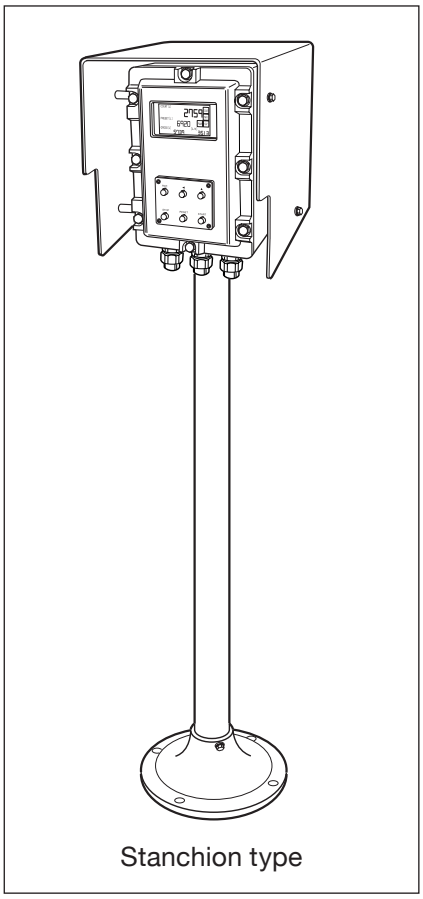
OVAL INSTRUCTIONS

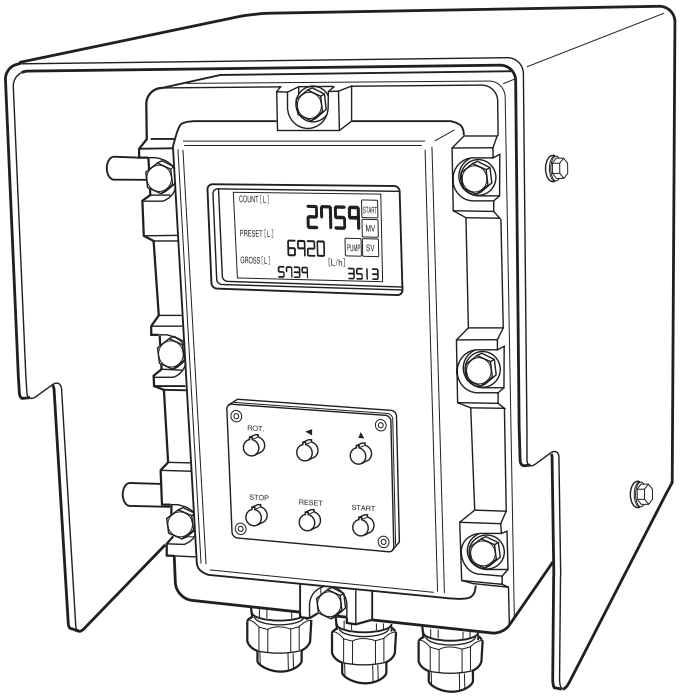
Ins. No. E-224-9-E

Explosionproof Batch Controller

Model : EL7210



Stanchion type



Wall-mount type

Every OVAL controller is fabricated and shipped from our factory under strict quality control. This manual is designed to assist the user to obtain the best performance of this product throughout its service life. In order to sufficiently install, operate, and execute maintenance, please read this instruction carefully before the use and keep it handy for quick reference.

Also, refer to the instruction manuals of other instruments used in combination with this Batch Controller such as a flowmeter, valve, etc.

CONTENTS

The indications **NOTE**, **CAUTION**, and **WARNING** shown throughout this manual are to draw your attention to specific items:

➡ NOTE

Notes are separated from the general text to bring user's attention to important information.

⚠ **CAUTION**

Caution statements call attention to user about hazards or unsafe practices that could result in minor personal injury or property damage.

⚠ **WARNING**

Warning statements call attention to user about hazards or unsafe practices that could result in serious personal injury or death.

1. BEFORE YOU BEGIN

Every OVAL controller is thoroughly tested before its delivery from the factory. Once you receive the product, it should be thoroughly inspected for any sign of damage by rough handling during transportation. Please read this section carefully since it contains necessary considerations in handling this product.
For detailed instructions, find the corresponding sections from "CONTENTS" on page 2 and 3.

If you have any inquries, please contact the nearest OVAL sales/service office in your district.

1.1 Confirming the Nameplate

OVAL controller is assembled and adjusted according to individual customer specifications.
Product code and ratings appear in the nameplate (tag) attached on the side of the product.
Make sure that the product you received complies with the specifications in your order by verifying against the general specifications (page 72) and product coded explanation (page 74).

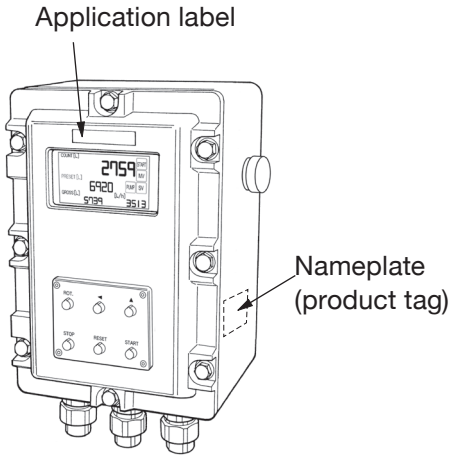


Fig. 1.1 Nameplate Location

◆ **When you make inquiries, please specify the product name, model No., serial No., ratings, and other pertinent information.**

1.2 Transportation Considerations

(1) OVAL controller can best be transported to the installation site in the original shipping package used during transportation from our factory if circumstances permit.
(2) Be extra careful to avoid high impact shocks to the product during transportation.

1.3 Storage Considerations

If your controller is stored for a long period of time upon receipt before installation, unexpected circumstances may arise. So if a long-term storage is inevitable, take the following precautions:

(1) Keep the product in the original shipping package used to transport it from the factory if possible.
(2) Select the place of storage that meets the following requirements:
  ☆ Free from rain and water
  ☆ Free from vibration and impact shocks
  ☆ Temperature and relative humidity at around 25℃ and 65%

1.4 Installation Location Guidelines

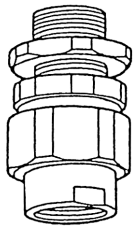
The allowable ambient temperature for this controller ranges from -10 to +50℃ . At an installation location where the equipment may be exposed to the direct sunlight, reflected heat, or rainwater, do not fail to provide a sun-shade (furnished as standard) or other protection to keep the equipment within allowable operating temperature range.

1.5 Structural Considerations

(1) The controller is made of explosionproof and waterproof configuration for outdoor service. After removing the controller lid for parameter reconfiguration or wiring connections, exercise care to prevent the cables from getting caught in the lid when re-installing it.

(2) Since the pressure-resistant packing unit constitutes a part of flameproof configuration, do not use pressure-resistant packings other than those specified by OVAL. Equally important is to tighten the union firmly upon completion of wiring.

(3) Two different packings (ϕ18 and ϕ20) are supplied in the pressure-resistant packing unit (the ϕ18 packing is installed at the time of shipment). Select and install the one that better suits the O.D of the cable to be used.



Pressure-resistant packing unit

Applicable Cable O.D. (Units in mm)

Packing Code	Packing I.D.	Cable O.D.
18	18	16.0 to 18.0
20	20	18.0 to 20.0

(4) The pressure-resistant packing unit has a G1 cable entry.

1.6 Explosionproof Considerations

To maintain the validity of controller's explosionproof rating, the following requirements must be met:

(1) Use the controller within the specified ratings.
(2) Do not attempt to modify internal wirings or replace parts.
(3) Use only the pressure-resistant packings specified by OVAL.
(4) Never apply modification to this product.

2. GENERAL

Combined with a flowmeter and a shutoff valve, the batch controller passes a predetermined amount of the process fluid in batching operations. Built around a single chip microprocessor, this versatile, multifunctional controller is designed for easy operation. It saves time and effort in many processes, such as blending materials, dosing with additives, transferring materials from one tank to another, or shipping from an outlet, at chemical, food, paint plants and wherever streamlined production lines are desired.

2.1 Features and Functions

(1) Flameproof rated
Because of flameproof configuration (Ex d IIB T4), the controller can be installed in a hazardous location (Divisions 1 and 2 area).

(2) Easy to operate
Pushbuttons on the front panel are used for batch setting, start, stop, and reset to ensure secure controller operation.

(3) Precise batch control
With status valve actuating outputs (two points) and 4 to 20mA PID control signal outputs, precise valve control and accurate batch measurements can be achieved to suit your particular application.

(4) Simple system configuration
The system can be controlled with remote start, stop, and reset signals. Also available is an end-of-batch signal.
Interlocking with other control systems can be easily done.

(5) Increased process safety
① The valve can be programmed to open in two stages (reducing the initial velocity) and close in two stages. This arrangement prevents not only static electricity generation in the pipeline or in the tank at startup, but also water hammer, or hydraulic shock, to the pipeline at valve closure.
② When trouble occurs in the process for some reason, resulting in absence of incoming pulses, or when the flow measurement exceeds a preset batch quantity, the controller can produce an alarm output with buzzer sound.

(6) Communication capability is provided as standard.
Can communicate with host CPU.

Interface: RS-485 (standard)
RS-232C (option)
USB (standard)
Protocol: Modbus RTU

➡ NOTES 1. For details, see Section 9 "Communication Capabilities".
2. Procedure to select available interfaces, see Section 6.2 "Jumper Setting".

Baud rate: 1200, 2400, 4800, 9600, 19200, 38400 bps

(7) Reliable and straightforward maintenance
① Major circuits are modularized on printed circuit boards for reliability and simple maintenance.
② In the event of a power failure or power cycling, total flow rate, parameters and variables will be retained in the EEPROM.

3. COMPONENT NAMES

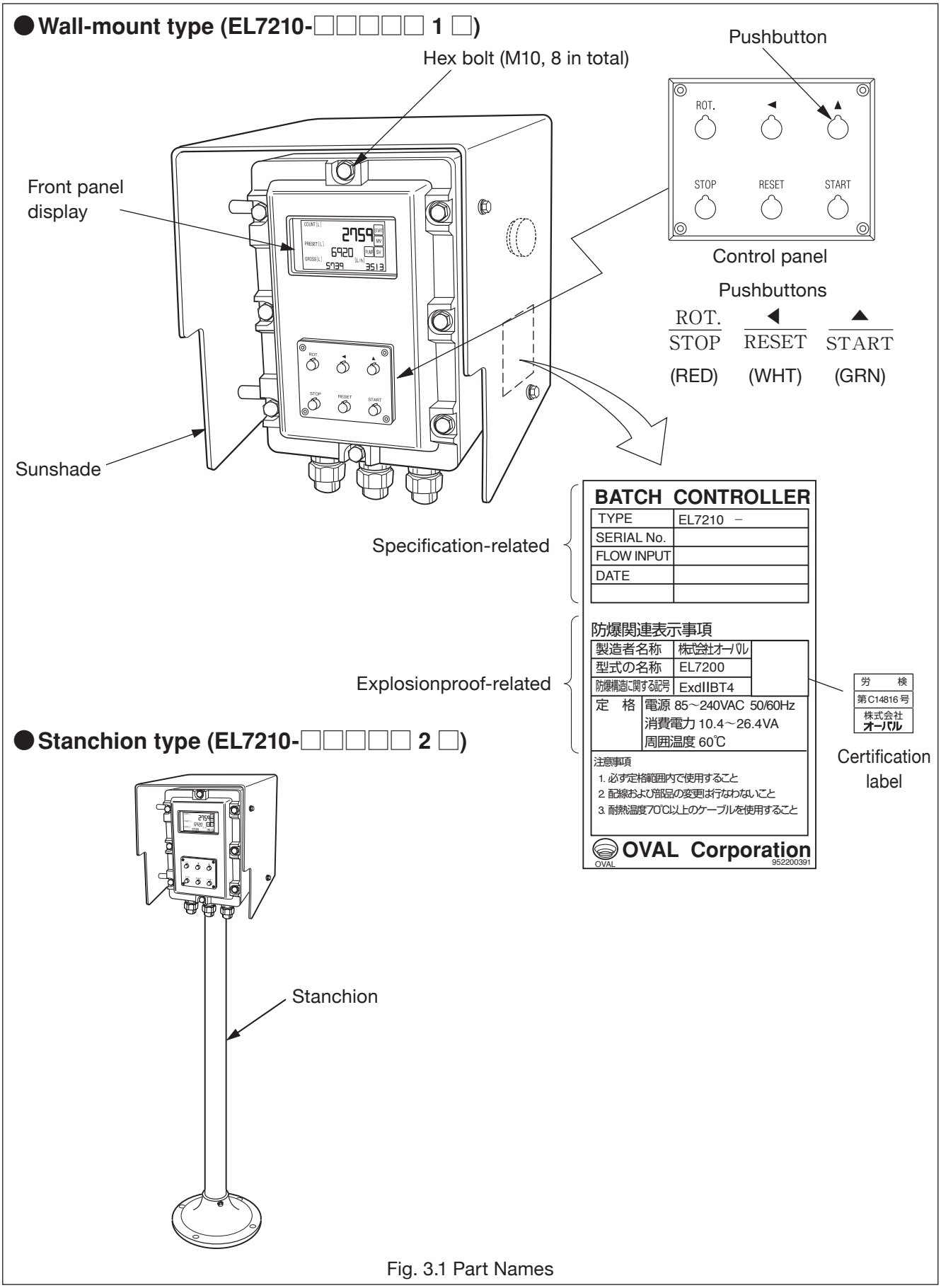


Fig. 3.1 Part Names

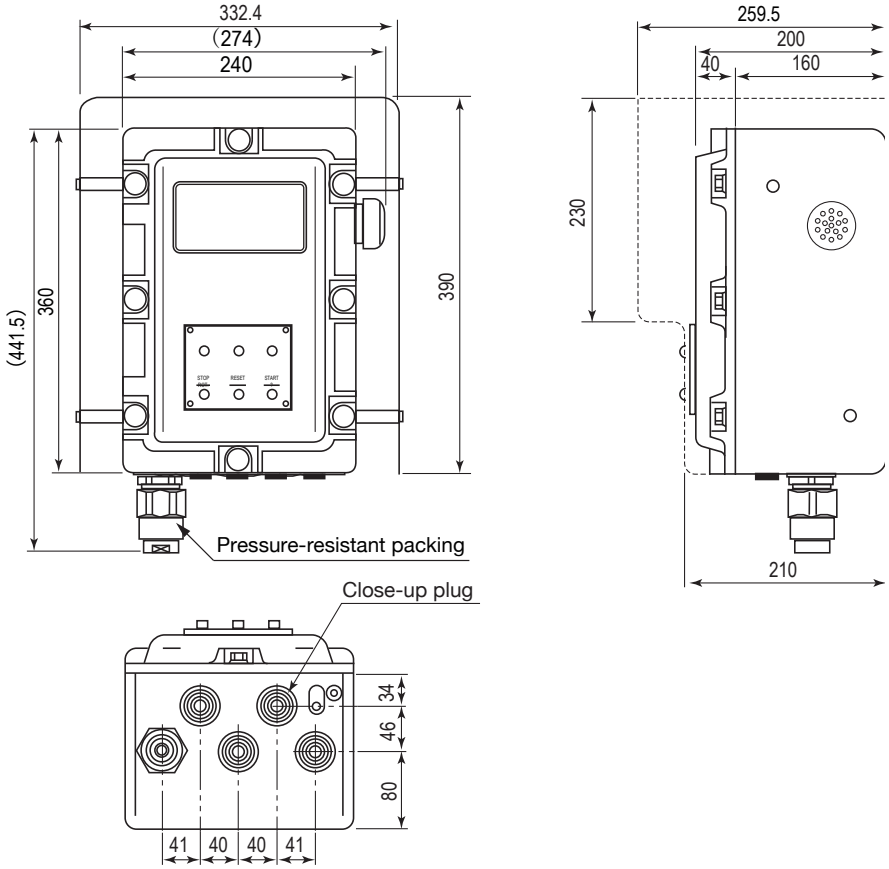
➡ NOTE: Detail description of front panel display can be found in Section 7 on page 19.

4. INSTALLATION

4.1 Outline Dimensions

All dimensions in millimeters

● Wall mount type (EL7210-□□□□□1□)



● Stanchion type (EL7210−□□□□□2□)

Weight: 50 kg approx.

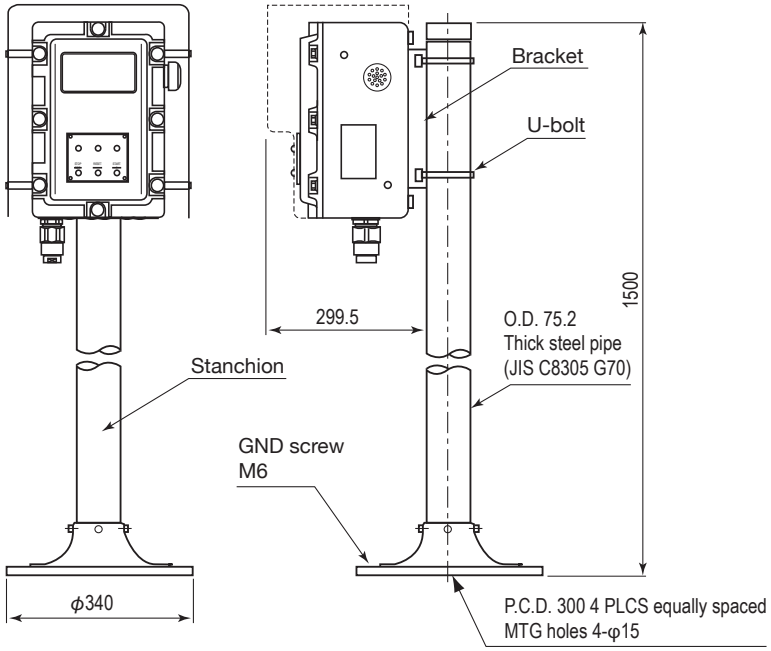


Fig. 4.1

4.2 Installation

4.2.1 Installation Location

Although this controller is weatherproof, avoid places where the controller is exposed to direct sunshine, mechanical vibration, and corrosive gasses.

4.2.2 Installation

● Wall-mount type (EL-7210-□□□□□ 1 □)

Mounting holes are found at back of the controller. Secure it with four bolts from behind the panel.

➡NOTE: Wall-mount controller weights 25 kilograms approx.

All dimensions in millimeters

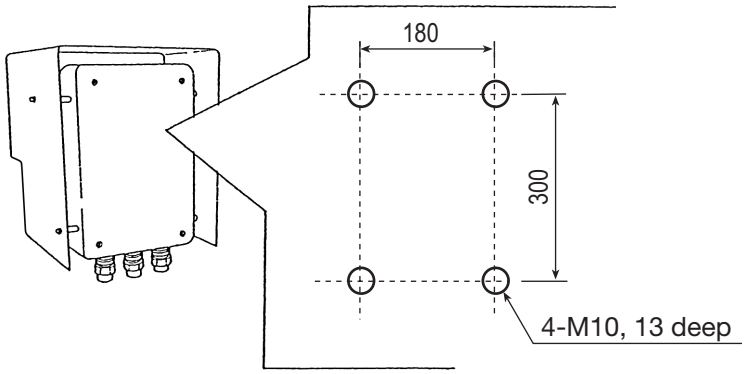


Fig. 4.2 Hole Layout (wall-mount type)

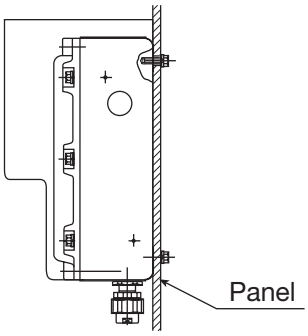


Fig. 4.3 Installation (wall-mount type)

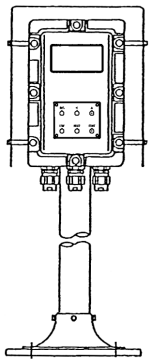
● Stanchon-mount type (EL-7210-□□□□□ 2 □)

For mounting on a stanchion, concrete the foundation and secure with anchor bolts according to the mounting hole layout in Fig. 4.4 (or approval drawing).
Follow the mounting procedures given below.

⚠ **CAUTION: The controller is quite heavy. Install it securely to prevent falling or overturn.**

➡NOTE: Stanchion mount controller weights 50 kilograms approx.

All dimensions in millimeters



Mtg. Hole Layout

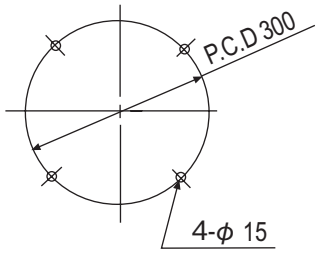


Fig. 4.4 Stanchion Mtg. Hole Layout

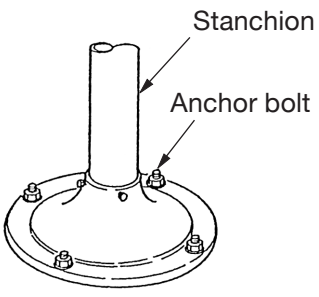


Fig. 4.5

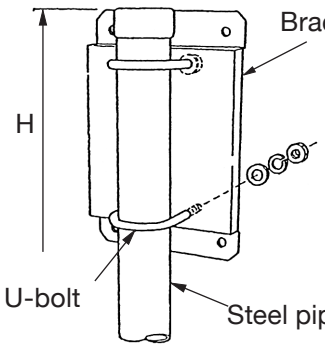


Fig. 4.6

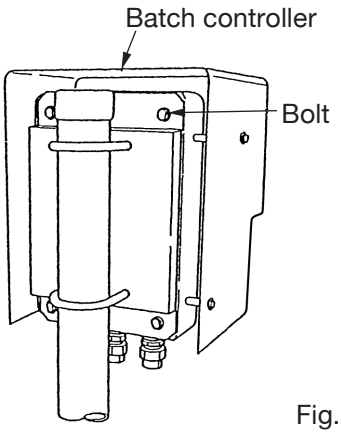


Fig. 4.7

① Secure the stanchion base with anchor bolts.

② Attach the bracket to the pipe securely by using two U-bolts.

③ Secure the batch controller to the bracket with four bolts.

5. WIRING

5.1 Field Wiring

(1) For field wiring of pulse signal from the flowmeter and of resistance thermometer signal, be sure to use electrostatically shielded, vinyl sheathed control cables (CVVS 1.25 to 2.0mm^2) or equivalent.
(2) For communications, use electrostatically shielded, vinyl sheathed, twisted-pair control cable (1.25 to 2.0mm^2) or equivalent.
(3) For other signals, use insulated, vinyl sheathed control cables (CVV 1.25 to 2.0mm^2) or equivalent.
(4) Use crimp contacts for secure electrical connection of field wiring.
(5) Connect shield wires to GND terminal of the controller. At the probe end, leave the shield wire unterminated.
(6) GND terminal of this controller is connected to earth ground within the enclosure. Accordingly, if the controller is located on an insulator, earth ground the GND terminal externally located of the controller.

➡ NOTES
1. This controller has an explosionproof rating, including the pressure-resistant packing. No packings other than pressure-resistant packings furnished are acceptable for this reason. Serviceable cable O.D. ranges from ϕ16.0 to ϕ20.0.
2. RS-485 communication function is built-in as standard. Even if you do not intend to use this function, it is ideal to run communication wires for service and maintenance purposes.

5.2 Wiring Connections

(1) Conduit work is suggested for field wiring.
➡ NOTE: In conduit work, route power cable and signal cables in separate conduits. Otherwise, stray current pickup may occur.
(2) Keep field wiring away from other power lines or power circuits, and reduce the possibility of inductive interference to a minimum.
(3) Connection terminals are located inside the controller. Use crimp contacts for connections and ensure good electrical contact. (Fig. 5.3)
(4) In applications where an inductive load (valve, pump, etc.) is active, it is recommended to install surge suppressors on the inductive load side.

⚠ **CAUTION: Verify compatibility between the flowmeter (pulse generator) and receiving instrument to be used in combination by checking their model numbers, tags, etc. before making wiring connections.**

5.3 Terminal Block for External Connections

⚠ **CAUTION: Be careful not to get your fingers pinched between the door and frame when you close it.**

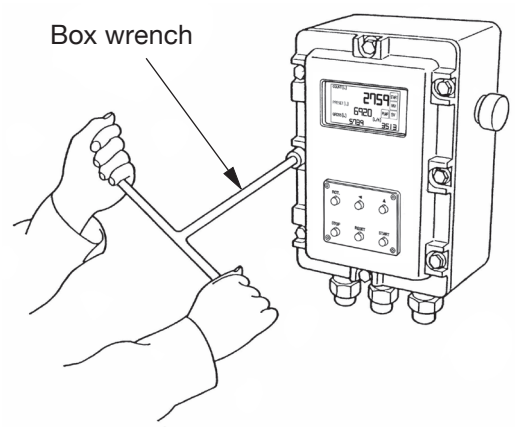


Fig. 5.1

① Using box wrench (17mm) or similar tool, take off eight hex bolts (M10) securing the controller door.

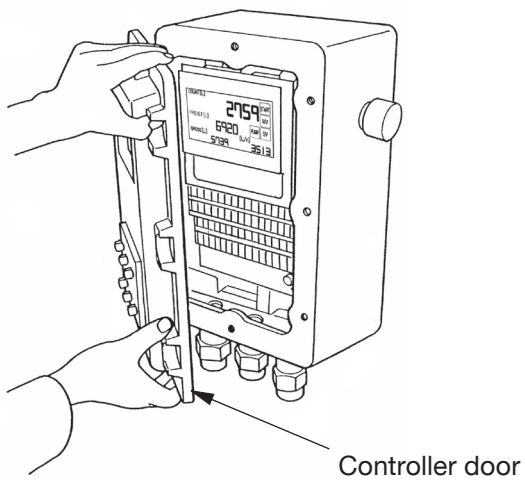


Fig. 5.2

② Gradually open the controller door forward.

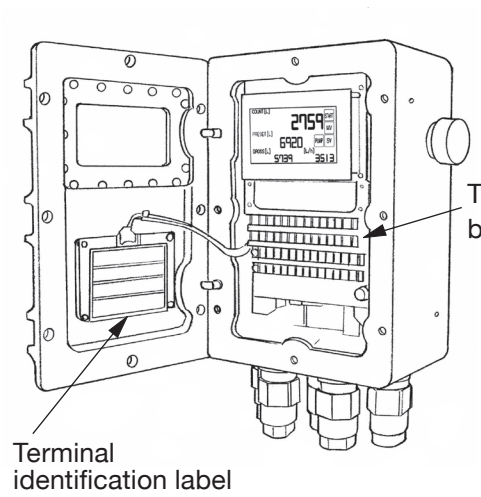


Fig. 5.3

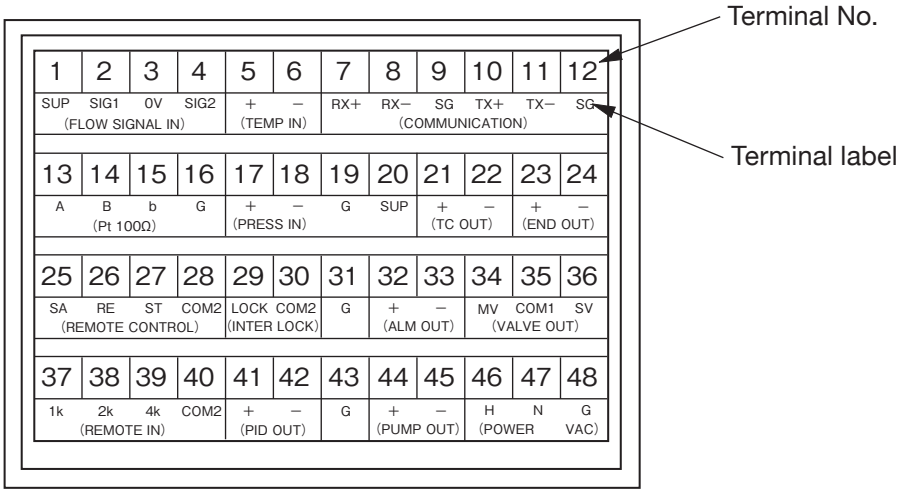
③ Opening the controller door provides access to a four-row terminal block.

