN Levels

	UP/DOWN level
UP level	32000
DOWN level	2999

The monitor range is fixed to the range set by the limit in the MANUAL mode.

Pressing the AUTO RANGE switch again in the AUTO RANGE mode changes the TR6143 to the MANUAL mode.

(19) NULL Switch

This switch is used to start a NULL operation (measured value-NULL reference value).

When the device is set in the NULL operation mode, the NULL lamp comes on.

(20) RUN/HOLD Switch

This switch is used to set the sampling mode (RUN or HOLD). When the device is set in the RUN mode, the RUN/HOLD lamp comes on.

(21) TRIG Switch

This switch is used to start sampling when the sampling mode is set to HOLD.

When the TR6143 is set in the SWEEP mode, this is used to start and stop sweeping.

(22) LOCAL Switch and GPIB Status Lamp

This switch is used to release external control and to set the TR6143 to the local state which can be controlled from the front panel when the TR6143 is in the remote state (REMOTE lamp is ON) controlled externally by GPIB. In the local state, the REMOTE lamp goes off.

However, the remote state cannot be released when the LLO (Local Lockout) command is set by GPIB.

A Status lamp (SRQ, TALK, LISTEN, or REMOTE) is used to display the state of the TR6143 when it is controlled by GPIB.

The SRQ lamp goes on when the TR6143 transmits a service request to a controller.

The TALK lamp goes on when the TR6143 is in talk state for sending data.

The LISTEN lamp goes on when the TR6143 is in listen state for receiving data.

The REMOTE lamp goes on when the TR6143 is controlled externally.

When the REMOTE lamp is on, all panel switches except the LOCAL, SENSE, and GUARD switches become invalid.

(23) Power Switch

Pressing this switch supplies power to the internal circuits.

Pressing this switch again disconnects the power.

(24) V/mA, mV/ A, CE, EXIT Switches

This switch is used to set a variety of parameters. Pressing any one of the switches from the first parameter group to the third parameter group causes the device to enter the parameter group setting mode. To return from the parameter setting mode to the normal mode, press the exit switch EXIT .

To change to another parameter group setting mode, press the exit switch EXIT . And after returning to the normal mode, press the required parameter switch.

	Parameter item	Display	Contents
V/mA → First parameter group	RESPONSE	rESP	Sets the output response (FAST or SLOW).
	I.T	inteG	Sets the A/D integration time (10 ms, 1 PLC, 10 PLC, or 100 PLC).
	A.CAL	A-CAL	Sets the auto calibration function on/off.
	CMPR	CMPr	Set the comparison operation function on/off.
	UPPER	UPPEr	Sets the comparison upper limit value.
	LOWER	LoWEr	Sets the comparison lower limit value.
	BUZZ (CMPR)	b-CMP	Controls the buzzer according to the comparison operation result.
V/mA	BUZZ (LIMIT)	b-Lmt	Turns the buzzer on/off by Limit detection and Oscillation detection.

(cont'd)

	Parameter item	Display	Contents
□ → mV/ μA Second parameter group	SWEEP	SWEEP	Sets the sweep mode (linear, log, or random).
	SWEEP TRIG	trIG	Sets the sweep trigger (auto/external, normal/ reverse, or single/ repeat).
	START	StArt	Sets the sweep start value/start channel.
	STOP	StoP	Sets the sweep stop value/stop channel.
	STEP	StEP	Sets the sweep step value/decayed divisor.
	HOLD	Hold	Sets the hold time (from trigger input to start of sweeping).
	DELAY	dELAY	Sets the delay time (from sweeping to start of measuring, or from trigger input to start of measuring).
	PERIOD	PEr1	Sets the period time (auto sweep cycle time or free run measurement cycle time).
	COMPLETE	CoMPL	Sets the complete output conditions (FRONT, END, HI, GO, LO mode).
□ → CE Third parameter group □ CE	MEMORY	C000	Sets random sweep data.
	GPIB ADDRESS	GP-1b	Sets the GPIB parameters (header ON/OFF, talk only)/addressable, device address).
	LINE FREQUENCY	L1nE	Sets the operating power frequency (50 Hz/60 Hz).

(25) Fast/Slow Display

Displays the response (response speed of generation voltage and generation current) state.

(26) DIRECT (Enter) Switch

- o This switch is usually used to enter a mode (direct mode) for which a voltage generation value or current generation value is set by a numeric value. When the TR6143 enters the direct mode, the DIRECT lamp goes on.
  When the ENTER switch is pressed after a numeric value setting, the generation value will change.
- o 0 to 9 switches
  These switches are used to input numeric values in the numeric value setting mode (direct mode).
- o . Decimal point switch
  This switch is used to input a decimal point in the numeric value setting mode (direct mode).
- o +/- switches
  These switches are used to reverse the polarity of the numeric value setting mode (direct mode).
- o CB switch
  This switch is used to return to the former setting state in the numeric setting mode (direct mode).

(27) Power Source Connector

This is for connecting an AC power source via the attached power cable (A01402). Before connecting the power source, ensure that the power voltage to be used matches the voltage set in the TR6143.

(28) Fuse Holder

A slow-blow fuse of 3.15 A is used at 100 V AC.

When replacing a fuse, remove it by turning the cap in the direction of the arrow "↶" with the cap lightly pressed. (See to " (32) Power Voltage Display".)

(29) GND Terminal

This terminal is for a ground connection.

When a two-pin adaptor is attached to the plug of the power cable, be sure to ground the wire on the adaptor or this ground terminal.

(30) Serial Nameplate

The manufacturing number of the TR6143 is stamped here.

(31) Cooling Fan

This fan is used to prevent excessive temperatures inside the TR6143. The fan should be well ventilated when the TR6143 is in use.

(32) Power Voltage Display

Displays the operating power voltage and used fuses.

Example of display at AC100 V

	SET	LINE V	FUSE
Mark →	●	90 to 100 V	T3.15 A/250 V
		108 to 132 V	
		198 to 242 V	T1.6 A/250 V
		216 to 250 V	

(33) GPIB Connector

This connector is used to control the TR6143 externally and to output data using GPIB.

(34) COMPLETE Output Terminal

This connector is used to output a trigger signal (front mode) for starting measuring, or control signals (End/HI/GO/LO mode) for control using a scanner or two or more of these instruments. Output signals are at the TTL level with negative pulses (pulse width: 20 µsec to 100 µsec).

(35) OPERATE INPUT/OUTPUT Terminal and IN/OUT Change Switch
(See "4.1 Example of Connection to R12701 and another TR7101".)

- o This is a connector used to input signals for externally setting the TR6143 in the standby mode when the Change switch is set to IN. Input signals are set to the standby mode when the TTL level varies from 0 to 1. Pulses are positive pulses (pulse width: approx. 20 ms or more).

- o When the Change switch is set to OUT, this connector is used for output in the operate mode of the TR6143. An output signal is TTL level (Operate mode: level "0", Standby mode: level "1").

(36) TRIGGER Input Terminal

When the sampling mode is HOLD, this connector is used to input a trigger signal for starting measuring. (See "2.8.3 Sampling Mode and Sampling Parameter".)

When an external sweep trigger is used in the sweep mode, this connector is used to input a trigger signal for executing sweeping. And, when an auto-sweep trigger is used in the sweep mode, this connector is used to start/stop sweeping. (See to "3.1.2 SWEEP TRIG: Trigger Mode".)

Input signals are at the TTL level with negative pulses (pulse width: 10 μsec or more).

(37) SYNC. OUTPUT Terminal

This connector is used to output a synchronous signal for synchronously operating two or more of these devices. The synchronous signal is output when sweeping advances one step. (See "3.1.2 SWEEP TRIG: Trigger Mode".) Output signals are at the TTL level with negative pulses (pulse width: 80 μsec to 300 μsec).

(38) EXT CAL Switch

This switch is used to calibrate each generation range, measurement range, and integration time. Usually, it is set to DISABLE. The functions of this switch cannot be controlled externally.

(39) HI OUTPUT Terminal, HI SENSE Input Terminal, and LO OUTPUT/SENSE Terminal

The HI OUTPUT terminal is a connector for voltage or current output.

- o Use any one of the HI OUTPUT, DRIVING GUARD, and GUARD terminals on the front panel since they are internally connected.
  The LO OUTPUT/SENSE terminal is a low side terminal for voltage or current output.
- o Use any one of the LO OUTPUT, LO SENSE, and GUARD terminals on the front panel since they are internally connected.

2.1 Explanation of the Panel

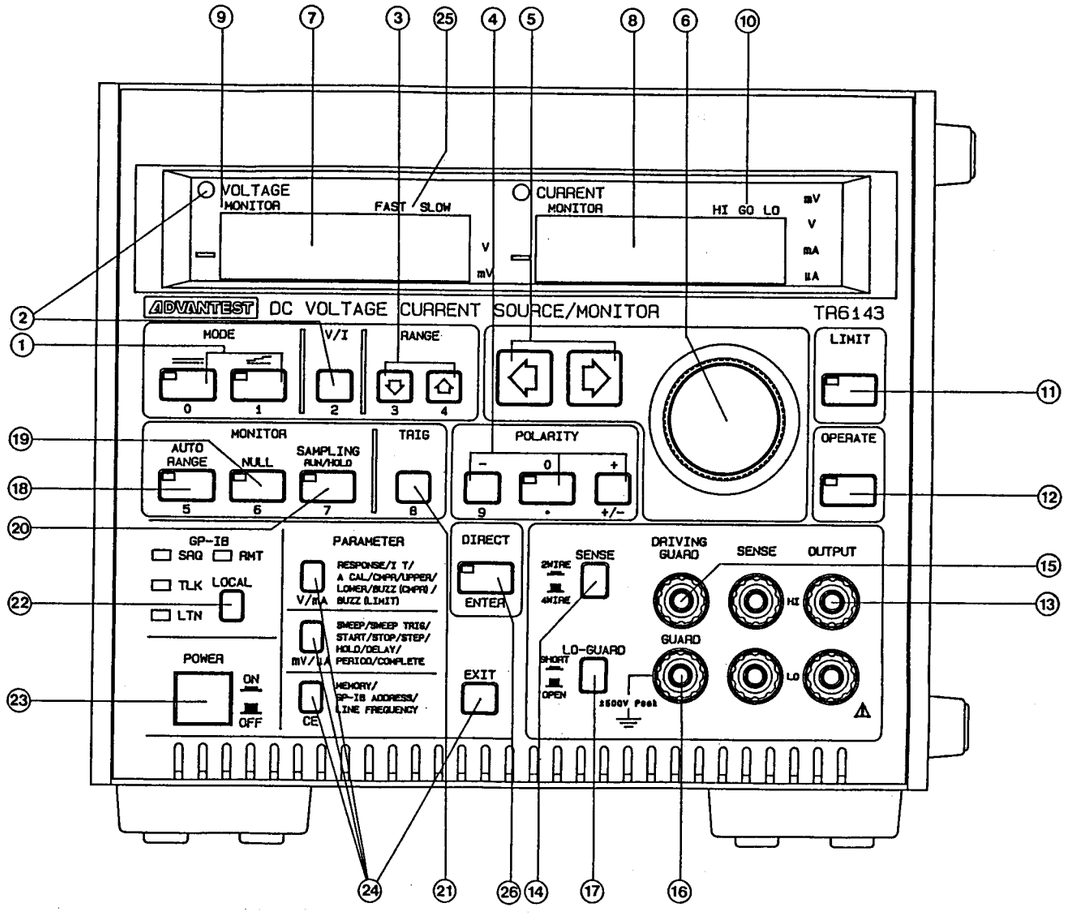


Figure 2-4 Front Panel

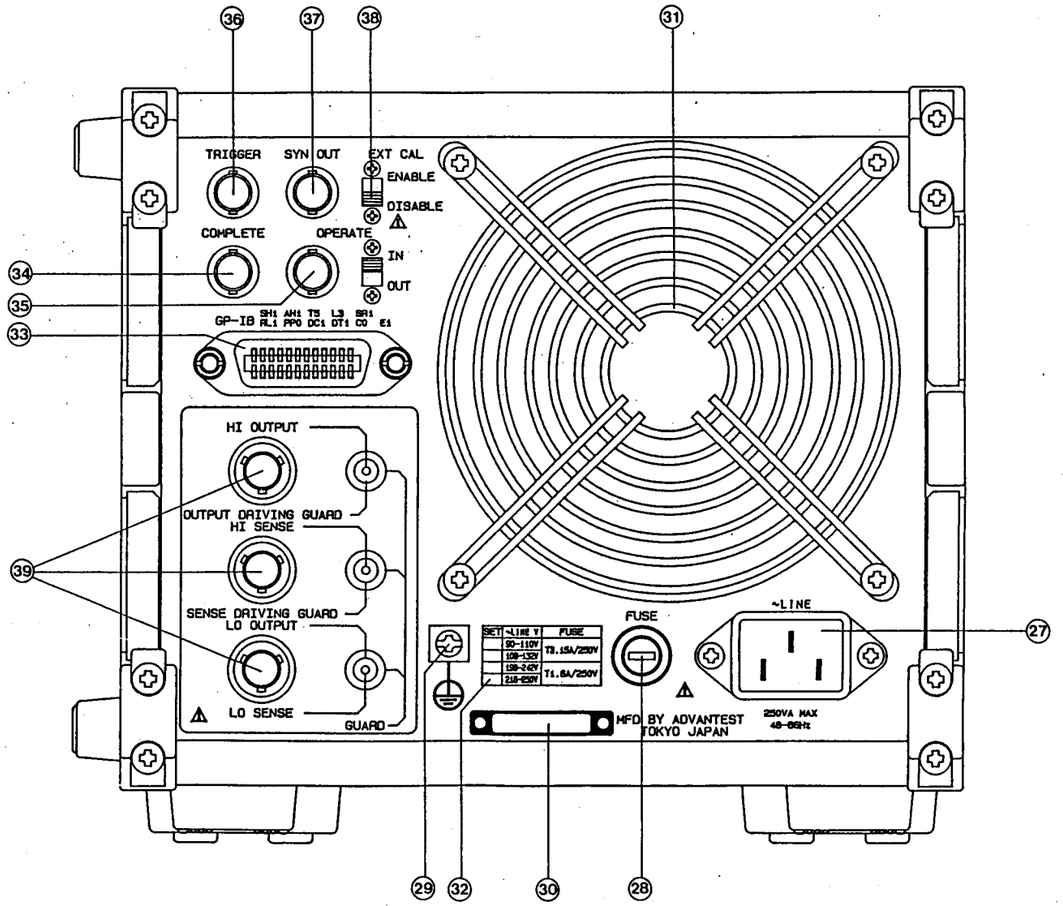
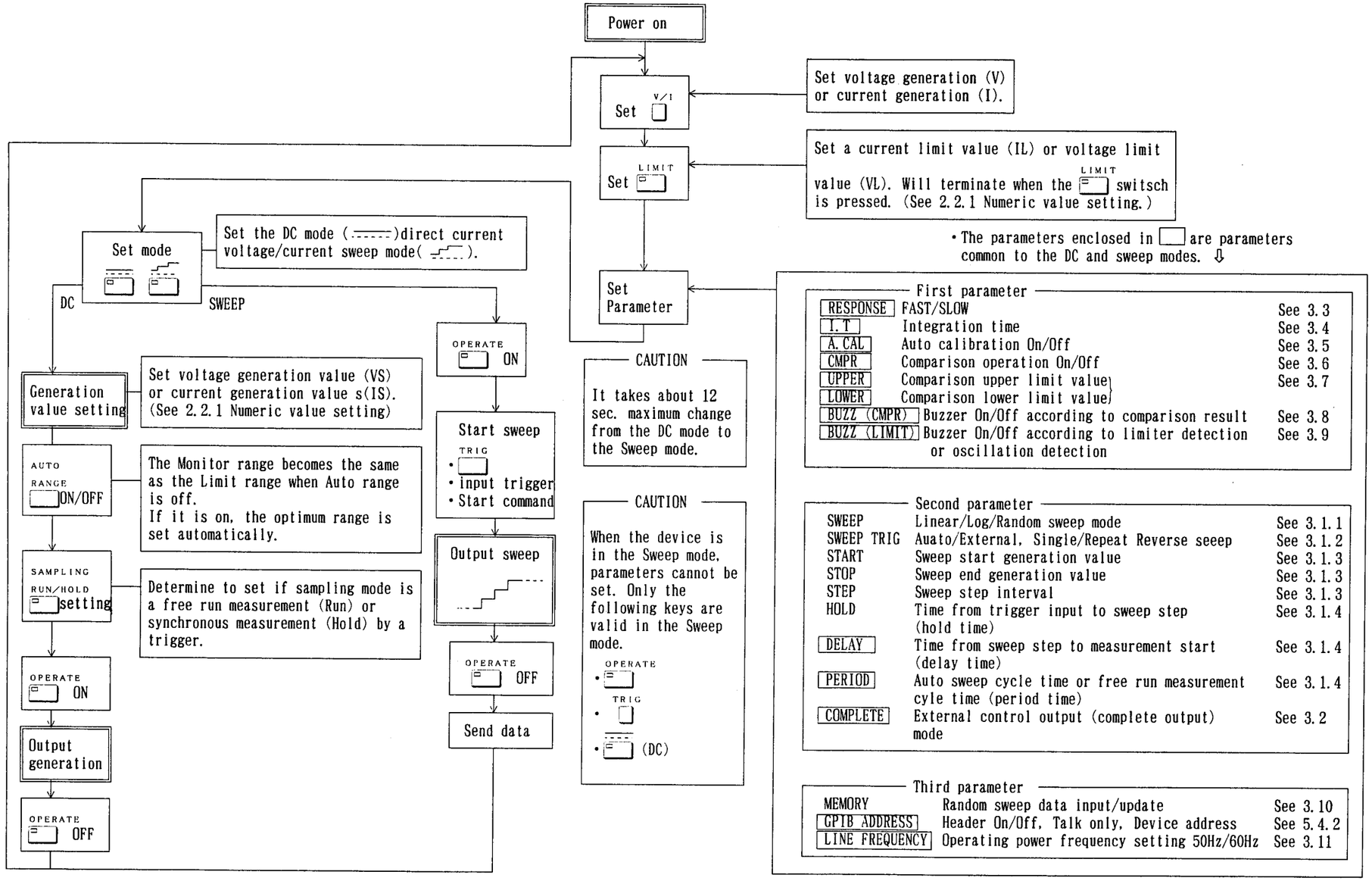


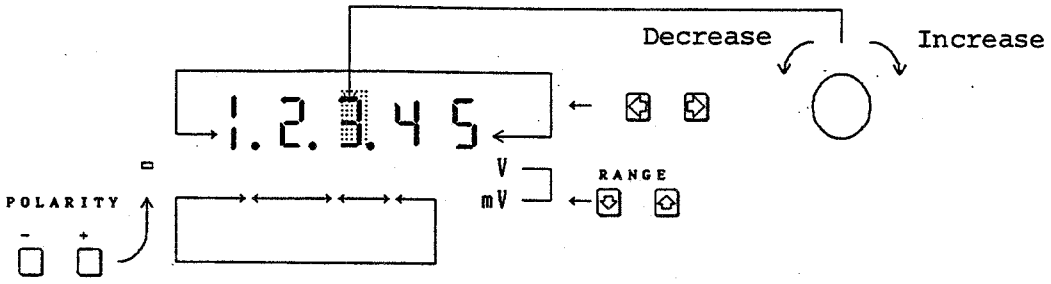
Figure 2-5 Rear Panel

2.2 Outline of Operational Procedures



2.2.1 Numeric Value Setting

[Dial operation]



o Set the polarity of the generation value using Polarity switches [-] and [+]. (Only the generation value is valid.)

o Set the range using Range switches [▽] and [△].

Example of operation

12.345 V
[▽] [△]
1.2345 V
[▽] [△]
123.45 mV

o When changing to the 110 V range or 2 A range using a Range switch , if the set value becomes 110.00 V or more or 2000.0 mA or more, the numeric value is reduced to one-tenth (1/10) of its value.

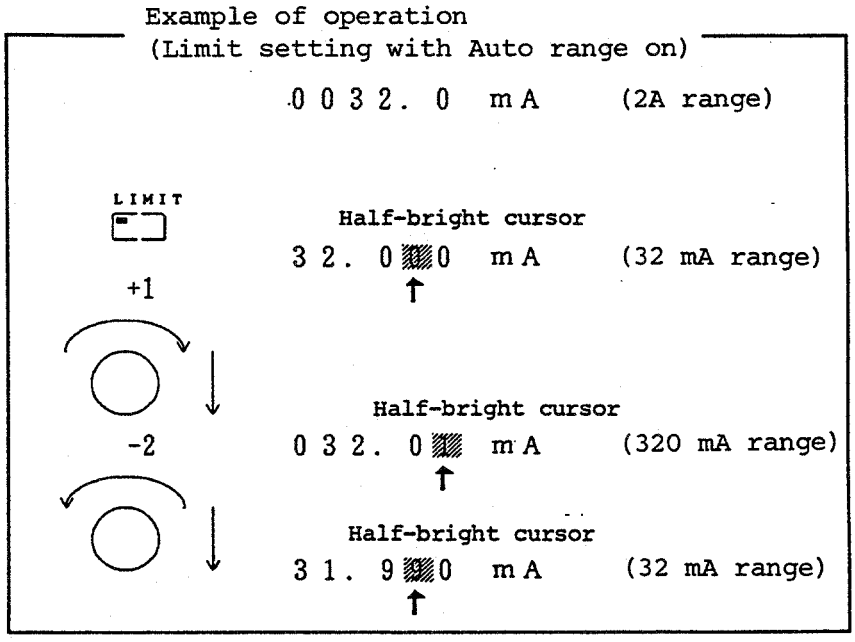
Example of operation

012.34 V
[△]
12.345 V

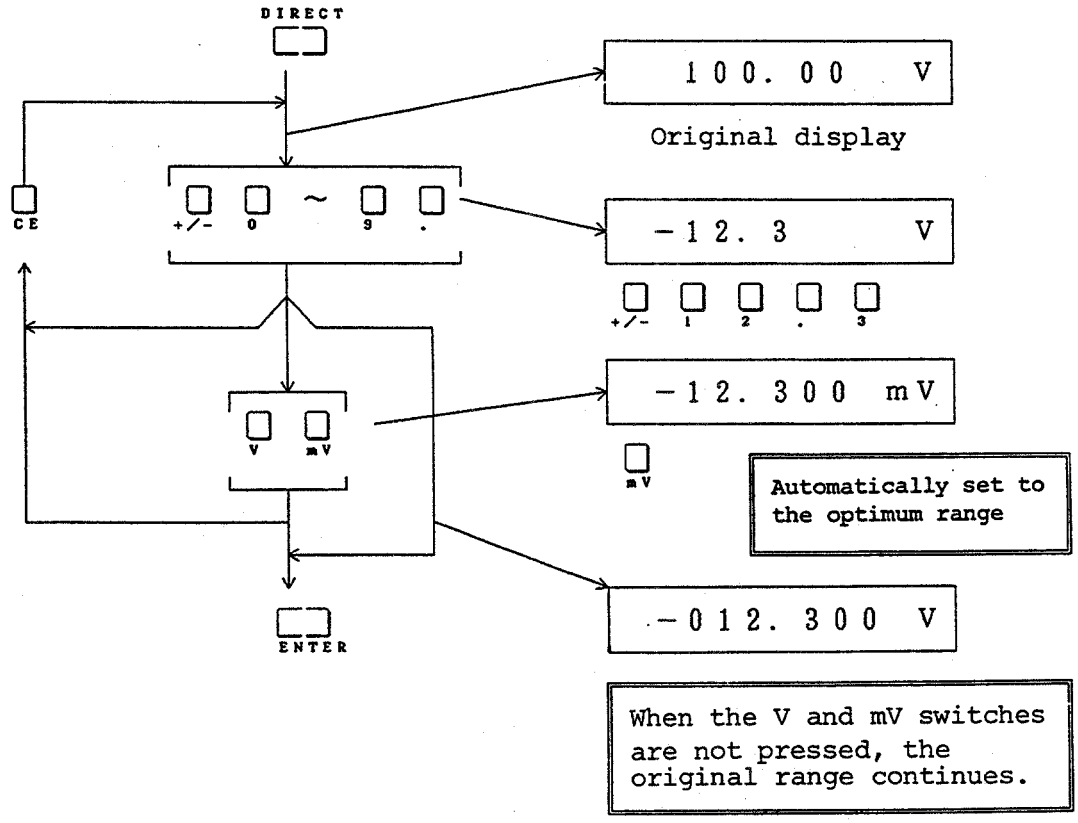
Example of operation

0320.0 mA
[△]
320.00 mA

o When setting a limit value with Auto Range ON, a numeric value other than these in the 32 μA range is set in the range from 03200 to 32000 (20000 2 A range) automatically.



[Direct operation]



o The optimum range is displayed in Table 2-2.

Table 2-2 Optimum Range Setting

	Setting range	Optimum range
Voltage generation Voltage limit	000.00 mV to 320.00 mV 0.3200 V to 3.2000 V 03.200 V to 32.000 V 032.00 V to 110.00 V	320 mV 3.2 V 32 V 110 V
Current generation Current limit	00.000 µA to 32.000 µA 032.00 µA to 320.00 µA 0.3200 mA to 3.2000 mA 03.200 mA to 32.000 mA 032.00 mA to 320.00 mA 0320.0 mA to 2000.0 mA	32 µA 320 µA 3.2 mA 32 mA 320 mA 2 A

CAUTION

A set value for the voltage limit or current limit should be more than 30 counts.

2.3 Cable Connection(Two-Terminal Connection/Four-Terminal Connection)

(1) Two-terminal Connection (2-wire)

When errors due to voltage drops in the lead wires can be ignored, a two-terminal connection used.

Figure 2-6 shows the connection method.

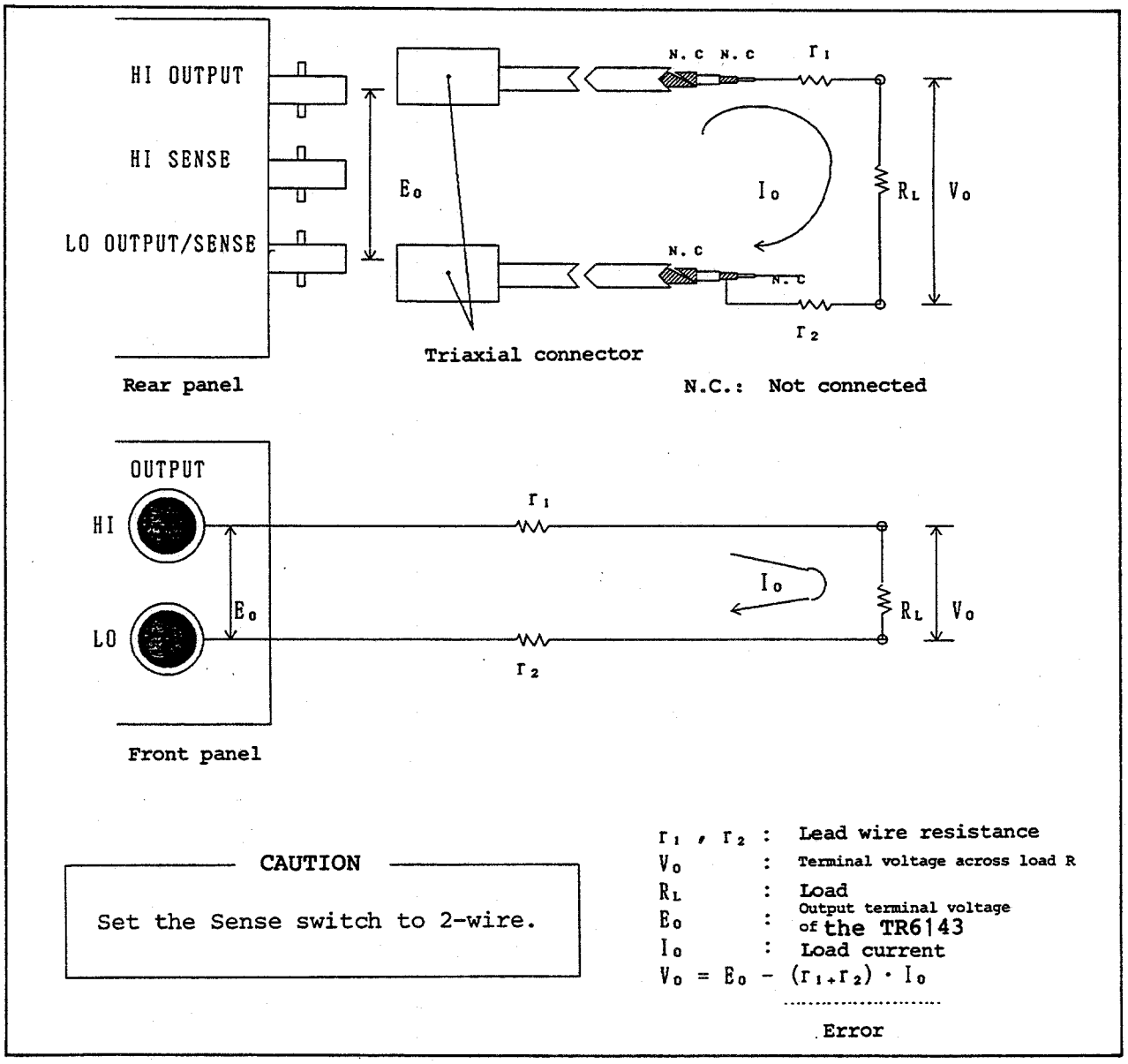


Figure 2-6 Two-terminal Connection

(2) Four-terminal Connection (4-wire)

A four-terminal connection is used to minimize errors due to voltage drops in the lead wires. Figure 2-7 shows the connection method.

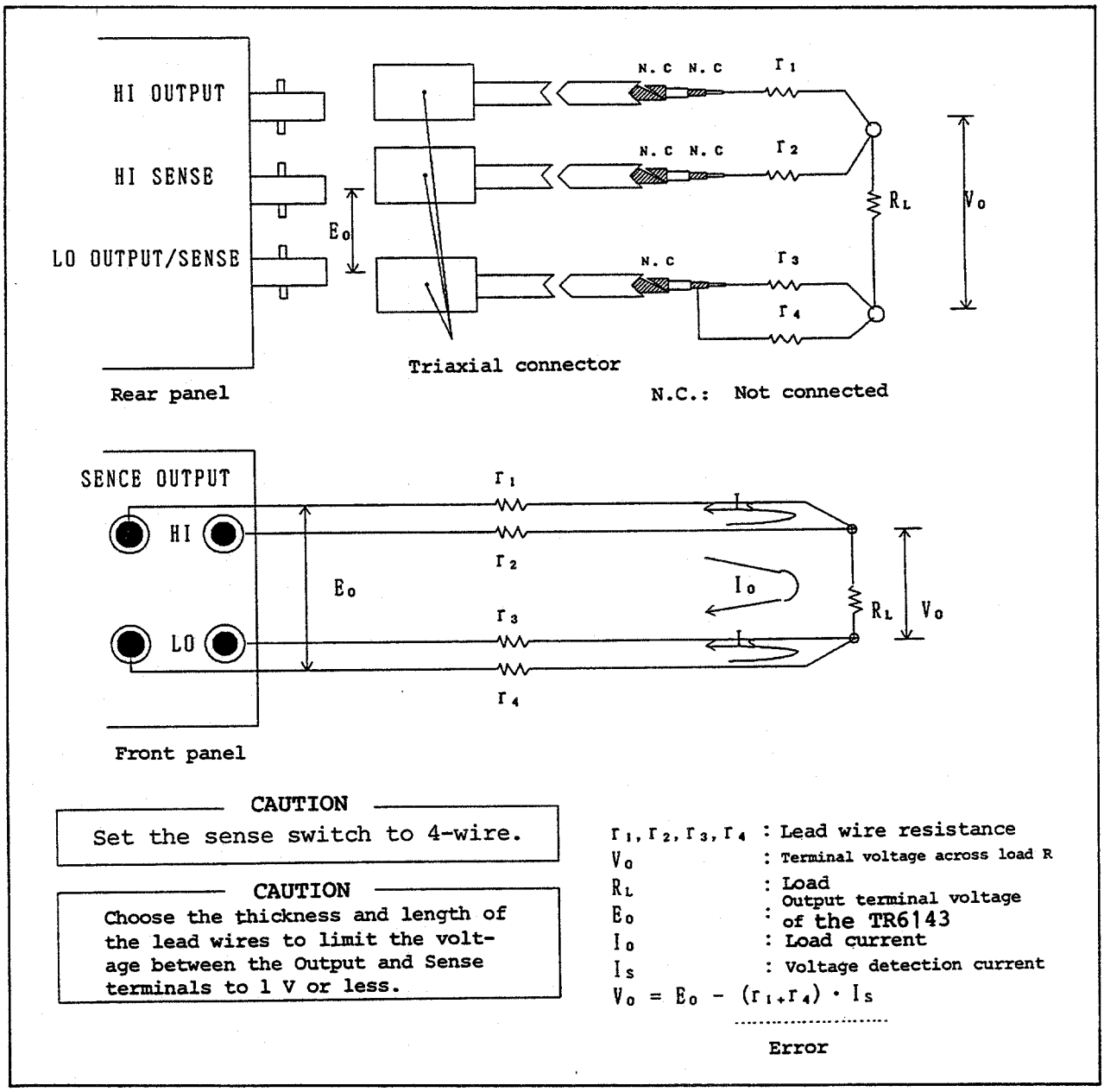


Figure 2-7 Four-terminal Connection

2.4 POWER ON and Output ON

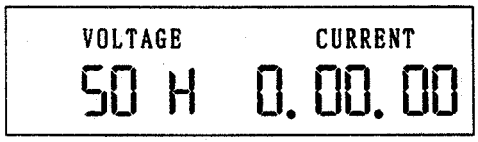
2.4.1 Self-diagnosis and Indication of Revision Number

(1) Ensure that the operating power voltage is the same as the set voltage indicated on the rear panel.

(2) Setting the power switch to ON causes the self-diagnosis function to run automatically.

If the TR6143 is normal, all LED lamps on the panel come on during the execution of self-diagnosis function. If an abnormality occurs, an error code corresponding to the error contents is displayed. (see Appendix A.1 Error code table.)

Next, a current revision number is displayed on the current side, with the operating power frequency on the voltage side.



Software update number: Indicates the update number of the internal software for the TR6143. This example shows the update number of 00.00.

Revision number: Indicates the revision number of the TR6143. This example shows Revision 0.

Operating power frequency setting: Indicates that the power frequency is 50 Hz or 60 Hz. The power frequency must be set equal to this. To change the setting, see "3.11 Line Frequency".

2.4.2 Set Value of Parameter and Condition of output ON/OFF for Shipment

(1) If the self-diagnosis function terminates and an abnormality is not found, the TR6143 is set to the operating condition according to the parameter set last. (see Table 2-3.)

Table 2-3 Parameter Setting on Delivery and Backup Capabilities

Parameter	Set value on delivery	Backup
MODE	DC	No
V/I	VOLTAGE	Yes
RANGE	100 V Range	Yes
GENERATION VALUE	+000.00 V	Yes
LIMIT VALUE	0500.00 mA	Yes
OPERATE	OFF	No
AUTORANGE	OFF	Yes
NULL	OFF	No
SAMPLING	RUN	Yes
RESPONSE	SLOW	Yes
I.T	1 PLC	Yes
A.CAL	ON	Yes
CMPR	OFF	Yes
UPPER	0000.0 mA	Yes
LOWER	0000.0 mA	Yes
BUZZER (COMP)	OFF	Yes
BUZZER (LIMIT)	OFF	Yes
SWEEP MODE	Linear	Yes
SWEEP TRIGGER	Automatic Single Reverse OFF	Yes
START	000.00 V	Yes
STOP	000.00 V	Yes
STEP	000.00 V 10 (Log sweep)	Yes
START CH	000	Yes
STOP CH	000	Yes
HOLD TIME	10 ms	Yes
DELAY TIME	10 ms	Yes
PERIOD TIME	10 ms	Yes
COMPLETE MODE	END mode	Yes
MEMORY	000.00 mV	Yes
GPIB ADDRESS	Header ON Addressable Address 01	Yes
LINE FREQUENCY	50 Hz	Yes
SERVICE REQUEST	S1	No

(2) Set V/I, limit value, each parameter, mode, generation value, monitor range, and sampling mode. (see 2.2 Outline of operational Procedures.)

(3) Set output to ON. Conditions for setting output ON/OFF are listed in Table 2-4.

Table 2-4 Conditions for Setting Output On/Off

	Output ON	Output OFF
OPERATE	ON	OFF
MODE		When the mode changes from DC to SWEEP
Rear panel operation (In)		When TTL level changes from L to H
GPIB command	E	SDC, DCL H C
Output protection		Overheating detecting

2.5 Voltage Generation/Monitor (VSIM)

When this is used with the voltage generation function, a current limit (limiting value for the load current) is set to protect the load.

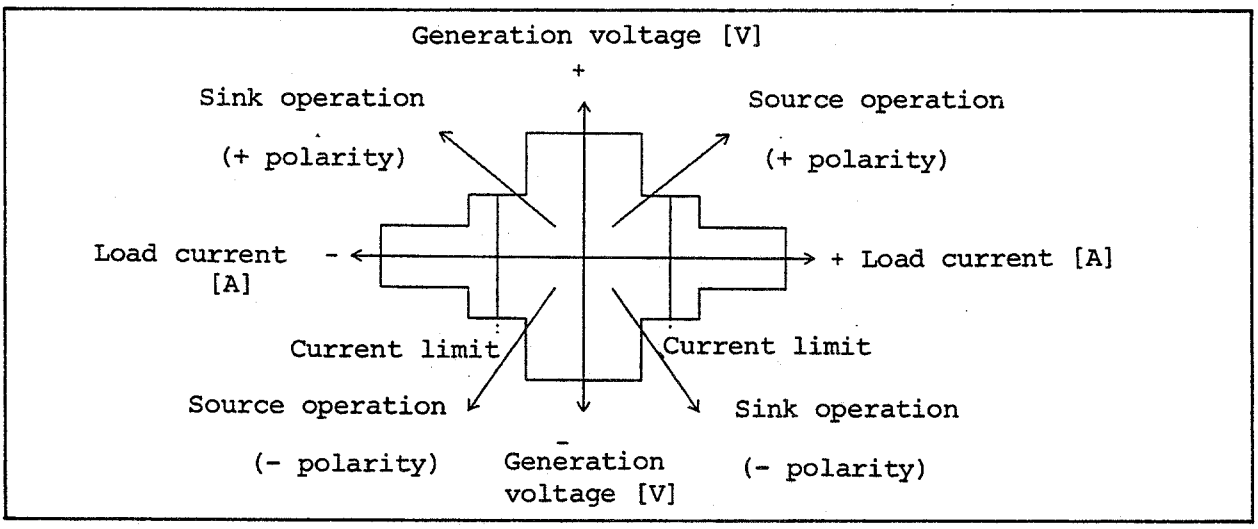


Figure 2-8 Voltage Generation and Current Limit

2.5.1 Voltage Generation

① Set the mode to ⎓ (DC) and V/I to "VOLTAGE".

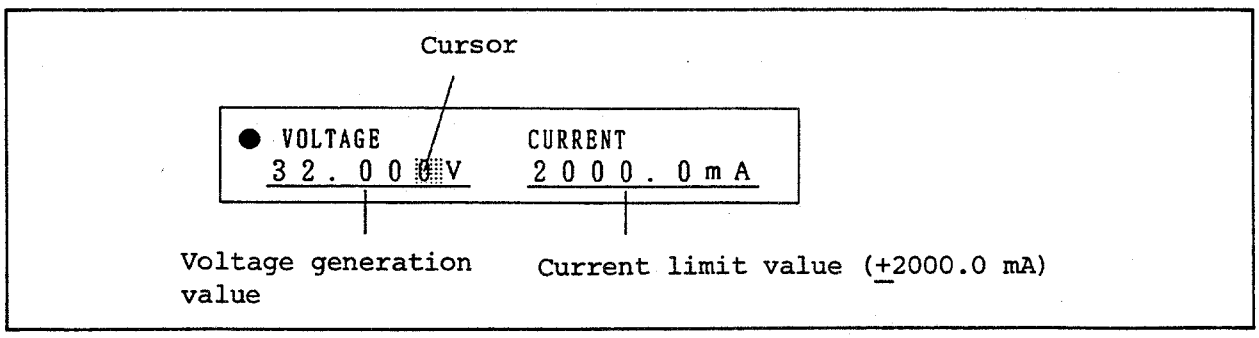


Figure 2-9 Display of a Voltage Generation Value

② Set a generation value using a dial operation or direct operation. (see 2.2.1 Numeric value setting.)

