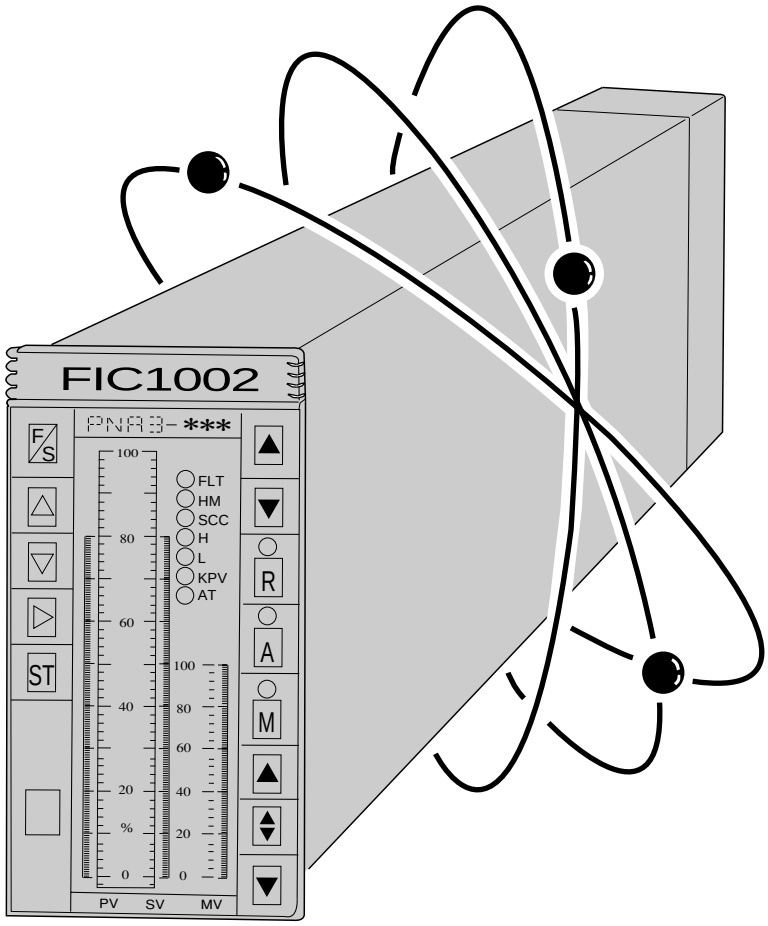
FUJI ELECTRIC

Instruction Manual

FC SERIES
COMPACT CONTROLLER S
(CONTINUOUS OUTPUT TYPE)

TYPE: PNA3

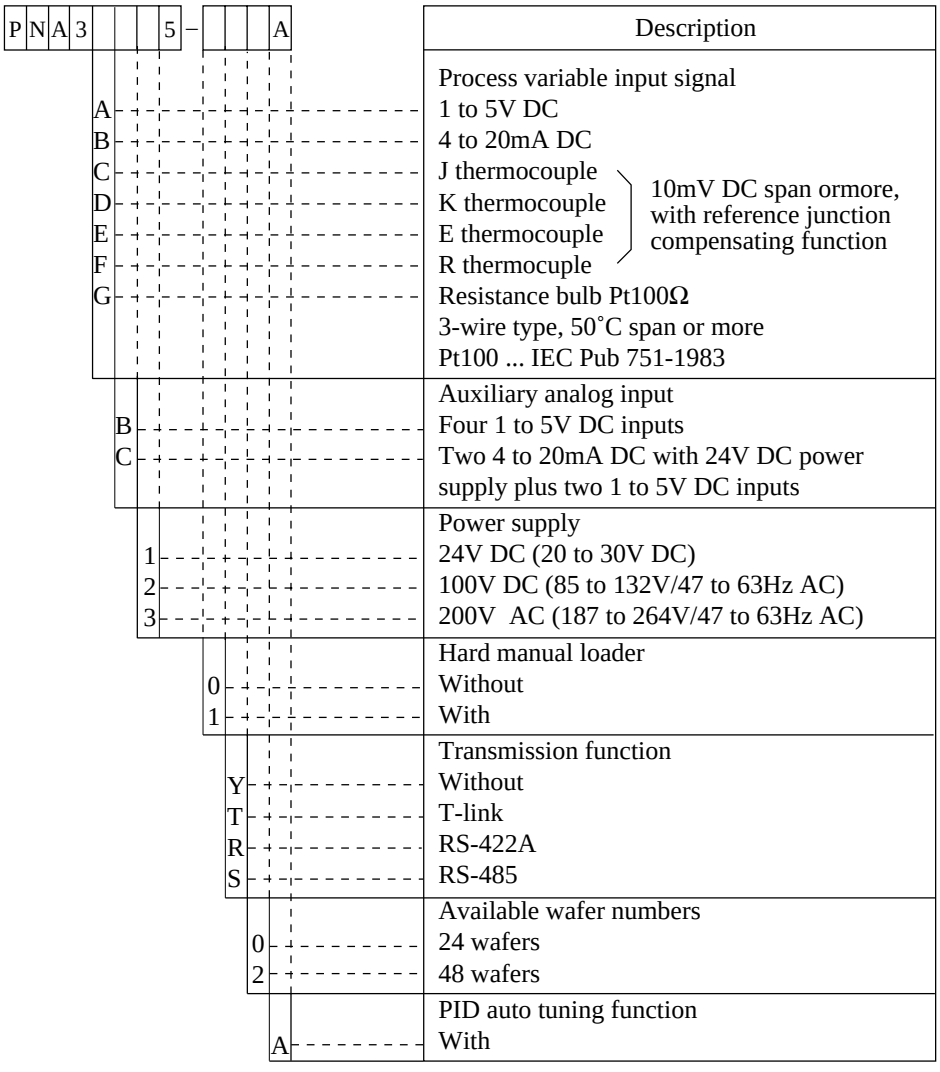


Preface

We thank you for purchasing our Compact Controller S (CC-S).

This manual explains the installation, wiring, operation and maintenance of the Compact Controller S, so please read through it before using the controller.

Code Symbols



Note

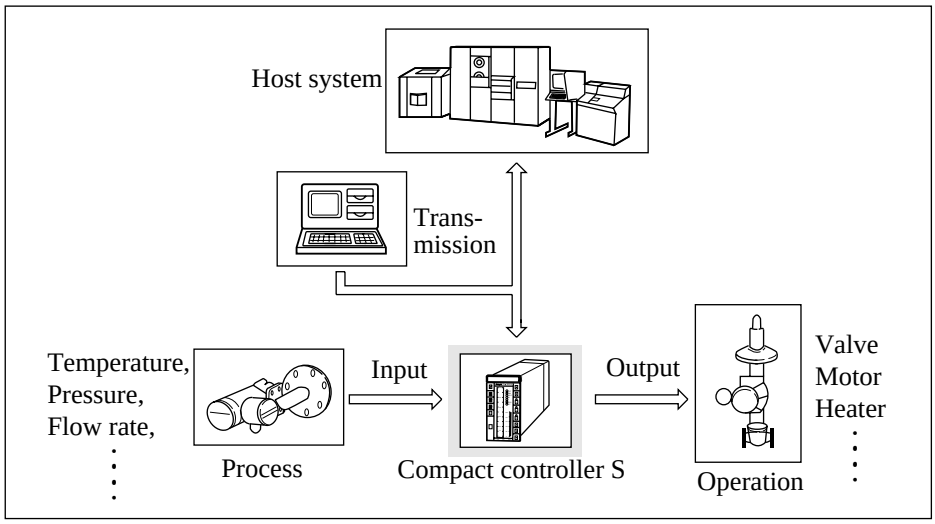
- Reproduction of any part of this manual without Fuji's authorization is forbidden.
- The contents of this manual are subject to change without prior notice.

Issued in May, 1995

Contents

Features of Compact Controller S

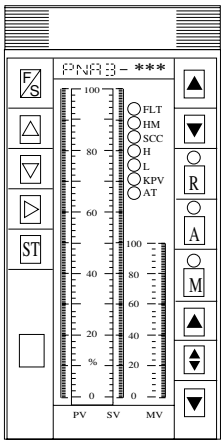
The Compact Controller S is a compact single-loop controller using a microprocessor.
This controller is equipped with abundant control and computation functions to allow composing a flexible system with a high cost/performance. Transmission function capable of monitoring and control with host system is also available.



Check of delivered instrument

Upon receipt of the equipment, be sure to check.

- Be careful not to apply unreasonable force to the interior when unpacking the instrument.
- Take the instrument out of the package and check for any cracks or other damage on the front panel and case.

List of delivered items			
	Main unit 1 set	Open Close	Opening direction nameplate 2 sheets
			TAG plate 1sheet
			Scale pointer
			Blind sheet 2 sheets
		Instruction manual INP-TN5PNA3-E	1set

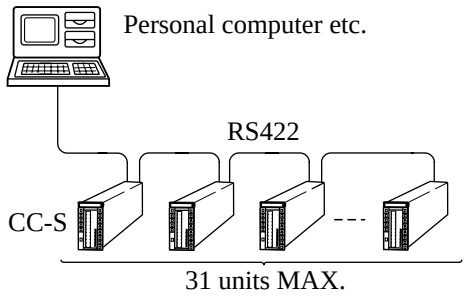
Transmission

This controller can perform data transmission with a host system via the T-link or RS422/485 interface.
The host system can set control parameters in the controller and read out control data from the controller, and besides, the host system can perform SV setting and MV operation when the controller is in SCC operation.
Before making transmission, set station No., transmission speed and code format. For setting, refer to the "System function setting codes".
As for the transmission protocol used with T-link or RS-422/485 interface, refer to

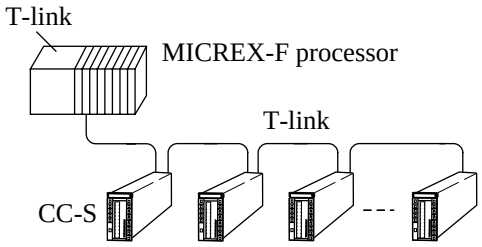
	T-link	RS-422/485
Transmission protocol manual INP-TN507785-E	—	○
T-link interface manual INP-TN508202-E	○	—
File specification manual INP-TN507874-E	○	○

■ **Transmission system configuration**

<RS-422/485 system>



<T-link system>



Relevant manual

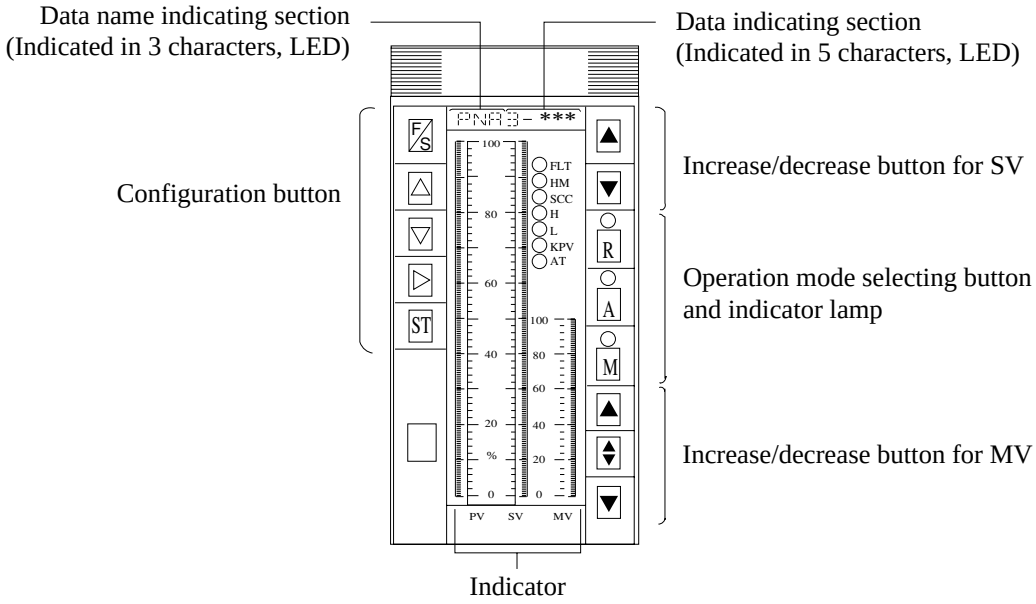
Relevant manual explaining the wiring method on wafer and the contents of wafer usable for Compact Controller S are available. Read this manual together with the instruction manual for Compact Controller S.

Manual name	Manual No.
Wafer instruction manual	INP-TN508296-E

1. NAME AND FUNCTION OF EACH PART

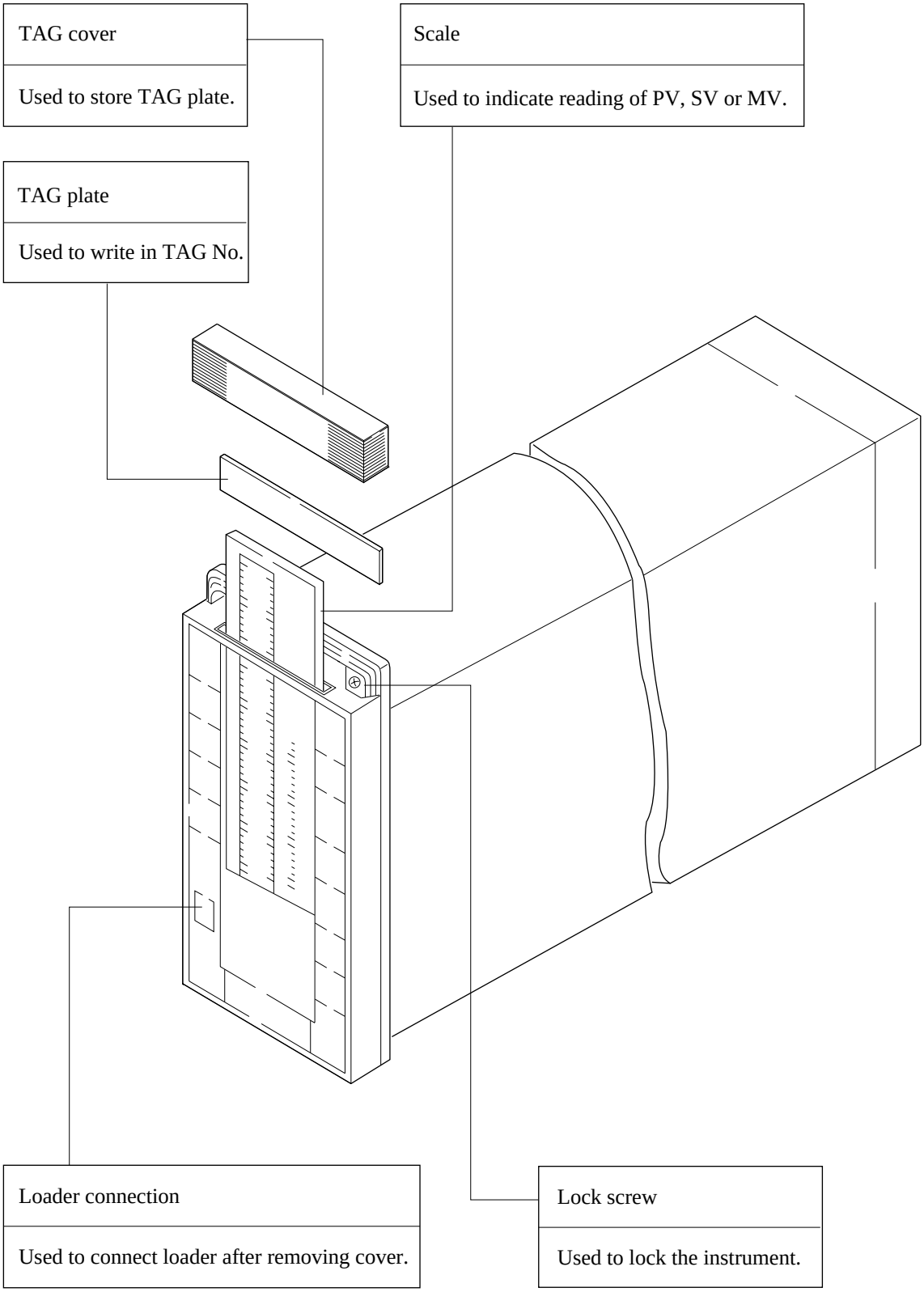
1.1 Front Panel

This controller is operated by means of the buttons on the front panel, and allows checking the operating status by means of the front panel indicator and data indicating LED's.
Section 2 explains the fundamental operating method for each part. Refer to the appendix at the end of the manual for the specifications and terminal board of the instrument.



Lamp	Name	Function
○ FLT	Fault indicator lamp	Lights up when the instrument incurs a fault.
○ HM	Hard manual operation mode indicator lamp	Lights up in hard manual operation mode.
○ SCC	SCC enable indicator lamp	Lights up when SV setting or MV operation is possible via transmission.
○ H	High alarm indicator lamp	Lights up when KPV (compensated measurement value) exceeds the high limit of alarm setting.
○ L	Low alarm indicator lamp	Lights up when KPV (compensated measurement value) is below the low limit of alarm setting.
○ KPV	KPV indicator lamp	Lights up at the setting of KPV (compensated measurement value). (It does not light when KPV is indicated on meters other than PV indicator, after selecting the bar graph display mode (X24-X26).)
○ AT	Auto tuning indicator lamp	Flickers during auto turning.

1.2 Names of other parts



2. INSTALLATION AND WIRING

2.1 Installation

2.1.1 Installation place

This controller is designed to be installed in an indoor panel. Since the condition of the installation place will affect the controller life and also the ease of inspection and maintenance, select a place that meets the following conditions.

(1) There is little vibration or shock.

(2) The ambient temperature doesn't exceed a range of 0 to 50°C, there is little change in the temperature, and the place is not exposed to a heated object or direct sunlight. A good operation result will be obtained when the ambient temperature is kept near room temperature (20 to 25°C).

(3) Relative humidity is below 90% and there is no condensation.

(4) There is no dust and/or corrosive gas.

(5) Avoid installation near an equipment that produces a large current or sparks, or near a relay panel, so as to prevent electrical inductive disturbance.

(6) There is good ventilation to disperse the heat radiated from the instrument.

(7) There is sufficient space for wiring, inspection and maintenance.

2.1.2 Temperature inside panel

The temperature around the instrument (within 15cm of the instrument) inside the panel should not exceed 50°C.

The panel should thus be manufactured in consideration of the following points.

(1) Avoid installing an equipment which produces much heat near the controller.

(2) Arrange other equipment so that the ventilation around the instrument will not be hindered.

(3) If it is probable that the temperature around the controller with exceed 50°C, then install a fan for taking outside air into the panel forcedly.

2.1.3 Installation method

(1) Cut out a hole in the panel according to Panel cutout in item 2.2 "outline diagram". Since a considerable force will be applied to the panel by installing several instruments side by side in the panel, the instruments should be supported from underneath if necessary. The position for the supporting bracket is shown in Fig. 2-1.

(2) Remove the mounting bracket from the case, insert the instrument into the panel cutout from the panel front, insert the mounting bracket from the panel rear, and fasten to the panel with the mounting screws (Fig. 2-2)

Note: The instrument and panel cutout size conform to IEC standard.

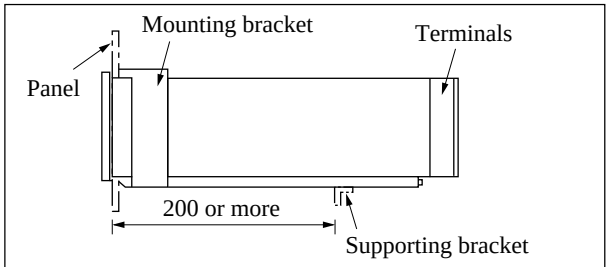


Fig. 2-1

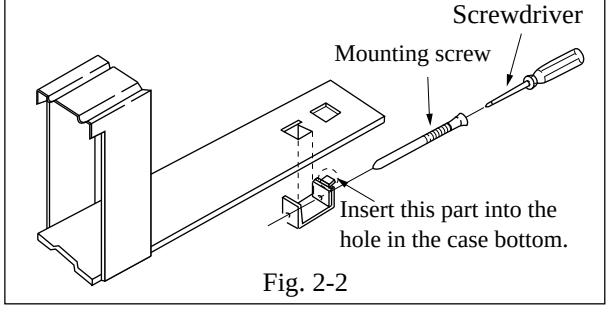


Fig. 2-2

2.2 Outline diagram

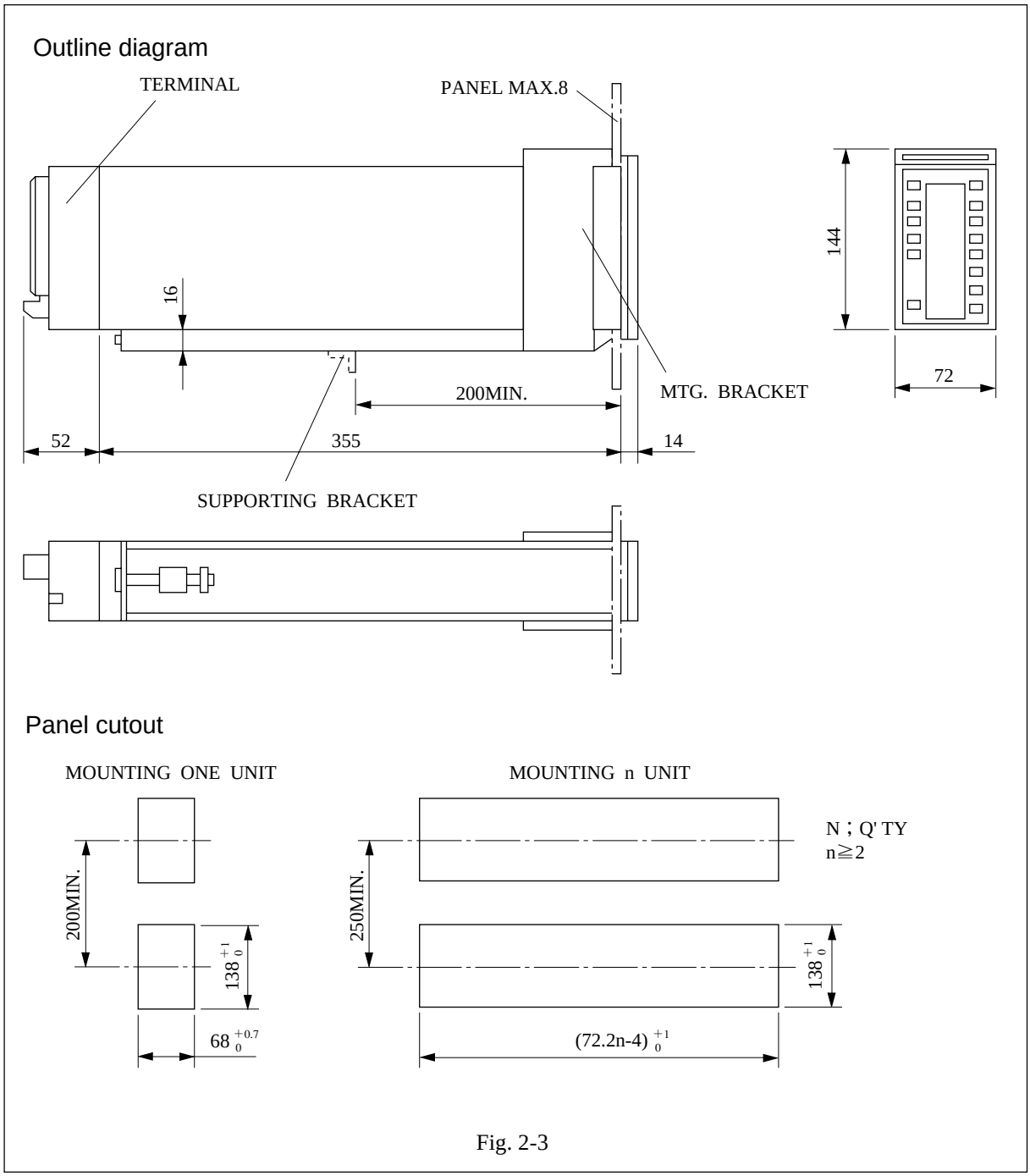
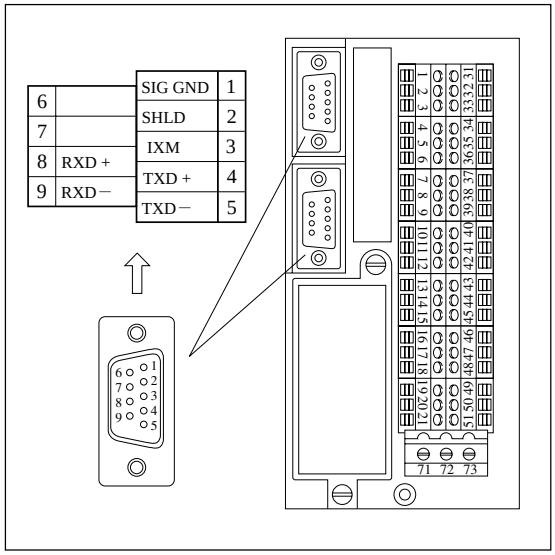


Fig. 2-3

2.3 Wiring

Before starting the wiring work, be sure to check the terminal symbols on the power terminal block and read the instructions for your confirmation.



Note

The illustration above shows the layout of the power terminal block. When DC power terminal block is used, the following should be observed.

- Terminal No. 21: PCO → PC
- Terminal No. 51: VPO → VP

Do not make wiring to terminals without terminal symbols.

2.3.1 Wiring to screw terminals

(1) Use 600V vinyl-insulated wire IV (JIS C 3307) or control-use vinyl-insulated cable CVV (JIS C 3401) for wiring to the screw terminals.

(2) If there is a possibility of inductive disturbance, use shielded wires and connect the shielded line to G terminal.

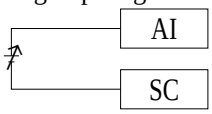
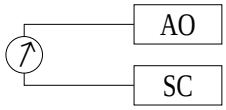
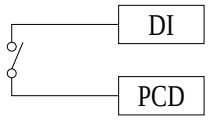
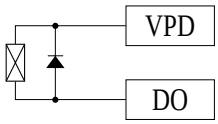
Shielded wires should be used for the following terminals.

- Analog input ..... AI1 AI2 AI3 PV CAS
- Analog output ..... A01 KPV SV MI + MI – MV
- Signal reference line ..... SC
- Signal supply wires ..... VP PC

2.3.2 Meanings of transmission connector and block terminal symbols

Terminal symbol	Terminal No.	Meaning	Remarks
TXD+(T1) TXD–(T2)	4 5	Data transmission signal terminals	———
RXD+ RXD–	8 9	Data reception signal terminals	This signal can't be used in case of T-link.
INH	3	Data reception inhibit signal	This signal can't be used in case of RS-422, T-link.
SIG GND	1	Signal reference line	This signal can't be used in case of T-link.
SHLD (SD)	2	Cable shield	Connected with SIG GND inside the instrument.

Two transmission connectors are connected in parallel inside the instrument (terminal unit).

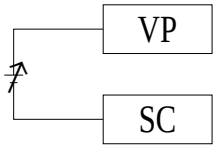
Terminal symbol	Terminal No.	Meaning	Remarks
I+(PV) Io I-(SC)	31 32 33	Process variable signal	Refer to (1) on page 2-7
CAS	1	External set point	Uniform voltage input signal 1 to 5 V DC 
AI1	2	Aux. analog input signal 1	
AI2	3	Aux. analog input signal 2	
AI3	4	Aux. analog input signal 3	
KPV	34	Compensated PV signal	Uniform voltage output signal 1 to 5 V DC 
SV	35	Set point transmit signal	
A01	36	Aux. analog output signal	
MV	5	Manipulated signal (voltage converted value of manipulated output)	
S01	9	Current/voltage conversion output signal 1	1 to 5V DC output signal
IR1	10	Transmitter signal input terminal 1	4 to 20mA DC input signal
I01	11	Transmitter output power supply 1	24V DC output power supply
S02	39	Current/voltage conversion output signal 2	1 to 5V DC output signal
IRL	40	Transmitter signal input terminal 2	4 to 20mA DC input signal
I02	41	Transmitter output power supply 2	24V DC output power supply
MI+ MI-	12 13	Manipulated output (current)	Refer to (2) on page 2-7
SMV	42	Manual mode control	Digital input signal 
DI1	43	Aux. digital output signal 1	
DI2	44	Aux. digital output signal 2	
DI3	45	Aux. digital output signal 3	
PI+	14	Increase-direction pulse setting input	
PI-	15	Decrease-direction pulse setting input	
FLT	18	Fault status output	Digital output signal 
H	16	High alarm output	
L	17	Low alarm output	
M	48	Manual control status output	
DO1	47	Aux. digital output 1	
DO2	46	Aux. digital output 2	
SC *1)	7, 8 37, 38	Common bus of voltage input/output signal	There are 4 SC terminals. They are shorted inside the instrument.
VP *2)	51	+ side of instrument power supply (during operation on DC power)	Refer to (3) ① on page 2-7.
PC *1) *2)	21	- side of instrument power supply (during operation on DC power)	
VPD	49, 50	+ side of digital input/output power supply	Refer to (3) ② on page 2-7.
PCD	19, 20	- side of digital input/output power supply	
G	71	Grounding terminal	Used to ground the instrument case.
AC *2)	72, 73	Instrument power supply (during operation on AC power)	Refer to (3) ③ on page 2-7
VPO PCO	51 21	Aux. digital I/O power supply (during operation on AC power)	When the instrument power supply is AC, supply the power to 24V±2V DC (0.1A max.) from the instrument.

*1) SC and PC are connected via a resistance (2.2 kΩ) inside the instrument. The connection is opened by removing the main unit.

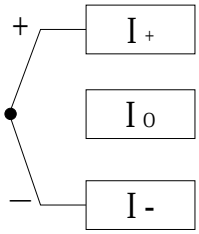
*2) Only one instrument power supply among 24V DC (20 to 30V DC), 110V AC (85 to 132V AC) and 220 V AC (187 to 264V AC) is usable (according to code specification).

(1) Wiring of Thermocouple, resistance bulb input, or Uniform voltage input signal.

