Digital Controller

REX-G9 SERIES/A

INSTRUCTION MANUAL

RKC RKC INSTURUMENT INC.

IM9G09-E2

INTRODUCTION

Thank you very much purchasing our "*REX–G9 series/A*". This manual describes the "*REX–G9 series/A*" instruments. Please read this manual carefully before using the instruments. Before using the unit, carefully read this instruction manual. Also keep this manual with much care for future reference.

USERS OF THIS MANUAL

This manual is prepared for all personnel who use "*REX–G9 series/A*". However, it is desirable that they have a fundamental knowledge of electrical engineering and communication.

CAUTIONS

- The contents of this manual may subject to change without prior notice.
- Examples of figures, diagrams and numeric values used in this manual are for a better understanding of the text, but not for assuring the resultant operation.
- The contents of this manual are copy righted; all rights are reserved by RKC INSTRUMENT INC. It is prohibited to reprint or reproduce the whole or a part of this manual without the prior of RKC INSTRUMENT INC.
- "*REX–G9 series/A* " and this manual are manufactured and prepared under strict quality control before delivery. However, if any problems arise, please contact us directly or your nearest our sales agent.
- RKC assumes no responsibility for any of the following damages which the user or third party may suffer.

  ① Damage incurred as a result of using this product.
  ② Damage caused by product failure which cannot be predicted by RKC.
  ③ Other indirect damages.

⚠ WARNING

● Wiring precautions

- If failure or error of this instrument could result in a critical accident of the system, install an external protection circuit to prevent such an accident.
- In order to prevent instrument damage or failure, protect the power line and the input/output lines from high currents by using fuses with appropriate ratings.

● Power supply

- In order to prevent instrument damage or failure, supply power of the specified rating.
- In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.

● Never use the instrument near inflammable gases.

- In order to prevent fire, explosion or instrument damage, never use this insturment at a location where inflammable or explosive gases or vapour exist.

● Never touch the inside of the instrument.

- In order to prevent electric shock or burns, never touch the inside of the instrument. Only RKC service engineers can touch the inside of the instrument to check the circuit or to replace parts. High voltage and high temperature sections inside the instrument are extremely dangerous.

● Never modify the instrument.

- In order to prevent accident or instrument failure, never modify the instrument.

● Maintenance

- In order to prevent electric shock, burns or instrument failure, only RKC service engineers may replace parts.
- In order to use this instrument continuously and safely, conduct periodic maintenance. Some parts used in this instrument have a limited service life and may deteriorate over time.

★ For safe operation of "REX−G9 series/A"

1. "REX−G9 series/A" must be used under the following conditions.
   "REX−G9 series/A" is a component type and is used after mounting on an instrument panel. It is thus manufactured as a component destined for the final product, so its high−voltage blocks such as the power terminals are uncovered.
   Therefore, after it is installed on the final product, the final product supplier must take the necessary measures for the user to prevent touching directly the high−voltage blocks.

2. For correct and safe operation of "REX−G9 series/A", always observe the safety precautions described in this manual when performing operations, maintenance and repair work.
   RKC neither assures responsibility nor provides warranty for problems or accidents occurring if these precautions are not observed.

● **For safe operation of "REX−G9 series/A", the following "Signal Words and Symbol Marks" are used in this manual.**

< **Signal Words** >

WARNING : Where there are possible dangers such as electric shock, fire (burns), etc. which could cause loss of life or injury, precautions to avoid such dangers are described.

CAUTION : These describe precautions to be taken if unit damage may result if operating procedures are not strictly followed.

NOTE : Extra notes or precautions are added to operating procedures and explanations.

< **Symbol Marks** >

⚠ : This mark is used when great care is needed especially for safety.

✻ : This mark is used to add extra notes, precautions or supplementary explanations to table and figures.

Name and number of this instruction manual:

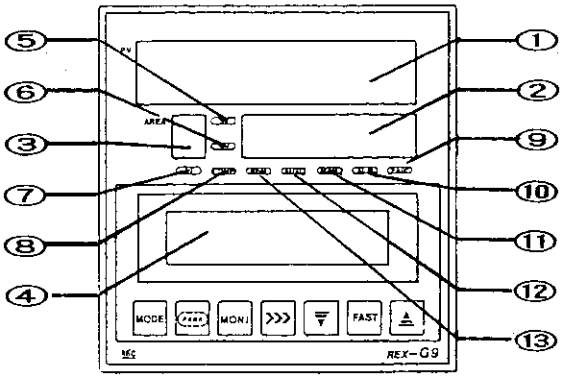
Name : **REX-G9** SERIES/A INSTRUCTION MANUAL
Manual number : IM9G09-E2

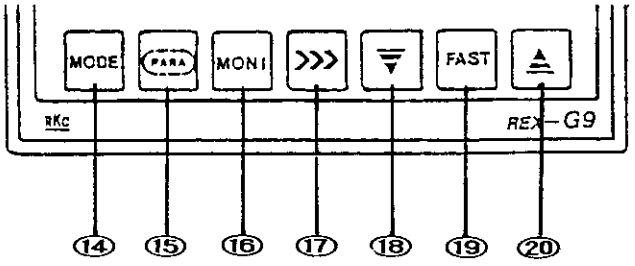
■ Revisions

Date of revision	Manual number	Reason of revision
October 31, 1994	IM9G09-E1	The First edition issue
May 15, 1995	IM9G09-E2	Addtion of "RUN/STOP function" etc.

CONTENTS

1 . FUNCTIONAL DESCRIPTION





Display units

① Measured-value(PV) display unit

Displays measured-value(PV). Flashes when the measured-value deviates side from the value of input error discrimination point(high-limit/low-limit). Also, displays "□□□□□" at overscale and "-□□□□" at underscale.

② Set-value(SV) display unit

Displays local set-value(SV), remote setting(RS) value or manipulated output(MV) value.

③ Memory area display unit

Displays the currently controlled area NO.
(Flashes when the area NO. now being displayed differs from that currently being controlled.)

④ Message display unit (Liquid crystal display unit:LCD)

Displays setting parameter(PARA), operation transfer (MODE) and monitoring(MONI) display panels in message form.

Indication lamps

⑤ Set-value indication lamp

Lights up when the set-value is shown on the set-value(SV) display unit.

⑥ Manipulated output(MV) indication lamp

Lights up when the manipulated (control) output value is shown on the set-value(SV) display unit.

⑦ Auto-tuning(AT) indication lamp

Flashes during auto-tuning.

⑧ Computer mode(COMP) indication lamp

Lights up in the computer mode.

⑨ FAIL indication lamp

Lights up when there is trouble in this controller.

⑩ Alarm(ALM) indication lamp

Lights up when the alarm is turned ON.

⑪ Manual(MAN) indication lamp

Lights up in the manual mode.

⑫ AUTO indication lamp

Lights up in the AUTO mode.

⑬ Remote(REM) indication lamp

Lights up in the remote mode.

Operation keys

Keys for selecting the display panel shown on the message display unit

⑭ Mode(MODE) key

Pressing this key changes the display to the message display panel, mainly to facilitate operation transfer such as Auto/Manual, Operation execution/stop, etc.

⑮ Parameter(PARA) key

Pressing this key calls up the message display panel, mainly to change and confirm the setting data.

⑯ Monitoring(MONI) key

Pressing this key calls up the message display panel to show controloutput, deviation bar graphs, alarm or auto-tuning(AT) statuses.

Operation transfer execution, set-value increment/decrement or selection keys

⑰ Operation transfer (>>>) key

If the operation transfer (MODE) display panel shows the message ">>>", press this key to transfer operation status.

⑱ Set-value decrement (▼) key

Pressing this key decrements the set-value.
(If kept pressed, this key decrements the set-value every 0.5 sec.)

⑲ Fast(FAST) key

Pressing this key simultaneously with the increment (▲) or decrement (▼) key increases incremental or decremental speed.
(Automatic acceleration/deceleration function)

⑳ Set-value increment (▲) key

Pressing this key increments the set-value.
(If kept pressed, this key increments the set-value every 0.5 sec.)

★Automatic acceleration/deceleration function

Keeping the FAST key pressed while pressing the ▲ or ▼ key increases set-value incremental or decremental speed to 6 steps every 2 sec.
In addition, every time the FAST key is pressed while pressing the ▲ or ▼ key, incremental or decremental speed hastens in 6 steps.
If the FAST key is released at a certain speed that speed is maintained. However, if the ▲ or ▼ key is released once at that speed, that speed is reset (defaults) to the lowest speed.

2 . PROCEDURE OF CALLING UP EACH MESSAGE DISPLAY PANEL

The message display panel can be classified into the following 3 groups for setting, operation selection and status checks.

① Operation transfer(MODE) display panel ---------- Display shown when the MODE key is pressed.

Used for auto/manual transfer, control area transfer, lock/unlock transfer, operation execution/stop transfer, etc.

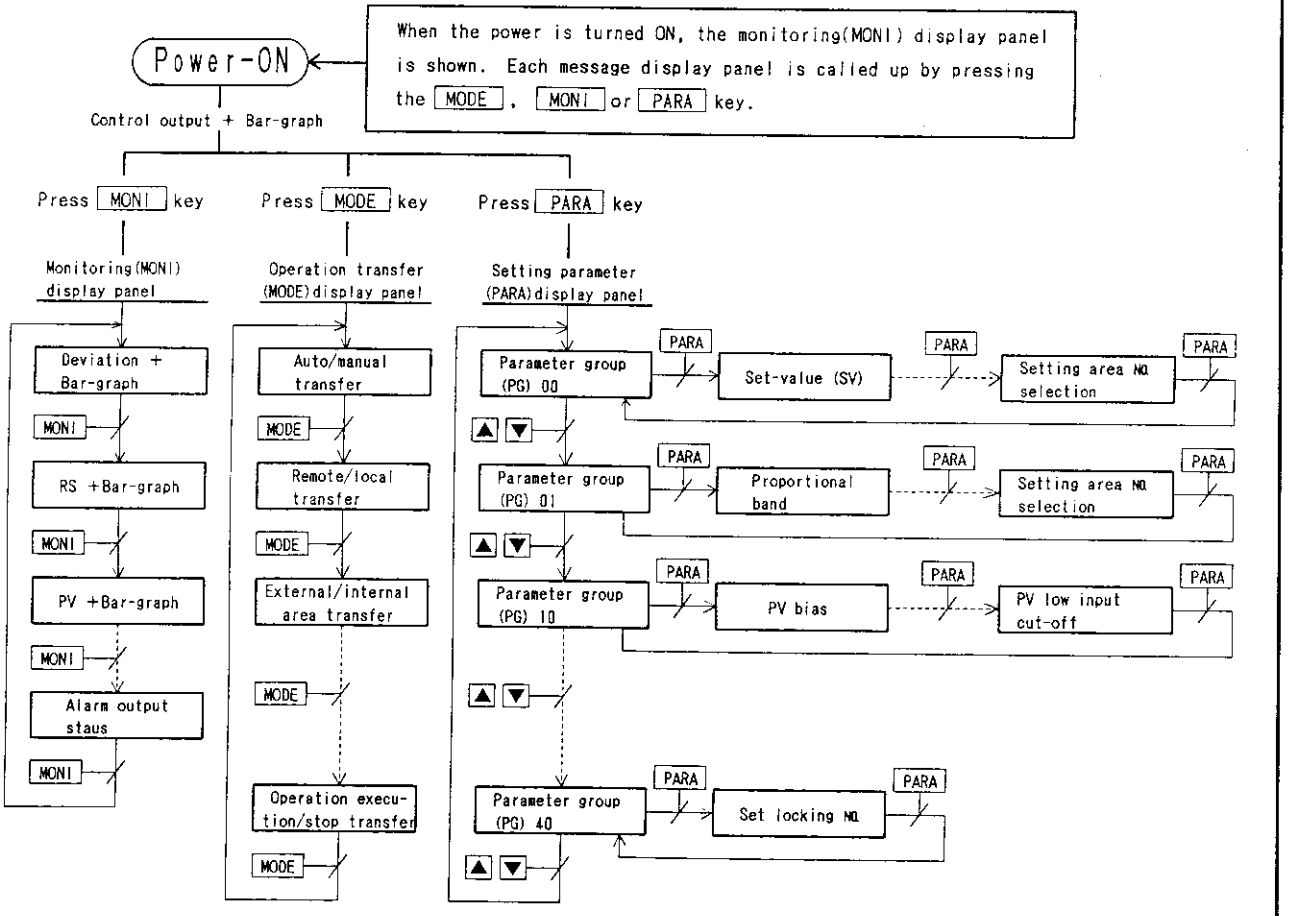
② Monitoring(MONI) display panel ---------- Display shown when the MONI key is pressed.

Displays output and deviation bar graphs, auto-tuning status, etc.

③ Setting parameter(PARA) display panel ---------- Display shown when the PARA key is pressed.

Set-value(SV), alarm setting and etc are displayed and set in each parameter groups.

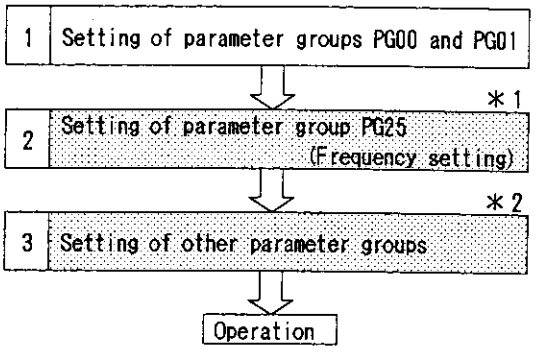
< Procedure of calling up each message display panel >



★ For details, see the description of each display panel.

All settings are performed on the setting parameter(PARA) display panel.

3 . 1 Setting procedure



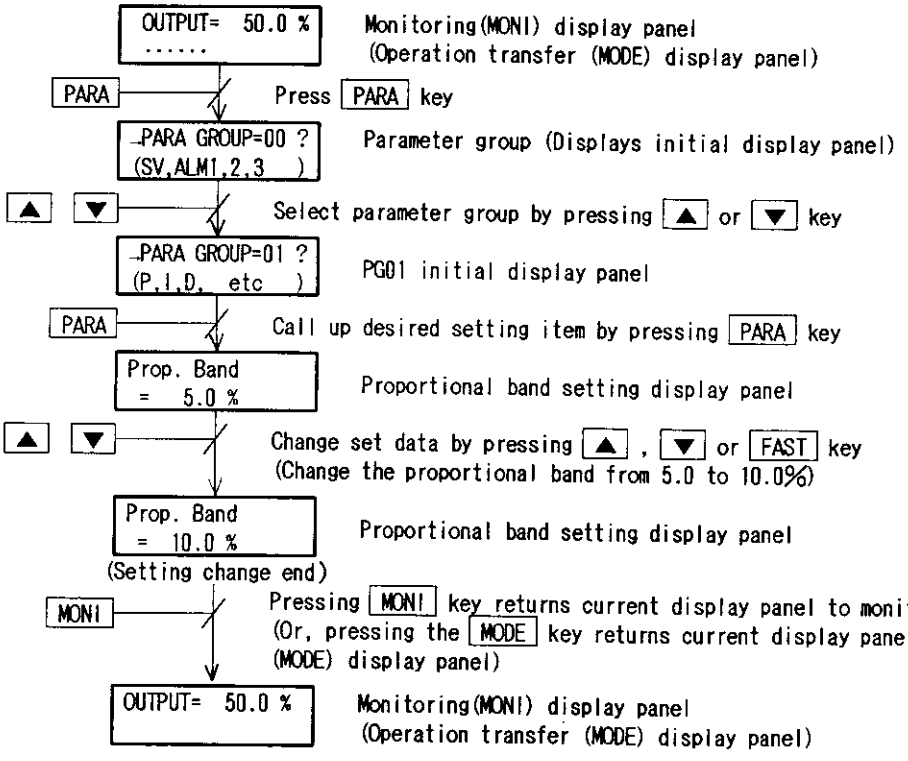
*1 : Set the power frequency used. If the frequency of the power used does not match the set frequency, it may not be possible to achieve good control due to normal mode noise effect.

*2 : A prior to shipment, the normal set-value(default value) is set to the controller. (The value give in item "3.3 Setting parameter(PARA) display items", see page 4.)
Change various set values so as to meet the customer's control purpose.

3 . 2 Setting data example

The following example shows the fundamentals of data setting.
It also applies to each data setting and change in each parameter group.

Example : Procedure for changing the proportional band from 5.0% to 10.0%.



① For parameter group selection, press the PARA key on the monitoring(MONI) display panel or operation transfer(MODE) display panel to change to the setting parameter(PARA) display panel, then call up the parameter group(PG) including the set data to be changed by pressing the ▲ or ▼ key.

