ADVANTEST®
ADVANTEST CORPORATION

R6871E SERIES
DIGITAL MULTI-METER
INSTRUCTION MANUAL

MANUAL NUMBER OEA00 9301

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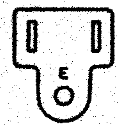
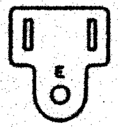
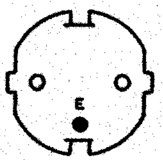
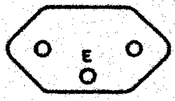
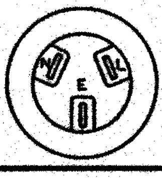
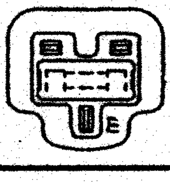
NOTICE

*ADVANTEST provides the following power cables for each country.
If there was any inconvenience on your use, please contact our subsidiaries or ADVANTEST representatives.*

	Plugs	Standards/Countries	Ratings/Color/ Length	Accessory Codes
1		JIS : JAPAN	Rating :125V 7A Color :Black Length :2m	A01402 A01412
2		UL : USA CSA : CANADA	Rating :125V 7A Color :Black Length :2m	A01403 (Opt.95) A01413
3		CEE : EUROPE VDE : FRG OVE : AUSTRIA SEMKO : SWEDEN DEMKO : DENMARK KEMA : NETHERLANDS FIMKO : FINLAND NEMKO : NORWAY CEBEC : BELGIUM	Rating :250V 6A Color :Gray Length :2m	A01404 (Opt.96) A01414
4		SEV : SWITZERLAND	Rating :250V 6A Color :Gray Length :2m	A01405 (Opt.97) A01415
5		SAA : AUSTRALIA NEWZELAND	Rating :250V 6A Color :Gray Length :2m	A01406 (Opt.98)
6		BS : UK	Rating :250V 6A Color :Black Length :2m	A01407 (Opt.99) A01417

Note : “E“ shows earth (ground).

Mc-cbl-9106

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PREFACE

(1) Applicable devices

R6871E
R6871E/E-DC
R6871E-OHM

(2) An instruction is provided if each explanation of R6871E, R6871E-DC and R6871E-OHM is different. Unless otherwise specified, explanation is common.

(3) Change "equipment" in this manual to the usage model.

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LIST OF TABLES

1. BEFORE POWER ON

1.1 How to Use This Manual

This manual is intended to be used by the user who is familiar with electronic measuring equipment. Figure 1-1 shows the basic configuration of this manual.

The user who uses R6871E/E-DC should read the manual from its beginning.

An experienced user is enough to read Section 2.1 of panel layout and Section 2.3 of measurement flowchart of Chapter 2.

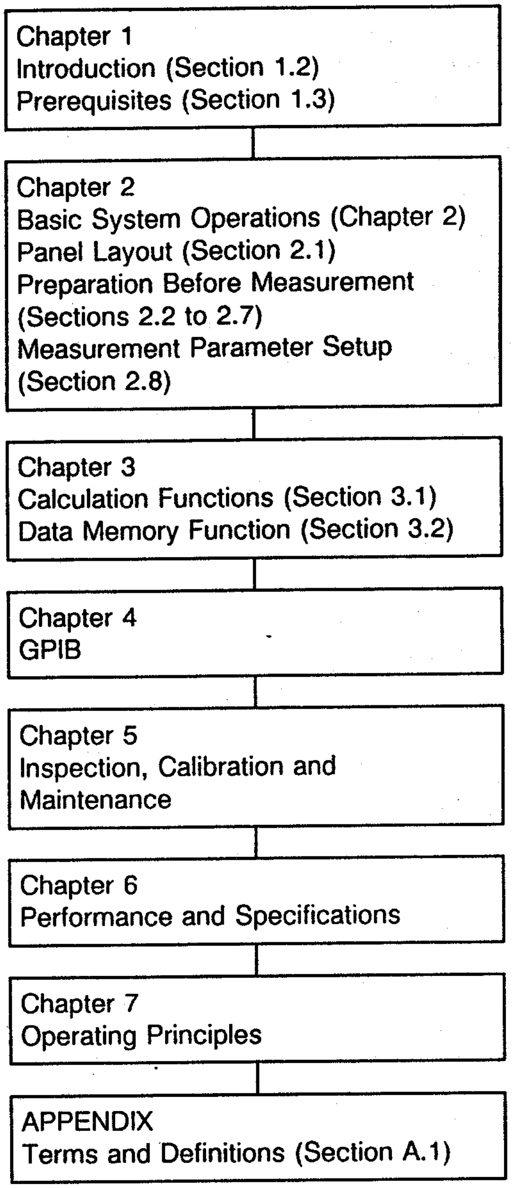


Figure 1-1 Manual Configuration

1.2 Introduction

The R6871E multi-meter has five measurement functions, the R6871E-DC has two measurement functions, and the R6871E-OHM has three measurement functions.

Measurement function

Function	R6871E	R6871E-DC	R6871E-OHM
DC Voltage	○	○	○
AC Voltage	○	—	—
DC Current	○	—	—
AC Current	○	—	—
Resistance	○	○	○
Network Resistance	—	—	○

○: Enable
–: Disable

Up to 2,000 times per second of high-speed sampling has been realized based on the advanced A/D conversion technologies. Typical applications are high-speed data acquisition and measurement with the automatic test instrument.

In addition, the R6871E/E-DC provides the digital memory function (allowing up to 10,000 data sets to be stored) with high-speed data sampling, pre-trigger functions allowing high-speed and individual event triggering, NULL function for easy offset calibration, digital smoothing functions, powerful arithmetic calculation for measurement data processing. The integration time, measurement cycle, and trigger delay time can be set for flexible measurement in various applications. The measurement reliability has greatly been enhanced through self-diagnostic functions and software calibration.

The R6871E/E-DC provides the standard full-remote control functions, trigger input, measurement end signal output via the GPIB.

[features]

- High-precision DC voltage and resistance measurement with 6 1/2 digit display (up to 1999999) in 0.5 ppm resolution and overrange measurement of up to 7 1/2 digit display (up to 19999999)
- High-precision DC current measurement with 5 1/2 digit display in 5 ppm resolution and overrange measurement of up to 6 1/2 digit display
- High-speed data sampling (up to 2,000 times/sec in 4 1/2 digit measurement)
- Easy change of integration time setup (9 types of setup) and highly reliable measurement against noise
- Data memory function (for storage of up to 10,000 data) and pre and delay triggering functions
- Null function allowing one-touch offset correction
- Digital smoothing functions provided
- Software calibration allowing very easy calibration
- Panel-compatible GPIB interface, trigger input, and measurement end signal output terminals are included as standard.
- Powerful arithmetic operation functions are also provided for dB, dBm, rms, statistic processing, and wire resistance temperature correction (20°C)
- Network resistance measurement which can measure resistance without switching off network
- Output of comparator operation result--only the R6871E-OHM is enabled

1.3 Before Use

1.3.1 Checking External View and Accessories

On receiving the R6871E/E-DC inspect the external view and check whether any cracks or damage has occurred during transportation.

Then, check the standard accessories according to Table 1-1 and verify each quantity and specification.

If any cracks or damage is found or if some accessories are missing, contact the sales division or agency nearest your place of business.
Address and telephone numbers are listed at the end of this manual.

Request to User : When ordering add-on attachment and the like, be good enough to stipulate the model (or stock No.) concerned.

Table 1-1 Standard Accessary List

Description	Specification	Stock No.	Q'ty	Remarks
Power cable	A01402	DCB-DD3130×01	1	
Input signal cable	MI-37	DCB-MM0412	1	For voltage, current, and 2-wired cable resistance measurement
	A01005A	AAA-A01005A	1	4-wired cable resistance measurement
Slow blow fuse	EAWK0.315A	DFT-AAR315A	2	For line voltage of 100/120V
	EAWK0.16A	DFT-AAR16A		For line voltage of 220/240V
	EAWK2A	DFT-AA2A	2	DC/AC current protection during measurement (R6871E only)
Instruction manual	–	JR6871E/E-DC	1	Japanese manual
	–	ER6871E/E-DC		English manual

1.3.2 Ambient Conditions

Use the multimeter in the temperature of 0°C to +40°C and relative humidity of 85% or less (70% RH or less in the 10-MΩ, 100-MΩ, or 1000-MΩ range).

Avoid using the R6871E/E-DC in the excessive dust, direct sun light, or corrosive gas. Also protect the multimeter from excessive vibration or mechanical shock.

1.3.3 Power Supply and Fuses

(1) Power Supply

The supply voltage is factory-present to the value indicated above the power connector on the rear panel.

Make sure that the source voltage matches the number identified.

Plug the power cable only when the POWER switch is turned off.

(2) Power Cable

To prevent any possible electrical shock, always ground the R6871E/E-DC if it is powered by the commercial power supply. The power cable plug has 3 pins. The round pin should be grounded. When using the A09034 adapter of accessory kit, ground the adapter ground pin (see Figure 1 - 2 (b)) or rear panel GND terminal.

Use the A09034 adapter or equivalent that meets the applicable electric appliances safety regulations and standards.

The adapter has 2 pins whose width differs from each other. Plug the adapter into receptacle in the correct direction. Use the KPR-13 optional adapter if necessary.

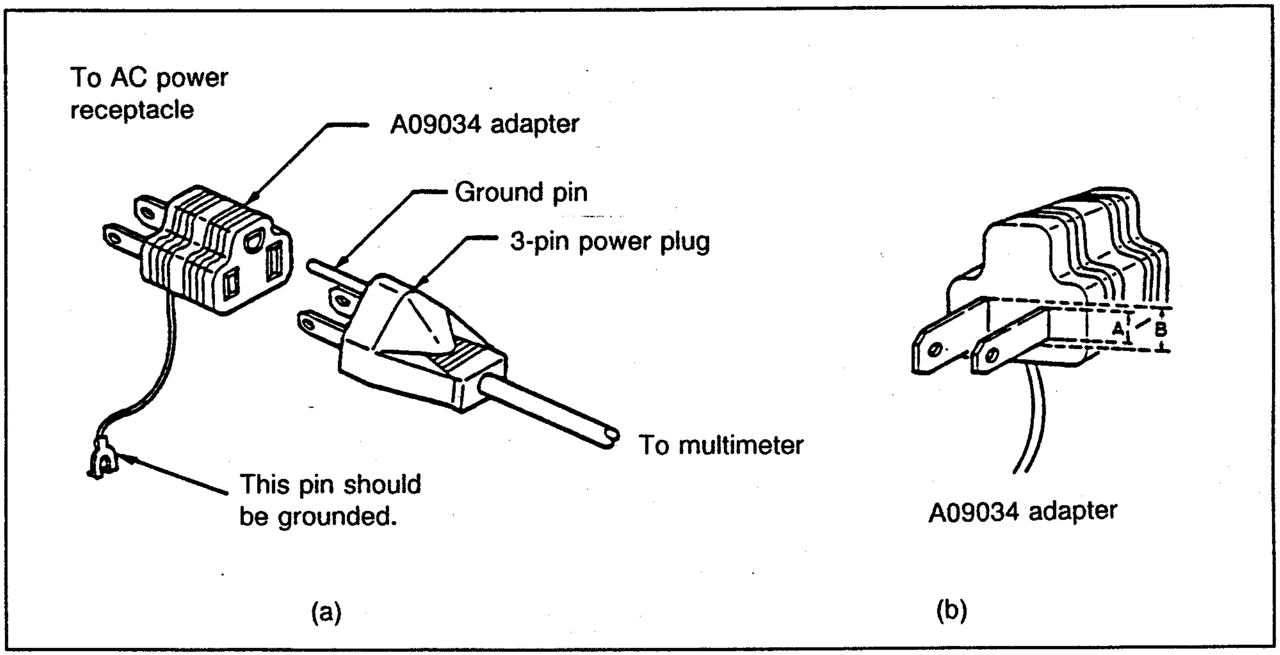


Figure 1-2 Figure Power Cable Plug and Adapter

(3) Frequency

The line frequency should be 50 or 60Hz.

For the power frequency setup, see Subsection 2.8.17 "Line frequency".

(4) Fuse Check and Replacement of Source Voltage

CAUTION

Before replacing a fuse, always unplug the power cable from the receptacle.

The line fuse is accommodated in the fuse holder of the rear panel. to make a fuse check or replacement, disconnect the power cable from the power connector and then turn the cap of the fuse holder in the direction of the arrow (↷) while slightly pressing and holding it down. The fuse can now be removed. Replace the blown fuse with a new one that meets the fuse capacity standards (see Table 1-2).

Table 1-2 Fuse Capacity Standards

Card Setup Voltage	Fuse Capacity
100VAC	0.315A
120VAC	0.315A
220VAC	0.16A
240VAC	0.16A

(5) Warm-up Time

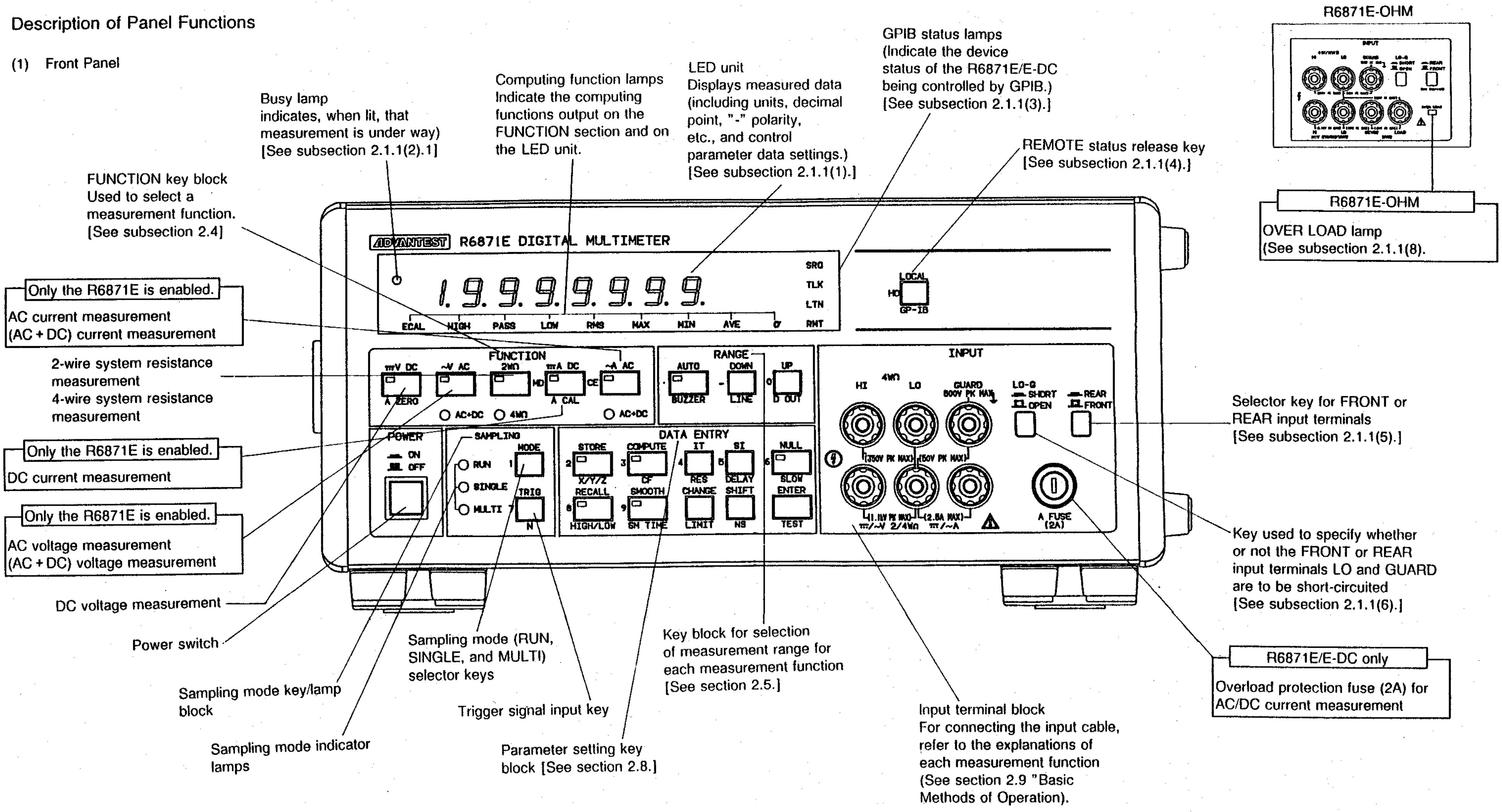
Although all functions activate upon power-on, 60 minutes or more should be allowed for warm-up to ensure the required accuracy.

MEMO

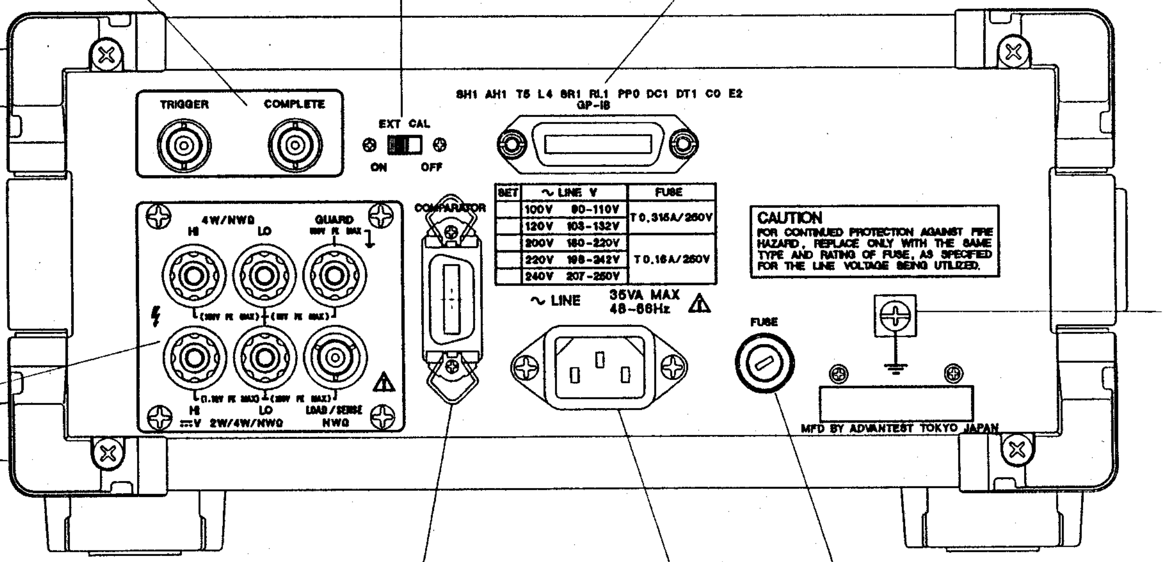
2. OPERATION METHOD-I (PARAMETER SETTING)

2.1 Description of Panel Functions

(1) Front Panel



(2) Rear Panel



Control signal connectors
TRIGGER input terminal and
COMPLETE output terminal
[See subsection 2.1.1(11).]

EXT CAL key
For external calibration of
each measurement function
[See subsection 2.1.1(10).]

GPIB connector
Used to provide external
control of the R6871E/E-DC
from GPIB

GND (Grounding) terminal
[See subsection 2.1.1(9).]

REAR input terminals
For connecting the input cable,
refer to the explanations of
each measurement function
[See section 2.9 "Basic
Methods of Operation].

R6871E-OHM only

Output connector for comparator
results

AC power connector
[See subsection 2.1.1(8).]

Power fuse

2.1.1 Supplementary Description of Panel Functions

[Front Panel]

(1) LED Unit

The LED (light emitting diode) section displays measured data (including the units of measurement, the decimal point, and "-" polarity) and control parameter data settings.
Data is displayed in ten digits: the first eight digits are provided by a 7-segment LED, and the remaining two digits are provided by an LED of a 5x7 dot matrix. The maximum data that can be displayed is "19999999" (7 1/2 digit display).
Of the first eight digits, the least significant digit becomes blank during 6 1/2 digit display, the low-order two digits become blank during 5 1/2 digit display, and the low-order three digits become blank during 4 1/2 digit display.
If an excessive load (overcurrent or overvoltage) is applied, then the message "OL" (overload) is displayed. The decimal point is also displayed at this time to allow easy identification of the measurement range being used during an overload.

(2) BUSY Lamp

This lamp, which indicates that measurement is under way, lights up during measurement or during output of recall data.

(3) GPIB Status Lamps

These lamps indicate the device status of the R6871E/E-DC when it is placed under the control of GPIB.

- The SRQ lamp lights up when the R6871E/E-DC transmits a service request signal to the controller.

- The TLK lamp lights up when the R6871E/E-DC enters a talker status in which data can be transmitted from the multimeter.

- The LTN lamp lights up when the R6871E/E-DC enters a listener status in which data can be received by the multimeter.

- The RMT lamp lights up when remote control is provided to the R6871E/E-DC.
  When the RMT lamp is lit, all panel keys are in operative with the exception of the LOCAL key.

(4) LOCAL Key

The LOCAL switch is used to release the remote-controlled status of the R6871E/E-DC (RMT lamp lit), thus allowing control of the multimeter from the front panel. (The remote-controlled status cannot be released if the "LLO" (Local Lockout) command is set using the GPIB.)

(5) INPUT Key (Selector Key for Input Terminal Block)

This key is used to select input terminals. It is possible with this key to select which of the two types of input terminals (FRONT and REAR) is to be used for each measurement.
Pressing the key allows REAR input, and re-pressing the key allows FRONT input.
When measuring the current, set the INPUT key to FRONT input regardless of which type of input terminals (FRONT or REAR) is used.

(6) LO-G SHORT Key

This key is used to short-circuit the LO and GUARD terminals of the FRONT or REAR input terminals selected with the INPUT key.
Pressing the key causes short-circuiting of the above two terminals, and re-pressing the key causes opening of the terminals.

(7) OVERLOAD -- R6871E-OHM only --

[Rear Panel]

(8) AC Power Connector

This connector is used to connect the AC power supply to the R6871E/E-DC. The power cable (supplied) is to be used.

(9) GND (Grounding) Terminal

This terminal is used to ground the R6871E/E-DC. When using a power cable together with the 2-pin adapter (supplied), be sure to connect either the adapter pin (see Figure 1-2) or the GND terminal to ground.

(10) EXT CAL Key

This key is used for external calibration of each measurement function. Normally, set the key to the OFF position.
If the key is set to the ON position, the E CAL lamp below the LED display comes on.

(11) Control Signal Connectors

The TRIGGER input terminal is used to send a measurement start signal to the R6871E/E-DC from an external equipment. The input signal is of the TTL level, negative pulse type (pulse width : 100µsec or more).
The COMPLETE output terminal is used to generate a strobe signal for output of measured data or arithmetically processed data. The output signal is of the TTL level, negative pulse type (pulse width : 130µsec or more).

(12) Output Connector for Comparator Results -- R6871E-OHM only --

Comparator results are output by open collector.

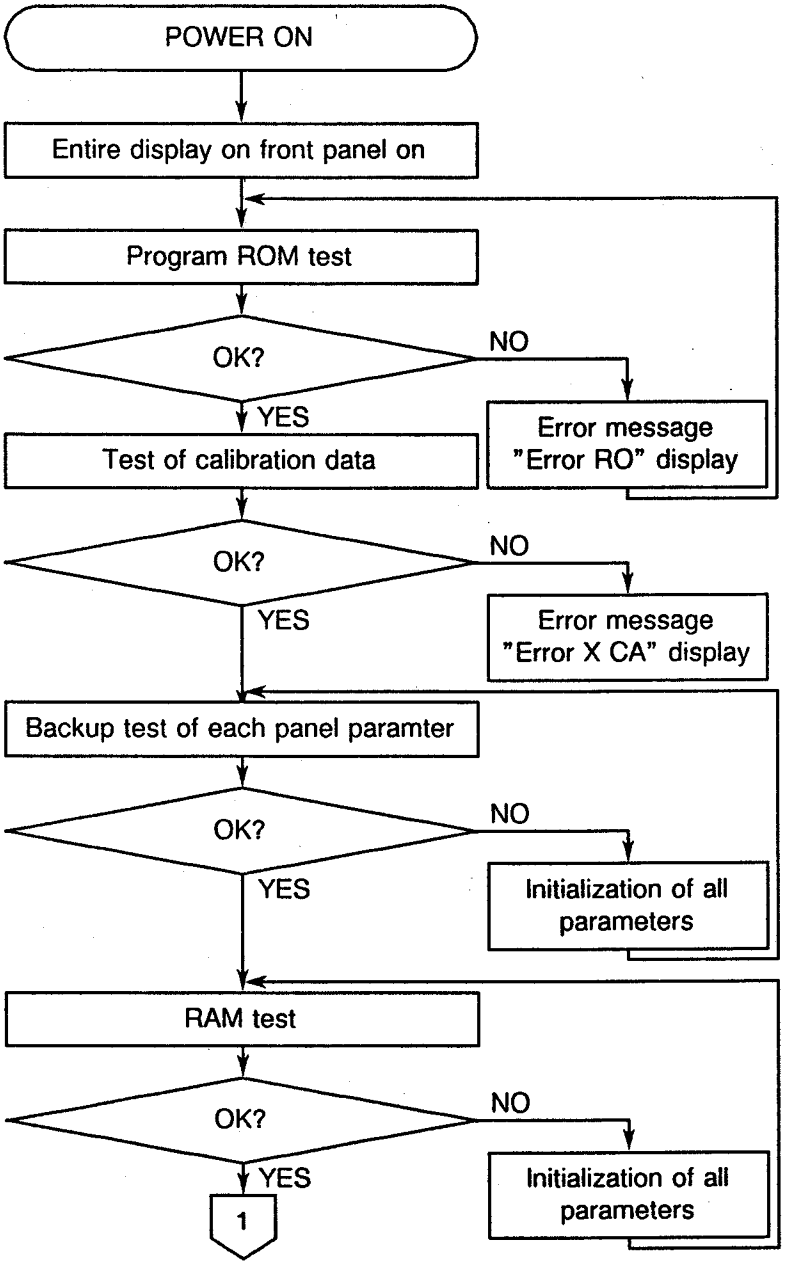
2.2 Power-On/Off Procedures

CAUTION

Although all functions activate upon power-on, 60 minutes or more should be allowed for warm-up to ensure the required accuracy.

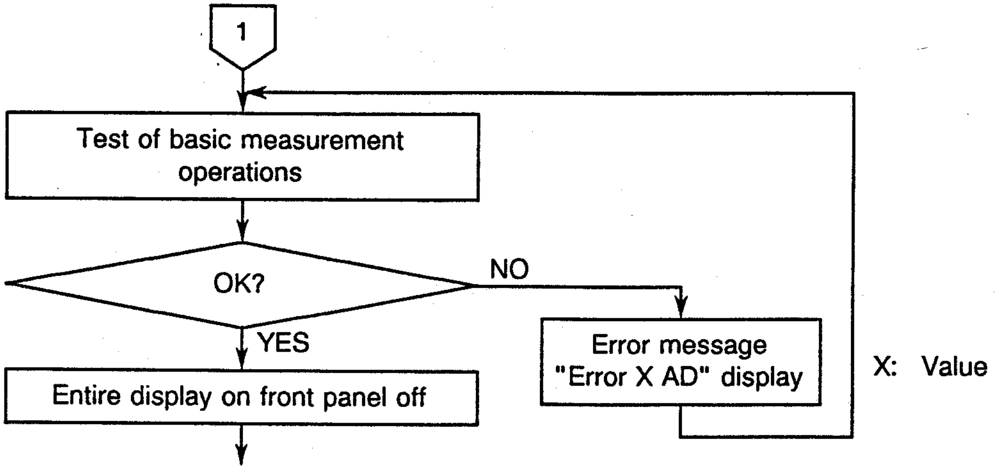
2.2.1 Power-on Procedure

(1) Pressing the POWER switch causes the entire display on the front panel to appear. At the same time, the various states of self-tests and the R6871E/E-DC are displayed and then the multimeter enters the normal measurement mode.
The following shows an operation flow starting with the power-on action:

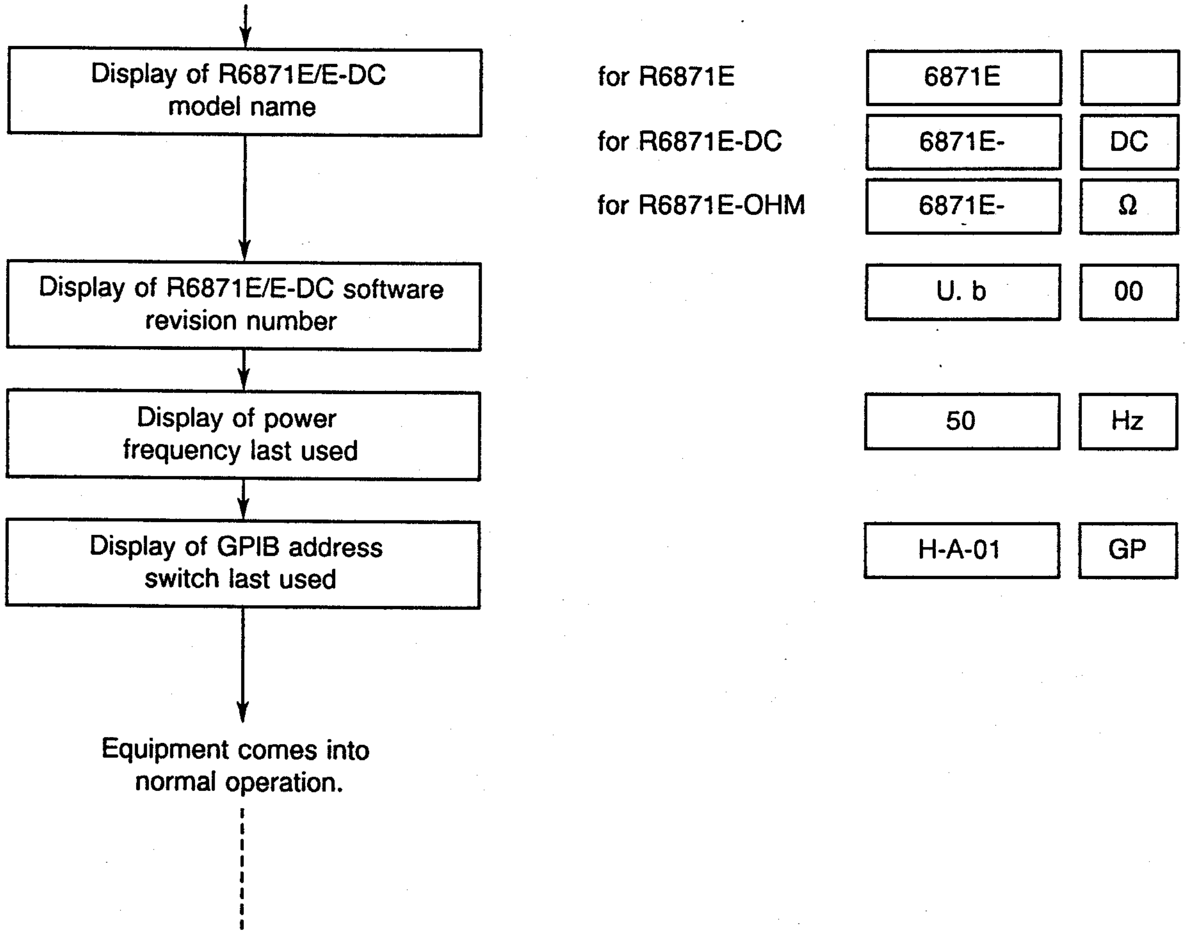


See section 5.2 for POWER ON details of error messages. If error message display occurs during this power-on procedure, the R6871E/E-DC is malfunctioning. In such cases, turn the power off with the error message left on the display and then contact the sales division or agency nearest your place of business.

X: Value

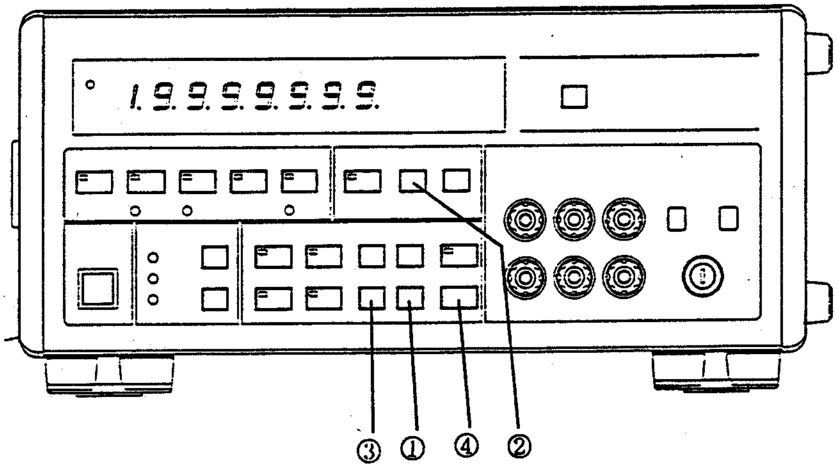


Self-testing is now complete, followed by display of the various states of the R6871E/E-DC.



(2) After the R6871E/E-DC has come into normal operation, first set the power frequency (50Hz or 60Hz) using the following procedure:

[Setting procedure]



[These numbers indicate the following procedure numbers.]

<u>LINE parameter setting</u>

① Press the $\overset{\text{SHIFT}}{\boxed{}}$ key.

Each of the keys will then work as the parameters inscribed below the keys.

$\boxed{\text{5 0 H z}}$

② Press the $\underset{\text{LINE}}{\boxed{}}$ key.

The power frequency setting last used will then be displayed on the LED unit.

Power frequency selection

③ Select the power frequency
(50Hz or 60Hz) using the $\overset{\text{CHANGE}}{\boxed{}}$ key.
Each time the $\overset{\text{CHANGE}}{\boxed{}}$ key is pressed,
the display changes as follows:
50Hz⇆60Hz
In this way, display the power frequency setting on the LED unit.

Setting of power frequency completed

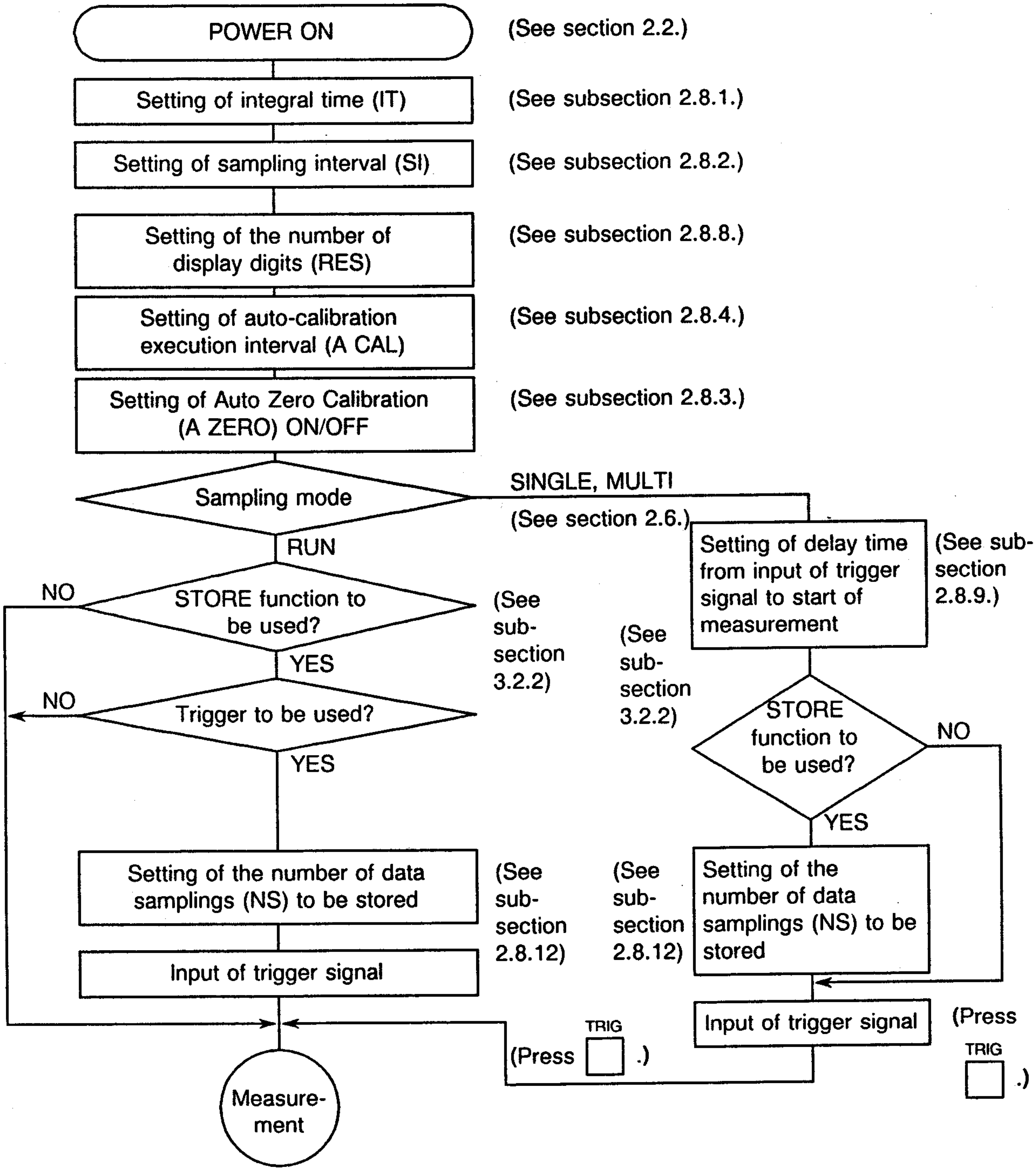
④ Press the $\overset{\text{ENTER}}{\boxed{}}$ key.
The power frequency setting being displayed will then be stored in memory.
This completes the power-frequency setting sequence.

2.2.2 Power-off Procedure

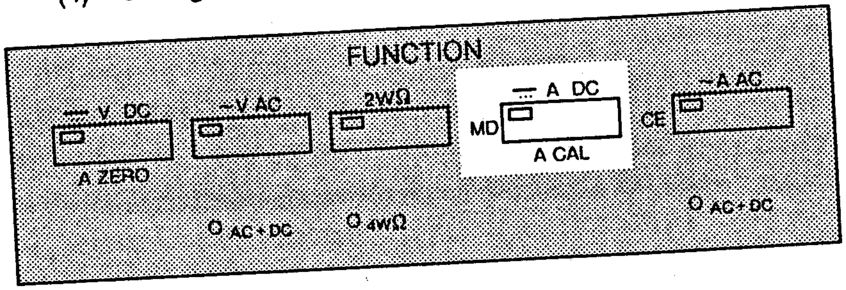
Pressing the POWER switch with the power on will cause the power to turn off.
Built-in batteries provide backing-up of the parameters that have been set, and thus they are retained even when power is turned off.

2.3 Measurement Flowchart

The flowchart of the operating procedure from power-on to the start of measurement is shown below. See the relevant sections (or subsections) for details of the individual procedural steps.



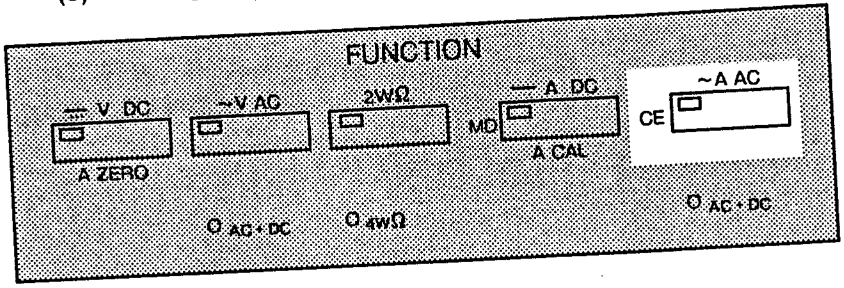
(4) Setting the DC current measurement function : Only the R6871E is enabled.



Press the ⎓ A DC MD ☐ A CAL key.

The lamp of the key will then light up to indicate that setting is complete.

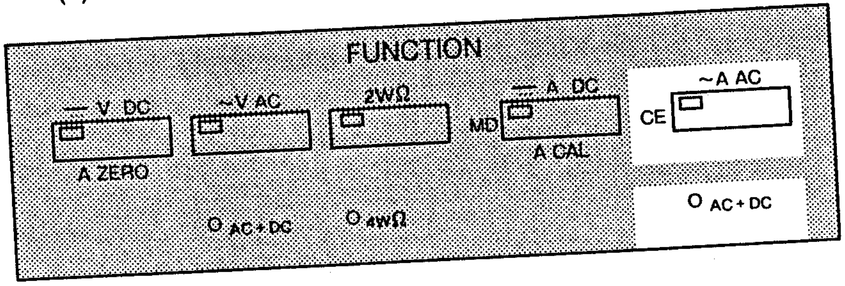
(5) Setting the AC current measurement function : Only the R6871E is enabled.



Press the ~A AC ☐ key.

The lamp of the key will then light up to indicate that setting is complete.

(6) Setting the AC+DC current measurement function: Only the R6871E is enabled.

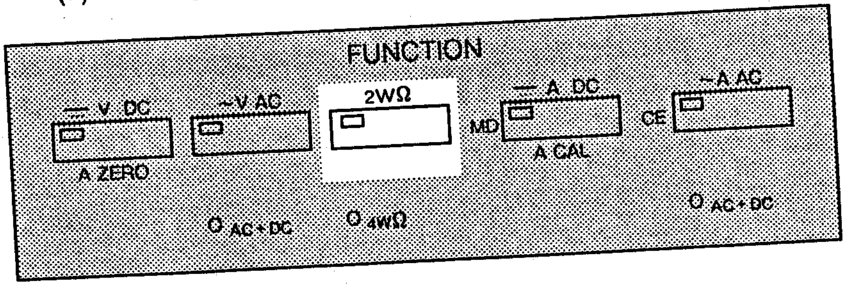


: Only the R6871E is enabled.

With the AC voltage measurement function set,

press the ~A AC ☐ key once again. The AC+DC lamp below the key will then light to indicate that setting is complete.

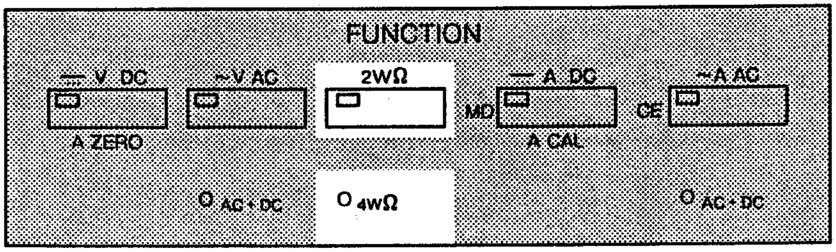
(7) Setting the 2-wire system resistance measurement function



Press the 2WΩ ☐ key.

The lamp of the key will then light up to indicate that setting is complete.

(8) Setting the 4-wire system resistance measurement function
(Network resistance measurement : Only the R6871E-OHM is enabled.)



With the 2-wire system resistance measurement function set,

press the 2WΩ key once again. The 4WΩ lamp below the key will then light to indicate that setting is complete.

2.5 RANGE Section

[Functional description]

Keys in the RANGE section are used to select a measurement range.
The selected measurement range can be identified by checking the corresponding unit of display and the position of the decimal point.
The following table shows the range configuration of the R6871E/E-DC:

Table 2-1 Measurement Range Configuration

VDC	VAC*3, V(AC + DC)*3	ADC*3	AAC*3, A(AC + DC)*3	2/4WΩ*4, NWΩ
200mV	200mV	2000μA	2000μA	10Ω
2000mV	2000mV	20mA	20mA	100Ω
*1 10V	*2 20V	*2 200mA	*2 200mA	*4 1000Ω
*2 20V	200V	2000mA	2000mA	*2 10kΩ *4
200V	500V			*4 100kΩ
1000V				*4 1000kΩ
				*4 10MΩ
				100MΩ
				1000MΩ

*1 : The 10V range can be selected only when the EXT CAL key is placed in its ON position.

*2 : Initial value.

*3 : Only the R6871E is enabled.

*4 : Only the R6871E-OHM is enabled. Accuracy is not guaranteed though the measurement operation is done in 10Ω, 100Ω, 100MΩ or 1000MΩ range.

Table 2 - 2 Automatic Range Levels

Function	Range	Max. No. of display digits	Full-scale	UP level	DOWN level
VDC	200mV	6 1/2	1999999	2000000	–
	2000mV	7 1/2	19999999	20000000	1799999
	20V	7 1/2	19999999	20000000	1799999
	200V	7 1/2	19999999	20000000	1799999
	1000V	7 1/2	11000000	1100***1	1799999
VAC *1 V(AC + DC) *1	200mV	5 1/2	199999	200000	–
	2000mV	5 1/2	199999	200000	17999
	20V	5 1/2	199999	200000	17999
	200V	5 1/2	199999	200000	17999
	500V	5 1/2	50000	500*1	17999
ADC *1 *2 AAC *1 A(AC + DC)*1	2000µA	5 1/2	199999	200000	–
	20mA	5 1/2	199999	200000	17999
	200mA	5 1/2	199999	200000	17999
	2000mA	5 1/2	199999	200000	17999
2WΩ 4WΩ NWΩ *3	10Ω	6 1/2	1199999	1200000	–
	100Ω	7 1/2	11999999	12000000	999999
	1000Ω	7 1/2	11999999	12000000	999999
	10kΩ	7 1/2	11999999	12000000	999999
	100kΩ	7 1/2	11999999	12000000	999999
	1000kΩ	7 1/2	11999999	12000000	999999
	10MΩ	7 1/2	11999999	12000000	999999
	100MΩ	7 1/2	11999999	12000000	999999
	1000MΩ	7 1/2	11999999	12000000	999999

*1 : Only the R6871E is enabled.

*2 : ADC is displayed in a maximum of 6 and a half digits

*3 : Only the R6871E-OHM is enabled.

Note : For the least significant digit of output-digit mode data, "1",. For all other digits, "0".

2.6 SAMPLING Section

[Functional description]

Keys in the SAMPLING section are used to select a sampling mode (RUN, SINGLE, or MULTI). MULTI BULK cannot be selected from the panel.
Keys for trigger signal input are also located in this section.
In each such mode, sampling is performed as follows:

(1) RUN mode* : Sampling is automatically repeated at the cycle that has been set using the SI parameter. (See subsection 2.8.2, "SI : Sampling interval".)

(2) SINGLE mode : Sampling is performed just once each time the trigger signal is input.

(3) MULTI mode : Each time the trigger signal is input, sampling is performed in accordance with the NS parameter setting (number of times of sampling). The sampling cycle at this time refers to the SI parameter setting. (See subsection 2.8.12, "NS : Number of samples".)

(4) MULTI BULK mode : Each time the trigger signal is input, sampling is performed NS times at intervals of SI. After sampling is performed NS times, th measurement data for NS samples is output to the GPIB all togeth in response to the data output request. This is the sampling mo selectable in the GPIB system and cannot be selected from panel.

Features of sampling in each mode are outlined below.

(1) RUN mode :

① Sampling is performed at the sampling interval that has been set.
② Each time a sampling operation is performed, the BUSY lamp loca the left of the LED unit blinks just once and the measured value time is displayed.

(2) SINGLE mode :

① If this mode has been selected, sampling can be done with the $\overset{\text{TRIG}}{\boxed{}}$ key.

② Pressing $\overset{\text{TRIG}}{\boxed{}}$ causes sampling to be performed after the lapse of the trigger delay time that has been set using the DELAY parameter. (See subsection 2.8.9, "DELAY".)

③ Sampling can be done only once.

④ When sampling is performed, the BUSY lamp located to the left of the LED unit will blink just once and the measured value at that time will be displayed.

⑤ Sampling is not performed until $\overset{\text{TRIG}}{\boxed{}}$ is subsequently pressed once again.

(3) MULTI mode :

① If this mode has been selected, sampling can be done with the $\overset{\text{TRIG}}{\boxed{}}$ key.

② The only one difference from the SINGLE mode is that while the SINGLE mode allows sampling to be performed just once, the MULTI mode allows continuous sampling to be performed in accordance with the specified number of times of sampling.

③ Pressing $\overset{\text{TRIG}}{\boxed{}}$ causes sampling to be started after the lapse of the trigger delay time that has been set using the DELAY parameter.

④ Sampling is performed at the set sampling interval.

⑤ Each time a sampling operation is performed, the BUSY lamp located to the left of the LED unit blinks just once and the measured value at that time is displayed.

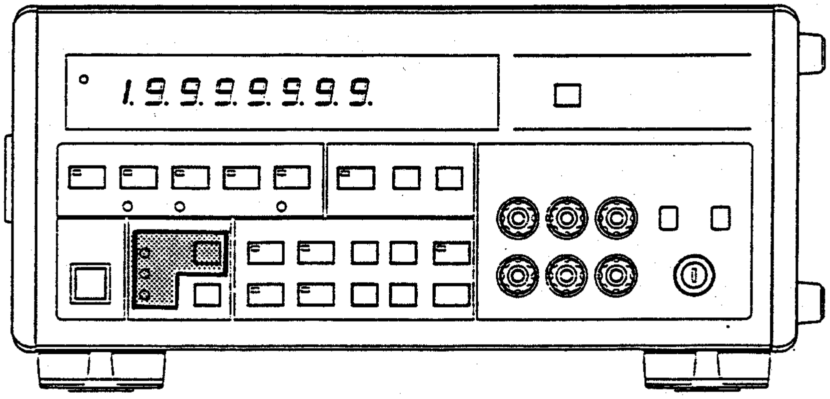
⑥ Sampling takes place by the specified number of times and then terminates automatically.

⑦ Sampling does not occur until the $\overset{\text{TRIG}}{\boxed{}}$ key is subsequently pressed once again.

(4) MULTI BULK mode : See Chapter 4. MULTI-SAMPLING BULK OUTPUT.

[Setting procedure]

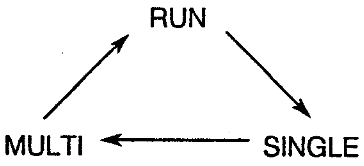
The procedure for setting the sampling mode is described below.



Setting of the sampling mode

Select a sampling mode (RUN, SINGLE, or MULTI) using the $\overset{\text{MODE}}{\square}$ key.

Each time the key is pressed, the lamp located to the left of the $\overset{\text{MODE}}{\square}$ keys light up in the following order:

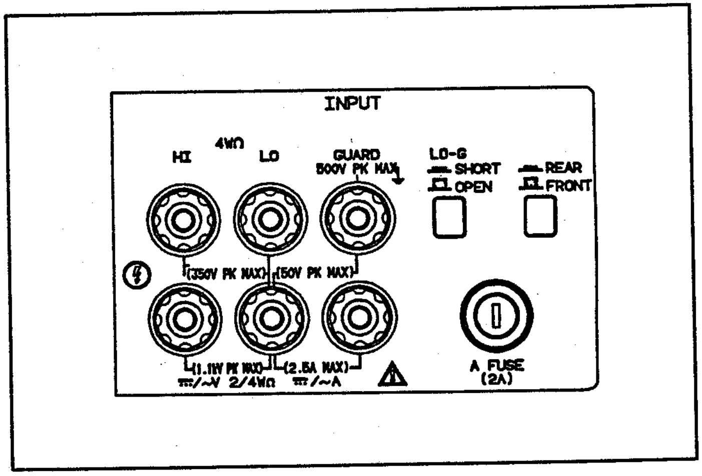


Setting is complete when the lamp of the mode to be set comes on.

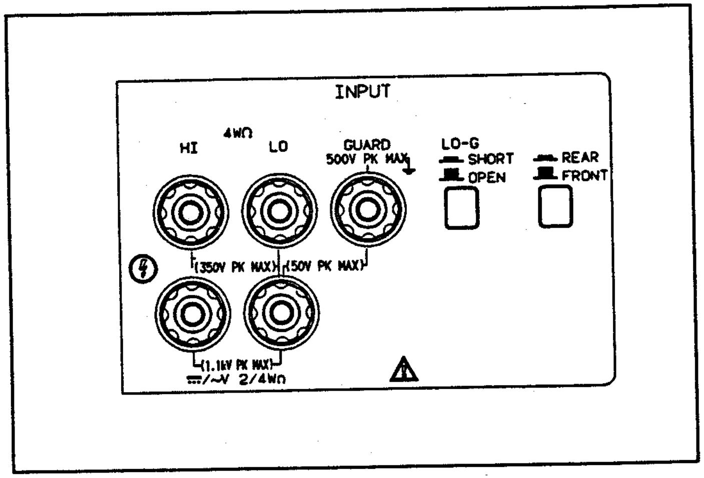
2.7 INPUT Section (Selection of Input Terminal)

FRONT/REAR terminal selection

R6871E



R6871E-DC

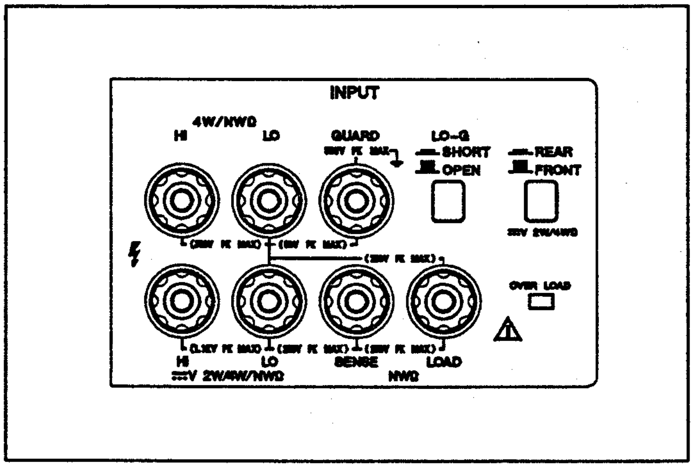


Make the selection using the

▬ REAR
■ FRONT
☐ selector switch located in the upper right section of the front panel input terminals of the R6871E/E-DC. This switch usually assumes either a protruding state (■) or a recessed state (▬).

The switch changes between these two states each time it is pressed. Place the switch in its protruding state (■) to select the FRONT terminals, and place the switch in its recessed state (▬) to select the REAR terminals.

R6871E-OHM



CAUTION

Only the R6871E is enabled.
For current measurement, use one of the FRONT and REAR sets of input terminals. Current measurement is possible only when the INPUT key is set to the FRONT position, irrespective of whether the input terminal blocks on the front panel is being used or that on the rear panel is being used.

Only the R6871E-OHM is enabled.
For network resistance, use one of the FRONT and REAR sets of input terminals (LOAD/SENSE), irrespective of pressing INPUT key.

2.8 Description of Parameters and Their Setting Procedures

Parameters refer to the variables used to set various measurement conditions so that the R687lE/E-DC obtains accurate measurements.
Before offering a description of the parameter setting procedures, we will first describe the keys necessary to set parameters.
Parameter settings are backed up by built-in batteries, and thus they do not disappear even when power is turned off.

[Initial value of each parameter]

• GPIB	Cannot be initialized.
• LINE	Cannot be initialized.
• FUNCTION	⎓ V DC
• RANGE	AUTO (20V range)
• SAMPLING MODE	RUN
• IT	5PLC
• SI	250msec
• A ZERO	ON
• A CAL	1 minute
• BUZZER	OFF
• D OUT	Output mode 0 (Output to the entire output system)
• CF	0-0 (OFF for both primary and secondary computation)
• RES	6 1/2 digit mode
• DELAY	0msec
• SLOW	ON (SLOW mode)
• N	2

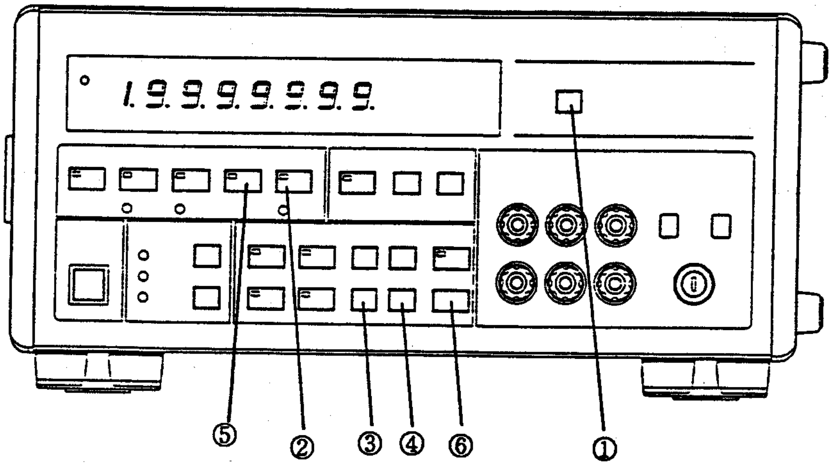
• SM TIME	10
• NS	1
• X/Y/Z	X, Z = 1 Y = 0
• HIGH/LOW	HIGH1, HIGH2 = 1 LOW1, LOW2 = 0
• LIMIT	Reference value = 1 %1, %2 = 10%

[Parameters that are automatically initialized at power-on]

- STORE
- RECALL
- COMPUTE
- NULL
- SMOOTH
- D OUT

To initialize the parameter, press
SHIFT MODE ENTER
keys ☐ ☐ ☐ , in this order.
[keys necessary to set the parameter]

CLEAr



[These numbers indicate the following procedure numbers.]

① HO ☐ (HOME key)

This key is used to cancel the parameter data being set (that is, the data existing before the ENTER ☐ key is pressed) and thus allows measurement to be made in the normal mode using the old data of the corresponding parameter.

② CE ☐ (CE key)

This key is used to cancel the entire set of parameter data being input (that is, the data being displayed on the LED unit).

③ CHANGE ☐ (CHANGE key)

This key is used to change the data settings being displayed (that is, ON/OFF of various parameters, units, and the number of display digits).

④ $\overset{\text{SHIFT}}{\square}$ (SHIFT key)

This key has the following two functions:

(a) Calling on the display unit the RES, DELAY, SLOW, and other parameters that are printed in blue underneath the corresponding keys.

(b) Shifting the blinking display position.

⑤ MD ☐ (MD key)

This key sets the previously-tested value or the result of function as data for parameter. The key is enabled when X/Y/Z, HIGH/LOW, LIMIT, and parameter are set.

⑥ $\overset{\text{ENTER}}{\square}$ (ENTER key)

This key is used to store data settings into the internal memory.

(a) When using $_0\underset{\text{DOUT}}{\overset{\text{UP}}{\square}}$ to $_S\underset{\text{SM TIME}}{\overset{\text{SMOOTH}}{\square}}$ as numeric keys:

After the following parameters (the parameters that require setting of numerics) have been set, $_0\underset{\text{DOUT}}{\overset{\text{UP}}{\square}}$ to $_9\underset{\text{SM TIME}}{\overset{\text{SMOOTH}}{\square}}$ act as numeric keys:

A CAL
CF
DELAY
GPIB (address)
HIGH/LOW
LIMIT
N
NS
SI
SM TIME
X/Y/Z

This is, $_0\underset{\text{DOUT}}{\overset{\text{UP}}{\square}}$ to $_9\underset{\text{SM TIME}}{\overset{\text{SMOOTH}}{\square}}$ act as numeric keys after selection of a parameter that requires numerical setting.

(b) When setting the parameters that are printed in blue:

After pressing $\underset{\text{NS}}{\overset{\text{SHIFT}}{\boxed{}}}$, press the key under which the desired parameter is printed.

2.8.1 IT : Integrate Time

[Functional description]

The IT parameter is used to set the integral time on which the R6871E/E-DC is to make an A/D conversion.

(1) Use of the IT parameter makes it possible for the integral time that matches measurement resolution and measurement speed to be selected from the following nine types:

100μs, 1ms, 10ms, 1PLC, 5PLC, 10PLC, 20PLC, 50PLC, 100PLC

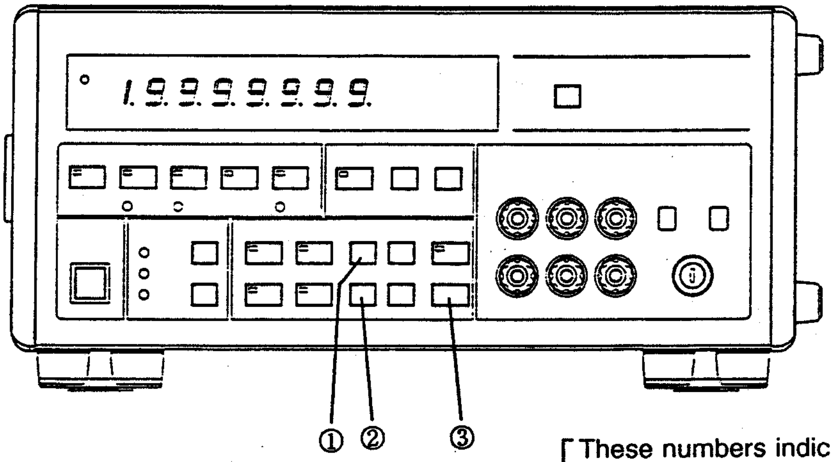
where PLC stands for Power-Line Cycle. The value of 1PLC changes as follows according to the power-line frequency selected:

For the power-line frequency of 50Hz, 1PLC = 20msec
For the power-line frequency of 60Hz, 1PLC = 16.7msec

Measurements highly resistant to noise can be obtained by setting a large value as integral time.

