Multi-point Digital Controller

MA900/MA901

Instruction Manual

IMR01H01-E8

Thank you for purchasing this RKC product. In order to achieve maximum performance and ensure proper operation of your new instrument, carefully read all the instructions in this manual. Please place the manual in a convenient location for easy reference.

SYMBOLS

WARNING : This mark indicates precautions that must be taken if there is danger of electric shock, fire, etc., which could result in loss of life or injury.

CAUTION : This mark indicates that if these precautions and operating procedures are not taken, damage to the instrument may result.

: This mark indicates that all precautions should be taken for safe usage.

: This mark indicates important information on installation, handling and operating procedures.

: This mark indicates supplemental information on installation, handling and operating procedures.

: This mark indicates where additional information may be located.

WARNING

- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to instrument and equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction can occur and warranty is void under these conditions.

CAUTION

- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy.)
- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless the length.
- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- All wiring must be in accordance with local codes and regulations.
- All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.
- To prevent instrument damage or failure, protect the power line and the input/output lines from high currents with a protection device such as fuse, circuit breaker, etc.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dispensation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration will occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.
- When High alarm with hold action is used for Alarm function, Alarm does not turn on while Hold action is in operation. Take measures to prevent overheating which may occur if the control device fails.

NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

CONTENTS

1. OUTLINE

As a multi-point digital controller of a DIN size 96 × 96 mm, there are MA900 of 4-channel type and MA901 of 8-channel type. This manual describes the specifications, setting, mounting and wiring. For the communication function, refer to the **MA900/MA901 Communication Instruction Manual (IMR01H02-E□)**.

1.1 Product Check

When unpacking your new instrument, please confirm that the following products are included. If any of the products are missing, damaged, or if your manual is incomplete, please contact RKC sales office or the agent.

- MA900 (MA901): 1
- Instruction Manual: 1 (IMR01H01-E8)
- Mounting brackets: 2 (Waterproof/dustproof optional: 4)

1.2 Confirmation of the Model Code

Check whether the delivered product is as specified by referring to the following model code. If the product you received is not the one ordered, please contact RKC sales office or the agent.

MA900 - 4 □ □□□ - □ □ - □*□ □ □ - □ □ / □ / Y
MA901 - 8 □ □□□ - □ □ - □*□ □ □ - □ □ / □ / Y
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12)

(1) Number of channel
4: 4 channels (MA900) 8: 8 channels (MA901)

(2) Control action type
F: PID control with autotuning (Reverse action)
D: PID control with autotuning (Direct action)
W: Heat/cool PID control with autotuning (Water cooling) [1]
A: Heat/cool PID control with autotuning (Air cooling) [1]

(3) Input type/Input range (This code is common to all channels.)
Refer to ■ **Input Range Table (P. 21)**

(4) Output 1 (OUT1 to OUT4) [2]
M: Relay contact output
V: Voltage pulse output
T: Triac output
7: Current output (0 to 20 mA DC)
8: Current output (4 to 20 mA DC)
D: Open collector output

(5) Output 2 (OUT5 to OUT8) [2]
N: No output
M: Relay contact output
V: Voltage pulse output
T: Triac output
7: Current output (0 to 20 mA DC)
8: Current output (4 to 20 mA DC)
D: Open collector output

(6) Power supply voltage
3: 24 V AC/DC
4: 100 to 240 V AC

(7) Alarm 1 [3]
A: Deviation high alarm
B: Deviation low alarm
C: Deviation high/low alarm
D: Band alarm
E: Deviation high alarm [4]
F: Deviation low alarm [4]
G: Deviation high/low alarm [4]
H: Process high alarm
J: Process low alarm
K: Process high alarm [4]
L: Process low alarm [4]
M: FAIL alarm
R: Control loop break alarm
V: SV high alarm
W: SV low alarm

(8) Alarm 2 (optional) [3]
N: No alarm
A: Deviation high alarm
B: Deviation low alarm
C: Deviation high/low alarm
D: Band alarm
E: Deviation high alarm [4]
F: Deviation low alarm [4]
G: Deviation high/low alarm [4]
H: Process high alarm
J: Process low alarm
K: Process high alarm [4]
L: Process low alarm [4]
M: FAIL alarm
P: Heater break alarm (CTL6P) [5, 6]
S: Heater break alarm (CTL12) [5, 6]
V: SV high alarm
W: SV low alarm

(9) Alarm 3 (optional) [3]
N: No alarm
A: Deviation high alarm
B: Deviation low alarm
C: Deviation high/low alarm
D: Band alarm
E: Deviation high alarm [4]
F: Deviation low alarm [4]
G: Deviation high/low alarm [4]
H: Process high alarm
J: Process low alarm
K: Process high alarm [4]
L: Process low alarm [4]
M: FAIL alarm
V: SV high alarm
W: SV low alarm

(10) Contact input (optional)
N: No contact input
D: Contact input (RUN/STOP, Memory area transfer)

(11) Communication Interface (optional)
N: No communication function
1: RS-232C (RKC communication)
4: RS-422A (RKC communication)
5: RS-485 (RKC communication)
6: RS-485 (Modbus)
7: RS-422A (Modbus)
8: RS-232C (Modbus)

(12) Waterproof/dustproof (optional)
N: No waterproof/dustproof
1: waterproof/dustproof

[1] In case of MA901, heat/cool PID action cannot be specified.

[2] Output assignment of output 1 and output 2:

Control action	Output 1 (OUT1 to OUT4)	Output 2 (OUT5 to OUT8)
F or **D** action type (MA900)	Control output (CH1 to CH4)	Alarm 3 output [a, b] (CH1 to CH4) [Optional]
F or **D** action type (MA901)	Control output (CH1 to CH4)	Control output (CH5 to CH8)
W or **A** action type (MA900)	Heat-side control output (CH1 to CH4)	Cool-side control output (CH1 to CH4)

[a] When the FAIL alarm is specified, the output 2 is not output. FAIL alarm is output from the contact output of alarm 3 (terminal No.51 and 52).

[b] When the alarm 3 is specified as the output 2, output type is only relay contact output.

[3] The selection of the alarm action type is common to all channels.

[4] With hold action

[5] For three-phase heater break alarm, special specified code "Z-168" must be specified at the end of the model code. Three-phase heater break alarm cannot be specified with MA901.

[6] If the heater break alarm is selected, contact input and communication function cannot be selected (MA901 only).

2. MOUNTING

This chapter describes installation environment, mounting cautions, dimensions and mounting procedures.

> **WARNING**
>
> To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.

2.1 Mounting Environment

(1) This instrument is intended to be used under the following environmental conditions. (**IEC61010-1**)
[OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2]

(2) Avoid the following conditions when selecting the mounting location:

- Ambient temperature less than 0 °C or more than 50 °C.
- Ambient humidity of less than 45 % or more than 85 % RH.
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

2.2 Mounting Cautions

Take the following points into consideration when mounting this instrument in the panel.

- Provide adequate ventilation space so that heat does not build up.
- Do not mount this instrument directly above equipment that generates large amount of heat (heaters, transformers, semi-conductor functional devices, large-wattage resistors).
- If the ambient temperature rises above 50 °C, cool this instrument with a forced air fan, cooler, etc. Cooled air should not blow directly on this instrument.
- In order to improve safety and the immunity to withstand noise, mount this instrument as far away as possible from high voltage equipment, power lines, and rotating machinery.

  High voltage equipment: Do not mount within the same panel.
  Power lines: Separate at least 200 mm.
  Rotating machinery: Separate as far as possible.
- Mount this instrument in the horizontal direction for panel. If you did installation except a horizontal direction, this causes malfunction.

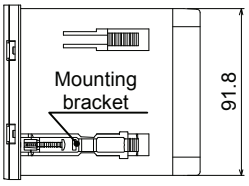
2.3 Dimensions

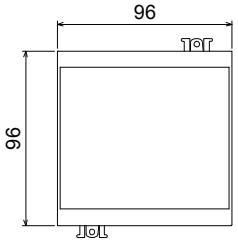
■ External dimensions

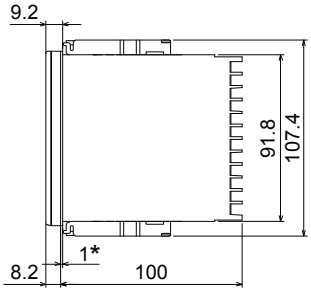
(Unit: mm)

Up to 4 mounting brackets can be used.

* Rubber (optional)

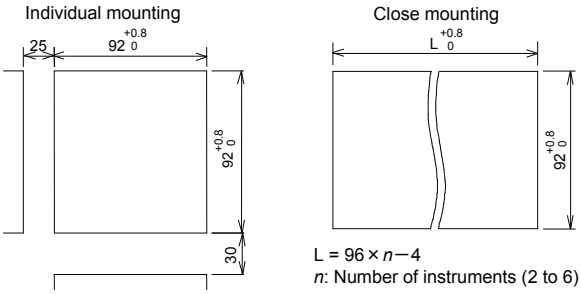






■ Panel cutout

(Unit: mm)



L = 96 × *n* − 4
n: Number of instruments (2 to 6)

For mounting of the MA900/MA901, panel thickness must be between 1 to 10 mm. When mounting multiple MA900/MA901s close together, the panel strength should be checked to ensure proper support.

If the MA900/MA901s have waterproof/dustproof options, protection will be compromised and not meet IP65 by close mounting.

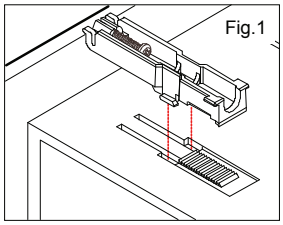
2.4 Mounting Procedures

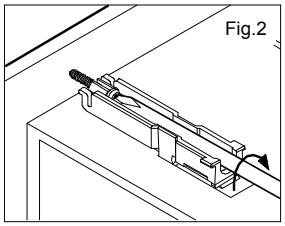
<Mounting Procedures>

1. Prepare the panel cutout as specified in **2.3 Dimensions**.
2. Insert the instrument through the panel cutout.
3. Insert the mounting bracket into the mounting groove of the instrument. Do not push the mounting bracket forward. (Fig. 1)
4. Secure the bracket to the instrument by tightening the screw. Take care to refrain from moving the bracket forward.
5. Only turn about one full revolution after the screw touches the panel. (Fig. 2)

If the screw has been rotated too tight, the screw may turn idle. In such a case, loosen the screw once and tighten it again until the instrument is firmly fixed.

6. The other mounting bracket should be installed in the same way as described in ***3.*** to ***5.***



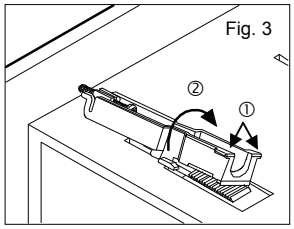


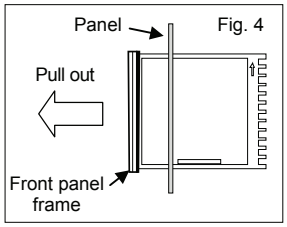
When the instrument is mounted, always secure with two mounting brackets so that upper and lower mounting brackets are positioned diagonally.

The waterproof/dustproof option on the front of the instrument conforms to IP65 when mounted on the panel. For effective waterproof/dustproof, the gasket must be securely placed between instrument and panel without any gap. If gasket is damaged, please contact RKC sales office or the agent.

<Removal Procedures>

1. Turn the power OFF.
2. Remove the wiring.
3. Loosen the screw of the mounting bracket.
4. Hold the mounting bracket by the edge (①) and tilt it (②) to remove from the case. (Fig. 3)
5. The other mounting bracket should be removed in the same way as described in ***3.*** and ***4.***
6. Pull out the instrument from the mounting cutout while holding the front panel frame of this instrument. (Fig. 4)





3. WIRING

This chapter describes wiring cautions and terminal configuration.