2.5.2 Current limit

① Turn the limit lamp ON by pressing LIMIT. The TR6143 then enters the limit setting mode.

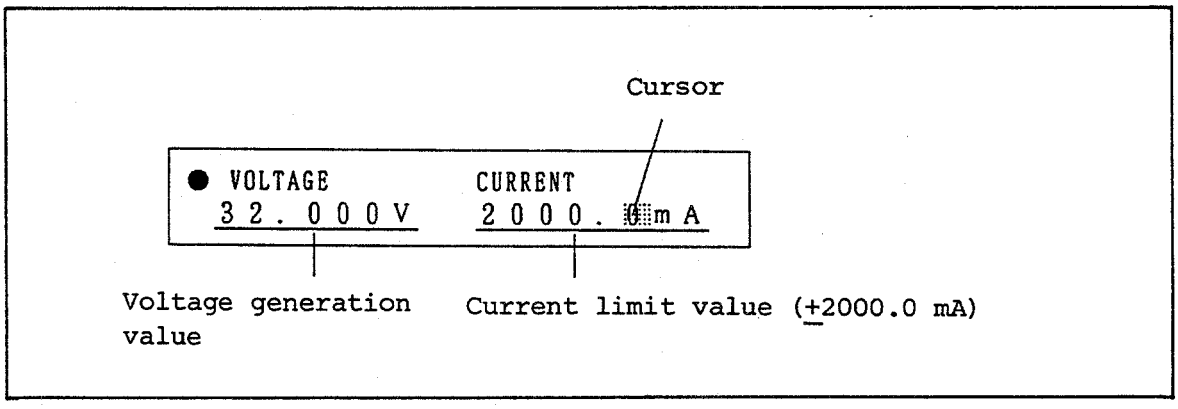


Figure 2-10 Display of Current Limit Value

② Set a limit value using a dial operation or direct operation. (See 2.2.1 Numeric value setting.)

③ Termination operation

Pressing LIMIT again causes it to terminate and the limit lamp to turn OFF.

2.6 Current Generation/Monitor (ISVM)

When this is used with the current generation function, a voltage limit (Limiting value for the load voltage) is set to protect the load.

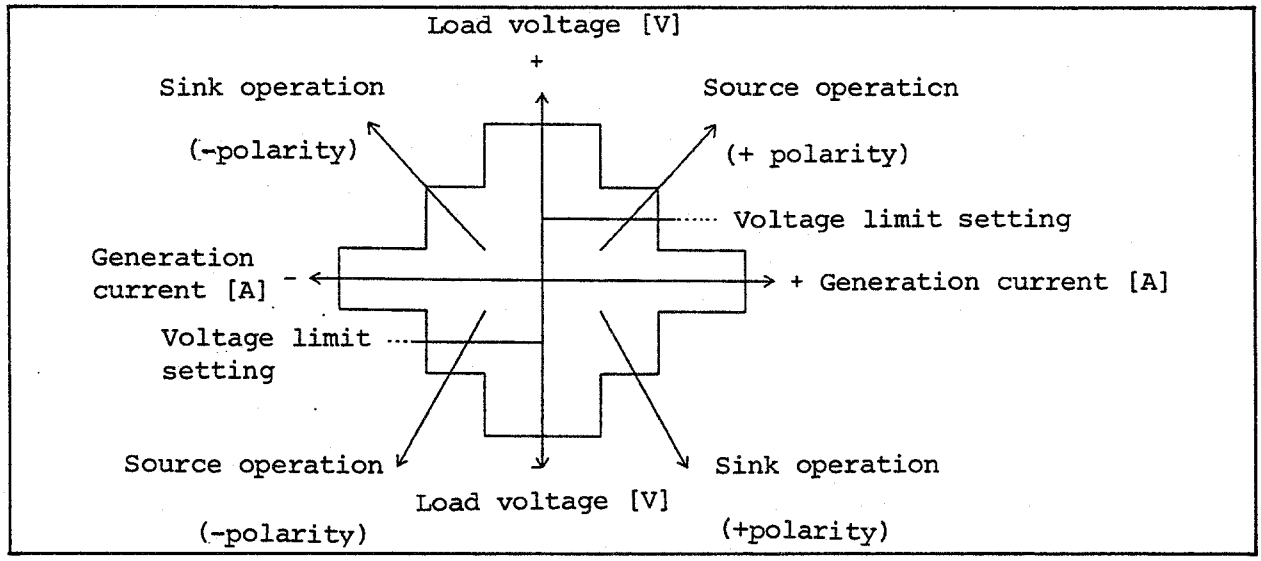


Figure 2-11 Current Generation and Voltage Limit

2.6.1 Current Generation

① Set the mode to ⎓ (DC) and V/I to "CURRENT".

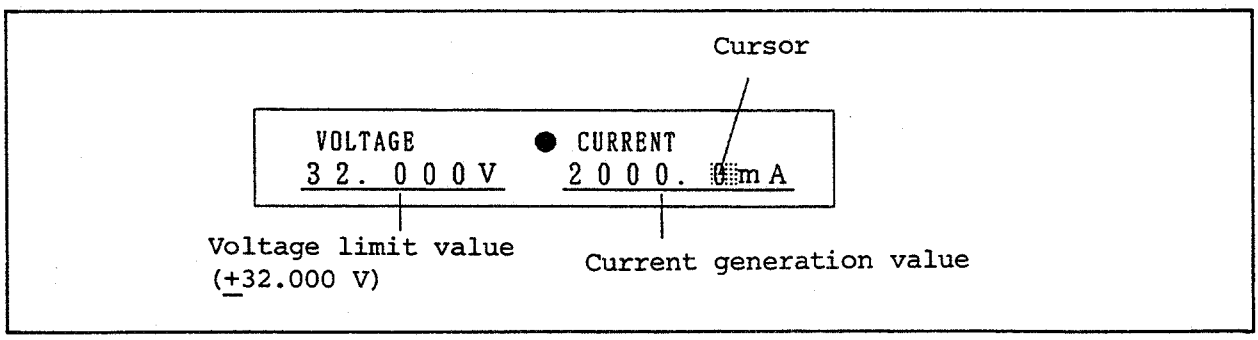


Figure 2-12 Display of Current Generation of Value

② Set a generation value using a dial operation or direct operation. (see 2.2.1 Numeric value setting.)

2.6.2 Voltage limit

① Turn the LIMIT lamp ON by pressing LIMIT and the device enters the limit setting mode.

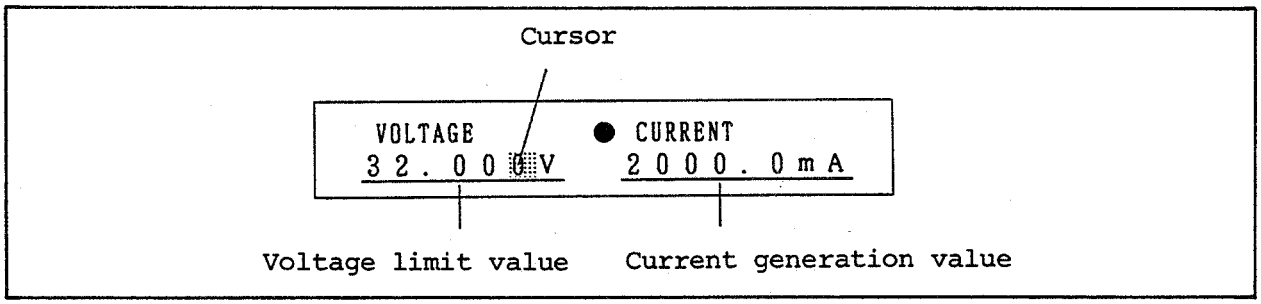


Figure 2-13 Display of Voltage Limit Value

② Set a limit value using a dial operation or direct operation. (see 2.2.1 Numeric value setting.)

③ Termination operation

Pressing LIMIT again extinguishes the LIMIT lamp and terminates the operation.

2.7 Zero Setting

(1) How to Set 0 V or 0 A

When the output is set to 0 V or 0 A b7 [0] being pressed, a lamp in this switch is turned ON.

(2) How to Release the Zero Setting

- Returns to the original set value if [+] or [−] is pressed. The polarity changes from [+], [−].
- Returns to the original set value if [0] is pressed again. But, the polarity does not changes.

2.8 Sampling Mode and Sampling Parameter

2.8.1 How to Set a Sampling Mode

Select a sampling mode (RUN or HOLD) by pressing RUN/HOLD .

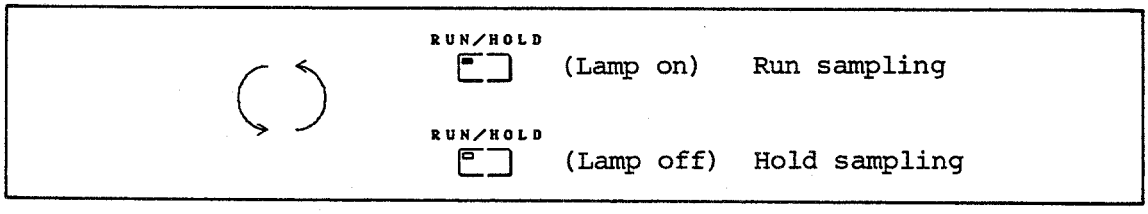
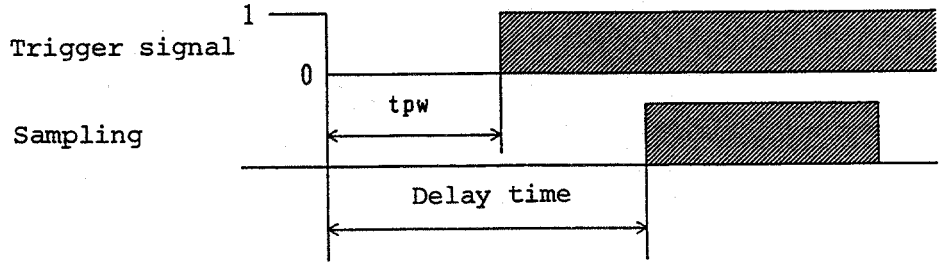


Figure 2-14 Sampling Mode Setting

2.8.2 HOLD Sampling Start

(1) Set the sampling mode to HOLD (RUN/HOLD lamp OFF), and press the TRIG switch.

(2) Set the sampling mode to HOLD, and apply a TRIGGER signal to the trigger input terminal on the rear panel.



SIGNAL SPECIFICATIONS

Trigger signal level	: TTL level
Trigger signal pulse width (tpw)	: 10 µsec or more
Sampling delay time (t_{DELAY})	: Delay time + measurement preparation time

See Appendix A.2 Control Input Output Circuit for details on input terminals.

2.8.3 Sampling Mode and Sampling Parameter

Table 2-5 shows the relationship between the sampling modes (RUN and HOLD) and sampling parameters.

Table 2-5 Relationship between Sampling Modes and Sampling Parameters

Sampling mode / Sampling parameter	RUN	HOLD
Delay time	x	o
Period time	o	x

x: parameter not related to operation
o: parameter related to operation

The operation state in each sampling mode is explained below using figures.

(1) RUN Mode

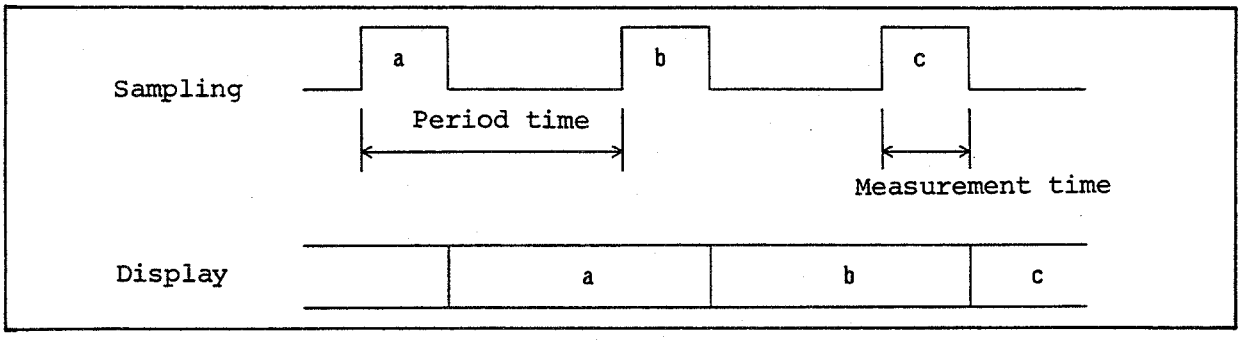


Figure 2-15 RUN Mode

Sampling is performed in cycles whose lengths are the period time.

If the period time is set to less than the integration time, the sampling cycle length becomes the integration time + CPU measurement operation time.

(2) HOLD Mode

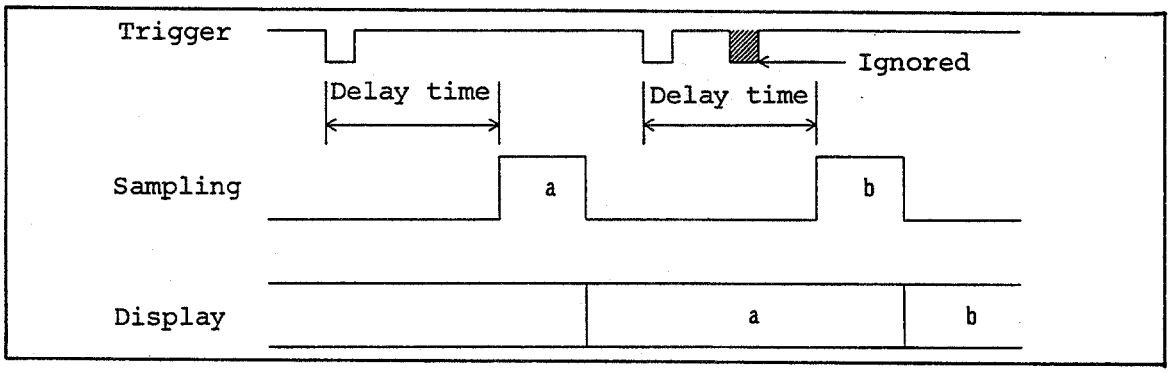


Figure 2-16 HOLD Mode

One sampling is performed for each trigger input. But if the next trigger is input before the sampling terminates, the trigger input will be ignored.

2.9 NULL

The TR6143 measures an input value using the NULL function when specified and considers the result as a NULL reference value. In the measurements thereafter, the results with this reference value subtracted can be used as measurement data.

Figure 2-17 shows an example of use.

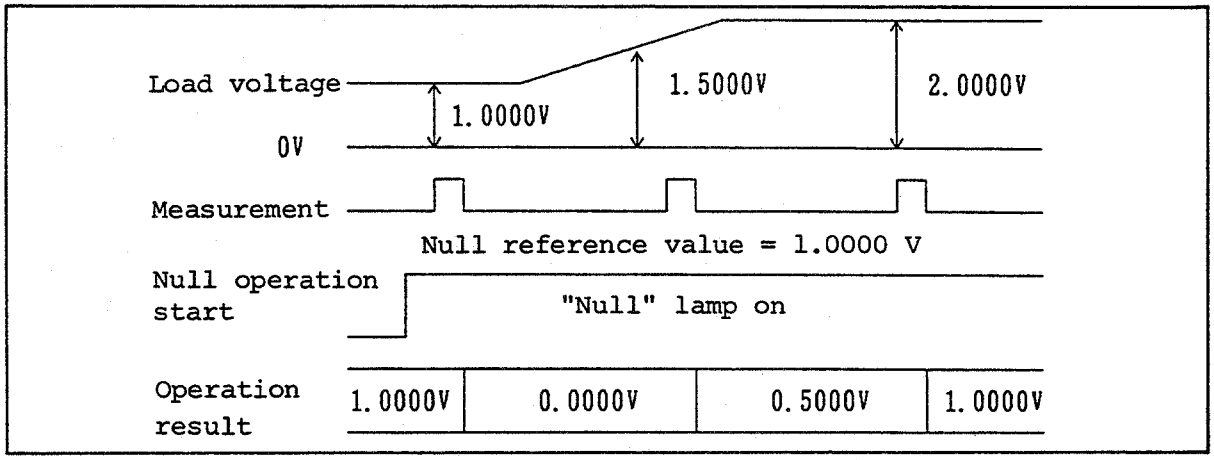


Figure 2-17 Example of Use of NULL Function

EXAMPLE OF OPERATION

Null (Lamp OFF).....Normal state

NULLED (Lamp ON) .....NULL operation state

3. MODE USEFUL FUNCTIONS

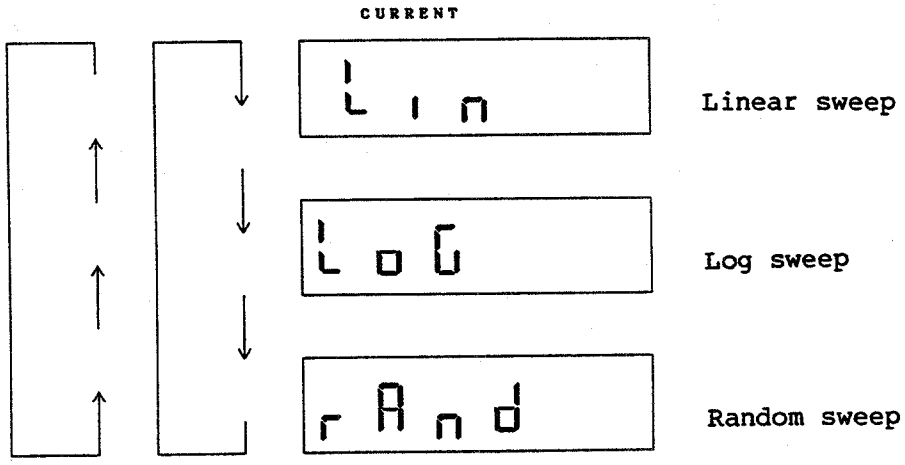
3.1 How to Use the Sweep Function

3.1.1 SWEEP: Linear/Log/Random Sweep Mode

VOLTAGE

Select  by pressing the second parameter switch

Select the sweep mode by turning the data knob.



(a) Linear sweep: Sweep in equally spaced steps

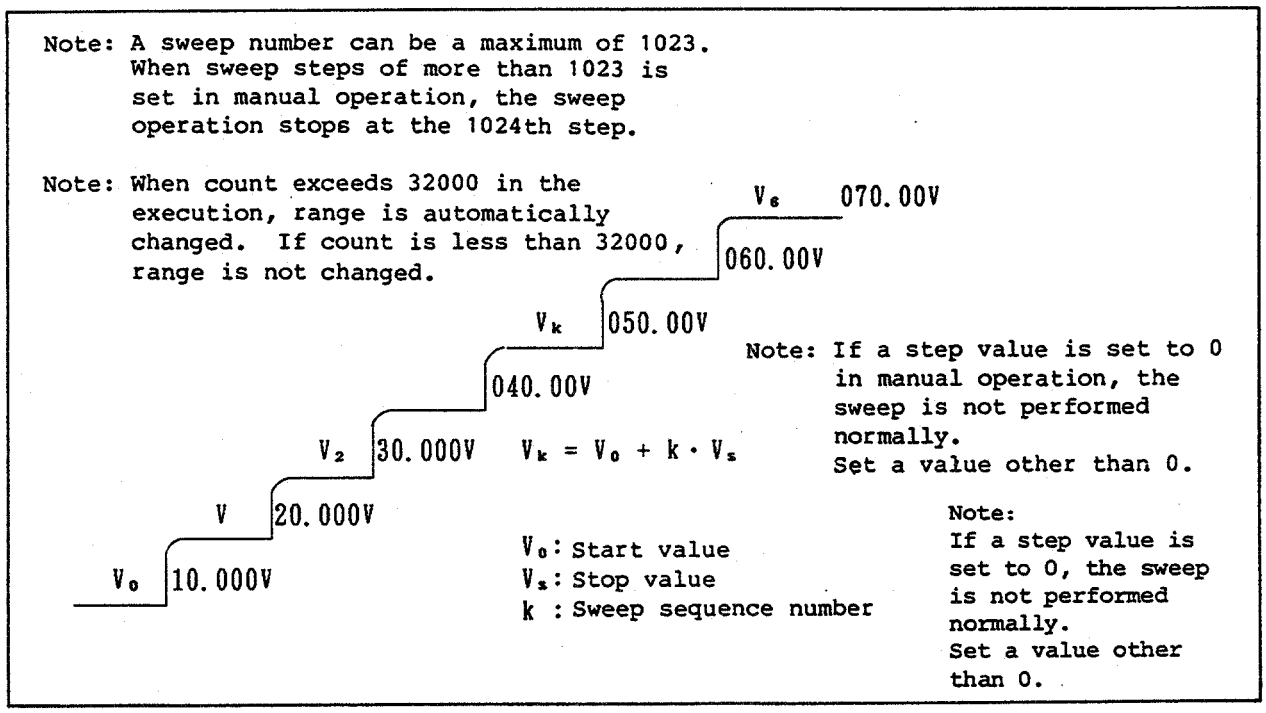


Figure 3-1 Linear Sweep

Figure 3-1 shows an example with a start value of 10 V, stop value of 70 V, step value of 10 V, and a general expression.

(b) Log sweep: Equally divided on a logarithm scale.

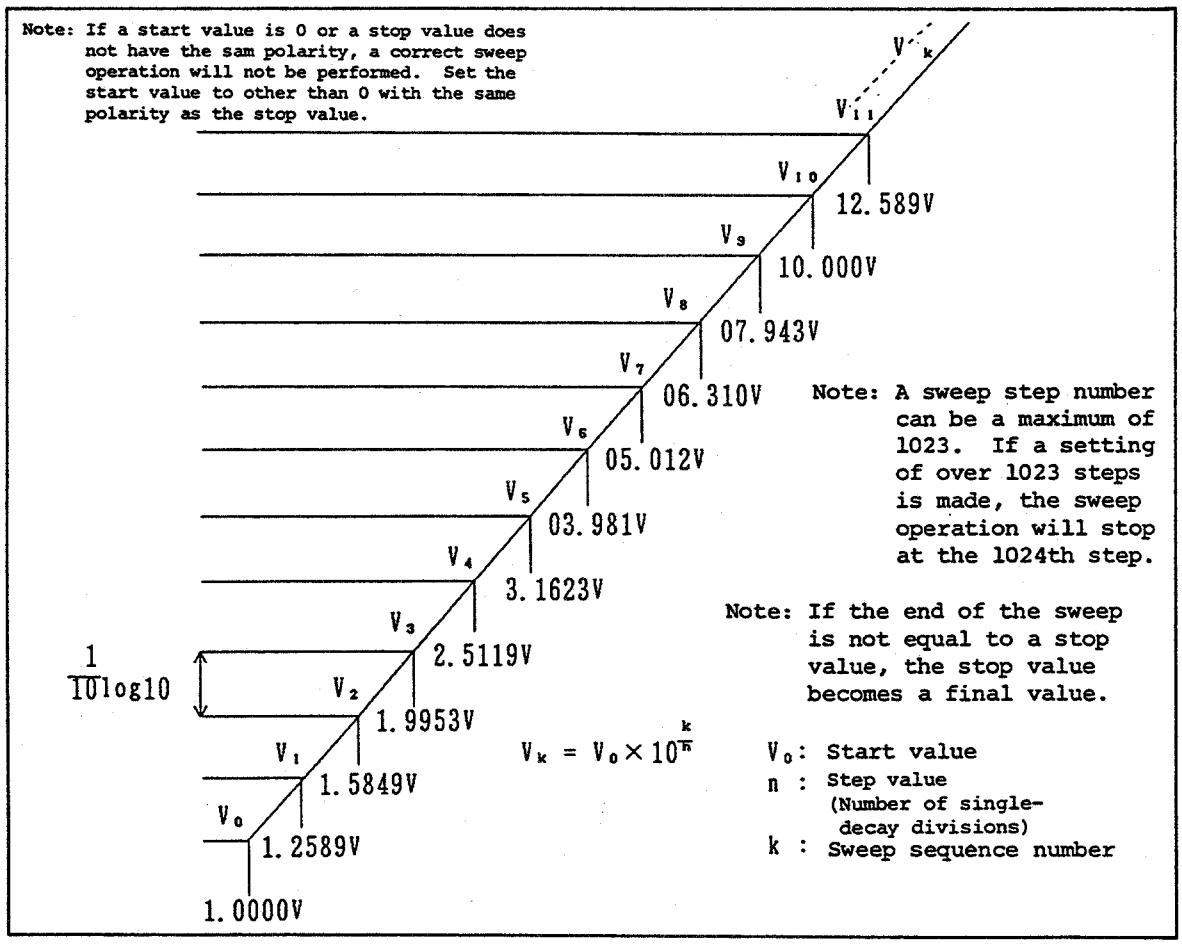


Figure 3-2 Log Sweep

Figure 3-2 shows a log sweep example with a start value of 1.0000 V, step value of 10, and a general expression.

(c) Random sweep: Generates preset data in the memory one item at a time.

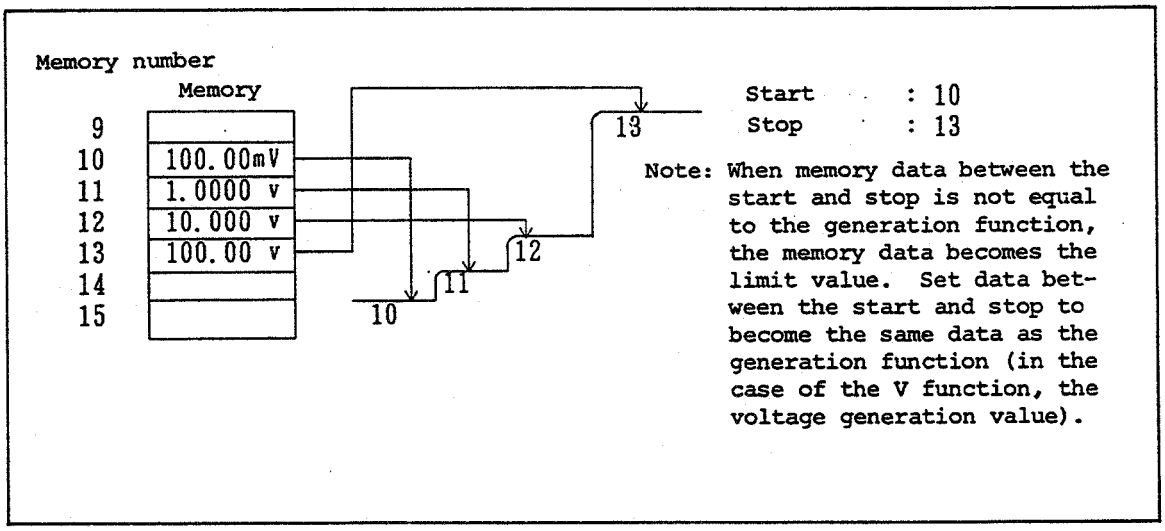
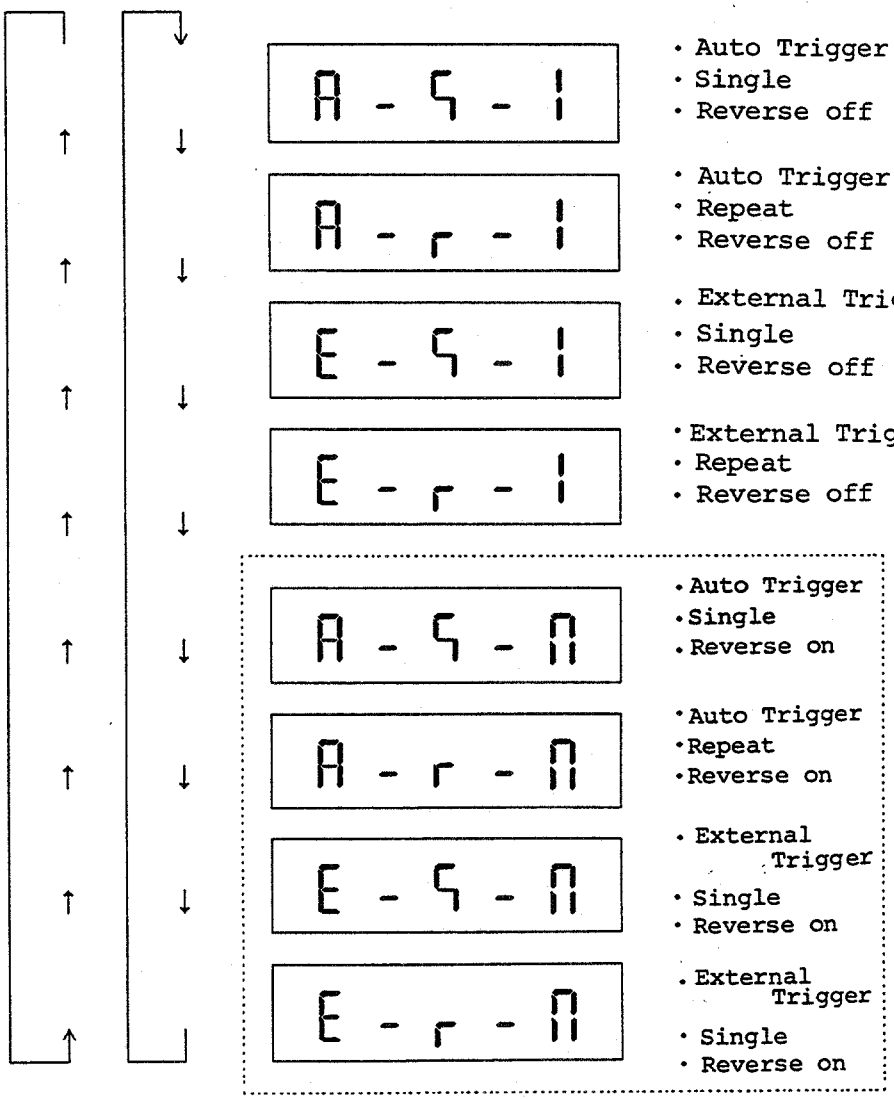


Figure 3-3 Random Sweep

3.1.2 SWEEP TRIG: Trigger Mode (Auto/External trigger, Single, Repeat, Reverse ON/OFF) and SYNC.OUT Output

Select  by pressing the second parameter switch  .

Select the Trigger mode by turning the data knob.



Note: When log sweep mode has been set, the setting in the above [ ] (Reverse on) cannot be made.

(a) Auto trigger and external trigger

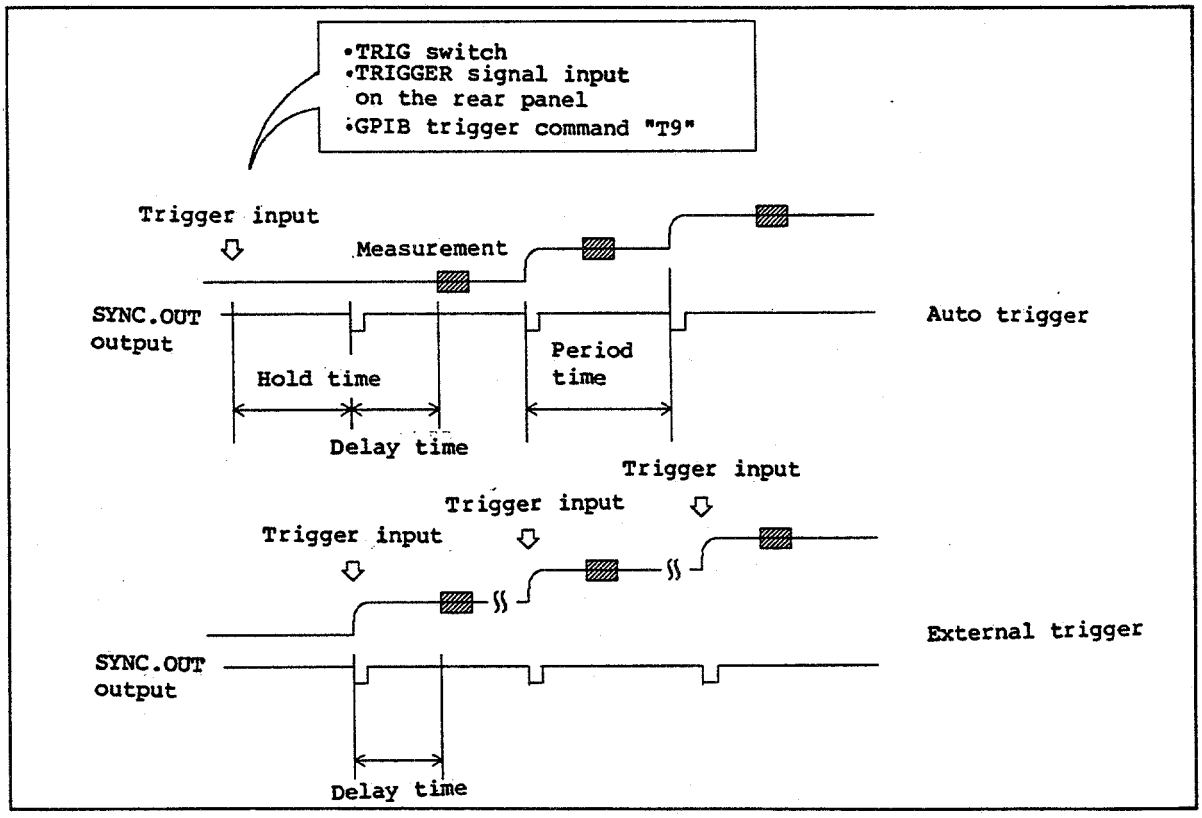


Figure 3-4 Auto Trigger and External Trigger

(b) Single mode and repeat mode

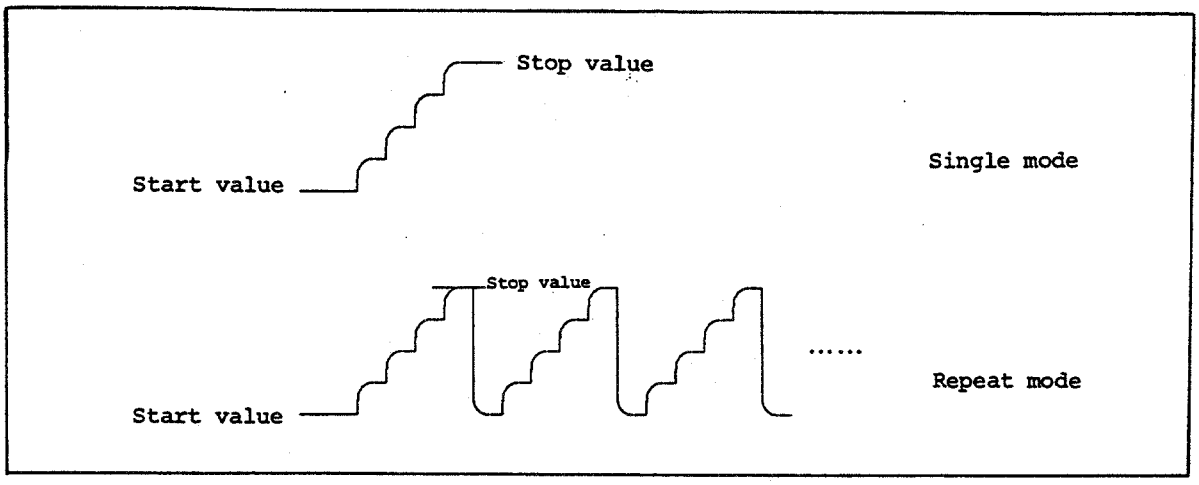


Figure 3-5 Single Mode and Repeat Mode

(c) Reverse Mode ON/OFF

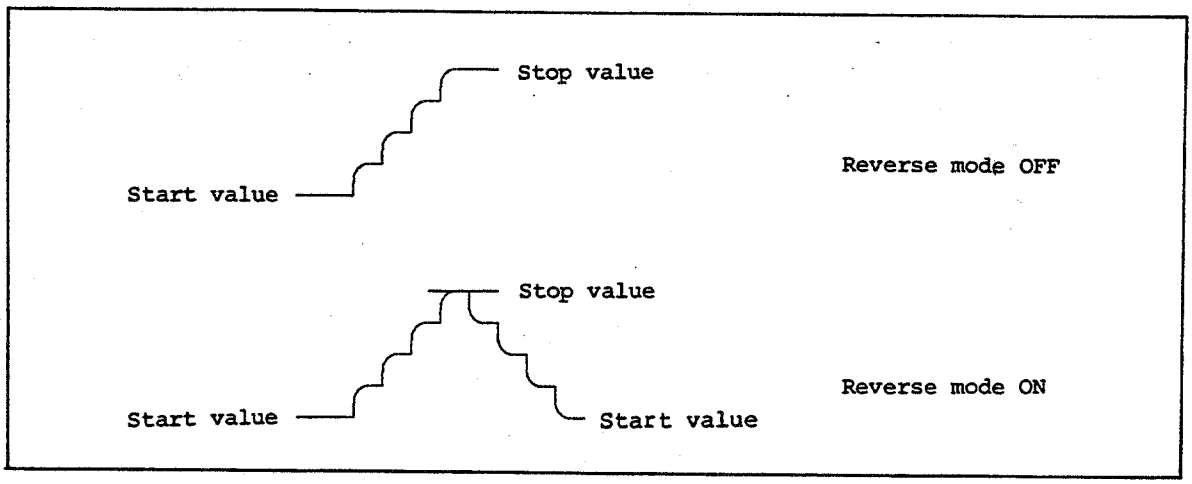


Figure 3-6 Reverse Mode ON/OFF

3.1.3 STATE/STOP/STEP : sweep start generation value/final generation value/sweep step value

Select a parameter by pressing the second parameter switch ☐ , and set by direct operation (see 2.2.1 Direct operation).

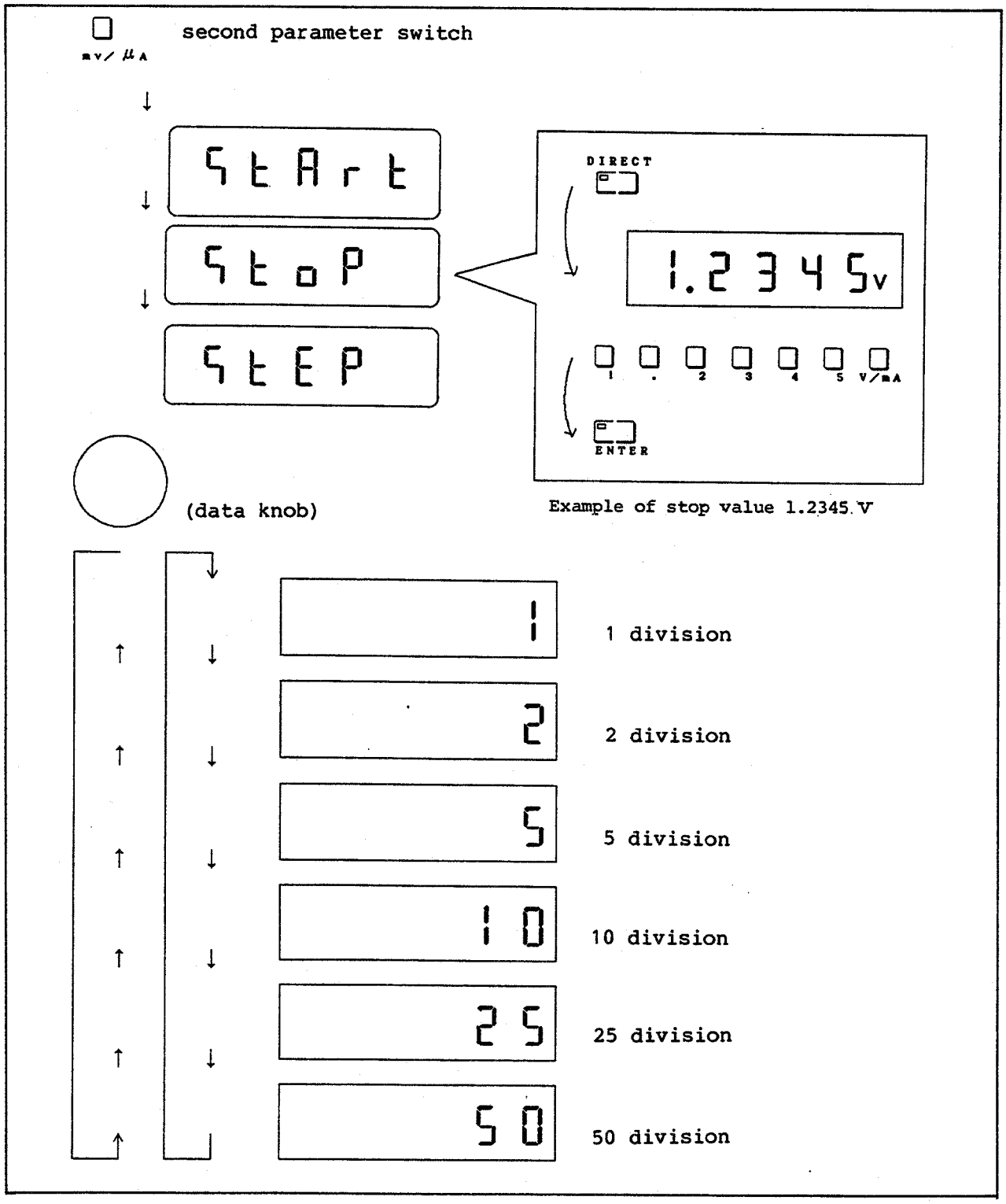


Figure 3-7 Setting of the Number of Single-decade Divisions in Log Sweeping

The correspondence between the sweep mode and parameters is shown in Table 3-1.