[Setting procedure]

The procedure for setting integral time is described below.



[These numbers indicate the following procedure numbers.]

Setting the IT parameter

① Press the $\overset{\text{IT}}{\boxed{}}$ key.

The integral time last set will then be displayed on the LED unit.

5PL

Selecting integral time

1 0 P L

② Select the desired integral time by pressing the CHANGE ☐ key.

Each time CHANGE ☐ is pressed,

the display on the LED unit changes as follows:

100µs → 1ms → 10ms → 1PL
1PL ↓ 5PL ↓ 10PL
100PL ← 50PL ← 20PL ← 10PL
100PL ↑ 100µs

Display the desired integral time on the LED unit by pressing CHANGE ☐ .

Setting of integral time completed

③ Press the ENTER ☐ key.

This causes the displayed integral time to be stored in memory. Setting of the integral time is now complete.

2.8.2 SI: Sampling Interval

[Functional description]

The SI parameter is used to set the sampling time interval (hereinafter referred to as the sampling interval).
When the sampling interval is set using the SI parameter:

(1) In the RUN or MULTI sampling mode, measurement is performed at the sampling interval setting.

(2) Reading of the data that has been written using the data memory functions is also performed at the sampling interval setting. However, if the sampling interval setting is smaller than the repetition period (time from the start of measurement to output of data), then the minimum repetition period of the corresponding integral time becomes the sampling interval.

(3) The setting range is from 0 to 60,000msec in 1msec increments.

Figure 2-1 below shows an operation example that represents the relationship between the DELAY parameter and the SI parameter.

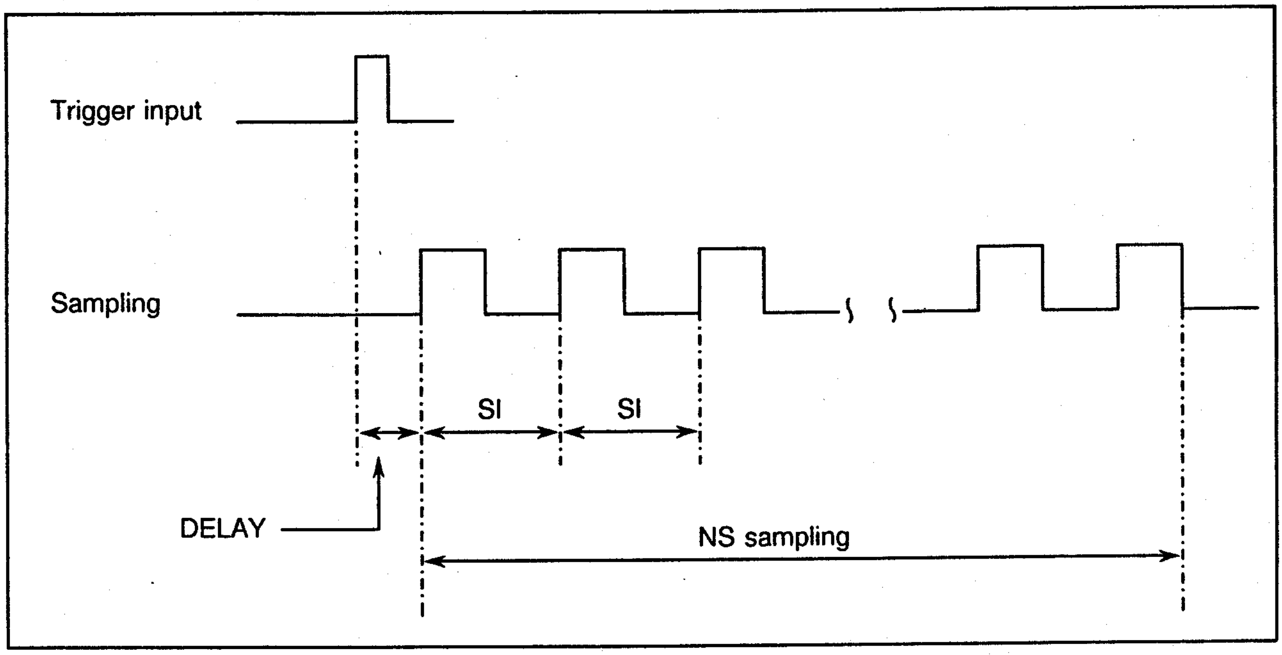
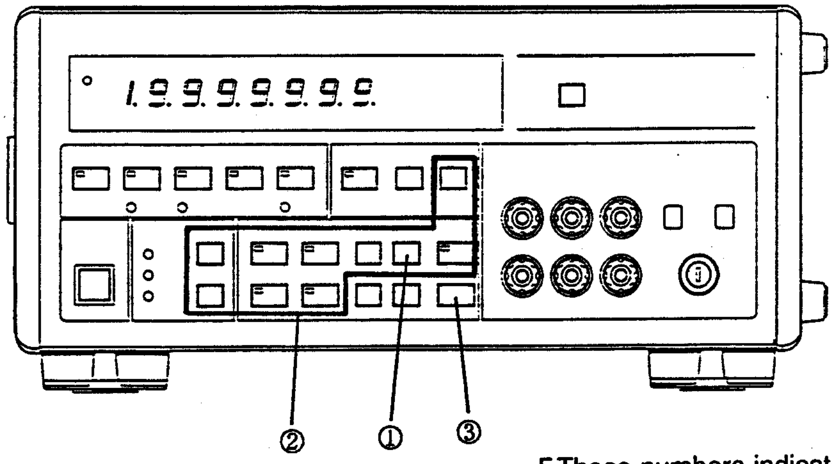


Figure 2-1 Operation Example That Represents the Relationship Between "DELAY" and "SI" (Sampling Mode: MULTI)

[Setting procedure]

The procedure for setting the sampling interval is described below.



[These numbers indicate the following procedure numbers.]

Setting of SI parameter

① Press the SI ☐ key.
The sampling interval last set will then be displayed on the LED unit.

250ms

Setting of sampling interval value

② Set the sampling interval value using the numeric keys 0 ☐ to 9 ☐. For SI parameter setting, 0 ☐ to 9 ☐ act as numeric keys.

The value set here will be displayed on the LED unit.

913ms

(Example)

To set 913, press keys,
9 ☐ 1 ☐ 3 ☐ in this order.

Setting of the sampling interval completed

③ Press the ENTER ☐ key.
The displayed sampling interval value will then be displayed on the LED unit. This completes setting of the sampling interval.

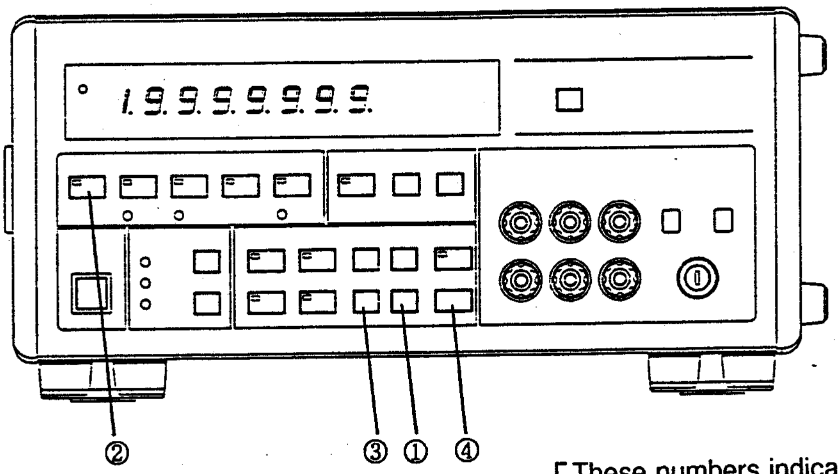
2.8.3 A ZERO : Auto Zero Calibration

[Functional description]

The A ZERO parameter is used to select whether or not offset errors in the analog circuitry of the R6871E/E-DC are to be automatically eliminated (Auto Zero Calibration).

[Setting procedure]

The ON/OFF setting procedure for the Auto Zero Calibration function is described below.



[These numbers indicate the following procedure numbers.]

A ZERO parameter setting

① Press the SHIFT ☐ key.

② Press the ☐ A ZERO key.

The previous ON/OFF setting of the A ZERO function will then be displayed on the LED unit.

onAZ

A ZERO function ON/OFF setting

③ The ON and OFF states are alternately displayed on the LED unit each time CHANGE ☐ is pressed.

(a) To set the ON state, display "ON" on the LED unit using the CHANGE ☐ key and then proceed to step (4).

o n A Z

(b) To set the OFF state, display "OFF" on the LED unit using the CHANGE ☐ key and then proceed to step (4).

o F F A Z

A ZERO function setting complete

④ Press the ENTER ☐ key.

This will cause the A ZERO function ON or OFF setting on the display to be stored in memory. ON/OFF setting of the A ZERO function is now complete.

If A ZERO is set in its ON state, measurement time becomes about twice that taken with A ZERO OFF, since the Auto Zero Calibration time (equal to integral measurement time) is required for each measurement operation.

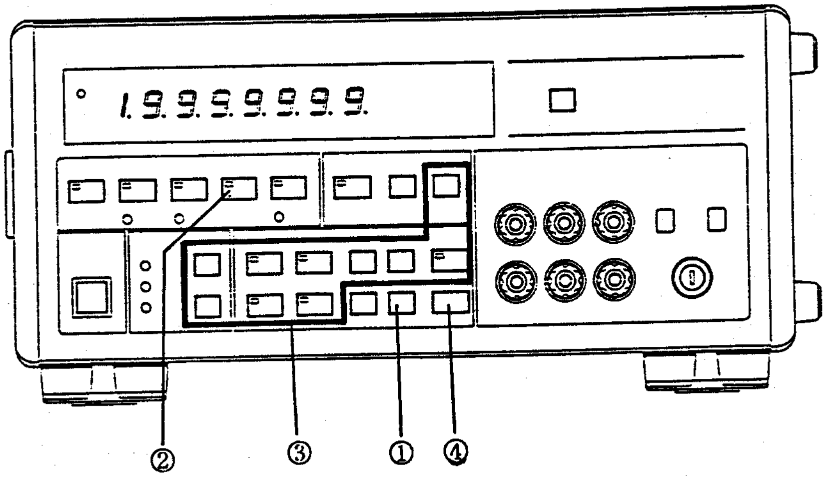
2.8.4 A CAL : Auto Calibration Interval

[Functional description]

The A CAL parameter is used to set the execution interval of Auto Calibration.
Based on the internal reference voltage, automatic calibration of the measuring system of the R6871E/E-DC takes place at fixed intervals to ensure constant stability of the measuring system.
The setting range is from 0 to 999 minutes in units of one minute. The A CAL function becomes invalid if the interval time is set to 0 minutes.

[Setting procedure]

The procedure for setting the execution interval value of the Auto Calibration function is described below.



[These numbers indicate the following procedure numbers.]

A CAL parameter setting

① Press the SHIFT ☐ key.

② Press the ☐ A CAL key.

The execution interval last set will then be displayed on the LED unit.

Execution interval value setting

③ Set the desired execution interval value using the numeric keys 0☐ to 9☐.

For A CAL parameter setting, 0☐ to 9☐ act as numeric keys. The value set here will be displayed on the LED unit.

360mn

(Example)

To set 360, press keys 3☐ 6☐ 0☐, in this order.

Setting of the execution interval value completed

④ Press the ENTER ☐ key.

The displayed execution interval value will then be displayed on the LED unit. This completes setting of the execution interval.

2.8.5 BUZZER : Buzzer mode

[Functional description]

The BUZZER parameter is used to select whether or not the buzzer function is to be used. The following three modes of buzzer are available:

(1) OFF : The buzzer function is not used.

(2) ON-1 : If this mode is selected, the buzzer sounds when the results of comparator computation are either R(H2), R(H1), R(L1), or R(L2).

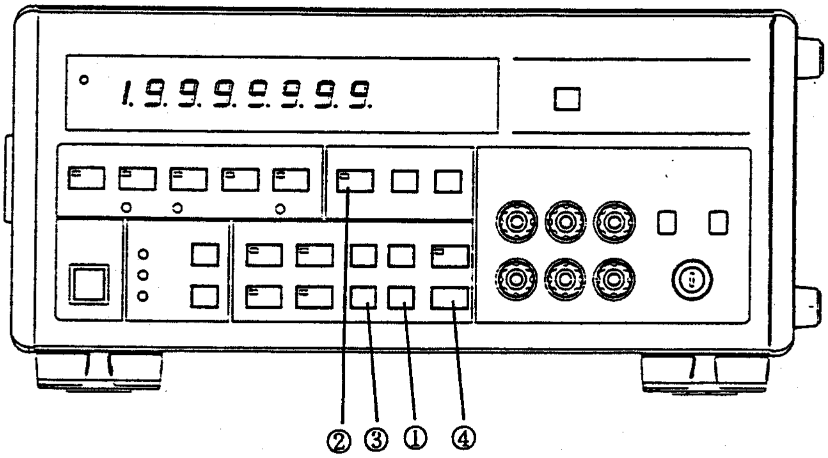
(3) ON-2 : If this mode is selected, the buzzer sounds when the results of comparator computation are R(PASS).

If mode (2) or (3) is selected, the buzzer also sounds in the following cases:

- When an error occurs
- When a panel key is pressed

[Setting procedure]

The BUZZER parameter setting procedure is described below.



[These numbers indicate the following procedure numbers.]

BUZZER parameter setting

① Press the SHIFT key.

oFF BU

② Press the BUZZER key.

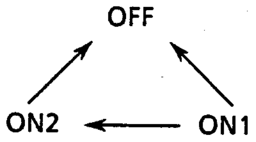
The buzzer mode last set will then be displayed on the LED unit.

Buzzer mode selection

③ Select the desired buzzer mode using the $\overset{\text{CHANGE}}{\boxed{}}$ key.

The available buzzer modes are OFF, ON1, and ON2.

The display changes as follows each time $\overset{\text{CHANGE}}{\boxed{}}$ is pressed:



In this way, display the desired mode name on the LED unit.

Buzzer mode setting complete

④ Press the $\overset{\text{ENTER}}{\boxed{}}$ key.

The mode name being displayed on the LED unit will then be stored in memory.

Setting of the buzzer mode is now complete.

2.8.6 D OUT : Data Output mode

[Function]

The D OUT is a parameter selecting the output system and high-speed measurement mode to be executed. The R6871E/E-DC has the display and GPIB to output data. The device considers that storing data in the internal data memory is a kind of data output. It can output data to all output systems in the normal measurement mode (D OUT mode 0), and especially outputs data to a certain output system for high-speed measurement.

The following explains the modes of the D OUT parameter.

Mode 0: Displays measured data or data after operational processing, then outputs it to the GPIB.

Mode 1: Outputs measured data or data after operational processing to the GPIB.
Stores measured data in data memory.

Mode 2: Stores measured data in data memory.

Mode 3: Stores measured data before the calculation of a true value in data memory at full speed mode.

Table 2-3 Relation Between the D OUT Mode and Data Processing

D OUT mode	NULL execution	SMOOTH execution	STORE/RECALL execution	COMPUTE execution	Output to output system
0	Enable	Enable	STORE enable	Enable	Displays and outputs to the GPIB
			RECALL enable	Enable	Displays and outputs to the GPIB
1	Enable	Enable	STORE enable	Enable	Outputs to the GPIB
			RECALL enable	Enable	Displays and outputs to the GPIB
2	Enable	Enable	Automatic STORE RECALL enable	Enable	Displays and outputs to the GPIB
3	Disable	Disable	Automatic STORE RECALL enable	Enable	Displays and outputs to the-GPIB
→ Flow of processing (see Figure 7-1)					

CAUTION

1. The D OUT parameter is initialized (mode 0) when the R6871E/E-DC is powered on.
2. When mode 2 or 3 is set, the store function is automatically turned on. In this case, the output system that enables realtime output of measurement is data memory only. When the recall function is turned on, the store function is turned off and the data memory recall mode is set. In the recall mode, the operation can be executed and data can be output to output systems.
3. When the full speed mode is set, parameters are automatically set as follows.
   - FUNCTION : Fixed
   - RANGE : Fixed
   - SAMPLING MODE : RUN
   - STORE : ON
   - RECALL : OFF
   - COMPUTE : OFF
   - SMOOTH : OFF
   - IT : 100μs
   - SI : 0msec
   - A ZERO : OFF
   - A CAL : OFF
   - SLOW : OFF (FAST)
   - NULL : OFF
4. When the D OUT mode is changed, the content of data memory is initialized.
5. The single line signal (COMPLETE) is output regardless of the D OUT mode. It is also output when data memory is recalled.

2.8.7 CF : Computing Function

[Functional description]

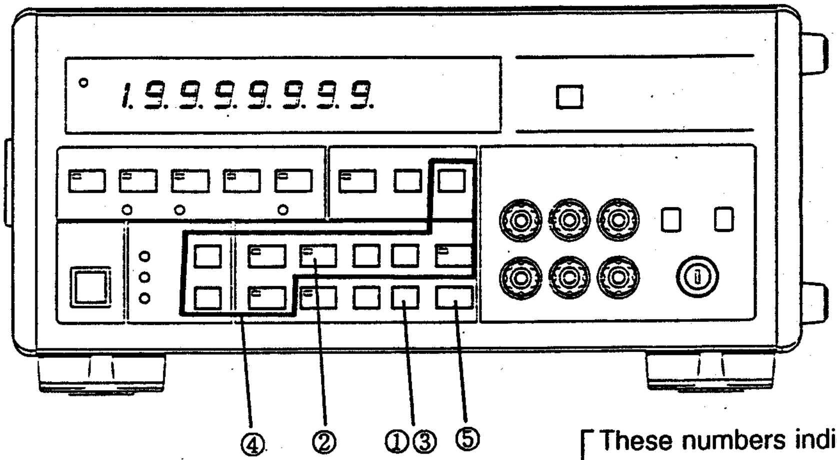
The CF parameter is used to select a computing function from among those provided by the R6871E/E-DC.
See section 3.1, "Computing Functions", for details of the computing functions.
Table 2-4 gives a listing of functions available for primary computation and secondary computation.

Table 2-4 Computing Functions

Data	Primary computation	Secondary computation
0	OFF	OFF
1	SCALING	COMPARATOR 1
2	%DEVIATION	COMPARATOR 2
3	DELTA	Statistical processing
4	MULTIPLY	
5	Decibel conversion	
6	RMS Value	
7	dBm conversion	
8	Resistance value temperature compensation	

[Setting procedures]

The procedures for setting the computing functions are described below.



[These numbers indicate the following procedure numbers.]

CF parameter setting

① Press the SHIFT ☐ key.

② Press the ☐ CF key.

The states last set for primary and secondary computation will then be displayed on the LED unit. The display of "0 - 0" blinks at this time.

Blinking Primary computation

Secondary computation

0 - 0 C F

Selection of computing functions

③ Setting computation functions involves setting those for primary computation and for secondary computation.
Here, select one of the two types of setting. The desired type of setting may come first, whichever you select.

Press the $\overset{\text{SHIFT}}{\square}$ key to select between setting of primary computation functions and setting of secondary computation function.
This allows the display of the desired type of setting to blink.

Each time $\overset{\text{SHIFT}}{\square}$ is pressed, the displays of the two types of setting blink alternately.

(Example)

- To set primary computation functions: Make the display of primary computation functions blink by pressing $\overset{\text{SHIFT}}{\square}$.
- To set secondary computation functions:
  Make the display of secondary computation functions blink by pressing $\overset{\text{SHIFT}}{\square}$.
  [If both primary and secondary computation functions are to be set]
  Functions for both primary and secondary computation can be set at one time. The setting method is described in step (4) below.

④ Set the identification numbers of the desired computing functions using the numeric keys 0 □ to 8 □.
Function numbers 0 through 8 can be set for primary computation, and function numbers 0 through 3 can be set for secondary computation.
Functions being displayed in normal form (ON) or in blinking form (Blinking) can only be set.

(Example)

- To set the SCALING function used for primary computation:
  Press 1 □.

Blinking ON

1 - 0 C F

- To set the COMPARATOR-2 function used for secondary computation:

  Press 2 ☐.

  See Table 2-2 for details of the primary and secondary computation function data.

  [If functions for both primary and secondary computation are to be set at one time]

  Set a primary (or secondary) computation function first.

  The display of primary computation will then come on and the display of secondary computation will blink.

  At this time, set a secondary computation function.

  This causes the display of secondary computation to come on once again and the display of primary computation to blink. After setting functions for both primary and secondary computation, ignore the blinking state of the display and proceed to step (5).

ON Blinking

0 - 2 C F

Setting of computing functions completed

⑤ Press the ENTER ☐ key.

The displayed ID number of the computing function will then be stored in memory. This completes setting of the computing functions.

2.8.8 RES : Resolution

[Functional description]

The RES parameter is used to set the number of display digits. The following describes the precautions to be taken when carrying out the setting operation:

(1) The number of digits that can be set is either 4 1/2 digits, 5 1/2 digits, 6 1/2 digits, or 7 1/2 digits.

(2) Notes on priority of the number of display digits.
For the number of display digits, priority is given to RES parameter setting over measurement function setting or IT (integral time) parameter setting.
The integral time, measurement functions, and the number of display digits are maintained in a predetermined relationship as listed in Table 2-5. That is, when the integral time is set to l00/sec using the IT parameter, the actual number of display digits becomes four and a half even if the number is set to six and a half digits using the RES parameter.

(3) Notes on the relationship between the number of display digits and the selected measurement range The number of digits in the integral part of the number of display digits becomes the same as the maximum number of digits in the selected measurement range.

(Example 1)
If 5 1/2 digit measurement is made using the 1000Ω range, the integral part and the decimal part become a 3 1/2 digit value (since 1000 takes 3 1/2 digits) and a 2-digit value, respectively, as shown on the right.

1128.83 Ω

57.26 Ω

(Example 2)
If 7 1/2 digit measurement is made using the 1000Ω range, the integral part and the decimal part become a 3 1/2 digit value (since 1000 takes 3 1/2 digits) and a 4 digit value, respectively, as shown on the right.

1128.8334 Ω

57.2616 Ω

(4) Meaning of the 1/2 digit in 7 1/2 measurements

If the 1000Ω range is selected, for example, the maximum value of data measurements obtained will be 1199.9999Ω. At this time, it is good enough just to display "1" for the most significant digit. In actuality, only "1" can be displayed. Thus, the most significant digit is taken as a 1/2 digit.

Table 2-5 Relationship Between Integral Time and Number of Digits Displayed

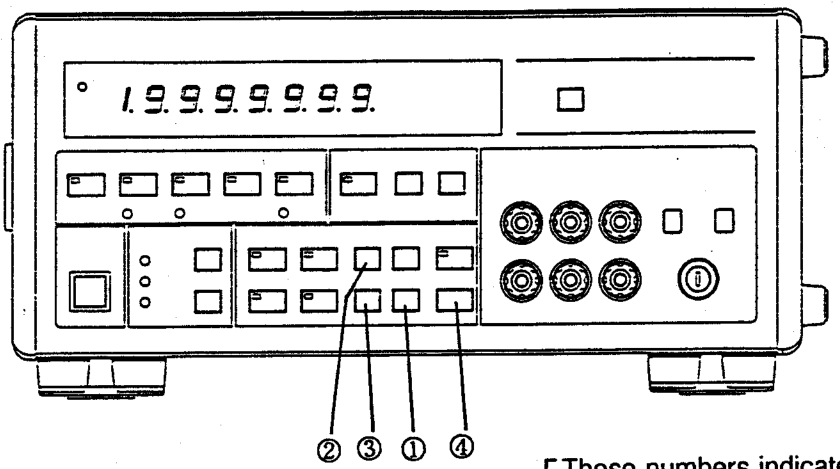
<table>
<tr><th>Integral time
Measurement function</th><th>100µs</th><th>1ms</th><th>10ms</th><th>1PLC</th><th>5PLC</th><th>10PLC</th><th>20PLC</th><th>50PLC</th><th>100 PLC</th></tr>
<tr><td rowspan="4">DC voltage measurement</td><td colspan="9">4 1/2 digit display</td></tr>
<tr><td></td><td colspan="8">5 1/2 digit display</td></tr>
<tr><td></td><td></td><td colspan="7">6 1/2 digit display</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="5">7 1/2 digit display</td></tr>
<tr><td rowspan="3">DC current measurement*</td><td colspan="9">4 1/2 digit display</td></tr>
<tr><td></td><td colspan="8">5 1/2 digit display</td></tr>
<tr><td></td><td></td><td colspan="7">6 1/2 digit display</td></tr>
<tr><td rowspan="4">Resistance measurement (Common to 2-wire, 4-wire and NWΩ*2)</td><td colspan="9">4 1/2 digit display</td></tr>
<tr><td></td><td colspan="8">5 1/2 digit display</td></tr>
<tr><td></td><td></td><td colspan="7">6 1/2 digit display</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="5">7 1/2 digit display</td></tr>
<tr><td rowspan="2">AC voltage measurement*1 or DC + AC voltage measurement *1</td><td colspan="9">4 1/2 digit display</td></tr>
<tr><td></td><td colspan="8">5 1/2 digit display</td></tr>
<tr><td rowspan="2">AC current measurement *1 or DC + AC current measurement *1</td><td colspan="9">4 1/2 digit display</td></tr>
<tr><td></td><td colspan="8">5 1/2 digit display</td></tr>
</table>

*1 : Only the R6871E is enabled.

*2 : Only the R6871E-OHM is enabled.

[Setting procedure]

The procedure for setting the number of display digits is described below.



[These numbers indicate the following procedure numbers.]

RES parameter setting

SHIFT
① Press the ☐ key.

② Press the ☐ key.
RES

The number of display digits last set will then be displayed on the LED unit. 4 1/2 digit display appears as follows:

0 1 2 3 4 R E

Selection of the number of display digits

③ Select the desired number of display digits (4 1/2 digits, 5 1/2 digits, 6 1/2 digits, or 7 1/2 digits).

Use $\overset{\text{CHANGE}}{\boxed{}}$ to make the selection.

The display of the number of display digits changes as follows each time $\overset{\text{CHANGE}}{\boxed{}}$ is pressed:

$$\begin{tikzcd}
\text{4 1/2 digits} \arrow[r] & \text{5 1/2 digits} \arrow[d] \\
\text{7 1/2 digits} \arrow[u] & \text{6 1/2 digits} \arrow[l]
\end{tikzcd}$$

The display of each digit is made as follows:

• 5 1/2 digits	012345 RE
• 6 1/2 digits	0123456 RE
• 7 1/2 digits	01234567RE

In this way, display the number of display digits to be set.

Setting of the number of display digits completed

④ Press the $\overset{\text{ENTER}}{\boxed{}}$ key.

The displayed number of display digits will then be stored in memory. This completes setting of the number of display digits.

2.8.9 DELAY : Trigger Delay

[Functional description]

The DELAY parameter is used to set the delay time from input of the trigger signal to the start of the first sampling operation (this delay time will be hereinafter referred to as the trigger delay time).

When the trigger delay time is set using the DELAY parameter:

(1) In the SINGLE or MULTI mode, the first sampling operation begins after the lapse of the set trigger delay time which starts upon input of the trigger signal.

(2) In the RUN sampling mode, the trigger delay time setting is ignored.

(3) The setting range is from 0 to 60,000msec in units of 1msec.

Figure 2-2 below shows an operation example that represents the relationship between the DELAY parameter and the SI parameter.

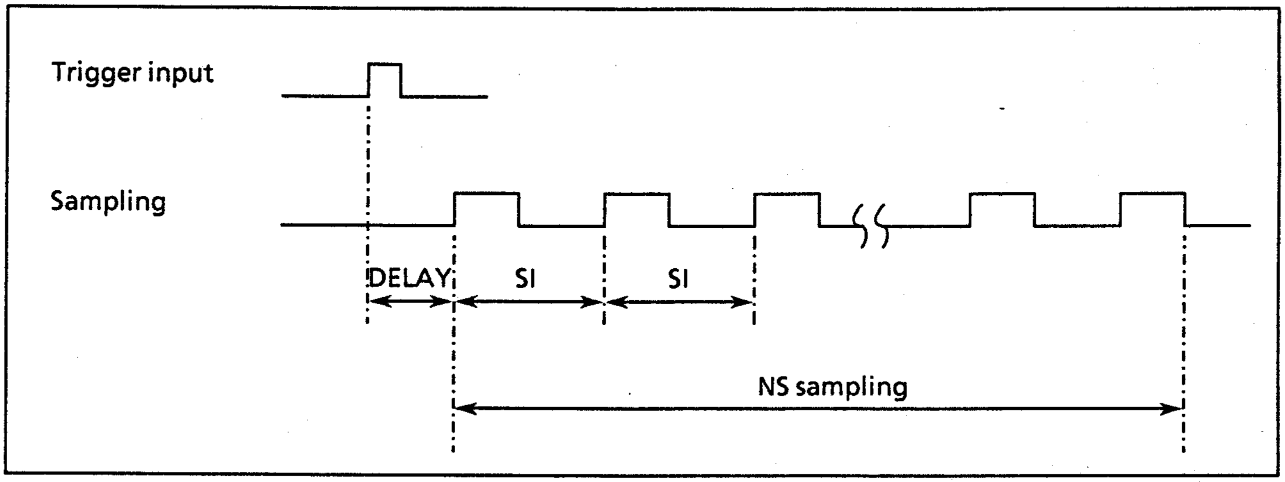
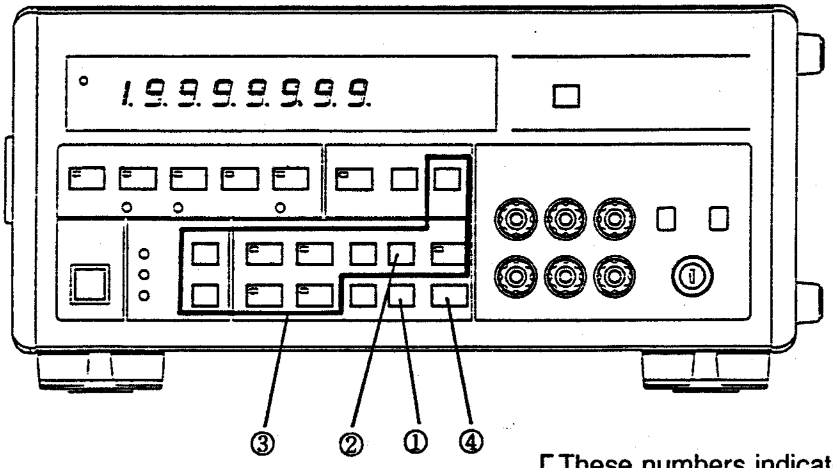


Figure 2-2 Operation Example That Represents the Relationship Between "DELAY" and "SI" (Sampling Mode : MULTI)

[Setting procedure]

The procedure for setting the trigger delay time is described below.



[These numbers indicate the following procedure numbers.]

Setting of DELAY parameter

① Press the SHIFT ☐ key.

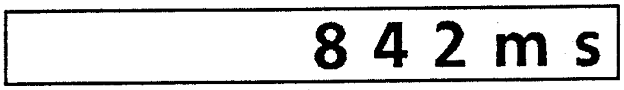
② Press the ☐ DELAY key.

The trigger delay time last set will then be displayed on the LED unit.

0 ms

Setting the trigger delay time

③ Set the desired trigger delay time using the numeric keys 0 ☐ to 9 ☐.
For DELAY parameter setting, 0 ☐ to 9 ☐ act as numeric keys. The value set here will be displayed on the LED unit.



(Example)
To set 842, press keys 8 ☐ 4 ☐ 2 ☐ , in this order.

Setting of the trigger delay time completed

④ Press the ENTER ☐ key.
The displayed trigger delay time will then be stored in memory. This completes setting of the trigger delay time.

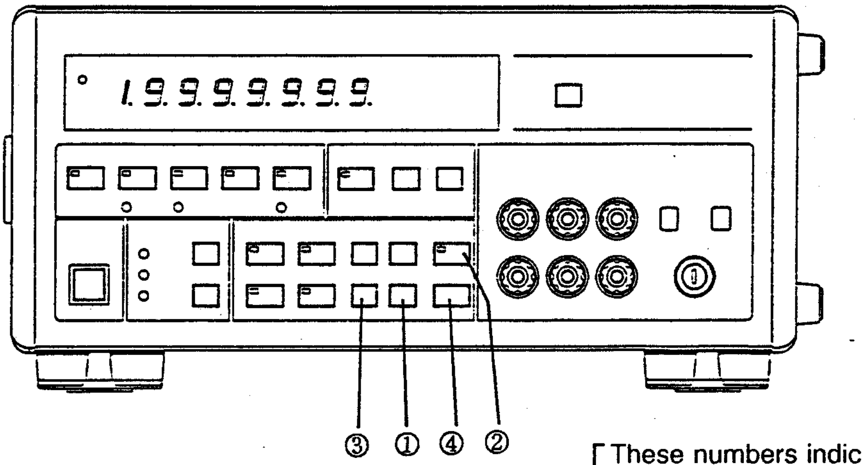
2.8.10 SLOW: AC Sampling SLOW/FAST

[Functional description]

The SLOW parameter key is used to select a frequency band for AC voltage measurement.
For FAST, the selectable frequency band is from 300Hz to 1MHz. For SLOW, the selectable frequency band is from 20Hz to 1MHz. That is, SLOW should be set for a wider frequency band.

[Setting procedure]

The SLOW/FAST selection procedure for AC voltage measurement is described below.



[These numbers indicate the following procedure numbers.]

SLOW parameter setting

① Press the ☐ (SHIFT).

② Press ☐ (SLOW).

The ON or OFF state of the SLOW parameter last set will then be displayed on the LED unit.

oFF SL	

ON : SLOW
OFF : FAST

SLOW/FAST selection

③ Select SLOW or FAST with the CHANGE ☐ key. Each time CHANGE ☐ is pressed, the display changes as follows:
ON (SLOW) ⇆ OFF (FAST)
Display either ON or OFF on the LED unit in this manner.

SLOW parameter setting completed

④ Press ENTER ☐ .

The ON or OFF state being displayed on the LED unit will then be stored in memory. This completes setting of the SLOW parameter.

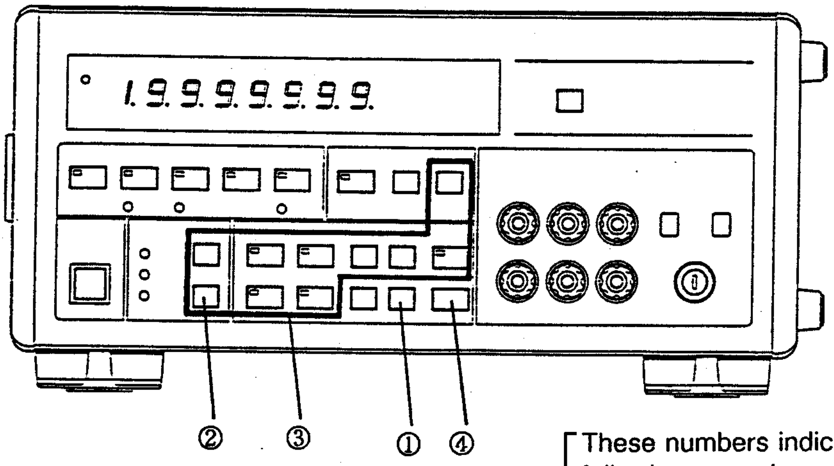
2.8.11 N

[Functional description]

The N parameter is used to set the number of times that data is to be set for statistical computation.
The setting number of times is from 2 to 10000.

[Setting procedure]

The procedure for setting the constant N is described below.



[These numbers indicate the following procedure numbers.]

N parameter setting

SHIFT
① Press ☐ .

② Press ☐ .
N

The value of the constant N last set will then be displayed on the LED unit.

2 N

Constant setting

③ Use numeric keys 0☐ to 9☐ to set the value of the constant N.

For N parameter setting, 0☐ to 9☐ act as numeric keys.

The value set here will be displayed on the LED unit.

63 N

(Example)

To set 63, press keys 6☐ 3☐ in this order.

Constant setting completed

④ Press ENTER☐ .

The value being displayed on the LED unit will then be stored in memory.
Setting of the constant N is now complete.

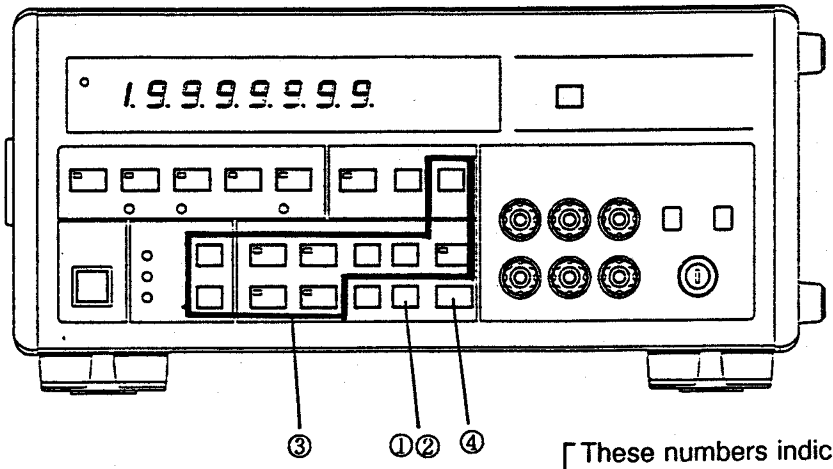
2.8.12 NS : Number of Samples

[Functional description]

The NS parameter is used to set the number of samples to be obtained in the MULTI sampling mode and the number of samples to be stored into the data memory.
The setting number of samples is from 1 to 10000.

[Setting procedure]

The procedure for setting the number of samples is described below.



[These numbers indicate the following procedure numbers.]

Setting the NS parameter

SHIFT
① Press ☐ .

② Press ☐ .
NS

The number of samples that was last set will then be displayed on the LED unit.

10NS

Setting the number of samples

③ Use numeric keys 0 ☐ to 9 ☐ to set the number of samples.

For NS parameter setting, 0 ☐ to 9 ☐ act as numeric keys.
The value set here will be displayed on the LED unit.

25NS

(Example)
To set 25, press keys 2 ☐ 5 ☐, in this order.

Setting of the number of samples completed

④ Press ENTER ☐.
The value being displayed on the LED unit will then be stored in memory.
Setting of the NS parameter is now complete.

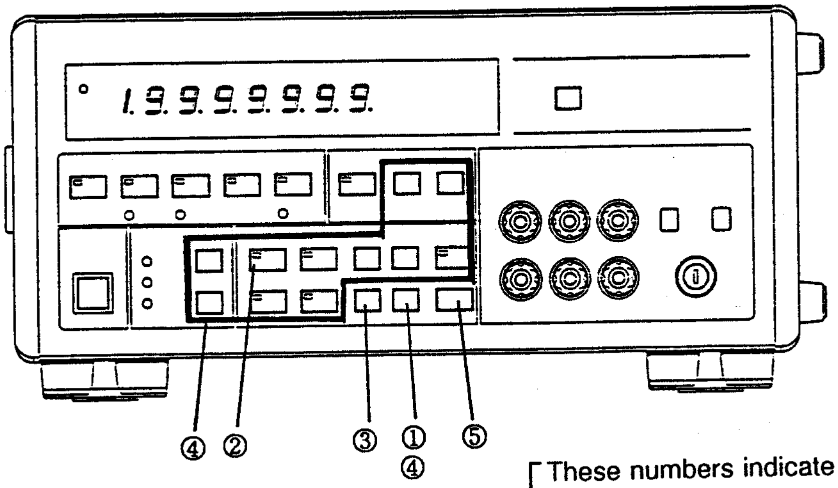
2.8.13 X/Y/Z

[Functional description]

The X/Y/Z parameter is used to set the constants to be included in arithmetic expressions.
In addition, use of the MD key allows the data last measured (or arithmetic results) to be set as constants.
The range of values that can be set is from ±19999999E-9 to ±19999999E+9.
Depending on the selected computation mode, either the X, the Y, or the Z parameter is to be used as the constant.
Therefore, check the appropriate type of parameter for the particular computation mode prior to setting. (See section 3.1, "Computing Functions", for details.)

[Setting procedure]

The procedure for setting the X, Y, or Z parameter is described below.



[These numbers indicate the following procedure numbers.]

X/Y/Z parameter setting

① Press the SHIFT ☐ key.

② Press the ☐ X/Y/Z key.

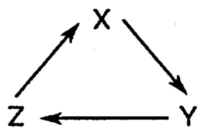
The value last set as the constant X will then be displayed on the LED unit.

1. 0 0 0 0 0 0 0 X

Constant selection

③ Select the constant to be set using the CHANGE ☐ key.

The display changes as follows each time CHANGE ☐ Is pressed:



In this way, display the desired constant on the LED unit.

(Example)

To set Y, press CHANGE ☐ once.

1. 0 0 0 0 0 0 0 Y

This causes Y to be displayed.

[If two or more constants are to be set]

Only one constant can be set during one setting operation. If three constants (X, Y, Z) are to be set, therefore, report the setting operation three times.

Constant setting

④ Set each of the mantissa part and exponential part separately, in that order, for one constant.

(a) Setting the mantissa part
The value that has been displayed during constant selection is the mantissa part of the constant. Set the mantissa part using numeric keys
0 ☐ to 9 ☐.
For X/Y/Z parameter setting, 0 ☐ to 9 ☐ act as numeric keys. The value set here will be displayed on the LED unit.

(Example)
To set 18, press keys
1 ☐ 8 ☐, in this order.

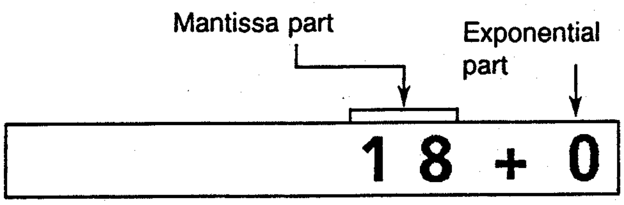
18 Y

(b) Setting the exponential part

To set the exponential part, it is necessary firstly to display the exponential part on the LED unit.

This can be done by pressing the SHIFT key following the completion of setting the mantissa part.

This key action will change the display as follows:



Pressing a numeric key here will cause the value of the exponential part to change. Use numeric keys to display the desired value on the LED unit.

(Example)

To set -3, press keys - 3 , in this order.

Constant setting completed

⑤ Press the ENTER key.

This causes the displayed value to be stored in memory. Setting of the constant is now complete. Repeat the setting procedure from the beginning if another constant is to be set.

2.8.14 HIGH/LOW

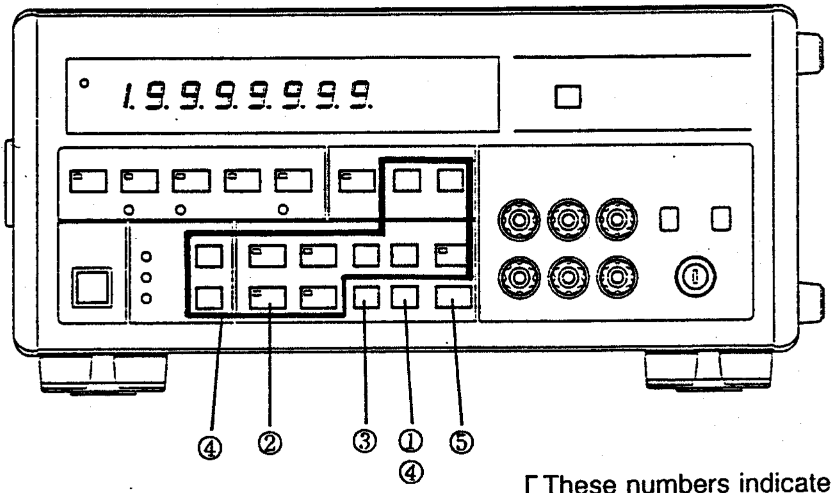
[Functional description]

The HIGH/LOW parameter is used to set the upper and lower limit values for COMPARATOR-1 computation.
The setting range is from ±19999999E-9 to ±19999999E+9.

These values are set so that they can be HIGH1≦HIGH2, LOW2≦LOW1 (HIGH<LOW is enabled). When the setting is improper, Error 5 occurs if the result of the function is executed.

[Setting procedure]

The setting procedure for constants HIGH-1, HIGH-2, LOW-1, or LOW-2 is described below.



[These numbers indicate the following procedure numbers.]

HIGH/LOW parameter setting

① Press the SHIFT ☐ key.

② Press the ☐ HIGH/LOW key.

The value last set for constant HIGH-1 (H1) will then be displayed on the LED unit.

1. 0 0 0 0 0 0 0 H 1

Constant selection

③. Select the constant to be set using the $\overset{\text{CHANGE}}{\square}$ key.
The display changes as follows each time $\overset{\text{CHANGE}}{\square}$ is pressed:

$$\begin{tikzcd}
\text{H1(HIGH1)} \arrow[r] & \text{H2(HIGH2)} \arrow[d] \\
\text{L2(LOW3)} \arrow[u] & \text{L1(LOW4)} \arrow[l]
\end{tikzcd}$$

In this way, display the desired constant on the LED unit.

(Example)

To set L2, press $\overset{\text{CHANGE}}{\square}$ three times in succession. This causes L2 to be displayed.

. 0 0 0 0 0 0 0 L 2

[If two or more constants are to be set]
Only one constant can be set during one setting operation. Repeat the setting operation twice to set two constants (HIGH-1 and LOW-1, for example).

Constant setting

④ Set each of the mantissa part and exponential part separately, in that order, for one constant.

(a) Setting the mantissa part
The value that has been displayed during constant selection is the mantissa part of the constant.
Set the mantissa part using numeric keys 0☐ to 9☐.
For HIGH/LOW parameter setting, 0☐ to 9☐ act as numeric keys. The value set here will be displayed on the LED unit.

(Example)
To set 18, press keys 1☐ 8☐, in this order.

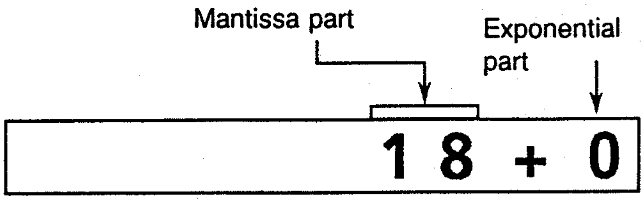
18L2

(b) Setting the exponential part

To set the exponential part, it is necessary firstly to display the exponential part on the LED unit.

This can be done by pressing the SHIFT ☐ key following the completion of setting the mantissa part.

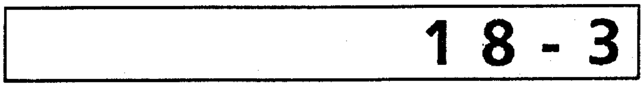
This key action will change the display as follows:



Pressing a numeric key here will cause the value of the exponential part to change. Use numeric keys to display the desired value on the LED unit.

(Example)

To set -3, press keys -☐ 3☐, in this order.



Constant setting completed

⑤ Press the SHIFT ☐ key.

This causes the displayed value to be stored in memory. Setting of the constant is now complete. Repeat the setting procedure from the beginning if another constant is to be set.

2.8.15 LIMIT

[Functional description]

The LIMIT parameter is used to set the reference value and tolerance that are to be used for COMPARATOR-2 computation.
The setting ranges of both are:

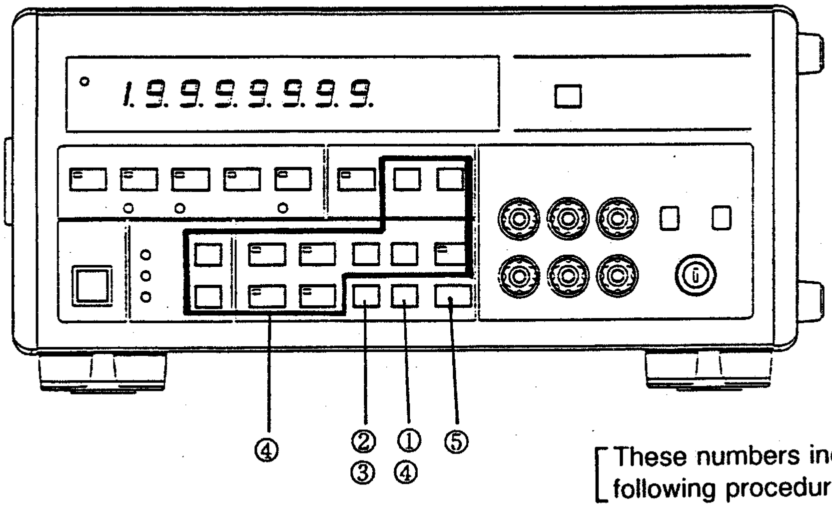
For reference value : from ±19999999E-9 to ±19999999E+9 (Except 0)

For tolerance (%) : from 0.000 to 100.0 (Real number consisting of four digits or less)

These values are set so that they can be %1≦%2. When the setting is improper, Error 5 occurs if the result of the function is executed.

[Setting procedure]

The setting procedure for LIMIT constants (reference value, %1, %2) is described below.



[These numbers indicate the following procedure numbers.]

LIMIT parameter setting

① Press the $\overset{\text{SHIFT}}{\boxed{}}$ key.

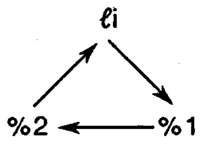
② Press the $\underset{\text{LIMIT}}{\boxed{}}$ key.

The value last set for reference value li will then be displayed on the LED unit.

1.0000000li

Constant selection

③ Select the constant to be set using the $\overset{\text{CHANGE}}{\boxed{}}$ key.
The display changes as follows each time $\overset{\text{CHANGE}}{\boxed{}}$ is pressed:
(Reference value)



In this way, display the desired constant on the LED unit.

10.00%1

(Example)
To set %1, press $\overset{\text{CHANGE}}{\boxed{}}$ once.
This causes %1 to be displayed.

[If two or more constants are to be set]

Only one constant can be set during one setting operation. Repeat the setting operation three times to set three constants (reference value, %1, %2).

Contant setting

④ When setting the LIMIT parameter, either the reference value or %1/%2 must be set.

④-1 Setting the reference value
Set each of the mantissa part and exponential part separately, in that order, for the reference value.

(a) Setting the mantissa part
The value that has been displayed during constant selection is the mantissa part of the constant. Set the mantissa part using numeric keys 0 ☐ to 9 ☐.
For LIMIT parameter setting, 0 ☐ to 9 ☐ act as numeric keys. The value set here will be displayed on the LED unit.

(Example)
To set 18, press keys 1 ☐ 8 ☐, in this order.

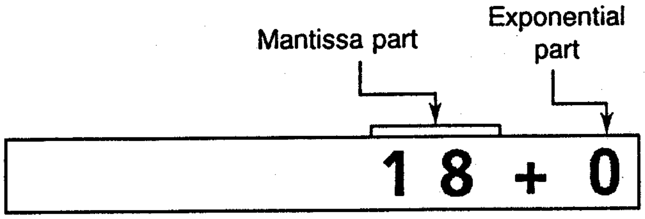
18li

(b) Setting the exponential part

To set the exponential part, it is necessary firstly to display the exponential part on the LED unit.

This can be done by pressing the SHIFT ☐ key following the completion of setting the mantissa part.

This key action will change the display as follows:



Pressing a numeric key here will cause the value of the exponential part to change. Use numeric keys to display the desired value on the LED unit.

(Example)

To set -3, press keys
- ☐ 3 ☐, in this order.

④-2 Setting %1 and %2

Set %1 and %2 using numeric keys 0 ☐ to 9 ☐.

For LIMIT parameter setting, 0 ☐ to 9 ☐ act as numeric keys. The value set here will be displayed on the LED unit.

(Example)

To set 25, press keys
2 ☐ 5 ☐, in this order.

Setting of constant completed

⑤ Press the ENTER key.

This causes the displayed value to be stored in memory. Setting of the constant is now complete. Repeat the setting procedure from the beginning if another constant is to be set.

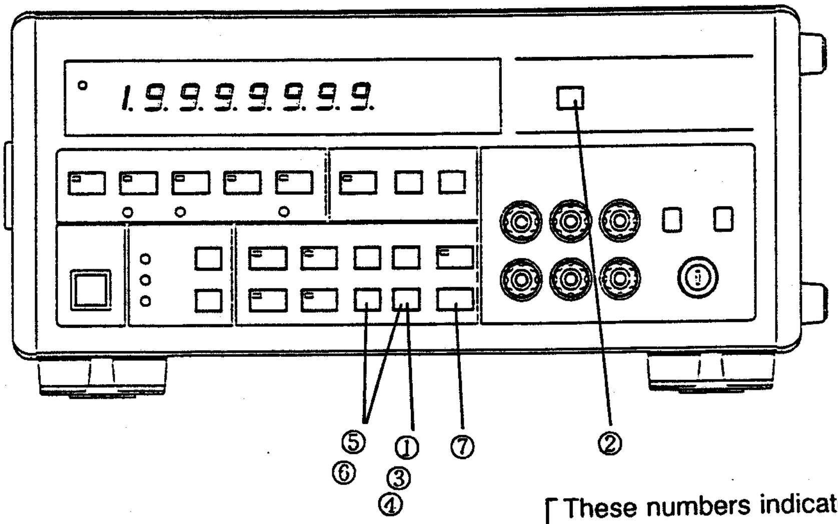
2.8.16 GPIB : GPIB Address Switch

[Functional description]

The GPIB parameter is used with GPIB to set the device address of the R6871E/E-DC, the address mode, and the format mode for output of measured data.
If "Addressable" is selected as the address mode, addressing from the controller becomes possible.
If "Talk only" is selected as the address mode, data transmission takes place, irrespective of addressing from external devices.
Values 0 through 30 can be set as addresses.

[Setting procedures]

The GPIB setting procedures are described below.



[These numbers indicate the following procedure numbers.]

GPIB parameter setting

SHIFT
① Press the ☐ key.

② Press the ☐ key.
GPIB

The GPIB address parameter data last set will then be displayed on the LED unit.

H - A - 0 1 G P

[Description of parameter data displayed on the LED unit]
Parameter data consists of the following three parts:
The part where "H" is displayed:
Format mode
The part where "A" is displayed:
Address mode
The part where "01" is displayed:
Address
Detailed description of each of these three parts is given below.

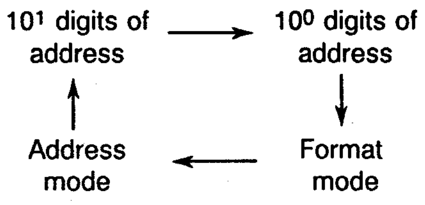
- Format mode
  In the format mode, the header assumes either an ON or an OFF state. "H" is displayed when the header is ON.
  "-" (underline) is displayed when the header is OFF.
- Address mode
  The address mode is either "Addressable or "Talk only". "A" is displayed for "Addressable", and "O" is displayed for "Talk only".
- Address
  The address can assume a two-digit number from "00" to "30".

Parameter data selection

③ · Select the type of parameter data to be set using the $\overset{\text{SHIFT}}{\boxed{}}$ key.
The available types of parameter data are : format mode, address mode, and address.

Selection of the desired type of parameter data causes the display of the data to blink.

Each time $\overset{\text{SHIFT}}{\boxed{}}$ is pressed, the blinking display position moves as follows:



Address setting

④ Press SHIFT ☐ to make the address display blink. This allows a value to be set in the blinking display position.
Either the 10^1 or the 10^0 digits of the address will be displayed in blinking form when the key is pressed. Set the desired value using numeric keys. At this time, the blinking display position shifts through one digit to the left or to the right.
(It shifts to the right if 10^1 -digit data is input, and shifts to the left if 10^0 -digit data is input.)
Set a 10^1 -digit or a 10^0 -digit value.

(Example)

To set the address to "25" in the following state:

Blinking

H - A - 0 1 G P

First, press 2 ☐.

Blinking

H - A - 2 1 G P

Next, press 5 ☐.

Blinking

H - A - 2 5 G P

Address mode setting

⑤ Make the display of the address mode blink by pressing the $\overset{\text{SHIFT}}{\square}$ key.
Either "A" or "0" is available as the address mode using the $\overset{\text{CHANGE}}{\square}$ key.
The display changes as follows each time $\overset{\text{CHANGE}}{\square}$ is pressed:

"A" ⇆ "0"

Format mode setting

⑥ Make the display of the address mode blink by pressing the $\overset{\text{SHIFT}}{\square}$ key.
Either "H" or "-" is available as the format mode. Using the $\overset{\text{CHANGE}}{\square}$ key.
The display changes as follows each time $\overset{\text{CHANGE}}{\square}$ is pressed:

"H" ⇆ "_"

GPIB parameter setting completed

⑦ Press the ENTER key.

The parameter data being displayed on the LED unit will then be stored in memory. This completes setting of the GPIB parameter.

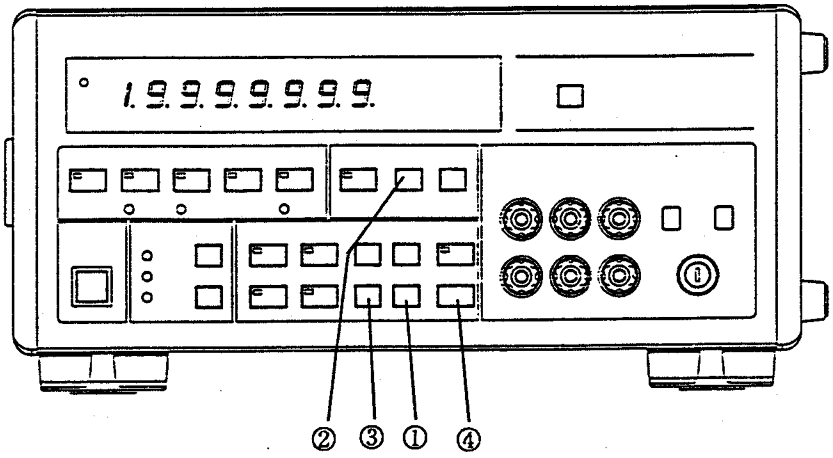
2.8.17 LINE : Line Frequency

[Functional description]

The LINE parameter is used to set the line frequency of 50Hz or 60Hz at which the R6871E/E-DC is to be operated.
The LINE parameter data is not initialized.

[Setting procedure]

The line frequency setting procedure is described below.



[These numbers indicate the following procedure numbers.]

LINE parameter setting

① Press the $\overset{\text{SHIFT}}{\boxed{}}$ key.

② Press the $\underset{\text{LINE}}{\boxed{}}$ key.

The line frequency last set will then be displayed on the LED unit.

50Hz

Line frequency selection

③ Select a line frequency of either 50Hz or 60Hz using the $\overset{\text{CHANGE}}{\boxed{}}$ key. The display changes as follows each time the $\overset{\text{CHANGE}}{\boxed{}}$ key is pressed:

50Hz ⇆ 60Hz

In this way, display the required line frequency on the LED unit.