⚠ **CAUTION: Screws at both ends of terminal block serve to secure the terminals in place. Do not use them for wiring connection.**

5.4 Terminal Arrangement for External Connections

➡ NOTE: Terminal arrangement may differ depending on specifications.

Terminal Identification Label (inside the controller door)



Terminal Block (controller side)

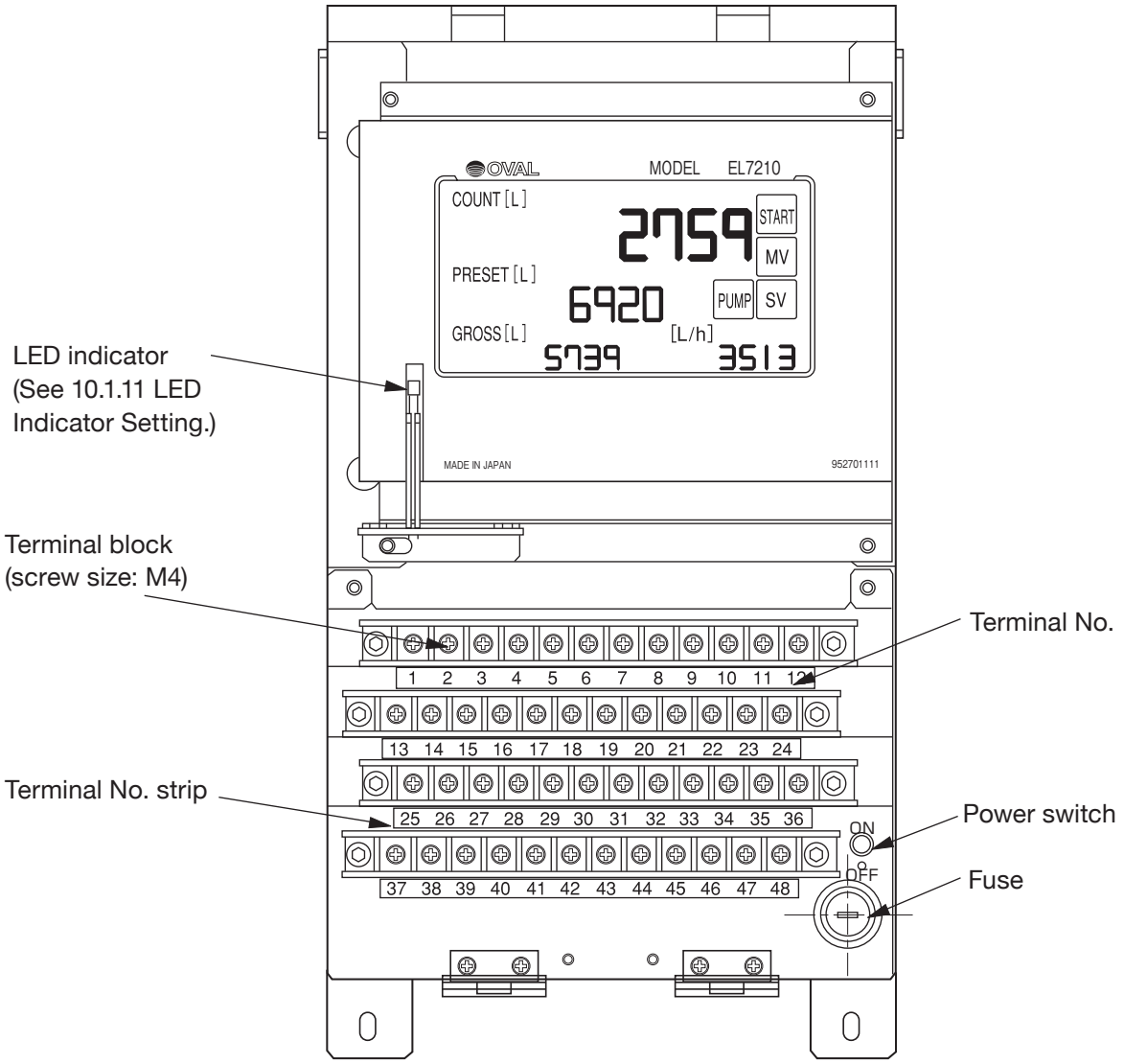


Fig. 5.4

5.5 Description of Flow Input and Terminal Connections

Table 5.1 (1/2)

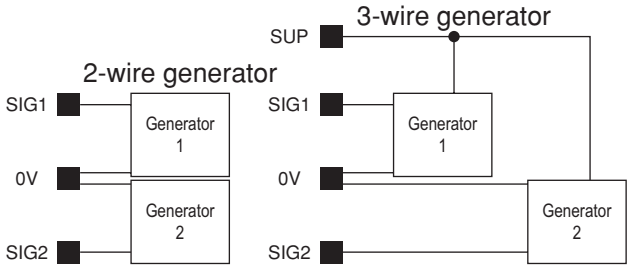
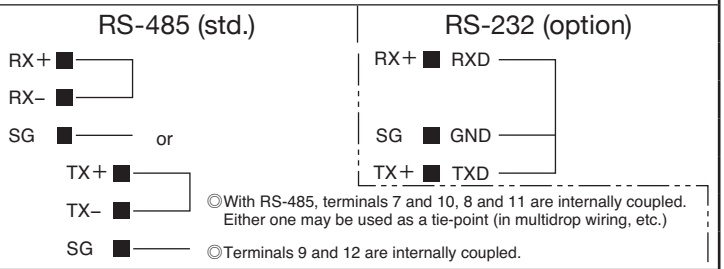
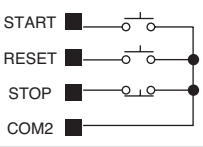
Term. No.	Label			Description
1	Flow signal Input	SUP	FLOW SIGNAL IN	
2		SIG1		
3		0V		
4		SIG2 (option)		
5	Temp. transmitter	+	TEMP IN	Selection between 4 to 20mA current Input (internal load resistance; 250Ω) and 1 to 5V voltage input is determined by parameter setting.
6		–		
7	Communication	RX+	COMMUNI-CATION	
8		RX–		
9		SG		
10		TX+		
11		TX–		
12		SG		
13	Resistance thermome-ter	A	Pt100Ω	 Input terminals for resistance thermometer element Terminal G = GND
14		B		
15		b		
16		G		
17	Press. transducer	+ (option terminal)	PRESS IN	Selection between 4 to 20mA current input (internal load resistance: 250 Q) and 1 to 5V voltage input is determined by parameter setting. Terminal G = GND (earth ground terminal) SUP = Power to transmitter (temp.& press.) (24VDC, 80mA)
18		– (option terminal)		
19		G		
20		SUP		
21	Pulse out-put	+	TC OUT	Pulse output terminals: Non-contact relay (250V AC/DC, 0.15A, resistance 16Ω or less at ON, leak current 1μA or less at OFF)
22		–		
23	End out-put	+	END OUT	End output terminals: Non-contact relay (250V AC/DC, 0.15A, resistance 16Ω or less at ON, leak current 1μA or less at OFF)
24		–		
25	Contact-closure input	SA	REMOTE CONTROL	 START: Form "a" contact Capacity: 24VDC, 5mA max. RESET: Form "a" contact Pulse width: 30 ms min. STOP: Form "b" contact Intervals between signals: 0.5s min. NOTE: Shortcircuit STOP when not in use.
26		RE		
27		ST		
28		COM2		
29		LOCK	INTER LOCK	Interlock terminals (earth grounding input signal, etc.)
30		COM2		
31		G	GND terminal	Earth ground terminal
32	Alarm out-put	+	ALM OUT	Alarm output terminals: Non-contact relay (250V AC/DC, 0.15A, resistance 16Ω or less at ON, leak current 1μA or less at OFF)
33		–		
34	Valve actuating signal	MV (N)	VALVE OUT	Control output signals for controlling the valve (2-stage shutoff valve) MV: Stays on from end of initial restricted flow until start of final restricted flow. SV: Stays on from batch start until batch end. Same voltage as line voltage or Form "a" contact (250VAC, 1A)
35		COM1 (H)		
36		SV (N)		
37	Con-tact-closure input	1k	REMOTE IN	Input terminals for selecting batch setting value.
38		2k		
39		4k		
40		COM2		

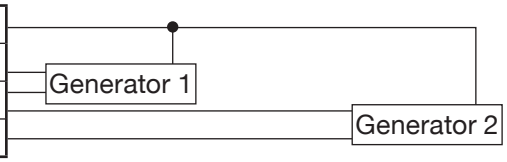
Table 5.1 (2/2)

Term. No.	Label			Description
41	Valve actuating signal	+	PID OUT	PID output terminals for controlling the valve/Instant flow rate analog output terminal 4 to 20mA output (max. load resistance 750Ω)
42		–		
43		G	GND terminal	Earth ground terminal
44	Pump output	+	PUMP OUT	Pump output terminals Stays on from batch start until "batch end + timer setting" Form "a" contact or From "b" contact (250VAC, 1A)
45		–		
46	Power input	H	POWER VAC	100/110/115 VAC, 50/60Hz or 200/220/230 VAC, 50/60Hz Terminal G = GND (earth ground terminal)
47		N		
48		G		

5.6 Wiring Diagrams

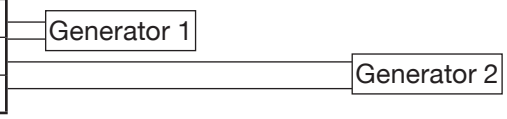
● Pulse generator (3-wire) (FLOW SIGNAL IN)

1	Power to pulse generator
2	Pulse input 1
3	0V
4	Pulse input 2 (option)



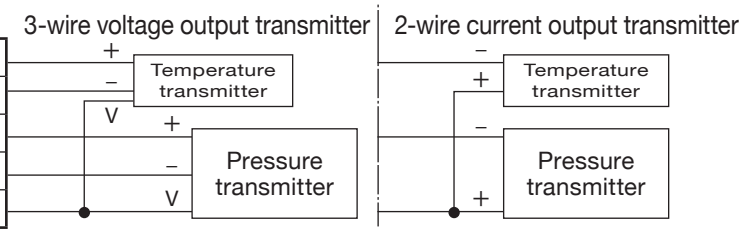
● Pulse generator (2-wire) (FLOW SIGNAL IN)

1	Power to pulse generator
2	Pulse input 1
3	0V
4	Pulse input 2 (option)



● Temperature transmitter (TEMP IN) / Pressure transmitter (PRESS IN)

5	Temperature input +
6	Temperature input -
17	Pressure input + (option) Pressure
18	Pressure input - (option) Pressure
20	Power to transmitter: 24VDC



➡ NOTES: 1. When you couple to a 2-wire current output transmitter, terminals 6 and 18 are unused.
2. 0V of power output is common to terminals 6 and 18.
3. Selection between current input (4 to 20mA) and voltage input (1 to 5V) is determined by parameter setting.

● Communication

	RS-485	RS-232C
7	RX+	RXD
8	RX–	
9	SG	GND
10	TX+	TXD
11	TX–	
12	SG	GND

➡ NOTES: 1. With RS-485, terminals 7 and 10, 8 and 11 are internally connected; either one may be used as a tie-point (in multidrop wiring, for example).
2. Terminals 9 and 12 are internally connected.

● Resistance thermometer element (Pt100Ω): 3-wire system

13	A
14	B
15	b

Res. thermometer

● Output (TC OUT, END OUT, ALM OUT)

21	Pulse output
22	Pulse output
23	END output
24	END output
32	ALARM output
33	ALARM output

Non-contact relay output (no polarity observation required)

● Contact-closure input (REMOTE CONTROL, INTERLOCK, REMOTE IN)

25	REMOTE START
26	REMOTE RESET
27	REMOTE STOP
28	COM2
29	INTERLOCK
30	COM2
37	REMOTE IN 1k
38	REMOTE IN 2k
39	REMOTE IN 4k
40	COM2

(Form "a" contact)
(Form "a" contact)
(Form "b" contact)
(Form "a" contact)

Eight kinds of batch setting values can be selected by short-circuit combination.

➡ NOTE: For details, see Table 8.1 on Page 21.

● Valve actuating signal (VALVE OUT, PID OUT)

34	MV (N)
35	COM1 (H)
36	SV (N)
41	PID output/Instant flow rate analog output +
42	PID output /Instant flow rate analog output -

Form "a" or "b" volt. out
Form "a" or "b" volt. out
4 to 20mA output

➡ NOTES: 1. For SV and MV output selection, see Section 6.2 (3).
2. As shown below, it is recommended that surge suppressors, etc. be installed on the inductive load side to protect contact points.

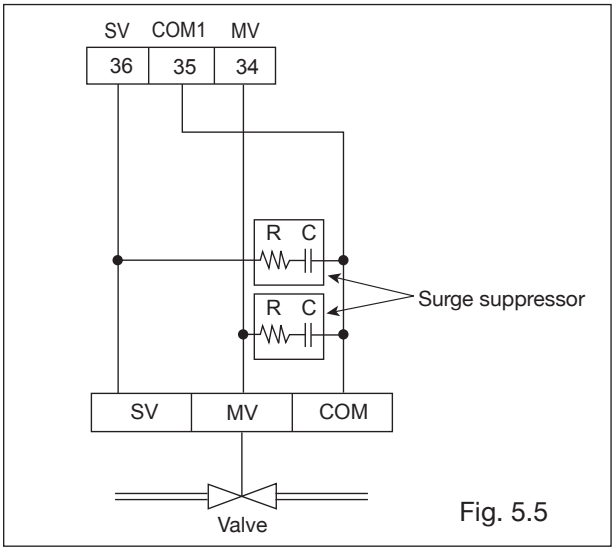


Fig. 5.5

● Pump output (PUMP OUT)

44	Pump output
45	Pump output

Form "a" or "b" volt. out

➡ NOTE: For output selection, see Section 6.2 (2).

● Power input (POWER)

46	H
47	N

AC100 to 115V, AC200 to 230V

● GND terminal

16, 19, 31, 43, 48: GND terminal (FG)

6. CONSTRUCTION OF INTERNAL ASSEMBLY AND JUMPER SETTING

※The following is described for reference.

➡NOTE: Parameters are set in the factory according to individual customer specifications. Consult OVAL if any change is desired. Unauthorized modification will nullify our warranty.

6.1 Construction of Internal Assembly

The main and relay boards are located below the LCD and terminals panels. Setting the jumpers on the main and relay boards requires opening the hinged terminals panel forward and removing the LCD panel.

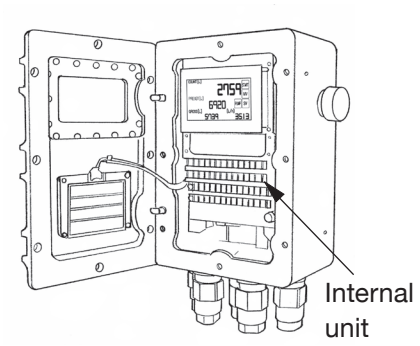


Fig. 6.1

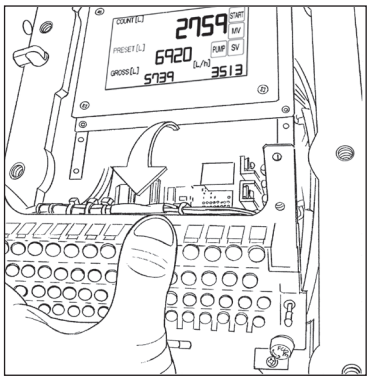


Fig. 6.2

Take off screws securing the terminals panel and open it toward you.

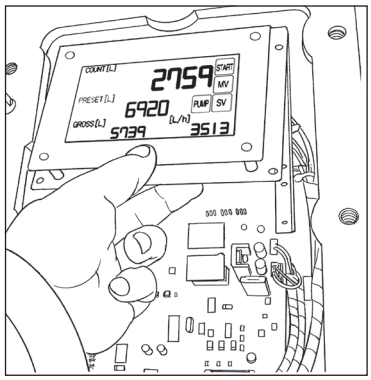


Fig. 6.3

Take off screws securing the LCD panel and remove the flat cable connecting the LCD panel to the main panel.

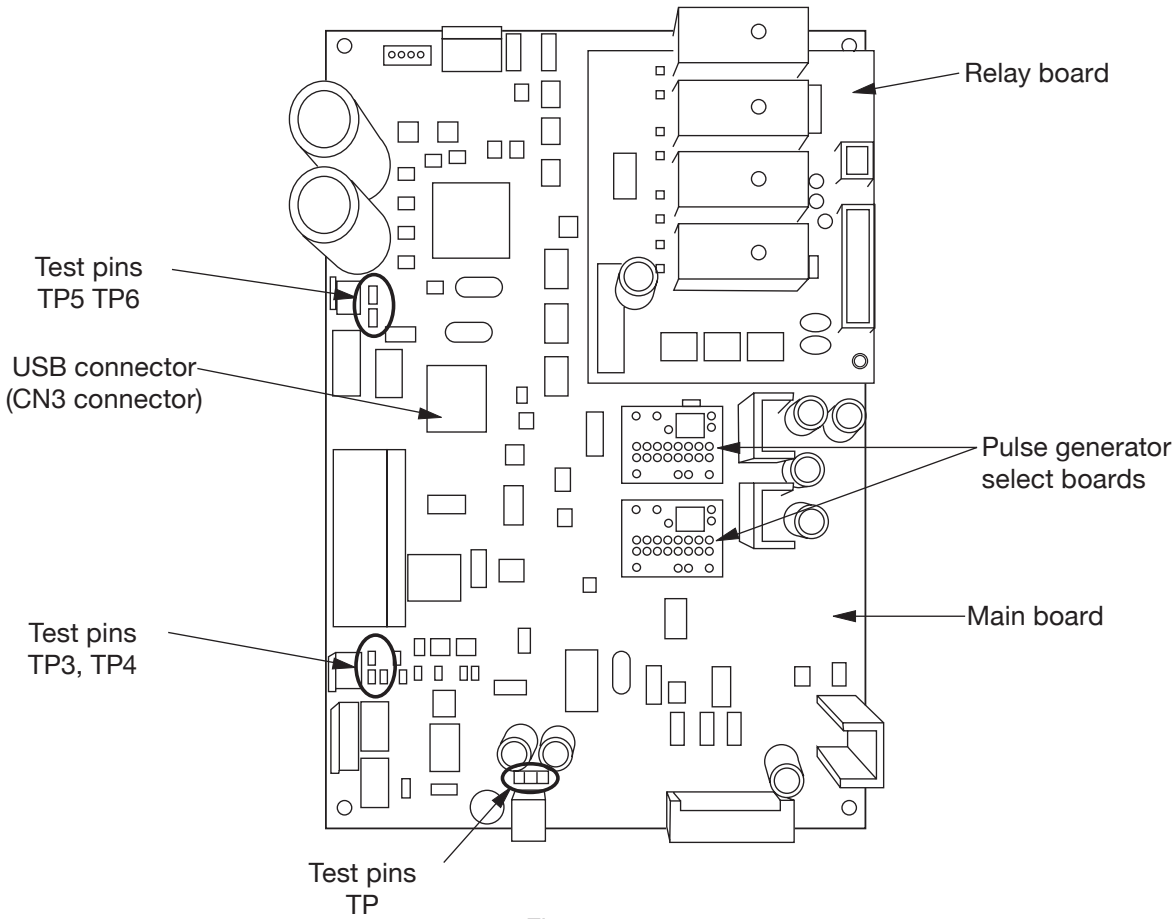


Fig. 6.4

6.2 Jumper Setting

Location and orientation of jumpers on the main board selects jumper settings (1) through (7).

➡ NOTE: Jumper switch locations are shown in Fig. 6.5.

(1) JP1 to 3: Communication interface selection

Jumpers JP1 through 3 selects RS-232C or RS-485 (default setting).

Jumper	JP1		JP2				JP3			
Pin No.	1–3	2–4	1–5	2–6	3–7	4–8	1–5	2–6	3–7	4–8
RS–232C	O	S	S	O	O	O	S	O	O	O
RS–485	S	O	O	S	S	S	O	S	S	S

➡ NOTE: O: Open, S: Shorted

(2) JP4: Pump signal selection

Jumper	JP4	
Pin No.	1–2	2–3
Form "a" contact	S	O
Form "b" contact	O	S

➡ NOTE: O: Open, S: Shorted

(3) JP5: Valve actuating signal selection

Same voltage as supply voltage: Shortcircuit pins 1-2 and 3-4 of JP5.
Contact-closure signal : Shortcircuit pins 2-3 of JP5.

(4) JP6: Pulse generator power shunt jumper

When signal generator is 3-wire type (power supply for signal generator is necessary): JP6 open
When signal generator is 2-wire type (power supply for signal generator is unnecessary): JP6 short-circuited

➡ NOTE: If the power to the pulse generator is unused, set Input Disconnection ALM (parameter No. 17) to 0.

(5) WRT jumper: Write protect mode setting

Inhibits Calibration Set and EEPROM CLEAR.

WRT is short-circuited: Clear Write-protect mode.
WRT is open : Set Write-protect mode.

➡ NOTE: For details, see Section 8.2 "SET Mode"

(6) Test jumper

Shorted at all times

(7) WDT jumper

Left open at all times

(8) BZ ON/OFF jumper

Sets presence or absence of buzzer sound at the operation of pushbutton.

Short-circuit : Buzzer off
Open : Buzzer on

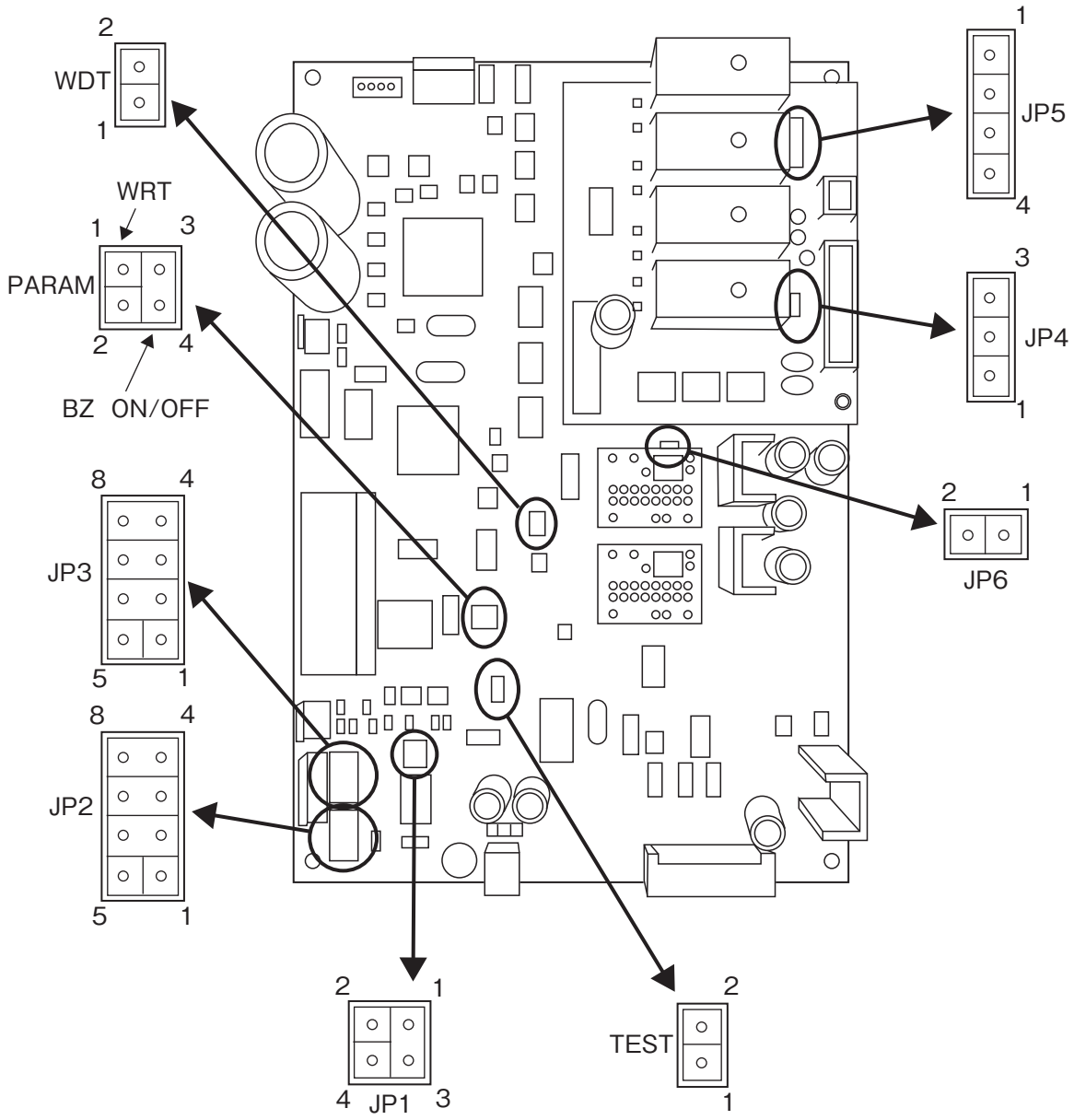


Fig. 6.5 Jumper Switch Locations

7. FRONT PANEL DISPLAY AND PUSHBUTTON CONTROLS

There are six pushbuttons on the control panel to operate the batch process and program settings. The display is a backlit LCD and indicates total count, batch setting, scrolling variables (NET, GROSS, TEMP, PRESS, DENSITY, and K), instant flow rate, alarm indication, etc.

7.1 Functions of Front Panel Display

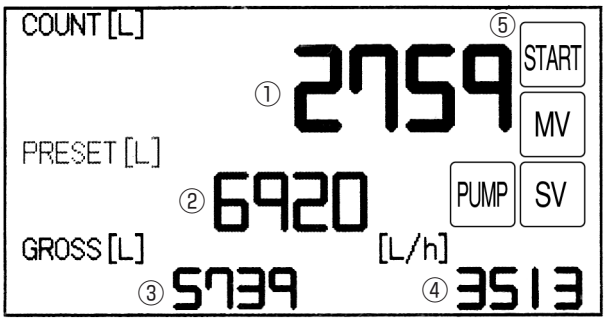


Fig. 7.1 Display Screen and Assigned Fields

Table 7.1 Functions of Panel Display

Display fields shown in Fig. 7.1			Functions			
①	Total counter		Total flow in a range of 0 to 999,999,999.			
②	Batch setting		Target setting in a range of 0 to 999,999,999			
③	Scroll variables		NET, GROSS, TEMP, PRESS, DENSITY, and K			
		NET	Net total in a range of 0 to 999,999,999.			
		GROSS	Gross total in a range of 0 to 999,999,999.			
		TEMP	Measured temperature in a range low to high limit. ※1			
		PRESS	Measured pressure in a range low to high limit. ※2			
		DENSITY	Measured density to two decimal points. ※3			
		K	Volume conversion factor to four decimal points. ※4			
④	Normally Flow Rate is indicated. At the occurrence of an alarm, Alarm information is indicated.					
	Instant flow rate		Fluid velocity in a range of 0 to 9,999,999 while a batch is in progress (temporary interruption incl.). Above this range, "Flow Over" appears. In a standby and end-of-batch state, "********" appears.			
	Alarm description		MissP.	Missing pulse	Over	Overflow
			Temp.Ovr	High temperature	Temp.Udr	Low temperature
			Pres.Ovr	High pressure	Pres.Udr	High pressure
			Sensor	Sensor disconnected or short-circuited	FlowOver	Excessive flow
			Pulsedif	Pulse difference	Pra.ERR	Parameter
⑤	Status		START/STOP/END, MV, SV, PUMP, COM are displayed. ・ "START", "STOP", "END", are displayed according to the status. (No indication for standby state) ・ "SV", "MV", and "PUMP" are indicated in gray when the output is off. They are indicated in colors when the output is on. ・ "COM" is indicated only during communication.			