Table 3-1 Correspondence between Sweep Mode and Parameters

	Linear sweep	Log sweep	Random sweep
StArt	Start value (*1)	Start value (*1)	
StoP	Stop value (*1)	Stop value (*1)	
StEP	Step value (*1)	Number of single-decade divisions (*2)	
St-CH			Start address (*3)
SP-CH			Stop address (*3)

Number of single-decade divisions: Number of the measurement points from start value to progress of one decade.

*1: Set the start value, stop value, and step value with direct operation. Each parameter is stored for each VOLTAGE and CURRENT function.

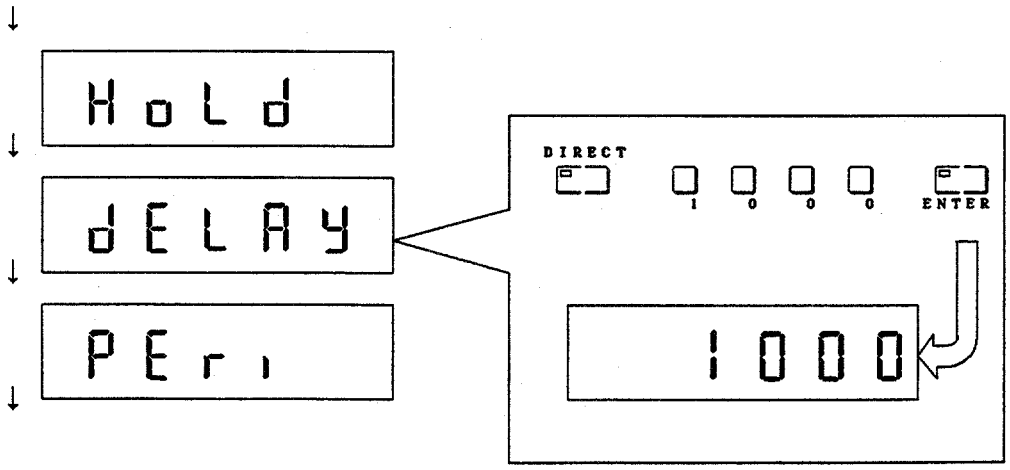
*2: Set the number of single-decade division by turning the data knob.

*3: Set the start address and stop address by turning the data knob. The setting range is 000 to 499.

3.1.4 HOLD/DELAY/PERIOD : From trigger input to sweep step (hold time)/from sweep step to measurement start, or from trigger input to measurement start (delay time)/Auto sweep cycle, or free run measurement cycle (period time)

Select a parameter by pressing the second parameter switch ☐ mV/μA, and set by direct operation (see 2.2.1 Direct operation).

☐ mV/μA Second parameter switch



Example of setting delay time of 1 sec.

The correspondence between modes and parameters is shown in Table 3-2.

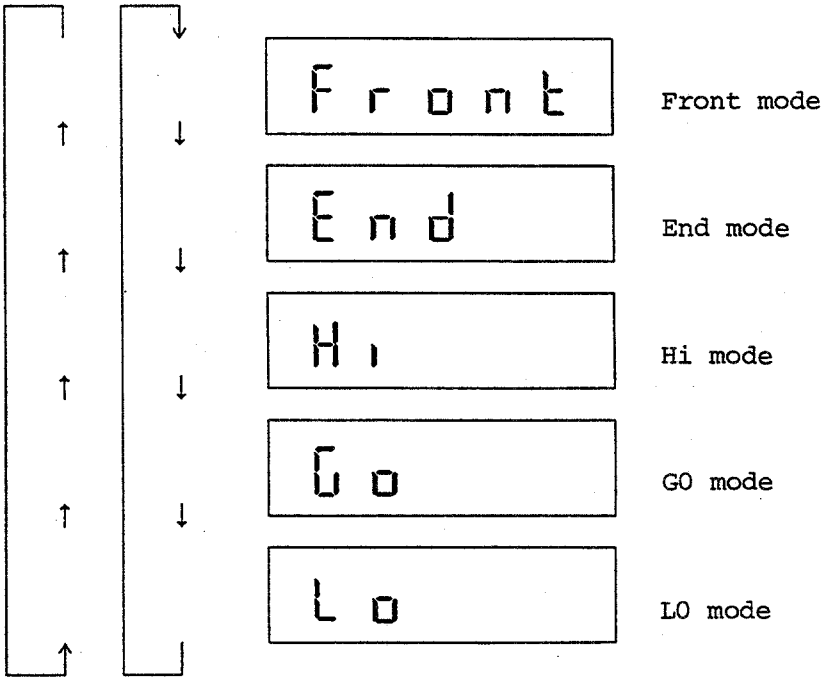
Table 3-2 Correspondence between Modes and Time Parameters

	Sweep mode	DC mode
HoLd	From trigger input to sweep step	-
dELAy	From sweep step to measurement start	From trigger input to measurement start
PEr1	Sweep step cycle	Free run measurement cycle

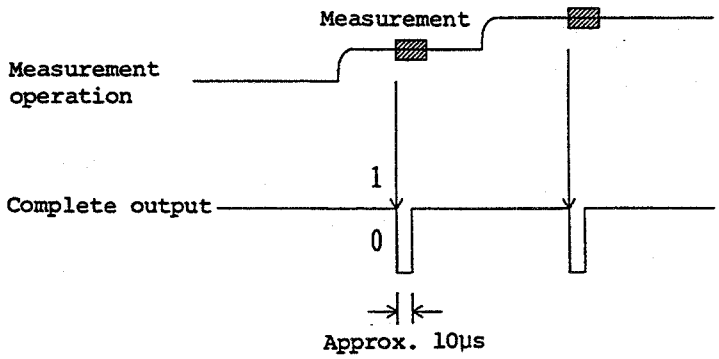
3.2 COMPLETE : External Control Output Mode (FRONT/END/HI/GO/LO)

Select  by pressing the second parameter switch

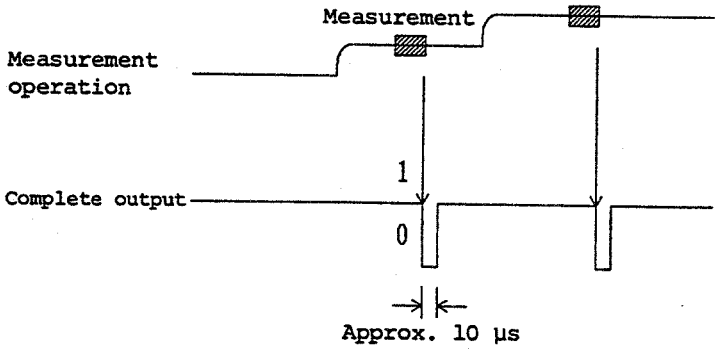
Select an external control output mode by turning the data knob.



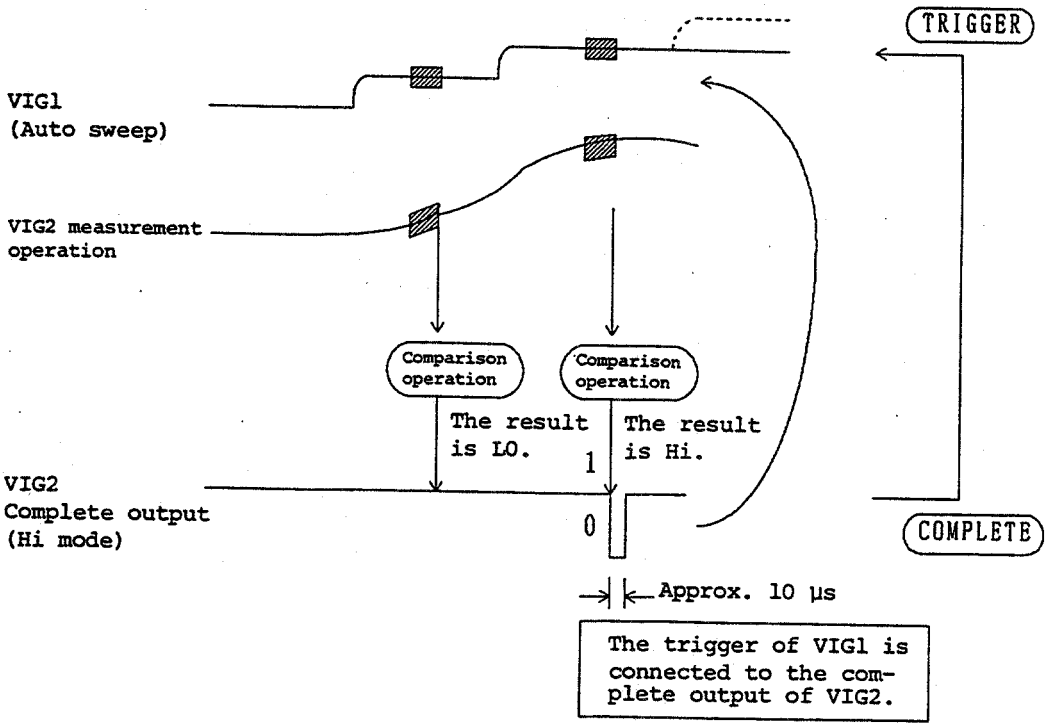
(a) Front mode: Output a measurement start signal to external DVM.



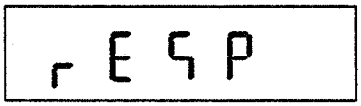
(b) End mode: Output a measurement end signal to an external instrument.



(c) HI/GO/LO mode: Using two or more of the TR6143, output control signals which stop the other TR6143 according to the result of the comparison operation.

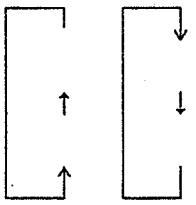


3.3 RESPONSE : Output Response and Load Capacitance and Noise selection. (FAST/SLOW)

Select  by pressing the first parameter switch

.

Select a mode by turning the data knob.

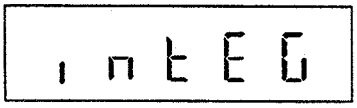


Fast lamp on

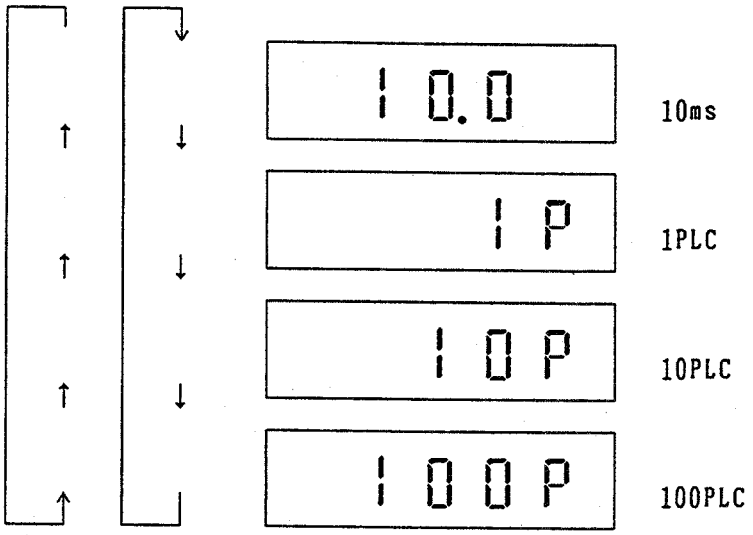
Slow lamp on

To set a output response time to SLOW can magnify a limit of the load capacitance and reduce noise. Refer to "7. SPECIFICATION" for output response time, load capacitance and noise.)

3.4 I.T : Setting of A/D Converter Input Signal Integration Time

Select  by pressing the first parameter switch  .

Select an integration time by turning the data knob.



An integration time giving a good measurement accuracy, noise rejection ratio, and measurement speed can be selected between 10 ms and 100 PLC.

PLC is an abbreviation of Power Line Cycle, the length of one cycle of the alternating current power source. 1 PLC = 20 ms at 50 Hz, and approx. 16.667 ms at 60 Hz.

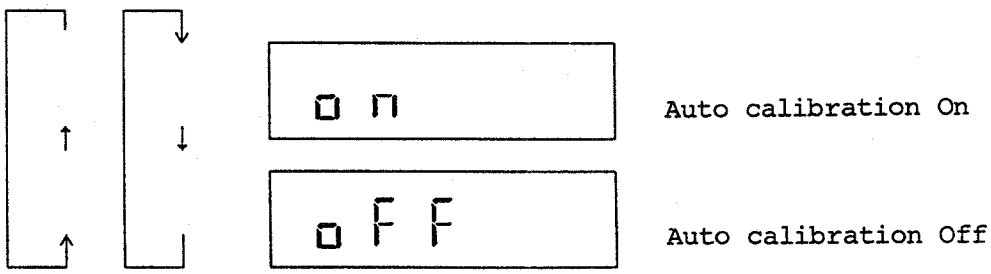
See 3.11. Line frequency for the power frequency.

Note: If the integration time is changed during RUN sampling measurement, measured data right after the change may not be correct. An integration time setting should be performed before starting the measurement operation.

3.5 A.CAL : Auto Calibration ON/OFF

Select  by pressing the first parameter switch  .

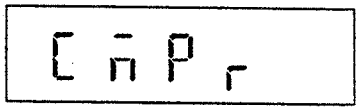
Set auto calibration to ON/OFF by turning the data knob.



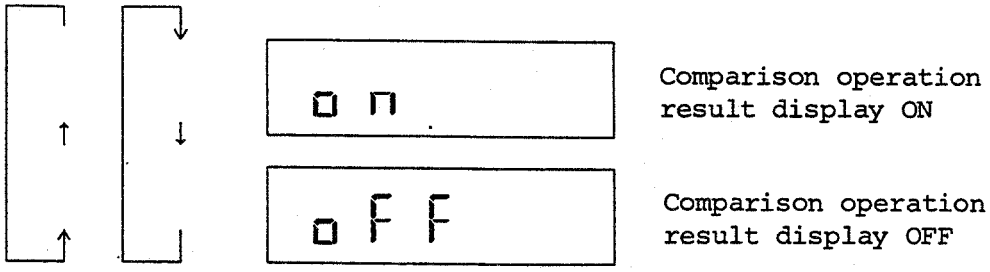
If auto calibration is set to ON, a gain correction and zero correction for the measuring system is set at intervals of 5 sec. on the basis of an internal reference voltage.

Auto calibration is not performed during a sweep mode setting.

3.6 CMPR : ON/OFF Setting of Comparison Operation Result Display (HI/GO/LO)

Select  by pressing the first parameter switch  .

Set the comparison operation result ON/OFF by turning the data knob.



The comparison operation result and its display are shown in Table 3-3.

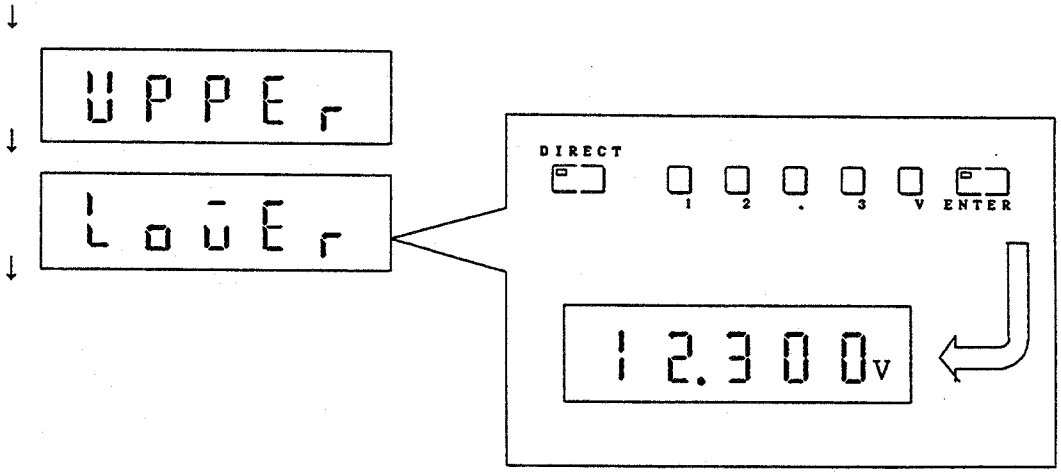
Table 3-3 Comparison Operation Result and Display

Operation result	Display
Measurement value > Upper limit value	HI
Upper limit value ≧ Measured value ≧ Lower limit value	GO
Measured value < Lower limit value	LO

3.7 UPPER/LOWER : Setting of Comparison Upper Limit Value/Comparison Lower Limit Value

Select a parameter by pressing the first parameter switch V/mA and set using a direct operation (see 2.2.1 Direct operation).

V/mA First parameter switch



Example of setting lower limit value of 12.3 V.

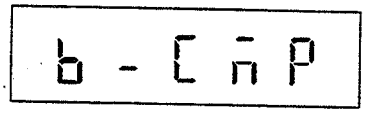
The relationship between the functions and parameters is shown in Table 3-4.

Table 3-4 Functions and Comparison Upper/Lower Limit Parameters

	VOLTAGE function	CURRENT function
UPPEr	Comparison upper limit current value	Comparison upper limit voltage value
LouEr	Comparison lower limit current value	Comparison lower limit voltage value

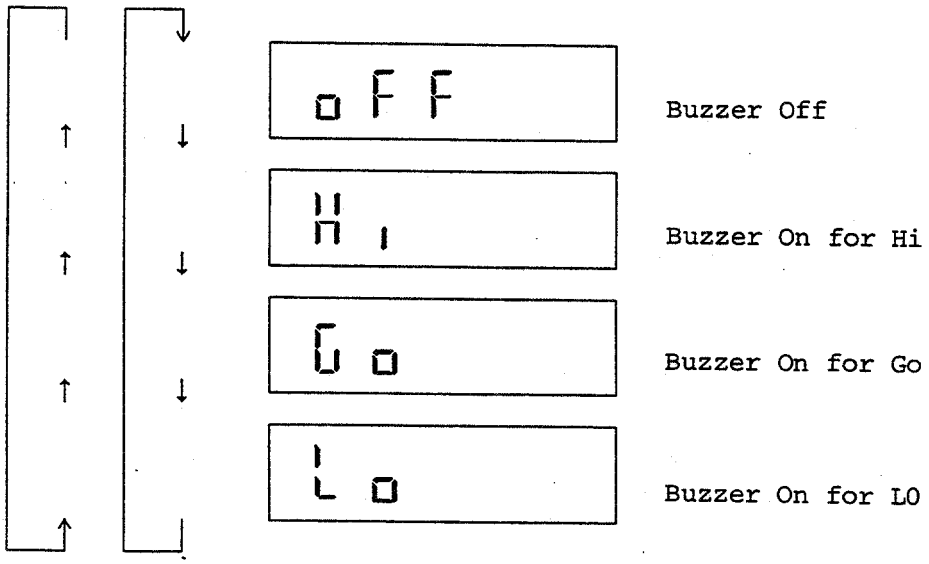
Note: A comparison upper limit value and a comparison lower limit value are kept for each function.

3.8 BUZZ (CMPR) : Setting of Buzzer Conditions by Comparison Operation Results (OFF/HI/GO/LO)

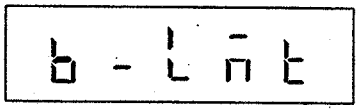
Select  by pressing the first parameter switch

.

Select a buzzer condition by turning the data knob.

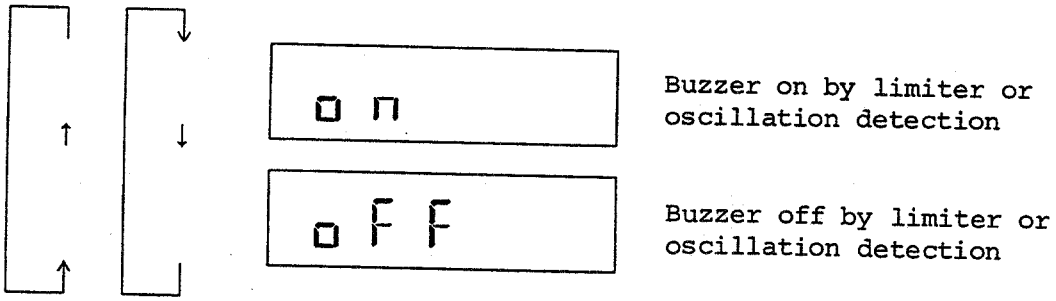


3.9 BUZZ (LIMIT) : Buzzer ON/OFF Setting by a Limiter or Oscillation Detection

Select  by pressing the first parameter switch 

.

Select a buzzer ON/OFF by turning the data knob.



Buzzer on by limiter or oscillation detection

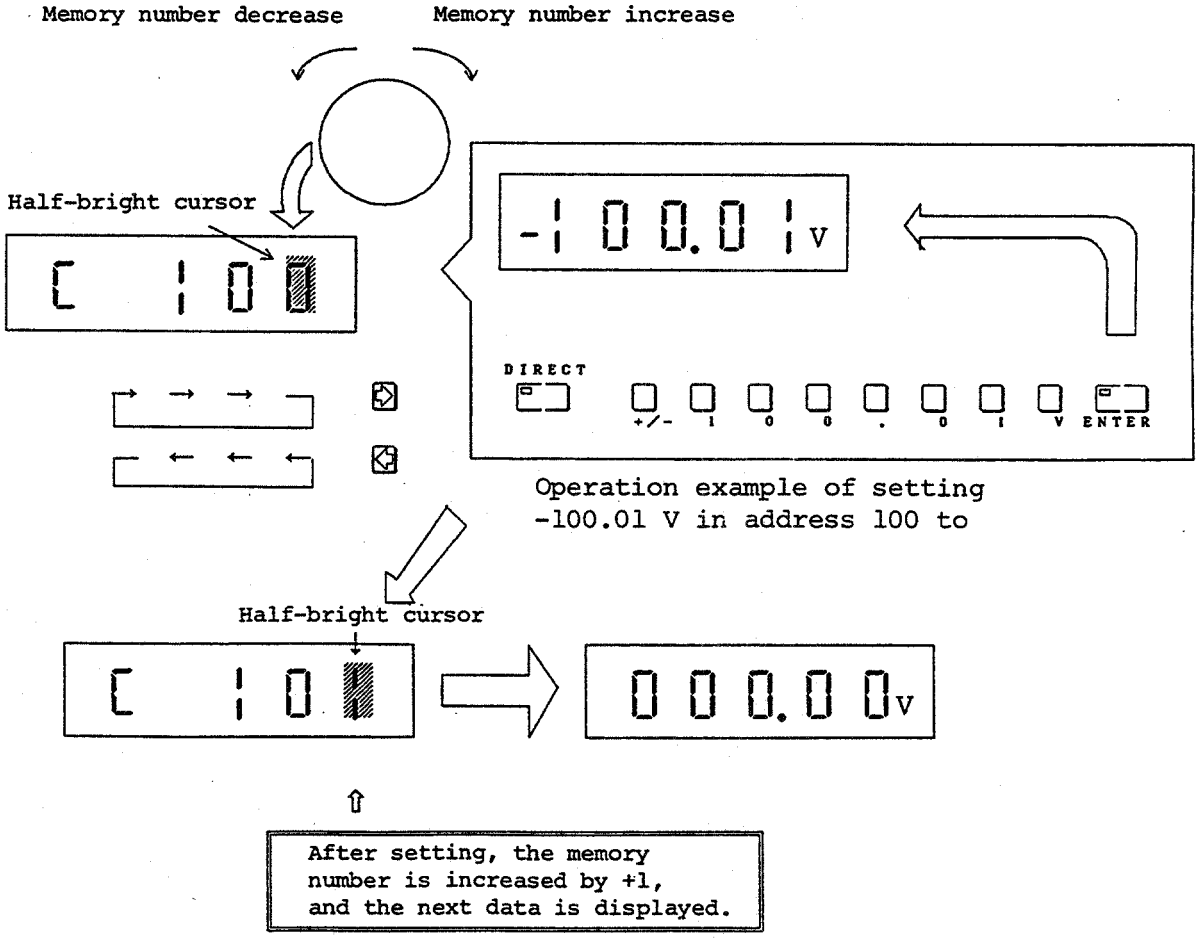
Buzzer off by limiter or oscillation detection

3.10 MEMORY : Input and Update Random Sweep Data to Memory

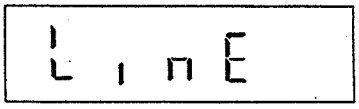
① Select the random sweep data function (VOLTAGE or CURRENT) using the V/I switch.

② Select [000] by pressing the third parameter switch CE.

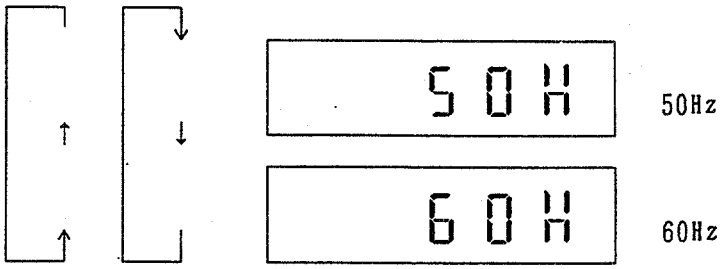
Set a memory number using ◁, ▷, and the data knob, and set using a direct operation (see 2.2.1 Direct operation).



3.11 LINE FREQUENCY : Operating Power Frequency Setting (50 Hz/60 Hz)

Select  by pressing the first parameter switch CE.

Select an operating power frequency by turning the data knob.



If the operating power frequency is changed, the integration time (1 PLC to 100 PLC) is recalculated. (see 3.4 I.T.)

4. APPLICATIONS

4.1 Example of Connection to R12701 or TR7101

The method of connecting the two TR6143s and the R12701 is shown in Figure 4-1.

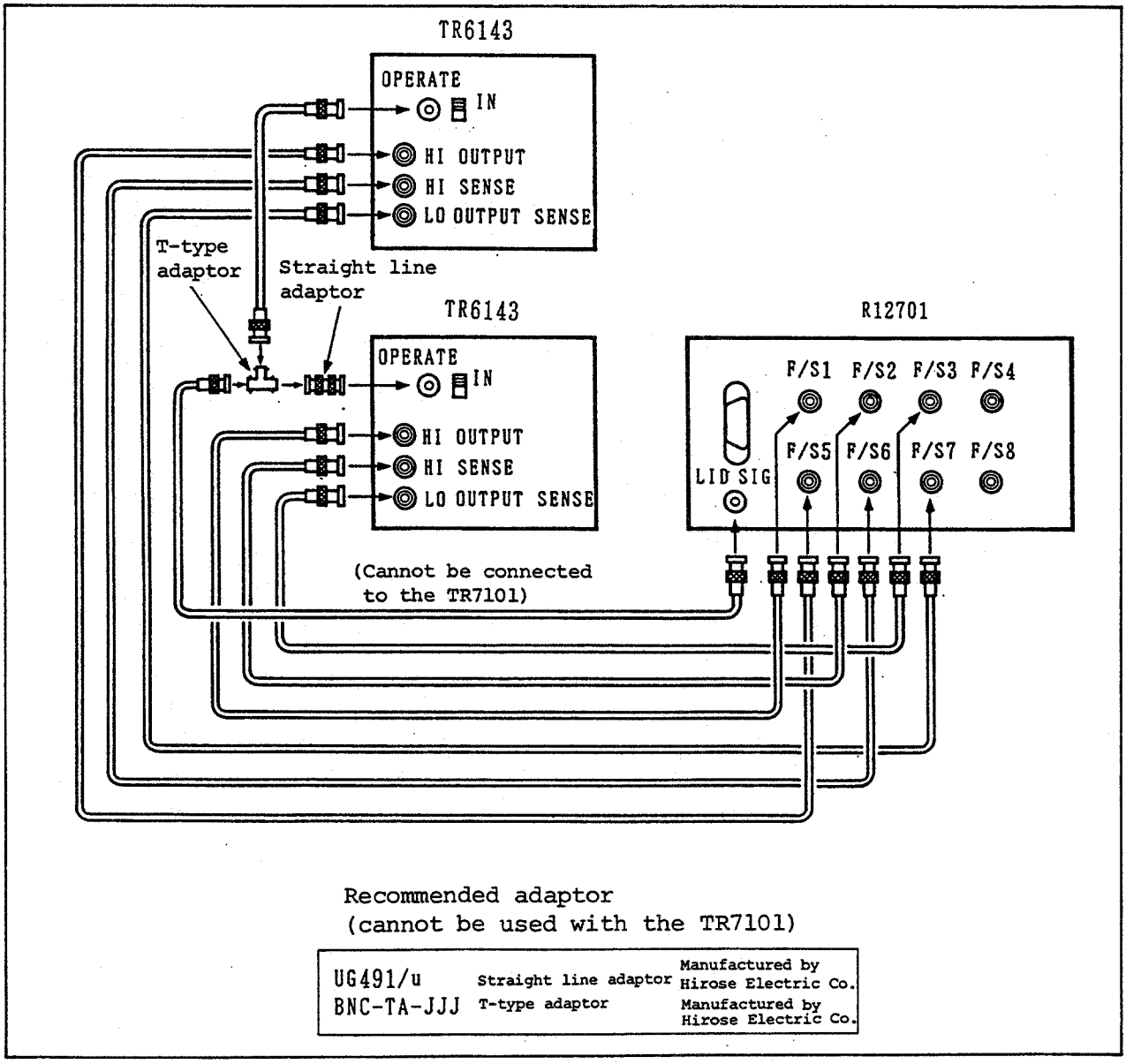
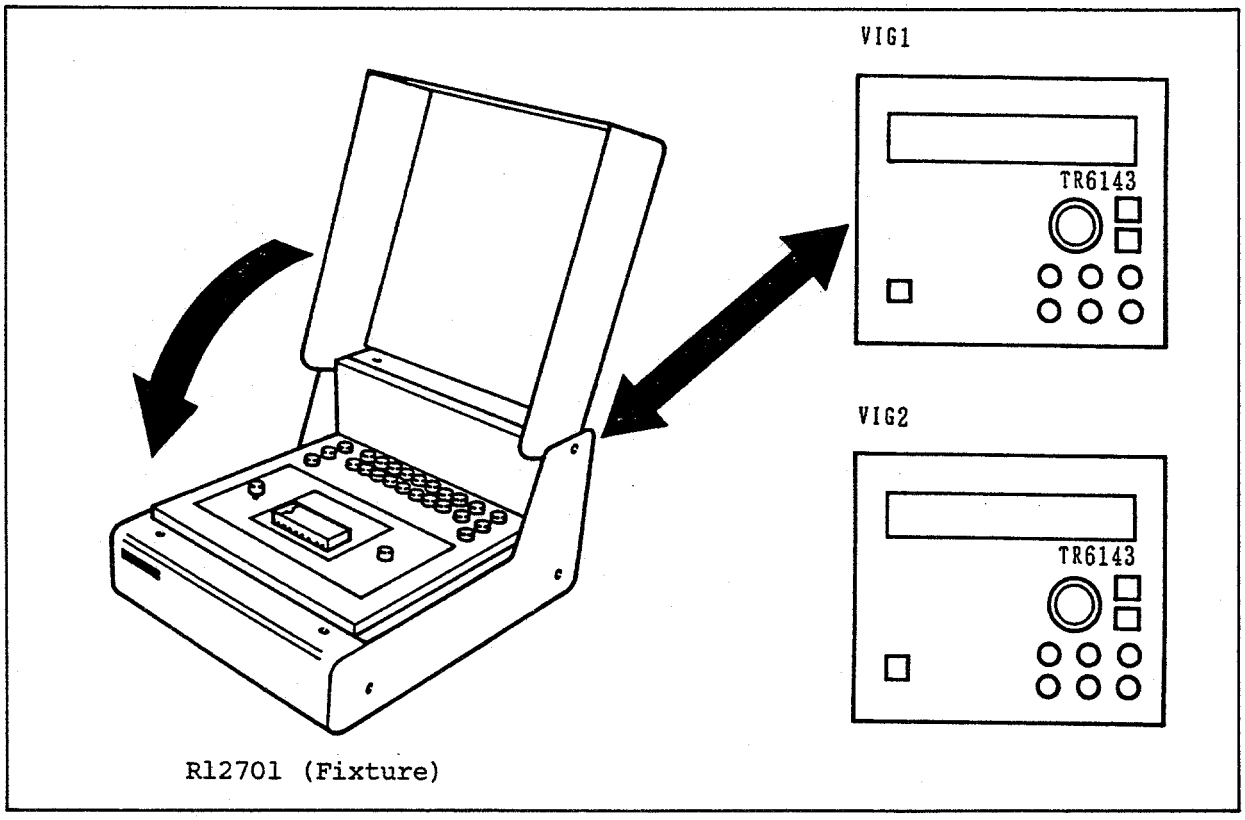


Figure 4-1 Example of Connection with Fixture

Note 1: As Figure 4-1 is a connection example, refer to the instruction manuals for the fixtures for the actual connections.

2: The output of the TR6143 is shown as a four-terminal connection (see 2.3 Cable connection).

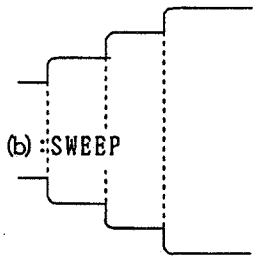
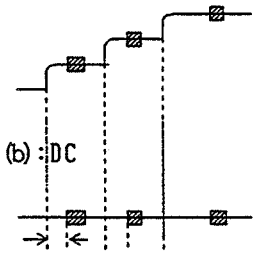
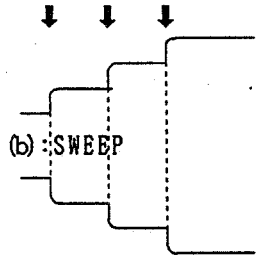


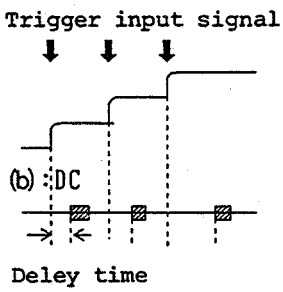
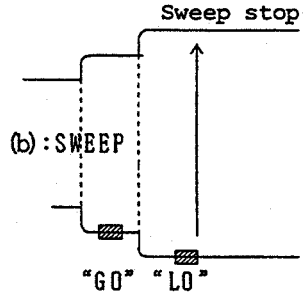
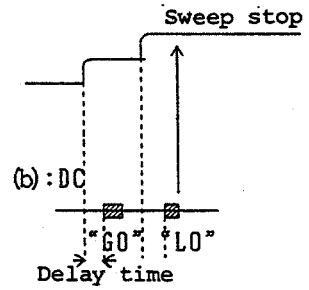
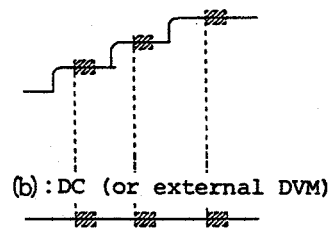
HOW TO USE IT

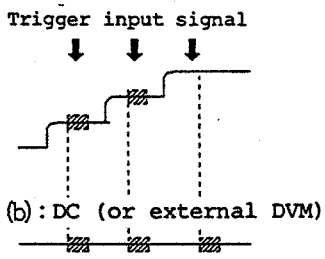
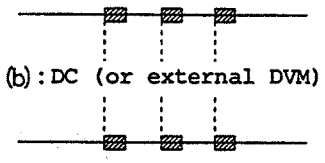
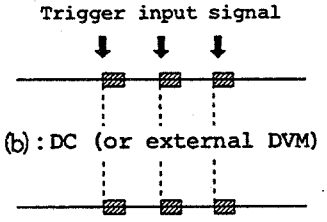
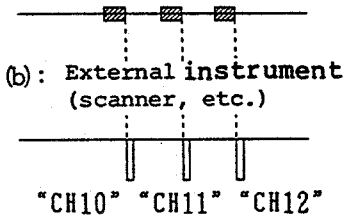
① Set VIG1 and VIG2.
② Connect materials.
③ Close the fixture lid.
④ Set the OPERATE switches of VIG1 and VIG2 to ON. (Voltage/current is applied.)
⑤ When the lid is opened, the voltage/current turns OFF (R12701 only).

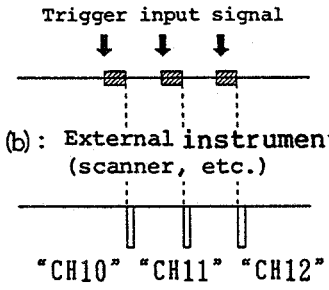
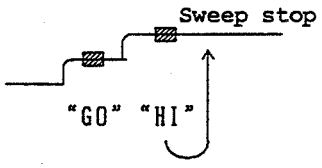
4.2 How to Combine a Variety of Synchronous Operations

Examples are given here of the connection and setting mode when a synchronous operation is performed using a combination of two TR6143s ((a) and (b)) or an external DVM, or an external instrument (scanner, etc.).

	Waveform and mode	Connection	Trigger mode (Sampling mode)	External control output mode
(1)	(a): SWEEP  	SYNC. OUT ← TRIGGER ←	Auto	
			External	
(2)	(a): SWEEP  Delay time	SYNC. OUT ← TRIGGER ←	Auto	
			(HOLD)	
(3)	(a): SWEEP Trigger input signal  	(Trigger input signal) ← TRIGGER ←	External	
		SYNC. OUT ← TRIGGER ←	External	

	Waveform and mode	Connection	Trigger mode (Sampling mode)	External control output mode
(4)	(a): SWEEP  	(Trigger input signal) TRIGGER	External	
		SYNC. OUT TRIGGER	(HOLD)	
(5)	(a): SWEEP  	SYNC. OUT TRIGGER TRIGGER COMPLETE	Auto	
			External	LO (Outputs a control signal when the result of a comparison operation is "LO".)
(6)	(a): SWEEP  	SYNC. OUT TRIGGER TRIGGER COMPLETE	Auto	
			(HOLD)	LO
(7)	(a): SWEEP  	COMPLETE TRIGGER	Auto	FRONT
			(HOLD)	

	Waveform and mode	Connection	Trigger mode (Sampling mode)	External control output mode
(8)	(a): SWEEP  	(Trigger input signal) TRIGGER COMPLETE TRIGGER	External	FRONT
			(HOLD)	
(9)	(a): DC  	COMPLETE TRIGGER	(RUN)	FRONT
			(HOLD)	
(10)	(a): DC  	(Trigger input signal) TRIGGER COMPLETE TRIGGER	(HOLD)	FRONT
			(HOLD)	
(11)	(a): DC  	COMPLETE CH step-up input	(RUN)	END

<table>
<tr><th></th><th>Waveform and mode</th><th>Connection</th><th>Trigger mode
(Sampling mode)</th><th>External control
output mode</th></tr>
<tr><td rowspan="2">(12)</td><td rowspan="2">(a): DC
 
</td><td rowspan="2">(Trigger input signal)
TRIGGER
COMPLETE
CH step-up input</td><td>(HOLD)</td><td>END</td></tr>
<tr><td></td><td></td></tr>
<tr><td>(13)</td><td>(a): SWEEP
 
</td><td>TRIGGER
COMPLETE</td><td>Auto</td><td>HI
(Stops sweep when the result of a comparison operation is "HI".)</td></tr>
<tr><td colspan="3"></td><td colspan="2">Set the period time to more than (delay time + integral time + 20 ms) to stop sweep at the "HI" step.</td></tr>
</table>

5. GPIB CONNECTION AND PROGRAMMING

5.1 Outline

The TR6143 can be connected to measuring bus GPIB (General Purpose Interface Bus) with IEEE Specification 488-1978 via the supplied GPIB interface.