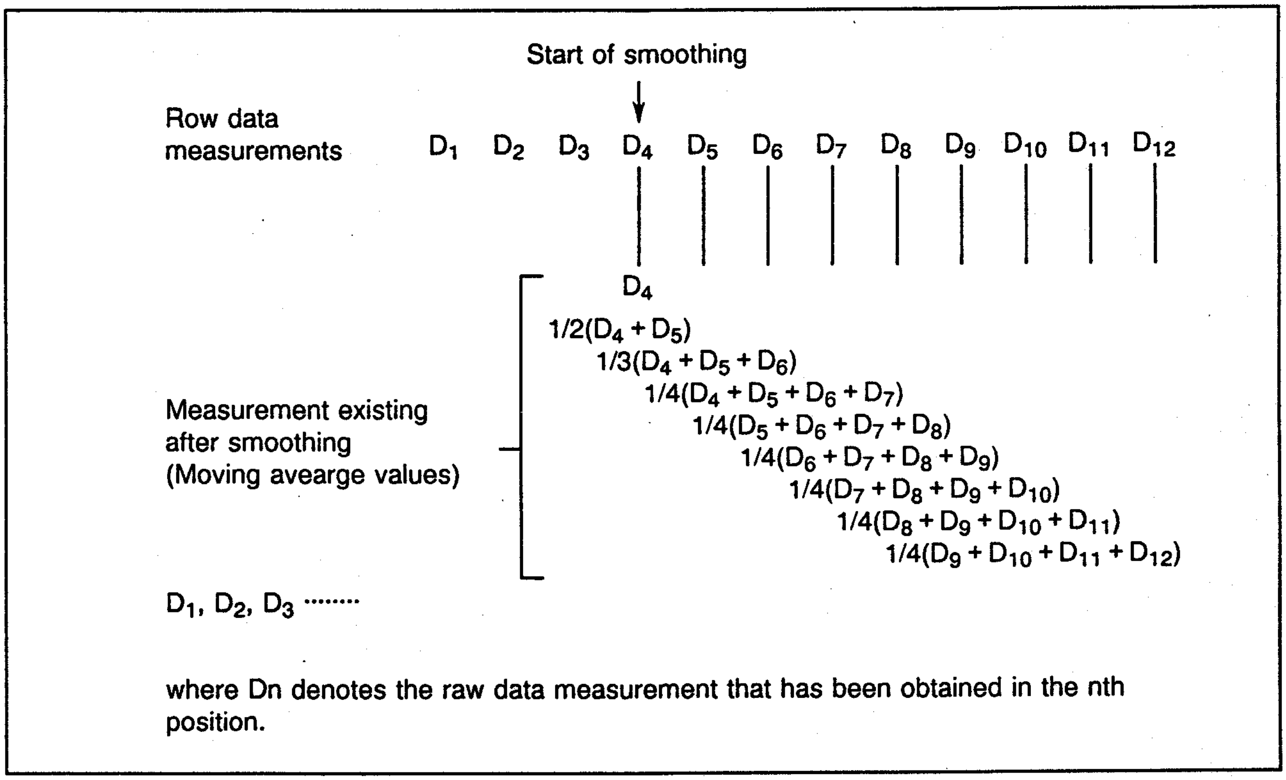
Line frequency setting completed

④ Press the $\overset{\text{ENTER}}{\boxed{}}$ key. This causes the displayed line frequency value to be stored in memory. Setting of the line frequency is now complete.

2.8.18 SMOOTH

[Functional description]

The SMOOTH parameter is used to implement the smoothing function. The smoothing function is used to eliminate superimposed noise from measurement signals.
It allows dispersion in measured data to be reduced since the moving average values previously obtained from raw data measurements during the specified number of times of smoothing are taken as measured data.
The moving average values (measured data existing after smoothing) are described below.
The moving average values refer to the average values of T number of measurements which are the total of T-1 number of measurements existing prior to smoothing and the measurements to undergo smoothing. T indicates the specified number of times of smoothing. During the time from the start of smoothing to arrival of the specified number of times of smoothing.
The average values of all measurements obtained up to that time are displayed on the LED unit. Figure 2-3 below shows the case of four times of smoothing.



where Dn denotes the raw data measurement that has been obtained in the nth position.

Figure 2-3 Relationship Between Raw Data Measurements and the Data Measurements Existing After Smoothing

In general, the nth data measurement D(sm) existing after smoothing has been performed is represented by:

$$D(sm) = \frac{1}{T} \sum_{i=n-T+1}^{n} D_i$$

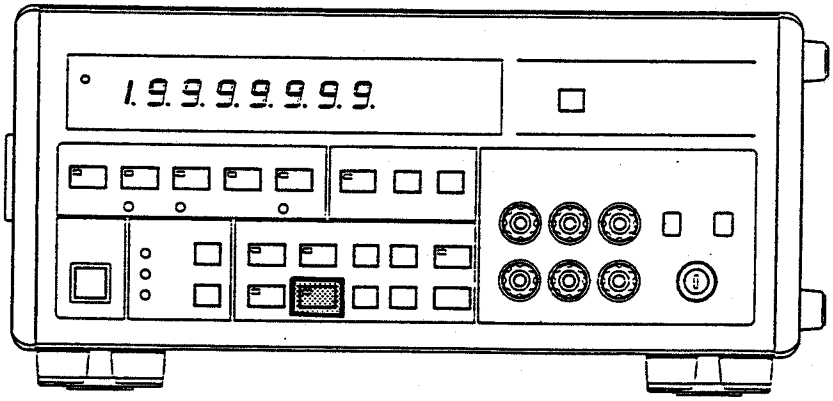
Di = measured data existing before smoothing
D(sm) = measured data existing after smoothing
T = Number of times that the smoothing operation has been performed (Integer from 2 to 100)

If the following parameters are changed during execution of the smoothing function, the smoothing data obtained up to that time will be initialized and the smoothing function will be performed once again from the beginning in accordance with the newly set number of times of smoothing:

- Measurement function
- Measurement range
- IT parameter
- SLOW parameter
- SM TIME parameter

[Setting procedure]

The procedure for setting the SMOOTH function on or off is described below.



SMOOTH function on/off setting

Set the SMOOTH function on or off using the $\overset{\text{SMOOTH}}{\boxed{\square\qquad}}$ key.

Each time the $\overset{\text{SMOOTH}}{\boxed{\square\qquad}}$ key is pressed, the lamp of the key alternates between on and off. When the lamp is on, this indicates that the SMOOTH function is set on. When the lamp is off, this indicates that the SMOOTH function is set off.

Setting is complete when the lamp is made to turn on or off to obtain the desired state.

The lamp, however, remains blinking until smoothing has been performed the specified number of times.

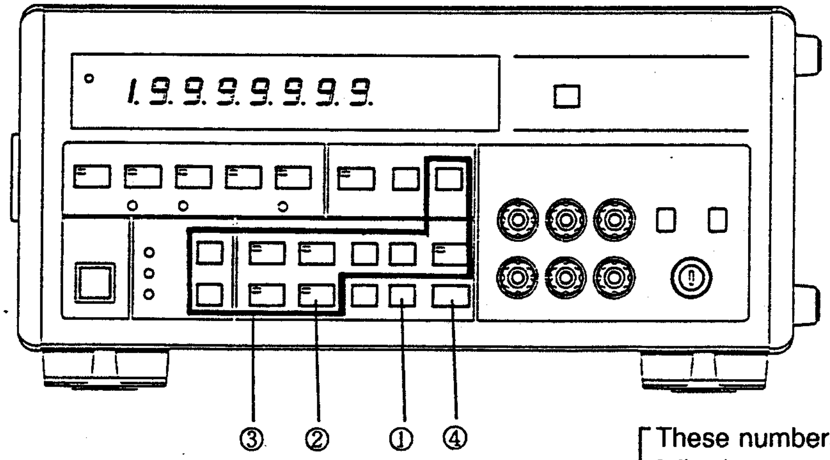
2.8.19 SM TIME: Smoothing Time

[Functional description]

The SM TIME parameter is used to set the number of times that the smoothing operation is to be performed.
See the description of the SMOOTH parameter for details of the smoothing function.
The setting range is from 2 to 100 times.

[Setting procedure]

The procedure for setting the number of times of smoothing is described below.



[These numbers indicate the following procedure numbers.]

Setting the SM TIME parameter

① Press the $\overset{\text{SHIFT}}{\boxed{\ }}$ key.

② Press the $\underset{\text{SM TIME}}{\boxed{\quad\quad}}$ key.

The number of times of smoothing that was last set will then be displayed on the LED unit.

1 0 S T

Setting the number of times of smoothing

③ Set the desired number of times of smoothing using the numeric keys 0☐ to 9☐.
For SM TIME setting, 0☐ to 9☐ act as numeric keys. The value set here will be displayed on the LED unit.

(Example)

To set 12, press keys 1☐ 2☐, in this order.

12 ST

Setting of the number of times of smoothing completed

④ Press the ENTER☐ key.
This causes the displayed value (number of times of smoothing) to be stored in memory. Setting of the number of times of smoothing is now complete.

2.8.20 NULL

[Functional description]

The NULL parameter is used to specify whether or not computation is to be performed with offset values during calculation of measured data.

When the NULL ▭ key is pressed and the key lamp comes on, the NULL function becomes valid (ON).

The measurement object already connected to the input terminals at depression of the NULL ▭ key is measured and the measured values are taken as the NULL values. (Measurement is made over all ranges from the measurement range available for the specified function to the maximum range.) In subsequent measurement operations, measured values from which the NULL values have been subtracted become the measurement results.

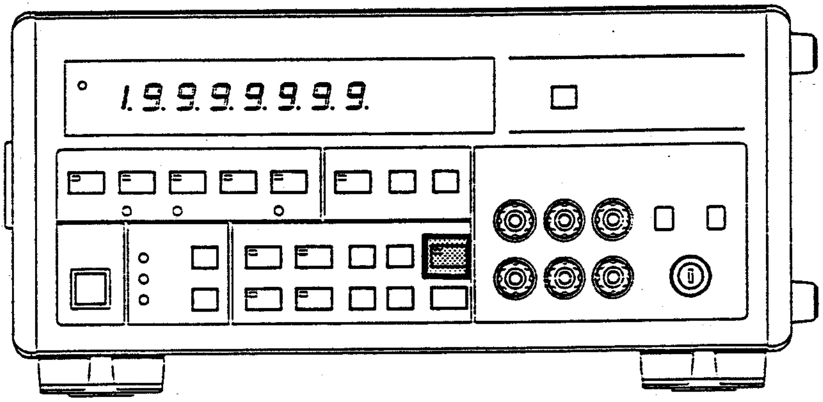
When the NULL key is pressed once again, the NULL function will turn off for all ranges.

Note 1 : The auto range function of the R6871E/E-DC is performed on measured data only: it is not performed on the results of NULL computation or smoothing computation.
Thus, an OVER error message may be displayed because of the auto range function even if measurement is not performed in the maximum range.

Note 2 : The NULL function becomes invalid (OFF) if input data is changed using a measurement function.

[Setting procedure]

The ON/OFF setting procedure for the NULL function is described below.



NULL function ON/OFF setting

Set the NULL function on or off using the NULL ☐ key.

NULL computation is peformed while the NULL ☐ key lamp stays lit.

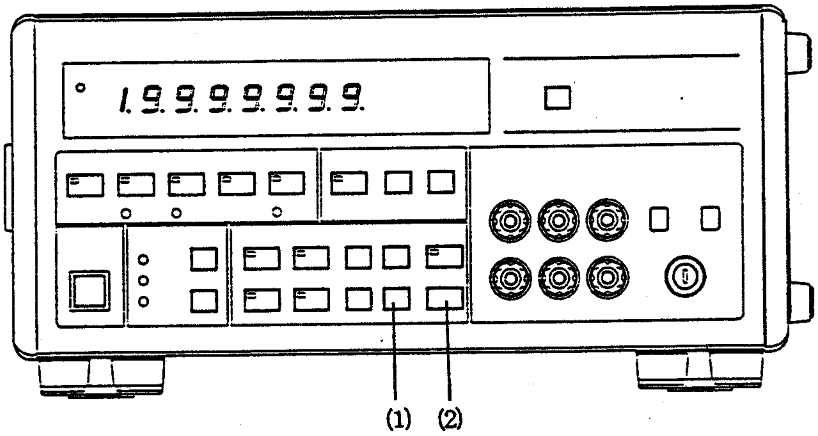
2.8.21 TEST

[Functional description]

The TEST parameter is used to set whether or not the self-tests of the R6871E/E-DC are to be performed.

[Setting procedure]

The operating procedure for the self-tests is described below.



[These numbers indicate the following procedure numbers.]

Execution of self-tests

① Press the SHIFT ☐ key.

② Press the ☐ TEST key.

This causes the self-tests to be performed. Check the individual test items that are displayed in the following order:

(a) The entire display blinks five times at 1 sec intervals, and a buzzer sound is generated at the same intervals as the blinking intervals.

8. 8. 8. 8. 8. 8. 8. 8. ▒ ▒

(b) The model name of R6871E/E-DC is displayed.

for R6871E

6 8 7 1 E

for R6871E-DC

6 8 7 1 E - D C

for R6871E-OHM

6 8 7 1 E - Ω

(c) The revision number of the software is displayed.

U . b 0 0

(d) The existing line frequency is displayed.

5 0 H z

(e) The GPIB address of the R6871E/E-DC is displayed.

H - A - 0 1 G P

(f) The following display is made when the sum check of the program ROM shows correct results:

8. 8. 8. 8. 8. 8. 8. 8. R 0

(g) The following display is made when the sum check of the calibration data saved within the R6871E/E-DC shows correct results:

8. 8. 8. 8. 8. 8. 8. 8. C A

(h) The following display is made when the READ/WRITE tests of the RAM show correct results:

8. 8. 8. 8. 8. 8. 8. 8. R A

(i) The following display is made when the test of the analog section shows correct results:

8. 8. 8. 8. 8. 8. 8. 8. A D

(j) Automatic calibration is performed and the results are displayed as follows:

A. C A L

(k) The entire display goes out.

2.9 Basic Methods of Operation

This section describes basic methods of operation for DC/AC voltage measurement, DC/AC current measurement, resistance, and network resistance measurement.

2.9.1 Basic Operations

(1) Make sure that the operating supply voltage is the same as the voltage that has been set using the line voltage value marked on the rear panel located in the rear panel.

(2) Set the POWER switch to the ON position. This causes automatic execution of the self-diagnostic functions. When the R6871E/E-DC is found to be normal, all panel lamps light up during execution of the self-diagnostic functions. (See subsection 2.8.21, "TEST function", for details.)
If an R6871E/E-DC malfunction is detected, then the appropriate error code is displayed. (See section 5.2, "Error Codes", for details.)
Following this, the R6871E/E-DC software revision number, the existing line frequency, the GPIB address are each displayed at 1 sec intervals. Check that all these settings match the actual operating conditions.

(3) If no errors are detected throughout the entire execution time of the self-diagnostic functions, then the R6871E/E-DC is set to the operating conditions preset when the POWER switch was last set to the ON position. (Note, however, that the COMPUTE, STORE, RECALL, NULL, and SMOOTH keys are set to the OFF position whenever power is turned on.)

(4) When execution of the self-diagnostic functions is completed, check each parameter setting to ensure that they match the actual operating conditions, as described below.
First, check that the FUNCTION, RANGE, SAMPLING, and INPUT keys (these are the basic measurement parameter keys) are all set to the correct positions.
Next, check that the settings of the A CAL, A ZERO, IT, SI, RES, and NULL parameters (these parameters are used to control the measurement functions and operations) are all correct.

CAUTION

In an environment where temperature suffers significant changes, set the AUTO CAL interval of the A CAL parameter to a small value.

2.9.2 DC Voltage Measurement

(1) Input Impedances

As shown in the table below, the input impedance varies according to the measurement range selected.

Range	200mV	2000mV	20V	200V	1000V
Input impedance	$10^{10}\Omega$ or more			10MΩ ± 0.5%	

(2) Input Cables

Connect the MI-37 (*) input cables (supplied) to the lower input terminals of the FRONT or REAR input terminals (select either with the INPUT key). (See Figure 2-4 below.)

* The MI-37 has three leads (red, black, blue).

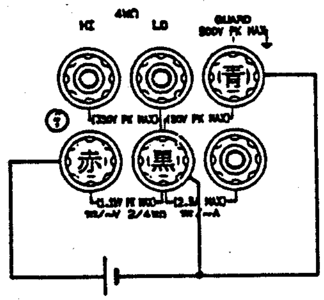


Figure 2-4 Input Cable Connection Diagram for DC Voltage Measurement

(3) Maximum Input Voltages

The maximum available input voltages are listed in the table below. Take great care to ensure that the maximum input voltage is not exceeded.

Voltage applied between:		Maximum input voltage
Hi terminal - LO terminal	200mV, 2000mV, 20V ranges	±1100V peak (for 10sec) ±500V peak (continuous)
	200V, 1000V ranges	±1100V peak (continuous)
GUARD terminal - chassis		±500V peak (continuous)
GUARD terminal - LO terminal		±50V peak (continuous)

(4) If a large influence is likely to result from noise included in measured signals, proceed as follows to minimize reading errors:
Setting the integral time (IT) to 1PLC or more will give improved effects of line noise rejection. In addition, a larger IT setting will give more stable measurements since low-frequency-component noise included in measured voltages will also be averaged.

Note : The integral time (IT) is initially set to 5PLC.

See section 2.8 for the parameter setting procedures.

CAUTION

The 200mV range (6 1/2 digit display) provides a resolution of 0.1µV/digit). When making measurements, therefore, careful attention should be paid to the occurrence of a thermal electromotive force.

A thermal electromotive force of several microvoltages to ten microvoltages per degree C may develop in the form of a thermocouple effect if temperature differences occur in signal wire connections between the clip terminals of measured signals and the input section of the R6871E/E-DC. This thermal electromotive force, if generated, will be added up for each wire connection, appear as zero drift, and thus result in significant measurement errors.

Therefore, strictly observe the following precautions:

(1) Notes on the connections of the measurement terminals
- Keep your hands away from the end of an input cable during measurement.
- Read the measured data only after a sufficient temperature balance has been attained.
- Do not make measurements in places where air circulates.

(2) Notes on the ambient conditions of the R6871E/E-DC
- Allow a sufficient warm-up time (approximately 60 minutes) after power has been turned on.
- Also take a sufficient warm-up time when making measurements in places where significant temperature differences occur.
- Avoid installing the R6871E/E-DC in places where air circulates.

2.9.3 Resistance Measurement

(1) Measurement Currents

Resistance measurement currents are listed in the table below.

Range	10Ω	100Ω	1000Ω	10kΩ	100kΩ	1000kΩ
Measurement current	10mA	10mA	10mA/1mA*	1mA	100μA	10μA

Range	10MΩ	100MΩ	1000MΩ
Measurement current	1μ	100nA	10nA

* : For option 10, 1mA is enabled.

(2) Voltages between Open Terminals

Resistance measurement voltages between open terminals (current source terminals) are listed in the table below.

Range	10Ω	100Ω	1000Ω	10kΩ	100kΩ	1000kΩ	10MΩ
Voltage between open terminals	24V				18V		

Range	100MΩ	1000MΩ
Voltage between open terminals	24V	

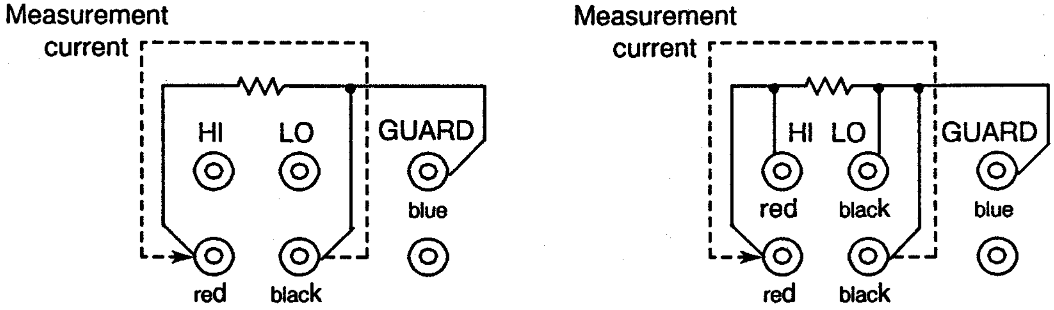
(3) Maximum Input Voltages

The maximum input voltages are listed in the table below. Take extra care to ensure that the voltages are not exceeded.

Votage applied between	Maximum input voltage (continous)
Between measurement terminals	± 350V peak
GUARD terminal - chassis	± 500V peak
GUARD terminal - measurement terminal	± 50V peak

(4) Input Cables

Figure 2-5 shows the input cable connection diagrams for 2-wire and 4-wire system resistance measurement.
For 2-wire system resistance measurement, use the MI-37 input cables (supplied).
For 4-wire system resistance measurement, use the A01005 input cables (supplied).



The A01005 has five leads (red, black, blue). The HI and LO terminals of lower side are the current forcing terminals. The HI and LO terminals of upper side are the voltage measurement terminals.

2-wire system (MI-37)

4-wire system (A01005)

Figure 2-5 Input Cable Connection Diagrams for Resistance Measurement

(5) 2-wire System Resistance Measurement

The NULL function of the equipment is effective for measurement ranges in which the resistance of the MI-37 input cable (approximately 0.5/) becomes an error. (See subsection 2.8.20, "NULL".)

When using the NULL function, the end of the input cable must be short-circuited and the resistance of that cable measured in advance. Subtracting this value from subsequent measurements makes it possible to prevent the resistance of the input cable from becoming an error.

CAUTION

When measuring resistances using the 10M/ range or higher, apply a shielding case over the resistor to be measured, in order to achieve the maximum high accuracy of measurement. (See Figure 2-6.) In addition, fix the input cable to prevent its sagging during measurement, and take special notice of noise induced from peripheral measuring instruments.

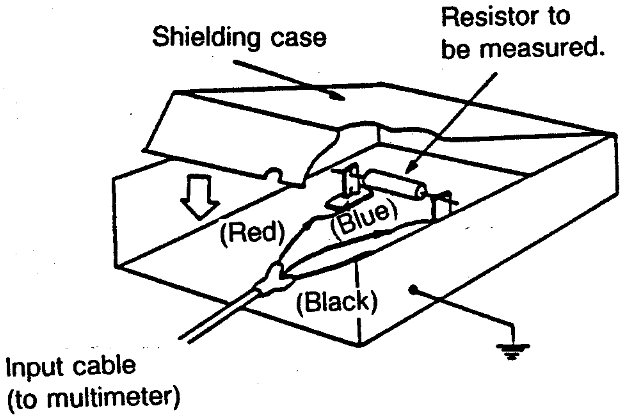


Figure 2-6 Shielding Example for Resistance Measurement

2.9.4 Network Resistance Measurement: Only the R6871E-OHM is enabled.

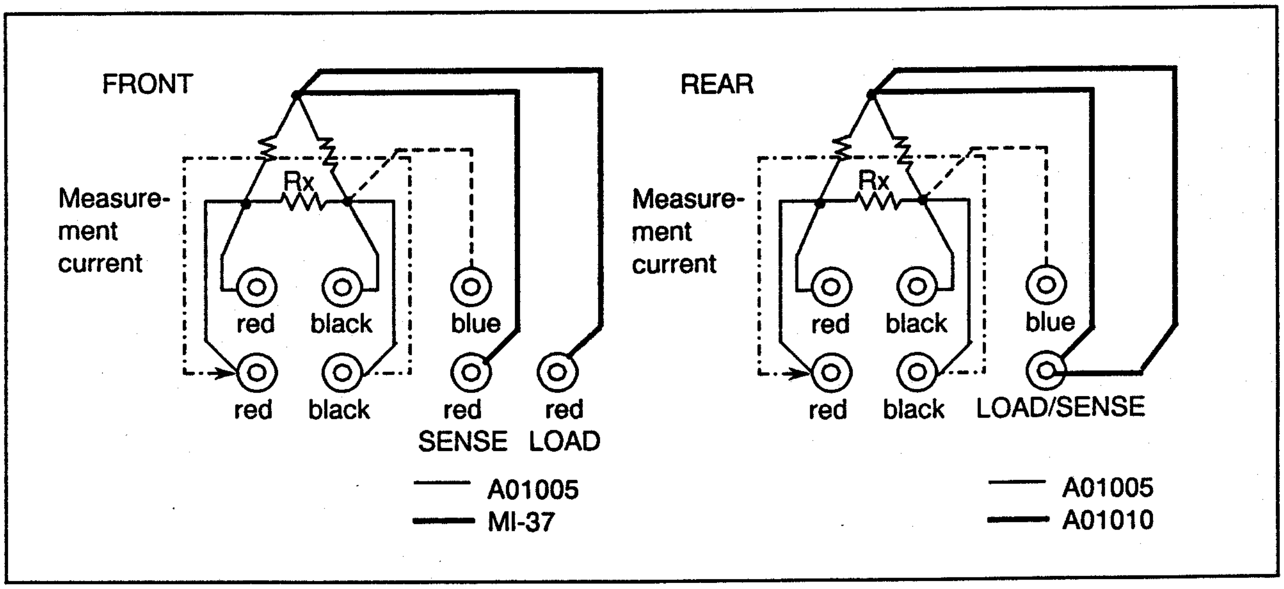
The network resistance measurement is a measurement method without need for switching off the network

(1) Measurement Range

Set the measurement function to four-wire resistance measurement. Set resistance for the closed circuit to 300Ω or more (5MΩ or less). (1kΩ to 10MΩ range)
Measurement result of 300Ω or less (5MΩ or more) is not guaranteed.
The output current will reach a limit if the resistance of about 300Ω or less is connected, and LED (OVERLOAD) on the front panel will light. The error increases for about 5MΩ or more.
Accuracy is not guranteed though the measurement operation is done in 10Ω , 100Ω , 100MΩ , or 1000MΩ range.
Select the integration time between 5PLC to 100PLCS.
Adjust the ratio of the resistance to be measured and resistance in the closed circuit to 1:100 or less.
The error increases when the ratio exceeds 1:100.

(2) Input Cable

The following figure shows the connection of the input cable of front and rear.
Both MI-37 and A01005 are used for the network resistance measurement. (Use optional A01010 for the REAR input.)
The FRONT and REAR terminals are internally connected to each of the SENSE and LOAD terminals. Connect the cable to either the FRONT or REAR terminal.
Do not connect with the LOAD terminal or SENSE terminal when usual resistance which is not the closed circuit is measured.



(3) Measurement Current, voltage between open terminals

Refer to "Resistance Measurement" of subsection 2.9.3.

(4) Maximum Input Voltages

Voltage applied between	Maximum input voltage (continuous)
Between measurement terminals (voltage/resistance)	±350V peak
Between measurement terminals (LOAD/SENSE)	±250V peak
GUARD terminal-chassis	±500V peak
GUARD terminal-measurement terminal	±50V peak

2.9.5 DC Current Measurement: Only the R6871E is enabled.

(1) Maximum Permissible Current Applied

The maximum permissible current applied is 2.5 amperes for the range from 2000 A to 2000mA.

If a protective fuse has blown due to an excessive input current, replace the current fuse (A FUSE), which is located in the lower central section of the front panel, with the required one (2A).

The fuse can be removed by turning the fuse holder counterclockwise with a light push upon the fuse holder.

Make the input cable connection securely: the circuit under measurement may be adversely affected if the input cable becomes disconnected during measurement.

(2) Input Impedances

Range	200μA	20mA	200mA	2000mA
Input impedance	102Ω or less	12Ω or less	3Ω or less	2Ω or less

(3) Input Cables

Figure 2-7 shows the input cable (MI-37) connection diagram for DC current measurement.

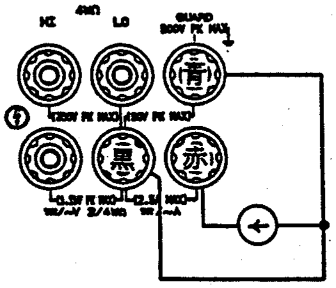


Figure 2-7 Input Cable Connection Diagram for DC Current Measurement

2.9.6 AC Voltage Measurement (DC + AC) Voltage Measurement: Only the R6871E is enabled.

(1) Input Impedances

The input impedance varies according to the measurement range selected, as shown in the table below.
The input impedance for each range is shown below.

Range	200mV	2000mV	20V	200V	500V
Input impedance	1MΩ ± 2% 300pF or less AC coupled				

(2) Input Cables

Connect the MI-37 (*) input cables (supplied) to the lower input terminals of the FRONT or REAR input terminals (select either with the INPUT key). (See Figure 2-8 below.)

* The MI-37 has three leads (red, black, blue).

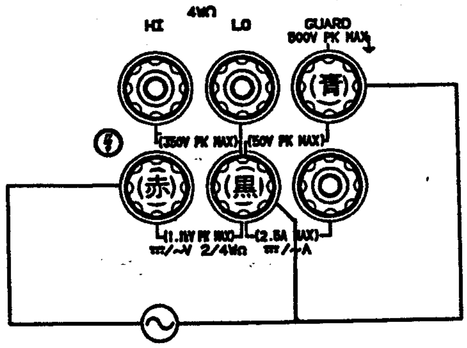


Figure 2-8 Input Cable Connection Diagram for AC Voltage Measurement

(3) Maximum Input Voltages

The maximum available input voltages are listed in the table below. Take great care to ensure that the maximum input voltage is not exceeded.

Voltage applied between:		Maximum input voltage
HI terminal - LO terminal	200mV, 2000mV, 20V, 200V, 500V ranges	HI terminal - LO terminal 520Vrms 750V peak

(4) If a large influence is likely to result from noise included in measured signals, proceed as follows to minimize reading errors:
Setting the integral time (IT) to 1PLC or more will give improved effects of line noise rejection. In addition, a larger IT setting will give more stable measurements since low-frequency-component noise included in measured voltages will also be averaged.

Note : The integral time (IT) is initially set to 5PLC.

See section 2.8 for the parameter setting procedures.

2.9.7 AC Current Measurement (DC + AC) Current Measurement: Only the R6871E is enabled.

(1) Maximum Permissible Current Applied

The maximum permissible current applied is 2.5Arms for the range from 2000μA to 2000mA.
If a protective fuse has blown due to an excessive input current, replace the current fuse (A FUSE), which is located in the lower central section of the front panel, with the required one (2A).
The fuse can be removed by turning the fuse holder counterclockwise with a light push upon the fuse holder.
Make the input cable connection securely; the circuit under measurement may be adversely affected if the input cable becomes disconnected during measurement.

(2) Input Impedances

Range	Input impedance
2000μA	102Ω or less
20mA	12Ω or less
200mA	3Ω or less
2000mA	2Ω or less

(3) Input Cables

Figure 2-9 shows the input cable (MI-37) connection diagram for AC current measurement.

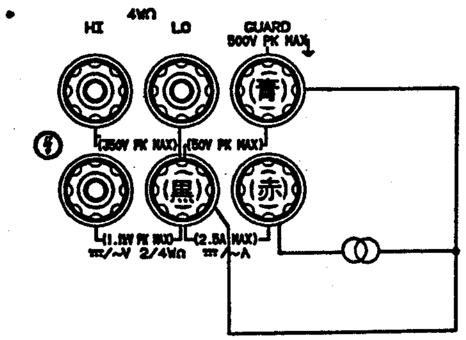


Figure 2-9 Input Cable Connection Diagram for AC Current Measurement

MEMO

3. OPERATING METHOD - 2 (COMPUTING FUNCTIONS AND MEMORY FUNCTIONS)

3.1 Computing Functions

3.1.1 General

Two types of computing functions are provided : primary computing functions and secondary computing functions.

Only the names of the primary and secondary computing functions are listed here. Detailed description of the various functions is given in subsection 3.1.3 onward.

(1) Primary Computing Functions

① SCALING
② %DEVIATION
③ DELTA
④ MULTIPLY
⑤ DECIBEL CONVERSION
⑥ REAL VALUE
⑦ dBm CONVERSION
⑧ RESISTANCE VALUE TEMPERATURE COMPENSATION

(2) Secondary Computing Functions

① COMPARATOR-1
② COMPARATOR-2
③ STATISTICAL PROCESSING

Notes on description of each computing function

(1) Symbols Used in Calculation Expressions

* : Multiplication symbol
Σ : Cumulative addition symbol
/ : Division symbol

(2) Each of the computation results displays shown by way of example is for the case of 7 1/2 digit display.
In actuality, the symbol 'E' for the exponential part is not displayed.

Note : Subsection 3.1.2, "Constant setting and the display of computation results", should be read before proceeding to description of each computing function.

3.1.2 Constant Setting and the Display of Computation Results

(1) Constant Setting

In principle, constants should be set in fundamental units.

Unless otherwise specified, real-number constants must be set in floating point BCD (binary coded decimal) form.

The setting range is from −19999999 E9 to 199999999 E9
(± 1.9.9.9.9.9.9.9. ± E9).

Only the mantissa part can be set if the exponential part is 0, and integers can be input if the exponential part is an integer.

Constants X, Y, Z, HIGH-1, HIGH-2, LOW-1, LOW-2, and LIMIT can be set to the previous values using the MD key.

Note : Data integrity is not guaranteed if the function range is changed over to another range during the time from the preceding measurement operation to MD key setting.

(2) Display of Computation Results

① Computation results are rounded up or off, depending on the output digit mode.

② OL (overload) is displayed if the particular measured value is out of the permissible range.

The units display section displays the units of measurement that correspond to the computation results.

③ For the display formats of computation results, see the description of the computation items.

CAUTION

(1) Fundamental units
Voltage measurement : V
Current measurement : A
Resistance measurement : Ω

(2) The COMPUTE key is automatically set to the OFF position if changes are made to the computation mode, constant settings or ON/OFF switching of data memory during execution of a computing operation.

3.1.3 SCALING

[Data operated on]

SCALING allows computation to be made on the following data:

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$$R = \frac{D - Y}{X} * Z$$

R : Results of computation
D : Data to be operated on
X : Constant (Set value)
Y : Constant (Set value)
Z : Constant (Set value)

[Setting range of constants]

X : ± 19999999 E-9 to ± 19999999 E + 9 (except 0)
Y, Z : ± 19999999 E-9 to ± 19999999 E + 9

[Display of computation results]

The significant digits in each measured value are automatically identified and the computation results are displayed in the following order of priority :

(1) R : −19999999 to +19999999
This value is displayed in the units of measurement.

(2) R : ±19999999 E-19 to ±19999999 E+19
This value is displayed in the fundamental units of each measurement function.
However, if the particular value has an exponential part, then the fundamental units are not displayed.

(3) In the fundamental units, a computation error message is displayed if the exponential part is larger than E+19, and "0. E-19" is displayed if the exponential part is smaller than E-19.

[Applications]

Output signals from pressure, thermal, distortion, and other such sensors and transducers can be measured. Direct reading of these measurements is possible because they can be converted into the units that correspond to the respective physical quantities.

(1) Setting "Y=0, Z=1" allows a $\frac{D}{X}$ calculation to be made, thus giving the results of division of data by the desired value (X).

Using this computation, it is also possible to measure the voltage drop (D) across the resistor (X) and directly read the value of the current flowing through the resistor.

(2) Setting "X=Z=1" allows R=D-Y calculation and hence elimination of offset values.

(3) Offset values and slope-compensated scaling factors can be obtained by first assigning to Y the sensor output value existing when the sensor input is zero and then assigning to X the span value between the zero and full-scale of the sensor input level so that Z becomes equal to 1.

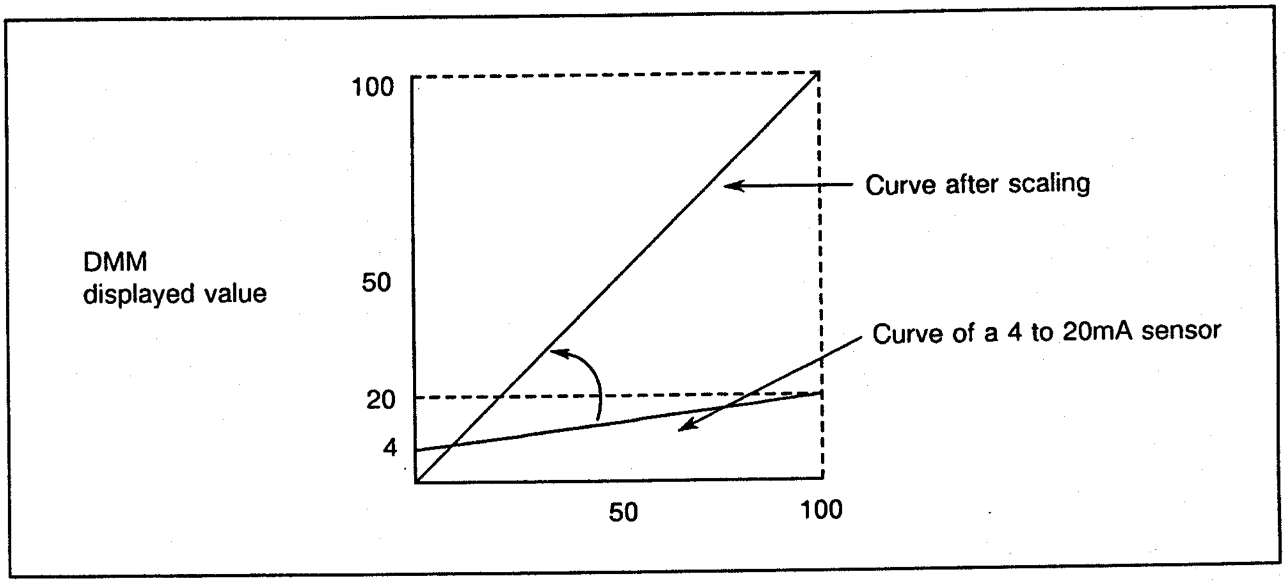


Figure 3-1 Sensor Inputs (Pressure, Temperature, Distortion, etc.)
[Scaling for Direct Reading of 4mA to 20mA Sensor or Transmitter Values]

Calculation expression for scaling

$$R = \frac{D - Y}{X} * Z$$

R : Results of computation
D : Data to be operated on
X : 0.16
Y : 4
Z : 1

$$R = \frac{D - 4}{0.16}$$

3.1.4 %DEVIATION

[Data operated on]

DEVIATION allows computation to be made on the following data :

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$$R = \frac{D - X}{|X|} *100$$

R : Results of computation
D : Data to be operated on
X : Constant (Set value)

[Setting range of constants]

X : ± 19999999 E-9 to ± 19999999 E + 9 (except 0)

[Display of computation results]

R : −1999.9999 to + 1999.9999
Unit : Display is made in %.

A computation error message is displayed if the particular R value is out of the permissible range.

[Applications]

This function can be applied to selection, ranking, etc. of resistors or other circuit components. Setting a reference value to X makes it possible for the deviation of data D from X to be obtained in percentage terms.

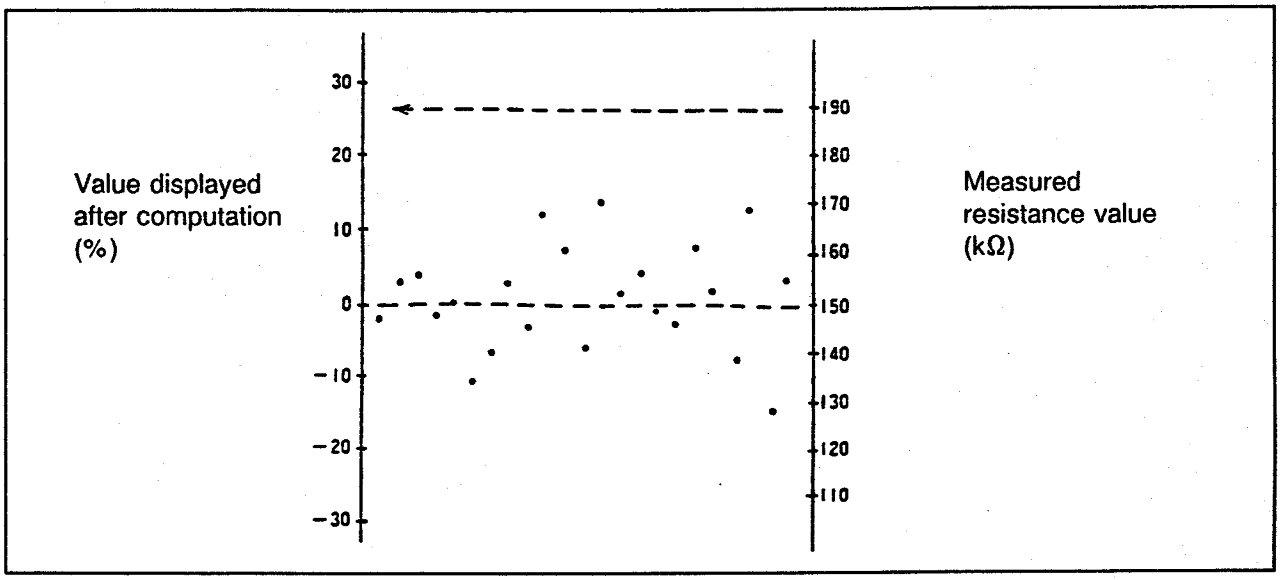


Figure 3-2 Application Example of ΩDeviation Caliculation
(Measurement of Resistance Value Deviation with X Set Equal to 150kΩ)

3.1.5 DELTA

[Data operated on]

DELTA allows computation to be made on the following data:

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$R = Dt - Dt-1$

R : Results of computation
Dt : Data to be measured at time t
Dt-1 : Data to be measured during the sampling operation that precedes time t

[Display of computation results]

R : −19999999 to +19999999

This value is displayed in the units of measurement.
A computation error message is displayed if the particular R value is out of the permissible range.

[Notes on execution of computation]

(1) When DELTA computation is performed, the data to be operated on will be displayed as the results of the first processing operation.
In the second and subsequent processing operations, the results of computation will be displayed.

(2) If the measurement function is changed over to another function during the execution of computation, then the data that has been set using the preceding function will be initialized and then computation will proceed.

[Applications]

This function allows display of input signal variations for each sampling interval. Differential values of the input signal are therefore obtained. This computation function is effective when the input signal is judged to be in a stable state (that is, below the required level) by monitoring variations in temperature' pressure' etc.

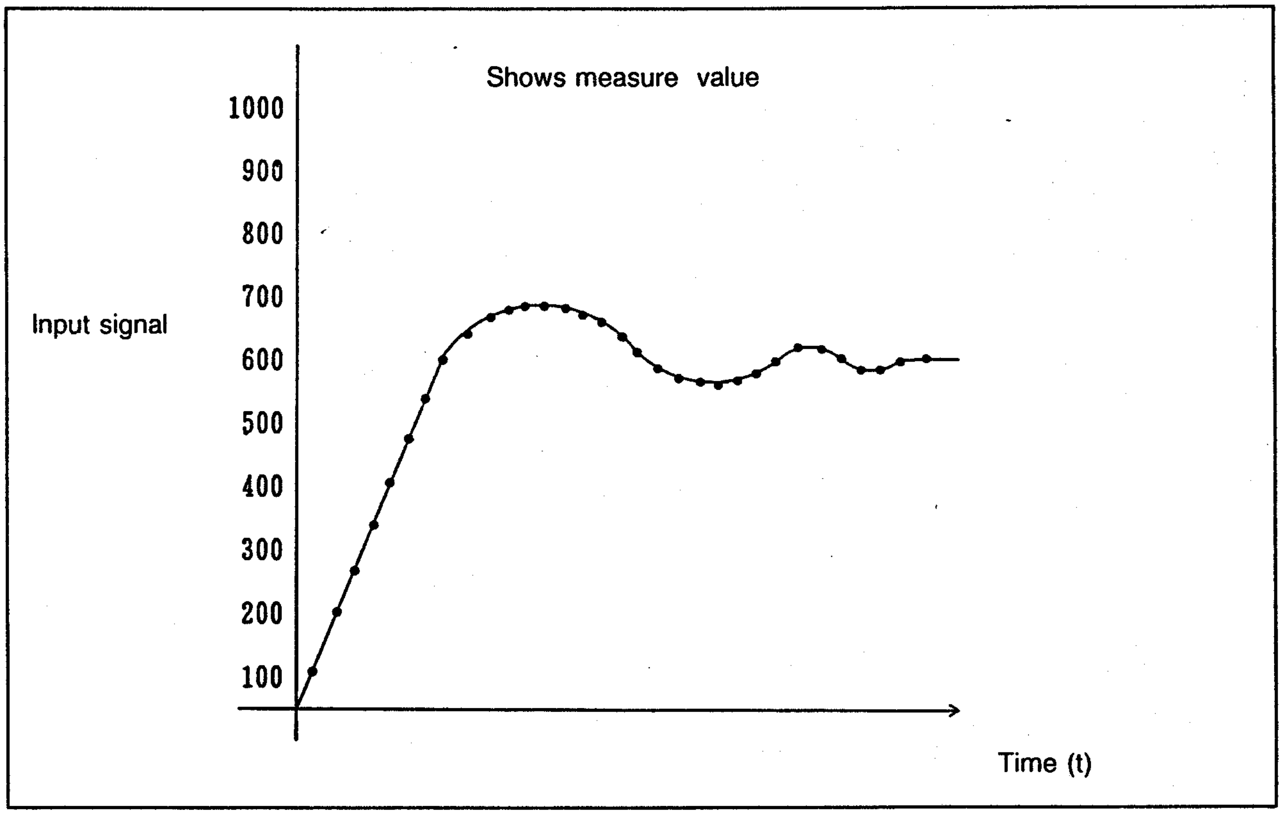


Figure 3-3 Application Example of DELTA Processing

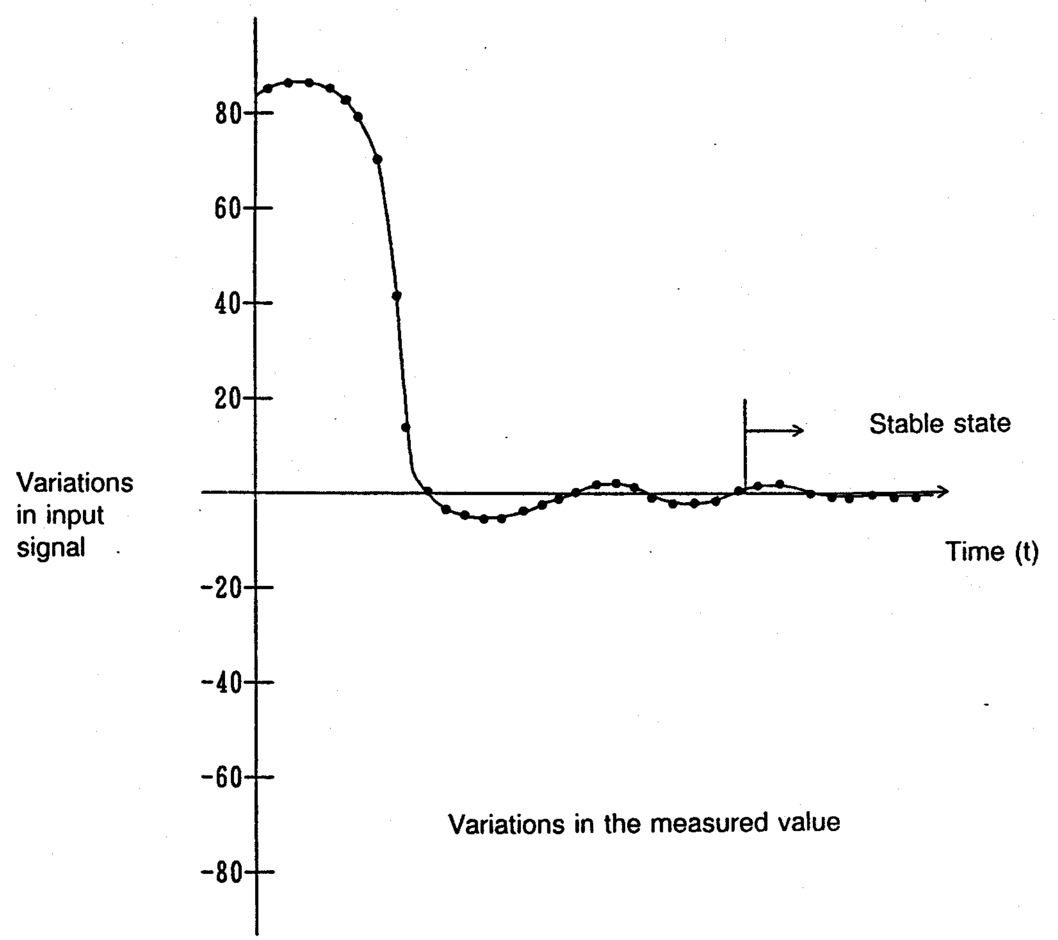


Figure 3-3 Application Example of DELTA Processing (cont'd)

3.1.6 MULTIPLY

[Data operated on]

MULTIPLY allows computation to be made on the following data:

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

R = Dt * Dt–1

R : Results of computation
D : Data to be measured at time t
Dt–1 : Data to be measured during the sampling operation that precedes time t

[Display of computation results]

R : ± 19999999 E-19 to ± 19999999 E + 19

This value is displayed without units.
A computation error message is displayed if the exponential part of the value is out of the E + 19 range.
"0. E-19" is displayed if the exponential part of the value is out of the E-19 range.

[Notes on execution of computation]

(1) When MULTIPLY computation is performed, the data to be operated on will be displayed as the results of the first processing operation. In the second and subsequent processing operations, the results of computation will be displayed.

(2) MULTIPLY computation continues even if changes are made to the measurement function settings during the computing operation. (The product between V, A, and Ω can be obtained.)

3.1.7 dB (Decibel Conversion)

Decibel conversion allows the following data to be operated on :

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$$R = 20*Y*\log_{10} \left| \frac{D}{X} \right|$$

R : Results of computation
D : Data to be operated on
X : Constant (Set value)
Y : Constant (Set value)

[Setting range of constants]

X : ± 19999999 E-9 to ± 19999999 E + 9 (except 0)
Y : ± 19999999 E-9 to ± 19999999 E + 9

[Display of computation results]

R : −1999.9999 to + 1999.9999
This value is displayed in dB.
A computation error message is displayed if the output range has been overstepped.

[Notes on execution of computation]

A computation error message is displayed if the data to be operated on (D) has become zero during dB computation.

[Applications]

This function is effective typically for the following two cases :

(1) When obtaining the voltage gain level
Setting the input signal voltage value to "Y = 1, X" and then measuring the output voltage will cause :

$$Gv = 20\log_{10} \left| \frac{D}{X} \right|$$

The voltage gain level can be obtained from this expression.

(2) When obtaining the current gain level
Setting the input signal current value to "Y = 1, X" and then measuring the output current will cause :

$$Gi = 20\log_{10} \left| \frac{D}{X} \right|$$

The current gain level can be obtained from this expression.

3.1.8 RMS Value (Effective Value)

[Data to be operated on]

RMS Value allows the following data to be operated on :

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$$R = \sqrt{\frac{1}{X} \sum_{K=1}^{X} Dk^2}$$

R : Results of computation
Dk : Data to be operated on
X : Constant (Set value)
K : Variable that takes an integer from 1 to X

[Setting range of constants]

X : Integer from 2 to 10000
(If a real number is input, it will be rounded into an integer.)

[Display of computation results]

Significant digits of the data that has been measured on the maximum ragne are identified from the X number of measurements and then the computation results are displayed in the following order of priority:

(1) R : 0 to 19999999
Display is made in the measurement unit of the final data.

(2) R : 19999999 E-19 to 19999999 E+19
Display is made in the fundamental units of each measurement function.
However, if the particular value has an exponential part, then the exponential part is displayed and the fundamental units are not displayed.

(3) In the fundamental units, a computation error message is displayed if the exponential part is larger than E+19, and "0. E-19" is displayed if the exponential part is smaller than E-19.

[Notes on execution of computation]

(1) When RMS computation is selected, the RMS lamp under the display section will light and the entire display will go out until the first results of computation are obtained. The computation results are displayed when measurement has been performed the number of times that has been set using the constant X.

(2) If the data range that has been previously set is overstepped during RMS computation, then the data measurements become invalid and are excluded from the total number of measurements.

(3) Changes to the measurement function settings during RMS computation causes initialization of the data that has been set using the old settings of the measurement functions. In that case, computation restarts from the beginning.

[Operating notes]

(1) Depression of the HO☐ (HOME) key during RMS computation causes display of the results of RMS computations obtained up to that time. In that case, computation restarts from the beginning.

(2) Depression of the HO☐ (HOME) key during the execution of computation in the data-memory recall mode causes initialization of all previous computation results and resumption of the store-data quantity display (initial state of the recall mode).

3.1.9 dBm (dBm Conversion)

[Data to be operated on]

dBm conversion allows the following data to be operated on :

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$$R = 10 * \log_{10} \frac{D^2/X}{1\text{mW}}$$

R : Results of computation
D : Data to be operated on
X : Reference resistance value (Ω)

[Starting range of constants]

X : 0 to 19999999E9 (except 0)

[Display of computation results]

R : −1999.9999 to +1999.9999
Unit : dBm
Display is made in Bm.

A computation error message is displayed if the output range has been overstepped.

[Applications]

This function is affective for calculation of power gain.
If the resistance value at which the voltage D has been measured is set to X, then the calculation expression is given and the power gain can be obtained from the expression.

$$Gw = 10 * \log_{10} \frac{D^2/X}{1mW}$$

[Operating notes]

dBm computation is effective only for voltage measurement.
The COMPUTE key is automatically turned off if the voltage measurement function is changed over to another function during dBm computation.

3.1.10 Resistance Value Compensation (20 degrees Centigrade)

[Data to be operated on]

Resistance value compensation allows the following data to be operated on :

(1) Measured data
(2) Data that has been recalled from the data memory

[Calculation expression]

$$R_{20} = \frac{Rx}{1 + 0.00393\ (X-20)} * \frac{1000}{Y}$$

R20	:	Electric wire with resistance value as converted into 20°C (per km)
Rx	:	Resistance value measured at a temperature of X°C (Ω)
X	:	Room temperature during measurement (°C)
Y	:	Length of measured cable (m)

[Setting range of constants]

X : Room temperature during measurement (°C)
(± 19999999 E-9 to ± 19999999 E + 9)

Y : Length of measured cable (m)
(0 to 19999999E9) (except 0)

[Display of computation results]

The significant digits in the final measured value are automatically identified and the computation results are displayed in the following order of priority :

(1) R : –19999999 to +19999999
Display is made in the measurement unit.

(2) R : ±19999999 E-19 to ±19999999 E+19
Display is made in the fundamental unit (Ω).
However, if the particular value has an exponential part, then the exponential part is displayed and the fundamental unit is not displayed.

(3) For the fundamental unit, a computation error message is displayed if the exponential part is out of the E+19 range, and "0. E-19" is displayed if the exponential part is out of the E-19 range.

[Applications]

This computation expression is used mainly in electric wire manufacturers to convert the resistance values of annealed copper wires (IEC standard type) at 20°C into those existing at X°C.

[Operating notes]

Resistance value compensation is effective only for resistance measurement.
The COMPUTE key is automatically turned off if the resistance measurement function is changed over to another function during resistance value compensation computation.

3.1.11 COMPARATOR-1

[Data to be operated on]

COMPARATOR-1 allows the following data to be operated on :

(1) Measured data
(2) Data that has undergone primary computation processing
(3) Data that has been recalled from the data memory

[Calculation expression]

If HIGH 2 < D, then R (HIGH2)
If HIGH 1 < D ≦ HIGH 2, then R (HIGH1)
If LOW 1 ≦ D ≦ HIGH 1, then R (PASS)
If LOW 2 ≦ D < LOW 1, then R (LOW1)
D < LOW 2, then R (LOW2)

R( ) : Results of computation of each item
D : Data to be operated on
HIGH 1 : Constant (set value), upper-limit value 1
HIGH 2 : Constant (set value), upper-limit value 2
LOW 1 : Constant (set value), upper-limit value 1
LOW 2 : Constant (set value), upper-limit value 2

[Setting range of constants]

HIGH 1, HIGH 2, LOW 1, LOW 2 : ±19999999 E-9 to ±19999999 E+9

where HIGH 1 ≦ HIGH 2
LOW 2 ≦ LOW 1 (Permitted if HIGH < LOW)

[Display computation results]

The computation results are indicated by lamps as follows according to the classification of the results :

If R (HIGH2), the HIGH lamp lights.
If R (HIGH1), the HIGH lamp flashes.
If R (PASS), the PASS lamp lights.
If R (LOW1), the LOW lamp flashes.
If R (LOW2), the LOW lamp lights.

The data on which COMPARATOR-1 computation has been performed is displayed on the LCD unit.

[When the BUZZER parameter has been set]

(1) If the BUZZER parameter setting is ON-1 :
A buzzer sound is generated when the computation results are R (HIGH2), R (HIGH1), R (LOW1), or R (LOW2).

(2) If the BUZZER parameter setting is ON-2 :
A buzzer sound is generated when the computation results are R (PASS).

3.1.12 COMPARATOR-2

[Data to be operated on]

COMPARATOR-2 allows the following data to be operated on :

(1) Measured data
(2) Data that has undergone primary computation processing
(3) Data that has been recalled from the data memory

[Calculation expression]

If $H2 = LIMIT + \%2$
If $H1 = LIMIT + \%1$
If $L1 = LIMIT - \%1$
If $L2 = LIMIT - \%2$

then data D is compared with H1, H2, L1, and L2 and the results are sorted out according to which is larger.

If $H2 < D$, then R (HIGH2)
If $H1 < D \leqq H2$, then R (HIGH1)
If $L1 \leqq D \leqq H1$, then R (PASS)
If $L2 \leqq D < L1$, then R (LOW1)
$D < L2$, then R (LOW2)

R( ) : Results of computation of each item
D : Data to be operated on
LIMIT : Constant (set value); reference value
%1 : Constant (set value); tolerance ; (% deviation from reference value)
%2 : Constant (set value), tolerance ; (% deviation from reference value)

[Setting range of constants]

LIMIT : Reference value
±19999999 E-9 to ±19999999 E+9 (except 0)
%1, %2 : Tolerance (in %)
0.000 to 100.0 (Real number consisting of four digits or less)
where %1 %2

[Display computation results]

The computation results are indicated by lamps as follows according to the classification of the results :

If R (HIGH2), the HIGH lamp lights.
If R (HIGH1), the HIGH lamp flashes.
If R (PASS), the PASS lamp lights.
If R (LOW1), the LOW lamp flashes.
If R (LOW2), the LOW lamp lights.

The % deviation value into which the operated data has been converted with respect to the reference value is displayed on the LCD unit.

[When the BUZZER parameter has been set]

(1) If the BUZZER parameter setting is ON-1 :
A buzzer sound is generated when the computation results are R (HIGH2), R (HIGH1), R (LOW1), or R (LOW2).

(2) If the BUZZER parameter setting is ON-2 :
A buzzer sound is generated when the computation results are R (PASS).

3.1.13 STATISTICS (Statistical Processing)

[Data to be operated on]

Statistical processing allows the following data to be operated on :

(1) Measured data
(2) Data that has undergone primary computation processing
(3) Data that has been recalled from the data memory

[Calculation expression]

The meaning of computation results and the calculation expression are shown below.

R (COUNT) : Number of samples
R (MAX) : Maximum value
R (MIN) : Minimum value
R (AVE) : Average value

$$R\ (AVE) = \frac{\sum_{K=1}^{N} Dk}{N}$$

R (P-P) : Disparation range
R (P-P) = | R (MAX) − R (MIN) |

R (δ) : Standard deviation

$$R\ (\delta) = \sqrt{\frac{1}{N-1}\sum_{K=1}^{N}(Dk - \overline{D}^{2})}$$

$$\text{where } \overline{D} = \left(\frac{\sum_{K=1}^{N} Dk}{N}\right) = R\ (AVE)$$

R (UCL) : Upper control line
R (AVE) + 3R (δ)

R (LCL) : Low control line
R (AVE) − 3R (δ)

R( ) : Results of computation of each item
Dk : Data to be operated on
N : Constant (set value); number of data sets

[Setting range of constants]

N : Number of data sets
Integer from 2 to 10000

[Display of computation results]

R (COUNT) : Integer from 2 to 10000

R (MAX), R (MIN), R (AVE), R (P-P), R (UCL), R (LCL)
: The output ranges and units of these values are displayed in the same manner as done for the data that is to be operated on.
If the data to be operated on is measured data or the results of scaling computation, RMS computation, resistance value temperature compensation, then the significant digits and the unit of measurement are judged from the final data that has been operated on.

R (δ) : ±1999 E-19 to ±1999 E+19
For the mantissa part, only three and a half digits is valid.
Display is made in the same units as those of data to be operated on. However, except when there is a significant dispersion of data to be operated on, data display usually appears with the exponential part, but without unit.

[Operating procedure]

The operating procedure for statistical processing computation is described below.