➡ NOTE ※1: Constantly indicates the value of Fixed Pressure (No.126) when there is no temperature input.
※2: Constantly indicates the value of Fixed Temperature (No.103) when there is no pressure input.
※3: Constantly indicates the value of Reference Pressure (No.105) when "Without Temperature Compensation" is selected.
※4: Constantly indicates "1" when "Without Temperature Compensation" is selected.

7.2 Functions of Pushbutton Controls

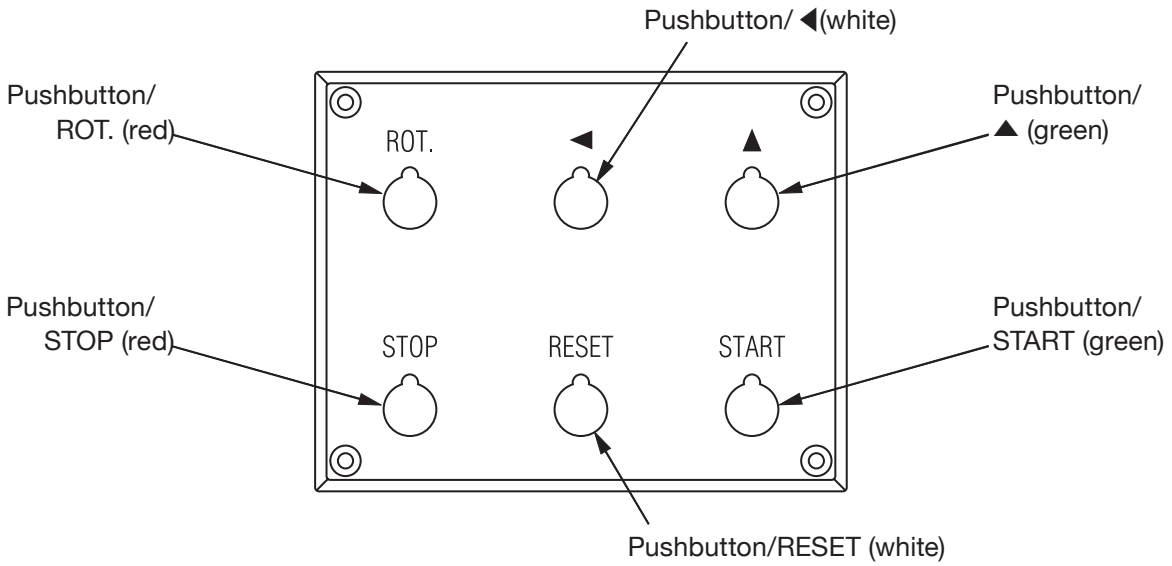


Fig. 7.2 Pushbutton Control

Table 7.2 Pushbutton Functions

Pushbutton Label	Functions
ROT.	Scrolls through the menu items in the scroll display. Pressing the button for 3 seconds moves the screen to Parameter SET mode.
◀	Moves the cursor when setting a parameter.
▲	Pressing this button for 3 seconds moves the screen to SET mode (for selecting various setup modes). Pushing the button also increases the numeric value at parameter setting.
STOP	Pauses a batch process temporarily. Also cancels the buzzer sound in an alarmed condition or clear an alarmed condition. (See Sec. 12.2 "Alarm Output and Disalarm Procedure")
RESET	Resets a batch process or resets the pulse input (count value) before startup or disalarm.
START	Starts or restarts a batch process. In addition, this button is used for finalizing the set item and value.

8. OPERATION IN INDIVIDUAL MODES

8.1 Operation Sequence in RUN Mode

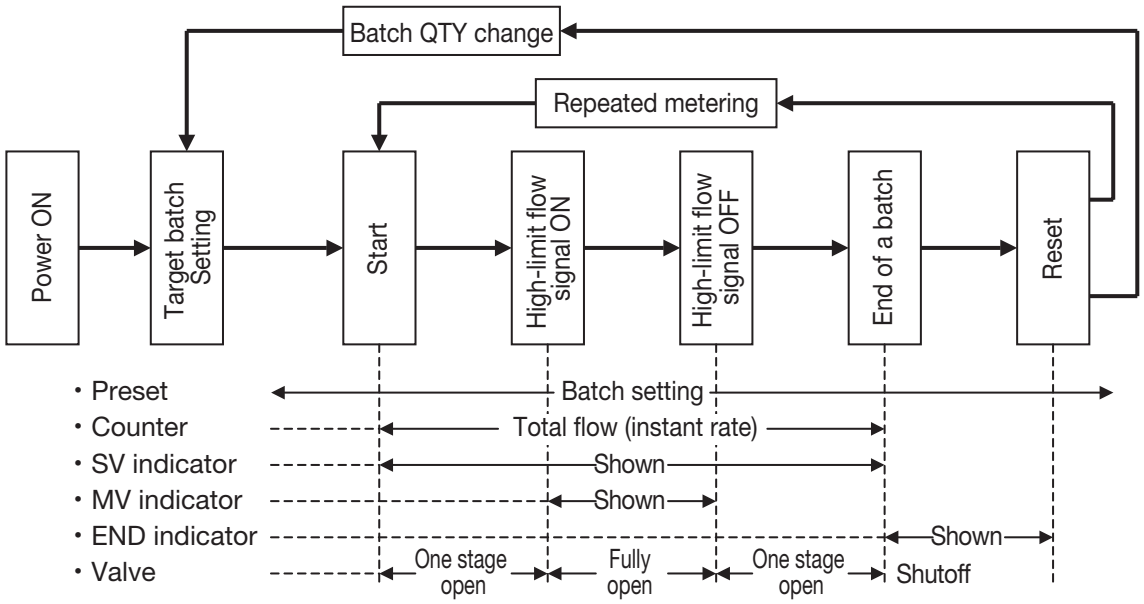


Fig. 8.1 Basic Operating Process in the RUN Mode

(1) Normal batch sequence (time chart)

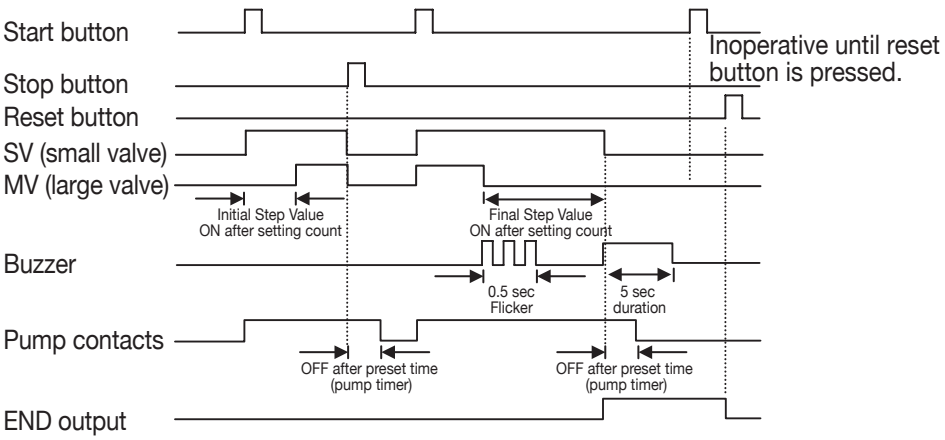


Fig. 8.2 Time Chart

(2) Interlock functions

Leaving INTERLOK (terminal No. 29-30, form "b" contact input) open enables the interlock functions.

Interlock functions

- In the standby mode, starting is disabled.
- In the course of a batch process, the process is temporarily paused.
  (Valve actuating signals, pump output signal, etc. are turned off.)

(3) Reset-start

Only in the standby mode and in the batch end state ("END" indicator stays on), this function automatically resets (the same state as is brought up by RESET button depression) and starts the process just by pressing START button.

To validate a reset and start operation, it is also required to change parameter No. 26.

➡NOTE: While the buzzer sounds in an alarmed condition, canceling the buzzer is required.

(4) Setting procedures

An "arbitrary 6-digit setup" and a "remote input to select 1-2-4k batch setting value" are selectable with internal parameters.

1. Arbitrary 6-digit setup (Parameter No. 25 "0": Invalid)
   The controller is provided with remote input as standard: in the case of "arbitrary 6-digit setup", you can perform an "arbitrary 6-digit setup" and 1-2-4k remote input. For remote input, see Table 8.1.
2. Remote input to select 1-2-4k batch setting value (Parameter No. 25 "1": Valid)
   When REMOTE IN 1k, 2k, and 4k are all left open, the function becomes the same as STOP button (in an emergency stop, canceling the buzzer in an alarmed condition, start inhibit, etc.). If REMOTE IN 1k, 2k, and 4k are all left open at power ON, the PRESET shows "0". (See Section 12.2 "Alarm Output and Disalarm Procedure".)
   For information about the procedure to set up parameters, see Section 10.1.7 "Programming (PRESET) Procedure".

Table 8.1 PRESET IN 1k/2k/4k Combination (3-bit BCD expression)

PRESET IN			Name	Default
4 (Across terminals 39 and 40)	2 (Across terminals 38 and 40)	1 (Across terminals 37 and 40)		
OPEN	OPEN	CLOSE	EXT PRESET 1	1,000 count (option)
OPEN	CLOSE	OPEN	EXT PRESET 2	2,000 count (option)
OPEN	CLOSE	CLOSE	EXT PRESET 3	4,000 count (option)
CLOSE	OPEN	OPEN	EXT PRESET 4	4,000 count (option)
CLOSE	OPEN	CLOSE	EXT PRESET 5	1,000 count (option)
CLOSE	CLOSE	OPEN	EXT PRESET 6	1,000 count (option)
CLOSE	CLOSE	CLOSE	EXT PRESET 7	1,000 count (option)

(5) Start prohibiting conditions

While any of the following conditions exists, starting or restarting of a batch operation is unavailable.

1. Interlock functions are enabled.
2. STOP button is in the depressed position.
3. PRESET is set to 0.
4. With EXT PRESET Select = 1 ("1-2-4k remote input" specification), and all REMOTE IN are left open.
5. After completion of a batch process (except when reset-start function is enabled)
6. An alarm is being set off (except for certain alarms, such as pressure alarm)

(6) Write-protect mode

By setting jumpers, you can set up write-protect mode. In the write-protect mode, Calibration Set and EEPROM CLEAR operation are inhibited. (Write-protect mode is enabled when the product leaves the factory.)

➡NOTE: Information about jumper setting can be found in Section 6.2.

8.2 SET Mode

With the controller powered on, pressing ▲ button for 5 seconds in the RUN and standby mode brings up the following screen, enabling the SET mode.

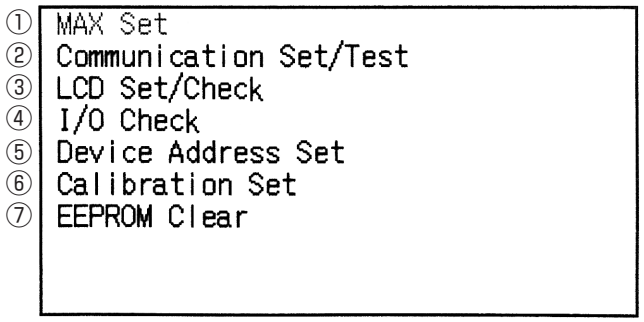


Fig. 8.3 SET Mode Screen

In the SET mode, seven special settings, functional tests, etc. shown in the table below are available. Of the seven menu items, Calibration Set and EEPROM CLEAR do not appear with write-protect mode enabled (see Sec. 6.2 "Jumper Setting").

Table 8.1 Special Setting Items

No.	Special setup item	Description	Reference
①	MAX Set	Changes the max. setting available for "PRESET", "Initial Step Value", and "Final Step Value".	8.2.1 (P.24)
②	Communication Set/Test	Changes the communication settings (baud rate, stop bit, and parity) and runs communication test. Jumpers on the main board select RS-232C or RS-485 (see the topic under "Jumper Setting")	8.2.2 (P.25)
③	LCD Set/Check	Sets and checks LCD output.	8.2.3 (P.26)
④	I/O Check	Tests the input and output port. When a change occurs in the input, it is reflected on the corresponding bit as 0 ⇔ 1 (Contacts open: 1 Contacts closed: 0).	8.2.4 (P.27)
⑤	Device Address Set	Sets device address.	8.2.5 (P.28)
⑥	Calibration Set (Valid only when Write-protect mode is cleared)	(1) Temperature input calibration Pt (adjust at 0 and 200Ω), 4 to 20mA (adjust at 4 and 0mA), 1 to 5V (adjust at 1 and 5V) (2) Pressure input calibration Either 4 to 20mA (adjust at 4 and 20mA) or 1 to 5V (adjust at 1 and 5V). (3) PID output (4mA/20mA) calibration Enter DA count reading that produces in a 4mA PID output. Enter DA count reading that produces a 20mA PID output. (4) Notch filter setting: Select line frequency 50Hz or 60Hz.	6.2 (P.17) 8.2.6 (P.29)
⑦	EEPROM Clear (Valid only when Write-protect mode is cleared)	Initializes any of the following data: (1) PRESET MAX Set value 1) PRESET MAX (batch setting) 2) Initial Step Value MAX (initial setting) 3) Final Step Value MAX (final setting) (2) Calibration Set data 1) Temp. input calibration 2) Press. input calibration 3) PID output calibration 4) Notch filter setting (3) Communication Set data 1) Baud Rate 2) Stop Bit 3) Parity (4) Parameters (Totalizer-NET and Totalizer-GROSS excluded)	6.2 (P.17) 8.2.7 (P.31)

8.2.1 MAX Set

By setting MAX Set items to the values within your predetermined range, setting erroneous values in the Parameter SET mode can be prevented.

In the RUN and standby mode, press ▲ button for 3 seconds to enable the SET mode.

At SET mode screen in Fig. 8.3, press ROT. button to select the PRESET MAX Set and press START button to finalize the setting.

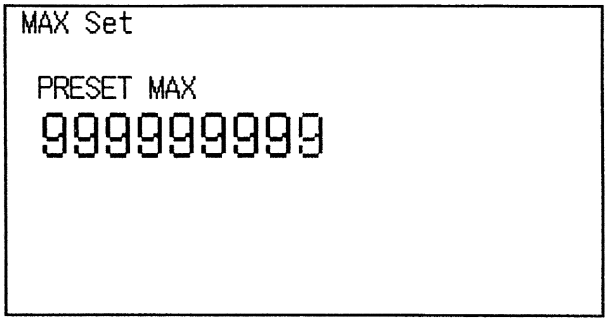


Fig. 8.4 MAX Set Screen

By pressing ROT. button, you can view the following three parameter setting screens.

(1) Initial step
Can set the max. value in a range of 0 to 9,999.

(2) Final step
Can set the max. value in a range of 0 to 9,999.

(3) Batch setting
Can set the max. value in a range of 0 to 999,999,999.

Shown in the table below are the operating buttons and corresponding functions.

ROT.	Selects a menu item to be set up. Pressing the button for 3 seconds causes the new setting to be stored in the EEPROM and returns the screen to the SET mode.
◄	Moves the cursor to the left.
▲	Changes the value at the cursor position.
START	Sets the value that has been changed. Pressing ROT. button without setting the value abandons the changed value shown.

➡NOTE: In the MAX Set, only buttons shown above are used.

Setup operation:

Selects the parameter desired to be reconfigured. Enter a new setting desired with ◄ and ▲ buttons, and then press START button to finalize the setting.

To return to the SET mode, press ROT. button for 3 seconds.

8.2.2 Communication Set/Test

Sets and tests communication.

In the RUN and standby mode, press ▲ button for 3 seconds to enable the SET mode.

In the SET mode screen in Fig. 8.3, press ROT. button to select the Communication Set/Test and press START button to finalize the setting.

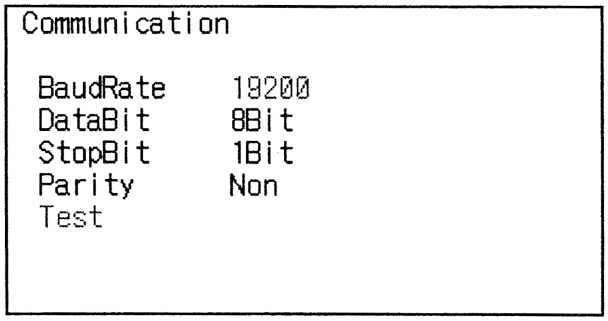


Fig. 8.5 Communication Set/Test Screen

In the Communication Set/Test, you can set the following five format settings and test the communication. Data bit is fixed at 8 bits.

➡ NOTE: This setting is common to RS-485 (RS-232C option) and USB.

(1) Baud rate: 1,200, 2,400, 4,800, 9,600, 19,200, and 38,400 communication rate.
(2) Data bit: Set at 8 bits. Unalterable.
(3) Stop bit: Select 1 bit or 2 bits.
(4) Parity bit: Select None, Odd, or Even.
(5) Test: Allows loopback test for checking transmitting and receiving lines.
If the communication is found normal by exercising a test with external terminals TXD and RXD of the communication line at the controller short-circuited, OK is indicated. If found abnormal, NG is indicated.
➡ NOTE: Test is valid only with RS-232C. (Test is invalid with RS-485 and USB.)

Shown below are the operating buttons and corresponding functions.

ROT.	Selects a menu item to be set up. Pressing the button for 3 seconds causes the new setting to be stored in the EEPROM and returns the screen to the SET mode.
▲	Changes the setting of the item selected.

➡ NOTE: Only two buttons shown above are used in Communication Set/Test.

Operations for setting:

With ROT. button, select the parameter desired to be reconfigured, set the new value with ▲ button.

Upon completion of setting, press ROT. button for 3 seconds to return to the SET mode.

8.2.3 LCD Set/Check

Sets LCD output and checks LCD.

In the RUN and standby mode, press the ▲ button for 3 seconds to enable the SET mode.

In the SET mode screen in Fig. 8.3, press the ROT. button to select the LCD Set/Check and press START button to finalize the setting.

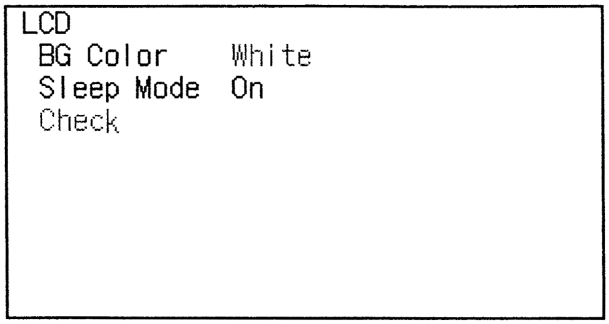


Fig. 8.6 LCD Set/Check Screen

In the LCD Set/Check mode, you can set LCD display mode (BG Color) and Sleep mode, and check the display operation.

BG Color	Selects display with white background or black background.
Sleep mode	Sets Sleep mode on or off. ON : When the status without button operation or pulse input lasts for more than 5 seconds, LCD is turned off to protect the LCD. OFF : LCD is displayed at all times during power condition.
Check	Proper LCD illumination can be verified by two horizontal stripe test patterns - one indicating a screen where even lines of the LCD are marked out and the other screen where odd lines of the LCD are marked out. Pressing ROT. button brings up one status screen where only even lines of the LCD are marked out and the other status screen where only odd lines are marked out to help you locate "missing or dead" pixels or other defects.

Shown below is the operating button and corresponding function.

ROT.	Selects an item to be set. Pressing this button for 3 seconds returns to the SET mode screen.
▲	Changes the setting of the item selected.

➡ NOTE: In the LCD Set/Check, buttons other than the above are unused.

Operations for setting:

With the ROT. button, select the parameter you want to change and change the set value with the ▲ button.

If setting is completed, press the ROT button for 3 seconds to return the screen to the SET mode.

8.2.4 I/O Check

Checks the input/output port.

In the RUN and standby mode, press the ▲ button for 3 seconds to enable the SET mode.

In the SET mode screen in Fig. 8.3, press the ROT. button to select the I/O Check and press the START button to finalize the setting.

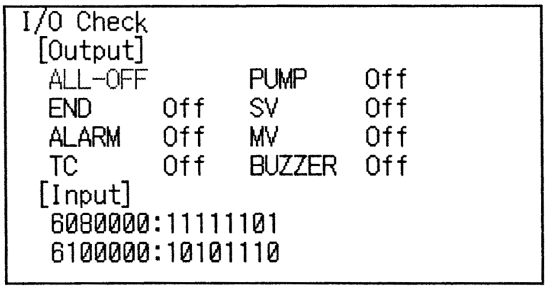


Fig. 8.7 I/O Check Screen

I/O Check enables you to check the input and output port.

⚠ **CAUTION: During an I/O Check, a signal is actually produced. Disconnect the input/output wiring on the part of the customer, or make certain that the resultant signal will by no means cause any adverse effects on associated equipment before you run a check. (Especially be careful when checking "START" corresponding to bit 0 of the input port below.)**

➡ NOTE: All items are off in the initial state. Select outputs individually to turn on or off.

Shown in this screen is the status of the 8-bit input port as viewed from the CPU. Assigned address for input port 1 is 6080000h while 6100000h for input port 2. These input statuses are shown in a binary 8-digit form where the order of higher to lower bit is shown from left to right. All outputs are off in the initial state. Select outputs individually to turn on or off.

bit	Output port (6100000h)	Input port 1 (6080000h)	Input port 2 (6100000h)
bit 7	Unused	OPTION	Unused
bit 6	BZ	↑	Unused
bit 5	ALM	←	Short (Meter line shorted)
bit 4	END	ROT	Short (Meter line open)
bit 3	TC	RESET	PRESET IN 4
bit 2	PU	STOP (A connection)	PRESET IN 2
bit 1	SV	STOP (B connection)	PRESET IN 1
bit 0	MV	START	LOCK

Use the following buttons for operation.

ROT.	Selects the item to be set. Press the button for 3 seconds to return the screen to the SET mode.
START	Turns the output on or off.

➡ NOTE: In I/O Check, buttons other than the above are unused.

Operations for checking:

Press the ROT. button to select the output you want to check. Press the START button to turn the display on, resulting in output to respective terminals. Pressing the START button again causes the display to be off and the output from the corresponding terminal to be stopped.

8.2.5 Device Address Set

Sets the address of the controller at the time of communication.

In the RUN and standby mode, press the ▲ button for 3 seconds enable the SET mode.

In the SET mode screen in Fig. 8.3, press the ROT. button to select the Device Address Set and press the START button to finalize the setting.

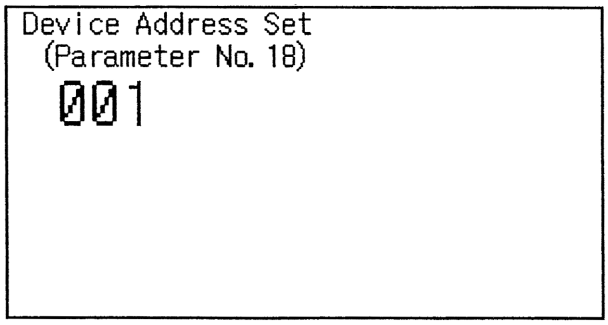


Fig. 8.8 Device Address Set Screen

The Device Address Set setting ranges from 1 to 247. Initial value is 1.

Use the following buttons for operation.

ROT.	Selects the item to be set. Press the button for 3 seconds causes the change to be stored in EEPROM and the screen to return to the main mode.
◄	Moves the cursor.
▲	Changes the value at cursor.
START	Finalizes the value changed.

➡ NOTE: In Device Address Set, buttons except the above are unused.

Operations for setting:

With the Device Address Set screen in Fig. 8.8 displayed, enter the setting value using the ◄ and ▲ button and press the START button to finalize the setting. After completing the setting, press the ROT. button for 3 seconds to return to the SET mode.

8.2.6 Calibration Set

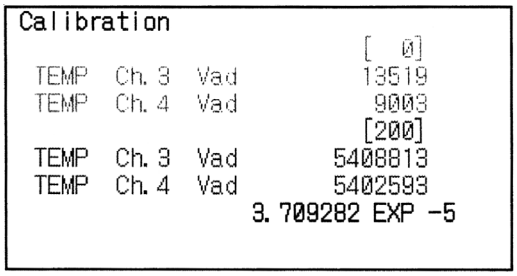
In the Calibration Set, you can calibrate the temperature and pressure, set the 4 to 20mA output and the filter parameters, and displays the version.

In the RUN and standby mode, press the ▲ button for 3 seconds to enable the SET mode.

In the SET mode screen in Fig. 8.3, press the ROT. button to select the Calibration Set and press the START button to finalize the setting.

➡ NOTE: 1. At the time of shipment, Write-protect mode is set. It is necessary to clear the Write-protect mode to enable operation. (See Section 6.2 "Jumper Setting".)
2. As this item is related to the performance of the equipment, contact our sales agent or service center for operation.

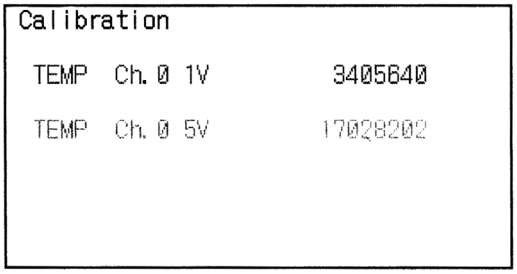
① Temperature calibration (Pt100 Ω) parameter No.: Displayed only when 110 is 1.



Enter 0Ω and 200Ω, save the A/D readings at this time, and take the factors obtained from these data as calibration data.

Fig. 8.9 Temperature Calibration (Pt100 input) Screen

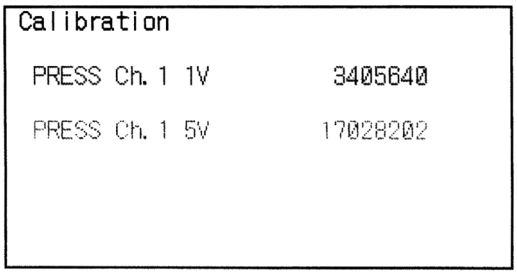
② Temperature calibration (Analog input) parameter No.: Displayed only when 110 is 0.



Enter 4/20mA and 1/5V, and save the A/D readings at this time, and take the factors obtained from these data as calibration data.

Fig. 8.10 Temperature Calibration (Analog input) Screen

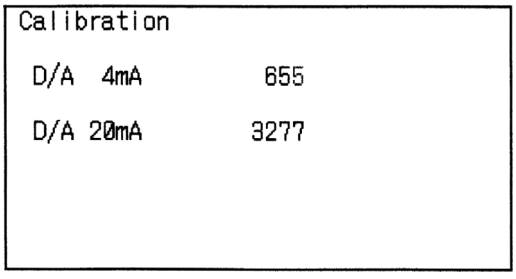
③ Pressure calibration (Analog input)



Enter 4/20mA and 1/5V, and save the A/D readings at this time, and take the factors obtained from these data as calibration data.

Fig. 8.11 Pressure Calibration (Analog input) Screen

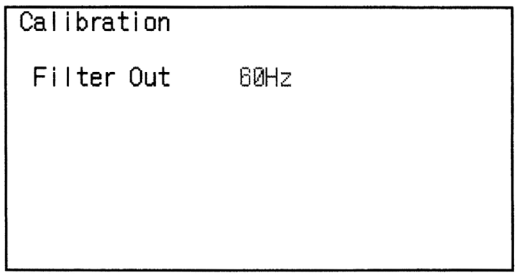
④ Current output calibration:



Sets the D/A value to produce 4mA and 20mA output.

Fig. 8.12 Current Output Calibration Screen

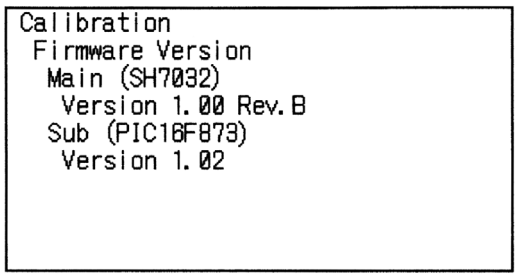
⑤ Filter setting:



Sets the 50Hz/60Hz notch filter.

Fig. 8.13 Filter Setting Screen

⑥ Version indication



Indicates firmware version.

