Digital Scaling Panel Meter
A5□□□-16-□□
Frequency Measurement Unit User's Manual

Thank you for purchasing our Digital Scaling Panel Meter (A5000 series).
This manual describes how to handle and connect this product.
If the product has a communication function, please download and read the communication user's manual from our website.
(https://www.watanabe-electric.co.jp/en/)

● SUPPLIED ITEMS

Meter	1 unit
Mounting bracket (installed)	2 pieces
Mounting bracket fixing screws (installed)	2 pieces
Power terminal (installed)	1 piece (2P)
Input terminal (installed)	1 piece (3P)
External control terminal (installed)	1 piece (4P)
Comparison output terminal (installed*)	1 piece (8P) ＊When optional output is selected
Analog output terminal (installed*)	1 piece (3P) ＊When optional output is selected
Unit label	1 sheet
User's manual (this manual)	1 part

1. BEFORE USING THE PRODUCT

1－1. Model Codes

Please make sure that the product you receive matches the model codes of your order.

A5 ① ② ③ - ④ - ⑤

Series	① Power supply	② Display	③ Output	④ Input	⑤ Identification	Description
A5						A5000 series
	1					100 to 240VAC ±10%
	2					9 to 60VDC
		1				Single display
		2				Multi-display
			0			None
			1			Comparison outputs
			2			Analog output
			3			RS-232C communication
			4			RS-485 communication
			5			Comparison outputs + Analog output
			6			Comparison outputs + Analog output + RS-232C communication
			7			Comparison outputs + Analog output + RS-485 communication
				01		DC voltage measurement (±99.99mV)
				02		DC voltage measurement (±999.9mV/±9.999V/±99.99V/±600V)
				03		DC current measurement (±9.999mA/±99.99mA/±999.9mA)
				04		AC voltage measurement (Average) (99.99mV/999.9mV/9.999V)
				05		AC voltage measurement (Average) (99.99V/600V)
				06		AC voltage measurement (True RMS) (99.99mV/999.9mV/9.999V)
				07		AC voltage measurement (True RMS) (99.99V/600V)
				08		AC current measurement (Average) (9.999mA/99.99mA/999.9mA)
				09		AC high current measurement (Average) (5A)
				10		AC current measurement (True RMS) (9.999mA/99.99mA/999.9mA)
				11		AC high current measurement (True RMS) (5A)
				12		Resistance measurement
				13		Thermocouple measurement
				14		Resistance temperature detector measurement
				15		Frequency measurement (Open Collector, Logic, Magnetic)
				16		Frequency measurement (Input 50V to 500Vrms)
				17		Load cell measurement (Strain gauge)
				18		Process signal measurement (1 to 5V/4 to 20mA)
					R1	Standard
					S1	Custom

＊ If the comparison output is not selected for the above product models, the HI, GO, and LO judgment indicators (Lamps) will not turns on.

2. PRECAUTIONS FOR USE

2－1. Environments and Conditions of Use

Please do not use the product under the following circumstances.
It might cause malfunctions and shortening the life.

1) Ambient temperature of out of 0 to 50℃.
2) Ambient humidity of out of 35 to 85%, or freezing condensing.
3) High dust or metallic powder level.
(Storing in a dust-proof chassis and a countermeasure against heat dissipation are required.)
4) Environment of corrosive gas, salty air or oily smoke.
5) Environment of much vibration or impact.
6) Environment of rain or water drops (Except the front panel).
7) Environment of strong electromagnetic field or much exogenous noise.

Conditions of use

1) Please use this equipment at an altitude of up to 2000 m.
2) This equipment is compliant with installation Category Ⅱ and Pollution Degree 2 environment.

⚠ WARNING

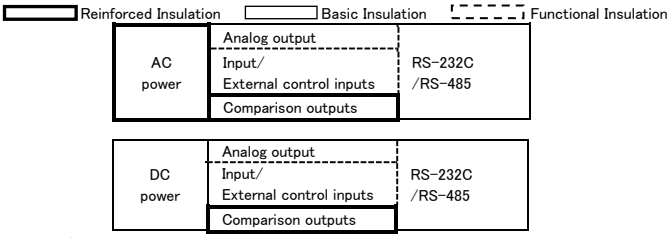
① Do not use this product as a part of equipment which aimed at life maintenance of human bodies.
② Please avoid usages of this product which bring physical accident or property damage when it breaks down.

⚠ CAUTION

① Please avoid live line works. It may cause an electric shock, troubles or a burnout of the product by the short circuit or a fire.
② Paying attention to the circuit diagram, connect wires to this product carefully. An inappropriate connection may cause troubles of the product, a fire or an electric shock.
③ Please use the power supply voltage, input and load within the specification range. Otherwise, it may result in a fire, electrical shock, or malfunction.
④ Never attempt to disassemble or modify this product. It may cause a breakdown, an electric shock or a fire.
⑤ This product is a precision measuring instrument. Please be careful not to add the strong shock to this product by falls and so on.
⑥ Please use wire which has appropriate specifications. Inappropriate wire may cause a fire because of heat generation.
⑦ After tightening screws, confirm that the screws do not loosen. A looseness of screws may cause a malfunction of the product, a fire or an electric shock.
⑧ An excessive tightening of screws may damage terminals or screws. A poor tightening of screws may cause a malfunction of the product, a fire or an electric shock.
⑨ This product is a general-purpose product for general industrial use. Please take safety measures to prevent danger in the unlikely event that this product breaks down or an abnormality occurs due to external factors.

2－2. Installation and Connection

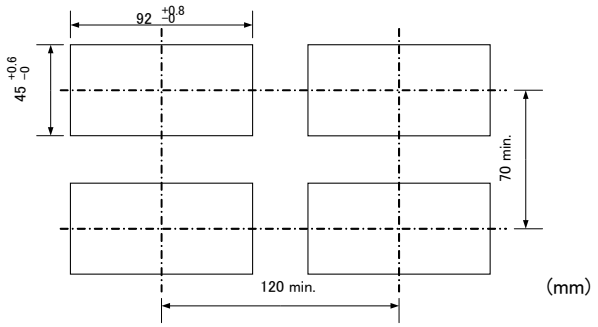
1) Please read this manual carefully before setting and connecting, be performed by a person having a specialized technique.
The insulation class of this product is as shown by the figure below. Please confirm that the insulation class satisfies a use condition prior to setting.



2) Do not wire the power supply line, input signal lines and output signal lines near noise sources or relay drive lines.
3) Do not bundle the lines with noise-generating lines or store them in the same duct, as this may cause malfunction.
4) This product works functionally normally right after power activation, but requires 30 minutes warming to satisfy all performance requirements.

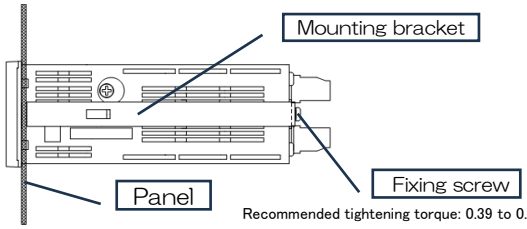
3. DIMENSIONS OF CUTTING PANEL

Panel cut dimensions are as shown by the figure below.



4. PANEL MOUNTING METHOD

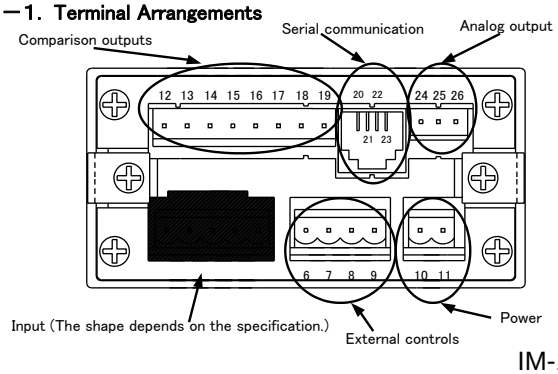
When mounting the unit on a panel, remove the two mounting brackets on the sides of the case. Insert it from the front of the panel and fix it with the mounting bracket from the rear of the panel (See the diagram below).



Recommended tightening torque: 0.39 to 0.49 Nm
Recommended panel thickness: 0.8 to 5 mm

5. CONNECTING TERMINALS

5－1. Terminal Arrangements



5−2. Wiring to Removable Screw Terminal Block

Except for analog output (2P, 3P, 4P, 8P)

① Use a flat-head screwdriver to turn the screw and open the wire insertion hole.
(Compatible flat head screwdriver: M2.5 (PH1 thickness of 0.6mm x width of 3.5mm))

② Insert the wire into the wire holes and close the holes by turning the screw with a screwdriver.
(Applicable wire: Single wire AWG28−12, Stranded wire AWG30−12 Stripping length: 7−8mm)
Recommended tightening torque: 0.55N・m

Analog output (3P)

① Use a flat-head screwdriver to turn the screw and open the wire insertion hole.
(Compatible flat head screwdriver: M2 (PH0 thickness of 0.4mm x width of 2.5mm))

② Insert the wires into the wire holes and close the holes by turning the screws with a screwdriver.
(Applicable wire: Single wire AWG28−14, Stranded wire AWG28−14 Stripping length: 7−8mm)
Recommended tightening torque: 0.22N・m

＊When inserting two wires into the above terminals, please use wires of the same material and diameter.