This chapter describes the specifications, functions, and programming of the GPIB interface.

5.2 Outline of GPIB

The GPIB is an interface system used to connect measuring instruments to controllers and peripheral devices with a simple cable (bus line). Compared with conventional interface methods, it can be easily expanded, is easy to use, and is compatible with products from other manufactures. Thus, with one line of bus cable, not only simple systems but also automatic measurement systems with high performance can be created.

In the GPIB system, the "address" of each component device connected to a bus line must be set first. These devices can perform one or more of the three roles - controller, talker, and listener.

While the system is operating, only one talker can send data to the bus line and more than one listener can receive the data. The controller transfers data from a talker to a listener by specifying the addresses of the talker and listener, and the controller itself (in this case, the talker) sets the measurement conditions for a listener.

Eight bit parallel byte serial data lines are used for data transfer between devices. Data is transmitted in full duplex asynchronously. Because the system is asynchronous both high and speed devices can be connected in any combination.

Data (messages) sent and received between devices includes measured data, measurement conditions (programs), and many kinds of commands. ASCII code is used.

The GPIB has three handshake lines for controlling the sending and receiving of asynchronous data between devices and five control lines for controlling the information flow on the bus besides the eight data lines previously described.

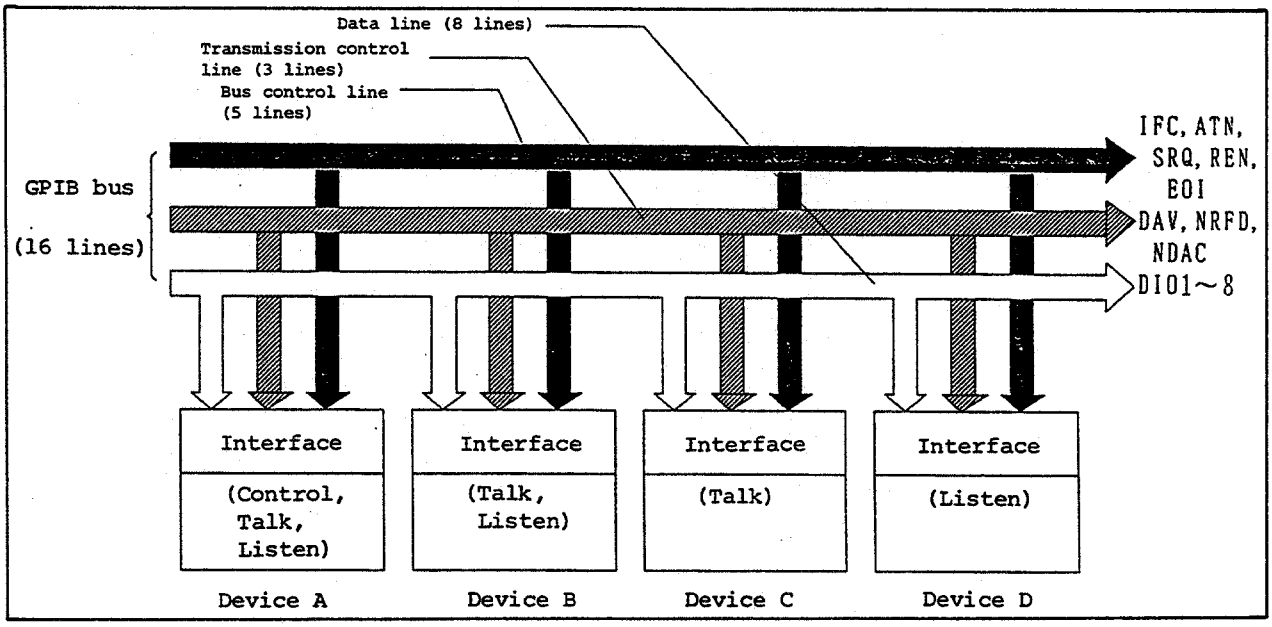


Figure 5-1 Outline of GPIB

o The following signals are used for the handshake line:

DAV (Data Valid)	Signal that indicates the validity of data
NRFD (Not Ready For Data)	Signal that indicates "ready to receive data"
NDAC (Not Data Accepted)	Signal that indicates that reception is complete

o The following signals are used for the control line:

ATN (Attention)	Signal used to identify signals on the data line as an address, command, or other information.
IFC (Interface Identify)	Signal to clear the interface
EOI (End or Identify)	Signal used when information transfer is terminated
SRQ (Service Request)	Signal used to request service from any device to the controller
REN (Remote Enable)	Signal used to remotely control a remote programmable device

5.3 Specification

5.3.1 GPIB Specification

Specification complied with	:	IEEE Specification 488-1978
Code used	:	ASCII code, but binary code for packed format
Logic level	:	Logic 0 High state +2.4 V or more Logic 1 Low state +0.4 V or less
Termination of a signal line	:	The 16 bus lines are terminated as follows:

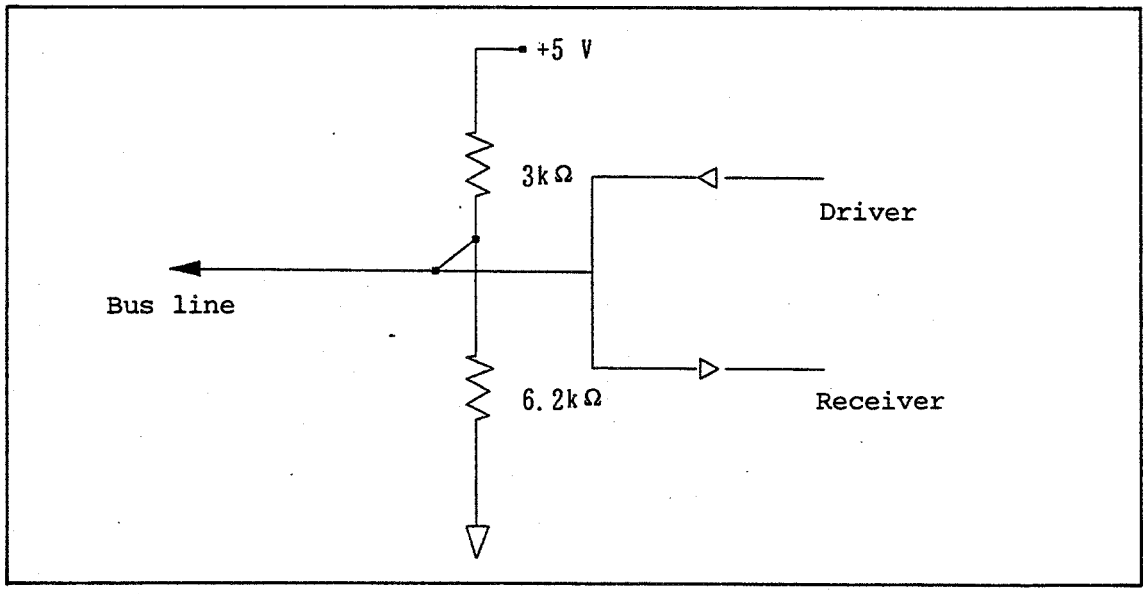
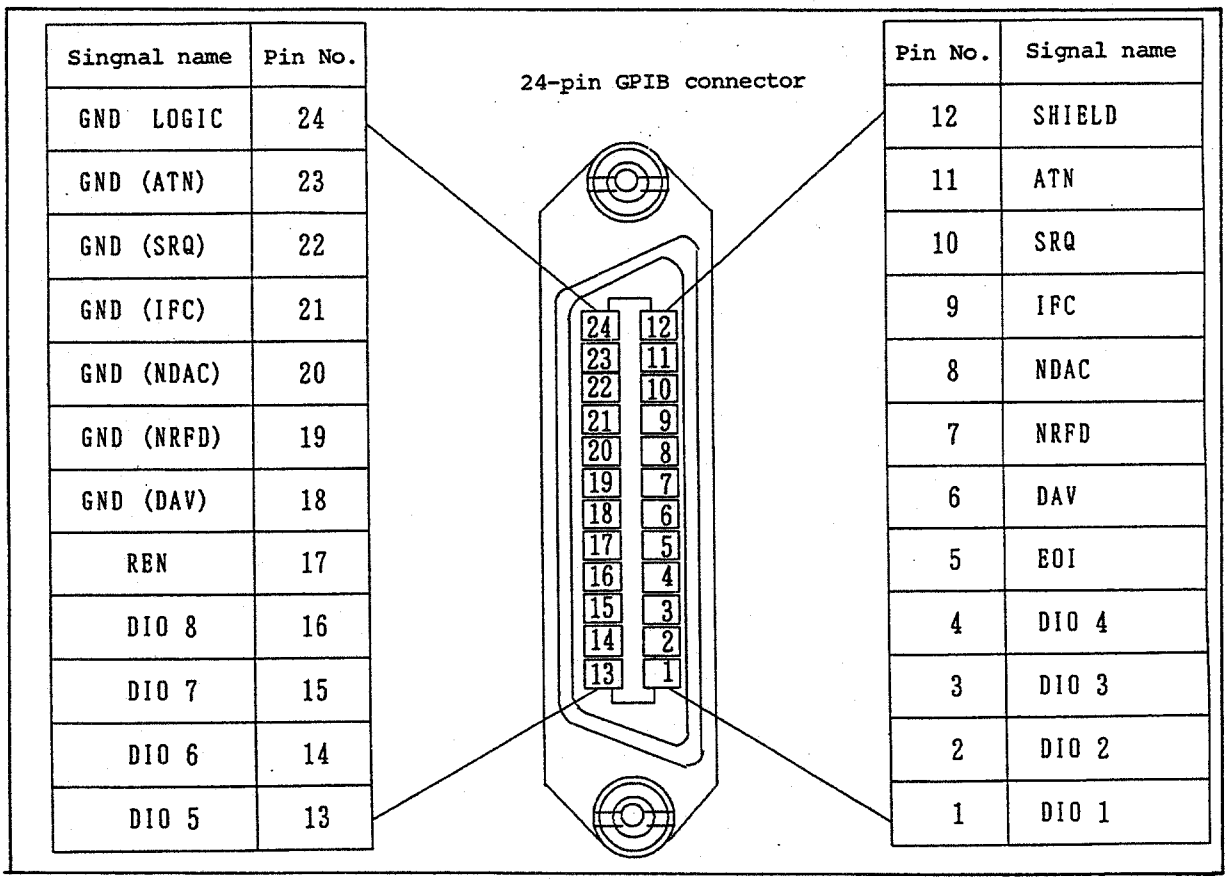


Figure 5-2 Termination of Signal Line

Driver specification	:	Open-collector type Low state output: +0.4 V or less, 48 mA High state output: +2.4 V or more, -5.2 mA
Receiver specification	:	Low state at +0.6 V or less High state at +2.0 V or more
Length of bus cable	:	The length of each cable is to be less than 4 m, and for the total length of all bus cables should not be more than 20 m.

Address setting : 31 kinds of Talk address/Listen address can be set by key operations on the panel.
After the addresses have been set, turn the power switch on again after it has been turned off once.

Connector : 24-pin GPIB connector
57-20240-D35A (Equivalent to product manufactured by Amphenole Inc.)



Singnal name	Pin No.
GND LOGIC	24
GND (ATN)	23
GND (SRQ)	22
GND (IFC)	21
GND (NDAC)	20
GND (NRFD)	19
GND (DAV)	18
REN	17
DIO 8	16
DIO 7	15
DIO 6	14
DIO 5	13

Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO 4
3	DIO 3
2	DIO 2
1	DIO 1

Figure 5-3 GPIB Connector Pin Arrangement

5.3.2 Interface Function

Table 5-1 Interface Function

Code	Function and explanation
SH1	Source handshake function
AH1	Acceptor handshake function
T5	Basic talker function, talker release function by a listener's designation, talk only mode function, serial poll function
L4	Basic listener function, listener release function by a talker specification
SR1	Service request function
RL1	Remote/local switching function available
PP0	No parallel poll function
DC1	Has a device clear function (SDC and DCL commands available)
DT1	Has a device trigger function (GET command available)
C0	No controller function
E1	Used open-collector bus driver. However, EOI, and DAV is used a three-state bus driver.

5.4 How to Handle the GPIB

5.4.1 Connection with Component Devices

As the GPIB system is composed of multiple devices, prepare the entire system taking special care with the following:

(1) Ensure that the state and operation of each device are correct before connecting it by following the instruction manuals for the TR6143, controller, and peripheral devices, etc.

(2) The length of bus cables are connected to each measuring instrument and controllers should not longer than necessary. The length of each cable is to be 4 m or less, and for the total length bus cables, the number of devices connected to the bus should not be more than 10. Advantest can provide the cables listed in Table 5-2 as standard cables.

Table 5-2 Standard Bus Cable (Optional)

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

(3) The connectors for bus cables are of a piggyback type. As one connector has both male and female connectors, it can be used in series.

When connecting bus cables, do not use three or more connectors in series. And fasten them securely with a connecter set screw.

(4) Before the power of devices connected to the bus is turned on, ensure that the power conditions grounding, and setting conditions are correct when necessary for each device. Be sure to turn on the power to each component device. If a device does not have the power on, the entire system operation cannot be guaranteed.

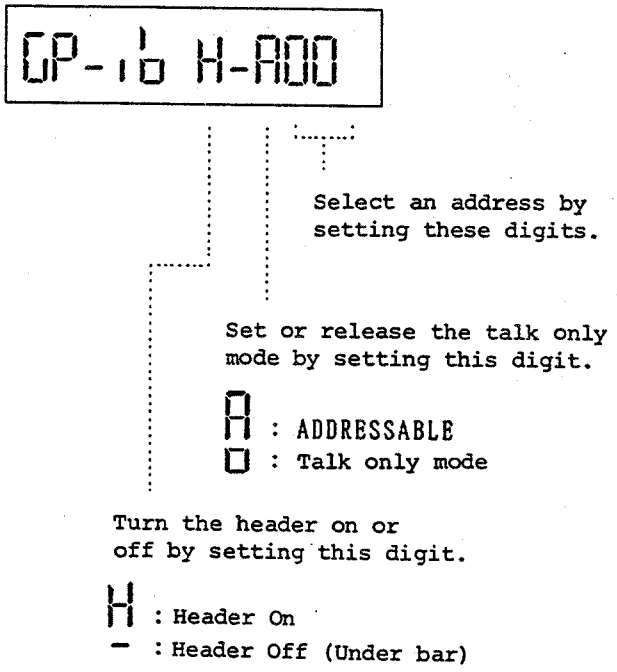
5.4.2 Setting of Addresses and Turning the Header on and off

The setting of GPIB talk/listen addresses and turning the header on and off are done using the keys on the panel of the main body. Any address can be set in a decimal code from the 31 kinds listed in Table 5-3.

Table 5-3 Address Code

Address		
Setting of the lower two digits (Decimal code)	ASCII code	
	Listen	Talk
0	SP	@
1	!	A
2	"	B
3	#	C
4	$	D
5	%	E
6	&	F
7	'	G
8	(	H
9	)	I
10	*	J
11	+	K
12	,	L
13	-	M
14	.	N
15	/	O
16	0	P
17	1	Q
18	2	R
19	3	S
20	4	T
21	5	U
22	6	V
23	7	W
24	8	X
25	9	Y
26	:	Z
27	;	[
28	<	/
29	=	]
30	>	~

① Select the below display by pressing the third parameter switch.



② Move the cursor to a digit that you want to change by pressing ◁ or ▷.

Change each setting by turning the data knob.

5.5 Command Buffer and Measurement Data Buffer

To shorten the time that the GPIB bus is occupied, the TR6143 stores the program code in a command buffer in the listener mode and after receiving a block delimiter, analyzes the stored program code and executes it. During this execution, it can control other devices.

The measured data during a sweep can be stored in a measurement data buffer and transferred to a controller in batches. (see 5.6.10 Data Output Request and Setting of Delimiter/header.)

The measured data is stored one item after another in a measurement data buffer by OM5 being set and the data can be transferred in the order of measurement by sending a send request to OM1 or OM2 with the talker specified.

The buffer size is shown in Table 5-4.

Table 5-4 Buffer Size

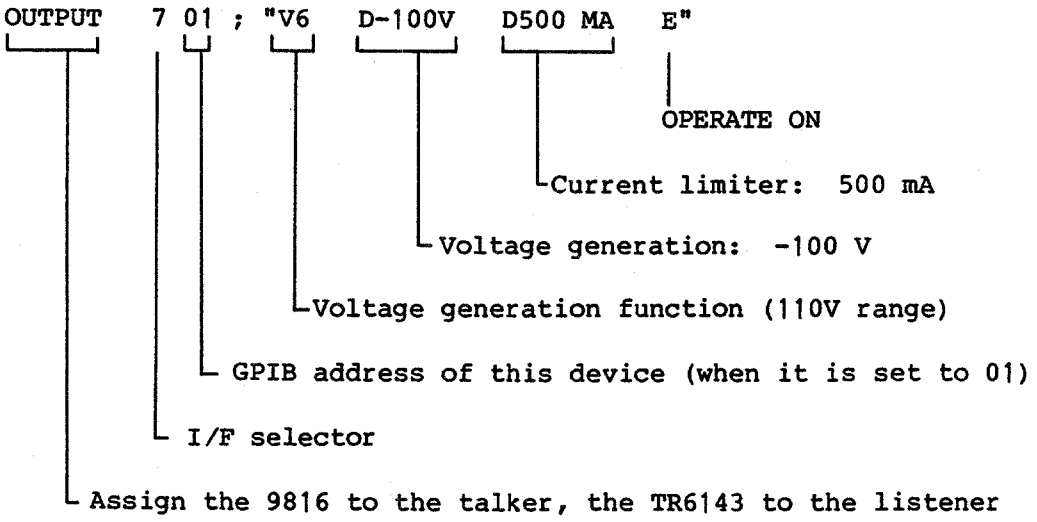
Buffer	Size
Command buffer	128 bytes
Measurement data buffer	1024 bytes

5.6 Setting of Each Function and GPIB Program Code List

All functions of the TR6143 can be remotely set by a GPIB controller. In this section, an example of program with which a Hewlett Packard 9816 desk-top computer is used to set each function is explained.

All examples here are set from the initial state.

Ex. 5-1: Voltage generation by voltage generation function -100 V
Current limiter 500 mA, OPERATE ON



Programmed as shown above and run, the TR6143 is set for voltage generation: voltage generation -100 V, current limiter 500 mA, and operating (output on). V6, D, V, MA, E, and so on in the program are GPIB commands used to control the TR6143.

Table 5 - 5 GPIB Program Code List

Sweep mode : Usable code in the sweep mode
Initial value: A value set by an initialization code

Item	Code	Contents	Initial value	Sweep mode
Function/Range	V3	320 mV		
	V4	3.2 V		
	V5	32 V		
	V6	110 V	o	
	I-1	32 µA		
	I0	320 µA		
	I1	3.2 mA		
	I2	32 mA		
	I3	320 mA		
	I4	2 A		
Generation value, limit value Range specification: D ± dddd Automatically optimum range : D ± dddd Unit Header, Polarity, Data, Units		Initial value: D + 000.00 V, D + 0500.0 MA Range is specified by Function/Range code.		
Output on/off and Initial setting	E	Set output ON		o
	H	Set output OFF	o	
	C	Initial setting and set output to Off		
Response mode	RP0	SLOW	o	
	PR1	FAST		
Limit/Oscillation detection buzzer	UZ0	OFF	o	
	UZ1	ON when limit or oscillation is detected		
Buffering control	B	Buffering-control generation values. Output varies at "E".		

(cont'd)

Item	Code	Contents	Initial value	Sweep mode
Sampling mode	M0	RUN	o	
	M1	HOLD (SINGLE)		
NULL	NL0	NULL OFF	o	
	NL1	NULL ON		
Comparison operation	C00	Display, comparison result buzzer OFF	o	
	C01	ON		
Comparison result buzzer	UZ3	Buzzer ON for "HI"		
	UZ4	Buzzer ON for "GO"		
	UZ5	Buzzer ON for "LO"		
Comparison operation upper/lower limit value KH comparison upper limit value, comparison lower limit value		Initial value: KH + 0000.0 MA + 0000.0 MA		
Auto range	R0	AUTO		
	R1	LIMIT range fixed	o	
Integration time	IT2	10 ms		
	IT3	1 PLC	o	
	IT4	10 PLC		
	IT5	100 PLC		
Frequency of power supply	LF0	50 Hz		
	LF1	60 Hz		
Auto calibration	AC0	OFF		
	AC1	ON	o	
Linear sweep range mode	SR0	Automatic setting of sweep range	o	
	SR1	Setting of fixed sweep range		
Sweep function Initial value: SN000.00V, 000.00V, 000.00V Linear sweep: SN start value, stop value, step value Log sweep : SG start value, stop value, single-decade division number Random sweep: SC start address, stop address				
Sweep time parameter Initial value: SP10, 10, 10 : SP hold time, delay time, period time (Units ms) : SI period time (Units 100 ms)				

(cont'd)

Item	Code	Contents	Initial value	Sweep mode
Reverse mode	SV0	Reverse OFF	o	
	SV1	Reverse ON		
Single/Repeat	T2	Single sweep	o	
	T3	Repeat sweep		
Sweep mode	T0	Sweep mode ON by auto trigger		
	T1	Sweep mode ON by external trigger		o
	C1	Sweep mode OFF	o	
Measurement/Sweep Start	T9	Trigger in Hold mode, Auto sweep start, External trigger start, and trigger		o
Pause auto sweep	C2			o
Clear measurement buffer	C4		o	o
Output mode of Complete signal	CP0	FRONT		
	CP1	END	o	
	CP2	HI		
	CP3	GO		
	CP4	LO		
Setting memories of random sweep data : N100, D1V, D2V, ..., P Memory address / Data at address 100 / Data at address 101 / Memory setting termination				
Request data output	OM0	Request to output generation values in ASCII		
	OM1	Request to output measured values in ASCII	o	o
	OM2	Request to output measured values in binary		
	OM3	Request to output amount of data in buffer memory		
	OM4	Request to output operation status		
Operation of measurement data buffer	OM5	ON		
	OM6	OFF	o	

(cont'd)

Item	Code	Contents	Initial value	Sweep mode
Block delimiter	DL0	CR/LF, EOI	o	
	DL1	LF		
	DL2	EOI		
String delimiter	SL0	,(comma)	o	
	SL1	␣ (blank)		
	SL2	CR/LF		
Header output	S4	OFF		
	S5	ON	o	
Service request	S0	ON		
	S1	OFF	o	
Status byte function	S2	Level 0	o	o
	S3	Level 1		
Mask bit setting	MSnnn	0 to 255 Initial value: MS 000		o

5.6.1 Generation Function and Range Setting

```
Ex. 5-2:  Set to voltage function, 32 V range
          10 OUTPUT 701; "V5"
          20 END
```

Table 5-6 Generation Function and Range Code

Code	Function	Range	Initial value
V3	VOLTAGE	320 mV	
V4		3.2 V	
V5		32 V	
V6		110 V	o
I-1	CURRENT	32 µA	
I0		320 µA	
I1		3.2 mA	
I2		32 mA	
I3		320 mA	
I4		2 A	

CAUTION

If the function is changed and the limit value becomes less than 300 counts, the limit value will change to 300 counts.

A range setting range for a limiter set value is shown in Table 5-7.

Table 5-7 Setting Range for Limiter Set Value

Function	Limiter Set Value	Setting Range
Voltage	0 to 0500.0 mA	V3 to V6
	0500.1 mA to 1000.0 mA	V3 to V5 V6 (However, set value to be 64 V or less)
	1000.1 mA to 2000.0 mA	V3 to V5 V6 (However, set value to be 32 V or less)
Current	0 to 32.000 V	I-1 to I4
	0 to 032.00 V 032.01 V to 064.00 V	I-1 to I3 I4 (However, set value to be 1 A or less)
	064.01 V to 110.00 V	I-1 to I 3 I4 (However, set value to be 0.5 A or less)

5.6.2 Setting of Voltage, Current Generation Value and Limit Value

Ex. 5-3: Set the voltage generation to 010.00 V, and current limit to 2 A for the voltage function 110 V range.

```
10  OUTPUT 701; "V6"
20  OUTPUT 701; "D10 D2A"
30  END
```

	Explanation
10	Set to voltage function 110 V range
20	Set the voltage generation to 010.00 V without changing the range, and the current limit to 2000.0 mA (range is changed).
30	Terminate

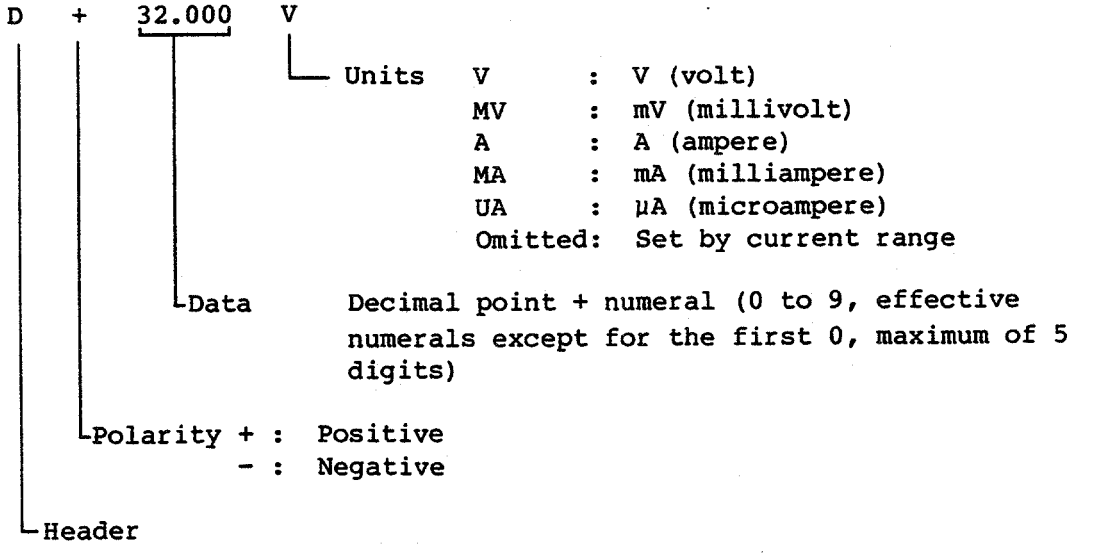
Ex. 5-4: Set the voltage generation to 10 V and current limit 2 A using the voltage function.

```
10 OUTPUT 701; "V6"
20 OUTPUT 701; D10 V_ D2A"
30 END
```

If a unit is entered, it will be set to an optimum range automatically.

	Explanation
10	Set to voltage function.
20	Set the voltage generation to 10.000 V (change to 32 V range), and current limit to 2000.0 mA (change to 2 A range).
30	Terminate

The general format of a generation value or limit value is shown below.



CAUTION

For exponent format data (0.32E + 2), error occurs after diciphering.

The method of setting a generation value or limit value for a function is shown in Table 5-8.

Table 5-8 Method of Setting Function, Generation Value, and Limit Value

	VOLTAGE	CURRENT
Generation value setting		
Range not changed	D + 32	D 320
Range changed	D + 32 V	D 320 MA
Limit value setting	D 320 MA	D 32 V

Ex. 5-5: Set voltage generation values in the order of 20 V, 40 V, and 80 V. The function and voltage limit is set to the below values.

o Voltage function 32 V range
o Current limit value 2000.0 mA

```
10  OUTPUT 701; "D20 V"
20  OUTPUT 701; "D1 A"
30  OUTPUT 701; "D40 V"
40  OUTPUT 701; "D0.5 A"
50  OUTPUT 701; "D80 V"
60  END
```

	Explanation
10	Set the voltage generation value to 20 V.
20	Reset the current limit value to 1 A. (A setting of 40 V with the current limit value 2000.0 mA cannot be made.)
30	Set the voltage value to 40 V.
40	Reset the current limit value to 0.5 A. (A setting 80 V with a current limit value 1000.0 mA cannot be made.)
50	Set the voltage generation value to 80 V.

The generation setting range for a limit value and limit value setting range for a generation value are shown in Tables. 5-9 and 5-10.

Table 5-9 Generation Value Setting Range for a Limit Value

Function	Limit value	Generation value setting range
Voltage	Limit minimum value to 0500.0 mA 0500.1 mA to 1000.0 mA 1000.1 mA to 2000.0 mA	0 to 110.00 V 0 to 064.00 V 0 to 32.000 V 0 to 032.00 V
Current	Limit minimum value to 32.000 V Limit minimum value to 032.00 V 032.01 V to 064.00 V 064.01 V to 110.00 V	0 to 2000.0 mA 0 to 1000.0 mA 0 to 0500.0 mA

Table 5-10 Limit Value Setting Range for a Generation Value

Function	Generation value	Limit value setting range
Voltage	0 to 32 000 V 0 to 032.00 V 032.01V to 064.00 V 064.01 V to 110.00 V	Limit minimum value to 2000.0 mA Limit minimum value to 1000.0 mA Limit minimum value to 0500.0 mA
Current	0 to 0500.0 mA 0500.1 mA to 1000.0 mA 1000.1 mA to 2000.0 mA	Limit minimum value to 110.00 V Limit minimum value to 064.00 V Limit minimum value to 032.00 V Limit minimum value to 32.000 V

Limit minimum value: 300 counts in each range

CAUTION

Set values of the voltage limit and current limit should be 300 counts or more.

5.6.3 Output ON/OFF, Initialization, Response, and Limit/Oscillation Detection Buzzer Control

Ex. 5-6: Set the limit/oscillation detection buzzer to ON, response to the fast mode, and output to ON.

```
10 OUTPUT 701; "UZ1 RP1 E"
20 END
```

Function	Code	Initial value	Remarks
Output ON/OFF			
ON	E		
OFF	H	o	
Initialization	C		See the initialization codes and parameter set values when the power was turned on.
Response mode			
SLOW	RP0	o	
FAST	RP1		
Buzzer by limiter/ oscillation detection			
OFF	UZ0	o	
ON	UZ1		

The initialization codes and parameter set values at power-on are listed in Table 5-11.

Table 5 - 11 List of Initialization Codes and Parameter set values at Power-on

Function	Execution by initialization Code	At power on
Generation function	VOLTAGE	Backup
Generation range	110 V ragne	↕
Generation value	+000.00 V	↕
Limit value	0500.0mA	Backup
Output On/Off	OFF	OFF
Response mode	SLOW	Backup
Buzzer by limit/oscillation detection	OFF	↕
Sampling mode	RUN	Backup
NULL	OFF	OFF
Comparison operation display	OFF	Backup
Comparison result buzzer	OFF	↕
Comparison operation upper limit value	+0000.0 mA	↕
Comparison operation lower limit value	+0000.0 mA	↕
Auto range	OFF	↕
Integration time	1 PLC	↕
Operating power frequency	No change	↕
Auto calibration	ON	↕
Sweep	Linear	↕
Sweep start value	000.00 V	↕
Sweep stop value	000.00 V	↕
Sweep step value	000.00 V	↕
	10 (Log sweep)	↕
Start address	000	↕
Stop address	000	↕
Hold time	10 ms	↕
Delay time	10 ms	↕
Period time	10 ms	↕
Reverse mode	OFF	↕
Single/Repeat	Single	↕
Sweep mode	OFF (DC mode)	↕
Complete signal output mode	END	↕
Random sweep data	No change	Backup
Data output request	Measured data (ASCII)	Measured data (ASCII)
Operation of measurement data buffer	OFF	OFF
Block delimiter	CR/LF, EOI	CR/LF, EOI
Starting delimiter	, (Comma)	, (Comma)
Header output	ON	Backup
Service request	Transmit Off	Transmit OFF
Status byte	Level 0	Level 0
Mask bit	0	0

5.6.4 Buffering Control for Voltage and Current Generation Value

Ex. 5-7: Change set values of two TR6143s (set GPIB addresses to 1 and 2 respectively) simultaneously while the output is on.

```
10  OUTPUT 701; "E"
20  OUTPUT 702; "E"
30  OUTPUT 701; "B D10 V"
40  OUTPUT 702; "B D-15 V"
50  SEND 7; LISTEN 1 LISTEN 2
60  SEND 7; DATA "E", 10, 13
70  SEND 7; UNL          ↑   ↑
80  END               (CR) (LF)
```

	Explanation
10	Set device (A) with address 1 to output on
20	Set device (B) with address 2 to output on
30	Store a set value of (A) (Voltage generation value of 10 V) in the buffer
40	Store a set value of (B) (Voltage generation value of -15 V) in the buffer
50	Set (A) and (B) to the state in which codes can be received simultaneously
60	Contents of (A) and (B) buffers (A): Voltage generation value 10 V (B): Voltage generation value -15 V
70	Release listener
80	Terminate

Function	Code	Remarks
Buffering control	B	This command is used to store the next data (D ±dddd unit) to buffer temporarily and output it when E code is received. This is useful for changing the outputs of several TR6143s at the same time.

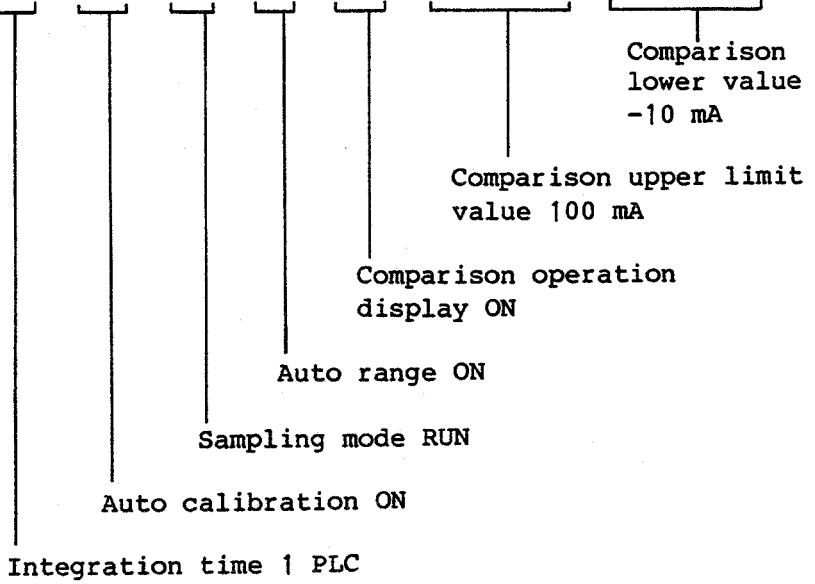
Note 1: During the time from when a B code is received to when an E code is received, the function setting code (V and I) and generated value (D) code are only stored in the buffer and the value before the B code was received will be held. To release, send a C or H code.

Note 2: When an E code is received and buffer data is to be output, if the limit value is not appropiate, a syntax error bit is set to 1

5.6.5 Parameter Setting Necessary for Measurement

Ex. 5-8: Set to integration time of 1 PLC, auto calibration ON, sampling mode RUN, auto range ON, comparison operation ON, comparison upper limit value of 100 mA, and comparison lower limit value of -10 mA.

```
10  OUTPUT  701 ; "IT3   AC1   M0   R0   CO1   KH100 MA   , -10 MA"
20  END
```



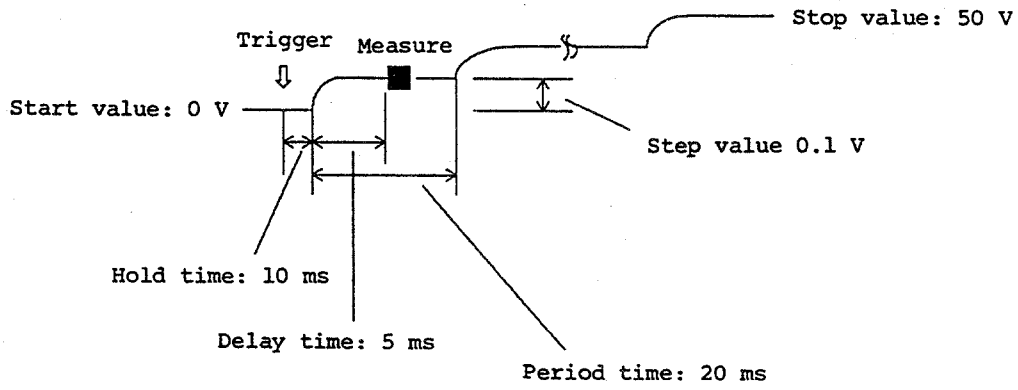
Function	Code	Initial value	Remarks
Sampling mode RUN HOLD	 M0 M1	 o	
NULL ON OFF	 NL1 NL0	 o	Even if NL1 is received when the null operation is on, a new operation is not performed and the present measurement continues.
Comparison operation display ON OFF	 CO1 CO0	 o	
Comparison result buzzer Buzzer ON for HI Buzzer ON for GO Buzzer ON for LO	 UZ3 UZ4 UZ5		For the buzzer to be set to off, the comparison operation display needs to be set to off (CO0). For the buzzer to be set to on, resetting is necessary.
Comparison operation upper lower value KH + 100.00 V, -10.000 V Comparison lower limit value Comparison upper limit value		Upper limit value Lower limit value 0000.0 mA 0000.0 mA	The values are made up of a polarity (+ or -) a decimal point (.) numeric values (0 to 9) and units (V, mV, A, mA, or µA). V/mV and A/mA µA cannot be mixed. If the units are omitted, a limiter range will be assumed. When units are used for the comparison upper limit value and the units of the lower limit value are omitted, the lower limit unit is assumed to have the same units as the upper limit value.

(cont'd)

Function	Code	Initial value	Remarks
Auto range ON OFF	 R0 R1	 o	If the auto range is off, the measurement range will be the same as those for the limit range.
Integration time 10 ms 1 PLC 10 PLC 100 PLC	 IT2 IT3 IT4 IT5	 o	If an integration time change is received, a gain correction and zero correction for the measurement system will be performed on the basis of an internal reference voltage. Note: If an integration time change is made during a RUN sampling measurement, the measured data just after the change may not be correct. The setting of an integration time should be performed before a measurement operation starts.
Operating power frequency 50 Hz 60 Hz	 LF0 LF1		
Auto calibration ON OFF	 AC1 AC0	 o	If AC1 is received, a gain correction and zero correction for the measurement system will be performed.