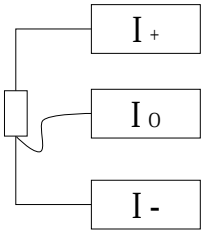
① Uniform voltage input signal



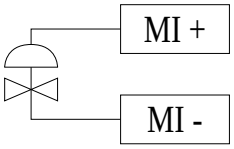
② Thermocouple input



③ Resistance bulb input

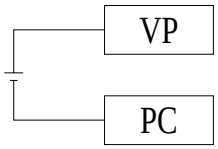


(2) Uniform voltage output signal (DC4 to 20mA)

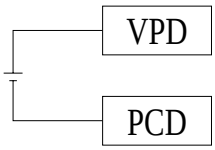


(3) Instrument power supply

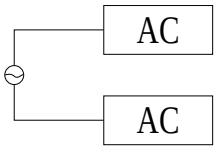
① Instrument power supply (DC 24V)



② Digital input/output power supply (DC 24V)



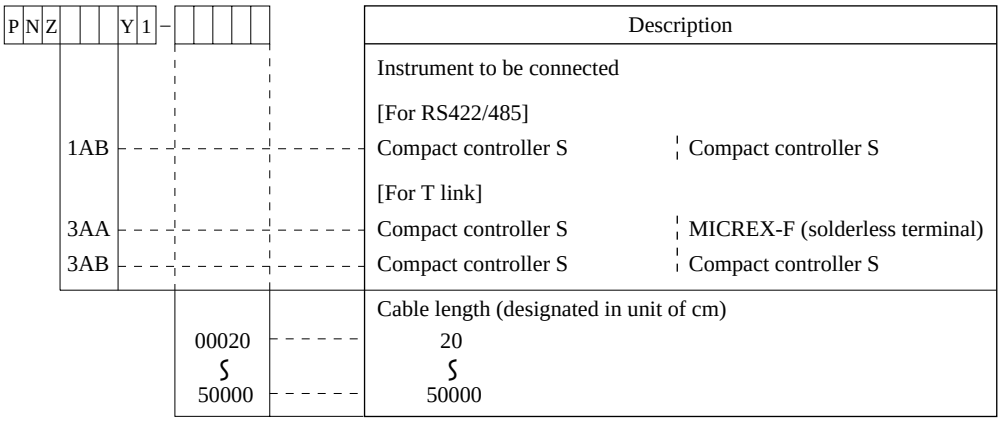
③ Instrument power supply (AC power)



2.3.3 Transmission connector cable

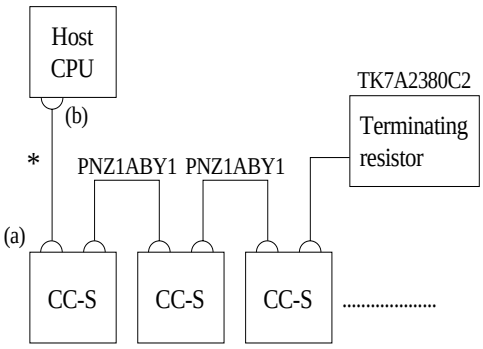
For wiring to the transmission connector, use a cable equipped with the following connector (This cable is not supplied with the instrument and should be supplied by the user).

(1) Code symbols

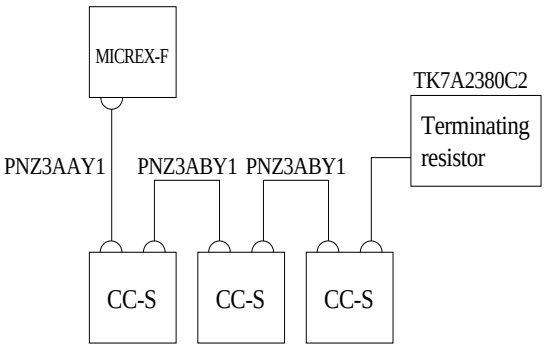


(2) Configuration example

① RS422/485



② T link



Note) The required cable length for mounting the controller is 20 cm.

* Recommended transmission connectors are listed below.
CC-S transmission connector is provided with Dsub 9-pin male connector
(Type: DE-9P-T-55, JAE)

Classification	Method	Item	Type	Maker
(a) CC-S female connector	Soldering	Rectangular clamp Shell Screw lock	DE-24657 DE-9S-UL D20419-16: Two required per unit	JAE
	Solderless fitting	Rectangular clamp Shell Press fit pin Screw lock	DE-24657 DEU-9S-F0 030-50643: Nine or more required per unit D20419-16: Two required per unit	
(b) Host CPU side	To be estimated and arranged according to the type of host CPU connector.			

(3) Terminating resistor unit

Attach a resistor unit to the instrument connector for terminating the compact controller.
The terminating resistor unit is not supplied with the instrument and should be furnished by the user.

Product	Device No.	
Compact controller S	TK7A2380C2	..... For RS422/485

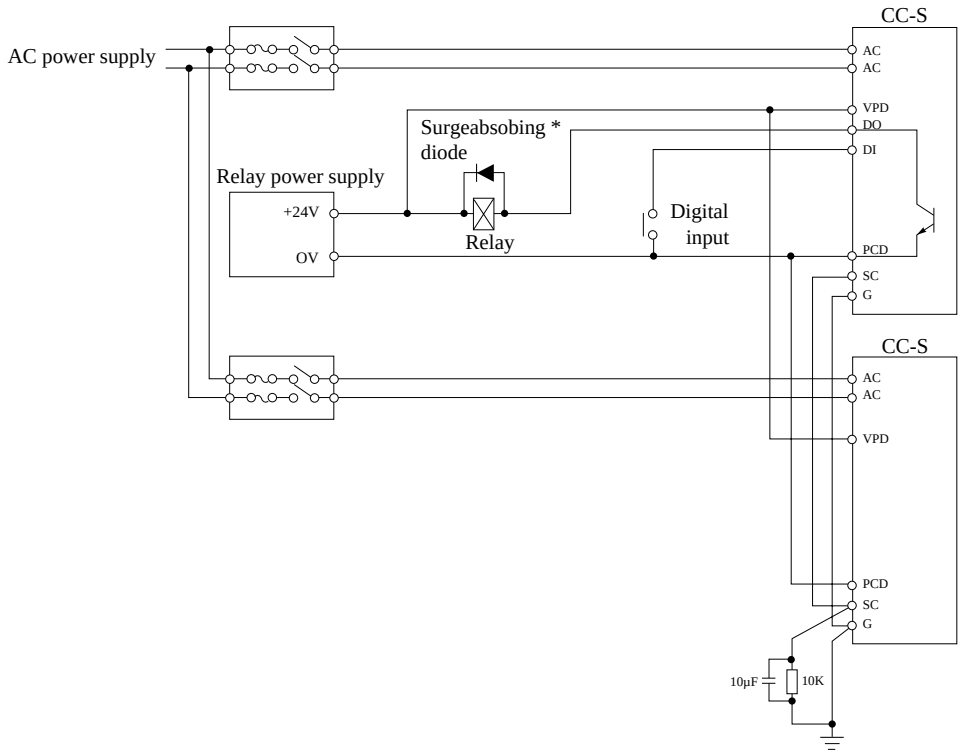
2.4 Wiring to instrument

2.4.1 Power supply connection

Neither a power switch nor fuse is incorporated in this instrument. So provide a switch and fuse externally if necessary.

(1) In case of instrument power supply of 100/200V AC

VPD	49	50			:	+24V side of 24V DC power supply for digital input/output signal
PCD	19	20			:	0V side of power supply for digital input/output signal
SC	7	8	37	38	:	Reference potential of analog signal
AC	72	73			:	Instrument power supply
VPO	51				:	Approx. 24V DC power output (output current: approx. 0.1A)
PCO	21					



*) Since there is a possibility of the instrument operating erroneously due to surge when a relay or the like is used, make sure to provide a surge absorber externally.

Connect the AC power supply to AC power terminal (terminal nos. 72, 73).

Note

An instrument of 110V AC specification will be damaged if 220V AC is input to it so be sure to check the power supply and instrument specifications before turning on power.

(2) In case of instrument power supply of 24V DC

VP	51				:	+24V side of instrument power supply 24V DC
PC	21				:	0V side of instrument power supply 24V DC
VPD	49	50			:	+24V side of power supply for digital input/output signal
PCD	19	20			:	0V side of power supply for digital input/output signal
SC	7	8	37	38	:	Reference potential of analog signal (1 to 5V DC)

The wiring resistance between VP , PC and the system power supply should be 1 ohm or less.

This corresponds to a 2 mm^2 cable length of about 100 m. But with a number of instrument in a cascade connection, it should be N units x wiring resistance < 1 ohm.

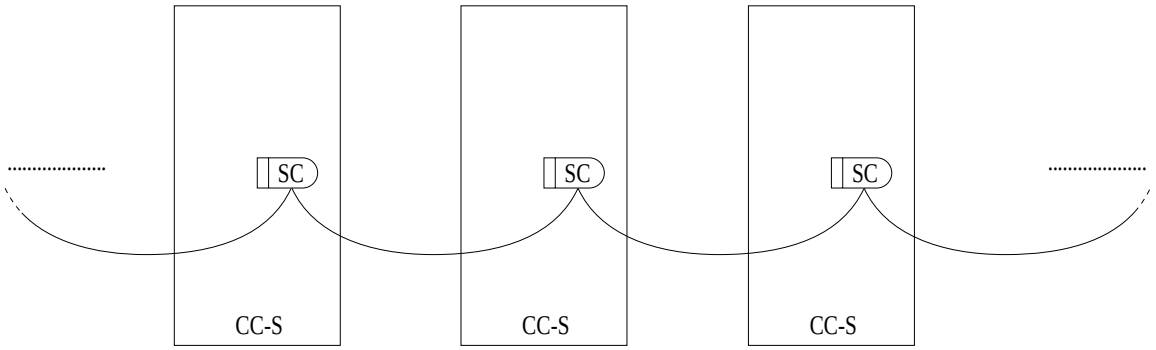
Instrument power and digital input/output power can be supplied separately to the instrument. So if a short-circuit occurs in the relay or the protective diode connected in a parallel with the relay, the instrument power supply will not be lost. But if this arrangement is unnecessary, normal operation will be obtained by connection VP - VPD and PC - PCD and omitting the digital input/output power supply. Since neither a power switch nor fuse is incorporated in this instrument, provide them externally if needed.

Connect 24V DC + side to VP terminal (51)and - side to PC terminal (21).

Note

A mistake in polarity of DC power will cause instrument damage, so be sure to check the polarity.

It is unnecessary to wire the SC lines (signal common bus) independently from each instrument, and transition wiring can be used for this. It is recommended to put this wiring in a loop form from the viewpoint of safety.



2.4.2 Grounding

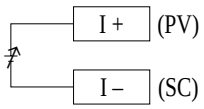
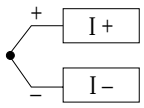
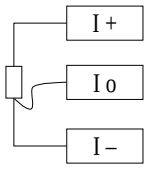
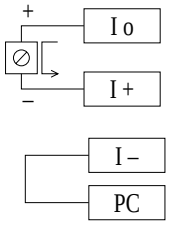
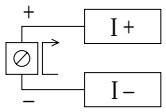
(1) Ground to the G 71 terminal using wire of 2 mm^2 or larger and 3rd class or better grounding structure (grounding resistance 100 ohms or less).

(2) Make a C.R (10 µF.10 kΩ) grounding to either one of the SC terminals [see → Item 2.4.1 (1).]

2.4.3 Wiring of analog input signal

(1) Wiring to PV input signal

Any one of 1 to 5V DC, 4 to 20 mA DC, thermocouple and resistance bulb inputs is selectable for the inputs. Direct input unit (option) is also necessary at input except for 1 to 5V DC.

1 to 5V DC input	Thermocouple	Resistance bulb	4 to 20mA DC input	
			Power supply to transmitter	Power supply is not required
				
I- terminal is shorted to SC terminal internally in the internal instrument.			Output voltage: 24V DC (+2V, -3V) current is limit to approx. 35mA at output short.	

(2) Wiring to aux. analog input/output signals

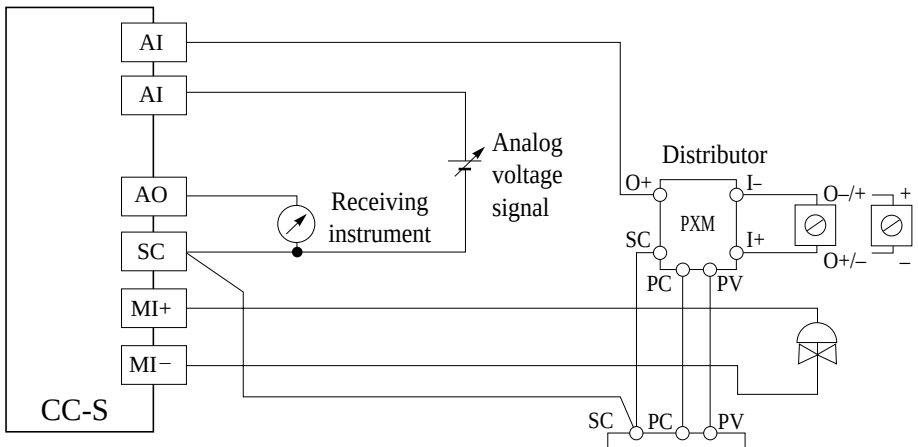
Connect analog signals as shown below.

SC is the reference potential of analog input/output signals (1 to 5V DC signals). Four SC terminals are connected inside the instrument.

The current output (manipulated variable) flows from MI+ to MI–. If the current loop is disconnected, this detected, and an alarm (fault signal) is generated.

Input rating: Input resistance: Higher than 1 M
Input resistance outside the range about 15 k (1 to 5V DC signals)

Output rating: Output resistance: Lower than 1 (1 to 5V DC signals)
Allowable load resistance: Lower than 600 (current output)

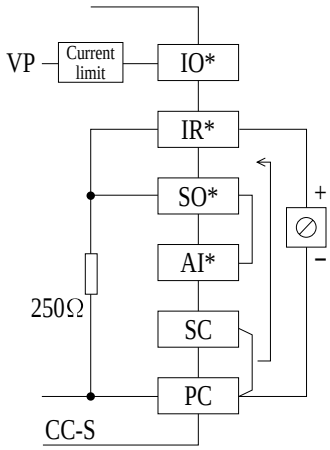


AI: Analog input
AO: Analog output

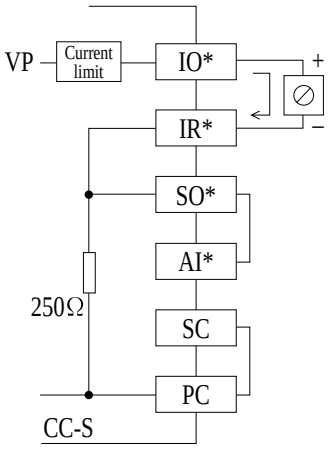
* PC is connected to SC inthe system power supply unit (PXJ).

(3) Wiring to auxiliary input signal (4 to 20mA DC)

6th digit of code symbol: "C"



Power supply for transmitter is not required



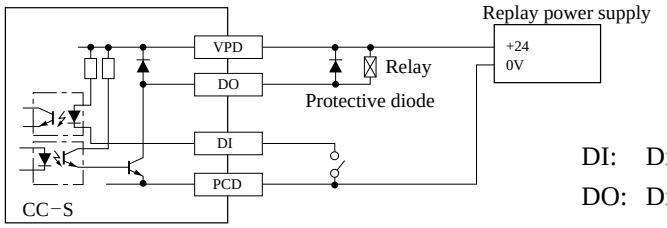
Power supply for transmitter is required

2.4.4 Wiring to digital input/output signals

Connect the contact input/output signals as illustrated below.
Make sure that the protective diode connected in parallel with the relay have the polarity shown below without fail before turning on the system power supply. Make sure that the protective diode has the polarity below, if the protective diode is built inside the relay. If this polarity is inverted, an overcurrent flows to break the output circuit.

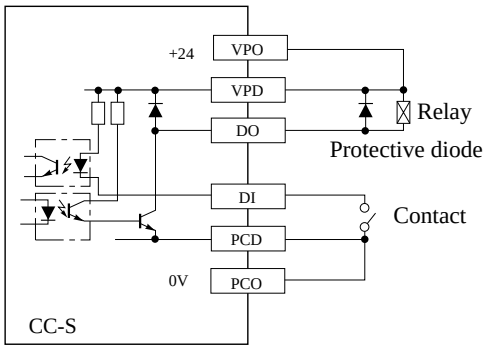
Input rating : Input current about 11 mA/24V DC

Output rating : 30V DC × 0.1A (maximum rating)



DI: Digital input
DO: Digital output

If the instrumentation power supply is AC, supply the power to digital I/O from the VPO, PCO terminals (Refer to below).

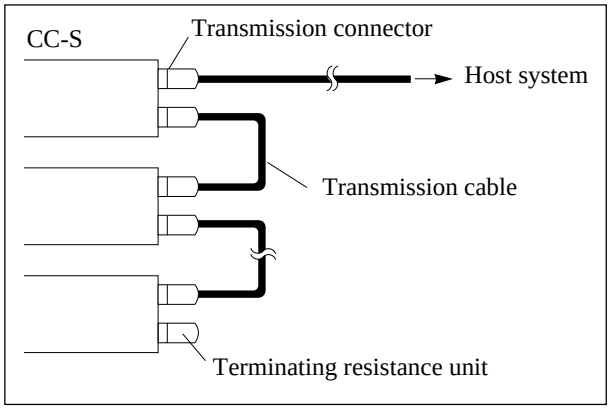


Note

Output rating at 24V±2V DC (0.1 A max.) corresponds to digital outputs, 2 points and digital inputs, 3 points. If the output current exceeds 0.1A, the instrumentation power supply becomes defective, therefore be sure to check the wiring used power supply for relay, if the load is large.

2.4.5 Wiring to transmission connector

Use connector-equipped cable for wiring to the transmission connector.
Sequential transition wiring is used between instruments as shown below. A terminating resistance unit is connected to a single transmission connector of the final instrument. After connection to the transmission connector, secure it with the two lock screws of the connector.



Note

. A cover is attached for protecting the connector. Make sure the cover is attached when the connector is not used.

. Two transmission connectors are connected in parallel inside the instrument (terminal unit)

2.4.6 Mounting method of direct input unit

Mounting procedure and gain setting of direct input unit is explained.
Input gain of the unit is initialized according to the designation of temperature range. To change temperature range, the resetting should be required.

(1) Mounting of direct input

Direct input unit are secured by screws on the main board of the instrument.
Mounting method is shown below.

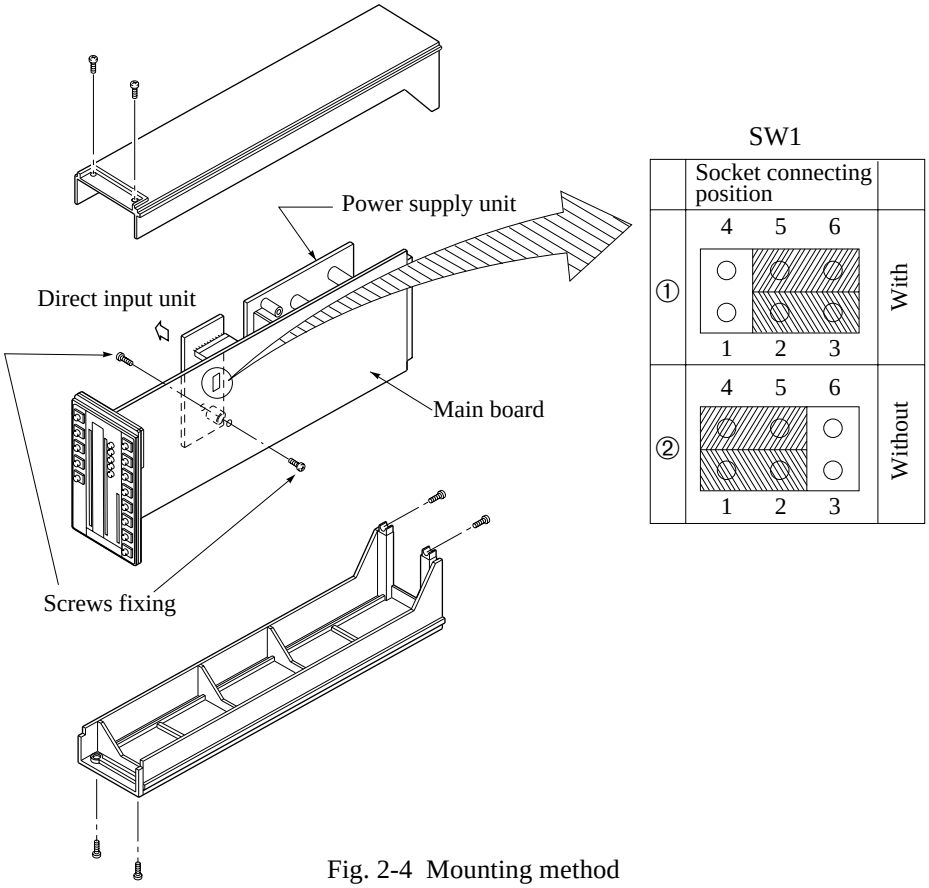


Fig. 2-4 Mounting method

(2) Gain setting

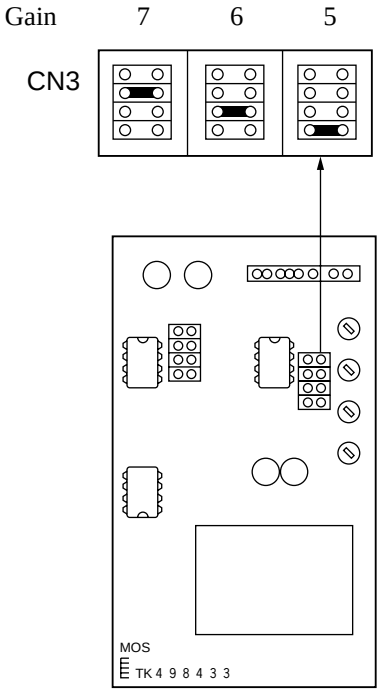
When connecting direct input unit, input gain setting should be required according to the temperature range. The gain setting should be carried by select pin on direct input unit and PV input designation (X17) of system configuration channel (CONF.CH) on direct input unit.

For details, refer to item 4.3.6 (13).

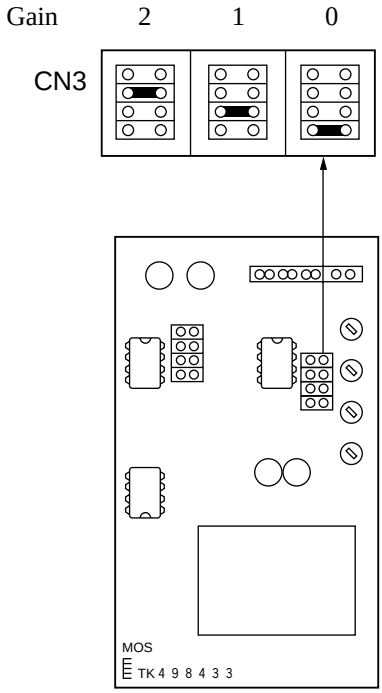
Input	Measurement range (°C)	Gain	(X17)
TC (J)	0-200, 0-300	7	72
	0-400, 0-500, 0-600, 200-400, 300-600	6	62
TC (K)	0-300, 0-400	7	73
	0-500, 0-600, 0-800, 300-600, 400-800	6	63
	0-1000, 0-1200, 500-1000, 600-1200	5	53
TC (E)	0-200	7	74
	0-300, 0-400, 200-400	6	64
	0-500, 0-600, 0-800, 300-600	5	54
TC (R)	0-1000, 0-1200, 0-1600, 400-1400, 600-1600, 800-1600	7	75
RTD	0-50, 0-100, -50-100	2	26
	0-150, 0-200	1	16
	0-300, 0-400, 0-500, 100-300, 200-400, -50-500	0	06

• Setting of direct input unit

a. Thermocouple input card



b. RTD input card



3. Fundamental Operation

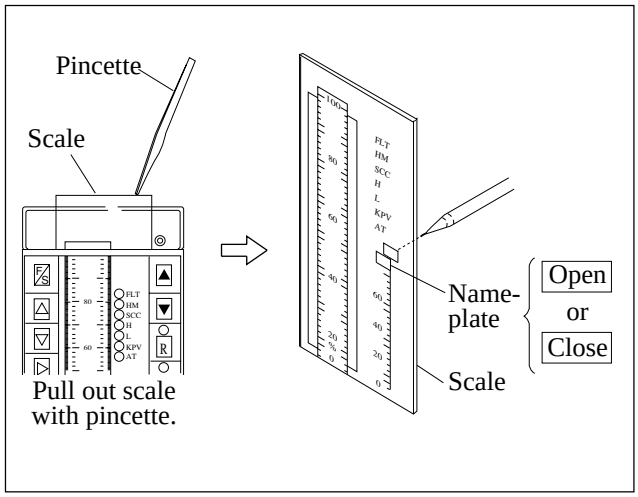
3.1 Preparation for operation

3.1.1 Attachment of opening indication nameplate

Attach the opening direction indicating nameplate if necessary above the manipulated output (MV) indicator (Open is indicated unless otherwise designated.)

Attach the Open nameplate for opening the valve at the 100% indication side of the MV indicator, or the Close nameplate for closing the valve at that side.

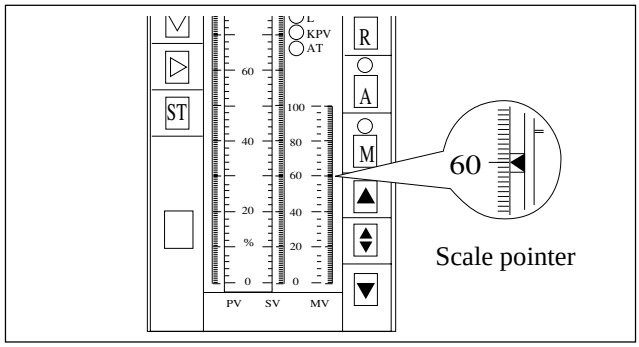
For changing from the Open to the Close nameplate, push with a sharp objet like a pencil from the rear of the Open nameplate and it will come off. Then just attach the furnished Close nameplate.



3.1.2 Attachment of scale pointer

For indicating the desired PV, SV and MV values for operation, it is convenient to attach the furnished scale pointer.

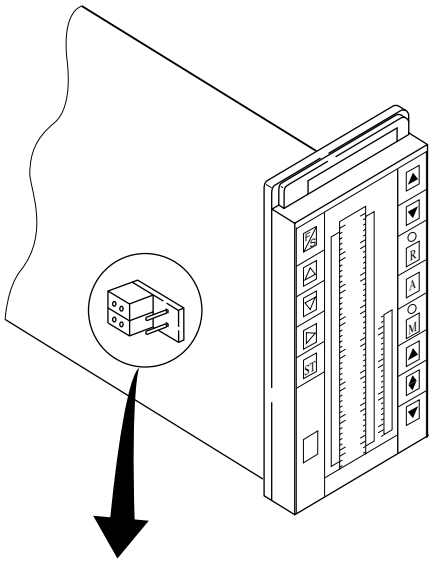
Peel off the necessary scale pointers and either attach them directly to the front panel or else pull out the scale and attach them directly to the scale as shown in the upper figure.

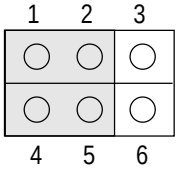
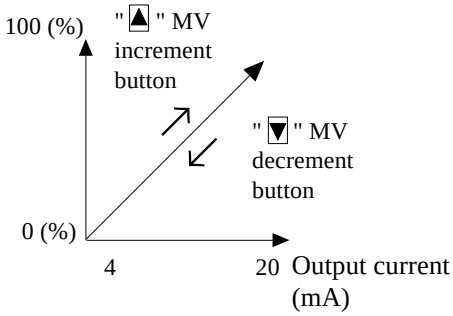
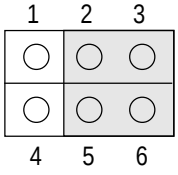
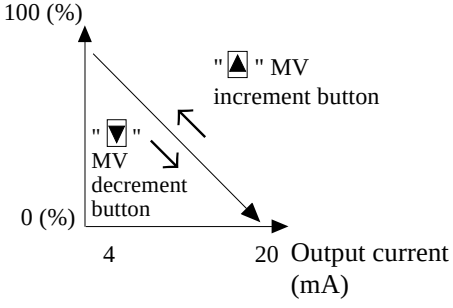


3.1.3 Setting of MV indicator polarity

When the main unit is pulled out, the MV indication switching connector is seen as shown below. By reversing the position of the socket plugged into the connector, the direction of the indication of the MV indicator can be changed.

Note) The switching function is not used for selection of forward/revers action of the controller. For forward/ reverse action selection, refer to "4.3.6 System function setting codes".



	Socket position		Setting	MV operation button
①	Set SW2 in the left position.		PNA3-*** SYS CH. CONF CH. X26 04 (See Item 4.3.6)	MV bar graph 
②	Set SW2 in the right position		PNA3-*** SYS CH. CONF CH. X26 34 (See Item 4.3.6)	MV bar graph 

3.2 Turning on power

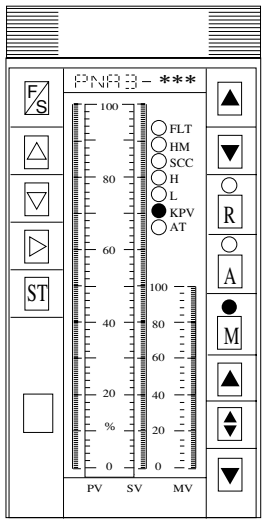
Make sure that mounting and wiring (see Chapter 2) are completed, then turn ON the instrument power supply.

3.2.1 Check of power turn-on

The following will be indicated on the instrument front when power is turned on.

- PNA3-*** is indicated on data indicator.
- M button lamp and KPV lamp light up.
- Preset values are output for SV and MV.

If indication doesn't appear despite power being turned on, it could be due to miswiring, so turn off the power and check the wiring again.



● indicates lamp is lit.

Note

- The initial conditions can be changed by means of start mode setting; code in section 4.3.6.
- The indication "PNA3-***" will disappear by pressing ▷ button. "PNA3-***" will be indicated by pressing ▷ button again.

Reference

When the power is ON, the following items are displayed on the data display unit at the *** position according to the code symbols of instrument.

PNA3 – ***

- Control function ..... 0: Basic PID control
  1: Programmable (PID control)
  2: Programmable (cascade control)
  3: Programmable (radio control)
  4: Programmable (program set control PGC)
  5: Programmable (program set control PGS)
  6: Programmable (program set control PLC)
  7: Programmable (program set control PLS)
- Setting method ..... 1: R-A-M type
- With/without auto-tuning ..... 1: With

3.3 Initial setting

When power is ON, be sure to check for manual operation (" M " button lamp ON). Manula mode is used for initial setting of parameters.

3.3.1 Setting of instrument parameters

Instrument parameters are settable according to the set value list (see Appendix 2). Instrument parameters should be changed as necessary during processing operation.

3.3.2 Setting of PID parameters

Set the PID parameters of the controller in accordance with the characteristics of the process.

If the correct PID values are unknown, then optimum values can be determined through use of auto tuning. Refer to section 4.3.5 on auto tuning, determine optimum values and then set the PID parameters.

3.3.3 Storing of instrument parameters in nonvolatile memory

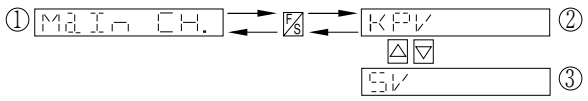
When the setting of instrument parameters, PID parameters and the like is finished, store them in the nonvolatile memory so that they won't be lost even if power is interrupted.

Refer to section 4.3.2 for the method of storing data in the nonvolatile memory.

