DIGITAL METER RELAY

MODEL AM—147

INSTRUCTION MANUAL

Introduction

Thank you for purchasing the Model AM−147 Series digital meter relay. Prior to operation, please check that the meter has not been damaged during transportation.
Make this manual easily available to the operator of this meter.

Safety Precautions

⚠ Precautions

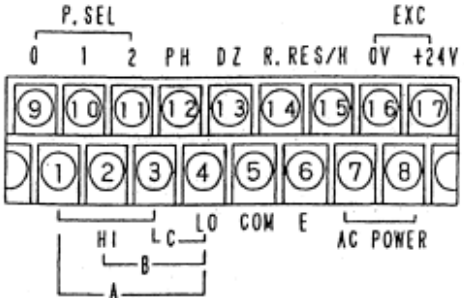
(1) If voltage or current exceeding the allowable maximum voltage or current is applied to the input terminals, the meter may be damaged.
(2)Apply power within the applicable range of the meter. Otherwise, fire, electric shock or meter damage may result.
(3)The contents of this instruction manual may subject to change without prior notice.
(4) This instruction manual is carefully prepared. However, if any mistake or omission is found, contact your nearest Watanabe agent or Watanabe directly.
(5)Keep this manual available easily anytime.

Contents

1. Prior to operation

1-1 Terminal connection and description

■ Lower screw terminal board

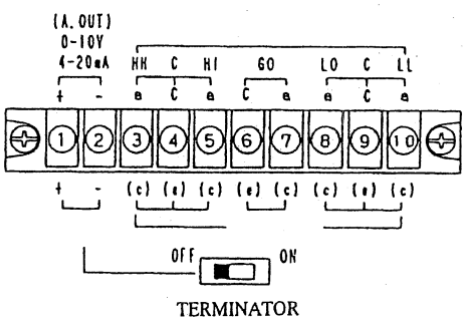


Terminal NO.	Function name	Outline
①②③	Input terminals (HI side)	The connection terminals differ depending on the range. Connect the input wires to the relevant terminals by referring to the following table.

TYPE	A①-④	B②-④	C③-④
DV RANGE	14:±99.99V 15:±700.0V	13:±9.999V 1V:1 to 5V	11:±99.99mV 12:±999.9mV
DA RANGE	25:±999.9mA	24:±99.99mA	23:±9.999mA 2A:4 to 20mA

④	Input terminal (LO side)	Analog input grounding terminal
⑤	Common terminal (COM)	Common terminal for control input (This terminal is isolated from④ (LO terminal).
⑥	E terminal (E)	Grounding terminal As this terminal is charge by the neutral-point potential of the supply voltage, do not contact this terminal with any other terminal.
⑦⑧	Power supply terminals (AC POWER)	Power to the meter is connected to these terminals. (90 to 264V AC)
⑨⑩⑪	Pattern select terminals(P.SEL)	Terminals to change the used pattern.
⑫	Peak hold terminal (PH)	Used to display the maximum (PH) or minimum (VH) value.
⑬	Digital zero terminal(DZ)	Used to measure the value just before this terminal is shorted with this value set to zero.
⑭	Relay reset terminal (R.RE)	Used when all comparison outputs need to be turned off.
⑮	Start/hold terminal (S/H)	The measured data or comparison result just before this terminal is shorted, is held.
⑯⑰	Sensor power supply terminals (EXC)	Can be used for sensor power supply. These terminals are isolated from all other terminals. [24VDC/40mA max.][Isolation voltage: 500V DC)

■ Lower screw terminal board



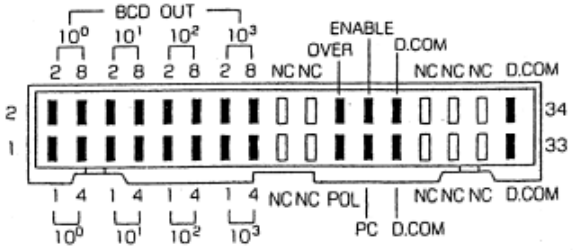
Terminal No.	Function name	Outline
①②	Analog output terminals (A.OUT) RS-485 output terminals (RS-485)	Used for the specification of either analog or RS-485 output. Usually, these terminals are not used, but do not use them for junction terminals.
③ to ⑩	Comparison output terminals	◎Relay output HH to LL relay output terminals for comparison output. Relays HH and HI use the common 'c' contact. Also, relays LO and LL use the common 'c' contact. Use these relays within their ratings. 250V AC 0.2A 120V AC 0.5A 28V DC 1A: Resistive load
		◎Photo—coupler output HH to LL photo-coupler output terminals (NPN open-collector) for comparison output. ③,⑤,⑦ and ⑧terminals: Collector side ④,⑥and ⑨ terminals: Emitter side Use the photo-coupler within its rated capacity. Do no apply any reverse voltage to the photo-coupler. Sink current: 50mA max. (Less than 30V) Saturated output voltage: Less than 1.2V at 50mA

when the meter has the data output specification, its input/output terminals are arranged as follows.

■ BCD output connector (With strain relief type compressed connector)

Plug output conforming to the MIL Standard.
Use the connector attached.
This connector is interchangeable with any commercially available socket conforming to the MIL Standard.

TTL or NPN open-collector output is available.



⚠ Caution

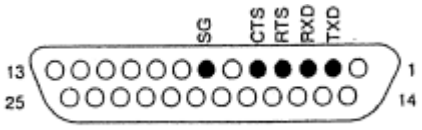
The above NC terminals are vacant. However, do not use them for junction terminals.

Accessory connector:HIF3BA-34DA-2.54R(HIROSE ELECTRIC)

■ RS-232C D Sub-connector

This connector is not attached to the meter.

Use a commercially available 25-P D-sub-connector.



⚠ Caution

The above o terminals are vacant. However, do not use them for junction terminals.

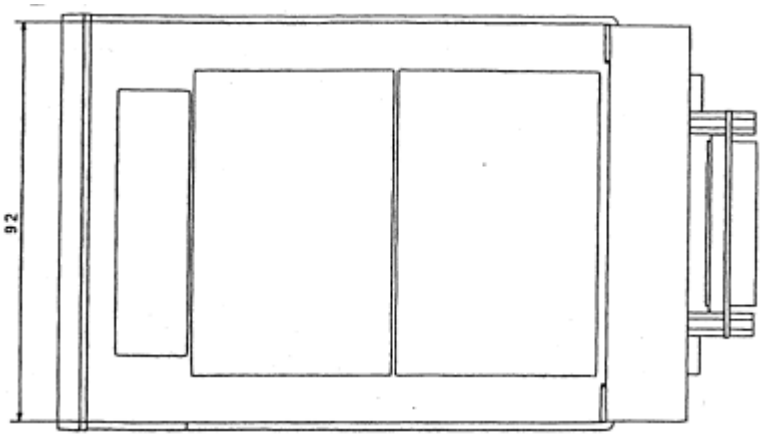
Note 1:The analog or RS-485 signal is output between the ① and② terminals of the upper screw terminal board.

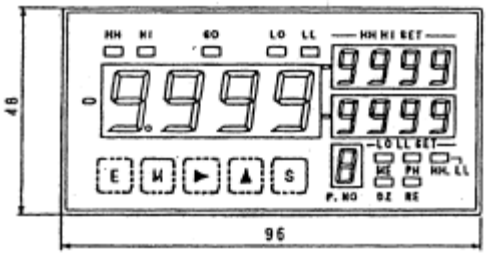
Note 2:For the analog output specification, either 4 to 20mA or 0 to 10V signal is output.

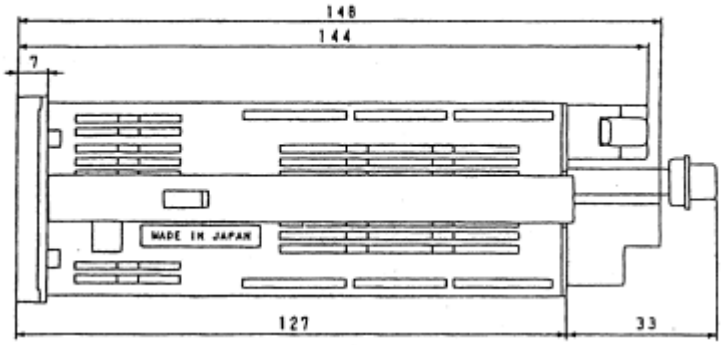
Note 3:For RS-485 and RS-232C, see the instruction manual for "AM-147 Series RS-232C/RS-485".

1-2 Dimensions and mounting

■ Dimensions (The following drawings are for the RS-232C specification .)

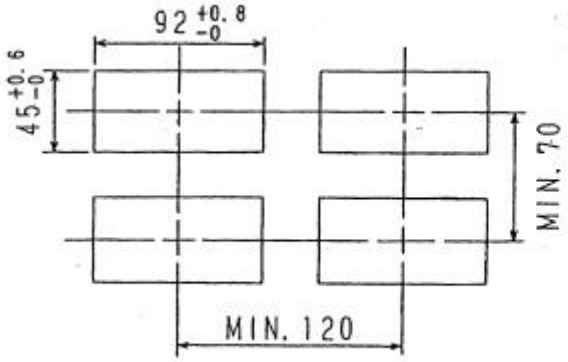




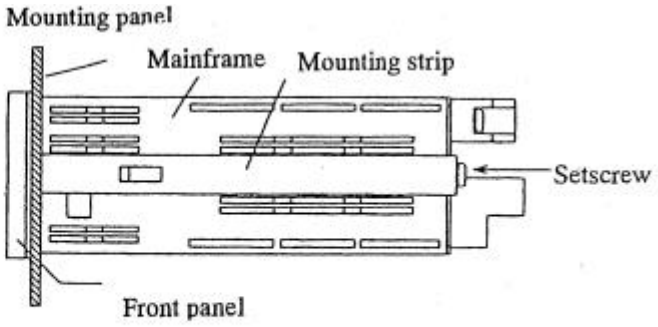


■ Mounting

Make a panel cutout as shown in the following panel cutout drawing: insert the mainframe in the panel from the panel front, then fix the mainframe from the rear using a mounting strip.



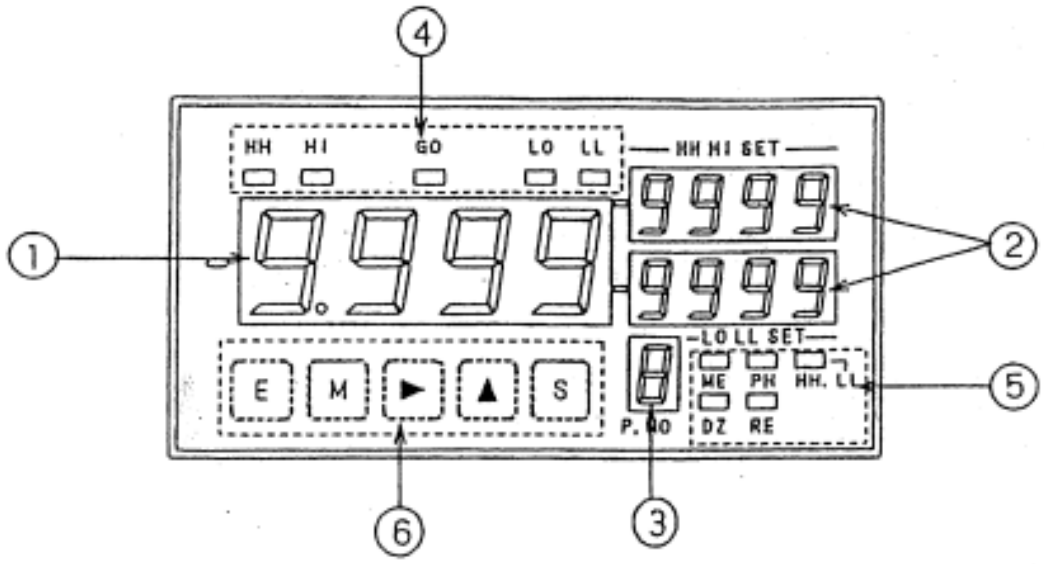
Panel cutout drawing



⚠ Cautions

(1) Recommended panel thickness: 0.8 to 5mm
Tightening torque: 0.39 to 0.49N・m (4 to 5 kg f・m)
It is recommended that the meter be installed where:
(2) ・the meter is not exposed to the direct sunshine,
・the ambient temperature is between 0 and 50°C,
・the relative humidity is between 35 and 85% RH,
・the temperature does not change rapidly not to cause dew condensation,or
(3) Use this meter where there are no chemicals or gases harmful to electrical parts nor dust.
(4) Do no apply vibration or shock to the meter.
(5) If the meter is installed within any equipment, disperse the heat so that the temperature within the equipment does not exceed 50°C.

1-3 Functional description



No.	Name		Function
①	Main display unit		Displays measured value, error, each scaling value in setting mode, comparison value, and data during condition data setting.
②	Monitor display units		Displays HI/LO or HH/LL setpoint, minimum value, maximum value, difference between maximum and minimum values, input value and message in setting mode.
③	Pattern display unit		Displays comparison data and scaling data patterns.
④	Comparison output display unit		Displays the comparison output state.
⑤	Function display unit	ME (DZ value memory)	Lights when the digital zero value backup function is selected.
		DZ (Digital zero)	Lights when the digital zero function is activated.
		PH (Peak hold)	Lights when the peak hold function (peak/valley/peak valley) is activated.
		RE (Remote mode)	Lights when the meter is in the RS specification and is remotely controlled.
		HH/LL(Comparison value)	Lights when the ② monitor display unit displays the HH or LL comparison setpoint.
⑥	Sheet switch	Ⓔ (Entry SW.)	Used to activate the double function to establish the data or to return to the measurement state.
		Ⓜ (Mode SW.)	Used to select each data setting item or to check comparison setting data.
		▶ (Shift sw.)	Used to select each data setting digit or to check Scaling setting data.
		▲ (Increment SW.)	Used to set each data item setting (in order from 0 to 9 and from −1 to −9) or to check condition data.
		Ⓢ (Set sw.)	Used to activate the double function to set the relevant data directly or to change the display.

Note 1) Double function: Operation function to enter each setting mode by pressing the relevant key while the Ⓔ or Ⓢ switch is being pressed.

Note 2) Condition data setting: Used to set data to determine the operation status of each meter function.

1-4 Double function key operation list

Operaticn key	Function	Operation	Ref. page
Ⓔ+▲	Condition data setting (Measurement operation suspended)	Item shift(P u H ～ P r o) by pressing the Ⓜ switch Data setting by pressing the ▲ switch Return to the measurement state by pressing the Ⓔ switch.	Page 9
Ⓔ+Ⓜ	Comparison data setting (Measurement operation suspended)	Item shift(P - - ～ H - L L)by pressing the Ⓜ switch Data setting by pressing the ▶ or ▲ switch Return to the measurement state by pressing the Ⓔ switch	Page 12
Ⓔ+▶	Scaling data setting (Measurement operation suspended)	Item shift(P - - ～ d E P) by pressing the Ⓜ switch Data setting by pressing the ▶ or ▲ switch Return to the measurement state by pressing the Ⓔ switch	Page 15
Ⓢ+Ⓜ	Peak/valley value display Input value display (During measurement operation)	Item shift(P H → u H → P u H)by pressing the Ⓜ switch Clear of each peak value by pressing the ▲ switch. Change between the peak and input value displays by pressing the Ⓢ switch Change to the comparison setpoint display by pressing the Ⓔ switch.	Page 18
Ⓢ+▶	Comparison setpoint change (During measurement operation)	Alternate change of the HI/LO setpoint → the HH/LL setpoint by pressing the Ⓢ+▶ switches	Page 18
Ⓢ+▲	Pattern change(During measurement operation)	Pattern change every time the Ⓢ+▲ switches are pressed (Changed 2 sec after change)	Page 18

Note 1: When the double function is activated, always press the Ⓔ or Ⓢ switch first. Otherwise, no operation is accepted.

Note 2:The pattern can be changed only when the " P S E L " condition data is set to " I n S "(internal).

