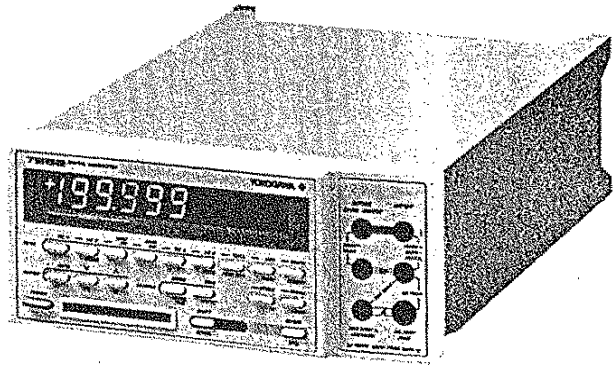
Instruction Manual

7551
7552

Models 7551 and 7552 Digital Multimeters (5-1/2 digits)

Model 7551



Model 7552

YOKOGAWA
Yokogawa Electric Corporation

IM 7550 - 10E
2nd Edition

INTRODUCTION

Models 7551 and 7552 are high-speed and high-accuracy multifunctional multimeters that meet the diversified needs of our customers.

Please read this manual carefully before using the meter. It is necessary to study all the controls and functions of the meter for correct measurement and maximum utilization.

PRECAUTIONS

1. To maintain stable operation and high performance for an extended period, read Section 1.1.3 and follow the precautions described in that section.

2. This manual covers detailed operating instructions and measurement procedures, but if you have any problems or questions, contact your nearest Yokogawa agent.

3. The contents of this manual will be subject to change without notice.

4. All or part of this manual is prohibited to be copied.

FD No. 10014-Q

This manual consists of eleven chapters which describe detailed functions and operating instructions of the Models 7551 and 7552 Digital Multimeters. If you use these multimeters for the first time, read this manual, starting from Chapter 1 "DESCRIPTION" throughout. If you want to operate the multimeter immediately after you received the meter, start from Chapter 4 "MEASUREMENT AND SETTING".

CONTENS

1. DESCRIPTION

The Models 7551 and 7552 are high performance digital multimeters with excellent stability, high speed and noise resistance. These multimeters make use of an A / D feedback pulse converter and a modulation system. A GP-IB or RS-232C communications interface is provided as standard equipment. The multimeter incorporates a memory unit which can store 1000 measured data and buffer data for system use. Furthermore, an IC memory card option is available for storing measured data and setting a 20-step program for changing measurement functions and ranges.

1.1 Operation Preliminaries

The multimeter is thoroughly tested at the factory before shipment. When the instrument is delivered, check that all accessories are included in the packing case. Also check that the instrument model and specifications are correct. Perform a visual check to ascertain that no damage occurred during shipment.

1.1.1 Model and Specifications

The instrument nameplate is located at the rear of the multimeter (see the figure below). Check this nameplate to confirm that the instrument model and suffix codes agree with your specification requirements (see Table 1.1). Should any questions arise which may not be answered specifically by these instructions, contact your nearest Yokogawa agent. Write the Model, Suffix Codes and Serial No.

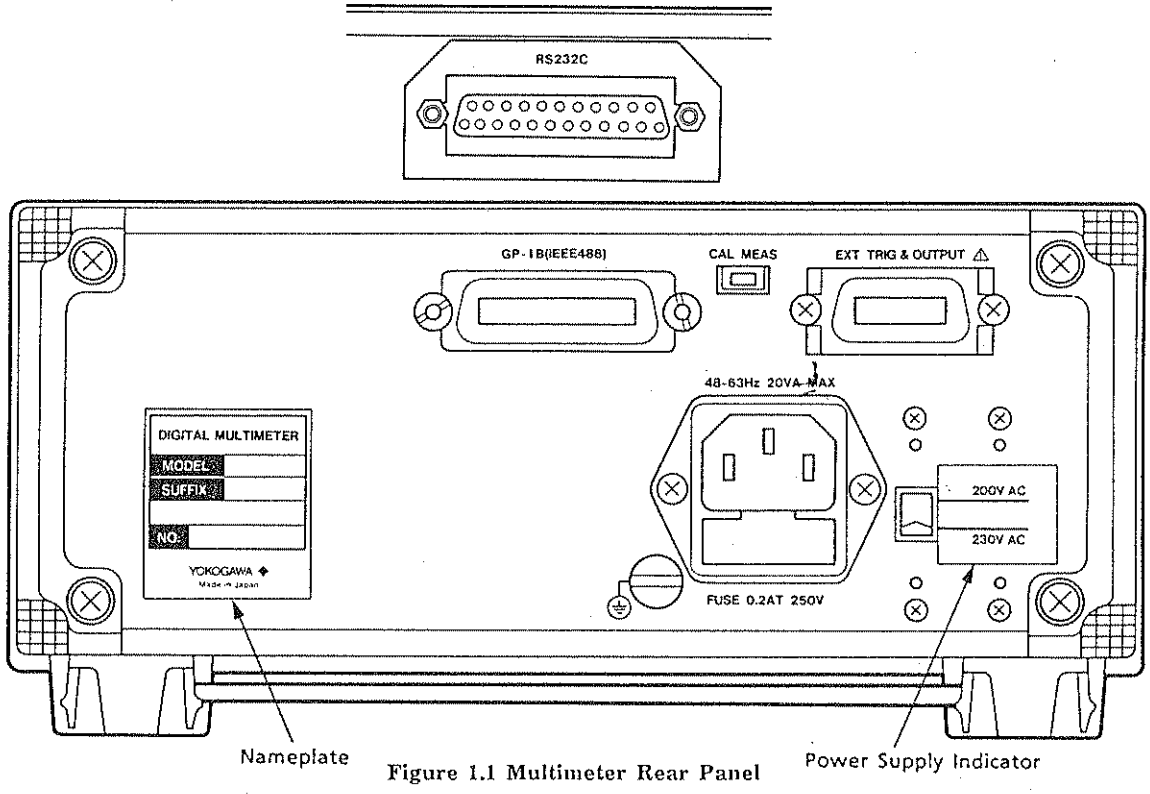


Figure 1.1 Multimeter Rear Panel

Model and Suffix Codes

Table 1.1 Model, Suffix Codes and Specifications

Model	Suffix Codes		Specifications	
7551 01	.....	.....	5-1/2 digits	DC V, DC A, OHM, AC V, AC A (built-in GP-IB interface)
7551 02	.....	.....		DC V, DC A, OHM, AC V, AC A (built-in RS-232C interface)
7552 01	.....	.....		DC V, DC A, f, OHM, AC V, AC A (built-in GP-IB interface)
7552 02	.....	.....		DC V, DC A, f, OHM, AC V, AC A (built-in RS-232C interface)
* Specifications for new version	-B	.....		
Power requirements	-1	.....	100 or 115V AC, 50 or 60Hz	
	-3	.....	115 or 100V AC, 50 or 60Hz	
	-5	.....	200 or 230V AC, 50 or 60Hz	
	-7	.....	230 or 200V AC, 50 or 60Hz	
Options		/DA	D-A converter output	

* Specifications for new version ..... AC V: 700V measurable, Automatic Loading is settable

1.1.2 Accessories

The following accessory items are supplied with the multimeter. Upon receipt of the meter, check that all the accessory items are included. If any of the accessory items are not found, contact your nearest Yokogawa agent.

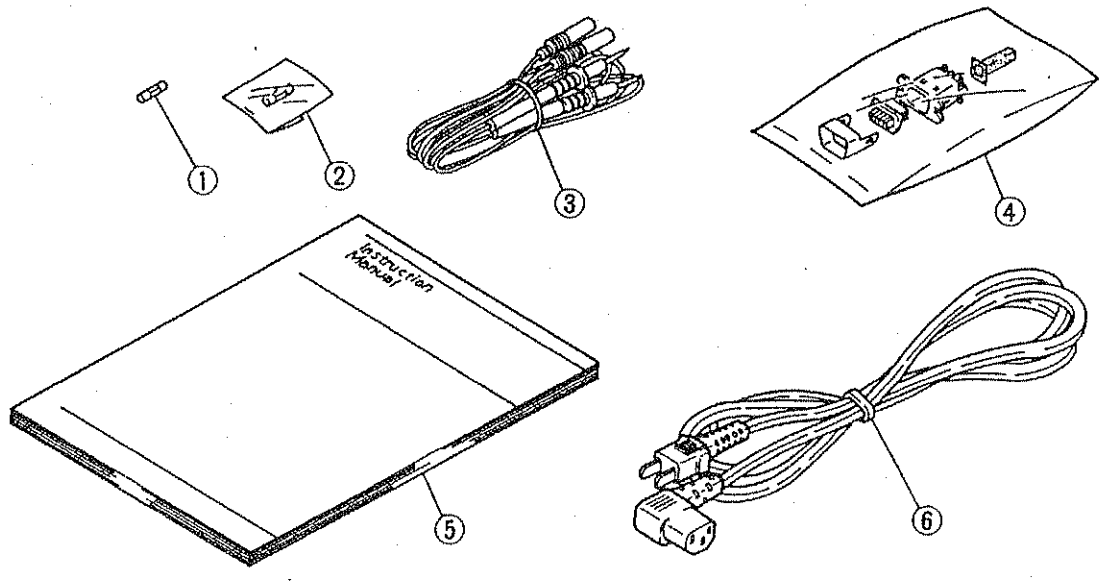


Figure 1.2 Accessories

Table 1.2 Accessories

Item	Parts	Part Number	Quantity	Description
①	Fuse	A9128 KF or A9126 KF	1 1	0.2A TL (100V series) 0.1A TL (200V series) (Install in fuse holder at the rear of the multimeter)
②	Fuse	A9114 KF	1	2A (current input circuit protection)
③	Measurement lead	B9280 TZ	1	
④	Remote connector	A9024 KC	1	
⑤	Instruction manual	IM 7550-10E		For a GP-IB interface, GP-IB instructions are attached.
⑥	Power supply cord	A9009 WD or A9008 WD A9011 WD or A9015 WD	1 1 1 1	100V series 100V series (conforms to UL standard.) 200V series (conforms to VDE standard.) 200V series (conforms to SAA standard.)

1.1.3 Precautions

- Do not put any container on this meter. If liquid gets on the meter, unplug the power cable from the power outlet and contact your nearest Yokogawa agent.
- Do not put any heavy instruments on this meter.
- Prior to carrying the meter, remove the power cable from the power outlet.
- Do not drop the meter or let it fall.
- Do not use benzene or lacquer thinner to clean the case or front panel. Otherwise they will deform or the paint will be damaged.
- When the meter is stored, remove the built-in battery from the case.
- When a voltage exceeding 30V is measured, be sure to ground the meter.
- Do not remove the meter case top which covers the high-voltage circuit.
- If the meter fails, remove the power plug from the power outlet. Contact your nearest Yokogawa agent.
- Do not drop foreign matter into the meter's internal assembly. If foreign matter does fall into the assembly, remove the power plug and contact your nearest Yokogawa agent.
- Do not put anything heavy on the power cord. Do not allow the power cord to come into contact with heat sources. If the power cord is faulty, contact your nearest Yokogawa agent. When the power plug is removed from the power outlet, hold the plug to remove it.
- Select an installation location where the meter is well-ventilated.
- Do not leave the meter in direct sunlight.
- Select a location where the ambient temperature raries little. An ambient temperature of about 23°C is recommended.

1.1.4 Operation Check

(1) Power Supply Connection

After installing the multimeter, connect the power supply cord (supplied with the instrument) to the power supply connector at the rear of the instrument (see Figure 1.3).

Check that the instrument power switch is in the OFF position. Connect the power plug to the power outlet. Use a power supply within the rated voltage. The rated power supply is indicated to the right of the power switch (see Figure 1.3).

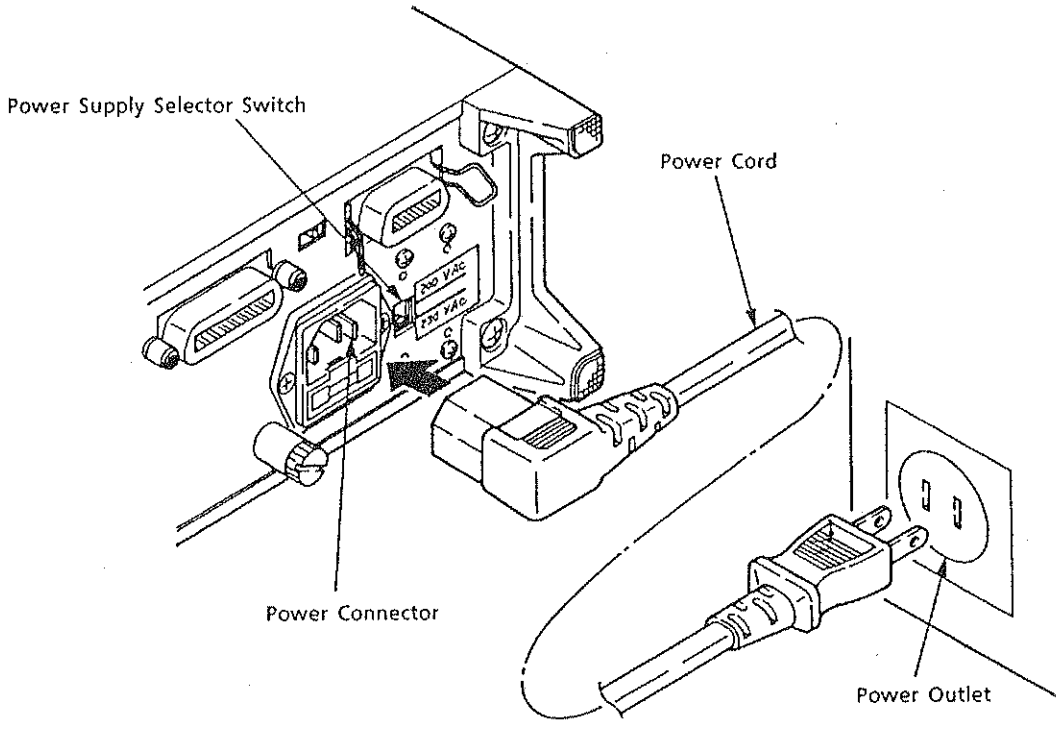


Figure 1.3 Power Supply Connection

(2) Turn ON the Power

Turn ON the power and check that the instrument is automatically tested.

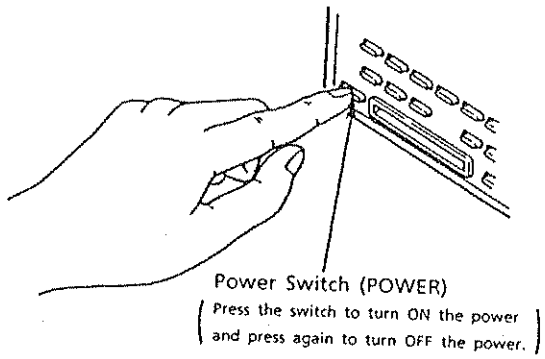
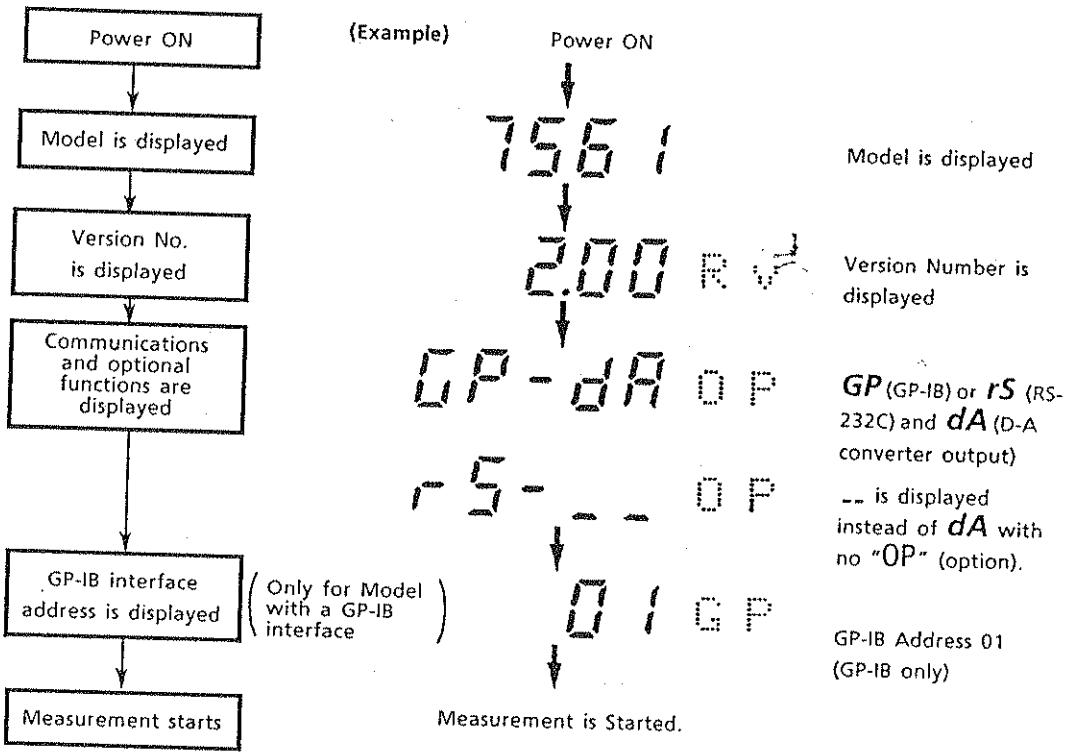


Figure 1.4 Power Switch ON

- Self test when the power is ON.

When the power turns ON, a self-test starts automatically. Check that the following "opening" messages are displayed. If the opening messages are not displayed in the following order, a multimeter internal circuit may be defective. If so, contact your nearest Yokogawa agent.



NOTE

- Measuring interval (INTVL) is not lost even if the power is turned OFF. When the power is turned ON, opening messages are displayed, measurement starts and the measured data is displayed. When the INTVL is short, measured data is updated. However, if an extended INTVL is set, measured data is not updated because the next measuring interval set point has not been reached. Bear in mind that this is not an error.

2. GENERAL DESCRIPTION

2.1 Features

- **High Accuracy and Stability**

  This digital multimeter has a basic accuracy of 0.003% of span (in 2000 mV DC range) and also has a resolution of 0.1 μV. Uses an integral-type A-D converter in the feedback pulse-width-modulation system. This allows noise resistance as well as outstanding linearity and stability.

- **A Wide Range of Applications - From Bench Use to System Use.**

  ① High-speed sampling (125 cycles / second)

  A-D converters use a feedback pulse-width-modulation system as well as a new counting system, providing high-speed response.

  ② Built-in data memory

  A built-in memory (with memory capacity of up to 1000 data) is provided as a standard buffer. An additional IC memory card can store up to 8000 data. Data sampled at high speed can be transferred after measurement without any consideration of the transmission capability of the communications bus necessary, so measurement work is efficiently done.

  ③ Standard communication connectors

  A GP-IB or RS-232C communications interface is included as standard equipment. This interface enables most panel keys (except the POWER key and front/rear transfer switch) to be controlled remotely.

- **IC memory Cards**

  Optional IC memory cards available for:

  - measured data storage
  - panel-set data storage
  - automatic reading of panel-set data (automatic loading function)
  - program setting and measured data storage

  ① Automatic loading functions

  Use a card with measuring functions and conditions already stored, and turn ON the power. The contents of memory are then read and set automatically.

  ② Program functions

  Up to 20 programing steps, including measuring functions, measuring range setting, computational expressions, ON / OFF, etc., can be created on the panel. Using these programs, you can measure data repeatedly.

2.2 Block Diagram

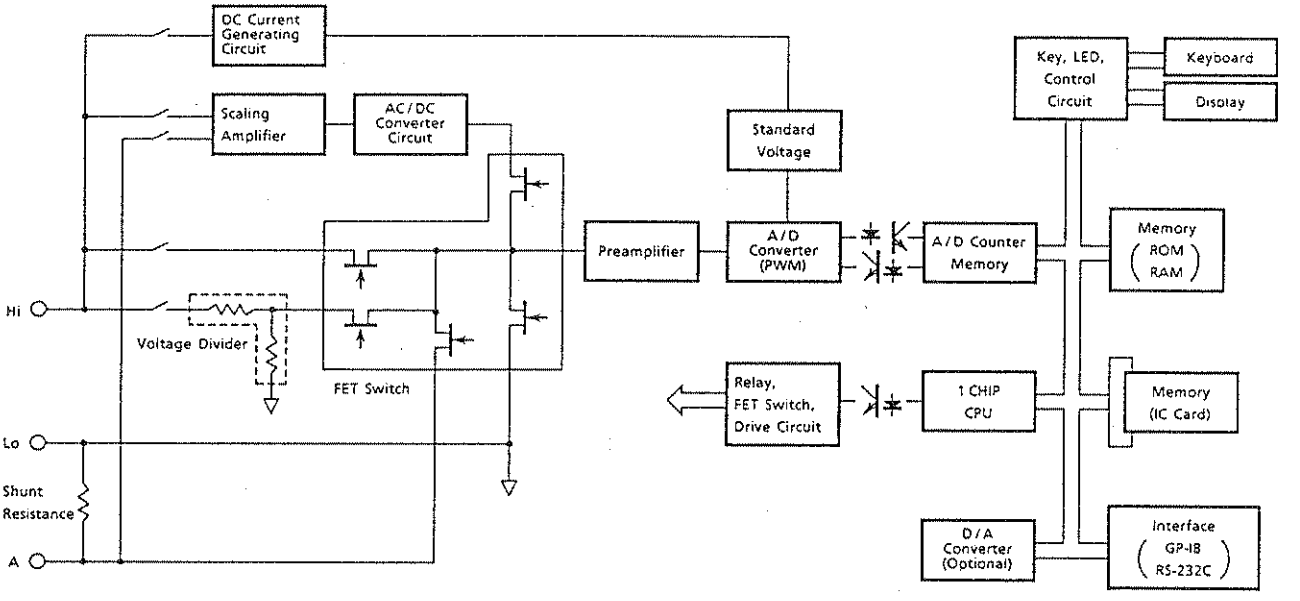


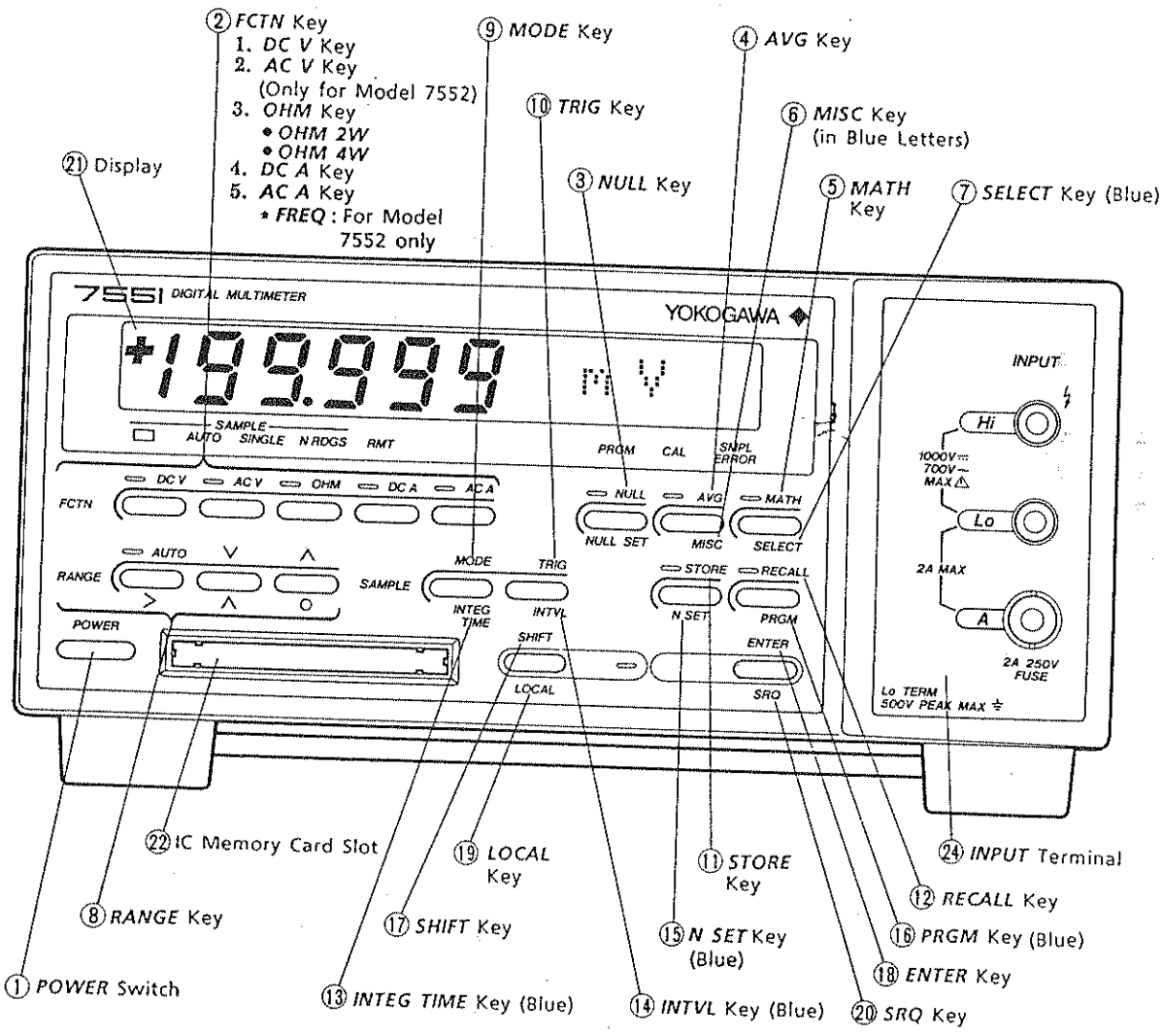
Figure 2.1 Models 7551 and 7552 Digital Multimeter, Block Diagram

Figure 2.1 shows a digital multimeter block diagram. For DC voltage measurements, an input voltage is directly measured by a preamplifier within a range of a high input impedance of 200 to 2000mV. The voltage is scaled in the preamplifier within the range of 20 to 1000V by a voltage divider. For AC voltage measurements, the voltage is normalized in a scaling preamplifier by a coupling capacitor and is converted to a DC current in an AC / DC converter circuit. Model 7551 uses an average value rectifying system (effective value calibration) and Model 7552 uses a highly effective value system. Resistance can be measured within seven (7) ranges from 200 ohms to 200 megohms. A DC current flows through the resistor to be measured and its voltage drop is displayed as a resistance value. The four-wire measurement system can be selected in the case of Model 7552. For current measurements, the voltage drop in the shunt resistor between the current terminal and Lo terminal is displayed as a current value. Any change of function and range can be made by the relay or FET switch which is driven by the control signal from the CPU according to the selected mode. A high speed and low bias current of FET input type is conducted into the preamplifier. The automatic zero point correction of the preamplifier and A / D converter is carried out by installing a zero point correcting switch at the input side of the preamplifier. A feedback pulse modulating system is adopted to the A / D converter and is insulated with PWM and a photo isolator. The counting of PWM output, measurement sequence, data correction, display, keyboard interface, operation, IC memory card, data output interface, etc. are processed in the digital portion.

3. COMPONENT NAMES AND FUNCTIONS

3.1 Front Panel

Model 7551



* Blue keys are settable while SHIFT mode is ON.

Figure 3.1 Model 7551 Front Panel Components

Model 7552

The numerals and names are identical to those for Model 7551

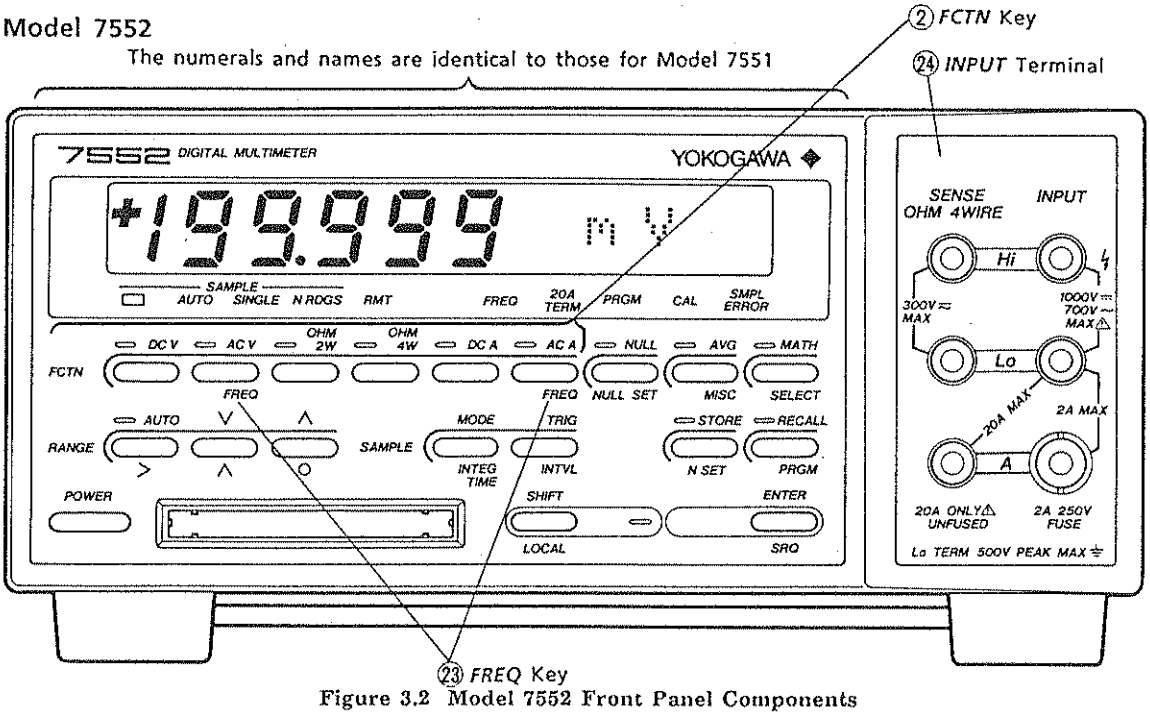
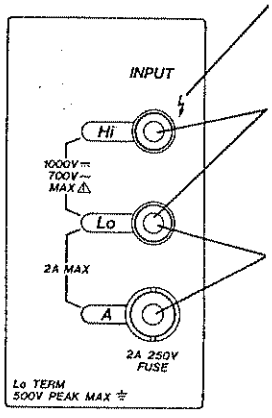


Figure 3.2 Model 7552 Front Panel Components

Model 7551 INPUT Terminal

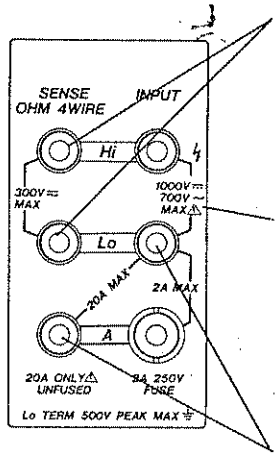


High voltage terminal symbol

For DC V, AC V, and OHM (2W) measurement

For DC A and AC A measurement. On terminal A, a current input circuit protective fuse is provided. For fuse replacement, see Section 7.1.2. Push and turn the fuse holder counterclockwise to remove the fuse together with its holder. Replace the fuse with a new one.

Model 7552 INPUT Terminal



For INPUT Hi and Lo (current terminals) as well as voltage terminals for 4-wire resistance (OHM 4W) measurement.

International symbol, which means "Consult the Instruction Manual". The symbol " ⚠ " is marked in the application portion of the instruction manual.

For DC A and AC A (up to 20A) measurement. (Take care that there is no input circuit protection fuse for 20A terminal.)

3.2 Rear Panel

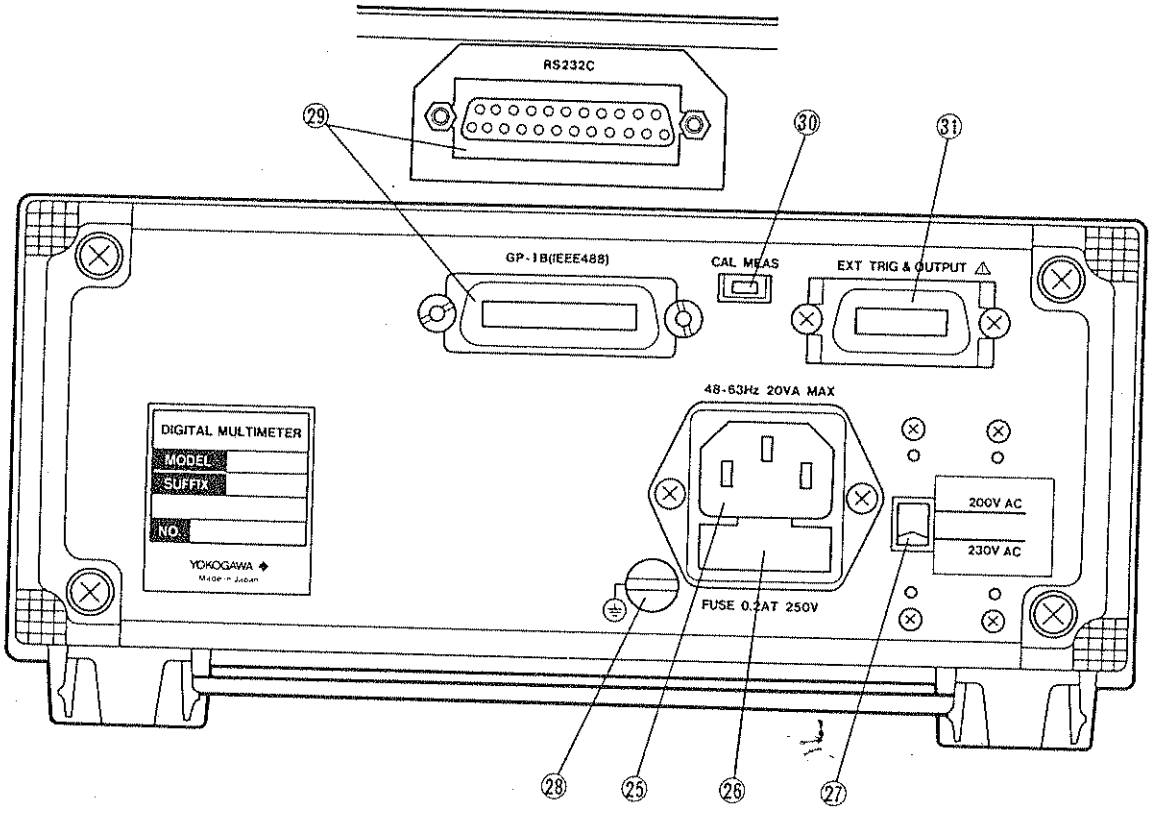


Figure 3.3 Models 7551 and 7552 Rear Panel Components

㉕ Power Supply Connector

A three-pin connector with ground terminal. Use the rated supply voltage and frequency.

㉖ Fuse

A time delay fuse with the capacity of 0.2A (100V series) or 0.1A (200V series).

㉗ Power Supply Selector Switch

This switch is set at the factory in accordance with power supply requirements:

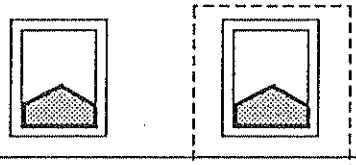
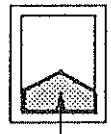
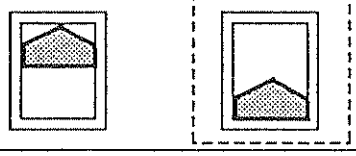
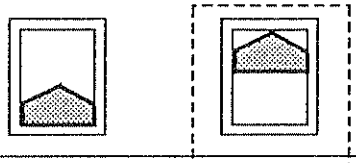
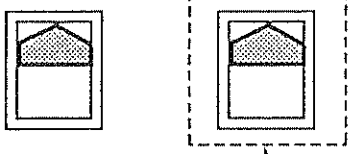
100V series : 100V or 115V
200V series : 200V or 230V

To change the supply voltage from 100V to 115V or vice versa or 200V to 230V or vice versa, select the switch position (see the table below).

CAUTION

- After changing the supply voltage, be sure that the fuse rating is correct.

Table 3.1 Power Supply Selector Switch Position

Supply Voltage	Switch Position	Fuse	Remarks
100V		0.2A	 Switch Position
115V			
200V		0.1A	
230V			

Switch positions enclosed by dotted lines are covered with the supply voltage indicator.

㉘ **Ground Terminal**

A case ground terminal for Class 3 grounding (ground resistance up to 100 ohms). (When a power cord with ground is used and grounded through the receptacle, the case ground terminal need not be grounded.)

㉙ **GP-IB Interface Connector (For Models 7551 01 and 7552 01)**

Models 7551 02 and 7552 02 are available with RS-232C communications interface connectors.

㉚ **CAL/MEAS Switch**

This switch is used to select calibration or measurement mode. In normal measurement mode, this switch is in MEAS position. To set the calibration mode, place this switch in CAL position.

㉛ **EXT TRIG & OUTPUT ⚠ Connector**

This connector is used for connecting remote I/O signals, such as the remote trigger (measurement-start) signal, measurement-end signal output, comparator (HIGH, LOW and PASS) output, and D/A output (optional).

4. MEASUREMENT AND SETTING

The stand for this instrument can be positioned as shown below. When highly accurate measurement is required, place the instrument in a horizontal position or set its stand upright. Keep the instrument away from heat sources. This instrument can be mounted on a rack using a rack-mounting kit (see Figure 4.2).

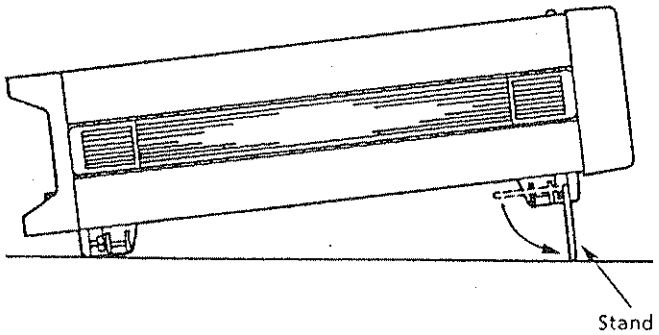
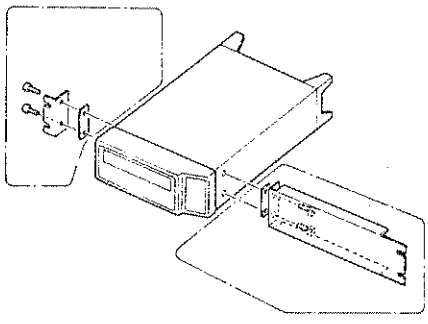
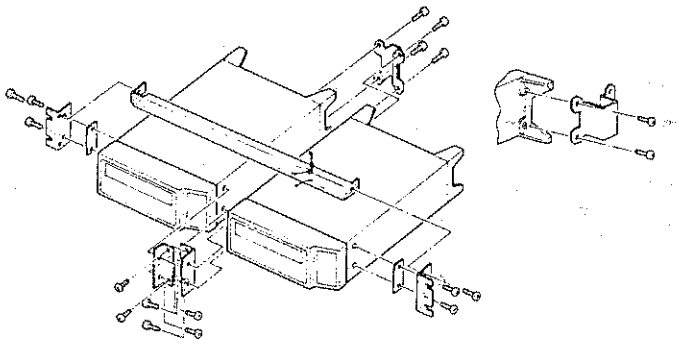


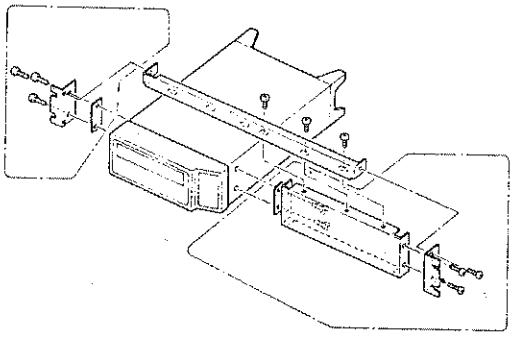
Figure 4.1 Set Stand Upright



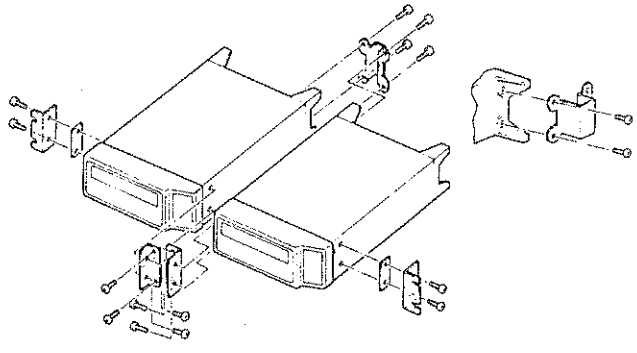
For Model 7515 01



For Model 7515 02



For Model 7515 03



For Model 7515 04

Figure 4.2 Rack-Mounting Hardware

CAUTION

- The display window is made of thermoplastic resin. Do not touch soldering irons to the display window. Do not wipe off the display window with a cloth wet with benzine, alcohol, etc.