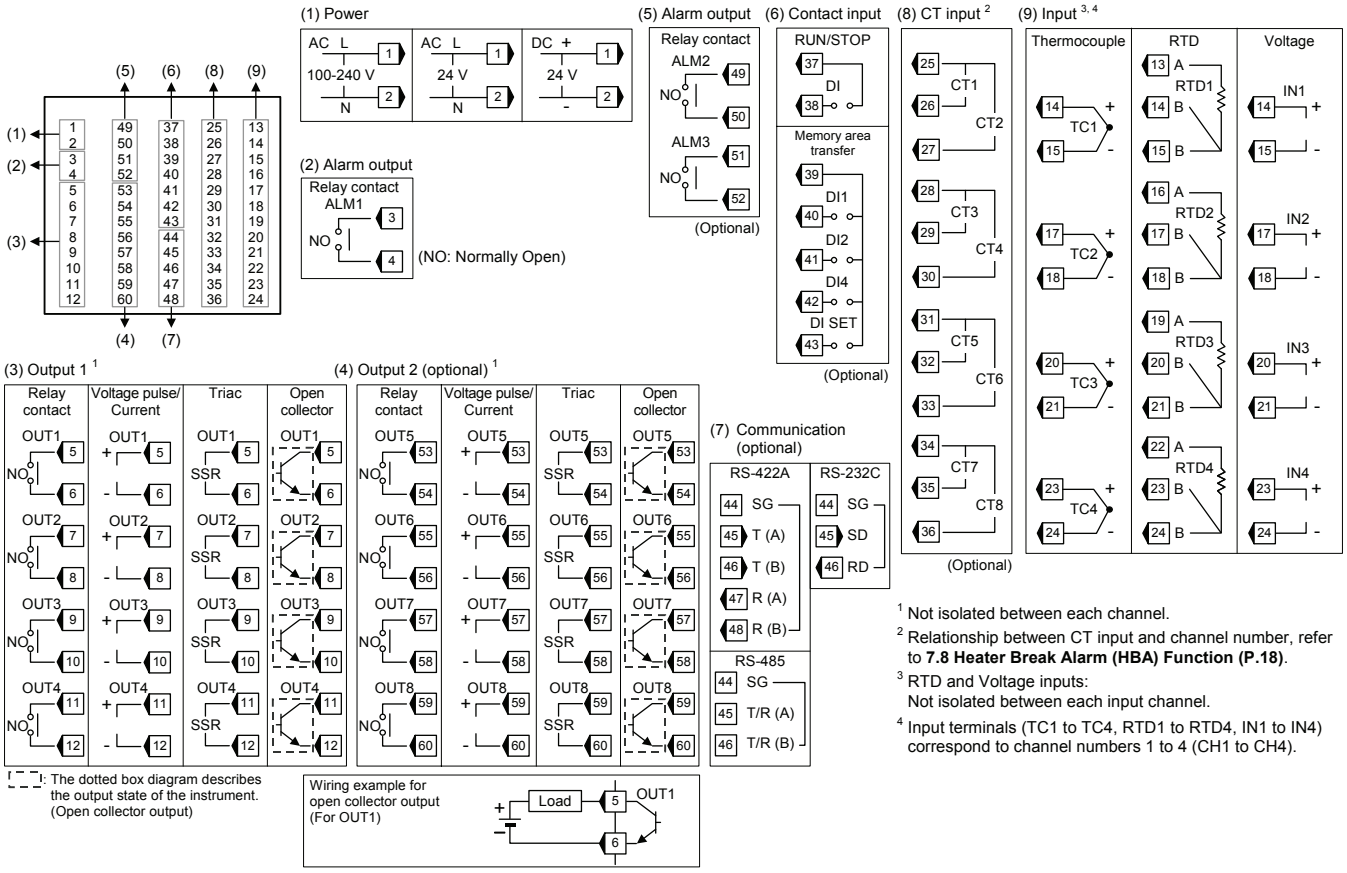
> **WARNING**
>
> To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed.
> Make sure that the wiring is correct before applying power to the instrument.

3.1 Wiring Cautions

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
  - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
  - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- Allow approximately 4 seconds for contact output when the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not furnished with a power supply switch or fuse. If a fuse or power supply switch is required, install close to the instrument.
  Recommended fuse rating: Rated voltage 250 V, Rated current 1 A Fuse type: Time-lag fuse
- For an instrument with 24 V power supply, supply power from a SELV circuit.
- Use the solderless terminal appropriate to the screw size.
  Screw size: M3×6 Recommended tightening torque: 0.4 N·m (4 kgf·cm)
  Specified solderless terminals: With isolation
- Make sure that the any wiring such as solderless terminal is not in contact with the adjoining terminals.

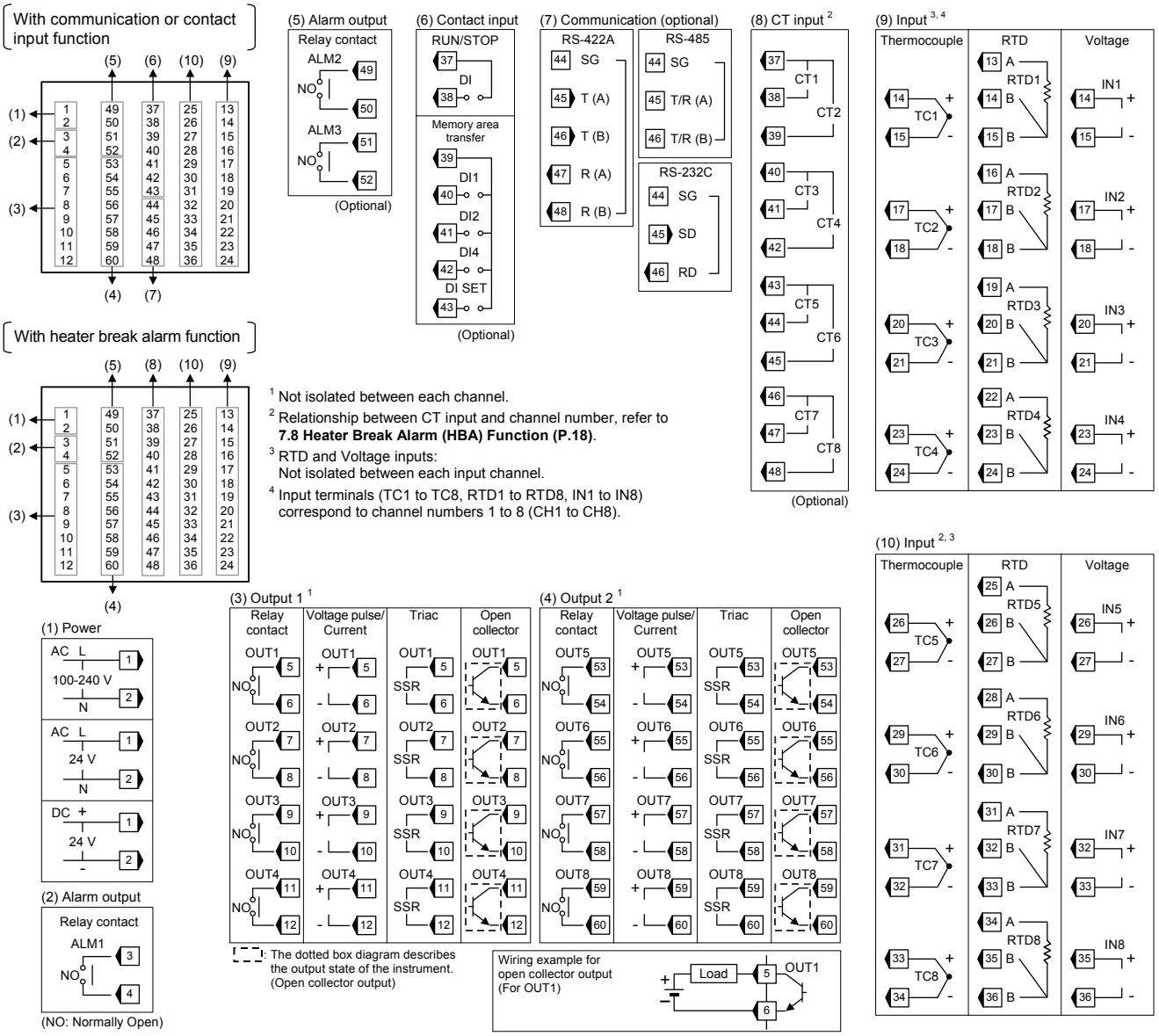
3.2 Terminal Configuration

■ MA900



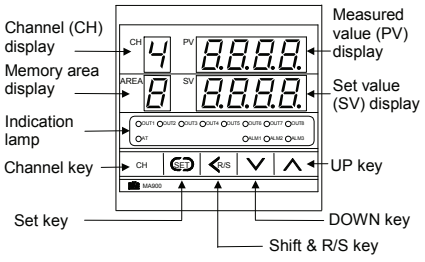
[1] Not isolated between each channel.
[2] Relationship between CT input and channel number, refer to **7.8 Heater Break Alarm (HBA) Function (P.18)**.
[3] RTD and Voltage inputs:
Not isolated between each input channel.
[4] Input terminals (TC1 to TC4, RTD1 to RTD4, IN1 to IN4) correspond to channel numbers 1 to 4 (CH1 to CH4).

■ **MA901**



4. PARTS DESCRIPTION

This chapter describes various display units and the key functions.



(The above figure is MA900. The figure of MA901 is the same as a MA900.)

Measured value (PV) display [Green]
Displays PV or various parameter symbols.

Set value (SV) display [Orange]
Displays SV or various parameter set value.

Channel (CH) display [Green]
- Displays channel number.
- Displays character "A" showing batch setting.

Memory area (AREA) display [Orange]
Displays memory area number.

Indication lamps:
Autotuning (AT) lamp [Green]
Flashes with the autotuning activated in the displayed channel.

Output (OUT1 to OUT8) lamp [Green]
Lights when the output corresponding to each lamp is ON.

Alarm lamp * (ALM1 to ALM3) [Red]
ALM1: Lights when alarm1 is turned on.
ALM2: Lights when alarm2 is turned on.
ALM3: Lights when alarm3 is turned on.
*Bright lighting:
Indicates that the display channel is alarm state.
Dim lighting:
Indicates that other channel except a display channel is alarm state.

Channel key
- Used when the channel number is changed.
- Used to display the character "A" showing batch setting.
- Used for start/stop of scan display.

Shift & R/S key
- Shift digits when settings are changed.
- Selects the RUN/STOP.

Set key
Used for parameter calling up and set value registration.