2. How to use each function

2-1 Initial setpoint of each data

■ Condition data

Display	Function	Initial value	
		DV	DA
PvH (PVH)	Peak hold mode setting	PH	PH
rAnG (RANG)	Input range setting	15	25
SnP (SMP)	Sampling speed setting	1	1
cYcL (CYCL)	Power frequency setting	50	50
nAv (MAV)	No. of moving averaging times setting	oFF	oFF
F1- (FIX)	Fixed zero setting	oFF	oFF
bLn- (BLNK)	Display blank setting	oFF	oFF
PSEL (PSEL)	Pattern control select setting	out	out
S-H (S—H)	Start/hold type setting	A	A
Adr (ADR)	Communication device No. setting	0.0	0.0
bAud (BAUD)	Baud rate setting	9600	9600
b.uP (B.UP)	Digital zero backup	oFF	oFF
Pro (PRO)	Switch operation protect setting	oFF	oFF

Note 1: The above condition data is effective and common to any pattern from 1 to 8.
Note 2: bAud (baud rate setting): Displayed only for the RS output specification.
Note 3: Adr (Communication device N0. setting): Displayed only for the RS-485 output specification.

■ Comparison data

Display	Function	Initial value	
		DV	DA
S-HH (S—HH)	HH comparison setpoint	5000	5000
S-H1 (S—HI)	HI comparison setpoint	1000	1000
S-Lo (S—LO)	LO comparison setpoint	500	500
S-LL (S—LL)	LL comparison setpoint	0	0
H-HH (H—HH)	HH hysteresis setpoint	0	0
H-H1 (H—HI)	HI hysteresis setpoint	0	0
H-Lo (H—LO)	LO hysteresis setpoint	0	0
H-LL (H—LL)	LL hysteresis setpoint	0	0

Note 1 : As the initial values prior to factory shipment, the above data items are set to patterns 1 to 8.

■ Scaling data

Display	Function	Initial value	
		DV	DA
FSc (FSC)	Fullscale value setting	9999	9999
F1n (FIN)	Input value setting for fullscale	9999	9999
oFS (OFS)	Offset value setting	0	0
o1n (OIN)	Input value setting for offset	0	0
AoH1 (AOHI)	Analog output HI setting	9999	9999
AoLo (AOLO)	Analog output LO setting	0	0
dEP (DEP)	Decimal point setting	....	....

F1n initial value for standardized input

Display	Function	Initial value	
		DV	DA
F1n (FIN)	Input value setting for fullscale	5.000	20.00

Note 1:As the initial values prior to factory shipment, the above data items are set to patterns 1 to 8.
Note 2: The AoH1 and AoLo settings are displayed only for the analog output specification
Note 3: The digit set with the decimal point blinks.

No decimal point is set as the initial value prior to factory shipment.

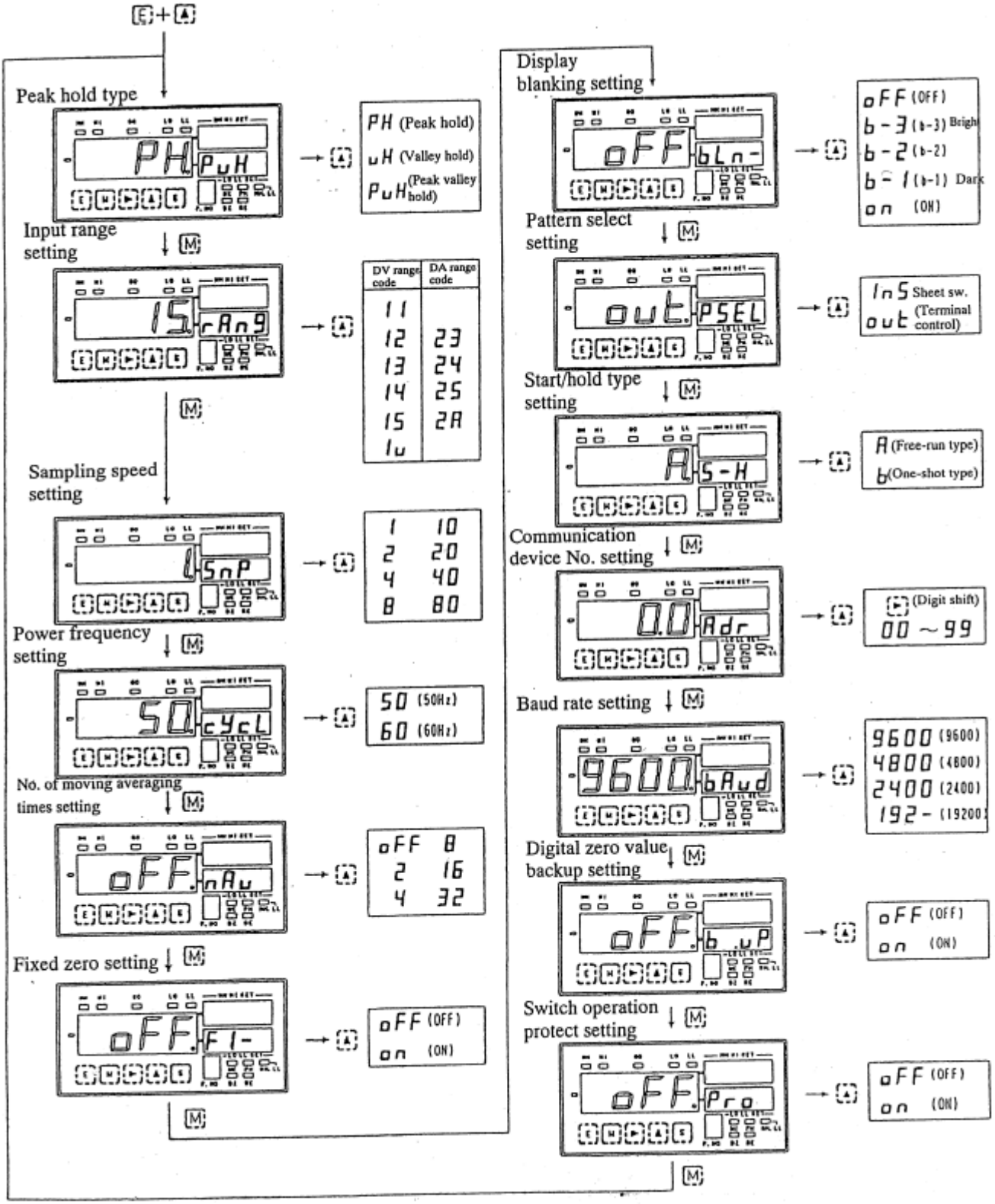
2-2-1 Condition data settings

Condition data settings are used to determine the activation state of each function.

Pressing the Ⓔ+▲ front sheet switches sets the meter to any of the following condition data setting modes.

Each condition appears on the monitor display unit every time the Ⓜ switch is pressed.

Set the desired data by pressing the ▲ or ▶ switch. The data thus set becomes effective by pressing the Ⓔ switch, and the meter is ready to start measurement.



2-2-2 Description of condition data

・ PvH (PVH)

Sets the peak hold type.

Select the desired type from among PH (PH/peak hold), vH (VH/valley hold) and PvH (PVH/peak valley hold).

・ rAng (RANG)

Sets the input range.

As this meter accepts the multi-range type input, it is set to the measurement state at the specified range for the first time when the input range is set and the input terminals are selected.

Select any DV range code (voltage input) from among 11, 12, 13, 14, 15 and 1v, and select any DA range code (current input) from among 23, 24, 25 and 2A.

・ SnP (SMP)

Sampling speed setting

*No. of averaging times setting.

Each data output also synchronizes.

Sampling period (ms)					
Display	50Hz	60Hz	Display	50Hz	60Hz
1	80.0	66.6	10	800.0	666.6
2	160.0	133.2	20	1600.0	1333.2
4	320.0	266.4	40	3200.0	2666.4
8	640.0	532.8	80	6400.0	5332.8

・ cycl (CYCL)

Power frequency selection for induction noise rejection. Set the frequency to 50 (50z) or 60 (60 Hz) according to the power frequency used.

・ nAv (MAV)

No. of moving averaging times setting.

This is effective to reduce a noise contained in the input signal. Set the desired number of moving averaging times from among OFF, 2, 4, 8, 16 and 32 .

The larger the number of moving averaging times, the higher the filter effect.

・ F1- (FIX)

Fixed zero setting.

The 10^0-digit is forcibly fixed to "0" with this function turned on.

・ bLn- (BLNK)

Used to adjust display brightness.

off: Normal display brightness

b-3→b-1: The display gradually gets darker.

on : The display becomes blank.

* Comparison output LED: Displayed even when the display becomes blank.

・ PSEL (PSEL)

Sets pattern select control.

When set to Ins : Internal control (sheet switch)

When set to out : External control (screw terminal board)

・ S-H (S-H)

Sets the external terminal S/H type.

When set to A :Free-run type

When set to b :One-shot type

・ Adr (ADR)

For the RS-485 specification, sets the identification No. of this meter.

Setting range:No. 01 to No. 99

・ bAud (BAUD)

Baud rate setting

For the RS specification, set the baud rate to match the device connected.

・ b.uP (B.UP)

Digital zero value backup setting.

If the DZ control terminal is turned on with this setting turned on, the digital zero value at that time is written in EEPROM (memory).

If this meter is operated next time with the DZ control terminal turned on, that value becomes effective, and the display shows (Input value − Digital zero value).

When "backup" is set to on, "ME" on the monitor LED lights.

N0. of EEPROM write times:100,000 times guaranteed

・ Pro (PRO)

Switch operation protect function setting.

If this function is turned on, the ▶ or ▲ switch is not accepted during measurement operation.

Note 1: For the external control terminal ,also see "Chapter 3 , 3−1 Control terminal "

Note 2: For RS−232C/RS−485, see the instruction manual for "AM−147 Series RS−232C/RS−485".

2-3-1 Comparison data settings

For comparison data settings, the following two methods are available.

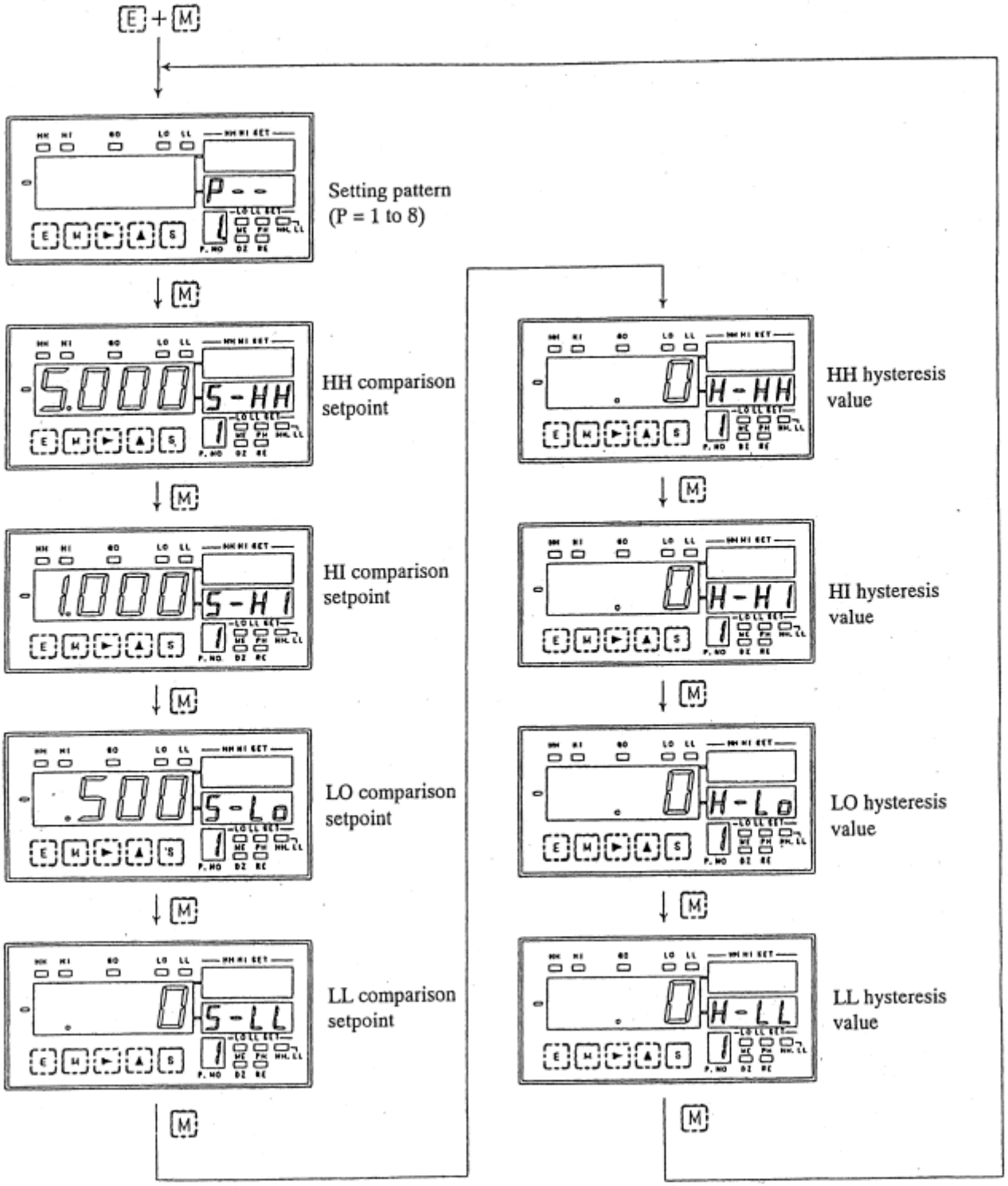
·By pressing the Ⓔ+Ⓜ front sheet switches

·By keeping pressing the Ⓜ switch for 2 sec (hereinafter indicated as Ⓜ +2sec")

If the former method is used, measurement is suspended while the data is being set.

On the other hand, if the latter method is used, measurement continues while the data is being set.

■ Ⓔ+Ⓜ : Comparison value and hysteresis settings (Measurement operation suspended)



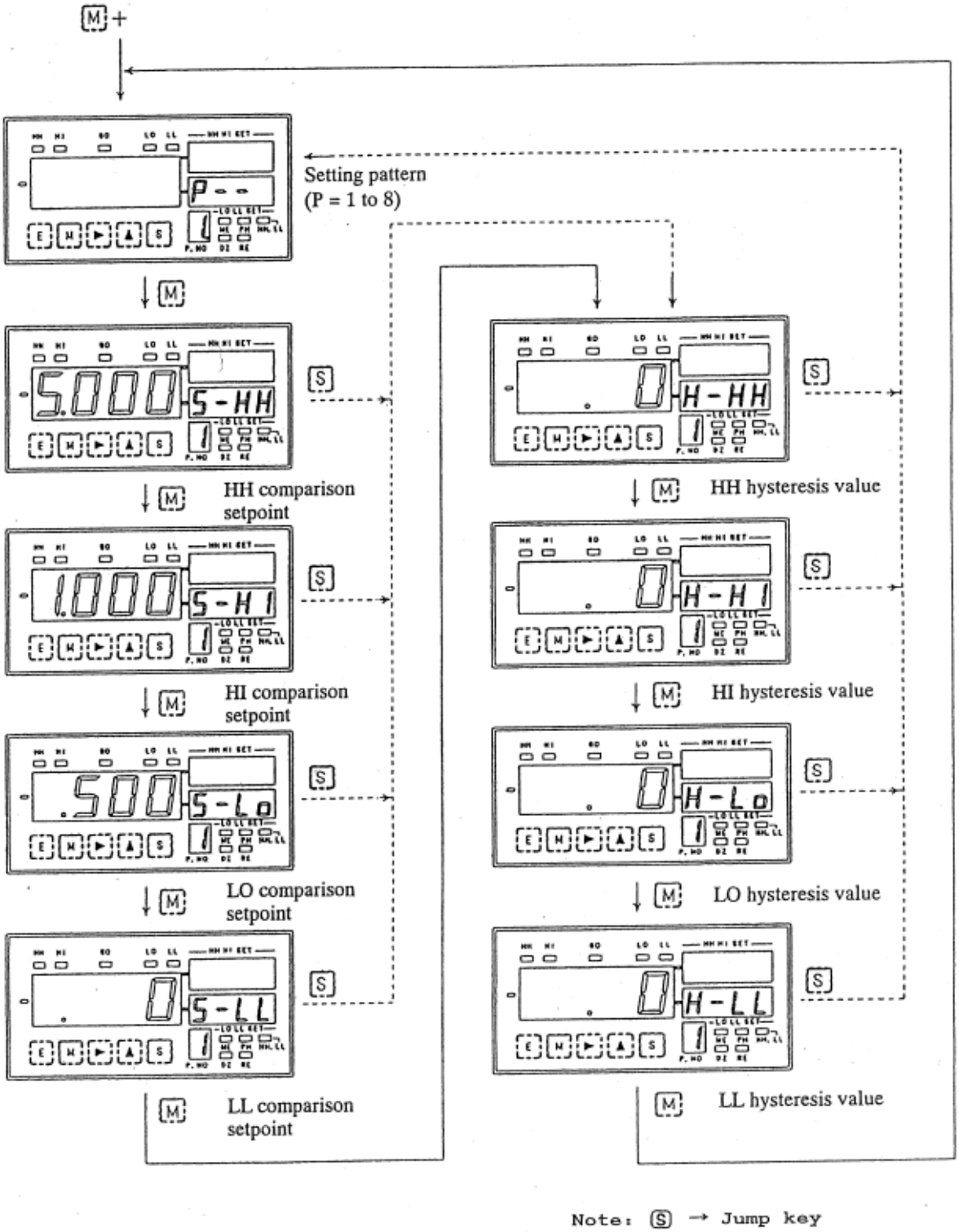
The meter is set to the setting state by pressing the ▶ or ▲ switch twice.