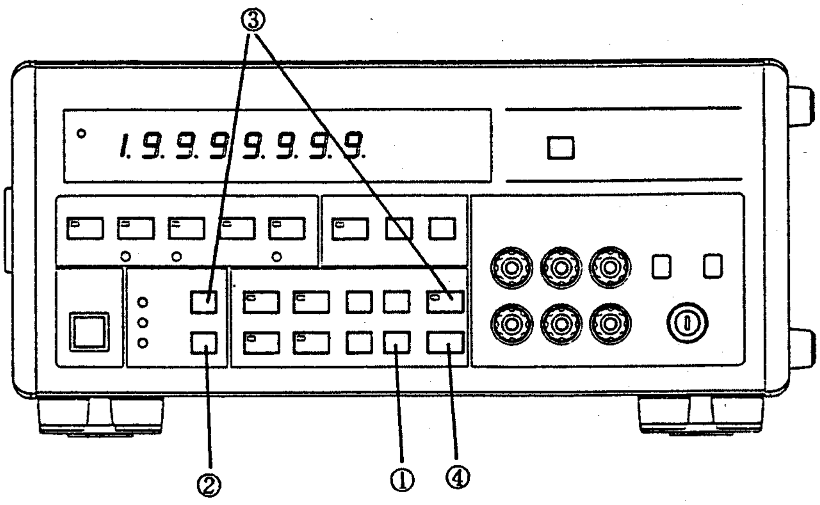
Outline

An example of execution of statistical processing computation with 1000 samples is given here.

The proceeding procedure is outlined below.

I. Setting of the number of samples (N parameter)
II. Setting of the computing function (CF parameter)
III. Execution of the computing operation
IV. Output of the computation results

I. Setting of the number of samples



[These numbers indicate the following procedure numbers]

Setting the N parameter

(1) Press the SHIFT ☐ key.

(2) Press the ☐ N key.

The existing setting of the constant N will then be displayed on the LCD unit.

2 N

Setting a constant

(3) Set the sample quantity of 1000 as the constant N.

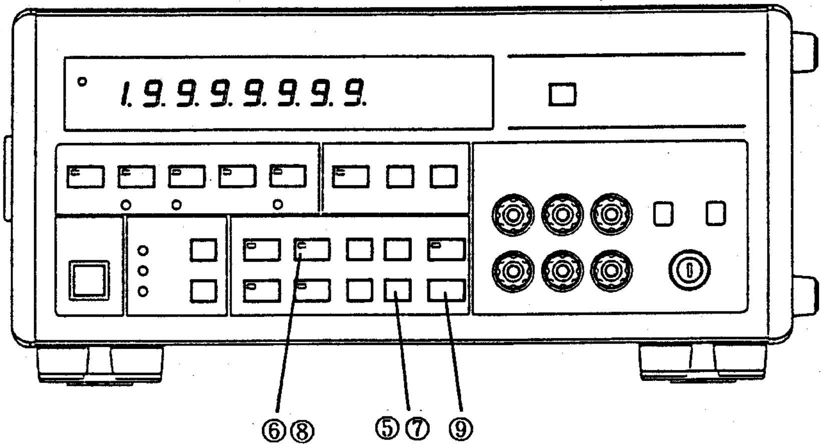
1 0 0 0 N

To do this, press keys 1☐ 0☐ 0☐ 0☐, in that order.

Constant setting completed

(4) Press the ENTER ☐ key.

II. Setting of the Computing Function

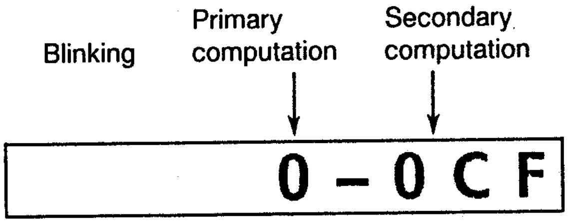


[These numbers indicate the following procedure numbers]

CF parameter setting

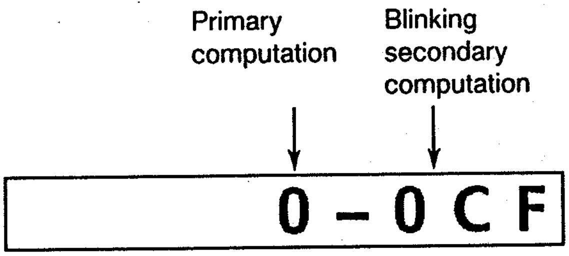
(5) Press the $\overset{\text{SHIFT}}{\boxed{}}$ key.

(6) Press the $\overset{\text{CF}}{\boxed{}}$ key.
The primary and secondary computing function codes last set will then be displayed on the LCD unit.



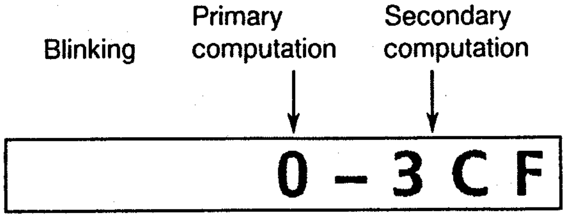
Computing function selection

(7) Press the $\overset{\text{SHIFT}}{\boxed{}}$ key.
This causes blinking of the secondary computing display, enabling setting of the statistical computation function.



Computing function setting

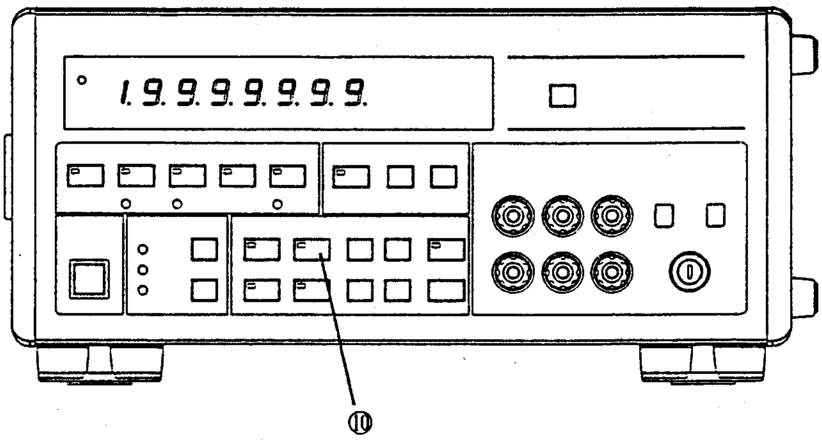
(8) Input the statistical computation function code '3'.



Setting of the computing function completed

(9) Press the ENTER key.

III. Execution of the computing operation

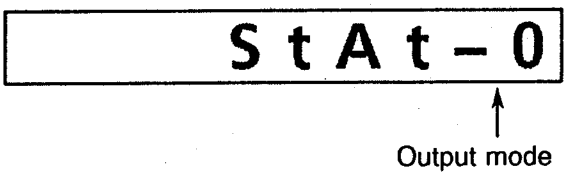


These numbers indicate the following procedure numbers

Execution of computation

(10) Press the COMPUTE key.

This initiates the computing operation. Computation is performed on 1000 samplings and the data that is currently undergoing processing is displayed on the LCD unit. When computation is completed, the waiting state for input of an output mode will be displayed on the LCD unit. The output mode, which refers to the computation results output method, is available in two versions : stepped output mode and continuous output mode. The output mode last set will be displayed at this point of time.



[Stepped output mode]

The stepped output mode refers to the mode in which eight types of computation results are output one by one. If this mode is desired, set "0" in the display position shown above.

[Continuous output mode]

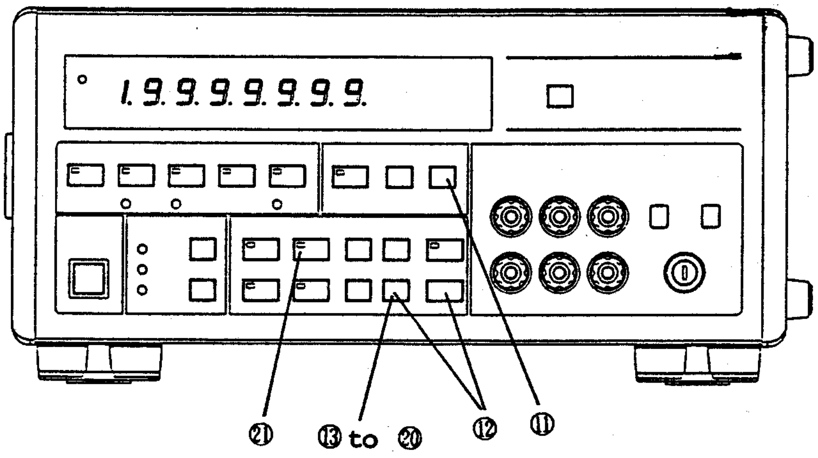
The continuous output mode refers to the mode in which eight types of computation results are all output at one time. If this mode is desired, set "1" in the display position shown above.

Note: If data is to be both displayed and output, the stepped output mode should be selected. If the output object is to be displayed only, then the display speed will become too high to see.

IV. Output of the computation results

The operating procedures for data output in the stepped output mode and in the continuous output mode are described here.

[Data output in the stepped output mode]



[These numbers indicate the following procedure numbers]

Setting of the stepped output mode

(11) Press the 0☐ key.

This causes the stepped output mode to be displayed on the LCD unit.

StAt-0

Execution of stepped output

(12) Press the ENTER☐ key.

This causes the number of samples to be output first. Subsequent computation results are output each time the SHIFT☐ key is pressed.

Number of samples

1000 N

[Output order]

The computation results are output in the following order each time the SHIFT ☐ key is pressed :

Number of samples	
Maximum value	R (MAX)
Minimum value	R (MIN)
Average value	R (AVE)
Dispersion range	R (P-P)
Sigma	R (δ)
Average value + 3 sigma	R (UCL)
Average value –3 sigma	R (LCL)

If the SHIFT ☐ key is pressed following the completion of output of all the eight types of computation results, then the output mode input awaiting display (the display appearing in procedural step (10)) reappears.

Execution of stepped output

(13) Press the SHIFT ☐ key.

This causes display of the maximum value and lighting of the MAX lamp located below the display section.

–6.11633 V

MAX

Execution of stepped output

(14) Press the SHIFT ☐ key.

This causes display of the minimum value and lighting of the MIN lamp located below the display section.

–6.11926 V

MIN

Execution of stepped output

SHIFT
(15) Press the ☐ key.

This causes display of the average value and lighting of the AVE lamp located below the display section.

-6.11752 V
AVE

Execution of stepped output

SHIFT
(16) Press the ☐ key.

This causes display of the dispersion range and lighting of the MAX and MIN lamps located below the display section.

0.00293 V
MAX MIN

Execution of stepped output

SHIFT
(17) Press the ☐ key.

This causes display of the sigma value (δ) and lighting of the lamp located below the display section.

1.014000-3
δ

Exeution of stepped output

SHIFT
(18) Press the ☐ key.

This causes display of the UCL value and lighting of the δ and HIGH lamps located below the display section.

-6.11448 V
HIGH δ

Execution of stepped output

SHIFT
(19) Press the ☐ key.

This causes display of the LCL value and lighting of the δ and LOW lamps located below the display section.

-6.12056 V
LOW δ

Execution of stepped output

(20) Press the SHIFT ☐ key.

StAt – 0

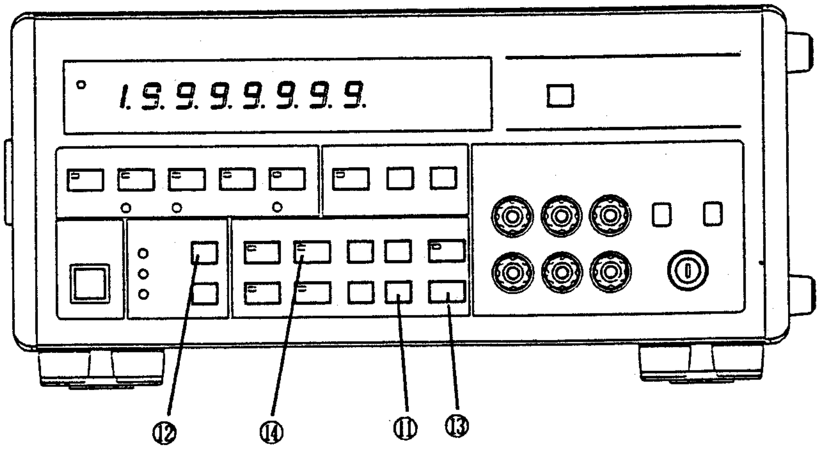
Output of all the eight types of computation results has been completed when step (19) above was carried out. If this step (20) is carried out, then the output mode input awaiting display (the display appearing in step (10)) reappears.

End of the stepped output mode

(21) Press the COMPUTE ☐ key.

This causes the COMPUTE ☐ lamp to go out, the stepped output mode to terminate, and the equipment to return to the measurement mode.

[Data output in the continuous output mode]



[These numbers indicate the following procedure numbers]

Setting of the continuous output mode

(11) Press the SHIFT ☐ key.

(12) Press the 1☐ key.

This causes the continuous output mode to be displayed on the LCD unit.

StAt-1

Execution of continuous output

(13) Press the ENTER ☐ key.

This causes the eight types of computation results to be continuously output.

StAt-1

These computation results are output in the following order :

Number of samples	
Maximum value	R (MAX)
Minimum value	R (MIN)
Average value	R (AVE)
Dispersion range	R (P-P)
Sigma	R (δ)
Average value + 3 sigma	R (UCL)
Average value–3 sigma	R (LCL)

When output of all the eight types of computation results is completed, the output mode input awaiting display (the display appearing in procedural step (10) reappears automatically.

End of the continuous output mode

(14) Press the COMPUTE ▭ key.

This causes the COMPUTE ▭ lamp to go out, the continuous output mode to terminate, and the R6871E/E-DC to return to the measurement mode.

[Notes on the display made until the specified number of samplings is reached]

If statistical processing computation is selected, the data that is subjected to computation will be displayed until the specified number of samplings is reached.

When the specified number of samplings is reached, the computer will wait for input of an output mode. The results of statistical processing computation will be displayed according to the readout mode selected.

[Notes on execution of computation]

(1) If the particular data oversteps the selected data range during execution of statistical processing computation, then the data becomes invalid and is excluded from the total measurement count.

(2) If the measurement function being used is changed over to another function during execution of statistical processing computation, then the data that has been obtained using the previous function is initialized and computation restarts from the beginning.

[Operating notes]

(1) If the HO☐ (HOME) key is pressed during execution of statistical processing computation, then the computing operation will terminate at that time and the display indicating the waiting state for input of an output mode will appear.

(2) If the HO☐ (HOME) key is pressed during readout of the statistical computation results, then the readout operation will terminate immediately.

(The lamp of the COMPUTE ☐ key will stay lit and statistical computation will start anew.)

(3) If the COMPUTE ☐ key is pressed during setting of the readout mode, then the statistical computing operation will terminate. At the same time, the readout mode of the statistical computation results will end and the R6871E/E-DC will resume the measurement mode.

(4) If the HO☐ (HOME) and COMPUTE ☐ keys may be pressed at any time.

(5) Depression of the HO☐ (HOME) key during the execution of statistical processing in the data-memory recall mode (or during readout of computation results) will cause initialization of the data being operated on (or of all previous computation results) and resumption of the store-data quantity display (initial state of the recall mode).

(6) To terminate the data-memory recall mode during readout of computation results, first press HO☐ (HOME key) or COMPUTE ☐ to exit from the readout mode.

3.2 Data Memory Functions

Two data memory functions are provided : the function that allows data measurements to be stored into the internal memory of the R6871E/E-DC, and the function that allows the desired number of stored data measurements to be read out. The R6871E/E-DC can store up to a maximum of 1000 data samplings (measurements) into its internal memory.

This section describes the methods of storing data measurements into the memory and the methods of reading out stored data.

The data memory functions provide a wide variety of applications because they make it possible to capture high speed events, to capture single events due to pre-triggering and delayed triggering, and to make various types of computations on the same type of data prior to readout operations.

3.2.1 Data Numbers (Required for Storage of Measured Data)

The data numbers refer to the numbers that are automatically assigned to all sets of measured data prior to storage of the data into the internal memory (hereinafter referred to as the data memory).

With the data numbers, it becomes possible to read out the desired data from the data memory.

If data were stored without being numbered, it would become impossible to specify data since no distinction would be drawn between the desired data and other data.

Thus, data is automatically numbered by the corresponding function of the data memory prior to storage. Numbering of data makes it possible to read out the desired data directly from the data memory.

Please note that the manner of automatic data numbering differs according to the method of storing measured data into the data memory.

3.2.2 Methods of Storing Measured Data into the Data Memory

(1) When measured data is stored into the data memory :

If the STORE lamp is on at the occurrence of measured data, then the data is stored into the data memory.

The STORE lamp turns on when the STORE key is pressed.

The STORE lamp alternates between its 'on' and 'off' states each time the STORE key is pressed. It should be noted, however, that the data numbering manner differs according to the manner of data storage, that is, according to the type of sampling mode selected or the presence/absence of connected trigger inputs.

(2) When stored data disappears :

① Stored data disappears from the data memory if : Power is turned off.

② The STORE lamp is made to go out and then come back on.

(3) Parameters related to storage

Parameters related to storage of measured data into the data memory are listed in Table 3-1, in which the parameters are classified according to the type of sampling mode (RUN, SINGLE, or MULTI) and the presence/absence of connected trigger inputs.
Check the relationship between 'SI', 'DELAY', or 'NS' parameters and storage operation prior to setting these parameters.

(4) Parameters related to store operation
Parameters 'SI', 'TD', and 'NS' are related to store operation when measured data is stored into the data memory. These parameters, however, do or do not become concerned with store operation, depending on the sampling mode and the presence/absence of trigger inputs. This relationship is shown in Table 3-1. Set these parameters only after checking their relationship to storage operation.

Table 3-1 Relationship Between the Parameters and Storage Operation

	RUN		SINGLE	MULTI
	Without trigger	With trigger		
SI	①	②	—	③
DELAY	—	—	④	⑤
NS	—	⑥	⑦	⑧

(Description)
The relationship between the three parameters and storage operation is described follows.

①②③ : Measured data is stored into the data memory at the sampling interval that has been set using the 'SI' parameter.

④⑤ : Storage operation starts after the trigger delay time that has been set using the 'DELAY' parameter elapses following input of the trigger signal.

⑥⑦⑧ : The volume or measured data that corresponds to the number of sampling operations that has been set using the 'NS' is stored into the data memory after the trigger signal has been input.

In the RUN mode, however, storage operation starts when the STORE key lamp has come on. In this case, data numbers are involved.

In the above description, trigger input refers to the following cases :

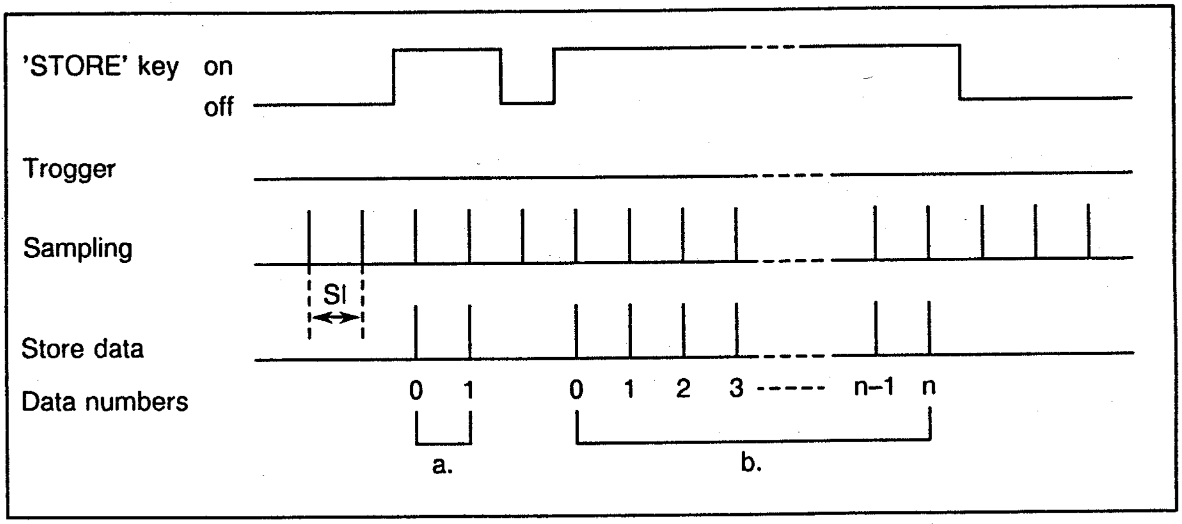
① When the TRIG key on the R6871E/E-DC front panel has been pressed

② When an external signal has been input via the EXT. TRIGGER connector located on the R6871E/E-DC rear panel

③ When the 'E' or 'GET' command, which corresponds to a trigger, has been input via GPIB

(5) Sampling mode : RUN
If the selected sampling mode is RUN, take care when reading out data from the data memory, because the data numbers that are assigned to data stored differ according to the presence or absence of trigger signal inputs.

① If trigger signals are not input



(Description)

ⓐ In the RUN mode, data can be stored at any time while the STORE ▭ key lamp stays on.

ⓑ If no trigger signal inputs are present, the first data stored when the STORE ▭ key lamp has turned on is numbered "0".

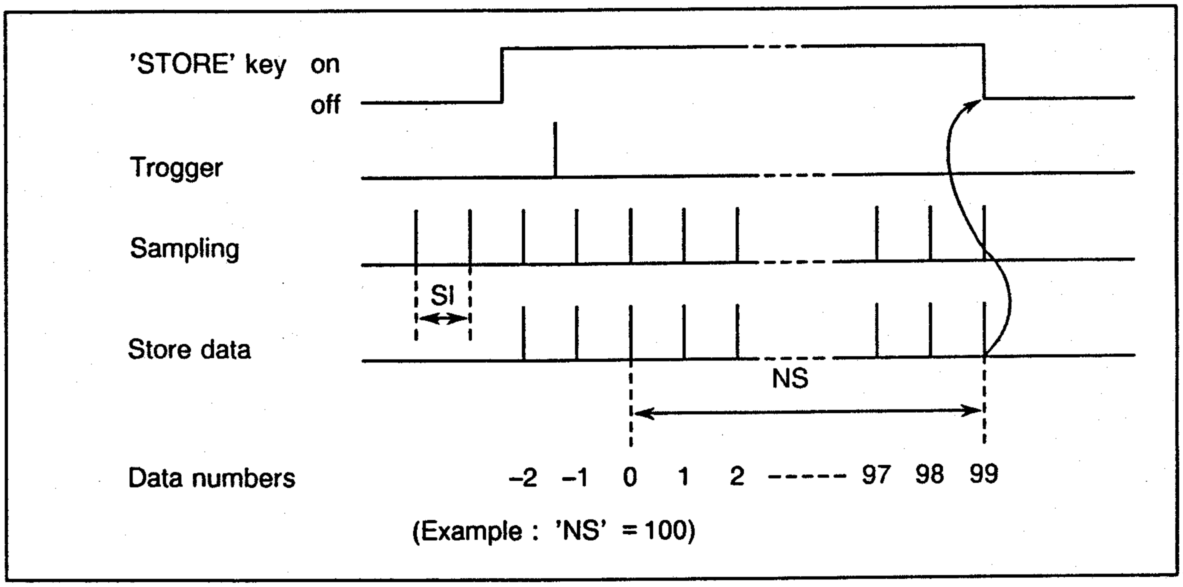
ⓒ Data storage terminates immediately if the STORE ▭ key is turned off.

ⓓ Data in the section, STORE ▭ , disappears next time the STORE ▭ key lamp turns on.

ⓔ If the total number of data samplings has exceeded 1000, then the excess amount of data disappears starting with the oldest data first.

ⓕ Data is stored at the interval that has been set using the 'SI' parameter.

② If trigger signals are input



(Example : 'NS' = 100)

(Description)

ⓐ In the RUN mode, data can be stored at any time while the STORE key lamp stays on.

ⓑ If trigger signal inputs are present, the first data that stored when the trigger signal has been input is numbered "0".

ⓒ Data storage terminates immediately if the STORE key is turned off.

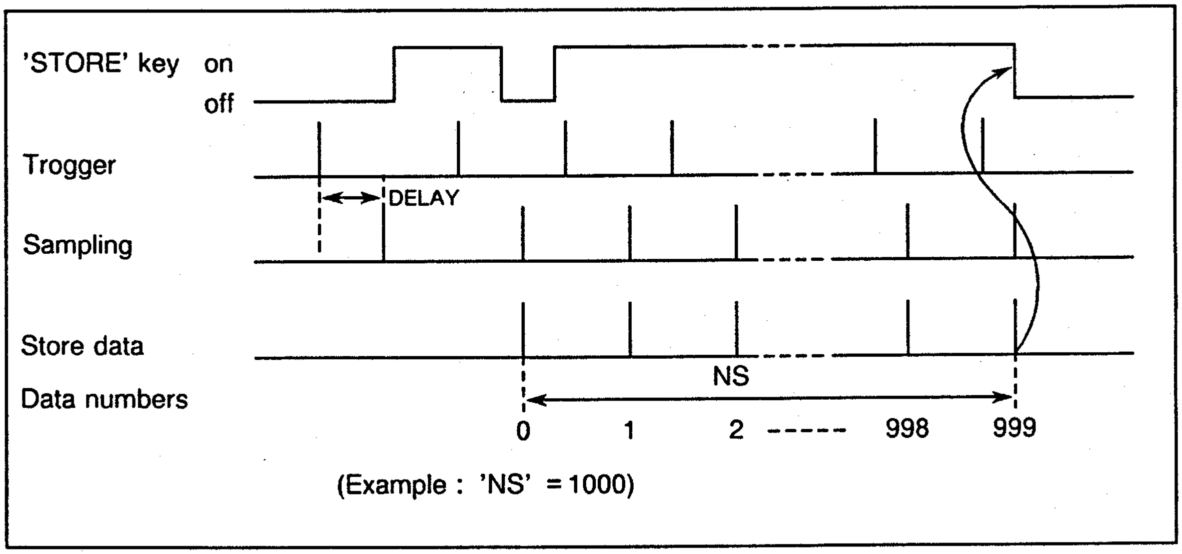
ⓓ The STORE key lamp automatically turns off when the number of data samplings that has been set using the 'NS' parameter is stored into the data memory following input of the trigger signal.

ⓔ Data is stored at the interval that has been set using the 'SI' parameter.

[Applications]

This mode can be applied when it is desired that during data storage into the data memory, trigger signals be automatically input at the time of the occurrence of a storage error in order to make an error-cause check from the data existing before and after the error (that is, the data immediately preceding and succeeding the one numbered 0).

(6) Sampling mode : SINGLE



(Example : 'NS' = 1000)

(Description)

ⓐ If the STORE key lamp is on, input of a trigger signal causes data firstly to be sampled after the trigger delay time that has been set using the 'DELAY' parameter has elapsed an then to be stored into the data memory.

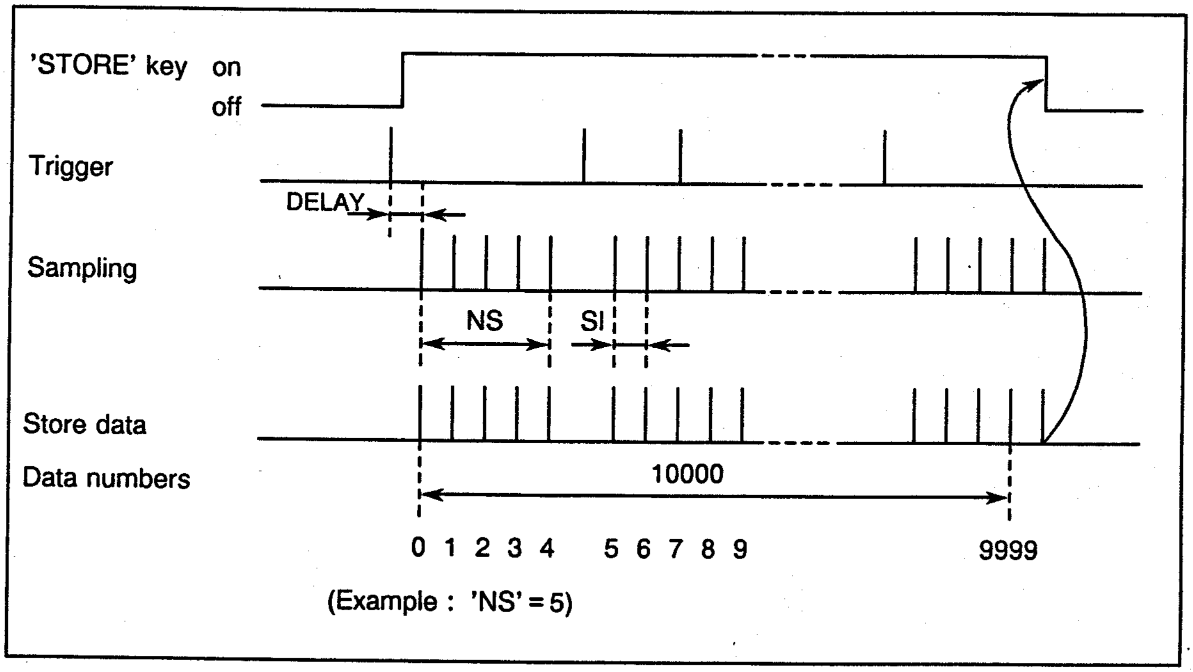
ⓑ One data sampling is stored by one trigger signal input.

ⓒ The STORE key lamp automatically turns off when trigger signals as many as there have been data samplings set using the 'NS' parameter are input and the corresponding volume of data is stored.

ⓓ Data storage terminate immediately if the STORE key is turned.

ⓔ The data storage internal is the same as the trigger signal input interval.
If the next trigger signal is input before the end of sampling, that signal will be ignored.

(7) Sampling mode: MULTI



(Example : 'NS' = 5)

(Description)

ⓐ If the STORE key lamp is on, input of a trigger causes data firstly to be sampled after the trigger delay time that has been set using the 'DELAY' parameter has elapsed and then to be stored into the data memory.

ⓑ The number of data sampling that has been set using the 'NS' parameter are stored by one trigger signal input.

ⓒ Data storage terminates immediately if the STORE key is turned off.

ⓓ Data is stored at the interval that has been set using the 'SI' parameter.

ⓔ The STORE key lamp automatically turns off when up to a maximum of 10000 data samplings are stored into the data memory.

If the next trigger signals is input before completion of sampling of the number of data sets that has been set using the 'NS' parameter is completed, that signal will be ignored.

3.2.3 Methods of Reading Out Data from the Data Memory

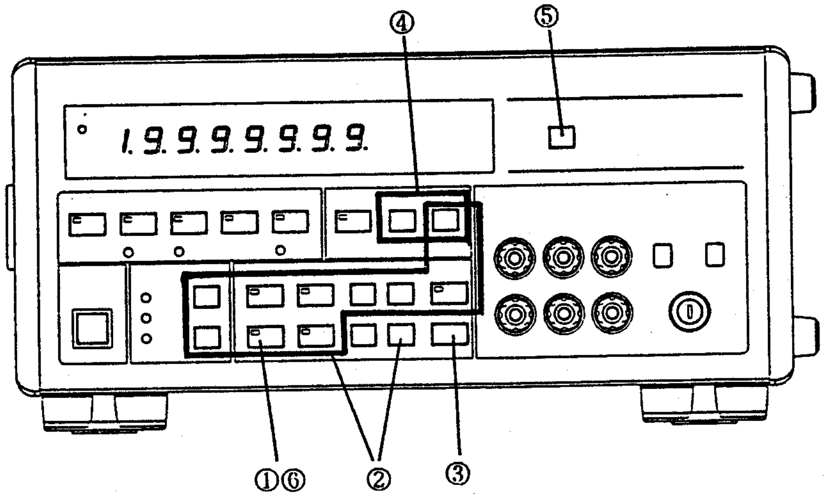
(1) Types of data readout modes available

Either the stepped output mode or the continuous output mode is available for reading out data from the data memory.

In the stepped output mode, the desired number of data samplings can be read out, one at a time, from the data memory.

In the continuous output mode, the desired number of data samplings can be read out continuously from the data memory.

(2) Data output in the stepped output mode



These numbers indicate the following procedure numbers

Setting of the recall mode

(1) Press the RECALL key.

The RECALL key lamp will light the recall mode that allows data reading from the data memory will be set, and the existing number of data samplings stored within the data memory will be displayed on the LCD unit.

n n n n n M R

nnnn: Number of stored data samplings (Integer from 1 to 10000)

Setting of the data number and display of the desired data

(2) Input the data number of the desired data.

(Example)
To input 23, press SHIFT 2 3, in this order.

2 3 N O

↑
Data number

Data number : –9999 to 9999

CAUTION

Be sure to press SHIFT before setting values (data number and the number of data sampling to be output.)

(3) Press the ENTER key.

The data that has the input data number will then be displayed on the LCD unit.

Stepped output of data

(4)

ⓐ If data that is larger by one data a number than that currently being displayed is to be displayed :

Press UP ☐ just once.

Every keystroke of UP ☐ causes display of the data that is larger by one data number than that being displayed at that time.

ⓑ If data that is smaller by one data number than that currently being displayed is to be displayed :

Press DOWN ☐ just once.

Every keystroke of DOWN ☐ causes display of the data that is smaller by one data number than that being displayed at that time.

End of the stepped output mode

(5) Press HO☐ .

The LCD display will then return to the state exiting when the recall mode was set, that is, the display of the existing number of data samplings stored within the data memory.

The HO☐ key functions as the HOME key while the recall mode remains set.

[Selection between data number display and data display]

While data stays on the display, press CHANGE ☐ if it is desired to know the data number of the displayed data or if is desired to change the data number display state over to the data display state.

Every keystroke of CHANGE ☐ causes the LCD display to alternate between data number display and data display.

[If data that is greatly different in data number is to be read out]

Readout of data that is greatly different in data number takes time if UP ☐ or DOWN ☐ are used. In such a case, therefore, first press HO☐ just once (this causes the display procedural step (1) above to reappear) and then set the desired data number and read out the data.

End of the recall mode

(5) Press RECELL ☐ .
The recall mode will end and the RECELL ☐ key lamp will go out.

[An example of operations in the stepped output mode]

An outline of the operation example given below :

ⓐ The method that has been described in the section of the sampling mode SINGLE is taken as an example.

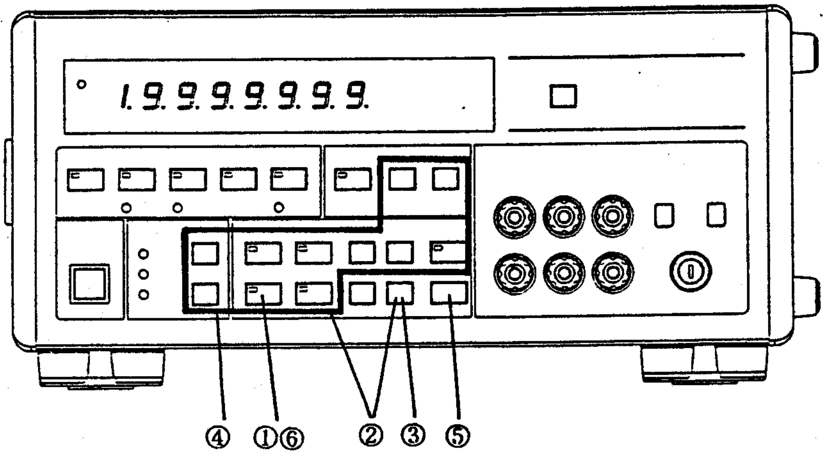
ⓑ The number of data samplings that have been stored is 1000.

Key input and data display	Explanation
① Press RECALL ☐. 1000MR	The equipment enters the recall mode, and the total number of data samplings that have been stored is displayed on the LCD unit.
② Press SHIFT ☐. NO	The data number input mode is set.
③ Press keys 1 ☐ 0 ☐ 0 ☐ ENTER ☐, in that order. 17.89001 V	Data that has data number "100" is read out.
④ Press UP ☐. 17.89000 V	Data that has data number "101" ("100" plus "1") is displayed.
⑤ Press UP ☐. 17.89999 V	Data that has data number "102" ("101" plus "1") is displayed.
⑥ Press CHANGE ☐. 102NO	The display changes from data display over to data number display.

Key input and data display	Explanation
⑦ Press DOWN ☐ DOWN ☐. **100NO**	Data that has data number "100" ("102" minus "2") is read out once again.
⑧ Press UP ☐. **17.89001 V**	The display changes from data number display over to data display.
⑨ Press HO☐. **1000MR**	The display state existing when the recall mode was set is resumed.
⑩ Press SHIFT ☐. **NO**	The data number input mode is set.
⑪ Press keys 1☐ 0☐ 0☐ 0☐ ENTER ☐, in that order. **Error 8**	Although an attempt has been made to read out data that has data number "1000", the data does not exist and thus an error message is displayed.
⑫ Press SHIFT ☐. **NO**	The data number input mode is set.

Key input and data display	Explanation
⑬ Press keys 9 9 9 ENTER , in that order. 17.89010 V	Data that has data number "999" is read out.
⑭ Press UP . Error 8	Although an attempt has been made to read out data that has data number "1000" ("999" plus "1"), the data does not exist and thus an error message is displayed. At this time, data number "999" stays on the display.
⑮ Press DOWN . 17.89009 V	Data that has data number "998" ("999" minus "1") is read out.
⑯ Press RECALL .	The recall mode ends.

(3) Data output in the continuous output mode



[These numbers indicate the following procedure numbers]

Setting of the recall mode

(1) Press the RECALL ☐ key.

The RECALL ☐ key lamp will light, the recall mode that allows data reading from the data memory will be set, and the existing number of data samplings stored within the data memory will be displayed on the LCD unit.

nnnnnMR

nnnn: number of stored data samplings (Integer from 1 to 10000)

Setting of the data number

(2) Input the data number of the desired data.

(Example)
To input 35, press SHIFT ☐ 3☐ 5☐, in this order.

35NO

↑
Data number

Data number : -9999 to 9999

CAUTION

Be sure to press $\overset{\text{SHIFT}}{\boxed{}}$ before setting values (data number and the number of data samplings to be output).

(3) Press $\overset{\text{SHIFT}}{\boxed{}}$ to set the desired number of data samplings to be read out.

Setting of the number of data samplings to be read out

(4) Set the desired number of data samplings to be read out.
This value must be input with either a plus or a minus sign preceding the value.
If a plus value is input, data will be read out starting sequentially with the input data number through subsequent ones.
If a minus value is input, data will be read out starting sequentially from the input data number to preceding ones.

(Example)
To read out 10 data samplings from data number 20 through 29 in that order, input data number 20 in procedural step (2) and then set 10 (or +10) as the number of data samplings to be read out.

1 0 N S

(Example)
To read out 10 data samplings from data number 20 back to 11 in that order, input data number 20 in procedural step (2) and then set -10 as the number of data samplings to be read out.

– 1 0 N S

Data readout

(5) Press ENTER .

The specified number of data samplings will then be read out starting sequentially with the input data number first.
After completion of readout of the specified range of data, the display state becomes that which existed in procedural step (1) above.

End of the recall mode

(5) Press RECALL .

The recall mode will end and the RECALL key lamp will go out.

[An example of operations in the continuous output mode]

An outline of the operation example given below :

ⓐ The method that has been described in the section of the sampling mode RUN is taken as an example.

ⓑ The 'NS' parameter has been set to 10 and trigger signals are have been input during storage.

ⓒ The number of data samplings that have been stored is 103.

Key input and data display	Explanation
① Press RECALL ☐ 1 0 3 M R	The R6871E/E-DC enters the recall mode, and the total number of data samplings that have been stored is displayed on the LCD unit.
② Press SHIFT ☐. N O	The data number input mode is set.
③ Press keys -☐ 2☐, in that order. – 2 N O	Data number "–2" is set.
④ Press SHIFT ☐. N S	The display state changes from data number display to display of the number of data samplings to be read NS out. This allows setting of the number of data samplings to be read out.
⑤ Press keys 1☐ 0☐ ENTER ☐, in that order. 1 2 3. 4 5 6 K Ω ⋮ 1 2 3. 4 5 0 K Ω 1 0 3 M R	The total number of data samplings to be read out is set to 10 and the readout operation begins. Ten data samplings starting with data number "–2" (that is "–2", "–1", "0", "1", "2", - - - -, in that order) are read out continuously. [Two data samplings (data number -2 and -1) existing before a trigger was input and eight data samplings (data number 0 through 7) existing after the trigger was input are read out continuously.] After complete of readout, the display state existing when the recall mode was entered (that is, the display of 103 as the total stored number of data samplings) will be resumed.

Key input and data display	Explanation
⑥ Press SHIFT ☐. NO	The data number input mode is set.
⑦ Press 9☐. 9NO	Data number "9" is set.
⑧ Press SHIFT ☐. NS	The display state changes from data number display over to display of the number of data samplings to be read out. This allows setting of the number of data samplings to be read out.
⑨ Press keys -☐ 1☐ 0☐ 3☐ ENTER ☐, in that order. -103NS 123.450 KΩ ⋮ 123.457 KΩ	The total number of data samplings to be read out is set to -103 and the readout operation begins. 103 data samplings starting with data number (that is, "9", "8", "6", "5", - - -, in that order) are read out continuously. [10 data samplings (data number 9, 8, 7, - - -) existing after a trigger was input and 93 data samplings (data number -1, -2, - - -, up to -93) existing before the trigger was input are read out continuously.]
103MR	After completion of readout, the display state existing when the recall mode was entered (that is, the display of 103 as the total stored number of data samplings) will be resumed.

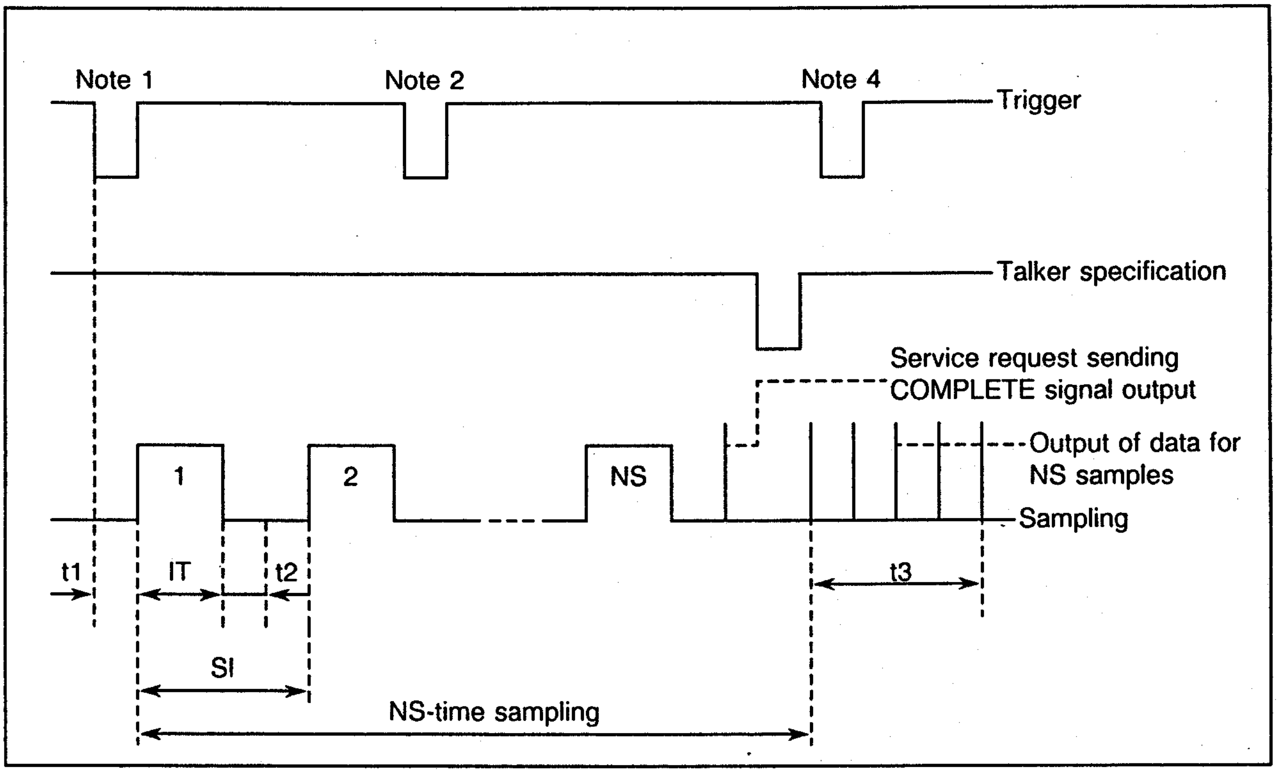
Key input and data display	Explanation
⑩ Press RECALL ☐ .	The recall mode terminates.

4. MULTI-SAMPLING BULK OUTPUT

Multi-sampling bulk output is the sampling mode selectable only in the GPIB system.

4.1 Measurement Operation in MULTI BULK Sampling Mode

When the trigger signal is input, sampling is performed NS times at intervals of SI. The BUSY lamp is lit during this sampling. After sampling is performed NS times, the sampling complete and data output ready service request is sent in the "SO"mode. At the same time, the COMPLETE signal is output. When data output is requested, all measurement data for NS samples are output to the GPIB at a time.



- DELAY : Fixed to 0 ms
- IT : Integral time
- SI : Sampling interval
- A CAL : Fixed to OFF
- A ZERO : OFF
- t1 : Internal delay time between reception of trigger signal and start of measurement
- t2 : 2ms (internal processing time)
- t3 : Hand shake time

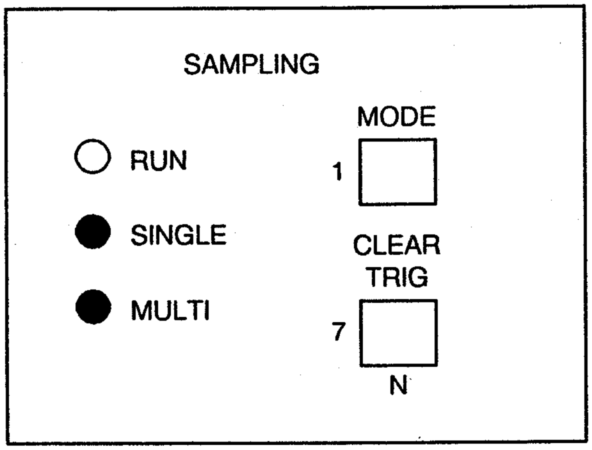
CAUTION

1. The trigger signal can be input from the GPIB and trigger signal input terminal.
2. The trigger signal sent during NS sample measurement is ignored.
3. The trigger signal sent from the trigger signal input terminal during the following processing is ignored:
    - "AC" A CAL Execution
    - "TE" TEST Execution
    - "LFd" LINE Althernation
    - "ITd" IT Alternation
    - "AZ1" A ZERO ON Alternation
    - "Fd" FUNCTION Alternation
    - "Rd" RANGE Alternation
    - "NL1" NULL ON Alternation
    - "ABd" SLOW Alternation
4. Upon reception of the trigger signal during data output, NS-time sampling measurement is started, and further data output is performed in an idle time.
   The second and following trigger signals during data output are ignored.

4.2 MULTI BULK Sampling Mode Setting

To set the MULTI BULK sampling mode, specify "M3" from the GPIB. Program code "M3" should be set independently.

When the MULTI BULK sampling mode is set, the SINGLE and MULTI lamps come on. At the same time, the data in the previous sampling mode is cleared and blanks are displayed on the display unit.



When the MULTI BULK sampling mode is set, the following parameters are automatically set.

- D OUT : Mode 0
- A CAL : OFF
- AUTO : OFF
- DELAY : 0 ms
- NS : 1 to 1000
- STORE : OFF
- RECALL : OFF
- SMOOTH : OFF
- COMPUTE : OFF

CAUTION

1. When the MULTI BULK mode is set, the A CAL parameter is set to OFF. To execute automatic calibration, instruct it with code "AC".
2. In the MULTI BULK mode, NS is changed to 1000 if NS is larger than 1000.

4.3 Parameter Setting in MULTI BULK Sampling Mode

The parameters automatically set for the MULTI BULK mode shown in section 4.2 cannot be changed while the MULTI BULK mode is set except for the NS parameter.

In the MULTI BULK mode, the set range and conditions of the following parameters are changed.

- IT : 6.666 or 8.333ms can be specified for the integral time. Specify "ITdd" from the GPIB.

"IT9"	Integral time: 6.666ms, Number of digits displayed: Equivalent to 6 1/2 digits
"IT10"	Integral time: 8.333ms, Number of digits displayed: Equivalent to 6 1/2 digits

  If the integral time is set to 6.666ms or 8.333ms and the sampling mode is set to other than the MULTI BULK mode, the IT parameter is automatically changed to 10ms.

- SI : The sampling interval can be set at intervals of 0.5ms. Specify "SId..d.d" from the GPIB to set the sampling interval. If the SI parameter is set at intervals of 0.5ms and the sampling mode is set to other than the MULTI BULK mode, the SI parameter is automatically set by discarding the values with fractions (0.5ms).

If the measurement conditions are changed in the MULTI BULK mode after completion of NS-time measurement and generation of outputtable data, the data of the measurement under the previous conditions is cleared. If the measurement conditions are changed during NS-time measurement, however, the data of the measurement under the previous conditions is not cleared.

4.4 End of MULTI BULK Sampling Mode

To change the sampling mode from the MULTI BULK mode to other mode, specify "Md" or press the MODE key. Then, the measurement data in the MULTI BULK mode is cleared.

4.5 Initialization for MULTI BULK Sampling Mode

Pay attention to the following points concerning the initialization for the MULTI BULK sampling mode.

- If the power is turned ON or program code "C" is instructed, the sampling mode is not initialized.
- If the parameters are initialized or program code "Z" is instructed, the sampling mode is initialized to RUN.

4.6 Output in MULTI BULK Sampling Mode

In the MULTI BULK sampling mode, the measurement data is output only to the GPIB. The measurement data is not output to the display. In response to the data output request from the GPIB, the measurement data of NS samples is output to the GPIB alogether.

The output format for the MULTI BULK sampling mode is as follows:

```
E±dd  SL  DATA(1)  DATA(2) ---------  DATA(NS)  DL
 ①    ②     ③                           ③       ④
```

				Number of bytes
①	Exponent	:	4 bytes (ASCII)	4
②	String delimiter	:	CR + LF	2
③	Data	:	4 bytes (binary) * NS	4 * NS
④	Block delimiter	:	CR + LF (EOI)/LF/(EOI)	0 to 2

CAUTION

1. Specify CR + LF in "SL2" for the string delimiter. If other one is specified, the operation will be stopped upon a string delimiter output.
2. If measurement data overflow occurs, the data is output as follows:
   Data overflow in + : 99999999
   Data overflow in - : -99999999

4.7 Program Examples

(1) HP version program example

```
10    !
20    !
30    !
40    DIM Head$[10]
50    INTEGER Tq,Cnt,Ccnt
60    REAL Y(1000),X,Z
70    Tq=701
80    Cnt=10
90    Ccnt=Cnt*2-1
100   ALLOCATE INTEGER Dbuf(Ccnt)
110   !
120   ON INTR 7 GOSUB Srq
130   OUTPUT Tq;"DL2,SL2,CS,S0,MS174,AZ0"
140   OUTPUT Tq;"NS",Cnt
150   OUTPUT Tq;"M3"
160   !
170   OUTPUT Tq;"IT3,SI50"
180   ENABLE INTR 7;2
190   !
200   OUTPUT Tq;"E"
210   Wait_f=0
220   IF Wait_f=1 THEN 200
230   GOTO 220
240   !
250 Srq:STATUS 7,1;X
260   S=SPOLL(Tq)
270   IF S<>81 THEN 390
280   ENTER Tq;Head$
290   PRINT Head$
300   ENTER Tq USING "#,W";Dbuf(*)
310   FOR I=0 TO Cnt-1
320     X=Dbuf(2*I)*2^16
330     Z=Dbuf(2*I+1)
340     IF Z<0 THEN Z=Z+65536
350     Y(I)=Z+X
360     PRINT Y(I)
370   NEXT I
380   Wait_f=1
390   ENABLE INTR 7;2
400   RETURN
410   !
420   DEALLOCATE Dbuf(*)
430   END
```

(Output data)

```
E-07
 9. 98262E+6
 9. 98262E+6
 9. 98262E+6
 9. 98262E+6
 9. 98261E+6
 9. 98261E+6
 9. 98262E+6
 9. 98262E+6
 9. 98262E+6
 9. 98261E+6
```

Description	
10	!
20	!
30	!
40	Defines the header data area.
50	Defines the variable name.
60	Defines the data area.
70	Sets R6871E's address to variable "Tq".
80	Substitutes the number of sampling times to the variable.
90	Calculates the area for binary data from the number of sampling times.
100	Allocates the memory area for binary data.
110	!
120	Defines the interrupt processing routine.
130	"DL1" : Block delimiter: EOI "SL2" : String delimiter: CRLF "CS" : Clears the status bytes. "SO" : SRQ send ON "MS174" : Masks the status bytes. "AZO" : Sets the automatic zero calibration to OFF.
140	"NS10" : The number of sampling times: 10
150	"M3" : Sampling mode: MULTI BULK
160	!
170	"IT3" : Integral time: 1PLC "SI50" : Sampling interval: 50ms
180	Permission of SRQ receiving
190	!
200	"E" : Trigger
210	Substitutes 0 to the flag (Wait__ f).
220	Branches to 200 if the flag (Wait__ f) is set to 1.

	Description
230	Branches to 220.
240	!
250	Interrupt processing routine name : Polling to read the status.
260	
270	Branches to 390 otherwise the status byte is 81.
280	Reception of the header data.
290	Display of the header data.
300	Reads the binary data.
310	Loops for 10 sampling data.
320	Calculates the highest 2 bytes.
330	Calculates the lowest 2 bytes.
340	Converts the negative value to the positive value.
350	Substitutes the data to the buffer.
360	Displays the data.
370	Loop.
380	Substitutes 1 to the flag (Wait__ f).
390	Permission of SRQ receiving
400	RETURN
410	!
420	Release the binary data memory area.
430	End of the program.

(2) PC version program example

```
10    '***************************************************
20    '       MULTI SAMPLING BULK OUTPUT
30    '
40    '       SAMPLING MODE : MULTI BULK
50    '***************************************************
60    '
70    DIM HEAD$(10), Y(1000)
80    NS=10
90    UNL=&H3F : UNT=&H5F : MTA=&H40 : MLA=&H20
100   A71=1    : APC=IEEE(1) AND &H1F
110   TLK=MTA+A71 : LSN=MLA+APC
120   CMD DELIM=0
130   ISET IFC : ISET REN
140   POLL A71,S
150   GOSUB *CLRSRQ
160   ON SRQ GOSUB *SRQINT
170   '
180   GOSUB *SETPARA
190   SRQ ON
200   '
210   NS.END=0
220   PRINT @A71;"E"
230   WHILE NS.END=0 : WEND
240   GOTO 210
250   END
260   '
270   *SETPARA
280     PRINT @A71;"DL2,SL2,CS,SO,MS172,AZO"
290     PRINT @71;"M3"
300   '
310     PRINT @71;"IT3,SI50,"+"NS"+STR$(NS)
320     RETURN
330   '
340   *SRQINT
350     POLL A71,S
360     IF S <>81 THEN 490
370     INPUT @A71;HEAD$ : PRINT HEAD$
380     WBYTE UNL,TLK,LSN;
390     FOR I=0 TO NS-1
400       RBYTE;Y1
410       RBYTE;Y2
420       RBYTE;Y3
430       RBYTE;Y4
440       YY1=Y1*2^8+Y2 : YY2=Y3*2^8+Y4
450       IF 2^15<=YY1 THEN YY1=YY1-2^16
```

(cont'd)

```
460      Y(I)=YY1*2^16+YY2 : PRINT Y(I)
470    NEXT I
480    NS.END=1
490    SRQ ON
500    RETURN
510  '
520  *CLRSRQ
530    DEF SEG=&H60
540    A%=PEEK(&H9F3)
550    A%=A% AND &HBF
560    POKE &H9F3,A%
570    RETURN
580  '
```

	Description
60	'
70	Defines the data area.
80	Substitutes 10, the number of sampling times to variable "NS".
90	Allocates the interface message code to the variable.
100	Substitutes R6871E's address and controller's address to variable "A71" and variable "APC" respectively.
110	Substitutes the talker address and listener address to each variable.
120	Specifies CR + LF for the delimiter.
130	Interface clear remote enable.
140	Serial polling.
150	Clears the SRQ signal in the GPIB of the PC9801.
160	Specifies the heading address for the SRQ subroutine.
170	'
180	Set each parameter for R6871E.
190	Permission of SRQ receiving.
200	'
210	Clears the interrupt processing completion flag.

Description	
220	"E": Trigger.
230	Loop until the interrupt processing is completed.
240	Branches to 210 for performing sampling NS times.
250	Completes program execution.
260	'
270-320	Sets each parameter for R6871E.
280	"DL2" : Plotter delimiter (EOI) "SL2" : String delimiter : CR, LF "CS" : Clears the status bytes "SO" : SRQ sending : ON "MS172" : Masks the status bytes excluding bits 0, 1, 4 and 6. "AZO" : Automatic zero calibration : OFF
290	"M3" : Sampling mode : MULTI BULK
300	'
310	"IT3" : Integral time : 1PLC "SI50" : Sampling interval : 50ms "NS10" : Number of sampling times : 10
320	RETURN
330	'
340-500	Interrupt processing routine.
350	Serial polling.
360	Branched to 490 if no service request is output after sampling is completed specified times.
370	Receives and displays the specified data.
380	Set this unit as the talker and the controller as the listener.
390-470	Loop by the specified number of sampling times.
400-430	Read the data by one byte from higher bytes. (4 bytes for one block of data)
440	Calculates the highest 2 bytes and lowest 2 bytes.
450	Generates the negative value.
460	Substitutes the data to the buffer and displays.

Description	
470	Counter +1, Loops back to 390.
480	Sets the interrupt processing completion flag.
490	Permission of SRQ receiving.
500	RETURN
510	'
520-570	Clears the SRQ signal in the GPIB of PC9801.
580	'

MEMO

5. GPIB INTERFACE

5.1 General

The R6871E/E-DC is equipped with the GPIB interface in standard configuration, allowing connection with the IEEE standard 488-1978 measurement bus GPIB.

The standard and functions of the GPIB interface are described here in this chapter.

5.2 Outline of the GPIB

The GPIB is an interface system that can connect the measuring device with the controller and peripheral devices with a simple cable (bus line).

Compared with conventional interfaces, the GPIB is superior in its expandability, easy to use, and has electrical as well as mechanical and functional compatibility with products of other manufacturers. A single bus cable can structure simple to high function automatic measuring systems.

In the GPIB system, the "address" of the various devices connected to the bus line must first be set. These devices can act as the controller, the talker, and/or the listener.

During system operation, a single "talker" can send data to the bus line, but multiple "listener" can receive the data.

The controller specifies the address of the "talker" and the"listener", to transmit data form the "talker" to the "listener" or the controller itself ("talker") can set measurement conditions to the "listener".

8 data lines of bit parallel, byte serial form are used for data transmission between each device, and transmission is done to both direction asynchronously. As the system is an asynchronous system, high-speed devices and low-speed devices can freely be mixed and connected together.

The data (message) transmitted and received between the devices includes measurement data, measurement conditions (program), or various commands. The data is expressed in ASCII codes.

Besides the above 8 data lines, the GPIB has 3 hand-shake lines to control asynchronous data exchange between devices as well as 5 control lines to control the information flow on the bus.

- The hand-shake line uses the following signals.

  DAV (data valid) : A symbol that indicates whether the data is effective.
  NRFD (not ready for data) : A symbol that indicates the data reception ready status.
  NDAC (data not accepted) : A symbol that indicates end of reception.

- The following signals are used in the control line.

  ATN (attention) : A signal used to distinguish whether the signal on the data line is address, command, or other information.

IFC (interface clear) : A signal used to clear the interface.

EOI (end or identify) : A signal used to end transmission of information.

SRQ (service request) : A signal used to request service from an optional device to the controller.