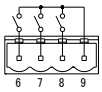
5−3. Terminal Description

5−3−1. Input Signals

Terminals	Name	Description
1	HI	Input terminal
2	NC	Do not connect this terminal.
3	LO	Input terminal

5−3−2. External Controls

<Wiring example>



Terminals	Name	Description
6	HOLD	Hold function control terminal Enabled when shorted with COM(9) terminal
7	DZ	Digital Zero function control terminal Enabled when shorted with COM(9) terminal
8	PH	Peak hold function control terminal Enabled when shorted with COM(9) terminal
9	COM	External control common terminal

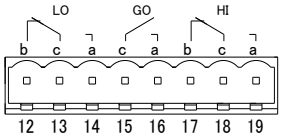
5−3−3. Power

Terminals	Name	Description
10	POWER	Power terminal (Without polarity for both AC and DC)
11	POWER	Power terminal (Without polarity for both AC and DC)

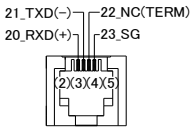
5−3−4. Comparison Outputs (Optional Output Model)

Terminals	Name	Description	
12	LO−b	LO output terminal (b−contact)	(ON when LO is off)
13	LO−c	Common terminal for LO output	(Common)
14	LO−a	LO output terminal (a−contact)	(ON when LO is lit)
15	GO−c	Common terminal for GO output	(Common)
16	GO−a	GO output terminal (a−contact)	(ON when GO is lit)
17	HI −b	HI output terminal (b−contact)	(ON when HI is off)
18	HI −c	Common terminal for HI output	(Common)
19	HI −a	HI output terminal (a−contact)	(ON when HI is lit)

<Internal circuit of relay contact>



5−3−5. Serial Communication (Modular Jack: RJ14 6-pole 4-core) (Optional Output Model)



RS−232C		
Terminals	Name	Description
20	RXD	RS−232C receive data terminal
21	TXD	RS−232C transmit data terminal
22	NC	Do not connect this terminal
23	SG	Common terminal for communication function (Circuit signal GND)

RS−485		
Terminals	Name	Description
20	+	RS−485 non−inverting signal (+)
21	−	RS−485 inverting signal (−)
22	TERM	RS−485 termination resistor terminal
23	SG	Common terminal for communication function (Circuit signal GND)
＊If terminals 21 and 22 are shorted, a 200Ω termination resistor will be enabled.		

⚠CAUTION

Do not wire a shield to the "SG" terminal of the instrument. Communication may not be possible.

<RS−232C connection example>

25−PIN D−sub (female)

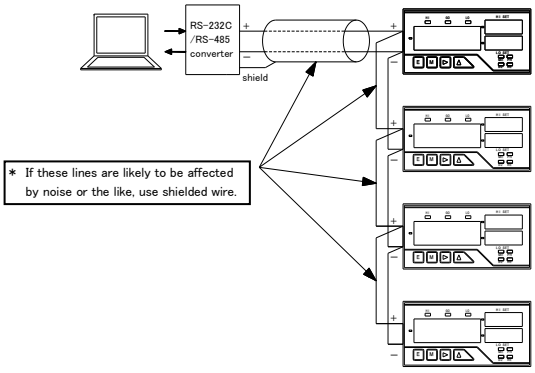
Pin	Signal		Pin	Signal
2	TXD	→	20	RXD
3	RXD	←	21	TXD
4	RTS	⌐		
5	CTS	⌐ ＊Short circuit at connector		
7	SG	—	23	SG

9−PIN D−sub (female)

Pin	Signal		Pin	Signal
2	RXD	←	21	TXD
3	TXD	→	20	RXD
5	SG	—	23	SG
7	RTS	⌐		
8	CTS	⌐ ＊Short circuit at connector		

＊The host side CTS and RTS terminals connection is a typical example of a connection for hardware control. Please check with the system designer for details before making the connection.

<RS−485 connection example>



＊ To enable the termination resistor, short−circuit terminals 21 and 22.

5−3−6. Analog Output (Optional Output Model)

Terminals	Name	Description
24	COM	Common terminal for analog output (GND for output circuit)
25	A−OUT	Current output terminal (4 to 20mA)
26	V−OUT	Voltage output terminal (0−1V, 0−10V, 1−5V)

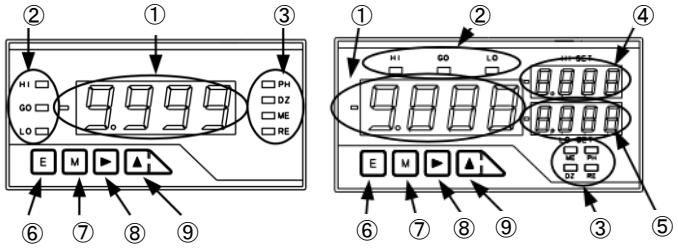
⚠CAUTION

By changing the analog output type (Voltage, Current) setting, the terminal to be connected will also change.

6. COMPONENTS AND THEIR FUNCTION

The front panel design differs depending on the display unit selected.

＜Single Display＞ ＜Multi-Display＞



	Name		Main functions: During measurement	Main functions: During parameter setup
①	Main display		・Indicates the measured value. ・Indication of contents in each monitor mode.	Indicates information on the parameter to be set.
②	Judgment indicators	HI	・Indication of the judgment result. (Lights up when HI judgment value < Measured value)	
		GO	・Indication of the judgment result. (Lights up when LO judgment value ≦ Measured value ≦ HI judgment value)	
		LO	・Indication of the judgment result. (Lights up when measured value < LO judgment value)	
③	Function indicators	PH	・Turns on when each holds (PH, VH, PVH) are ON.	
		DZ	・Turns on when "Digital Zero" is ON.	
		ME	・Turns on when "Digital Zero backup" is ON.	
		RE	・Turns on when remotely controlled via communication.	
④	Sub display 1 (Top right 7 SEG)		・Indication of HI side judgment value. ・Indication of item in each monitor mode.	
⑤	Sub display 2 (Bottom right 7SEG)		・Indication of LO side judgment value. ・Indication of contents in each monitor mode.	
⑥	Enter key (E)		・Used when changes modes. ・Changes from monitor mode to comparison judgment value indicators. ・Changes to measured value indicator when in single display.	Return to measurement
⑦	Mode key (M)		・Used when changes modes. ・Used to turn "Digital Zero" ON/OFF.	Selects the item to be set.
⑧	Shift key (▶)		・Changes to the shift function setup ・Changes to HI judgment value indicator. ・Changes monitor mode. (Press and hold for about 1 second.) ・Changes to parameter confirmation mode. ((E) + (▶))	Change selected digit.
⑨	Increment key (▲)		・Used when changes modes. ・Used to turn "Digital Zero" ON/OFF ・Reset in monitor mode of max/min/(max−min)/Input. (Press and hold for about 1 second.)	Changes the value or content of the selected digit. (Increment for values)

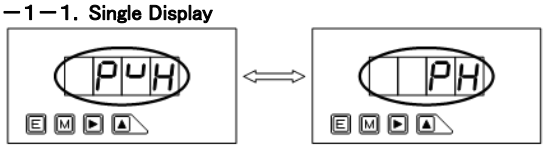
＊ Monitor mode : Indicates input value/max value/min value/(max value − min value)

＊ ②The judgment indicators turns on only when the comparison output is provided.

7. PARAMETER SETUP

7－1. Differences in Display Units

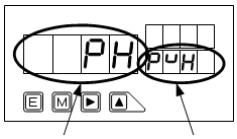
7－1－1. Single Display



Parameter name　　Setup contents

＊ When the parameter name is indicated, pressing the Mode key (M) makes it switch to the parameter content display.
＊ When the parameter contents are indicated, pressing the Mode key (M) makes it switch to the next parameter.
＊ If no key is pressed for 8 seconds while the parameter content is indicated, the indication will return to the parameter name.

7－1－2. Multi-Display



Setup contents　　Parameter name

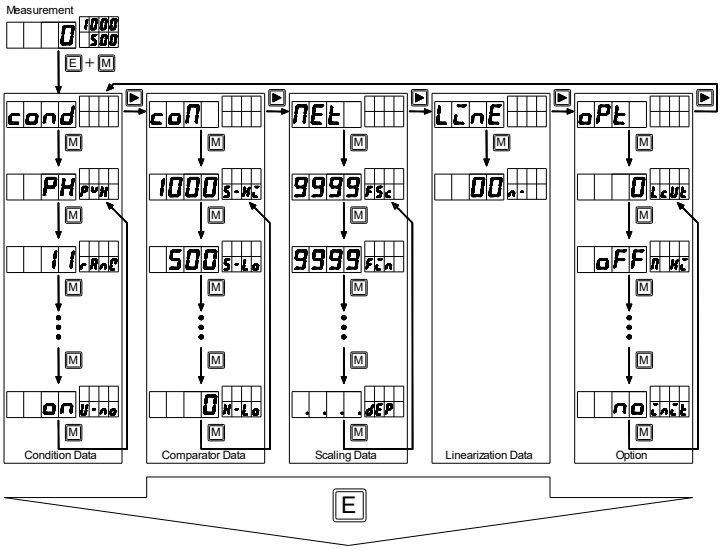
＊ Pressing the Mode key (M), indicates the next parameter.

7－2. Parameter Groups

Each parameter group is as shown in the table below.