5.6.6 Setting of Parameters Necessary for Sweep
(See "3.1 How to use the Sweep Function".)

Ex. 5-9: After a setting to a start value of 0 V, stop value of 50 V, step value of 0.1 V, linear sweep mode, hold time of 10 ms, delay time of 5 ms, period time of 20 ms, reverse off, and single mode, set to the sweep mode. The sweep trigger is auto.




```
10  OUTPUT  701 ;"SN  0 V , 50 V , 0.1 V  SP  10 , 5 , 20  SV0  T2 "
20  OUTPUT  701 ; "T0"
30  END
```

Single
Reverse OFF
Period time: 20 ms
Delay time: 5 ms
Hold time: 10 ms
Step value: 0.1 V
Stop value: 50 V
Start value: 0 V
Sweep mode setting
Sweep trigger:Auto

Function	Code	Initial value	Remarks
Sweep range mode Auto range Fixed range	 SR0 SR1	 o	In the auto range mode, ranges for start, stop, and step values are automatically set to the most applicable range to each value. In the fixed range mode, maximum range is set to the start, stop, and step values.
Sweep function Linear sweep: SN -10 V, +10 V, 0.1 V (Step value / Stop value / Start value) Log sweep: SG 0.01 V, 100 V, 5 (Single-decade division number / Stop value / Start value) Random sweep: SC 0, 100 (Stop address / Start address)		o	Initial value: SN 0 V, 0 V, 0 V or SN 0 A, 0 A, 0 A Note 1: The maximum number of sweep steps is 1023. If a setting over the 1023th step is made, an error occurs. Note 2: If the step value is set to 0, an error occurs. Set a value other than 0. Note 3: If the end of sweep is not equal to the stop value, the final value will become the stop value. A single-decade division number is any of 1, 2, 5, 10, 25, and 50. If it is omitted, it is assumed to be 10. Note 4: If the start value is 0 or the start value is different from the polarity of the stop value in the log sweep, an error occurs. Set to other than 0 and the same polarity as that of the stop value. Note 5: When log sweep setting is made, reverse mode is set to OFF.
Sweep time parameter SI 10 Period time: 10 x 100 ms SP 1, 10, 100 (Period time: 100 ms / Delay time: 10 ms / Hold time: 1 ms)			Initial value: SP10, 10, 10 The SI code parameter is for the interval of 100 ms units and its setting range is 0 to 99.

(cont'd)

Function	Code	Initial value	Remarks
Reverse mode ON OFF	 SV1 SV0	 o	If log sweep has been set, error occurs when reverse mode is set to ON.
Single/Repeat Single Repeat	 T2 T3	 o	Note: In the case of an external trigger, single and repeat operate in the same manner.
Sweep mode	C1 T0 T1	o	When the trigger mode is set, the sweep mode (⎍⎍⎍) will be set to on at the same time. When a "C1" is received, it will be set to the DC mode (⎓).

CAUTION

1. While the sweep mode is on (after T0, and T1 have been received), the program codes that can be used are limited. See "GPIB" Program Code List".

2. If a controller performs a control operation such as serial polling consecutively during a sweep operation, the sweep operation will stop. When serial polling is done consecutively, perform it at an interval of 10 ms or more.

3. Set to that the generation function and the memory data between the start and stop become the same function (in the case of the V funtion, the voltage generation value) in a random sweep.

   If the generation function is unequal to the memory data, the memory data will become a limit value and the generation value will become the value of the previous memory data.

5.6.7 Measurement or Sweep Control and Measurement Buffer Clearing

Ex. 5-10: The measurement starts in the Hold sampling mode, and the data is displayed.

```
10  OUTPUT 701; "OM1"
20  OUTPUT 701; "M1 T9"
30  ENTER 701; A$
40  PRINT A$
50  END
```

Explanation	
10	Set to the mode in which the measured data displayed on the panel is transmitted. See 5.6.10.
20	Set the sampling mode to Hold and an external start occurs.
30	Send the measured data to a controller.
40	Displays
50	End

Function	Code	Remarks
Start measure/sweep (Trigger function)	T9 GET (Address specific command)	If T9 is received during the auto sweep, the sweep operation will stop. If T9 is received after the auto sweep, the operation will start again. If T9 is received in the external sweep mode, it will become a sweep trigger. If T9 is received in the HOLD sampling mode, measurement will start.
Pause auto sweep	C2	If C2 is received during the auto operation, the sweep operation will stop. (This is the same as for T9.)
Clear measurement buffer	C4	If C4 is received, the data in the measurement buffer will be cleared.

5.6.8 Output Mode of COMPLETE Signal

Ex. 5-11: Set to the mode in which a complete signal is output when the comparison result is HI.

```
10  OUTPUT 701; "CP2"
20  END
```

Explanation	
10	Set the COMPLETE signal output mode to HI.
20	End

Function		Code	Initial value	Remarks
Output mode for complete signal				See 3.2 Complete.
	FRONT	CP0		
	END	CP1	o	
	HI	CP2		
	GO	CP3		
	LO	CP4		

5.6.9 Setting of Random Sweep Data Memory

Ex. 5-12: Store data strings defined by a controller in the TR6143 memories as random sweep data.

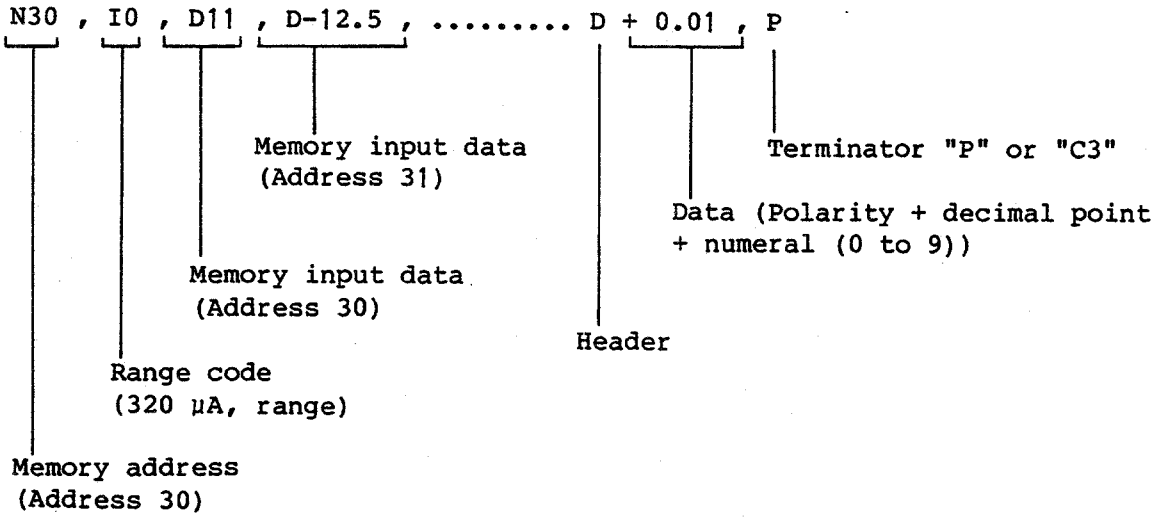
```
10  DATA "0.987 V, "1.234 V", "2.345 V", "3.456 V"
20  OUTPUT 701; "N0,"
30  FOR N = 0 TO 3 STEP 1
40  READ DATA$
50  OUTPUT 701; "D"; DATA$; ","
60  NEXT N
70  OUTPUT 701; "P"
80  END
```

Explanation	
10	Define data strings. 0.987 V, 1.234 V, 2.345 V, 3.456 V.
20	Set the start address of the TR6143 memory to 0.
30	Repeat to specify a memory address from 0 to 3.
40	Read data from a data string.
50	Send data to the TR6143.
60	Repeat
70	The data transmitted by the TR6143 ends.
80	End

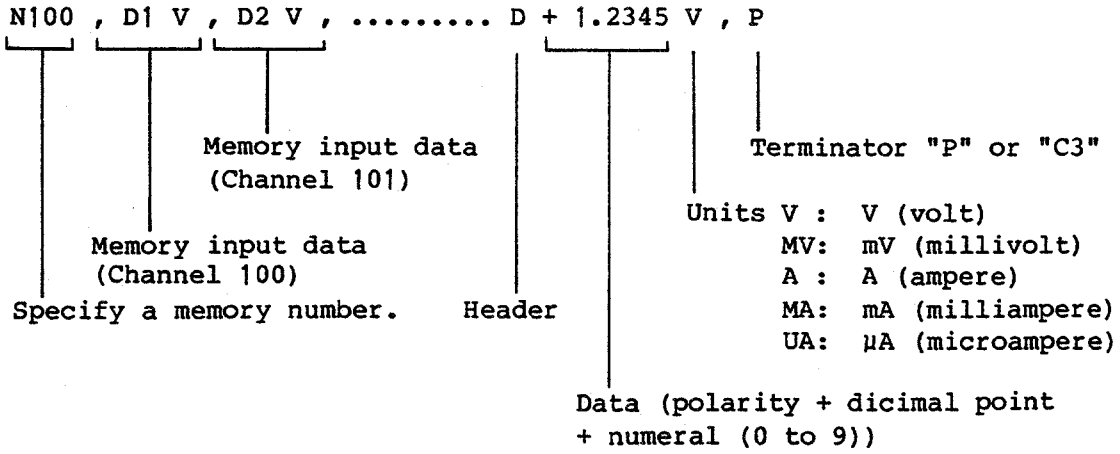
Function	Code	Remarks
Memory address specification and memory setting mode control N 100, Memory address: 100		Initial value: N0 To set data in a memory, use "D ± dddd Unit". See the general format for random sweep data.
Memory setting mode release	P C3	This command is used to release the memory setting mode set by "Nnnn".

The general format of a random sweep data is shown here.

(1) How to Specify a Range



(2) How to Set to the Optimum Range Automatically



Note 1: The data and range code ("D" + 1.2345 V", "D10.5", "V5") is stored in the memory from when a memory number specification is received to when terminator is received.

Note 2: When specifying a range, specify a range code right after the memory address. If memory input data without a range specification or units is specified, it will cause a SYNTAX error. If after a range code is specified, memory input data with units is specified, it will cause a SYNTAX error.

5.6.10 Data Output Request and Setting of Delimiter/header

Ex. 5-13: 500 pieces of measured data in the buffer of the TR6143 is transferred to a controller in binary format, and is stored in the memory.

```
10  DIM Range (500), Data (500)
20  OUTPUT 701; "OM2"
30  ENTER 701 USING "%, 500 (B, W)"; Range, Data
40  END
```

	Explanation
10	Secure 500 bytes of the range part and 500 bytes of the data part as a data area.
20	Set to the mode in which the data in the buffer of the TR6143 is sent in binary format.
30	Receives 500 pieces of data with a combination of 1 byte of the range part and 2 bytes of the data part.
40	End

Function	Code	Initial value	Remarks
Data output request			When OM3 is received, it is possible to output the number of data items in the buffer for the measured data.
Generation data (ASCII code)	OM0		
Measurement data (ASCII code)	OM1	o	
Measurement data (binary code)	OM2		
Number of items of measured data	OM3		
Operation status	OM4		
Operation of measurement data buffer			If it is set to OM1 or OM2 and the OM5 is received, the measured data after that will be stored in the buffer one item after another, and if the TR6143 is designated as a talker, the data can be transferred in the order of measurement.
ON	OM5		
OFF	OM6	o	
Block delimiter			This output indicates the end of output data in ASCII code.
Output CR/LF and EOI	DL0	o	
Output only LF	DL1		
Output only EOI	DL2		
String delimiter			This becomes a delimiter for data when the data in the measurment data buffer is to be output.
, (Comma)	SL0	o	
␣ (Blank)	SL1		
CR/LF	SL2		
Header output			
ON	S5	o	
OFF	S4		

5.6.11 Talker Format

When the TR6143 is assigned as a talker, the measurement data is output in the following data format.

(1) Talker Format of Generation, Measured Data, Measurement Data Buffer Using ASCII Code

xxx ± ddd. dd E ±D (BD) (or (BL))

① ② ③ ④ ④

① Header of three alphabetical letters
② Mantissa part (polarity + decimal point + 5-digit numeral)
③ Exponent part ("E" + polarity + 1-digit numeral)
④ Block delimiter (or string delimiter)

① Header

This displays the kind of a measured data and is output only when the header is on. If the header is set off, this data is not output but the mantissa part is.

Three bytes of ASCII codes are output as a header and Table 5-12 shows the kinds of headers and the kinds of data that the header indicates.

Table 5-12 Header Codes and Kinds of Send Data

Header code	Kind of send data
DV␣	DC voltage measured data
DI␣	DC current measured data
LM␣	Measured data for which a limit was reached
OS␣	Oscillation occurred
OL␣	Measurement range exceeded
DVH	DC voltage measured data of comparison operation result HI
DVG	DC voltage measured data of comparison operation result GO
DVL	DC voltage measured data of comparison operation result LO
DIH	DC current measured data of comparison operation result HI
DIG	DC current measured data of comparison operation result GO
DIL	DC current measured data of comparison operation result LO

② Mantissa Part and Exponent Part

The mantissa part of data is fixed at seven bytes and its decimal point is output to a position that corresponds to the display.

③ Exponent Part

The exponent part of data is fixed at three bytes and any one of three kinds ("E + 0", "E - 3", and "E - 6") is output.

Table 5-13 shows the mantissa and exponent part of data in each function/range.

Table 5-13 Mantissa and Exponent Part of Data in each Function/Range

Function	Limiter range	Mantissa part of data	Exponent part of data
VOLTAGE	32 μA	±d d. d d d	E - 6
	320 μA	±d d d. d d	E - 6
	3.2 mA	±d. d d d d	E - 3
	32 mA	±d d. d d d	E - 3
	320 mA	±d d d. d d	E - 3
	2 A	±d. d d d d	E + 0
CURRENT	320 mA	±d d d. d d	E - 3
	3.2 V	±d. d d d d	E + 0
	32 V	±d d. d d d	E + 0
	110 V	±d d d. d d	E + 0

④ Block Delimiter (or String Delimiter)

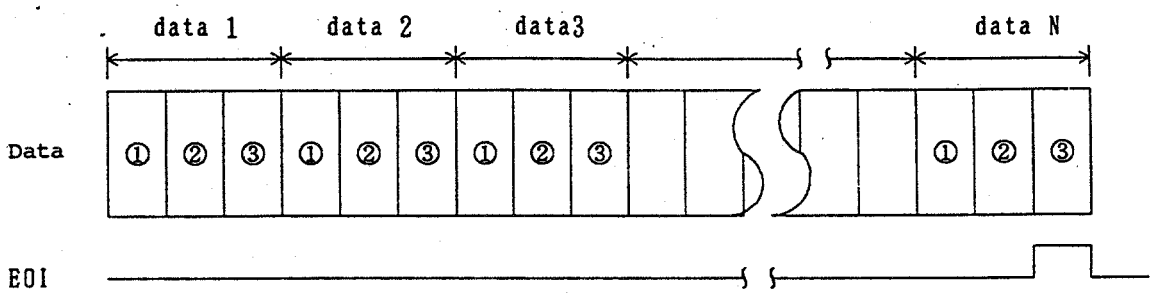
This is output to indicate the end of one data item. Usually, the two bytes of CR ($0D_H$) and LF ($0A_H$) are output and when LF is output, single line signal EOI is transmitted at the same time.

Moreover, the data which is output as a block delimiter can be changed by program code DL_n and will become CR, LF (EOI) at DL0, LF at DL1, and (EOI) when the end of the exponent part of the data is output at DL2.

When the data in the measurement data buffer is output, a string delimiter is output as a delimiter for data and the only for the final data, a block delimiter is output. Data output with a string delimiter can be changed by program code SL_n, and the delimiter is, (comma) for SL0, (blank) for SL1, and CRLF for SL2.

(2) Talker Format of Measured Data in Binary Code

The format in which data in the measured data buffer is stored during a sweep or measurement is shown here.



① First byte (flag + V/I + range code)
② Second byte (sign + 2^{14} to 2^8 data)
③ Third byte (2^7 to 2^0 data)

The data structure is shown below.

	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
First byte	f_2	f_1	f_0	V/I	Range code			
Second byte	Sign	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^3	2^8
Third byte	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

o V/I means current measurement data when V/I = 0 or means voltage measurement data when V/I = 1.

o Flag

f_2	f_1	f_0	Meaning
0	0	0	DC voltage or current measurement data
0	0	1	Measured data for comparison operation result LO
0	1	0	Measured data for comparison operation result GO
0	1	1	Measured data for comparison operation result HI
1	0	0	Measured data that limiter generated
1	0	1	Measured data that oscillation generated
1	1	0	Indicates that an overvoltage was detected

o Range code

V/I	Range code				Measurd data	Range
	D_3	D_2	D_1	D_0		
1	0	1	0	0	Voltage	320 mV
	0	1	0	1		3.2 V
	0	1	1	0		32 V
	0	1	1	1		110 V
0	0	0	1	1	Current	32 µA
	0	1	0	0		320 µA
	0	1	0	1		3.2 mA
	0	1	1	0		32 mA
	0	1	1	1		320 mA
	1	0	0	0		2 A

o Sign and data
The MSB is a sign bit and the 15 lower-order bits are data. A negative numeric is expressed by 2's compliment.

0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	+32767
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	+1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-32768

Sign 2^{14} 2^{13} 2^{11} 2^{10} 2^{9} 2^{8} 2^{7} 2^{6} 2^{5} 2^{4} 2^{3} 2^{2} 2^{1} 2^{0}

(3) Talker Format of Operation Status

If the TR6143 is set to operation status output, the details of the internal operation state can be understood.

The contents of an operation status byte are shown in Table 5-14.

S S b (BD)

① ② ③

① ..... Header ("SS")
② ..... Operation status byte
③ ..... Block delimiter

Table 5-14 Contents of Operation Status

Bit number	Decimal	Internal Operation State
7	128	0: No limit detected 1: Limit detected
6	64	0: No load oscillation 1: Load oscillation
5	32	0: Normal 1: Overheating detected
4	16	0: Normal 1: Overvoltage input detected
3	8	
2	4	
1	2	0: Sweep operation stopped 1: Sweep in operation
0	1	0: OPERATE OFF 1: OPERATE ON

(4) Number of Measured Data Items

The format by which the number of measured data items stored in the measurement data buffer is output in two-byte binary code is given here.

DC bb (BD)

① ② ③

① ..... Header (DC; 2 characters)
② ..... Number of data items. Output in 16-bit binary code in order from upper-order to lower-order.
③ ..... Block delimiter

5.6.12 Service Request Control

Ex. 5-14: Transmit a service request and set mask data so that bit 5 and bit 7 will not become 1.

```
10  OUTPUT 701; "MS 160 S0"
20  END
```

Mask data

	Explanation
10	Mask bits 5 and 7 and make a service request to be ready for transmission.
20	End

The mask data has a decimal number corresponding to each mask bit is added to it. (see Table 5-15 Contents of service request.)
When bit 5 is 32 and bit 7 is 128, the mask data becomes 160 (32 + 128).

Function	Code	Initial value	Remarks
Service request ON OFF	 S0 S1	 o	In the case of S1, even if bit 6 of the status byte becomes 1, a SRQ signal will not be transmitted.
Status byte function Level 0 Level 1	 S2 S3	 o	
Setting of mask bit MSooo		 o	The range of mask data is 0 to 255.

5.6.13 Service Request

By using a service request from the GPIB, various states of the TR6143 can be detected externally. The service request is set to ON or OFF by GPIB commands S0 and S1.

The contents of a service request can be recognized according to the status byte.

Table 5-15 Contents of Service Request

Bit No.	Decimal number	Bit name	Function	
			Level 0	Level 1
7	128	OPERATE OFF	Operation signal break input detection	
6	64		Service request (SRQ)	
5	32	TRIGGER IN	Trigger signal input detection	
4	16			
3	8	SWEEP END BUFFER FULL	Sweep end	Buffer data full
2	4	RECEIVE READY MEASURE END	Program code receive ready	Measurement end
1	2	SYNTAX ERROR	Unidentified code, syntax error, or setting range exceeded	
0	1	LIMIT/OSC	Limit/oscillation detection bit	

Shown are the conditions for which each bit of the status byte is set to 1, the operation when serial polling is performed, and the conditions for which each bit is cleared to 0.

The timing chart shown next is for when the mask data of the status byte is 0 after a S0 command.

CAUTION

1. The program codes are executed one after another after a block delimiter is received (after one program step is received).

   For polling, it should be performed after a program code is completed (after the RECEIVE READY status is changed to 1).

2. When polling continuously from a controller, perform at an interval of 10 ms or more.

(1) LIMIT/OSCILLATION Bit (Bit 0)

When oscillation by a limiter or load is detected, this bit is set to 1. When oscillation by a limiter or load returns to normal, it is cleared to 0.

If it returns to normal before polling, the SRQ bit remains 1 and the limit/oscillation detection bit is cleared to 0.

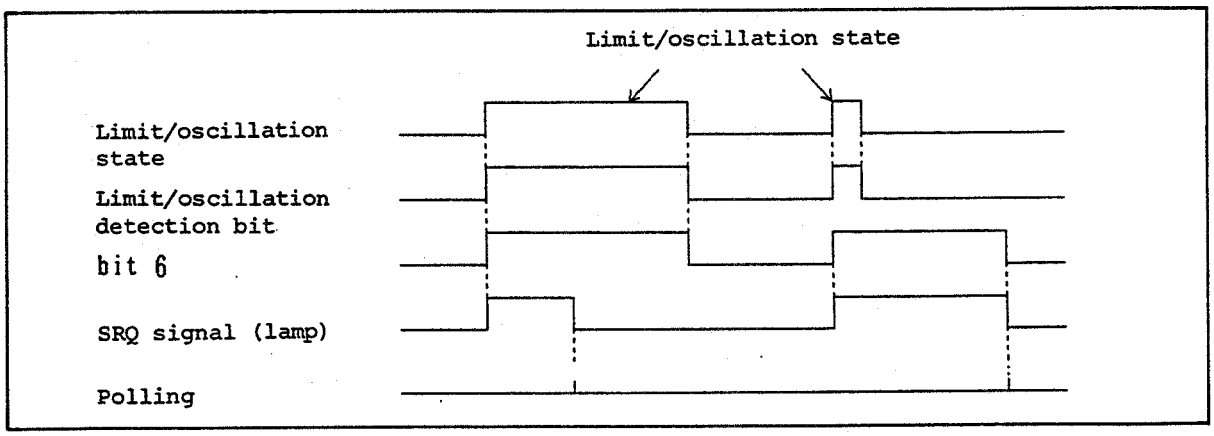


Figure 5-4 Timing Chart for Limit/oscillation Bit

(2) SYNTAX ERROR Bit (bit 1)

When an unidentified code, syntax error, or exceeded setting range is detected during execution, this bit is set to 1.

The codes for the block delimiter which errors are detected are skipped.

When program codes are read normally into the block delimiter, they will be cleared to 0.

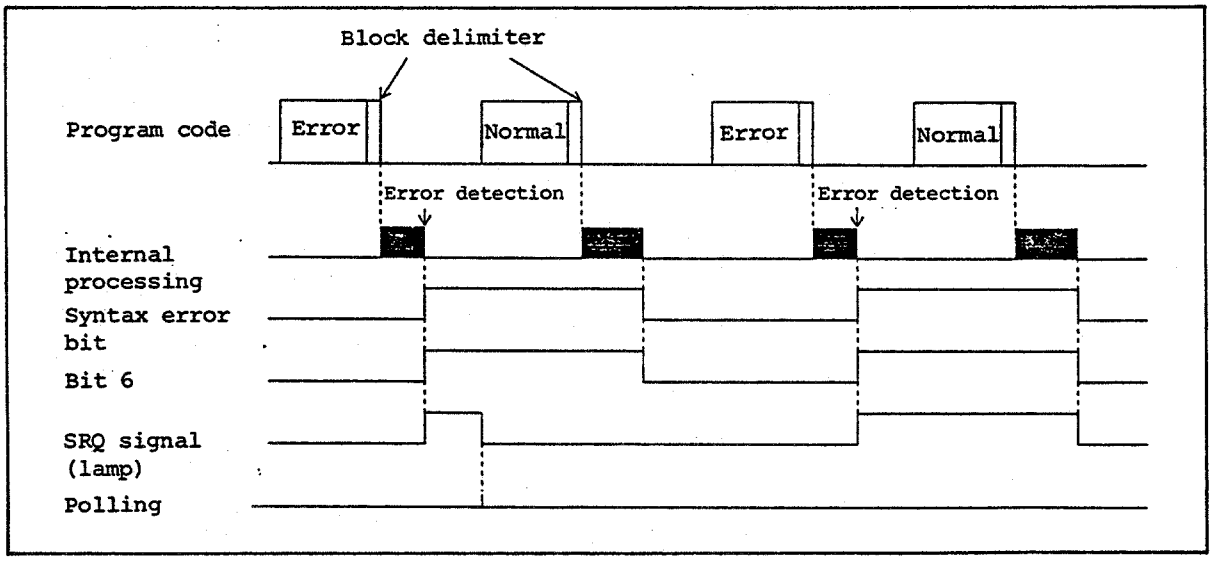


Figure 5-5 Timing Chart for Syntax Error Bit

(3) RECEIVE READY Bit (bit 2)

The following operation is performed when a service request is in the state of level 0.

When a program code is received and the internal processing is terminated, this bit is set to 1.

When a program code starts being received, this bit is cleared to 0.

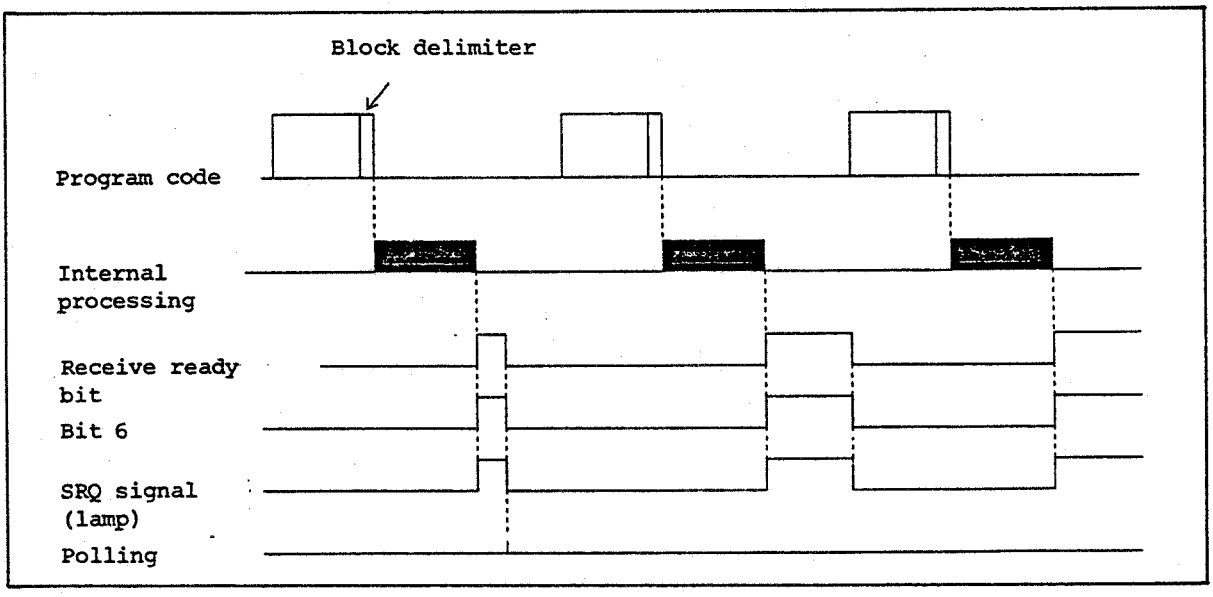


Figure 5-6 Timing Chart of Receive Ready Bit

(4) MEASURE END Bit (bit 2)

When a measurement terminates, this bit is set to 1.

When it is terminated to transfer the measured data to a controller, this bit is cleared to 0.

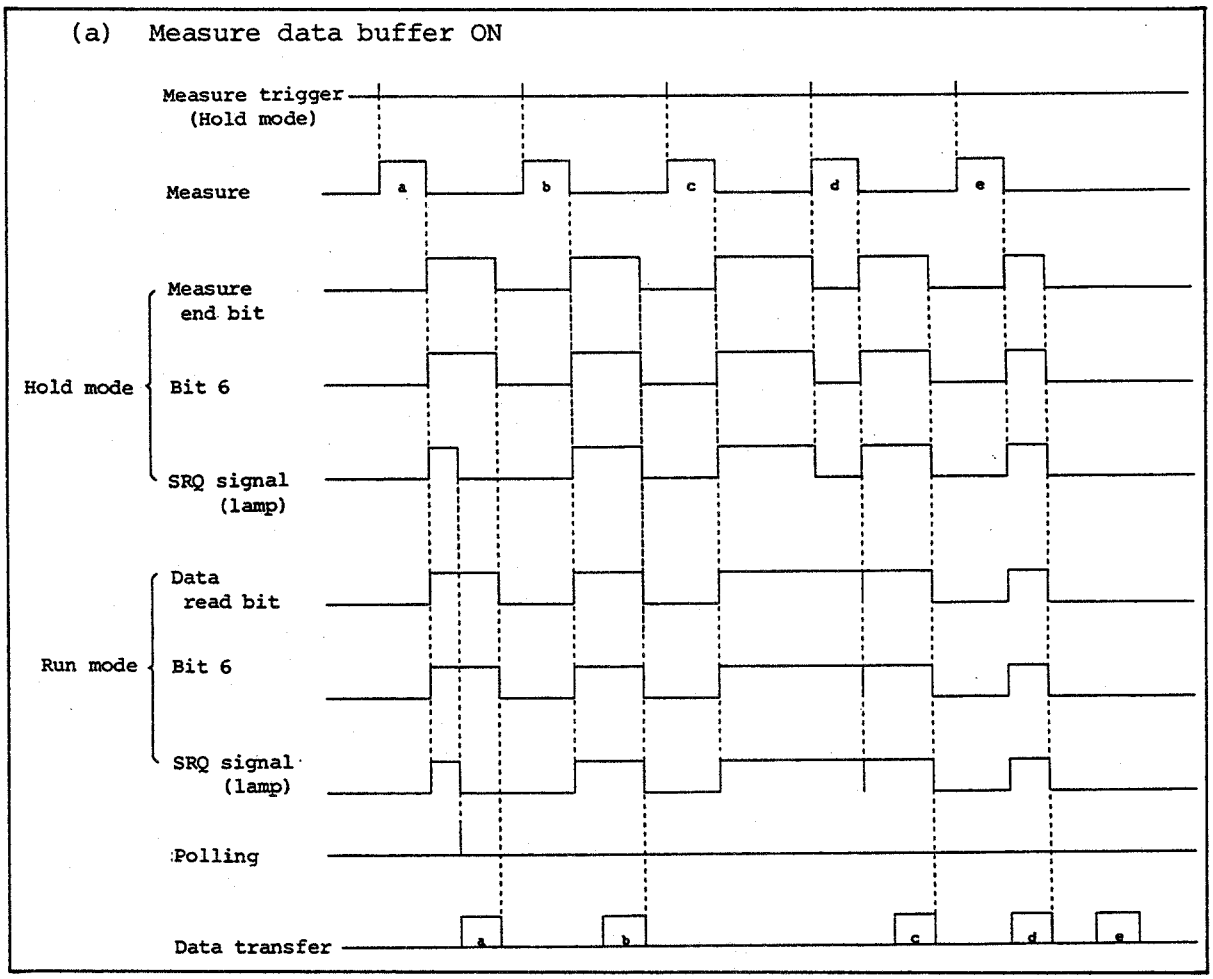


Figure 5-7 Timing Chart of Measure End Bit

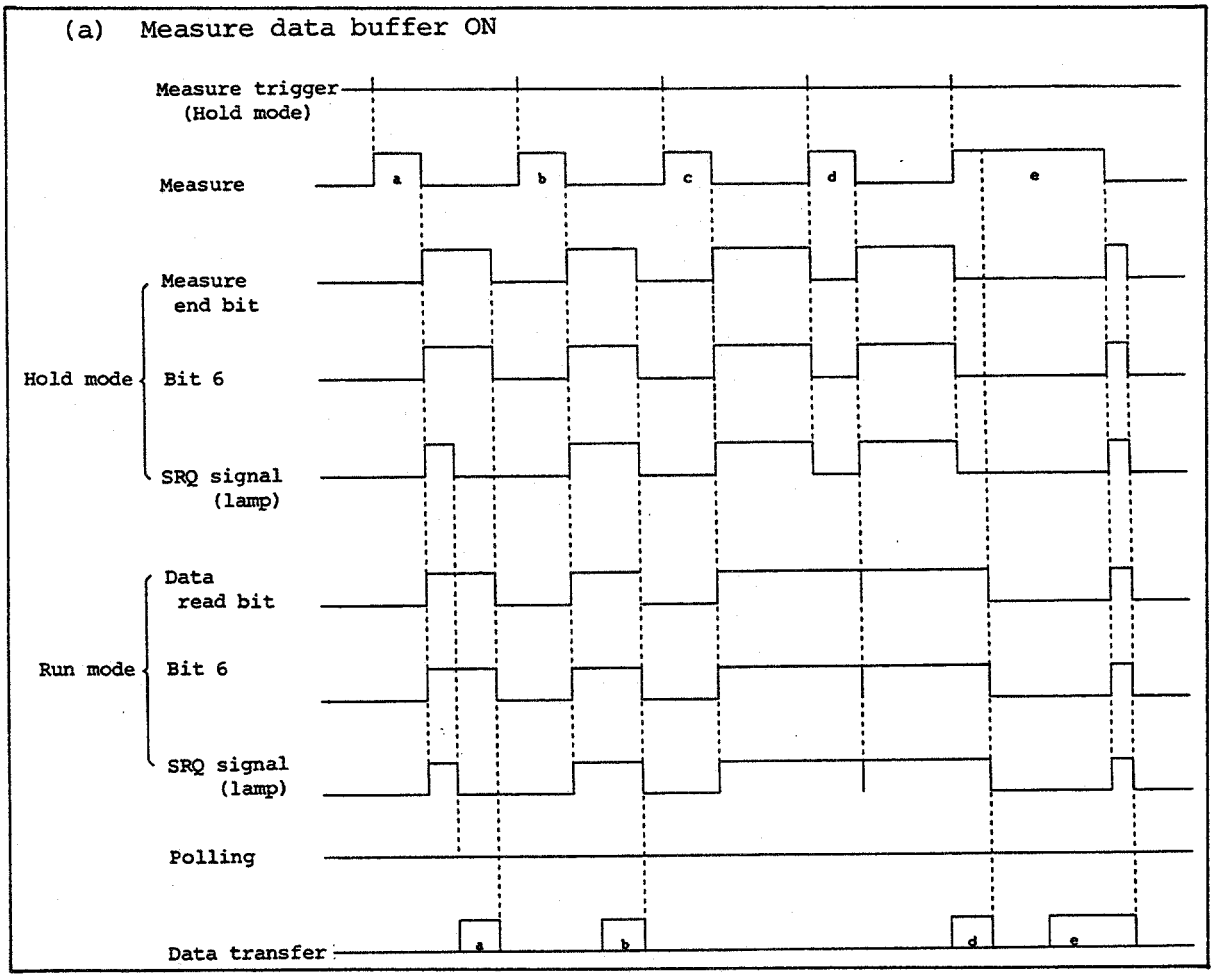


Figure 5-7 Timing Chart of Measure End Bit (cont'd)

(5) SWEEP END Bit (bit 3)

When a sweep terminates in the single mode, this bit is set to 1. In the repeat mode, it is not set to 1.

When a sweep starts, it is cleared to 0. After a change to the DC mode, it is cleared to 0.

WHen a polling is performed, it is cleared to 0.

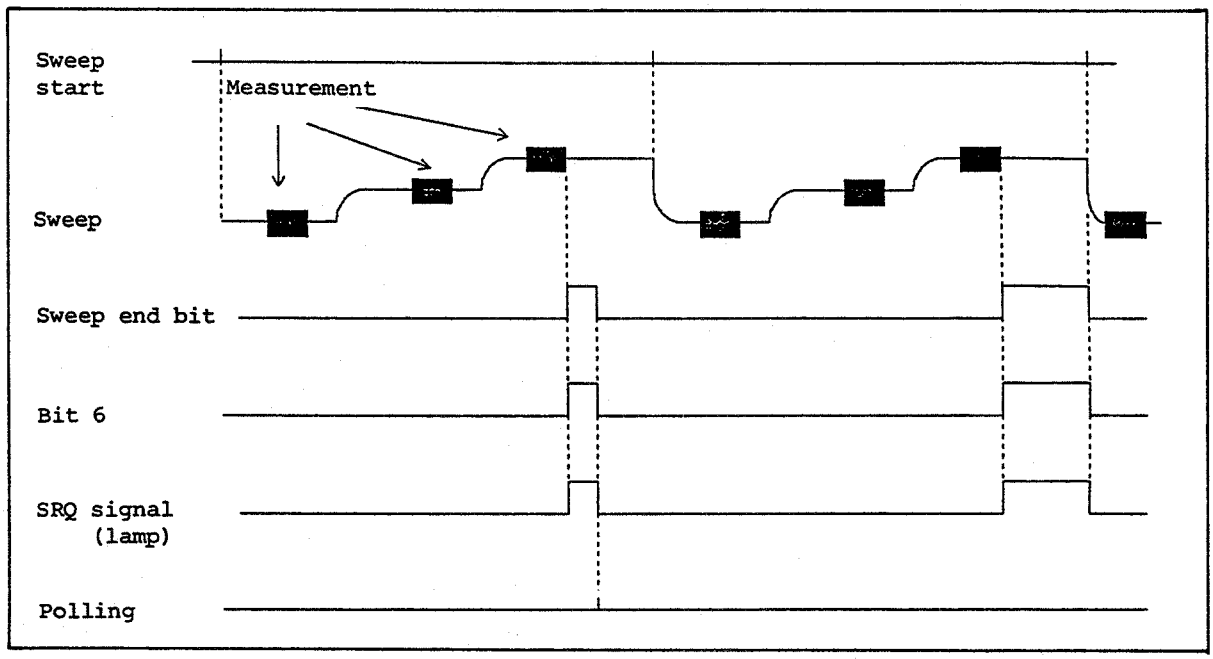


Figure 5-8 Timing Chart of Sweep End Bit

(6) BUFFER FULL Bit (bit 3)

When the measured data in the repeat sweep or measure data buffer becomes full, this bit is set to 1.

When the measured data buffer becomes empty after a data transfer, this bit is set to 0.

When clear C4 for the measure data buffer is received, it is cleared to 0.

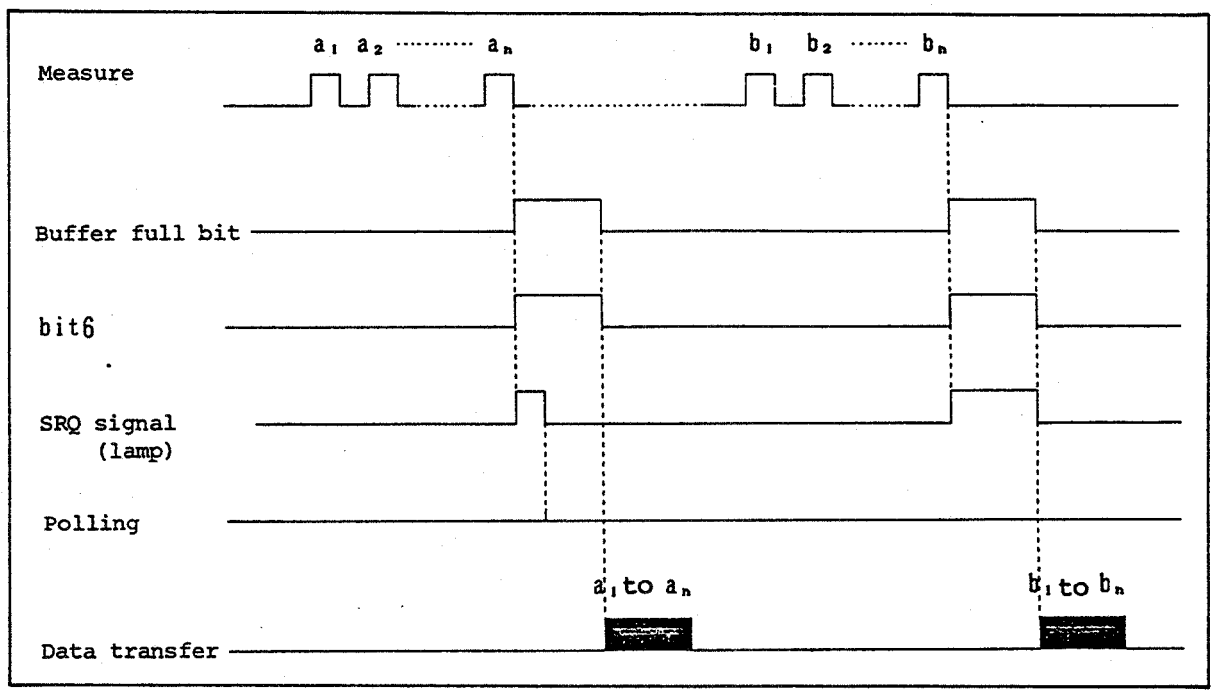


Figure 5-9 Timing Chart of Buffer Full Bit

(7) TRIGGER IN Bit (bit 4)

When a signal is input from a trigger terminal on the rear panel, this bit is set to 1.