4.1 Preparation for Measurement and Some Cautions

Connect the power cord to the instrument rear power connector and apply the rated power to the instrument. Turn ON the power switch and allow at least 60 minutes for if to warm up.

4.1.1 DC V Measurement

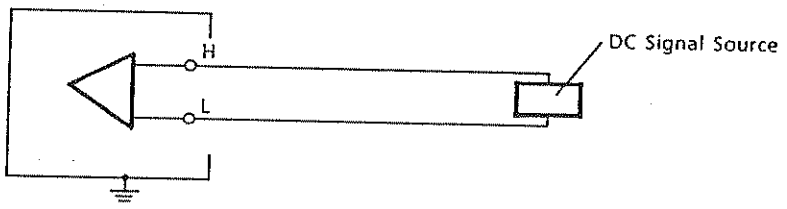
PRECAUTION

- The maximum input voltage is about ±1000V (peak) for 10 seconds and about ± 600V (peak) continuously in a DC voltage range of 200mV to 2V. The mximum voltage is about ±1000V (peak) continuously in a DC voltage k of 20V to 1000V. The maximum voltage with respect to the ground is ± 500V (peak). If the voltage is beyond these limits, the instrument will be damaged. If a voltage higher than the maximum input voltage is applied, the input impedance will drop to around 100 kiloohms.

(1) Connect leadwires to the input terminals (high voltage to Hi, low voltage to Lo). The polarity indication will be "–" when the Hi terminal is negative. See Figure 4.3 for interconnections.

(2) When a voltage is measured repeatedly in the same measuring range, set the manual range mode and select an appropriate range.

① **Interconnections for General Use**



② **High-accuracy Measurement**

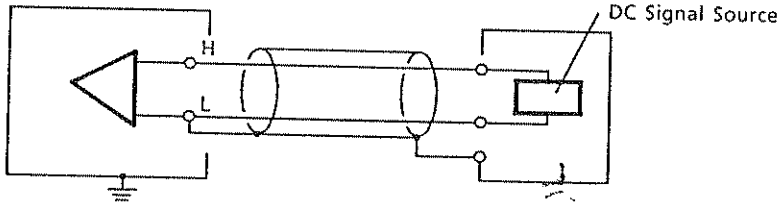


Figure 4.3 Interconnections for DC V measurement

CAUTION

- When very low voltage measurement is required, there is a problem of generating thermoelectromotive force due to connections between the measurement leadwire and instrument terminals. For this measuring application, be careful not to generate a temperature difference between the H and L terminals. Short-circuit between H and L terminals and use NULL functions to cancel the residual voltage.
- In high-speed sampling mode, use shielded cables. Otherwise the high-speed mode is affected by power supply noise.

4.1.2 AC V Measurement

⚠

CAUTION

- The allowable maximum input voltage is 700V. The maximum voltage with respect to the ground is ±500V (peak). If the voltage is beyond the above limits, the instrument will be damaged.

(1) Connect the leadwires to Hi (high voltage) and Lo (low voltage).

(2) Model 7551 rectifies average values to indicate effective values.
If a distorted wave signal is applied, an error occurs.
Model 7552 indicates effective values in AC V measurement.

(3) The instrument can measure a minimum frequency of 20Hz. If a frequency signal lower than the above is applied, the meter display may fluctuate. When an AC voltage superimposed on a DC voltage is measured, the frequency of AC components must be higher than 20Hz. When the multimeter is in high-speed sampling mode and used for low-frequency measurement, the fluctuation in the meter display will become greater.

(4) Use the instrument in a measuring range of 5 to 100%. Otherwise, the meter display will not be stable.

4.1.3 Resistance (OHM) Measurement

CAUTION

- Up to 300V RMS can be input. Do not leave the instrument with the input voltage applied. The maximum voltage with respect to the ground is ±500V (peak). Do not exceed these voltage limits.

(1) Connections for resistance measurement in two-wire or four-wire system

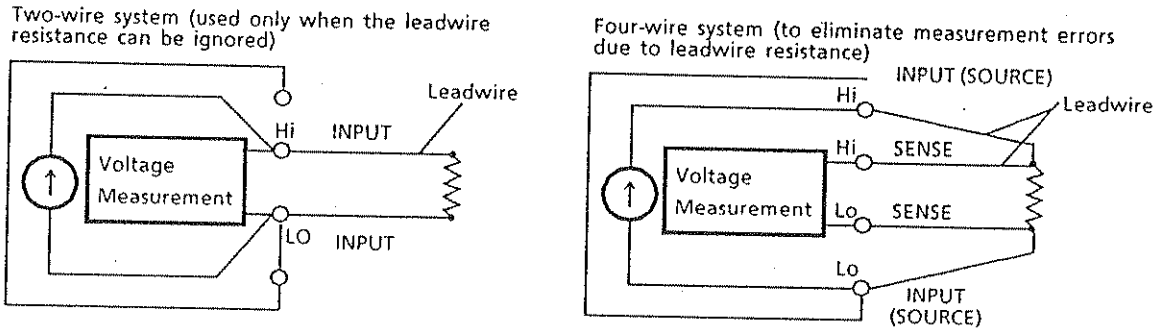


Figure 4.4 Connections for Resistance (OHM) Measurement

Connect leadwires to the input terminal. For connections for two-wire and four-wire systems, see Figure 4.4. Connect a high voltage terminal to "Hi" and low voltage terminal to "Lo".

(2) For the four-wire system, use the leadwires option (Model 7515 10), the leadwires (supplied with the meter) or leadwires prepared by users and make a four-wire system. Turn ON the AUTO ZERO and put it into use.

(3) Table 4.1 shows the currents flowing from "Hi" to "Lo" terminal through the resistance to be measured.

Table 4.1

Range (ohms)	Current Flowing
200Ω	1 mA
2000Ω	1 mA
20kΩ	0.1mA
200kΩ	10μA
2000kΩ	1 μA
20MΩ	0.1μA
200MΩ	50nA

PLEASE NOTE

- Do not touch the measurement clip during measurement. Otherwise indication errors occur.
- In high-resistance measurement (10 Megohms or more), if there is considerable noise at the "Hi" terminal side, it may result in a fluctuating indication or unstable operation in auto range. When the multimeter is used in high-speed sampling mode, use shielded wires for input connections. Connect the instrument case to the "Lo" terminal to prevent common mode noise.
- For the 2-wire system, shorten the tips of the leadwires and make a zero point adjustment (see Section 5.2 for NULL Adjustment).
- In very low or high resistance measurement, use an averaging function to ensure stable operation.
- When the input terminal is open, the voltage between the input terminals is 12.5V maximum.

4.1.4 DC A / AC A Measurements

CAUTION

- **For Model 7551 :** Allowable maximum input current is ± 2A (DC+AC peak). If the input current is beyond the above limits, the protective fuse will blow. For fuse replacement, see Section 8.1.2 "Fuse Replacement".
- **For Model 7552 :** Allowable maximum input current is 20A. Do not exceed this current limit. Otherwise, the instrument will be damaged.
- Allowable maximum voltage with respect to the ground is ±500V (peak value). Do not exceed this voltage limit. Otherwise, the instrument will be damaged.
- The current flowing thru the leadwire supplied with the multimeter is limited to 5A. When a larger current is to be measured, use a special leadwire (for large current measurement) available upon request.

(1) Connect the leadwire to the current input terminals A and "Lo" (current flows A to Lo, see Figure 4.5).

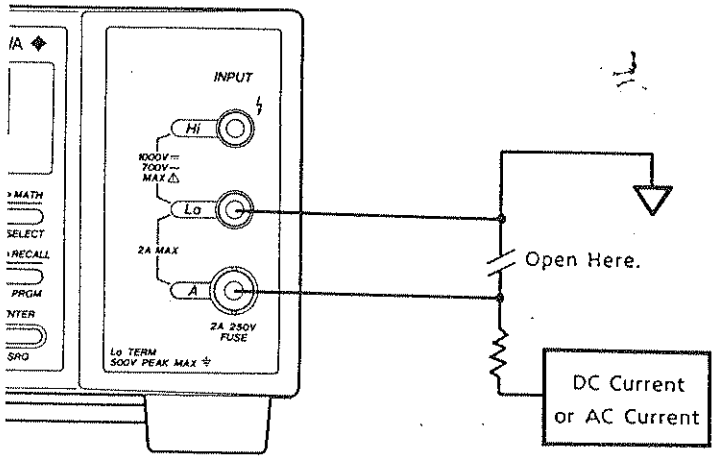


Figure 4.5 DC A Measurement

(2) When the current is measured repeatedly in the same range, set manual range mode and select the desired range.

PRECAUTION

- For 20A measurement, the multimeter dissipates heat. Do not contact input leadwires with each other. Make sure that leadwires are properly connected. Avoid continuous current flow of 10A or larger for more than an hour.

(3) Model 7551 displays effective values that average values are rectified. Model 7552 displays true effective values.

<AC Current Measurement for Model 7552 Only>

(4) The instrument can measure a minimum frequency of 20Hz. If a frequency signal lower than the above is applied, the meter display may fluctuate. Even when AC current superimposed on DC current is measured, the frequency of AC components must be higher than 20Hz. When the multimeter is in high-speed sampling mode and used for low-frequency measurement, the fluctuation of meter indication will become greater.

(5) Use the instrument in the measuring range of 5 to 100%. Otherwise the meter display will not be stable.

PRECAUTION

- In AC range, the meter may not display zero even though there may be no input. This is due to internal noises (not a false reading).
- For 20A measurement, the multimeter dissipates heat. Do not contact input leadwires with each other. Make sure that leadwires are properly connected. Avoid continuous current flow of 10A or larger.

4.1.5 Frequency (FREQ) Measurement

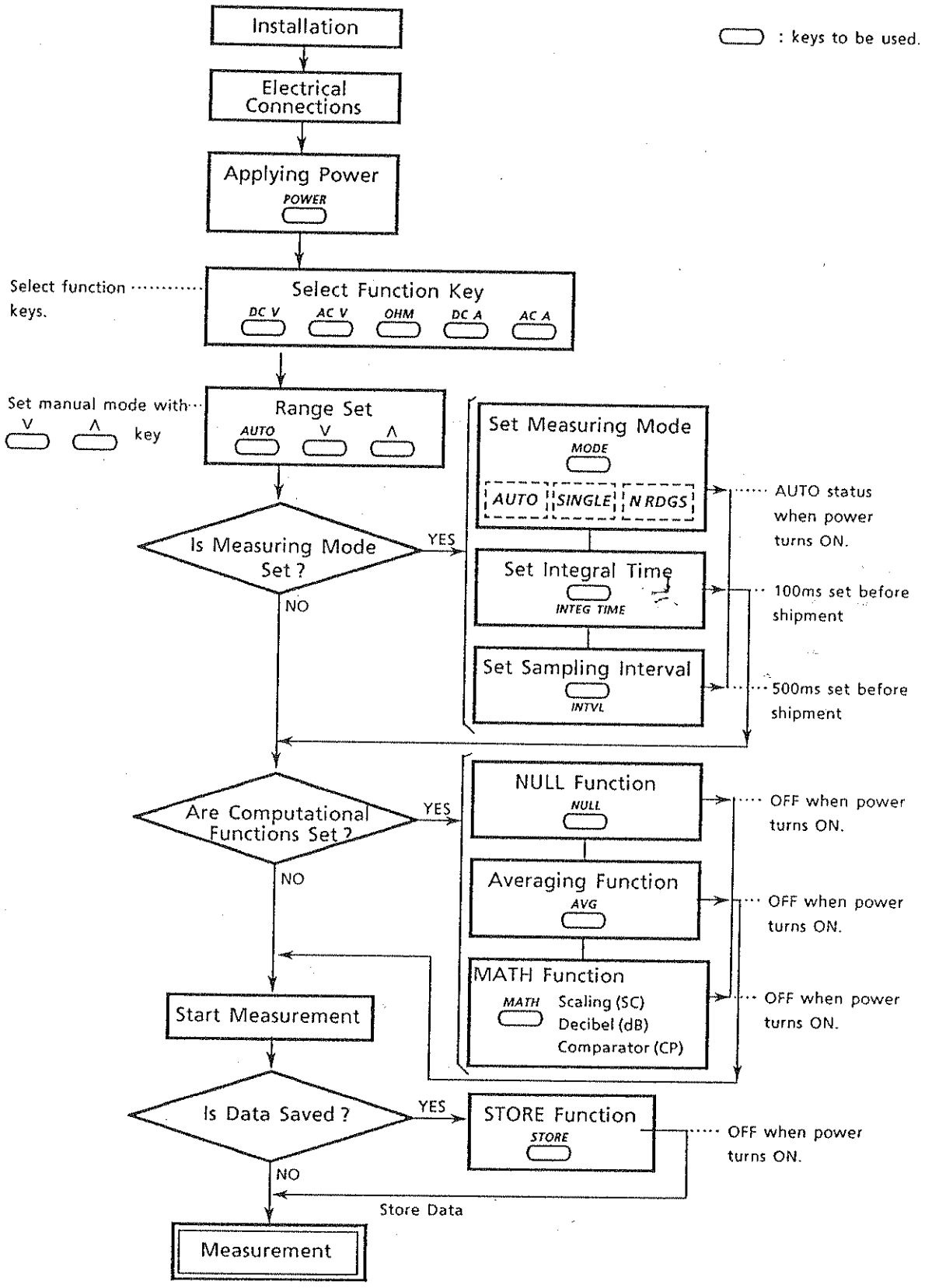
(1) The input connections are same as those for AC V or AC A.

(2) Press AC V or AC A key and check that the input signal is greater than 5% of input range. Press the AC V or AC A key again. Now the multimeter is in frequency measurement mode.

(3) If the input level is lower than the limits specified, the meter display may be unstable or invalid data may be displayed.

4.2 Measurement Procedures

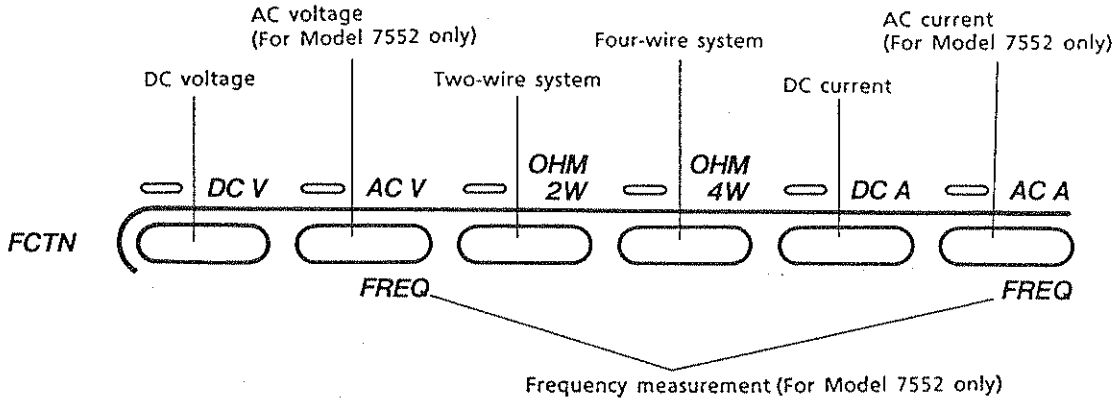
- Normal measurement procedures are as follows :



4.3 Setting Keys

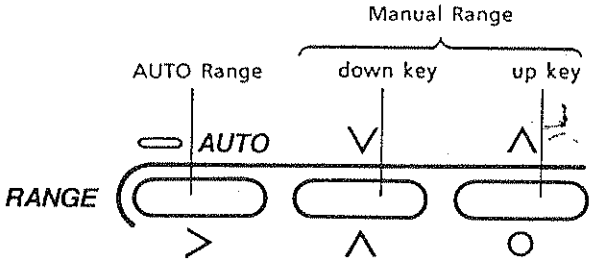
4.3.1 Setting Function (FCTN) Keys

The following function keys are included. Press the desired function key. The corresponding LED lights up.



4.3.2 Setting Measuring Range (RANGE)

The multimeter includes two measuring ranges – auto range and manual range. When auto range is selected, an LED lights up.



- Measuring ranges that are set for individual measuring functions are stored in memory.
- After a measuring function has been changed to another function, if it is used again, the current measuring range is also returned to the previous range.

(1) Auto Range Mode

- When the display data increases more than 20000/200000, the range is automatically changed (increased), whereas when the display data goes down to less than 1800/18000, the range is automatically changed (decreased).
- When the mode changes from manual to automatic, measurement starts from the range selected in manual mode.
- In 20A range, manual mode cannot be changed to automatic mode. Decrease the range in manual mode and then change from manual to automatic mode.

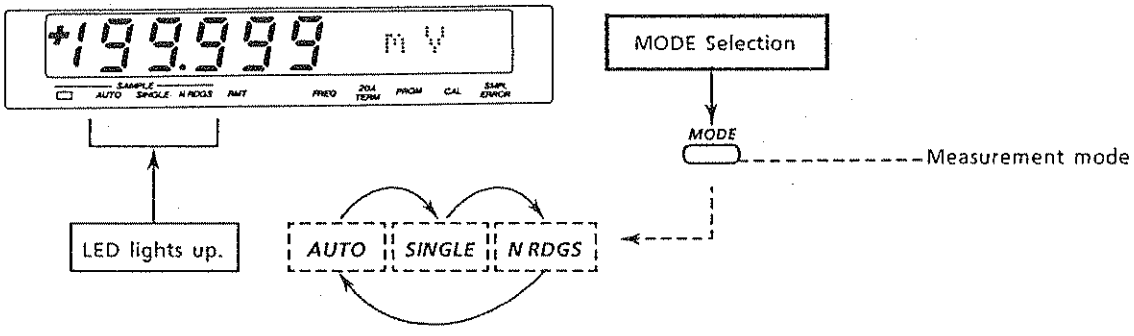
(2) Manual Range Mode

- When manual mode is selected with AUTO key, a range that is selected in auto range comes up.
- If manual mode is selected with the UP or DOWN key, the range will be changed.
- If the measuring range exceeds upper-limit setpoint, **– OL –** (overload) is displayed. Set the range again or select auto range.
- A 20A measuring range can be selected manually.

Note : For AC voltage or current measurement, if the input is below 5%, measurement accuracy can not be assured.

4.3.3 Setting Measurement Mode (MODE)

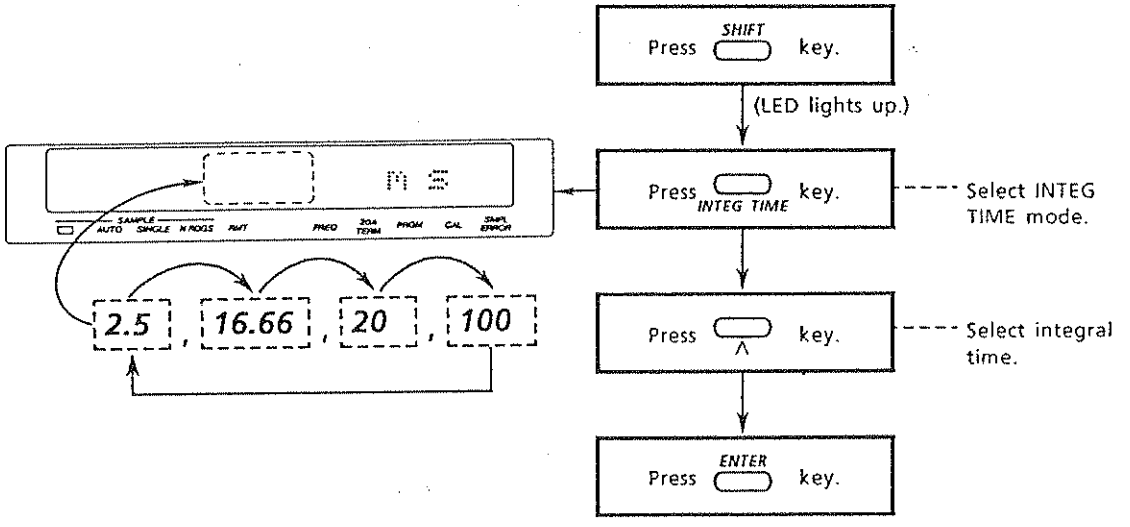
The MODE key is used to the select sampling mode. When the key is pressed repeatedly, the mode changes to AUTO, SINGLE, N RDGS, and AUTO in turn. The corresponding LED lights up every time the mode is selected. For detailed information the about measurement mode, see Section 5.2.1.



- "AUTO" mode allows free-run sampling with integral time and measurement intervals.
- In "SINGLE" mode, a single data is sampled every time triggering is executed.
- In "N RDGS" mode, data are sampled in the set cycle every time triggering is executed.

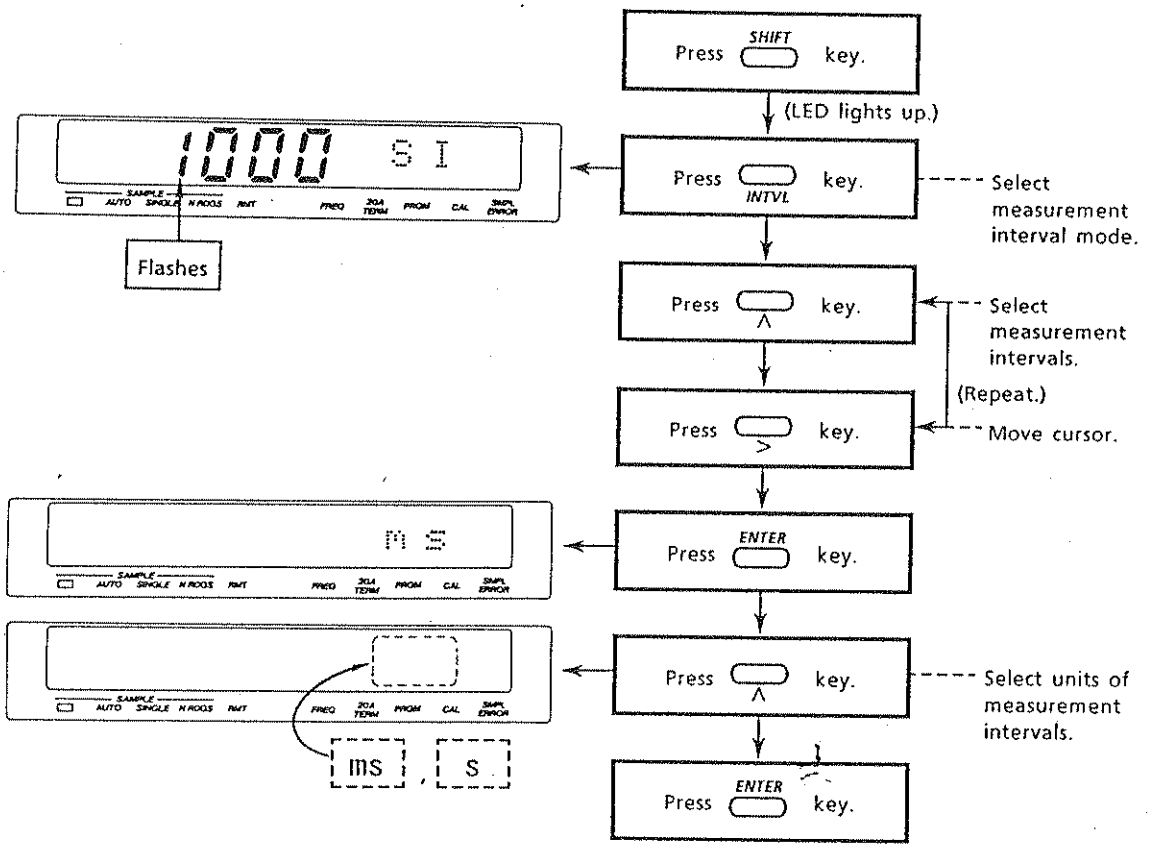
4.3.4 Setting Integral Time (INTEG TIME)

The INTEG TIME key sets A/D converter integral time. For details, see Section 5.2.4.



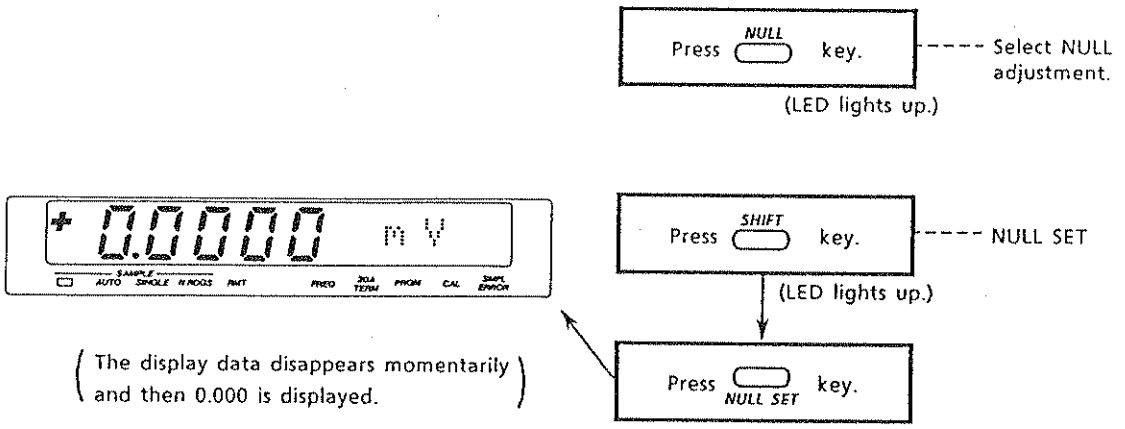
4.3.5 Setting Measurement Interval (INTVL)

The INTVL key sets measurement intervals. For details, see Section 5.2.5.



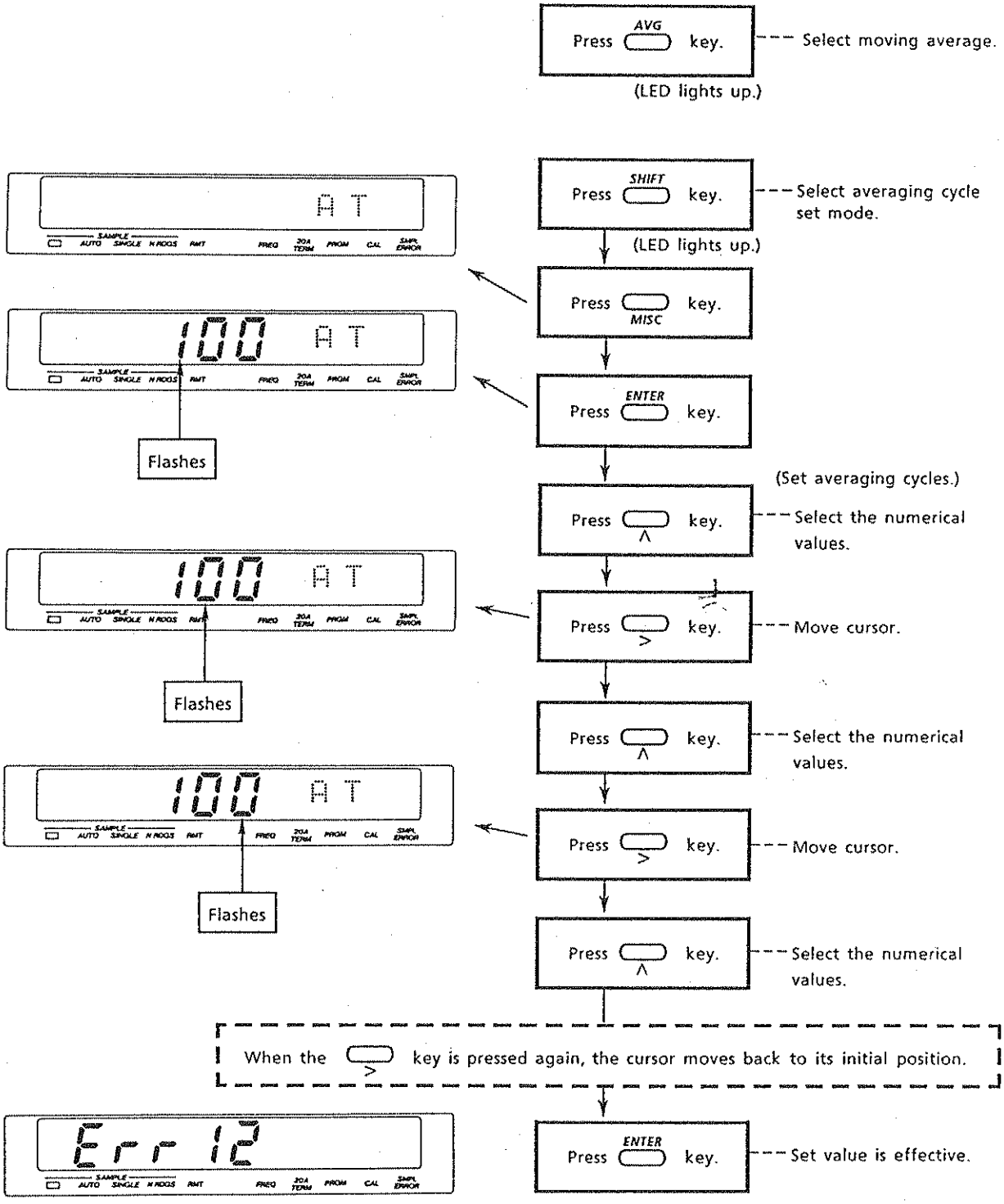
4.3.6 Setting NULL Adjustment (NULL / NULL SET)

The NULL and NULL SET keys are used to set null value. When the NULL adjustment is ON, the corresponding LED lights up. For more detailed information, see Section 5.3.



4.3.7 Setting Averaging (AVG)

The AVG key is used to set moving average. When this key is pressed, the corresponding LED lights up. For details, see Section 4.4.



* Up to 100 averaging cycles can be set. If averaging cycles exceed the above limit, an error message is displayed and the average set mode comes up.

4.3.8 Setting MATH Functions

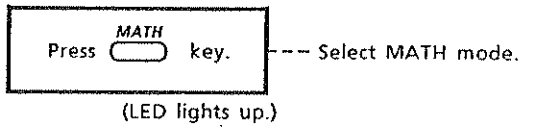
The MATH key is used to set MATH functions, types of MATH, and MATH constants. When the MATH key is pressed, the corresponding LED lights up.

Three mathematical functions are available :

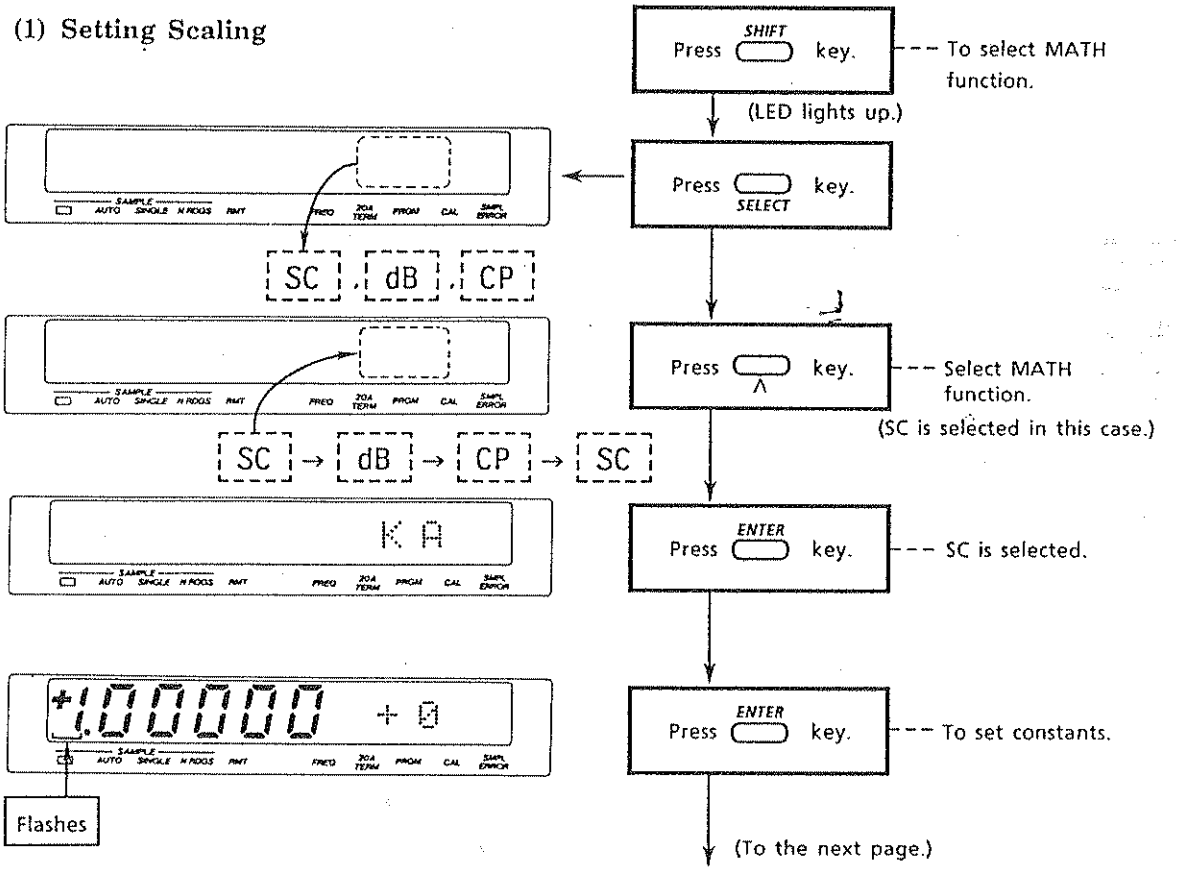
(1) Scaling ; constant KA, KB
(2) Decibel : constant KC, KD
(3) Comparator : constant HI, LO

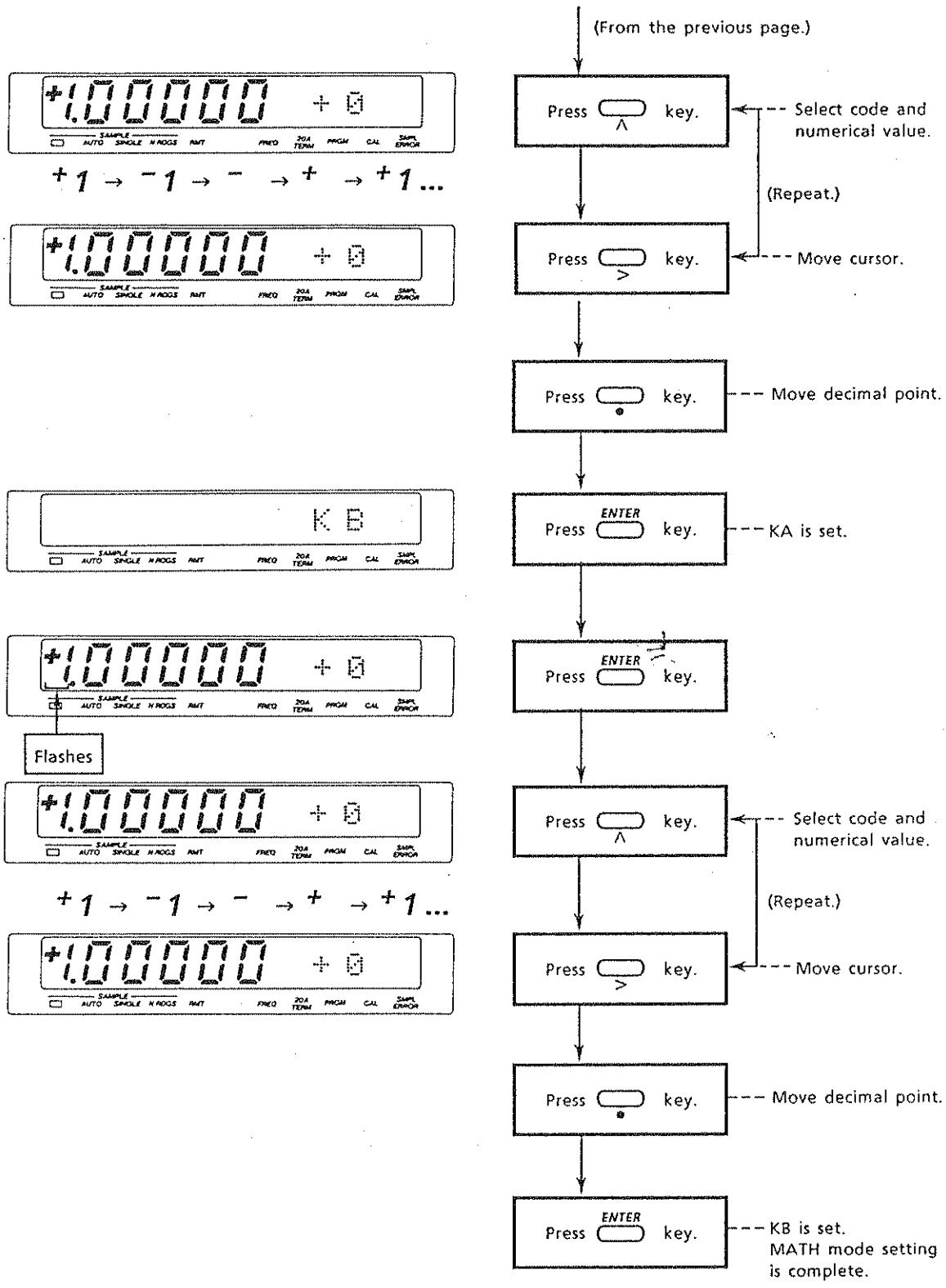
$-199999E9 \leqq KA, KB, KC, KD, HI, LO \leqq 199999E9$

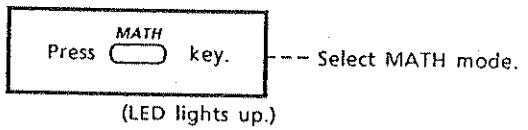
For details, see Section 5.5.