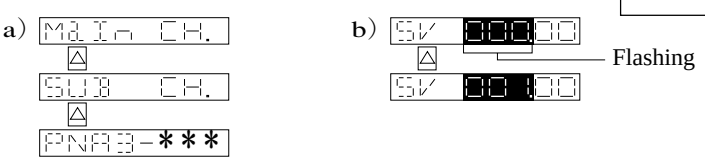
3.3.4 Description of configuration

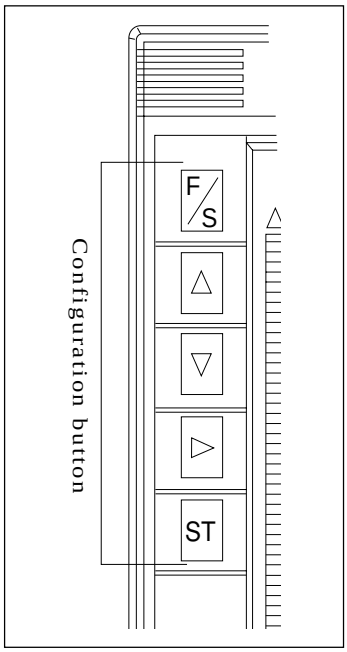
The configuration button functions are shown below.

F/S button: Used when CH (called as channel) is displayed in data indicating section. Press this button when checking or setting data in each CH. By pressing the button when CH is displayed, the data are returned to the channel. (If the button is pressed in ③ conditions, return to ①.)



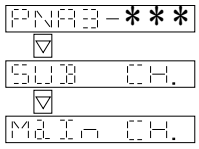
△ button: Used when data are returned (refer to a), or used when the numeric value at the flickering digit is increased (the rightmost digit is effective in case of two digits or more) with the setting mode by pressing the ▷ button.



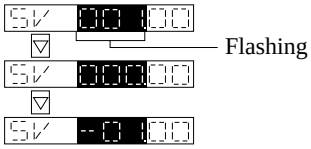


▽ button: Used when data are advanced (refer to c), or used when the numeric value at the flickering digit is decreased (the rightmost digit is effective in case of two digits or more), and also when the negative number is set with the setting mode by pressing the ▷ button.

c)

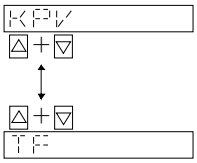


d)

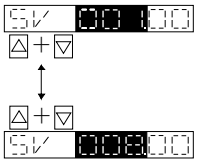


△ + ▽ button: By pressing two buttons, the fast-forward and fast-backward (refer to e) of data name and the fast-forward and fast-backward (refer to f) set value are carried out.

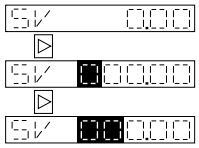
e)



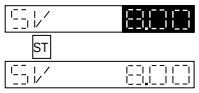
f)



▷ button: Used when the digit of data to be changed is selected. For setting, use the extreme right digit which is flickering. Data can be changed with the " △" / " ▽" button (setting mode)



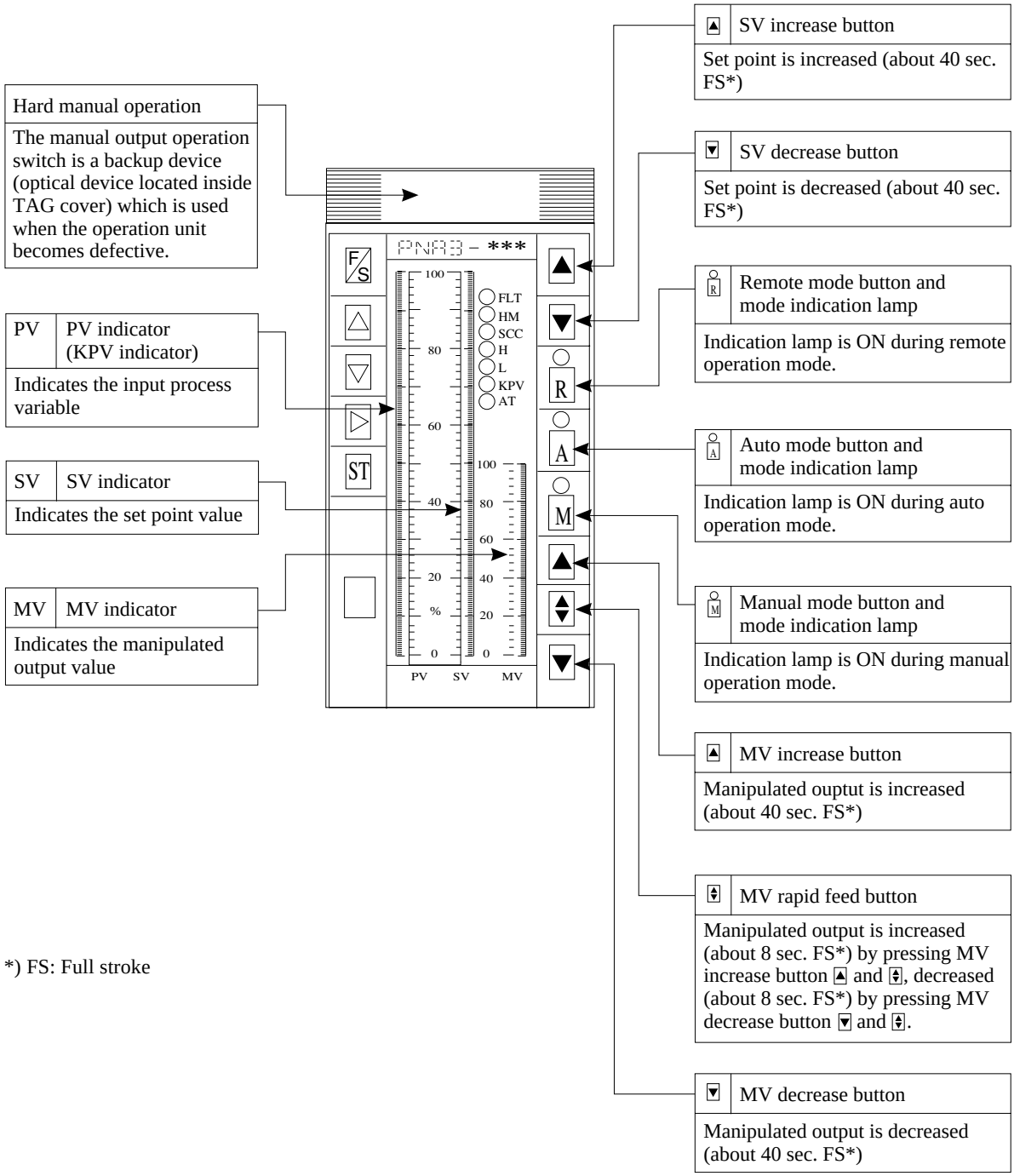
ST button: This button is used to determine the data to be set. The data which is flickering is determined with the ST button.



3.4 Operation

This controller can perform the following operations by means of the mode selecting buttons on the front panel or commands sent from the host system.

- Manual operation (3.4.1)
- Automatic operation (3.4.2)
- SCC operation (4.3.1)
- Hard manual operation (3.4.3)



*) FS: Full stroke

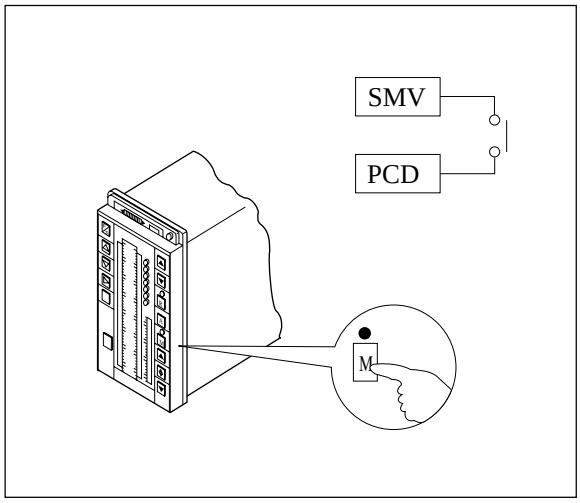
3.4.1 Manual operation

Manual operation is used when processing operation is made directly by operator.

1) Either select the manual operation mode by pushing the M button or turn ON the SMV input from externally, then the mode indicator lamp on the front panel will light and manual operation is assumed.

Note

With SMV input, manual operation is possible only while the input is ON.



2) MV operation is possible by (▲ ▼ ▲▼) pushing the MV operating buttons

- ▲ : MV is increased (full stroke is about 40 sec.)
- ▼ : MV is decreased (full stroke is about 40 sec.)
- Pressing ▲ and ▲▼ simultaneously will increase the MV at 5 times the usual speed, while pressing ▼ and ▲▼ simultaneously will decrease the MV at 5 times the usual speed (full stroke about 8 sec.)

3.4.2 Automatic operation

Auto operation is used to shift the processing operation from operator to controller so that PID control is effected to the desired value by the controller.

(1) Local operation (fixed value control)

1) Local operation mode is assumed by pushing A button on the front panel, and mode indicator lamp A lights up and local operation starts.

Note

Manual operation has priority over local operation during SMV input, and change will not be made to local operation, so turn OFF the SMV.

When SMV input is ON, the corresponding lamp flickers to indicate the previous request mode (R or A) on the front panel.

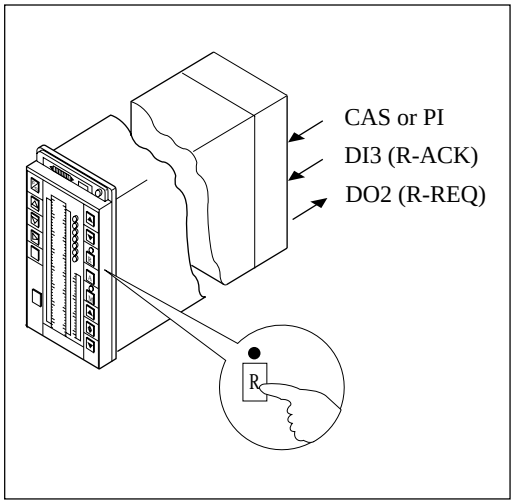
2) SV operation is possible by pushing the SV operating ▲ and ▼ buttons.

- ▲ : SV is increased (full stroke about 40 sec).
- ▼ : SV is decreased (full stroke, about 40 sec).

(2) Remote operation (cascade control)

This mode is used for making the process variable or status follow up an external input value (output of another instrument).

The remote operation request mode is assumed by pushing the R button on the front panel, and R-REQ is turned ON. When R-ACK is turned ON, the mode indicator lamp R lights up and remote operation starts.



Note

When programmable type wafer is used for operation, R-REQ and R-ACK signals vary with wafer connection.

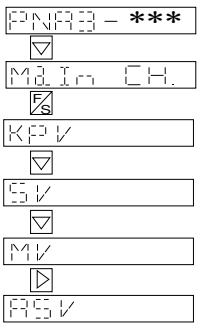
Since the external signal (CAS or PI) is PID-controlled as a target value in remote operation, operation with the SV buttons (▲, ▼)or MV buttons (▲, ◆, ▼) is impossible.

Note

Manual operation has priority over remote operation during SMV input, so change will not be made to remote operation. SMV must be turned OFF.

The R lamp flickers if R-ACK is not turned on by pushing R button.

If the SV value in local operation and the CAS input value differ when using CAS as an external set value, a shock will be produced when changing to remote operation. To prevent this, display the RSV digitally as shown in the figure in local operation, adjust the SV at local to the RSV value, and then make the changeover.



Note

The above operation is unnecessary when using PI for the external set value.

3.4.3 Hard manual operation (option)

Since output is provided from the hard manual unit during the hard manual operation, the output is retained and operation can be continued even with the main unit pulled out of the frame.

(1) Changeover to hard manual operation

Hard manual operation is assumed in the following cases.

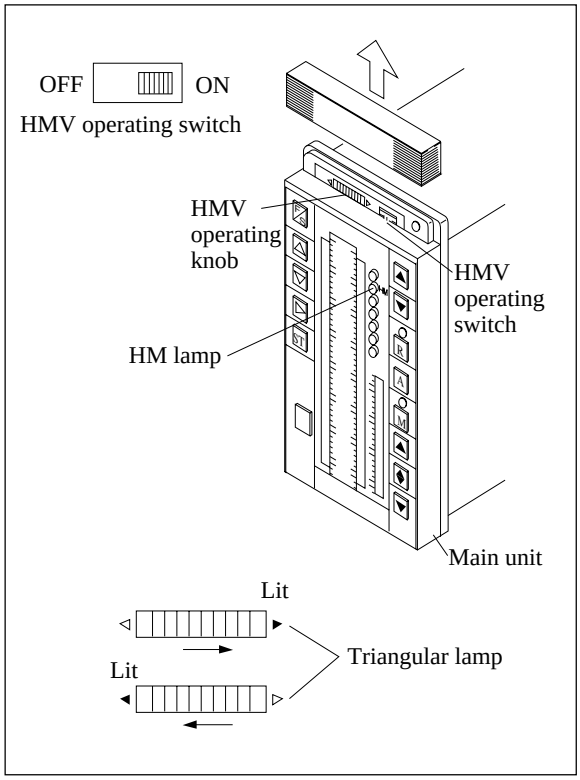
1) When the main unit is pulled out
2) When the power unit of the main unit is stopped.
3) When the switch of hard manual unit is turned ON manually.

The output is the value set by the operating knob of the hard manual unit.

When turned ON manually as in 3) above, the HM lamp on the main unit front lights up, and the output of the hard manual unit is indicated on the MV indicator.

The triangular lamps on either side of the HMV operating knob light up when the outputs of the main unit and hard manual unit differ.

With the operating switch turned OFF, turn the knob in the direction of the lit lamp, and when both lamps are off, turn ON the HMV operating switch again. Thus changeover can be made without shock to the output.



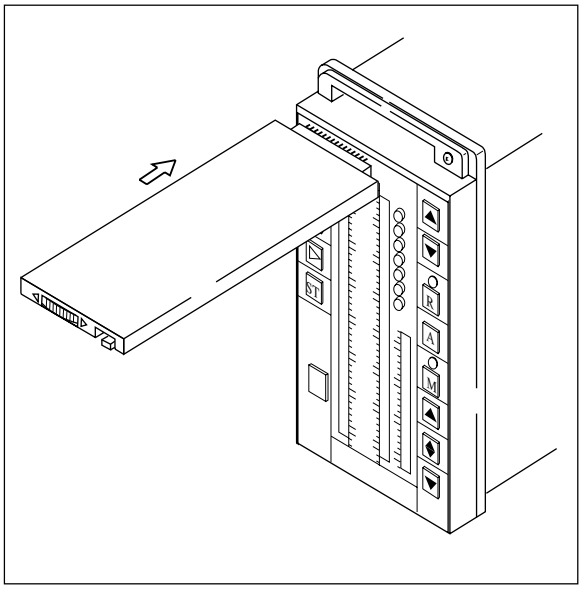
(2) Changeover from hard manual unit to main unit

Turn the operating knob of the hard manual unit or the MV operating buttons (▲ ◆ ▼) of the main unit, and when the triangular lamps on both sides of the knob go out, turn OFF the switch of the hard manual unit.

Thus the changeover can be made bumplessly.

(3) Attachment/detachment of hard manual unit during operation

When the main unit is operating normally, be sure to turn OFF the HMV switch. When there is an abnormality in the main unit, the hard manual unit can be attached even with the HMV switch turned ON, but since the manipulated signal will be output immediately, it is best to check the knob setting of the hard manual unit beforehand.



3.5 Power supply cutoff

The digital output is turned OFF and the analog output becomes 0V when the power is cutoff.

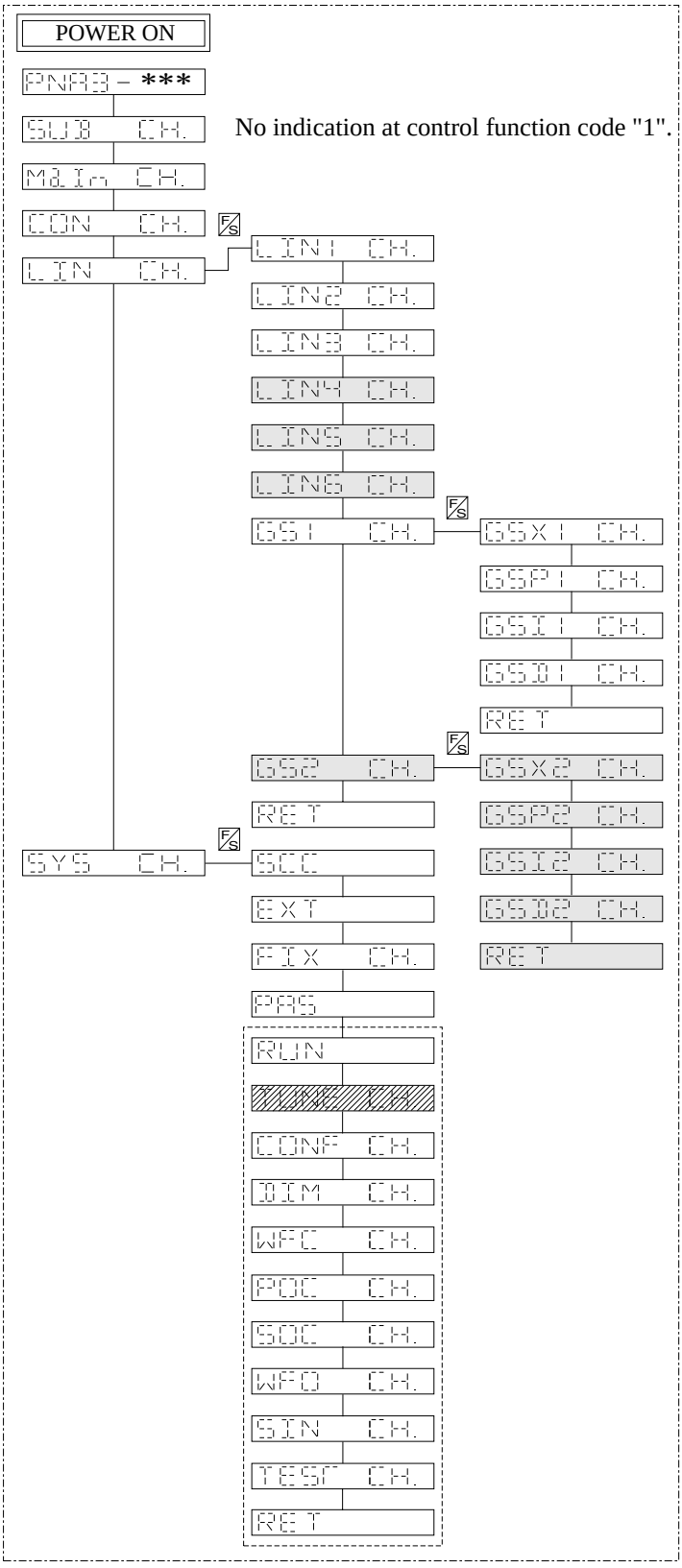
Although the parameters stored in the nonvolatile memory are retained, other data will be destroyed, so for changing parameters during operation, carry out the procedures in section 4.3.2 on storing of data in the nonvolatile memory, and then turn off the power.

Next that data in the memory will be retained for a maximum of 5 minutes in the case of a momentary power failure or the like. Set initial start or continuous start as a recovery mode after power interruption.

Refer to the following or section 4.3.6 on system configuration function setting code for the method of setting.

4. FUNCTION SETTING

4.1 Operation flow for function setting



: Data input and display are not possible at pass code setting.

: Only the data with auto-tuning is displayed.

: Displayed when data is "48 sheets".

4.2 Function fixing type PID control

Fig. 4-1 shows a function block diagram for function fixing type PID control.

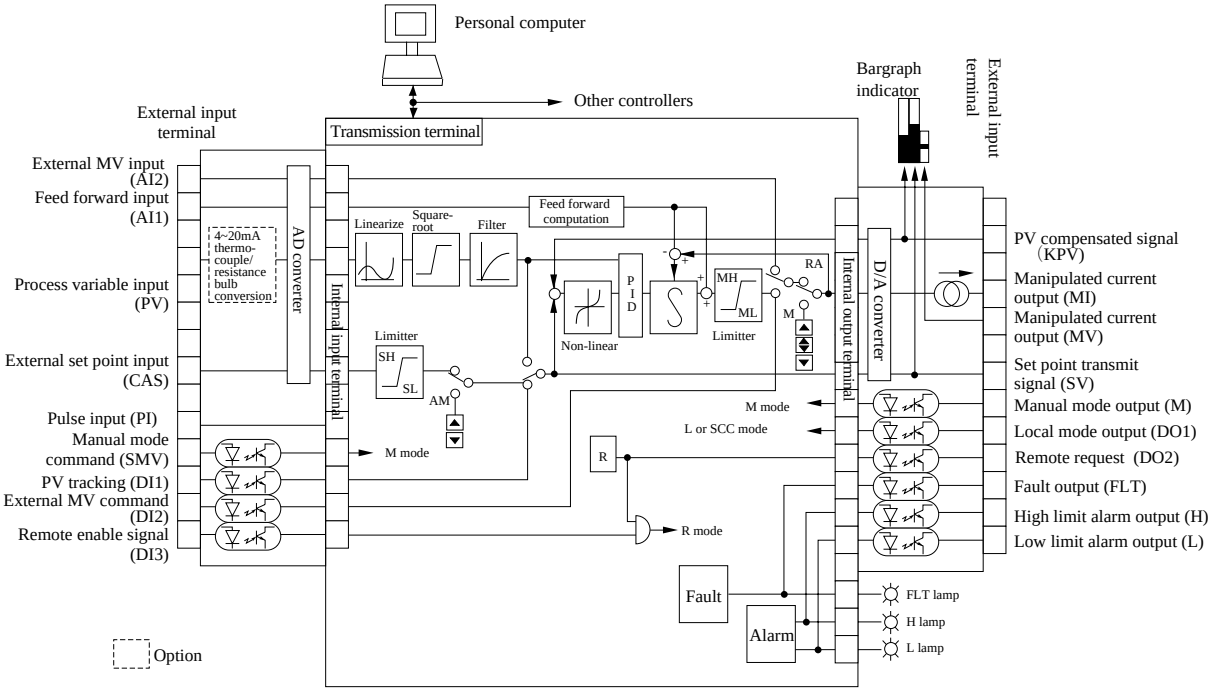
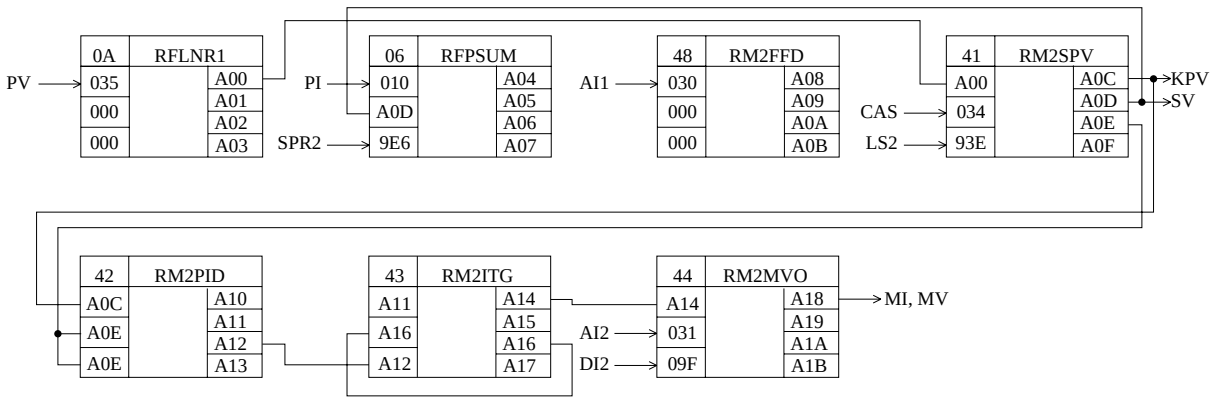


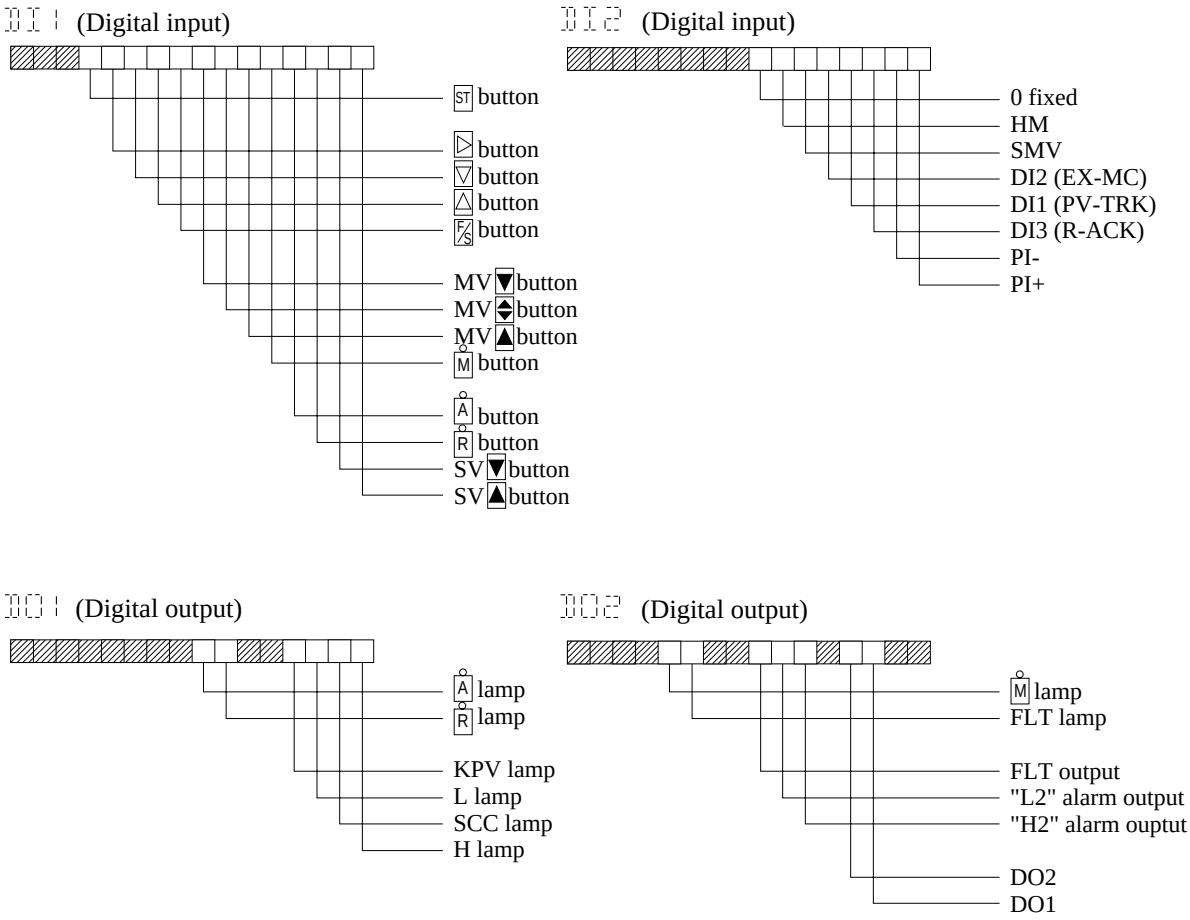
Fig. 4-1



4.2.1 Status channel data display

Analog input/output data and digital input/output data can be displayed.

Indication	Name	Unit	Range	Remarks
PNA3-***				
FLT	Fault information			When multiple faults occur, Fault information can be indicated alternately pressing the ▷ button (Refer to 5.2.2)
ALM	Alarm information			When multiple alarms occur, alarm information can be indicated alternately by pressing the ▷ button (refer to 5.2.2)
AI1	Analog input value	%	-327.6 ~ 327.67	1 to 5V external signal is indicated by 0 to 100%.
AI2	Analog input value	%	-327.6 ~ 327.67	
AI3	Analog input value	%	-327.6 ~ 327.67	
TMP	Cold junction temperature	˚C	-20.0 ~ 60.0	
PV	Analog input value	%	-327.6 ~ 327.67	
CAS	Analog input value	%	-327.6 ~ 327.67	
MVR	Manipulated output read back value	%	-327.6 ~ 327.67	
Vr F	Voltage for power failure time	%	-327.6 ~ 327.67	
AO1	Analog output value	%	-327.6 ~ 327.67	1 to 5V analog output value is indicated by 0 to 100%
AO2	Analog output value	%	-327.6 ~ 327.67	
KPV	Analog output value	%	-327.6 ~ 327.67	
SV	Analog output value	%	-327.6 ~ 327.67	
MI	Manipulated output value	%	-327.6 ~ 327.67	4 to 20mA output is indicated by 0 to 100%
MV	Analog output value	%	-327.6 ~ 327.67	1 to 5V analog output value is indicated by 0 to 100%.
DI1	Digital-input value		Hexadecimal form	See the next page
DI2	Digital-input value		Hexadecimal form	See the next page
DO1	Digital-output value		Hexadecimal form	See the next page
DO2	Digital-output value		Hexadecimal form	See the next page
mod	Control mode		Hexadecimal form	Not displayed with function fixing type.
MOD	Control mode		Hexadecimal form	See the next page
RET				


DI1 (Digital input)
ST button
button
button
button
F/S button
MV button
MV button
MV button
M button
A button
R button
SV button
SV button
DI2 (Digital input)
0 fixed
HM
SMV
DI2 (EX-MC)
DI1 (PV-TRK)
DI3 (R-ACK)
PI-
PI+
DO1 (Digital output)
A lamp
R lamp
KPV lamp
L lamp
SCC lamp
H lamp
DO2 (Digital output)
M lamp
FLT lamp
FLT output
"L2" alarm output
"H2" alarm ouptut
DO2
DO1
MOD (Digital output)
HM (Hard manual mode)
M (Manual mode)
EXM (External MV mode)
SCCM (SCC manual mode)
SCC (SCC mode)
R (Remote mode)
L (Local mode)
RV-TRK (RV-TRACK mode)
NORMAL (Normal action)
SCC-REQ (SCC request in progress)
R-REQ (Remote request in progress)
NOT-A (Not automatic mode)
SCC-ENABLE (SCC is being enabled)
LS (Local or PV-TRACK mode)
FAULT (Fault)

4.2.2 Parameter setting for MAIN control block

Data indication and parameter setting for the MAIN control block are carried out in MAIN channel. Main channel data are common parameter to all control functions.

Indication	Name	Unit	Range	Remarks
PNB-***				
MAIn CH.				
KPV	Compensation PV *	Industrial value	-327.6 ~ 327.67	
SV	Set point	Industrial value	0.00 ~ 100.00	Settable in local mode
MV	Manipulated output *	%	-327.6 ~ 327.6	
RSV	Remote set point *	Industrial value	-327.6 ~ 327.67	
DV	Control deviation *	%	-327.6 ~ 327.6	
ΔMV	Manipulated output change *	%	-327.6 ~ 327.6	
P	Proportional band	%	1.0 ~ 3276.7	
I	Integral time	Sec.	0.1 ~ 3276.7	
D	Derivative time	Sec.	0.0 ~ 900.0	No derivative action when D is 0.0
DH	Deviation absolute value	%	0.00 ~ 327.67	
SH	Set point high limit	Industrial value	-327.6 ~ 327.67	
SL	Set point low limit	Industrial value	-327.6 ~ 327.67	
PH	PV high limit	Industrial value	-327.6 ~ 327.67	
PL	PV low limit	Industrial value	-327.6 ~ 327.67	
MH	Manipulated output high limit	%	-327.6 ~ 327.6	
ML	Manipulated output low limit	%	-327.6 ~ 327.6	
ΔPH	PV change rate high limit	%	0.00~ 327.67	
ΔMH	Manipulated output change rate hight limit	%	0.00 ~ 327.6	
ΔT	Sampling cycle	Sec.	0.1 ~ 327.6	
CUT	Cutoff point of rooter	%	-327.6 ~ 327.67	No square root computation when CUT is less than 0.
TF	Filter time constant	Sec.	0.0 ~ 900.0	
GAP	Dead band	%	0.0 ~ 327.6	
KnL	Non-linear gain	%	0.00 ~ 327.67	
KF	Feed forward gain	%	-327.6 ~ 327.67	
D1F	Feed forward bias 1	%	-327.6 ~ 327.67	
D2F	Feed forward bias 2	%	-327.6 ~ 327.67	
SPR	SV preset value	Industrial value	0.00 ~ 100.00	
MPR	MV preset value	%	-327.6 ~ 327.67	

* : Data display only
** : Industrial value unit varies with dimension channel setting data.