Fig. 8.14 Version Indication Screen

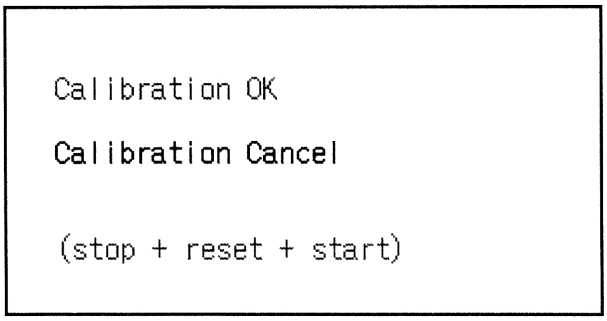


Fig. 8.15 Calibration OK/Cancel Screen

Upon START button depression, a review screen appears. With "Calibration OK" selected, pressing STOP, RESET, and START buttons simultaneously finalizes the calibration settings.

Shown below are the operating buttons and corresponding functions.

ROT.	Selects calibration items. Pressing the button for 3 seconds causes the modified setting to be saved in the EEPROM and returns the screen to the SET mode.
◄	Moves the cursor to the left during the 4 to 20mA setting process.
▲	Adjusts the numerical value at the cursor during the 4 to 20mA setting, or selects 50Hz or 60Hz during the filter setting.
STOP	Selects 1 to 5V input or 4 to 20mA input during temperature calibration (only analog input) and pressure calibration.
RESET	Selects 1V/4mA or 5V/20mA input during temperature calibration (only analog input) and pressure calibration.
START	Shows the calibration setting screen.

8.2.7 EEPROM CLEAR

EEPROM clears various kinds of set data written in EEPROM and sets to the default value.

➡NOTE: 1. At the time of shipment, Write-protect mode is set. It is necessary to clear the Write-protect mode to enable operation. (See Section 6.2 "Jumper Setting")
2. As this item is related to the performance of the equipment, contact our sales agent or service center for operation.

In the RUN and standby mode, press the ▲ button for 3 seconds to enable the SET mode.

In the SET mode screen in Fig. 8.3, press the ROT. button to select the EEPROM Clear and press the START button to finalize the setting.

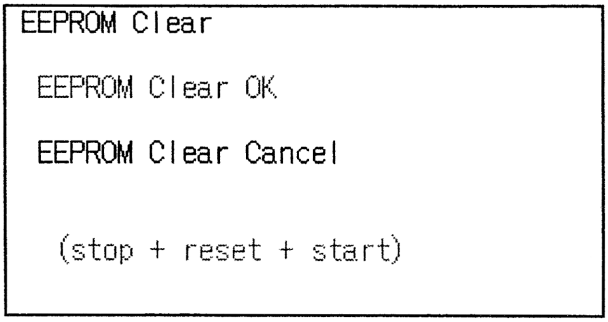


Fig. 8.16 EEPROM Clear OK/Cancel Screen

This operation clears the data from (1) to (8) below:

(1) Max. batch setting value setting
(2) Max. initial step value setting
(3) Max. final step value setting
(4) Temperature calibration setting
(5) Pressure calibration data
(6) 4 to 20 mA output calibration data
(7) Communication setting
(8) Notch filter setting

With START button, select EEPROM Clear OK, by pressing STOP, RESET and START buttons simultaneously, clear EEPROM data and return to the SET mode. During the data clear process, the screen shows a message "Please wait .....".

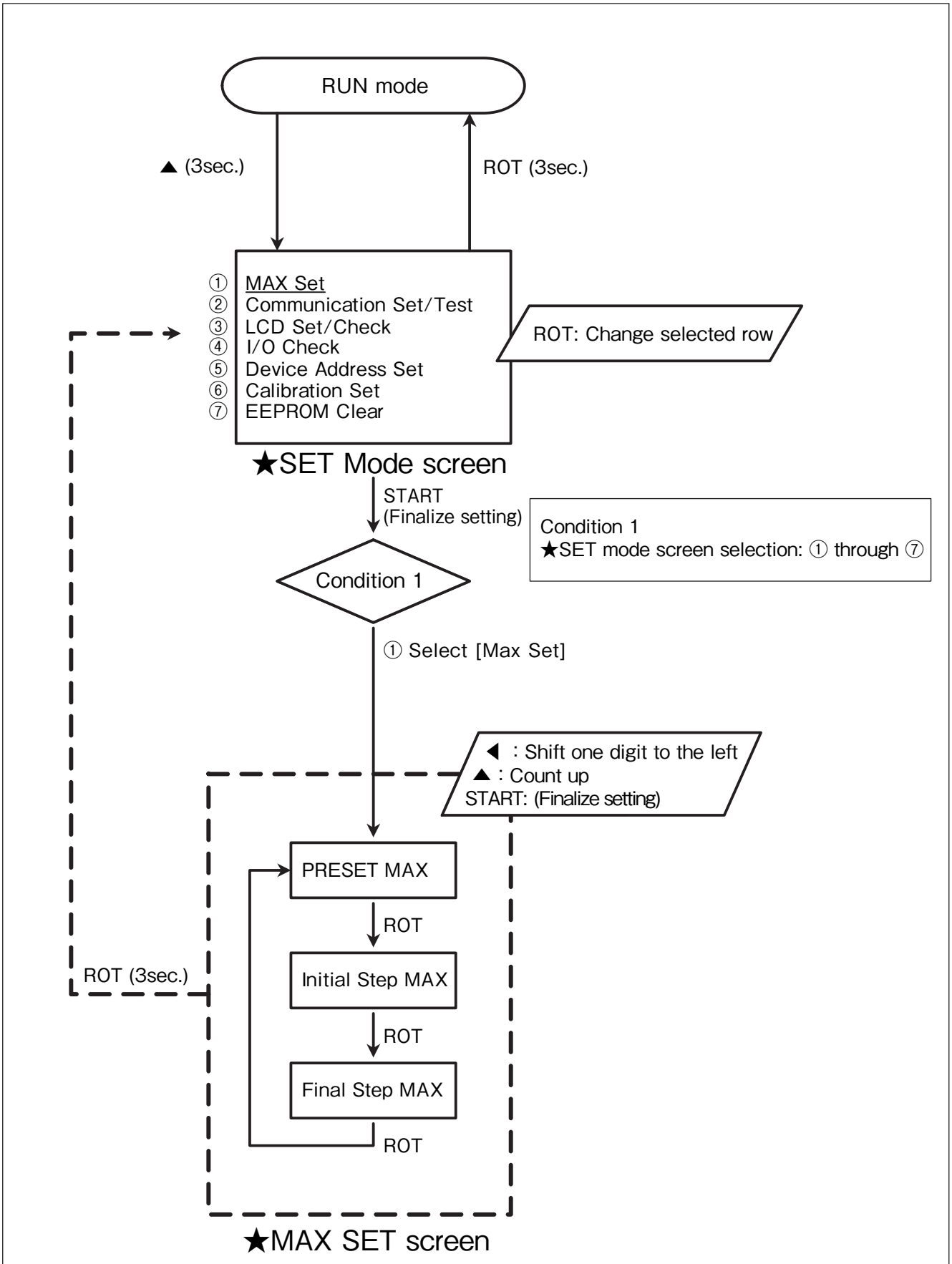
Shown below are the operating buttons.

ROT.	Press the button for 3 seconds to return to the normal standby window.
▲	Selects EEPROM Clear OK or EEPROM Clear cancel.
STOP	With EEPROM Clear OK selected, pressing STOP, RESET, and START simultaneously clears the EEPROM data.
RESET	With EEPROM Clear OK selected, pressing STOP, RESET, and START simultaneously clears the EEPROM data.
START	With EEPROM Clear OK selected, pressing STOP, RESET, and START simultaneously clears the EEPROM data. If EEPROM Clear Cancel has been selected, the controller returns to the SET mode without the process to clear the EEPROM data.

➡NOTE: In the EPROM Clear process, buttons other than shown above are unused.

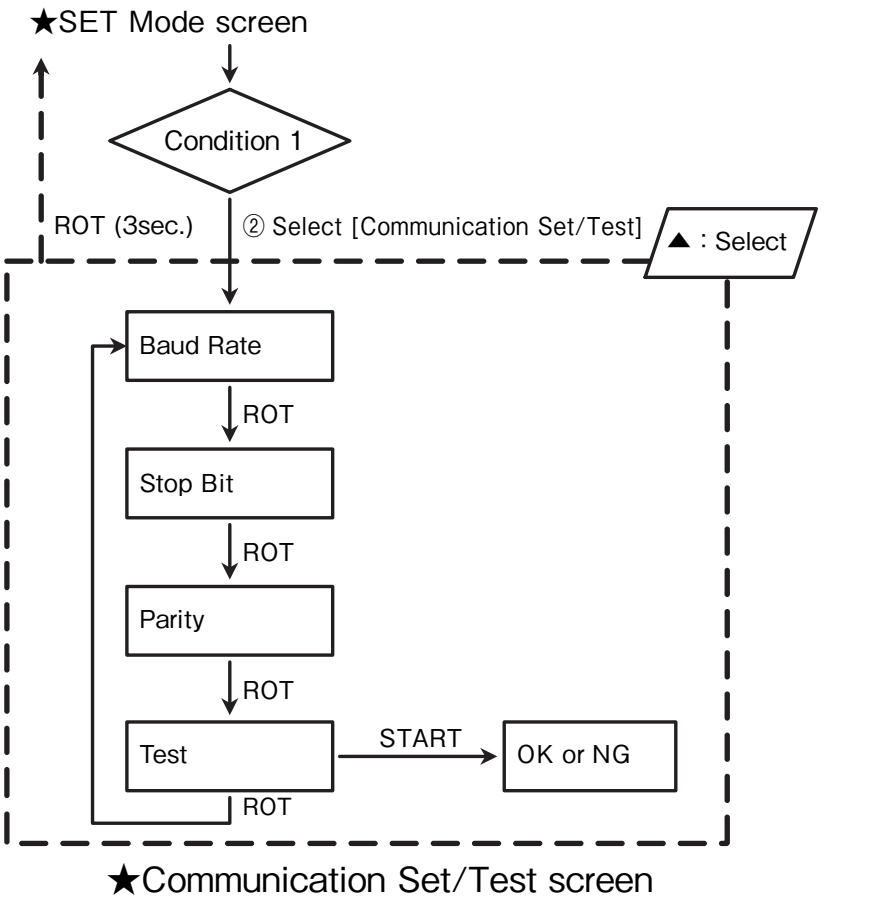
8.2.8 SET Mode Operation Flowchart

Table 8.2 (1/5)

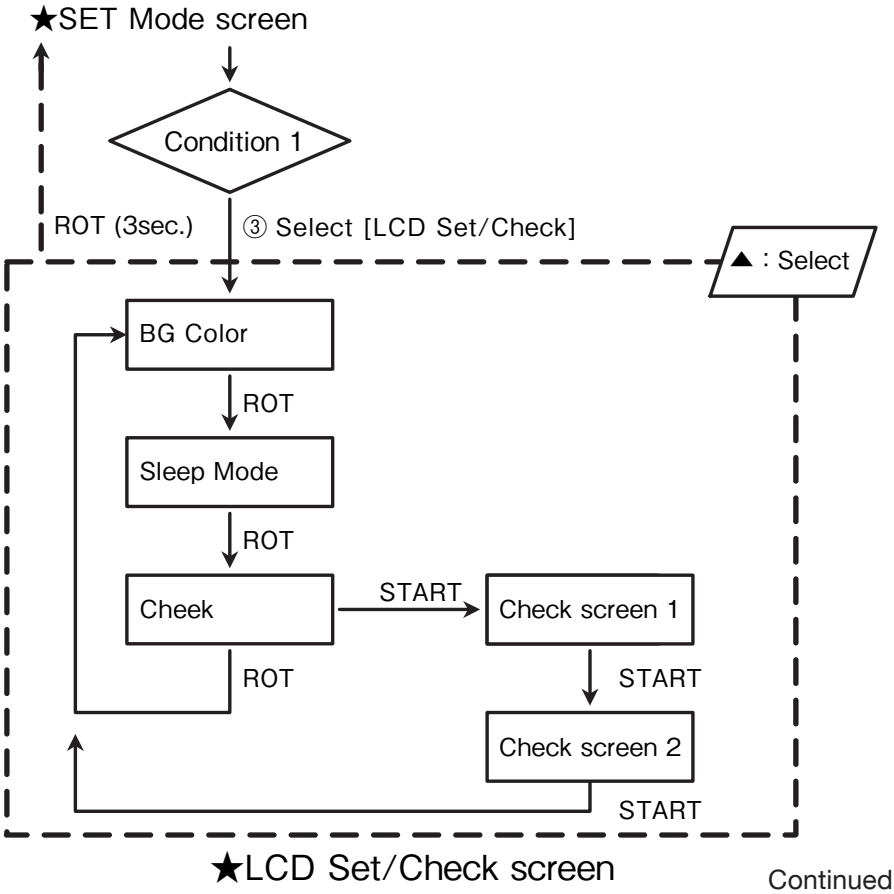


Continued on next page.

Table 8.2 (2/5)



★Communication Set/Test screen



★LCD Set/Check screen

Continued on next page.

Table 8.2 (3/5)

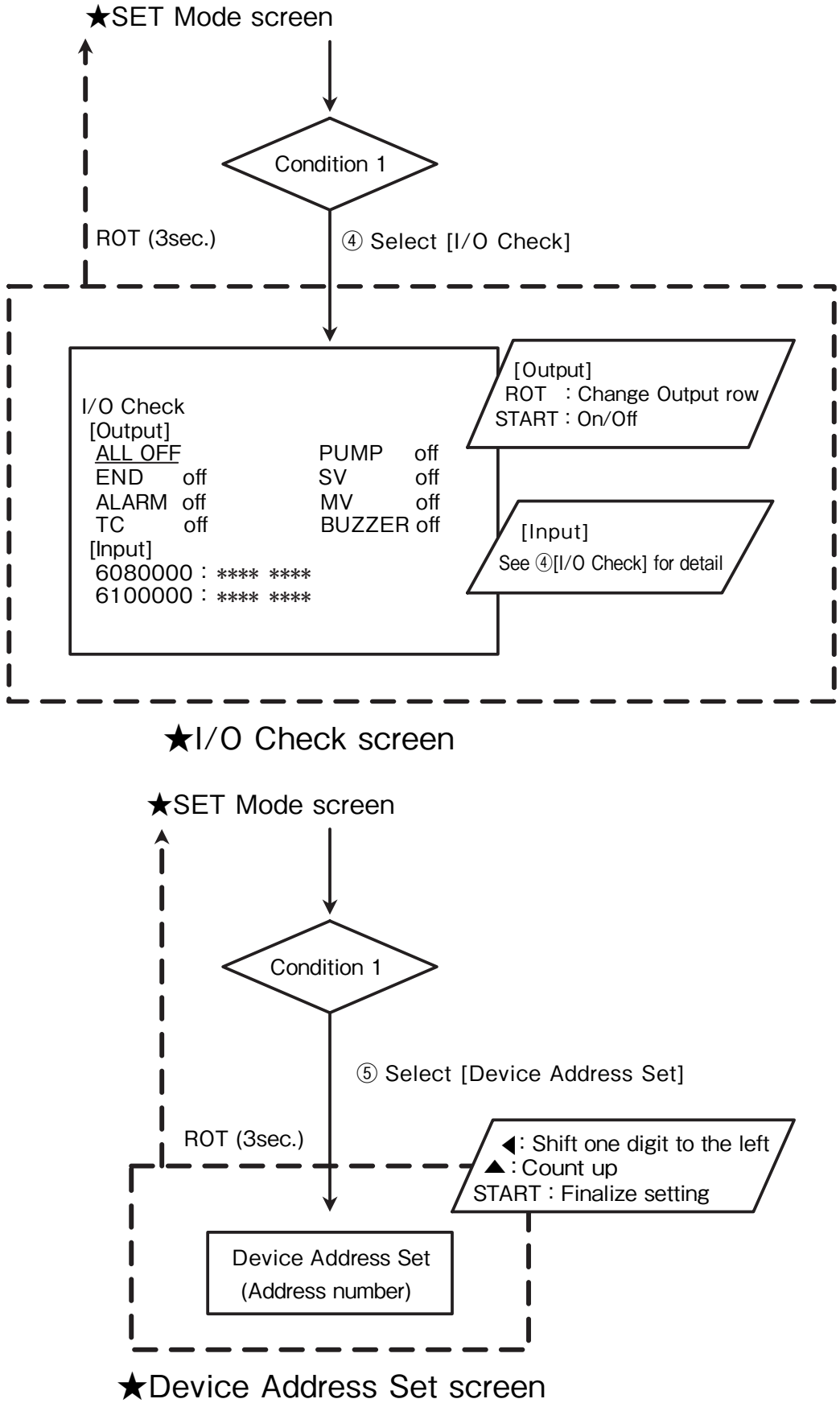


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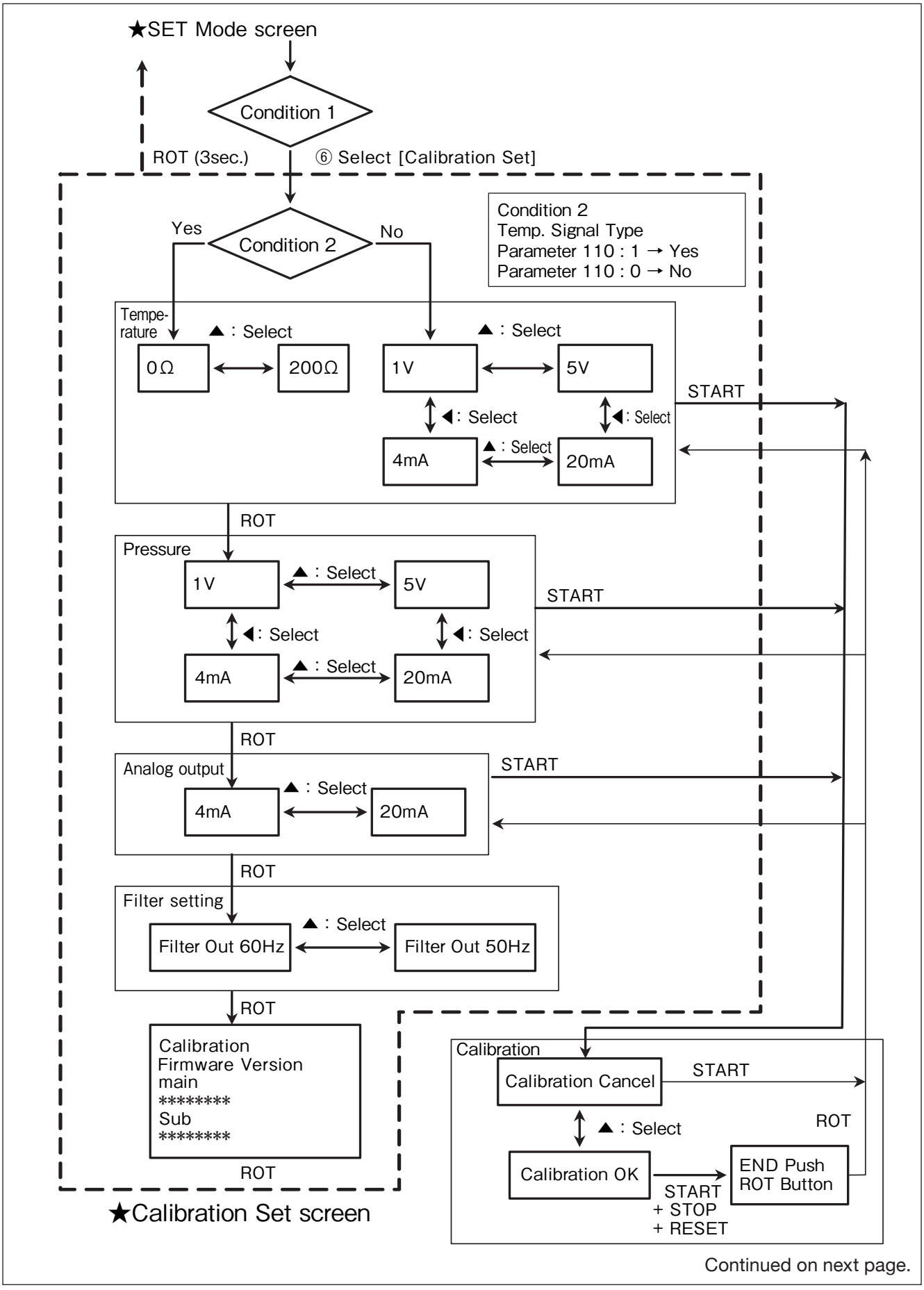
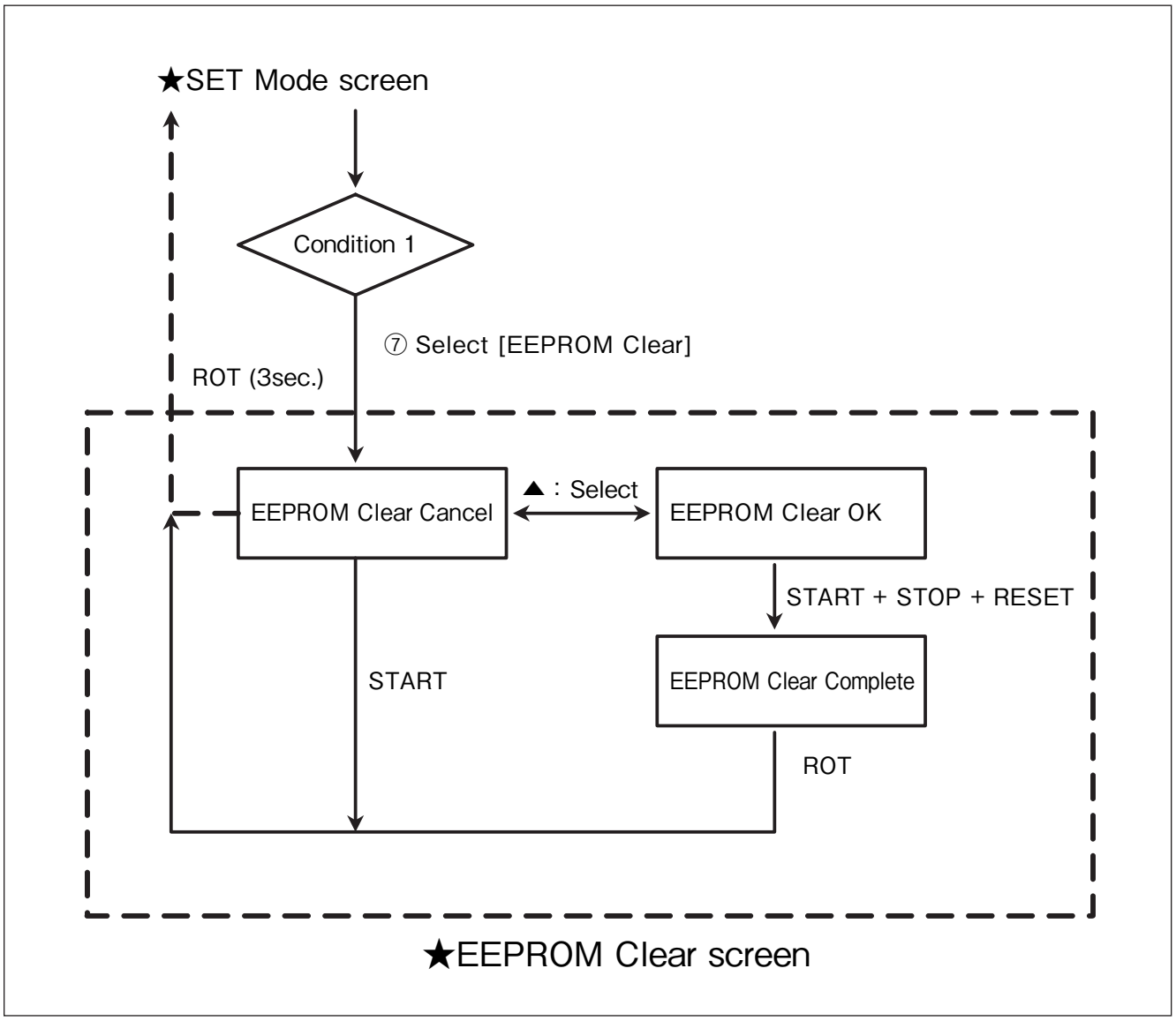
Table 8.2 (4/5)



Continued on next page.

Table 8.2 (5/5)



8.3 Parameter SET Mode

Refer to the attached “Parameter SET Mode Setup Manual”.

9. COMMUNICATION CAPABILITIES

9.1 MODBUS Communication

Via RS-485 or RS-232 (option), controller parameters can be reconfigured through communication lines. Also, by using the MODBUS communication protocol, multiple controllers can connect to one host computer (via RS-485).

Communication format is made up of the following parts and specifications:
(See "8.2.2 Communication Set/Test" for how to change setting.)

Baud Rate : 1,200, 2,400, 4,800, 9,600, 19,200, 38,400bps
Start Bit : 1 bit
Data Bit : 8 bit
Stop Bit : 1 bit, 2 bit
Parity : None, Odd, Even

➡ NOTE: Underlined specifications indicate default settings.

(1) Floating point data representation

Floating point handled by the microprocessor in the batch controller conforms to the IEEE standard.

(2) Frame structure in RTU mode

Address	Function code	Data	CRC Theck
8-bit	8-bit	n x 8-bit	16-bit

(3) Address setting

By changing "Device Address" (parameter No. 18) during communication, the address can be set between 1 and 247. "0" is used for broadcast address and therefore unacceptable, however.

(4) Corresponding function code

① Read Holding Registers: 03 (Broadcast: Not compatible)

By specifying the address, register, and register number of interest, the value from the holding register is read. The holding register consists of 16-bit long words.
As an example, a query to read the values of holding register 7007 (1B5Fh) and its response are shown below. The starting register is 7006 (1B5Eh) where 1 is subtracted from 7007.

● **Query**

	Ex. (hex)
Address	01
Function code	03
Starting register (high order)	1B
Starting register (low order)	5E
Register No. (high order)	00
Register No. (low order)	02
CRC	A3 3D

● **Response**

	Ex. (hex)
Address	01
Function code	03
Number of data bytes	04
Data 1 (high order)	3F
Data 1 (low order)	80
Data 2 (high order)	00
Data 2 (low order)	00
CRC	F7 CF

② Preset Multiple Registers: 16 (Broadcast: compatible)

Arbitrary data is written into multiple holding registers at consecutive addresses of interest. A holding register consists of 16-bit long words. As an example, a query to write 160 (43200000h in IEEE style) into holding register 7111 (1BC7h) and its response are shown below. The starting register is 7110 (1 BC6h) where one is subtracted from 7111.