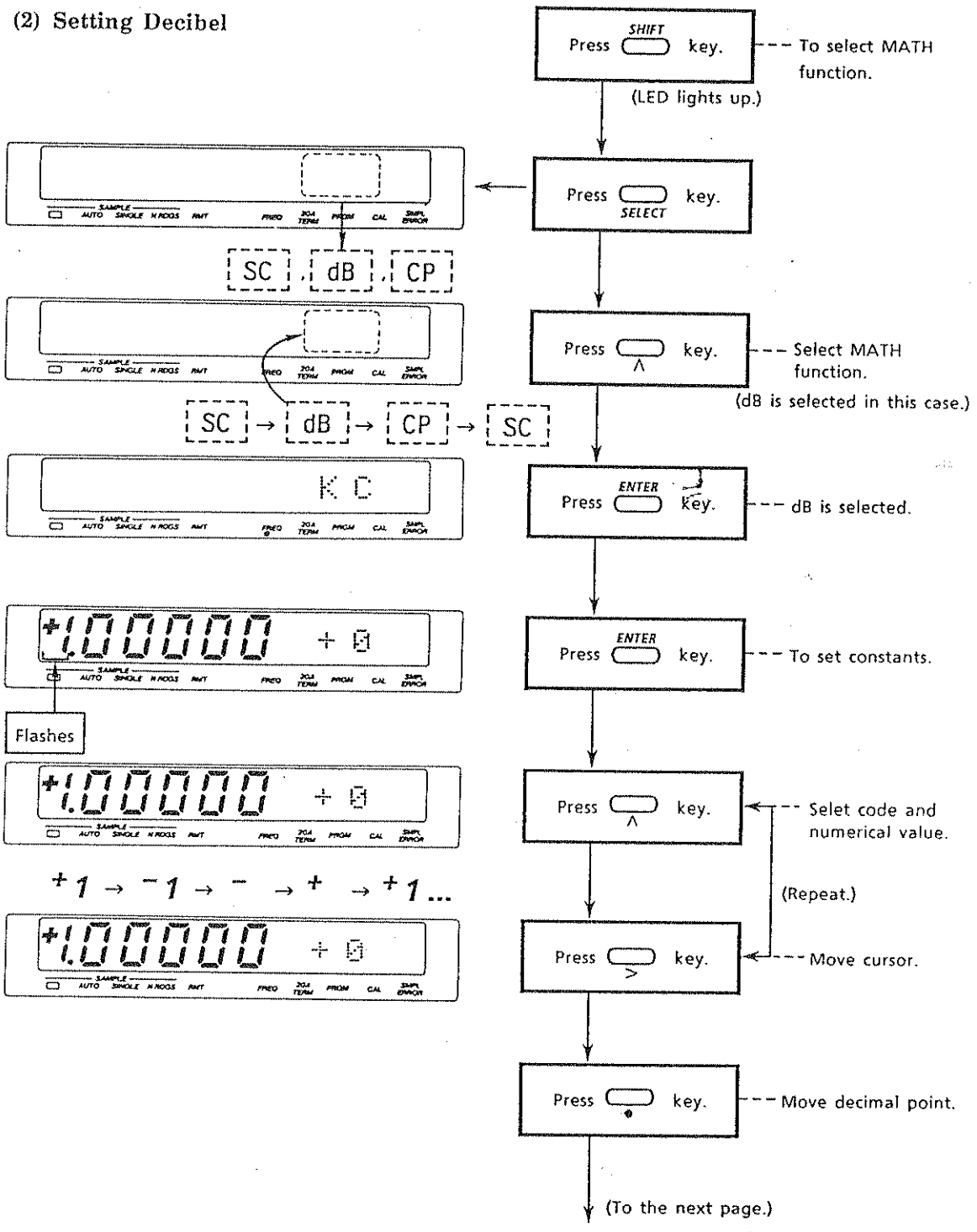
(1) Setting Scaling

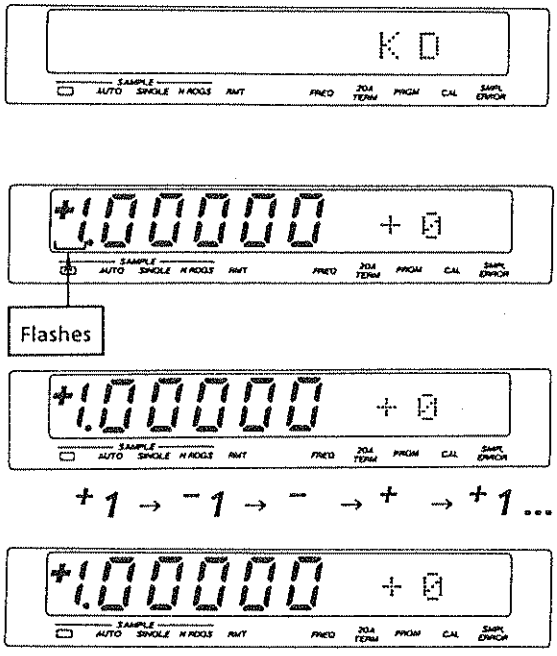



(From the previous page.)
+1.000000 + 0
+1 → −1 → − → + → +1...
Press key.
Select code and numerical value.
(Repeat.)
Move cursor.
Move decimal point.
K B
ENTER
KA is set.
Flashes
KB is set.
MATH mode setting is complete.



(2) Setting Decibel





(From the previous page.)

Press ENTER key. --- KC is set.

Press ENTER key.

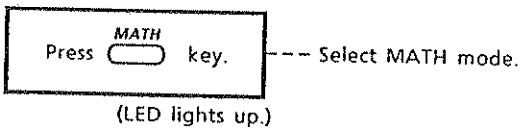
Press ∧ key. --- Seleet code and numerical values.

(Repeat.)

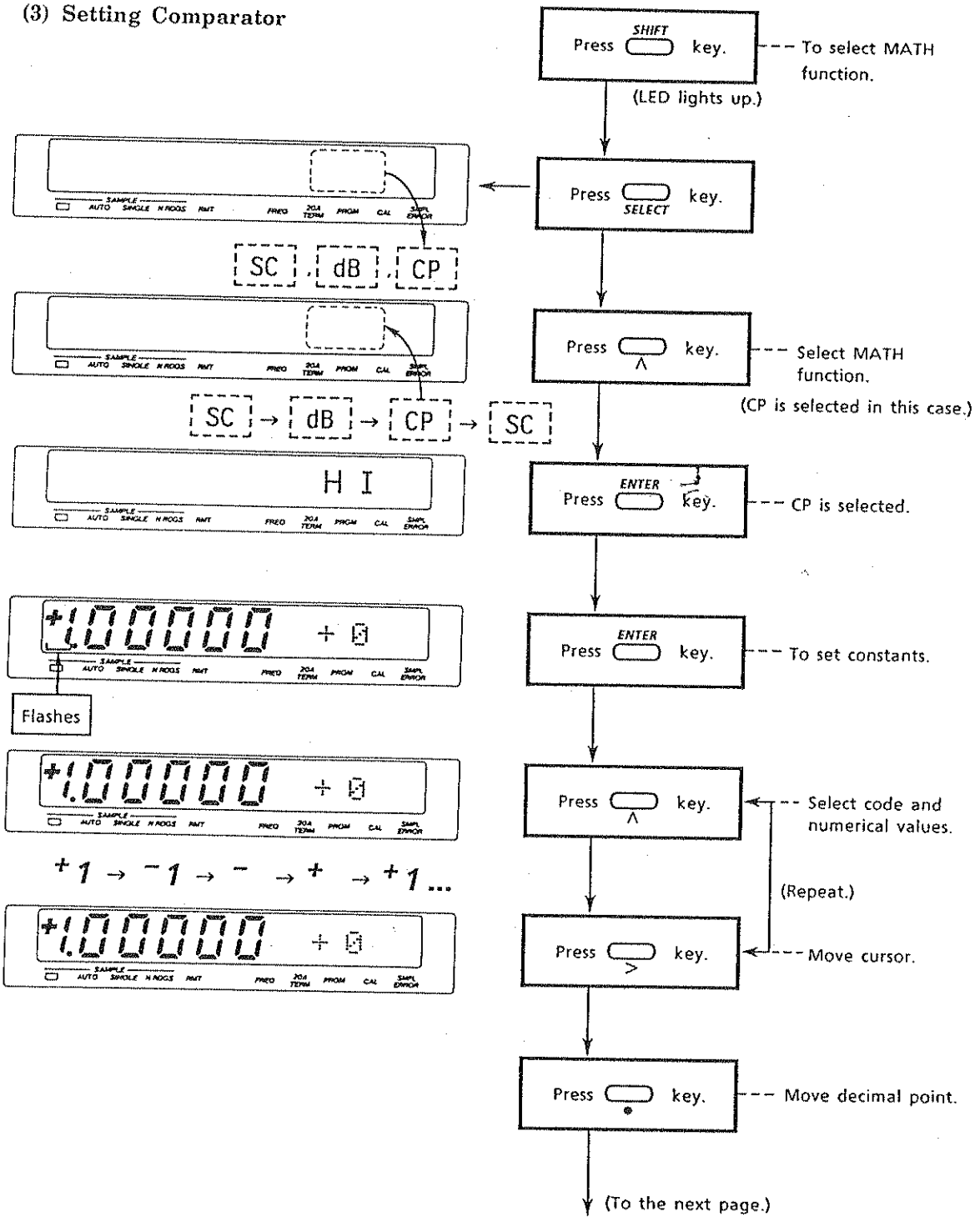
Press > key. --- Move cursor.

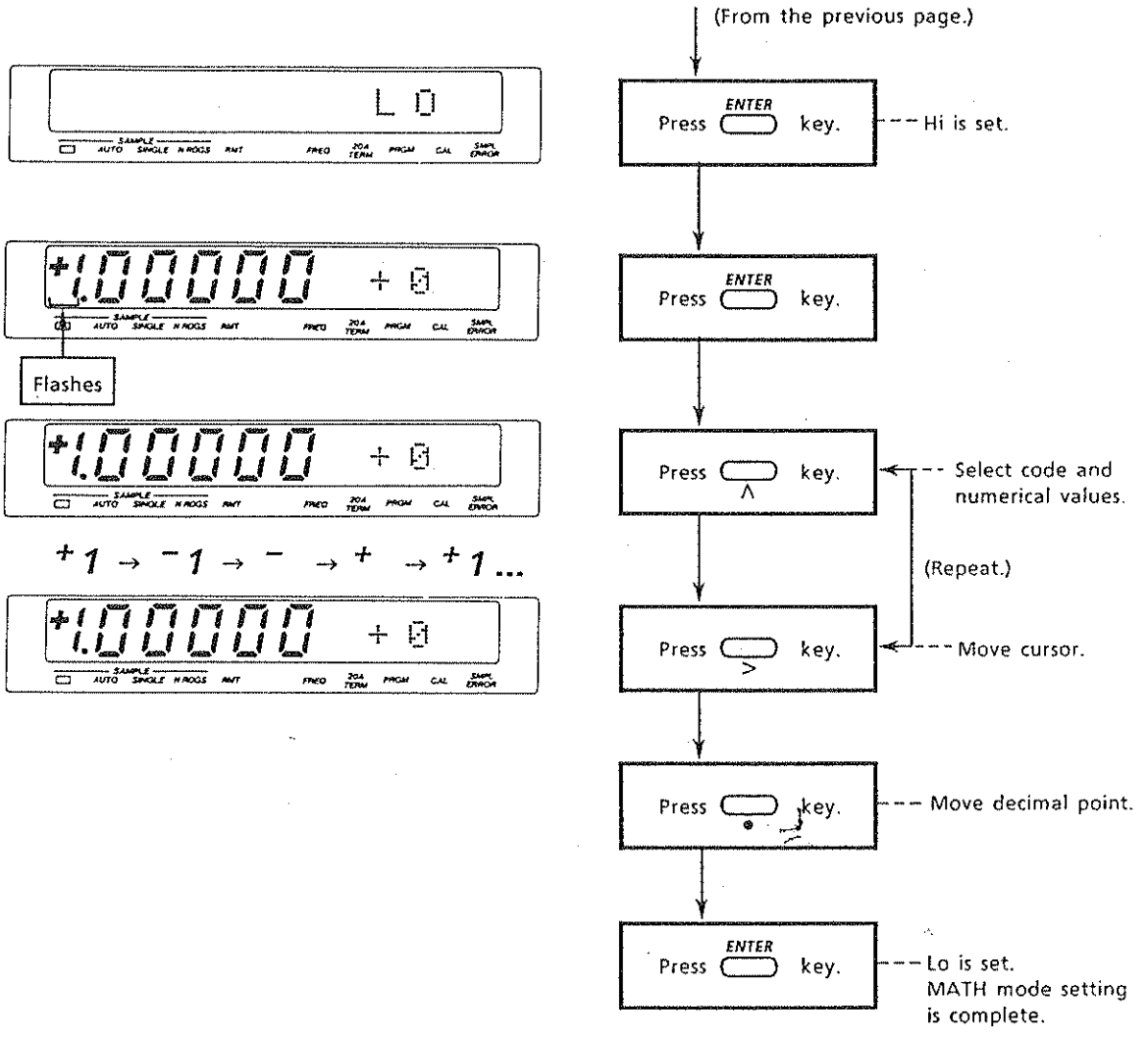
Press . key. --- Move decimal point.

Press ENTER key. --- KD is set.
MATH mode setting is complete.



(3) Setting Comparator





4.3.9 Setting Trigger (TRIG)

The TRIG key is used to output a sampling start signal. Use this key when the measurement mode is in "AUTO", "SINGLE" or "N RDGS".

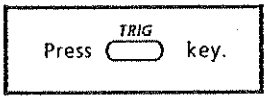
In "*AUTO*" mode : Pretrigger is generated while data is being stored.

In "*SINGLE*" mode : Data sampling, data storage and recall every time a trigger signal is generated.

In "*N RDGS*" mode : Data sampling in the specified sampling cycle, data storage and recall every time a trigger signal is generated.

* For measurement cycles and pretrigger setting, see Section 4.3.10. For data storage, see Section 4.3.15. For data recall, see Section 4.3.16.

* For more detailed trigger functions, see Section 5.1.2.



4.3.10 Setting Sampling Cycles, Used Memory Areas, Head Number of Called Memory

Set the following, used for store and recall functions:

Set the following:

NS: Measurement (sampling) cycles (in "SINGLE" mode, "N RDGS" mode) and used memory areas.

RD: Head number of called memory

Set measurement (sampling) cycles and used memory areas (NS):

In "AUTO" mode : Number of pretrigger cycles while data are being stored.

In "SINGLE" mode: Preset cycles while data are being stored.
Preset cycles while data are being recalled.

In "N RDGS" mode: Post-trigger cycles while data are being stored.
Post-trigger cycles while data are being recalled.

Set head number of called memory in recall function (RD).

where:

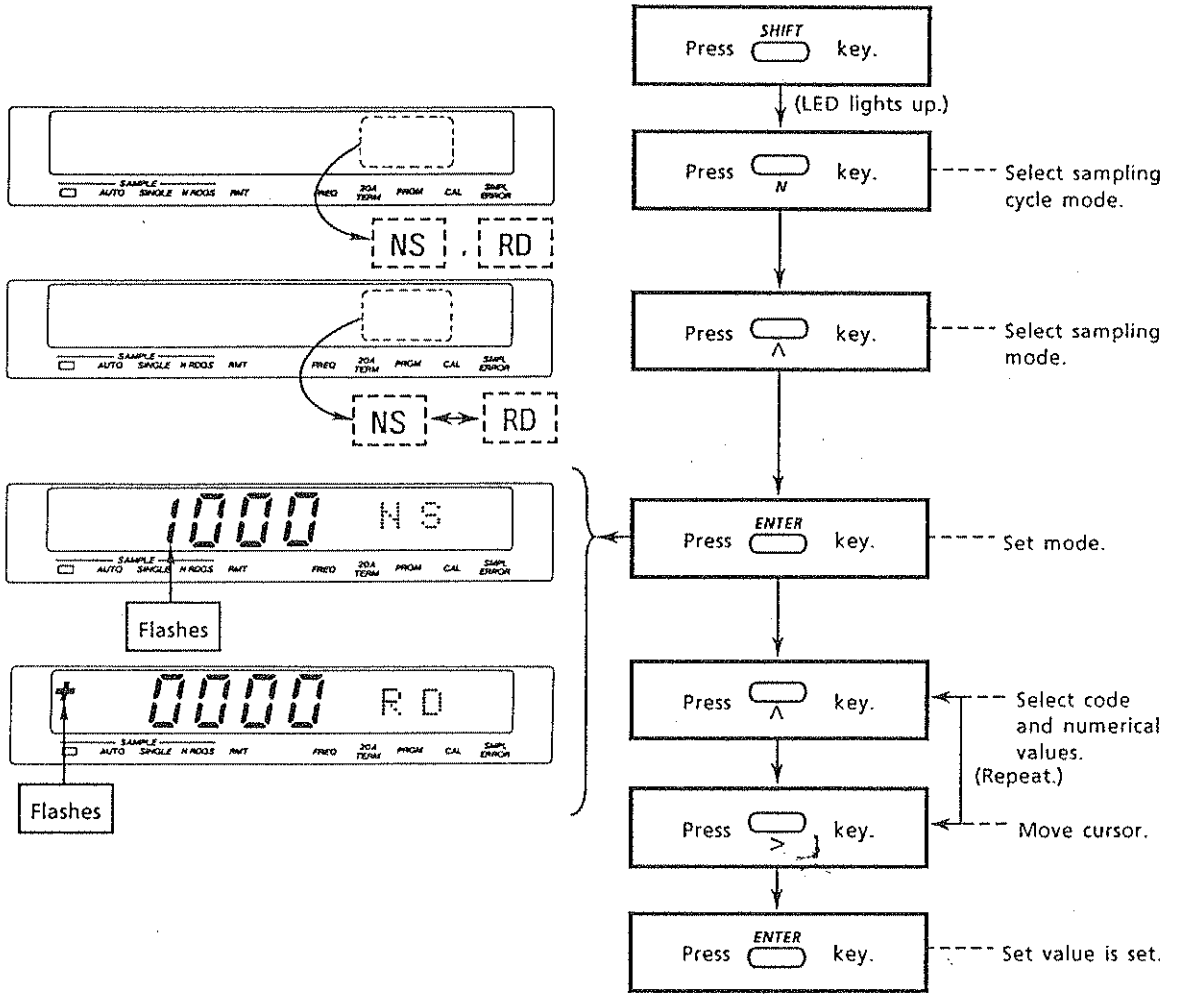
NS=Range from 1 to 8000

RD=Range from −7999 to 7999

Ranges that can be set are as follows:

	Built-in Memory	IC Memory Card (8 KB)	IC Memory Card (16 KB)	IC Memory Card (64 KB)
NS	1 to 1000	1 to 500	1 to 1500	1 to 8000
RD	−999 to 999	−499 to 499	−1499 to 1499	−7999 to 7999

* For details about store function, see Section 5.5, and about recall function, see Section 5.6.

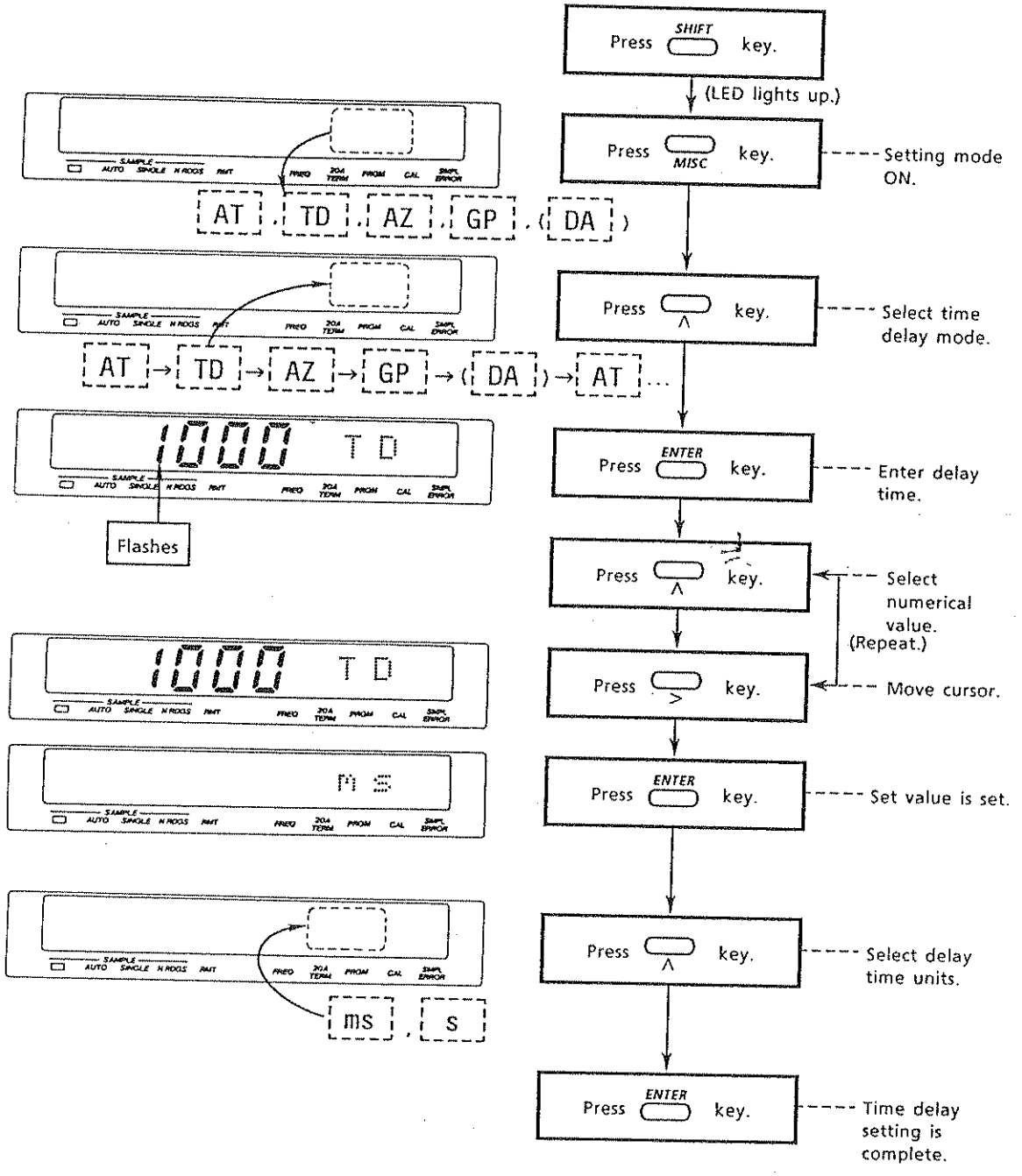

Press SHIFT key.
(LED lights up.)
Press N key.
Select sampling cycle mode.
Press ∧ key.
Select sampling mode.
Press ENTER key.
Set mode.
Press ∧ key.
Select code and numerical values.
(Repeat.)
Press > key.
Move cursor.
Press ENTER key.
Set value is set.
NS
RD
1000
NS
Flashes
0000
RD
Flashes

4.3.11 Setting Delay Time (TD)

Set the time delay. Time delay means the "period" after the generation of a trigger signal but before sampling starts.

The delay time can be set between 0 and 60 min in 1-ms units.

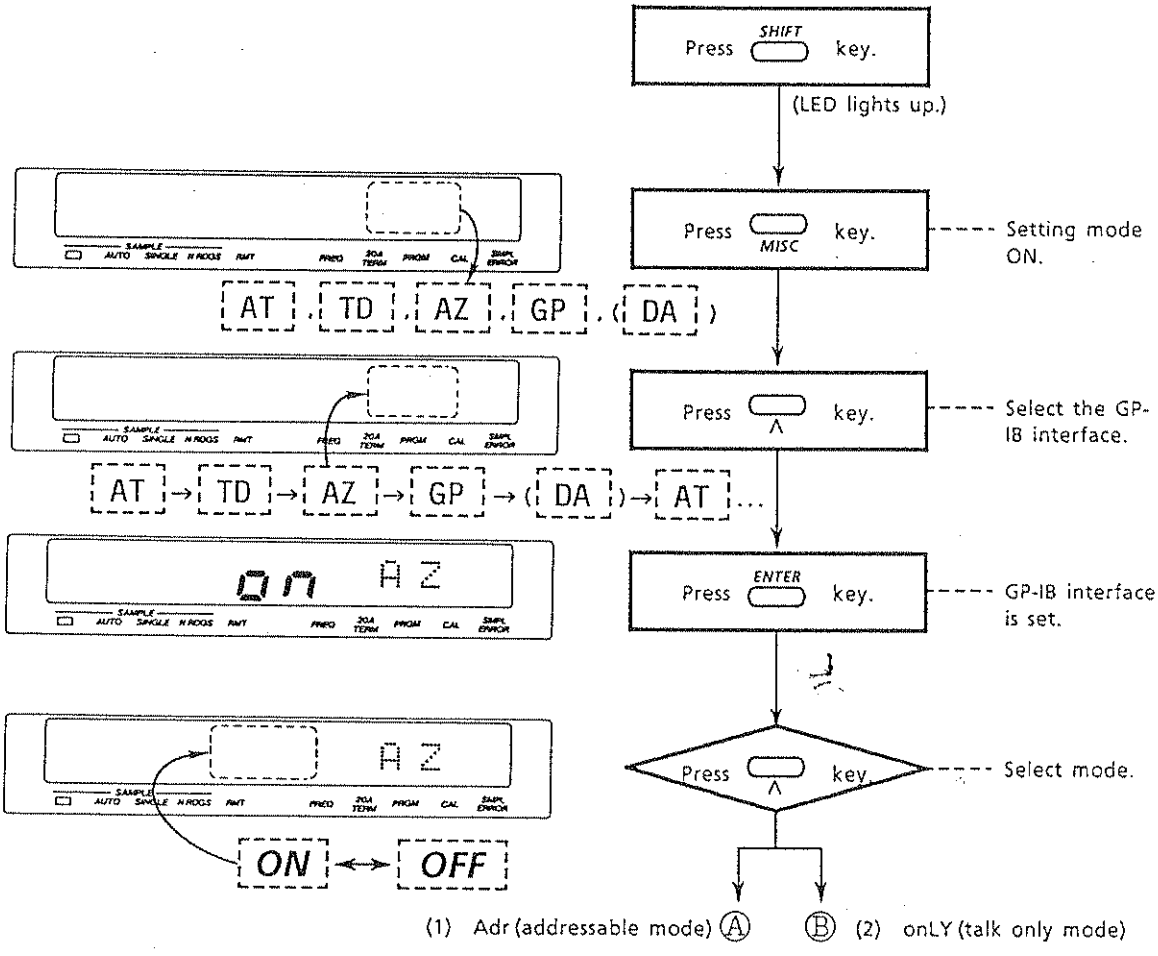
where 0 to 3000ms : 1-ms units
3 to 3600s : 1-s units



* For details about delay function, see Section 5.1.3, and about trigger function, see Section 5.1.2.

4.3.12 Setting AUTO ZERO (AZ)

The AZ key turns ON or OFF AUTO ZERO. AUTO ZERO (AZ) compensates for zero drift which will be generated in the internal circuit every time sampling is executed. In high-speed sampling mode, measurement time is decreased by eliminating AUTO ZERO functions.

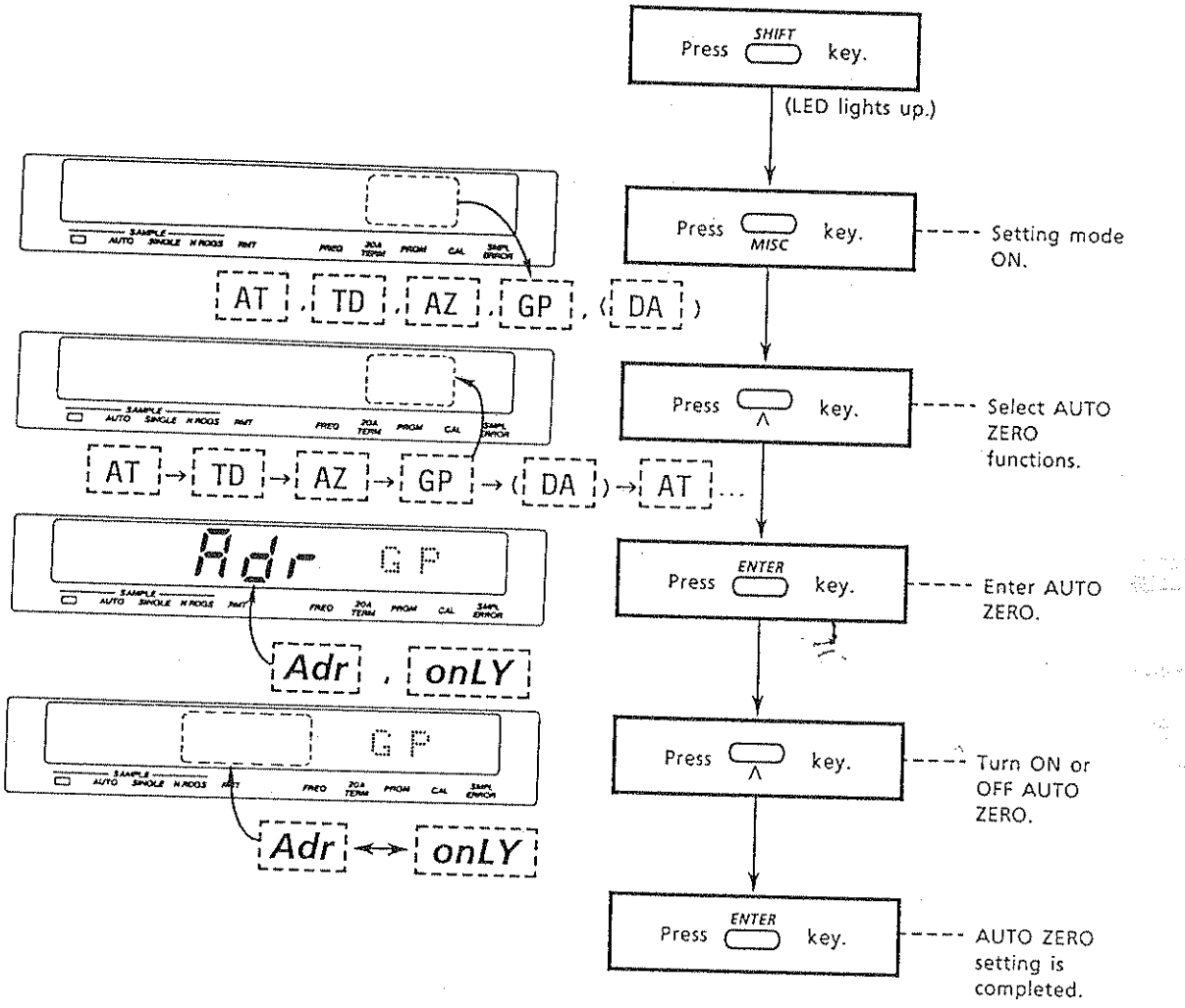


(To the next page.)

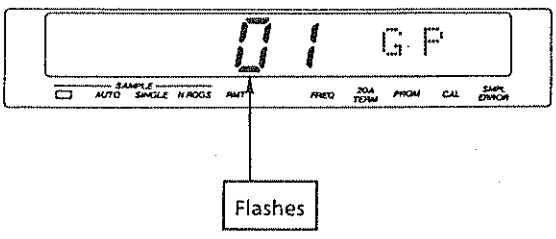
4.3.13 Setting Communication Interface (GP-IB or RS-232C) Functions

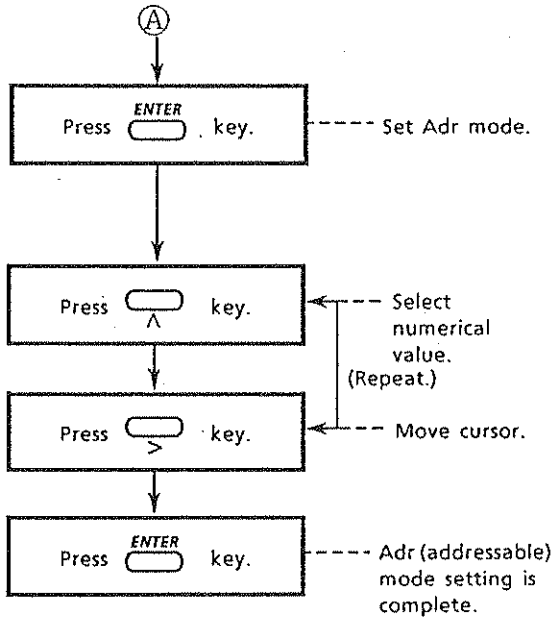
Set communication interface functions. Set GP-IB communication interface functions for Models 7551 01 and 7552 01 and RS-232C communication interface functions for Models 7551 02 and 7552 02.

For details, see Chapter 7.

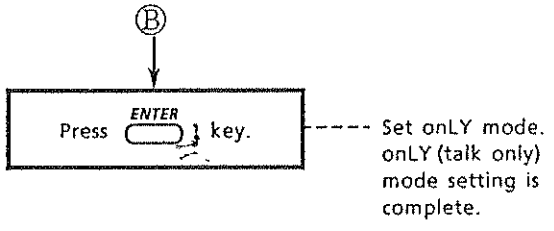


(1) For Adr (Addressable Mode) :





(2) For onLY (Talk Only Mode) :

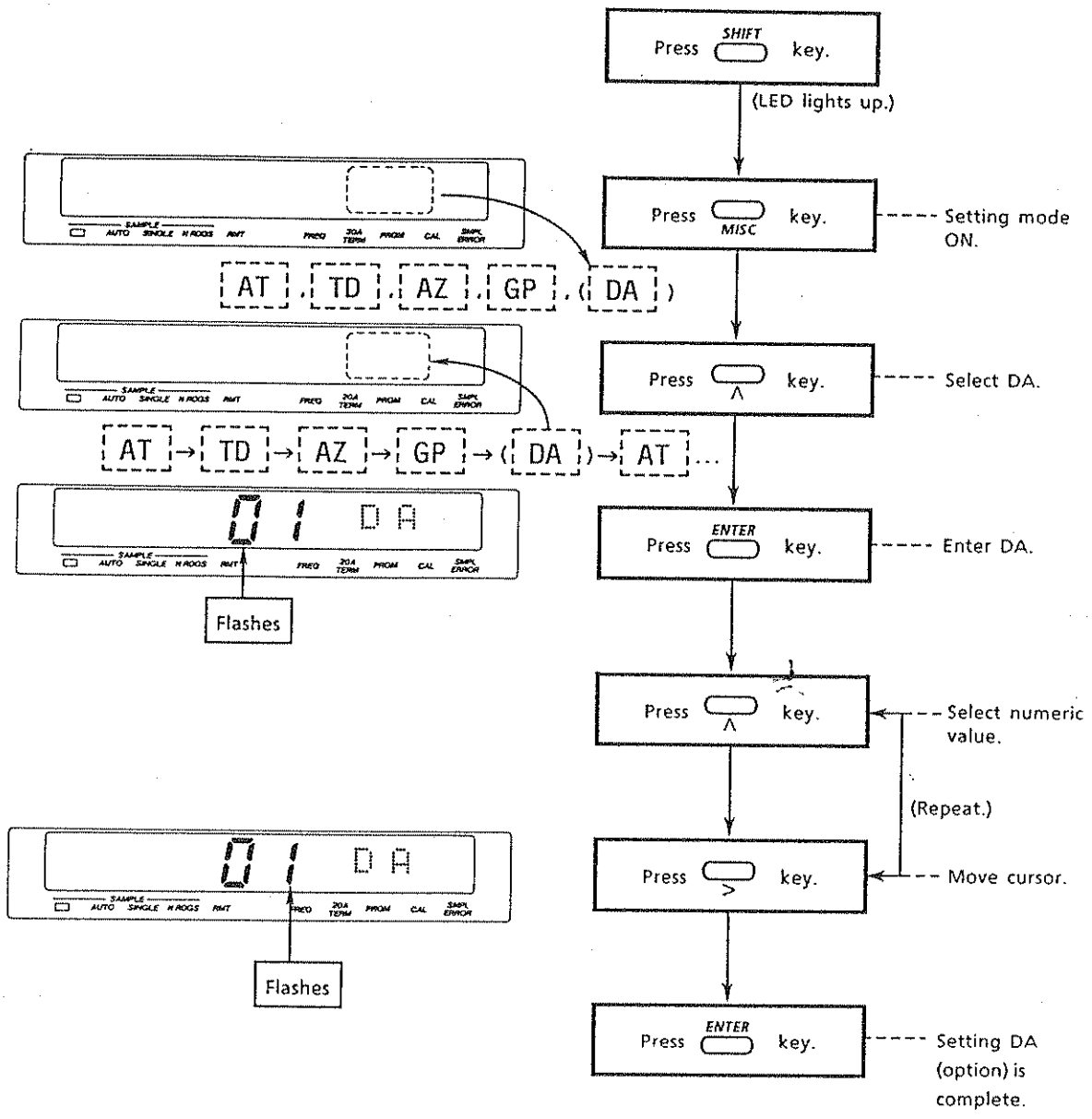


* : When an RS-232C communication interface is selected, RS is displayed.

4.3.14 Setting D-A Output (DA) (Option)

D-A output (DA) is optional. Set the D-A output (DA) option when necessary.

* For details, see Section 6.2.



4.3.15 Setting Memory Storage (STORE)

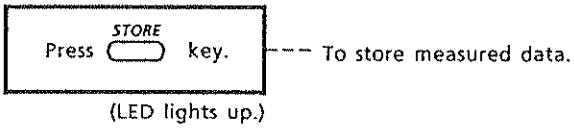
The STORE key is used to store the measured data. When this key is pressed, the corresponding LED lights up. Up to 1000 data can be stored.

In "*AUTO*" Mode : Overwrite functions, (stores data updated (overwritten)).
Sets a pretrigger level with TRIG key.

In "*SINGLE*" Mode : Stores the measured data every time the trigger signal is applied.

In "*N RDGS*" Mode : Stores the measured data (in NS cycles) every time the trigger signal is applied.

For more detailed information, see Section 5.6, and about trigger function, see Section 5.1.2.



4.3.16 Setting Memory Read (RECALL)

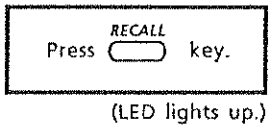
The RECALL key is used to recall stored data. When the key is pressed, the corresponding LED lights up.

In "*AUTO*" Mode : Recalls all stored data.

In "*SINGLE*" Mode : Recalls stored data every time the trigger signal is applied.

In "*N RDGS*" Mode : Recalls stored data (in NS cycles) every time the trigger signal is applied.

For more detailed information about recall function, see Section 4.7.



4.3.17 Execution of Program (PRGM)

The PRGM key is used to generate and execute a program.