(1) DH, PH, PL, ΔPH (Alarm function)

Check the deviation, PV and absolute value of PV change rate according to PH/PL, DH/DL, and DPH. When an abnormality is detected, the information is output at the input terminal board.

- PH2: PV high alarm
- DH2: Deviation high alarm
- DPH2: PV change rate high alarm
- PL2: PV low alarm
- DL2: Deviation low alarm
- DPL2: PV change rate low alarm

(2) SH, SL, MH, ML, ΔMH (Limit function)

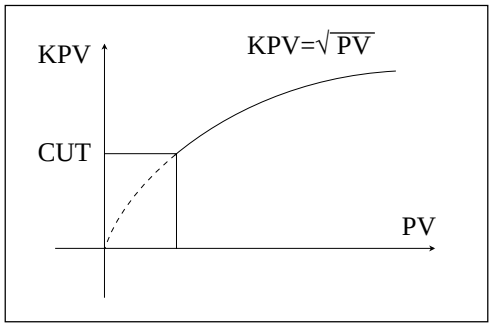
A limit can be applied to the SV (external set point or transmitted set point), MV and MV change rate by means of SH/SL, MH/ML and DMH.

- SH2: Set point high limit
- MH2: Manipulated output high limit
- DMH2: MV absolute value high limit
- SL2: Set point low limit
- ML2: Manipulated output low limit

(3) CUT (Square root computation function)

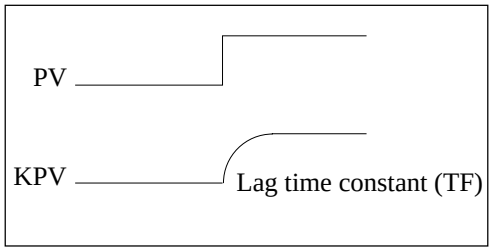
Square root computation function can be applied to the PV of the MAIN control block.

The cutoff point of the rooter is designated with CUT. When KPV is smaller than the CUT value, then KPV = 0, and when a negative value is set for CUT, then square root computation is not performed.



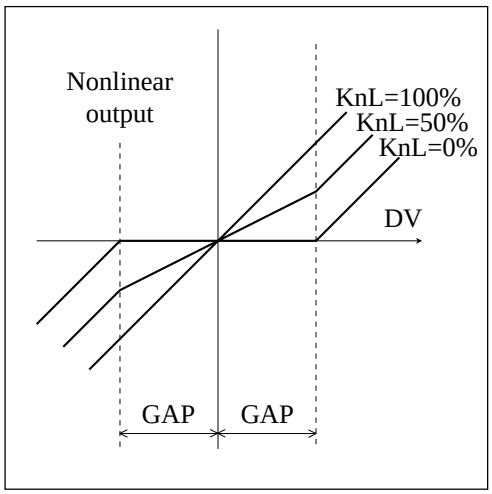
(4) TF (Filter function)

A primary lag filter can be applied to the PV of the MAIN control block with TF.

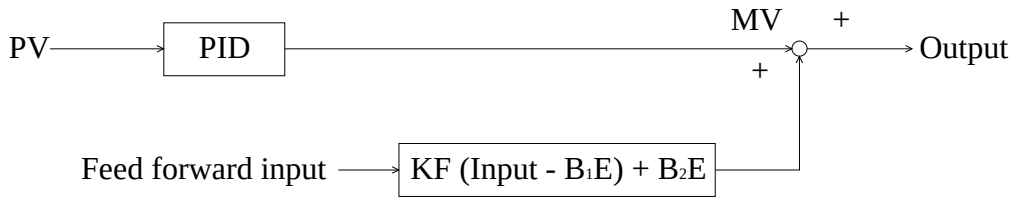


(5) GAP, KnL (Nonlinear control function)

Nonlinear computation performed for the deviation of the MAIN control block using GAP and KnL.
When $|DV| < GAP$, output = KnL × DV
When $|DV| \geqq GAP$,
output = DV - (100 - KnL) × GAP.
Non linear computation is not performed when GAP = 0%.



(6) KF, B1F, B2F (Feed forward function)



Feed forward function compensates for signals and eliminates external disturbance from the control value when the source of external disturbance in the process can be measured.

(7) SPR, MPR (Preset value)

Set the SV and MV values for initial start (power ON) using SPR and MPR.

4.2.3 Parameter setting for SUB control block (cascade control)

Data indication and parameter setting are performed with the SUB channel.

The following parameters are displayed when selecting cascade control by function codes.

Indication	Name	Unit	Range	Remarks
PNR3-***				
SUB CH.				
KPv	Compensation PV *	Industrial value	-327.6 ~ 327.67	
sv	Set point	Industrial value	0.00 ~ 100.00	Settable in local mode
mv	Manipulated output *	%	-327.6 ~ 327.6	
rsv	Remote set point *	Industrial value	-327.6 ~ 327.67	
dv	Control deviation *	%	-327.6 ~ 327.6	
Δmv	Manipulated output change *	%	-327.6 ~ 327.6	
P	Proportional band	%	1.0 ~ 3276.7	
I	Integral time	Sec.	0.1 ~ 3276.7	
d	Derivative time	Sec.	0.0 ~ 900.0	
dh	Deviation absolute value	%	0.00 ~ 327.67	
sh	Set point high limit	Industrial value	-327.6 ~ 327.67	
sl	Set point low limit	Industrial value	-327.6 ~ 327.67	
Ph	PV high limit	Industrial value	-327.6 ~ 327.67	
Pl	PV low limit	Industrial value	-327.6 ~ 327.67	
mh	Manipulated output high limit	%	-327.6 ~ 327.6	
ml	Manipulated output low limit	%	-327.6 ~ 327.6	
ΔPh	PV change rate high limit	%	0.00~ 327.67	
Δmh	MV change rate high limit	%	0.0 ~ 327.6	
Δt	Sampling cycle	Sec.	0.1 ~ 327.6	
cut	Cutoff point of rooter	%	-327.6 ~ 327.67	No square root computation when CUT is less than 0.
tf	Filter time constant	Sec.	0.0 ~ 900.0	
gdP	Dead band	%	0.0 ~ 327.6	
Knl	Non-linear gain	%	0.00 ~ 327.67	
sPr	SV preset value	Industrial value	0.00 ~ 100.00	
mPr	MV preset value	%	-327.6 ~ 327.67	

* : Data display only

** : Industrial value unit varies with dimension channel setting data.

As well as the MAIN control block, the following functions are available.

- Alarm functions (ph, pl, dh, dl, Δph)
- Limit functions (sh, sl, mh, ml, Δmh)
- Square root computation (cut)
- Filter function (tf)
- Nonlinear control function (gap, knl)

4.2.4 Parameter setting for SUB control block (ratio control block)

Data indication and parameter setting are carried out in the SUB channel.

The following parameters are displayed when selecting ratio control by function codes.

Indication	Name	Unit	Range	Remarks
PNR3-***				
SUB CH.				
KPv	Compensated PV *	Industrial value	-327.6 ~ 327.67	
sv	Ratio set point	Industrial value	0.00 ~ 100.00	Settable in local mode
mv	Manipulated output *	%	-327.6 ~ 327.6	
rsv	Remote set point *	Industrial value	-327.6 ~ 327.67	
r	Ratio coefficient	%	-327.6 ~ 327.67	
d1	Ratio bias 1	%	-327.6 ~ 327.67	
d2	Ratio bias 2	%	-327.6 ~ 327.67	
d3	Ratio bias 3	%	-327.6 ~ 327.67	
sh	Set point high limit	Industrial value	-327.6 ~ 327.67	
sl	Set point low limit	Industrial value	-327.6 ~ 327.67	
Ph	PV high limit	%	-327.6 ~ 327.67	
Pl	PV low limit	%	-327.6 ~ 327.67	
mh	Manipulated output high limit	%	-327.6 ~ 327.6	
ml	Manipulated output low limit	%	-327.6 ~ 327.6	
ΔPh	PV change rate high limit	%	0.00~ 327.67	
cut	Cutoff point of rooter	%	-327.6 ~ 327.67	No square root computation when CUT is less than 0.
tf	Filter time constant	Sec.	0.0 ~ 900.0	
spr	SV preset value	Industrial value	0.00 ~ 100.00	

* : Data display only

** : Industrial value unit varies with dimension channel setting data.

As well as the SUB control block, the following functions are available.

• Alarm functions (ph, pl, Δph)
• Limit functions (sh, sl, mh, ml,)
• Square root computation function (cut)
• Filter function (tf)

4.2.5 Parameter setting for SUB control block (program setting block)

Data indication and parameter setting are carried out in the SUB channel.

The following parameters are displayed when selecting ratio control by function codes.

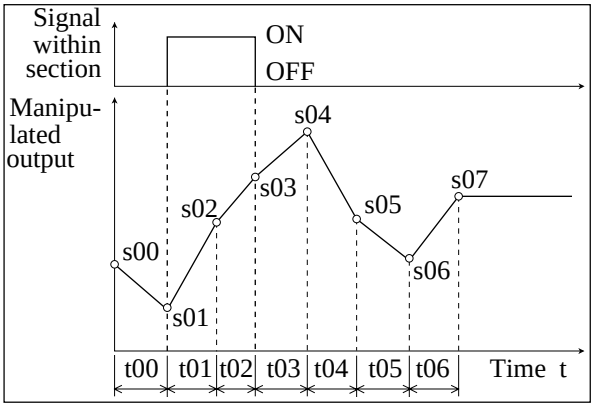
Indication	Name	Unit	Range
PNR3-***			
SUB CH.			
stP	Step counter		0 ~ 7
tim	Elapsed time	Set in sec or min	0 ~ 32767
mv	Manipulated output indicated *	%	-327.6 ~ 327.6
zon	Sectional set point		0 ~ 67
s00	Output value 0	Industrial value	-327.6 ~ 327.67
s01	Output value 1	Industrial value	-327.6 ~ 327.67
s02	Output value 2	Industrial value	-327.6 ~ 327.67
s03	Output value 3	Industrial value	-327.6 ~ 327.67
s04	Output value 4	Industrial value	-327.6 ~ 327.67
s05	Output value 5	Industrial value	-327.6 ~ 327.67
s06	Output value 6	Industrial value	-327.6 ~ 327.67
s07	Output value 7	Industrial value	-327.6 ~ 327.67
t00	Time span 0	Set in sec or min	0 ~ 32767 according to wafer used
t01	Time span 1	Set in sec or min	0 ~ 32767 according to wafer used
t02	Time span 2	Set in sec or min	0 ~ 32767 according to wafer used
t03	Time span 3	Set in sec or min	0 ~ 32767 according to wafer used
t04	Time span 4	Set in sec or min	0 ~ 32767 according to wafer used
t05	Time span 5	Set in sec or min	0 ~ 32767 according to wafer used
t06	Time span 6	Set in sec or min	0 ~ 32767 according to wafer used
tPr	Preset time for initial start	Set in sec or min	0 ~ 327.67

* : Data display only

** : Industrial value unit varies with dimension channel setting data.

- The time axis can be arbitrarily moved by setting stp and tim.
- The zon is used for setting the output of the sectional signal, where 10 is the start point and 1 is the end point. So if zon = 13 is set, the sectional signal is ON from S01 to S03.

  By setting data including non-existent points when the start point is equal to or less than the end point such as 20n = 42 or 18, zon = 0 will be indicated and the sectional signal will be turned OFF immediately.



4.2.6 Constant channel (only programable type)

Up to 32 constants when 24 wafers (or 48 constants when 48 wafers) are usable, and are connectable to the wafer input terminal.

The constant 1 (CON01) is used as a low cut point of the temperature/pressure compensation wafer (wafer code 07).

When using this wafer, it cannot be used as a general constant.

Indication	Name	Unit	Rang
PNA3-***			
CON CH.			
C01	Constant channel 1	%	-327.6 ~ 327.67 (Analog data)
		Constant	0.00 (OFF) or 0.01 (ON) (Digital data)
C02	Constant channel 2	%	-327.6 ~ 327.67 (Analog data)
		Constant	0.00 (OFF) or 0.01 (ON) (Digital data)
C03	Constant channel 3	%	-327.6 ~ 327.67 (Analog data)
		Constant	0.00 (OFF) or 0.01 (ON) (Digital data)
⋮	⋮	⋮	⋮
C48	Constant channel 48	%	-327.6 ~ 327.67 (Analog data)
		Constant	0.00 (OFF) or 0.01 (ON) (Digital data)

4.2.7 Parameter setting for linearize channel

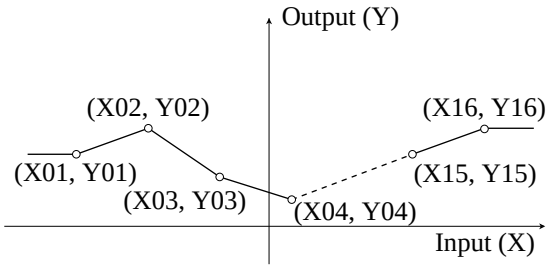
Approximation is applied to the input by using a segmented-line table. Up to 16 points can be set for X and Y axes in each of channels. When 16 points are not set in the table, then operation versus an input exceeding the maximum value will not be guaranteed.

Indication	Name	Unit	Rang
PNA3-***			
L_IN CH.			
L_IN1 CH.	Linearize Channel 1		
X01	X01 coordinate of segmented-line table	%	-327.6 ~ 327.67
Y01	Y01 coordinate of segmented-line table	%	-327.6 ~ 327.67
⋮	⋮	⋮	⋮
X16	X16 coordinate of segmented-line table	%	-327.6 ~ 327.67
Y16	Y16 coordinate of segmented-line table	%	-327.6 ~ 327.67
⋮	⋮	⋮	⋮
L_IN6 CH.	Linearize Channel 6		
X01	X01 coordinate of segmented-line table	%	-327.6 ~ 327.67
Y01	Y01 coordinate of segmented-line table	%	-327.6 ~ 327.67
⋮	⋮	⋮	⋮
X16	X16 coordinate of segmented-line table	%	-327.6 ~ 327.67
Y16	Y16 coordinate of segmented-line table	%	-327.6 ~ 327.67
GS CH.	Gain schedule channel		

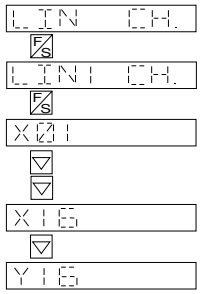
[Example]

Register segmented-line patter 1 in LIN1 channel.

Up to 16 points can be set for X and Y axes in each of channels LIN1 to LIN3.



• Resistaration of segment-line pattern



Note

The number of linearize tables is based on the following. When used with function fixed PID ..... 1 (LIN CH.)
In other cases, it is based on code symbols.
24 wafers ..... 3 (LIN 1 to 3), 48 wafer ..... 6 (LIN 1 to 6)

(1) Parameter setting for gain schedule (only programable type)

Register the GS curve by using the gain schedule (GS) channel.

Up to one kind of GS card (or two kinds) can be registered.

(One kind for 24 wafers and 2 kinds for 48 wafers, depending on code symbols)

Indication	Name	Unit	Range
PNB3-***			
LIN CH.			
GS CH.			
GS1 CH.	Gain schedule Channel 1		
GSX1 CH.	Channel GSX		
X01	Adaptability index 1	%	-327.6 ~ 327.67
⋮	⋮	⋮	⋮
X08	Adaptability index 8	%	-327.6 ~ 327.67
GSP1 CH.	Channel GSP		
P01	Proportional band 1	%	1.0 ~ 327.67
⋮	⋮	⋮	⋮
P08	Proportional band 8	%	1.0 ~ 327.67
GSI1 CH.	Channel GSI		
I01	Integral time 1	Sec.	1.0 ~ 327.67
⋮	⋮	⋮	⋮
I08	Integral time 8	Sec.	1.0 ~ 327.67
GSD1 CH.	Channel GSD		
D01	Derivative time 1	Sec.	0.0 ~ 900.0
⋮	⋮	⋮	⋮
D08	Deviative time 8	Sec.	0.0 ~ 900.0
GS2 CH.	Gain schedule channel 2		
GSX2 CH.	Channel GSX		
X01	Adaptability index 1	%	-327.6 ~ 327.67
⋮	⋮	⋮	⋮
X08	Adaptability index 8	%	-327.6 ~ 327.67
GSP2 CH.	Channel GSP		
P01	Proportional band 1	%	1.0 ~ 327.67
⋮	⋮	⋮	⋮
P08	Proportional band 8	%	1.0 ~ 327.67
GSI2 CH.	Channel GSI		
I01	Integral time 1	Sec.	1.0 ~ 327.67
⋮	⋮	⋮	⋮
I08	Integral time 8	Sec.	1.0 ~ 327.67
GSD2 CH.	Channel GSD		
D01	Deviative time 1	Sec.	0.0 ~ 900.0
⋮	⋮	⋮	⋮
D08	Deviative time 8	Sec.	0.0 ~ 900.0

4.3 Function Setting

The following explains the method of setting each function. For the initial value of data, refer to the "Appendix 2. Set values list".

Indication	Name	Range	Remarks
PNA3-***			
SYS CH.			
SCC	SCC operation mode	00: SCC mode: disabled 01: SCC mode: enabled	Refer to 4.3.1.
EXT	EXT/INT mode	00: INTERNAL mode 01: EXTERNAL mode	Invalid when basic control type
FIX CH.	Data storage in non-volatile memory	00: Displayed after data storage is finished correctly 01: Data is being transferred in non-volatile memory.	
PAS	Pass code	0000 ~ FFFF	Pass is released only when this matches pass setting (X22).
RUN	Instrument operation	00: Opeartion STOP 01: Operation START	
TUNE CH.	Tuning channel		
CONF CH.	System configuration channel		
DIM CH.	Dimension channel		
WFC CH.	Wafer connection channel *		
POC CH.	Process output connection channel *		
SOC CH.	SCC output connection channel *		
WFO CH.	Wafer output indication channel *		
SIN CH.	SCC input indication channel*		
TEST CH.	Test channel		
RET			

Note

When the basic control type is selected in control function code, the channels with "*" are not indicated.
To display these channels, change them according to item 4.3.6 “System configuration function setting code”.

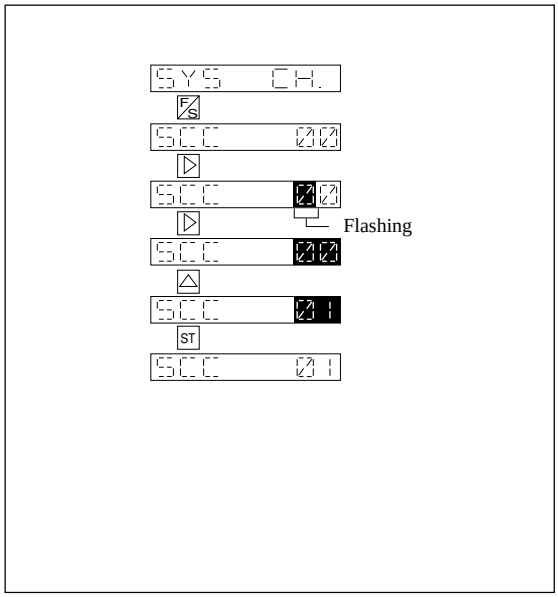
4.3.1 SCC operation

SCC (SCC operation mode)

This mode is used for fixed value control or manual operation of transmission via transmission from the host system.

When setting is made as shown below, the SCC lamp lights up and the SCC operating status is assumed.

Operation mode change and SV and MV operation are possible during the SCC operation.



- SCC-M mode ..... The SCC and mode indicator M lamps light up and MV operation is possible via transmission.
- SCC-A mode ..... The SCC and mode indicator A lamps light up and SV operation is possible via transmission.
- SCC-R mode ..... The SCC lamp and mode indicator R lamps light up and performs the control by charging SV over external set value.

Note

Remote operation through transmission can be selected only by the models designated as "T", "S", "R" or "C" in the 10th digit of the code symbols. Before using, be sure to check the code of your model.

4.3.2 Storing of data in nonvolatile memory

FIX (storing of data in nonvolatile memory)

Although the data set with this instrument is stored in the RAM, it must also be stored in the nonvolatile memory to prevent erasure in the event of a power interruption.

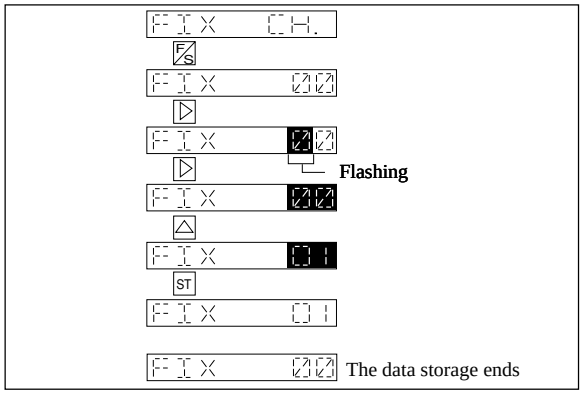
(1) Method of storing data

By setting 01 in FIX, all the parameters in the RAM are transferred to the nonvolatile memory.

If the data storage ends normally, 00 is indicated in FIX.

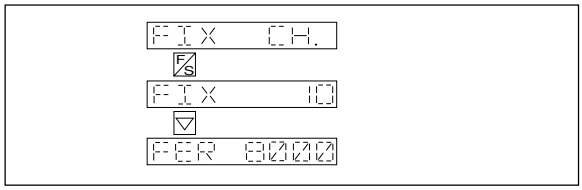
Note

Do not interrupt the power supply or do not remove the main unit until the data are stored in nonvolatile memory.



(2) Error processing at data storage

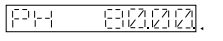
In an errors during write-in to the nonvolatile memory, 10 will be indicated in FIX. And the address in which the error occurred will be indicated in FER.



(3) In case of storing data incoincidence

If the data on RAM incoincidences with the data on nonvolatile memory, a point lights up at the lowermost digit of display data.

[Example]



This point lights up.

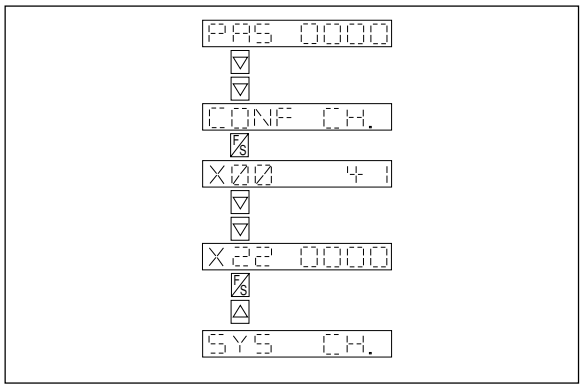
4.3.3 Pass code

PAS (pass code)

Pass code setting is performed for protecting various data used in system configuration; indication and setting will be impossible unless the pass codes are input.

Carry out the pass code setting as shown at the right. The pass is normally released when X22 = 0000. When the data is set on X22, X22 will be light off. Return to SYS.CH (system channel) by pressing F/S , △ buttons.

Once a pass doce is inputted in X22, the pass cannot be released unless the next pass code is inputted. Keep in mind the pass code which has been set.



4.3.4 RUN/STOP of controller

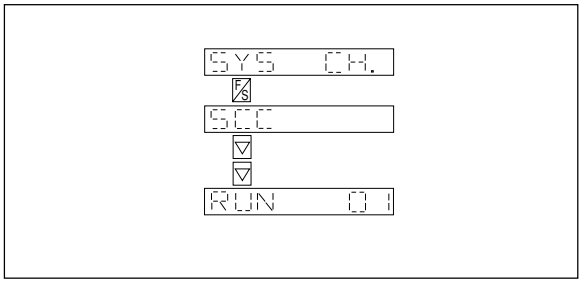
RUN (controller opertion)

It is necessary to stop the controller for collectively down-loading parameters or changing system parameters. When the controller is stopped, control and computation are stopped and the present output value is held.

• When RUN = 01 ..... Controller in RUN status

• When RUN = 00 ..... Controller in STOP status

(FLT lamp flickers, indicating manual operation is possible.)



4.3.5 Tuning channel

This is used for display of tuning channel data and setting of parameters. During tuning operation, the "AT lamp" flickers.

Indication	Name	Unit	Range
PNAB-***			
SYS CH.			
TUNE CH.			
COM	Tuning command		00: Completion of tuning 01: Tuning start/setting confirmation 03: Output ON, PV change stand-by mode 04: Output OFF, PV return stand-by mode 05: Optimum value calculation
MOD	Control system		* * Upper digit 0: PID control 1: PI control Lower digit 0: Overshoot normal 1: Overshoot small
PLS*	Magnitude of output pulse	%	-327.6 ~ 327.6 (Reference value:10.0)
FLV*	Span of PV change	%	-327.66 ~ 327.67 (Reference value: 8.00)
TIM*	Max. standby time for PV change	min.	0.00 ~ 327.6 (Reference value: 30.0)
SDV*	Setting check width	%	0.00 ~ 327.67 (Reference value: 0.2)
A P	Tuning result (Proportional band)	%	
A I	Tuning result (Integral time)	sec.	
A D	Tuning result (Derivative time)	sec.	
SET	Parameter setting command		
TMX	Estimated hunching cycle	sec.	
KP	Presumed process gain	%	
TP	Presumed process lag time	sec.	
LP	Presumed process dead time	sec.	

- PLS: Set the magnitude of pulse to be output.
- PLV: Set the width of PV change.
- TIM: For TIM, set the maximum time for PV to change up to FLV.
- SDV: Set the width at the start of turning.

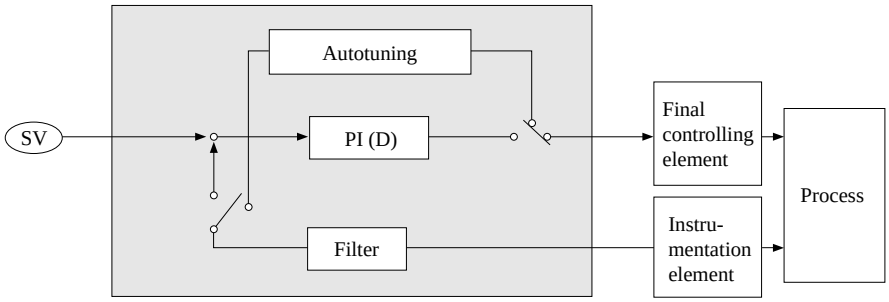
Obtained when the PV deviation is less than SDV.

At the end of tuning, COM 00 is displayed, and if the tuning result is correct, it will be indicated in A.P, A.I. and A.D. Check for this indication.

By setting 01 in SET, the value determined by auto tuning is automatically set in SUB and MAIN control blocks.

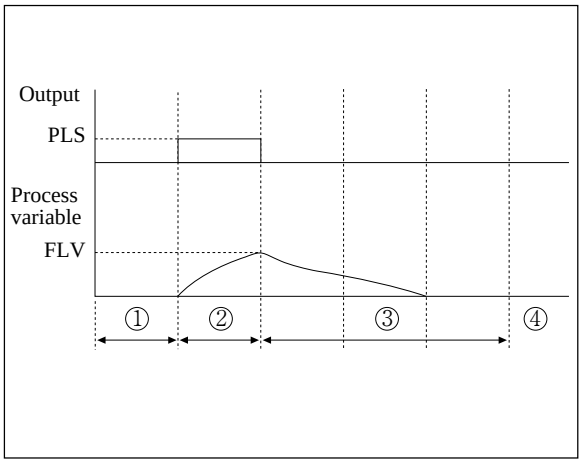
(1) Auto tuning action

Since the PID action is not executed, open-loop control is formed on control. To execute compensated computation by filter to PV, the process characteristic should be assumed including PV filter characteristic.



(2) Response during tuning

The figure at the right indicates the response wave form during tuning.



① Check the process setting. The setting is assumed when the PV standard deviation is smaller than SDV setting value. The tuning discontinues if the setting is not executed in ten minutes later.

② If the process setting is assured, output is changed only for the value to be set by PLS.
If the process is acknowledged in response to output change (PV change is greater than FLV setting value), the output becomes the previous value.

③ Carry out sampling of response data after pulse output. The data collection stops if the data value is larger than four times of output pulse width.

④ Search the optimum parameter by characteristic area method by the collected data.

(3) Error message and remedy

Error code	Trouble	Remedy
99	Control mode was changed during turning.	Retry it in same condition.
91	PV setting check error PV is not determined in ten minutes later.	Retry it in the same condition/Because larger the SDV value if the error occurs at usual time.
92	MV high/low limit alarm	Because shorter PLS setting and retry it.
93	Time over PV does not coincide with FLV even if TIM setting overshoots.	Become shorter FLV or become PLS larger, and retry it.
95 84 82	Data error (response data abnormal) If the large disturbance is contained.	Retry it in same condition.
81	Excessive gain Delay time constant is larger than pulse-on.	Become FLV larger or become PLS shorter.

4.3.6 System function setting code

Function of each code is displayed and set.

Indication	Name	Value	Range
PNR3-***			
SYS CH.			
CONF CH.			
X00	Module code		41 Fixed
X01	Device function code		33 Fixed
X02	Control function code	30 ~ 37	30: Function setting PID control 31: PID control 32: Cascade control 33: Ratio control 34: Program setting control (PGC) 35: Program setting control (PGS) 36: Program setting control (PLC) 37: Program setting control (PLS)
X03	Setting method	30, 31	30: A-M Type 31: R-A-M type
X04	Auto-tuning function setting	30, 31	30: Auto tuning function invalid 31: Auto tuning function valid
X05	Basic cycle	01 ~ 05	Setting value 0.1 sec. ~ 0.5 Sec. 24 wafer ..... 0.2 sec 48 wafer 0.4sec
X06	Station No.	01 ~ 6F	
X07	AI check designation	00 ~ FF	
X08	Designation of normal/reverse operation (Sub control block)	03, 0C	03: Normal operation 0C: Reverse operation
X09	Designation of normal/reverse operation (Main control block)	03, 0C	03: Normal operation 0C: Reverse operation
X10	Transmission method Transmission speed		RS-422/485 ..... 01: 2400 bps 02: 4800 bps 03: 9600 bps 04: 19200 bps T link ..... See the instruction manual for "T-link interface".