The setpoint is displayed on the main display unit.

This setting becomes effective just when the Ⓔ switch is pressed, and the meter returns to the measurement state.

■ Ⓜ+2 sec: Comparison value and hysteresis settings (During measurement operation)

■ Ⓜ+2 sec



The meter is set to the setting state by pressing the ▶ or ▲ switch twice.
The setpoint is displayed on the main display unit.
If Pro (protect function) is set to on, the ▶ or ▲ key cannot be accepted not to set any condition data. If there is no switch operation for more than 16 sec, the meter is automatically reset (measurement state). If this setting is made, it becomes effective just when the Ⓜ switch is pressed. Pressing the Ⓔ switch returns the meter to the measurement state. This is effective even when the meter is automatically reset . Pressing the Ⓜ switch twice after the setting is made moves the present setting to the next setting.

2-3-2 Description of comparison data settings

1) Setting method

After the meter enters comparison data setting mode, the pattern display unit displays the pattern to be set. When changing the pattern, press the ▲ switch.

Every time the M switch is pressed, the monitor display unit displays each item to be set from the HH comparison setpoint to LL hysteresis value, and the main display unit displays the respective data. If the meter enters setting mode during measurement operation, in order to check the setpoint, press the M switch twice to move to the next item. If the meter enters setting mode, the decimal point in the digit to be set blinks.

Set the desired setting item by pressing the ▶ or ▲ switch.

The setting function of the S switch during measurement operation suspension differs from that during measurement operation.

During measurement operation suspension, the switch acts as a "direct setting" switch which can set the actual measured-value to its setpoint. For details, see "Chapter 3, 3-2 Direct setting." The switch acts as a jump switch during measurement operation and is used.when the relevant setting item is skipped in order of HH comparison setpoint —> HH hysteresis value -—> setting pattern.

Comparison value setting range: -9999 to 9999

* There are no restriction on the magnitude of the setpoint.

2) Hysteresis

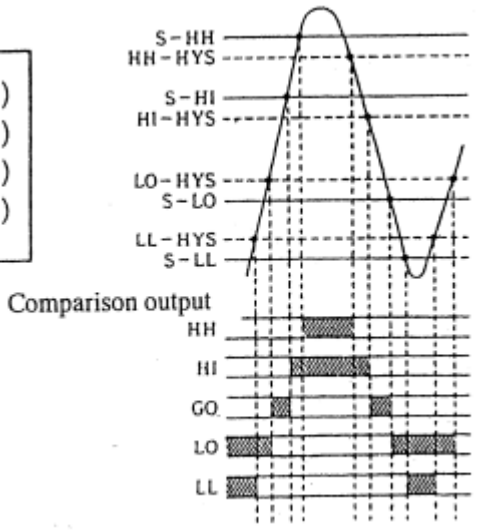
The meter is designed so that hysteresis (dead band) can be added to the comparison setpoint. The hysteresis is added to the lower side of the HH/HI comparison setpoint and the upper side of the LO/LL comparison setpoint.

The HH, HI , LO or LL hysteresis width can be independently set within the setting range between 0 and 999 digits.

There are no restrictions on the magnitude of the comparison setpoint with hysteresis.

* When the meter is used with the peak hold function turned on, as the hysteresis does not function, it is ignored even if set .

HH−HYS= (S−HH) − (H−HH)
HI−HYS= (S−HI) − (H−HI)
LO−HYS= (S−LO) + (H−LO)
LL−HYS= (S−LL) + (H−LL)



2-4-1 Scaling data settings

For scaling data settings, the following two methods are available:

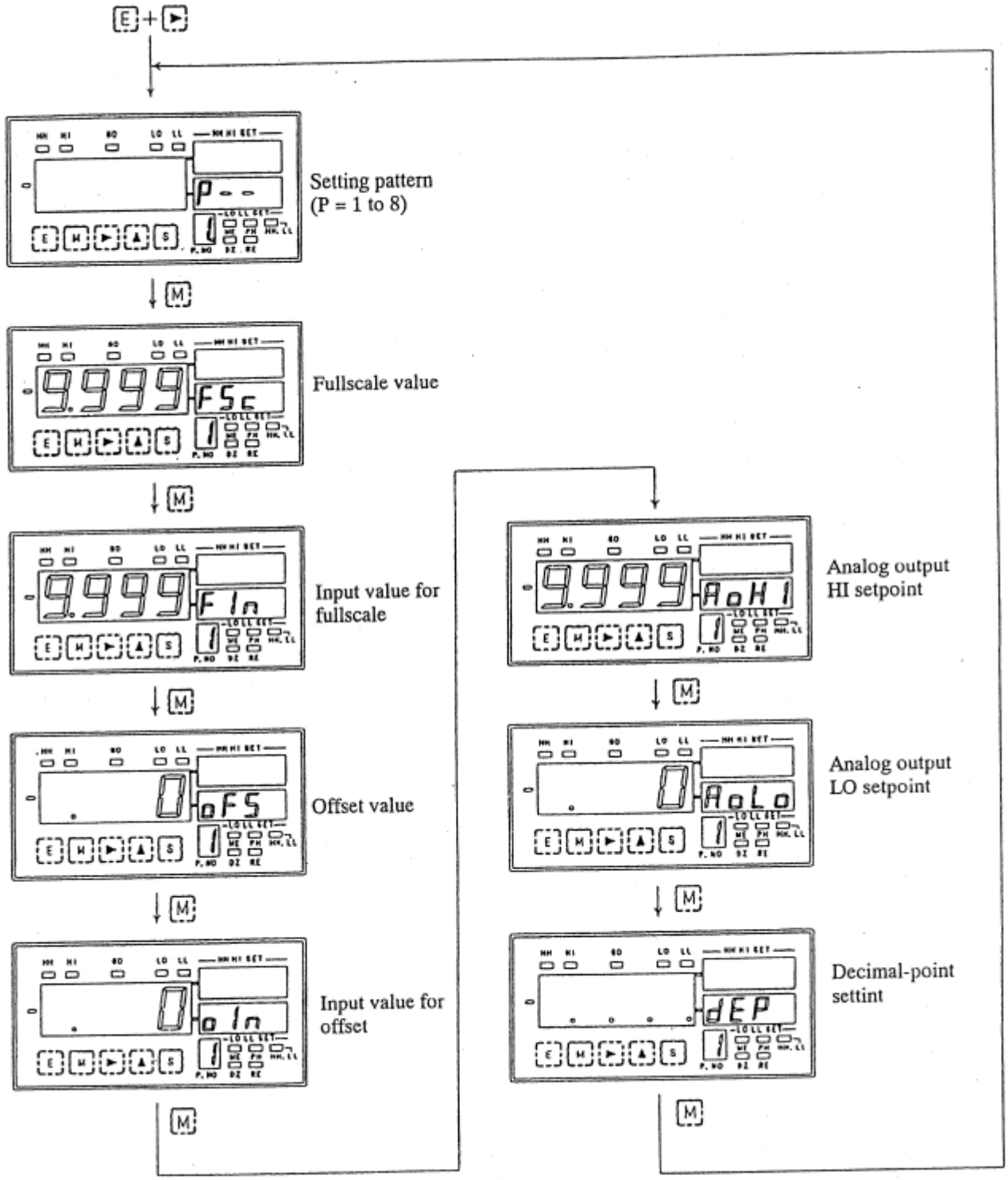
・by pressing the E+▶ front sheet switches,

・by keeping pressing the ▶ switch for 2 sec (hereinafter indicated as " ▶+ 2 sec")

If the former methods is used, measurement is suspended while the data is being set.

On the otherhand, if the latter method is used, measurement continues while the data is being set.

■ E+M : Scaling data setting (Measurement operation suspended)

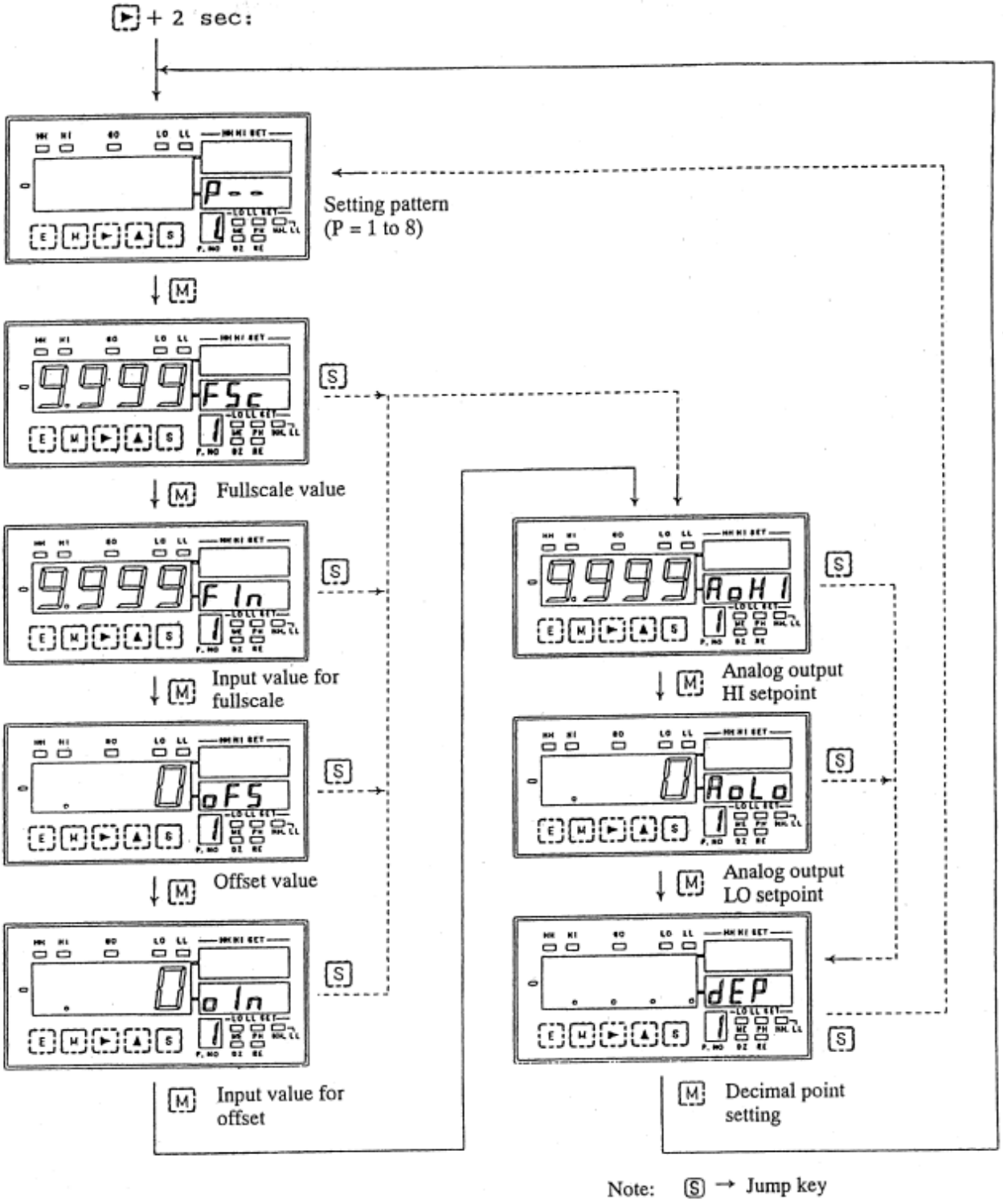


The meter is set to the setting state by pressing the ▶ or ▲ switch twice.

The setpoint is displayed on the main display unit.

This setting becomes effective just when the E switch is pressed, and the meter returns to the measurement state.

■ ▶+ 2sec: Scaling data setting (During measurement)



The meter is set to the setting state by pressing the ▶ or ▲ switch twice.
The main display unit displays the setpoint.
If Pro (protect function) is set on, the ▶ or ▲ key is not accepted not to set any condition data. If the switch is not pressed for more than 16 sec, the meter is automatically reset (measurement state). If the setting is made, the setting is effective just when the Ⓜ switch is pressed, and the meter returns to the measurement state when the Ⓔ switch is pressed. This setting is effective even when the meter is automatically reset. Pressing the Ⓜ switch twice moves the present setting to the next setting.
Setting ranges FSC, FIN, OFS and OIN: −9999 to 9999
For 1V range (FIN): −5000 to 5000

2-4-2 Description of scaling data setting

1) Setting method

After the meter enters scaling data setting mode, the pattern display unit shows the pattern to be set. When changing the pattern, press the ▲ switch. Every time the M switch is pressed, the monitor display unit displays the item to be set from the fullscale value (FSc) to the decimal-point setting (dEP), and the main display unit displays the respective data. If the meter enters setting mode during measurement operation, press the M switch twice to re- check the measured value, then move to the next item. After the meter enters setting mode, the decimal point in the digit to be set blinks.

Press the ► or ▲ switch at the item position to be set.

The setting function of the S switch during measurement operation suspension differs from that during measurement operation.

The S switch is used for a "direct setting" switch during measurement operation suspension. See "Chapter 3, 3-2 Direct setting." The switch is used for a jump switch during measurement operation and is used to skip the setting items in order of fullscale value →decimal-point setting → setting pattern (for the analog output specification, fullscale value → analog HI setpoint → decimal-point setting → setting pattern). For the analog HI setpoint (AoH1) or analog LO setpoint(AoLo)set for the analog output specification, see"Chapter 3, 3-3 Analog output."

2) Setting examples

Ex.1 For range code 13 (9.999V)
When "5000" is displayed for an input of 6V
When "500" is displayed an input of 1V

FSc	5000
FIn	6000
oFS	500
oIn	1000
dEP	....

(Decimal-point lighting)

Ex.3 For range code 1V (1 to 5V)
When "8000" is displayed for an input of 5V
When "0" is displayed for an input of 1V

FSc	8000
FIn	5000
oFS	0
oIn	1000
dEP	....

(Decimal-point lighting)

Ex.2 For range code 13 (9.999V)
When "2.00" is displayed for an input of 6V
When "50.00" is displayed an input of 1V

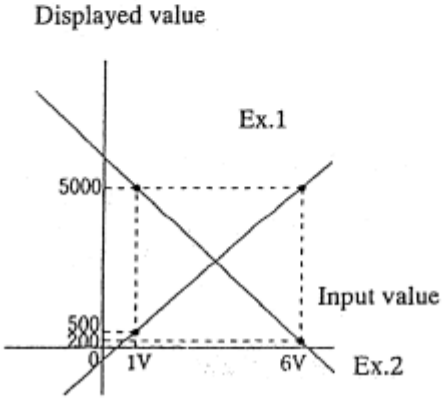
FSc	200
FIn	6000
oFS	5000
oIn	1000
dEP	.:..

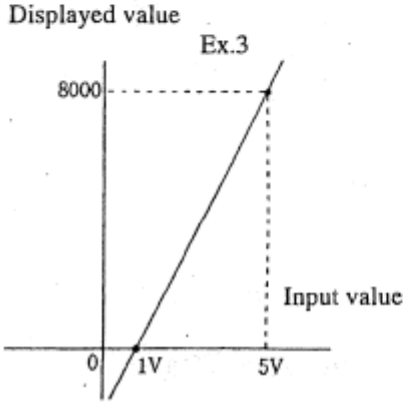
(Decimal point in the 10^2-digit blinks.)

● Displayed-value calculation equations

$a = (FSC-OFS)/(FIN-OIN)$: Gain
$b = OFS-(OIN \times a)$: Offset
$y = (a \times X) + b$: Displayed value

X : Input value
Ex.: For range code 13 and an input of 1V
X=1000





Note 1) For the standardized input, F In (input value setting at fullscale) is set to the initial value (1V → 5,000 or 2A → 20.00). However, as oIn (input value for offset) becomes 0, set 1V → 1,000 or,2A → 4.00.
After the meter is used for the standardized input, if its range is changed oIn (input value for offset) does not become 0. Therefore, it is necessary to re-set the meter.