- **Program Set Mode (PR)**
- **Program Execution (RU)**
- **IC Memory Card Set Mode (Panel-Set Data Save and Load)**

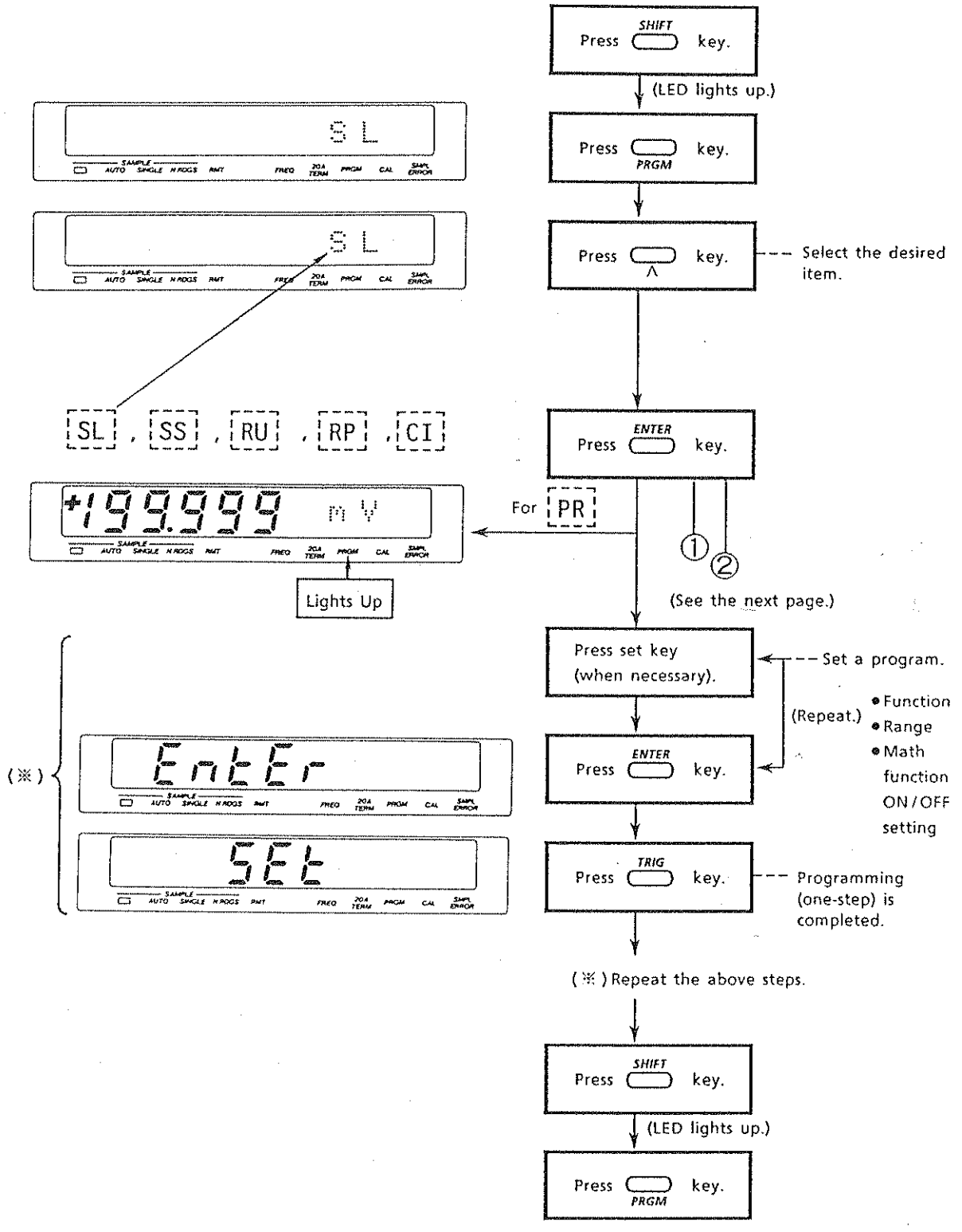
"Initialize (CI)" – Initializes IC memory card. Initialize IC memory card when it is used for the first time.

"Load panel-set data (SL)" – Calls and loads data from IC memory card.

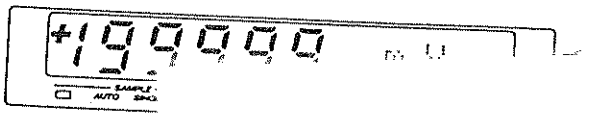
"Save panel-set data (SS)" – Stores data entered by panel keys in IC card memory.

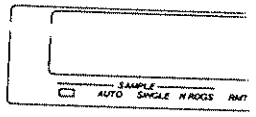
Data that can be saved and loaded are : functions, ranges, sampling intervals, delay time, integral time, NULL data, auto zero, averaging functions, D-A mode data, averaging cycles, MATH data.

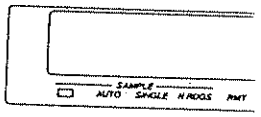
For details, see Section 5.8.


Press SHIFT key.
(LED lights up.)
Press PRGM key.
Press ^ key.
Select the desired item.
SL
SL
SL , SS , RU , RP , CI
Press ENTER key.
For PR
+199.999 mV
Lights Up
①
②
(See the next page.)
Press set key (when necessary).
Set a program.
(Repeat.)
• Function
• Range
• Math function ON/OFF setting
Press ENTER key.
Press TRIG key.
Programming (one-step) is completed.
(※) Repeat the above steps.
(※)
EntEr
SEt
Press SHIFT key.
(LED lights up.)
Press PRGM key.

(From the previous page.)







by step.

4.3.18 Setting Local Status (LOCAL)

The LOCAL key changes from remote to local status. When the GP-IB or RS-232C communications interface is being used, press LOCAL key to change from remote status.

Press LOCAL key.

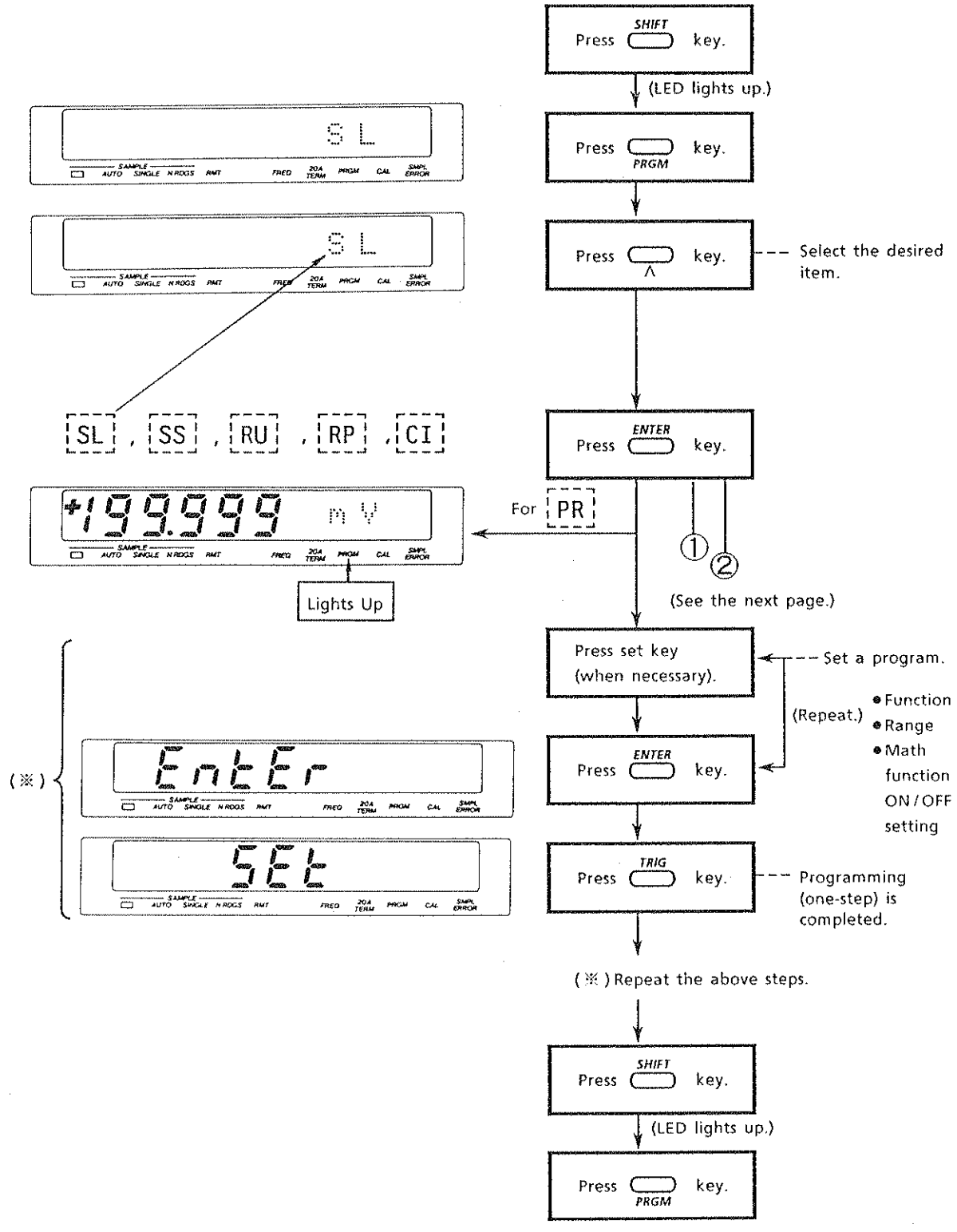
4.3.19 Generating Service Request (SRQ)

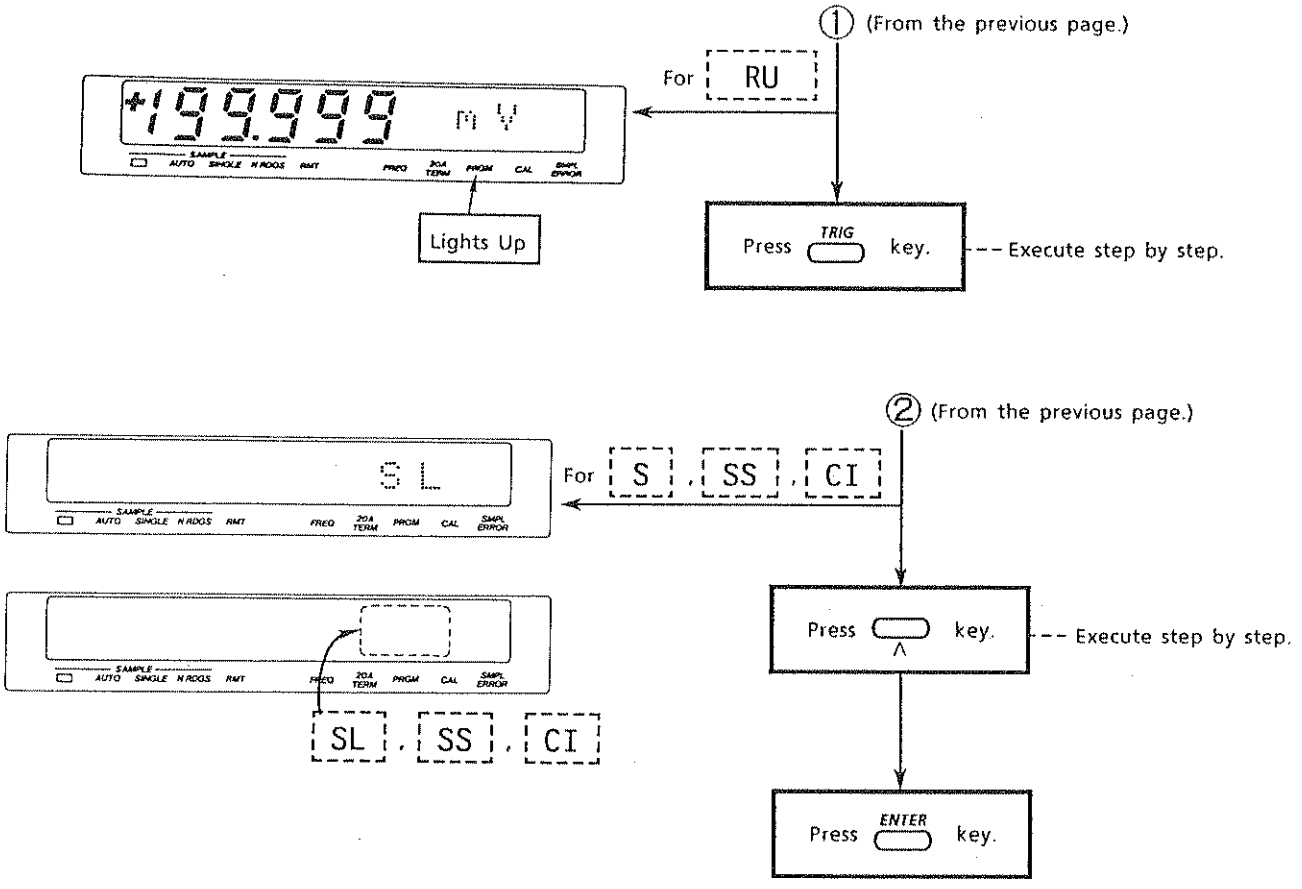
A GP-IB or RS-232C communications interface includes the following functions :

- When a GP-IB interface is used, the multimeter sends a service request (SRQ) to the controller.
- When an RS-232C communications interface is used, the multimeter sends measured data each time.

Press SRQ key.

Note : In local status, if SHIFT LED is ON, SRQ key is not in effect.


Press SHIFT key.
(LED lights up.)
Press PRGM key.
Press ^ key.
Select the desired item.
SL
SL
SL , SS , RU , RP , CI
Press ENTER key.
+199.999 mV
For PR
Lights Up
(See the next page.)
(※)
EnterEr
SEt
Press set key (when necessary).
Set a program.
(Repeat.)
• Function
• Range
• Math function ON / OFF setting
Press ENTER key.
Press TRIG key.
Programming (one-step) is completed.
(※) Repeat the above steps.
Press SHIFT key.
(LED lights up.)
Press PRGM key.



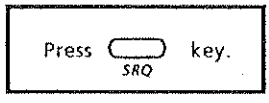
4.3.18 Setting Local Status (LOCAL)

The LOCAL key changes from remote to local status. When the GP-IB or RS-232C communications interface is being used, press LOCAL key to change from remote status.

4.3.19 Generating Service Request (SRQ)

A GP-IB or RS-232C communications interface includes the following functions :

- When a GP-IB interface is used, the multimeter sends a service request (SRQ) to the controller.
- When an RS-232C communications interface is used, the multimeter sends measured data each time.



Note : In local status, if SHIFT LED is ON, SRQ key is not in effect.

4.3.20 Setting Initial Values

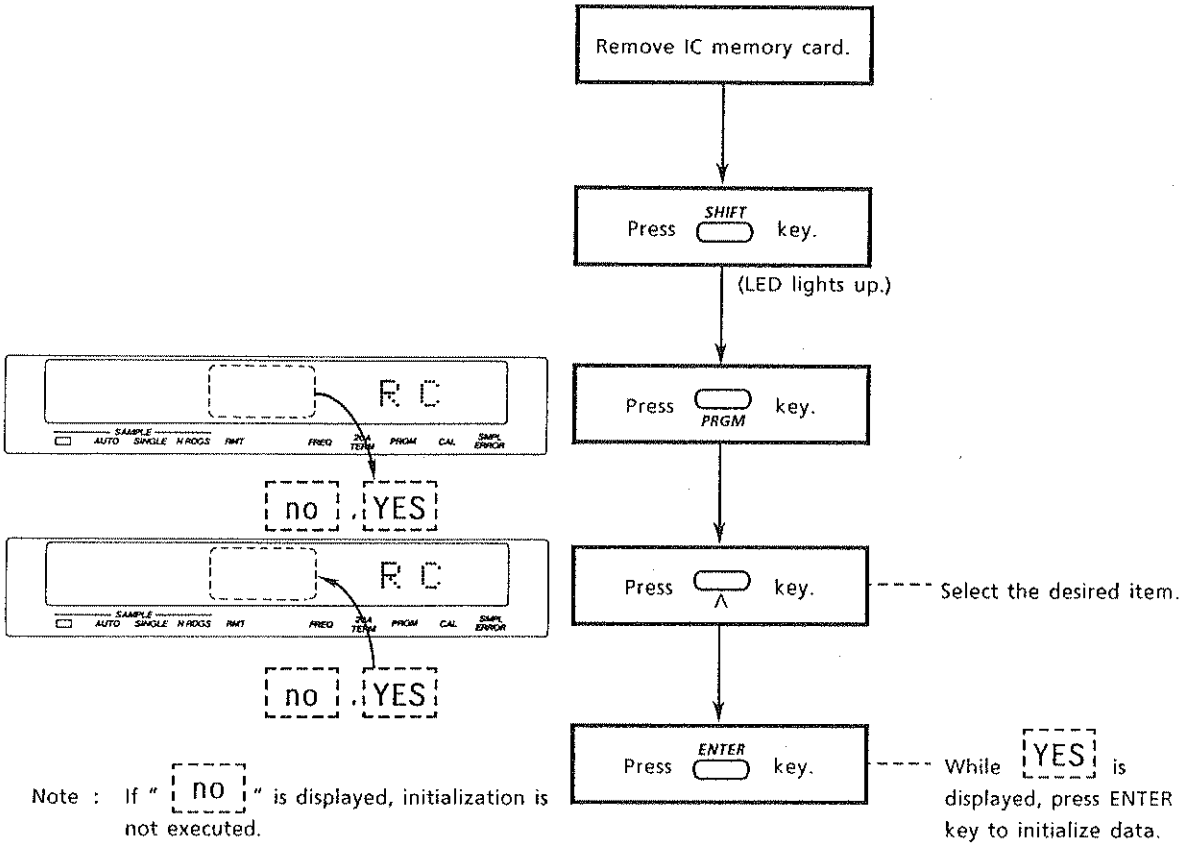
When the power turns ON, or when initialization is executed, initial values are set. Before starting measurement, initialize data to cancel already measured data and set values. For initial values, see Section 10.1.

The following two ways of initializing data are used :

- **Use Panel Keys (Manual Set).**
- **Use a GP-IB Communication Interface (Remote Set).**

For details, see the following flowchart.

(1) Manual Set



(2) Remote Setting

Program data for initialization via a GP-IB or RS-232C communication interface are as follows :

(a) Remote setting via a GP-IB communications interface

Format • RC <terminator>

(b) Remote setting via an RS-232C communications interface

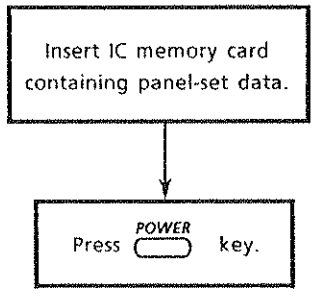
Format • RC <terminator>

Note 1 : When RC <terminator> is executed, the system is reset.

Note 2 : In addressable mode or normal mode, if RC is executed, communications data is cancelled and the personal computer program may be stopped. In such a case, stop the program and try to execute RC again.

4.3.21 Automatic Loading

Insert an IC memory card containing panel-set data, and turn ON the power. The panel-set data are then loaded automatically. For more detailed information about automatic loading, see Section 5.9.



4.3.22 Calibration

To calibrate the instrument, set the CAL / MEAS switch to CAL position. Then apply power to the instrument. For details, see Section 8 "MAINTENANCE AND CALIBRATION".

5. FUNCTIONAL DESCRIPTION

5.1 Sampling Functions

5.1.1 Sampling Mode (SAMPLE)

(1) Auto Mode (AUTO)

- Data is sampled at a preset integral time and measuring intervals.
- Trigger signals that are generated in auto mode are ignored except when data are being stored.
- During measurement at high-speed sampling intervals, if any one of the keys is pressed, it may happen that the measured data is missing or data cannot be measured at the preset measuring intervals. In such a case, a "SMPL ERROR" LED lights up.
- When data is recalled from memory, the data is recalled at preset sample intervals.

Note : Data cannot be transmitted via a GP-IB or RS-232C communication interface when the data is measured at less than 20ms intervals. Store the data and then transmit it via a GP-IB or RS-232C communication interface.

(2) Single Mode (SINGLE)

- One datum is sampled at the preset integral time every time a trigger signal is generated.
- In the following function and measuring ranges, set the time delay at 400ms or longer as waiting time until data communications are completed.
  AC V
  AC A
  OHM 2W / 4W (20 and 200 Megohms)
- When the stored data are recalled, data are called one by one every time a trigger signal is generated.
- To generate a trigger signal, press the TRIG key or send the "E" or GET command.

(3) N Reading Mode (N RDGS)

- Data are sampled in the cycles set by the integral time and measuring intervals.
- A trigger signal that is generated during sampling operation is ignored.
- In the following functions and measuring ranges, set the time delay at 400ms or longer.
  AC V
  AC A
  OHM 2W / 4W (20 and 200Megohms)
- When the stored data are recalled, data are called at the set sample intervals every time a trigger signal is generated.
- To generate a trigger signal, press the TRIG key or send the GET command.

Note : Data cannot be transmitted via a GP-IB or RS-232C communication interface when the data is measured at less than 20ms intervals. Store the data and then transmit it via a GP-IB or RS-232C communication interface.

5.1.2 Trigger Function (TRIG)

- The following three ways are available for generating trigger signals.
  (1) Press the TRIG key on the front panel.
  (2) Input a contact signal or TTL logic signal to the I/O signal connector (pin No. 1). For details, see Section 6.1.2 Remote Control Function.
  (3) Send the "E" or GET command. For details, see Section 7.3

- In the normal operation mode (excluding STORE and RECALL modes), a trigger signal is used to start sampling. In SINGLE sampling mode, one cycle of sampling is executed every time a trigger signal is generated. In N RDGS mode, NS cycles of sampling are executed continuously.

- In STORE mode, triggering performs three types of operations according to measurement modes as follows:
  (1) In AUTO mode, data are written leaving NS-1 data before generating trigger signals and the STORE mode is automatically turned OFF when memory capacity is full. Amounts of data that are written depend on the built-in memory or IC card memory. If the STORE mode is turned OFF without performing a trigger operation, data corresponding to the memory capacity are stored before the STORE mode is turned off.
  (2) In SINGLE mode, sampled data is stored every time a trigger signal is generated. If NS data that are preset are stored, STORE mode is automatically turned OFF.
  (3) In N RDGS mode, each NS data is stored every time a trigger signal is generated. STORE mode is in halt status until the next trigger signal is generated. The STORE mode is automatically turned OFF when memory capacity is full.

- In RECALL mode, data are recalled whenever a trigger signal is generated according to measurement mode. In AUTO mode, data are automatically recalled at measurement intervals which have been set at the time of recall.

5.1.3 Delay Time (TD)

The time delay (TD) sets intervals after the initiation of A-D converter with a trigger signal but before starting sampling operation. The delay time can range from 0 to 3600sec (60min.), in 1ms units between 0 and 3000ms and in 1ms units between 3 and 3600sec. Set the time delay for AC or resistance measurement, or for signal source measurement with first-order lag or dead time.

5.1.4 Integral Time (INTEG TIME)

- Select any of the following integral times—2.5, 16.66, 20 and 100ms.
- If the integral time less than 2.5ms is selected, line frequency noise included in the input signal cannot be eliminated. When the integral time 16.66ms is selected, line frequency (60Hz) noise included in the input signal can be eliminated. When the integral time 20ms is selected, line frequency (50Hz) noise included in the input signal can be eliminated. The integral time more than 100ms can eliminate line frequency (50 and 60Hz) noise included in the input signal.
- The digits displayed according to the integral time are as follows :

Table 5.1

Integral Time (ms)	DC V	AC V	2W OHM	4W OHM	DC A	AC A
2.5	19999	19999	19999	19999	19999	19999
16.66	199999	199999	199999	199999	199999	199999
20	199999	199999	199999	199999	199999	199999
100	199999	199999	199999	199999	199999	199999

The shorter the integral time, the faster the sampling speed, but the worse the stability or the smaller the digit number displayed.

5.1.5 Sampling Interval (INTVL)

- There exists the following conditions in setting the measurement intervals:
  - The measurement intervals that can be set range from 8ms (125 cycles / sec) to 3600ms (1cycle / hour).
  - The minimum units that can be set are :
    1ms for a range from 8 to 3000ms.
    1s for a range from 3 to 3600s.
- Set longer measurement intervals than those listed in the table below.
  If shorter intervals are set, sampling operation may be missing and "SAMPLE ERROR" lights up.

Integral Time (ms)	Measurement Intervals (ms) (In Auto Zero OFF)	Measurement Intervals (ms) (In Auto Zero ON)
2.5	8ms	15ms
16.66	25ms	45ms
20	30ms	55ms
100	110ms	215ms

[Sample mode is AUTO (NULL off, AVG off and MATH off) in a fixed range.]

- In AUTO and N RDGS modes, if the sampling interval is set from 8 to 19ms, data cannot be output in real-time using data communication functions. Set the sampling interval from 20ms or longer.
  If sampling intervals are less than 20ms , data should be stored in built-in memory using the STORE function. Then set sampling intervals to more than 20ms and output communications data. And in the same case, D-A output is 0 and comparator output is OFF.
- In resistance range (20 or 200 megohms), set the measurement intervals at 400ms or longer, taking into consideration the time required for the completion of the measurement circuit.

Note : In frequency measurement (AC V or AC A), set measurement intervals to 165ms or longer.

5.2 Null (NULL) Functions

$Y = X - X_0$

where X_0 : initially set value (NULL value)

Y : computed value

X : measured value

Reset an initially set value (data being displayed) to zero as a NULL value. Thereafter a value subtracted by a NULL value is displayed as a measured value. This null function is used to eliminate leadwire resistance or cancel initial values.

- The null value can be set for each function. However, no NULL function is provided for frequency measurement.
- Use the same NULL value as for two-wire and four-wire resistance measurements.
- The null value is stored in EEPROM memory. Even though the power turns OFF and ON, the previous null value is retained.

When ranges are changed in measuring resistance are as follows :

Input		Display	
00.100Ω		00.100Ω	SET
00.100Ω		00.000Ω	
10.000	10.000 − 0.1	9.900Ω	

NULL Value

Change the resistance measuring range and enter the data :

30.00Ω	30.00 − 0.1	29.90Ω

NULL Value

5.3 Averaging (AVG) Function

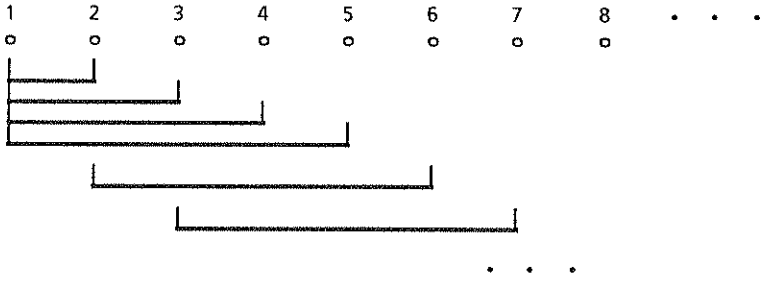
- The AVG function is used to average the measured data. This is in effect when noise components must be eliminated from the measured value.
- The calculation expression is given by :

  $Y = (X_{AT} + X_{AT-1} + \ldots + X_1) \div AT$

  where AT : 2 to 100 (number of average data)
  X : measured value
  Y : computed value

  If the amount of input data exceeds the preset cycles, the old data will be canceled in sequence and averaging is executed by entering the updated input data (AT) into the calculation expression shown above.

  ex. Moving Average
  if AT = 5 (sampling cycles)



- If a function or range is changed, the data that has been measured so far is deleted and averaging is executed again. (Changing ranges in AUTO mode is also possible.)
- If the input exceeds the measurable range, data that has been measured so far is cancelled and averaging is executed again.
- If a numerical value exceeding a maximum value of 100 for preset cycles is set, an error occurs and the AVG mode returns to the preset mode.

5.4 MATH Functions

- MATH functions include three types of computations—scaling, decibel and comparator. These computational functions are applied to measured data.
- Set a constant for each function. The constant is expressed in an exponential power (see note below). Even when an exponential power is not used, a constant that was entered once is corrected to the exponential power.

  Note : What is meant by exponential power?

  Example :

  Exponential ower indication (indicated by exponent)

  10000 ⟶ 1×10^4 ⟶

  Display*

  *: A constant and computed data are displayed as shown above.

- Even if a function of range is changed, preset constants are still saved. However, if the power is turned OFF, preset constants are cancelled.
- Invalid data are not computed.

Note : Computed data are multiplied by a power and displayed as follows :

Example : For scaling : $-199999E9 \leqq Y \leqq 199999E9$

For decibel : +19.9999 dB

↑ Decimal point moves.

For comparator : +19.9999Hi ---------- High

+19.9999(units) ------- Pass

+19.9999Lo ---------- Low

(1) Scaling

$Y = (X - A) / B$,

X : measured value;

Y : computed value;

A and B : Constants, where :

$-199999E9 \leqq A \leqq 199999E9$

$-199999E9 \leqq B \leqq 199999E9, B \neq 0$

Scaling functions serve not only to indicate a multiple with preset multiplying factors but also to obtain deviation from the preset reference value.

- Measured value display examples are as follows :

  1mV = 1E − 3

  1mA = 1E − 3

  1 ohm = 1E0

  100Hz = 1E2

(2) Decibel

$Y = C \times \log_{10} (X / D)$,

X : measured value;

Y : computed value;

C and D : constants, where :

$-199999E9 \leqq C \leqq 199999E9$

$-199999E9 \leqq D \leqq 199999E9, D \neq 0$

- Decibel functions serve to perform logarithmic operations (common logarithms) for measured values (or null and averaging values).

A logarithmic operation is named a decibel operation in this manual.

(3) Comparator

$H \leqq X$ .... High; $L \geqq X$ .... Low; $L < X < H$ ... Pass,

X: measured value;

H and L : constants, where :

$-199999E-9 \leqq H \leqq 199999E9$

$-199999E-9 \leqq L \leqq 199999E9$

The comparator function compares a measured value (or null or averaging value) with the reference value to determine which value is larger or smaller or if the measured value is within the limits. If H and L are set to the same value, whichever value is larger or smaller is indicated.

5.5 Store (STORE) Function

- Store the measured data in built-in memory or IC card memory. When an IC memory card is installed, the measured data is stored in the IC card memory. If the IC memory card is not present, the measured data is stored in the built-in memory.
- The STORE function has three operations depending on measurement modes as follows :

(1) In AUTO Mode :

In AUTO mode, press the STORE key to store data in memory. If the memory overflows, the oldest data are automatically erased and replaced by the newest data. If the STORE mode is OFF, data is no longer stored. In AUTO mode, if a trigger signal is generated, data can be written to the memory, leaving NS-1 data before generating a trigger signal.

Example :

When data are stored in an 8KB IC memory card :

Data No. 0 to 499 (500 data)

where :

NS : 150 (when a trigger signal is generated as the 200th data.)

Data No. when the trigger signal is generated : 0 (200th data)

Pre-trigger : 149 data (data No. −149 to −1, 51st to 199th from the head of memory ("oldest data")

Data after generating a trigger signal : 351 data (data No. : 0 to 350, 200th to 500th data, 1st data to 50th data from the head of memory)

In this example, effective RD data ranges −149 to 350 (data No.).

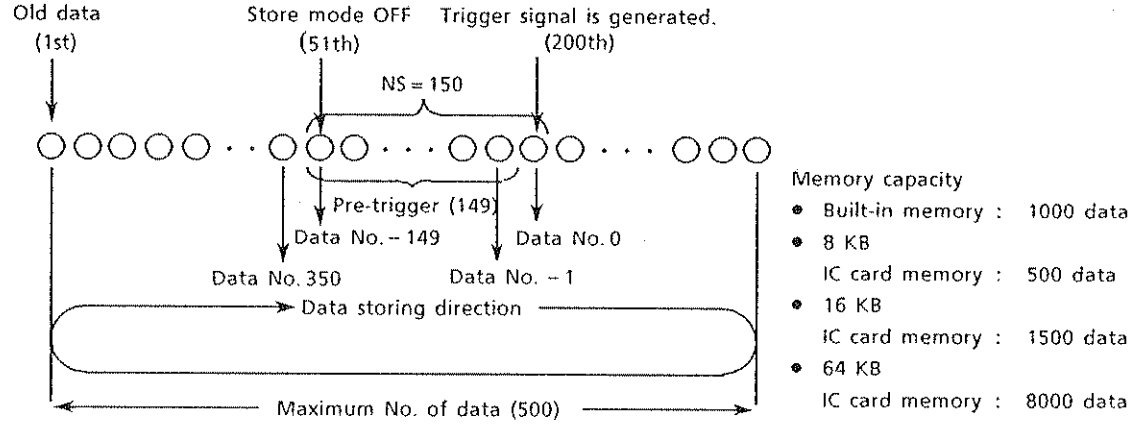


図5.1

(2) In SINGLE Mode :

In SINGLE mode, data measured in each sampling cycle are stored every time a trigger signal is generated. If NS data that was preset are stored, STORE mode is automatically turned OFF.

(3) In N RDGS Mode :

NS data are stored every time a trigger signal is generated. The STORE mode is in halt status until the next trigger signal is generated. If the memory overflows, the STORE mode is automatically turned OFF.

- In either case, if the STORE key is pressed again, the store mode is turned OFF. If the STORE key is pressed again, data that has already been stored are erased and new data are stored instead.

- The store mode is turned OFF when the recall key is pressed. For detailed information about the recall functions, see Section 5.6 on Recall Function.

- If sampling conditions or store conditions (IT, SI, TD, NS, RD modes) are changed, the store mode is turned OFF. If a certain function is changed while data are being stored in memory, the store mode is turned OFF.

- When the IC memory card is used, even if a certain function is changed, the store memory is not turned OFF.

- In case of storing the measured data, trigger signal must be generated after sampling more than NS cycles.

5.6 Recall (RECALL) Function

- Recalls the stored data from the memory. The recall functions are as follows :

(1) In AUTO Mode :

Data are output at the preset measurement intervals. When the final data are output, the recall mode is automatically turned OFF.

Data cannot be output if the measurement interval is less than 20ms. Set the measurement interval at 20ms or longer.

(2) In SINGLE Mode :

Data are recalled every time a trigger signal is generated. When the final data are output, the recall mode is automatically turned OFF.

(3) In N RDGS Mode :

NS data are output at the preset measurement intervals whenever a trigger signal is generated. Then the mode is in the halt state. If the trigger key is pressed again, recalling of data is started. If the final data are output, the recall mode is automatically turned OFF.

If the measurement interval is set at 20ms or less, data cannot be output. Set the measurement interval at 20ms or longer.

- In either mode, recall head position can be set with "RD".
  Data No. that is set is as follows :

(1) In AUTO Mode :

When STORE mode is ON, data that is sampled for the first time has data No. 0 or the oldest data has data No. 0.

When pretrigger functions are used, data at the time the trigger is generated has data No. 0.

(2) In SINGLE Mode or N RDGS Mode :

When STORE mode is ON, data that is sampled for the first time has data No. 0.
If STORE mode is set OFF and this mode is set ON again, old data are erased.

- If sampling or store condition (IT, SI, NS, or RD mode) is changed, recall mode is set OFF. While data are being stored in the built-in memory, if any of the function keys is pressed, recall mode is turned OFF.

5.7 Program (PROG) Function

- Functions that can be programmed are as follows :
  (1) **Function Set**
  (2) **Range Set**
  (3) **NULL Function ON/OFF**
  (4) **Averaging Function ON/OFF**
  (5) **MATH Function ON/OFF**

—— Program Examples : ——

Measurement function	OHM 2W	Step 1
Measuring range	AUTO	
NULL function	ON	
MATH function	ON	
Measurement function	DC V	Step 2
Measuring range	2V	
MATH function	ON	
Measurement function	AC V	Step 3
Measuring range	AUTO	
Averaging function	ON	
⋮		⋮

- The program input capacity is up to 20 steps. The program mode is automatically turned OFF when 20 program steps have been entered.
- AUTO mode is automatically set while creating a program. The sampling mode is automatically in "SINGLE" while executing a program. Whenever a trigger signal is generated, the program is executed step by step. When a final step is executed, program execution returns to step 1.
- To stop program execution, press any key (excluding TRIG and ENTER (SRQ) keys).
- In program mode, only one MATH function can be selected.
- No priority exists in programming. However, set the factors in the order of function, range, and MATH.

★ **Notes on Programming** ★

(1) Install the IC memory card before generating a program. Otherwise, the program menu cannot be displayed.

(2) If an invalid key is entered during programming, try to reprogram.

(3) You cannot add to nor change the program.

(4) After programs are created, if the program mode is set again, the previous program is erased.

(5) When the function or range is changed, no averaging functions are in effect. For details, see Section 5.4 "Averaging Functions".

(6) While the program is executing, if a communications command other than "E" is entered, program execution stops.

5.8 IC Memory Card

An IC memory card contains small memory boards and is backed up by a built-in battery. The following four types of functions are incorporated :

(1) Storage of the Measured Data
(2) Storage of Set Data
(3) Programming Measurement Procedures and Measured Data Storage
(4) Reading and Setting Saved Data Automatically with the Power ON

- IC card memory capacity of 8 KB can save 500 data ; 16 KB memory card can save 1500 data ; and 64 KB memory card can save 8000 data.
  The measured data as well as measurement conditions such as measurement functions, ranges, triggering points are contained in each data.

- If the store mode is set before executing a program, data is stored while executing a program.

- If a memory card reader option is used, the meter can be connected to a personal computer and data processing carried out. The stored data can be recorded using LR Series Recorders.

Note 1 : Do not remove the IC memory card while it is being accessed. Do not insert the card immediately after the power is turned ON.

Note 2 : When the built-in battery is replaced, refer to Figure 5.2. If the battery is removed, the stored data are lost. In case of this, the battery should be removed with DMM power supply set to ON and IC memory card installed in it. Built-in battery life expectancy is about five years.

Note 3 : Do not touch the "ground" on the IC memory card.

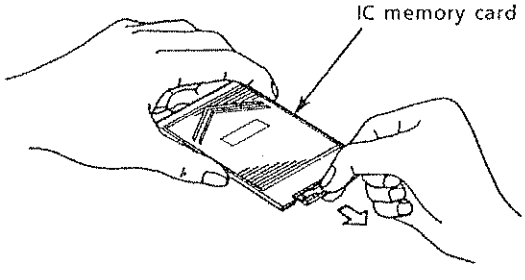


Figure 5.2 Replacing Battery

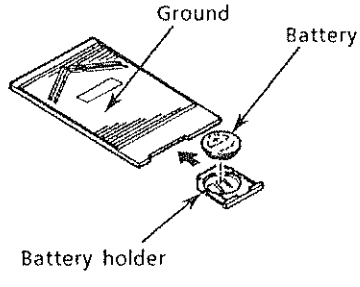


Figure 5.3 Inserting Battery

5.9 Automatic Loading

Using an IC memory card, users can set initial set-up data (data saved by panel keys or an SS command, FUNCTION, RANGE, computation ON / OFF, integral time for A-D converter, and measurement cycles — see Section 4.3.17 for details) without using panel operations. Insert the IC memory card into its connector and turn ON the power. Thus the initial set-up data are automatically loaded. This is very useful for measuring data repeatedly under the same measurement conditions or in the production line.

Note 1: If the IC memory card does not contain set data, no data is entered with the power ON.

Note 2: In CAL mode, automatic loading function does not work.

6. I / O SIGNALS

The multimeter incorporates an I / O signal connector on its rear panel to provide an external trigger start signal, a comparator output and a D-A converter output (option).

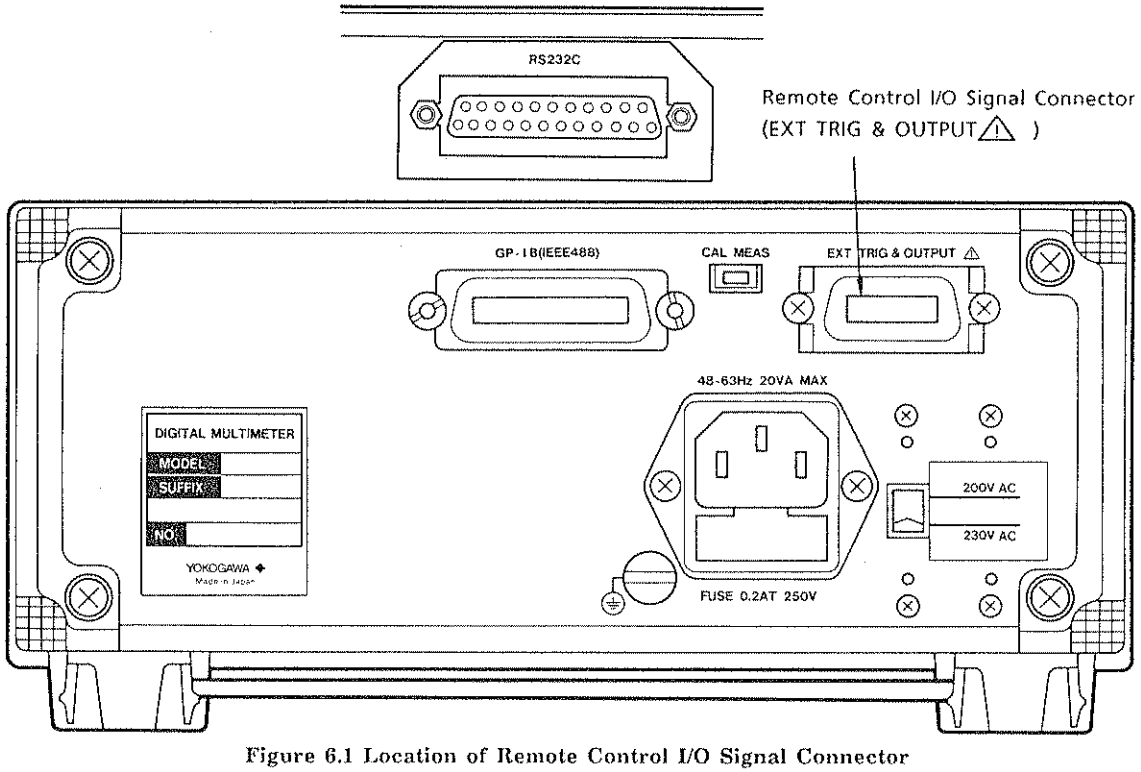


Figure 6.1 Location of Remote Control I/O Signal Connector

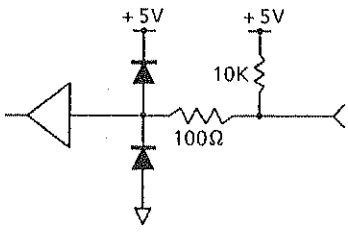
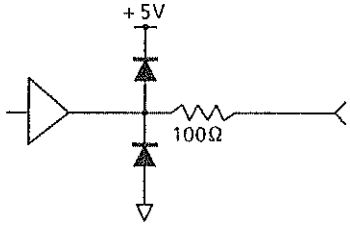
6.1 Remote Control Signal

6.1.1 Remote Control Signal Connector and I / O Signal Level

(1) An AMPHENOL 57-30140 connector is used. For signal names and pin Nos., see Table 7.4.