Up key Increase numerals.
DOWN key Decrease numerals

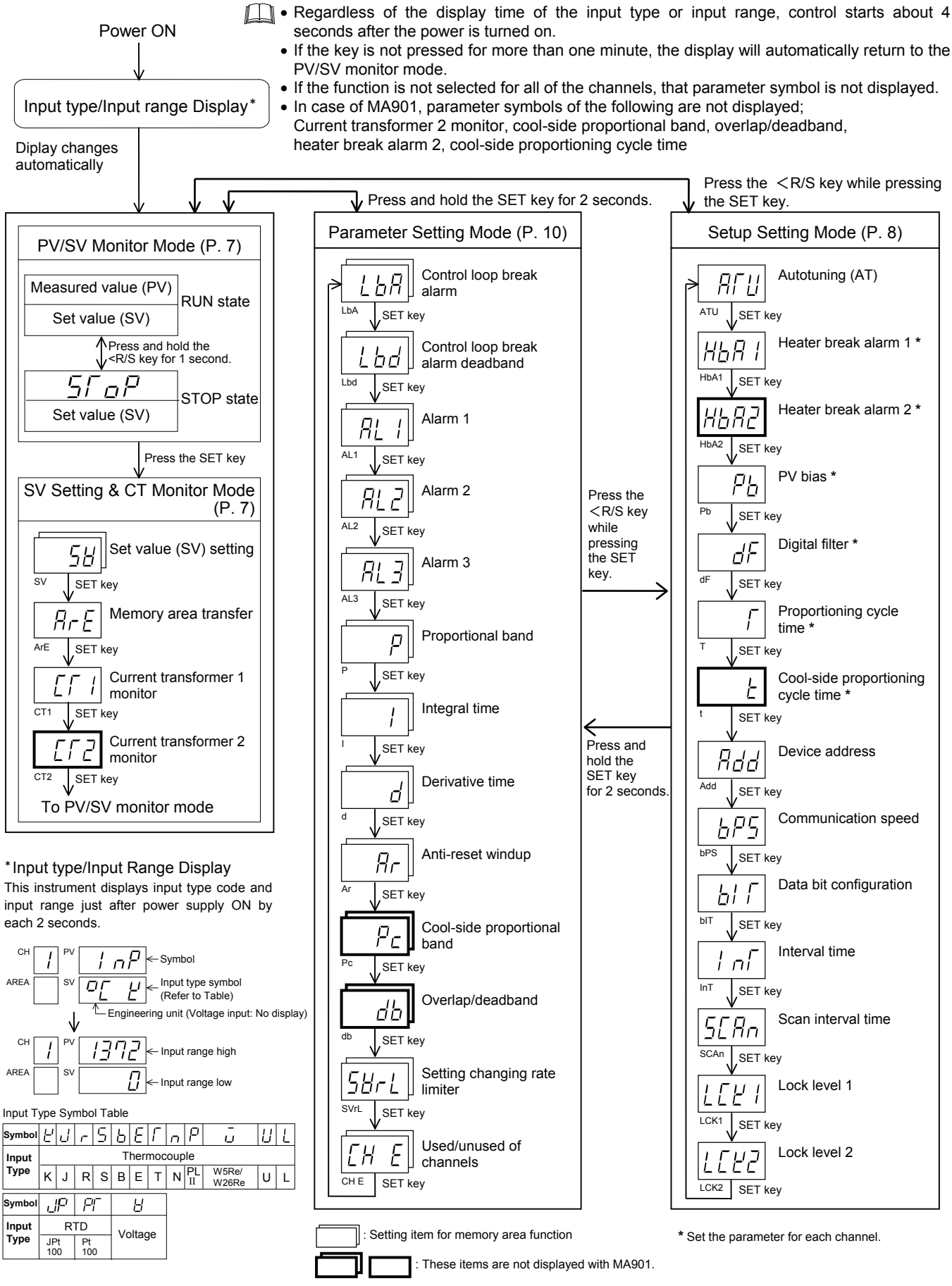
To avoid damage to the instrument, never use a sharp object to press keys.

5. SETTING

This chapter describes the operation flowchart of mode and the setting item of each mode. This instrument classes setting item in four kinds of mode. The mode can be selected by pressing the SET or <R/S key.

5.1 Operation Flowchart of Mode

- Regardless of the display time of the input type or input range, control starts about 4 seconds after the power is turned on.
- If the key is not pressed for more than one minute, the display will automatically return to the PV/SV monitor mode.
- If the function is not selected for all of the channels, that parameter symbol is not displayed.
- In case of MA901, parameter symbols of the following are not displayed;
  Current transformer 2 monitor, cool-side proportional band, overlap/deadband, heater break alarm 2, cool-side proportioning cycle time



*Input type/Input Range Display

This instrument displays input type code and input range just after power supply ON by each 2 seconds.

Input Type Symbol Table

Symbol												
Input Type	Thermocouple											
	K	J	R	S	B	E	T	N	PL II	W5Re/ W26Re	U	L

Symbol			
Input Type	RTD		Voltage
	JPt 100	Pt 100	

5.2 PV/SV Monitor Mode

PV/SV monitor mode can confirm the measured value (PV) and the set value (SV). Usually, set to this mode during control execution. For checking the measured value (PV) and set value (SV) during operation, the following two methods are available.

■ Checking PV and SV corresponding to each channel

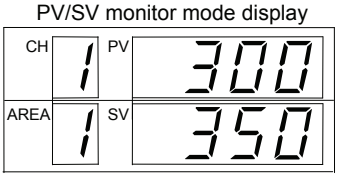
In PV/SV monitor mode, the PV and SV corresponding to the displayed channel can be checked. Each time the CH key is pressed, the SV corresponding to each channel within the memory area (hereinafter called “control area”) used for control can be checked for each channel.

Display example:

Indicates that PV/SV now on display corresponds to channel 1 within control area 1.

Indicates that memory area number 1 is selected as a control area.

PV/SV monitor mode display



Indicates that PV corresponding to channel 1 within the control area is 300 °C

Indicates that PV corresponding to channel 1 within the control area is 350 °C.

When the setting change rate limiter is set, a condition in which the set value (SV) goes changing according to that rate of change is displayed.

If the instrument needs to be switched to RUN or STOP mode, press the <R/S key in PV/SV monitor mode. In addition, RUN/STOP can be selected by key operation or by open or closed contact input (optional).

☞ **6.3 Transfer of RUN/STOP (P. 14)**

■ Checking SV corresponding to all of the channels within the control area

The SV corresponding to all the channels within the control area are automatically checked at each scan interval time.

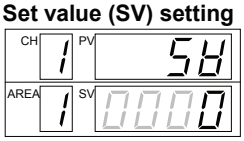
☞ **5.4 Setup Setting Mode (P. 8), 7.5 Scan Display Function (P. 16)**

5.3 SV Setting & CT Monitor Mode

SV setting & CT monitor mode is used to set the set value (SV) and control area or to monitor the current value (current transformer 1, current transformer 2). Press the SET key with state of PV/SV monitor mode to shift to this mode. The UP, DOWN or <R/S key is used to change the numeric value, and the SET key is used to change the parameter as well as to register the numeric value.

■ Description of each parameter

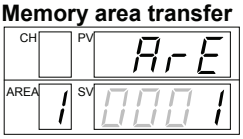
Set value (SV) setting



Set the set value (SV) which is the desired value for control.
Setting range: Within input range
Factory set value: Temperature input 0 °C [°F] or 0.0 °C [°F] Voltage input 0.0 %

- Up to eight memories per channel can be set with one set value (SV) assumed to be one memory.
- The set values (SV) corresponding to all of the channels within the same control area can be simultaneously set as the same value.
- No setting can be changed when “1 (Lock)” is selected by the lock level 1.

Memory area transfer

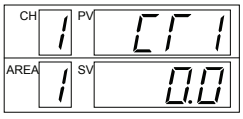


Selects the memory area used for control (Hereafter called the control area).
Setting range: 1 to 8
Factory set value: 1

- No setting can be changed when “1 (Lock)” is selected by the lock level 2.
- One set value (SV) and up to eight setting items of the parameter setting mode per channel can be stored.

☞ For details of the setting items of parameter setting mode, refer to **5.5 Parameter Setting Mode. (P. 10)**

Current transformer 1 monitor

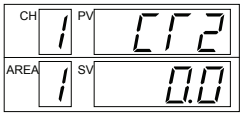


(Optional)

Displays the input value of the current transformer 1 used when the instrument is provided with the heater break alarm 1.
Display range: 0.0 to 100.0 A

- Not displayed when this instrument is not provided with the heater break alarm 1 function.
- Displays the input value of the current transformer 1 used when the instrument is provided with the heater break alarm 2 (Z-168).

Current transformer 2 monitor [Correspond to only MA900]



(Optional)

Displays the input value of the current transformer 2 used when the instrument is provided with the heater break alarm 2 (Z-168).
Display range: 0.0 to 100.0 A

- Not displayed when this instrument is not provided with the heater break alarm 2 function.
- In case of MA901, this monitoring screen is not provided.

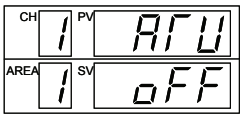
To PV/SV monitor mode

5.4 Setup Setting Mode

Setup setting mode is used to set the heater beak alarms, PV bias, digital filter, communication, and to lock the set data. The instrument can be switched to AT start or AT cancel. Press the <R/S key while pressing the SET key with state of PV/SV monitor mode, SV setting & CT monitor mode, or parameter setting mode to shift to this mode. The UP, DOWN or <R/S key is used to change the numeric value, and the SET key is used to change the parameter as well as to register the numeric value.

■ Description of each parameter

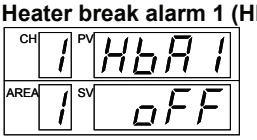
Execution of autotuning (AT)



The AT function is executed to the control area now in operation.
Setting range: ON: AT start or execution OFF: AT end or cancel
Factory set value: OFF

- The batch setting allows the autotuning to be executed simultaneously in all channels.
- When instrument displays data without a channel, an AT lamp does not flash during AT execution.

Heater break alarm 1 (HBA1)

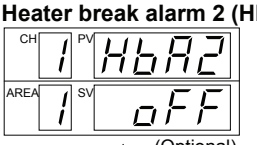


(Optional)

HBA1 set value is set by referring to monitor value from the current transformer 1.
Used for single-phase or three-phase.
Displayed only for when the heater break alarm is selected as alarm 2.
Setting range: 0.0 to 100.0 A OFF: HBA1 function OFF
Factory set value: OFF

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- HBA is not available on a current output.
- Set HBA1 set value to a value about 85 % of current transformer 1 input value.
- When power supply variations are large, set the HBA1 set value to a slightly smaller value. In addition, when two or more heaters are connected in parallel, set the HBA1 set value to a slightly larger value so that it is activated even with only one heater broken (However, within the value of current transformer 1).
- When no current transformer is connected in any setting other than “OFF,” the heater break alarm is turned on.

Heater break alarm 2 (HBA2) [Correspond to only MA900]

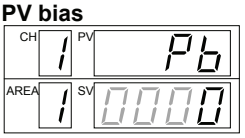


(Optional)

HBA2 set value is set by referring to monitor value from the current transformer 2. Used only for three-phase. Displayed only for when the heater break alarm (Z-168) is selected as alarm 2.
Setting range: 0.0 to 100.0 A OFF: HBA2 function OFF
Factory set value: OFF

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- HBA is not available on a current output.
- Set HBA2 set value to a value about 85 % of current transformer 2 input value.
- When power supply variations are large, set the HBA2 set value to a slightly smaller value. In addition, when two or more heaters are connected in parallel, set the HBA2 set value to a slightly larger value so that it is activated even with only one heater broken (However, within the value of current transformer 2).
- When no current transformer is connected in any setting other than “OFF,” the heater break alarm is turned on.
- In case of MA901, this setting item is not provided.

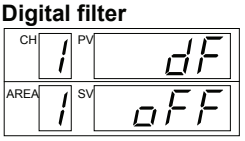
PV bias



Set the PV bias to add to measured value for sensor correction, etc. The PV bias is used to correct the individual variations in the sensors or when there is difference between the measured values (PV) of other instruments.
Setting range: −Input span to +Input span (Within −1999 to +9999 digits)
Factory set value: Temperature input 0 °C [°F] or 0.0 °C [°F] Voltage input 0.0 %

No setting can be changed when “1 (Lock)” is selected by the lock level 1.

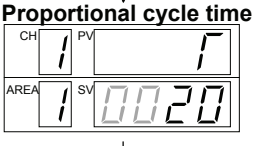
Digital filter



Set the time of the first-order lag filter which rejects any noise contained in the measured input.
Setting range: 1 to 100 seconds OFF: Digital filter function OFF
Factory set value: OFF

No setting can be changed when “1 (Lock)” is selected by the lock level 1.

Proportional cycle time



Set control output cycle. For heat/cool PID action: Heat-side proportional cycle time
Setting range: 1 to 100 seconds
Factory set value: Relay contact output: 20 seconds
Voltage pulse output, triac output and open collector output: 2 seconds

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- Not displayed for current output.