Indication	Group name	Contents
COND	Condition Data	Parameters related to basic operations, each function and optional functions such as measurement range, power supply frequency sampling rate, etc.
COM	Comparator Data	Parameters related to comparison operations such as HI/LO comparison judgment values and hysteresis, etc.
MET	Scaling Data	Parameters for setting of correlation between input signal and reading, reading and analog output, etc.
LINE	Linearized Data	Parameters related to the linearization (Correcting linearity) function.
OPT	Option	Parameters for option settings.

7－3. Parameter Setting Flow



Press the Enter key to saves the data and returns to measurement mode.
(Data are backed up with EEPROM even when the power is turned off.)

＊ The diagram shows the case of multi-display, but it is the same in single display.
＊ Some menus may not be indicated depending on the specifications.
＊ When pressing keys simultaneously, press the left key while pressing the other key.

⚠CAUTION

Even if you cycle through the parameters, the data will not be saved, so be sure to press the Enter key to saves the data.

7－4. Parameter List and Default Settings

The ● mark in the table indicates a standard feature. The × mark indicates that the feature is not available depending on the optional output specifications.

Indication	Name	Default	Input	Output							
			16	0	1	2	3	4	5	6	7
●Condition data (COND)											
PVH	Peak hold setup	PH	●								
RANG	Measurement range setup	14	●								
MAV	Number of moving average setup	OFF	●								
S.WD	Step wide setup	1	●								
BLNK	Indication blank setup	OFF	●								
BAUD	Baud rate setup (bps)	9600		×	×	×	●	●	×	●	●
DATA	Data length setup	7		×	×	×	●	●	×	●	●
P.BIT	Parity bit setup	E		×	×	×	●	●	×	●	●
S.BIT	Stop bit setup	2		×	×	×	●	●	×	●	●
T-	Delimiter setup	CR,LF		×	×	×	●	●	×	●	●
ADR	Device ID setup (address)	00		×	×	×	×	●	×	×	●
A.OUT	Analog output type setup	0 - 1		×	×	●	×	×	●	●	●
LINE	Linearization setup	CLR	●								
PON	Power-on delay setup	OFF	●								
PRO	Protection setup	OFF	●								
U-NO	Unit number indication setup	ON	●								
●Comparator data (COM)											
S-HI	HI side judgment value setup	1000		×	●	×	×	×	●	●	●
S-LO	LO side judgment value setup	500		×	●	×	×	×	●	●	●
H-HI	HI side hysteresis setup	0		×	●	×	×	×	●	●	●
H-LO	LO side hysteresis setup	0		×	●	×	×	×	●	●	●
●Scaling data (MET)											
PS	Pre-scaling value setup	1.000	●								
PPR	Frequency division setup	1	●								
DLHI	Digital limiter HI value setup	9999	●								
DLLO	Digital limiter LO value setup	-9999	●								
AOHI	Analog output HI indication setup	9999		×	×	●	×	×	●	●	●
AOLO	Analog output LO indication setup	0		×	×	●	×	×	●	●	●
DEP	Decimal point position setup	none	●								
●Linearization data (LINE)											
N-		00 *1	●								
●Shift data											
SHF	Shift data setup	0	●								
●Options (OPT)											
LCUT	Low cut value setup	0	●								
M_HI	Comparison output HI test	OFF		×	●	×	×	×	●	●	●
M_GO	Comparison output GO test	OFF		×	●	×	×	×	●	●	●
M_LO	Comparison output LO test	OFF		×	●	×	×	×	●	●	●
M_AO	Analog output test	OFF		×	×	●	×	×	●	●	●
TREC	Communication reception test	REC		×	×	×	●	●	×	●	●
TSND	Communication transmission test	TEST		×	×	×	●	●	×	●	●
INIT	Initialization	NO									

7－5. Details of Each Parameter

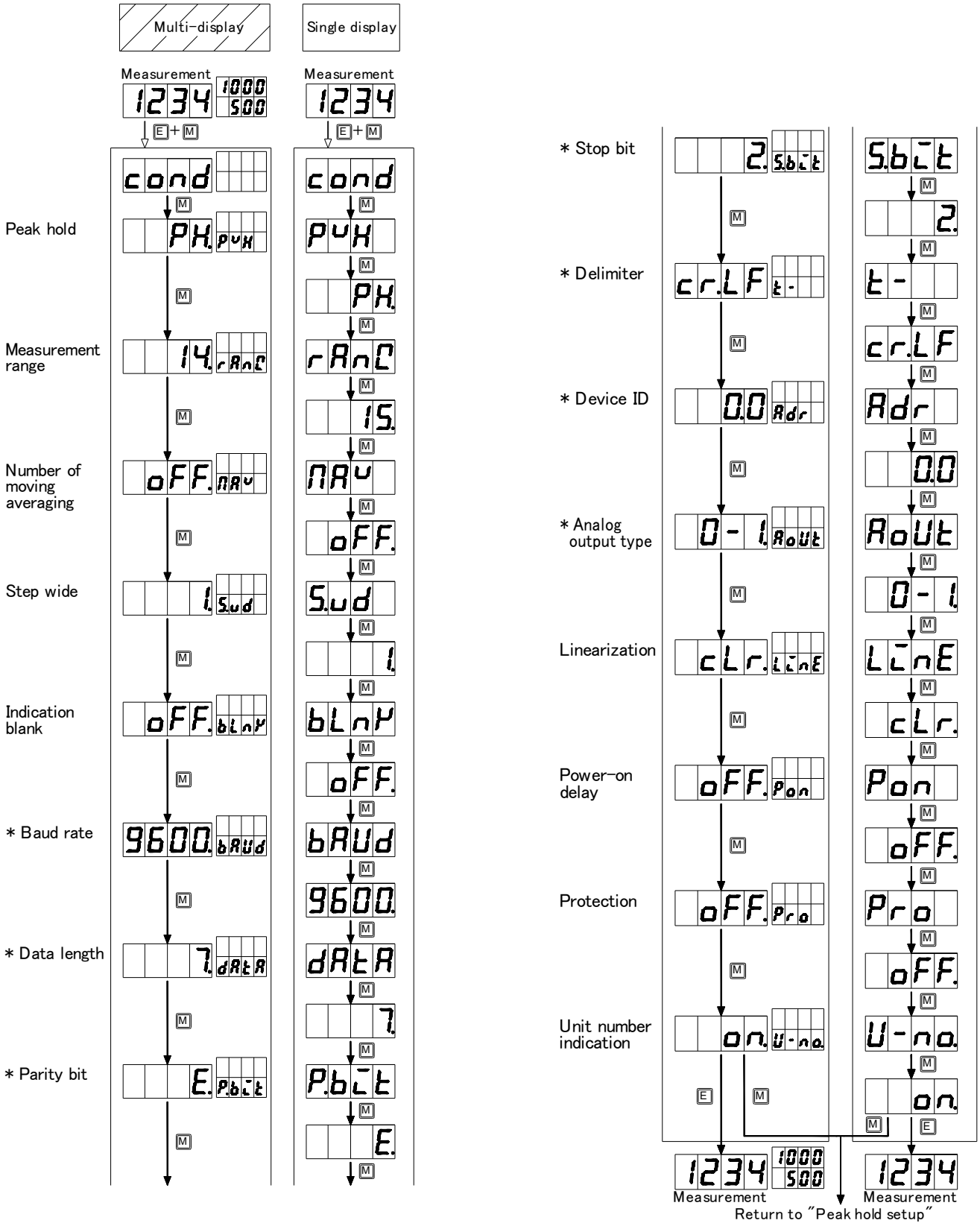
Indication	Name	Parameter setting details	Default
●Condition Data			
PVH	Peak hold setup	PH (max) / VH (min) / PVH (max-min)	PH
RANG	Measurement range setup	11(0.1~200Hz) / 12(1~2000Hz) / 13(0.01k~20kHz) / 14(0.1k~200kHz)	14
MAV	Number of moving average setup	OFF / 2 times / 4 / 6 / 16 / 32	OFF
S.WD	Step wide setup	1 (1 digit) / 2 (2 digits) / 5 (5 digits) / 0 (10 digits)	1
BLANK	Indication blank setup	OFF(bright) / B-3 / B-2 / B-1 (dark) / ON(light off)	OFF
BAUD	Baud rate setup (bps)	9600 / 4800 / 2400 / 384-(38.4k) / 192-(19.2k)	9600
DATA	Data length setup	7 (7bit) / 8 (8bit)	7
P.BIT	Parity bit setup	E (even) / O (odd) / N (none)	E
S.BIT	Stop bit setup	2 (2bit) / 1 (1bit)	2
T-	Delimiter Setups	CR,LF / CR	CR,LF
ADR	Device ID setup (address)	01 to 99 ＊Please do not duplicate within the same network.	00
A.OUT	Analog output type setup	OFF / 0 - 1 (V) / 0 - 10 (V) / 1 - 5 (V) / 4-20 (mA)	0 - 1
LINE	Linearization setup	OFF / ON ＊Selectable when linearization data is set	CLR
PON	Power-on delay setup	OFF / 1 to 30	OFF
PRO	Protection setup	OFF / ON	OFF
U-NO	Unit number indication setup	OFF / ON	ON
●Comparator data			
S-HI	HI side judgment value setup	-9999 to 9999	1000
S-LO	LO side judgment value setup	-9999 to 9999	500
H-HI	HI side hysteresis setup	0 to 999	0
H-LO	LO side hysteresis setup	0 to 999	0
●Scaling data			
PS	Pre-scaling value setup	0.001 to 9.999	1.000
PPR	Frequency division setup	1 to 9999	1
DLHI	Digital Limiter HI value setup	-9999 to 9999	9999
DLLO	Digital Limiter LO value setup	-9999 to 9999	-9999
AOHI	Analog output HI indication setup	-9999 to 9999	9999
AOLO	Analog output LO indication setup	-9999 to 9999	0
DEP	Decimal point position setup	none / □.□□□ / □□.□□ / □□□.□ / □□□□.	none
●Linearization data			
LINE			*1
●Shift data			
SHF	Shift data setup		0
●Options (OPT)			
LCUT	Low cut value setup	0 to 9999	0
M_HI	Comparison output HI test	OFF / ON	OFF
M_GO	Comparison output GO test	OFF / ON	OFF
M_LO	Comparison output LO test	OFF / ON	OFF
M_AO	Analog output test	OFF / ON→ / 0 (%) / 25 (%) / 50 (%) / 75 (%) / 100 (%)	OFF
TREC	Communication reception test	REC	REC
TSND	Communication transmission test	TEST → END	TEST
INIT	Initialization	NO → YES	NO

*1 No linearization data is set as the default value.