● **Query**

	Ex. (hex)
Address	01
Function code	10
Starting register (high order)	1B
Starling register (low order)	C6
Register No. (high order)	00
Register No. (low order)	02
Number of data bytes	04
Data 1 (high order)	43
Data 1 (low order)	20
Data 2 (high order)	00
Data 2 (low order)	00
CRC	D5 6B

● **Response**

	Ex. (hex)
Address	01
Function code	10
Starting register (high order)	1B
Starling register (low order)	C6
Register No. (high order)	00
Register No. (low order)	02
CRC	A7 11

(5) Exception codes

Exception codes correspond to the following three:

02 : ILLEGAL DATA ADDRESS
03 : ILLEGAL DATA VALUE
06 : SLAVE DEVICE BUSY

● **Query**

	Ex. (hex)
Address	01
Function code	10
Starting register (high order)	1B
Starting register (low order)	58
Register No. (high order)	00
Register No. (low order)	01
Number of data bytes	02
Data 1 (high order)	00
Data 1 (low order)	50
CRC	00 75

● **Response**

	Ex. (hex)
Address	01
Function code	90
Exception code	06
CRC	CC 02

➡NOTE: Regarding the function code of response, its MSB is set to 1 with respect to the function code of query.
(10h : 00010000→90h : 10010000)

⚠ **CAUTION: For communication interval, make sure to give the interval of 200ms.**

10. DESCRIPTION OF PARAMETERS

Table 10.1 Parameter List (1/4)

Param. No.	Register	Parameter name	Setting range	Initial value	Description	Data type		Remarks
001	7001	Initial Step Value	0 to Initial Step Value MAX	80	Sets flow quantity till MV is opened.	16 intgr	W/R	Initial Step Value
002	7002	Final Step Value	0 to Final Step Value MAX	80	Sets flow quantity till MV is closed.	16 intgr	W/R	Final Step Value
003	7003	Anticipated Overshoot	0 to 99 Yet less than PRESET value	2	Sets Anticipated overshoot	16 intgr	W/R	Anticipated Overshoot
004	7004	Overshoot Setting	0 to 99	2	Sets Overshoot alarm.	16 intgr	W/R	Overshoot Setting
005	7005	Pulse Deviation	0 to 15	5	Sets pulse deviation for two inputs. NOTE) With one input set to 0.	16 intgr	W/R	Pulse Deviation
006	7006	Missing Pulse	0 to 999	5	Sets the duration of Missing Pulse alarm detection. Issues alarm when no pulse is input within preset time.	16 intgr	W/R	Missing Pulse
007	7007	M.F. Mantissa Value	0.0001 to 9.9999	1	Meter factor: Mantissa (Used in NET, COUNT, GROSS, and instant. flow rate calculation formula.)	32 float	W/R	M.F. Mantissa Value
009	7009	M.F. Exponent Value	–5 to 5	0	Meter factor: Exponent (Used in NET, COUNT, GROSS, and instant. flow rate calculation formula.)	16 intgr	W/R	M.F. Exponent Value
010	7010	Over Flow Rate	1 to 99999	99999	Sets excessive flow alarm value. The alarm is activated when the instant flow rate exceeds this value.	32 intgr	W/R	Over Flow Rate
012	7012	Batch Setting Value	"Anticipated Overshoot" +1 to "PRESET MAX"	1000	If EXT Batch Select = 0, Batch Setting Value when REMOTE IN 1k, 2k, 4k inputs are all open can be set.	32 intgr	W/R	PRESET
014	7014	Pump Output Timer	0 to 9999	30	Sets duration of time before pump control signal is turned off.	16 intgr	W/R	Pump Output Timer
015	7015	Sample Cycle Count	1 to 999	1	Sets sample cycle count for flow rate measurement.	16 intgr	W/R	Sample Cycle Count
016	7016	Sampling Time	1 to 999	5	Sets valid duration of time for flow rate measurement. Instant. flow rate is not calculated if there is no pulse input within this duration.	16 intgr	W/R	Sampling Time
017	7017	Input Disconnection ALM	0 or 1	0	Sets sensor (sensor “open” and short alarm) functions. 0: Without alarm function 1: With alarm function	16 intgr	W/R	Input Disconnection ALM
018	7018	Device Address No.	1 to 247	1	Displays the address setting of the controller at the time of communication.	16 intgr	R	Device Address
019	7019	EXT PRESET1	"Anticipated Overshoot" +1 to "PRESET MAX"	1000	Sets Batch Setting Value for REMOTE IN input 1.	32 intgr	W/R	EXT PRESET1
021	7021	EXT PRESET2	"Anticipated Overshoot" +1 to "PRESET MAX"	2000	Sets Batch Setting Value for REMOTE IN input 2.	32 intgr	W/R	EXT PRESET2
023	7023	EXT PRESET3	"Anticipated Overshoot" +1 to "PRESET MAX"	4000	Sets Batch Setting Value for REMOTE IN input 3.	32 intgr	W/R	EXT PRESET3
025	7025	EXT Batch Select	0 or 1	0	0 : Sets Batch Setting Value and EXT PRESET 1-7 batch quantity at REMOTE IN terminals. 1 : Sets the state equivalent to that after pressing the STOP button when EXT PRESET1-7 batch quantity is set at REMOTE IN terminal and all REMOTE IN terminals are opened.	16 intgr	W/R	EXT Batch Select
026	7026	Reset + Start	0 or 1	0	Sets the Reset + Start function. 0: Reset + Without Start function 1: Reset + With Start function	16 intgr	W/R	Reset + Start
027	7027	Pulse In Alarm	0 or 1	1	Sets Pulse In Alarm (activated if there is pulse input before batch start) function. 0: Without Alarm function 1: With Alarm function	16 intgr	W/R	Pulse In Alarm
028	7028	EXT PRESET4	"Anticipated Overshoot" +1 to "PRESET MAX"	4000	Sets Batch Setting Value for REMOTE IN input 4.	32 intgr	W/R	EXT PRESET4
030	7030	EXT PRESET5	"Anticipated Overshoot" +1 to "PRESET MAX"	1000	Sets Batch Setting Value for REMOTE IN input 5.	32 intgr	W/R	EXT PRESET5
032	7032	EXT PRESET6	"Anticipated Overshoot" +1 to "PRESET MAX"	1000	Sets Batch Setting Value for REMOTE IN input 6.	32 intgr	W/R	EXT PRESET6
034	7034	EXT PRESET7	"Anticipated Overshoot" +1 to "PRESET MAX"	1000	Sets Batch Setting Value for REMOTE IN input 7.	32 intgr	W/R	EXT PRESET7
101	7101	Temp. Compensation	0 or 1	1	Sets temperature compensation. 0: Without temp. compensation function 1: With temp. compensation function	16 intgr	W/R	Temp. Compensation
102	7102	Temp. Input	0 or 1	0	Sets temperature signal incoming from outside. 0:Fixed temperature input 1:External input by Pt. (Resistance temp. sensor) input or analog Input	16 intgr	W/R	Temp. Input
103	7103	Fixed Temp.	℃ : -20 to 160 ℉ : -4 to 320	15	Sets temperature when param. No. 102 is set "0"	32 float	W/R	Fixed Temp.

Table 10.1 Parameter List (2/4)

Param. No.	Register	Parameter name	Setting range	Initial value	Description	Data type		Remarks
105	7105	Reference Density	0.5000 to 1.9999	1	Sets reference density. (Used in temp. compensation and density calculation formulas.)	32 float	W/R	Reference Density
107	7107	Temp. Compensation Table setting	0 to 4	1	Sets liquid type. 0: Crude oil, 1: Fuel oil, 2: Lubricant, 3: LPG, 4: Chemical liquid	16 intgr	W/R	Fluid
108	7108	Reference Temperature	℃: -20 to 160 ℉: -4 to 320	15	Sets Reference temperature. (Used in 3α compensation and temp. compensation formulas.)	32 float	W/R	Reference Temp.
110	7110	Temp. Signal Type (Pt 100Ω)	0 or 1	1	Selects temperature input type when Pram. No. 102 is set to "1". 0: Analog input 1: Pt (Resistance temp. sensor) input	16 intgr	W/R	Temp. Signal Type
111	7111	Temp. Upper Limit	℃: -20 to 160 ℉: -4 to 320	160	Sets Temp. Ovr [temp. upper limit alarm] level.	32 float	W/R	Temp. Upper Limit
113	7113	Temp. Lower Limit	℃: -20 to 160 ℉: -4 to 320	-20	Sets Temp. Udr [temp. lower limit alarm] level.	32 float	W/R	Temp. Lower Limit
115	7115	α Expansion coefficient	0.000000 to 0.000060	0.000016	Sets 3α compensation factor.	32 float	W/R	α Expansion coeff.
117	7117	3α Compen. Limit Temp.	℃: -20 to 160 ℉: -4 to 320	160	Sets 3α compensation starting temperature.	32 float	W/R	3α Compen. Limit Temp.
119	7119	New JIS/Old JIS setting	0 or 1	0	Selects Resistance temperature sensor type. 0: Pt 1: JPt (Old JIS)	16 intgr	W/R	Pt Type
120	7120	Temp. Over FB	℃: -20 to 160 ℉: -4 to 320	150	Sets temp. level at Temp. Ovr [temp. ovr alarm]	32 float	W/R	Temp. Over FB
122	7122	Temp. Under FB	℃: -20 to 160 ℉: -4 to 320	-10	Sets temp. level at Temp. Udr [temp. udr alarm]	32 float	W/R	Temp. Under FB
124	7124	Press. Compensation	0 or 1	0	Sets pressure compensation. 0: Without pressure comp. function 1: With pressure comp. function	16 intgr	W/R	Press. Compensation
125	7125	Press. Input	0 or 1	0	Sets press. signal input from outside. 0: Fixed pressure 1 : Analog input	16 intgr	W/R	Press. Input
126	7126	Fixed Presssure	※1	1	Sets Pressure when Param. 125 is set to "0".	32 float	W/R	Fixed Press.
128	7128	Reference Pressure	※1	0	Sets Reference pressure.	32 float	W/R	Reference Press.
130	7130	Compressibility Factor	※2	1	Sets Compression coefficient.	32 float	W/R	Compressibility Factor
132	7132	Pressure Upper Limit	※1	9.8066	Sets press. level at Press. Ovr [press. ovr alarm] .	32 float	W/R	Press. Upper Limit
134	7134	Pressure Lower Limit	※1	0	Sets press. level at Press. Udr [press. udr alarm] .	32 float	W/R	Press. Lower Limit
136	7136	Pressure Over FB	※1	9.8066	Sets press. level at Press. Ovr [press. ovr alarm] .	32 float	W/R	Press. Over FB
138	7138	Pressure Under FB	※1	0	Sets press. level at Press. Udr [press. udr alarm] .	32 float	W/R	Press. Under FB
140	7140	A1 Coefficient	-9.9999 to 9.9999	0	Can set the value of mantissa of A1 coefficient. Used in temperature. compensation equation for chemical liquid (quadratic).	32 float	W/R	A1 Mantissa
142	7142	A1 Exponent	-9 to 0	0	Can set the value of mantissa of A1 coefficient. Used in temperature. compensation equation for chemical liquid (quadratic).	16 intgr	W/R	A1 Exponent
143	7143	A2 Coefficient	-9.9999 to 9.9999	0	Can set the value of mantissa of A2 coefficient. Used in temperature. compensation equation for chemical liquid (quadratic).	32 float	W/R	A2 Mantissa
145	7145	A2 Exponent	-9 to 0	0	Can set the value of mantissa of A2 coefficient. Used in temperature. compensation equation for chemical liquid (quadratic).	16 intgr	W/R	A2 Exponent
146	7146	B Coefficient	-9.9999 to 9.9999	1	Can set the value of mantissa of B coefficient. Used in temperature. compensation equation for chemical liquid (quadratic).	32 float	W/R	B Mantissa
148	7148	B Exponent	-5 to 5	0	Can set the value of mantissa of B coefficient. Used in temperature. compensation equation for chemical liquid (quadratic).	16 intgr	W/R	B Exponent
149	7149	Instant Flow Rate Calculation Compensation	0 or 1	1	Sets the compensating function for instant flow rate calculation. 0: Without Instant flow rate compensating function, 1: With Instant flow rate compensating function	16 intgr	W/R	Flow Rate Correction
201	7201	Analog Output	0 to 2	0	Sets analog output function. 0: Without function (always 4mA), 1: With PID output function, 2: With instant flow rate analog output function	16 intgr	W/R	Analog Out
202	7202	PID Initial Flow Rate	0 to 99999	100	Sets initial flow rate at PID output.	32 intgr	W/R	PID Initial Flow Rate

Table 10.1 Parameter List (3/4)

Param. No.	Register	Parameter name	Setting range	Initial value	Description	Data type		Remarks
204	7204	PID Final Flow Rate	0 to 99999	100	Sets final instant. flow rate at PID output.	32 intgr	W/R	PID Final Flow Rate
206	7206	PID Flow Upper Rate	0 to 99999	200	Sets upper limit instant. flow rate at PID output.	32 intgr	W/R	PID Flow Upper Rate
208	7208	P Set Value	0 to 9999	200	Sets Proportional band (P component, %)	16 intgr	W/R	P Set Value
209	7209	I Set Value (PID output)	0.01 to 99.99	0.7	When PID output is used (No.201=1): Sets integral time (I component) value (sec).	32 float	W/R	I Set Value
		Time Constant (Instant flow rate)	0.05 to 99.99		When instant. flow rate analog output is used (No.201=2): Sets time constant value (sec).			Smoothing
211	7211	D Set Value	0 to 99.99	0	Sets Derivative time (D component) in sec.	32 float	W/R	D Set Value
213	7213	20mA Flow Rate	0 to 99999	800	Sets instant. flow rate at full open valve (PID output at 20mA)	32 intgr	W/R	Span Flow Rate
215	7215	4mA Flow Rate	0 to 99999	800	When instant. flow rate analog output is used (No.201=2): Sets instant. flow rate of analog output at 4mA.	32 intgr	W/R	Zero Flow Rate
217	7217	Analog output Upper Limit	-10 to 110	110	Sets upper limit (%) of PID/instant flow rate analog output.	16 intgr	W/R	Analog Out Upper Limit
218	7218	Analog output Lower Limit	-10 to 110	-5	Sets lower limit (%) of PID/instant flow rate analog output.	16 intgr	W/R	Analog Out Lower Limit
301	7301	Input Pulse Type	0 to 2	0	Selects input pulse type. 0: Volume without compensation, 1: Volume with compensation, 2: Mass	16 intgr	W/R	Input Pulse Type
302	7302	Hardware Input Pulse Dividing	0 or 1	0	Selects Input pulse scaling. 0: 1/1, 1: 1/10	16 intgr	W/R	Input Pulse Dividing
303	7303	Output Pulse Dividing	0 to 3	0	Selects Pulse output (total count) scaling. 0: 1/1, 1: 1/10, 2: 1/100, 3: 1/1000	16 intgr	W/R	Output Pulse Dividing
304	7304	Output Pulse Width	1 to 99	1	Sets Total count pulse output width in 1 msec steps.	16 intgr	W/R	Output Pulse Width
305	7305	Auto Flow Rate Unit Select	0 or 1	0	Sets auto setting function of instant. flow rate unit. 0: Without function, 1: With function	16 intgr	W/R	Auto Flow Rate Unit Select
306	7306	Unit Conversion Factor Setting	0 or 1	1	Determine the validity of unit conversion of flow rate unit and totalizer unit (No.401, 402) to the measurement value. 0: Conversion invalid, 1: Conversion valid	16 intgr	W/R	Unit Conversion
401	7401	Flow Rate Unit	0 to 21	3	Sets flow rate unit. 0: mL/h, 1: mL/min, 2: mL/sec, 3: L/h, 4: L/min, 5: L/sec, 6: kL/h, 7: kL/min, 8: m^3/h, 9: m^3/min, 10: g/h, 11: g/min, 12: g/sec, 13: kg/h, 14: kg/min, 15: t/h, 16: t/min, 17: USG/h, 18: USG/min, 19: USG/sec, 20: barrel/h, 21: barrel/min	16 intgr	W/R	Flow Rate Unit
402	7402	Totalizer Unit	0 to 8	1	Sets totalizing unit. 0: mL, 1: L, 2: kL, 3: m^3, 4: g, 5: kg, 6: t, 7: USG, 8: barrel	16 intgr	W/R	Totalizer Unit
403	7403	Temperature Unit	0 or 1	0	Sets Temperature unit. 0: C, 1: F	16 intgr	W/R	Temp. Unit
404	7404	Pressure Unit	0 to 2	0	Sets Pressure unit. 0: MPa, 1: kgf/cm^2, 2: psi	16 intgr	W/R	Press. Unit
405	7405	Density Unit	0 to 2	1	Sets Density unit. 0: g/cm^3, 1: g/mL, 2: kg/L	16 intgr	W/R	Density Unit
406	7406	Unit Coefficient	0 to 6	3	Sets Unit coefficient. The following selected unit coefficient is displayed for each totalizing unit. The totalizing value is displayed by multiplying reciprocal of selected unit coefficient. 0: x1000, 1: x100, 2: x10, 3: 1, 4: x0.1, 5: x0.01, 6: x0.01	16 intgr	W/R	Unit Coefficient
501	7501	Temperature Span	℃ : -20 to 160, °F : -4 to 320	160	Sets temperature value when temperature (analog) input is 20mA (5V).	32 float	W/R	Temp. Span
503	7503	Temperature Zero	℃ : -20 to 160, °F : -4 to 320	-20	Sets temperature value when temperature (analog) input is 4mA (1V).	32 float	W/R	Temp. Zero
505	7505	Pressure Span	※1	9.8066	Sets pressure value when pressure (analog) input is 20mA (5V).	32 float	W/R	Press. Span
507	7507	Pressure Zero	※1	0	Sets pressure value when pressure (analog) input is at 4mA (1V).	32 float	W/R	Press. Zero

Param. No.	Register	Parameter name	Setting range	Initial value	Description	Data type		Remarks
509	7509	LED Control	0 or 1	1	Sets the function of operation check LED on the display panel. Normally, LED is on. When error or alarm occurs, LED blinks at 1 s intervals. 0: Disabled, 1: Enabled	16 intgr	W/R	LED Control
601	7601	NET Totalizer Reset	0 or 1	0	Resets NET totalizer value. 0: Normal 1: Reset (Writes "1")	32 float	W	NET Totalizer Reset
603	7603	GROSS Totalizer Reset	0 or 1	0	Resets GROSS totalizer value. 0: Normal 1: Reset (Writes "1")	32 float	W	GROSS Totalizer Reset
605	7605	Master Reset	1234	0	Initializes parameter. 1234: Reset (Writes "1234")	32 intgr	W	Master Reset(Caution)
701	7701	Current Totalizing Value		0	Shows the number of counts on the display.	32 intgr	R	COUNT
703	7703	Current Instant Flow Rate		0	Shows instant flow rate on the display.	32 intgr	R	Flow Rate
705	7705	Current Valve Status		0	Shows valve actuating signal status. 0: Closed, 1: SV, 2: MV	16 intgr	R	Valve Status
706	7706	Start/Stop/Reset	0 to 2	0	Can Start, Stop, and Reset through communication. 0: Reset, 1: Start, 2: Stop	16 intgr	W/R	Start/Stop/Reset
707	7707	Alarm Indicator		0	Indicates occurrence of alarm when the bit in binary number notation (16-bit) is "1". bit 1: Miss P., bit 2: Over, bit 3: Temp. Ovr, bit 4: Temp.Udr, bit 5: Press.Ovr, bit 6: Press. Udr, bit 7: Sensor, bit 8: FlowOver, bit 9: Pulsedif, bit 10: Unused, bit 11: Pra. ERR, bit 12: Pulse In, bit 13: ADRD Err, bit 14 to 16: Unused Example: bit 6 with 0000000000100000: Press. Udr is happening.	16 intgr	R	Alarm Indicator
708	7708	Temperature		-20	Shows temperature on the display.	32 float	R	Current Temp.
710	7710	Pressure		0	Shows pressure on the display.	32 float	R	Current Press
712	7712	Conversion Factor		0	Shows volume conversion factor (K) on the display.	32 float	R	Volume Conversion Factor
714	7714	Density		1	Shows density on the display.	32 float	R	Density
716	7716	Totalizer-NET		0	Shows NET on the display.	32 intgr	R	Totalizer-NET
718	7718	Totalizer-GROSS		0	Shows GROSS on the display.	32 intgr	R	Totalizer-GROSS
801	7801	ROM version		0	Shows ROM version.	32 float	R	Ver. No.

Table 10.1 Parameter List (4/4)

➡NOTES ※1 Pressure range
(MPa：0.0000 to 9.8066, kgf/cm^2：0.000 to 99.999, psi：0.0 to 1422.4)
※2 Compression coefficient range (MPa:0.00 to 102, kgf/cm^2:0.00 to 9.99, psi:0.000 to 0.703)

➡NOTE

W: Write
R : Read

16 intgr: 16-bit integer type
32 intgr: 32-bit integer type
32 float: 32-bit floating point type

10.1 Parameter Reconfiguration

10.1.1 Setting the Temperature Input

① **Temperature input setting**

The controller can select remote input (Pt, analog) or fixed temperature. In the case of "Without temperature compensation" in (2), set the fixed temperature at 15℃ .

Param. No.	Param. Name	Pt (New JIS)	JPt (Old JIS)	Analog	Fixed Value
102	Temp. Input	1	1	1	0
103	Fixed Temp.	*	*	*	Customer spec.
110	Temp. Signal Type	1	1	0	*
111	Temp. Upper Limit	Customer spec.	Customer spec.	Customer spec.	**
113	Temp. Lower Limit	Customer spec.	Customer spec.	Customer spec.	**
119	New JIS/Old JIS	0	1	*	*
120	Temp. Over FB	Customer spec.	Customer spec.	Customer spec.	**
122	Temp. Under FB	Customer spec.	Customer spec.	Customer spec.	**
403	Temp. Unit	Customer spec.	Customer spec.	Customer spec.	Customer spec.
501	Temp. Span	*	*	Customer spec.	*
503	Temp. Zero	*	*	Customer spec.	*

➡NOTE: 1. * is functionally irrelevant; select default setting.
2. ** Set the value that may not cause Temp. Ovr or Temp. Udr alarm.

② **With or without temperature compensation**

Param. No.	Param. Name	Without Temperature compensation	With Temperature compensation
101	Temp. Compensation	0	1

③ **Temperature compensation setting**

Param. No.	Param. Name	Crude oil	Fuel oil	Lubricating oil	LPG	Chemical Liquid (quadratic exp)
107	Fluid	0	1	2	3	4
105	Reference Density	Customer spec.	Customer spec.	Customer spec.	Customer spec.	Customer spec.
108	Reference Temp.	℃ : 15 ˚F : 59	℃ : 15 ˚F : 59	℃ : 15 ˚F : 59	℃ : 15 ˚F : 59	Customer spec.
140	A1 Coefficient	*	*	*	*	Customer spec.
142	A1 Exponent	*	*	*	*	Customer spec.
143	A2 Coefficient	*	*	*	*	Customer spec.
145	A2 Exponent	*	*	*	*	Customer spec.
146	B Coefficient	*	*	*	*	Customer spec.
148	B Exponent	*	*	*	*	Customer spec.

➡NOTE: In case of "without temperature compensation", select default settings because the above parameters are irrelevant.

④ **With or without 3α compensation setting**

Param. No.	Param. Name	With 3α Compensation	Without 3α Compensation
115	α Expansion coeff.	Depends on flowmeter used	0
108	Reference Temp.	Common to the reference temp. at temperature correction	*
117	3α Compen. Limit Temp.	Customer specification	*

➡NOTE: 1. If compensation is applied at all times, set "3α Compen. Limit Temp (param. No. 117)" to the lowest temperature (-20°C or -4°F).
2. * is functionally irrelevant; select default setting.
3. When entering the temperature, it reads in the unit set at "Temp. Unit (param. No. 403)".

10.1.2 Setting the Pressure Input

① **Pressure input setting**

Similar to temperature reading, pressure is shown at remote input (analog) or fixed temperature. Accordingly, if "without" pressure compensation is your option, set a fixed pressure level of 1 MPa.

Param. No.	Param. Name	Analog	Fixed value
125	Press. Input	1	0
126	Fixed Pressure	*	Customer spec.
132	Press Upper Limit	Customer spec.	**
134	Press Lower Limit	Customer spec.	**
136	Press. Over FB	Customer spec.	**
138	Press. Under FB	Customer spec.	**
404	Press. Unit	Customer spec.	Customer spec.
505	Press. Span	Customer spec.	*
507	Press. Zero	Customer spec.	*

➡NOTE: ** Set the value that may not cause Press. Ovr or Press. Udr alarm.

② **Pressure compensation setting**

Param. No.	Param. Name	With Compensation	Without Compensation
124	Press. Compensation	1	0
128	Reference Press.	Customer spec.	*
130	Compressibility Factor	Customer spec.	*

➡NOTE: 1. * is functionally irrelevant; select default setting.
2. When entering the pressure, the unit set at "Press. Unit (param. 404)" is used.

10.1.3 Setting the Sample Cycle Count

Standard setting is selected in a range determined by the formula below and, of 2^n, the largest value is selected.

Sampling Time (param. No. 16) sec x Frequency at the minimum flow rate in the specification (Hz)

Default setting of Sampling Time is 5 sec.

10.1.4 Setting the Scaling of Flow Signal Input (Pulse Input) Frequency

Hardware-defined scale factor for pulse input frequency is adjustable by changing param. setting below.

Param. No.	Param. Name	1/1	1/10 Scale factor
302	Input Pulse Dividing	0	1

➡ NOTE: When hardware-defined input pulse scaling is enabled, the input pulse rate is reduced to 1/10 using hardware means. So it is then multiplied by 10 using software means.

10.1.5 Setting the Scaling of Pulse Output Frequency

Param. No.	Param. Name	1/1	1/10 Scale factor	1/100 Scale factor	1/1000 Scale factor
303	Output Pulse Dividing	0	1	2	3

10.1.6 Setting the Pulse Width of Pulse Output

By changing "Output Pulse Width (param. No. 304)", pulse output width is adjustable over a range 1 to 99 msec. (Only integer is acceptable.)

10.1.7 Programming the PRESET

Param. No.	Param. Name	Any 6-digit setting (arbitrary-1k-2k-4kL)	1k-2k-4kL
25	EXT PRESET Select	0	1

By changing the following parameters, you can select any batch setting value:

Arbitrary : Batch Setting Value (parameter No. 12)
1kL : EXT PRESET 1 (parameter No. 19)
2kL : EXT PRESET 2 (parameter No. 21)
4kL : EXT PRESET 3 (parameter No. 23)
EXT PRESET 4 (parameter No. 28)
EXT PRESET 5 (parameter No. 30)
EXT PRESET 6 (parameter No. 32)
EXT PRESET 7 (parameter No. 34)

10.1.8 Reset-Start Setting

Param. No.	Param. Name	Non-reset-start	Reset-start
26	Reset + Start	0	1

10.1.9 NET and GROSS Reset

NET reset: Set "NET Totalizer Reset (param. No. 601) to "1".
GROSS reset: Set "GROSS Totalizer Reset (param. No. 603) to "1".

10.1.10 Programming the PID Flow Control

Refer to the attached “Parameter SET Mode Setup Manual”.

10.1.11 Setting the LED Indicator

LED indicator can be turned on to make sure the controller is in operation. By enabling this function, the LED indicator blinks at 1 sec intervals at the occurrence of an alarm.

Param. No.	Param. Name	Without function	With function
509	LED Control	0	1

➡ NOTE: "1" is set as default value.

11. OPERATION

11.1 Preparation Before Operation

(1) Make sure to see that the controller and associated equipment are correctly installed, connected and wired with nothing left unfinished.

(2) Set supply air pressure to the valve to the specified pressure with reducing valve (air set) or verify the pressure in daily operation.

(3) Assuming the case where the controller or valve is failed, installation of a manual valve at the downstream or upstream side of the valve is recommended for the purpose of safety.

⚠ WARNING

Ensure that the power terminals are connected to a source of the rated voltage.

Applying an incorrect supply voltage may ruin the controller.

11.2 Preoperational Checks on Valve Actuation

● Without allowing the fluid to flow, make sure to see that the valve operates correctly.

This operation check should be performed after the controller has been left unused for a long period of time or as routine check.

(1) Turn the power switch to the controller on.

(2) Set the batch setting value to any value.

➡ NOTE: For the setting procedure, refer to the attached “Parameter SET Mode Setup Manual”.

(3) Press the START button to confirm that the pump starts and valves (SV and MV) open.

➡ NOTE: To verify the two-stage valve operation, use the following procedure.

○ Select "0" for the initial and final step settings once and set the quantity of a batch setting value to somewhere above "1". In this state, by pressing the START and STOP buttons, test the valves for proper operation.

(4) Press STOP button to confirm that the valves (SV and MV) close properly.

Also, make certain that the PUMP signal stops as set by the timer.

➡ NOTE: For timer setting procedure, see Param. No. 014 of section 10 "DESCRIPTION OF PARAMETERS".

(5) Repeat steps (3) and (4) above several times to make certain that the valves (SV and MV) open and close properly.

(6) If the controller is euipped for remote control, test it by repeating steps (3), (4) and (5).