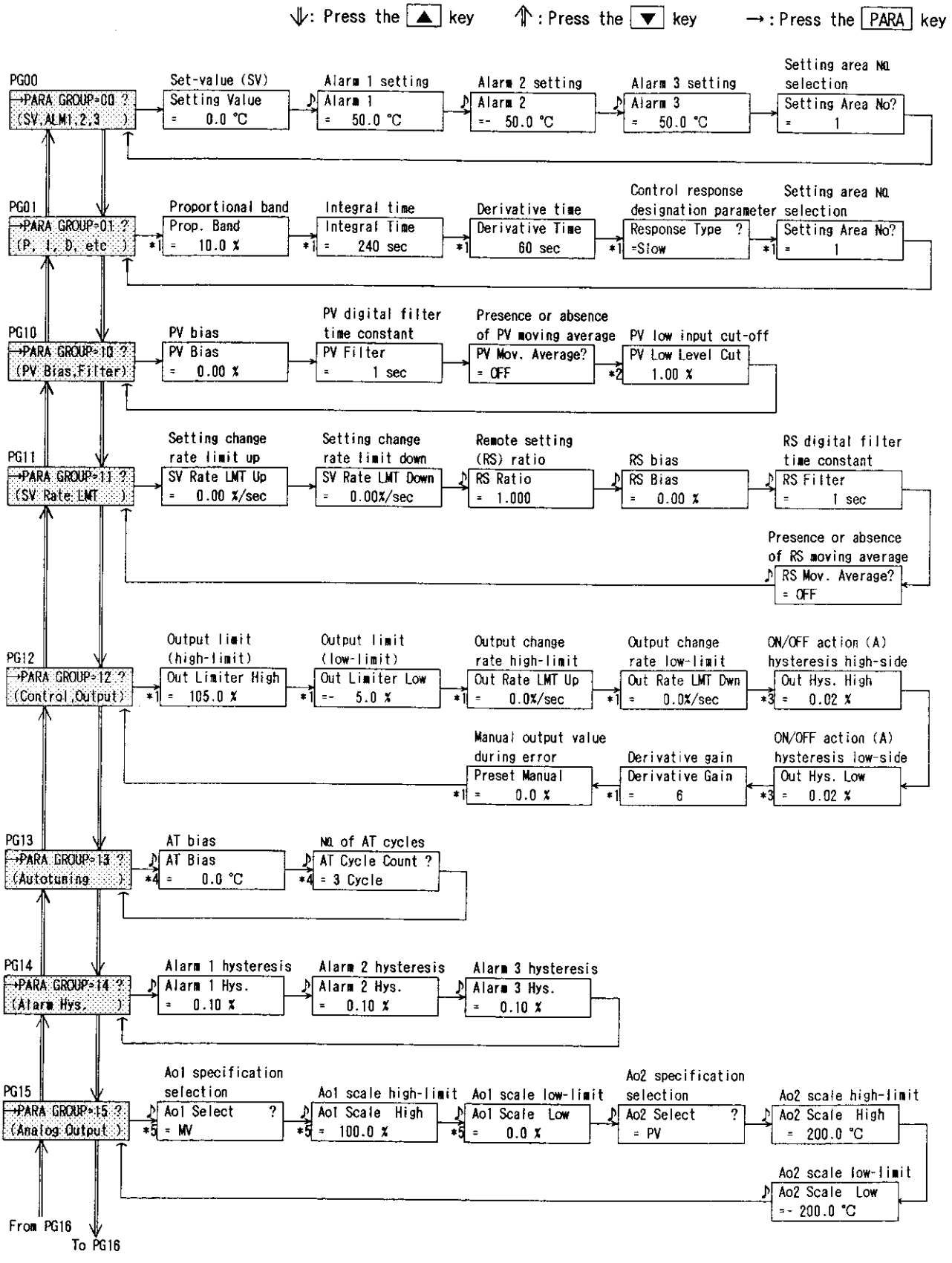
② If the group to be set is displayed, press the PARA key to specify the setting item.

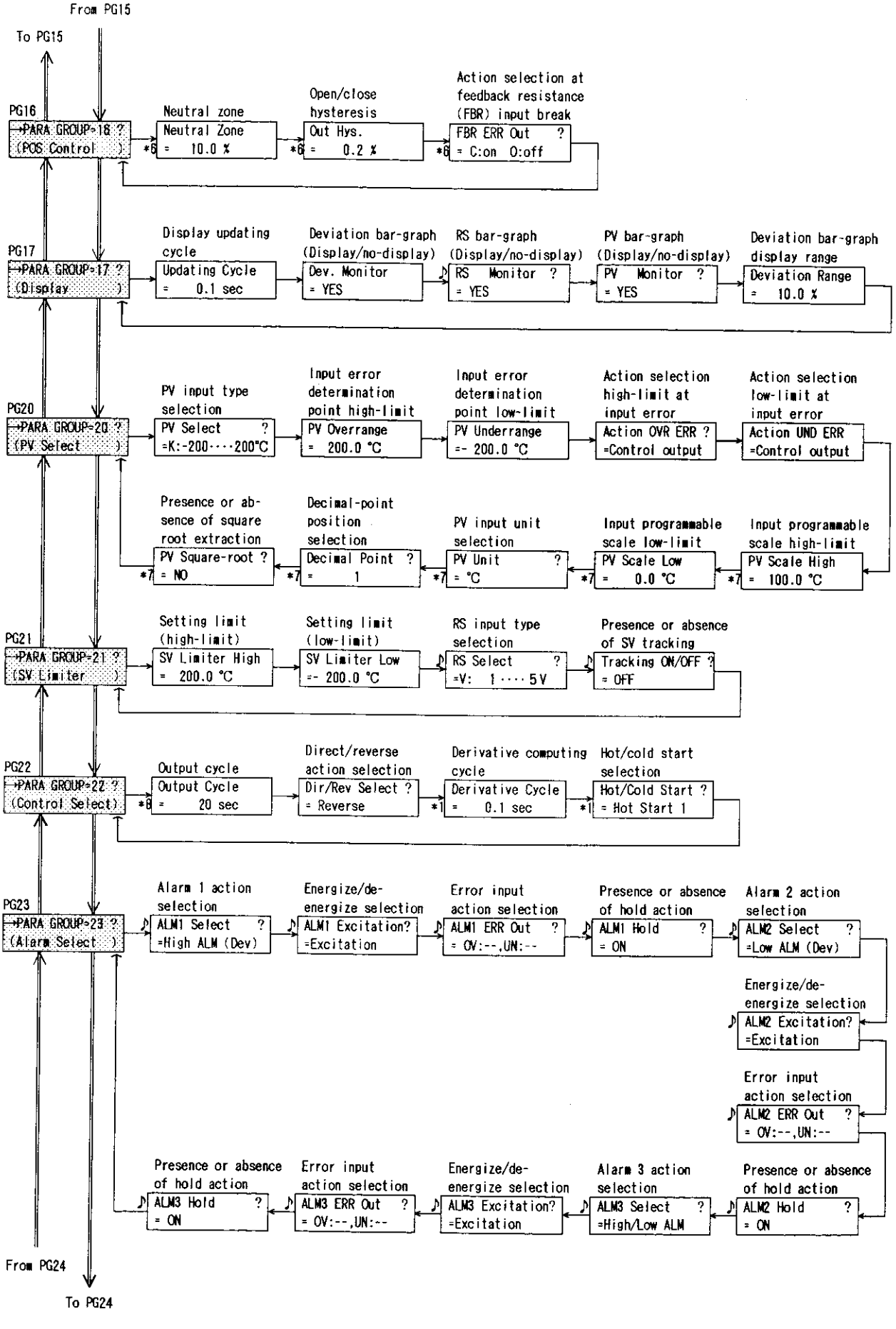
③ Change the set data by pressing the ▲ or ▼ key. The set data becomes effective when the ▲ or ▼ key is pressed.
(If the ▲ or ▼ key is pressed simultaneously with the FAST key, incremental or decremental speed is accelerated or decelerated.)

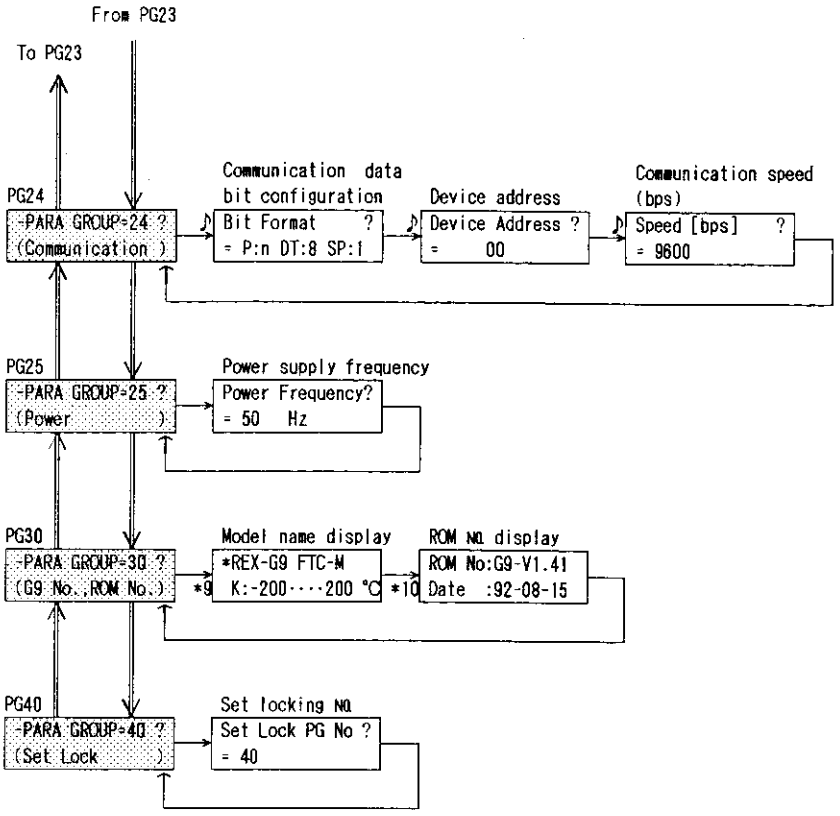
3．3 Setting parameter(PARA) display items

NOTE

All the values included in each setting item are default values set prior to shipment. Except for parameter groups PG00 and PG01, change settings in accordance with control purpose. The unit varies with the customer's request.




From PG15
To PG15
PG16
→PARA GROUP=16 ?
(POS Control)
Neutral zone
Neutral Zone
= 10.0 %
Open/close hysteresis
Out Hys.
= 0.2 %
Action selection at feedback resistance (FBR) input break
FBR ERR Out ?
= C:on O:off
PG17
→PARA GROUP=17 ?
(Display)
Display updating cycle
Updating Cycle
= 0.1 sec
Deviation bar-graph (Display/no-display)
Dev. Monitor
= YES
RS bar-graph (Display/no-display)
RS Monitor ?
= YES
PV bar-graph (Display/no-display)
PV Monitor ?
= YES
Deviation bar-graph display range
Deviation Range
= 10.0 %
PG20
→PARA GROUP=20 ?
(PV Select)
PV input type selection
PV Select ?
=K:-200····200°C
Input error determination point high-limit
PV Overrange
= 200.0 °C
Input error determination point low-limit
PV Underrange
=- 200.0 °C
Action selection high-limit at input error
Action OVR ERR ?
=Control output
Action selection low-limit at input error
Action UND ERR
=Control output
Presence or absence of square root extraction
PV Square-root ?
= NO
Decimal-point position selection
Decimal Point ?
= 1
PV input unit selection
PV Unit ?
= °C
Input programmable scale low-limit
PV Scale Low
= 0.0 °C
Input programmable scale high-limit
PV Scale High
= 100.0 °C
PG21
→PARA GROUP=21 ?
(SV Limiter)
Setting limit (high-limit)
SV Limiter High
= 200.0 °C
Setting limit (low-limit)
SV Limiter Low
=- 200.0 °C
RS input type selection
RS Select ?
=V: 1 ···· 5 V
Presence or absence of SV tracking
Tracking ON/OFF ?
= OFF
PG22
→PARA GROUP=22 ?
(Control Select)
Output cycle
Output Cycle
= 20 sec
Direct/reverse action selection
Dir/Rev Select ?
= Reverse
Derivative computing cycle
Derivative Cycle
= 0.1 sec
Hot/cold start selection
Hot/Cold Start ?
= Hot Start 1
PG23
→PARA GROUP=23 ?
(Alarm Select)
Alarm 1 action selection
ALM1 Select ?
=High ALM (Dev)
Energize/de-energize selection
ALM1 Excitation?
=Excitation
Error input action selection
ALM1 ERR Out ?
= OV:--,UN:--
Presence or absence of hold action
ALM1 Hold ?
= ON
Alarm 2 action selection
ALM2 Select ?
=Low ALM (Dev)
Energize/de-energize selection
ALM2 Excitation?
=Excitation
Error input action selection
ALM2 ERR Out ?
= OV:--,UN:--
Presence or absence of hold action
ALM2 Hold ?
= ON
Alarm 3 action selection
ALM3 Select ?
=High/Low ALM
Energize/de-energize selection
ALM3 Excitation?
=Excitation
Error input action selection
ALM3 ERR Out ?
= OV:--,UN:--
Presence or absence of hold action
ALM3 Hold ?
= ON
From PG24
To PG24



♪ : Option (No option, no display)

＊1 : There is no display when the control action is ON/OFF action [A].

＊2 : The display appears only when the square-root extracted is provided with voltage/current input.

＊3 : The display appears only when the control action is ON/OFF action. There are no displays for PID action [H], PID action with auto-tuning(AT) [F] and position proportioning PID action [Y].

＊4 : The display appears only when the control action is PID action with auto-tuning(AT) [F].

＊5 : There is no display when the control outputs are continuous voltage output [E] or current output [R].

＊6 : The display appears only when the control action is position proportioning PID action [Y].

＊7 : The display appears only when the input types are DC voltage(low) input [V], DC voltage(high) input [E] and DC current input [I].

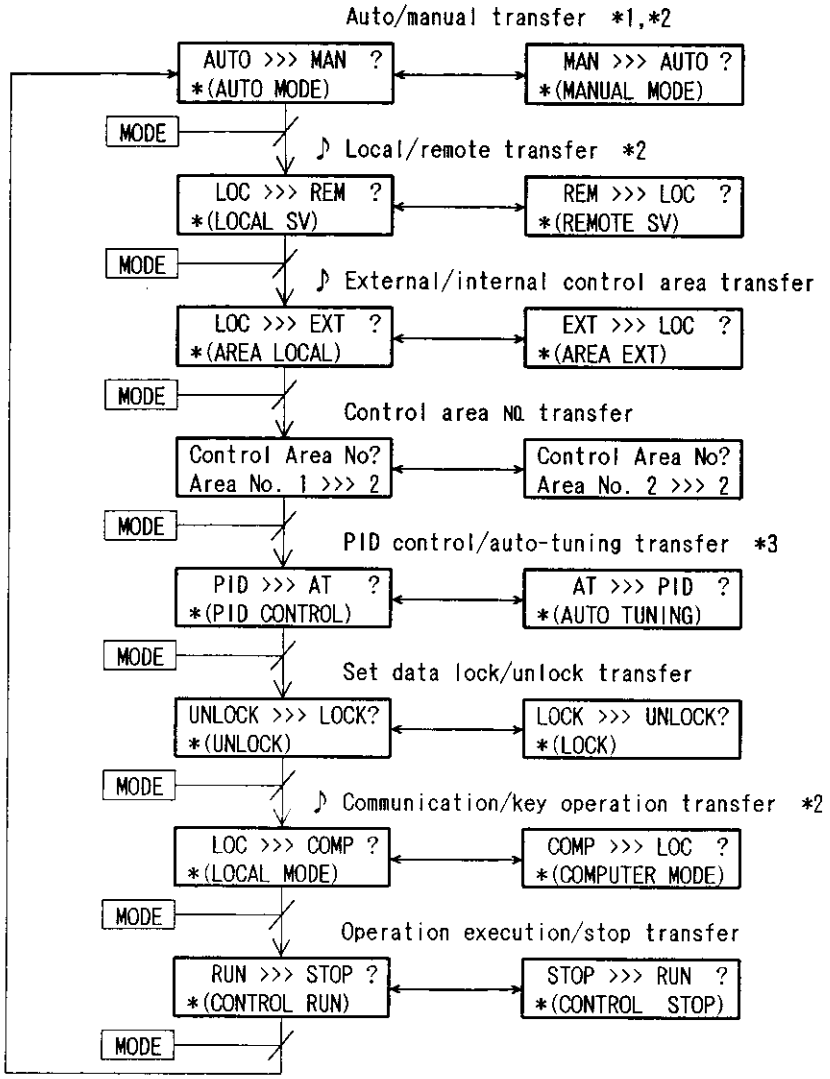
＊8 : The display appears only when the control actions are PID action [H] or PID action with auto-tuning(AT) [F]. However, there is no display when the control outputs are continuous voltage output [E] or current output [R].