Note 2:When the same value is set to FSc and oFS, and F In and oIn.
In the + area: oFS−1、oIn−1
In the − area: FSc+1、F In+1

2−5 Peak valley value display and pattern change

1) Peak valley value display/input display

The monitor display unit on this meter can display the peak, valley or peak valley values , or the input value. (The upper part of the monitor display unit: Message display)
Pressing the Ⓢ+Ⓜ switch with the comparison value displayed sets the meter to the display state of the peak, valley or peak valley value or the input value.
In order to return the meter to comparison setpoint display, press the Ⓔ switch.
The peak valley or input value is displayed depending on the previous display state in this mode. (When the power is turned off, the peak value is displayed.)
The peak valley or input value is selected by pressing the Ⓢ switch for its display, and the peak, valley or peak valley value is selected by pressing the Ⓜ switch. The peak valley value is always stored. All of these data are cleared by pressing the ▲ switch.
The displayed input value is updated corresponding to the input. Therefore, when the meter is used with the peak hold function activated, the main display unit can display the peak hold value and the monitor display unit can display the present measured value.

The following messages are displayed.

PH: : Peak value (PH)
uH: : Valley value (VH)
PuH: : Peak valley value (PVH)
In: : Input value (IN)

2) Pattern change

The pattern can be changed internally (sheet switch) or externally (terminal) with the PSEL condition data set.
For its internal (Sheet switch) selection, every time the Ⓢ+▲ switches are pressed the pattern from P-1 to, P-8 can be changed.
For its external selection, see "Chapter 3, 3−1−1 Pattern select."

3) Comparison setpoint monitor display selection

When the monitor display unit displays the comparison setpoint, the HH/LL comparison setpoint or the HI/LO comparison setpoint can be selected by pressing the Ⓢ+▶ switches . When the meter is in the HH/HL comparison setting display state, the HH/HL function display LED lights.

Note 1: The peak valley value and the HH/LL comparison setpoint displayed on the monitor display unit are not backed up. Therefore, if the power is turned off and is turned on again, the HI/LO comparison setpoint is displayed.

Note 2:If the peak valley value is selected with the HH/HL comparison setpoint monitored, the HH/LL function display LED keeps lighting.

3. How to use other functions

3-1 Control terminals

This meter has control terminals for pattern select, peak hold, digital zero, relay reset, start/hold and.ENABLE for the BCD output specification, but use a dry contact for control signal input.

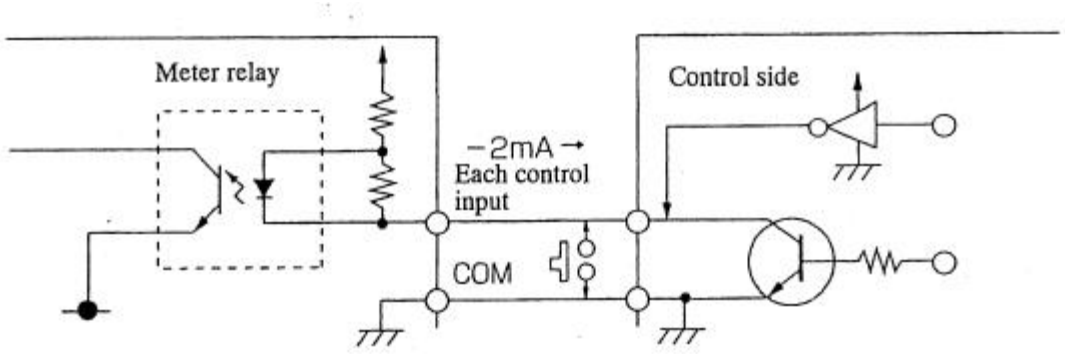
As the contact current is small, use an extremely small current contact for contact input.

Control terminal input rating:

Level "0": 0 to less than 1.5V

Level "1": 3.5 to 5V

Input current: Less than −2mA



1) Pattern select

When the pattern is changed from the external terminal, connect that terminal to the COM terminal as follows.

Lower screw terminal \ Pattern No.	P−1	P−2	P−3	P−4	P−5	P−6	P−7	P−8
⑨ [0]	1	0	1	0	1	0	1	0
⑩ [1]	1	1	0	0	1	1	0	0
⑪ [2]	1	1	1	1	0	0	0	0

*0 = Shorted
*1 = Open

Note: This is effective when "PSEL" is set to out in the condition data setting.

2) Peak hold

The peak hold.(PH /maximum value), valley hold (uH /minimum value) or peak valley hold (PuH /difference between maximum and minimum values) value is displayed according to the data selected in the PuH condition data setting.

Note 1: If 'OVER' (oL or -oL) occurs during peak hold measurement, no 'OVER' display is released if 'OVER' is not returned to normal display once.

Note 2: Peak hold type selection is effective only with the PH terminal opened or set to level "1."

3) Digital zero

Measurement is conducted by setting the displayed value just before the DZ terminal is shorted with the COM terminal or set to level "0," to zero. The succeeding display becomes (Input value − Digital zero value = Displayed value (Measured value) .

This setting is not accepted during hold. Therefore conduct this setting in the free−run state.

Note: If the digital zero and peak hold functions are simultaneously activated, the former has priority over the latter.

4) Relay reset

All of the comparison outputs are turned off with the R.RE terminal shorted with the COM terminal or set to level "0."

The comparison output display also disappears.

Can be controlled regardless of the start/hold state.

5) Start/hold (how to use the A or B type)

The measured data or comparison data just before the S/H terminal is shorted with the COM terminal or is set to level "0," is held. Measurement re−starts with the S/H terminal opened or set to level "1."

Both A and B types are available for start/hold. Each of these types is selected by setting the condition data. The A type corresponds to the free−run type and the measured data or comparison result just before the S/H terminal is shorted with the COM terminal or is set to level "0," is held. Measurement re−starts with the S/H terminal opened or set to level "1". The B type corresponds to the one−shot type and the measured data or comparison result is output only once with the S/H terminal changed from level "1" to level "0" or from open to shorting.

For both A and B types, the time until the measurement result is output changes depending on the sampling speed.

Each control function is activated with the respective terminal shorted with the COM terminal on the lower screw terminal board or set to level "0." It is released with these terminals opened, or the respective terminal set to level "1." (For the start/hold B type, the terminal control level is reversed.)

Each control terminal input rating

Level "0": 0 to 1.5V

Level "1": 3.5 to 5V

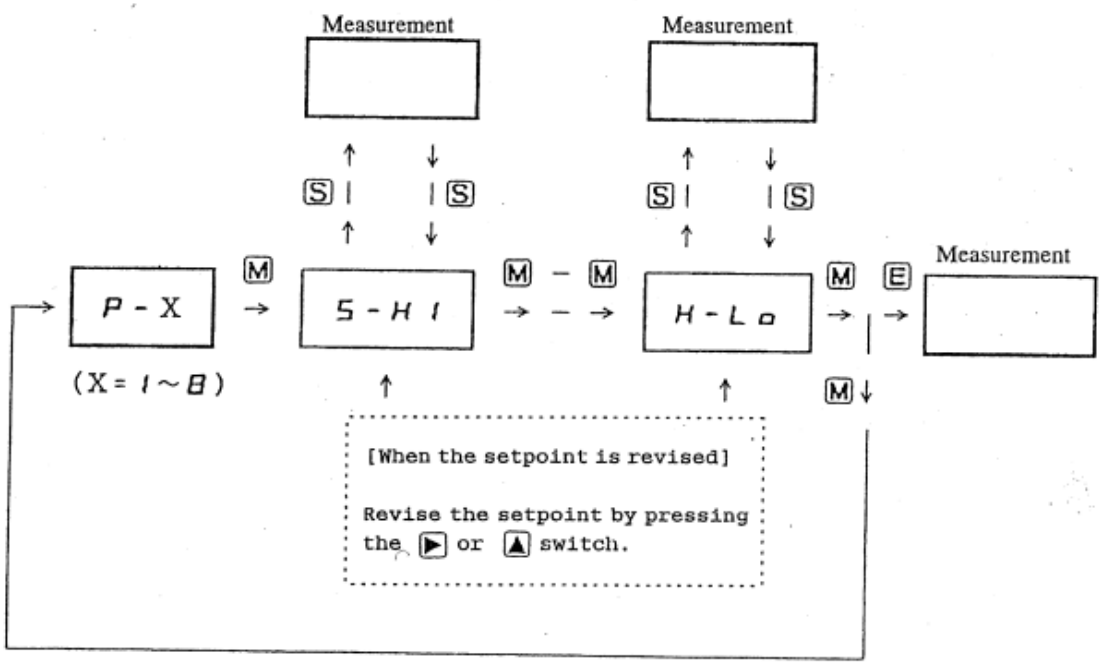
Input current: Less than −2mA

3-2 Direct setting

The direct setting function is used to set the actual measured value to the comparison value, hystrresis value, scaling value or analog output scaling values as its setpoint.
As each data can be set while the measured value is being monitored, this is the very convenient function for data settings in the operation state.
This direct setting can be made in the following two modes:

Ⓔ+Ⓜ (comparison value setting)
Ⓔ+▶ (scaling value setting)

Each setting is made by suspending measurement operation.
This setting is made by pressing the Ⓢ switch.
The setting range is within the range specified for each setpoint. NO setting can be made for any input value causing ± OVER (oL or -oL display). Therefore in this case return the meter to the measurement state (by pressing the Ⓔ switch) to enter each setting mode again, then conduct the setting. Negative measured value cannot be set to hysteresis vallue.
Example: When measured value is set to S-H1 (HH comparison setpoint) or H-Lo(LO hysteresis value)



Set the meter to comparison setpoint mode by pressing the Ⓔ+Ⓜ switches, then move to "S-H1" by pressing the Ⓜ switch.
Measurement starts just when the Ⓢ switch is pressed and the data is displayed on the main display unit.
"ME" on the function display LED (for DZ value memory) blinks during measurement.
Press the Ⓢ switch again at the desired value. "ME" on the function display LED disappears to suspend measurement, and the measured value just before measurement is suspended is displayed on the main display unit. Revise the measured value by pressing the ▶ or ▲ switch.
Press the Ⓜ switch to move to "H-Lo" to be set next and similarly make the setting.
The setting becomes effective just when the Ⓔ switch is pressed, and the meter returns to the measurement state.
* When the scaling data is set, the displayed value just before scaling computation (gain a=1) is used, and when the comparison setpoint is set, the displayed value just after scaling computation is used.

3-3 Analog output

As the analog output of this meter, a voltage of 0 to 10V or a current of 4 to 20mA is obtained in proportion to input changes within any displayed-value range.

The output range can be set by the AoH1 (AOHI/analog HI setpoint) and AoLo (AOLO/analog LO setpoint) scaling data settings.

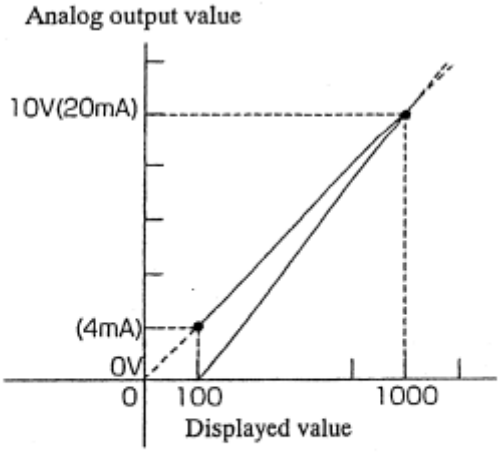
The output is set by pressing the M , ▶ or ▲ switches. It can also be set by the direct setting function.

There are no restrictions on the magnitude of AoH1 and AoLo. Therefore, it is possible to output 10 to 0V with respect to 0 to 10V (reverse conversion).

AoH1 : Displayed value for an analog output of 10V (20mA)

AoLo : Displayed value for an analog output of 0V (4mA)

Ex.) When an analog signal of 10V (20mA) is output for a displayed value of 1000
When an analog signal of 0V (4mA) is output for a displayed value of 100



Setting ranges: AOH I : -9999 to 999
AOLO : -9999 to 9999

Note 1: When the same value is set to AoH1 and AoLo, one is subtracted from AoLo in the plus area and one is added to AoH1 in the minus area.

Note 2: When the displayed value becomes larger than the analog output setpoint, the 0 to 10V output becomes an output of more than 12V and the 4 to 20mA output becomes an output of more than 21mA.

Note 3: The analog signal out of the setting range is not correctly output.

4. Error messages

Each error message is shown on the main display unit.

Display	Error	Recovery
dAtJ 10^0-digit segment lighting D.P blinking	Error of mainframe memory	Turn the power on again. If the meter still does not recover, Contact us.
d..E.. Decimal point blinking	Error of digital zero value backup data	Write the digital zero value. (See the description of "b. uP" in condition data settings."
c.o.n.X blinking (X: Pattern No.)	Error of pattern data displayed on X	Check the pattern No. with the error and re-set the hysteresis data.
n.E.t.X blinking (X: Pattern N0.)	Error of pattern data displayed on X	Re-set the scaling data corresponding to the pattern No . with the error.
c.o.n.d. blinking	Condition data error	Re-set the condition data.
9.9.8.9. Decimal point blinking(The numeral varies depending on the situation.)	When the input value or dispayed value exceeds the measuring range during peak hold operation	Release the peak hold function once.
o.L., -o.L.	When the input value or displayed value exceeds the measuring range	Use the meter within the specified measured and display ranges
uAit	The microcomputer waits for data entry.	When the setting is changed with the start/hold or peak hold turned on, release the function once.

⚠ Caution

If dAtJ., n.E.t.X, c.o.n.Xor c.o.n.d. is frequently displayed, it is assumed that the meter is affected by noise. Therefore in this case, take the necessary measures for noise rejection.

5. Specifications

■ DC voltage measurement

Input	Range code	Measuring range	Display	Input impedance	Allowable max. input voltage
DV	11	±99.99mV	Offset ±9999 Fullscale ±0 to 9999	100MΩ	±250V
	12	±999.9mV		100MΩ	±250V
	13	±9.999V		1MΩ	±250V
	14	±99.99V		10MΩ	±500V
	15	±700.0V		10MΩ	±700V
	1V	1 to 5V		1MΩ	±250V

Accuracy: ± (0.03% of rdg + 2 digits) (23°C±5°C 45 to 75% RH)

■ DC current measurement

Input	Range code	Measuring range	Display	Input resistance	Allowable max input current
DA	23	±9.999mA	Offset ±9999 Fullscale ±0 to 9999	10Ω	±150mA
	24	±99.99mA		1Ω	±500mA
	25	±999.9mA		0.1Ω	± 3A
	2A	4 to 20mA		10Ω	±150mA

Accuracy: ± (0.1% of rdg + 2 digits) (23°C ± 5°C, 45 to 75% RH)

Only for range code No. 25: ± (0.3% of rdg + 2 digit)

■ General specifications

·Measurement block

Measurement function:

Specify one Model from among DC voltage and current measurement Models.

Input circuit:

Single-ended type

Operation method:

Dual slope integration

Sampling speed:

12.5 times/sec (50 Hz)

15 times/sec (60 Hz)

Noise rejection ratio:

NMC More than 50dB (50/60Hz)

Temperature characteristics:

± (0.005% of rdg + 0.3-digit)/℃

Display:

7-segment LED(Light emitting diode numeric elements) Height,14.2mm(red)

: Comparison setting display unit height, 8mm (green)

Polarity display:

"-" is displayed when the computation result is minus.

Overrange warning:

"oL" or "-oL" display for input signal exceeding the display range.

Maximum display:

0 to ±9999 (4 digits)

Decimal point:

Can be set to any position. (By sheet switch)

Zero display:

Leading "zero" suppression

·External control

Hold:

The S/H terminal shorted with the COM terminal, or set to level "0"

Start:

The S/H terminal opened from the COM terminal or set to level "1"

Digital zero:

The displayed.value just before the DZ terminal is shorted with the COM terminal or is set to level "0," is set to "zero" and this value is stored.

Peak hold
Valley hold
Peak valley hold
The respective function is activated with the PH terminal shorted with the COM terminal or set to level "0."