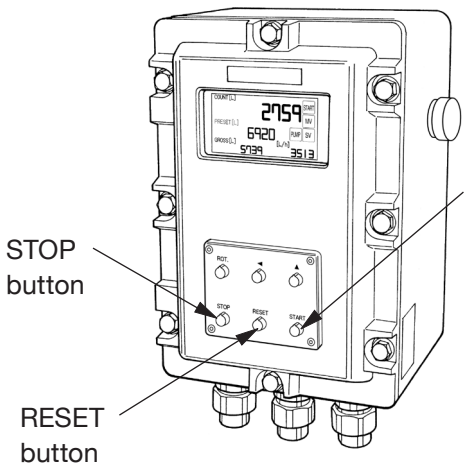


Fig. 11.1

11.3 Operation Sequence

(1) Turn on power to the controller.

(2) A standby screen appears in the RUN mode.

(3) Bring up the Parameter SET mode screen and set a batch setting value.

(4) Return to the RUN mode screen and press the RESET button to reset the count value. Make sure it indicates "0".

(5) Press START button to start up and the controller starts a batch process.
(When the totalizing counter reaches the batch setting value, the operation stops automatically to complete the operation.)

(6) To make a repeated measurement with previous batch setting value:
Press RESET button to reset the total counter and set it to "0".
Press START button to start a repeated measurement.

➡ NOTE: If the batch setting value is different, reconfigure the batch setting value correspondingly.

(7) Emergency stop (or temporary suspension)

Press STOP button. Valves (SV and MV) will move to a full open position and the pump will come to a stop after the timer has cycled.

To restart the batch process:

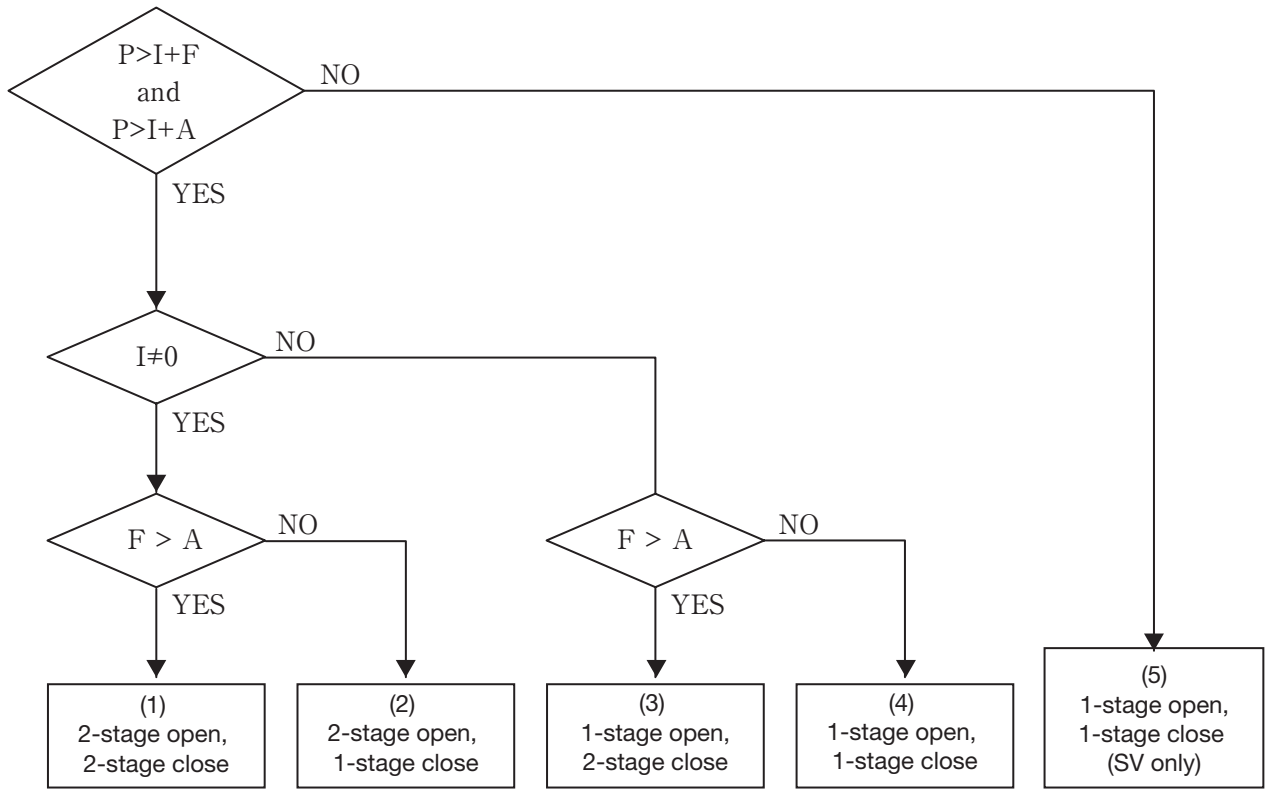
Press START button. Measurement will be resumed at the state from which it was last suspended.

In this way, the controller allows you to make safe and accurate measurements.

11.4 Batch Measurement Cycle

11.4.1 Programming the Batch Measurement Cycle

From the settings of Initial Step Value (initial setting), Final Step Value (final setting), Batch Setting Value (PRESET), and Anticipated Overshoot, five patterns of batch measurement operations are shown. In sync with valve actuating signals and pump signals, SV, MV, and PUMP indicators appear; in an alarmed condition, alarm name is also shown. (Concerning alarms, only one alarm appears; under multiple alarm conditions, alarm messages are shown one after the other.)



➡ NOTE: Symbols used in the flowchart

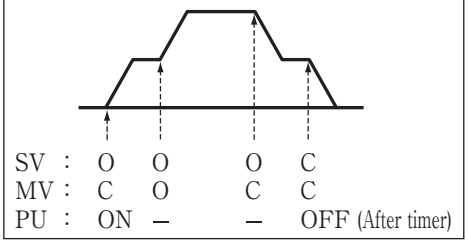
P : PRESET (param. Nos. 12, 19, 21, and 23)
I : Initial Step Value (param. No. 1)
F : Final Step Value (param. No. 2)
A : Anticipated Overshoot (on condition P > A; param. No. 3)

Fig.11.2 Selection of Control Patterns

(1) Two stage open, two stage closure

1. On startup, SV appears.
2. On "COUNT" = "Initial Step Value", MV appears.
3. On "COUNT" = "PRESET" – "Final Step Value", MV becomes hidden.
4. On "COUNT" = "PRESET" – "Anticipated Overshoot", SV becomes hidden.

Operation chart of (1)

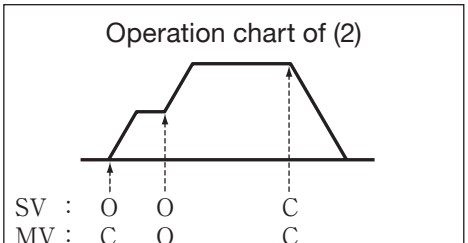


O : OPEN C : CLOSE

(2) Two-stage open, single-stage closure

1. On startup, SV indicator appears.
2. On "COUNT" = "Initial Step Value", MV indicator appears.
3. On "COUNT" = "PRESET" - "Anticipated Overshoot", SV and MV Indicators become hidden.

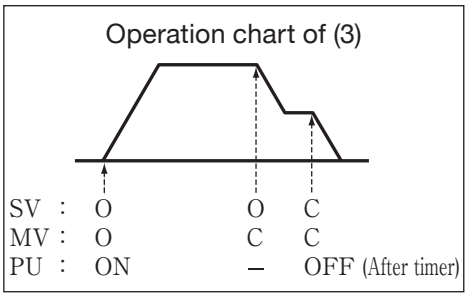
Operation chart of (2)



(3) Single-stage open, two-stage closure

1. On startup, SV indicator appears.
2. On "COUNT" = "PRESET" - "Final Step Value", MV becomes hidden.
3. On "COUNT" = "PRESET"' - "Anticipated Overshoot", SV indictor becomes hidden.

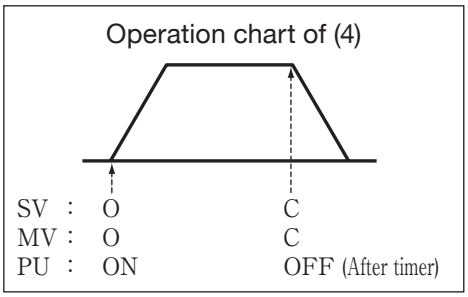
Operation chart of (3)



(4) Single-stage open, single-stage closure

1. On startup, SV and MV indicators appear.
2. On "COUNT" = "PRESET" - "Anticipated Overshoot", SV and MV Indicators become hidden.

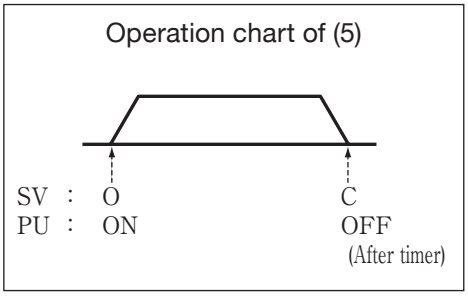
Operation chart of (4)



(5) Single-stage open, single-stage closure (SV only)

1. On startup, SV indicator appears.
2. On "COUNT" = "PRESET" - "Anticipated Overshoot", SV indicator becomes hidden.

Operation chart of (5)



➡NOTES

PUMP indicator appears in sync with pump output.

- PUMP output, after indicating END or STOP (including a pause stopped by ALARM), goes off after expiration of the duration set at "Pump Timer (param. No. 14)".

11.5 Batch Operation Time Charts

Metering Process time chart

A batch process varies with the parameter settings below and comes in five control patterns (1) to (5). A graphic representation of a chart for operation also varies accordingly.

Setup parameters

a. Initial Step Value (initial setting) (param. No. 1)
b. Final Step Value (final setting) (param. No. 2)
c. Anticipated Overshoot (anticipated overshoot setting) (param. No. 3)
d. Batch Setting Value (PRESET) (param. No. 12)

(1) Two-stage open, two stage closure

When setup conditions "Batch Setting Value > Initial Step Value + Final Step Value" and " Batch Setting Value > Initial Step Value + Anticipated Overshoot", "Initial Step Value is larger than 1", and "Final Step Value > Anticipated Overshoot" are all met, the valves open and close according to this pattern.

A batch cycle begins by first opening the SV; then as the quantity of process fluid delivered reaches the Initial Step Value, the MV opens, and as the quantity delivered reaches the Final Step Value, the MV closes. Upon reaching the Anticipated Overshoot setting; the SV shuts off to complete a batch cycle.

Example: Batch Setting Value: 1,000; Initial Step Value: 80; Final Step Value: 80; Anticipated Overshoot: 2

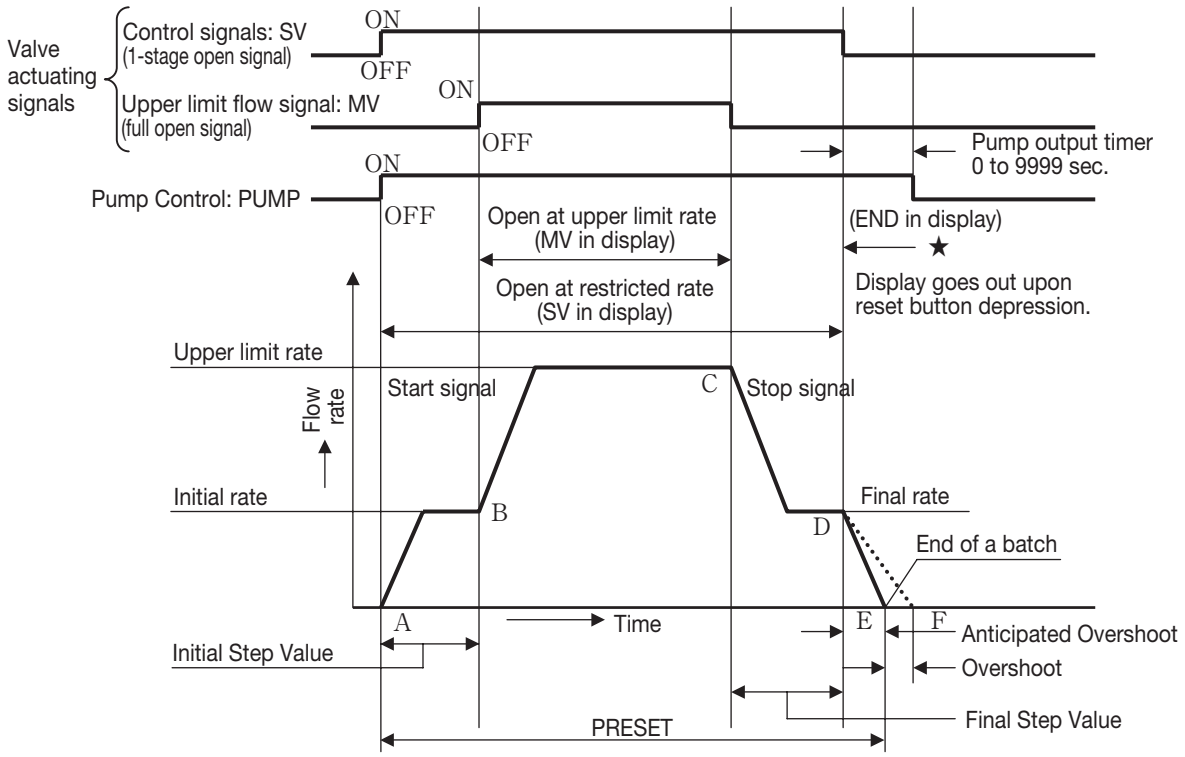


Fig. 11.3 Control Pattern of (1) (Time chart)

(2) Two-stage open, single-stage closure

When setup conditions "Batch Setting Value > Initial Step Value + Final Step Value " and " Batch Setting Value > Initial Step Value + Anticipated Overshoot", "Initial Step Value is larger than 1" are all met and in addition, "Final Step Value > Anticipated Overshoot" is not met, the valves open and close according to this pattern.

A batch cycle begins by first opening the SV; then as the quantity of process fluid delivered reaches the initial setting, the MV opens, and as the quantity delivered reaches the Initial Step Value, SV and MV shut off simultaneously to complete a batch cycle.

Example: Batch Setting Value: 1,000; Initial Step Value: 80; Final Step Value: 0; Anticipated Overshoot: 2

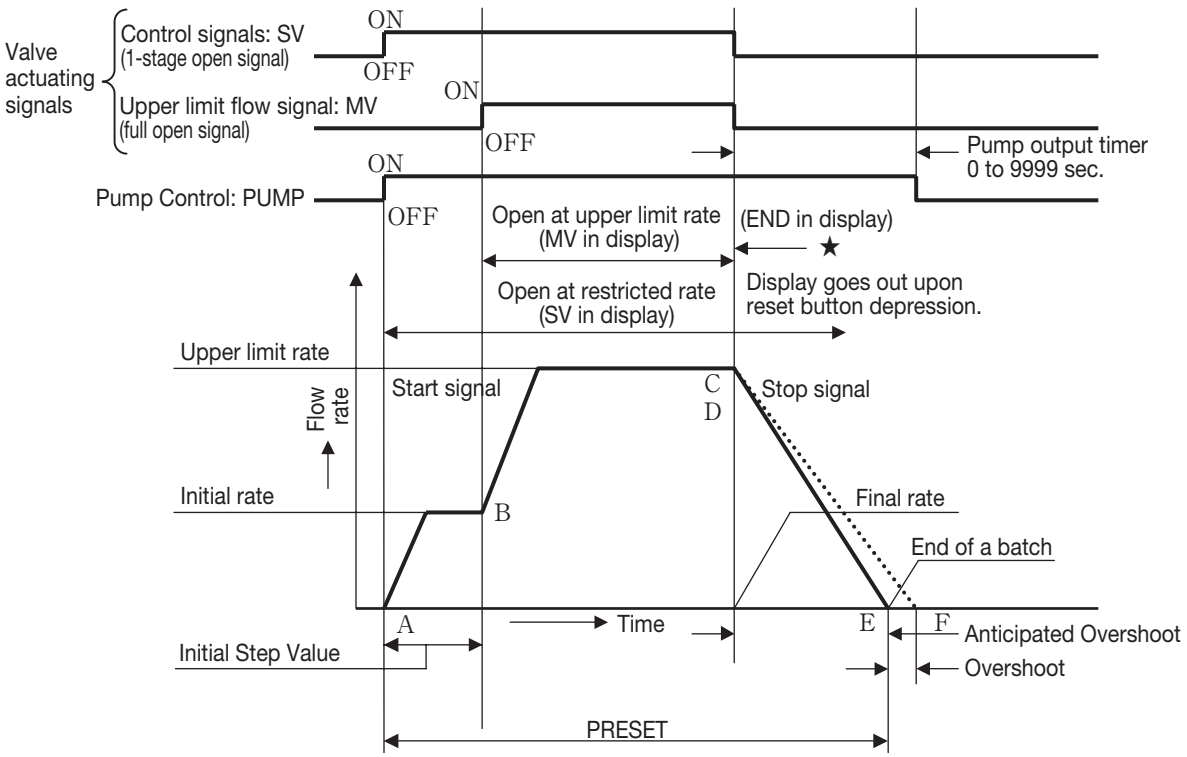


Fig. 11.4 Control Pattern of (2) (Time chart)

(3) Single-stage open, two-stage closure

When setup conditions "Batch Setting Value > Initial Step Value + Final Step Value" and "Batch Setting Value > Initial Step Value + Anticipated Overshoot", and "Initial Step Value is 0" are all met besides "Final Step Value > Anticipated Overshoot" is met, the valves open and close according to this pattern.

A batch cycle begins by first opening the valves SV and MV simultaneously; then as the quantity of process fluid delivered reaches the Final Step Value, the MV closes, and as the quantity delivered reaches the anticipated overshoot setting, the SV shuts off to complete a batch cycle.

Example: Batch Setting Value: 1,000; Initial Step Value: 0; Final Step Value: 80; Anticipated Overshoot: 2

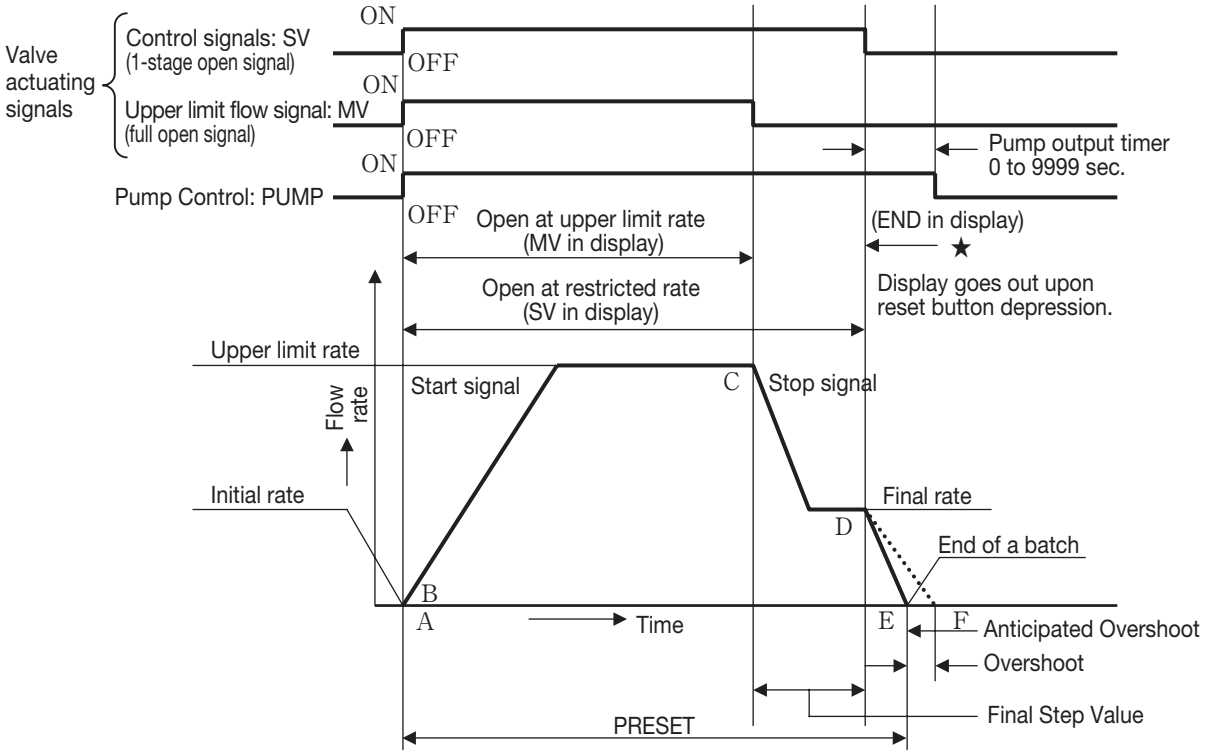


Fig. 11.5 Control Pattern of (3) (Time chart)

(4) Single-stage open, single-stage closure

When setup conditions "Batch Setting Value > Initial Step Value + Final Step Value" and "Batch Setting Value > Initial Step Value + Anticipated Overshoot", and "Initial Step Value is 0" are all met and in addition, "Final Step Value > Anticipated Overshoot" is not met, the valves open and close according to this pattern.

A batch cycle begins by first opening the valves SV and MV simultaneously; then as the quantity of process fluid delivered reaches the Final Step Value, the SV and MV shut off simultaneously to complete a batch cycle.

Example: Batch Setting Value: 1,000; Initial Step Value: 0; Final Step Value: 0; Anticipated Overshoot: 2

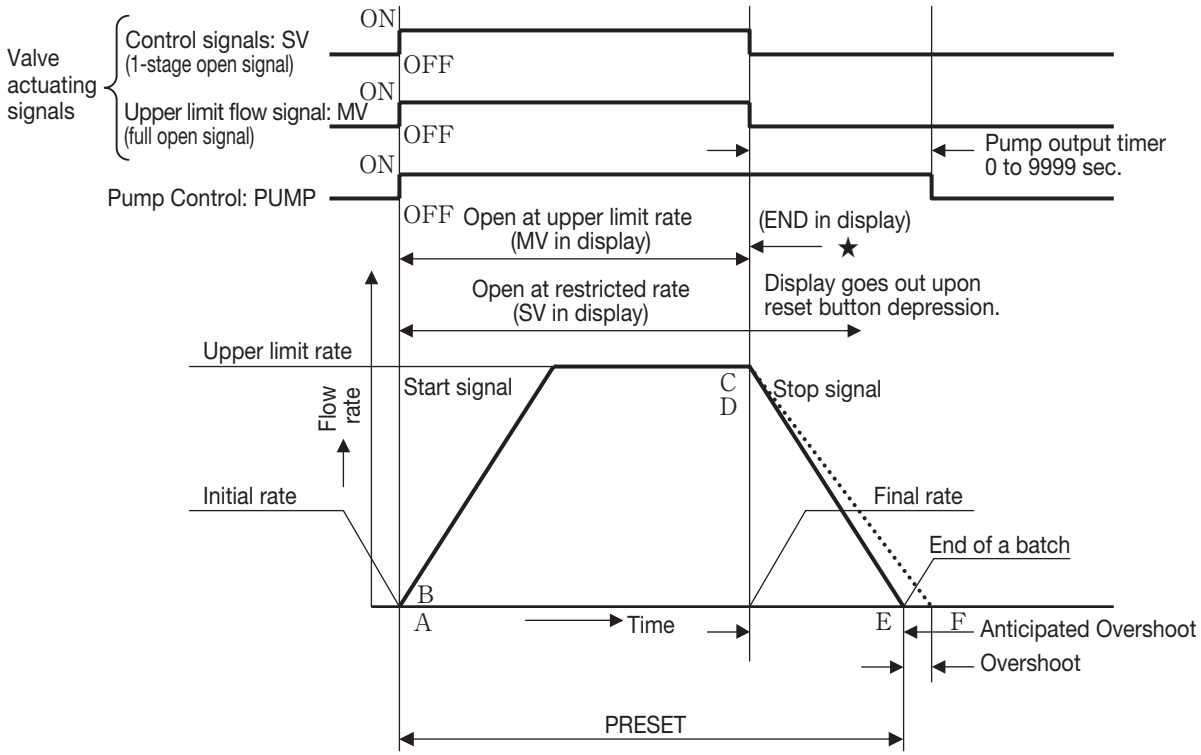


Fig. 11.6 Control Pattern of (4) (Time chart)

(5) Single-stage open, single-stage closure (SV only)

When setup conditions either "Batch Setting Value > Initial Step Value + Final Step Value" or "Batch Setting Value > Initial Step Value + Anticipated Overshoot" is not met or when both are not met, the valves open and close according to this pattern.

A batch cycle begins by opening the SV and, as the quantity of process fluid delivered reaches the Initial Step Value and; Final Step Value at the same time, the SV shuts off without opening the MV, thus completing a batch cycle.

Example: Batch Setting Value: 100; Initial Step Value: 80; Final Step Value: 80; Anticipated Overshoot: 2

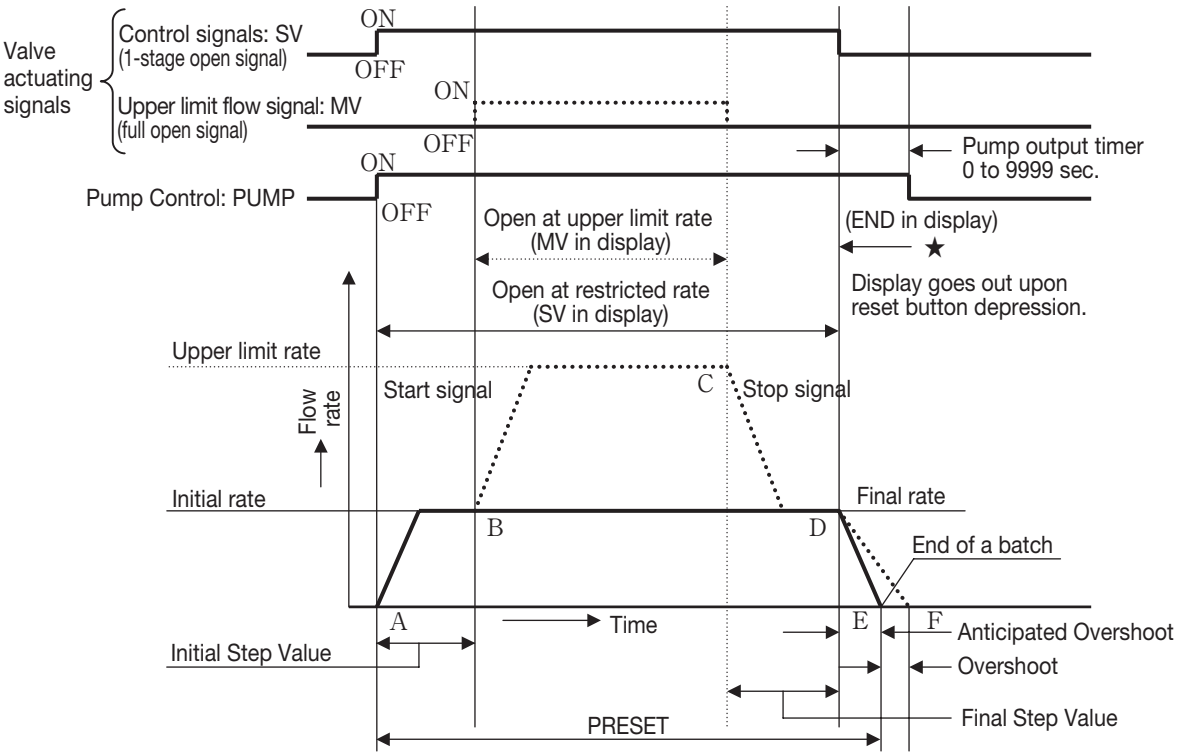


Fig. 11.7 Control Pattern of (5) (Time chart)

12. ALARMS

12.1 Types of Alarms (① to ⑫)

➡NOTE: Information about parameter numbers appears in Section 10 "Description of Parameters".

① **Miss P. (missing pulse alarm)**

If the controller fails to receive incoming pulses within the time interval set at "Missing Pulse (param. No. 6)" between startup and end-or-batch (setting < missing pulse duration), it interprets the situation as an alarmed condition and sounds a buzzer. Measurement of missing pulse duration starts 5 seconds after startup (or restart).