＊9 : The display varies with the model identification code specified by the customer.

＊10 : The display depends on when the customer purchased the controller.

4 . 1 Operation transfer (MODE) display at each display

Press the [MODE] key on the monitoring(MONI) display or setting parameter(PARA) display to set the operation transfer (MODE) display. The display changes every time the [MODE] key is pressed.



♪ : Option (The display appears only when the controller is provided with an option.)
＊1 : There is no display when the control action is ON/OFF action [A].
＊2 : When the external contact input function is provided, the increase in messages depends on the external contact status.
For details, see "8.8 Contact input " (page 25).
＊3 : The display appears only when the control action is PID action with auto-tuning [F] .

[NOTE] No other operation transfer displays appear during operation " STOP ".

4 . 2 Operation transfer method at each display

The operation transfer (MODE) display the message ">>>" on the display panel. For example, when the display appears as shown in ①, it indicates the present AUTO status. Then, press the [>>>] key, and ② is displayed to show the MANUAL status.

① AUTO >>> MAN ?
*(AUTO MODE)

② MAN >>> AUTO ?
*(MANUAL MODE)

When ">>>" is shown on the message display as shown above, operation transfer is enabled by pressing the [>>>] key.

4．3 Description of each display

(1) Auto/manual transfer display

This display is used to select the auto and manual mode.

(2) Local/remote transfer display (Option)

This display enables the selection of set-values used for control.

REMOTE SV : Enables setting by external analog input
LOCAL SV : Enables setting by the front key or via communication

(3) External/internal control area transfer display (Option)

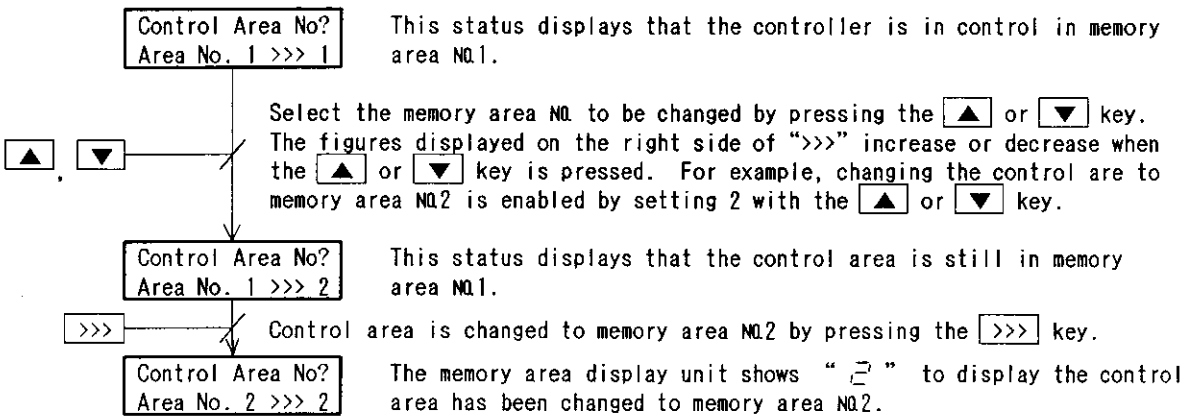
This display is used for selecting the control area transfer method.

AREA E X T : Enables selection by contact input (DI)
AREA LOCAL : Enables selection by the front key or via communication

(4) Control area transfer display

This display is used to select the control area NO. required from any of the eight memory areas. For details, see "8.1 Multi-memory areas (PG00, PG01)" (page 18).

◎ Setting method (Transfer method)

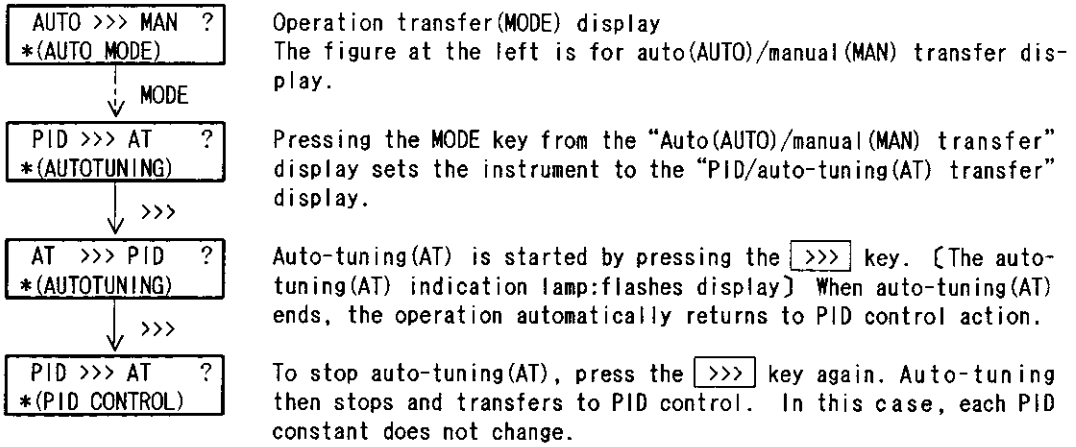


NOTE The control area is not selectable when it is set to the external area(AREA EXT) or the communication mode(COMPUTER MODE).
(Even if the ▲ or ▼ key is pressed, it is not activated.)

(5) PID control/auto-tuning(AT) transfer display

This display is used to select the PID control/auto-tuning(AT).
Auto-tuning(AT) is the function of measuring and setting the optimum PID constants.
The requirements for auto-tuning(AT) start and suspension are described in the following.

① Auto-tuning start/stop method



② Requirements for auto-tuning (AT)

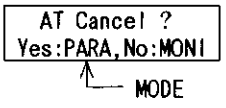
■Requirements for conducting auto-tuning (AT)

- In the operation transfer (MODE) display
  - · Auto(AUTO)/manual(MAN) transfer → Auto mode
  - · Local(LOC)/remote(REM) transfer → Local SV
  - · PID/auto-tuning(AT) transfer → PID control
  - · Operation execution(RUN)/STOP transfer → execution(RUN)
- Input value should not be abnormal. (According to the input abnormality determination point)

■Conditions under which auto-tuning (AT) is suspended automatially

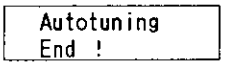
①When set-value (SV) is changed *1
②When the control area is changed *1
③When high or low output limiter value is changed *1
④When PV bias and/or PV digital filter are changed *1
⑤When AT bias is changed *1
⑥When AT cycle is changed *1
⑦When the instrument is transferred to the manual mode by "AUTO/MAN transfer" *1
⑧When the instrument is transferred to the remote mode by "LOC/REM transfer" *1
⑨When the instrument is transferred to PID control by "PID/AT transfer" *2
⑩When operation is stopped by "Operation execution(RUN)/STOP transfer" *2
⑪When input value becomes abnormal. (According to the input abnormality determination point *3)
⑫When power failure occurs *2
⑬When the instrument is in the FAIL status *4

*1. The message shown in the figure at the right appears on the message display unit. Pressing the PARA key (the MODE key only for ②, ⑦ or ⑧) at this time suspends the auto-tuning (AT) function. Pressing the MONI key continues this function.



*2. The display of "AT Cancel?" does not appear, and the auto-tuning (AT) lamp is also extinguished to automatically suspend the auto-tuning (AT) function.

*3. If a measured-value enters the input error determination area, then the message shown in the figure at the right appears, and the auto-tuning (AT) lamp is extingished to automatically suspend the auto-tuning (AT) function.



*4. The FAIL lamp turns on to automatically suspend the auto-tuning (AT) function.

NOTE 1. When auto-tuning(AT) suspension requirements are established, the instrument immediately suspends auto-tuning(AT) function to transfer the above function to PID control. PID constants at that time are left as they were before auto-tuning(AT) start.

2. If the output change late limit (see on page 34) is set, the optimum PID constants may not be obtained even with the auto-tuning(AT) function activated.

(6) Set data lock/unlock transfer display

Set data lock/unlock is transferred on this display panel.
For detail, see "6. SET DATA LOCKING" (page 14).

(7) Communication/key operation transfer 〔Option〕

This display enables selection so that this controller can be operated via communication or by the front key.

(8) Operation RUN/STOP transfer display

This display enables the selection of operation RUN/STOP.

(a) Operation Stop (Output and action of control, alarm, etc. are the same as those at power OFF.)

① Show the operation RUN/STOP transfer display panel by pressing the [MODE] key.

② Next, press the [>>>] key to stop operation. However, the [>>>] key is not valid in the computer (communication) mode.
〔Operation RUN/STOP transfer is performed via communication in the computer (communication) mode.〕

③ If operation is stopped, even with the [MODE] key pressed, only the operation RUN/STOP transfer display panel is shown, and therefore no other operation transfer is done. In addition, all the indication lamps go off.

The measured-value(PV) display unit shows measured-value(PV) as usual. The set-value(SV) display unit shows MV (-5.0%) in the manual mode before operation stop. It also shows the set-value in the auto mode or in the remote setting(REMOTE SV) mode before operation stop.
In the operation stop status(STOP), all the settings in the parameter group can be changed regardless of whether the setting is locked/unlocked (Setting after parameter group PG20 can be changed.)
For details, see " 6. SET DATA LOCKING " (page 14).

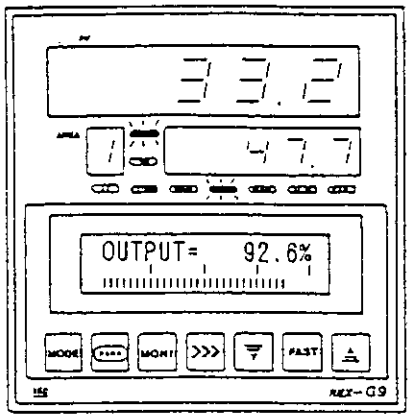
(b) Operation RUN

Operation RUN/STOP transfer display panel.

Pressing the [>>>] key run operation.
If operation is runc from the operation stop status(STOP), all the front displays disappear instantaneously and operation re-starts.
Operation starts in the state where power failure is assumed to occur for more than 3 sec., and the message display unit shows the monitoring(MONI) display panel.

4．4 Each display unit during operation

Display shown when set-value(SV) is changed in auto mode



——— Display units ———

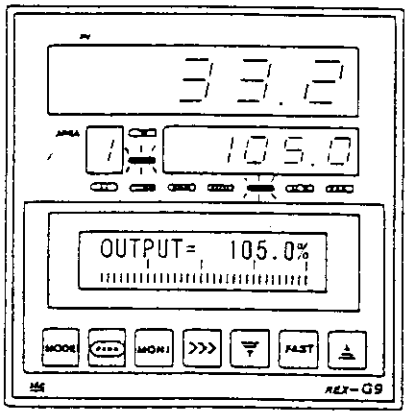
- Measured-value(PV) display unit
  Displays measured-value.
- Set-value(SV) display unit
  Displays set-value via a setting change rate limit.
- Memory area display unit
  Displays current control area NO.
  ＊ When the display area NO. differs from actually controlled control area NO. : Display flashes.
- Message display unit(LCD)
  Displays set-value set by the ▲, FAST and ▼ keys.

——— Indication lamps ———

Set-value(SV) and AUTO indication lamps light up.

＊ When the set-value is changed during control, the set-value(SV) display unit shows the set-value (set-value in actual control) via the setting change rate limit while the message display unit shows the set-value (final set-value) set by the ▲ , FAST and ▼ keys.
Thus, when the setting change rate limit is activated, changes in the set-value(SV) and message display units differ and the value on the set-value(SV) display unit varies with that in the setting change rate limit.

Display shown when MV is changed in manual mode



——— Display units ———

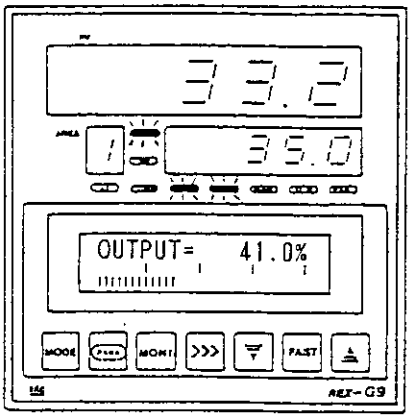
- Measured-value(PV) display unit
  Displays measured-value.
- Set-value(SV) display unit
  Displays manipulated output value(MV) via the output change rate limit.
- Memory area display unit
  Displays current control area NO.
- Message display unit (LCD)
  Displays manipulated output value(MV) set by the ▲ , FAST and ▼ keys.

——— Indication lamps ———

The manipulated output(MV) and MANUAL(MAN) indication lamps light up.

＊ In the manual mode, the set-value(SV) display unit shows manipulated output value(MV) via the output change rate limit while the message display unit shows manipulated output value (final set-value) set by the ▲ , FAST and ▼ keys.
Thus, when the output change rate limit is activated, changes in the set-value(SV) and message display units differ and the value on the set-value(SV) display unit varies with that from the output change rate limit.

Display shown in remote mode (REMOTE SV)



Display units

- **Measured-value(PV) display unit**
  Displays measured-value.
- **Set-value(SV) display unit**
  Displays value via the setting change rate limit.
- **Memory area display unit**
  Displays current control area NO.
- **Message display unit(LCD)**
  Displays remote setting(RS) value not set via the setting change rate limit.

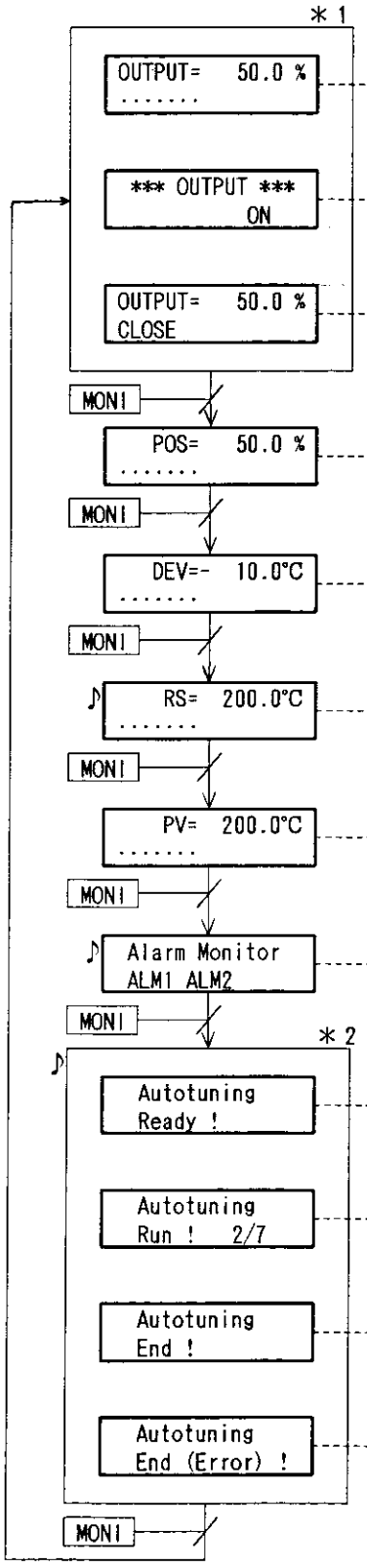
Indication lamps

The set-value(SV), REMOTE(REM) and AUTO(AUTO) indication lamps light up.

* In the remote mode, the set-value(SV) display unit shows the remote setting(RS) value (Control set-value) via the setting change rate limit, while the message display unit shows the remote setting(RS) value not set via the setting change rate limit.
  Thus, when the setting change rate limit is activated, changes in the set-value(SV) and message display units differ, and the value on the set-value(SV) display unit varies with that from the setting change rate limit.

5. MONITORING (MONI) DISPLAY PANEL DESCRIPTION

Every time the [MONI] key is pressed, the following status is displayed.



● Control output + Bar-graph
Displayed only when control action is PID [H] or PID with AT [F].

● ON/OFF display
Displayed only when control action is ON/OFF action [A].

● Control output + CLOSE, OFF, OPEN
Displayed only when control action is position proportioning PID action [Y].