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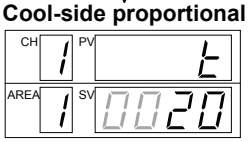
(A)

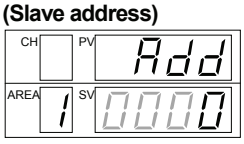
Cool-side proportional cycle time [Correspond to only MA900]



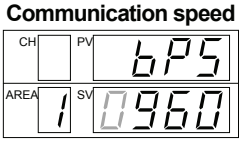
Displayed only for heat/cool PID control. Set the cool-side control output cycle for the heat/cool PID control.
Setting range: 1 to 100 seconds
Factory set value: Relay contact output: 20 seconds
Voltage pulse output, triac output and open collector output: 2 seconds

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- Not displayed for current output.
- In case of MA901, this setting item is not provided.

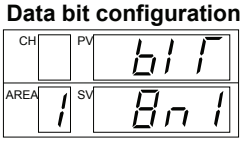
Device address (Slave address)



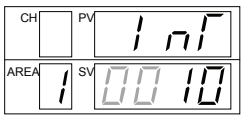
Communication speed



Data bit configuration



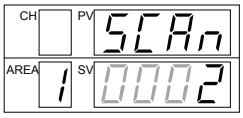
Interval time



These parameter is displayed when the communication function is provided.

For details, refer to the **MA900/MA901 Communication Instruction Manual (IMR01H02-E□)**.

Scan interval time

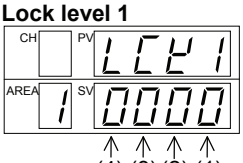


Sets the time until changed to the next screen when scan-displayed.
Setting range: 1 to 10 seconds
Factory set value: 2 seconds

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- Only the relevant parameter corresponding to the cannel set to “MonI” or “ConT” in “used/unused channels” of the parameter setting mode can be scan-displayed.

7.5 Scan Display Function (P. 16)

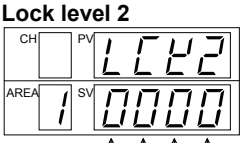
Lock level 1



Set to the control area now in operation to restrict parameter setting changes by the key operation.
Setting range: (1) Items other than SV and alarms (ALM1 to ALM3)
0: Unlock 1: Lock
(2) Alarms (ALM1 to ALM3) 0: Unlock 1: Lock
(3) SV 0: Unlock 1: Lock
(4) No setting (“0” Fixed)
Factory set value: 0000

The lock level 1 can be changed even when the whole set data is locked.

Lock level 2



Set to the control area now in operation to restrict RUN/STOP and memory area changes.
Setting range: (1) RUN/STOP transfer 0: Unlock 1: Lock
(2) Memory area transfer 0: Unlock 1: Lock
(3) No setting (“0” Fixed)
(4) No setting (“0” Fixed)
Factory set value: 0000

The lock level 2 can be changed even when the whole set data is locked.

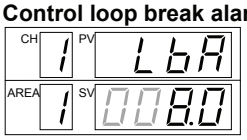
Return to first parameter “Execution of autotuning (AT)”

5.5 Parameter Setting Mode

The parameter setting mode is used to set various settings relating to control, to change various alarm settings and also to set the setting change rate limiter and used/unused channels. Setting items belonging to the parameter setting mode correspond to the multi-memory area functions and can be stored up to eight memories. Press and hold the SET key for 2 seconds with state of PV/SV monitor mode, SV setting & CT monitor mode, or setup setting mode to shift to this mode. The UP, DOWN or <R/S key is used to change the numeric value, and the SET key is used to change the parameter as well as to register the numeric value.

■ Description of each parameter

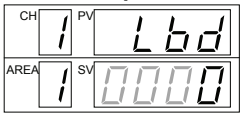
Control loop break alarm (LBA)



Monitors measured value variations and also sets the time to detect any abnormal control loop. Displayed only for when the LBA is selected as alarm 1.
Setting range: 0.1 to 200.0 minutes OFF: LBA function OFF
Factory set value: 8.0 minutes

- No setting can be changed when "1 (Lock)" is selected by the lock level 1.
- We recommend that the set value of LBA be twice the value of the integral time (I). If the autotuning function is used, the LBA setting time twice as large as the integral time is automatically set.

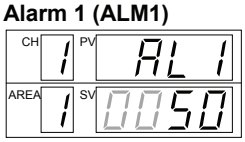
Control loop break alarm deadband (LBD)



Set the area of not outputting LBA. Displayed only for when the LBA is selected as alarm 1.
Setting range: 0 to Input span (However, 9999 digits or less) [0: LBD OFF]
Factory set value: Temperature input 0 °C [°F] or 0.0 °C [°F] Voltage input 0.0 %

No setting can be changed when "1 (Lock)" is selected by the lock level 1.

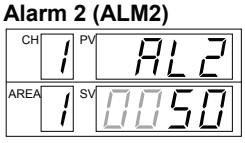
Alarm 1 (ALM1)



Set the ALM1 set value. Displayed when any one of the deviation, process and SV alarms is selected as the alarm 1.
Setting range: Process alarm, SV alarm: Same as input range
Deviation alarm: − Input span to + Input span (Within −1999 to +9999 digits)
Factory set value: Temperature input 50 °C [°F] or 50.0 °C [°F] Voltage input 5.0 %

- No setting can be changed when "1 (Lock)" is selected by the lock level 1.
- Not displayed when FAIL alarm or control loop break alarm is selected for alarm 1.

Alarm 2 (ALM2)

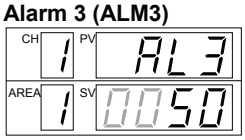


(Optional)

Set the ALM2 set value. Displayed when any one of the deviation, process and SV alarms is selected as the alarm 2.
Setting range: Process alarm, SV alarm: Same as input range
Deviation alarm: − Input span to + Input span (Within −1999 to +9999 digits)
Factory set value: Temperature input 50 °C [°F] or 50.0 °C [°F] Voltage input 5.0 %

- No setting can be changed when "1 (Lock)" is selected by the lock level 1.
- Not displayed when FAIL alarm or heater break alarm is selected for alarm 2.

Alarm 3 (ALM3)

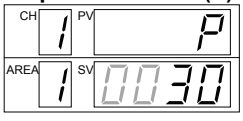


(Optional)

Set the ALM3 set value. Displayed when any one of the deviation, process and SV alarms is selected as the alarm 3.
Setting range: Process alarm, SV alarm: Same as input range
Deviation alarm: − Input span to + Input span (Within −1999 to +9999 digits)
Factory set value: Temperature input 50 °C [°F] or 50.0 °C [°F] Voltage input 5.0 %

- No setting can be changed when "1 (Lock)" is selected by the lock level 1.
- Not displayed when FAIL alarm is selected for alarm 3.

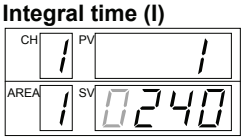
Proportional band (P)



Set the proportional band for the P control, PI control or PD control.
For heat/cool PID action: Proportional band setting on the heat-side.
Setting range: 0 (0.0) to Input span (However, 9999 digits or less)
Factory set value: Temperature input 30 °C [°F] or 30.0 °C [°F] Voltage input 3.0 %

- No setting can be changed when "1 (Lock)" is selected by the lock level 1.
- ON/OFF action when set to 0 (0.0).

Integral time (I)



Set the time of integral action which eliminates the offset occurring in proportional control.
Setting range: 1 to 3600 seconds OFF (0 second): Integral action OFF (PD action)
Factory set value: 240 seconds

No setting can be changed when "1 (Lock)" is selected by the lock level 1.

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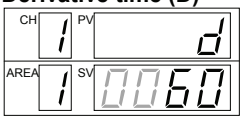
(A)

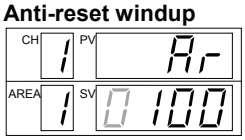
Derivative time (D)



Set the time of derivative action which prevents ripples by predicting output changes and thus improves control stability.
Setting range: 1 to 3600 seconds OFF (0 second): Derivative action OFF (PI action)
Factory set value: 60 seconds

No setting can be changed when “1 (Lock)” is selected by the lock level 1.

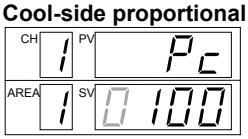
Anti-reset windup



In order to prevent an overshoot caused by the integral effect, sets the value to restrict the effective range of integral action.
Setting range: 0 to 100 % of proportional band (0: Integral action OFF)
Factory set value: 100 %

No setting can be changed when “1 (Lock)” is selected by the lock level 1.

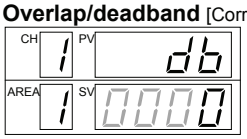
Cool-side proportional band [Correspond to only MA900]



Displayed only for heat/cool PID control. Set the cool-side proportional band for the heat/cool PID control.
Setting range: 1 to 1000 % of heat-side proportional band
Factory set value: 100 %

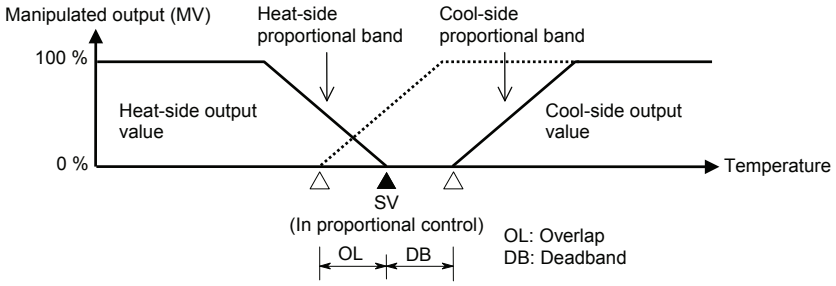
- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- In case of MA901, this setting item is not provided.

Overlap/deadband [Correspond to only MA900]

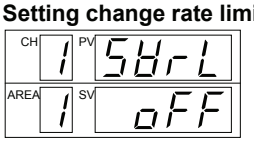


Displayed only for heat/cool PID control. Set the deadband between the heat-side proportional band and the cool-side proportional band.
Setting range: −Input span to +Input span (Within −1999 to +9999 digits)
Factory set value: Temperature input 0 °C [°F] or 0.0 °C [°F] Voltage input 0.0 %

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- In case of MA901, this setting item is not provided.
- Minus (−) setting results in overlap.



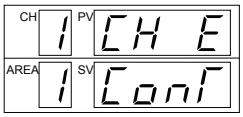
Setting change rate limiter



Set the amount of set value (SV) change per 1 minute when the SV is changed.
Setting range: 0 (0.1) to Input span/min. (However, 9999 digits or less)
OFF: Setting change rate limiter OFF
Factory set value: OFF

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- The set value (SV) while the setting change rate limiter can be checked in PV/SV monitor mode.
- When the power is turned on or the operation is changed from STOP to RUN, the setting change rate limiter functions toward the set value (SV) from the measured value (PV) when started.
- If the autotuning (AT) function is activated while the setting change rate limiter functions, PID control continues until the limiter completes its functioning, and the AT function is activated after the limiter completes its functioning.

Used/unused of channels



Select the used or unused of each channel for each memory area.
Setting range: oFF (oFF): Unused Monl (Monl): Used for only alarm
Conf (ConT): Used for control and alarm
Factory set value: ConT

- No setting can be changed when “1 (Lock)” is selected by the lock level 1.
- During display scanning, each unused channel is skipped. When the channel number is selected by the CH key, any unused channel is displayed.

Return to first parameter setting item.

5.6 Setting Procedure

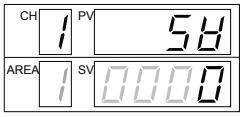
5.6.1 Usual setting (Setting for each channel)

Some examples of changing the set value (SV) are described in the following. The same setting procedure applies when other parameters are also set.

● When the SV is changed

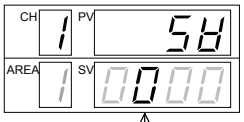
When CH1 set value (SV) of the control area 1 is change from 0 °C to 300 °C:

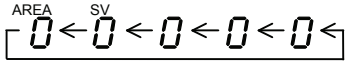
1. Press the SET key in PV/SV monitor mode state to transfer to SV setting & CT monitor mode.



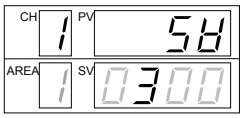
2. Press the <R/S key to high-light the hundreds digit. The high-light digit indicates which digit can be set.