Pattern select:
Any one of 8 patterns can be set by combing the COM terminal with any one of the 0, 1 and 2 P.SEL terminals.
Level "0": 0 to 1.5V
Level "1": 3.5 to 5V
Input current: Less than −2mA

・Comparison block

Control method:
Microcomputer computation

Setting range:
High/low limit setting including polarity
−9999 to 0 to +9999

Comparison operation:
By sampling speed

Setting condition:
There are no restrictions on the magnitude of the setpoint.

Comparison condition:

Comparison condition	Comparison result
High/high limit setpoint < Displayed value	HH
High limit setpoint < Displayed value	HI
High/high limit setpoint ≧ Displayed value ≧ High limit setpoint (Low/low limit setpoint ≦ Low limit setpoint)	GO
Displayed value < Low limit Setpoint	LO
Displayed value < Low/low limit setpoint	LL

Comparison relay:
Contact capacity 250V AC 0.2A Resistive load
120V AC 0.5A Resistive load
28V DC 1A Resistive load

Photo−coupler output (NPN type):
Voltage, 30V max.
Current, 50mA max.
Saturated output voltage, Less than 1.2V at 50mA

Hysteresis:
Can be set from 1 up to 999 digits for each comparison setpoint.

External control:
Relay reset
Comparison operation suspended with the R.RE terminal shorted with the COM terminal or set to level "0"
Level "0": 0 to 1.5V
Level "1": 3.5 to 5V
Input current: Less than −2mA

・Common specifications

Memory backup:
EEPROM is used to store the set data for about 10 years
(No. of write times: 100,000 guaranteed)

Working temperature/humidity range :
0 to 50°C/35 to 85% RH (No dew−condensing)

Storage temperature/humidity:
−10 to 70°C/Less than 60% RH

Power supply:
90 to 264V DC (50Hz/60Hz)

Power consumption:
Approx. 10VA (TYP) (At 100V AC)

Dimensions:
96(W) x 48(H) x 148(D)mm DIN size
Weight:
Approx. 450g
Dielectric strength:
For 1 min. between the input terminal and COM/EXC (0V)/comparison output at 500V DC
For 1 min. between the input terminal and COM of each output (BCD: D.COM, ANALOG: −, RS−232C: SG, RS−485:−) at 500V DC
For 1 min. between the power supply terminal and the input terminal/COM/EXC (0V)/case/comparison output at 1500V AC
For 1 min. between the power supply terminal and COM of each output (BCD: D.COM, ANALOG: −, RS−232C: SG, RS−485:−) at 1500V AC
Insulation resistance:
More than 100MΩ between each terminal above at 500V DC
Anti−noise characteristics:
Power supply terminal, normal/common mode ±1500V
Square wave of a rise time of 1ns
Noise width, 500ns (By noise simulator)
Sensor power supply:
24V DC ±10% 4mA
Ripple 100mVp−p
Accessories:
Instruction manual
Quick reference manual
Setting table
Unit label
Terminal cover

■ Input/output specifications
・BCD data output (Isolated from input (LO))
◎TTL
Measured data:
Tri−state parallel BCD positive logic latch output
Polarity signal:
Level "1" for minus display
'OVER' signal:
Level "1" for OVER display
Printing command signal:
Positive pulse of approx. 20ms every time measurement is finished
* It is possible to change each signal to the negative logic.
Each signal described above:
TTL level, Fanout 2 5V CMOS compatible
◎Open−collector (NPN type)
Measured data:
Transistor turned on at negative logic "1"
Polarity signal:
Transistor turned on for minus display
'OVER' signal:
Transistor turned on for OVER display
Printing command signal:
Transistor turned on for approx. 20ms every time measurement is finished
Transistor output capacity:
Voltage, 30V max.
Current, 10mA max.
Saturated output voltage, Less than 1.2V at 10mA
ENABLE input
The data output transistor is turned off with the ENABLE terminal shorted with the D.COM terminal or set to level "0." '(For TTL, the data output is set to the high impedance state.)
Level "0": 0 to 1.5V
Level "1": 3.5 to 5V
Input current: Less than −2mA

・RS-232C output (Isolated from input (LO))
Electrical characteristics:
Conforming to EIA RS-232C
Communication method:
Full-duplex
Synchronizing method:
Start-stop
Transmission speed:
2400/4800/9600/19200 bps
Start bit:
1 bit
Data length
7 bits
Error detection:
Even parity
Stop bit:
2 bits
Delimiter:
CR/LF
Character code:
ASCII code
Transmission control:
Ignored process

・RS-485 output (Isolated from input (LO))
Electrical characteristics:
Conforming to EIA RS-485
Communication method:
2-wire system, half-duplex (polling/selecting method)
Synchronizing method:
Start-stop
Transmission speed:
2400/4800/9600/19200 bps
Start bit:
1 bit
Data length:
7 bits
Error detection:
Even parity, BCC (Block check character) check sum
Stop bit:
2 bits
Delimiter:
CR/LF
Character code:
ASCII code
Transmission control:
Ignored process
Signal names used:

Signal name	Signal	Signal direction
Non-reversal output	+	Input/output
Reversal output	−	Input/output

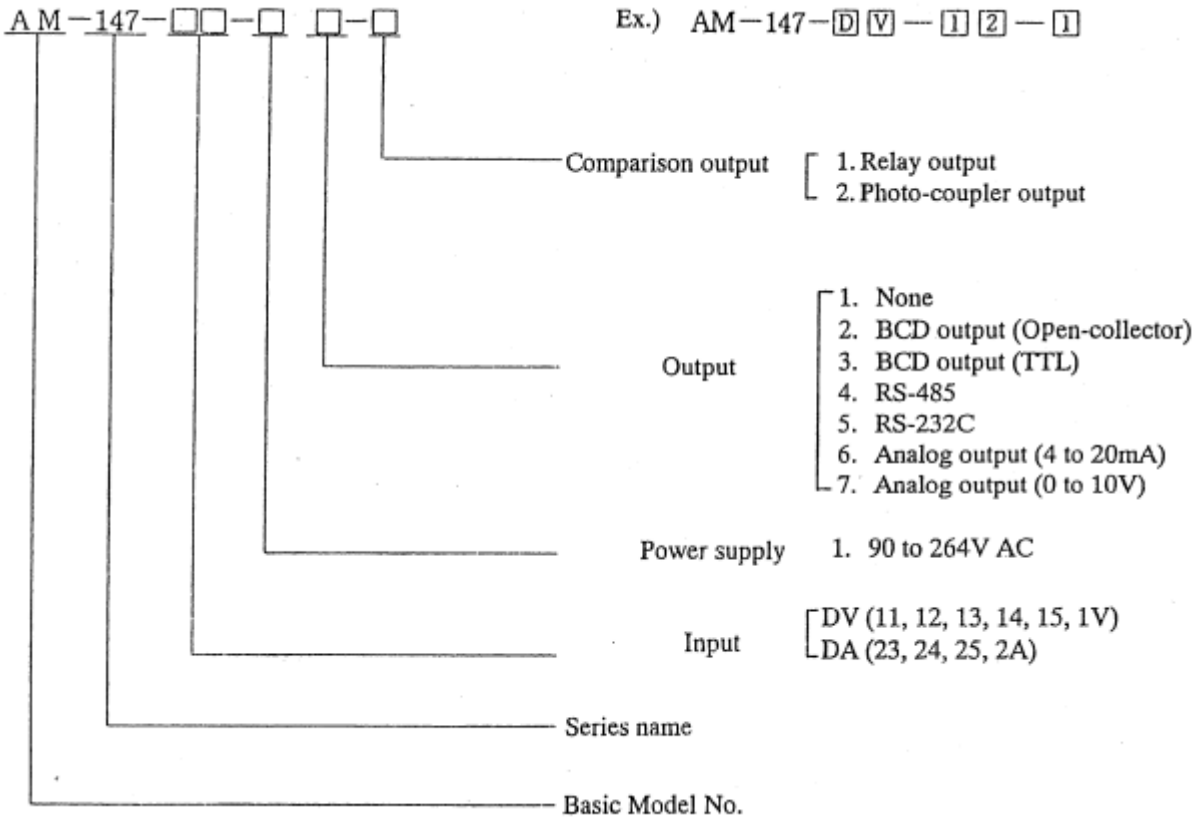
Connectable No. of meters:
Up to 31 sets
Line length:
Up to 500m in total

•Analog output (Isolated from input (LO))
The display range to output analog signal can be freely set.
Resolution:
13 bits
Output response:
Less than 0.5s (0 → 90%)

Output	Load resistance	Accuracy (23°C±5°C)	Ripple
0 to 10V	More than 10kΩ	±0.5% of FS	50mVp—p
4 to 20mA	0 to 550Ω	±0.5% of FS	Less than 0.5%

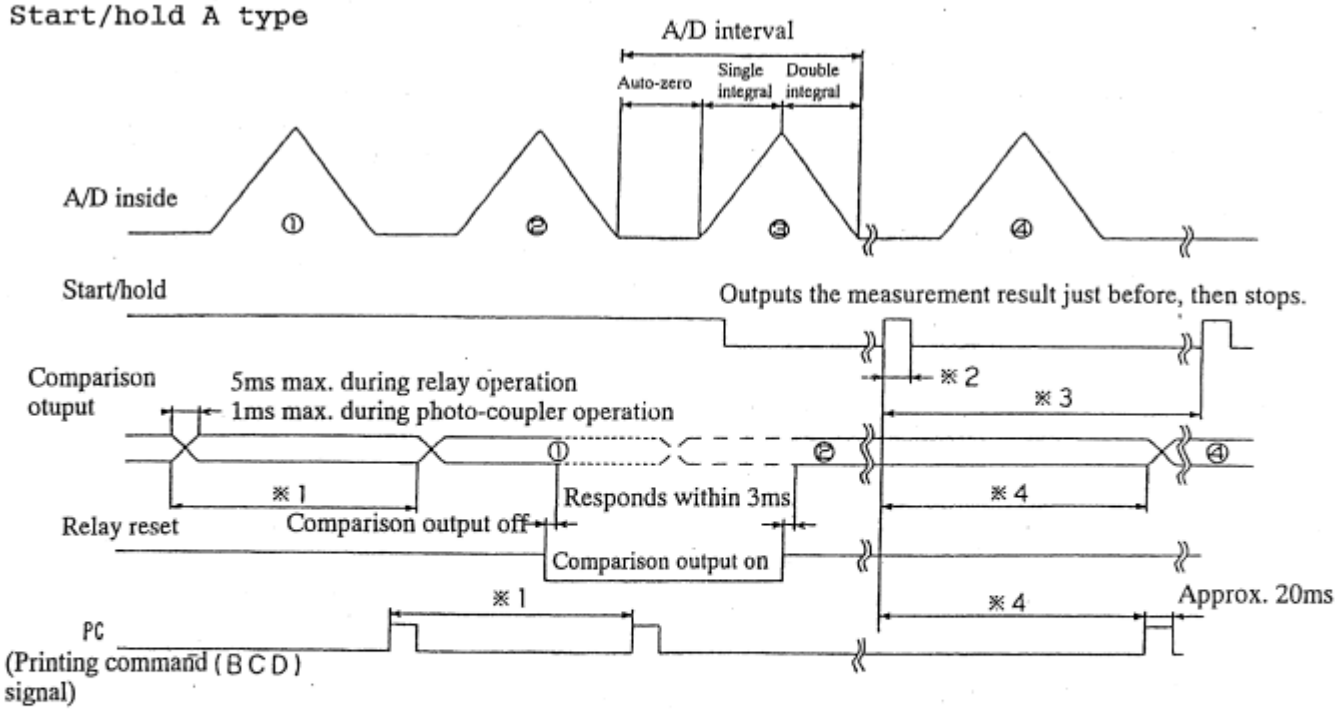
* Ripple at 4 to 20mA: At a load resistance of 250Ω and a current of 20mA.

■ Model No. configuration



6. Timing chart

Start/hold A type

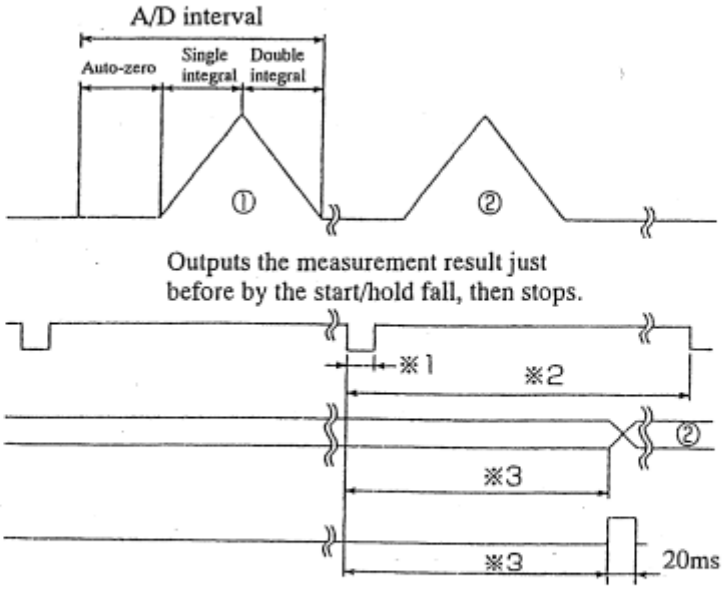


※1 { 15 times/sec 66.6ms / 12.5 times/80 ms }　※2 { 2ms to 100ms }　※3 { More than sampling speed }

※4 { MAX *1 + 20ms }

* The above data is that when set to sampling "1." When set to "2" or more, each value marked with *1 becomes that multiplied by the sampling setpoint (66.6ms/80ms × Sampling setpoint).

Start/hold B type (One-shot)



*1 (Any value of more than 2ms)
*2 (More than sampling speed)
*3 (Max. sampling speed + 20ms)

7. Warranty and after-sale service

1) Wananty

This meter is warranted for a period of one year form date of delivery. Any defect which occurs in this period and is undoubtedly causd by Watanabe's faults will be remedied free of charge. This warranty does not apply to the meter showing abuse or damage which has been altered or repaired by others except as authorized by Watanabe Co., Ltd.

2) After-sale service

This meter is delivered after being manufactured tested and inspected under strict quality control.

However, if any problem does occur, contact your nearest Watanabe sales agent or Watanabe directly giving as much information on problem as possible.

watanabe
WATANABE ELECTRIC INDUSTRY CO., LTD.
6-16-19, Jingumae, Shibuya-ku, Tokyo 150-0001, Japan
Phone: (81)3-3400-6141
Homepage http://www.watanabe-electric.co.jp/en/

ED-50097b

1. Outline

This manual describes the specification and operation of the RS-232C/RS-485 interface built in the AM-147 Series digital meter relay. With the RS interface built in the meter relay connected to an external device such as a personal computer, etc., measured values can be captured and parameters necessary for measurement can also be set.

2. Specifications

2-1 (Conforming to EIA RS-232C)

a) Synchronizing method: Start-stop
b) Communication method: Full duplex
c) Transmission speed: 19200/9600/4800/2400 bps
d) Start bit: 1 bit
e) Data length: 7 bits
f) Error detection: Even parity
g) Stop bit: 2 bits
h) Character code: ASCII code
i) Transmission control procedure: Ignored process
j) Signal names used: TXD, RXD, RTS, CTS and SG only
k) Delimiter: CR•LF

2-2 (Conforming to EIA RS-485)

a) Synchronizing method: Start-stop
b) Communication method: 2-wire system Half-duplex (Polling/selecting method)
c) Transmission speed: 19200/9600/4800/2400 bps
d) Start bit: 1 bit
e) Data length: 7 bits
f) Error detection: Even parity BCC (Block Check Character) Check sum
g) Stop bit: 2 bits
h) Character code: ASCII code
i) Transmission control procedure: Ignored process
j) Signal names used:

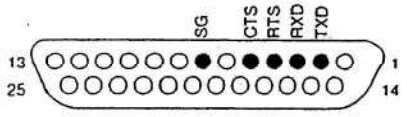
Signal name	Symbol	Signal direction
Non-reversal output	+	Input/output
Reversal output	-	Input/output

k) Maximum No. of meters connected: 31
l) Line length: Up to 500m in total
m) Delimiter: CR•LF

3. Terminal connection

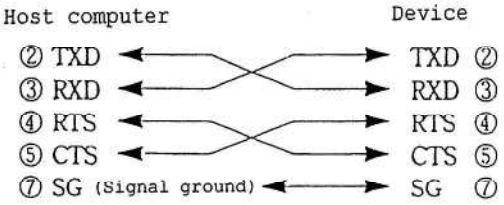
3-1 RS-232C

■ RS-232C input/output connector



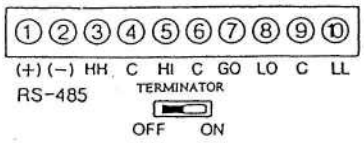
⚠Caution:
○ indicates a vacant terminal. However, do not use it for a junction terminal.