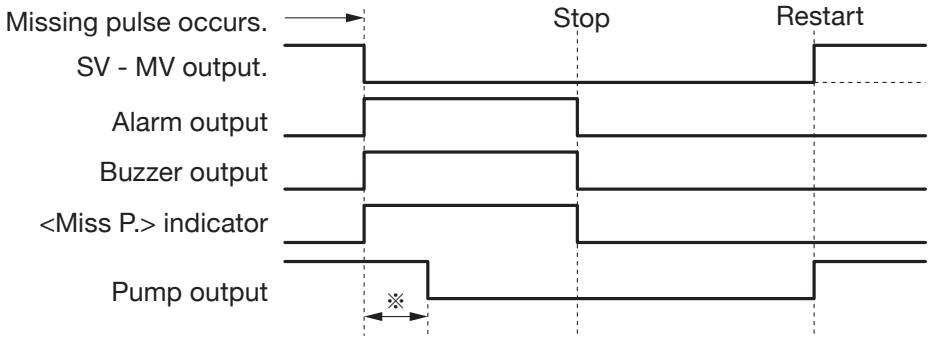


Fig. 12.1

➡NOTE: ※Pump output is dependent on pump output timer (param. No.14).

② **Over (overshoot alarm)**

When a condition "COUNT" = "PRESET" + "Overshoot Setting (param. No. 4)" comes to exist, the controller interprets the situation as an alarmed condition and sounds a buzzer.

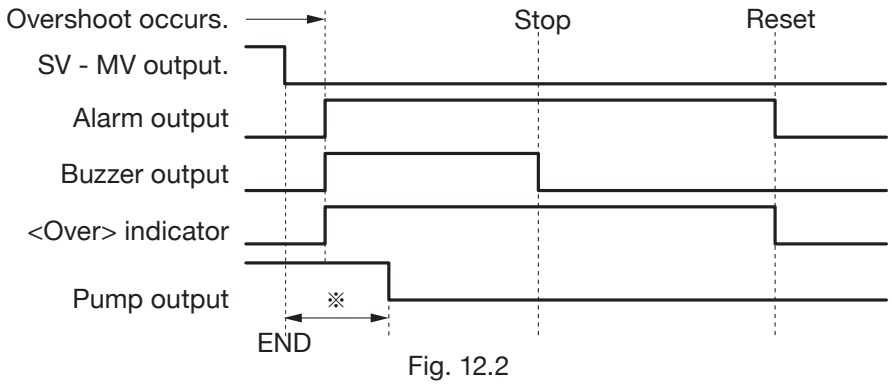


Fig. 12.2

➡NOTE: ※Pump output is dependent on pump output timer (param. No. 14).

③ **Temp.Ovr (upper limit temperature alarm)**

When measured temperature reading exceeds the level set at "Temp Upper Limit (param. No. 111)", the controller interprets the situation as an alarmed condition. A message "Temp. Over FB (param. No. 120)" appears at this time and the controller calculates the temperature compensation using this reading. (Buzzer does not sound.)

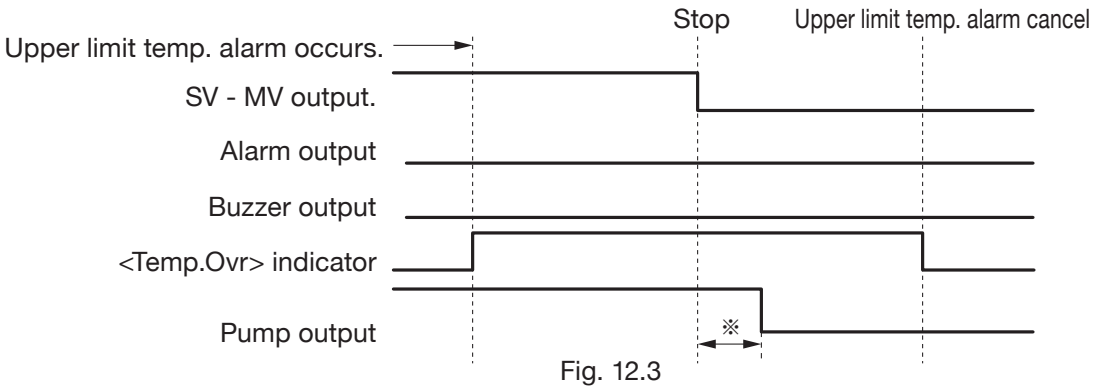


Fig. 12.3

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).
Valves SV and MV and pump output remain in the current state.

④ **Temp.Udr (lower limit temperature alarm)**

When measured temperature reading falls below the level set at "Temp Lower Limit (param. No. 113)", the controller interprets the situation as an alarmed condition. A message "Temp. Under FB (param. No. 122)" appears at this time and the controller calculates for temp. compensation using this reading. (Buzzer does not sound.)

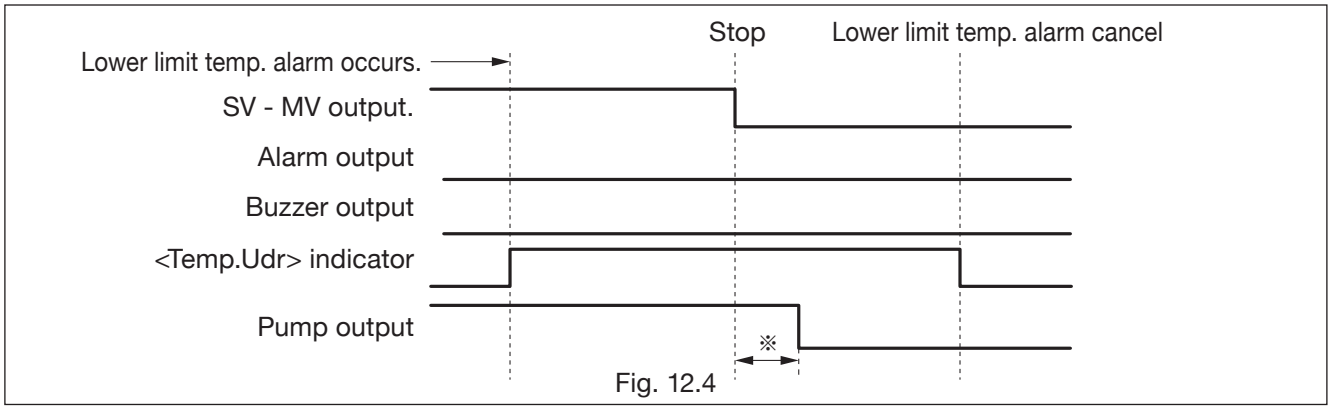


Fig. 12.4

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).
Valves SV and MV and pump output remain in the current state.

⑤ **Pres.Ovr (upper limit pressure alarm)**

When measured pressure reading exceeds the level set at "Press Upper Limit (param. No. 132)", the controller interprets the situation as an alarmed condition. A message "Press. Ovr FB (param. No. 136)" appears at this time and the controller calculates the pressure compensation using this reading. (Buzzer does not sound.

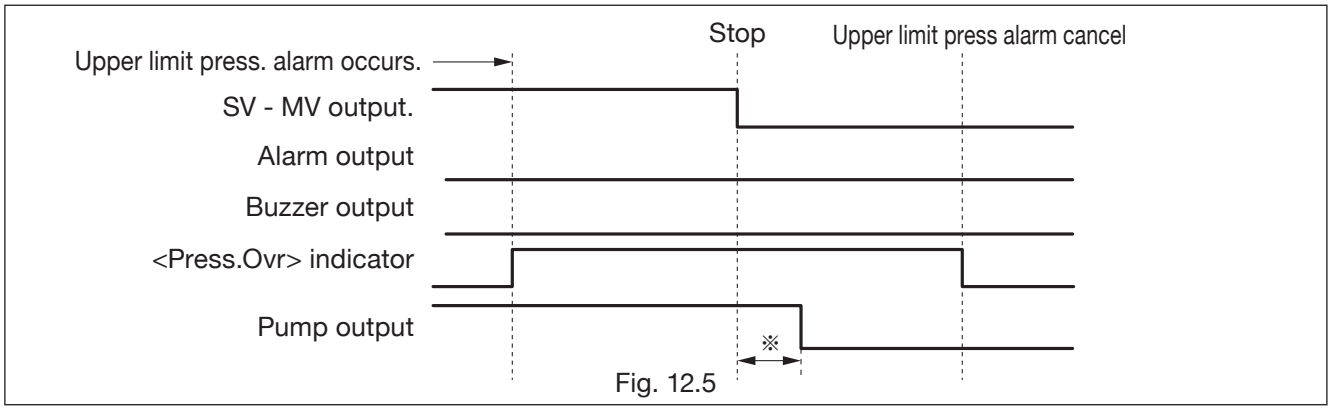


Fig. 12.5

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).
Valves SV and MV and pump output remain in the current state.

⑥ **Pres.Udr (lower limit pressure alarm)**

When measured pressure reading falls below the level set at "Press Lower Limit (param. No. 134)", the controller interprets the situation as an alarmed condition. A message "Press. Under FB (param. No. 138)" appears at this time and the controller calculates the pressure compensation using this reading. (Buzzer does not sound.)

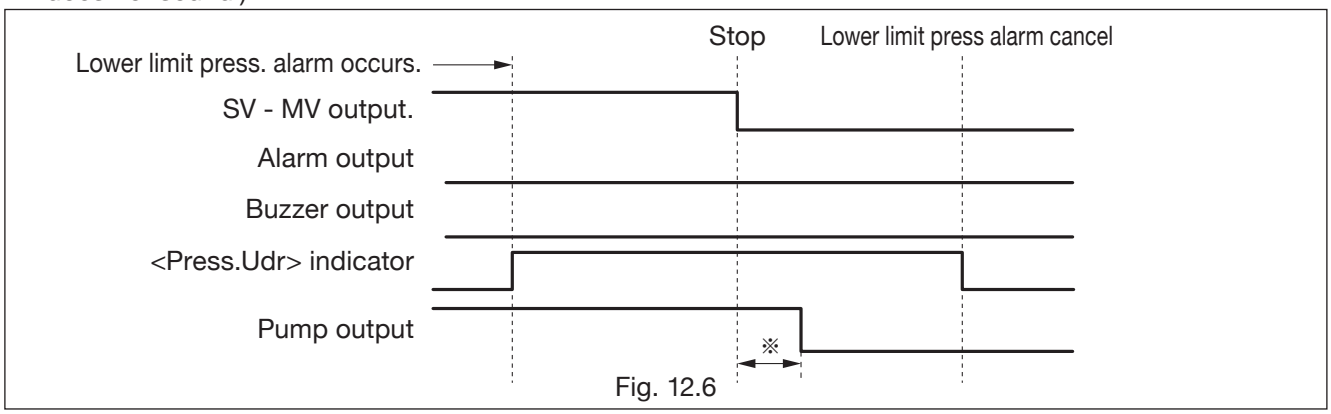


Fig. 12.6

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).
Valves SV and MV and pump output remain in the current state.

⑦ **Sensor (sensor "open" or short alarm)**

With "Input Disconnection ALM (param. No. 17)" set to 1 (alarm enabled), an alarmed condition occurs upon detection of an "open" or short in the pulse generator power. Buzzer sounds at the same time.

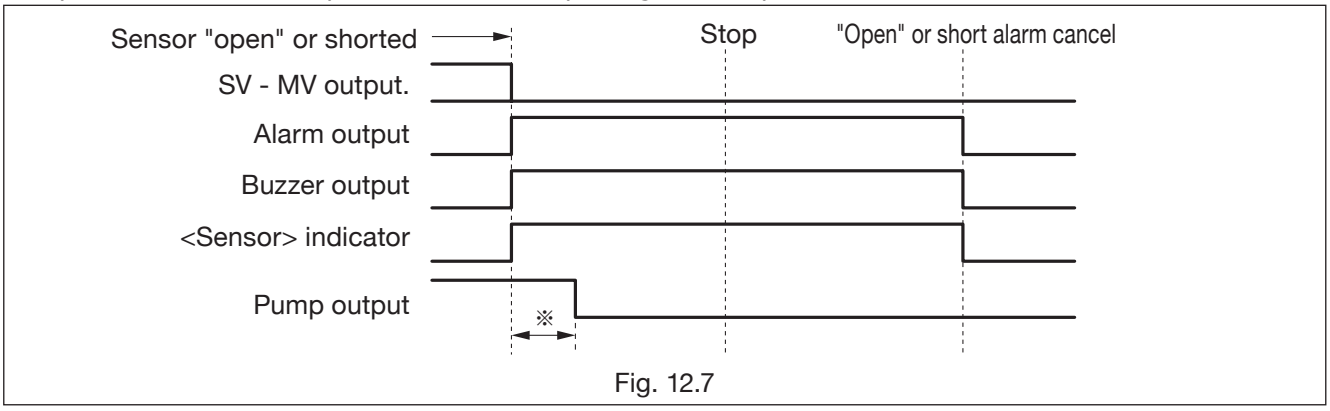


Fig. 12.7

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).

⑧ **FlowOver (excessive flow alarm)**

When instant rate exceeds the level set at "Over Flow Rate" (param. No. 10), the controller interprets this situation as an alarmed condition and the buzzer sounds.

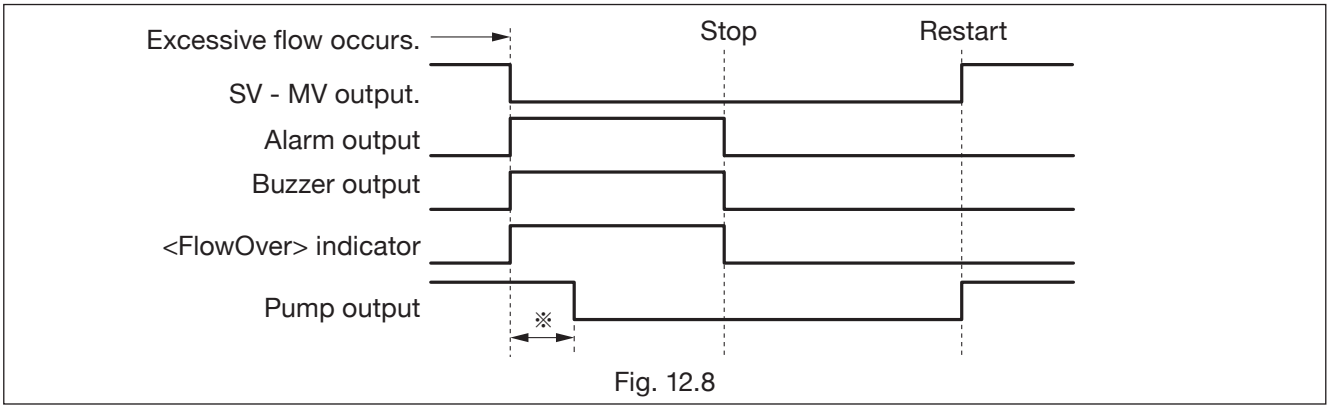


Fig. 12.8

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).

⑨ **Pulsedif (pulse deviation alarm)**

When deviation between flow pulse inputs SIG 1 and SIG 2 exceeds the number of pulses set at "Pulse Deviation (param. No. 5)", the controller interprets this situation as an alarmed condition and the buzzer sounds.

When only one flow pulse input is present, the alarm function is cleared by the setting of pulse deviation (param. No. 5) to 0.

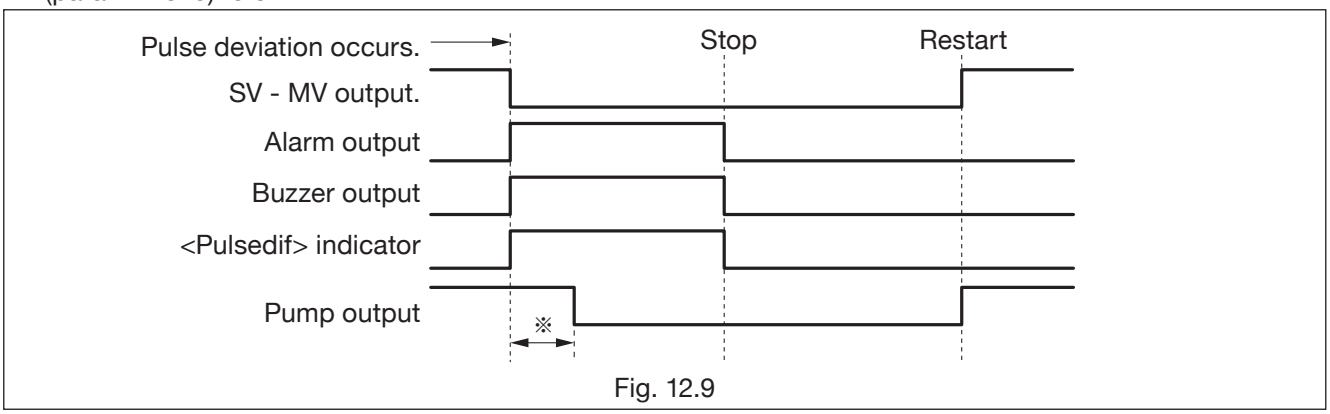


Fig. 12.9

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).

⑩ **Pra. ERR (parameter error alarm)**

At startup, the controller runs a data check in the EEPROM. Upon detection of a checksum error, it interprets this situation as an alarm condition and the buzzer sounds. Following this event, parameter initialization takes place.

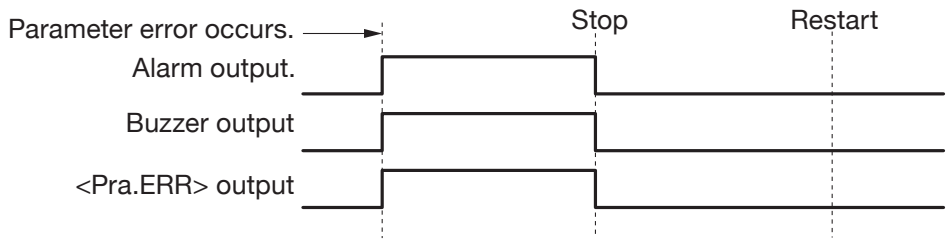


Fig. 12.10

⑪ **Pulse in (pulse in alarm)**

With "Pulse In Alarm Pulse Deviation (param. No. 27)" set to 1 (alarm enabled), upon detection of incoming flow pulses (after frequency division if scaled at 1/10) the controller interprets this situation as an alarm condition and the buzzer sounds. This alarm condition also arises when batch setting value is changed during the END state, resulting in some incoming pulses (after frequency division if scaled at 1/10).

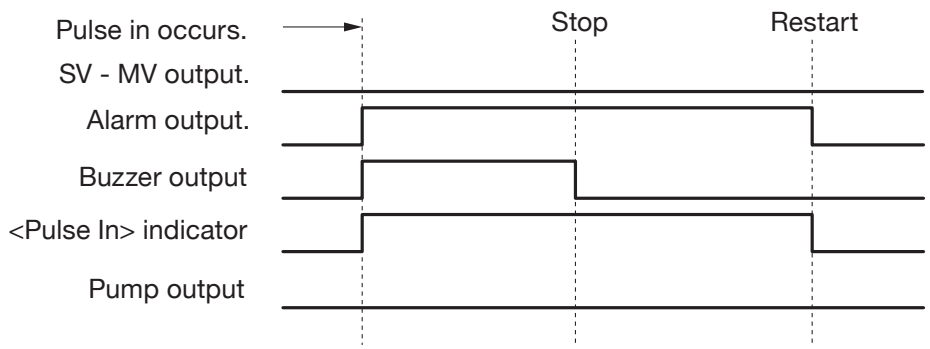


Fig. 12.11

⑫ **ADRD Err (A/D read error alarm)**

When the controller fails to read A/D conversion data (measured temperature and pressure data), an alarmed condition arises and the buzzer sounds.

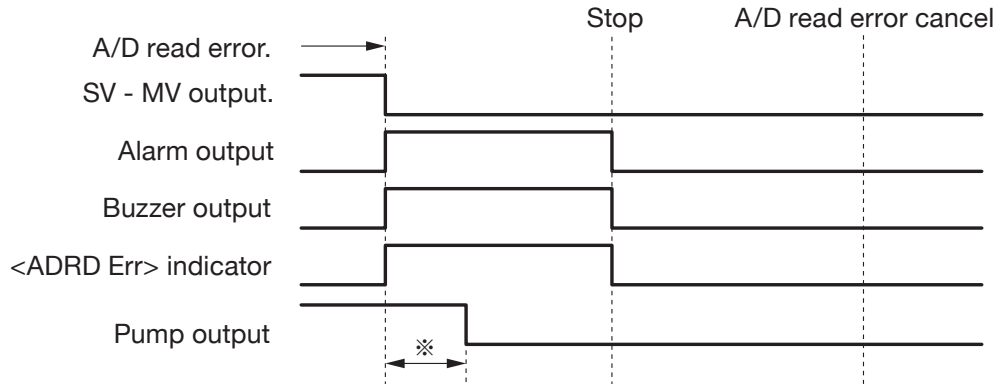


Fig. 12.12

➡NOTE: ※ Pump output is dependent on pump output timer (param. No. 14).

12.2 Alarm Output and Canceling

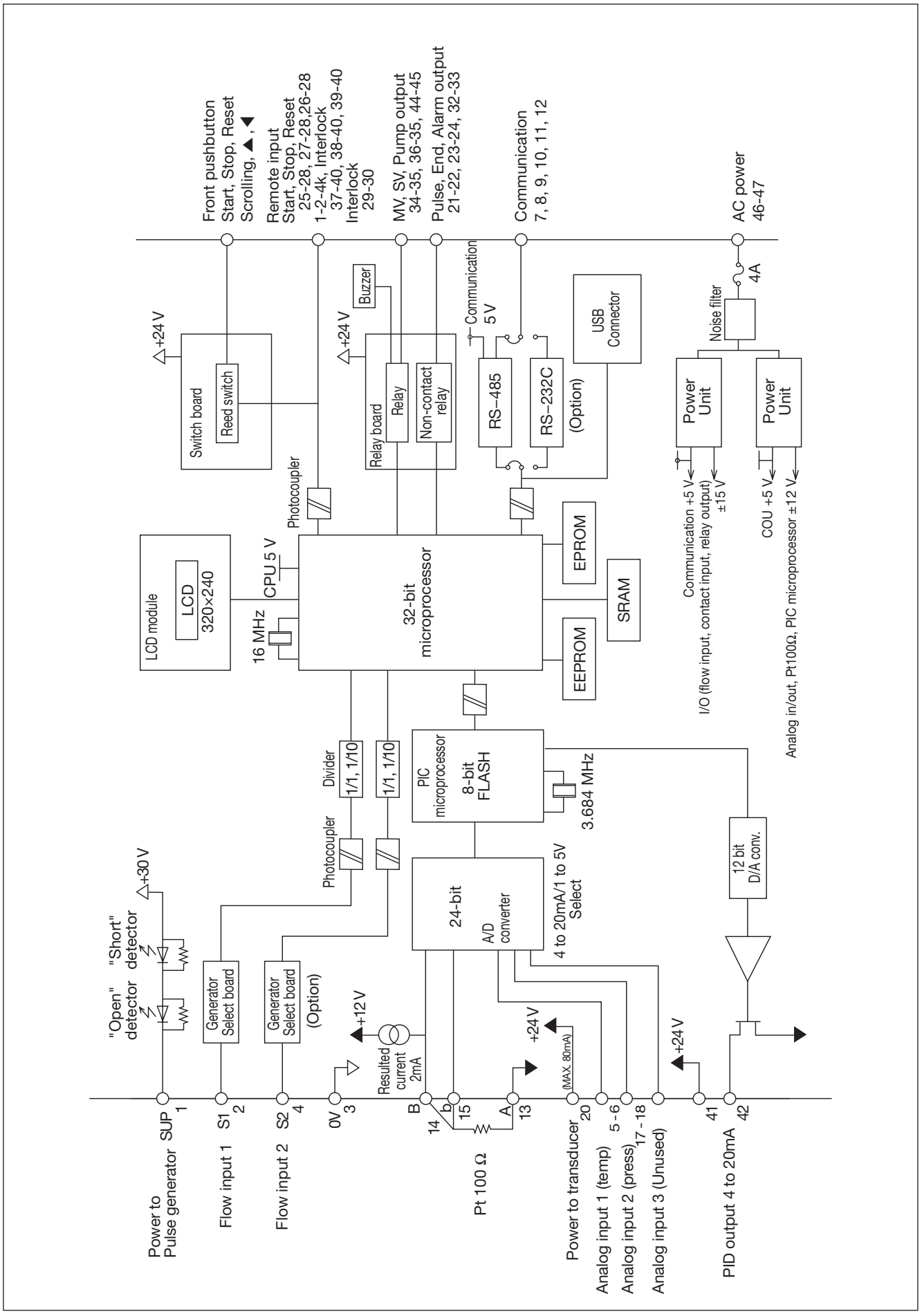
The table below shows the outputs (buzzer, LCD display, and valve control signal) in alarm conditions and the procedure to cancel them.

Table 12.1

Alarm name	Buzzer	Buzzer cancel	LCD display	Display cancel	Alarm output	Status cancel	Valve control signal
①Miss P.	○	STOP button	○	STOP button	○	STOP button	OFF
②Over	○	STOP button	○	RESET button after buzzer cancel	○	RESET button after buzzer cancel	OFF
③Temp. Ovr	×	–	○	When back to normal	×	–	Un-changed
④Temp. Udr	×	–	○	When back to normal	×	–	Un-changed
⑤Pres. Ovr	×	–	○	When back to normal	×	–	Un-changed
⑥Pres. Udr	×	–	○	When back to normal	×	–	Un-changed
⑦Sensor	○	STOP button	○	STOP button	○	STOP button	OFF
⑧FlowOver	○	STOP button	○	STOP button	○	STOP button	OFF
⑨Pulsedif	○	STOP button	○	STOP button	○	STOP button	OFF
⑩Pra. ERR	○	STOP button	○	STOP button	○	STOP button	OFF
⑪Pulse In	○	STOP button	○	RESET button after buzzer cancel	○	RESET button after buzzer cancel	OFF
⑫ADRD Err	○	STOP button	○	When back to normal after STOP button	○	STOP button	OFF

➡NOTE ○: Output or indication provided × : Neither output nor indication provided

13. OVERALL BLOCK DIAGRAM



14. CALCULATION FORMULAS

14.1 Volume Conversion Factor: K

14.1.1 Crude Oil and Petroleum Products Service

(Fluid (param. No. 107) = "0" to "2" is selected.)

$$K = \exp[-\alpha_T \times \Delta t \times (1.0 + 0.8 \times \alpha_T \times \Delta t)]$$

α_T : Thermal expansion coefficient at 15℃

$$\alpha_T = \frac{K_0}{(\rho_r \times 1000)^2} + \frac{K_1}{\rho_r \times 1000} \quad \text{or} \quad \alpha_T = A + \frac{B}{(\rho_r \times 1000)^2}$$

ρ_r : Reference Density (param. No. 105)

K_0, K_1, A, B : Constants (See table below.)

$\Delta t = t - t_r$

t : Temperature during the measurement

t_r : Reference Temp. (param. No. 108)

Fluid	Category	Sample kind	Density range at reference temperature [g/cm³]	Constants			
				K_0	K_1	A	B
0	Crude Oil	Crude oil, natural gasoline, condensate	----------	613.9723	0.0	–	–
1	Fuel Oil	Automotive gasoline	Density ＜0.7705	346.4228	0.4388	–	–
		Fuel oil	0.7705≦ Density ＜0.7880	–	–	-0.00336312	2680.3206
		Kerosene, industrial gasoline, aviation turbine oil	0.7880≦ Density ＜0.8390	594.5418	0.0	–	–
		Light oil, heavy oil	0.8390≦ Density	186.9696	0.4862	–	–
2	Lubricant	Petroleum lubricant	----------	0.0	0.6278	–	–

(An excerpt from JIS K 2249-1995)

14.1.2 LP Gas Service

(Fluid (Param. No. 107) = "3" is selected.)

$$K = 1 + A_1 \times \Delta t + A_2 \times \Delta t^2$$

A_1 : The first-order coefficient of expansion

A_2 : The second-order coefficient of expansion

$\Delta t = t - t_r$

t : Temperature during the measurement

t_r : Reference Temp. (param. No. 108)

Applicable temperature: -10.0 to 50.0 [℃]

Applicable specific gravity (ρ_r)range : 0.5000 to 0.5950 [g/cm³]

[ρ_r : Reference Density (param. No. 105)]

Programming is also possible with other parameter values.