Every time the <R/S key is pressed, the high-lighted digit moves as follows.

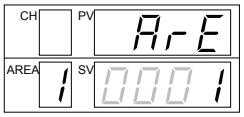




3. Press the UP key to change the number to *3*.



4. Press the SET key to store the new value. The display goes to the next parameter (Memory area transfer display).

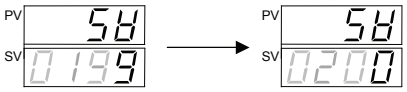


The following is also available when changing the set value.

● Increase SV from 199 °C to 200 °C:

1. Press the <R/S key to light brightly the least significant digit.

2. Press the UP key to change to *0*.
The display changes to *200*.



● Decrease SV from 200 °C to 190 °C:

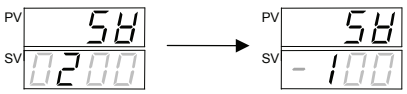
1. Press the <R/S key to light brightly the tens digit.

2. Press the DOWN key to change to *9*.
The display changes to *190*.

● Decrease SV from 200 °C to −100 °C:

1. Press the <R/S key to light brightly the hundreds digit.

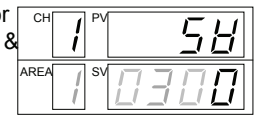
2. Press the DOWN key (three times) to change to *−1*.
The display changes to *−100*.



● When another area set value (SV) is changed without changing control area

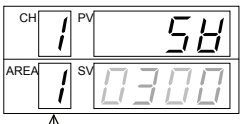
When changing the set value (SV) corresponding to channel 2 in memory area 3 from 150 °C to 100 °C with the memory area set to memory area 1:

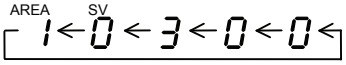
1. Press the SET key in PV/SV monitor mode state to transfer to SV setting & CT monitor mode.



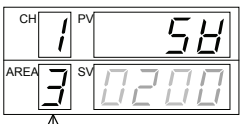
2. Press the <R/S key until the AREA display unit is high-lighted. The high-light digit indicates which digit can be set.

Every time the <R/S key is pressed, the high-lighted digit moves as follows.

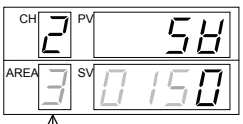




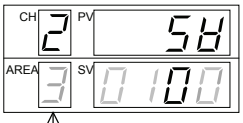
3. Press the UP key to change the number to *3*.
The SV display shows the channel 1 set value (SV) of the memory area number 3. Also, the number of AREA display flashes.



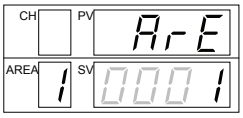
4. Press the CH key to change the number to *2*.
The SV display shows the channel 2 set value (SV) of the memory area number 3.



5. Press the DOWN key to change to *0* in the tens digit.



6. Press the SET key to store the new value. The display goes to the next parameter (Memory area transfer display).



The changed set value is registered by pressing the SET key or also at the time when any of the following key operations is performed.

- When the channel number is changed by the CH key
- When the memory area number is changed

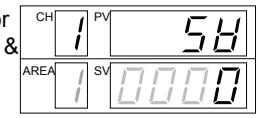
5.6.2 Batch setting (All channels batch setting)

The parameters selected from one memory area and corresponding to all of the channels can be simultaneously set as the same value. The set values (SV) as well as the parameters set for each channel can be simultaneously set. Some examples of changing the set value (SV) simultaneously are described in the following. The same setting procedure applies when other parameters for each channel are also set.

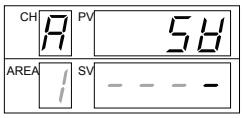
● When the SV is changed in batch setting

When all set value (SV) of the control area (memory area 1) is change from 0 °C to 300 °C:

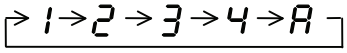
1. Press the SET key in PV/SV monitor mode state to transfer to SV setting & CT monitor mode.



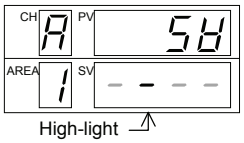
2. Press the CH key. Display the character *A* on the CH display and "----" on the SV display. The character *A* indicates that the batch setting.



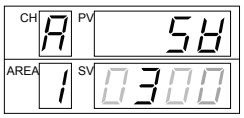
Every time the CH key is pressed, the channel number changes as follows.



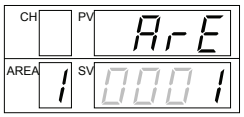
3. Press the <R/S key to high-light the hundreds digit.



4. Press the UP key to change the number to *3*.



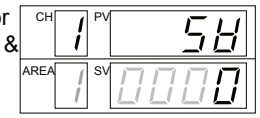
5. Press the SET key. The value thus set is stored simultaneously for all of the channels. The display goes to the next parameter (Memory area transfer).



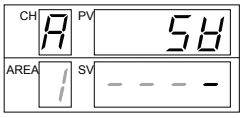
● The set values (SV) in other memory areas are simultaneously set to the same value without changing the control area

When changing the set values (SV) corresponding to all of the channels in memory area 2 from 0 °C to 300 °C with the control area corresponding to memory area 1:

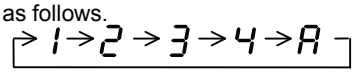
1. Press the SET key in PV/SV monitor mode state to transfer to SV setting & CT monitor mode.



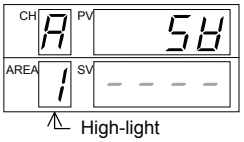
2. Press the CH key. Display the character *A* on the CH display and "----" on the SV display. The character *A* indicates that the batch setting.



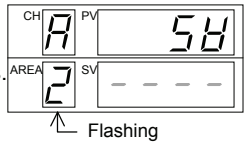
Every time the CH key is pressed, the channel number changes as follows.



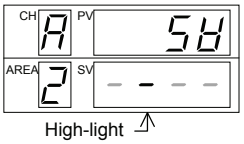
3. Press the <R/S key until the AREA display unit is high-lighted.



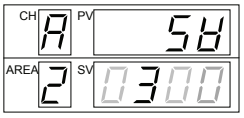
4. Press the UP key to change the number to *2*.
The number of AREA display flashes.



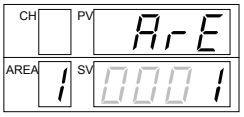
5. Press the <R/S key to high-light the hundreds digit.



6. Press the UP key to change the number to *3*.



7. Press the SET key. The value thus set is stored simultaneously for all of the channels. The display changes to the next parameter (Memory area transfer).



The set value (SV) corresponding to any unused channel is also subjected to the batch setting.

For details of shifting, refer to page 12.

6. OPERATION

This chapter describes instrument operation, the instrument operation, RUN/STOP transfer, and control area transfer, etc.

6.1 Power ON

After power on, this instrument starts control in about 4 seconds.

When a power failure of more than 30 ms occurs, the instrument assumes that the power has been turned off. When power return, the instrument performs the same operation as that at the time of power on.

6.2 Change of the Set Value (SV)

- To change the set value (SV), set the instrument to SV setting & CT monitor mode.
  5.1 Operation Flowchart of Mode (P. 6), 5.6 Setting Procedure (P. 12)
- The set values (SV) corresponding to all of the channels within the same control area can be simultaneously set as the same value.
  5.6.2 Batch setting (P. 13)
- The set values (SV) in other memory areas can be changed without changing the control area.
  5.6.1 Usual setting (P. 12), 5.6.2 Batch setting (P. 13)
- While the set value (SV) is locked by Lock Level 1, no set value (SV) can be changed.
  5.4 Setup Setting Mode (P. 8)

6.3 Transfer of RUN/STOP

RUN/STOP can be selected by contact input (optional) or communication (optional) other than the key operation. In addition, at STOP the key operation and contact state are displayed on the PV display. Relationships between key operation, RUN/STOP and the characters to indicate the STOP state are shown in the following. When the RUN/STOP is transferred by communication, refer to the **MA900/MA901 Communication Instruction Manual (IMR01H02-E□).**

		RUN/STOP with Contact Input	
		RUN (Contact closed)	STOP (Contact open)
RUN/STOP with Key Operation	RUN	RUN	STOP
		STOP is not displayed	dSTP (dSTP)
	STOP	STOP	STOP
		KSTP (KSTP)	SToP (SToP)

After the contact is closed, it takes a short time* until the action of this device is actually selected. Therefore, pay attention to this delay time if the device is used together with a sequencer, etc.

*** 0.5 seconds (shortest)**

Only *SToP* is displayed at the time of STOP in the state without RUN/STOP transfer by contact input.

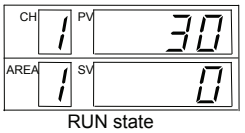
When the contact input state is RUN mode, RUN/STOP can be selected by key operation.

KSTP : Only key operation is in the STOP mode.
dSTP : Only contact input is in the STOP mode.
STOP : Both key operation and contact input are in the STOP mode.

Conditions when changed to STOP mode:
- Control: OFF
- Alarm: OFF
- AT: Cancel (The PID constants are not updated)

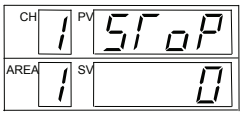
■ RUN/STOP transfer by key operation

When changing RUN to STOP in the state without RUN/STOP transfer by contact input.



RUN state

1. Press and hold the <R/S key for 1 second in PV/SV monitor mode.



STOP state

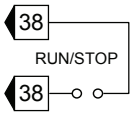
2. The mode is changed to STOP from RUN. The PV display shows the characters of showing the relevant STOP state.

Also when changing from STOP to RUN, press and hold the <R/S key for 1 second while in the PV/SV monitor display.

No RUN/STOP transfer by key operation can be made when "1 (Lock)" is selected by the lock level 2.

■ RUN/STOP transfer by contact input (Optional)

RUN/STOP can be selected according to the open or closed state of the terminal numbers 37 and 38.



Terminal No.	RUN	STOP
37 - 38	Contact closed	Contact open

After the contact is closed, it takes a short time* until the action of this device is actually selected. Therefore, pay attention to this delay time if the device is used together with a sequencer, etc.

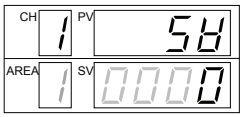
*** 0.5 seconds (shortest)**

6.4 Transfer of Control Area

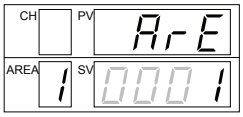
The memory area used for this control (control area) can be selected by contact input (optional) or communication (optional) other than the key operation. The memory area transfer by contact input and the key operation is shown in the following. When the memory area is transferred by communication, refer to the **MA900/MA901 Communication Instruction Manual (IMR01H02-E□).**

■ Control area transfer by key operation

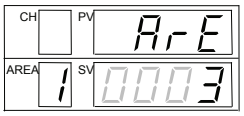
When the control area is changed from memory area number 1 to 3.



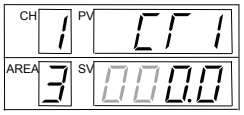
1. Press the SET key in PV/SV monitor mode state to transfer to SV setting & CT monitor mode.



2. Press the SET key to change the display to *ArE* (memory area transfer display).



3. Press the UP key to change the number to *3*.



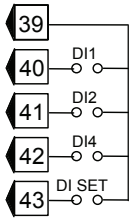
4. Press the SET key to store the new value. The AREA display shows the memory area number *3*. (The figure at left shows the current transformer 1 monitor display)

For memory area numbers, the number changed last is effective.

The memory area number (control area) can be changed at either RUN or STOP.

■ Control area transfer by contact input (Optional)

The control area can be selected according to the open or close state of the terminal numbers 39 to 43. The memory area number is selected according to the open or close state of the terminal number 39 to 42, and the selected memory area number is registered when the terminal number 39 and 43 (DI SET) changes from the open state to the close state.