＊ Turn on the power while holding down all operation keys (E, M, ▶, ▲) and continue to hold down all operation keys until the LED turns off to reset all data to the default values. This has the same function as "Initialization" the options.

7−6. How to Set Condition Data

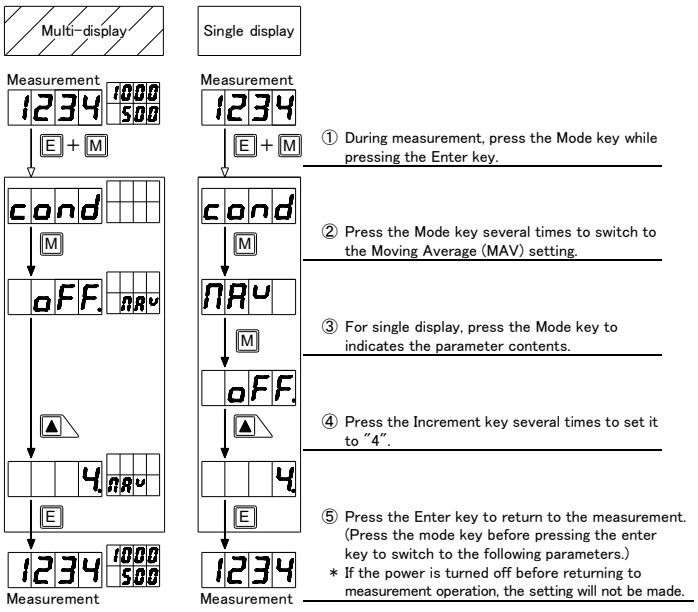
* Items marked with "*" may not be indicated depending on the optional output specifications.



7－6－1. Example of Condition Data Setup

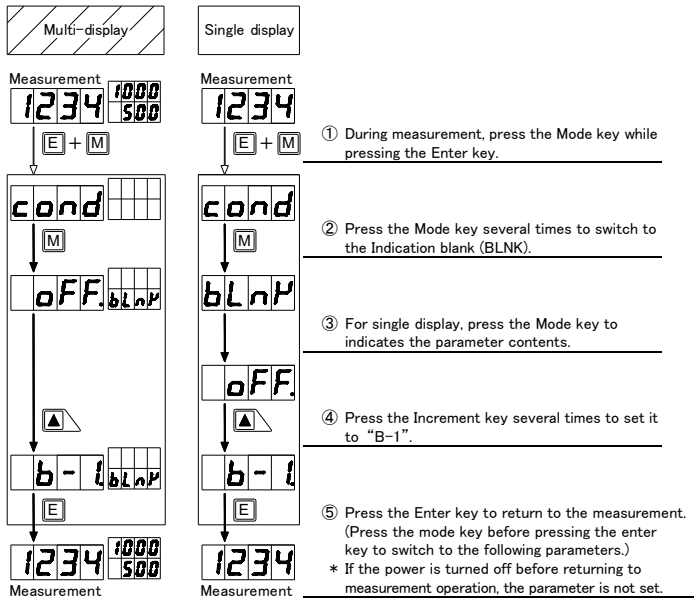
The following is an example of the settings. The other parameters can be set in the same way.

<Moving average counts setting>･･･How to set the moving average counts to 4.



* This function allows you to obtain a filtering effect without slowing down the sampling rate.
* Increasing the number of moving averages increases the filtering effect, but it also slows down the response to transient changes in the input signal.

<Indication blank setup>･･･How to set the display blank to "B-1".



* When the indication blank function is ON, the main display and sub display (Multi-display only) will be completely turned off. To turn them on, follow the steps above from step ①. (During parameter setup, the display blank function is turned off and the indication is turn on.)
OFF(bright) → B-3 → B-2 → B-1 (dark) → ON (turn off)

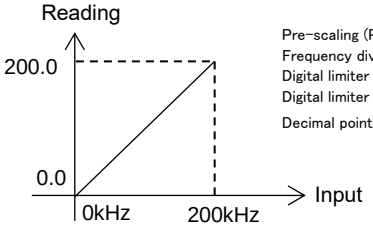
7－7. How to Set Scaling Data

* Reading value scaling is set by the "PS" and "PPR" setup in frequency measurement.
* When the digital limiter is set, the indicate will not show anything outside the range between DLHI and DLLO, and the DLHI (or DLLO) value will be held (however, if the input signal is over the range, an "OL" will be indicated).

7－7－1. Example of Reading Value Scaling Setup

Example 1 * Range 14 is used.

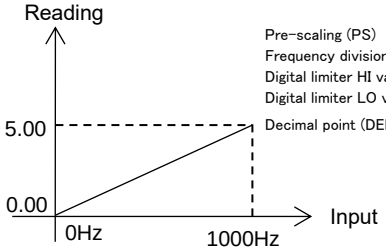
We want to change reading value from 0 to 200.0
when our input signal changes from 0 to 200kHz of open collector type.



Pre-scaling (PS) : 1.000
Frequency division (PPR) : 001
Digital limiter HI value (DLHI) : 9999
Digital limiter LO value (DLLO) : -9999
Decimal point (DEP) :The place of 10^{1} is lit

Example 2 * Range 12 is used.

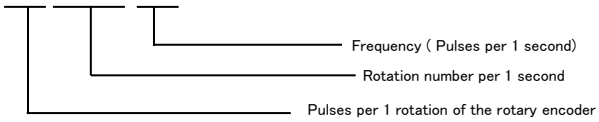
We want to change reading value from 0.00 to 5.00
when our input signal changes from 0 to 1000Hz of voltage pulse.



Pre-scaling (PS) : 0.500
Frequency division (PPR) : 001
Digital limiter HI value (DLHI) : 9999
Digital limiter LO value (DLLO) : -9999
Decimal point (DEP) :The place of 10^{2} is lit

Example 3

We want to get rotation number[rpm] by using a rotary encoder with 30 pulses per 1 rotation.
① Find appropriate measurement range by calculating a max frequency.
For example, case of the rotation number increasing to 100[rpm] at maximum …
30 * 100 ÷ 60 = 50



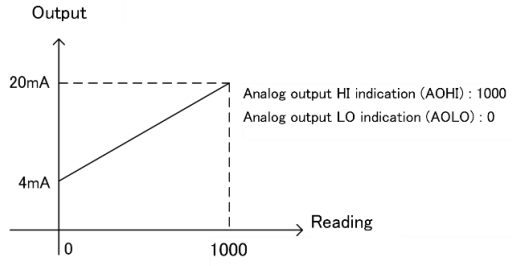
② The range is decided on range 11 because the calculated frequency is 50[Hz] in ①.
③ If we measure the pulse input of 50[Hz] in range 11 and default setup (PS=1, PPR=1), the display show the reading value "500".
We should set PS=2 and PPR=1 to set the decimal point as 10^{1}.
(The display show "100.0" when we input 50[Hz].)