When polling is performed, it is cleared to 0.

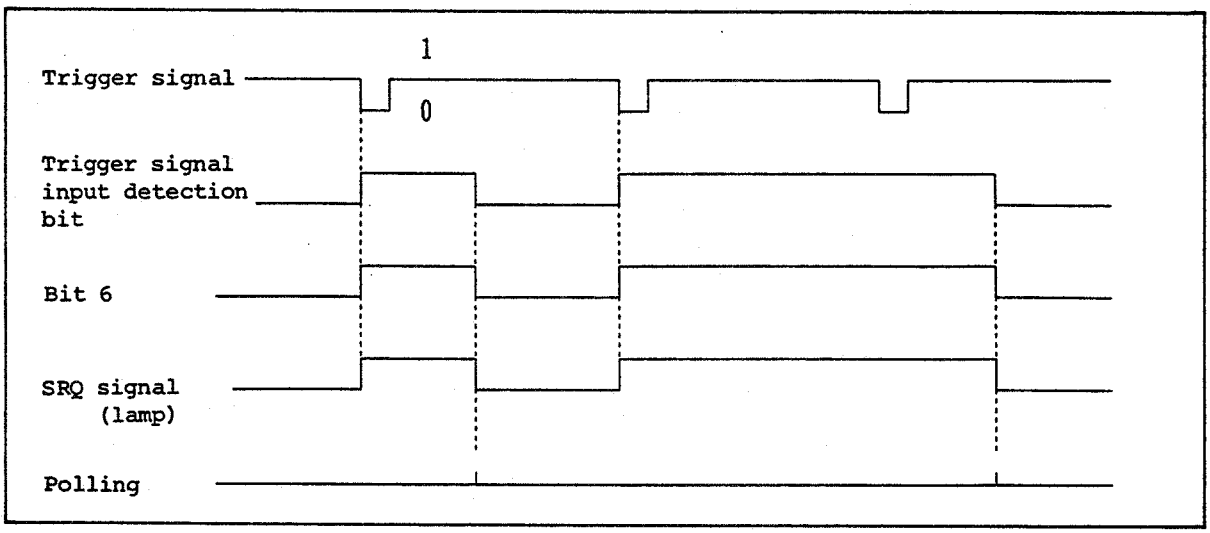


Figure 5-10 Timing Chart of Trigger Signal Input Detect Bit

(8) OPERATE OFF Bit (bit 7)

When a break signal is input from an operation input terminal on the rear panel, this bit is set to 1.

When polling is performed, it is cleared to 0.

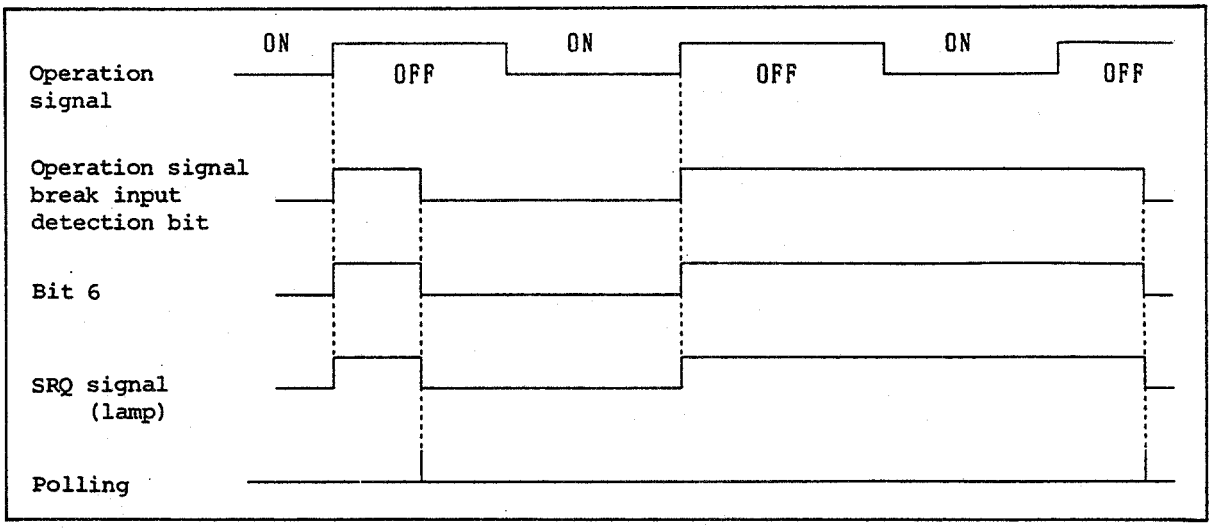


Figure 5-11 Timing Chart of Operation Signal Break Input Detection Bit

6. CALIBRATION

To meet the accuracy required for generation and measurement, perform a calibration periodically. The calibration cycle of the TR6143 is six months.

An outline of the calibration procedure flow is shown in Figure 6-1.

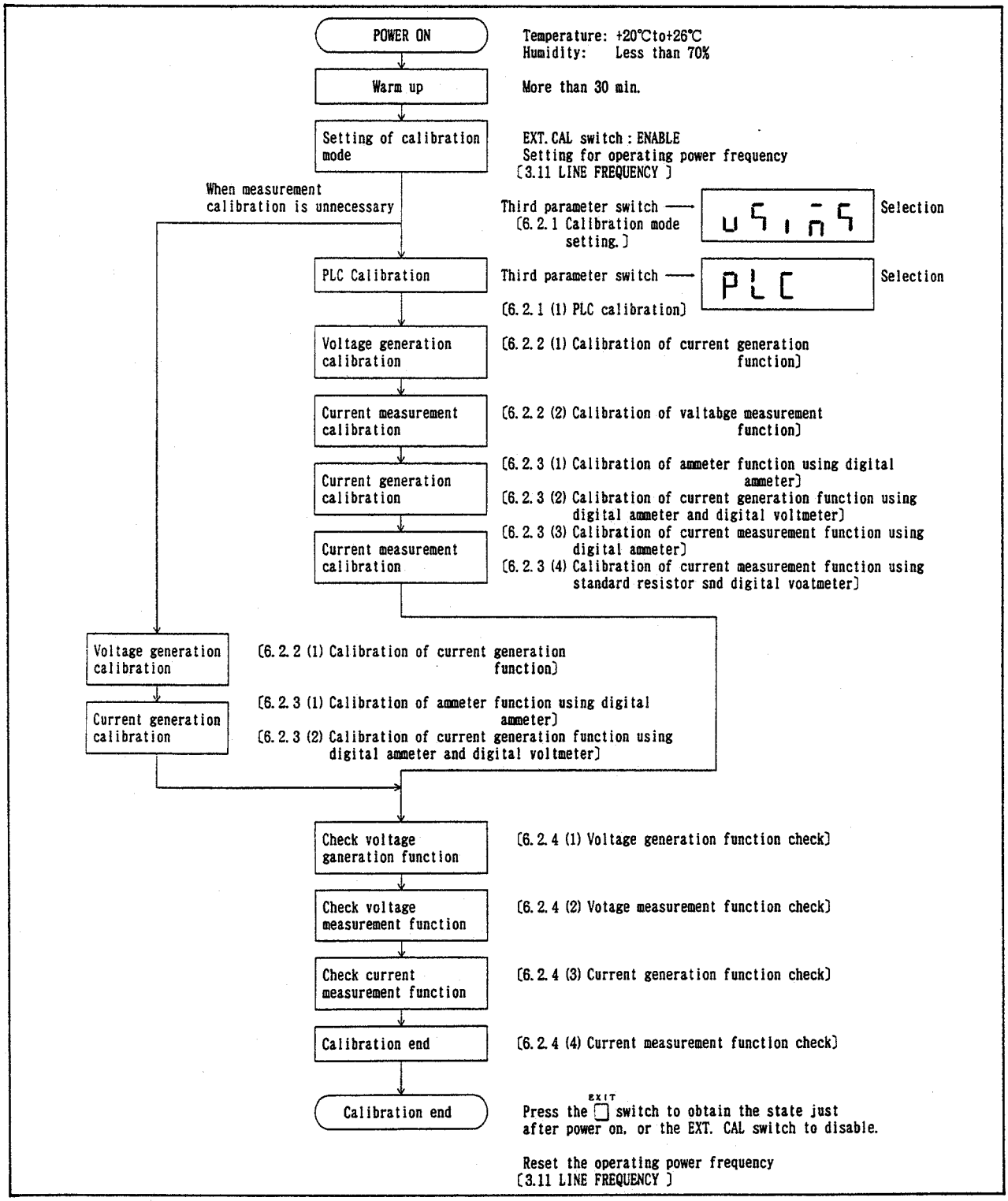


Figure 6-1 Outline of the Calibration Procedure Flow

6.1 Preparation for Calibration

(1) Power

Use 50 Hz/60 Hz AC power.

(2) Environment

Calibrate in a place with a temperature of 20 to 26°C and a humidity of 70% or less with no dust, vibration, or noise.

(3) Warm Up

Warm up for more than 30 minutes. Warm up standard devices for each calibration for the specified time.

(4) Standard Instruments to be Used

Standard Instrument	Operating range	Accuracy	Recommended instrument
Digital voltmeter	0 V to 120 V	Less than ±0.005%	TR6878
Digital ammeter	0 µA to 120 mA	Less than ±0.01%	
Standard resistor (for 320 mA range calibration)	300 mA	Less than ±0.01%	
Standard resistor (for 2 A range calibration)	2A	Less than ±0.01%	

6.2 How to Calibrate

Perform a zero point calibration and full scale calibration for each range of each generation and measurement function.

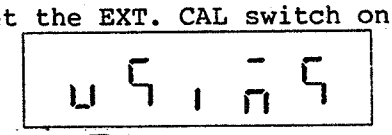
Table 6-1 lists the calibration items, recommended set values, input values, and allowable calibration errors.

Table 6-1 Calibration Items and Recommended Set Values

Measurement item	Range	Polarity	Calibration item, calibration set value, and accuracy			
			Zero point calibration set value	Zero point adjustment range	Full scale calibration set value	Full scale adjustment range
Voltage generation (VSVM function)	320 mV	+	000.00 mV	±0.01 mV	300.00 mV	±0.03 mV
	3.2 V	+	0.0000 V	±0.0001 V	3.0000 V	±0.0003 V
	32 V	+	00.000 V	±0.001 V	30.000 V	±0.003 V
	110 V	+	000.00 V	±0.01 V	100.00 V	±0.03 V
Current generation (ISIM function)	32 µA	+	00.000 µA	±0.002 µA	30.000 µA	±0.003 µA
		−	-00.000 µA		-30.000 µA	
	320 µA	+	000.00 µA	±0.01 µA	300.00 µA	±0.03 µA
		−	-000.00 µA		-300.00 µA	
	3.2 mA	+	0.0000 mA	±0.0001 mA	3.0000 mA	±0.0003 mA
		−	-0.0000 mA		-3.0000 mA	
	32 mA	+	00.000 mA	±0.001 mA	30.000 mA	±0.003 mA
		−	-00.000 mA		-30.000 mA	
	320 mA	+	000.00 mA	±0.01 mA	300.00 mA	±0.03 mA
		−	-000.00 mA		-300.00 mA	
	2A	+	0000.0 mA	±0.1 mA	2000.0 mA	±0.3 mA
		−	-0000.0 mA		-2000.0 mA	
Voltage measurement (VSVM function)	320 mV	+	000.00 mV	±1d	300.00 mV	±3d
	3.2 V	+	0.0000 V	±1d	3.0000 V	±3d
	32 V	+	00.000 V	±1d	30.000 V	±3d
	110 V	+	000.00 V	±1d	100.00 V	±3d
Current measurement (ISIM function)	32 µA	+	00.000 µA	±2d	30.000 µA	±3d
	320 µA	+	000.00 µA	±2d	300.00 µA	±3d
	3.2 mA	+	0.0000 mA	±2d	3.0000 mA	±3d
	32 mA	+	00.000 mA	±2d	30.000 mA	±3d
	320 mA	+	000.00 mA	±2d	300.00 mA	±3d
	2 A	+	0000.0 mA	±2d	2000.0 mA	±3d

Procedures for calibration are shown below. Though calibration is valid if it is only a particular range of a particular setting and measurement function, it is explained in the order of the calibration items in Table 6-1 Calibration item list and recommended set values here.

6.2.1 Calibration Mode Setting

Set the EXT. CAL switch on the rear panel to Enable, and select  display by pressing the third parameter switch  .

CAUTION

Calibrate the measurement function after the PLC calibration has been done.

(1) PLC Calibration

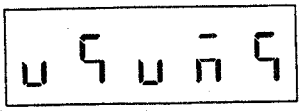
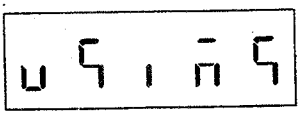
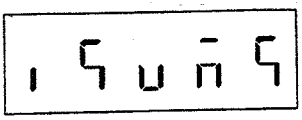
① Select the  display by pressing the third parameter switch.

② Press the AUTO RANGE switch

Measures the total integration time ratio internally in about five seconds.

③ When  is displayed, it is finished.

④ TR6143 is left for about five minutes until the circuit operation is steady.

⑤ Select the  
 or 
display by pressing the third parameter switch.

6.2.2 Calibration of Voltage Function

(1) Calibration of Voltage Generation Function

① Select the  display by pressing the V/I switch.

(Voltage generation function)

② Select the range for calibration by pressing the ▽, △ switch.

③ Connect the output terminals (OUTPUT HI/LO and GUARD SENSE switch: 2 WIRE) of the TR6143 and the input terminal of a digital voltmeter.

Adjust the range of the digital voltmeter to the calibration range of the TR6143.

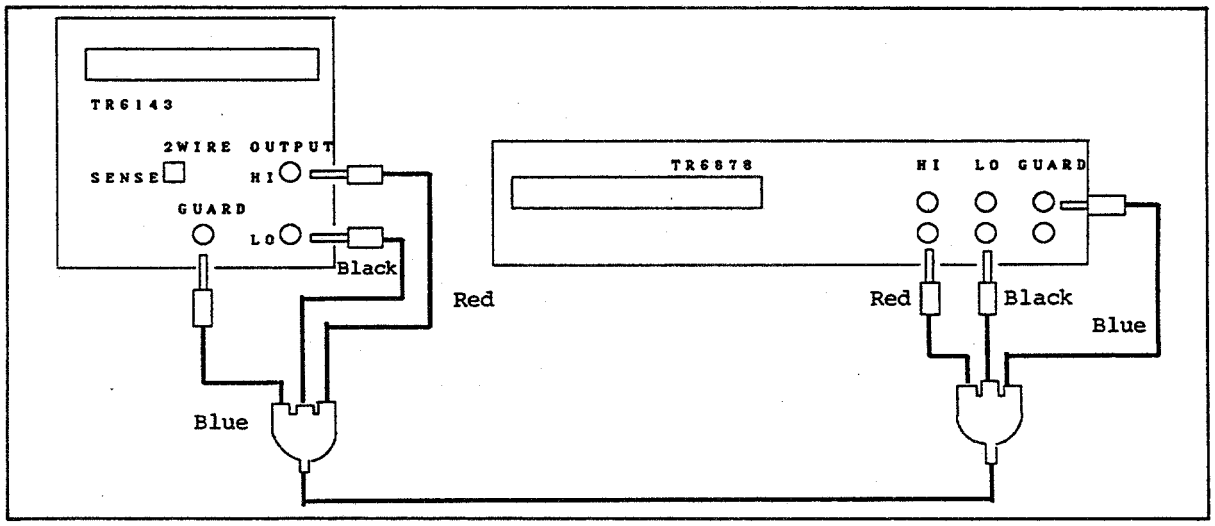


Figure 6-2 How to Connect to a Digital Voltmeter

④ Set to Operation ON by pressing the OPERATE switch.

⑤ Set the display to 0 by tuning the data knob switch and pressing the ◁ or ▷ switch. (see Table 6-1 Calibration items and recommended set values.)

⑥ Select the | uSCAL | display by pressing the third parameter switch.

Read the measured value using a digital voltmeter and key input.

DIRECT ENTER

0 0 0 . 1 2

Value read using a digital voltmeter

⑦ Select the | uSuSn | display by pressing the third parameter switch.

⑧ Set a full scale calibration value by tuning the data knob switch and pressing the ◁ or ▷ switch.

(see Table 6-1 Calibration items and recommended set values.)

⑨ Select the | uSCAL | display by pressing the third parameter switch.

Read the measured value using a digital voltmeter and key input.

DIRECT ENTER

0 9 9 . 7 5

Value read using a digital voltmeter

⑩ Select the [U 5 U n] display by pressing the third parameter switch.

⑪ Ensure that the zero point and full scale calibration are correct. (see Table 6-1 Calibration items and recommended set values.

ZERO POINT AND FULL SCALE CALIBRATION TO BE ENSURED [1]

(a) Ensure that the value read using the digital voltmeter is in the zero point adjustment range by setting a zero point calibration value.
If it is over the zero point adjustment range, fine tuning is required. (see Figure 6-3)

(b) Ensure that the value read using the digital voltmeter is in the full scale adjustment range by setting a full scale calibration value.
If it is over the full scale adjustment range, fine tuning is required. (see Figure 6-4)

(a) Set the display to 0.

(b) Start fine tuning the zero point calibration at NULL ON.

(c) Perform fine tuning while watching the value measured by the voltmeter by tuning the data knob.

(d) Terminates at NULL OFF.

Figure 6-3 Fine Tuning of Zero Point Calibration

(a) Set the display to the full scale calibration value.

(b) Start fine tuning at NULL ON.

(c) Perform fine tuning while watching the measured value by tuning the data knob.

(d) Terminates at NULL OFF.

Figure 6-4 Fine Tuning for Full Scale Calibration

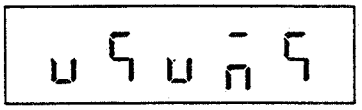
⑫ Change the calibration range by pressing the or switch. Repeat from ⑤ hereafter.

o Calibrate 320 mV, 3.2 V, 32 V, and 110 V in the above manner.

(2) Calibration of Voltage Measurement Function

CAUTION

Calibrate the measurement function after the PLC calibration has been performed.

① Select the  display by pressing the V/I switch.

(Voltage generation and voltage measurement function)

② Select the range for which calibration is to be performed by pressing the ⇩ or ⇧ switch.

③ Connect the output terminals (OUTPUT HI/LO and GUARD SENSE switch: 2 WIRE) of the TR6143 and the input terminals of the digital voltmeter.

Adjust the calibration range of the TR6143 to the range of the digital voltmeter.

④ Set the operation ON by pressing the OPERATE switch.

⑤ Set the set value to 0 by tuning the data knob switch and pressing the ◁ or ▷ switch.

(see Table 6-1 Calibration items and recommended set values.)

⑥ Select the uSCAL display by pressing the third parameter switch.

⑦ Select the uñCAL display by pressing the LIMIT switch.

(Voltage measurement function calibration value input mode)

Read the value measured by the digital voltmeter and key input.

DIRECT 0 0 0 . 1 2 ENTER

Value read using a digital voltmeter

⑧ Select the uSuñS display by pressing the third parameter switch.

⑨ Set a calibration value by tuning the data knob switch and pressing the ◁ or ▷ switch.

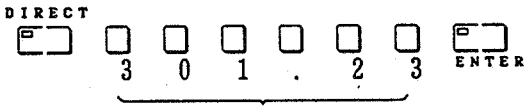
(see Table 6-1 Calibration items and recommended values.)

⑩ Select the uSCAL display by pressing the third parameter switch.

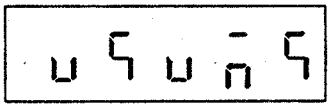
⑪ Select the  display by pressing the LIMIT switch.

(Voltage measurement function calibration value input mode)

Read the value measured by the digital voltmeter and key input,



Value read using a digital voltmeter

⑫ Select the  display by pressing the third parameter switch.

⑬ Ensure that the zero point and full scale calibration are correct. (see Table 6-1 Calibration items and recommended set values.)

ZERO POINT AND FULL SCALE CALIBRATION TO BE ENSURED [2]

(a) Set a zero point calibration value and press the LIMIT switch.
(The display will change from a zero point calibration value to a measured value display.)
Ensure that the read value of a measured value of the TR6143 is within the calibration error range for a read value of the digital voltmeter.
If it is outside the calibration error range, perform fine tuning.
(see Figure 6-3 Fine tuning of zero point calibration.)

Return to the ×××× display by pressing the LIMIT switch.

(Returns to the zero point calibration value display)

(b) Set a full scale calibration value and press the LIMIT switch.

(The display will change from a full scale calibration value to a measured value display.)
Ensure that the read value of a measured value of the TR6143 is with the calibration error range for a read value of the digital voltmeter.
If it is outside calibration error range, perform fine tuning.
(see Figure 6-4 Fine tuning of full scale calibration.)

Return to the ×××× display by pressing the LIMIT switch.

(Returns to a full scale calibration value display.)

⑭ By pressing the ⇩ or ⇧ switch, change the calibration range and also the range of the digital voltmeter. Hereafter, repeat from ⑤.

Perform the zero point and full scale calibration for the 320 mV, 3.2 V, 32 V, and 110 V ranges of the measurement function in the above manner.

6.2.3 Calibration of Current Generation Function

(1) Calibration of current generation function by a digital ammeter.

> **CAUTION**
>
> A calibration value can be input up to 32000 counts. If a measured value of the digital ammeter becomes more than 32000 counts, lower the full scale calibration set value to 28000 counts.

① Select the display by pressing the V/I switch.

② Select a range for calibration by pressing the ▽ or △ switch.

③ Connect the output terminals (OUTPUT HI/LO and GUARD SENSE switch: 2 WIRE) and the input terminals of the digital ammeter.

Adjust the range of the digital ammeter to the calibration range of the TR6143.

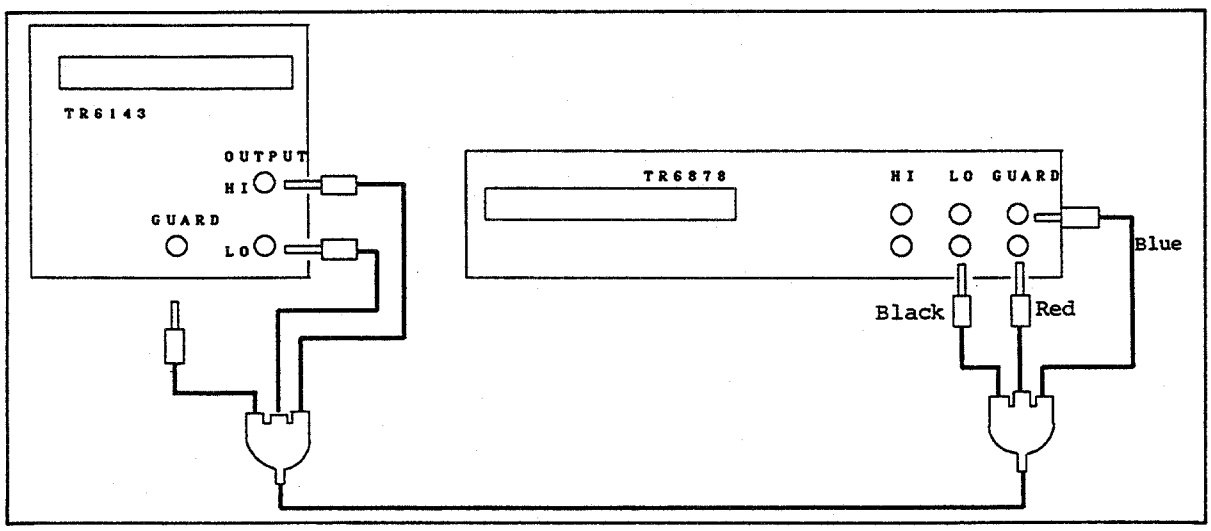


Figure 6-5 How to Connect to a Digital Ammeter

④ Set the operation ON by pressing the OPERATE switch.

⑤ Set the polarity by pressing the + switch.

⑥ Calibrate the + polarity as in 6.2.2 Item (1) ⑤ - ⑫ .

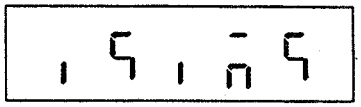
⑦ Set the polarity to - by pressing the - switch.

⑧ Calibrate the - polarity as in 6.2.2 Item (1) ⑤- ⑫ .

⑨ Change the calibration range by pressing the ⇩ or ⇧ switch and also change the range of the digital ammeter. Hereafter, repeat from ⑤.

- Calibrate the zero point of each polarity (+ and -) for the 32 μA, 320 μA, 3.2 mA, 32 mA ranges and perform a full scale calibration in the above manner.

(2) Calibration of current generation function using a standard resistor and digital voltmeter

① Select the  display by pressing the V/I switch.

(Current generation function)

② Select the range for which calibration is to be performed by pressing the ⇩ or ⇧ switch.

③ Connect a standard resistor and digital voltmeter to the TR6143. (Figure 6-6 shows the connection method.)

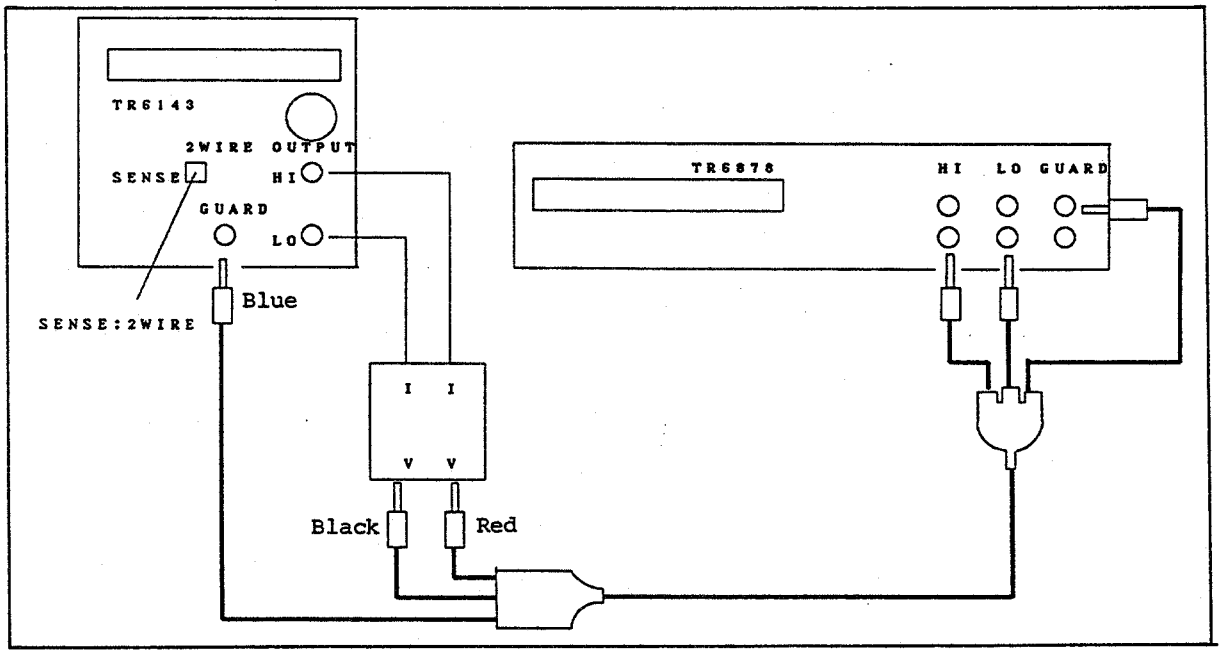


Figure 6-6 Connection to the Standard Resistor and Digital Voltmeter

④ Set the operation ON by pressing the OPERATE switch.

⑤ Set the polarity to + by pressing the + switch.

⑥ Calibrate the + polarity as in 6.2.2 Item (1) ⑤ to ⑪ .

For a key input, enter the current conversion value, that is a value read using the digital voltmeter divided by the calibration value of a standard resistor.

$$\text{Current conversion value} = \frac{\text{Value read by digital voltmeter}}{\text{Calibration value of standard resistor}} \quad \text{[Expression 1]}$$

⑦ Set the polarity to - by pressing the [−] switch.

⑧ Calibrate the - polarity as in 6.2.2 Item (1) ⑤ to ⑪. (see Expression 1.)

⑨ Change the calibration range by pressing the [▽] or [△] switch and replace the standard resistor. Hereafter, repeat from ⑤.

- Calibrate the 320 mA and 2 A ranges in the above manner.

(3) Calibration of current measurement function using a digital ammeter

CAUTION

Calibrate the measurement function after the PLC calibration.

① Select the  display by pressing the [V/I] switch.

(Current generation and current measurement function)

② Select the range for which the calibration is to be performed by pressing the or switch.

③ Connect the output terminals (OUTPUT HI/LO and GUARD SENSE switch: 2 WIRE) to the input terminals of the digital ammeter. Adjust the range of the digital ammeter to the calibration range of the TR6143.

④ Set to operation ON by pressing the [OPERATE] switch.

⑤ Calibrate as in 6.2.2 Item (2) ⑤ to ⑬.

⑥ Change the calibration range by pressing the [▽] or [△] switch and also change the range of the digital ammeter. Hereafter, repeat from ⑤.

- Calibrate the zero point of the 32 µA, 320 µA, 3.2 mA, and 32 mA ranges and perform a full scale calibration.

(4) Calibration of current measurement function using a standard resistor and digital voltmeter

CAUTION

Calibrate the measurement function after the PLC calibration.

① Select the I SI I mS display by pressing the V/I switch.

(Current generation and current measurement function)

② Select the range for which the calibration is to be performed by pressing the ▽ or △ switch.

③ Connect the standard resistor and digital voltmeter to the TR6143. Figure 6-6 shows the connection method.

④ Set the operation ON by pressing the OPERATE switch.

⑤ Calibrate as in 6.2.2 Item (2) ⑤ to ⑬.
For a key input, enter a current conversion value, that is a value read using the digital voltmeter divided by the calibration value of the standard resistor. (see Expression 1.)

⑥ Change the calibration range by pressing the ▽ or △ switch and also change the range of the digital ammeter. Hereafter, repeat from ⑤.

- Calibrate the zero point of the 320 mA and 2 A ranges and perform a full scale calibration manner.

6.2.4 Check After Calibration

It is recommended that the zero point of all functions and full scale values be checked again after the calibration is completed.

(1) Voltage Generation Function Check

① Select the USUmS display by pressing the V/I switch.

② Connect to the output terminal of the TR6143 by referring to Figure 6-5 Connection to a digital voltmeter.

③ Check the zero point and full scale calibration value as in 6.2.2 (1) ⑪.

④ Change the calibration range and voltage range by pressing the ▽ or △ switch.

Hereafter, repeat from ③

- Check the 320 mV, 3.2 V, 32 V and 110 V ranges in the same manner.

(2) Voltage Measurement Function Check

① Select the [U5U-5] display by pressing the V/I switch.

② Connect to the output terminal of the TR6143 by referring to Figure 6-5 Connection to a digital voltmeter.

③ Check the zero point and full scale calibration value as in 6.2.2 (2) 13.

④ Change the calibration range and voltmeter range by pressing the ▽ or △ switch.

Hereafter, repeat from ③.

o Check the 320 mV, 3.2 V, 32 V, and 110 V ranges in the above manner.

(3) Current Generation Function Check

① Select the [I5I-5] display by pressing the V/I switch.

② Connect the output terminal to a digital ammeter or connect a standard resistor to the digital voltmeter as in 6.2.3 (1) ③ (32 μA to 32 mA ranges) or 6.2.3 (2) ③ (320 mA and 2 A ranges). (see Figure 6-5 Connection to a digital ammeter or Figure 6-6 Connection to a standard resistor and digital voltmeter.)

③ Set the polarity to + by pressing the [+] switch.

④ Check the zero point and full scale calibration value as in 6.2.2 (1) ⑪.
When calibrated by a standard resistor, convert it to a current value using Expression 1.

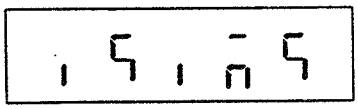
⑤ Set the polarity to - by pressing the [−] switch.

⑥ Check the zero point and full scale calibration value as in 6.2.2 (1) ⑪.
When calibrated by a standard resistor, convert it to a current value using Expression 1.

⑦ Change the calibration range and ammeter range or the standard resistor by pressing the [▽] or [△] switch. Hereafter, repeat from ②.

- Check the 32 µA, 320 µA, 3.2 mA, 32 mA, 320 mA, and 2 A ranges in the above manner.

(4) Current Measurement Function Check

① Select the  display by pressing the [V/I] switch.

② Connect the output terminal to a digital ammeter or connect a standard resistor to a digital voltmeter as in 6.2.3 (1) ③ (32 µA to 32 mA ranges) or 6.2.3 (2) ③ (320 mA and 2 A ranges).
(see Figure 6-5 Connection to a digital ammeter or Figure 6-6 Connection to a standard resistor and digital voltmeter.)

③ Set the polarity to + by pressing the [+] switch.

④ Check the zero point and full scale calibration value as in 6.2.2 (2) ⑬.
When calibrated by a standard resistor, convert it to a current value using Expression 1.

⑤ Change the calibration range and ammeter range or a standard resistor by pressing the [▽] or [△] switch.

- Check the 32 µA, 320 µA, 3.2 mA, 320 mA, and 2 A ranges in the above manner.

6.2.5 Calibration Termination

CAUTION

Operation shown in "6.2.5 Calibration Termination" is required to turn off the power in the midst of the calibration.
If the power is removed because of a power failure during calibration, first set the EXT.CAL switch to DISABLE. Press the + switch immediately after powering on to initialize the parameters, then go on in calibration.

① Press the EXIT switch. The device will return to the same state as when the power was turned on.

② Set the EXT.CAL switch on the panel to DISABLE.

③ After it is powered on again, press the + switch immediately to initialize the parameters.

7. SPECIFICATION

7.1 Voltage Generation/Current Measurement (VSIM)

Generation and measurement ranges:

Setting ranges	Generation ranges	Minimum step
320 mV	0 to ±320.00 mV	10 µV
3.2 V	0 to ±3.2000 V	100 µV
32 V	0 to ±32.000 V	1 mV
110 V	0 to ±110.00 V	10 mV
Setting ranges	**Measurement ranges**	**Resolution**
32 µA	0 to ±32.000 µA	1 nA
320 µA	0 to ±320.00 µA	10 nA
3.2 mA	0 to ±3.2000 mA	100 nA
32 mA	0 to ±32.000 mA	1 µA
320 mA	0 to ±320.00 mA	10 µA
2 A	0 to ±2000.0 mA	100 µA

Overall accuracy: Overall accuracy including calibration accuracy, daily stability, temperature coefficient and linearity is guaranteed for the duration of six months in the condition of temperature of 23°C ± 5°C, humidity of less than 85% and constant line voltage.

Voltage generation ranges	Generation accuracy ± (% of setting + V)	
320 mV	0.05 + 160 µV	
3.2 V	0.05 + 960 µV	
32 V	0.05 + 9.6 mV	
110 V	0.05 + 64 mV	
Current measurement ranges	Integration time (IT)	Measurement accuracy ± (% of rdg + digit + digit x V_0/1V)
32 µA	10 ms 1 PLC 10 PLC 100 PLC	0.05 + 7d + 0.5d x V_0/1V
320 µA		
3.2 mA		
32 mA		
320 mA		
2 A		0.05 + 7d + 0.5d x V_0/1V

Auto calibration is ON.

Daily stability: At temperature of 23°C ± 5°C, humidity of 85% or less, and constant line voltage and load conditions.

Voltage generation ranges	Generation stability ± (% of setting + V)	
320 mV	0.015 + 50 µV	
3.2 V	0.015 + 300 µV	
32 V	0.015 + 3 mV	
110 V	0.015 + 20 mV	
Current measurement ranges	Integration time (IT)	Measurement stability ± (% of rdg + digit + digit x V_0/1V)
32 µA	10 ms 1 PLC 10 PLC 100 PLC	0.02 + 4d + 0.2d x V_0/1V
320 µA		
3.2 mA		
32 mA		
320 mA		
2 A		0.03 + 4d + 0.2d x V_0/1V

Auto calibration is ON.

Temperature coefficient:

At temperature of 0°C to +40°C and humidity of 85% or less

Voltage generation ranges	Temperature coefficient ± (ppm/°C of setting + V/°C)	
320 mV	20 + 12 µV	
3.2 V	20 + 64 µV	
32 V	20 + 640 µV	
2 A	20 + 6.4 mV	
Current measurement ranges	Integration time (IT)	Temperature coefficient ± (ppm/°C of rdg + digit/°C + digit/°C x V_0/1V)
32 µA	10 ms 1 PLC 10 PLC 100 PLC	25 + 0.5d + 0.03d x V_0/1V
320 µA		
3.2 mA		
32 mA		
320 mA		35 + 0.5d + 0.03d x v_0/1V
110 A		50 + 0.5d + 0.03d x V_0/1V

Auto calibration is ON.

Voltage generation linearity:

±0.012% of the range at temperature of 23°C ± 5°C and humidity of 85% or less.

Voltage generation noise and fluctuation:

Response	No-load		
	DC to 100Hz	DC to 10kHz	20Hz to 20MHz
FAST	50µVp to p±1d	1mVp to p±1d	10mVp to p±1d
SLOW	50µVp to p±1d	1mVp to p±1d	5mVp to p±1d

Response	Maximum load		
	DC to 100Hz	DC to 10kHz	20Hz to 20MHz
FAST	50µVp to p±1d	1mVp to p±1d	10mVp to p±1d
SLOW	50µVp to p±1d	1mVp to p±1d	5mVp to p±1d

Range-switching noise:

Range switching	Conditions	Noise
Voltage generation range switching	—	50mVp-p±1d
Current measurement range switching	When current limiter does not operate.	50mVp-p
	When current limiter operates.	±300d 50mv
Current limiter range switching	—	±300d±50mV

1d is a display resolution of voltage generation or current limiter.

Response time: Time needed to come within 0.05% of the full scale in all ranges. However, this is when a limiter is set to the full scale value of each limiter range.
FAST: 3ms or less
SLOW: 20ms or less

Line regulation: ±0.003% of the range or less at AC100 V ± 10%

Load regulation: ±0.003% of the setting or less at maximum load of each range with 4 WIRE connected

Maximum output current:
Source: 2 A, up to ±32 V
1 A, up to ±64 V
0.5 A, up to ±110 V
Sink : 2 A, up to ±32 V
1 A, up to ±64 V
0.5 A, up to ±110 V

Output impedance: At output terminal with 2 WIRE connected

Current measurement ranges	Output impedance
32 µA	100 mΩ or less
320 µA	20 mΩ or less
3.2 mA	10 mΩ or less
32 mA	
320 mA	
2 A	

Maximum capacitive load:

Current measurement ranges	Maximum capacitive load	
	FAST	SLOW
32 µA	0.01 µF	1 µF
320 µA		
3.2 mA	0.1 µF	100 µF
32 mA		
320 mA	100 µF	2000 µF
2 A	1000 µF	

Common mode noise rejection ratio:
80 dB or more between Lo and GUARD terminals with the 1 kΩ unbalanced impedance for DC and 50 Hz/60 Hz ± 1%

Current measurement NMR: 50/60 Hz ± 0.09%

Integration time (IT)	NMR
10 ms	0 dB
1 PLC to 100 PLC	60 dB or more

Current limiter

Setting ranges:

Ranges	Setting ranges	Minimum step
32 µA	±0.300 µA to ±32.000 µA	1 nA
320 µA	±3.00 µA to ±320.00 µA	10 nA
3.2 mA	±0.0300 mA to ±3.2000 mA	100 nA
32 mA	±0.300 mA to ±32.000 mA	1 µA
320 mA	±3.00 mA to ±320.00 mA	10 µA
2 A	±30.0 mA to ±2000.0 mA	100 µA

Overall accuracy: ±0.07% of the setting ± (0.1% + 0.003% x V_0/1V) of the range at temperature of 23°C ± 5°C and humidity of 85% or less for all ranges

Temperature coefficient and daily stability:
Same as that of current generation

7.2 Output Current/Voltage Measurement (ISVM)

Generation and measurement ranges:

Ranges	Generation ranges	Minimum step
32 µA	0 to ±32.000 µA	1 nA
320 µA	0 to ±320.00 µA	10 nA
3.2 mA	0 to ±3.2000 mA	100 nA
32 mA	0 to ±32.000 mA	1 µA
320 mA	0 to ±320.00 mA	10 µA
2 A	0 to ±2000.0 mA	100 µA
Ranges	Measurement ranges	Resolution
320 mV	0 to ±320.00 mV	10 µV
3.2 V	0 to ±3.2000 V	100 µV
32 V	0 to ±32.000 V	1 mV
110 V	0 to ±110.00 V	10 mV

Overall accuracy: Overall accuracy including calibration accuracy, daily stability, temperature coefficient and linearity is guaranteed for the duration of six months in the condition of temperature of 23°C ± 5°C with humidity of 85% or less, and constant line voltage.