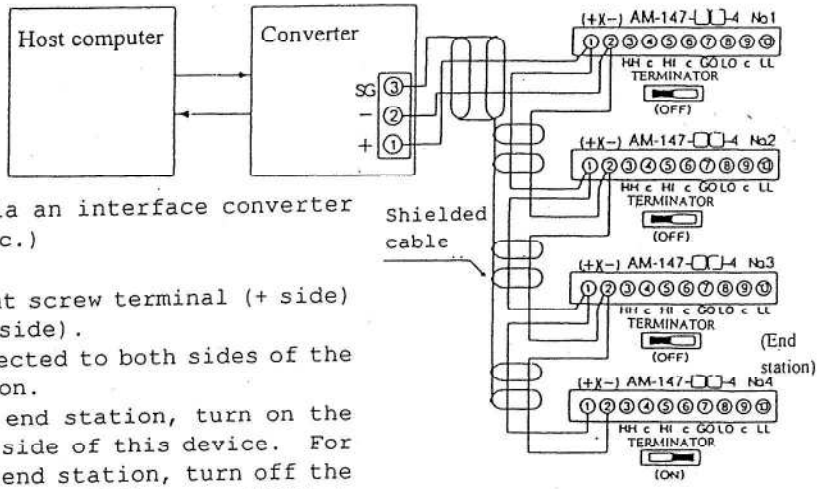
This device uses 5 wires: send (TXD), receive (RXD), send request (RTS), send permit (CTS) and signal ground (SG), and does not use any other control signals. In addition, RS-232C can be variously used from its standard. Therefore prior to its use, see the relevant computer manual as the connector pin arrangement and control signal control method differ depending on the computer to be used.



3-2. RS-485

■ RS-485 input/output screw terminal board





(Terminated at 200Ω)

Connect RS-485 to the host computer side via an interface converter (RS-232C/RS-485 signal level converter, etc.)
Up to 31 meters can be connected.
Connect each meter to the non-reversal output screw terminal (+ side) and the reversal output screw terminal (- side).
For RS-485, it is necessary for devices connected to both sides of the transmission line to specify the end station.
However, if this device corresponds to the end station, turn on the slide switch for the terminator on the rear side of this device. For the other stations not corresponding to the end station, turn off the slide switches for the terminators. Always turn off the power prior to turning the switch. Use shielded wires, and connect each shield at one point on the host computer side.
Use a commercially available interface converter.
(S1-30 manufactured by Sekisui Chemical Industry Co., Ltd. or equal.)

4. Baud rate/communication device No. setting

4-1 Baud rate setting

Enter the meter in condition data setting mode by pressing the ▲ switch while pressing the E switch. Then, press the M switch until "bAud" (baud rate setting) appears. As the present data (initial value: "9600" bps) appears, set the desired baud rate by pressing the ▲ switch. After the above setting is finished, press the E switch to return the meter to measurement operation.

4-2 Communication device No. setting (For RS-485)

In the same way as the setting in item 4-1 above, enter the meter in condition data setting mode by pressing the E and ▲ switches. Then, press the M switch until "Adr" (device No. setting) appears. The meter displays "Adr" and also the present set data (initial value: "0.0").
Therefore, set the desired device No. by pressing the ▶ switch (digit selection) and ▲ (No. selection). After the above setting is fnished, press the E switch to return the meter to measurement operation.
Note: Always specify device No. in 2 digits from 01 to 99. Device No. 00 is invalid.

5. Operation check

5-1 RS-232C

```
100  '
110  '
120  CLS :CR$=CHR$(13)+CHR$(10) ──────────  Creation of delimiter
130  '
140  OPEN "COM:E73NN" AS #1 ──────────  Communication line opened
150  '
160  PRINT :K$="":A$="" ──────────  Line feed and data clear
170  INPUT "COMMAND ENTRY" ;K$ ──────────  Command (data) entry
180  '
190  PRINT #1,K$+CR$; ──────────  Command (data) entry
200  CNT=0 ──────────  Receive wait counter clear
210  '
220  IF CNT > 3000 THEN PRINT "NO RESPONSE" :GOTO 160 ──  If there is no response, jump to command entry.
230  IF LOC(1) < 2 THEN CNT=CNT+1 :GOTO 220 ──────────  Presence or absence of receive data
240  LINE INPUT #1,A$ ──────────  Receive data capture
250  FOR T=1 TO 200:NEXT ──────────  Timing adjustment
260  '
270  PRINT "(METER OUTPUT)=" ;A$ ──────────  Receive data display
280  IF LOC(1) < 2 THEN 160 ELSE 240 ──────────  If there is no receive data, return to command entry
290  '
300  END
```

Execution example

```
run
IS COMMAND ENTERED?   DSP ↵
(METER OUTPUT)  =␣␣␣1000·····When display is set to 1000

IS COMMAND ENTERED?
```

5-2. RS-485

```
 100  '
 110  '
 120  CLS :CR$=CHR$(13)+CHR$(10) ------------------------ Creation of delimiter
 130  STX$=CHR$(2) :ETX$=CHR$(3) :ENQ$=CHR$(5) :EOT$=CHR$(4) ---- Creation of control code
 140  '
 150  OPEN "COM:E73NN" AS #1 ------------------------------ Communication line opened
 160  '
 170  PRINT :K$="":A$="" ---------------------------------- Line feed and data clear
 180  INPUT "COMMAND ENTRY";K$ ---------------------------- Command (data) entry
 190  IF LEFT$(K$,3)= "ENQ" THEN K$=ENQ$+RIGHT$(K$,2):GOTO 260 ---- Send "ENQ" to establish communication.
 200  IF K$="EOT" THEN PRINT #1,EOT$+CR$;:GOTO 170 -------- Send "EOT" to open communication.
 210  '
 220  K$=K$+ETX$ ------------------------------------------ Creation of send data
 230  '
 240  GOSUB *BCC ------------------------------------------ Jump to BCC calculation
 250  '
 260  PRINT "SEND DATA";K$ -------------------------------- Send data display
 270  PRINT #1,K$+CR$; ------------------------------------ Command (data) send
 280  CNT=0 ----------------------------------------------- Receive wait counter clear
 290  '
 300  IF CNT > 3000 THEN PRINT "NO RESPONSE" :GOTO 170 ---- If there is no response, jump to command entry
 310  IF LOC(1) < 2 THEN CNT=CNT+1:GOTO 300 --------------- Presence or absence of receive data
 320  LINE INPUT #1,A$ ------------------------------------ Receive data capture
 330  IF A$=K$ THEN 300 ----------------------------------- Receive data and send data checks
 340  FOR T=1 TO 200 :NEXT -------------------------------- Timing adjusement
 350  '
 360  PRINT "(METER OUTPUT)=" ;A$ ------------------------- Receive data display
 370  IF LOC(1) < 2 THEN 170 ELSE 320 -------------------- If there is no receive data, return to command entry.
 380  '
 390  *BCC'----------------------------------- ------------ BCC calculation routine
 400  MOJ=LEN(K$) :SUM=0 :BC$="" :BCC$="" ----------------- Obtain calculation range.
 410  FOR M=1 TO MOJ
 420  SUM=SUM+ASC(MID$(K$,M,1)) --------------------------- Calculation
 430  NEXT M
 440  BCC$=RIGHT$(HEX$(SUM),2) ---------------------------- HEX conversion of BCC
 450  K$=STX$+K$+RIGHT$(BCC$,1)+LEFT$(BCC$,1) ------------ Send data establishment
 460  RETURN
 470  END
```

Execution example (When communication device No. is set to 10)

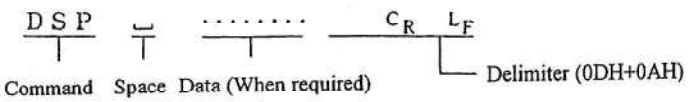
```
run
IS COMMAND ENTERED? ENQ20 ↵
SEND DATA 20
NO RESPONSE

IS COMMAND ENTERED? ENQ10 ↵
SEND DATA 10
(METER OUTPUT) = 10

IS COMMAND ENTERED? DSP ↵
SEND DATA DSPAE
          └─ BCC (CHECK SUM)
(METER OUT) =␣␣␣100042····· When display is set to 1000
             └─ BCC (CHECK SUM)
IS COMMAND ENTERED?
```

* These operation check programs are for the PC9801 manufactured by NEC
When other computers are used, create programs equal to the above samples. (When the baud rate is set to 9600 bps; the delimiter is set to CR•LF; and the SI-30 (manufactured by Sekisui Chemical Industry Co., Ltd.) is used as an RS-485 interface converter.)
The operation can also be checked using these programs but it cannot be warranted if these programs are used for the actual programs.

6. Command and response formats

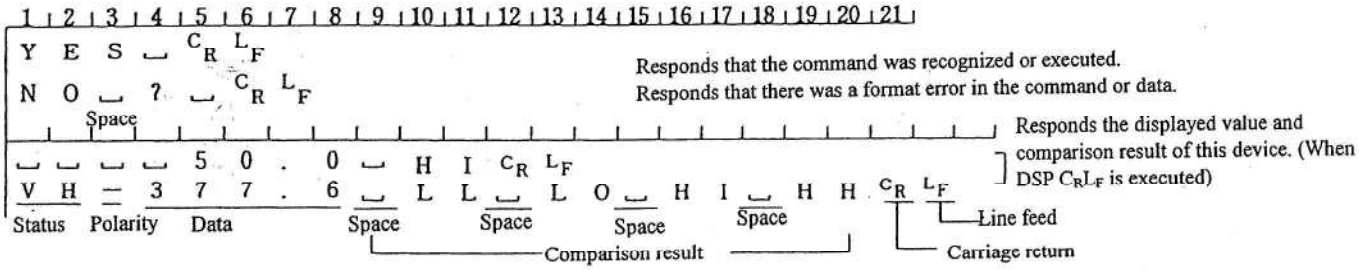
6-1. RS-232C command and response formats

1) Command (Host-computer side)



Note 1) For the DSP command, an error occurs if data is set. This is only for explaining the command function.

2) Response (Examaple)

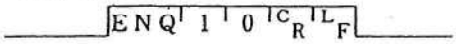


6-2 RS-485 command and response formats

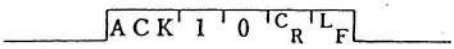
1) Communication establishment

Communication with the device is established by sending the device identification No. from the host computer side, thereby enabling data transmission.

a) Communication establishment (Device No. designation from the host computer side)
* For device No. 10



b) Response to communication establishment (Response from the meter)

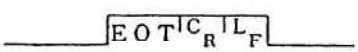


Note 1) Always specify device No. in 2 digits from 01 to 99. Device No. designation of 00 becomes invalid.
Note 2) There is no response if the specified device No. does not exist.
Note 3) Response time
Communication establishment: 40 ms max.
Actual communication: 60 ms max. (In free-run state)
(When data is read continuously, the sampling time is added on and after the 2nd time.)
Communication open: 20 ms max.

2) Communication open

When communication is made with any device other than that now under communication, first open communication as follows, then specify that device No. after the communication with the device is established according to the procedure in the above item. (Communication can also be conducted by specifying another device No. without opening the communication.)

a) Communication open(To be conducted from the host side)

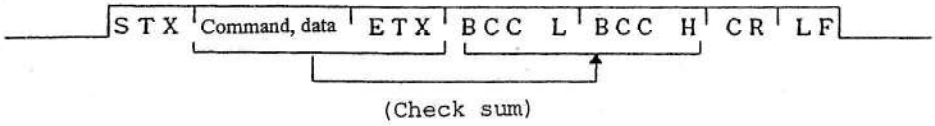


Note 1: No response to line open.

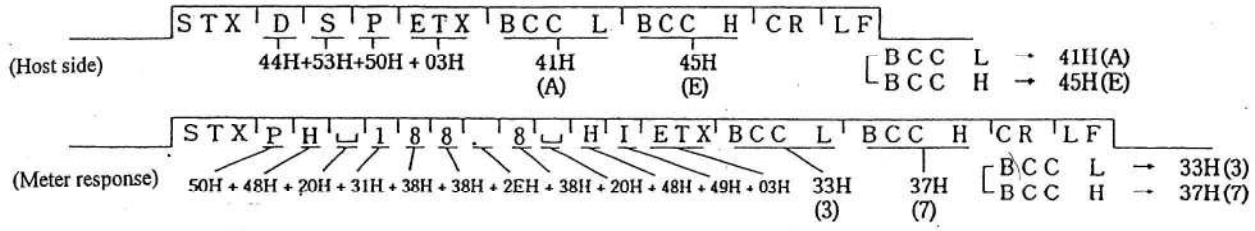
3) Format for data send/receive

a) Basic communication format

The command and data to be sent are totalized as binary digits. The upper 8 bits are divided into the upper and lower 4 bits respectively, then are sent as 2-digit hexadecimal characters (check sum).



Example of send/receive sum code



b) Actual communication format

As shown in the send/receive example, communication is conducted while the check sum procedure is performed. Therefore, always attach the check sum. For the character length of command or response data, see Command Table in item 7.

4) Control code

Control code	Hexadecimal	Name
STX	02 H	Start of Text
ETX	03 H	End of Text
EOT	04 H	End of Transmission
ENQ	05 H	Enquiry
ACK	06 H	Acknowledge

BCC: Block check character check sum

* No BCC is added to ACK, EOT and ENQ.
* BCC is added to and checked for both send and receive data.

5) ASCII Code table

Lower level \ Upper level	0	1	2	3	4	5	6	7
0	NUL	DLE	SPACE	0	@	P	'	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	,	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	|
C	FF	FS	,	<	L	\	l	|
D	CR	GS	−	=	M	]	m	]
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

* No lower case characters can be used for RS-485 programs.

7. Commands and formats

Any command other than MET, COM and RLY does not affect the measurement operation of the meter. If any command marked with [R] in the following table is executed, the RE (remote) LED on the front panel of the device lights. No control (start/hold, relay reset, peak hold or digital zero) can be performed from the screw terminal board on the rear panel of the device.
In addition, no comparison result is output for the RLY command.
For returning the above control to the screw terminal board, enter the E □ M (EXTERNAL □ MOVE) command; or for releasing the RLY command, enter the RCM command.
Thus, the RE (remote) LED is extinguished to enable the control from the terminal board, and the comparison result continues to be output .