REN (remote enable) : A signal used for remote control of remote-programmable devices

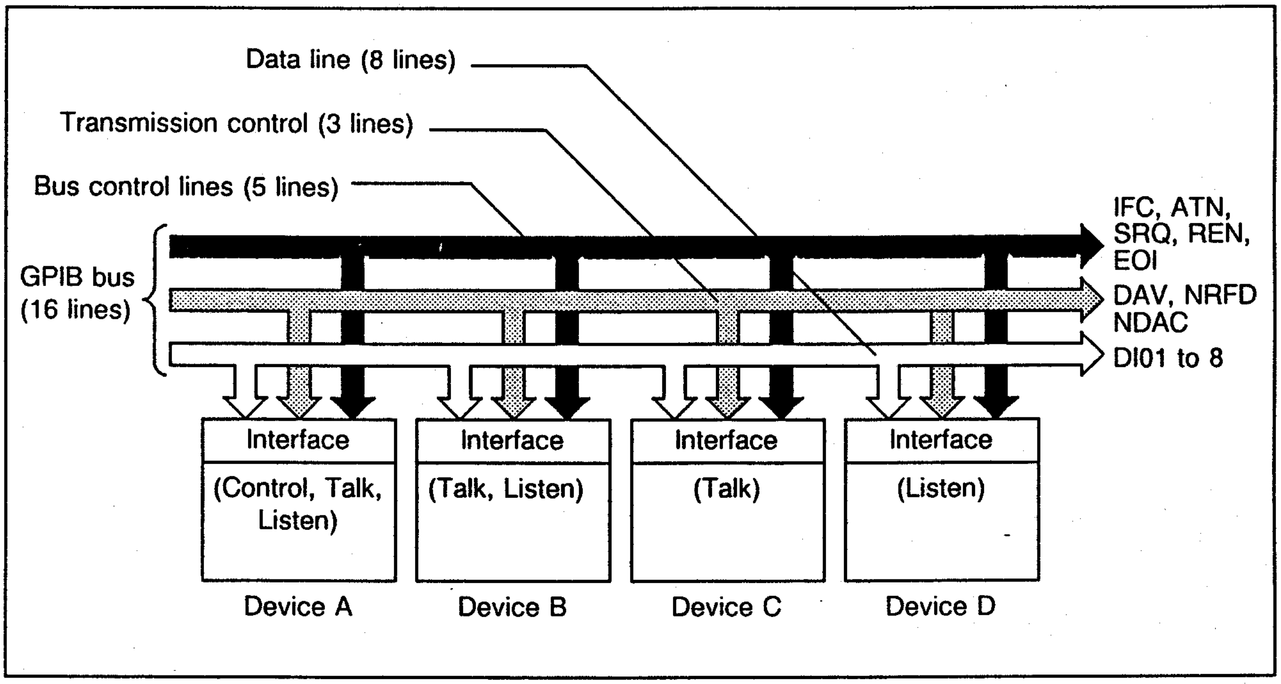


Figure 5-1 GPIB

5.3 Specification of the GPIB

Standard : IEEE standard 488-1978
Used code : ASCII code
Logical level : Logical 0 "High" state : +2.4V or more
Logical 1 "Low" state : +0.4V or less
Signal line termination : The 16 bus lines are terminated as shown below.

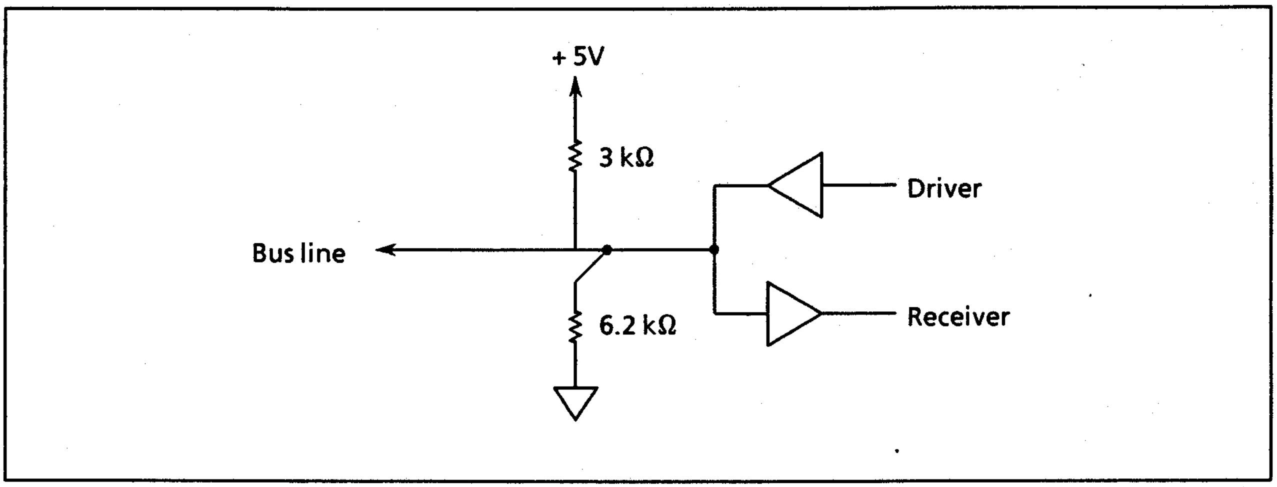


Figure 5-2 Termination of Signal Lines

Driver specification : Try state system
"Low" status output voltage : +0.4V or less 4.8mA
"High" status output voltage : +2.4V or more −5.2mA

Receiver specifications : "Low" status with +0.6V or less "High" status with +2.0V or more

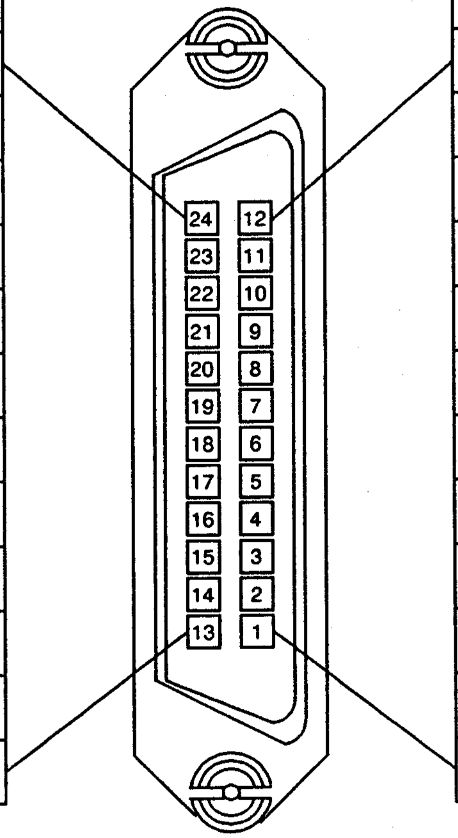
Bus cable length : Total length of bus cable is (devices connected to the bus) × 2m or less, and must not exceed 20m.

Address designation : By selecting the GPIB key on the front panel, 31 kinds of talk address/listen address can be optionally set.

Connector : 24-pin GPIB connector 57FE-20240-20SD35 (Daiichi Denshi Kogyo's product or equivalent)

24-pin GPIB connector

Signal 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

Interface functions : See Table 5-1.

Table 5-1 Interface Functions

Code	Function and description
SH1	Source hand-shake function
AH1	Acceptor hand-shake function
T5	Basic talker function, serial pole function, talk only mode function, talker reset function by listener designation
L4	Basic listener function, listener reset function by talker designation
SR1	Service request function
RL1	Remote/local switching function
PP0	No parallel function
DC1	Device-clear function ("SDC", "DCL" commands can be used)
DT1	Device trigger function ("GET" command can be used)
C0	No controller function
E2	3-state bus driver is used

5.4 How to Handle the GPIB

5.4.1 Connection with the System Devices

The GPIB system is structured by multiple devices, and preparation of the entire system must be done taking care of the following points.

(1) Refer to the instruction manuals of the R6871E/E-DC, controller and peripheral devices, to check the status and operation of each devices, before connection.

(2) Be careful not to leave the connection cable with the measuring device and the bus cables connected to the controller, etc. unnecessarily long. The bus cable length must not exceed the standard. The length of all bus cables must be kept (number of devices connected to the bus) × 2m or less, and must not exceed 20m.

We also offer the following standard bus cables.

Table 5-2 Standard Bus Cable (Option)

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

(3) When connecting the bus cable, be careful not to connect 3 or more connectors. Also tighten the connector firmly with the fix-screws.
The bus cable connector are piggy-back type with both male and female on a single connector, and can be connected together.

(4) Check the electrical conditions, grounding state, or if necessary, the setting conditions of each system device before supplying power to each system device.
The power of all devices connected to the bus must be turned ON. If there is a single device which power is not supplied, the operation of the entire system cannot be assured.

(5) Before fitting or removing the bus cable, always remove the power cable out of the wall outlet.

5.4.2 Preparation for Operation

The following preparation must be done before measurement from the GPIB.

(1) Connect the object of measurement to the R6871E/E-DC.

(2) Check the following three points by the GPIB key on the front panel.

  (a) Device address (0 to 30)

  (b) The R6871E/E-DC address mode (Addressible/Talk only)

  (c) Format mode when outputting measurement data (Header ON/OFF)

(3) If other panel setting is required, set as necessary.

*1 Refer to 2.8 for how to set.

*2 On device address
There are also controllers in which addresses 0 to 30 as well as the corresponding ASCII code must be written.
Refer to the following Table 5-3 for the corresponding ASCII codes.

Table 5-3 ASCII Code - Address Code Cross Reference Table

ASCII code character		Decimal codes
LISTEN	TALK	
SP	@	00
!	A	01
”	B	02
#	C	03
$	D	04
%	E	05
&	F	06
’	G	07
(	H	08
)	I	09
*	J	10
+	K	11
,	L	12
-	M	13
.	N	14
/	O	15
0	P	16
1	Q	17
2	R	18
3	S	19
4	T	20
5	U	21
6	V	22
7	W	23
8	X	24
9	Y	25
:	Z	26
;	[	27
<	\	28
=	]	29
>	–	30

5.4.3 General Notes on Operation

(1) Notes on using the only-mode

CAUTION

When using the only-mode, do not use (operate) the controller at the same time.
When the controller is used under the only-mode, normal operation cannot be guaranteed.

(a) Refer to 2.8 for how to set the only-mode.

(b) Also set the address mode of the other device connected via the bus line to only-mode.

(2) Notes on changing the address setting during operation
When the address of the main device is changed during operation, operation can be continued, but in case the old address is specified from the controller, it will be ignored.

(3) The status of this device is as shown in the following Table 5-4 when power is supplied or when various commands are received.

(4) In case "ATN" interrupts message transmission between devices, the "ATN" is granted priority, and the previous state will be cleared.

Table 5-4 Interface Functions

Command Code	Talker (with lamp)	Listener (with lamp)	Remote (with lamp)	SRQ (with lamp)	Status byte	Transmission data
POWER ON	Clear	Clear	Local	Clear	Clear	Clear
IFC	Clear	Clear	—	—	—	—
"DCL", "SDC" command	Clear	—	—	Clear	Clear	Clear
"C"*, "Z"* code	Clear	Set	Remote	Clear	Clear	Clear
"GET" command	Clear	—	—	—	Clear bit b0	Clear
"E"* code	Clear	Set	Remote	—	Clear bit b0	Clear
Talker designation to this device	Set	Clear	—	—	—	—
Talker reset command	Clear	—	—	—	—	—
Listener designation to this device	Clear	Set	—	—	—	—
Listener reset command	—	Clear	—	—	—	—
Serial polling	—	Clear	—	Clear	—	—

(Note) "*" is the program code.

5.5 Talker Format

The talker format can be divided into basic format, data memory output format, statistical operation output format, statistical operation output format and multi-sampling bulk output format.

The output data is output in ASCII code. In the multi-sampling bulk output format, however, the mantissa data is output in binary notation.

Next comes explanation on these formats.

5.5.1 Basic Format

(1) The basic format is expressed in the following form.

XXYZ ± dd.dddddd E ± dd CR/LF(EOI) ...... (1)
① ② ③ ④

① Header
② Mantissa part
③ Exponential part
④ Delimiter

There are 12 types of pattern available for the basic format.

ⓐ XXYZ ± dd.dddE ± ddCR/LF(EOI)
ⓑ XXYZ ± dd.dddE ± ddLF
ⓒ XXYZ ± dd.dddE ± dd(EOI)
ⓓ ± dd.dddE ± ddCR/LF(EOI)
ⓔ ± dd.dddE ± ddLF
ⓕ ± dd.dddE ± dd(EOI)
ⓖ XXYZ ± dd.ddddE ± ddCR/LF(EOI)
ⓗ ± dd.ddddE ± dd(EOI)
ⓘ XXY ± Z dd.dddddE ± ddCR/LF(EOI)
ⓙ ± dd.dddddE ± dd(EOI)
ⓚ XXYZ ± dd.ddddddE ± ddCR/LF(EOI)
ⓛ ± dd.ddddddE ± dd(EOI)

When the above is arranged with headers, measurement digits, delimiters, number of characters (bytes), it becomes as shown in the following table.

Table 5-5 Basic Format

	Header	Measurement digits	Delimiter	Number of characters (bytes)
ⓐ	ON	4 1/2 digits	CR/LF (EOI)	17
ⓑ	ON	4 1/2 digits	LF	16
ⓒ	ON	4 1/2 digits	(EOI)	15
ⓓ	OFF	4 1/2 digits	CR/LF (EOI)	13
ⓔ	OFF	4 1/2 digits	LF	12
ⓔ	OFF	4 1/2 digits	(EOI)	11 (Minimum)
ⓖ	ON	5 1/2 digits	CR/LF (EOI)	18
ⓗ	OFF	5 1/2 digits	(EOI)	12
ⓘ	ON	6 1/2 digits	CR/LF (EOI)	19
ⓙ	OFF	6 1/2 digits	(EOI)	13
ⓚ	ON	7 1/2 digits	CR/LF (EOI)	20 (Maximum)
ⓛ	OFF	7 1/2 digits	(EOI)	14

CAUTION

Both "CR" and "LF" already exist as ASCII codes, so they are both counted as 1 byte. The single line signal "EOI" is transmitted by another signal line, and is not counted as a character (byte).

(2) Description

① Header (4-digit alpha-numerical character or omitted): XXYZ

The header expressed the type of output data. Structure by 2 main header characters (XX) and 2 subheader characters (YZ).
The main header (XX) and subheader (YZ) represents the following.

ⓐ Main header (XX) ..... Type of measurement function

ⓑ Subheader (Y) .... Type of primary operation

ⓒ Subheader (Z) .... Type of secondary operation

The header is omitted when the header mode is set OFF. The types of measurement function, primary operation, and secondary operation of the main and subheaders are given in the following 3 tables.

Table 5-6 Interface Basic Format Header (1/2)

Main header (XX)	Type of output data
DV	DC voltage measurement
AV	AC voltage measurement
	(DC + AC) voltage measurement
DI	DC measurement
AI	AC measurement
	(DC + AC) current measurement
R	Resistance measurement

Subheader (Y)	Type of primary operation, etc.
␣ (Space)	Off
S	Scaling
P	% deviation
D	delta
M	multiply
B	Decibel conversion
R	Real value
W	dBm conversion
T	Resistance value temperature amendment
O	Over-scale data
E	Operation error data

Table 5-6 Interface Basic Format Header (2/2)

Subheader (Z)	Type of secondary operation
␣ (Space)	Off
H	Comparator 1, comparator 2 R(HIGH1), R(HIGH2)
P	Comparator 1, comparator 2 R(PASS)
L	Comparator 1, comparator 2 R(LOW1), R(LOW2)
C	Statistical processing (number of samples)
X	Statistical processing (Maximum value)
N	Statistical processing (Minimum value)
A	Statistical processing (Average)
K	Statistical processing (Inconstant width)
S	Statistical processing (Standard deviation)
Y	Statistical processing (Upper control line)
Z	Statistical processing (Lower control line)

(Example) Actual example of basic format header

DV␣␣ : Direct current voltage measurement data

DVM␣ : Data gained by primary operation processing (multiply) after measurement of the direct current voltage.

R␣TH : Data gained by primary operation processing (resistance value temperature conversion), secondary operation processing (comparator), resulted HIGH after measurement of the resistance.

Note: When comparator 1 or 2 is executed in the second function, header H is output if the result of function is R(HIGH1) or R(HIGH2), or header L is output if the result is R(LOW1) or R(LOW2). When the result of the function of comparator 1 is R(HIGH1) or R(HIGH2), and R(LOW1) or R(LOW2), the header is to be space ' '.

② Mantissa part
(polarity + decimal point + 4 1/2 to 7 1/2 digit number): ± dd.dddddd

The mantissa part of the measured value outputs digits and decimal position corresponding to the display of this device in 7 to 10-byte variable length including polarity and decimal point.
" + " or "-" code is output as polarity for direct current voltage/current and 2-line resistance measurement.
The space code " " is output in other cases.
The mantissa part and exponential part under various measurement conditions are shown in Table 5-7.

③ Exponential part
("E" + polarity + 2-digit numeral) : E ± dd

The exponential part data is decided according to the measurement function and measurement range. This is done to express all measurement data by the basic units (V, A, Ω).
Table 5-7 is the mantissa part and exponential part under various measurement conditions.
The exponential part is related to the unit of the measurement range.
Note the measurement range unit in the table and the numeral of the exponential part. The following relation can be observed.

μA, μV E–06

mA, mV, mΩ E–03

A, V, Ω . . . . E + 00

kΩ . . . . E + 03

MΩ . . . . E + 06

(Example) 2000mV range
When the mantissa part display is 30.0000, it is 30mV. The exponential part of this range is –3, so
$30 \times 10^{-3} = 0.03$ (V)

The above 0.03 is 30mV expressed in the basic unit (V).

Table 5-7 Mantissa and Exponential Parts Under Various Measurement Conditions

Function	Range	Mantissa part	Exponential part
Direct current voltage measurement	200mV	± ddd.dddd	E–03
	2000mV	± dddd.dddd	E–03
	10V, 20V	± dd.dddddd	E + 00
	200V	± ddd.ddddd	E + 00
	1000V	± dddd.dddd	E + 00
Alternative current voltage measurement (Alternating current + Direct current)	200mV	ddd.ddd	E–03
	2000mV	dddd.dd	E–03
	20V	dd.dddd	E + 00
	200V	ddd.ddd	E + 00
	500V	0dd.ddd	E + 00
Direct current voltage measurement	2000μA	± dddd.ddd	E–06
	20mA	± dd.ddddd	E–03
	200mA	± ddd.dddd	E–03
	2000mA	± dddd.ddd	E–03
Alternative current voltage measurement (Alternating current + Direct current)	2000μA	dddd.dd	E–06
	20mA	dd.dddd	E–03
	200mA	ddd.ddd	E–03
	2000mA	dddd.dd	E–03
Resistance measurement (2WΩ)	10Ω	± dd.ddddd	E + 00
	100Ω	± ddd.ddddd	E + 00
	1000Ω	± dddd.dddd	E + 00
	10kΩ	± dd.dddddd	E + 03
	100kΩ	± ddd.ddddd	E + 03
	1000kΩ	± dddd.dddd	E + 03
	10MΩ	± dd.dddddd	E + 06
	100MΩ	± ddd.ddddd	E + 06
	1000MΩ	± dddd.dddd	E + 06
Resistance measurement (4WΩ)	10Ω	dd.ddddd	E + 00
	100Ω	ddd.ddddd	E + 00
	1000Ω	dddd.dddd	E + 00
	10kΩ	dd.dddddd	E + 03
	100kΩ	ddd.ddddd	E + 03
	1000kΩ	dddd.dddd	E + 03
	10MΩ	dd.dddddd	E + 06
	100MΩ	ddd.ddddd	E + 06
	1000MΩ	dddd.dddd	E + 06

d : Numerals from 0 to 9 (Depends on the measurement data)

* The following message is displayed in case of measurement-over.

XXO ±99999.E+19	(4 1/2 digit measurement)
XXO ±999999.E+19	(5 1/2 digit measurement)
XXO ±9999999.E+19	(6 1/2 digit measurement)
XXO ±99999999.E+19	(7 1/2 digit measurement)

* The following message is displayed in case of operation error.

XXE 99999.E+19	(4 1/2 digit measurement)
XXE 999999.E+19	(5 1/2 digit measurement)
XXE 9999999.E+19	(6 1/2 digit measurement)
XXE 99999999.E+19	(7 1/2 digit measurement)

Note: As in the basic format, both the mantissa and exponential parts outputs the digits and decimal position corresponding to the display of this device on execution of operation.
See 5.5.3 for details on the output format of the result of statistical processing operation.

④ Block delimiter

Output to indicate end of one data.
The block delimiter can be selected from the following 3 types, according to the program code "DLd".

(a) Outputs 2-byte data of "CR", "LF". When "LF" is output, the single line signal "EOI" is also output at the same time.

(b) Outputs the 1-byte data of "LF".

(c) Outputs the signal lien signal "EOI" at the same time as the final byte of the data.

CAUTION

Both "CR" and "LF" already exist as ASCII code, so "CR" is counted as 1 byte.
The single line signal "EOI" is sent by another signal line, and is not counted as a character (byte).

5.5.2 Data Memory Output Format

(1) When data stored in data memory is recalled, the following output formats are used.
When batch output of data in data memory is executed:
(program code "BO")

DCNTddddd<u>CR/LF(EOI)</u> .... Output data number
①　(header + five-digit number)
NO ±dddd, XXYZ ± dd.ddddddE ± dd, ... Recall data
②　Data number
(header + polarity + four-digit number)
Content of data
(the same as the basic format)
NO ±dddd, XXYZ ± dd.ddddddE ± dd<u>CR/LF(EOI)</u>
①

When data is output continuously by specified number from specified data No.
(program code "RD ± d..d, ± d..d")

NO ± dddd, XXYZ ± dd.ddddddE ± dd, ... Recall data
②
NO ± dddd,XXYZ ± dd.ddddddE ± dd<u>CR/LF(EOI)</u>
①

When data for specified data No. is output one by one
(program code "RD ± d..d", "RN", "RP")

NO ± dddd, XXYZ ± dd.ddddddE ± dd<u>CR/LF(EOI)</u> ... Recall data
②

(2) Explanation

① Block delimiter : Output to indicate the end of one piece of data.

② String delimiter : Output to indicate the end of one string.

Whether data No. is output or not can be specified by program code "NOd".

5.5.3 Output Format of the Result of Statistical Operation

(1) The following formats are used when the result of statistical operation is output.

```
XXYC  ddddd,                                   Sample number (header + five-digit number)
           ②
XXYX ±ddd.dddddE±dd, ..............  Maximum value (Same as the basic format)
XXYN ±ddd.dddddE±dd, ..............  Minimum value (Same as the basic format)
XXYA ±ddd.dddddE±dd, ..............  Average (Same as the basic format)
XXYK ±ddd.dddddE±dd, ..............  Inconstant width (Same as the basic format)
XXYS ±d.ddd0000E±dd, ..............  Standard deviation (Same as the basic format)
XXYY ±ddd.dddddE±dd, ..............  UCL (Same as the basic format)
XXYZ ±ddd.dddddE±ddCR/LF(EOI)  ......  LCL (Same as the basic format)
                         ①
```

(2) Explanation

① Block delimiter

② String delimiter

When the step output mode is set, the part of string delimiter is changed to the block delimiter.

5.5.4 Output Format for MULTI BULK Sampling Mode

(1) The output format for the MULTI BULK sampling mode is as follows:

E ±d d S L DATA(1) DATA(2) .... DATA(NS) D L
① ② ③ ③ ④

			Number of bytes
① Exponent	:	4 bytes (ASCII)	4
② String delimiter	:	CR + LF	2
③ Data	:	4 bytes (binary) * NS	4 * NS
④ Block delimiter	:	CR + LF (EOI)/LF/(EOI)	0 to 2

CAUTION

1. Specify CR + LF in "SL2" for the string delimiter. If other one is specified, the operation will be stopped upon a string delimiter output.
2. If measurement data over occurs, the data is output as follows:
   Over data in + : 99999999
   Over data in – : –99999999

5.6 Listener Format

Setting the parameters and control of the operation can be done by the controller of this device.

Table 5-8 is the parameters and the corresponding program codes.

Table 5-8 Program Codes

Item	Code	Description
Measurement function	F1 (Initial value)	Direct current voltage measurement (VDC)
	F2	Alternative current voltage measurement (VAC)*1
	F3	2-line resistance measurement (2WΩ)
	F4	4-line resistance measurement (4WΩ), network resistance measurement (NW)*2
	F5	Direct current current measurement (ADC)*1
	F6	Alternative current current measurement (AAC)*1
	F8	(Alternative current + Direct current) Voltage measurement V(AC + DC)*1
	F9	(Alternative current + Direct current) Current measurement A(AC + DC)*1
Measurment rage	Rd d = 0 (Initial value)	d = 0 to 9 See Table 5 - 9.
Sampling mode	M0 (Initial value)	RUN
	M1	SINGLE
	M2	MULTI
	M3	MULTI BULK
Control parameter		Specifies the AC band.
	AB0 (Initial value)	SLOW
	AB1	FAST
	AC	Specifies execution of auto-calibration.
	CI ddd d = 1 (Initial value)	ddd : 0 to 999 Specifies the interval for execution of auto-calibration. The unit is minutes. 0 : off 1 to 999 : Setting can be done in 1-minute interval.
		Specifies whether to include the auto-zero-calibration function.
	AZ0	off
	AZ1 (Initial value)	on

*1 : Only the R6871E is enabled.

*2 : Only the R6871E-OHM is enabled.

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Control parameter		Specifies the buzzer mode.
	BZ0	off
	BZ1	on (When the comparator operation result is HIGH/LOW)
	BZ2	on (When the comparator operation result is PASS)
	CFd1, d2 d1, d2 = 0 (Initial value)	Specifies the operation function. d1 : 0 to 8, primary operation mode 0 : off 1 : scaling 2 : % deviation 3 : Delta (difference between the previous measurement value) 4 : Multiply (multiplication with the previous measurement value) 5 : Decibel conversion 6 : Real value 7 : dBm conversion 8 : Resistance value temperature amendment d2 : 0 to 3, secondary operation mode 0 : off 1 : Comparator 1 (using HIGH/LOW constant) 2 : Comparator 2 (using LIMIT constant) 3 : Statistical processing ● The d2 data cannot be omitted.
		Specifies whether the operation function is executed.
	CO0 (Initial value)	off
	CO1	on

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Control parameter		The data output mode is specified.
	DO0 (Initial value)	The output data is output to the display and GPIB. It can be stored in data memory.
	DO1	The output data is output to the GPIB. It can be stored in data memory.
	DO2	The output data is stored in data memory.
	DO3	The output data is stored in data memory in the maximum speed mode. When the MULTI BULK sampling mode is set, the parameter is initialized to DO0.
		The GPIB output format is specified.
	H0	The header is not added on data output.
	H1 (Initial value)	The header is added on data output.
		Specifies the integral time on A/D measurement.
	IT0	100µs
	IT1	1ms
	IT2	10ms
	IT3	1PLC
	IT4 (Initial value)	5PLC
	IT5	10PLC
	IT6	20PLC
	IT7	50PLC
	IT8	100PLC
	IT9	6.666 ms*
	IT10	8.333 ms*
	KNd..d d = 2 (Initial value)	d..d : 2 to 10000 Specifies the number of statistical processing operation samples.

* : Can be set for the MULTI BULK sampling mode.

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Control parameter	Kn ± d..d E ± d KnMD n = X, Y, Z Initial value X, Z = 1 Y = 0	± d..d : Mantissa data Sign + Numeral of 8 digits or less + decimal point –19999999 to 19999999 E ± d : Exponential data 'E' + Sign + 1-digit numeral E–9 to E + 9 Sets the constant used for operation. ● The decimal point can be omitted. ● When setting the previous measurement value as the constant, use "KnMD" (n = X, Y, Z). ● The exponential data can be omitted.
	HI1 ± d..d E ± d HI2 ± d..d E ± d LO1 ± d..d E ± d LO2 ± d..d E ± d Initial value HI1 = 1	± d..d : Mantissa data Sign + Numeral of 8 digits or less + decimal point –19999999 to 19999999 E ± d : Exponential data 'E' + Sign + 1-digit numeral E–9 to E + 9 Sets the constant used for comparator 1 operation. ● The decimal point can be omitted. ● The exponential data can be omitted.

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Control parameter	HI2 = 1 LO1 = 0 LO2 = 0 L1 ± d..d E ± d d..d, d..d	$\frac{\pm d..dE \pm d}{\text{LIMIT}}, \frac{d..d}{\%1}, \frac{d..d}{\%2}$
	Initial value LIMIT = 1 %1 = 10 %2 = 10	LIMIT : Mantissa data Sign + Numeral of 8 digits or less + decimal point –19999999 to 19999999 Exponential data 'E' + Sign + 1-digit numeral E–9 to E + 9 %1, %2 : 0.000 to 100.0 Decimal point + numeral of 4 digits or less
		The constant used for the operation of comparator 2. The judgment level is set by deviation %(%1, %2) to the reference value (LIMIT). ● The decimal point can be omitted. ● The exponential data of the LIMIT can be omitted. ● The %1, %2 data cannot be omitted.
		Specifies the power frequency used.
	LF50	50Hz
	LF60	60Hz
		Specifies the measurement digits.
	RE4	4 1/2 digits (19999)
	RE5	5 1/2 digits (199999)
	RE6 (Initial value)	6 1/2 digits (1999999)
	RE7	7 1/2 digits (19999999)

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Control parameter	NL0(Initial value) NL1	Specifies whether to execute the NULL function. off on
	SM0 (Initial value) SM1	Specifies whether to execute the smoothing function. off on
	TId..d d = 10 (Initial value)	d : 2 to 100 Specifies the count of smoothing
	SId..d d = 250 (Initial value)	d..d: 0 to 60000 Specifies the measurement interval. The unit is ms. Can be set at intervals of 0.5 ms for the MULTI BULK sampling mode.
	TDd..d d = 0 (Initial value)	d..d: 0 to 60000 Specifies the trigger delay time. The unit is ms. It is initialized to 0 ms when the MULTI BULK sampling mode is set.
	NSd..d d = 1 (Initial value)	d..d: 1 to 10000 Specifies the number of samples for multi-sampling, the constant (number of samples) used when using the data memory function. d..d : 1 to 1000 Specifies the number of samples for the MULTI BULK sampling mode.
	SH0 (Initial value) SH1	Specifies the output mode for result of statistical operation. Step output mode in which output is done data by data (use the "RN" code from the 2nd data and after.) Consecutive output mode which outputs 8 data consecutively

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Control parameter	ST0 (Initial value) ST1	Specifies whether to store the measurement value to the data memory. off on
	Parameters used for recall operation	
	RO0 (Initial value) RO1	Specifies whether to recall data from the data memory. off on
	BO	Commands start of batch output of data stored in the data memory.
	RD ± d..d, ± d..d	Continuously recalls data stored in data memory. ± d..d, ± d..d Direction of continuous recall and data number 1 to 10000 + : Old data→new data – : New data→old data First-recalled data No. • Code (+) can be omitted.
	NO0 NO1 (Initial value)	Specifies whether to output the data number when data is recalled. Do not output. Output.

Table 5-8 Program Codes (Cont'd)

Item	Code	Description
Others	E	Measurement start command code. The same meaning with the "TRIG" of panel. The same processing as the "GET" is done.
	C	Initializes the setting of GPIB. The same processing as the "DCL" and "SDC" is done.
	Z	The initial value is set to each parameter. Also executes the processing of program code "C".
	 S0 S1 (Initial value)	Specifies whether to transmit the SRQ signal. Transmit the SRQ signal. Do not transmit the SRQ signal.
	   SL0 (Initial value) SL1 SL2	Specifies the data (string delimiter) to be output as the delimiters, when outputting multiple data (output of the recall data, result of statistical operation). "," is output. " " (space) is output. "CR/LF" is output.
	DL0 (Initial value) DL1 DL2	Specifies the block delimiter of data output. Single line signal (EOI) is output when "CR/LF" and "LF" is output. "LF" is output. The single line signal (EOI) is output on output of the final data.
	CS	The status byte is cleared to 0. When SRQ is generated, the SRQ signal is made FALSE (cancel transmission).

Table 5-8 Program Codes (Cont'd)

<table>
<tr><th>Item</th><th>Code</th><th>Description</th></tr>
<tr><td>Control parameter</td><td>MSddd
d = 0 (Initial value)</td><td>ddd : 0 to 255
The specified bit in the status byte is masked.
The bit to be masked is specified by ddd. The bit where "1" is set is masked (the decimal number set by ddd is converted in binary value to be masked).
Note that bit 6 (RQS) cannot be masked. (Setting can be done.)
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Status</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>bytes</td><td>128</td><td>64</td><td>32</td><td>16</td><td>8</td><td>4</td><td>2</td><td>1</td></tr>
</table></td></tr>
<tr><td></td><td>TE</td><td>Executes the self diagnosis function.</td></tr>
<tr><td></td><td>SD ± d..d</td><td>Setting and calibration of the ± d..d : sign + numeral of 8 digits or less + decimal point calibration value.
The ± d..d value specifies whether the calibration is on the zero point or a full-scale calibration.
● See the chapter on calibration for the setting range.
● d..d allows data of fixed decimal point form only. (No data with exponential part is allowed.)
● Set d..d with data corresponding to the display.
● (If it is 20V range, it is d..d = 18, and 18V.)
● The sign (+) can be omitted.</td></tr>
</table>

Table 5-9 Measurement Range Code

Code	VDC	VAC*1 V (AC + DC)*1	ADC*1, AAC*1 A (AC + DC)*1	2/4WΩ NWΩ*3
0	auto	auto	auto	auto
1	—	—	—	1000MΩ
2	—	—	—	10Ω
3	200mV	200mV	—	100Ω
4	2000mV	2000mV	2000μA	1000Ω
5	20V	20V	20mA	10kΩ
6	200V	200V	200mA	100kΩ
7	1000V	500V	2000mA	1000kΩ
8	—	—	—	10MΩ
9	10V*2	—	—	100MΩ

*1 : Only the R6871E is enabled.

*2 : Only for calibration mode.

*3 : Only the R6871E-OHM is enabled. Accuracy is not guaranteed though the measurement operation is done in 10Ω, 100Ω, 100MΩ, or 1000MΩ range.

Notes on setting the program codes

1. 50 characters is the maximum number of program code characters that can be received at once.

   (Explanation)
   In this device, the reception program codes are sequentially read in the internal buffer, and the processing corresponding to the program code is performed as soon as the terminator is received. Therefore, the number of program code characters that can be received at once is limited to 50 characters. The " " (space) code in the terminator and string is not included as a character.

2. Transmit a "LF" (¥12) code at the end of the string of 1 line.

   (Explanation)
   Transmit a "LF" (¥12) code (or "CR", "LF") at the end of the 1-line string. If "LF" is not transmitted, output the single line signal "EOI" when transmitting the final character. (Both "LF" and "EOI" can be output.)
   If neither the "LF" code nor "EOI" signal is output, the end of the string cannot be detected, and the operation stops in a hand-shake wait status.
   The following terminators can be used.

   ● CR/LF (EOI) ● LF (EOI) ● CR (EOI) ● (EOI) ● CR/LF ● LF

3. Each program code can make multiple descriptions in a single string.

   (Explanation)
   Example :
   "F1R4M1" ..... The delimiter of each program code is not required.
   "F1, R4" ...... "," is used as the delimiter of each program code.
   "F1 R4" ...... " " (space) is used as the delimiter of each program code.

   The following program codes must be set individually.
   "COd", "STd", "ROd", "BO", "M3"
   Use program code "E" independently in the MULTI BULK sampling mode.

4. The following characters can be used in remote programming.

   (Explanation)
   The following characters can be used in remote programming.

Numerals	"1" to "9", "0"
Alphabets	"A" to "Z", "a" to "z"
Symbols	",", ".", " + ", "-"
Others	"CR", "LF", " " (space)

   It becomes setting error if characters other than the above are set. (Small letters "a" to "z" are handled in the same way as capital letters "A" to "Z".)

5. When a code which format cannot be used in the setting program was found;

   (Explanation)
   When a code which format cannot be used in the setting program was found, processing will be done normally till immediately before the code, but all later codes will be ignored.

6. The following are factors for generation of syntax errors.

   (Explanation)
   The following are factors for generation of syntax errors.

   - When the received string exceeded 50 characters (the received string is completely ignored)
   - When an unexciting program code is received
   - When the preset data exceeded the specified allowable range
   - When a character that cannot be used is received

   In case the above occurs, error code is displayed on the panel display unit.

7. The following listener codes can be received under calibration mode (when the "EXT CAL" switch on the rear panel is on).
   "Fd", "Rd", "SD ± d..d", "AC", "LFdd",
   "Hd", "DLd", "SLd", "Sd", "MSddd", "CS", "C", "Z"

8. The following listener codes can be received under data memory recall mode (when the "RECALL" key on the front panel is on).
   "COd", "NOd", "ROd", "BO", "RD ± d..d, ± d..d", "RD ± d..d", "RN", "RP",
   "Hd", "DLd", "SLD", "Sd", "MSddd", "CS", "C", "Z"

9. The following listener codes can be received under statistical operation result output mode.
   "COd", "SHd", "RN",
   "Hd", "DLd", "SLd", "Sd", "MSddd", "CS", "C", "Z"

10. Note the following on data memory operation.
    "NOd", "BO", "RD ± d..d, ± d..d", "RD ± d..d" are accepted only under store data number display status.
    "RN", "RP" are recall one piece of data by RD/d..d, and accepted when it is under step output mode.
    No sequential output mode setting can be done once it enters the step output mode. Exit the recall mode once by "RO0" if necessary.

5.7 Service Request ("SRQ")

5.7.1 General

The service request is a function that informs the operation status by interrupting the controller as soon as the device enters the specified operation status.

The operation status is notified by the status byte. When the device transmits the service request, the controller searches the device one by one in sequence. (This is called serial polling.)

As soon as the device is found, the controller transmits the SPE (serial poll enable) command to this device, to inform that it is ready to accept the status byte. As soon as the device receives this command, it transmits a status byte to the controller.

The controller judges the operation status of the device by this status byte.

5.7.2 Service Request and Status Byte

When specified to the "S0" mode, this device transmits service requests to the controller by the operation statues of the following (1) to (7).

When a service request is transmitted, the status byte is transmitted to the controller by execution of the serial polling of the controller.

When specified to the "S1" mode, no service request is transmitted by the status byte is transmitted.

The bits of the status byte is set according to the operation status of (1) to (7).

Each bit in the status byte can also be masked by program code "MSnnn".

All bits can be cleared by program code "CS".

The following is the relation of the operation status and each bit.

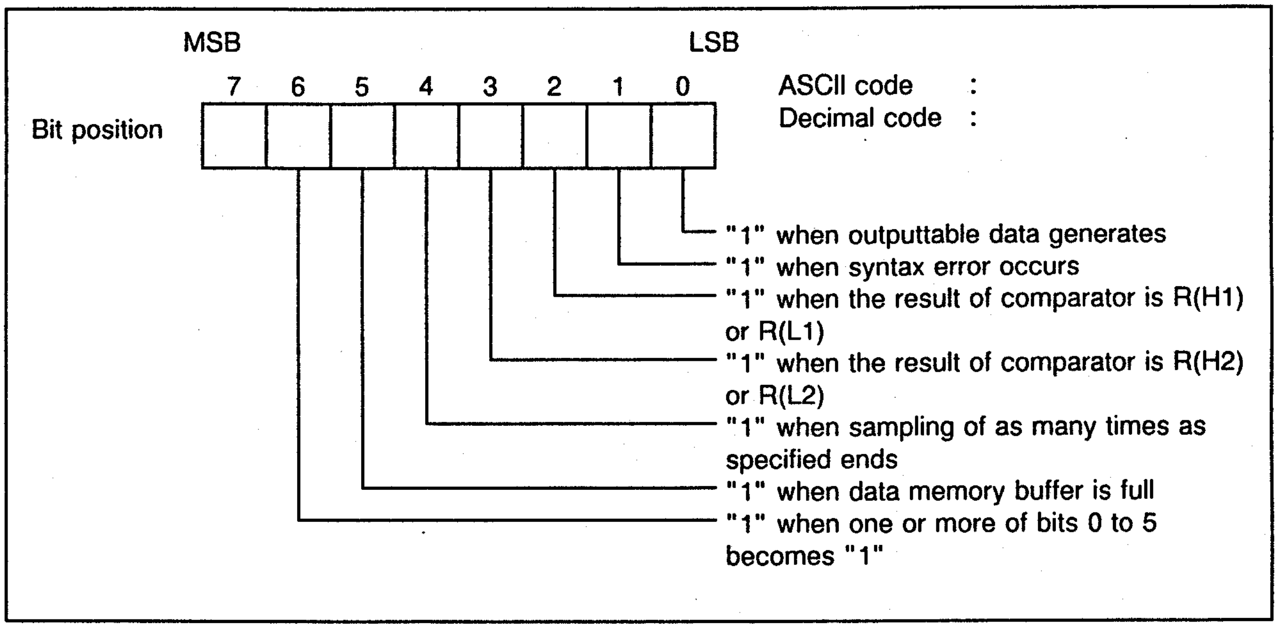


Figure 5-4 Relation of the Operation Status and Each Bit on Service Request

(1) Service request by generation of outputtable data
The following is the status byte in this case.

MSB — LSB

	7	6	5	4	3	2	1	0
Bit position	0	1	0	0	0	0	0	1

ASCII code : A
Decimal code : 65

The service request is dispatched when data that can be output as the measurement data, operation result, or data recalled from the data memory, generates.
The status byte is cleared to 0 when the following status occurs.

① When output of the outputtable data is completed.

② When program code "E" or "GET" command is received while the sampling mode is set at SINGLE or MULTI.

③ When program code "ROd" is received, and when program code "RN" or "RP" is received while data is recalled from the data memory in step output mode.

④ When program code "SHd" is received, and when program code "RN" is received while outputting the result of statistical operation in step output mode.

(2) Service request by generation of syntax error
The following is the status byte in this case.

	MSB							LSB
	7	6	5	4	3	2	1	0
Bit position	0	1	0	0	0	0	1	0

ASCII code : B
Decimal code : 66

The service request is dispatched when there is a setting error in the remote program code. The status byte is cleared to 0 by the next remote program code.

(3) Service request by result of comparator 1, comparator 2
(When the result of operation is R(H1) or R(L1))
The following is the status byte in this case.

	MSB							LSB
	7	6	5	4	3	2	1	0
Bit position	0	1	0	0	0	1	0	0

ASCII code : D
Decimal code : 68

The service request is dispatched when the result of comparator operation is R(H1) or R(L1). The status byte is cleared to 0 as soon as the output of operation result data is completed.

(4) Service request by result of comparator 1, comparator 2
(When the result of operation is R(H2) or R(L2))
The following is the status byte in this case.

	MSB							LSB
	7	6	5	4	3	2	1	0
Bit position	0	1	0	0	1	0	0	0

ASCII code : H
Decimal code : 72

The service request is dispatched when the result of comparator operation is R(H2) or R(L2). The status byte is cleared to 0 as soon as the output of operation result data is completed.

(5) Service request by end of sampling as many times as specified
The following is the status byte in this case.

	MSB							LSB
	7	6	5	4	3	2	1	0
Bit position	0	1	0	1	0	0	0	0

ASCII code : P
Decimal code : 80

① When the sampling mode is MULTI
The service request is dispatched after input of the trigger (measurement start command signal, command) and after sampling is completed for as many times as specified.
The status byte is cleared to 0 when the trigger is input, or when output of 1 data is completed.

② When operation requesting a certain number of sampling is executed
The service request is dispatched as soon as the sampling for as many times as specified (the value of constant "N" for total operation, and the value of constant "X" for RMS operation) is completed.
Cleared when COMPUTE ▭ is turned OFF or when program code "SHd" is cleared.

③ When smoothing operation is executed
The service request is dispatched when it reaches the specified count (the value of constant "SM TIME") and the result of smoothing operation of as many times as specified is output.

④ When the data memory function is used
The service request is dispatched after trigger input when sampling of as many times as specified ends and STORE ▭ turns ON or OFF.
The status byte is cleared to 0 when STORE ▭ is turned ON again, or when RECALL ▭ is turned ON.

(6) Service request by data memory buffer full status
The following is the status byte in this case.

	MSB							LSB
	7	6	5	4	3	2	1	0
Bit position	0	1	1	0	0	0	0	0

ASCII code :
Decimal code : 96

The service request is dispatched when 10000 data is stored in the data memory (the buffer is full).

The status byte is cleared to 0 when STORE ▭ is turned ON again, or when RECALL ▭ is turned ON.

Note that status byte, bit 6 is a bit that indicates the service request. "1" is set to bit 6 when one or more bits of bits 0 to 5 become "1".
When all bits of bit 0 to 5 are cleared to 0, bit 6 is also cleared to 0.

The status bytes shown above are all cleared to 0 on power supply, on reception of the "SDC", "DCL" commands, and on reception of program codes "C", "Z", "CS".

5.8 Operation Flow Chart

A rough operation flow chart is given in Figure 5-5.

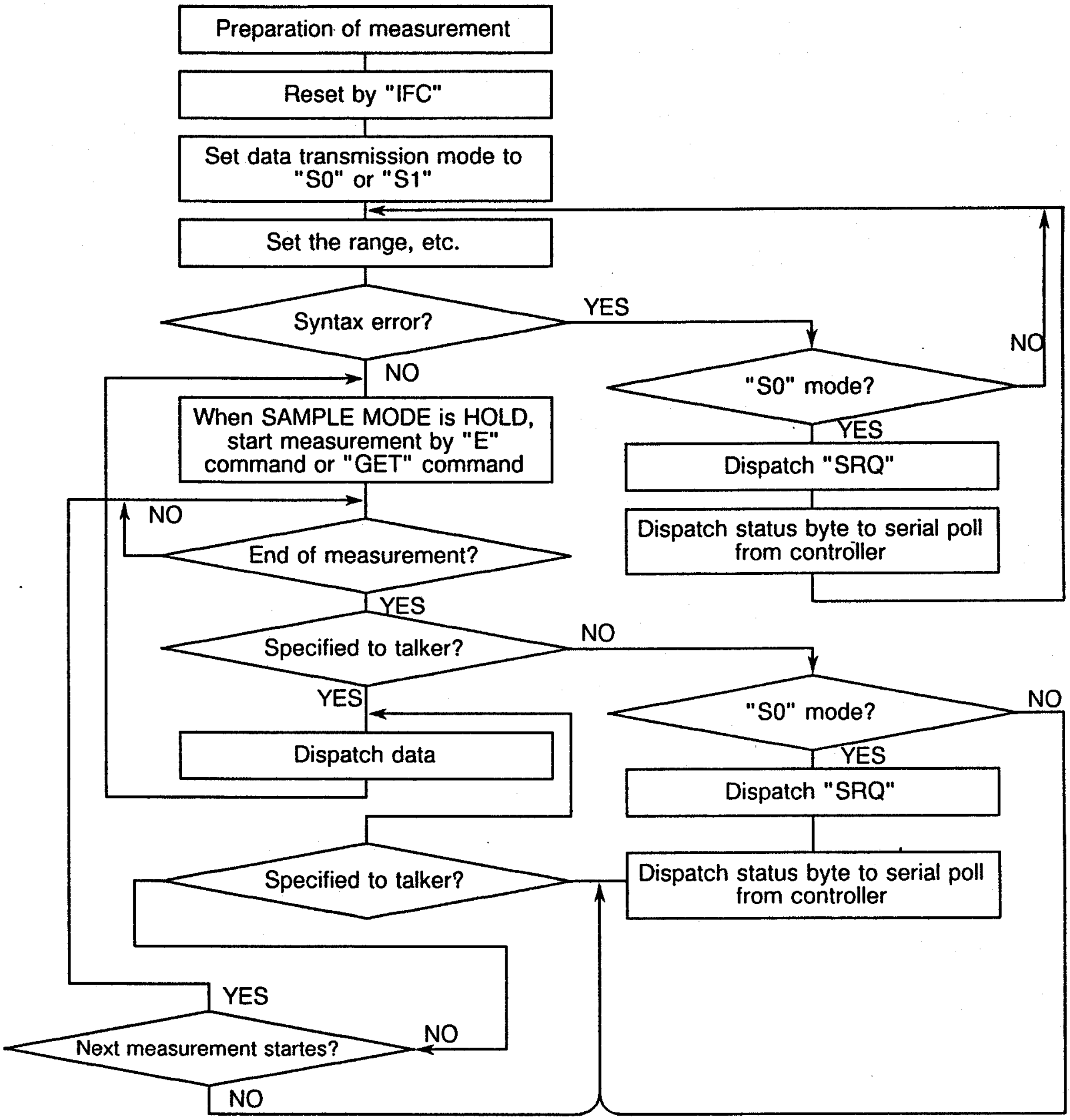


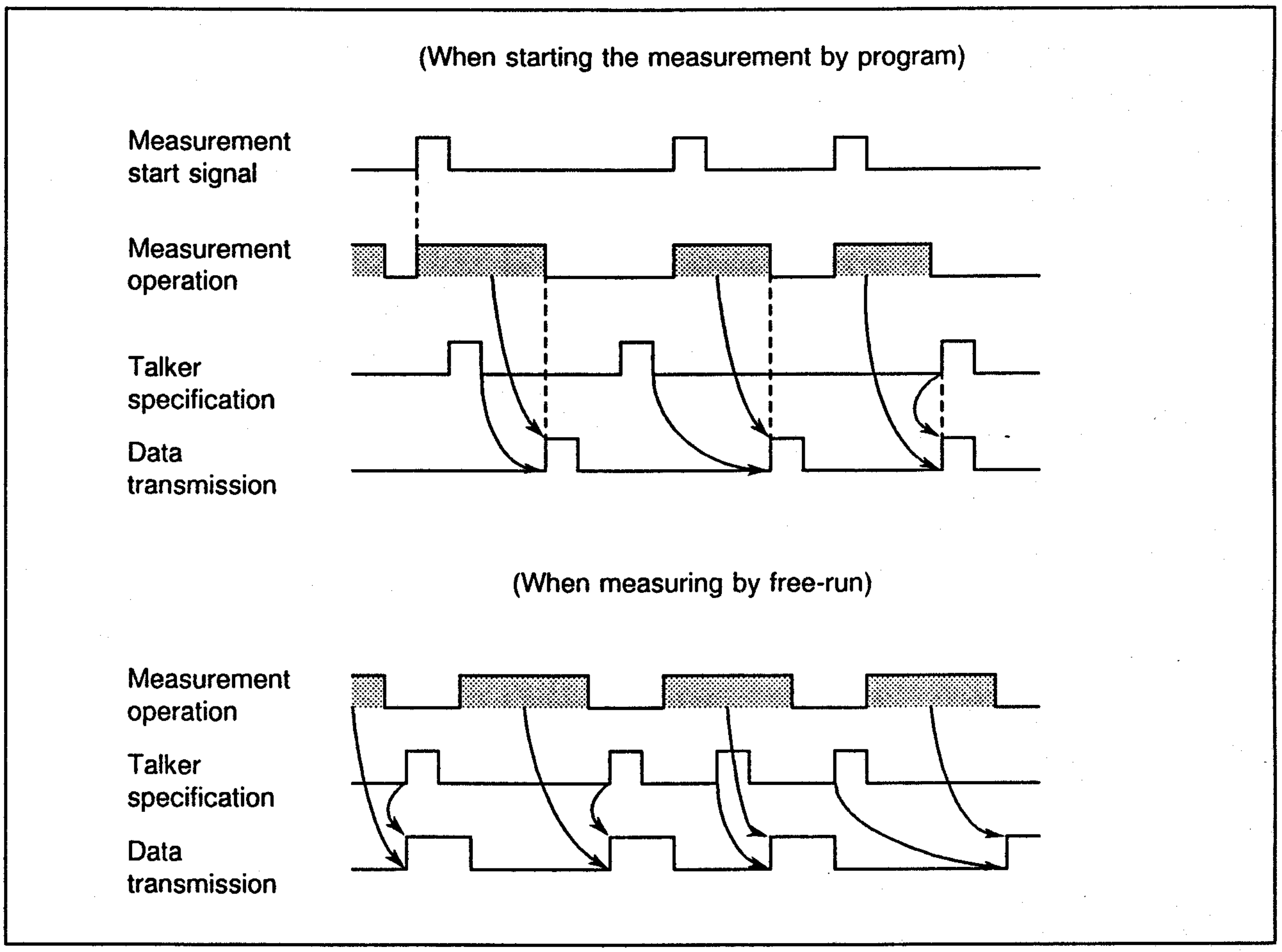
Figure 5-5 GPIB Flow Chart

5.9 Notes on Operation

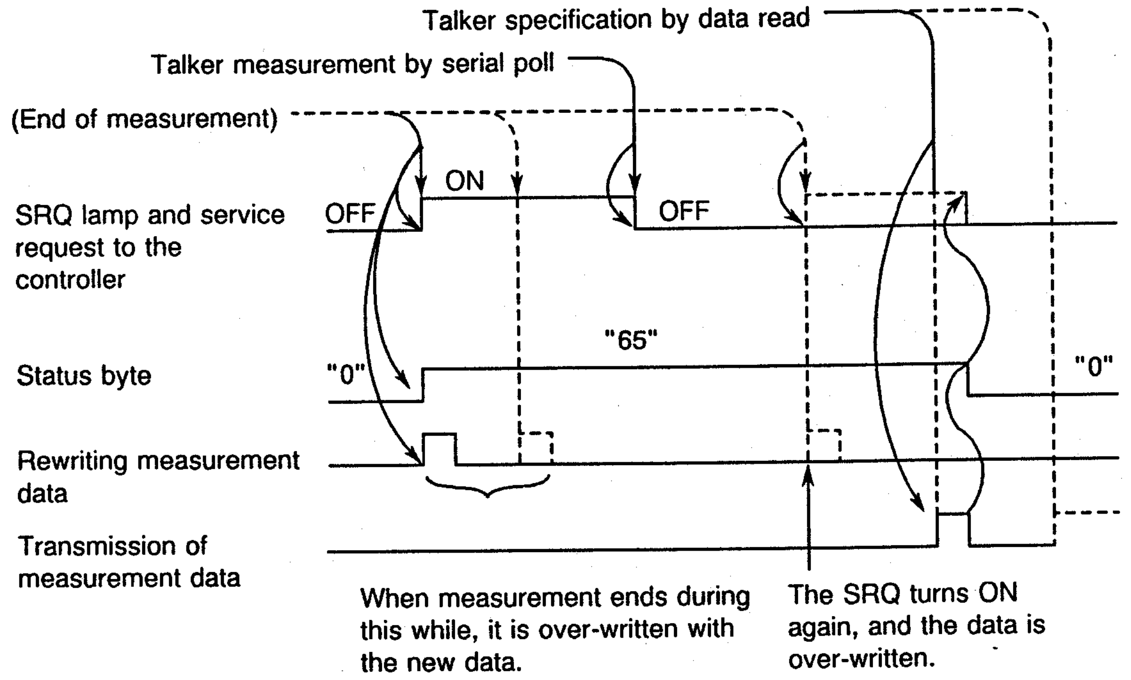
(1) Operation on service request

Be careful when creating the program, because if service request is generated (under S0 mode) by end of measurement and syntax error, the operation will become as shown in Figure 5-6.

(2) Difference of transmission data by talker-specified timing



(a) When using serial polling



(b) When not using serial polling

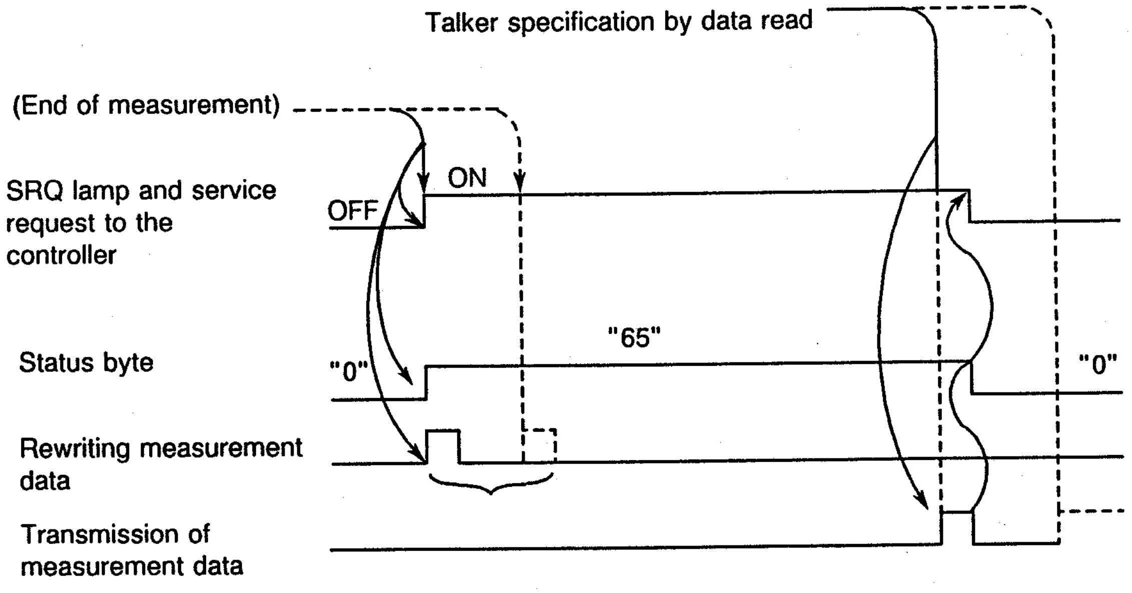
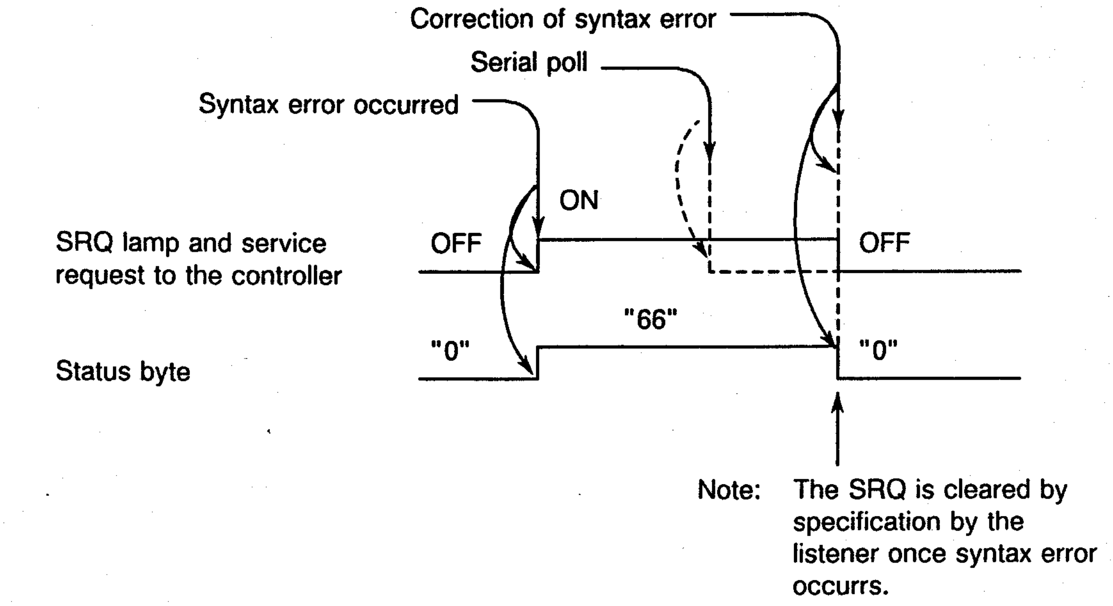


Figure 5-6 Operation Timing on Service Request

(c) In case syntax error occurred



Note: The SRQ is cleared by specification by the listener once syntax error occurrs.

Figure 5-6 Operation Timing on Service Request (cont'd)

5.10 Program Examples

The following are some program examples using Hewlet Paccard's HP200 series and NEC's PC9801.

Example 1 : External start is commanded to start the direct current voltage measurement, 20V-range, SIGNLE sampling.

(1) Example of program using the HP200 series

```
10     !
20     !
30     !
40     DIM A$ [20]
50     R6871E=701
60     !
70     CLEAR R6871E
80     OUTPUT R6871E; "F1,R5,M1"
90     OUTPUT R6871E; "IT4,DL0,S1"
100    TRIGGER R6871E
110    ENTER R6871E;A$
120    PRINT A$
130    GOTO 100
140    !
150    END
```

Description	
40	Data area is defined.
50	The R6871E address is set at variable "R6871E".
70	The GPIB interface device is initialized.
80 to 90	The R6871E parameter is set. "F1" . . . Direct current voltage measurement function "R5" . . Measurement range 20V "M1" . . . Sampling mode : SINGLE "IT4" . . Integral time : 5PLC "DL0" . Block delimiter : CR LF EOI "S1" . . SRQ transmission OFF
100	External start is commanded.
110	Data is received.
120	Display
130	It branches to line number 100.
150	End of program

(2) Example of program using the PC9801 series

```
10     '
20     '
30     '
40     ISET IFC
50     ISET REN
60     CMD DELIM=0
70     PRINT @1;"C"
80     PRINT @1;"F1,R5,M1"
90     PRINT @1;"IT4,DL0,S1"
100    PRINT @1;"E"
110    INPUT @1;A$
120    PRINT A$
130    GOTO 100
140    END
```

Description	
40	Interface clear
50	Remote enable
60	The delimiter is CR + LF.
70	Initializing the setting for the GPIB of R6871E. ("SDC")
80	Sets the R6871E parameter. "F1" . . . Direct current voltage measurement function "R5" . . . Measurement range 20V "M1" . . . Sampling mode : SINGLE
90	"IT4" . . Integral time : 5PLC "DL0" . Block delimiter : CR LF EOI "S1" . . . SRQ transmission OFF
100	External start is commanded.
110	Data reception
120	Display
130	It branches to line number 100.
140	End of program

Example 2 : The measurement parameter is set externally. Measurement is started by external start, and data is read using the SRQ.