(2) Remote Control Circuit and Output Level

Table 6.1

Signal Name		Control Circuit	Output Level
A-D control signal	EXT TRIGGER (input)		TTL level Lo (0 to 0.4V) Hi (2.4 to 5V)
	A-D END (output)		TTL level IoL=1.8mA IoH=−0.4mA
Comparator signal	HIGH (output)	Same as the A-D END	Same as the A-D END
	LOW (output)	Same as the A-D END	Same as the A-D END
	PASS (output)	Same as the A-D END	Same as the A-D END

6.1.2 Remote Control Functions

See Table 6.2.

Table 6.2

Signal Name	Function	Signal
EXT TRIG	External measurement and control start signals	TRIG : Rise edge.
END	Measurement end signal	Pulse WIDTH : 10μs (min)

(1) External Trigger Start Signal

In SINGLE, N RDGS, program execution, STORE or RECALL mode, when an external signal is used, connect a contact signal or TTL logic signal between connector pins ① and ⑦. The measurement timing chart is shown below:

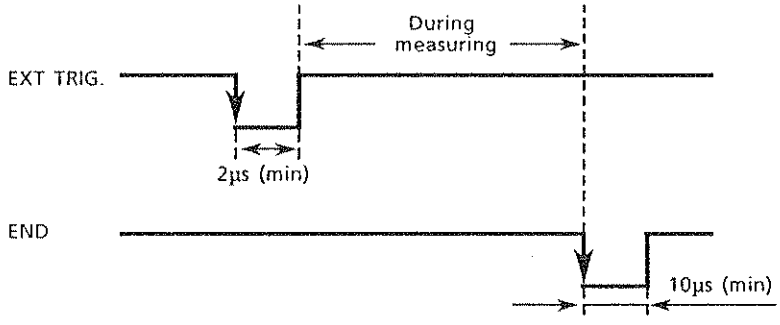


Figure 6.2

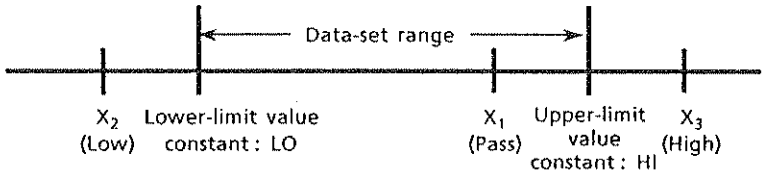
(2) Comparator Output

When the MATH function is used to select comparator function (CP) for sending its output signal to an external control circuit, pin ⑦ is used as "COMMON", pin ④ as "HIGH", pin ⑤ as "PASS", and pin ⑥ as "LOW". The comparator output circuit is shown below:

Table 6.3

Signal Name	Function	Signal
HIGH LOW PASS	Comparator output	Active LEVEL : L

X_1, X_2, X_3 ; Measured Data

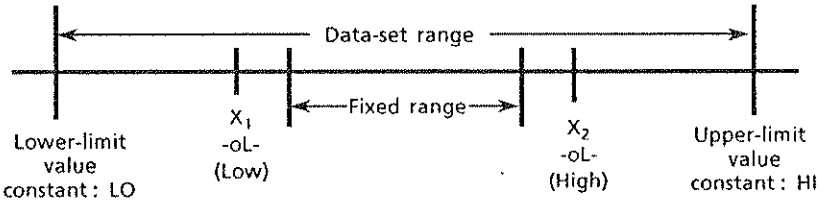


If the measured value exceeds a data-set upper-limit value, only the high alarm is ON.

If the measured value is less than a data-set lower-limit value, only the low alarm is ON.

(1) Data Output in Manual Range (Fixed Range)

When the data-set range (between upper- and lower-limit values) is out of the fixed range (see below), even though the measured value is within the data-set range, if the measured value exceeds the fixed range, it will overrange, and "High" or "Low" is output.



(2) Data Output in Automatic Range

Regardless of the current data-set range, if the measured value is within the data-set range, "Pass" is output; while if it is out of the data-set range, "Low" is output.

* Among of MATH mode is OFF, sampling interval is shorter than 20ms, and F / R input is error, the outputs of High, Low, Pass are all OFF.

6.2 D-A Output Signal Option

Among the measured data that are being displayed, some 3.5- or 3-digit data can be D-A converted and output. Two output modes, 0 and 1, are available. To select the output mode and to display digits, press the MISC key. DA output signals are indicated by an analog recorder. For signal names and pin Nos., see Table 5.1.

6.2.1 Selecting D-A Output Digits

Select a desired output display mode from among the four modes shown in the table below:

Table 6.4

	4.5 Digits	5.5 Digits
Maximum Digit Display	19999	199999
Mode 0	1999-	1999--
Mode 1	--999	--999-
Mode 2	--999	---999
Mode 3	--999	---999

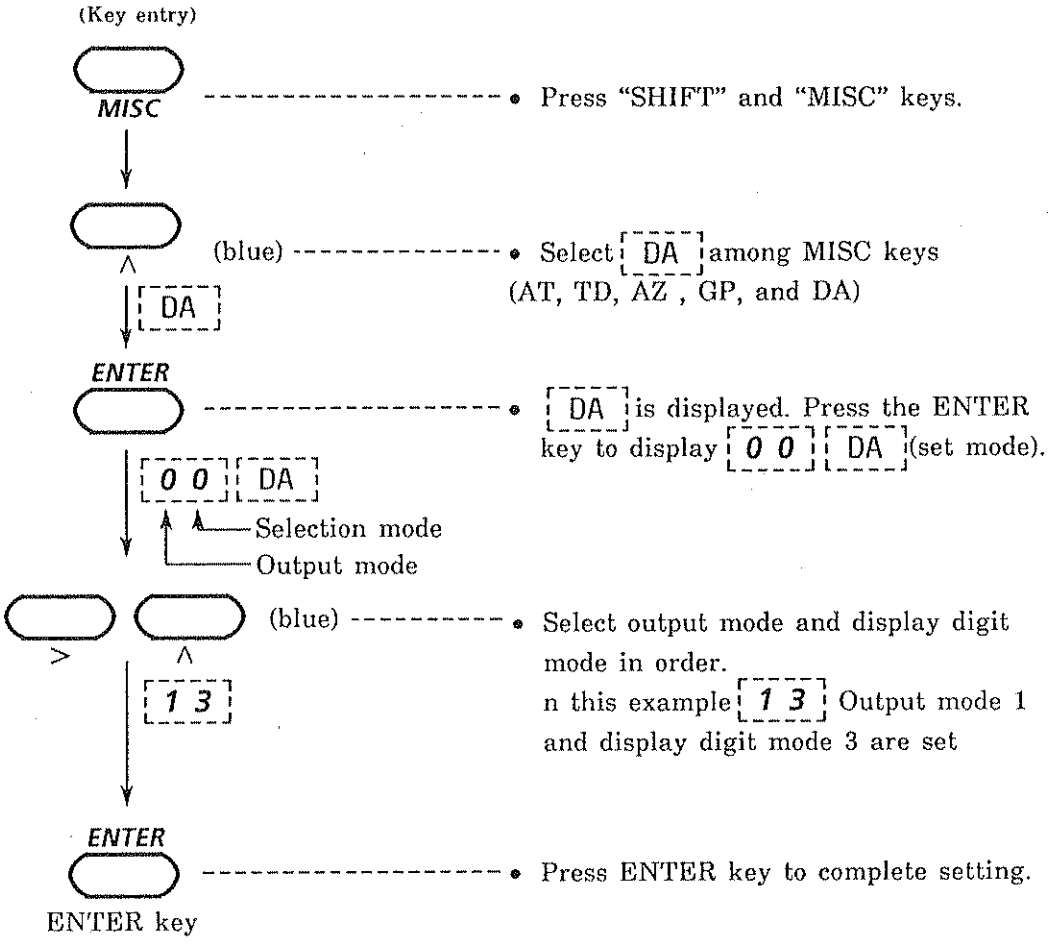
- As shown above, any one of the modes 0 to 3 can be selected.
  For 4.5-digit Display : The same digits are displayed in modes 1 to 3.
  For 5.5-digit Display : The same digits are displayed in modes 2 and 3.
- The output and display digit modes are not changed even if the range and digits are changed.

CAUTION

- Do not apply DC voltage to the D-A output terminal.

6.2.2 Setting Output Mode and Display Digit Mode*

Use the panel keys to set the output mode and display digit mode as follows:



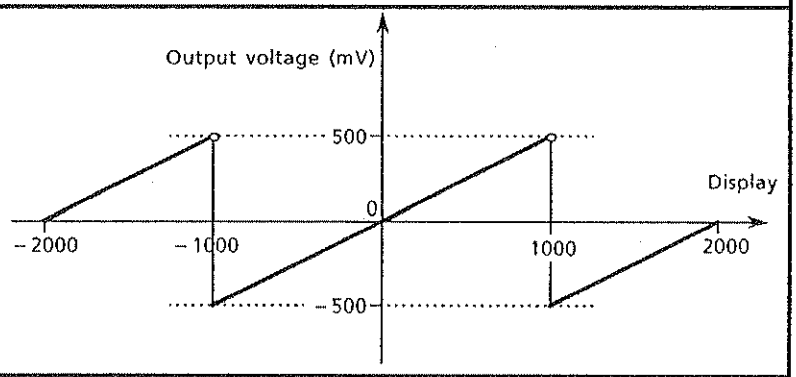
* : Available for D-A option only.

6.2.3 D-A Output Mode

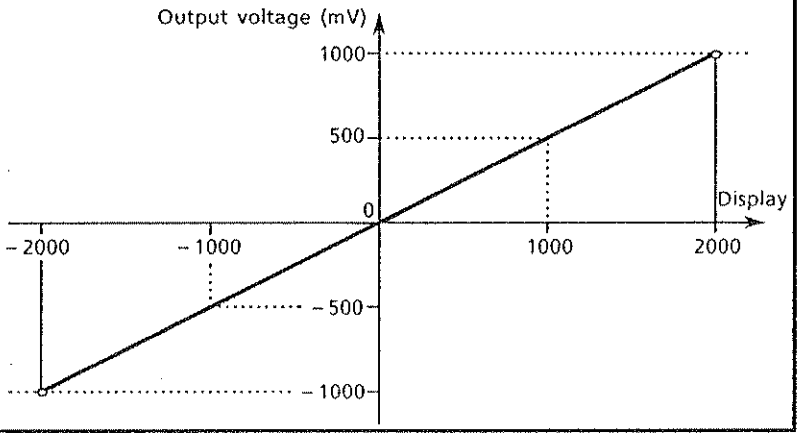
"D-A" output includes four output patterns according to combinations of the output mode and selected mode. The output modes include output mode 0 and output mode 1:

- Output mode 0 : Output voltage −500 to 499 mV DC
- Output mode 1 : Output voltage −999 to 999 mV DC

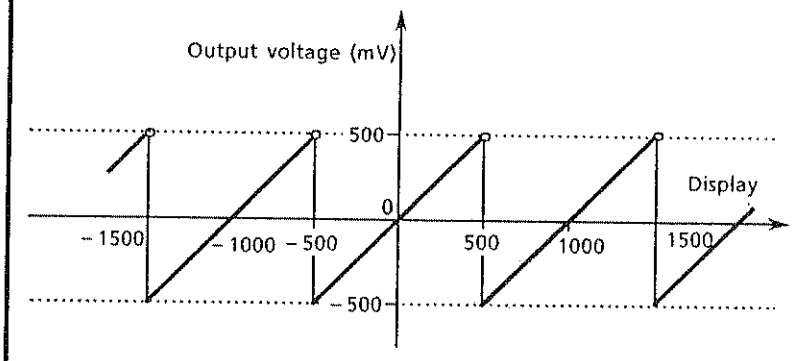
(1) D-A Output Pattern 1

	Output Mode 0 (−500 to 499 mV)
Selected Mode 0 *(−1999 to 1999)*	

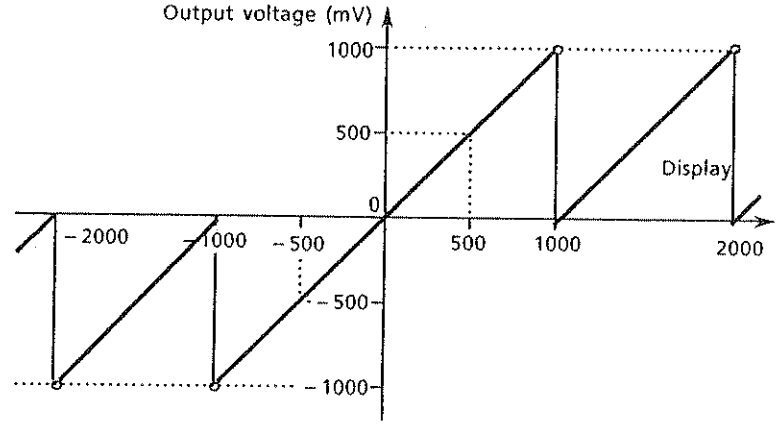
(2) D-A Output Pattern 2

	Output Mode 1 (−999 to 999 mV)
Selected Mode 0 *(−1999 to 1999)*	

(3) D-A Output Pattern 3

	Output Mode 1 (−500 to 499 mV)
Selected Mode 1, 2 or 3 (−999 to 999)	

(4) D-A Output Pattern 4

	Output Mode 1 (−999 to 999 mV)
Selected Mode 1, 2 or 3 (−999 to 999)	

* D-A output is maximum voltage value in case of out of range in the plus domain, F/R input error or math function error. And it is also minimum voltage value in case of out of range in the minus domain.

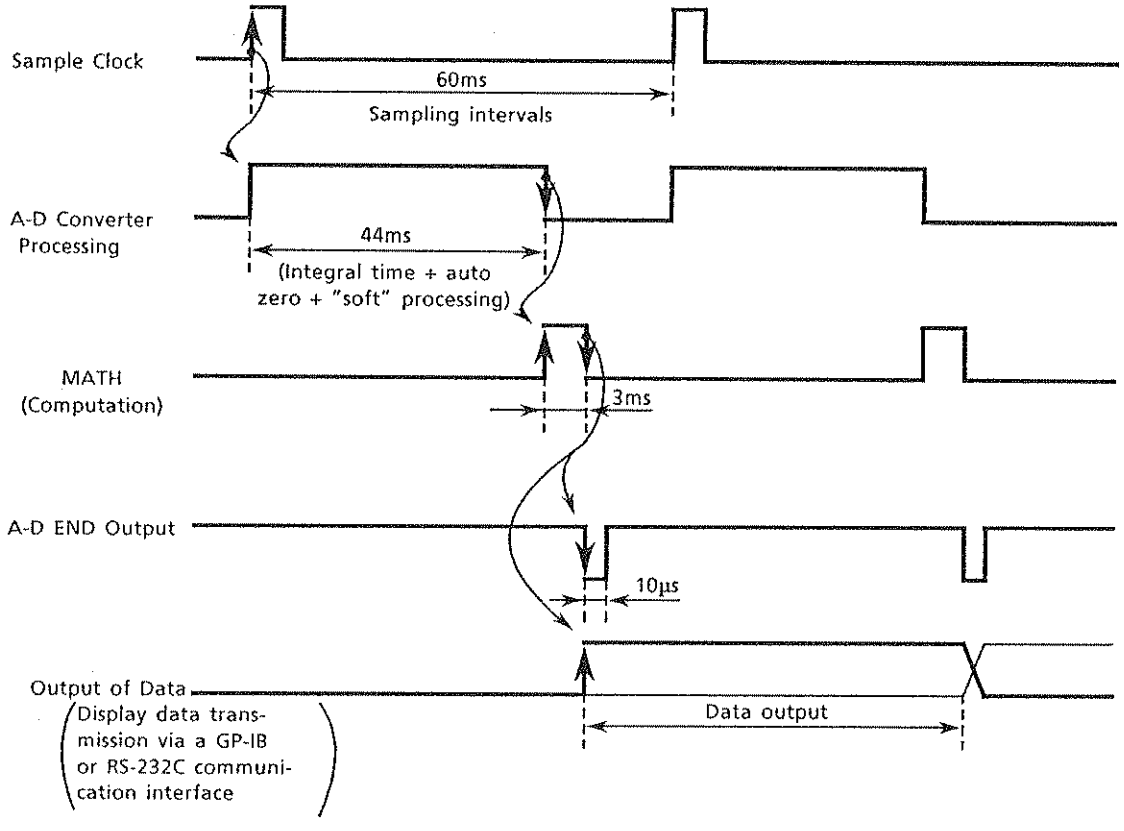
6.3 Timing Chart

6.3.1 Auto Mode (AUTO)

In auto mode, data processing (timing chart) is flowcharted as follows:

Measurement Condition

- Measurement mode : AUTO
- Sampling intervals : 60ms
- Integral time : 20ms
- Auto Zero : ON*
- MATH (computation) : OFF**



* : Time required for auto zero varies depending on the integral time.
For details, see Section 5. 2. 5.

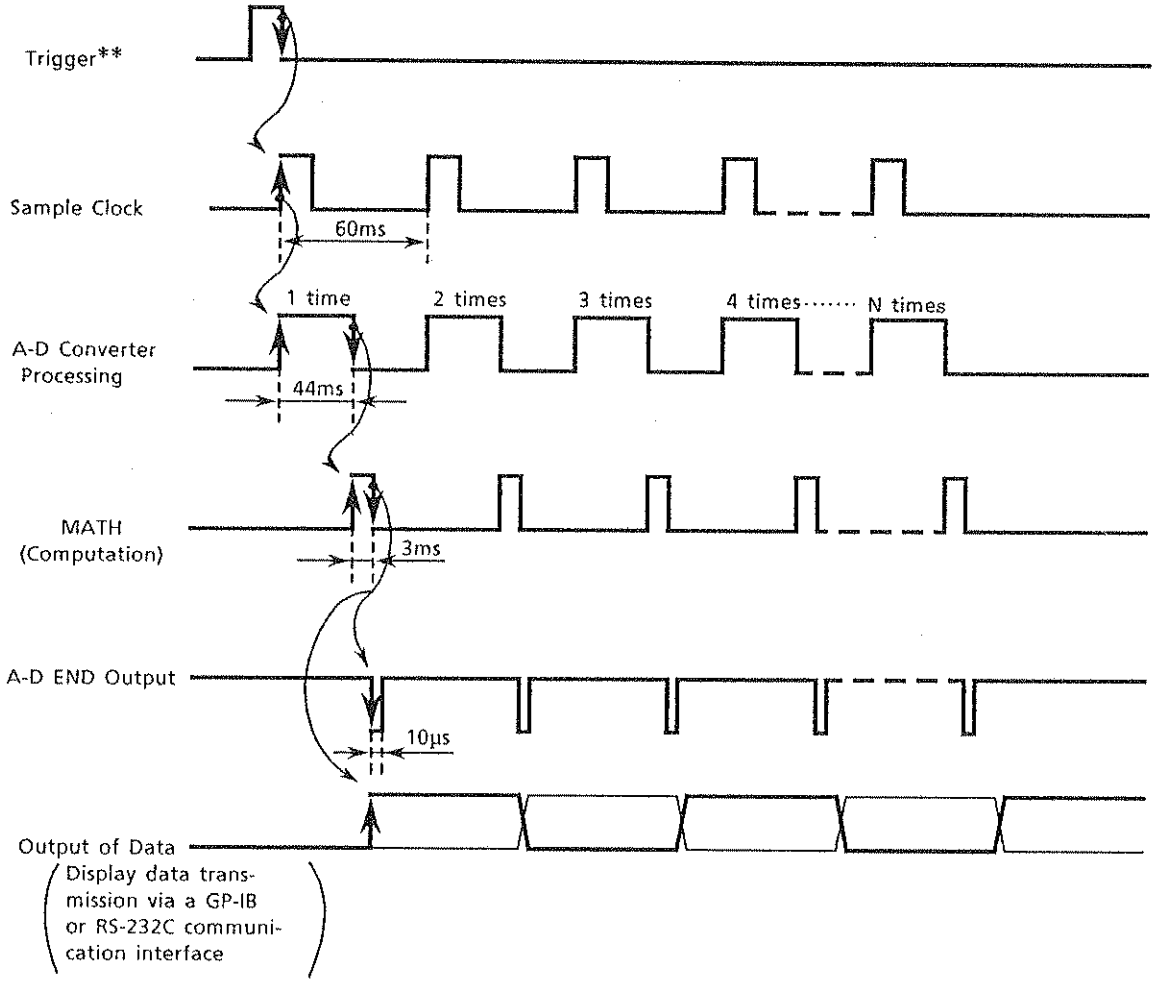
** : In MATH ON, the processing time (TYPICAL) listed below are added:

MATH Functions	Processing Time (TYPICAL)
NULL	0.2ms
AVG (averaging)	2ms
Scaling (SC)	4ms
Decibel (dB)	15ms
Comparator (CP)	1.5ms

6.3.2 N Reading Mode (N RDGS)

Measurement Condition

- Measurement mode : N RDGS
- Sampling intervals : 60ms
- Integral time : 20ms
- Auto Zero : ON*
- MATH (computation) : OFF*



* : Same as for "Auto Mode".

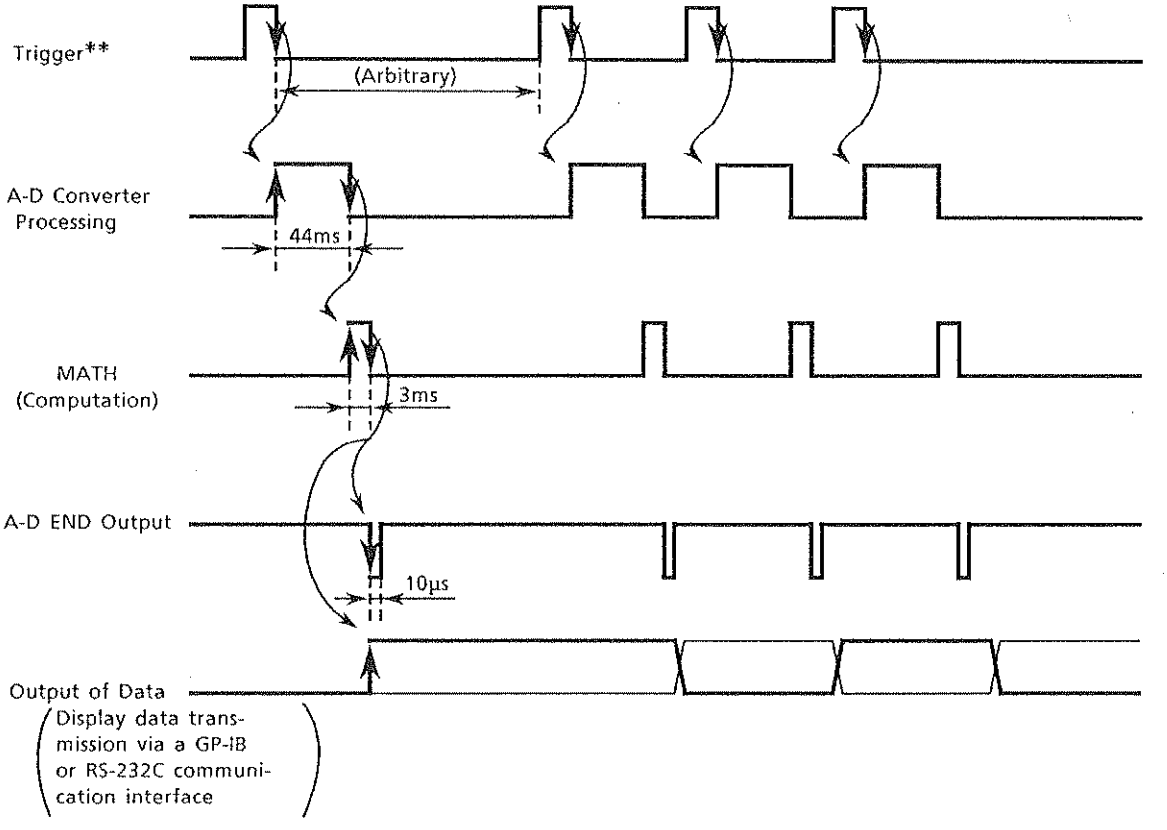
** : The following processing times are required until the A-D converter status after a trigger signal is generated :

- Key entry ..... 3.8 ms approx.
- EXT signal ..... 1 ms approx.
- "E" command ..... 2.5 ms approx.
- <GET> command ... 2.7 ms approx.

6.3.3 Single Mode (SINGLE)

Measurement Condition

- Measurement mode : SINGLE
- Integral time : 20ms
- Auto Zero : ON*
- MATH (computation) : OFF*



* : Same as for "Auto Mode".

** : The following processing times are required until the A-D converter status after a trigger signal is generated:

- Key entry ..... 3.5 ms approx.
- EXT signal ..... 0.7 ms approx.
- "E" command ..... 2 ms approx.
- <GET> command ... 2.5 ms approx.

7. COMMUNICATIONS FUNCTIONS

7.1 GP-IB Communications Interface (for Models 7551 01 and 7552 01)

7.1.1 Introduction

(1) Outline

Models 7551 and 7552 are high-accuracy, high-speed sampling multifunctional instruments not only for bench use but also for manufacturing-line automatic measurement systems.

Models 7551 01 and 7552 01 come with a GP-IB communication interface as standard equipment. These models can be used with a remote controller to allow remote control and various data to be output.

- The following functions are available with a GP-IB communication interface:

Table 7.1

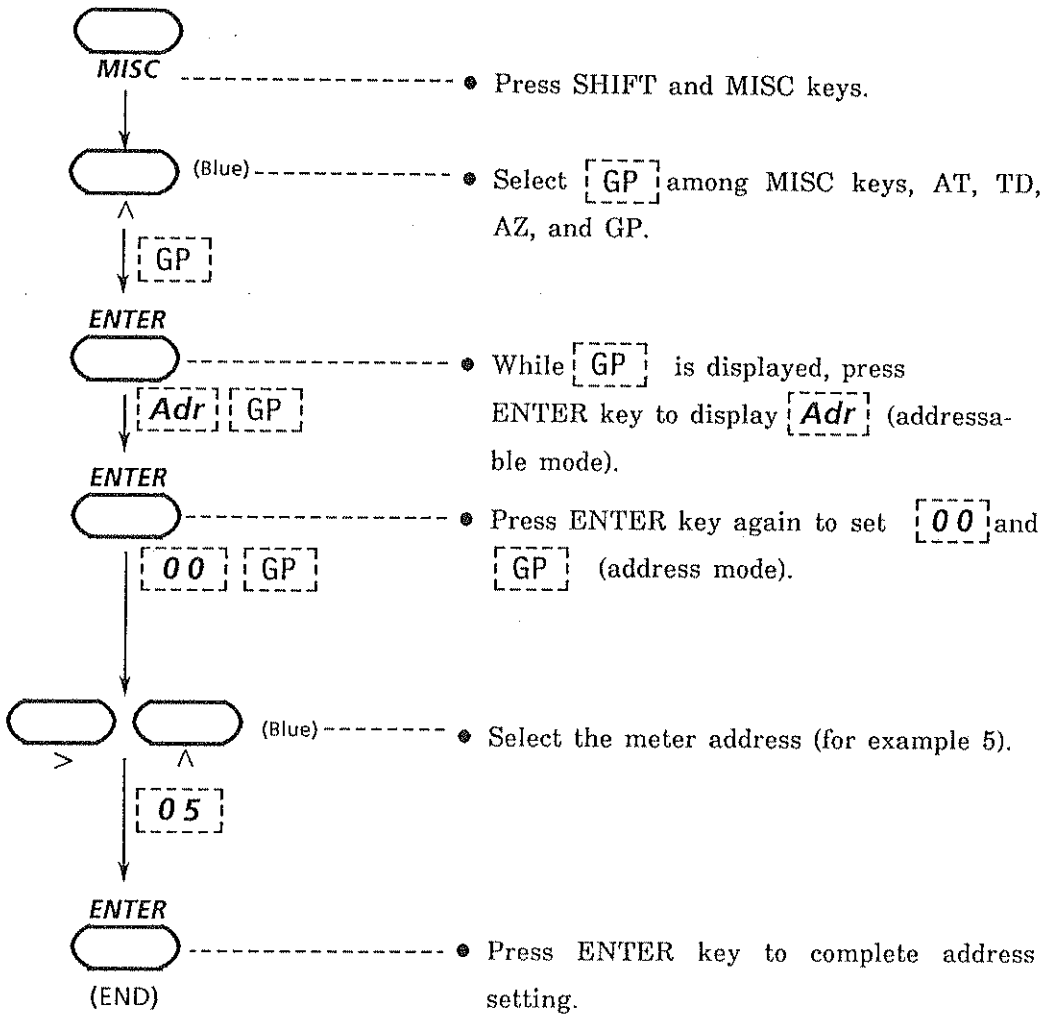
Mode and Function		Enabled Output Functions
Addressable Mode	Listener Function	• Functions that can be entered by panel keys (except POWER and SRQ keys) • Panel-set data output request
	Talker Function	• Measured data output • Panel-set data output • Stored data output • Status byte output
Talk Only Mode	Talker Function	• Measured data output • Stored data output

(2) Setting Addressable Mode and Talk-Only Mode

① Addressable Mode (*Adr*)

This mode sets a controller address to control the meter using program data. Talker and listener functions can be used. Decide when meter address is to get the controller address. To set the meter address, use the panel keys. Key entry procedures are as follows:

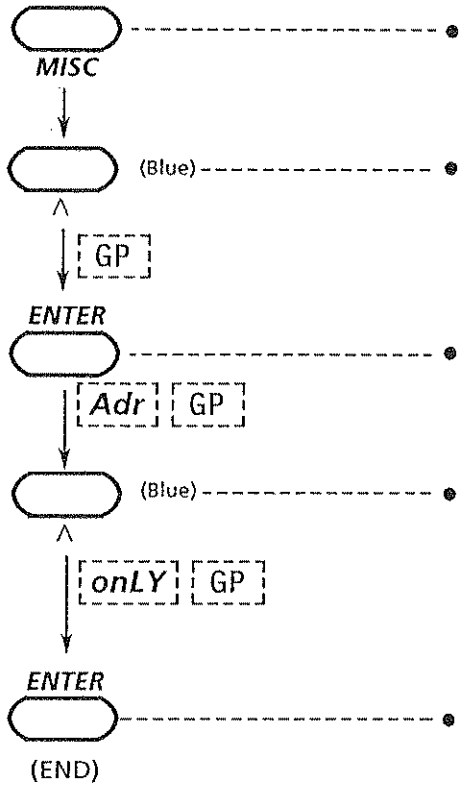
[Key Entry]



② Talk-Only Mode (*onLY*)

In this mode, data can be output without any controller. To set talk-only mode, use the panel keys. Key entry procedures are as follows:

[Key Entry]



- Press SHIFT and MISC keys.
- Select [GP] among MISC keys -- AT, TD, AZ, and GP.
- While [GP] is displayed, press the ENTER key to display [Adr].
- Press the key to display [onLY].
- Press ENTER key again to complete setting.

(3) Specifications

- **Electric and Mechanical Specifications** : Conform to IEEE Standards 488-1978.
- **Functional Specifications** : SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0
- **Codes Used** : ISO (ASCII) code.
- **Address Setting** : Use MISC key.
- **Remote Cancel** : Use LOCAL key to cancel remote control.

Table 7.2

Function	Contents
SH1	All handshake functions for sending data
AH1	All handshake functions for receiving data
T5	Basic talker functions, serial poll functions, talk-only functions, talker cancelling with MLA (My Listen Address)
L4	Basic listener functions, listener cancelling with MTA (My Talk Address)
SR1	Service request
RL1	Remote / local functions
PP0	Parallel poll functions
DC1	Device clear
DT1	Device trigger
C0	Without controller functions

Response to Interface Messages:

- **Device Trigger** : <GET> …… Start the meter A-D converter. Same as for command "E".
- **Device Clear** : <SDC> and <DCL> …… Set the meter panel-set data as in power ON status.

For more detailed information about GP-IB communications interface specifications, see the applicable Instruction Manual.

7.1.2 Listener Functions

Listener functions enable panel keys (except POWER switch and SRQ key) to be entered remotely.

Listener functions work with program data sent from a talker when ATN (attention) signal line is false (off).

Program data are composed of [command + parameter] + terminator .
Set the program data using ASCII codes.

Note : Use up to 50 characters for setting [command + parameter]. If more than 51 characters are used, they are ignored.

- **Command**: Use one or two alphabetical characters.
- **Parameter** : Use numerical characters (ASCII codes).
- **Terminator** : CR IF
  LF
  EOI
  ; (semicolon)

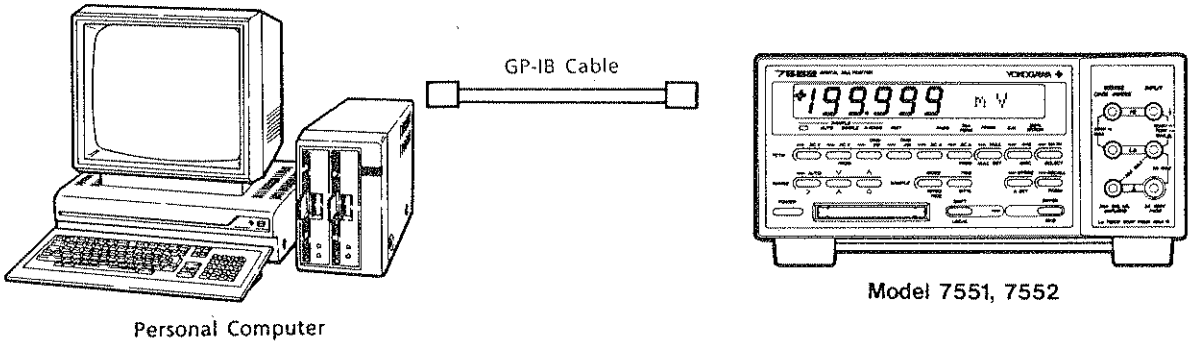


Figure 7.1 Connecting Multimeter to Computer with a GP-IB Cable

Note 1: In AUTO mode, use ";" as a terminator.

Note 2: Panel data that are set with programs, IC memory card data – read functions, or data communication functions are lost if the power is turned off.

7.1.3 Talker Functions

(1) Talker Functions

Multimeters incorporate talker functions in two modes : addressable mode and talk-only mode. With talker functions, measured data and panel-set data can be output. Measured data can be output for each measurement cycle. If a trigger signal is output, measured data cannot be output until the delay time has elapsed and the measurement is completed. The stored data cannot be output until the delay time has elapsed. To output data using talker functions, use a printer with a GP-IB communication interface.

① Talker Functions in Addressable Mode

The measured data, panel-set data, and stored data can be output. The measured data can be output in real-time when sampling intervals are set to 20ms or longer. Refer to Section 7.1.1 (2), for addressable-mode setting.

② Talker Functions in Talk Only Mode

The measured data and stored data can be output with sampling intervals 20ms or longer. Refer to Section 7.1.1 (2) for talk-only mode setting.

(2) Data Output Format

① Measured Data and Stored Data Output Formats

Data No.	,	Header	Data	Terminator

- **Data No.** : Added only when the stored data is output. Values are −7999 to +7999 including 0000 for trigger point.
- **Header** : $a_1a_2a_3a_4$ (four alphabetical characters) including :

a_1 :
- N .... MATH (computation) OFF
- S .... Scaling
- D .... dB
- H .... Comparator Hi
- L .... Comparator Lo
- P .... Comparator Pass
- O .... Overrange
- V .... MATH error
- E .... Illegal error

a_2a_3 :
- DC ... Direct current
- AC ... Alternating current
- R2 ... Two-wire resistance
- R4 ... Four-wire resistance
- FV ... Frequency (voltage mode)
- FA ... Frequency (current mode)

a_4 :
- V .... VOLT
- A .... AMPERE
- O .... OHM
- H .... Hz

- **Data** : $m_1\ m_2\ m_3\ m_4\ m_5\ m_6\ E\ +\ m_7 m_8{}^*$

  A maximum of 5-1/2 digits characters Exponent

  Note: Number of output characters is varied depending on the number of digits displayed.

- **Terminator**: CR LF (+EOI)

  * : m_8 is used when MATH function is set ON (1 or 2 digits)

Output Example 1:

Function	Range	Display	GP-IB Interface Output
DC V	200 mV	+199.999 mV	NDCV +199.999E−3
	2000 mV	+1999.99 mV	NDCV +1999.99E−3
	20 V	+19.9999 V	NDCV +19.9999E−0
	200 V	+199.999 V	NDCV +199.999E−0
	1000 V	+1100.00 V	NDCV +1000.00E−0
Ω 2W	200 Ω	+199.999 Ω	NR2O+199.999E+0
	2000 Ω	+1999.99 Ω	NR2O+1999.99E+0
	20 kΩ	+19.9999k Ω	NR2O+19.9999E+3
	200 kΩ	+199.999k Ω	NR2O+199.999E+3
	2000 kΩ	+1999.99k Ω	NR2O+1999.99E+3
	20 MΩ	+19.9999M Ω	NR2O+19.9999E+6
	200 MΩ	+199.999M Ω	NR2O+199.999E+6
DC A	2000 μA	+1999.99 μA	NDCA+1999.99E−6
	20 mA	+19.9999 mA	NDCA+19.9999E−3
	200 mA	+199.999 mA	NDCA+199.999E−3
	2000 mA	+1999.99 mA	NDCA+1999.99E−3
	20A	+19.9999 A	NDCA+19.9999E−0

Output Example 2:

		GP-IB interface output	
• Measured data		NDCV	+0000.99E+3
• dB	……+19.9999dB	DDCV	+19.9999E+0
• Comparator	……+199.999Hi	HDCV	+199.999E+0
• Overrange	……+−oL−mV	ODCV	+9999.99E−3
• MATH error	…… −oL−	VDCV	999999.E+9
• Header OFF	……		+19.9999E+0

• Stored-data read ……NO+0012, NDCV+199.999E+3

• Stored-data read when header is OFF …… +19.9999E+0

(2) Panel-Set Data Output Format

When an OS command is received, panel-set data is output in the following order:

Line	Output
1	Model D-A output condition (option)
2	Function and range
3	Sample mode, integral time, sampling intervals, delay time
4	NULL ON/OFF, auto zero switch
5	Sample cycles and recall No.
6	Averaging ON/OFF and averaging cycles
7	MATH ON/OFF and types of MATH
8	MATH constants A and B
9	MATH constants C and D
10	Comparator constant H and L

(3) Status Byte Output Format

The status bytes transmitted in serial poll are output with the following formats:

bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01
0	SRQ	ERR	BUSY	OL	SYN ERR	SRQ SW	A-D END
Mask values				8	4	2	1

- bit 8 : 0 (fixed)
- bit 7 : Service request. When any one of bits 6, 4, 3, 2, 1 is 1, "1" is set.
- bit 6 : If an error occurs (any one of bits 4 and 3 is 1), bit 6 is set.
- bit 5 : When IC memory card opens its file, bit 5 is set.
- bit 4 : If in overrange, MATH (computation) overrange, or a MATH error occurs, bit 4 is set.
- bit 3 : If a syntax error occurs, this bit is set.
- bit 2 : When SRQ switch on the front panel is pressed, this bit is set.
- bit 1 : Set when the measurement is terminated.