Current generation ranges	Setting accuracy	
	± (% of setting + A + A x $V_{0/1V}$)	
32 µA	0.05 + 9.6nA + 480pA x $V_{0/1V}$	
320 µA	0.05 + 64nA + 4.8nA x $V_{0/1V}$	
3.2 mA	0.05 + 960nA + 48nA x $V_{0/1V}$	
32 mA	0.05 + 6.4 µA + 480nA x $V_{0/1V}$	
320 mA	0.05 + 96 µA + 4.8µA x $V_{0/1V}$	
2 A	0.07 + 960µA + 48µA x $V_{0/1V}$	
Voltage measurement ranges	Integration time (IT)	Measurement accuracy
		± (% of rdg + digit)
320 mV	10 ms	0.05 + 7d
3.2 V	1 PLC	
32 V	10 PLC	
110 V	100 PLC	0.05 + 3d

Auto calibration is ON.

Daily stability: At temperature of 23°C ± 5°C, humidity of 85% or less, and constant line voltage and load conditions.

Current generation ranges	Generation stability	
	± (% of setting + A + A x $V_{0/1V}$)	
32 µA	0.02 + 6.4nA + 200pA x $V_{0/1V}$	
320 µA	0.02 + 32nA + 2nA x $V_{0/1V}$	
3.2 mA	0.02 + 640nA + 20nA x $V_{0/1V}$	
32 mA	0.02 + 3.2µA + 200nA x $V_{0/1V}$	
320 mA	0.02 + 64µA + 2µA x $V_{0/1V}$	
2 A	0.03 + 640µA + 20µA x $V_{0/1V}$	
Voltage measurement ranges	Integration time (IT)	Measurement Stability
		± (% of rdg + digit)
320 mV	10 ms	0.015 + 3d
3.2 V	1 PLC	0.015 + 2d
32 V	10 PLC	
110 V	100 PLC	

Auto calibration is ON.

Temperature coefficient: At temperature of 0°C to +40°C and humidity of 85% or less.

Current generation ranges	Temperature coefficient	
	± (ppm/°C of setting + A/°C + A/°C x V_0/1V)	
32 µA	25 + 1nA + 30pA x V_0/1V	
320 µA	25 + 6.4nA + 300pA x V_0/1V	
3.2 mA	25 + 100nA + 3nA x V_0/1V	
32 mA	25 + 640nA + 30nA x V_0/1V	
320 mA	35 + 10µA + 300nA x V_0/1V	
2 A	50 + 100µA + 3µA x V_0/1V	
Voltage measurement ranges	Integration time (IT)	Measurement temperature coefficient
		± (ppm/°C of rdg + digit/°C)
320 mV	10 ms	20 + 0.2d
3.2 V	1 PLC	
32 V	10 PLC	
110 V	100 PLC	

Auto calibration is ON.

Current generation linearity:
±0.012% of range at temperature of 23°C ± 5°C and humidity of 85% or less

Current generation noise and fluctuation:
For 1 kΩ load resistance

Current ranges	Response	DC to 100Hz	DC to 10kHz	DC to 20MHz
2A, 320mA	SLOW	±1d	±1d	1mAp-p
	FAST	±2d	±2d	2mAp-p
32mA to 32µA	SLOW	20nAp-p±1d	200nAp-p±20d	
	FAST	20nAp-p±2d	200nAp-p±50d	

Range-switching noise:

Range switching	Noise
Current generation range switching	±300d±50mV
Voltage measurement range switching	50mVp-p
Voltage limiter range switching	50mVp-p±1d

1d is a display resolution of current generation or voltage limiter.

Response time: Time needed to come within 0.05% of the full scale in all ranges without capacitive load
FAST: 3 ms
SLOW: 20ms

Line regulation: ±0.003% or less of the range for the variation of AC100 V ± 10%

Load regulation: Same as the item of the overall accuracy, ± (A x V_O/1V), at the tracking voltage of 0 to ±110 V (V_O: Tracking voltage)

Maximum tracking voltage:
Source: 110 V, up to ±0.5 A
64 V, up to ±1 A
32 V, up to ±2 A
Sink : 110 V, up to ±0.5 A
64 V, up to ±1 A
32 V, up to ±2 A

Output impedance:

Current measurement ranges	Output impedance
32 µA	10^{10} Ω or more
320 µA	10^{9} Ω or more
3.2 mA	10^{8} Ω or more
32 mA	10^{7} Ω or more
320 mA	10^{6} Ω or more
2 A	10^{5} Ω or more

Voltage measurement input impedance:
1 x 10^{10} Ω or more
Voltage measurement leakage current:
1 nA or less (0 V measurement)
Maximum capacitive load: Same as that for voltage generation when voltage limiter is operating.

Common mode noise rejection ratio:
80 dB or more between Lo and GUARD terminals with the 1 kΩ unbalanced impedance for DC and 50 Hz/60 Hz ± 1%

Voltage measurement NMR: 50 Hz/60 Hz ± 0.09%

Integration time (IT)	NMR
10 ms	0 dB
1 PLC to 100 PLC	60 dB or more

Voltage limiter

Setting ranges:

Ranges	Setting ranges	Minimum step
320 mV	±3.00 mV to ±320.00 mV	10 µV
3.2 V	±0.0300 V to ±3.2000 V	100 µV
32 V	±0.300 V to ±32.000 V	1 mV
110 V	±3.00 V to ±110.00 V	10 mV

Overall accuracy: ±0.05% of the setting ± 0.1% of the range at temperature of 23°C ± 5°C and humidity of 85% or less for all ranges

Temperature coefficient and daily stability:
Same as that of voltage generation

7.3 Common Specifications

Allowable guard capacitance:
2000 PF (including cable capacitance) between Hi (OUTPUT or SENSE) and DG

Allowable shield capacitance:
5000 PF (including cable capacitance) between DG and Lo (OUTPUT or SENCE)

Maximum remote sensing voltage:
0.5 VDC between Hi OUTPUT and Lo OUTPUT (including voltage drop due to cable resistance)

Guard voltage offset: ±500 μV or less

Measurement speed: From TRIGGER input to COMPLETE output (END mode) in HOLD condition

Line frequency \ Integration time (IT)	10 ms	1 PLC	10 PLC	100 PLC
50 Hz	25.0 ms	35.0 ms	215.0 ms	2.015 s
60 Hz		31.7 ms	181.7 ms	1.682 s

Execution time: The time from program code transmission to SRQ signal generation by completion of preparation for receiving program code. (Typical value)
When using HP9000 series Model 216.
Forcing (Voltage/current generation); Approx. 30 ms
Measurement (Voltage/current measurement); Approx. 27 ms
(IT = 10 ms)

Output method: Floating bipolar output

Outputs: Hi force/Hi sense/Lo force/Lo sense/Driving guard/Guard

Output terminals:
Front; Binding post
Rear; Triaxial connector

Voltage/current setting mode:
Dial setting, direct setting and GPIB

Sweep mode: Linear sweep, log sweep and random sweep

Maximum step number for sweep: 1023 steps

Maximum memory capacity for random sweep: 500 data

Measurement mode: Sampling mode; RUN/HOLD

Measurement parameter:
Integration time (IT); 10 ms, 1 PLC, 10 PLC, 100 PLC

Measurement data buffer memory: 1024 data

Measurement data output method: ASCII or binary

HOLD time: Maximum 9999 ms, resolution; 1 ms
setting accuracy; 5% + 10 ms

Delay time: Maximum 9999 ms, resolution; 1 ms
setting accuracy; 5% + 10 ms

Period time: Maximum 9999 ms, resolution; 1 ms
setting accuracy; 5% + 5 ms (25 ms or more)

Protection: Over voltage, overheat and oscillation detecting function

I/O functions

GPIB interface: Follows IEEE-STD488-1978
Interface functions; SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E1

Single line signal: Input; TRIGGER, OPERATE
Output; COMPLETE, OPERATE, SYN OUT

7.4 General Specification

Display functions:
Voltage display; Polarity + 5 digits (7 segments) + units
Current display; Polarity + 5 digits (7 segments) + units

Maximum applicable voltage between terminals:

Terminal	Maximum applicable voltage
Between Hi and Lo	110 V peak
Between Lo and Guard	50 V peak
Between Guard and frame	500 V peak

Warm-up time : 30 minutes or more
(until the specified accuracy is reached)

Operating environment:
0 to 40°C with humidity of less than 85%

Storage ambient temperature range:
-25 to +70°C

Line voltage: AC90 V to 110 V

Option No.	Opt. 31	Opt. 32	Opt. 42	Opt. 43	Opt. 44
Line voltage (V)	103 to 127	108 to 132	198 to 242	207 to 250	216 to 250

Power frequency : 48 Hz to 66 Hz

Power consumption: Less than 340 VA

Dimensions : 212 (width) x 177 (height) x 450 (depth) mm (approx.)

Weight : Less than 17 kg

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WFU-6143E

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
B1	DMF-001008-1		
C1	CSM-AC1000PR5K		
C2	CSM-AC1000PR5K		
C3 -7	CMC-AC1000PR3K		
D1	SDS-RB402		
F1	DFT-AA3R15A		
FH1	DFH-000844		
FH2	DFH-000845		
J1	JCS-AA064JX01-2		
J2	JCP-AS003JX01		
J3	DCB-QS0497-1		
J4	DCB-RR0942X07-1		
J5	DCB-RR2330X02-1		
J6	JTB-AA001JX03		
J7 -8	JTB-AA001JX02		
J9	JTB-AA001JX03		
J10 -11	JTB-AA001JX01		
J12 -14	JCF-AS001JX01		
J15 -18	JCF-AB001JX02		
J19	JCD-AE003PX05		
L1	DEE-000066-1		
L2 -3	DEE-000066-1		
P1	JTE-AG001EX01		
S1	KSP-000035		
S2 -3	KSP-000102		
S4 -5	KSL-000140		

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Parts No.	ADVANTEST Stock No.
C1 -2	CSM-ACR01U50V
C3	CFM-BBR022UR1K-1
C4	CTM-AA4P
C5 -6	CSM-ACR01U50V
C7	CFM-BBR022UR1K-1
C8	CTM-AA4P
C9 -10	CSM-ACR01U50V
C11	CFM-BBR022UR1K-1
C12	CTM-AA4P
C13 -14	CFM-ASR047U50V
C15	CFM-AS1000P50V
C16	CSM-ACR01U50V
C17	CTA-AC1U50V
C18	CSM-AG1U50V
C19	CFM-ASR047U50V
C20 -21	CTA-AC1U50V
C22 -23	CMC-AB47PR3K
C24 -26	CTA-AC1U50V
C27	CFM-AS3300P50V
C28	CMC-AB330PR3K
C29	CMC-AB220PR3K
C30	CSM-AC33P50V
C31 -32	CSM-ACR01U50V
C33	CSM-AC1000PR5K
C34	CSM-AC1500P50V
C35	CFM-AS3300P50V
C36	CMC-AB330PR3K
C37	CMC-AB220PR3K
C38	CMC-AB47PR3K
C39	CFM-AS3300P50V
C40 -41	CSM-ACR01U50V
C42	CSM-AC33P50V
C43 -44	CSM-ACR01U50V
C45	CSM-AC33P50V
C46	CSM-ACR01U50V
C47	CSM-AC22P50V
C48	CSM-ACR01U50V
C49 -50	CCK-AA22U10V
C51 -52	CCK-AA1U350V
C53 -54	CCK-AA22U25V
C55	CSM-ACR01U50V
C56	CSM-AC33P50V
C57	CSM-ACR01U50V
C58	CSM-AC1000P50V
C59 -60	CSM-ACR01U50V
C61 -62	CSM-ACR022U50V
C64	CMC-AB220PR3K
C65	CSM-AC5P50V
C66 -67	CSM-ACR01U50V
C69 -70	CTA-AC1U50V
C71	CSM-ACR01U50V
C72 -77	CSM-ACR022U50V
C78	CTA-AC1U50V
C79	CSM-AFR047U50V
C80 -83	CTA-AC1U50V
C84	CSM-AC3300P50V
C85	CSM-AC33P50V
C86	CSM-AFR1U50V
C87	CCK-AA4R7U35V
C88	CCK-AA22U25V
C89 -90	CCK-AA10U16V
C91	CCK-AA22U25V
C92 -93	CMC-AB20PR5K
C94 -95	CMC-AB220PR3K
C96	CSM-AC330P50V
C97 -99	CSM-AC1000P50V
CP1 -3	SEC-TLP521*4-1
D1 -6	SDS-1S953
D7 -8	SDS-LD1-1
D9 -10	SDS-1SS286-2
D11	SDZ-H6L-1
D12	SDS-1SS286-2
D13	SDZ-H6L-1
D14	SDS-1SS286-2
D15 -16	SDS-1S953
D17	SDZ-W050
D18 -23	SDS-1S953
D24	SDZ-W110
D25 -31	SDS-1S953
D32 -33	SDP-SM1-7
D34 -36	SDS-1S953
D37	SDS-1SS286-2
D38	SDS-1SS97
D39 -40	SDS-1S953
D41 -46	SDS-LD1-1
D47 -48	SDS-1S953
D49 -50	SDS-LD1-1
D51 -56	SDS-1S953
D57	SDZ-W110
D58	SDZ-W050
D59 -60	SDS-1S953
D61 -62	SDZ-W050-5
D63 -64	SDS-LD1-19
D65 -72	SDS-1S953
D73 -74	SDZ-W120
D75 -76	SDS-LD1-19
D77	SDP-S5KC40R-1
D78	SDP-S5KC40-1
D79	SDS-AP401
D80 -81	SDS-LD1-1
D82	SDS-1S953
J2 -6	JCP-BL001PX01
K1	KRR-000801-1
K2	KRL-000402
Q1 -3	SFN-2N4393-18
Q4 -5	SFT-A71-38

Parts No.	ADVANTEST Stock No.
Q6	SFN-2N4393-18
Q7	SFT-A71-38
Q8	STN-2SC1815-15
Q9	STP-2SA1015-1
Q10 -14	SFN-2N4393-18
Q16	SFN-2N4393-18
Q17	STN-2SC1815-55
Q18	SFT-A71
Q19 -20	STN-2SC2551-2
Q21 -22	STP-2SA1015
Q23	STP-2N5416-1
Q24	STN-2SC1815-55
Q25	STP-2N5416-1
Q26	STN-2N3439-1
Q27	STP-2SA1015
Q28 -29	SFN-2N4393-18
Q31	SFN-2N4393-18
Q32 -40	STN-2SC1815-55
Q41 -46	STP-2SA1015
Q47 -48	SFN-2SK429-1
Q49	SFN-2N4393-18
Q50 -51	SFN-2N4859-18
Q52 -53	SFM-2SK428-1
Q54	STP-2SA1015
Q55	STN-2SC1815-55
Q56	STP-2SA1015
Q57	STN-2SC1815-55
R1	RMF-AB1KFG-2
R2	RMF-AB33KBG-2
R3	RCB-AH47K
R4	RCB-AH7R5K
R5	RMF-AB1KFG-2
R6	RMF-AB33KBG-2
R7	RCB-AH47K
R8	RCB-AH7R5K
R9	RMF-AB1KFG-2
R10	RCB-AH47K
R11	RMF-AB33KBG-2
R12	RCB-AH7R5K
R13	RFL-AB8KB
R14	RFL-AB1KB
R15	RAY-AL100K4
R16	RCB-AH22K
R17	RAY-AL100K4
R18	RCB-AH47K
R19	RFL-AB8KB
R20	RFL-AB1KB
R22	RHB-000022-1
R23	RCB-AH100K
R24	RAY-AL100K6
R25 -27	RAY-AK330Q4
R28	RCB-AH220K
R29 -30	RCB-AH18K

Parts No.	ADVANTEST Stock No.
R31	RAY-AL4R7K6
R32 -33	RMF-AR4R7KFK
R34	RCB-AH100
R35	RCB-AH1K
R36	RCB-AH10K
R37	RCB-AH5R6K
R38	RCB-AH100
R39	RCB-AH120K
R40	RCB-AH10K
R41	RMF-AR10KFK
R42	RMF-AR3R9KFK
R43	RMF-AR10KFK
R44	RCB-AK47K
R45 -46	RMF-AR15KFK
R47	RCB-AH220
R48	RCB-AH22K
R49	RCB-AH220
R50 -51	RCB-AH22K
R52	RCB-AH100K
R53	RCB-AH22K
R54	RCB-AH330
R55	RCB-AH47K
R56	RCB-AH150K
R57	RCB-AH220
R58	RCB-AH680
R59	RCB-AH2R7K
R61	RCB-AH680
R62	RCB-AH220
R63	RCB-AH2R7K
R64	RCB-AH220
R65	RCB-AH33K
R66	RCB-AH100
R67	RAY-AL100K4
R68	RAY-AL22K4
R69	RCB-AH68K
R70 -71	RCB-AH3R9K
R72	RCB-AH68K
R73	RMF-AR3R3KFK
R74	RMF-AR36KFK
R75	RHB-000021-1
R76	RAY-AL22K4
R77	RCB-AH82K
R78	RCB-AH6R8K
R79	RCB-AH3R9K
R80	RAY-AL220K4
R81	RAY-AL22K4
R82	RAY-AL47K4
R83	RCB-AH4R7K
R84	RCB-AH10K
R85	RCB-AH33K
R86 -87	RCB-AH1M
R88	RCB-AH47K
R89	RCB-AH470K

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
R90	RCB-AH47K	U18	SIA-TL084
R91	RCB-AH470K	U19	SIA-4052-18
R92	RAY-AK100K4	U20	SIA-LT1008CN8-1
R93	RCB-AH47K	U21	SIA-4053-19
R94	RCB-AH3R9K	U22	SIA-318-1
R95	RPW-AS1-2	U23	SIA-LT1008CN8-1
R96	RPW-AWR1-1		
R97	RAY-AL22K4		
R98	RAY-AK10K4		
R99	RCB-AH150K		
R100	RCB-AH10K		
R101	RFL-AB10KB-1		
R102-103	RCB-AH10K		
R104	RMF-AE90KBF-1		
R105	RCB-AH1M		
R106-107	RCB-AH330		
R108	RCB-AH100		
R109	RCB-AH10K		
R110	RCB-AH100K		
R111	DSP-000016		
R112	RCB-AH10K		
R113	RCB-AH1K		
R114-115	RCB-AH10K		
R116	RCB-AH100K		
R117	RFL-AB100QA-1		
R118	RCB-AH1M		
R119-120	RCB-AH10K		
R121	RCB-AH100K		
R122	RCB-AH1K		
R123	RCB-AH100		
R124	RCB-AH10K		
R125	DSP-000016		
R126	RCB-AH100		
R127	RCB-AH10K		
R129	RVR-BD2K-1		
R130	RCB-AH10K		
R131-132	RCB-AH220K		
R133	RCB-AH220K		
R135-136	RCB-AH10K		
R137	RCB-AH1M		
R138	RCB-AH220K		
U1 -3	SIA-TL072		
U4	SIA-339		
U5	SIT-75468		
U6	SIA-339		
U7	SIT-75468		
U8	SIA-OP07P-2		
U9	SIA-4053		
U10	SIA-TL081-1		
U11	SIA-339		
U12 -14	SIA-LT1008CN8-1		
U15	SIA-339		
U16 -17	SIA-LT1008CN8-1		

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Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
C2	CSM-AC33P50V	Q24	STP-2SA1015
C6 -7	CTA-AC1U50V	Q25 -27	STN-2SC641
C8 -9	CFM-BBR033UR1K-1	Q28 -30	STP-2SA1015
C10 -11	CFM-ASR022U50V	Q31 -32	STN-2SC1815-55
C12 -13	CSM-AC100P50V	Q34	STN-2SC641
C14 -19	CSM-ACR047U50V	Q35	SFN-2SK141-18
C20 -26	CTA-AC1U50V	Q36	STN-2SC1815-55
C27	CTA-AC3R3U16V	Q37	SFN-2SK30
C33	CSM-AC330P50V	Q38	SFN-2SK141-18
C34	CSM-AC100P50V	Q39	STP-2SA1015
C35 -36	CSM-AC150P50V	Q40	SFN-2SK141-18
C37 -38	CCK-AR10U16V	R1	RHB-000021-1
C40 -42	CTA-AC1U50V	R2	RMF-AJ47KJM
C43 -44	CFM-BBR033UR1K-1	R3 -4	RCB-AH2R2K
C45 -50	CSM-ACR047U50V	R5	RAY-AL100K6
C51	CSM-AC10P50V	R6 -7	RAY-AK10K4
C52 -57	CSM-ACR047U50V	R13	RHB-000008-1
C58	CSM-AC330P50V	R14	RCB-AH220
C59	CSM-ACR1U50V	R15	RCB-AH3R3K
C60	CSM-AC330P50V	R16	RCB-AH33K
C61	CSM-ACR1U50V	R17	RCB-AH10K
C62	CSM-AC100P50V	R18	RCB-AH33
C63 -67	CSM-AC150P50V	R19	RCB-AH150
C68	CCK-AA10U16V	R20	RCB-AH1K
C69 -76	CSM-ACR047U50V	R21	RMF-AR560KFK
C77 -78	CCK-AA47U10V	R22	RMF-AR470KFK
C80 -81	CCK-AA47U35V	R23	RMF-AR5R1KFK
C83 -84	CTA-AC1U50V	R24	RMF-AR4R7KFK
C86 -87	CTA-AC1U50V	R25	RMF-AR1R1KFK
C88	CFM-AMR1U100V	R28 -29	RCB-AH33K
CP1 -2	SEC-PS2006	R30	RAY-AL3R3K4
CP3 -5	SEC-TLP521*1-1	R31	RAY-AL1K4
D1	SDZ-6-15	R32 -33	RCB-AH3R3K
D2 -3	SDZ-W120-5	R34 -35	RCB-AH33K
D4 -5	SDS-LD1-19	R36 -37	RCB-AH270
D6 -19	SDS-1S953	R38	RCB-AH6R8K
D24 -25	SDS-1S953	R39	RCB-AH470
D30	SDZ-W120-5	R40	RCB-AH6R8K
D32 -33	SDS-1SS97	R41	RCB-AH470
D34	SDS-1S953	R42	RAY-AL3R9K8
D35 -36	SDS-1SS97	R43	RAY-AK330Q4
D37 -38	SDS-LD1-19	R44	RCB-AH2R2K
D39	SDS-1S953	R45	RAY-AK4R7K4
D41 -44	SDS-1S953	R46	RAY-AK470Q4
J1	JCS-BQ064PX01-1	R47	RAY-AK10K4
J2	JCR-AF016PX02	R49	RAY-AK470Q4
Q5	SFN-2N4117-18	R50 -51	RCB-AH47K
Q6 -8	SFN-2SK141-18	R52	RCB-AH220
Q10 -13	SFN-2SK141-18	R56	RCB-AH2R2K
Q14 -18	SFN-2N4393-18	R57	RMF-AR180KFK
Q19 -20	STP-2SA711	R58	RMF-AR2R21MFK
Q21 -22	SFT-A71-38	R59	RCB-AH47K
Q23	SFN-2N4393-18	R60	RCB-AH15K

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Parts No.	ADVANTEST Stock No.
R61	RMF-AR100KFK
R62	RMF-AR1KFK
R63	RCB-AH47K
R64	RCB-AH15K
R65	RMF-AR100KFK
R66	RMF-AR1KFK
R68 -69	RCB-AH22K
R70	RCB-AH10K
R77	RCB-AH1K
R80	RCB-AH1R2K
R81	RCB-AH510
R82 -83	RCB-AH100
R84	RCB-AH1K
R85 -86	RCB-AH4R7K
R87	RAY-AL100K4
R88	RCB-AH470
R89	RCB-AH100K
R90	RCB-AH10K
R91	RCB-AH1K
R92 -93	RCB-AH10K
R94	RAY-AL10K4
R95	RCB-AH3R3K
R96	RCB-AH150K
R97 -98	RCB-AH22K
R99	RCB-AH10K
R100	RCB-AH22K
R101	RCB-AH100K
R102-103	RCB-AH33K
R104-105	RCB-AH10K
R106	RCB-AH1K
R107-108	RCB-AH100K
R109	RAY-AK100K4
R110-111	RCB-AH10K
U1 -2	SIM-74HC273
U3	SIA-DAC703K-1
U4	SIA-TL072-1
U5	SIA-4053-19
U6	SIM-74HC04
U7	SIT-74LS07
U8 -9	SIM-74HC138
U10	SIA-LT1008CN8-1
U11	SIM-74HC32
U12	SIM-74HC00
U13	SIT-74LS04
U14	SIA-TL072-1
U15	SIA-TL082-1
U16	SIM-63B03
U17	SMM-27C256B
U18	SIM-74HC32
U19	SIM-74HC04
U20	SIT-74LS00
U21	SIT-74ALS74
U22	SIA-4053-19

Parts No.	ADVANTEST Stock No.
U23	SIM-74HC393
U24	SIM-74HC04
U25 -26	SIT-74ALS74
U27	SIA-TL072-1
U28	SIA-LT1008CN8-1
U29	SIA-TL082-1
U30	SIM-74HC373
U31	SIT-74LS00
U32	SMM-8464B
U33	SIM-74HC74
U34	SIM-74HC08
U35	SIM-60H125-1
U36	SIT-74LS74
U37	SIT-74LS92
U38	SIA-TL7700-1
U39	SIM-74HC161
U40 -41	SIM-74HC273
U42	SIM-74HC00
U43	SIM-74HC273
U44	SIA-339
U45	SIA-311-1
U46	SIA-318-1
U47	SIA-TL081
U48	SIA-308A-1
U49 -50	SIM-74HC273
U51	SIM-74HC299
U52	SIM-74HC74
U53	SIA-339
U54	SIA-308A-1
U55	SIA-TL072-1
U56	SIA-393
X1	DXD-000653

TR6143

BLC-014341

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
B1	DEE-000382		
C1	CSM-ACR047U50V		
C2	CCK-AR3R3U50V		
C3	CCK-AR10U16V		
C4 -7	CSM-ACR047U50V		
D1	SDS-1S953		
J1	JCR-AF034PX02		
J2	JCR-AF026PX02		
R1	RCB-AH150K		
R2	RCB-AH22K		
R3	RCB-AH4R7K		
TP1 -2	JTE-AH001JX01		
U1	SIA-TL7700		
U2	SIT-74LS07		
U3	SIM-74HC4020		
U4	SIM-74HC273		
U5	SIM-9914		
U6	SIM-74HC00		
U7	SIT-75161		
U8	SIT-75160		

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BGK-013359

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
C1 -3	CSM-AC1000P50V		
C4	CCK-AA33U10V		
C6 -10	CSM-ACR047U50V		
C11 -18	CSM-AC68P50V		
D1	NLD-000198		
D4 -5	NLD-000183		
D6	NLD-000198		
D8 -11	NLD-000185		
D12 -16	NLD-000014		
D17 -19	NLD-000185		
D20 -24	NLD-000014		
D25 -26	NLD-000185		
D28 -29	NLD-000185		
D31 -35	NLD-000003-1		
D37 -38	NLD-000185		
D39 -46	NLD-000003-1		
D47 -48	SDS-1S953		
J2	DCB-RR2329X01		
Q1 -8	STP-2SA965		
R1 -2	RCB-AH120		
R3 -4	RCB-AH220		
R5 -8	RAY-AK100Q4		
R11 -12	RAY-AL1K4		
R13	RCB-AH10K		
R14	RCB-AH4R7K		
R15	RCB-AH100		
R21 -28	RCB-AH1K		
S1 -18	KSP-000250		
S19	KSR-000804-1		
S20 -23	KSP-000250		
U1 -2	SIM-74HC08		
U3	SIM-74HC04		
U4	SIT-74LS374		
U5	SIM-8279		
U6	SIM-74HC374		
U7	SIT-74LS374		
U8	SIM-74HC374		
U9	SIM-74HC161		
U10	SIT-74LS136		
U11	SIT-74LS42		
U12	SIT-74LS156		

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BLJ-013360 1/2

Parts No.	ADVANTEST Stock No.
C1	CSM-ACR01U50V
C2	CSM-AC100PR5K
C3	CMC-AB220PR3K
C4 -7	CSM-AC1000PR5K
C8	CSM-ACR01U50V
C9	CSM-AC100PR5K
C10	CMC-AB220PR3K
C11	CSM-ACR01U50V
C12	CSM-AC100PR5K
C13	CTA-AC10U16V
C14	CSM-AC1000P50V
C15	CTA-AC10U16V
C16	CSM-AC1000P50V
C17 -19	CTA-AC1U50V
C20	CSM-AC100PR5K
C21	CSM-ACR01U50V
C22	CSM-AC1000PR5K
C23	CMC-AB100PR3K
C24	CSM-AC3300P50V
C25	CSM-AC1000PR5K
C26	CSM-AC3300P50V
C27	CMC-AB100PR3K
C28	CSM-AFR1U50V
C29 -30	CTA-AC1U50V
C31	CSM-AC33P50V
C32	CSM-AC1000P50V
C33 -34	CTA-AC3R3U16V
C35 -37	CCK-AA1U50V
C38	CTA-AC1U50V
C39	CCK-AA1U50V
C40	CCK-AA1U350V
C41	CCK-AA1U250V
C42	CCK-AA1U160V
C43	CCK-AA1U100V
C44 -45	CTA-AC10U16V
C46	CCK-AA1U100V
C47	CCK-AA1U160V
C48	CCK-AA1U250V
C49	CCK-AA1U350V
C50 -51	CSM-AC1000P50V
C52	CSM-AC2200PR5K-1
C53	CTA-AC1U50V
C54	CSM-AC2200PR5K-1
C55	CTA-AC1U50V
C56 -59	CCK-AA1U50V
C60 -61	CSM-AC220P50V
C62	CCK-AA1U50V
C63 -64	CSM-AC4700PR5K
C67 -70	CSM-AC1000PR5K
D1 -2	SDP-S5KC40
D3 -4	SDP-S5KC40R
D5	SDP-SM1-6
D6	SDP-RU2
D7	SDP-1S2764-1
D8	SDP-RU2
D9	SDP-1S2764-1
D10	SDP-SM1-6
D11	SDP-SM1-7
D12	SDP-1S2764-1
D13 -15	SDP-S6K40H
D16 -17	SDP-SM1-7
D18 -21	SDP-1S2764-1
D22 -27	SDS-1S953
D28 -29	SDP-SM1-7
D30 -32	SDP-S6K40H
D33	SDP-S5KC40R
D34	SDP-S5KC40
D35 -38	SDP-S6K40H
D39	SDP-1S2764-1
D40 -47	SDP-SM1-7
D48	SDP-SM1-6
D49 -50	SDP-1S2764
D51	SDP-SM1-6
D52 -53	SDP-1S2764
J1 -2	JCS-BQ064PX01
J3	JCP-AA024PX01-1
J4	JCP-AA018PX01-1
J5	JCP-AA024PX01-1
J6	JCP-AA018PX01-1
J7 -8	JCP-AA006PX01-1
K1	KRL-000631-1
Q1	STN-2SC3182
Q2 -4	STN-2SC3907
Q5 -6	STP-2SA1516
Q7	STP-2SA968
Q8 -9	STP-2SA1516
Q10	STP-2SA1265
Q11	STP-2SA1328
Q12	STN-2SC3345
Q13	STN-2SC2551-2
Q14	STP-2N5416
Q15	STN-2SC1815-55
Q16 -17	STN-2SC2551-2
Q18	STN-2SC1815-55
Q19	STN-2SC2551-2
Q20	STN-2SC3182
Q21 -22	STN-2SC3907
Q23	STN-2SC2238
Q24	STN-2SC3907
Q25	STP-2SA968
Q26	STP-2SA1091-2
Q27 -29	STP-2SA1516
Q30	STP-2SA1265
Q31 -32	STP-2SA1091-2
Q33	STP-2SA1015

Parts No.	ADVANTEST Stock No.
Q34	STP-2SA1091-2
Q35	STN-2N3439
Q36	STP-2SA1015
Q37	STN-2SC1815-55
Q38	STN-2SC3907
Q39	STN-2SC2238
Q40 -41	STN-2SC3182
Q42	STP-2SA1265
Q43	STN-2SC1815-55
Q44	STP-2SA1015
Q45	STP-2SA1516
Q46	STP-2SA968
Q47	STN-2SC2238
Q48 -50	STN-2SC3907
Q51	STP-2SA1265
Q52 -53	STP-2SA1516
Q54	STP-2SA1009
Q55	STN-2SC2335
Q56	STP-2SA1015
Q57	STN-2SC1815-55
R1	RCB-AH47
R2	RPW-AV1
R3 -4	RCB-AF47K
R5	RCB-AF22K
R6 -7	RPW-AV1
R8	RCB-AH4R7K
R9	RCB-AH150
R10	RCB-AH10
R11	RCB-AH150
R12	RPW-AV1R5
R13	RCB-AH330
R14	RCB-AH10
R15	RCB-AH330
R16	RCB-AH4R7K
R17 -18	RPW-AV1R5
R19 -21	RCB-AH10
R22 -23	RPW-AV1R5
R24	RCB-AH4R7K
R25	RCB-AH150
R26	RPW-AV1R5
R27 -29	RCB-AH10
R30 -32	RCB-AH330
R33 -34	RPW-AV1
R35	RPW-AVR56
R36	RCB-AH4R7K
R37	RCB-AH150
R38 -39	RCB-AH10
R40 -41	RPW-AV1R5
R42	RCB-AH10
R43	RPW-AV1
R44	RCB-AH10
R45	RCB-AH150

Parts No.	ADVANTEST Stock No.
R46	RCB-AH4R7K
R47 -48	RCB-AH47
R49 -50	RCB-AF22K
R51 -52	RCB-AK10
R53 -54	RCB-AF47K
R55	RCB-AH180
R56	RCB-AF22K
R57	RCB-AH330
R58	RCB-AH47
R59	RCB-AH4R7K
R60	RCB-AH150
R61	RPW-AVR56
R62 -63	RPW-AV1R5
R64 -67	RCB-AH10
R68	RCB-AH330
R69	RCB-AH150
R71	RPW-AVR82
R72	RCB-AH330
R73	RCB-AH4R7K
R74	RCB-AH10
R75 -78	RPW-AV1R5
R79	RCB-AH4R7K
R80	RCB-AH330
R81	RPW-AVR56
R82	RPW-AVR82
R84 -85	RPW-AV1R5
R86	RCB-AH150
R87 -89	RCB-AH10
R90	RCB-AH330
R91	RCB-AH15K
R92	RCB-AH1K
R93	RCB-AH15K
R94	RCB-AH1K
R95	RCB-AH10K
R96	RCB-AH4R7K
R97	RCB-AH100
R98	RCB-AH10
R99	RCB-AH100
R100	RCB-AH10
R101	RCB-AH330
R102	RCB-AH12
R103	RCB-AH330
R104	RCB-AH12
R105	RCB-AH1K
R106	RPW-AVR56
R107	RCB-AH1K
TP1 -23	MBM-10372A-1
U1	SIA-LT1008CN8
U2	SIA-7815U
U3	SIA-7808U
U4	SIA-7908U
U5	SIA-7918U
U6	SIA-7915U

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BLJ-013379

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
C1	CCK-CA1000U		
C2	CCK-CB1000U		
C3	CCK-CA1000U		
C4	CCK-CB1000U		
C5	CCK-CA1000U		
C6	CCK-BR390U315V		
C7	CCK-CA1000U		
C8	CCK-BR390U315V		
C9 -10	CCK-BR3300U63V		
C11 -12	CCK-BJ2200U16V		
C13 -14	CCK-BRR015U16V		
C15 -16	CCK-BJ1000U35V		
C17 -18	CCK-BJ1000U50V		
C19 -22	CSM-AFR1U50V		
D1 -4	SDP-SM1-7		
D5 -7	SDP-W02		
D8 -9	SDP-S5KC40R		
D10 -11	SDP-S5KC40		
D12	SDP-S5KC40R		
D13 -14	SDP-S5KC40		
D15	SDP-S5KC40R		
J1	JCS-BQ064PX01		
J2	JCS-AA064PX04-2		
Q1	STN-2SC2335		
Q2	STP-2SA1009		
TP1	MBM-10372A		
U1	SIA-7905U		
U2	SIA-7805U		
U3	SIA-7815U		
U4	SIA-7915U		

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BLK-013326

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
BT1	DBP-000829		
C1 -2	CSM-AC22P50V		
C3	CCK-AR10U16V		
C4	CSM-ACR047U50V		
C5	CSM-AC100P50V		
C6	CTA-AC10U16V		
C7	CSM-ACR047U50V		
C8	CSM-AC100P50V		
C9	CCK-AR1U50V		
C10 -15	CSM-ACR047U50V		
C16	CSM-ACR01U50V		
D3	SDS-AN401		
D4	SDZ-H3-8		
D5	SDS-1S953		
J1	JCP-AS003PX01		
J2	JCR-AF034PX02		
J3	JCP-AA012PX03		
J4	JCR-AF016PX02		
Q2	STN-2SC1815-55		
Q3	STP-2SA1015		
R1 -2	RCB-AH47K		
R3	RCB-AH330		
R6	RAY-AK220Q4		
R7	RAY-AL2R2K4		
R8	RCB-AH100		
R9	RCB-AH1K		
R10	RCB-AH560		
R11	RAY-AL47K6		
R12	RCB-AH4R7K		
R13	RAY-AK10K4		
R14	RAY-AL4R7K6		
R15	RCB-AH47K		
R16	RCB-AH1R5K		
R17 -24	RCB-AG180		
TP1	JTE-AH001JX01		
TP2 -12	JTE-AH001JX01		
U1	SIM-63B03		
U2	SMM-27C512A		
U3	SMM-5564A		
U4	SMM-2817-2		
U5	SIM-74HC373		
U6	SIM-74HC138		
U7	SIM-74HC74		
U8	SIM-74HC04		
U9	SIM-74HC10		
U10	SIM-74HC00		
U11	SIM-74HC138		
U12	SIT-74LS07		
X1	DXD-001306		

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BLK-013361

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
C1 -5	CSM-AWR01U400V		
C6 -7	CCK-BJ47U10V		
C8 -9	CCK-BJ33U25V		
C10 -16	CSM-AWR01U400V		
D1 -2	SDS-1S953		
J1 -3	JCS-BQ064JX01		
J4	JCS-BQ090JX01		
J5	JCS-BQ064JX01		
Q1 -2	STN-2SC2551-2		
Q3 -4	STP-2SA1009		
R1	RCB-AH39K		
R2	RCB-AH120K		
R3	RCB-AH100K		
R4	RCB-AH39K		
R5	RCB-AH15K		
R6	RCB-AH47K		
R7	RCB-AH100K		
R8	RCB-AH47K		
R9	RCB-AH120K		
R10	RCB-AH15K		