Indication	Name	Value	Range
X11	Code format		RS-422/485 ** Upper digit 0: Non-parity 1: Odd parity 2: Even parity Lower digit 1: 1 stop bit 2: 2 stop bit T-link ** Upper digit 0: 4 words (without input/output type) 1: 8 words 2: 16 words Lower digit 1: Input 2: Output 3: Input/output Transmission speed from STOP to RUN mode is effective.
X12	Data inhibit	00, 01	Data settable at 00 No data settable at 01
	Start mode		
X13	Designation of FLT/ALM retention		
X14	Alarm output	00 ~ 03	
X15	Input in remote operation	00 ~ 02	
X16	Selection on PV input signal	00 ~ 96	
X17 X18	Full stroke	sec. or pulse	Pulse width input: 0.1 ~ 3276.7 Pulse number input: 0 ~ 10000
	Unused		
X19	Temperature range (full scale)	˚C	
X20	Temperature range (base scale)	˚C	
X21 X22	Pass code	0000 ~ FFFF	Refer to 4.3.3
	Power failure recovery mode	%	
X23 X24	Bar graph indication mode of PV indicator	00~59FF	
X25	Bar graph indication mode of SV indicator		
X26	Bar graph indication mode of MV indicator		
X28	Loader interface (RS-232C)		

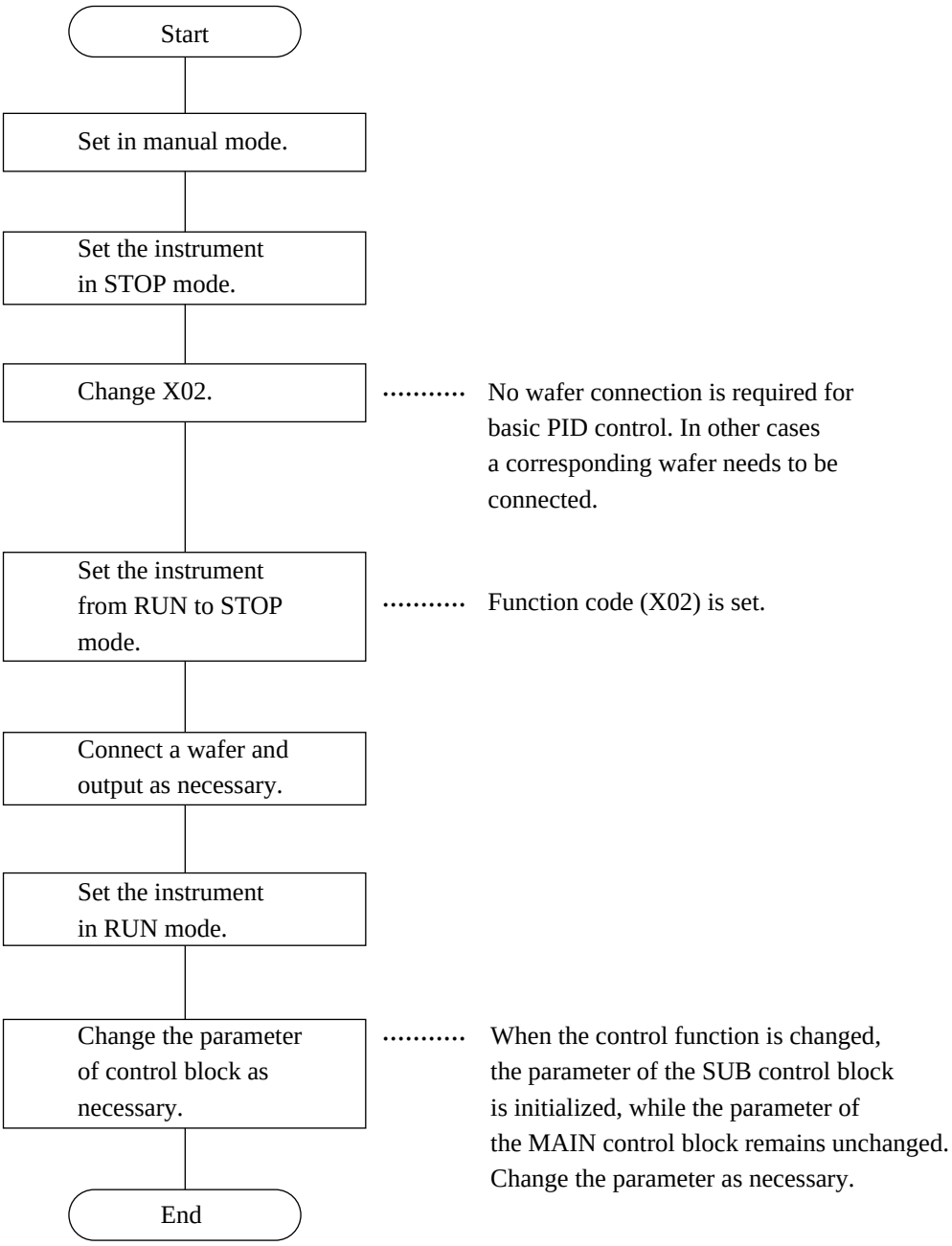
(1) X00 ~ X04 (Function code)

[Change method of control function]

Control function can be changed as shown in the following flow chart.

For the status setting of instrument, refer to 4.3.4 RUN/STOP of controller.

This change is invalid when X01 is "31".



(2) X06 (Station No. setting)

Set the station No. in a hexadecimal number in X06.

With RS422/485 ..... 01 to 1F

With T-link ..... 00 to 6F

When the station No. is duplicated, note that the correct transmission can't be performed.

When the uppermost bit of X06 is ON (81 at station No. 01, and 9F at 1F) the setting of the data being transmitted is prohibited (except T-link).

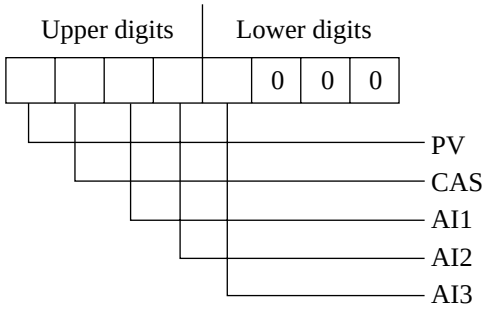
The station No. which has been set is effective when the controller is set from the STOP mode to the RUN mode.

(3) X07 (AI check designation)

Designate the check of analog input

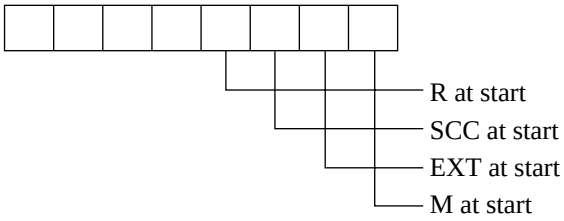
Make the setting in hexadecimal number with the right bit configuration

The analog input whose corresponding bits are on becomes the check object, and an input voltage outside a range of 0.5 to 5.5V results in a FLT 6.



(4) X13 (Start mode setting)

The operation mode at initial start can be designated in the following way.

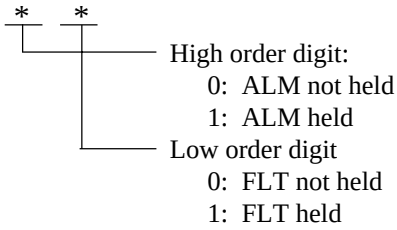


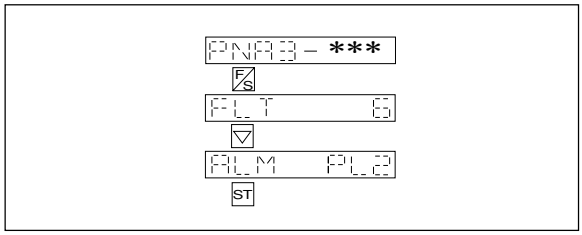
M, R is not designition: A

X13		Mode	SCC mode
INT	EXT		
00	02	A mode	OFF
01	03	M mode	
08	0A	R mode	
04	06	A mode	ON
05	07	M mode	
0C	0E	R mode	

(5) X14 (Designation of FLT, ARM retention)

With this setting, a FLT/ALM occurring will be held and the front panel lamp indication and external output will continue. Make the setting as follows.





Even if the cause of a FLT/ALM is eliminated, the data on a item for which the retention is designated can be read out as shown upper. By pressing the ST button, the held information is released.

(6) X15 (Alarm output)

When setting this data, put the controller in STOP mode.

00: No alarm output
01: PV high/low limit alarm output
02: DV high/low limit alarm output
03: ΔPV change rate high/low limit alarm output

Set the output of the high/low limit alarm of PV, DV and ΔPV, when basic control type PID is selected.

The connection of alarm setting is necessary individually, with programable type is selected.

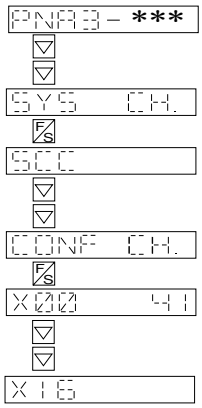
When the corresponding alarm is detected, the H/L indicator lamp on the front panel lights up and the H/L contact is turned ON.

After setting, this data will be valid by changing the controller from the STOP to the RUN status.

(7) X16 (Input designation in remote operation)

The selection of external set value input (CAS) and pulse width input (PI) of external signal should be designated in remote operation, when basic control type is selected.

[Setting method]



Designate the external signal

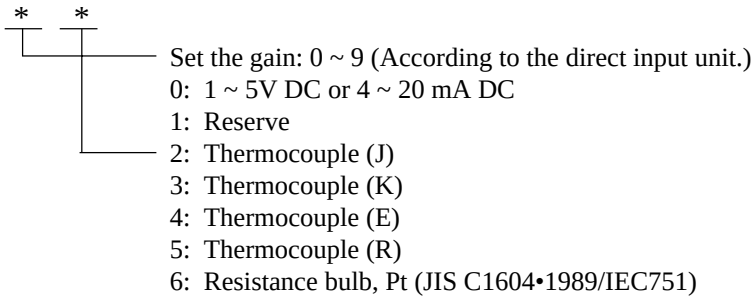
00 ..... CAS input used
01 ..... PI (pulse width) input used
02 ..... PI (pulse number) input used

For selection of pulse input (PI), the full stroke of PI must be set in X18.

(8) X11 (Selection on PV input signal)

Select a measured value input, DC1 ~ 5V, DC4 ~ 20mA, thermocouple (J, K, E, R) input or resistance bulb input.

Select a measured value input signal as shown below.



(9) X20, X21 (Setting of temperature range)

Full scale : -3276 ~ 3276.7˚C
Base scale : -3276 ~ 3276.7˚C

When a resistance bulb or thermocouple input is selected by "X12 (PV input signal selection)", the corresponding temperature range should be set. Input signal is converted into unified data (0~100%) according to individual setting.

When temperature input is indicated in industrial values, it should be set in advance according to the setting of industrial values in "4.3.7 Dimension channel".

(10) X23 (Setting of power failure recovery mode)

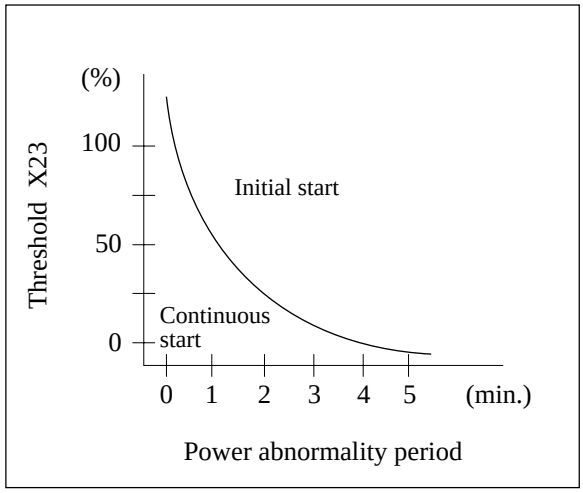
When power is interrupted to the controller due to power failure or the like, the power failure time is detected. So set either initial start or continuous start for when the power is recovered.

① Initial start

In this method, the parameters are transferred form the non-volatile memory to the main memory, the interior is initialized and then a computation start is made. MV becomes the preset values.

② Continuous start

In this method, start is made while carrying out computation continuously from the status before power failure. Power failure time detection is settable as follows using a threshold X23.



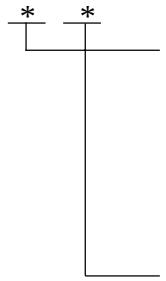
By setting X23 = 50%, continuous start will be made versus a power failure of about 1 minute.

(11) X24, X25, X26 (Changeover of bargraph indication mode)

Change the bargraph indication mode by using X24, X25 and X26.

- X24: PV indicator
- X25: SV indicator
- X26: MV indicator

The setting data becomes as follows.



High order digit
- 0: Usual indication
- 1: Line segment indication
- 2: Indication based on center of indicator
- 3: Inverted indication
- 4: Line segment indication based on center of indicator
- 5: Inverted line segment indication

Low order digit
- 0: PV indication
- 1: KPV indication
- 2: CAS indication
- 3: SV indication
- 4: MV indication
- 8: KPV-SV indication
- 9: PV-SV indication

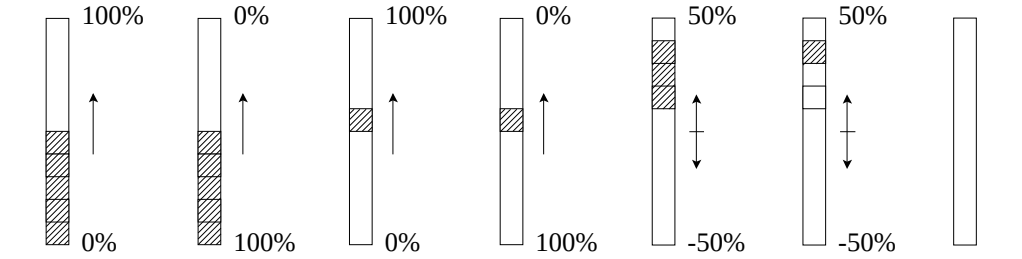
If bar graph display is not required, it can be disabled by setting X24, X25 and X26 to "FF".

Note

When a deviation value is to be displayed on bar graph (lower digit = 8 or 9), the upper digit should be set to 2 or 4. When any values other than deviation values are to be displayed on bar graph (lower digit = 0, 1, 2, 3, 4), the upper digit should be set to 0, 1, 3, or 5.

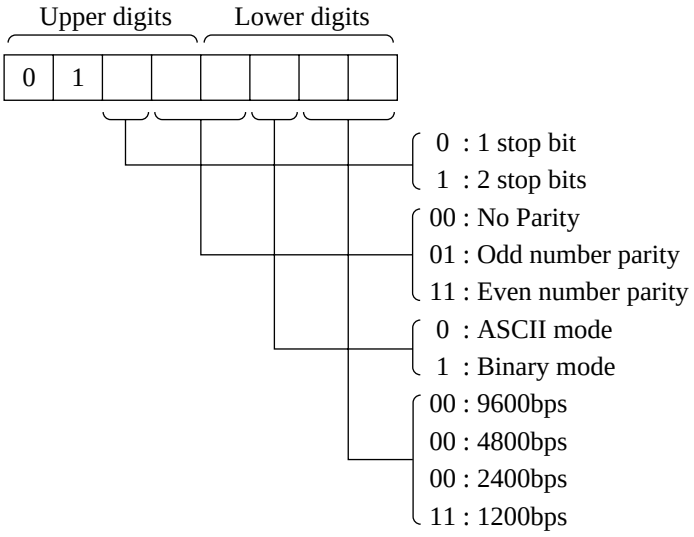
(1) PV can be indicated in analog value

(2) Indication format can be selected from the following 7 patterns.



(12) ｘｺﾎﾞ (Loader interface (RS-232C) setting)

When setting the loader interface (RS-232C), use the following codes in hexadecimal numbers.



Codes from STOP to RUN mode are effective.

4.3.7 Dimension Channel

Each function should be set to display data in industrial values.

Indication	Name	Unit	Indication and Setting code
PNB3-***			
SYS CH.			
DIM CH.			
dm1	Full scale (Sub control block)	Industrial value	-9999 ~ 32767
dm2	Base scale (Sub control block)	Industrial value	-9999 ~ 32767
dm3	Point position (Sub control block)	Industrial value	0 ~ 4
DM1	Full scale (Main control block)	Industrial value	-9999 ~ 32767
DM2	Base scale (Main control block)	Industrial value	-9999 ~ 32767
DM3	Point position (Main control block)	Industrial value	0 ~ 4

Note

When the basic control type or programable type PID control is selected in function code, dm1 to dm3 described above are not displayed.

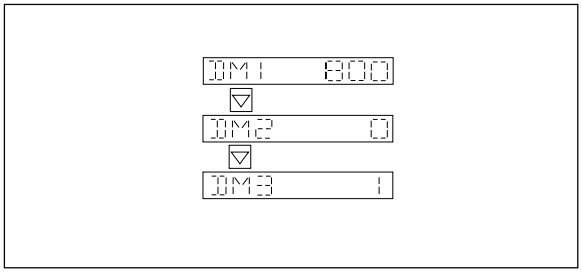
(1) Industrial value setting

Since PV, SV and RSV are indicated digitally in industrial values, set the full scale, base scale and decimal point position for the industrial values.

dm1 ~ dm3 corresponds to the SUB control block, while DM1 ~ DM3 corresponds to the MAIN control block.

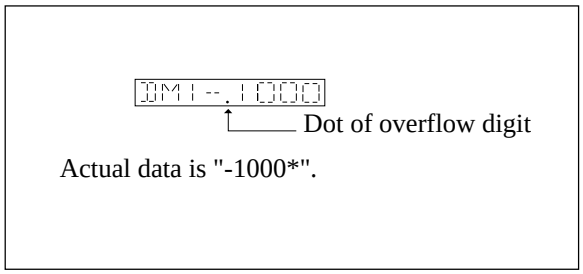
DM1 = 800
DM2 = 0
DM3 = 1

By setting an indica-tion of 0 to 100% will become 0 to 80.0.



Note) Industrial value setting range:
$|(\text{Full scale}) - (\text{Base scale})| \leq 32767$

When dm1, dm2, DM1 and DM2 are set in 5 digits of negative number such as -10000, only the upper 4 digits with digit overflow dots are displayed.



4.3.8 Test channel

Test channnel is used for testing analog input and output, digital input, and output, and transmission.

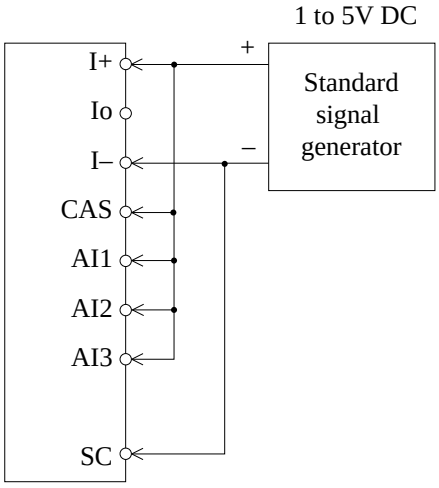
Indication	Name	Unit	Indication Range
PNB-***			
SYS CH.			
TEST CH.			
AI1	Analog input value *	%	-25.00 ~ 125.00
AI2	Analog input value *	%	-25.00 ~ 125.00
AI3	Analog input value *	%	-25.00 ~ 125.00
TMP	Cold junction temperature *	˚C	-20.00 ~ 60.00
PV	Measured value input *	%	-25.00 ~ 125.00
CAS	External set value *	%	-25.00 ~ 125.00
MVA	Manipulated output readback value *	%	-25.00 ~ 125.00
VrF	Voltage for power failure time *	%	-25.00 ~ 125.00
AO1	Analog output value	%	-25.00 ~ 125.00
AO2	—	—	Unused
KPV	Compensation PV	%	-25.00 ~ 125.00
SV		%	-25.00 ~ 125.00
MI	Manipulated output value (Current)	%	-25.00 ~ 125.00
MV	Manipulated output value (Voltage)	%	-25.00 ~ 125.00
DI1	Digital input value *		Hexadecimal form
DI2	Digital input value *		Hexadecimal form
DO1	Digital output value		Hexadecimal form
DO2	Digital output value		Hexadecimal form
TRS	Transmission shuttle command		00, 01
TR1	Transmission shuttle testing data	%	-327.6 ~ 327.67
TR2	Transmission shuttle testing data *	%	-327.6 ~ 327.67

* : Data display only
** : Test should be made in STOP mode of the controller.

(1) Analog input check

① AI1, AI2, AI3, PV and CAS input

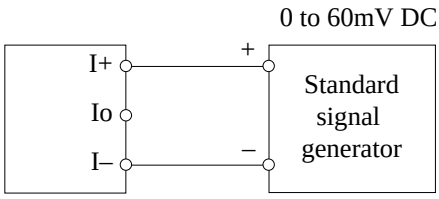
Apply DC1 to 5V to AI1, AI2, AI3, PV and CAS input terminals, then check the conversion data for each input using the test channel.



Read value	Input		
	1.000V	3.000V	5.000V
AI1	0.00%	50.00%	100.00%
AI2			
AI3			
PV			
CAS			

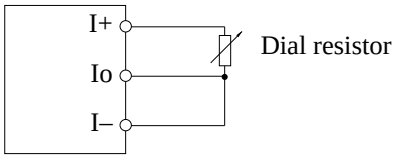
When PV is thermocouple or resistance bulb input, check the input as shown below. In this case, the PV input (X17) in the system configuration channel (CONF CH.) should be set to "00".

• Thermocouple input



Direct input gain	0%	50%	100%
At 7	0mV	9mV	18mV
At 6	0mV	18mV	36mV
At 5	0mV	30mV	60mV

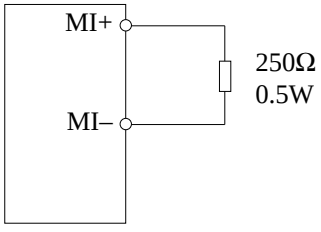
• Resistance bulb input



Direct input gain	0%	50%	100%
At 2	82Ω	111Ω	140Ω
At 1	82Ω	131Ω	180Ω
At 0	82Ω	183.5Ω	285Ω

MV read-back input

Check the MV read-back value at DC4 to 20mA of operation output. The operation output can be changed by setting the data to MI in the automatic (A) mode of CC-S.

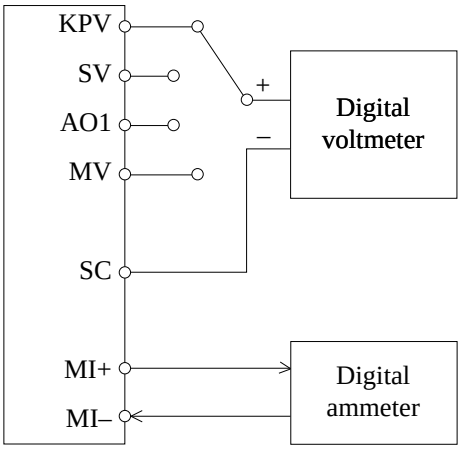


Operation output (MI) set value	0.00%	50.00%	100.00%
MVA	0.00%	50.00%	10.00%

(2) Analog output test

Check each output voltage after setting each output data using the test channel.

Note) When testing the operation output (MI), set the operation mode in "A".



Output	Output set value		
	0.00%	50.00%	100.00%
KPV	1V	3V	5V
SV			
A01			
MV			
MI	4mA	12mA	20mA

(3) Bar graph display test

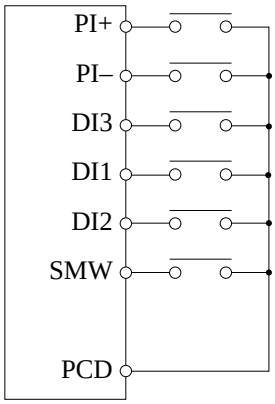
For testing the bar graph display, use the following procedures.

① Set the indicator display mode (X24, X25, X26) in the system configuration channel (CONF CH.) to "01" so that KPV is displayed on all the indicators.

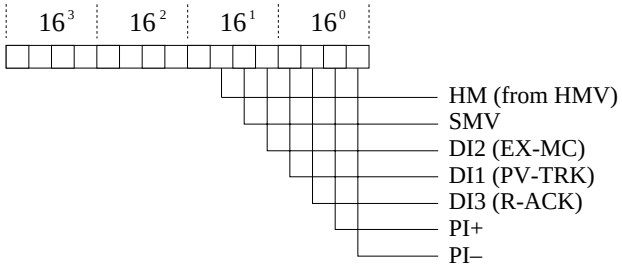
Set the data to KPV in the test channel and check the display accuracy of indicators.

(4) Digital input test

Using the following connections, check the data in the test channel at ON (contact closed) of each digital input.



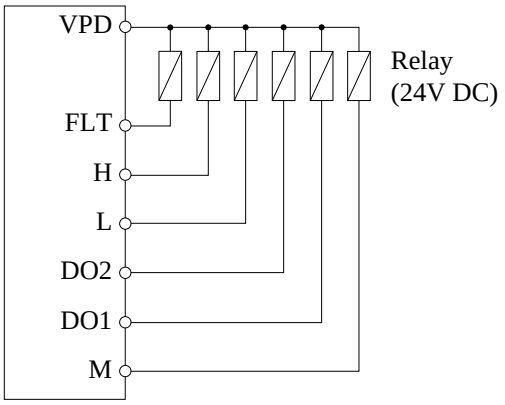
Each signal condition is displayed in hexadecimal number on D12, while the corresponding bit becomes "1" at ON of input.



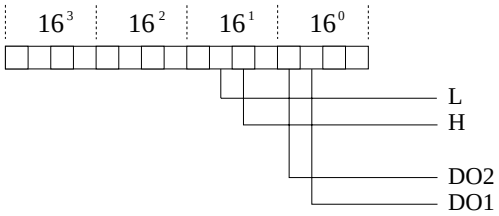
(5) Digital output test

Using the following connection, set "DO2" in the test channel and check that each output turns ON/ OFF.

If two or more outputs are turned ON simultaneously while using AC power, the digital input/output compensation power (VPO, PCO) could be overloaded (max. 0.1A). Therefore, digital outputs must be checked one by one.



Digital output condition is displayed in hexadecimal number on DO2, while the corresponding output turns ON when "1" is written in the corresponding bit.



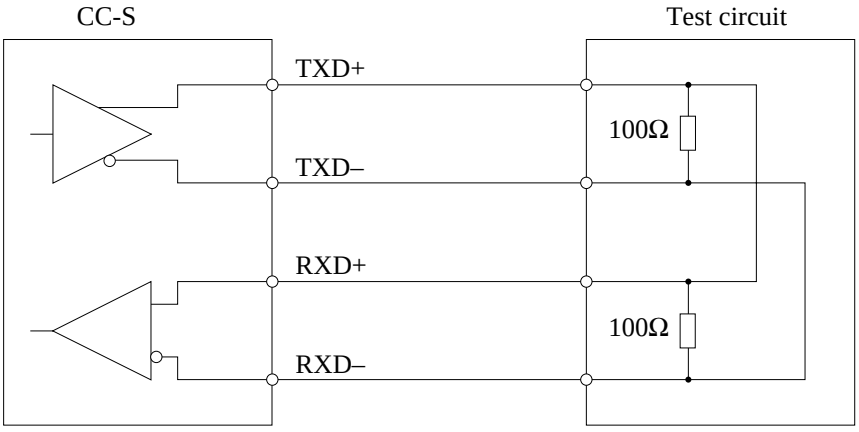
FLT output test : Output is obtained by setting the forward/reverse code (X09) in the system configuration channel (CONF CH.) to "00".

M output test : Output turns ON by pressing the M button on the front panel and turns OFF by pressing the A button.

(6) Transmission shuttle test

The following circuit is used for transmission shuttle test.

① RS-422/485



Test procedures

i) Set desired data in TR1 in the test channel.

ii) Transmission shuttle test is started by setting "01" in TRS 01 in the test channel. The display is automatically reset to "00" when the test is completed.

iii) The data set in TR1 is copied in TR2 by the shuttle of transmission.

② T-link

Shuttle transmission is effected in combination with MICREX-F.

5. INSPECTION AND MAINTENANCE

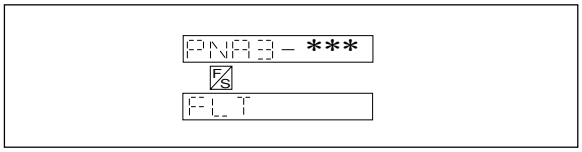
5.1 Inspection

The following points should be inspected periodically for keeping the instrument in good conditions.

- Screws will loosen if the instrument is always used in a place affected by vibration, so they should be tightened as needed during the inspection.
- There is a possibility of dust entering the instrument when used in a dusty place, so carry out cleaning during the inspection.

5.1.1 Fault diagnosis by means of operating buttons on front panel

If a fault occurs during operation of the instrument, the details of the fault will be indicated via the following setting and FLT indicator lamps on the front panel will light up.



Refer to error message in section 5.2.2 for details.

(1) Fault in computation/control circuit.

The FAULT lamp will light up, the FAULT contact output will turn ON and computation and control will stop. But manual operation of the manipulated output is possible.

(2) Input / Output signal fault, manipulated output disconnection

The FAULT lamp will light up, the FAULT contact output will turn ON and control will stop, but the manipulated output will be held. Computation and output processing for other than the manipulated output will continue in this case.

5.1.2 Input/output signal check

Input/output signal should be checked referring to Test Channel (4.3.8).

5.2 Troubleshooting

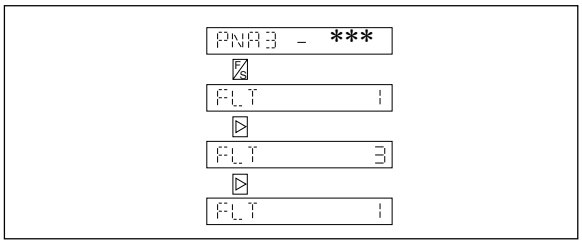
5.2.1 Instrument troubles and remedies

Trouble	Probable case	Remedy
Power is not supplied.	Power supply is not connected correctly.	Check the power supply connection and the instrument power supply specification.
	Power supply card is faulty.	Replace the power supply card.
Data cannot be indicated or set.	Main board is faulty.	Check the status of front panel indication and contact Fuji.
Indicator does not display anything.	Setting of indication mode (X24, X25, X26) is faulty.	Set correct data in X24, X25 and X26.
	Indicating section is faulty	Check the status of lamps and digital indications and contact Fuji.
SV doesn't change when pressing SV ▲ ▼ buttons.	Control mode is set to remote.	Press the A button.
	Hardware faulty	Check the indication of status channel DI1 and contact Fuji.
MV doesn't change when pressing MV ▲ ▼ buttons.	Hard manual mode is set.	Turn off the switch of HMV unit.
	SCC manual mode is set.	Press the M button
	Hardware faulty	Check the indication of test channel DI1 and contact Fuji.
FLT lamp is lit.	Fault detected by self-diagnosis program	See error messages in 5.2.2.
ALM lamp is lit.	PV, DV or △PV fault is detected.	See error messages in 5.2.2.
FLT and ALM can't be released.	FLT and ALM hold designation (CONF CH. X14) has been set.	Release the hold designation.
	FLT cause is not removed.	Remove the cause.
R or A lamp is flashing.	Flashes when the operation mode requested via the front panel and the actual operation mode differ (not a trouble).	———————
R mode not assumed by pressing R button	DO2 (R-REQ) and DI3 (R-ACK) not connected.	Connect these terminals.
	Digital I/O power supply (VPD, PCD) not input.	Input this power supply.
DI and DO don't operate.	Digital I/O power supply (VPD, PCD) not input.	Input this power supply.
	Hardware faulty.	Check the indication of status channels DI2 and DO2 and contact Fuji.