No	Function	1 2 3 4 5 6 7 8 9 10 11 12 13	Charact. length	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Charact. length
7-1-1	Key operation response Key operation (double function) inhibit command state of this device	K E Y $_R$ $_F$	3	K E Y ␣ O F F $_R$ $_F$] Responds either one K E Y ␣ O N $_R$ $_F$] depending on the state of the device.	7 6
7-1-2	Key operation inhibit	K E Y ␣ O N $_R$ $_F$	6	Y E S ␣ ␣ $_R$ $_F$	5
7-1-3	Key operation inhibit release	K E Y ␣ O F $_R$ $_F$	6	Y E S ␣ ␣ $_R$ $_F$	5
7-2-1	Measured value] Response Comparison result] Responds the measured value, comparison result and the state of this device.	D S P $_R$ $_F$	3	␣ ␣ − 5 0 0 0 ␣ L L ␣ L O $_R$ $_F$ (Minus display)	13
				␣ ␣ ␣ 5 0 0 . 0 ␣ H I ␣ H H $_R$ $_F$ (When the decimal point lights)	14
				< = ␣ 8 6 5 . 2 ␣ L O $_R$ $_F$ (At overflow).	11
				P H ␣ 6 5 0 . 0 ␣ H I ␣ H H $_R$ $_F$ (At peak hold)	14
7-3-1	Protect response State of comparison set data change inhibit command during measurement operation	P R O $_R$ $_F$	3	P R O ␣ O F F $_R$ $_F$] Responds either one P R O ␣ O N $_R$ $_F$] depending on the state of the device.	7 6
7-3-2	Protect setting	P R O ␣ O N $_R$ $_F$	6	Y E S ␣ ␣ $_R$ $_F$	5
7-3-3	Protect release	P R O ␣ O F $_R$ $_F$	6	Y E S ␣ ␣ $_R$ $_F$	5
7-4-1	Relay reset response Remote control state	R E S $_R$ $_F$ (RELAY RESET)	3	R E S ␣ O F F $_R$ $_F$] Responds either one R E S ␣ O N $_R$ $_F$	7 6
7-4-2	Relay reset input terminal response Relay reset terminal state	E R A $_R$ $_F$ (EXTERNAL RESET ANSWER)	3	R E S ␣ O F F $_R$ $_F$] Responds either one. R E S ␣ O N $_R$ $_F$	7 6
7-4-3 [R]	Relay reset control Directly controlled from the host side. The terminal is ignored.	R E S ␣ O N $_R$ $_F$ (RELAY RESET ON) All relay outputs: OFF	6	Y E S ␣ ␣ $_R$ $_F$	5
		R E S ␣ O F $_R$ $_F$ Output according to the comparison result. (RELAY RESET OFF)	6	Y E S ␣ ␣ $_R$ $_F$	5
7-4-4	Relay reset control release Returns control to the input terminal.	E R M $_R$ $_F$ (EXTERNAL RESET MOVE)	3	Y E S ␣ ␣ $_R$ $_F$	5

No	Function		Character length		Character length
7-5-1	Peak hold response Remote control response	PVH$_{CR}$ $_{LF}$ (PEAK VALLEY HOLD)	3	PVH␣PH—OFF$_{CR}$ $_{LF}$] (At peak hold) PVH␣PH—ON$_{CR}$ $_{LF}$	10 9
7-5-2	Peak hold terminal response Peak hold terminal state	EPA$_{CR}$ $_{LF}$ (EXTERNAL PH, VH, PV ANSER)	3	PVH␣OFF$_{CR}$ $_{LF}$] Responds either one. PVH␣ON$_{CR}$ $_{LF}$	7 6
7-5-3	Peak hold setting No change can be made for PVH_□□_ON. Turn OFF once, then conduct the setting.	PVH␣PH$_{CR}$ $_{LF}$ (Peak hold display) (PEAK VALLEY HOLD → PEAK)	6	YES␣␣$_{CR}$ $_{LF}$	5
		PVH␣VH$_{CR}$ $_{LF}$ (Valley hold display) (PEAK VALLEY HOLD→ VALLEY)	6	YES␣␣$_{CR}$ $_{LF}$	5
		PVH␣PV$_{CR}$ $_{LF}$ (Peak valley hold display) (PEAK VALLEY HOLD → PEAK VALLEY)	6	YES␣␣$_{CR}$ $_{LF}$	5
7-5-4 [R]	Peak hold control Directly controlled from the host side. The terminal is ignored.	PVH␣ON$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$	5
		PVH␣OFF$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$	5
7-5-5	Peak hold value response Displayed PH, VH and PV are always stored. Responds their contents.	PVD$_{CR}$ $_{LF}$ (PEAK VALLEY HOLD DISPLAY)	3	PH␣␣␣100.0$_{CR}$ $_{LF}$] Simultaneously output. VH␣␣—250.0$_{CR}$ $_{LF}$ PV␣␣␣350.0$_{CR}$ $_{LF}$	9~10 9~10 9~10
7-5-6	Peak hold value clear Clears the contents of item 7-5-5. Then, updated by the next sampling.	PCL␣PH$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$ (Peak value clear)	5
		PCL␣VH$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$ (Valley value clear)	5
		PCL␣PV$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$ (Peak valley value clear)	5
7-5-7	Peak hold control release Returns control to the input terminal.	EPM$_{CR}$ $_{LF}$ (EXTERNAL PEAK HOLD MOVE)	3	YES␣␣$_{CR}$ $_{LF}$	5
7-6-1	Digital zero response	DZR$_{CR}$ $_{LF}$	3	DZR␣OFF$_{CR}$ $_{LF}$] Responds either one. DZR␣1000$_{CR}$ $_{LF}$	7 9~10
7-6-2	Digital zero terminal response State of the digital zero terminal	EZA$_{CR}$ $_{LF}$	3	DZR␣OFF$_{CR}$ $_{LF}$] Responds either one. DZR␣ON$_{CR}$ $_{LF}$	7 6
7-6-3 [R]	Digital zero control Directly controlled and set from the host side. The digital zero terminal is ignored.	DZR␣ON$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$	5
		DZR␣OFF$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$	5
		DZR␣1000$_{CR}$ $_{LF}$	5~8	YES␣␣$_{CR}$ $_{LF}$ (When "+1000" is subtracted)	5
7-6-4	Digital zero control release Returns control to the input terminal.	EZM$_{CR}$ $_{LF}$	3	YES␣␣$_{CR}$ $_{LF}$	5
7-6-5	Digital zero backup state response	BDZ$_{CR}$ $_{LF}$	3	BDZ␣OFF$_{CR}$ $_{LF}$] Responds either one. BDZ␣ON$_{CR}$ $_{LF}$	7 6
7-6-6	Digital zero backup control	BDZ␣OFF$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$	5
		BDZ␣ON$_{CR}$ $_{LF}$	6	YES␣␣$_{CR}$ $_{LF}$	5
		* As the digital zero value is stored even if the power is turned off, started up with the previous digital zero function activated when the power is turned on again even if the power is turned off at the DZR OFF state.			

No.	Function	1 2 3 4 5 6 7 8 9 10 11 12 13	Charact. length	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Charact. length
7-7-1	Start/hold response Present state of remote control	S T H C_R I_F (START/HOLD)	3	S T A R T ␣ C_R I_F H O L D ␣ ␣ C_R I_F] Responds either one depending on the state of this device.	6 6
7-7-2	Start/hold input terminal response State of the start/hold terminal	E S A C_R I_F (EXTERNAL S/H ANSWER)	3	S T A R T ␣ C_R I_F H O L D ␣ ␣ C_R I_F] Responds either one depending on the state of this device.	6 6
7-7-3 [R]	Start/hold control Directly controlled from the host side. The terminal is ignored.	S T H ␣ S C_R I_F (Start) (START/HOLD START)	5	Y E S ␣ ␣ C_R I_F	5
		S T H ␣ H C_R I_F (Hold) (START/HOLD HOLD)	5	Y E S ␣ ␣ C_R I_F	5
7-7-4	Start control Measurement operation is performed only once at the hold state and the result is output.	T C_R I_F	1	␣ ␣ ␣ 5 0 0 . 0 ␣ H I ␣ H H C_R I_F	10–14
7-7-5	Start/hold control release Returns control to the input terminal.	E S M C_R I_F (EXTERNAL S/H CONTROL MOVE)	3	Y E S ␣ ␣ C_R I_F	5
7-8-1	Relay output Photo-coupler output Control response	R L Y C_R I_F	3	R L Y ␣ O F F C_R I_F R L Y ␣ H H C_R I_F R L Y ␣ H I C_R I_F R L Y ␣ G O C_R I_F R L Y ␣ L O C_R I_F R L Y ␣ L L C_R I_F] Responds any one of them.	7 6 6 6 6 6
7-8-2 [R]	Relay output Photo-coupler output Control Outputs the HH, HI, GO, LO or LL relay or controls the photo-coupler output regardless of the comparison result.	R L Y ␣ H H C_R I_F	6	Y E S ␣ ␣ C_R I_F The HH LED flahses to turn on between a and COM of the HH relay. ON between c and e of the HH photo-coupler	5
		R L Y ␣ H I C_R I_F	6	Y E S ␣ ␣ C_R I_F The HI LED flahses to turn on between a and COM of the HI relay. ON between c and e of the HH photo-coupler	5
		R L Y ␣ G O C_R I_F	6	Y E S ␣ ␣ C_R I_F The GO LED flahses to turn on between a and COM of the GO relay. ON between c and e of the GO photo-coupler	5
		R L Y ␣ L O C_R I_F	6	Y E S ␣ ␣ C_R I_F The LO LED flahses to turn on between a and COM of the LO relay. ON between c and e of the LO photo-coupler	5
		R L Y ␣ L L C_R I_F	6	Y E S ␣ ␣ C_R I_F The LL LED flashes to turn on between a and COM of the LL relay. ON between c and e of the LL photo-coupler	5
		R L Y ␣ O F C_R I_F * The comparison result is not output only by the RLY␣OF command. It is output after the following "RCM" command is executed.	6	Y E S ␣ ␣ C_R I_F All of the HH, HI, GO, LO and LL LEDs are extinguished. The relay or photo-coupler is turned off.	5
7-8-3	Relay output Photo-coupler output Control release Returns to the normal state.	R C M C_R I_F (RELAY CONTROL MOVE)	3	Y E S ␣ ␣ C_R I_F	5

No	Function	1 2 3 4 5 6 7 8 9 10 11 12 13	Charact. length	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Charact. length
7-9-1	Remote control state response Responds the function set to remote mode.	R E A C_R I_F	3	N O ␣ ? ␣ C_R I_F (When no function control is performed in remote mode) R E S C_R I_F P V H C_R I_F (When the RES, PVH, DZR, STH or D Z R C_R I_F RLY function becomes effective in remote mode.) S T H C_R I_F (Delimited by the delimiter) R L Y C_R I_F	5 3 3 3 3 3
7-10-1	Sampling speed response Responds the contents of this device.	S M P C_R I_F (SAMPLING SPEED ANSWER)	3	S M P ␣ ␣ 1 C_R I_F When "1" is set S M P ␣ 2 0 C_R I_F When "20" is set	6 6
7-10-2	Sampling speed control Directly sets the sampling from the host side.	S M P ␣ 2 0 C_R I_F	5~6	Y E S ␣ ␣ C_R I_F	5

Sampling period (ms)					
Setting	50Hz	60Hz	Setting	50Hz	60Hz
1	80.0	66.6	10	800.0	666.6
2	160.0	133.2	20	1600.0	1333.2
4	320.0	266.4	40	3200.0	2666.4
8	640.0	532.8	80	6400.0	5332.8

7-11-1	Moving average response Responds the state of this device.	M A V C_R I_F	3	M A V ␣ O F F C_R I_F M A V ␣ O N = 1 6 C_R I_F Responds either one. — When set to 16 times	7 9
7-11-2	Moving average control Performs control or release by setting the number of moving averaging times from the host side.	M A V ␣ N C_R I_F * N is as shown in the following table.	5~6	Y E S ␣ ␣ C_R I_F	5

N=0	No. of moving averaging times
N=2	No. of moving averaging times Twice
N=4	No. of moving averaging times 4 times
N=8	No. of moving averaging times 8 times
N=16	No. of moving averaging times 16 times
N=32	No. of moving averaging times 32 times

7-12-1	Range response Responds the range set by this device.	R N G C_R I_F	3	R A N G E ␣ 1 3 C_R I_F	8
7-12-2	Range setting Directly sets the range from the host side.	R N G ␣ 1 3 C_R I_F	6	Y E S ␣ ␣ C_R I_F	5
7-13-1	Peak hold comparison response Responds the state of this device.	C P V C_R I_F	3	C P V ␣ O N C_R I_F C P V ␣ O F F C_R I_F Responds either one.	6 7
7-13-2	Peak hold comparison control Makes effective comparison with the peak, valley or peak valley hold value from the host side.	C P V ␣ O N C_R I_F Set to peak hold comparison prior to factory shipment.	6	Y E S ␣ ␣ C_R I_F	5
7-13-3	Peak hold comparison control release Returns to normal comparison.	C P V ␣ O F F C_R I_F Performs comparison operation by input value for CPV OF.	6	Y E S ␣ ␣ C_R I_F	5
7-14-1	Fixed zero response Responds the state of this device.	F I X C_R I_F	3	F I X ␣ O F F C_R I_F F I X ␣ O N C_R I_F Responds either one.	7 6
7-14-2	Fixed zero control Makes effective fixed zero from the host side.	F I X ␣ O N C_R I_F If the above is executed, the 10° digit is forcibly set to zero to become effective for data output..	6	Y E S ␣ ␣ C_R I_F	5
7-14-3	Fixed zero control release Returns to normal operation.	F I X ␣ O F F C_R I_F	6	Y E S ␣ ␣ C_R I_F	5

No.	Function	1 2 3 4 5 6 7 8 9 10 11 12 13	Charact. length	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Charact. length
7-15-1	Maximum/minimum value response	M A X ␣ C_R I_F	3	M A X ␣ ␣ 1 0 0 . 0 C_R I_F M I N ␣ — 2 5 0 . 0 C_R I_F M — M ␣ ␣ 3 5 0 . 0 C_R I_F Simultaneously output.	9~10 9~10 9~10
7-15-2	Maximum/minimum value clear Clears the contents of item 7-15-1. Updated by the next sampling.	M C L ␣ M A C_R I_F (Maximum value clear)	6	Y E S ␣ ␣ C_R I_F	5
		M C L ␣ M I C_R I_F (Minimum value clear)	6	Y E S ␣ ␣ C_R I_F	5
		M C L ␣ M M C_R I_F (Clear of the difference between the maximum and minimum values)	6	Y E S ␣ ␣ C_R I_F	5
7-16-1	Pattern select response Responds the pattern set by this device.	P S L C_R I_F	3	P — 1 C_R I_F	3
7-16-2	Pattern setting Directly sets the pattern from the host side.	P S L ␣ 8 C_R I_F Pattern select response and setting are effective only when the condition data setting of P S E L is set to i n S .	5	Y E S ␣ ␣ C_R I_F	5
7-17-1	Baud rate response Responds the state of this device.	B P S C_R I_F	3	B P S ␣ 9 6 0 0 C_R I_F	8~9
	Baud rate setting Sets the baud rate from the host side. The baud rate thus set becomes effective just when the power is turned on again.	B P S ␣ 1 9 2 0 0 C_R I_F Baud rates to be set: 2400 / 4800 / 9600 / 19200	9	Y E S ␣ ␣ C_R I_F	5
7-18-1	Condition data response Responds the condition data set by this device.	A L L C_R I_F	3	P V H ␣ ␣ P H C_R I_F R A N G ␣ 1 2 C_R I_F S M P ␣ ␣ 1 C_R I_F C Y C L ␣ 5 0 C_R I_F M A V ␣ ␣ O F F C_R I_F F I X ␣ ␣ O F F C_R I_F B L N K ␣ O F F C_R I_F P S E L ␣ I N S C_R I_F S — H ␣ ␣ A C_R I_F B A U D ␣ 9 6 0 0 C_R I_F B . U P ␣ ␣ O F F C_R I_F P R O ␣ ␣ O F F C_R I_F Simultaneously output.	7 7 6~7 7 7~8 7~8 7~8 8 6 9~10 7~8 7~8
7-19-1	Scaling data response Measurement operation suspended Scaling data setting and change Each data is output in order by the input of N or J. Returns to normal operation by the input of R. " n E t " appears during MET command execution.	M E T C_R I_F	3	P — ␣ 1 ␣ C_R I_F	7
		N C_R I_F	1	F S C ␣ ␣ ␣ 1 0 0 . 0 C_R I_F	10~11
		N C_R I_F * Enter the N command when moving to the next item.	1	F I N ␣ ␣ ␣ 1 0 0 . 0 C_R I_F	10~11
		N C_R I_F	1	O F S ␣ ␣ ␣ ␣ ␣ 0 . 0 C_R I_F	10~11
		N C_R I_F	1	O I N ␣ ␣ ␣ ␣ ␣ 0 . 0 C_R I_F	10~11
		1 0 0 C_R I_F * When OIN data is changed to 100	3	O I N ␣ ␣ ␣ ␣ 1 0 . 0 C_R I_F	10~11
		N C_R I_F	1	A O H I ␣ ␣ 1 0 0 . 0 C_R I_F	10~11
		N C_R I_F	1	A O L O ␣ ␣ ␣ ␣ 0 . 0 C_R I_F	10~11
		N C_R I_F	1	D E P ␣ ␣ 1 C_R I_F	6
		R C_R I_F	1	Y E S ␣ ␣ C_R I_F	5
	Scaling data setting and change	M E T C_R I_F	3	P — ␣ 1 ␣ C_R I_F	5
		J C_R I_F * Enter J when jumping for each item.	1	F S C ␣ ␣ ␣ 1 0 0 . 0 C_R I_F	10~11
		J C_R I_F	1	A O H I ␣ ␣ 1 0 0 . 0 C_R I_F	10~11
		J C_R I_F	1	D E P ␣ ␣ 1 C_R I_F	6
		3 C_R I_F * When the position of the decimal point is changed.	1	D E P ␣ ␣ 3 C_R I_F	6
		R C_R I_F	1	Y E S ␣ ␣ C_R I_F	5