7－7－2. Example of Analog Output Scaling Setup (With Analog Output)

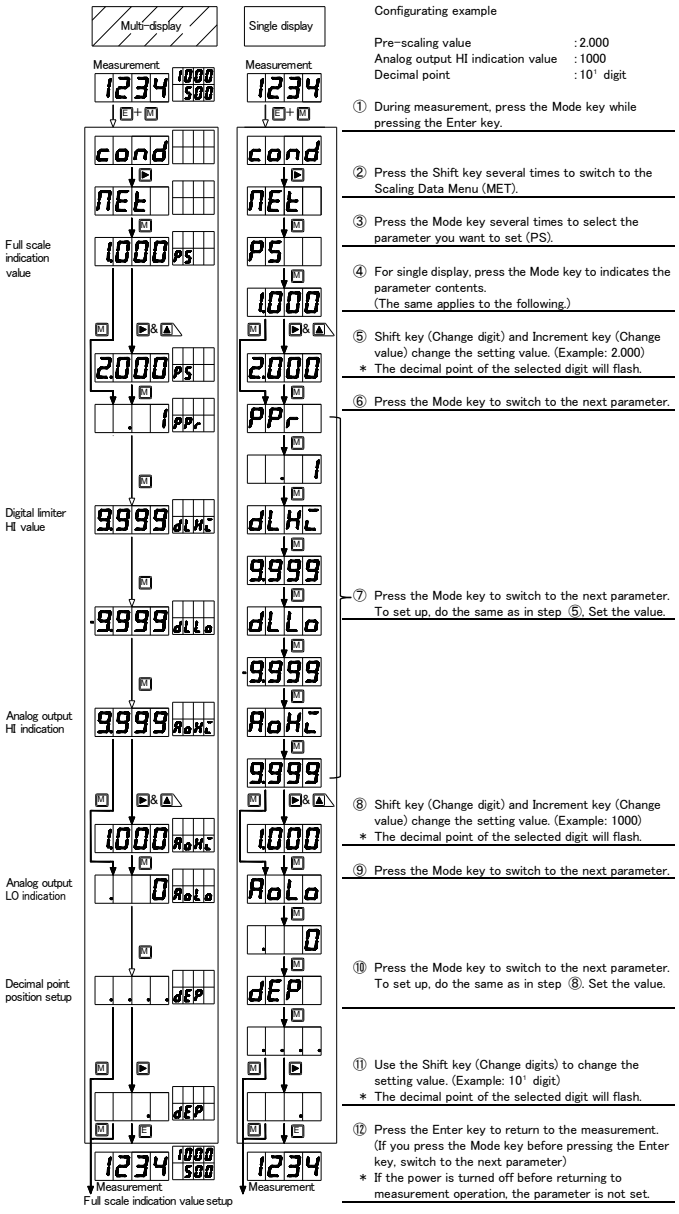
* For analog output scaling, set the reading value when the max output value output value (1V/10V/5V/20mA) is output to "AOHI", and set the reading value when the min (0V/1V/4mA) is output to "AOLO".
* Values outside the setting range will not be output correctly.
* Reverse slope scaling is also possible. (Setting example 2)

Example 1

We want to set the analog output from 4 to 20mA when the reading value changes 0 to 1000.



7－7－3. Example of Scaling Setup



Configurating example

Pre-scaling value : 2.000
Analog output HI indication value : 1000
Decimal point : 10¹ digit

① During measurement, press the Mode key while pressing the Enter key.

② Press the Shift key several times to switch to the Scaling Data Menu (MET).

③ Press the Mode key several times to select the parameter you want to set (PS).

④ For single display, press the Mode key to indicates the parameter contents. (The same applies to the following.)

⑤ Shift key (Change digit) and Increment key (Change value) change the setting value. (Example: 2.000)
* The decimal point of the selected digit will flash.

⑥ Press the Mode key to switch to the next parameter.

⑦ Press the Mode key to switch to the next parameter. To set up, do the same as in step ⑤. Set the value.

⑧ Shift key (Change digit) and Increment key (Change value) change the setting value. (Example: 1000)
* The decimal point of the selected digit will flash.

⑨ Press the Mode key to switch to the next parameter.

⑩ Press the Mode key to switch to the next parameter. To set up, do the same as in step ⑧. Set the value.

⑪ Use the Shift key (Change digits) to change the setting value. (Example: 10¹ digit)
* The decimal point of the selected digit will flash.

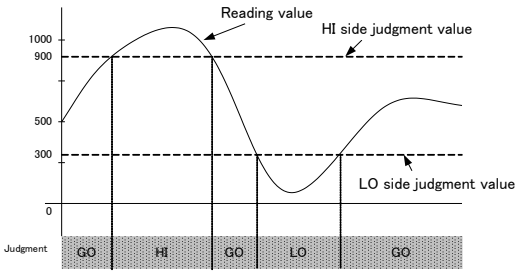
⑫ Press the Enter key to return to the measurement. (If you press the Mode key before pressing the Enter key, switch to the next parameter)
* If the power is turned off before returning to measurement operation, the parameter is not set.

7－8. Comparator Data (With Comparison Output)

7－8－1. Action of The Judgment

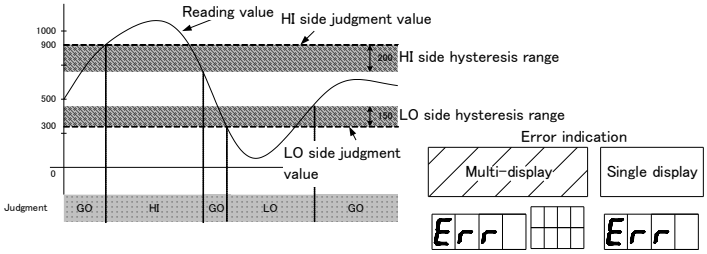
<Example 1>

HI side judgment value : 900
HI hysteresis value : 0
LO side judgment value : 300
LO hysteresis value : 0



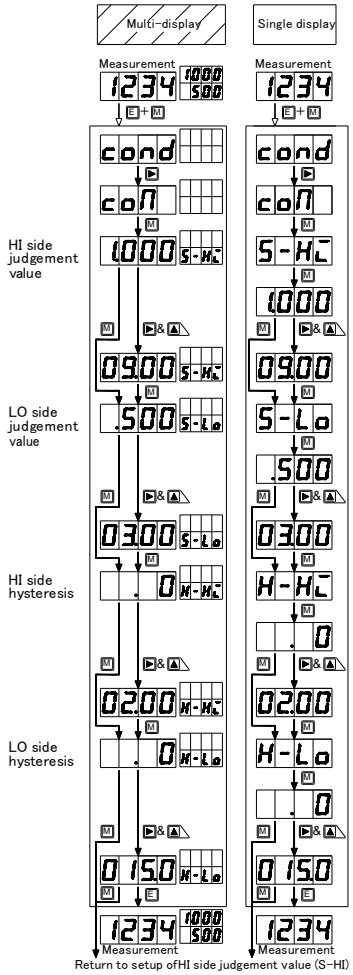
<Example 2>

HI side judgment value : 900
HI hysteresis value : 200
LO side judgment value : 300
LO hysteresis value : 150



* The setting conditions are:
LO side judgment value < HI side judgment value
LO side judgment value + LO side hysteresis ≦ HI side judgment value [(S-LO) + (H-LO) ≦ (S-HI)]
LO side judgment value ≦ HI side judgment value − HI side hysteresis [(S-LO) ≦ (S-HI) − (H-HI)]
If the above conditions are not met, an error will be indicated.
If an error is indicated, the setting will automatically return to the HI side judgment value setting (S-HI) and you will need to do setup again using appropriate judgment values.

7－8－2. Example of Comparator Data Setup



Configurating example

HI side judgment value : 900
LO side judgment value : 300
HI side hysteresis : 200
LO side hysteresis : 150

① During measurement, press the Mode key while pressing the Enter key.

② Press the Shift key several times to indicates the Comparator data menu (COM).

③ Press the Mode key several times to select the parameter you want to set. (S-Hi)

④ For single display, press the Mode key to indicates the parameter contents.

⑤ Shift key (Change digit) and Increment key (Change value) change the setting value. (Example: 900)
* The decimal point of the selected digit will flash.

⑥ Press the Mode key to switch to the next parameter.

⑦ Shift key (Change digit) and Increment key (Change value) change the setting value. (Example: 300)
* The decimal point of the selected digit will flash.

⑧ Press the Mode key to switch to the next parameter.

⑨ Shift key (Change digit) and increment key (Change value) change the setting value. (Example: 200)
* The decimal point of the selected digit will flash.

⑩ Press the Mode key to switch to the next parameter.

⑪ Shift key (Change digit) and increment key (Change value) change the setting value. (Example: 150)
* The decimal point of the selected digit will flash.

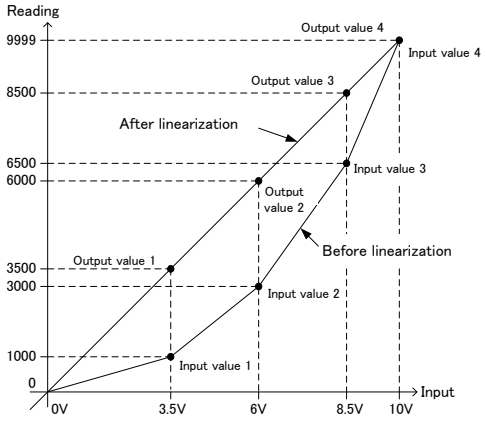
⑫ Press the Enter key to return to the measurement. (Press the Mode key to return to the HI value judgment value setup (S-HI).)
* If the power is turned off before returning to measurement operation, the parameter is not set.

7－9. Linearization Data

The linearization function means a function that changes the slope of straight lines in the relationship between the input and indication by correcting the relations at arbitrary points.

* Linearization data are set using the input value (Indicated value before correction) and the output value (Indicated value after correction) at each arbitrary point.
* The setting conditions are N-1 < N-2 ... N-15 < N-16 (N is the number of data).
* After making this setting, turn the linearization setting of the condition data to "ON".