5.2.2 Error messages

(1) Fault information

If a fault occurs in the instrument, the FLT lamp on the front panel will light up and the FLT contact will turn ON. For indication of the fault contents, use the operating procedure explained below.
The fault information is indicated by numerals 1 to 8, 10 and 13. If two or more faults occur simultaneously, they can be indicated alternately by pressing the ▷ button.



Indicating lamp	Trouble	Cause
FLT1	Non-volatile memory abnormal	Integrated value of non-volatile memory is abnormal. Basic cycle over.
FLT2	Wafer connection error	Incorrect code is used for wafer connection, process output connection or SCC output connection.
FLT3	Normal/reverse designation abnormal	Normal/reverse operation designation code is wrong.
FLT4	Fixed cycle interruption abnormal	Fixed cycle interruption is not generated.
FLT5	A/D converter abnormal	A/D convertion is incorrect.
FLT6	Analog input abnormal	Input of PV, CAS, AI 1, AI 2 or AI 3 in which AI input check is designated is rangeover.
FLT8	Operation output abnormal	When the operation output value does not conform to the read-back value, the instruments becomes abnormal.
FLT10	Front panel failure	Failure of front panel control processor.
FLT13	MV clock abnormal	Failure of MV up/down clock.

(2) Alarm information

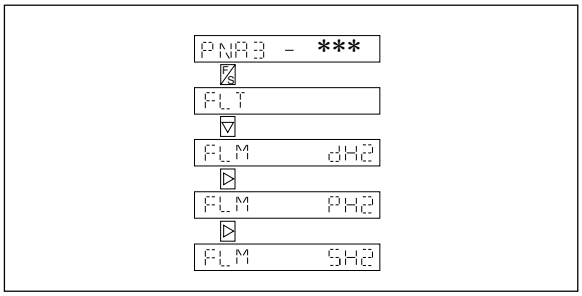
When an alarm occurs, one of the H/L lamps on the front panel lights up and the H/L contact turns ON. For indication of the alarm contents, operate according to the procedure explained below.

*) In the function setting type, H/L lamp or H/L contact output is emitted based on 4.2.6 “X15 (Alarm output)”. For other control functions, it is necessary to connect the process output.

Alarm information of primary and secondary control blocks is indicated as follows.
If two or more alarms occur simultaneously, they can be indicated alternately by pressing the ▷ button.

[Alarm contents]

- PH1, PH2 ..... PV high limit alarm
- PL1, PL2 ..... PV low limit alarm
- DH1, DH2 ..... Control deviation high limit alarm
- DL1, DL2 ..... Control deviation low limit alarm
- PH1, PH2 ..... PV change rate high limit alarm
- PL1, PL2 ..... PV change rate low limit alarm
- SH1, SH2 ..... Set point high limit alarm
- SL1, SL2 ..... Set point low limit alarm
- OH1, OH2 ..... Manipulated output high limit alarm
- OL1, OL2 ..... Manipulated output low limit alarm
- OH1, OH2 ..... Manipulated output change rate absolute value high limit alarm



The figure at the right shows alarms occurring at DH2, PH2 and SH2.

(3) Error messages at digital indication/setting

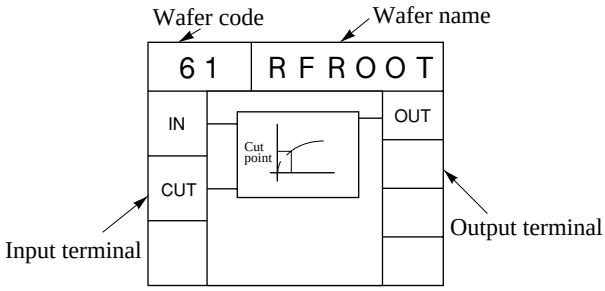
Indication	Meaning
Err 10	The key operating procedure is incorrect.
Err 20	Setting impossible, only indication possible.
Err 21	Set point data exceed the high limit of setting range.
Err 22	Set point data are below the low limit of setting range.
Err 23	Set point data exceed the internal processing range.

6. WAFER CONNECTION

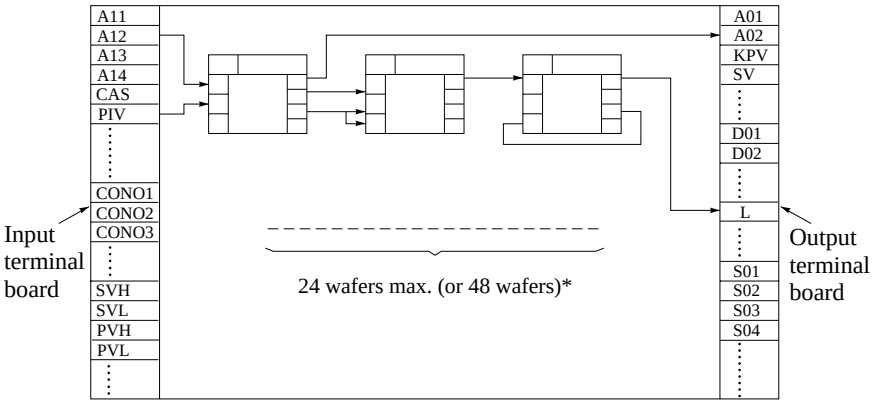
6.1 Wafer

6.1.1 Outline of wafer

The programmable compact controller S carries out control and computation by means of a combination of functional blocks called wafers. A single wafer can input up to 3 signals for computation and output the computation result to a maximum of 4 output terminals. The following shows the wafer symbol.



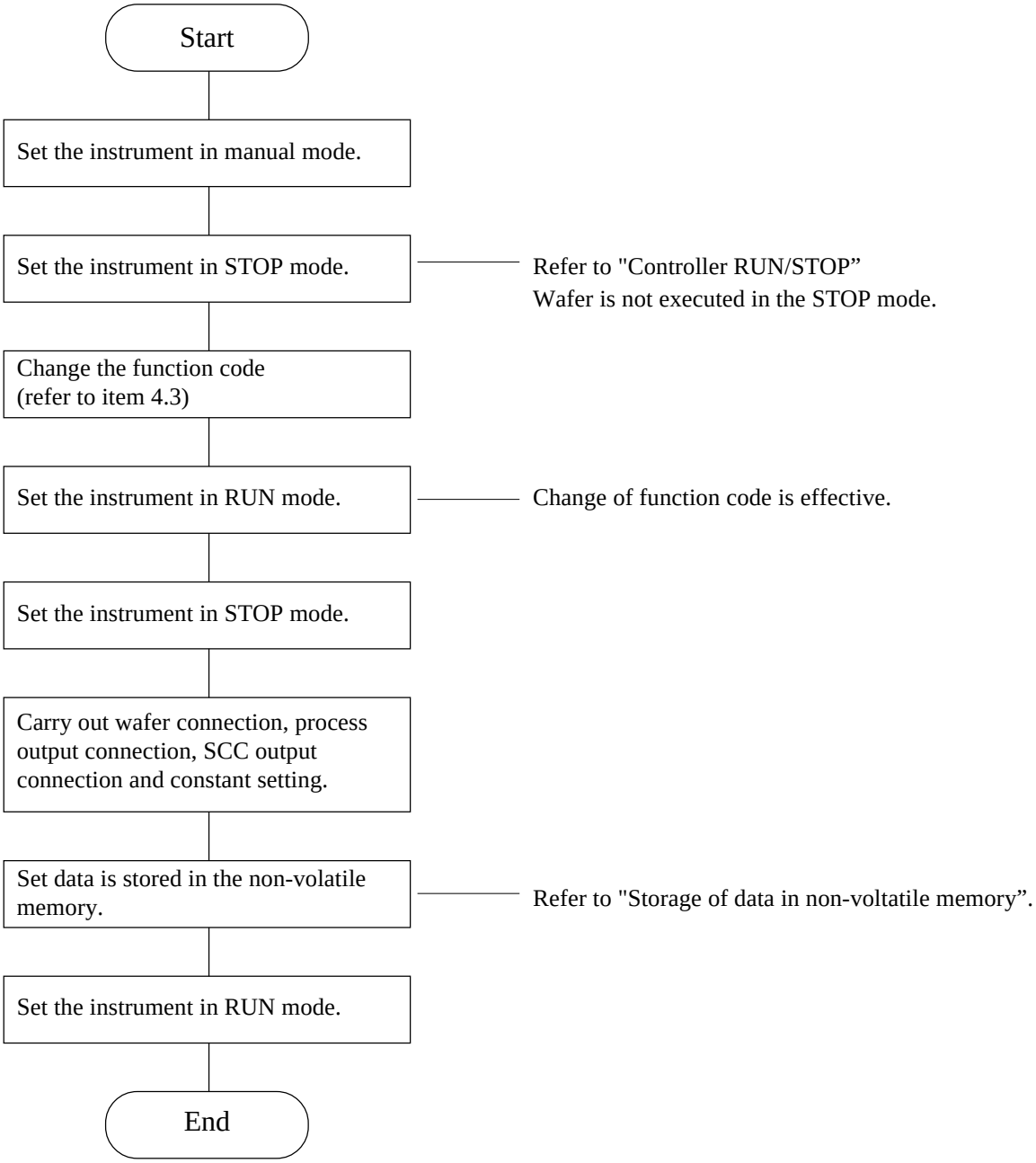
A maximum of 24 wafers (or 48 wafers) can be registered in the wafer area shown in the figure below. In this area, there is an input terminal board for storing external inputs, constants, RAS information and the like, and an output terminal board for designating external output and transmission output, so computation can be applied to a suitable input and the result output to the exterior. (For wafer connection, refer to table of wafers.)



*) Depends on code symbols.

6.1.2 Wafer connection procedure

For wafer connection, use the following procedures.



6.1.3 Display of wafer channels

Indication	Name	Range	Remarks
PNA3-***			
SYS CH.			
⋮			
FIX CH.	Storage of data in non-volatile memory	00: Display after data storage normal end 01: Transfer of data to non-volatile memory	
PAS	Pass code	0000–FFFF	Pass is released only when this matches pass setting "X22".
RUN	Instrument operation	00: Operation STOP 00: Operation START	
⋮			
WFC CH.	Wafer connection channel		
POC CH.	Process output connection channel		
SOC CH.	SCC output connection channel		
WFO CH.	Wafer output indication channel		
SIN CH.	SCC input indication channel		
⋮			
RET			

6.2 Wafer connection

6.2.1Wafer connection channel

Wafer connection data should be set to enable calculation functions required for control.

For connection data, input terminal board or wafer output terminal code should be set in wafer code and input terminals 1-3. For the setting code, refer to the wafer connection table and input terminals.

Indication	Name	Range	Remarks
PNB-***			
SYS CH.			
WFC CH.			
W01-	Wafer code of execution sequence 1	Pure binary code	Wafer of execution sequence 1
W011	Input terminal 1 of execution sequence 1		
W012	Input terminal 2 of execution sequence 1		
W013	Input terminal 3 of execution sequence 1		
⋮			
W24-	Wafer code of execution sequence 24	Pure binary code	Wafer of execution sequence 24
W241	Input terminal 1 of execution sequence 24		
W242	Input terminal 2 of execution sequence 24		
W243	Input terminal 3 of execution sequence 24		
⋮		Pure binary code	Wafer of execution sequence 48
W48-	Wafer code of execution sequence 48		
W481	Input terminal 1 of execution sequence 48		
W482	Input terminal 2 of execution sequence 48		
W483	Input terminal 3 of execution sequence 48		

Note

The number of wafer displayed varies with code symbols.

24 wafers ..... Execution sequence up to 24 wafers

48 wafers ..... Execution sequence up to 48 wafers

6.2.2 Process output connection channel

To output signals to the bar graph indicator and external terminals, wafer output terminal or input terminal board code should be set in P01–P32.

For the setting code, refer to the wafer connection table and input terminals.

Indication	Name	Range	Remarks
PNB3-***			
SYS CH.			
POC CH.			
P01	Process output terminal 1	Pure binary code	A01
P02	Process output terminal 2	Pure binary code	—
P03	Process output terminal 3	Pure binary code	KPV
⋮			
P32	Process output terminal 32	Pure binary code	

6.2.3 SCC output connection channel

When the desired data are arranged and outputted through SCC (transmission), wafer output terminal or input terminal board code should be set in S01–S16.

For the setting code, refer to the wafer connection table and input terminals.

Indication	Name	Range	Remarks
PNB3-***			
SYS CH.			
SOC CH.			
S01	SCC output terminal 1	Pure binary code	
S02	SCC output terminal 2	Pure binary code	
⋮			
S16	SCC output terminal 16	Pure binary code	

6.2.4 Wafer output indication channel

Output data of executed wafers can be displayed.

24 sheets of executed wafers: O00–05F

48 sheets of executed wafers: O00–OBF

Indication	Name	Range	Remarks
PNR3-***			
SYS CH.			
WFO CH.			
O00	Wafer output 1 of execution sequence 1	-327.6% ~ 327.67%	Wafer of execution sequence 1
O01	Wafer output 1 of execution sequence 2		
O02	Wafer output 1 of execution sequence 3		
O03	Wafer output 1 of execution sequence 4		
⋮			
O5C	Wafer output 24 of execution sequence 1	-327.6% ~ 327.67%	Wafer of execution sequence 24
O5D	Wafer output 24 of execution sequence 2		
O5E	Wafer output 24 of execution sequence 3		
O5F	Wafer output 24 of execution sequence 4		
⋮			
OBC	Wafer output 48 of execution sequence 1	-327.6% ~ 327.67%	Wafer of execution sequence 48
OBD	Wafer output 48 of execution sequence 2		
OBE	Wafer output 48 of execution sequence 3		
OBF	Wafer output 48 of execution sequence 4		

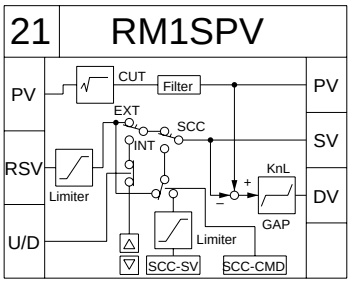
6.2.5 SCC input indication channel

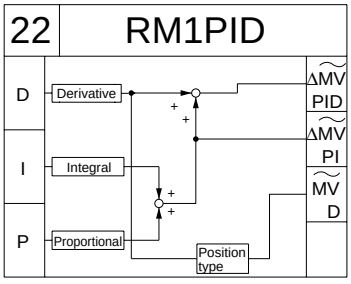
When the desired data are arranged and inputted through SCC (transmission), the received data can be displayed by R01–R16.

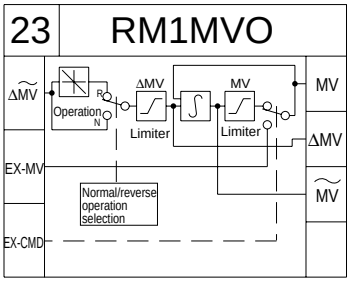
Indication	Name	Range	Remarks
PNR3-***			
SYS CH.			
SIN CH.			
R01	SCC input terminal 1	-327.6% ~ 327.67%	
R02	SCC input terminal 2	-327.6% ~ 327.67%	
⋮			
R16	SCC input terminal 16	-327.6% ~ 327.67%	

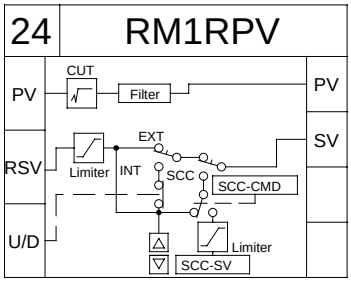
6.3 Table of Wafer

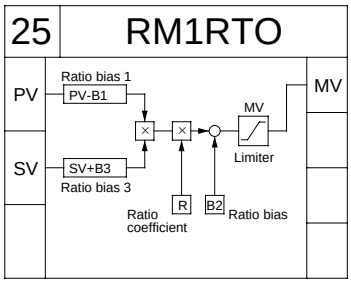
6.3.1 SUB control block

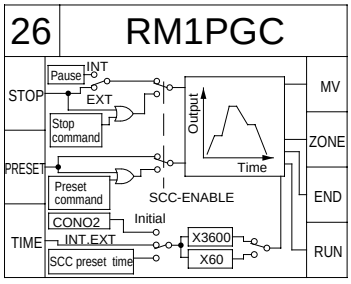


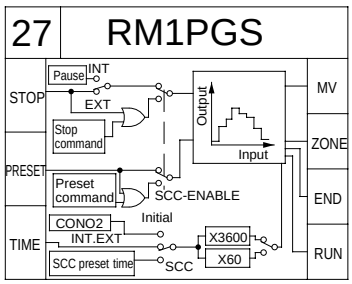


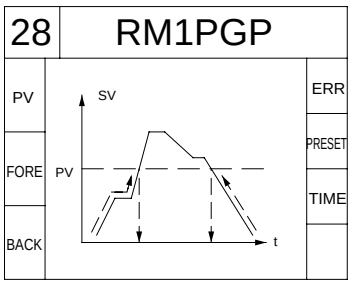


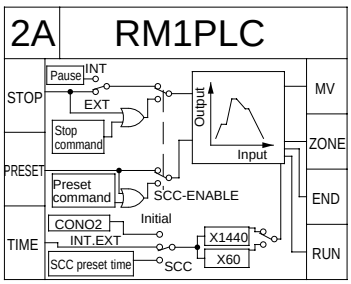


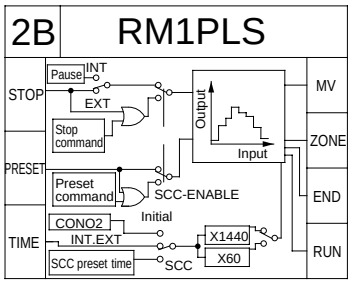


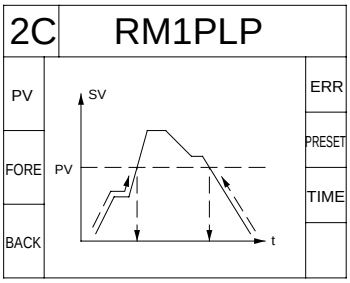


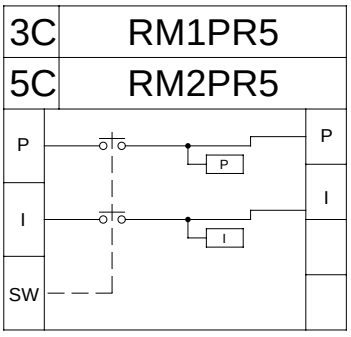


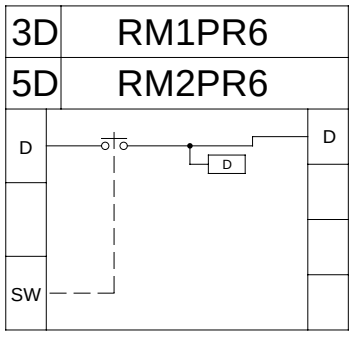




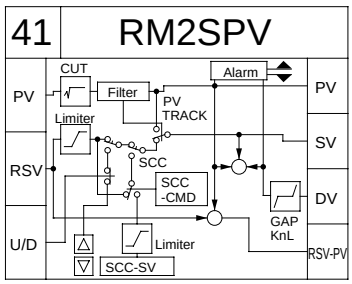


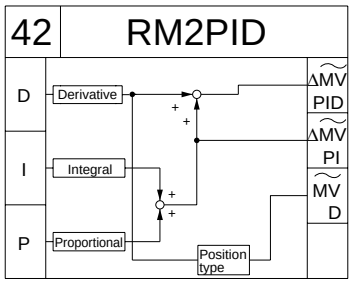


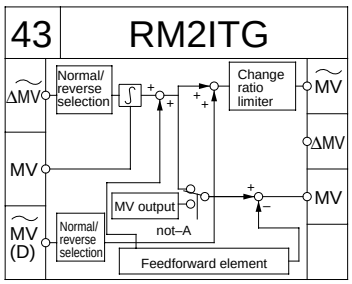


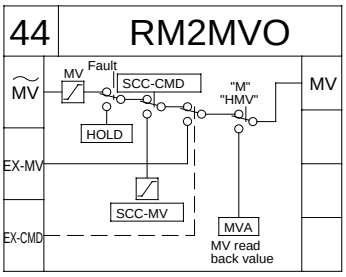


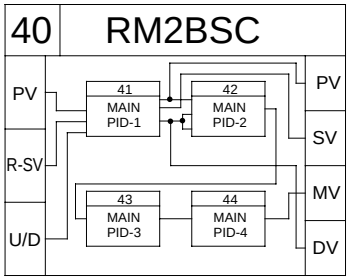
6.3.2 MAIN control block

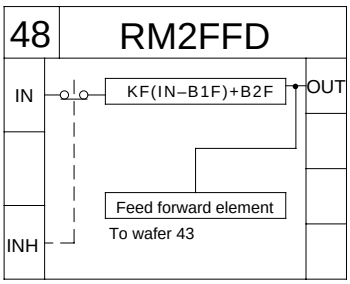


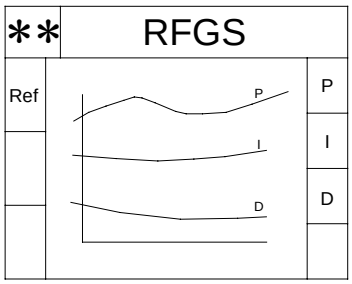


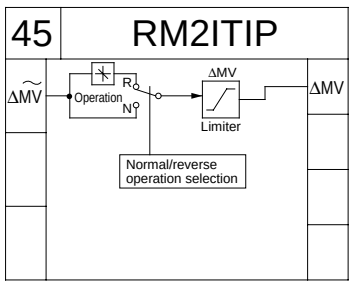


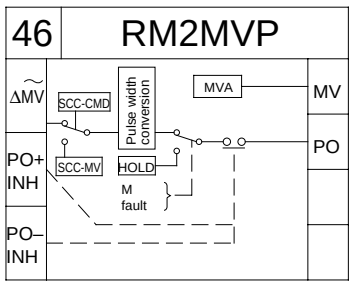




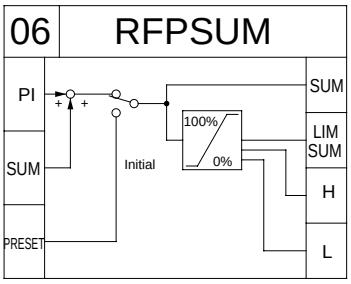


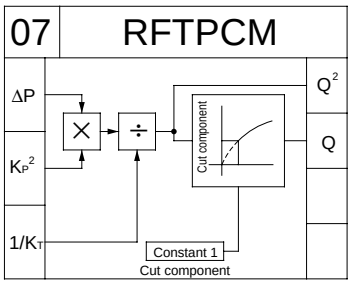


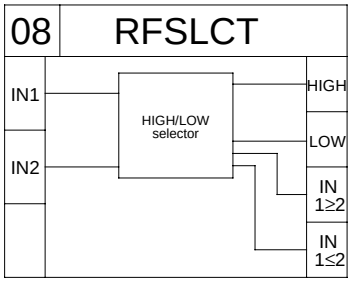


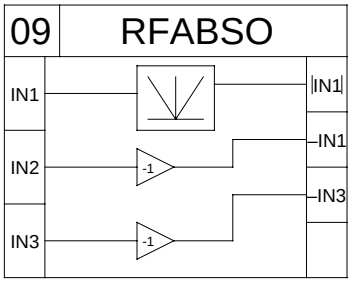


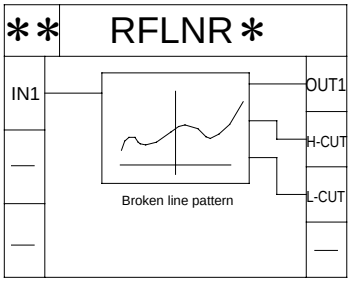
6.3.3 Computation wafer (1/4)

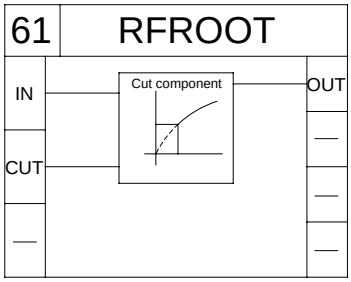


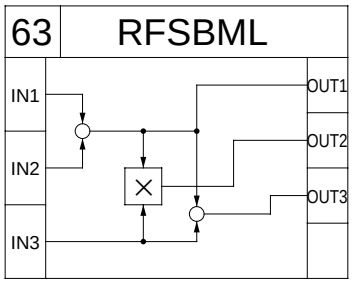


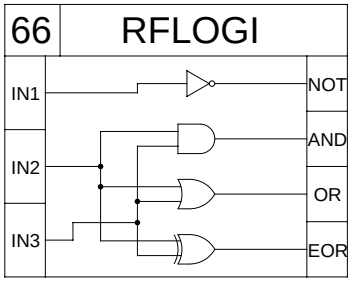


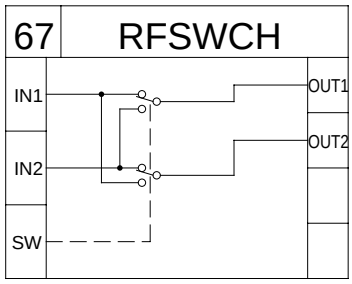


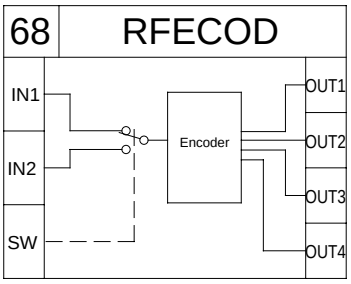


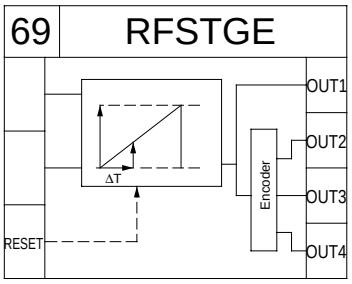


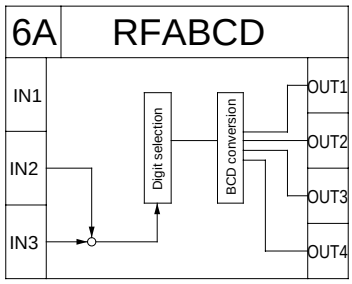


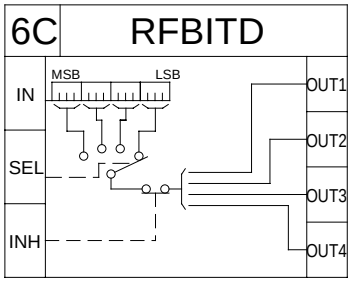


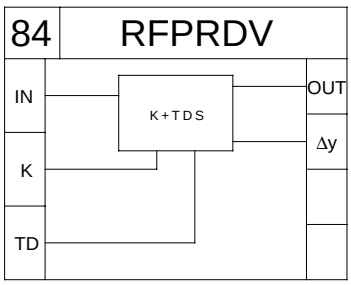


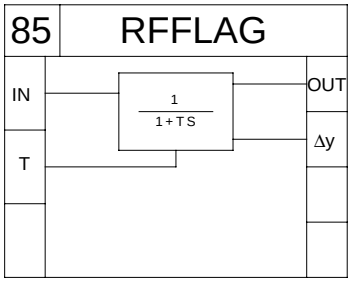




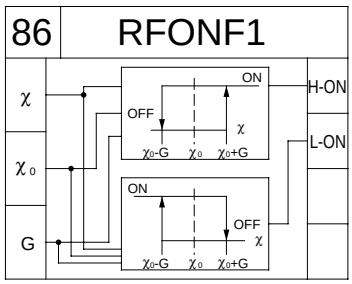


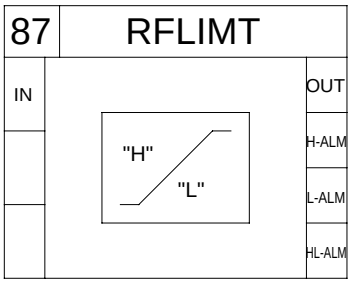


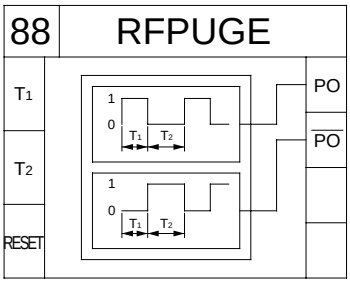


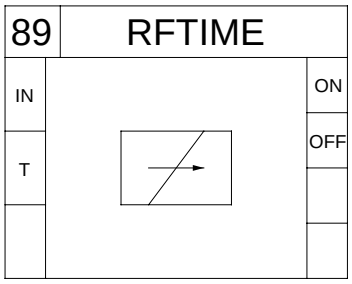


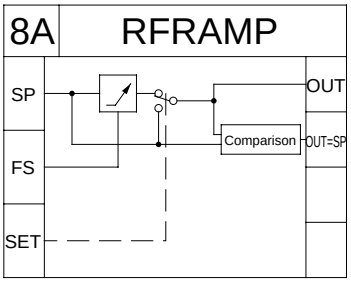
Computation wafer (2/4)