No.	Function		Charact. length		Charact. length
7-19-2	Scaling data setting and change During measurement operation	M E * CR LF * Both N and J are the same as for "MET." If the condition data setting of P r o is turned o n, the scaling data cannot be set or changed. If there is no communication, returns to the normal state about 16 sec later.	3	P — ␣ 1 ␣ CR LF (Same as for "MET")	5
		R CR LF	1	Y E S ␣ ␣ CR LF	5
7-19-3	Direct setting Sets measured data to scaling data. Cannot be set by "ME*."	M E T CR LF *When measured value is set to FSC data.	3	P — ␣ 1 ␣ CR LF	5
		N CR LF	1	F S C ␣ ␣ ␣ 1 0 0 . 0 CR LF	10~11
		S CR LF Measurement started	1	Y E S ␣ ␣ CR LF	5
		H CR LF Measurement suspended	1	F S C ␣ ␣ ␣ 1 2 1 . 0 CR LF (Measured value)	10~11
		1 2 0 0 CR LF Measured value is corrected to 1200.	1~5	F S C ␣ ␣ ␣ 1 2 0 . 0 CR LF	10~11
		R CR LF	1	Y E S ␣ ␣ CR LF	5
7-20-1	Comparison data response Measurement operation suspended Comparison data setting and change Each data is output in order by the input of N or J. Returns to normal operation by the input of R. "c o n" appears during COM command execution.	C O M CR LF	3	P — ␣ 1 ␣ CR LF	5
		N CR LF	1	S — H H ␣ ␣ 5 0 0 . 0 CR LF	10~11
		N CR LF	1	S — H I ␣ ␣ 1 0 0 . 0 CR LF	10~11
		N CR LF * Enter the N command when moving to the next item.	1	S — L O ␣ ␣ ␣ 5 0 . 0 CR LF	10~11
		N CR LF	1	S — L L ␣ ␣ ␣ ␣ 0 . 0 CR LF	10~11
		1 0 0 CR LF * When changing S-LL data to 100.	1	S — L L ␣ ␣ ␣ 1 0 . 0 CR LF	10~11
		N CR LF	1	H — H H ␣ ␣ ␣ ␣ 0 . 0 CR LF	10~11
		N CR LF	1	H — H I ␣ ␣ ␣ ␣ 0 . 0 CR LF	10~11
		N CR LF	1	H — L O ␣ ␣ ␣ ␣ 0 . 0 CR LF	10~11
		N CR LF	1	H — L L ␣ ␣ ␣ ␣ 0 . 0 CR LF	10~11
		R CR LF * Enter the R command to finish the setting..	1	Y E S ␣ ␣ CR LF	5
	Comparison data setting and change	C O M CR LF	3	P — ␣ 1 ␣ CR LF	5
		J CR LF	1	S — H H ␣ ␣ 5 0 0 . 0 CR LF	10~11
		J CR LF * Enter the J command when jumping for each data.	1	H — H H ␣ ␣ ␣ ␣ 0 . 0 CR LF	10~11
		R CR LF	1	Y E S ␣ ␣ CR LF	5
7-20-2	Comparison data setting and change During measurement operation	C O * CR LF * Both N and J are the same as for "COM". If the condition data setting of P r o is turned o n, the comparison data cannot be set or changed. If there is no communication, returns to the normal state about 16 sec later.	3	P — ␣ 1 ␣ CR LF	5
		R CR LF	1	Y E S ␣ ␣ CR LF	5
7-20-3	Direct setting Sets measured value to comparison data. No setting can be made by "CO*."	C O M CR LF	3	P — ␣ 1 ␣ CR LF	5
		N CR LF * When setting the setpoint to S-HH data.	1	S — H H ␣ ␣ 5 0 0 . 0 CR LF	10~11
		S CR LF Measurement started	1	Y E S ␣ ␣ CR LF	5
		H CR LF Measurement suspended	1	S — H H ␣ ␣ 3 2 5 . 0 CR LF (Merasured value)	10~11
		3 2 0 0 CR LF Measured value is corrected to 3200.	1~5	S — H H ␣ ␣ 3 2 0 . 0 CR LF	10~11
		R CR LF	1	Y E S ␣ ␣ CR LF	5
7-21-1	Error message response Normal			Y E S ␣ ␣ CR LF	5
7-21-2	Error Format error Undefined command			N O ␣ ? ␣ CR LF	5
7-21-3	Error out of specs. When misoperation is performed or data out of the range is set.			E r r o r ␣ CR LF	6

No	Function	1 2 3 4 5 6 7 8 9 10 11 12 13	Charact. length	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Charact. length
7-21-4	Internal memory error	* For DATA_LOST_□ error response, noise exceeding the allowable noise level of this device may exert a bad influence. Therefore, externally install such a noise absorption circuit as a line filter, etc.		D A T A ␣ L O S T ␣ C O N D C_R L_F (Condition data error) Recovery: Re-set the condition data by the operation switch of this device. D A T A ␣ L O S T ␣ C O M □ C_R L_F (Comparison data error) (□→Pattern No.) Recovery: Re-set the comparison data by the COM command. D A T A ␣ L O S T ␣ M E T □ C_R L_F (Scaling data error) (□→Pattern No.) Recovery: Re-set the scaling data by the MET command. D A T A ␣ L O S T ␣ D . Z C_R L_F If there is an error in the DZ memory value when the DZ function is controlled from the terminal side. Recovery: Write the digital zero value. D A T A ␣ L O S T ␣ □ C_R L_F (□→A~G) Recovery: Turn the power on again. If no recovery is made, contact Asahi sales agent or Asahi directly.	14 13 13 13 11
7-22-1	RS-485 specification only Communication device No. response Responds the state of this device.	A D R C_R L_F	3	A D R ␣ 1 0 B 5 C_R L_F When communication device No. is set to "10" Check sum	8
7-22-2	Communication device No. setting	A D R ␣ 0 5 C_R L_F	6	Y E S ␣ ␣ 4 3 C_R L_F	7

8. Detailed command description

8-1 Moving average

The moving average is computed digitally using a software filter. This is effective for reducing the influence of noise contained in input signals. The more the number of moving averaging times, the more effective for noise rejection .

Setting	No. of moving averaging times
N = 0	Released
N = 2	Twice
N = 4	4 times
N = 8	8 times
N = 16	16 times
N = 32	32 times

* See Item 7-11-1.

Example: MAV␣8 C_R L_F

The above shows a case in which the number of moving averaging times is set to 8, but time (t) until the displayed value reaches 100% when the input is changed stepwise becomes as follows.

t (SEC) = No. of moving averaging times × 1/Sampling speed (tmes).

⚠ **Precauions:**

(1) The contents of this manual may subject to change without prior notice.
(2) This manual is carefully prepared. However, if any mistake or omission is found, contact your nearest Watanabe sales agent or Watanabe directly.
(3) As a rule, Watanabe is not responsible for the operation result of this device rgardless of the description in item (2) above.

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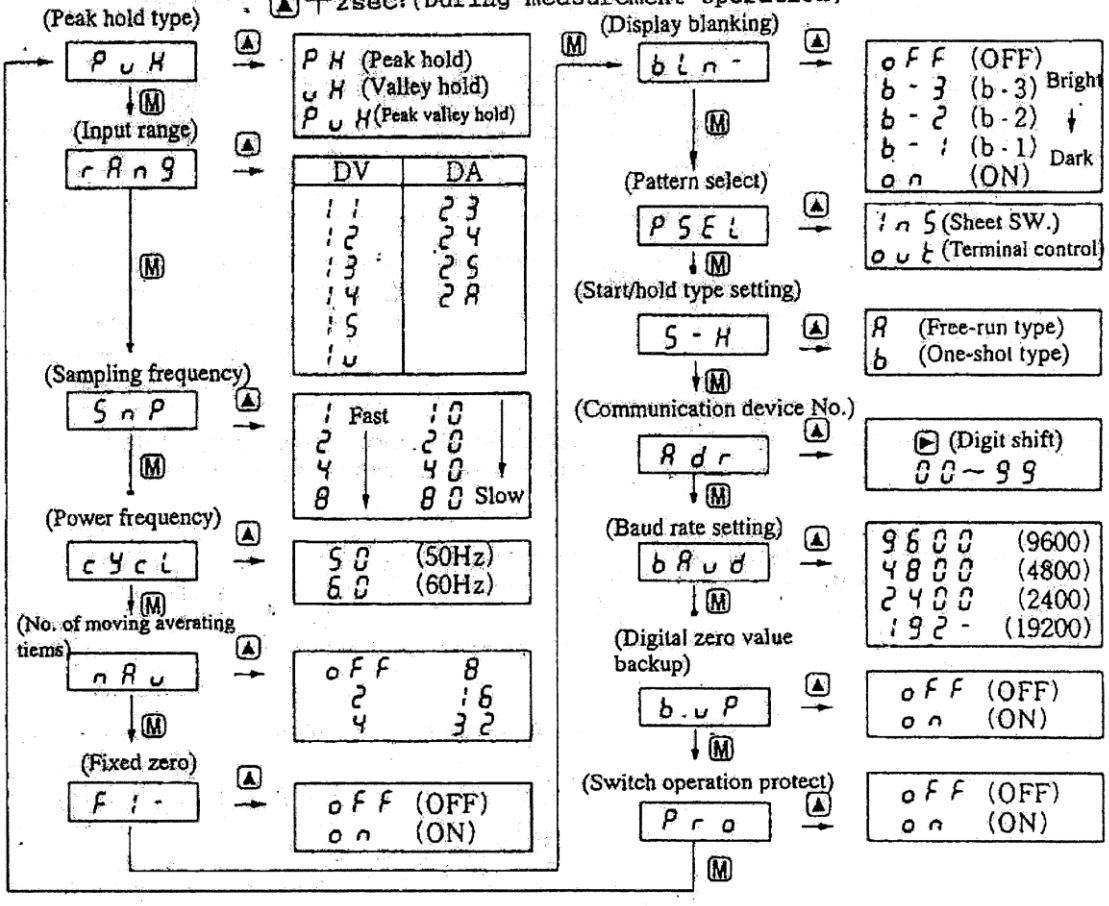
Operation of each mode

● Condition data setting (E)+(▲) : (Measurement operation suspended)
(▲)+2sec: (During measurement operation)

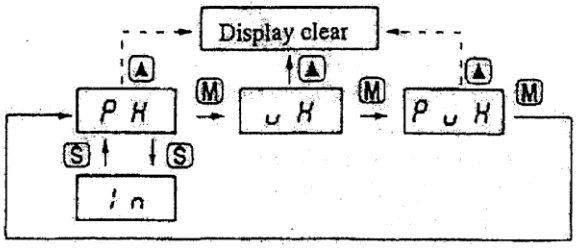


- The set data becomes effective just when the (E) switch is pressed and the meter returns to the measurement state.
- Each setting is made by pressing the (▶) or (▲) switch.
- If the switch is not operated for more than 10 sec during measurement operation, the meter is automatically rest (measurement state).

● Pattern selection
(S)+(▲): The pattern changes from P-1 to P-8 every time the sheet switches are pressed.
- No condition data can be selected with "PSEL" (pattern control selection) set to "out".

● HH,HL/HI,LO comparison setpoint display selection
(S)+(▶): The comparison setpoint (HH, LL or HI, LO) is monitored by pressing the sheet switches.

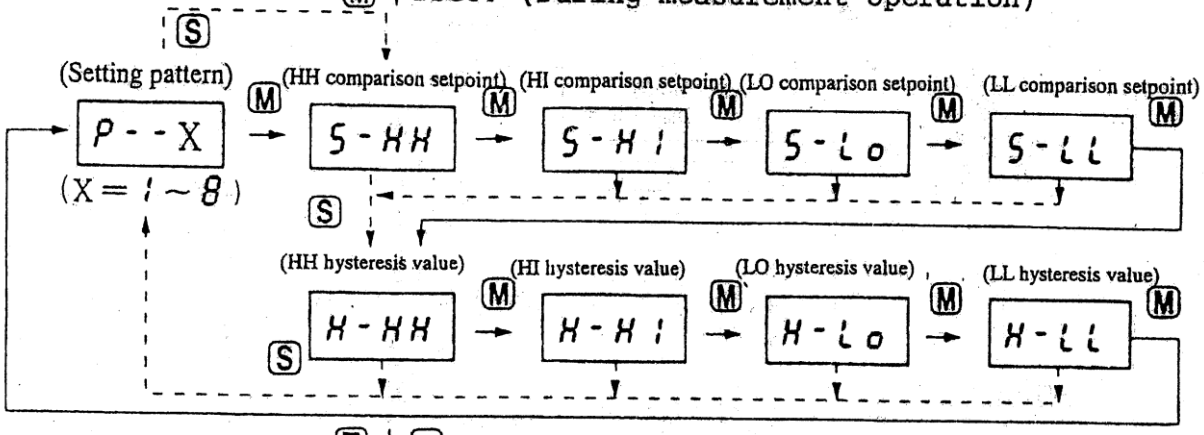
● Peak valley value/Display input value
(S)+(M) :



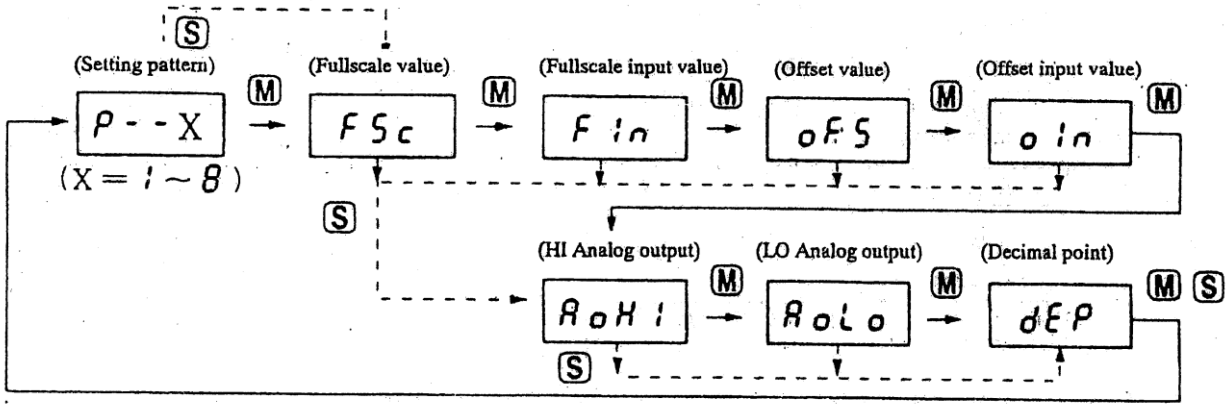
- The comparison setpoint display is selected just when the (E) switch is pressed.

Operation of each mode

● **Comparison data setting** E+M: (Measurement operation suspended)
M+2sec: (During measurement operation)

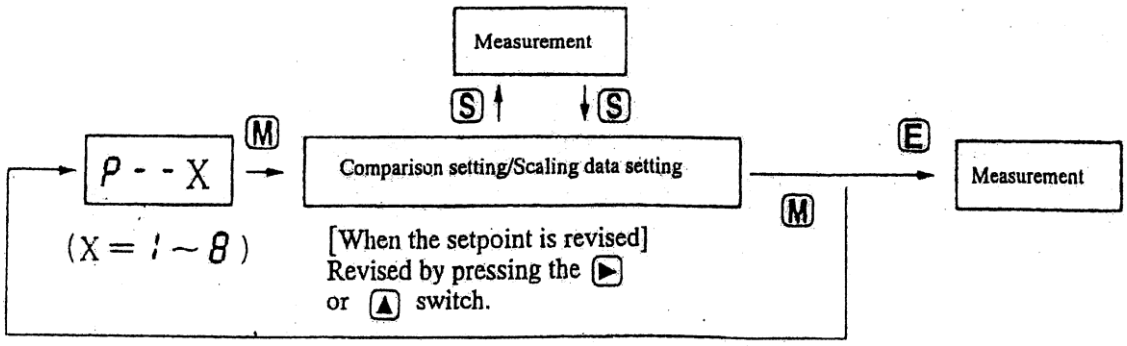


●**Scaling data setting** E+▶: (Measurement operation suspended)
▶+2sec: (During measurement operation)



- The set data becomes effective just when the E switch is pressed, and the meter returns to the measurement state.
- Each setpoint can be set by pressing the ▶ or ▲ switch. After the switch is pressed twice, the meter is set to the setting state.
- If the switch is not operated for more than 16 sec during measurement operation, the meter is automatically reset (measurement state).
- No condition data can be selected with "Pro" (protect function) set to "on."
- The S switch is used for a jump switch and is effective only during measurement operation. (When measurement operation is suspended: Direct setting function)

● **Direct setting** (Effective only when measurement operation is suspended)



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