14.1.3 Other Liquids Service

(Fluid (Param. No. 107) = "4" is selected.) --- Approximation of second-order compensation is used

$$K = BMantissa \times 10^{B\ expon} + (A1Mantissa \times 10^{A1\ expon}) \times \Delta t + (A2Mantissa \times 10^{A2\ expon}) \times \Delta t^2$$

A1 Mantissa (param. No. 140)
A1 Exponent (param. No. 142)
A2 Mantissa (param. No. 143)
A2 Exponent (param. No. 145)
B Mantissa (param. No. 146)
B Exponent (param. No. 148)
$\Delta t = t - t_r$
t : Temperature during the measurement
t_r : Reference Temp. (param. No. 108)

14.2 Pressure Compensation Factor

$$K_p = \frac{1}{1-(P-P_r)\times F_c \times 10^{-4}}$$

P : Pressure during the measurement
P_r : Reference Press. (param. No. 128)
F_C : Compressibility Factor (param. No. 130)

14.3 3α Compensation Factor

$$K_{3\alpha} = 1 + 3 \times \alpha \times (t - t_r)$$

α : α Expansion coeff. (param. No. 115)
t_r : Reference Temp. (param. No. 108)
t : Temperature during the measurement

When t <"3α Compen. Limit Temp (param. No. 117)", $K_{3\alpha}$=1

14.4 Density

$$\rho_a = \rho_r \times K \times Ut$$

ρ_r : Reference Density (param. No. 105)
K : Volume conversion factor
Ut : Unit conversion factor
Determined by Density Unit (param. No. 405)

Density Unit	0 (g/cm^3)	1 (g/mL)	2 (kg/L)
Ut	1	1	1

14.5 GROSS

Calculation formula varies according to "Input Pulse Type (param. No. 301)" and "Totalizer Unit (param. No. 402)".

Input Pulse Type: [0] Volume input without compensation (With/Without of Pressure Compensation does not matter.)

Volume unit	GROSS=P×a×K3α×Ut×ni×Uw
Mass unit (with Temp. compensation)	GROSS=P×a×K3α×Ut×ni×Uw×ρa
Mass unit (without Temp. compensation)	GROSS=P×a×K3α×Ut×ni×Uw×ρa

Input Pulse Type: [1] Volume input with compensation (Without Temp. Compensation)

Volume unit	GROSS=P×a×K3α×Ut×ni×Uw
Mass unit	GROSS=P×a×K3α×Ut×ni×Uw×ρr

Input Pulse Type: [2] Mass input (Without Temp. and Pressure Compensation)

Mass unit	GROSS=P×a×K3α×Ut×ni×Uw

P : Number of input pulses

a : Meter factor [L/P] when Input Pulse Type (param. No. 301) is Volume Input (0 or 1)
Meter factor [kg/P] when Input Pulse Type (param. No. 301) is Mass Input (2)

$a=MV\times10^{EV}$

- MV=M.F. Mantissa Value (param. No. 7)
- EV=M.F. Exponent Value (param. No. 9)

$K_{3\alpha}$: 3α compensation factor (See Section 14.3 "3α Compensation Factor")

Ut : Totalizer Unit conversion factor
As the value is calculated in L for Volume Unit and kg for Mass Unit, it is determined as shown in the following table.

Totalizer Unit	0 (mL)	1 (L)	2 (kL)	3 (m^3)	4 (g)	5 (kg)	6 (t)	7 (USG)	8 (barrel)
K_T	1000	1	0.001	0.001	1000	1	0.001	0.264172	0.00628982

➡NOTE: When unit conversion factor setting (parameter No. 306) is invalid (0), Ut=1 is given at all times.

ni : The following is defined by the setting of Input Pulse Dividing (param. No. 302)
When Set value is 0, ni = 1, When Set value is 1, ni = 10

U_W : Values in the following table are defined by the setting of Unit Coefficient (param. No. 406).

Unit Coefficient	0	1	2	3	4	5	6
LCD display	×1000	×100	×10	×1	×0.1	×0.01	×0.001
U_W	0.001	0.01	0.1	1	10	100	1000

ρa : Density during measurement

ρ_r : Reference Density (param. No. 105)

Totalizer Unit :

- Volume units → 0: mL, 1: L, 2: kL, 3: m^3, 7: USG, 8: barrel
- Mass units → 4: g, 5: kg, 6: t

➡NOTE: While GROSS is shown by rounding down the digits under displayed digits, fractions are calculated inside the controller. As a result, repeating a 10L batch cycle ten times brings up a reading of 101L rather than 100L if calculation in the controller turns out to be 10.1 L (10L on the display).

14.6 NET, COUNT

Calculation formula varies according to "Input Pulse Type (param. No. 301)", "Totalizer Unit (param. No. 402)", and "Temp. Compensation (param. No. 101)".

Input Pulse Type: [0] Volume input without compensation (With/Without of Pressure Compensation does not matter.)

Volume unit	NET=P×a×K3α×Ut×K×Kp×ni×Uw
Mass unit (with Temp. compensation)	NET=P×a×K3α×Ut×K×Kp×ni×Uw×ρr
Mass unit (without Temp. compensation)	NET=P×a×K3α×Ut×K×Kp×ni×Uw×ρa

Input Pulse Type: [1] Volume input with compensation (Without Temp. Compensation)

Volume unit	NET=P×a×K3α×Ut×K×Kp×ni×Uw
Mass unit	NET=P×a×K3α×Ut×K×Kp×ni×Uw×ρa

Input Pulse Type: [2] Mass input (Without Temp. and Pressure Compensation)

Mass unit	NET=P×a×K3α×Ut×K×Kp×ni×Uw

P : Number of input pulses

a : Meter factor [L/P] when Input Pulse Type (param. No. 301) is Volume Input (0 or 1)
Meter factor [kg/P] when Input Pulse Type (param. No. 301) is Mass Input (2)
$a=MV\times10^{EV}$
MV=M.F. Mantissa Value (param. No. 7)
EV=M.F. Exponent Value (param. No. 9)

$K_{3\alpha}$: 3α compensation factor (See Section 14.3 "3α Compensation Factor")

Ut : Totalizer Unit conversion factor
As the value is calculated in L for Volume Unit and kg for Mass Unit, it is determined as shown in the following table.

Totalizer Unit	0 (mL)	1 (L)	2 (kL)	3 (m^3)	4 (g)	5 (kg)	6 (t)	7 (USG)	8 (barrel)
K_T	1000	1	0.001	0.001	1000	1	0.001	0.264172	0.00628982

➡NOTE: When unit conversion factor setting (parameter No. 306) is invalid (0), Ut=1 is given at all times.

K : Volume Conversion Factor (See Section 14.1 "Volume Conversion Factor: K")

Kp : Pressure Compensation Factor [Kp= 1 without pressure compensation]
(See Section 14.2 "Pressure Compensation Factor")

ni : Defined by the setting of Hardware Input Pulse Dividing (param. No. 302) as following:
When Set value is 0, ni = 1,
When Set value is 1, ni = 10

U_w : Defined by the setting of Unit Coefficient (param. No. 406) shown in the following chart on the next page.

Unit Coefficient	0	1	2	3	4	5	6
LCD display	×1000	×100	×10	×1	×0.1	×0.01	×0.001
U_W	0.001	0.01	0.1	1	10	100	1000

ρ_a : Density during measurement

ρ_r : Reference Density (param. No. 105)

Totalizer Unit :
Volumetric units → 0: mL, 1: L, 2: kL, 3: m^3, 7: USG, 8: barrel
Mass units → 4: g, 5: kg, 6: t

➡NOTE: While GROSS is shown by rounding down the digits under displayed digits, fractions are calculated inside the controller. As a result, repeating a 10L batch cycle ten times brings up a reading of 101 L rather than 100L if calculation in the controller turns out to be 10.1L (10L on the display).

14.7 Instant Flow Rate

Calculation formula varies according to "Input Pulse Type (param. No. 301)", "Flow Rate Unit (param. No. 401)", and "Temp. Compensation (param. No. 101)" settings. If pulses fail to arrive for the time period set at "Sampling Time (param. No. 016)" in seconds, the controller sets the instant flow rate to 0.

Input Pulse Type: [0] Volume input without compensation (With/Without of Pressure Compensation does not matter.)

Volume unit	$Qf=3600\times a\times ni\times Ut\times K3\alpha\times K\times A\div T\times Kp$
Mass unit (with Temp. compensation)	$Qf=3600\times a\times ni\times Ut\times K3\alpha\times K\times A\div T\times Kp\times \rho r$
Mass unit (without Temp. compensation)	$Qf=3600\times a\times ni\times Ut\times K3\alpha\times K\times A\div T\times Kp\times \rho a$

Input Pulse Type: [1] Volume input with compensation (Without Temp. Compensation)

Volume unit	$Qf=3600\times a\times ni\times Ut\times K3\alpha\times K\times A\div T\times Kp$
Mass unit	$Qf=3600\times a\times ni\times Ut\times K3\alpha\times K\times A\div T\times Kp\times \rho a$

Input Pulse Type: [2] Mass input (Without Temp. and Pressure Compensation)

Mass unit	$Qf=3600\times a\times ni\times Ut\times K3\alpha\times K\times A\div T\times Kp$

➡NOTE: In this case, set "Temperature compensation (param. No. 101)" and "Pressure compensation (param. No. 124)" to "0".

P : Number of input pulses

a : Meter factor [L/P] when Input Pulse Type (param. No. 301) is Volume Input (0 or 1)
Meter factor [kg/P] when Input Pulse Type (param. No. 301) is Mass Input (2)
$a=MV\times 10^{EV}$
- MV=M.F. Mantissa Value (param. No. 7)
- EV=M.F. Exponent Value (param. No. 9)

$K_{3\alpha}$: 3α compensation factor (See Section 14.3 "3α Compensation Factor")

A : Sample Cycle Count (param. No. 15)

T : Measurement time (sec)
(The CPU measures the time interval until the number of pulses set at Sample Cycle Count arrives at the CPU.)

Ut : Flow Rate Unit conversion factor
Determined by the flow rate unit (param. No. 401).

Flow Rate Unit	Factor	Flow Rate Unit	Factor	Flow Rate Unit	Factor
0(mL/h)	1000	9(m^3/min)	0.001÷60	18(USG/min)	0.264172÷60
1(mL/min)	1000÷60	10(g/h)	1000	19(USG/sec)	0.264172÷3600
2(mL/sec)	1000÷3600	11(g/min)	1000÷60	20(barrel/h)	0.00628982
3(L/h)	1	12(g/sec)	1000÷3600	21(barrel/min)	0.00628982÷60
4(L/min)	1÷60	13(kg/h)	1		
5(L/sec)	1÷3600	14(kg/min)	1÷60		
6(kL/h)	0.001	15(t/h)	0.001		
7(kL/min)	0.001÷60	16(t/min)	0.001÷60		
8(m^3/h)	0.001	17(USG/h)	0.264172		

Flow Rate Unit :
- Volume unit → 0 to 9, 17 to 21
- Mass unit → 10 to 16

➡NOTE: When instant flow rate calculation compensating function (parameter No. 149) is invalid (0), factors K, $K_{3\alpha}$, K_T in the above are treated as “1” respectively.

15. QUICK TROUBLESHOOTING

15.1 Inspection Items

➡ NOTE: If trouble is suspected to be internal, isolate the problem according to the table below and ask our service

Table 15.1

Problem	Inspection Procedure	Possible causes
Display is not functioning.	1. Inspect fuse. 2. Check line voltage. 200, 220, 230 VAC, 50/60 Hz 100, 110, 115 VAC, 50/60 Hz	1. Fuse is blown. (⇨ See Section 15.2.) 2. Improper line voltage. 3. A fault in the controller.
No response to START button depression	1. Terminals 27-28 on the terminal block (Form "b" contact input for remote command STOP) short-circuited?	1. Unless terminals 27-28 on the terminal block (remote command STOP input) are short-circuited with a Form "b" contact switch, shorting strip, etc., the controller remains in a state where STOP button is held depressed, preventing it from responding to any command.
	2. In response to START button depression, do indicators PUMP and SV appear in the graphic representation fields of LCD?	2. A fault in the controller.
	3. Is valve actuating signal produced properly? SV: Terminals 36-35 on the terminal block MV: Terminals 34-35 on the terminal block	3. A fault in the relay for valve actuating signal output.
	4. Valve actuating signal lines properly wired and supply voltage correct?	4. Valve actuating signal lines not correctly wired. Or an "open" in the cable.
	5. Valve actuating pressure and control pressure correct?	5. Improper valve actuating pressure and control pressure.
	6. Has the previous batch process been reset? (Disalarm, batch-end output cancel, etc.)	6. Reset the current batch process.
Valve does move but total counter is not functioning.	1. Flow signal coming in from the flowmeter?	1. Incorrect wiring or an "open" in the cable. A fault in the flowmeter itself or pulse generator.
	2. Does Incoming flow signal fall within the frequency response range?	2. Out of acceptable frequency response range. (200Hz max. to the microprocessor)
Fails to perform operation at target batch setting.	1. 1. Valve actuating signals (SV and MV) produced at the target batch setting?	1. A fault in the relay for valve actuating signal output.
	2. Does indicator SV go out and END appear at the target batch setting?	2. A fault in the controller.
No response to remote commands.	1. Remote control input lines wired correctly?	1. Incorrect wiring to accept remote control commands or an "open" in the interconnect cable. 2. A fault in the controller.

15.2 Fuse Inspection

Remove the fuse cover on the power supply board and inspect the glass cartridge fuse.
If the fuse is blown, extract from its holder and replace it with a new one.

➡NOTE: Be careful when you remove and install a glass cartridge fuse so as not to damage it.

⚠CAUTION : Never attempt to use out-of-specification fuses.

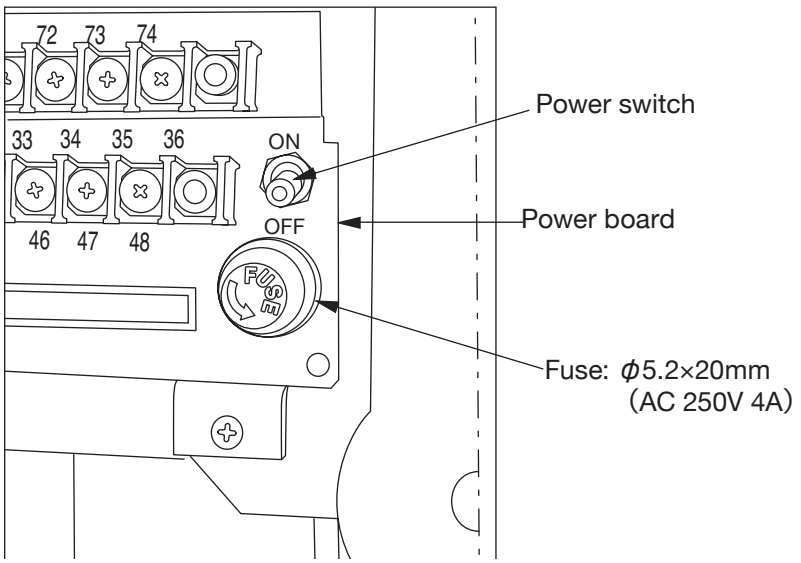


Fig. 15.1 Power Board and Fuse

16. GENERAL SPECIFICATIONS

Table 16.1 (1/2)

Item			Description		
Principle of operation			Pulse addition		
Display			Backlit LCD 320×R. G. B×240 dots		
Information shown	Shown at all times		Grand total (9-digit)：Target batch 6-digit, standard (9-digit max.)：Instant rate (corrected) SV, MV, PU, END, ALARM, com. status, measurement units Alarm identification		
	Scrolling variables		Front panel pushbuttons select one of the variables below. (Temp., press., density, volume conv. factor, grand total (9-digit), total before temp. corr. (9-digit))		
Input signal	Number of flow inputs		Pulse generator selector board is used. Can accept 2 inputs (option: for checking the deviation of pulse input value)		
	Input pulse	2-wire type / 12VDC 3-wire type contact pulse	PG20, etc.	12VDC	Shortcircuit current 40mA
		2-wire type / 12VDC 3-wire type voltage pulse	PG30, etc.		
		2-wire type / 12VDC 3-wire type Open collector pulse	FLOWPET-NX NPG60A		
		12VDC 2-wire type current pulse	PG30S		
		24VDC 2-wire type current pulse (4/20mA)	PA14/15/25 ULTRA OVAL	24VDC	
		Frequency response	200Hz (2kHz with hardware input scaling enabled)		
		Minimum pulse width	0.2ms		
	Remote control input	Start	Instant make, form "a" contact	Capacity 24VDC, 5mA max. Pulse width: 30 ms min. Secure at least a 0.5 sec interval between signals.	
		Reset	Instant make, form "a" contact		
		Stop	Instant break, form "b" contact		
		Interlock	Normally “short”input (Form“a”contact)		
	Temperature		3-wire Pt100		
			Transmission length: 300 meters (loop DC resistance 5Ω max. with CVVS 1.25 sq. mm or equiv.)		
			4 to 20mA (internal load resist.: 250Ω) or 1 to 5V		
	Pressure (option)		4 to 20mA (internal load resist.: 250Ω) or 1 to 5V		
	Power to transmitter (temp. and press.)		24V±10%VDC Max.: 80mA		
Meter factor setting			Significand: 0.0001 to 9.9999 Exponent part: -5 to +5		
Correction	Temperature		JIS K 2249-1995 "Crude Oil and Petroleum Product" JIS K 2240-2007 "LPG" Other liquids (Correction formula using a quadratic approximation)		
	Temperature range		−20 to +160℃		
	3 α		Yes (Can set up temp. to start correction.)		
	Pressure		Option		
Temperature correction accuracy			±0.075% RD, Ambient temperature error: ±0.004%/℃ (Reference: 20℃)		
Batch setting	Batch setting value		Any setting or 7 kinds of setting - Default 1k: 1000, 2k: 2000, 4k: 4000 and additional four settings are selectable		
	Initial step value		0 to 9999 counts (default: 80 couns)		
	Final step value		0 to 9999 counts (default: 80 couns)		
	Anticipated overshoot		0 to 99 counts (default: 2 couns)		
	Overshoot		0 to 99 counts (default: 2 couns)		

Table 16.1 (2/2)

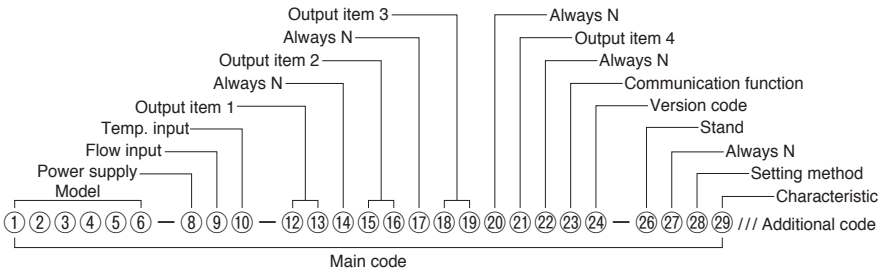
Item			Description
Pump output delay timer			0 to 9999 sec. (default: 30 sec.)
Alarms	Pulse variation		0 to 15 pulses (default: 0 pulse)
	Missing pulse		0 to 99 sec (default: 5 sec) Invalid for 5 sec after startup
	Excessive flowrate		1 to 99999
Valve operate signals		SV	Holds from the start of a batch until end of a batch. Voltage signal which is the same as supply voltage, or Form Relay contact "a" (250VAC, 1A)
		MV	Holds from the end of initial controlled flow until the start of final controlled flow. Voltage signal which is the same as supply voltage, or Form Relay contact "a" (250VAC, 1A)
		PID	4 to 20mA (Max. load resistance 750Ω)
Output	Pump		Holds from the start of a batch until "end of a batch + timer" setting relay contact "a" or contact "b" (250VAC, 1A)
	End and Alarm		Non-contact relay (250V AC/DC, 0.15A, resistance 16Ω or less at ON, leak current 1μA or less at OFF)
	Pulse		
		Pulse width	1 to 99 ms selectable in 1 ms steps One kilometer max. with CVVS 1.25sq. mm or equiv.
		Transmission length	
Communication	Interface		RS-485 (standard), RS-232C (option), USB2.0 (standard)
	Protocol		Modbus RTU
	Baud rate		1200, 2400, 4800, 9600, 19200, 38400bps
	Transmission length		RS-485; 1.2 kilometers max. ※1
	Contents		Parameter read/write, total and other variables read
Operation check functions			Yes (I/O check except for pulse, temp., press. input, PID output)
Parameter configuration			Front-panel pushbuttons (available only part of parameters), Communication ※2
Power failure backup			Evacuates critical data in EEPROM.
Power supply			100/110/115 VAC, 200/220/230 VAC 50/60Hz
Max. Power consumption (apparent power)			AC230V : 58VA , AC220V : 51VA , AC200V : 45VA, AC100V : 38VA , AC110V : 40VA , AC115V : 41VA
Ambient temperature			−10 to +50℃
Insulation resistance			Because of surge suppressors installed, insulation resistance and dielectric tests are unacceptable.
Dielectric strength			
Explosionproof rating			Flameproof enclosure ExdⅡBT4 ※3
Installation			Stanchion or wall mount type
Finish			Munsell 2.5PB5/8 (glossy)
Weight			Stanchion type: 50 kg approx. or wall mount type: 25 kg approx.
Electromagnetic compatibility			EMC EN55011 EN61000-6-2

➡NOTES ※1: Varies depending on communication rate, cable diameter, and termination resistance.

※2: Reconfigurable parameters are: initial step value, final step value, anticipated overshoot, overshoot, missing pulse interval, and batch setting. Of the PID control function, only set values of P, I, and D parameters can be modified with front-panel pushbutton operation.

※3: To use this controller in a hazardous location, the following pressure-resistant gaskets (options) are required: •Model SXC-28B supplied by Shimada Electric Co.
Ground the GND terminal surely.

17. PRODUCT CODE EXPLANATION

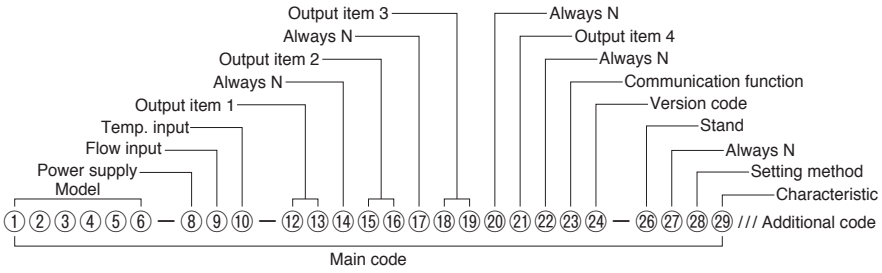


●Main code

①	②	③	④	⑤	⑥	**Model**
E	L	7	2	1	0	High performance explosionproof batch controller
⑦	—					
⑧	**Power supply**					
E	100VAC 50/60Hz					
F	110/115VAC 50/60Hz					
G	200VAC 50/60Hz					
H	220/230VAC 50/60Hz					
⑨	**Flow input**					
B	Voltage pulse 12VDC 2 wires / 3 wires					
C	Current pulse 12V (PG30S)					
D	Current pulse 24VDC (4/20mA)					
G	Open collector pulse 12VDC 2 wires / 3 wires					
K	Contact pulse 12VDC 2 wires / 3 wires					
Z	Special (including 2 inputs)					
⑩	**Temp. input**					
B	1 to 5VDC voltage input					
E	4 to 20mA current input					
F	Pt100Ω					
G	JPt100Ω					
N	Non (no temp. compensation)					
⑪	—					
⑫	⑬	**Output item 1**				
Pulse output						
B	1	Pulse width 1ms				
B	5	Pulse width 50ms				
B	9	Pulse width other than above				
Z	Z	Special				
⑭	**Always N**					
N	Always N					
⑮	⑯	**Output item 2**				
Pump signal						
A	C	a contact (standard)				
B	C	b contact				
Z	Z	Special				

⑰	**Always N**
N	Always N
⑱	⑲	**Output item 3**
Valve operation signal		
1	V	Same as supply power
2	C	Contact output
Z	Z	Special
⑳	**Always N**
N	Always N
㉑	**Output item 4**
Analog output	
N	Non
P	Flow controlling PID output 4 to 20mA
Z	Special
㉒	**Always N**
N	Always N
㉓	**Communication function**
R	RS-485
Z	Special
㉔	**Version code**
A	Version A
㉕	—
㉖	**Stand**
N	Non
1	Yes
㉗	**Always N**
N	Always N
㉘	**Setting method**
1	6 digits arbitrary setting
2	1-2-4k external input
Z	Special
㉙	**Characteristic**
0	Standard
Z	Special

※: Pressure input (pressure compensation) is option.



●Additional code

Special test				
A	1	0	Taxed custody transfer	
A	2	0	By certified measurer	
A	3	0	Taxed alcohol	
Designated special paint on transmitter				
S	F	0	Corrosion proof	Special treatment
S	D	0	Salinity tolerance	Special treatment
S	E	0	Acid tolerance	Special treatment
S	X	0	Customer designated paint	Special treatment
Document				
D	S	J	DWG and specifications for approval (Japanese)	
D	S	E	DWG and specifications for approval (English)	
D	R	0	Re-submission of DWG and specifications	
D	C	J	Final DWG (Japanese)	
D	C	E	Final DWG (English)	
D	W	J	Wiring diagram (Japanese)	
D	W	E	Wiring diagram (English)	
D	T	J	Inspection procedure (Japanese)	
D	T	E	Inspection procedure (English)	
C	B	J	Inspection certificate: B set	Only Japanese
Witnessed by customer				
V	1	0	Required	

● Code Explanation for Pressure-tight Packing Cable Gland

(This item should be prepared separately from this equipment itself. Do not fail to prepare this item when used asexplosionproof equipment.)

Code Explanation: SXC-28B
Manufacture name: SHIMADA ELECTRIC CO., LTD
Applicable Cable O.D.: 16.0 to 18.0 or 18.0 to 12.0

《PRODUCT CODE EXPLANATION OF THE OLD PRODUCT CODE》

The new product code has been implemented since April 2017.
Therefore, the product code explanation of the old product code will not be updated after April 2017.
Contact OVAL if you wish to order with the old product code for reasons such as type approval.

Item	Product Code							Supplementary Code							Description
	①	②	③	④	⑤	⑥	–	⑦	⑧	⑨	⑩	⑪	⑫	⑬	
Model	E	L	7	2	1	0	–								Explosionproof Type Batch Controller
Power Supply								1							100VAC 50/60Hz
								2							200VAC 50/60Hz
								3							110/115VAC 50/60Hz
								4							220/230VAC 50/60Hz
								9							Other than above
Flowrate input									2						2-wire type / 12VDC 3-wire type contact pulse (PG20 etc.)
									3						2-wire type / 12VDC 3-wire type voltage pulse (PG30 etc.)
									4						24VDC 2-wire type current pulse (4/20mA DC)
									5						12VDC 2-wire type current pulse (PG30S)
									6						2-wire type / 12VDC 3-wire type open collector pulse
									9						Other than above (2 inputs inclusive)
Programming										1					Any 6-digit setting
										2					1- 2 -4 k remote input
										9					Other than above
Temperature Input											0				Less temperature input (no temperature correction)
											1				Pt 100Ω
											2				1 to 5VDC voltage input
											3				4 to 20mA current input
											9				Other than above
Valve operate signals												1			The same voltage as supply voltage
												2			Contact-closure output
												3			For controlled flow PID 4 to 20mA
												4			For controlled flow (term 1 + term 3)
												5			For controlled flow (term 2 + term 3)
												9			Other than above
Installation													1		Wall mount type
													2		Stanchion type
Finish														1	Munsell 2.5PB5/8, glossy
														9	Other than above

➡ NOTE: 1. Standard communication interface: RS-485 (RS-232C is optional.)
2. Pressure input (pressure compensation) is optional.

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