● Opening + Bar-graph
Displayed only when control action is position proportioning PID action [Y].

● Deviation + Bar-graph
Can select display/no-display and can set deviation bar graph display range. (Can be selected from to parameter group PG17 on setting parameter(PARA) display panel.)

● RS + Bar-graph
Display/no-display can be selected from parameter group PG17 on setting parameter(PARA) display panel.

● PV + Bar-graph
Display/no-display can be selected from parameter group PG17 on setting parameter(PARA) display panel.

● Alarm output status
Displayed when alarm function is provided.

● Auto-tuning(AT) ready status

● Auto-tuning(AT) execution status
Displays the number of auto-tuning cycles.

● Auto-tuning(AT) end status

● Auto-tuning(AT) error status

♪ : Option (Displayed only when option is provided.)
＊1 : Display varies with control action type.
＊2 : Displayed only when control action is PID action with auto-tuning [F] and during auto-tuning.

★ For details of auto-tuning(AT) status display, see "(5) PID control/auto-tuning(AT) transfer" (page 8).

(1) Setting change

Set-values belong to two parameter groups in which they can be changed, even during operation, and can not be changed if on operation cannot be stopped.
The details are as follows.

Setting changeable : × Setting not changeable : −

Parameter group (PGNO.)	With control output	No control output	
PG00	Setting can always be changed regardless of set locking and control.		
PG01			
PG10	×	×	Item to be locked depend on the set data locking level (PG 40)
PG11	×	×	
PG12	×	×	
PG13	×	×	
PG14	×	×	
PG15	×	×	
PG16	×	×	
PG17	×	×	
PG20	−	×	
PG21	−	×	
PG22	−	×	
PG23	−	×	
PG24	−	×	
PG25	−	×	
PG30	−	−	
PG40	−	×	

- The set contents of parameter groups PG00 and PG01 can always be confirmed and changed regardless of set data lock/unlock.

- The set contents of parameter groups PG10 to PG17 can be confirmed and changed even during control(RUN) if set data is not locked.

- The set contents of parameter group PG20 to PG40 can be confirmed if set data is not locked, but they cannot be changed.
  The set data can be changed by stopping operation on the operation transfer(MODE) display "Operation RUN/STOP transfer" (see page 7).

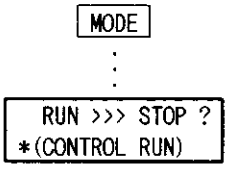
(2) Set data locking

Each set-value cannot be changed if the set data lock function is activated. Set data can be locked on the operation transfer (MODE) display panel. Also set data in every parameter group is locked.

If any parameter group NO. is set by "Set data lock NO. setting" in the parameter group PG40, set data in the parameter group with that NO. or NO. larger than that NO. is locked.
For example, if set data lock NO. "20" is set, set data in any parameter group from PG20 to PG40 is locked. These paramter groups are not displayed if the set data lock function is activated, and thus each set-value can be neither checked nor changed. However, if the set data lock function is deactivated, all set-values in parameter groups from PG00 to PG40 can be checked regardless of "Set-data lock NO. setting".

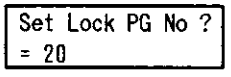
< Setting procedure >

① The operation RUN/STOP display panel is shown with the [MODE] key pressed.



Pressing the [>>>] key stops operation.

② Press the [PARA], [▲] and [▼] keys to call up the set data locking display panel (PG40).

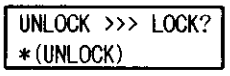


Change the set data locking NO. to 20, for example, by pressing the [▲] and [▼] key.

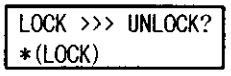
③ Press the [MODE] key to show the operation RUN/STOP display panel.

Pressing the [>>>] key starts operation, and when operation starts, the display panel changes to the monitoring(MONI) display panel.

④ Press the [MODE] key to show the set data lock/unlock transfer display panel.



Pressing the [>>>] key sets the controller to the set data locking status.



⚠ WARNING!

- **In order to prevent electric shock or instrument failure, set the feedback resistance & visual angle adjustments after turning OFF the power.**
- **In order to prevent electric injury or instrument failure, do not touch the internal printed circuit board.**

This controller enables the adjustment of visual message display unit viewing angle and feedback resistance prior to operation.

7 . 1 Preparation

As shown in Fig. 1, the internal chassis can be withdrawn from its housing if it is pulled forward while the stopper at the bottom of the mainframe is pushed up. Next, as shown in Fig. 2, turn ON internal switch Nos. 1 and 2 at the top of the controller, then push the internal chassis into the housing to enable the above adjustment.
Turn OFF the internal switch shown in Fig. 2 to exit from this adjustment.

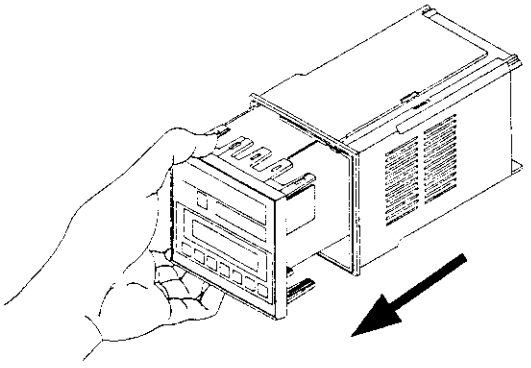


Fig. 1

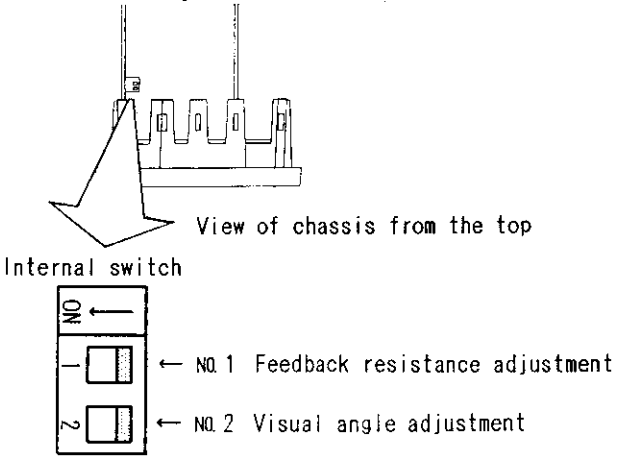


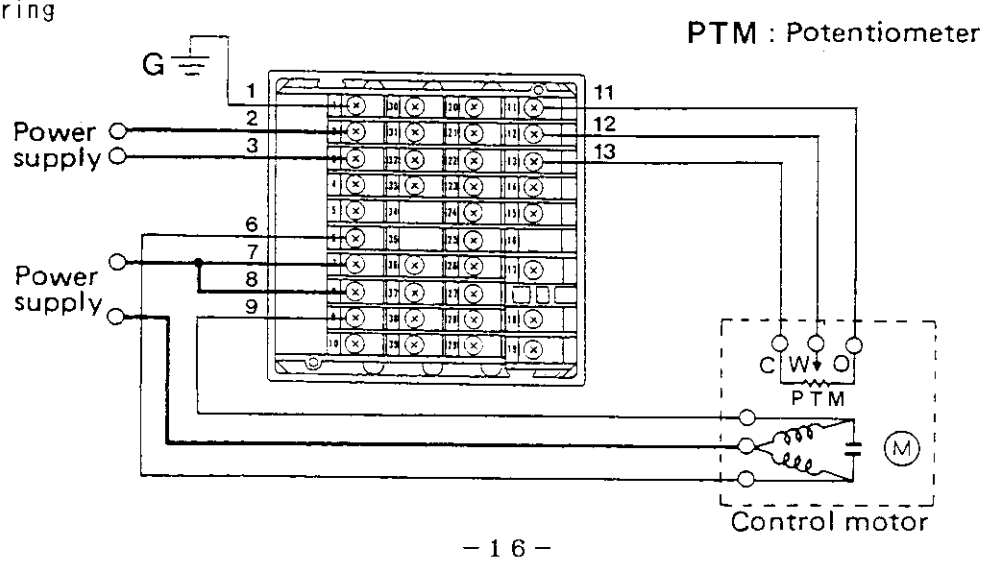
Fig. 2

7 . 2 Feedback resistance adjustment

[Apply only when control action is position proportioning PID action]

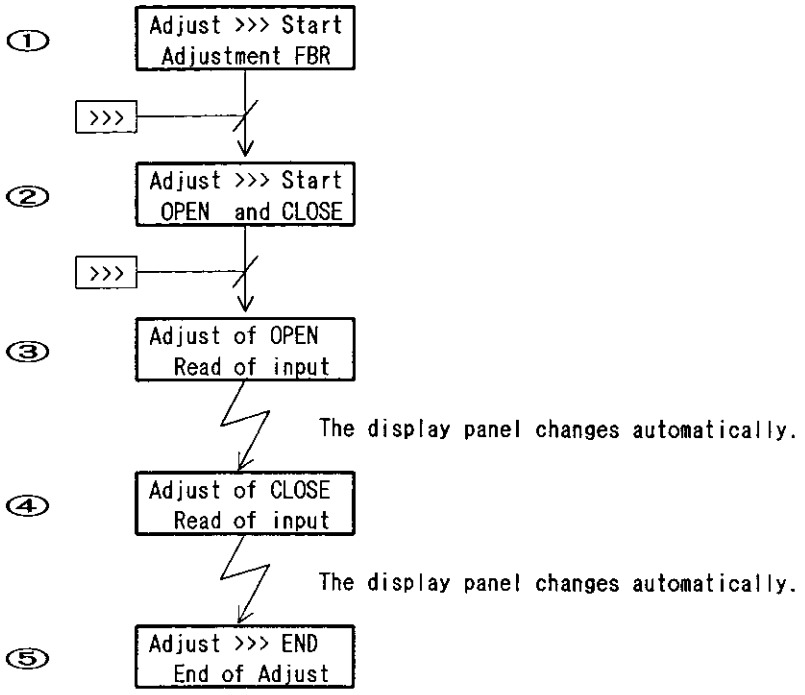
The controller is adjusted to the feedback resistance input value specified by the customer prior to shipment but if fine adjustment is required, follow the procedure described below. Prior to adjustment, check to see if the wiring is correct and that the control motor load is activated.

(1) Wiring



(2) Adjustment (F B R)

Turn ON internal switch(Fig. 2) NO.1, then turn ON the power with the internal chassis in the housing. This message display unit then shows ① and hereafter ②, ③, ④ and ⑤ in this order. The measured-value (PV) display unit shows the feedback resistance input value.



Press the [>>>] key to finish display panel setting and then all the feedback resistance adjustment is completed with the internal switch NO.1 turned OFF.

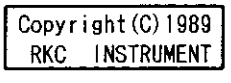
CAUTION Be careful during adjustment, as the control motor is running.

7 . 3 Visual message display unit viewing angle adjustment

The viewing angle of the message display unit (LCD) on this controller can be adjusted for to improve visibility (Visual message display unit viewing angle : density). When displayed characters are not clearly visible because of the angle of the display, adjust the angle.

[Adjustment procedure]

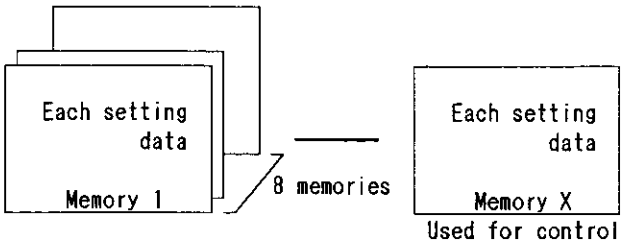
Turn ON internal switch(Fig. 2) NO.2, then turn ON the power with the internal chassis in the housing. The message display unit then shows the following display panel.



Adjust density by pressing the [▲] or [▼] key. Keys other than the above keys are not valid. Turn OFF internal switch NO.2 to end adjustment.

8. 1 Multi-memory areas (PG00, PG01)

This function stores up to 8 memories with setting values (set-value, proportional band, integral time, derivative time, etc.) parameter groups PG00 and PG01 including PID constants set to 1 memory, and if necessary, one area can be called up to be used for control.
In addition, data in the areas not used for control is changeable.



* Control area NO. can be selected by external contact input.
See " 8.8 Control area (memory area) transfer by contact input [Option] " (page 24).

8. 2 Control response designation parameter (PG01)

Control response setting change in PID control can be specified in 3 steps(Slow, Medium and Fast). When quick response to setting change is required for the controlled object, select " Fast ". However, in this case, slight overshoot cannot be avoided, so if overshoot is unacceptable, select " slow ".

8. 3 Input processing

(1) Functional description

① PV bias and RS bias (PG10, PG11)

If a PV bias is set for the following case, a value obtained by adding the PV bias to a measured-value becomes an indicated value, and computation is performed using that value.
Similarly, remote signal correction in remote setting is called " RS bias " .

- For thermocouple/RTD input
  When indicated values need to be corrected because the indicated value on the controller differs from the measured-value(PV) on other instruments used due to characteristic dispersion of each sensor or the difference in sensor mounting locations.
- For voltage/current input
  When input values need to be corrected.

② PV digital filter and RS digital filter (PG10, PG11)

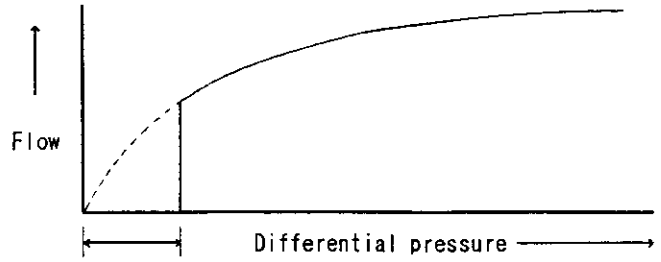
This is a filter provided for rejectingnoise in a measured-value(PV) and remote setting(SV) value. Control in which input noise influence is restricted can be performed by adjusting one of the filter's time constants.

③ PV (RS) moving average (PG10, PG11)

PV (RS) is sampled every 0.1 sec(0.2 sec). If there is not PV (RS) moving average, this sampling value is read without modification and then processed, but if there is PV (RS) sampling average, the result of 4 samplings is averaged and then processed. Even in this case, the sampling interval becomes 0.1 sec(0.2 sec). (Mean value of 1 to 4 samples → Mean value of 2 to 5 samples → Mean value of 3 to 6 samples → Mean value of 4 to 7 samples ···)
The moving average can eliminate noise influence.

④ PV low input cut-off (PG10)

When input signal square root-extraction is used, such as in flow control, the square-root extraction result varies widely in the selection with low input value. In order to eliminate control inconvenience caused by input variations at low input value, input of less than the value set is cut (0 input) and processed.



⑤ RS ratio (PG11)

The multiplying factor set to the remote setting(RS) value is called " RS ratio ". Thus, remote setting(RS) value input gradient can be adjusted.

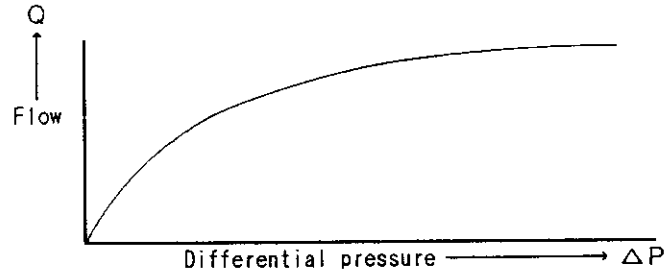
Remote setting(RS) value × RS ratio = Remote setting(RS) value used for calculation and display

⑥ Input error determination points (High-limit/Low-limit)

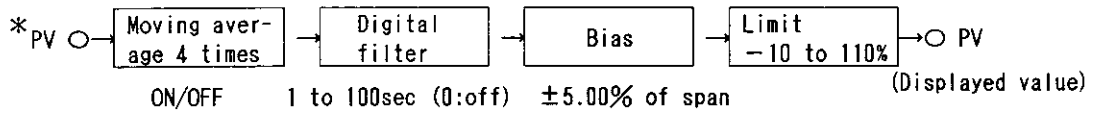
When measured-value(PV) input exceeds the value set here, it is determined to be input error. In this case, action set by " Action selection at input error " (PG20) is performed. (For details, see "(6) Special operation at input error ".) (page 20)

⑦ Square-root extraction (PG20)

For differential pressure flowmeters usually used in flow measurement, output signal ΔP (Differential pressure) has the relationship of $Q=\alpha\sqrt{\Delta P}$ with respect to flow Q. These, flow Q can be obtained by performing output ΔP square-root extraction from the flowmeter.