* : When the power turns ON, mask 0 is set.

The above status byte is held until the controller reads the corresponding status byte.

7.2 RS-232C Communications Interface (for Models 7551 02 and 7552 02)

7.2.1 Introduction

RS-232C communications interfaces are used for the interconnection of data terminal equipment (DTE) and data communications equipment (DCE) employing serial binary data interchange, conforming to EIA (Electronic Industries Association).

(1) Outline

Models 7551 02 and 7552 02 incorporate RS-232C communications interfaces as standard equipment. These communications interfaces allow remote control from a personal computer and data to be output. Normal mode and talk-only mode are available. Use "MISC" key for mode setting.

- Data that can be output via an RS-232C communications interface are as follows:

Table 7.3

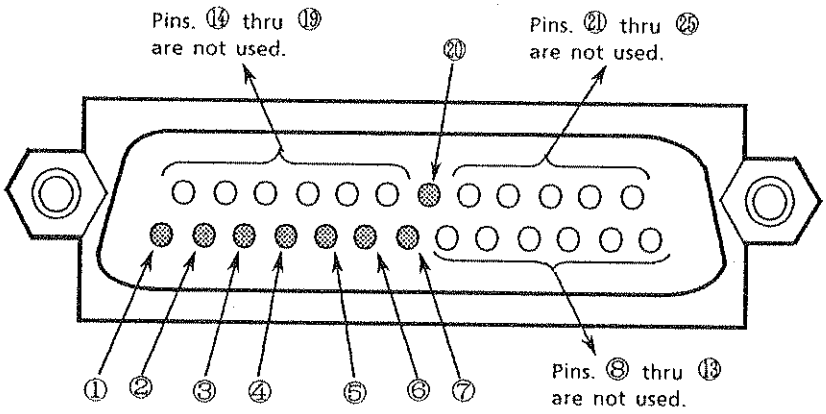
Control Mode		Data that can be Output
Normal Mode	Data set Function	• Functions using panel keys except POWER and SRQ keys • Panel-set data output request
	Output Functions	• Measured data output • Panel-set data output • Stored data output • Status byte output
Talk-Only Mode	Output Functions	• Measured data output • Stored data output

(2) Specifications

- **Connection** : Point-to-point.
- **Communications** : Full duplex (FDX).
- **Synchronous System** : Start-stop system.
- **Transmission Speed (bps)** : 75, 150, 300, 600, 1200, 2400, 4800 or 9600.
- **Start Bit** : 1 bit (fixed).
- **Data (Word) Length** : 7 or 8 bits.
- **Parity** : Even, odd or no parity.
- **Stop Bit** : 1 or 2 bits.
- **Electric Characteristics** : Conform to EIA RS-232C.
- **Connector** : DBSP-JB25S (JAE) provided on the rear panel. Use DB-25P connector for an RS-232C interface.
- **Hardware Handshake** : For CA, CB, CC, and CD signals, select TRUE or control line.
- **Software Handshake** : Select X-on and X-off signals for sending and receiving data.
- **Buffer Data Length** : 64 bytes.

7.2.2 RS-232C Communication Interface Functions

(1) RS-232C Connector and Signal Names



Numbers denote pin No. respectively.

Figure 7.2 RS-232C Connector (Equivalent to DBSP-JB25S)

Table 7.4

Pin No.	Signal Name	Pin No.	Signal Name
①	EXT-TRIGGER	⑧	D-A OUT
②	A - D END	⑨	D-A COMMON
③		⑩	
④	HIGH	⑪	
⑤	PASS	⑫	
⑥	LOW	⑬	
⑦	DIGITAL COMMON	⑭	DIGITAL COMMON

Note : DIGITAL COMMON and D-A COMMON are internally connected to each other.

① **AA (GND ; Protective Ground)** : Already grounded to 7551 / 7552 case.

② **BA (TXD ; Transmitted Data)** : To data communication equipment (personal computer)

③ **BB (RXD ; Received Data)** : From data communication equipment (personal computer)

④ **CA (RTS ; Request to Send)** : A handshake signal for receiving data from a personal computer.
Direction : To data communication equipment.

⑤ **CB (CTS ; Clear to Send)** : A handshake signal to send data to a personal computer.
Direction : From data communication equipment.

⑥ **CC (DSR ; Data Set Ready)** : A handshake signal to send data to a personal computer.
Direction : From data communication equipment.

⑦ **AB (GND ; Signal Ground)** : Signal ground.
Direction : Not applicable.

⑳ **CD (DTR ; Data Terminal Ready)** : A handshake signal for receiving data from a personal computer.
Direction : To data communication equipment.

Note : Pins ⑧ to ⑲ and ㉑ to ㉕ are not used.

(2) Handshake Systems

When multimeters are connected to a personal computer via an RS-232C communications interface, data-exchange "handshake" procedures are needed.

This section describes "handshake" procedures consisting of 8 types of systems using panel key switches (see Table 7.5 below).

Table 7.5

Mode Select No.	To Send Data to Data Communication Equipment (Computer)				To Receive Data from Data Communication Equipment (Computer)			
	Soft Handshake	Hard Handshake		Without Handshake	Soft Handshake	Hard Handshake		Without Handshake
	Stop sending data when X-off is sent. Data is sent again when X-on is sent.	When CB (CTS) is false, sending data stops. When CB (CTS) is true, data is sent again.	When CC (DSR) is false, sending data stops. When CC (DSR) is true, data is sent again.		When receive buffer is 3/4, X-off is sent. When receive buffer is 1/4, X-on is sent.	When receive buffer is 3/4, CD (DTR) is false. When receive buffer is 1/4, CD (DTR) is true.	When receive buffer is 3/4, CA (RTS) is false. When receive buffer is 1/4, CA is true.	
0				○				○
1	○				○			
2	○					○		
3	○						○	
4		○				○		
5		○					○	
6			○			○		
7			○				○	

(3) Data Control

In receive-data control, while "handshaking" data, data communication equipment (personal computer) may also send data.

In this case, if the receive buffer is full, data will not be saved.

If some memory areas remain in the buffer, data can be saved.

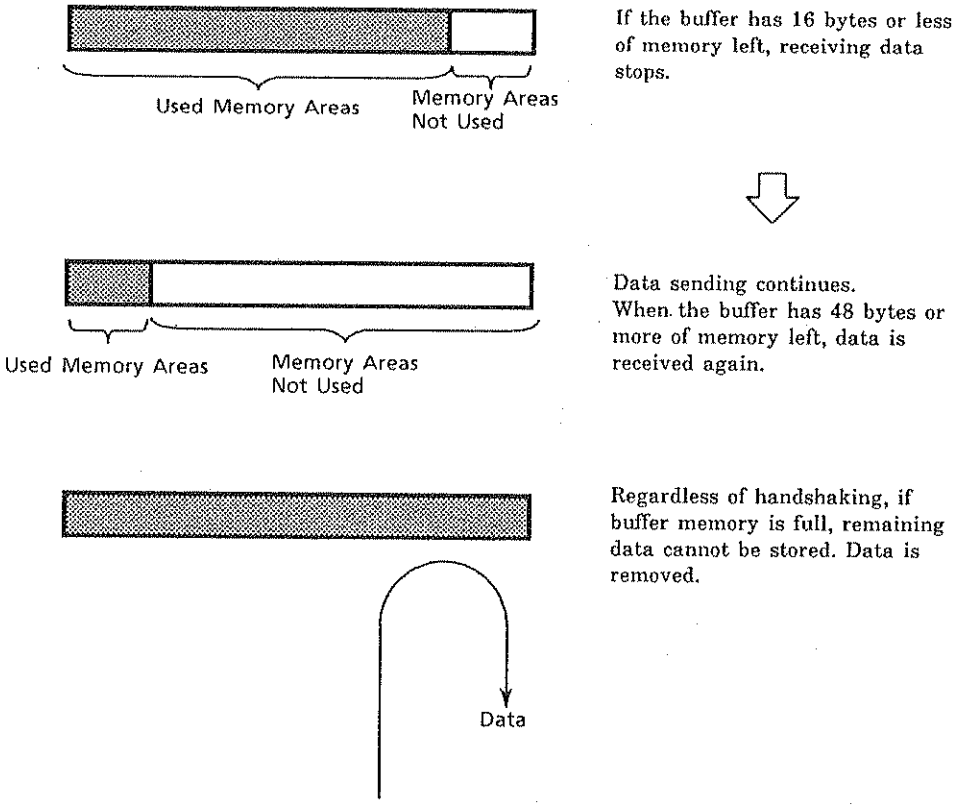


Figure 7.3 Data Control Configuration Diagram

(4) Communications Data Format

This RS-232C communications interface uses a start-stop system to communicate data. The start-stop transmission system adds a start bit to the data head every time one character is sent. Data bits, parity bits, and stop bits are added as follows:

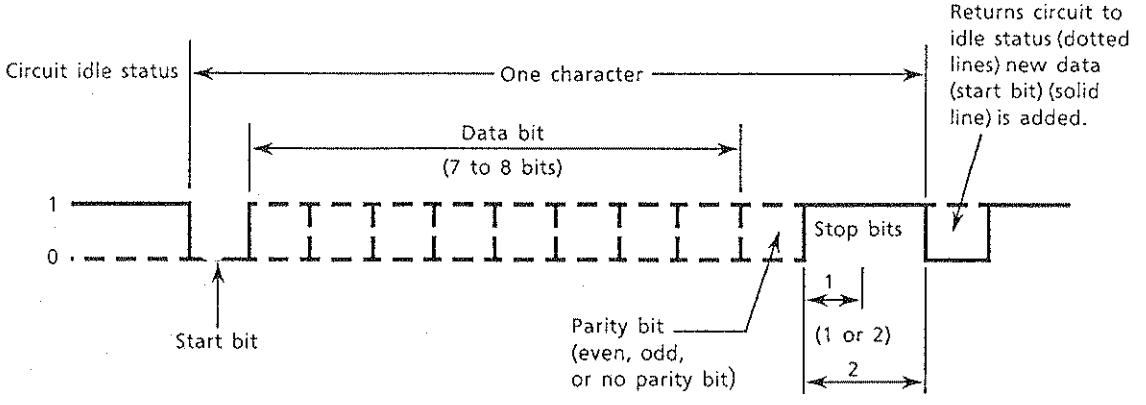


Figure 7.4 Communications Data Format

Table 7.6 Data Format Table

Set Value	Start Bit	Data Length	Parity	Stop Bit
0	1	8	No parity	1
1	1	7	Odd	1
2	1	7	Even	1
3	1	7	No parity	2

To set data format, use "MISC" key. For details, see Section 7.2.3, (1).

(5) Connecting the Meter to a Computer

When the meter is connected to a computer, use panel keys to set handshake procedures, data transmission rate, and data format. For details see item (1) in this section. Use an RS-232C cable applicable to this meter.

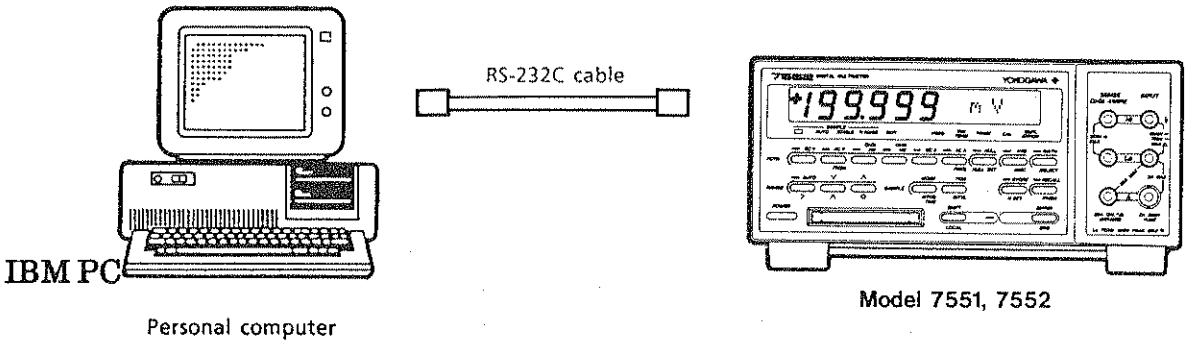
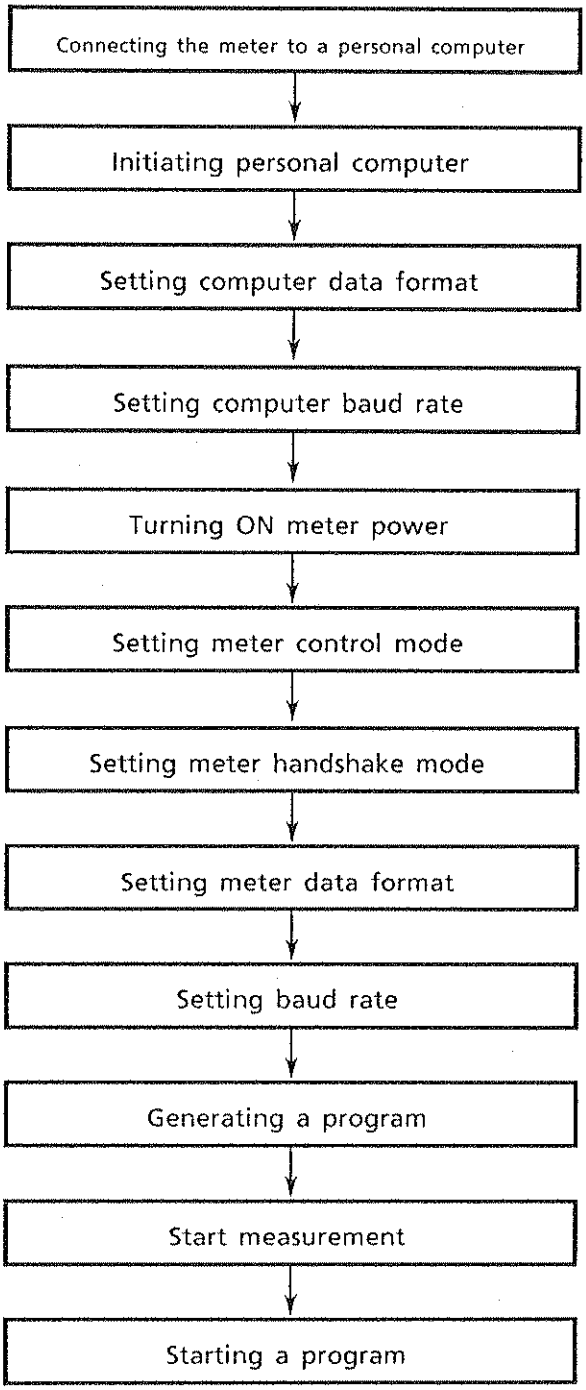


Figure 7.5 Connecting Multimeter to Computer with an RC-232C Cable

7.2.3 Remote Control Functions

In normal mode, the panel keys except "POWER" and communication-set keys can be controlled remotely.

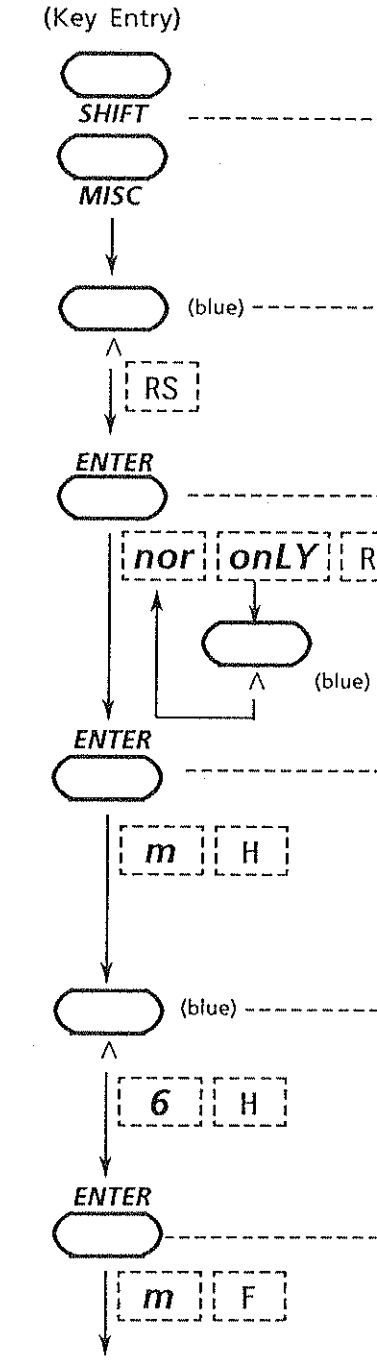
(1) Steps



(2) Setting Normal Mode And Talk-Only Mode

① Normal Mode (*nor*)

In normal mode, the meter can be controlled by a command from the personal computer. To set the meter in normal mode, use the meter panel keys. Key entry procedures are as follows:



- Press SHIFT and MISC key.
- Use MISC key to select [RS] among the AT, TD, AZ, and RS.
- Press ENTER key while [RS] is displayed. Press (blue) key to display [nor].
- To set normal mode, press ENTER key while [nor] is displayed. [m] and [H] are displayed and handshake mode is set.
- Press (blue) key to display handshake mode (0 to 7). In this example, mode 6 is set.
- Press ENTER key. [m] [F] are displayed and data format is set.

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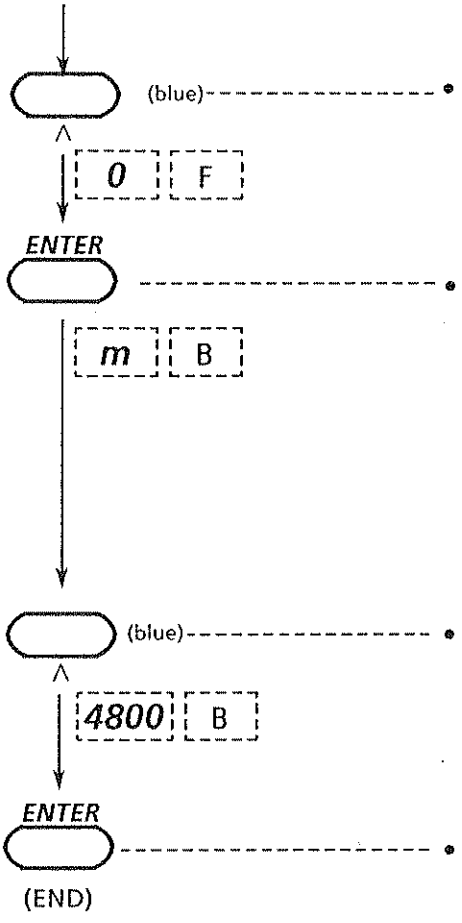


Press ( ) (blue) key to display the desired data format (0 to 3). In this example, mode 0 is set.

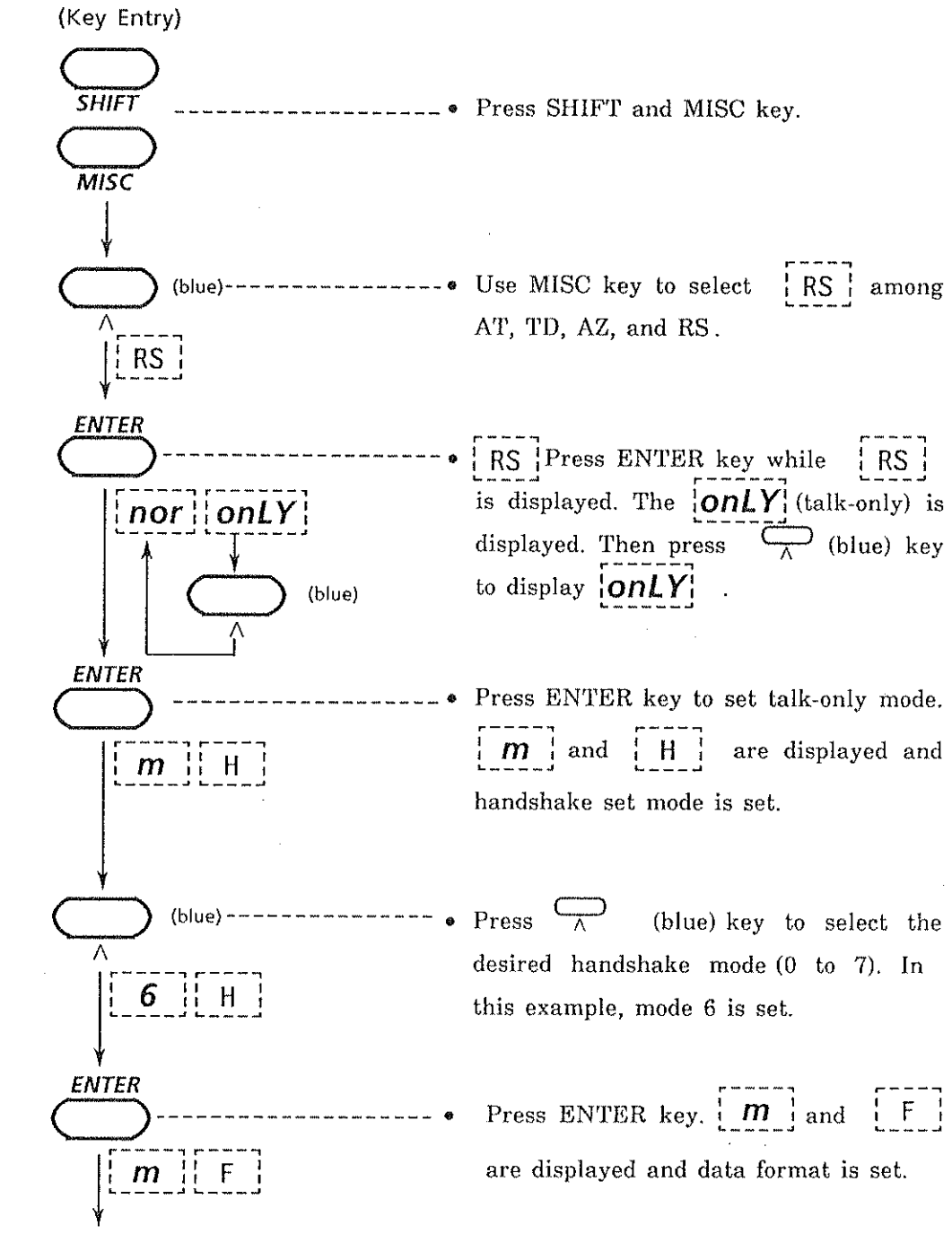
Press ENTER key to set the data format. m and B are displayed and baud rate mode is set.

Press (blue) key to display the desired baud rate (75 to 9600). In this example, baud rate 4800 is set.

Press ENTER key to complete setting.

② Setting Talk-Only Mode (*onLY*)

This mode is used to output data. In this mode, data can be output without a personal computer. Use the panel keys to set talk-only mode. Key entry procedures as follows:



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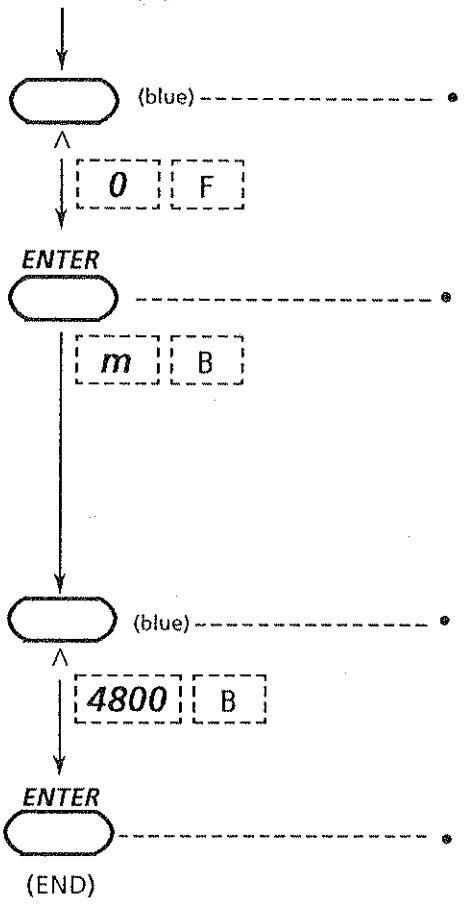


- Press (blue) key to display the desired data format (0 to 3). In this example, mode 0 is set.
- Press ENTER key. m and B are displayed and baud rate mode is set.
- Press (blue) key to display the desired baud rate (75 to 9600). In this example, baud rate 4800 is set.
- Press ENTER key to complete setting.

(3) Programming Example

The multimeter can be controlled remotely by a program command (command + parameters) from the personal computer.

Program commands consist of [command] + [parameter] + [terminator] with ASCII codes.

Note : Use up to 50 characters for setting [command + parameter]. If more than 50 characters are used, the [command + parameter] setting is ignored.

(command)	(parameter)	(terminator)
TD	m	CR LF LF ;

- Command : Defined with one or two alphabetical characters.
- Parameter : Use numerical ASCII codes.
- Terminator : CR LF
  LF
  ; (semicolon)

Note: Panal data that are set with programs, IC memory card data – read functions, or data communication functions are lost if the power is turned off.

7.2.4 Data Output

(1) Data Output Functions

Data are output in two modes—normal mode and talk-only mode. Data and panel-set data can be output. The measured data is output once every time one cycle of measurement is carried out. If a trigger signal is output, the measured data and stored data are not output until the delay time has elapsed.

To output data, use a printer with an RS-232C communication interface.

① Data Output in Normal Mode

In normal mode, the measured data, panel-set data, stored data and status bytes can be output.

The measured data is output once every time a data output command [ESC D] is received. Data output in this mode is available only with sampling interval (INTVL) set to 20ms or longer. For details, see Section 7.2.3, (2).

② Data Output in Talk-Only Mode

Measured data and stored data can be output in this mode.

Data is output once every time one cycle of measurement is carried out.

This mode cannot be controlled by a command. Data output in this mode is available only with sampling interval (INTVL) set to 20ms or longer. For details, see Section 7.2.3, (2).

(2) **Data Output Format**

The measured and stored data output format is as follows:

Data No.	,	Header	Data	Terminator

- Data No. : Added when the stored data is output. Values range from −9999 to +9999 (0000 indicates a trigger point).
- Header : $a_1a_2a_3a_4$ (four alphabetical characters) which mean:

  a_1 : N ..... MATH OFF
  S ..... Scaling
  D ..... dB
  H ..... Comparator Hi
  L ..... Comparator Lo
  P ..... Comparator Pass
  O ..... Overrange
  V ..... MATH error
  E ..... Illegal data

  a_2a_3 : DC ..... Direct current
  AC ..... Alternating current
  R2 ..... Two-wire resistance
  R4 ..... Four-wire resistance
  FV ..... Frequency (voltage mode)
  FA ..... Frequency (current mode)

  a_4 : V ..... VOLT
  A ..... AMPERE
  O ..... OHM
  H ..... Hz

- Data : $m_1m_2m_3m_4m_5m_6$ E + m_7m_8*
  A maximum of 5-1/2 digits Exponent

Note: Number of output characters is varied depending on the number of digits displayed.

- Terminator : CRLF

  * m_8: MATH ON

Output Example 1:

Function	Range	Display	Output
DC V	200mV	+199.999mV	NDCV+199.999E-3
	2000mV	+1999.99mV	NDCV+1999.99E-3
	20V	+19.9999V	NDCV+19.9999E-0
	200V	+199.999V	NDCV+199.999E-0
	1000V	+1100.00V	NDCV+1000.00E-0
Ω 2W	200Ω	+199.999Ω	NR2O+199.999E+0
	2000Ω	+1999.99Ω	NR2O+1999.99E+0
	20kΩ	+19.9999kΩ	NR2O+19.9999E+3
	200kΩ	+199.999kΩ	NR2O+199.999E+3
	2000kΩ	+1999.99kΩ	NR2O+1999.99E+3
	20MΩ	+19.9999MΩ	NR2O+19.9999E+6
	200MΩ	+199.999MΩ	NR2O+199.999E+6
DC A	200μA	+1999.99μA	NDCA+1999.99E-6
	20mA	+19.9999mA	NDCA+19.9999E-3
	200mA	+199.999mA	NDCA+199.999E-3
	2000mA	+1999.99mA	NDCA+1999.99E-3
	20A	+19.9999A	NDCA+19.9999E-3

Output Example 2:

		RS-232C output
• Measured data		NDCV+0000.99E+3
• dB	+19.9999dB	DDCV+19.9999E+0
• Comparator	+19.9999dB	HDCV+19.9999E+0
• Overrange	+−oL−mV	ODCV+9999.99E−3
• MATH error	−oL−	VDCV 999999.E+9
• Header OFF		+19.9999E+0
• Stored-data read		NO+0012,NDCV+199.999E+3
• Stored-data read when header is OFF		+19.9999E+0

(3) Status Byte Output Format

The status byte output format that is output with ESC S is as follows:

- **Status Byte**

bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01
0	1	ERR	BUSY	OL	SYN ERR	0	A-D END
Mask value				**8**	**4**	**2**	**1**

- bit 8 : 0 (fixed)
- bit 7 : 1 (fixed)
- bit 6 : Any one of bit 4 and 3 is set when an error occurs.
- bit 5 : Store, recall, program entry or program execution is set while opening an IC memory card file.
- bit 4 : Set when overrange, MATH overrange, MATH error occurs.
- bit 3 : Set when a syntax error occurs.
- bit 2 : 0 (fixed)
- bit 1 : Set when the measurement ends.

7.3 Program Data (Common to GP-IB and RS-232C Communications Interfaces)

Table 7.7 GP-IB and RS-232C Interface Program Data List

Item	Set Data	Program Data	Page
1	Function (FCTN) Setting	Fm1	7 - 28
2	Range (RANGE) Setting	Rm2	7 - 28
3	Sampling Mode Setting	Mm	7 - 29
4	Trigger (TRIG) Setting	E	7 - 29
5	Sampling Interval (INTVL) Setting	SIm	7 - 29
6	Trigger Time Delay Setting	TDm	7 - 30
7	Null (NULL) Setting	NLm	7 - 30
8	Integral Time (INTEG TIME) Setting	ITm	7 - 31
9	Sampling Cycle (N) Setting	NSm	7 - 31
10	Data Storage (STORE) Setting	STm	7 - 32
11	Data Recall (RECALL) Setting	ROm	7 - 32
12	Data Head No. Setting	RDm	7 - 32
13	Panel-Setting Data Save	SS	7 - 33
14	Panel-Setting Data Recall	SL	7 - 33
15	IC Memory Card Initialize	CI	7 - 33
16	Auto Zero Setting	AZm	7 - 34
17	Averaging (AVG) Setting	SMm	7 - 34
18	Averaging Cycle Setting	ATm	7 - 34
19	Computation Setting (MATH)	COm	7 - 35
20	Type-of-Computation Setting	CFm	7 - 35
21	Computation-Parameter (A, B, C, D) Setting	Knm1Em2	7 - 36
22	Computation-Parameter (Hi and Lo) Setting	HIm1Em2 LOm3Em4	7 - 36
23	D-A Output Mode Setting	DAm1m2	7 - 37
24	Header Setting	Hm	7 - 37
25	Terminator Output Setting	DLm	7 - 37
26	Panel-Setting Data Output	OS	7 - 38
27 (RS)	Measured Data Output	ESC D	7 - 38
28 (RS)	Remote Control Setting	ESC R	7 - 38
29 (RS)	Local Control Setting	ESC L	7 - 38
30 (RS)	Status Byte Output	ESC S	7 - 39
31 (RS)	Status Byte Mask Setting	MSm	7 - 40
32 (GP)	SRQ Mask Setting	MSm	7 - 41
33	Panel-Setting Data Initialization	RC	7 - 41
34	Calibration Setting	PCmFC (frequency)	7 - 42
35	AC Range Offset Setting	ACm	7 - 44
36	Writes programs, communication data, and data-set using an IC card.	SV	7 - 44
37	Setting program entry mode	PR	7 - 45
38	Setting program execution mode	RU	7 - 45
39	Status output	OC	7 - 46

No marks : Common to GP-IB and RS-232C communications interface
(RS) : For RS-232C communication interface
(GP) : For GP-IB communication interface

(1) Function (*FCTN*) Setting Fm1
(2) Range (*RANGE*) Setting Rm2

Function

- Sets measurement functions and measuring ranges. The measuring range and functions can be set independently.

Format

- Fm1 / Rm2 <terminator>
  m1 = 1 to 8 (determined by the function)
  m2 = 0, 1 to 9 (determined by the range)
- Functions and ranges are set independently.
  Fm1 <terminator>
  Rm2 <terminator>
- Program data for each function and range are as follows:

Function	Program Data (Fm1)	Range	Program Data (Rm2)
DC V	F1	Auto	R0
		200mV	R3
		2000mV	R4
		20V	R5
		200V	R6
		1000V	R7
AC V	F2	Auto	R0
		200mV	R3
		2000mV	R4
		20V	R5
		200V	R6
		700V	R7
OHM 2W	F3	Auto	R0
		200Ω	R3
		2000Ω	R4
		20kΩ	R5
		200kΩ	R6
		2000kΩ	R7
		20MΩ	R8
		200MΩ	R9

(RS) : For RS-232C communications interface
(GP) : For GP-IB communications interface

Function	Program Data (Fm1)	Range	Program Data (Rm2)
OHM 4W	F4	Auto	R0
		200Ω	R3
		2000Ω	R4
		20kΩ	R5
		200kΩ	R6
		2000kΩ	R7
		20MΩ	R8
		200MΩ	R9
DC A	F5	Auto	R0
		2000μA	R4
		20mA	R5
		200mA	R6
		2000mA	R7
		20A	R8*
AC A	F6	Auto	R0
		2000μA	R4
		20mA	R5
		200mA	R6
		2000mA	R7
		20A	R8*
V-FREQ	F7	Auto	R0
		200Hz	R1
		2000Hz	R2
		20kHz	R3
		200kHz	R4
A-FREQ	F8	Auto	R0
		200Hz	R1
		2000Hz	R2
		20kHz	R3
		200kHz	R4

Note : * Program data in auto mode is not in effect. The 20A range (for DC A and AC A) cannot be changed to AUTO range. Change the 20A range to another range and then set to AUTO range.
• For each program data, if invalid program data is entered, an error occurs.

(3) Sampling Mode (*SAMPLE MODE*) Setting ····· Mm

Function

- Sets sampling mode to AUTO, SINGLE or N RDGS.

Format

- Mm1 <terminator>
  m = 0, 1, 2 (determined by the mode)
- Program data for each sampling mode is as follows:

Mode	Program Data (Mm1)
Auto (AUTO)	M 0
Single (SINGLE)	M 1
N reading (N RDGS)	M 2

(4) Trigger (*TRIG*) Setting ····· E or <GET>*

Function

- Sets a trigger signal for starting the A-D converter.

Format

- E <terminator>
- <GET>* (interface message)
  * <GET> command is used for a GP-IB interface only.

(5) Sampling Interval (*INTVL*) Setting ····· Slm

Function

- Sets sampling intervals in 1ms units.

Format

- Slm <terminator>
  m = 8 to 3,600,000 (ms)
  If more than 3000ms is set, it is rounded off on a second-by-second basis. When 8 to 19ms sampling intervals are set, data and status bytes cannot be output. So store the data and status bytes using the STORE function. Then set sampling intervals of 20ms or more and output the data.

(6) Trigger Time Delay Setting ..... TDm

Function

- After an E or GET command for a trigger signal is entered, the time delay until the A-D converter is started is set in 1ms units.

Format

- TDm <terminator>
  m = 0 to 3,600,000 (ms)
  If more than 3000ms is set, it is rounded off on a second-by-second basis.

(7) Null (*NULL*) Setting ..... NLm

Function

- Sets null function ON / OFF and null values.

Format

- NLm <terminator>
  m = 0, 1, 2

Null Function	Program Data (NLm)
NULL function OFF	NL 0
NULL function ON	NL 1
NULL value set (NULL SET)	NL 2

(8) Integral Time (*INTEG TIME*) Setting ····· ITm

Function

- Sets the integral time for an A-D converter.

Format

- ITm <terminator>
  m = 1, 2, 3, 4 (determined by the integral time)
- Program data for integral times are listed below:

Integral Time	Program Data (ITm)
2.5ms	IT 1
16.66·····ms	IT 2
20ms	IT 3
100ms	IT 4

(9) Sampling Cycle (*N*) Setting ····· NSm

Function

- Sets sampling cycles, used memory capacity, number of pretrigger data when sampling mode is in "N RDGS". Corresponds to setting [NS] for "N SET" key.

Format

- NSm <terminator>
  m = 1 to 1000 (for built-in memory)
  m = 1 to 500 (for 8KB IC memory card)

(10) Data Storage (*STORE*) Setting ····· STm

Function

- Sets whether the measured data is stored in the built-in memory or IC card memory or not.

Format

- STm <terminator>
  m = 0, 1

STORE ON or OFF	Program Data (STm)
STORE OFF	ST 0
STORE ON	ST 1

(11) Data-Recall (*RECALL*) Setting ····· ROm

Function

- Sets whether the stored data (in the built-in memory or IC card memory) is recalled or not.

Format

- ROm <terminator>
  m = 0, 1

STORE ON or OFF	Program Data (ROm)
RECALL OFF	RO 0
RECALL ON	RO 1

(12) Data Head No. Setting ····· RDm

Function

- Sets the head data no. where the stored data (in the built-in memory or IC card memory) is recalled. For example, when the 30th data is recalled as head data, set n = 29. This function corresponds to RD with "N SET".

Format

- RDm <terminator>
  m = ± (0 to 999) (for data stored in built-in memory)
  m = ± (0 to 499) (for data stored in 8KB IC memory card)
  m = ± (0 to 1499) (for data stored in 16KB IC memory card)
  m = ± (0 to 7999) (for data stored in 64KB IC memory card)
  Note : "−" is used where data is recalled by a pretrigger signal.

(13) Panel-Setting Data Save ····· SS

Function

- Saves the panel key-entry data in the IC card memory. Data that can be saved are model name, function, range, sampling mode, sampling intervals, delay time, integral time, null functions, auto zero, averaging functions, D-A mode, averaging cycles, MATH mode, and MATH parameters.
  This function corresponds to [SS] that is set with a "PRGM" key.

Format

- SS <terminator>

(14) Panel-Setting Data Recall ····· SL

Function

- Recalls panel entry data stored in the IC card memory. Data that can be recalled are model name, function, range, sampling mode, sampling intervals, delay time, integral time, null functions, auto zero, averaging functions, D-A mode, averaging cycles, MATH mode and MATH parameters.
- This function corresponds to [SL] that is set with "PRGM" key.

Format

- SL <terminator>

(15) IC Memory Card Initialize ····· CI

Function

- Initializes the IC memory card. The IC memory card is initialized when the card is used for the first time or when data stored on this card are all erased. This function corresponds to [CI] that is set with "PRGM" key.

Format

- CI <terminator>

(16) Auto Zero Setting ····· AZm

Function

- Sets whether or not auto zero is executed. If auto zero is executed, the relation of integral time to sampling interval must be taken into account.

Format

This is equivalent to [AZ] setting in the contents of the "MISC" key.

- AZm <terminator>
  m = 0, 1, or 2

Auto Zero Contents	Program Data (AZm)
Auto zero OFF	AZ 0
Auto zero ON (Execution)	AZ 1
Zero measurement (Note)	AZ 2

Note : In "Zero measurement", Auto zero is executed only once by sending this program if Auto zero is OFF.
If trigger-waiting continues for a long time with high-speed sampling and measurement with auto zero OFF, execution of this program data setting immediately before trigger signal is effective for high accuracy measurement.
This function is not provided in key operation.