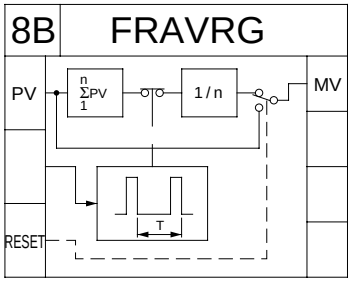


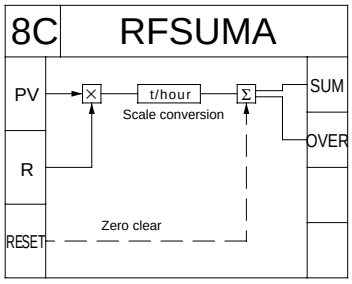


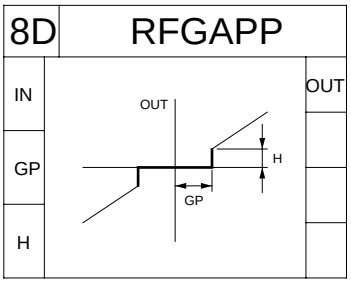


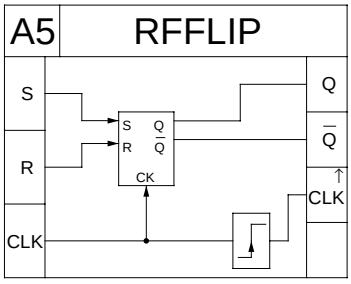


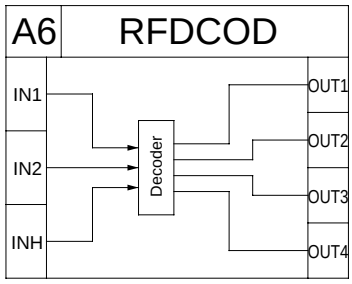


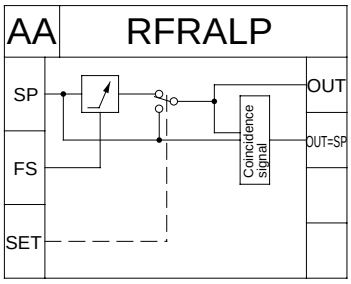


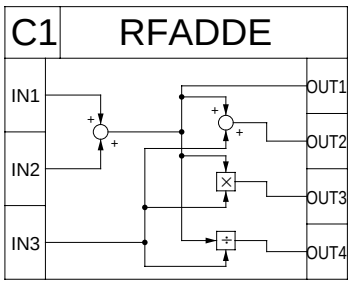


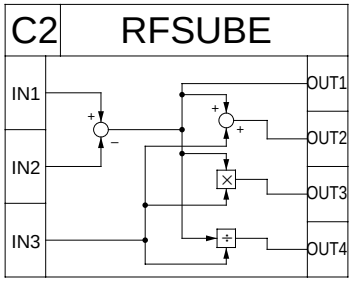


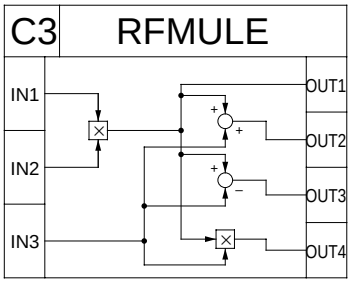


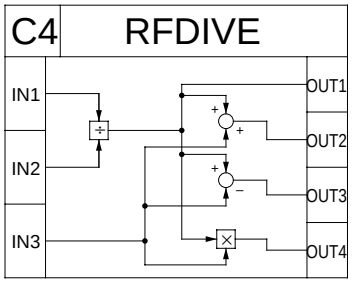




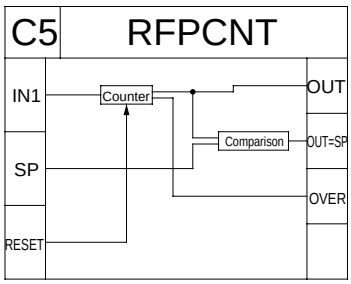


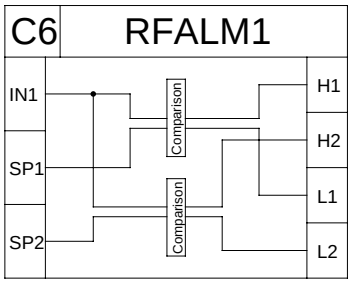


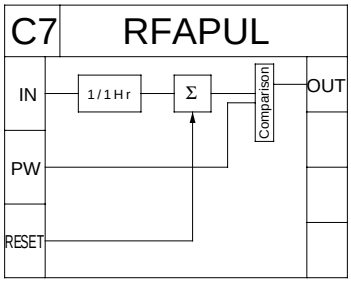


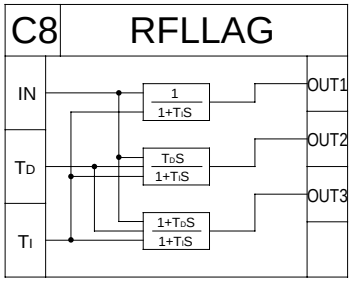


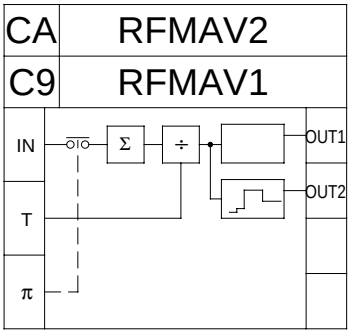
Computation wafer (3/4)

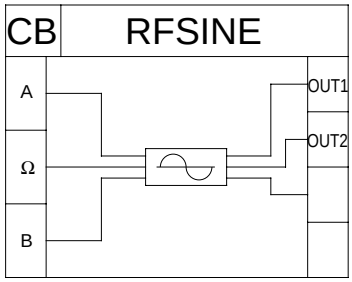


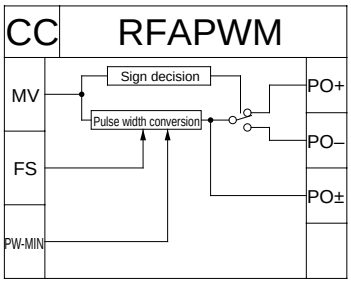


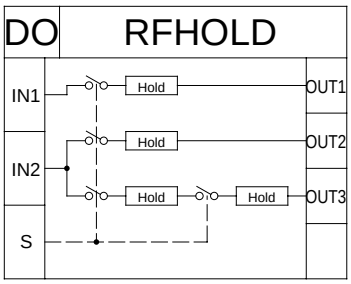


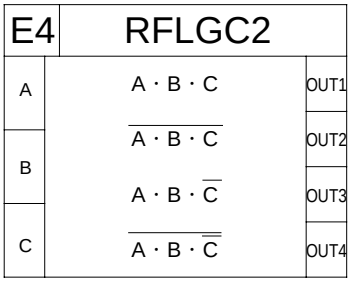


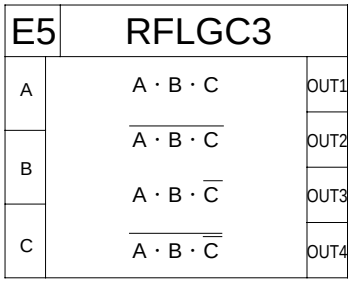


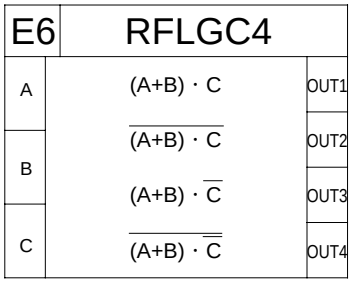


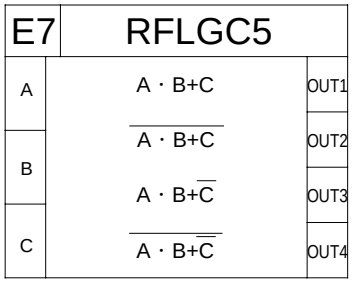


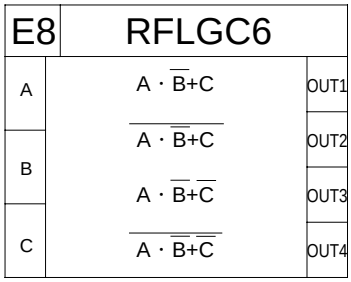




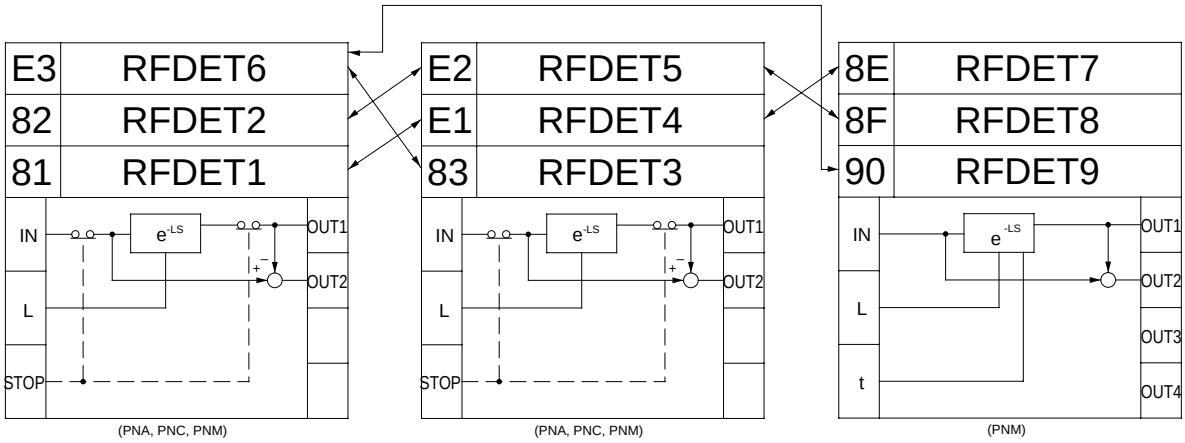




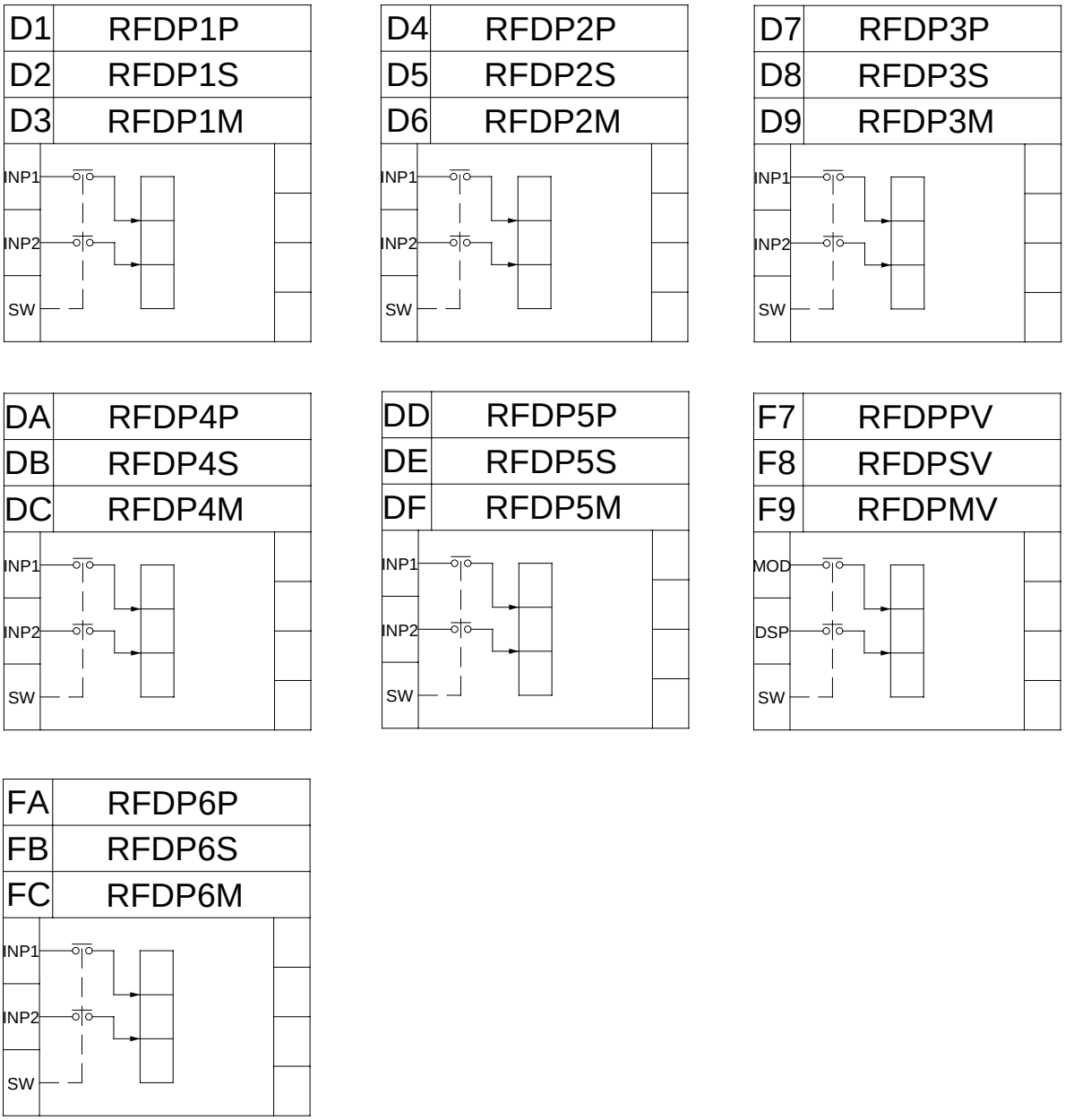




Computation wafer (4/4)



One of paired wafers only is employable.



6.4 Descriptions of terminals

6.4.1 Input terminal

(1) Front SW input terminal

Abbreviation	Code	Content	Range of value
MV ▼	008	It becomes on, when MV ▼ button of the front panel is pushed.	0/1
MV ▲▼	009	It becomes on, when MV ▲▼ button of the front panel is pushed.	0/1
MV ▲	00A	It becomes on, when MV ▲ button of the front panel is pushed.	0/1
M M	00B	It becomes on, when M button of the front panel is pushed.	0/1
A A	00C	It becomes on, when A button of the front panel is pushed.	0/1
R R	00D	It becomes on, when R button of the front panel is pushed.	0/1
SV ▼	00E	It becomes on, when SV ▼ button of the front panel is pushed.	0/1
SV ▲	00F	It becomes on, when SV ▲ button of the front panel is pushed.	0/1

(2) Pulse width input terminal

Abbreviation	Code	Content	Range of value
PI	010	The change rate of pulse width input by external pulse width input signal (PI+, PI -) for each basic cycle is outputted. When PI+ signal is ON, output becomes (basic cycle/full stroke) × 100%	-327.67 ~ 327.67%
DSV	011	The change rate of SV by SV increase/descrease button for each basic cycle is outputted. When SV button is ON, output becomes (basic cycle/40 seconds) × 100%	-1.25 ~ 1.25%

(3) Analog input

Abbreviation	Code	Content	Range of value
AI 1 AI 2 AI 3 CAS MVA	030 031 032 034 037	The value of analog input AI 1, AI 2 and CAS and also W+, W- and Wo. Input voltage 1 ~ 5V is equal to 0 ~ 100% In case of AI input check specification, the input secified as “with check” is limited to the ranges of -12.5 ~ 112.5% (0.5 ~ 5.5V).	-327.67 ~ 327.67%
TMP	033	Cold junction temperature	-20.00 ~ 60.00°C
PV	035	Process value input When the process value is1 ~ 5V: 1 ~ 5V corresponds 0 ~ 100% When the process value is 4 ~ 20mA: 4 ~ 20mA corresponds 0 ~ 100% When the process value is resistance bulb and thermocouple: base ~ full scale of temperature range corresponds to 0 ~ 100%	-327.67 ~ 327.67%

(4) Digital input

Abbreviation	Code	Content	Range of value
DI3	09D	The value of digital input signal DI1 ~ DI3	0/1
DI1	09E		
DI2	09F		
HM	0A1	HM switch	0/1
SMV	0A2	SMV switch	0/1
PI-	0A6	PI- input signal	0/1
PI+	0A7	PI+ input signal	0/1

(5) SCC input

Abbreviation	Code	Content	Range of value
R 01 ~ R 16	200 ~ 20F	Input data via the transmission. The setted data of this terminal board from the host system can be used wiring of the wafer.	-327.67 ~ 327.67%

(6) Fault information

Abbreviation	Code	Content	Range of value
FLT 1 ~ FLT 13	300 ~ 30C	Fault information of instrument. The corresponding code becomes on “1” at the time of fault occurrence.	-327.67 ~ 327.67%

(7) RAS information

Abbreviation	Code	Content	Range of value
INIT	321	On “1” is setted during initial processing.	0/1
FLT	322	Instrument fault information. Logic sum of FLT1 ~ FLT13	0/1

(8) Constant

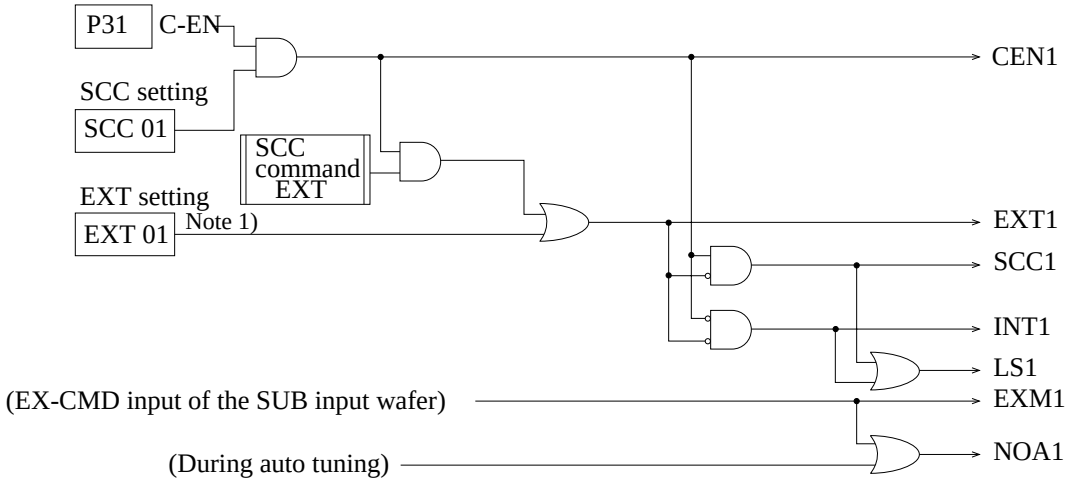
Abbreviation	Code	Content	Range of value
CON 01 ~ CON 48	880 ~ 8AF	Constant data. CON 01 can be used at the time of temperature and pressure correction wafer use, because CON 01 is used as a low cut point of temperature and pressure correction wafer (007).	-327.67 ~ 327.67%

(9) SUB block control mode terminals

SUB block control mode is set to the following input terminal code.

Abbreviation	Code	Content	Range of value
EXM1	912	"1" on EX-MV mode	0/1
SCC1	914	"1" on SCC mode	
EXT1	915	"1" on EXT mode	
INT1	916	"1" on INT mode	
NRM1	918	"1" on normal operation	
AT1	919	"1" on auto tuning	
PRE1	91A	"1" while program setting wafer is preset.	
RUN1	91B	"1" while program setting wafer is running.	
NOA1	91C	"1" on no auto operation.	
CEN1	91D	"1" on SCC-ENABLE	
LS1	91E	"1" on INT or SCC	

SUB control block control mode



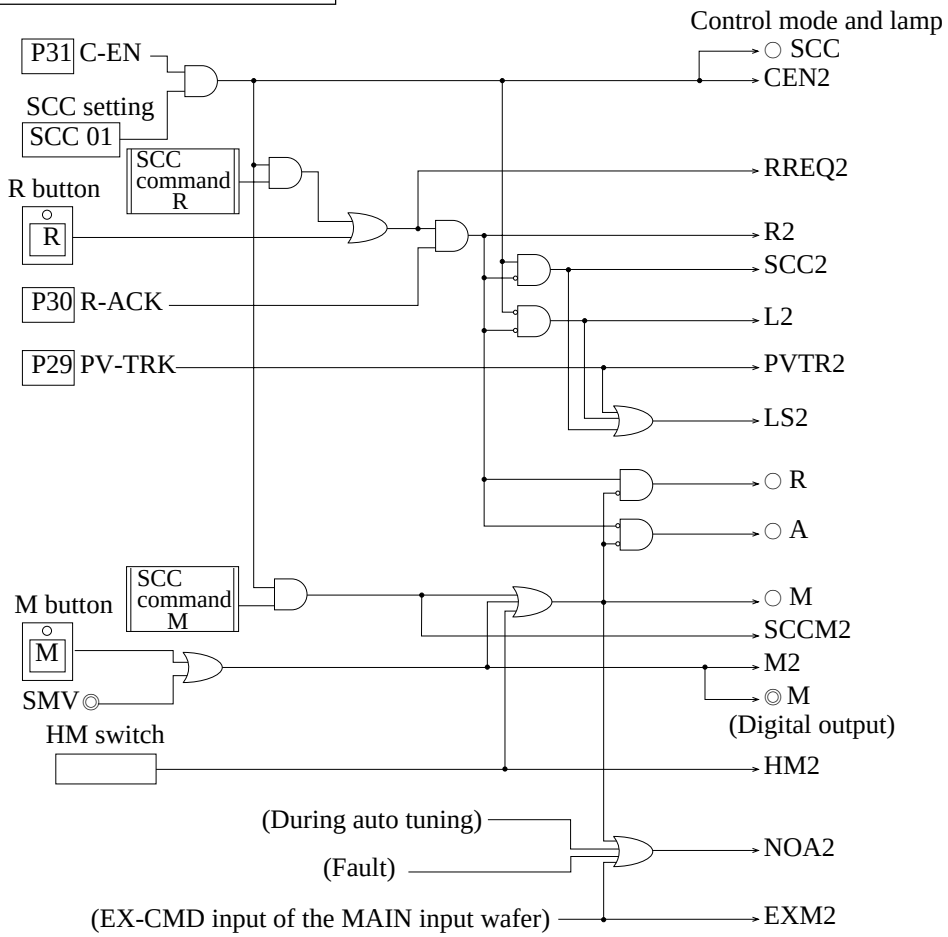
Note 1) As for the change over of INT/EXT, the command via transmission and the front setting are processed to a parallel. Therefore, INT/EXT change over is possible even from either the command or front setting, when SCC-ENABLE (CEN1) is ON.

(10) MAIN control block mode terminals

MAIN control block control mode is set to the following input terminal code.

Abbreviation	Code	Content	Range of value
HM2	930	1” on hard manual mode	0/1
M2	931	“1” on manual mode	
EXM2	932	“1” on EX-MV mode	
SCCM2	933	“1” on SCC-MV mode	
SCC2	934	“1” on SCC mode	
R2	935	“1” on remote mode	
L2	936	“1” on local mode	
PVTR2	937	“1” on PV tracking mode	
NRM2	938	“1” on normal operation	
AT2	939	“1” during auto tuning	
RREQ2	93A	“1” during remote mode request	
NOA2	93C	“1” during no automatic operation	
CEN2	93D	“1” on SCC-ENABLE	
LS2	93E	“1” on local, SCC or PV tracking mode	

MAIN control block control mode



Note

The change over of R/A/M is executed by a command of via a front push button or transmission.

In the case of SCC-ENABLE, the mode is changed over even from either front button or command.

(11) SUB block alarm terminals

SUB block alarm is set to the following input terminal code. When an alarm occurs, 1 is obtained.

Abbreviation	Code	Content	Range of value
SH1	940	SV high limit alarm	0/1
SL1	941	SV low limit alarm	
PH1	942	PV high limit alarm	
PL1	943	PV low limit alarm	
△PH1	944	PV change ratio high limit alarm	
△PL1	945	PV change ratio low limit alarm	
DH1	946	DV high limit alarm	
DL1	947	DV low limit alarm	
OH1	948	Operation output high limit alarm	
OL1	949	Operation output low limit alarm	
△OH1	94C	MV change rate alarm	

(12) MAIN block alarm terminals

MAIN block alarm is set to the following input terminal code. When an alarm is occurred, “1” is obtained.

Abbreviation	Code	Content	Range of value
SH2	950	SV high limit alarm	0/1
SL2	951	SV low limit alarm	
PH2	952	PV high limit alarm	
PL2	953	PV low limit alarm	
△PH2	954	PV change ratio high limit alarm	
△PL2	955	PV change ratio low limit alarm	
DH2	956	DV high limit alarm	
DL2	957	DV low limit alarm	
OH2	958	Operation output high limit alarm	
OL2	959	Operation output low limit alarm	
△OH2	95C	MV change rate alarm	

(13) Digital terminal board data

Abbreviation	Code		Content	Range of value
	PNA	PNC		
FNTSW	960		Front panel switch and external digital input information	0/1
EXTDI	961		External digital input information	
MODE1	962		SUB control mode	
ALM1	963		SUB alarm information	
MODE2	964		MAIN control mode	
ALM2	965		MAIN alarm information	
STEP	966		Section information of SUB program step	
FAULT	967		Fault information	

(14) Program step terminals

Set the information to the following input terminal codes in accordance with the progress of a program setting wafer program.

Abbreviation	Code	Content	Range of value
STEP 0	9A8	“1” in case that the time width is T00 section (section 0)	0/1
STEP 1	9A9	“1” in case that the time width is T01 section (section 1)	
STEP 2	9AA	“1” in case that the time width is T02 section (section 2)	
STEP 3	9AB	“1” in case that the time width is T03 section (section 3)	
STEP 4	9AC	“1” in case that the time width is T04 section (section 4)	
STEP 5	9AD	“1” in case that the time width is T05 section (section 5)	
STEP 6	9AE	“1” in case that the time width is T06 section (section 6)	
STEP 7	9AF	“1” in case of section 6 and after.	

(15) Others

Abbreviation	Code	Content	Range of value
SVP1	9A6	SV preset value of SUB control block	-327.67 ~ 327.67%
MVP1	9A7	MV preset value of SUB control block	
SVP2	9E6	SV preset value of MAIN control block	
MVP2	9E7	MV preset value of MAIN control block	
INIT	321	“1” during initial processing	0/1
FLT	322	“1” during fault occurrence	
SCREQ	323	“1” on SCC request and SCC setting by system channel	

6.4.2 Output terminals

Data are output to the external output terminals and transmission outut terminals.

Signal	Code	Content
AO1	P01	Terminals which output data to the external analog output AO1, MI+, MI–.
KPV	P03	
SV	P04	
MI	P05	
MV	P06	
DO1	P07	Wires output data to the external digital output (DO1, DO2, H, L) and also front H lamp and L lamp
DO2	P08	
H	P09	
L	P10	
H lamp	P11	
L lamp	P12	
PH1-INH	P17	Terminals which inhibits the SUB control block alarm When data wired to this output terminal is 1, the corresponding alarm output is inhibited.
PL1-INH	P18	
DPH1-INH	P19	
DPL1-INH	P20	
DH1-INH	P21	
DL1-INH	P22	
PH2-INH	P23	Terminals which inhibits the MAIN control block alarm When data wired to this output terminal is 1, the corresponding alarm output is inhibited.
PL2-INH	P24	
DPH2-INH	P25	
DPL2-INH	P26	
DH2-INH	P27	
DL2-INH	P28	
PV-TRK	P29	PV tracking command of the MAIN conrol block.
R-ACK	P30	Remote enable command of the MAIN control block. When the signal connected to this output terminal is 1, the remote operation is enabled. When a signal is not connected to this output terminal, the remote operation becomes enable condition.
C-EN	P31	SCC Operation enable command. When the signal connected to this output terminal is 1, the SCC operation is enabled. When a signal is not connected to this output terminal, the SCC operation bemoces enable condition.
S01 ～ S16	S01 〉 S16	Transmission output terminal Data connected to this output terminal is checked via transmission

Appendix 1. SPECIFICATIONS

SPECIFICATIONS

1. Control system configuration

There are two methods of control system configuration for CC-S, one is configuration by basic PID and the other is by wafer connection.

(1) Configuration by basic PID

Basic PID control function is fixedly defined as standard control function in the controller beforehand. Configuration of basic PID can be performed through simple operation on the front panel keys, where wafer connection mentioned below is unnecessary.

Computation wafers such as square root, filter, limiter, non linear, etc. can be made valid or invalid by simple operation of front panel keys.

(2) Configuration by wafer connection (freely configurable)

1) Wafer

The wafer is a functional block (software package) containing control and computation functions needed for measurement and control. Combination of these wafers, each having its own particular function, enables configuring a flexible system applicable to a wide range of control ... from basic PID control up to sophisticated advanced control.

The PNA3 can accommodate up to 24 or 48 wafers. The following kinds of wafers are prepared to allow selection according to the control purpose.

① For control ..... PID control, ratio control, time schedule control, gain schedule control, PID parameter setting

② For computation ... Various computations performed by connecting wafers given in Table 1

2) Internal input/output terminals

Various internal terminals are provided for external analog input/output, digital input/output and wafer connection.

3) Constants

Various parameters used in computation and control can be freely defined (32 constants or 48 constants).

The following control configuration are achieved.

4) Control functions

By connecting wafers (function blocks)

Control examples:

Cascade control, ratio control, time schedule control, gain schedule control, selective control, dead time compensation control etc.

Alarm function:

PV high/low alarm PV change rate alarm DV high/low alarm	Configurable by wafer connection, front panel indicator light up

2. Control performance

- PID control:
  Proportional band (P): 1.0 to 3276.7%
  Integration time (I): 0.1 to 3276.7 sec.
  Differentiation time (D): 0.0 to 900.0 sec.
  PID auto tuning function
- Execution rate:
  Ten (10) times per second/basic PID control
  Five (5) times per second/others

Table 1 List of computation wafer

Wafer name	Kinds
Logical operation	6
Arithmetic operation	5
Temperature/pressure compensation	1
Linearize	3/6
Time schedule control	4
Flip-flop	1
Pulse width integration	1
Selector	1
Changeover	1
Timer	1
Absolute value/sign inversion	1
Square root extraction	1
Lead, lag	1
Limiter	1
Ramp function	2
Analog averaging	1
Analog integration	1
Pulse generation	1
Dead band	1
Pulse no. counter	1
Pulse no. output	1
Detector	1
Moving average	2
Sample hold	1
Dead time	6
ON-OFF	1
Alarm	1
Position type pulse width conversion	1
Bargraph indication	21
Gain schedule control	5

3. Input signals

(1) Process value input signal: One input selectable from the following

Voltage input signal	I_+ I_o I_-	1~5V DC	Input resistance 1M or more Allowable error ±0.2%/FS*
Current input signal		4~20mA DC	Allowable error ±0.2%/FS* 24V ±2V DC can be supplied to transmitter in case of AC power supply approx. 35mA max.
Thermo-couple input		Types J:0~600°C K:0~1200°C E:0~800°C R:0~1600°C	10mV DC or more; cold junction compensation comprised Allowable error ±0.5%/FS*
Resistance bulb input		Pt100 (0°C) –50~500°C	50°C span or more Allowable error ±0.5%/FS*

(2) Analog input signal: 4 points

External set point	CAS	four 1 to 5V DC inputs or two 4 to 20mADC inputs plus two 1 to 5VDC inputs	Input resistance 1M or more, allowable error ±0.2%/FS* Two transmitter power supply 24V ±2V DC approx. 35mA max.
Aux. analog input	AI1		
Aux. analog input	AI2		
Aux. analog input	AI3		

CAS is usable as aux. analog input.

(3) Digital input signal: 4 Points

Manual mode command	SMV	Contact input (Photo-coupler isolation)	ON 0V DC, OFF 24V DC (Input current approx. 11mA/24V DC)
Aux. digital input	DI1		
Aux. digital input	DI2		
Aux. digital input	DI3		

(4) Pulse width input signal: 1 set

Pulse width input signal	PI_+ PI_-	Contact input (Photo-coupler isolation)	ON 0VDC, OFF 24V DC (Input current approx, 11mA/24V DC)

4. Output signals

(1) Control output signal: 1 point

Current output	MI_+ MI_-	4~20mA DC	Allowable load resistance 600 or less, allowable error ±0.2%/FS*

(2) Analog output signal: 4 points

Compensated SV signal	KPV	1~5V DC	Output resistance 1 or less, allowable error ±0.2%/FS*
Set point transmit signal	SV		
Manipulated output (Voltage)	MV		
Aux. analog output	AO1		

KPV, SV and MV is usable as aux. analog output.

(3) Digital output signal: 6 points

Fault output	FLT	Open collector output (Photo-coupler isolation)	Output rating 30V DC 0.1A Max.
Manual mode output	M		
High limit alarm output	H		
Low limit alarm output	L		
Aux. digital output	DO1		
Aux. digital output	DO2		

H and L are usable as aux. digital output.