(1) Example of program using the HP200 series

```
10     !
20     !
30     !
40     DIM A$ [20]
50     R6871E=701
60     ON INTR 7 GOSUB Srq
70     !
80     CLEAR R6871E
90     OUTPUT R6871E; "F4,R5,M1"
100    OUTPUT R6871E; "IT3,DLO,SO"
110    ENABLE INTR 7;2
120    TRIGGER R6871E
130    Wait_f=0
140    IF Wait_f=1 THEN 120
150    GOTO 140
160    !
170 Srq: STATUS 7,1;X
180    S=SPOLL(R6871E)
190    IF S<>65 THEN 230
200    ENTER R6871E;A$
210    PRINT A$
220    Wait_f=1
230    ENABLE INTR 7;2
240    RETURN
250    !
260    END
```

	Description
40	Data area is defined.
50	The R6871E address is set at a "R6871E" variable.
60	The interruption processing routine is defined.
80	The GPIB interface device is initialized.
90	The R6871E parameter is set. "F4" . . . 4-line resistance measurement function "R5" . . . Measurement range 10KΩ "M1" . . . Sampling mode : SINGLE
100	"IT3" . . Integral time : 1PLC "DL0" . Block delimiter : CR LF EOI "S0" . . . SRQ transmission ON
110	Allows interruption by SRQ.
120	External start is commanded.
130 to 150	Interruption and interruption-wait to processing loop
170 to 180	Interruption processing routine name :R6871E is polled and the status is read.
190	When interrupting from other than the R6871E, it branches to line number 230.
200	Data reception
210	Display
220	Interruption processing end flag (Wai__ f) is set.
230	Interruption by SRQ is allowed.
240	Return to main routine
260	End of program

(2) Example of program using the PC9801 series

```
10   '
20   '
30   '
40   ISET IFC
50   ISET REN
60   CMD DELIM=0
70   DEF SEG=&H60
80   A%=PEEK(&H9F3)
90   A%=A% AND &HBF
100  POKE &H9F3,A%
110  ON SRQ GOSUB 210
120  '
130  PRINT @1;"C"
140  PRINT @1;"F4,R5,M1"
150  PRINT @1;"IT3,DL0,S0,CS"
160  SRQ ON
170  PRINT @1;"E"
180  WAITF=0
190  IF WAITF=1 THEN 170
200  GOTO 190
210  POLL 1,S
220  IF S<>65 THEN 260
230  INPUT @1;A$
240  PRINT ;A$
250  WAITF=1
260  SRQ ON
270  RETURN
280  END
```

Description	
40	Interface clear
50	Remote enable
60	The delimiter is CR + LF
70	The SRQ signal in the PC9801 GPIB is cleared (70-100). Declaration of segment base address.
80	Reading address
90	AND is removed (to clear interruption bit)
100	Write data to the specified address on the memory.
110	The head address of the SRQ subroutine is specified.
130	Initializes the setting for the GPIB of R6871E. ("SDC")
140	Sets the R6871E parameter. "F4" . . . 4-line resistance measurement function "R5" . . . measurement range 10KΩ "M1" . . . Sampling mode : SINGLE
150	"IT3" . . Integral time : 1PLC "DL0" . Block delimiter : CR LF EOI "S0" . . . SRQ transmission ON "CS" . . . Clears status byte
160	Allows interruption by SRQ.
170	External start is commanded.
180	Substitute 0 to the flag (WAITF)
190	Branches to 170 if the flag (WAITF) is 0.
200	Branches to 190.
210	Serial poll is performed.
220	Branches to 260 if the interruption from other than R6871E.
230	Data reception
240	Display
250	1 is substituted to the flag (WAITF)
260	SRQ reception is allowed.
270	RETURN
280	End of program

Example 3 : Example of program using the data memory function

```
10    !******************************************************
20    !        DATA-MEMORY PROGRAM
30    !
40    !        MULTI SAMPLING, NS=50
50    !******************************************************
60    !
70    DIM  M_data$ [30]
80    R6871E=701
90    Ns_end=0
100   CLEAR R6871E
110   ON INTR 7 GOSUB Srq
120   GOSUB Set_para
130   OUTPUT R6871E;"ST1"
140   TRIGGER R6871E
150   ENABLE INTR 7;2
160 Wait_srq:  IF Ns_end=0 THEN Wait_srq
170         OUTPUT R6871E;"RO0"
180         STOP
190         !
200         !
210   !******************************************************
220   !      INTERRUPT !!
230   !******************************************************
240   !
250 Srq:    STATUS 7,1;X
260         S=SPOLL(R6871E)
270         IF BIT(S,4)=0 THEN Rtn
280         OUTPUT R6871E;"RO1"
290         OUTPUT R6871E;"NO1"
300         OUTPUT R6871E;"RD0"
310         GOSUB Rec_data
320         FOR N=1 TO 49
330             OUTPUT R6871E;"RN"
340             GOSUB Rec_data
350         NEXT N
360         Ns_end=1
370 Rtn:    ENABLE INTR 7;2
380         RETURN
390         !
400         !
```

(cont'd)

```
410   !**********************************************
420   !      SET R6871E PARAMETER!!
430   !**********************************************
440           OUTPUT R6871E;"F1,R4,M2,IT1,SI0,TD0,AZ0,NS50"
450           OUTPUT R6871E;"H1,S0,SL2,DL0,CS,MS175"
460           RETURN
470           !
480           !
490   !**********************************************
500   !       READ DATA-MEMORY DATA !!
510   !**********************************************
520   !
530 Rec data:     ENTER R6871E;M_data$
540               PRINT M_data$
550               RETURN
560               !
570  END
```

	Description
70	The data area is defined.
80	The address of R6871E is set in the "R6871E" variable.
90	The end of recall output flag is cleared.
100	The device of GPIB interface is initialized.
110	The interruption processing routine is defined.
120	The subroutine "Set__para" that sets the parameters of the R6871E is executed.
130	The data memory storage function is enabled.
140	External start is commanded
150	SRQ interruption is allowed.
160	Interruption wait loop (looped here till 50 samplings end).
170	The data memory recall function is turned off.
250 to 260	The interruption processing routine name: R6871E is polled and the status read.
270	The status byte bit 4 (service request by end of specified counts) is tested.
280	The data memory recall function is set on.

	Description
300	Dat number "0" is read.
300	Dat number "0" is read.
310	Subroutine "Rec_data" to receive data from the R6871E is executed.
320 to 350	Process to read data numbers "1" to "49" is executed. Each data is read under step output mode by the "RN" code.
360	Recall output end flag is set.
370	Interruption by SRQ is allowed.
380	Returns to the main routine.
440 to 460	Each parameter of subroutine name : R7681E is set. "F1" .... Measurement function : VDC "R4" .... Measurement range : 2000mV "M2" .... Sampling mode : MULTI "IT1" .... Integral time : 1ms "SI0" .... Sampling interval : 0ms "TD0" .... Trigger delay time : 0ms "AZ0" .... Auto-zero calibration : OFF "NS50" ...... Count of samples : 50 counts "H1" .... Header output : ON "S0" .... SRQ mode : ON "SL2" .... String delimiter : "CR/LF" "DL0" .... Block delimiter : "CR/LF (EOI)" "CS" .... Clear status byte "MS175" ..... Mask status byte except bits 4 and 6.
530 to 550	Receive recall data from subroutine name : R6871E.
570	End of program

(Output data)

```
NO+0000,DV  +1000.05E-03
NO+0001,DV  +1000.05E-03
NO+0002,DV  +1000.03E-03
NO+0003,DV  +1000.02E-03
NO+0004,DV  +1000.06E-03
NO+0005,DV  +1000.05E-03
NO+0006,DV  +1000.04E-03
NO+0007,DV  +1000.06E-03
NO+0008,DV  +1000.07E-03
NO+0009,DV  +1000.05E-03
NO+0010,DV  +1000.05E-03
NO+0011,DV  +1000.07E-03
NO+0012,DV  +1000.06E-03
NO+0013,DV  +1000.03E-03
NO+0014,DV  +1000.06E-03
NO+0015,DV  +1000.07E-03
NO+0016,DV  +1000.06E-03
NO+0017,DV  +1000.05E-03
NO+0018,DV  +1000.07E-03
NO+0019,DV  +1000.03E-03
NO+0020,DV  +1000.02E-03
NO+0021,DV  +1000.06E-03
NO+0022,DV  +1000.05E-03
NO+0023,DV  +1000.05E-03
NO+0024,DV  +1000.05E-03
NO+0025,DV  +1000.05E-03
NO+0026,DV  +1000.04E-03
NO+0027,DV  +1000.02E-03
NO+0028,DV  +1000.06E-03
NO+0029,DV  +1000.04E-03
NO+0030,DV  +1000.03E-03
NO+0031,DV  +1000.06E-03
NO+0032,DV  +1000.06E-03
NO+0033,DV  +1000.04E-03
NO+0034,DV  +1000.03E-03
NO+0035,DV  +1000.06E-03
NO+0036,DV  +1000.03E-03
NO+0037,DV  +1000.04E-03
NO+0038,DV  +1000.06E-03
NO+0039,DV  +1000.06E-03
NO+0040,DV  +1000.06E-03
NO+0041,DV  +1000.05E-03
NO+0042,DV  +1000.07E-03
NO+0043,DV  +1000.04E-03
NO+0044,DV  +1000.03E-03
NO+0045,DV  +1000.06E-03
NO+0046,DV  +1000.06E-03
NO+0047,DV  +1000.05E-03
NO+0048,DV  +1000.07E-03
NO+0049,DV  +1000.07E-03
```

Example 4 : Example of program using the data memory function
Unlike (Example 3), the recall is done by specifying "," as the string delimiter, to reach the recall data as a character string.
When the "BO" code is sent to the R6871E, the number of data stored in the data memory is output.

```
10    !*****************************************************
20    !         DATA-MEMORY PROGRAM
30    !
40    !      .  MULTI SAMPLING, NS=200
50    !*****************************************************
60    !
70    DIM  M_data$ [2500]
80    R6871E=701
90    Ns_end=0
100   CLEAR R6871E
110   ON INTR 7 GOSUB Srq
120   GOSUB Set_para
130   TRIGGER R6871E
140   ENABLE INTR 7;2
150 Wait_srq:   IF Ns_end=0 THEN Wait_srq
160        OUTPUT R6871E;"RO0"
170        STOP
180        !
190        !
200   !*****************************************************
210   !        INTERRUPT !!
220   !*****************************************************
230   !
240 Srq:     STATUS 7,1;X
250          S=SPOLL(R6871E)
260          IF BIT(S,4)=0 THEN Rtn
270          OUTPUT R6871E;"RO1"
280          OUTPUT R6871E;"NO0"
290          OUTPUT R6871E;"BO"
300          ENTER R6871E;Count
310          PRINT "SAMPLE = ";Count
320          ENTER R6871E;M_data$
330          PRINT M_data$
340          Ns_end=1
350 Rtn:     ENABLE INTR 7;2
360          RETURN
370          !
380          !
```

(cont'd)

```
390   !***************************************************
400   !      SET R6871E PARAMETER !!
410   !***************************************************
420           OUTPUT R6871E;"F1,R3,M2,IT0,SI0,TD0,AZ0,NS200"
430           OUTPUT R6871E;"H0,S0,SL0,DL0,CS,MS175"
440           OUTPUT R6871E;"ST1"
450           RETURN
460           !
470   END
```

(Output data)

```
SAMPLE =  200
-099.94E-03,-099.86E-03,-099.79E-03,-099.88E-03.-099.61E-03,-100.03E-03,-099.95E
-03,-099.85E-03,-100.07E-03,-099.79E-03,-100.02E-03,-099.80E-03,-099.72E-03,-099
,91E-03,-099.65E-03,-100.15E-03,-099.74E-03,-099.84E-03,-099.89E-03,-099.72E-03,
-100.12E-03,-099.69E-03,-099.81E-03,-100.08E-03,-099.69E-03,-099.99E-03,-099.25E
-03,-099.79E-03,-099.87E-03,-099.65E-03,-099.86E-03,-099.46E-03,-100.11E-03,-099
.93E-03,-099.97E-03,-100.09E-03,-099.42E-03,-100.00E-03,-099.83E-03,-099.66E-03,
-099.91E-03,-099.56E-03,-100.23E-03,-099.87E-03,-099.83E-03,-100.14E-03,-099.60E
-03,-100.16E-03,-099.46E-03,-099.81E-03,-099.84E-03,-099.66E-03,-100.18E-03,-099
.56E-03,-099.79E-03,-100.06E-03,-099.59E-03,-100.05E-03,-099.64E-03,-099.91E-03,
-099.80E-03,-099.57E-03,-099.86E-03,-099.35E-03,-100.51E-03,-099.93E-03,-099.90E
-03,-100.09E-03,-099.38E-03,-100.00E-03,-099.73E-03,-099.61E-03,-099.89E-03,-099
.57E-03,-100.22E-03,-099.90E-03,-099.84E-03,-100.15E-03,-099.65E-03,-100.12E-03,
-099.61E-03,-099.84E-03,-099.89E-03,-099.63E-03,-100.05E-03,-099.37E-03,-099.69E
-03,-099.96E-03,-099.70E-03,-100.04E-03,-099.61E-03,-100.01E-03,-100.06E-03,-099
.89E-03,-100.17E-03,-099.63E-03,-099.95E-03,-099.80E-03,-099.78E-03,-099.92E-03,
-099.64E-03,-100.09E-03,-099.93E-03,-099.86E-03,-100.08E-03,-099.84E-03,-100.02E
-03,-099.01E-03,-099.65E-03,-099.93E-03,-099.64E-03,-100.09E-03,-099.67E-03,-099
.84E-03,-099.86E-03,-099.72E-03,-099.98E-03,-099.61E-03,-099.84E-03,-100.03E-03,
-099.88E-03,-100.02E-03,-099.40E-03,-099.88E-03,-099.88E-03,-099.68E-03,-099.90E
-03,-099.57E-03,-100.14E-03,-099.90E-03,-099.89E-03,-100.07E-03,-099.67E-03,-100
.03E-03,-099.97E-03,-099.85E-03,-099.93E-03,-099.70E-03,-100.11E-03,-099.76E-03,
-099.82E-03,-100.11E-03,-099.73E-03,-100.07E-03,-099.67E-03,-099.87E-03,-100.03E
-03,-099.92E-03,-100.08E-03,-099.49E-03,-099.94E-03,-099.86E-03,-099.79E-03,-099
.92E-03,-099.69E-03,-099.87E-03,-099.88E-03,-099.70E-03,-099.91E-03,-099.56E-03,
-099.95E-03,-099.91E-03,-099.90E-03,-100.07E-03,-099.82E-03,-100.04E-03,-099.81E
-03,-099.79E-03,-099.94E-03,-099.76E-03,-100.06E-03,-099.74E-03,-099.85E-03,-100
.09E-03,-099.74E-03,-100.06E-03,-099.68E-03,-099.91E-03,-100.05E-03,-099.94E-03,
-100.10E-03,-099.49E-03,-099.83E-03,-099.85E-03,-099.77E-03,-099.90E-03,-099.62E
-03,-100.00E-03,-099.97E-03,-099.89E-03,-100.11E-03,-099.81E-03,-099.97E-03,-099
.82E-03,-099.75E-03,-099.93E-03,-099.67E-03,-100.10E-03,-099.79E-03,-099.87E-03
```

Description

Setting status of each R6871E parameters
"F1" ..... Measurement function : VDC
"R3" .... Measurement range : 200mV
"M2" .... Sampling mode : MULTI
"IT0" ..... Integral time : 100μs
"SI0" ..... Sampling interval : 0ms
"TD0" .... Trigger delay time : 0ms
"AZ0" .... Auto-zero calibration : OFF
"NS200" .. Count of samples : 200 counts
"H0" .... Header output : OFF
"S0" .... SRQ mode : ON
"SL0" .... String delimiter : ","
"DL0" .... Block delimiter : "CR/LF (EOI)"
"CS" .... Clear status byte.
"MS175" .. Mask status byte except bits 4 and 6.
"ST1" .... Set data memory store function ON.

Example 5 : Example of a program where sampling is executed under the highest-speed mode using the data memory function

```
10    !*******************************************************
20    !         DATA-MEMORY PROGRAM (FAST SAMPLING)
30    !
40    !         SAMPLING MODE :RUN,   NS:  1000
50    !*******************************************************
60    !
70    DIM Rec_data$(10000) [20]
80    INTEGER Data_count,N
90    R6871E=701
100   Ns_end=0
110   CLEAR R6871E
120   ON INTR 7 GOSUB Srq
130   GOSUB Set_para
140   TRIGGER R6871E
150   ENABLE INTR 7;2
160 Wait_srq:   IF Ns_end=0 THEN Wait_srq
170        OUTPUT R6871E;"RO0"
180        STOP
190        !
200   !*******************************************************
210   !       INTERRUPT !!
220   !*******************************************************
230   !
240 Srq:     STATUS 7,1;X
250          S=SPOLL (R6871E)
260          IF BIT(S,4)=0 THEN Rtn
270          OUTPUT R6871E;"RO1"
280          OUTPUT R6871E;"NO0"
290          GOSUB Rec_data
300          Ns_end=1
310 Rtn:     ENABLE INTR 7;2
320          RETURN
330          !
340   !*********************************************************
350   !      SET R6871E PARAMETER !!
360   !*********************************************************
370 Set_para:  OUTPUT R6871E,"F1,R3,TD0,NS1000"
380            OUTPUT R6871E;"H0,S0,SL2,DL0,CS,MS175"
390            OUTPUT R6871E;"DO3"
400            RETURN
410            !
420            !
```

(cont'd)

```
430   !**********************************************
440   !       GET DATA-MEMORY DATA !!
450   !**********************************************
460 Rec_data:    OUTPUT R6871E,"BO"
470              ENTER R6871E;Data_count
480              FOR N=1 TO Data_count
490                  ENTER R6871E;Rec_data$(N)
500              NEXT N
510              PRINT "DATA COUNT= ";Data_count
520              PRINT
530              FOR N=1 TO Data_count
540                  PRINT Rec_data$(N)
550              NEXT N
560              RETURN
570              !
580   END
```

(Output data)

```
DATA COUNT=   1575
+000.04E-03
+000.04E-03
+000.07E-03
+000.03E-03
+000.06E-03
+000.04E-03
+000.03E-03
+000.06E-03
+000.04E-03
+000.05E-03
+000.05E-03
+000.04E-03
+000.05E-03
+000.02E-03
+000.02E-03
+000.03E-03
+000.02E-03
+000.05E-03
+000.05E-03
+000.02E-03
+000.04E-03
+000.03E-03
+000.02E-03
+000.02E-03
+000.00E-03
-000.01E-03
+000.01E-03
-000.01E-03
+000.00E-03
+000.03E-03
+000.02E-03
+000.01E-03
+000.04E-03
+000.02E-03
+000.02E-03
```

Description	
70 to 80	Defines the data area.
90	The address of R6871E is set in the "R6871E" variable.
100	The end of recall output flag is cleared.
110	The device of GPIB interface is initialized.
120	The interruption processing routine is defined.
130	The subroutine "Set_para" that sets the parameters of the R6871E parameters is executed.
140	External start is commanded
150	SRQ interruption is allowed.
160	Interruption wait loop (looped here till 1000 samplings end after external start is commanded)
170	The data memory recall function is turned off.
180	The program is stopped.
240 to 250	The interruption processing routine name : R6871E is polled and to the status is read.
260	The status byte bit 4 (service request by end of specified counts) is tested.
270	The data memory recall function is set on.
280	It is set so that the recall data is output without data number.
290	Subroutine "Rec_data" to receive data from the R6871E is executed.
300	Recall output end flag is set.
310	Interruption by SRQ is allowed.
320	Returns to the main routine.

(Cont'd to the next page)

Description	
370 to 400	Each parameter of subroutine name : R6871E is set. "F1" .... Measurement function : VDC "R3" ...... Measurement range : 200mV "TD0" ..... Trigger delay time : 0ms "NS1000" ... Count of samples : 1000 counts "H0" ...... Header output : OFF "S0" ...... SRQ mode : ON "SL2" ...... String delimiter : "CR/LF" "DL0" ..... Block delimiter : "CR/LF (EOI)" "CS" ...... Clear status byte. "MS175" .... Mask status byte except bits 4 and 6. "DO3" ..... Data output mode : 3 (Highest-speed mode)
460	Batch output from data memory by subroutine name : "BO"
470	Reads number of data stored in the data memory.
480 to 500	Reads data from the data memory, to save the data to the to Rec_data buffer.
510	Displays number of data.
520 to 550	Displays all recalled data.
560	Return to the main routine.
580	End of program

Example 6 : Example of a program that executes the statistical operation of the operation function

```
10    !*****************************************************
20    !         COMPUTING FUNCTION : STATISTICS
30    !
40    !         20V range.SAMPLE : 10
50    !*****************************************************
60    !
70    DIM M_data$ [30]
80    R6871E=701
90    Ns_end=0
100   CLEAR R6871E
110   ON INTR 7 GOSUB Srq
120   GOSUB Set_para
130   TRIGGER R6871E
140   ENABLE INTR 7;2
150 Wait_srq:   IF Ns_end=0 THEN Wait_srq
160         OUTPUT R6871E;"CO0"
170         STOP
180         !
190         !
200   !************************************************
210   !      INTERRUPT !!
220   !************************************************
230   !
240 Srq:    STATUS 7,1;X
250         S=SPOLL(R6871E)
260         IF BIT(S,4)=0 THEN Rtn
270         OUTPUT R6871E;"SH0"
280         GOSUB Comp_data
290         FOR N=1 TO 7
300             OUTPUT R6871E;"RN"
310             GOSUB Comp_data
320         NEXT N
330         Ns_end=1
340 Rtn:    ENABLE INTR 7;2
350         RETURN
360         !
370         !
380   !************************************************
390   !     SET R6871E PARAMETER !!
400   !************************************************
410 Set_para: OUTPUT R6871E;"F1,R5,M2,IT5,RE7,SI0,TD1000,NS10,CF0,3,KN10"
420           OUTPUT R6871E;"H1,S0,SL2,DL0,CS,MS175"
430           OUTPUT R6871E;"CO1"
440           RETURN
450          !
460          !
```

(cont'd)

```
470   !***************************************************
480   !      READ COMPUTING DATA !!
490   !***************************************************
500   !
510 Comp_data:  ENTER R6871E;M_data$
520             PRINT M_data$
530             RETURN
540             !
550  End
```

(Output data)

```
DV C00010
DV X+11.234576E+00
DV N+11.234569E+00
DV A+11.234573E+00
DV K+00.000007E+00
DV S+1.9340000E-06
DV Y+11.234579E+00
DV Z+11.234567E+00
```

Description	
70	Defines the data area
80	The address of R6871E is set in the "R6871E" variable.
90	The end of statistical operation result output flag is cleared.
100	The device of GPIB interface is initialized.
110	The interruption processing routine is defined.
120	The subroutine "Set_para" that sets the parameters of the R6871E parameters is executed.
130	External start is commanded.
140	SRQ interruption is allowed.
150	Interruption wait loop (looped here till 10 samplings end)
160	The operation function is turned off.
170	The program is stopped.
240 to 250	The interruption processing routine name : R6871E is polled and to the status is read.
260	The status byte bit 4 (service request by end of specified counts) is tested.
270	Specify 'step' as the statistical operation result output mode.
280	Subroutine "Comp_data" that receives data from the R6871E is executed. (As many data as sampled is received.)
290 to 320	Process to receive the MAX, MIN, AVE, P-P,σ, UCL, LCL to data of the statistical operation result
330	End of operation result output flag is set.
340	Interruption by SRQ is allowed.
350	Returns to the main routine.

(Cont'd to the next page)

	Description
410 to 440	Each parameter of subroutine name : R6871E is set.
	"F1" .... Measurement function : VDC
	"R5" ...... Measurement range : 20V
	"M2" ...... Sampling mode : MULTI
	"IT5" ...... Integral time : 10PLC
	"RE7" ..... Displayed digits : 7 1/2 digit mode
	"SI0" ...... Sampling interval : 0ms
	"TD1000" ... Trigger delay time : 1000ms
	"NS10" .... Count of samples : 10 counts
	"CF0, 3" .... Operation function : Statistical process is set for 2-dimensional operation
	"KN10" .... Number of statistical operation object samples : 10 samples
	"H1" ...... Header output : ON
	"S0" ...... SRQ mode : ON
	"SL2" ...... String delimiter : "CR/LF"
	"DL0" ..... Block delimiter : "CR/LF (EOI)"
	"CS" ...... Clear status byte.
	"MS175" ... Mask status byte except bits 4 and 6.
	"CO1" ..... Set operation function ON.
510 to 530	Result of operation is received from subroutine name : R6871E
550	End of program

5.11 Output of Comparator Calculation Results (for R6871E-OHM only)

In this section, the function of comparator results output is explained.

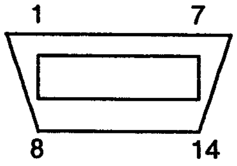
5.11.1 Outline

The R6871E-OHM is equipped with an output of comparator calculation result function as a standard attachment.

5.11.2 The Function

The results of comparator calculation is output to HIGH2, HIGH1, PASS, LOW1, LOW2, and FAIL by open collector. Dealing with pin number of connector and the signal is as follows.

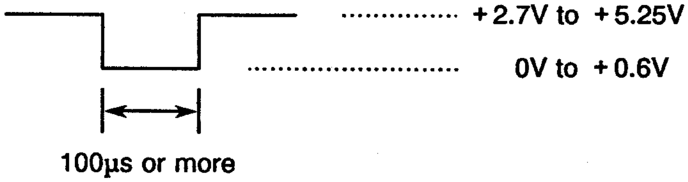
- Output Connector 57-40140 (produced by DDK)



Pin No.	Signal name	Pin No.	Signal name
1	GND	8	GND
2	*EXT.TRIGGER	9	*DATA.OUT
3	HIGH2	10	LOW1
4	HIGH1	11	LOW2
5	PASS	12	FAIL
6	NC	13	NC
7	NC	14	NC

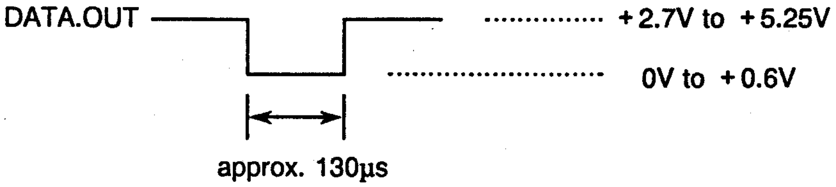
NC : No-connect

- External Start Signal
  EXT.TRIGGER : TTL level negative pulse



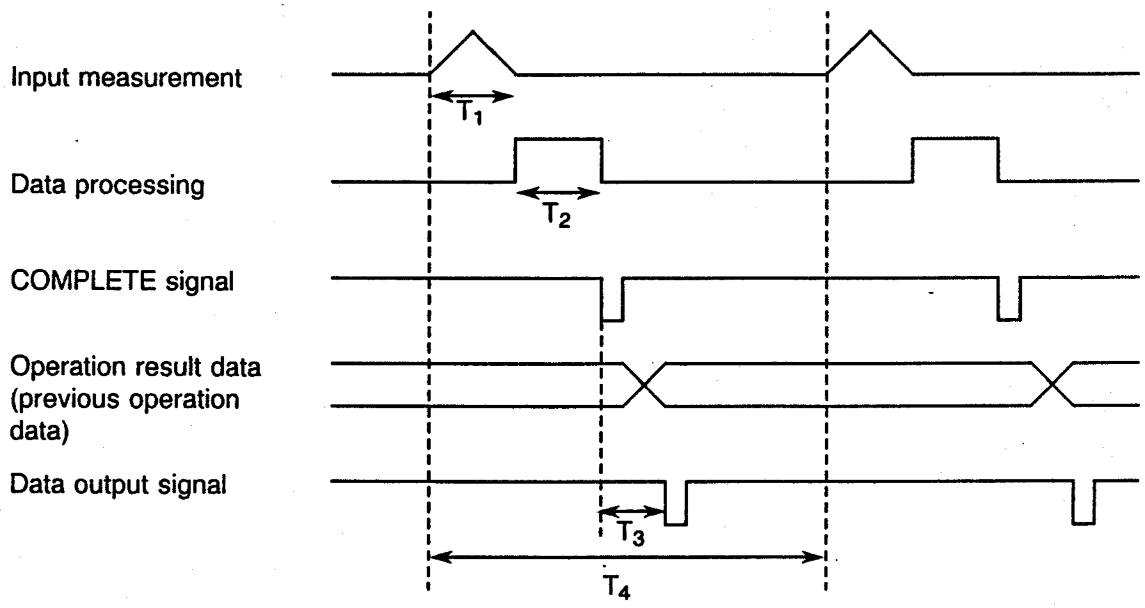
- Data Output Signal

  DATA.OUT : TTL level negative pulse



5.11.3 Output Timing

(1) Sampling mode : RUN



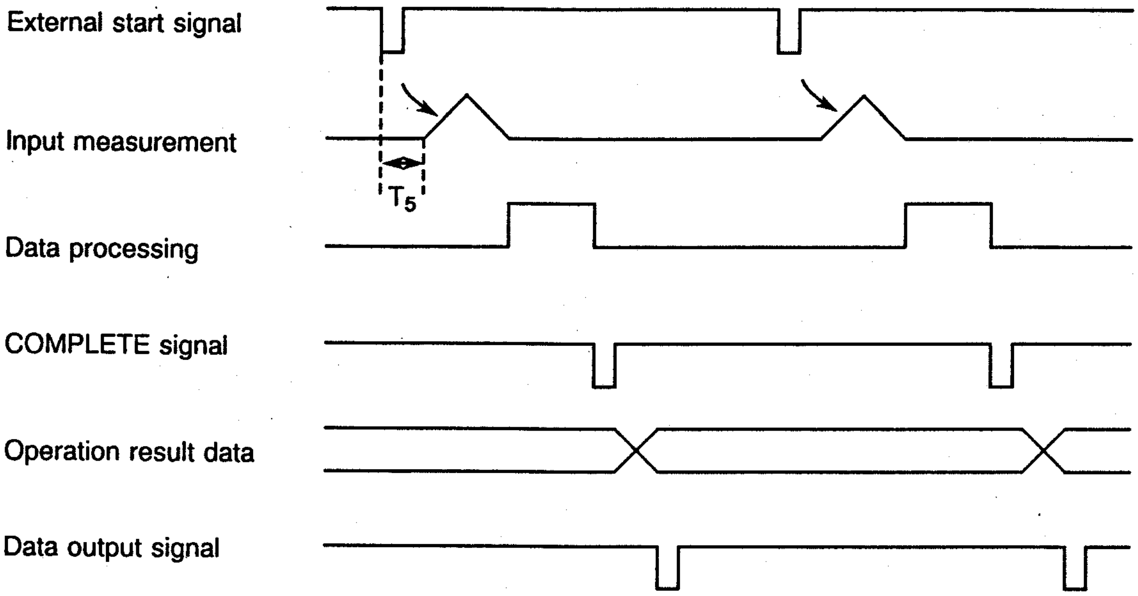
T_1 : Depends on the measurement function and the integration time (IT).

T_2 : True value enumeration, operation execution time

T_3 : 450µs to 600µs (DOUT mode: 0 when outputting only to display)

T_4 : Depends on sampling interval (SI).

(2) Sampling mode : SINGLE



T_5 : When trigger delay is "TD" > 0ms, depends on "TD". When the trigger delay is 0ms, the time is approximately 200μsec.

Note : An external start during the measurement operation (from external start to data output) is effective only once.

6. MAINTENANCE, CHECK, CALIBRATION

6.1 Before Asking for Repair

In case trouble occurs while using the R6871E/E-DC, always check the following check items before calling the reception desk of the sales division or agency nearest your place of business. The locations and phone numbers are given at the back of this manual. Once we are called, the repair will be charged, even if the repair is as simple as shown below. Please check the following check items well before calling.

Condition	Cause	Treatment
The display does not appear.	● The power fuse is broken.	● Replace the broken fuse with the attached fuse, referring to Section 1.3.3-(4).
The measurement value is unstable, or the value is abnormal.	● The setting of the function range, etc. is incorrect. ● The setting of the frequency (50/60 Hz) is wrong.	● Check the function and range again. ● Set the correct frequency matching the AC power source. [See Section 2.8.17.]
Measurement is not done even when input signal is applied.	● The cable is connected to the wrong input terminal ● The key setting of the input terminal is wrong.	● Connect the input cable to the correct input terminal. ● Set the key correctly.

6.2 Error Messages

(1) Errors that may occur during normal operation

Error 1	Error occurred during measurement with this device. (hardware failure)
Error 2	Tried to execute calibration, but the EXT CAL switch on the rear panel is not ON. Tried to execute calibration, but the calibration value input via the panel or the GPIB is out of the setting range.
Error 3	Tried to execute calibration, but the calibration value is out of the allowable range.
Error 4	Tried to set the parameter via the panel, but the setting value is out of the setting range.
Error 5	Tried to execute operation, but the setting of the constant is inappropriate.
Error 6	Operation error occurred.
Error 7	The RECALL key was pressed to enter the recall mode, but no stored data exists.
Error 8	The data number recalled from the data memory does not exist.

Error 10		• Data corresponding to the listener code sent from the GPIB is not found.
Error 11		• The string length of the listener code sent from the GPIB exceeded 50 characters.
Error 12		• Inappropriate use conditions or data for the listener code sent from the GPIB.

(2) Error that may occur during self test

Error	RO	• Error occurred during program ROM test.
Error 1	CA	• Error occurred during calibration data test.
Error	RA	• Error occurred during RAM test.
Error 1	AD	• Error occurred in the basic measurement operation test.

CAUTION

In case "Error 1", self test error or error except the above occurred, the R6871E/E-DC must be failing. Turn off the power, and call the service center shown at the end of this manual.

6.3 Storage

When not using the R6871E/E-DC for a considerable time, cover the device with vinyl cover, place it in a carton box, and store the box where there is little humidity and not affected by direct sun ray. The storage temperature range is –25°C to +70°C.

6.4 Calibration

This section gives explanation on how to calibrate the R6871E/E-DC. Calibration must be done once every guaranteed period (6 months) to satisfy the likelihood of measurement.
The R6871E/E-DC can perform calibration of each range of direct current/alternative current voltage and direct current/alternative current current measurement or resistance measurement via the front panel keys or by the GPIB program.

6.4.1 Preparation for Calibration

(1) Instruments necessary for calibration

The instruments necessary for calibration are as shown in Table 6-1.
Use instruments with performance as shown in the following table or equivalent.

Table 6-1 Instruments Necessary for Calibration

Calibration Instrument	Range	Likelihood
Standard direct current voltage generator	± 20mV to ± 1000V	± 0.0005% or more
Standard direct current current generator	± 1μA to ± 2A	± 0.01% or more
Standard alternating current voltage generator	10mVrms to 500Vrms Frequency 20Hz to 1MHz	± 0.005% or more
Standard alternating current current generator	± 1μA to ± 2A	± 0.01% or more
Standard resistor	10Ω 100Ω 1kΩ 10kΩ 100kΩ 1MΩ	± 0.001% or more
	10MΩ	± 0.003% or more
	100MΩ	± 0.01% or more
	1000MΩ	± 0.1% or more

(2) Tolerances of calibration data

The tolerances of calibration data to be set using each function and range are listed in Table 6-2. Any calibration can be made to the desired value provided that the calibration data stays within the appropriate tolerance.

Table 6-2 Tolerances of Calibration Data

Function	Range	Calibration point	Tolerance
VDC	200mV	Zero	–2mV to 2mV
		Full-scale	160mV to 200mV
	2000mV	Zero	–20mV to 20mV
		Full-scale	1600mV to 2000mV
	10V	Zero	–0.1V to 0.1V
		Full-scale	8V to 12V
	20V	Zero	–0.2V to 0.2V
		+ Full-scale	16V to 20V
		– Full-scale	–16V to –20V
	200V	Zero	–2V to 2V
		Full-scale	160V to 200V
	1000V	Zero	–10V to 10V
		Full-scale	800V to 1000V
VAC* V(AC + DC)*	200mV	1/10 Full-scale	16mV to 20mV
		Full-scale	160mV to 200mV
	2000mV	1/10 Full-scale	160mV to 200mV
		Full-scale	1600mV to 2000mV
	20V	1/10 Full-scale	1.6V to 2V
		Full-scale	16V to 20V

* : Only the R6871E is enabled.

Table 6-2 Tolerances of Calibration Data (cont'd)

Function	Range	Calibration point	Tolerance
VAC* V(AC + DC)*	200V	Zero	16V to 20V
		Full-scale	160V to 200V
	500V	1/10 Full-scale	46V to 50V
		Full-scale	460V to 500V
ADC*	2000µA	Zero	–20µV to 20µV
		Full-scale	1600µA to 2000µA
	20mA	Zero	–0.2mA to 0.2mA
		Full-scale	16mA to 20mA
	200mA	Zero	–2mA to 2mA
		Full-scale	160mA to 200mA
	2000mA	Zero	–20mA to 20mA
		Full-scale	1600mA to 2000mA
AAC* A(AC + DC)*	2000µA	1/10 full-scale	160µA to 200µA
		Full-scale	1600µA to 2000µA
	20mA	1/10 full-scale	1.6mA to 2mA
		Full-scale	16mA to 20mA
	200mA	1/10 full-scale	16mA to 20mA
		Full-scale	160mA to 200mA
	2000mA	1/10 full-scale	160mA to 200mA
		Full-scale	1600mA to 2000mA
2WΩ	10Ω to 1000MΩ	Zero	0Ω

* : Only the R6871E is enabled.

Table 6-2 Tolerances of Calibration Data (cont'd)

Function	Range	Calibration point	Tolerance
4WΩ	10Ω	Zero	0Ω
		Full-scale	8Ω to 12Ω
	100Ω	Zero	0Ω
		Full-scale	80Ω to 120Ω
	1000Ω	Zero	0Ω
		Full-scale	800Ω to 1200Ω
	10kΩ	Zero	0Ω
		Full-scale	8kΩ to 12kΩ
	100kΩ	Zero	0Ω
		Full-scale	80kΩ to 120kΩ
	1000kΩ	Zero	0Ω
		Full-scale	800kΩ to 1200kΩ
	10MΩ	Zero	0Ω
		Full-scale	8MΩ to 12MΩ
	100MΩ	Zero	0Ω
		Full-scale	80MΩ to 120MΩ
	1000MΩ	Zero	0Ω
		Full-scale	800MΩ to 1200MΩ

* : Only the R6871E is enabled.

(3) Power supply and frequency

The AC power supply must be within the specified voltage (100V ± 10%, 120V ± 10%, 220V ± 10%, 240V (+ 10V, −33V)).
The power supply frequency is 50Hz or 60Hz.

(4) Environment for calibration

Calibration must be done under the following environment.
Temperature : +23°C ±5°C
Humidity : 70% or less
Also avoid dust, vibration, noise, etc.

(5) Pre-heating time

Although all functions activate upon power-on, 60 minutes or more should be allowed for warm-up to ensure the required accuracy.

(6) It is useful to log the date of calibration and the deadline for the next calibration on cards or stickers after each calibration ends.

CAUTION

When connecting the power cable, always check that the POWER switch is OFF.

6.4.2 Common Operation and Notes

(1) Perform the following before each measurement calibration.

① Set the EXT CAL switch on the rear side of the panel ON.

② Check that the ECAL lamp on the lower left of the front panel is on.

(2) The calibration of the direct current voltage measurement must be done first.

The remaining calibrations can be done in any order.

6.4.3 Calibration of DC Voltage Measurement

Instrument used : Standard direct current voltage generator

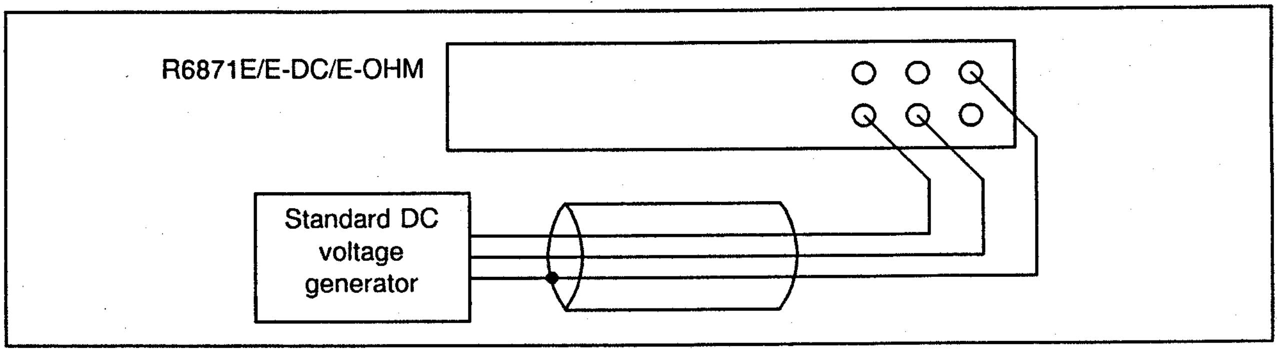
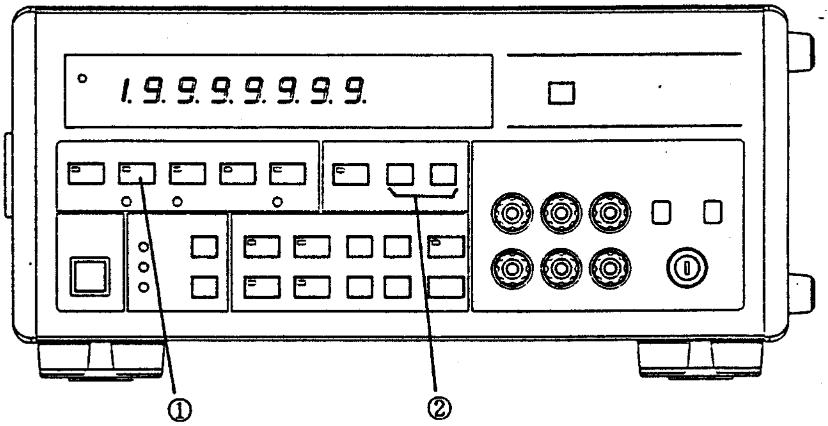


Figure 6-1 Calibration of DC Voltage Measurement

0-point calibration and full-scale calibration of each range is done as calibration of the DC voltage measurement.

[Calibration]



These numbers indicate the following procedure numbers

Setting the function

(1) Press ⎓ V DC to set the function at DC voltage measurement.

Setting 20V-range

(2) Use the UP or DOWN key to set the measurement range at 20V. Check at this time that the HIGH lamp under the digital display section is lit.

Connecting the standard DC voltage generator

(3) As shown in Figure 6-1, connect the standard DC voltage generator with the attached cable (MI-37) between the HI-LO terminals of the lower input terminal.

20V-range 0-point calibration

(1) Set the measurement range at 20V.

(2) Set the output of the standard DC voltage generator at 0V.

0 V

(3) Press SHIFT.

(4) Press 0.

(5) Press ENTER.

0.000000 V

20V-range + full-scale calibration

(1) Set the output of the standard DC voltage generator at 18V.

18 V

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ , in this order.

(4) Press ENTER ☐ .

18.000000 V

20V-range -full-scale calibration

(1) Set the output of the standard DC voltage generator at -18V.

– 18 V

(2) Press SHIFT ☐ .

(3) Press –☐ 1☐ 8☐ , in this order.

(4) Press ENTER ☐ .

– 18.000000 V

10V-range 0-point calibration

(1) Set the measurement range to the 10V range.
(The 10V range can be set at any time while the ECAL lamp stays lit.)
Check at this time that the LOW lamp under the digital display sectioin is lit.

(2) Set the output of the standard DC voltage generator at 0V.

`0 V`

(3) Press SHIFT ☐ .

(4) Press 0☐ .

(5) Press ENTER ☐ .

`0.000000 V`

When there is offset voltage, 10V-rang 0-point calibration.

If there is offset voltage in the generator and it does not become 0V even if the standard DC voltage generator is set at 0V, operate as follows.

(Example)
When there is 20μV offset voltage

`.00002 V`

(1) Press SHIFT ☐ .

(2) Press .☐ 0☐ 0☐ 0☐ 0☐ 2☐ ,
in this order.

(3) Press ENTER ☐ .

`0.000020 V`

10V-range full-scale calibration

(1) Set the output of the standard DC voltage generator at 10V.

10 V

(2) Press SHIFT □ .

(3) Press 1 □ 0 □ , in this order.

(4) Press ENTER □ .

10.000000 V

When there is setting error, 10V-range 0-point calibration

When the standard DC voltage generator has set error of -0.0005%, perform the following steps.

(1) Set the output of the standard DC voltage generator at 10V.

9.99995 V

(2) Press SHIFT □ .

(3) Press 9 □ . □ 9 □ 9 □ 9 □ 9 □ 5 □ , in this order.

(4) Press ENTER □ .

9.999950 V

200mV-range 0-point calibration

(1) Use the UP ☐ or DOWN ☐ key to set the measurement range at 200mV.

(2) Set the output of the standard DC voltage generator at 0V.

0 mV

(3) Press SHIFT ☐ .

(4) Press 0 ☐ .

(5) Press ENTER ☐ .

0.0 0 0 0 mV

200mV-range full-scale calibration

(1) Set the output of the standard DC voltage generator at 180mV.

1 8 0 mV

(2) Press SHIFT ☐ .

(3) Press 1 ☐ 8 ☐ 0 ☐ , in this order.

(4) Press ENTER ☐ .

1 8 0.0 0 0 0 mV

2000mV-range 0-point calibration

(1) Press UP ☐ key to set the measurement range at 2000mV.

(2) Set the output of the standard DC voltage generator at 0V.

0 mV

(3) Press SHIFT ☐ .

(4) Press 0☐ .

(5) Press ENTER ☐ .

0.0000 mV

2000mV-range full-scale calibration

(1) Set the output of the standard DC voltage generator at 1.8V.

1800 mV

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1800.0000 mV

200V-range 0-point calibration

(1) Set the measurement range at 200V.

(2) Set the output of the standard DC voltage generator at 0V.

0 V

(3) Press SHIFT ☐ .

(4) Press 0 ☐ .

(5) Press ENTER ☐ .

0.00000 V

200V-range full-scale calibration

(1) Set the output of the standard DC voltage generator at 180V.

180 V

(2) Press SHIFT ☐ .

(3) Press 1 ☐ 8 ☐ 0 ☐ , in this order.

(4) Press ENTER ☐ .

180.0000 V

1000V-range 0-point calibration

(1) Set the measurement range at 1000V.

(2) Set the output of the standard DC voltage generator at 0V.

0 V

(3) Press SHIFT ☐ .

(4) Press 0☐ .

(5) Press ENTER ☐ .

0.0000 V

1000V-range full-scale calibration

(1) Set the output of the standard DC voltage generator at 1000V.

1000 V

(2) Press SHIFT ☐ .

(3) Press 1☐ 0☐ 0☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1000.0000 V

Note : The internal electric parts will be heated by the 1000V-range calibration. Wait enough till the parts are well cooled, till performing the calibration of the next function.

CAUTION

[In case error was found after pressing the ENTER ☐ key]
For instance, when the 200V-range full-scale calibration was done with the wrong value, perform the 200V-range full-scale calibration from the beginning again.

6.4.4 Calibration of AC Voltage Measurement : Only the R6871E is enabled.

Instrument used : Standard AC voltage generator

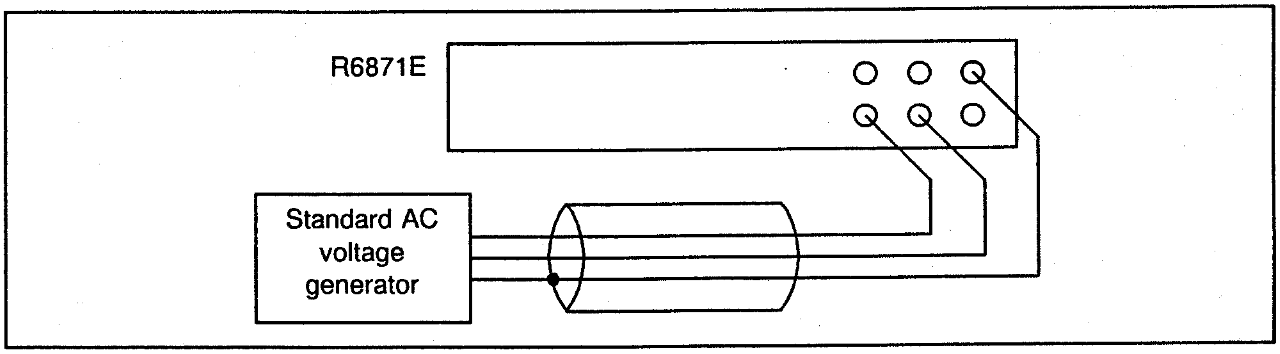
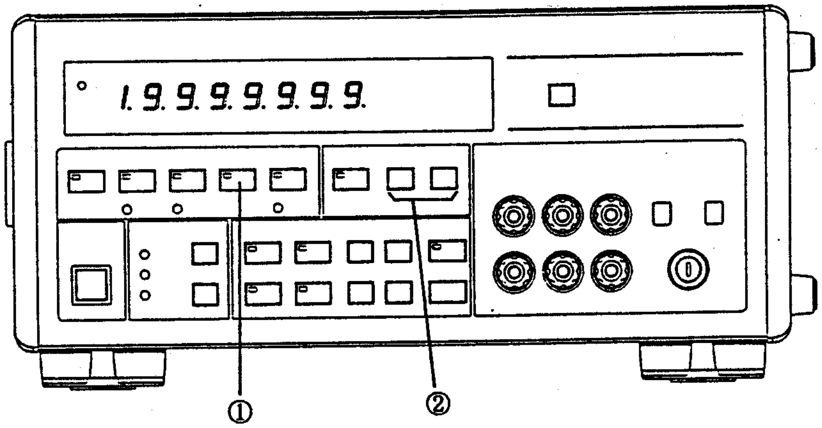


Figure 6-2 Calibration of AC Voltage Measurement

1/10 full-scale calibration and full-scale calibration of each range are done in the calibration of the AC voltage measurement.

[Calibration]



[These numbers indicate the following procedure numbers]

Setting the function

(1) Press ~V AC to set the function at AC voltage measurement.

Setting 20V-range

(2) Use the UP or DOWN key to set the measurement range at 20V.

Connecting the standard AC voltage generator

(3) As shown in Figure 6-2, connect the standard AC voltage generator with the attached cable (MI-37) between the HI-LO terminals of the lower input terminal.

20V-range full-scale calibration

(1) Set the output of the standard AC voltage generator at 18V, 1kHz.

18 V

(2) Press SHIFT .

(3) Press 1 8 , in this order.

(4) Press ENTER .

18.0000 V

20V-range 1/10 full-scale calibration

(1) Set the output of the standard AC voltage generator at 1.8V, 1kHz.

1.8 V

(2) Press SHIFT □ .

(3) Press 1□ .□ 8□ ,
in this order.

(4) Press ENTER □ .

1.8000 V

200mV-range full-scale calibration

(1) Set the measurement range at 200mV.

(2) Set the output of the standard AC voltage generator at 180mV, 1kHz.

180 mV

(3) Press SHIFT □ .

(4) Press 1□ 8□ 0□ ,
in this order.

(5) Press ENTER □ .

180.000 mV

200mV-range 1/10 full-scale calibration

(1) Set the output of the standard AC voltage generator at 18mV, 1kHz.

1 8 mV

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ , in this order.

(4) Press ENTER ☐ .

1 8.0 0 0 mV

2000mV-range full-scale calibration

(1) Set the measurement range at 2000mV.

(2) Set the output of the standard AC voltage generator at 1800mV, 1kHz.

1 8 0 0 mV

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(5) Press ENTER ☐ .

1 8 0 0.0 0 mV

2000mV-range 1/10 full-scale calibration

(1) Set the output of the standard AC voltage generator at 180mV, 1kHz.

1 8 0 mV

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1 8 0.0 0 mV

200V-range full-scale calibration

(1) Set the measurement range at 200V.

(2) Set the output of the standard AC voltage generator at 180V, 1kHz.

180 V

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ 0☐ , in this order.

(5) Press ENTER ☐ .

180.000 V

200V-range 1/10 full-scale calibration

(1) Set the output of the standard AC voltage generator at 18V, 1kHz.

18 V

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ , in this order.

(4) Press ENTER ☐ .

18.000 V

500V-range full-scale calibration

(1) Set the measurement range at 500V.

(2) Set the output of the standard AC voltage generator at 480V, 1kHz.

480 V

(3) Press SHIFT .

(4) Press 4 8 0 , in this order.

(5) Press ENTER .

480.00 V

500V-range 1/10 full-scale calibration

(1) Set the output of the standard AC voltage generator at 48V, 1kHz.

48 V

(2) Press SHIFT .

(3) Press 4 8 , in this order.

(4) Press ENTER .

48.00 V

CAUTION

[In case error was found after pressing the ENTER key]
For instance, when the 200V-range full-scale calibration was done with the wrong value, perform the 200V-range full-scale calibration from the beginning again.

6.4.5 Calibration of DC Current Measurement: Only the R6871E is enabled.

Instrument used : Standard DC current generator

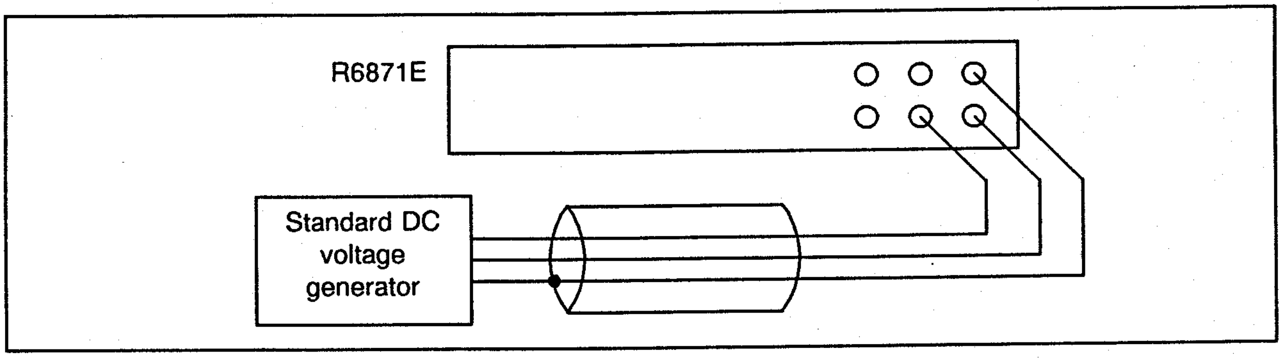
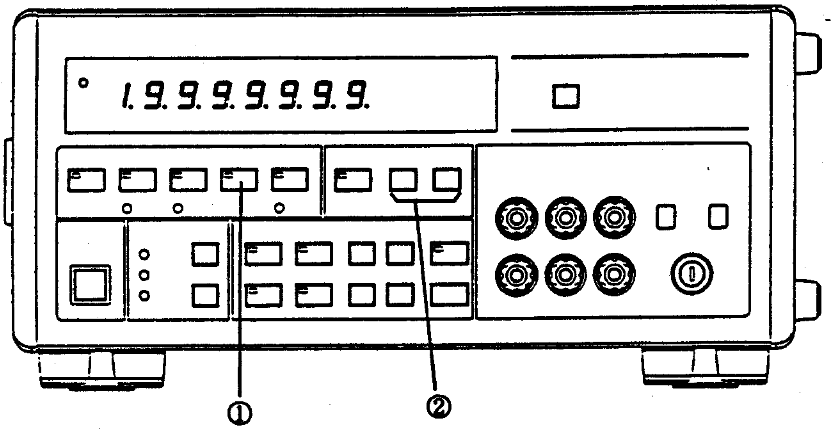


Figure 6-3 Calibration of DC Current Measurement

0-point calibration and full-scale calibration of each range are done as calibration of the DC current measurement.

[Calibration]



These numbers indicate the following procedure numbers

Setting the function

(1) Press ⎓ A DC ☐ to set the function at DC voltage measurement.

Setting 200mA-range

(2) Use the UP ☐ or DOWN ☐ key to set the measurement range at 200mA.

Connecting the standard DC current generator

(3) As shown in Figure 6-3, connect the standard DC current generator with the attached cable (MI-37) between the HI-LO terminals of the lower input terminal.

200mA-range 0-point calibration

(1) Open the input of the R6871E.

0 mA

(2) Press SHIFT ☐ .

(3) Press 0 ☐ .

0.0 0 0 0 mA

(4) Press ENTER ☐ .

200mA-range full-scale calibration

(1) Connect the input cable and set the output of the reference DC current generator to the 180mA range.

180 mA

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ , in this order.

(4) Press ENTER ☐ .

180.0000 mA

2000μA-range 0-point calibration

(1) Set the measurement range at 2000μA.

(2) Open the input of the R6871E.

0 μA

(3) Press SHIFT ☐ .

(4) Press 0☐ .

(5) Press ENTER ☐ .

0.000 μA

2000μA-range full-scale calibration

(1) Set the output of the standard DC current generator at 1800μA by connecting the input cable.

1800 μA

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1800.000 μA

20mA-range 0-point calibration

(1) Set the measurement range at 20mA.

(2) Open the input of the R6871E.

0 mA

(3) Press SHIFT ☐ .

(4) Press 0☐ .

(5) Press ENTER ☐ .

0.00000 mA

20mA-range full-scale calibration

(1) Set the output of the standard DC current generator at 18mA by connecting the input cable.

18 mA

(2) Press SHIFT ☐ .

(3) Press 1☐8☐ , in this order.

(4) Press ENTER ☐ .

18.00000 mA

2000mA-range 0-point calibration

(1) Set the measurement range at 2000mA.

(2) Open the input of the R6871E.

0 mA

(3) Press SHIFT ☐ .

(4) Press 0☐ .

(5) Press ENTER ☐ .

0.000 mA

2000mA-range full-scale calibration

(1) Set the output of the standard DC current generator at 1800mA by connecting the input cable.

1 8 0 0 mA

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1 8 0 0.0 0 0 mA

CAUTION

[In case error was found after pressing the ENTER ☐ key]
For instance, when the 200mA-range full-scale calibration was done with the wrong value, perform the 200mA-range full-scale calibration from the beginning again.

6.4.6 Calibration of AC Current Measurement: Only the R6871E is enabled.

Instrument used : Standard AC current generator

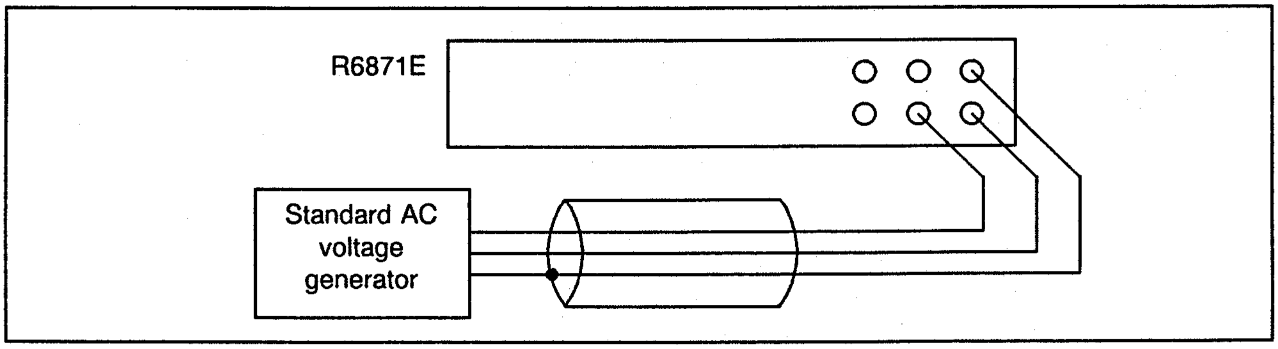
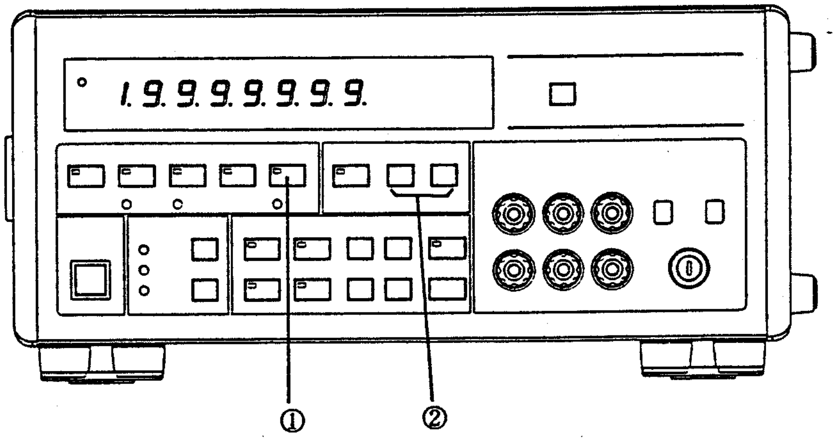


Figure 6-4 Calibration of AC Current Measurement

1/10 full-scale calibration and full-scale calibration of each range are done as calibration of the AC current measurement.