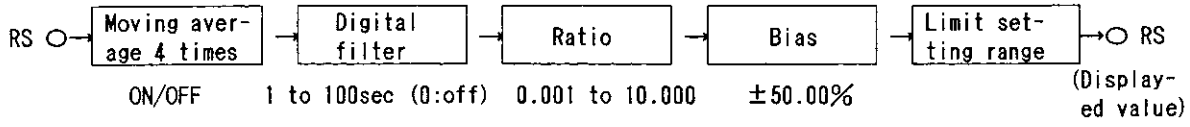


(2) Measured-input value(PV) processing (0.1 sec. sampling)

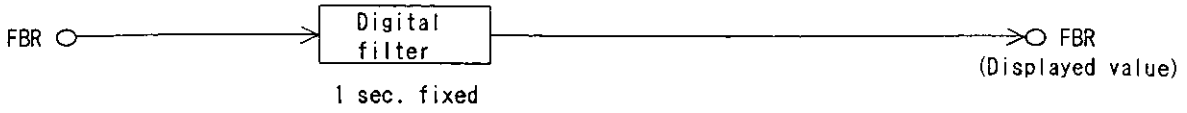


*PV : Data after linearization or square-root extraction

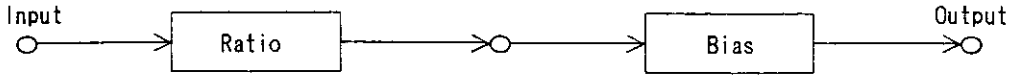
(3) Remote setting(RS) input processing (0.2 sec. sampling)



(4) Feedback resistance(FBR) input processing (0.4 sec. sampling)

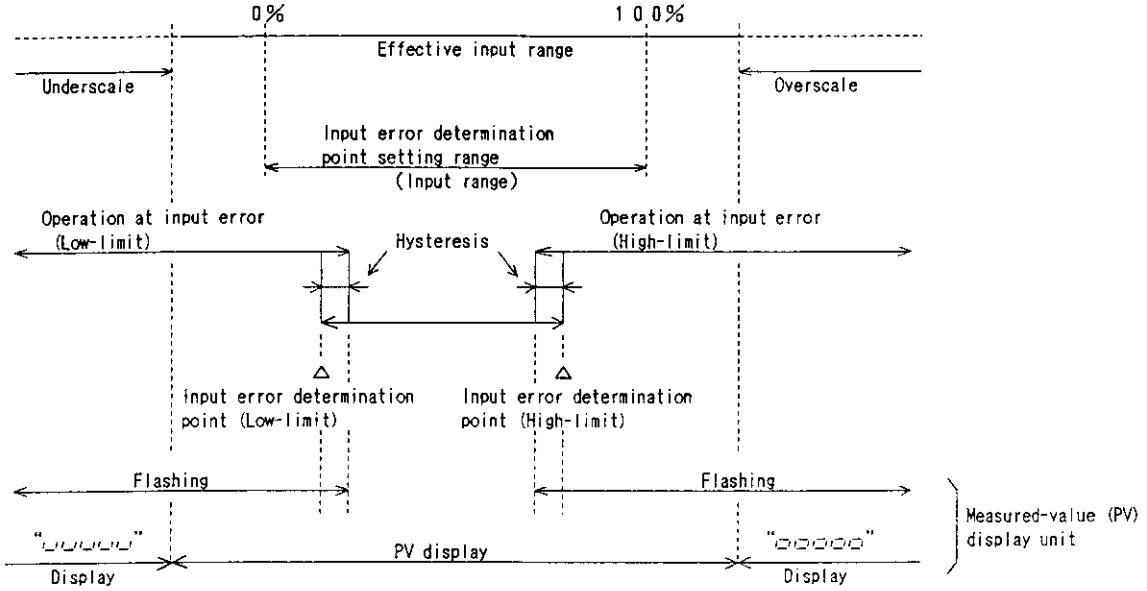


(5) Remote setting(RS) ratio/bias operation



(6) Special operation at input error

① Configuration diagram



② Setting range for each function

Input error determination point (PG20) : Same as input range (Independent high/low setting)

Action hysteresis : 0.1% of span (Fixed)

Action selection at input error value (PG20) :

Message display	Action
Action *** ERR ? =Control output	Usual control continues
Action *** ERR ? =Preset Manual	Set the mode to "MANUAL" to output the manual output value during error.

*** : OVR(high) or UND(low)

Manual output during error (PG12) : −5.0% to +105.0%

Display : PV display flashing during error

Others : When input is set to the error status during auto-tuning, auto-tuning is suspended.

(7) Input range table

Group		Input type	
Temperature input	TC	K	-200.0 to 200.0°C
			0.0 to 400.0°C
			0.0 to 1300.0°C
			0.0 to 800.0°F
			0.0 to 2400.0°F
		J	-200.0 to 200.0°C
			0.0 to 400.0°C
			0.0 to 800.0°C
			0.0 to 1200.0°C
			0.0 to 1600.0°F
			0.0 to 2100.0°F
		R	0.0 to 1700.0°C
			0.0 to 3200.0°F
		S	0.0 to 1700.0°C
			0.0 to 3200.0°F
		B *	0.0 to 1400.0°C
			0.0 to 1800.0°C
			0.0 to 2500.0°F
			0.0 to 3300.0°F
		E	-200.0 to 200.0°C
			0.0 to 1000.0°C
			0.0 to 1800.0°F
		T	-200.0 to 200.0°C
			-200.0 to 400.0°C
			0.0 to 400.0°C
			-300.0 to 400.0°F
			-300.0 to 700.0°F
			0.0 to 700.0°F
		N	0.0 to 1300.0°C
			0.0 to 2300.0°F
		PL II	0.0 to 1300.0°C
			0.0 to 2300.0°F

Group			Input type
Temperature input	TC	W5Re/W26Re	0.0 to 1200.0°C
			0.0 to 2300.0°C
			0.0 to 2200.0°F
			0.0 to 4200.0°F
		U	-200.0 to 200.0°C
			0.0 to 600.0°C
			-300.0 to 400.0°F
			0.0 to 1100.0°F
		L	-200.0 to 200.0°C
			0.0 to 900.0°C
			-300.0 to 400.0°F
			0.0 to 1600.0°F
	RTD	JPt100	-200.0 to 600.0°C
			-300.0 to 1200.0°F
		Pt100	-200.0 to 600.0°C
			-300.0 to 1100.0°F
Voltage input	Voltage input (Low)	mV, V	0 to 10mV
			-10 to 10mV
			0 to 100mV
			-100 to 100mV
			0 to 1 V
			-1 to 1 V
			0 to 5 V
			1 to 5 V
	Voltage input (High)	V	0 to 10 V
Current input		mA	0 to 20mA
			4 to 20mA

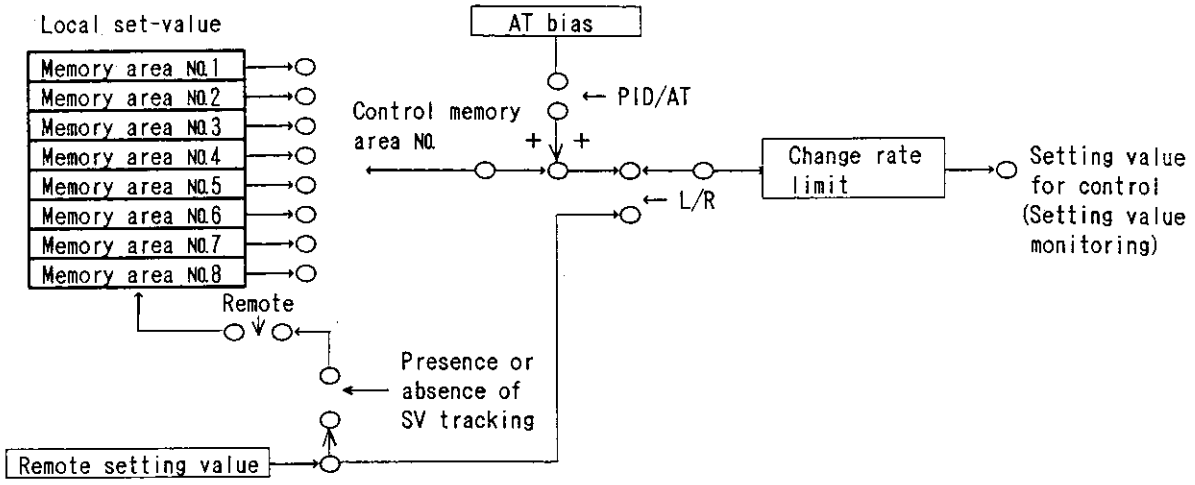
* Accuracy in the range of 0 to 400°C (0 to 800°F) : Not guaranteed.

8．4 Set-value processing

(1) Setting change rate limit (PG11)

In processes where the set-value(SV) needs to be changed gradually, it is changed so that it does not exceed the rate of change set by the setting change rate limit.

(a) Configuration diagram



① The setting change rate limit is effective for changing set-value as the result of remote/local transfer and control area change.
② The setting change rate limit is activated regardless of the auto and manual modes.
③ The set-value continues changing even with the mode set to manual during set-value change.

(b) Action

When the setting change rate limit is set at power-ON, the measured-value(PV) is changed as initial value (PV start).

< Initial value of the setting change rate limit at power-ON >

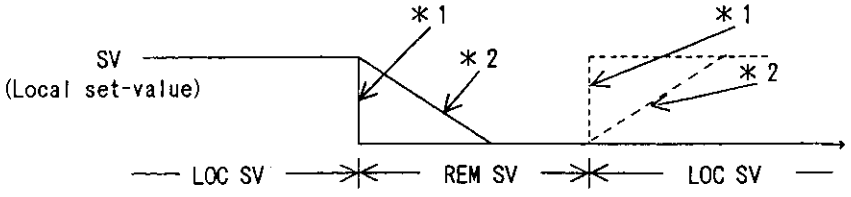
Relationship between measured-value(PV) and set-value at power-ON	Setting change rate limit			
	Increasing (UP) set-value		Decreasing (DOWN) set-value	
	0	Other than 0	0	Other than 0
Measured-value(PV) >Set-value	———	———	Set-value	Measured-value (PV)
Measured-value(PV) <Set-value	Set-value	Measured-value (PV)	———	———
Measured-value(PV) =Set-value	Set-value	Set-value	Set-value	Set-value

* The initial value at overscale " ▫▫▫▫▫ " or underscale " ▫▫▫▫▫ " becomes the set-value.
* The initial value when measured-value(PV) exceeds the setting range becomes the high or low limit in the setting range.

(2) SV tracking (PG21)

This function is used to select whether the local set-value follows the remote setting when the operation mode is changed to a local setting from remote setting.

Set-value movement



★ Solid line : When there is tracking.
★ Dotted line : When there is no tracking.
＊1 : The setting change rate limit is turned OFF.
＊2 : The setting change rate limit is turned ON.

8．5 Output processing

(1) Output change rate limit (PG12) high/low-limits

In a controlled object which dislikes sudden output change, output can be limited by the rate of output change set, and especially in a controlled object in which large current may flow due to sudden output change, use the output change rate limit.

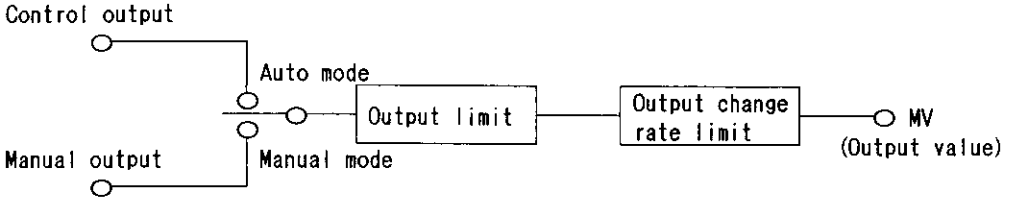
① Output limit and output change rate limit action

	Output limit	Output change rate limit
ON/OFF action [A]	—	—
Position proportioning PID action [Y]	×	×
During PID control	×	×
During auto-tuning(AT)	×	×
During manual setting	×	×

× : Settable — : Not settable

* If the output change rate limit is activated, there may be cased where the appropriate PID constants cannot be obtained at auto-tuning(AT).

② Configuration diagram of output limit and output change rate limit



(2) Derivative gain (PG12)

Derivative gain is adjusted. It is not necessary to change the value set prior to shipment when the controller is being used normally.

(3) Manual output value during error (PG12)

When input is above or below the value set on the high or low-limit of the input error determination point, it is determination to be input error. At this time, if manual mode is selected according to action selection (PG20) at input error, normal control is suspended to automatically set the controller to the manual output status. The output value at this time becomes that set by " Manual output value during error ".

8．6 Hot/cold start Selection (PG22)

Instrument action is not influenced by instantaneous power failure. Also power recovery action after extended power failure can be selected from the following 3 items. Slection is setting parameter(PARA) display in the parameter group (See "3.3 Setting parameter(PARA) display items" on page 4).

	Operation mode at power recovery	Output value at power recovery	
Hot start 1	Same as that before power failure	Same as that before power failure	
Hot start 2	Same as that before power failure	MAN Mode	Low output limiter value
		AUTO Mode	Value as a result of * control computation
Cold start	MAN mode	Low output limiter value	

* The result of control computation varies with the control designation parameter. (See "3.3 Setting parameter(PARA) display items" on page 4.)

NOTE (1) A power failure for less than 50msec. does not affect controller operation.

(2) A power failure for less than 3 sec. results in the activation of HOT START 1. A power failure for more than 3 sec. results in the operation mode designated by the setting. However, the failure for less than 3 sec. slightly varies with power supply voltage and power consumption.

(3) Transfer from operation STOP to RUN also results in the same start as that at power recovery.

(4) HOT/COLD START cannot be selected in the ON/OFF action.

(5) If a power failure occurs while the auto-tuning(AT) function is activated, HOT START conditions become as follows, respectively.

HOT START 1: Only the auto-tuning(AT) function is suspended in the operation mode before a power failure occurs and the output restarts its operation from the load factor almost at the set-value(SV).

HOT START 2: Only the auto-tuning(AT) function is suspended in the operation mode before a power failure occurs and the output restarts its operation from the same output value as that in the auto mode of normal HOT START 2.

8. 7 Display related function (PG17)

(1) Display updating cycle function

This function enables to change the display updating cycle. For example, when it becomes difficult to see the display's least significant digit due to input value fluctuation, it can be made legible if the display updating cycle is varied (to lengthen the cycle).

Setting range : 0.1 to 10.0 sec.
Displays whose updating cycles becomes valid :

- Measured-value(PV) and set-value(SV) display units (7-segment LED)
- Control output + Bar-graph, Control output + CLOSE/OFF/OPEN, Deviation + Bar-graph, RS + Bar-graph and PV + Bar-graph (Message display panel)

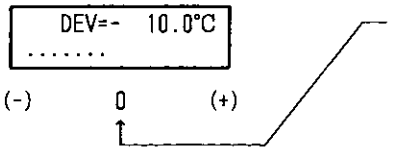
(2) Display/no-display function (PG17)

This function enables the deviation + bar-graph, RS + bar-graph and PV + bar-graph monitoring (MONI) display panel when it is required.

(3) Deviation bar-graph display range setting function (PG17)

Deviation bar-graph display range can be set.

Setting range : 0.1 to 10.0% of span



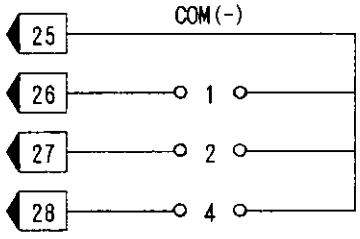
The bar-graph center corresponds to the zero deviation poistion.
The plus deviation is displayed on the right side from the bar-graph center, while the minus deviation, on the left side from the center.

8. 8 Contact input 〔Option〕

In this instrument, the control area and each operation mode can be transferred by the front keys and also by contact input. (Optional)
Three types of contact inputs are available: "Control area selection (3 points)", "Control area selection + operation mode selection (1 point), and "Operation mode selection (4 points)" (To be specified when ordering).

(1) Control area transfer

The control area can be transferred according to the open/close status of rear terminals Nos. 25 to 28.



<Control area transfer according to rear terminal open/close status>

Control area / Terminals	1	2	3	4	5	6	7	8
Nos.25 and 26	×	−	×	−	×	−	×	−
Nos.25 and 27	×	×	−	−	×	×	−	−
Nos.25 and 28	×	×	×	×	−	−	−	−

× : Open − : Closed

NOTE

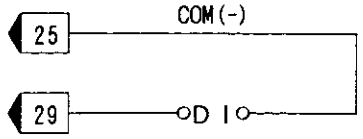
1. When the control area is transferred by contact input, set the instrument to the「AREA EXT」according to the operation mode(MODE) display "Control area internal (local)/external transfer" (see page 7).
2. In this instrument, the control area is transferred approx. 2 sec. after the rear terminal (Nos.25 to 28) open/close status is changed.
3. The selection method of each control area is determined depending on the operation mode shown below.