Terminal No.	Memory area number							
	1	2	3	4	5	6	7	8
39 - 40	×	–	×	–	×	–	×	–
39 - 41	×	×	–	–	×	×	–	–
39 - 42	×	×	×	×	–	–	–	–

×: Contact open –: Contact closed

After the contact is closed, it takes a short time* until the action of this device is actually selected. Therefore, pay attention to this delay time if the device is used together with a sequencer, etc.

*** Select the area in a period 0.5 seconds after the DI SET terminals are closed.**

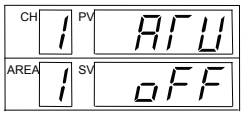
6.5 Autotuning (AT)

The AT function automatically measures, computes and sets the optimum PID and LBA constants. If the AT function is activated, the optimum PID constants concerning the set value (SV) in the control area and the LBA setting time can be automatically set (Limit cycle system is adopted). This function is activated power-ON, during temperature rise and/or when control is stabilized from any process state. The result obtained by AT is reflected to the parameters (P, I, D and LBA) of the parameter setting mode.

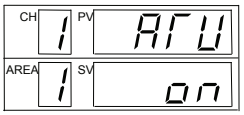
■ Requirements for AT start

- Start AT when all following conditions are satisfied:
  - Prior to starting the AT, end all the parameter settings other than PID and LBA.
  - Both the lock level 1 and the lock level 2 should be set to *0000.*
  - RUN/STOP is in the RUN mode.

- Procedure:



1. Change the mode to the setup setting mode to show the execution of autotuning (AT) display.



2. Press the UP key to change to *on.*

3. Press the SET key.
After this function is executed, the autotuning lamp flashes.

When the AT is finished, the execution of autotuning (AT) will automatically return to show *oFF* (AT lamp OFF).

■ Requirements AT cancellation

The AT is canceled if any of the following conditions exist:

- When the SV is changed
- When the PV bias value is changed
- When the PV becomes abnormal when burnout occurs
- When the AT does not end in nine hours after AT started
- When the power is turned off
- When the RUN/STOP is changed to the STOP mode
- When a power failure longer than 30 ms occurs
- When the control area is changed

If the AT is canceled, the controller immediately changes to PID control. The PID and LBA constants will be the same as before AT was activated.

When AT is competed, the controller immediately changes to PID control. If the control system does not allow the AT cycling process, do not use AT and set each PID constant to meet the needs of the application.

7. FUNCTIONS

This chapter describes an outline of function of MA900/MA901.

7.1 PV Bias Function

The value set in the PV bias is added to the input value (actual measured value) to correct the input value. The PV bias is used to correct the individual variations in the sensors or when there is difference between the measured values (PV) of other instruments.

☞ **5.4 Setup Setting Mode (P. 8)**

7.2 Digital Filter Function

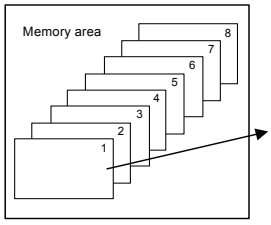
This is a software filter which reduces input value variations caused by noise. If the time constant of this filter is set appropriately to match the characteristics of the controlled object and the noise level, the effects of input noise can be suppressed. However, if the time constant is too small, the filter may not be effective, while if the time constant is too large, then the input response may actually deteriorate.

☞ **5.4 Setup Setting Mode (P. 8)**

7.3 Multi-Memory Area Function

This function is to store the parameters such as temperature set value (SV), etc. in up to 8 memories. The parameters which can be stored as one of memories are set value (SV), alarm 1, alarm 2, alarm 3, proportional band, integral time, derivative time, anti-reset windup, cool-side proportional band, overlap/deadband, setting change rate limiter and use/unused of channels. The parameters stored in one of 8 memories retrieved at necessity and used for control. The memory area used for this control is called the control area.

☞ **5.3 SV Setting & CT Monitor Mode (P. 7),**
5.5 Parameter Setting Mode (P. 10)



∗ These setting items cannot be set in MA901.

Control area

Parameter	CH1	CH2	CH3	CH4
Set value (SV)				
Control loop break alarm				
Control loop break alarm deadband				
Alarm 1				
Alarm 2				
Alarm 3				
Proportional band				
Integral time				
Derivative time				
Anti-reset windup				
Cool-side proportional band *				
Overlap/deadband *				
Setting change rate limiter				
Use/unused of channels				

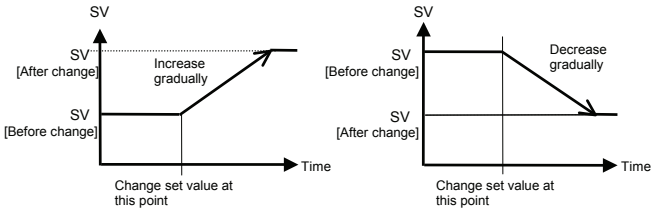
7.4 Setting Change Rate Limiter Function

The setting change rate limiter functions so as to change the set value (SV) gradually toward the set value after being changed. This limiter sets how much the set value is changed upward or downward per minute.

☞ **5.5 Parameter Setting Mode (P. 10)**

Example:

<Increasing set value to higher value> <Decreasing set value to lower value>



7.5 Scan Display Function

The scan display function is for automatically selecting the PV/SV monitor at the scan interval time for the measured values (PV) and set values (SV) corresponding to all of the channels within the control area. This function enables the control trend of each channel to be checked.

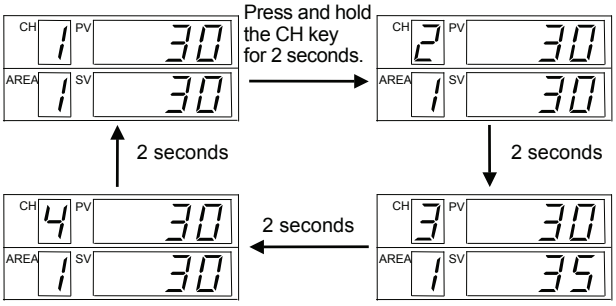
- The transfer speed of the scan display is set with the interval time of setup setting mode (P. 9).
- Use the CH key to stop or start of the scan display function. The CH key operation is as follows.

Press and hold the CH key for 2 seconds	Scan start.
Press the CH key	Scan stop.
	The channel number can be changed like 1→2→3→4→1・・・ during scan stopping.* * In case of MA901: 1→2→3→4→5→6→7→8→1・・・

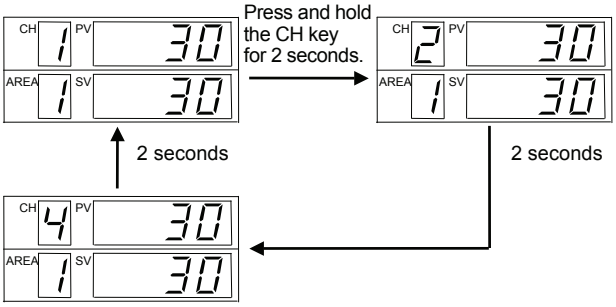
- During display scanning, each unused channel is skipped. The unused channel means the channel set to *oFF* in used/unused channels of the parameter setting mode.
- When the channel number is manually changed, both PV and SV corresponding to any unused channel are also scan-displayed.
- The scan display can be made even at any of RUN and STOP.
- If the instrument power is turned off while on scan display, the scan display function is deactivated. If the scan display function needs to be activated when the power is turned or again, press and hold the CH key for 2 seconds.

Scanning display examples:

When scanning PV/SV corresponding to channel 1 to channel 4 in the control area 1 at 2 seconds intervals:



When scanning PV/SV corresponding to channel 1 to channel 4 (channel 3: unused channel) in the control area 1 at 2 seconds intervals:



7.6 Batch Setting Function

The batch setting function enables the setting of the parameters selected within one memory area simultaneously to the same value for all of the channels. The set values (SV) as well as the parameters set for each channel can be simultaneously set.

5.6.2 Batch setting (P. 13)

The set value (SV) corresponding to any unused channel is also subjected to the batch setting.

All channels of all memory area cannot be simultaneously set as the same value.

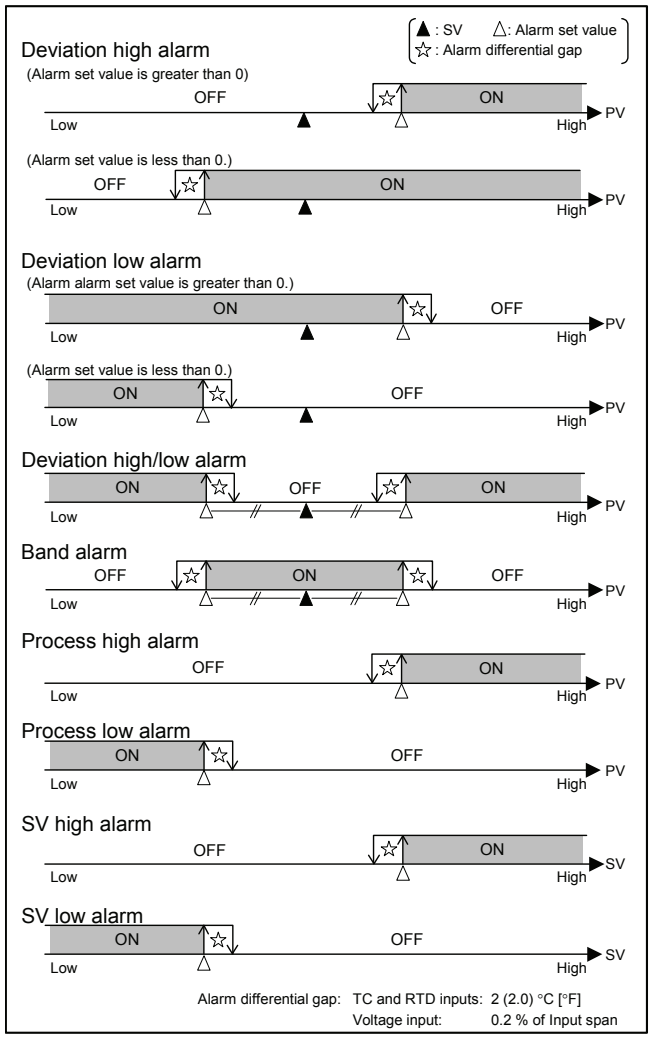
7.7 Alarm Function

Alarm function sets up the alarm state when the measured value (PV) or the deviation reaches the alarm set values. In the alarm state, the alarm output is output, and the alarms are used to drive the equipment danger signals or the safety equipment.

- The output specifications are the relay contact output.
- The alarm output condition can be determined by the type of alarm action[1], the output destination[1] and each alarm set value[2].

[1] Specify when ordering
[2] Setting item of the parameter setting mode

■ Alarm action type



■ Alarm output

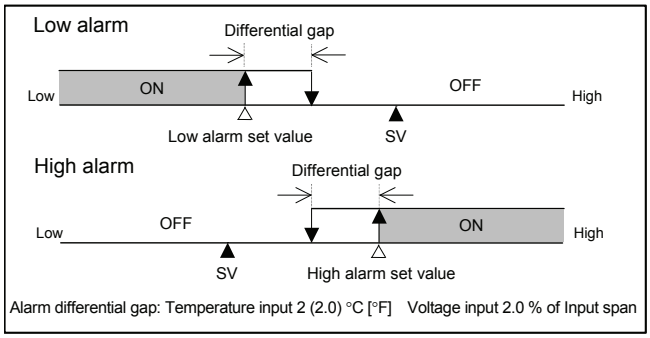
The alarm output (factory set value) of the alarm 1, alarm 2 and alarm 3 are as follows.

Alarm 1	*OR* output of the alarm 1 in all channels (Energized) *
Alarm 2 (Optional)	*OR* output of the alarm 2 in all channels (Energized) *
Alarm 3 (Optional)	*OR* output of the alarm 3 in all channels (Energized) *

* FAIL alarm is fixed to "De-energized."

■ Alarm differential gap

If measured value (PV) is close to the alarm set value, the alarm relay contact may repeatedly turn on and off due to input fluctuations. By the differential gap, repeated turning ON and OFF of the relay contact can be prevented.