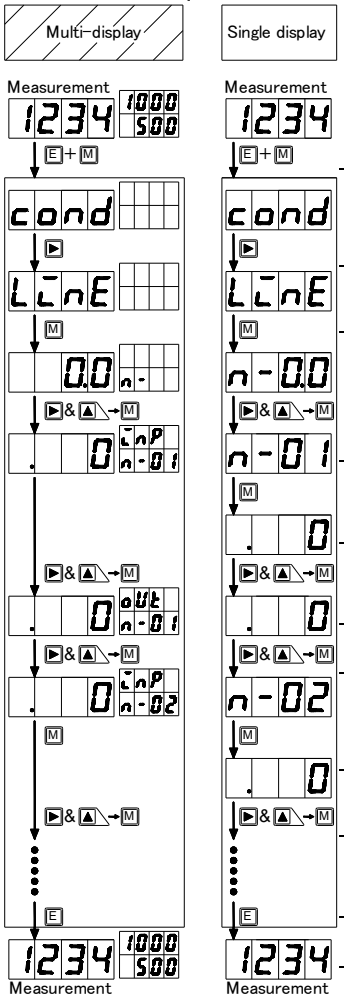
Configuration Example



Setting for correction of the top figure
Number of correction data : N-04

N-01 (Setting of data #1)
inP n-01 1000 (Indicated value before linearization [Input value 1])
OUt n-01 3500 (Indicated value after linearization [Output value 1])
N-02 (Setting of data #2)
inP n-02 3000 (Indicated value before linearization [Input value 2])
OUt n-02 6000 (Indicated value after linearization [Output value 2])
N-03 (Setting of data #3)
inP n-03 6500 (Indicated value before linearization [Input value 3])
OUt n-03 8500 (Indicated value after linearization [Output value 3])
N-04 (Setting of data #4)
inP n-04 9999 (Indicated value before linearization [Input value 4])
OUt n-04 9999 (Indicated value after linearization [Output value 4])

7－9－1. Example of Linearization Data Setup



① During measurement, press the Mode key while pressing the Enter key.

② Press the Shift key several times to switch to the Linearization data menu (LINE).

③ Press the Mode key to switch to the setup of number of correction data.

④ Use the Shift key (Digit change) and Increment key (Value change) to set the number of correction data.
After press the mode key.
* The decimal point of the selected digit will blink.
* If the number of correction data is "0", the indication will not proceed to the numerical setting.

⑤ For single display, press the Mode key to indicates the parameter contents.
* If no key is pressed for 8 seconds, the reading will automatically change to "N-01". pressing the mode key will return to the parameter contents.

⑥ Use the Shift key (Digit change) and Increment key (Value change) to set the "N-01" input value.
After that press the Mode key.
* In the case of single display, "RE" blinks when setting the input value and "DZ" blinks when setting the output.

⑦ Use the shift key (Digit change) and increment key (Value change) to set the "N-01" output value.
After that press the Mode key.

⑧ For single display, press the Mode key to indicates the parameter contents.
* If no key is pressed for 8 seconds, the reading will automatically change to "N-02". pressing the mode key will return to the parameter contents.

⑨ Use the shift key (Digit change) and increment key (Value change) to set the "N-02" input value.
After that press the Mode key.

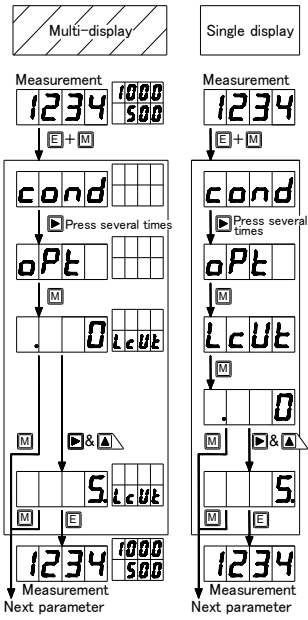
⑩ Use the Shift key (Digit change) and increment key (Value change) to set the "N-02" output value.
After that press the Mode key.
● Repeat ⑧ to ⑩ until the final correction data is set.

⑪ When the setup of final correction data is complete, press the Enter key to return to the measurement.

7－10. Optional Setup

7－10－1. Low Cut Setup

This function will make the reading "0" if the absolute value is less than the set value.
The below is how to set the low cut to "5".



① During measurement, press the Mode key while pressing the Enter key.

② Press the Shift key to select option mode (OPT).

③ Press the Mode key to switch to the low cut (LCUT).

④ For single display, press the Mode key to indicates the parameter contents.

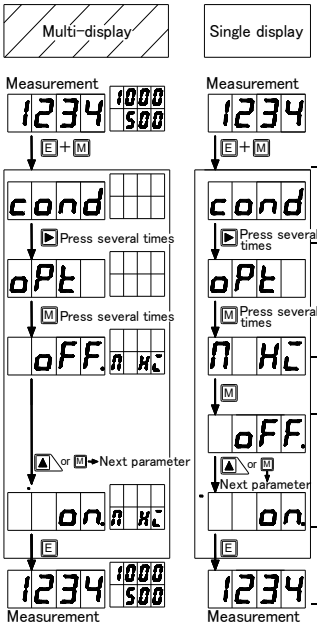
⑤ Use Shift key (Digit change) and Increment key (Change value) to set it to "5".
* The decimal point of the selected digit will blink.

⑥ Press the Enter key to return to the measurement.
(If you press the Mode key before pressing the Enter key, the switch transit to next parameter.)

* If the power is turned off before returning to measurement operation, the parameter is not set.

7－10－2. Comparison Output Test (With Comparison Output)

The below is how to set the comparison output HI (M HI) to "ON".



① During measurement, press the Mode key while pressing the Enter key.

② Press the Shift key to select option mode (OPT).

③ Press the Mode key to switch to comparison output test (M HI).
* Press the Mode key again to switch to setup of GO and LO comparison outputs test.

④ For single display, press the Mode key to indicates the parameter contents.

⑤ Use the increment key to set to "ON".
* At this point, the "HI" judgment indicator turns on and the comparison output will be done. In cases of GO and LO comparison outputs, the "GO" and "LO" judgment indicators will turn on.

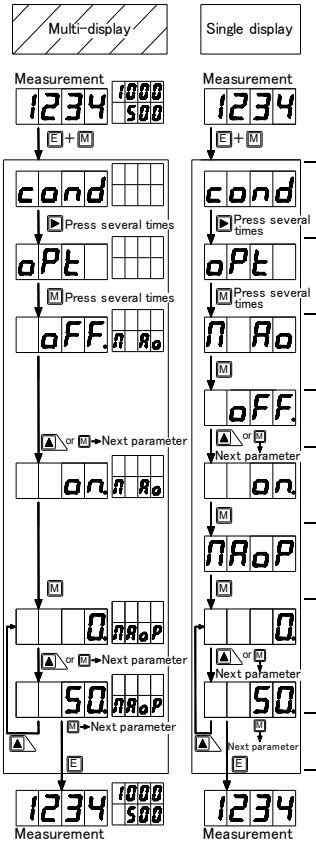
⑥ Press the Enter key to return to the measurement.
(If you press the Mode key before pressing the Enter key, the switch transit to next parameter.)

* If you switch to another indication using the Mode key etc., while the setup is "ON", the output will automatically return to "OFF"(Original state).
* The judgment indicators will also turn on in accordance with the state of comparison output.

7－10－3. Analog Output Test (With Analog Output)

＊ If the analog output setting is set to "OFF" in the condition data, the Analog output test setting will not be set to "ON".
＊ Output is within the range set in the condition data.

Below is how to set the analog output to "50%".

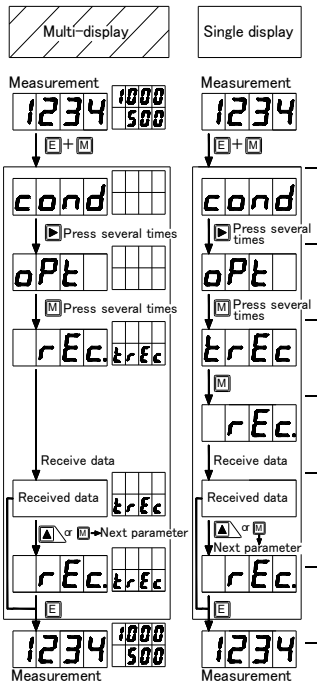


① During measurement, press the Mode key while pressing the Enter key.
② Press the Shift key to select to option mode (OPT).
③ Press the Mode key to switch to the setup of analog output test (M AO).
④ For single display, press the Mode key to indicates the parameter contents.
⑤ Use the Increment key to set to "ON".
⑥ For single display, press the Mode key to indicates the parameter contents (MAOP).
⑦ Press the Mode key to switch to the setup of analog output value.
⑧ Press the Increment key to set it to "50". In the order 0 → 25 → 50 → 75 → 100 → 0, → ... the percentage changes. The percentage of the reading value will be output.
⑨ Press the Enter key to return to the measurement. (If you press the Mode key before pressing the Enter key, the switch transit to next parameter.)

＊ When you exit the output value (%) indication, the analog output test will turn off and return to the original output value.

7－10－4. Communication Reception Test (With Communication Function (RS-232C/RS-485))

The below is how to perform a communication reception test.

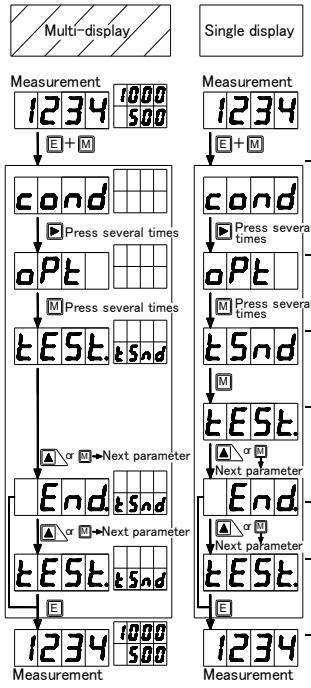


① During measurement, press the Mode key while pressing the Enter key.
② Press the Shift key to select option mode (OPT).
③ Press the Mode key to enter communication reception test mode (TREC)
④ For single display, press the Mode key to indicates the parameter contents (REC).
⑤ Once data is received it will be indicated on the main display.
⑥ Press the increment key to return to the communication reception test mode (REC). (Reception standby state)
⑦ Press the Enter key to return to the measurement. (If you press the Mode key before pressing the Enter key, the switch transit to next parameter.)