Operation mode (LOC/COMP)	External/internal (EXT/LOC)	Description
Communication (COMPUTER MODE)	External control area (AREA EXT)	Contact input becomes effective (Change via communication is not available)
	Internal control area (AREA LOCAL)	Control area No. transfer via communication
Key operation (LOCAL MODE)	External control area (AREA EXT)	Contact input becomes effective (Change by key operation is not available)
	Internal control area (AREA LOCAL)	Control area No. transfer by key operation

(2) Operation mode transfer

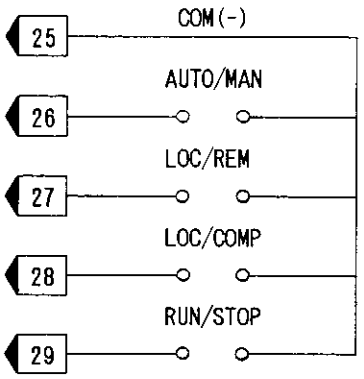
The operation mode can be transferred according to the open/close status of the rear terminal Nos.25 and 29.

<When the operation mode transfer (1 point)>



* The operation mode transferred any one of AUTO/MAN, LOC/REM, LOC/COMP and RUN/STOP. (To be specified when ordering.)

<When the operation mode transfer (4 points)>



The operation mode transfer status by contact input is shown in the following.

	Front key mode selection	Status of rear terminal No.	Actual operation mode	Lamp status			Message display
Auto/manual transfer	Auto	Closed	Auto	AUTO Auto mode lamp	AUTO	ON	AUTO >>> MAN ? *D/I:CLS(AUTO)
		Open	Manual		-AUTO-	Flashing	AUTO >>> MAN ? *D/I:OPN(MANUAL)
	Manual	Closed				OFF	MAN >>> AUTO ? *D/I:CLS(MANUAL)
		Open					MAN >>> AUTO ? *D/I:OPN(MANUAL)
Local/remote transfer	Remote	Closed	Remote	REM Remote mode lamp	REM	ON	REM >>> LOC ? *D/I:CLS(REM.SV)
		Open	Local		-REM-	Flashing	REM >>> LOC ? *D/I:OPN(LOC.SV)
	Local	Closed				OFF	LOC >>> REM ? *D/I:CLS(LOC.SV)
		Open					LOC >>> REM ? *D/I:OPN(LOC.SV)
Local/computer transfer	Computer	Closed	Computer	COMP Computer mode lamp	COMP	ON	COMP >>> LOC ? *D/I:CLS(COMP)
		Open	Local		-COMP-	Flashing	COMP >>> LOC ? *D/I:OPN(LOCAL)
	Local	Closed				OFF	LOC >>> COMP ? *D/I:CLS(LOCAL)
		Open					LOC >>> COMP ? *D/I:OPN(LOCAL)
Operation execution(RUN) /STOP transfer	RUN	Closed	RUN	———			RUN >>> STOP ? *D/I:CLS(RUN)
		Open	STOP				*RUN >>> STOP ? *D/I:OPN(STOP)
	STOP	Closed					STOP >>> RUN ? *D/I:CLS(STOP)
		Open					STOP >>> RUN ? *D/I:OPN(STOP)

NOTE In this instrument, the operation mode is transferred approx. 1 sec. after the rear terminal (Nos.25 to 29) open/close status is changed.

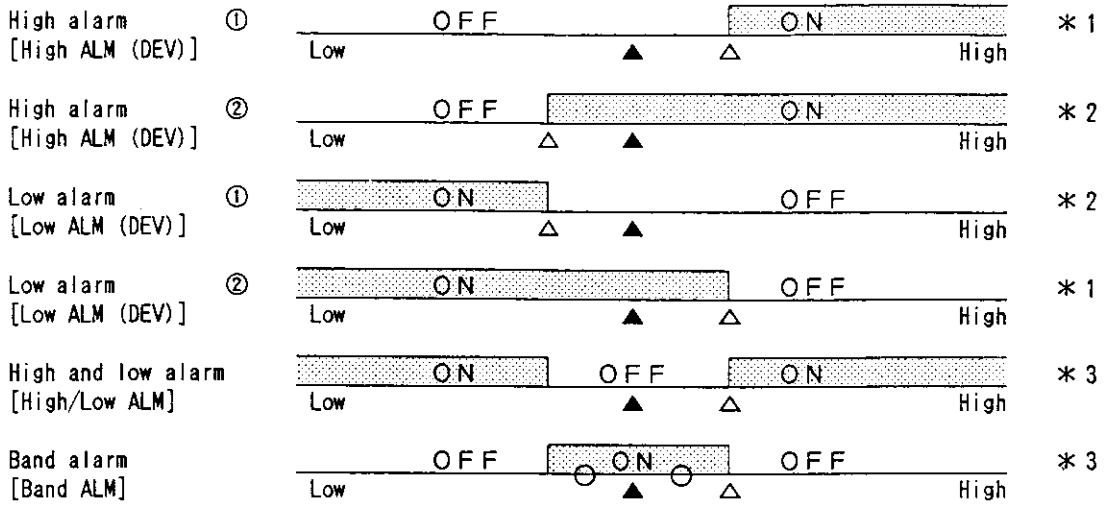
8. 9 Alarm〔Option〕

Up to 3 alarm output points are available. Select the following functions for each point.

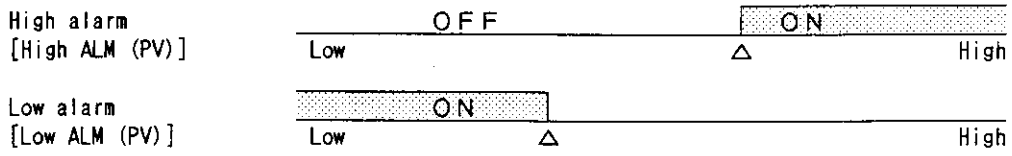
(1) Action selection (PG23)

Any of the following actions can be selected.

◎ Deviation alarm (▲ : Set-value (SV) △ : Alarm set-value)



◎ Process alarm (△ : Alarm set-value)



＊1 Alarm status where the alarm set-value is set to plus(+).
＊2 Alarm status where the alarm set-value is set to minus(−).
＊3 Status where alarm is activated at 2 equal deviation point from the set-value(SV) with the alarm set-value (absolute deviation) is set.

(2) Energize/de-energize selection (PG23)

Alarm status relay energize/de-energize can be selected.

(3) Error input action selection (PG23)

When there is input above or below the value set by the high/low limit at the input error determination point (PG20), this function sets the alarm to the ON state compulsory. Select any of the following 4 points according to the application being used.

Trouble determination point	High-limit (OV)	Low-limit (UN)
1	—	—
2	ON	ON
3	ON	—
4	—	ON

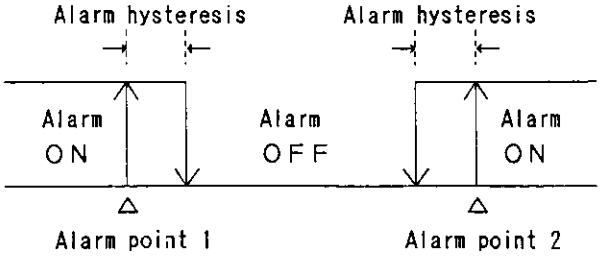
(4) Selection of presence or absence of hold action (PG23)

The hold action is activated so that even if input signal is within the alarm area at the time of power-ON, alarm generation is made invalid until the signal once exits the area. This hold action can be selected.

(5) Alarm hysteresis (PG14)

This is the function of freely setting an alarm action hysteresis band.

〔Example〕



Alarm point 1 : Alarm set-value for low alarm
Alarm point 2 : Alarm set-value for high alarm

8. 10 Auto-tuning(AT) 〔Option〕

A lot of attention has been paid to this controller's auto-tuning(AT) function to facilitate the selection of the number of cycles and display during auto-tuning(AT).

(1) Display during auto-tuning(AT)

See " 4. Operation " (page 7).

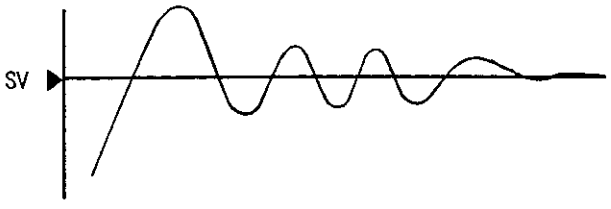
(2) Number of AT cycles (PG13)

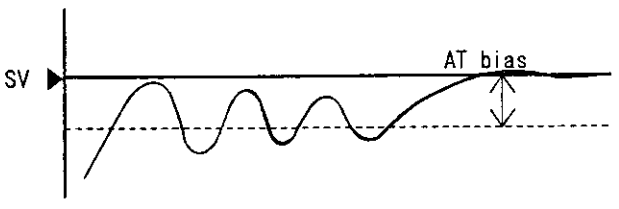
The number of AT cycles can be selected from the following 2 types. Select the number of cycles suitable for application.

① Number of cycles 2 : Select number of cycles 2 when faster auto-tuning is required.
② Number of cycles 3 : Select number of cycles 3 when auto-tuning accuracy is more important than speed.

(3) AT bias (PG13)

Our auto-tuning method involves hunting at the set-value(SV) by ON/OFF action, thereby computing and setting PID constants. However, depending on the process, this hunting may not be desirable, so an AT bias is set to enable auto-tuning execution in the area where measured-value(PV) does not reach the set-value(SV).

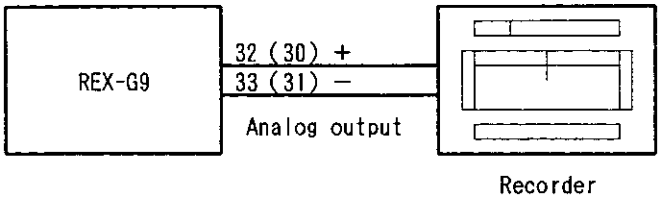




8．11 Analog output function〔Option〕(PG15)

Manipulated output(MV), measured-value(PV), set-value(SV), remote-setting(RS) value and deviation (Dev) are available as analog outputs. For the-position proportioning PID action type, feedback resistance input(POS) is also output. Also, up to 2 analog output points are available. However, when DC voltage or DC current is specified as control output, the number of analog output points becomes one. Output signal type can be specified by the customer.

● Analog output can be used when external instruments such as recorders, etc. are used.



＊ If manipulated output(MV) is connected to a recorder as the analog output type, its selection can also be recorded.

● Output impedance/allowable load resistance

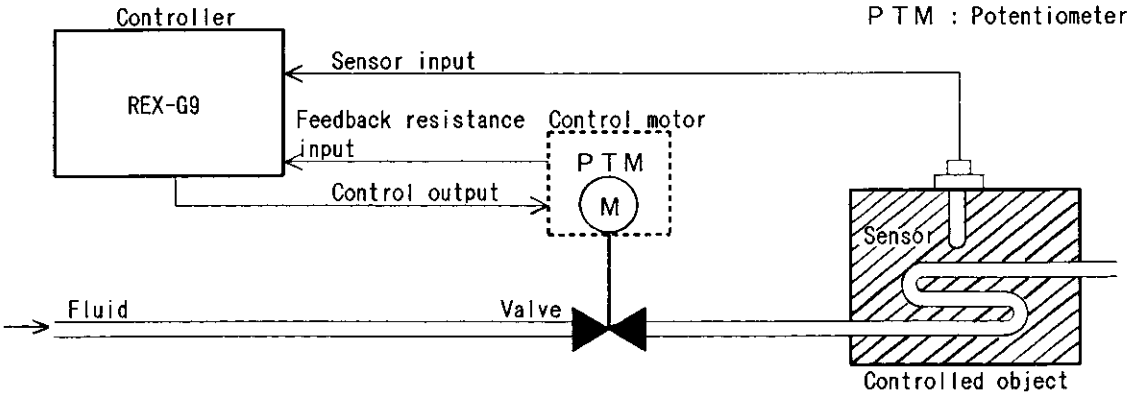
Output signal	Output impedance	Allowable load resistance
DC 0 to 10mV DC 0 to 100mV	Approx. 10Ω	20kΩ or more
DC 0 to 1V DC 0 to 5V DC 0 to 10V DC 1 to 5V	0.1Ω or less	1kΩ or more
DC 0 to 20mA DC 4 to 20mA	5MΩ or more	600Ω or less

8．12 Position proportioning PID action

A valve is used frequently in fluid (gas, liquid, etc) control. Controller position proportioning PID action is to control this valve itself.

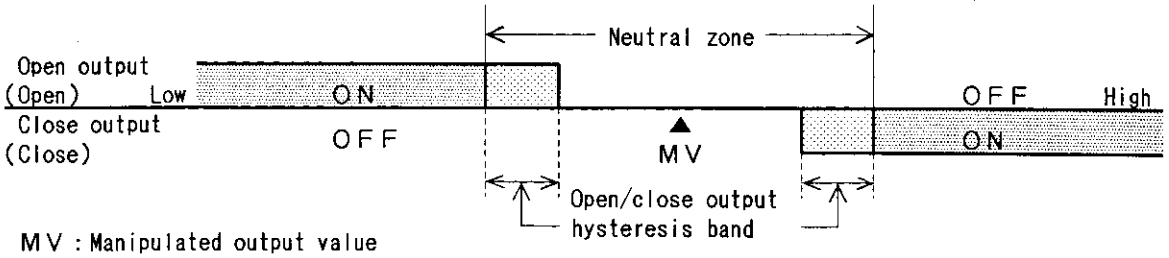
(1) In addition to a signal from the sensor, a valve open/close status signal (feedback resistance input) is also input to the controller as a position proportioning PID action input signal. The controller performs PID computation using the sensor's input signal and set-value(SV). And outputs 2 relay contact signals as the output signal to open and close the valve by comparing the computed result with the valve open/close status signal (feedback resistance input). The valve open/close status signal (feedback resistance input) is feedback to the controller via a potentiometer (feedback resistance) which is usually attached to the controller.

[Connection example]



(2) Neutral zone and open/close output hysteresis

The position proportioning PID action function sets the neutral zone and the open/close output hysteresis band. The neutral zone indicates that both the opening and closing side outputs are OFF, and values half the set-value centering around the manipulated output value are put in the high and low sides. In addition, the open/close output hysteresis bands half the set-value are put on each inside of the high and low limit values in the neutral zone.



MV : Manipulated output value

* Both the set-value of the neutral zone and the open/close output hysteresis band must not be "0.0%".
* The hysteresis band is handled as (neutral zone/2) > Hysteresis band at (neutral zone/2) ≦ Hysteresis band.

(3) Action selection at feedback resistor (FBR) input break (PG16)

Anyone of the following 3 actions can be selected.

	Output at resistor wire break	
	Close side (C)	Open side (O)
1	OFF	OFF
2	ON	OFF
3	OFF	ON

8.13 Communication function [Option]

The controller enables data communication with a host computer having RS-422A(2-wire system), RS-422A(4-wire system) or RS-232C interface built in it. For details, see "REX-G9 Communication instruction manual" separately prepared.
In addition, this controller enables the setting of communication data bit configuration, device address and communication speed in parameter group PG24.

(1) Communication data bit configuration

① Parity bit(P) : No parity(n), Odd(o) or Even(e)
② Data bit(DT) : 7 or 8
③ Stop bit(SP) : 1 or 2
* Start bit : Fixed to 1

(2) Device address

Specified only for RS-422A (0 0 to 9 9)* * Actually connectable number of sets : Up to 16

(3) Communication speed

9600bps, 4800bps, 2400bps, 1200bps

8.14 Model and ROM NO. check (PG30)

Controller models other than those of options and ROM NO. can be checked. Please check the model and/or ROM NO. when inquiry for the instrument model or trouble is made to us.

8.15 Self-diagnostic function

Self-diagnostic function	During abnormality	
	Display	Output
RAM/ROM check A/D converter check Watch-dog timer	FAIL indication lamp (red) lights up and other all the lamps on the REX-G9 light out.	● FAIL output ····· Contact open ● Control output ··· OFF ● Alarm output ····· OFF ● Analog output ··· Output low-limit

⚠ WARNING!