Alarm differential gap: Temperature input 2 (2.0) °C [°F] Voltage input 2.0 % of Input span

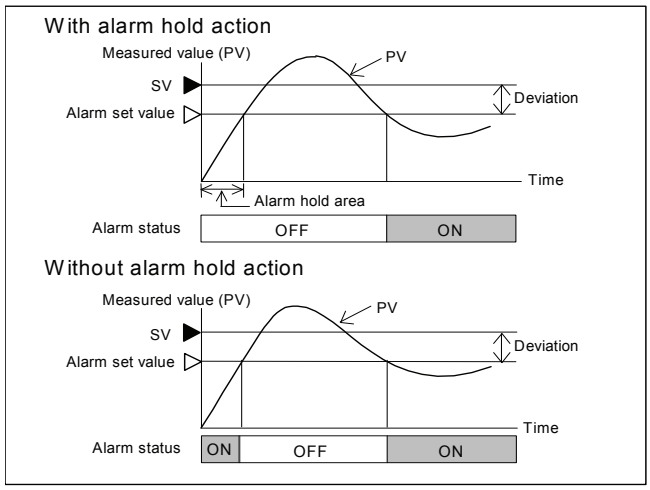
■ Alarm hold action (Specify when ordering)

This hold action is used to make alarm invalid until the PV exits once from the alarm region by ignoring the alarm state even if the PV is in the alarm state when the power is turned on.

The alarm hold action is activated when not only the power is turned on, but also the following conditions

- When the RUN/STOP is changed to the RUN mode
- When the SV is changed
- When the memory area (control area) is changed

Example:



7.8 Heater Break Alarm (HBA) Function

The heater break alarm (HBA) function is used to detect the current flowing through the load (heater) by using a current transformer (CT), to compare the current thus detected to the heater break alarm set value, and thus to produce a heater break alarm when any of the following causes occurs.

5.3 SV Setting & CT Monitor Mode (P. 7),
5.4 Setup Setting Mode (P. 8)

■ Occurrence of heater break alarm

When heater current does not flow (Heater break, malfunction of the control device, etc.):
Alarm is issued when the input value of the current transformer is below the heater break alarm set value with the control output turned on. However, no alarm may be normally issued when the control output is turned on for less than 2 seconds.

When heater current goes following (welded relay contact, etc.):
Alarm is issued when the input value of the current transformer is above the heater break alarm set value with the control output turned off. However, no alarm may be normally issued when the control output is turned off for less than 2 seconds.

Three-phase heater break alarm function (Z-168):
A heater break alarm occurs in the following configuration. The inputs of CT1 and CT5 are compared with the set values of HBA1 and HBA2, respectively to decide heater break or welding.
[Corresponding to MA900]

Input ⟶ Occurrence of alarm ⟶ Output

CT1 (CH1) — HBA1
CT5 (CH1) — HBA2
HBA1, HBA2 ⟶ HBA output

Relationship between CT input and channel number:
The following table shows which CT input corresponds to what input channel number and what CT monitoring display you can check it with.

Single-phase heater break alarm

CH No.	CT input	MA900 Terminal No.	MA901 Terminal No.	CT monitoring display
CH1	CT1	No.25 to 26	No.37 to 38	
CH2	CT2	No.25 to 27	No.37 to 39	
CH3	CT3	No.28 to 29	No.40 to 41	
CH4	CT4	No.28 to 30	No.40 to 42	CT1
CH5	CT5	Unused	No.43 to 44	
CH6	CT6		No.43 to 45	
CH7	CT7		No.46 to 47	
CH8	CT8		No.46 to 48	

Three-phase heater break alarm (Z-168)

CH No.	CT input	MA900 Terminal No.	MA901 Terminal No.	CT monitoring display
CH1	CT1	No.25 to 26	No function	
CH2	CT2	No.25 to 27		CT1
CH3	CT3	No.28 to 29		
CH4	CT4	No.28 to 30		
CH1	CT5	No.31 to 32		
CH2	CT6	No.31 to 33		CT2
CH3	CT7	No.34 to 35		
CH4	CT8	No.34 to 36		

7.9 Control Loop Break Alarm (LBA) Function

The control loop break alarm (LBA) function is used to detect a load (heater) break or a failure in the external actuator (magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break. The LBA function is activated when PID computed value (output ON time/cycle) falls below 0 % or exceeds 100 %. The time required for the LBA output to turn on includes both the time from the initial occurrence of loop failure and the LBA setting time.

5.5 Parameter Setting Mode (P. 10)

■ Alarm action

Heat control:

LBA triggering width: Temperature input: 2 °C [°F] (fixed)
Voltage input: 0.2 % of Input span (fixed)

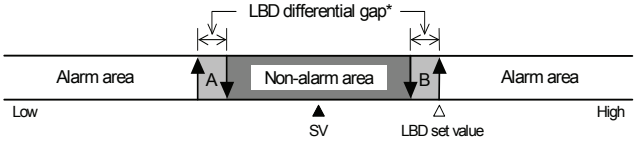
When the PID computed value falls below 0 %:
- For direct action:
  This alarm is produced when the measured value (PV) does not rise beyond the LBA triggering width within the LBA setting time.
- For reverse action:
  This alarm is produced when the measured value (PV) does not fall below the LBA triggering width within the LBA setting time.

When the PID computed value exceeds 100 %:
- For direct action:
  This alarm is produced when the measured value (PV) does not fall below the LBA triggering width within the LBA setting time.
- For reverse action:
  This alarm is produced when the measured value (PV) does not rise beyond the LBA triggering width within the LBA setting time.

■ Control loop break alarm deadband (LBD)

The control loop break alarm may be produced by disturbances (other heat sources) even if the control system is not abnormal. In such a case, an area in which no alarm is produced can be set by setting the desired LBD.
When the measured value (PV) is within the LBD area, no alarm is produced even if all of the conditions to produce the alarm are satisfied. Therefore, carefully set the LBD.

5.5 Parameter Setting Mode (P. 10)



A: During temperature rise: Alarm area
During temperature fall: Non-alarm area
B: During temperature rise: Non-alarm area
During temperature fall: Alarm area
* TC and RTD inputs: 0.8 °C [°F] (fixed)
Voltage input: 0.8 % of span Input (fixed)

■ Cautions for LBA

- When AT function is turned on, the LBA function cannot be activated.
- No LBA function can be used at heat/cool PID action.
- If LBA setting time does not match the controlled object requirements, the LBA setting time should be lengthened.
  If setting time is not correct, the LBA will malfunction by turning on or off at inappropriate times or not turning on at all.
- LBA time is set to "0."
- LBA function is not assigned to Alarm 1.
- The LBA output is turned off when any of the following cases occurs with the LBA output turned on.
  - When the measured value (PV) rises beyond (or falls below) the LBA triggering width within the LBA setting time
  - When the measured value (PV) is within the LBD

7.10 Set Data Lock Function

The set data lock function permits locking of critical parameters and prevents unauthorized personnel from changing parameters. This instrument has the following two lock levels. The two lock levels can be changed even when the whole set data is locked.

- Lock level to restrict parameter setting changes by key operation (Lock level 1)
- Lock level to restrict RUN/STOP and memory area changes (Lock level 2)

5.4 Setup Setting Mode (P. 8)

7.11 Contact Input Function (Optional)

The external contact signal of this instrument can do the RUN/STOP and the memory area changes.

■ Transfer of RUN/STOP

The RUN or STOP selects by external contact input.

6.3 Transfer of RUN/STOP (P. 14)

■ Transfer of Control Area

The memory area selects by external contact input. Select one memory area among memorized 8 memory area and change memory area.

6.4 Transfer of Control Area (P. 15)

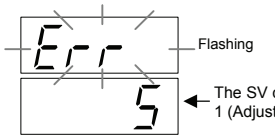
8. ERROR DISPLAYS

■ Self-diagnostic error

If an error is detected by the self-diagnostic, the PV display flashes "*Err*," and the SV display shows the error code. When two or more errors occur simultaneously, the error code numbers are totaled and displayed as one number.

Error number	Description	Action (Output)	Solution
1	Adjusted data error	Contol output: All the output is OFF. Alarm output: All the output is OFF. However, FAIL alarm is turned ON.* * De-energized fixed: Contact opens under FAIL	Turn off the power at once. If error occurs after the power is turned on again, please contact RKC sales office or the agent.
2	EEPROM error		
4	A/D conversion error		
16	Board configuration error		
128	Watchdog timer error		

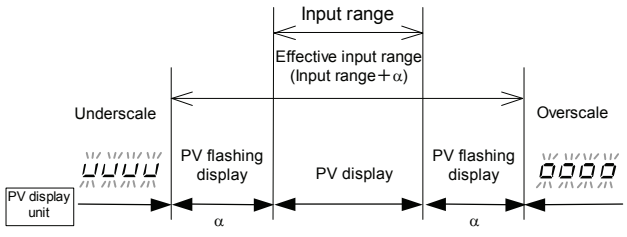
When the adjusted data error and A/D conversion error occurs simultaneously



The SV display shows the number *5* obtained by adding 1 (Adjusted data error) to 4 (A/D conversion error).

■ Overscale and Underscale

Display	Description	Solution
Measured value (PV) is flashing	**Input error** PV is outside of input range.	⚠ **WARNING** To prevent electric shock, always turn off the power before replacing the sensor.
0000 [Flashing]	**Overscale** PV is above the high input display range limit.	Check Input type, Input range and connecting state of sensor. Confirm that the sensor or wire is not broken.
UUUU [Flashing]	**Underscale** PV is below the low input display range limit.	



α: The range to be displayed differ depending on the input type or the setting limit.

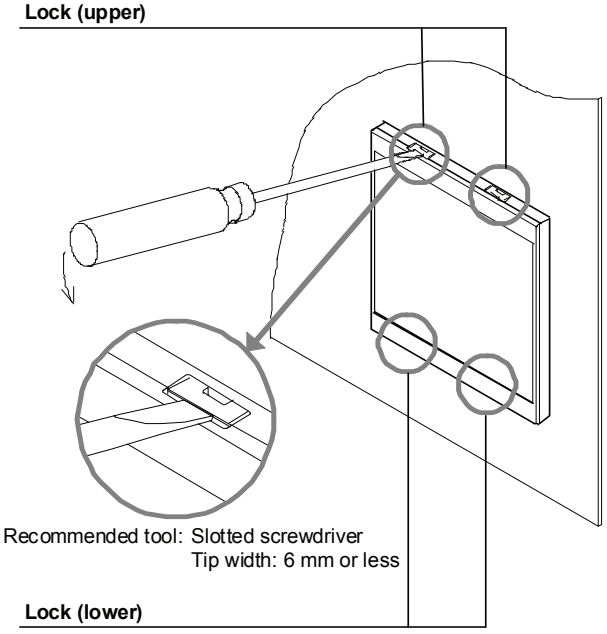
9. REMOVING THE INTERNAL ASSEMBLY

Usually, this instrument is not necessary to remove the internal assembly from the case. When removing the internal assembly without disconnecting the external wiring, take the following steps.

⚠ **WARNING**

- To prevent electric shock or instrument failure, only qualified personnel should be allowed to pull out the internal assembly.
- To prevent electrical shock or instrument failure, always turn off the power before pulling out the internal assembly.
- To prevent injury or instrument failure, do not touch the internal printed wiring board.

Lock (upper)



Recommended tool: Slotted screwdriver
Tip width: 6 mm or less

Lock (lower)

Unlock using such a slotted screwdriver. Gently press down on handle for the upper lock and lift up for the lower lock.

Apply pressure very carefully when removing internal assembly to avoid damage to the frame.

To conform to **IEC61010-1** requirements for protection from electric shock, the internal assembly of this instrument can only be removed with an appropriate tool.