＊ The received data is indicated as is in four digits.
Example: When the string "AB" is received
If the ASCII code for A is 41h (Hexadecimal) and
the ASCII code for B is 42h (Hexadecimal), it will indicate "4142" on the main display.

7－10－5. Communication Transmission Test (With Communication Function (RS-232C/RS-485))

The below is how to perform a communication transmission test.

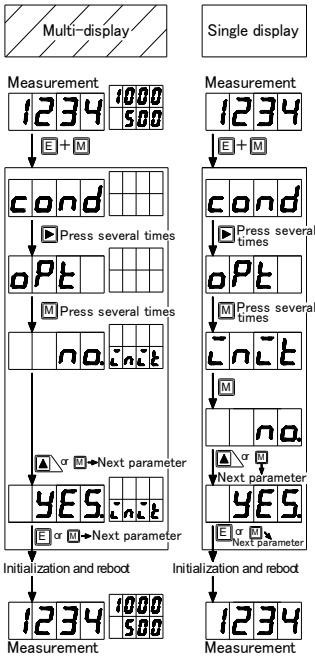


① During measurement, press the Mode key while pressing the Enter key.
② Press the Shift key to select the option mode (OPT).
③ Press the Mode key to enter the communication transmission test mode (TSND).
④ For single display, press the Mode key to indicates the parameter contents (TEST).
⑤ Press the shift key to send a test message and indicate "END."
＊ After END is indicated, press the Enter key to return to measurement operation.
⑥ Press the increment key to return to the communication transmission test mode (TEST). (Transmission standby state).
⑦ Press the Enter key to return to the measurement. (If you press the Mode key before pressing the Enter key, the switch transit to next parameter).

＊ The four characters "TEST" will be sent. ASCII code [54h 45h 53h 54h].
＊ Assumes One-to-One communication.

7－10－6. Full Initialization (Factory Default Load)

This operation initializes all values of setup.



① During measurement, press the Mode key while pressing the Enter key.
② Press the Shift key to select the option mode (OPT).
③ Press the Mode key to switch to the full initialization mode (INIT).
④ For single display, press the Mode key to indicates the parameter contents.
⑤ Press the increment key and "YES" will be indicated.
⑥ Press the Enter key to initialize to restart the system and the measurement operation resumes. (If you press the Mode key before pressing the Enter key, the switch transit to next parameter).

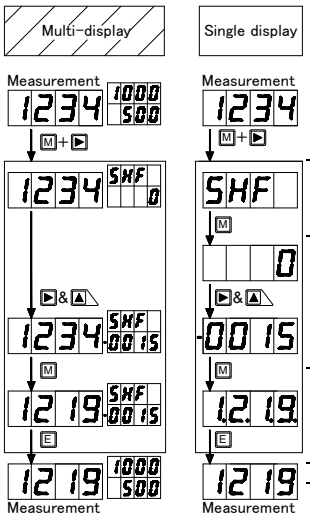
8. OTHER FEATURES

8－1. Monitor Mode

This mode can indicate the max, min, (max − min), and input value on the display.
Each mode will be indicated by pressing the Enter key (E) and the Increment key (▲) at the same time.
To return to the normal display, press the Enter key (E).
The mode in which it is indicated is determined by the previous indication state of this mode.
(If the power is turned off, the indication mode will return to the max value the next time the power is turned on.)
To switch between modes, press and hold the Shift key (▸) for about 1 second.
The max, min and (max − min) are always saved in the memory for the measurement results.
This data can be cleared using the Increment key (▲).

8－2. Indication Shift Function

This function arbitrarily shifts the indication without changing the slope of the input signal.
＊ To disable the indication shift function, set to "0".
The below is how to set the indicated value to be shifted by "−15" .



① During measurement, press the Mode key while pressing the Enter key. (3 seconds or more).

② For single display, press the Mode key to indicates the parameter contents.

③ Use Shift key (Digit change) and Increment key (Change value) to set it to "−0015".
＊ The decimal point of the selected digit will blink.
＊ The polarity can be changed by incrementing the most significant digit.
(0 → 1…9 → −0 → −1 →…−9 → 0).

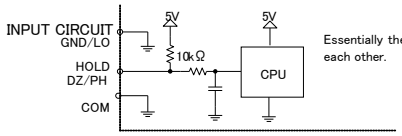
④ Press the Mode key to check the computed results.
＊ For a single display, the decimal points in the 3rd and 4th digits will blink.
The decimal point that is lit during measurement remains lit.

⑤ Press the Enter key to return to the measurement.

9. CONTROL FUNCTIONS

9－1. About Control Functions

It has hold, Digital Zero and peak hold controls.



Essentially the input and external control have not insulated each other.

9－2. Hold Function

Hold function : This function can hold the indication.
By shorting the HOLD terminal and the COM terminal or setting them to the same potential, the function will be turned on and hold the indication given at the moment.

9－3. Digital Zero Function (Indication Reset Function)

＊ In frequency measurement, Digital Zero function becomes a reset function for the indication. You can use this function a force reset when no input signal come perfectly in low-frequency range.

9－3－1. Terminal Control

When the DZ terminal and COM terminal are short-circuited or set at the same potential, the Digital Zero function is ON. This causes the display shown at that point to be zero.

9－3－2. Front Key Control

If the Increment key is pressed for about 1 second with the Mode key held down, the display shown at the point becomes zero.
If the two keys are pressed for about 1 second again, the function will be OFF.

9－4. Peak Hold Function

Peak hold function : By controlling from the external control terminal, it holds the max (Peak)/ min (Valley)/max − min (Peak valley) and outputs according to the value.
Switching of max (Peak hold) / min (Valley hold) / max − min (Peak/Valley hold) is set according to condition data. The peak hold function is enabled by shorting the PH terminal and the COM terminal or setting them to the same potential.

10. VARIOUS OUTPUT FUNCTIONS

10－1. Comparison Output Function (Optional Output Specification)

It is possible to set two judgment values, HI and LO, for the measurement value (Reading value) and output the judgment result via relay contacts.

10－2. Analog Output Function (Optional Output Specification)

It is possible to output an analog signal corresponding to the displayed value.
There are four types of output: 0−1V/0−10V/1−5V/4−20mA and switching can be done by setting the condition data. Arbitrary output scaling is possible by setting the reading value when outputting the full-scale side (20mA when outputting 4 to 20mA), as "AOHI" of the scaling data.

10－3. RS-485 Function (Optional Output Specification)

RS-485 communication is possible.
For details on the RS-485 function, see 13-4-3 Communication specifications.

10－4. RS-232C Function (Optional Output Specification)

RS-232C communication is possible.
For details on the RS-232C function, see 13-4-3 Communication specifications .

11. ERROR MESSAGES

This describes the inspection points, remedies, etc. taken if abnormal indications or erroneous operating conditions occur.

	Indication	Error description	Remedy
1	dAt8.	Internal memory error (DAT8.) ←Either one segment is lit at the lowest digit	Turn the power supply OFF and then ON again. If this does not solve the problem, contact your sales representative or our sales department directly.
2	c.o.n.d.	Condition data error (C.O.N.D.)	Set condition data again.
3	c.o.n.	Comparator data error (C.O.M.)	Set comparator data again.
4	n.E.t.	Scaling data error (MET.)	Set scaling data again.
5	L.i.n.E.	Linearization data error (LINE)	Set linearization data again.
6	c.A.L.	Calibration data error (CAL.)	Set calibration data again.
7	S.H.F.t.	Shift data error (SHFT)	Set shift data again by the shift function.
8	d. .Z.	Digital Zero value backup data error (D. .Z. .)	Write Digital Zero value again.
9	9.9.8.7.	An input value or indicated value has exceeded the measurable range during peak hold action. (All decimal points blink)	Cancel peak hold action once.
10	oL -oL	An input value or indicated value has exceeded the measurable range. (OL, −OL)	Use the meter within the measurement range and indication range of a specified range.
11	uAit	Waiting for input. (WAIT)	If setup is modified while hold or peak hold is ON, cancel the relevant action once.

⚠CAUTION

If items 1 to 6 are indicated frequently, it is likely due to noise or other factors.
Please take appropriate countermeasures against noise.

12. LED INDICATION

Since a 7-segment display is used for the indication section, numbers and letters are indicated as shown in the table below.