[Calibration]



[These numbers indicate the following procedure numbers]

Setting the function

(1) Press ~A AC ☐ to set the function at AC current measurement.

Setting 200mA-range

(2) Use the UP ☐ or DOWN ☐ key to set the measurement range at 200mA.

Connecting the standard AC current generator

(3) As shown in Figure 6-4, connect the standard AC current generator with the attached cable (MI-37) to the lower input terminal.

200mA-range full-scale calibration

(1) Set the output of the standard AC current generator at 180mA, 1kHz.

1 8 0 mA

(2) Press SHIFT ☐ .

(3) Press 1 ☐ 8 ☐ 0 ☐ , in this order.

(4) Press ENTER ☐ .

1 8 0.0 0 0 mA

200mA-range 1/10 full-scale calibration

(1) Set the output of the standard AC current generator at 18mA, 1kHz.

1 8 mA

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ ,
in this order.

(4) Press ENTER ☐ .

1 8.0 0 0 mA

2000µA-range full-scale calibration

(1) Set the measurement range at 2000µA.

(2) Set the output of the standard AC current generator at 1800µA, 1kHz.

1 8 0 0 µA

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ 0☐ 0☐ ,
in this order.

1 8 0 0.0 0 µA

(5) Press ENTER ☐ .

2000µA-range 1/10 full-scale calibration

(1) Set the output of the standard AC current generator at 180µA.

1 8 0 µA

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ ,
in this order.

(4) Press ENTER ☐ .

1 8 0.0 0 µA

20mA-range full-scale calibration

(1) Set the measurement range at 20mA.

(2) Set the output of the standard AC current generator at 18mA, 1kHz.

1 8 mA

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ , in this order.

(5) Press ENTER ☐ .

1 8.0 0 0 0 mA

20mA-range 1/10 full-scale calibration

(1) Set the output of the standard AC current generator at 1.8mA, 1kHz.

1.8 mA

(2) Press SHIFT ☐ .

(3) Press 1☐ .☐ 8☐ , in this order.

(4) Press ENTER ☐ .

1.8 0 0 0 mA

2000mA-range full-scale calibration

(1) Set the measurement range at 2000mA.

(2) Set the output of the standard AC current generator at 1800mA, 1kHz.

1 8 0 0 mA

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(5) Press ENTER ☐ .

1 8 0 0.0 0 mA

2000mA-range 1/10 full-scale calibration

(1) Set the output of the standard AC current generator at 180mA, 1kHz.

1 8 0 mA

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1 8 0.0 0	**mA**

CAUTION

[In case error was found after pressing the ENTER ☐ key]
For instance, when the 200mA-range full-scale calibration was done with the wrong value, perform the 200mA-range full-scale calibration from the beginning again.

6.4.7 Calibration of (DC + AC) Voltage Measurement
: Only the R6871E is enabled.

Instrument used : Standard DC voltage generator

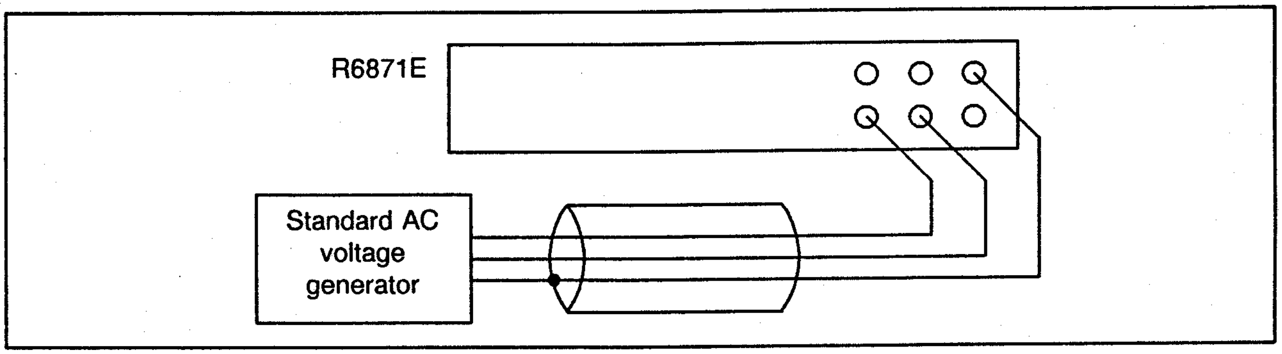
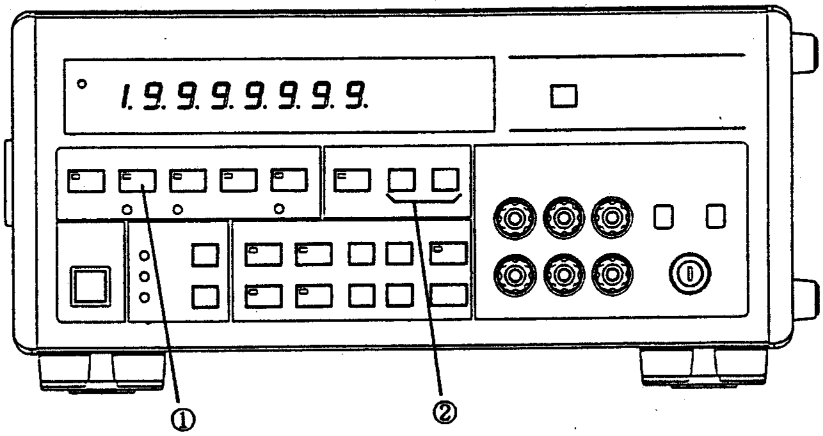


Figure 6-5 Calibration of (DC + AC) Voltage Measurement

AC voltage 1/10 full-scale calibration and full-scale calibration of each AC voltage range are done as calibration of the (DC + AC) voltage measurement.

[Calibration]



[These numbers indicate the following procedure numbers]

Setting the function

(1) Press ~V AC ☐ ~V AC ☐
to light the AC + DC lamp, and to set the function at (DC + AC) voltage measurement.

Setting 20V-range

(2) Use the UP ☐ or DOWN ☐ key to set the measurement range at 20V.

Connecting the standard AC voltage generator

(3) As shown in Figure 6-5, connect the standard AC voltage generator with the attached cable (MI-37) between the HI-LO terminals of the lower input terminal.

20V-range 1/10 full-scale calibration

(1) Set the measurement range at 20V.

(2) Set the output of the standard AC voltage generator at 1.8V and 1kHz.

1.8 V

(3) Press SHIFT ☐ .

(4) Press 1☐ .☐ 8☐ ,
in this order.

(5) Press ENTER ☐ .

1.8 0 0 0 V

20V-range full-scale calibration

(1) Set the output of the standard AC voltage generator at 18V and 1kHz.

18 V

(2) Press SHIFT ☐ .

(3) Press 1 ☐ 8 ☐ , in this order.

(4) Press ENTER ☐ .

18.0000 V

200mV-range 1/10 full-scale calibration

(1) Use the UP ☐ or DOWN ☐ key to set the measurement range at 200mV.

(2) Set the output of the standard AC voltage generator at 18mV and 1kHz.

18 mV

(3) Press SHIFT ☐ .

(4) Press 1 ☐ 8 ☐ , in this order.

(5) Press ENTER ☐ .

18.000 mV

200mV-range full-scale calibration

(1) Set the output of the standard AC voltage generator at 180mV and 1kHz.

180 mV

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ , in this order.

(4) Press ENTER ☐ .

180.000 mV

2000mV-range 1/10 full-scale calibration

(1) Set the measurement range at 2000mV.

(2) Set the output of the standard AC voltage generator at 180mV and 1kHz.

180 mV

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ 0☐ , in this order.

(5) Press ENTER ☐ .

180.00 mV

2000mV-range full-scale calibration

(1) Set the output of the standard AC voltage generator at 1.8V and 1kHz.

1800 mV

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(4) Press ENTER ☐ .

1800.00 mV

200V-range 1/10 full-scale calibration

(1) Set the measurement range at 200V.

(2) Set the output of the standard AC voltage generator at 18V and 1kHz.

18 V

(3) Press SHIFT .

(4) Press 1 8 , in this order.

(5) Press ENTER .

18.000 V

200V-range full-scale calibration

(1) Set the output of the standard AC voltage generator at 180V and 1kHz.

180 V

(2) Press SHIFT .

(3) Press 1 8 0 , in this order.

(4) Press ENTER .

180.000 V

500V-range 1/10 full-scale calibration

(1) Set the measurement range at 500V.

(2) Set the output of the standard AC voltage generator at 48V and 1kHz.

48 V

(3) Press $\overset{\text{SHIFT}}{\boxed{}}$.

(4) Press $4\boxed{}\,8\boxed{}$, in this order.

(5) Press $\overset{\text{ENTER}}{\boxed{}}$.

48.00 V

500V-range full-scale calibration

(1) Set the output of the standard AC voltage generator at 480V and 1kHz.

480 V

(2) Press $\overset{\text{SHIFT}}{\boxed{}}$.

(3) Press $4\boxed{}\,8\boxed{}\,0\boxed{}$, in this order.

(4) Press $\overset{\text{ENTER}}{\boxed{}}$.

480.00 V

CAUTION

[In case error was found after pressing the $\overset{\text{ENTER}}{\boxed{}}$ key]
For instance, when the 200V-range full-scale calibration was done with the wrong value, perform the 200V-range full-scale calibration from the beginning again.

6.4.8 Calibration of (DC + AC) Current Measurement
: Only the R6871E is enabled.

Instrument used : Standard AC current generator

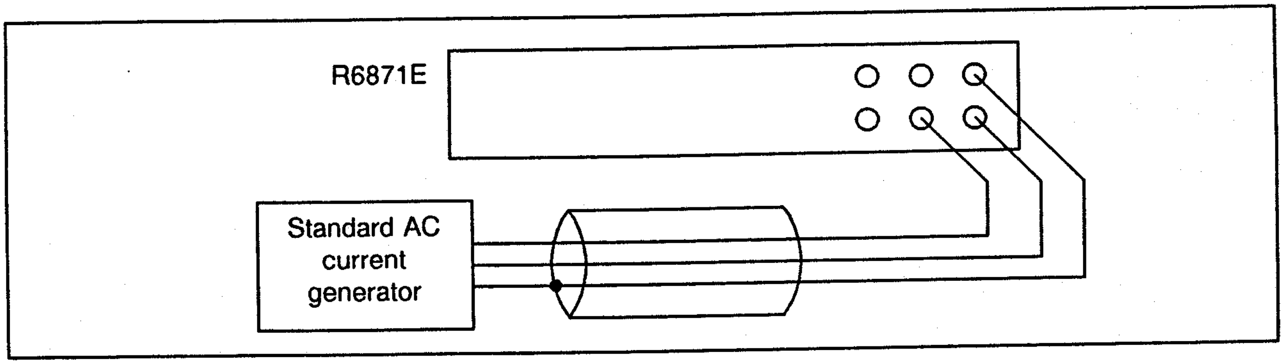
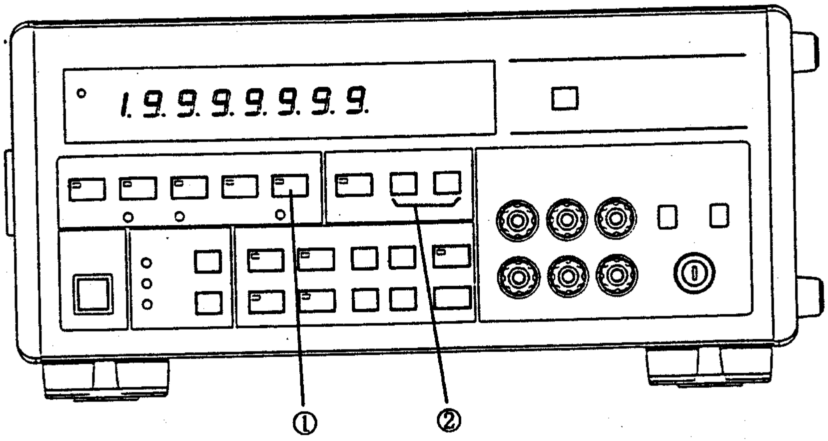


Figure 6-6 Calibration of (DC + AC) Current Measurement

1/10 full-scale calibration and full-scale calibration of each AC range are done as calibration of the (DC + AC) current measurement.

[Calibration]



[These numbers indicate the following procedure numbers]

Setting the function

(1) Press ~A AC ~A AC
and light the AC + DC lamp to set the function at (DC + AC) current measurement.

Setting 200mA-range

(2) Use the UP or DOWN key to set the measurement range at 200mA.

Connecting the standard AC current generator

(3) As shown in Figure 6-6, connect the standard AC current generator with the attached cable (MI-37) between the HI-LO terminals of the lower input terminal.

200mA-range 1/10 full-scale calibration

(1) Set the output of the standard AC current generator at 18mA and 1kHz.

1 8 mA

(2) Press SHIFT .

(3) Press 1 8 ,
in this order.

(4) Press ENTER .

1 8.0 0 0 mA

200mA-range full-scale calibration

(1) Set the output of the standard AC current generator at 180mA and 1kHz.

1 8 0 mA

(2) Press ☐ .
SHIFT

(3) Press 1☐8☐0☐ ,
in this order.

(4) Press ☐ .
ENTER

1 8 0.0 0 0 mA

2000μA-range 1/10 full-scale calibration

(1) Set the measurement range at 2000μA.

(2) Set the output of the standard AC current generator at 180μA and 1kHz.

1 8 0 μA

(3) Press ☐ .
SHIFT

(4) Press 1☐8☐0☐ ,
in this order.

(5) Press ☐ .
ENTER

1 8 0.0 0 μA

2000µA-range full-scale calibration

(1) Set the output of the standard AC current generator at 1800µA and 1kHz.

1 8 0 0 µA

(2) Press SHIFT ☐ .

(3) Press 1 ☐ 8 ☐ 0 ☐ 0 ☐ , in this order.

(4) Press ENTER ☐ .

1 8 0 0.0 0 µA

20mA-range 1/10 full-scale calibration

(1) Set the measurement range at 20mA.

(2) Set the output of the standard AC current generator at 1.8mA and 1kHz.

1.8 mA

(3) Press SHIFT ☐ .

(4) Press 1 ☐ . ☐ 8 ☐ , in this order.

(5) Press ENTER ☐ .

1.8 0 0 0 mA

20mA-range full-scale calibration

(1) Set the output of the standard AC current generator at 18mA and 1kHz.

1 8 mA

(2) Press SHIFT ☐ .

(3) Press 1 ☐ 8 ☐ , in this order.

(4) Press ENTER ☐ .

1 8.0 0 0 0 mA

2000mA-range 1/10 full-scale calibration

(1) Set the measurement rage at 2000mA.

(2) Set the output of the standard AC current generator at 180mA and 1kHz.

```
                180 mA
```

(3) Press SHIFT ☐ .

(4) Press 1☐ 8☐ 0☐ , in this order.

(5) Press ENTER ☐ .

```
    180.00        mA
```

2000mA-range full-scale calibration

(1) Set the output of the standard AC current generator at 1800mA and 1kHz.

```
              1800 mA
```

(2) Press SHIFT ☐ .

(3) Press 1☐ 8☐ 0☐ 0☐ , in this order.

(4) Press ENTER ☐ .

```
  1800.00         mA
```

CAUTION

[In case error was found after pressing the ENTER ☐ key]
For instance, when the 200mA-range full-scale calibration was done with the wrong value, perform the 200mA-range full-scale calibration from the beginning again.

6.4.9 Calibration of Resistance Measurement

Calibration of 2-wire resistance measurement, 4-wire resistance measurement, and network resistance measurement is done by a single process.

Instrument used : Standard resistor

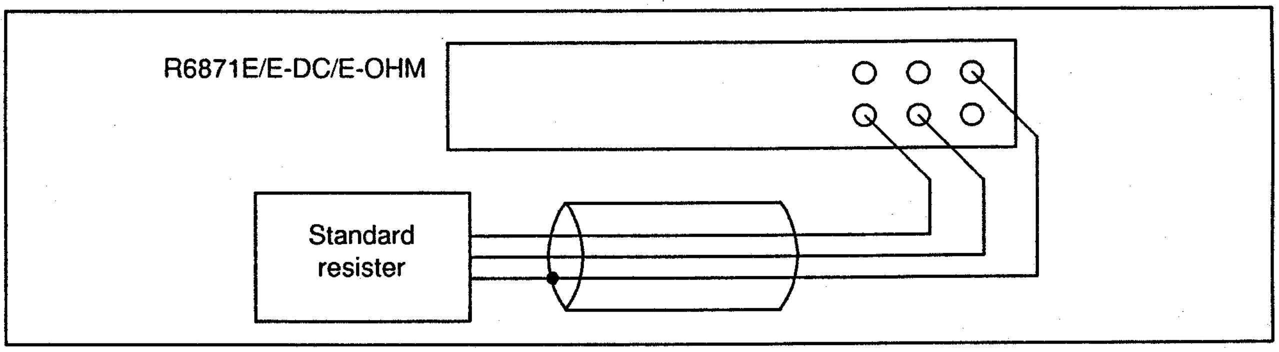


Figure 6-7 0-point Calibration of 2-wire Resistance Measurement

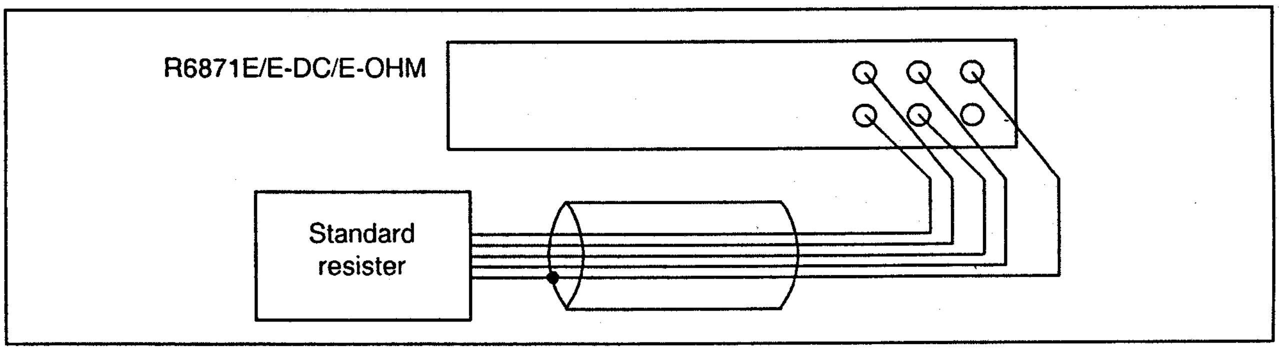


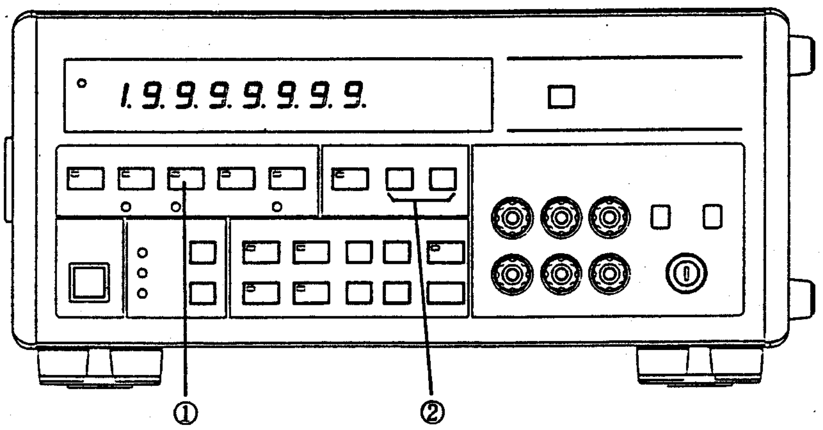
Figure 6-8 Full-scale Calibration of 4-wire Resistance Measurement

0-point calibration of 2-wire resistance measurement and 0-point calibration and full-scale calibration of 4-wire resistance measurement of each range is done in calibration of the resistance measurement.

Network resistance measurement is executed by calibrating of 4-wire resistance measuremnt.

[Calibration]

0-point calibration of 2-wire resistance is first performed, and then, 0-point and full-scale calibration of 4-wire resistance is performed.



[These numbers indicate the following procedure numbers]

Setting the function

(1) Press $\overset{\text{2W}\Omega}{\boxed{\qquad}}$ to set the function at 2-wire resistance measurement.

Setting the 10β range

(2) Use the $\overset{\text{UP}}{\boxed{\quad}}$ or $\overset{\text{DOWN}}{\boxed{\quad}}$ key to set the measurement range at 10β.

Connection of the standard resistor

(3) As shown in Figure 6-7, connect the attached cable (MI-37) between the HI-LO terminals of the lower input terminal.

(4) Calibration of all the 2-wire resistance range is executed at once by performing 0-point calibration of a single range.

10Ω-range 0-point calibration

(1) Set the measurement range at 10Ω.
(2) Short-circuit the clip at the end of the cable.

0 Ω

(3) Press SHIFT ☐ .
(4) Press 0 ☐ .
(5) Press ENTER ☐ .

0.00000 Ω

Next, as shown in Figure 6-8, connect the attached cable (A01005) between the HI - LO terminals of the input terminal, to perform 0-point and full-scale calibrations for 4-wire resistance measurement. Set the measurement function at 4WΩ (light the 4WΩ lamp.)

10Ω-range 0-point calibration

The 0-point calibration of 4-wire resistance is performed on all the range, once executed on a single range. This is the same as with the 2-wire resistance.

10Ω-range full-scale calibration

(1) Set the measurement range at 10Ω.
(2) Connect the 10Ω standard resistor.

10 Ω

(3) Press SHIFT ☐ .
(4) Press 1 ☐ 0 ☐ , in this order.
(5) Press ENTER ☐ .

10.00000 Ω

100Ω-range full-scale calibration

(1) Set the measurement range at 100Ω.
(2) Connect the 100Ω standard resistor.
(3) Press SHIFT ☐ .
(4) Press 1 ☐ 0 ☐ 0 ☐ , in this order.
(5) Press ENTER ☐ .

100 Ω

100.00000 Ω

1000Ω-range full-scale calibration

(1) Set the measurement range at 1000Ω.
(2) Connect the 1000Ω standard resistor.
(3) Press SHIFT ☐ .
(4) Press 1 ☐ 0 ☐ 0 ☐ 0 ☐ , in this order.
(5) Press ENTER ☐ .

1000 Ω

1000.0000 Ω

10kΩ-range full-scale calibration

(1) Set the measurement range at 10kΩ.

(2) Connect the 10kΩ standard resistor.

10 kΩ

(3) Press SHIFT ☐ .

(4) Press 1 ☐ 0 ☐ , in this order.

(5) Press ENTER ☐ .

10.000000 kΩ

100kΩ-range full-scale calibration

(1) Set the measurement range at 100kΩ.

(2) Connect the 100kΩ standard resistor.

100 kΩ

(3) Press SHIFT ☐ .

(4) Press 1 ☐ 0 ☐ 0 ☐ , in this order.

(5) Press ENTER ☐ .

100.00000 kΩ

1000kΩ-range full-scale calibration

(1) Set the measurement range at 1000kΩ.

(2) Connect the 1000kΩ standard resistor.

1000kΩ

(3) Press SHIFT ☐ .

(4) Press 1 ☐ 0 ☐ 0 ☐ 0 ☐ , in this order.

(5) Press ENTER ☐ .

1000.0000kΩ

10MΩ-range full-scale calibaration

(1) Set the measurement range at 10MΩ.

(2) Connect the 10MΩ standard resistor.

10MΩ

(3) Press SHIFT ☐ .

(4) Press 1 ☐ 0 ☐ , in this order.

(5) Press ENTER ☐ .

10.000000MΩ

100MΩ-range full-scale calibaration

(1) Set the measurement range at 100MΩ.

(2) Connect the 100MΩ standard resistor.

`100 MΩ`

(3) Press SHIFT ☐ .

(4) Press 1☐ 0☐ 0☐ , in this order.

(5) Press ENTER ☐ .

`100.00000 MΩ`

1000MΩ-range full-scale calibaration

(1) Set the measurement range at 1000MΩ.

(2) Connect the 1000MΩ standard resistor.

`1000 MΩ`

(3) Press SHIFT ☐ .

(4) Press 1☐ 0☐ 0☐ 0☐ , in this order.

(5) Press ENTER ☐ .

`1000.0000 MΩ`

CAUTION

1. [In case error was found after pressing the ENTER key]
   For instance, when the 1000Ω-range full-scale calibration was done with the wrong value, perform the 1000Ω-range full-scale calibration from the beginning again.
2. The GUARD terminal must always be short-circuited with the Lo terminal at the cable end, and the front panel Lo-G SHORT switch must be set at Lo-G OPEN.
3. When calibrating ranges of 1MΩ or more, the display value will change if the input cable vibrates. Fix the input cable firmly. If it is affected by external noise, shield the standard resistor.

MEMO

7. SPECIFICATION

7.1 Measurement Functions

7.1.1 DC voltage measurement

Range, maximum voltage display, resolution, input impedance, and maximum input voltage :

Range	7 1/2 digit display		6 1/2 digit display		5 1/2 digit display		4 1/2 digit display	
	Maximum display	Resolution	Maximum display	Resolution	Maximum display	Resolution	Maximum display	Resolution
200mV	199.9999mV	0.1μV	199.9999mV	0.1μV	199.999mV	1μV	199.99mV	10μV
2000mV	1999.9999V	0.1μV	1999.999V	1μV	1999.99V	10μV	1999.9V	100μV
20V	19.999999V	1μV	19.99999V	10μV	19.9999V	100μV	19.999V	1mV
200V	199.99999V	10μV	199.9999V	100μV	199.999V	1mV	199.99V	10mV
1000V	1100.0000V	100μV	1100.000V	1mV	1100.00V	10mV	1100.0V	100mV

Range	Input impedance	Maximum input voltage		
		Bet. input Hi and Lo Terminals	Bet. GUARD and chassis	Bet. GUARD and Lo Terminal
200mV	$10^{10}\Omega$ or more	±1100Vpeak 10sec, or ±500Vpeak continuous	±500Vpeak continuous	±500Vpeak continuous
2000mV				
20V				
200V	10MΩ ±0.5%	±1100Vpeak continuous		
1000V				

Measurement accuracy: A value is displayed with a positive and negative allowance ±(% of reading + digit) when the Auto Zero and Auto Calibration functions are turned on (with the calibration time interval of 1 hour or less).

Measurement accuracy during 4 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
100µs	200mV	0.06 + 10	Same as for 24 hours	
	2000mV	0.05 + 4		
	20V			
	200V			
	1000V	0.05 + 3		
1ms	200mV to 1000V	1/10 of the digit value of 5 1/2 digit display measurement accuracy		
10ms to 1PLC	200mV to 1000V	1/100 of the digit value of 6 1/2 digit display measurement accuracy		
5PLC to 100PLC	200mV to 1000V	1/100 of the digit value of 6 1/2 digit display measurement accuracy		

Measurement accuracy during 5 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
1ms	200mV	0.008 + 50	Same as for 24 hours	
	2000mV	0.006 + 6		
	20V	0.006 + 4		
	200V	0.006 + 6		
	1000V	0.006 + 3		
10ms to 1PLC	200mV to 1000V	1/10 of the digit value of 6 1/2 digit display measurement accuracy		
5PLC to 100PLC	200mV to 1000V	1/10 of the digit value of 6 1/2 digit display measurement accuracy		

Measurement accuracy during 6 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
10ms	200mV	0.007 + 300	0.008 + 300	Same as for 24 hours
	2000mV	0.007 + 60	Same as for 24 hours	
	20V	0.006 + 40		
	200V	0.006 + 60		
	1000V	0.006 + 20		
1PLC	200mV	0.0025 + 40	0.004 + 40	0.005 + 40
	2000mV	0.0015 + 8	0.003 + 8	0.004 + 8
	20V	0.0012 + 5	0.0027 + 5	0.0037 + 5
	200V	0.0015 + 8	0.003 + 8	0.004 + 8
	1000V	0.0015 + 4	0.003 + 4	0.004 + 4
5PLC to 100PLC	200mV	0.0025 + 35	0.004 + 35	0.005 + 35
	2000mV	0.0015 + 6	0.003 + 6	0.004 + 6
	20V	0.0012 + 4	0.0027 + 4	0.0037 + 4
	200V	0.0015 + 6	0.003 + 6	0.004 + 6
	1000V	0.0015 + 3	0.003 + 3	0.004 + 3

Measurement accuracy during 7 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
5PLC to 100PLC	2000mV	10 of the digit value of 6 1/2 digit display measurement accuracy		
	20V			
	200V			
	1000V			

Temperature coefficient: Indicated as a value ±(% of reading + digit) per temperature (°C) in the temperature range of +18 to +28°C. 0.0001 is added to this value if the temperature is between 0 to +18°C or between +28 to +40°C.

Range	7 1/2 digit display	6 1/2 digit display	5 1/2 digit display	4 1/2 digit display
200mV	—	0.0003 + 3	0.0003 + 0.3	0.0003 + 0.03
2000mV	0.0003 + 3	0.0003 + 0.3	0.0003 + 0.03	0.0003 + 0.003
20V	0.0002 + 2	0.0002 + 0.2	0.0002 + 0.02	0.0002 + 0.002
200V	0.0003 + 3	0.0003 + 0.3	0.0003 + 0.03	0.0003 + 0.003
1000V	0.0003 + 1	0.0003 + 0.1	0.0003 + 0.01	0.0003 + 0.001

Noise suppression: Between Guard and Lo terminals with the 1kΩ unbalanced impedance

Integration Time	Effective CMR		NMR 50/60Hz ± 0.09%
	50/60HZ ± 0.09%	DC	
10msec or less	100dB	140dB	0dB
1PLC or more	160dB	140dB	60dB

7.1.2 DC current measurement –Only the R6871E is enabled.–

Range, maximum voltage display, maximum resolution, and input impedance :

Range	6 1/2 digit display		5 1/2 digit display		4 1/2 digit display		Input impedance	Over-current protection
	Maximum display	Resolution	Maximum display	Resolution	Maximum display	Resolution		
2000µA	1999.999µA	1nA	1999.99µA	10nA	1999.9µA	100nA	102Ω or less	2A current fuse
20mA	19.99999mA	10nA	19.9999mA	100nA	1.9999mA	1µA	12Ω or less	
200mA	199.9999mA	100nA	199.999mA	1µA	199.99mA	10µA	3Ω or less	
2000mA	1999.999mA	1µA	1999.99mA	10µA	1999.9mA	100µA	2Ω or less	

Measurement accuracy: A value is displayed with a positive and negative allowance ±(% of reading + digit) when the Auto Zero and Auto Calibration functions are turned on (with the calibration time interval of 1 hour or less).

Measurement accuracy during 4 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
100µs	2000µA	0.12 + 10	0.15 + 10	0.18 + 10
	20mA		0.14 + 10	0.16 + 10
	200mA		0.12 + 10	0.13 + 10
	2000mA	0.125	0.145 + 10	0.17 + 10
1ms	2000µA to 2000mA	1/10 of the digit value of 5 1/2 digit display measurement accuracy		
10ms to 1PLC	2000µA to 2000mA	1/100 of the digit value of 6 1/2 digit display measurement accuracy		
5PLC to 100PLC	2000µA to 2000mA	1/100 of the digit value of 6 1/2 digit display measurement accuracy		

Measurement accuracy during 5 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
1ms	2000μA	0.06 + 50	0.1 + 50	0.13 + 50
	20mA		0.09 + 50	0.11 + 50
	200mA		0.07 + 50	0.075 + 50
	2000mA	0.065 + 50	0.09 + 50	0.125 + 50
10ms to 1PLC	2000μA to 2000mA	1/10 of the digit value of 6 1/2 digit display measurement accuracy		
5PLC to 100PLC	2000μA to 2000mA	1/10 of the digit value of 6 1/2 digit display measurement accuracy		

Measurement accuracy during 6 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
10ms	2000μA	0.06 + 300	0.1 + 300	0.13 + 300
	20mA		0.085 + 300	0.11 + 300
	200mA		0.065 + 300	0.075 + 300
	2000mA	0.065 + 300	0.09 + 300	0.115 + 300
1PLC	2000μA	0.06 + 40	0.1 + 40	0.13 + 40
	20mA		0.085 + 40	0.11 + 40
	200mA		0.065 + 40	0.075 + 40
	2000mA	0.065 + 40	0.09 + 40	0.115 + 40
5PLC to 100PLC	2000μA	0.06 + 300	0.1 + 35	0.13 + 35
	20mA		0.085 + 35	0.11 + 35
	200mA		0.065 + 35	0.075 + 35
	2000mA	0.065 + 35	0.09 + 35	0.115 + 35

Temperature coefficient: Indicated as a value ±(% of reading + digit) per temperature (°C) in the temperature range of 0 to +40°C.

Range	6 1/2 digit display	5 1/2 digit display	4 1/2 digit display
2000μA	0.0035 + 5	0.0035 + 0.5	0.0035 + 0.05
20mA			
200mA	0.0015 + 5	0.0015 + 0.5	0.0015 + 0.05
2000mA			

7.1.3 Resistance measurement

Range, maximum resistance display, maximum resolution, measurement current, voltage between open terminals, and maximum input voltage :

Range	Maximum resistance display (7 1/2 digit) display	Resolution				Measure -ment current	Max. voltage bet. open terminals	Maximum input voltage		
		7 1/2 digit	6 1/2 digit	5 1/2 digit	4 1/2 digit			Bet. terminals	Bet. GUARD and chassis	Bet. terminals and GUARD
10Ω	11.99999Ω	10μΩ	10μΩ	100μΩ	1mΩ	10mA	24V	±350Vpeak contin-uous	±500Vpeak contin-uous	±50Vpeak contin-uous
100Ω	119.99999Ω	10μΩ	100μΩ	1mΩ	10mΩ	10mA				
1kΩ	1199.9999Ω	100μΩ	1mΩ	10mΩ	100mΩ	10mA*				
10kΩ	11.999999Ω	1mΩ	10mΩ	100mΩ	1Ω	1mA				
100kΩ	119.99999Ω	10mΩ	100mΩ	1Ω	10Ω	100μA	18V			
1MΩ	1199.9999kΩ	100mΩ	1Ω	10Ω	100Ω	10μA				
10MΩ	11.999999MΩ	1Ω	10Ω	100Ω	1kΩ	1μA				
100MΩ	119.99999MΩ	10Ω	100Ω	1kΩ	10kΩ	100nA	24V			
1000MΩ	1199.9999MΩ	100Ω	1kΩ	10kΩ	100kΩ	10nA				

* For option 10, 1mA is enabled.

Measurement accuracy: Values measured at 4 terminals are displayed with a positive and negative allowance ±(% of reading + digit) when the Auto Zero and Auto Calibration functions are turned on (with the calibration time interval of 1 hour or less).

The measurement accuracy for 2WΩ (measurement at 2 terminals) is equal to the measurement accuracy for 4WΩ (measurement at 4 terminals) added by 0.2Ω maximum.

Note: If a cable, whose line resistance is less than that of the cable used for 2WΩ calibration (measurement at 2 terminals), a negative sign (–) is displayed during zero point measurement.

Measurement accuracy during 4 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
100μs	10Ω	0.08 + 10	Same as for 24 hours	Same as for 90days
	100Ω	0.07 + 4		
	1kΩ*			
	1kΩ	0.06 + 3		
	10kΩ			
	100kΩ			
	1MΩ	0.07 + 3		
	10MΩ	0.09 + 3		
	100MΩ	0.25 + 3	0.3 + 3	
	1000MΩ	2.5 + 3	3 + 3	
1ms	10Ω to 1000MΩ	1/10 of the digit value of 5 1/2 digit display measurement accuracy		
10ms to 1PLC	10Ω to 1000MΩ	1/100 of the digit value of 5 1/2 digit display measurement accuracy		
5ms to 100PLC	10Ω to 1000MΩ	1/100 of the digit value of 6 1/2 digit display measurement accuracy		

*: When measurement current is 1mA (selectable for option 10)

Measurement accuracy during 5 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
1ms	10Ω	0.011 + 50	Same as for 24 hours	Same as for 90days
	100Ω	0.009 + 6		
	1kΩ*			
	1kΩ	0.08 + 4		
	10kΩ			
	100kΩ			
	1MΩ	0.01 + 4		
	10MΩ	0.036 + 4		
	100MΩ	0.2 + 5	0.25 + 5	
	1000MΩ	2 + 5	2.5 + 5	
10ms to 1PLC	10Ω to 1000MΩ	1/10 of the digit value of 6 1/2 digit display measurement accuracy		
5ms to 100PLC	10Ω to 1000MΩ	1/10 of the digit value of 6 1/2 digit display measurement accuracy		

*: When measurement current is 1mA (selectable for option 10)

Measurement accuracy during 6 1/2 digit display :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
10ms	10Ω	0.008 + 300	0.009 + 300	Same as for 90days
	100Ω	0.008 + 60	0.009 + 60	
	1kΩ*			
	1kΩ	0.007 + 30	0.008 + 30	
	10kΩ			
	100kΩ			
	1MΩ	0.009 + 30	0.01 + 30	
	10MΩ	0.03 + 30	0.036 + 30	
	100MΩ	0.2 + 30	0.25 + 30	
	1000MΩ	2 + 30	2.5 + 30	
1PLC	10Ω	0.004 + 40	0.006 + 40	0.007 + 40
	100Ω	0.003 + 8	0.005 + 8	0.006 + 8
	1kΩ*			
	1kΩ	0.002 + 4	0.004 + 4	0.006 + 4
	10kΩ			
	100kΩ			
	1MΩ	0.004 + 4	0.006 + 4	0.007 + 4
	10MΩ	0.022 + 5	0.028 + 4	0.03 + 4
	100MΩ	0.15 + 4	0.2 + 4	0.21 + 4
	1000MΩ	1.5 + 4	2 + 4	2 + 4

*: When measurement current is 1mA (selectable for option 10)

(Cont'd)

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
5PLC to 100PLC	10Ω	0.004 + 35	0.006 + 35	0.007 + 35
	100Ω	0.003 + 6	0.005 + 6	0.006 + 6
	1kΩ*			
	1kΩ	0.002 + 3	0.004 + 3	0.006 + 3
	10kΩ			
	100kΩ			
	1MΩ	0.004 + 3	0.006 + 3	0.007 + 3
	10MΩ	0.022 + 3	0.028 + 3	0.03 + 3
	100MΩ	0.15 + 3	0.2 + 3	0.21 + 3
	1000MΩ	1.5 + 3	2 + 3	2.1 + 3

Measurement accuracy during 7 1/2 digit display (10 times of smoothing turned on) :

Integration Time (IT)	Range	Measurement accuracy		
		24 hours (at 23°C ± 1°C)	90 days (at 23°C ± 5°C)	180 days (at 23°C ± 5°C)
5PLC to 100PLC	100Ω	0.003 + 40	0.005 + 40	0.006 + 40
	1kΩ*			
	1kΩ	0.002 + 25	0.004 + 25	0.006 + 25
	10kΩ			
	100kΩ			
	1MΩ	0.004 + 25	0.006 + 25	0.007 + 25
	10MΩ	0.022 + 25	0.028 + 25	0.03 + 25
	100MΩ	0.15 + 25	0.2 + 25	0.21 + 25
	1000MΩ	1.5 + 25	2 + 25	2.1 + 25

*: When measurement current is 1mA (selectable for option 10)

Temperature coefficient: Indicated as a value for 4WΩ ±(% of reading + digit) per temperature (°C) in the temperature range of 0 to +40°C.
(The coefficient for 2WΩ is equal to this value added by 0.02Ω per temperature (°C).)

Range	7 1/2 digit display	6 1/2 digit display	5 1/2 digit display	4 1/2 digit display
10Ω	—	0.0004 + 3	0.0004 + 0.3	0.0004 + 0.03
100Ω	0.0004 + 3	0.0004 + 0.3	0.0004 + 0.03	0.0004 + 0.003
1kΩ*				
1kΩ ～ 1MΩ	0.0004 + 2	0.0004 + 0.2	0.0004 + 0.02	0.0004 + 0.002
10MΩ	0.0015 + 2	0.0015 + 0.2	0.0015 + 0.02	0.0015 + 0.02
100MΩ	0.015 + 2	0.015 + 0.2	0.015 + 0.02	0.015 + 0.002
1000MΩ	0.15 + 2	0.15 + 0.2	0.15 + 0.02	0.15 + 0.002

*: When measurement current is 1mA (selectable for option 10)

7.1.4 Network Resistance Measurement Accuracy –Only the R6871E-OHM is enabled–

Measurement accuracy during 6 1/2 digit display:

Range	Measurement accuracy (180days, at 23°C ± 5°C), ± % of Reading ± Digit			
	1:100 or less	1:50 or less	1:20 or less	1:10 or less
1kΩ	—	—	—	± 0.015% ± 5
1kΩ*	—	—	—	± 0.08% ± 5
10kΩ	—	± 0.045% ± 5	± 0.025% ± 5	± 0.015% ± 5
100kΩ	± 0.08% ± 5	± 0.045% ± 5	± 0.025% ± 5	± 0.015% ± 5
1MΩ	± 0.09% ± 5	± 0.05% ± 5	± 0.03% ± 5	± 0.02% ± 5
10MΩ	± 0.14% ± 5	± 0.11% ± 5	± 0.09% ± 5	± 0.08% ± 5

Minimum resistance value in closed circuit : 300Ω or more (5MΩ or less)
Resistance ratio : 1:100 or less
Integration time : 5PLC to 100PLC

The value is displayed with a positive and negative allowance ± (% of reading + digit) when the Auto Zero and Auto Calibration functions are turned on (with the calibration time interval of 1 hour or less).

Temperature coefficient during 6 1/2 digit display:

Range	Temperature coefficient (0 to 18°C, 28°C to 40°C), (± % of Reading ± Digit)/°C			
	1:100 or less	1:50 or less	1:20 or less	1:10 or less
1kΩ	—	—	—	± 0.0006% ± 0.2
1kΩ*	—	—	—	± 0.0021% ± 0.3
10kΩ	—	± 0.0013% ± 0.2	± 0.0008% ± 0.2	± 0.0006% ± 0.2
100kΩ	± 0.0021% ± 0.2	± 0.0013% ± 0.2	± 0.0008% ± 0.2	± 0.0006% ± 0.2
1MΩ	± 0.0021% ± 0.2	± 0.0013% ± 0.2	± 0.0008% ± 0.2	± 0.0006% ± 0.2
10MΩ	± 0.0036% ± 0.2	± 0.0028% ± 0.2	± 0.0023% ± 0.2	± 0.0021% ± 0.2

*: When measurement current is 1mA (selectable for option 10)

7.1.5 AC voltage measurement (True RMS): Only the R6871E is enabled.

Range, maximum voltage display, maximum resolution, input impedance, and maximum applicable voltage :

Range	Maximum voltage display (5 1/2 digit display)	Resolution		Input Impedance	Maximum applicable voltage
		5 1/2 digit	4 1/2 digit		
200mV	199.999mV	1µV	10µV	1MΩ ± 2%, 300pF or less, AC coupling	520Vrms (750V peak) between Hi and Lo terminals
2000mV	1999.99V	10µV	100µV		
20V	19.9999V	100µV	1mV		
200V	199.999V	1mV	10mV		
500V	500.00V	10mV	100mV		

Measurement accuracy : The value is displayed with a positive and negative allowance ±(% of reading + digit) when the Auto Zero and Auto Calibration functions are turned on (with the calibration time interval of 1 hour or less).

This value is reliable for the input in 5% or more of the full scale or 1 × 10⁷ VHz or less.

Measurement accuracy (ACV) during 5 1/2 digit display :

Integration time (IT)	1ms to 10ms		1ms to 10ms	
Frequency range	24 hours (23°C ± 1°C)	180days (23°C ± 5°C)	24 hours (23°C ± 5°C)	180days (23°C ± 5°C)
20Hz to 45Hz	0.25 + 800	0.35 + 800	0.25 + 70	0.35 + 90
45Hz to 300Hz	0.1 + 400	0.2 + 400	0.1 + 70	0.2 + 90
300Hz to 10kHz	0.1 + 400	0.2 + 400	0.1 + 70	0.2 + 90
10kHz to 100kHz	0.8 + 700	1 + 900	0.8 + 700	1 + 900
100kHz to 1MHz	7 + 3000	8 + 4000	7 + 3000	8 + 4000

For 200mV range, the above listed accuracy should be added by 100 digits.

Measurement accuracy during 4 1/2 digit display; Equal to 1/10 of the measurement accuracy during 5 1/2 digit display

Temperature coefficient : 1/10 of the 24-hour measurement accuracy of 1 to 100PLC (per temperature (°C))

Crest factor : 1:4

Response time : Time period required for setup within 0.2% of input step
Fast: Approx. 200msec
Slow: Approx. 2sec

Note : Slow : 20Hz to 1MHz
Fast : 300Hz to 1MHz
In the fast sampling of 20 to 300Hz frequency, data is measured but the measurement accuracy is unreliable.

Measurement accuracy of AC + DC voltages
: Equal to the AC voltage measurement accuracy + 70 digits

7.1.6 AC current measurement (True RMS): Only the R6871E is enabled.

Range, maximum current display, maximum resolution, and input impedance :

Range	5 1/2 digit display		4 1/2 digit display		Input Impedance	Over-current protection
	Maximum display	Resolution	Maximum display	Resolution		
2000µV	1999.99mA	10nA	1999.9mA	100nA	102Ωor less	2A current fuse
20mA	19.9999mA	100nA	19.999mA	1µA	12Ωor less	
200mA	199.999mA	1µA	199.99mA	10µA	3Ωor less	
2000mA	1999.99A	10µA	1999.9A	100µA	2Ωor less	

Measurement accuracy : The value is displayed with a positive and negative allowance ±(% of reading + digit) when the Auto Zero and Auto Calibration functions are turned on (with the calibration time interval of 1 hour or less).

Measurement accuracy during 5 1/2 digit display
(reliable for input of 5% or more on the full scale) :

Integration time (IT)	1ms to 10ms		1PLC to 100PLC	
Frequency range	24 hours (23°C ± 1°C)	180days (23°C ± 5°C)	24 hours (23°C ± 5°C)	180days (23°C ± 5°C)
20Hz to 45Hz	0.5 + 200	0.65 + 220	0.5 + 180	0.65 + 200
45Hz to 5kHz	0.35 + 200	0.5 + 220	0.35 + 180	0.5 + 200

Measurement accuracy during 4 1/2 digit display
: Equal to 1/10 of the measurement accuracy during 5 1/2 digit display

Temperature coefficient : 1/10 of the 24-hour measurement accuracy of 1 to 100PLC (per temperature (°C)) for each measurement range and frequency range

Crest factor : 1:4

Response time : Same as for AC voltage measurement

Measurement accuracy of AC + DC voltages
: Equal to the measurement accuracy of AC current + 70 digits

7.2 Measurement Speed

(1) DATA OUT Mode 0 (Mode that allows data output to all output lines)

For display output only

Sampling mode : RUN
COMPUTE : OFF
STORE : OFF
SMOOTH : OFF
NULL : OFF

Sampling interval : 0ms
A ZERO : OFF
A CAL : OFF
Line : 50Hz

Measurement function / Integration time (IT)	DC voltage	AC*1 voltage (AC + DC)	DC*1 current	AC*1 current (AC + DC)	2WΩ (10β to 1000MΩ)	4WΩ (10Ω to 100kΩ)	4WΩ (1000kΩ)	4WΩ (10MΩ)	4WΩ (100MΩ)	4WΩ (1000MΩ)
100μs (4 1/2 digit)	2.2ms	2.5ms	2.5ms	2.5ms	2.5ms	23.4ms	65.6ms	222ms	536ms	2591ms
1ms (5 1/2 digit)	3.5ms	3.4ms	3.9ms	3.4ms	3.5ms	25.7ms	67.5ms	224ms	538ms	2593ms
10ms (6 1/2 digit)	12.4ms	12.4ms	13.1ms	12.4ms	12.7ms	43.9ms	85.7ms	242ms	556ms	2611ms
5PLC (7 1/2 digit)	102ms	102ms	103ms	102ms	103ms	224ms	266ms	423ms	736ms	2791ms

*1 Only the R6871E is enabled.

* Except for 4WΩ, measuring cycles in the integration time range from 1ms to 100PLC can be obtained by (measuring cycle at an integration time of 100μs) + (integration time desired). For 4WΩ, they can be obtained by [(measuring cycle at an integration time of 100μs) + (integration time desired)] × 2.

For output onto the GPIB

Controller : HP300 series
GPIB output format : Minimum length, with header = OFF and block delimiter = EOI

Measurement function / Integration time (IT)	DC voltage	AC*1 voltage (AC + DC)	DC*1 current	AC*1 current (AC + DC)	2WΩ (10β to 1000MΩ)	4WΩ (10Ω to 100kΩ)	4WΩ (1000kΩ)	4WΩ (10MΩ)	4WΩ (100MΩ)	4WΩ (1000MΩ)
100μs (4 1/2 digit)	2.5ms	2.8ms	2.9ms	2.8ms	2.9ms	24.1ms	66.0ms	223ms	536ms	2591ms
1ms (5 1/2 digit)	3.8ms	3.8ms	4.3ms	3.8ms	3.9ms	26.1ms	67.9ms	225ms	538ms	2593ms
10ms (6 1/2 digit)	12.9ms	12.8ms	13.5ms	12.8ms	13.0ms	44.3ms	86.1ms	243ms	556ms	2611ms
5PLC (7 1/2 digit)	103ms	103ms	104ms	103ms	103ms	224ms	266ms	423ms	736ms	2791ms

*1 Only the R6871E is enabled.

* Add about 300 s if the GPIB output format has been set to the standard format (header = OFF, block delimiter = CR/LF (EOI)).

* Add about 1.5ms if SINGLE (Hold-Trigger) has been selected as the sampling mode.

(2) DATA OUT mode 2 (Mode that allows data output to the data memory only, data is saved after true-value calculation)

COMPUTE : OFF
STORE : ON
SMOOTH : OFF
NULL : OFF
A CAL : OFF

Function : VDC
Range : 20V
Sampling mode : RUN
Sample interval : 0ms
A ZERO : OFF
Line : 50Hz

Integration time (IT)	100μs	1ms	10ms	1PLC	5PLC	10PLC	20PLC	50PLC	100PLC
Measurement period	1.6ms	2.9ms	11.9ms	22.0ms	102ms	202ms	402ms	1002ms	2002ms

(3) DATA OUT mode 3 (Maximum-speed mode that allows data output to the data memory only, raw datais saved)

Function : Previous status
Range : Previous status
Integrate time : 100μs
Auto ZERO : OFF
COMPUTE : OFF
SMOOTHING : OFF

Sampling mode : RUN
Sampling interval : 0ms
Auto calibration : OFF
STORE : ON
NULL : OFF

Measurement function (Measurement range)	DC voltage	AC*1 voltage (AC + DC)	DC*1 current	AC*1 current (AC + DC)	2WΩ (10Ω to 1000MΩ)	4WΩ (10Ω to 100kΩ)	4WΩ (1000kΩ)	4WΩ (10MΩ)	4WΩ (100MΩ)	4WΩ (1000MΩ)
Measurement period	500μs	500μs	500μs	500μs	500μs	21.3ms	62.3ms	216ms	523ms	2534ms

*1 : Only the R6871E is enabled.

7.3 Integration Time

The following integration times can be set :

100μsec, 1msec, 10msec, 1PLC, 5PLC, 10PLC, 20PLC, 50PLC, or 100PLC (9 modes)

PLC is the sorted power line cycle.

In the 4 1/2 igit display mode, the integration time can be set within the range of 100 sec to 100PLC.

In the 5 1/2 digit display mode, it can be set within the range of 1msec to 100PLC.

In the 6 1/2 digit display mode, it can be set within the range of 10msec to 100PLC.

In the 7 1/2 digit display mode, it can be set within the range of 5PLC to 100PLC.

7.4 Null Function

When the Null function is turned on, the null value is measured and the subsequent measurement data is automatically subtracted by the null value.

The correction range is within ±1% of each range.

7.5 Input Terminals

One of the Front Input, and Rear Input, inputs can be selected, and must be selected by the selector switch on the panel.

(1) Front Input DC/AC V, DC/AC I, 2WΩ, 4WΩ NWΩ *2

(2) Rear Input DC/AC V, *1DC/AC I, 2WΩ, 4WΩ NWΩ *2

*1 Signal can be input to the rear current input terminal only when the Front/Rear selector switch is set to the Front position.

*2 One of the FRONT and REAR sets of input terminals, irrespective of pressing selector switch.

7.6 Smoothing Function

When the smoothing function is turned on, the moving average is determined based on the data measured for the number of times set by the SM TIME key.

7.7 Sampling

(1) RUN : Data sampling continues at the interval specified by SI (Sample Interval).

(2) SINGLE : Data is sampled only once for a single trigger input signal after the DELAY (Trigger Delay)

(3) MULTI : Data is sampled for the specified number of times when a single trigger input signal is received. Data sampling starts after the DELAY has passed and data is sampled at the SI interval.

(4) MULTI BULK : Sampling is performed NS times at intervals of SI in response to a trigger signal 1 input. After sampling is performed NS times, the measurement data of NS samples is output to the GPIB all together in response to the data output request.

SI (Sample Interval) : 0 to 60000ms
DELAY (Trigger Delay) : 0 to 60000ms (0ms for MULTI BULK)
NS (No. of Sample) : 1 to 10000 (1 to 1000 for MULTI BULK)

(5) Trigger source

① Panel switch

② GET command of GPIB "E"

③ TRIGER dingle line signal (negative TTL pulse ¯|_|¯)

7.8 Data Memory Functions

(1) Memory function on/off control : Measurement data storage is controlled by the STORE key.

(2) No. of memory data : Any 10,000 data before and after trigger point can be stored in memory. (Available pre-trigger and display-trigger)

(3) Measurement data acquisition : Any single data can be read from memory by using the RECALL key or data number setup (step output mode). Any number of data can also be read sequentially (continuous output mode). The read data is output to the display, or GPIB output terminal. The data is output continuously at the SI interval in the continuous output mode.

7.9 Calculation Function

7.9.1 Primary Calculation Functions

The following calculations can be made for measurement value D :

(1) Scaling $R = \frac{D - Y}{X} * Z$ (X, Y, and Z are constants.)

(2) % Deviation $R = \frac{D - X}{|X|} * 100$ (%)

(3) Delta $R = D_t - D_{t-1}$ (difference between the previous measurement value)

(4) Multiply $R = D_t * D_{t-1}$ (multiplication with the previous measurement value)

(5) Decibel conversion $R = 20 * Y * \log | D/X |$ (dB)

(6) RMS value

$$R = \sqrt{\frac{1}{X} \sum_{K=1}^{X} Dk^2}$$

(7) dBm conversion $R = 10 \log_{10} \frac{D^2 / X}{1mW}$ (D : Measurement voltage)

where
R : value (dBm) to be converted by dBm based on 1 mW (= 0 dBm)
D : voltage measurement value (V)
X : Standard resistance value (Ω)

(8) Temperature Correction of Resistance

$$R_{20} = \frac{Rx}{1 + 0.00393*(X-20)} * \frac{1000}{Y} \; [\Omega/km]$$

where
R_{20} : Resistance of leads (Ω/km) at the room temperature (20°C)
Rx : Measurement resistance (Ω) at temperature X°C
X : Room temperature (°C) during measurement
Y : Cable length measures (meters)

7.9.2 Secondary Calculation Functions

There are 3 types of secondary calculation functions : calculation of measurement data, calculation of primary calculation results, and calculation of data recalled from memory.

Calculation type, item and expression	Constant setup range	Calculation result display
(1) COMPARATOR 1 (comparator-1) R (HIGH2) : HIGH2 < D R (HIGH1) : HIGH1 < D ≦ HIGH2 R (PASS) : LOW1 ≦ D ≦ HIGH1 R (LOW1) : LOW2 ≦ D < LOW1 R (LOW2) : D < LOW2	HIGH1, HIGH2, LOW1, LOW2: Upper and lower limits if: HIGH1 ≦ HIGH2 LOW2 ≦ LOW1 (HIGH LOW is also allowed)	Indicated by the lamp as follows: R(HIGH2) : HIGH lamp lights R(HIGH1) : HIGH lamp lights R(PASS) : PASS lamp lights R(LOW1) : LOW lamp lights. R(LOW2) : LOW lamp lights. Display values: The measurement value is displayed if the primary calculation is not set. The primary calculation result is displayed if it is set.
(2) COMPARATOR-2 (comparator-2) H2 = LIMIT + %2 H1 = LIMIT + %1 L2 = LIMIT − %2 L1 = LIMIT − %1 R (HIGH2) : HIGH2 < D R (HIGH1) : HIGH1 < D ≦ HIGH2 R (PASS) : LOW1 ≦ D ≦ HIGH1 R (LOW1) : LOW2 ≦ D < LOW1 R (LOW2) : D < LOW2	LIMIT: Reference value (except 0) %1 and %2: Tolerance (%), 0.000 to 100.0 where, %1 ≦ %2	Indicated by the lamp as follows: R(HIGH2) : HIGH lamp lights R(HIGH1) : HIGH lamp lights R(PASS) : PASS lamp lights R(LOW1) : LOW lamp lights R(LOW2) : LOW lamp lights Display values: The measurement value or primary calculation result is converted into percent deviation and displayed based on the reference.

(3) Statistical preocessing

R (COUNT): Sample count
R (MAX) : Maximum value
R (MIN) : Minimum value
R (AVE) : Average $\frac{1}{N}\sum_{K=1}^{N} D_k$

R (P-P) : Inconstant width $| R (MAX) - R (MIN) |$

R (δ) : Standard deviation $\sqrt{\frac{1}{N-1}\sum_{K=1}^{N} (D_k - \bar{D})^2}$

R (UCL) : Upper control line $R (AVE) + 3R (\delta)$

R (LCL) : Lower control line $R (AVE) - 3R (\delta)$

7.10 GPIB Interface

(1)	Standard	IEEE-488-1978
(2)	Interfacing Functions	SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, CO, and E2
(3)	Remote programming	Anylyzer front panel key functions (except for POWER switch and front/rear input selector switch)
(4)	Data output	ASCII format

7.11 Output of Comparator Operation Result
–Only the R6871E-OHM is enabled.–

(1) Operation result is output. (Open collector)
HIGH2, HIGH1, PASS, LOW1, LOW2

(2) TRIGGER input signal (TTL negative pulse, 100µsec or more)

(3) Data output signal (TTL negative pulse, approx, 130µsec)

7.12 Control Signals (Single Line Signals)

(1) TRIGGER input signal (TTL negative pulse, 100µsec or more)

(2) COMPLETE output signal (TTL negative pulse, approx. 130µsec)

(3) Input terminals : BNC connectors

7.13 Buzzer Function (with ON/OFF Switching)

The buzzer sounds when :

(1) Data is entered from panel keys.

(2) An error occurs.

(3) Comparator calculation is executed.

7.14 General Specifications

Measurement technique : Integration measurement

Data input : Floating and guarded

Range selection modes : Auto, manual, or remote

Data display : 7-segment green LEDs

Polarity indication : Negative polarity indication

Display unit : 5 × 7-dot matrix LEDs

Software calibration : Each function and range of DC voltage/current, AC voltage/current, and resistance can be calibrated through main panel key operation or GPIB program.