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BLD-014882

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
B1	DEE-000382	U12	SIT-74LS07
BT1	DBP-001486-1	U13	SIA-TL7700
C1 -2	CSM-AC22P50V	U14	SIT-74LS07
C3	CCK-BJ220U10V	U15	SIM-74HC4020
C4	CSM-AGR1U50V	U16	SIM-74HC273
C5	CSM-AY100P50V	U17	SIM-9914
C6	CTA-AC10U16V	U18	SIM-74HC00
C7	CSM-AGR1U50V	U19	SIT-75161
C8	CSM-AY100P50V	U20	SIT-75160
C9	CCK-CD1U50V	X1	DXD-001306
C10 -17	CSM-AGR1U50V		
C18	CCK-CD3R3U50V		
C19	CCK-CD10U16V		
C20 -23	CSM-AGR1U50V		
D3	SDS-AN401		
D4	SDZ-H3-8		
D5 -6	SDS-1S953		
J1	JCP-BH003PX01-1		
J2	JCR-BN034PX02		
J3	JCP-AA012PX01		
J4	JCR-AF016PX01		
J5	JCR-AF026PX01		
Q2	STN-2SC1815		
Q3	STP-2SA1015		
R1 -2	RCB-AG47K		
R3	RCB-AG330		
R6	RCB-AG680		
R7	RAY-AL2R2K4		
R8	RCB-AG100		
R9	RCB-AG1K		
R10	RCB-AG560		
R11	RAY-AL47K6		
R12	RCB-AG4R7K		
R13	RAY-AK10K4		
R14	RAY-AL4R7K6		
R15	RCB-AH47K		
R16	RCB-AH1R5K		
R17 -18	RAY-AK220Q4		
R25	RCB-AG150K		
R26	RCB-AG22K		
R27	RAY-AK220Q4		
TP1 -12	JTE-AH001JX01		
U1	SIM-63B03		
U3	SMM-5564A		
U4	SMM-2817-2		
U5	SIM-74HC373		
U6	SIM-74HC138		
U7	SIM-74HC74		
U8	SIM-74HC04		
U9	SIM-74HC10		
U10	SIM-74HC00		
U11	SIM-74HC138		

TR6143

BLB-014864

Parts No.	ADVANTEST Stock No.	Parts No.	ADVANTEST Stock No.
C1	CCK-BZ4700U16V		
C2	CCK-CE47U10V		
C3	CSM-AGR1U50V		
D1	SDS-RB402		
J1	YEE-000733-1		
U1	SIA-7805U		

APPENDIX

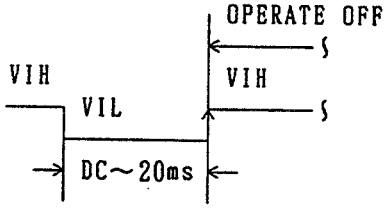
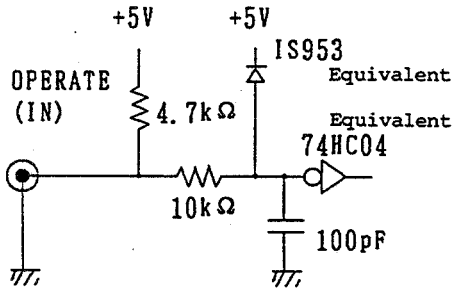
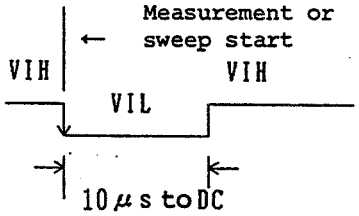
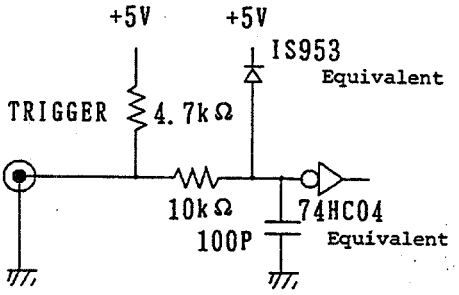
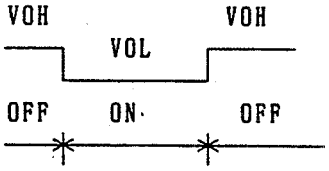
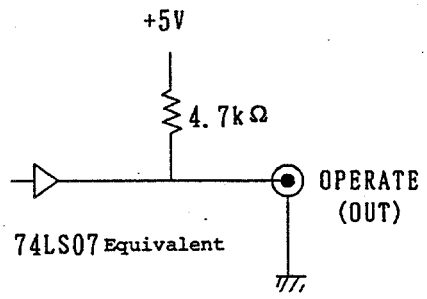
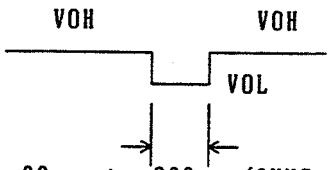
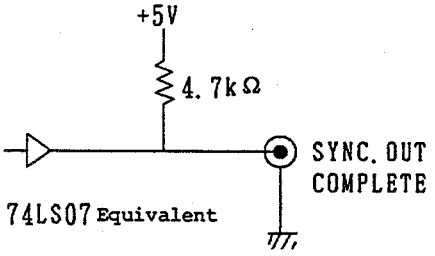
A.1 ERROR CODE LIST

Error code	Explanation
Err 01	This message is displayed when an abnormality has occurred during a read/write check of the RAM. When this message appears, contact the nearest service center or representative.
Err 02	This message is displayed when an abnormality has occurred during a ROM check. When this message appears, contact the nearest service center or representative.
Err 03	This message is displayed when an abnormality has occurred during a non-volatile RAM (E^2PROM) check, which stores the calibration parameters and random sweep data for backed up. When this message appears, depress the † switch immediately after powering on, and parameters will be initialized about 5 minutes after and operation will continue. If Err 03 appears after this operation, contact the nearest service center or representative.
Err 04	This message indicates that the backup battery for a RAM is abnormal. When this message appears, depress † switch immediately after powering on, and the parameters will be initialized about 5 minutes after and operation will continue. If Err 04 appears after this operation, contact the nearest service center or representative.
Err 05	This message is displayed when an error has occurred during the sending or receiving of generation data and measured data inside this device. When this message appears, power on again. If Err05 occurs in succession after this operation, contact the nearest service center or representative.
Err 06	Theis message is displayed when revision number is unsuitable. When changing software revision in this unit, it must be made for both logic and analog parts at a time.

CAUTION

When executing initialization of the parameters, set the EXT CAT switch on the rear panel to DISABLE. If ENABLE is set, the calibration parameters are also initialized, requiring a re-calibration for all ranges.

A.2 CONTROL INPUT/OUTPUT CIRCUIT

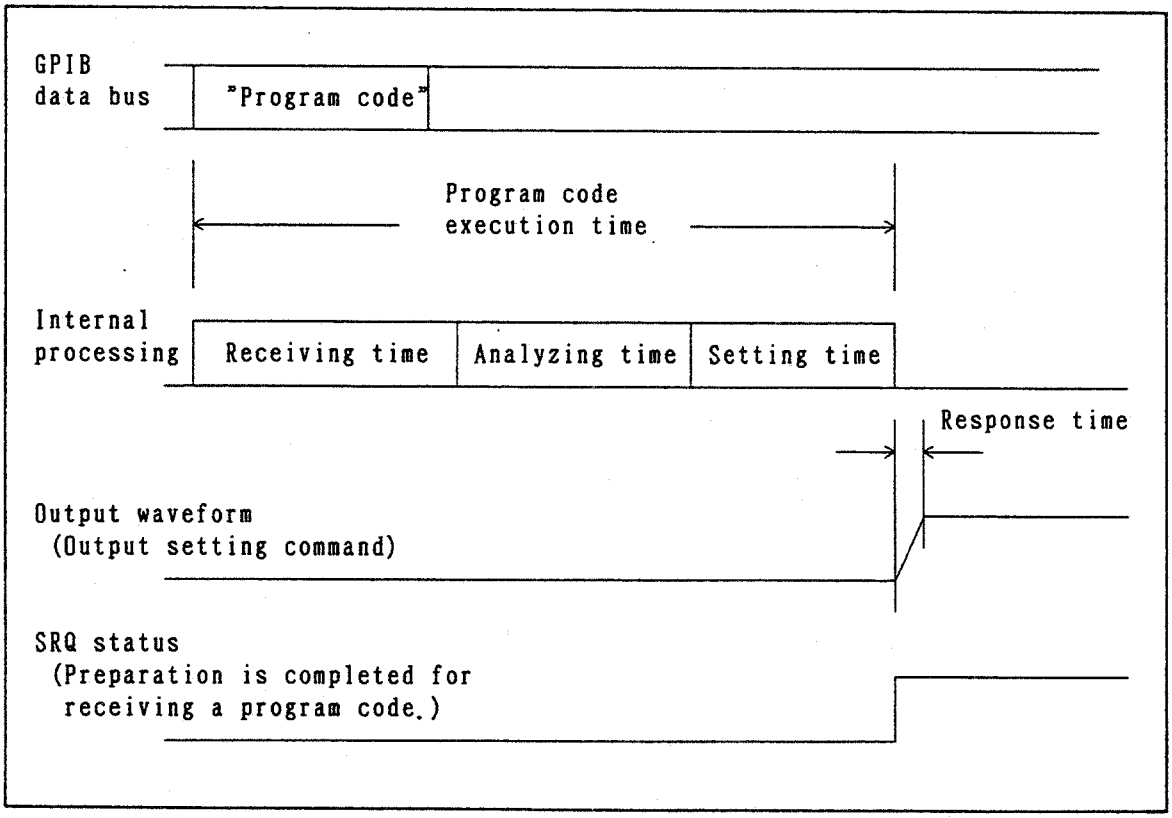
Single line signal name	Input or output signal	Input or output circuit
OPERATE (IN) (Input)	 Operation OFF by the change from VIL to VIH	
TRIGGER (Input)	 Measurement or sweep starts by the change from VIH to VIH	
OPERATE (OUT) (Output)		
SYNC. OUT COMPLETE (Output)		

VIH: 2.7 to 5.25 V or open-circuited
VIL: 0 to 0.5 V, or shorted and ground
VOH: 2.7 to 5.25 V
VOL: 0 V to 0.5 V

A.3 GPIB REMOTE EXECUTING TIME (TYPICAL VALUE)

Computer: HP9000 series Model 216 BASIC2.0

A.3.1 Program Code Execution Time



A.3 GPIB REMOTE EXECUTING TIME (TYPICAL VALUE)

(1) Function/range switching

Program codes	Response conditions	
	FAST	SLOW
Vx	60 ms	60 ms
Ix	50 ms to 75 ms	50 ms to 140 ms

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD
Initial value; 0

(2) Generation and limit values

Program codes	Response conditions	
	FAST	SLOW
Voltage generation without unit Dxxxx	30 ms	30 ms
Voltage generation with unit Dxxxx V(MV)	60 ms	60 ms
Current generation without unit Dxxxx	30 ms	30 ms
Current generation with unit Dxxxx A(MA, UA)	50 ms to 75 ms	50 ms to 140 ms
Voltage limit Dxxxx V(MV)	60 ms	60 ms
Current limit Dxxxx A(MA, UA)	40 ms to 75 ms	40 ms to 140 ms

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD
Initial value; 0

(3) Output ON/OFF and initial setting

Program codes	Response conditions	
	FAST	SLOW
E	140 ms	280 ms
H	140 ms	280 ms
C	330 ms	330 ms

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD
Initial value; 0

(4) Buffering control

Program codes	Response conditons	
	FAST	SLOW
Buffering "BD320MV"	20 ms	20 ms
Outputs by E Voltage range not changed	20 ms	20 ms
Outputs by E Voltage range changed	50 ms	50 ms
Outputs by E Current range not changed	20 ms	20 ms
Outputs by E Current range changed	50 ms	140 ms

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD
Initial value; 0

(5) Sampling modes

Program codes	Output conditions	
	ON	OFF
M0	20 ms	20 ms
M1	30 ms	20 ms

Auto calibration; OFF
Initial value; 0
Auto range; OFF

(6) Auto range

Program codes	Setting time
R0	30 ms
R1	30 ms

Measurement conditions:
Auto calibration; OFF
Output; ON
Initial value; 0
Sampling; HOLD

(7) Integration time and power frequency

Program codes	Power frequency	
	50 Hz	60 Hz
IT2	1.22 s	1.21 s
IT3	1.26 s	1.24 s
IT4	1.98 s	1.85 s
IT5	9.18 s	7.85 s

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD
Auto range; OFF

(8) Memory setting of random sweep data

	Setting time
Setting time for one data	240 ms

Measurement condition:
Mean time for 30 data

(9) Other program code

	Setting time
Program code setting other than (1) to (8)	20 ms

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD

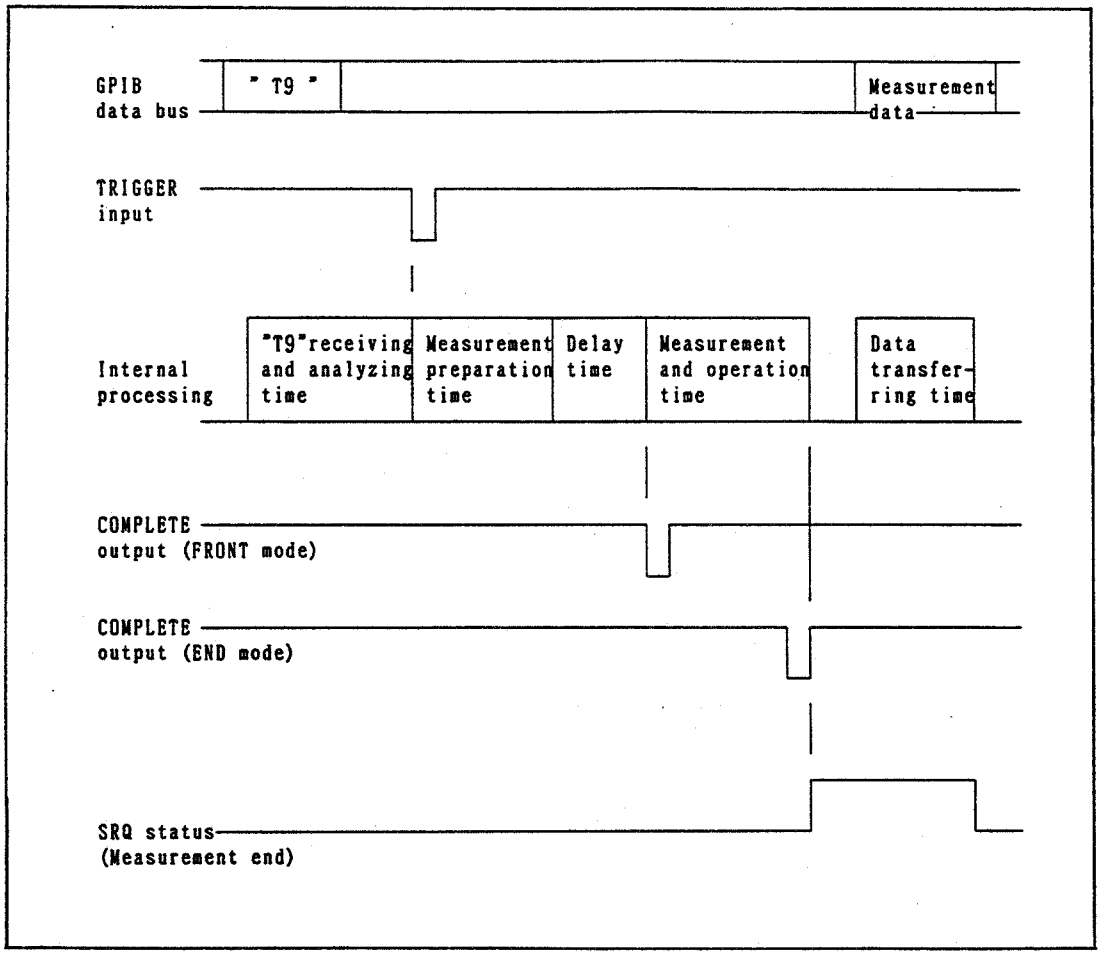
(10) Program code receiving process

Measurement items	Processing time
Processing time for one character	0.24 ms
Processing time after receiving block delimiter	1.35 ms

Measurement conditions:
Auto calibration; OFF
Sampling; HOLD

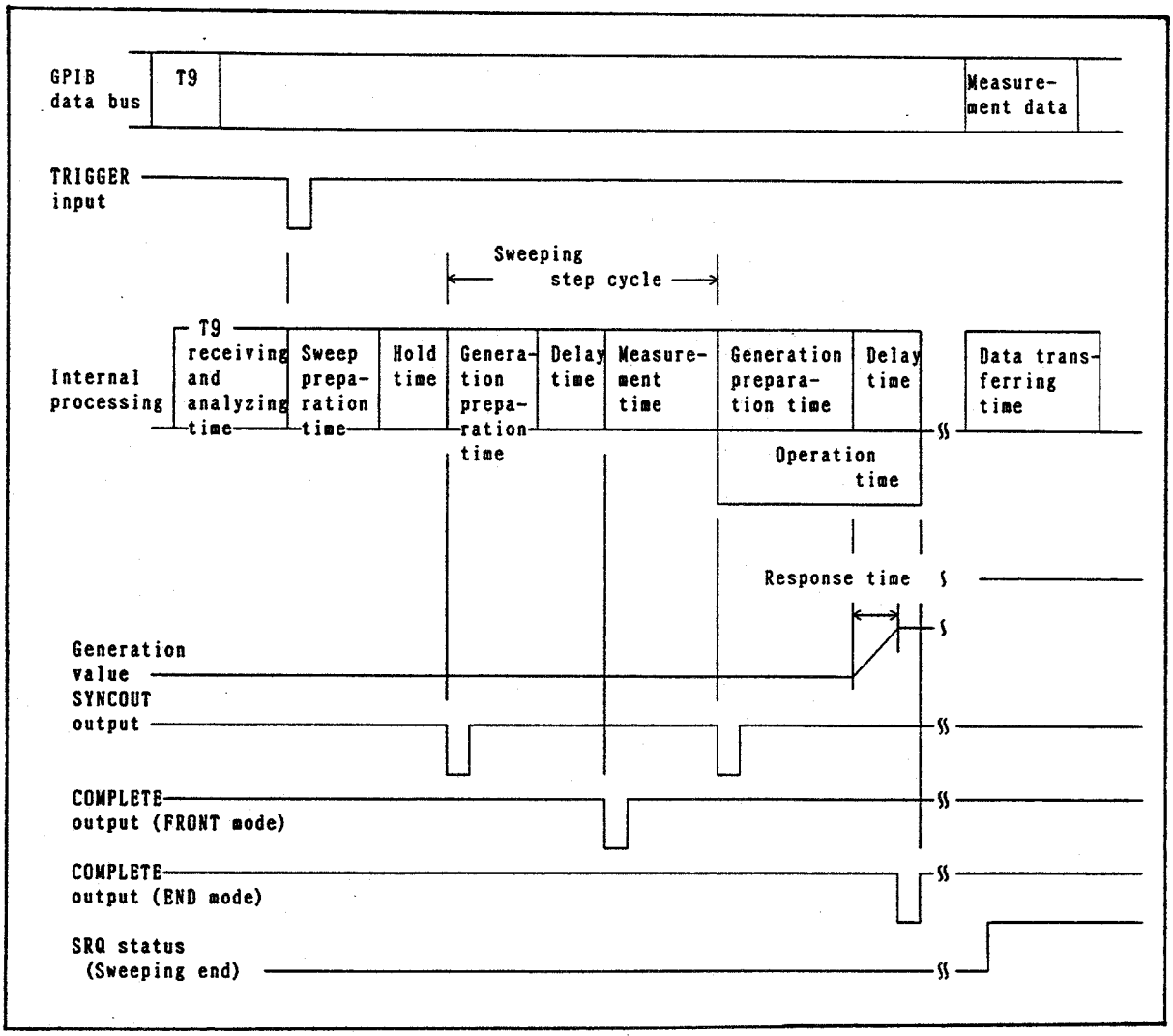
Processing time for receiving program code
= 0.24 ms x number of characters (including block delimiter) + 1.35 ms

A.3.2 Measurement Execution Time (HOLD Sampling)



Items		Execution time (Typical value)	Remarks
"T9" receiving and analyzing time		2.7 ms	"T9" receiving time + analyzing time
Measurement preparation time		3.5 ms	Time from TRIGGER input to COMPLETE output (FRONT mode)
Delay time		0 to 9999 ms	Delay time setting
Measurement and operation time		18 ms	Integration time: 10 ms Auto range: OFF
Data transferring time	ASCII format	2.7 ms	Header ON
	Binary (image input)	1.9 ms	

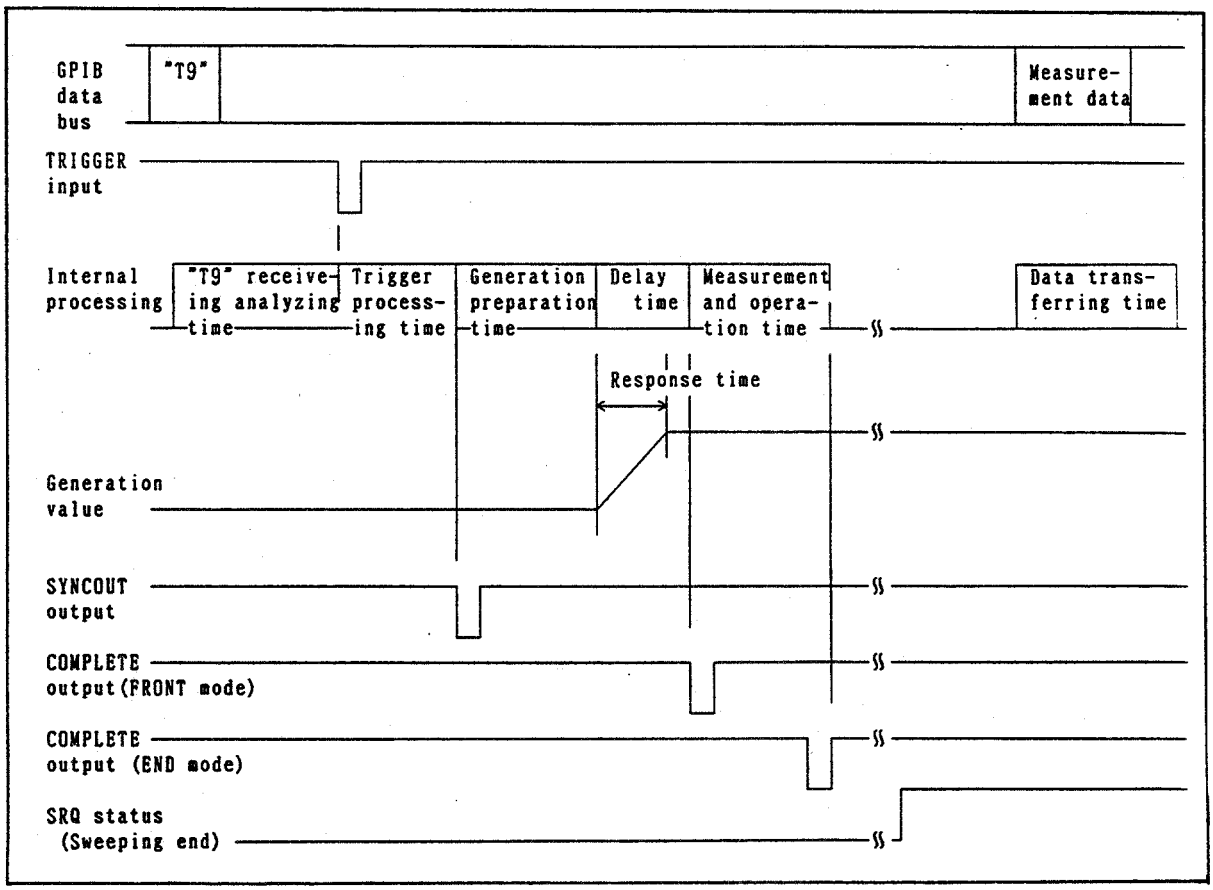
A.3.3 Sweep Execution Time (Auto Sweep)



A.3 GPIB REMOTE EXECUTING TIME (TYPICAL VALUE)

Items		Execution time (Typical value)	Remarks
T9 receiving and analyzing time		2.7 ms	T9 receiving time + analyzing time
Sweep preparation time		7.5 ms	Time from TRIGGER input to SYNCOUT output
Hold time		0 to 9999 ms	Hold setting time
Generation preparation time		2.2 ms	Time from SYNCOUT output to COMPLETE output (FRONT mode) Range not changed.
Delay time		0 to 9999 ms	Delay time setting
Measurement time + operation time		20 ms	Integration time: 10 ms Auto range: OFF
Sweeping step cycle		24 ms	Integration time: 10 ms Auto range: OFF
Data transferring time for 1 step	ASCII format	2.7 ms	Header ON
	Binary (image input)	1.9 ms	

A.3.4 Sweep Execution Time (External Sweep)



A.3 GPIB REMOTE EXECUTING TIME (TYPICAL VALUE)

Items		Execution time (Typical value)	Remarks
T9 receiving and analyzing time		2.7 ms	T9 receiving time + analyzing time
TRIGGER processing time		1.9 ms	Time from TRIGGER input to SYNCOUT output
Generation preparation time		2.4 ms	Time from SYNCOUT output to COMPLETE output (FRONT mode) Range not changed
Delay time		0 to 9999 ms	Delay time setting
Measurement and operation time		19 ms	Integration time: 10 ms Auto range: OFF
Data transferring time for 1 step	ASCII format	2.7 ms	Header ON
	Binary (image input)	1.9 ms	

A.4 L LOAD

When using the TR6143 as a current generator, load of inductance capacity including the cable connected with output terminal must be use within the following range.

Response mode	FAST	SLOW
Inductance capacity	10μH or less	470μH or less

CAUTION

When inductance capacity is out of the above range, TR6143 oscilates. And device may be damaged.

ALPHABETICAL INDEX

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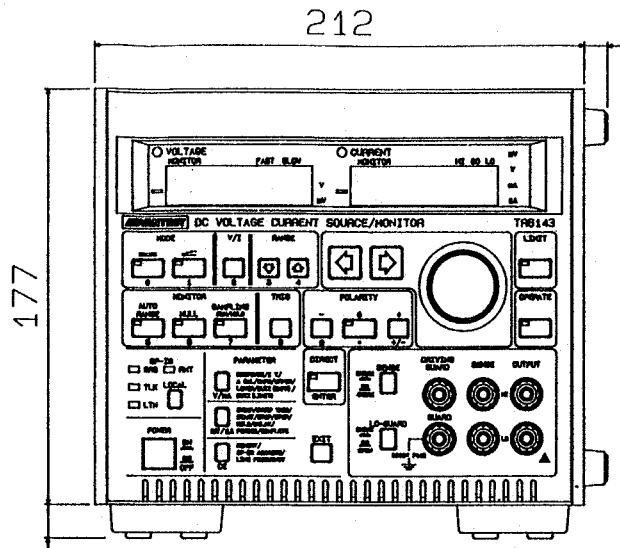
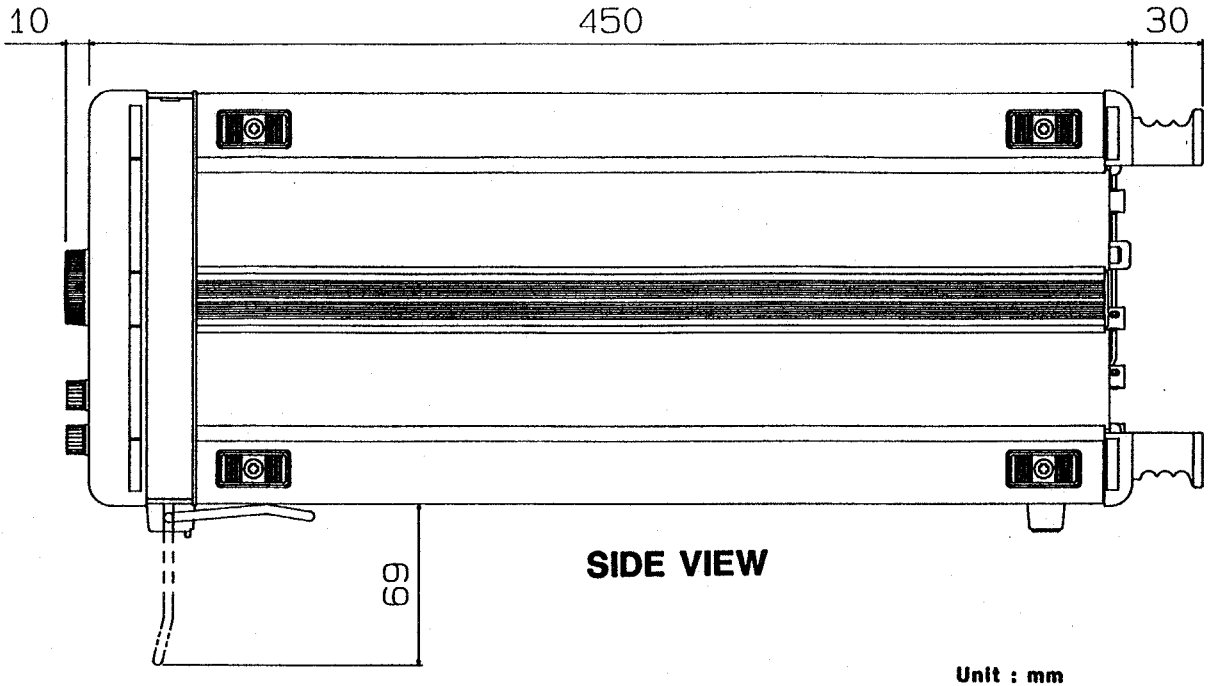
ALPHABETICAL INDEX

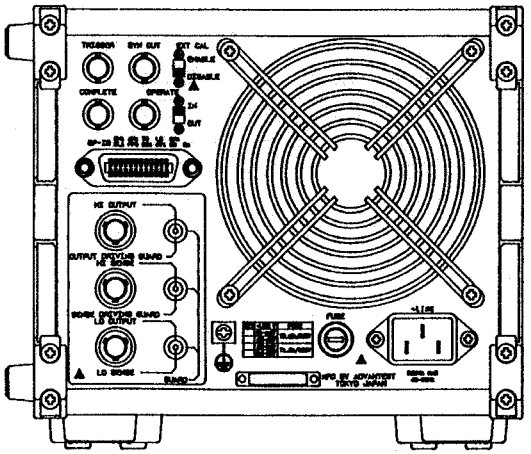


FRONT VIEW



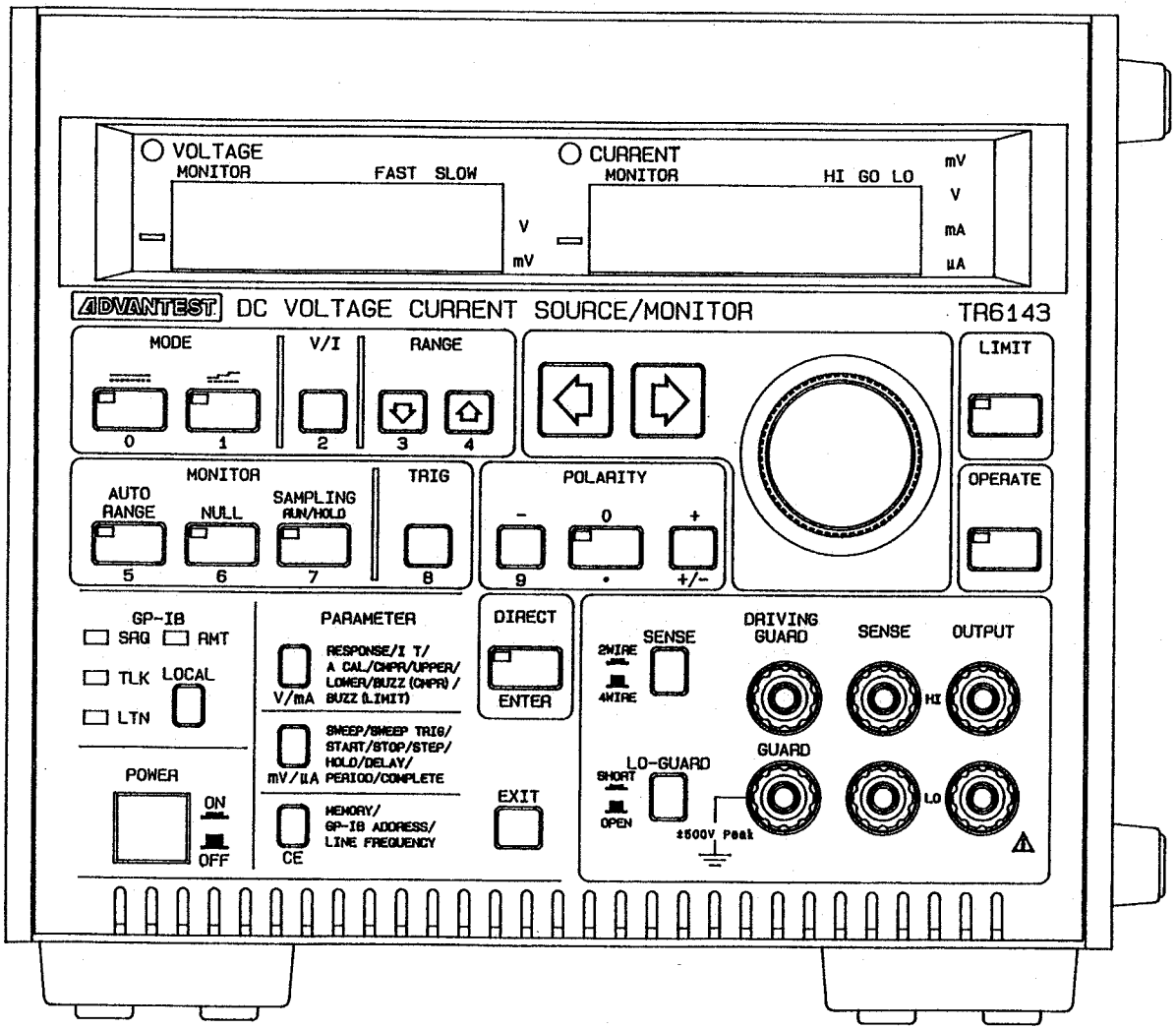
SIDE VIEW

Unit : mm



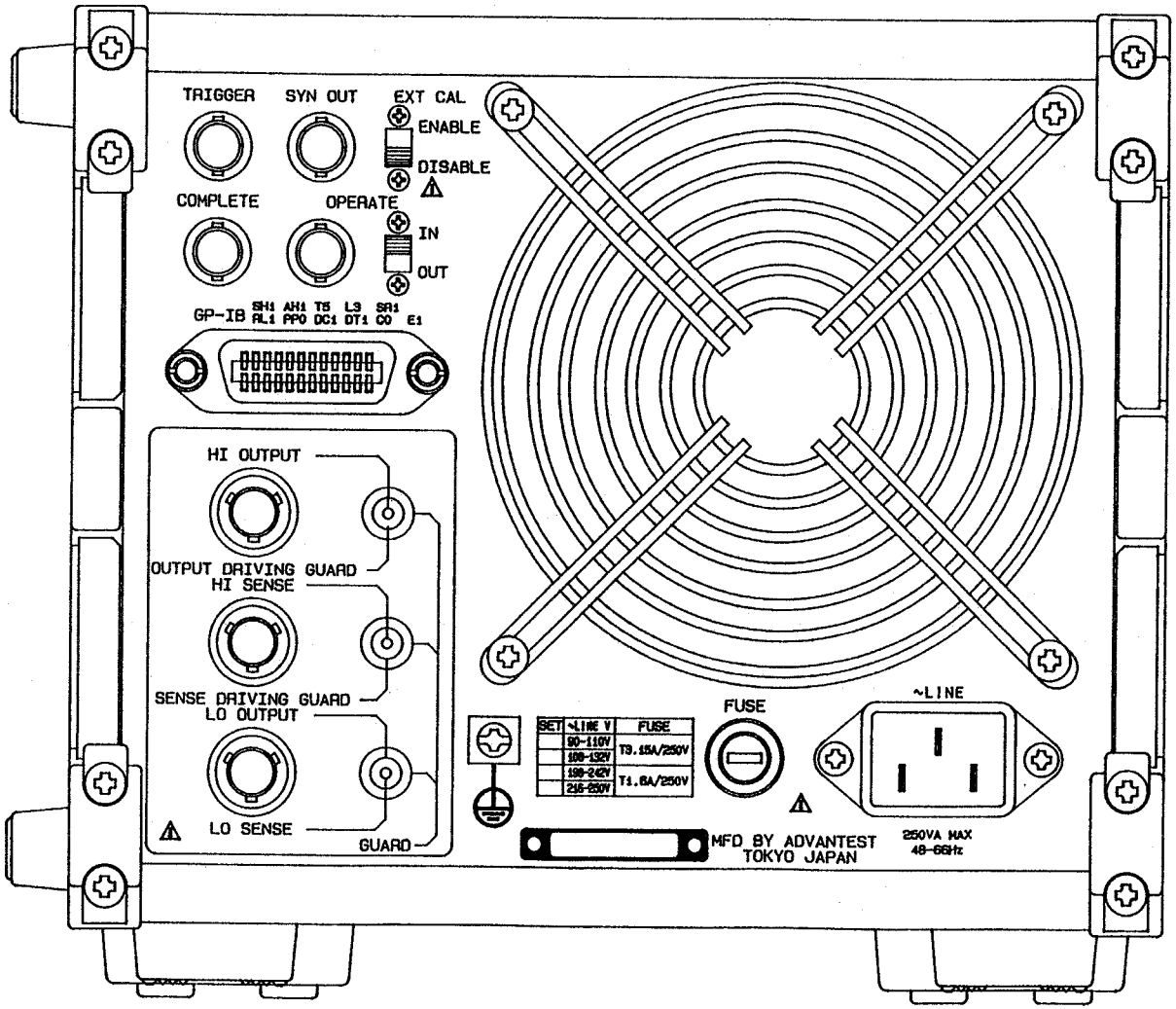
REAR VIEW

TR6143
EXTERNAL VIEW



TR6143 FRONT VIEW

EXT2-612-A



TR6143 REAR VIEW

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

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

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

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Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest ADVANTEST office listed at the end of this Operation Manual or ADVANTEST's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

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The product should be thoroughly inspected immediately upon original delivery to buyer. All material in the container should be checked against the enclosed packing list or the instruction manual alternatively. ADVANTEST will not be responsible for shortage unless notified immediately.
If the product is damaged in any way, a claim should be filed by the buyer with carrier immediately. (To obtain a quotation to repair shipment damage, contact ADVANTEST or the local supplier.) Final claim and negotiations with the carrier must be completed by buyer.

SALES & SUPPORT OFFICES

Advantest America, Inc.(North America)
New Jersey Office
258 Fernwood Avenue Edison, NJ 08837, U.S.A.
Phone: +1-732-346-2600 Facsimile: +1-732-346-2610

Advantest Taiwan Inc. (Taiwan)
No.1 Alley 17, Lane 62, Chung-Ho Street,
Chu-Pei, Hsin-Chu Hsien, Taiwan R.O.C. 302
Phone: +886-3-5532111 Facsimile: +886-3-5541168

Advantest (Singapore) Pte. Ltd. (Singapore)
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100 Facsimile: +65-6274-4055

Advantest Korea Co., Ltd. (Korea)
22BF, Kyobo KangNam Tower, 1303-22,
Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071 Facsimile: +82-2-532-7132

Advantest (Suzhou) Co., Ltd. (China)
Shanghai Branch Office
5F, No.46 Section Factory Building, No.555 Gui Ping Road,
Caohejing, Hi-Tech Area, Shanghai, China 200233
Phone: +86-21-6485-2725 Facsimile: +86-21-6485-2726
Beijing Branch Office
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing, China 100083
Phone: +86-10-8235-3377 Facsimile: +86-10-8235-6717

ROHDE & SCHWARZ Europe GmbH (Europe)
Mühldorfstraße 15
D-81671 München, Germany
(P.O.B. 80 14 60
D-81614 München, Germany)
Phone: +49-89-4129-13711
Facsimile:+49-89-4129-13723

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ADVANTEST CORPORATION

Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Tel: +81-3-3214-7500