5. Internal data conversion

(1) Analog data

Standard	Minimum	Maximum
0.00 to 100.00%	–327.6%	327.67%

(2) Digital data

Signal status	Data
ON (Contact closed)	0.01%
OFF (Contact open)	0.00%

6. Indication, setting, operation functions

(1) Bargraph indication

	PV indicator	SV indicator	MV indicator
Indication system	LED (red)	LED (green)	LED (red)
No. of segments	101 + 2	101 + 2	51 + 2
Range	0 ~ 100%, linear	0 ~ 100%, linear	0 ~ 100%, linear
Resolution	1%/FS*	1%/FS*	1%/FS*
Scale length	100mm	100mm	50mm
Indication mode	0 ~ 100% bar graph display, 0 ~ 100% reverse bar graph display, dot display, -50 ~ +50% deviation		

(2) Operation mode indication

Indication method:

LED (red and green)

Red; M, HM, SCC

Green; A, R

***Note:** "FS" stands for "Full Scale".

(3) Numeric indication, setting

Indication method:

LED (red), name 3 digits + data in 5 digits (negative sign included)

Indication contents:

Process value (industrial value), set point (industrial value), alarm high/low limit values, PID parameter, etc.

Indication data are selectable by F/S, △, ▽ keys on front panel.

Setting method:

By use of F/S, △, ▽, ▷, ST keys on front panel.

(4) SV setting function

Fixed value setting method:

By ▲, ▼ buttons on front panel.

Setting speed: about 40 sec/FS

Remote setting method:

By external set point signal (voltage or pulse width input)

(5) MV operating function

Manual operation method:

By ▲, ▲▼, ▼ buttons on front panel.

Setting speed: about 40 sec/FS

About 8 sec/FS when ▲▼ pressed simultaneously.

(6) Operation mode selection

By R/A/M pushbuttons and HM switch on front panel

R→A changeover		Balanceless bumpless
A→R changeover	Voltage signal	Balance bumpless
	Pulse width input	Balanceless bumpless
A or R↔M changeover		Balanceless bumpless
A or R←HM changeover		Balanceless bumpless
A or R→HM changeover		Balance bumpless

7. Power failure and restart function

Power failure detection:

Control function interrupted at power failure detection.

During power failure:

Operating parameters backed up by capacitor when power failure within 5 minutes.

Initial set point and control output values, PID parameters etc. are stored in non-volatile memory (lasts for 10 years expected at ambient temperature of 50°C or less)

Restart from power failure:

Initial or continuous start is selectable for power failure within 5 minutes.

Restart from power failure lasting longer than 5 minutes is made by initial automatically.

Control mode at initial start is selectable from.

R: Remote mode

M: Manual mode

A: Automatic mode

SCC: SCC mode

8. Self-check function

Computation/control function failure:

FLT indicator lights up, FLT contact output closes, and computation and control function interrupted.

Manipulated output can be controlled manually at FLT (Soft manual).

Input signal and control output failure:

FLT indicator lights up, FLT contact output closes, control stops, and control output is held, while other computation and control functions continue to be processed.

Fault indication:

Cause of fault is indicated numerically on digital indicator of front panel.

9. Communication functions

(1) Communication items

Supervisory items:

PNA → host

Process value, set point, control output, deviation, operation mode, alarm information, fault information. PID parameters, various limiter values, constants, etc.

Setting items:

Host → PNA

Set point, control output, operation mode, PID parameters, various limiter values, constants, etc.

(2) Communication enable/inhibit:

Data setting from the host can be enabled/inhibited by set keys on the front panel.

(3) Communication interface

(a) T-link: Private interface

Transmission speed: 500kbps

No. of units connectable: 32 max.

Transmission distance: 1km (Max.)

Transmission form: Multi-drop

Control method: I/O transmission and message

(b) RS-422A/485: Universal interface

Transmission speed: 2400, 4800, 9600, 19200bps configurable

No. of units connectable: 31 units (Max.)

Transmission distance: 1km (Max.)

Transmission form: Multi-drop

Control method: Polling/selecting

10. Personal computer software packages

Two software packages, running on IBM PC-AT, are provided for CC-S supervision, operation, maintenance and configuration.

They are FIX/D MACS software package and CC-S configurator.

FIX/D MACS is a user-configurable, menu-driven software packages for CC-S supervision, operation and maintenance, while CC-S configurator is another package to configure CC-S control system.

E.g. Real time process display

Process alarming

Trending

Control strategy configuration

FIX/D MACS is a trade mark of Intellution Inc./ U.S.A. Standard software packages for plant supervision, operation and maintenance are available under Fix:

11. Security functions

Data security function by means of pass code.

12. Back-up manual function

Hard manual back-up unit (HMV)

Control output: 4 to 20mA DC

Allowable load resistance: 600 or less

13. Operating conditions

Supply voltage:

24V DC (20 to 30V DC), 110V AC (85 to 132V AC), 220V AC (187 to 264V AC)

Power consumption:

Approx. 13W (DC), 20VA (AC)

Power factor: approx. 0.6

Dielectric strength:

1500V AC for 1 minute

Insulation resistance:

100M or more at 500V DC

Ambient temperature:

0 to 50°C

Ambient humidity:

90%RH or less

Enclosure: Steel case

Enclosure class: Front IP65 (IEC 529)

Rating plate (Name plate):

10(H) × 70(W), white acrylic

Dimensions:

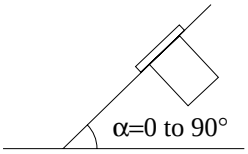
144(H) × 72(W) × 407(D) mm, IEC 668 (DIN) standards

Mass {weight}: Approx. 2.9kg

Mounting method:

Flush with indoor panel; vertical mounting is standard.

Mounting on tilted surface possible (Angle α)



Finish color: Munsell Nl.5

Scope of delivery: Controller and mounting bracket.

Item to be ordered separately:

Communication cable (Type: PNZ)

Terminal resistor (Type: PNY)

STANDARD TEMPERATURE RANGE

Followings are standard input temperature ranges to be selected and to be specified with the ordering code.

Detector	Measurement range
J type termocouple	0 to 200, 0 to 300, 0 to 400, 0 to 500, 0 to 600, 200 to 400, 300 to 600 deg C
K type termocouple	0 to 300, 0 to 400, 0 to 500, 0 to 600, 0 to 800, 0 to 1000, 0 to 1200, 300 to 600, 400 to 800, 500 to 1000, 600 to 1200 deg C
E type termocouple	0 to 200, 0 to 300, 0 to 400, 0 to 500, 0 to 600, 0 to 800, 200 to 400, 300 to 600 deg C
R type termocouple	0 to 1000, 0 to 1200, 0 to 1600, 400 to 1400, 600 to 1600, 800 to 1600 deg C
Platinum resistor temperature detector	0 to 50, 0 to 100, 0 to 150, 0 to 200, 0 to 300, 0 to 400, 100 to 300, 200 to 400, -50 to 100, -50 to 500 deg C

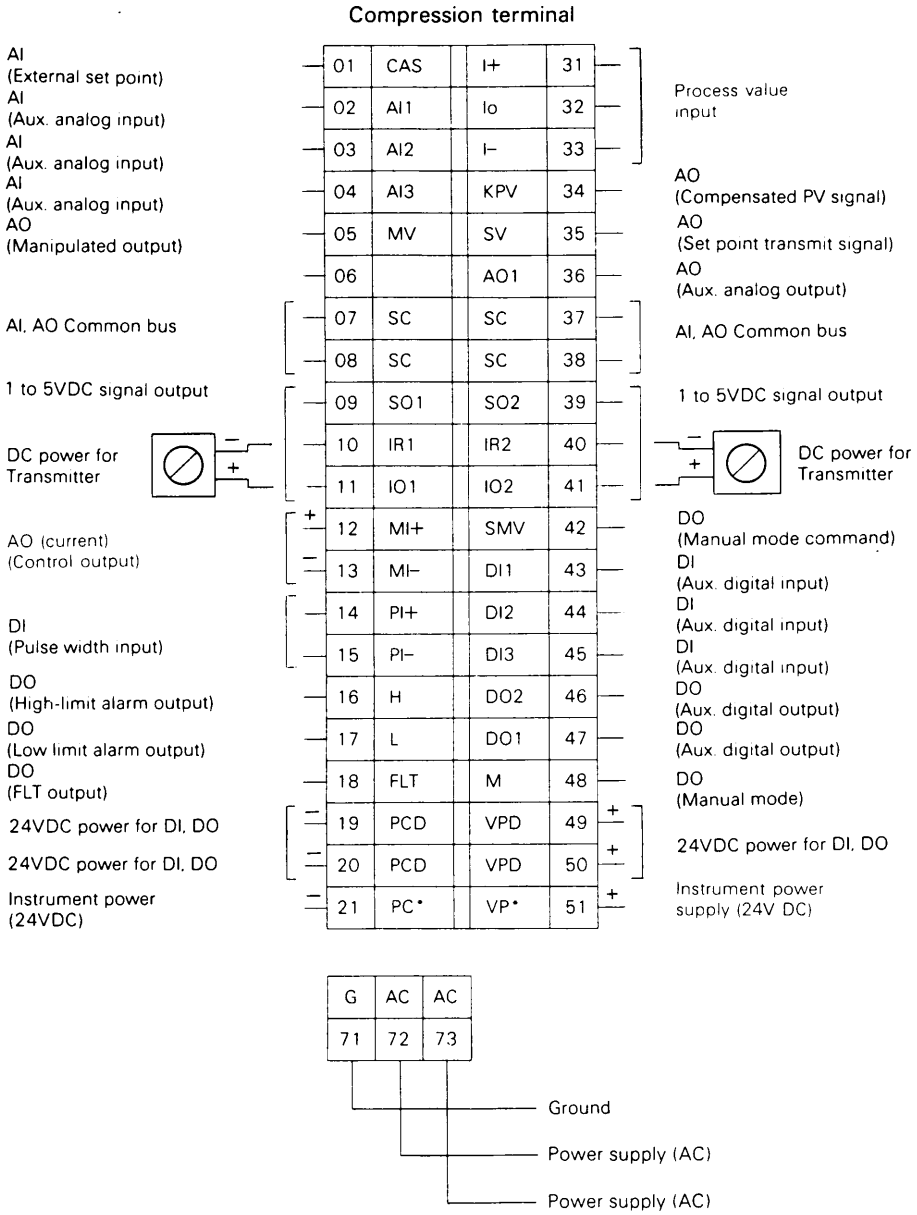
Note: The underlines temperature range will be selected and delivered, when input temperature range is not specified in the ordering code.

STANDARD SCALE

Followings are standard scales to be selected and to be specified with the ordering code.
On condition that PV and SV are of the same scale each other, following standard scale plates are prepared as standard.

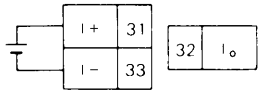
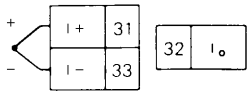
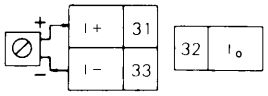
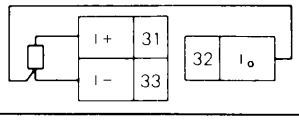
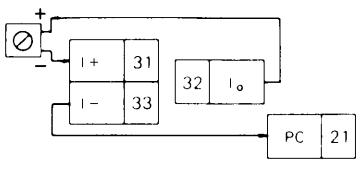
Detector	PV and SV scale
J type termocouple	0 to 200, 0 to 300, 0 to 400, 0 to 500, 0 to 600, 200 to 400, 300 to 600 deg C, 0 to 100%
K type termocouple	0 to 300, 0 to 400, 0 to 500, 0 to 600, 0 to 800, 0 to 1000, 0 to 1200, 300 to 600, 400 to 800, 500 to 1000, 600 to 1200 deg C, 0 to 100%
E type termocouple	0 to 200, 0 to 300, 0 to 400, 0 to 500, 0 to 600, 0 to 800, 200 to 400, 300 to 600 deg C, 0 to 100%
R type termocouple	0 to 1000, 0 to 1200, 0 to 1600, 400 to 1400, 600 to 1600, 800 to 1600 deg C, 0 to 100%
Platinum resistor temperature detector	0 to 50, 0 to 100, 0 to 150, 0 to 200, 0 to 300, 0 to 400, 100 to 300, 200 to 400, -50 to 100, -50 to 500 deg C, 0 to 100%.
1 to 5V DC input	0 to 10, 0 to 20, 0 to 30, 0 to 40, 0 to 50, 0 to 60, 0 to 80, 0 to 100, 0 to 200, 0 to 300, 0 to 400, 0 to 500, 0 to 600, 0 to 800, 0 to 1000 unit. 0 to 100%
MV	0 to 100%

EXTERNAL CONNECTION DIAGRAM

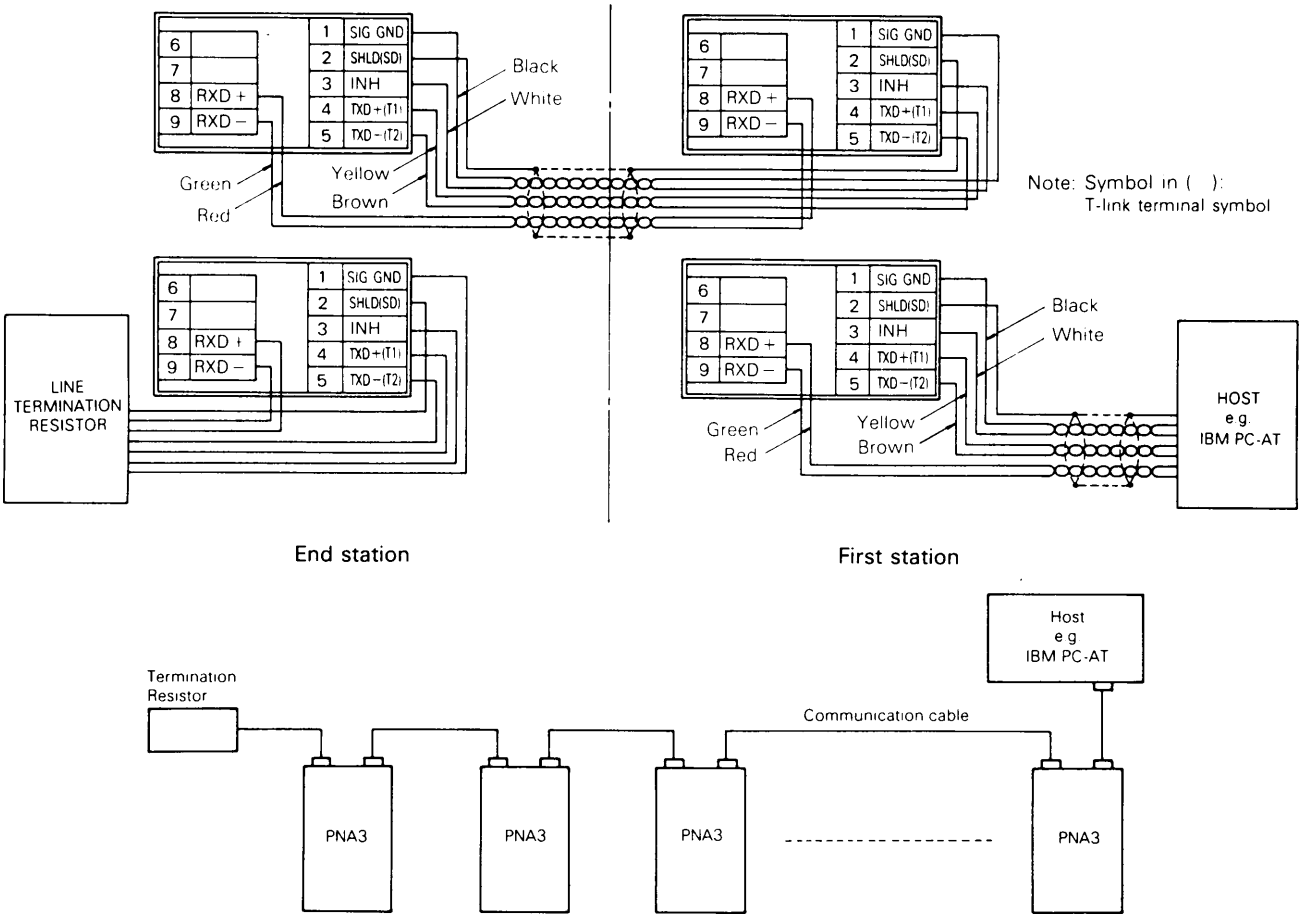


Note* : In case of AC instrument power supply, approximately 24V DC (0.1A max.) is supplied as VPO and PCO for hard manual back-up unit.

Process value input terminals connections

1 to 5V DC The 5th digit of code symbols: A		Thermocouple The 5th digit of code symbols: C, D, E, F	
4 to 20mA DC The 5th digit of code symbols: B		Resistance bulb The 5th digit of code symbols: G	
4 to 20mA DC with inner DC power supply of CC-S The 5th digit of code symbols: B			

COMMUNICATION CONNECTOR



Appendix 2. LIST OF SET VALUES

Channel		Item	Item value
SUB control channel (PID)	P	Proportional band	3276.7 %
	i	Integral time	3276.7 sec
	d	Derivative time	0.0 sec
	dh	High limit deviation absolute	100.00 %
	sh	High limit set value*	125.00 %
	sl	Low limit set value*	-25.00 %
	ph	High limit process value*	125.00 %
	pl	Low limit process value*	-25.00 %
	mh	High limit value position input	125.0 %
	ml	Low limit value position input	-25.0 %
	Δph	Upper limit variation factor	100.00 %
	Δmh	Upper limit operating output variation factor	100.0 %
	Δt	Sampling cycle	0.2 sec
	cut	Rooter cut point	-0.01 %
	tf	filter time constant	0.0 sec
	gap	Dead band	0.00 %
	knl	Non-linear gain	0.00 %
	spr	SV preset value*	0.00 %
	mpr	MV preset value	0.0 %
SUB control channel (ratio)	r	Ratio factor	100.00 %
	b1	Ratio bias 1	0.00 %
	b2	Ratio bias 2	0.00 %
	b3	Ratio bias 3	0.00 %
	sh	High limit set value*	125.00 %
	sl	Low limit set value*	-25.00 %
	ph	High limit measured value*	125.00 %
	pl	Low limit measured value*	-25.00 %
	mh	High limit value position input	125.0 %
	ml	Low limit value position input	-25.0 %
	Δph	High limit measured value variation factor	100.00 %
	cut	rooter cut point	-0.01 %
	tf	filter time constant	0.0 sec
	spr	SV preset value*	0.00 %

Channel		Item	Item value
SUB control channel (program setting)	ZON	Area set value	0
	S00	Output value 0	0.00%
	S01	Output value 1	0.00%
	S02	Output value 2	0.00%
	S03	Output value 3	0.00%
	S04	Output value 4	0.00%
	S05	Output value 5	0.00%
	S06	Output value 6	0.00%
	S07	Output value 7	0.00%
	t00	Time width 0	0
	t01	Time width 1	0
	t02	Time width 2	0
	t03	Time width 3	0
	t04	Time width 4	0
	t05	Time width 5	0
	t06	Time width 6	0
	tpr	Initial preset time	0.00
MAIN control channel block	P	Proportional band	3276.7 %
	I	Reset time	3276.7 sec
	D	Reset time	0.0 sec
	DH	High limit deviation absolute value	100.00 %
	SH	High limit set value*	125.00 %
	SL	Low limit set value*	-25.00 %
	PH	High limit measured value*	125.00 %
	PL	Low limit measured value*	-25.00 %
	MH	High limit value position input	125.0 %
	ML	Low limit value position input	-25.0 %
	ΔPH	High limit variation factor	100.00 %
	ΔMH	High limit manipulated output variation factor	100.0 %
	ΔT	Samle cycle	0.1 sec
	CUT	Rooter cut point	-0.01 %
	TF	Filter time constant	0.0 sec
	GAP	Dead band	0.00 %
	KnL	Non-linear gain	0.00 %
	KF	Feed forward gain	0.00 %
	B1F	Feed forward bias 1	0.00 %
	B2F	Feed forward bias 2	0.00 %
	SPR	SV preset value*	0.00
	MPR	MV preset value	0.00 %

- Initial value is a value where wafer connection is not specified in the code symbols. When it is specified, the corresponding parameter is set the specfied value.

- When wafer is not connected, the SUB control channel is not displayed.
  (Initial setting is made by function fixed PID.)
  The initial value of the SUB control channel is set when the function code is canged.

*) These data are set the industrial values. Since industrial values are initialized based on the scale specifications, the actual initial value is different.

Channel		Item	Item value
Dimension channel	dm1	SUB control block*1	10000
	dm2		0
	dm3	Industrial value dimension	2
	DM1	MAIN control block *2	10000
	DM2		0
	DM3	Industrial value dimension	2
System configuration channel	X00	Function code *3	41
	X01		32
	X02		30
	X03		31
	X04		31
	X05	Computation cycle	01
	X06	Station No.	01
	X07	AI check designation	00
	X08	SUB block Normal/ reverse designation	03
	X09	MAIN block Normal/ reverce designation	0C
	X10	Transmission method/ Transmission rate	04
	X11	Code format	11
	X12	Data setting inhibit designation	00
	X13	Start mode	01
	X14	FLT/ALM hold designation	00
	X15	Alarm designation	00
	X16	SV input designation	00
	X17	PV input designation *4	00
	X18	PI full stroke	30.0 sec.
	X19		
	X20	Temperature range (full scale)	*4
	X21	Temperature range (base scale)	*4
	X22	Pass code set value	0000
	X23	Power failure detect time	125.00 %
	X24	PV indicator indication mode	01
	X25	SV indicator indication mode	03
	X26	MV indicator indication mode	04
	X27	Flickering cycle	01
	X28	Loader interface	4C

Channel		Item	Item value
Constants channel	C01	Constant 1	0.00%
	C02	Constant 2	0.00%
	C03	Constant 3	0.00%
	C04	Constant 4	0.00%
	C05	Constant 5	0.00%
	C06	Constant 6	0.00%
	C07	Constant 7	0.00%
	C08	Constant 8	0.00%
	C09	Constant 9	0.00%
	C10	Constant 10	0.00%
	C11	Constant 11	0.00%
	C12	Constant 12	0.00%
	C13	Constant 13	0.00%
	C14	Constant 14	0.00%
	C15	Constant 15	0.00%
	C16	Constant 16	0.00%
	C17	Constant 17	0.00%
	C18	Constant 18	0.00%
	C19	Constant 19	0.00%
	C20	Constant 20	0.00%
	C21	Constant 21	0.00%
	C22	Constant 22	0.00%
	C23	Constant 23	0.00%
	C24	Constant 24	0.00%
	C25	Constant 25	0.00%
	C26	Constant 26	0.00%
	C27	Constant 27	0.00%
	C28	Constant 28	0.00%
	C29	Constant 29	0.00%
	C30	Constant 30	0.00%
	C31	Constant 31	0.00%
	C32	Constant 32	0.00%
Auto-tuning channel	PLS	MV pulse width	10.0 %
	FLV	PV variation width	8.00 %
	TIM	Maximum wating time	30.0 min.
	SDV	PV standard deviation	0.20 %

*1) Not indicated when “No wafer connection is specified on the type of instrument. (Initial setting is made by function fixed PID.)

*2) Initial setting is based on the scale specification.

*3) Initial setting of X03 is based on the type of instrument to be used.

*4) Initial setting of X17, X20 and X21 is based on the specifications of direct input signal.

(Segmented-line table)

Common data are usable in segmented-line tables 1 through 6.

X coordinate	Initial value	Y coordinate	Initial value
X01	-25.00%	Y01	-25.00%
X02	125.00%	Y02	125.00%
X03	125.00%	Y03	125.00%
X04	125.00%	Y04	125.00%
X05	125.00%	Y05	125.00%
X06	125.00%	Y06	125.00%
X07	125.00%	Y07	125.00%
X08	125.00%	Y08	125.00%
X09	125.00%	Y09	125.00%
X10	125.00%	Y10	125.00%
X11	125.00%	Y11	125.00%
X12	125.00%	Y12	125.00%
X13	125.00%	Y13	125.00%
X14	125.00%	Y14	125.00%
X15	125.00%	Y15	125.00%
X16	125.00%	Y16	125.00%

(Gain schedule table)

Common data are usable in gain schedules 1 to 2

Adaptability index	Initial value	Proportional band	Initial value
X01	0.00%	P01	3276.7%
X02	100.00%	P02	3276.7%
X03	100.00%	P03	3276.7%
X04	100.00%	P04	3276.7%
X05	100.00%	P05	3276.7%
X06	100.00%	P06	3276.7%
X07	100.00%	P07	3276.7%
X08	100.00%	P08	3276.7%

Integration time	Initial value	Derivative time	Initial value
I01	3276.7%	D01	0.0 sec.
I02	3276.7%	D02	0.0 sec.
I03	3276.7%	D03	0.0 sec.
I04	3276.7%	D04	0.0 sec.
I05	3276.7%	D05	0.0 sec.
I06	3276.7%	D06	0.0 sec.
I07	3276.7%	D07	0.0 sec.
I08	3276.7%	D08	0.0 sec.

Wafer connection table

Compact Controller S	Wafer Connection Figure (1~48)	TYPE	PN□

EXM1	912
SCCM1	913
SCC1	914
EXT1	915
INT1	916
NRM1	918
AT1	919
PRE1	91A
RUN1	91B
NOA1	91C
CEN1	91D
LS1	91E
SH1	940
SL1	941
SH1	942
SL1	943
ΔPH	944
ΔPL	945
DH1	946
DL1	947
OH1	948
OL1	949
ΔOH1	94C
STEP0	9A8
STEP1	9A9
STEP2	9AA
STEP3	9AB
STEP4	9AC
STEP5	9AD
STEP6	9AE
STEP7	9AF
HM2	930
M2	931
EXM2	932
SCCM2	933
SCC2	934
R2	935
L2	936
PVTR2	937
NRM2	938
AT2	939
RREQ2	93A
NAO2	93C
CEN2	93D
LS2	93E
SH2	950
SL2	951
SH2	952
PL2	953
ΔPH2	954
ΔPL2	955
DH2	956
DL2	957
OH2	958
OL2	959
ΔOH2	95C
FNTSW	960
EXTDI	961
MODE1	962
ALM1	963
MODE2	964
ALM2	965
STEP	966
FAULT	967
FLT1	300
FLT2	301
FLT3	302
FLT4	303
FLT5	304

MV ▲	008
MV ▼	009
MV ◆	00A
M	00B
A	00C
R	00D
SV ▲	00E
SV ▼	00F
PI	010
DSV	011
AI1	030
AI2	031
AI3	032
TMP	033
CAS	034
PV	035
Vref	036
MVA	037
DI3	09D
DI1	09E
DI2	09F
HM	0A1
SMV	0A2
PI–	0A6
PI+	0A7
SPR1	9A6
MPR1	9A7
SPR2	9E6
MPR2	9E7
R01	200
R02	201
R03	202
R04	203
R05	204
R06	205
R07	206
R08	207
R09	208
R10	209
R11	20A
R12	20B
R13	20C
R14	20D
R15	20E
R16	20F

CON01	880
CON02	881
CON03	882
CON04	883
CON05	884
CON06	885
CON07	886
CON08	887
CON09	888
CON10	889
CON11	88A
CON12	88B
CON13	88C
CON14	88D
CON15	88E
CON16	88F
CON17	890
CON18	891
CON19	892
CON20	893
CON21	894
CON22	895
CON23	896
CON24	897
CON25	898
CON26	899
CON27	89A
CON28	89B
CON29	89C
CON30	89D
CON31	89E
CON32	89F
CON33	8A0
CON34	8A1
CON35	8A2
CON36	8A3
CON37	8A4
CON38	8A5
CON39	8A6
CON40	8A7
CON41	8A8
CON42	8A9
CON43	8AA
CON44	8AB
CON45	8AC
CON46	8AD
CON47	8AE
CON48	8AF

W01		
		A00
		A01
		A02
		A03

W02		
		A04
		A05
		A06
		A07

W03		
		A08
		A09
		A0A
		A0B

W04		
		A0C
		A0D
		A0E
		A0F

W05		
		A10
		A11
		A12
		A13

W06		
		A14
		A15
		A16
		A17

W07		
		A18
		A19
		A1A
		A1B

W08		
		A1C
		A1D
		A1E
		A1F

W09		
		A20
		A21
		A22
		A23

W10		
		A24
		A25
		A26
		A27

W11		
		A28
		A29
		A2A
		A2B

W12		
		A2C
		A2D
		A2E
		A2F

W13		
		A30
		A31
		A32
		A33

W14		
		A34
		A35
		A36
		A37

W15		
		A38
		A39
		A3A
		A3B

W16		
		A3C
		A3D
		A3E
		A3F

W17		
		A40
		A41
		A42
		A43

W18		
		A44
		A45
		A46
		A47

W19		
		A48
		A49
		A4A
		A4B

W20		
		A4C
		A4D
		A4E
		A4F

W21		
		A50
		A51
		A52
		A53

W22		
		A54
		A55
		A56
		A57

W23		
		A58
		A59
		A5A
		A5B

W24		
		A5C
		A5D
		A5E
		A5F

W25		
		A60
		A61
		A62
		A63

W26		
		A64
		A65
		A66
		A67

W27		
		A68
		A69
		A6A
		A6B

W28		
		A6C
		A6D
		A6E
		A6F

W29		
		A70
		A71
		A72
		A73

W30		
		A74
		A75
		A76
		A77

W31		
		A78
		A79
		A7A
		A7B

W32		
		A7C
		A7D
		A7E
		A7F

W33		
		A80
		A81
		A82
		A83

W34		
		A84
		A85
		A86
		A87

W35		
		A88
		A89
		A8A
		A8B

W36		
		A8C
		A8D
		A8E
		A8F

W37		
		A90
		A91
		A92
		A93

W38		
		A94
		A95
		A96
		A97

W39		
		A98
		A99
		A9A
		A9B

W40		
		A9C
		A9D
		A9E
		A9F

W41		
		AA0
		AA1
		AA2
		AA3

W42		
		AA4
		AA5
		AA6
		AA7

W43		
		AA8
		AA9
		AAA
		AAB

W44		
		AAC
		AAD
		AAE
		AAF

W45		
		AB0
		AB1
		AB2
		AB3

W46		
		AB4
		AB5
		AB6
		AB7

W47		
		AB8
		AB9
		ABA
		ABB

W48		
		ABC
		ABD
		ABE
		ABF

	AO1	P01
	KPV	P03
	SC	P04
	MI	P05
	MV	P06
	DO1	P07
	DO2	P08
	H	P09
	L	P10
	H-indicator	P11
	L-indicator	P12
	PH1-1NH	P17
	PL1-1NH	P18
	DPH1-1NH	P19
	DPL1-1NH	P20
	DH1-1NH	P21
	DL1-1NH	P22
	PH2-1NH	P23
	PL2-1NH	P24
	DPH2-1NH	P25
	DPL2-1NH	P26
	DH2-1NH	P27
	DL2-1NH	P28
	PV-TRK	P29
	R-ACK	P30
	C-EN	P31
	S01	S01
	S02	S02
	S03	S03
	S04	S04
	S05	S05
	S06	S06
	S07	S07
	S08	S08
	S09	S09
	S10	S10
	S11	S11
	S12	S12
	S13	S13
	S14	S14
	S15	S15
	S16	S16