Storage temperature : –25°C to +70°C

Environment conditions : Temperature of 0 to +40°C and relative humidity of 85% or less (70% or less in the 10MΩ, 100MΩ, and 1000MΩ resistance range)

Power supply : The power voltage of the equipment is set at the delivery according to the customer's ordering information.

Type	Standard	Option 32	Option 42	Option 44
Source voltage (VAC)	90 to 110	103 to 132	198 to 242	207 to 250

Line frequencey : 48Hz to 66Hz

Power comsumption : R6871E/E-OEM ; 35VA or less
R6871E-DC ; 30VA or less

Dimensions : Approx. 300(W) × 132(H) × 450(D)mm

Weight : R6871E ; 9.5kg or less
R6871E-DC/E-OHM ; 8.5kg or less

Current of resistance measurement : The current of the equipment is set at the delivery according to the customer's ordering information.

Type	Standard	Option 10
Measurement current (mA)	10	1

8. OPERATIONS

8.1 General

By using the built-in microprocessor, the R6871E/E-DC can process various measurement data required for output (to data memory, display, and GPIB).

This chapter explains the general operation of the R6871E/E-DC by using operational diagrams and charts.

Figure 8-1 shows the operation concept of the R6871E/E-DC from data measurement to data output. Figure 8-2 shows the block diagram of the R6871E/E-DC.

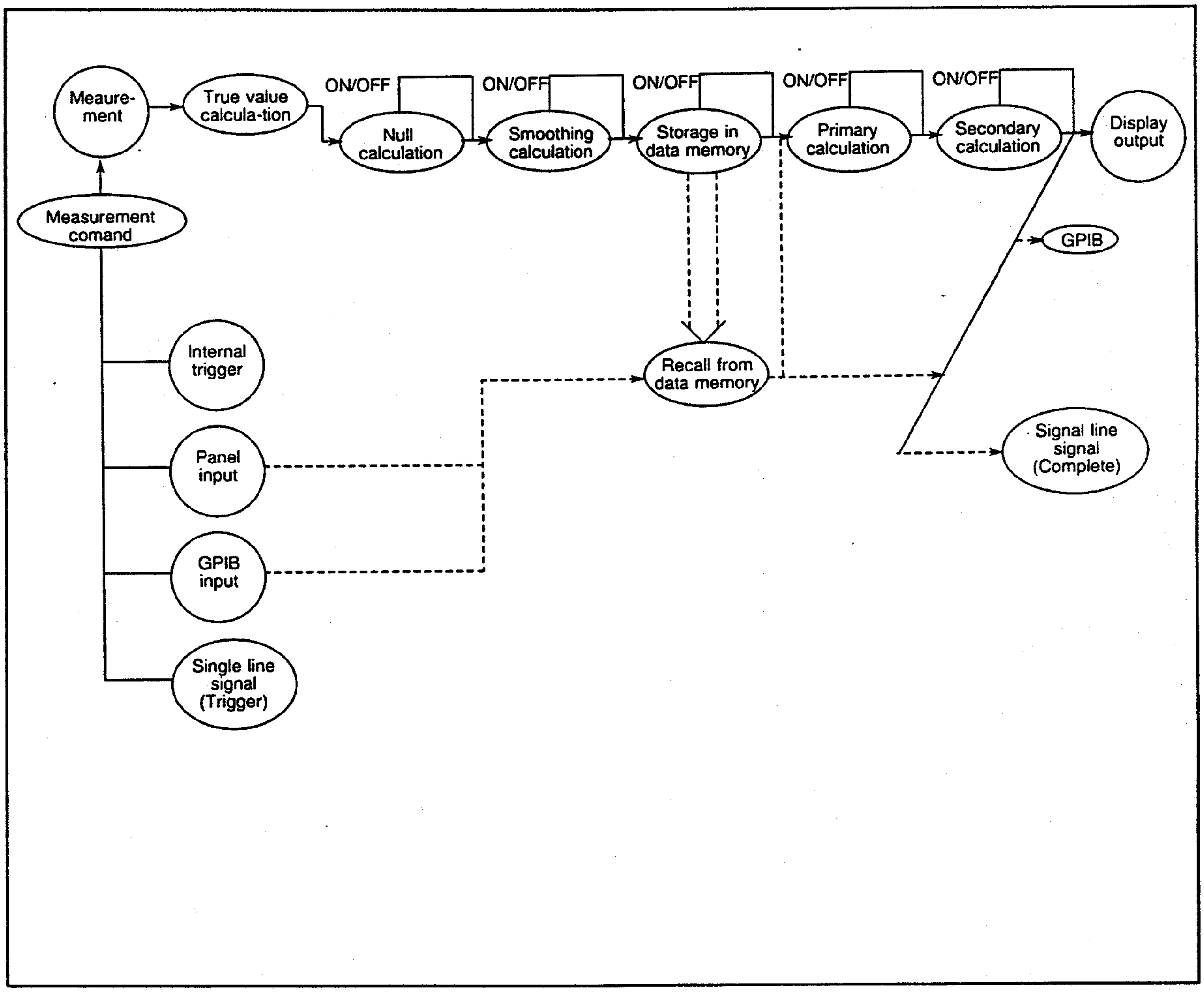


Figure 8-1 Operation Concept

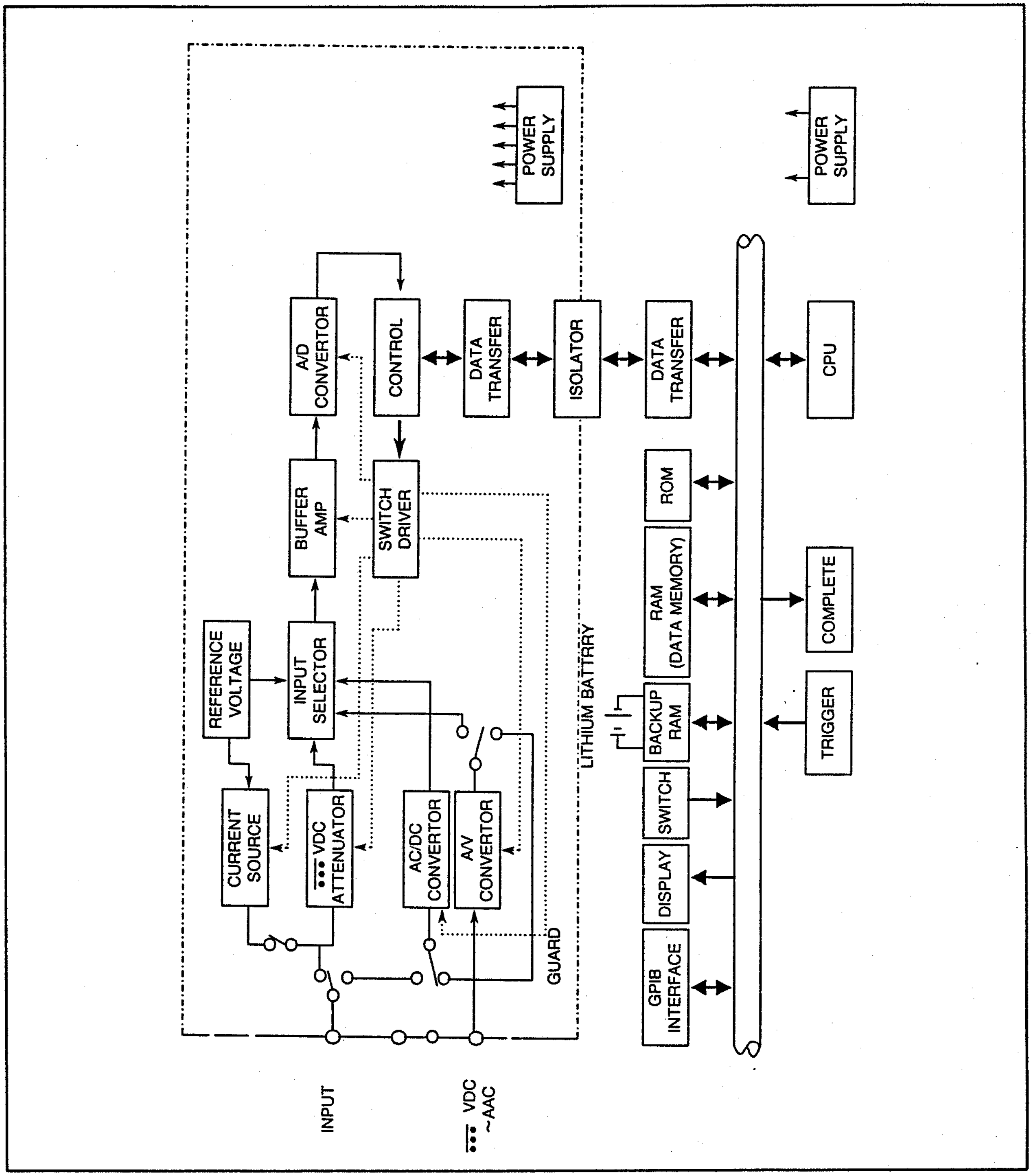


Figure 8-2 Block Diagram

8.2 Operations

Figure 8-3 shows the R6871E/E-DC data processing timing chart.

The R6871E/E-DC starts measurement when receiving an internal or external measurement command. After the measurement has completed, the R6871E/E-DC calculates and determines the true value by using various measurement functions.

The measurement value of input is determined. If the Auto Range mode has been selected (by turning on the AUTO key), the measurement range selection appropriate to the input can be checked. If not selected, the measurement range should be changed and the same operation (input measurement or true value calculation) should be repeated.

After the data has been measured, it is processed by various data processing functions (such as NULL and smoothing functions) which are turned on or off.

If the data memory function is on (that is, if the lamp of STORE key is on), the measured data or the resulting data of NULL or smoothing calculation is stored in the data memory.

The data is processed through primary and secondary calculation in succession.

When the sequential data processing is complete, the data is output to each output (such as display, and GPIB.) Single line signals (approximately 130µsec negative pulses output from the COMPLETE output terminal) are also output simultaneously.

To increase the sampling rate, turn off all function that can be turned on or off (such as NULL, smoothing, data memory, and calculation functions), set the SI parameter of 0msec, and turn off the Auto Zero function.

Analog data is calibrated in the cycle set by the A CAL parameter during automatic calibration. This calibration precedes the measurement commands.

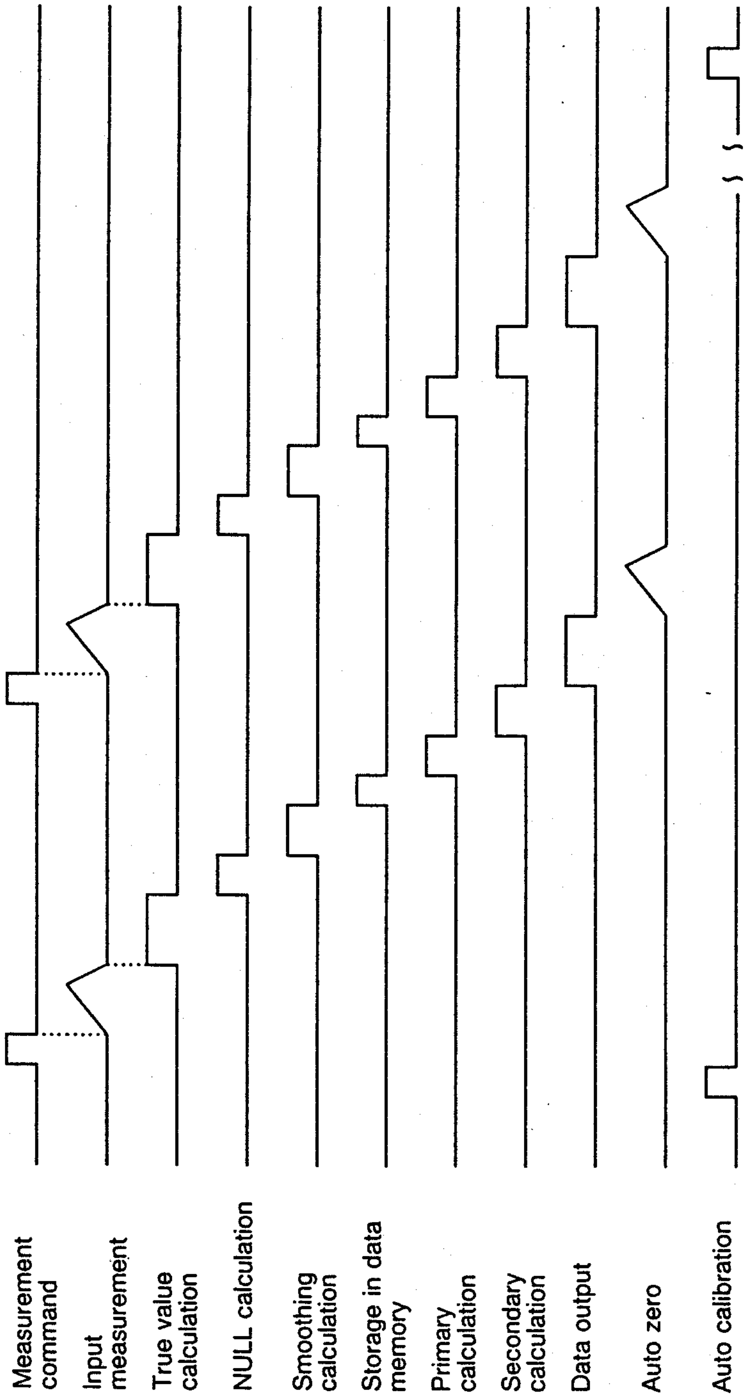


Figure 8-3 Data Processing Timing Chart

APPENDIX 1. TERMINOLOGIES

Sensitivity and Resolution

The resolution of a digital voltmeter is the minimum unit of quantization. For example, the maximum sensitivity range of the R6871E/E-DC digital multimeter is 200mV and the resolution if, therefore, 0.1μV/digit.

This value also represents the sensitivity. The values indicating the sensitivity and resolution of a digital voltmeter are vital factors for voltmeter selection. They also indicates the limit of voltmeter performance.

Measurement Accuracy

The measurement accuracy is defined as follows:

$$\text{Measurement accuracy} = \frac{(\text{Reading value} - \text{True value})}{(\text{Full scale value})} + 1 \text{ digit}$$

The reading value minus true value is called a reading error. The reading error of the R6871E/E-DC is indicated as ±0.00XX% of rdg. The full-scale error is indicated as of fs (or digits). The full-scale error and quantization error (explained below) result from different causes. However, the full-scale error may be added the quantization error and displayed for simple calculation of measurement accuracy. The full-scale error is primarily caused by zero-point drifting. This drifting is automatically corrected by the automatic zero point correction circuit.

An error within ±1 digit is called the quantization error. This may occur during data conversion from analog into digital form.

Input Impedance

A digital voltmeter has its inherent input resistance (Rin). This is usually called as an input impedance. Voltage Es of the power supply (shown in Figure A-1) to be measured is reduced by the output resistance (Rs) of the power supply and the input impedance (Rin), and voltage Es' is displayed on the digital voltmeter. To reduce the loading error, the input impedance (Rin) of the digital voltmeter must be increased.

In addition to the error due to the output resistance (Rs) of the power supply and the input impedance of multimeter, an error due to current offset exists. This current offset occurs inside the digital voltmeter. A voltage offset may also occur, but it can be ignored even when output resistance Rs increases.

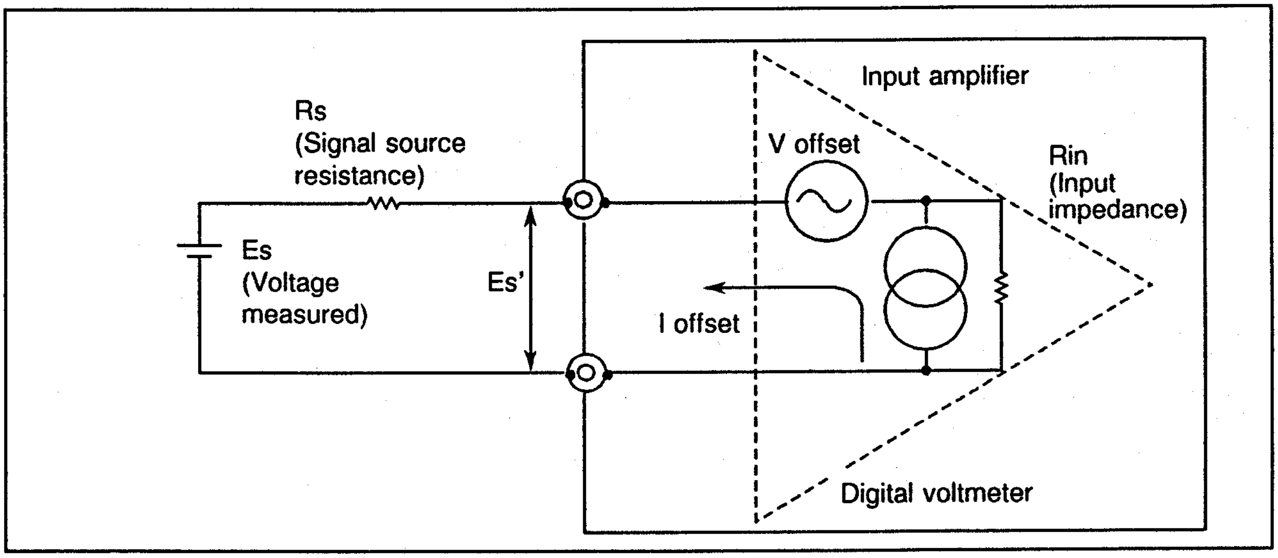


Figure A-1 Input Equivalent Circuit by Considering Current and Voltage Offsets and Input Impedance

The current offset is caused by elements used in the primary stage of input amplifier. To minimize the the offset, field effect transistors (FETs) are used. Therefore, if the power supply to be measured has output resistance Rs, voltage Es' appearing at the input terminal of the digital voltmeter can be defined in the following equation. Resistance Rs divided by resistance Rin, and resistance Rs multiplied by I offset should be considered.

$$Es' = \frac{1}{1 + \frac{Rs}{Rin}} Es - Rs \times I\ offset$$

Normal Mode Noise Voltage Rejection Ratio (NMRR) and Common Mode Noise Voltage Rejection Ratio (CMRR)

A certain level of noise always exits during measurement and this noise causes a measurement error. During low-voltage signal measurement below 10μV, a measurement error is often caused by troubles of grounding or cables, ground current, or induction noise from the power supply. The measurement may fail due to errors. To solve such measurement problems, the R6871E/E-DC digital multimeter involves the integration measurement and the noise rejectors are included in its power supply.

The noise source can be eliminated during measurement by using the measuring circuit shown in Figure A-2. Noise voltage 'en' is called the normal mode noise voltage or series mode noise voltage. The noise voltage is fed in series in the signal line. This noise usually consists of power frequency components and their subharmonics. The affection of these noise components on the measurement or the noise elimination efficiency is called the normal mode noise voltage rejection ratio (NMRR). The NMRR can be determined by the following equattion:

$$\mathrm{NMRR} = 20 \log \frac{en}{\Delta\, en}$$

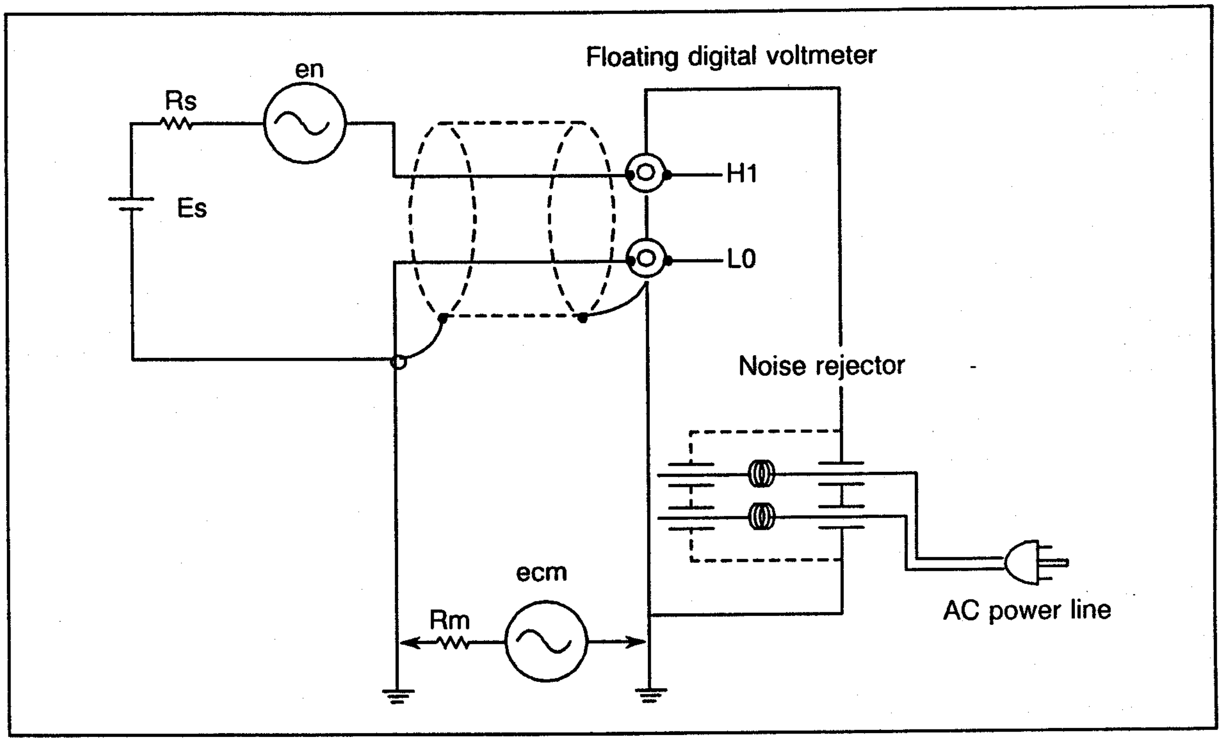


Figure A-2 Measuring Circuit Featuring Effective Noise Elimination

'Δen' is the measurement error caused by 'en'. 'ecm' is a noise, called the common mode noise voltage, and occurs between the signal line and the ground of the voltmeter. The noise level increase if the distance between them increases.

The affection of the noise components on the measurement, or its noise elimination efficiency is called the common mode noise voltage rejection ratio (CMRR). The CMRR can be defined by the following equation:

$$\text{NMRR} = 20 \log \frac{\text{ecm}}{\Delta\,\text{ecm}}$$

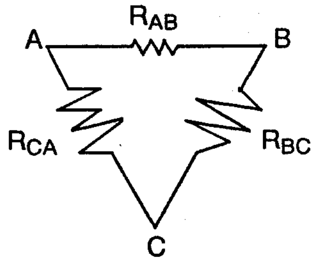
'Δecm' is the voltage that appears at the input terminal of the voltmeter. The combination efficiency of the above two noise voltage rejection ratios is indicated as the effective CMR. The R6871E/E-DC/E-OHM multimeter using the integration calculation can provide the higher NMR.

The CMR greatly varies depending on the frequency of noise voltage, signal source circuit, shielding, input cable type, and input connection. If the CMR of 120dB is shown on the multimeter document and if the errors are ignored in the 'ecm' voltage exceeding $1/10^6$, the measured data is unreliable.
A shielded cable should be connected to the multimeter to eliminate any induction, and the ground lead of the power cable should be connected directly to the ground. The voltmeter digital display (calculation) section is electrically disconnected from the A/D converter section. Dual shielding of the measuring circuits from the ground allows the highest common mode noise voltage rejection ratio.

Measurement of Network Resistance

Resistance R_{AB}, R_{BC}, and R_{CA} are shown like the figure below.

R_{BA} + R_{CA} will become parallel resistance of R_{AB} if the digital multimeter is connected to measure R_{AB} between A-B points and R_{AB} cannot be measured correctly.



So far, it was measured so as not to become parallel resistance cutting somewhere of the loop of R_{ABC}.

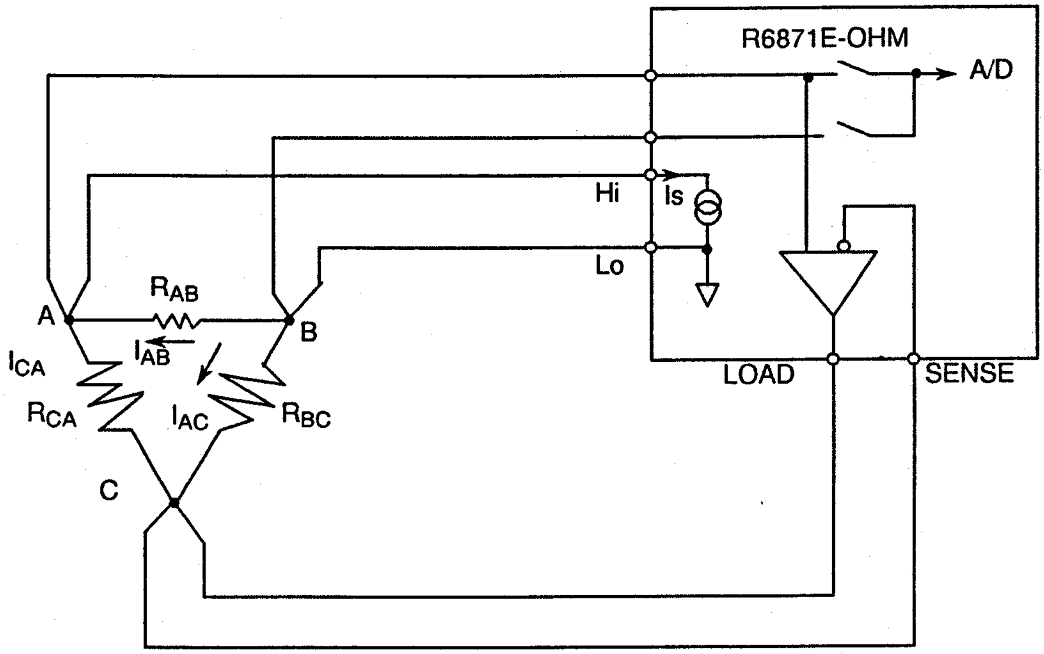
The buffer amplifier is added and the potential of C point is set in the same potential as A point.

$$I_{BC} = \frac{V_C - V_B}{R_{BC}}$$

$$I_{CA} = \frac{V_C - V_A}{R_{CA}} = 0$$

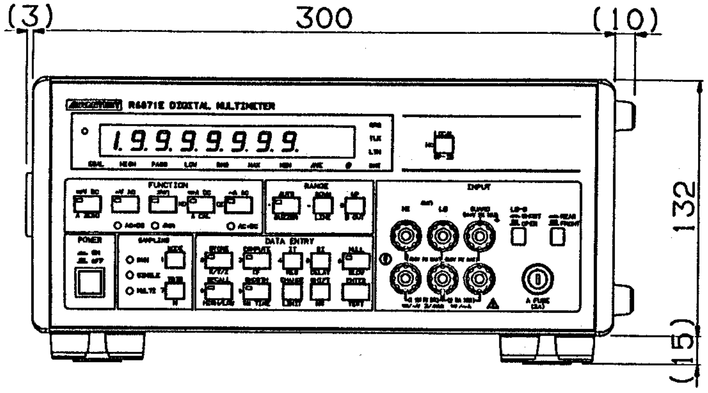
$$I_{AB} = \frac{V_B - V_A}{R_{AB}} = I_S$$

Then R_{AB} can be measured.

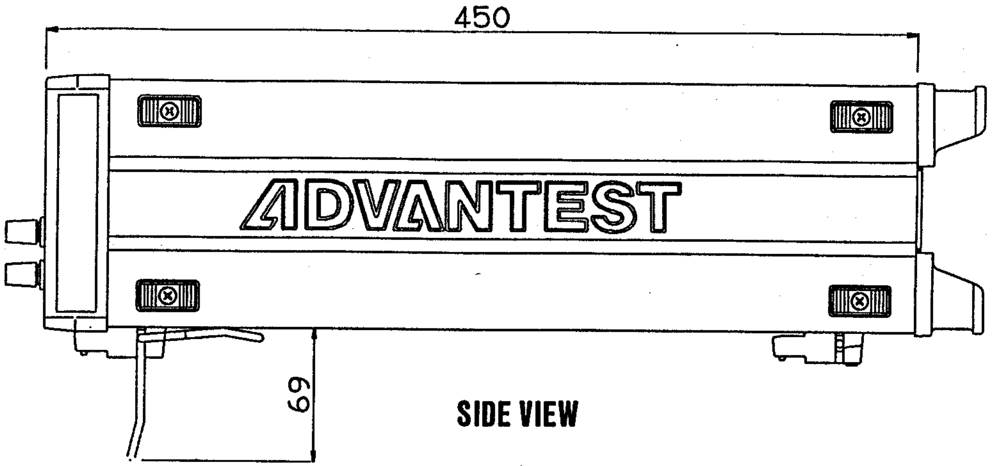


MEMO

ALPHABETICAL INDEX

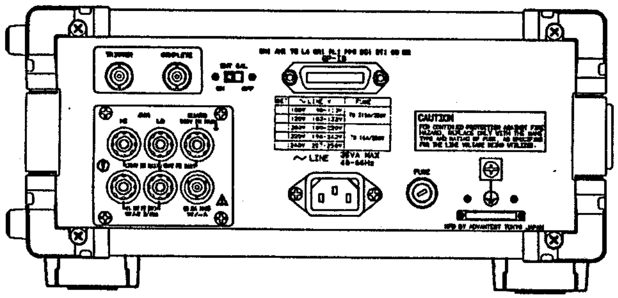


FRONT VIEW



SIDE VIEW

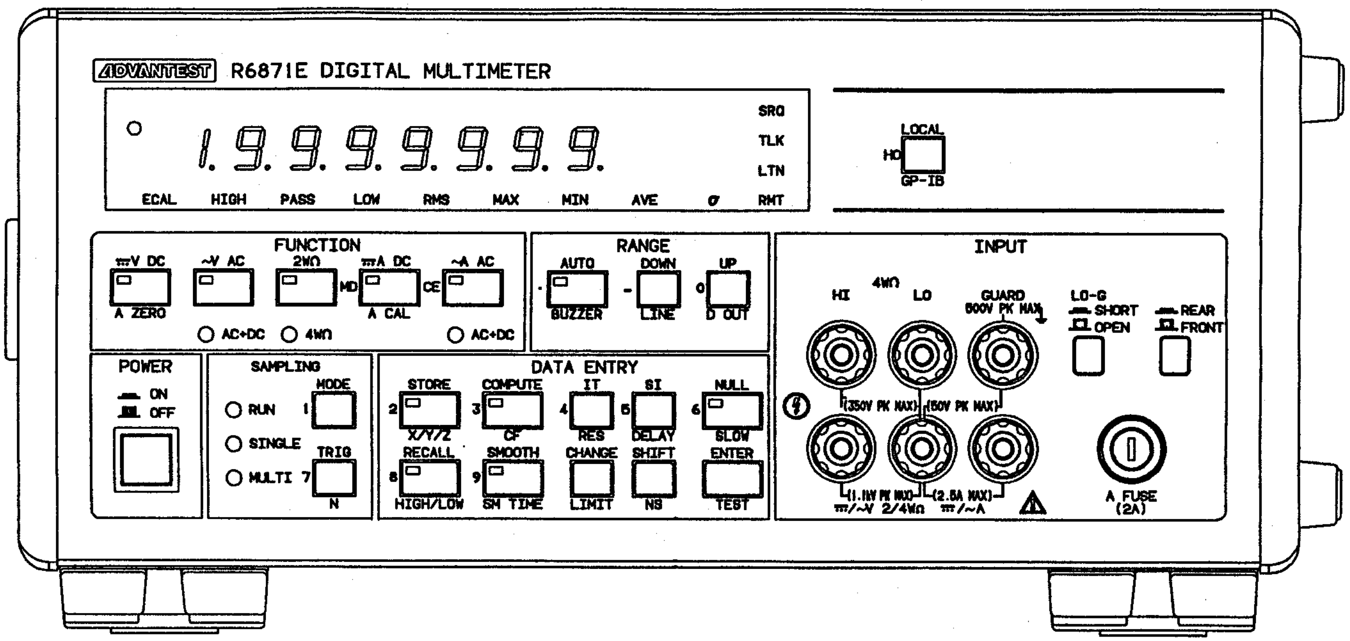
Unit: mm



REAR VIEW

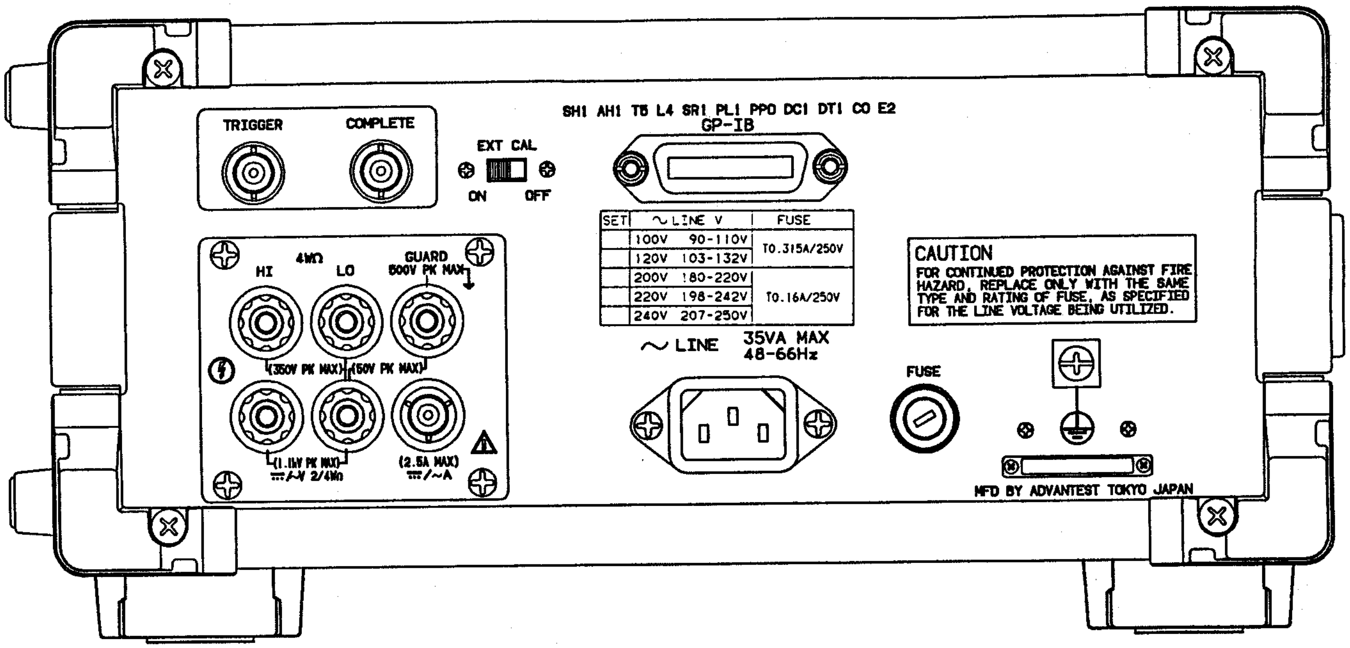
EXT1-9009-B

R6871E
EXTERNAL VIEW



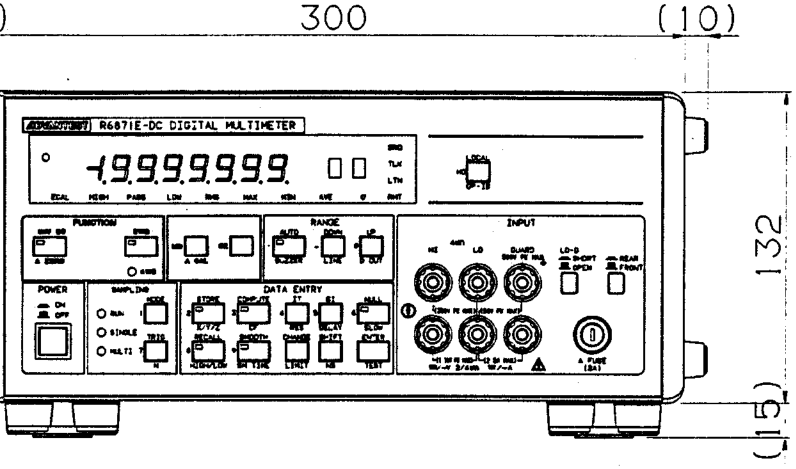
EXT2-712-A

R6871E
FRONT VIEW

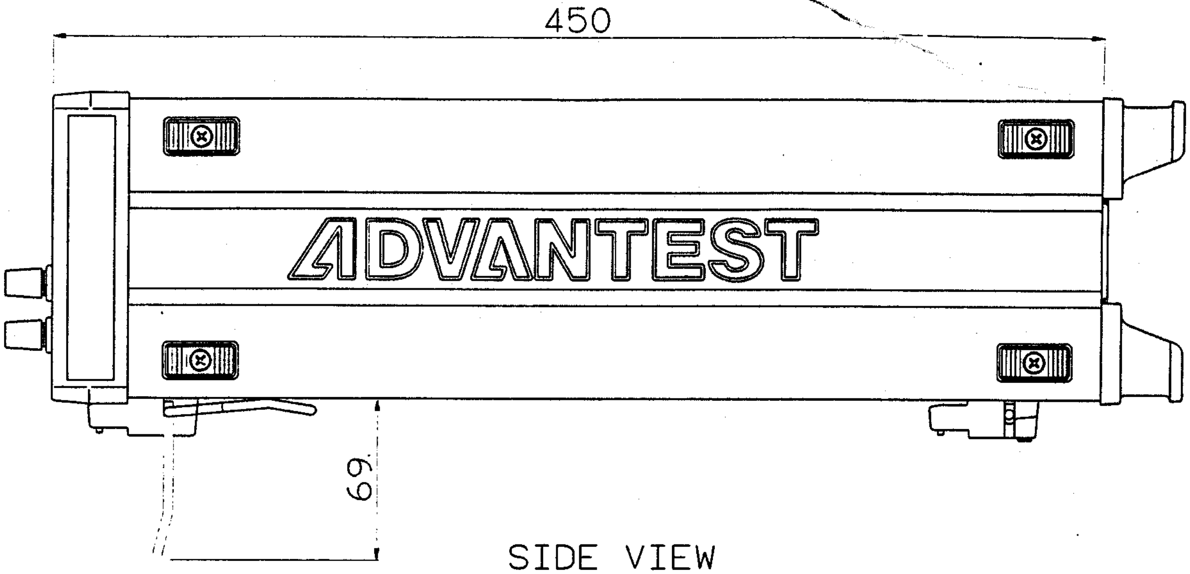


EXT3-9009-B

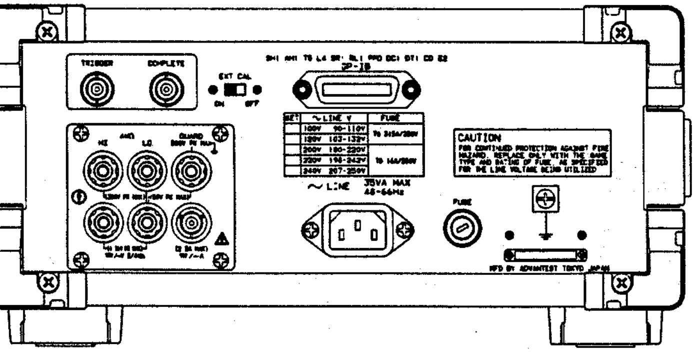
R6871E
REAR VIEW



FRONT VIEW



SIDE VIEW

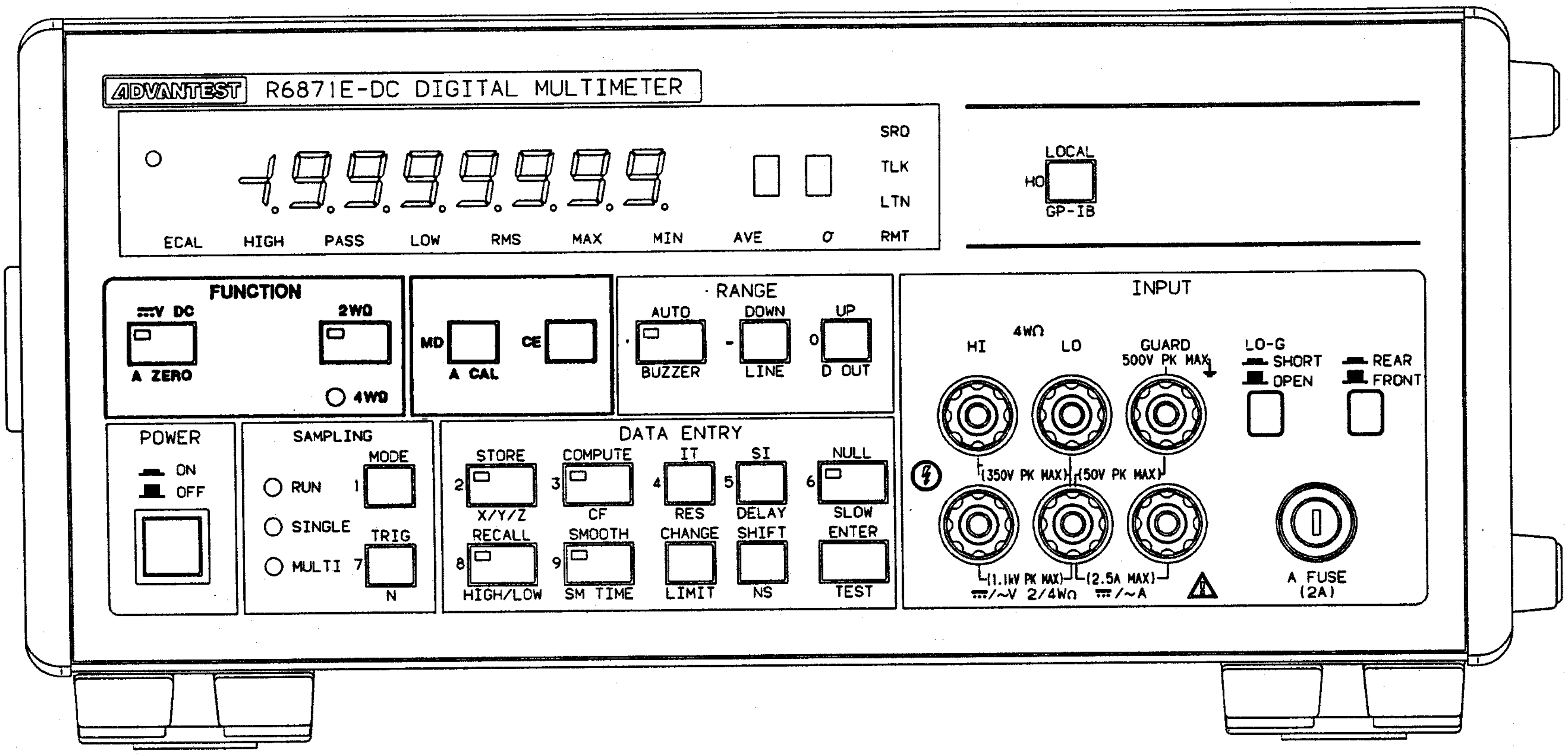


REAR VIEW

EXT4-9009-B

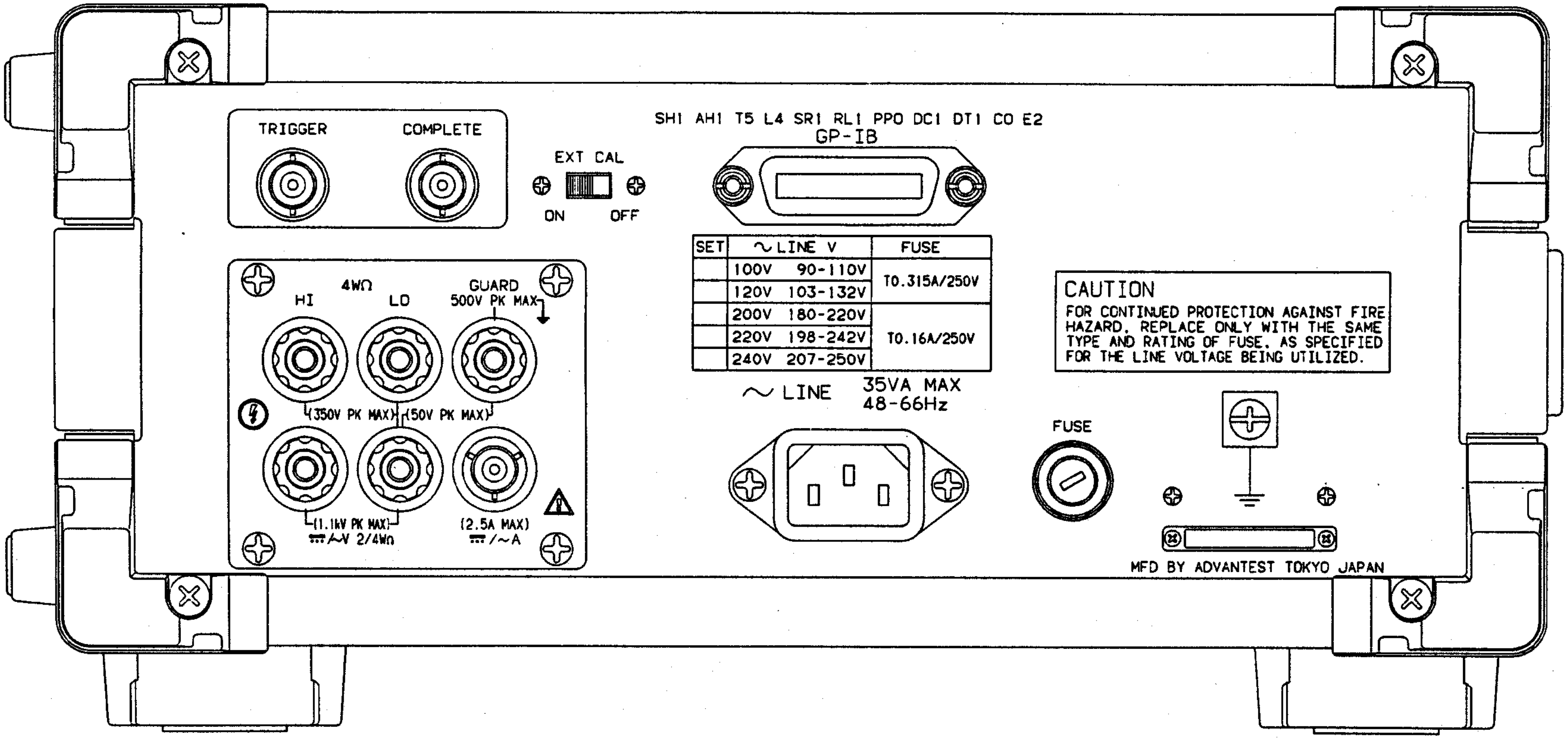
Unit: mm

R6871E-DC
EXTERNAL VIEW



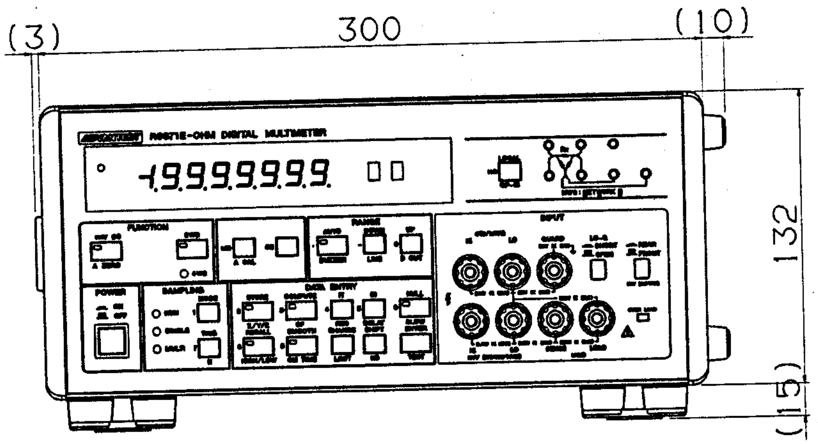
R6871E-DC
FRONT VIEW

R6871E-DC
REAR VIEW

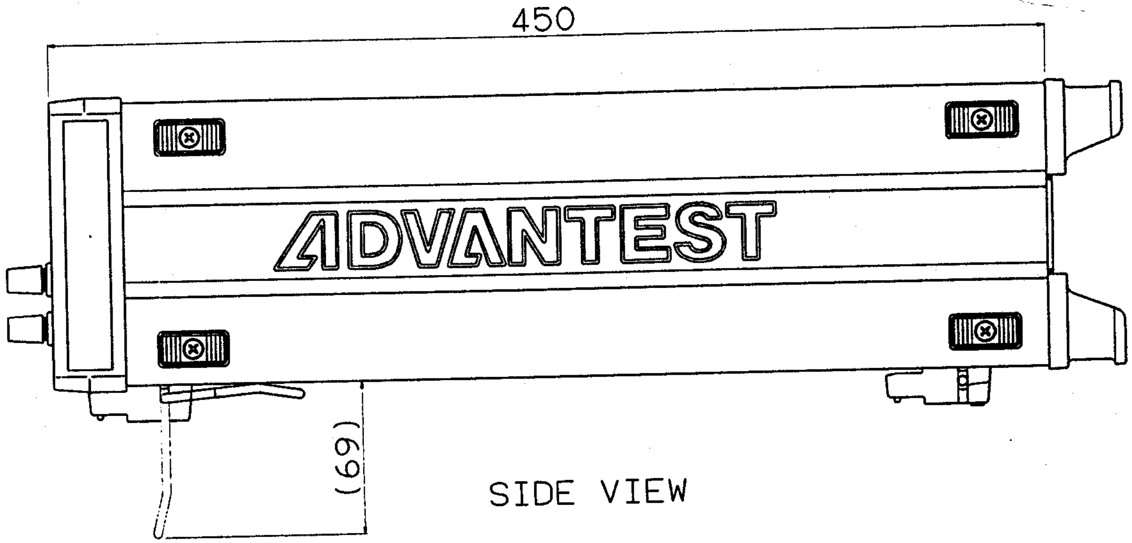


SET	∿LINE V		FUSE
	100V	90-110V	T0.315A/250V
	120V	103-132V	
	200V	180-220V	T0.16A/250V
	220V	198-242V	
	240V	207-250V	

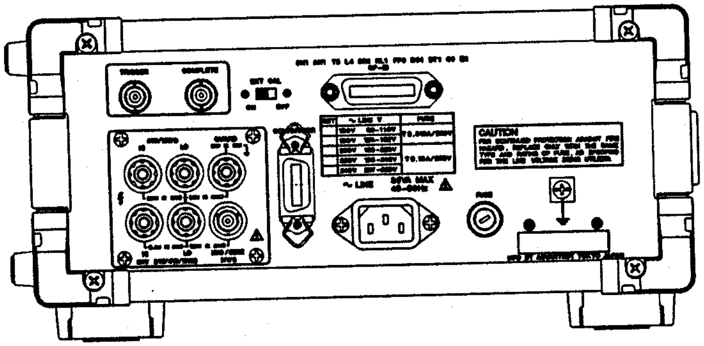
CAUTION
FOR CONTINUED PROTECTION AGAINST FIRE HAZARD, REPLACE ONLY WITH THE SAME TYPE AND RATING OF FUSE, AS SPECIFIED FOR THE LINE VOLTAGE BEING UTILIZED.



FRONT VIEW



SIDE VIEW

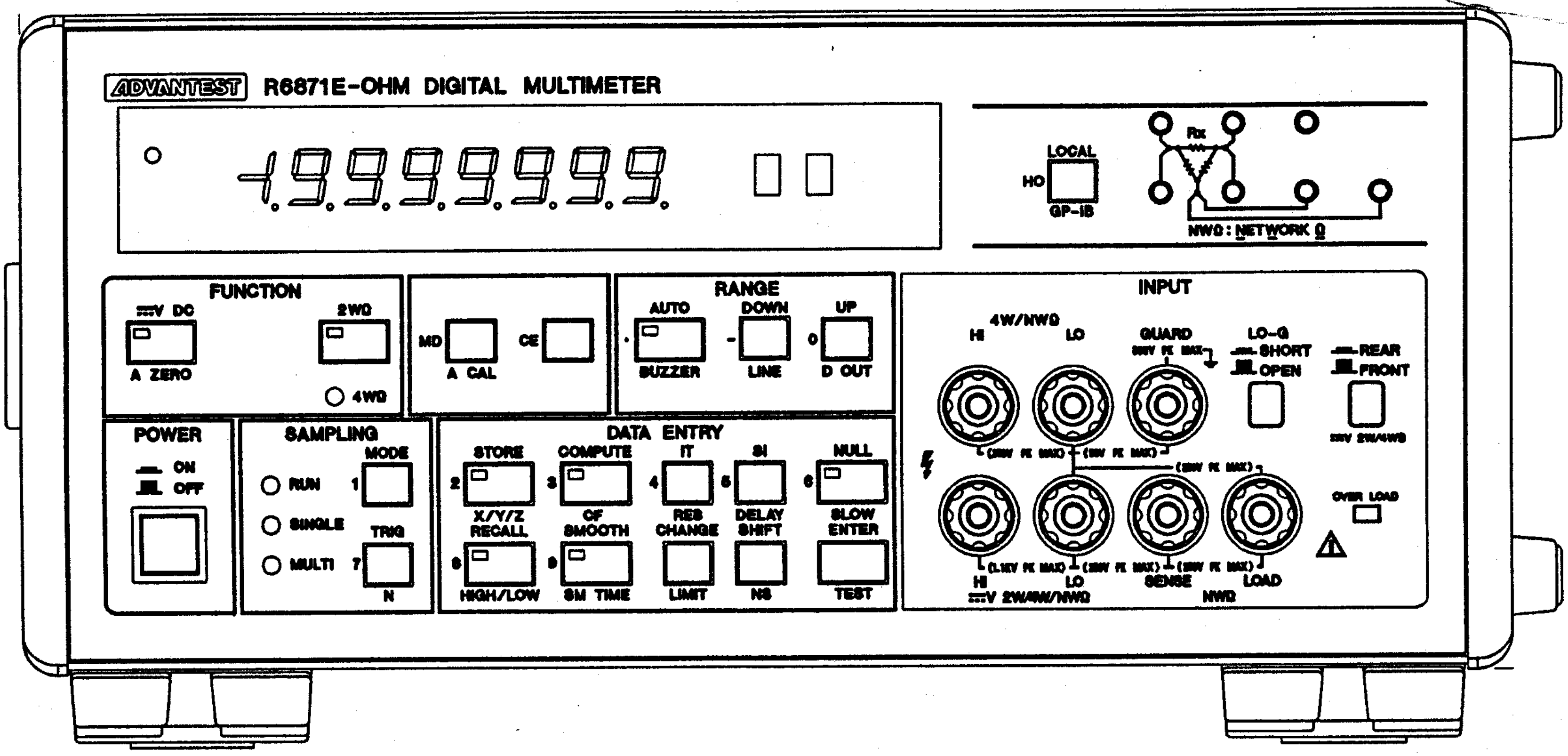


REAR VIEW

Unit: mm

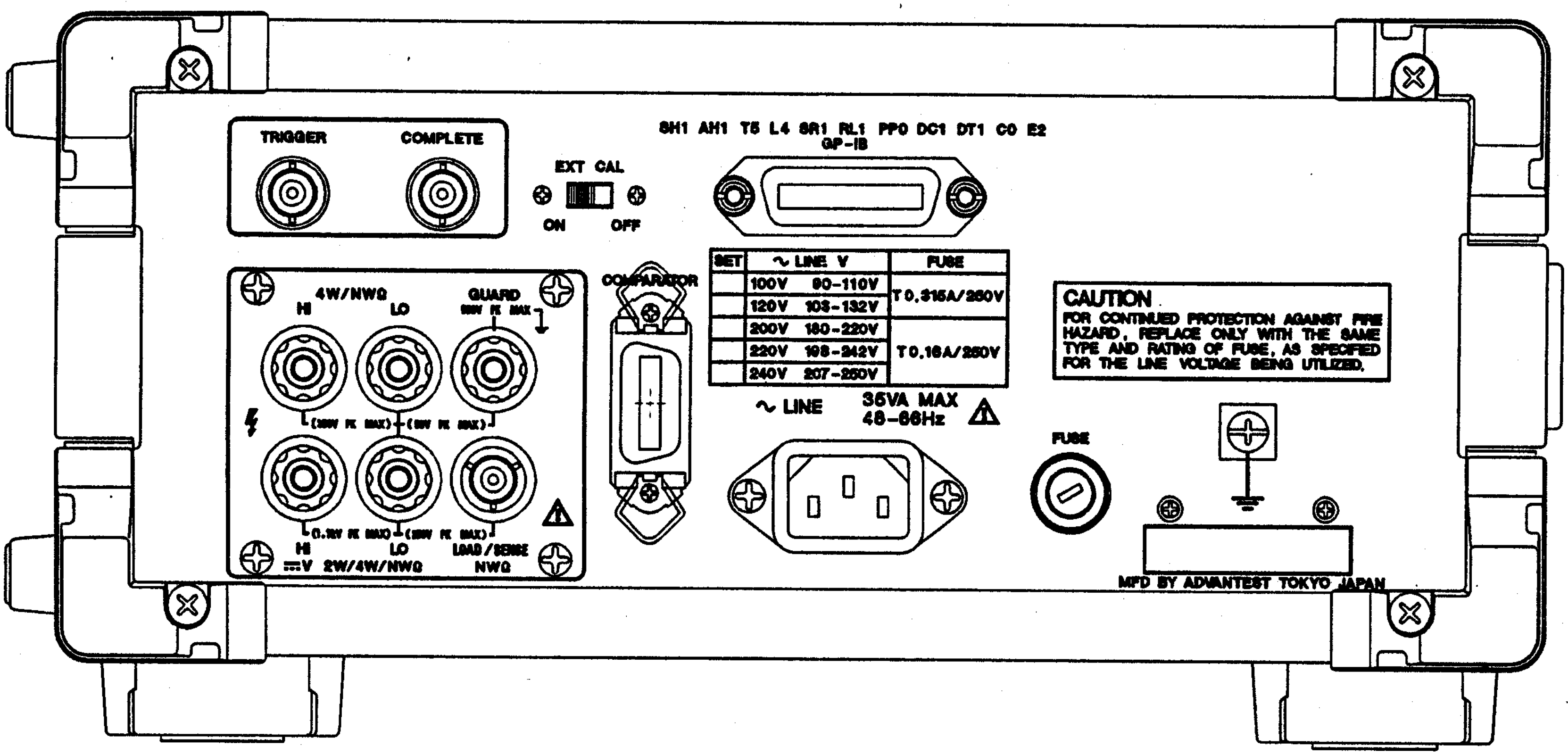
R6871E-OHM
EXTERNAL VIEW

EXT7-9212-A



R6871E-OHM
FRONT VIEW

EXT8-9212-A



SET	~ LINE V		FUSE
	100V	90-110V	T 0.315A/250V
	120V	103-132V	
	200V	180-220V	T 0.16A/250V
	220V	198-242V	
	240V	207-250V	

CAUTION

FOR CONTINUED PROTECTION AGAINST FIRE HAZARD, REPLACE ONLY WITH THE SAME TYPE AND RATING OF FUSE, AS SPECIFIED FOR THE LINE VOLTAGE BEING UTILIZED.

R6871E-OHM
REAR VIEW

EXT9-9212-A

WARRANTY

ADVANTEST product is warranted against defects in material and workmanship for a period of one year from the date of delivery to original buyer.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by buyer, unauthorized modification or misuse, accident or abnormal conditions of operations.

No other warranty is expressed or implied. ADVANTEST specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

ADVANTEST shall not be liable for any special incidental or consequential damages, whether in contract, tort or otherwise.

Any and all warranties are revoked if the product is removed from the country in which it was originally purchased.

SERVICE

During the warranty period, ADVANTEST will, at its option, either repair or replace products which prove to be defective.

When trouble occurs, buyer should contact his local supplier or ADVANTEST giving full details of the problem and the model name and serial number.

For the products returned to ADVANTEST for warranty service, buyer shall prepay shipping and transportation charges to ADVANTEST and ADVANTEST shall pay shipping and transportation charges to return the product to buyer. However, buyer shall pay all charges, duties, and taxes incurred in his country for products returned from ADVANTEST.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL BUYER

The product should be throughly inspected immediately upon original derivery 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.

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