(17) Averaging (*AVG*) Setting ····· SMm

Function

- Sets whether or not the averaging is executed. If averaging is executed, the number of execution times must be specified (see the next (18)).

Format

- SMm <terminator>
  m = 0 or 1

Averaging Contents	Program Data (SMm)
Averaging OFF	SM 0
Averaging ON (Execution)	SM 1

(18) Setting the Number of Averaging Times ····· ATm

Function

- Sets the number of averaging times when averaging is executed.
- The setting is equivalent to setting [AT] of "MISC" key contents Format.

Format

- ATm <terminator>
  m = 2 to 100 (times)

(19) Computation Setting (*MATH*) ..... COm

Function

- Sets whether or not computation is carried out against the measured data. For execution of computation, the type of computation and parameters must be set (see (20), (21), and (22)).

Format

- COm<terminator>

Type of Computation	Program Data (COm)
OFF	CO 0
ON	CO 1

(20) Type of Computation Setting..... CFm

Function

- Sets the type of computation. This is equivalent to key operation of selecting the type of computation by "SELECT" key.

Format

- CFm <terminator>
  m = 1, 2, or 3

Type of Computation	Program Data (CFm)
Scaling (SC)	CF 1
Decibel (dB)	CF 2
Comparator (CP)	CF 3

(21) Computation Parameter A, B, C, and D Setting ··· Knm1 Em2

Function

- Sets parameters A, B, C, and D in the scaling expression (X-A) / B and decibel expression $C \times \log_{10}(X / D)$.

Format

- Knm1 Em2 <terminator>

n = A or n = B or n = C or n = D

Thus,

Parameter A : KAm1 Em2
However, this shows m1 × 10^{m2}.

Parameter B : KBm1 Em2
However, this shows m1 × 10^{m2}.

Parameter C : KCm1 Em2
However, this shows m1 × 10^{m2}.

Parameter D : KDm1 Em2
However, this shows m1 × 10^{m2}.

m1 = (−199999 to +199999) ..... (decimal point usable)

m2 = (−9 to +9)

(22) Computation (Comparator) Parameter Hi and Lo Setting ··· HIm1 Em2 LOm3 Em4

Function

- Sets parameters H and L in comparator expressions H ≦ X (High), L ≧ X (Low), L<X<H (Pass). Set the parameters in the form of exponential function ($X \times 10^{y}$).

Format

- Parameter H ; HIm1 Em2 <terminator>
  However, this shows m1 × 10^{m2}.
- Parameter L ; LOm3 Em4 <terminator>
  However, this shows m3 × 10^{m4}.

Settable numbers:

- m1 = (−199999 to +199999)
- m2 = (−9 to +9)
- m3 = (−199999 to +199999)
- m4 = (−9 to +9)

(23) D-A Output Mode Setting ····· DAm1m2

Function

- Sets D-A output signal output mode and display mode.

Format

- DAm1m2 <terminator>
  m1 ; Output mode = 0 or 1
  m2 ; Display mode = 0, 1, 2, or 3
- The output mode and display mode combined program data items are expressed as shown below.

Output Mode	Display Mode	Program Data (DAm1m2)
0	0	DA00
0	1	DA01
0	2	DA02
0	3	DA03
1	0	DA10
1	1	DA11
1	2	DA12
1	3	DA13

(24) Header Setting ····· Hm

Function

- Sets whether or not the header is attached to the output data. For header, see subsection 6.2.4, (2) "Data Output Format".

Format

- Hm <terminator>
  m = 0 or 1

Header Contents	Program Data (Hm)
Without header	H 0
With header	H 1

(25) Terminator Output Setting ····· DLm

Function

- Sets the output data terminator.

Format

- DLm <terminator>
  m = 0, 1, or 2

Terminator Contents	Program Data (DLm)
CR/LF/EOI*	DL 0
LF	DL 1
EOI*	DL 2

* EOI: For a GP-IB interface only.

(26) Panel-Setting Information Output ····· OS

Function

- This causes the current panel-setting information to be output. Information that can be output includes model, function, range, sampling mode, sampling interval, delay time, integral time, NULL function, auto zero, averaging function, D-A mode, number of averaging times, computation mode and parameters.

Format

- OS <terminator>

(27) Measured Data Output ····· ESC D (Exclusive to RS-232C Interface)

Function

- Outputs the measured data and memory data.

Format

- ESC D <terminator>
  * ESC = 1BH

(28) Remote Control Setting ····· ESC R (Exclusive to RS-232C Interface)

Function

- Sets the multimeter to the status where remote control by RS-232C communication can be performed. If going into remote control status, operation by panel key switches cannot be done.

Format

- ESC R < terminator>
  *ESC = 1BH

(29) Local Control Setting ····· ESC L (Exclusive to RS-232C Interface)

Function

- Sets the multimeter to local control status from remote control status. If the local control status is reached, operation with panel key switches becomes possible.

Format

- ESC L <terminator>
  * ESC = 1BH

(30) Status Byte Output ····· ESC S (Exclusive to RS-232C Interface)

Function

- Status byte is output from the multimeter.
- Status byte

bit 8	7	6	5	4	3	2	1
DIO 8	DIO 7	DIO 6	DIO 5	DIO 4	DIO 3	DIO 2	DIO 1
0	SRQ	ERR	BUSY	OL	SYN ERR	0	A/D END

- bit 8 ; 0 fixed
- bit 7 ; 1 fixed
- bit 6 ; Set when an error occurs. (Either bit 4 or bit 3 is or both are 1)
- bit 5 ; Set while IC memory card file is opened (during storing or recalling).
- bit 4 ; Set at overrange, over computation, and computation error.
- bit 3 ; Set in syntax error.
- bit 2 ; 0 fixed
- bit 1 ; Set at the measurement end.

Format

- ESC S <terminator>

(31) Status Byte Mask Setting ··· MSm (Exclusive to RS-232C Interface)

Function

- Performs mask setting of status bytes DI01 to DI04 occurrence cause. Set causes (masked values) become valid.

Format

- MSm <terminator>
  m = 1 to 13
  * Setting is performed with a pattern of combined three causes.
- Three causes and program data are as shown below. If two or more combinations are to be set, set the value which is obtained by adding each mask values as m.

Occurrence Cause	Mask Value	Program Data (MSm)
A-D conversion end	1	MS 1
Syntax error	4	MS 4
Overrange	8	MS 8

- Status byte

DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
0	1	ERROR	BUSY	OVER-RANGE	SYNTAX ERROR	0	A-D Conver-sion end
Mask Value				8	4	2	1

(32) SRQ Mask Setting ····· MSm (Exclusive to GP-IB Interface)

Function

- Sets the occurrence cause for status byte interruption. Set cause (mask value) becomes valid to cause interruption.

Format

- MSm <terminator>
  m = 1 to 15
  * Setting is performed with a combination of four causes.
- Four causes and program data are as shown below. If two or more combinations are to be set, set the value which is obtained by adding each mask value as m.

Occurrence Cause	Mask Value	Program Data (MSm)
A-D conversion end	1	MS 1
Panel "SRQ" key ON	2	MS 2
Syntax error	4	MS 4
Overrange	8	MS 8

- Status byte

	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
	0	SERVICE REQUEST	ERROR	BUSY	OVER-RANGE	SYNTAX ERROR	SRQ Key ON	A-D Conver-sion end
Mask Value					8	4	2	1

(33) Panel-Setting Information Initialization ····· RC

Function

- Initializes the panel-setting information forcibly regardless of the current setting contents (except for the interface function setting).

Format

- RC <terminator>

Device Clear "RC" make all of setting parameters to initial values, and communication functions stop for a while.

It is recommended not to carry out this function except it really needs necessary.

(34) Calibration Setting ····· PCm
FC (Frequency Only)

Function

- If the multimeter is to be calibrated by GP-IB communication, set calibration values for each function and range. This is valid when the selector switch on the rear panel is placed in "CAL" position. If calibration is to be performed for AC values, AC offset setting in the next item (35) must first be executed. When calibration is normally completed, the current input value is measured and displayed. For details of calibration, see Chapter 8. "MAINTENANCE AND CALIBRATION".

Format

- PCm <terminator>
  FC <terminator> ..... Frequency only
  m = 0, and calibration values
- Calibration values and program data for each function and range are as listed below. For AC function, no zero correction is provided.

Function	Range	Calibration Value (m)	Program Data (PCm)
(DC V)	200mV	0mV	PC 0
		190mV	PC 190000
	2000mV	0mv	PC 0
		1900mV	PC 190000
	20V	0V	PC 0
		19V	PC 190000
	200V	190V	PC 190000
	1000V	1000V	PC 100000
(AC V)	200mV	190mV	PC 190000
	2000mV	1900mV	PC 190000
	20V	19V	PC 190000
	200V	190V	PC 190000
	700V	690V	PC 69000
OHM 4W / OHM 2W for Model 7551	200Ω	0Ω	PC 0
		100Ω	PC 100000
	2000Ω	0Ω	PC 0
		1000Ω	PC 100000
	20kΩ	0kΩ	PC 0
		10kΩ	PC 100000
	200kΩ	100kΩ	PC 100000
	2000kΩ	1000kΩ	PC 100000
	20MΩ	10MΩ	PC 100000
	200MΩ	100MΩ	PC 100000

Function	Range	Range	Program data (PCm)
DC A	2000μA	1900μA	PC 190000
	20mA	19mA	PC 190000
	200mA	190mA	PC 190000
	2000mA	1900mA	PC 190000
	20A	19A	PC 190000
AC A	2000μA	1900μA	PC 190000
	20mA	19mA	PC 190000
	200mA	190mA	PC 190000
	2000mA	1900mA	PC 190000
FREQ (AC V)	2000 Hz (AC V 2000mV)	1.9kHz(AC V)	FC

Note :

- Set the calibration values actually generated from the calibration equipment irrespective of the values in the table (though, for PC 0, the generated value is valid at 0 only). In this case, set a value larger than the value shown in the table to ensure accuracy. Numerical value of program data in this case should be set in digits equal to the maximum display digits in that range.

  Ex.1 • Calibration equipment generated voltage 1903mV
  • Range of DMM to be calibrated 2000mV
  Then program data is: PC 190300

  Since the max. display in a 2000 mV range is 199999 (5-1/2 digits), set program data also to 5-1/2 digits.

- If the calibration value exceeds the maximum value provided for that function range, an error occurs (Error No.21).

(35) AC Range-Offset Setting ····· ACm

(AC/DC Converter Offset Compensation)

Function

- Sets offset calibration for AC ranges. For AC function, the offset calibration must be performed prior to calibration for each range according to the preceding item (34) (though unnecessary for single-range calibration only). Carry out offset compensation at two points of 1/10 full scale and full scale in the AC V 2000mV range.

Format

- ACm<terminator>
  m = 0 or 1

Offset Contents	Program Data (ACm)
1/10 full-scale value (0.19V input)	AC 0
Full-scale value offset (1.9V input)	AC 1

Setting Example (Program)

① PRINT #1, "F2R4 ····· AC V, 2000mV range setting (fixed.)
② PRINT #1, "AC 0" ····· 1/10 full-scale value offset setting
③ PRINT #1, "AC 1" ····· Full-scale value offset

(36) Writing Programs and Communication Data ····· SV

Function

- Writes programs, communication data, and panel-set data to "EEPROM" using an IC memory card.

Format

- SV <terminator>

Caution: Do not turn OFF the power immediately after sending the SV command.
Otherwise, the EEPROM set data may be lost.

(37) Setting Program Entry Mode ····· PR

Function

- Sets the program entry mode.

Format

- PRm <terminator>
  m = 0 or 1

Terminator	Program data (PRm)
Program entry mode ON	PR1
Program entry mode OFF	PR0

Setting Example (Program)

① PRINT @ 1: "PR1" ..... Program entry mode ON.
② PRINT @ 1: "F1R4NL1" ..... Sets program step 1.
③ PRINT @ 1: "E" ..... Program step 1 is entered.
⋮ Repeat ② and ③ above.
④ PRINT @ 1: "PR0" ..... Program entry mode OFF.

(38) Setting Program Execution Mode ····· RU

Function

- Enters the program execution mode.

Format

- RUm <terminator>
  m = 0 or 1

Terminator	Program data (RUm)
Program execution mode ON	RU1
Program execution mode OFF	RU0

Setting Example (Program)

① PRINT @ 1: "RU1" ..... Program execution ON.
② PRINT @ 1: "E" ..... Execute program step 1.
③ PRINT @ 1: "RU0" ..... Program execution OFF.

Note: An "RU" command and "E" command should be sent separately. While the program is running, if a command other than "E" command is sent, the program execution is terminated. If an RU1 command is sent, the program returns to the program step 1.

(39) Status Output ····· OC

Function

- Sends one-byte data with an OC command via a GP-IB or RS-232C interface.

Format

- OC <terminator>

7	6	5	4	3	2	1	0
0	1	0	0	CARD	F/R	CAL	0

bit 7 to 4, 0 : fixed
bit 3 : IC memory card
bit 2 : Front/Rear (1 ··· Rear)
bit 1 : CAL/MEAS switch (1 ··· CAL)

8. MAINTENANCE AND CALIBRATION

8.1 Maintenance

8.1.1 Storage

When storing the instrument, avoid areas which are :

- Very humid.
- Subject to direct sunlight.
- Near high temperature heat sources.
- Subject to strong vibration.
- Very dusty, or contain corrosive gases.

> If you have any problem with the instrument, contact your nearest YOKOGAWA service center or representative.

8.1.2 Fuse Replacement

■ Front Fuse

■ Rear Fuse

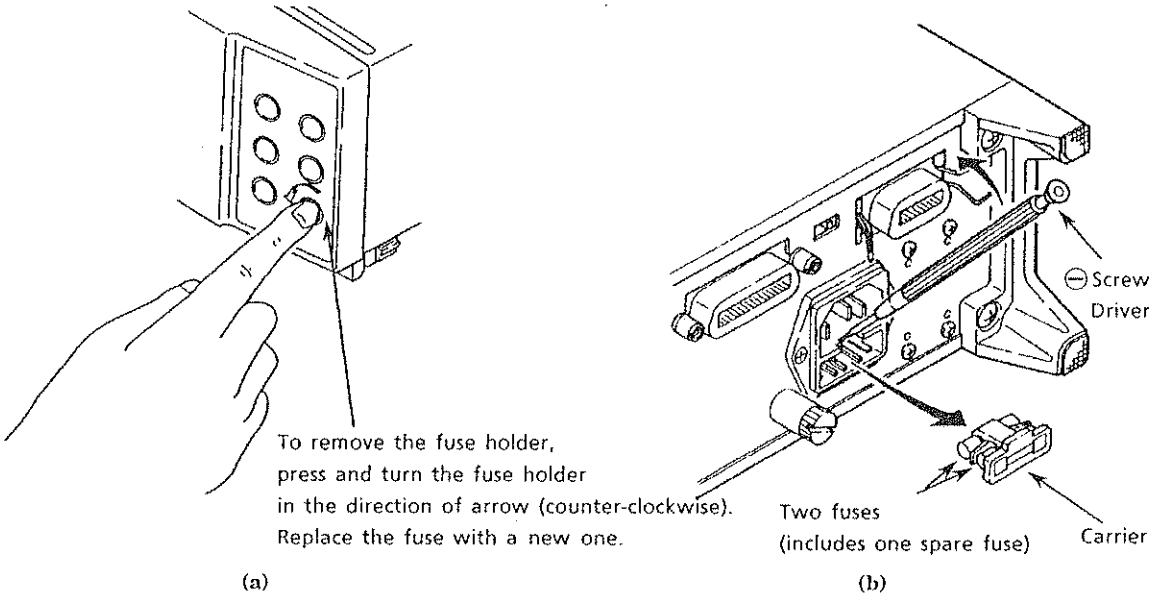


Figure 8.1 Fuse Replacement

Before replacing the fuse, remove the power cord from the power outlet. Remove the carrier with a blade (standard) ⊖ screw driver (see Figure 8.1 (b)). One spare fuse can be installed in the carrier.

8.2 Calibration

For high-accuracy measurement and stable operation, the multimeter should be calibrated every three months.

8.2.1 Using the Standard Equipment

Table 8.1

Measure-ment	Standard Equipment	Range	Accuracy	Remarks
DC V	Standard DC voltage generator	190mV to 1.9V	±10ppm	• 4708 (DATRON) • 2781 (YOKOGAWA or equivalent equipment)
		19V, 1000V	±20ppm	
AC V	Standard AC voltage generator	190mVrms to 700Vrms	±0.02%	
OHM	Standard resistors	100 ohms to 1000 kiloohms	±20ppm	
		10 Megohms	0.02%	
		100 Megohm	0.02%	
DC A	Standard DC current generator	1.9mA to 1.9A	±100ppm	• 4708 (DATRON) • 5220A* (FLUKE) or equivalent equipment * For 20A calibration
		19A	±200ppm	
AC A	Standard AC current generator	1.9mA to 1.9A	±0.1%	
		19A	±0.2%	

8.2.2 Ambient Conditions

① **Temperature** : 23 ± 1°C
② **Humidity** : 45 to 75% relative humidity
③ **Power Requirements** : Specified voltage ± 5%
④ **Line Frequency** : Specified frequency ± 1Hz
⑤ **Vibration** : Relatively free of vibration.
⑥ **Electric Field and Magnetic Field** : Relatively free of such fields.
⑦ **Other Conditions** : Relatively free of corrosive gases, vapor, dust, etc.
⑧ **Warming Up** : Allow at least 2 hours for standard equipment, and 1 hour for other equipment, before calibrating.

8.2.3 Precautions

① Ground the case ground ⏚ during calibration.

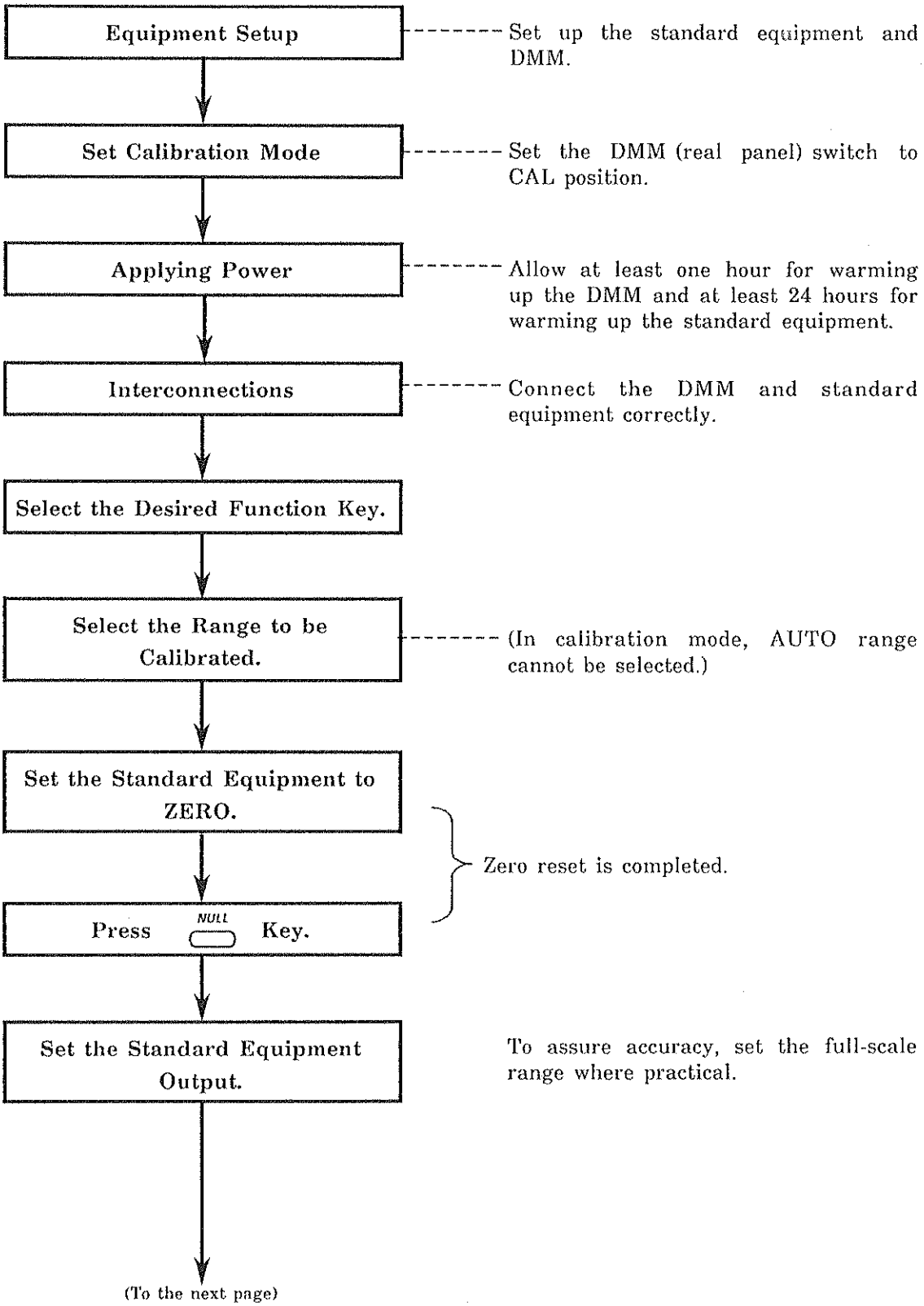
8.2.4 Equipment Setup During Calibration

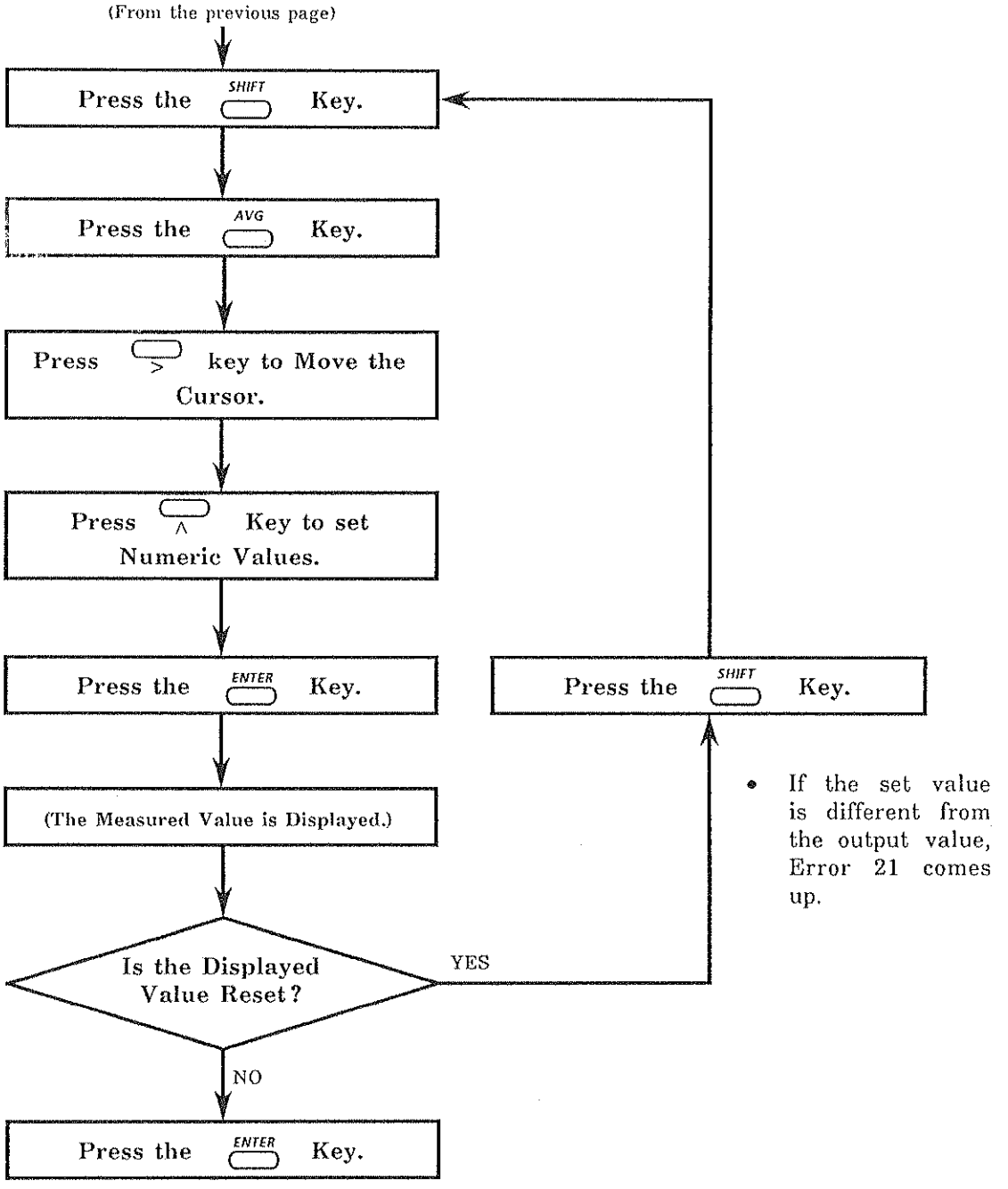
Table 8.2

FCTN		AUTO ZERO	INTEG TIME	INPUT	Remarks
DC V		ON	100ms	Front	
AC V		ON	100ms	Front	
OHM	2W	ON	100ms	Front	
	4W	ON	100ms	Front	For Model 7552 only
DC A		ON	100ms	Front	
AC A		ON	100ms	Front	

8.2.5 Calibration Procedures

(1) For DC Voltage, Current, and OHM (Two- or Four-Wire) Measurements



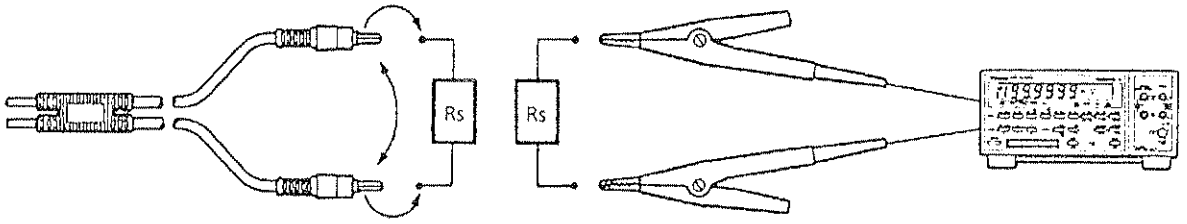


Notes

1 : Check that the output value is not beyond the specified range.

2 : During calibration, if the NULL key is pressed out of null position, the calibrated full-scale value is not displayed correctly. Change the range with the RANGE key and return it to its original range. This action allows the calibrated full-scale value to be displayed correctly.

3 : For the calibration of two-wire resistance measurements, short the leadwires and adjust a zero point to set the correct output value.



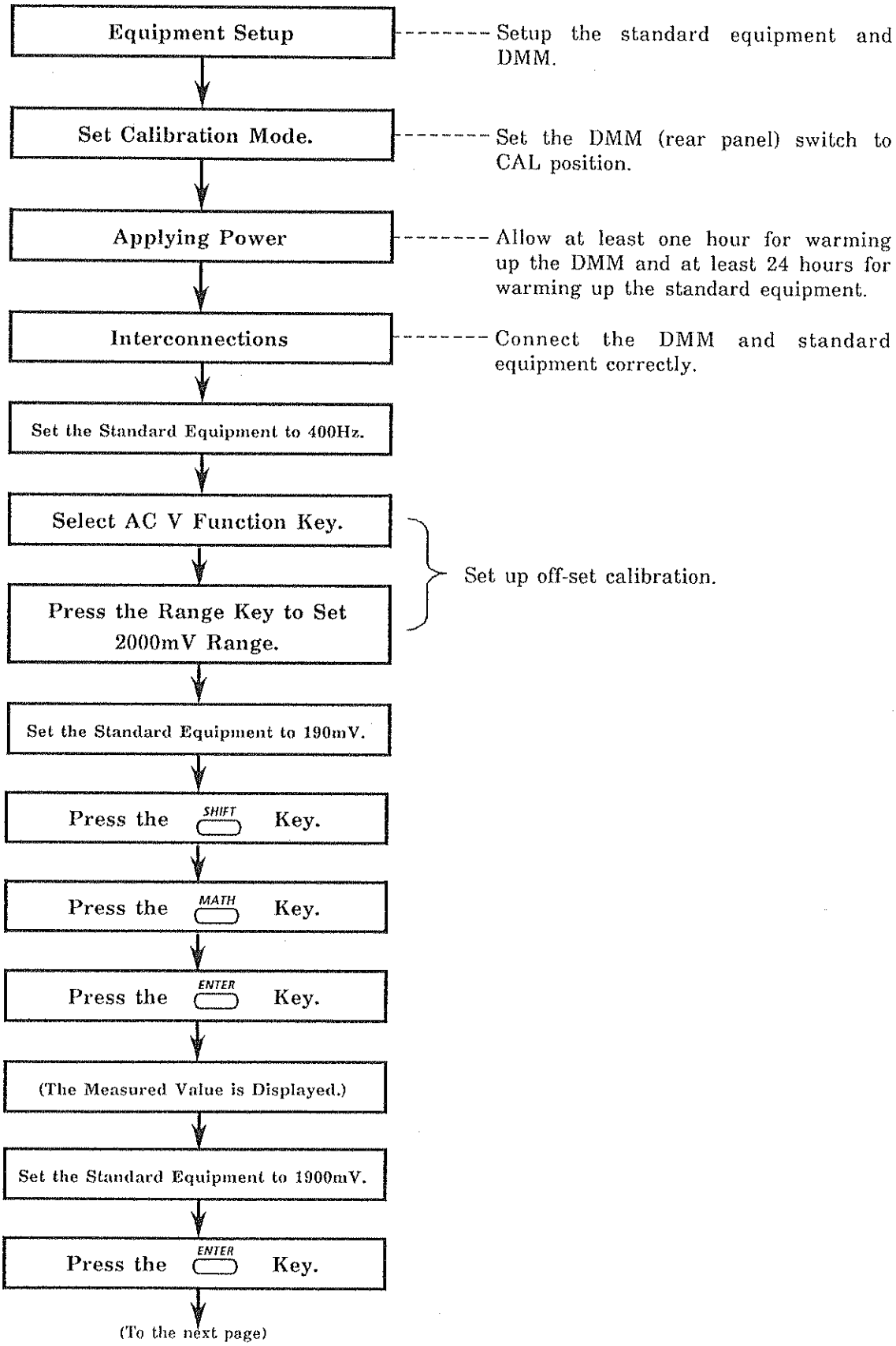
Short-circuit both terminals for NULL adjustment

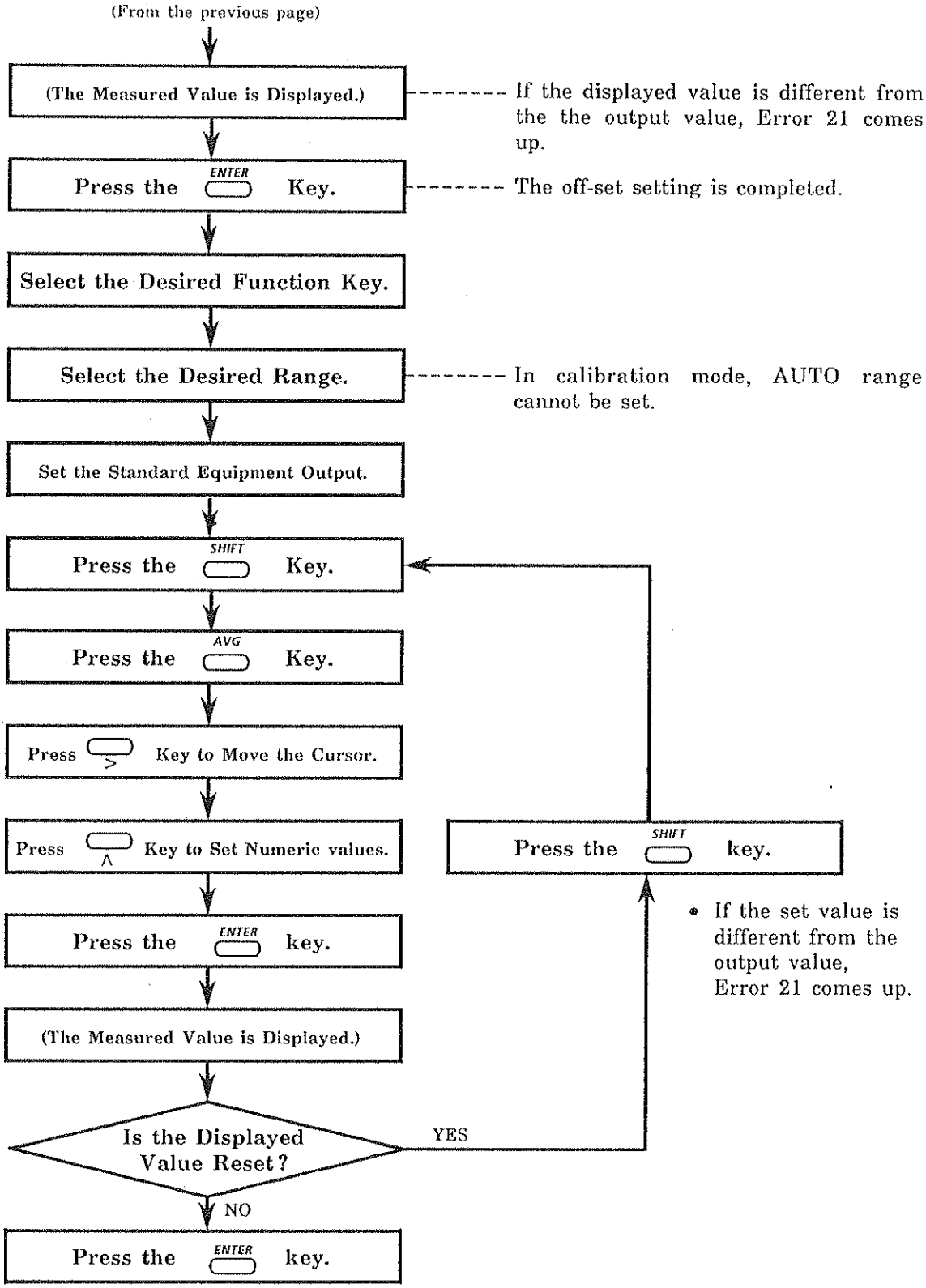
Connect terminals across RS for calibration

Lead wires must be calibrated another DMM

Figure 8.2

(2) For AC Voltage and Current Measurements





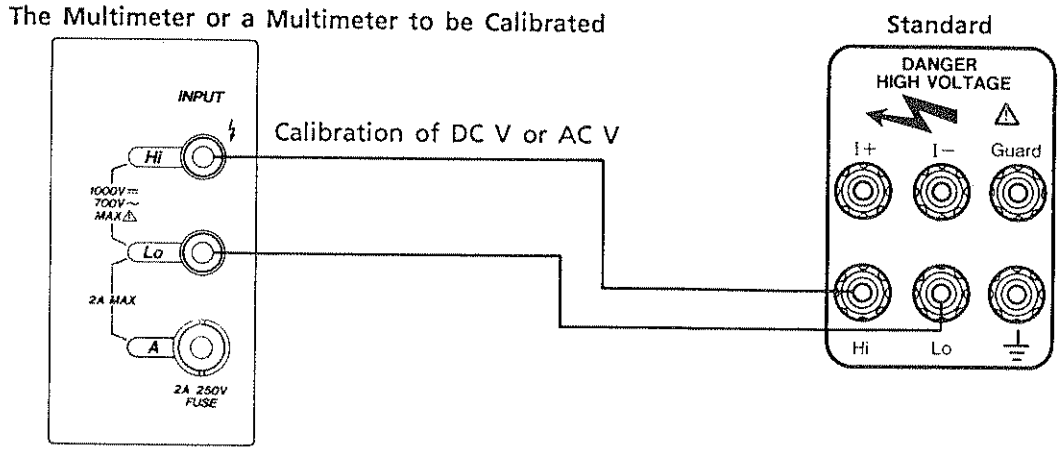
Notes

1 : Check that the output value is not beyond the specified range.

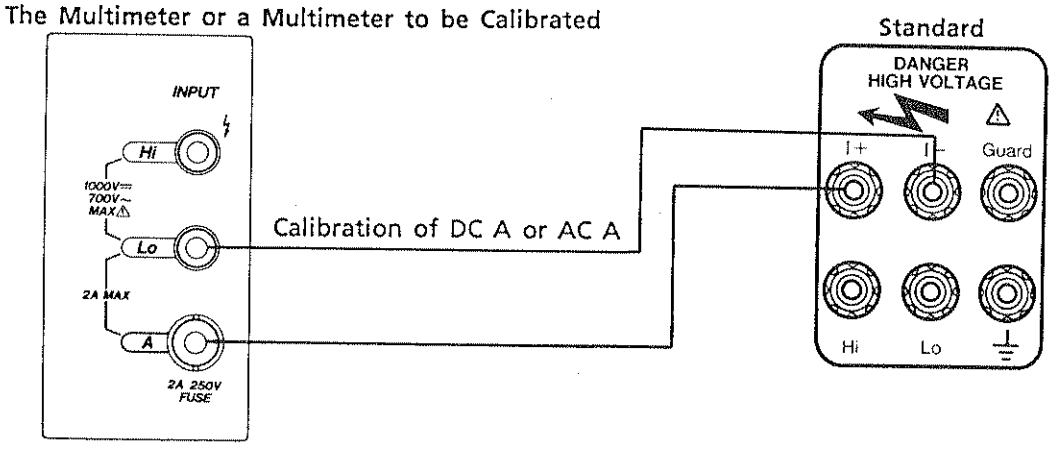
2 : During calibration, if the NULL key is pressed out of null position, the calibrated full-scale value is not displayed correctly. Change the range with the RANGE key and return it to its original range. This action allows the calibrated full-scale value to be displayed correctly.

3 : For the calibration of two-wire resistance measurements, short the leadwires and adjust a zero point to set the correct output value.