- **In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.**
- **If failure or error of this instrument could result in a critical accident of the system, install an external protection circuit to prevent such an accident.**
- **In order to prevent instrument damage or failure, protect power line and the input/output lines from high currents by using fuses with appropriate ratings.**

9 . 1 Cautions for wiring ⚠

(1) For thermocouple input, use the specified compensation wire.

(2) For RTD input, use leads with low resistance and having no resistance differences between the 3 leads.

(3) Conduct input signal wiring away from instrument power, electric equipment power and load lines as such as possible to avoid noise induction.

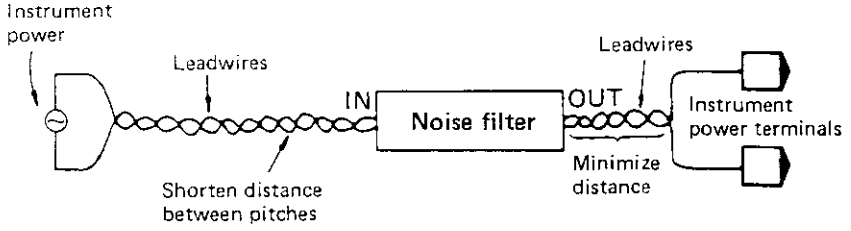
(4) Conduct instrument power wiring so as not to be influenced by noise from the electric equipment power. If it is assumed that a noise generation source is located near the controller and the controller is influenced by noise, use a noise filter.

① To obtain a satisfactory noise filter effect, select the most suitable type after due consideration of instrument power supply voltage and filter frequency characteristics.

② For instrument power wiring, if it is assumed that noise exerts a bad influence upon the controller, shorten the distance between twisted power supply wire pitches. (The shorter the distance between the pitches, the more effective for noise reduction.)

③ Install the noise filter on the panel which is always grounded and minimize the wiring distance between the noise filter output side and the instrument power terminals. Otherwise, the longer the distance wiring, the less effective for noise.

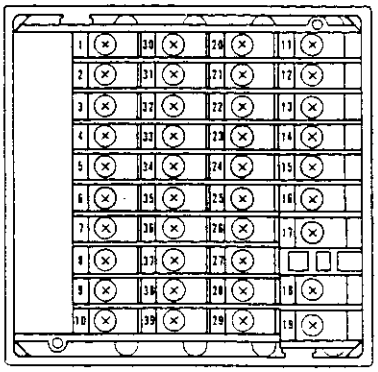
④ Do not install fuses and/or switches on the filter output signal since this may lessen filter effect.



(5) For wiring, use wires conforming to the domestic standard of each country. (For instrument grounding, use wires with nominal sectional area of 1.25 to 2.0mm², and securely ground the instrument at the minimum distance.)

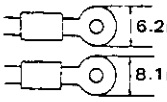
(6) About 1 to 2 sec. are required as the preparation time of contact output during power-ON. Use a delay relay when the output line, is used for an external interlock circuit.

9．2 Rear terminals ⚠



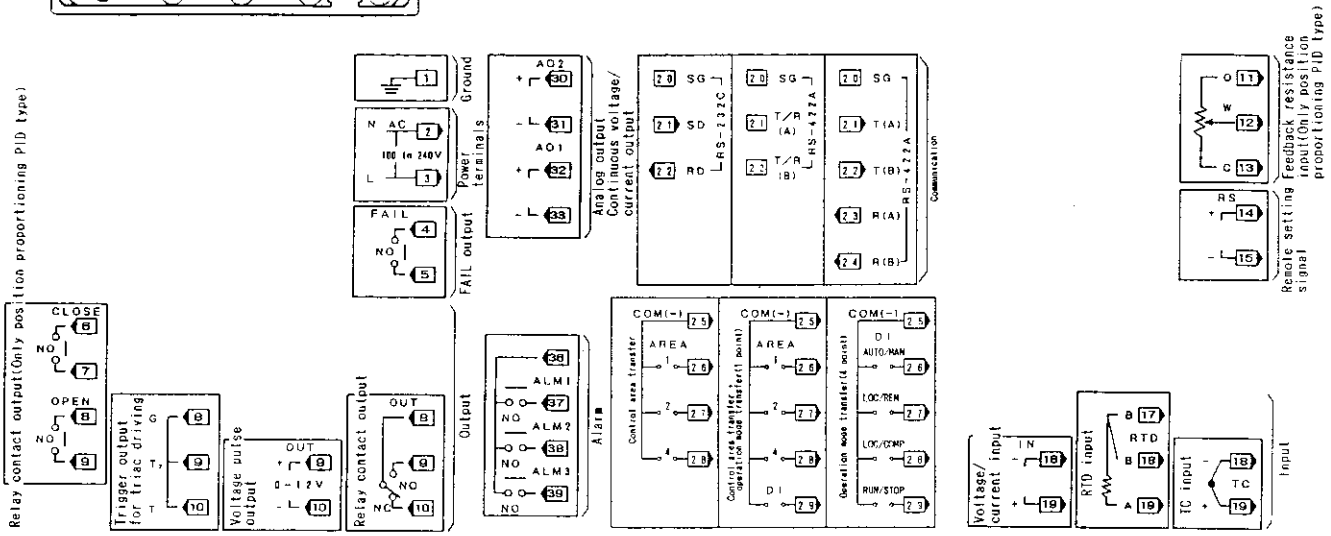
NOTE

1. Each unused terminal (which varies with instrument Model) is fitted with a blind patch.
2. Use the lug suitable for a terminal screw.



Recommended tighten torque : 4kgf·cm
Maximum allowance tighten torque : 7kgf·cm

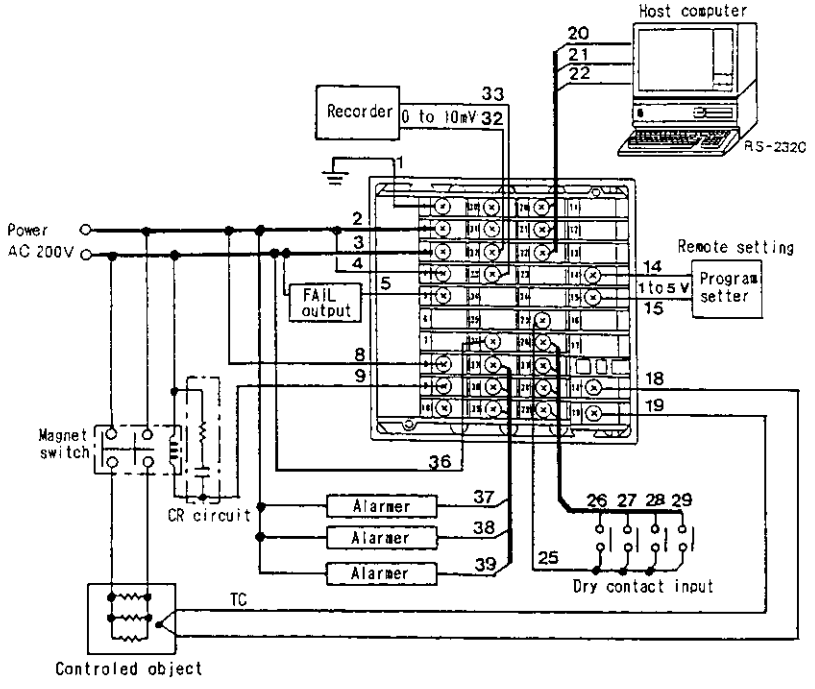
Recommended tighten torque : 4kgf·cm
Maximum allowance tighten torque : 10kgf·cm



9．3 Wiring example

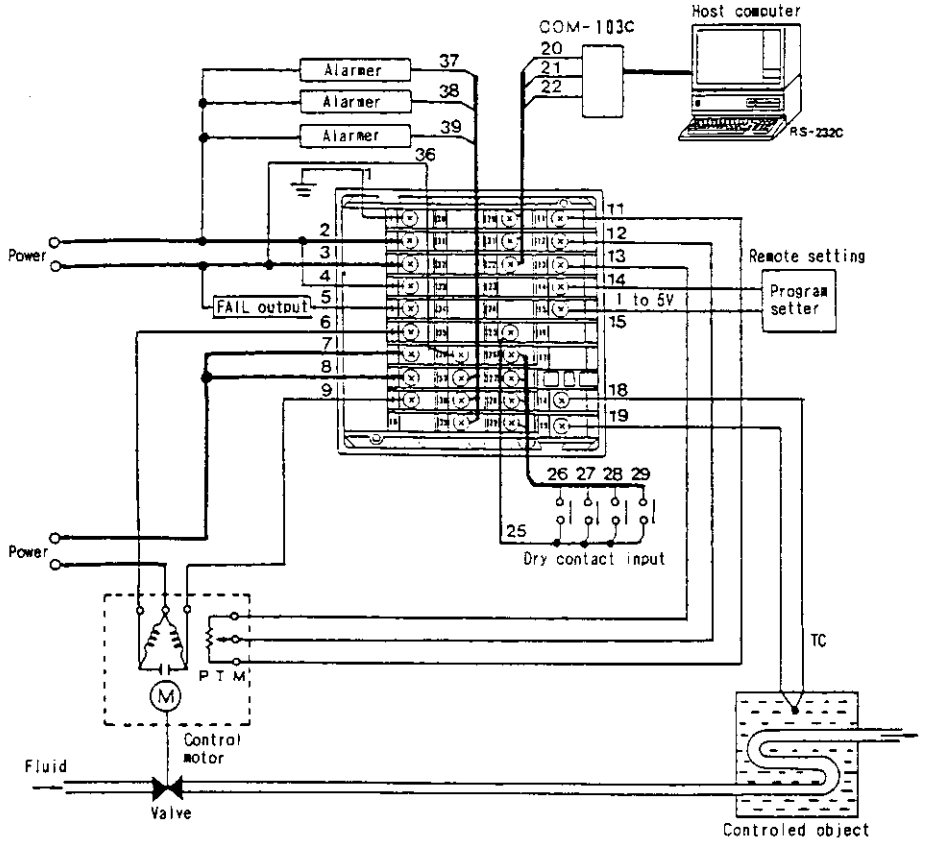
● ON/OFF action type, PID action type and PID action with auto-tuning function type

REX－G9[A/H/F]TC－M＊VMN－1N－1／A



● Position proportioning PID action type

REX-G9YTC-M*VMN-NN-2/A



⚠ WARNING!

● In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.

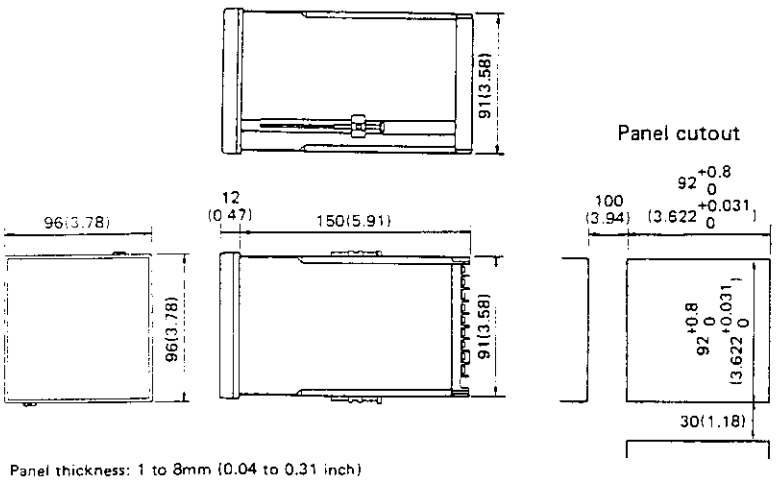
10.1 Cautions for mounting

Avoid the following location where the controller is mounted.

- Ambient temperature of less than 0°C (32°F) or more than 50°C (122°F).
- Ambient humidity of less than 20%RH or more than 80%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.
- Should be used indoors where the controller is not exposed to direct sunlight.
- Heat to be accumulated due to radiation heat.

10.2 Dimensions

Unit : mm (inch)



Panel thickness: 1 to 8mm (0.04 to 0.31 inch)

* Dimensions in inches are shown for reference.

10.3 Mounting procedures

① Mount the panel cutout corresponding to the number of units on the panel by referring to panel cutout dimensions.

② Insert the instrument into the panel from the front side.

③ Engage each mountig bracket with the bracket insertion slots.(Fig.1)

④ Then tighten the mounting bracket setscrew from the rear with a Phillips screwdriver. (Recommended tightening torque : 3kgf·cm or less)

⑤ Engage the other bracket with the slots in the same way as in items ③ and ④.

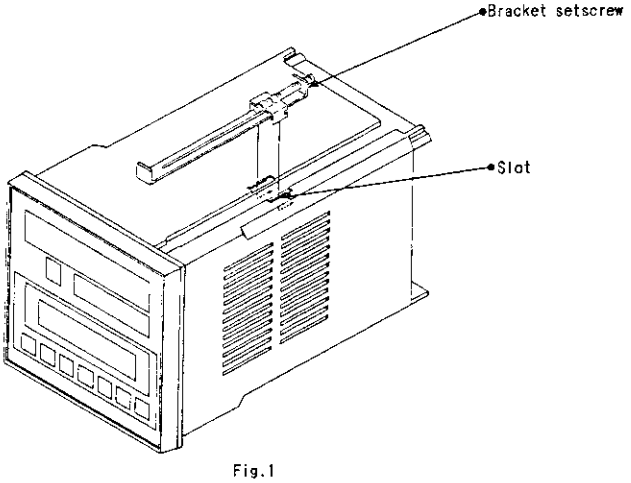


Fig.1

11. SPECIFICATIONS

1. Input

(1) Input type :

(a) Temperature input group

① Thermocouple input type : K,J,R,S,B,E,T,N,PLⅡ,W5Re/WR26e,U,L

② Signal source resistance effect : Approx. 0.3μV/Ω

③ Input impedance : 1MΩ or more

④ Action at input break : Specify any of upscale or downscale

(b) RTD input group

① RTD input type : Pt100,JPt100

② Sensor current : Approx. 300μA

③ Allowable input lead : 10Ω or less

④ Action at input break : Upscale

⑤ Action at input shorting : Downscale

(c) DC (low) voltage input group

① DC (low) voltage input type : 0 to 10mV DC, -10 to +10mV DC,
0 to 100mV DC, -100 to +100mV DC,
0 to 1V DC, -1 to +1V DC,
0 to 5V DC, 1 to 5V DC

② Input impedance : 1MΩ or more

③ Allowable input voltage : Within ±7V

④ Action at input break : Downscale

(d) DC (high) voltage input group

① DC (high) voltage input type : 0 to 10V DC

② Input impedance : Approx. 1MΩ

③ Allowable input valtage : Within ±14V

④ Action at input break: Downscale(Indicates value near 0.)

(e) DC current input group

① DC current input type : 0 to 20mA DC, 4 to 20mA DC

② Input impedance : Approx. 250Ω

③ Action at input break : Downscale

(2) Input accuracy :

(a) Measuring accuracy : ±(0.1% of span + 1 digit)
(However, thermocouple type B input 0 to 400°C
[0 to 800°F]: Not guaranteed)

(b) Cold junction temperature compensation error : Within ±0.5°C
(From 0 to 50°C)

(3) Sampling cycle : 0.1sec.

(4) PV bias : -5.00 to +5.00% of span

(5) PV digital filter : The first order lag filter : 0 to 100sec.
("0" setting:PV digital filter OFF)

(6) Square root extraction : The presence or absence of this function can be selected.

(a) PV low input cut off : 0.00 to 25.00% of span

(b) Square root extraction accuracy:
±0.1% of span when the square root extraction result is more than 1%.

* The square root extraction function can be selected only when measured-value (PV) input is voltage or current input.