0	1	2	3	4	5	6	7	8	9	−
0	1	2	3	4	5	6	7	8	9	-

A	B	C	D	E	F	G	H	I	J	K	L	M
A	b	c	d	E	F	C	H	I	J	K	L	M

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
n	o	P	q	r	S	t	U	v	w	x	y	Z

13. SPECIFICATIONS

13−1. Input Specifications

Frequency measurement unit (16)... 11 to 14 ranges

Range	Measurement range	Indication	Highest resolution	Indication update time	Accuracy (23℃±5℃)
11	0.1 to 200.0Hz	Pre-scaling	0.1Hz	1 to 10s	±(0.2%fs)
12	1 to 2000Hz	:0.001 to 9.999	1Hz	1s	
13	0.01k to 20.00kHz	Frequency division	10Hz	100ms	
14	0.1k to 200.0kHz	:1 to 9999	100Hz	100ms	

Input type	Input voltage	Max allowable input
Voltage	50Vrms to 500Vrms	500V

・Duty ratio : 50%

13−2. Common Specifications

Display : 7-segment LED display
(Character height: Main display: 14.2 mm, Sub display: 8 mm)
Indication update cycle : Depends on indication update time described in 13-1 table.
Polarity indication : Automatically indicated when the calculated result is negative.
Indication range : −9999 to 9999
Over-range alarm : OL or −OL for input signals outside the indication range.
Decimal point : Can be set to any digit
Zero indication : Leading zero suppression (Leading zeros are hidden)
Low cut : Setting range: 0000 (Default) to 9999
Digital Zero backup : 100,000 times guaranteed about writing to EEPROM
Operating temperature and humidity range : 0 to 50℃ 35 to 85%RH (Non-condensing)
Storage temperature and humidity range : −10 to 70℃, 60% RH or less
Power input : 100 to 240V AC ±10% for AC power (50/60Hz)
9 to 60V DC for DC power
Power consumption : 100VAC±10%_7VAmax, 240VAC±10%_12VAmax for AC power supply
7Wmax for DC power supply
External dimensions : 96mm(W)×48mm(H)×146.5mm(D)
＊Depth (D) is the max when the connector is connected.
Mass : Approx. 450g
Withstand voltage (AC power) : 3000V AC for 1min. between power terminal and input terminal, and between power terminals and each output terminal.
Withstand voltage (DC power) : 500V DC for 1min. between power terminal and input terminal, and between power terminal and each output terminal.
Withstand voltage (common) : 500V DC for 1min. between input terminal and each output terminal, and between analog output terminal and communication terminal, and between each comparison output terminal.
3000V AC for 1 min. between the case and each terminal.
Insulation resistance : DC500 V more than 100 MΩ at the above terminals.
Compliance directive : EMC Directive 2014/30/EU
Low Voltage Directive 2014/35/EU (AC power specifications only)
RoHS Directive 2011/65/EU (EU)2015/863 (10 substances)
(Applicable when input/output lines are 30m or less)
＊Applies to products with the CE mark on the label
Fuse : 1.0A at AC power
1.6A at DC power
Case material : Black polycarbonate resin UL94 V-2
Standard accessories : Unit label
Compatible accessories (sold separately) : Front panel cover (WP, WP-3)
Location of installation : Indoor use
Vibration resistance : 10 to 55Hz, single amplitude 0.15mm, X, Y, Z directions 30 minutes
Rated Altitude : Up to 2000m
Installation category : II (AC power only)
Pollution degree : 2

13−3. External Control Specifications

Number of input points : 3 points
Control function : ■HOLD
・The indicated value at the start of the instruction is retained.
■Digital Zero (DZ)
＊In frequency measurement, this becomes a reset function for the display.
＊When operating via the control terminal or the front keys, the control terminal takes priority.
■Peak hold (PH)
・You can choose peak hold (Max hold), valley hold (Min hold), and peak and valley hold. (Hold the difference between max and min values).
Voltage of opened terminal : Approx. 5V
Current of shorted circuit : Approx. 500uA
Insulation : Not isolated from the input terminal. The input LO terminal and the external control COM terminal are at the same potential.

13−4. Output Specifications (Optional Output)

13−4−1. Comparison Output

Conditions for comparison	Judging result
Upper limit judgment value < Indicated value	HI
Lower limit judgment value ≦ Indicated value ≦ Upper limit judgment value	GO
Indicated value < Lower limit judgment value	LO

Control system : Microcomputer operating system
Judgment value setup range : −9999 to 9999
Hysteresis : Each judgment value can be set in the range of 1 to 999 digits.
Operating speed : Depends on sampling rate.
Output method : Relay contact output
(Make and break contacts for HI and LO and make contacts for GO)
Output rating : AC240V 8A (Resistive load), DC30V 8A (Resistive load)
Mechanical life : 20,000,000 times or more
Electrical life : 50,000 times or more (Resistive load)
Minimum applicable load : 5VDC 100mA Reference value
(Contact material: an alloy of gold-flashed silver and tin-oxide)
Output test : Possible depending on the settings

13−4−2. Analog Output

Output type	Load resistance	Accuracy (23℃±5℃, 35 to 85%RH)	Ripple
0 to 1V	10kΩ or more	±(0.2%fs)	±50mVp-p
0 to 10V			
1 to 5V			
4 to 20mA	550Ω or less		±25mVp-p

＊4 to 20mA ripple is at load resistance of 250Ω and output of 20mA

Conversion system : PWM conversion
Resolution : Equivalent to 13 bits
Scaling : Digital scaling
Response speed : Approx. 0.5 seconds (0% → 90%)
Output test : Possible by setting (0% / 25% / 50% / 75% / 100%)

＊ If the indicated value exceeds the value set in "AOHI", the output will be extended up to the output limit. However, if the set value of "AOHI" is "9999", the excess indicates OL(Overload), so the value will also exceed the limit .
＊ If the analog output and the reading are scaled in the opposite direction, the analog output will exceed the limit as shown below.

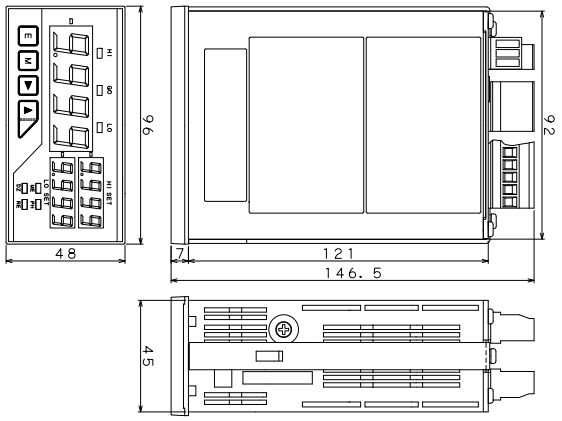
Scale setup		Too little input		Excessive input	
Indication	Analog output	Indication	Analog output	Indication	Analog output
Forward	Forward	−OL	Downward swing	OL	Upward swing
Forward	**Reverse**	−OL	Upward swing	OL	Downward swing
Reverse	Forward	OL	Upward swing	−OL	Downward swing
Reverse	**Reverse**	OL	Downward swing	−OL	Upward swing

13−4−3. Communication Function

	RS-232C	RS-485	Select
Synchronization system	Start and stop synchronization		
Communication system	Full duplex	Two wire half duplexes (Polling and selecting system)	
Communication rate	38400bps / 19200bps / 9600bps (Default) / 4800bps / 2400bps		○
Start bit	1bit		
Data length	7bit (Default) / 8bit		○
Error detection (parity bit)	Even parity (Default) / Odd parity / No parity		○
		BCC (Block Check Character) checksum	
Stop bit	1bit / 2bit (Default)		○
Character code	ASCII Code		
Communication control procedure	No procedure		
Signal name used	TXD, RXD, SG	Non-inverted (+), inverted (−)	
Number of connectable units	1 unit	Max 31 units	
Line length	15m	Up to 500m (Network total)	
		＊Less than 30m if CE compliant	
Delimiter	CR+LF (Default) / CR		○

＊ For details on the communication function's send/receive format and commands, please refer to the separate communication User's manual.

13−5. External Dimensions



(mm)

14. WARRANTY

14−1. Warranty Period

The warranty period for this product is one year from the date of delivery.

14−2. Warranty Coverage

If a malfunction occurs within the warranty period due to reasons attributable to our company, we will provide a replacement product or take custody of the malfunctioning product free of charge. However, if the cause of the malfunction falls under any of the following, it will be excluded from the scope of coverage.

1) If the product is used outside the range of conditions, environments, and handling specified in this manual.
2) When the structure, performance, specifications, etc. have been modified or repaired by anyone other than our company.
3) If the cause is other than this product.
4) They are causes that could not have been foreseen with the level of science and technology at the time of shipment by our company.
5) Other causes beyond our control, such as natural disasters, disasters, or force majeure.

Please note that the warranty here is limited to this product alone and does not cover any secondary damages induced by failure or defects of this product.

14−3. Responsible Authority

We shall not be liable under any circumstances for any damages arising from this product.

Note: Please note that the contents of this manual may be changed without notice.

15. EXPLANATION OF TERMS

Step wide function	By forcibly changing the resolution of the least significant digit, it suppresses the indication drifts etc.
Indication blank function	It adjusts the indication brightness.
Linearization function	It can correct the linear relationship between the input value and the indicated value at any point and change the slope. * Linearization setup of condition data sets whether to use the linearization function. For setup instructions, see 7-9. linearization data. If the linearization data is not set, the setting value of condition data "ON" is not indicated.
Power On Delay function	When the power is turned on, operation is suspended for a certain period of time. When it is stopped, all indications will show "- - - -". Segment check → Delay time → Unit No. indication → Measurement operation
Protecting function	It restrict changes of all parameters except condition data. Optional settings are also excluded.
Unit number indication setup	When the power is turned on, the installed unit number is indicated. (Unit: Input/Output specification)

watanabe
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