10. SPECIFICATIONS

■ Input

Number of inputs: MA900: 4 channels MA901: 8 channels
Thermocouple: Isolated between each input channel
RTD, Voltage: Not isolated between each input channel
Input type:
Thermocouple: K, J, R, S, B, E, T, N, PLII, W5Re/W26Re, U, L
Input impedance: Approx. 1 MΩ
RTD: Pt100, JPt100
Voltage: 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC
Input range: Refer to **Input range table**
Sampling cycle: MA900: 0.5 seconds MA901: 1 second
Signal source resistance effect:
Approx. 0.2 μV/Ω
Influence of input lead:
Approx. 0.01 %/Ω of reading
(10 Ω or less per wire)
Input filter: First order lag digital filter
1 to 100 seconds (0: OFF)
PV bias: ±Input span (Within −1999 to +9999 digits)
Action at input beak:
Thermocouple: Upscale or downscale (Specify when ordering)
RTD: Upscale
Voltage: Downscale
Action at input short circuit:
Downscale (RTD)

■ Control action

Control method: PID control (With autotuning function)
ON/OFF, P, PI, or PD actions is available
Heat/cool action is available (Specify when ordering)
[Only MA900]

■ Control output

Number of outputs:
MA900: 4 points*, 8 points (Heat/cool type)*
MA901: 8 points*
*Not isolated between each output channel
Output type:
Relay contact output:
Contact type: 1a contact
Contact rating: 250 V AC, 3A (Resistive load)
Electrical life 300,000 times or more (Rated load)
Voltage pulse output:
0/12 V DC (Load resistance 600 Ω or more)
Current output: 0 to 20 mA DC, 4 to 20 mA DC
(Load resistance 600 Ω or less)
Triac output: 0.5 A (Ambient temperature 40 °C or less)
Open collector output:
Output method: Sink type
Allowable load current: 100 mA
Load voltage: 30 V DC or less
ON voltage: 2 V or less
Leakage current at OFF: 0.1 mA or less

■ Performance

Display accuracy:
Thermocouple:
± (0.3 % of display value + 1 digit) or ± 2 °C [4 °F]
Within the value whichever is the greater
RTD: ± (0.3 % of display value + 1 digit) or ± 0.8 °C [1.6 °F]
Within the value whichever is the greater
Voltage: ± (0.3 % of Input span + 1 digit)
Insulation resistance:
Between measuring terminal and grounding:
20 MΩ or more at 500 V DC
Between power terminal and grounding:
20 MΩ or more at 500 V DC
Withstand voltage:
Between measuring terminal and grounding:
1 minute at 1000 V AC
Between power terminal and grounding:
1 minute at 1500 V AC
Between power and measuring terminals:
1 minute at 2300 V AC
Power failure effect:
No influence is exerted upon the instrument for power failure of less than 30 ms.
Memory backup:
Backed up by EEPROM
Number of write times: Approx. 100,000 times
Data storage period: Approx. 10 years

■ Alarm function

Number of points: 3 points (Optional: 2 points)
Alarm type: Specify when ordering
Deviation high alarm FAIL alarm
Deviation low alarm Deviation high alarm with hold action
Deviation high/low alarm
Deviation low alarm with hold action
Band alarm Deviation high/low alarm with hold action
Process high alarm Process high alarm with hold action
Process low alarm Process low alarm with hold action
SV high alarm SV low alarm
Setting range:
Deviation alarm ±Input span
(Within -1999 to 9999 digits)
Process alarm, SV alarm Same as input range
Differential gap: 0 to Input span (However, 9999 digits or less)
Output method: Relay contact output (Independent common)
ALM1 to ALM3:
Contact type 1a contact
Rating 250 V AC, 1A (Resistive load)
Electrical life 300,000 times or more (Rated load)
OUT5 to OUT8 (MA901 cannot be specified):
Contact type 1a contact
Rating 250 V AC, 3A (Resistive load)
Electrical life 300,000 times or more (Rated load)

■ Control loop break alarm (LBA) function

LBA time setting: 0.1 to 200.0 minutes
LBA deadband: 0 to Input span (However, 9999 digits or less)
Differential gap Temperature input: 0.8 °C [°F]
Voltage input: 0.8 % of Input span
Alarm output: LBA can be selected for ALM1

■ Heater break alarm function (optional)

Input: Current transformer (CT) output
CTL-6-P-N: 0 to 30 A, CTL-12-S56-10L-N: 0 to 100 A
Heater current display range: 0.0 to 100.0 A
Heater current display accuracy: ±5 % of input value or ±2 A
Within the value whichever is the greater
Setting range: 0.0 to 100.0 A
Alarm output: HBA can be selected for ALM2

■ Contact input function (optional)

Number of inputs: 5 points
Input method: Dry contact input
At open 500 kΩ or more, At close 10 Ω or less
Functions: RUN/STOP transfer 1 point
Memory area transfer 4 points

■ Communication function (optional)

Interface: Based on RS-232C, RS422A, or RS-485
EIA standard
Protocol: ANSI X3.28 subcategories 2.5 and A4
Modbus

■ Power

Power supply voltage:
90 to 264 V AC (Power supply voltage range), 50/60 Hz
Rating: 100 to 240 V AC
21.6 to 26.4 V AC (Power supply voltage range), 50/60 Hz
Rating: 24 V AC
21.6 to 26.4 V DC (Power supply voltage range)
Rating: 24V DC
Power consumption:
14 VA max. (at 100 V AC) 20 VA max. (at 240 V AC)
11 VA max. (at 24 V AC) 330 mA max. (at 24 V AC)

■ General specifications

Ambient temperature: 0 to 50 °C
Ambient humidity: 45 to 85 % RH (Non-condensing)
Operating environment:
There should be neither corrosive gases nor much dust
Weight: Approx. 560 g

■ Input range table

● Thermocouple input and RTD input

Type	Range	Code	
K	0 to 200 °C	K	01
	0 to 400 °C	K	02
	0 to 600 °C	K	03
	0 to 800 °C	K	04
	0 to 1000 °C	K	05
	0 to 1200 °C	K	06
	0 to 1372 °C	K	07
	−199.9 to +300.0 °C [1]	K	08
	0.0 to 400.0 °C	K	09
	0.0 to 800.0 °C	K	10
	0 to 100 °C	K	13
	0 to 300 °C	K	14
	0 to 450 °C	K	17
	0 to 500 °C	K	20
	0.0 to 200.0 °C	K	29
	0.0 to 600.0 °C	K	37
	−199.9 to +800.0 °C [1]	K	38
	0 to 800 °F	K	A1
	0 to 1600 °F	K	A2
	0 to 2502 °F	K	A3
	0.0 to 800.0 °F	K	A4
	20 to 70 °F	K	A9
	−199.9 to +999.9 °F [1]	K	B2
J	0 to 200 °C	J	01
	0 to 400 °C	J	02
	0 to 600 °C	J	03
	0 to 800 °C	J	04
	0 to 1000 °C	J	05
	0 to 1200 °C	J	06
	−199.9 to +300.0 °C [1]	J	07
	0.0 to 400.0 °C	J	08
	0.0 to 800.0 °C	J	09
	0 to 450 °C	J	10
	0.0 to 200.0 °C	J	22
	0.0 to 600.0 °C	J	23
	−199.9 to +600.0 °C [1]	J	30
	0 to 800 °F	J	A1
	0 to 1600 °F	J	A2
	0 to 2192 °F	J	A3
	0 to 400 °F	J	A6
	−199.9 to +999.9 °F [1]	J	A9
	0.0 to 800.0 °F	J	B6
R	0 to 1600 °C [2]	R	01
	0 to 1769 °C [2]	R	02
	0 to 1350 °C [2]	R	04
	0 to 3200 °F [2]	R	A1
	0 to 3216 °F [2]	R	A2
S	0 to 1600 °C [2]	S	01
	0 to 1769 °C [2]	S	02
	0 to 3200 °F [2]	S	A1
	0 to 3216 °F [2]	S	A2
B	400 to 1800 °C	B	01
	0 to 1820 °C [2]	B	02
	800 to 3200 °F	B	A1
	0 to 3308 °F [2]	B	A2
E	0 to 800 °C	E	01
	0 to 1000 °C	E	02
	0 to 1600 °F	E	A1
	0 to 1832 °F	E	A2
N	0 to 1200 °C	N	01
	0 to 1300 °C	N	02
	0.0 to 800.0 °C	N	06
	0 to 2300 °F	N	A1
	0 to 2372 °F	N	A2
	0.0 to 999.9 °F	N	A5
T	−199.9 to +400.0 °C [1]	T	01
	−199.9 to +100.0 °C [1]	T	02
	−100.0 to +200.0 °C	T	03

● Thermocouple input and RTD input

Type	Range	Code	
T	0.0 to 350.0 °C	T	04
	−199.9 to +752.0 °F [1]	T	A1
	−100.0 to +200.0 °F	T	A2
	−100.0 to +400.0 °F	T	A3
	0.0 to 450.0 °F	T	A4
	0.0 to 752.0 °F	T	A5
W5Re/ W26Re	0 to 2000 °C	W	01
	0 to 2320 °C	W	02
	0 to 4000 °F	W	A1
PL II	0 to 1300 °C	A	01
	0 to 1390 °C	A	02
	0 to 1200 °C	A	03
	0 to 2400 °F	A	A1
	0 to 2534 °F	A	A2
U	−199.9 to +600.0 °C [1]	U	01
	−199.9 to +100.0 °C [1]	U	02
	0.0 to 400.0 °C	U	03
	−199.9 to +999.9 °F [1]	U	A1
	−100.0 to +200.0 °F	U	A2
	0.0 to 999.9 °F	U	A3
L	0 to 400 °C	L	01
	0 to 800 °C	L	02
	0 to 800 °F	L	A1
	0 to 1600 °F	L	A2
Pt100	−199.9 to +649.0 °C	D	01
	−199.9 to +200.0 °C	D	02
	−100.0 to +50.0 °C	D	03
	−100.0 to +100.0 °C	D	04
	−100.0 to +200.0 °C	D	05
	0.0 to 50.0 °C	D	06
	0.0 to 100.0 °C	D	07
	0.0 to 200.0 °C	D	08
	0.0 to 300.0 °C	D	09
	0.0 to 500.0 °C	D	10
	−199.9 to +999.9 °F	D	A1
	−199.9 to +400.0 °F	D	A2
	−199.9 to +200.0 °F	D	A3
	−100.0 to +100.0 °F	D	A4
	−100.0 to +300.0 °F	D	A5
	0.0 to 100.0 °F	D	A6
	0.0 to 200.0 °F	D	A7
	0.0 to 400.0 °F	D	A8
	0.0 to 500.0 °F	D	A9
JPt100	−199.9 to +649.0 °C	P	01
	−199.9 to +200.0 °C	P	02
	−100.0 to +50.0 °C	P	03
	−100.0 to +100.0 °C	P	04
	−100.0 to +200.0 °C	P	05
	0.0 to 50.0 °C	P	06
	0.0 to 100.0 °C	P	07
	0.0 to 200.0 °C	P	08
	0.0 to 300.0 °C	P	09
	0.0 to 500.0 °C	P	10

[1] Accuracy is not guaranteed between −199.9 to −100.0 °C (−199.9 to −148.0 °F)

[2] Accuracy is not guaranteed between 0 to 399 °C (0 to 751 °F)

● Voltage input

Type	Range	Code	
0 to 5 V DC	0.0 to 100.0 %	4	01
0 to 10 V DC	0.0 to 100.0 %	5	01
1 to 5 V DC	0.0 to 100.0 %	6	01

Memory Area Data List (Copy this sheet for its use.)

Sheet No.	Date:	Name:

Memory area No.	

Display	Item	Set value							
		CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
SV	Set value (SV)								
LbA	Control loop break alarm								
Lbd	Control loop break alarm deadband								
AL1	Alarm 1								
AL2	Alarm 2								
AL3	Alarm 3								
P	Proportional band								
I	Integral time								
d	Derivative time								
Ar	Anti-reset windup								
Pc	Cool-side proportional band								
db	Overlap/deadband								
SVrL	Setting changing rate limiter								
CH E	Used/unused of channels								

Memory area No.	

Display	Item	Set value							
		CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
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