(1) For DC V and AC V



(2) For DC A and AC A



(3) For 2WΩ

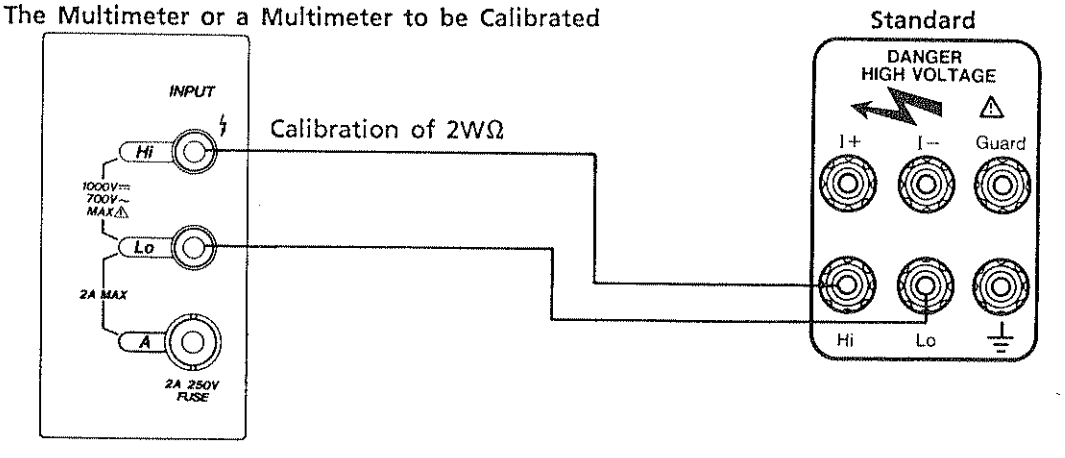
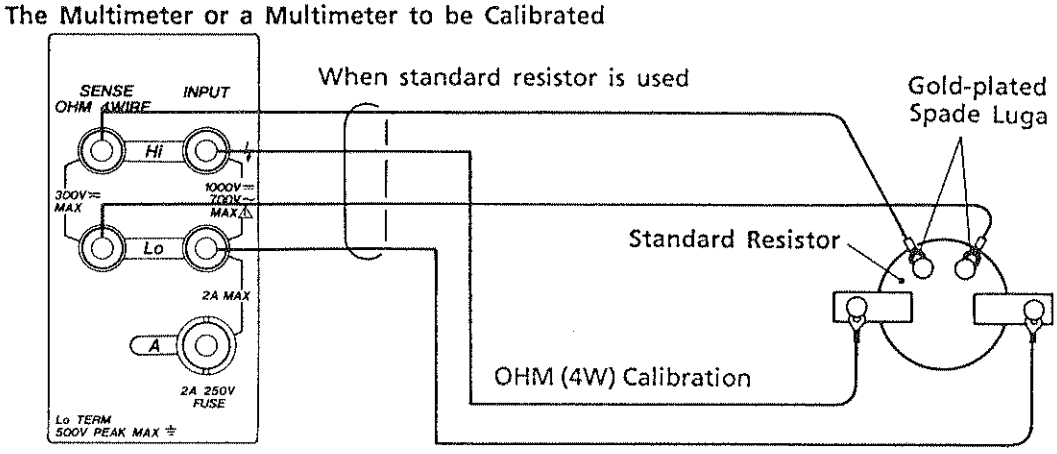
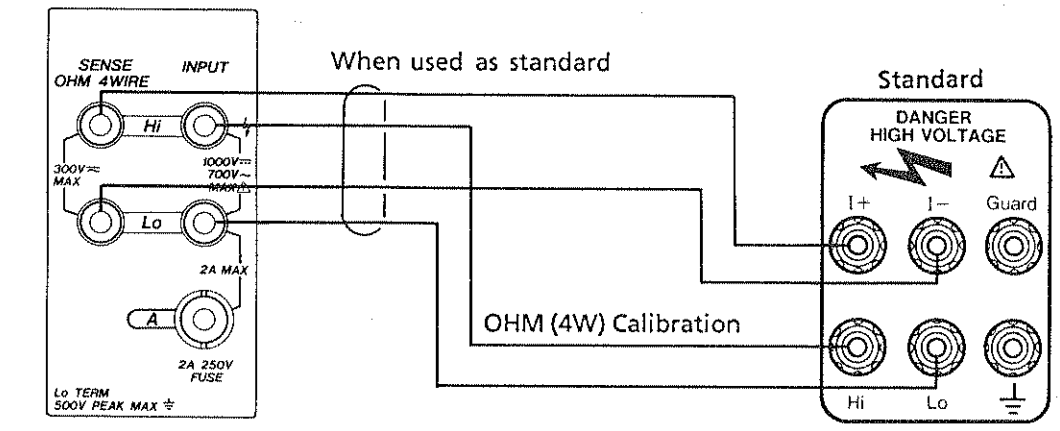


Figure 8.2 Connection of Multimeter to Standard when Calibrating the Multimeter (1/2)

(4) For 4WΩ ①



(5) For 4WΩ ②



(6) For DC A / AC A 20A

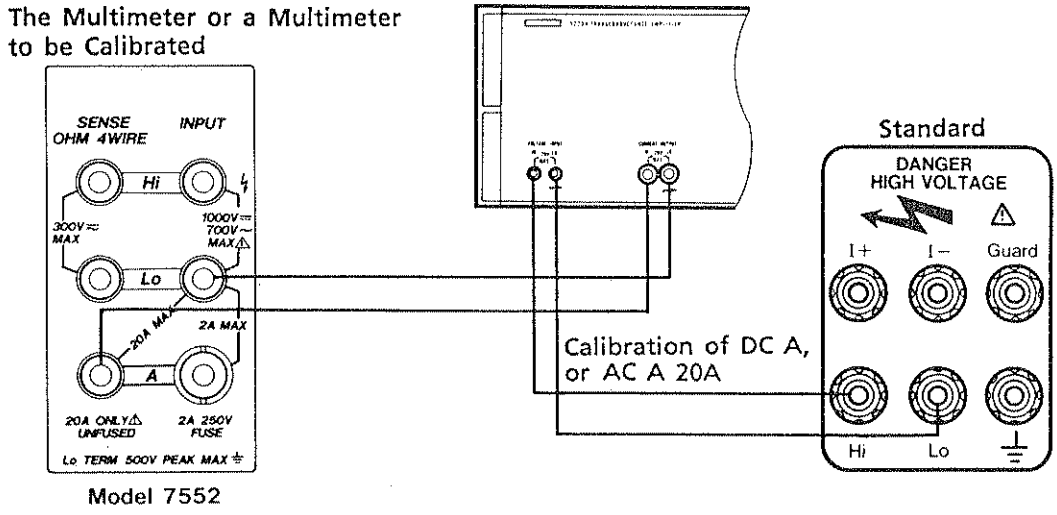


Figure 8.2 Connection of Multimeter to Standard when Calibrating the Multimeter (2 / 2)

9. SPECIFICATIONS

9.1 DC Voltage (DC V)

- Range :

Range	Integral Time 100 / 20 / 16.7ms*		Integral Time 2.5ms		Input Resistance	Max. Input
	Max. Indication	Resolution	Max. Indication	Resolution		
200mV	199.999	1μV	199.99	10μV	>1GΩ	± 1000 V peak(for 10 seconds) ± 600 V peak continuous (Between Hi and Lo) ± 1000 V peak continous
2000mV	1999.99	10μV	1999.9	100μV		
20V	19.9999	100μV	19.999	1mV	10MΩ ±1%	
200V	199.999	1mV	199.99	10mV		
1000V	1100.00	10mV	1100.0	100mV		

- Accuracy (Integral Time 100 ms) : ± (% of Reading + Digits)

Range	24h, 23±1°C	90 Days, 23 ± 5°C	One Year, 23±5°C	Temperature Coefficient (5 to 18, 28 to 40°C)
200mV	0.005 + 6 (4)	0.008 + 8 (4)	0.011 + 8 (4)	0.001 + 1 (.2)
2000mV	0.0035 + 3 (3)	0.005 + 3 (3)	0.008 + 3 (3)	0.0007 + .5 (.1)
20V	0.007 + 4 (4)	0.012 + 4 (4)	0.02 + 4 (4)	0.0012 + .5 (.1)
200V	0.006 + 3 (3)	0.011 + 3 (3)	0.019 + 3 (3)	0.0012 + .5 (.1)
1000V	0.008 + 3 (3)	0.013 + 3 (3)	0.021 + 3 (3)	0.0015 + .5 (.1)

- Accuracy for 24h, 23 ± 1°C is the value for calibration standard.
- Using Auto Zero ON and Null function
- When the integral time is 20 / 16.7ms, add 2 to the digit value at 100ms.
- The value in ( ) shows the values of digits when the integral time is 2.5ms digits are displayed.
- When Auto Zero is OFF, add the temperature coefficient ± (0.003% of range + 40 μV) / °C (at 5 to 40°C).
- Common Mode Voltage-Rejection Ratio : 120 dB or more
  : Integral time ; 100, 20 / 16.7ms,
  Rs = 1kΩ , 50 / 60Hz ± 0.1%
- Normal Mode Voltage-Rejection Ratio : 60dB or more
  : Integral time ; 100, 20 / 16.7ms, 50 / 60Hz
  ±0.1%
- A Maximum Applied Voltage : 500V peak between Lo and case

* : Integral time of 16.7ms implies 16.666 ..... ms.

9.2 DC Current (DC A)

• Range :

Range	Integral Time 100/20/16.7ms*		Integral Time 2.5ms		Input Resistance
	Max. Indication	Resolution	Max. Indication	Resolution	
2mA	1.99999	10nA	1.9999	100nA	<110Ω
20mA	19.9999	100nA	19.999	1μA	<11Ω
200mA	199.999	1μA	199.99	10μA	<1.2Ω
2000mA	1999.99	10μA	1999.9	100μA	<0.3Ω
20A (Model 7552 Only)	19.9999	100μA	19.999	1mA	<0.01Ω

• Accuracy (Integral Time 100ms) : ± (% of Reading + Digits)

Range	One Year, 23 ± 5°C
2mA	0.07 + 100
20mA	0.07 + 20
200mA	0.07 + 20
2000mA	0.15 + 40
20A (Model 7552 Only)	0.4 + 200

• Auto Zero : ON

• When the integral time is 20/16.7ms, add 20 to the value of digits for 100ms.

• Temperature Coefficient : ± (1/10 of measuring accuracy) / °C

• Permissible Current : Model 7551 ; 2A (2A fuse incorporated)

: Model 7552 ; 2 to 2000mA range ··· 2A (2A fuse incorporated)

20A range ····· 20A (no fuse)

* : Integral time of 16.7ms implies 16.666 ... ms.

9.3 Resistance Measurement (OHM)

- Range :

Range	Integral Time 100 / 20 / 16.7ms*		Integral Time 2.5ms		Measuring Current
	Max. Indication	Resolution	Max. Indication	Resolution	
200Ω	199.999	1mΩ	199.99	10mΩ	1mA
2000Ω	1999.99	10mΩ	1999.9	100mΩ	1mA
20kΩ	19.9999	100mΩ	19.999	1Ω	100μA
200kΩ	199.999	1Ω	199.99	10Ω	10μA
2000kΩ	1999.99	10Ω	1999.9	100Ω	1μA
20MΩ	19.9999	100Ω	19.999	1kΩ	100nA
200MΩ	199.999	1kΩ	199.99	10kΩ	50nA

- Accuracy (4 Wire System, Integral Time 100ms) : ± (% of Reading + Digits)

Range	24h, 23±1°C	90 Days, 23±5°C	One Year, 23±5°C	Temperature Coefficient (5 to 18, 28 to 40 °C)
200Ω	0.008 + 6 (4)	0.014 + 7 (4)	0.018 + 7 (4)	0.002 + 1 (1)
2000Ω	0.007 + 4 (3)	0.011 + 6 (3)	0.015 + 6 (3)	0.0015 + 1 (.2)
20kΩ	0.007 + 3 (3)	0.011 + 5 (3)	0.015 + 5 (3)	0.0015 + 1 (.2)
200kΩ	0.008 + 3 (3)	0.012 + 5 (3)	0.016 + 5 (3)	0.0015 + 1 (.2)
2000kΩ	0.03 + 15 (20)	0.05 + 20 (30)	0.05 + 20 (30)	0.005 + 1 (.2)
20MΩ	0.25 + 30	0.25 + 30	0.25 + 30	0.02 + 3
200MΩ	2 + 200	2 + 200	2 + 200	0.05 + 5

- Accuracy for 24h, 23 ± 1°C is the value for calibration standard.
- Model 7551 is supplied only with 2-wire type. Add 4mΩ / °C for 2-wire type.
- Using Auto Zero ON and Null function
- When the integral time is 20 / 16.7ms, add 2 to the digit value at 100ms.
- The value in ( ) shows the values of digits when the integral time is 2.5ms.
- Accuracy for ranges 20MΩ and 200MΩ is not specified if the integral time is 2.5ms.
- When Auto Zero is OFF, the temperature coefficient is ± (0.015% of of range) / °C in 200Ω range. In other ranges, add ± (0.005% of range) / °C (at 5 to 40°C)
- The effect of leadwires is not included.
- **Open terminal Voltage** : Max. 10V (Max. 12.5V in 200MΩ range)
- **Max. Input** : ± 300V peak or 300V RMS (between Hi and Lo)
- **Response Time** : 2000kΩ / 20MΩ range ; 0.4 second or less
  200MΩ range ; 5 seconds or less

* : Integral time 16.7ms implies 16.666 ... ms.

9.4 AC Voltage (AC V)

- **Range :**

Range	Integral Time 100/20/16.7ms*		Integral Time 2.5ms		Input Resistance	Max. Input
	Max. Indication	Resolution	Max. Indication	Resolution		
200mV	199.999	1μV	199.99	10μV	1 MΩ ± 2% Approx. 150 pF	700 V RMS or ± 1000 V peak (Between Hi and Lo)
2000mV	1999.99	10μV	1999.9	100μV		
20V	19.9999	100μV	19.999	1mV		
200V	199.999	1mV	199.99	10mV		
700V	700.00	10mV	700.0	100mV		

- **Accuracy (Integral Time 100ms) : ± (% of Reading + Digits), 90 Days, 23 ± 5°C**

Range	20Hz to 30Hz	30Hz to 45Hz	45Hz to 10kHz	10kHz to 20kHz	20kHz to 50kHz	50kHz to 100kHz
200mV	0.9 + 200	0.5 + 200	0.4 + 200	0.5 + 300	0.8 + 500	2 + 500
2000mV	0.8 + 100	0.4 + 100	0.2 + 100	0.4 + 200	0.6 + 500	2 + 500
20V	0.8 + 100	0.4 + 100	0.2 + 100	0.4 + 200	0.6 + 500	2 + 500
200V	1.0 + 100	0.4 + 100	0.3 + 100	0.4 + 200	0.8 + 500	3 + 500
600V	1.0 + 100	0.4 + 100	0.4 + 100	0.6 + 300		

- **Auto Zero** : ON
- When the integral time is 20/16.7ms, add 20 to the digit value at 100ms.
- **AC Coupling** : Average rectifying method (RMS calibrated) (Model 7551)
  True RMS value method (Model 7552)
- Input is defined as 5 to 100% of range, sinusoidal
- **Response Time** : 400ms or less (Until ± 0.2% of the final value is reached)
- **Crest Factor** : 3 (Model 7552 only)
  (at full scale ; 2 at full scale for 700V range)
- **Temperature Coefficient** : ± (1/10 of the measuring accuracy)/°C

* : Integral time of 16.7ms implies 16.666 ... ms.

9.5 AC Current (AC A)

- Range

Range	Integral Time 100 / 20 / 16.7ms*		Integral Time 2.5ms		Input Resistance (50 Hz)
	Max. Indication	Resolution	Max. Indication	Resolution	
2mA	1.99999	10nA	1.9999	100nA	<110Ω
20mA	19.9999	100nA	19.999	1μA	<11Ω
200mA	199.999	1μA	199.99	10μA	<1.2Ω
2000mA	1999.99	10μA	1999.9	100μA	<0.3Ω
20A (Model 7552 Only)	19.9999	100μA	19.999	1mA	<0.01Ω

- Accuracy (Integral Time 100ms) : ± (% of Reading + Digits), One Year, 23 ± 5°C

Range	20Hz to 30Hz	30Hz to 45Hz	45Hz to 2kHz	2kHz to 5kHz
2mA	1.5 + 350	0.8 + 250	0.5 + 300	0.8 + 300
20mA	1.3 + 300	0.8 + 200	0.5 + 200	0.8 + 200
200mA	1.3 + 300	0.8 + 200	0.5 + 200	0.8 + 200
2000mA	1.5 + 300	1.5 + 200	1.0 + 200	1.5 + 200
20A (Model 7552 only)	2 + 300	2 + 200	1.2 + 300	———

- Auto Zero : ON
- When the integral time is 20 / 16.7ms, add 20 to the digits value at 100ms.
- AC Coupling : Average rectifying method (RMS calibrated) (Model 7551)
  True RMS value method (Model 7552)
- Input is defined as 5 to 100% of ranges, sinusoidal
- Response Time : 400ms or less (Until ± 0.2% of the final value is reached)
- Crest Factor : 3 (For Model 7552 only)
- Temperature Coefficient : ± (1 / 10 of the measuring accuracy) / °C
- Permissible Current : Model 7551 ; 2A (2A fuse incorporated)
  Model 7552 ; 2 to 2000mA range ... 2A (2A fuse incorporated)
  20A range ..... 20 A (no fuse)

* : Integral time of 16.7ms implies 16.666 ... ms.

9.6 Frequency (FREQ) (For Model 7552 only)

- Range

Range	Frequency Range and Indication
200 Hz	20.000 to 199.999 Hz
2000 Hz	180.00 to 1999.99 Hz
20 kHz	1.8000 to 19.9999 kHz
200 kHz	18.000 to 199.999 kHz

- **Measuring Method** : Reciprocal
- **Reference Frequency Accuracy** : ±100ppm (5 to 40°C)
- **Input** : According to AC V or AC A range selected immediately before use
- **Input Sensitivity** : 5% p-p of V/A RANGE

9.7 Communication Functions

- **GP-IB Interface**

  Electrical and mechanical specifications : Conforming to IEEE Std. 488-1978
  Functional specifications : SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0
  Address mode, address, and header ON/OFF settable

- **RS-232C Interface**

  Transmission system : Start stop method
  Transmission rate : 75, 150, 300, 600, 1200, 2400, 4800, and 9600 bit/s
  Handshaking mode, Baud rate, and the number of bits are settable.

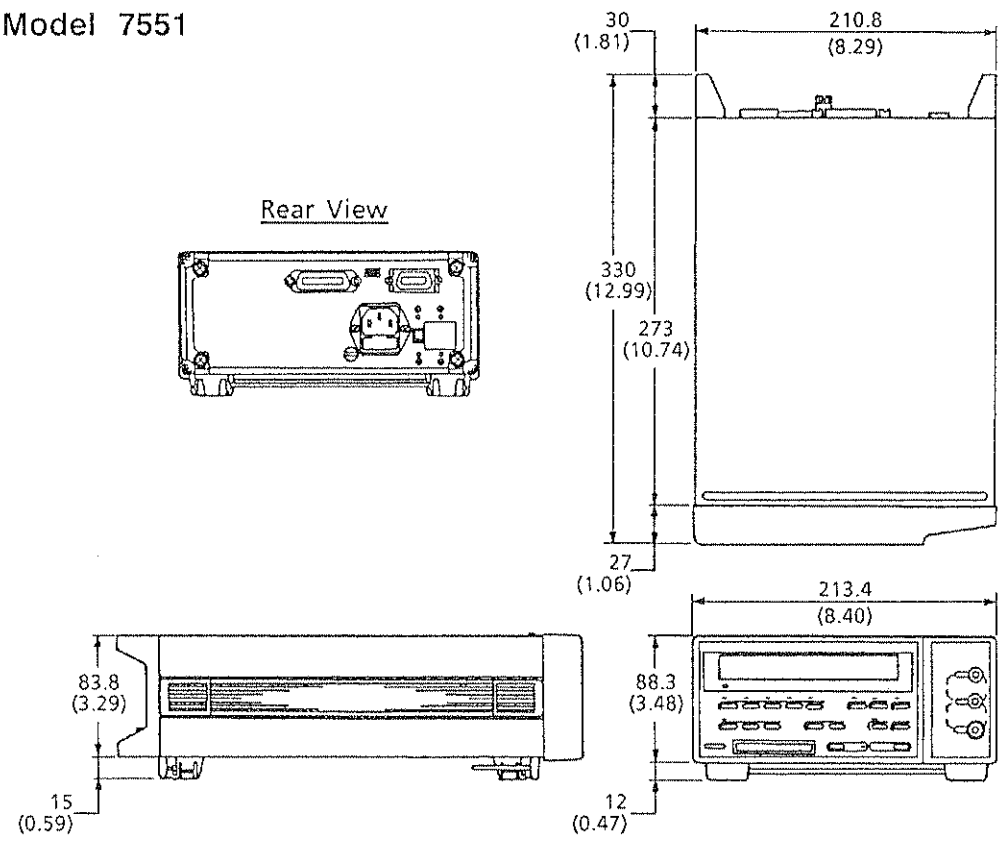
9.8 General and Common Specifications

Operating Method : Feedback pulse-width-modulation
Sampling Mode : Auto mode / single mode / N reading mode
Sampling Period : 8ms to 60min. (Minimum unit 1ms)
Maximum Indication : 99999
Overrange Display : " −OL− " is displayed.
Data Memory : 1000 data items incorporated (Store / Recall mode ON / OFF in measuring are settable).
Range Selection : AUTO, MANUAL, Remote control and program settable
Working Temperature and Humidity Range : 5 to 40°C, 20 to 80% RH
Warmup Time : About 60 minutes (until all the specifications are met)
Power Supply : 100/115V AC ± 10%, 50/60Hz, 100/115V selection is performed with a switch. (200/230V must be specified if necessary. Selectable.)
Power Consumption : 20VA max.
External Dimensions : Approx. 88 (H) × 213 (W) × 300 (D) mm
Weight : Approx.3kg
Accessories : Power cord ..... one, Measuring lead ..... 1.
Fuse 0.2A/100V (Time lag type), ... 1, 2A (FAST) 1,
Remote connector ..... 1, Instruction Manual ..... 1 copy
Analog Output (D-A Converter) : Optional specifications

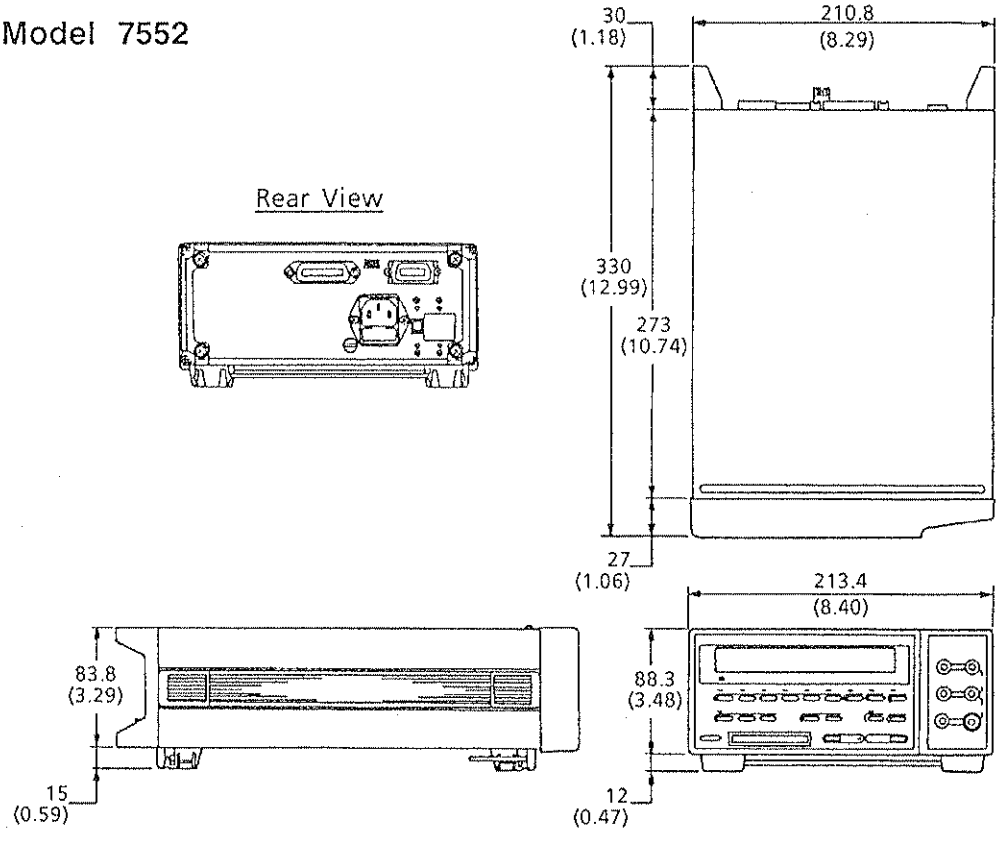
9.9 External Dimensions

Unit : mm
(Approx. inch)

Model 7551



Model 7552



9.10 Accessories (Options)

Name	Part No.	Specification	Min, Sales Amount
IC Memory Card	3789 01	8KB (500 data memory available)	1
IC Memory Card	3789 02	16KB (1500 data memory available)	1
IC Memory Card	3789 03	64KB (8000 data memory available)	1
Dummy Card	B9586NG	For IC memory card slot	2
20A Measuring Lead	B9646GQ	0.8m	1
Shielded Measuring Lead	B9409LA	0.8m with alligator clips	1
Rack Mounting Kit	751501	EIA (ANSI) rack, single mounting	1
	751502	EIA (ANSI) rack, double mounting	1
	751503	JIS rack, single mounting	1
	751504	JIS rack, double mounting	1

Recommendable Communication Cable

Name	Number of Parts	Specification
GP-IB Cable	10833A	1 m
GP-IB Cable	10833B	2 m
GP-IB Cable	10833C	4 m
GP-IB Cable	10833D	0.5 m
RS-232C Cable		

10. INITIAL VALUES

10.1 Set Data List

Table 10.1 shows the initial values already set at the factory before shipment.

Table 10.1 Initial Values (1/2)

Item		Set at the Factory	Data Even with Power OFF (Panel Set Data)	Initial Values with Power ON	In Initialized Status
Function		DC V	○	——	DC V
Range		AUTO	○	——	AUTO
Sample Mode		——	×	AUTO	AUTO
Integral Time		100 ms	○	——	100 ms
Sampling Interval		500 ms	○	——	500 ms
Delay Time		0	○	——	0
NULL Value	NULL	——	×	OFF	OFF
	DC V	0	○		0
	AC V	0	○		0
	Ω	0	○		0
	DC A	0	○		0
	AC A	0	○		0
Average		——	×	OFF	OFF
Averaging Cycles		100 cycles	○		100 cycles
MATH	MATH Mode	——	×	OFF	OFF
	MATH Items	——	×	Scaling	Scaling
	MATH Constant A	——	×	Constant KA 0	0
	B	——	×	KB 1	1
	C	——	×	KC 20	20
	D	——	×	KD 1	1
	H	——	×	HI 0	0
	L	——	×	LO 0	0
Storage		——	×	OFF	OFF
Recall		——	×	OFF	OFF
Recall No.		——	×	0	0
N		——	×	500	500
Auto Zero		——	×	ON	ON
GP-IB	Address Mode	Addressable	○	——	——
	Address	1	○	——	——
Output Format	Header	——	×	ON	ON
	Delimiter	——	×	CRLF+EOI	CRLF+EOI
	Status Byte		×	0	0
	Mask	——	×	0	0

Table 10.1 Initial Values (2/2)

Item		Set at the Factory	Data with Power OFF	Initial Values with Power ON	In Initialized Status
RS-232C	Baud Rate	9600	○	——	——
	Data Format	Mode 0	○	——	——
	(Start Bit / Data Length / Stop Bit / Parity)	(Start Bit 1 / Data Length 8 / Stop Bit 1 / No Parity)			
	Data mode (Talk Only / Normal)	Normal	○	——	——
	Handshake Mode	Mode 0	○	——	——
D-A Output (Output Mode / Display Mode)		00	○	——	00
Operation Mode (MEAS Mode / CAL Mode)		MEAS mode	○ (switched)	——	——

Note: Panel data that are set with programs, IC memory card data-read functions, or data communication functions are lost if the power is turned off.

10.2 Items to Be Selected and Set

Table 10.2 lists items to be selected and set with panel keys.

Table 10.2 Items to Be Selected and Set (1/2)

Key	Item to Be Selected (I)	Item to Be Selected (II)	Contents	Description
MISC	AT	-------	2 to 100	Averaging cycles.
	TD	-------	0 to 3600 sec. (msec. or sec)	Trigger delay time.
	AZ	-------	ON/OFF	Auto zero ON/OFF.
	GP-IB	Adr (addressable)	0 to 30	Address set in addressable mode.
		ONLY (talk only)	-------	Talk only mode set.
	DA (option)	0 (output mode)	0, 1, 2, 3 (display mode)	D-A output and display modes are set.
		1 (output mode)	0, 1, 2, 3 (display mode)	
	RS-232C option NOR (normal)	NOR (normal)	Handshake mode 0, 1 to 7	Handshake mode is selected.
			Data format 0, 1, 2, 3	Data format is set.
		ONLY (talk only)	Baud rate 75, 150, 300, 600, 1200, 2400, 4800, 9600	Baud rate is set.
SELECT	SC (scaling)	KA	-199999×10^{9} to 199999×10^{9}	Constant A for SC is set.
		KB	-199999×10^{9} to 199999×10^{9}	Constant B for SC is set.
	dB (decibel)	KC	-199999×10^{9} to 199999×10^{9}	Constant C for dB is set.
		KD	-199999×10^{9} to 199999×10^{9}	Constant D for dB is set.
	CP (comparator)	HI	-199999×10^{9} to 199999×10^{9}	Constant H for CP is set.
		LO	-199999×10^{9} to 199999×10^{9}	Constant L for CP is set.
N	NS		1 to 8000	Measurement cycles and used-memory areas in N RDGS mode.
	RD		-7999 to 7999	Number of heads in recalled memory.

Table 10.2 Items to Be Selected and Set (2/2)

Key	Item to Be Selected	Contents	Description
PRGM	SL (load)	-------	Sets card memory with panel keys.
	SS (save)	-------	Saves card memory with panel keys.
	PR	-------	Program set mode
	RU	-------	Executes program mode
	CI (card initialize)	-------	Executes memory card format.

10.3 Error Messages

Error No.	Error Message	Probable Cause and What to Do
02	IC memory card error.	IC memory card is faulty. Or IC memory card was removed while recalling memory.
03	A-D converter error.	A-D converter is faulty.
04	EEPROM write error.	Calibrated data-rite error. (EEPROM broken)
11	Communications command error.	Illegal command Invalidly set data or program file in IC memory card.
12	Parameter entry error.	Parameter out of range. Auto range is selected in 20 A range set.
21	Calibration error.	Calibrated data out of range. Enter data correctly.
22	EEPROM error.	EEPROM contents (calibrated data) broken. Recalibrate data. (Note)
23	Self-test error.	Self-test error when Power ON.
24	EEPROM	Set data in EEPROM broken. Clear EEPROM (set datra only).
31	IC memory card not initialized.	Execute memory card formatting with "PROG" key.
32	No file on IC memory card.	No file (data not written).
33	File capacity overflow.	NS values exceed memory capacity.
34	No IC memory card.	IC memory card not inserted correctly.
35	IC memory card cannot be initialized.	Card cannot be formatted. (Card failure)
36	No data to be recalled.	Attempt to remove card. Or attempt to set STORE key OFF before storing data. Illegal initialization method (illegal recall head No. position).
37	IC memory card battery error.	Battery backup error (no battery in IC memory card).
38	IC memory card program memory area is small. Or no program.	Attempt to enter program into a file that is full. Or attempt to execute a program that doesn't exist.
39	Not a DMM file.	A different memory card is accessed. A file with invalid data is accessed, for example : • While data is stored, IC card removed and recalled. • While a program is generated, IC card removed and used for executing a program.

NOTE

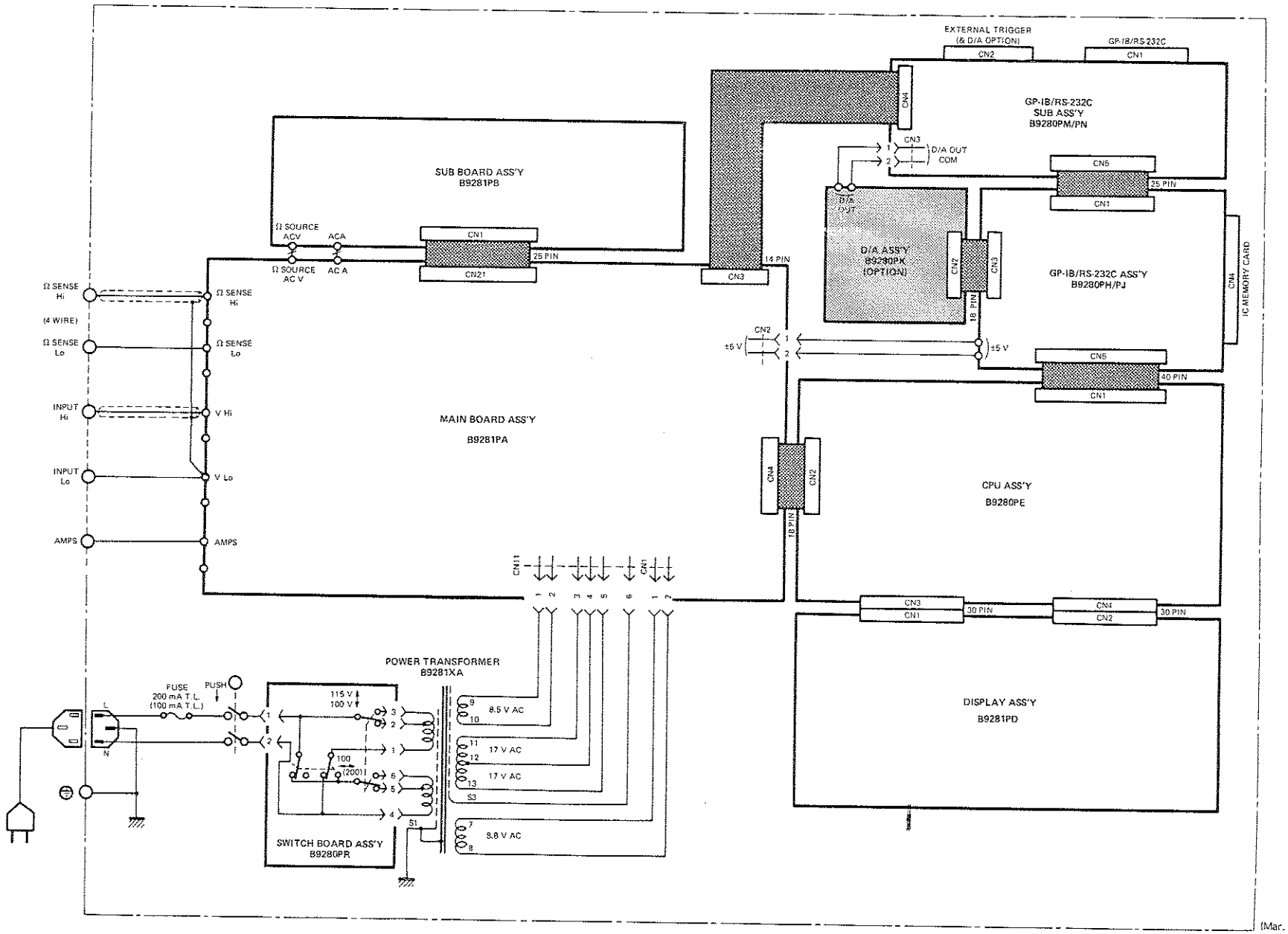
If EEPROM (storing calibrated data) is lost, ERROR 22 is displayed and all operations stop. If ERROR 22 is displayed, perform the following :

(1) Turn OFF the meter power.
(2) Set "CAL-MEAS" switch to "CAL" position.
(3) Turn ON the power. ERROR 22 comes up and then disappears about 2 to 3 seconds later. All calibration data are reset.
(4) Now the meter is in calibration mode. See Chapter 8. "MAINTENANCE AND CALIBRATION" to calibrate the meter.
(5) After the calibration, turn OFF the power. Set the "CAL-MEAS" switch to "MEAS" position.
(6) If the meter cannot be calibrated, contact your nearest Yokogawa agent.
(7) If the Steps (1) through (5) are not performed by the user, contact your nearest Yokogawa agent.

11. Models 7551 and 7552 DIGITAL MULTIMETER OVERALL WIRING

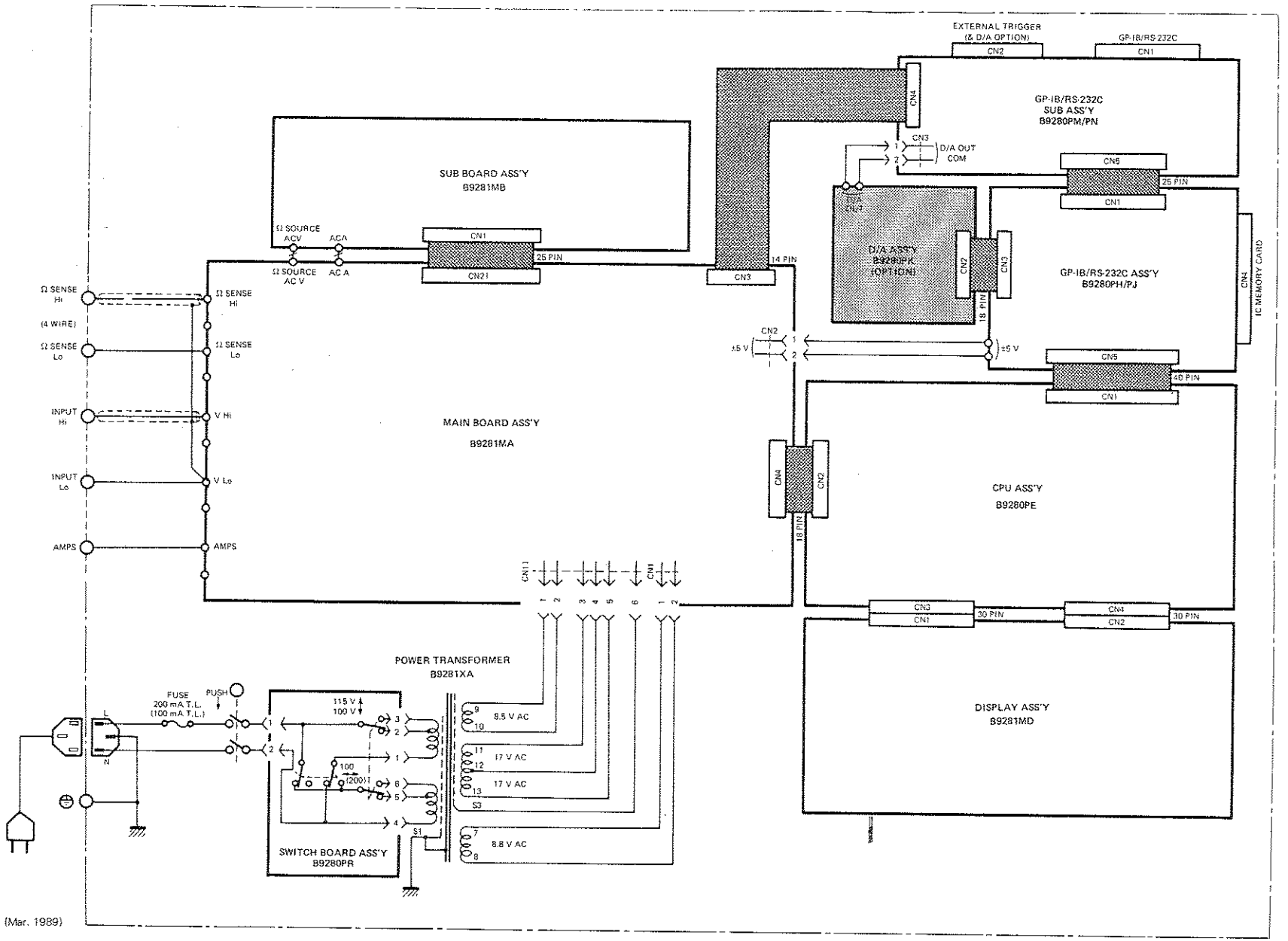
Description	Ass'y No.
Model 7551	
Main Board Ass'y	B9281MA
Sub Board Ass'y	B9281MB
Display Ass'y	B9281MD
CPU Ass'y	B9280PE
D / A Ass'y (Op.)	B9280PK (Op.)
GP-IB / RS-232C Ass'y	B9280PH / PJ
GP-IB / RS-232C Sub Ass'y	B9280PM / PN
Switch Board Ass'y	B9280PR
Power Trans Ass'y	B9281XA
Model 7552	
Main Board Ass'y	B9281PA
Sub Board Ass'y	B9281PB
Display Ass'y	B9281PD
CPU Ass'y	B9280PE
D / A Ass'y (Op.)	B9280PK (Op.)
GP-IB / RS-232C Ass'y	B9280PH / PJ
GP-IB / RS-232C Sub Ass'y	B9280PM / PN
Switch Board Ass'y	B9280PR
Power Trans Ass'y	B9281XA

Chapter 11



(Mar. 1989)

Figure 11.2 Model 7552 Digital Multimeter Overall Wiring.



(Mar. 1989)

Figure 11.1 Model 7551 Digital Multimeter Overall Wiring.