2. Display function

(1) Measured-value (PV) display unit : 5-digit, 7-segment LED (Green)

(2) Set-value (SV) display unit : 5-digit, 7-segment LED (Orange)

(3) Memory area display unit : 1-digit, 7-segment LED (Orange)

(4) Liquid crystal display unit(LCD) : 5×7 dots 16character 2-line dot matrix(Back lighting)
Message display, Bar-graph display

(5) Operation display unit : Point emission LED (Red/green)

3. Setting

(1) Setting range : Set-value(SV) : Same as input range

(2) Setting resolution : (a) Thermocouple input : 0.1℃[℉]
(b) RTD input : 0.1℃[℉]
(c) Voltage/current input : Depending on input range

(3) Setting limit : Any input range value
However, [High-limit of setting limit] > [Low-limit of setting limit]

(4) Setting change rate limit : 0.01 to 100.00%/sec of span
("0.00" setting : Setting change rate limit OFF)

(5) Memory area function : (a) Number of memory areas : 8
(b) Memory area selection
① Selection by front key
② Selection by contact input
③ Selection by communication

(6) Remote setting : See, additional function "B. Remote setting"(Page 43)

4. Control

(1) Control action type : (a) ON/OFF action :
Differential gap(upper):0.00 to 10.00% of span
Differential gap(lower):0.00 to 10.00% of span
(b) Brilliant PID action :
Proportional band(P):0.1 to 1000.0% of span ("0.0" can not be set.)
Integral time(I): 1 to 3600sec. ("0" can not be set.)
Derivative time(D): 0, 1 to 3600sec. ("0" setting:Derivative OFF)
Control response designation parmeter:
Slow, Medium, Fast(3-Step selection)
Derivative gain: 1 to 10
Derivative computing cycle: 0.1 to 1.0sec.
Proportioning cycle: 1 to 100sec. ("0" can not be set.)
Output limit(high-limit):-5.0 to +105.0%
Output limit(low-limit): -5.0 to +105.0%
However, [High-limit of output limit] > [Low-limit of output limit]

Output change rate limit:0.0 to 100.0%/sec.
("0.0" setting:Output change rate limit OFF)

* For enchanced auto-tuning function, see Additional function "F. Auto-tuning function"(Page 47)

(c) Position proportioning action : See Additional function "G. Position proportioning control"(Page 47)

(2) Control cycle : 0.1sec.

(3) Operation(control) execution/stop function : Provided as standard

(4) Direct/reverse action : Changeable by setting

(5) Balanceless/bumpless function :
Bi-directionally Balanceless/bumpless during auto/manual transfer

5. Control output

(1) Continuous current output : 0 to 20mA DC, 4 to 20mA DC
(a) Allowable load resistance: 600Ω or less
(b) Output impedance: 5MΩ or more

(2) Continuous voltage output : 0 to 10mV DC, 0 to 100mV DC
(a) Allowable load resistance: 20kΩ or more
(b) Output impedance: 10Ω

0 to 1V DC, 0 to 5V DC, 0 to 10V DC, 1 to 5V DC
(a) Allowable load resistance: 1kΩ or more
(b) Output impedance: 0.1Ω or less

(3) Voltage pulse output : 0/20V DC
(a) Allowable load resistance: 800Ω or more
(b) Cycle: 1 to 100sec. variable

(4) Relay contact output : 250V AC, 3A(Resistive load)
(a) Electrical life : 300,000 time or more(Rated load)
(b) Cycle : 1 to 100sec. variable
(c) Contact: 1a contact

(5) Trigger output for triac driving :
(a) Trigger type: Zero-cross method
(b) Execution ON current:50mA(At=50℃), 100mA(At=25℃)

6. Action at input abnormality

(1) Setting :
(a) Input abnormality determination point(High-limit, Low-limit):Same as input range
(b) Differential gap:0.1% of span(Fixed)
(c) Outputs manual output value at abnormality:-5.0 to +105.0%
(d) Action selection at input abnormality:
Selects whether manual output value at abnormal is output or value as a result of control computation is output.

(2) Display : Measured-value (PV) flashes if the measured-value (PV) is above or below the high/low limits of input abnormality determination point.

7. Self-diagnostic function

(1) Check item :	(a) ROM·RAM check (b) Input value check (c) CPU power monitoring (d) Watchdog timer
(2) Display in trouble :	Only the FAIL lamp lights up (Error message display at back up and input value checking)
(3) Output in trouble :	All outputs: OFF FAIL output: Open Relay contact 250V AC, 0.1A(Resistive load) 1a contact

8. General specification

(1) Insulation resistance :	Between measuring and grounding terminals: 20MΩ or more at 500V DC Between power and grounding terminals: 20MΩ or more at 500V DC
(2) Dielectric resistance :	Between measuring and grounding terminals: 1 minute at 1000V AC Between power and grounding terminals: 1 minute at 1500V AC
(3) Power supply voltage :	90 to 264V AC [Including power supply variation](Rated: 100 to 240V AC)
(4) Power comsumption :	264V AC: 16VA or less 200V AC: 14VA or less 100V AC: 10VA or less * The rush current during power-ON are as follows. 264V AC: 24A or less 200V AC: 19A or less 100V AC: 10A or less
(5) Power failure effect :	No influence even under power failure of less than 50msec. Power failure for less than 3 sec.: Hot start 1 Power failure for 3 sec. or more: Hot start 1, 2 and cold start (According to the mode specified by setting)
(6) Warm-up time :	60 minutes
(7) Memory back up :	RAM back up by lithium cells About 10 years (However, varies with product storage period, storage environment and operating environment.)
(8) Weight :	Approx. 800g
(9) Accessories :	Mounting brackets, 2pcs. (1 set) Engineering unit seal

9. Working environment conditions (Normal operating conditions)

(1) Ambient temperature :	0 to 50℃(32 to 122℉)
(2) Ambient humidity :	20 to 80%RH

(3) Operating environment : There should be neither corrosive gases nor much dust

(4) Power supply voltage : ±10% of rating

(5) Power supply frequency : ±5% of rating

(6) Magnetic field : 400AT/m or less

(7) Warm-up time : 60 minutes or more

10. Transportation and storage conditions

(1) Temperature : -20 to +50℃ (-4 to +122℉)

(2) Humidity : 95%RH or less (non-condensing)

(3) Vibration : 5m/sec²

(4) Mechanical shock : 100m/sec²

* Prior to operating the instrument stored for more than 6 months, its re-calibration and operation check are required

[ADDITIONAL FUNCTION]

A. Alarm function

(1) No. of alarm points : 3 points

(2) Alarm types : High limit process alarm, Low-limit process alarm, High-limit deviation alarm, Low-limit deviation alarm, Deviation high/low-limit alarm, Band alarm (Changeable by setting)

(3) Setting range :
- (a) Process alarm : Same as input range
- (b) Deviation alarm : -span to +span
- (c) Band alarm : 0 to +span
- (d) Deviation high/low alarm : 0 to +span

(4) Differential gap : 0.00 to 10.00% of span

(5) Hold action functions : Changeable by setting

(6) Energized/de-energized alarm : The presence or absence of this function can be selected.

(7) Output : Relay contact output
- (a) Rated: 250V AC, 0.5A (Resistive load)
- (b) Electrical life: 50,000 time or more(Rated load)
- (c) Contact: 1a contact

(8) Alarm action at input abnormality :
- (a) No alarm action
- (b) Alarm ON when measured-value (PV) is out of high or low limit of input abnormality determination point.
- (c) Alarm ON when measured-value (PV) exceeds high limit of input abnormality determination point.
- (d) Alarm ON when measured-value (PV) falls below low limit of input abnormality determination point.

* Changeable by setting

B. Remote setting (RS) function

(1) Setting signal :
- (a) DC (Low) voltage: 0 to 10mV DC, 0 to 100mV DC, 0 to 1V DC, 0 to 5V DC, 1 to 5V DC (Specify any of the above) Input impedance: 1MΩ
- (b) DC (High) voltage : 0 to 10V DC, 0 to 5V DC, 1 to 5V DC Input impedance: 1MΩ
- (c) DC current : 0 to 20mA DC, 4 to 20mA DC (Specify any of the above) Input impedance: Approx. 250Ω

(2) RS sampling cycle : 0.2sec.

(3) RS bias : ±50.00% of span

(4) RS ratio : 0.001 to 10.000 variable

(5) RS digital filter : The first order lag filter: 0 to 100sec. ("0" setting:RS digital filter OFF)

(6) Allowable input voltage :
- (a) DC (low) voltage: Within ±7V
- (b) DC (high) voltage: Within ±12V

(7) Action at remote setting (RS) input break : Downscale(Indicates value near 0.)

C. Analog output function

(1) No. of output points : 2 points (1 point: Control output specified current output and continuous voltage output.)

(2) Output type : Measured-value (PV), Deviation value (DEV), Set-value (SV), Remote set-value (RS), Manipulated output (MV), Feedback resistance value (POS)

*Changeable by setting.

*Feedback resistance value, effective only for the position proportioning PID action type.

(3) Setting signal : DC voltage input: 0 to 10mV DC, 0 to 100mV DC, 0 to 1V DC, 0 to 5V DC, 1 to 5V DC, 0 to 10V DC

DC current input: 0 to 20mA DC, 4 to 20mA DC

[Output impedance/allowable load resistance]

Output signal	Output impedance	Allowable load resistance
0 to 10mV DC 0 to 100mV DC	Approx. 10Ω	Approx. 20kΩ or more
0 to 1 V DC 0 to 5 V DC 0 to 10 V DC 0 to 5 V DC	0.1Ω or less	1kΩ or more
0 to 20mA DC 4 to 20mA DC	5MΩ or more	600Ω or less

(4) Analog output range :
(a) Measured-value (PV): Same as input range
(b) Deviation of measured-value (PV) from set-value (SV): -span to +span
(c) Set-value (SV): Same input range
(d) Remote set-value (RS): Same input range
(e) Manipulated output: 0.0 to 100.0%(Fixed)
(f) Feedback resistance input value (POS): 0.0 to 100.0%(Fixed)

(5) Output resolution : 11 bit or more

(6) Output accuracy : 0.1% of span

D. Contact input function

(1) No. of input points :
(a) Memory area selection: 3 points
(b) Operation mode selection: 1 point
① AUTO/MAN transfer, MAN when opened *
② LOC/REM transfer, LOC when opened *
③ LOC/COMP transfer, LOC when opened *
* Specify any of the above.
(c) Operation mode selection: 4 points
① AUTO/MAN transfer, MAN when opened *
② LOC/REM transfer, LOC when opened *
③ LOC/COMP transfer, LOC when opened *
④ Operation execution(RUN)/STOP transfer, STOP when opened *
* Specify any one of (a), (a)+(b) and (c)

(2) Input type : Dry contact input
(a) 500kΩ or more: Open
(b) 10Ω or less : Close

E. Communication function

(1) Interface : ① EIA standard Based on RS-422A
② EIA standard Based on RS-232C

(2) Connection method : ① 4-wire system, half-duplex multi-drop connection *1
② 2-wire system, half-duplex multi-drop connection *1
③ 2-wire system, half-duplex point to point connection *2
*1 Specification conforming to RS-422A
*2 Specification conforming to RS-232C

(3) Communication distance : ① RS-422A: 1km(Max)
② RS-232C: 15m(Max)
*However, communication distance varies slightly with the surroundings such as cables, etc.

(4) Synchronous method : Start/stop synchronous type

(5) Communication speed : 1200bps, 2400bps, 4800bps, 9600bps

(6) Data format : ① Start bit: 1
② Data bit: 7 or 8
③ Parity bit : None or 1(Odd number or Even number)
④ Stop bit: 1 or 2

(7) Transmission control procedure : ANSI X3.28 subcategory 2.5, A4
Polling/selection type

(8) Error control : ① Vertical parity (With parity bit selected)
② Horizontal parity

(9) Block length : Within 16 bytes

(10) Maximum connection ① RS-422A: 16 sets
② RS-232C: 1 set

(11) Communication code : JIS/ASCII 7-bit code

(12) Details of terminals : ① RS-422A(4-wire system)

Terminal NO.	Signal name	Signal direction REX-G9⟷HOST	Remarks
20	SG	———	Signal ground
21	T／R(A)	———→	Send data
22	T／R(B)	———→	Send data
23	R(A)	←———	Receive data
24	R(B)	←———	Receive data

② RS-422A(2-wire system)

Terminal NO.	Signal name	Signal direction REX-G9←→HOST	Remarks
20	SG	———	Signal ground
21	T/R(A)	←——→	Send data/Receive data
22	T/R(B)	←——→	Send data/Receive data

③ RS-232C

Terminal NO.	Signal name	Signal direction REX-G9←→HOST	Remarks
20	SG	———	Signal ground
21	T/R(A)	——→	Send data
22	T/R(B)	←——	Receive data

(13) Signal logic : ① RS-422A

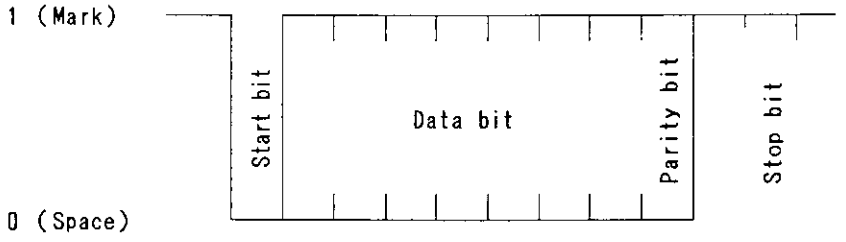
Signal voltage	Logic
V(A) > V(B)	0 (Space status)
V(A) < V(B)	1 (Mark status)

V(A) : Voltage of T(A) or R(A)
V(B) : Voltage of T(B) or R(B)

② RS-232C

Signal voltage	Logic
+3A or more	0 (Space status)
−3A or less	1 (Mark status)

(14) Bit configuration : [Example] For Data bit : 7 , Parity bit : 1 , Stop bit : 2



F. Auto-tuning function

(1) Display: Transmission type surface light emitting diode (LED) display(Green)

(2) AT cycle: 2 or 3 cycle

(3) Requirement for auto-tuning (AT) start:

(a) In the MODE status

- AUTO/MAN transfer → Auto mode
- LOC/REM transfer → Local mode
- PID/Auto-tuning → PID control
- Operation execution (RUN)/Stop(STOP) transfer →execution(RUN)

(b) Input value should not be abnormal
(According to the input abnormality determination point)

(4) Requirements for auto-tuning (AT) suspension:

(a) When set-value(SV) is changed

(b) When the control area is changed

(c) When high or low output limit value is changed

(d) When PV bias and/or PV digital filter are changed

(e) When AT bias is changed

(f) When AT cycle number is changed

(g) When the instrument is transferred to the manual mode by "AUTO/MAN transfer"

(h) When the instrument is transferred to the remote mode "LOC/REM transfer"

(i) When the instrument is transferred to PID control by "PID/AT transfer"

(j) When the operation is stopped by "operation execution (RUN)/STOP transfer"

(k) When the input value becomes abnormal.
(According to the input abnormality determination point)

(l) When power failure occurs

(m) When the instrument is in the FAIL status

(5) AT bias: -span to +span

G. Position proportioning control

(1) Setting:

(a) Neutral zone: 0.1 to 10.0% of output

(b) Differential gap: 0.1 to 5.0% of output

(c) Action at feedback resistance (FBR) input break:

① Open-side output OFF, close-side output OFF

② Open-side output ON, close-side output OFF

③ Open-side output OFF, close-side output ON

* Changeable by setting

(2) Feedback resistance input: 135Ω standard (Can be specified from 100Ω to 10kΩ)

(3) Output :

(a) Type: Relay contact output
(b) Rated: 250V AC, 3A(Resistive load)
(c) Electrical life: 300,000 time or more (Rated load)
(d) Open side: 1a contact
(e) Close side: 1a contact

(4) Motor revolution : Conforming to 20 to 240sec.

The REX-G9/A Model identification code is printed on a nameplate inside the instrument.

Model	Description	Suffix code
REX-G9		□ □ □-□*□ □ □-□ □-□/A
Control action	ON/OFF action PID action PID action with Auto-tuning Position proportioning PID action	A H F Y
Alarm function	Without alarm function With alarm function	 N T
Type of input	Thermocouple input RTD input DC voltage (Low) input DC voltage (High) input (0 to 10V DC) DC current input	 C R V E I
Type of control output	Relay contact output Voltage pulse output Trigger output for triac driving Continuous voltage output Current output	 M V G E R
Analog input (Remote input)	Without analog input function DC voltage (Low) input DC voltage (High) input (0 to 10V DC) DC current input	 N V E I
Contact input 1	Without memory area/operation mode transfer Memory area transfer Operation mode transfer	 N 1 M
Contact input 2	Without operation mode transfer AUTO/MAN transfer LOC/REM transfer LOC/COMP transfer RUN/STOP transfer	 N A R C S
Analog output 1	Without analog output function Signal level selection (See the signal code table)	 N □
Analog output 2	Without analog output function Signal level selection (See the signal code table)	 N □
Communication function	Without communication function RS-232C RS-422A (2-wire system) RS-422A (4-wire system)	 N 1 2 4

<Signal code table>

1 : 0 to 10 mV DC
2 : 0 to 100mV DC
3 : 0 to 1 V DC
4 : 0 to 5 V DC
5 : 0 to 10V DC
6 : 1 to 5 V DC
7 : 0 to 20mA DC
8 : 4 to 20mA DC
9 : Others

13. INDEX

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IM9G09−E2

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